




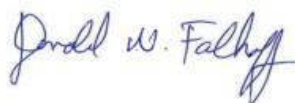


SINGAPORE ENVIRONMENTAL CONSULTANCY AND SOLUTIONS PTE LTD

**CONTRACT J112 – DESIGN AND CONSTRUCTION OF JURONG HILL STATION, JURONG
PIER STATION AND VIADUCT FOR JURONG REGION LINE**

ENVIRONMENTAL IMPACT ASSESSMENT (EIA) FOR JURONG HILL (AREA 1 & 2)

Job No: SO00752-2 (Rev 14)

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* Jurong Hill and Jurong Pier are used as MRT station names in this report. These are working names and not the final names for the associated stations.

Executive Summary

The proposed development will include the construction of the new Jurong Hill MRT Station (JS11) and vehicular underpass at Jurong Pier Road. Two areas, namely Area 1 (7,520 m², in yellow) and Area 2 (4,875 m², in blue), which are located within the Jurong Hill forested area will be cleared to facilitate the construction of the Project. The Environmental Impact Assessment (EIA) Study Area will thus cover up to 100 m from the proposed work boundary and has a size of approximately 60,000 m², as shown in Figure 1 below. The EIA has assessed the impacts of the development on the surrounding environment and biodiversity, the residual impacts will be reduced to mainly slight impacts with the proposed mitigation measures. These proposed mitigation measures should be implemented during the construction phase of the Project.



Figure 1: Study Area (100m from the boundary of Area 1 and 2)

Ecological Baseline Findings

Extensive baseline surveys included Flora and Tree Survey, Habitat and Spatial Mapping, Camera Trapping and Fauna Transect Surveys, were conducted from February till March 2023 using methods aligned with NParks' Biodiversity Impact Assessment (BIA) Guidelines. A summary of the main findings of each aspect studied has been provided below.

Habitat Mapping and Vegetative Habitat

The habitat map is compiled with reference to formal flora sampling plots and walking transects utilised as ground truth basis for satellite image interpretation. The Study Area comprises of four (4) distinct vegetative habitats (refer to Figure 2 below). It also includes a small ephemeral pond which is located at the southern extent of the Study Area. The pond could be fed by surface runoff and could dry up during longer dry spells.



Figure 2: Habitat Map

Fauna Inventory

In total, the fauna survey recorded 98 species, including 55 birds, eight (8) mammals, five (5) reptiles, six (6) amphibians, 18 butterflies, and six (6) odonates. These include the information collected during transect surveys (Diurnal and Nocturnal) and camera trapping surveys. Of the 98 species, seven (7) species were considered as species of concern which is defined by their national or international conservation status. All seven (7) species of concern were birds and they were of local significance under Singapore Red Data Book Version 3 (SRDB3) i.e., one (1) Endangered (EN) and six (6) Vulnerable (VU), and they were categorised as Least Concern (LC) under the International Union of Conservation of Nature (IUCN) Red List of Threatened Species.

Flora Inventory

A total of 69 species of plants were recorded, with 68 species were identified through flora transect surveys, box plot surveys and an extensive tree survey, and the addition of one (1) species (*Entada spiralis*) which was not discovered during the flora survey but previously noted (personal communication, 27 September 2022) by NParks as being present within the Study Area. Of the 69 species, 15 species were considered as species of concern which is defined by their national or international conservation status based on the *Flora of Singapore: Checklist and Bibliography* (Lindsay, S. et al., 2022) and *A Checklist of the Total Vascular Plant Flora of Singapore: Native, Naturalised and Cultivated Species* (Chong et al., 2009). These include three (3) Critically Endangered (CR) species, two (2) Endangered (EN) species and 10 Vulnerable (VU) species.

Environmental Impact Assessment

Possible impacts from construction activities of the Project were predicted and assessed. Rapid Impact Assessment Matrix (RIAM) has been adopted to assess the environmental impacts from the construction works on wildlife especially from habitat loss, human disturbance, noise and light. Mitigation measures were recommended to minimize those minor negative impacts to slight impacts on the environment. The details of the impact assessment and proposed mitigation measures are further explained in the EIA report.

An Environmental Management and Monitoring Plan (EMMP) has been developed to ensure the potential impacts are minimised during the construction phase of the Project. The EMMP includes biodiversity, soil erosion and water quality, and noise monitoring as well as site audits for all environmental aspects.

Environmental impacts of slight to minor levels were predicted to be resulting from the clearance of the required forested areas. These include disruption to wildlife and its connectivity. Impacts on water quality in the vicinity of the site due to land clearance and tree felling was also evaluated, as it makes the area vulnerable to erosion effect during wet weather events. With the relevant mitigation measures proposed for the specific impacts, the impacts were reduced to mainly slight levels.

Conclusion

The EIA was scoped and conducted according to the scope of works that are required for this Project. Relevant studies were carried out to assess the possible environmental impacts. The EIA has proposed a series of mitigation and monitoring measures to be implemented during the construction phase. These measures are designed to minimize and manage potential impacts, ensuring they remain less significant for the overall Project.

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List of Terminology

Acronyms	Terminology
AEC	Affinity Engineering Consultancy Pte Ltd
AYE	Ayer Rajah Expressway
BIA	Biodiversity Impact Assessment
BOD	Biochemical Oxygen Demand
CBP	Contiguous Bored Piled
CCTV	Closed Circuit Television
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
COPPC	Code of Practice on Pollution Control
CR	Critically Endangered
CS	Conservation Significance
CVPA	Control of Vectors and Pesticides Act
DO	Dissolved Oxygen
DSTA	Defence Science and Technology Agency
ECB	Erosion Control Blanket
ECM	Earth Control Measures
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
EN	Endangered
EPH	Environmental Public Health
EPHA	Environmental Public Health Act
EPMA	Environmental Protection and Management Act
ESC	EnviroSolutions and Consulting Pte Ltd
EU	European Union
GPS	Global Positioning System
IDA	Infectious Diseases Act
ISA	International Society of Arboriculture
IUCN	International Union for Conservation of Nature
JRL	Jurong Region Line
LC	Least Concern
LMP	Light Management Plan
LTA	Land Transport Authority
MND	Ministry of National Development
MRT	Mass Rapid Transit
MSS	Meteorological Service Singapore
NAAQS	National Ambient Air Quality Standards
NBSAP	National Biodiversity Strategy and Action Plan
NCMP	Nature Conservation Master Plan
NEA	National Environment Agency

Acronyms	Terminology
NH4	Ammonia
NIA	Noise Impact Assessment
NMP	Noise Management Plan
NMS	Noise Monitoring Station
NO2	Nitrite / Nitrogen Dioxide
NO3	Nitrate
NParks	National Parks Board
O3	Ozone
PCD	Pollution Control Department
PCN	Park Connector Network
PCS	Guidelines for Pollution Control Study
PM	Particulate Matter
PME	Powered Mobile Equipment
PO4	Phosphate
PUB	Public Utilities Board
QECF	Qualified Erosion Control Professional
QGIS	Quantum Geographic Information System
RIAM	Rapid Impact Assessment Matrix
SECS	Singapore Environmental Consultancy and Solutions Pte Ltd
SO2	Sulphur Dioxide
SRDB3	Singapore Red Data Book Version 3 (2024)
SVY21	Plane Coordinate System - SVY21
TCA	Tree Conservation Area
TDS	Total Dissolved Solids
TIW	Toxic Industrial Waste
TN	Total Nitrogen
TP	Total Phosphorus
TPZs	Tree Protection Zones
TSS	Total Suspended Solids
URA	Urban Redevelopment Authority
USEPA	United States Environmental Protection Agency
VU	Vulnerable
WGS84	World Geodetic System 1984
WHO	World Health Organization
WSP	Wildlife Shepherding Plan

1. Introduction

The Land Transport Authority (LTA) contract for J112 involves the construction of the proposed Jurong Hill Station (JS11) located along Jurong Pier Road, (hereinafter referred as “the Project”). The works will include the clearing of Area 1 and 2 to facilitate construction of JS11 MRT station and vehicular underpass at Jurong Pier Road.

The contract has been awarded to China Civil Engineering Construction Corporation Branch Office Singapore – SCB Building Construction Pte. Ltd. Joint Venture (CCECC-SCB-JV). Singapore Environmental Consultancy and Solutions Pte Ltd (SECS) has thus been engaged as the Environmental Impact Assessment (EIA) consultant for this Project.

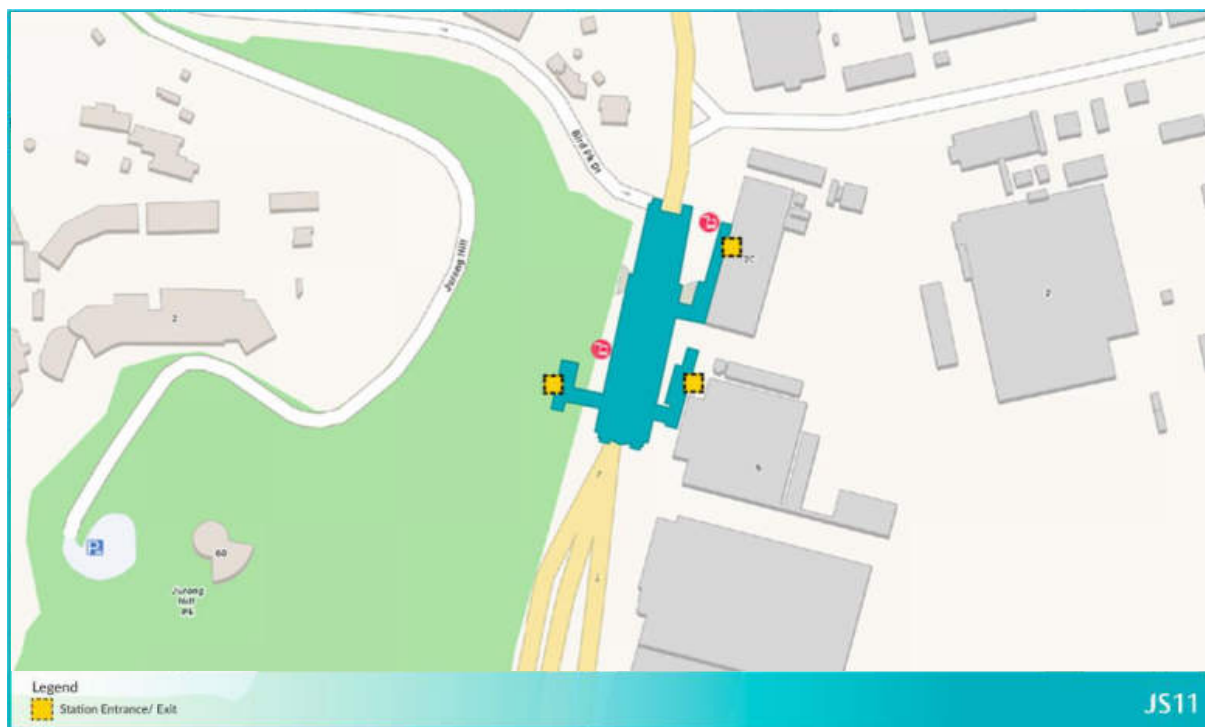


Figure 1-1: Location of JS11 - Jurong Hill MRT Station

As shown in Figure 1-2, Area 1 (7,520 m², in yellow) and Area 2 (4,875 m², in blue) are located adjacent to Jurong Pier Road, and within Jurong Hill forested area. The EIA study area will thus cover up to 100m from the proposed work boundary. Therefore, an EIA has been carried out to study environmental and biodiversity impacts of construction works for slope cutting and Contiguous Bored Piled (CBP) at Area 1 and Excavation & Cable Laying at Area 2 during construction stage only. The study is also to recommend appropriate mitigation measures to further aid the Environmental Monitoring and Management Plan (EMMP), which aims to minimise environmental impact during the construction phase.

This report will consider the impacts of the development on the surrounding environment and biodiversity, and propose mitigation measures that will reduce negative impacts as far as possible. These proposed measures should be implemented during the construction phases of the development.

The EIA study area, refer to Figure 1-2, has a size of approximately 60,000 m².



Figure 1-2: Study Area (100m from the boundary of Area 1 and 2)

The scope of works for Area 1 comprises of construction of CBP wall and stable slope formation, required to safely widen Jurong Pier Road and provide sufficient space for the construction of JS11 MRT station and vehicular underpass at Jurong Pier Road. Tree felling and slope cutting at Jurong Hill will be required for this area to ensure the safety of the Project site. The scope of works for Area 2 comprises of laying out of the proposed utilities (66kV and 230kV cables) outside the Road Reserve Line.

The following studies are proposed to study the impact of proposed works during construction stage:

- Vegetation mapping;
- Habitat mapping;
- Visual survey for birds, mammals, herpetofauna, butterflies and dragonflies; and
- Camera trapping for ground-dwelling animals.

1.1. EIA Project Team

This study will be carried out by Singapore Environmental Consultancy and Solutions Pte Ltd (SECS) with support from affiliated specialists. Our proposed organisation chart is provided in Figure 1-3.

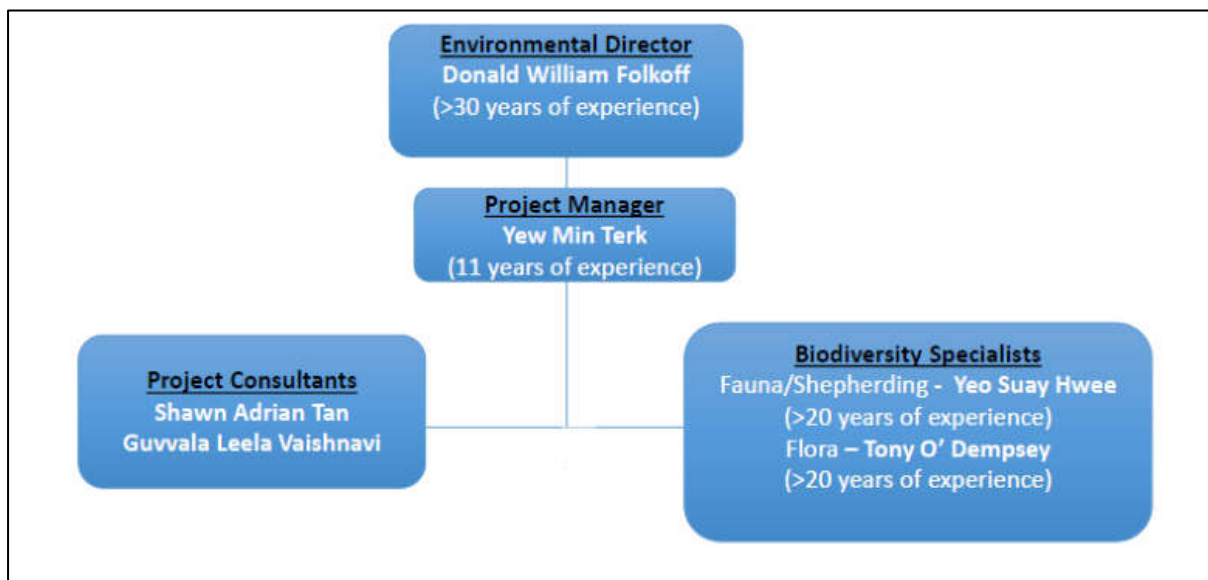


Figure 1-3: Organisation Chart

1.2. Project Development Summary

The scope of work for the Project within the Study Area comprises of installation and construction of the Contiguous Bored Piles (CBP) Wall, removal of the existing retaining wall system and have the new JS11 MRT Station built in this location. The development would thus involve land clearance, construction of access path and cutting of slopes to carry out the scope of works. The Project area is presented in Figure 1-2, where Area 1 and 2 are located adjacent to Jurong Pier Road, within Jurong Hill forested area. The EIA study area (Figure 1-4) covered up to 100m from the proposed work boundary. Certain parts of the study area did not extend to a whole 100m as the areas fall under Jurong Bird Park (to the West of study boundary) or are existing urban infrastructure (to the East of study boundary). The total study area is approximately 60,000 m².



Figure 1-4: EIA Study Area and nearby facilities

Detailed summary of the construction activities associated with the development of the site is as follows:

i. Access Paths Construction and Cutting of Slopes

1. preliminaries and preparatory works to access the worksite
2. land clearance of planned access path (highlighted in blue in Figure 1-5) & laying of hard core on access path
3. land clearance of remaining site area
4. excavation/slope cutting works for respective platforms (1 – 4) (Figure 1-6)

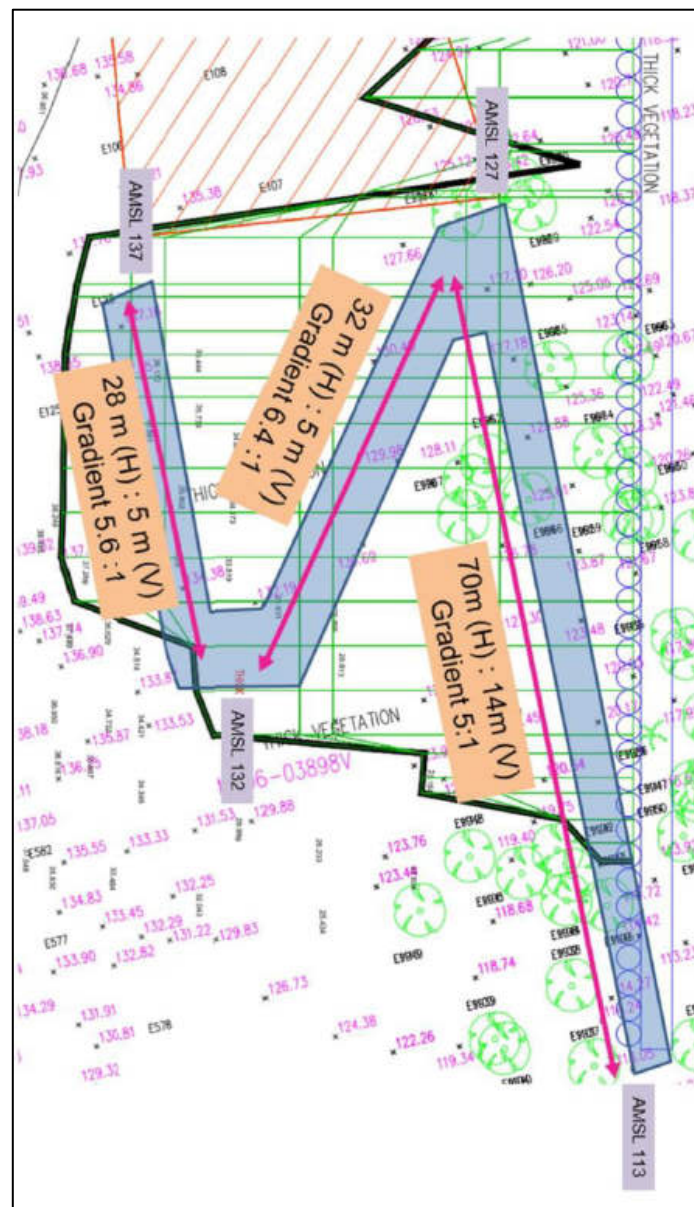


Figure 1-5: Layout of 12m wide access paths identifying the minimum slope gradient to be followed

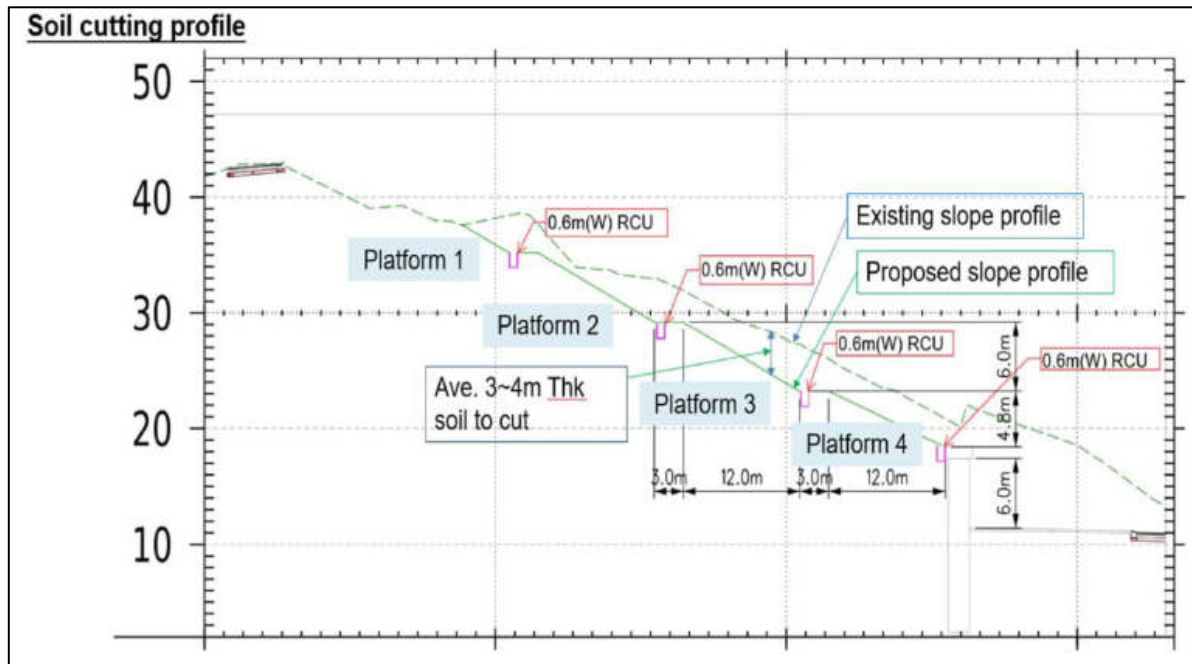


Figure 1-6: Detailed elevation view of cut slope profiles on all 4 platforms

- ii. Building up a compacted temporary working platform
 1. Backfill works at bottom of slope
 2. Road diversion works

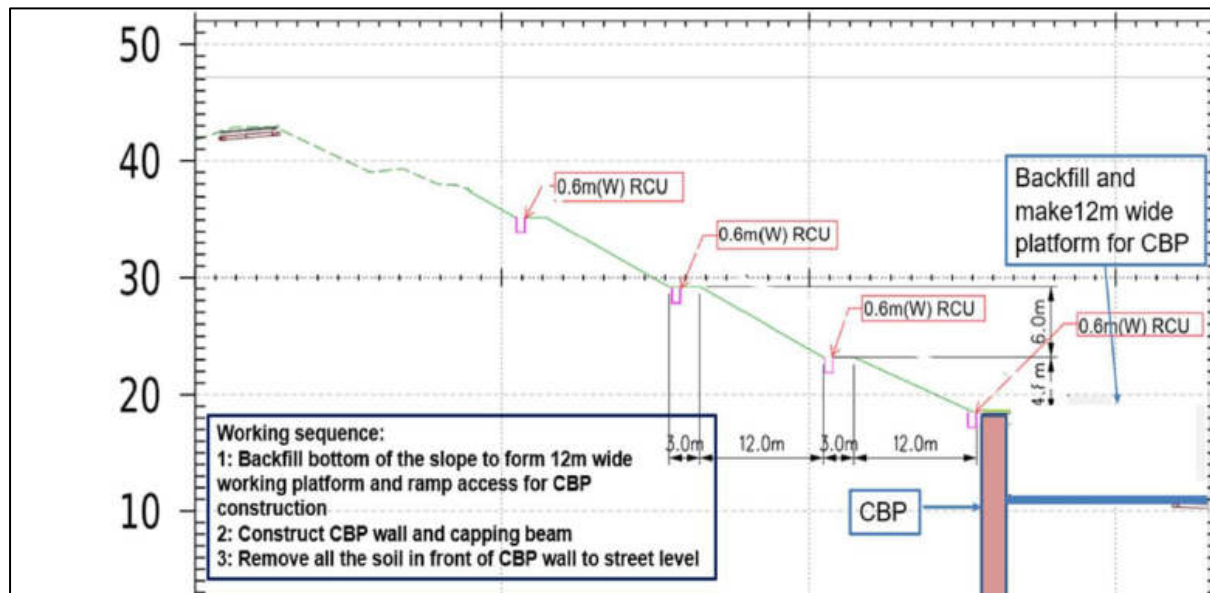


Figure 1-7: Elevation view of backfilling to existing Retaining wall to construct CBP wall

- iii. Installation and Construction of the Contiguous Bored Piles Wall
 1. Excavation works
 2. Bored piling operations
 3. Rebar and casting works

- iv. Removal of the temporary working platform including the existing ERSS wall
 1. Excavation/slope cutting works

The expected construction machinery involved is listed below:

- i. Piling Rig
- ii. Sheet Pile Rig
- iii. Service Crane
- iv. Mobile Crane
- v. Excavator
- vi. Dump Truck
- vii. Roller Compactor
- viii. Segment Lifter
- ix. Concrete Pump
- x. Generator Set

Area 2

- i. Trench excavation works for existing services
- ii. Construction of temporary shoring
- iii. Tunnelling works for underneath drain/services area
- iv. Excavation works for installation of cable duct
- v. Casting works
- vi. Backfilling works

The expected construction machinery involved is also listed below:

- i. Asphalt Cutter
- ii. Excavator
- iii. Vibrator Engine
- iv. Rammer
- v. Vibration Plate Rammer
- vi. Compaction Roller
- vii. Diesel Water Pump
- viii. Generator Set

In summary, the principal construction activities listed will be carried out in the forested area. As such, care should be taken to minimise the impact inflicted on the surrounding environment.

1.3. Scope of Work

SECS was contracted to carry out an Environmental Impact Assessment (EIA) for this Project. The components of the EIA study are summarised in Table 1-1.

Table 1-1: EIA Study Components

Type of Survey/Study	Component(s)
Flora Survey	Trees, shrubs herbaceous plants, climbers, and epiphytes
Habitat and Spatial Mapping	Mapping based on topography maps, satellite images and ground truth-data
Camera Trapping	Ground-Dwelling Mammals
Fauna Transect Survey	Birds
	Mammals
	Herpetofauna
	Butterflies
	Dragonflies
Desktop Study/ Impact Assessment	Study of the ecological connectivity of study area with surrounding greeneries
	Determine baseline, impact assessment, and propose monitoring and mitigation measure(s) to minimize any potential adverse impacts
	Propose an outline Environmental Monitoring and Management Plan (EMMP) for the Project area

It is important to note that no surface water bodies (such as streams, PUB drains, etc.) were observed within or in the vicinity of the EIA survey boundary. Consequently, a water quality assessment was not carried out.

2. Environmental Regulations and Standards

This section outlines the legislation and guidelines in Singapore relevant to the Environmental Impact Assessment (EIA) for the Project.

2.1. Singapore Legislation

The *Environmental Protection and Management Act 1999 (EPMA)* provides the legislative framework for the control of environmental pollution. The scope covers air pollution, water pollution, land pollution, noise pollution, and hazardous substances control. The EPMA becomes relevant in EIA studies especially since there is no specific law or regulation in Singapore covering the EIA study. Some sections which play an important part are those related to noise from construction and other works, sections on prevention of pollution from construction site and the pollution control studies.

The *Guidelines for Pollution Control Study (PCS)* is further detailed in the Code of Practice on Pollution Control setting the tone for a PCS report. The PCS study is typically part of a submission for an industrial building plans addressing water, air, and noise pollution control, hazardous substances control, toxic industrial wastes control, and control of land pollution and remediation of contaminated sites. This is typically limited to functions of the facilities.

The PCS is useful in providing guidance to an EIA process in certain aspects but lacks ecological aspect of the study. However, it is limited to the identification of pollution sources, the quantification and evaluation of pollution impacts, and recommendations of mitigation measures for air pollution control, water pollution control, noise pollution control, management of hazardous chemicals, toxic wastes management, recycling and resources conservation and prevention of land contamination.

In addition of the EPMA, the following Acts and subsidiary regulations (relevant to environmental protection) are summarised in the table below:

Table 2-1: Summary of Environmental Protection Acts and Subsidiary Regulations

Environmental Aspects	Relevant Local Acts / Regulations / Guidelines / Action Plans	Acronyms	Jurisdiction / Enforcement Agencies
Air Pollution	Environmental Protection and Management (Vehicular Emission) Regulations	EPMA (Vehicular Emission)	NEA
	Environmental Protection and Management (Air Impurities) Regulations	EPMA (Air Impurities)	
	Environmental Protection and Management (Off-Road Diesel Engine Emissions) Regulations 2012	EPMA (Off-Road Diesel Engine Emission)	
	Environmental Protection and Management (Prohibition on the Use of Open Fires) Order	EPMA (Prohibition on the Use of Open Fires)	
	Singapore Ambient Air Quality Targets	-	
Water Pollution	Environmental Protection and Management (Trade Effluent) (Amendment) Regulations	EPMA (Trade Effluent)	NEA
	Sewerage and Drainage Act 1999 (and its subsidiary legislation)	Sewerage and Drainage Act	PUB
	Public Utilities (Reservoirs, Catchment Areas and Waterway) Regulations 2006	Public Utilities Act	
Noise Pollution	Environmental Protection and Management (Control of Noise at Construction Sites) Regulations	EPMA (Control of Noise at Construction Sites)	NEA
Waste Management	Environmental Public Health Act 1987	EPHA	NEA
	Environmental Public Health (Toxic Industrial Waste) Regulations	EPHA (Toxic Industrial Waste)	
	Environmental Public Health (General Waste Collection) Regulations	EPHA (General Waste Collection)	
Vectors	Infectious Diseases Act 1976	IDA	NEA
	Control of Vectors and Pesticides Act 1998	CVPA	
	Environmental Public Health (Employment of Environmental Control Officers) Order	EPHA (Employment of Environmental Control Officers)	

Environmental Aspects	Relevant Local Acts / Regulations / Guidelines / Action Plans	Acronyms	Jurisdiction / Enforcement Agencies
Biodiversity	Parks and Trees Act 2005	Parks and Trees Act	NParks
	Planning Act 1998	Planning Act	URA
	Wildlife Act 1965	Wildlife Act	NParks
	National Biodiversity Strategy and Action Plan	NBSAP	
	Nature Conservation Masterplan	NCMP	
	NParks Biodiversity Impact Assessment Guidelines	BIA	

2.2. Specific Environmental Legislation

The specific legislation requirements on the various environmental aspects relevant to the Project are presented in the following sub-sections. They include six sub-sections: Air Pollution, Water Pollution, Noise and Vibrations, Waste Management, Vectors, and Biodiversity.

2.2.1. Air Pollution

Ambient Air

Singapore announced in 2012 that it was adopting ambient air quality targets for ozone, nitrogen dioxide, sulphur dioxide, particulate matter and carbon monoxide, based on the World Health Organization (WHO) Air Quality Guidelines (AQGs) for the prevention of public health impacts by air pollution, and is working towards achieving the WHO AQGs for all air pollutants in the long term. This includes the relevant ambient air quality targets that may be affected based on the Project's construction activities (such as the use of diesel generators and construction vehicles), which are CO, NO₂, PM₁₀ and PM_{2.5}. As a result, the table below outlines *Singapore's Ambient Air Quality Targets*.

Table 2-2: Singapore Ambient Air Quality Targets (Long Term Targets)

Pollutant	Units	Averaging Period	Long Term Targets
SO ₂	µg/m ³	24-hour	20
PM _{2.5}	µg/m ³	24-hour	25
	µg/m ³	Annual	10
PM ₁₀	µg/m ³	24-hour	50
	µg/m ³	Annual	20
O ₃	µg/m ³	8-hour	100
NO ₂	µg/m ³	1-hour	200
	µg/m ³	Annual	40
CO	mg/m ³	8-hour	10
	mg/m ³	1-hour	30

Industrial Emissions

The Pollution Control Department (PCD) of the NEA (under the Ministry of Sustainability and the Environment) is responsible for the prevention and control of air pollution in Singapore. Pursuant to the *EPMA 1999*, the Minister for the Environment has appointed a "Director-General of Environmental Protection" to assist in the implementation and administration of the Act and its regulations.

The *EPMA (Part IV – Air Pollution Control)* repealed the outdated Clean Air Act. Together with the *EPMA (Prohibition on the Use of Open Fires)*, *EPMA (Vehicular Emissions)*, *EPMA (Air Impurities)*, and the *EPMA (Off-Road Diesel Engine Emissions)* regulate the emission of air pollutants from industrial or trade premises.

Vehicular emissions control is regulated against the EU Directive 98/69/EC-B (2005) Exhaust Emissions Limits for passenger cars and light commercial vehicles and the EU Directive 1999/96/EC-B1 (2005) Exhaust Emission Limits for heavy duty vehicles. The regulations stipulate standards for exhaust gas emissions from diesel-powered motor vehicles are presented below in the table below.

Table 2-3: Exhaust Emission Limits from Diesel-Powered Motor Vehicles

For Diesel-Powered Motor Vehicles Registered in Singapore on or after 1 January 2001, and Before 1 October 2006	
Class of Vehicle	Standard for Exhaust Emission
(a) Passenger car	EC Directive 96/69/EC
(b) Light commercial vehicle with gross vehicle weight not exceeding 3.5 tons	EC Directive 96/69/EC
(c) Heavy duty vehicle with gross vehicle weight exceeding 3.5 tons	EC Directive 91/542/EEC stage 11
For Diesel-Powered Motor Vehicles Registered in Singapore on or after 1 October 2006	
Class of Vehicle	Standard for Exhaust Emission
(a) Passenger car	EC Directive 96/69/EC-B (2005)
(b) Light commercial vehicle with gross vehicle weight not exceeding 3.5 tons	EC Directive 96/69/EC-B (2005)
(c) Heavy duty vehicle with gross vehicle weight exceeding 3.5 tons	EC Directive 1999/96/EC-B1(2005)

2.2.2. Water Pollution

Water Quality

The Pollution Control Department (PCD) of National Environment Agency (NEA) has a prime responsibility for the regulation of liquid effluent in Singapore. The main legislative instruments governing water pollution are the *EPMA (Part V – Water Pollution Control)*, the *EPMA (Trade Effluent)* and the *Sewerage and Drainage Act*. The Director-General of Environmental Protection (of the PCD) is responsible for the implementation and administration of the EPMA regulations, while provisions under the *Sewerage and Drainage Act* comes under PUB. The provisions given under each of these Acts or Regulations are described below, whilst a summary of Effluent Discharge Standards applicable to a watercourse is presented in the table below.

Table 2-4: Trade Effluent Discharge Standard

Items of Analysis	Watercourse (Units in mg/L or otherwise stated)	Controlled Watercourse ¹ (Units in mg/L or otherwise stated)
Temperature of discharge	45°C	45°C
Colour	7 Lovibond Units	7 Lovibond Units
pH value	6-9	6-9
BOD (5 days at 20°C)	50	20
COD	100	60
Total Suspended Solids	50	30
Total Dissolved Solids	-	1,000
Chloride (as chloride ion)	-	250
Sulphate (as SO ₄)	-	200
Sulphide (as sulphur)	0.2	0.2
Cyanide (as CN)	0.1	0.1
Detergents	15	5
Grease and Oil	10 (Total) 10 (Hydrocarbons)	1 (Total)
Arsenic	0.1	0.01
Barium	2	1
Tin	-	5
Iron (as Fe)	10	1
Beryllium	-	0.5
Boron	5	0.5
Manganese	5	0.5

Items of Analysis	Watercourse (Units in mg/L or otherwise stated)	Controlled Watercourse ¹ (Units in mg/L or otherwise stated)
Phenolic Compounds (expressed as phenol)	0.2	Nil
*Cadmium	0.1	0.003
*Chromium (trivalent and hexavalent)	1	0.05
*Copper	0.1	0.1
*Lead	0.1	0.1
*Mercury	0.05	0.001
*Nickel	1	0.1
*Selenium	0.5	0.01
*Silver	0.1	0.1
*Zinc	1	0.5
*Metals in Total	1	0.5
Chlorine (Free)	1	1
Phosphate (as PO ₄)	5	2
Calcium (as Ca)	-	150
Magnesium (as Mg)	-	150
Nitrate (NO ₃)	-	20
¹ The set allowable limited for controlled watercourse, as defined by the <i>EPMA</i> .		
*The concentration of Toxic Metal shall not exceed the limits as shown, individually or in total.		

EPMA (Part V – Water Pollution Control) includes the following measures to protect water bodies from pollution:

- Penalties for the discharge of pollutive matters into inland waters;
- Licensing requirements for the treatment and discharge of trade effluent, oil, chemical, sewage or other polluting matters; and
- Measures to be undertaken to prevent water pollution due to storage or transportation of toxic substances or other polluting matter.

The *EPMA (Trade Effluent)* establishes regulatory control over industrial and other activities that may have adverse impacts on water quality. The Regulations provide details on effluent quality standards for discharge of wastewater into watercourses, but do not cover the discharge of trade effluent into the public sewer system (as it is covered under the sewer regulations). Effluent standards and permitting requirements are stipulated in the Regulations and all wastewater must be treated to the stipulated standards prior to discharge, with standards being applied depending on the watercourse being discharged into. Controlled watercourses have particularly stringent standards, as these are located within water catchment areas.

The *Public Utilities Act* may also be referred to as definition of water catchment areas, and activities prohibited within Catchment Area Parks.

Construction Surface Water Runoff

Under the requirements stipulated by PUB in the *Sewerage and Drainage Act: Code of Practice on Surface Water Drainage*, effective Earth Control Measures (ECM) should be implemented at all construction sites to minimise the effects of construction site runoff and surface water pollution.

Before commencement of construction and earthworks, Contractors are required to engage a Qualified Erosion Control Professional (QECP) to plan, design, supervise and review a system of earth control measures (ECM) to meet the requirements cited in the Code of Practice on Surface Water Drainage and to comply with the Sewerage and Drainage Act. The QECP is required to submit the detailed ECM proposal, on behalf of the site owner/ developer to the Public Utilities Board (PUB), prior to the commencement of works.

2.2.3. Noise Pollution

Operating under the *EPMA (Part VIII – Noise Control)* and the *EPMA (Control of Noise at Construction Sites)*, acceptable noise limits are set for construction activities within Singapore, including adjustments based on ambient background noise levels. The accepted construction noise levels provided in Table 2-5 are recommended to be followed for any construction works from Mondays to Saturdays.

Table 2-5: Allowable Noise Limits on Building Receptors from Construction Sites (Mondays to Saturdays)

Type of Affected Building	Work Site Operational Hours		
	Day (7 a.m. – 7 p.m.)	Evening (7 p.m. – 10 p.m.)	Night (10 p.m. – 7 a.m.)
Hospital, School, University, Aged Care Facility	60 dB LA _{eq} , 12hr	50 dB LA _{eq} , 12hr	
	75 dB LA _{eq} , 5min	55 dB LA _{eq} , 5min	
Residential (Within 150 m of construction site)	75 dB LA _{eq} , 12hr	65 dB LA _{eq} , 1hr	55 dB LA _{eq} , 1hr
	90 dB LA _{eq} , 5min	70 dB LA _{eq} , 5min	55 dB LA _{eq} , 5min
All other buildings	75 dB LA _{eq} , 12hr	65 dB LA _{eq} , 12hr	
	90 dB LA _{eq} , 5min	70 dB LA _{eq} , 5min	

Table 2-6: Allowable Noise Limits on Building Receptors from Construction Sites (Sundays and Public Holidays)

Type of Affected Building	Work Site Operational Hours		
	Day (7 a.m. – 7 p.m.)	Evening (7 p.m. – 10 p.m.)	Night (10 p.m. – 7 a.m.)
Hospital, School, University, Aged Care Facility	60 dB LA _{eq} , 12hr	50 dB LA _{eq} , 12hr	
	75 dB LA _{eq} , 5min	55 dB LA _{eq} , 5min	
Residential (Within 150 m of construction site)	75 dB LA _{eq} , 12hr	-	
	75 dB LA _{eq} , 5min	55 dB LA _{eq} , 5min	
All other buildings	75 dB LA _{eq} , 12hr	65 dB LA _{eq} , 12hr	
	90 dB LA _{eq} , 5min	70 dB LA _{eq} , 5min	

In addition, Table 2-6 shows that the maximum permissible noise levels were tightened when the regulations were reviewed in 2007 to address concerns about construction noise at night and on Sundays and public holidays for construction sites located within 150 metres (m) of residential premises. NEA further updated the regulations in 2011, and has implemented a rule on prohibition of work on Sundays and Public Holidays for construction sites located within 150 m of residential premises and near to noise sensitive premises as follows:

1. Construction sites established from 1 September 2011 onwards will not be allowed to carry out construction activities from 10 p.m. every Saturday to 7 a.m. on the following Monday.
2. Construction sites established from 1 September 2011 onwards will not be allowed to carry out construction activities from 10 p.m. on the eve of a public holiday to 7 a.m. on the day following the public holiday.

The Singapore Standard CP 602:2014 (Code of Practice for Noise Control on Construction and Demolition Sites) was developed by SPRING Singapore in 1998 to complement the *EPMA (Control of Noise at Construction Sites) Regulations*.

There is no specific regulation for vibration impact assessment in Singapore. The German Standards (DIN) 4150-2:1999 (Structural Vibration – Human Exposure to Vibration in Buildings) and DIN 4150-3:1999 (Structural Vibration – Effects of Vibration on Structures) are used as references for vibration impact assessments.

2.2.4. Waste Management

The *Environmental Public Health Act 1987 (EPHA)* contains specific provisions relating to industrial waste and its disposal. Under the EPHA, sludge from the pipe-jacking operation would be classified as toxic industrial waste (TIW). The Commissioner for Public Health may require the owner or occupier of any workplace to furnish information on the amount, type and nature of any industrial waste found on his premises. The owner or occupier may also be required to treat the industrial waste at their own expense before disposal.

EPHA (Toxic Industrial Waste) specifies wastes which are classified as TIW and regulates their handling, transport and disposal. The COPPC provides recommended control measures for industries and trade premises in handling, transport and disposal of TIW. Factories are required to install in-house treatment facilities to recycle and reuse their TIW or to treat their TIW for safe disposal. However, factories may apply for clearance from the PCD of NEA to engage licensed TIW collectors to collect their wastes for recycling or treatment for safe disposal.

The *EPHA (General Waste Collection)* governs the collection and disposal of general waste. All waste collectors must be licensed and listed by the NEA. Wastes are classified into three types (bulky wastes, putrefiable waste, sludge) and disposed of differently in particular vehicles, e.g., sludge and latrine waste from aircraft and portable toilets must be transported in tanker trucks. All wastes must be disposed of only at disposal facilities or incineration plants. The collector must keep proper records including the place and frequency of collection, place of disposal, type and tonnage of waste collected and disposed of and the vehicle used. Collectors must ensure that the refuse or waste is not dropped, scattered or spilled into any public place.

2.2.5. Vectors

Three pieces of legislation are enforced for the prevention and control of vectors in Singapore, namely: The *Infectious Diseases Act 1976 (IDA)* which deals with the notification, investigation and treatment of infectious diseases such as Dengue; the *Control of Vectors and Pesticides Act 1998 (CVPA)* which is focussed on the prevention of vectors and where necessary treatments to remove them; and the *EPHA 1987* which deals with environmental sanitation and other public health issues – such as but not limited to *EPHA (Part III – Public Cleansing)*. A key element of legislation applicable to all construction projects is detailed in Section 15 of the CVPA; which states that no person shall create or cause or permit to be created any condition favourable to the propagation or harbouring of vectors.

The NEA is the regulatory body responsible for minimising the incidence of vector-borne diseases in Singapore and it defines disease vectors as organisms that transmit diseases as “any insect, including its egg, larva and pupa, and any rodent, including its young, carrying or causing, or capable of carrying or causing any disease to human beings”. The five main vectors in Singapore are mosquitoes, fleas, cockroaches, rodents and flies. The presence of which is associated with stagnant water or food waste. NEA has the power to direct the owner or occupier of premises to implement vector control work per the requirements of the Act. The vector control work must be carried out by a vector control operator registered with NEA.

NEA also oversees the *EPHA (Employment of Environmental Control Officers)* and *Code of Practice for Environmental Control Officers for Construction Sites Published 2021*, which requires construction site occupiers to employ either a part-time or full-time Environmental Control Officer (ECO), depending on the contract sum of the construction works. The *Code of Practice for Environmental Control Officers* also spells out the responsibilities of the ECO and recommended measures in vector control.

2.2.6. Biodiversity

The main legislations enforced relevant to the protection, preservation and management of biodiversity within Singapore are the *Parks and Trees Act 2005*, *Planning Act 1998*, and the *Wildlife Act 1965*. This is reinforced by Singapore's various commitments and guidelines aimed at promoting biodiversity conservation, such as the National Biodiversity Strategy and Action Plan (NBSAP).

Parks and Trees Act

The *Parks and Trees Act* provides for the planting, maintenance, and conservation of trees and plants within various designated zones and areas in Singapore. These protected spaces include National Parks, Nature Reserves, Tree Conservation Areas (TCA), and Heritage Road Green Buffers.

Planning Act

The *Planning Act*, administrated by URA, establishes the legal basis for the regulation of development, conservation and land use planning in Singapore. Development in Singapore in the medium term is guided by the Master Plan which is a statutory land use plan.

Wildlife Act

The *Wildlife Act* includes sections relevant to this Project, summarized in the table below. New site personnel will be briefed on the relevant legal requirements and penalties from the *Wildlife Act* during the Biodiversity Awareness Briefing, prior to the commencement of any physical work on site.

Table 2-7: Summary of Wildlife Act 1965

Activity	Applicable Section	Legal Requirement	Penalty
Feeding of wildlife	5A	<i>A person must not intentionally feed any wildlife in any place unless the person has the Director-General's written approval to do so</i>	<ul style="list-style-type: none"> • For a first offence, to a fine not exceeding \$5,000 • For a second or subsequent offence, to a fine not exceeding \$10,000
Killing, trapping, taking or	5C	<i>A person must not intentionally kill, trap, take or keep any wildlife in any place unless the person</i>	<ul style="list-style-type: none"> • In the case where the offence is committed in respect of a protected wildlife, to a fine not exceeding \$50,000 or to

Activity	Applicable Section	Legal Requirement	Penalty
keeping of wildlife		<i>has the Director-General's written approval to do so.</i>	<i>imprisonment for a term not exceeding 2 years or to both.</i>
Wildlife-related measures for development or works	10	<i>The Director-General may direct a person to implement, in respect of any development or works being carried out, or to be carried out, by or on behalf of the person, any wildlife related measure that the Director-General considers necessary to safeguard</i>	<ul style="list-style-type: none"> • <i>A person who, without reasonable excuse, contravenes subsection (3) shall be guilty of an offence and shall be liable on conviction to a fine not exceeding \$50,000 or to imprisonment for a term not exceeding 6 months or to both.</i>

National Biodiversity Strategy and Action Plan (NBSAP)

There is no specific legislation on biodiversity conservation in Singapore. However, a non-statutory publication by NParks – *Conserving Our Biodiversity: Singapore's National Biodiversity Strategy and Action Plan (NBSAP)*, provides an integrated framework for the conservation of Singapore's natural heritage. The NBSAP sets out five strategies to create a city biodiversity conservation model that champions environmental sustainability in an urban setting (NParks, 2009).

- Strategy 1: Safeguard Our Biodiversity;
- Strategy 2: Consider Biodiversity Issues in Policy and Decision-making;
- Strategy 3: Improve Knowledge of Our Biodiversity and the Natural Environment;
- Strategy 4: Enhance Education and Public Awareness; and
- Strategy 5: Strengthen Partnerships with All Stakeholders and Promote International Collaboration

Strategy 2 is applicable to this development where biodiversity conservation considerations are included into the administrative processes of approving an EIA.

Nature Conservation Masterplan (NCMP)

In addition to the NBSAP, a holistic NParks' Nature Conservation Master Plan (NCMP) was subsequently launched in 2015 (NParks, 2015). This aims to chart Singapore's future biodiversity conservation efforts through systematically consolidating, coordinating, strengthening and intensifying conservation efforts outlines in the NBSAP.

3. Environmental Baseline

Understanding current environmental conditions is a crucial part of the EIA process. Current data prior to any work will help assess the environmental quality and ecosystem health of the site. It will give an understanding of how far the current environmental conditions have deviated from the values expected in quality guidelines and standards. This baseline assessment includes survey data such as Fauna and Flora Biodiversity, as well as secondary data from literature review. An Ecological Connectivity Study was also conducted.

3.1. Site History

Understanding the site history will give assessors an understanding on the past land use and how much over time the site has changed. This information will help determine if habitats are young or have been present for a significant amount of time. The progression of land use since 1924 at Jurong Hill is illustrated in the following series of historical maps and archived aerial photography. Note that the hill was originally known as Bukit Peropok however the name was changed to Jurong Hill when the Jurong Industrial development occurred during the 1960's.

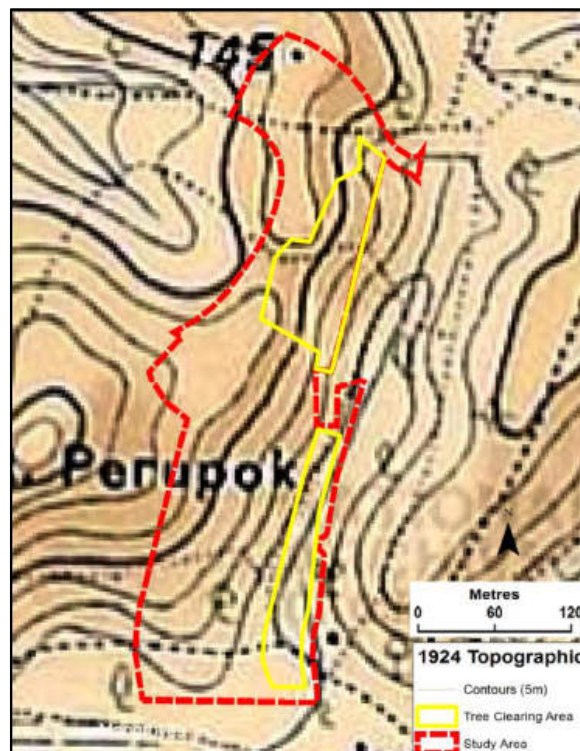


Figure 3-1: Topographical Map of the Study Area, dated 1924

The 1924 Topographic map shows rubber plantation about the low-lying land however none is shown on the hillside of Bukit Peropok. However, 1951 aerial photography (Figure 3-2 below) shows evidence of cleared rubber plantation in the post war period. It is likely that rubber was planted on the hillside at some point after 1924 and decimated during or soon after WW2.

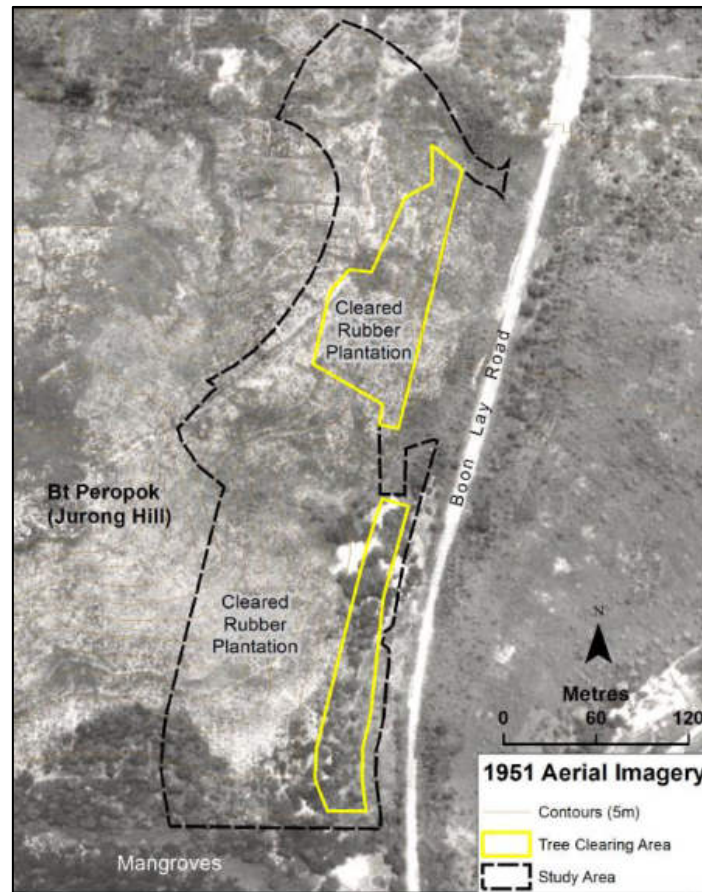


Figure 3-2: Aerial Photograph of the Study Area, dated 1951 (NAS, 1951)

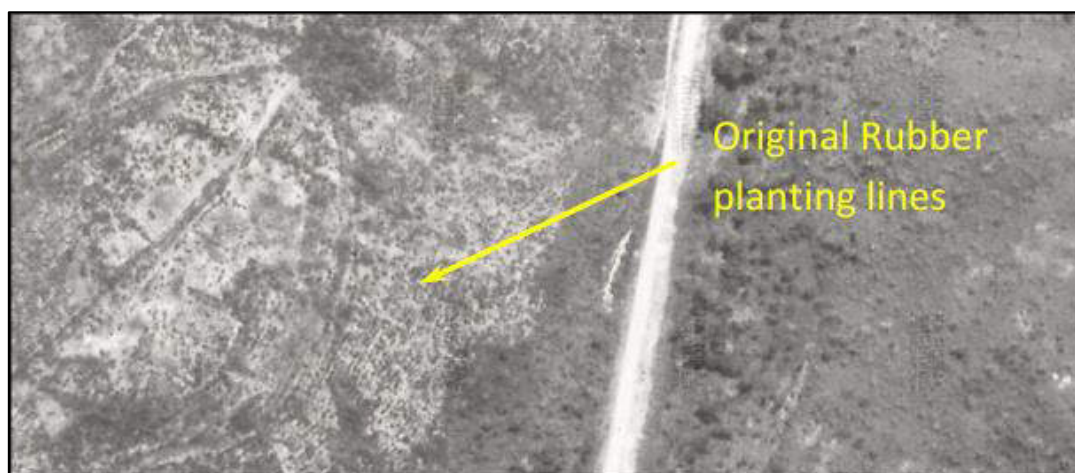


Figure 3-3: Enlarged Section Showing Original Rubber Planting Lines (NAS, 1951)

The 1951 aerial imagery (Figure 3-2 and Figure 3-3 above) shows cleared rubber plantation. During the war years, rubber plantations were harvested for building material and some were cleared for purpose of agriculture. During the post war period some older rubber plantations were cleared and replanted as a result of research indicating productivity gains by doing so. It is apparent that the rubber plantation on this site was cleared post-war. However, there is no evidence of replanting and that natural regeneration of vegetation has occurred since then.



Figure 3-4: Aerial Imagery of Jurong Hill, dated 1966 (NAS, 1966)

The 1966 aerial imagery shows the reclamation and development of the Jurong Industrial precinct. Jurong Hill was retained as an island of regenerated forest. In 1968, the Jurong Town Council established Jurong Hill Park at this location.



Figure 3-5: NUS Map Library Topographic map, dated 1975

The 1975 Topographic map shows the Jurong Hill Park along with the adjacent Jurong Bird Park established and surrounded by industrial development. The 2022 Google imagery shows the Jurong Hill Park and adjacent Jurong Bird Park (now relocated to Mandai) surrounded by industrial development. The historical analysis shows that while the Jurong Hillside was originally planted with rubber trees, these were removed during or just after the war. Since then, the site has undergone spontaneous regeneration for the past 70+ years.



Figure 3-6: Google Imagery showing Jurong Hill Park, 2022

3.2. Current Site Conditions

Presently, the site is vegetated with secondary forest and grassland. The Study Area is enclosed by public amenities, such as roads, former Jurong Bird Park and existing J112 development work site.



Figure 3-7: Jurong Hill EIA Study Area

The Study Area is an open forested area that is accessible to the public. However, due to the topography of the area and the intensity of flora growth within the understory, it is unlikely that much human activity is observed within the forest. The area has a steep incline ranging approximately 20m – 50m.



Figure 3-8: Topographical Map of Jurong Hill Area

3.3. Singapore Environment Setting

Singapore has a land area of 735.2 km² as of December 2023 (Singstat, 2023). It lies off the southern tip of the Malay Peninsula, and also separated from West Malaysia and Indonesia by the by the Johor Straits in the north, and Straits of Singapore in the south. Situated 1° 22' North of the equator, it has an equatorial tropical climate, characterized by high temperatures, humidity and seasonal rainfall. Singapore was once nearly covered with primary rainforest and the entire coast supported mangrove habitat and other coastal vegetation, but economic development has since changed much of the original habitat.

Urban development has had an effect on the local climate of Singapore. Due to the substantially increased extent of hard surfaces and a significant reduction in tree cover, urban areas are subject to the 'urban heat island' effect, where ambient temperatures are slightly elevated. Reduced surfaces also increase higher runoff volumes that were previously absorbed into the ground calling for the increasing need to channel water to the sea to reduce potential flooding issues.

In recent times, transboundary haze which posed health concerns has not been a threat.

3.3.1. Temperature

The mean temperature in Singapore for the last 10 years (from 2012–2021) was 27.97°C (MSS, 2021). Which is also the warmest decade on record. The annual mean temperature in 2021 was 27.9°C (MSS, 2021). This was 0.01°C higher than the long-term average, and also the 10th warmest year on record. All 10 of the warmest years were recorded after 1997 (MSS, 2022).

In general, temperature variation month-on-month is small. The cooler periods typically occurred during the first half of the year, with warmer temperatures in the second half due to relatively drier conditions.

While there is no distinct difference between "Urbanised" and "Rural" areas in Singapore, a maximum temperature difference of 4.01°C was observed (Wong & Chen, 2005). In general, the Study Area temperature also followed the nationwide temperature fluctuations, except for the high mean temperature recorded in July 2021. The monthly mean temperature recorded from the nearest NEA weather station is provided in Figure 3-10.

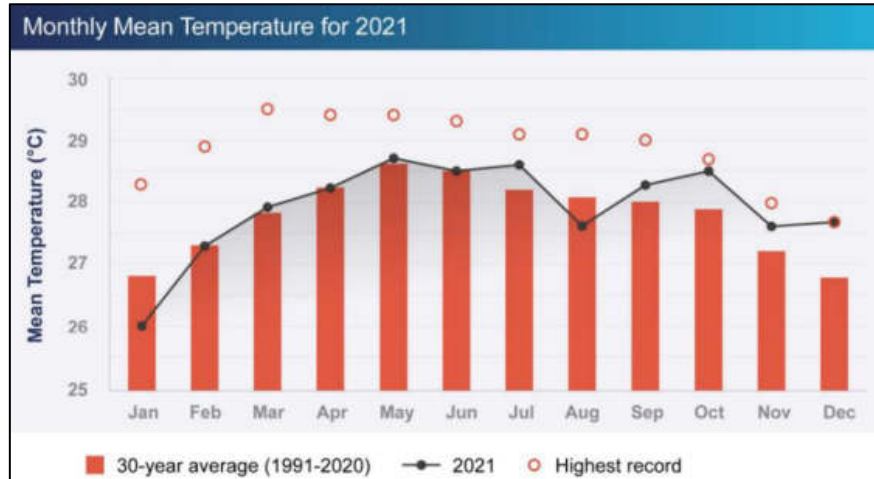


Figure 3-9: Singapore Monthly Mean Temperature 2021 (MSS, 2021)

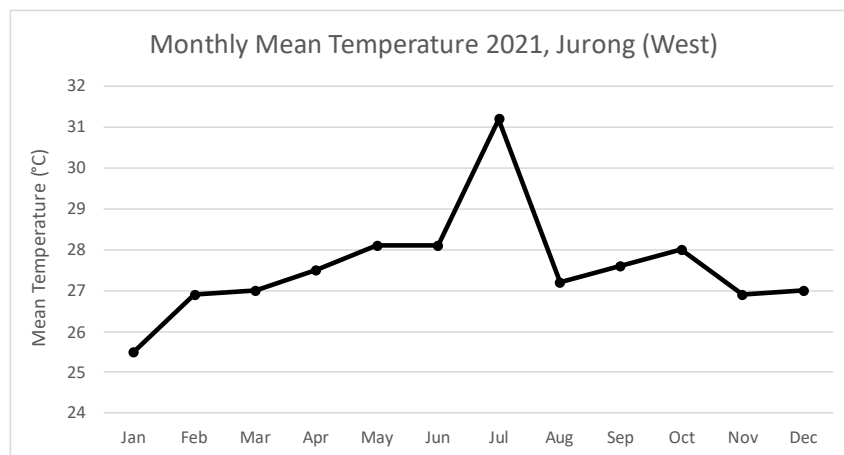


Figure 3-10: Monthly Mean Temperature of nearest weather station – Jurong (West) 2021 (MSS, 2021)

3.3.2. Rainfall

The total rainfall in Singapore for 2021 was well above average, resulting in the 2nd wettest year since 1980. This is due to most months experiencing above-average rainfall. January 2021 and August 2021 were especially wet, while February 2021 was especially dry.

The variation in rainfall across the months are largely influenced by the two monsoon seasons. The Northeast Monsoon (December to March), and the Southwest Monsoon (June to September). The monthly total rainfall of nearest weather station – Jurong (West) 2022 is provided in Figure 3-12.

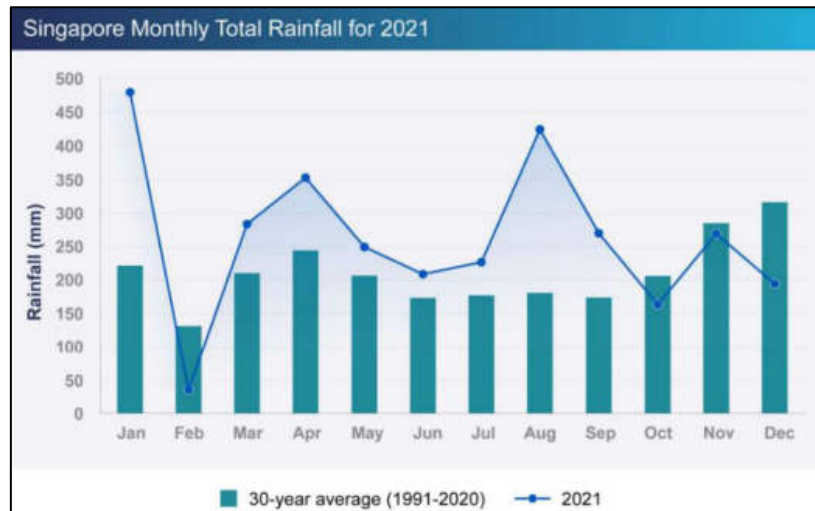


Figure 3-11: Singapore Monthly Total Rainfall 2021 (MSS, 2021)

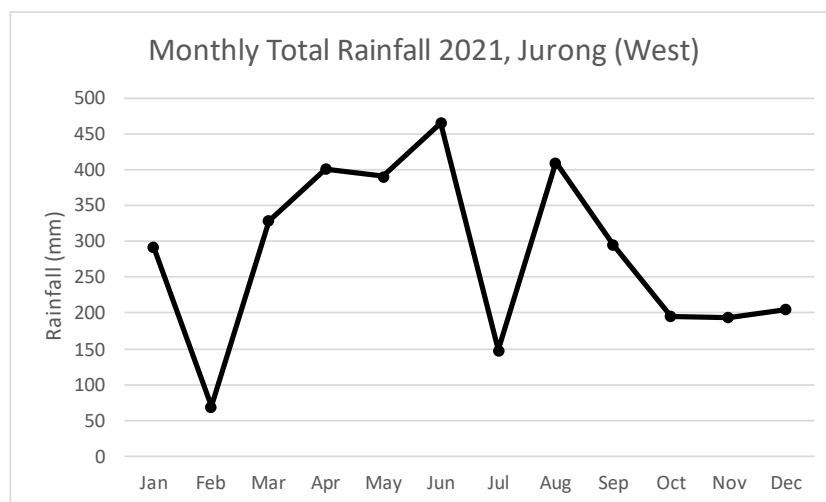


Figure 3-12: Monthly Total Rainfall of nearest weather station – Jurong (West) 2021 (MSS, 2021)

The spatial distribution of rainfall through Singapore for 2021 showed higher rainfall over northern and western parts of the island. This meant, the southern and eastern parts of the island typically receive lower rainfall. But the disparity remains minimal as seen in Figure 3-12, with the Study Area monthly rainfall following the nationwide monthly rainfall fluctuations closely.

3.3.3. Relative Humidity

Relative humidity is fairly uniform and consistent throughout the year. The month-on-month variations are marginal. Instead, the daily variation is more marked, with pre-dawn humidity exceeding 90%, which noon humidity falling around 60% during dry weathers. Relative humidity also frequently reaches 100% during prolonged periods of rain. The hourly variation of humidity is reflected below.

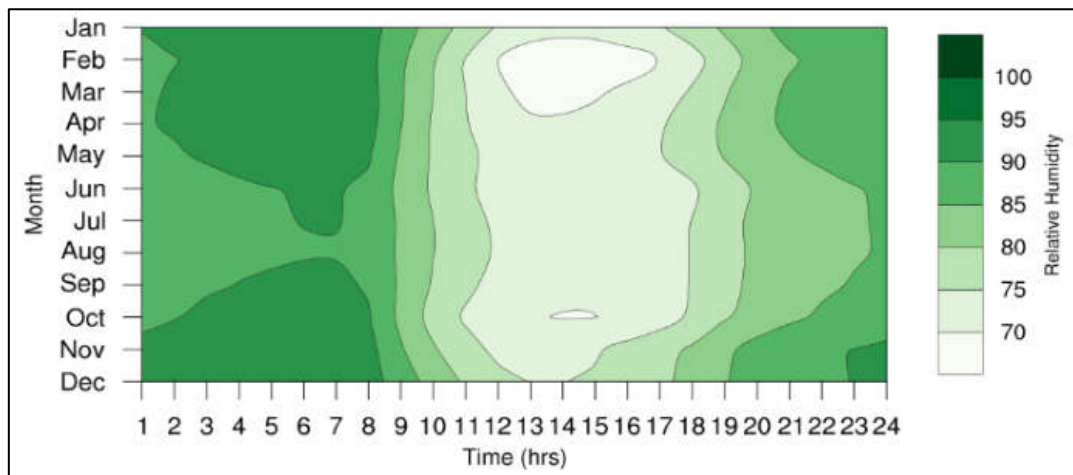


Figure 3-13: Hourly and Monthly variation of relative humidity for 1981 – 2010 (MSS, 2022)

3.3.4. Surface Wind

Surface winds largely reflect the dominance of the monsoons in Singapore. Wind direction flowed mainly north-eastward during the Northeast Monsoon (December to March), and south-eastward during the Southwest Monsoon (June to September). The wind strength is greatest during the Northeast Monsoon.

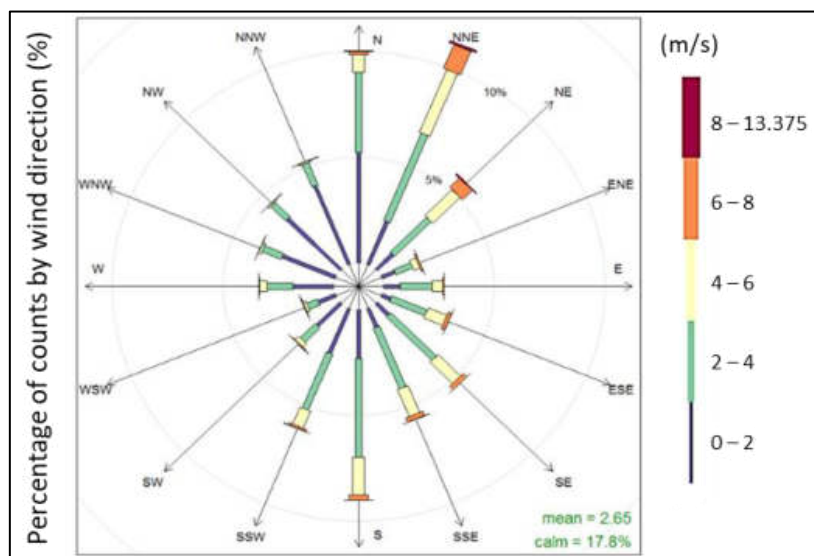


Figure 3-14: Annual wind rose, m/s for 1981 – 2010 (MSS, 2022)

3.3.5. Geomorphology, Geology, & Topography

Geomorphology and Geology

Geomorphology describes the processes relating to the topographical formation and physical geography of an area. Generally, such processes determine the broad physical characteristics of ecological habitats, their species composition, as well as their value for conservation purposes.

DSTA (2009) shows that Singapore can be mapped into three rock units – granite, shale and sandstone, and high-level alluvium plus recent alluvium.

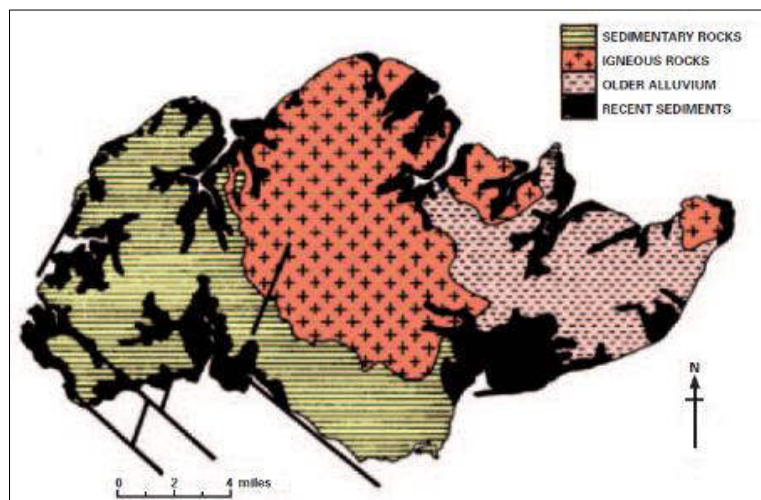


Figure 3-15: Simplified geological map of Singapore (DSTA, 2009)

The geology of Singapore has been strongly influenced by its location, being relatively near to the boundary between the Eurasian and Australian tectonic plates. Southern Sumatra marks one boundary between the two plates in the Southeast Asian Region. Singapore, along with the Malay Peninsula, Borneo, Indochina and the shallow shelf areas of the South China Sea, form a stable block of the earth's crust called the 'Sundaland' which is largely unaffected by the tectonic and volcanic activity around its southern and eastern margins.

The study area is dominated by Jurong Formation. It is made of sediments from weathered material of older rocks which were deposited in a shallow marine basin formed between Bukit Timah Granite and the Main Range Granite and later lithified into rocks. Through lateral basin compression, the rocks were uplifted, folded, faulted, and metamorphosed. Most rocks are weak where rock mass quality is usually fair to poor due to extensive fracturing and low

strength of the rocks. The groundwater table is located between 5 and 20 m below ground surface. It is usually present in the zone of residual soil or completely weathered rock.

Topography

Due to Singapore's low lying and unilateral topography, it lacks extensive natural aquifers or lakes. As a result, stormwater is vital in being a main source of water for drinking and industrial purposes. Thus, stormwater are collected through a network of rivers, canals, and drains, which are then directed to reservoirs. At present, there are 17 reservoirs in Singapore.

The Study Area lies within the water catchment zone of Pandan Reservoir. As a result, stormwater from the canals is naturally channelled there using gravity to the lower lying reservoir, Pandan Reservoir.

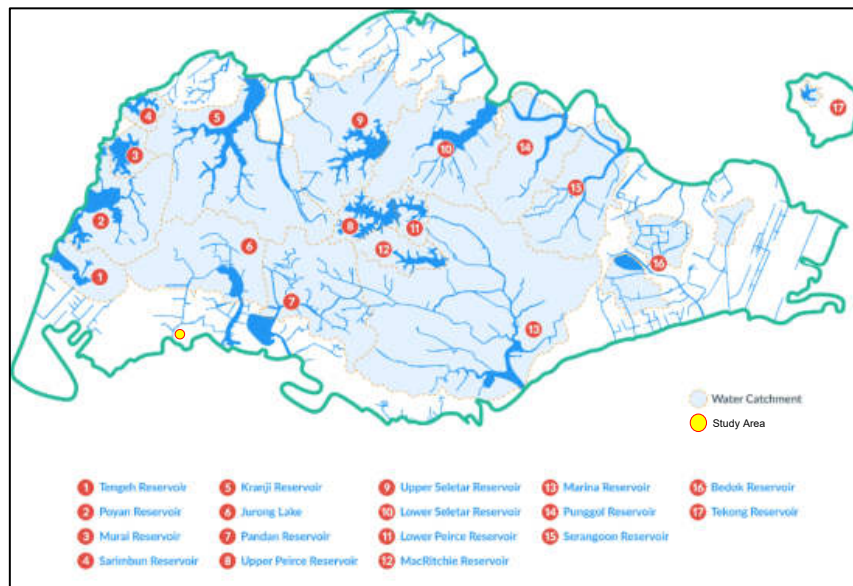


Figure 3-16: Singapore Water Catchment Area (PUB, 2022)

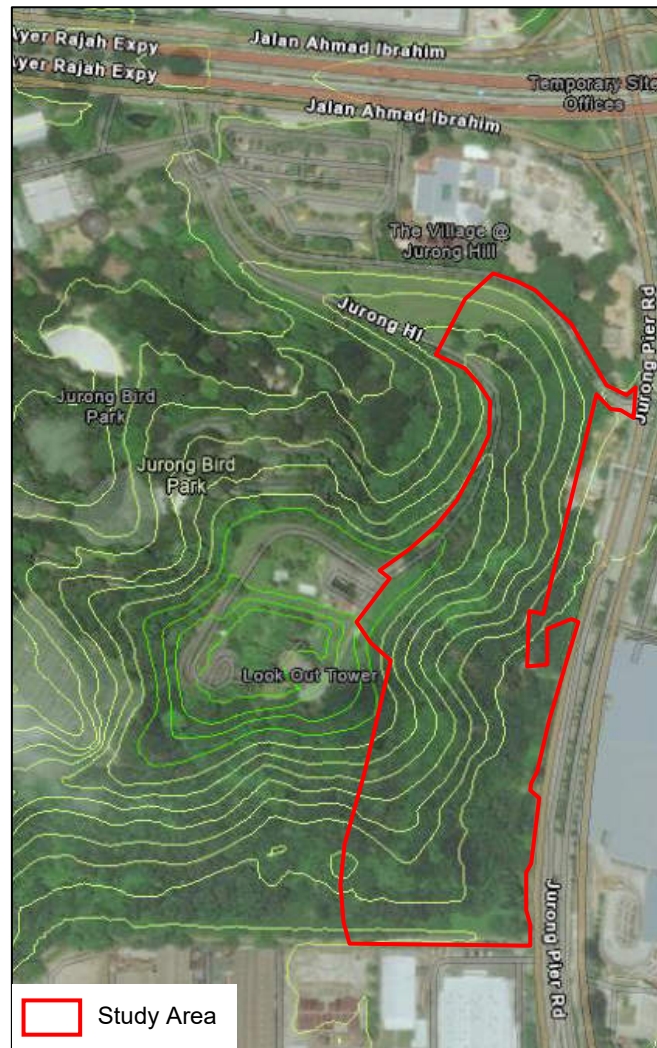


Figure 3-17: Topography of the Study Area



Figure 3-18: Topography of surrounding region around the Study Area

The surrounding vicinity showed no drastic changes in topography unlike within the study area. The highest peak would be Jurong Hill Park, to the west of study area.

3.4. Biodiversity Study

The Biodiversity Study aims to establish a baseline biodiversity information of the Study Area, and to determine if there is any impact by the proposed Project on the existing biodiversity. The baseline biodiversity information collected would be used in the evaluation and scale of impact assessment associated with the proposed Project, in the later sections.

This biodiversity study was conducted to cover and study fauna and flora within the site with the aim of identifying habitats and relevant species for biodiversity protection. Understanding what is present on site will help in proposing the best control and mitigation measures to ensure their survival and conservation. All proposed biodiversity surveys carried out within the study area, are based on the recommended methodologies from the *Biodiversity Impact Assessment (BIA) Guideline* by NParks (NParks, 2021).

Specifically, the study aims to:

- Conduct and document a biodiversity inventory of the local flora and fauna, with special attention to the forest ecosystems within the Study Area;
- Indicate the Conservation-significant (CS) fauna species based on the statuses outlined in the Singapore Red Data Book Version 3 (SRDB3) published on the official website of NParks and International Union of Conservation of Nature (IUCN) Red List of Threatened Species. For flora species, they are based on the *Flora of Singapore: Checklist and Bibliography* (Lindsay, S. et al., 2022) and *A Checklist of the Total Vascular Plant Flora of Singapore: Native, Naturalised and Cultivated Species* (Chong et al., 2009); and
- Recommend a wildlife shepherding plan (Section 4.4) for future site clearance.

This study has included a Flora & Tree Survey, Habitat and Spatial Mapping, Camera Trapping and Fauna Transect Surveys. The assessment covers a total area of ~60,000 m².

3.4.1. Methodology

3.4.1.1. Flora & Tree Survey

The flora study was conducted by roaming transect and 10m x 10m sampling plots due to the steep slope of the survey area. The roaming transects were conducted at the same time as the tree identification study this means that most of the site will be covered except for areas

that are treeless in which case these areas are *Dillenia suffruticosa*. Four 10m x 10m sampling plots were set up evenly across the site, which were measured by setting out two parallel internal transect lines 5 metres apart, at locations where they are likely to capture the maximum diversity of flora. All species above 3 cm girth were captured along with climbers and epiphytes. Trees of girth 100 cm or greater (measured 1.5 m above ground) were surveyed by registered surveyor to a minimum accuracy of 1m @ 95% confidence.

The vegetation was identified by the Flora Specialist. All sightings, including opportunistic sightings, of vascular flora species, e.g., trees, herbaceous plants, climbers, and epiphytes, were identified to species level or the next lowest taxonomic rank, and compiled to create a flora inventory.

The location of all observed Conservation-significant (CS) flora and tree species found along the transects and plots were mapped using a handheld GPS. The species of CS species (i.e., trees, shrubs, herbs, climbers and epiphytes) were recorded. The conservation status of all trees more than 1m girth were also recorded using a handheld GPS. Their location, girth size, height, species, and conservation status are provided.



Figure 3-19: Flora Survey Sampling Plots

3.4.1.2. Habitat and Spatial Mapping

Based on the identified floral communities, the surveyed results were reviewed in conjunction with site morphology (from topography map) and satellite imageries. A map was produced via QGIS showing the boundaries of various habitat types occurred at the survey area and detailing the location and extent of vegetation zones. The map is georeferenced to the WGS84 or SVY21 geographical coordinate system. These habitats are classified according to the main habitat types in Singapore as per NParks' Biodiversity Impact Assessment Guidelines v2 (2021). Particular attention was paid to any observed habitats of conservation importance. Thus, the deliverables would include the habitat map showing the boundaries of various habitat types based on identified plant species and past land use of the site.

3.4.1.3. Camera Trapping

The camera traps are intended to determine the presence of nocturnal/crepuscular ground dwelling animals. Four (4) camera traps were mounted at a height of 30 – 50 cm off the ground in the vicinity of animal crossings within the forested area for a duration of 30 days. The camera traps will be placed within the boundary of the EIA study area, which is defined as up to 100m from the proposed work boundary. Species captured in the camera traps will be documented along with information such as, date and time, behaviour of the animals, and national and international conservation status in both the local Singapore Red Data Book – 3rd Edition (SRDB3) and International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN, 2022), for national and international conservation status respectively.

The locations of the camera traps are included below, Figure 3-20. The camera traps were deployed based on field considerations, such as terrains, habitats and possible sighting of fauna during the recce. This was done considering to best option to document fauna within the study area.



Figure 3-20: Camera Trap Locations

Photo example of their location is depicted in the table below:

Table 3-1: Camera Trapping Locations





CT1	CT2
	
CT3	CT4
	

Table 3-2: Ground and Arboreal Camera Trapping GPS Locations

Sampling Point	Latitude	Longitude
CT1	1.318430	103.709300
CT2	1.316580	103.709400
CT3	1.315740	103.708640
CT4	1.319740	103.709300

3.4.1.4. Fauna Transect Survey

The fauna transect surveys were carried out to survey birds, mammals, reptiles, amphibians, butterflies and odonates. Field surveys involved both full mornings (Diurnal, 0700 - 1100hrs) and evenings (Nocturnal, 1900 - 2100hrs). The diurnal surveys were carried out with the aid of binoculars and the nocturnal surveys were carried out with the aid of a torch and binoculars. A total of three (3) transects, each measuring 200 m and spaced approximately 100 m apart, as illustrated in Figure 3-21, were surveyed.

The transects were allocated along the boundary of Study Area as indicated in Figure 3-21, which are flanked by Jurong Pier Road and Jurong Hill Road. The transects were placed along the boundary as the terrain of the study area within the boundary is observed to be steep which raises safety concerns during the survey, especially during nocturnal survey.

A total of three (3) replicates were carried out, for both diurnal and nocturnal surveys. However, this is with the exception of Transect 1 (T1), which due to safety concerns – uneven and dangerous terrain, only one (1) replicate of the nocturnal survey was conducted. A brief summary of the transects and their respective replicates are included below.

Table 3-3: Transect Replicates

Transect	Diurnal Replicates	Nocturnal Replicates
T1	3	1
T2	3	3
T3	3	3

All species were compared against both the local Singapore Red Data Book – 3rd Edition (SRDB3) and International Union for Conservation of Nature (IUCN) Red List of Threatened Species (IUCN, 2022), for national and international conservation status, respectively.



Figure 3-21: Fauna Survey Transects

Birds

Surveyors walk along the transect at a steady pace and record all birds heard and seen within 50 m of either side of the transect and 50m ahead. The survey duration for each transect was approximately 30 minutes. Both diurnal and nocturnal surveys were conducted for this taxa group.

Mammals

Surveyors walk along the transect at a steady pace and record each mammal observed within 50 m of either side of the transect and 50m ahead, including indirect evidence of mammals, such as scat and tracks. The survey duration for each transect was approximately 30 minutes. Both diurnal and nocturnal surveys were conducted for this taxa group.

Reptiles and Amphibians

Surveyors walk along the transect at a steady pace and record each reptile or amphibian observed within 10 m of either side of the transect ahead. Presence of calling frogs were also recorded. The survey duration for each transect was approximately 30 minutes. Both diurnal and nocturnal surveys were conducted for this taxa group.

Butterflies

Surveyors walk along the transect at a steady pace and record all butterflies and hymenopterans observed within 5m of either side of the track or 5m ahead. The survey duration for each transect was approximately 30 minutes. Only diurnal surveys were conducted for this taxa group.

Odonates

Surveyors walk along the transect at a steady pace and record all odonates observed within 5m of either side of the track or 5m ahead. The survey duration for each transect was approximately 30 minutes. Only diurnal surveys were conducted for this taxa group.

3.4.2. Results & Discussion

3.4.2.1. Flora & Tree Survey

The flora study was conducted from February 2023 through March 2023 for the Study Area. A total of 69 species of plants were recorded in this study, with 68 species of plants were identified within the Study Area by the flora transect surveys, four (4) box plot surveys, and an extensive tree survey, and the addition of one (1) species (*Entada spiralis*) which was not discovered during the flora survey but previously noted (personal communication, 27 September 2022) by NParks as being present within the Study Area. Therefore, it was still included within this study as further transect surveys may detect the presence of this.

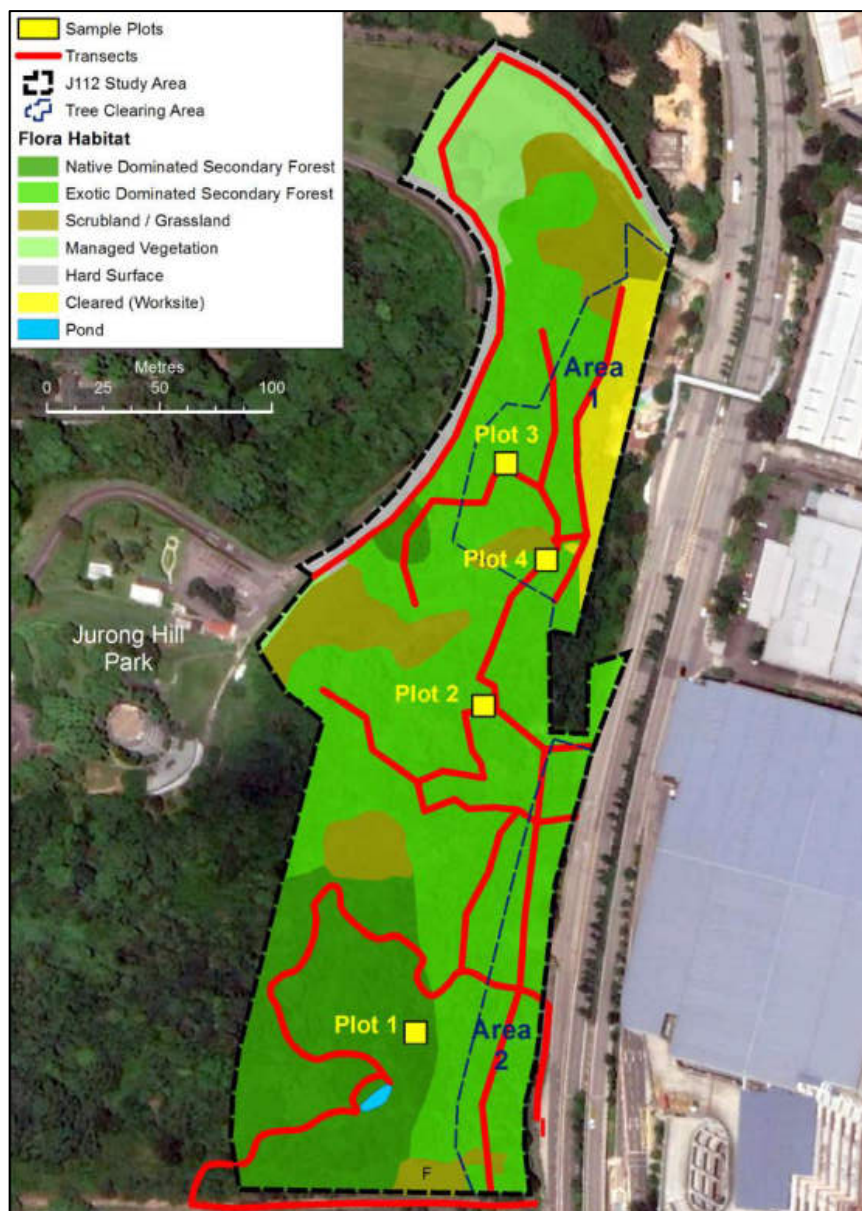
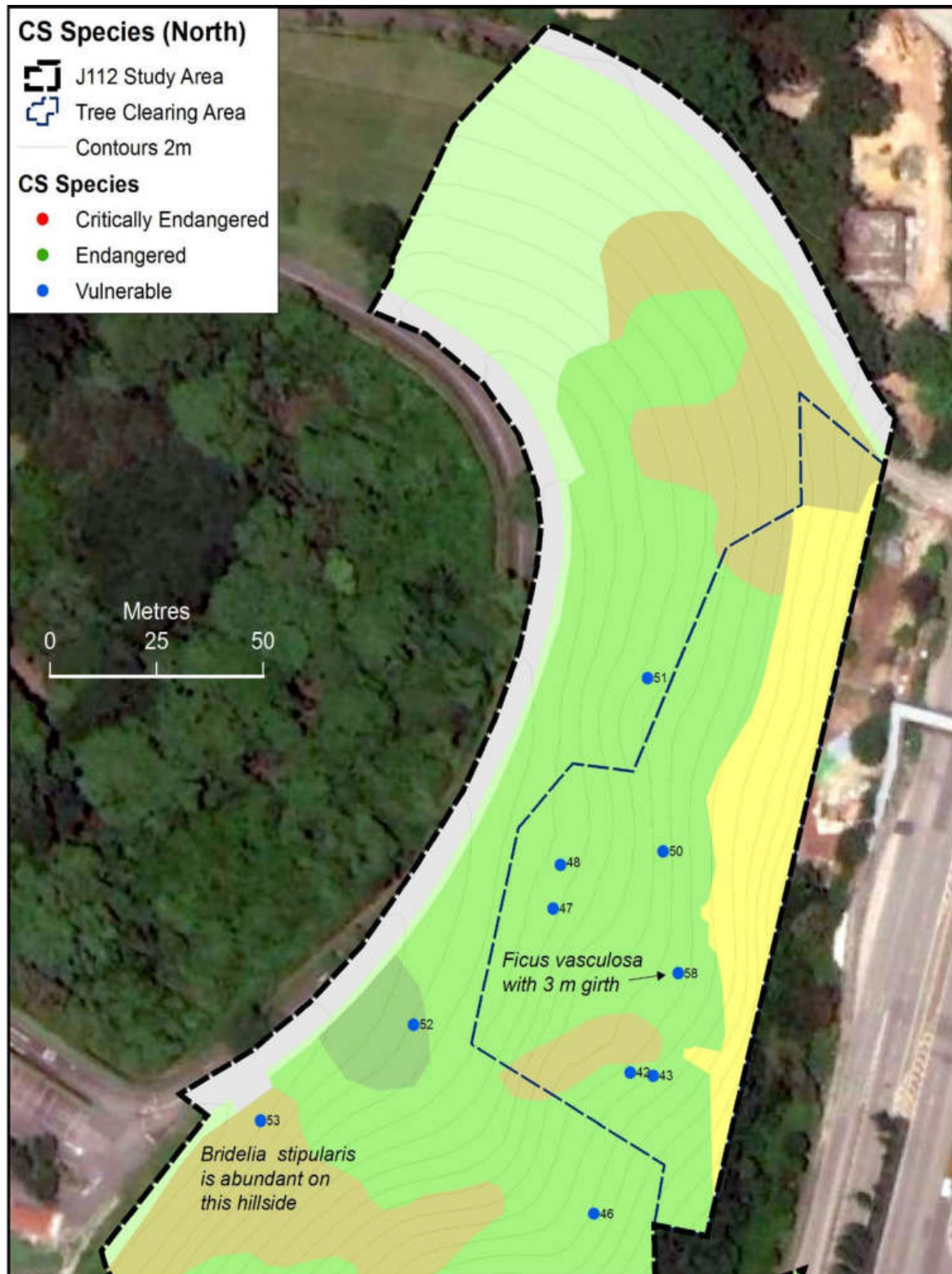


Figure 3-22: Flora Transects and Sampling Plots Layout

Among the 69 flora species, there are 51 native species, 17 exotic species, and one (1) unidentified thorny liana species which was encountered outside of Area 1 and 2 at the Sampling Plot 2 (refer to Figure 3-22). Among the exotics, 12 species are considered naturalised. There was a total of 15 species with conservation statuses, including the *Entada spiralis*. These are recognised as having conservation status of either Critically Endangered (CR), Endangered (EN), and Vulnerable (VU). Flora Species of conservation status are included in Table 3-4. A map of their distribution is also included in Figure 3-23, and 3-24, and Appendix I. A full flora species list is also included in Appendix I. The tree schedule with reference to two (2) A1 size tree maps is in Appendix I.

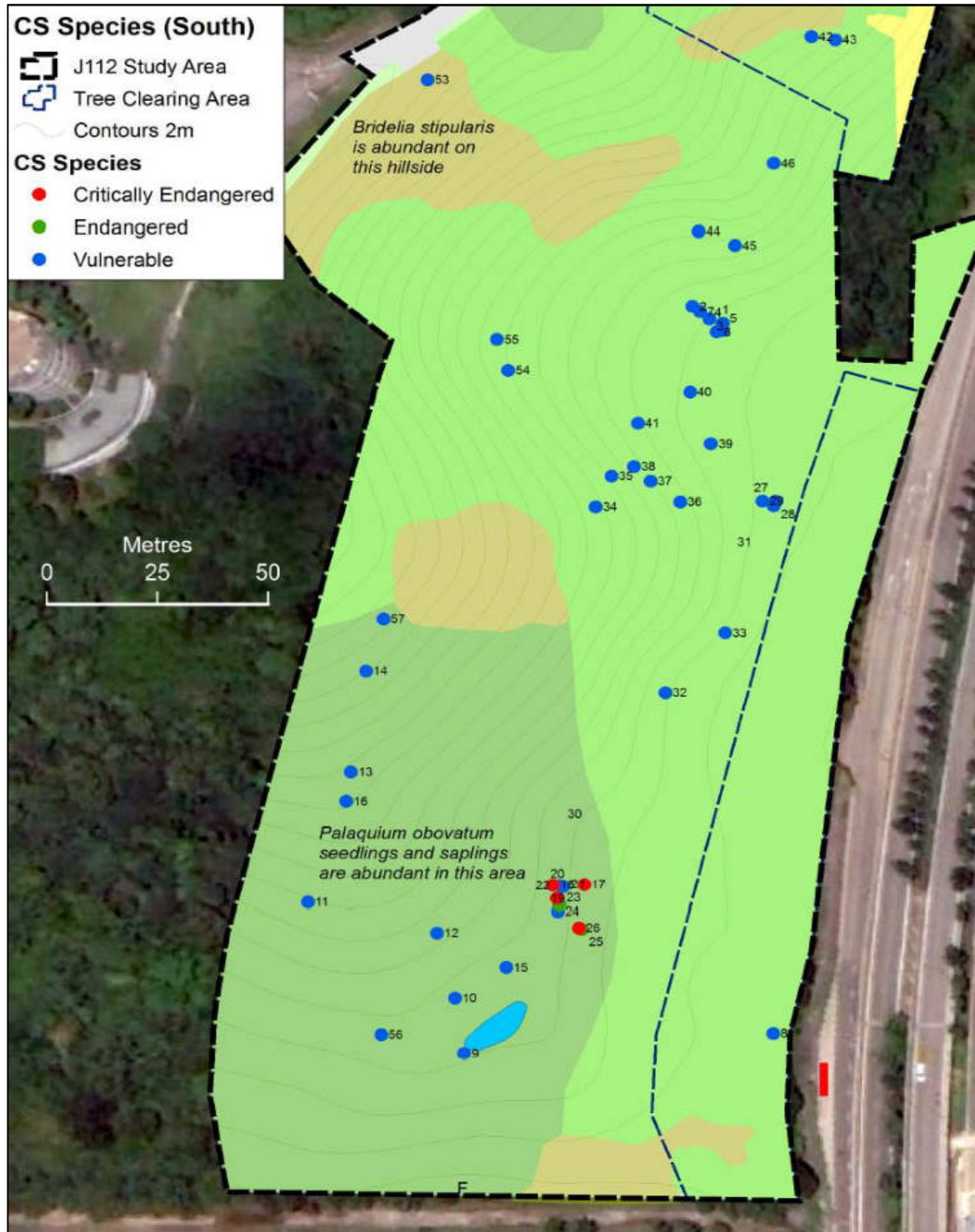
Table 3-4: Summary of Flora Species (including trees) with Conservation Status

ID	Species	Origin	Status	Comment
1	<i>Aidia densiflora</i>	Native	Vulnerable	Within Tree Survey
2	<i>Archidendron jiringa</i>	Native	Vulnerable	Within Plot and Transect survey
3	<i>Bridelia stipularis</i>	Native	Vulnerable	Within Transect survey
4	<i>Cayratia mollissima</i>	Native	Endangered	Within Transect survey
5	<i>Entada spiralis</i>	Native	Vulnerable	Noted by NParks, but not found during the survey
6	<i>Ficus vasculosa</i>	Native	Vulnerable	Within Transect and Tree Survey
7	<i>Garcinia griffithii</i>	Native	Endangered	Within Plot and Transect survey
8	<i>Gnetum cf. latifolium</i>	Native	Critically Endangered	Within Plot and Transect survey
9	<i>Gnetum gnemon</i>	Native	Critically Endangered	Within Transect survey
10	<i>Licuala spinosa</i>	Native	Vulnerable	Within Plot and Transect survey
11	<i>Limacia scandens</i>	Native	Vulnerable	Within Transect survey
12	<i>Neolitsea cassia</i>	Native	Vulnerable	Within Transect survey
13	<i>Oncosperma tigillarium</i>	Native	Vulnerable	Within Transect survey
14	<i>Palaquium obovatum</i>	Native	Vulnerable	Within Plot and Transect survey
15	<i>Syzygium myrtifolium</i>	Native	Critically Endangered	Within Transect survey



Note: The numbers are corresponded to the list of conservation-significant flora species recorded in Appendix I - Table 2: Conservation Significant Species Schedule.

Figure 3-23: Conservation Significant species map (North)




Note: The numbers are corresponded to the list of conservation-significant flora species recorded in Appendix I Table 2: Conservation Significant Species Schedule.

Figure 3-24: Conservation Significant species map (South)

3.4.2.2. Habitat and Spatial Mapping

The habitat map is compiled with reference to formal flora sampling plots and walking transects utilised as ground truth basis for satellite image interpretation. The habitat classes have been chosen to coincide as much as possible with the Biodiversity Impact Assessment Guidelines published by the National Parks Board. (NParks, 2021)

Habitat Map Class	Description												
Native Dominated Secondary Forest	Areas to the south of the study area feature the following native species: <i>Cyrtophyllum fragrans</i> , <i>Palaquium obovatum</i> , <i>Syzygium grande</i> , and <i>Syzygium zeylanicum</i> . <i>Palaquium obovatum</i> seedlings and saplings are particularly abundant in the southern extent of the study area. The area labelled B in the habitat map below features mature <i>Rhodamnia cinerea</i> and <i>Diospyros lanceifolia</i> trees.												
Scrub Land	<p>Scrub Land areas on site have different species assemblages. With reference to labels on the habitat map below these scrub areas are characterised as follows:</p> <table> <tr> <th>Label</th><th>Dominant Species</th></tr> <tr> <td>A</td><td><i>Dillenia sufruticosa</i></td></tr> <tr> <td>C</td><td><i>Dicranopteris linearis</i></td></tr> <tr> <td>D</td><td><i>Bridelia stipularis</i></td></tr> <tr> <td>E</td><td><i>Fibraurea tinctoria</i></td></tr> <tr> <td>F</td><td><i>Dillenia suffruticosa</i></td></tr> </table>	Label	Dominant Species	A	<i>Dillenia sufruticosa</i>	C	<i>Dicranopteris linearis</i>	D	<i>Bridelia stipularis</i>	E	<i>Fibraurea tinctoria</i>	F	<i>Dillenia suffruticosa</i>
Label	Dominant Species												
A	<i>Dillenia sufruticosa</i>												
C	<i>Dicranopteris linearis</i>												
D	<i>Bridelia stipularis</i>												
E	<i>Fibraurea tinctoria</i>												
F	<i>Dillenia suffruticosa</i>												
Exotic Dominated Secondary Forest	<p>The dominant species under this habitat category is <i>Hevea brasiliensis</i> due to the past land use of rubber plantation. The original production rubber trees were removed prior to 1950 and the rubber trees dominating the site are progeny of these original plantation trees.</p> <p>The understory includes spontaneous growth of mainly native species such as <i>Syzygium grande</i>, <i>Archidendron jringa</i>, <i>Palaquium obovatum</i>, <i>Caryota mitis</i>, <i>Ficus vasculosa</i>, <i>F. aurata</i>, <i>F. variegata</i> and <i>F. fistulosa</i>. The native climber <i>Fibraurea tinctoria</i> is common throughout this area.</p>												

Habitat Map Class	Description
Ephemeral Pond	<p>A small ephemeral pond is situated within the southern extent of the study area. It also features the same native species such as <i>Cyrtophyllum fragrans</i>, <i>Palaquium obovatum</i>, <i>Syzygium grande</i>, and <i>Syzygium zeylanicum</i>.</p> <p>It is noted that the pond could be dry up during longer dry spells because there are rubber trees growing out of the water. The rubber trees would not have been able to germinate if the pond was always with water.</p> 

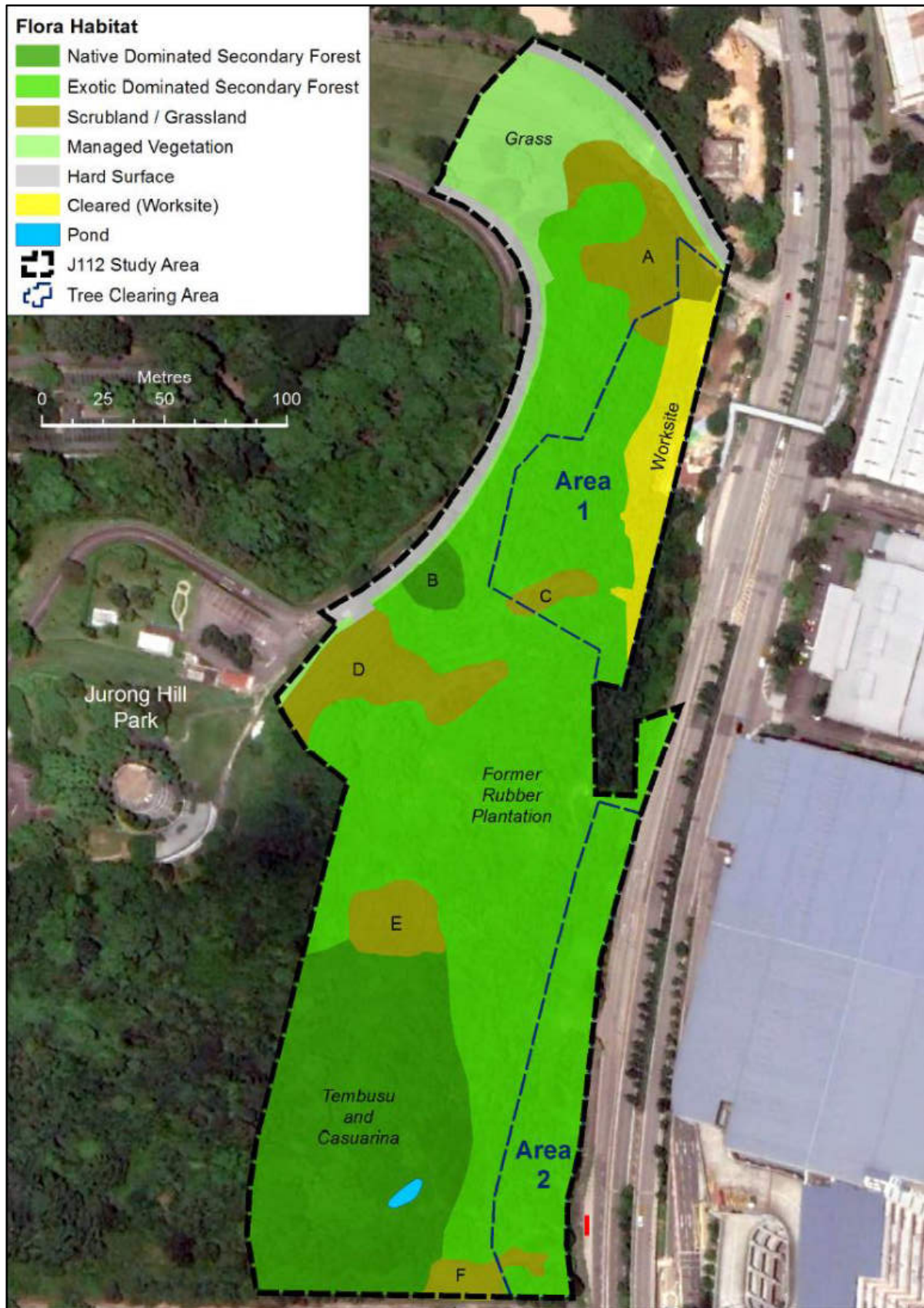


Figure 3-25: Habitat Map

3.4.2.3. Fauna Transect Survey

The Fauna Transect Survey was carried out over a span of one month, from 13 January 2023 to 13 February 2023. The following table shows the details of the fauna transect survey:

Table 3-5: Fauna Transect Survey Dates

Type of Fauna Transect	Replicate 1	Replicate 2	Replicate 3
Diurnal	13/01/2023	17/01/2023	01/02/2023
Nocturnal	01/02/2023	07/02/2023*	13/02/2023*

*Note: No replicate 2 and 3 carried out for Transect 1 (T1) for Nocturnal Fauna Transect Survey.

The Camera Trapping Survey was carried out from 12 January 2023 to 12 February 2023. Nine (9) species were identified throughout the survey period, including 4 birds, 4 mammals and 1 reptile. No Conservation Significance (CS) species were recorded from the camera traps. The summary of camera trapping survey data is presented in Appendix II, and the result was tabulated and compiled together with the Fauna Transect Survey. The overall fauna results are listed below:

In total, the fauna biodiversity study recorded 98 species of fauna within the study area, including 55 birds, 8 mammals, 5 reptiles, 6 amphibians, 18 butterflies, and 6 odonates. This result reflects the diversity of fauna in the small study area. These include the information collected during transect surveys, and camera trapping surveys.

From the transect surveys alone, a total of 95 species were counted. While the camera trapping survey counted 9 species, some of which overlaps with the transect surveys.

Table 3-6: Summary of Fauna Species Recorded, Categorised by Taxa Group

Taxa	Number of recorded species	
	All species	Conservation Significant
Birds	55	7
Mammals	8	0
Reptiles	5	0
Amphibians	6	0
Butterflies	18	0
Odonates	6	0

Of the 98 species on record, seven (7) species were of CS which is defined by either their international or national conservation status. This is typically categorised as Critically Endangered (CR), Endangered (EN), and Vulnerable (VU). All seven (7) of the CS species

were birds. All seven (7) of the CS species are of local significance but they categorise as Least Concern (LC) under the International Union of Conservation of Nature (IUCN) Red List of Threatened Species. While the local Singapore Red Data Book categorises 1 Endangered (EN), and 6 Vulnerable (VU). Only species of concern are reflected within the table below, and in the figure below. The detailed survey results are presented in the Appendix II.

Table 3-7: Summary of Conservation Significant Species

No	Common Name	Scientific Name	Taxa	Residential Status	RDB3	IUCN	Documented on:	
							Camera Trap	Transect
1	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Aves	Native	EN	LC	-	✓
2	Brown Shrike	<i>Lanius cristatus</i>	Aves	Native	VU	LC	-	✓
3	Changeable Hawk Eagle	<i>Nisaetus limnaeetus</i>	Aves	Native	VU	LC	-	✓
4	Common Tailorbird	<i>Orthotomus sutorius</i>	Aves	Native	VU	LC	-	✓
5	Oriental Honey Buzzard	<i>Pernis ptilorhynchus</i>	Aves	Native	VU	LC	-	✓
6	Oriental Magpie-robin	<i>Copsychus saularis</i>	Aves	Native	VU	LC	-	✓
7	Southern Jungle Crow	<i>Corvus macrorhynchos</i>	Aves	Native	VU	LC	-	✓
Legend: LC – Least Concern VU – Vulnerable EN – Endangered CR – Critically Endangered								



Figure 3-26: Locations of Fauna Conservation Significant Species from Fauna Transect Surveys

In terms of habitat specialisation and dependence, their distribution is as illustrated in Figure 3-25. Woodland Dependent consists of 14 individuals (9 birds, 2 mammals, 2 butterflies and 1 odonate). The Grassland and open habitats Dependents consist of 7 others (4 birds, and 3 butterflies). Lastly, the Aquatic Dependent individuals consist of 5 species (2 birds, and 3 odonates). Some examples of aquatic dependent species include the White-bellied Fish Eagle (*Haliaeetus leucogaster*) that forage and hunt along streams, reservoirs, and coastlines within the vicinity. Refer to Appendix II for habitat dependency and their conservational status.

As the development is limited to an area along the eastern edge of the Study Area, the habitat available for some of the species such as Black-crowned Night Heron and Common Tailorbird would be reduced, where they were observed from the fauna transects (T1 and T3) (Figure 3-26). However, the surrounding forest are of similar habitat to the potential development area, which would allow for the fauna to be shepherded towards a similar habitat.

The Black-crowned Night Heron (*Nycticorax nycticorax*) recorded along T3 is listed in Singapore Red Data Book (SRDB) as Endangered (EN). It was previously listed as Critically Endangered (CR) within the 2008 version of the SRDB. It mainly occurs in brackish or

freshwater wetlands. Since the Study Area does not have any wetlands, they may be from the adjacent canals and nearby Jurong Lake – approximately 2 km away, where they are reported to have a stable nesting population.

One observation made was the encounter of Changeable Hawk-Eagle (*Nisaetus limnaeetus*) was more frequent at T2, as indicated in Figure 3-26. The concentrated encounter along T2 is due to a potential nest outside the study area. Most of the Changeable Hawk-Eagles were observed to be perching on bare branches in the area.

3.5. Ecological Connectivity Study

The Study Area was originally thought to be isolated by the development of the surrounding area and major roads (i.e., AYE, Jurong Pier Road, Jalan Buroh). However, the existing fauna still exhibits some diversity due to the presence of Park Connector Network (PCN). Niche and habitat specific species were still identified within the study area.

The Study Area falls within the highlighted area (highlighted in blue) in Figure 3-27. The Study Area is a nature area with limited wildlife connectivity to Jurong Lake Garden via Jurong Park Connector. The Jurong Park Connector provides wildlife connectivity from Jurong Hill Forest to Jurong Lake Gardens via riparian corridor (canal) and canopy cover (trees) (Figure 3-27). The nearby Jurong River – a fully canalised stream, stretching to Jurong Lake Gardens is a potential blue connectivity that have allowed for some aquatic dependent species to move.

However, the connectivity is limited to more urban-adapted riparian species and birds as the Ayer Rajah Expressway (AYE) cut through the connectivity (Figure 3-27). The wildlife connectivity may not support understorey birds due to the lack of understorey trees/shrub layers along the park connector (Figure 3-27).

Riparian species such as amphibians, odonates and aquatic birds (e.g. Black-crowned Night Heron) may disperse to Jurong Lake Garden via the canal. Birds not requiring understorey cover may disperse to Jurong Central Park and Jurong Lake Garden via planted trees along the Jurong Park Connector. The proposed development at J112 is located at the eastern edge of the forest and does not disrupt the ecological connectivity between Jurong Hill Forest and Jurong Lake Garden.

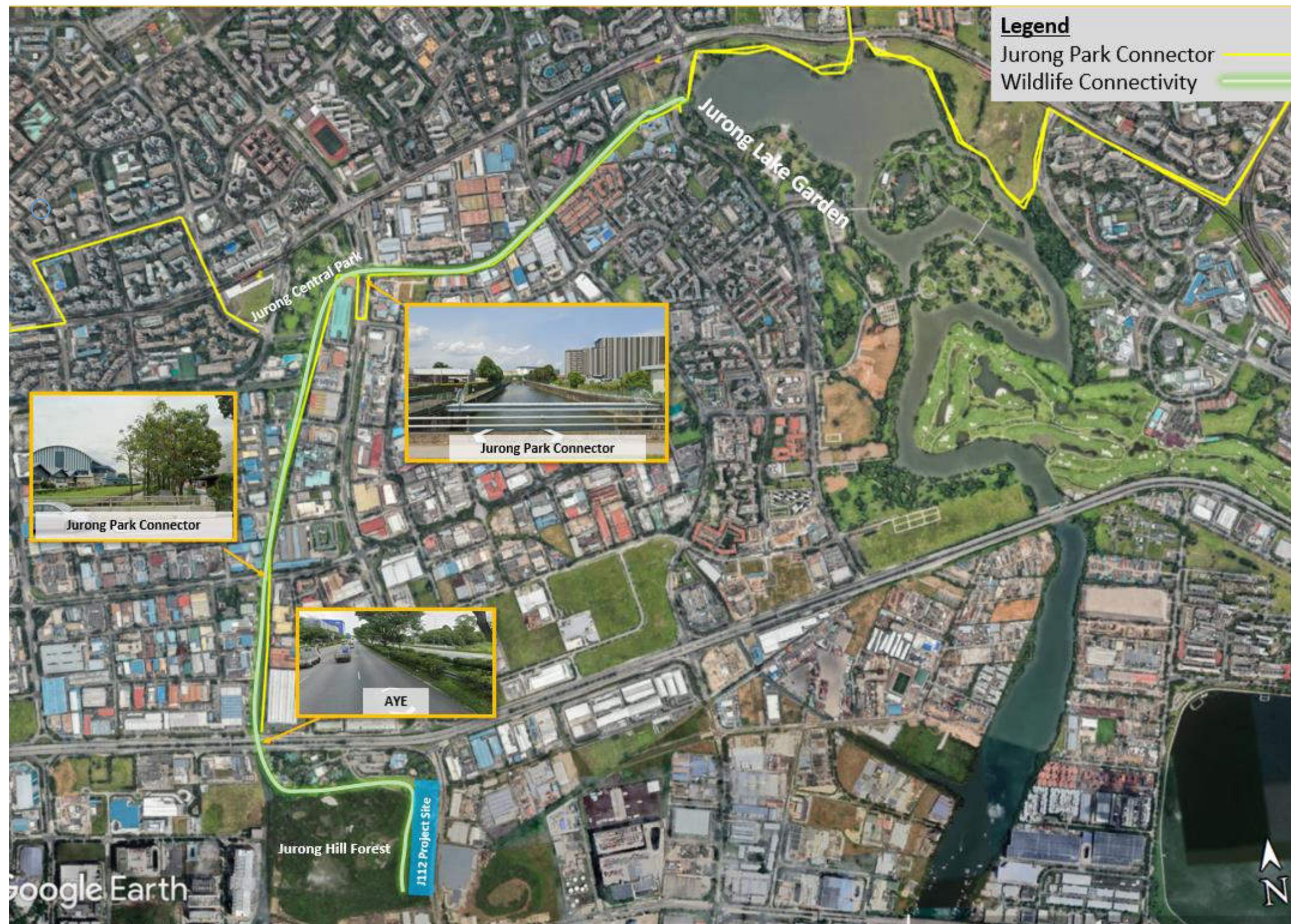


Figure 3-27: Wildlife Connectivity between Jurong Hill Forest and Jurong Lake Garden (Source: Google Earth, 2022).

4. Impact Assessment and Mitigation

This section plays an important role in understanding possible activities from the Project and assessing the potential impacts arising from the activities. It will also discuss possible mitigation measures that can be taken to minimize impacts on the environment.

4.1. Methodology

The purpose of the impact assessment is to investigate the impact of construction works for slope cutting and Contiguous Bored Piled (CBP) at Area 1 and Excavation & Cable Laying at Area 2 on the surrounding biodiversity. SECS proposes a Rapid Impact Assessment Matrix (RIAM) (Pastakia and Jesen, 1998) method to the assessment of construction impact on wildlife especially from habitat loss, human disturbance, noise and light. The magnitude of source impact, such as intensity and duration will be considered.

Steps used as part of the impact analysis include:

1. Environmental aspect identification from the construction activities with the focus of activities that can generate environmental pollution or hazards on site as part of the activities.
2. Each potential pollution and hazards identified will be studied further to determine the impacts and likelihood of occurrence to determine the significant of the impacts.

Once environmental aspects and impacts are identified for the construction activities, items with major and moderate significant impacts will have mitigation and control measures recommended to reduce the significant impacts.

The following environmental impacts on biodiversity will be assessed but not limited to:

- i. Edge effect;
- ii. Habitat degradation;
- iii. Animal mortality/roadkill;
- iv. Loss/reduction in ecological connectivity;
- v. Human-wildlife conflict;
- vi. Light disturbance on animal; and
- vii. Noise disturbance on animal.

The RIAM method is based on a standard definition of the important assessment criteria as well as the means by which semi-quantitative values for each of these criteria can be collected to provide an accurate and independent score for each condition. The impact of Project activities is evaluated against the environmental components and for each component a score is determined, which provides a measure of the impact expected from the component.

The importance of the evaluation criterion is divided in two groups:

- (A) criteria relative to the degree of the relevance of the condition, and that individually can alter the resulting classification;
- (B) criteria relative to the development of the condition but individually is not capable of altering the obtained classification.

Within the (A) criterion, scoring is given for the importance of receptor and magnitude of impact. (A1) refers to the measure of the importance of the relevance condition is evaluated according to the space borders or interest of the receptors that will be affected. (A2) refers to the measure of the scale of benefit/damage of an impact or condition.

Within the (B) criterion, scoring is further categorised. The permanent criterion (B1) defines if a condition is temporary or permanent, and if it should only be seen as a measure of the temporary state of the condition. The reversibility criterion (B2) defines if a condition can be changed and if it can be seen as a measure of control on effect of the condition. This cumulative criterion (B3), where the effect of a condition will have a single direct impact or there will be a cumulative effect during the course of time, or, on the other hand, a synergetic effect with other conditions.

Table 4-1: Scoring for Individual Category

Group	Category	Description	Score
A	A1 (Importance of Receptor)	Important to national/international interests	4
		Important to regional/national interests	3
		Important to areas immediately outside the local condition	2
		Important to the local condition	1
		Not Important	0
	A2 (Magnitude of Impact)	Major positive benefit or change	+3
		Moderate positive benefit or change	+2
		Minor positive benefit or change	+1
		No change/status quo	0
		Minor negative disadvantage or change	-1
		Moderate negative disadvantage or change	-2
		Major negative disadvantage or change	-3
B	B1 (Permanence)	No change/not applicable	1
		Temporary	2
		Permanent	3
	B2 (Reversibility)	No change/not applicable	1
		Reversible	2
		Irreversible	3
	B3 (Cumulative Impact)	No change/not applicable	1
		Non-cumulative/single	2
		Cumulative/multiple	3

An Environmental Score (ES) is calculated from respective scoring categories using the following formulae:

$$\text{Environmental Score (ES)} = \sum A1 * A2 * (B1 + B2 + B3)$$

The respective scoring system and summation and multiplication of the scores will provide the resulting range of environmental scores as provided in Table 4-2.

Table 4-2: Environmental Score Range and Respective Class

Environmental Score (ES)	Value of Class	Description of Class
116 to 180	D	Major positive impact
81 to 115	C	Moderate positive impact
37 to 80	B	Minor positive impact
7 to 36	A	Slight positive impact
-6 to 6	N	No change/ status quo
-7 to -36	-A	Slight negative impact
-37 to -80	-B	Minor negative impact
-81 to -115	-C	Moderate negative impact
-116 to -180	-D	Major negative impact

4.2. Biodiversity

This section details the identification and analysis of the predicted environmental impacts on biodiversity from the construction activities within the site boundary.

4.2.1. Evaluation Criteria

The specific criteria for each score under respective Group A category is detailed in the table below:

Table 4-3: Specific Criteria for Evaluation of Biodiversity Impacts

Category	Score	Description	Specific Criteria
A1 (Importance of Receptor)	4	Important to national/international interests	<ul style="list-style-type: none"> Primary Forest / freshwater habitat / sensitive ecosystem High presence of critically endangered species High importance of area for surrounding habitat and ecology
	3	Important to regional/national interests	<ul style="list-style-type: none"> Secondary forest / habitat with presence of endangered flora Presence of critically endangered species Importance of area for functioning of adjacent areas
	2	Important to areas immediately outside the local condition	<ul style="list-style-type: none"> Secondary Forest / Habitat environments Presence of endangered or vulnerable species Importance of area for functioning of adjacent areas
	1	Important to the local condition	<ul style="list-style-type: none"> The site is a greenfield with no forest habitats and only grass and shrubs Common species present on site Modified habitats with limited biodiversity
	0	Not Important	<ul style="list-style-type: none"> Fully concreted and/or void of vegetated with no habitat No species present
A2 (Magnitude of Impact)	+3	Major positive benefit or change	<ul style="list-style-type: none"> Moderate net gain in habitat/species abundance
	+2	Moderate positive benefit or change	<ul style="list-style-type: none"> Small net gain in habitat/species abundance
	+1	Minor positive benefit or change	<ul style="list-style-type: none"> Limited net gain in habitat/species abundance
	0	No change/status quo	-

Category	Score	Description	Specific Criteria
	-1	Minor negative disadvantage or change	<ul style="list-style-type: none"> <10% loss of Jurong Hill Forest Limited impact to surrounding habitat with no disruption in ecological connectivity Species able to adapt to the minor loss of habitat surroundings
	-2	Moderate negative disadvantage or change	<ul style="list-style-type: none"> 10 – 40% loss of Jurong Hill Forest Moderate impact to surrounding habitat with some disruption in ecological connectivity Decline in species abundance within site boundary
	-3	Major negative disadvantage or change	<ul style="list-style-type: none"> >40% loss of Jurong Hill Forest Major impact to surrounding habitat with major disruption in ecological connectivity Decline in species abundance within site boundary and surrounding areas

4.2.2. Identification of Impacts

Construction Activity	Predicted Impact Aspect	Sensitive Receptors
Land Clearance and site preparatory work	Loss of Flora and Fauna	Forest
		Birds
		Mammals
		Reptiles and Amphibians
Excavation works Piling works Use of machinery, and generators General construction activities	Human Presence	Birds
		Mammals
		Reptiles and Amphibians
Land Clearance and General construction activities	Forest Edge Effects	Forest

4.2.2.1. Loss of Flora and Fauna

The species of focus for the impact assessment are the conservation-significant species, according to the local and international databases. Section 3.4.2 discussed the composition of flora and fauna within and beyond the Project site. The Project site contains species of conservation value, both flora and fauna.

Loss of flora and fauna species will be most prominent within Area 1 and 2, where the construction activities will take place. It is estimated that eight (8) flora species of conservation significance fall within the site boundary and will be affected by the Project.

The Project site is adjacent to a major road, Jurong Pier Road and other minor roads like Bird Park Drive and Jurong Hill. The Jurong Pier Road is relatively busy where heavy vehicles were often observed to be using this major road. During the clearance of Area 1 and 2, if appropriate measures are not taken, it is probable to see wildlife running across the major road. This will lead to possible wildlife road kills during pre-construction and construction stages.

4.2.2.2. Human Presence

Clearance of site area leads to the loss of habitats for fauna species. With further presence of human and their construction activities, it may negatively impact the fauna activities such as foraging for food and habitat, roosting, breeding and nesting activities, especially in surrounding forested area. This is because wildlife tend to avoid the presence of humans. Furthermore, human-wildlife conflicts are probable during construction works.

Moreover, the construction activities may produce noise and vibration which are likely to interfere with the communication calls for certain wildlife, especially birds such as territory marking, courtship and predator alarms at the surrounding forested areas. In addition, the noise and vibration may prevail in the future, during the operation phase of the JRL MRT station. However, the noise disturbance is less likely to be as significant as the construction phase (refer to Section 4.5 for noise impact assessment and noise management plan).

Dust and exhaust emission are unavoidable during the construction stage of the Project. Various construction activities like site clearance, excavation works, vehicular movement on unpaved surfaces generate dust emissions. The dust emissions may have a slightly negative impact on the surrounding flora and fauna species with the settling of dust matter on plant leaves or accumulation of dust in fauna respiratory systems. Furthermore, any machinery or

equipment used during the construction are likely to contribute to exhaust emission. These factors are likely to deteriorate the local air quality. However, it is to be noted that the site area is thus far exposed to dust emissions and exhaust emissions from the existing worksite and Jurong Pier Road adjacent to the site boundary. Therefore, the impact of dust and exhaust emission from the Project is relatively minor.

The noise and air quality impacts are likely to be temporary for the duration of the construction. The impacts are reversible with the end of construction activities and the operation of equipment and machinery. In addition, the impacts could be minimised with the implementation of proposed mitigation measures in Section 5.3.

4.2.2.3. Forest Edge Effects

Clearance of certain parts of the forested area will leave edge effects on the surrounding forested area that is adjacent to the cleared or construction site areas. The vegetation clearance will leave the forest edges exposed to biotic or abiotic changes. Changes may include heat and light reflection into forested areas causing drying out of forest edges. Dust may also be emitted from construction sites, depositing on surrounding vegetation. Sudden exposure to wind speeds at the exposed forest edge is likely to introduce wind-induced damage and treefalls, and consequently elevated tree mortality. Understorey plants along the edge between the construction site and the forest may be exposed to more heat and solar radiation and therefore might cause changes in understorey plant richness and composition.

In addition, the disturbance to the forested area could also create opportunities for invasive species to establish and thrive. As a result, the species composition of plants in the cleared areas may shift towards invasive species and the diversity of native plants may decrease.

4.2.3. Mitigation Measures

The table below summaries the mitigation measures for the impacts identified and analysed.

Table 4-4: Mitigation Measure for Biodiversity Impacts

Predicted Impact Aspect	Mitigation Measures
Loss of Flora and Fauna	<p><u>Construction Phase</u></p> <ul style="list-style-type: none"> Safeguard all flora species of conservation significance by salvaging the saplings/seedlings. Contractor to engage with Flora Specialist/Arborist to confirm species of conservation significance on site and appropriate management. Before clearance, the Flora Specialist/Arborist must ensure all conservation significant species/species of interest are tagged. Establish Tree Protection Zones (TPZs) for trees to be retained. Trees identified for retention at the boundaries of the working area should be demarcated by Tree Protection Zones (TPZs) determined by ISA-certified arborist. Land clearance should be carried out following the wildlife shepherding plan. Pre-felling checks must be conducted by Fauna Specialist to determine if any fauna is currently inhabiting any trees that are planned to be fell. Erect hoarding and barriers along Jurong Pier Road prior to start of clearance to prevent road kills. Erect hoarding and barriers progressively to prevent fauna from entering Project site. Daily observation of the nearby roads (Jurong Pier Road, Jurong Hill Road and Bird Park Drive) during clearing and construction phase to record any road kills. This information must be highlighted in the monthly reports. Site clearance should strictly adhere to the designated areas to be cleared. <p><u>Operation Phase</u></p> <ul style="list-style-type: none"> It is recommended to replant unused areas with appropriate shrubs or native plants and to turf the sloped areas.
Human Presence	<p><u>Construction Phase</u></p> <ul style="list-style-type: none"> Worker assembly area, worksite entrances and access routes shall be located away from the edge of forest if possible. Usage of equipment with less noise generation.

Predicted Impact Aspect	Mitigation Measures
	<ul style="list-style-type: none"> Damping or erection of barrier around equipment to reduce noise and vibration pollution to surrounding fauna, especially at the edges of the forest. Set up hoarding of 2.4m high to act as physical barrier to prevent dust movement out of the site Regular compaction of exposed surfaces and cover exposed surfaces to reduce dust emissions with biodegradable erosion control blankets or concrete lining. Water sprinkling of dust should be carried out on dry days. Rubbish bins shall be secured or fenced to prevent monkey from gaining access to the facilities. Bins at open space shall be monkey-proof to prevent monkey from scouring food. Do not feed monkey and any other wildlife. Do not leave garbage, recyclables or food waste outside. Wildlife response plan shall be developed to provide guidance and strategies for the protection of wildlife during encounters and incident. All site personnel shall attend biodiversity awareness training and should be briefed on wildlife response plan. Refreshers to be conducted regularly such as during toolbox briefings. Contractor shall keep a register of personnel who have undertaken the training. All lighting to be directed inwards to site and have shading fixtures to ensure no light spill into surrounding areas except lighting for safety and security purpose. All lighting should not exceed the height of hoarding.
Forest Edge Effects	<u>Construction Phase</u> <ul style="list-style-type: none"> Where forest edges are newly exposed following clearing, implement a sprinkler system to increase moisture levels if forest edges are observed to be drying out.

4.2.4. Assessment Scoring

Table 4-5: Evaluation Assessment Scoring for Biodiversity Impacts

Predicted Impact Aspect	Sensitive Receptors	Without Mitigation Measures							With Mitigation Measures		
		A1	A2	B1	B2	B3	ES	ES Class	A2	ES	ES Class
Loss of Flora and Fauna	Forest Habitat	3	-2	3	3	3	-54	Minor negative impact	-2	-54	Minor negative impact
	Fauna Mortality	3	-2	3	3	2	-48	Minor negative impact	-1	-24	Slight negative impact
Human Presence	Birds, Mammals, Reptiles and Amphibians	3	-2	1	1	1	-18	Slight negative impact	-1	-9	Slight negative impact
Forest Edge Effect	Forest	3	-2	3	3	3	-54	Minor negative impact	-1	-27	Slight negative impact

4.3. Soil/Water Quality

This section details the identification and analysis of the predicted impact on the soil or surface water quality from the construction activities within the site boundary.

4.3.1. Evaluation Criteria

The specific criteria for each score under respective Group A category is detailed in the table below:

Table 4-6: Specific Criteria for Evaluation of Impacts

Category	Score	Description	Specific Criteria
A1 (Importance of Receptor)	4	Important to national/international interests	The soil and surface water quality having importance in terms of regional/ national/ international interests
	3	Important to regional/national interests	
	2	Important to areas immediately outside the local condition	The soil and surface water having localised importance to the adjacent surroundings
	1	Important to the local condition	
	0	Not Important	The soil and surface water having no importance to the adjacent surroundings
	0	No change/status quo	-
	-1	Minor negative disadvantage or change	Short-term localised changes to soil and slope Potential surface runoff which may be short term
	-2	Moderate negative disadvantage or change	Localised changes to soil and slope Potential moderate quantity of surface runoff which may be moderate to long term
	-3	Major negative disadvantage or change	Significant change to soil and slope Potential large quantity of surface runoff which may be moderate to long term

4.3.2. Identification of Impacts

Construction Activity	Predicted Impact	Sensitive Receptors
Land Clearance Site Preparatory work General construction activities	Soil Erosion and Water Pollution	Forest

4.3.2.1. Soil Erosion and Water Pollution

The removal of flora, tree-felling and removal of remaining underground roots during the land clearance, will make the area vulnerable to erosion effect during wet weather events. Soil erosion from the exposed slope area would subsequently be discharged into the enclosed underground stormwater drains, causing an increase in turbidity levels and water quality degradation. However, not all eroded material is discharged immediately as much of it may be deposited temporarily or permanently on the land surface where the slope becomes gentler (road level).

Given the presence of a steep slope within the site boundary, there is a risk of slope failure during land clearance. Hence, slope cutting works will be required to change the slope gradient to reduce soil erosion and accumulation of silt deposits on the road level (refer to Section 1.2.1 for the principal construction activities).

Regardless, effective Earth Control Measures (ECM) practices are required to be implemented. The proposed erosion control measures shall be submitted by a Qualified Erosion Control Professional (QECP) to Public Utilities Board before commencement of works. ECM design should comply with the Code of Practice on Surface Water Drainage. Control measures should be put into place to control the siltation and sediment plume prior to start of construction. It is recommended that the proposed site area is well contained prior to the start of the work.

During post-construction, it is anticipated that design slopes will be of sufficient gradient as to minimise risk of slope failure. Slopes will be vegetated or otherwise covered to minimise erosion impacts which may ultimately result in downstream siltation.

4.3.3. Mitigation Measures

The table below summaries the mitigation measures for the impacts identified and analysed.

Table 4-7: Mitigation Measure for Biodiversity Impacts

Predicted Impact Aspect	Mitigation Measures
Soil Erosion and Water Pollution	<p><u>Construction Phase</u></p> <ul style="list-style-type: none"> • Various layers of silt fence/curtain should be utilised along hoarding adjacent to enclosed stormwater drain to prevent silty runoff and spillage from development works. • Drainages should also be diverted when possible, and assessed to accommodate heavy rain and large volume of water. Should a backlog be encountered, a water pump may be installed to prevent any waterlogged areas. • ECM should be in place to treat runoff prior discharge. During construction, the QECP will carry out regular inspection and monitoring to verify ECM implementation and its effectiveness. • The construction site should also have an ECO on site to ensure the implementation, maintenance and inspection of the ECM plan at all times during the construction period. • Site boundary should have a 0.5m high bund with perimeter cut-off drains to prevent surface runoff within the site from flowing out of the site. All surface runoff should be channelled to ECM treatment system. • Proper construction staging and work sequencing shall be adopted to ensure that no large bare/erodible surfaces are exposed for long direction. Exposed bare earth area should be covered with biodegradable Erosion Control Blanket (ECB), concreted or replanted with vegetation. There shall be progressive and timely revegetation and stabilisation, with all bare surfaces restored immediately upon completion of work at every stage, to minimise bare erodible surfaces and reduce the volume of silty water to be contained and treated. • The biodegradable ECB used should not contain any plastic netting or plastic components, which may fatally trap crawling wildlife (e.g., snakes) and does not break down. • Concrete spillage during pile filling will be avoided by careful concrete handling and placement; if necessary, water will be pumped out of the pile to avoid overflow.

Predicted Impact Aspect	Mitigation Measures
	<ul style="list-style-type: none"> Piles to be filled with concrete will be isolated with a surrounding impermeable curtain. Cover the stockpile with tarpaulin at the end of day or during rain. Exposed bare earth area should be covered with biodegradable ECB, concreted or replanted with vegetation. The water used to wash the wheels of the trucks/vehicles shall not be discharged into any stormwater drains. The silty water within the wheel wash basin shall be connected to the ECM plant. ECM should only be removed after completion of works. The silt collected at the bottom of the wheel wash shall be removed. <p><u>Operation Phase</u></p> <ul style="list-style-type: none"> It is recommended to turf the bare sloped areas to prevent soil erosion.

4.3.4. Assessment Scoring

Table 4-8: Evaluation Assessment Scoring for Soil/ Water Quality Impacts

Predicted Impact Aspect	Sensitive Receptors	Without Mitigation Measures							With Mitigation Measures		
		A1	A2	B1	B2	B3	ES	ES Class	A2	ES	ES Class
Soil Erosion and Water Pollution	Forest	2	-3	2	3	3	-48	Minor negative impact	-2	-32	Slight negative impact

4.4. Recommended Wildlife Shepherding Plan

The main objective of the Wildlife Shepherding Plan (WSP) is to mitigate against fauna mortality arising from clearance of the forest habitat. The habitats are mainly all secondary in nature, but have been around for a period of time, allowing for its current biodiversity. This vegetative clearance of the site would have negative impacts to the fauna around and within the site. This is exacerbated for habitat-specific species within the site.

As such, the Recommended WSP highlights a few key considerations which should be considered:

- Shepherding should be directed away from roads and human development (mainly concentrated in the south of the Project area)
- Shepherding should lead existing fauna into similar surrounding habitats. Preferably towards the northeast direction of the Project.
- Pre-survey of the area to be cleared and to check for animals that may be burrowed or nesting in trees.
- Buffer of 3 days should be given for animals to migrate once the undergrowth is cleared. After 3 days, inspection should be carried out for each tree for any nesting and finally the trees can be felled.
- Must be done in multiple stages to provide animals with sufficient time to move.
- After clearing both undergrowth and trees, temporary or permanent hoardings should be erected to prevent wildlife from re-entering the site.
- All site personnel should be trained to handle encounters with wildlife during site clearing/construction phase. Or familiar with reporting protocol for such incidents.
- CCTVs can be installed towards the forest side to monitor the flora and fauna habitats during the course of construction activities. Mitigation action shall be taken depending on any observed affect/impact.



Figure 4-1: Suggested Wildlife Shepherding Direction

4.5. Noise Impact Assessment and Noise Management Plan

Noise impact assessment (NIA) and noise management plan (NMP) were prepared by Affinity Engineering Consultancy Pte Ltd (AEC) for the Project in October 2021. The report was then submitted to NEA via email dated 5 November 2021, and acknowledged by NEA via email dated 15 November 2021 that the NMP is not required for the Project as there is no noise sensitive receptor (i.e. school, hospital, residential area, etc.) located within 150 m from the Project boundary, and NEA will keep the NMP for reference and record.

Since the Project site is located along Jalan Boon Lay and Jurong Pier Road, the noise climate was found to be dominated by road traffic noise as these are the major roads used by many heavy vehicles in the area. Low ambient noise level will be expected during night time due to the reduce road traffic and surrounding human activities as the neighbouring areas are mainly industrial premises. Table 4-9 listed the nearby industrial tenants, their approximate distances to the Project site, land-use type and operating hours.

Table 4-9: List of Industrial Premises nearby to the Project Site

Premise	Approx. distance to Project site	Land Use Type	Operating Hours
Caterpillar	<35m	Industrial	8:30-5:30pm Monday to Friday
JTC MedTech Hub	<40m	Industrial	Varies
Substation	<100m	Industrial	-
Greenhub	<120m	Industrial	Varies
Jurong Power Station	<35m	Industrial	-
The Village at Jurong Hill	<35m	Sports and Recreation	Varies
Hardaya Equipment	<35m	Industrial	8:45am-5:30pm Monday to Friday
Mecomb Singapore	<35m	Industrial	8:30am-5:45pm Monday to Friday
Yang Kee Logistics	<35m	Industrial	9am-6pm Monday to Friday
Kohler Power Systems	<35m	Industrial	8:30am-5:15pm Monday to Friday

Premise	Approx. distance to Project site	Land Use Type	Operating Hours
HG Metal Manufacturing	<40m	Industrial	8am-5:30pm Monday to Friday, Saturday 8am-12pm
MEP Building	<35m	Industrial	Varies
Eneos Italsing	<50m	Industrial	-

In the NIA, baseline noise monitoring was conducted over a period of one (1) week including weekend at three (3) selected locations (NMS-1 – NMS-3) to record the ambient noise around the Project site prior to the start of construction activities. The baseline noise monitoring locations were presented in Figure 4-2. The ambient noise levels measured across all monitoring locations were generally complied to the permissible limits set by NEA.

In addition, noise modelling for various phases of the construction works was also carried out based on the worst-case scenarios with all expected activities happened at the same time. The detailed assessment of the noise modelling can be referred to the NIA. However, it is highly unlikely to occur as the construction noise is generally intermittent due to the short period of construction work during the actual construction phase. Furthermore, the noise impact generated from the Project activities can be minimised by implementing the mitigation measures proposed in the NMP. Noise control measures indicated in Section 5.3 of this EIA and in the EMMP are also developed based on the said NMP.

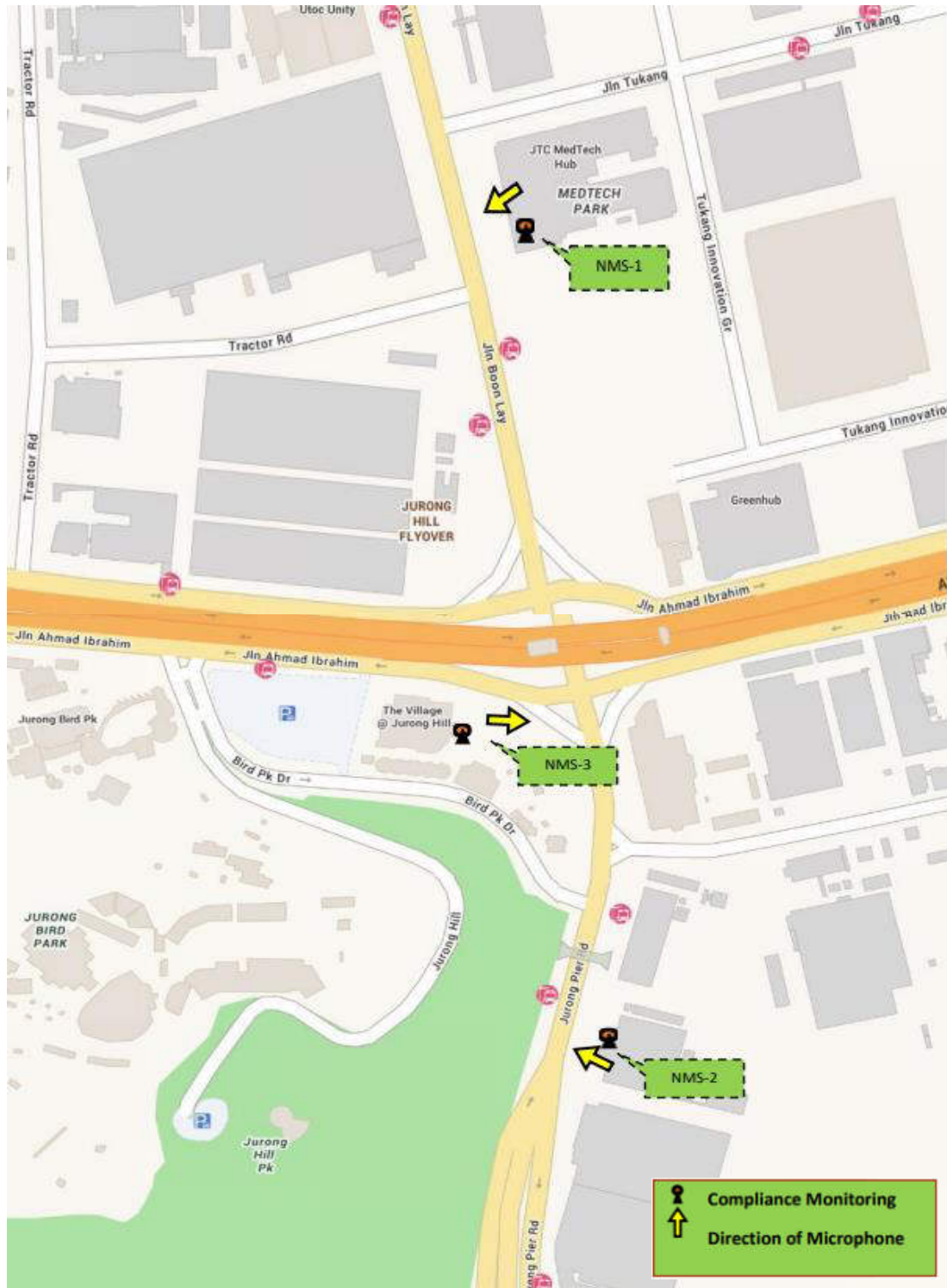


Figure 4-2: Baseline Noise Monitoring Locations

5. Environmental Management and Monitoring Plan

The proposed Environmental Monitoring and Management Plan (EMMP) is an important document (separated from the contract specific EMMP) to help manage environmental pollution generated and ensure that proper mitigation measures are taken with proper monitoring during the construction phase. This chapter intends to provide a broad framework for the EMMP consultant (to be engaged during construction stage) to prepare a contract-specific EMMP. Since the Project will evolve over time, the EMMP is an adaptive document meant to be amended where necessary and customise according to the construction method.

The EMMP is typically implemented by the Contractor and the EMMP consultant during the construction phase of the Project. Some of the key monitoring scopes include:

- General site inspection: inspection of hoarding around site boundary, housekeeping of storage areas, housekeeping of waste disposal area, and identification of any visually observable impacts. This should be conducted on a daily basis by the Contractor employed Environmental Control Officer (ECO) to ensure that the site is well maintained and to rectify any issues that is spotted immediately. The EMMP consultant should audit the site on a monthly basis and generate a monthly report to be submitted to the developer (LTA) and technical agencies (e.g., NParks and NEA) for reference.
- Engagement of fauna specialist to ensure site clearance is carried out properly and ensure no road kills.
- Water monitoring regime with the monitoring locations, frequency, parameters and threshold limits. Water monitoring is required during the construction stage. PUB must be informed once there is exceedance of NEA EPMA water quality guidelines for Controlled Watercourses, which will require an investigation to identify the potential source of contamination and relevant mitigation measures to be undertaken promptly.
- Earth control measures and treatment system, prepared by QECP and approved by PUB, should be installed prior to construction and monitored daily to ensure effectiveness. During construction, the ECO will carry out regular inspection and monitoring to verify ECM implementation and its effectiveness.

5.1. EMMP Objectives

The EMMP is a critical document to help manage environmental pollution and disturbances generated during the construction stage. The standalone EMMP will be updated with the inputs from the contractor on-site utilization plans, method statements and other information. These inputs will help generate an EMMP that is robust and identify relevant impacts and mitigations measure taken by the contractor. It serves the following objectives:

- a) Define roles and responsibilities for environmental management;
- b) As a guiding document to the contractor and all site users on environmental management and monitoring;
- c) Ensure all construction activities are conducted in a manner consistent with the laws and regulations, including applicable regulatory approval conditions from relevant authorities and agencies;
- d) Ensure proper and effective mitigation measures are taken with proper monitoring during the construction phase;
- e) Provide a framework to track, document and monitor environmental compliance with statutory requirements and to ensure full EMMP compliance is achieved;
- f) Set out the monitoring frequency and procedures for environmental monitoring (if required);
- g) Define reporting and submission requirements;
- h) Establish emergency response procedures for environmental incidents, including roadkill, trapped animal found at site and ensure effective corrective action is taken.

5.2. Roles and Responsibilities of the Contractor during Construction Stage

The responsibility of the parties involved in the EMMP should:

- Ensure that the EMMP requirements are planned, implemented and maintained throughout the Project in accordance with the regulations drawn by the relevant authorities;
- Implement the procedures on monitoring and measures the effectiveness of mitigation measures undertaken;
- Implement corrective or preventive action measures to eliminate non-compliance and incidences; and
- Ensure action is taken on environmental pollution issues;

The following sections provide the parties involved and their roles in the EMMP:

5.2.1. Developer

The developer should regularly liaise with the Project Management to review all compliances status during the implementation. The developer is Land Transport Authority (LTA).

5.2.2. Main Contractor

The main contractor should provide sufficient manpower and resources to implement the requirement of the EMMP. The contractor's Project Manager is the team leader responsible for the implementation of the EMMP. Appropriate personnel should be appointed by the Contractor to look after all implementation and reporting. The contractor is also required to regularly coordinate with the environmental consultant involved for any environmental issues.

The key members of the Project Team and their responsibilities to implement the EMMP are outlines as follows:

1) Project Manager

- To ensure implementation of all policies, activities, procedures, instructions as relevant and anything required by the EMMP.
- To ensure compliance with legal and other requirements applicable to this Project.
- To carry out planning on all Project activities throughout Project planning, budgeting, execution and completion.
- To provide solutions of significant technical matters which are unable to be decided by sub-ordinates.
- To monitor and measure the timely completion of the Project.
- To liaise with Environment Consultant and Client on Project matters.
- Keeping track of Project costs and expenditures, including implementation of EMMP to ensure that any control measures implemented will meet the Project budget.

2) Environmental Control Officer (ECO)

- Adhere to all legal, environmental requirements (listed in Chapter 2).
- Perform the role of ECO stipulated in the Code of Practise for Environmental Control Officers.

- Implement and monitor the EMMP implementation on-site and recommend any monitoring and mitigation amendments to the plan where necessary to the environmental consultant.
- Assist the Project Manager in undertaking the Project in an environmentally sustainable manner.
- Train and educate all site personnel to work in a manner to respect the surrounding environment.
- Continually identify, report, record potential, and present environmental issues on-site to the Environmental Consultant.
- Limit or stop any Project activities if potential or presenting environmental issues are identified until rectified.
- To report any environmental incidence to Environmental Consultant and provide support to address the incidence.
- Inform client and EMMP consultant in the event of an environmental emergency (e.g. oil/chemical spill).

5.2.3. Environmental Consultant

The responsibilities of the Environmental Consultant are as follow:

- To ensure the implementation of the EMMP by all parties.
- Provide a solution if any environmental issue arises.
- Ensure that the Project team, subcontractors and site personnel understand and implement the EMMP requirements.
- Provide input for environmental mitigation measures prior to any physical works.
- To advise all parties (e.g., Project Manager, Environmental Control Officer, Site Engineers, Site Supervisors, Subcontractors etc) on matters related to environmental management and promote awareness within site.
- Ensure the preparation and submittal of EMMP to Contractor/Client is within a specified time frame.
- To ensure the monthly environmental inspection is carried out.
- To liaise with Client/Authorities on environmental matters.

5.3. Proposed EMMP

The following table consist of the environmental management and monitoring plan for the Project:

Environmental Aspect	Monitoring Scope	Management and Monitoring Plan	Responsible Party	Remarks
Air Quality	Site inspection and equipment maintenance checks	<p>Daily inspection of the site to ensure mitigation measures listed in section 4.2.3 are carried out and effective.</p> <p>Open burning is strictly prohibited at all times.</p> <p>Water sprinkling for dust suppression should be carried out on dry days.</p> <p>All construction equipment and machinery should be checked and maintained regularly, and should not emit dark smoke.</p> <p>Routine maintenance logs of construction equipment and machinery should be checked to ensure proper upkeep (weekly).</p> <p>Regular compaction and/or cover exposed surfaces with biodegradable erosion control blanket to reduce dust emissions.</p> <p>Proper set up of access road for vehicular movement within the site.</p> <p>Turn off engines and equipment when not in use.</p> <p>Cover with tarpaulin is mandatory for all lorries transporting materials.</p> <p>Mud and dust on vehicle should be washed properly before leaving the site.</p>	Contractor's Safety Team and ECO	Additional mitigation measures should be implemented if they prove to be insufficient.

Environmental Aspect	Monitoring Scope	Management and Monitoring Plan	Responsible Party	Remarks
Surface runoff, spills and discharge	Site hording and boundary	<p>ECM measures such as proper site hoarding and perimeter drains should be installed prior to construction.</p> <p>Inspect hoarding and perimeter daily to ensure no surface runoff is flowing out the site untreated and perimeter drains are not flooded. All runoff to be flowing to ECM.</p> <p>ECM measures such as perimeter drains should be regularly maintained.</p> <p>EMMP consultant should audit the site on monthly basis.</p>	Contractor's Engineer, ECO, QECP and EMMP consultant.	Repair damaged hoarding and perimeter drains immediately
	Potential runoff and/or spills of chemical and fuels	<p>Operate and maintain the ECM regularly to ensure the ECM remains effective throughout construction stage.</p> <p>Site should be inspected daily to ensure that no surface runoff flowing out of the site but directed to ECM treatment system.</p> <p>Silt fence and/or curtain should be utilised within site boundary adjacent to the Jurong Hill Road.</p> <p>ECM measures such as silt fence and turbidity curtain should be inspected, reviewed, and maintained regularly to make sure they are performing as intended. Where implemented, this includes:</p> <ol style="list-style-type: none"> Replacing of silt fences and biodegradable erosion control blankets Re-paving of worn-out concrete surfaces Replacing of membrane modules Calibration of silty water treatment plant according to the manufacturer's specification Removal of silt accumulated in the holding sump Removal of silt accumulated at the silt fence and beside the boundary wall 	Contractor's ECO and EMMP consultant.	Toolbox should inform workers on how to reduce drips and spills of chemicals and fuel.

Environmental Aspect	Monitoring Scope	Management and Monitoring Plan	Responsible Party	Remarks
		<p>Real time monitoring of Total Suspended Solids (TSS) through CCTV and TSS meter positioned at the discharge outlets, and submit regular reports (including photographic and monitoring records) of the site ECM as well as those for discharge quality to PUB. The discharge from any construction /earthwork sites into stormwater drainage system shall not contain TSS in concentrations greater than the prescribed limits of 50mg/L under Regulation 4(1) of the Sewerage and Drainage (Surface Water Drainage) Regulations. Routine water quality testing plan shall be included as part of the contract specific EMMP.</p> <p>Used water from wheel wash of trucks and vehicles shall not be discharged directly to the drain and should be connected to sedimentation basin and ECM Plant. The silt collected at the bottom of the wheel wash should be removed.</p> <p>Carry out repair, servicing, engine overhaul works etc on an area that is contained and all wastes be appropriately disposed of.</p> <p>EMMP consultant should audit the site on monthly basis.</p>		

Environmental Aspect	Monitoring Scope	Management and Monitoring Plan	Responsible Party	Remarks
Noise Pollution	Localised measures	<p>Noise barriers shall be erected above the hoarding around the site to prevent excess transmission of loud noise to the surrounding areas.</p> <p>Continuous noise monitoring to be conducted as per NEA requirements.</p> <p>Damping or erection of localised noise barrier/enclosure around piling equipment should be implemented to ensure that noise does not exceed permissible limits whereby it could cause harm to noise sensitive fauna.</p> <p>Use of alternative equipment with less noise emission such as use of rubber mallets instead of metal hammer.</p> <p>Silencers or mufflers on PME (e.g. generator sets) should be utilised and should be properly maintained during the construction.</p> <p>Mobile PME (i.e. trucks and cranes) should be sited away from noise sensitive receptors where possible.</p> <p>Avoid parallel use of noisy equipment and machinery.</p> <p>Turn off the equipment and machinery when not in use.</p> <p>Construction works should be limited between 8am to 6pm daily and night work where possible should be avoided.</p> <p>Adopting good practices such as proper training for the machine operators, regular maintenance of construction vehicles and machinery, etc.</p> <p>Care shall be taken during loading/unloading activities, dismantling scaffolding or moving materials to minimise noise generated.</p>	Contractor's ECO	-

Environmental Aspect	Monitoring Scope	Management and Monitoring Plan	Responsible Party	Remarks
Waste Management	Site inspection – food waste and chemical waste	<p>Food should be consumed at designated locations and waste stored in covered bins and routine removed.</p> <p>Outdoor bin and dumpster should be “monkey-proof” or have lid that animals may find difficult to open.</p> <p>Chemical waste to be stored in proper location that is sheltered and kerbed, and as far away from the canal as possible (at least 10m away from waterbody) and removed regularly to be disposed off-site by licensed waste collector.</p> <p>EMMP consultant should audit the site on a monthly basis.</p>	Contractor's ECO and EMMP consultant.	-
Biodiversity Monitoring	Wildlife shepherding plan	<p>Pre-felling checks must be conducted by Fauna Specialist to determine if any fauna is currently inhabiting any trees that are planned to be fell.</p> <p>Erect hoarding and barriers along Jurong Pier Road prior to start of clearance to prevent road kills.</p> <p>Erect hoarding and barriers progressively to prevent fauna from entering Project site.</p> <p>Daily observation of the nearby roads (Jurong Pier Road, Jurong Hill Road and Bird Park Drive) during clearing and construction phase to record any road kills. This information must be highlighted in the monthly reports.</p> <p>Site clearance should strictly adhere to the designated areas to be cleared.</p> <p>Wildlife shepherding plan should be followed as per section 4.4. Weekly monitoring of biodiversity and wildlife shepherding should be done during the land clearance.</p>	Contractor, EMMP Consultant, Fauna Specialist	Methodology is typically visual study using transect and point counts. Monitoring of the wildlife shepherding would be inspection the section to be cleared.

Environmental Aspect	Monitoring Scope	Management and Monitoring Plan	Responsible Party	Remarks
		Look out for any signs of animal fatalities, observing the next phase of clearing, as well as ensuring that the contractor is carrying out the clearing in accordance to the wildlife shepherding plan.		
	Monthly Monitoring of Biodiversity after site clearance	After the wildlife shepherding plan phase, monitoring of fauna should continue throughout the construction phase on a monthly basis. This should be to ensure no signs of animal entry into the construction site (hoarding checks) as well as general biodiversity monitoring outside the site.	EMMP consultant	Monitoring conducted using point counts and transect survey methods comparing the finding to the EIA findings.
	Monthly Monitoring of trees' health and forest edge effect	The health of the trees along the forest edge outside the boundary hoarding should be monitored on a regular basis for any trees that may have roots affected by the site works, and necessary pruning works to minimise the risk of tree failure onto the worksite.	Contractor's Arborist	-
	Daily checks for animals being trapped in ECM and entrapment by pits	Site personnel should inspect any pits dug and ECM ponds for any trapped animals. If animals are observed to be trapped, the Contractor should immediately contact the NParks Animal Response Center to rescue the animal.	Contractor	-
Light Management	Site inspection	A Light Management Plan (LMP) has been included as part of the EMMP (refer to Section 5.2.3 of the EMMP) in the event of potential night work to be carried out (e.g., any work beyond 6pm).	Contractor's ECO and EMMP consultant.	Should there be any potential night work to be carried out, the Contractor would strictly follow the LMP.

6. Conclusion

Singapore Environmental Consultancy and Solutions Pte Ltd (SECS) has conducted an Environmental Impact Assessment (EIA) for Jurong Hill (Area 1 and 2). In summary, the development of the Project area is the proposed construction of the proposed Jurong Hill Station (JS11) located along Jurong Pier Road. These involves construction works for slope cutting and Contiguous Bored Piled (CBP) at Area 1 and Excavation & Cable Laying at Area 2. As such, care should be taken to minimise the impact inflicted on the surrounding environment.

The EIA has identified potential environmental impacts during the construction work and has recommended mitigation measures to reduce the risk. The following items are crucial in minimizing the impacts to the area:

- Implementation of the recommended Wildlife Management Plan with the engagement of fauna specialist and EMMP consultant during construction stage. NParks should be consulted and engaged to further discuss the shepherding plan;
- Replanting of native species within and around the site is recommended once the construction is completed;
- No surface runoff, chemical, or fuel should be allowed to runoff out of the site into the enclosed underground stormwater drains in the vicinity of the development site;
- Work should be kept during day time hours (8 am – 6 pm) and no work should be done during the night;
- Water quality monitoring of ECM discharge should be carried out every month during construction;
- During the site clearance, biodiversity monitoring should be carried out on a weekly basis;
- Biodiversity awareness training is recommended for all construction personnel;
- After land clearance, biodiversity monitoring should be carried out on a monthly basis; and
- All other control and mitigation measures recommended in the EIA should be implemented.

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SINGAPORE ENVIRONMENTAL CONSULTANCY AND SOLUTIONS PTE LTD

APPENDICES

APPENDIX I:

Flora Survey Data

Singapore Environmental Consultancy and Solutions Pte. Ltd

J112 Ecological Baseline Study

Flora Assessment

Tony O'Dempsey
3/9/2023

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INTRODUCTION

LOCALITY

The J112 (Jurong Hill MRT Station) ecological baseline study covers an area of approximately 5.9 hectares over the eastern slopes of Jurong Hill and centred at geographic coordinates E: 103° 42' 33" and N: 1° 19' 04". The station construction areas (1 & 2) which will be cleared and excavated are shown in yellow on the locality map (Figure 1) below.

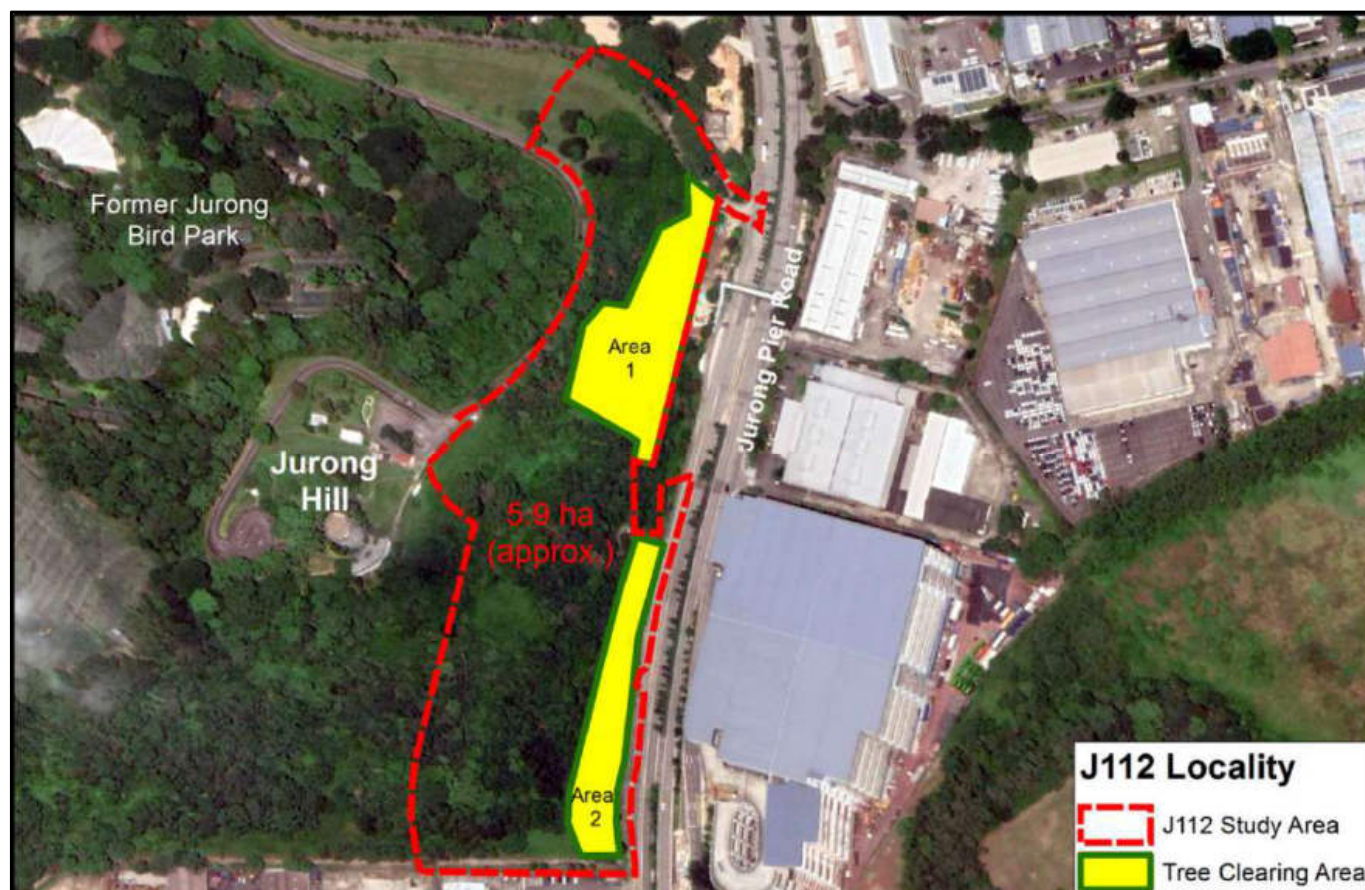


Figure 1: J112 Locality Map

SCOPE OF FLORA STUDY

The scope of work for the baseline flora study calls for positioning and identification of trees of 1 metre girth and above as well as any conservation significant trees from 30 cm girth that occur within the station clearing areas (1 & 2). For the remainder of the site the diversity of vascular flora will be assessed by the method of transects and sample plots. Four 10m x 10m sample plots are to be distributed more or less evenly across the study area site in locations that represent the typical assemblage of species for the area. A habitat map is to be produced showing the different flora communities present within the study area.

HISTORICAL LANDUSE ANALYSIS

The progression of landuse since 1924 at Jurong Hill is illustrated in the following series of historical maps and archived aerial photography. Note that the hill was originally known as Bukit Peropok however the name was changed to Jurong Hill when the Jurong Industrial development occurred during the 1960's.

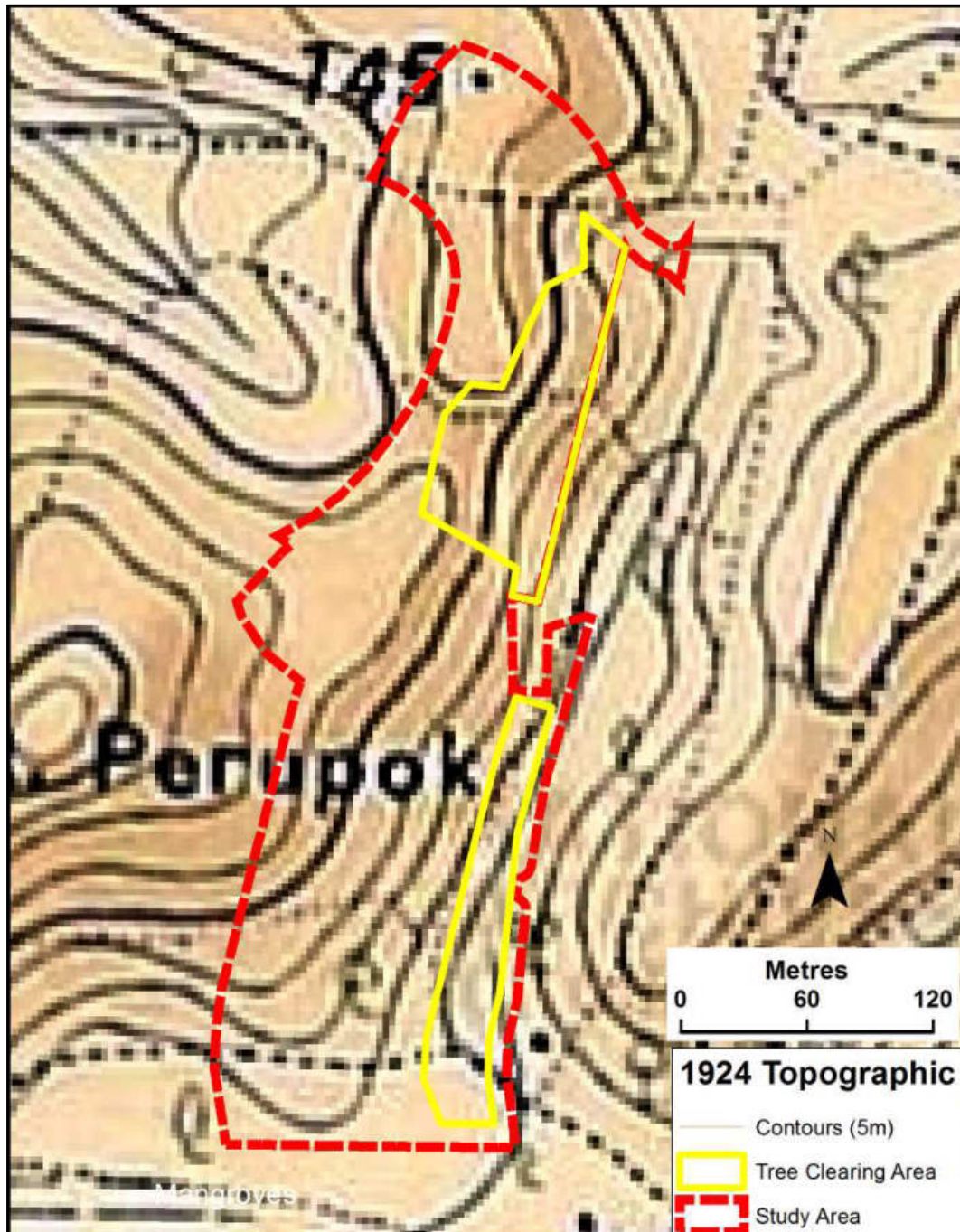


Figure 2: 1924 Topographic map

The 1924 Topographic map shows rubber plantation about the low lying land however none is shown on the hillside of Bukit Peropok. However 1951 aerial photography (Figure 3 below) shows evidence of cleared rubber plantation in the post war period. It is likely that rubber was planted on the hillside at some point after 1924 and decimated during or soon after WW2.

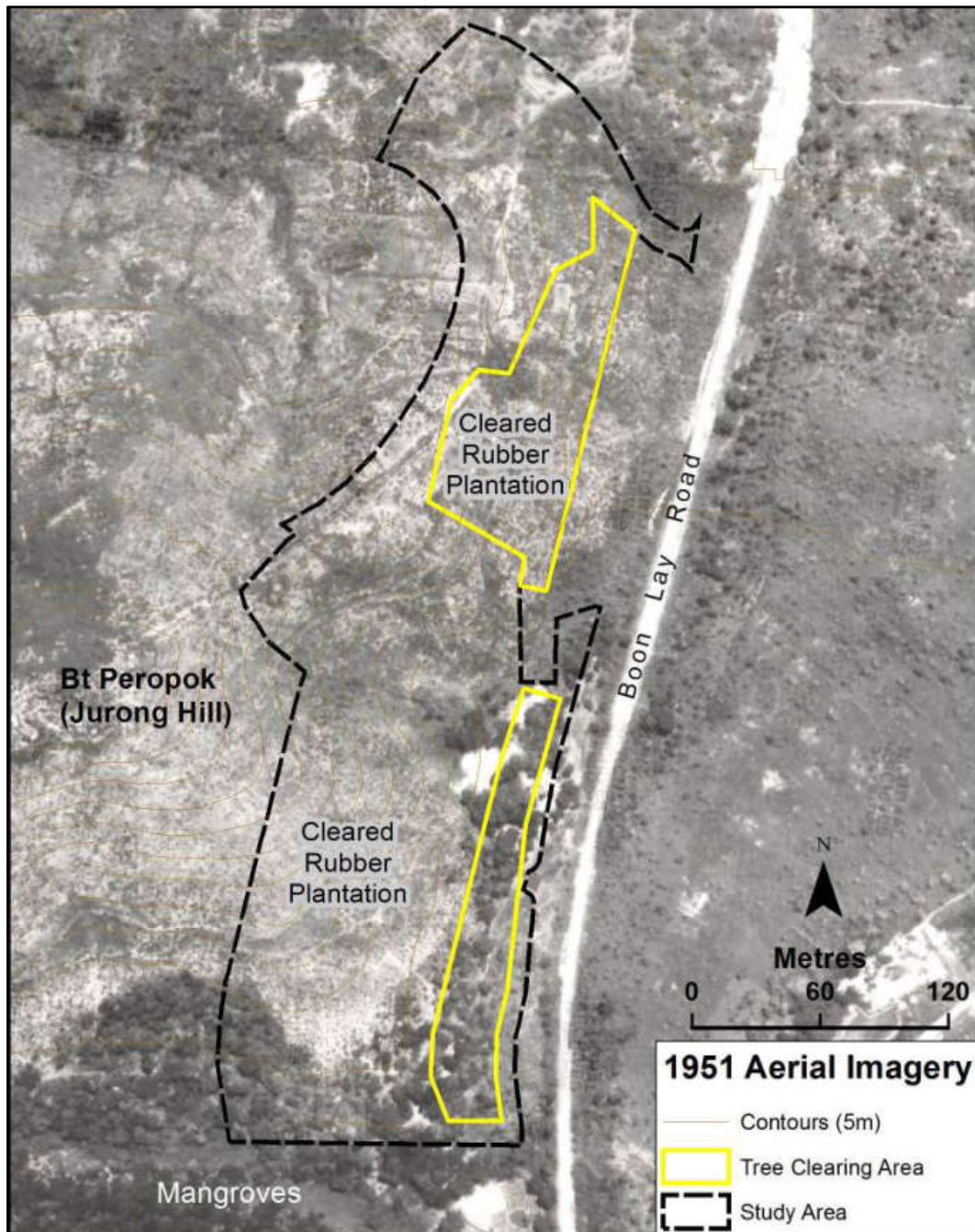


Figure 3: 1951 Aerial photo of the study area (NAS Accession 260946).



Figure 4: Enlarged section showing original rubber planting lines (NAS Accession 260946).

The 1951 aerial imagery (Figure 3 and Figure 4 above) shows cleared rubber plantation. During the war years rubber plantations were harvested for building material and some were cleared for purpose of agriculture. During the post war period some older rubber plantations were cleared and replanted as a result of research indicating productivity gains by doing so. It is apparent that rubber plantation on this site was cleared post war however there is no evidence of replanting and natural regeneration of vegetation occurred from this point onwards.



Figure 5: NAS 1966 Aerial Imagery (NAS Accession: 246200).

The 1966 aerial imagery shows the reclamation and development of the Jurong Industrial precinct. Jurong Hill was retained as an island of regeneration forest. In 1968 the Jurong Town Council established the Jurong Hill Park at this location.

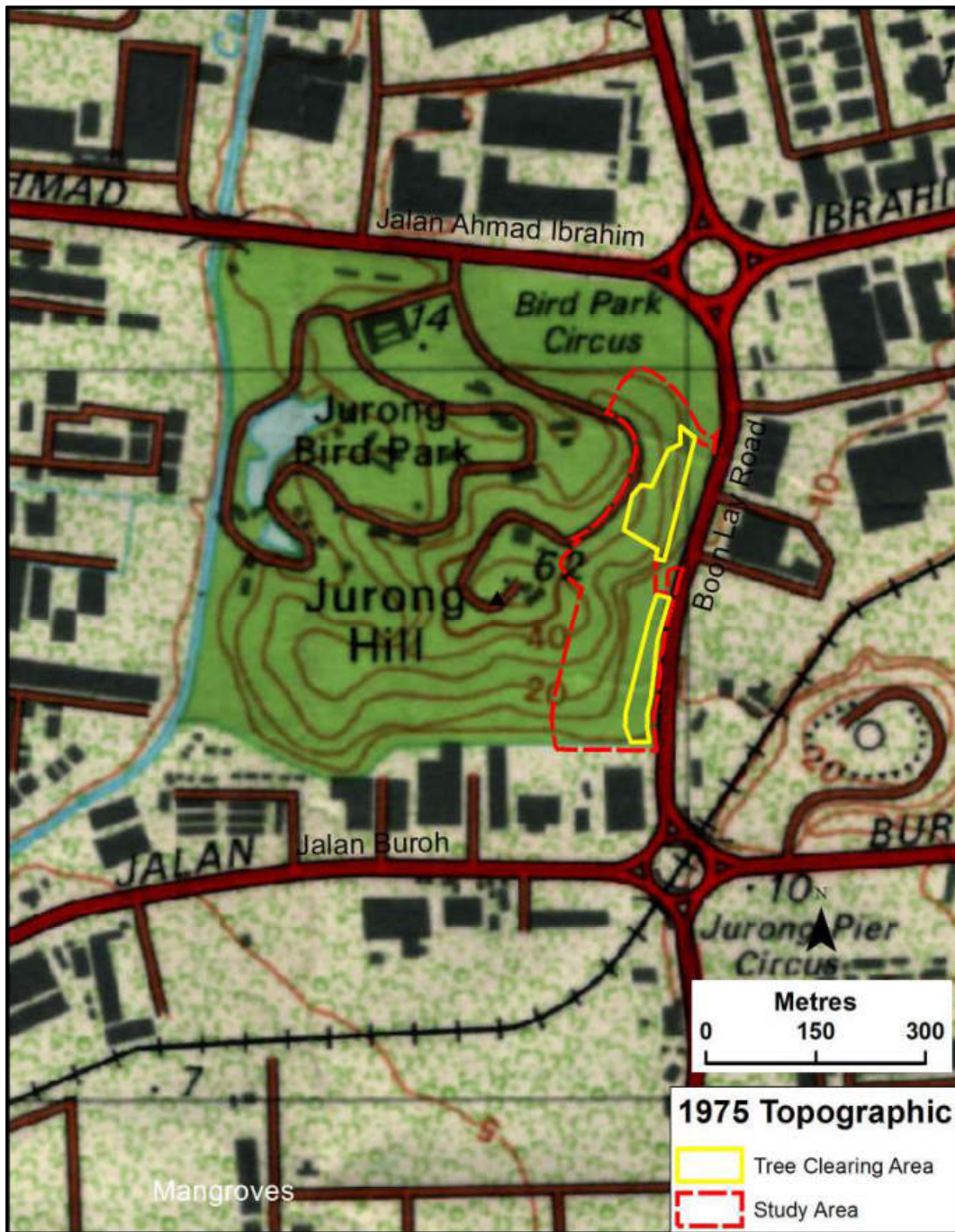


Figure 6: 1975 NUS Map Library Topographic map.

The 1975 Topographic map shows the Jurong Hill Park along with the adjacent Jurong Bird Park established and surrounded by industrial development.

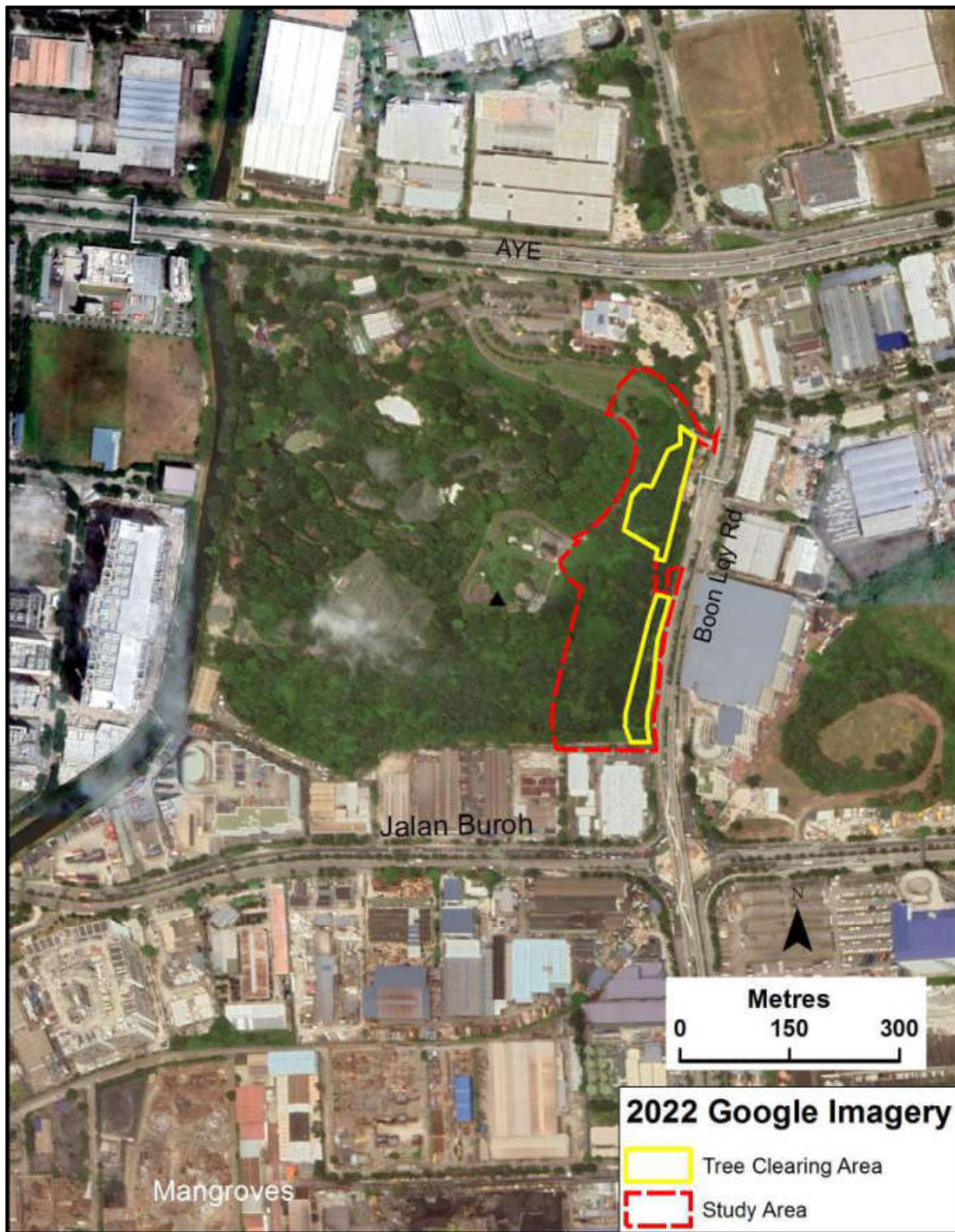


Figure 7: 2022 Google Imagery showing Jurong Hill Park.

The 2022 Google imagery shows the Jurong Hill Park and adjacent Jurong Bird Park (now relocated to Mandai) surrounded by industrial development.

The historical analysis shows that while the Jurong Hillside was originally planted with rubber trees, these were removed during or just after the war. Since then the site has undergone spontaneous regeneration for the past 70+ years.

HABITAT MAPPING

The habitat map is compiled with reference to formal flora sampling plots and walking transects utilised as ground truth basis for satellite image interpretation.

HABITAT CLASSIFICATION

The habitat classes have been chosen to coincide as much as possible with the Biodiversity Impact Assessment Guidelines published by the National Parks Board (NParks)¹.

Table 1: Flora Habitat Classes

Habitat Map Class	Description												
Native Dominated Secondary Forest	Areas to the south of the study area feature the following native species: <i>Cyrtophyllum fragrans</i> , <i>Palaquium obovatum</i> , <i>Syzygium grande</i> , and <i>Syzygium zeylanicum</i> . <i>Palaquium obovatum</i> seedlings and saplings are particularly abundant in the southern extent of the study area. The area labelled B in the habitat map below features mature <i>Rhodamnia cinerea</i> and <i>Diospyros lanceifolia</i> trees.												
Scrub Land	<p>Scrub Land areas on site have different species assemblages. With reference to labels on the habitat map below these scrub areas are characterised as follows:</p> <table> <tr> <th>Label</th><th>Dominant Species</th></tr> <tr> <td>A</td><td><i>Dillenia sufruticosa</i></td></tr> <tr> <td>C</td><td><i>Dicranopteris linearis</i></td></tr> <tr> <td>D</td><td><i>Bridelia stipularis</i></td></tr> <tr> <td>E</td><td><i>Fibraurea tinctoria</i></td></tr> <tr> <td>F</td><td><i>Dillenia suffruticosa</i></td></tr> </table> <p>:</p>	Label	Dominant Species	A	<i>Dillenia sufruticosa</i>	C	<i>Dicranopteris linearis</i>	D	<i>Bridelia stipularis</i>	E	<i>Fibraurea tinctoria</i>	F	<i>Dillenia suffruticosa</i>
Label	Dominant Species												
A	<i>Dillenia sufruticosa</i>												
C	<i>Dicranopteris linearis</i>												
D	<i>Bridelia stipularis</i>												
E	<i>Fibraurea tinctoria</i>												
F	<i>Dillenia suffruticosa</i>												
Exotic Dominated Secondary Forest	<p>The dominant species under this habitat category is <i>Hevea brasiliensis</i> due to the past landuse of rubber plantation. The original production rubber trees were removed prior to 1950 and the rubber trees dominating the site are progeny of these original plantation trees.</p> <p>The understory includes spontaneous growth of mainly native species such as <i>Syzygium grande</i>, <i>Archidendron jringa</i>, <i>Palaquium obovatum</i>, <i>Caryota mitis</i>, <i>Ficus vasculosa</i>, <i>F. aurata</i>, <i>F. variegata</i> and <i>F. fistulosa</i>. The native climber <i>Fibraurea tinctoria</i> is common throughout this area.</p>												
Ponds	A small pond (constructed dam) is situated within the southern extent of the study area.												

HABITAT MAP

¹ Biodiversity Impact Assessment (BIA) Guidelines, National Biodiversity Centre, NParks, 2020

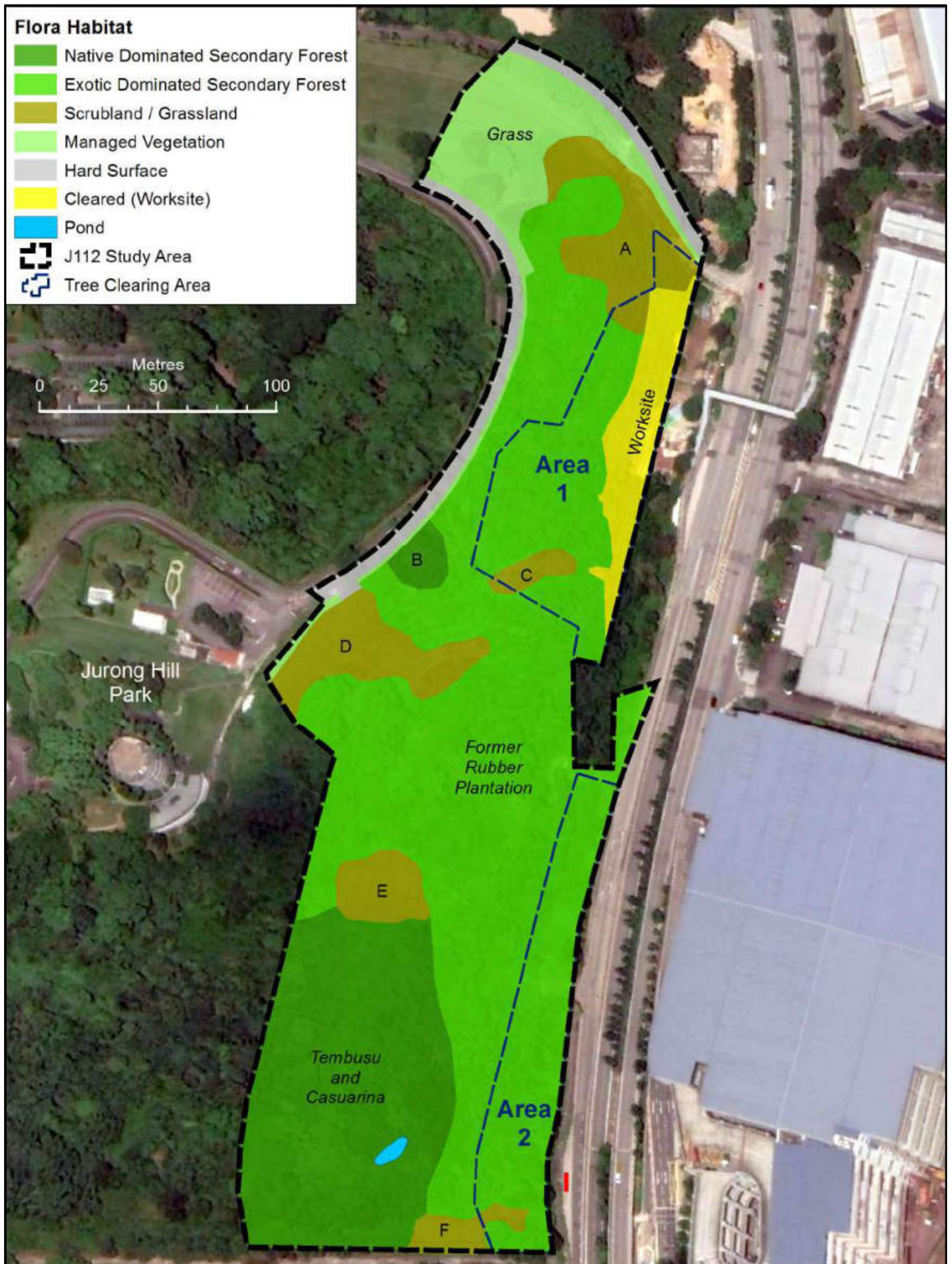


Figure 8: Habitat Map

SURVEY METHODOLOGY AND RESULTS

METHODOLOGY

Measured Plots

Measured plots are located in the vicinity of pre-determined locations² with the objective of obtaining coverage across the whole study area. Plot dimensions are 10m x 10m and are measured by setting out two parallel internal transect lines 5 metres apart. Plant locations are determined by distance along each transect (0 to 10 m) and with offsets left/right up to 2.5 m. A GPS location is obtained for the initial point located at the South west corner of the plot. Plotting coordinates are post-computed as a function of initial coordinate, chainage, offset and transect line.

Walking Transects

Walking Transects involve walking along a pre-determined path while periodically recording location with a GPS device. Plants encountered are booked sequentially with reference to the most recent GPS position ID recorded. The GPS positions of conservation significant species are recorded as they are encountered.

Species Identification

Species are generally identified from vegetative characteristics due to non-availability of fertile specimens at time of survey. Some species are difficult to identify to species level when infertile, these are referred to the Singapore Herbarium for determination if an initial attempt at identification using online and text book resources failed to reveal a reliable identification.

² Predetermined locations are documented in the project inception report.

SAMPLING PLOTS & TRANSECTS

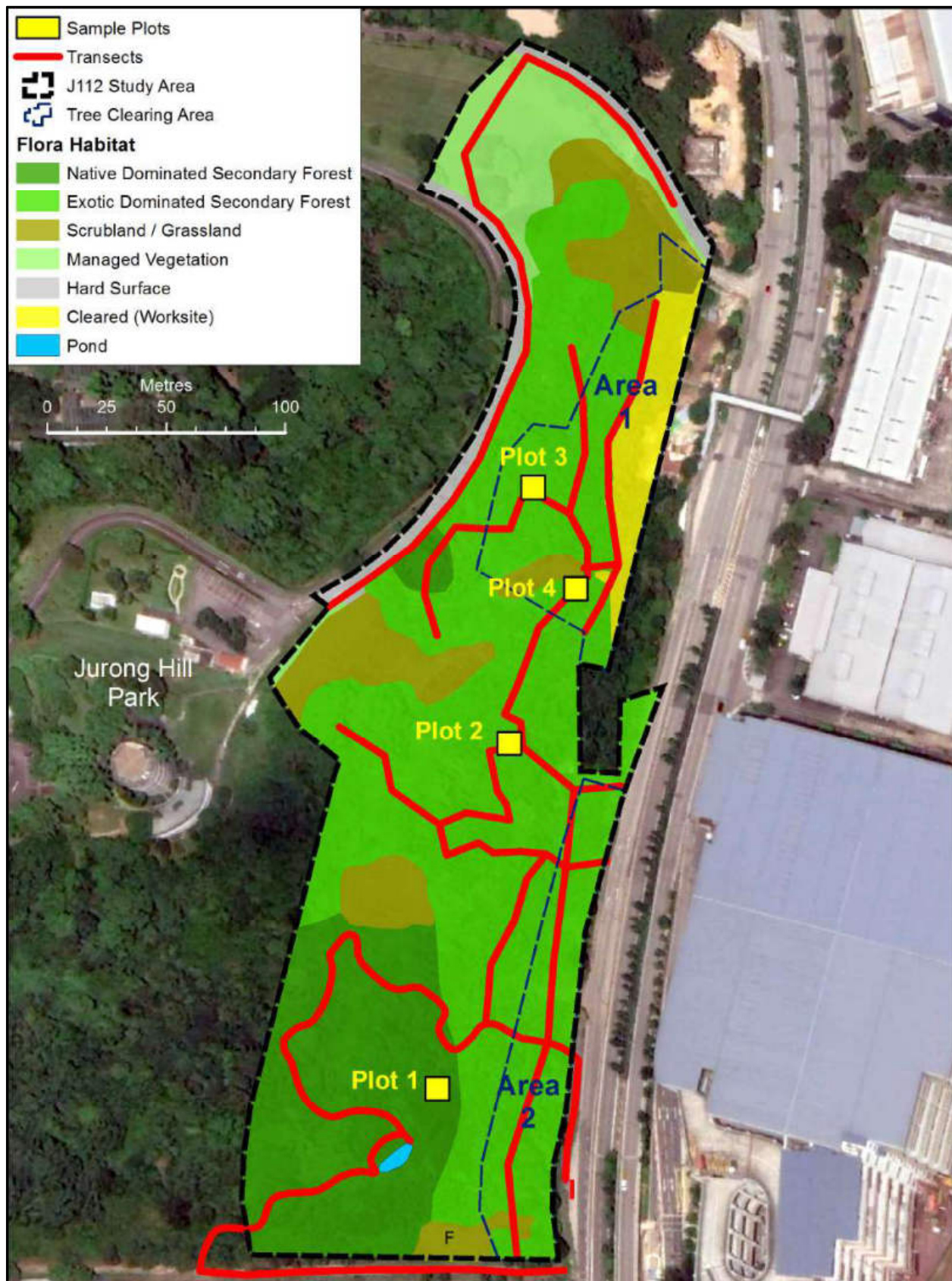


Figure 9: Transects and Sampling Plots layout map.

CONSERVATION SIGNIFICANT SPECIES

Conservation significant species encountered during transects as well as within the four sampling plots are illustrated in the maps (Figure 10 and Figure 11) below:

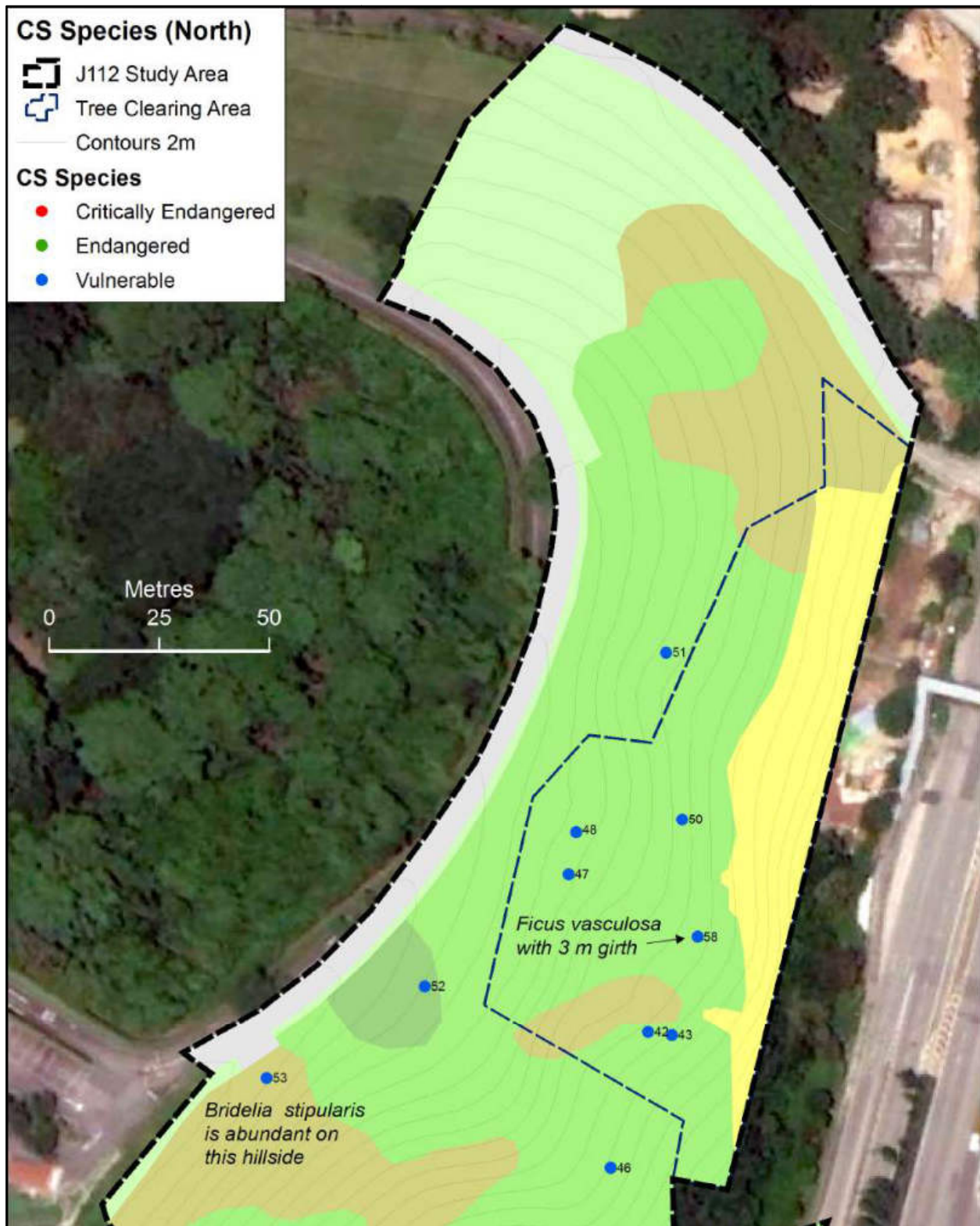


Figure 10: Conservation Significant species map (North)

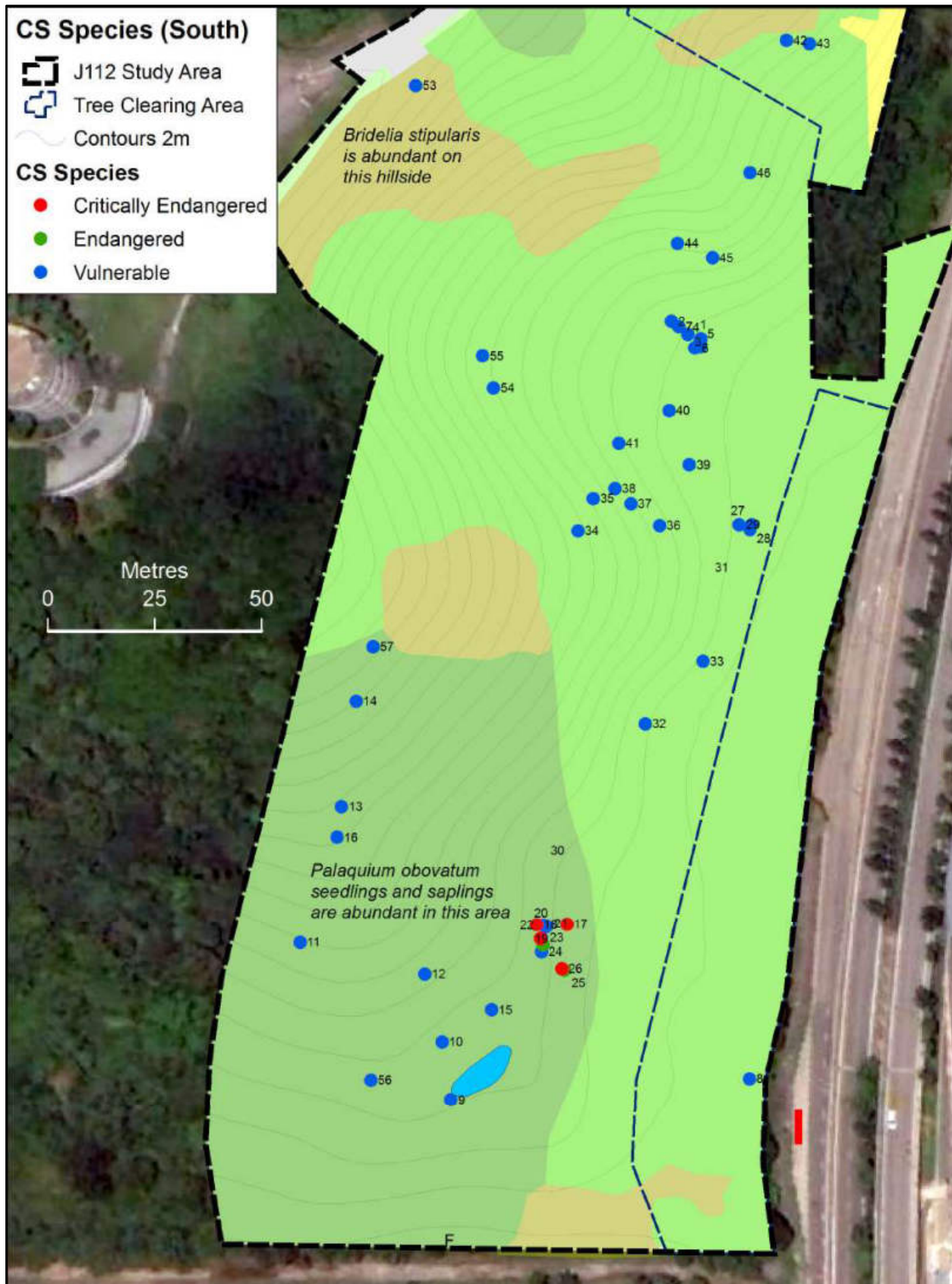


Figure 11: Conservation Significant species map (South).

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Table 2: Conservation Significant Species Schedule

ID	Species	Status	Longitude	Latitude
1	<i>Archidendron jiringa</i>	Vulnerable	103.709250	1.317535
2	<i>Archidendron jiringa</i>	Vulnerable	103.709188	1.317571
3	<i>Archidendron jiringa</i>	Vulnerable	103.709222	1.317544
4	<i>Archidendron jiringa</i>	Vulnerable	103.709249	1.317529
5	<i>Archidendron jiringa</i>	Vulnerable	103.709249	1.317518
6	<i>Archidendron jiringa</i>	Vulnerable	103.709238	1.317515
7	<i>Archidendron jiringa</i>	Vulnerable	103.709204	1.317560
8	<i>Neolitsea cassia</i>	Vulnerable	103.709352	1.315966
9	<i>Palaquium obovatum</i>	Vulnerable	103.708725	1.315922
10	<i>Palaquium obovatum</i>	Vulnerable	103.708706	1.316044
11	<i>Palaquium obovatum</i>	Vulnerable	103.708407	1.316255
12	<i>Palaquium obovatum</i>	Vulnerable	103.708670	1.316188
13	<i>Palaquium obovatum</i>	Vulnerable	103.708495	1.316543
14	<i>Palaquium obovatum</i>	Vulnerable	103.708525	1.316767
15	<i>Palaquium obovatum</i>	Vulnerable	103.708810	1.316112
16	<i>Palaquium obovatum</i>	Vulnerable	103.708485	1.316477
17	<i>Gnetum cf. latifolium</i>	Critically Endangered	103.708969	1.316293
18	<i>Gnetum cf. latifolium</i>	Critically Endangered	103.708905	1.316293
19	<i>Archidendron jiringa</i>	Vulnerable	103.708920	1.316292
20	<i>Archidendron jiringa</i>	Vulnerable	103.708923	1.316288
21	<i>Archidendron jiringa</i>	Vulnerable	103.708926	1.316290
22	<i>Gnetum cf. latifolia</i>	Critically Endangered	103.708913	1.316263
23	<i>Garcinia griffithii</i>	Endangered	103.708918	1.316249
24	<i>Palaquium obovatum</i>	Vulnerable	103.708915	1.316235
25	<i>Cayratia mollissima</i>	Endangered	103.708963	1.316196
26	<i>Gnetum cf. latifolium</i>	Critically Endangered	103.708958	1.316198
27	<i>Limacia scandens</i>	Vulnerable	103.709357	1.317141
28	<i>Lamacia scandens</i>	Vulnerable	103.709354	1.317131
29	<i>Archidendron jiringa</i>	Vulnerable	103.709331	1.317141
30	<i>Palaquium obovatum</i>	Vulnerable	103.708934	1.316449
31	<i>Archidendron jiringa</i>	Vulnerable	103.709279	1.317049
32	<i>Palaquium obovatum</i>	Vulnerable	103.709133	1.316719
33	<i>Archidendron jiringa</i>	Vulnerable	103.709254	1.316851
34	<i>Archidendron jiringa</i>	Vulnerable	103.708992	1.317128
35	<i>Palaquium obovatum</i>	Vulnerable	103.709024	1.317196
36	<i>Archidendron jiringa</i>	Vulnerable	103.709163	1.317139
37	<i>Ficus vasculosa</i>	Vulnerable	103.709103	1.317185
38	<i>Ficus vasculosa</i>	Vulnerable	103.709070	1.317217
39	<i>Lamacia scandens</i>	Vulnerable	103.709226	1.317267
40	<i>Ficus vasculosa</i>	Vulnerable	103.709183	1.317382
41	<i>Archidendron jiringa</i>	Vulnerable	103.709077	1.317312
42	<i>Licuala spinosa</i>	Vulnerable	103.709430	1.318166
43	<i>Archidendron jiringa</i>	Vulnerable	103.709478	1.318159

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44	<i>Palaquium obovatum</i>	Vulnerable	103.709201	1.317737
45	<i>Ficus vasculosa</i>	Vulnerable	103.709275	1.317705
46	<i>Archidendron jiringa</i>	Vulnerable	103.709353	1.317887
47	<i>Licuala spinosa</i>	Vulnerable	103.709267	1.318490
48	<i>Licuala spinosa</i>	Vulnerable	103.709283	1.318576
50	<i>Archidendron jiringa</i>	Vulnerable	103.709499	1.318603
51	<i>Archidendron jiringa</i>	Vulnerable	103.709467	1.318945
52	<i>Archidendron jiringa</i>	Vulnerable	103.708973	1.318260
53	<i>Bridelia stipularis</i>	Vulnerable	103.708650	1.318071
54	<i>Archidendron jiringa</i>	Vulnerable	103.708814	1.317430
55	<i>Ficus vasculosa</i>	Vulnerable	103.708791	1.317499
56	<i>Palaquium obovatum</i>	Vulnerable	103.708557	1.315963
57	<i>Oncosperma tigillarium</i>	Vulnerable	103.708561	1.316881
58	<i>Ficus vasculosa</i> ³	Vulnerable	103.709531	1.318362

³ The large *Ficus vasculosa* (Tree 58) is in poor condition

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Table 3: Sampling plot 1 species assemblage.

Species	Type	Origin	Status	Count
<i>Acacia auriculiformis</i>	Tree	Exotic	Naturalised	1
<i>Adenanthera pavonina</i>	Tree	Exotic	Naturalised	6
<i>Adiantum latifolium</i>	Tree	Exotic	Naturalised	1
<i>Archidendron jiringa</i>	Tree	Native	Vulnerable	1
<i>Caryota mitis</i>	Tree	Native	Least Concern	12
<i>Casuarina equisetifolia</i>	Tree	Native	Least Concern	1
<i>Cynometra cauliflora</i>	Tree	Exotic	Casual	7
<i>Dillenia suffruticosa</i>	Shrub	Native	Least Concern	3
<i>Fibraurea tinctoria</i>	Climber	Native	Least Concern	8
<i>Garcinia griffithii</i>	Tree	Native	Endangered	1
<i>Heavea brasiliensis</i>	Tree	Exotic	Naturalised	17
<i>Palaquium obovatum</i>	Tree	Native	Vulnerable	3
<i>Ptychosperma macarthurii</i>	Tree	Exotic	Naturalised	7
<i>Embelia ribes</i>	Climber	Native	Least Concern	3
<i>Gnetum cf. latifolium</i>	Climber	Native	Critically Endangered	6
<i>Stenochlaena palustris</i>	Climber	Native	Least Concern	1
<i>Syzygium grande</i>	Tree	Native	Least Concern	4
<i>Syzygium polyanthum</i>	Tree	Native	Least Concern	1
<i>Syzygium zeylanicum</i>	Tree	Native	Least Concern	1

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Sampling Plot 2

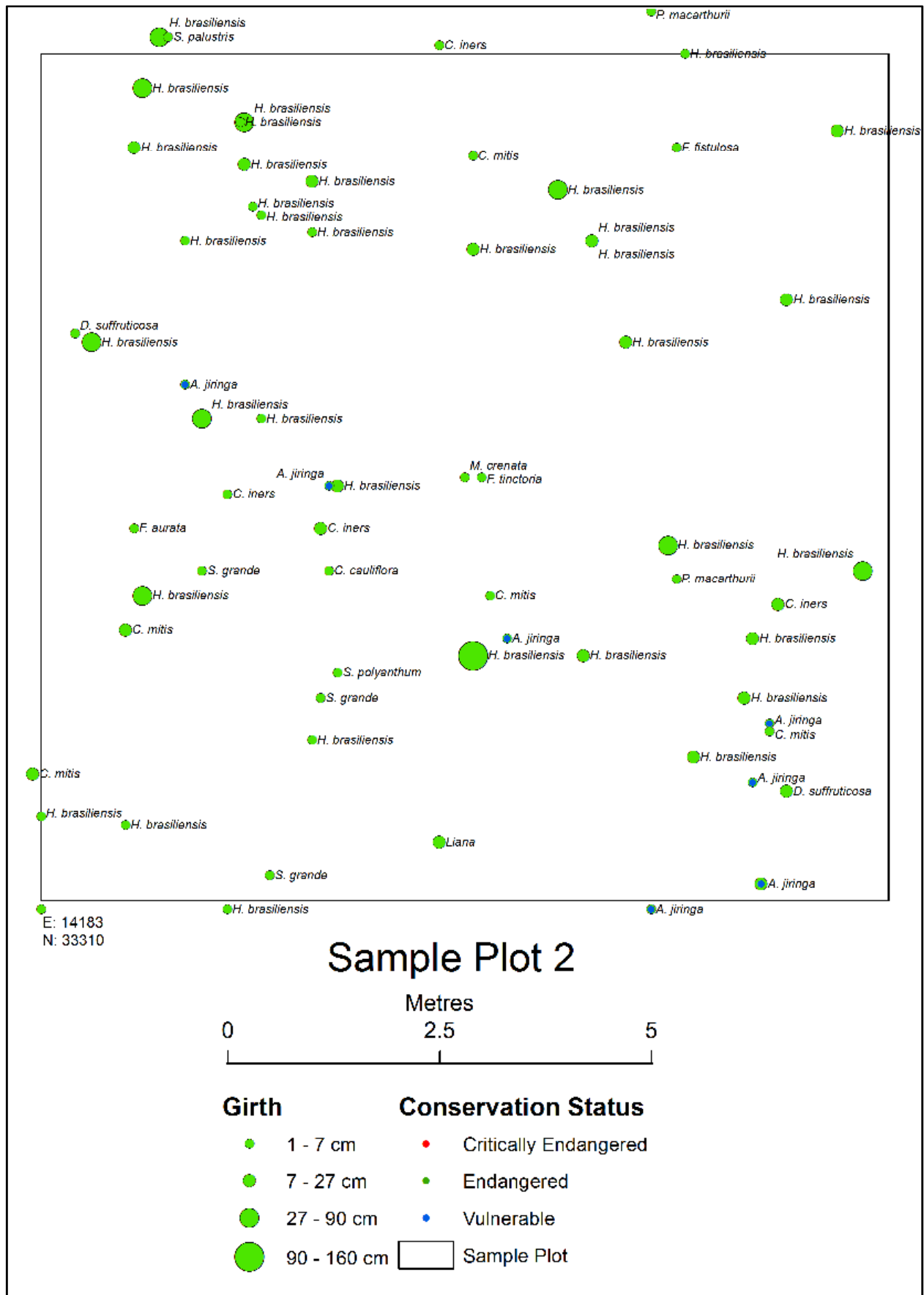


Figure 13: Sampling Plot 2 Diagram

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Table 4: Sampling Plot 2 species assemblage.

Species	Type	Origin	Status	Count
<i>Archidendron jiringa</i>	Tree	Native	Vulnerable	7
<i>Caryota mitis</i>	Tree	Native	Least Concern	5
<i>Cinnamomum iners</i>	Tree	Native	Least Concern	4
<i>Cynometra cauliflora</i>	Tree	Exotic	Casual	1
<i>Dillenia suffruticosa</i>	Shrub	Native	Least Concern	2
<i>Fibraurea tinctoria</i>	Climber	Native	Least Concern	1
<i>Ficus aurata</i>	Shrub	Native	Least Concern	1
<i>Ficus fistulosa</i>	Tree	Native	Least Concern	1
<i>Ficus grossularioides</i>	Tree	Native	Least Concern	1
<i>Hevea brasiliensis</i>	Tree	Exotic	Naturalised	35
<i>Liana with thorns</i>	Climber	n/a	n/a	1
<i>Miconia crenata</i>	Herb	Exotic	Naturalised	1
<i>Ptychosperma macarthurii</i>	Tree	Exotic	Naturalised	2
<i>Stenochlaena palustris</i>	Climber	Native	Least Concern	1
<i>Syzygium grande</i>	Tree	Native	Least Concern	3
<i>Syzygium polyanthum</i>	Tree	Native	Least Concern	1

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Table 5: Sampling Plot 3 species assemblage.

Species	Type	Origin	Status	Count
<i>Caryota mitis</i>	Tree	Native	Least Concern	1
<i>Cinnamomum iners</i>	Tree	Native	Least Concern	1
<i>Dillenia suffruticosa</i>	Shrub	Native	Least Concern	3
<i>Diospyros lanceifolia</i>	Tree	Native	Least Concern	7
<i>Fibraurea tinctoria</i>	Climber	Native	Least Concern	15
<i>Hevea brasiliensis</i>	Tree	Exotic	Naturalised	31
<i>Licuala spinosa</i>	Shrub	Native	Vulnerable	2
<i>Ptychosperma macarthurii</i>	Tree	Exotic	Naturalised	6
<i>Stenochlaena palustris</i>	Climber	Native	Least Concern	1
<i>Syzygium grande</i>	Tree	Native	Least Concern	1
<i>Kopsia sp</i> ⁴	Tree	n/a	n/a	1

⁴ The *Kopsia sp* ID was provided by SING Herbarium, it is likely to be progeny of cultivated species. It is unlikely to be *Kopsia singapurensis* (a swamp forest species and only native *Kopsia sp* in our flora) due to habitat and location.

Sampling Plot 4

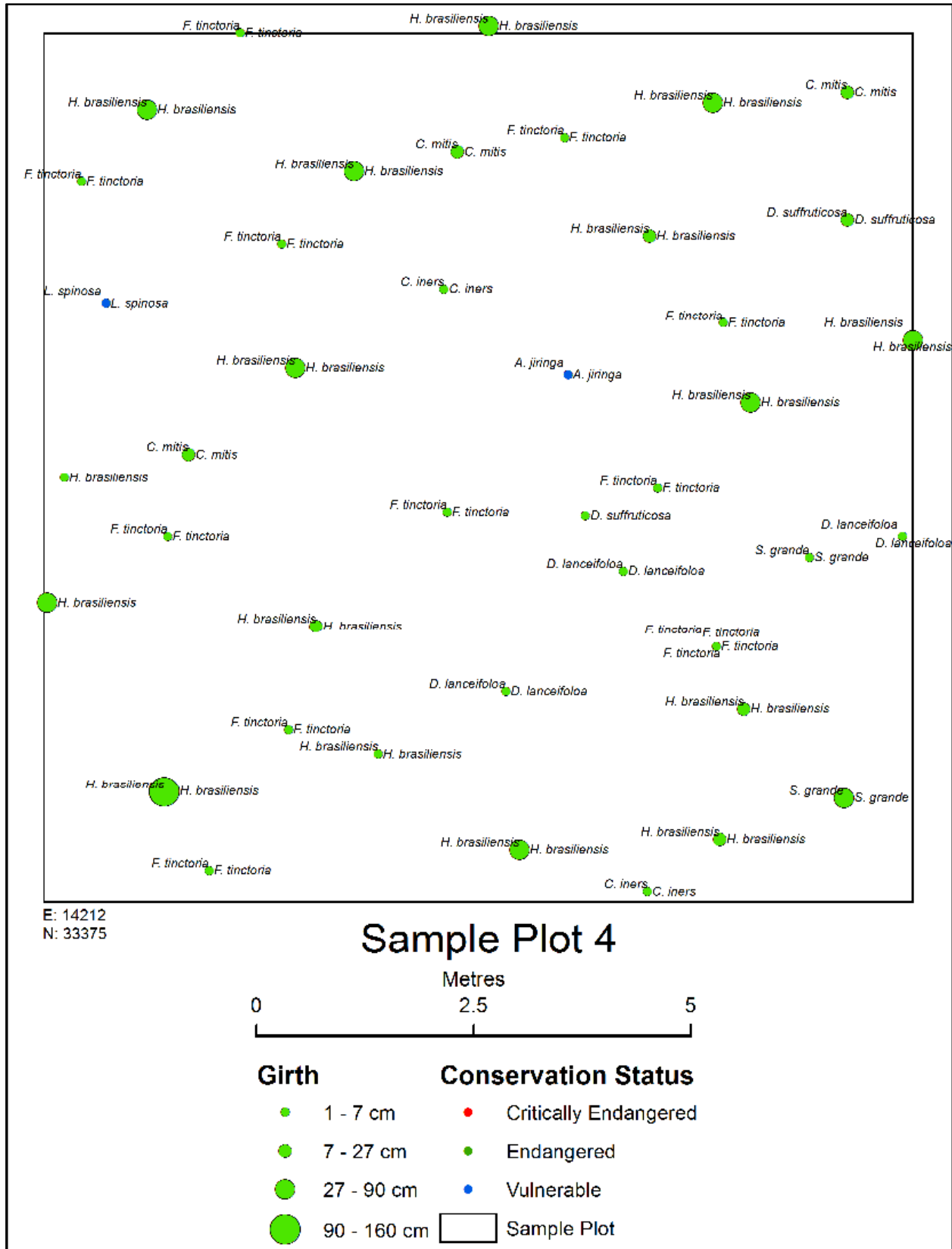


Figure 15: Sampling Plot 4 Diagram.

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Table 6: Sampling Plot 4 species assemblage.

Species	Type	Origin	Status	Count
<i>Archidendron jiringa</i>	Tree	Native	Vulnerable	1
<i>Caryota mitis</i>	<i>Tree</i>	Native	Least Concern	2
<i>Cinnamomum iners</i>	<i>Tree</i>	Native	Least Concern	1
<i>Dillenia suffruticosa</i>	<i>Shrub</i>	Native	Least Concern	2
<i>Diospyros lanceifolia</i>	<i>Tree</i>	Native	Least Concern	3
<i>Fibraurea tinctoria</i>	<i>Climber</i>	Native	Least Concern	12
<i>Hevea brasiliensis</i>	<i>Tree</i>	Exotic	Exotic	15
<i>Licuala spinosa</i>	<i>Shrub</i>	Native	Vulnerable	1
<i>Syzygium grande</i>	<i>Tree</i>	Native	Least Concern	1

SPECIES CHECKLIST

The primary reference for species names and conservation status is the Flora of Singapore: Checklist and bibliography (Gardens' Bulletin Singapore 74(Suppl. 1): 3–860. 2022).

Family	Species	Origin	Status
Apocynaceae	<i>Alstonia scholaris</i>	Exotic	Naturalised
Apocynaceae	<i>Kopsia sp</i>	n/a	n/a
Araceae	<i>Alocasia macrorrhizos</i>	Exotic	Naturalised
Araliaceae	<i>Arthrophyllum jackianum</i>	Native	Least Concern
Arecaceae	<i>Caryota mitis</i>	Native	Least Concern
Arecaceae	<i>Elaeis guineensis</i>	Exotic	Naturalised
Arecaceae	<i>Licuala spinosa</i>	Native	Vulnerable
Arecaceae	<i>Oncosperma tigillarium</i>	Native	Vulnerable
Arecaceae	<i>Ptychosperma macarthurii</i>	Exotic	Naturalised
Aspleniaceae	<i>Asplenium nidus</i>	Native	Least Concern
Bignoniaceae	<i>Spathodea campanulata</i>	Exotic	Naturalised
Blechnaceae	<i>Stenochlaena palustris</i>	Native	Least Concern
Casuarinaceae	<i>Casuarina equisetifolia</i>	Native	Least Concern
Clusiaceae	<i>Garcinia griffithii</i>	Native	Endangered
Convolvulaceae	<i>Erycibe tomentosa</i>	Native	Least Concern
Dilleniaceae	<i>Dillenia suffruticosa</i>	Native	Least Concern
Dilleniaceae	<i>Tetracera indica</i>	Native	Least Concern
Ebenaceae	<i>Diospyros lanceifolia</i>	Native	Least Concern
Euphorbiaceae	<i>Hevea brasiliensis</i>	Exotic	Naturalised
Euphorbiaceae	<i>Macaranga gigantea</i>	Native	Least Concern
Euphorbiaceae	<i>Macaranga heynei</i>	Native	Least Concern
Euphorbiaceae	<i>Mallotus paniculatus</i>	Native	Least Concern
Fabaceae	<i>Acacia auriculiformis</i>	Exotic	Naturalised
Fabaceae	<i>Adenanthera pavonina</i>	Exotic	Naturalised
Fabaceae	<i>Archidendron jiringa</i>	Native	Vulnerable
Fabaceae	<i>Baphia nitida</i>	Exotic	Casual
Fabaceae	<i>Cynometra cauliflora</i>	Exotic	Casual
Fabaceae	<i>Entada spiralis</i> ⁵	Native	Vulnerable
Fabaceae	<i>Falcataria falcata</i>	Exotic	Naturalised
Fabaceae	<i>Leucaena leucocephala</i>	Exotic	Naturalised
Fabaceae	<i>Samanea saman</i>	Exotic	Casual
Gentianaceae	<i>Cyrtophyllum fragrans</i>	Native	Least Concern
Gleicheniaceae	<i>Dicranopteris linearis</i>	Native	Least Concern
Gnetaceae	<i>Gnetum cf. latifolium</i>	Native	Critically Endangered
Ixonanthaceae	<i>Ixonanthes reticulata</i>	Native	Least Concern
Lamiaceae	<i>Congea tomentosa</i>	Exotic	Casual
Lamiaceae	<i>Vitex pinnata</i>	Native	Least Concern
Lauraceae	<i>Cinnamomum iners</i>	Native	Least Concern

⁵ *Entada spiralis* was noted by NParks, however it was not encountered during the transect or sampling plot surveys.

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Lauraceae	<i>Neolitsea cassia</i>	Native	Vulnerable
Lauraceae	<i>Syzygium grande</i>	Native	Least Concern
Lauraceae	<i>Syzygium myrtifolium</i> ⁶	Native	Critically Endangered
Lauraceae	<i>Syzygium polyanthum</i>	Native	Least Concern
Lauraceae	<i>Syzygium zeylanicum</i>	Native	Least Concern
Linaceae	<i>Indorouchera griffithiana</i>	Native	Least Concern
Melastomataceae	<i>Melastoma malabathricum</i>	Native	Least Concern
Melastomataceae	<i>Miconia crenata</i>	Exotic	Naturalised
Menispermaceae	<i>Fibraurea tinctoria</i>	Native	Least Concern
Menispermaceae	<i>Limacia scandens</i>	Native	Vulnerable
Moraceae	<i>Ficus aurata</i>	Native	Least Concern
Moraceae	<i>Ficus fistulosa</i>	Native	Least Concern
Moraceae	<i>Ficus grossularioides</i>	Native	Least Concern
Moraceae	<i>Ficus punctata</i>	Native	Least Concern
Moraceae	<i>Ficus variegata</i>	Native	Least Concern
Moraceae	<i>Ficus vasculosa</i>	Native	Vulnerable
Myrtaceae	<i>Rhodamnia cinerea</i>	Native	Least Concern
Nephrolepidaceae	<i>Nephrolepis biserrata</i>	Native	Least Concern
Opiliaceae	<i>Champereia manillana</i>	Native	Least Concern
Phyllanthaceae	<i>Bridelia stipularis</i>	Native	Vulnerable
Phyllanthaceae	<i>Bridelia tomentosa</i>	Native	Least Concern
Phyllanthaceae	<i>cf. Glochidion</i> ⁷	n/a	n/a
Piperaceae	<i>Piper sarmentosum</i>	Native	Least Concern
Primulaceae	<i>Embelia ribes</i>	Exotic	Least Concern
Pteridaceae	<i>Adiantum latifolium</i>	Exotic	Naturalised
Rubiaceae	<i>Aidia densiflora</i>	Native	Vulnerable
Sapotaceae	<i>Palaquium obovatum</i>	Native	Vulnerable
Vitaceae	<i>Cayratia mollissima</i>	Native	Endangered
Vitaceae	<i>Cissus hastata</i>	Native	Least Concern

⁶ *Syzygium myrtifolium* is attributed conservation status however the specimens occurring at this site are persistent from cultivation and have no conservation significance in this context.

⁷ *Glochidion* ID is based on fallen leaflets only, also see Figure 34 and Figure 35.

PHOTO GALLERY



Figure 16: *Arthrophyllum jackianum*



Figure 17: *Baphia nitida*



Figure 18: *Casuarina equisetifolia*



Figure 19: *Cayratia mollissima*



Figure 20: *Champereia manillana*



Figure 21: *Cinnamomum iners*



Figure 22: *Cissus hastata*



Figure 23: *Cynometra cauliflora*



Figure 24: *Cyrtophyllum fragrans*



Figure 25: *Diospyros lanceifolia* (with witches broom)



Figure 26: *Fibraurea tinctoria*



Figure 27: *Fibraurea tinctoria*



Figure 28: *Samanea saman* and *Ficus benjamina*



Figure 29: *ficus grossularioides*



Figure 30: *Ficus punctata*



Figure 31: *Ficus vasculosa*



Figure 32: *Garcinia parvifolia*



Figure 33: *Gnetum cf. latifolium*



Figure 34: *cf. Glochidion*⁸



Figure 35: *cf. Glochidion*



Figure 36: *Ixonanthes reticulara* (seedling)



Figure 37: *Khaya sengalensis*

⁸ Glochidion sp. presumed for these fallen leaflets.



Figure 38: *Kopsia* sp.



Figure 39: *Kopsia* sp.



Figure 40: *Licuala spinosa*



Figure 41: *Limacia scandens*



Figure 42: *Macaranga heynei*



Figure 43: *Mallotus paniculatus*



Figure 44: *Melastoma malabathricum* & *Dillenia suffruticosa*



Figure 45: *Mukia maderaspatana*



Figure 46: *Oncosperma tigillarum*



Figure 47: *Palaquium obovatum*



Figure 48: *Rhodamnia cinerea*



Figure 49: *Syzygium myrtifolium*



Figure 50: *Syzygium zeylanicum*



Figure 51: *Vitex pinnata*



Figure 52: *Kopsia* sp.



Figure 53: *Kopsia* sp

TREE SCHEDULE

The tree schedule below is read with reference to two A1 size tree maps provided as separate documents. Coordinates provided are derived from original registered surveyor tree survey and are based on the SVY21 coordinate system.

Tree_ID	Type	Species	Girth (cm)	Height (m)	East	North
E108	Tree	<i>Dead</i>	130	12	14202.4	33443.8
E106	Tree	<i>Hevea brasiliensis</i>	75	8	14192.1	33436.8
E128	Tree	<i>Hevea brasiliensis</i>	120	14	14210.0	33445.3
T3064	Tree	<i>Syzygium grande</i>	120	15	14216.4	33442.8
T3063	Tree	<i>Syzygium grande</i>	100	12	14211.0	33441.7
T3062	Tree	<i>Syzygium grande</i>	100	12	14210.5	33440.6
T3111	Tree	<i>Cinnamomum iners</i>	100	12	14210.9	33436.8
T3109	Tree	<i>Hevea brasiliensis</i>	80	12	14207.1	33434.8
T3108	Tree	<i>Hevea brasiliensis</i>	50	10	14207.6	33436.2
T3110	Tree	<i>Syzygium grande</i>	80	10	14198.5	33432.0
T3113	Tree	<i>Syzygium grande</i>	80	12	14195.8	33433.3
T3134	Tree	<i>Syzygium grande</i>	70	12	14191.7	33427.6
T3133	Tree	<i>Syzygium grande</i>	110	12	14192.5	33425.4
T3123	Tree	<i>Syzygium grande</i>	100	12	14199.4	33419.5
T3122	Tree	<i>Syzygium grande</i>	80	12	14199.7	33418.8
T3121	Tree	<i>Syzygium grande</i>	50	12	14200.5	33418.7
T3128	Tree	<i>Syzygium grande</i>	80	12	14201.4	33417.5
T3130	Tree	<i>Cinnamomum iners</i>	80	10	14203.1	33415.9
T3129	Tree	<i>Dillenia suffrotica</i>	100	7	14201.3	33415.6
T3053	Tree	<i>Hevea brasiliensis</i>	60	9	14197.0	33412.4
T3131	Tree	<i>Syzygium grande</i>	50	12	14200.5	33410.9
T3078	Tree	<i>Hevea brasiliensis</i>	80	10	14211.6	33413.7
T3125	Tree	<i>Syzygium grande</i>	80	12	14212.9	33413.5
T3115	Tree	<i>Hevea brasiliensis</i>	50	10	14213.9	33413.6
T3126	Tree	<i>Syzygium grande</i>	70	10	14211.5	33412.2
T3127	Tree	<i>Syzygium grande</i>	80	10	14211.3	33410.7
T3117	Tree	<i>Syzygium grande</i>	80	12	14215.7	33411.7
T3078	Tree	<i>Hevea brasiliensis</i>	80	10	14216.0	33413.7
T3077	Tree	<i>Hevea brasiliensis</i>	100	8	14215.5	33418.9
T3079	Tree	<i>Hevea brasiliensis</i>	100	8	14215.4	33418.1
T3074	Tree	<i>Hevea brasiliensis</i>	100	12	14218.3	33411.2
T3116	Tree	<i>Hevea brasiliensis</i>	100	12	14221.8	33415.5
T3075	Tree	<i>Hevea brasiliensis</i>	100	12	14222.4	33414.7
T3073	Tree	<i>Hevea brasiliensis</i>	50	10	14220.6	33410.3
T3072	Tree	<i>Ficus vasculosa</i>⁹	300	8	14223.5	33404.1
T3080	Tree	<i>Hevea brasiliensis</i>	80	10	14216.6	33407.5
T3081	Tree	<i>Hevea brasiliensis</i>	50	8	14216.1	33408.2

⁹ This very large *Ficus vasculosa* was originally incorrectly identified in the arborist report as *Ficus variegata*.

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T3082	Tree	<i>Hevea brasiliensis</i>	50	10	14214.5	33407.6
T3083	Tree	<i>Hevea brasiliensis</i>	60	7	14213.2	33405.7
T3124	Tree	<i>Syzygium grande</i>	50	8	14205.8	33406.7
T3120	Tree	<i>Syzygium grande</i>	100	16	14203.6	33405.1
T3118	Tree	<i>Syzygium grande</i>	60	8	14202.3	33406.2
T3119	Tree	<i>Syzygium grande</i>	60	10	14202.8	33404.9
T3139	Tree	<i>Cinnamomum iners</i>	80	10	14199.6	33407.5
T3138	Tree	<i>Cinnamomum iners</i>	100	10	14200.3	33406.7
T3142	Tree	<i>Syzygium grande</i>	120	8	14199.3	33401.3
T3141	Tree	<i>Dead</i>	120	0	14198.8	33400.6
E1120	Palm	<i>Elaeis guineensis</i>	150	6	14226.3	33365.5
E176	Tree	<i>Syzygium grande</i>	90	12	14219.8	33398.0
E162	Tree	<i>Syzygium polyanthum</i>	90	10	14226.6	33397.7
E171	Tree	<i>Aidia densiflora</i>	130	12	14234.0	33395.4
E185	Tree	<i>Alstonia scholaris</i>	110	15	14234.8	33395.0
E174	Tree	<i>Hevea brasiliensis</i>	60	12	14232.7	33391.4
E175	Tree	<i>Syzygium grande</i>	100	14	14218.5	33393.0
E181	Tree	<i>Syzygium grande</i>	100	16	14235.4	33399.3
E1116	Tree	<i>Syzygium grande</i>	80	12	14220.9	33376.4
E1117	Tree	<i>Hevea brasiliensis</i>	70	12	14226.0	33374.9
E1118	Tree	<i>Hevea brasiliensis</i>	110	14	14229.0	33375.2
E1114	Tree	<i>Hevea brasiliensis</i>	85	10	14217.3	33372.5
E1112	Tree	<i>Hevea brasiliensis</i>	100	9	14213.0	33376.2
E1105	Tree	<i>Hevea brasiliensis</i>	110	12	14213.9	33372.6
E1106	Tree	<i>Hevea brasiliensis</i>	70	10	14215.3	33370.9
E1109	Tree	<i>Hevea brasiliensis</i>	50	10	14216.0	33371.3
E1115	Tree	<i>Hevea brasiliensis</i>	40	8	14215.9	33369.4
E1111	Tree	<i>Hevea brasiliensis</i>	70	8	14218.2	33369.2
E1119	Tree	<i>Hevea brasiliensis</i>	160	14	14227.0	33365.9
E1108	Tree	<i>Hevea brasiliensis</i>	100	10	14210.2	33371.5
E1107	Tree	<i>Hevea brasiliensis</i>	70	9	14211.8	33369.9
E1110	Tree	<i>Hevea brasiliensis</i>	50	10	14218.3	33363.1
T3071	Tree	<i>Syzygium grande</i>	80	10	14225.4	33466.9
T3067	Tree	<i>Syzygium grande</i>	100	12	14222.3	33467.5
E166	Tree	<i>Hevea brasiliensis</i>	30	8	14227.3	33433.3
E168	Tree	<i>Hevea brasiliensis</i>	30	9	14227.4	33432.5
E167	Tree	<i>Hevea brasiliensis</i>	30	10	14226.7	33432.2
E163	Tree	<i>Hevea brasiliensis</i>	40	9	14227.1	33430.7
E165	Tree	<i>Hevea brasiliensis</i>	60	10	14224.9	33427.4
E170	Tree	<i>Hevea brasiliensis</i>	30	8	14226.6	33425.7
E164	Tree	<i>Hevea brasiliensis</i>	30	8	14227.3	33425.1
E161	Tree	<i>Hevea brasiliensis</i>	40	8	14229.2	33426.1
E160	Tree	<i>Hevea brasiliensis</i>	30	8	14229.1	33424.8
E169	Tree	<i>Hevea brasiliensis</i>	40	8	14227.8	33423.8
T3066	Tree	<i>Syzygium grande</i>	100	15	14213.8	33450.9

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T3065	Tree	<i>Syzygium grande</i>	150	15	14213.4	33449.7
T3068	Tree	<i>Syzygium grande</i>	200	15	14222.2	33465.1
T3070	Tree	<i>Syzygium grande</i>	80	12	14221.1	33465.2
T3069	Tree	<i>Syzygium grande</i>	100	12	14229.2	33460.3
T3060	Tree	<i>Syzygium grande</i>	100	12	14230.9	33459.2
E173	Tree	<i>Syzygium polyanthum</i>	80	9	14226.8	33444.5
E124	Tree	<i>Syzygium grande</i>	120	15	14181.0	33389.2
T3084	Tree	<i>Syzygium grande</i>	80	7	14187.4	33389.1
T1262	Tree	<i>Falcataria falcata</i>	220	8	14230.0	33292.7
T1263	Tree	<i>Caryota mitis</i>	30	5	14229.7	33290.2
T1264	Tree	<i>Falcataria falcata</i>	100	8	14228.4	33286.7
88	Tree	<i>Falcataria falcata</i>	80	10	14227.5	33280.5
87	Tree	<i>Hevea brasiliensis</i>	100	12	14218.4	33285.7
89	Tree	<i>Hevea brasiliensis</i>	120	15	14223.1	33291.6
86	Tree	<i>Hevea brasiliensis</i>	100	15	14217.5	33292.4
T1330	Tree	<i>Acacia auriculiformis</i>	100	12	14187.2	33149.0
T1331	Tree	<i>Falcataria falcata</i>	50	10	14190.4	33148.1
T1310	Tree	<i>Acacia auriculiformis</i>	100	12	14198.1	33152.2
T1332	Tree	<i>Spathodea campanulata</i>	60	12	14193.3	33149.4
E9746	Tree	<i>Casuarina equisetifolia</i>	130	17	14205.7	33142.3
E8748	Tree	<i>Casuarina equisetifolia</i>	140	18	14206.2	33140.3
E9750	Tree	<i>Casuarina equisetifolia</i>	120	16	14206.2	33139.6
E10501	Tree	<i>Casuarina equisetifolia</i>	150	18	14205.6	33137.9
E10504	Tree	<i>Casuarina equisetifolia</i>	150	18	14204.4	33134.8
E10507	Tree	<i>Casuarina equisetifolia</i>	160	19	14203.8	33129.4
T1328	Tree	<i>Acacia auriculiformis</i>	50	10	14179.2	33141.9
T1329	Tree	<i>Acacia auriculiformis</i>	50	10	14180.5	33140.4
T1327	Tree	<i>Acacia auriculiformis</i>	80	10	14196.2	33137.1
T1346	Tree	<i>Acacia auriculiformis</i>	50	10	14192.0	33106.0
T1347	Tree	<i>Falcataria falcata</i>	100	10	14188.4	33104.6
T1348	Tree	<i>Samanea saman</i>	200	8	14191.9	33097.9
T1345	Tree	<i>Spathodea campanulata</i>	50	10	14197.2	33100.4
T1342	Tree	<i>Falcataria falcata</i>	30	8	14201.6	33103.7
T1344	Tree	<i>Caryota mitis</i>	30	6	14200.9	33099.7
T1343	Tree	<i>Falcataria falcata</i>	200	12	14202.3	33098.9
T1341	Tree	<i>Falcataria falcata</i>	30	10	14203.1	33102.9
T1340	Tree	<i>Falcataria falcata</i>	50	12	14206.7	33101.0
E10523	Tree	<i>Casuarina equisetifolia</i>	120	17	14204.7	33118.2
E10524	Tree	<i>Casuarina equisetifolia</i>	130	18	14204.1	33114.9
E10525	Tree	<i>Casuarina equisetifolia</i>	160	18	14206.0	33109.1
E10520	Tree	<i>Casuarina equisetifolia</i>	150	18	14205.1	33123.3
T1285	Tree	<i>Falcataria falcata</i>	120	10	14211.8	33202.8
T1286	Tree	<i>Falcataria falcata</i>	50	12	14210.1	33196.1
T1287	Tree	<i>Falcataria falcata</i>	80	14	14206.9	33190.3
E9719	Tree	<i>Casuarina equisetifolia</i>	120	18	14213.2	33189.4

J112 Jurong Hill Baseline Flora Assessment

E9721	Tree	<i>Casuarina equisetifolia</i>	140	18	14212.4	33187.0
E9725	Tree	<i>Casuarina equisetifolia</i>	130	18	14212.4	33184.1
E9729	Tree	<i>Casuarina equisetifolia</i>	150	20	14211.3	33177.6
E9730	Tree	<i>Casuarina equisetifolia</i>	130	18	14211.8	33175.5
E9734	Tree	<i>Casuarina equisetifolia</i>	130	18	14210.2	33169.7
E9741	Tree	<i>Spathodea campanulata</i>	70	13	14202.4	33152.3
T1312	Tree	<i>Spathodea campanulata</i>	50	10	14203.9	33146.7
T1308	Tree	<i>Spathodea campanulata</i>	30	10	14203.1	33155.8
T1309	Tree	<i>Acacia auriculiformis</i>	100	12	14195.7	33162.7
T1305	Tree	<i>Spathodea campanulata</i>	100	14	14204.7	33163.7
T1306	Tree	<i>Spathodea campanulata</i>	100	14	14204.7	33161.5
T1273	Tree	<i>Hevea brasiliensis</i>	80	11	14222.7	33259.0
T1274	Tree	<i>Falcataria falcata</i>	40	8	14221.9	33253.9
T1277	Tree	<i>Hevea brasiliensis</i>	70	12	14220.9	33247.0
T1278	Tree	<i>Hevea brasiliensis</i>	70	12	14214.4	33251.9
E1100	Tree	<i>Hevea brasiliensis</i>	130	15	14206.8	33244.5
E1099	Tree	<i>Hevea brasiliensis</i>	100	15	14205.8	33243.2
E1098	Tree	<i>Hevea brasiliensis</i>	100	15	14204.2	33238.2

Legend

Surveyed Trees

J112 Study Area

Tree Clearing Area



Tree Schedule (North)

0

25

50

Metres

Legend

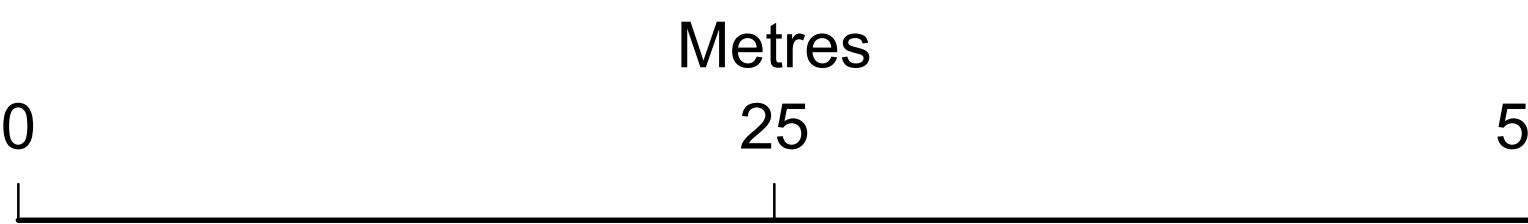
Surveyed Trees

J112 Study Area

Tree Clearing Area



Tree Schedule (South)



APPENDIX II:

Fauna Survey Data

Species Summary of Fauna									
No.	Common Name	Scientific Name	Taxa	Status (NParks)	RDB3	IUCN	Habitat	Camera Trap	Transect
1	Ancyra Blue	Catoprops ancyra	Butterflies	Native	LC	-			✓
2	Asian Glossy Starling	Aplonis panayensis	Aves	Native	LC	LC			✓
3	Asian House Shrew	Suncus murinus	Mammals	Non-Native	-	LC			✓
4	Asian Koel	Eudynamis scolopaceus	Aves	Native	LC	LC			✓
5	Asian Toad	Duttaphrynus melanostictus	Amphibians	Native	LC	LC			✓
6	Asiatic Lesser Yellow Bat	Scotophilus kuhlii	Mammals	-	-	LC			✓
7	Bee-eater sp.	Merops sp.	Aves	Native	LC	LC			✓
8	Black-crowned Night Heron	Nycticorax nycticorax	Aves	Native	EN	LC	Aquatic		✓
9	Black-napped Oriole	Oriolus chinensis	Aves	Native	LC	LC			✓
10	Black-Nest Swiftlet	Aerodramus maximus	Aves	Native	NT	LC			✓
11	Blue-crowned Hanging Parrot	Loriculus galgulus	Aves	Native	LC	LC			✓
12	Blue-throated Bee-eater	Merops viridis	Aves	Native	LC	LC	Woodland		✓
13	Brown Shrike	Lanius cristatus	Aves	Native	VU	LC	Grassland		✓
14	Brown-throated Sunbird	Anthreptes malacensis	Aves	Native	LC	LC			✓
15	Burmese Bush Brown	Mycalesis perseoides	Butterflies	Native	LC	-	Grassland		✓
16	Bush Brown Species	Mycalesis sp.	Butterflies	-	-	-			✓
17	Changeable Hawk-Eagle	Nisetus cirrhatus	Aves	Native	VU	LC	Woodland		✓
18	Changeable Lizard	Calotes versicolor	Reptiles	Native	-	LC			✓
19	Chestnut Bob	Lamprolaima salsola	Butterflies	Native	-	-	Woodland		✓
20	Chocolate Pansy	Junonia hedonia	Butterflies	Native	-	-			✓
21	Collared Kingfisher	Todiramphus chloris	Aves	Native	LC	LC			✓
22	Collared Scops Owl	Otus bakkamoena	Aves	-	-	LC	Woodland		✓
23	Common Flameback	Dinopium javanense	Aves	Native	LC	LC			✓
24	Common Grass Yellow	Eurema hecabe	Butterflies	Native	-	-			✓
25	Common Iora	Aegithina tiphia	Aves	Native	LC	LC			✓
26	Common Palmfly	Elymnias hypermnestra	Butterflies	Native	-	-			✓
27	Common Parasol	Neurothemis fluctuans	Odonates	Native	LC	LC			✓
28	Common Sailor	Neptis hylas	Butterflies	Native	-	-			✓
29	Common Snow Flat	Tagiades jopetus	Butterflies	Native	LC	-			✓
30	Common Tailorbird	Orthotomus sutorius	Aves	Native	LC	LC			✓
31	Common Tree Frog	Polypedates leucomystax	Amphibians	-	-	LC			✓
32	Common Treeshrew	Tupaia glis	Mammals	Native	LC	LC	Woodland	✓	✓
33	Coppersmith Barbet	Megalaima haemacephala	Aves	Native/Introduced	-	-	Grassland		✓
34	Dark Brand Bush Brown	Mycalesis mineus	Butterflies	Native	-	-	Grassland		✓
35	Dark Glassy Tiger	Parantica agleoides	Butterflies	Native	-	-			✓
36	Dark-sided Chorus Frog	Microhyla heymansi	Amphibians	Native	-	LC			✓
37	Dollarbird	Eucystomus orientalis	Aves	Native	LC	LC	Woodland		✓
38	East Asian Ornate Chorus Frog	Microhyla fissipes	Amphibians	-	-	LC			✓
39	Eurasian Sparrow	Passer montanus	Aves	-	LC	LC			✓
40	Field Frog	Feljeryara limncharis	Amphibians	Native	-	LC			✓
41	Germain's Swiftlet	Aerodramus germaini	Aves	Native	LC	LC			✓
42	Gram Blue	Euchrysops cnejus	Butterflies	Native	-	-			✓
43	Greater Coucal	Centropus sinensis	Aves	Native	NT	LC	Woodland	✓	✓
44	Greater Mouse-Eared Bat	Myotis sp.	Mammals	-	-	-			✓
45	Green Iguana	Iguana iguana	Reptiles	Introduced (Established)	-	LC			✓
46	Grenadier	Agrioloptera insignis	Odonates	Native	LC	LC	Woodland		✓
47	Grey Heron	Ardea cinerea	Aves	Native	LC	LC			✓
48	Günther's Frog	Sylvirana guentheri	Amphibians	-	-	LC			✓
49	House Crow	Corvus splendens	Aves	Introduced	NA	LC			✓
50	House Swallow	Hirundo tahitica	Aves	Native	LC	LC			✓
51	Intermediate Egret	Ardea intermedia	Aves	Native	LC	LC			✓
52	Javan Myna	Acridotheres javanicus	Aves	Introduced	NA	VU			✓
53	Julia Heliconian	Dryas julia	Butterflies	Introduced (Established)	-	-			✓
54	Laced Woodpecker	Picus vittatus	Aves	-	LC	LC		✓	✓
55	Large-tailed Nightjar	Caprimulgus macrurus	Aves	Native	LC	LC	Grassland		✓
56	Lesser Dog-faced Fruit Bat	Cynopterus brachyotis	Mammals	Native	LC	LC	Woodland		✓
57	Lesser Grass Blue	Zizina otis	Butterflies	Native	-	-	Grassland		✓
58	Lineated Barbet	Psilopogon lineatus	Aves	Introduced	NA	LC			✓
59	Malaysian Pied Fantail	Rhipidura javanica	Aves	Native	LC	LC			✓
60	Munia species	Lunchura sp.	Aves	-	-	-			✓
61	Olive-backed Sunbird	Cinnyris jugularis	Aves	Native	LC	LC			✓
62	Olive-winged Bulbul	Pycnonotus plumosus	Aves	Native	LC	LC			✓
63	Oriental Honey Buzzard	Pernis ptilorhynchus	Aves	Native	VU	LC	Woodland		✓
64	Oriental Magpie-robin	Copsychus saularis	Aves	Native	VU	LC			✓
65	Painted Jezebel	Delias hyparete	Butterflies	Native	-	-	Woodland		✓
66	Peacock Pansy	Junonia almana	Butterflies	Native	LC	-			✓
67	Philippine Swift	Caloritis philippina	Butterflies	-	-	-			✓
68	Pied Hornbill	Anthracoceros albirostris	Aves	Native	-	LC			✓
69	Pied Imperial Pigeon	Ducula bicolor	Aves	Native/Introduced	DD	LC			✓
70	Pied Triller	Lalage nigra	Aves	-	-	NT			✓
71	Pink-necked Green Pigeon	Trogon veranous	Aves	Native	LC	LC			✓
72	Pin-striped Tit-babbler	Macronus gularis	Aves	Native	LC	LC	Woodland		✓
73	Plantain Squirrel	Callosciurus notatus	Mammals	Native	LC	LC		✓	✓
74	Rat sp.	Rattus sp.	Mammals	-	-	-		✓	✓
75	Red-whiskered Bulbul	Pycnonotus jocosus	Aves	Native	NT	LC			✓
76	Rock Dove	Columba livia	Aves	Introduced	NA	LC			✓
77	Rose-ringed Parakeet	Psittacula krameri	Aves	Introduced (Invasive)	NA	LC			✓
78	Scarlet-backed Flowerpecker	Dicaeum cruentatum	Aves	Native	LC	LC			✓
79	Small Branded Swift	Plelidaps mathias	Butterflies	Native	-	-			✓
80	Southern Jungle Crow	Corvus macrorhynchos	Aves	Native	VU	LC			✓
81	Spine-tufted Skimmer	Orthetrum chrys	Odonates	Native	LC	LC	Aquatic		✓
82	Spiny-tailed Gecko	Hemidactylus frenatus	Reptiles	Native	-	LC			✓
83	Spot-billed Pelican	Pelecanus philippensis	Aves	-	-	NT			✓
84	Spotted Dove	Spilopelia chinensis	Aves	Native	LC	LC			✓
85	Spotted House Gecko	Gekko monarachus	Reptiles	Native	-	LC			✓
86	Sunda Pygmy Woodpecker	Dendrocopos moluccensis	Aves	Native	-	LC	Woodland		✓
87	Swiftlet sp.	Aerodramus	Aves	Native	-	-			✓
88	Variegated Green Skimmer	Orthetrum sabina	Odonates	Native	LC	LC	Aquatic		✓
89	Wandering Glider	Pantala flavescens	Odonates	Native	LC	LC			✓
90	White-barred Duskhawk	Thalysius tillarga	Odonates	Native	LC	LC	Aquatic		✓
91	White-bellied Fish Eagle	Haliaeetus leucogaster	Aves	Native	LC	LC	Aquatic		✓
92	White-breasted Waterhen	Amaurornis phoenicurus	Aves	Native	LC	LC		✓	✓
93	White-throated Kingfisher	Halcyon smyrnensis	Aves	Native	LC	LC			✓
94	Yellow-vented Bulbul	Pycnonotus goiavier	Aves	Native	LC	LC			✓
95	Zebra Dove	Geopelia striata	Aves	Native	LC	LC	Grassland		✓
96	Asian Water Monitor	Varanus salvator	Reptiles	Native	LC	LC		✓	
97	Blue-Winged Pitta	Pitta moluccensis	Aves	Native	LC	LC	Woodland	✓	
98	Dog	Canis lupus familiaris	Mammals	-	-	-		✓	
Note: Excludes opportunistic sialtinas									

Summary of Conservation Significant Species

Diurnal Round 1

Transect	Common Name	Scientific Name	Residential Status	RDB3	IUCN
T1	Oriental Magpie Robin	<i>Copsychus saularis</i>	Native	VU	LC
T2	Changeable Hawk Eagle	<i>Nisaetus limnaeetus</i>	Native	VU	LC
T2	Oriental Magpie Robin	<i>Copsychus saularis</i>	Native	VU	LC
T2	Southern Jungle Crow	<i>Corvus macrorhynchos</i>	Native	VU	LC

Diurnal Round 2

Transect	Common Name	Scientific Name	Residential Status	RDB3	IUCN
T2	Changeable Hawk Eagle	<i>Nisaetus limnaeetus</i>	Native	VU	LC
T2	Common Tailorbird	<i>Orthotomus sutorius</i>	Native	VU	LC
T2	Oriental Honey Buzzard	<i>Pernis ptilorhynchus</i>	Native	VU	LC
T2	Oriental Magpie Robin	<i>Copsychus saularis</i>	Native	VU	LC
T3	Common Tailorbird	<i>Orthotomus sutorius</i>	Native	VU	LC

Diurnal Round 3

Transect	Common Name	Scientific Name	Residential Status	RDB3	IUCN
T2	Changeable Hawk Eagle	<i>Nisaetus limnaeetus</i>	Native	VU	LC
T2	Oriental Magpie Robin	<i>Copsychus saularis</i>	Native	VU	LC
T3	Brown Shrike	<i>Lanius cristatus</i>	Native	VU	LC
T3	Common Tailorbird	<i>Orthotomus sutorius</i>	Native	VU	LC

Nocturnal Round 1

Transect	Common Name	Scientific Name	Residential Status	RDB3	IUCN
T2	Changeable Hawk-Eagle	<i>Nisaetus limnaeetus</i>	Native	VU	LC
T2	Oriental Magpie-robin	<i>Copsychus saularis</i>	Native	VU	LC
T3	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Native	EN	LC

Nocturnal Round 2

Transect	Common Name	Scientific Name	Residential Status	RDB3	IUCN
T2	Changeable Hawk-Eagle	<i>Nisaetus limnaeetus</i>	Native	VU	LC

Nocturnal Round 3

Transect	Common Name	Scientific Name	Residential Status	RDB3	IUCN
T2	Changeable Hawk-Eagle	<i>Nisaetus limnaeetus</i>	Native	VU	LC
T2	Oriental Magpie-robin	<i>Copsychus saularis</i>	Native	VU	LC
T2	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Native	EN	LC

Diurnal Round 1

Mammals

						Abundance of Individual Species			
No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									13/1/2023
1	Plantain Squirrel	<i>Collosciurus notatus</i>	Native	LC	LC		2	2	
Species Richness	1								

Avifauna

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									13/1/2023
1	Asian Koel	<i>Eudynamys scolopacea</i>	Native	LC	LC			1	
2	Black-napped Oriole	<i>Oriolus chinensis</i>	Native	LC	LC	2	4	1	
3	Black-Nest Swiftlet	<i>Aerodramus maximus</i>	Native	NT	LC		4		
4	Blue-crowned Hanging Parrot	<i>Loriculus galgulus</i>	Native	LC	LC		1		
5	Blue-throated Bee-eater	<i>Merops viridis</i>	Native	LC	LC		4		
6	Brown-throated Sunbird	<i>Antheptes malacensis</i>	Native	LC	LC			1	
7	Changeable Hawk Eagle	<i>Nisaetus limnoetus</i>	Native	VU	LC		1		
8	Common Iora	<i>Aegintha tiphia</i>	Native	LC	LC		1		
9	Dollarbird	<i>Eurystomus orientalis</i>	Native	LC	LC		1	1	
10	House Crow	<i>Corvus splendens</i>	Introduced (Invasive)	-	LC	11			
11	Javan Myna	<i>Acridotheres javanicus</i>	Introduced (Invasive)	-	LC	2	3	2	
12	Munia species	<i>Lanchnura sp.</i>	-	-	-	1			
13	Olive-backed Sunbird	<i>Cinnyris jugularis</i>	Introduced	-	LC			1	
14	Olive-winged Bulbul	<i>Pycnonotus plumosus</i>	Native	LC	LC		1		
15	Oriental Magpie Robin	<i>Copsychus saularis</i>	Native	VU	LC	1	2		
16	Pied Hornbill	<i>Anthracceros albirostris</i>	Native	-	LC		1		
17	Pied Imperial Pigeon	<i>Ducula bicolor</i>	Native/Introduced	DD	LC	1	12	2	
18	Pied Triller	<i>Lalage nigra</i>	-	-	NT		1		
19	Pink-necked Green Pigeon	<i>Treron vernans</i>	Native	LC	LC		10	3	
20	Pin-striped Tit-babbler	<i>Macronus gularis</i>	Native	LC	LC		2		
21	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Native	NT	LC		1		
22	Rock Dove	<i>Columba livia</i>	Native	NA	LC		2		
23	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Introduced (Invasive)	NA	LC		1		
24	Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	Native	LC	LC		1		
25	Southern Jungle Crow	<i>Corvus macrorhynchos</i>	Native	VU	LC		2		
26	Spotted Dove	<i>Spilopelia chinensis</i>	Native	LC	LC	2	1		
27	Sunda Pygmy Woodpecker	<i>Dendrocopos moluccensis</i>	Native	-	LC		1		
28	Swiftlet sp.	<i>Aerodramus sp.</i>	Native	-	-	1			
29	White-bellied Fish Eagle	<i>Haliaeetus leucogaster</i>	Native	LC	LC		1		
30	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	Native	LC	LC		4		
31	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	Native	LC	LC	1	4	2	
32	Zebra Dove	<i>Geopelia striata</i>	Native	LC	LC		1		
Species Richness	32								

Herpetofauna (Reptiles and Amphibians)

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									13/1/2023
1	Green Iguana	<i>Iguana iguana</i>	Introduced (Established)	-	LC	1			Road Killed
Species Richness	1								

Butterflies and Hymenoptera

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									13/1/2023
1	Ancyra Blue	<i>Catopyrops ancyra</i>	Native	-	-	1			
2	Bush Brown Species	<i>Mycalesis sp.</i>	-	-	-			2	
3	Chestnut Bob	<i>Lambrix salsala</i>	Native	-	-			1	
4	Chocolate Pansy	<i>Junonia hedonia</i>	Native	-	-	7		2	
5	Common Grass Yellow	<i>Eurema hecabe</i>	Native	-	-	5		4	
6	Common Sailor	<i>Neptis hylas</i>	Native	-	-			2	
7	Dark Brand Bush Brown	<i>Mycalesis mineus</i>	Native	-	-			1	
8	Dark Glassy Tiger	<i>Parantica agleoides</i>	Native	-	-			1	
9	Gram Blue	<i>Euchrysops cnejus</i>	Native	-	-			2	
10	Julia Heliconian	<i>Dryas iulia</i>	Introduced (Established)	-	-			4	
11	Lesser Grass Blue	<i>Zizina otis</i>	Native	-	-	1	2	1	
12	Peacock Pansy	<i>Junonia almana</i>	Native	-	-			2	
13	Small Branded Swift	<i>Pelopidas mathias</i>	Native	-	-	1			
Species Richness	13								

Odonates

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									13/1/2023
1	Spine-tufted Skimmer	<i>Orthetrum chrys</i>	Native	LC	LC			2	
2	Variegated Green Skimmer	<i>Orthetrum sabina</i>	Native	LC	LC			1	
3	Wandering Glider	<i>Pantala flavescens</i>	Native	-	LC		1		
Species Richness	3								

Diurnal Round 2

Mammals

						Abundance of Individual Species			
No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									17/1/2023
1	Common Treeshrew	<i>Tupaia glis</i>	Native	LC	LC		11		
2	Plantain Squirrel	<i>Callosciurus notatus</i>	Native	LC	LC	1	1	1	
Species Richness		2							

Avifauna

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									17/1/2023
1	Asian Koel	<i>Eudynamis scolopacea</i>	Native	LC	LC	1	1	1	
2	Black-napped Oriole	<i>Oriolus chinensis</i>	Native	LC	LC	1	9	1	
3	Black-Nest Swiftlet	<i>Aerodramus maximus</i>	Native	NT	LC				
4	Blue-crowned Hanging Parrot	<i>Loriculus galgulus</i>	Native	LC	LC	1			
5	Blue-throated Bee-eater	<i>Merops viridis</i>	Native	LC	LC		1		
6	Brown-throated Sunbird	<i>Antheptes malacensis</i>	Native	LC	LC		1		
7	Changeable Hawk Eagle	<i>Nisaetus limnaeetus</i>	Native	VU	LC		1		
8	Common Iora	<i>Aegithina tiphia</i>	Native	LC	LC			1	
9	Common Tailorbird	<i>Orthotomus sutorius</i>	Native	VU	LC		1	1	
10	Coppersmith Barbet	<i>Megalaima haemacephala</i>	Native/Introduced	-	-	1			
11	Dollarbird	<i>Eurystomus orientalis</i>	Native	LC	LC				
12	Germain's Swiftlet	<i>Aerodramus germaini</i>	Native	LC	LC			10	
13	Greater Coucal	<i>Centropus sinensis</i>	Native	NT	LC		1		
14	House Crow	<i>Corvus splendens</i>	Introduced (Invasive)	-	LC	1			
15	Javan Myna	<i>Acridotheres javanicus</i>	Introduced (Invasive)	-	LC	2	4	2	
16	Munia species	<i>Lonchura sp.</i>	-	-	-				
17	Olive-backed Sunbird	<i>Cinnyris jugularis</i>	Introduced	-	LC		4		
18	Olive-winged Bulbul	<i>Pycnonotus plumosus</i>	Native	LC	LC				
19	Oriental Honey Buzzard	<i>Pernis ptilorhynchus</i>	Native	VU	LC		1		
20	Oriental Magpie Robin	<i>Copsychus saularis</i>	Native	VU	LC		2		
21	Pied Hornbill	<i>Antheroceros albirostris</i>	Native	-	LC		1		
22	Pied Imperial Pigeon	<i>Ducula bicolor</i>	Native/Introduced	DD	LC		25		
23	Pied Triller	<i>Lalage nigra</i>	-	-	NT				
24	Pink-necked Green Pigeon	<i>Treron vernans</i>	Native	LC	LC	3	8	2	
25	Pin-striped Tit-babbler	<i>Macronus gularis</i>	Native	LC	LC		1		
26	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Native	NT	LC				
27	Rock Dove	<i>Columba livia</i>	Native	NA	LC				
28	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Introduced (Invasive)	NA	LC				
29	Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	Native	LC	LC		2		
30	Southern Jungle Crow	<i>Corvus macrorhynchos</i>	Native	VU	LC				
31	Spotted Dove	<i>Spilopelia chinensis</i>	Native	LC	LC		1		
32	Sunda Pygmy Woodpecker	<i>Dendrocopos moluccensis</i>	Native	-	LC				
33	Swiftlet	<i>Aerodramus</i>	Native	-	-		1		
34	White-bellied Fish Eagle	<i>Haliaeetus leucogaster</i>	Native	LC	LC		3		
35	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	Native	LC	LC		1	1	
36	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	Native	LC	LC	1	6		
37	Zebra Dove	<i>Geopelia striata</i>	Native	LC	LC				
Species Richness		37							

Herpetofauna (Reptiles and Amphibians)

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									17/1/2023
1	Green Iguana	<i>Iguana iguana</i>	Introduced (Established)	-	LC				
Species Richness		1							

Butterflies and Hymenopterans

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									17/1/2023
1	Ancyra Blue	<i>Catopyrops ancyra</i>	Native	-	-				
2	Bush Brown Species	<i>Mycalesis sp.</i>	-	-	-				
3	Chestnut Bob	<i>Lambrix salsala</i>	Native	-	-	1			
4	Chocolate Pansy	<i>Junonia hedonia</i>	Native	-	-			2	
5	Common Grass Yellow	<i>Eurema hecabe</i>	Native	-	-	5		5	
6	Common Palmfly	<i>Elymnias hypermnestra</i>	Native	-	-	1		1	
7	Common Sailor	<i>Neptis hylas</i>	Native	-	-			1	
8	Dark Brand Bush Brown	<i>Mycalesis mineus</i>	Native	-	-			2	
9	Dark Glassy Tiger	<i>Parantica agleioides</i>	Native	-	-				
10	Gram Blue	<i>Euchrysops cnejus</i>	Native	-	-			6	
11	Julia Heliconian	<i>Dryas iulia</i>	Introduced (Established)	-	-			2	
12	Lesser Grass Blue	<i>Zizina otis</i>	Native	-	-	1			
13	Painted Jezebel	<i>Delias hyparete</i>	Native	-	-			1	
14	Peacock Pansy	<i>Junonia almana</i>	Native	-	-			1	
15	Philippine Swift	<i>Caloris philippina</i>	-	-	-			1	
16	Small Branded Swift	<i>Pelopidas mathias</i>	Native	-	-			1	
Species Richness		16							

Odonates

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									17/1/2023
1	Common Parasol	<i>Neurothemis fluctuans</i>	Native	LC	LC	1		3	
2	Grenadier	<i>Agrioptera insignis</i>	Native	LC	LC			1	
3	Spine-tufted Skimmer	<i>Orthetrum chrysis</i>	Native	LC	LC				
4	Variegated Green Skimmer	<i>Orthetrum sabina</i>	Native	LC	LC			1	
5	Wandering Glider	<i>Pantala flavescens</i>	Native	LC	LC	1			
6	White-barred Duskhawk	<i>Tholymis tillarga</i>	Native	LC	LC		3		
Species Richness		6							

Diurnal Round 3

Mammals

						Abundance of Individual Species			
No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									1/2/2023
1	Common Treeshrew	<i>Tupaia glis</i>	Native	LC	LC				
2	Lesser Dog-faced Fruit Bat	<i>Cynopterus brachyotis</i>	Native	LC	VU				
3	Plantain Squirrel	<i>Callosciurus notatus</i>	Native	LC	LC		2		
Species Richness		3							

Avifauna

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									1/2/2023
1	Asian Glossy Starling		Native	LC	LC			1	
2	Asian Koel	<i>Eudynamys scolopacea</i>	Native	LC	LC		2		
2	Bee-eater sp.	<i>Merops sp.</i>	Native	LC	LC		20		
3	Black-napped Oriole	<i>Oriolus chinensis</i>	Native	LC	LC	2	6	4	
4	Black-Nest Swiftlet	<i>Aerodramus maximus</i>	Native	NT	LC				
5	Blue-crowned Hanging Parrot	<i>Loriculus galgulus</i>	Native	LC	LC				
6	Blue-throated Bee-eater	<i>Merops viridis</i>	Native	LC	LC		2	1	
7	Brown Shrike	<i>Lanius cristatus</i>	Native	VU	LC			1	
8	Brown-throated Sunbird	<i>Antheptes malacensis</i>	Native	LC	LC				
9	Changeable Hawk Eagle	<i>Nisaetus limnoeetus</i>	Native	VU	LC		1		
10	Collared Scops Owl	<i>Otus bakkamoena</i>	-	-	LC		2		
11	Common Flameback	<i>Dinopium javanense</i>	-	-	LC			1	
12	Common Iora	<i>Aegithina tiphia</i>	Native	LC	LC				
13	Common Tailorbird	<i>Orthotomus sutorius</i>	Native	VU	LC			1	
14	Coppersmith Barbet	<i>Megalaima haemacephala</i>	Native/Introduced	-	-				
15	Dollarbird	<i>Eurystomus orientalis</i>	Native	LC	LC		1		
16	Germain's Swiftlet	<i>Aerodramus germaini</i>	Native	LC	LC		5		
17	Greater Coucal	<i>Centropus sinensis</i>	Native	NT	LC				
18	House Crow	<i>Corvus splendens</i>	Introduced (Invasive)	-	LC		1		
19	House Swallow	<i>Hirundo tahitica</i>	Native	LC	LC		2		
20	Intermediate Egret	<i>Ardea intermedia</i>	Native	LC	LC		1		
21	Javan Myna	<i>Acridotheres javanicus</i>	Introduced (Invasive)	-	LC	2	5	2	
22	Large-tailed Nightjar	<i>Caprimulgus macrurus</i>	Native	LC	LC	1			
23	Munia species	<i>Lonchura sp.</i>	-	-	-				
24	Olive-backed Sunbird	<i>Cinnyris jugularis</i>	Introduced	-	LC	2	3	1	
25	Olive-winged Bulbul	<i>Pycnonotus plumosus</i>	Native	LC	LC				
26	Oriental Honey Buzzard	<i>Pernis ptilorhynchus</i>	Native	VU	LC				
27	Oriental Magpie Robin	<i>Copsychus saularis</i>	Native	VU	LC		1		
28	Pied Hornbill	<i>Anthraceroceros albirostris</i>	Native	-	LC		1		
29	Pied Imperial Pigeon	<i>Ducula bicolor</i>	Native/Introduced	DD	LC		11	2	
30	Pied Triller	<i>Lalage nigra</i>	-	-	NT				
31	Pink-necked Green Pigeon	<i>Treron vernans</i>	Native	LC	LC	2	6	1	
32	Pin-striped Tit-babbler	<i>Macronus gularis</i>	Native	LC	LC		2		
33	Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>	Native	NT	LC				
34	Rock Dove	<i>Columba livia</i>	Native	NA	LC			1	
35	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Introduced (Invasive)	NA	LC				
36	Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	Native	LC	LC	2	2		
37	Southern Jungle Crow	<i>Corvus macrorhynchos</i>	Native	VU	LC				
38	Spotted Dove	<i>Spilopelia chinensis</i>	Native	LC	LC				
39	Sunda Pygmy Woodpecker	<i>Dendrocopos moluccensis</i>	Native	-	LC		1		
40	Swiftlet sp.	<i>Aerodramus</i>	Native	-	-		9	13	
41	White-bellied Fish Eagle	<i>Haliaeetus leucogaster</i>	Native	LC	LC		2		
42	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Native	LC	LC			1	
43	White-throated Kingfisher	<i>Halcyon smyrnensis</i>	Native	LC	LC		1	1	
44	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	Native	LC	LC	4	7		
45	Zebra Dove	<i>Geopelia striata</i>	Native	LC	LC			3	
Species Richness		45							

Herpetofauna (Reptiles and Amphibians)

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									1/2/2023
1	Günther's Frog	<i>Sylvirana guentheri</i>	-	-	-	1		1	
2	Green Iguana	<i>Iguana iguana</i>	Introduced (Established)	-	LC				
Species Richness		2							

Butterflies and Hymenopterans

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									1/2/2023
1	Ancylus Blue	<i>Catopyrops ancylus</i>	Native	-	-				
2	Burmese Bush Brown	<i>Mycalis perseoides</i>	Native	-	-			1	
3	Bush Brown Species	<i>Mycalis sp.</i>	-	-	-				
4	Chestnut Bob	<i>Lambrix salsala</i>	Native	-	-				
5	Chocolate Pansy	<i>Junonia hedonia</i>	Native	-	-			3	
6	Common Grass Yellow	<i>Eurema hecabe</i>	Native	-	-			5	
7	Common Palmfly	<i>Elymnias hypermnestra</i>	Native	-	-			2	
8	Common Sailor	<i>Neptis hylas</i>	Native	-	-			2	
9	Common Snow Flat	<i>Tagiades jopetus</i>	Native	-	-			1	
10	Dark Brand Bush Brown	<i>Mycalis mineus</i>	Native	-	-			1	
11	Dark Glassy Tiger	<i>Parantica ogleoides</i>	Native	-	-				
12	Gram Blue	<i>Euchrysops cnejus</i>	Native	-	-			2	
13	Julia Heliconian	<i>Dryas iulia</i>	Introduced (Established)	-	-			7	
14	Lesser Grass Blue	<i>Zizina otis</i>	Native	-	-				
15	Painted Jezebel	<i>Delias hyparete</i>	Native	-	-				
16	Peacock Pansy	<i>Junonia almana</i>	Native	-	-			2	
17	Philippine Swift	<i>Caltois philippina</i>	-	-	-				
18	Small Branded Swift	<i>Pelopidas mathias</i>	Native	-	-				
Species Richness		18							

Odonates

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date									1/2/2023
1	Common Parasol	<i>Neurothemis fluctuans</i>	Native	LC	LC			2	
2	Grenadier	<i>Agrioptera insignis</i>	Native	LC	LC				
3	Spine-tufted Skimmer	<i>Orthetrum chrys</i>	Native	LC	LC				
4	Variegated Green Skimmer	<i>Orthetrum sabina</i>	Native	LC	LC			2	
5	Wandering Glider	<i>Pantala flavescens</i>	Native	LC	LC				
6	White-barred Duskhawk	<i>Tholymis tillarga</i>	Native	LC	LC				
Species Richness		6							

Nocturnal Round 1

Mammals

Abundance of Individual Species

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date						1/2/2023			
1	Greater Mouse-Eared Bat	<i>Cynopterus brachyotis</i>	Native	LC	LC	3	2	1	
2	Lesser Dog-faced Fruit Bat	<i>Myotis</i> sp.	-	-	-		1		
3	Plantain Squirrel	<i>Callosciurus notatus</i>	Native	LC	LC		1		
Species Richness		3							

Avifauna

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date						1/2/2023			
1	Asian Glossy Starling	<i>Aplonis panayensis</i>	Native	LC	LC	4			
2	Asian Koel	<i>Eudynamis scolopaceus</i>	Native	LC	LC		1		
3	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Native	EN	LC			1	
4	Black-naped Oriole	<i>Oriolus chinensis</i>	Native	LC	LC		3		
5	Changeable Hawk-Eagle	<i>Nisaetus limnaeetus</i>	Native	VU	LC		2		
6	Collared Kingfisher	<i>Todiramphus chloris</i>	Native	LC	LC			1	
7	Common Flameback	<i>Dinopium javanense</i>	Native	LC	LC		1		
8	Common Iora	<i>Aegithina tiphia</i>	Native	LC	LC	2			
9	Common Tailorbird	<i>Orthotomus sutorius</i>	Native	LC	LC	1			
10	Eurasian Sparrow	<i>Passer montanus</i>		LC	LC	1			
11	Grey Heron	<i>Ardea cinerea</i>	Native	LC	LC		1		
12	House Crow	<i>Corvus splendens</i>	Introduced	NA	LC	1	4		
13	Javan Myna	<i>Acridotheres javanicus</i>	Introduced	NA	VU	2	11		
14	Large-tailed Nightjar	<i>Caprimulgus macrurus</i>	Native	LC	LC		2	3	
15	Lineated Barbet	<i>Psilopogon lineatus</i>	Introduced	NA	LC		1		
16	Malaysian Pied Fantail	<i>Rhipidura javanica</i>	Native	LC	LC		1		
17	Olive-backed Sunbird	<i>Cinnyris jugularis</i>	Native	LC	LC	2	3		
18	Oriental Magpie-robin	<i>Copsychus saularis</i>	Native	VU	LC		3		
19	Pied Imperial Pigeon	<i>Ducula bicolor</i>	Native + Introduced	DD	LC	4			
20	Pink-necked Green Pigeon	<i>Treron vernans</i>	Native	LC	LC	1			
21	Rock Dove	<i>Columba livia</i>	Introduced	NA	LC		3		
22	Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	Native	LC	LC		2		
23	Spot-billed Pelican	<i>Pelecanus philippensis</i>	-	-	NT	3			
24	Spotted Dove	<i>Spilopelia chinensis</i>	Native	LC	LC		1		
25	Swiftlet sp.	<i>Aerodramus</i> sp.	-	-	LC		2		
26	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Native	LC	LC			1	
27	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	Native	LC	LC	4	1	1	
Species Richness		27							

Herpetofauna (Reptiles and Amphibians)

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date						1/2/2023			
1	Asian Toad	<i>Duttaphrynus melanostictus</i>	Native	LC	LC		2		
2	Changeable Lizard	<i>Calotes versicolor</i>	Native	-	LC	1	1		
3	Common Tree Frog	<i>Polypedates leucomystax</i>	-	-	LC		3		
4	Dark-sided Chorus Frog	<i>Microhyla heymansi</i>	Native	-	LC	8	15	28	
5	East Asian Ornate Chorus Frog	<i>Microhyla fissipes</i>	-	-	LC	6	11	33	
6	Field Frog	<i>Fejervarya limnocharis</i>	Native	-	LC	1			
7	Günther's Frog	<i>Sylvirana guentheri</i>	-	-	LC	1	3		
8	Spiny-tailed Gecko	<i>Hemidactylus frenatus</i>	Native	-	LC	11	3	2	
9	Spotted House Gecko	<i>Gekko monarchus</i>	Native	-	LC	1			
Species Richness		9							

Nocturnal Round 2

Mammals

Abundance of Individual Species

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date						7/2/2023			
1	Greater Mouse-Eared Bat	<i>Myotis</i> sp.	-	-	-				
2	Lesser Dog-faced Fruit Bat	<i>Cynopterus brachyotis</i>	Native	LC	LC		5		
3	Plantain Squirrel	<i>Callosciurus notatus</i>	Native	LC	LC				
Species Richness		3							

Avifauna

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date						7/2/2023			
1	Asian Glossy Starling	<i>Aplonis panayensis</i>	Native	LC	LC		9		
2	Asian Koel	<i>Eudynamys scolopaceus</i>	Native	LC	LC		2		
3	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Native	EN	LC				
4	Black-naped Oriole	<i>Oriolus chinensis</i>	Native	LC	LC		1		
5	Changeable Hawk-Eagle	<i>Nisaetus limnaeetus</i>	Native	VU	LC		1		
6	Collared Kingfisher	<i>Todiramphus chloris</i>	Native	LC	LC		3		
7	Common Flameback	<i>Dinopium javanense</i>	Native	LC	LC				
8	Common Iora	<i>Aegithina tiphia</i>	Native	LC	LC				
9	Common Tailorbird	<i>Orthotomus sutorius</i>	Native	LC	LC				
10	Eurasian Sparrow	<i>Passer montanus</i>		LC	LC		1		
11	Grey Heron	<i>Ardea cinerea</i>	Native	LC	LC				
12	House Crow	<i>Corvus splendens</i>	Introduced	NA	LC			1	
13	Javan Myna	<i>Acridotheres javanicus</i>	Introduced	NA	VU		4	2	
14	Laced Woodpecker	<i>Picus vittatus</i>		LC	LC		1		
15	Large-tailed Nightjar	<i>Caprimulgus macrurus</i>	Native	LC	LC		8	3	
16	Lineated Barbet	<i>Psilopogon lineatus</i>	Introduced	NA	LC		2		
17	Malaysian Pied Fantail	<i>Rhipidura javanica</i>	Native	LC	LC				
18	Olive-backed Sunbird	<i>Cinnyris jugularis</i>	Native	LC	LC		1		
19	Oriental Magpie-robin	<i>Copsychus saularis</i>	Native	VU	LC				
20	Pied Imperial Pigeon	<i>Ducula bicolor</i>	Native + Introduced	DD	LC		2		
21	Pink-necked Green Pigeon	<i>Treron vernans</i>	Native	LC	LC		1		
22	Rock Dove	<i>Columba livia</i>	Introduced	NA	LC		2		
23	Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	Native	LC	LC		1		
24	Spot-billed Pelican	<i>Pelecanus philippensis</i>		-	NT				
25	Spotted Dove	<i>Spilopelia chinensis</i>	Native	LC	LC				
26	Swiftlet sp.	<i>Aerodramus</i> sp.		-	LC		4		
27	White-breasted Waterhen	<i>Amurornis phoenicurus</i>	Native	LC	LC			2	
28	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	Native	LC	LC		5		
Species Richness		28							

Herpetofauna (Reptiles and Amphibians)

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date						7/2/2023			
1	Asian Toad	<i>Duttaphrynus melanostictus</i>	Native	LC	LC		1		
2	Changeable Lizard	<i>Calotes versicolor</i>	Native	-	LC		3		
3	Common Tree Frog	<i>Polypedates leucomystax</i>		-	LC		5		
4	Common Tree Frog	<i>Polypedates leucomystax</i>		-	LC		9	16	
5	Dark-sided Chorus Frog	<i>Microhyla heymonsi</i>	Native	-	LC		5	24	
6	East Asian Ornate Chorus Frog	<i>Microhyla fissipes</i>		-	LC		1		
7	Field Frog	<i>Fejervarya limnocharis</i>	Native	-	LC		2		
8	Günther's Frog	<i>Sylvirana guentheri</i>		-	LC		8	2	
9	Spiny-tailed Gecko	<i>Hemidactylus frenatus</i>	Native	-	LC		21	3	
10	Spotted House Gecko	<i>Gekko monarchus</i>	Native	-	LC		2		
Species Richness		10							

Nocturnal Round 3

Mammals						Abundance of Individual Species			
No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date						13/2/2023			
1	Asian House Shrew	<i>Suncus murinus</i>	Non-Native	-	LC			1	
2	Asiatic Lesser Yellow Bat	<i>Scotophilus kuhlii</i>	-	-	LC		1		
3	Greater Mouse-Eared Bat	<i>Myotis</i> sp.	-	-	-		1		
4	Lesser Dog-faced Fruit Bat	<i>Cynopterus brachyotis</i>	Native	LC	LC		3	4	
5	Plantain Squirrel	<i>Callosciurus notatus</i>	Native	LC	LC			2	
6	Rat sp.	<i>Rattus</i> sp.	-	-	-			1	
Species Richness		6							

Avifauna

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date						13/2/2023			
1	Asian Glossy Starling	<i>Aplonis panayensis</i>	Native	LC	LC		6		
2	Asian Koel	<i>Eudynamis scolopaceus</i>	Native	LC	LC		1	1	
3	Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Native	EN	LC			1	
4	Black-naped Oriole	<i>Oriolus chinensis</i>	Native	LC	LC		2		
5	Changeable Hawk-Eagle	<i>Nisaetus limnaeetus</i>	Native	VU	LC		2		
6	Collared Kingfisher	<i>Todiramphus chloris</i>	Native	LC	LC		1	2	
7	Common Flameback	<i>Dinopium javaense</i>	Native	LC	LC		2		
8	Common Iora	<i>Aegithina tiphia</i>	Native	LC	LC		1		
9	Common Tailorbird	<i>Orthotomus sutorius</i>	Native	LC	LC		2		
10	Eurasian Sparrow	<i>Passer montanus</i>	-	LC	LC		2		
11	Grey Heron	<i>Ardea cinerea</i>	Native	LC	LC				
12	House Crow	<i>Corvus splendens</i>	Introduced	NA	LC		2		
13	Javan Myna	<i>Acridotheres javanicus</i>	Introduced	NA	VU		8	1	
14	Laced Woodpecker	<i>Picus vittatus</i>	-	LC	LC				
15	Large-tailed Nightjar	<i>Caprimulgus macrurus</i>	Native	LC	LC		5	7	
16	Lineated Barbet	<i>Psilopogon lineatus</i>	Introduced	NA	LC				
17	Malaysian Pied Fantail	<i>Rhipidura javanica</i>	Native	LC	LC				
18	Olive-backed Sunbird	<i>Cinnyris jugularis</i>	Native	LC	LC		2		
19	Oriental Magpie-robin	<i>Copsychus saularis</i>	Native	VU	LC		2		
20	Pied Imperial Pigeon	<i>Ducula bicolor</i>	Native + Introduced	DD	LC				
21	Pink-necked Green Pigeon	<i>Treron vernans</i>	Native	LC	LC		2	1	
22	Rock Dove	<i>Columba livia</i>	Introduced	NA	LC		4		
23	Scarlet-backed Flowerpecker	<i>Dicaeum cruentatum</i>	Native	LC	LC		1		
24	Spot-billed Pelican	<i>Pelecanus philippensis</i>	-	-	NT			1	
25	Spotted Dove	<i>Spilopelia chinensis</i>	Native	LC	LC		2		
26	Swiftlet sp.	<i>Aerodramus</i> sp.	-	-	LC				
27	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	Native	LC	LC			1	
28	Yellow-vented Bulbul	<i>Pycnonotus goiavier</i>	Native	LC	LC		4		
Species Richness		28							

Herpetofauna (Reptiles and Amphibians)

No.	Common Name	Scientific Name	Residential Status	RDB3	IUCN	T1	T2	T3	Observation Notes
Date						13/2/2023			
1	Asian Toad	<i>Duttaphrynus melanostictus</i>	Native	LC	LC		2		
2	Changeable Lizard	<i>Calotes versicolor</i>	Native	-	LC		1		
3	Common Tree Frog	<i>Polypedates leucomystax</i>	-	-	LC		7		
4	Dark-sided Chorus Frog	<i>Microhyla heymonsi</i>	Native	-	LC		3	18	
5	East Asian Ornate Chorus Frog	<i>Microhyla fissipes</i>	-	-	LC			3	
6	Field Frog	<i>Fejervarya limnocharis</i>	Native	-	LC				
8	Günther's Frog	<i>Sylvirana guentheri</i>	-	-	LC		5		
9	Spiny-tailed Gecko	<i>Hemidactylus frenatus</i>	Native	-	LC		14	5	
10	Spotted House Gecko	<i>Gekko monarchus</i>	Native	-	LC				
Species Richness		10							

Summary of Camera Trap Data

No.	Common Name	Scientific Name	RDB3	IUCN
1	Asian Water Monitor	<i>Varanus salvator</i>	LC	LC
2	Plantain Squirrel	<i>Callosciurus notatus</i>	LC	LC
3	Rat	<i>Rattus sp.</i>	-	-
4	Blue-Winged Pitta	<i>Pitta moluccensis</i>	LC	LC
5	Dog	<i>Canis lupus familiaris</i>	-	-
6	Common Treeshrew	<i>Tupaia glis</i>	LC	LC
7	White-breasted Waterhen	<i>Amaurornis phoenicurus</i>	LC	LC
8	Laced Woodpecker	<i>Picus vittatus</i>	LC	LC
9	Greater Coucal	<i>Centropus sinensis</i>	LC	NT

Summary of Species for Respective Camera Trap

Camera Trap	CT1	CT2	CT3	CT4
Species Count				
1	Plantain Squirrel		Asian Water Monitor	Dog
2	Rat		Plantain Squirrel	
3	Common Treeshrew		Rat	
4	White-breasted Waterhen		Blue-Winged Pitta	
5	Laced Woodpecker			
6	Greater Coucal			

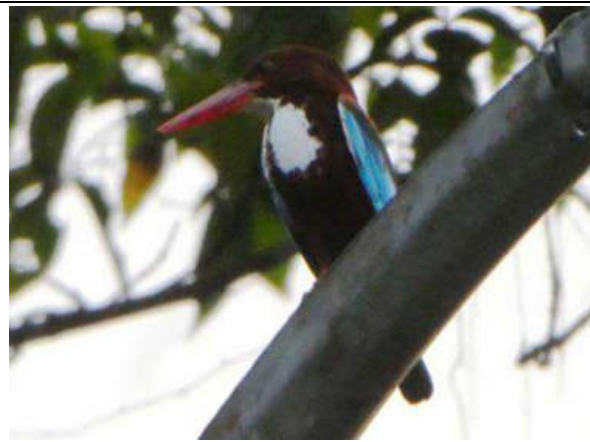
Photos of Fauna Species Spotted on 13th January 2023



Changeable Hawk Eagle



Oriental Pied Hornbill



White-throated Kingfisher



Pink-necked Green Pigeon



Oriental Magpie Robin



Blue-throated Bee-eater



Yellow-vented Bulbul



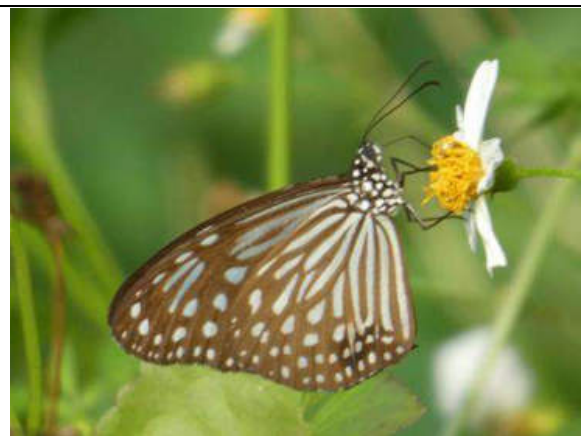
Pied Imperial Pigeon



Common Grass Yellow



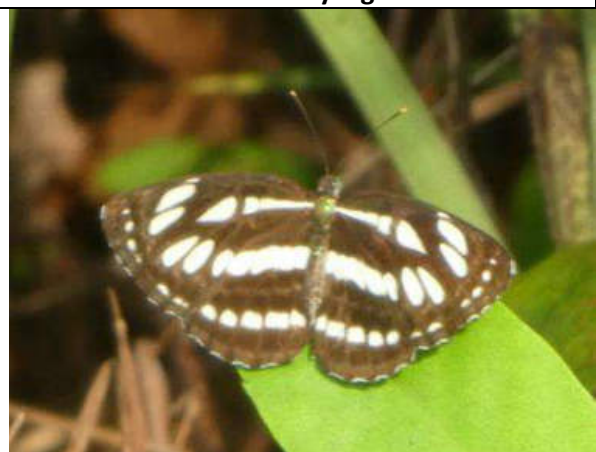
Julia Heliconian



Dark Glassy Tiger



Gram Blue



Common Sailor



Peacock Pansy



Variegated Green Skimmer



Spine-tufted Skimmer



Green Iguana (Road Kill)

Photos of Fauna Species Spotted on 17th January 2023



Changeable Hawk Eagle



Blue-throated Bee-eater



Black-napped Oriole



Southern Jungle Crow



Spotted Dove



Pink-necked green pigeon



Pied Imperial Pigeon



Gram Blue



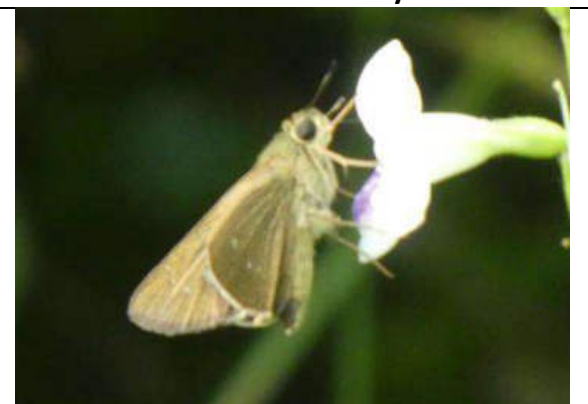
Julia Heliconian



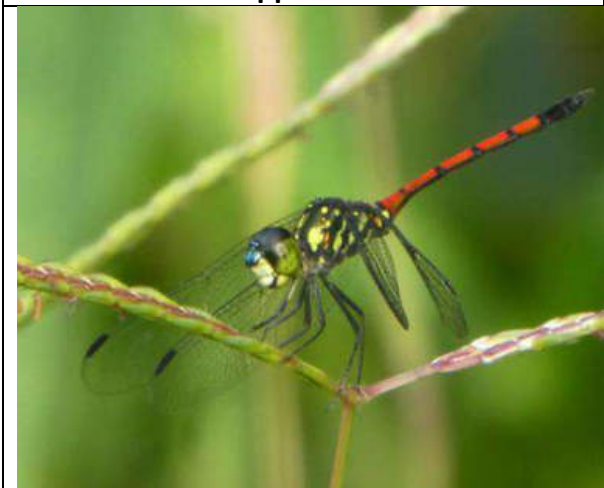
Common Palmfly



Philippine Swift



Small Branded Swift



Grenadier



Common Parasol



Variegated Green Skimmer



Plantain Squirrel

Photos of Fauna Species Spotted on 1st February 2023



Yellow-vented Bulbul



Sunda Pygmy Woodpecker



Pink-necked Green Pigeon



Blue-throated Bee-eater



Variegated Green Skimmer



Julia Heliconian



Peacock Pansy



Gram Blue



Common Palmfly



Common Snow Flat



Chocolate Pansy



Burmese Bush Brown



Dark Brand Bush Brown

