

Specialist Consultancy Services for Environmental Impact Assessment (EIA) at Chencharu (Site 1)

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Final EIA Report



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Acronyms and Abbreviations

>	Greater than
≤	Less than or equal to
≥	Greater than or equal to
APHA	American Public Health Association
BIA	Biodiversity Impact Assessment
BOD	Biological Oxygen Demand
BS	British Standards
COD	Chemical Oxygen Demand
COP	Code of Practice
CS	Conservation Significance
dB	decibels
DEM	Digital Elevation Model
DIV	Dutch Intervention Values
DO	Dissolved Oxygen
e.g.	exempli gratia
EIA	Environmental Impact Assessment
EPHA	Environmental Public Health Act
EPMA	Environmental Protection and Management Act
ES	Environmental Score
ESA	Environmental Site Assessment
ESRI	Environmental Systems Research Institute
GLS	Government Land Sales
GPS	Global Positioning System
ha	Hectare
HDB	Housing & Development Board
HK EPD	Hong Kong Environmental Protection Department
i.e.	id est
INLIS	Integrated Land Information Service
IUCN	International Union for Conservation of Nature
km	kilometer

LTA	Land Transport Authority
m	meter
MND	Ministry of National Development
MRT	Mass Rapid Transit system
NAS	National Archives of Singapore
NEA	National Environment Agency
NSC	North-South Corridor
NParks	National Parks Board
NSR	Noise Sensitive Receiver
NTU	Nephelometric Turbidity Unit
NUS	National University of Singapore
PUB	Public Utilities Board
QGIS	Quantum Geographic Information System
RIAM	Rapid Impact Assessment Matrix
SGBA	Singapore Biodiversity Accounting Tool
SLA	Singapore Land Authority
SRDB3	Singapore Red Data Book
TDS	Total Dissolved Solids
TN	Total Nitrogen
TOC	Total Organic Carbon
TP	Total Phosphorous
TSS	Total Suspended Solids
URA	Urban Redevelopment Authority
PRO	Public Relation Officer
PME	Power Mechanical Equipment

1. Introduction

1.1 Overview

The National Parks Board (NParks) has appointed Jacobs (under the contracting entity of CH2M Hill Singapore Pte Ltd) on behalf of the Housing & Development Board (HDB) on 29 July 2024 to conduct Specialist Consultancy Services for an Environmental Impact Assessment (EIA) at Yishun ("hereinafter referred as "the EIA Study").

This Report for Site 1 has been prepared as one of the deliverables of the EIA Study for the proposed upcoming public housing developments at Chencharu in Yishun (referred to as the "Project"). The area of these proposed developments (hereinafter referred to as the "Subject Site") is bounded by Sembawang Road, Yishun Avenue 1 / 2, Yishun Walk, and ongoing construction works for the first phase of public housing developments in Chencharu and spans an approximate area of thirty-three hectares (33 ha), as shown in **Figure 1-1**. Site 1 consists of a vegetated patch with an approximate area of seven hectares (7 ha) along Yishun Avenue 1. The EIA Study also contains a separate Report for Site 2, which consists of an earth drain of approximately 869 meters (m) long and 18 m wide, that ran from Sembawang Road to Yishun Avenue 2, which is planned to undergo diversion and improvement works to minimise flood risk. The Report for Site 2 was published on 15 January 2025 and opened for public feedback until 11 February 2025, and stakeholder feedback has been incorporated into the mitigation measures. The approved Report for Site 2 and HDB's response to stakeholder feedback can be viewed on HDB InfoWEB.

The Developing Agency for the proposed developments at Chencharu is HDB, while NParks is the Agency managing the conduct of the EIA.

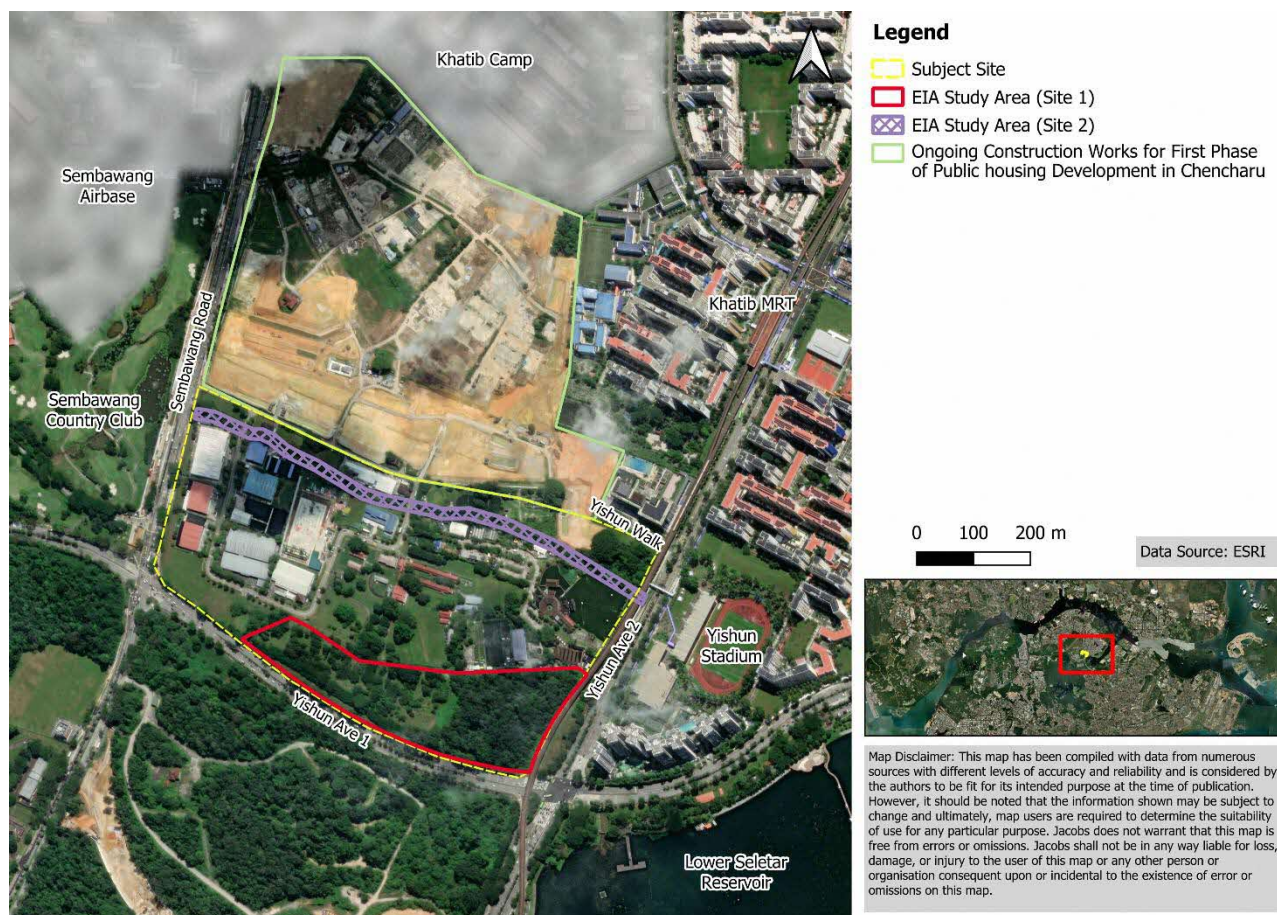


Figure 1-1: Overview of EIA Study Area for Site 1 and Subject Site Boundary

1.2 EIA Requirement for the Project

An EIA has been commissioned to assess the environmental impact of the construction and operational phases of the Project's proposed works at Site 1. The results of the EIA aim to guide decision making for the following:

- Any environmental impact on Site 1 that are likely to arise from the Project.
- The conditions and requirements for the Project's proposed works at Site 1 to mitigate the anticipated environmental impact, wherever practicable.
- Residual environmental impact after the proposed mitigation measures is implemented.

1.3 Report Objectives

The objectives of this report are to:

- Identify and describe the elements of the community and environment likely to be affected by the Project and/or likely to cause impact to the Project, including both the natural and man-made environment and the associated environmental constraints to and by the Project.
- Identify, quantify, and assess the potential impact and determine the significance of these impact areas on sensitive receptors in the vicinity of Site 1.
- Propose and justify effective mitigation measures (if any) to minimise the environmental impact (e.g. pollution, environmental disturbance) during the construction and operational phases of the Project.
- Identify, predict, and evaluate the residual environmental impact (i.e., after practicable mitigation) expected to arise during the development of the Project in relation to the sensitive receptors.
- Investigate the extent of the secondary environmental impact that may arise from the proposed mitigation measures and identify constraints associated with the mitigation measures (if any) recommended in the EIA, as well as the provision of any necessary modifications.

1.4 Applicable Environmental Legislation, Regulations, and Guidelines

The EIA will adopt and refer to applicable standards and references that are relevant to the Project, the establishment of baseline conditions, environmental impact assessment, and mitigation measures, as follows:

- Singapore's laws, acts, rules, and regulations listed in **Appendix 1A**.
- Other relevant Codes of Practice and Guidelines listed in **Appendix 1A**.

1.5 Limitations

In preparing this Report, we have utilised information related to the development provided by the client and third parties. The findings and conclusions outlined in this Report are compiled on a best-effort basis and are based on the data and information available at the time of writing.

Regarding the fauna surveys, it is important to note that the surveys may not have recorded all species present within Site 1 due to various factors, such as the limited duration of the study, activity patterns of fauna, weather conditions, seasonal variations, and other environmental considerations. To address this limitation, species identified through literature reviews were also taken into consideration for the baseline and impact assessment. These surveys were conducted by experienced field biologists with extensive knowledge of local fauna.

The assessment outlined in this Report reflects an approximation of the environmental conditions within the Study Area at the time of reporting based on available literature, expert observations, and professional judgement.

This Report has been prepared for the sole use of HDB and NParks and is not intended for distribution, disclosure, or reliance by any third party without prior written consent. Such consent may be granted or withheld at our discretion.

2. Project Description

2.1 Project Location

Site 1 consists of a vegetated area of approximately 7 ha located within the Subject Site, bounded by Yishun Avenue 2 to the east, Yishun Avenue 1 to the south, existing ornamental fish farms and temporary worksites to the west, Yishun Walk and ongoing construction works for earlier phases of public housing developments in Chencharu to the north (**Figure 2-1**). ORTO Leisure Park and SingHealth's National Large Animal Research Facility once occupied the eastern and central portions of the Subject Site respectively but has since vacated in 2024. Ground-Up Initiative and the Live Turtle and Tortoise Museum, which occupies a small part of the northern portion, has relocated to a nearby location north of the Subject Site. The southern portion of the Subject Site and majority of the EIA Study Area is currently occupied by NParks' tree bank for landscaping works.

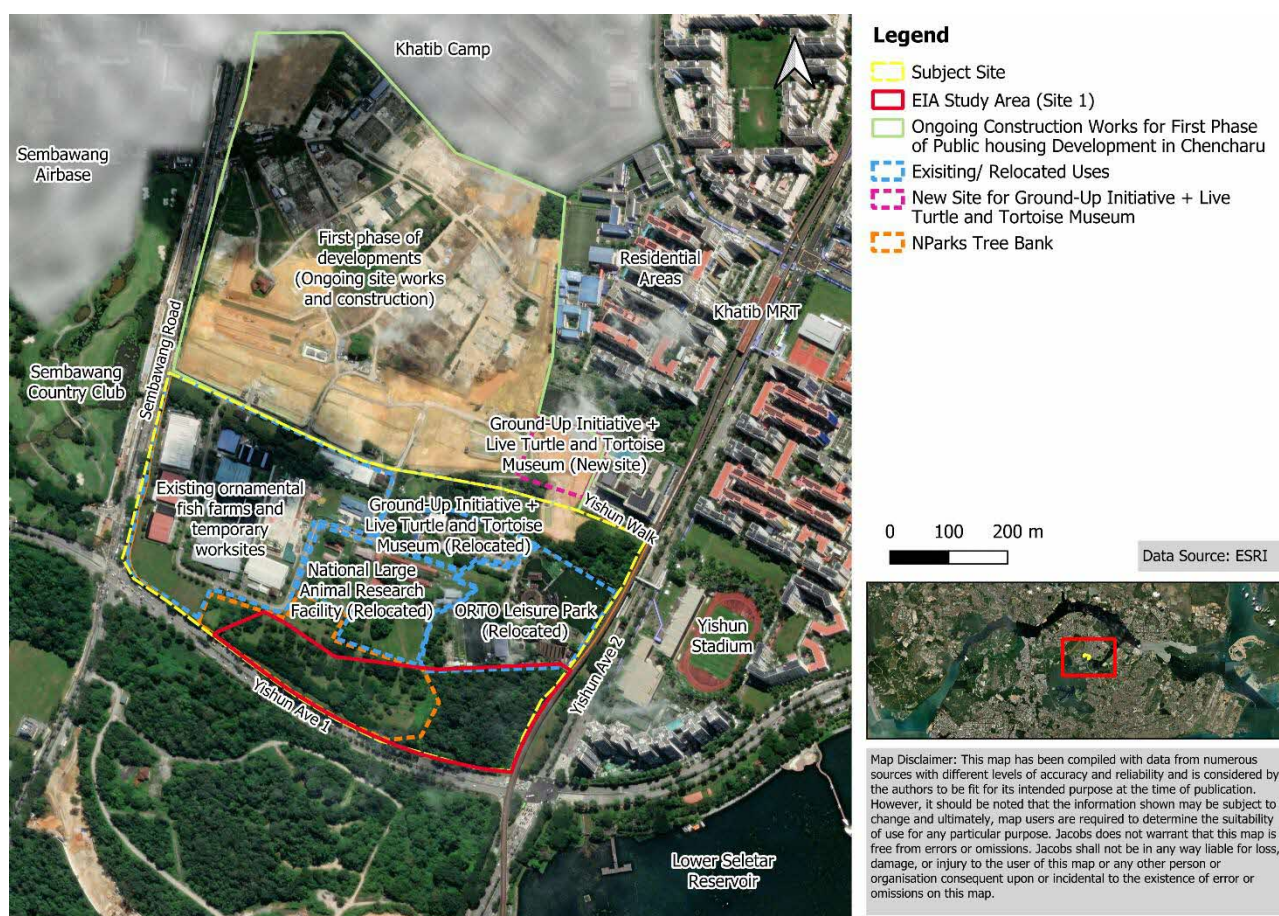


Figure 2-1: Project Location and Land Uses

2.2 Land Use Intent

The land use within the Subject Site is predominantly zoned "Residential (Subject to Detailed Planning)" in URA's gazetted Master Plan 2025 (**Figure 2-2**). This area has also been announced in 2024 for housing developments and accompanying amenities as part of the larger Chencharu housing area within Yishun Town, given its proximity to Khatib MRT and the existing town fabric of Yishun.

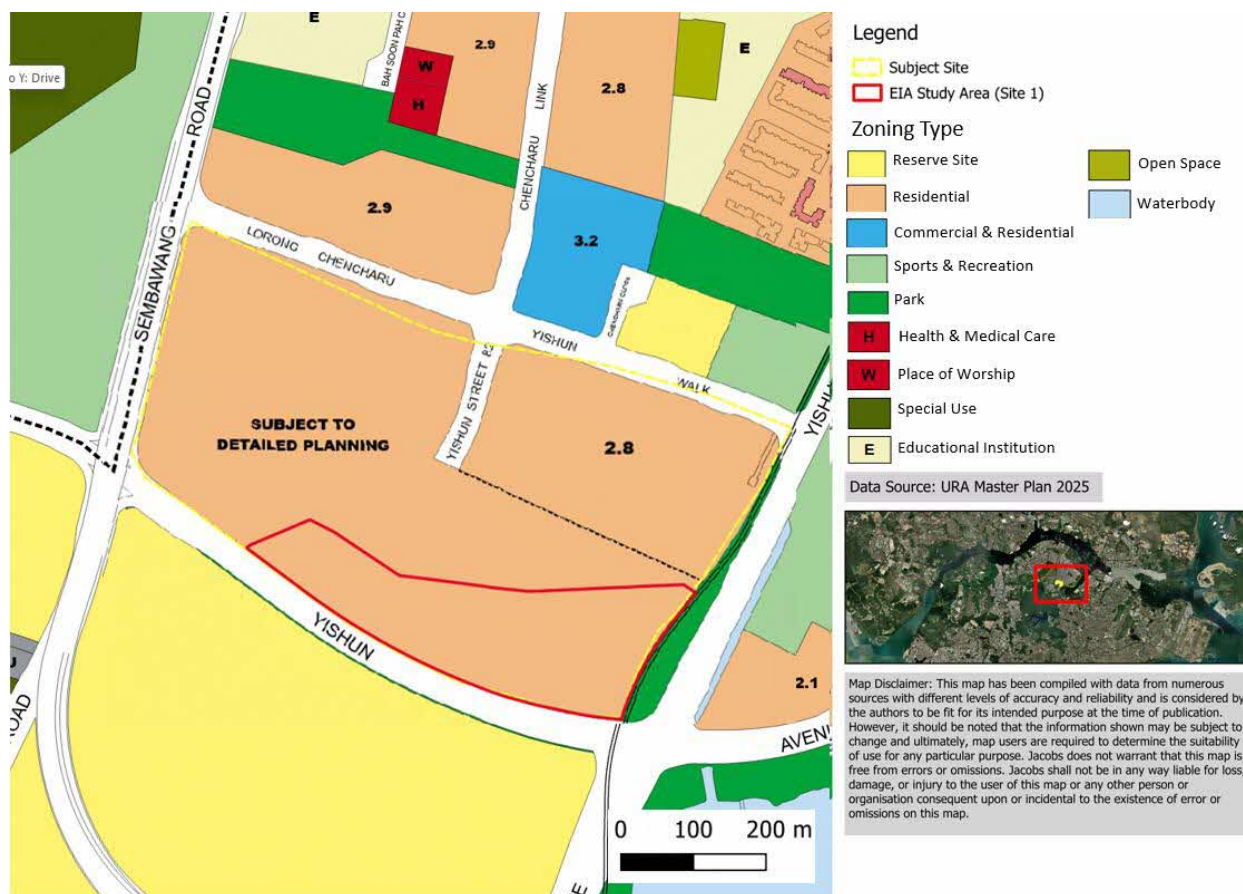


Figure 2-2: Land Use Intent

2.3 Land Use History

Historical and present-day land uses at the Subject Site were reviewed to obtain an understanding of the habitat and areas surrounding Site 1. Information on land use history was primarily gathered from published literature and historical maps in the online collections of the National University of Singapore Libraries (National University of Singapore Libraries, 2024) and National Archives of Singapore (NAS) (National Archives of Singapore, 2024).

Before British colonization in 1819, Singapore's primeval vegetation consisted largely of lowland dipterocarp forest, freshwater swamp forest inland, and mangrove forest fringing much of the coast (Corlett, 1991). During the early years of British colonial rule, Site 1 was largely forested without indications of developments apart from a main road along the east, which remains as present-day Sembawang Road (Figure 2-3A). Hence, it is likely that the vegetation of Site 1 had been an undisturbed freshwater swamp forest or mangrove forest, given the proximity to Sungei Seletar.

This primeval vegetation persisted until the early-1900s, where most of the forests were cleared to make way for gambier, pepper plantations and farms in the Sembawang Estate, which were later replaced by pineapple and rubber plantations following the acquisition of land surrounding Bah Soon Pah road by Lim Nee Soon in 1919, who owned Bukit Sembawang Rubber Company (BSRC) (Remember Singapore, 2022). In 1928, the plantations were taken over by "Rubber King" Lee Kong Chian and as of 1945, Site 1 was covered by rubber plantations with car tracks and small buildings as part of the Lee Rubber Factory (Figure 2-3B; Lim, 2010). Some areas of primeval tidal mangrove swamp and open swamps along Sungei Seletar, including those which were located close to the east of Site 1, remained untouched (Figure 2-3B). The land use of the area remained largely unchanged until the late 1900s.

In 1986, Sungei Seletar was dammed to form Lower Seletar Reservoir, converting the surrounding natural vegetation from tidal swamps into freshwater swamp forest (**Figure 2-3C**; PUB, n.d.). After 1975, the western section of Site 1 was occupied by Sembawang Nursery, where land was utilised to cultivate plants of agricultural and horticultural value (**Figure 2-3D**). By 1998, the rubber plantations, roads, and buildings within Site 1 were replaced by sundry cultivation, and a portion was eventually repurposed by NParks as a tree bank for landscaping works. Additionally, new roads and train tracks, namely Yishun Avenue 1 and the North-South Mass Rapid Transit (MRT) track, were also constructed, running along the southern and eastern boundary of Site 1 (**Figure 2-3E**). Since then, the general setting of Site 1 remained generally unchanged until recent years, where satellite imagery shows that the eastern side of Site 1 being abandoned, allowing for some secondary forest regrowth (**Figure 2-3F**).

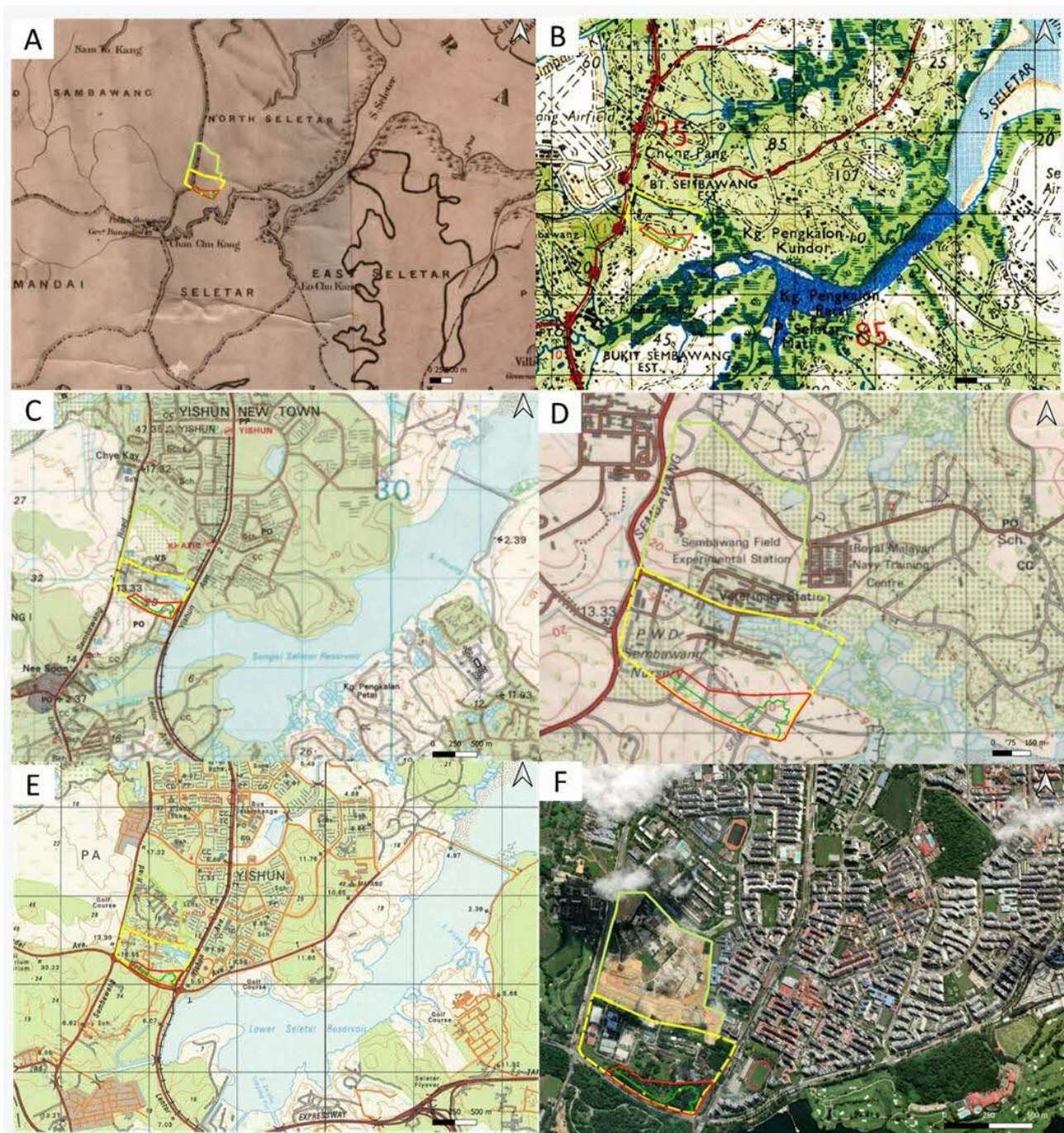


Figure 2-3: Historical and Present Land Use Changes of Chencharu (NUS Historical Maps of Singapore: Historical and Present Land Use Changes of Chencharu (NUS Historical Maps of Singapore). A) 1873, B) 1945, C) 1987, D) 1975, E) 1998 and F) 2024.

2.4 Site Conditions

The area around Site 1 is relatively flat with some mild undulations. It is part of the Yishun Planning Area, which is generally low-lying and historically characterised by swamps and mangroves. Over time, the land was drained and utilised for plantations and agriculture, and subsequently for urban development, thus significantly altering the hydrology and drainage of the area. Currently, the land uses around Site 1 include a mix of residential developments, recreational and commercial uses.

2.5 Proposed Works at Site 1

As described in **Section 2.2**, Site 1 has been safeguarded for residential developments. HDB is reviewing plans to develop Site 1 for housing and accompanying amenities, and the expected works include:

- Land preparation works:
 - Site clearance (removal of existing trees and vegetation).
 - Slope formation.
 - Earthworks cutting/ filling within the site to achieve a desirable platform level required for residential development and associated drainage and sewerage catchment.
- Construction of new utilities and infrastructure to support building works and future developments:
 - Construction of roads.
 - Drainage and sewerage works.
- Building construction and associated works:
 - Demolition of existing structures.
 - Construction of new foundation.
 - Utilities and services laying.
 - Superstructure construction, etc.

2.6 Environmental Sensitive Receptors

Environmental sensitive receptors include the current habitat conditions of the vegetated area within Site 1, as well as forested areas south of the EIA Study Area. This EIA scope focuses on these receptors to assess and mitigate the potential impact arising from the proposed activities.

Ecological sensitive receptors in the EIA Study Area encompass a range of fauna, including odonates, mammals, birds, and reptiles. High-sensitivity species include those of conservation significance, while moderate and low-sensitivity groups consist primarily of native and exotic fauna which are not of conservation significance.

2.7 Project Implementation Schedule

The proposed site clearance and land preparation works at Site 1 are expected to commence in 3Q 2026, after the detailed Environmental Management and Monitoring Plan (EMMP) has been developed and the relevant approvals have been obtained.

2.8 Concurrent Developments (Ongoing and Upcoming Projects)

There are several ongoing developments within the vicinity of the Subject Site. A summary of the ongoing and upcoming developments located within a 2 km radius of the Subject Site is tabulated in **Table 2-1**.

Table 2-1: Concurrent Developments within a 2-km Radius of the Subject Site

Development	Description	Tentative Development Timeline
North-South Corridor (LTA)	The North-South Corridor (NSC) is a multi-modal transportation corridor that will enhance connectivity from the northern region to the city, serving towns such as Sembawang, Yishun, Ang Mo Kio, Toa Payoh, Novena and Rochor. It will help to relieve traffic along Singapore's north-south transportation axis and support new developments along the corridor.	Ongoing. The NSC is expected to be completed in phases from 2027. The EIA for this development was completed and published in 2021.
Public housing developments at Chencharu, Yishun (HDB)	HDB unveiled the master plan for the first phase of public housing developments in Chencharu in June 2024. Chencharu will also feature a range of new amenities such as a bus interchange, hawker centre, neighbourhood park, and shops to serve new and existing residents of Yishun Town. The four BTO project were launched for sale in 2024 – 2025.	Earthworks and construction works are ongoing. The first BTO Project launched (Chencharu Hills) is estimated to be completed in December 2028.
	Detailed plans for subsequent phases of public housing developments in Chencharu are currently under study within the Subject Site.	Demolition works and earthworks of vacated or relocated brownfield uses in the eastern half of the Subject Site are ongoing.
Chong Pang City (SLA)	Chong Pang City is a 0.9ha integrated development that will rejuvenate the Chong Pang City neighbourhood centre with a community club, market and hawker centre, and facilities such as swimming pools, a gym, and a variety of shops including a supermarket.	Ongoing. Expected to complete in 2027.
Springleaf Precinct (URA)	Bounded by Seletar Expressway, Mandai Road, and Upper Thomson Road, the Springleaf site has been planned to utilise the site for about 2,000 new dwelling units and more nature-based recreation opportunities to the public.	Ongoing. One Government Land Sales (GLS) site has been awarded in 2024, while the second GLS site was launched in June 2025. The EIA for this development was completed and published in 2022.

Source: Chong Pang Integrated Development, URA, 2022; 2025; LTA, 2025; HDB, 2025.

3. EIA Approach and Methodology

3.1 EIA Baseline Components

The baseline study aims to establish the existing environmental conditions at Site 1 prior to any land clearance and development and provide a benchmark against which the potential impact of the proposed project development can be assessed to determine its significance.

The environmental aspects for the baseline study will comprise the following:

- Geomorphology, topography, and soil – Bedrock types found in Site 1 and potential soil erosion.
- Ecology and Biodiversity – Species recorded, focusing specifically on species and taxonomic groups that are rare and threatened, have significant ecological or keystone functions, or are otherwise of public interest.
- Ambient Noise – Ambient noise level in fauna-sensitive areas around Site 1.

3.2 Assessment of Potential Environmental Impact

3.2.1 Aspects of Impact Assessment for the Project

Based on the nature of the project, the impact assessment in this EIA is outlined below in **Table 3-1**.

Table 3-1: Aspects of Impact Assessment for Site 1

Aspect	Impact Assessment	Project Stage
Geomorphology	Qualitative assessment of soil infiltration capacity by the alteration of topography through cut-and-fill activities.	Construction Phase
Geomorphology	Estimation of soil loss, erodibility and run-off potential using the Modified Universal Soil Loss Equation (MUSLE).	Construction Phase
Ecology and Biodiversity	Qualitative assessment of the ecological value of the habitats and faunal species recorded within Site 1.	Construction and Operation/ Post-Construction Phases
Noise	Evaluation of noise nuisance effects from construction activities on fauna-sensitive receptors.	Construction Phase
Waste	Qualitative assessment of potential impact of waste generation (including hazardous wastes) from construction activities to sensitive receptors (soil and groundwater).	Construction Phase

3.2.2 Assessment Method for Impact Assessment

The Modified Rapid Impact Assessment Matrix (RIAM) is used as the impact assessment methodology to assess the overall impact on the key environmental aspects from the development of this Project in the pre-construction, construction, and post-construction phases. RIAM is a semi-quantitative impact assessment method modified/ adopted from Pastakia (1998) and Ijas et al. (2009). This modified RIAM approach applies a scoring matrix (quantitative indicators) for impact evaluation in the form of Environmental Scores (ES), which

range from an extreme positive impact to critically negative impact for each specific project activity, with consideration of the sensitivity level of the existing baseline environmental conditions.

The criteria used for the assessment fall into two groups, Group A and Group B, with their respective factors of assessment indicated in **Figure 3-1**.

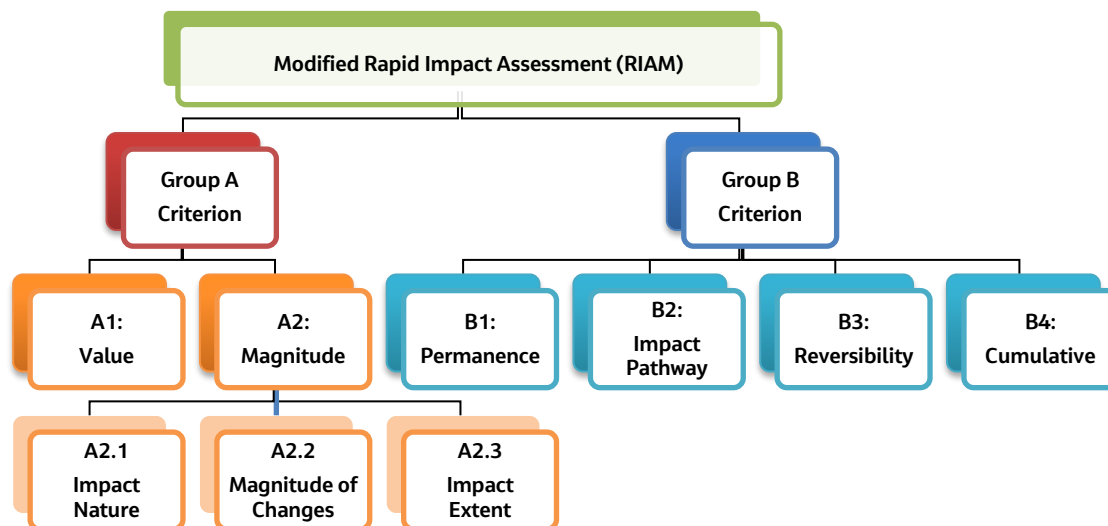


Figure 3-1: Assessment Criteria for Impact Significance following the RIAM Method

3.2.2.1 Group A Criteria

Group A Criteria are measures of importance of the existing sensitive receiver characteristics with value levels (A1) against the magnitude (scale) of the changes regardless of whether the impact nature is a beneficial or dis-beneficial impact (A2). The score for Group A will be calculated using multiplication, i.e. $(A1) \times (A2.1) \times (A2.2) \times (A2.3) = AT$, where (A1) to (A2.3) are the individual criteria scores in Group A and (AT) is the result of multiplication of all Group A scores. The definition and score general criteria considered for Group A is given in **Table 3-2**.

Table 3-2: Definition and Score Criteria for Group A Criterion

Group A Criterion	Score/ General Criteria Considered	
A1 – Value Sensitive Receiver Characteristic	4:	Important to international interests (beyond Singapore) (Very High)
	3:	Important to national/ regional interests (within Singapore) (High)
	2:	Important to the area immediately outside local conditions (i.e., 100m buffer around Site 1) (Medium)
	1:	Important to local conditions (within Site 1) (Low)
	0:	No importance, i.e., value does not carry important role of local interest (Not Important)
A2 – Magnitude Measure of the scale of benefit/dis- benefit (impact)	A2.1 – Impact Nature (Benefit or Dis-benefit)	
	+1:	Positive impact
	-1:	Negative impact
	0:	Negligible impact/ no change/ status quo

Group A Criterion	Score/ General Criteria Considered
nature) of an impact or a condition	A2.2 – Magnitude of Changes*
	3: High impact/ changes
	2: Medium impact/ changes
	1: Low impact/ changes
	0: No change/ status quo/ negligible
	A2.3 – Impact Extent (Geographical Extent of the Induced Change)
	4: Transboundary (Impact extends beyond Singapore's boundary)
	3: Impact extends up to national boundary
	2: Impact extends immediately beyond Site 1, i.e., Buffer area
	1: Impact within local area, i.e., within Site 1
	0: No change/ status quo

Note: *Magnitude of changes – there will be specific definitions of magnitude for each environmental component/ aspect given in their respective evaluation sections.

3.2.2.2 Group B Criteria

Group B Criteria are measures of value to the situation but should not individually be capable of changing the overall score obtained. Each of the Group B criteria collectively contributes to the assessment, without allowing any single criterion to disproportionately influence the overall score. The criteria definitions are shown in **Table 3-3**.

The score for the criteria in Group B will be calculated using summation, i.e. (B1) + (B2) + (B3) + (B4) = BT, where (B1) to (B4) are the individual criteria scores in Group B and (BT) is the result of summation of all Group B scores.

Table 3-3: Definition and Score Criteria for Group B Criterion

Group B Criterion	Scores/ Definition
B1 – Permanence Whether a condition is temporary or permanent and should be seen only as a measure of the temporal status of the condition (i.e. the time period over which a resource/ receptor is affected)	4: Long term effects, i.e., > 10 years (over the lifetime of the Project)
	3: Medium term, i.e., ≥ 3 years ≤ 10 years
	2: Short term, i.e., less than 3 years
	1: Temporary, i.e., less than one month
B2 – Impact Pathway Whether the receivers are directly or indirectly impacted	3: Direct impact
	2: Indirect impact
	1: No change/ not applicable

Group B Criterion	Scores/ Definition	
B3 – Reversibility Whether a condition can be changed and is a measure of the control over the effect of the conditions	3:	Irreversible
	2:	Reversible
	1:	No change/ not applicable
B4 – Cumulative Whether the effect will have a single direct impact or whether there will be a cumulative effect over time or synergistic effect with other conditions	3:	Cumulative/ synergistic
	2:	Non-cumulative/ single
	1:	No change/ not applicable

3.2.2.3 Impact Severity/ Significance

The impact severity/ significance is evaluated against the impact criteria (Group A and Group B) and a score is determined for each criterion, which provides a measure of the impact severity expected for the potential impact area identified.

The total environmental score (ES) will be calculated using the equation **(AT) x (BT) = ES**.

The severity of impact for each of the evaluated potential impact identified has been categorised using a qualitative scale of severity with range bands as indicated in **Table 3-4**.

Table 3-4: Range Bands of Environmental Score (ES) and the Corresponding Level of Impact Significance

Environmental Score (ES)	Impact Severity/ Significance	Definition
481 to 624	Extreme Positive Effect	Impact which causes great improvement or benefit to the existing environment
313 to 480	Major Positive Effect	Impact which causes major improvement or benefit to the existing environment
121 to 312	Moderate Positive Impact	Impact which causes noticeable improvement or benefit to the existing environment
53 to 120	Minor Positive Impact	Impact which causes minor improvement or benefit to the existing environment
1 to 52	Slight Positive Impact	Impact which causes slight improvement or benefit to the existing environment
0	No Change/ Status Quo	No discernible deterioration or improvement to the existing environment
-1 to -52	Slight Negative Impact	Impact which causes slight deterioration or dis-benefit to the existing environment
-53 to -120	Minor Negative Impact	Impact which causes minor deterioration or dis-benefit to the existing environment
-121 to -312	Moderate Negative Impact	Impact which causes a noticeable deterioration or dis-benefit to the existing environment

Environmental Score (ES)	Impact Severity/ Significance	Definition
-313 to -480	Major Negative Impact	Impact which causes major deterioration or dis-benefit to the existing environment
-480 to -624	Critically Negative Impact	Impact which causes critical deterioration or dis-benefit to the existing environment

3.2.3 Identification and Recommendation of Applicable Mitigation/ Enhancement Measures

As the impact significance is evaluated, preventative measures and/or mitigation measures are determined. The mitigation hierarchy is shown in **Figure 3-2**.



Figure 3-2: Mitigation Hierarchy

The priority of the Mitigation Hierarchy is to first apply feasible prevention/ mitigation/ control measures to the source of impact, i.e., avoid or reduce the magnitude of impact or alleviate the significance of any negative impact identified from the associated design initiatives, construction method approach, construction and operation activities to as low as reasonably practicable (ALARP) using the following types of control methods as shown in **Figure 3-3**.

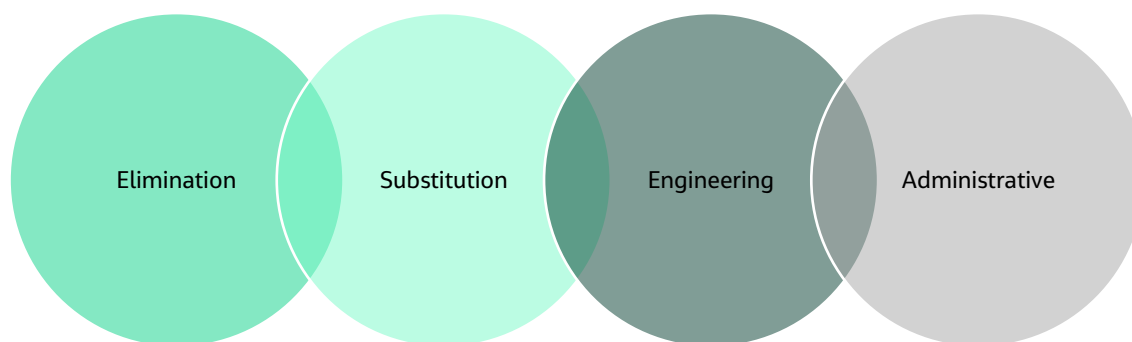


Figure 3-3: Control Method

The mitigation measures proposed will consider their effectiveness, embedded measures, safety, practicality, and suitability for implementation for the proposed project design initiatives, construction methodology, timeline, and site space. Any resultant effects to the specific environmental aspects/ resources/ receptors will be addressed via abatement or compensatory measures or offset.

Physical or procedural controls (embedded control measures or minimum control measures) that are planned as part of the Project design in complying with applicable statutory legislation but not added solely based on mitigation measures identified by the impact assessment process, are distinguished from mitigation measures in the impact significance assigned for the potential impact of the Project.

Once embedded mitigation measures are declared, the next step will be to evaluate the residual impact significance. Any subsequent residual impact following the implementation of the proposed mitigation measures from the study and their significance, will also be assessed.

The RIAM method impact assessment approach has considered the cumulative impact/ effects to which the Project may contribute to. The approach for assessing the cumulative impact and effects resulting from the Project and its associated facilities with another activity affecting the same resource/ receptor is based on consideration of the approval/ existence status of the other activity and the nature of information available to aid in predicting the magnitude of impact from the other activity.

4. Assessment of Geomorphology

This section assesses the potential changes in geomorphology related to the proposed construction activities. It includes a description of the available topographical and geological baseline, methodology, and criteria used for the assessment. Appropriate mitigation measures are proposed, where necessary.

4.1 Applicable Legislation Standards

There is no specific legislation and standard in Singapore that describes the impact assessment requirements for geomorphology and soil erosion associated with the environmental impact of developments. The Environmental Protection and Management Act (EPMA) and the Code of Practice (COP) on Surface Water Drainage are referred to for the assessment. Both the EPMA and COP prescribe the prevention and alteration to the natural baseline drainage morphology and provision of monitoring of surface water resources, particularly on the aspects of flow, discharge value and quality.

4.2 Methodology for Geomorphologic Assessment

The geomorphologic assessment involves the evaluation of landforms, and in particular, their nature, origin, and processes of development. This therefore includes the evaluation of topography, and the factors that contributed to the present land profile, including soils in relation to erosion or subsidence. It should be noted that for Site 1, a baseline assessment of the original geomorphologic conditions is not possible as the EIA Study Area has undergone significant land use changes over the years.

4.2.1 Topography

A Singapore Land Authority (SLA) licensed surveyor, YJP Surveyors Pte Ltd, was engaged to conduct a topographical survey for Site 1 from 1 Nov 2024 to 11 Dec 2024. The topographical map prepared by the SLA licensed surveyor with terrain levels within Site 1 was assessed and processed to generate a Digital Elevation Model (DEM). The DEM enables the visualisation of slopes with the proposed parcellation overlain. A generalised terrain analysis was conducted using this DEM to evaluate the implication of the proposed development activities.

4.2.2 Geology

The Singapore Geological Map (BCA, 2021) and the topographical map of Site 1 was assessed and processed through GIS to generate a thematic map and likewise overlain with the Project development. This indicates potential ground conditions to assess its implication of each project component.

4.2.3 Soil Erosion

The Universal Soil Loss Equation (USLE) was developed to assess soil erosion over extended periods under various land management practices. It predicts the long-term average annual soil loss from specific slopes. By combining empirical data with process-based erosion technology, the USLE offers a more accurate measure of the impact of land management on erosion rates. For the soil loss estimation of Site 1, a Modified Universal Soil Loss Equation (MUSLE) is used. The MUSLE is a modification of the original USLE where the general run-off factor is replaced with the storm runoff volume. This allows MUSLE to better predict soil erosion from individual storm events and better represent the local context.

To provide a basis for theoretical calculations of potential sediment yield in the project area under different scenarios, a worst-case scenario can be modelled by assuming the entire area is cleared and no control measures are installed. The MUSLE has the form of:

$$T = R.K.LS.C.P$$

Where:

T = Sediment Yield per Storm Event, tons

R = Rainfall Erosivity Factor, tons/ha/storm

K = Soil Erodibility Factor, tons/ha/ (MJ.mm/ha/h)

LS = Slope Factor (dimensionless)

C = Cover Management Factor (dimensionless)

P = Support Practice Factor (dimensionless)

The Rainfall Erosivity Factor (*R*) for this analysis was obtained using the rainfall intensity data retrieved from the Meteorological Service Singapore.

The Soil Erodibility Factor (*K*) is computed using the equation for the standard soil erodibility nomograph. Subfactors were determined through borehole data.

The Slope Factor (*LS*) is the combination of the Slope Length (*L*) and Slope Steepness (*S*), which is calculated from the height and length of the slope. Values were derived from the Digital Elevation Model (DEM).

The Cover Management Factor (*C*) and Support Practice Factor (*P*) are determined based on the density and continuity of the vegetation cover.

4.3 Existing Pre-Construction Conditions

4.3.1 Geological Investigation Desktop Review

Historical Soil Investigation (SI) works conducted around the EIA Study Area were reviewed to evaluate the sub-surface conditions in the vicinity of Site 1. Historical borehole information was obtained from SI Reports as published and made available on the Singapore Integrated Land Information Service (INLIS) provided by the Singapore Land Authority (SLA). Having reviewed SI Reports on INLIS, no boreholes were found to be studied within the EIA Study Area, therefore the review was expanded to cover a 100m buffer around Site 1 (**Figure 4-1**). Borehole information was obtained from the following reports:

- LTA ER336A - WO62331 Site Investigation Works for Road Projects (A/10) (2010).
- LTA C402 – Final Factual Report on SI Along Phase 2 & 3 MRT Route (Yio Chu Kang to Yishun) (1985).

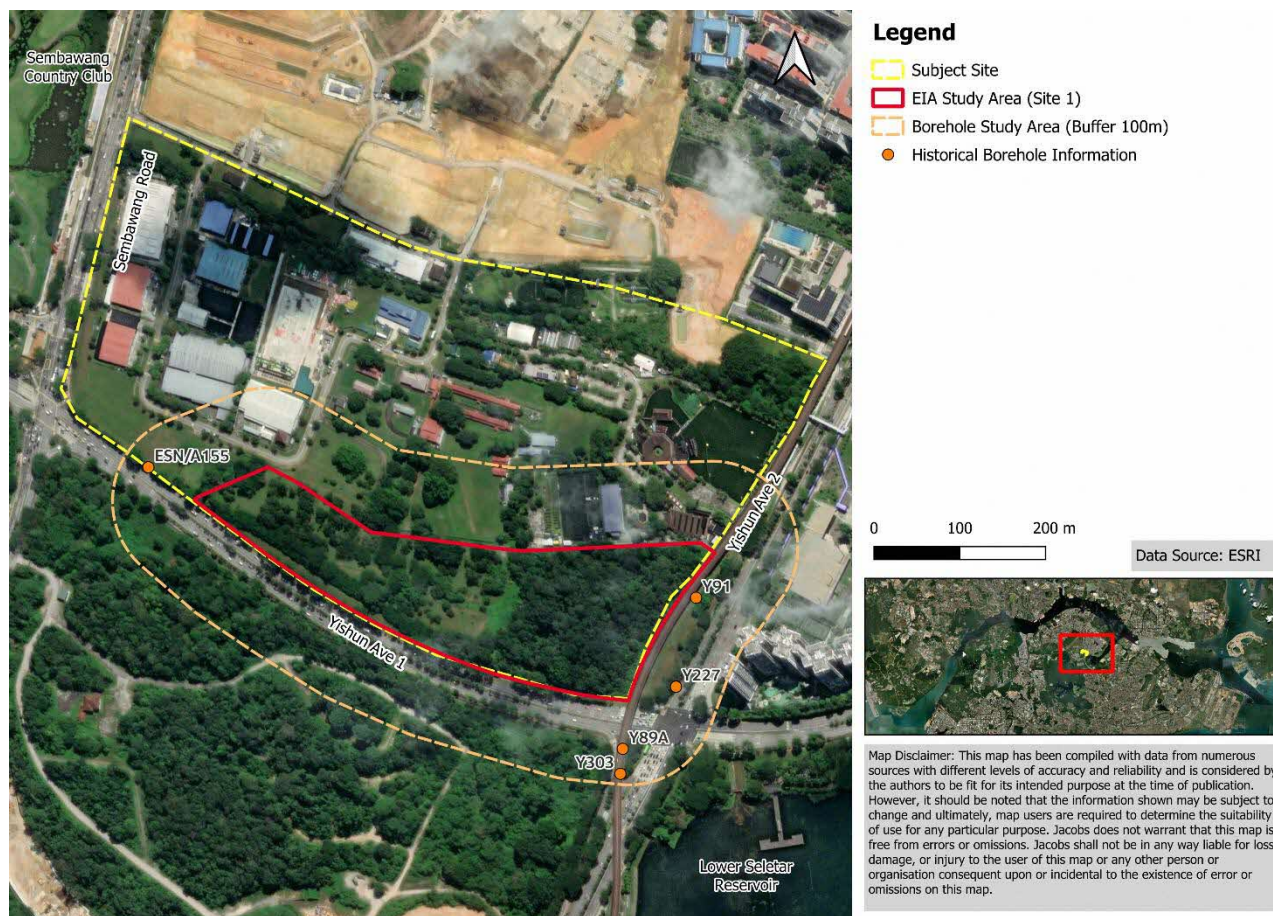


Figure 4-1: Historical Soil Investigation Locations in the Vicinity of Site 1

4.3.1.1 Soil

Based on the aforementioned SI Reports, the general geological formation proximate to Site 1 indicates silty SAND with organic matter (medium dense) and traces of decomposed vegetation (loose) with varying depths of 0 to 2 meters below ground surface (mbgs). Reddish yellow and reddish-orange sandy SILT (medium stiff) and clayey SILT (medium stiff) was also found at with varying depths of 0 to 2 mbgs. Between depths of 2 to 7 mbgs, the soil types included clayey SILT (stiff, completely decomposed granite), sandy SILT (stiff, completely decomposed granite), clayey SILT with sand (medium stiff), and slightly sandy CLAY. Silty CLAY (stiff), clayey SILT (stiff), clayey SILT with sand (stiff), and silty SAND (medium dense to very dense) were found at varying depths between 7 to 11 mbgs. Coarse sand, grading with rock fragments, and granite was recorded from 13.5 to 19.5 mbgs.

4.3.1.2 Groundwater

Based on the SI reports mentioned in **Section 4.3.1**, groundwater was recorded at varying depths of 0.8 to 3.3 mbgs. The water level recorded within these SI reports, however, was taken between March and April 1985, thus these records may not be representative of present-day groundwater levels.

4.3.2 Geology

Based on Singapore Geology (BCA, 2021), the Subject Site is characterised by a diverse geological composition, comprising two types of bedrock, namely Dairy Farm granite (microgranite pluton) and Simpang granite pluton, and two types of superficial geological layers consisting of the Jalan Besar formation and Kranji formation. The

composition and characteristics of each of the geological types are given in **Table 4-1** with their geological locations **Figure 4-2**.

Based on the desktop review, the most dominant rock formations found in Site 1 as indicated in the geological map (**Figure 4-2**) is the Kranji formation, and bedrock types of Dairy Farm granite and Simpang granite. Most of Site 1 sits on the Simpang Granite Pluton, with the western tip sitting on the Dairy Farm granite and a southern portion sitting on the Kranji formation. The northern portion of the Subject Site lays on the Jalan Besar formation.

Table 4-1: Geological Formations and Characteristics in the EIA Study Area

	Geological Type	Composition	Characteristics
Bedrock	Dairy Farm granite-microgranite pluton (granite)	Equigranular monzogranite	This granite type is known for its uniform grain size. Microgranite pluton indicates that it formed from magma that cooled slowly beneath the earth's surface, where crystals have grown to a visible size. This type of granite is typically hard and durable, making it a stable foundation for construction.
	Simpang Granite Pluton	Equigranular syenogranite and monzogranite	This granite type also features a uniform grain size but includes both syenogranite and monzogranite. This granite type typically has high heat production due to the presence of radioactive elements.
Superficial layer	Jalan Besar formation	Silt to coarse sand	The Jalan Besar formation consists of grain sizes that range from fine silt to coarse sand, indicating a varied depositional environment. The sediments are typically loose and unlithified, indicating that they haven't been compacted into solid rock. This formation is often associated with fluvial deposits.
	Kranji formation	Peat-rich clay and silt	This formation usually consists of high organic content, with peat-rich clay and silt, suggesting a depositional environment with accumulation of organic matter. The presence of peat may indicate that the land use was once covered by dense vegetation that has since decomposed. The sediment type is typically soft and may pose a challenge for construction.

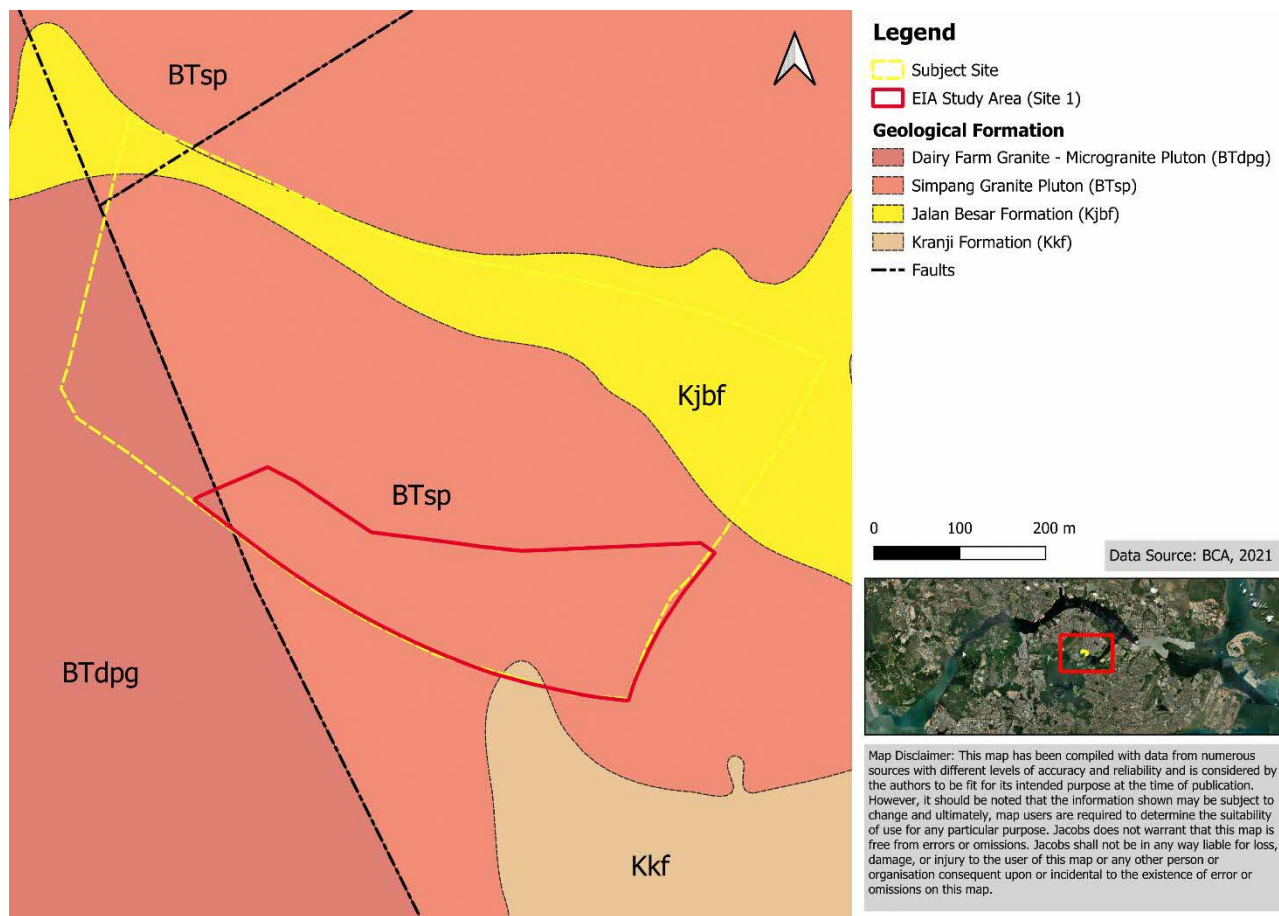


Figure 4-2: Geological Formation in the EIA Study Area
Source: Singapore Geology (BCA, 2021)

4.3.3 Topographic Survey

Site 1 exhibits a range in elevation from a low of 5.49 m to a high of 22.34 m (**Figure 4-3**), indicating a general slope across the site. The lowest point is located at the southeast corner of the EIA Study Area, while the highest elevation is situated at the northwest corner. This elevation difference of 16.85 m creates a gentle slope from northwest to southeast. The topographical map endorsed by SLA licensed surveyor is presented in **Appendix 4A**.

Despite the elevation change, the topography does not exhibit significant undulations throughout Site 1, suggesting a relatively smooth and consistent gradient. This gentle slope may influence various aspects of the site, including drainage patterns and soil stability.

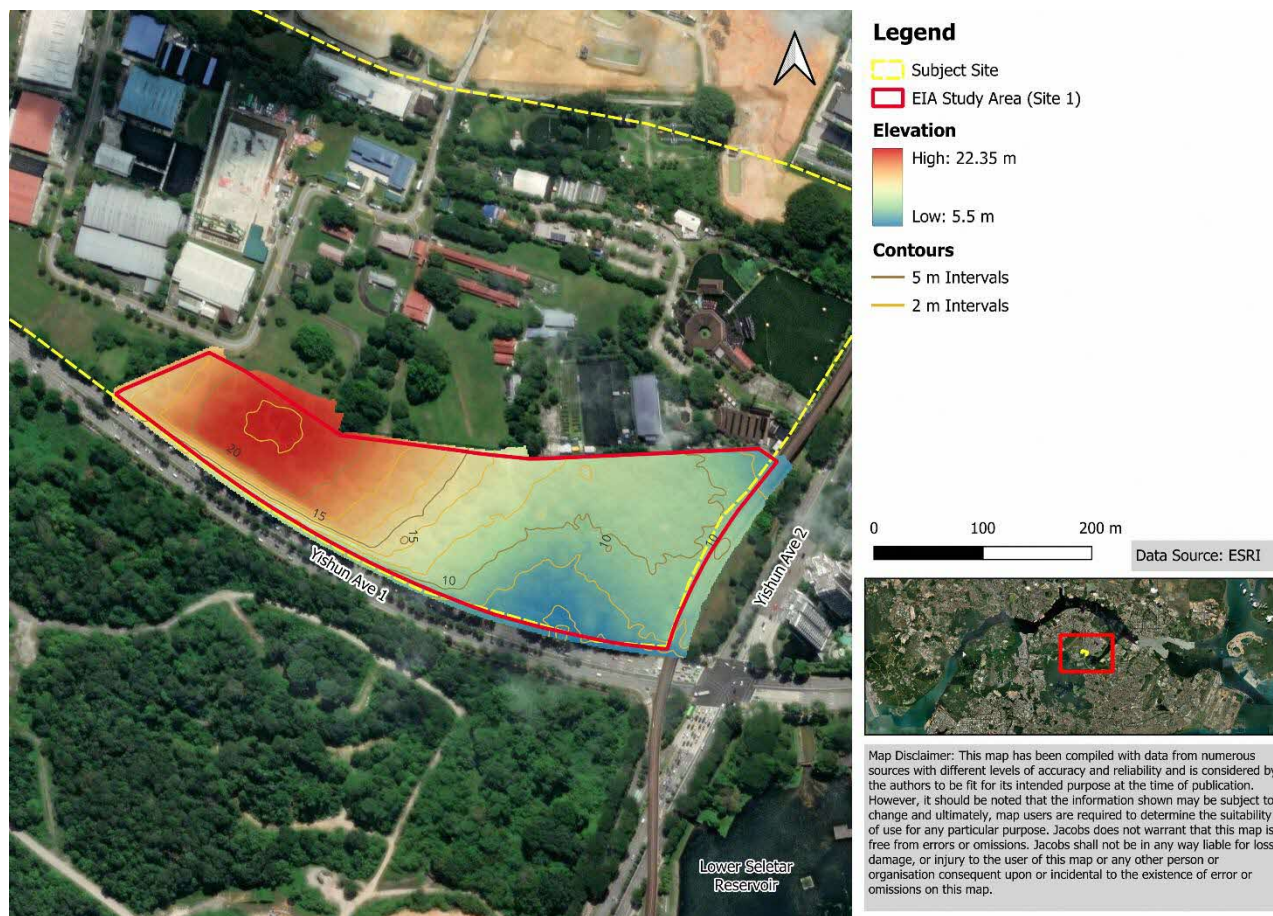


Figure 4-3: Digital Elevation Model (DEM) of the EIA Study Area

4.4 Impact Assessment

4.4.1 Evaluation of Geomorphology Impact

The construction activities may involve at least one or a combination of the following activities:

- Stripping or removal of soil cover.
- Ground/subsurface excavation, cut and fill.
- Earthmoving of excavated materials.
- Temporary soils and spoil stockpiling.
- Ground compaction and sealing.

These activities have a direct impact on the soil infiltration capacity, soil loss and erosion, and hydrogeological conditions. These are further described as follows.

4.4.2 Changes to Soil Infiltration Capacity

Soil compaction is anticipated as a consequence of any, or a combination, of the construction activities previously mentioned in **Section 2.5**, as well as from the use of temporary work areas within the bounds of the Site 1. This compaction may lead to either a temporary or permanent reduction of the soil infiltration capacity.

In areas where pavement or ground sealing is applied for buildings, infrastructure, and amenities such as roads and drainage lines, the soil and underlying subsurface are expected to permanently lose their infiltration capacity. The extent of ground compaction, depending on the degree of compaction, may influence whether lateral hydraulic conductivity in the subsurface is affected, which in turn could impact groundwater movement.

As indicated in **Section 4.3.1.1**, the soil type across Site 1 is predominant silty sand, though the soil types and their permeability values shall be confirmed by soil investigation (S.I.) during the detailed design stage. During the ground preparation and construction phase, a reduction below the baseline permeability value is expected to occur in working areas. Near-permanent loss (infiltration rate reduced to near zero) may occur in areas where permanent removal of soil and subsurface materials is expected to take place. This report therefore defines the magnitude of changes as "Low" if the reduction infiltration rate is less than and same with 10% of the measured pre-construction infiltration rate, "High" if the infiltration rate reduction is more than 50% of the measured pre-construction infiltration rate, and "Medium" if the changes are in between these.

Table 4-2: Impact Significance for Soil Infiltration Capacity

Assessment Criterion	Score Rating	Rating Justification/ Definition
A1: Value	1: Local	Changes in infiltration capacity are limited to areas of local interest within Site 1.
A2.1: Impact Nature	-1: Negative	Loss or reduction of infiltration capacity in the work areas of Site 1 for permanent structures is a negative impact which may lead to waterlogging issues and groundwater movement.
A2.2: Magnitude of Changes	2: Medium	Changes in infiltration capacity in working areas within the Project site are predicted to be between 10% and 50%.
A2.3: Impact Extent	1: Local	Impact is limited within the disturbance areas where temporary and permanent earthworks are expected to take place.
B1: Permanence	2: Short-term	Construction activities that have an impact on soil infiltration, including ground compaction, excavation and earthworks, are estimated to be less than three years (short-term).
B2: Impact Pathway	3: Direct	Ground disturbance is expected to have direct impact on soil infiltration.
B3: Reversibility	3: Irreversible	Original soil material and profiles cannot be returned to their original locations after disturbance and change in the land use. Permanent loss or reduction of infiltration capacity where surfaces are expected to be stripped or excavated.
B4: Cumulative	2: Non-cumulative	Changes in soil infiltration capacity results in non-cumulative impact and only occur during site earth movement activities for specific locations due to the project development.
Environmental Score (ES)	$(-2) \times (10) = -20$	
Range Bands ES/ Impact Significance	Minor Negative Impact	

4.4.3 Soil Erosion and Sediment Yield

4.4.3.1 Sediment Yield Determination

The MUSLE was used to assess the erosion risk of Site 1 under three conditions (scenarios):

- Condition 1: Existing (undisturbed) condition – without any works on site.
- Condition 2: Uncontrolled (no mitigation measures) – worst-case scenario assuming total site clearance without control measures.
- Condition 3: Controlled (with mitigation measures) – assuming the conditions of site clearance and earthworks are managed on-site with the implementation of Earth Control Measures (ECM) designed by the Qualified Earth Control Professional (QECF), adopting construction staging measures, sedimentation control measures and other best practices on site such as using silt fences and cut-off drains.

The sediment yield for Site 1 is calculated through the following steps:

(a) Step 1: Determination of Zones of the Site based on Slope Classification

The footprint of Site 1 is divided into different zones, with each zone representing a slope range (**Table 4-3**). Slope categories are based on the United States Department of Agriculture (USDA) 2018 Slope Classification table. The zone categories are shown in **Table 4-3** and **Figure 4-4** below. Zone 2A is a subcategory due to difference in vegetation cover.

Table 4-3: Zones Identified per Slope Category (USDA, 2018)

Zone	Slope (in percent)	Description	Vegetation Cover/ Remarks
1A	0-3	Level to nearly level	Forested Area
1B	0-3	Level to nearly level	Forested Area
2	3-8	Gently sloping to undulating	Forested Area
2A	3-8	Gently sloping to undulating	Shrubland
3	8-18	Undulating to rolling	Forested Area
4	30-50	Steep	Forested Area

Slopes ranging from 18% to 30% were observed downhill of Zone 4. However, no zone was assigned for this slope category since it only covers an insignificant portion (0.16 ha).

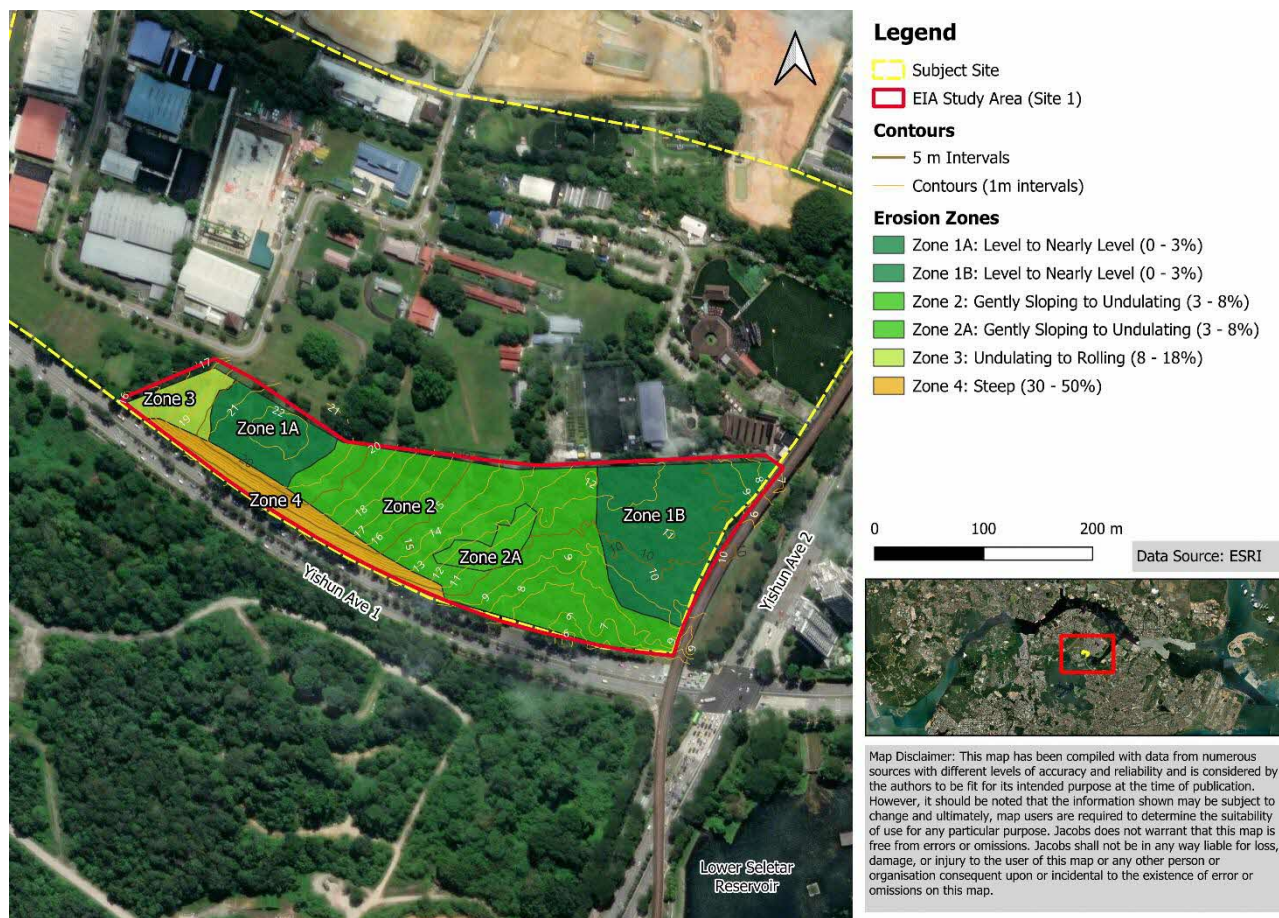


Figure 4-4: Map Showing Zones per Slope Category

(b) Step 2: Determination of Rainfall Erosivity Factor, R Factor

The Rainfall Erosivity Factor (R) for the different zones was calculated using the following equation:

$$R = \psi_z (V \times Q_p)^{0.56}$$

where,

R = Rainfall erosivity factor

$\psi_z = 89.6$ for SI units

V = Runoff volume (m³)

Q_p = Peak Flow (m³/s)

The runoff volume (V) was calculated using the formula $V = \alpha \times I \times T \times A$, where α is the runoff coefficient at 0.65, I is the rainfall intensity, T is the duration of storm, and A is the area in m². The values of I and T are 147 mm/hour and 60 minutes, respectively, from the historical extreme rainfall data of the Meteorological Service Singapore. Whereas for the peak flow (Q_p), the value was derived by dividing V with T.

(c) Step 3: Determination of Soil Erodibility Factor, K Factor

K Factor is determined as 0.26 using the following equation for the standard soil erodibility nomograph and soil classification from soil samples taken at 0.9m to 3m deep boreholes collected during the site investigation works for road projects within the vicinity of Yishun (LTA, 1985; LTA, 2010).

$$K = (k_t k_o + k_s + k_p) / 100$$

where,

K = soil erodibility factor

k_t = texture subfactor

k_o = organic matter subfactor

k_s = soil structure subfactor

k_p = soil profile permeability factor

Substituting the values of each subfactor (see the following computations for the subfactors), we have:

$$\begin{aligned} K &= [(3.02) (9) + (-3.25) + 2.5] / 100 \\ &= 26.43 / 100 \\ &= 0.26 \end{aligned}$$

Texture Subfactor (k_t)

The soil texture subfactor equation (Wischmeier et al., 1971) is shown below. This equation shall apply if the percentage of silt and very fine sand is less than 68%.

$$\begin{aligned} k_{tb} &= 2.1[(P_{sl} + P_{vfs})(100 - P_{cl})]^{1.14} / 10,000 \\ k_t &= k_{tb} \text{ if } P_{sl} + P_{vfs} \leq 68\% \end{aligned}$$

Since the percentage of very fine sand is not indicated in the borehole test report, this was computed using the following equation:

$$\begin{aligned} P_{vfs} &= (0.74 - 0.62 P_{sd} / 100) P_{sd} \\ &= (0.74 - 0.62 (52.03) / 100) (52.03) \\ &= (0.74 - 0.32) (52.03) \\ &= 21.85 \end{aligned}$$

Substituting the values, we have:

$$\begin{aligned} k_t &= 2.1 [(31.4 + 21.85) (100 - 16.56)]^{1.14} / 10,000 \\ &= 2.1 (4,443.18)^{1.14} / 10,000 \\ &= 3.02 \end{aligned}$$

Organic Matter Subfactor (k_o)

The percentage of organic matter cannot be quantitatively determined as this parameter was not analysed in the site investigation works. A value of 3 (as O_m) was instead given for typical medium soils, though actual organic matter may vary depending on topsoil exposure and soil management practices. The k_o computed is 9 using the below equation.

$$\begin{aligned} k_o &= (12 - O_m) \\ &= 12 - 3 \end{aligned}$$

$$= 9$$

Soil Structure Subfactor (k_s)

Four (4) soil structural classes (1-very fine granular, 2-fine granular, 3-medium or coarse granular, and 4-blocky, platy, or massive) were used in the nomograph. These classes are defined in the USDA Natural Resources Conservation Service (NRCS) soil survey manual. A structural class of 1 was assigned in this case as clay to very fine sand fractions comprised more than 50% of the borehole samples.

The applicable equation used to obtain the soil structure subfactor could be one of the two following equations depending on the resulting value (if $k_t k_o + k_s$ is less than 7, or greater or equal to 7).

$$k_s = 3.25 (S_s - 2) \text{ if } (k_t k_o + k_s) \geq 7$$

$$k_t k_o + k_s = 7 \text{ if } (k_t k_o + k_s) < 7$$

Substituting the values for organic matter, texture and structural class, the resultant value would exceed 7 and therefore requires using the first equation. The k_s is computed as follows:

$$k_s = 3.25 (1-2)$$

$$= 3.25 (-1)$$

$$= -3.25$$

Soil Profile Permeability Subfactor (K_p)

Six permeability classes that range from 1-rapid (very low runoff potential) to 6-very slow (very high runoff potential) were used to rate the soil profile for infiltrating precipitation and reducing runoff. A soil profile permeability class (P_r) of 4 was assigned for Site 1.

The equation for the permeability subfactor is given by:

$$K_p = 2.5 (P_r - 3)$$

Given the permeability class, the calculation is as follows:

$$K_p = 2.5 (4-3)$$

$$= 2.5$$

(d) Determination of LS Factor

Slope length and gradient were derived using the Digital Elevation Model (DEM). The values are listed in **Table 4-4**.

Table 4-4: LS Value of the Various Zones

Zone	LS Value
Zone 1A	3.28
Zone 1B	9.82
Zone 2	24.21
Zone 2A	6.09
Zone 3	7.74
Zone 4	19.49

(e) Determination of CP Factor

The C Factor for Site 1 is assigned as follows:

- Condition 1: Existing (undisturbed) condition = 0.03 (100% forest cover); 0.05 (scrubland)
- Condition 2: Uncontrolled (no mitigation measures) = 1.00 (Newly cleared land)
- Condition 3: Controlled (with mitigation measures) = 0.05 (60% turfing/grass cover)

The P Factor is assigned as follows:

- Condition 1: Existing (undisturbed) condition = 0.6 (no management support practice provided)
- Condition 2: Uncontrolled (without mitigation measures) = 1.0 (no management support practice provided)
- Condition 3: Controlled (with mitigation measures) = 0.5 (sediment containment systems)

4.4.3.2 Sediment Yield for Site 1

The sediment yields for Site 1 under various conditions are summarised in **Table 4-5**. Under the worst-case scenario (uncontrolled site clearance/ earthworks), there would be a significant increase in erosion risk, where sediment yield is more than 658 tons/storm.

Table 4-5: Summary of Sediment Yield Assessment for Existing and Worst-Case Conditions

Condition	Parameter	Zone 1A	Zone 1B	Zone 2	Zone 2A	Zone 3	Zone 4
Existing	R	1,304	3,116	7,768	415	530	1,112
	K	0.26	0.26	0.26	0.26	0.26	0.26
	LS	3.28	9.82	24.21	6.09	7.74	19.49
	C	0.03	0.03	0.03	0.05	0.03	0.03
	P	0.60	0.60	0.60	0.60	0.60	0.60
	T (tons/storm)	20.02	143.20	880.14	21.87	19.20	101.43
Uncontrolled	R	1,304	3,116	7,768	415	530	1,112
	K	0.26	0.26	0.26	0.26	0.26	0.26
	LS	3.28	9.82	24.21	6.09	7.74	19.49
	C	1.00	1.00	1.00	1.00	1.00	1.00
	P	1.00	1.00	1.00	1.00	1.00	1.00
	T (tons/storm)	1,112	7,956	48,896	658	1,066	5,6345

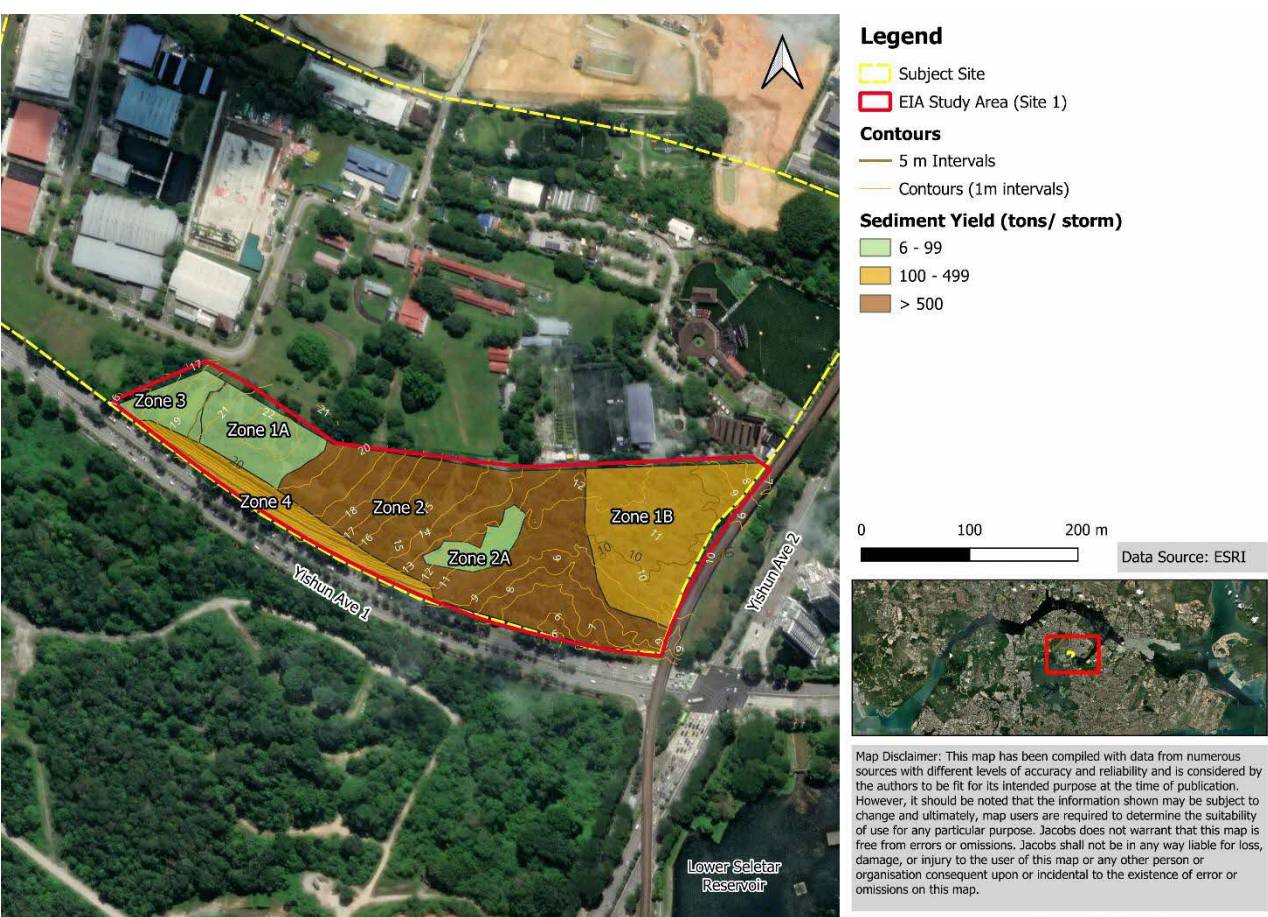


Figure 4-5: Sediment Yield for Condition 1 (Existing Conditions)

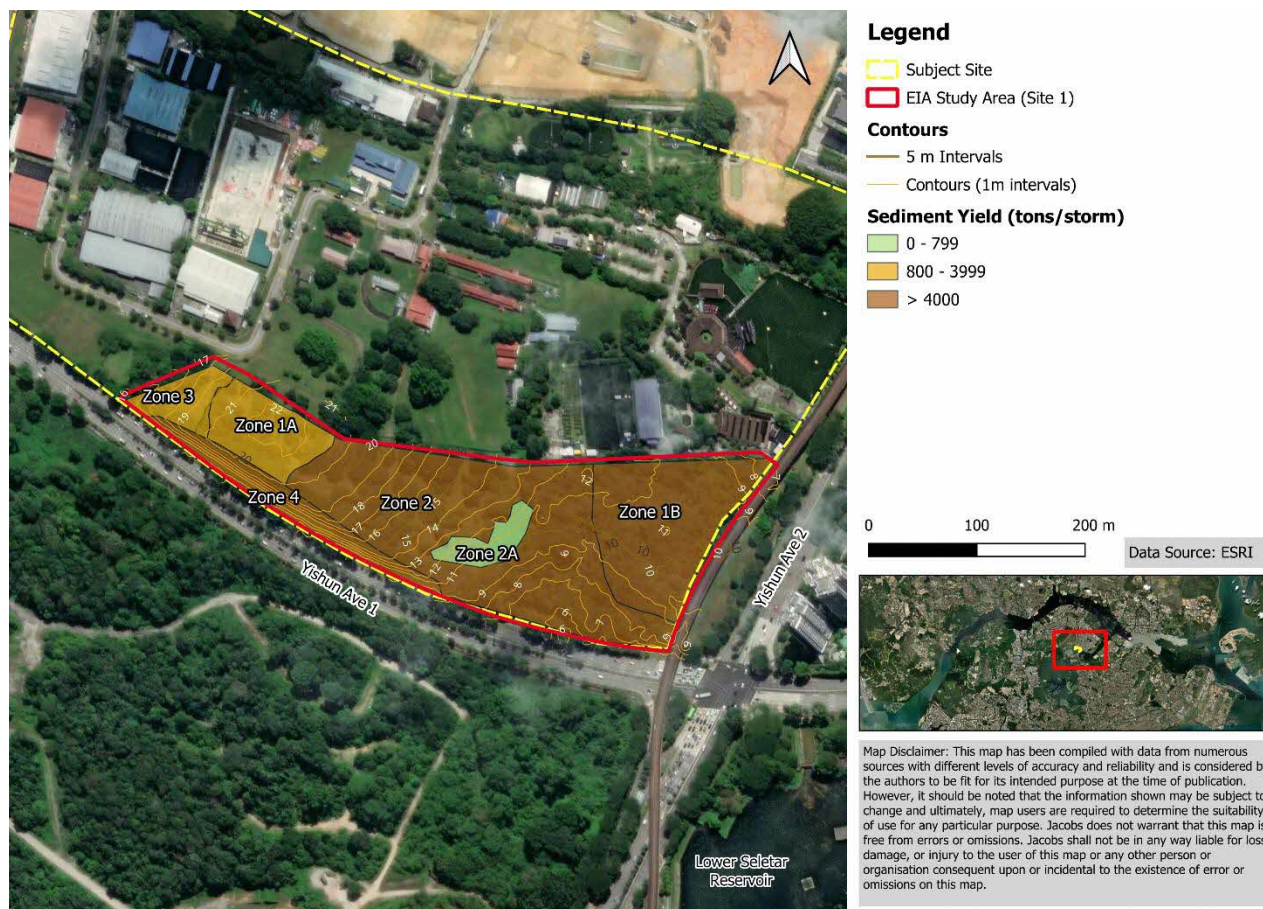


Figure 4-6: Sediment Yield for Condition 2 (Uncontrolled)

4.4.3.3 Evaluation of Impact Significance for Soil Loss of Site 1

The sediment yield determined from MUSLE for Site 1 is a conservative rate assuming total clearance of Site 1 without site clearance work phasing and under a worst storm event. The rate of sediment yield will fall to zero upon the completion of all site clearance and earthworks, as erodible material is assumed to be completely removed while previously exposed subsurface will be permanently covered with concrete or other material within the work site. The evaluation of impact significance of soil loss under unmitigated conditions is given in **Table 4-6**, with the magnitude changes (A2.2) defined on the sediment yield derived from uncontrolled conditions as below:

1. Rating "zero": no change/ status quo for exceedances compared with *in-situ* (existing condition).
2. Rating 1: Low impact for exceedance ≤ 5 times of *in-situ* (existing condition).
3. Rating 2: Medium impact for exceedance > 5 times but ≤ 10 times of *in-situ* (existing condition).
4. Rating 3: High impact for exceedance > 10 times of *in-situ* (existing condition).

Table 4-6: Impact Significance for Soil Erosion and Sediment Yield

Assessment Criterion	Score Rating	Rating Justification/ Definition
A1: Value	1: Local	Soil loss is limited to local areas of interest within Site 1
A2.1: Impact Nature	-1: Negative	Site clearance will result in loss of soil cover within working zones for permanent structures in Site 1, and the soil loss (sediment yield per storm event) may increase the erodibility in adjacent areas if no control measures are applied. Soil loss may eventually contribute to downstream siltation, in particular during storm events under uncontrolled conditions.
A2.2: Magnitude of Changes	3: High	Based on the sediment yield calculated under worst case conditions for Site 1 (all zones), magnitude of changes is evaluated as High (exceedance >10 times of <i>in-situ</i> existing conditions).
A2.3: Impact Extent	2: Impact extends immediately beyond Site 1, i.e., Buffer area	Impact, although more localised within the disturbed work areas, may eventually lead to sedimentation at downstream areas beyond Site 1's boundary under uncontrolled conditions.
B1: Permanence	2: Short-term	Construction activities that have impact on soil loss, including site clearance, earthworks, and ground disturbance, are estimated to last less than three years (short-term)
B2: Impact Pathway	3: Direct	Ground disturbance is expected to have a direct impact on soil loss and sedimentation as it involves stripping of soil cover.
B3: Reversibility	3: Irreversible	Original soil material and profiles cannot be returned to their original location after disturbance and land use changes. Permanent loss of soil cover is expected to occur in areas where permanent structures will be built.
B4: Cumulative	2: Non-cumulative	The impact of soil loss resulting from surface stripping is expected to be non-cumulative, only occurring during site clearance and earthwork activities for specific locations due to the project development.
Environmental Score (ES)	$(-6) \times (10) = -60$	
Range Bands ES/ Impact Significance	Minor Negative Impact	

4.5 Minimum Control Measures

This section lists sedimentation/ erosion -specific minimum controls commonly implemented in Singapore for similar construction activities. These include the basis for developing, implementing and monitoring earth control measures (ECM) at the construction sites as required by Regulation 4 of the *Sewerage and Drainage (Surface Water Drainage) Regulations*, Code of Practice (COP) for Environmental Control Officer (ECO) issued by NEA, COP on Surface Water Drainage issued by PUB as well as the Guidebook on Erosion and Sediment Control at Construction Sites and the Guidebook for Qualified Erosion Control Professional (QECP).

These measures are assumed to be implemented by HDB as embedded measures or minimum control measures required by the applicable regulations and COPs (Table 4-7).

Table 4-7: Minimum Controls of Sedimentation/ Soil Erosion Implemented at Construction Phase Applicable to Site 1 Development

Impact	Minimum Controls Adhered to Applicable Regulations and COP
Sedimentation/ Soil Erosion	▪ Before work commences, submit a detailed ECM proposal duly endorsed by a Qualified Erosion Control Professional (QECP) to PUB and copied to HDB indicating: - Plans to minimise exposed surfaces - Implementation of effective sediment control facilities (including storage and treatment facilities). - ECM systems that will be put in place prior to the commencement of physical works. - A Clearance Certificate that is obtained prior to the commencement of physical works. - Revisions or updates to the ECM systems during construction to control silty discharge, where necessary. - ECM shall not be removed prior to the completion of physical works. Relevant approvals from PUB shall be obtained for removal of ECM upon the completion of physical works. - Condition of ECM shall be inspected regularly and during/after every rain event. - QECP shall carry out regular audits/reviews for every stage of the construction works and revise the ECM on-site accordingly. ▪ Earth surfaces or slopes adjacent to any drain shall be close turfed, paved or covered with appropriate materials. ▪ Bare surfaces shall be covered up with appropriate materials before rain and daily works should be halted to reduce the volume of silty water to be contained and treated. ▪ The treatment of silty water shall be closely monitored, and the treatment shall be halted immediately if silty water is being discharged to public drains.

4.6 Recommendation of Preventive and Mitigation Measures

A range of mitigation measures may be adopted to minimise, if not completely eliminate, geomorphological changes that may affect soil infiltration capacity and soil loss. These may be implemented individually or in combination, where applicable.

- Implement the site clearance and earthworks in stages with a programmatic Excavation, Cut and Fill and Earthmoving plan to minimise the area disturbed at any given time. Potential erosion and topsoil loss can be reduced by minimising the disturbance areas affected by excavation and earthworks to only the necessary areas,
- Engage a Qualified Person (QP)/Professional Engineer to conduct slope stability and soil compaction studies within and adjacent to the areas of concern prior to any clearing and earthworks. The results of this assessment can be incorporated into the operational manual during earth-moving and excavation activities.
- Engage a certified Qualified Erosion Control Professional (QECF) to design an Earth Control Measure (ECM) plan for Site 1 prior to construction commencement and obtain endorsement from PUB. The potential impact on geomorphology and soil erodibility identified in this EIA can be further verified by the ECM design calculation prepared by the QECF based on more specific project information in the detailed design stage.
- Adopt the ECM plan and ECM minimum control and best practices onsite at all times (i.e., cover stockpiles, cover bare earth areas after work, isolate bare earth areas with silt fences, pave up access paths/ roads, etc.).
- The excavated topsoil will be used to backfill the low-laying grounds to form the platform for BTO development. Excess soil material can be exported outside for further reuse. Unsuitable materials are recommended to be separately stockpiled, which can be disposed off-site.
- Rehabilitate temporary construction areas such as staging and stockpiling zones as close as practicable to its pre-construction conditions.

With reference to **Figure 4-7** and **Table 4-8**, implementation of the recommended control and mitigation measures manages can reduce sediment yield to a much lower value (1.65 tons/storm – 244.38 tons/storm), which is lower than that of existing conditions (19.20 tons/storm – 880.14 tons/storm). The reduction of sediment yield with the minimum control measures and recommended mitigation measures can likewise reduce the magnitude of impact from “high” to “low” or “medium” depending on the zoning area of Site 1. The detailed of the RIAM is given in **Appendix 4B**.

Table 4-8: Summary of Sediment Yield Assessment for Controlled Conditions (with Mitigation Measures)

Condition	Parameter	Zone 1A	Zone 1B	Zone 2	Zone 2A	Zone 3	Zone 4
Controlled	R	1,304	3,116	7,768	415	530	1,112
	K	0.26	0.26	0.26	0.26	0.26	0.26
	LS	0.33	0.98	4.84	0.61	0.77	3.90
	C	0.05	0.05	0.05	0.05	0.05	0.05
	P	0.50	0.50	0.50	0.50	0.50	0.50
	T (tons/ storm)	2.80	19.85	244.38	1.65	2.65	28.19

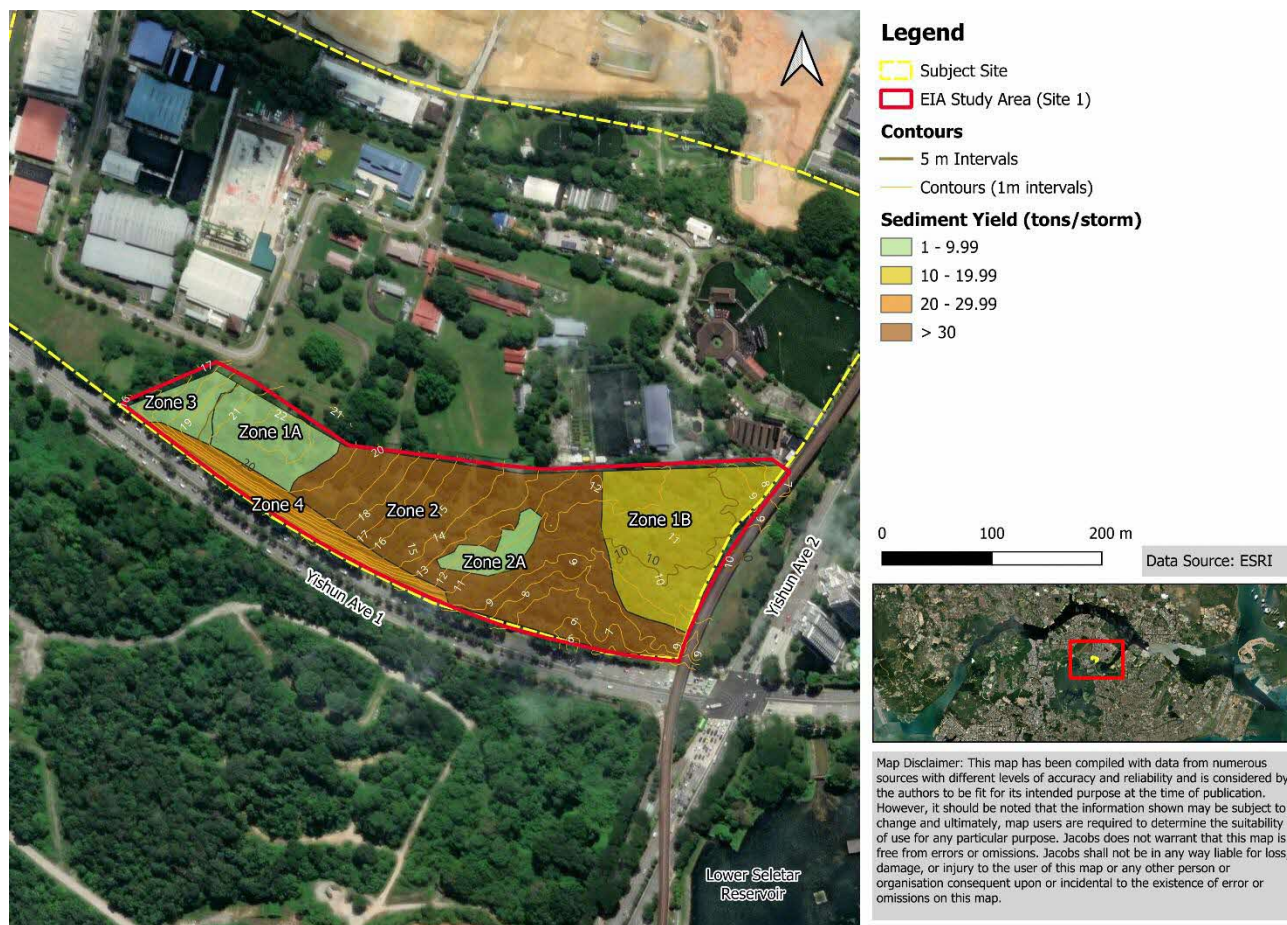


Figure 4-7: Sediment Yield for Condition 3 (Controlled)

4.7 Residual Impact

With the implementation of the following recommended mitigation measures, the residual impact in affected areas is tabulated in **Table 4-9**.

- Permanent reduction of land area with soil cover.
- Amelioration of conserved soil.
- Reduction of soil loss.
- Improvement of soil infiltration capacity.

The adoption of the applicable embedded control measures and mitigation measures recommended above will assist in reducing the impact magnitude to the soil and groundwater quality. As described in **Section 4.5**, the reduction of sediment yield with the minimum control measures and recommended mitigation measures can reduce the magnitude of impact from "high" to "low" or "medium" depending on the zoning area of Site 1.

Table 4-9: Summary of Evaluation of Residual Impact for Geomorphology

Impact Register	Before Mitigation Measures		Post-Mitigation Measures	
	Environmental Score (ES)	Range Bands of ES	Environmental Score (ES)	Range Bands of ES
Soil infiltration capacity	-20	Minor Negative Impact	-10	Slight Negative
Soil loss	-60	Minor Negative Impact	-10 to -20	Slight Negative – Minor Negative

5. Assessment of Ecology and Biodiversity

5.1 Applicable Legislation Standards

NParks administers the Parks and Trees Act which regulates the planting, maintenance and conservation of trees and plants within national parks, nature reserves, tree conservation areas, heritage road green buffers and other specified areas, and the Wildlife Act which enacts protection, preservation, and management of wildlife for the purposes of maintaining healthy ecosystems.

NParks has released the Biodiversity Impact Assessment (BIA) Guidelines (latest revision in May 2024) as a non-prescriptive guide and reference to recognise the basic requirements for the biodiversity component of an EIA.

5.2 Methodology for Ecological Assessment

The EIA focuses on the assessment of the potential impact on habitats and fauna observed and documented during ecology field surveys arising from the proposed works at Site 1. It includes a description of guidelines and methodology used for the assessment.

Ecology field investigations within Site 1 were carried out to establish baseline biodiversity information on the EIA Study Area. Baseline information was first gathered through reviews of past and present biodiversity records, published literature, and in consultation with taxonomic experts. Actual field surveys were then carried out to verify and supplement the data. Specific details of the ecology baseline survey are detailed in the sections below.

5.2.1 Desktop Assessment

5.2.1.1 Taxonomy and Nomenclature

Past and present floristic and faunistic species composition were examined using relevant key references that include books, scientific publications, unpublished literature, and online databases. Sources of these references are The Biodiversity of Singapore by the Lee Kong Chian Natural History Museum (LKCNHM, 2024a), Flora and Fauna Web by the National Parks Board (NParks, 2024b), and iNaturalist (2024). Other key references included the Singapore Red Data Book 3 (NParks, 2024c) and the flora and fauna records compiled by our biodiversity specialists. Key local and/ or regional references for the various taxonomic groups are listed in **Table 5-1** below.

Table 5-1: Key References for the Nomenclature and Taxonomy for Each Taxonomic Group

Taxon	Key References
Plants	Chong et al., 2009; Lindsay et al., 2022; Singapore Red Data Book 3 (SRDB3) (NParks, 2024c); Plants of the World Online (POWO) (Royal Botanic Gardens, 2024a); World Checklist of Selected Plant Families (Royal Botanic Gardens, 2024b)
Aculeate hymenopterans	Ascher et al., 2018; Ascher et al., 2022., NParks, 2024c
Odonates	NParks, 2024b
Butterflies	NParks, 2024b
Herpetofauna (amphibians and reptiles)	Figueroa et al., 2023
Birds	Gill et al., 2024
Mammals	NParks, 2024b

5.2.1.2 Species of Conservation Significance

The assessment of species that are of conservation significance is important for highlighting conservation needs and priorities.

Threatened species of flora, i.e., listed in SRDB3 (NParks, 2024c) as nationally Vulnerable, Endangered, Critically Endangered, or Presumed Extinct (which indicates a rediscovery), were assessed to determine whether they are of conservation significance. While the national conservation status of threatened species is true of wild populations that originate in an area without direct or indirect human intervention, some populations may be relics that persist from past cultivation or escapees from present-day cultivation that do not belong to native genetic stock. The assessment of whether a threatened species is of conservation significance was based on, but not limited to, information on the following: (1) land use history, (2) presence of large parent tree(s), (3) commercial availability, (4) data from previous environmental impact assessments, (5) reforestation efforts, (6) natural range, and (7) importance for associated fauna. If the origin of a threatened species population is disputable or difficult to determine, a more conservative approach was adopted, i.e., they will be considered of conservation significance, with or without corroborating findings from field surveys of fauna.

Faunal species of conservation significance are threatened species which are listed as nationally or globally Vulnerable, Endangered, Critically Endangered, or Extinct, and are native to Singapore. The national conservation statuses were based on the SRDB3 (NParks, 2024c) whereas global conservation statuses followed that of the Red List of Threatened Species by the International Union for Conservation of Nature (IUCN) (2024).

5.2.1.3 Conservation Significance Species of Probable Occurrence

A list of faunal species of conservation significance that were assessed to be probable at Site 1 (termed thereafter as "CS species of probable occurrence") was generated using information on past faunal records and existing habitat types.

5.2.2 Site Reconnaissance Survey

Site reconnaissance surveys were conducted on 16 and 19 August 2024 to obtain an initial understanding of the existing habitats and biodiversity. Field observations were used for planning and execution of the actual surveys. The objectives of the reconnaissance survey were as follows:

- Determine site accessibility and terrain.
- Conduct a preliminary assessment to determine the dominant vegetation types.
- Mark out survey sampling routes and points, and potential locations for camera traps.

5.2.3 Ecology Field Assessment

The field assessment for Site 1 was conducted between 20 August 2024, and 14 January 2025 and camera traps were installed between 9 December and 7 February 2025.

5.2.3.1 Tree Mapping and Assessment

Tree mapping and assessment were carried out within Site 1. All trees, single-stemmed palms (i.e., defined as having one obvious and erect stem), and strangling *Ficus* species of ≥ 1.0 m girth or spread were assessed during arboriculture surveys and tagged with a unique serial number. Other specimens that were of conservation significance with ≥ 0.3 m girth or spread were tagged on a best-effort basis. Weatherproof and tearproof paper tags secured with gardening wire were used for tree tagging. Sufficient slack of a few centimetres and/or up to one arm's length was provided, depending on the size of the tree to cater for tree growth. This was to prevent the wire from girdling the trunk of the tree. Geographic locations, girth/spread, and

height were also recorded. The tree tagging team provided the tree tagging information to the topographical survey team and worked with them to verify the tree species and respective locations indicated on the topographical plan.

A differential Global Positioning System (DGPS) that can achieve up to sub-meter accuracy was used to record geographic locations of the specimens using the SVY21 plane coordinate system. This local datum gives a more accurate representation of the areas of coverage in Singapore compared to a global datum and is used by the Singapore Land Authority (SLA).

Specimens that were inaccessible due to any obstructions, (e.g., streams, nearby tree fall), these were not given a physical tag on site. Instead, locations were marked using the DGPS and the assessment was still carried out by certified arborists.

Arboriculture assessment of the trees was conducted by certified arborists. Plant health and structural stability were assessed by observing for damages, decays, and/or canopy asymmetry, which, if present, may compromise plant longevity and stability.

5.2.3.2 Floristic Field Assessment

The field assessment for flora consisted of 1) Habitat and vegetation mapping and 2) General walking floristic surveys within Site 1.

5.2.3.2.1 Habitat and vegetation mapping

A preliminary vegetation map was first prepared based on visual interpretations of satellite images from Google Earth 0.59.0.2 (Google, 2023) and the information gathered from site reconnaissance surveys. Preliminary classification of the vegetation types (e.g., forests, grasslands, or managed vegetation) was determined using visual features, such as textures and colours observed in the satellite images. Adjustments were then made to the preliminary maps according to actual observations during ground truthing. Ground truthing was conducted throughout the survey area with the aid of a GPS receiver (Garmin GPSMap® 64s). Photographs of the vegetated areas were also taken. The boundaries of each vegetation type were tracked on the GPS receiver and mapped out on Google Earth 10.59.0.2. Vegetation type identification redereced the classification indicated on NParks BIA guidelines (NParks, 2024a).

5.2.3.2.2 General walking floristic surveys

All plants observed within Site 1 during floristic surveys were identified to species level whenever possible. A checklist of all the plant species recorded from the present floristic surveys was compiled. The nomenclature and national conservation status followed that of SRDB3 (NParks, 2024c) and/or other published papers with updated information, such as and Chong et al. (2009) and Lindsay et al. (2022). Other information on the plant species was also crosschecked with online databases, namely, NParks Flora and Fauna Web (NParks, 2024b) and Singapore Biodiversity Online (LKCNCM, 2024a).

For plants that could not be immediately identified with certainty in the field, photographs and/ or voucher specimens were taken. They were then identified using identification keys, taxonomic descriptions, online plant photo databases, with the help of taxonomic experts, and/ or by matching the pressed and dried collected specimens with existing specimens in the Singapore Botanic Gardens' Herbarium (SING).

For very tall unidentifiable trees with leaves that were too high in the canopy to photograph, dried leaves matching these trees were collected from the forest floor and used to aid in species identification.

Species of Conservation Significance

The geographic coordinates of plants of conservation significance, i.e., listed in SRDB3 (NParks, 2024c) as nationally Vulnerable, Endangered, Critically Endangered or Presumed Extinct (which indicates a rediscovery), were marked using a Global Positioning System ("GPS") receiver (Garmin GPSMap® 64s), which recorded locations with accuracy of ± 4 m, during floristic surveys. Where there were clusters of plants of conservation significance, i.e., more than one individual occurring within 5 m or less of another individual, the approximate centre of the area was marked using the GPS receiver.

Large Plant Specimens

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

Other Specimens of Value

Locations of other plants that are of value but do not meet the minimum size requirement, as detailed in the above, were recorded using the GPS receiver. Examples of such include bamboo clusters of < 3 m spread that may be important refugia for rare bamboo bats, exotic albizia trees (*Falcataria moluccana*) with raptor nests, amongst others.

5.2.3.3 Faunistic Field Assessment

Faunistic field surveys were carried out within Site 1 for the following taxa: (1) aculeate hymenopterans (bees and stinging wasps, excluding ants) (2) butterflies, (3) odonates (damselflies and dragonflies), (4) herpetofauna (amphibians and reptiles), (5) birds and (6) mammals (including bats). Each survey was conducted twice with an interval of at least one month between the survey cycles (i.e. two cycles). All observations of species of conservation significance from the aforementioned taxa were also recorded if seen outside the stated survey times. A checklist of all species of fauna observed from the surveys were compiled.

Figure 5-1 and **Figure 5-2** shows the locations of terrestrial transects, roadkill transects and camera traps, where fauna surveys were conducted along. **Table 5-2** summarises all the surveys that were carried out for fauna. Each survey was performed by at least two surveyors. All fauna encountered was identified to the species level, or to the next lowest taxonomic level possible, and the location of each sighting was recorded using a handheld GPS (Garmin GPSMAP 64s). The number of individuals observed was also documented.

Specialist Consultancy Services for Environmental Impact Assessment (EIA) at Chencharu (Site 1)

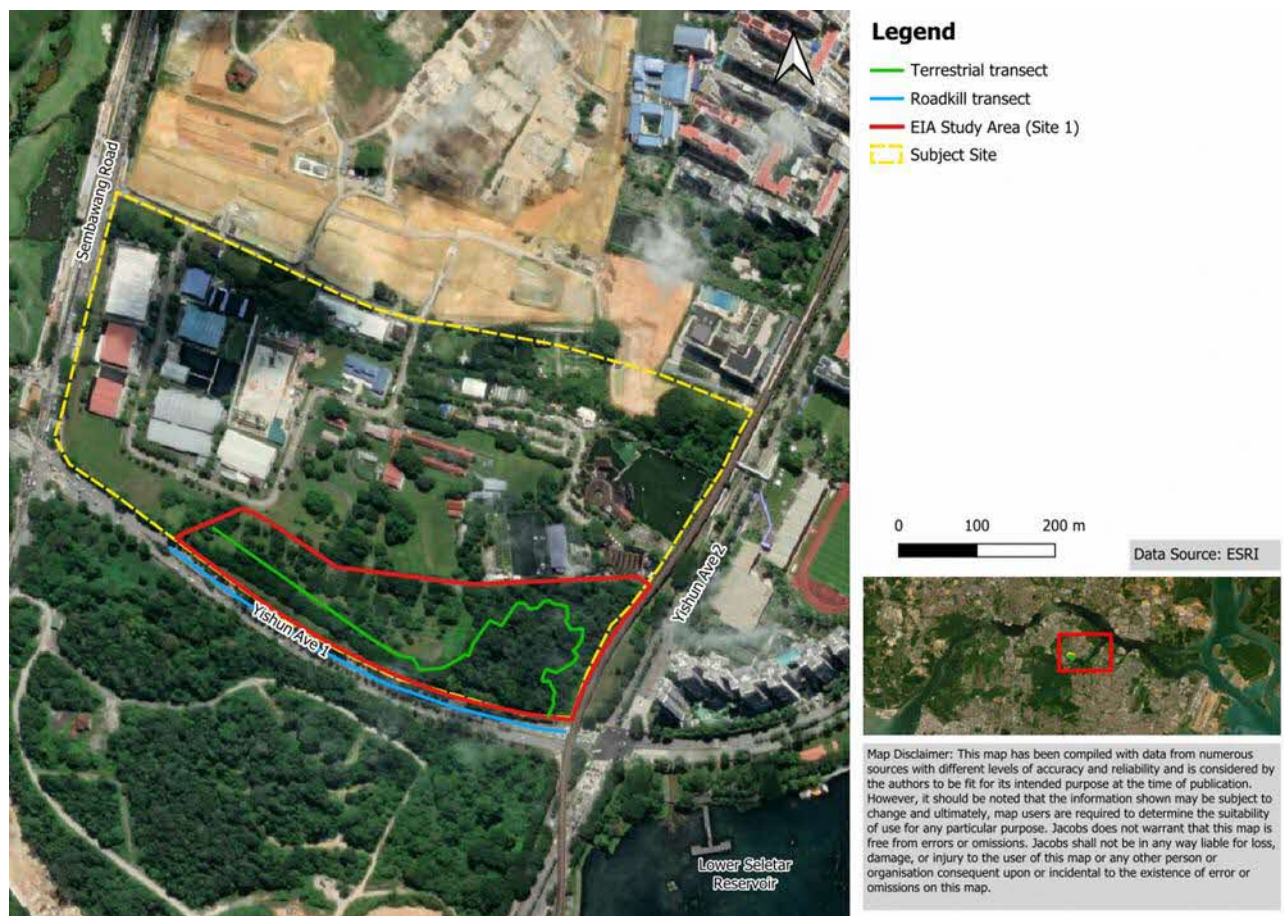


Figure 5-1: Locations of Terrestrial Transects in Site 1

Table 5-2: Summary of Fauna Surveys

Survey Type	Taxon	Timing (h)	Duration	Sampling Unit*	No. of sampling units	Technique	Data Collected
Diurnal transect surveys	Aculeate hymenopterans	0900–1200	20–30 minutes per transect; two cycles	200-m continuous transects along a sampling route	4	Visual only; up to 25 m left, right, and front of surveyor	Location, species, quantity, date, time
	Butterflies	0900–1600	20–30 min per transect; two cycles	200 m continuous transects along a sampling route	4	Visual only; up to 25 m left, right, and front of surveyor	Location, species, quantity, date, time
	Odonates (damselflies and dragonflies)	0900–1600	20–30 min per transect; two cycles	200 m continuous transects along a sampling route	4	Visual only; up to 25 m left, right, and front of surveyor	Location, species, quantity, date, time

Survey Type	Taxon	Timing (h)	Duration	Sampling Unit*	No. of sampling units	Technique	Data Collected
Diurnal and nocturnal transect surveys	Herpetofauna (amphibians and reptiles)	0700–1000; 2000–2300	20–30 min per transect; two cycles	200 m continuous transects along a sampling route	4	Visual and auditory; up to 50 m left, right, and front of surveyor	Location, species, quantity, date, time
	Birds	0700–1000h; 2000–2300	20–30 min per transect; two cycles	200 m continuous transects along a sampling route	4	Visual and auditory; up to 50 m left, right, and front of surveyor	Location, species, quantity, date, time
	Mammals (non-volant)	0700–1000; 2000–2300	20–30 min per transect; two cycles	200 m continuous transects along a sampling route	4	Visual and auditory; up to 50 m left, right, and front of surveyor	Location, species, quantity, date, time
Camera trapping	Mammals (non-volant)	24 h a day	60 days per camera trap	24 h continuous period of recording on a camera trap	2	Infrared motion sensing	Location, species, quantity, date, time
Bio-acoustic sampling (hand-held bat detector)	Mammals (bats)	2000–2300	Continuous; two cycles	200 m continuous transects along a sampling route	4	Auditory only	Location, species, date, time
Harp trap	Mammals (bats)	1930–2100; 2100–0800	Overnight	-	1	Trapping	-

Survey Type	Taxon	Timing (h)	Duration	Sampling Unit*	No. of sampling units	Technique	Data Collected
Roadkill surveys	Terrestrial fauna	0700–1000	-	Along Yishun Ave 1, which borders the forest edge of Site 1 and has vegetated habitats on both sides of the road	-	Visual only	Location, species, quantity, date, time

**A sampling unit is the building block of the dataset that will be used for statistical analyses. For transect surveys, one sampling unit is defined as a 200-m long transect. Hence, a sampling route may consist of several 200 m transects.*

a) Aculeate hymenopterans

Diurnal transect surveys were carried out for aculeate hymenopterans along 200 m continuous transects on a sampling route between 0900 h and 1200 h (**Figure 5-1**). Aculeate hymenopterans were identified visually (with binoculars where necessary), photographed, or caught using insect nets, if required. Captured individuals were released immediately after identification. When identification in the field was not possible, live specimens were collected and examined post-hoc under a microscope. The specimens were identified to the lowest taxonomic level using relevant references, identification keys, or in consultation with taxonomic experts. Two cycles of surveys were carried out.

b) Butterflies

Diurnal transect surveys were carried out for adult butterflies along 200 m continuous transects on a sampling route between 0900 h and 1600 h (**Figure 5-1**). Butterfly caterpillars, pupae, eggs, and host plants were also recorded when observed. Adult butterflies were identified visually (with binoculars where necessary), photographed, or caught using insect nets, if required. Captured individuals were released immediately after identification. Two cycles of surveys were carried out.

c) Odonates (Dragonflies and Damselflies)

Diurnal transect surveys were carried out for adult damselflies and dragonflies along 200 m continuous transects on a sampling route between 0900 h and 1600 h (**Figure 5-1**). Adult odonates were identified visually (with binoculars where necessary), photographed, or caught using insect nets, if required. Captured individuals were released immediately after identification. Two cycles of surveys were conducted.

d) Herpetofauna (Amphibians and Reptiles)

Diurnal (0700 h–1000 h) and nocturnal (2000 h–2300 h) surveys were carried out for amphibians and reptiles along 200 m continuous transects on a sampling route (**Figure 5-1**). As herpetofauna occupy a wide range of habitat types, both the diurnal and nocturnal surveys also involved active searches for individuals on the ground, below rocks, logs, leaf litter and debris and/or on vegetation. Rocks, logs, and other structures were returned to their original positions if moved during the searches. Torches and/or headlamps were used to elicit eyeshine during nocturnal surveys. Vocalising fauna were also located or identified by call recognition, whenever possible. For species that are capable of quick retreats and escapes, the individuals were captured by

hand, or using hooks, tongs, or dip nets for identification. Captured individuals were released immediately after identification. Two cycles of surveys were conducted.

e) Birds

Diurnal (0700 h–1000 h) and nocturnal (2000 h–2300 h) surveys were carried out for birds along 200 m continuous transects on a sampling route (**Figure 5-1**). Birds were identified visually (with binoculars where necessary) and photographed. Torches and/or headlamps were used to elicit eyeshine during nocturnal surveys. Vocalising birds were also located or identified by call recognition, whenever possible. Two cycles of surveys were conducted. All surveys were carried out within the peak bird migratory season in Singapore, which is between September and March (Lim, 2009), based on the baseline survey period (Sep–Feb).

f) Mammals (Non-volant)

Diurnal (0700 h–1000 h) and nocturnal (2000 h–2300 h) surveys were carried out for non-volant mammals along 200 m continuous transects on a sampling route (**Figure 5-1**). Both the diurnal and nocturnal surveys also involved searches in burrows and tree holes. Tracks and scats were also recorded. Mammals were identified visually (with binoculars where necessary) and photographed. Torches and/or headlamps were used to elicit eyeshine during nocturnal surveys. Vocalising mammals, such as squirrels, were also located or identified by call recognition, whenever possible. Two cycles of surveys were conducted.



Figure 5-2: Camera Trap Locations in Site 1

Mammals were also surveyed via camera trapping. Two terrestrial camera traps were deployed across Site 1 (**Figure 5-2**). The deployment location was relatively free of vegetation to reduce false triggers and for optimal detection range. Each terrestrial camera trap was set up approximately 20–30 cm above ground (**Figure 5-3**). They operated 24 h a day and were programmed to record one 10 second footage per motion trigger with a 10 second quiet period following each trigger. Each camera trap was deployed for 60 days.



Figure 5-3: Camera Trap Locations in Site 1

g) Mammals (Bats Only)

Acoustic surveys were carried out for bats along 200 m continuous transects on a sampling route between 2000 h and 2300 h. An unattended bat detector (Song Meter) was used to record and attenuate ultrasonic calls between 18 and 192 kHz at a sampling frequency of 384 kHz to low frequency signals below 20 kHz, a range that is inaudible to the human ear.

One harp trap (**Figure 5-4**) was deployed strategically at one location at potential flyways across Site 1 (**Figure 5-5**) to improve accuracy of species identification. Harp traps target the smaller insectivorous bats (Microchiroptera). The harp trap was set up between 1730 h–1930 h and the trapping duration occurred between 1930 h–2100 h, during which the trap was repeatedly checked. The trap was left overnight and checked the following morning between 0800 h and 0900 h and removed. No bats were collected.



Figure 5-4: Photo of the Harp Trap Set Up

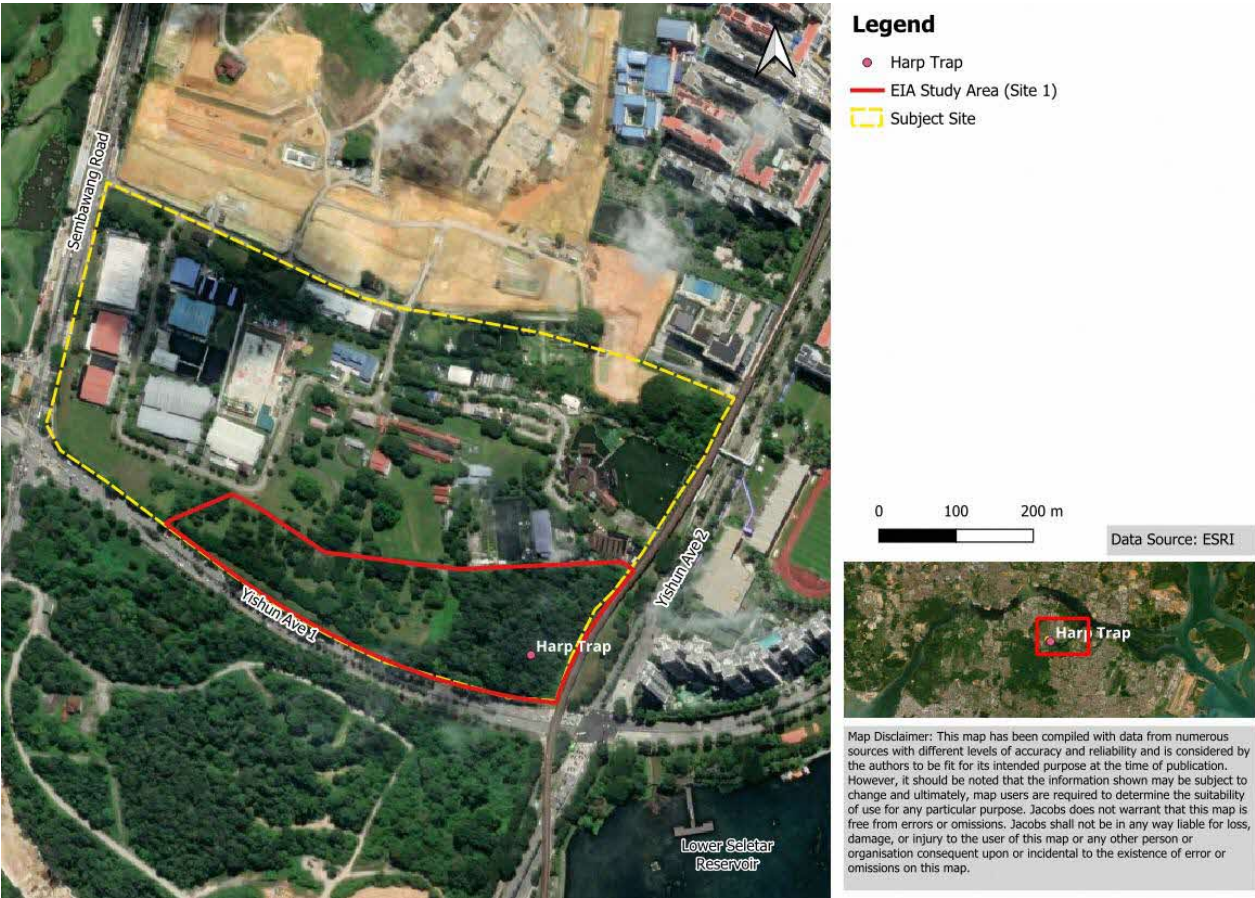


Figure 5-5: Harp Trap Location in Site 1

5.2.4 Data Analysis

5.2.4.1 Species Distribution Maps

The distribution of species of conservation significance was mapped using QGIS v.3.4 (Quantum GIS Development Team, 2019).

5.2.4.2 Camera Trapping

The camera trap location, species identity, and the number of individuals were recorded for each video with a positive capture of fauna. An independent detection constitutes a video of one or a group of individuals of the same faunal species occurring within 60 minutes at each camera trap. The number of independent detections was used to calculate detection rate of each mammal species.

5.2.4.3 Bat Sound File Analysis

All bat sound files were processed using Kaleidoscope v.4.5.4 (Wildlife Acoustics, Inc.) to separate extraneous noise from files with bat echolocation calls. The signal parameters for recognising a potential bat echolocation call were configured as follows: frequency range of 20–200 kilohertz (kHz), duration of 2–500 milliseconds (ms), maximum inter-syllable gap of 500 ms, and a minimum of 2 pulses. These files were visually processed to identify bat species based on call structures, peak frequency, minimum frequency, and call duration. They were identified with reference to those in Pottie et al. (2005), which provides echolocation signatures for bats in Singapore, and other relevant references (Collen, 2012; Hughes et al., 2011).

5.2.4.4 Taxon Sampling Curves

Taxon sampling curves were plotted for selected taxa with sufficient occurrences as large sample sizes are required for the estimation of sample coverage to be robust (Chao & Jost, 2012). The observed sample of incidence data was used to estimate sample coverage and species richness. Species richness was plotted against sample coverage, as opposed to survey effort, to estimate sample completeness/ survey adequacy, i.e., how extensively the species in the community has been sampled. Sample coverage refers to “the proportion of the total number of species in a community that belongs to the species represented in the sample” (Chao & Jost, 2012). The curve was extrapolated to provide an estimation of species richness and sample coverage if sample size was doubled. The associated standard error and 95% confidence interval were also computed. Standard error represents the range of uncertainty of the estimate, while 95% confidence interval is the interval in which there is a 0.95 probability of containing the estimated true species richness. As some species will always remain undetected, total species richness had to be estimated via extrapolation. This was done using the Chao estimator. All statistical analyses were carried out in the statistical programming environment R version 3.4.3 using the “iNEXT” package 2.0.20 (Hsieh et al., 2019).

5.3 Existing Pre-Construction Conditions

This section presents the preliminary biodiversity baseline findings for Site 1 conducted from 20 August 2024 to 14 January 2025.

5.3.1 Habitat Description

Site 1 comprises three habitat types: abandoned land forest, scrubland /grassland, and urban vegetation (**Table 5-3; Figure 5-6**). Among these, the abandoned land forest was the largest, covering 2.83 ha (41%). This forest was primarily located in the eastern half of the EIA Study Area. Scrubland / grassland was the next largest habitat type occupying 2.40 ha (35%) and was concentrated in the central portion, tapering off toward the western boundary. Additionally, smaller patches of scrubland/ grassland were also found along the southeastern border. Urban vegetation, the smallest habitat type, covered 1.68 ha (24%) and was distributed across the southwestern and northwestern sections of Site 1.

Table 5-3: Absolute (ha) and Relative (%) Size of Each Habitat and Vegetation Type in Site 1

Habitat and Vegetation Type	Absolute size (ha)	Relative size (%)
Abandoned land forest	2.83	41
Scrubland / grassland	2.40	35
Urban vegetation	1.68	24
Total	6.91	100

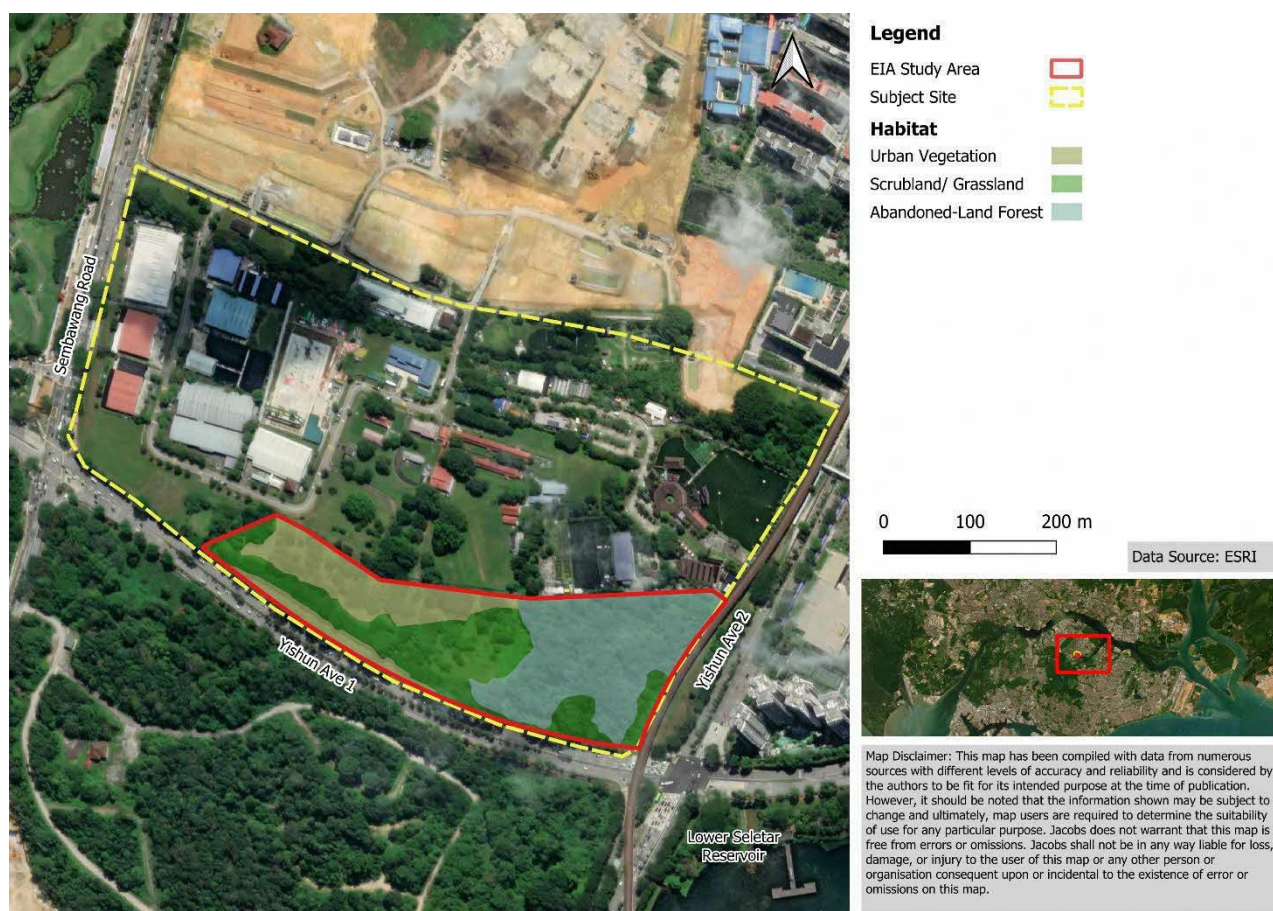


Figure 5-6: Habitats within Site 1

5.3.1.1 Abandoned Land Forest

The abandoned land forest occupied 2.83 ha or 41% of the Study Area and was concentrated in the eastern half of the Study Area. The commonly encountered tree species for Site 1 include rubber (*Hevea brasiliensis*), durian (*Durio zibethinus*), longan (*Dimocarpus longan*) and rambutan (*Nephelium lappaceum*) (Figure 5-7A). The dominance of rubber and fruit trees in the abandoned land forest aligns with the site's historical land use, as it was originally covered by rubber plantations in 1945 (The Long and Winding Road, 2010; Figure 5-7B) before eventually replaced with "sundry tree cultivation" (comprising crop, fruit and/or ornamental trees) by 1998 (Figure 5-7E).

It is worth noting that small sections of the forested interior were seemingly cleared with the presence of makeshift structures and undocumented small-scale farming activities (e.g. banana, pandan, cassava, pineapple were observed on-site), potentially by members of the public (Figure 5-7B).

Although the abandoned land forests are generally dominated by exotic cultivated species, they can also be refugia and resource pools for local biodiversity, as they have been shown to support re-colonisation of native species (Lugo & Helmer 2004; Mcshea *et al.*, 2009; Edwards *et al.*, 2011). This was evident in the understorey layer of Site 1, where, aside from the saplings of rubber and fruit trees, native species such as wild cinnamon (*Cinnamomum iners*), common tree-vine (*Leea indica*), and rukam utan (*Aporosa frutescens*) (Figure 5-7C) were frequently recorded. Several clusters of threatened species were also observed in this habitat, including the nationally Endangered climber *Adenia cordifolia* (Figure 5-7D), *Melicope lunu-ankenda*, as well as Vulnerable grass *Cyrtococcum patens*, bayas (*Oncosperma horridum*), *Glochidion zeylanicum* var. *zeylanicum*, and *Symplocos fasciculata*.



Figure 5-7: Abandoned Land Forest in Site 1, (A) Dominated by Rubber (*Hevea brasiliensis*); (B) Presence of Undocumented Small-Scale Farming ; (C) Saplings of Native Tree Rukam Utan (*Aporosa frutescens*); (D) Nationally Endangered Climber *Adenia cordifolia*.

5.3.1.2 Scrubland / Grassland

Scrubland / grassland occupied about 2.40 ha (35%) of Site 1. It was mostly concentrated in the central part of Site 1, extending towards the southeastern and western border of the site. This habitat was characterised by short herbaceous vegetation with a uniform stratum and open canopy, consisting of a mix of sun-loving shrubs, grasses, ferns, and climbers.

The southeastern section was dominated by shrubs such as bitter cassava (*Manihot esculenta*), simpoh air (*Dillenia suffruticosa*), ornamental corn palm (*Dracaena fragrans*), and Chinese creeper (*Mikania micrantha*) (Figure 5-8A). In contrast, the central and the westernmost portions were primarily comprised overgrown native grass (*Ottocloa nodosa*) and broad sword ferns (*Nephrolepis biserrata*), interspersed with herbaceous shrubs such as giant taro (*Alocasia macrorrhizos*), along with weeds like coat buttons (*Tridax procumbens*) and Messina creepers (*Ipomoea cairica*) (Figure 5-8B). Lastly, the southwestern side contained a dense strip of

camwood (*Baphia nitida*), which is a shrub commonly planted as hedges along streetscapes (Figure 5-8C). Fruit trees such as mango (*Mangifera indica*) and mangosteen (*Garcinia mangostana* var. *mangostana*), as well as common native species like wild cinnamon (*Cinnamomum iners*) and weeping fig (*Ficus benjamina*), were also scattered sparsely throughout this vegetation type. Notably, three saplings of the nationally Vulnerable tree (*Lindera lucida*) were observed in this habitat.



Figure 5-8: Scrubland / grassland in Site 1. (A) Scrubland dominated by bitter cassava (*Manihot esculenta*) and Chinese creeper (*Mikania micrantha*); (B) Grass and fern-dominated habitat; (C) Camwood (*Baphia nitida*)-dominated habitat.

5.3.1.3 Urban Vegetation

Urban vegetation occupied the smallest portion of Site 1, covering 1.68 ha (24%). A small patch of urban vegetation was found on the sloped southwestern side, adjacent to Yishun Avenue 1. It was mostly composed of planted turf grass species, namely wide-leaved carpet grass (*Axonopus compressus*), with spontaneous grass species including *Ottolochloa nodosa* and lalang (*Imperata cylindrica*). Spontaneous herbs such as scattered Malayan eyebright (*Legazpia polygonoides*), ribu-ribu (*Lygodium microphyllum*), and swamp shield fern (*Cyclosorus interruptus*) were also scattered within this area. This part of Site 1 appeared to be regularly maintained due to its proximity to the walkway and main road (Figure 5-9A).

In addition, a larger portion of urban vegetation was located on the northwestern side and featured a similar composition of grasses and herbs (Figure 5-9B). While this area showed signs of maintenance, such as periodic grass cutting, it was less regularly maintained than the southwestern section, as evidenced by the presence of overgrown grasses and weeds. Moreover, scattered clusters of durian (*Durio zibethinus*), rain tree (*Samanea saman*), and *Khaya nyasica* were observed in this habitat. Their equidistant arrangement suggests that they were remnants of past cultivation, which can also be attributed to the site's historical land use. The western section of Site 1 was formerly part of Sembawang Nursery, where land was utilised to cultivate plants of agricultural and horticultural value, as reflected in the 1975 topographical maps (Figure 2-3, Figure 2-3D).



Figure 5-9: Urban vegetation in Site 1. (A) Regularly maintained grass-dominated vegetation adjacent to Yishun Avenue 1; (B) Urban vegetation dominated by grasses with scattered clusters of durian and rain trees.

5.3.2 Floristic Baseline Results

5.3.2.1 Overall Floristic Findings

A total of 203 plant species and species groups (i.e., plants that could not be identified to species with certainty), belonging to 78 families, were recorded within Site 1. There were three species groups in total, comprising the following: (1) *Dipterocarpus* sp., (2) *Khaya* cf. *nyasica*, (3) *Horsfieldia* cf. *polyspherula* var. *polyspherula*. The list of flora species is provided in **Appendix 5A**.

Of the 203 species and species group recorded, 100 (49.3%) were native, 89 (43.8%) exotic, and 12 (5.9%) cryptogenic (i.e., of unknown or uncertain origin despite being a known species). One (0.5%) has not been assessed and one (0.5%) was of unknown origin as they could not be identified to species. The full list of the number and percentage of plant species and species groups belonging to each status category are summarised in **Table 5-4**.

Within Site 1, 27 native threatened species and species groups (13.3%) were recorded. Native threatened species comprised species that have been accorded the following statuses: Vulnerable, Endangered, Critically Endangered, and Presumed Extinct. For overall findings, however, a distinction was not made as to whether threatened species were from native wild populations or were cultivated locally and/or relics from past cultivation. Species belonging to the latter category are not of conservation significance even though they have been accorded with a threatened status. This is discussed in greater detail in 'Species of Conservation Significance' under **Section 5.3.2.2**.

Other findings include 14 large plant specimens, and 8 specimens of value (**Figure 5-10**). Large specimens comprise all plant specimens of ≥ 3 m girth, as well as bamboo clusters, palm clusters, and strangling *Ficus* species of ≥ 3 m spread; while other specimens of value include plant specimens < 3 m spread that may be important to fauna species such as refugia for rare bamboo bats, exotic albizia trees (*Falcataria moluccana*) with raptor nests, amongst others.

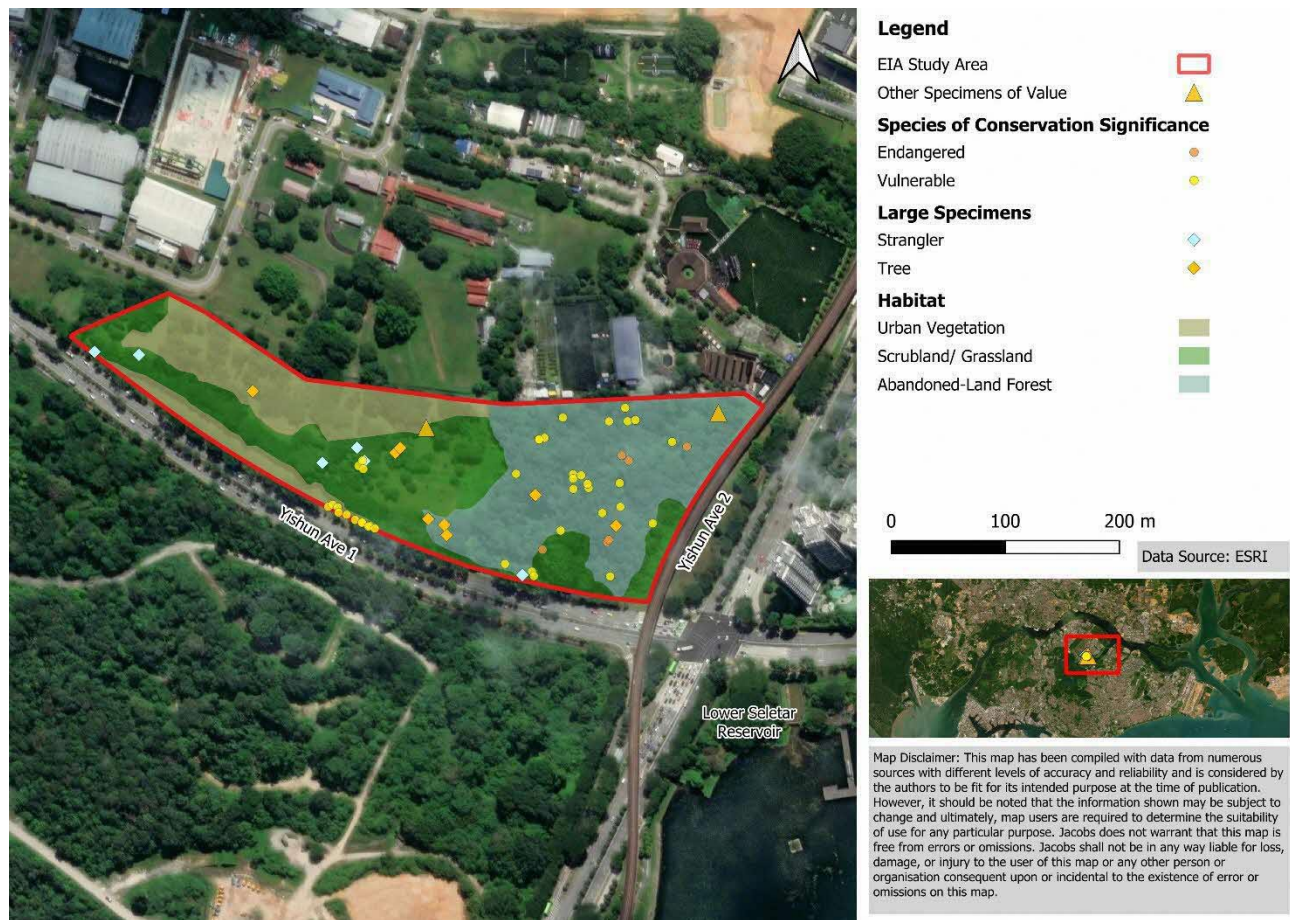


Figure 5-10: Distribution of Species of Conservation Significance, Large Specimens, and Other Specimens of Value within Site 1

Table 5-4: Number and Percentage of Species Belonging to Each Category

Origin	Status	Number of Species	Percentage (%)
Native		100	49.3
	Common	73	36.0
	Vulnerable	13	6.4
	Endangered	6	3.0
	Critically Endangered	8	3.9
	Presumed Extinct	0	0.0
Exotic		89	43.8
	Cultivated Only	19	9.4
	Casual	27	13.3
	Naturalised	40	19.7
	Not Assessed	3	1.5

Origin	Status	Number of Species	Percentage (%)
Cryptogenic		12	5.9
Not Assessed		1	0.5
Unidentified		1	0.5
Total		203	100.0

5.3.2.2 Species of Conservation Significance

Of the 27 threatened native species (species with Vulnerable, Endangered and Critically Endangered status), 14 species are considered of conservation significance (CS) in Site 1 (**Appendix 5B**). Of these, ten are nationally Vulnerable and four are nationally Endangered (**Table 5-5**). Altogether, 44 specimens and/or clusters of specimens belonging to these species of conservation significance were recorded within Site 1 (**Table 5-6**). Majority of these specimens were concentrated within the eastern abandoned land forest patch. The distribution of plant specimens of conservation significance within Site 1 is provided in **Figure 5-12**.

The other 13 species, though listed as nationally threatened, were not considered species of conservation significance in this EIA study because they were most likely planted, escapees from present-day cultivation, or relics that have persisted from the past. This is likely due to the site's historical land use as part of Sembawang Nursery as well as its proximity to NParks' tree bank and surrounding streetscapes. The excluded species include commonly planted roadside trees such as *Cynometra ramiflora*, *Cratoxylum cochinchinense*, *Syzygium myrtifolium*, and *Syzygium oblatum* var. *oblatum*. The assessment of whether a threatened plant species is of conservation significance was carried out based on the criteria detailed in **Section 5.2.1.2**.

Table 5-5: Number of Threatened Species within Site 1

Species Conservation Status*	VU	EN	CR	EX
Non-cultivated Threatened Species	10	4	0	0
Cultivated Threatened Species	3	2	8	0

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

Table 5-6: Number of Plant Specimens and Species of Conservation Significance in Site 1

Habitat	Number of Individuals and/or Clusters					Number of Species				
	VU	EN	CR	EX	Total	VU	EN	CR	EX	Total
Abandoned Land Forest	22	5	0	0	27	9	3	0	0	12
Scrubland / Grassland	5	1	0	0	6	2	1	0	0	3
Urban Vegetation	10	0	0	0	10	1	0	0	0	1

*Note: Total species richness of Site 1 is not the sum of species richness per vegetation type as some species occur in more than one vegetation type. VU – Vulnerable; EN – Endangered; CR – Critically Endangered.

Of the ten nationally Vulnerable species recorded from Site 1, *Symplocos fasciculata* (**Figure 5-11A**) could readily be found within the abandoned land forest habitat on the eastern half of Site 1, with 12 specimens recorded in total. The presence of mature trees and young saplings of girths ranging from less than 0.05 m to 1.1 m suggests active recruitment of this species. *Microlepia speluncae* (**Figure 5-11B**) was also relatively abundant within Site 1, with ten specimens concentrated near the dense strip of camwood (*Baphia nitida*). Previously not listed as a threatened species in RDB2, *Microlepia speluncae* is now classified as vulnerable in

RDB3, suggesting that its population has declined in recent years. Both *Symplocos fasciculata* and *Microlepia speluncae* are commonly encountered in secondary regrowth forests on abandoned rubber plantations, with the former found in Lentor Forest (Neo et al., 2013a) and Upper Thomson Forest (Neo et al., 2014) and the latter in Bukit Batok East Forest (Neo et al., 2012) and Clementi Forest (Neo et al., 2013b).

The nationally Vulnerable *Lindera lucida* and *Glochidion zeylanicum* var. *zeylanicum* were found in both abandoned land forest and scrubland / grassland habitats, with few specimens tending to occur in clusters. Three specimens of the nationally Vulnerable *Oncosperma horridum* were found in the interior of the abandoned land forest, two specimens were recorded for *Cyrtococcum patens* on the forest edges, and only one specimen was recorded for *Litsea umbellata*, *Macaranga griffithiana*, *Horsfieldia* cf. *polyspherula* var. *polyspherula*, and *Hornstedtia scyphifera* var. *scyphifera*, respectively.

Of the four nationally Endangered species recorded from Site 1, *Adenia cordifolia* was the most frequently observed species, with a total of three specimens found growing on trees as a climbing vine (**Figure 5-11C**). Other nationally Endangered species found within Site 1 include *Litsea castanea*, *Melicope lunu-ankenda*, and *Xanthophyllum flavescens*, with only one specimen recorded for each species.



Figure 5-11: Species of conservation significance found in Site 1. (A) *Symplocos fasciculata*; (B) *Microlepia speluncae*; (C) *Adenia cordifolia*.

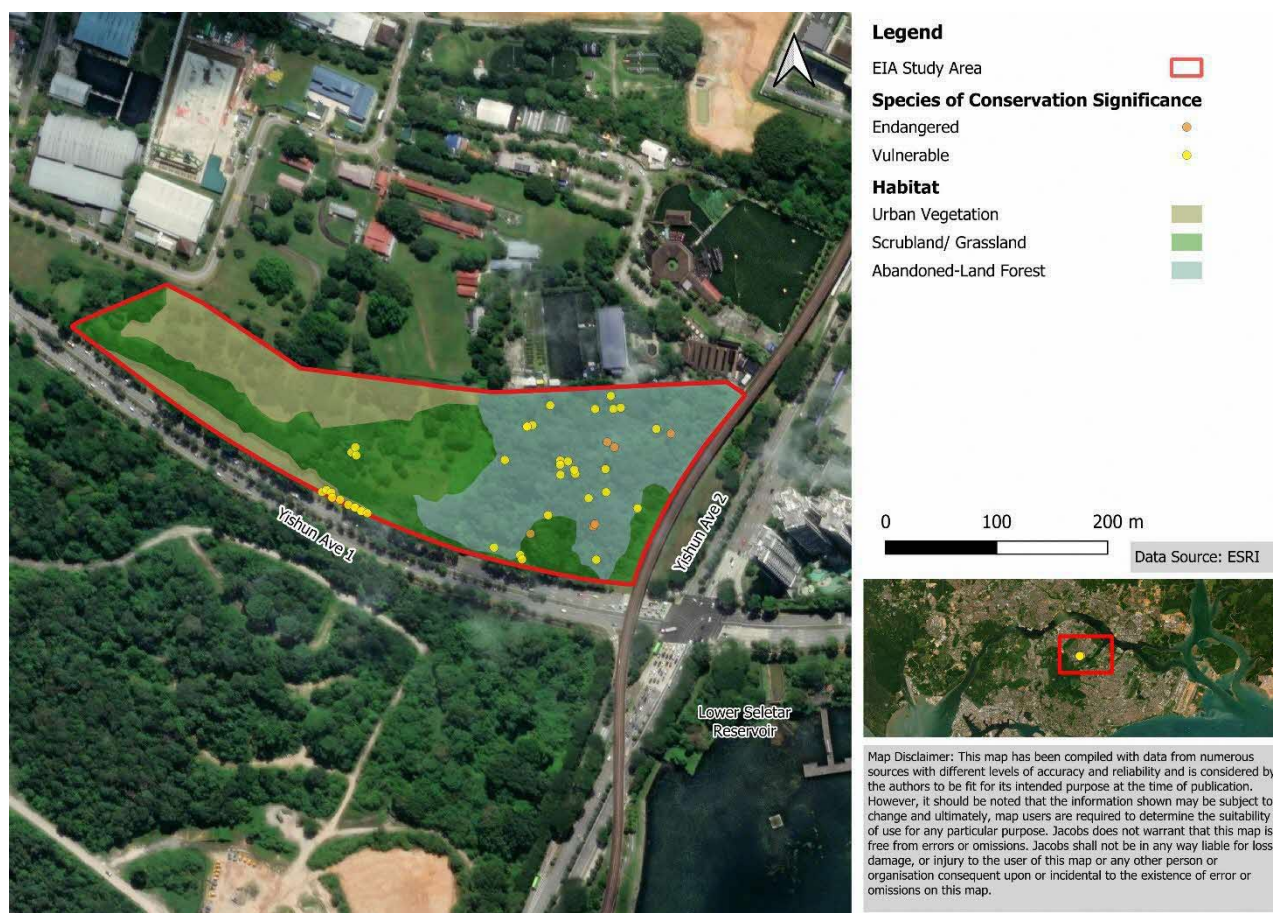


Figure 5-12: Location of Plant Species of Conservation Significance within Site 1

5.3.2.3 Large Plant Specimens

A total of 14 large plant specimens were recorded during the floristic surveys in Site 1 (Table 5-7; Appendix 5C). Of these specimens, eight are large trees (3.0 – 6.0 m in girth) and the remaining six are stranglers (3.0 – 20 m in spread).

Majority of the large tree specimens recorded on-site belonged to species that can bear edible fruit and are likely remnants from past sundry cultivation, including the exotic durian (*Durio zibethinus*) and cashew nut (*Anacardium occidentale*) trees, as well as native species of rambai (*Baccaurea motleyana*) and sentul (*Sandoricum koetjape*). The remaining large trees were rubber trees (*Hevea brasiliensis*) and are also likely relics from past rubber cultivation. These large tree specimens sometimes occurred in clusters but were otherwise scattered across Site 1 (Figure 5-13).

Four (4) weeping fig (*Ficus benjamina*) and two Malayan banyan (*Ficus microcarpa*) stranglers were recorded within scrubland habitats and along the forest edge. Of these, the largest specimen encountered was a native *Ficus microcarpa* strangler, boasting a spread of 20 m and a height of 20 m.

Table 5-7: Number of Large Plant Specimens in Site 1

Habit	Species	Origin	No. of Specimens
Tree	<i>Anacardium occidentale</i>	Exotic	1
	<i>Baccaurea motleyana</i>	Native	1
	<i>Durio zibethinus</i>	Exotic	3

Habit	Species	Origin	No. of Specimens
Strangler	<i>Hevea brasiliensis</i>	Exotic	2
	<i>Sandoricum koetjape</i>	Native	1
	<i>Ficus benjamina</i>	Cryptogenic	4
	<i>Ficus microcarpa</i>	Native	2
Total			14

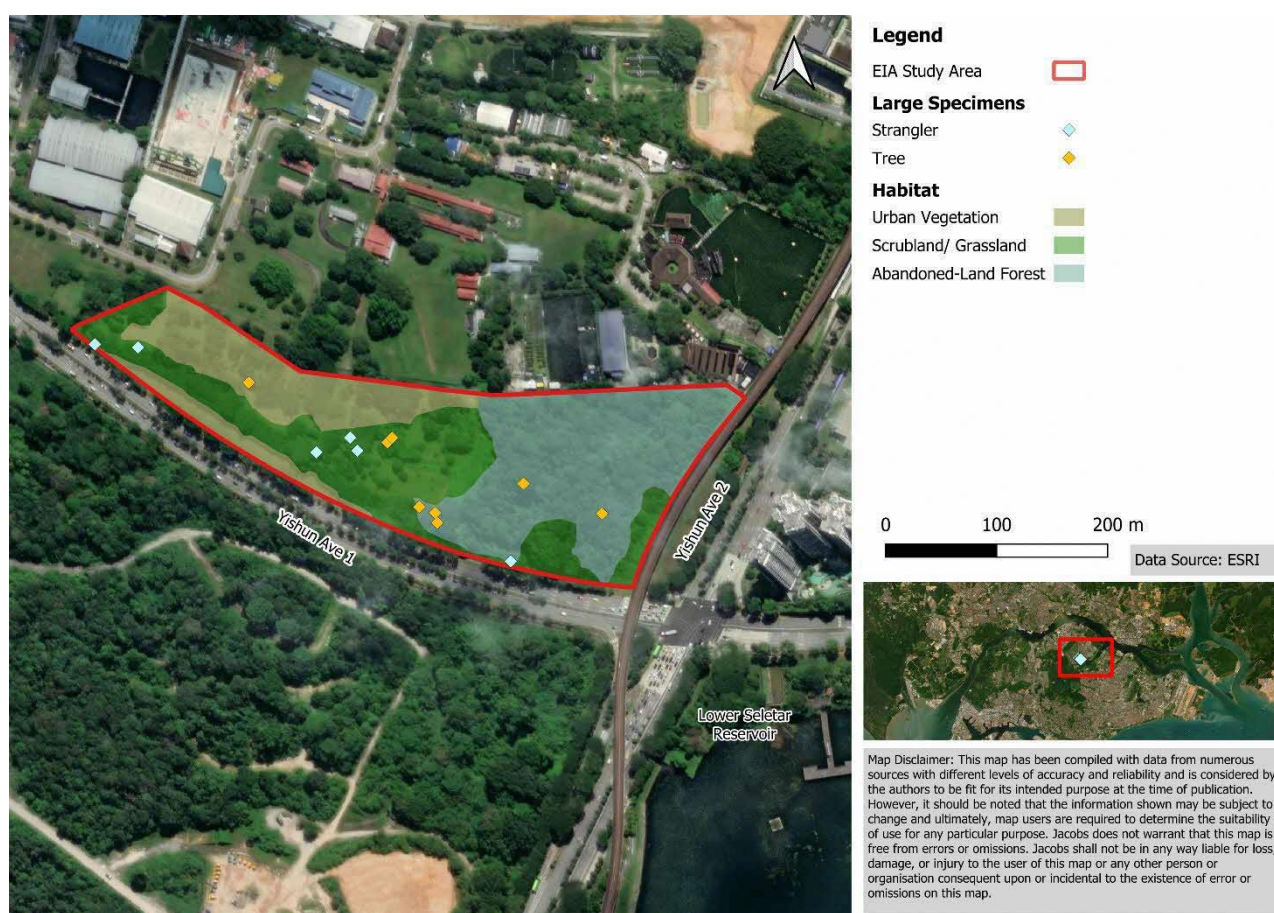


Figure 5-13: Location of Large Plant Specimens in Site 1

5.3.2.4 Other Specimens of Value

Excluding the six large *Ficus* specimens (i.e., with a spread of 3.0 m and above) that were already represented in Section 5.3.2.3, two other *Ficus* specimens of value were found within Site 1, namely a weeping fig tree (*Ficus benjamina*) and a variegated fig tree (*Ficus variegata*) (Figure 5-14; Appendix 5D).

These *Ficus* species are known as keystone species in most tropical rainforests in Southeast Asia. Monoecious figs (i.e., species that bear both male and female reproductive organs within the same individual) can produce fruits all year round. This makes figs an important food source for many frugivores, especially during the time of the year where no other fruits are available (Lok et al., 2013; Mills et al., 1993). Dioecious figs are also important as they provide food for numerous avian insectivores that feed on fig wasps.

No other plant specimens of value, such as those with bird nests or bamboo clusters, were recorded from the surveys.



Figure 5-14: Other Plant Specimens of Value Recorded in Site 1: (A) Weeping Fig (*Ficus benjamina*) Tree; and (B) Variegated Fig (*Ficus variegata*) Tree with Figs Growing on the Trunk

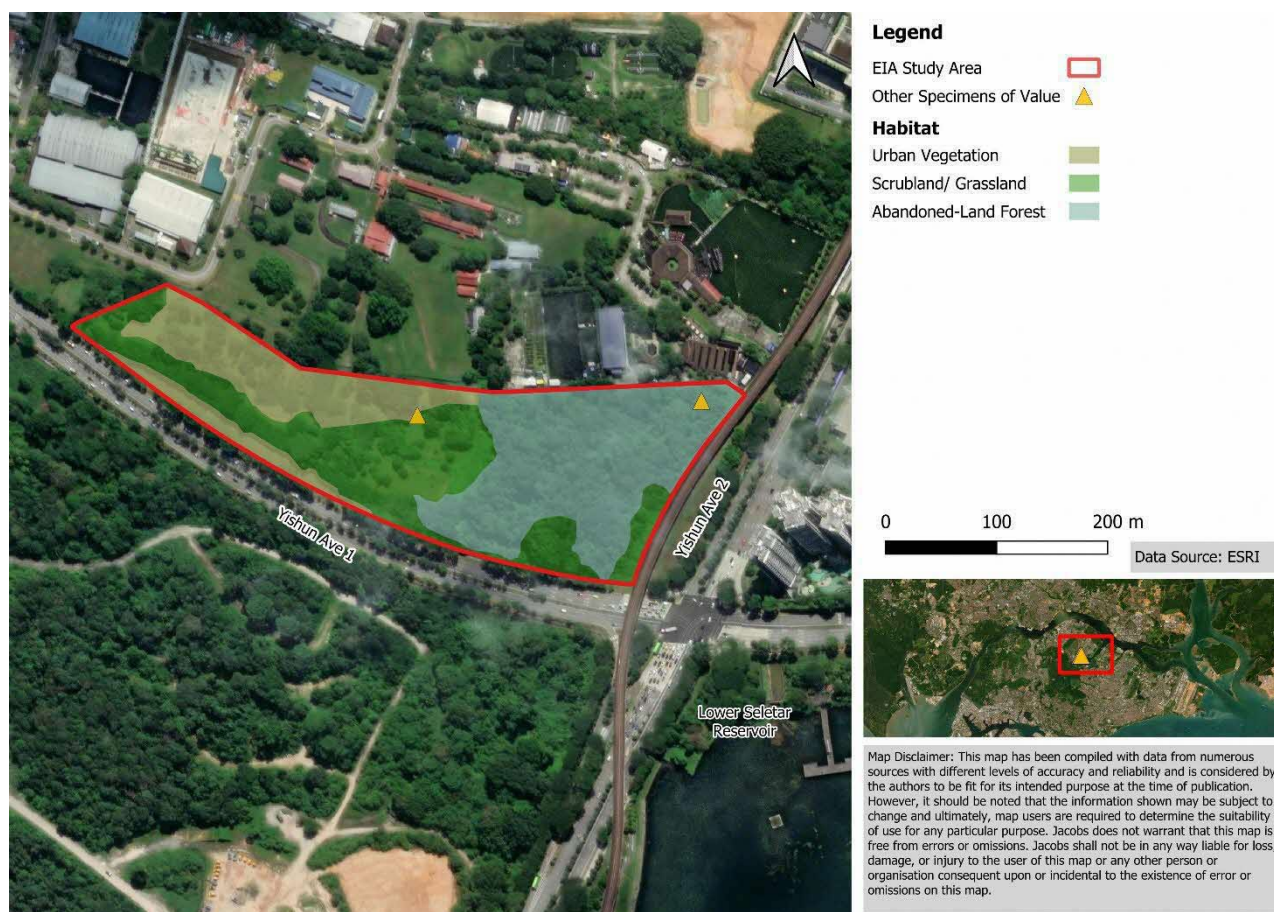


Figure 5-15: Location of Other Plant Specimens of Value in Site 1

5.3.3 Faunistic Baseline Results

5.3.3.1 Overall Faunistic Findings

The field assessment recorded a total of 137 faunal species, comprising 21 aculeate hymenopterans, 49 birds, 34 butterflies, 15 herpetofauna, nine mammals, and nine odonates (summarised in **Table 5-8**; and detailed in **Appendix 5E** and **Appendix 5F**). Birds (49 species) and butterflies (34 species) make up more than half the species assemblage. The faunal species observed were mostly widespread and common.

Additionally, roadkill surveys conducted along Yishun Ave 1 bordering the forest edge did not record any findings.

Table 5-8: Summary of Recorded Faunal Species

Faunal Group	All species	Species of Conservation Significance
Aculeata	21	0
Bees	11	0
Stinging wasps	10	0
Birds	49	4
Butterflies	34	0
Herpetofauna	15	0
Amphibians	8	0
Reptiles	7	0
Mammals	9	1
Non-volant Mammals	3	1
Bats	6	0
Odonates	9	0
Dragonflies	9	0
Damselflies	0	0
Total	137	5

5.3.3.2 Species of Conservation Significance

Of the 137 faunal species recorded, five species of conservation significance were recorded (**Appendix 5G**), comprising four bird species—Straw-headed bulbul, Plume-toed swiftlet, Swinhoe's white-eye, and long-tailed parakeet—and one mammal species, the Long-tailed macaque, as presented in **Table 5-8**. The long-tailed macaque was observed exclusively in the abandoned land forest section while birds of conservation significance were recorded throughout Site 1 (**Figure 5-16**). It is likely that these species are utilising Site 1 as a stepping stone between forest patches, connecting to the larger forested areas such as Springleaf, or the Central Catchment Nature Reserve (CCNR) to the south. Alternatively, their presence on-site may also represent a spillover from these adjacent forest patches. There were no records of species of conservation significance from the aculeata, butterfly, odonates and herpetofauna groups. Further details on findings are discussed in the respective sections below.

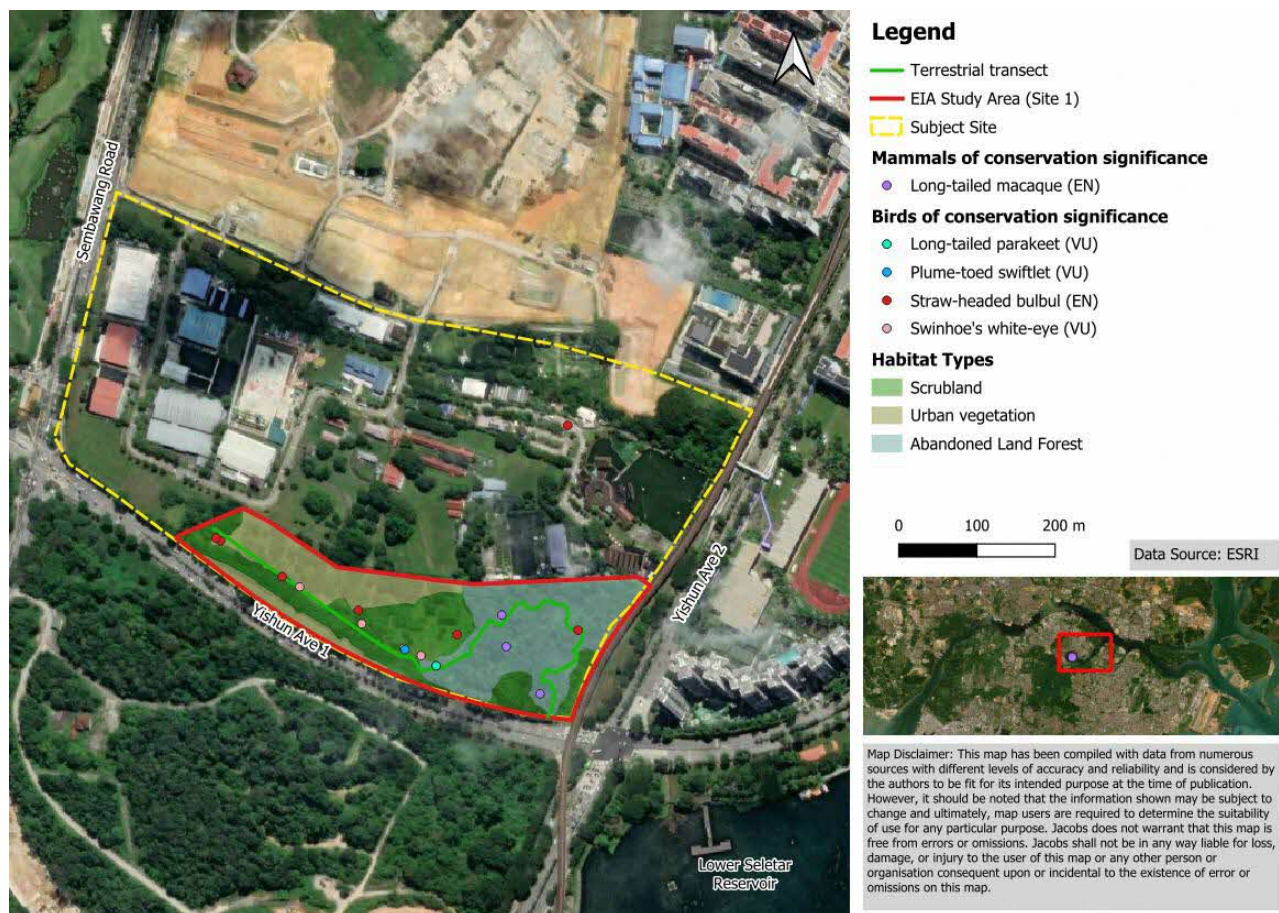


Figure 5-16: Location of Faunal Species of Conservation Significance within Site 1

5.3.3.3 Taxon Sampling Curve

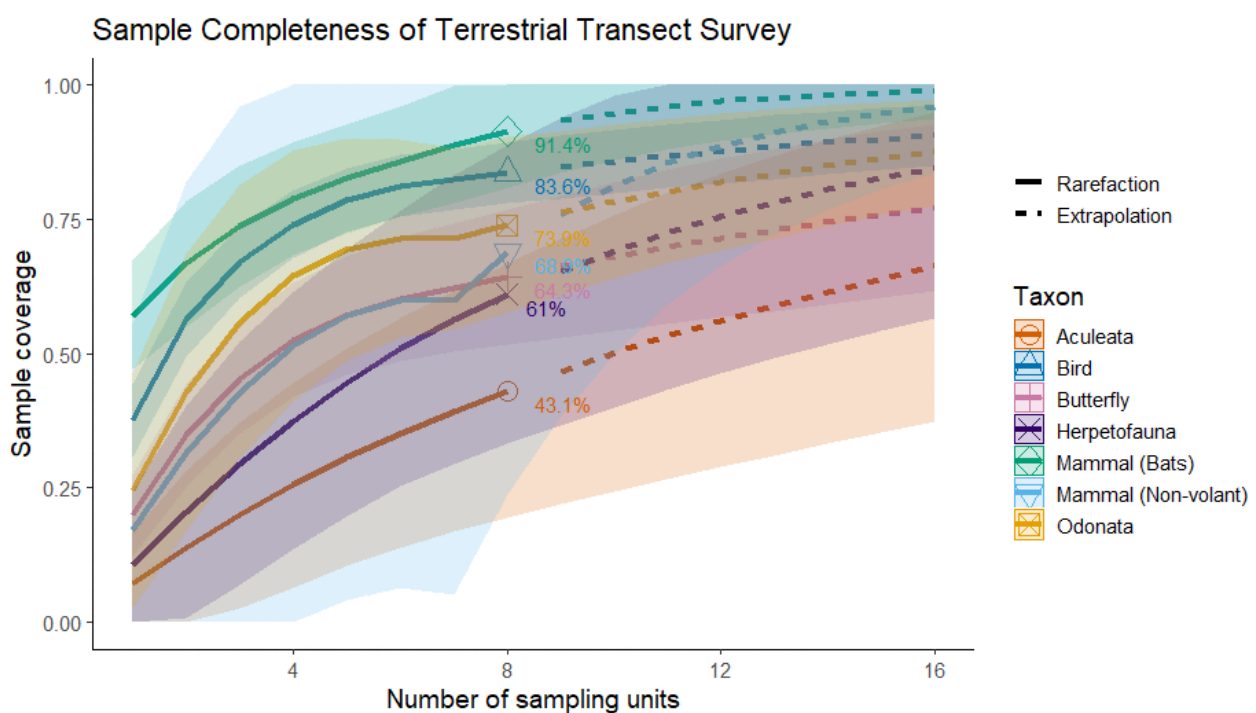


Figure 5-17: Sample Coverage for Each Taxon for Terrestrial Surveys

For transect surveys, sample coverage was generated for the following target taxa: 1) aculeata, 2) butterflies, 3) birds, 4) herpetofauna, 5) mammals (excluding bats) and 6) odonata. For camera trapping, iNEXT was not run due to small sample size ($n = 2$). Typically, one camera trap is placed every 6.25 ha based on the home range of pangolins, a species of probable occurrence. As the area of Site 1 was only 7 ha, a total of two camera traps were placed on site.

All faunal groups on average achieved a sample coverage of 69% for transect surveys. The lowest sample coverage was 43.1% for aculeata, while the remaining taxa had a sample coverage of above 60%. Surveys were conducted during the monsoon season between November 2024 and January 2025 where the weather was overcast. This is not ideal for various taxa such as odonates, butterflies and aculeata as well as herpetofauna which led to a low detection of these taxa even if these species were common. Moreover, species detection of all species including common species were further limited by the small size of the EIA Study Area and short transects. This resulted in the lower sampling coverage observed in these taxa due to the overestimation of species richness, which is not uncommon for small sites such as Chencharu.

With the observed richness obtained via sampling, the estimated richness for each taxon was derived for Site 1 per sampling method (Figure 5-17; Table 5-9).

Table 5-9: Result Summary of Taxon Sampling Analysis

Faunal group	Sample coverage (%)	Observed Richness	Estimated Richness	95% Confidence Interval
Transect Surveys				
Aculeata	43.1	22	53.6	30.9 - 134
Birds	83.6	46	81	56.9 - 159
Butterflies	64.3	31	74.8	43.9 - 179
Herpetofauna	61	11	18.1	12.4 - 48.5
Non-volant mammals	68.9	3	3.9	3.1 - 14.5
Bats	91.4	6	6.9	6.1 - 15.9
Odonata	73.9	7	12.2	7.8 - 39.9

5.3.3.4 Aculeata

A total of 21 species of aculeate hymenopterans were recorded, with 11 species of bees and 10 species of wasps. None of the aculeata were of conservation significance. There is one species that is nationally Near Threatened, the takau austral-nomia (*Lipotriches takauensis*) (Figure 5-18A). This uncommon bee primarily visits the flowers of low-lying shrubs in scrubland habitats (Soh and Ascher, 2022), which was where it was observed.

The most common aculeata recorded were the Asian honeybee (*Apis cerana*) and red dwarf honeybee (*Apis florea*). They were recorded visiting a large patch of low-lying scrubland flowers at the forest edge in between the scrubland and the abandoned land forest. These shrubs can provide a source of nectar and pollen for the bees. Bee-attracting flowers such as *Melastoma malabaticum*, *Bidens* sp. and *Asystasia gangetica*, were fairly abundant in the scrublands of Site 1.

Subsequently, two nests belonging to the Sumatran paper wasp (*Ropalidia sumatrae*), a common forest-associated species (Lee JXQ pers. comm., 2023), were observed in Site 1. This can indicate the suitability of the forests as a nesting and breeding ground (Figure 5-18B and Figure 5-18C) for bee species.

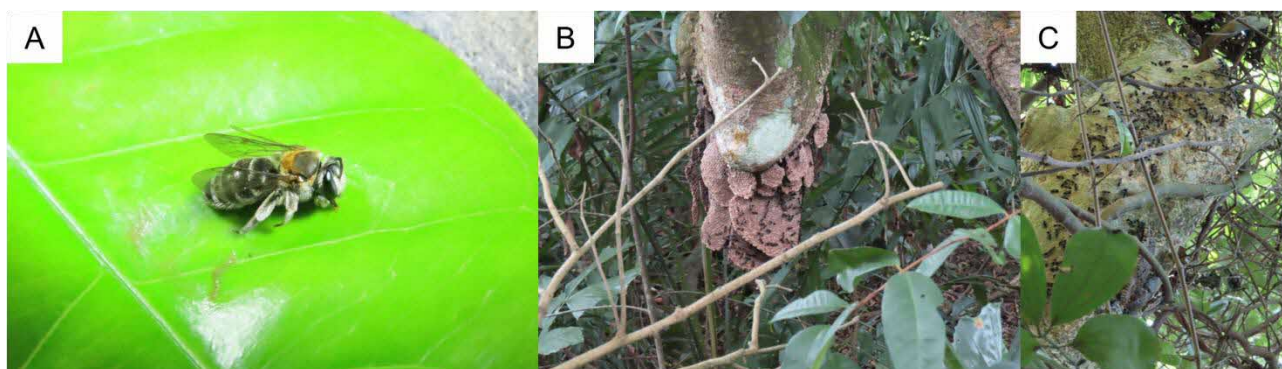


Figure 5-18: (A) Takau Austral-nomia (*Lipotriches takauensis*), (B) and (C) Sumatran Paper Wasp's Nest (*Ropalidia sumatrae*)

5.3.3.5 Birds

A total of 49 species of birds were recorded, 39 resident species (31 native and eight introduced) and 10 migrant/visitor species. Four were of conservation significance, the globally Critically Endangered straw-headed bulbul (*Pycnonotus zeylanicus*) (**Figure 5-19**), nationally Vulnerable plume-toed swiftlet (*Collocalia affinis*) and Swinhoe's white-eye (*Zosterops simplex*), and globally Vulnerable long-tailed parakeet (*Psittacula longicauda*).

Records of the straw-headed bulbul were distributed across the transect (**Figure 5-20**), with one incidentally heard to the north of Site 1. The straw-headed bulbul is heavily threatened by the songbird trade and loss of forest habitats. Its global status was uplisted from Endangered to Critically Endangered as populations worldwide experience rapid decline (BirdLife International, 2023). A recent study by Chiok et al., 2020 revealed the importance of Singapore as a stronghold with local population estimates ranging from 22.9-57.3% of the species in Southeast Asia. In contrast to the global populations, local populations are less susceptible to poaching pressures, although not completely unexposed to poaching.

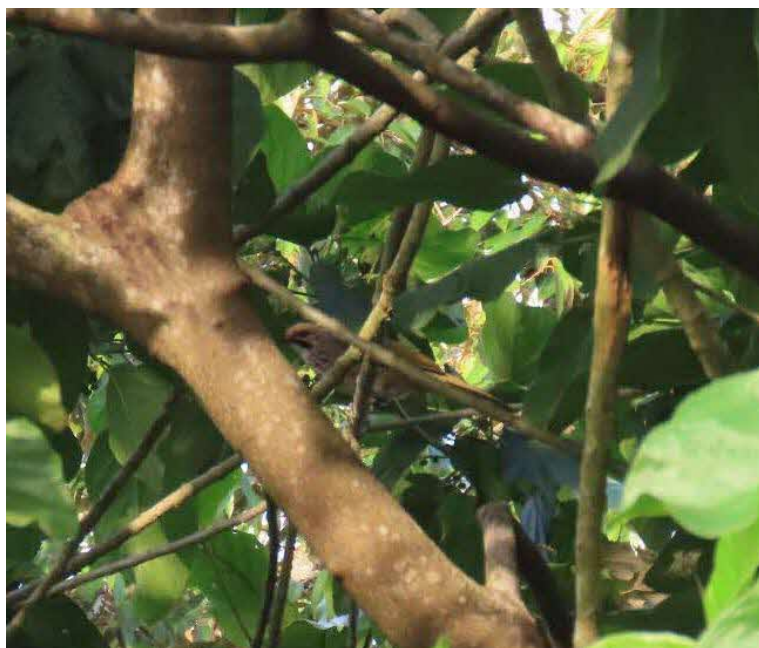


Figure 5-19: Straw-headed Bulbul (*Pycnonotus zeylanicus*) Observed in Site 1

The Swinhoe's white-eye (*Zosterops simplex*) is a commonly traded songbird species. Within Singapore, this species can utilise a variety of habitats including forests and urban parkland (Bird Society of Singapore, 2023a; 2023b) as shown by their records within Site 1 (**Figure 5-20**). The national status of the Swinhoe's white-eye

(*Zosterops simplex*) was recently raised to Vulnerable (NParks, 2023) because the local population of the naturally occurring native erwini subspecies appears to be confined to Pulau Ubin (Wu et al., 2023). On the main island of Singapore, the white-eye population mostly composes of the non-native simplex or hybrid simplex-erwini gene pools believed to be established from escaped individuals from the pet trade. Although the individuals recorded in this assessment were most likely of introduced origin and unlikely to be of true conservation significance, there is still a possibility that they were from the native gene pool established from natural range expansion. Hence, it is still conservatively regarded as a species of conservation significance in this study.

The plume-toed swiftlet (*Collocalia affinis*) is an uncommon resident breeder. It is prone to habitat loss and destruction, accounting for their nationally Vulnerable status. Breeding activity of the plume-toed swiftlet was only first recorded in 2017, with breeding colonies making use of culverts to build nests (Chia et al., 2019). These nests are prone to destruction from inundation and water damage when the culverts flood during the monsoon season. One individual was recorded in the scrubland habitat of Site 1.

The long-tailed parakeet (*Psittacula longicauda*) is a globally Vulnerable and nationally Near Threatened species, although it is common within Singapore. Its global status is attributed to habitat loss and the bird trade as well as being dependent on mature forest for nesting (BirdLife International, 2024). The locations where these birds were observed are shown in (Figure 5-20).

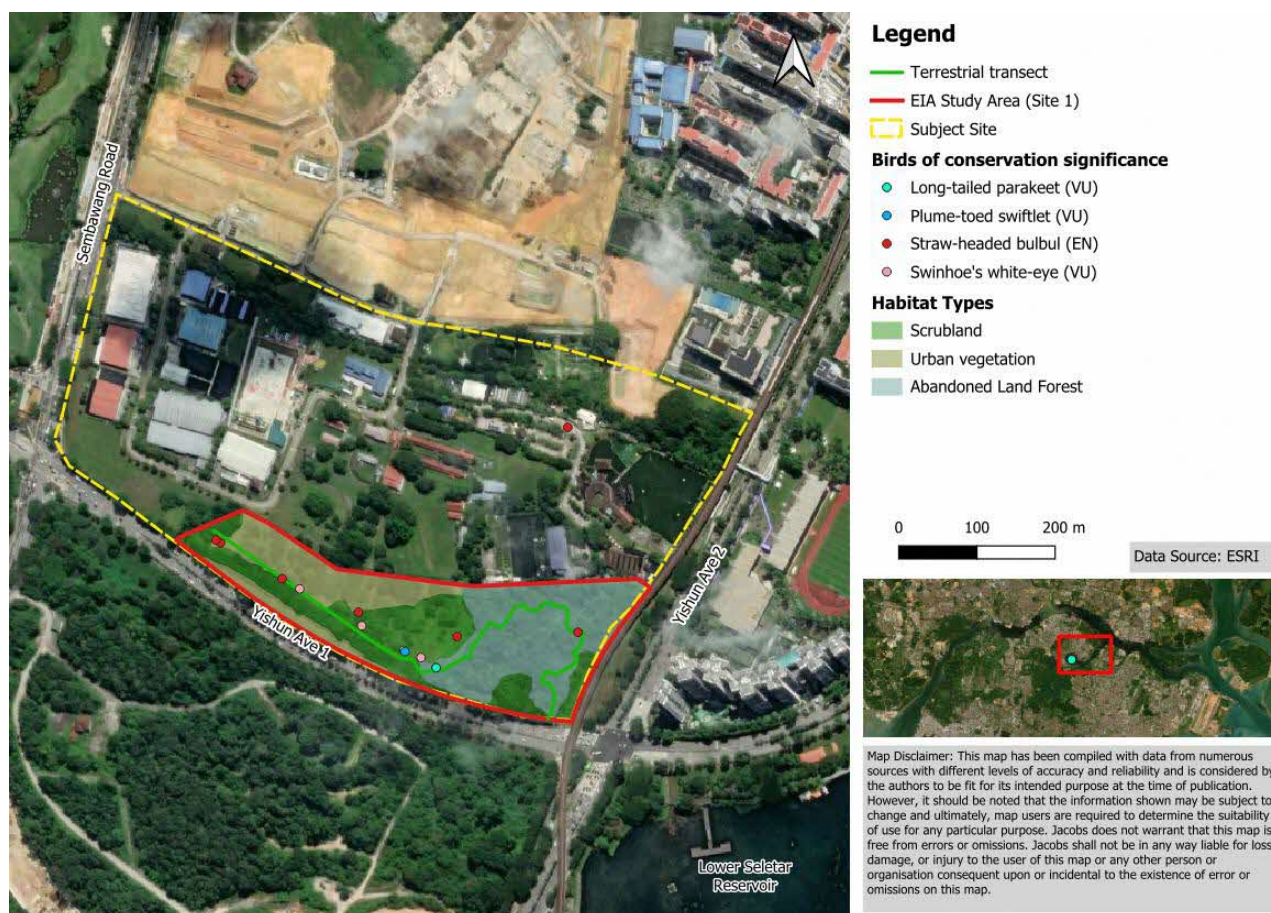


Figure 5-20: Birds of Conservation Significance within Site 1

5.3.3.6 Butterflies

A total of 34 butterfly species were recorded. None of the butterflies were of conservation significance. All except one species surveyed in Site 1 are common or moderately common in Singapore. Most of the butterflies were recorded in the open grassland and scrubland habitat. Among them, the dark brand bush brown (*Mycalesis mineus macromalayana*) and chocolate pansy (*Junonia hedonia ida*) were most abundant.

One notable species was the rare Malay dartlet (*Oriens paragola*). Along with other skipper species that are common in Singapore such as the chestnut bob (*Iambrix salsala salsala*) and common dartlet (*Oriens gola pseudolus*), it utilises the grass species *Ottouchloa nodosa* as its host plant which is found within the urban vegetation habitat (**Figure 5-21**) (Tan, 2012a). Additionally, there was one species that is nationally Near Threatened - the tawny palmfly (*Elymnias panthera panthera*). Although considered moderately common, it was recorded at the forest edge typical of its species, which prefers shaded areas and are commonly found at forest edges and in proximity to palm trees. (Tan, 2012b).



Figure 5-21: Species of Butterflies that Feed on *Ottouchloa nodosa*. (A): Malay Dartlet (*Oriens paragola*). (B): Chestnut Bob (*Iambrix salsala salsala*). (C): Common Dartlet (*Oriens gola pseudolus*).

5.3.3.7 Herpetofauna

A total of 15 species of herpetofauna were recorded, with eight species of amphibians and seven species of reptiles. None of the herpetofauna were of conservation significance.

5.3.3.7.1 Amphibians

Of the eight recorded species, four are native to Singapore, the field frog (*Fejervarya limnocharis*), Malayan giant frog (*Limnonectes blythii*), dark-sided chorus frog (*Microhyla heymonsi*) and four-lined tree frog (*Polypedates leucomystax*). The species with the highest number of records in Site 1 was the native Malayan giant frog (*Limnonectes blythii*) (**Figure 5-22A**), with tadpoles observed at the forest edge indicating signs of population establishment. The second most recorded amphibian species was the widespread and common Guenther's frog (*Sylvirana guentheri*).

5.3.3.7.2 Reptiles

All reptile species recorded are native to Singapore. The most common reptile recorded was the painted bronzeback (*Dendrelaphis pictus*) (**Figure 5-22C**) which was sighted three times. Other snake species observed includes a two-metre-long reticulated python (*Malayopython reticulatus*) (**Figure 5-22D**) and the oriental whipsnake (*Ahaetulla prasina*) (**Figure 5-22E**). The green crested lizard (*Bronchocela cristatella*), Sumatran flying dragon (*Draco sumatranus*), and clouded monitor (*Varanus nebulosus*) were observed during the diurnal terrestrial transect surveys.

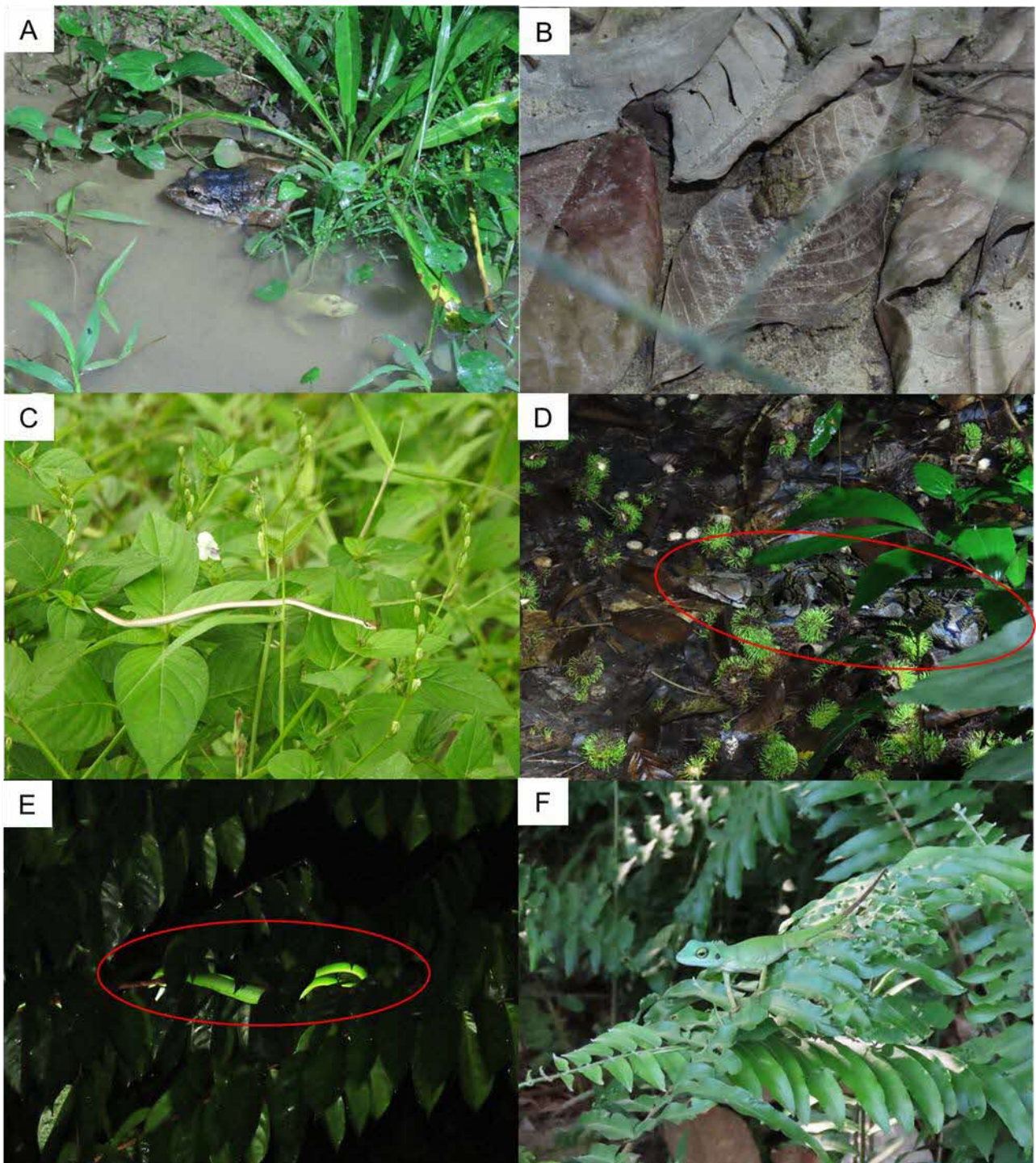


Figure 5-22: Herpetofauna Species Found in Site 1; (A) Malayan Giant Frog (*Limnonectes blythii*), (B) Greenhouse Frog (*Eleutherodactylus planirostris*), (C) Painted Bronzeback (*Dendrelaphis pictus*), (D) Reticulated Python (*Malayopython reticulatus*), (E) Oriental Whip Snake (*Ahaetulla prasina*), (F) Green-crested Lizard (*Bronchocela cristella*).

5.3.3.8 Non-volant Mammals

A total of three non-volant mammal species were recorded, with one of conservation significance, the long-tailed macaque (*Macaca fascicularis*). Long-tailed macaques are globally Endangered, though they are nationally Least Concern. A total of three individuals were observed on two occasions during the survey, as well as once on camera trap CT01 (Figure 5-23).

The other two species recorded were the plantain squirrel (*Callosciurus notatus*) and the common treeshrew (*Tupaia glis*), recorded during the transect survey as well as on camera traps CT1 and CT2. All species including the long-tailed macaque are widespread and common in Singapore, inhabiting forests, parks and gardens as these extremely adaptable species are able to traverse urban landscapes. Although pangolins were not recorded from the site, the Singapore Pangolin Working Group was consulted as part of desktop study and there were previous records of pangolins around Yishun Ave 1 / 2 and Sembawang Road.



Figure 5-23: Mammals of Conservation Significance within Site 1

5.3.3.9 Bats

A total of six species of bats were recorded. None of the bats were of conservation significance. The six species of bats recorded include the lesser short-nosed fruit bat (*Cynopterus brachyotis*), Asian whiskered myotis (*Myotis muricola*), Javan pipistrelle (*Pipistrellus javanicus*), narrow-winged pipistrelle (*Pipistrellus stenopterus*), lesser Asian house bat (*Scotophilus kuhlii*) and pouch tomb bat (*Saccolaimus saccolaimus*). All the bats recorded are common in Singapore. These bats were recorded either acoustically with a handheld bat detector or visually during the transect survey. No bats were captured using the harp trap.

5.3.3.10 Odonata

A total of nine species of dragonflies were recorded. None of the odonates were of conservation significance. Seven out of nine species are widespread and common, including the common blue skimmer (*Orthetrum glaucum*), common parasol (*Neurothemis fluctuans*), common scarlet (*Crocothemis servilia*), variegated green skimmer, (*Orthetrum sabina*), wandering glider (*Pantala flavescens*), white-barred duskhawk (*Tholymis tillarga*) and yellow-barred flutterer (*Rhyothemis phyllis*). These species can be found in urban parks and gardens, typically favouring open pond habitats. As there are no permanent waterbodies within Site 1, fewer species of odonates were expected. Among them, the wandering glider was most abundant as they can breed in ephemeral ponds present within Site 1 (**Figure 5-24**).

Only one species, the dancing dropwing (*Trithemis pallidinervis*), was widespread and uncommon. It is a coastal glider that can be found near reservoirs and has previously been sighted in areas of Yishun close to Upper and Lower Seletar Reservoir (NParks BIOME Sightings, 2016; Tan, 2015).



Figure 5-24: Ephemeral Pond within Site 1

5.4 Ecological Significance of Site 1

In summary, Site 1 comprises three habitat types: abandoned land forest, scrubland/grassland, and urban vegetation, with abandoned land forest covering around 40% of the study area. The abandoned land forest is dominated by exotic species like rubber and fruit trees (e.g., rambutan and durian), reflecting the site's historical land use as a rubber plantation eventually replaced with sundry tree cultivation.

A total of 203 plant species were recorded, nearly half of which are native, including 14 species of conservation significance, mostly distributed within the abandoned land forest. Notable species of conservation significance include *Symplocos fasciculata*, *Microlepis speluncae*, and *Adenia cordifolia*, which are only commonly found in secondary regrowth forests and not common in more degraded or urbanised fragments. In addition, eight specimens of keystone fig species were also present on-site, which provide food sources for frugivores.

Fauna surveys recorded a total of 137 species, of which birds and butterflies make up more than half the species assemblage. Majority of the species that were recorded at Site 1 are considered widespread and common. Five species of conservation significance were recorded – four birds and one mammal.

Inferring from the baseline data collected, the abandoned land forest habitat within Site 1 functions as a potential refugia for plants and stepping stone for volant species. The frequent presence of native saplings (e.g., wild cinnamon *Cinnamomum iners*, common tree-vine *Leea indica*, rukam-utan *Aporosa frutescens*) in the understorey of the abandoned land forest, despite the exotic-dominated canopy, indicates active natural regeneration. This regeneration is likely facilitated by animal dispersers, confirming functional fauna usage of the habitat. Furthermore, given its proximity to larger forest patches (e.g., Springleaf Nature Park, Lower Seletar Reservoir Park, Central Catchment Nature Reserve), Site 1 holds potential as a complementary stepping stone habitat for volant fauna (birds, bats, butterflies, odonates, bees) traversing between these forested areas that instead serve as wider primary connectivity pathways and habitats themselves. However, connectivity is limited for non-volant species as the site is bound by major roads (Yishun Avenue 1 and Yishun Avenue 2), surrounding brownfield uses and the North-South Line MRT track, constraining ground movement.

5.5 Impact Assessment

In this section, the identified biodiversity sensitive receptors were evaluated based on Group A and Group B criteria in order to derive the impact significance.

5.5.1 Assessment of Ecological Value

5.5.1.1 Habitat

The ecological value assessment for habitats references the metric in the Singapore Biodiversity Accounting Tool (SGBA) (AECOM & Camphora, 2024). Habitats were assessed and scored based on four criteria – i) flora and fauna species richness, ii) irreplaceability, iii) local rarity of habitats, and iv) unique flora and fauna species. All habitats were then accorded an ecological value, i.e., high, medium, or low, based on the overall scoring (Figure 5-25).

DISTINCTIVENESS CRITERIA - TERRESTRIAL				
CRITERIA	HIGH (3)	MEDIUM (2)	LOW (1)	ZERO (0)
SPECIES RICHNESS: the total number of flora (vascular plant) and fauna (bird, butterfly, odonate, amphibian, reptile, mammal) species that can be expected to occur in the habitat, excluding introduced fauna species.	High flora and fauna species richness (900 or more species)	Moderate flora and fauna species richness (600 to 899 species)	Low flora and fauna species richness (300 to 599 species)	Very low flora and fauna species richness (Less than 300 species)
IRREPLACABILITY: the difficulty of recreating, or replacing the habitat to its ecologically optimal structure and species composition via human intervention, natural or accelerated succession within 30 years. This also takes into account re-establishing of habitat or ecosystem health, and ecological (biotic and abiotic) dynamics required to establish an effectively functioning habitat.	Impossible to recreate/replace (e.g., lowland dipterocarp primary forest)	Difficult to recreate/replace (e.g., native-dominated secondary forest, coastal forest)	Easy to recreate/replace	Not ideal to recreate/replace for biodiversity
RARITY: area of a particular habitat type remaining as a percentage of all terrestrial land mass in Singapore. For intertidal and marine habitats, this is taken as the proportion of land to sea surface area that the habitat covers across Singapore's total coastal area.	Habitat is rare in Singapore (e.g., lowland dipterocarp primary forest, native-dominated secondary forest, coastal forest, casuarina-dominated forest, grassland, fern-dominated vegetation) (<5%).	Habitat is uncommon in Singapore (e.g., abandoned-land forest, waste woodland, scrubland) (5% to 30%)	Habitat is common in Singapore (e.g., vertical greenery, streetscape, urban park/garden, community farm, commercial farm, golf course, turf, skyline greenery) (>30%). Habitat types which support <300 species, are assumed to be lowest priority for biodiversity and therefore automatically fall under this category (e.g., farm).	Habitat is ubiquitous in Singapore (e.g., buildings).
UNIQUE SPECIES: the total number of unique flora (vascular plant) and fauna (bird, butterfly, odonate, amphibian, reptile, mammal) species that can be expected to occur in the habitat. Unique species are those that are not typically found in other habitats.	Supports a high number of unique flora and fauna species (15 or more unique species)	Supports some unique flora and fauna species (10 to 14 unique species)	Supports few unique flora and fauna species (Less than 10 species)	Does not support any unique flora and fauna species

Figure 5-25: Habitat Distinctiveness Criteria from SGBA

Table 5-10: Total Distinctiveness Score from SGBA and Corresponding Ecological Value

Ecological Value	Total Distinctiveness Score from SGBA
High	>7
Medium	6-7
Low	<6

Three habitat types were observed in Site 1 – abandoned land forest, scrubland/grassland, and urban vegetation. Based on the SGBA metric, the abandoned land forest is considered to have an overall medium ecological value. It supports moderate flora and fauna species (Score 2) and a few unique flora and fauna species (Score 1). In Singapore, the abandoned land forest is uncommon (Score 2) and easily re-creatable (Score 1) over a short duration. Based on the four criteria assessed, the overall score for the abandoned land forest is six (6), which translates to a medium ecological value (Table 5-10). Both scrubland/grassland and urban vegetation, are considered to support fewer flora and fauna species (Score 1) and are common in Singapore (Score 1). Scrubland/grassland is easy to replace (Score 1) and supports a moderate number of unique species. (Score 2). In contrast, it is not considered ideal to replace or recreate urban vegetation (Score = 0), and it typically does not support any unique flora and fauna species (Score 0). Overall, the overall score for scrubland/grassland and urban vegetation is five (5) and two (2) respectively. Hence, both habitats are of a low ecological value (Table 5-10). No areas of high ecological value were identified in Site 1.

5.5.1.2 Flora

The ecological value of 203 plant species was assessed, of which 17 species were identified to have high ecological value and selected for the assessment of ecological impact. The selection was based on the following: (1) species with specimens of conservation significance and/or common native trees that had their ecological value raised, large specimens, or other specimens of value within Site 1 and (2) keystone species.

5.5.1.3 Fauna

All recorded and probable fauna species were accorded an ecological value based on its conservation significance and species origin:

- High ecological value: Species of conservation significance
- Medium ecological value: All other native and migratory bird species, and species of indeterminate status
- Low ecological value: Exotic species

Species of probable occurrence are species of conservation significance that were assessed to potentially occur on site. While these species were not recorded during the baseline assessment, they remain as a potential occurrence due to the habitats onsite and surrounding habitats. As established in **Section 1.5**, it is difficult for biodiversity surveys to record the full species assemblage onsite, especially for elusive species. Our impact assessment considers the potential occurrence of these undetected species to provide a holistic assessment.

The ecological value of 173 fauna species was assessed. This includes the 137 terrestrial species (including five species of conservation significance) recorded from field assessments, as well as an additional 36 species of conservation significance of probable occurrence. The 36 species include three aculeata, 22 bird, six butterfly, one reptile, and four mammal species.

For the 137 recorded species, five species were deemed to be high ecological value, 113 species were deemed to be medium ecological value, 14 species were deemed to be low ecological value, and five species could not be evaluated as they were only identified to the genus level.

A total of 41 fauna species of high ecological value recorded and of probable occurrence in the EIA Study Area were selected for the assessment of ecological impact. This comprises three aculeata, 26 bird, six butterfly, one reptile, and five mammal species.

This list of species and their ecological value are presented in **Appendix 5F**.

Loss of vegetation, mortality in plant species, loss of/ reduction in habitats and food sources, and accidental injury or mortality of fauna species are some of the potential kinds of direct impact that may be expected during the construction phase. Impact types such as human-wildlife conflict, light and human disturbances from future developments are expected to occur during the operational phase.

Impact during the construction and operational phases are assessed separately for habitats, flora, and fauna, as detailed in **Section 5.5.4** and **Section 5.5.5** respectively. These fall into two main categories: (1) direct impact—affecting habitats and species located within the worksites; and (2) indirect impact—affecting habitats and species outside the worksites but within the designated impact zones. For habitat, flora and fauna receptors, the impact zone is defined as the area within 30 m of the proposed development. At Site 1, the proposed development is assumed to overlap with the Study Area completely.

Table 5-11 and **Table 5-12** detail a list of potential impact types on habitat, flora and fauna receptors during the construction and operational phases respectively. A total of seven impact types were assessed: one for habitat, two for flora and four for fauna receptors.

Table 5-11: List of Potential Impacts during Construction Phase

Phase	Receptor	Impact Type	Description	Impact category
Construction	Habitat	Loss of habitat	Direct removal of vegetation (with extensive underground root systems that protect against soil erosion) to create space for construction activities.	Direct
	Flora Species	Mortality	Direct removal of vegetation to create space for construction activities.	Direct
		Decline in plant health	Changes in microclimatic conditions (i.e., dust, noise, and light, temperature, and humidity) and hydrology	Indirect
	Fauna Species	Loss of/ reduction in habitats and food sources	Direct removal of vegetation, nests or roost sites to create space for construction activities.	Direct
		Accidental injury or mortality	Collisions with machineries, entrapments in construction materials (such as non-biodegradable erosion control blankets) and structures (such as exposed pits or drains), and accidental kills by construction personnel, including roadkill.	Direct
		Human-wildlife conflict	Negative consequences of human-wildlife interactions, such as deliberate killing and depopulation of fauna species perceived as nuisances or threats by construction personnel.	Indirect
		Loss/ reduction of ecological connectivity for fauna movement	Habitat fragmentation from the removal of vegetation.	Indirect

Table 5-12: List of Potential Impacts during Operational Phase

Phase	Receptor	Impact Type	Description	Impact category
Operational	Habitat	NA	NA	NA
	Flora Species	NA	NA	NA
	Fauna Species	Accidental injury or mortality	Navigation failures into the wrong areas and entrapment in facility structures, including bird collision into buildings (distorted perceptions of reflective surfaces on buildings as flyways, greenery, and/or water) and roadkill.	Direct
		Human-wildlife conflict	Negative consequences of human-wildlife interactions, such as deliberate killing and depopulation of fauna species perceived as nuisances or threats by members of the public.	Direct

Phase	Receptor	Impact Type	Description	Impact category
		Loss of ecological connectivity for fauna movement	Impediment to fauna movement by presence of buildings, infrastructure, and human activity.	Indirect

5.5.2 Minimum Control Measures

This section lists biodiversity-specific minimum controls commonly implemented in Singapore for similar construction activities. These measures are assumed to be implemented for impact assessment. Minimum controls for each potential impact occurring from the construction phase and operational phase are listed in **Table 5-13**. These measures should be adopted in tandem with other environmental receptors (e.g., noise).

Table 5-13: Description of Minimum Controls Implemented at Construction Phase

Work Activities	Minimum Controls
General	- Install hoarding to delineate worksite. - Avoid fogging by implementing preventive measures for mosquito breeding to remove sources of stagnant water or water-bearing receptacles, e.g., providing well-maintained pitched roofs, clearing discarded items daily, store materials appropriately, level up ground depression/uneven surfaces, ensure effective drainage flow - Visual checks for gaps in hoarding. - Execute a wildlife response plan when a trapped/ dead/ dangerous animal is encountered around or within the worksite according to Appendix 1A Section 10 of the Wildlife Act.
Vegetation Clearance	- Conduct inspections of fauna prior to felling or removal of vegetation. This should be done by an ecologist who is able to identify wildlife and/ or active nesting structures, such as bird nests, tree hollows and/or burrows, and bamboo clusters. - Implement soil erosion control measures as soon as vegetation has been removed and soil is exposed (refer to Section 5.5). - Engage a Qualified Erosion Control Professional (QECP) to formulate and implement an Earth Control Measures (ECM) plan in accordance with PUB requirements. - Set up Tree Protection Zones (TPZs) around trees or other plant specimens to be retained within the worksites, if any, within which no construction works are allowed. This should be executed by certified arborists and in accordance with NParks' guidelines (NParks, 2019).

5.5.3 Assessment of Biodiversity-Sensitive Receptors

The definition and scoring of each assessment criterion for biodiversity-sensitive receivers are described in **Section 3.2.2**. However, the definitions for two criteria A1 (Value) and A2.2 (Magnitude of Changes) in relation to ecology are refined to represent the ecological value of an impact receiver and impact significance respectively. The assumptions for four group B criteria are further defined. These ecological criteria are further explained below.

- a) The A1 value of each biodiversity-sensitive value is categorised according to its ecological value in **Section 5.5.1**. They are categorised as follows:
- 4 for habitat or species with high ecological value and has international importance
 - 3 for habitat or species with high ecological value
 - 2 for habitat or species with moderate ecological value
 - 1 for habitat or species with low ecological value
 - 0 for habitat or species with no ecological value
- b) Positive impact significance under criterion A2.1 are defined as follows:
- 2 for enhancement or creation of habitats in a forested site that is likely to significantly improve ecological functions.
 - 1 for planting within a managed landscape context or small localised areas, or ecological features, with potential but limited value in improving ecological functions.
- c) The criterion A2.2 (Magnitude of Changes) factors in the likelihood of occurrence.
- The preliminary magnitude of change is first derived (Impact Intensity) and subsequently multiplied with its likelihood of occurrence. The final value is assigned a score for the Magnitude of Change.
 - The impact intensity is given a score ranging from 0 to 3 as follows – Negligible (0), Low (1), Medium (2) and High (3)
 - The likelihood is given a score ranging from 0 to 4 as follows – Unlikely/Remote (0), Less Likely/Rare (1), Possible/Occasional (2), Likely/Regular (3) and Certain/Continuous (4).
 - The impact intensity and likelihood are then multiplied and assigned with a score under Magnitude of Change – No Change (0), Low (1–3), Medium (4–6) and High (8–12).
 - The various levels of impact intensity and likelihood during the construction and operational phases are defined for the biodiversity sensitive receptors in the following sections.
- d) The impact extent (A2.3) for all biodiversity impact is assumed to be of a national level (3) since loss of habitats and populations is regarded as a national impact.
- e) Permanence (B1) is assumed to be permanent for all impact types, with scoring as follows:
- 4 for long-term effects. Includes all operational phase impact types as they will persist for as long as the upcoming developments are present onsite. Also includes the following construction phase impact types that are likely to outlast the project construction duration:
 - Loss of habitat (habitat)
 - Mortality (flora)

- Loss of/reduction in habitats and food sources (fauna)
 - 3 for medium-term impact expected to persist only during the project lifetime (~5 years)
 - Accidental injury or mortality (fauna)
 - Human-wildlife conflict (fauna)
 - Loss/reduction of ecological connectivity for fauna movement (fauna)
 - Decline in plant health and survival (flora)
- f) The impact pathway (B2) of each biodiversity impact type is categorised according to its impact category in **Table 5-11** and **Table 5-12**. For the impact type “Accidental injury or mortality” in the operational phase which has both direct and indirect impact pathways, it was given a value of 3 for direct impact. The remaining are valued as follows:
- 3 for direct impact
 - 2 for indirect impact
- g) The reversibility (B3) for all biodiversity impact types are assumed to be irreversible (3).
- h) Given that several projects are occurring in the vicinity, such as housing developments north of Site 1 (see **Section 2.2**), all ecological impact types have a B4 value of cumulative/synergistic (3) as ecosystems are highly interconnected and each successive negative impact is increasingly damaging to the environment.

For both construction and operational phases, the full list of the values assigned for each criterion in the RIAM as well as the resulting impact significance for the habitat, flora and fauna receptors are provided in **Appendix 5H**, **Appendix 5I**, and **Appendix 5J** respectively.

Identified biodiversity sensitive receptors were evaluated based on impact intensity and likelihood, which eventually derives the impact significance. The impact intensity and likelihood of each impact type during the construction phase are defined for habitats, flora, and fauna species respectively below. The impact intensity and likelihood of each impact type during construction phase are defined for habitats and fauna species respectively below.

5.5.4 Construction Phase Impact

5.5.4.1.1 Habitats

The definitions for impact magnitude for habitat receptors is given **Table 5-14**.

Table 5-14: Definitions of Each Level of Impact Intensity for Impact Types During Construction for Habitat Receptors

Impact Type	Negligible	Low	Medium	High
Loss of Habitat	The habitat does not overlap with the worksites	≤ 10% of the habitat overlaps with the worksites	10–40% of the habitat overlaps with the worksites	> 40% of the habitat overlaps with the worksites Worksite overlaps with waterbody.

Table 5-15: Definitions of Each Level of Likelihood for all Impact Types During Construction for Habitat Receptors

Likelihood	Loss of habitat
Unlikely/Remote	The habitat does not overlap with the worksites
Less Likely/ Rare	N.A.
Possible/ Occasional	N.A.
Likely/ Regular	N.A.
Almost Certain/ Continuous	The habitat overlaps with the worksites

One construction phase impacts was identified and assessed for habitat receptors: (1) Loss of habitat.

Loss of habitat

Vegetation clearance will occur in all terrestrial habitat types – abandoned land forest, scrubland/grassland, and urban vegetation. Based on the area of vegetation clearance, the impact intensity is “High” while the likelihood of impact is “Certain” for all habitat types. Overall, the impact significance of loss of vegetation will be **Moderate Negative** for the abandoned land forest and **Minor Negative** for the remaining habitat types of low ecological value.

The values assigned for each criterion in RIAM as well as the resulting impact significance for the habitat are provided in **Appendix 5H**.

5.5.4.1.2 Flora

The definitions for impact intensity and likelihood for flora species receptors of conservation significance are presented in **Table 5-16** and **Table 5-17** respectively.

Table 5-16: Definitions of Each Level of Impact Intensity for Impact Types During Construction for Flora Species Receptors

Impact Type	Negligible	Low	Medium	High
Mortality	No plant specimens of this species are within the worksites	Less than 50% of all plant specimens of this species are within the worksites	More than or exactly 50% of all plant specimens of this species are within the worksites	All plant specimens of this species are within the worksites
Decline in plant health and survival	No specimens of this species are within 30 m from the worksites	Less than 50% of all specimens of this species are within 30 m from the worksites	More than or exactly 50% of all specimens of this species are within 30 m from the worksites	All specimens of this species are within 30 m from the worksites

Table 5-17: Definitions of Each Level of Likelihood for Impact Types During Construction Phase for Plant Species Receptors

Likelihood	Mortality	Decline in Plant Health and Survival
Unlikely/Remote	No plant specimens of this species are within the worksites	No formation of forest edges (i.e., construction activities are fully underground and/or in existing built-up areas outside the mangrove or forest) that changes the existing microclimate conditions
Less Likely/ Rare	Plants specimens of this species located in the worksite is less likely to be inflicted with mechanical injuries during construction	Formation of scrubland edges in scrubland areas only.
Possible/ Occasional	No count data and/or locations of specimens of this species is available, but specimens could possibly be within the worksites	Formation of some forest and scrubland edges in urban vegetation, scrubland and/or mangrove/forested areas.
Likely/ Regular	N.A.	N.A.
Almost Certain/ Continuous	Plant specimens of this species located within the worksite are cleared	Formation of new forest edges (i.e., complete clearance within mangrove/forested areas) or

One construction phase impact was identified and assessed for flora receptors: (1) Mortality.

Mortality

All specimens of the 17 flora receptors identified are within the worksites and thus will be impacted by mortality assuming complete site clearance. A summary of all the impact on flora receptors is given on **Table 5-18**. 14 of these species, all of which are of conservation significance (e.g., *Adenia cordifolia*, *Symplocos fasciculata*, and *Microlepis speluncae*), are assessed to have **Major Negative** impact. These species are expected to be entirely removed from the site, leading to a "High" impact intensity with a "Certain" likelihood. Furthermore, due to their conservation status, the mortality of these species represents a national-level impact extent affecting their local distribution.

The remaining three species, which are keystone *Ficus* species (*Ficus benjamina*, *F. microcarpa*, and *F. variegata*), will experience **Minor Negative** impact. While the impact intensity and likelihood are similar to those of the conservation-significant species, the geographical extent of the mortality impact on these *Ficus* species is limited to the Study Area.

The values assigned for each criterion in the RIAM as well as the resulting impact significance for each flora receptor are provided in **Appendix 5I**.

Table 5-18: Summary of Construction Phase Impact to Flora Receptors with Number Indicating Number of Species

Impact Type	No Change	Minor Negative	Moderate Negative	Major Negative
Mortality	0	3	0	14

5.5.4.1.3 Fauna

The definitions for impact intensity and likelihood for fauna species receptors of conservation significance are presented in **Table 5-19** and **Table 5-20** respectively.

Table 5-19: Definitions of Level of Impact Intensity for all Impact Types During Construction Phase for Fauna Species Receptors

Impact Type	Negligible	Low	Medium	High
Accidental injury or mortality	Species with negligible susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkill	Species with low susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkill: Volant species (e.g., odonates, butterflies, highly volant birds, most bats)	Species that are mobile but possibly susceptible to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkill: - Less volant birds - All amphibians - Some mammals (e.g., squirrels, shrews)	Species with high susceptibility to accidental injury/mortality from construction activities (large vehicles, excavation, piling, etc.) and roadkill: - Reptiles - Some mammals (e.g., Sunda pangolin, long-tailed macaque, smooth otter)
Loss of/reduction in habitats and food sources	No loss of habitat, raptor nests, or roosts	Loss of <10% of habitat, or roosts	Loss of 10–40% of habitat, or roosts	Loss of >40% of habitat or roosts; loss of any raptor nests
Human-wildlife conflict	Species that are not perceived as nuisances or threats by construction personnel: - Odonates - Butterflies - Most birds - Bats - Amphibians	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments: Some reptiles	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict: - Smooth-coated otter - Aculeate hymenopterans	Species that are typically perceived as both nuisances and threats by construction personnel, highly tolerant of human presence and urban environments, and are frequently implicated in human-wildlife conflict: - Long-tailed macaque - Some snakes

Impact Type	Negligible	Low	Medium	High
Loss of/ reduction in of ecological connectivity for fauna movement (within region)	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Slightly dependent on connected habitats for dispersal and adaptable to traverse urban infrastructures if needed	Dependent on connected habitats for dispersal	Highly dependent on connected habitats for dispersal

Table 5-20: Definitions of Each Level of Likelihood for all Impact Types During Construction Phase for Fauna Species Receptors

Likelihood	Definition
Unlikely/ Remote	Impact is not expected to happen during the construction phase of the project
Less Likely/ Rare	Impact is not likely to happen during the construction phase of the project
Possible/ Occasional	Impact could possibly happen or known to occur during the construction phase of the project
Likely/ Regular	Impact is a common occurrence during the construction phase of the project
Almost Certain/ Continuous	Impact is a continual or repeated process during the construction phase of the project

Four construction phase impact types were identified and assessed for the pre-mitigated fauna receptors: (1) Loss of/reduction in habitats and food sources, (2) Accidental injury or mortality, (3) Human-wildlife conflict and (4) Loss/reduction of ecological connectivity for fauna movement.

The impact significance ranged from **No Change** to **Major Negative** with minimum control measures in place. The more substantial impact arising from each impact type are briefly explained below. A summary of all the impact on fauna receptors is given on **Table 5-21**, with the numbers indicating the number of species that experience that magnitude of impact. The values assigned for each criterion in the RIAM as well as the resulting impact significance for each fauna receptor are provided in **Appendix 5J**.

Table 5-21: Summary of Construction Impacts to Fauna Receptors with Number Indicating Number of Species

Impact Type	No Change	Minor Negative	Moderate Negative	Major Negative
Loss of/ reduction in habitats and food sources	0	7	0	34
Accidental injury or mortality	0	37	4	0
Human-wildlife conflict	34	2	5	0

Impact Type	No Change	Minor Negative	Moderate Negative	Major Negative
Loss/reduction of ecological connectivity for fauna movement	11	14	16	0

Loss of/reduction in habitats and food sources

Major Negative impact is expected for 34 species from loss of/reduction in habitats or food sources as complete habitat loss is assumed during the construction phase. The impact significance for these species is “High”, and the likelihood is “Certain”. **Minor Negative** impact is expected for seven species that may use Site 1 as a transient habitat. Four of these species—the red-tailed pipe snake, smooth-coated otter, buffy fish owl, and eastern cattle egret—are associated with aquatic habitats, which are not present within the site but exist in nearby areas such as Lower Seletar Reservoir, suggesting a possibility of occasional use. The remaining three aculeate species—the island forest-digger, dusky-winged small carpenter bee, and Indonesian resin bee—are typically found in mature forests such as Bukit Timah Nature Reserve and the Central Catchment Nature Reserve (Soh & Ascher, 2022). Although Site 1 does not contain mature forest, its proximity to the Central Catchment area may allow for some movement of these species into the site, given the known habitat plasticity and mobility of aculeates (pers. comms. J.X.Q. Lee, 2025). For them, the impact intensity and likelihood is “Low” and “Less Likely” respectively, resulting in **Minor Negative** impact significance.

Accidental injury or mortality

Assuming total site clearance, there is a possible chance that fauna would come into accidental injury or mortality. Given minimum controls are in place (pre-felling fauna inspection, hoarding and wildlife response plan), impact significance is expected to range from **Minor to Moderate Negative**. Impact intensity is “High” for four species that have high susceptibility to accidental injury from construction activities and roadkill (long-tailed macaque, Sunda pangolin, smooth-coated otter and red-tailed pipe snake), thus resulting in **Moderate Negative** impact significance. The remaining 37 species are volant, thus have a “low” impact intensity, resulting in **Minor Negative** impact significance.

Human-wildlife conflict

Human-wildlife conflict between fauna species and construction site personnel is deemed to be **No Change** for 34 species not perceived as nuisances or threats to construction personnel, such as butterflies, odonates, and birds that would avoid human presence.

For the remaining species, the likelihood of human-wildlife conflict is “Likely”. Human-wildlife interactions may escalate into conflicts for many reasons. Nuisance species, such as long-tailed macaques, may be attracted to food waste or other materials within the worksite, and lead to negative interactions with site personnel. The smooth-coated otter is not a naturally an aggressive species and can co-exist with humans, but a lack of understanding regarding how to safely interact with wildlife, can cause species to retaliate in defence. The impact significance is hence assessed to be **Moderate Negative** for these species. Three aculeate species are assessed to have a “Medium” impact intensity and **Moderate Negative** impact significance due to potential human-wildlife conflict. Although these bee species do not form hives like honeybees and are unlikely to exhibit aggressive swarming behaviour, they may still be perceived as threats by construction personnel when encountered, which could lead to negative interactions.

The remaining two species—the red-tailed pipe snake and the Sunda pangolin—are assessed to have **Minor Negative** impact significance due to the “Low” impact intensity of potential human-wildlife conflict.

Loss/reduction of ecological connectivity for fauna movement

This assessment considers the potential loss or reduction of ecological connectivity for fauna movement beyond Site 1, focusing on impact within the broader Singaporean landscape rather than solely within the site. **No Change** is expected for 11 species that do not rely on connected habitats for dispersal and are capable of traversing urban infrastructure. These include the long-tailed macaque, urban-adapted bird species, and moderately common butterflies that utilise scrubland and streetscapes.

For the remaining species, the likelihood of the loss of connectivity impacting fauna species is “Possible” as Site 1 is a potential stepping stone habitat alongside other larger forested areas despite having limited connectivity due to being bounded by major roads (see **Section 5.4**). **Moderate Negative** impact significance is anticipated for 16 species that are highly dependent on connected habitats for dispersal. These include forest-associated birds such as the straw-headed bulbul, ruddy kingfisher, and square-tailed drongo-cuckoo; forest butterflies such as the pugnacious lancer and great mormon; and mammals like the Sunda pangolin, which is particularly vulnerable to roadkill during forest-to-forest movement, as well as the red-tailed pipe snake.

Minor Negative impact significance is expected for the remaining 14 species that exhibit some dependence on connected habitats but are more adaptable and capable of navigating through urban infrastructure when necessary. This group includes all aculeata species, raptors like kites and eagles, the long-winged tomb bat—known to roost in buildings—and moderately rare butterflies such as the forget-me-not and great swift, which can make use of open scrubland and urban streetscapes.

5.5.5 Operational Phase Impact

There are no operational phase impact types for habitat and flora receptors as complete site clearance will result in no retention of any habitats or flora of the original site.

5.5.5.1 Habitats

There are no operational impact types to be assessed as established above.

5.5.5.2 Flora

There are no operational impact types to be assessed as established above.

5.5.5.3 Fauna

The impact intensity and likelihood of each impact type during the operational phase are defined for fauna species receptors in **Table 5-22** and **Table 5-23**, respectively.

Table 5-22: Definitions of Level of Impact Intensity for all Impact Types During Operational Phase for Fauna Receptors

Impact Type	Negligible	Low	Medium	High
Accidental injury or mortality	Species with negligible susceptibility to accidental injury/mortality from operation activities, roadkill, and collision with buildings	Species with low susceptibility to accidental injury/mortality from operation activities, roadkill, and collision with buildings: Birds with low susceptibility to collision with buildings	Species that are mobile but possibly susceptible to accidental injury/mortality from operation activities and roadkill, and collision with buildings: Birds that are possibly susceptible to collision with buildings (e.g., resident species with	Species with high susceptibility to accidental injury/mortality from operation activities and roadkill, and collision with buildings: Birds with high susceptibility to collision with buildings (e.g., forest-edge

Impact Type	Negligible	Low	Medium	High
		Volant species (e.g., odonates, butterflies, raptors and frugivorous bats)	known records of bird-building collision. - All amphibians - Some mammals (e.g., squirrels, shrews) - Insectivorous bats (susceptible to roadkill as they are attracted to insects that are attracted to street lamps)	frugivores, migratory species) - Reptiles - Some mammals (e.g., Sunda pangolin, long-tailed macaque, smooth otter)
Human-wildlife conflict	Species that are not perceived as nuisances or threats by construction personnel: - Odonates - Butterflies - Most birds - Bats - Amphibians	Species that are possibly perceived as both nuisances and threats by construction personnel, less tolerant of human presence and urban environments: Some reptiles	Species that are typically perceived as nuisances and possibly as threats by construction personnel, highly tolerant of human presence and urban environments, and frequently implicated in human-wildlife conflict: - Smooth otter - Aculeate hymenopterans	Species that are typically perceived as both nuisances and threats by construction personnel, highly tolerant of human presence and urban environments, and are frequently implicated in human-wildlife conflict: - Long-tailed macaque - Some snakes
Loss of/reduction in of ecological connectivity for fauna movement (within region)	Not dependent on connected habitats for dispersal and able to traverse urban infrastructure	Slightly dependent on connected habitats for dispersal and adaptable to traverse urban infrastructures if needed	Dependent on connected habitats for dispersal	Highly dependent on connected habitats for dispersal

Table 5-23: Definitions of Each Level of Likelihood for all Impact Types During Operational Phase for Fauna Receptors

Likelihood	Definition
Unlikely/ Remote	Impact is not expected to happen during the operational phase of the project
Less Likely/ Rare	Impact is not likely to happen during the operational phase of the project
Possible/ Occasional	Impact could possibly happen or known to occur during the operational phase of the project
Likely/ Regular	Impact is a common occurrence during the operational phase of the project
Certain/ Continuous	Impact is a continual or repeated process during the operational phase of the project

Three operational phase impact types were identified and assessed for the pre-mitigated fauna receptors: (1) Loss/reduction of ecological connectivity for fauna movement, (2) Accidental injury or mortality, and (3) Human-wildlife conflict.

The impact significance ranged from **No Change** to **Minor Negative**. A summary of all the impact on fauna receptors is given on **Table 5-24**, with the numbers indicating the number of species that experience that magnitude of impact. The values assigned for each criterion in the RIAM as well as the resulting impact significance for each fauna receptor are provided in **Appendix 5J**.

Table 5-24: Summary of Operational Phase Impact to Fauna Receptors with Number indicating Number of Species

Impact Type	No Change	Minor	Moderate	Major
Accidental injury or mortality	0	36	5	0
Human-wildlife conflict	32	3	5	1
Loss/reduction of ecological connectivity for fauna movement	11	14	16	0

Human-wildlife conflict

The impact significance during the operational phase is largely similar to that of the construction phase, with the exception of two bat species: the long-winged tomb bat and the cave nectar bat. These species, previously assessed as **No Change** during the construction phase, are evaluated in the operational phase as **Moderate Negative** and **Minor Negative**, respectively.

This is due to the increased likelihood of human-wildlife conflict during the operational phase, with residents who are likely to be present at night when bats are active. Potential conflict may arise from bats flying into homes, roosting in residential ceilings, or feeding on accessible fruits grown or stored by residents. Notably, the long-winged tomb bat has been documented roosting in urban structures, including a basement along Orchard Road (Pottie et al., 2005).

There is one species with **Major Negative** impact – the long-tailed macaque. Similar to the construction phase, this species has a high impact intensity because it is frequently perceived by the public as both a nuisance and a threat. As an urban-adapted species that is highly tolerant of human presence, the long-tailed macaque is more likely to be attracted to the site by food and food waste rather than move away, thereby contributing to human-wildlife conflict during the operational phase.

Accidental injury or mortality

The development of new road infrastructure associated with the conversion of forest to residential areas is expected to increase the risk of roadkill, particularly for species with low mobility. The impact intensity for the long-winged tomb bat increases from “Low” in the construction phase to “Medium” in the operational phase as they have a higher susceptibility to roadkill when attracted to insects at streetlamps. This accounts for one additional species with **Moderate Negative** impact compared to the construction phase. Newly built residential buildings may expose birds to the risk of crashing into windows, often resulting in death. However, the incoming residential buildings are unlikely to have large glass or reflective surfaces and thus the impact likelihood for birds will be “Less Likely”.

Loss/reduction of ecological connectivity for fauna movement

Impact significance is similar to that in the construction phase—refer to **Section 5.5.4.1.3**.

5.5.6 Recommendation of Preventive and Mitigation Measures

This section discusses mitigation measures for future residential developments, which are implemented based on the mitigation hierarchy in the following order: (1) avoidance, (2) minimisation, and (3) enhancement/rehabilitation as well as compensation. Avoidance of impact would first be considered, subject to development considerations and technical assessments. If avoidance is not feasible, efforts are made to minimise construction impact. Finally, if habitat loss is inevitable, suggestions for compensation and enhancement/rehabilitation of remaining and/ or nearby habitats are proposed as a form of impact mitigation.

It is important to note that the successful implementation of mitigation measures relies on the commitment of contractors, arborists, and biodiversity specialists.

5.5.6.1 Design Phase

The design of the development should be considered first in the mitigation plan as it has the potential to influence the extent and types of impacts that can influence any sensitive ecological receptors at the operational phase.

5.5.6.1.1 Avoid

Selected trees and plant specimens are recommended to be retained on-site where feasible — these include keystone species *Ficus benjamina* (CTP6690), a large specimen of *F. microcarpa* (SU0991) with 20 m spread and height, and clusters of the Vulnerable fern *Microlepia speluncae* growing within the proposed linear green strip (see subsequent sections), subject to feasibility studies and subsequent arborist assessments. It is important to note that this fern thrives in semi-shade conditions. Adequate canopy cover and a minimum buffer of 1m is needed to ensure its survival and growth.

Additionally, several existing trees on-site within the precinct area have also been identified for potential retention to maintain ecological connectivity for volant species, subject to feasibility studies and arborist assessments. The complete list and locations of all trees proposed for retention are provided in **Appendix 5K**.

5.5.6.1.2 Minimise

The key mitigation measures to minimise biodiversity impact through the design of the proposed development at Site 1 are summarised in **Table 5-25** below.

Table 5-25: Key Recommended Design Measures to Minimise Biodiversity Impact during Design Phase

Receptors	Impact Types	Mitigation Measures
Flora	Plant mortality	Salvage saplings of species of conservation significance (0.3 m girth or less). See Appendix 5B2 for the list of species suitable for salvaging.
Fauna species	Accidental injury and mortality	Road calming measures such as speed bumps or speed limits can be incorporated as part of the newly built roads to minimise roadkill accidents. Directional site clearance to shepherd fauna to an area allowing them to leave by themselves or through rescue and relocation if needed.

5.5.6.1.3 Compensatory Measures

Enhanced native multi-tiered planting within the future residential precinct is proposed at the southeastern corner of Site 1 to achieve a greater amount of biomass and ecological synergy with Lower Seletar Reservoir Park and the adjacent forested areas south of Yishun Avenue 1. A linear green strip with a rustic native planting palette of minimally 5m along the southern boundary of Site 1 is also proposed, and should be wide enough to accommodate tiered planting with trees and shrubs in between ground cover. The planting palette should be carefully curated to ensure structural complexity by incorporating different layers and forms of vegetation, including ground cover, shrubs, trees and epiphytes, which would provide refuge for wildlife species, and the species assemblage should include plant species that attract native volant fauna, such as bees, butterflies and birds. These planted areas would also consist of any retained specimens identified in **Section 5.5.6.1.2** subject to feasibility studies and arborist assessments.

These measures are proposed to maintain ecological connectivity, particularly for native volant and urban-tolerant fauna groups, that use the abandoned land forest as a complementary stepping stone between larger forested areas in the region. The surrounding forested areas can continue to serve as wider primary connectivity corridors for wildlife. The following measures are summarised in **Table 5-26** below.

Table 5-26: Key Recommended Design Measures to Rehabilitate/Restore Biodiversity During Design Phase

Receptors	Impact Types	Mitigation Measures
Fauna Species	Loss/reduction of ecological connectivity for fauna movement	- A linear green strip of minimally 5m in width along the southern edge and enhanced native multi-tiered planting in the southeastern corner of Site 1 has been proposed to provide refuge for native volant urban-tolerant fauna such as birds and butterflies passing through the area (Figure 5-26). - Enhancement planting to increase vegetation structural complexity by incorporating different layers and forms of vegetation including ground cover, shrubs, trees, and epiphytes. - Design for native planting palette, which should include plant species that would attract native fauna such as bees, butterflies and birds. Refer to Appendix 5L for the recommended species for the proposed planting palette.

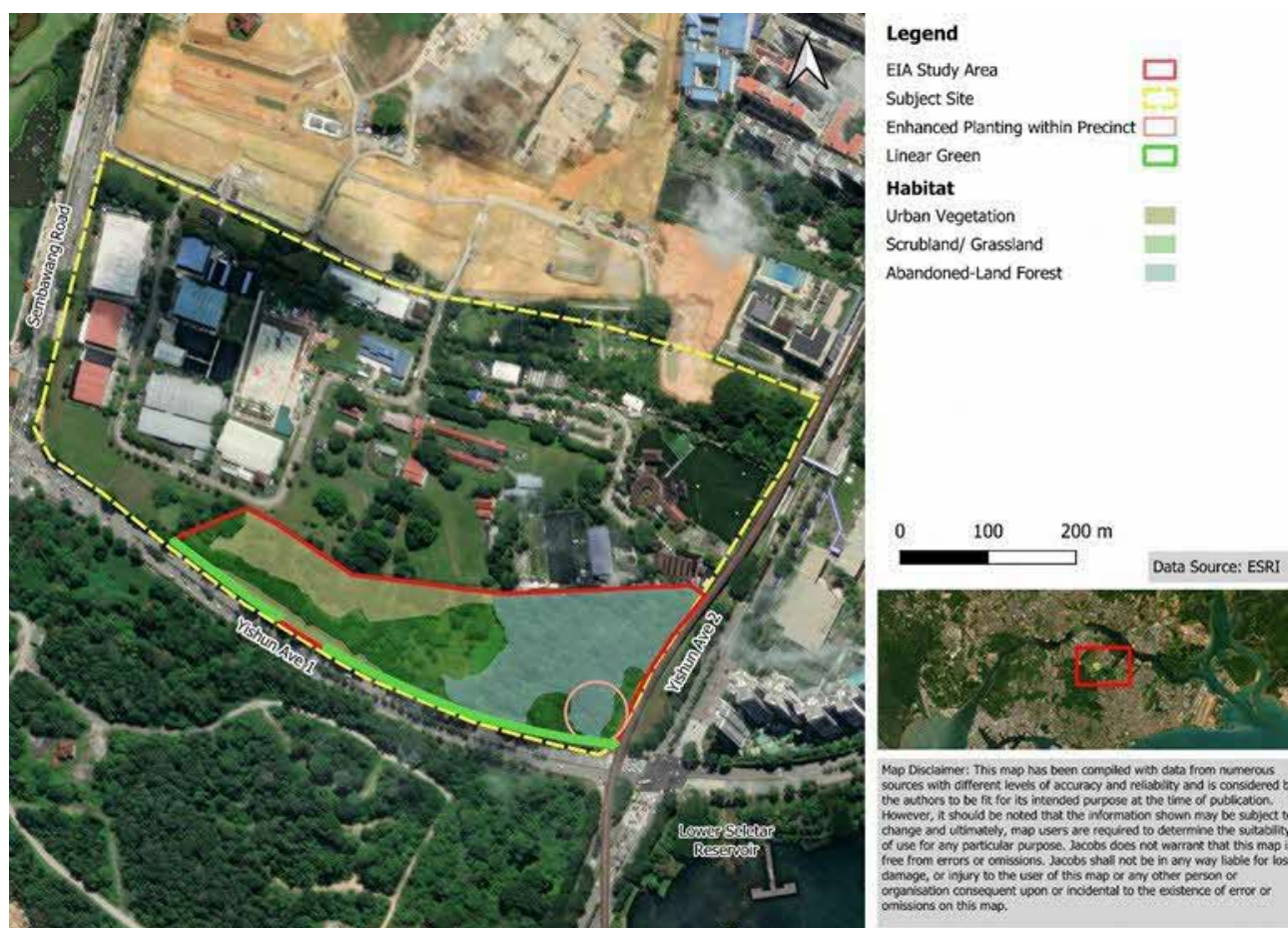


Figure 5-26: Linear Green Strip and Enhanced Planting within Precinct

5.5.6.2 Construction Phase

In addition to minimum controls in **Section 5.5.2**, other measures to minimise biodiversity impacts during the construction phase are summarised in **Table 5-27**.

Table 5-27: Key Recommended Measures to Minimise Biodiversity Impacts During Construction Phase

Receptors	Impact Types	Mitigation Measures
Flora species	Plant mortality	Engage flora specialists to monitor the health of transplanted individuals.
Fauna species	Accidental injury or mortality	- Directional site clearance to shepherd fauna to an area allowing them to leave by themselves or through rescue and relocation if needed. More importantly, it is recommended that the hoardings along the roads should be properly constructed before any directional site clearance commences. Further information can be found in Section 7.4.1.2.1). - Use of biodegradable erosion control blankets (for snakes). - Regularly inspect hoarding and maintain its structural integrity (to prevent fauna entering through gaps from adjacent forested areas, if present).

Receptors	Impact Types	Mitigation Measures
		• Ensure good housekeeping practices (to prevent attracting fauna to worksites) such as provision of wildlife-proof bins and indoor eating areas. • Conduct biodiversity awareness training for site personnel (to reinforce wildlife response plan). • Conduct regular site inspections to ensure contractor compliance with EMMP and identify potential fauna entrapments.
	Human-wildlife conflict	• Regularly inspect hoarding and maintain its structural integrity (to prevent fauna entering through gaps from adjacent forested areas, if present). • Ensure good housekeeping practices (to prevent attracting fauna to worksite) such as provision of wildlife-proof bins and indoor eating areas. • Conduct biodiversity awareness training for site personnel (to reinforce wildlife response plan). • Conduct regular site inspections to ensure contractor compliance with EMMP as well as for bee/wasp nests.

5.5.6.3 Operational Phase

Mitigation measures stated here should be relevant for Site 1 and enforced if applicable. However, most of the strategies for enhancement should have been considered during the design phase. Minimisation, restoration, and compensation measures would be the most applicable at the operational phase.

5.5.6.3.1 Minimise

The key mitigation measures to minimise biodiversity impact during the operational phase of the proposed development at Site 1 are summarised in **Table 5-28**.

Table 5-28: Key Recommended Measures to Minimise Biodiversity Impact During Operational Phase

Receptors	Impact Types	Mitigation Measures
Fauna species	Accidental injury or mortality	• Adopt road calming measures such as speed bumps and speed limits to minimise roadkill accidents.
	Human-wildlife conflict	• Educational signboards can be displayed near HDB's lift lobbies or nearby bus stops to educate the residents on how to identify, interact with, and respond to wildlife. Sign boards should include information on rescue hotlines i.e., ACRES or NParks. • Proper trash management measures should be implemented such as wildlife-proof bins, especially in amenities that serve food and beverages.

5.5.7 Residual Impact

5.5.7.1 Construction Phase

5.5.7.1.1 Habitats

Loss of habitat

As there are no mitigation measures for loss of habitat as outlined earlier, there are no changes in impact for habitat loss.

5.5.7.1.2 Flora

Similar to the pre-mitigation impact assessment, all 17 flora species receptors are assessed for mortality. The assessment considers mitigation measures detailed in Section 5.5.6.2. A summary of residual impact to flora receptors is given in Table 5-29 and detailed in Appendix 5I.

Mortality

Two *Ficus* trees (*Ficus microcarpa* and *Ficus benjamina*) and clusters of one fern species (*Microlepia speluncae*) situated in the proposed linear green strip will be studied for retention. As these species are proposed to be retained subject to feasibility studies, their mortality assessment remains as **No Change**.

During the construction phase, mitigation measures such as salvaging of specimens with $\leq 0.3\text{m}$ girth will be implemented to reduce impact on flora receptors. With these measures in place, mortality is still expected to have a **Major Negative** impact significance to two conservation significant species (i.e., *Lindera lucida* and *Oncosperma horridum*) as more than 50% of the specimens cannot be salvaged and will remain in the worksite. Mortality for one species (*Symplocos fasciculata*) is classified as "Low" impact intensity, since less than 50% of its specimens will remain affected by site clearance, resulting in **Moderate Negative** impact. In addition, mortality of a single specimen of *Ficus variegata*, which is unsuitable for salvaging, will result in **Minor Negative** impact.

Impact significance is **Not Applicable (NA)** to the remaining 10 conservation significant species, as all specimens are proposed to be salvaged and will therefore no longer be present on site. It is important to note, however, that this does not account for the success rate of salvaging and/or transplantation efforts, which depend on various external factors such as specimen adaptability and the microclimatic conditions of the relocation site.

Table 5-29: Summary of Residual Construction Impact to Flora Receptors with Number Indicating Number of Species

Impact Type	No Change	Slight Negative	Minor Negative	Moderate Negative	Major Negative	Not Applicable (NA)
Mortality	3	0	1	1	2	10 (if salvaged)

5.5.7.1.3 Fauna

Similar to the pre-mitigation impact assessment, all 41 fauna species receptors are assessed for four ecological impact types. The assessment considers mitigation measures for the construction phase detailed in Section 5.5.6.2. A summary of residual impact to fauna receptors is given in Table 5-30 and detailed in Appendix 5J.

Loss of/ reduction in habitats and food sources

As no existing habitats are proposed for retention, this impact type remains the same as the unmitigated scenario with 34 species having **Major Negative** impact and seven species having **Minor Negative** impact.

Accidental injury and mortality

Minor Negative impact for all 41 species is expected for accidental injury or mortality after mitigation measures such as directional site clearance, site inspections, biodiversity awareness training and road calming measures are applied, reducing the impact likelihood to "Less Likely".

Human-wildlife conflict

After mitigation measures such as biodiversity awareness training, wildlife-proof bins, site inspections and designated areas for eating are applied, the impact likelihood has been reduced to "Less Likely" and 34 species will face **No change**, while 7 species (animals that will be perceived as nuisance or threats) will face **Minor Negative** impact.

Loss/reduction of ecological connectivity for fauna movement

The creation of the proposed linear green will only come into effect during the operational phase, thus the residual impact significance at construction phase is similar to the unmitigated impact, refer to **Section 5.5.4.1.3**.

Table 5-30: Summary of Residual Construction Impact to Fauna Receptors with Number Indicating Number of Species

Impact Type	No Change	Minor Negative	Moderate Negative	Major Negative
Loss of/ reduction in habitats and food sources	0	7	0	34
Accidental injury or mortality	0	41	0	0
Human-wildlife conflict	34	7	0	0
Loss/reduction of ecological connectivity for fauna movement	11	14	16	0

5.5.7.2 Operational Phase

5.5.7.2.1 Habitats

There is no operational phase impact to be assessed.

5.5.7.2.2 Flora

There is no operational phase impact to be assessed, as none of the retained flora species are considered to have ornamental value or to be at risk of poaching.

5.5.7.2.3 Fauna

Accidental injury and mortality

After implementing road calming measures, impact likelihood is reduced to “Less Likely” for mammals, resulting in **Minor Negative** impact for all 41 species.

Human-wildlife conflict

After mitigation measures are applied, such as placing up advisories at lift lobbies and notice boards, the impact likelihood has been reduced to “Less Likely” and 32 species will face **No change**, while 9 species (animals that will be perceived as nuisance or threats) will face **Minor Negative** impact.

Loss/reduction of ecological connectivity for fauna movement

The linear green and enhanced precinct planting potentially provides connectivity for urban-tolerant volant species. Urban-tolerant bird species in particular are defined as birds that can be found in streetscape habitats, as the linear green will be a streetscape / urban vegetation habitat type. This lowers the impact likelihood of five urban-tolerant bird species from “Possible” to “Less Likely”. As a result, the impact significance for the Large-billed Crow is reduced from **Moderate Negative** to **Minor Negative**, while the four other urban-tolerant bird species, including the Long-tailed Parakeet and Oriental Magpie-robin, remain at **Minor Negative**.

Table 5-31: Summary of Residual Impact to Fauna Receptors during Operational Phase with Number Indicating Number of Species

Impact Type	No Change	Minor Negative	Moderate Negative	Major Negative
Accidental injury or mortality	0	41	0	0
Human-wildlife conflict	32	9	0	0
Loss/reduction of ecological connectivity for fauna movement	11	15	15	0

6. Assessment of Ambient Noise

This section describes the regulations and standards for noise pollution control that are applicable to the Project development during construction activities, discusses the baseline ambient noise data obtained and assesses the potential noise impacts associated with the construction activities of the Project development to the sensitive receivers. For this EIA Study Area, the report assesses the impact of noise to the fauna receiver identified. It is to be noted, although not covered in this report, that the Project is still mandated to comply with relevant construction noise regulations in Singapore governing noise emission to human receivers.

6.1 Applicable Legislation Standards

In Singapore, construction sites are required to adhere to the permissible noise limits established by the National Environment Agency (NEA) under the Environmental Protection and Management (Control of Noise at Construction Sites) Regulations. These regulations specify maximum permissible noise levels, which vary depending on the time of day and proximity to human noise sensitive premises such as residential buildings, hospitals, and schools. Compliance with the prescribed noise limits at these sensitive receivers for construction work is mandated and not further assessed in this report. The focus of this report is on the baseline and potential impact assessment of the fauna receiver.

There is currently no specific legislation, standard or widely accepted guidelines in Singapore that describe the noise levels or threshold limit for fauna. Humans and fauna have different hearing abilities and acoustic behaviours, and it is not possible to directly extrapolate human standards to fauna. For instance, the range of frequencies that fauna can hear differ greatly from humans and amongst themselves. Humans have a hearing range of approximately 64 to 23,000 hertz (Hz), while dogs can hear between 67 and 45,000 Hz, owls between 200 and 12,000 Hz and bats between 2,000 and 110,000 Hz. Fauna also have different sound sensitivities, with some able to hear very low or very high frequencies once crossing a certain threshold of sound intensity (Strain, 2017).

It should be recognised that amongst and within different fauna taxa, there is substantial variation of auditory capabilities and behaviours, which translate to a wide range of physiological and behavioural reactions to sound that current literature has limited coverage on. Fauna that relies on vocal communication for a range of functions such as mating courtship, prey location, threat detection and navigation are more severely affected by noise pollution. There are a few known fauna exceptions where current research points towards a greater tolerance to noise due to lower hearing capabilities such as odonates (Robert, 2005) and snakes (Christensen et al., 2012) who depend on other sensory faculties. It is also noted for bats that acoustic interference with bat calls based on frequencies rather than the specific noise levels have a larger impact on their response to noise pollution (Bunkley et al., 2015).

In general, the main impacts noted in most research consists of avoidance, behavioural changes, psychological impacts, auditory damage and masking of auditory signals. A brief summary of selected laboratory and field research which broadly investigate faunal responses to road and construction noise is shown in **Table 6-1** to highlight the broad range of noise levels and their impacts on different taxa.

Table 6-1: Summary of Noise Levels and Impacts on Fauna Biological Responses

Taxon	Noise level	Biological Responses
Non-volant Mammals	≥ 43 dBA ⁽¹⁾	▪ Behavioural and psychological responses of fear such as vocalisations and movement away from noise.
	≥ 52 dBA ⁽²⁾	▪ Increase in physiological stress ▪ Decrease in reproductive efficiency
Bats	≥ 80 dBA ⁽¹⁾	▪ Reduction in foraging efficiency

Taxon	Noise level	Biological Responses
Birds	≥ 45 dBA ⁽³⁾	▪ Changes in song frequency and length
	$\geq 48 - 55$ dBA ⁽³⁾	▪ Decline in occupancy and abundance
	≥ 52 dBA ⁽²⁾	▪ Increase in physiological stress levels
	≥ 68 dBA ⁽²⁾	▪ Reduction in breeding success
	$\geq 50 - 60$ dBA ⁽²⁾	▪ Changes in community and species interactions
Amphibians (frogs)	60 dBA ⁽⁴⁾	▪ Increased minimum frequency of vocalisations
	72 dBA ⁽²⁾	▪ Impact to vocal behaviour/ reduction in chorus tenure in male frogs
Reptiles	74 dBA ⁽¹⁾	▪ Freezing (fear or stress reactions) in lizards/ geckos
Invertebrates	81 dBA ⁽⁴⁾	▪ Higher frequency components in courtship signal

Source: Shannon et al., 2016; Simmons & Narins, 2018

Note:

⁽¹⁾Studies simply reported sound pressure level (SPL), while others in this category also reported the square root of the mean of the pressures squared (rms) in a given time interval.

⁽²⁾Studies calculated an acoustic metric (e.g. SPL, L_{eq}) in a given time interval over a specific duration and then calculated an average or median of these values.

⁽³⁾Equivalent continuous sound level (L_{eq} or L_{Aeq}).

⁽⁴⁾Studies reported 'dB' without any information on the specific metrics (SPL, SEL, etc.).

Pertinent to the information presented in **Table 6-1**, the impact of noise level ranges differs greatly across various species and taxa, and impact can begin from very low noise levels. Regarding these noise level sensitivities and conservation status, fauna found during the baseline study can be divided into three categories as described in **Table 6-2**. A full list of fauna recorded during the baseline study can be found in **Appendix 5F**. Fauna that are considered sensitive to sound include those which utilise auditory cues and communication for survival, while non-noise sensitive fauna tends to rely less, or not at all, on auditory means for survival. A reasonable assumption adopted was that fauna in the EIA Study Area have since adapted to current baseline ambient noise levels, using that as the threshold limit for fauna receiver assessment, even if these levels may differ from what literature suggests.

Table 6-2: Noise-Sensitivity and Conservation Significance of Fauna on Site

Fauna	General Taxon	Fauna Identified from Baseline Survey
Fauna of conservation significance (i.e. threatened species) that are sensitive to sound	▪ Aculeate hymenopterans ▪ Birds ▪ Amphibians ▪ Reptiles	▪ Plume-toed swiftlet ▪ Straw-headed bulbul ▪ Swinhoe's white-eye ▪ Long-tailed macaque
Fauna of non-conservation significance (i.e. common species) that are sensitive to sound	▪ Mammals	▪ Collared kingfisher ▪ Oriental pied hornbill ▪ Plantain squirrel ▪ Common treeshrew ▪ Lesser short-nosed fruit bat ▪ Banded bull frog

Fauna	General Taxon	Fauna Identified from Baseline Survey
		▪ Bengal toad ▪ Clouded monitor ▪ Reticulated python ▪ Oriental whipsnake
Fauna who have lower sensitivity to sound	▪ Odonates	▪ Common blue skimmer ▪ Common parasol

6.2 Existing Pre-Construction Conditions

6.2.1 Determination of Noise Sensitive Receivers (NSR)

The NSR considered within the 150 m buffer of the EIA Study Area is only for receivers with potential noise-sensitivity. The fauna receiver (within the adjacent forested area, 36 m south of Site 1) was selected due to the potential impact by the Project development, and was identified through the desktop study (i.e., review of publicly available street directories and satellite map) and site reconnaissance carried out on 13 August 2024 and is shown in **Figure 6-1**.



Figure 6-1: Noise Sampling Location

6.2.2 Baseline Ambient Noise Measurements

The baseline ambient noise levels for fauna NSR were measured using a Type 1 sound level meter at 5-minute intervals over three different periods of time, i.e., daytime (7 am – 7 pm), evening-time (7 pm – 10 pm), and night-time (10 pm – 7 am) for one week on a continuous basis to present a representative baseline of the existing environment. The parameters measured include sound pressure level (in dBA). The purpose of the noise monitoring is to establish baseline noise levels at the identified NSR, which will be used in the noise impact assessment and mitigation recommendations for the potential developments in Site 1. The baseline measurement does not support any discussion or assessment of specific noise characteristics such as instantaneous, tonal, and intermittent noise impacts on fauna.

6.2.3 Results and Discussion

The baseline ambient noise sampling for fauna was conducted for a week (or 7 days) continuously from 23 January to 30 January 2025. Baseline ambient noise result and photographic logs are provided in **Appendix 6A**, and summary results are tabulated in **Table 6-3**. The baseline ambient noise monitoring results are summarised below:

- L_{Aeq} 5 mins, L_{Aeq} 1 hour and L_{Aeq} 12 hours during the day, evening and night on weekdays were generally higher than Sunday and public holidays, with the exception of L_{Aeq} 5 mins during the day and the evening.
- The maximum L_{Aeq} 5 mins baseline ambient noise levels observed were 62.0 dBA during the day, 57.6 dBA during the evening, and 58.9 dBA during the night.
- The maximum L_{Aeq} 1 hour baseline ambient noise levels observed were 56.0 dBA during the day, 56.4 dBA during the evening, and 57.1 dBA during the night.
- The maximum L_{Aeq} 12 hours baseline ambient noise levels observed during the day was 53.9 dBA
- The maximum L_{Aeq} 5 mins and 1 hour baseline ambient noise levels observed during the day were higher than evenings and nights on weekdays.

Possible contributors to the baseline ambient noise levels measured in the forested patch south of Site 1 include vehicular traffic along Yishun Avenue 1 and Lontor Avenue, adjacent MRT operations, and fauna within the forest. The combined possible noise contribution from the aforementioned sources is observed to be higher during the day compared to the night. This is reflected in the lower evening and night noise levels, as compared to day noise levels for both weekdays and weekends/ public holidays. Over time, the fauna in this patch is expected to have adapted to noise levels either by moving away, exhibiting behavioural changes, or changing their vocal behaviour (Berger-Tal, et al., 2019). It is therefore a reasonable assumption that fauna have adapted to these maximum ambient baseline noise levels at these respective areas.

Fauna Biological Responses

Non-volant mammals and birds are identified as the most noise-sensitive species. Non-volant mammals exhibit behavioral and psychological responses such as fear, vocalisations, and movement away from noise at levels as low as 43 dBA. At 52 dBA, these mammals experience increased physiological stress and decreased reproductive efficiency, highlighting their vulnerability to noise disturbances.

Birds are also highly sensitive to noise pollution, with biological responses observed at 45 dBA based on literature. At this level, birds may alter their song frequency and length, which can affect communication and mating success. As noise levels increase to 48 dBA or more, birds may experience a decline in occupancy and abundance, increased physiological stress, reduced breeding success, and changes in community and species interactions.

Frogs, with a biological response threshold level from as low as 60 dBA can be particularly affected by noise pollution in their vocal behavior. Male frogs may reduce their chorus tenure and increased minimum frequency of vocalisations both of which can impede their reproductive success.

Reptiles, such as lizards and geckos, show stress reactions like freezing at noise levels of 74 dBA, while bats and invertebrates are less sensitive, with biological response threshold levels of 80 dBA and 81 dBA respectively. Based on literature described in **Table 6-1**, invertebrates (e.g. insects) are the least sensitive to sound, however, noisy environments of > 81dBA could mask or interfere with courtship signals. Bats may experience reduced foraging efficiency, and invertebrates may exhibit changes in courtship signals at these higher noise levels.

Given the baseline ambient noise levels monitored, which range from 52.5 to 62.0 dBA, the species most likely to be impacted by future construction activities are non-volant mammals, birds and frogs. These groups are already experiencing noise levels that exceed their reported biological response threshold, and any further increase due to construction activities could exacerbate the impacts on their behavior, physiology, and reproductive success. However, it is to be noted that birds may be less impacted as they are expected to fly away once construction activities commence. It is also reasonable to assume that certain species have likely developed coping mechanisms to existing noise sources and adapted to current baseline ambient noise levels.

Table 6-3: Baseline Ambient Noise Result

Monitoring Point (ID)	Period	Time	Parameter	Maximum Baseline Ambient Noise Level (dBA)
NSR1	Weekday	Day 7 am – 7 pm	L _{Aeq} 5 mins	61.5
			L _{Aeq} 1 hour	56.0
			L _{Aeq} 12 hours	53.9
		Evening 7 pm – 10 pm	L _{Aeq} 5 mins	57.5
			L _{Aeq} 1 hour	56.4
			L _{Aeq} 12 hours	-
		Night 10 pm – 7 am	L _{Aeq} 5 mins	58.9
			L _{Aeq} 1 hour	57.1
			L _{Aeq} 12 hours	-
	Sunday	Day 7 am – 7 pm	L _{Aeq} 5 mins	62.0
			L _{Aeq} 1 hour	55.7
			L _{Aeq} 12 hours	52.5
		Evening 7 pm – 10 pm	L _{Aeq} 5 mins	57.6
			L _{Aeq} 1 hour	55.9
			L _{Aeq} 12 hours	-
		Night 10 pm – 7 am	L _{Aeq} 5 mins	57.7
			L _{Aeq} 1 hour	56.8
			L _{Aeq} 12 hours	-

6.3 Evaluation of Noise Impact

The quantitative assessment of potential noise impact distinguishes between those that are positive or negative in nature; major, moderate or minor magnitude of changes; transboundary, national, or local extents; long or short term; direct or indirect; reversible or irreversible; cumulative and non-cumulative.

The prediction of the potential noise levels generated by the construction activities is simulated using noise modelling software CadnaA version 2025 (CadnaA), developed by DataKustik.

The assessment of potential noise impact distinguishes high, medium, or low magnitudes of changes as defined in **Table 6-4**. The impact magnitude of the exceedance in noise limits is based on the subjective perception of noise levels by humans. **Table 6-4** describes human responses to changes in noise levels and are taken as a guide to the impact magnitude on the fauna NSR when noise exceeds the maximum baseline noise level. Although fauna is likely to respond differently to these changes in noise levels, there are no known studies that have investigated responses to varying changes, and the same impact magnitude criteria is therefore adopted.

Table 6-4: Noise Impact Magnitude Definition Table

Exceedance Level (dBA)	Subjective Response	Impact Magnitude
> 0 to < 5	Just perceptible	Low
≥ 5 to < 10	Clearly perceptible	Medium
> 10	More than twice as loud	High

Source: Adapted from (Murphy & King, 2014)

6.3.1 Noise Emission Sources from the Proposed Construction Activities

Noise is expected to be mainly generated from the following sources during construction:

- Operation of fuel burning equipment (e.g., generator) and handheld tools (e.g., electric drilling, nail gun, welding, grinder, gas cutter, chainsaw).
- Operation and movement of heavy vehicle/ machinery (e.g., excavators, piling machines, dozers, drilling machines, cranes, asphalt pavers, rollers, lorry cranes, transit mixers, and dump trucks).

Noise levels generated by construction equipment vary greatly depending on the construction stage, type of construction activities, construction methodology, type of equipment, model and condition of equipment, quantity and duration of operation. The noise levels are also affected by distance, locations (either stationary or mobile sources), variations in the power of the equipment, and noise characteristics (e.g., continuous or intermittent noise, low frequency or high frequency noise) of the equipment.

At the time of this EIA report preparation, the construction methodology and technical details of the power mechanical equipment (PME) are only expected to be available at a later stage when the construction sub-contractor is on board. Therefore, for this EIA, the modelling assumptions for construction methodology, type of equipment, quantity, and duration of operation that are likely to be used at each construction stage were built based on typical industry practices and construction works done by HDB as well as Jacobs' project experience on similar construction projects (**Appendix 6B**). **Table 6-5** summarises the list of emission sources from the PMEs and their respective sound power level (SWL). All SWL for emission sources were either referenced from SS 602: 2014 Code of Practice for Noise Control on Construction and Demolition Sites or the British Standards BS 5228-1: 2009 Code of Practice for Noise and Vibration Control on Construction or Open Sites – Part 1: Noise as a general industrial common value for this assessment. Wherever a range of noise levels was reported, the higher value is adopted as the model input following a conservative approach. A more detailed description of the phases of work and the PMEs used in each phase is provided in **Appendix 6C**.

Table 6-5: Summary of the List of Emission Sources and Their Respective Sound Power Level (SWL)

Emission Sources	Sound Power Level (SWL, dBA)	Source
Asphalt paver	119	SS602:2014
Boom lift	105	BS5228-1
Bored piling	124	SS602:2014
Chainsaw	126	SS602:2014
Concrete discharging and pumping	107	SS602:2014
Concrete/ rock drilling	129	SS602:2014
Crawler crane	115	SS602:2014
Dozer	110	BS5228-1
Drilling machine	102	BS5228-1
Dump truck	114	SS602:2014
Electric drill	94	SS602:2014
Excavator	118	SS602:2014
Gas cutter	94	SS602:2014
Generator	119	SS602:2014
Grinding	106	SS602:2014
Lorry crane	120	SS602:2014
Mobile crane	98	BS5228-1
Nail gun	101	BS5228-1
Poker vibrator	112	SS602:2014
Pre-cast concrete piling	128	SS602:2014
Pump	108	SS602:2014
Roller	104	SS602:2014
Tower crane	108	SS602:2014
Transit mixer	116	SS602:2014
Vibratory piling	130	SS602:2014
Welding	96	SS602:2014

6.3.2 Noise Modelling Approach

As part of a conservative approach in the noise modelling, the entire construction timeline was divided into two distinct day time scenarios, i.e., Scenarios 1 and 2. Construction activities and their associated noise sources were categorised accordingly and modelled, as presented in **Table 6-6**.

Table 6-6: Estimated Noise Modelling Scenario and List of Construction Activities in the Day that will be Modelled in each Scenario

Scenario	Stage of Construction	Construction Activities
Scenario 1: Infrastructure Works	Construction Phase – Advance Works	- Wildlife shepherding - Erection of perimeter hoarding - Erection of tree protection zone (TPZ) (if any) - Tree felling and land/ vegetation clearance - Vegetation & debris transportation - Site preparation e.g. entrance and access road, temporary facilities (e.g. site office, Earth Control Measures (ECM) facilities, noise barriers) - Installation of mitigation measures (if any) - General works, e.g. machinery maintenance, construction materials delivery, waste management, storage and handling, electricity supply
	Construction Phase – Earthworks	- Soil and geotechnical investigation - Cut and fill/ regrading/ levelling/ platforming/ excavation - Installing sheet pile/soldier pile/soil nail - General works, e.g. machinery maintenance, construction materials delivery, waste management, storage and handling, electricity supply
	Construction Phase – Infrastructure	- Road works layering e.g. spreading, rolling, compaction, paving - Excavation - Drainage and sewerage work - Mechanical and Electrical works - General works, e.g. machinery maintenance, construction materials delivery, waste management, storage and handling
Scenario 2: BTO Works	Construction Phase – Building	- Bottom-up construction – substructure building foundation works and base slab casting - Bottom-up construction – superstructure prefabrication and structure installation - Architectural works e.g. window, painting, door, railing, etc. - Pavement construction works - General works, e.g. machinery maintenance, construction materials delivery, waste management, storage and handling, electricity supply

6.3.3 Noise Modelling Assumptions

The following assumptions were adopted for the noise modelling assessment:

- Construction activities are conducted during the day (7am – 7 pm) from Monday to Saturday excluding public holidays.
- The sound power levels are obtained from the SS 602: 2014 Code of Practice for Noise Control on Construction and Demolition Sites or the British Standards BS 5228-1: 2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise.
- All equipment is cumulatively modelled as an area source in CadnaA.
- Singapore's annual average ambient temperature of 28.11 °C¹, relative humidity of 77.9 %², and wind speed of 3 m/s was used in the noise modelling.
- Fauna NSR along the construction site boundary at the south were compared with the maximum baseline levels obtained during the baseline monitoring with the assumption that they have since adapted to current baseline noise levels, even if these levels may be higher from what literature suggests as explained in **Section 6.1**.
- Noise levels generated from construction activities to fauna NSR are estimated by receiver points of 0.5 m high for ground-dwelling fauna and 15 m high for arboreal fauna.
- The arboreal fauna NSR height of 15 m was chosen as the general height of trees around the Project.
- Noise is modelled with 10 m x 10 m horizontal grid spacing, and 0.5 m (ground-dwelling fauna) and 15 m (arboreal fauna) vertical grid spacing.
- Predicted noise levels at NSR were determined by adding maximum background noise levels from the baseline monitoring to the maximum modelled noise as shown:

$$\text{Predicted noise (dBA)} = \text{Maximum background noise (dBA)} + \text{Maximum modelled noise (dBA)}$$

6.3.4 Noise Modelling Results

The summary of the predicted noise levels during the infrastructure and BTO works in the day generated over 12 hours (L_{Aeq} 12 hours) and over 5 mins (L_{Aeq} 5 mins), in the absence of any mitigation measures, are presented in **Table 6-7** and **Table 6-8**, respectively. Modelled noise contours are provided in **Appendix 6D**.

The predicted noise levels over 12 hours for day (L_{Aeq} 12 hours) presented on **Table 6-7** indicates that in the absence of noise mitigation measures within and along the Project footprint, there will be exceedances of the maximum baseline noise level of up to 21.4 dBA (ground-dwelling fauna) and 25.1 dBA (arboreal fauna) for infrastructure works and up to 22.4 dBA (ground-dwelling fauna) and 26.1 dBA (arboreal fauna) for BTO works.

The predicted noise levels over 5 mins for day (L_{Aeq} 5 mins) presented on **Table 6-8** indicates that in the absence of noise mitigation measures at source and along the Project footprint, there will be exceedances of the maximum baseline noise level of up to 14.9 dBA (ground-dwelling fauna) and 18.6 dBA (arboreal fauna) for infrastructure works and up to 15.9 dBA (ground-dwelling fauna) and 19.5 dBA (arboreal fauna) for BTO works.

¹ Meteorological Service Singapore Annual Climate Assessment Report (2024)

² Singapore Department of Statistics. (2024). Air Temperature And Sunshine, Relative Humidity And Rainfall, Annual (2025) [Dataset]. data.gov.sg. Retrieved July 28, 2025 from https://data.gov.sg/datasets/d_19c6ce4509e0bddde2062298aa8ce9ab/view

Table 6-7: Predicted Unmitigated Noise Levels for Day (L_{Aeq} 12 hours)

NSR Cluster	Type of NSR	Max Baseline Noise Level (dBA)	Noise Level from Construction Activities ¹ (dBA)	Predicted Noise Level ² (dBA)	Exceedance Levels vs Max Baseline (dBA)	Impact Magnitude
Infrastructure Works						
N1 (0.5m)	Ground-dwelling fauna	53.9	75.3	75.3	21.4	High
N1 (15m)	Arboreal fauna	53.9	79.0	79.0	25.1	High
BTO Works						
N1 (0.5m)	Ground-dwelling fauna	53.9	76.3	76.3	22.4	High
N1 (15m)	Arboreal fauna	53.9	80.0	80.0	26.1	High

Note:

Red indicates exceedance of maximum baseline noise level

¹ Noise modelling output. Noise level is from construction activities only, without background noise

² Addition of background noise to modelling output

Table 6-8: Predicted Unmitigated Noise Levels for Day (L_{Aeq} 5 mins)

NSR Cluster	Type of NSR	Max Baseline Noise Level (dBA)	Noise Level from Construction Activities ¹ (dBA)	Predicted Noise Level ² (dBA)	Exceedance Levels (dBA)	Impact Magnitude
Infrastructure Works						
N1 (0.5m)	Ground-dwelling fauna	61.5	76.3	76.4	14.9	High
N1 (15m)	Arboreal fauna	61.5	80.0	80.1	18.6	High
BTO Works						
N1 (0.5m)	Ground-dwelling fauna	61.5	77.3	77.4	15.9	High
N1 (15m)	Arboreal fauna	61.5	81.0	81.0	19.5	High

Note:

Red indicates exceedance of max baseline noise level

¹ Noise modelling output. Noise level is from construction activities only, without background noise

² Addition of background noise to modelling output

6.3.5 Evaluation of Impact Significance for Construction Noise

Fauna NSR considered in the assessment are the identified species of conservation significance (i.e., birds and mammals) and fauna of non-conservation significance (i.e., birds, mammals, amphibians, and reptiles) which are sensitive to sound. Noise impact to fauna can range in severity and form, from damaged hearing due to the exposure to sound above a certain threshold to behavioural responses such as moving away from the noise source into other patches of forests. The impact magnitude for infrastructure works is expected to be high as the predicted noise exceedance ranges from 21.4 dBA to 25.1 dBA (L_{Aeq} 12 hours) and 14.9 dBA to 18.6 dBA (L_{Aeq} 5 mins) from the maximum baseline noise level. High impact magnitude is also expected for the BTO

works, as the predicted noise exceedance ranges from 22.4 dBA to 26.1 dBA (L_{Aeq} 12 hours) and 15.9 dBA to 19.5 dBA (L_{Aeq} 5 mins) from the maximum baseline noise level.

The impact permanence is anticipated to be short-term for Scenario 1 (infrastructure works) as the construction activities are expected to last less than 3 years, while medium term for Scenario 2 (BTO works) with an anticipated timeline between 3 to 10 years for the BTO works, with reversible impact as works will cease upon completion of the construction activities. The geographical extent of noise impact extends beyond the Project footprint with cumulative impact, as there are other construction activities occurring near the fauna NSR.

The impact significance of noise generated over 12 hours and 5 mins (L_{Aeq} 12 hours and L_{Aeq} 5 mins) during day time is presented in **Table 6-9** for infrastructure works and **Table 6-10** for the BTO works.

Table 6-9: Impact Significance for Predicted Unmitigated Noise (L_{Aeq} 12 hours and L_{Aeq} 5 mins) to Fauna NSR for Infrastructure Works

Assessment Criterion	Score Rating	Rating Justification/ Definition
A1: Value	3: National	Fauna of conservation significance (i.e., threatened species) e.g., plume-toed swiftlet, straw-headed bulbul, Swinhoe's white-eye which are sensitive to sound (i.e., birds and mammals).
	2: Local	Fauna of non-conservation significance (i.e., common species) e.g. collared kingfisher, striped albatross, plantain squirrel, banded bull frog, clouded monitor which are sensitive to sound (i.e., birds, mammals, amphibians, reptiles).
A2.1: Impact Nature	-1: Negative	Noise levels are expected to increase due to the construction activities.
A2.2: Magnitude of Changes	High (3)	Predicted noise levels for increased from baseline noise levels (refer to Table 6-7 and Table 6-8). - For Ground-dwelling fauna – High: more than 10 dBA above baseline levels. - For Arboreal fauna – High: more than 10 dBA above the baseline levels.
A2.3: Impact Extent	2: Beyond Project footprint	Noise impact is anticipated to extend beyond the Project footprint.
B1: Permanence	2: Short term	Noise impact for the entire infrastructure works will be less than 3 years and will cease when construction works stop.
B2: Impact Pathway	3: Direct	Noise impact results in direct impact to the NSR.
B3: Reversibility	2: Reversible	Noise-sensitive fauna could experience physiological damage from the exposure to sound above a certain threshold. Animals are generally mobile and could move away from the noise source. Thus, affected populations are expected to return once construction has ceased.
B4: Cumulative	3: Cumulative	Cumulative impact to the local noise levels is expected to be caused by noise generated from other construction projects when they occur concurrently.

Assessment Criterion	Score Rating	Rating Justification/ Definition
Environmental Score (ES)	-180	For sound-sensitive ground-dwelling and arboreal fauna of conservation significance.
	-120	For sound-sensitive ground-dwelling and arboreal fauna of non-conservation significance.
Range Bands of ES/ Impact Significance	Moderate Negative Impact	For ground-dwelling/ understory and arboreal fauna of conservation significance who are sensitive to sound
	Minor Negative Impact	For ground-dwelling/ understory and arboreal fauna of conservation significance who are sensitive to sound

Table 6-10: Impact Significance for Predicted Unmitigated Noise (L_{Aeq} 12 hours and L_{Aeq} 5 mins) to Fauna NSR for BTO Works

Assessment Criterion	Score Rating	Rating Justification/ Definition
A1: Value	3: National	Fauna of conservation significance (i.e., threatened species) e.g., plume-toed swiftlet, straw-headed bulbul, Swinhoe's white-eye which are sensitive to sound (i.e., birds and mammals).
	2: Local	Fauna of non-conservation significance (i.e., common species) e.g. collared kingfisher, striped albatross, plantain squirrel, banded bull frog, clouded monitor which are sensitive to sound (i.e., birds, butterflies, mammals, amphibians, reptiles).
A2.1: Impact Nature	-1: Negative	Noise levels are expected to increase due to the construction activities.
A2.2: Magnitude of Changes	3: High	Predicted noise levels increased from baseline noise levels (refer to Table 6-7 and Table 6-8). - For Ground-dwelling fauna – High: more than 10 dBA above baseline levels. - For Arboreal fauna – High: more than 10 dBA above the baseline levels.
A2.3: Impact Extent	2: Beyond Project footprint	Noise impact is anticipated to extend beyond the Project footprint.
B1: Permanence	3: Medium term	Noise impact for the entire BTO works will be between 3 to 10 years and will cease when construction works stops.
B2: Impact Pathway	3: Direct	Noise impact results in direct impact to the NSR.
B3: Reversibility	2: Reversible	Noise-sensitive fauna could experience physiological damage from the exposure to sound above a certain threshold. Animals are generally mobile and could move away from the noise source. Thus, the affected population is expected to return once construction has ceased.

Assessment Criterion	Score Rating	Rating Justification/ Definition
B4: Cumulative	3: Cumulative	Cumulative impact to the local noise levels is expected to be caused by noise generated from other construction projects when they occur concurrently.
Environmental Score (ES)	-198	For sound sensitive ground-dwelling and arboreal fauna of conservation significance.
	-132	For sound sensitive ground-dwelling and arboreal fauna of non-conservation significance.
Range Bands of ES/ Impact Significance	Moderate Negative Impact	For ground-dwelling/ understory and arboreal fauna of conservation significance and non-conservation significance who are sensitive to sound

6.3.6 Evaluation of Impact Significance for Operation Phase

During the operational phase of the proposed residential development, noise emissions are anticipated to be minimal and not significant. The primary sources of noise during this phase are expected to be limited to typical residential activities and vehicular traffic.

No commercial, industrial, or high-noise-generating facilities are included in the development plan. As such, projected increases in traffic noise are anticipated to be marginal and are not expected to result in a significant change from the existing baseline noise level.

6.4 Recommendation of Preventive and Mitigation Measures

To protect the fauna NSR from excessive exposure to the construction noise, further mitigation measures such as noise source controls, barriers to block noise propagating pathways are reviewed, tested and presented in this section for consideration and implementation during the infrastructure and BTO works. The assumptions used in formulating mitigation measures and their practicality are based on the available information and assumptions at the time of writing. For this reason, it is recommended that a contract-specific Environmental Monitoring and Management Plan (EMMP) be prepared by the contractor. This plan should include updated noise modelling based on the actual equipment list and noise emission levels, as well as the feasible source control measures and noise barrier specifications that will be implemented.

Modelling of source control, in addition to the noise barriers, has been incorporated to demonstrate how the layering of mitigation measures can reduce the predicted impact to ALARP. This approach provides a clear illustration of the potential benefits to the fauna NSR.

6.4.1 Noise Barrier

Noise barriers are highly effective measures to reduce the noise level from construction activities. Noise Barriers include Permanent Noise Control Barriers (PNCB), Temporary Noise Control Barriers (TNCB), as well as Portable Noise Control Barriers and Noise Reduction Nets, also known as Sound Blankets.

A noise barrier should ideally be constructed such that it blocks the line of sight between fauna NSR and the noise source (ground-dwelling fauna is expected to have more noise reduction from noise barriers than arboreal fauna).

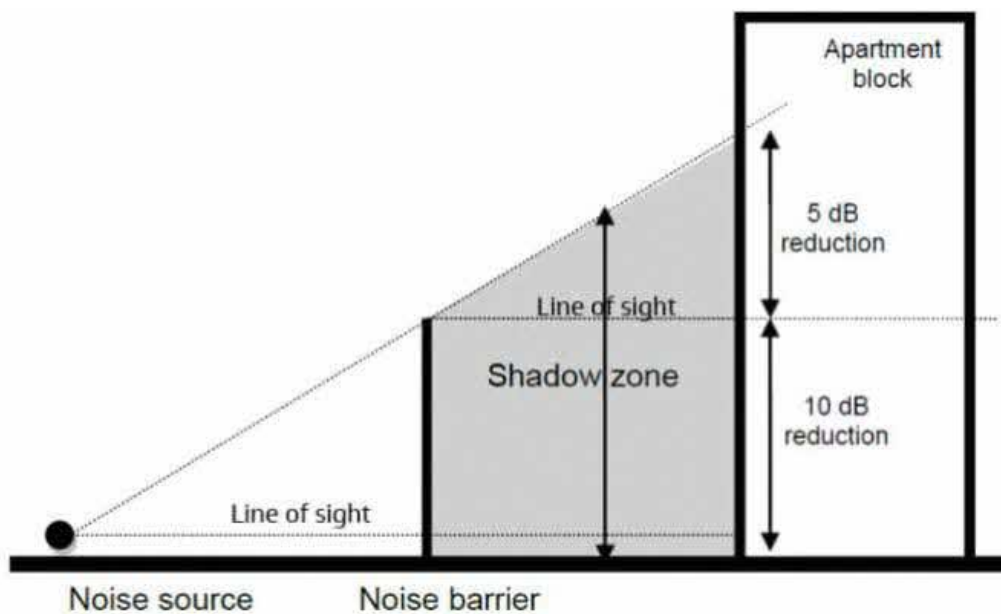


Figure 6-2: Effectiveness of a Noise Barrier

Source: Figure F.6 of SS 602: 2014

The deployment of noise barriers will depend on specific construction site circumstances, which are unknown until construction site works commence. The detail specification and positioning of noise barriers would be best determined by the contractor in consultation with the provider of the noise barriers during the infrastructure and BTO works, depending on the actual noise level emission and distance of the construction equipment from the fauna NSR. The location and height are to be determined with the aid of the noise modelling exercise to achieve the required noise reduction objectives.

6.4.2 Control Measures at Emission Source

The source emission control measures include adopting quieter construction methodology/ machines/ equipment, enclosures, noise screen/ noise panel, portable noise barrier. During construction, the contractor may use the Powered Mechanical Equipment (PME) with different sound power levels, different quantity, and operating time from what was modelled.

- Enclosure at PME with sufficient height and width to shield the noisy parts may achieve noise level reduction of up to 15 dBA (Table F.3 of SS 602: 2014).
- Noise screens/ noise panels at PME of sufficient height and width to shield the noisy parts may achieve a noise level reduction of up to 10 dBA (Table F.3 of SS 602: 2014).
- Portable noise barrier at construction activities where possible, which are close to the site boundary may achieve a noise level reduction of at least 10 dBA (Section F.3.3.4 of SS 602: 2014).
- Quieter construction methodology such as the use of diamond wire saw cutter can achieve up to 30 dBA of noise reduction (based on LTA's Noise Guidance: Developing a Noise Management Plan).

The applicable engineering control measures at/near noise sources that may further apply to reduce the noise and the estimated dBA reduction are listed in **Table 6-11**.

Example of mitigation measures at source are shown in **Figure 6-3**.

Table 6-11: Reduced Sound Power Level of Equipment with Additional Engineering Control Measures

Equipment	Initial Sound Power Level (dBA)	Type of Engineering Control Measures	Assumed Noise Reduction by Control Measures ¹	Reduced Sound Power Level at Source (dBA)
Pump	108	Noise reduction screen/ noise reduction panel	-10	98
Generator	119	Noise reduction screen/ noise reduction panel	-10	109
Excavator	118	Noise reduction screen/ noise reduction panel	-10	108
Vibro hammer	130	Noise reduction screen/ noise reduction panel	-10	120
Crawler crane	115	Noise reduction screen/ noise reduction panel	-10	105
Rock drill	129	Noise reduction screen/ noise reduction panel	-10	119
Drop hammer	128	Noise reduction screen/ noise reduction panel	-10	118
Bored piler	124	Noise reduction screen/ noise reduction panel	-10	114
Poker vibrator	112	Noise reduction screen/ noise reduction panel	-10	102
Transit mixer	116	Noise reduction screen/ noise reduction panel	-10	116

Note:

¹Noise reduction assumed conservatively below SS 602: 2014 Code of Practice for Noise Control on Construction and Demolition Sites SS 602:2014

	
Noise proofing enclosure	Acoustic material installation for PME
	
Portable acoustic barrier for localised works	Noise panel fitted on noise emission outlet of bored piler

Figure 6-3: Examples of Noise Mitigation at Source

Source: LTA, Jacobs

6.4.3 Noise Modelling Results of Mitigation Measures

To determine the additional control measures that may be required to reduce the potential noise impact to the NSR, modelling trials were conducted for infrastructure and BTO works as its results have exceedances at the NSR as presented in **Section 6.3.4**.

Noise modelling trials are carried out for L_{Aeq} 12 hours and L_{Aeq} 5 mins. The predicted noise levels are summarised and compared in **Table 6-12** and **Table 6-13**. As a result of the modelling trials, the recommended mitigation options are:

- 12 m high noise barrier along the construction site boundary as shown in **Figure 6-4**.
- Reduction of sound power level at sources as specified in **Table 6-11**.

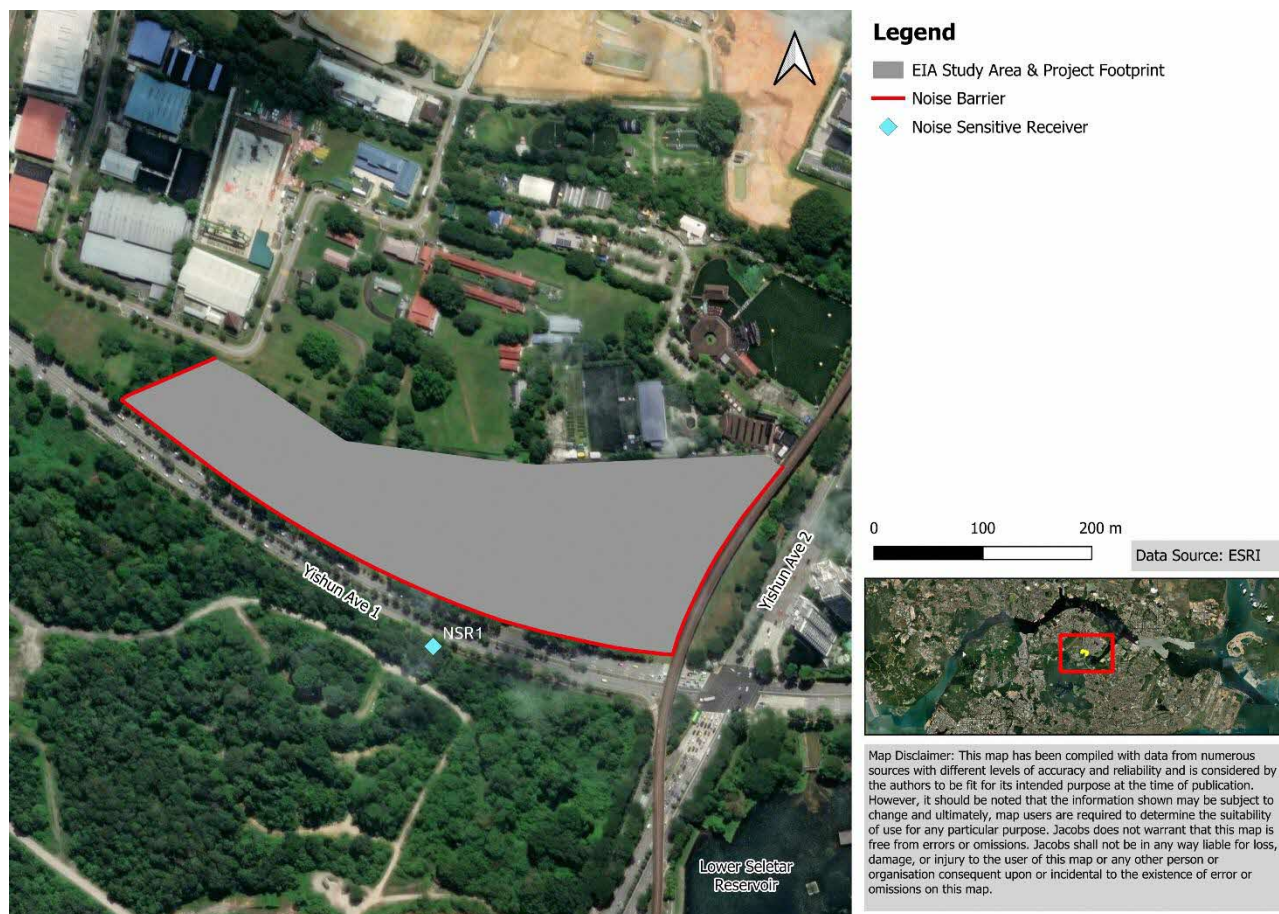


Figure 6-4: Recommended Location of 12 m Noise Barrier

Table 6-12: Predicted Mitigated Noise Levels for Day (L_{Aeq} 12 hours)

NSR Cluster	Type of NSR	Max Baseline Noise Level (dBA)	Noise Level from Construction Activities ¹ (dBA)	Predicted Noise Level ² (dBA)	Exceedance vs Max Baseline (dBA)	Impact Magnitude
Infrastructure Works						
N1 (0.5m)	Ground-dwelling fauna	53.9	56.0	58.1	4.2	Low
N1 (15m)	Arboreal fauna	53.9	64.5	64.9	11.0	High
BTO Works						
N1 (0.5m)	Ground-dwelling fauna	53.9	56.0	58.1	4.2	Low
N1 (15m)	Arboreal fauna	53.9	64.5	64.9	11.0	High

Note:

Red indicates exceedance of max baseline noise level

¹ Noise modelling output. Noise level is from construction activities only, without background noise

² Addition of background noise to modelling output

Table 6-13: Predicted Mitigated Noise Levels for Day (L_{Aeq} 5 mins)

NSR Cluster	Type of NSR	Max Baseline Noise Level (dBA)	Noise Level from Construction Activities ¹ (dBA)	Predicted Noise Level ² (dBA)	Exceedance vs Max Baseline (dBA)	Impact Magnitude
Infrastructure Works						
N1 (0.5m)	Ground-dwelling fauna	61.5	57.0	62.8	1.3	Low
N1 (15m)	Arboreal fauna	61.5	65.5	67.0	5.5	Medium
BTO Works						
N1 (0.5m)	Ground-dwelling fauna	61.5	57.0	62.8	1.3	Low
N1 (15m)	Arboreal fauna	61.5	65.5	67.0	5.5	Medium

Note:

Red indicates exceedance of maximum baseline noise level

¹ Noise modelling output. Noise level is from construction activities only, without background noise

² Addition of background noise to modelling output

6.5 Residual Impact

The adoption of the mitigation measures recommended will assist in reducing the noise impact during the construction phase of the Project. After implementing these recommended mitigation measures, the residual significance of noise impact is anticipated to be Slight Negative to Moderate Negative. With the implementation of the recommended mitigation measures, the residual impacts evaluated are summarised in **Table 6-14**.

The results indicated improvements in impact magnitude to ground-dwelling fauna, following the implementation of mitigation measures, with predicted noise levels for infrastructure and BTO works reduced significantly at NSR1, for L_{Aeq} 12 hours and For L_{Aeq} 5 minutes, reductions of 19.3 dBA (infrastructure works) to 20.3 dBA (BTO works). This resulted in a decrease in impact on conservation significant species, ranging from Moderate to Slight negative (infrastructure works) and Moderate to Minor Negative (BTO works), and on non-conservation significant species, ranging from Minor to Slight Negative (infrastructure works) and Moderate to Slight Negative (BTO works).

Predicted noise levels at the NSR1 were reduced by 14.5 dBA (infrastructure works) to 15.5 dBA (BTO works) for both L_{Aeq} 12 hours and L_{Aeq} 5 minutes for arboreal fauna. The impact of infrastructure works on arboreal species remained at Moderate Negative (conservation significant species) and Minor Negative (non-conservation significant species) for L_{Aeq} 12 hours, whereas it reduced from Moderate Negative to Minor Negative (conservation significant species) and remained at Minor Negative (non-conservation significant species) for L_{Aeq} 5 mins. The impact of BTO works on non-conservation and conservation significant arboreal species remained at Moderate Negative for L_{Aeq} 12 hours, whereas it reduced from Moderate Negative to Minor Negative (non-conservation significant species) and remained at Moderate Negative (conservation significant species) for L_{Aeq} 5 mins. This highlights the limitations of current mitigation measures for species occupying elevated vegetation layers as the species may be located above the level of the noise barriers. However, arboreal fauna is regarded as being more mobile than other types of fauna, allowing them to move away from the noise source during Project implementation.

In summary, the modelling results have predicted that higher noise levels are mostly experienced by arboreal fauna which are generally also more mobile and could move away from the noise source. Although it is also possible that ground-dwelling fauna will move away from loud noises, they may expend considerable energy to find other suitable habitats. This energy could otherwise be used for breeding, hunting or defence purposes. In addition, there remains some which are less mobile such as birds which have nested in nearby trees. This could lead to higher mortality rates and contribute to greater ecosystem pressures, as fauna move towards more crowded habitats. As the construction works progress over time, fauna may adapt to heightened noise levels whether by moving away, behavioural changes, or changing their vocal behaviour (Berger-Tal, et al., 2019). This may also assist them in adapting to the operational noise when the development is completed.

Table 6-14. Summary of Evaluation of Residual Impacts for Infrastructure and BTO Works Noise Impact

Impact Register	Before Mitigation Measures		Post-Mitigation Measures	
	Environmental Score (ES)	Range Bands of ES/ Impact Significance	Environmental Score (ES)	Range Bands of ES/ Impact Significance
L_{Aeq} 12 hours – Infrastructure Works				
Noise emission from construction site to sound sensitive ground-dwelling fauna of conservation significance	-180	Moderate Negative	-60	Slight Negative
Noise emission from construction site to sound sensitive arboreal fauna of conservation significance	-180	Moderate Negative	-180	Moderate Negative
Noise emission from construction site to sound sensitive ground-dwelling fauna of non-conservation significance	-120	Minor Negative	-40	Slight Negative
Noise emission from construction site to sound sensitive arboreal fauna of non-conservation significance	-120	Minor Negative	-120	Minor Negative
L_{Aeq} 5 mins – Infrastructure Works				
Noise emission from construction site to sound sensitive ground-dwelling fauna of conservation significance	-180	Moderate Negative	-60	Slight Negative
Noise emission from construction site to sound sensitive arboreal fauna of conservation significance	-180	Moderate Negative	-120	Minor Negative

Impact Register	Before Mitigation Measures		Post-Mitigation Measures	
	Environmental Score (ES)	Range Bands of ES/ Impact Significance	Environmental Score (ES)	Range Bands of ES/ Impact Significance
Noise emission from construction site to sound sensitive ground-dwelling fauna of non-conservation significance	-120	Minor Negative	-40	Slight Negative
Noise emission from construction site to sound sensitive arboreal fauna of non-conservation significance	-120	Minor Negative	-80	Minor Negative
L_{Aeq} 12 hours – BTO Works				
Noise emission from construction site to sound sensitive ground-dwelling fauna of conservation significance	-198	Moderate Negative	-66	Minor Negative
Noise emission from construction site to sound sensitive arboreal fauna of conservation significance	-198	Moderate Negative	-198	Moderate Negative
Noise emission from construction site to sound sensitive ground-dwelling fauna of non-conservation significance	-132	Moderate Negative	-44	Slight Negative
Noise emission from construction site to sound sensitive arboreal fauna of non-conservation significance	-132	Moderate Negative	-132	Moderate Negative

Impact Register	Before Mitigation Measures		Post-Mitigation Measures	
	Environmental Score (ES)	Range Bands of ES/ Impact Significance	Environmental Score (ES)	Range Bands of ES/ Impact Significance
L_{Aeq} 5 mins – BTO Works				
Noise emission from construction site to sound sensitive ground-dwelling fauna of conservation significance	-198	Moderate Negative	-66	Minor Negative
Noise emission from construction site to sound sensitive arboreal fauna of conservation significance	-198	Moderate Negative	-132	Moderate Negative
Noise emission from construction site to sound sensitive ground-dwelling fauna of non-conservation significance	-132	Moderate Negative	-44	Slight Negative
Noise emission from construction site to sound sensitive arboreal fauna of non-conservation significance	-132	Moderate Negative	-88	Minor Negative

6.6 Good Practices on Noise Control

Table 6-14 showed that the noise source control measures and noise barriers are effective in reducing the noise impact magnitude to fauna NSR (especially the impact to the ground-dwelling fauna). As the noise level of the construction equipment and activities may have been limited by the technology available, the contractor may consider combining a variety of methods, e.g., combining quieter equipment and noise barriers to achieve the protection objectives.

Hence, it is recommended for the appointed contractor consider the installation of a 12-m high noise barrier to protect the ground-dwelling fauna NSR from exposure to excessive noise, i.e., net increase of sound pressure level <10 dBA during the construction period. To minimise unmitigated noise exposure to fauna NSR, installation of the noise barrier along the Project perimeter at the earliest practicable stage along the Project timeline is recommended, preferably before any type of infrastructure or BTO works commences. It is to be noted that a higher value of the sound power level range for PMEs was adopted in the noise modelling based on conservative assumptions. If the contractor uses different equipment, improved construction methods, more advanced source control technology and noise barrier specification, the contractor may review and verify their

effectiveness using a similar noise modelling approach and assessment criteria before carrying out the physical works on site.

Where applicable, the following good practices, including administrative measures, can be further reviewed and adopted by the contractor to further reduce the potential construction noise impact of infrastructure and BTO works to ALARP:

- Prepare a noise management plan (NMP) with the finalised construction method, schedule and equipment sound power levels to reconfirm the noise impact to fauna NSR are within acceptable ranges. The suggested NMP template is indicated in Annex H of SS 602: 2014.
- Use engineering methodology to control noise at source (examples provided in **Figure 6-3**), such as:
 - Quieter construction methodology such as silent piers instead of vibratory piling, hydraulic splitter instead of concrete/ rock drilling.
 - Noise enclosures to cover stationary PME such as generators.
- Noise screens/ noise panels to partially shield noise generated from noisy PME such as generators and excavators.
 - Portable noise barriers for noisy construction activities e.g., soil investigation drilling activities, or road and drainage works which are close to the site boundary.
- Plan the construction works to minimise noise sources onsite through the optimisation of construction sequences and methods, such as:
 - Optimising vehicular access to minimise reversing of vehicles.
 - Making use of existing structures such as silos or site offices as noise shields to reduce noise transmission from noisy static equipment to the fauna NSR.
- Conduct continuous real time noise monitoring using a Type 1 sound level meter with data logging at the fauna NSR. When noise levels exceed the maximum adjusted noise level, the contractor should investigate and apply appropriate mitigation measures.

Noise meters are recommended to be located at the site boundary near adjacent forested areas.

- Implement industry best practices:
 - On-site PME should be well-maintained, i.e. serviced regularly during the construction period.
 - The number of PME should be reduced as far as practicable when construction works are carried out at areas close to the NSRs.
 - Alternative equipment with less noise emission can be considered, such as the use of rubber mallets instead of metal hammers.
 - Care shall be taken during loading or unloading, dismantling, or moving materials to reduce noise.
 - Silencers or mufflers on PME (e.g., generator sets) should be utilised and properly maintained during construction.
 - Mobile PME, if any, should be sited as far from fauna NSR as possible.
 - PME (such as trucks and cranes) that may be in intermittent use should be shut down between work periods or throttled down to a minimum where possible.

- PME known to emit noise strongly in one direction should, whenever possible, be oriented so that the noise is directed away from the fauna NSR.
- Consider limiting heavy construction working hours to 8 am to 6 pm where possible to avoid the timings when crepuscular species may be active. Toolbox meetings and winding down of work can be done outside of these hours.
- Implement progressive starting of loud construction activities to gradually increase noise levels for mobile fauna who have returned to roost during the night or are in the area to move away before noise levels get more intense.
- Where night works are conducted, the minimal amount of equipment should be used to reduce noise levels.
- Where night works are conducted, workers should refrain from shouting or using loud hailers aside from emergencies.
- In the event of planned night work, additional assessment, i.e. noise, light impact should be conducted and submitted to NParks for approval prior to commencement.

7. Environmental Management and Monitoring Plan

This Section outlines a preliminary Environmental Management and Monitoring Plan (EMMP) specification and its structure which consists of the requirement of policy statement, organisational structure with assigned roles and responsibilities, reporting and communication plans, management and monitoring measures, and training programme that will be put in place during the construction phase and post-construction phase (first three months) of the Project for implementation of all the recommended prevention and mitigation measures in the preceding sections.

7.1 Purpose of EMMP

An EMMP for project-specific implementation during the various stages of construction and/or post-construction (first three months) phase has the following purposes for:

- Commitment of compliance with mitigation and enhancement measures identified in this EIA as well as the relevant environmental legislation by responsible parties.
- Basis of guidance to the appointed Project Consultant and Main Contractor in developing an EMMP for implementing appropriate environmental controls and monitoring procedures.
- Basis of guidance to the Project's developing agency (HDB) in establishing impact registers and management protocols to minimise the identified environmental impact during the construction phase.
- Performance monitoring and auditing of the actual environmental impact of the Project during different stages of the project development.

7.2 Change Management and Review Process

The EIA has been prepared based on information available at the design stage of the Project. The EMMP may be updated once the detailed design is approved for the construction works. In particular, the recommended mitigation measures in this EIA may be revised in detail in parallel with the approved design for the Project.

For each of the issues identified as impact in the preceding sections, suitable mitigation measures have been proposed to reduce the significance of each impact type or to avoid the impact occurring at all. In tandem with the assessment and mitigation steps, the expected impact and their associated mitigation measures must be monitored to determine the effectiveness of mitigation and to revise relevant mitigation measures that are shown to be inadequate or unsuccessful based on monitoring.

As the EMMP serves as a "live document", the plan will be reviewed and updated as additional project information become available and in further consultation with technical agencies. The change management review process comprises:

- Verification if the EMMP is still achieving the established objectives.
- Environmental impact register evaluation.
- Mitigation measures enhancement, where necessary.
- Upcoming or new environmental impact due to change in construction methodology.

7.3 Contract-Specific EMMP Structure

A Contract-Specific EMMP is required to be developed by the appointed Contractors (this shall be referred to by all contractors for various stages of construction phase). The Contract-Specific EMMP shall include but not be limited to the following scopes where their respective specifications are described in the following subsections.

- Project description.
- Project environmental policy and objectives.
- EMMP organisation structure.
- EMMP roles and responsibilities.
- Reporting and communication plans.
- Training programme.
- Environmental impact register with identified sensitive receivers from the EIA findings (key aspect of concerns), potential impact with their respective mitigation and/or enhancement measures to be implemented, including the wildlife shepherding plan for wildlife migration out of the project construction boundary.
- Environmental performance inspection and monitoring regime for aspects such as air, noise, water quality and biodiversity to be conducted during the construction period.
- Environmental audit programme.
- Contingency plan.
- Stakeholder engagement and management.

7.3.1 Project Description

The Contractor is required to include a description of the Project with the following key content:

- Overall site utilisation and layout plan.
- Construction method statements.
- Utilities and services plan.
- Access (e.g., vehicular entrances and vehicle movement to the Project development).
- Construction material and chemical storages, soil stockpile area, etc.
- Hoarding and tree felling plan.
- Construction sequence.
- Waste handling and management.

7.3.2 Project Environmental Policy and Objectives

The Contractor is required to establish a project-specific environmental policy that affirms their commitment to EMMP implementation. The project-specific environmental policy should cover the following:

- Commitment from the company's management on environmental safeguarding for the Project.

- Compliance with all applicable environmental legislation and relevant requirements including mitigation measures from this EIA and industry best practices.
- Commitment to prevent pollution.
- Commitment to continually improve environmental performance by setting and reviewing environmental objectives and targets.
- Communication and education plans with all associated persons/ affected communities/ stakeholders to achieve environmental goals.

7.3.3 EMMP Organisation Structure

The developing agency, HDB, will oversee the implementation of the Contract-Specific EMMP by the Contractor and its subcontractors, or any third party during the construction period of the Project. The Technical Agencies and relevant authorities and stakeholders (i.e., NParks, NEA and PUB) will be responsible for providing guidance for requirements and sharing with HDB for issues related to interfacing works where cumulative impact is identified. A recommended organisation structure for EMMP implementation during the construction phase and post-construction (the first three months) is presented in **Figure 7-1**.

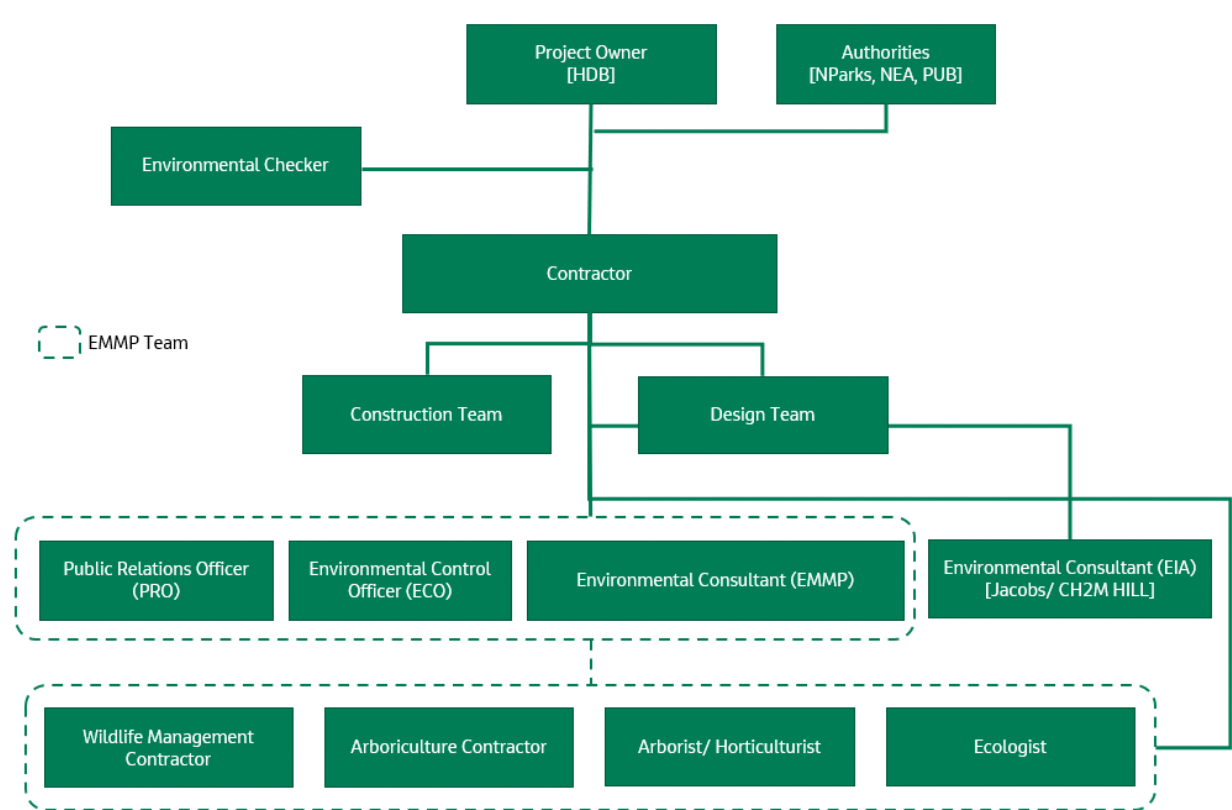


Figure 7-1. Recommended Organisation Chart for EMMP Implementation

7.3.4 EMMP Roles and Responsibilities

The roles and responsibilities for each key party in the recommended EMMP Organisation Structure during the construction phase is given on **Table 7-1**.

Table 7-1. Roles and Responsibilities of Key Parties in Recommended EMMP Organisation Structure

Role	Party	Key Responsibilities
Developing Agency/ Project Owner	HDB	- Accountable for the overall environmental performance throughout the Project lifecycle. - Assume ultimate ownership of the Project compliance and commitment with relevant environmental legislation, guidelines, and best practices.
Project Management and Construction Supervision	HDB / QP (Supervision) Team / Environmental Checker	- Responsible for the overall management of the project development with full commitment to environmental policy and EMMP implementation. - Review internal and external audit reports relating to environmental management for the respective developments. - Communicate requirements from agencies/EIA to the Contractors. - Supervise and oversee construction works undertaken by Contractor according to contracts requirement, engineering, construction and EMMP specifications set by Developing Agency/ Authorities. - Monitor compliance of the implementation of the EMMP against the Contract specification and relevant environmental legislation requirements. - Audit the environmental performance monitoring. - Activate relevant response plans in the event of any exceedances or incidents. - Carry out complaint investigations, where applicable.
Contractor	TBA	- Responsible to execute the contract in compliance to applicable environmental legislation, environmental policy, mitigation/ enhancement measures recommended in the EIA, etc., set by relevant authorities and the Developing Agency. - Employ and appoint an Environmental Monitoring and Management team consisting of the Consultant, adequately supported by specialist teams including but not limited to the scopes of water,

Role	Party	Key Responsibilities
		noise, air quality, wildlife shepherding, flora and fauna monitoring. • Appoint a Public Relation Officer (PRO) to support the SO in carrying out complaint investigation. • Establish method statements according to recommended mitigation measures, provide relevant information to Contract Specific EMMP Team on potential activities that create adverse environmental conditions. • Participate in the site audits undertaken by the third party independent Environmental Performance Auditor and undertake corrective actions instructed by the Environmental Performance Auditor. • Submit proposal for mitigation measures should there be an exceedances or incidents. • Implement approved mitigation measures to reduce the potential impacts from exceedances or incidents. • Submit periodic environmental performance monitoring reports to SO for review.
Environmental Consultant (EIA)	Jacobs	• Recommend environmental parameters to be managed and monitored in the EMMP. • Recommend environmental performance monitoring and auditing scheme to be transform as part of Contract specification requirement.
Environmental Consultant (EMMP)	TBA	• Prepare and develop a contract-specific Environmental Monitoring and Management Plan (CEMMP) based on the detailed construction method and the EMMP developed during the EIA • Submit to all relevant Authorities, including but not limited to NEA, NParks and the SO for approval prior to the commencement of the works.

Role	Party	Key Responsibilities
Environmental Checker	TBA	• Support the SO as an environmental advisory role. • Conduct environmental site inspections. • Conduct environmental performance audits. • Review environmental monitoring and management regime. • Review implementation of environmental protection measures. • Advise remediation actions for contingency scenarios.

7.3.5 Reporting and Communication Plan

All documentation throughout the construction contract period should exist in a written format and be filed in a traceable and systematic manner. The Contractor is to establish templates for reporting for approval by the Developing Agency prior to commencement of contract works. All documentation templates/ formats should be clearly communicated to potential users (i.e., Project Management Team, Project Consultants and Contract Specific EMMP Team). The documents shall include the following at a minimum:

- Minutes of records and attendance records for all meetings and trainings related to the environment.
- Special management plan and/ or technical records.
- Method statement for construction approved by Developing Agency and SO.
- Environmental inspection reports.
- Environmental performance monitoring reports.
- Environmental audit reports.
- Non-compliance and remedial action plans.

All documents should be kept throughout the construction contract and defects-liability periods.

Minutes of records of trainings and meetings shall be reported within five working days to the SO/ Developing Agency. The reporting timeframe for environmental performance monitoring and audit reports shall follow the recommended monitoring and audit regime (i.e., monthly/ quarterly) as indicated in **Section 7.4**.

In the event of non-compliance by the Contractor against the requirements of the EMMP, the following process of reporting and communication is recommended:

- Contractors via Contract-Specific EMMP Team to notify the Project Manager/ Construction Manager from SO/ Developing Agency upon a finding of non-compliance.
- SO/ Developing Agency to issue a notice of non-compliance to the Contractors, stating the nature and magnitude of the contravention.
- Contractors to provide the SO/ Developing Agency with a written statement describing remedial actions to be taken to rectify the non-compliance and expected results of the actions.

- Contractors to correct the non-compliance within a period that is stipulated by the SO/ Developing Agency, to provide the SO/ Developing Agency with documented evidence of the completed remedial actions and obtain the SO/ Developing Agency's approval for closure of the non-compliance notice.

If the Contractor fails to remedy the non-compliance within the predetermined timeframe or if the non-compliance gives rise to physical environmental damage, the SO/ Developing Agency may act (e.g., impose a penalty, require specific remedial action to be undertaken or stop work) based on the conditions of contract.

7.3.6 Specific Management and Monitoring Plans

The Environmental Impact Register outlined in **Section 8** is recommended as a management and monitoring tool. Continuous Compliance Monitoring is recommended throughout the Project development by both the Project Owner and Contractor.

7.3.7 Training Programme

The appointed EMMP team under the Contractors are responsible for induction and appropriate trainings related to environment topics of all workers employed on the construction site. The main purposes are to translate/ communicate EMMP requirements, to promote environmental awareness on responsibilities and to build capacity in mitigation measures implementation. The recommended training programmes are listed but not limited to:

- Tree protection management plan.
- Wildlife awareness and response procedures.
- Earth control measures management plan.
- Noise management plan.
- Environmental incident response and reporting procedures.

The SO will conduct periodic reviews and update training programme requirements to align with any project information changes.

7.3.8 Environmental Audit Regime

The purpose of environmental auditing is to provide an independent check that appropriate environmental management is taking place in accordance with statutory requirements and the EMMP. The environmental audit will also review the results of monitoring undertaken during the construction phase to identify the need for any additional environmental management or mitigation measures to be implemented.

The scope of the Environmental Audit Regime shall cover all the environmental issues relating to construction that are addressed in this EIA report and by the EMMP. The Environmental Audit shall be undertaken by the Developing Agency's appointed Environmental Checker. The activities to be undertaken as part of an environmental audit include:

- Examination of the environmental incidents and complaints log.
- Examination of the environmental register, including results of monitoring.
- Interviews with the Contractor's Project Manager, Contract-Specific EMMP representative(s) and ECO and other site staff as required.
- Consultation with relevant statutory authorities, where appropriate.

- Visual examination of the construction site, to examine working practices, environmental effects, mitigation measures and monitoring activities.

For this Project, it is recommended that environmental auditing be carried out on a quarterly (i.e., every three months) basis throughout the construction phase and post-construction phase (first three months).

7.3.9 Contingency Plan

In order to safeguard the environment and workers' health and safety, the construction contract specification should include the requirement for Contractors to develop an Emergency Preparedness and Response Plan for any emergency/ incidents/ accidents happen during construction according to the regulations/ guidelines (e.g. Environmental Protection and Management Act, Environmental Public Health Act, Building Control Act, Control of Vectors and Pesticides Act, Code of Practice on Surface Water Drainage, National Heritage Board Act, Parks and Trees Act and Sewerage and Drainage Act).

The plan should include environmental related emergency/ incidents (i.e., spillage, wildlife incidents), which should cover the following recommended specifications:

- Emergency contact personnel and contact details (internal and external contacts).
- Emergency contact organisation, include first and second point of contacts.
- Incident response notification procedures and action flow chart.
- Response reporting timeframe.
- Reporting requirement (i.e., date, time, location, incident encounter, reporting person and witness) and reporting timeframe (i.e., within 24 hours of an incident occurring).
- Reporting flow, i.e., report should be prepared by Contractor's appointed Ecologist/ EMMP Team and ultimately reporting to Developing Agency.

7.3.10 Stakeholder Engagement and Communication Plan

A specific Stakeholder Engagement Plan and Grievance Mechanism procedures shall be established as part of the Contract-Specific EMMP with the following specifications:

- Stakeholder identifications and analysis, i.e., nature groups (NG) engaged during the EIA stage.
- Information disclosure. The type of information should be on environmental impact and public safety concerns.
- Stakeholder consultation requirements.
- Communication channels where project information can be shared and communicated to affected communities and the public to provide greater transparency and help in allaying uncertainty or misconceptions about the project.
- A grievance mechanism/ procedure to handle feedback and complaints to incorporate input from various stakeholders and the public.
- Organisation chart with roles and responsibilities for stakeholder engagement and grievance mechanism.
- Documentation and investigation procedures.
- Performance monitoring and evaluation of effectiveness of plan.

7.4 Biodiversity Monitoring Programme Requirement

During the construction and operational phase (first three months of post-construction) of the Project, an adequate Contract-Specific EMMP for flora and fauna needs to be developed in order to minimise and manage predicted construction and operational impact. The biodiversity monitoring programme, as detailed in the sections below, shall be carried out by the Contractor, under supervision of the SO Rep and HDB.

7.4.1 Construction Phase

7.4.1.1 Flora Management and Monitoring Plan

The flora and arboriculture programme aims to assess and manage the impact of construction to retained vegetation and habitats, such as tree health, unauthorised vegetation removal, habitat degradation from soil erosion, and rubbish dumping.

This includes the reviewing of tree felling and site clearance plans (**Section 7.4.1.1.1**), establishment of tree protection zones (**Section 7.4.1.1.2**), verification and reviewing of site works (**Section 7.4.1.1.3**), transplantation of species of conservation significance (**Section 7.4.1.1.4**) and site inspections (**Section 7.4.1.1.5; Section 7.4.1.1.6**).

7.4.1.1.1 Review of Tree Felling and Site Clearance Plans

The Contractor shall appoint an International Society of Arboriculture (ISA) certified arborist(s) to review the tree felling and site clearance plans. The Arborist's role is to determine the trees to be retained or felled before the commencement of construction activities. This includes the assessment of tree physiological health, vigour, and structural stability, photographs, as well as the geographic locations of each specimen. This should apply to trees within the development footprint, including working spaces, construction access roads, and hoarding boundaries.

Any horticultural waste resulting from vegetation clearance should be disposed of on the same day to reduce the likelihood of fauna seeking shelter among the horticultural waste.

7.4.1.1.2 Establishment of Tree Protection Zones (TPZs)

TPZs are to be erected for tree specimens recommended for retention by the Arborist, including the trees recommended for conservation from the EIA. These specimens could be within the development footprint and/or very close to but are outside the worksite boundary. Proper TPZs with a designated access for monitoring purposes should be established according to guidelines provided in **Appendix 7A** Measures should be proposed to ensure trees remain protected from damage from adjacent construction works including site access. This should be executed in consultation with the structural engineers and in accordance with the guidelines established by NParks. Construction works, such as tree felling and works in the 'no-go zone' for laying of footpaths/ roads, would require the Arborist to oversee the works.

In the event of observed damage to flora and trees, the Contractor shall carry out the following steps:

- a) Take immediate action to avoid further damage to the surrounding flora and trees.
- b) Notify HDB for further assessment and determine the retention value of affected trees.
- c) Implement the mitigation measures as per the approved Contract Specific EMMP.

7.4.1.1.3 Verification and Review of Footprints for Hoarding, Worksite Boundaries, and Access Roads

Following the pegging of the hoarding alignment or worksite boundaries, as well as setting out for areas required for access roads, site offices, storage yards, etc., the alignment and footprints are to be verified by the HDB's Flora Specialist via ground-truthing. This is to be carried out with the aid of a Global Positioning System (GPS) receiver and cross-checked with the development footprint drawings. The Flora Specialist should ensure there is no excessive vegetation and/or tree removal within the site. The Flora Specialist shall also review the proposed locations for access roads, site offices, storage yards, etc., to ensure vegetation removal is kept to a minimum where feasible.

7.4.1.1.4 Transplantation of Plant Species of Conservation Significance

For affected plant species of conservation significance located within the worksite identified for salvaging, they should be transplanted prior to the start of hoarding installation and clearance works. The Flora Specialist appointed by the Contractor(s) should carry out consultations with NParks to determine the final list of specimens to be transplanted. See **Appendix 5B2** for list species suitable for salvaging.

7.4.1.1.5 Monthly Arboriculture Inspection

The Contractor-appointed Arborist shall carry out the following during the monthly arboriculture inspections:

- Assess the conditions of retained trees and trees within and around the worksite, i.e., physiological health, vigour, and structural stability, and recommend mitigation measures where necessary.
 - a. Ensure they have not deteriorated and that there are no mechanical damages.
 - b. Carry out rehabilitation and remediation measures if the trees exhibit signs of stress (e.g., implement a watering schedule to prevent plants from drying out).
 - c. Implement long-term mitigation solutions or recommend additional tree removal where necessary.
- Review method statements from builders for construction in close proximity to trees.
- Determine if more trees need to be removed after site clearance based on the construction activities happening in proximity to the retained trees and liaise with NParks for permission where necessary.
- Ensure that works are carried in alignment with NParks' standards.

7.4.1.1.6 Monthly Flora Inspection

The Flora Specialist appointed by the Contractor(s) is to carry out the following during the monthly flora inspections:

- Assess the impact of operations on the overall health of vegetation at proximity to the development.
- Identify excessive and/or unauthorised removal of vegetation beyond the development boundary.
- Monitor and assess potential edge effects (e.g., predictable failures, accelerated growth of climbers on canopy, change in species composition at the edge) within vegetation adjacent to development.
- Identify unauthorised dumping of rubbish (e.g., food materials), construction debris and materials, oil/chemical leakage that may contaminate soil and waterbodies after construction.

7.4.1.2 Wildlife Management and Monitoring Plan

The fauna programme consists of managing concerns related to fauna within and around all designated work areas. The objectives of the fauna management plan are as follows:

- Minimise negative impact to fauna, particularly to species of conservation significance.
- Minimise fauna entrapment on-site by inspecting features such as hoarding that may cause fauna entrapment as well as use of 100% biodegradable erosion control blankets.
- Monitor presence of trapped/injured/dead fauna inside hoarded areas.
- Prevent human-wildlife conflict.

It includes directional site clearance (**Section 7.4.1.2.1**), pre-felling tree inspections for fauna (**Section 7.4.1.2.2**), regular biodiversity awareness training for the site team and workers (**Section 7.4.1.2.4**), fauna response plan in event of animal encounters (**Section 7.4.1.2.5**), as well as site inspections (**Section 7.4.1.2.3**).

7.4.1.2.1 Directional Site Clearance

The worksite is bounded along the perimeter by roads and/or urban developments. Hence, there is no suitable refuge area that is directly contiguous to the worksite identified. However, it is still recommended for site clearance to be carried out in a directional manner. The objective of directional site clearance is to encourage fauna to leave the worksite before construction works begin to prevent fauna entrapment, injury and mortality, while minimising contact between human and wildlife. Directional site clearance also prevents incidents of fauna entrapment within isolated green patches, which may otherwise occur if site clearance was to be carried in an unspecified manner.

Before commencing site clearance, hoarding must be erected along the perimeter of the site to prevent fauna from leaving the site during vegetation clearance. It is recommended to set up hoarding in a specified order as shown in **Figure 7-2**. The hoarding along Yishun Avenue 1 and Yishun Avenue 2 shall be erected first as these roads have heavier traffic and pose the greatest risk of fauna injury.

Given that there is no suitable refuge area that is contiguous to Site 1, formulation of a fauna rescue plan is recommended to rescue fauna trapped within Site 1 during site clearance. During site clearance, clearance of vegetation is recommended to be carried out in the direction of east to west towards the Scrubland / Grassland habitat. The disturbance generated by site clearance activities is expected to encourage target fauna to move towards the western part of the worksite where fauna rescue can occur. Target fauna species include ground-dwelling mammals such as the Sunda pangolin (*Manis javanica*), as well as animals that may be implicated in human-wildlife conflicts (e.g. snakes). It is recommended to parcel Site 1 into two sections separated by a temporary hoarding and wildlife exits should be installed at the temporary hoarding. This prevents re-entry of fauna into the eastern part of Site 1. The proposed specifications of the wildlife exits are shown in **Figure 7-4**. Site clearance is recommended to be completed in an east to west direction. Due to heavy traffic along Yishun Ave 1 and 2, shepherding fauna towards the south shall be avoided to reduce risk of fauna injury.

The general proposed sequence and details for directional site clearance is provided below.

a) Hoarding installation

- Hoarding installation is recommended in order of the sequence as shown in **Figure 7-2** below to reduce the likelihood of roadkill, especially along major roads (i.e. Yishun Avenue 1 and 2). However, if hoarding has been installed at the northern and western end due to ongoing construction works, hoarding installation should be installed along Yishun Avenue 1 and 2 as soon as possible and more importantly ensure that the whole worksite is properly hoarded up with no gaps before works commence.
- The site clearance zones shall be hoarding up with zinc sheets (minimum 1.8m height).

- Directional site clearance shall be carried out in an east to west direction, i.e., away from Yishun Avenue 2. The recommended directional clearance plan is shown in **Figure 7-3** below.

b) **Pre-site clearance fauna inspection**

- Prior to site clearance, camera trap monitoring may be conducted to determine the presence of target fauna within site clearance. Camera traps may be deployed 50m apart within the forested area over a three-day period.
- Additionally, removal of wild boars (if any) should be stipulated by NParks before site clearance.
- Before the commencement of site clearance works, the Ecologist shall conduct a fauna inspection in areas slated for clearance according to the workflow stated in **Figure 7-5**.
- If fauna is found present, the Fauna Response Plan is to be activated.

c) **Directional site clearance**

- Directional site clearance is recommended to be carried out from the eastern to western end, i.e. away from Yishun Avenue 2 (**Figure 7-3**).

d) **Post-site clearance fauna inspection**

- After site clearance has been completed, the Ecologists will visually inspect the site for presence of target fauna species (i.e., ground-dwelling birds and snakes). If there are no remaining fauna on site, the site clearance is then completed. If there are remaining fauna on-site, the Ecologists will develop methods to remove them in consultation with the Contractor and relevant authorities (e.g., NParks).

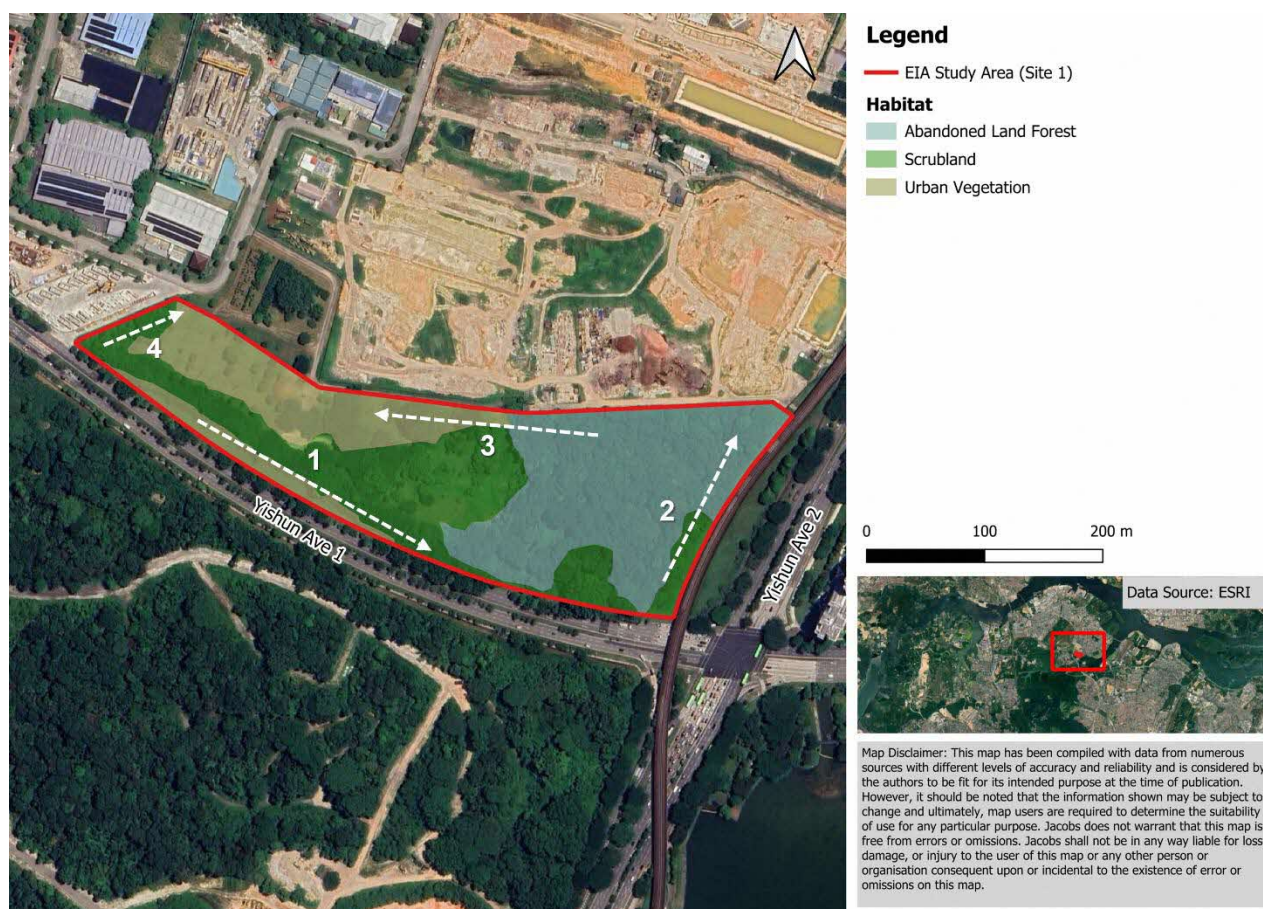


Figure 7-2: Proposed Sequence of Hoarding for Directional Site Clearance

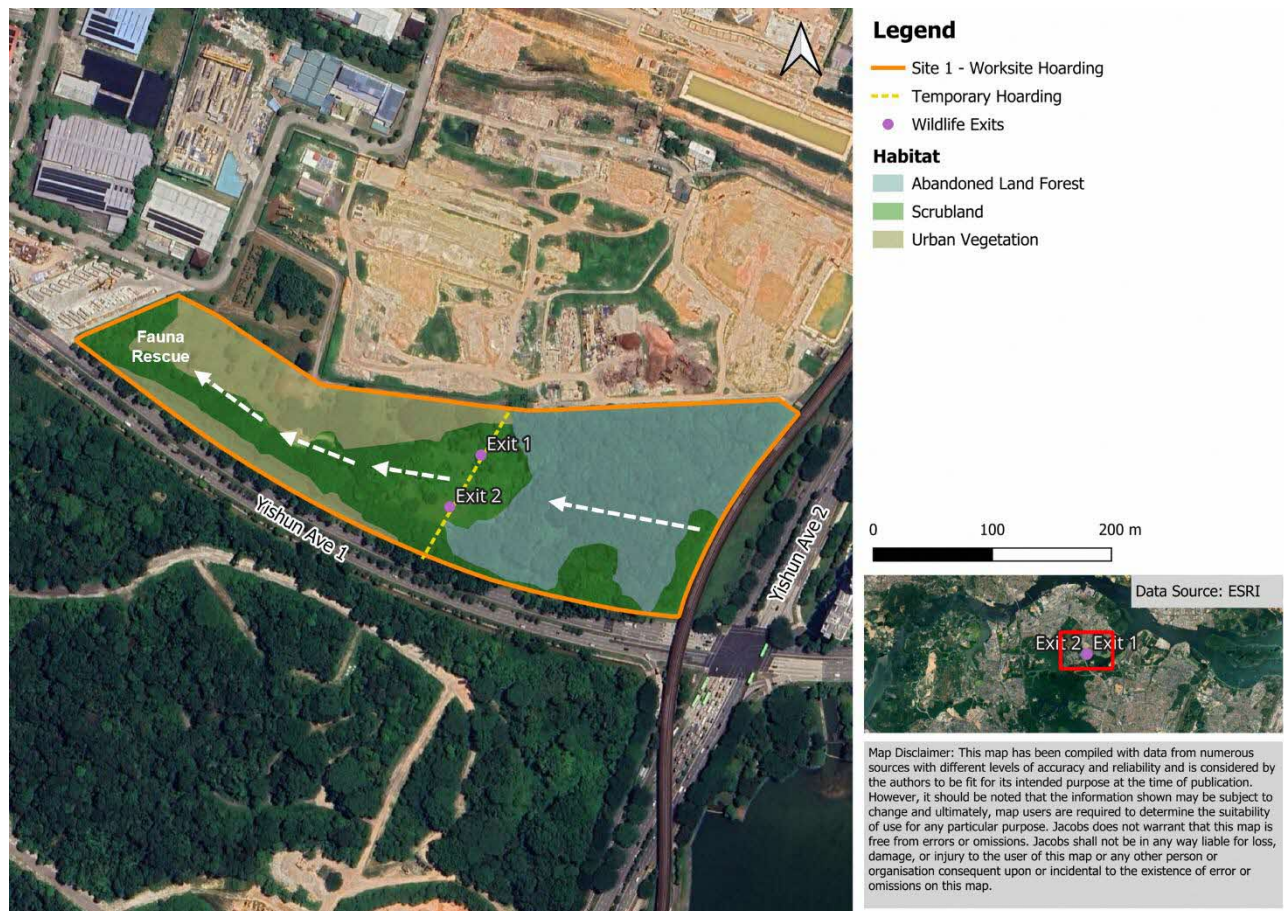


Figure 7-3: Proposed Directional Site Clearance Plan

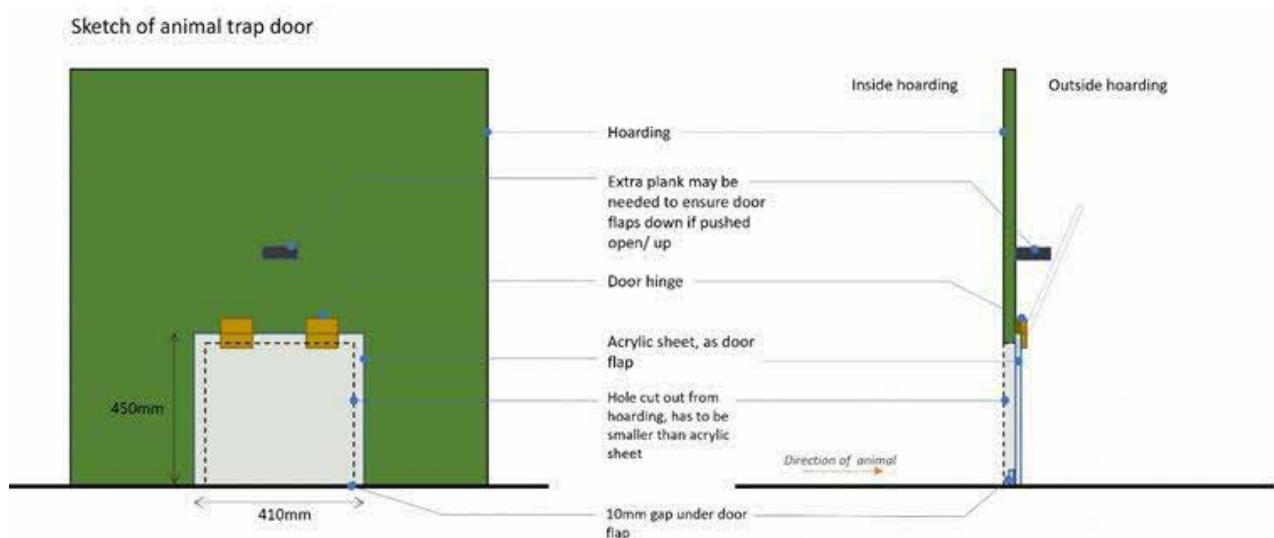


Figure 7-4: Sketch of Proposed one-way Trapdoor Wildlife Exit

7.4.1.2.2 Pre-felling Fauna Inspection

Pre-felling fauna inspections shall be carried out by Ecologists appointed by the Contractor. Clearance of undergrowth will first be conducted prior to felling of trees on site. After completion of undergrowth clearance, each zone shall be left to fallow for three days to encourage arboreal fauna to leave the site, before clearance of remaining trees within the zone can take place. No vegetation clearance can take place within this fallow period of three days. Pre-felling inspections for the undergrowth and remaining trees can be conducted together on the first day of each round of inspection.

- a) Conduct pre-site clearance fauna inspections for trees and non-tree vegetation to be removed. The pre-site clearance fauna inspection includes the identification and reporting of the following:
 - Active bird nests, including hollows, and other forms of nesting structures utilised by birds.
 - Active mammal nests/burrows/roosts.
 - Other less mobile animals that are at risk of injury/mortality during tree felling or vegetation removal (e.g., Sunda pangolin).
 - Animals that may be susceptible to human-wildlife conflict (e.g., snakes).
- b) Check tree trunks, branches and canopy with binoculars from multiple angles and distances. Any cavities in tree trunks that may be utilised as nesting/roosting structures are to be noted for closer inspection if deemed potentially active. If a nest is potentially identified and activity level is uncertain, the Ecologist will conduct or supervise the closer investigation of the nest site utilising elevating equipment where required.
- c) Produce a pre-felling fauna inspection report, indicating any relevant information collected during the inspection, including Tree Tag ID (and/or flora location coordinates if not tagged), animal observations, recommended actions, and photographic evidence.
- d) Pre-felling fauna inspection is valid for seven days, i.e., if the inspected trees or vegetation are not removed within seven days of the Ecologist's inspection, the inspection will be repeated.
- e) If animals or active nests are found, the Contractor shall:
 - Not disturb the animal and allowed them to move away on their own before tree felling or vegetation removal, unless the Ecologist deems it necessary to relocate them.
 - Allow nesting birds to fledge and leave the nests on their own before tree felling or vegetation removal.

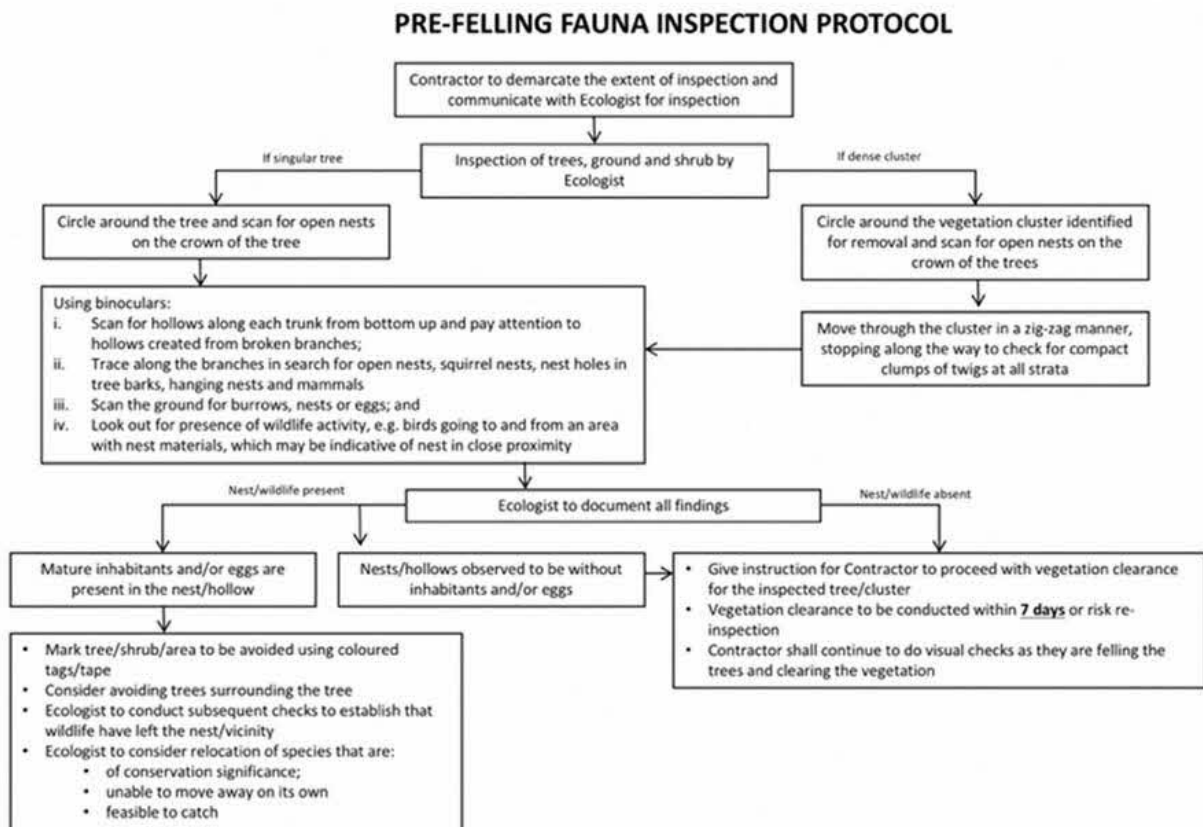


Figure 7-5: Pre-felling Fauna Inspection Protocol

7.4.1.2.3 Monthly Fauna Inspection

It is recommended that Contractor to appoint Fauna Specialist(s)/ Ecologist(s) to carry out monthly fauna inspection within the worksite boundaries. The following should be noted during the inspections:

- Checks for the presence of trapped, injured, or dead fauna shall be carried out daily by the Contractor to enable timely rescue, and monthly by the Ecologist during site inspections. A collation of all wildlife incidents shall be recorded in the monthly inspection checklist and report.
- The Contractor shall ensure that 100% bio-degradable erosion control blankets are used to prevent snake entrapment.
- Potential fauna entrapments (e.g., ECBs, TPZs, pits, drains, ponds, trenches, tanks).
- Gaps in hoarding around worksites involving heavy machinery that may allow entry of ground-dwelling fauna.
- Non-compliance of ECM measures.
- Improperly disposed/stored food and food packaging.

7.4.1.2.4 Biodiversity Awareness Training

The Contractor shall appoint Ecologist(s) to conduct toolbox briefings on biodiversity awareness to inform site personnel of but not limited to the following:

- Ecological value of the site and its surrounding habitats.

- Types of fauna present.
- Biodiversity protection strategies.
- Site personnel's responsibilities towards biodiversity.
- How to respond to fauna encounters.
- No feeding of wildlife.
- Prevention of roadkill.
- Inspection of trees before felling.

All site personnel shall undergo biodiversity awareness training prior to commencing work on-site, and regularly (every six months) throughout the duration of the construction. Documentation of such trainings and briefings shall be maintained.

Reminders on biodiversity awareness and actions to take when encountering wildlife will also be given to all site personnel during daily toolbox briefings.

7.4.1.2.5 Fauna Response Plan

The Fauna Response Plan shall be activated whenever a trapped/injured/dead/dangerous animal is encountered around or within the worksite. The objective of the Fauna Response Plan is to minimise animal injury and mortality by responding appropriately to the different fauna encounter scenarios in **Figure 7-6**. This will be emphasised during the Biodiversity and Environmental Awareness Trainings. All wildlife incidents shall be reported and documented in a Wildlife Incident Form.

Where fauna is trapped on-site, species-specific methods (e.g., one-way flap doors) shall be formulated to remove them, in consultation with HDB and NParks.

The Contractor shall engage a Wildlife Management Company to carry out trapping, rescue, and/or relocation of trapped or injured fauna in accordance with NParks' directions. The Wildlife Management Company shall be listed under NParks' public register of certified Wildlife Management Contractors.

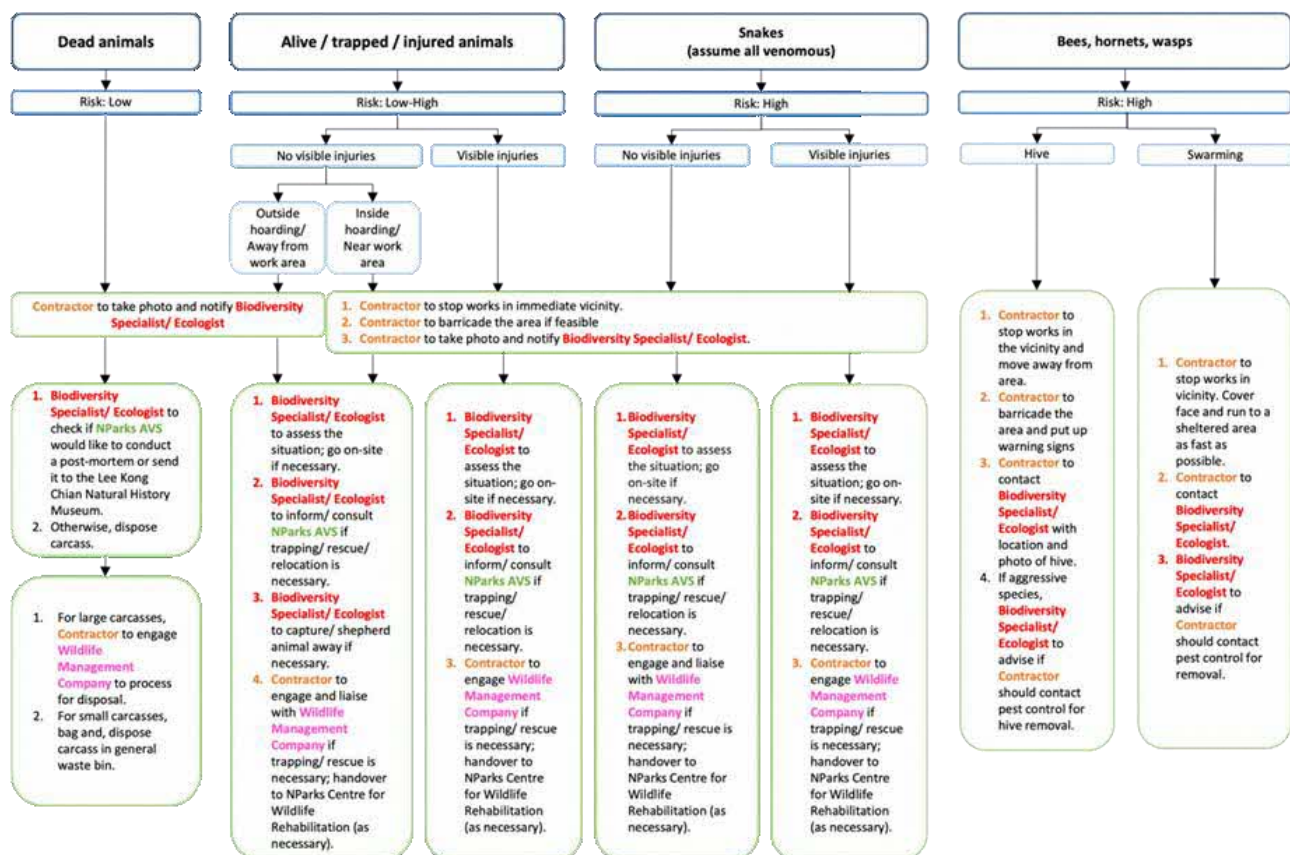


Figure 7-6: Fauna Response Plan

7.4.2 Post-Construction/Operational Phase

7.4.2.1 Flora, Vegetation, and Trees

The flora and arboriculture programme aims to assess post-construction/operation impact to the retained vegetation and rectify problems identified. The contractor is required to monitor flora, vegetation and trees for at least the first three months after reinstatement.

7.4.2.1.1 Monthly Arboriculture Inspection

The Arborist is to carry out the following during the monthly arboriculture inspections:

- Assess the conditions of retained trees within the development, i.e., physiological health, vigour, and structural stability, and recommended mitigation measures where necessary.
- Ensure they have not deteriorated and that there are no mechanical damages.
- Carry out rehabilitation and remediation measures of the trees exhibit signs of stress (e.g., implement a watering schedule to prevent plants from drying out).

7.4.2.1.2 Monthly Flora Inspection

The Flora Specialist is to carry out the following during the monthly flora inspections:

- Assess the impact of operations on the overall health of vegetation in close proximity to the development.
- Identify excessive and/or unauthorised removal of vegetation beyond the development boundary.

- Monitor and assess potential edge effects (e.g., predictable failures, accelerated growth of climbers on canopy, change in species composition at the edge) within vegetation adjacent to the development.
- Identify unauthorised dumping of rubbish (e.g., food materials), construction debris and materials, oil/chemical leakage that may contaminate soil and waterbodies after construction.

7.5 Noise Monitoring Programme

Pre-construction baseline noise measurement at the identified noise sensitive receiver during the EIA Stage (NSR1) shall be re-established prior to construction work commencement. The re-establishment of the latest baseline noise before construction commencement will provide a benchmark for the monitoring programme.

During the construction phase, the Contractor shall develop and implement a noise control and management plan with monitoring programme to monitor the effectiveness of the recommended mitigation measures from the EIA stage and the approved Contract-Specific EMMP. The noise monitoring programme shall be conducted by the Contractor under the oversight of HDB. All monitoring activities measures shall be documented and made available for review by the relevant regulatory authorities.

- Noise monitoring shall be done continuously using Class 1/Type 1 Data Logging Sound Level Meter.
- Parameters to be monitored include L_{Aeq} 5 mins, L_{Aeq} 1 hour, and L_{Aeq} 12 hours noise levels. The monitoring results shall be assessed against the re-established baseline noise data. The incremental noise levels recorded during the monitoring period should not exceed 5 dBA above the re-established baseline.
- Corrective actions shall be applied whenever there is any exceedance shown in the monitoring result.
- Noise monitoring data from the laboratory and environmental service providers shall be documented and reported in the Monthly Environmental Performance Report.

8. Environmental Impact Register

Section 4 to Section 7 outline the potential environmental impact associated with the construction activities of the Project development as identified in the EIA, and identify the mitigation measures proposed for each anticipated impact.

The environmental impact register (**Table 8-1**) outlines the minimum procedures that are recommended to ensure proper management of the various environmental aspects associated with the construction as well as the responsibilities for action and monitoring the effectiveness of the mitigation measures. This register forms the basis for the EMMP recommended for the Employer and Contractor to follow.

Table 8-1: Environmental Impact Register

Environmental Aspect	Receptor		Potential Impact		Recommended Mitigation Measures	Residual Impact Significance	Description of Monitoring Required	Resources and Responsible Party
	Sensitive Receiver	Value/ Sensitivity	Impact	Overall Impact significance				
Geomorphology and Soil	Soil at Buffer Area	Outside Local/ Medium	Changes to Soil Infiltration Capacity	Minor Negative Impact	- Develop and undertake a programmatic Excavation, Cut and Fill and Earthmoving plan. - Engagement of a Qualified Person (QP)/Professional Engineer (PE) to conduct slope stability and soil compaction studies within and adjacent to the areas of concern prior to any clearing and earthworks. - Stockpile stripped topsoil in a designated area strategically placed within the Contract Boundary and cover the area as necessary to reduce or prevent soil loss from secondary erosion from wind or runoff. - Placement of Erosion and Sediment Control (ESC) structures (i.e., biodegradable Erosion Control Blanket (ECB)) at open areas where applicable. - Rehabilitate temporary construction areas such as staging and stockpiling zones as close as practicable to pre-construction conditions.	Slight Negative Impact	Daily Environmental Inspection	- Contractor Project Manager (PM) - ECO
	Soil at Buffer Area	Outside Local/Medium	Soil Loss and Sediment Yield	Minor Negative Impact		Slight Negative – Minor Negative Impact		
Ecology	Abandoned land Forest	Medium	Loss of habitat	Moderate Negative Impact	N.A.	Moderate Negative Impact	N.A.	
	Scrubland / Grassland	Low	Loss of habitat	Minor Negative Impact		Minor Negative Impact		
	Urban vegetation	Low	Loss of habitat	Minor Negative Impact		Minor Negative Impact		
	Flora species of high ecological value	High	Mortality	Minor to Major Negative Impact	- Salvage saplings of species of conservation significance (0.3 m girth or less). - Retain 2 <i>Ficus</i> sp. specimens and clusters of ferns	No change to Major Negative Impact	Engage flora specialists to monitor health of transplanted individuals.	
	Fauna species of high ecological value	High	Accidental injury or mortality	Minor to Moderate Negative Impact	- Directional site clearance - Regularly inspect hoarding and maintain its structural integrity - Ensure good housekeeping practices - Conduct biodiversity awareness training for site personnel (to reinforce wildlife response plan)	Minor Negative Impact	Conduct regular site inspection to ensure Contractor compliance with EMMP	
	Fauna species of high ecological value	High	Human-wildlife conflict	No Change to Moderate Negative Impact	Conduct biodiversity awareness training for site personnel	No Change to Minor Negative Impact	Conduct site inspections to minimise features for fauna entry (e.g., wildlife-proof bins and eating at	

Environmental Aspect	Receptor		Potential Impact		Recommended Mitigation Measures	Residual Impact Significance	Description of Monitoring Required	Resources and Responsible Party
	Sensitive Receiver	Value/ Sensitivity	Impact	Overall Impact significance				
							designated areas) - Regularly inspect hoarding and maintain its structural integrity - Conduct site inspections for bee/wasp nests	
	Fauna species of high ecological value	High	Loss of/reduction in habitats and food sources	Minor to Major Negative Impact	- Designing enhanced native multi-tiered planting within the southeastern corner of the future precinct, with any retained or salvaged flora specimens where feasible - Designing a linear green strip of minimally 5m in width along the southern boundary of the future precinct, with any retained or salvaged flora specimens where feasible (including 2 Ficus specimens) - Design of planting palette with sufficient structural complexity and species assemblage consisting of native species that attract volant fauna	Minor to Major Negative Impact	N. A.	
	Fauna species of high ecological value	High	Loss/reduction of ecological connectivity for faunal movement	No Change to Moderate Negative Impact		No Change to Moderate Negative Impact	N. A.	
Ambient Noise	Ground-dwelling fauna at NSR1	CS Species	Noise from infrastructure works during daytime	Moderate Negative Impact	- Noise barriers, 12 m high, are recommended to be erected along the eastern, southern and western Project boundary. - Noise barriers should be with a minimum of Sound Transmission Class (STC) 20, to be effective to reduce noise level for ground-dwelling fauna. - Additional engineering control measures such as enclosures, noise screens/ noise panels: - Enclosure at stationary PME such as generators with sufficient height and width to accommodate for machinery/equipment housed within. The proposed enclosures may achieve noise level reduction of at least 15 dBA (Table F.3 of SS 602: 2014). - Noise screens/ noise panels at moveable PME such excavators and crawlers/ mobile cranes should be of sufficient height and width to shield the noisy parts. The proposed screening may achieve noise level reductions of at least 7 dBA (Table F.3 of SS 602: 2014). - Portable noise barriers at construction activities e.g., soil investigation drilling activities, road and drainage work which are close to the site boundary. The proposed portable noise barrier may achieve noise level reductions of at least 7 dBA (Section F.3.3.4 of SS 602: 2014).	Slight Negative Impact	Conduct continuous real time noise monitoring using Type 1 sound level meter with data logging at the affected NSR. When the noise level exceeds the maximum baseline ambient noise level, the contractor should investigate and apply appropriate mitigation measures. Recommended monitoring locations: noise meters to be located at site	- Contractor Project Manager (PM) - ECO
		Non-CS Species	Noise from infrastructure works during daytime	Minor Negative Impact		Slight Negative Impact		
	Arboreal fauna at NSR1	CS Species	Noise from infrastructure works during daytime	Moderate Negative Impact		Minor to Moderate Negative Impact		
		Non-CS Species	Noise from infrastructure works during daytime	Minor Negative Impact		Minor Negative Impact		
	Ground-dwelling fauna at NSR1	CS Species	Noise from BTO works during daytime	Moderate Negative Impact		Minor Negative Impact		
		Non-CS Species	Noise from BTO works during daytime	Moderate Negative Impact		Slight Negative Impact		

Environmental Aspect	Receptor		Potential Impact		Recommended Mitigation Measures	Residual Impact Significance	Description of Monitoring Required	Resources and Responsible Party
	Sensitive Receiver	Value/ Sensitivity	Impact	Overall Impact significance				
	Arboreal fauna at NSR1	CS Species	Noise from BTO works during daytime	Moderate Negative Impact	- Quieter construction methodology such as the use of diamond wire saw cutters can achieve up to 30 dBA of noise reduction (based on LTA's Noise Guidance: Developing a Noise Management Plan). ▪ Contractor to prepare a noise management plan (NMP) with the finalised construction method, schedule and equipment sound power levels to reconfirm the noise impact to fauna receivers are within acceptable ranges. The suggested NMP template is indicted in Annex H of SS 602: 2014. ▪ Contractor to use engineering methodology to control noise at source, such as: - Noise enclosures to cover stationary PME such as generator. - Noise screens/ noise panels to partially shield noise generated from noisy PME such as cranes and excavators. - Portable noise barriers for noisy construction activities. ▪ Quieter construction methodology such as silent pilers instead of vibratory piling, hydraulic splitters instead of concrete/ rock drilling ▪ Contractor should plan the construction works to minimise noise sources onsite through optimisation of the construction sequence and methods, such as optimising vehicular access to minimise reversing of vehicles and making use of existing structures such as silos or site offices as noise shields to reduce noise transmission from noisy static equipment to the noise receivers. ▪ Implement industry best practices: - Only well-maintained PME should be operated on-site and should be serviced regularly during construction. - The number of PMEs should be reduced as far as practicable when construction works are carried out in areas close to the fauna NSR. - Alternative equipment with less noise emission can be considered, such as the use of rubber mallets instead of metal hammers. - Care shall be taken during loading or unloading, dismantling, or moving materials to reduce noise impact. - Silencers or mufflers on PME (e.g., generator sets) should be utilised and should be properly maintained during construction. - Mobile PME, if any, should be sited as far from the fauna NSR as possible. PME (such as trucks and cranes) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum where possible. - PME known to emit noise strongly in one direction should, whenever possible, be oriented so that the noise is directed away from the fauna NSR. - Noisy construction activities shall be avoided at night when the noise limits are more stringent. ▪ Consider limiting heavy construction working hours to 8 a.m. to 6 p.m. where possible to avoid the timings when crepuscular species may be active. Toolbox meetings and winding down of work can be done outside of these hours.	Moderate Negative Impact	boundary adjacent to forested areas for entire construction period.	
		Non-CS Species	Noise from BTO works during daytime	Moderate Negative Impact		Minor to Moderate Negative Impact		

Environmental Aspect	Receptor		Potential Impact		Recommended Mitigation Measures	Residual Impact Significance	Description of Monitoring Required	Resources and Responsible Party
	Sensitive Receiver	Value/ Sensitivity	Impact	Overall Impact significance				
					▪ Implement progressive starting of loud construction activities to gradually increase noise levels for mobile fauna who have returned to roost during the night or are in the area to move away before noise levels get more intense. ▪ Where night works are conducted, the minimal amount of equipment should be used to reduce noise levels. ▪ Where night works are conducted, workers should refrain from shouting or using loud hailers aside from emergencies. Hand signals or walkie talkies can be employed instead.			

9. Conclusion

9.1 Geomorphology Assessment

The baseline survey for geomorphology and hydrogeology at Site 1 established the general characteristics of the terrain, soil composition, and groundwater conditions. The study identified distinct zones of varying slope categories, with erosion susceptibility determined based on the soil structure and hydrological flow patterns. Groundwater levels and flow dynamics were mapped to assess potential interactions with surface water bodies. Soil and groundwater quality analyses indicated generally stable conditions, with no significant contamination detected in the preliminary assessment.

Soil compaction was predicted as a potential result of any, or a combination, of the anticipated construction activities, as well as from the use of temporary work areas within the bounds of Site 1. This compaction may lead to either a temporary or permanent reduction of the soil infiltration capacity. The unmitigated impact significance for soil infiltration capacity is assessed as Minor Negative. Soil loss and sediment yield is anticipated due to site clearance and subsequent earthworks, as erodible material is assumed to be completely removed. While the magnitude of change is high, the impact significance for soil loss is assessed to be Minor Negative. This is primarily because other Group A criteria, specifically the value and extent of the impact, have been rated as "1", indicating low sensitivity and limited spatial or temporal extent.

A range of mitigation measures can be adopted to minimise, if not completely eliminate, geomorphology changes that may affect soil infiltration capacity and soil loss, including implementing site clearance and earthworks in stages, engaging a QP and QECP to design an effective ECM plan and best practices, and rehabilitating temporary construction areas to as close as practicable to pre-construction conditions. With the implementation of the recommended mitigation measures, the residual impact for soil infiltration capacity is reduced to Slight Negative, while the impact for soil loss ranges from Slight Negative to Minor Negative.

9.2 Ecology and Biodiversity Assessment

The ecological baseline survey provided an inventory of flora and fauna within the EIA Study Area. The habitat assessment identified 3 habitat types, i.e. abandoned land forest, scrubland/grassland and urban vegetation.

A total of 203 plant species were recorded during the floristic surveys, including 14 species of conservation significance, of which 10 are Vulnerable (e.g., *Symplocos fasciculata* and *Microlepia speluncae*) and 4 are Endangered (e.g., *Adenia cordifolia* and *Melicope lunu-ankenda*). Almost all species of conservation significance were concentrated within the abandoned land forest in the eastern section of Site 1.

Faunal surveys recorded a total of 137 species. Five species of conservation significance were recorded: straw-headed bulbul (*Pycnonotus zeylanicus*), plume-toed swiftlet (*Collocalia affinis*), Swinhoe's white-eye (*Zosterops simplex*), long-tailed parakeet (*Psittacula longicauda*), and long-tailed macaque (*Macaca fascicularis*). Given the ecological baseline survey results, it is likely that Site 1 is used as a complementary stepping stone mainly for volant fauna to traverse between larger surrounding forest patches south of Yishun Ave 1 and around Lower Seletar Reservoir.

In terms of ecological value, there were no Areas of High Ecological Value identified within Site 1. The scrubland / grassland and urban vegetation habitat types, which collectively occupy around 60% of Site 1, were assessed to be of low ecological value as they did not contain unique flora or fauna species and are common habitat types in Singapore. The abandoned land forest habitat concentrated within the eastern portion of Site 1 was assessed to be of medium ecological value, as it serves as a complementary stepping stone primarily for volant fauna traversing between nearby forested areas and a potential refugia for native flora and volant fauna. The presence of native saplings indicates active forest regeneration, likely facilitated by faunal dispersers which implies fauna usage of this habitat. However, ground connectivity for ground-dwelling fauna is limited at Site 1 since it is bound by major roads and surrounding brownfield uses.

Based on the proposed development works during the construction phase, the main unmitigated impact types were assessed to be plant mortality, loss of or reduction in habitats and food sources for fauna species within Site 1, and loss of ecological connectivity. Avoidance measures such as retaining two keystone *Ficus* species and clusters of the Vulnerable *Microlepia speluncae* fern, and compensatory measures such as designing a linear green strip along the southern boundary and enhanced multi-tiered precinct planting at the southeastern corner of the site with a carefully curated native planting palette, have been proposed to maintain ecological connectivity, particularly for native urban-tolerant volant species. Minimise measures such as salvaging flora saplings of conservation significance and implementing a comprehensive wildlife management plan have also been proposed to reduce flora mortality and fauna injury, and mitigate human-wildlife conflict.

With the proposed mitigation measures in place for flora mortality, construction phase impact is expected to result in No Change for three species identified for retention, while four species with limited scope for retention are assessed to experience impact ranging from Minor Negative to Major Negative. An additional ten species are classified as Not Applicable if salvaged. In view of the proposed developments, construction phase impact on habitat receptors is expected to remain as Moderate Negative for the abandoned land forest as a result of site clearance, and Minor Negative for the scrubland / grassland and urban vegetation as the latter is of low ecological significance.

With the proposed mitigation measures to maintain volant connectivity for fauna and adopt fauna management strategies for sensitive development, loss of or reduction in habitats and food sources remains the only impact on fauna with Major residual impact significance. Loss/reduction of ecological connectivity for faunal movement remains at Moderate residual impact significance. Other impact types, such as accidental injury or mortality and human-wildlife conflict were assessed to be No Change or Minor Negative during the construction phase. During the operational phase, residual impact from loss/reduction of ecological connectivity for faunal movement were assessed to be No Change to Moderate Negative depending on the specific species. Most remaining impacts were assessed to be No Change to Moderate Negative, with one receptor (long-tailed macaque) assessed as Major Negative

9.3 Ambient Noise Assessment

Baseline ambient noise monitoring in the forested patch south of Site 1 identified key noise-sensitive areas and established reference noise levels before construction activities. The highest L_{Aeq} 5-min and 1-hour noise levels were recorded during the day, possibly attributed to existing vehicular traffic along major roads (Yishun Avenue 1 / 2 and Lentor Avenue), as well as MRT operations from the adjacent elevated North-South Line MRT viaduct. Evening and nighttime noise levels were comparatively lower.

The species groups most likely to be impacted by future construction activities are non-volant mammals, birds, and frogs, as these groups are already experiencing noise levels that exceed their biological response threshold, and any further increase due to construction activities could exacerbate the impact on their behavior, physiology, and reproductive success. However, it is reasonable to assume that certain species have likely developed coping mechanisms to existing noise sources and adapted to current baseline ambient noise levels. This information provides a crucial baseline for future impact assessments on ecological receptors.

Unmitigated noise levels predicted during the construction phase were found to affect both conservation-significant and non-significant fauna, with exceedances ranging from 14.9 to 26.1 dBA. The impact was assessed to be Moderate Negative, since it was considered medium-term and reversible, and would extend beyond the project footprint. To address these effects, mitigation measures including noise source controls and noise barriers were modelled. Post-mitigation, noise levels were reduced by up to 20.3 dBA for ground-dwelling fauna and 15.5 dBA for arboreal fauna. As a result, the impact significance for ground-dwelling fauna was reduced to Minor Negative. Arboreal fauna continued to experience Moderate Negative impact, attributed to their potential positioning above the noise barriers. Nevertheless, arboreal fauna are more mobile than other fauna types, enabling them to relocate away from the noise source during Project implementation.

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11. Appendices

Appendix 1A. Relevant EIA Regulations in Singapore

The Environmental Protection and Management Act (EPMA) provides the legislative framework for the control of environmental pollution, and covers air pollution, water pollution, land pollution, noise pollution and hazardous substances control. The EPMA is administered and enforced by NEA. Some sections of the EPMA are relevant to the preparation of EIA report for this Project, namely Section 35 on the prevention of pollution from construction sites and Section 36 on pollution control studies.

In addition to the EPMA, the following Acts and their subsidiary regulations (**Table 1A.1**) are also relevant to environmental protection in Singapore with implications to EIA studies:

Table 1A.1: Applicable Acts and Subsidiary Regulations

Environmental Aspects	Relevant Local Acts/ Regulations/ Action Plans	Jurisdiction/ Administrative/ Enforcement Agencies
Parks, Tree and Flora Protection	• Parks and Trees Act • Parks and Trees Regulations • Parks and Trees (Preservation of trees) order • Parks and Trees (Heritage Road Green Buffer)	NParks
Animal/ Wildlife/ Fauna Protection ³	• Wildlife Act	NParks
Development and Redevelopment	• Planning Act	MND/URA
Reservoirs and Catchment Area Protection	• Public Utilities Act • Public Utilities (Water Supply) regulations • Public Utilities Act (Reservoirs and Catchment Areas) Regulations, 2006	PUB
Sewerage and Drainage Planning and Development	• Sewerage and Drainage Act • Sewerage and Drainage (Surface Water Drainage) Regulations • Sewerage and Drainage (Trade Effluent) Regulations	PUB
Noise at Construction Sites	• Environmental Protection and Management (Control of Noise at Construction Sites) Regulations 2008	NEA

³ Formerly administered and enforced by Agri-Food & Veterinary Authority of Singapore (AVA)

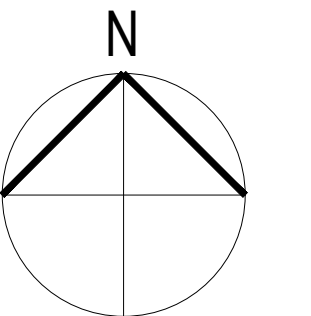
Environmental Aspects	Relevant Local Acts/ Regulations/ Action Plans	Jurisdiction/ Administrative/ Enforcement Agencies
Air Pollution	- Environmental Protection and Management (Vehicular Emissions) Regulations 2008 - Environmental Protection and Management (Air Impurities) Regulations 2008 - Environmental Protection and Management (Off-Road Diesel Engine Emissions) Regulations 2008 - Singapore Air Quality Targets	NEA
Water Pollution	Environmental Protection and Management (Trade Effluent) Regulations 2008	NEA
Public Health and Environment	- Environmental Public Health Act - Environmental Public Health (Registration of Environmental Control Officer) regulations - Environmental Public Health (Employment of Environmental Control Officer) Order - Environmental Public Health (Qualifications of Environmental Control Officer)	NEA
Waste	- Environmental Protection and Management (Hazardous Substances) Regulations - Environmental Public Health (General Waste Collection) Regulations, 2000 - Environmental Public Health (Toxic Industrial Waste) Regulations, 2000	NEA
Vector Management	- Control of Vectors and Pesticides Act, 2002 - Environmental Public Health (Food hygiene) regulations	NEA

These frameworks also give relevant agencies the power to issue directions on environmental management and pollution control as required. This has led to the development of Code of Practices (COPs) and guidelines issued by the relevant agencies. These COPs and guidelines detail more specific requirements on regulatory compliance, various control techniques as well as best practices with regards to environmental management and related issues. The relevant COPs and guidelines are described on **Table 1A.2**.

Table 1A.2: Relevant Code of Practice and Guidelines

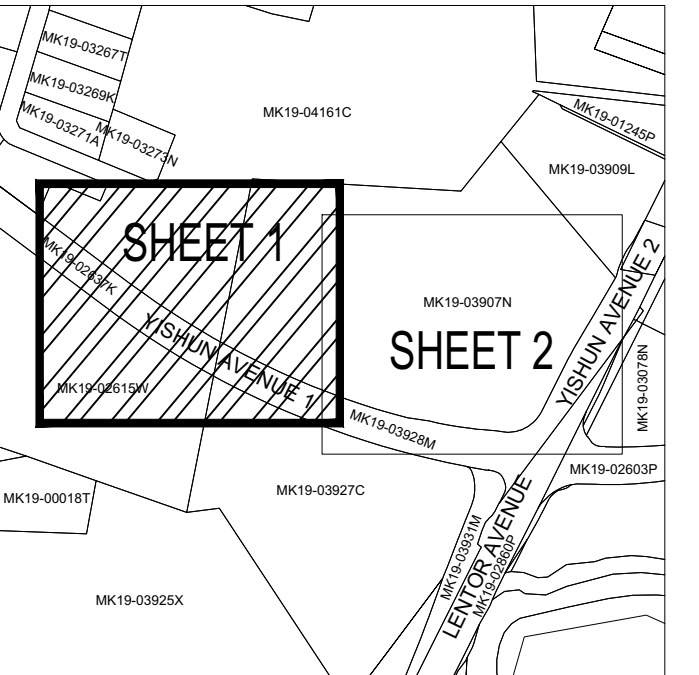
Environmental Aspects	Relevant Local Acts/ Regulations/ Action Plans	Jurisdiction/ Administrative/ Enforcement Agencies
Biodiversity	• Singapore Red Data Book • NParks Biodiversity Impact Assessment (BIA) Guidelines	NParks
General Environment	• SS 593 : 2013 Code of Practice on Pollution Control • Code of Practice for Environmental Control Officers	NEA
Surface Water	• Code of Practice on Surface Water Drainage • Guidebook on Erosion and Sediment Control at Construction Sites • PUB Circular on Preventing Muddy Water from the Construction Site	PUB
Noise	• Code of Practice for Noise Control on Construction and Demolition Sites • BS 5228-1 2009: Code of Practice for Noise and Vibration Control on Construction – Part 1: Noise	NEA International
Waste	• Code of Practice for Licensed General Waste Collectors • SS 603 : 2014 Code of Practice for Hazardous Waste Management	NEA
Sustainability	• United Nations Sustainable Development Goals: 17 Goals to Transform our World	International

Appendix 4A. Topography Survey

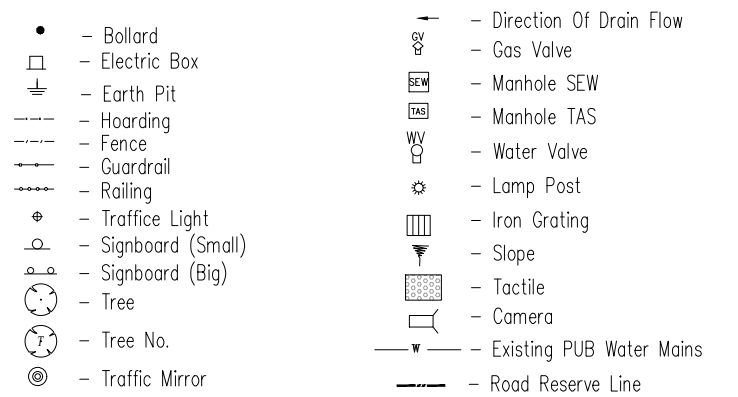


SVY21
MK19

KEY PLAN:



LEGEND:



NOTE:

- Horizontal Datum is in SVY21 Datum
- Levels are based on SLA SINGAPORE HEIGHT DATUM (SHD).
- Road Line Plan (RLP), purchased from INLIS dated 29/11/2024.
- Railway Protection Plan (RPP), purchased from INLIS dated 11/12/2024.
- Line of Sewerage Interpretation, Drainage Interpretation & Water Service Plan are indicative only and are subjected to changes purchased dated 29/11/2024.
- All information shown on are correct as on 11/12/2024 and should be verified on site before commencement of work.
- All dimensions shown hereon are in metres unless otherwise stated.

REV	DATE	AMENDMENTS

CLIENT:

Jacobs International Consultants Pte Ltd

SURVEYOR:
 **YJP SURVEYORS PTE LTD**
10, GENTING ROAD
#05-00 THE BLUE Building
SINGAPORE 349473
TEL: 6743 0838 FAX: 6743 6732
Email: office@jpsurveyors.com

PROJECT TITLE:

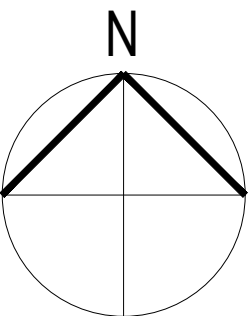
TOPOGRAPHIC SURVEY AT YISHUN AVENUE 1

DRAWING TITLE:

TOPOGRAPHICAL SURVEY PLAN
(SHEET 1 OF 2)

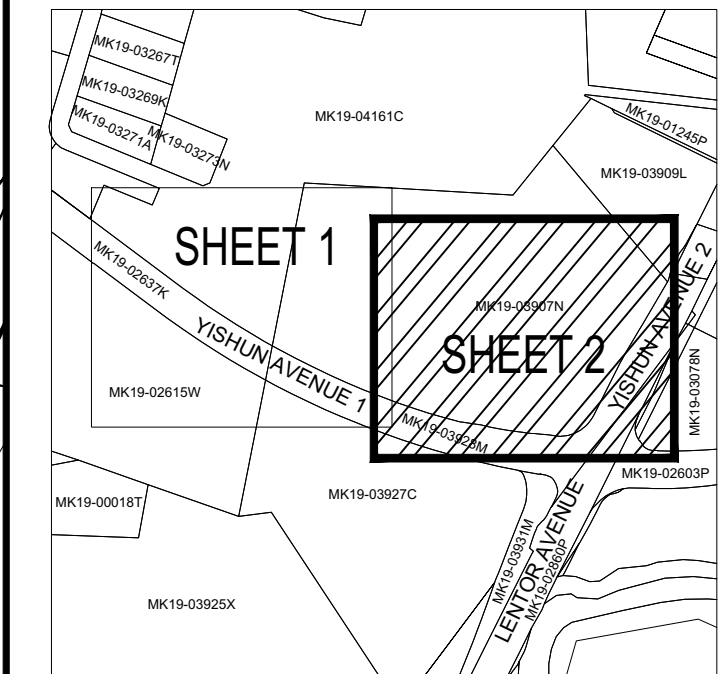
SURVEYED BY: MANI, MATHI, PANI	DRAWN BY: AZILA
CHECKED BY: DENNIS	DATE: 11 DEC 2024
DRAWING NO: YJP/80255/YS/TP/01	REVISION:  SCALE: 1:500

Derek Chan Wei Hoong
Registered Surveyor (Singapore)
M.S.I.S.V
BEng. (Hons) Surveying and Spatial Information System (Aust)



SVY21
MK19

KEY PLAN:



LEGEND:

- Bollard
- Electric Box
- ⬇ Earth Pit
- ⋯ Hoarding
- ⋯ Fence
- ⋯ Guardrail
- ⋯ Railing
- Traffic Light
- ⬆ Signboard (Small)
- ⬆ Signboard (Big)
- Tree
- Tree No.
- ⊙ Traffic Mirror
- Direction Of Drain Flow
- ⬆ Gas Valve
- ⬆ Manhole SEW
- ⬆ Manhole T&S
- ⬆ Water Valve
- ⬆ Lamp Post
- ⬆ Iron Grating
- ⬆ Slope
- ⬆ Tactile
- ⬆ Camera
- ⬆ Existing PUB Water Mains
- ⬆ Road Reserve Line

NOTE:

- Horizontal Datum is in SVY21 Datum
- Levels are based on SLA SINGAPORE HEIGHT DATUM (SHD).
- Road Line Plan (RLP), purchased from INLIS dated 29/11/2024.
- Railway Protection Plan (RPP), purchased from INLIS dated 11/12/2024.
- Line of Sewerage Interpretation, Drainage Interpretation & Water Service Plan are indicative only and are subjected to changes purchased dated 29/11/2024.
- All information shown on are correct as on 11/12/2024 and should be verified on site before commencement of work.
- All dimensions shown hereon are in metres unless otherwise stated.

REV	DATE	AMENDMENTS

CLIENT:

Jacobs International Consultants Pte Ltd

SURVEYOR:

YJP SURVEYORS PTE LTD
10, GENTING ROAD
#05-00 THE BLUE Building
SINGAPORE 349473
TEL: 6743 0838 FAX: 6743 6732
Email: office@yjsurveyors.com

PROJECT TITLE:

TOPOGRAPHIC SURVEY AT YISHUN AVENUE 1

DRAWING TITLE:

**TOPOGRAPHICAL SURVEY PLAN
(SHEET 2 OF 2)**

SURVEYED BY: MANI, MATHI, PANI	DRAWN BY: AZILA
CHECKED BY: DENNIS	DATE: 11 DEC 2024
DRAWING NO: YJP/80255/YS/TP/01	REVISION: 1 SCALE: 1:500

Derek Chan Wei Hoong
Registered Surveyor (Singapore)
M.S.I.S.V
BEng. (Hons) Surveying and Spatial Information System (Aust)

Tree ID	Scientific Name	Girth/ spread (m)	Height(m)
CTP6680	Durio zibethinus	1.5	15
CTP6681	Durio zibethinus	1.4	12
CTP6682	Durio zibethinus	2.9	15
CTP6683	Ficus benjamina	7	20
CTP6683A	Ficus benjamina	7	20
CTP6683B	Ficus benjamina	7	20
CTP6684	Nephelium lappaceum var. lappaceum	2	18
CTP6685	Nephelium ramboutan-ake	1.5	15
CTP6686	Nephelium lappaceum	2.6	15
CTP6687	Manilkara zapota	1	8
CTP6688	Manilkara zapota	1.6	15
CTP6689	Artocarpus heterophyllus	1.2	12
CTP6690	Ficus benjamina	3.8	18
CTP6691	Durio zibethinus	2.8	18
CTP6692	Artocarpus heterophyllus	2	15
CTP6693	Durio zibethinus	1.7	15
CTP6694	Durio zibethinus	1.4	12
CTP6695	Durio zibethinus	1.7	15
CTP6730	Ficus benjamina	1	10
CTP6731	Durio zibethinus	1.5	8
CTP6732	Durio zibethinus	1.3	8
CTP6733	Durio zibethinus	2.8	10
CTP6734	Durio zibethinus	1.8	10
CTP6735	Samanea saman	1.8	15
CTP6736	Durio zibethinus	1.7	6
CTP6737	Cinnamomum iners	1.7	8
CTP6738	Cinnamomum iners	1.6	10
CTP6739	Cinnamomum iners	2	10
CTP6740	Cinnamomum iners	1.8	10
CTP6741	Cinnamomum iners	1.7	10
CTP6742	Cinnamomum iners	1.1	8
CTP6743	Cinnamomum iners	1.3	10
CTP6744	Cinnamomum iners	1.2	10
CTP6745	Cinnamomum iners	1.4	10
CTP6746	Morinda citrifolia	1.2	7
CTP6747	Morinda citrifolia	1.3	7
CTP6810	Mangifera indica	1.8	15
CTP6811	Hevea brasiliensis	1	18
CTP6812	Sandoricum koetjape	3.4	15
CTP6813	Sandoricum koetjape	1.6	15
CTP6814	Sandoricum koetjape	2.5	18
CTP6815	Mangifera indica	1.7	15
CTP6816	Mangifera indica	1.7	16
CTP6817	Pouteria campechiana	1.5	10
CTP6818	Langium domesticum	1.4	4.5
CTP6819	Langium domesticum	1	8
CTP6820	Macaranga gigantea	1.4	12
CTP6821	Diospyros discolor	1.3	8
CTP6822	Averrhoa carambola	1.5	6
CTP6823	Mangifera indica	2	15
CTP6824	Nephelium ramboutan-ake	1.7	8
CTP6825	Nephelium ramboutan-ake	1.1	8
CTP6826	Ficus benjamina	5	18
CTP6826A	Ficus benjamina	5	18
CTP6827	Ficus microcarpa	4	20
CTP6827A	Ficus microcarpa	4	20
CTP6828	Mangifera indica	2	15
CTP6829	Averrhoa carambola	1.7	8
CTP6830	Ficus benjamina	3	20
CTP6831	Garcinia mangostana var. mangostana	1	12
CTP6832	Garcinia mangostana var. mangostana	1.1	12
CTP6833	Garcinia mangostana var. mangostana	1.4	12
CTP6834	Samanea saman	1	18
CTP6835	Samanea saman	1.9	20
CTP6836	Mangifera indica	1.6	15
CTP6837	Samanea saman	1.8	18
CTP6838	Garcinia mangostana var. mangostana	1.4	12
CTP6839	Samanea saman	1.4	10
CTP6840	Samanea saman	1.5	10
CTP6841	Samanea saman	1.1	10
CTP6842	Samanea saman	1.9	12
CTP6843	Samanea saman	1.4	15
CTP6844	Samanea saman	1.8	15
CTP6845	Samanea saman	1.3	15
CTP6846	Durio zibethinus	1.1	7.5
CTP6847	Samanea saman	1.3	15
CTP6848	Samanea saman	1.7	18
CTP6849	Cinnamomum iners	1.1	7
CTP6850	Spathodea campanulata	1.5	16
CTP6851	Anacardium occidentale	3	10
CTP6852	Baccaurea motleyana	1.8	10
CTP6853	Baccaurea motleyana	3	10
CTP6854	Pouteria campechiana	1.3	8
CTP6855	Pouteria campechiana	1.3	7
CTP6856	Manilkara zapota	1	7
CTP6857	Syzygium aqueum	1.3	5
CTP6858	Syzygium aqueum	1.5	8
CTP6859	Syzygium aqueum	2.5	7
CTP6860	Durio zibethinus	1.9	12
CTP6861	Durio zibethinus	1.2	10
CTP6862	Durio zibethinus	2	11
CTP6863	Durio zibethinus	2.2	12
CTP6864	Mangifera caesia	1.9	13
CTP6865	Ficus benjamina	1.4	10
CTP6866	Durio zibethinus	1.4	10
CTP6867	Durio zibethinus	1.3	8
CTP6868	Durio zibethinus	1.5	12
CTP6869	Durio zibethinus	1.6	12
CTP6870	Durio zibethinus	1.7	12
CTP6871	Durio zibethinus	1.2	10
CTP6872	Durio zibethinus	1.7	12
CTP6873	Durio zibethinus	1.7	12
CTP6874	Durio zibethinus	1.4	12
CTP6875	Samanea saman	1.2	15
CTP6876	Samanea saman	1.3	15
CTP6877	Samanea saman	1.1	15
CTP6878	Samanea saman	1	15
CTP6879	Samanea saman	1.1	15
CTP6880	Samanea saman	1.1	15
CTP6881	Samanea saman	2	16
CTP6882	Samanea saman	1.9	16
CTP6883	Durio zibethinus	1.4	8
CTP6884	Durio zibethinus	3	15
CTP6885	Samanea saman	1.4	15
CTP6886	Samanea saman	1.3	15
CTP6887	Durio zibethinus	1.3	8
CTP6888	Durio zibethinus	2.5	12
CTP6889	Khaya nyasica	2.2	18
CTP6890	Khaya nyasica	1.2	18
CTP6891	Khaya nyasica	1.2	18

CTP6892	Khaya nyasica	2.1	18
CTP6893	Khaya nyasica	1.9	18
CTP6894	Khaya nyasica	1	15
CTP6895	Khaya nyasica	1.6	18
CTP6896	Khaya nyasica	1.4	18
CTP6897	Khaya nyasica	1.4	18
CTP6898	Khaya nyasica	1.4	18
CTP6899	Khaya nyasica	1.5	18
CTP6900	Khaya nyasica	1.8	18
SU0480	Hevea brasiliensis	1.2	15
SU0481	Hevea brasiliensis	1.3	15
SU0482	Hevea brasiliensis	2.2	18
SU0483	Elaeis guineensis	2	10
SU0484	Hevea brasiliensis	1.2	15
SU0485	Hevea brasiliensis	1.2	153
SU0486	Hevea brasiliensis	1.1	15
SU0487	Hevea brasiliensis	1.2	15
SU0488	Hevea brasiliensis	1.2	15
SU0489	Hevea brasiliensis	2	15
SU0490	Hevea brasiliensis	1.1	15
SU0491	Nephelium lappaceum var. lappaceum	1	12
SU0492	Hevea brasiliensis	1.3	15
SU0493	Nephelium lappaceum var. lappaceum	1.5	15
SU0494	Nephelium lappaceum var. lappaceum	1.3	15
SU0495	Nephelium lappaceum var. lappaceum	1.4	15
SU0496	Cinnamomum iners	1.1	12
SU0497	Cinnamomum iners	1	12
SU0498	Hevea brasiliensis	3	18
SU0499	Hevea brasiliensis	1.2	18
SU0500	Durio zibethinus	1.3	18
SU0501	Mangifera indica	1.8	18
SU0502	Mangifera indica	1.1	15
SU0503	Nephelium lappaceum var. lappaceum	1.4	12
SU0504	Mangifera indica	2.3	18
SU0505	Hevea brasiliensis	1.4	15
SU0506	Hevea brasiliensis	1.6	18
SU0507	Hevea brasiliensis	1	18
SU0508	Mangifera indica	1.7	18
SU0509	Durio zibethinus	1.8	15
SU0510	Nephelium lappaceum var. lappaceum	2.2	18
SU0511	Hevea brasiliensis	1	10
SU0512	Nephelium lappaceum var. lappaceum	1.3	15
SU0513	Hevea brasiliensis	1	12
SU0514	Mangifera indica	1.8	15
SU0515	Hevea brasiliensis	1.2	15
SU0516	Hevea brasiliensis	1.8	15
SU0517	Hevea brasiliensis	1.2	15
SU0518	Hevea brasiliensis	1.2	15
SU0519	Hevea brasiliensis	1.5	15
SU0520	Hevea brasiliensis	1.1	15
SU0521	Nephelium lappaceum var. lappaceum	1.2	12
SU0522	Syzygium grande	2.2	18
SU0523	Durio zibethinus	2.7	20
SU0524	Cinnamomum iners	1.2	15
SU0525	Cinnamomum iners	1.2	15
SU0526	Cinnamomum iners	1.1	12
SU0527	Hevea brasiliensis	1.1	15
SU0528	Durio zibethinus	1.7	20
SU0529	Durio zibethinus	1	15
SU0530	Hevea brasiliensis	1.3	18
SU0531	Hevea brasiliensis	1	12
SU0532	Durio zibethinus	6	25
SU0533	Hevea brasiliensis	1.1	15
SU0534	Hevea brasiliensis	1.1	15
SU0535	Hevea brasiliensis	1	15
SU0536	Hevea brasiliensis	1.1	15
SU0537	Hevea brasiliensis	1.1	15
SU0538	Hevea brasiliensis	2	18
SU0539	Hevea brasiliensis	1.5	18
SU0540	Hevea brasiliensis	1.6	18
SU0541	Hevea brasiliensis	1.6	18
SU0542	Hevea brasiliensis	1.1	15
SU0543	Hevea brasiliensis	1.1	15
SU0544	Hevea brasiliensis	1.1	15
SU0545	Hevea brasiliensis	1.2	15
SU0546	Hevea brasiliensis	2	18
SU0547	Hevea brasiliensis	1.7	18
SU0548	Hevea brasiliensis	3.2	18
SU0549	Hevea brasiliensis	1	15
SU0550	Hevea brasiliensis	1.1	15
SU0551	Nephelium lappaceum var. lappaceum	1.2	12
SU0552	Syzygium grande	2.2	18
SU0553	Durio zibethinus	2.7	20
SU0554	Cinnamomum iners	1.2	15
SU0555	Cinnamomum iners	1.2	15
SU0556	Cinnamomum iners	1.1	12
SU0557	Hevea brasiliensis	1.1	15
SU0558	Durio zibethinus	1.7	20
SU0559	Durio zibethinus	1	15
SU0560	Hevea brasiliensis	1.3	18
SU0561	Hevea brasiliensis	1	12
SU0562	Durio zibethinus	6	25
SU0563	Hevea brasiliensis	1.1	15
SU0564	Hevea brasiliensis	1.1	15
SU0565	Hevea brasiliensis	1	15
SU0566	Hevea brasiliensis	1.1	15
SU0567	Hevea brasiliensis	1.1	15
SU0568	Hevea brasiliensis	2	18
SU0569	Hevea brasiliensis	1.5	18
SU0570	Hevea brasiliensis	2	18
SU0571	Hevea brasiliensis	1.6	18
SU0572	Hevea brasiliensis	1.1	15
SU0573	Hevea brasiliensis	1.3	15
SU0574	Hevea brasiliensis	1.4	18
SU0575	Hevea brasiliensis	1.4	18
SU0576	Hevea brasiliensis	1.2	15
SU0577	Hevea brasiliensis	1.4	15
SU0578	Hevea brasiliensis	1.1	15
SU0579	Hevea brasiliensis	1.8	18
SU0580	Hevea brasiliensis	1.4	15
SU0581	Hevea brasiliensis	1.2	15
SU0582	Hevea brasiliensis	1.4	15
SU0583	Hevea brasiliensis	2.2	20
SU0584	Hevea brasiliensis	1.8	18
SU0585	Hevea brasiliensis	1.2	15
SU0586	Hevea brasiliensis	1.2	15
SU0587	Cassipouva indica	1.1	12
SU0588	Hevea brasiliensis	1	15
SU0589	Hevea brasiliensis	1.1	15
SU0590	Cinnamomum iners	1	12
SU0591	Hevea brasiliensis	1.2	15
SU0592	Hevea brasiliensis	1.2	15
SU0592A	Syzygium cerasiflorae	1.2	12
SU0593	Hevea brasiliensis	2.5	18
SU0594	Hevea brasiliensis	1.1	15
SU0595	Hevea brasiliensis	1.1	15
SU0596	Hevea brasiliensis	1.1	15
SU0597	Hevea brasiliensis	1.4	15
SU0598	Hevea brasiliensis	1	15
SU0599	Hevea brasiliensis	1.2	15
SU0600	Hevea brasiliensis	1.2	18
SU0601	Hevea brasiliensis	1.2	18
SU0602	Symplocos fasciculata	0.3	8
SU0603	Syzygium cerasiflorae	1.2	16
SU0604	Symplocos fasciculata	0.3	7
SU0605	Symplocos fasciculata	0.4	10
SU0606	Symplocos fasciculata	0.3	8
SU0607	Hevea brasiliensis	1.7	20
SU0608	Hevea brasiliensis	1.6	18
SU0609	Hevea brasiliensis	1.6	18
SU0610	Hevea brasiliensis	1.6	18
SU0611	Hevea brasiliensis	2.5	25
SU0612	Hevea brasiliensis	1.2	18
SU0613	Hevea brasiliensis	1.7	20
SU0614	Hevea brasiliensis	1.4	18
SU0615	Hevea brasiliensis	1.4	18
SU0616	Hevea brasiliensis	2.2	25

SU0686	Hevea brasiliensis	1.4	20
SU0687	Hevea brasiliensis	1.4	20
SU0688	Hevea brasiliensis	1	15
SU0689	Hevea brasiliensis	1.1	18
SU0690	Hevea brasiliensis	1.8	20
SU0691	Hevea brasiliensis	1.5	20
SU0692	Hevea brasiliensis	1.5	15
SU0693	Hevea brasiliensis	1.2	18
SU0694	Hevea brasiliensis	2	25
SU0695	Dimocarpus longan	1.7	14
SU0828	Dimocarpus longan	1	15
SU0829	Durio zibethinus	1.7	18
SU0830	Dimocarpus longan	1.3	16
SU0831	Dimocarpus longan	1.8	20
SU0832	Durio zibethinus	2	25
SU0833	Durio zibethinus	2.4	30
SU0834	Durio zibethinus	1.5	30
SU0835	Dimocarpus longan	2.2	30
SU0836	Dimocarpus longan	1.6	20
SU0837	Dimocarpus longan	1.4	16
SU0838	Dimocarpus longan	1.6	30
SU0839	Durio zibethinus	2.5	30
SU0840	Durio zibethinus	2.3	30
SU0841	Dimocarpus longan	1.4	25
SU0842	Mangifera indica	1.4	18
SU0843	Durio zibethinus	2	30
SU0844	Durio zibethinus	3.2	30
SU0845	Durio zibethinus	1.3	18
SU0846	Durio zibethinus	2	18
SU0847	Durio zibethinus	2	20
SU0848	Hevea brasiliensis	1.1	18
SU0849	Durio zibethinus	1.8	30
SU0850	Macaranga gigantea	1.1	15
SU0851	Hevea brasiliensis	1.2	18
SU0852	Syzygium grande	1.2	20
SU0853	Hevea brasiliensis	1.8	10
SU0854	Cinnamomum iners	1	12
SU0855	Dimocarpus longan	1.1	12
SU0856	Hevea brasiliensis	2	20
SU0857	Cinnamomum iners	1.1	18
SU0858	Dimocarpus longan	1	15
SU0859	Falcataria moluccana	1.4	15
SU0860	Antocarpus integer	2	20
SU0861	Hevea brasiliensis	1.7	15
SU0862	Dimocarpus longan	1.5	15
SU0863	Hevea brasiliensis	1.5	11
SU0864	Hevea brasiliensis	1.1	15
SU0865	Hevea brasiliensis	1.2	15
SU0866	Hevea brasiliensis	1.5	15
SU0867	Hevea brasiliensis	1.2	12
SU0868	Dimocarpus longan	1.1	18
SU0869	Durio zibethinus	1.5	20
SU0870	Durio zibethinus	2.5	25
SU0871	Durio zibethinus	1	20
SU0872	Macaranga gigantea	1.4	10
SU0873	Dimocarpus longan	1.2	15
SU0874	Dimocarpus longan	1	12
SU0875	Hevea brasiliensis	1.4	15
SU0876	Hevea brasiliensis	1.8	1
SU0877	Hevea brasiliensis	2.5	18
SU0878	Dimocarpus longan	1.4	18
SU0879	Hevea brasiliensis	1.5	20
SU0880	Hevea brasiliensis	1.5	18
SU0881	Hevea brasiliensis	1.1	15
SU0882	Hevea brasiliensis	1.5	15
SU0883	Hevea brasiliensis	1.6	16
SU0884	Hevea brasiliensis	1.1	15
SU0885	Hevea brasiliensis	1	15
SU0886	Hevea brasiliensis	1	15
SU0887	Hevea brasiliensis	1.2	14
SU0888	Syzygium cerasifforme	1	18
SU0889	Hevea brasiliensis	1.1	15
SU0890	Hevea brasiliensis	2.5	16
SU0891	Hevea brasiliensis	1.4	18
SU0892	Hevea brasiliensis	1.8	20
SU0893	Hevea brasiliensis	1	18
SU0894	Hevea brasiliensis	1.3	18
SU0895	Oncosperma horridum	1	18
SU0896	Hevea brasiliensis	1.5	18
SU0897	Hevea brasiliensis	1.2	18
SU0898	Hevea brasiliensis	1.2	18
SU0899	Dimocarpus longan	1.3	15
SU0900	Hevea brasiliensis	1.9	15
SU0901	Hevea brasiliensis	1	12
SU0902	Hevea brasiliensis	1	12
SU0903	Hevea brasiliensis	1	12
SU0904	Hevea brasiliensis	1.2	12
SU0905	Hevea brasiliensis	1.2	15
SU0906	Hevea brasiliensis	1.2	12
SU0907	Hevea brasiliensis	2.25	15
SU0908	Hevea brasiliensis	1.5	15
SU0909	Hevea brasiliensis	1.4	15
SU0910	Hevea brasiliensis	1.5	15
SU0911	Hevea brasiliensis	1.2	12
SU0912	Hevea brasiliensis	1.3	15
SU0913	Hevea brasiliensis	1.3	15
SU0914	Hevea brasiliensis	1.5	15
SU0915	Hevea brasiliensis	1.2	15
SU0916	Hevea brasiliensis	1.3	12
SU0917	Hevea brasiliensis	1.1	15
SU0918	Hevea brasiliensis	1.2	12
SU0919	Hevea brasiliensis	1.5	12
SU0920	Ficus variegata	1.8	15
SU0921	Hevea brasiliensis	1.1	10
SU0922	Hevea brasiliensis	1.1	15
SU0923	Cinnamomum iners	1.6	6
SU0924	Hevea brasiliensis	1.2	1
SU0925	Hevea brasiliensis	1.6	15
SU0926	Hevea brasiliensis	1.5	15
SU0927	Hevea brasiliensis	1.1	12
SU0928	Hevea brasiliensis	1.1	15
SU0929	Hevea brasiliensis	1	15
SU0930	Hevea brasiliensis	1.2	13
SU0931	Hevea brasiliensis	1.2	15
SU0932	Hevea brasiliensis	1.6	18
SU0933	Hevea brasiliensis	1.2	15
SU0934	Hevea brasiliensis	1.8	15
SU0935	Hevea brasiliensis	1.5	15
SU0936	Hevea brasiliensis	1.2	12
SU0937	Hevea brasiliensis	1.1	15
SU0938	Hevea brasiliensis	1.3	15
SU0939	Hevea brasiliensis	1.8	18

Appendix 4B. RIAM for Geomorphology IA

Assessment Criteria and Impact Evaluation Method for Geomorphology, Soil and Groundwater

Impact	A1: Value	A2.1: Impact Nature	A2.2:	A2.3: Impact Extend	B1: Permanence	B2: Impact	B3: Reversibility	B4: Cumulative	at	bt	ES	Impact Severity								
IA Before Mitigation Measures																				
Soil Infiltration Capacity	Important to local conditions (within Site 1)	1	Negative	-1	Medium	2	Impact within local area, i.e., within Site 1	1	Short Term	2	Direct	3	Irreversible	3	Non-Cumulative	2	-2	10	-20	Minor Negative
Soil Erosion (All Zones)	Important to local conditions (within Site 1)	1	Negative	-1	High	3	Impact extends immediately beyond Site 1, i.e., Buffer area	2	Short Term	2	Direct	3	Irreversible	3	Non-Cumulative	2	-6	10	-60	Minor Negative
IA After Mitigation Measures																				
Soil Infiltration Capacity	Important to local conditions (within Site 1)	1	Negative	-1	Low	1	Impact within local area, i.e., within Site 1	1	Short Term	2	Direct	3	Irreversible	3	Non-Cumulative	2	-1	10	-10	Slight Negative
Soil Erosion at Critical Zone (Zone 2A, 4)	Important to local conditions (within Site 1)	1	Negative	-1	Medium	2	Impact within local area, i.e., within Site 1	1	Short Term	2	Direct	3	Irreversible	3	Non-Cumulative	2	-2	10	-20	Minor Negative
Soil Erosion at Other Zones (Zone 1A, 1B, 2, 3)	Important to local conditions (within Site 1)	1	Negative	-1	Low	1	Impact within local area, i.e., within Site 1	1	Short Term	2	Direct	3	Irreversible	3	Non-Cumulative	2	-1	10	-10	Slight Negative

Appendix 5A. List of Recorded Flora Species

Appendix 5A- List of Flora Species

Species	Family	Origin	National Status	IUCN Global Status	Habit
<i>Acacia auriculiformis</i>	Fabaceae	Exotic	Naturalised	Least Concern	Tree
<i>Acacia mangium</i>	Fabaceae	Exotic	Naturalised	Least Concern	Tree
<i>Adenanthra pavonina</i>	Fabaceae	Exotic	Naturalised	Least Concern	Tree
<i>Adenia cordifolia</i>	Passifloraceae	Native	Endangered	Not Assessed	Climber
<i>Adiantum latifolium</i>	Pteridaceae	Exotic	Naturalised	Not Assessed	Herb
<i>Agelaea macrophylla</i>	Connaraceae	Native	Least concern	Least Concern	Climber
<i>Alocasia macrorrhizos</i>	Araceae	Exotic	Naturalised	Not Assessed	Herb
<i>Alsophila latebrosa</i>	Cyatheaceae	Native	Least concern	Not Assessed	Tree
<i>Ananas comosus</i>	Bromeliaceae	Exotic	Casual	Not Assessed	Herb
<i>Aphanamixis polystachya</i>	Meliaceae	Native	Least concern	Least Concern	Tree
<i>Aporosa frutescens</i>	Phyllanthaceae	Native	Least concern	Least Concern	Tree
<i>Artemisia vulgaris</i>	Asteraceae	Exotic	Cultivated only	Not Assessed	Herb
<i>Arthrophyllum jackianum</i>	Araliaceae	Native	Least concern	Not Assessed	Tree
<i>Artocarpus heterophyllus</i>	Moraceae	Exotic	Casual	Not Assessed	Tree
<i>Artocarpus integer</i> var. <i>integer</i>	Moraceae	Cryptogenic	-	Not Assessed	Tree
<i>Asplenium nidus</i> var. <i>nidus</i>	Aspleniaceae	Native	Least concern	Not Assessed	Epiphyte
<i>Asystasia gangetica</i> subsp. <i>micrantha</i>	Acanthaceae	Exotic	Naturalised	Not Assessed	Herb
<i>Averrhoa carambola</i>	Oxalidaceae	Exotic	Casual	Data Deficient	Tree
<i>Axonopus compressus</i>	Poaceae	Exotic	Naturalised	Least Concern	Herb
<i>Baccaurea motleyana</i> *	Phyllanthaceae	Native	Critically endangered	Least Concern	Tree
<i>Bambusa vulgaris</i>	Poaceae	Exotic	Casual	Not Assessed	Shrub
<i>Baphia nitida</i>	Fabaceae	Exotic	Casual	Least Concern	Shrub
<i>Barringtonia racemosa</i> *	Lecythidaceae	Native	Critically endangered	Least Concern	Tree
<i>Blechnopsis orientalis</i>	Blechnaceae	Native	Least concern	Not Assessed	Herb
<i>Bougainvillea glabra</i>	Nyctaginaceae	Exotic	Cultivated only	Least Concern	Shrub
<i>Breynia androgyna</i> *	Phyllanthaceae	Native	Vulnerable	Least Concern	Shrub
<i>Brownea grandiceps</i>	Fabaceae	Exotic	Cultivated only	Least Concern	Tree
<i>Caryota mitis</i>	Arecaceae	Native	Least concern	Least Concern	Tree
<i>Cecropia pachystachya</i>	Urticaceae	Exotic	Naturalised	Least Concern	Tree
<i>Centotheca lappacea</i>	Poaceae	Native	Least concern	Not Assessed	Herb
<i>Centrosema molle</i>	Fabaceae	Exotic	Naturalised	Not Assessed	Climber
<i>Cheilocostus speciosus</i> *	Costaceae	Native	Critically endangered	Least Concern	Herb
<i>Christella dentata</i>	Thelypteridaceae	Native	Least concern	Not Assessed	Herb
<i>Chrysopogon aciculatus</i>	Poaceae	Native	Least concern	Not Assessed	Herb
<i>Cinnamomum iners</i>	Lauraceae	Native	Least concern	Least Concern	Tree
<i>Cissus hastata</i>	Vitaceae	Native	Least concern	Not Assessed	Climber
<i>Claoxylon indicum</i>	Euphorbiaceae	Native	Least concern	Least Concern	Tree
<i>Clausena excavata</i>	Rutaceae	Native	Least concern	Least Concern	Shrub
<i>Clerodendrum disparifolium</i>	Lamiaceae	Native	Least concern	Least Concern	Tree
<i>Clerodendrum paniculatum</i>	Lamiaceae	Exotic	Naturalised	Not Assessed	Shrub
<i>Colocasia esculenta</i>	Araceae	Exotic	Casual	Least Concern	Herb
<i>Combretum indicum</i>	Combretaceae	Exotic	Casual	Not Assessed	Climber
<i>Commelina diffusa</i>	Commelinaceae	Cryptogenic	-	Least Concern	Herb
<i>Commersonia bartramia</i>	Malvaceae	Native	Least concern	Least Concern	Tree
<i>Cratogeomys cochinchinense</i> *	Hypericaceae	Native	Endangered	Least Concern	Tree
<i>Cuphea hyssopifolia</i>	Lythraceae	Exotic	Cultivated only	Not Assessed	Shrub
<i>Cyathula prostrata</i>	Amaranthaceae	Native	Least concern	Not Assessed	Shrub
<i>Cyclosorus interruptus</i>	Thelypteridaceae	Native	Least concern	Least Concern	Herb
<i>Cynometra browneoides</i>	Fabaceae	Exotic	Cultivated only	Not Assessed	Tree
<i>Cynometra ramiflora</i> *	Fabaceae	Native	Critically endangered	Least Concern	Tree
<i>Cyperus aromaticus</i>	Cyperaceae	Exotic	Naturalised	Not Assessed	Herb
<i>Cyperus mindorensis</i>	Cyperaceae	Native	Least concern	Not Assessed	Herb
<i>Cyperus sphacelatus</i>	Cyperaceae	Exotic	Naturalised	Not Assessed	Herb
<i>Cyrtococcum patens</i>	Poaceae	Native	Vulnerable	Not Assessed	Herb
<i>Davallia denticulata</i> var. <i>denticulata</i>	Davalliaceae	Native	Least concern	Not Assessed	Herb
<i>Dendrophthoe pentandra</i>	Loranthaceae	Native	Least concern	Not Assessed	Epiphyte
<i>Dieffenbachia seguine</i>	Araceae	Exotic	Casual	Not Assessed	Herb
<i>Digitaria ciliaris</i>	Poaceae	Native	Least concern	Not Assessed	Herb
<i>Dillenia suffruticosa</i>	Dilleniaceae	Native	Least concern	Not Assessed	Shrub
<i>Diospyros discolor</i>	Ebenaceae	Exotic	Cultivated only	Not Assessed	Tree
<i>Dipterocarpus kunstleri</i> *	Dipterocarpaceae	Native	Endangered	Least Concern	Tree
<i>Dipterocarpus scaber</i>	Dipterocarpaceae	Exotic	Not Assessed	Data Deficient	Tree
<i>Dipterocarpus</i> sp.	Dipterocarpaceae	Unidentified	-	-	Tree
<i>Dischidia nummularia</i>	Apocynaceae	Native	Least concern	Not Assessed	Epiphyte
<i>Dracaena fragrans</i>	Asparagaceae	Exotic	Casual	Least Concern	Shrub
<i>Dracaena sanderiana</i>	Asparagaceae	Exotic	Naturalised	Not Assessed	Shrub
<i>Drynaria quercifolia</i>	Polypodiaceae	Native	Least concern	Not Assessed	Epiphyte
<i>Durio zibethinus</i>	Malvaceae	Exotic	Casual	Data Deficient	Tree
<i>Echinodorus palifolius</i>	Alismataceae	Exotic	Cultivated only	Not Assessed	Aquatic
<i>Elaeis guineensis</i>	Arecaceae	Exotic	Casual	Least Concern	Tree
<i>Elaeocarpus angustifolius</i>	Equisetaceae	Exotic	Cultivated only	Least Concern	Tree

Appendix 5A- List of Flora Species

Species	Family	Origin	National Status	IUCN Global Status	Habit
<i>Elephantopus scaber</i>	Asteraceae	Exotic	Naturalised	Not Assessed	Herb
<i>Emblia urinaria</i>	Phyllanthaceae	Exotic	Naturalised	Not Assessed	Shrub
<i>Emilia praetermissa</i>	Asteraceae	Exotic	Not Assessed	Not Assessed	Herb
<i>Epipremnum aureum</i>	Araceae	Exotic	Casual	Not Assessed	Climber
<i>Epipremnum pinnatum</i>	Araceae	Exotic	Naturalised	Not Assessed	Climber
<i>Erycibe tomentosa</i>	Convolvulaceae	Native	Least concern	Not Assessed	Climber
<i>Eryngium foetidum</i>	Apiaceae	Exotic	Casual	Not Assessed	Herb
<i>Etlingera elatior</i>	Zingiberaceae	Cryptogenic	-	Data Deficient	Herb
<i>Excoecaria cochinchinensis</i>	Euphorbiaceae	Exotic	Cultivated only	Least Concern	Shrub
<i>Ficus aurata</i>	Moraceae	Native	Least concern	Least Concern	Tree
<i>Ficus benjamina</i>	Moraceae	Cryptogenic	-	Least Concern	Strangler
<i>Ficus fistulosa</i>	Moraceae	Native	Least concern	Least Concern	Tree
<i>Ficus hispida</i>	Moraceae	Exotic	Casual	Least Concern	Tree
<i>Ficus microcarpa</i>	Moraceae	Native	Least concern	Least Concern	Tree
<i>Ficus variegata</i>	Moraceae	Native	Least concern	Least Concern	Tree
<i>Fimbristylis dichotoma</i>	Cyperaceae	Native	Least concern	Least Concern	Herb
<i>Flagellaria indica</i>	Flagellariaceae	Native	Least concern	Not Assessed	Climber
<i>Garcinia mangostana</i>	Clusiaceae	Exotic	Casual	Data Deficient	Tree
<i>Girroniera nervosa</i>	Cannabaceae	Native	Least concern	Least Concern	Tree
<i>Glochidion zeylanicum</i> var. <i>zeylanicum</i>	Phyllanthaceae	Native	Vulnerable	Not Assessed	Tree
<i>Gnetum gnemon</i> var. <i>gnemon</i> *	Gnetaceae	Native	Critically endangered	Not Assessed	Tree
<i>Grona triflora</i>	Fabaceae	Native	Least concern	Not Assessed	Herb
<i>Grypothrix triphylla</i>	Thelypteridaceae	Native	Least concern	Not Assessed	Herb
<i>Heliconia chartacea</i>	Heliconiaceae	Exotic	Cultivated only	Not Assessed	Herb
<i>Heliconia psittacorum</i>	Heliconiaceae	Exotic	Casual	Not Assessed	Herb
<i>Hevea brasiliensis</i>	Euphorbiaceae	Exotic	Naturalised	Least Concern	Tree
<i>Hornstedtia scyphifera</i> var. <i>scyphifera</i>	Zingiberaceae	Native	Vulnerable	Not Assessed	Herb
<i>Horsfieldia cf. polyspherula</i> var. <i>polyspherula</i>	Myristicaceae	Native	Vulnerable	Not Assessed	Tree
<i>Houttuynia cordata</i>	Saururaceae	Exotic	Cultivated only	Not Assessed	Climber
<i>Hydrilla verticillata</i>	Hydrocharitaceae	Cryptogenic	-	Least Concern	Herb
<i>Imperata cylindrica</i>	Poaceae	Native	Least concern	Not Assessed	Herb
<i>Ipomoea cairica</i>	Convolvulaceae	Exotic	Naturalised	Least Concern	Climber
<i>Ischaemum muticum</i>	Poaceae	Native	Least concern	Least Concern	Herb
<i>Justicia procumbens</i>	Acanthaceae	Cryptogenic	-	Not Assessed	Herb
<i>Khaya cf. nyasica</i>	Meliaceae	Exotic	Not Assessed	Not Assessed	Tree
<i>Lagerstroemia floribunda</i>	Lythraceae	Exotic	Cultivated only	Not Assessed	Tree
<i>Lansium domesticum</i>	Meliaceae	Exotic	Casual	Not Assessed	Tree
<i>Leea indica</i>	Vitaceae	Native	Least concern	Least Concern	Shrub/ Tree
<i>Legazpia polygonoides</i>	Linderniaceae	Cryptogenic	-	Not Assessed	Herb
<i>Lindera lucida</i>	Lauraceae	Native	Vulnerable	Least Concern	Tree
<i>Litsea castanea</i>	Lauraceae	Native	Endangered	Least Concern	Tree
<i>Litsea elliptica</i>	Lauraceae	Native	Least concern	Least Concern	Tree
<i>Litsea umbellata</i>	Lauraceae	Native	Vulnerable	Least Concern	Shrub
<i>Lygodium flexuosum</i>	Lygodiaceae	Native	Least concern	Not Assessed	Climber
<i>Lygodium longifolium</i>	Lygodiaceae	Native	Least concern	Not Assessed	Climber
<i>Lygodium microphyllum</i>	Lygodiaceae	Native	Least concern	Least Concern	Climber
<i>Macaranga bancana</i>	Euphorbiaceae	Native	Least concern	Least Concern	Tree
<i>Macaranga confiera</i>	Euphorbiaceae	Native	Least concern	Least Concern	Tree
<i>Macaranga gigantea</i>	Euphorbiaceae	Native	Least concern	Least Concern	Tree
<i>Macaranga griffithiana</i>	Euphorbiaceae	Native	Vulnerable	Least Concern	Tree
<i>Macaranga hypoleuca</i>	Euphorbiaceae	Native	Least concern	Least Concern	Tree
<i>Mallotus paniculatus</i>	Euphorbiaceae	Native	Least concern	Least Concern	Tree
<i>Mangifera x odorata</i>	Anacardiaceae	Exotic	Casual	Not Assessed	Tree
<i>Mangifera indica</i>	Anacardiaceae	Exotic	Casual	Data Deficient	Tree
<i>Manihot esculenta</i>	Euphorbiaceae	Exotic	Naturalised	Not Assessed	Shrub
<i>Melastoma malabathricum</i>	Melastomataceae	Native	Least concern	Not Assessed	Shrub
<i>Melicope lunu-ankenda</i>	Rutaceae	Native	Endangered	Least Concern	Tree
<i>Melothria pendula</i>	Cucurbitaceae	Exotic	Naturalised	Not Assessed	Climber
<i>Miconia crenata</i>	Melastomataceae	Exotic	Naturalised	Not Assessed	Herb
<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Not Assessed	Herb
<i>Mikania micrantha</i>	Asteraceae	Exotic	Naturalised	Not Assessed	Climber
<i>Momordica charantia</i>	Cucurbitaceae	Exotic	Casual	Not Assessed	Climber
<i>Morinda citrifolia</i>	Rubiaceae	Native	Least concern	Least Concern	Tree
<i>Musa acuminata</i> var. <i>sumatrana</i>	Musaceae	Exotic	Cultivated only	Not Assessed	Herb
<i>Nephelium lappaceum</i> var. <i>lappaceum</i>	Sapindaceae	Cryptogenic	-	Not Assessed	Tree
<i>Nephelium ramboutan-ake</i>	Sapindaceae	Cryptogenic	-	Least Concern	Tree
<i>Nephrolepis biserrata</i>	Nephrolepidaceae	Native	Least concern	Not Assessed	Herb
<i>Nothaphoebe umbelliflora</i>	Lauraceae	Native	Least concern	Least Concern	Tree
<i>Nymphaea rubra</i>	Nymphaeaceae	Exotic	Cultivated only	Least Concern	Herb

Appendix 5A- List of Flora Species

Species	Family	Origin	National Status	IUCN Global Status	Habit
<i>Ohwia caudata</i>	Fabaceae	Exotic	Naturalised	Not Assessed	Shrub
<i>Oncosperma horridum</i>	Arecaceae	Native	Vulnerable	Least Concern	Shrub
<i>Ottochloa nodosa</i>	Poaceae	Native	Least concern	Not Assessed	Herb
<i>Oxyceros longiflorus</i>	Rubiaceae	Native	Least concern	Least Concern	Climber
<i>Paederia foetida</i>	Rubiaceae	Native	Least concern	Not Assessed	Climber
<i>Panicum laxum</i>	Poaceae	Exotic	Naturalised	Not Assessed	Herb
<i>Paspalum conjugatum</i>	Poaceae	Exotic	Naturalised	Least Concern	Herb
<i>Peperomia pellucida</i>	Piperaceae	Exotic	Naturalised	Not Assessed	Herb
<i>Persicaria chinensis</i> var. <i>chinensis</i>	Polygonaceae	Exotic	Naturalised	Not Assessed	Herb
<i>Persicaria odorata</i>	Polygonaceae	Exotic	Cultivated only	Not Assessed	Shrub
<i>Piper aduncum</i>	Piperaceae	Exotic	Naturalised	Least Concern	Tree
<i>Piper betle</i>	Piperaceae	Exotic	Casual	Not Assessed	Climber
<i>Piper sarmentosum</i>	Piperaceae	Native	Least concern	Not Assessed	Climber
<i>Pipturus argenteus</i>	Urticaceae	Cryptogenic	-	Least Concern	Tree/Shrub
<i>Pittosporum tobira</i>	Pittosporaceae	Exotic	Cultivated only	Not Assessed	Tree
<i>Planchonella obovata</i>	Sapotaceae	Native	Least concern	Not Assessed	Tree
<i>Pseuderanthemum bicolor</i>	Acanthaceae	Exotic	Cultivated only	Not Assessed	Shrub
<i>Ptychosperma macarthurii</i>	Arecaceae	Exotic	Naturalised	Least Concern	Tree
<i>Pyrrosia longifolia</i>	Polypodiaceae	Native	Least concern	Not Assessed	Epiphyte
<i>Pyrrosia piloselloides</i>	Polypodiaceae	Native	Least concern	Not Assessed	Epiphyte
<i>Radermachera 'Kunming'</i>	Bignoniaceae	Not Assessed	-	Not Assessed	Shrub
<i>Rhodamnia cinerea</i>	Myrtaceae	Native	Least concern	Least Concern	Tree
<i>Ruellia blechum</i>	Acanthaceae	Exotic	Casual	Not Assessed	Herb
<i>Ruellia repens</i>	Acanthaceae	Cryptogenic	-	Not Assessed	Herb
<i>Saccharum officinarum</i>	Poaceae	Exotic	Casual	Not Assessed	Herb
<i>Samanea saman</i>	Fabaceae	Exotic	Casual	Least Concern	Tree
<i>Sandoricum koetjape</i> *	Meliaceae	Native	Vulnerable	Least Concern	Tree
<i>Saribus rotundifolius</i>	Arecaceae	Exotic	Casual	Not Assessed	Palm
<i>Selaginella ciliaris</i>	Selaginellaceae	Native	Least concern	Not Assessed	Climber
<i>Sieruela rudidosperma</i>	Cleomaceae	Exotic	Naturalised	Not Assessed	Herb
<i>Spathodea campanulata</i>	Bignoniaceae	Exotic	Naturalised	Least Concern	Tree
<i>Spermacoce exilis</i>	Rubiaceae	Exotic	Naturalised	Not Assessed	Herb
<i>Spermacoce latifolia</i>	Rubiaceae	Exotic	Naturalised	Not Assessed	Herb
<i>Spermacoce remota</i>	Rubiaceae	Exotic	Naturalised	Least Concern	Herb
<i>Stachytarpheta jamaicensis</i>	Verbenaceae	Exotic	Naturalised	Least Concern	Shrub
<i>Stenochlaena palustris</i>	Blechnaceae	Native	Least concern	Not Assessed	Climber
<i>Sterculia parviflora</i> *	Malvaceae	Native	Critically endangered	Least Concern	Herb
<i>Strobilanthes reptans</i>	Acanthaceae	Exotic	Naturalised	Not Assessed	Herb
<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Least Concern	Tree
<i>Syngonium angustatum</i>	Araceae	Exotic	Naturalised	Not Assessed	Climber
<i>Syzygium aqueum</i>	Myrtaceae	Exotic	Cultivated only	Least Concern	Tree
<i>Syzygium borneense</i>	Myrtaceae	Native	Least concern	Not Assessed	Tree
<i>Syzygium cerasiforme</i>	Myrtaceae	Native	Least concern	Not Assessed	Tree
<i>Syzygium glaucum</i> *	Myrtaceae	Native	Vulnerable	Not Assessed	Tree
<i>Syzygium grande</i>	Myrtaceae	Native	Least concern	Least Concern	Tree
<i>Syzygium myrtifolium</i> *	Myrtaceae	Native	Critically endangered	Not Assessed	Tree
<i>Syzygium oblatum</i> var. <i>oblatum</i> *	Myrtaceae	Native	Critically endangered	Not Assessed	Tree
<i>Syzygium polyanthum</i>	Myrtaceae	Native	Least concern	Not Assessed	Tree
<i>Syzygium zeylanicum</i>	Myrtaceae	Native	Least concern	Not Assessed	Shrub
<i>Taenitis blechnoides</i>	Pteridaceae	Native	Least concern	Not Assessed	Climber
<i>Tamarindus indica</i>	Fabaceae	Exotic	Casual	Least Concern	Tree
<i>Terminalia catappa</i>	Combretaceae	Native	Least concern	Least Concern	Tree
<i>Tetracera indica</i>	Dilleniaceae	Native	Least concern	Not Assessed	Climber
<i>Thelypteris triphylla</i>	Thelypteridaceae	Native	Least concern	Not Assessed	Herb
<i>Thunbergia fragrans</i>	Acanthaceae	Exotic	Naturalised	Not Assessed	Climber
<i>Thunbergia laurifolia</i>	Acanthaceae	Exotic	Casual	Not Assessed	Climber
<i>Trema cannabina</i>	Cannabaceae	Native	Least concern	Not Assessed	Shrub
<i>Tridax procumbens</i>	Asteraceae	Exotic	Naturalised	Not Assessed	Herb
<i>Typhonium roxburghii</i>	Araceae	Cryptogenic	-	Not Assessed	Herb
<i>Uncaria gambir</i>	Rubiaceae	Exotic	Naturalised	Not Assessed	Climber
<i>Vernonia cinerea</i>	Asteraceae	Native	Least concern	Not Assessed	Herb
<i>Xanthophyllum flavescens</i>	Polygalaceae	Native	Endangered	Not Assessed	Tree
<i>Zingiber officinale</i>	Zingiberaceae	Exotic	Cultivated only	Data Deficient	Herb

* indicates nationally threatened species that are **not** considered of conservation significance in this study.

Appendix 5B1. List of Flora Species of Conservation Significance

Appendix 5B.1- List of Flora CS Species

Species	Family	Origin	Status	Habit
<i>Adenia cordifolia</i>	Passifloraceae	Native	Endangered	Climber
<i>Cyrtococcum patens</i>	Poaceae	Native	Vulnerable	Herb
<i>Glochidion zeylanicum</i> var. <i>zeylanicum</i>	Phyllanthaceae	Native	Vulnerable	Tree
<i>Hornstedtia scyphifera</i> var. <i>scyphifera</i>	Zingiberaceae	Native	Vulnerable	Herb
<i>Horsfieldia</i> cf. <i>polyspherula</i> var. <i>polyspherula</i>	Myristicaceae	Native	Vulnerable	Tree
<i>Lindera lucida</i>	Lauraceae	Native	Vulnerable	Tree
<i>Litsea castanea</i>	Lauraceae	Native	Endangered	Tree
<i>Litsea umbellata</i>	Lauraceae	Native	Vulnerable	Shrub
<i>Macaranga griffithiana</i>	Euphorbiaceae	Native	Vulnerable	Tree
<i>Melicope lunu-ankenda</i>	Rutaceae	Native	Endangered	Tree
<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb
<i>Oncosperma horridum</i>	Arecaceae	Native	Vulnerable	Shrub
<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree
<i>Xanthophyllum flavescens</i>	Polygalaceae	Native	Endangered	Tree

Appendix 5B2. Locations of Flora Species of Conservation Significance

ID	Species	Family	Origin	Status	Habit	Northing	Easting	Girth/Spread (m)	Height (m)	Remarks
CS	<i>Adenia cordifolia</i>	Passifloraceae	Native	Endangered	Climber	43630.807	27506.162	NA	NA	Clusters in proximity, Suitable for salvaging
CS	<i>Adenia cordifolia</i>	Passifloraceae	Native	Endangered	Climber	43632.791	27507.608	NA	NA	Suitable for salvaging
CS	<i>Adenia cordifolia</i>	Passifloraceae	Native	Endangered	Climber	43702.127	27525.191	NA	NA	Suitable for salvaging
CS	<i>Cyrtococcum patens</i>	Poaceae	Native	Vulnerable	Herb	43690.625	27426.371	NA	NA	Suitable for salvaging
CS	<i>Cyrtococcum patens</i>	Poaceae	Native	Vulnerable	Herb	43611.678	27416.689	NA	NA	Suitable for salvaging
CS	<i>Glochidion zeylanicum</i> var. <i>zeylanicum</i>	Phyllanthaceae	Native	Vulnerable	Tree	43604.931	27440.279	0.05	1.5	Suitable for salvaging
CS	<i>Glochidion zeylanicum</i> var. <i>zeylanicum</i>	Phyllanthaceae	Native	Vulnerable	Tree	43601.056	27441.949	0.05	0.5	Suitable for salvaging
CS	<i>Glochidion cf. zeylanicum</i> var. <i>zeylanicum</i>	Phyllanthaceae	Native	Vulnerable	Tree	43640.864	27465.429	< 0.05	0.7	Suitable for salvaging
CS	<i>Horsfieldia cf. polyspherula</i> var. <i>polysphenula</i>	Myristicaceae	Native	Vulnerable	Tree	43600.732	27508.83	0.05	1	Suitable for salvaging
CS	<i>Hornstedtia scyphifera</i> var. <i>scyphifera</i>	Zingiberaceae	Native	Vulnerable	Herb	43647.166	27546.111	NA	NA	Suitable for salvaging
CS	<i>Lindera lucida</i>	Lauraceae	Native	Vulnerable	Tree	43720.701	27446.51	< 0.05	1	Suitable for salvaging
CS	<i>Lindera lucida</i>	Lauraceae	Native	Vulnerable	Tree	43697.484	27288.151	0.5	1.5	
CS	<i>Lindera lucida</i>	Lauraceae	Native	Vulnerable	Tree	43694.824	27292.488	0.5	1	
CS	<i>Lindera lucida</i>	Lauraceae	Native	Vulnerable	Tree	43702.239	27291.714	0.5	0.5	
CS	<i>Litsea castanea</i>	Lauraceae	Native	Endangered	Tree	43624.171	27449.514	< 0.05	1	Suitable for salvaging
CS	<i>Litsea umbellata</i>	Lauraceae	Native	Vulnerable	Shrub	43736.512	27507.832	<0.05	1.6	Suitable for salvaging
CS	<i>Macaranga griffithiana</i>	Euphorbiaceae	Native	Vulnerable	Tree	43722.026	27451.296	< 0.05	1.5	Suitable for salvaging
CS	<i>Melicope inu-ankenda</i>	Rutaceae	Native	Endangered	Tree	43714.398	27576.047	<0.05	1	Clusters in proximity, Suitable for salvaging
CS	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43661.766	27261.665	NA	NA	Suitable for salvaging
CS	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43663.646	27265.56	NA	NA	Suitable for salvaging
CS	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43656.767	27270.757	NA	NA	Suitable for salvaging
CS	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43661.324	27270.011	NA	NA	Suitable for salvaging
CS	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43654.8	27277.912	NA	NA	Suitable for salvaging
CS	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43650.267	27285.257	NA	NA	Suitable for salvaging
CS	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43646.396	27289.931	NA	NA	Suitable for salvaging
CS	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43645.069	27297.721	NA	NA	Suitable for salvaging
CS	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43644.514	27296.917	NA	NA	Suitable for salvaging
CS	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43642.7	27302.441	NA	NA	Suitable for salvaging
CS	<i>Oncosperma horridum</i>	Arecaceae	Native	Vulnerable	Shrub	43661.652	27517.738	1	12	
CS	<i>Oncosperma horridum</i>	Arecaceae	Native	Vulnerable	Shrub	43656.24	27501.927	1	10	
CS	<i>Oncosperma horridum</i>	Arecaceae	Native	Vulnerable	Shrub	43682.412	27517.176	1	18	
CS	<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree	43678.131	27489.913	0.4	6	
CS	<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree	43720.701	27446.51	0.2	7	Suitable for salvaging
CS	<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree	43739.83	27467.321	0.4	6	
CS	<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree	43736.623	27524.184	0.2	5	Suitable for salvaging
CS	<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree	43737.726	27530.974	<0.05	1	Suitable for salvaging
CS	<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree	43718.606	27563.025	0.05	1.5	Suitable for salvaging
CS	<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree	43681.755	27489.018	0.3	6	Suitable for salvaging
CS	<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree	43677.299	27476.503	0.3	8	Suitable for salvaging
CS	<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree	43690.104	27476.336	0.3	7	Suitable for salvaging
CS	<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree	43689.242	27483.38	0.4	10	
CS	<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree	43686.4	27476.3	0.3	8	Suitable for salvaging
CS	<i>Symplocos fasciculata</i>	Symplocaceae	Native	Vulnerable	Tree	43748.378	27521.981	1.1	12	
CS	<i>Xanthophyllum flavescens</i>	Polygalaceae	Native	Endangered	Tree	43706.77	27518.848	0.5	0.5	

Appendix 5C. Large Plant Specimens

Tag ID	Species	Family	Origin	Status	Habit	Northing	Easting	Northing (Additional Point 1)	Easting (Additional Point 1)	Northing (Additional Point 2)	Easting (Additional Point 2)	Girth/Spread (m)	Height (m)
CTP6851	<i>Anacardium occidentale</i>	Anacardiaceae	Exotic	Casual	Tree	43709.165	27320.615	-	-	-	-	3	10
CTP6853	<i>Baccaurea motleyana</i>	Phyllanthaceae	Native	Critically Endangered	Tree	43713.328	27324.757	-	-	-	-	3	10
CTP6884	<i>Durio zibelthinus</i>	Malvaceae	Exotic	Casual	Tree	43763.011	27195.604	-	-	-	-	3	15
SU0844	<i>Durio zibelthinus</i>	Malvaceae	Exotic	Casual	Tree	43645.08	27513.939	-	-	-	-	3.2	30
SU0562	<i>Durio zibelthinus</i>	Malvaceae	Exotic	Casual	Tree	43672.126	27443.208	-	-	-	-	6	25
CTP6690	<i>Ficus benjamina</i>	Moraceae	Cryptogenic	-	Strangler	43797.564	27056.873	-	-	-	-	3.8	18
CTP6830	<i>Ficus benjamina</i>	Moraceae	Cryptogenic	-	Strangler	43700.286	27256.552	-	-	-	-	3	20
CTP6683, CTP6683A, CTP6683B	<i>Ficus benjamina</i>	Moraceae	Cryptogenic	-	Strangler	43794.805	27095.848	43794.511	27089.252	43800.507	27088.877	7	20
CTP6826, CTP6826A	<i>Ficus benjamina</i>	Moraceae	Cryptogenic	-	Strangler	43701.768	27293.574	43706.854	27294.123	-	-	5	18
CTP6827, CTP6827A	<i>Ficus microcarpa</i>	Moraceae	Native	Least concern	Strangler	43713.5	27286.97	43715.319	27291.045	-	-	4	a
SU0991, SU0991A, SU0991B	<i>Ficus microcarpa</i>	Moraceae	Native	Least concern	Strangler	43601.888	27431.807	43604.21	27428.013	43604.273	27438.724	20	20
SU0498	<i>Hevea brasiliensis</i>	Euphorbiaceae	Exotic	Naturalised	Tree	43651.036	27349.332	-	-	-	-	3	18
SU0548	<i>Hevea brasiliensis</i>	Euphorbiaceae	Exotic	Naturalised	Tree	43636.796	27365.538	-	-	-	-	3.2	18
CTP6812	<i>Sandoricum koelapae</i>	Meliaceae	Native	Vulnerable	Tree	43645.822	27363.385	-	-	-	-	3.4	15

Appendix 5D. Other Specimens of Value

Appendix 5D- List of Other Specimens of Value

Type of Specimen	ID	Species	Family	Origin	Status	Northing	Easting	Girth/Spread (m)	Height (m)
Keystone	CTP6730	<i>Ficus benjamina</i>	Moraceae	Cryptogenic	-	43730.934	27347.616	1	10
Keystone	SU0920	<i>Ficus variegata</i>	Moraceae	Native	Least concern	43744.056	27603.661	1.8	15

Appendix 5E. Faunal Survey Data

Date DD-MMM- YYYY	Cycle	Sampling method	Transect	Waypoint (E.g., ZH 1349)	Latitude	Longitude	Time (HH:MM)	Scientific name	Common name	Taxon	Global status	National status	Quantity	Observation type	Survey method
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1325	1.413784996	103.82916	7:00 AM	Pycnonotus zeylanicus	Straw-headed bulbul	Bird	Critically Endangered	Endangered	1	Heard	Incidental
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1326	1.410545977	103.82885	7:10 AM	Eudynamis scolopaceus	Asian koel	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1326	1.410545977	103.82885	7:10 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1326	1.410545977	103.82885	7:10 AM	Dinopium javanense	Common flameback	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1328	1.410988038	103.82891	7:15 AM	Garrulax leucolophus	White-crested laughingthrush	Bird	Least Concern	NA	5	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1327	1.410861975	103.82893	7:13 AM	Acridotheres javanicus	Javan myna	Bird	Vulnerable	NA	2	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1327	1.410861975	103.82893	7:13 AM	Loriculus galgulus	Blue-crowned hanging-parrot	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1328	1.410988038	103.82891	7:15 AM	Callosclurus notatus	Plantain squirrel	Mammal	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1329	1.411048975	103.82919	7:18 AM	Oriolus chinensis	Black-naped oriole	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1329	1.411048975	103.82919	7:18 AM	Dicaeum cruentatum	Scarlet-backed flowerpecker	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1329	1.411048975	103.82919	7:18 AM	Psilopogon lineatus	Lineated barbet	Bird	Least Concern	NA	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1330	1.411416018	103.82928	7:21 AM	Pycnonotus zeylanicus	Straw-headed bulbul	Bird	Critically Endangered	Endangered	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1331	1.411679965	103.82864	7:26 AM	Dicrurus paradiseus	Greater racket-tailed drongo	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1331	1.411679965	103.82864	7:26 AM	Psilopogon lineatus	Lineated barbet	Bird	Least Concern	NA	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1331	1.411679965	103.82864	7:26 AM	Garrulax leucolophus	White-crested laughingthrush	Bird	Least Concern	NA	3	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1332	1.411807034	103.82841	7:30 AM	Eudynamis scolopaceus	Asian koel	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1332	1.411807034	103.82841	7:30 AM	gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1333	1.411748026	103.82832	7:32 AM	Psittacula alexandri	Red-breasted parakeet	Bird	Near Threatened	NA	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1333	1.411748026	103.82832	7:32 AM	Mixornis gularis	Pin-striped tit-babbler	Bird	Least Concern	Least Concern	3	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1334	1.411548033	103.82818	7:33 AM	Sylvana guentheri	Guenther's frog	Amphibian	Least Concern	NA	2	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1335	1.411175039	103.82792	7:36 AM	Helopsates certhiola	Pallas's grasshopper warbler	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1335	1.411175039	103.82792	7:36 AM	Treron vernans	Pink-necked green pigeon	Bird	Least Concern	Least Concern	1	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1335	1.411175039	103.82792	7:36 AM	Acridotheres tristis	Common myna	Bird	Least Concern	Least Concern	2	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1335	1.411175039	103.82792	7:36 AM	Dicaeum cruentatum	Scarlet-backed flowerpecker	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1336	1.411069008	103.82755	7:39 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	1	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1336	1.411069008	103.82755	7:39 AM	Pycnonotus plumosus	Olive-winged bulbul	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1337	1.411122987	103.82747	7:40 AM	Spilopelia chinensis	Spotted dove	Bird	Least Concern	Least Concern	12	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1337	1.411122987	103.82747	7:40 AM	Treron vernans	Pink-necked green pigeon	Bird	Least Concern	Least Concern	4	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1337	1.411122987	103.82747	7:40 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	3	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1337	1.411122987	103.82747	7:40 AM	Acridotheres javanicus	Javan myna	Bird	Vulnerable	NA	1	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1337	1.411122987	103.82747	7:40 AM	Zosterops simplex	Swinhoe's white-eye	Bird	Least Concern	Vulnerable	3	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1337	1.411122987	103.82747	7:40 AM	Psilopogon lineatus	Lineated barbet	Bird	Least Concern	NA	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1338	1.411272017	103.82705	7:43 AM	Anthraccoceros albostriatus	Oriental pied hornbill	Bird	Least Concern	Near Threatened	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1338	1.411272017	103.82705	7:43 AM	Muscicapa dauarica	Asian brown flycatcher	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1338	1.411272017	103.82705	7:43 AM	Acridotheres javanicus	Javan myna	Bird	Vulnerable	NA	3	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1338	1.411272017	103.82705	7:43 AM	Cinnyris ornatus	Ornate sunbird	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1339	1.411388023	103.82697	7:44 AM	Dinopium javanense	Common flameback	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1340	1.411647024	103.82675	7:46 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	5	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1340	1.411647024	103.82675	7:46 AM	Psilopogon lineatus	Lineated barbet	Bird	Least Concern	NA	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1340	1.411647024	103.82675	7:46 AM	Pycnonotus zeylanicus	Straw-headed bulbul	Bird	Critically Endangered	Endangered	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1341	1.411701003	103.82641	7:48 AM	Dicaeum cruentatum	Scarlet-backed flowerpecker	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1341	1.411701003	103.82641	7:48 AM	Pericrocotus divaricatus	Ashy minivet	Bird	Least Concern	Least Concern	3	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1341	1.411701003	103.82641	7:48 AM	NA	NA	Bird	NA	NA	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1342	1.411853973	103.82617	7:49 AM	Mixornis gularis	Pin-striped tit-babbler	Bird	Least Concern	Least Concern	3	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1342	1.411853973	103.82617	7:49 AM	Orthotomus sutorius	Common tailorbird	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1342	1.411853973	103.82617	7:49 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	15	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1343	1.411917005	103.82608	7:49 AM	draco sumatranus	Sumatran flying dragon	Reptile	Least Concern	Least Concern	1	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1343	1.411917005	103.82608	7:49 AM	Oriolus chinensis	Black-naped oriole	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1343	1.411917005	103.82608	7:49 AM	Zosterops simplex	Swinhoe's white-eye	Bird	Least Concern	Vulnerable	3	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1343	1.411917005	103.82608	7:49 AM	Eudynamis scolopaceus	Asian koel	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1343	1.411917005	103.82608	7:49 AM	Spilopelia chinensis	Spotted dove	Bird	Least Concern	Least Concern	2	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1343	1.411917005	103.82608	7:49 AM	Orthotomus sutorius	Common tailorbird	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1344	1.412114985	103.82592	7:52 AM	Treron vernans	Pink-necked green pigeon	Bird	Least Concern	Least Concern	6	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1344	1.412114985	103.82592	7:52 AM	Todiramphus chloris	Collared kingfisher	Bird	Least Concern	Least Concern	2	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1344	1.412114985	103.82592	7:52 AM	Eurystomus orientalis	Oriental dollarbird	Bird	Least Concern	Least Concern	1	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1344	1.412114985	103.82592	7:52 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	10	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1344	1.412114985	103.82592	7:52 AM	Psittacula alexandri	Red-breasted parakeet	Bird	Near Threatened	NA	1	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1344	1.412114985	103.82592	7:52 AM	Pycnonotus olivaceus	Yellow-vented bulbul	Bird	Least Concern	Least Concern	2	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1345	1.412235014	103.82566	7:54 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	40	Seen	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1345	1.412235014	103.82566	7:54 AM	Psilopogon lineatus	Lineated barbet	Bird	Least Concern	NA	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1345	1.412235014	103.82566	7:54 AM	gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1345	1.412235014	103.82566	7:54 AM	Cinnyris ornatus	Ornate sunbird	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1345	1.412235014	103.82566	7:54 AM	Aegithina tiphia	Common iora	Bird	Least Concern	Least Concern	1	Heard	Targeted
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1345	1.412235014	103.82566	7:54 AM	Oriolus chinensis	Black-naped oriole	Bird	Least Concern	Least Concern	1	Seen	Targeted

Date DD-MMM- YYYY	Cycle	Sampling method	Transect	Waypoint (E.g., ZH 1349)	Latitude	Longitude	Time (HH:MM)	Scientific name	Common name	Taxon	Global status	National status	Quantity	Observation type	Survey method
26 Nov 2024	1	Terrestrial transect	AM BHM	AH1346	1.412512036	103.82495	7:57 AM	<i>Callosciurus notatus</i>	Plantain squirrel	Mammal	Least Concern	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1371	1.41070297	103.82899	9:19 AM	<i>ropalidia sumatrae</i>	NA	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1371	1.41070297	103.82899	9:19 AM	<i>Xylocopa latipes</i>	Broad-handed carpenter bee	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1371	1.41070297	103.82899	9:19 AM	<i>Delias hyparete metarete</i>	Painted jezebel	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1373	1.411649035	103.82839	9:51 AM	<i>Varanus nebulosus</i>	Clouded monitor	Reptile	Not Listed	Least Concern	1	Seen	Incidental
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>polytrems lubricans lubricans</i>	Contiguous swift	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>calesis mineus macromalaya</i>	Dark brand bush brown	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>calesis mineus macromalaya</i>	Dark brand bush brown	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>ropalidia sumatrae</i>	NA	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>Allorhynchium argentatum</i>	NA	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>Ceratina unimaculata</i>	NA	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>apis cerana</i>	Eastern honey bee	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>apis florea</i>	NA	Aculeata	Not Listed	NA	TMTC	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>ropalidia stigma</i>	NA	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>Junonia hedonia ida</i>	Chocolate pansy	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>vespa affinis</i>	Lesser banded hornet	Aculeata	Not Listed	Least Concern	2	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>Rhyothemis phyllis</i>	Yellow-barred flutterer	Odonata	Least Concern	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>Pycnonotus plumosus</i>	Olive-winged bulbul	Bird	Least Concern	Least Concern	1	Seen	Incidental
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>Amaurornis phoenicurus</i>	White-breasted waterhen	Bird	Least Concern	Least Concern	1	Seen	Incidental
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>Garrulax leucolophus</i>	White-crested laughingthrush	Bird	Least Concern	NA	6	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>Crocothemis servilia</i>	Common scarlet	Odonata	Least Concern	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>Taractrocera archias quinta</i>	Yellow grass dart	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1375	1.411239998	103.8279	9:56 AM	<i>Delias hyparete metarete</i>	Painted jezebel	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1376	1.411280986	103.82791	9:57 AM	<i>Delias hyparete metarete</i>	Painted jezebel	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1377	1.41111603	103.82787	10:13 AM	<i>Applias olferna olferna</i>	Striped albatross	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1378	1.41109298	103.82736	10:17 AM	<i>Euthalia aconthea gorda</i>	Baron	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1378	1.41109298	103.82736	10:17 AM	<i>Taractrocera archias quinta</i>	Yellow grass dart	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Dryas iulia</i>	Julia heliconian	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Pantala flavescens</i>	Wandering glider	Odonata	Least Concern	Least Concern	5	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Rhyothemis phyllis</i>	Yellow-barred flutterer	Odonata	Least Concern	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Megachile disjuncta</i>	NA	Aculeata	Not Listed	NA	4	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>megachile laticeps</i>	NA	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>vespa affinis</i>	Lesser banded hornet	Aculeata	Not Listed	Least Concern	2	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Taractrocera archias quinta</i>	Yellow grass dart	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Junonia hedonia ida</i>	Chocolate pansy	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Trithemis pallidinervis</i>	Dancing drowping	Odonata	Least Concern	Least Concern	2	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Crocothemis servilia</i>	Common scarlet	Odonata	Least Concern	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Junonia hedonia ida</i>	Chocolate pansy	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Junonia almana javana</i>	Peacock pansy	Butterfly	Least Concern	Least Concern	3	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>ceratina nigrolateralis</i>	NA	Aculeata	Not Listed	Least Concern	4	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>heriades othonis</i>	NA	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Papilio polytes romulus</i>	Common mormon	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>calesis mineus macromalaya</i>	Dark brand bush brown	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>apis cerana</i>	Eastern honey bee	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Borbo cinnara</i>	Formosan swift	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>lambrix salsala salsala</i>	Chestnut bob	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Taractrocera archias quinta</i>	Yellow grass dart	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1379	1.411073031	103.82742	10:18 AM	<i>Oriens gola pseudolus</i>	Common dartlet	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1380	1.411275035	103.82743	10:21 AM	<i>Applias olferna olferna</i>	Striped albatross	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1380	1.411275035	103.82743	10:21 AM	<i>Mycalasis sp.</i>	NA	Butterfly	NA	NA	2	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1381	1.411243016	103.82739	10:38 AM	<i>Rhyothemis phyllis</i>	Yellow-barred flutterer	Odonata	Least Concern	Least Concern	2	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1381	1.411243016	103.82739	10:38 AM	<i>Telictota colon stinga</i>	Common palm dart	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1381	1.411243016	103.82739	10:38 AM	<i>Pantala flavescens</i>	Wandering glider	Odonata	Least Concern	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1381	1.411243016	103.82739	10:38 AM	<i>Apodynerus troglodytes</i>	NA	Aculeata	Not Listed	Not Evaluated	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1381	1.411243016	103.82739	10:38 AM	<i>Epsilon sp.</i>	NA	Aculeata	NA	NA	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1382	1.411235975	103.82709	10:41 AM	<i>ropalidia stigma</i>	NA	Aculeata	Not Listed	Least Concern	2	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1382	1.411235975	103.82709	10:41 AM	<i>Junonia hedonia ida</i>	Chocolate pansy	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1382	1.411235975	103.82709	10:41 AM	<i>calesis mineus macromalaya</i>	Dark brand bush brown	Butterfly	Not Listed	Least Concern	2	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1382	1.411235975	103.82709	10:41 AM	<i>Arhopala major major</i>	NA	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1382	1.411235975	103.82709	10:41 AM	<i>hopala amphimuta amphimu</i>	NA	Butterfly	Not Listed	Near threatened	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1383	1.411296995	103.827	10:45 AM	<i>nomia strigata</i>	Pearly-banded bee	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1383	1.411296995	103.827	10:45 AM	<i>Stenodyneriellus guttulatus</i>	NA	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1384	1.411389029	103.82697	10:51 AM	<i>lambrix salsala salsala</i>	Chestnut bob	Butterfly	Not Listed	Least Concern	2	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1385	1.411434039	103.82668	10:55 AM	<i>Rhyothemis phyllis</i>	Yellow-barred flutterer	Odonata	Least Concern	Least Concern	3	Seen	Targeted

Date DD-MMM- YYYY	Cycle	Sampling method	Transect	Waypoint (E.g., ZH 1349)	Latitude	Longitude	Time (HH:MM)	Scientific name	Common name	Taxon	Global status	National status	Quantity	Observation type	Survey method
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1385	1.411434039	103.82668	10:55 AM	Junonia hedonia ida	Chocolate pansy	Butterfly	Not Listed	Least Concern	2	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1385	1.411434039	103.82668	10:55 AM	Pantala flavescens	Wandering glider	Odonata	Least Concern	Least Concern	2	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1385	1.411434039	103.82668	10:55 AM	Mycalasis sp.	NA	Butterfly	NA	NA	2	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1385	1.411434039	103.82668	10:55 AM	Potanthus omaha omaha	Lesser dart	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1385	1.411434039	103.82668	10:55 AM	lambrix salsala salsala	Chestnut bob	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1385	1.411434039	103.82668	10:55 AM	Appias olferna olferna	Striped abbatross	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1386	1.411722964	103.82625	10:56 AM	Crocothemis servilia	Common scarlet	Odonata	Least Concern	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1386	1.411722964	103.82625	10:56 AM	calesis mineus macromalaya	Dark brand bush brown	Butterfly	Not Listed	Least Concern	4	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1386	1.411722964	103.82625	10:56 AM	Junonia hedonia ida	Chocolate pansy	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1386	1.411722964	103.82625	10:56 AM	Junonia almana javana	Peacock pansy	Butterfly	Least Concern	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1386	1.411722964	103.82625	10:56 AM	Potanthus omaha omaha	Lesser dart	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1386	1.411722964	103.82625	10:56 AM	Unidentified Lycaenidae	NA	Butterfly	NA	NA	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1386	1.411722964	103.82625	10:56 AM	parapolybia varia	Lesser paper wasp	Aculeata	Not Listed	Near Threatened	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1387	1.411721036	103.82629	11:14 AM	Zizula hylax pygmaea	Pygmy grass blue	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1387	1.411721036	103.82629	11:14 AM	Taractroceras archias quinta	Yellow grass dart	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1388	1.411971199	103.82615	11:18 AM	Dendrelaphis pictus	Painted bronzeback	Reptile	Least Concern	Least Concern	1	Seen	Incidental
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1388	1.411971199	103.82615	11:18 AM	Junonia hedonia ida	Chocolate pansy	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1389	1.411990011	103.82601	11:20 AM	Oriens paragola	Malay dartlet	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1389	1.411990011	103.82601	11:20 AM	ropalidia sumatrae	NA	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1389	1.411990011	103.82601	11:20 AM	Mycalasis perseus cepheus	Dingy bush brown	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1389	1.411990011	103.82601	11:20 AM	lambrix salsala salsala	Chestnut bob	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1389	1.411990011	103.82601	11:20 AM	Zizeeria maha serica	Pale grass blue	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1390	1.412225962	103.82549	11:21 AM	Junonia hedonia ida	Chocolate pansy	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1390	1.412225962	103.82549	11:21 AM	Zizeeria maha serica	Pale grass blue	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
1 Dec 2024	1	Terrestrial transect	AM OBB	AH1392	1.410712022	103.82817	11:41 AM	Unidentified Aeshnidae	NA	Odonata	NA	NA	1	Seen	Targeted
16 Dec 2024	1	Terrestrial transect	PM BHM	VL1992	1.413274035	103.83079	7:26 PM	Fejervarya limnocharis	Field frog	Amphibian	Least Concern	Least Concern	1	Heard	Incidental
16 Dec 2024	1	Terrestrial transect	PM BHM	VL1993	1.413164986	103.83096	7:27 PM	Ardea cinerea	Grey heron	Bird	Least Concern	Least Concern	2	Heard	Incidental
16 Dec 2024	1	Terrestrial transect	PM BHM	VL1994	1.411089962	103.82887	7:36 PM	Microhyla heymonsi	Dark-sided chorus frog	Amphibian	Least Concern	Least Concern	1	Seen	Targeted
16 Dec 2024	1	Terrestrial transect	PM BHM	VL1994	1.411089962	103.82887	7:36 PM	Eleutherodactylus planirostris	Greenhouse frog	Amphibian	Least Concern	NA	1	Seen	Targeted
16 Dec 2024	1	Terrestrial transect	PM BHM	VL1995	1.411000025	103.829	7:40 PM	Eleutherodactylus planirostris	Greenhouse frog	Amphibian	Least Concern	NA	2	Seen	Targeted
16 Dec 2024	1	Terrestrial transect	PM BHM	VL1996	1.410974963	103.82919	7:43 PM	Polypedates leucomystax	Four-lined tree frog	Amphibian	Least Concern	Least Concern	1	Seen	Targeted
16 Dec 2024	1	Terrestrial transect	PM BHM	VL1996	1.410974963	103.82919	7:43 PM	Malayopython reticulatus	Reticulated python	Reptile	Least Concern	Least Concern	1	Seen	Targeted
16 Dec 2024	1	Terrestrial transect	PM BHM	VL1997	1.411457006	103.82832	7:56 PM	Polypedates leucomystax	Four-lined tree frog	Amphibian	Least Concern	Least Concern	1	Heard	Targeted
16 Dec 2024	1	Terrestrial transect	PM BHM	VL1997	1.411457006	103.82832	7:56 PM	Eleutherodactylus planirostris	Greenhouse frog	Amphibian	Least Concern	NA	1	Seen	Targeted
16 Dec 2024	1	Terrestrial transect	PM BHM	VL1998	1.411129022	103.82802	8:04 PM	Kaloula pulchra	Banded bull frog	Amphibian	Least Concern	NA	1	Seen	Targeted
16 Dec 2024	1	Terrestrial transect	PM BHM	VL1999	1.411037995	103.82807	8:09 PM	Duttaphrynus bengalensis	Bengal toad	Amphibian	Not Listed	NA	1	Seen	Targeted
16 Dec 2024	1	Terrestrial transect	PM BHM	VL2001	1.410745969	103.82816	8:11 PM	Limnonectes blythii	Malayan giant frog	Amphibian	Least Concern	Least Concern	1	Seen	Incidental
16 Dec 2024	1	Terrestrial transect	PM BHM	VL2002	1.410734989	103.82811	8:11 PM	Microhyla heymonsi	Dark-sided chorus frog	Amphibian	Least Concern	Least Concern	1	Seen	Incidental
16 Dec 2024	1	Terrestrial transect	PM BHM	VL2002	1.410734989	103.82811	8:11 PM	Limnonectes blythii	Malayan giant frog	Amphibian	Least Concern	Least Concern	50	Seen	Incidental
16 Dec 2024	1	Terrestrial transect	PM BHM	VL2003	1.410720991	103.82815	8:12 PM	Limnonectes blythii	Malayan giant frog	Amphibian	Least Concern	Least Concern	1	Seen	Incidental
16 Dec 2024	1	Terrestrial transect	PM BHM	VL2004	1.410715962	103.82822	8:13 PM	Cynopterus brachyotis	Lesser short-nosed fruit bat	Mammal	Least Concern	Least Concern	1	Seen	Incidental
16 Dec 2024	1	Terrestrial transect	PM BHM	VL2005	1.411508974	103.82678	8:26 PM	Ahaetulla prasina	Oriental whip snake	Reptile	Least Concern	Least Concern	1	Seen	Incidental
17 Dec 2024	NA	Terrestrial transect	NA	VL2007	1.411226	103.82845	12:31 PM	Macaca fascicularis	Long-tailed macaque	Mammal	Endangered	Least Concern	1	Seen	Incidental
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2092	1.412397036	103.82514	7:56 AM	rapala sp.	NA	Butterfly	NA	NA	1	Seen	Incidental
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2093	1.412437018	103.82518	7:56 AM	Treron vernans	Pink-necked green pigeon	Bird	Least Concern	Least Concern	8	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Orthotomus atrogularis	Dark-necked tailorbird	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Orthotomus atrogularis	Common tailorbird	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Dinopium javanense	Common flameback	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Ardea sp.	NA	Bird	NA	NA	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Pycnonotus goiavier	Yellow-vented bulbul	Bird	Least Concern	Least Concern	2	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	2	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Aethopyga siparaja	Crimson sunbird	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Dicaeum cruentatum	Scarlet-backed flowerpecker	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Cinnyris ornatus	Ornate sunbird	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Pycnonotus zeylanicus	Straw-headed bulbul	Bird	Critically Endangered	Endangered	2	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Todiramphus chloris	Collared kingfisher	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Pycnonotus goiavier	Yellow-vented bulbul	Bird	Least Concern	Least Concern	4	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Aegithina tiphia	Common iora	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Callosciurus notatus	Plantain squirrel	Mammal	Least Concern	Least Concern	2	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	Acridotheres javanicus	Javan myna	Bird	Vulnerable	NA	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2094	1.41245001	103.82517	7:57 AM	unidentified Psittaciformes	NA	Bird	NA	NA	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2096	1.412473982	103.8253	8:02 AM	Muscicapaa daurica	Asian brown flycatcher	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2096	1.412473982	103.8253	8:02 AM	Todiramphus chloris	Collared kingfisher	Bird	Least Concern	Least Concern	1	Heard	Targeted

Date DD-MMM- YYYY	Cycle	Sampling method	Transect	Waypoint (E.g., ZH 1349)	Latitude	Longitude	Time (HH:MM)	Scientific name	Common name	Taxon	Global status	National status	Quantity	Observation type	Survey method
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2096	1.412473982	103.8253	8:02 AM	Aerodramus sp.	NA	Bird	NA	NA	3	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2096	1.412473982	103.8253	8:02 AM	Psilopogon lineatus	Lineated barbet	Bird	Least Concern	NA	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2097	1.41256501	103.82541	8:04 AM	Dendrocoryna javanica	Lesser whistling duck	Bird	Least Concern	Endangered	3	Seen	Incidental
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2097	1.41256501	103.82541	8:04 AM	Psittacula alexandri	Red-breasted parakeet	Bird	Near Threatened	NA	4	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2098	1.412556963	103.82539	8:07 AM	Oriolus chinensis	Black-naped oriole	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2098	1.412556963	103.82539	8:07 AM	Prosotas dubiosa lumpura	Tailless line blue	Butterfly	Not Listed	Least Concern	1	Seen	Incidental
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2099	1.412482029	103.82511	8:11 AM	Pycnonotus zeylanicus	Straw-headed bulbul	Bird	Critically Endangered	Endangered	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2099	1.412482029	103.82511	8:11 AM	Aegithina tiphia	Common lora	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2099	1.412482029	103.82511	8:11 AM	Mixornis gularis	Pin-striped tit-babbler	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2099	1.412482029	103.82511	8:11 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	5	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2099	1.412482029	103.82511	8:11 AM	Pycnonotus goiavier	Yellow-vented bulbul	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2100	1.412332999	103.82538	8:15 AM	Eudynamis scolopaceus	Asian koel	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2100	1.412332999	103.82538	8:15 AM	Loriculus galgulus	Blue-crowned hanging-parrot	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2100	1.412332999	103.82538	8:15 AM	Eudynamis scolopaceus	Asian koel	Bird	Least Concern	Least Concern	2	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2100	1.412332999	103.82538	8:15 AM	Spilopelia chinensis	Spotted dove	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2100	1.412332999	103.82538	8:15 AM	Treron vernans	Pink-necked green pigeon	Bird	Least Concern	Least Concern	2	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2101	1.412179023	103.82557	8:19 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	2	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2102	1.412166031	103.82563	8:19 AM	Psittacula krameri	Rose-ringed parakeet	Bird	Least Concern	NA	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2102	1.412166031	103.82563	8:19 AM	Oriolus chinensis	Black-naped oriole	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2103	1.412085984	103.82583	8:21 AM	Todiramphus chloris	Collared kingfisher	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2103	1.412085984	103.82583	8:21 AM	Treron vernans	Pink-necked green pigeon	Bird	Least Concern	Least Concern	3	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2103	1.412085984	103.82583	8:21 AM	Trichoglossus haematodus	Coconut lorikeet	Bird	Least Concern	NA	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2103	1.412085984	103.82583	8:21 AM	Pycnonotus goiavier	Yellow-vented bulbul	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2104	1.412036028	103.82588	8:22 AM	Pycnonotus zeylanicus	Straw-headed bulbul	Bird	Critically Endangered	Endangered	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2105	1.411941983	103.82609	8:23 AM	Loriculus galgulus	Blue-crowned hanging-parrot	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2105	1.411941983	103.82609	8:23 AM	Treron vernans	Pink-necked green pigeon	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2106	1.411931003	103.82612	8:24 AM	Merops philippinus	Blue-tailed bee-eater	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2108	1.411678037	103.82646	8:26 AM	Acridotheres javanicus	Javan myna	Bird	Vulnerable	NA	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2108	1.411678037	103.82646	8:26 AM	Dicaeum cruentatum	Scarlet-backed flowerpecker	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2109	1.411537975	103.82658	8:27 AM	Todiramphus chloris	Collared kingfisher	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2110	1.411491036	103.82679	8:30 AM	Papilio clytia clytia	Common mime	Butterfly	Not Listed	Least Concern	6	Seen	Incidental
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2110	1.411491036	103.82679	8:30 AM	Pycnonotus jocosus	Red-whiskered bulbul	Bird	Least Concern	NA	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2110	1.411491036	103.82679	8:30 AM	Zosterops simplex	Swinhoe's white-eye	Bird	Least Concern	Vulnerable	3	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2110	1.411491036	103.82679	8:30 AM	Pycnonotus goiavier	Yellow-vented bulbul	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2111	1.411402021	103.82693	8:36 AM	Orthotomus sutorius	Common tailorbird	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2111	1.411402021	103.82693	8:36 AM	Phylloscopus borealis	Arctic warbler	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2111	1.411402021	103.82693	8:36 AM	Psilopogon lineatus	Lineated barbet	Bird	Least Concern	NA	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2112	1.411299007	103.82698	8:42 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2113	1.411345024	103.82712	8:43 AM	Arhopala sp.	NA	Butterfly	NA	NA	1	Seen	Incidental
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2114	1.411206974	103.82727	8:45 AM	Arhopala sp.	NA	Butterfly	NA	NA	1	Seen	Incidental
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2114	1.411206974	103.82727	8:45 AM	Pycnonotus goiavier	Yellow-vented bulbul	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2113	1.411345024	103.82712	8:43 AM	Xylocopa latipes	Broad-handed carpenter bee	Aculeata	Not Listed	Least Concern	1	Seen	Incidental
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2114	1.411206974	103.82727	8:45 AM	Zosterops simplex	Swinhoe's white-eye	Bird	Least Concern	Vulnerable	2	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2114	1.411206974	103.82727	8:45 AM	Treron vernans	Pink-necked green pigeon	Bird	Least Concern	Least Concern	2	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2115	1.41119197	103.82729	8:46 AM	Collocalia affinis	Plume-toed swiftlet	Bird	Least Concern	Vulnerable	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2116	1.411209991	103.82728	8:47 AM	Aerodramus sp.	NA	Bird	NA	NA	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2117	1.411206974	103.82742	8:48 AM	Treron vernans	Pink-necked green pigeon	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2117	1.411206974	103.82742	8:48 AM	Acridotheres javanicus	Javan myna	Bird	Vulnerable	NA	4	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2117	1.411206974	103.82742	8:48 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2118	1.41121896	103.82743	8:48 AM	hirundo tahitica	Pacific swallow	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2118	1.41121896	103.82743	8:48 AM	Acridotheres javanicus	Javan myna	Bird	Vulnerable	NA	2	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2119	1.411218038	103.82742	8:48 AM	Dicaeum cruentatum	Scarlet-backed flowerpecker	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2120	1.411362039	103.82749	8:52 AM	Aethopyga siparaja	Crimson sunbird	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2121	1.41100497	103.82765	8:57 AM	Merops viridis	Blue-throated bee-eater	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2121	1.41100497	103.82765	8:57 AM	Psittacula alexandri	Red-breasted parakeet	Bird	Near Threatened	NA	4	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2121	1.41100497	103.82765	8:57 AM	Corvus splendens	House crow	Bird	Least Concern	NA	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2121	1.41100497	103.82765	8:57 AM	Psittacula longicauda	Long-tailed parakeet	Bird	Vulnerable	Near Threatened	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2121	1.41100497	103.82765	8:57 AM	Ardea intermedia	Medium egret	Bird	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2121	1.41100497	103.82765	8:57 AM	Anthreptes malacensis	Brown-throated sunbird	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2121	1.41100497	103.82765	8:57 AM	Eudynamis scolopaceus	Asian koel	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2122	1.411173027	103.82786	9:05 AM	Garulax leucophus	White-crested laughingthrush	Bird	Least Concern	NA	3	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2121	1.41100497	103.82765	8:57 AM	Aplonis panayensis	Asian glossy starling	Bird	Least Concern	Least Concern	6	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2121	1.41100497	103.82765	8:57 AM	Pycnonotus goiavier	Yellow-vented bulbul	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2121	1.41100497	103.82765	8:57 AM	Muscicapa dauurica	Asian brown flycatcher	Bird	Least Concern	Least Concern	1	Seen	Targeted

Date DD-MMM- YYYY	Cycle	Sampling method	Transect	Waypoint (E.g., ZH 1349)	Latitude	Longitude	Time (HH:MM)	Scientific name	Common name	Taxon	Global status	National status	Quantity	Observation type	Survey method
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2122	1.411173027	103.82786	9:05 AM	<i>Pycnonotus goiavier</i>	Yellow-vented bulbul	Bird	Least Concern	Least Concern	2	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2122	1.411173027	103.82786	9:05 AM	<i>Bronchocela cristatella</i>	Green crested lizard	Reptile	Least Concern	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2123	1.411365978	103.82788	9:08 AM	<i>Pycnonotus zeylanicus</i>	Straw-headed bulbul	Bird	Critically Endangered	Endangered	2	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2124	1.411361033	103.82792	9:09 AM	<i>Sylvirana guentheri</i>	Guenther's frog	Amphibian	Least Concern	NA	2	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2125	1.41127998	103.82802	9:12 AM	<i>Psilopogon lineatus</i>	Lineated barbet	Bird	Least Concern	NA	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2125	1.41127998	103.82802	9:12 AM	<i>Pycnonotus plumosus</i>	Olive-winged bulbul	Bird	Least Concern	Least Concern	2	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2126	1.411529006	103.8282	9:16 AM	<i>Pycnonotus goiavier</i>	Yellow-vented bulbul	Bird	Least Concern	Least Concern	1	Seen	Incidental
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2126	1.411529006	103.8282	9:16 AM	<i>Tanaecia lapolis puseda</i>	Horsfield's baron	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2126	1.411529006	103.8282	9:16 AM	<i>Garrulax leucolophus</i>	White-crested laughingthrush	Bird	Least Concern	NA	4	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2127	1.411572006	103.82845	9:19 AM	<i>Tupaia glis</i>	Common treeshrew	Mammal	Least Concern	Least Concern	2	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2127	1.411572006	103.82845	9:19 AM	<i>Dicaeum cruentatum</i>	Scarlet-backed flowerpecker	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2128	1.411626991	103.82905	9:23 AM	<i>Oriolus chinensis</i>	Black-naped oriole	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2130	1.41135701	103.82931	9:26 AM	<i>Dicaeum cruentatum</i>	Scarlet-backed flowerpecker	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2130	1.41135701	103.82931	9:26 AM	<i>Eudynamis scolopaceus</i>	Asian koel	Bird	Least Concern	Least Concern	2	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2130	1.41135701	103.82931	9:26 AM	<i>Pycnonotus plumosus</i>	Olive-winged bulbul	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2132	1.411061967	103.8292	9:29 AM	<i>Oriolus chinensis</i>	Black-naped oriole	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2133	1.411003964	103.82924	9:30 AM	<i>Garrulax leucolophus</i>	White-crested laughingthrush	Bird	Least Concern	NA	3	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2134	1.410783017	103.82886	9:36 AM	<i>Ahopala sp.</i>	NA	Butterfly	NA	NA	1	Seen	Incidental
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2134	1.410783017	103.82886	9:36 AM	<i>Eudynamis scolopaceus</i>	Asian koel	Bird	Least Concern	Least Concern	1	Heard	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2135	1.410681009	103.82884	9:38 AM	<i>Macaca fascicularis</i>	Long-tailed macaque	Mammal	Endangered	Least Concern	2	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2136	1.41053902	103.82826	9:43 AM	<i>Gallus gallus</i>	Red junglefowl	Bird	Least Concern	Near Threatened	2	Seen	Targeted
7 Jan 2025	2	Terrestrial transect	AM BHM	VL2137	1.410728032	103.82807	9:48 AM	<i>Tanaecia lapolis puseda</i>	Horsfield's baron	Butterfly	Not Listed	Least Concern	1	Seen	Incidental
6 Jan 2025	2	Terrestrial transect	PM BHM	JK_0073	1.41219696	103.82577	7:36 PM	<i>Caprimulgus affinis</i>	Savanna nightjar	Bird	Least Concern	Least Concern	2	Seen	Incidental
6 Jan 2025	2	Terrestrial transect	PM BHM	JK_0073	1.41219696	103.82577	7:36 PM	<i>Caprimulgus macrurus</i>	Large-tailed nightjar	Bird	Least Concern	Least Concern	1	Seen	Incidental
6 Jan 2025	2	Terrestrial transect	PM BHM	JK_0073	1.41219696	103.82577	7:36 PM	<i>Vanelius indicus</i>	Red-wattled lapwing	Bird	Least Concern	Near Threatened	1	Heard	Incidental
6 Jan 2025	2	Terrestrial transect	PM BHM	JK_0073	1.41219696	103.82577	7:36 PM	<i>Fruit bat sp.</i>	NA	Mammal	NA	NA	3	Seen	Targeted
6 Jan 2025	2	Terrestrial transect	PM BHM	JK_0073	1.41219696	103.82577	7:36 PM	<i>Gecko sp.</i>	NA	Reptile	NA	NA	1	Heard	Targeted
6 Jan 2025	2	Terrestrial transect	PM BHM	JK_0074	1.411695974	103.82645	7:47 PM	<i>Fruit bat sp.</i>	NA	Mammal	NA	NA	1	Seen	Targeted
6 Jan 2025	2	Terrestrial transect	PM BHM	JK_0075	1.411013016	103.82742	7:53 PM	<i>Caprimulgus macrurus</i>	Large-tailed nightjar	Bird	Least Concern	Least Concern	1	Seen	Targeted
6 Jan 2025	2	Terrestrial transect	PM BHM	JK_0076	1.411101026	103.8278	7:57 PM	<i>Dendrelaphis pictus</i>	Painted bronzeback	Reptile	Least Concern	Least Concern	2	Seen	Targeted
6 Jan 2025	2	Terrestrial transect	PM BHM	JK_0078	1.41133396	103.82802	8:00 PM	<i>Sylvirana guentheri</i>	Guenther's frog	Amphibian	Least Concern	NA	2	Heard	Targeted
6 Jan 2025	2	Terrestrial transect	PM BHM	JK_0078	1.41133396	103.82802	8:00 PM	<i>Polydectes leucomystax</i>	Four-lined tree frog	Amphibian	Least Concern	Least Concern	2	Heard	Targeted
6 Jan 2025	2	Terrestrial transect	PM BHM	JK_0078	1.41133396	103.82802	8:00 PM	<i>Microhyla heymonsi</i>	Dark-sided chorus frog	Amphibian	Least Concern	Least Concern	2	Heard	Targeted
6 Jan 2025	2	Terrestrial transect	PM BHM	JK_0078	1.41133396	103.82802	8:00 PM	<i>Fruit bat sp.</i>	NA	Mammal	NA	NA	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1468	1.412495021	103.82512	9:58 AM	<i>Eumenes aff. punctatus</i>	NA	Aculeata	Not Listed	Least Concern	2	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1468	1.412495021	103.82512	9:58 AM	<i>Potanthus omaha omaha</i>	Lesser dart	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1468	1.412495021	103.82512	9:58 AM	<i>mycalesis sp.</i>	NA	Butterfly	NA	NA	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1468	1.412495021	103.82512	9:58 AM	<i>lambrix salsala salsala</i>	Chestnut bob	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1468	1.412495021	103.82512	9:58 AM	<i>Junonia hedonia ida</i>	Chocolate pansy	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1469	1.412432995	103.82517	10:04 AM	<i>Neurothemis fluctuans</i>	Common parasol	Odonata	Least Concern	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1469	1.412432995	103.82517	10:04 AM	<i>Potanthus omaha omaha</i>	Lesser dart	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1470	1.41229704	103.8254	10:07 AM	<i>calesis mineus macromalaya</i>	Dark brand bush brown	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1471	1.412199978	103.82555	10:07 AM	<i>Oriens gola pseudolus</i>	Common dartlet	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1471	1.412199978	103.82555	10:07 AM	<i>Mycalesis sp.</i>	NA	Butterfly	NA	NA	2	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1472	1.412101993	103.82591	10:09 AM	<i>Junonia hedonia ida</i>	Chocolate pansy	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1472	1.412101993	103.82591	10:09 AM	<i>calesis mineus macromalaya</i>	Dark brand bush brown	Butterfly	Not Listed	Least Concern	2	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1473	1.411855984	103.82621	10:14 AM	<i>Mycalesis sp.</i>	NA	Butterfly	NA	NA	2	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1473	1.411855984	103.82621	10:14 AM	<i>Pantala flavescens</i>	Wandering glider	Odonata	Least Concern	Least Concern	15	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1474	1.411699997	103.82636	10:19 AM	<i>Crocothemis servilia</i>	Common scarlet	Odonata	Least Concern	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1474	1.411699997	103.82636	10:19 AM	<i>Rhyothemis phyllis</i>	Yellow-barred flutterer	Odonata	Least Concern	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1474	1.411699997	103.82636	10:19 AM	<i>Junonia almana javana</i>	Peacock pansy	Butterfly	Least Concern	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1475	1.411736961	103.82662	10:22 AM	<i>Elymnias hypermnestra agina</i>	Common palmy	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1475	1.411736961	103.82662	10:22 AM	<i>mycalesis sp.</i>	NA	Butterfly	NA	NA	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1476	1.411662027	103.82677	10:22 AM	<i>Junonia hedonia ida</i>	Chocolate pansy	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1477	1.411724975	103.82683	10:24 AM	<i>Lipotriches takauensis</i>	NA	Aculeata	Not Listed	Vulnerable	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1478	1.411543004	103.82714	10:28 AM	<i>lambrix salsala salsala</i>	Chestnut bob	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1478	1.411539987	103.82713	10:29 AM	<i>Oriens gola pseudolus</i>	Common dartlet	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1478	1.411539987	103.82713	10:29 AM	<i>lambrix salsala salsala</i>	Chestnut bob	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1479	1.411386011	103.8272	10:32 AM	<i>Thylomis tillarga</i>	White-barred duskhawk	Odonata	Least Concern	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1479	1.411386011	103.8272	10:32 AM	<i>polytemis lubricans lubricans</i>	Contiguous swift	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1480	1.411422975	103.82723	10:35 AM	<i>Junonia almana javana</i>	Peacock pansy	Butterfly	Least Concern	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1481	1.411333038	103.82723	10:36 AM	<i>Mycalesis sp.</i>	NA	Butterfly	NA	NA	4	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1481	1.411333038	103.82723	10:36 AM	<i>Orthetrum sabina</i>	Variiegated green skimmer	Odonata	Least Concern	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1481	1.411333038	103.82723	10:36 AM	<i>Dryas iulia</i>	Julia heliconian	Butterfly	Not Listed	Least Concern	1	Seen	Targeted

Date DD-MMM- YYYY	Cycle	Sampling method	Transect	Waypoint (E.g., ZH 1349)	Latitude	Longitude	Time (HH:MM)	Scientific name	Common name	Taxon	Global status	National status	Quantity	Observation type	Survey method
14 Jan 2025	2	Terrestrial transect	OBB	AH1482	1.41130303	103.82737	10:37 AM	Eumenes aff. punctatus	NA	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1482	1.41130303	103.82737	10:37 AM	Xylocopa latipes	Broad-handed carpenter bee	Aculeata	Not Listed	Least Concern	4	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1482	1.41130303	103.82737	10:37 AM	Eurema sp.	NA	Butterfly	NA	NA	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1483	1.411336977	103.82754	10:39 AM	Neptis hylas papaja	Common sailor	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1484	1.41139498	103.82771	10:50 AM	Euchrysops cnejus cnejus	Gram blue	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1484	1.41139498	103.82771	10:50 AM	Junonia almana javana	Peacock pansy	Butterfly	Least Concern	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1484	1.41139498	103.82771	10:50 AM	apis cerana	Eastern honey bee	Aculeata	Not Listed	Least Concern	20	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1484	1.41139498	103.82771	10:50 AM	Udaspes folus	Grass demon	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1484	1.41139498	103.82771	10:50 AM	Pantala flavescens	Wandering glider	Odonata	Least Concern	Least Concern	2	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1484	1.41139498	103.82771	10:50 AM	ceratina nigrolateralis	NA	Aculeata	Not Listed	Least Concern	2	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1484	1.41139498	103.82771	10:50 AM	lambrix salsala salsala	Chestnut bob	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1484	1.41139498	103.82771	10:50 AM	Prosotas dubiosa lumpura	Tailless line blue	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1484	1.41139498	103.82771	10:50 AM	Junonia hedonia ida	Chocolate pansy	Butterfly	Not Listed	Least Concern	2	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1484	1.41139498	103.82771	10:50 AM	Ropalidia stigma	NA	Aculeata	Not Listed	Least Concern	2	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1484	1.41139498	103.82771	10:50 AM	megachile disjuncta	NA	Aculeata	Not Listed	NA	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1485	1.411236981	103.82778	10:54 AM	Rhyothemis phyllis	Yellow-barred flutterer	Odonata	Least Concern	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1485	1.411236981	103.82778	10:54 AM	apis cerana	Eastern honey bee	Aculeata	Not Listed	Least Concern	10	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1485	1.411236981	103.82778	10:54 AM	Ropalidia stigma	NA	Aculeata	Not Listed	Least Concern	2	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1485	1.411236981	103.82778	10:54 AM	Dryas lula	Julia heliconian	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1485	1.411236981	103.82778	10:54 AM	calesis mineus macromalaya	Dark brand bush brown	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1485	1.411236981	103.82778	10:54 AM	Mycaelis sp.	NA	Butterfly	NA	NA	3	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1485	1.411236981	103.82778	10:54 AM	Acraea terpsicore	Tawny coster	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1485	1.411236981	103.82778	10:54 AM	Eurema sp.	NA	Butterfly	NA	NA	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1486	1.411192976	103.82776	11:00 AM	Allorhynchium argentatum	NA	Aculeata	Not Listed	Least Concern	3	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1486	1.411192976	103.82776	11:00 AM	Delias hyparete metarete	Painted jezebel	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1486	1.411192976	103.82776	11:00 AM	Junonia hedonia ida	Chocolate pansy	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1486	1.411192976	103.82776	11:00 AM	Pantala flavescens	Wandering glider	Odonata	Least Concern	Least Concern	6	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1486	1.411192976	103.82776	11:00 AM	Parischnogaster nigricans	NA	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1486	1.411192976	103.82776	11:00 AM	Graphium sarpedon luctatus	Common bluebottle	Butterfly	Not Listed	Least Concern	2	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1486	1.411192976	103.82776	11:00 AM	Papilio polytes romulus	Common mormon	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1486	1.411192976	103.82776	11:00 AM	Catopsilia pomona pomona	Lemon emigrant	Butterfly	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1487	1.411276041	103.82806	11:06 AM	Elymnias panthera panthera	Tawny palmfly	Butterfly	Not Listed	Near threatened	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1487	1.411276041	103.82806	11:06 AM	Rhyothemis phyllis	Yellow-barred flutterer	Odonata	Least Concern	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1487	1.411276041	103.82806	11:06 AM	amegilla andrewsi	Andrew's blue-banded digger bee	Aculeata	Not Listed	Least Concern	1	Seen	Targeted
14 Jan 2025	2	Terrestrial transect	OBB	AH1488	1.410444975	103.82882	11:26 AM	Tanaecia iapis puseda	Horsfield's baron	Butterfly	Not Listed	Least Concern	3	Seen	Incidental
14 Jan 2025	2	Terrestrial transect	OBB	AH1490	1.410504989	103.82842	11:29 AM	Orthetrum glaucum	Common blue skimmer	Odonata	Least Concern	Least Concern	2	Seen	Incidental
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411079653	103.82893	7:39 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411079653	103.82893	7:39 PM	Unknown Bats	Unknown Bats	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.410995498	103.82908	7:41 PM	Unknown Bats	Unknown Bats	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411039587	103.82919	7:42 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411485421	103.82918	7:48 PM	Unknown Bats	Unknown Bats	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411409229	103.82846	7:55 PM	Unknown Bats	Unknown Bats	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411409229	103.82846	7:55 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411359357	103.82821	7:58 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.41111142	103.82817	8:00 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411134554	103.82819	8:01 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.41106884	103.82821	8:01 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.410960043	103.82824	8:03 PM	Unknown Bats	Unknown Bats	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.410960043	103.82824	8:03 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411257684	103.82809	8:04 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.410889467	103.82805	8:10 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.410894077	103.82814	8:14 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411223067	103.82707	8:25 PM	Myotis muricola	Asian whiskered myotis	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411275622	103.82701	8:25 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411365978	103.82697	8:25 PM	Myotis muricola	Asian whiskered myotis	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411449797	103.82688	8:26 PM	Myotis muricola	Asian whiskered myotis	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411449797	103.82688	8:26 PM	Myotis muricola	Asian whiskered myotis	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411492294	103.82685	8:26 PM	Myotis muricola	Asian whiskered myotis	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411513584	103.82678	8:26 PM	Myotis muricola	Asian whiskered myotis	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411487767	103.82674	8:27 PM	Myotis muricola	Asian whiskered myotis	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.411736123	103.82642	8:35 PM	Unknown Bats	Unknown Bats	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.412327718	103.82544	8:38 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.412395779	103.82535	8:38 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
16 Dec 2024	1	Bat acoustic	PM BHM	NA	1.412395779	103.82535	8:38 PM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted

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DD-MMM-YYYY	Cycle	Sampling method	Transect	Waypoint (E.g., ZH 1349)	Latitude	Longitude	Time (HH:MM)	Scientific name	Common name	Taxon	Global status	National status	Quantity	Observation type	Survey method
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.412107106	103.82581	7:44 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411873084	103.8261	7:45 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411820445	103.82616	7:45 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411820445	103.82616	7:45 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411820445	103.82616	7:45 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411798233	103.82621	7:46 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411798233	103.82621	7:46 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411764286	103.82626	7:46 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411764286	103.82626	7:46 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411741069	103.82632	7:46 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411741069	103.82632	7:46 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411728747	103.82637	7:46 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411728747	103.82637	7:46 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411683066	103.82643	7:46 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411683066	103.82643	7:46 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411484918	103.8267	7:48 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411484918	103.8267	7:48 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411484918	103.8267	7:48 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411461113	103.82684	7:49 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411383916	103.82682	7:49 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411342593	103.82684	7:49 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411342593	103.82684	7:49 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.41132365	103.8269	7:49 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.41132365	103.8269	7:49 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.41132365	103.8269	7:49 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411310323	103.82699	7:50 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411310323	103.82699	7:50 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411310323	103.82699	7:50 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411310323	103.82699	7:50 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411275286	103.82703	7:50 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411261037	103.82705	7:50 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411261037	103.82705	7:50 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411261037	103.82705	7:50 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411261037	103.82705	7:50 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411228348	103.82712	7:50 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411228348	103.82712	7:51 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411228348	103.82712	7:51 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411238657	103.82711	7:51 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411201442	103.82719	7:51 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411201442	103.82719	7:51 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411166154	103.82727	7:51 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411166154	103.82727	7:51 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411058446	103.82744	7:53 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411142182	103.82785	7:56 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411139583	103.82784	7:56 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411139583	103.82784	7:56 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411140505	103.82785	7:56 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.4111338	103.82784	7:57 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.41116868	103.82784	7:58 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411113013	103.82786	7:58 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411319291	103.82799	8:00 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411333121	103.82806	8:01 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411347622	103.82815	8:02 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411347622	103.82815	8:02 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411347622	103.82815	8:02 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.41133748	103.82811	8:02 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.41129557	103.82809	8:03 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.41129557	103.82809	8:03 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411313005	103.82806	8:04 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411313005	103.82806	8:04 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411522552	103.82824	8:06 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411471159	103.82833	8:07 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.410970772	103.82913	8:18 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.410927689	103.82892	8:19 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.410717303	103.82885	8:21 AM	Scotophilus kuhlii	Lesser Asian house bat	Mammal	Least Concern	Least Concern	NA	NA	Targeted

Date	DD-MM-YYYY	Cycle	Sampling method	Transect	Waypoint (E.g., ZH 1349)	Latitude	Longitude	Time (HH:MM)	Scientific name	Common name	Taxon	Global status	National status	Quantity	Observation type	Survey method
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411139583	103.82784	7:56 AM	Unknown Bats	Unknown Bats	Mammal	NA	NA	NA	NA	NA	
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411333876	103.82815	8:05 AM	Unknown Bats	Unknown Bats	Mammal	NA	NA	NA	NA	NA	
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.41139583	103.82784	7:56 AM	Unknown Bats	Unknown Bats	Mammal	Least Concern	Least Concern	NA	NA	Targeted	
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.411319291	103.82799	8:00 AM	Unknown Bats	Unknown Bats	Mammal	Least Concern	Least Concern	NA	NA	Targeted	
6 Jan 2025	2	Bat acoustic	PM BHM	NA	1.410445478	103.82861	8:22 AM	Unknown Bats	Unknown Bats	Mammal	Least Concern	Least Concern	NA	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:39 PM	Callosciurus notatus	Plantain squirrel	Mammal	Least Concern	Least Concern	1	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	6:07 PM	Callosciurus notatus	Plantain squirrel	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	6:48 PM	Callosciurus notatus	Plantain squirrel	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	5:29 PM	Callosciurus notatus	Plantain squirrel	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:01 PM	Callosciurus notatus	Plantain squirrel	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	6:14 PM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:40 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	5	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	6:18 PM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	4:52 PM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	8:55 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	4	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	8:23 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	3	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	5:40 PM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	8:33 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:28 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	3	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	4:56 PM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:56 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	2	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:42 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	5	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:16 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:26 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	5:45 PM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	2:08 PM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
16 Dec 2024	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	9:34 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
16 Dec 2024	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	1:53 PM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	2	NA	Targeted	
16 Dec 2024	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	10:28 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	7:57 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
2 Dec 2024	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	8:00 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	1	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	9:10 AM	Gallus gallus	Red junglefowl	Bird	Least Concern	Near Threatened	2	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	12:03 PM	Garrulax leucolophus	Garrulax leucolophus	Bird	Least Concern	NA	2	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	9:15 AM	Garrulax leucolophus	Garrulax leucolophus	Bird	Least Concern	NA	2	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	5:15 PM	Garrulax leucolophus	Garrulax leucolophus	Bird	Least Concern	NA	4	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	6:57 PM	Garrulax leucolophus	Garrulax leucolophus	Bird	Least Concern	NA	3	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	8:12 AM	Garrulax leucolophus	Garrulax leucolophus	Bird	Least Concern	NA	1	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	8:56 AM	Garrulax leucolophus	Garrulax leucolophus	Bird	Least Concern	NA	2	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT02	NA	1.411592	103.8284	9:47 AM	Garrulax leucolophus	Garrulax leucolophus	Bird	Least Concern	NA	1	NA	Targeted	
16 Dec 2024	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	12:58 PM	Garrulax leucolophus	Garrulax leucolophus	Bird	Least Concern	NA	1	NA	Targeted	
16 Dec 2024	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	1:53 PM	Garrulax leucolophus	Garrulax leucolophus	Bird	Least Concern	NA	2	NA	Targeted	
2 Dec 2024	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	10:46 AM	Garrulax leucolophus	Garrulax leucolophus	Bird	Least Concern	NA	2	NA	Targeted	
2 Dec 2024	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	10:07 AM	Garrulax leucolophus	Garrulax leucolophus	Bird	Least Concern	NA	4	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	1:32 PM	Macaca fascicularis	Macaca fascicularis	Mammal	Endangered	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:17 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:21 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:31 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:27 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:17 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:18 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	2:13 PM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:17 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	5:23 PM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	6:03 PM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:31 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	5:32 PM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	8:05 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
14 Jan 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	6:49 PM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:27 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:25 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	2	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:31 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:35 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:14 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:30 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted	

Date DD-MMM- YYYY	Cycle	Sampling method	Transect	Waypoint (E.g., ZH_1349)	Latitude	Longitude	Time (HH:MM)	Scientific name	Common name	Taxon	Global status	National status	Quantity	Observation type	Survey method
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:32 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	5:57 PM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:26 AM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted
16 Dec 2024	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	2:58 PM	Tupaia glis	Tupaia glis	Mammal	Least Concern	Least Concern	1	NA	Targeted
14 Jan 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	1:30 PM	Unidentified animal	Unidentified animal	NA	NA	NA	1	NA	Targeted
16 Dec 2024	NA	Camera Trapping	CT02	NA	1.411406966	103.82648	7:28 AM	Unidentified animal	Unidentified animal	NA	NA	NA	1	NA	Targeted
14 Jan 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	9:45 PM	Unidentified Anura	Unidentified Anura	Amphibian	NA	NA	1	NA	Targeted
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	3:15 AM	Unidentified Muridae	Unidentified Muridae	Mammal	NA	NA	1	NA	Targeted
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	8:52 PM	Unidentified Muridae	Unidentified Muridae	Mammal	NA	NA	1	NA	Targeted
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	12:29 AM	Unidentified Muridae	Unidentified Muridae	Mammal	NA	NA	1	NA	Targeted
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	12:18 AM	Unidentified Muridae	Unidentified Muridae	Mammal	NA	NA	1	NA	Targeted
17 Dec 2024	NA	Camera Trapping	CT01	NA	1.411592	103.8284	3:42 PM	Unidentified Snake	Unidentified Snake	Reptile	NA	NA	1	NA	Targeted
14 Jan 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:25 AM	identified Sciuridae or Tupaiid	Unidentified Sciuridae or Tupaiidae	Mammal	NA	NA	1	NA	Targeted
7 Feb 2025	NA	Camera Trapping	CT01	NA	1.411592	103.8284	7:11 AM	identified Sciuridae or Tupaiid	Unidentified Sciuridae or Tupaiidae	Mammal	NA	NA	1	NA	Targeted

Date (DD-MMM- YYYY)	Cycle	Survey type	Transect/ Survey point	Direction	Taxa	Time in (h)	Time out (h)	Surveyors	(Clear/cloi	Data entry by
26/11/2024	1	AM BHM	Terrestrial	Forward	Birds, Herps & Mammals	7:15:00 AM	7:57:00 AM	AH AC IK	Clear	AH
12/12/2024	1	AM OBB	Terrestrial	Forward	Butterflies, Odonates and Bees	9:19:00 AM	11:28:00 AM	AH HB John	Clear	AH
16/12/2024	1	PM BHM	Terrestrial	Forward	Birds, Herps & Mammals	7:33:00 PM	8:50:00 PM	VL LIS AC	Cloudy	VL
7/1/2025	2	AM BHM	Terrestrial	Reverse	Birds, Herps & Mammals	7:55:00 AM	9:42:00 AM	VL HB	Sunny	VL
6/1/2025	2	PM BHM	Terrestrial	Reverse	Birds, Herps & Mammals	7:36:00 PM	8:22:00 PM	VL ZH JK	Cloudy	JK
14/1/2025	2	AM OBB	Terrestrial	Reverse	Butterflies, Odonates and Bees	10:00:00 AM	12:00:00 PM	AH	Cloudy	AH

Appendix 5F. List of Recorded Faunal Species and Probable Species of Conservation Significance

Taxon	Total no. of recorded species		No. of probable CS species
	All species	CS species	
Aculeata	21	0	3
Bees	11	0	3
Stinging wasps	10	0	0
Birds	49	4	22
Butterflies	34	0	6
Herpetofauna	15	0	1
Amphibians	8	0	0
Reptiles	7	0	1
Mammals	9	1	4
Non-volant Mammals	3	1	2
Bats	6	0	2
Odonata	9	0	0
Dragonflies	9	0	0
Damselflies	0	0	0
Total	137	5	36

No.	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2024)	Species of Conservation Significance	Native	Recorded Species	Ecological Value
1	Apidae	<i>Amegilla andrewsi</i>	Sunda Blue-banded Digger	Not Listed	Least Concern	No	Yes	Yes	Medium
2	Apidae	<i>Apis cerana</i>	Asian honey bee	Not Listed	Least Concern	No	Yes	Yes	Medium
3	Apidae	<i>Apis florea</i>	Red dwarf honey bee	Not Listed	NA	No	No	Yes	Low
4	Apidae	<i>Ceratina nigrolateralis</i>	Black-sided small carpenter	Not Listed	Least Concern	No	Yes	Yes	Medium
5	Apidae	<i>Ceratina unimaculata</i>	One-spotted small carpenter	Not Listed	Least Concern	No	Yes	Yes	Medium
6	Apidae	<i>Xylocopa latipes</i>	Broad-handed carpenter bee	Not Listed	Least Concern	No	Yes	Yes	Medium
7	Eumeninae	<i>Epsilon sp.</i>	NA	Not Listed	NA	NA	NA	Yes	NA
8	Eumeninae	<i>Eumenes punctatus</i>	NA	Not Listed	Least Concern	No	Yes	Yes	Medium
9	Halictidae	<i>Lipotriches takauensis</i>	Takau austral-Nomia	Not Listed	Near Threatened	Yes	Yes	Yes	Medium
10	Halictidae	<i>Nomia strigata</i>	Striped Nomia	Not Listed	Least Concern	No	Yes	Yes	Medium
11	Megachilidae	<i>Heriades othonis</i>	Indomalayan armoured-resin b	Not Listed	Least Concern	No	Yes	Yes	Medium
12	Megachilidae	<i>Megachile disjuncta</i>	Disjunct resin bee	Not Listed	NA	No	No	Yes	Low
13	Megachilidae	<i>Megachile laticeps</i>	Broad-headed leafcutter	Not Listed	Least Concern	No	Yes	Yes	Medium
14	Vespidae	<i>Allorhynchium argentatum</i>	NA	Not Listed	Not Evaluated	No	Yes	Yes	Medium
15	Vespidae	<i>Apodynerus troglodytes</i>	NA	Not Listed	Not Evaluated	No	Yes	Yes	Medium
16	Vespidae	<i>Parapolybia varia</i>	Lesser paper wasp	Not Listed	Not Evaluated	No	Yes	Yes	Medium
17	Vespidae	<i>Parischnogaster nigricans</i>	NA	Not Listed	Not Evaluated	No	Yes	Yes	Medium
18	Vespidae	<i>Ropalidia stigma</i>	Stigma small paper wasp	Not Listed	Least Concern	No	Yes	Yes	Medium
19	Vespidae	<i>Ropalidia sumatrae</i>	Sumatran small paper wasp	Not Listed	Least Concern	No	Yes	Yes	Medium
20	Vespidae	<i>Stenodyneriellus guttulatus</i>	NA	Not Listed	Not Evaluated	No	Yes	Yes	Medium
21	Vespidae	<i>Vespa affinis</i>	Lesser banded hornet	Not Listed	Least Concern	No	Yes	Yes	Medium
22	Apidae	<i>Amegilla insularis</i>	Island forest-digger	Not Listed	Vulnerable	Yes	Yes	No	High
23	Apidae	<i>Ceratina fuliginosa</i>	Dusky-winged small carpenter	Not Listed	Vulnerable	Yes	Yes	No	High
24	Megachilidae	<i>Megachile indonesica</i>	Indonesian resin bee	Not Listed	Vulnerable	Yes	Yes	No	High

No.	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2024)	Species of Conservation Significance	Distribution/Rarity (NParks, 2023)	Native species	Native status	Recorded Species	Ecological Value
1	Aegithinidae	<i>Aegithina tiphia</i>	Common iora	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
2	Alcedinidae	<i>Todiramphus chloris</i>	Collared kingfisher	Least Concern	Least Concern	No	Abundant	Yes	Native resident	Yes	Medium
3	Apodidae	<i>Aerodramus sp.</i>	Swiftlet sp.	NA	NA	NA	NA	Yes	Native resident	Yes	NA
4	Apodidae	<i>Collocalia affinis</i>	Plume-toed swiftlet	Least Concern	Vulnerable	Yes	Uncommon	Yes	Native resident	Yes	High
5	Ardeidae	<i>Ardea cinerea</i>	Grey heron	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
6	Ardeidae	<i>Ardea intermedia</i>	Intermediate Egret	Least Concern	Least Concern	No	Uncommon	Yes	Visitor	Yes	Medium
7	Bucerotidae	<i>Anthraceroceros albirostris</i>	Oriental pied hornbill	Least Concern	Near Threatened	No	Common	Yes	Introduced resident	Yes	Medium
8	Campephagidae	<i>Pericrocotus divaricatus</i>	Ashy minivet	Least Concern	Least Concern	No	Common	Yes	Visitor	Yes	Medium
9	Caprimulgidae	<i>Caprimulgus affinis</i>	Savanna nightjar	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
10	Caprimulgidae	<i>Caprimulgus macrurus</i>	Large-tailed nightjar	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
11	Charadriidae	<i>Vanellus indicus</i>	Red-wattled lapwing	Least Concern	Near Threatened	No	Common	Yes	Native resident	Yes	Medium
12	Cisticolidae	<i>Orthotomus atrogularis</i>	Dark-necked tailorbird	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
13	Cisticolidae	<i>Orthotomus sutorius</i>	Common tailorbird	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
14	Columbidae	<i>Spilopelia chinensis</i>	Spotted dove	Least Concern	Least Concern	No	Abundant	Yes	Native resident	Yes	Medium
15	Columbidae	<i>Treron vernans</i>	Pink-necked green pigeon	Least Concern	Least Concern	No	Abundant	Yes	Native resident	Yes	Medium
16	Coraciidae	<i>Eurystomus orientalis</i>	Oriental dollarbird	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
17	Corvidae	<i>Corvus splendens</i>	House crow	Least Concern	NA	No	Common	No	Introduced resident	Yes	Low
18	Cuculidae	<i>Eudynamis scolopaceus</i>	Asian koel	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
19	Dicaeidae	<i>Dicaeum cruentatum</i>	Scarlet-backed flowerpecker	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
20	Dicruridae	<i>Dicrurus paradiseus</i>	Greater racket-tailed drongo	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
21	Hirundinidae	<i>Hirundo tahitica</i>	Pacific swallow	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
22	Leiothrichidae	<i>Garrulax leucolophus</i>	White-crested laughingthrush	Least Concern	NA	No	Common	No	Introduced resident	Yes	Low
23	Locustellidae	<i>Helopsaltes certhiola</i>	Pallas's grasshopper warbler	Least Concern	Least Concern	No	Common	Yes	Visitor	Yes	Medium
24	Megalaimidae	<i>Psilopogon lineatus</i>	Lineated barbet	Least Concern	NA	No	Common	No	Introduced resident	Yes	Low
25	Meropidae	<i>Merops philippinus</i>	Blue-tailed bee-eater	Least Concern	Least Concern	No	Common	Yes	Visitor	Yes	Medium
26	Meropidae	<i>Merops viridis</i>	Blue-throated bee-eater	Least Concern	Least Concern	No	Common	Yes	Migrant	Yes	Medium
27	Muscicapidae	<i>Muscicapa dauurica</i>	Asian brown flycatcher	Least Concern	Least Concern	No	Common	Yes	Visitor	Yes	Medium
28	Nectariniidae	<i>Aethopyga siparaja</i>	Crimson sunbird	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
29	Nectariniidae	<i>Anthreptes malacensis</i>	Brown-throated sunbird	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
30	Nectariniidae	<i>Cinnyris ornatus</i>	Ornate sunbird	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
31	Oriolidae	<i>Oriolus chinensis</i>	Black-naped oriole	Least Concern	Least Concern	No	Abundant	Yes	Native resident	Yes	Medium
32	Phasianidae	<i>Gallus gallus</i>	Red junglefowl	Least Concern	Near Threatened	No	Common	Yes	Native resident	Yes	Medium
33	Phylloscopidae	<i>Phylloscopus borealis</i>	Arctic warbler	Least Concern	Least Concern	No	Common	Yes	Visitor	Yes	Medium
34	Picidae	<i>Dinopium javanense</i>	Common flameback	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
35	Psittaculidae	<i>Loriculus galgulus</i>	Blue-crowned hanging-parrot	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
36	Psittaculidae	<i>Psittacula alexandri</i>	Red-breasted parakeet	Near Threatened	NA	No	Common	No	Introduced resident	Yes	Low
37	Psittaculidae	<i>Psittacula krameri</i>	Rose-ringed parakeet	Least Concern	NA	No	Common	No	Introduced resident	Yes	Low
38	Psittaculidae	<i>Psittacula longicauda</i>	Long-tailed parakeet	Vulnerable	Near Threatened	Yes	Common	Yes	Native resident	Yes	High
39	Psittaculidae	<i>Trichoglossus haematodus</i>	Coconut lorikeet	Least Concern	NA	No	Uncommon	No	Introduced resident	Yes	Low

No.	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2024)	Species of Conservation Significance	Distribution/Rarity (NParks, 2023)	Native species	Native status	Recorded Species	Ecological Value
40	Pycnonotidae	<i>Pycnonotus goiavier</i>	Yellow-vented bulbul	Least Concern	Least Concern	No	Abundant	Yes	Native resident	Yes	Medium
41	Pycnonotidae	<i>Pycnonotus jocosus</i>	Red-whiskered bulbul	Least Concern	NA	No	Uncommon	No	Introduced resident	Yes	Low
42	Pycnonotidae	<i>Pycnonotus plumosus</i>	Olive-winged bulbul	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
43	Pycnonotidae	<i>Pycnonotus zeylanicus</i>	Straw-headed bulbul	Critically Endangered	Endangered	Yes	Uncommon	Yes	Native resident	Yes	High
44	Rallidae	<i>Amaurornis phoenicurus</i>	White-breasted waterhen	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
45	Sturnidae	<i>Acridotheres javanicus</i>	Javan myna	Vulnerable	NA	No	Abundant	No	Introduced resident	Yes	Low
46	Sturnidae	<i>Acridotheres tristis</i>	Common myna	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
47	Sturnidae	<i>Aplopis panayensis</i>	Asian glossy starling	Least Concern	Least Concern	No	Abundant	Yes	Native resident	Yes	Medium
48	Timaliidae	<i>Mixornis gularis</i>	Pin-striped tit-babbler	Least Concern	Least Concern	No	Common	Yes	Native resident	Yes	Medium
49	Zosteropidae	<i>Zosterops simplex</i>	Swinhoe's white-eye	Least Concern	Vulnerable	Yes	Common	Yes	Native resident	Yes	High
50	Accipitridae	<i>Elanus caeruleus</i>	Black-winged kite	Least Concern	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High
51	Accipitridae	<i>Ichthyophaga ichthyaetus</i>	Grey-headed fish eagle	Near Threatened	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High
52	Accipitridae	<i>Nisaetus cirrhatus</i>	Changeable hawk-eagle	Least Concern	Vulnerable	Yes	Common	Yes	Native resident	No	High
53	Accipitridae	<i>Spilornis cheela</i>	Crested serpent eagle	Least Concern	Critically Endangered	Yes	Rare	Yes	Native resident	No	High
54	Acrocephalidae	<i>Acrocephalus orientalis</i>	Oriental reed warbler	Least Concern	Vulnerable	Yes	Common	Yes	Native resident	No	High
55	Alcedinidae	<i>Halcyon coromanda</i>	Ruddy kingfisher	Least Concern	Critically Endangered	Yes	Uncommon	Yes	Native resident	No	High
56	Apodidae	<i>Apus nipalensis</i>	House swift	Least Concern	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High
57	Ardeidae	<i>Bubulcus coromandus</i>	Eastern cattle egret	Least Concern	Vulnerable	Yes	Common	Yes	Introduced resident	No	High
58	Cisticolidae	<i>Cisticola juncidis</i>	Zitting cisticola	Least Concern	Vulnerable	Yes	Common	Yes	Native resident	No	High
59	Columbidae	<i>Ptilinopus jambu</i>	Jambu fruit dove	Near Threatened	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High
60	Columbidae	<i>Treron curvirostra</i>	Thick-billed green pigeon	Least Concern	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High
61	Corvidae	<i>Corvus macrorhynchos</i>	Large-billed crow	Least Concern	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High
62	Cuculidae	<i>Chrysococcyx xanthorhynchus</i>	Violet cuckoo	Least Concern	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High
63	Cuculidae	<i>Surniculus lugubris</i>	Square-tailed drongo-cuckoo	Least Concern	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High
64	Estrildidae	<i>Lonchura atricapilla</i>	Chestnut munia	Least Concern	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High
65	Laniidae	<i>Lanius cristatus</i>	Brown shrike	Least Concern	Vulnerable	Yes	Common	Yes	Visitor	No	High
66	Motacillidae	<i>Motacilla tschutschensis</i>	Eastern yellow wagtail	Least Concern	Vulnerable	Yes	Common	Yes	Visitor	No	High
67	Muscicapidae	<i>Copsychus saularis</i>	Oriental magpie-robin	Least Concern	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High
68	Muscicapidae	<i>Cyornis brunneatus</i>	Brown-chested jungle flycatcher	Vulnerable	Vulnerable	Yes	Uncommon	Yes	Visitor	No	High
69	Ploceidae	<i>Ploceus philippinus</i>	Baya weaver	Least Concern	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High
70	Strigidae	<i>Ketupa ketupu</i>	Buffy fish owl	Least Concern	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High
71	Strigidae	<i>Strix seloputo</i>	Spotted wood owl	Least Concern	Vulnerable	Yes	Uncommon	Yes	Native resident	No	High

No.	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2024)	Species of Conservation Significance	Distribution/Rarity (NParks, 2023)	Recorded Species	Ecological Value
1	Nymphalidae (Brush Fooths)	<i>Acraea terpsicore</i>	Tawny coster	Not Listed	Least Concern	No	Common	Yes	Medium
2	Pieridae (Whites & Sulphurs)	<i>Appias olferna olferna</i>	Striped albatross	Not Listed	Least Concern	No	Common	Yes	Medium
3	Lycaenidae	<i>Arhopala amphimuta amphimuta</i>	Broad yellow oakblue	Not Listed	Near threatened	No	Moderately common	Yes	Medium
4	Lycaenidae	<i>Arhopala major major</i>	Major yellow oakblue	Not Listed	Least Concern	No	Common	Yes	Medium
5	Hesperiidae	<i>Borbo cinnara</i>	Formosan swift	Not Listed	Least Concern	No	Moderately common	Yes	Medium
6	Pieridae (Whites & Sulphurs)	<i>Catopsilia pomona pomona</i>	Lemon emigrant	Not Listed	Least Concern	No	Common	Yes	Medium
7	Pieridae (Whites & Sulphurs)	<i>Delias hyparete metarete</i>	Painted jezebel	Not Listed	Least Concern	No	Common	Yes	Medium
8	Nymphalidae (Brush Fooths)	<i>Dryas iulia</i>	Julia heliconian	Not Listed	Least Concern	No	NA	Yes	Medium
9	Nymphalidae (Brush Fooths)	<i>Elymnias hypermnestra agina</i>	Common palmfly	Not Listed	Least Concern	No	Common	Yes	Medium
10	Nymphalidae (Brush Fooths)	<i>Elymnias panthera panthera</i>	Tawny palmfly	Not Listed	Near threatened	No	Moderately common	Yes	Medium
11	Lycaenidae	<i>Euchrysops cnejus cnejus</i>	Gram blue	Not Listed	Least Concern	No	Moderately common	Yes	Medium
12	Pieridae (Whites & Sulphurs)	<i>Eurema sp.</i>	NA	NA	NA	NA	NA	Yes	NA
13	Nymphalidae (Brush Fooths)	<i>Euthalia aconthea gurda</i>	Baron	Not Listed	Least Concern	No	Common	Yes	Medium
14	Papilionidae (Swallowtails & Birdwings)	<i>Graphium sarpedon luctatius</i>	Common bluebottle	Not Listed	Least Concern	No	Common	Yes	Medium
15	Hesperiidae	<i>Iambrix salsala salsala</i>	Chestnut bob	Not Listed	Least Concern	No	Common	Yes	Medium
16	Nymphalidae (Brush Fooths)	<i>Junonia almana javana</i>	Peacock pansy	Least Concern	Least Concern	No	Common	Yes	Medium
17	Nymphalidae (Brush Fooths)	<i>Junonia hedonia ida</i>	Chocolate pansy	Not Listed	Least Concern	No	Common	Yes	Medium

No.	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2024)	Species of Conservation Significance	Distribution/Rarity (NParks, 2023)	Recorded Species	Ecological Value
18	Nymphalidae (Brush Footh)	<i>Mycalesis mineus macromalayana</i>	Dark brand bush brown	Not Listed	Least Concern	No	Common	Yes	Medium
19	Nymphalidae (Brush Footh)	<i>Mycalesis perseus cepheus</i>	Dingy bush brown	Not Listed	Least Concern	No	Moderately common	Yes	Medium
20	Nymphalidae (Brush Footh)	<i>Neptis hylas papaja</i>	Common sailor	Not Listed	Least Concern	No	Moderately common	Yes	Medium
21	Hesperiidae	<i>Oriens gola pseudolus</i>	Common dartlet	Not Listed	Least Concern	No	Moderately common	Yes	Medium
22	Hesperiidae	<i>Oriens paragola</i>	Malay dartlet	Not Listed	Least Concern	No	Rare	Yes	Medium
23	Papilionidae (Swallowtails & Birdwings)	<i>Papilio clytia clytia</i>	Common mime	Not Listed	Least Concern	No	Common	Yes	Medium
24	Papilionidae (Swallowtails & Birdwings)	<i>Papilio polytes romulus</i>	Common mormon	Not Listed	Least Concern	No	Common	Yes	Medium
25	Hesperiidae	<i>Polytremis lubricans lubricans</i>	Contiguous swift	Not Listed	Least Concern	No	Common	Yes	Medium
26	Hesperiidae	<i>Potanthus omaha omaha</i>	Lesser dart	Not Listed	Least Concern	No	Common	Yes	Medium
27	Lycaenidae	<i>Prosotas dubiosa lumpura</i>	Tailless line blue	Not Listed	Least Concern	No	Common	Yes	Medium
28	Lycaenidae	<i>Rapala sp.</i>	NA	NA	NA	NA	NA	Yes	Medium
29	Nymphalidae (Brush Footh)	<i>Tanaecia iapis puseda</i>	Horsfield's baron	Not Listed	Least Concern	No	Common	Yes	Medium
30	Hesperiidae	<i>Taractrocera archias quinta</i>	Yellow grass dart	Not Listed	Least Concern	No	Moderately common	Yes	Medium
31	Hesperiidae	<i>Telicota colon stinga</i>	Common palm dart	Not Listed	Least Concern	No	Moderately common	Yes	Medium
32	Hesperiidae	<i>Udaspes folus</i>	Grass demon	Not Listed	Least Concern	No	Moderately common	Yes	Medium
33	Lycaenidae	<i>Zizeeria maha serica</i>	Pale grass blue	Not Listed	Least Concern	No	Common	Yes	Medium
34	Lycaenidae	<i>Zizula hylax pygmaea</i>	Pygmy grass blue	Not Listed	Least Concern	No	Common	Yes	Medium

No.	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2024)	Species of Conservation Significance	Distribution/Rarity (NParks, 2023)	Recorded Species	Ecological Value
35	Hesperiidae	<i>Cephrenes acalle niasicus</i>	Plain palm dart	Not Listed	Vulnerable	Yes	Moderately rare	No	High
36	Hesperiidae	<i>Pelopidas assamensis</i>	Great swift	Not Listed	Vulnerable	Yes	Moderately rare	No	High
37	Hesperiidae	<i>Pemara pugnans</i>	Pugnacious lancer	Not Listed	Vulnerable	Yes	Very rare	No	High
38	Lycaenidae	<i>Catochrysops strabo strabo</i>	Forget-me-not	Not Listed	Vulnerable	Yes	Moderately rare	No	High
39	Papilionidae (Swallowtails & Birdwings)	<i>Papilio memnon agenor</i>	Great mormon	Not Listed	Vulnerable	Yes	Moderately common	No	High
40	Papilionidae (Swallowtails & Birdwings)	<i>Troides helena cerberus</i>	Common birdwing	Not Listed	Vulnerable	Yes	Moderately common	No	High

No.	Family	Scientific Name	Common Name	Global Status (IUCN)	National Status (NParks, 2024)	Species of Conservation Significance	Distribution/Rarity. (Baker & Lim, 2012)	Native Status	Recorded Species	Ecological value
1	Cercopithecidae	<i>Macaca fascicularis</i>	Long-tailed macaque	Endangered	Least Concern	Yes	Widespread and Common	Native	Yes	High
2	Sciuridae	<i>Callosciurus notatus</i>	Plantain squirrel	Least Concern	Least Concern	No	Widespread and Common	Native	Yes	Medium
3	Tupaiaidae	<i>Tupaia glis</i>	Common treeshrew	Least Concern	Least Concern	No	Widespread and Common	Native	Yes	Medium
4	Manidae	<i>Manis javanica</i>	Sunda pangolin	Critically Endangered	Critically Endangered	Yes	Widespread but Rare	Native	No	High
5	Mustelidae	<i>Lutrogale perspicillata</i>	Smooth-coated otter	Vulnerable	Endangered	Yes	Widespread but Rare	Native	No	High

No.	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2024)	Recorded Species	Ecological value
1	Pteropodidae	<i>Cynopterus brachyotis</i>	Lesser short-nosed fru	Least Concern	Least Concern	Yes	Medium
2	Vespertilionidae	<i>Myotis muricola</i>	Asian whiskered myot	Least Concern	Least Concern	Yes	Medium
3	Vespertilionidae	<i>Pipistrellus javanicus</i>	Javan pipistrelle	Least Concern	Least Concern	Yes	Medium
4	Vespertilionidae	<i>Pipistrellus stenopterus</i>	Narrow-winged pipistr	Least Concern	Least Concern	Yes	Medium
5	Emballonuridae	<i>Saccolaimus saccolaimus</i>	Pouch tomb bat	Least Concern	Least Concern	Yes	Medium
6	Vespertilionidae	<i>Scotophilus kuhlii</i>	Lesser Asian house b	Least Concern	Least Concern	Yes	Medium
7	Emballonuridae	<i>Taphozous longimanus</i>	Long-winged tomb ba	Least Concern	Critically Endangered	No	High
8	Pteropodidae	<i>Eonycteris spelaea</i>	Cave nectar bat	Least Concern	Vulnerable	No	High

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2024)	Species of Conservation Significance	Distribution/Rarity (Figueroa et al., 2023)	Native Status (Figueroa et al., 2023)	Recorded Species	Ecological value
1	Toad	Bufonidae	<i>Duttaphrynus bengalensis</i>	Bengal toad	Not Listed	NA	No	Ubiquitous and Common	Non-native	Yes	Low
2	Frog	Eleutherodactylidae	<i>Eleutherodactylus planirostris</i>	Greenhouse frog	Least Concern	NA	No	Widespread and Common	Non-native	Yes	Low
3	Frog	Dicroglossidae	<i>Fejervarya limnocharis</i>	Field frog	Least Concern	Least Concern	No	Ubiquitous and Common	Native	Yes	Medium
4	Frog	Microhylidae	<i>Kaloula pulchra</i>	Banded bull frog	Least Concern	NA	No	Ubiquitous and Common	Non-native	Yes	Low
5	Frog	Dicroglossidae	<i>Limnonectes blythii</i>	Malayan giant frog	Least Concern	Least Concern	No	Widespread but Uncommon	Native	Yes	Medium
6	Frog	Microhylidae	<i>Microhyla heymonsi</i>	Dark-sided chorus frog	Least Concern	Least Concern	No	Ubiquitous and Common	Native	Yes	Medium
7	Frog	Rhacophoridae	<i>Polypedates leucomystax</i>	Four-lined tree frog	Least Concern	Least Concern	No	Ubiquitous and Common	Native	Yes	Medium
8	Toad	Ranidae	<i>Sylvirana guentheri</i>	Guenther's frog	Least Concern	NA	No	Widespread but Uncommon	Non-native	Yes	Low

No.	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2024)	Species of Conservation Significance	Distribution/Rarity (Figueroa et al., 2023)	Native Status (Figueroa et al., 2023)	Recorded Species	Ecological value
1	Agamidae	<i>Draco sumatranus</i>	Sumatran flying dragon	Least Concern	Least Concern	No	Ubiquitous and Common	Native	Yes	Medium
2	Varanidae	<i>Varanus nebulosus</i>	Clouded monitor	Not Listed	Least Concern	No	Wide-ranging and Common	Native	Yes	Medium
3	Colubridae (Ahaetuliinae)	<i>Dendrelaphis pictus</i>	Painted bronzeback	Least Concern	Least Concern	No	Widespread and Common	Native	Yes	Medium
4	Pythonidae	<i>Malayopython reticulatus</i>	Reticulated python	Least Concern	Least Concern	No	Widespread and Common	Native	Yes	Medium
5	Colubridae (Ahaetuliinae)	<i>Ahaetulla prasina</i>	Oriental whip snake	Least Concern	Least Concern	No	Widespread and Common	Native	Yes	Medium
6	Agamidae	<i>Bronchocela cristatella</i>	Green crested lizard	Least Concern	Least Concern	No	Widespread and Common	Native	Yes	Medium
7	Geckonidae	<i>Unidentified geckkonidae</i>	NA	NA	NA	NA	NA	NA	Yes	NA
8	Cylindrophiiidae	<i>Cylindrophis ruffus</i>	Red-tailed pipe snake	Least Concern	Vulnerable	Yes	Widespread but Rare	Native	No	High

No.	Type	Family	Scientific Name	Common Name	Global Status (IUCN/CITES)	National Status (NParks, 2024)	Species of Conservation Significance	Distribution/Rarity (NParks, 2023)	Recorded Species	Ecological Value
1	Dragonfly	Aeshnidae	Unidentified Aeshnidae	NA	NA	NA	NA	NA	Yes	NA
2	Dragonfly	Libellulidae	Crocothemis servilia	Common scarlet	Least Concern	Least Concern	No	Widespread and Common	Yes	Medium
3	Dragonfly	Libellulidae	Neurothemis fluctuans	Common parasol	Least Concern	Least Concern	No	Widespread and Common	Yes	Medium
4	Dragonfly	Libellulidae	Orthetrum glaucum	Common blue skimmer	Least Concern	Least Concern	Yes	Widespread and Common	Yes	Medium
5	Dragonfly	Libellulidae	Orthetrum sabina	Variegated green skimmer	Least Concern	Least Concern	No	Widespread and Common	Yes	Medium
6	Dragonfly	Libellulidae	Pantala flavescens	Wandering glider	Least Concern	Least Concern	No	Widespread and Common	Yes	Medium
7	Dragonfly	Libellulidae	Rhyothemis phyllis	Yellow-barred flutterer	Least Concern	Least Concern	No	Widespread and Common	Yes	Medium
8	Dragonfly	Libellulidae	Tholymis tillarga	White-barred duskhawk	Least Concern	Least Concern	No	Widespread and Common	Yes	Medium
9	Dragonfly	Libellulidae	Trithemis pallidinervis	Dancing dropwing	Least Concern	Least Concern	No	Widespread but Uncommon	Yes	Medium

Appendix 5G. Locations of Fauna of Conservation Significance

Taxon	Scientific Name	Common Name	IUCN	SRDB3	Abundance/Rarity	Latitude	Longitude
Bird	<i>Collocalia affinis</i>	Plume-toed swiftlet	Least Concern	Vulnerable	Uncommon	1.41119197	103.827287
Bird	<i>Pycnonotus zeylanicus</i>	Straw-headed bulbul	Critically Endangered	Endangered	Uncommon	1.413784996	103.829159
						1.411416018	103.829277
						1.411647024	103.826752
						1.41245001	103.825167
						1.412482029	103.825114
						1.412036028	103.825876
Bird	<i>Zosterops simplex</i>	Swinhoe's white-eye	Least Concern	Vulnerable	Common	1.411365978	103.827885
						1.411122987	103.827471
						1.411917005	103.826077
						1.411491036	103.82679
Bird	<i>Psittacula longicauda</i>	Long-tailed parakeet	Vulnerable	Near Threatened	Common	1.411206974	103.827274
						1.41100497	103.827645
Mammal	<i>Macaca fascicularis</i>	Long-tailed macaque	Endangered	Least Concern	Widespread but Common	1.411226	103.828452
						1.410681009	103.82884
						1.411592	103.8284

Appendix 5H. Habitat Impact Assessment

Phase	Impact type	Receptor	A1	A2.1	A2.2a	A2.2b	A2.2ab	A2.2	A2.3	AT	B1	B2	B3	B4	BT	Environmental Score (pre-mitigation)	Key Minimum Controls	Impact Significance (pre-mitigation)	Mitigation Measures	A1	A2.1	A2.2a	A2.2b	A2.2ab	A2.2	A2.3	AT	B1	B2	B3	B4	BT	Environmental Score (pre-mitigation)	Residual Impact Significance
Construction	Loss of habitat	Abandoned land forest	2	-1	3	4	12	3	3	-18	4	3	3	3	13	-234	N. A.	Moderate Negative Impact	NA	2	-1	3	4	12	3	3	-18	4	3	3	3	13	-234	Moderate Negative Impact
Construction	Loss of habitat	Scrubland / Grassland	1	-1	3	4	12	3	3	-9	4	3	3	3	13	-117	N. A.	Minor Negative Impact	NA	1	-1	3	4	12	3	3	-9	4	3	3	3	13	-117	Minor Negative Impact
Construction	Loss of habitat	Urban vegetation	1	-1	3	4	12	3	3	-9	4	3	3	3	13	-117	N. A.	Minor Negative Impact	NA	1	-1	3	4	12	3	3	-9	4	3	3	3	13	-117	Minor Negative Impact

Appendix 5I. Flora Impact Assessment

Phase	Impact type	Species	A1	A2.1	A2.2a	A2.2b	A2.2a _b	A2.2	A2.3	AT	B1	B2	B3	B4	BT	Environmental Score (pre-mitigation)	Key Minimum Controls	Impact Significance (pre-mitigation)	Mitigation Measures	A1	A2.1	A2.2a	A2.2b	A2.2a _b	A2.2	A2.3	AT	B1	B2	B3	B4	BT	Environmental Score (pre-mitigation)	Residual Impact Significance	Remarks
Construction	Mortality	<i>Adenia cordifolia</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351	Install hoarding to delimit impact; ensure works are kept within agreed working space	Major Negative Impact	1. Salvage saplings of species of conservation significance (0.3 m girth or less). 2. Engage flora specialists to monitor health of transplanted individuals.	3	-1	0	0	0	0	3	0	4	3	3	3	13	0	NA	100% of specimens can be salvaged
Construction	Mortality	<i>Cyrtococcum patens</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	1. Salvage saplings of species of conservation significance (0.3 m girth or less). 2. Engage flora specialists to monitor health of transplanted individuals.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA	100% of specimens can be salvaged
Construction	Mortality	<i>Glochidion zeylanicum</i> var. <i>zeylanicum</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	1. Salvage saplings of species of conservation significance (0.3 m girth or less). 2. Engage flora specialists to monitor health of transplanted individuals.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA	100% of specimens can be salvaged
Construction	Mortality	<i>Hornstedtia scyphifera</i> var. <i>scyphifera</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	1. Salvage saplings of species of conservation significance (0.3 m girth or less). 2. Engage flora specialists to monitor health of transplanted individuals.	3	-1	0	0	0	0	3	0	4	3	3	3	13	0	NA	100% of specimens can be salvaged
Construction	Mortality	<i>Horsfieldia cf. polyspherula</i> var. <i>polyspherula</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	1. Salvage saplings of species of conservation significance (0.3 m girth or less). 2. Engage flora specialists to monitor health of transplanted individuals.	3	-1	0	0	0	0	3	0	4	3	3	3	13	0	NA	100% of specimens can be salvaged
Construction	Mortality	<i>Lindera lucida</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	1. Salvage saplings of species of conservation significance (0.3 m girth or less). 2. Engage flora specialists to monitor health of transplanted individuals.	3	-1	2	4	8	3	3	-27	4	3	3	3	13	-351	Major Negative Impact	Only 25% of specimens can be salvaged.
Construction	Mortality	<i>Litsea castanea</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	1. Salvage saplings of species of conservation significance (0.3 m girth or less). 2. Engage flora specialists to monitor health of transplanted individuals.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA	100% of specimens can be salvaged
Construction	Mortality	<i>Litsea umbellata</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	1. Salvage saplings of species of conservation significance (0.3 m girth or less). 2. Engage flora specialists to monitor health of transplanted individuals.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA	100% of specimens can be salvaged
Construction	Mortality	<i>Macaranga griffithiana</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	1. Salvage saplings of species of conservation significance (0.3 m girth or less). 2. Engage flora specialists to monitor health of transplanted individuals.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA	100% of specimens can be salvaged
Construction	Mortality	<i>Melicope lunu-ankenda</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	1. Salvage saplings of species of conservation significance (0.3 m girth or less). 2. Engage flora specialists to monitor health of transplanted individuals.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA	100% of specimens can be salvaged
Construction	Mortality	<i>Microlepia speluncae</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	Specimens to be retained on site	3	-1	0	0	0	0	3	0	4	3	3	3	0	0	No Change	100% specimens within linear green and to be retained
Construction	Mortality	<i>Oncosperma horridum</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	-	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351	Major Negative Impact	None of the specimens can be salvaged
Construction	Mortality	<i>Symplocos fasciculata</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	1. Salvage saplings of species of conservation significance (0.3 m girth or less). 2. Engage flora specialists to monitor health of transplanted individuals.	3	-1	1	4	4	2	3	-18	4	3	3	3	13	-234	Moderate Negative Impact	67% of specimens can be salvaged
Construction	Mortality	<i>Xanthophyllum flavescens</i>	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	1. Salvage saplings of species of conservation significance (0.3 m girth or less). 2. Engage flora specialists to monitor health of transplanted individuals.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	NA	100% of specimens can be salvaged

Appendix 5J. Fauna Impact Assessment

	Impact type	Taxon	Receptor	Common name															Environmental Score (pre-mitigation)	Key Minimum Controls	Impact Significance (pre-mitigation)	Mitigation Measures																			Environmental Score (post-mitigation)	Residual Impact Significance
					A1	A2.1	A2.2a	A2.2b	A2.2ab	A2.2	A2.3	AT	B1	B2	B3	B4	BT	A1					A2.1	A2.2a	A2.2b	A2.2ab	A2.2	A2.3	AT	B1	B2	B3	B4	BT								
Construction	Accidental injury or mortality	Aculeata	<i>Amegilla insularis</i>	Island forest-digger	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	1) Install hoarding (to prevent fauna from entering or exiting site) 2) Establish wildlife response plan 3) Conduct pre-felling inspections before clearance	Minor Negative Impact	N.A.	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact						
Construction	Accidental injury or mortality	Aculeata	<i>Ceratina fuliginosa</i>	Dusky-winged small carpenter	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108		Minor Negative Impact		3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact						
Construction	Accidental injury or mortality	Aculeata	<i>Megachile indonesica</i>	Indonesian Resin Bee	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108		Minor Negative Impact		3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact						
Construction	Accidental injury or mortality	Bird	<i>Collocalia affinis</i>	Plume-toed swiftlet	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108		Minor Negative Impact		3	-1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact						
Construction	Accidental injury or mortality	Bird	<i>Psittacula longicauda</i>	Long-tailed parakeet	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	1) Directional site clearance 2) Regularly inspect hoarding and maintain its structural integrity 3) Ensure good housekeeping practices 4) Conduct biodiversity awareness training for site personnel (to reinforce wildlife response plan) 5) Conduct regular site inspection to ensure Contractor compliance with EMMP	Minor Negative Impact	1) Directional site clearance 2) Regularly inspect hoarding and maintain its structural integrity 3) Ensure good housekeeping practices 4) Conduct biodiversity awareness training for site personnel (to reinforce wildlife response plan) 5) Conduct regular site inspection to ensure Contractor compliance with EMMP	3	-1	1	1	1	1	1	3	-9	3	3	3	3	3	12	-108	Minor Negative Impact				
Construction	Accidental injury or mortality	Bird	<i>Pycnonotus zeylanicus</i>	Straw-headed bulbul	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108		Minor Negative Impact		3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact					
Construction	Accidental injury or mortality	Bird	<i>Zosterops simplex</i>	Swinhoe's white-eye	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108		Minor Negative Impact		3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact					
Construction	Accidental injury or mortality	Bird	<i>Elanus caeruleus</i>	Black-winged kite	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108		Minor Negative Impact		3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact					
Construction	Accidental injury or mortality	Bird	<i>Ichthyophaga ichthyaetus</i>	Grey-headed fish eagle	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Nisaetus cirrhatus</i>	Changeable hawk-eagle	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Spilornis cheela</i>	Crested serpent eagle	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Acrocephalus orientalis</i>	Oriental reed warbler	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Halcyon coromanda</i>	Ruddy kingfisher	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Apus nipalensis</i>	House swift	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Bubulcus coromandus</i>	Eastern cattle egret	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Cisticola juncidis</i>	Zitting cisticola	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Ptilinopus jambu</i>	Jambu fruit dove	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Treron curvirostra</i>	Thick-billed green pigeon	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Corvus macrorhynchos</i>	Large-billed crow	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Chrysococcyx xanthorhynchus</i>	Violet cuckoo	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Surniculus lugubris</i>	Square-tailed drongo-cuckoo	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Lonchura atricapilla</i>	Chestnut munia	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Copsychus saularis</i>	Oriental magpie-robin	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Cyornis brunneatus</i>	Brown-chested jungle flycatcher	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Ploceus philippinus</i>	Baya weaver	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Ketupa ketupu</i>	Buffy fish owl	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Bird	<i>Strix seloputo</i>	Spotted wood owl	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	1	1	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Butterfly	<i>Cephenes acalle niasicus</i>	Plain palm dart	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	2	2	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Butterfly	<i>Pelopidas assamensis</i>	Great swift	3	-1	1	2	2	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact	3	-1	1	2	2	1	1	3	-9	3	3	3	3	12	-108	Minor Negative Impact							
Construction	Accidental injury or mortality	Butterfly	<i>Pemara pugnans</i>	Pugnacious lancer	3	-1																																				

Phase	Impact type	Taxon	Receptor	Common name	A1	A2.1	A2.2a	A2.2b	A2.2ab	A2.2	A2.3	AT	B1	B2	B3	B4	BT	Environmental Score (pre-mitigation)	Key Minimum Controls	Impact Significance (pre-mitigation)	Mitigation Measures	A1	A2.1	A2.2a	A2.2b	A2.2ab	A2.2	A2.3	AT	B1	B2	B3	B4	BT	Environmental Score (post-mitigation)	Residual Impact Significance
Construction	Loss of/reduction in habitats	Bird	<i>Surniculus lugubris</i>	Square-tailed drongo-cuckoo	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Bird	<i>Lonchura atricapilla</i>	Chestnut munia	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Bird	<i>Lanius cristatus</i>	Brown shrike	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Bird	<i>Motacilla tschutschensis</i>	Eastern yellow wagtail	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Bird	<i>Copsychus saularis</i>	Oriental magpie-robin	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Bird	<i>Cyornis brunneatus</i>	Brown-chested jungle flycatcher	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Bird	<i>Ploceus philippinus</i>	Baya weaver	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Bird	<i>Ketupa ketupu</i>	Buffy fish owl	3	-1	1	1	1	1	3	-9	4	3	3	3	13	-117		Minor Negative Impact		3	-1	1	1	1	1	3	-9	4	3	3	13	-117	Minor Negative Impact	
Construction	Loss of/reduction in habitats	Bird	<i>Strix seloputo</i>	Spotted wood owl	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Butterfly	<i>Cephrenes acalle niasicus</i>	Plain palm dart	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Butterfly	<i>Pelopidas assamensis</i>	Great swift	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Butterfly	<i>Pemara pugnans</i>	Pugnacious lancer	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Butterfly	<i>Catochrysops strabo strabo</i>	Forget-me-not	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Butterfly	<i>Papilio memnon agenor</i>	Great mormon	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Butterfly	<i>Troides helena cerberus</i>	Common birdwing	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Mammal	<i>Macaca fascicularis</i>	Long-tailed macaque	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Mammal	<i>Manis javanica</i>	Sunda pangolin	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Mammal	<i>Lutrogale perspicillata</i>	Smooth-coated otter	3	-1	1	1	1	1	3	-9	4	3	3	3	13	-117		Minor Negative Impact		3	-1	1	1	1	1	3	-9	4	3	3	13	-117	Minor Negative Impact	
Construction	Loss of/reduction in habitats	Mammal	<i>Taphozous longimanus</i>	Long-winged tomb bat	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Mammal	<i>Eonycteris spelaea</i>	Cave nectar bat	3	-1	3	4	12	3	3	-27	4	3	3	3	13	-351		Major Negative Impact		3	-1	3	4	12	3	3	-27	4	3	3	13	-351	Major Negative Impact	
Construction	Loss of/reduction in habitats	Reptile	<i>Cylindrophis ruffus</i>	Red-tailed pipe snake	3	-1	1	1	1	1	3	-9	4	3	3	3	13	-117		Minor Negative Impact		3	-1	1	1	1	1	3	-9	4	3	3	13	-117	Minor Negative Impact	
Construction	Loss/reduction of ecological	Aculeata	<i>Amegilla insularis</i>	Island forest-digger	3	-1	1	2	2	1	3	-9	3	2	3	3	11	-99	N.A.	Minor Negative Impact	N.A.	3	-1	1	2	2	1	3	-9	3	2	3	11	-99	Minor Negative Impact	
Construction	Loss/reduction of ecological	Aculeata	<i>Ceratina fuliginosa</i>	Dusky-winged small carpenter	3	-1	1	2	2	1	3	-9	3	2	3	3	11	-99		Minor Negative Impact		3	-1	1	2	2	1	3	-9	3	2	3	11	-99	Minor Negative Impact	
Construction	Loss/reduction of ecological	Aculeata	<i>Megachile indonesica</i>	Indonesian Resin Bee	3	-1	1	2	2	1	3	-9	3	2	3	3	11	-99		Minor Negative Impact		3	-1	1	2	2	1	3	-9	3	2	3	11	-99	Minor Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Collocalia affinis</i>	Plume-toed swiftlet	3	-1	0	0	0	0	3	0	3	2	3	3	11	0		No Change		3	-1	0	0	0	0	3	2	3	3	11	0	No Change		
Construction	Loss/reduction of ecological	Bird	<i>Pittacula longicauda</i>	Long-tailed parakeet	3	-1	1	2	2	1	3	-9	3	2	3	3	11	-99		Minor Negative Impact		3	-1	1	2	2	1	3	-9	3	2	3	11	-99	Minor Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Pycnonotus zeylanicus</i>	Straw-headed bulbul	3	-1	3	2	6	2	3	-18	3	2	3	3	11	-198		Moderate Negative Impact		3	-1	3	2	6	2	3	-18	3	2	3	11	-198	Moderate Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Zosterops simplex</i>	Swinhoe's white-eye	3	-1	0	0	0	0	3	0	3	2	3	3	11	0		No Change		3	-1	0	0	0	0	3	2	3	3	11	0	No Change		
Construction	Loss/reduction of ecological	Bird	<i>Elaeus caeruleus</i>	Black-winged kite	3	-1	1	2	2	1	3	-9	3	2	3	3	11	-99		Minor Negative Impact		3	-1	1	2	2	1	3	-9	3	2	3	11	-99	Minor Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Ichthyophaga ichthyaetus</i>	Grey-headed fish eagle	3	-1	1	2	2	1	3	-9	3	2	3	3	11	-99		Minor Negative Impact		3	-1	1	2	2	1	3	-9	3	2	3	11	-99	Minor Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Nisaetus cirrhatus</i>	Changeable hawk-eagle	3	-1	1	2	2	1	3	-9	3	2	3	3	11	-99		Minor Negative Impact		3	-1	1	2	2	1	3	-9	3	2	3	11	-99	Minor Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Spilornis cheela</i>	Crested serpent eagle	3	-1	1	2	2	1	3	-9	3	2	3	3	11	-99		Minor Negative Impact		3	-1	1	2	2	1	3	-9	3	2	3	11	-99	Minor Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Acrocephalus orientalis</i>	Oriental reed warbler	3	-1	0	0	0	0	3	0	3	2	3	3	11	0		No Change		3	-1	0	0	0	0	3	2	3	3	11	0	No Change		
Construction	Loss/reduction of ecological	Bird	<i>Halcyon coromanda</i>	Ruddy kingfisher	3	-1	3	2	6	2	3	-18	3	2	3	3	11	-198		Moderate Negative Impact		3	-1	3	2	6	2	3	-18	3	2	3	11	-198	Moderate Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Apus nipalensis</i>	House swift	3	-1	0	0	0	0	3	0	3	2	3	3	11	0		No Change		3	-1	0	0	0	0	3	2	3	3	11	0	No Change		
Construction	Loss/reduction of ecological	Bird	<i>Bubulcus coromandus</i>	Eastern cattle egret	3	-1	2	2	4	2	3	-18	3	2	3	3	11	-198		Moderate Negative Impact		3	-1	2	2	4	2	3	-18	3	2	3	11	-198	Moderate Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Cisticola juncidis</i>	Zitting cisticola	3	-1	1	2	2	1	3	-9	3	2	3	3	11	-99		Minor Negative Impact		3	-1	1	2	2	1	3	-9	3	2	3	11	-99	Minor Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Ptilinopus jambu</i>	Jambu fruit dove	3	-1	3	2	6	2	3	-18	3	2	3	3	11	-198		Moderate Negative Impact		3	-1	3	2	6	2	3	-18	3	2	3	11	-198	Moderate Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Treeron curvirostra</i>	Thick-billed green pigeon	3	-1	3	2	6	2	3	-18	3	2	3	3	11	-198		Moderate Negative Impact		3	-1	3	2	6	2	3	-18	3	2	3	11	-198	Moderate Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Corvus macrorhynchos</i>	Large-billed crow	3	-1	2	2	4	2	3	-18	3	2	3	3	11	-198		Moderate Negative Impact		3	-1	2	2	4	2	3	-18	3	2	3	11	-198	Moderate Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Chrysococcyx xanthorhynchus</i>	Violet cuckoo	3	-1	3	2	6	2	3	-18	3	2	3	3	11	-198		Moderate Negative Impact		3	-1	3	2	6	2	3	-18	3	2	3	11	-198	Moderate Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Surniculus lugubris</i>	Square-tailed drongo-cuckoo	3	-1	3	2	6	2	3	-18	3	2	3	3	11	-198		Moderate Negative Impact		3	-1	3	2	6	2	3	-18	3	2	3	11	-198	Moderate Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Lonchura atricapilla</i>	Chestnut munia	3	-1	2	2	4	2	3	-18	3	2	3	3	11	-198		Moderate Negative Impact		3	-1	2	2	4	2	3	-18	3	2	3	11	-198	Moderate Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Lanius cristatus</i>	Brown shrike	3	-1	0	0	0	0	3	0	3	2	3	3	11	0		No Change		3	-1	0	0	0	0	3	0	3	2	3	11	0	No Change	
Construction	Loss/reduction of ecological	Bird	<i>Motacilla tschutschensis</i>	Eastern yellow wagtail	3	-1	0	0	0	0	3	0	3	2	3	3	11	0		No Change		3	-1	0	0	0	0	3	0	3	2	3	11	0	No Change	
Construction	Loss/reduction of ecological	Bird	<i>Copsychus saularis</i>	Oriental magpie-robin	3	-1	1	2	2	1	3	-9	3	2	3	3	11	-99		Minor Negative Impact		3	-1	1	2	2	1	3	-9	3	2	3	11	-99	Minor Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Cyornis brunneatus</i>	Brown-chested jungle flycatcher	3	-1	0	0	0	0	3	0	3	2	3	3	11	0		No Change		3	-1	0	0	0	0	3	0	3	2	3	11	0	No Change	
Construction	Loss/reduction of ecological	Bird	<i>Ploceus philippinus</i>	Baya weaver	3	-1	2	2	4	2	3	-18	3	2	3	3	11	-198		Moderate Negative Impact		3	-1	2	2	4	2	3	-18	3	2	3	11	-198	Moderate Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Ketupa ketupu</i>	Buffy fish owl	3	-1	2	2	4	2	3	-18	3	2	3	3	11	-198		Moderate Negative Impact		3	-1	2	2	4	2	3	-18	3	2	3	11	-198	Moderate Negative Impact	
Construction	Loss/reduction of ecological	Bird	<i>Strix seloputo</i>	Spotted wood owl	3	-1	1	2	2	1																										

Phase	Impact type	Taxon	Receptor	Common name	A1	A2.1	A2.2a	A2.2b	A2.2ab	A2.2	A2.3	AT	B1	B2	B3	B4	BT	Environmental Score (pre-mitigation)	Key Minimum Controls	Impact Significance (pre-mitigation)	Mitigation Measures	A1	A2.1	A2.2a	A2.2b	A2.2ab	A2.2	A2.3	AT	B1	B2	B3	B4	BT	Environmental Score (post-mitigation)	Residual Impact Significance
Operational	Human-wildlife conflict	Aculeata	<i>Ceratina fuliginosa</i>	Dusky-winged small carpenter	3	-1	2	3	6	2	3	-18	4	3	3	3	13	-234		Moderate Negative Impact	Advisories to be placed up at lift lobbies/notice board/AHEV	3	-1	2	1	2	1	3	-9	4	3	3	3	13	-117	Minor Negative Impact
Operational	Human-wildlife conflict	Aculeata	<i>Megachile indonesica</i>	Indonesian Resin Bee	3	-1	2	3	6	2	3	-18	4	3	3	3	13	-234		Moderate Negative Impact		3	-1	2	1	2	1	3	-9	4	3	3	3	13	-117	Minor Negative Impact
Operational	Human-wildlife conflict	Bird	<i>Collocalia affinis</i>	Plume-toed swiftlet	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change	N.A.	3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Psittacula longicauda</i>	Long-tailed parakeet	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Pycnonotus zeylanicus</i>	Straw-headed bulbul	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Zosterops simplex</i>	Swinhoe's white-eye	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Elanus caeruleus</i>	Black-winged kite	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Ichthyophaga ichthyaetus</i>	Grey-headed fish eagle	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Nisaetus cirrhatus</i>	Changeable hawk-eagle	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Spilornis cheela</i>	Crested serpent eagle	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Acrocephalus orientalis</i>	Oriental reed warbler	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Halcyon coromanda</i>	Ruddy kingfisher	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Apus nipalensis</i>	House swift	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Bubulcus coromandus</i>	Eastern cattle egret	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Cisticola juncidis</i>	Zitting cisticola	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Ptilinopus jambu</i>	Jambu fruit dove	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Treron curvirostra</i>	Thick-billed green pigeon	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Corvus macrorhynchos</i>	Large-billed crow	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Chrysococcyx xanthurhynchus</i>	Violet cuckoo	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Surniculus lugubris</i>	Square-tailed drongo-cuckoo	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Lonchura atricapilla</i>	Chestnut munia	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Lanius cristatus</i>	Brown shrike	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Motacilla tschutschensis</i>	Eastern yellow wagtail	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Copsychus saularis</i>	Oriental magpie-robin	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Cyornis brunneatus</i>	Brown-chested jungle flycatcher	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Ploceus philippinus</i>	Baya weaver	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Ketupa ketupu</i>	Buffy fish owl	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Bird	<i>Strix seloputo</i>	Spotted wood owl	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Butterfly	<i>Cephrenes acalle niasicus</i>	Plain palm dart	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Butterfly	<i>Pelopidas assamensis</i>	Great swift	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Butterfly	<i>Pemara pugnans</i>	Pugnacious lancer	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Butterfly	<i>Catochrysops strabo strabo</i>	Forget-me-not	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Butterfly	<i>Papilio memnon agenor</i>	Great mormon	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Butterfly	<i>Troides helena cerberus</i>	Common birdwing	3	-1	0	0	0	0	3	0	4	3	3	3	13	0		No Change		3	-1	0	0	0	0	3	0	4	3	3	3	13	0	No Change
Operational	Human-wildlife conflict	Mammal	<i>Macaca fascicularis</i>	Long-tailed macaque	3	-1	3	3	9	3	3	-27	4	3	3	3	13	-351		Major Negative Impact	Advisories to be placed up at lift lobbies/notice board/AHEV	3	-1	3	1	3	1	3	-9	4	3	3	3	13	-117	Minor Negative Impact
Operational	Human-wildlife conflict	Mammal	<i>Manis javanica</i>	Sunda pangolin	3	-1	1	3	3	1	3	-9	4	3	3	3	13	-117		Minor Negative Impact		3	-1	1	1	1	1	3	-9	4	3	3	3	13	-117	Minor Negative Impact
Operational	Human-wildlife conflict	Mammal	<i>Lutrogale perspicillata</i>	Smooth-coated otter	3	-1	2	3	6	2	3	-18	4	3	3	3	13	-234		Moderate Negative Impact		3	-1	2	1	2	1	3	-9	4	3	3	3	13	-117	Minor Negative Impact
Operational	Human-wildlife conflict	Mammal	<i>Taphozous longimanus</i>	Long-winged tomb bat	3	-1	2	3	6	2	3	-18	4	3	3	3	13	-234		Moderate Negative Impact		3	-1	2	1	2	1	3	-9	4	3	3	3	13	-117	Minor Negative Impact
Operational	Human-wildlife conflict	Mammal	<i>Eonycteris spelaea</i>	Cave nectar bat	3	-1	1	3	3	1	3	-9	4	3	3	3	13	-117		Minor Negative Impact		3	-1	1	1	1	1	3	-9	4	3	3	3	13	-117	Minor Negative Impact
Operational	Loss/reduction of ecological	Reptile	<i>Cylindrophis ruffus</i>	Red-tailed pipe snake	3	-1	1	3	3	1	3	-9	4	3	3	3	13	-117		Minor Negative Impact	N.A.	3	-1	1	1	1	1	3	-9	4	3	3	3	13	-117	Minor Negative Impact
Operational	Loss/reduction of ecological	Aculeata	<i>Ameigilla insularis</i>	Island forest-digger	3	-1	1	2	2	1	3	-9	4	2	3	3	12	-108		Minor Negative Impact		3	-1	1	2	2	1	3	-9	4	2	3	3	12	-108	Minor Negative Impact
Operational	Loss/reduction of ecological	Aculeata	<i>Ceratina fuliginosa</i>	Dusky-winged small carpenter	3	-1	1	2	2	1	3	-9	4	2	3	3	12	-108		Minor Negative Impact		3	-1	1	2	2	1	3	-9	4	2	3	3	12	-108	Minor Negative Impact
Operational	Loss/reduction of ecological	Aculeata	<i>Megachile indonesica</i>	Indonesian Resin Bee	3	-1	1	2	2	1	3	-9	4	2	3	3	12	-108		Minor Negative Impact		3	-1	1	2	2	1	3	-9	4	2	3	3	12	-108	Minor Negative Impact
Operational	Loss/reduction of ecological	Bird	<i>Collocalia affinis</i>	Plume-toed swiftlet	3	-1	0	0	0	0	3	0	4	2	3	3	12	0		No Change	Linear green planting and precinct planting	3	-1	0	0	0	0	3	0	4	2	3	3	12	0	No Change
Operational	Loss/reduction of ecological	Bird	<i>Psittacula longicauda</i>	Long-tailed parakeet	3	-1	1	2	2	1	3	-9	4	2	3	3	12	-108		Minor Negative Impact		3	-1	1	1	1	1	3	-9	4	2	3	3	12	-108	Minor Negative Impact
Operational	Loss/reduction of ecological	Bird	<i>Pycnonotus zeylanicus</i>	Straw-headed bulbul	3	-1	3	2	6	2	3	-18	4	2	3	3	12	-216		Moderate Negative Impact	N.A.	3	-1	3	2	6	2	3	-18	4	2	3	3	12	-216	Moderate Negative Impact
Operational	Loss/reduction of ecological	Bird	<i>Zosterops simplex</i>	Swinhoe's white-eye	3	-1	0	0	0	0	3	0	4	2	3	3	12	0		No Change	Linear green planting and precinct	3	-1	0	0	0	0	3	0	4	2	3	3	12	0	No Change
Operational	Loss/reduction of ecological	Bird	<i>Elanus caeruleus</i>	Black-winged kite	3	-1	1	2	2	1	3	-9	4	2	3	3	12	-108		Minor Negative Impact	N.A.	3	-1	1	2	2	1	3	-9	4	2	3	3	12	-108	Minor Negative Impact
Operational	Loss/reduction of ecological	Bird	<i>Ichthyophaga ichthyaetus</i>	Grey-headed fish eagle	3	-1	1	2	2	1	3	-9	4	2	3	3	12	-108		Minor Negative Impact		3	-1	1	2	2	1	3	-9	4	2	3	3</			

Appendix 5K. List of Specimens to be Retained

Tree ID	Species	Family	Origin	Status	Habit	Northing	Easting	Girth/spread (m)	Height (m)	Remarks
-	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43661.766	27261.665	NA	NA	Linear green
-	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43663.646	27265.56	NA	NA	Linear green
-	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43656.767	27270.757	NA	NA	Linear green
-	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43661.324	27270.011	NA	NA	Linear green
-	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43654.8	27277.912	NA	NA	Linear green
-	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43650.267	27285.257	NA	NA	Linear green
-	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43646.396	27289.931	NA	NA	Linear green
-	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43645.069	27297.721	NA	NA	Linear green
-	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43644.514	27296.917	NA	NA	Linear green
-	<i>Microlepia speluncae</i>	Dennstaedtiaceae	Native	Vulnerable	Herb	43642.7	27302.441	NA	NA	Linear green
CTP6690	<i>Ficus benjamina</i>	Moraceae	Cryptogenic	-	Strangler	43807.06	27065.748	3.8	18	TPZ to be installed
SU0991	<i>Ficus microcarpa</i>	Moraceae	Native	Least concern	Strangler	43603.736	27464.52	20	20	TPZ to be installed
SU0991A	<i>Ficus microcarpa</i>	Moraceae	Native	Least concern	Strangler	43604.352	27478.325	-	-	Additional GPS point
SU0991B	<i>Ficus microcarpa</i>	Moraceae	Native	Least concern	Strangler	43608.561	27469.717	-	-	Additional GPS point
SU0843	<i>Durio zibethinus</i>	Malvaceae	Exotic	Casual	Tree	43630.03	27503.797	2	30	Precinct
SU0844	<i>Durio zibethinus</i>	Malvaceae	Exotic	Casual	Tree	43635.524	27510.407	3.2	30	Precinct
SU0848	<i>Hevea brasiliensis</i>	Euphorbiaceae	Exotic	Naturalised	Tree	43622.371	27514.248	1.1	18	Precinct
SU0849	<i>Durio zibethinus</i>	Malvaceae	Exotic	Casual	Tree	43618.796	27513.061	1.8	30	Precinct
SU0850	<i>Macaranga gigantifolia</i>	Euphorbiaceae	Native	Least concern	Tree	43612.916	27503.2	1.1	15	Precinct
SU0851	<i>Hevea brasiliensis</i>	Euphorbiaceae	Exotic	Naturalised	Tree	43604.846	27500.255	1.2	18	Precinct
SU0852	<i>Syzygium grande</i>	Myrtaceae	Native	Least concern	Tree	43604.504	27489.274	1.2	20	Precinct
SU0853	<i>Hevea brasiliensis</i>	Euphorbiaceae	Exotic	Naturalised	Tree	43607.699	27486.925	1.8	10	Precinct
SU0854	<i>Cinnamomum iners</i>	Lauraceae	Native	Least concern	Tree	43599.396	27503.35	1	12	Precinct
SU0855	<i>Dimocarpus longan</i>	Sapindaceae	Exotic	Casual; cultivated	Tree	43598.064	27501.721	1.1	12	Precinct
SU0856	<i>Hevea brasiliensis</i>	Euphorbiaceae	Exotic	Naturalised	Tree	43594.936	27507.612	2	20	Precinct
SU0857	<i>Cinnamomum iners</i>	Lauraceae	Native	Least concern	Tree	43592.305	27508.501	1.1	18	Precinct
SU0858	<i>Dimocarpus longan</i>	Sapindaceae	Exotic	Casual; cultivated	Tree	43603.025	27514.835	1.1	15	Precinct
SU0862	<i>Dimocarpus longan</i>	Sapindaceae	Exotic	Casual; cultivated	Tree	43621.166	27523.025	1.5	15	Precinct
SU0863	<i>Hevea brasiliensis</i>	Euphorbiaceae	Exotic	Naturalised	Tree	43617.304	27530.704	1.1	15	Precinct
SU0864	<i>Hevea brasiliensis</i>	Euphorbiaceae	Exotic	Naturalised	Tree	43619.876	27530.188	1.1	15	Precinct
SU0865	<i>Hevea brasiliensis</i>	Euphorbiaceae	Exotic	Naturalised	Tree	43616.898	27535.379	1.2	15	Precinct
SU0866	<i>Hevea brasiliensis</i>	Euphorbiaceae	Exotic	Naturalised	Tree	43624.505	27528.569	1.5	15	Precinct
SU0868	<i>Hevea brasiliensis</i>	Sapindaceae	Exotic	Casual; cultivated	Tree	43624.875	27532.699	1.1	18	Precinct
SU0871	<i>Durio zibethinus</i>	Malvaceae	Exotic	Casual	Tree	43638.767	27529.751	1	20	Precinct
SU0872	<i>Macaranga gigantifolia</i>	Euphorbiaceae	Native	Least concern	Tree	43634.806	27540.287	1.4	10	Precinct
SU0874	<i>Dimocarpus longan</i>	Sapindaceae	Exotic	Casual; cultivated	Tree	43647.027	27534.884	1	12	Precinct

Appendix 5L. Proposed Species for Planting Palette

Scientific Name	Native Status	Common Name	Habit	Forest Enhancement (Species to be planted for infill planting in closed canopy habitat, to increase species diversity)	Street/ Promenade	Attracts Butterflies /Host Plant	Market Availability	Remarks	Species is found in Yishun EIA site	Associated fauna found/ probable in Yishun EIA site	Target fauna species observed onsite	Suitable in Linear Green	Suitable in Precinct	Canopy	Understory	Undergrowth	Epiphyte
<i>Alseodaphne latifolia</i>	Native	Tree Fern	Tree	Yes	-	-	Yes	Attracts <i>Delias hyparete metarete</i>	Yes	-	-	-	Yes	-	Yes	-	-
<i>Alokia angustiloba</i>	Native	Common Pulai	Tree	Yes	Yes	Yes	Yes		-	Yes	<i>Delias hyparete metarete</i>	Yes	Yes	Yes	-	-	-
<i>Angiopteris evecta</i>	Native	Elephant Fern	Herb	Yes	-	-	Yes		Yes	-	-	-	Yes	-	Yes	-	-
<i>Andisia elliptica</i>	Native	Sea-shore Cordia	Tree	Yes	Yes	Yes	Yes	Host plant for <i>Abisara salurella kassambioides</i> and <i>Taça bagarius</i>	-	-	-	Yes	Yes	-	Yes	-	-
<i>Aurundia graminifolia</i>	Native	Bamboo Orchid	Herb/Orchid	-	Yes	-	Yes		Yes	-	-	Yes	-	-	-	Yes	-
<i>Asplenium nidus</i>	Native	Bird's Nest Fern	Epiphyte	-	Yes	-	Yes		-	-	-	Yes	-	-	-	-	Yes
<i>Barringtonia racemosa</i>	Native	Pulai Kampung	Tree	Yes			Yes	It is the food plant for caterpillars of the moths <i>Altacus albus</i> (Atlas Moth), <i>Graphiproctodes tonsonis</i> , and <i>Thossea andamanica</i> . Its flowers are pollinated by bats and moths	Yes	Yes	Bats	Yes	-	Yes	-	-	-
<i>Caryota mitis</i>	Native	Fishtail Palm	Tree	Yes	Yes	Yes	Yes	Host plant for <i>Elymnias hypermetrae apina</i> , <i>Faunis canens areolaris</i> , <i>Platynia naga</i> and <i>Elymnias panthera</i>	Yes	Yes	<i>Elymnias hypermetrae apina</i> and <i>Elymnias panthera</i>	Yes	Yes	-	Yes	-	-
<i>Chelbocostus speciosus</i>	Native	Crape Ginger	Herb	-	Yes	Yes	Yes	Host plant for <i>Udaspes folus</i>	Yes	Yes	<i>Udaspes folus</i>	Yes	-	-	-	Yes	-
<i>Cinnamomum iners</i>	Native	Wild Cinnamon	Tree	Yes	Yes	Yes	Yes	Host plant for <i>Chenitra fraga faga</i> , <i>Chilasa clytia clytia</i> and <i>Graphium sarpedon lactatus</i>	Yes	Yes	<i>Graphium sarpedon lactatus</i>	Yes	Yes	Yes	-	-	-
<i>Cratogeomys cochinchinense</i>	Native	Yellow Cow Wood	Tree	Yes	Yes	Yes	Yes	Host plant for <i>Eurema hecabe contubernalis</i> , <i>Lixias pardalis diritana</i> and <i>Phaedyra columella singa</i>	Yes	Yes	<i>Eurema</i> sp.	Yes	Yes	Yes	-	-	-
<i>Cratogeomys formosum</i>	Native	Mempat	Tree	Yes	Yes	Yes	Yes	Host plant for <i>Eurema hecabe contubernalis</i> and <i>Lixias pardalis diritana</i> ; Attracts <i>Delias hyparete metarete</i>	-	Yes	<i>Eurema</i> sp. and <i>Delias hyparete metarete</i>	Yes	Yes	Yes	-	-	-
<i>Cyrtophyllum fragrans</i>	Native	Tembusu	Tree	Yes	Yes	Yes	Yes	Attracts <i>Delias hyparete metarete</i>	-	Yes	<i>Delias hyparete metarete</i>	-	Yes	Yes	-	-	-
<i>Cyrtostachys randa</i>	Native	Lalang Palm	Shrub	Yes	-	Yes	Yes	Host plant for <i>Graphania trichogaster</i>	-	-	-	Yes	-	-	Yes	-	-
<i>Dianella ensifolia</i>	Native	Campanula Orchid	Herb	Yes	Yes	-	Yes		-	-	-	Yes	-	-	-	Yes	-
<i>Eleocharis mastalis</i>	Native	Small-leaf Oil Fruit	Tree	Yes	-	-	Yes	Provides food for birds. May stain promenade.	-	Yes	Birds	-	Yes	Yes	-	-	-
<i>Fagraea auriculata</i>	Native	Pairi Musang	Epiphyte	-	-	-	Yes		-	-	-	Yes	-	-	-	-	Yes
<i>Novia lae</i>	Native	Eschwe	Epiphyte	-	-	-	Yes		-	-	-	Yes	-	-	-	-	Yes
<i>Leea indica</i>	Native	Bardicot Berry	Shrub	Yes	Yes	Yes	Yes	Attracts <i>lambrix salsala salsala</i> , <i>Cethosia hypsea hypsea</i> , <i>Neopithecops zalmora zalmora</i> , <i>Pyroneura latia latia</i> , <i>Eurema zari zodia</i> , <i>Tagides papetus albicus</i> , <i>Euploea cranei bremeri</i> , <i>Idopos vulgaris macrina</i> , <i>Spindasis lohta senania</i> , <i>Eurema hecabe contubernalis</i> , <i>Panemta aglaodes aglaodes</i> , <i>Eurema simulatrix hecassa</i> , <i>Gandaca harina dibani</i> , <i>Eurema blanda snellieri</i> , <i>Symenethia hippocus</i> , <i>lambrix stellifer</i> , <i>Ypthima huebneri</i>	Yes	Yes	<i>Eurema</i> sp., <i>lambrix salsala salsala</i>	Yes	-	-	Yes	-	-
<i>Leea rubra</i>	Native	Red Leea	Shrub	-	Yes	Yes	Yes	Attracts <i>Danaus melanippus hegesippus</i> , <i>Spindasis lohta senania</i> , <i>Spindasis syama terana</i> , <i>Nacaduba javana singapura</i> , <i>Tajuria cognis maenitius</i> , <i>Idopos vulgaris macrina</i> , <i>Eurema hecabe contubernalis</i> , <i>Chilasa clytia clytia</i> , <i>Phalanta phalantha phalantha</i> , <i>Hypolimnias anomala anomala</i> , <i>Hypolycaena eryllis healus</i> , <i>Graphium sarpedon lactatus</i> , <i>Danaus genivitta genivitta</i> and <i>Mycalasis minus macromalayana</i>	-	Yes	<i>Graphium sarpedon lactatus</i> , <i>Mycalasis minus macromalayana</i>	Yes	-	-	Yes	-	-
<i>Licuala spinosa</i>	Native	Mangrove Fan Palm	Shrub	Yes	-	Yes	Yes	Host plant for <i>Elymnias panthera panthera</i> and <i>Salicormia favovana</i>	-	Yes	<i>Elymnias panthera panthera</i>	-	Yes	-	-	Yes	-
<i>Melastoma malabathricum</i>	Native	Singapore Rhododendron	Shrub	Yes	Yes	Yes	Yes	Host plant for <i>Rapala arbus arbus</i> , <i>Spindasis lohta senania</i> , <i>Tenacio lae pusele</i> and <i>Samanga superba deliciosa</i>	Yes	Yes	<i>Rapala</i> sp., <i>Tenacio lae pusele</i>	Yes	-	-	-	Yes	-
<i>Morinda citrifolia</i>	Native	Noni	Tree/Shrub	Yes	-	Yes	Yes	Attracts <i>Cataglyphis pomona pomona</i> , <i>Curelis saronis saronis</i> and <i>Suaresia vivarana amissana</i>	Yes	Yes	<i>Cataglyphis pomona pomona</i>	-	Yes	-	Yes	-	-
<i>Parkia speciosa</i>	Native	Petai	Tree	Yes	-	Yes	Yes	Host plant for <i>Polysura hebe placus</i> , <i>Pantoporia hordonia hordonia</i> and <i>Surendra vivarana amissana</i>	-	-	-	-	Yes	Yes	-	-	-
<i>Pilea samaritanensis</i>	Native	Wild Pepper	Climber	-	Yes	Yes	Yes	Attracts <i>Pyroneura latia latia</i>	Yes	-	-	Yes	-	-	-	Yes	-
<i>Planchonella obovata</i>	Native	Sea Garia	Tree	Yes	Yes	Yes	Yes	Host plant for <i>Tanaccia pelva pelva</i>	-	-	-	Yes	Yes	Yes	-	-	-
<i>Procris repens</i>	Native	Watermelon Begonia	Herb	Yes	Yes	Yes	Yes	Can be full shade or semi shade	-	-	-	Yes	Yes	-	-	Yes	-
<i>Syzgium zeylanicum</i>	Native	Kalai Nasi Nasi	Tree	Yes	Yes	Yes	Yes	Host plant for <i>Arthemios emous genivitta</i> and <i>Rapala elipteris apodora</i>	Yes	Yes	<i>Rapala</i> sp.	Yes	Yes	Yes	-	-	-
<i>Vitex cinnata</i>	Native	Leban	Tree	Yes	-	-	Yes		-	-	-	Yes	Yes	Yes	-	-	-

Appendix 6A. Baseline Ambient Noise Results and Photographic Logs

CONFIDENTIAL

BASELINE NOISE SURVEY REPORT
NOISE MONITORING ENVIRONMENTAL WORK

REPORT REFERENCE NO: - 25021308/nms/ch2m/ForestYishunAve1/pt1

For

CH2M HILL SINGAPORE PTE LTD
150 Beach Road, Gateway West 34th Floor, Singapore 189720

Project Location:
Forest Along Yishun Avenue 1

Attention:
Ms Catherine Baldedara

Project Title.:
Baseline Noise Survey @ Sembawang Forest For Npark

Monitoring Location:
Sembawang Forest

Date of Monitoring:
23 January 2025 - 30 January 2025

Date of Report:
13 February 2025

Report is issued under the following conditions:

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1.0 INTRODUCTION

ENSSCOM PTE LTD was commissioned by:

CH2M HILL Singapore Pte Ltd
150 Beach Road, Gateway West 34th Floor, Singapore 189720

The purpose of this survey was to assess the current acoustical environment to establish the baseline background noise level generated before start of construction activities for

Project Title - Baseline Noise Survey @ Sembawang Forest For Npark

The survey is conducted in accordance to the Construction Noise control Guideline on NEA's permissible noise levels for construction sites and industrial premises.

2.0 NOISE SURVEY CONDITION

Report Reference No: 25021308/nms/ch2m/ForestYishunAve1/pt1

Date of Report: 13-Feb-2025

Survey On: 23-Jan-2025 (0700hrs) to 30-Jan-2025 (0700hrs)

Operating Condition of Site: All operations were under normal conditions during the noise survey. Construction activities have not begun during period of noise monitoring.

Noise survey was conducted using accepted standard procedures and appropriate sound measuring equipment, which is properly calibrated to ensure accuracy.

All noise measurements were made in terms of A-weighted equivalent continuous sound pressure level in LAeq,T over a period of time T. For example, LAeq,5min are the equivalent sound pressure level measured over a 5-minutes time.

Noise survey was conducted for a full continuous twenty-four (24) hours, Seven (7) days, for **One (1) monitoring points/location**. The noise levels emitted were monitored accordingly and recorded.

The survey is conducted by qualified noise monitoring personnel and reference to Appendix C for their certificate.

3.0 INSTRUMENTS

Monitoring instrument was positioned at between 1.8 meters to 3 meters in height from the floor (Ground Level), Mid Level (5 – 6 storey building height) Or High Level (Roof Level). Overall noise distribution was fairly homogenous throughout the duration of noise survey.

Sound Level Meter used complies and conform to the minimum requirements of a Type 1/Class 1 instrument specified in the International Electrotechnical Commission (IEC) publications of 60651 and 60804.

Before and after the noise measurements, the sound level meter is calibrated to verify the accuracy of the instrument.

3.1 Sound Level Meters

CIRRUS RESEARCH plc, Model: CR191SG
Class 1 Data Logging Sound Level Meter
Serial Number: **G303163**

3.2 Acoustic Calibrator

CIRRUS RESEARCH plc, Model: CR515
Acoustic Calibrator
Serial Number: **60614**

Acoustic Pressure level:	94.01 dB	(reference 20uPa)
Step +20dB:	113.93 dB	
Nominal Frequency:	992 Hz	

The calibration certificate of the monitoring instrument can be found in Appendix D

4.0 NOISE SURVEY TERMS

- 4.1 A Weighting
A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
- 4.2 Acoustic Calibrator
An instrument that provides a reference noise source that is used to calibrate and check the performance of a Sound Level Meter.
- 4.3 Broadband
Noise Measurements using parameters, which include all the audible noise
- 4.4 dB(A)
Decibels A Weighted
- 4.5 Decibel (dB)
The units of sound level and noise exposure measurement
- 4.6 Fast Time Weighting
A standard time weighting applied by the Sound Level Meter
- 4.7 IEC 60651:1979
The International Standard for Sound Level Meters
- 4.8 IEC 60804:1984
The International Standard for Integrating & Integrating-Averaging Sound Level Meters
- 4.9 IEC 61260:1995
The International Standard for 1:1 Octave & 1:3 Octave Band Filters
- 4.10 IEC 61672-1:2003
The International Standard for Sound Level Meter and Integrating Averaging Sound Level Meters that replaces both IEC 60651 and IEC 60804
- 4.11 Integrating Averaging Sound Level Meter
A Sound Level Meter which accumulates the total sound energy over a measurement period and calculates an average
- 4.12 LAeq,t
Equivalent continuous sound pressure level. A measure of the average sound pressure level during a period of time, t, in dB with 'A' weighting.
- 4.13 Sound Level
Sound Pressure Level with a Frequency weighting, such as dB(A)
- 4.14 Sound Level Meter
An instrument for measuring various noise parameters
- 4.15 Sound Pressure Level, SPL.
The basic measure of noise loudness, expressed in decibels

6.0 NOISE SURVEY RESULTS

The noise survey was carried out in accordance with the Environmental Pollution Control Act (Chapter 94A, Section 77(1)), Environmental Pollution Control (Control of Noise at Construction Sites) Regulations, 1999.

Monday to Saturday

Types of Affected Building	Maximum Noise Level Permitted for construction sites (reckoned as an equivalent continuous noise level over a period of 5 minutes) in decibel (A)		
	7am - 7pm	7pm - 10pm	10pm - 7am
(a) Hospitals, Schools, Institutions of Higher Learning, Homes for aged, Sick, etc	75 (Leq 5min)	55 (Leq 5min)	55 (Leq 5min)
	60 (LEQ 12hr)	50 (LEQ 12hr)	
(b) Residential Buildings Located less than 150m from the construction site where noise is being emitted	90 (Leq 5min)	70 (Leq 5min)	55 (Leq 5min)
	75 (LEQ 12hr)	65 (LEQ 1hr)	55 (LEQ 1hr)
(c) Buildings (other than those in Paragraphs (a) and (b) above	90 (Leq 5min)	70 (Leq 5min)	70 (Leq 5min)
	75 (LEQ 12hr)	65 (LEQ 12hr)	

Sunday and Public Holidays

Types of Affected Building	Maximum Noise Level Permitted for construction sites (reckoned as an equivalent continuous noise level over a period of 5 minutes) in decibel (A)		
	7am - 7pm	7pm - 10pm	10pm - 7am
(a) Hospitals, Schools, Institutions of Higher Learning, Homes for aged, Sick, etc	75 (Leq 5min)	55 (Leq 5min)	55 (Leq 5min)
	60 (LEQ 12hr)	50 (LEQ 12hr)	
(b) Residential Buildings Located less than 150m from the construction site where noise is being emitted	75 (Leq 5min)	55 (Leq 5min)	55 (Leq 5min)
	75 (LEQ 12hr)	-	-
(c) Buildings (other than those in Paragraphs (a) and (b) above	90 (Leq 5min)	70 (Leq 5min)	70 (Leq 5min)
	75 (LEQ 12hr)	65 (LEQ 12hr)	

Note:

No Work Rule on Sundays and Public Holidays

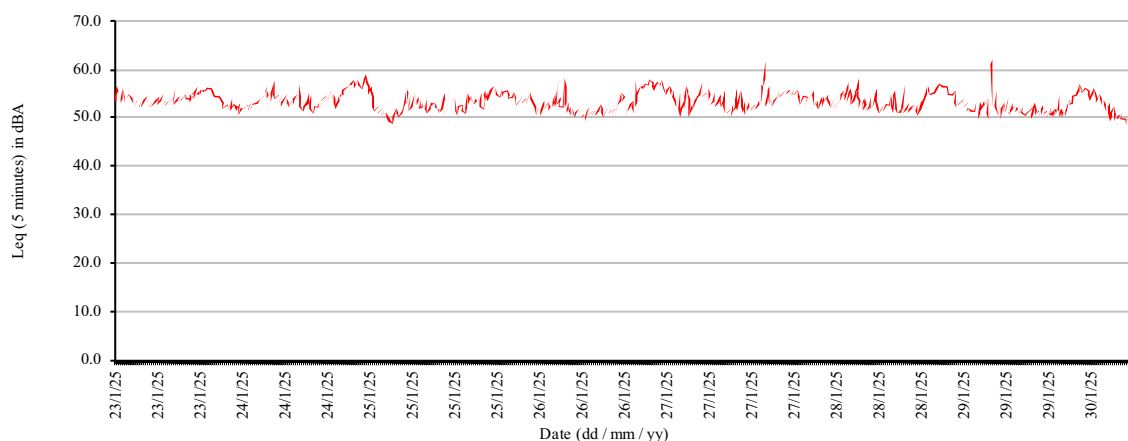
In addition to the settings of the permissible noise limits, NEA has also implemented a rule on prohibition of work on Sundays and Public Holidays (PH) for construction sites located within 150m away from residential premises and noise sensitive premises as follows:

Site Established from 1 September 2011. No work is allowed from 10.00pm on Sat/eve of PH to 7.00am on the following Mon/day after the PH. (For details, please refer to Appendix B)

Survey Results for monitoring point 1 from period : 23-Jan-2025 to 30-Jan-2025

Location : Sembawang Forest

Leq (5 Minutes) Plotted Against Date of Monitoring



Noise (Dosimeter)		Duration (DD/MM/YY Hr: Min)				Maximum Equivalent continuous sound level over 5 min in Leq db(A)	Maximum Noise Level permitted for construction sites Leq 5min db (A)
No. NM-1		From		To			
Sembawang Forest	Thu	23/1/25	0700	23/1/25	1900	58.3	90
	Thu	23/1/25	1900	23/1/25	2200	56.6	70
	Thu/Fri	23/1/25	2200	24/1/25	0700	56.3	70
	Fri	24/1/25	0700	24/1/25	1900	58.8	90
	Fri	24/1/25	1900	24/1/25	2200	57.0	70
	Fri/Sat	24/1/25	2200	25/1/25	0700	58.9	70
	Sat	25/1/25	0700	25/1/25	1900	58.7	90
	Sat	25/1/25	1900	25/1/25	2200	56.3	70
	Sat/Sun	25/1/25	2200	26/1/25	0700	55.9	70
	Sun	26/1/25	0700	26/1/25	1900	58.3	90
	Sun	26/1/25	1900	26/1/25	2200	57.6	70
	Sun/Mon	26/1/25	2200	27/1/25	0700	57.8	70
	Mon	27/1/25	0700	27/1/25	1900	61.5	90
	Mon	27/1/25	1900	27/1/25	2200	55.8	70
	Mon/Tue	27/1/25	2200	28/1/25	0700	56.1	70
	Tue	28/1/25	0700	28/1/25	1900	58.5	90
	Tue	28/1/25	1900	28/1/25	2200	57.5	70
	Tue/Wed	28/1/25	2200	29/1/25	0700	57.5	70
	Wed	29/1/25	0700	29/1/25	1900	62.0	90
	Wed	29/1/25	1900	29/1/25	2200	56.7	70
	Sun/Mon	29/1/25	2200	30/1/25	0700	56.7	70

Table 6.1 Summary of Noise Monitoring Results at Maximum Equivalent of LEQ 5 min

Noise (Dosimeter)		Duration (DD/MM/YY Hr: Min)				Maximum Equivalent continuous sound level over 1 hr in Leq db(A) for the specific period	Maximum Noise Level permitted for construction sites Leq 1 hr db (A)
No. NM-1		From		To			
Sembawang Forest	Thu	23/1/25	1900	23/1/25	2200	55.6	-
	Thu	23/1/25	2200	24/1/25	0700	55.8	-
	Fri	24/1/25	1900	24/1/25	2200	56.4	-
	Fri	24/1/25	2200	25/1/25	0700	57.1	-
	Sat	25/1/25	1900	25/1/25	2200	56.0	-
	Sat	25/1/25	2200	26/1/25	0700	55.2	-
	Sun	26/1/25	1900	26/1/25	2200	55.9	-
	Sun	26/1/25	2200	27/1/25	0700	56.9	-
	Mon	27/1/25	1900	27/1/25	2200	55.0	-
	Mon	27/1/25	2200	28/1/25	0700	55.3	-
	Tue	28/1/25	1900	28/1/25	2200	55.5	-
	Tue	28/1/25	2200	29/1/25	0700	56.6	-
	Wed	29/1/25	1900	29/1/25	2200	55.0	-
	Wed	29/1/25	2200	30/1/25	0700	55.8	-

Table 6.2 Summary of Noise Monitoring Results at Maximum Equivalent of LEQ 1 hr

Noise (Dosimeter)		Duration (DD/MM/YY Hr: Min)				Maximum Equivalent continuous sound level over 12 hr in Leq db(A)	Maximum Noise Level permitted for construction sites Leq 12 hr db (A)
No. NM-1		From		To			
Sembawang Forest	Thu	23/1/25	0700	23/1/25	1900	53.9	75
	Thu	23/1/25	1900	24/1/25	0700	53.9	65
	Fri	24/1/25	0700	24/1/25	1900	53.8	75
	Fri	24/1/25	1900	25/1/25	0700	54.4	65
	Sat	25/1/25	0700	25/1/25	1900	52.9	75
	Sat	25/1/25	1900	26/1/25	0700	53.9	65
	Sun	26/1/25	0700	26/1/25	1900	52.5	75
	Sun	26/1/25	1900	27/1/25	0700	55.1	65
	Mon	27/1/25	0700	27/1/25	1900	53.8	75
	Mon	27/1/25	1900	28/1/25	0700	54.0	65
	Tue	28/1/25	0700	28/1/25	1900	53.2	75
	Tue	28/1/25	1900	28/1/25	0700	54.2	65
	Wed	28/1/25	0700	29/1/25	1900	52.1	75
	Wed	29/1/25	1900	30/1/25	0700	53.3	65

Table 6.3 Summary of Noise Monitoring Results at LEQ 12 hr

Noise (Dosimeter)		Duration (DD/MM/YY Hr: Min)				Maximum Equivalent continuous sound level over specific period in Leq db(A)	Maximum Noise Level permitted for construction sites in db (A)
No. NM-1		From		To			
Sembawang Forest	Thu	23/1/25	700	23/1/25	1900	53.9	90(Leq5min) 75 (Leq12hrs)
	Thu	23/1/25	1900	23/1/25	2200	55.1	70 (Leq5min)
	Thu	23/1/25	2200	24/1/25	0000	55.3	70 (Leq5min)
	Fri	24/1/25	0000	24/1/25	700	52.6	70 (Leq5min)
	Fri	24/1/25	700	24/1/25	1900	53.8	90(Leq5min) 75 (Leq12hrs)
	Fri	24/1/25	1900	24/1/25	2200	55.1	70 (Leq5min)
	Fri	24/1/25	2200	25/1/25	0000	56.9	70 (Leq5min)
	Sat	25/1/25	0000	25/1/25	700	52.9	70 (Leq5min)
	Sat	25/1/25	700	25/1/25	1900	52.9	90(Leq5min) 75 (Leq12hrs)
	Sat	25/1/25	1900	25/1/25	2200	54.7	70 (Leq5min)
	Sat	25/1/25	2200	26/1/25	0000	55.0	70 (Leq5min)
	Sun	26/1/25	0000	26/1/25	700	53.2	70 (Leq5min)
	Sun	26/1/25	700	26/1/25	1900	52.5	90(Leq5min) 75 (Leq12hrs)
	Sun	26/1/25	1900	26/1/25	2200	54.0	70 (Leq5min)
	Sun	26/1/25	2200	27/1/25	0000	56.8	70 (Leq5min)
	Mon	27/1/25	0000	27/1/25	700	54.9	70 (Leq5min)
	Mon	27/1/25	700	27/1/25	1900	53.8	90(Leq5min) 75 (Leq12hrs)
	Mon	27/1/25	1900	27/1/25	2200	54.2	70 (Leq5min)
	Mon	27/1/25	2200	28/1/25	0000	55.0	70 (Leq5min)
	Tue	28/1/25	0000	28/1/25	700	53.6	70 (Leq5min)
	Tue	28/1/25	700	28/1/25	1900	53.2	90(Leq5min) 75 (Leq12hrs)
	Tue	28/1/25	1900	28/1/25	2200	54.2	70 (Leq5min)
	Tue	28/1/25	2200	29/1/25	0000	56.4	70 (Leq5min)
	Wed	29/1/25	0000	29/1/25	700	53.3	70 (Leq5min)
	Wed	29/1/25	700	29/1/25	1900	52.1	90(Leq5min) 75 (Leq12hrs)
	Wed	29/1/25	1900	29/1/25	2200	53.4	70 (Leq5min)
	Wed	29/1/25	2200	29/1/25	0000	55.5	70 (Leq5min)
	Thu	30/1/25	0000	30/1/25	0700	52.2	70 (Leq5min)

Table 6.4 Summary of Noise Monitoring Results at Continuous Equivalent of LEQ for specific period

7.0 SUMMARY

The purpose of this survey was to assess the current acoustical environment to establish the background noise level generated over One (1) monitoring point/location for continuous twenty-four (24) hours and seven (7) days noise monitoring at the boundary of the project site for Project Title

Baseline Noise Survey @ Sembawang Forest For Npark

The location of the nearest Noise Receiver (NSR) : **Sembawang Forest**

The findings show that,

The ambience noise at NSR Point 1 within the Sembawang Forest, falls within the Permissible limits stated in the NEA Guideline on construction noise control for most of the time period daily.

* Refer to Appendix E for full noise data report.

We recommend submitting an appeal to NEA to adjust the Noise Limit as in table 6.5 for NSR Point 1 within the Sembawang Forest

Background Noise Correction Factor

The adjusted value for the maximum noise level shall be obtained by adding the correction factor corresponding to the difference between the maximum permitted level and the background noise level, set out in the Table below, to the higher of the 2 noise levels.

Difference between 2 noise levels in decibels (A)	Correction factor in decibels (A)
a) Below 2	3
b) 2 to less than 4	2
c) 4 to less than 10	1
d) 10 and above	NIL

Proposed New Permissible Noise Level for monitoring point: **Sembawang Forest**

Period	Noise Limit	*Equivalent continuous sound level over period in Leq dB(A) - Background Noise	Difference	Correction Factor	Proposed Adjusted New Permissible Level (dBA)
7am to 7pm (Monday to Saturday)	90 (Leq 5min)	53.9	36.1	0	90 (Leq 5min)
	75 (Leq 12hr)	53.9	21.1	0	75 (Leq 12hr)
7pm to 10pm (Monday to Saturday)	70 (Leq 5min)	55.1	14.9	0	70 (Leq 5min)
10pm to 12am (Monday to Saturday)	70 (Leq 5min)	56.9	13.1	0	70 (Leq 5min)
12am to 7am (Monday to Saturday)	70 (Leq 5min)	54.9	15.1	0	70 (Leq 5min)
7pm to 7am (Monday to Saturday)	65 (Leq 12hrs)	54.4	10.6	0	65 (Leq 12hr)
7am to 7pm (Sunday)	90 (Leq 5min)	52.5	37.5	0	90 (Leq 5min)
	75 (Leq 12hr)	52.5	22.5	0	75 (Leq 12hr)
7pm to 10pm (Sunday)	70 (Leq 5min)	54.0	16.0	0	70 (Leq 5min)
10pm to 12am (Sunday)	70 (Leq 5min)	56.8	13.2	0	70 (Leq 5min)
12am to 7am (Sunday)	70 (Leq 5min)	53.2	16.8	0	70 (Leq 5min)
7pm to 7am (Sunday)	65 (Leq 12hrs)	55.1	9.9	1	66 (Leq 12hr)

* The highest equivalent continuous sound level in Leq dB(A) between Monday to Saturday is taken for calculating the adjusted new permissible level for each period.

Table 6.5 Proposed New Permissible Noise Level

8.0 CONFIRMATION

We, ENSSCOM PTE LTD, certify that the information given is correct. The noise survey was conducted for

CH2M HILL Singapore Pte Ltd
150 Beach Road, Gateway West 34th Floor, Singapore 189720

To carry out One (1) monitoring points/locations for continuous twenty-four (24) hours and seven (7) days noise monitoring at the boundary of the project site for Project Title

Baseline Noise Survey @ Sembawang Forest For Npark

was carried out as described in this report and the results resented herein.

Date of Monitoring:

From 23/1/25 (0700hrs) to 30/1/25 (0700hrs)

Hoo Hian Choon (Mr)
Noise Monitoring Consultant
13-Feb-2025

APPENDIX A : INSTRUMENT LAYOUT PLAN



APPENDIX B: NEA CONSTRUCTION NOISE CONTROL GUIDELINE

Construction Noise Control

Maximum Permissible Noise Levels for Construction Work Commenced on or after 1st October 2007

Noise Regulation

Mondays to Saturdays

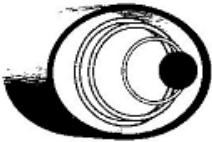
Types of affected buildings	7am - 7pm	7pm - 10pm	10pm - 7am
(a) Hospital, schools, institutions of higher learning, homes for aged sick, etc	60 dBA (Leq* 12 hrs)	50 dBA (Leq 12 hrs)	
	75 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)	
(b) Residential buildings located less than 150m from the construction site	75 dBA (Leq 12 hrs)	65 dBA (Leq 1 hr)	55 dBA (Leq 1 hr)
	90 dBA (Leq 5 mins)	70 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)
(c) Buildings other than those in (a) and (b) above	75 dBA (Leq 12 hrs)	65 dBA (Leq 12 hrs)	
	90 dBA (Leq 5 mins)	70 dBA (Leq 5 mins)	

Sundays and Public Holidays

Types of affected buildings	7am - 7pm	7pm - 10pm	10pm - 7am
(a) Hospital, schools, institutions of higher learning, homes for aged sick, etc	60 dBA (Leq* 12 hrs)	50 dBA (Leq 12 hrs)	
	75 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)	
(b) Residential buildings located less than 150m from the construction site	75 dBA (Leq 12 hrs)	-	
	75 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)	
(c) Buildings other than those in (a) and (b) above	75 dBA (Leq 12 hrs)	65 dBA (Leq 12 hrs)	
	90 dBA (Leq 5 mins)	70 dBA (Leq 5 mins)	

APPENDIX C: NOISE MONITORING OFFICER CERTIFICATES

S/No: 02/20/159



Acoustical Laboratory Pte Ltd
CENTRE FOR ENVIRONMENTAL CONSULTATION AND TRAINING

Certificate of Competence

This is to certify that

Hoo Hian Choon

has attended and passed an examination
for a course on

Noise Monitoring

held between 22nd May 2002 and 24th May 2002

Acoustical Laboratory is approved by the Ministry of
Labour as a Training Centre for the
Noise Monitoring Course




Tan Kok Yang
Course Co-ordinator


Koh L. B.
Managing Director



This is to certify that

Hoo Hian Choon

has successfully completed the 2½-day course

Industrial Noise Control

A handwritten signature in black ink, appearing to read "Seah Ben Hun".

Seah Ben Hun
Director
Centre for Continuing Education

27 August 2010

APPENDIX D: INSTRUMENT CALIBRATION CERTIFICATES



Certificate of Calibration

Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type	CR: 191 SG
Description	Sound Level Meter
Serial Number	G303163

Calibration Procedure

The instrument detailed above have been calibrated to the publish test and calibration data as detailed in the instrument hand book, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2013, IEC 61672-1:2002, IEC 60651:1979, IEC 60804: 2001, IEC 61260:1995, IEC 60942:2003, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983, ANSI S1.11-1986 and ANSI S1.43-1997 where applicable.
Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The instrument detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Multi Acoustic Calibrator	B & K 4226	Serial Number	3041345	Calibration Ref.	551220085662242
Microphone Type	MK 224	Serial Number	214953B	Calibration Ref.	187039

Calibrated by

Calibration Date

4 October 2024

Calibration Certificate Number

248176

This Calibration Certificate is valid for 12 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

CERTIFICATE OF CALIBRATION

ISSUED BY Cirrus Research plc
DATE OF ISSUE 03 January 2025 CERTIFICATE NUMBER 229571



Cirrus Research plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 2

Approved signatory
A. Windrass
Electronically signed:

Sound Calibrator : IEC 60942:2003

Instrument information

Manufacturer: Cirrus Research plc **Notes:**
Model: CR:515
Serial number: 60614
Class: 1

Test summary

Date of calibration: 03 January 2025

The sound calibrator detailed above has been calibrated to the published data as described in the operating manual and in the half-inch configuration. The procedures and techniques used are as described in IEC60942_2003 Annex B – Periodic Tests and three determinations of the sound pressure level, frequency and total distortion were made.

The sound pressure level was measured using a WS2F condenser microphone type MK:224 manufactured by Cirrus Research plc.

The results have been corrected to the reference pressure of 101.33 kPa using the manufacturer's data.

As public evidence was available, from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the Class 1 requirements of IEC 60942:2003.

The manufacturer's product information indicates that this model of sound calibrator has been formally pattern approved to IEC60942_2003 Annex A to Class 1. This has been confirmed by Laboratoire National d'Essais (LNE), Physikalisch-Technische Bundesanstalt (PTB) and APPLUS (APPLUS).

Notes:

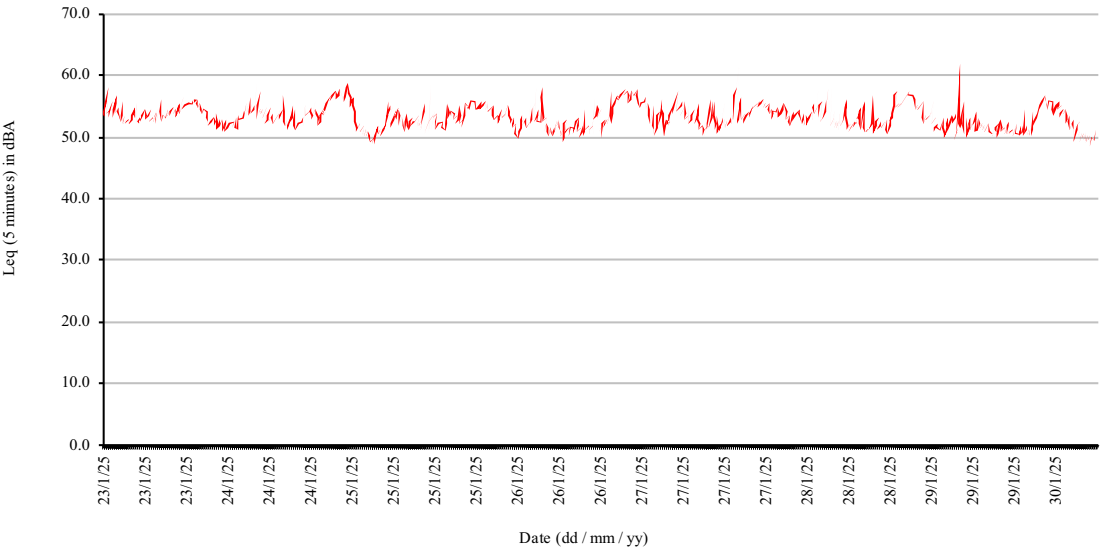
This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%.

APPENDIX E

CONSTRUCTION SITE NOISE MONITORING DATA AND CHART

NAME OF COMPANY	CH2M HILL Singapore Pte Ltd		
SITE LOCATION	Forest Along Yishun Avenue 1		
REPORT REFERENCE	23/01/2025 - 30/01/2025		
MODE	Environment	FREQUENCY WEIGHTING	A

Leq (5 Minutes) Plotted Against Date of Monitoring



NAME OF COMPANY			CH2M HILL Singapore Pte Ltd										
SITE LOCATION			Forest Along Yishun Avenue 1										
REPORT REFERENCE			23/01/2025 - 30/01/2025										
Start	23/1/25		7:05	Leq12h		53.9		Weighting		A			
End	23/1/25		19:00										
Date	Time	Leq5m		Date	Time	Leq5m		Date	Time	Leq5m			
23/1/25	7:05	53.5		23/1/25	11:05	52.8		23/1/25	15:05	52.8			
23/1/25	7:10	54.0		23/1/25	11:10	53.0		23/1/25	15:10	53.1			
23/1/25	7:15	56.3		23/1/25	11:15	52.8		23/1/25	15:15	53.7			
23/1/25	7:20	55.7		23/1/25	11:20	53.1		23/1/25	15:20	53.1			
23/1/25	7:25	54.6		23/1/25	11:25	52.7		23/1/25	15:25	53.2			
23/1/25	7:30	55.4		23/1/25	11:30	52.2		23/1/25	15:30	52.7			
23/1/25	7:35	58.3		23/1/25	11:35	52.5		23/1/25	15:35	52.9			
23/1/25	7:40	53.8		23/1/25	11:40	52.8		23/1/25	15:40	53.5			
23/1/25	7:45	54.1		23/1/25	11:45	52.8		23/1/25	15:45	52.8			
23/1/25	7:50	53.8		23/1/25	11:50	53.7		23/1/25	15:50	52.9			
23/1/25	7:55	54.7		23/1/25	11:55	53.3		23/1/25	15:55	54.4			
23/1/25	8:00	53.2		23/1/25	12:00	54.2		23/1/25	16:00	52.9			
23/1/25	8:05	54.1		23/1/25	12:05	55.0		23/1/25	16:05	52.2			
23/1/25	8:10	54.1		23/1/25	12:10	54.4		23/1/25	16:10	54.3			
23/1/25	8:15	56.0		23/1/25	12:15	53.9		23/1/25	16:15	54.5			
23/1/25	8:20	54.4		23/1/25	12:20	53.3		23/1/25	16:20	53.3			
23/1/25	8:25	54.5		23/1/25	12:25	55.4		23/1/25	16:25	53.1			
23/1/25	8:30	54.5		23/1/25	12:30	55.0		23/1/25	16:30	52.8			
23/1/25	8:35	54.2		23/1/25	12:35	53.2		23/1/25	16:35	53.7			
23/1/25	8:40	53.2		23/1/25	12:40	53.5		23/1/25	16:40	56.2			
23/1/25	8:45	53.7		23/1/25	12:45	52.9		23/1/25	16:45	54.1			
23/1/25	8:50	54.7		23/1/25	12:50	53.1		23/1/25	16:50	52.7			
23/1/25	8:55	54.1		23/1/25	12:55	52.5		23/1/25	16:55	52.8			
23/1/25	9:00	57.0		23/1/25	13:00	52.5		23/1/25	17:00	53.7			
23/1/25	9:05	55.6		23/1/25	13:05	53.5		23/1/25	17:05	53.9			
23/1/25	9:10	53.8		23/1/25	13:10	53.2		23/1/25	17:10	53.3			
23/1/25	9:15	55.0		23/1/25	13:15	52.1		23/1/25	17:15	54.0			
23/1/25	9:20	54.5		23/1/25	13:20	52.3		23/1/25	17:20	53.9			
23/1/25	9:25	54.2		23/1/25	13:25	52.3		23/1/25	17:25	54.0			
23/1/25	9:30	54.5		23/1/25	13:30	52.1		23/1/25	17:30	53.3			
23/1/25	9:35	54.2		23/1/25	13:35	52.3		23/1/25	17:35	54.5			
23/1/25	9:40	54.1		23/1/25	13:40	53.6		23/1/25	17:40	53.7			
23/1/25	9:45	53.6		23/1/25	13:45	53.3		23/1/25	17:45	54.1			
23/1/25	9:50	53.5		23/1/25	13:50	53.5		23/1/25	17:50	53.5			
23/1/25	9:55	54.0		23/1/25	13:55	53.9		23/1/25	17:55	53.7			
23/1/25	10:00	53.3		23/1/25	14:00	54.5		23/1/25	18:00	54.1			
23/1/25	10:05	52.6		23/1/25	14:05	53.7		23/1/25	18:05	54.2			
23/1/25	10:10	53.5		23/1/25	14:10	52.9		23/1/25	18:10	54.0			
23/1/25	10:15	55.8		23/1/25	14:15	53.1		23/1/25	18:15	53.6			
23/1/25	10:20	52.5	23/1/25	14:20	53.2	23/1/25	18:20	53.6					
23/1/25	10:25	53.5	23/1/25	14:25	52.9	23/1/25	18:25	54.1					
23/1/25	10:30	53.2	23/1/25	14:30	53.6	23/1/25	18:30	55.0					
23/1/25	10:35	52.3	23/1/25	14:35	53.4	23/1/25	18:35	54.8					
23/1/25	10:40	52.8	23/1/25	14:40	53.5	23/1/25	18:40	54.4					
23/1/25	10:45	52.4	23/1/25	14:45	53.9	23/1/25	18:45	55.1					
23/1/25	10:50	52.9	23/1/25	14:50	54.0	23/1/25	18:50	54.7					
23/1/25	10:55	52.2	23/1/25	14:55	54.7	23/1/25	18:55	54.0					
23/1/25	11:00	52.5	23/1/25	15:00	52.7	23/1/25	19:00	54.5					

NAME OF COMPANY			CH2M HILL Singapore Pte Ltd									
SITE LOCATION			Forest Along Yishun Avenue 1									
REPORT REFERENCE			23/01/2025 - 30/01/2025									
Start	23/1/25	19:05		Leq12h	53.9				Weighting		A	
End	24/1/25	7:00										
Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h	
23/1/25	19:05	54.1	54.3	23/1/25	23:05	55.4	54.7	24/1/25	3:05	52.1	51.6	
23/1/25	19:10	54.1		23/1/25	23:10	54.8		24/1/25	3:10	51.6		
23/1/25	19:15	53.8		23/1/25	23:15	55.4		24/1/25	3:15	51.0		
23/1/25	19:20	54.1		23/1/25	23:20	54.6		24/1/25	3:20	51.0		
23/1/25	19:25	54.3		23/1/25	23:25	55.0		24/1/25	3:25	51.1		
23/1/25	19:30	53.1		23/1/25	23:30	54.5		24/1/25	3:30	53.0		
23/1/25	19:35	54.9		23/1/25	23:35	54.8		24/1/25	3:35	52.2		
23/1/25	19:40	55.5		23/1/25	23:40	54.4		24/1/25	3:40	50.8		
23/1/25	19:45	54.7		23/1/25	23:45	54.2		24/1/25	3:45	50.6		
23/1/25	19:50	54.2		23/1/25	23:50	53.9		24/1/25	3:50	51.7		
23/1/25	19:55	54.5		23/1/25	23:55	54.6		24/1/25	3:55	51.7		
23/1/25	20:00	54.0	55.2	23/1/25	0:00	54.4	53.7	24/1/25	4:00	51.4	52.2	
23/1/25	20:05	55.3		24/1/25	0:05	54.8		24/1/25	4:05	51.8		
23/1/25	20:10	54.6		24/1/25	0:10	54.3		24/1/25	4:10	52.2		
23/1/25	20:15	55.0		24/1/25	0:15	55.0		24/1/25	4:15	51.9		
23/1/25	20:20	54.9		24/1/25	0:20	54.1		24/1/25	4:20	52.3		
23/1/25	20:25	56.6		24/1/25	0:25	54.2		24/1/25	4:25	52.6		
23/1/25	20:30	54.7		24/1/25	0:30	53.8		24/1/25	4:30	52.0		
23/1/25	20:35	54.8		24/1/25	0:35	54.3		24/1/25	4:35	52.2		
23/1/25	20:40	54.9		24/1/25	0:40	53.2		24/1/25	4:40	52.3		
23/1/25	20:45	55.3		24/1/25	0:45	52.7		24/1/25	4:45	51.8		
23/1/25	20:50	55.5		24/1/25	0:50	53.0		24/1/25	4:50	52.6		
23/1/25	20:55	55.6	55.6	24/1/25	0:55	52.0	52.5	24/1/25	4:55	52.6	52.5	
23/1/25	21:00	55.4		24/1/25	1:00	52.1		24/1/25	5:00	52.3		
23/1/25	21:05	55.0		24/1/25	1:05	51.7		24/1/25	5:05	51.7		
23/1/25	21:10	55.5		24/1/25	1:10	51.8		24/1/25	5:10	53.2		
23/1/25	21:15	55.5		24/1/25	1:15	52.4		24/1/25	5:15	51.6		
23/1/25	21:20	55.9		24/1/25	1:20	52.7		24/1/25	5:20	52.9		
23/1/25	21:25	56.0		24/1/25	1:25	52.4		24/1/25	5:25	52.0		
23/1/25	21:30	55.8		24/1/25	1:30	52.8		24/1/25	5:30	51.6		
23/1/25	21:35	55.3		24/1/25	1:35	53.2		24/1/25	5:35	52.0		
23/1/25	21:40	56.0		24/1/25	1:40	52.9		24/1/25	5:40	51.4		
23/1/25	21:45	55.5		24/1/25	1:45	52.7		24/1/25	5:45	53.6		
23/1/25	21:50	55.2	55.8	24/1/25	1:50	51.9	52.2	24/1/25	5:50	52.9	53.3	
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23/1/25	22:00	55.5		24/1/25	2:00	53.8		24/1/25	6:00	53.2		
23/1/25	22:05	55.9		24/1/25	2:05	52.5		24/1/25	6:05	52.8		
23/1/25	22:10	56.2		24/1/25	2:10	52.0		24/1/25	6:10	53.0		
23/1/25	22:15	56.0		24/1/25	2:15	51.4		24/1/25	6:15	53.3		
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23/1/25	22:25	55.6		24/1/25	2:25	51.3		24/1/25	6:25	53.0		
23/1/25	22:30	55.8		24/1/25	2:30	52.0		24/1/25	6:30	52.8		
23/1/25	22:35	55.7		24/1/25	2:35	52.8		24/1/25	6:35	53.3		
23/1/25	22:40	55.9		24/1/25	2:40	52.7		24/1/25	6:40	53.0		
23/1/25	22:45	55.9	24/1/25	2:45	52.3	24/1/25	6:45	54.1				
23/1/25	22:50	56.3	55.8	24/1/25	2:50	52.4	52.2	24/1/25	6:50	53.1	53.3	
23/1/25	22:55	55.6		24/1/25	2:55	53.0		24/1/25	6:55	53.8		
23/1/25	23:00	55.3		24/1/25	3:00	52.2		24/1/25	7:00	53.9		

NAME OF COMPANY			CH2M HILL Singapore Pte Ltd								
SITE LOCATION			Forest Along Yishun Avenue 1								
REPORT REFERENCE			23/01/2025 - 30/01/2025								
Start	24/1/25	7:05	19:00	Leq12h	53.8		Weighting			A	
End	24/1/25										
Date	Time	Leq5m		Date	Time	Leq5m		Date	Time	Leq5m	
24/1/25	7:05	53.7		24/1/25	11:05	54.8		24/1/25	15:05	52.9	
24/1/25	7:10	55.6		24/1/25	11:10	52.6		24/1/25	15:10	54.7	
24/1/25	7:15	53.6		24/1/25	11:15	52.3		24/1/25	15:15	53.0	
24/1/25	7:20	55.6		24/1/25	11:20	53.8		24/1/25	15:20	51.9	
24/1/25	7:25	54.8		24/1/25	11:25	53.2		24/1/25	15:25	52.1	
24/1/25	7:30	55.4		24/1/25	11:30	53.2		24/1/25	15:30	51.7	
24/1/25	7:35	53.5		24/1/25	11:35	52.9		24/1/25	15:35	52.4	
24/1/25	7:40	53.8		24/1/25	11:40	53.0		24/1/25	15:40	52.3	
24/1/25	7:45	54.1		24/1/25	11:45	52.1		24/1/25	15:45	51.1	
24/1/25	7:50	56.5		24/1/25	11:50	51.9		24/1/25	15:50	52.3	
24/1/25	7:55	54.9		24/1/25	11:55	52.2		24/1/25	15:55	52.6	
24/1/25	8:00	55.5		24/1/25	12:00	52.7		24/1/25	16:00	52.3	
24/1/25	8:05	54.8		24/1/25	12:05	52.2		24/1/25	16:05	52.0	
24/1/25	8:10	53.8		24/1/25	12:10	52.4		24/1/25	16:10	52.5	
24/1/25	8:15	53.8		24/1/25	12:15	52.3		24/1/25	16:15	52.4	
24/1/25	8:20	54.4		24/1/25	12:20	54.0		24/1/25	16:20	51.9	
24/1/25	8:25	54.2		24/1/25	12:25	52.7		24/1/25	16:25	52.4	
24/1/25	8:30	55.1		24/1/25	12:30	53.5		24/1/25	16:30	52.5	
24/1/25	8:35	55.5		24/1/25	12:35	52.9		24/1/25	16:35	53.1	
24/1/25	8:40	53.6		24/1/25	12:40	54.0		24/1/25	16:40	53.1	
24/1/25	8:45	53.6		24/1/25	12:45	53.9		24/1/25	16:45	53.1	
24/1/25	8:50	58.8		24/1/25	12:50	54.9		24/1/25	16:50	51.9	
24/1/25	8:55	53.0		24/1/25	12:55	53.0		24/1/25	16:55	52.1	
24/1/25	9:00	55.1		24/1/25	13:00	53.5		24/1/25	17:00	52.3	
24/1/25	9:05	55.0		24/1/25	13:05	54.7		24/1/25	17:05	55.3	
24/1/25	9:10	55.5		24/1/25	13:10	53.2		24/1/25	17:10	53.7	
24/1/25	9:15	57.6		24/1/25	13:15	56.9		24/1/25	17:15	53.8	
24/1/25	9:20	55.0		24/1/25	13:20	56.8		24/1/25	17:20	53.9	
24/1/25	9:25	54.0		24/1/25	13:25	54.3		24/1/25	17:25	53.7	
24/1/25	9:30	54.3	24/1/25	13:30	52.5	24/1/25	17:30	53.4			
24/1/25	9:35	54.6	24/1/25	13:35	52.4	24/1/25	17:35	54.3			
24/1/25	9:40	54.0	24/1/25	13:40	52.4	24/1/25	17:40	54.5			
24/1/25	9:45	54.5	24/1/25	13:45	51.9	24/1/25	17:45	53.7			
24/1/25	9:50	54.4	24/1/25	13:50	52.8	24/1/25	17:50	53.1			
24/1/25	9:55	54.6	24/1/25	13:55	52.3	24/1/25	17:55	53.7			
24/1/25	10:00	54.7	24/1/25	14:00	52.1	24/1/25	18:00	54.8			
24/1/25	10:05	53.1	24/1/25	14:05	51.4	24/1/25	18:05	54.2			
24/1/25	10:10	53.2	24/1/25	14:10	51.8	24/1/25	18:10	53.6			
24/1/25	10:15	53.1	24/1/25	14:15	52.1	24/1/25	18:15	53.0			
24/1/25	10:20	53.7	24/1/25	14:20	52.3	24/1/25	18:20	53.7			
24/1/25	10:25	55.0	24/1/25	14:25	53.5	24/1/25	18:25	53.8			
24/1/25	10:30	54.9	24/1/25	14:30	53.3	24/1/25	18:30	53.4			
24/1/25	10:35	52.2	24/1/25	14:35	52.4	24/1/25	18:35	54.0			
24/1/25	10:40	53.0	24/1/25	14:40	52.6	24/1/25	18:40	55.7			
24/1/25	10:45	52.9	24/1/25	14:45	52.4	24/1/25	18:45	53.9			
24/1/25	10:50	53.4	24/1/25	14:50	53.3	24/1/25	18:50	54.5			
24/1/25	10:55	53.7	24/1/25	14:55	55.2	24/1/25	18:55	54.5			
24/1/25	11:00	53.4	24/1/25	15:00	52.8	24/1/25	19:00	54.9			

NAME OF COMPANY			CH2M HILL Singapore Pte Ltd								
SITE LOCATION			Forest Along Yishun Avenue 1								
REPORT REFERENCE			23/01/2025 - 30/01/2025								
Start	24/1/25		19:05	Leq12h		54.4		Weighting		A	
End	25/1/25		7:00								
Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h
24/1/25	19:05	54.3	53.4	24/1/25	23:05	57.1	56.6	25/1/25	3:05	50.3	50.8
24/1/25	19:10	54.0		24/1/25	23:10	57.3		25/1/25	3:10	51.4	
24/1/25	19:15	53.8		24/1/25	23:15	57.2		25/1/25	3:15	51.0	
24/1/25	19:20	53.3		24/1/25	23:20	57.0		25/1/25	3:20	51.3	
24/1/25	19:25	52.0		24/1/25	23:25	56.6		25/1/25	3:25	51.1	
24/1/25	19:30	51.8		24/1/25	23:30	56.6		25/1/25	3:30	50.3	
24/1/25	19:35	52.6		24/1/25	23:35	56.6		25/1/25	3:35	50.1	
24/1/25	19:40	52.1		24/1/25	23:40	56.4		25/1/25	3:40	51.0	
24/1/25	19:45	52.2		24/1/25	23:45	55.9		25/1/25	3:45	50.6	
24/1/25	19:50	53.6		24/1/25	23:50	55.6		25/1/25	3:50	50.7	
24/1/25	19:55	54.6	55.0	24/1/25	23:55	56.4	57.1	25/1/25	3:55	51.0	49.8
24/1/25	20:00	54.7		24/1/25	0:00	56.4		25/1/25	4:00	50.9	
24/1/25	20:05	54.1		25/1/25	0:05	56.5		25/1/25	4:05	50.3	
24/1/25	20:10	53.7		25/1/25	0:10	56.6		25/1/25	4:10	50.3	
24/1/25	20:15	54.2		25/1/25	0:15	58.1		25/1/25	4:15	50.2	
24/1/25	20:20	53.7		25/1/25	0:20	58.9		25/1/25	4:20	49.9	
24/1/25	20:25	54.5		25/1/25	0:25	58.7		25/1/25	4:25	49.4	
24/1/25	20:30	54.7		25/1/25	0:30	57.2		25/1/25	4:30	49.9	
24/1/25	20:35	55.5		25/1/25	0:35	57.1		25/1/25	4:35	49.5	
24/1/25	20:40	55.4		25/1/25	0:40	56.8		25/1/25	4:40	49.1	
24/1/25	20:45	55.5	56.4	25/1/25	0:45	56.4	53.9	25/1/25	4:45	49.6	50.9
24/1/25	20:50	55.6		25/1/25	0:50	56.0		25/1/25	4:50	48.8	
24/1/25	20:55	55.8		25/1/25	0:55	54.8		25/1/25	4:55	50.1	
24/1/25	21:00	55.9		25/1/25	1:00	55.7		25/1/25	5:00	49.9	
24/1/25	21:05	56.5		25/1/25	1:05	56.6		25/1/25	5:05	50.2	
24/1/25	21:10	55.8		25/1/25	1:10	55.8		25/1/25	5:10	50.7	
24/1/25	21:15	56.0		25/1/25	1:15	55.7		25/1/25	5:15	50.0	
24/1/25	21:20	56.2		25/1/25	1:20	55.1		25/1/25	5:20	51.8	
24/1/25	21:25	57.0		25/1/25	1:25	54.2		25/1/25	5:25	51.3	
24/1/25	21:30	55.9		25/1/25	1:30	53.5		25/1/25	5:30	51.3	
24/1/25	21:35	55.5	57.1	25/1/25	1:35	52.5	51.4	25/1/25	5:35	50.9	51.7
24/1/25	21:40	56.1		25/1/25	1:40	52.1		25/1/25	5:40	50.7	
24/1/25	21:45	56.9		25/1/25	1:45	52.8		25/1/25	5:45	51.2	
24/1/25	21:50	56.8		25/1/25	1:50	51.5		25/1/25	5:50	51.4	
24/1/25	21:55	56.8		25/1/25	1:55	51.0		25/1/25	5:55	50.3	
24/1/25	22:00	56.9		25/1/25	2:00	51.2		25/1/25	6:00	50.2	
24/1/25	22:05	57.2		25/1/25	2:05	51.4		25/1/25	6:05	50.5	
24/1/25	22:10	56.7		25/1/25	2:10	52.4		25/1/25	6:10	51.2	
24/1/25	22:15	57.4		25/1/25	2:15	52.0		25/1/25	6:15	51.2	
24/1/25	22:20	57.7		25/1/25	2:20	52.0		25/1/25	6:20	52.2	
24/1/25	22:25	57.2	57.1	25/1/25	2:25	50.9	51.4	25/1/25	6:25	51.2	51.7
24/1/25	22:30	56.7		25/1/25	2:30	50.7		25/1/25	6:30	51.5	
24/1/25	22:35	56.2		25/1/25	2:35	51.2		25/1/25	6:35	52.1	
24/1/25	22:40	56.8		25/1/25	2:40	51.0		25/1/25	6:40	51.4	
24/1/25	22:45	56.6		25/1/25	2:45	51.8		25/1/25	6:45	51.7	
24/1/25	22:50	57.7		25/1/25	2:50	50.4		25/1/25	6:50	51.5	
24/1/25	22:55	57.6		25/1/25	2:55	51.1		25/1/25	6:55	51.6	
24/1/25	23:00	57.2		25/1/25	3:00	50.9		25/1/25	7:00	53.6	

NAME OF COMPANY			CH2M HILL Singapore Pte Ltd								
SITE LOCATION			Forest Along Yishun Avenue 1								
REPORT REFERENCE			23/01/2025 - 30/01/2025								
Start	25/1/25	7:05		Leq12h	52.9		Weighting			A	
End	25/1/25	19:00									
Date	Time	Leq5m		Date	Time	Leq5m		Date	Time	Leq5m	
25/1/25	7:05	56.0		25/1/25	11:05	52.6		25/1/25	15:05	53.8	
25/1/25	7:10	53.3		25/1/25	11:10	52.2		25/1/25	15:10	52.6	
25/1/25	7:15	54.5		25/1/25	11:15	52.0		25/1/25	15:15	52.3	
25/1/25	7:20	55.1		25/1/25	11:20	52.3		25/1/25	15:20	52.7	
25/1/25	7:25	52.7		25/1/25	11:25	52.5		25/1/25	15:25	51.4	
25/1/25	7:30	52.3		25/1/25	11:30	52.3		25/1/25	15:30	51.5	
25/1/25	7:35	54.8		25/1/25	11:35	52.5		25/1/25	15:35	50.8	
25/1/25	7:40	52.9		25/1/25	11:40	52.7		25/1/25	15:40	52.2	
25/1/25	7:45	51.5		25/1/25	11:45	53.0		25/1/25	15:45	52.0	
25/1/25	7:50	52.3		25/1/25	11:50	53.2		25/1/25	15:50	52.6	
25/1/25	7:55	52.7		25/1/25	11:55	52.6		25/1/25	15:55	52.0	
25/1/25	8:00	52.5		25/1/25	12:00	53.4		25/1/25	16:00	52.0	
25/1/25	8:05	52.9		25/1/25	12:05	52.2		25/1/25	16:05	52.3	
25/1/25	8:10	52.8		25/1/25	12:10	52.5		25/1/25	16:10	52.6	
25/1/25	8:15	54.7		25/1/25	12:15	51.7		25/1/25	16:15	52.4	
25/1/25	8:20	54.5		25/1/25	12:20	52.8		25/1/25	16:20	52.2	
25/1/25	8:25	54.7		25/1/25	12:25	51.8		25/1/25	16:25	51.6	
25/1/25	8:30	53.7		25/1/25	12:30	51.8		25/1/25	16:30	51.2	
25/1/25	8:35	54.8		25/1/25	12:35	52.5		25/1/25	16:35	51.7	
25/1/25	8:40	52.9		25/1/25	12:40	52.1		25/1/25	16:40	52.0	
25/1/25	8:45	53.1		25/1/25	12:45	51.2		25/1/25	16:45	51.8	
25/1/25	8:50	54.5		25/1/25	12:50	52.0		25/1/25	16:50	51.2	
25/1/25	8:55	53.5		25/1/25	12:55	53.1		25/1/25	16:55	51.5	
25/1/25	9:00	53.7		25/1/25	13:00	51.8		25/1/25	17:00	52.3	
25/1/25	9:05	52.8		25/1/25	13:05	51.6		25/1/25	17:05	55.4	
25/1/25	9:10	53.4		25/1/25	13:10	51.6		25/1/25	17:10	52.2	
25/1/25	9:15	52.0		25/1/25	13:15	54.1		25/1/25	17:15	52.6	
25/1/25	9:20	53.5		25/1/25	13:20	55.4		25/1/25	17:20	52.7	
25/1/25	9:25	53.2		25/1/25	13:25	50.5		25/1/25	17:25	52.9	
25/1/25	9:30	52.4		25/1/25	13:30	51.1		25/1/25	17:30	53.5	
25/1/25	9:35	53.1		25/1/25	13:35	51.9		25/1/25	17:35	54.2	
25/1/25	9:40	52.7		25/1/25	13:40	50.8		25/1/25	17:40	54.5	
25/1/25	9:45	52.0		25/1/25	13:45	52.7		25/1/25	17:45	53.7	
25/1/25	9:50	52.7		25/1/25	13:50	52.2		25/1/25	17:50	53.5	
25/1/25	9:55	51.9		25/1/25	13:55	52.4		25/1/25	17:55	53.1	
25/1/25	10:00	50.8		25/1/25	14:00	53.0		25/1/25	18:00	53.5	
25/1/25	10:05	52.6		25/1/25	14:05	51.0		25/1/25	18:05	53.1	
25/1/25	10:10	52.9		25/1/25	14:10	58.7		25/1/25	18:10	53.3	
25/1/25	10:15	53.9		25/1/25	14:15	54.8		25/1/25	18:15	53.9	
25/1/25	10:20	53.5	25/1/25	14:20	52.7	25/1/25	18:20	53.9			
25/1/25	10:25	51.8	25/1/25	14:25	53.5	25/1/25	18:25	52.8			
25/1/25	10:30	51.6	25/1/25	14:30	51.2	25/1/25	18:30	53.1			
25/1/25	10:35	51.6	25/1/25	14:35	51.4	25/1/25	18:35	53.0			
25/1/25	10:40	51.5	25/1/25	14:40	50.8	25/1/25	18:40	53.5			
25/1/25	10:45	51.2	25/1/25	14:45	54.3	25/1/25	18:45	52.1			
25/1/25	10:50	52.0	25/1/25	14:50	53.2	25/1/25	18:50	52.5			
25/1/25	10:55	52.5	25/1/25	14:55	53.0	25/1/25	18:55	52.4			
25/1/25	11:00	53.2	25/1/25	15:00	53.3	25/1/25	19:00	52.3			

NAME OF COMPANY			CH2M HILL Singapore Pte Ltd									
SITE LOCATION			Forest Along Yishun Avenue 1									
REPORT REFERENCE			23/01/2025 - 30/01/2025									
Start	25/1/25		19:05	Leq12h			53.9		Weighting		A	
End	26/1/25		7:00									
Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h	
25/1/25	19:05	52.8	53.2	25/1/25	23:05	55.2	55.2	26/1/25	3:05	53.3	54.1	
25/1/25	19:10	55.2		25/1/25	23:10	54.8		26/1/25	3:10	53.7		
25/1/25	19:15	53.5		25/1/25	23:15	55.4		26/1/25	3:15	55.2		
25/1/25	19:20	53.4		25/1/25	23:20	55.5		26/1/25	3:20	54.6		
25/1/25	19:25	52.3		25/1/25	23:25	55.2		26/1/25	3:25	55.1		
25/1/25	19:30	52.0		25/1/25	23:30	55.8		26/1/25	3:30	54.8		
25/1/25	19:35	51.9		25/1/25	23:35	55.8		26/1/25	3:35	54.1		
25/1/25	19:40	52.9		25/1/25	23:40	54.7		26/1/25	3:40	54.1		
25/1/25	19:45	51.7		25/1/25	23:45	55.8		26/1/25	3:45	53.6		
25/1/25	19:50	51.9		25/1/25	23:50	54.8		26/1/25	3:50	53.7		
25/1/25	19:55	53.4	54.5	25/1/25	23:55	54.6	54.3	26/1/25	3:55	53.0	51.6	
25/1/25	20:00	55.5		25/1/25	0:00	54.2		26/1/25	4:00	52.7		
25/1/25	20:05	54.6		26/1/25	0:05	54.0		26/1/25	4:05	52.3		
25/1/25	20:10	53.4		26/1/25	0:10	54.3		26/1/25	4:10	53.3		
25/1/25	20:15	54.0		26/1/25	0:15	54.2		26/1/25	4:15	52.2		
25/1/25	20:20	55.1		26/1/25	0:20	54.3		26/1/25	4:20	51.6		
25/1/25	20:25	54.5		26/1/25	0:25	54.5		26/1/25	4:25	51.6		
25/1/25	20:30	53.7		26/1/25	0:30	54.5		26/1/25	4:30	52.1		
25/1/25	20:35	54.4		26/1/25	0:35	54.5		26/1/25	4:35	50.5		
25/1/25	20:40	54.5		26/1/25	0:40	54.2		26/1/25	4:40	51.9		
25/1/25	20:45	54.5	56.0	26/1/25	0:45	55.2	53.1	26/1/25	4:45	50.7	52.0	
25/1/25	20:50	54.3		26/1/25	0:50	54.4		26/1/25	4:50	50.4		
25/1/25	20:55	54.2		26/1/25	0:55	53.7		26/1/25	4:55	50.6		
25/1/25	21:00	55.8		26/1/25	1:00	53.4		26/1/25	5:00	50.9		
25/1/25	21:05	56.0		26/1/25	1:05	53.0		26/1/25	5:05	50.2		
25/1/25	21:10	55.7		26/1/25	1:10	53.0		26/1/25	5:10	50.0		
25/1/25	21:15	55.6		26/1/25	1:15	53.0		26/1/25	5:15	50.8		
25/1/25	21:20	56.1		26/1/25	1:20	52.7		26/1/25	5:20	51.0		
25/1/25	21:25	56.3		26/1/25	1:25	53.2		26/1/25	5:25	51.2		
25/1/25	21:30	56.2		26/1/25	1:30	53.6		26/1/25	5:30	51.6		
25/1/25	21:35	55.4	54.8	26/1/25	1:35	53.5	53.9	26/1/25	5:35	52.0	52.4	
25/1/25	21:40	56.0		26/1/25	1:40	53.2		26/1/25	5:40	52.9		
25/1/25	21:45	56.0		26/1/25	1:45	52.9		26/1/25	5:45	53.4		
25/1/25	21:50	56.1		26/1/25	1:50	52.4		26/1/25	5:50	52.7		
25/1/25	21:55	56.3		26/1/25	1:55	53.3		26/1/25	5:55	52.9		
25/1/25	22:00	55.9		26/1/25	2:00	53.1		26/1/25	6:00	53.3		
25/1/25	22:05	54.7		26/1/25	2:05	54.5		26/1/25	6:05	53.1		
25/1/25	22:10	54.5		26/1/25	2:10	54.5		26/1/25	6:10	52.0		
25/1/25	22:15	54.7		26/1/25	2:15	54.4		26/1/25	6:15	51.8		
25/1/25	22:20	54.9		26/1/25	2:20	54.3		26/1/25	6:20	53.2		
25/1/25	22:25	54.6	54.8	26/1/25	2:25	53.2	53.9	26/1/25	6:25	53.0	52.4	
25/1/25	22:30	54.3		26/1/25	2:30	53.5		26/1/25	6:30	52.6		
25/1/25	22:35	55.0		26/1/25	2:35	53.7		26/1/25	6:35	52.3		
25/1/25	22:40	55.0		26/1/25	2:40	53.5		26/1/25	6:40	52.1		
25/1/25	22:45	55.8		26/1/25	2:45	53.8		26/1/25	6:45	52.6		
25/1/25	22:50	54.4		26/1/25	2:50	53.7		26/1/25	6:50	51.5		
25/1/25	22:55	54.6		26/1/25	2:55	53.8		26/1/25	6:55	52.7		
25/1/25	23:00	55.0		26/1/25	3:00	53.7		26/1/25	7:00	50.9		

NAME OF COMPANY			CH2M HILL Singapore Pte Ltd									
SITE LOCATION			Forest Along Yishun Avenue 1									
REPORT REFERENCE			23/01/2025 - 30/01/2025									
Start	26/1/25		7:05	Leq12h		52.5		Weighting		A		
End	26/1/25		19:00									
Date	Time	Leq5m	Date	Time	Leq5m	Date	Time	Leq5m				
26/1/25	7:05	52.6	26/1/25	11:05	50.9	26/1/25	15:05	52.8				
26/1/25	7:10	55.1	26/1/25	11:10	51.5	26/1/25	15:10	53.2				
26/1/25	7:15	52.2	26/1/25	11:15	51.9	26/1/25	15:15	52.0				
26/1/25	7:20	52.8	26/1/25	11:20	51.0	26/1/25	15:20	51.0				
26/1/25	7:25	53.2	26/1/25	11:25	51.4	26/1/25	15:25	51.2				
26/1/25	7:30	54.9	26/1/25	11:30	52.5	26/1/25	15:30	51.5				
26/1/25	7:35	52.5	26/1/25	11:35	50.9	26/1/25	15:35	51.2				
26/1/25	7:40	52.1	26/1/25	11:40	51.9	26/1/25	15:40	51.6				
26/1/25	7:45	53.0	26/1/25	11:45	52.8	26/1/25	15:45	50.0				
26/1/25	7:50	55.5	26/1/25	11:50	51.5	26/1/25	15:50	50.3				
26/1/25	7:55	54.0	26/1/25	11:55	51.2	26/1/25	15:55	50.8				
26/1/25	8:00	55.7	26/1/25	12:00	51.8	26/1/25	16:00	52.0				
26/1/25	8:05	58.3	26/1/25	12:05	51.0	26/1/25	16:05	52.1				
26/1/25	8:10	52.6	26/1/25	12:10	50.4	26/1/25	16:10	52.0				
26/1/25	8:15	53.6	26/1/25	12:15	50.3	26/1/25	16:15	50.4				
26/1/25	8:20	54.4	26/1/25	12:20	51.0	26/1/25	16:20	50.8				
26/1/25	8:25	53.5	26/1/25	12:25	50.5	26/1/25	16:25	54.7				
26/1/25	8:30	52.5	26/1/25	12:30	50.3	26/1/25	16:30	54.8				
26/1/25	8:35	52.5	26/1/25	12:35	51.4	26/1/25	16:35	51.2				
26/1/25	8:40	52.9	26/1/25	12:40	50.3	26/1/25	16:40	51.4				
26/1/25	8:45	52.2	26/1/25	12:45	50.5	26/1/25	16:45	51.1				
26/1/25	8:50	52.8	26/1/25	12:50	49.3	26/1/25	16:50	51.5				
26/1/25	8:55	52.5	26/1/25	12:55	49.8	26/1/25	16:55	50.9				
26/1/25	9:00	53.3	26/1/25	13:00	52.3	26/1/25	17:00	51.5				
26/1/25	9:05	54.8	26/1/25	13:05	52.9	26/1/25	17:05	51.9				
26/1/25	9:10	58.2	26/1/25	13:10	50.5	26/1/25	17:10	50.7				
26/1/25	9:15	56.5	26/1/25	13:15	52.6	26/1/25	17:15	51.1				
26/1/25	9:20	53.1	26/1/25	13:20	50.8	26/1/25	17:20	51.8				
26/1/25	9:25	53.2	26/1/25	13:25	51.0	26/1/25	17:25	51.4				
26/1/25	9:30	52.5	26/1/25	13:30	50.9	26/1/25	17:30	51.9				
26/1/25	9:35	52.3	26/1/25	13:35	50.8	26/1/25	17:35	51.5				
26/1/25	9:40	53.2	26/1/25	13:40	51.6	26/1/25	17:40	50.8				
26/1/25	9:45	51.8	26/1/25	13:45	50.4	26/1/25	17:45	52.7				
26/1/25	9:50	51.0	26/1/25	13:50	50.2	26/1/25	17:50	50.6				
26/1/25	9:55	52.2	26/1/25	13:55	50.3	26/1/25	17:55	51.3				
26/1/25	10:00	51.5	26/1/25	14:00	51.5	26/1/25	18:00	52.6				
26/1/25	10:05	51.7	26/1/25	14:05	51.3	26/1/25	18:05	56.6				
26/1/25	10:10	51.0	26/1/25	14:10	52.0	26/1/25	18:10	52.9				
26/1/25	10:15	50.5	26/1/25	14:15	52.0	26/1/25	18:15	53.2				
26/1/25	10:20	50.6	26/1/25	14:20	51.3	26/1/25	18:20	53.6				
26/1/25	10:25	50.4	26/1/25	14:25	51.7	26/1/25	18:25	53.1				
26/1/25	10:30	51.7	26/1/25	14:30	50.5	26/1/25	18:30	55.3				
26/1/25	10:35	51.8	26/1/25	14:35	51.5	26/1/25	18:35	55.6				
26/1/25	10:40	51.0	26/1/25	14:40	51.5	26/1/25	18:40	55.3				
26/1/25	10:45	50.5	26/1/25	14:45	51.8	26/1/25	18:45	54.5				
26/1/25	10:50	51.2	26/1/25	14:50	51.8	26/1/25	18:50	53.1				
26/1/25	10:55	50.8	26/1/25	14:55	52.6	26/1/25	18:55	53.0				
26/1/25	11:00	50.4	26/1/25	15:00	52.6	26/1/25	19:00	54.4				

NAME OF COMPANY			CH2M HILL Singapore Pte Ltd									
SITE LOCATION			Forest Along Yishun Avenue 1									
REPORT REFERENCE			23/01/2025 - 30/01/2025									
Start	26/1/25		19:05	Leq12h				55.1	Weighting			A
End	27/1/25		7:00									
Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h	
26/1/25	19:05	50.8	51.5	26/1/25	23:05	56.9	56.8	27/1/25	3:05	55.2	53.6	
26/1/25	19:10	51.7		26/1/25	23:10	57.0		27/1/25	3:10	54.5		
26/1/25	19:15	49.8		26/1/25	23:15	56.8		27/1/25	3:15	54.1		
26/1/25	19:20	50.4		26/1/25	23:20	57.0		27/1/25	3:20	53.7		
26/1/25	19:25	49.9		26/1/25	23:25	57.3		27/1/25	3:25	53.2		
26/1/25	19:30	52.3		26/1/25	23:30	57.1		27/1/25	3:30	53.3		
26/1/25	19:35	52.8		26/1/25	23:35	57.4		27/1/25	3:35	53.2		
26/1/25	19:40	52.1		26/1/25	23:40	57.1		27/1/25	3:40	52.3		
26/1/25	19:45	51.5		26/1/25	23:45	56.8		27/1/25	3:45	51.9		
26/1/25	19:50	51.2		26/1/25	23:50	56.4		27/1/25	3:50	52.3		
26/1/25	19:55	51.1	53.6	26/1/25	23:55	55.5	56.9	27/1/25	3:55	51.9	52.2	
26/1/25	20:00	52.9		26/1/25	0:00	55.8		27/1/25	4:00	55.3		
26/1/25	20:05	53.2		27/1/25	0:05	55.6		27/1/25	4:05	51.8		
26/1/25	20:10	52.5		27/1/25	0:10	56.3		27/1/25	4:10	51.3		
26/1/25	20:15	52.3		27/1/25	0:15	56.5		27/1/25	4:15	51.5		
26/1/25	20:20	53.7		27/1/25	0:20	57.4		27/1/25	4:20	50.1		
26/1/25	20:25	53.6		27/1/25	0:25	57.2		27/1/25	4:25	50.3		
26/1/25	20:30	52.4		27/1/25	0:30	57.1		27/1/25	4:30	51.7		
26/1/25	20:35	50.9		27/1/25	0:35	57.3		27/1/25	4:35	51.5		
26/1/25	20:40	53.8		27/1/25	0:40	57.7		27/1/25	4:40	52.8		
26/1/25	20:45	52.6	55.9	27/1/25	0:45	56.9	56.4	27/1/25	4:45	53.6	54.4	
26/1/25	20:50	57.6		27/1/25	0:50	56.9		27/1/25	4:50	54.1		
26/1/25	20:55	53.7		27/1/25	0:55	56.9		27/1/25	4:55	53.5		
26/1/25	21:00	52.4		27/1/25	1:00	57.1		27/1/25	5:00	52.0		
26/1/25	21:05	54.0		27/1/25	1:05	57.8		27/1/25	5:05	54.2		
26/1/25	21:10	54.9		27/1/25	1:10	57.4		27/1/25	5:10	56.3		
26/1/25	21:15	54.7		27/1/25	1:15	57.6		27/1/25	5:15	56.4		
26/1/25	21:20	55.4		27/1/25	1:20	57.0		27/1/25	5:20	55.7		
26/1/25	21:25	55.5		27/1/25	1:25	56.6		27/1/25	5:25	54.7		
26/1/25	21:30	55.8		27/1/25	1:30	56.4		27/1/25	5:30	54.4		
26/1/25	21:35	56.0	56.7	27/1/25	1:35	55.6	55.9	27/1/25	5:35	54.6	52.7	
26/1/25	21:40	56.9		27/1/25	1:40	55.6		27/1/25	5:40	53.9		
26/1/25	21:45	56.9		27/1/25	1:45	55.5		27/1/25	5:45	54.0		
26/1/25	21:50	56.2		27/1/25	1:50	55.1		27/1/25	5:50	52.5		
26/1/25	21:55	56.3		27/1/25	1:55	54.9		27/1/25	5:55	50.1		
26/1/25	22:00	56.9		27/1/25	2:00	55.6		27/1/25	6:00	51.9		
26/1/25	22:05	56.7		27/1/25	2:05	56.0		27/1/25	6:05	52.2		
26/1/25	22:10	56.6		27/1/25	2:10	55.9		27/1/25	6:10	52.9		
26/1/25	22:15	56.0		27/1/25	2:15	55.7		27/1/25	6:15	53.2		
26/1/25	22:20	56.9		27/1/25	2:20	55.6		27/1/25	6:20	51.8		
26/1/25	22:25	56.8	56.7	27/1/25	2:25	55.8	55.9	27/1/25	6:25	52.4	52.7	
26/1/25	22:30	56.8		27/1/25	2:30	56.5		27/1/25	6:30	52.1		
26/1/25	22:35	56.4		27/1/25	2:35	57.0		27/1/25	6:35	52.5		
26/1/25	22:40	56.5		27/1/25	2:40	56.1		27/1/25	6:40	51.8		
26/1/25	22:45	56.6		27/1/25	2:45	56.1		27/1/25	6:45	52.2		
26/1/25	22:50	56.6		27/1/25	2:50	55.7		27/1/25	6:50	53.4		
26/1/25	22:55	56.8		27/1/25	2:55	54.7		27/1/25	6:55	53.3		
26/1/25	23:00	57.7		27/1/25	3:00	55.5		27/1/25	7:00	53.7		

NAME OF COMPANY			CH2M HILL Singapore Pte Ltd										
SITE LOCATION			Forest Along Yishun Avenue 1										
REPORT REFERENCE			23/01/2025 - 30/01/2025										
Start	27/1/25		7:05	Leq12h		53.8				Weighting		A	
End	27/1/25		19:00										
Date	Time	Leq5m		Date	Time	Leq5m		Date	Time	Leq5m			
27/1/25	7:05	54.7		27/1/25	11:05	52.6		27/1/25	15:05	51.2			
27/1/25	7:10	54.1		27/1/25	11:10	52.4		27/1/25	15:10	52.2			
27/1/25	7:15	54.0		27/1/25	11:15	52.5		27/1/25	15:15	52.2			
27/1/25	7:20	54.2		27/1/25	11:20	53.5		27/1/25	15:20	51.6			
27/1/25	7:25	54.0		27/1/25	11:25	54.1		27/1/25	15:25	50.9			
27/1/25	7:30	54.9		27/1/25	11:30	55.5		27/1/25	15:30	52.5			
27/1/25	7:35	54.9		27/1/25	11:35	52.9		27/1/25	15:35	53.1			
27/1/25	7:40	55.0		27/1/25	11:40	52.3		27/1/25	15:40	52.8			
27/1/25	7:45	55.3		27/1/25	11:45	51.2		27/1/25	15:45	52.2			
27/1/25	7:50	55.2		27/1/25	11:50	51.3		27/1/25	15:50	52.4			
27/1/25	7:55	57.5		27/1/25	11:55	52.2		27/1/25	15:55	55.4			
27/1/25	8:00	54.2		27/1/25	12:00	51.2		27/1/25	16:00	52.0			
27/1/25	8:05	53.9		27/1/25	12:05	51.4		27/1/25	16:05	52.8			
27/1/25	8:10	53.8		27/1/25	12:10	51.7		27/1/25	16:10	52.8			
27/1/25	8:15	54.7		27/1/25	12:15	51.1		27/1/25	16:15	51.6			
27/1/25	8:20	54.0		27/1/25	12:20	51.9		27/1/25	16:20	51.9			
27/1/25	8:25	53.8		27/1/25	12:25	51.4		27/1/25	16:25	52.7			
27/1/25	8:30	53.8		27/1/25	12:30	52.2		27/1/25	16:30	52.7			
27/1/25	8:35	55.2		27/1/25	12:35	50.2		27/1/25	16:35	52.1			
27/1/25	8:40	53.5		27/1/25	12:40	52.2		27/1/25	16:40	51.9			
27/1/25	8:45	55.9		27/1/25	12:45	50.3		27/1/25	16:45	52.4			
27/1/25	8:50	54.2		27/1/25	12:50	52.9		27/1/25	16:50	52.2			
27/1/25	8:55	53.5		27/1/25	12:55	52.7		27/1/25	16:55	52.5			
27/1/25	9:00	54.8		27/1/25	13:00	51.3		27/1/25	17:00	52.6			
27/1/25	9:05	53.5		27/1/25	13:05	51.9		27/1/25	17:05	53.2			
27/1/25	9:10	54.0		27/1/25	13:10	51.2		27/1/25	17:10	52.3			
27/1/25	9:15	55.9		27/1/25	13:15	51.5		27/1/25	17:15	53.4			
27/1/25	9:20	53.9		27/1/25	13:20	52.4		27/1/25	17:20	53.8			
27/1/25	9:25	54.2		27/1/25	13:25	54.6		27/1/25	17:25	54.0			
27/1/25	9:30	52.9		27/1/25	13:30	56.2		27/1/25	17:30	52.8			
27/1/25	9:35	53.2		27/1/25	13:35	53.5		27/1/25	17:35	53.9			
27/1/25	9:40	53.3		27/1/25	13:40	51.5		27/1/25	17:40	53.0			
27/1/25	9:45	53.7		27/1/25	13:45	51.8		27/1/25	17:45	52.7			
27/1/25	9:50	53.0		27/1/25	13:50	52.0		27/1/25	17:50	56.7			
27/1/25	9:55	55.1		27/1/25	13:55	53.2		27/1/25	17:55	58.2			
27/1/25	10:00	52.3		27/1/25	14:00	55.7		27/1/25	18:00	58.1			
27/1/25	10:05	52.9		27/1/25	14:05	55.7		27/1/25	18:05	56.5			
27/1/25	10:10	53.0		27/1/25	14:10	54.9		27/1/25	18:10	58.3			
27/1/25	10:15	52.4		27/1/25	14:15	55.8		27/1/25	18:15	61.5			
27/1/25	10:20	52.9	27/1/25	14:20	53.4	27/1/25	18:20	52.3					
27/1/25	10:25	53.0	27/1/25	14:25	52.2	27/1/25	18:25	52.3					
27/1/25	10:30	53.6	27/1/25	14:30	52.2	27/1/25	18:30	52.9					
27/1/25	10:35	53.2	27/1/25	14:35	52.8	27/1/25	18:35	53.3					
27/1/25	10:40	54.6	27/1/25	14:40	51.1	27/1/25	18:40	53.3					
27/1/25	10:45	54.6	27/1/25	14:45	53.4	27/1/25	18:45	56.5					
27/1/25	10:50	54.2	27/1/25	14:50	53.1	27/1/25	18:50	55.5					
27/1/25	10:55	53.9	27/1/25	14:55	51.7	27/1/25	18:55	55.2					
27/1/25	11:00	52.2	27/1/25	15:00	50.7	27/1/25	19:00	52.8					

NAME OF COMPANY			CH2M HILL Singapore Pte Ltd										
SITE LOCATION			Forest Along Yishun Avenue 1										
REPORT REFERENCE			23/01/2025 - 30/01/2025										
Start	27/1/25		19:05	Leq12h			54.0		Weighting			A	
End	28/1/25		7:00										
Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h		
27/1/25	19:05	52.9	53.1	27/1/25	23:05	54.9	54.7	28/1/25	3:05	52.2	53.2		
27/1/25	19:10	52.5		27/1/25	23:10	54.9		28/1/25	3:10	52.3			
27/1/25	19:15	53.9		27/1/25	23:15	54.8		28/1/25	3:15	52.3			
27/1/25	19:20	53.1		27/1/25	23:20	54.7		28/1/25	3:20	52.0			
27/1/25	19:25	52.2		27/1/25	23:25	55.3		28/1/25	3:25	52.4			
27/1/25	19:30	52.9		27/1/25	23:30	55.1		28/1/25	3:30	53.6			
27/1/25	19:35	52.5		27/1/25	23:35	55.5		28/1/25	3:35	54.3			
27/1/25	19:40	53.4		27/1/25	23:40	54.5		28/1/25	3:40	54.1			
27/1/25	19:45	53.2		27/1/25	23:45	54.0		28/1/25	3:45	52.5			
27/1/25	19:50	53.2		27/1/25	23:50	53.5		28/1/25	3:50	53.7			
27/1/25	19:55	53.8		27/1/25	23:55	54.4		28/1/25	3:55	54.1			
27/1/25	20:00	53.2	54.2	27/1/25	0:00	54.5	54.2	28/1/25	4:00	54.2	53.6		
27/1/25	20:05	54.2		28/1/25	0:05	54.3		28/1/25	4:05	53.5			
27/1/25	20:10	53.6		28/1/25	0:10	53.8		28/1/25	4:10	53.4			
27/1/25	20:15	54.1		28/1/25	0:15	52.9		28/1/25	4:15	53.3			
27/1/25	20:20	53.1		28/1/25	0:20	54.3		28/1/25	4:20	53.9			
27/1/25	20:25	53.8		28/1/25	0:25	53.8		28/1/25	4:25	54.0			
27/1/25	20:30	53.6		28/1/25	0:30	54.2		28/1/25	4:30	54.7			
27/1/25	20:35	55.3		28/1/25	0:35	54.0		28/1/25	4:35	53.8			
27/1/25	20:40	54.5		28/1/25	0:40	54.1		28/1/25	4:40	53.6			
27/1/25	20:45	54.6		28/1/25	0:45	54.2		28/1/25	4:45	53.5			
27/1/25	20:50	54.6		28/1/25	0:50	54.9		28/1/25	4:50	53.2			
27/1/25	20:55	54.2	55.0	28/1/25	0:55	54.6	54.1	28/1/25	4:55	53.5	53.0		
27/1/25	21:00	54.2		28/1/25	1:00	54.4		28/1/25	5:00	53.0			
27/1/25	21:05	54.7		28/1/25	1:05	53.9		28/1/25	5:05	53.6			
27/1/25	21:10	54.9		28/1/25	1:10	54.1		28/1/25	5:10	53.1			
27/1/25	21:15	54.7		28/1/25	1:15	53.3		28/1/25	5:15	52.2			
27/1/25	21:20	55.6		28/1/25	1:20	53.7		28/1/25	5:20	52.8			
27/1/25	21:25	55.0		28/1/25	1:25	53.8		28/1/25	5:25	54.0			
27/1/25	21:30	55.1		28/1/25	1:30	54.2		28/1/25	5:30	52.3			
27/1/25	21:35	54.9		28/1/25	1:35	53.6		28/1/25	5:35	53.0			
27/1/25	21:40	55.3		28/1/25	1:40	53.4		28/1/25	5:40	52.0			
27/1/25	21:45	54.8		28/1/25	1:45	54.6		28/1/25	5:45	53.4			
27/1/25	21:50	55.8	55.3	28/1/25	1:50	54.7	53.9	28/1/25	5:50	53.9	53.4		
27/1/25	21:55	54.8		28/1/25	1:55	54.3		28/1/25	5:55	53.0			
27/1/25	22:00	54.7		28/1/25	2:00	55.6		28/1/25	6:00	52.0			
27/1/25	22:05	54.9		28/1/25	2:05	55.2		28/1/25	6:05	52.6			
27/1/25	22:10	55.0		28/1/25	2:10	55.0		28/1/25	6:10	52.7			
27/1/25	22:15	55.5		28/1/25	2:15	54.6		28/1/25	6:15	53.1			
27/1/25	22:20	55.3		28/1/25	2:20	54.4		28/1/25	6:20	53.0			
27/1/25	22:25	55.4		28/1/25	2:25	54.3		28/1/25	6:25	53.3			
27/1/25	22:30	55.1		28/1/25	2:30	52.8		28/1/25	6:30	53.3			
27/1/25	22:35	56.1		28/1/25	2:35	52.8		28/1/25	6:35	53.5			
27/1/25	22:40	54.8		28/1/25	2:40	53.2		28/1/25	6:40	53.0			
27/1/25	22:45	55.2	28/1/25	2:45	53.3	28/1/25	6:45	54.3					
27/1/25	22:50	55.5		28/1/25	2:50	53.6		28/1/25	6:50	53.4			
27/1/25	22:55	55.7		28/1/25	2:55	53.4		28/1/25	6:55	53.0			
27/1/25	23:00	55.2	55.3	28/1/25	3:00	52.7	53.9	28/1/25	7:00	54.6	53.4		

NAME OF COMPANY			CH2M HILL Singapore Pte Ltd										
SITE LOCATION			Forest Along Yishun Avenue 1										
REPORT REFERENCE			23/01/2025 - 30/01/2025										
Start	28/1/25		7:05	Leq12h		53.2		Weighting			A		
End	28/1/25		19:00										
Date	Time	Leq5m		Date	Time	Leq5m		Date	Time	Leq5m			
28/1/25	7:05	55.5		28/1/25	11:05	52.0		28/1/25	15:05	52.3			
28/1/25	7:10	54.9		28/1/25	11:10	52.5		28/1/25	15:10	51.4			
28/1/25	7:15	54.0		28/1/25	11:15	52.7		28/1/25	15:15	51.4			
28/1/25	7:20	55.0		28/1/25	11:20	51.3		28/1/25	15:20	52.5			
28/1/25	7:25	53.9		28/1/25	11:25	52.0		28/1/25	15:25	51.2			
28/1/25	7:30	53.6		28/1/25	11:30	52.1		28/1/25	15:30	51.3			
28/1/25	7:35	55.2		28/1/25	11:35	52.6		28/1/25	15:35	54.9			
28/1/25	7:40	53.5		28/1/25	11:40	54.4		28/1/25	15:40	55.7			
28/1/25	7:45	56.2		28/1/25	11:45	52.0		28/1/25	15:45	51.7			
28/1/25	7:50	57.5		28/1/25	11:50	52.4		28/1/25	15:50	51.2			
28/1/25	7:55	53.3		28/1/25	11:55	51.8		28/1/25	15:55	51.7			
28/1/25	8:00	53.4		28/1/25	12:00	52.1		28/1/25	16:00	51.7			
28/1/25	8:05	55.2		28/1/25	12:05	53.3		28/1/25	16:05	51.0			
28/1/25	8:10	54.8		28/1/25	12:10	52.4		28/1/25	16:10	51.5			
28/1/25	8:15	54.9		28/1/25	12:15	52.2		28/1/25	16:15	50.8			
28/1/25	8:20	56.0		28/1/25	12:20	52.4		28/1/25	16:20	51.1			
28/1/25	8:25	54.5		28/1/25	12:25	54.8		28/1/25	16:25	51.0			
28/1/25	8:30	53.7		28/1/25	12:30	53.8		28/1/25	16:30	51.3			
28/1/25	8:35	52.7		28/1/25	12:35	56.1		28/1/25	16:35	51.0			
28/1/25	8:40	52.7		28/1/25	12:40	53.4		28/1/25	16:40	51.9			
28/1/25	8:45	53.5		28/1/25	12:45	52.0		28/1/25	16:45	51.1			
28/1/25	8:50	53.0		28/1/25	12:50	51.5		28/1/25	16:50	51.2			
28/1/25	8:55	53.5		28/1/25	12:55	51.3		28/1/25	16:55	51.0			
28/1/25	9:00	53.6		28/1/25	13:00	51.7		28/1/25	17:00	52.1			
28/1/25	9:05	54.1		28/1/25	13:05	51.0		28/1/25	17:05	56.7			
28/1/25	9:10	54.6		28/1/25	13:10	52.3		28/1/25	17:10	51.1			
28/1/25	9:15	56.0		28/1/25	13:15	51.8		28/1/25	17:15	51.2			
28/1/25	9:20	55.2		28/1/25	13:20	51.0		28/1/25	17:20	51.2			
28/1/25	9:25	55.9		28/1/25	13:25	52.4		28/1/25	17:25	51.6			
28/1/25	9:30	58.0	28/1/25	13:30	51.8	28/1/25	17:30	50.7					
28/1/25	9:35	55.3	28/1/25	13:35	51.7	28/1/25	17:35	50.8					
28/1/25	9:40	54.5	28/1/25	13:40	51.8	28/1/25	17:40	51.9					
28/1/25	9:45	53.5	28/1/25	13:45	52.5	28/1/25	17:45	52.5					
28/1/25	9:50	56.4	28/1/25	13:50	52.3	28/1/25	17:50	52.5					
28/1/25	9:55	52.0	28/1/25	13:55	51.6	28/1/25	17:55	53.3					
28/1/25	10:00	58.5	28/1/25	14:00	51.9	28/1/25	18:00	51.1					
28/1/25	10:05	51.9	28/1/25	14:05	52.6	28/1/25	18:05	51.5					
28/1/25	10:10	51.9	28/1/25	14:10	52.6	28/1/25	18:10	51.3					
28/1/25	10:15	52.0	28/1/25	14:15	52.5	28/1/25	18:15	51.8					
28/1/25	10:20	53.3	28/1/25	14:20	53.1	28/1/25	18:20	52.5					
28/1/25	10:25	51.8	28/1/25	14:25	52.3	28/1/25	18:25	52.9					
28/1/25	10:30	51.5	28/1/25	14:30	53.0	28/1/25	18:30	52.2					
28/1/25	10:35	54.3	28/1/25	14:35	52.2	28/1/25	18:35	52.7					
28/1/25	10:40	51.6	28/1/25	14:40	52.8	28/1/25	18:40	51.7					
28/1/25	10:45	51.5	28/1/25	14:45	52.7	28/1/25	18:45	51.8					
28/1/25	10:50	52.7	28/1/25	14:50	52.7	28/1/25	18:50	51.8					
28/1/25	10:55	52.4	28/1/25	14:55	55.0	28/1/25	18:55	52.6					
28/1/25	11:00	51.5	28/1/25	15:00	54.3	28/1/25	19:00	51.6					

NAME OF COMPANY				CH2M HILL Singapore Pte Ltd							
SITE LOCATION				Forest Along Yishun Avenue 1							
REPORT REFERENCE				23/01/2025 - 30/01/2025							
Start	28/1/25	19:05		Leq12h	54.2			Weighting		A	
End	29/1/25	7:00									
Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h
28/1/25	19:05	51.7		28/1/25	23:05	56.7		29/1/25	3:05	52.8	
28/1/25	19:10	51.9		28/1/25	23:10	56.4		29/1/25	3:10	53.0	
28/1/25	19:15	52.8		28/1/25	23:15	56.4		29/1/25	3:15	52.8	
28/1/25	19:20	51.4		28/1/25	23:20	56.7		29/1/25	3:20	55.7	
28/1/25	19:25	51.1		28/1/25	23:25	56.6		29/1/25	3:25	52.2	
28/1/25	19:30	50.8		28/1/25	23:30	56.8		29/1/25	3:30	52.2	
28/1/25	19:35	50.8		28/1/25	23:35	56.4		29/1/25	3:35	53.2	
28/1/25	19:40	51.2		28/1/25	23:40	56.8		29/1/25	3:40	51.0	
28/1/25	19:45	50.5		28/1/25	23:45	57.0		29/1/25	3:45	51.7	
28/1/25	19:50	50.8		28/1/25	23:50	56.5		29/1/25	3:50	52.3	
28/1/25	19:55	51.8		28/1/25	23:55	56.8		29/1/25	3:55	52.1	
28/1/25	20:00	53.4	51.6	28/1/25	0:00	56.5	56.6	29/1/25	4:00	51.9	52.7
28/1/25	20:05	53.6		29/1/25	0:05	56.4		29/1/25	4:05	51.5	
28/1/25	20:10	52.5		29/1/25	0:10	56.2		29/1/25	4:10	51.6	
28/1/25	20:15	52.8		29/1/25	0:15	56.1		29/1/25	4:15	51.7	
28/1/25	20:20	53.1		29/1/25	0:20	56.5		29/1/25	4:20	51.7	
28/1/25	20:25	53.4		29/1/25	0:25	56.0		29/1/25	4:25	51.8	
28/1/25	20:30	53.0		29/1/25	0:30	54.6		29/1/25	4:30	51.2	
28/1/25	20:35	53.9		29/1/25	0:35	54.3		29/1/25	4:35	51.8	
28/1/25	20:40	54.2		29/1/25	0:40	55.1		29/1/25	4:40	51.3	
28/1/25	20:45	55.2		29/1/25	0:45	55.3		29/1/25	4:45	50.9	
28/1/25	20:50	55.0		29/1/25	0:50	54.4		29/1/25	4:50	51.4	
28/1/25	20:55	56.9		29/1/25	0:55	54.7		29/1/25	4:55	51.5	
28/1/25	21:00	57.5	54.6	29/1/25	1:00	54.8	55.4	29/1/25	5:00	53.2	51.7
28/1/25	21:05	57.4		29/1/25	1:05	54.6		29/1/25	5:05	51.5	
28/1/25	21:10	57.1		29/1/25	1:10	55.5		29/1/25	5:10	50.5	
28/1/25	21:15	54.8		29/1/25	1:15	54.8		29/1/25	5:15	50.5	
28/1/25	21:20	55.5		29/1/25	1:20	55.2		29/1/25	5:20	50.3	
28/1/25	21:25	55.0		29/1/25	1:25	55.8		29/1/25	5:25	50.9	
28/1/25	21:30	55.1		29/1/25	1:30	53.3		29/1/25	5:30	49.8	
28/1/25	21:35	54.9		29/1/25	1:35	53.6		29/1/25	5:35	50.4	
28/1/25	21:40	54.8		29/1/25	1:40	53.5		29/1/25	5:40	51.1	
28/1/25	21:45	55.4		29/1/25	1:45	52.1		29/1/25	5:45	53.1	
28/1/25	21:50	55.4		29/1/25	1:50	53.5		29/1/25	5:50	52.4	
28/1/25	21:55	54.8		29/1/25	1:55	53.4		29/1/25	5:55	51.4	
28/1/25	22:00	54.8	55.5	29/1/25	2:00	53.9	54.2	29/1/25	6:00	51.1	51.2
28/1/25	22:05	55.4		29/1/25	2:05	53.0		29/1/25	6:05	52.0	
28/1/25	22:10	55.6		29/1/25	2:10	53.5		29/1/25	6:10	51.5	
28/1/25	22:15	55.3		29/1/25	2:15	53.3		29/1/25	6:15	51.8	
28/1/25	22:20	55.6		29/1/25	2:20	53.0		29/1/25	6:20	52.9	
28/1/25	22:25	55.5		29/1/25	2:25	52.9		29/1/25	6:25	53.5	
28/1/25	22:30	56.2		29/1/25	2:30	53.1		29/1/25	6:30	53.3	
28/1/25	22:35	56.0		29/1/25	2:35	53.5		29/1/25	6:35	53.0	
28/1/25	22:40	55.9		29/1/25	2:40	53.0		29/1/25	6:40	52.9	
28/1/25	22:45	55.9		29/1/25	2:45	52.7		29/1/25	6:45	52.4	
28/1/25	22:50	56.1		29/1/25	2:50	54.1		29/1/25	6:50	52.1	
28/1/25	22:55	57.0		29/1/25	2:55	54.0		29/1/25	6:55	53.2	
28/1/25	23:00	57.5	56.0	29/1/25	3:00	53.1	53.3	29/1/25	7:00	53.8	52.8

NAME OF COMPANY			CH2M HILL Singapore Pte Ltd							
SITE LOCATION			Forest Along Yishun Avenue 1							
REPORT REFERENCE			23/01/2025 - 30/01/2025							
Start	29/1/25		7:05	Leq12h		52.1		Weighting		A
End	29/1/25		19:00							
Date	Time	Leq5m		Date	Time	Leq5m		Date	Time	Leq5m
29/1/25	7:05	51.0		29/1/25	11:05	51.6		29/1/25	15:05	50.8
29/1/25	7:10	49.7		29/1/25	11:10	51.6		29/1/25	15:10	50.9
29/1/25	7:15	51.4		29/1/25	11:15	52.4		29/1/25	15:15	51.4
29/1/25	7:20	50.3		29/1/25	11:20	52.7		29/1/25	15:20	50.8
29/1/25	7:25	51.6		29/1/25	11:25	52.2		29/1/25	15:25	51.5
29/1/25	7:30	50.3		29/1/25	11:30	51.5		29/1/25	15:30	51.5
29/1/25	7:35	55.7		29/1/25	11:35	52.4		29/1/25	15:35	51.3
29/1/25	7:40	62.0		29/1/25	11:40	52.1		29/1/25	15:40	50.7
29/1/25	7:45	61.2		29/1/25	11:45	51.2		29/1/25	15:45	50.9
29/1/25	7:50	52.2		29/1/25	11:50	51.8		29/1/25	15:50	50.5
29/1/25	7:55	51.7		29/1/25	11:55	51.6		29/1/25	15:55	52.6
29/1/25	8:00	52.2		29/1/25	12:00	51.5		29/1/25	16:00	52.0
29/1/25	8:05	52.7		29/1/25	12:05	51.6		29/1/25	16:05	50.5
29/1/25	8:10	52.8		29/1/25	12:10	51.7		29/1/25	16:10	51.4
29/1/25	8:15	55.8		29/1/25	12:15	51.0		29/1/25	16:15	51.1
29/1/25	8:20	52.3		29/1/25	12:20	51.0		29/1/25	16:20	50.7
29/1/25	8:25	52.8		29/1/25	12:25	51.0		29/1/25	16:25	50.2
29/1/25	8:30	52.0		29/1/25	12:30	51.4		29/1/25	16:30	50.1
29/1/25	8:35	52.4		29/1/25	12:35	51.2		29/1/25	16:35	50.8
29/1/25	8:40	52.0		29/1/25	12:40	52.1		29/1/25	16:40	51.4
29/1/25	8:45	52.4		29/1/25	12:45	50.9		29/1/25	16:45	51.3
29/1/25	8:50	50.6		29/1/25	12:50	50.7		29/1/25	16:50	51.2
29/1/25	8:55	53.2		29/1/25	12:55	51.4		29/1/25	16:55	51.0
29/1/25	9:00	50.9		29/1/25	13:00	51.2		29/1/25	17:00	50.4
29/1/25	9:05	50.6		29/1/25	13:05	51.0		29/1/25	17:05	50.5
29/1/25	9:10	49.8		29/1/25	13:10	50.7		29/1/25	17:10	50.6
29/1/25	9:15	50.3		29/1/25	13:15	51.0		29/1/25	17:15	52.2
29/1/25	9:20	50.0		29/1/25	13:20	51.0		29/1/25	17:20	50.7
29/1/25	9:25	51.7		29/1/25	13:25	50.7		29/1/25	17:25	50.4
29/1/25	9:30	53.1	29/1/25	13:30	50.6	29/1/25	17:30	50.6		
29/1/25	9:35	52.1	29/1/25	13:35	51.1	29/1/25	17:35	50.8		
29/1/25	9:40	51.9	29/1/25	13:40	50.2	29/1/25	17:40	50.8		
29/1/25	9:45	51.1	29/1/25	13:45	51.0	29/1/25	17:45	50.8		
29/1/25	9:50	51.6	29/1/25	13:50	51.7	29/1/25	17:50	50.5		
29/1/25	9:55	52.2	29/1/25	13:55	51.2	29/1/25	17:55	50.7		
29/1/25	10:00	51.2	29/1/25	14:00	51.1	29/1/25	18:00	51.8		
29/1/25	10:05	50.8	29/1/25	14:05	51.1	29/1/25	18:05	50.4		
29/1/25	10:10	53.3	29/1/25	14:10	52.3	29/1/25	18:10	50.5		
29/1/25	10:15	51.9	29/1/25	14:15	51.2	29/1/25	18:15	50.8		
29/1/25	10:20	53.0	29/1/25	14:20	49.8	29/1/25	18:20	51.9		
29/1/25	10:25	54.2	29/1/25	14:25	50.7	29/1/25	18:25	50.6		
29/1/25	10:30	51.0	29/1/25	14:30	50.9	29/1/25	18:30	51.4		
29/1/25	10:35	52.9	29/1/25	14:35	52.1	29/1/25	18:35	54.7		
29/1/25	10:40	51.3	29/1/25	14:40	52.6	29/1/25	18:40	51.3		
29/1/25	10:45	50.8	29/1/25	14:45	53.0	29/1/25	18:45	50.9		
29/1/25	10:50	51.7	29/1/25	14:50	51.5	29/1/25	18:50	50.4		
29/1/25	10:55	53.2	29/1/25	14:55	50.9	29/1/25	18:55	51.1		
29/1/25	11:00	51.4	29/1/25	15:00	50.9	29/1/25	19:00	51.5		

NAME OF COMPANY			CH2M HILL Singapore Pte Ltd										
SITE LOCATION			Forest Along Yishun Avenue 1										
REPORT REFERENCE			23/01/2025 - 30/01/2025										
Start	29/1/25	19:05	Leq12h	53.3				Weighting			A		
End	30/1/25	7:00											
Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h	Date	Time	Leq5m	Leq1h		
29/1/25	19:05	51.8	51.1	29/1/25	23:05	55.9	55.3	30/1/25	3:05	51.9	51.1		
29/1/25	19:10	51.7		29/1/25	23:10	56.3		30/1/25	3:10	51.2			
29/1/25	19:15	51.7		29/1/25	23:15	55.7		30/1/25	3:15	49.2			
29/1/25	19:20	51.0		29/1/25	23:20	56.0		30/1/25	3:20	50.2			
29/1/25	19:25	50.2		29/1/25	23:25	55.7		30/1/25	3:25	49.7			
29/1/25	19:30	51.1		29/1/25	23:30	55.8		30/1/25	3:30	51.2			
29/1/25	19:35	50.6		29/1/25	23:35	55.6		30/1/25	3:35	52.2			
29/1/25	19:40	51.5		29/1/25	23:40	54.6		30/1/25	3:40	51.8			
29/1/25	19:45	50.4		29/1/25	23:45	54.4		30/1/25	3:45	51.5			
29/1/25	19:50	51.8		29/1/25	23:50	54.7		30/1/25	3:50	52.5			
29/1/25	19:55	50.2	53.2	29/1/25	23:55	53.6	54.8	30/1/25	3:55	50.7	50.2		
29/1/25	20:00	51.3		29/1/25	0:00	54.4		30/1/25	4:00	50.0			
29/1/25	20:05	51.7		30/1/25	0:05	55.0		30/1/25	4:05	51.0			
29/1/25	20:10	54.1		30/1/25	0:10	54.3		30/1/25	4:10	49.4			
29/1/25	20:15	54.4		30/1/25	0:15	54.6		30/1/25	4:15	49.6			
29/1/25	20:20	52.0		30/1/25	0:20	55.1		30/1/25	4:20	50.7			
29/1/25	20:25	52.7		30/1/25	0:25	56.0		30/1/25	4:25	50.3			
29/1/25	20:30	52.3		30/1/25	0:30	55.3		30/1/25	4:30	49.9			
29/1/25	20:35	52.6		30/1/25	0:35	55.3		30/1/25	4:35	50.0			
29/1/25	20:40	53.0		30/1/25	0:40	54.6		30/1/25	4:40	50.5			
29/1/25	20:45	53.1	55.0	30/1/25	0:45	55.2	54.0	30/1/25	4:45	50.1	49.7		
29/1/25	20:50	53.1		30/1/25	0:50	53.8		30/1/25	4:50	49.7			
29/1/25	20:55	53.5		30/1/25	0:55	53.3		30/1/25	4:55	50.0			
29/1/25	21:00	54.5		30/1/25	1:00	53.9		30/1/25	5:00	50.9			
29/1/25	21:05	53.8		30/1/25	1:05	54.2		30/1/25	5:05	49.9			
29/1/25	21:10	54.2		30/1/25	1:10	54.7		30/1/25	5:10	49.8			
29/1/25	21:15	54.8		30/1/25	1:15	54.6		30/1/25	5:15	49.9			
29/1/25	21:20	54.5		30/1/25	1:20	54.1		30/1/25	5:20	49.3			
29/1/25	21:25	54.3		30/1/25	1:25	55.0		30/1/25	5:25	50.1			
29/1/25	21:30	54.6		30/1/25	1:30	54.5		30/1/25	5:30	49.9			
29/1/25	21:35	55.3	55.8	30/1/25	1:35	53.8	52.7	30/1/25	5:35	49.7	50.2		
29/1/25	21:40	54.8		30/1/25	1:40	54.5		30/1/25	5:40	50.0			
29/1/25	21:45	55.5		30/1/25	1:45	53.6		30/1/25	5:45	49.4			
29/1/25	21:50	54.9		30/1/25	1:50	52.9		30/1/25	5:50	50.1			
29/1/25	21:55	55.8		30/1/25	1:55	52.5		30/1/25	5:55	48.6			
29/1/25	22:00	56.7		30/1/25	2:00	52.2		30/1/25	6:00	48.8			
29/1/25	22:05	56.5		30/1/25	2:05	52.6		30/1/25	6:05	50.0			
29/1/25	22:10	56.3		30/1/25	2:10	53.5		30/1/25	6:10	49.5			
29/1/25	22:15	56.1		30/1/25	2:15	53.5		30/1/25	6:15	50.2			
29/1/25	22:20	56.0		30/1/25	2:20	53.4		30/1/25	6:20	49.6			
29/1/25	22:25	55.8		30/1/25	2:25	52.7		30/1/25	6:25	50.0			
29/1/25	22:30	55.7		30/1/25	2:30	52.8		30/1/25	6:30	49.9			
29/1/25	22:35	55.3		30/1/25	2:35	53.0		30/1/25	6:35	49.5			
29/1/25	22:40	54.6		30/1/25	2:40	52.5		30/1/25	6:40	49.7			
29/1/25	22:45	54.8		30/1/25	2:45	51.4		30/1/25	6:45	51.3			
29/1/25	22:50	55.7		30/1/25	2:50	51.6		30/1/25	6:50	50.5			
29/1/25	22:55	55.8		30/1/25	2:55	53.0		30/1/25	6:55	50.6			
29/1/25	23:00	56.1		30/1/25	3:00	52.4		30/1/25	7:00	50.9			

Appendix 6B. Construction Methodology Assumptions

Construction Phase	Main Construction Activity	Construction Activities	Equipment	Quantity	
Advance works	Tree protection zone and perimeter hoarding	Erection of tree protection zone and perimeter hoarding	Excavator	1	
			Nail gun	1	
	Tree felling and land clearance	Tree felling	Chainsaw	2	
			Lorry crane	2	
		Vegetation & debris transportation	Excavator	2	
	Site preparation	Access road	Excavator	1	
			Dozer	1	
			Roller	1	
		Site office	Excavator	1	
			Lorry crane	1	
			Welding	1	
			Generator	1	
		Installation of noise barrier	Mobile crane	1	
			Nail gun	1	
			Installation of ECM facilities	Excavator	1
				Concrete discharging and pumping	1
		General	Machinery maintenance	Welding	1
	Electric drill			1	
	Machinery/ construction material delivery		Dump truck	2	
	Waste Management		Dump truck	1	
	Electricity source		Generator	2	
Earthwork	Soil and geotechnical Investigation	Drilling	Drilling machine	2	
			Pump	2	
			Generator	2	
	Drainage and utilities diversion	Concrete hacking	Excavator	1	
		Pipe instalation	Crawler crane	1	
		Electricity source	Generator	1	
	Cut and fill / regrading/ platforming	Levelling and excavation	Excavator	5	
			Roller	2	
		Electricity source	Generator	2	
	Installing sheet pile/soldier pile/soil nail	Piling	Vibratory piling	2	
			Crawler crane	2	
			Concrete/rock drilling	2	
			Welding	2	
			Gas cutter	2	
		Excavation	Excavator	2	
	Electricity source	Generator	2		
	General	Machinery maintenance	Welding	1	
			Electric drill	1	
		Machinery / construction material delivery	Dump truck	2	
		Waste Management	Dump truck	2	

Construction Phase	Main Construction Activity	Construction Activities	Equipment	Quantity
		Electricity source	Generator	2
Infrastructure	Road works	Layering e.g. spreading, rolling, compaction, paving	Excavator	2
			Dozer	2
			Roller	2
			Asphalt paver	2
			Generator	2
	Drainage and sewerage work	Excavation	Excavator	2
		Concreting	Concrete discharging and pump	2
			Poker vibrator	2
			Generator	2
		Excavation	Excavator	2
		Pipe installation	Crawler crane	2
		General	Generator	2
	Mechanical and Electrical works	Excavation	Excavator	2
		Utilities installation	Crawler crane	2
			Lorry crane	2
	General	Machinery maintenance	Welding	1
			Electric drill	1
		Machinery / construction material delivery	Dump truck	5
			Transit mixer	5
		Waste management	Dump truck	5
		Electricity source	Generator	2
Building	Bottom-up construction - substructure	Foundation	Pre-cast concrete piling	2
			Welding	2
			Gas cutter	2
			Excavator	3
			Bored piling	5
			Concrete discharging and pumping	1
			Poker vibrator	2
			Crawler crane	2
		Base slab casting	Concrete discharging and pumping	2
			Poker vibrator	5
	Bottom-up construction - superstructure	Prefabrication structure installation	Tower crane	5
			Crawler crane	5
			Welding	5
			Gas cutter	5
			Grinding	5
	Finishing & exterior work	Architectural works e.g. window, painting, door, railing, etc	Welding	5
			Grinding	5
			Nail gun	5

Construction Phase	Main Construction Activity	Construction Activities	Equipment	Quantity
			Boom lift	2
		Pavement	Excavator	2
			Concrete discharging and pumping	1
	General	Machinery maintenance	Welding	1
			Electric drill	1
		Machinery / construction material delivery	Dump truck	5
			Transit mixer	7
		Waste Management	Dump truck	5
		Electricity source	Generator	5

Appendix 6C. Construction Phases and PME Noise Inventory

No	Constructi on Phase	Main Constru ction Activity	Construction Activities	Equipment	Qua ntity	Total SWL (dBA)	% On time		DAY - L _{Aeq} (12hrs) 7:00am - 7:00pm		DAY - L _{Aeq} (5mins) 7:00am - 7:00pm	
							L _{Aeq} 12hrs - Day	L _{Aeq} 5mins - Day	PWL, dB(A) - per total quantity	PWL, dB(A) - per total quantity & duration	PWL, dB(A) - per total quantity	PWL, dB(A) - per total quantity & duration
1b	Advance works	Tree protecti on zone and perimet er hoardin g	Erection of tree protection zone (if any) and perimeter hoarding	Excavator	1	118	80	100	119	118	119	119
				Nail gun	1	101	80	100	102	101	102	102
		Tree felling and land/ vegetati on clearan ce	Tree felling and land/ vegetation clearance	Chainsaw	2	126	80	100	130	129	130	130
				Lorry crane	2	120	80	100	120	119	120	120
			Vegetation & debris transportation	Excavator	2	118	80	100	122	121	122	122
		Site prepara tion		Access road	Excavator	1	118	80	100	116	115	116
			Dozer		1	110	80	100	108	107	108	108
			Roller		1	104	80	100	102	101	102	102
			Site office	Excavator	1	118	80	100	116	115	116	116
				Lorry crane	1	120	80	100	96	95	96	96
				Welding	1	96	80	100	94	93	94	94
				Generator	1	119	80	100	117	116	117	117
			Installation of ECM facilities	Excavator	1	118	80	100	119	118	119	119
				Concrete discharging and pumping	1	107	80	100	108	107	108	108
			Installation of mitigation measures (if any)	Mobile crane	1	98	80	100	96	95	96	96
		Nail gun		1	101	80	100	99	98	99	99	
		General	Machinery maintenance	Welding	1	96	8	100	94	83	94	94
				Electric drill	1	94	8	100	92	81	92	92
			Construction materials delivery	Dump truck	2	114	80	100	118	117	118	118
			Waste management storage and handling	Dump truck	1	114	80	100	112	111	112	112
			Electricity supply	Generator	2	119	100	100	123	123	123	123
												132
2	Earthwork	Soil and geotech nical investig ation	Drilling	Drilling machine	2	102	80	100	106	105	106	106
				Pump	2	108	80	100	112	111	112	112
				Generator	2	119	80	100	123	122	123	123
				Excavator	5	118	80	100	125	124	125	125

No	Constructi on Phase	Main Constru ction Activity	Construction Activities	Equipment	Qua ntity	Total SWL (dBA)	% On time		DAY - L _{Aeq} (12hrs) 7:00am - 7:00pm		DAY - L _{Aeq} (5mins) 7:00am - 7:00pm	
							L _{Aeq} 12hrs - Day	L _{Aeq} 5mins - Day	PWL, dB(A) - per total quantity	PWL, dB(A) - per total quantity & duration	PWL, dB(A) - per total quantity	PWL, dB(A) - per total quantity & duration
		Cut and fill / regrading/ levelling/ platforming/ excavation	Cut and fill / regrading/ levelling/ platforming/ excavation	Roller	2	104	80	100	108	107	108	108
		Installin g sheet pile/sol dier pile/soil nail	Piling	Vibratory piling	2	130	80	100	134	133	134	134
				Crawler crane	2	115	80	100	119	118	119	119
				Concrete/rock drilling	2	129	80	100	133	132	133	133
				Welding	2	96	80	100	100	99	100	100
				Gas cutter	2	94	80	100	98	97	98	98
			Excavation	Excavator	2	118	80	100	122	121	122	122
		Electricity source	Generator	2	119	80	100	123	122	123	123	
		General	Machinery maintenance	Welding	1	96	8	100	94	83	94	94
				Electric drill	1	94	8	100	92	81	92	92
			Construction materials delivery	Dump truck	2	114	80	100	118	117	118	118
			Waste management storage and handling	Dump truck	2	114	80	100	118	117	118	118
			Electricity supply	Generator	2	119	100	100	123	123	123	123
												136
3	Infrastruct ure	Road works layering	Layering e.g. spreading, rolling, compaction, paving	Excavator	2	118	80	100	122	121	122	122
				Dozer	2	110	80	100	114	113	114	114
				Roller	2	104	80	100	108	107	108	108
				Asphalt paver	2	119	80	100	123	122	123	123
				Generator	2	119	80	100	123	122	123	123
		Excavati on works	Excavation	Excavator	2	118	80	100	122	121	122	122
		Drainag e and sewerag e work	Concreting	Concrete discharging and pump	2	107	80	100	111	110	111	111
				Poker vibrator	2	112	80	100	116	115	116	116
				Generator	2	119	80	100	123	122	123	123
			Excavation	Excavator	2	118	80	100	122	121	122	122
			Pipe installation	Crawler crane	2	115	80	100	119	118	119	119
			General	Generator	2	119	80	100	123	122	123	123

No	Constructi on Phase	Main Constru ction Activity	Construction Activities	Equipment	Qua ntity	Total SWL (dBA)	% On time		DAY - L _{Aeq} (12hrs) 7:00am - 7:00pm		DAY - L _{Aeq} (5mins) 7:00am - 7:00pm	
							L _{Aeq} 12hrs - Day	L _{Aeq} 5mins - Day	PWL, dB(A) - per total quantity	PWL, dB(A) - per total quantity & duration	PWL, dB(A) - per total quantity	PWL, dB(A) - per total quantity & duration
		Mechan ical and electric al works	Excavation	Excavator	2	118	80	100	122	121	122	122
			Utilities installation	Lorry crane	2	120	80	100	124	123	124	124
		General	Machinery maintenance	Welding	1	96	8	100	94	83	94	94
				Electric drill	1	94	8	100	92	81	92	92
			Construction materials delivery	Dump truck	5	114	80	100	121	120	121	121
				Transit mixer	5	116	80	100	123	122	123	123
			Waste management storage and handling	Dump truck	5	114	80	100	121	120	121	121
			Electricity supply	Generator	2	119	100	100	123	123	123	123
											133	134
4	Building	Bottom up constru ction - substru cture	Building foundation works	Pre-cast concrete piling	2	128	80	100	132	131	132	132
				Welding	2	96	80	100	100	99	100	100
				Gas cutter	2	94	80	100	98	97	98	98
				Excavator	3	118	80	100	123	122	123	123
				Bored piling	5	124	80	100	131	130	131	131
				Concrete discharging and pumping	1	107	80	100	107	106	107	107
				Poker vibrator	2	112	80	100	116	115	116	116
				Crawler crane	2	115	80	100	119	118	119	119
			Base slab casting	Concrete discharging and pumping	2	107	80	100	110	109	110	110
				Poker vibrator	5	112	80	100	119	118	119	119
		Bottom up constru ction - superstr ucture	Prefabrication and structure installation	Tower crane	5	108	80	100	115	114	115	115
				Welding	5	96	80	100	103	102	103	103
				Gas cutter	5	94	80	100	101	100	101	101
				Grinding	5	106	80	100	113	112	113	113
		Architec tural works	Architectural works e.g. window, painting, door, railing, etc	Welding	5	96	80	100	103	102	103	103
				Grinding	5	106	80	100	113	112	113	113
				Nail gun	5	101	80	100	108	107	108	108
				Boom lift	2	105	80	100	108	107	108	108
		Paveme nt constru	Pavement construction works	Excavator	2	118	80	100	121	120	121	121
				Concrete discharging and pumping	1	107	80	100	107	106	107	107

No	Constructi on Phase	Main Constru ction Activity	Construction Activities	Equipment	Qua ntity	Total SWL (dBA)	% On time		DAY - L _{Aeq} (12hrs) 7:00am - 7:00pm		DAY - L _{Aeq} (5mins) 7:00am - 7:00pm	
							L _{Aeq} 12hrs - Day	L _{Aeq} 5mins - Day	PWL, dB(A) - per total quantity	PWL, dB(A) - per total quantity & duration	PWL, dB(A) - per total quantity	PWL, dB(A) - per total quantity & duration
		ction works										
		General	Machinery maintenance	Welding	1	96	8	100	94	83	94	94
				Electric drill	1	94	8	100	92	81	92	92
			Construction materials delivery	Dump truck	5	114	80	100	121	120	121	121
				Transit mixer	7	116	80	100	125	124	125	125
			Waste management storage and handling	Dump truck	5	114	80	100	121	120	121	121
			Electricity supply	Generator	5	119	100	100	126	126	126	126
										135		136

Appendix 6D. Noise Contours

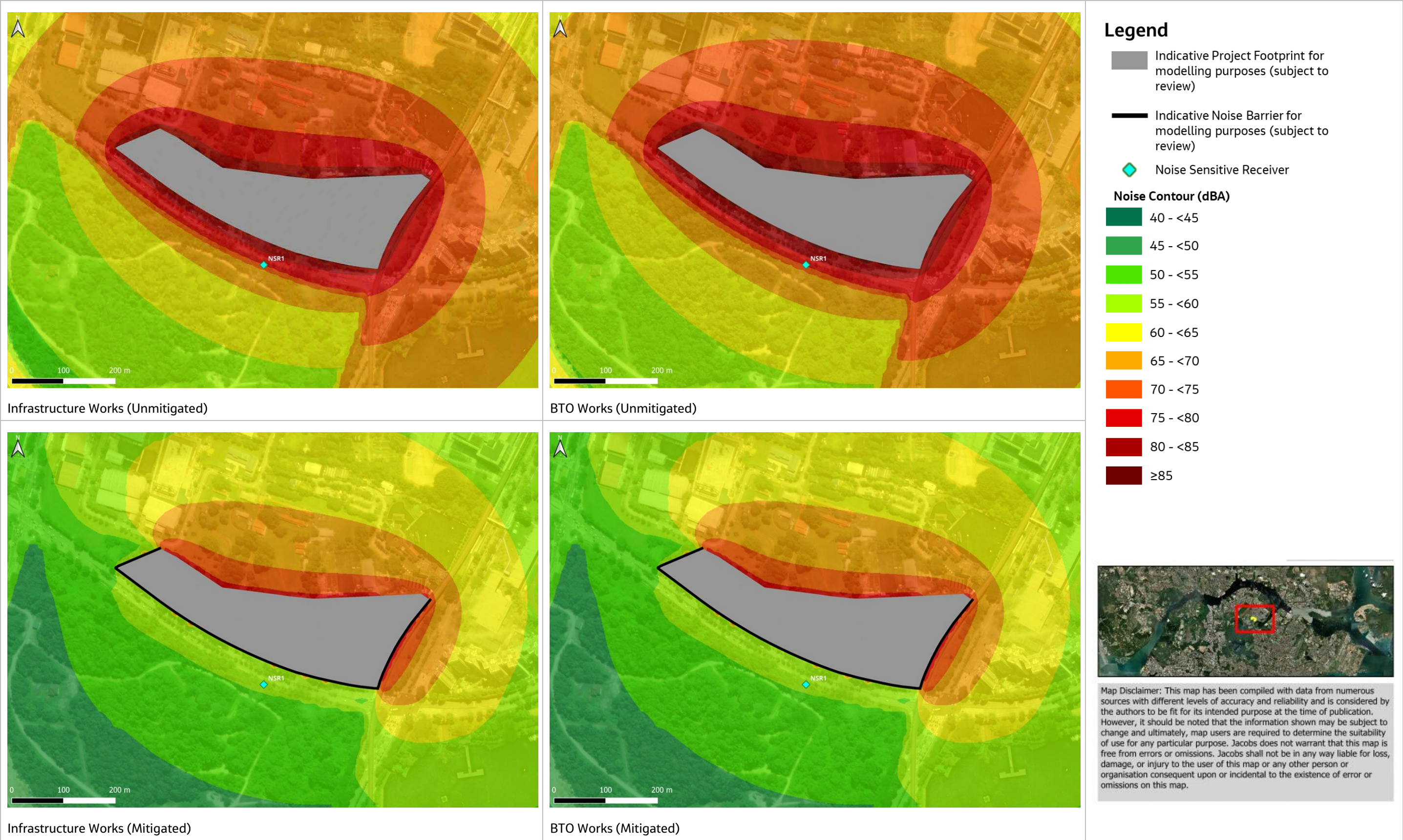


Figure 11-1. L_{Aeq} 12 Hours Noise Contours (0.5 m Above Ground Level)

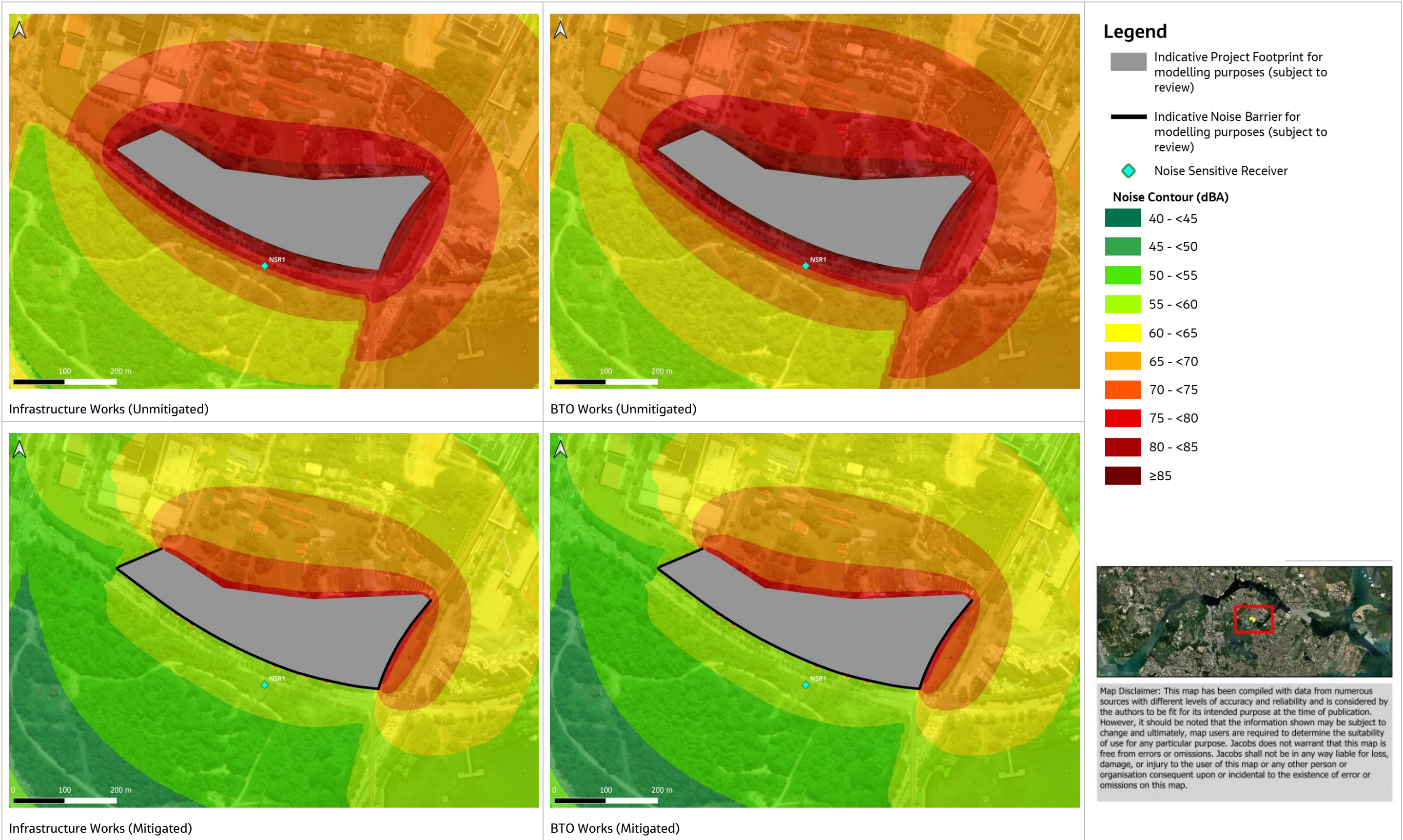


Figure 11-2. L_{Aeq} 5 mins Noise Contours (0.5 m Above Ground Level)

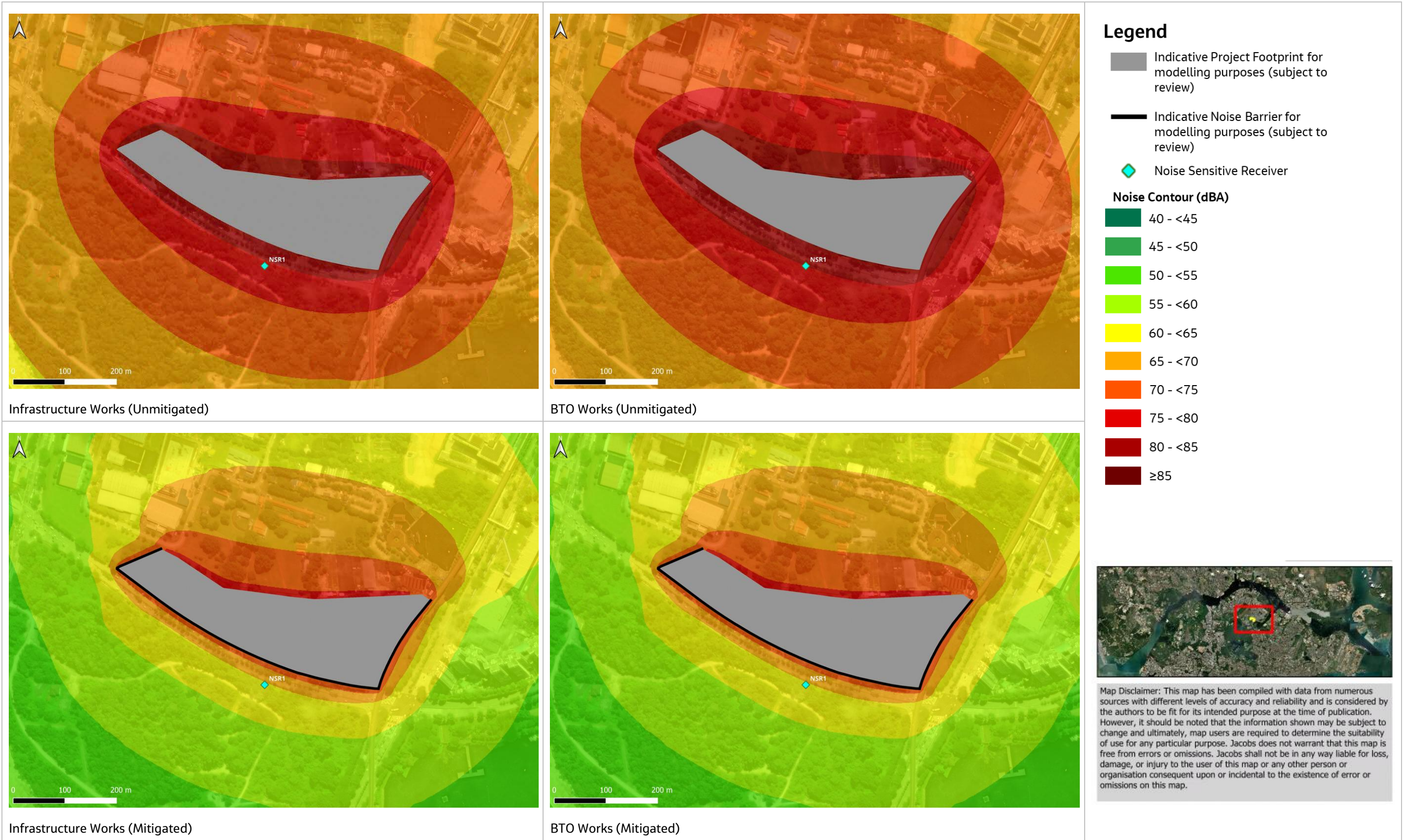


Figure 11-3. L_{Aeq} 12 Hours Noise Contours (15 m Above Ground Level)

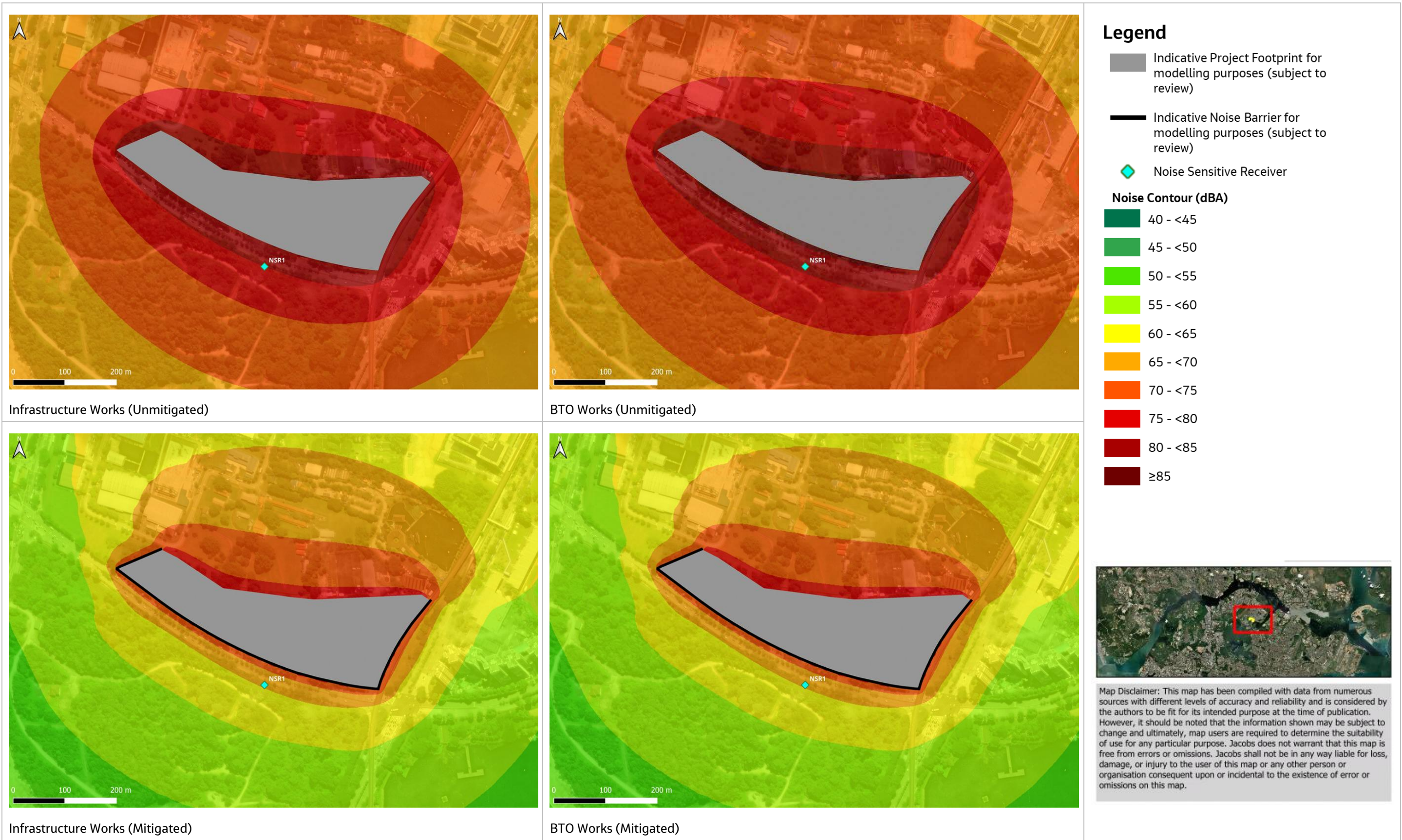


Figure 11-4. L_{Aeq} 5 mins Noise Contours (15 m Above Ground Level)

Appendix 7A. Guidelines for Tree Protection and Conservation

APPENDIX 7A

GUIDELINES FOR TREE PROTECTION AND CONSERVATION

By

Derek Yap

Lead Arborist

Camphora Pte Ltd

ISA certified

SG-0117A

CONTENT REQUIREMENTS

This document outlines specific measures to protect trees during construction or other site disturbance. The content and scope of the document will vary based on the site, type of construction, tree species, tree location and other factors.

TREE PROTECTION AND CONSERVATION GUIDELINES

This section outlines the general provisions for tree protection before, during and after construction. Additional measures may be added by the attending arborist on a case-by-case basis.

PRE-DEMOLITION/PILING/CONSTRUCTION

1. Pre-Construction Meeting

The attending arborist shall attend a pre-construction meeting with the project contractor or construction supervisor to explain the tree protection and monitoring requirements as outlined in this document.

In addition, the project contractor or construction supervisor shall complete the 'VERIFICATION OF TREE PROTECTION CHECKLIST' as attached in Annex A before the onset of the construction.

1.1 Tree Protection Zone

Prior to any site clearing (demolition works), piling works, grading, trenching or other soil disturbance, a tree protection zone (TPZ) must be installed as follows:

- i. Type
The barriers should be temporary, made of a hard material, 1.8-m tall and firmly installed into the ground. If footings are required, there should be no on-site casting of footings
- ii. Ground protection
Mulching material (can be compost or woodchips) at 100-mm thick to be laid within the TPZ. Woodchips with termiticide treatment should not be used to avoid chemical leeching into the soil

Apply complete fertilizer (N:P:K 15:15:15) upon or together with the application of mulch.

iii. Signage

A readily-visible and waterproof sign shall be installed on all sides of the fencing around each individual protected tree. The size of each sign must be a minimum of 300mm wide and must contain the wording below:



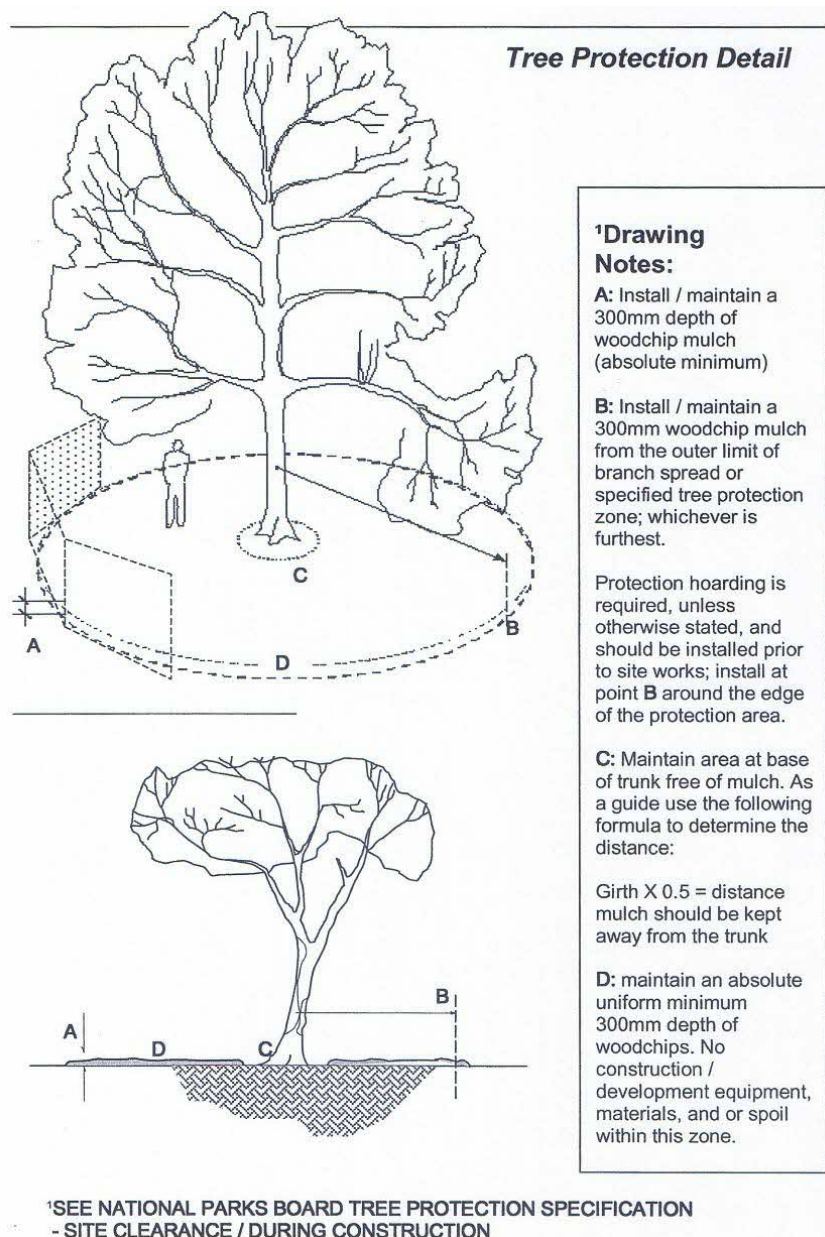
KEEP OUT!
TREE PROTECTION
ZONE

Entry prohibited. This fence shall remain in place throughout the entire construction period.

iv. Fencing installation

Installation must be approved by the attending arborists and/or the approved authority prior to construction.

A diagrammatic representation of a proper tree protection zone is presented below. The actual dimensions of the tree protection zone should be determined and documented by the attending Arborist.



1.2 Tree pruning and removal

Various trees may need to be pruned away from structures or proposed construction activity. **Construction or contractor personnel shall not attempt pruning or removal.** Consultation and written approval with attending arborist must be obtained prior to pruning.

Removal of trees adjacent to trees that are to be retained requires planning and skilled arboriculture workers. Trees should not be removed by pushing with excavators/heavy machinery or with lumberjack (one cut) methods. Directional felling methods (notch and back-cut) should be deployed during removal of trees.

Removal of trees that extend into branches or roots of protected trees shall not be attempted by the demolition or construction crew, or by grading or other heavy equipment. Before removing tree stumps, the project manager shall seek the advice from the attending arborist determine if roots are entangled with trees that are to remain. If so, these stumps shall have their roots severed before extracting them.

1.3 Site Clearance

To avoid lumber jack felling of trees that may severely damage the canopy of conserved trees, it is recommended that qualified (see Point 4.3 Tree Conservation Guidelines) Arboriculture contractors be engage to fell trees adjacent to protected trees to ensure that the trees (when cut) fall away from the protected trees and their associated TPZs.

Contractors carry out tree felling works near assigned TPZs of conserved trees should

- i. Employ directional felling through the use of notch and back cuts
- ii. Deploy cranes to tension trunks in the direction of the drop
- iii. Carry out pruning of canopy branches to remove entangling branches
- iv. If trees to be removed are taller than neighbouring trees to be retained, removal of branches should be carried out in a controlled manner using ropes and cranes to avoid damaging canopy of the lower trees.
- v. To avoid pruning of conserved trees at the proximity unless consultation and approval from attending arborist has been obtained.
- vi. No tree should be removed by pushing with an excavator or heavy machinery.

DURING DEMOLITION/PILING/CONSTRUCTION

2. Tree Protection Zone Restrictions

- No ground disturbance, grading, trenching or other construction activities shall occur within the TPZ except as specified and/or approved by the attending arborist or authority.
- No construction material, debris, machinery (e.g. generators) or other construction waste shall be stored within the TPZ. Weight and presence of these materials increases soil compaction and reduces the area exposed for water infiltration and gaseous exchange.



Figure 1: Construction material and heavy machinery are prohibited within the TPZ

- Excavation works within the TPZ are strictly prohibited. Unless otherwise specified by the attending arborist, all work done within the TPZ shall be completed with manual trenching with hand tools or other hand held power tools that will not cause any root/tree damage.

If roots need to be cut, it shall be done using proper equipment (e.g. pruning saw, chain saw) under the supervision of the attending arborist.



Figure 2: Trial trench by skilled workers using hand tools exposing root architecture

- Nailing, tying or pasting of materials on trees is prohibited. The tree shall not be used as an anchor for supporting structures during the construction.



Figure 3: Using tree as anchor may damage its bark.



Figure 4: No nails shall be driven into the tree as it promotes infiltration of pests/diseases

- Phytotoxic materials such as fuels, oils, cement, chemicals, and paint shall be kept away and stored/mixed at least 2.5m from the tree protection zone. Such chemicals can significantly change the cation exchange capacity and pH of the soil, rendering nutrient uptake inefficient and creating an environment too toxic for the roots to grow.

Construction slug especially from piling works should not be deposited within the TPZ. Such sludge is usually high in clay content and when layered over and within the TPZ could significantly alter the water infiltration and gaseous exchange rates of the root absorption area of the tree.

Canvass sheets/Eco-mat must be laid on the existing soil near the tree in view of soil protection during the demolition, drilling or other construction activities pertaining to concrete structures.



Figure 5: Construction cement deposited at tree base.



Figure 6: Tree showing signs of decline overtime.

- Lowering the grade around trees can have an immediate and long-term effect on trees.

Typically, most roots are within the top 1m of soil, and most of the fine roots active in water and nutrient absorption are in the top 300mm.

A) Grade changes within the TPZ are not permitted.

B) Grade changes outside the TPZ shall not significantly alter drainage.

C) Grade changes under specifically approved circumstances shall not allow more than 200mm of fill soil or allow more than 150mm of existing soil to be removed from

natural grade, unless mitigated.

D) Grade fills over 200mm or impervious overlay shall incorporate an approved permanent aeration system, permeable material, or other approved mitigation.

E) Grade cuts exceeding 150mm shall incorporate retaining walls or an appropriate transition equivalent.

No removal of the TPZ will be permitted under any circumstances.



Figure 7: Inappropriate installation/maintenance of TPZ during construction.

2.2 Proximity of Heavy machinery/vehicles

Heavy vehicles and machinery (e.g. excavators, piling cranes, 10 wheelers) movement should be limited near TPZs. Temporary access/passageways should be planned to avoid conserved trees.

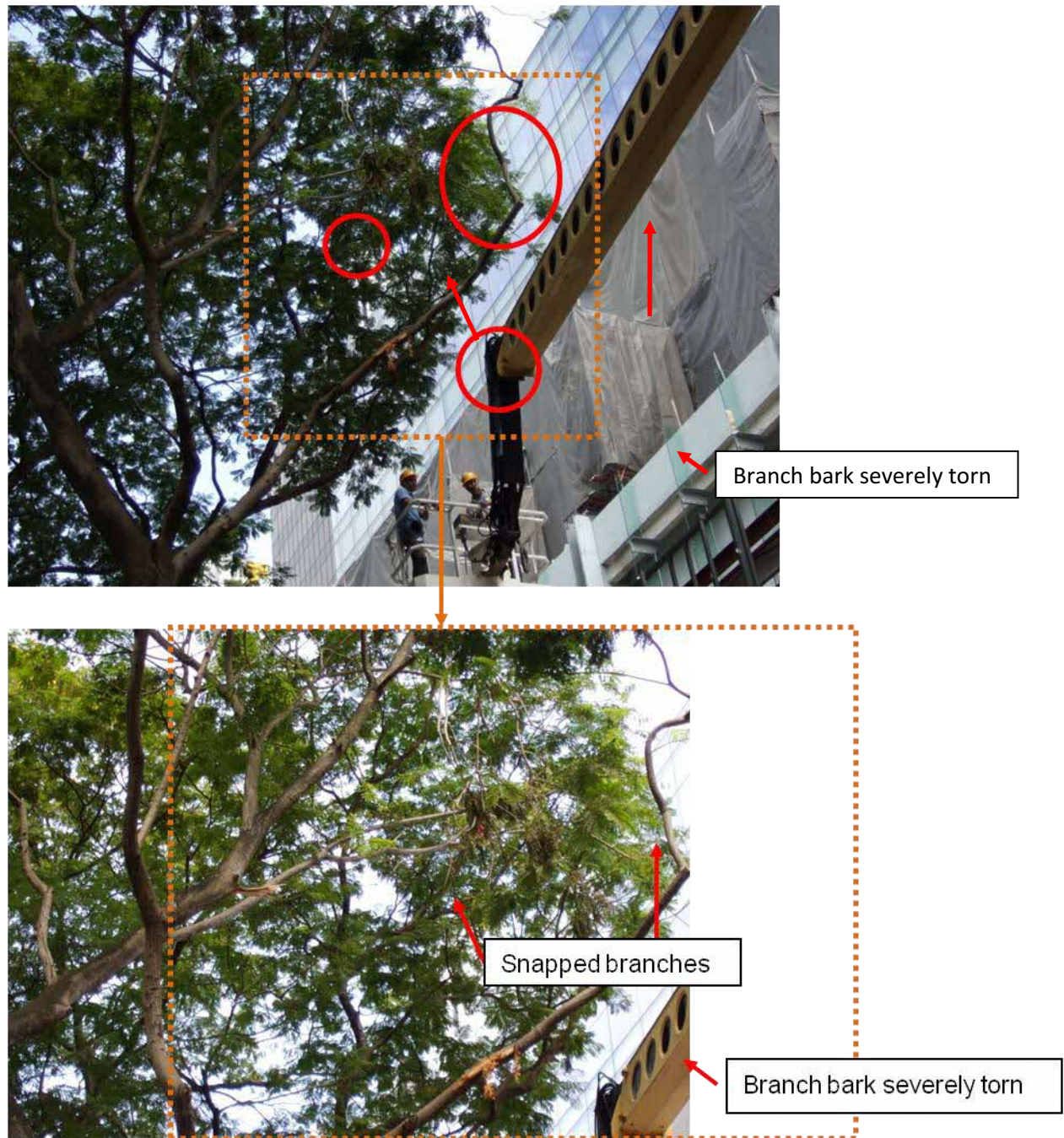


Figure 8: Tree branches were severed due to the negligence of the crane operator.

2.3 Drainage Considerations

In the event that water ponding conditions develop in the course of construction due to change in grade/platform levels, construction events or any other unforeseeable factors, the contractor is required to improve drainage around or within the TPZ in consultation with the attending arborist.

2.4 Trenching, Excavation and Equipment use

Trenching, excavation or boring within the TPZ shall be limited to activities approved by the architect and/or attending Arborist. Explore alternatives for trenching outside the root zone. Avoid exposing roots during hot, dry weather. Backfill trenches as soon as possible with soil and soak with water the same day. Small roots can die in 10 to 15 minutes and large roots may not survive an hour of exposure. If the trench must be left open all roots must be kept moist by wrapping them in peat moss and burlap.

i. Root Severance

Roots of any size requiring cutting should be assessed and documented by the attending Arborist according to the type of root, diameter, distance from trunk, and percentage of root base. Tunneling under roots is the approved alternative. Prior to excavation for foundation/footing/walls, or grading or trenching within the TPZ, roots shall be severed cleanly outside the TPZ to the depth of the planned excavation. When roots must be cut, they shall be cut cleanly with a sharp saw to sound wood and flush with the trench site.



Figure 9: Tunneling under roots.

ii. Excavation

Any approved excavation, demolition, or extraction of material shall be performed with equipment that is placed outside the TPZ. Hand digging, hydraulic, or pneumatic excavation (e.g. air spading) are permitted methods for excavation within the TPZ.



Figure 10: Root exploratory works using an air spade. Air spading avoids damage of structural and even feeder roots of the tree.

iii. Heavy Equipment

Use of backhoes, Ditch-Witches, steel tread tractors or other heavy vehicles within the TPZ is prohibited unless approved by the attending Arborist. If allowed, a protective root buffer is required.

2.5 Tree Care

In the course of construction, the following measures may be necessary to reduce the effects of construction stress on protected trees. Quantum, duration and extent to be advised by attending arborist.

(A) Fertilization

Records of fertilization should be kept. The records should include details such as the type and date of fertilization. Application of chemicals (e.g., chemical fertilizers) should be avoided. If necessary, approval from the Board should be sought.

A1 Vertical trenches and Nutrient Sinks

Create vertical trenching and nutrient sinks. These nutrient sinks should go down to at least 300mm deep and should be filled with high grade compost and 12% Humic acid (dilution 1:100). These sinks will act to reduce construction stress by conditioning the soil, increasing soil microbiological activity and increasing organic matter. At least 24 numbers of vertical trenches / nutrient sinks are required for trees greater than 2m in girth. Vertical trenches for trees under 2m in girth will be determined empirically by the attending arborist and will take into account site conditions, tree species and its pre construction vigor. Top up nutrient sinks every 3 months.

A2 Soil Injection of Biostimulants

Mandatory if TPZ has been infringed into, soil compaction has occurred, tree condition has observed to have declined (indicators: reduction in Live crown ratios, twig die back at canopy and change in leaf colour/size/density)

- **Purpose:** To de-compact soil using a hydraulic pressurized delivery of biostimulants that both hydrates and aerates at the same time. Aim to reduce compaction to less than 400psi in the first 500mm of the soil.
- Mixed bio stimulants – serves 2 functions
 - Decompaction**
- Humic acid – as soil conditioner and chelating agent (Nutrients are mobilized in forms that the plants can accept), facilitate release of nutrients and reduces leaching. Also improves water holding capacities of soil.

- Liquid gypsum / Dolomite – soil conditioner, improve soil structure and facilitate release of nutrients in clay soils typical of local conditions.

To feed and increase soil microbiology to increase tree vigor post damage. Soil microbiology helps nutrient uptake and encourages healthy root growth critical to prevent construction stress.

- Mollases – High CE for immediate uptake,
- Fish Kelp – Protein source. Organic fertilisers
- Slow release fertilizers (Osmocote)

(B) Watering

- Water supplement during periods of drought.
- Watering duration and extent depends on site conditions and species.
- Watering is carried out until first signs of inundation are observed (i.e. water infiltration observe to slow down significantly).

(C) Myconate treatment

- To trigger and stimulate growth of existing mycorrhizae.

(D) Pesticide treatment

- To control pest (e.g. termites, borers, caterpillars etc) when it occurs.
- Fungicide or bactericide as required or as determined by attending arborist to control microbe pathogens.

(E) Crown cleaning

To be carried out in consultation with the attending Arborist. Trees are living things and may require some form of pruning during the course of the development.

- Crown cleansing- Prune to remove dead branches that may have developed through time.
- Crown lifting- Prune to lift crown to avoid new amenities.
- Crown thinning- Prune to reduce canopy branches and loading.

Structural pruning (including crown reduction) to remove branches that may obstruct new amenities and/or movement of critically necessary equipment may require the planning and standing supervision of the attending arborist.

2.6 Engaging Arboriculture Contractors

All arboriculture works should be carried out by skilled and trained arboriculture teams. As such, it is preferred that only Arboriculture contractors which have at least 8 years working experience and must show previous work experience in developments of similar size or complexity. Arboriculture contractors should meet NParks safety requirements for work at height, LTA's requirements for temporary works along roadsides (where necessary) and have a certified arborist to supervise the pruning/felling/planting works.

All arboriculture workers engaged in tree climbing and chainsaw work shall possess a valid basic tree climbing certification base upon demonstrated competence in the WSQ module conducted by CUGE or an equivalent WSQ approved training organization.

Each Arboriculture crew shall possess the following VALID competences:

- Operation of chainsaw for ground work (LS-MT-103E-1)
- Chainsaw safety and maintenance (LS-MT-102E-1)
- Perform formative pruning of young trees (LS-MT-114E-1)
- Provide Arboriculture support on site (LS-MT-116E-1)
- Workplace safety and health – operators (ES-WSH-101G-1)
- Respond to Emergency (LS-HM-208E-1)
- Perform advance rigging and climbing techniques (LS-HM-308S-1)
- Perform aerial tree access and aerial rescue skills (LS-HM-204S-1)
- Implement and apply appropriate risk and safety management to sector practices (LS-BP-301S-1)
- Prepare risk assessment report (LS-HM-406S-1)
- Operate and work from an elevated work platform (CUGE-ARB-3501)

POST-CONSTRUCTION

3. Soft Landscaping

Ground works, site preparation and implementation of all landscaping near protected trees must be undertaken carefully.

TPZ barriers can only be removed at this juncture for the purpose. However, when working near trees, cultivation of soils in these areas must be cautiously handled using hand tools. Planting of shrubs shall be at a distance of at least 300mm away from existing root collar.

Avoid changes to ground levels or unnecessary compaction of soils within proximity to existing trees during the course.



Figure 10: New plantings at a minimum distance of 300mm (all round) from root collar

ANNEX A

VERIFICATION OF TREE PROTECTION CHECKLIST

Note: The project contractor or construction supervisor shall verify in writing that all **preconstruction** tree preservation conditions have been met as follows:

Submitted by: _____

Company/Project: _____

Date/Time: _____

S/N	Action	Checked (☐)	Remarks
1	Installation of tree fencing around identified trees within/near site (hard material at 1.8m tall)		
2	Tree protection zone (TPZ) dimensions meets specifications (from NParks and/or attending arborist)		
3	Warning signs prominently displayed on all sides of the fencing, including designated tree number		
4	Removal of construction material (ie machinery, debris, tools etc) within TPZ		
5	Mulching of high grade compost of 100mm thick around identified trees		
6	Completion of tree pruning (if necessary) under the supervision/written approval with the attending arborist		
7	Establishment of a tree maintenance schedule according to arborist recommendations (to be submitted to attending arborist)		
8	Documentation of trees removed and retained, including the species, height, and girth		

Verified by (attending arborist): _____

Date/Time: _____