

Specialist Consultancy Services for EMMP at Sembawang N4

Environmental Management and Monitoring Plan (EMMP)

Housing and Development Board (HDB) Singapore

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List of Acronyms

Acronym	Definition
ACMV	Air-conditioning and Mechanical Ventilation
APCP	Air Pollution Control Plan
BIA	Biodiversity Impact Assessment
BOD	Biochemical Oxygen Demand
BTNR	Bukit Timah Nature Reserve
CCNR	Central Catchment Nature Reserve
CCTV	Closed-Circuit Television
CS	Conservation Significant
COD	Chemical Oxygen Demand
DIV	Dutch Intervention Values
EBS	Environmental Baseline Study
ECB	Erosion Control Blanket
ECM	Earth Control Measure
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
EPMA	Environmental Protection and Management Act 1999
EPR	Environmental Performance Report
EQO	Environmental Quality Objective
ERP	Emergency Response Plan
ERSS	Earth Retaining and Stabilizing Structure
ERT	Emergency Response Team
HDB	Housing and Development Board
LTA	Land Transport Authority
NEA	National Environmental Agency
NParks	National Parks Board
NSR	Noise Sensitive Receptor
PAC	Potential Area of Contamination
PIE	Pan Island Expressway
QECP	Qualified Environmental Control Professional
RRNP	Rifle Range Nature Park
SCDF	Singapore Civil Defense Force
SDS	Safety Data Sheets
SIDS	Surface Inlet Detection Sensors
SLA	Singapore Land Authority
SO	Superintending Officer
SOP	Standard Operating Procedure
TBM	Tunnel Boring Machine
TPZ	Tree Protection Zone
TSS	Total Suspended Solids

1 Introduction

1.1 Project Description

1.1.1 Project Background

Singapore Environmental Consultancy Services Pte. Ltd. (SECS; now part of Aurecon Singapore Pte Ltd and hereafter Aurecon) has been appointed by the Housing & Development (HDB) (Contract No. L/333/25), to carry out the development of Environmental Management and Monitoring Plan (EMMP) specifications for the proposed developments located in the Sembawang N4 area (hereafter referred to as the “Project”). The Sembawang N4 forest and its adjacent area – which has largely been slated for residential development to cater for housing needs – is an approximately 20.9 hectares (ha) site bounded by Admiralty Road to the north, Canberra Road to the east and Sembawang Drive to the west (see Figure 1-1; demarcated as “EMMP Boundary”).

The Project development area is situated near the forested tracts of Sembawang Airbase and the Simpang forested area. At present, the Project site features a semi-naturalised canal and forested areas, as well as the Sembawang and Cochrane Recreation Centres that are adjacent to the Project site. Eastwards of the Project area lies the Sembawang N5 forested area (not part of this contract), and the colonial houses along Ottawa and Bermuda Roads. The proposed development is to be constructed within the Sembawang N4 Project area (EMMP Boundary), involving site clearances, earthworks, construction of drains, road works, sewer, drain and road related facilities (e.g. bus shelters), construction and demolition works concurrently. The overall works for the Project can be segregated into two main stages of work: Stage 1 – for land clearance and infrastructure development; Stage 2 – infrastructure works for residential development.

An Environmental Impact Assessment (EIA) (full EIA is available online [here](#)) was previously conducted for the N4 Project site (‘Project’ defined in EIA approximately 53ha), as reported by AECOM in 2024. Taking into account the ecological sensitivity of these areas, including the proximity of the Project site to residential areas and educational institutions, this EMMP therefore provides: (i) recommendations for mitigation measures to be implemented to reduce ecological and human impacts; and (ii) provide specific monitoring measures with associated environmental quality objectives (EQOs) to assess the effectiveness of said mitigation measures. The adherence to, and implementation of said measures are vital to ensure that the construction activities will be conducted with minimal impacts to the surrounding ecological and human sensitive receptors.



Legend

- N4 Forested Area
- Semi-naturalised Canal D2
- EMMP Boundary
- Demolished Area
- Recreation Centre (partially-retained)



Author: SC

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Date: 27/11/2025



A4 scale: 1:137,421
0 0.1 Km

Project Code: P529383
Coordinate System: SVY 21

P529383 EMMP at Sembawang N4 EMMP Report

Figure 1-1 Project Boundary

1.2 EMMP Objectives & Scope

1.2.1 EMMP Objectives

A preliminary EMMP has been proposed as part of the EIA for the Project. This document is intended to reiterate and outline the EMMP proposed in the EIA, including the recommended mitigation measures and monitoring regime for the different stages of the intended Project. The recommendations from the EIA were adapted with the aim of developing a suite of robust monitoring and mitigating measures in this detailed EMMP presented here.

This contract specific EMMP was developed for the Sembawang N4 development to provide management and monitoring requirements for biodiversity, surface water quality, airborne noise, vector control and waste management, for the overall development – with Stage 1 works involving initial land clearance and preparation works, followed by Stage 2 residential infrastructure works – to ensure that the proposed environmental protection measures fulfil relevant regulatory requirements. The roles and responsibilities of all relevant stakeholders (e.g., Environment Control Officer, EMMP Consultant, Arborist, Vector Control Operator, QECP) during the EMMP implementation throughout the Project are also detailed in this document.

Environmental monitoring will involve conducting compliance inspections for the specified mitigation measures and gathering data on environmental quality. These activities aim to ensure that the project does not lead to any significant long-term environmental effects. An environmental monitoring checklist has been created as part of the Environmental Management and Monitoring Plan (EMMP) to track and document its on-site implementation. A monthly Environmental Performance Report (EPR) will be submitted to the Authorities during the construction phase. This report will include all monitoring results, such as compliance checks and environmental quality data, as well as a summary of the actions taken to implement the EMMP, where applicable and available.

This EMMP shall be a live document that will be updated as and when the need arises, to revise and amend monitoring and mitigation measures, or a change in Project details as a result of unforeseen or unavoidable circumstances. Where applicable and relevant, addendums to this EMMP will be drafted and submitted, providing an outline of all stage specific measures and plans where they differ, or otherwise furnish new information (i.e. revised plans from the awarded Contractor) from what has already been described and recommended in this EMMP.

In summary, the EMMP serves the following objectives:

- Define roles and responsibilities for environmental management;
- Provide a framework/guiding document for the Contractor and site users to track, document and monitor environmental compliance with statutory and contractual requirements, and to ensure full EMMP compliance is achieved;
- Ensure all construction activities are conducted in a manner consistent with the laws and regulations, including applicable regulatory approval conditions from relevant authorities and agencies;
- Ensures proper and effective mitigation measures are taken with proper monitoring during the construction phase;
- Set out the monitoring frequency and procedures for environmental monitoring;

- Define reporting and submission requirements; and
- Establish emergency response procedures for environmental incidents, including road kills, trapped animals found on site, and ensure effective corrective actions are taken.

Additionally, it is recommended for physical and/or digital copies of the EMMP specification to be kept on-site for reference purposes at all times.

1.2.2 EMMP Scope

The main scope of works with regards to the EMMP generally include the following items, with the dedicated responsibilities assigned to the EMMP Consultant and Contractor.

1.2.2.1 EMMP Consultant Scope

- Stage 1 (Pre-construction) Responsibilities
 - To prepare, submit, and obtain approval from the National Parks Board (NParks), HDB, and other relevant Authorities an Environmental Management and Monitoring Plan (EMMP)
 - To define a procedure to minimise and control dust, exhaust emissions, fumes, etc. generated at construction sites and tolerable limits
 - To outline water pollution, construction waste management control and mitigation plans, and all other relevant mitigation plans
 - Preparation and submission of Stage 1 Pre-construction EMMP Close-off Audit Report
- Stage 2 (Construction) Responsibilities
 - To ensure implementation of environmental management measures by auditing/inspecting HDB's appointed Main Contractor throughout the Project works, and document the environmental compliance reporting
 - To prepare, submit, and present monthly EMMP Reports throughout the construction works
 - To carry out bi-weekly site inspections during the construction stage, and keep a record of any findings, potential or actual incidents, and non-conformances (if any)
 - To conduct briefings and trainings to the Main Contractor and subcontractors throughout the construction works
 - Preparation and submission of Stage 2 Post-construction EMMP Close-off Audit Report

1.2.2.2 Contractor Scope

- To carry out site preparation/clearance, infrastructure and/or BTO construction works, and implement the EMMP
- To fully comply with all codes and legislations stipulated in this EMMP, and by Regulatory Agencies
- To engage an EMMP Specialist team to carry out Project-related works and ensure compliance with EMMP measures. This EMMP Specialist team composition includes but is not limited to:
 - Project Manager
 - Contractor's ECO / EMMP In-Charge
 - EMMP Specialist (comprising fauna, flora and arboriculture specialists, where applicable)
 - QP, QECP & ECMO etc.
- To procure and deploy all necessary equipment and personnel to carry out stipulated EMMP surveys, monitoring, and mitigation measures

- To ensure that the EMMP Specialist team works with the EMMP Consultant to implement the monitoring regime and mitigation measures described in this EMMP, where applicable:
 - Monthly fauna monitoring (if applicable)
 - Monthly flora monitoring (if applicable)
 - Monthly hydrological and surface water quality monitoring, including monthly monitoring at all ECM discharge points (if applicable)
 - Monthly airborne noise monitoring (if applicable)
 - Monthly waste management monitoring
 - Monthly vector control monitoring
 - Conducting regular site inspections and verify that EMMP mitigation measures are in place
- To provide monthly data of all monitoring parameters, as well as the status of mitigation measures, site conditions, and non-compliances to the EMMP Consultant for the monthly EMMP report
- To facilitate briefings and trainings when conducted by the EMMP Consultant, to the Main Contractor's workers and subcontractors throughout the construction works – including the provision of equipment and facilities that are conducive for the briefing

1.3 EMMP Report Structure

The structure of the report is as follows:

- Section 1 – Introduction of the Project, the objectives and scope of the EMMP, its report structure and project roles and responsibilities
- Section 2 – Summary of Environmental Impact Assessment (EIA) details the key baseline findings, assessed impacts, proposed mitigation measures and Recommended Area for Conservation (RAC)
- Section 3 – The Project Overview and Description outlines the project's proposed construction activities and timeline, namely the overall schedule for construction, and the suggested activities for each stage of construction
- Section 4 – Applicable Environmental Legislation details the key legislative requirements pertinent to the Project
- Section 5 – Environmental Management and Monitoring Plan for Stage 1 details the EMMP programme during Stages 1 for biodiversity, surface water, groundwater, air quality, airborne noise, vector control and waste management
- Section 6 – EMMP Table Summary provides an overview of the monitoring regime and mitigation measures to be implemented, as well as the responsible parties

1.4 Environmental Roles and Responsibilities

The responsibilities of the parties involved in the EMMP are as follows:

- Ensure that the EMMP is designed, implemented and maintained throughout the construction phase in accordance with the regulations and requirements drawn by the relevant authorities;
- Implement the procedures on monitoring and measure the effectiveness of mitigation undertaken, via monthly monitoring of terrestrial fauna, water quality, air quality and noise; and
- Implement corrective or preventive action measures to eliminate non-compliance and incidences, including environmental pollution issues.

The following sub-sections lists the parties involved and their roles in the EMMP, with the Project Organizational Chart in Figure 5-1.

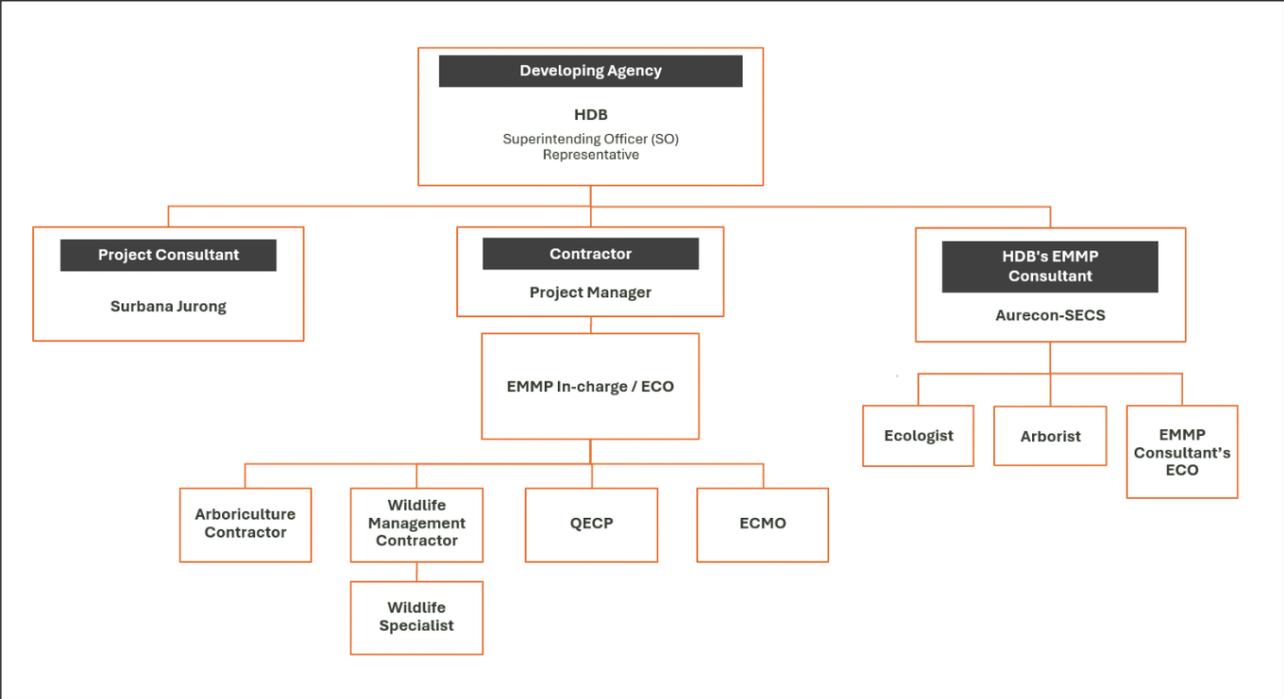


Figure 1-2 Environmental Management Organization Chart

1.4.1 Developer

The developer for this Project is the Housing and Development Board (HDB) and Surbana Jurong (SJ) is the Superintending Officer Representative (SO Rep) for HDB. HDB and SJ shall regularly liaise with the Contractor's Project Manager to review the effectiveness of measures implemented and compliances status during the implementation. The point of contacts for the developer and associated consultant are the HDB Project Coordinator/Director and Consultant Project Engineer.

1.4.2 EMMP Consultant

The EMMP Consultant provides technical knowledge on the mitigation and monitoring measures pertaining to EMMP. The responsibilities of the EMMP Consultant are as follows:

- General responsibilities:
 - To monitor and ensure that the implementation of the EMMP by all parties and provide oversight; and to ensure reporting is carried out and submitted timely to SJ, HDB and NParks;
 - Provide a solution if any environmental issue and/ or non-compliance arises and ensure that rectification is carried out to the satisfaction of Client and Technical Agencies (TAs);
 - Ensure that the project team, subcontractors and site personnel understand and implement the EMMP requirements;
 - Provide input for environmental mitigation measures and monitoring requirements prior to any physical works;
 - To advise all parties (e.g., Project Manager, Environmental Control Officer, Environmental Checker, Site Engineers, Site Supervisors, Subcontractors etc.) on matters related to environmental management and promote awareness within the site;

- To liaise with Agency/TA on environmental matters.

1.4.2.1 Ecologist

An Ecologist is engaged under the EMMP Consultant. The responsibilities of the Ecologist in this Project includes but are not limited to the following:

- To prepare Project site specific fauna management plan as part of EMMP, utilizing the EMMP framework recommended in the EIA Report and assist Contractor in obtaining authority approval;
- To conduct pre-felling fauna inspections and prepare wildlife management protocols as necessary during site clearance stage;
- To provide advice and training to site personnel throughout the construction duration;
- To visit the Project site regularly to carry out inspection related to fauna EMMP requirements;
- To assist the Contractor's Wildlife Management Specialist to identify, rescue, and manage any wildlife in and around the Project site that will affect the development;
- To assist in reporting requirements of EMMP during construction phase; and
- To liaise with NParks on addressing any comments or requirements related to wildlife implementation measures.

1.4.2.2 Arborist

An Arborist will be engaged under the EMMP Consultant for the Pre-Construction phase of the Project. The responsibilities of the Arborist in this Project include but are not limited to:

- To conduct Tree Mapping and Assessment, and to provide Arborist Tree Reports to update the topography plan and facilitate DC submission.
- If applicable, to conduct Monthly Inspections & Monitoring to ensure that NParks' specification and requirement of Tree Protection Zone (TPZ) are adhered to and adopt ISA TRAQ Level 1 for tree assessment
 - Tree physiological health condition
 - Highlight concerned defects
 - To ensure that NParks specification and requirement for Tree Protection Zone (TPZ) are adhered
- If there are trees to be retained, furnish monthly report on tree condition, TPZ condition, and recommend any mitigating/remedial measure(s) necessary for the trees based on the site inspection
 - The assessment & recommendation of the tree condition and TPZ conditions shall be presented in table format
 - Current month tree photograph (overall & tree base) is juxtaposed with previous month tree photograph.
- To advise and implement specific measures in the case of tree pruning prior to clearance, tree injury, and construction activities affecting tree roots;
- To identify any flora species of conservation significance prior to site clearance;
- If applicable, to provide checks on and submit to the Superintending Officer (SO), plan of Tree Protection Zone (TPZ); and
- To liaise with NParks on addressing any comments or requirements related to arboriculture implementation measures during the pre-construction phase.
- To work with the Contractor's Flora Specialist and Arboriculture Contractor for matters related to flora and arboriculture.

1.4.2.3 EMMP Consultant's ECO

An Environmental Control Officer (ECO) will be stationed full time on site during construction stage. The responsibilities of the ECO are as follows:

- To ensure the Contractor's adherence to all legal, environmental requirements (listed in Chapter 4);
- Perform the role of secondary ECO (with respect to the Contractor's ECO) stipulated in the Code of Practice for Environmental Control Officers;
- To monitor the EMMP implementations on-site by the Contractor and recommend any monitoring and mitigation amendments to the plan where necessary to the EMMP Consultant;
- To assist the Contractor's Project Manager in undertaking the Project in an environmentally sustainable manner;
- Train and educate all site personnel to work in a manner that respects the surrounding environment;
- Continually identify, report, and record potential and present environmental issues on-site to the EMMP Consultant;
- Limit or stop any activities if environmental issues are identified until rectified;
- Report any environmental incidence to the Contractor's Project Manager, EMMP Consultant and SJ, and provide support to address the incidence;
- Inform Contractor's Project Manager, HDB, SJ, PUB, NParks, NEA, and EMMP Consultant in the event of an environmental emergency (e.g. oil/chemical spill);
- Conduct environmental site inspections; and
- Conduct environmental performance audits.

1.4.3 Contractor

The Contractor shall provide sufficient manpower and resources to implement the requirements of the EMMP. Appropriate personnel shall be appointed by the Contractor to look after all implementations and reporting. The general responsibilities of the appointed Contractor's EMMP Specialist team for this Project is detailed in the following paragraphs.

1.4.3.1 Project Manager

The Contractor's Project Manager is the team leader responsible for the implementation of the EMMP. The Contractor is also required to regularly liaise with the appointed EMMP Consultant for monthly monitoring and site inspection

- To ensure implementation of all EMMP mitigation measures and monitoring procedures;
- To comply with environmental legislation and contractual requirements applicable to this Project;
- To carry out planning on all project activities throughout project planning, budgeting, execution and completion of EMMP;
- To provide solutions regarding significant construction matters if their subordinates are unable to decide;
- To monitor and measure the timely completion of the Project;
- To liaise with the EMMP Consultant and SJ on environmental matters; and
- Keep track of project costs and expenditures, including implementation of EMMP to ensure that any control measures implemented will meet the Project budget.
- To ensure all team members, including subcontractors, are briefed and aware of the conditions stated in the NParks S10 letter.

1.4.3.2 Contractor's ECO (EMMP In-Charge)

The requirements, duties and responsibilities of the Environmental Control Officer (ECO) engaged by the Contractor include:

- Ensures the Contractor's adherence to all legal, environmental requirements (listed in Chapter 4)
- Performs the role of ECO stipulated in the Code of Practice for Environmental Control Officers
- Possess relevant certifications to effectively implement EMMP requirements (e.g. Joint ITE-NEA Certificate in Pest Management for ECO or equivalent)
- Acts as the EMMP In-Charge and leads the implementation and reporting requirements of the EMMP during construction phase
- Responsible for managing all environmental issues arising from the construction work which includes monitoring and ensuring the implementation and management of change of the EMMP, the environmental performance of the project, investigation of incidents, inspections of site and implementing corrective/preventive measures
- Carries out daily compliance checks on all environmental aspects as per EMMP requirements
- To execute fauna response and rescue protocol when fauna is found on-site
- Conducts daily toolbox meetings with construction workers including subcontractors
- Monitors ECM performance and coordinates with the QECP on specific issue
- Coordinate with the EMMP Consultant's team, Qualified Erosion Control Personnel (QECP) and all other key personnel if necessary to ensure that the EMMP is implemented as per specifications and in accordance with the relevant regulations.
- Conducts all the necessary EMMP monitoring and fulfils associated reporting requirements
- Ensure the collection of all necessary monthly biodiversity and physical monitoring data (e.g., fauna, flora, arboriculture, noise, air quality and water quality, etc).
- Submits monthly Site Environmental Control Reports (SECR) and environmental monitoring reports for all necessary monthly biodiversity and physical monitoring data (e.g., fauna, flora, arboriculture, noise, air quality and water quality, etc); summarising the results of the EMMP implementation for that month; For the EMMP Consultant's submission of the monthly Environmental Performance Reports (EPRs)

1.4.3.3 Wildlife Management Contractor

The requirements, duties and responsibilities of the Wildlife Management Contractor engaged by the Contractor include:

- Listed under NParks' Public Registry of Certified Wildlife Management Specialists
- Identifies rescues and manages any trapped and/or injured wildlife at the project site
- Traps and removes any wild boar spotted within the project site at any time during the project
- Translocate beehives (if any) within the project site at any time during the project
- Traps and translocate aquatic fauna during the backfilling of the naturalised canal along with the necessary surveys (with reference to the Wildlife Translocation Plan) during the different stages of work
- Safeguards the welfare or safety of wildlife removed from the site
- Liaises with NParks on appropriate areas for translocation of wildlife within the project site

1.4.3.4 Wildlife Specialist (if applicable)

The Wildlife Specialist can be engaged separately by the Contractor, or be provided under the Wildlife Management Contractor:

- To facilitate and implement the fauna management plan described in the EMMP
- Work together with the Wildlife Management Contractor to implement the wildlife translocation plan, as well as softshell turtle rescue plan
- To work with the EMMP Consultant's team and Wildlife Management Contractor, for any issues pertaining to wildlife
- If applicable, to conduct fauna monitoring surveys as per the methodology and techniques specified in this EMMP, unless otherwise specified by NParks
- If applicable, to conduct regular site inspections to ensure proper implementation of fauna management and mitigation measures by the Contractor

1.4.3.5 Arboriculture Contractor

The requirements, duties and responsibilities of the Arboriculture Contractor engaged by the Contractor include:

- Arboriculture Contractor to liaise with NParks, EMMP Consultant and Developer on matters related to arboriculture (i.e. tree health, trees impacted by construction), and to prepare monthly reports (if relevant), to be submitted to EMMP Consultant for the submission of the monthly Environmental Performance Reports (EPRs)
- Arboriculture Contractor to be listed either under Contact List of NParks Term Contractor or Landscape Company Register list under Centre of Urban Greenery and Ecology (CUGE)
- Performs arboriculture and/or horticultural operation works such as pruning, tree removal, turfing, etc., and if necessitated, provide an arborist to address any tree or arboriculture-related works arising from the project, including provision and submission of reports to authorities (e.g. construction impact assessment report)

1.4.3.6 Qualified Erosion Control Professional (QECP)

The requirements, duties and responsibilities of the Qualified Erosion Control Professional (QECP) engaged by the Contractor include:

- To prepare, submit, and obtain approval for Earth Control Measures (ECM) Plan from PUB prior to Contractor starting work; and
- Verifies the ECM Plan implementation as per the approved design
- To ensure that the Contractor implements the ECM in compliance with the ECM Plan, via monthly site inspections.
- Recommends contingency plans and additional measures if implemented measures are ineffective

1.4.3.7 Earth Control Measures Officer (ECMO)

The requirements, duties and responsibilities of the Earth Control Measures Officer (ECMO) engaged by the Contractor include:

- To Implements all ECM requirements in compliance with the ECM Plan approved by PUB

2 Summary of Environmental Impact Assessment

2.1 EIA Objective

An environmental impact assessment (EIA) was conducted by AECOM in 2024, under appointment by the Housing Development Board (HDB). The aim of the EIA was to assess any potential environmental impacts that may arise from the construction and operation of the proposed development within the Sembawang N4 forested area.

2.2 EIA

The EIA N4 Project site ('Project' defined in EIA approximately 53ha) has been slated for development, namely Residential, Commercial, Civic and Community Institution, Educational Institution, Place of Worship. The site is bounded by Admiralty Road West and Admiralty Street to the north, Canberra Road to the east, residential areas to the south and Sungei Sembawang to the west. The forested areas of N4 and N5 were included in the EBS but N5 was excluded from the EIA, where only N4 was assessed (AECOM. 2024; Figure 2-1).

In summary, the following findings were presented in the EIA:

- (1) Identification and understanding of baseline conditions of biodiversity, water resources (i.e. hydrology, surface water quality and groundwater level) and airborne noise, as well as topography of the EBS Study Area (i.e. N4 and N5 Forested Areas);
- (2) An assessment of potential direct impacts on identified ecological receptors within the EBS Study Area;
- (3) An assessment of potential indirect impacts (i.e. due to changes in water resources and airborne noise) on biodiversity and identified ecological receptors within the EBS Study Area;
- (4) Proposed mitigation measures to minimise potential significant adverse impacts; and
- (5) Development of a Preliminary Environmental Management and Monitoring Plan (EMMP).

The baseline conditions, impact assessment and proposed mitigation measures are summarized in the following chapters.

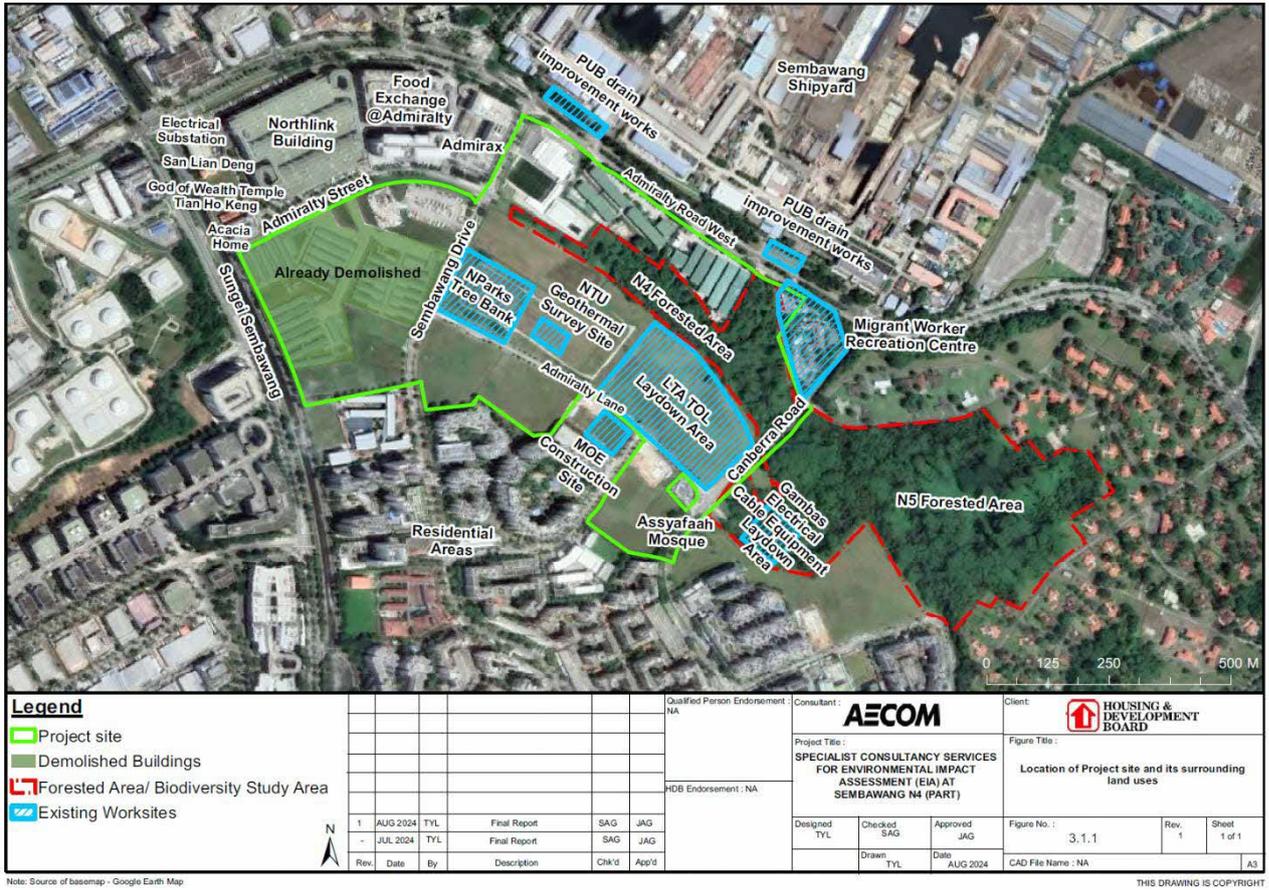


Figure 2-1 EIA N4 Project Site (AECOM, 2024)

2.3 Summary of EIA Baseline Findings

2.3.1 Habitat Classification

The EIA study was conducted for the N4 area, whilst the EBS Study Area consists of two (2) main forested areas, N4 and N5 (Figure 2-1 and Figure 2-2). Habitat classification definitions in this section takes reference from the National Parks Board (NParks) latest Biodiversity Impact Assessment (BIA) Guidelines V2, released in May 2024.

Taken together, the dominant vegetation type present in N4 and N5 Forested Areas was identified to be the exotic-dominated secondary forest, which made up approximately 33.5% of the total study area. This finding corresponds with the land use history of Sembawang, which comprised mainly of cleared lands in the mid-20th century period – which was left undeveloped – and eventually resulted in the spontaneous regeneration of the exotic-dominated secondary regrowth.

2.3.1.1 N4 Forested Area

The N4 Forested Area consists of four different habitat types (as summarised in Table 2-1 and shown in Figure 2-2). The N4 Forested Area is primarily made up of exotic-dominated secondary forest, followed by scrubland, grassland and semi-naturalised drain respectively.

Table 2-1 Absolute (ha) and Relative (%) Sizes of Each Vegetation Type

Habitat Type	Absolute N4 Forested size (ha)	Relative N4 Forested size (%)
Abandoned-land Forest*	-	-
Scrubland*	1.73	25.9
Exotic-dominated Secondary Forest*	4.22	63.1
Grassland*	0.69	10.3
Urban Vegetation (Turf)	-	-
Semi-naturalised Drain	0.05	0.7
Others (Infrastructure)	-	-
Others (Road)	-	-
Others (Construction Storage Facility)	-	-
Total Area	6.69	100

Note:

*Habitats are considered are spontaneous vegetation

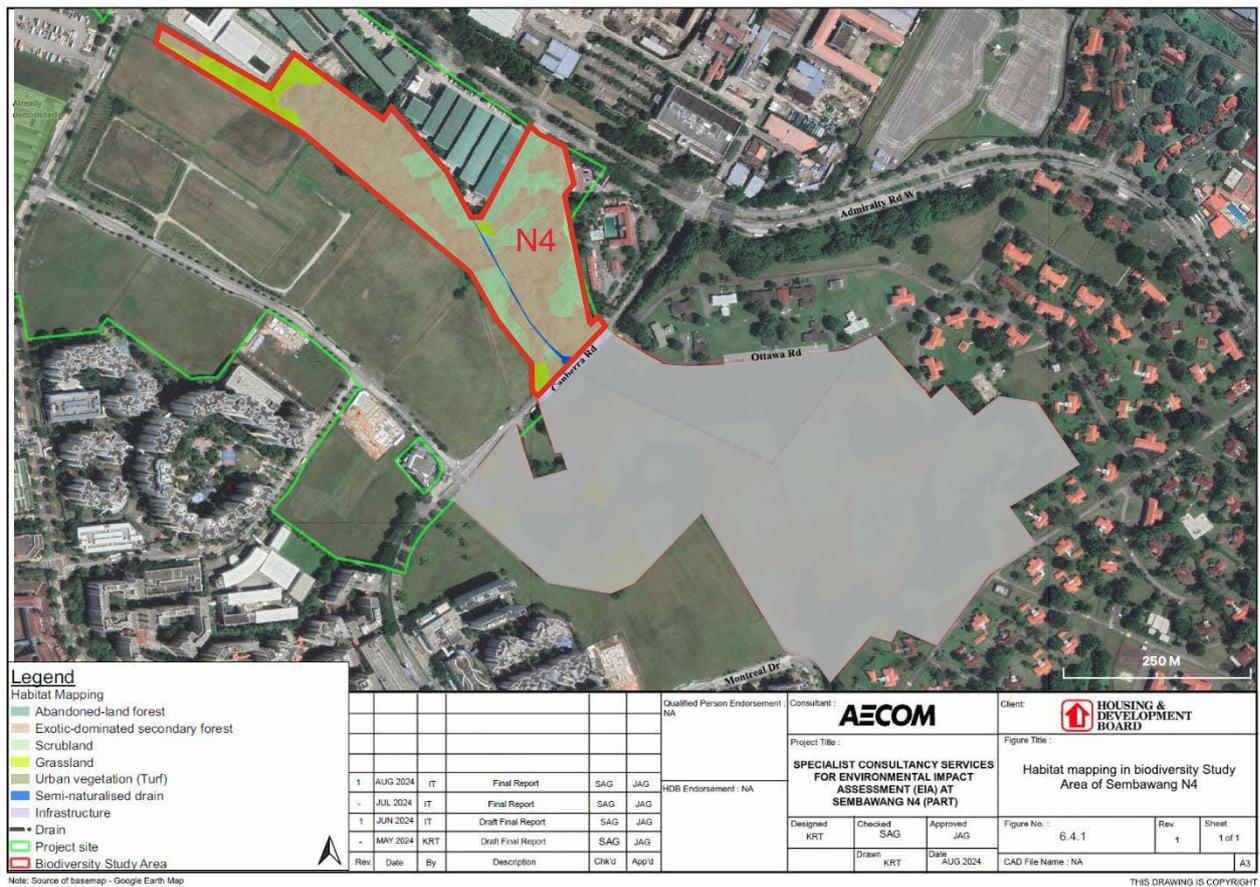


Figure 2-2 Habitat Map of EIA N4 Project Site (AECOM, 2024)

2.3.2 Flora

2.3.2.1 Species of Conservation Significance

The flora study encompassing the N4 and N5 Forested Areas recorded 249 species and two species groups (i.e., plants that could not be identified to species with certainty), belonging to at least 82 families. A total of 128 and 198 species were recorded in the N4 and N5 Forested Areas respectively (Figure 2-3). Species of conservation significance for N4 are shown in Table 2-2 below.

Out of 128 species found within N4 Forested Area, 57 were found to be native (44.5%), 66 were exotic (i.e. 51.6%) and 5 were cryptogenic (3.9%). Five (5) species within N4 Forested Area were of conservation significance – *Calophyllum inophyllum*, *Cyperus compressus*, *Macaranga griffithiana*, *Tectaria cf semipinnata* and *Trema tomentosum*.

Table 2-2 Notable Species of Conservation Significance found in N4

Habitat	Site	Number of Species			
		VU	EN	CR	Total
Abandoned-land Forest	N4	-	-	-	-
Exotic-dominated Secondary Forest	N4	1	2	-	3
Scrubland	N4	2	-	-	2
Grassland	N4	-	-	-	-
Note:					
VU – Vulnerable; EN – Endangered; CR – Critically Endangered					

2.3.2.2 Large Plant Specimens

A total of 28 large plant specimens were recorded within the N4 Forested Area. The N4 Forested Area had a single record of small Malayan banyan (*Ficus macrocarpa*).



Figure 2-3 Distribution of Plant Specimens of Conservation Significance (AECOM, 2024) Large Plant Specimens and Plant Specimens of Value

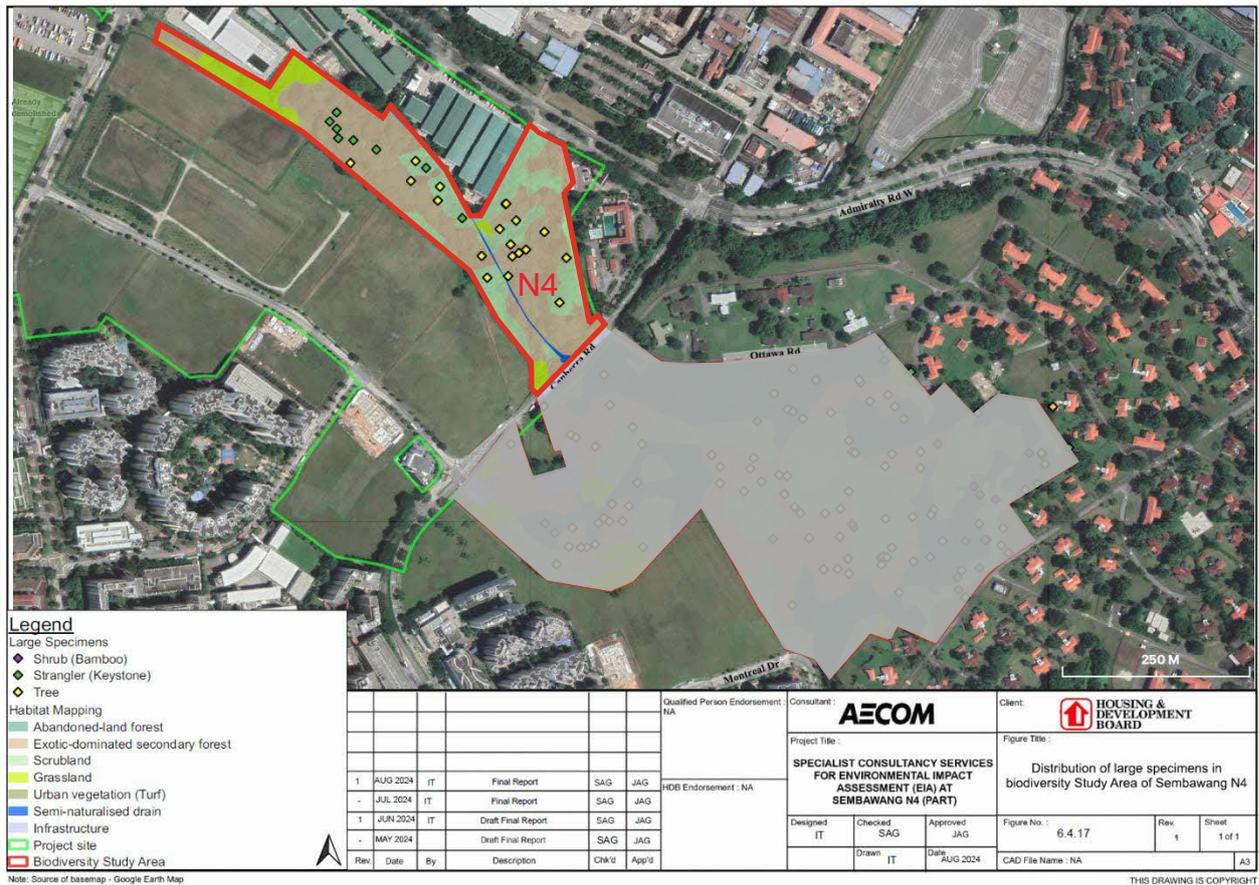


Figure 2-4 Distribution of Large Plant Specimens (AECOM, 2024)

2.3.3 Fauna

The field assessment across the N4 and N5 Forested Areas recorded a total of 212 species, with 61 birds and 56 butterflies making up more than half of the total species assemblage. The remaining fauna comprised of 20 odonate species (dragonflies and damselflies), 29 aculeate hymenopteran species (bees and stinging wasps), 17 mammal species, three (3) mollusc species and 21 herpetofauna species (amphibians and reptiles). Additionally, four (4) species of freshwater fish and one (1) species of decapod crustaceans were also documented. A total of 13 species of conservation significance were identified, all of which are birds and mammals (see Figure 2-5 & Table 2-3).

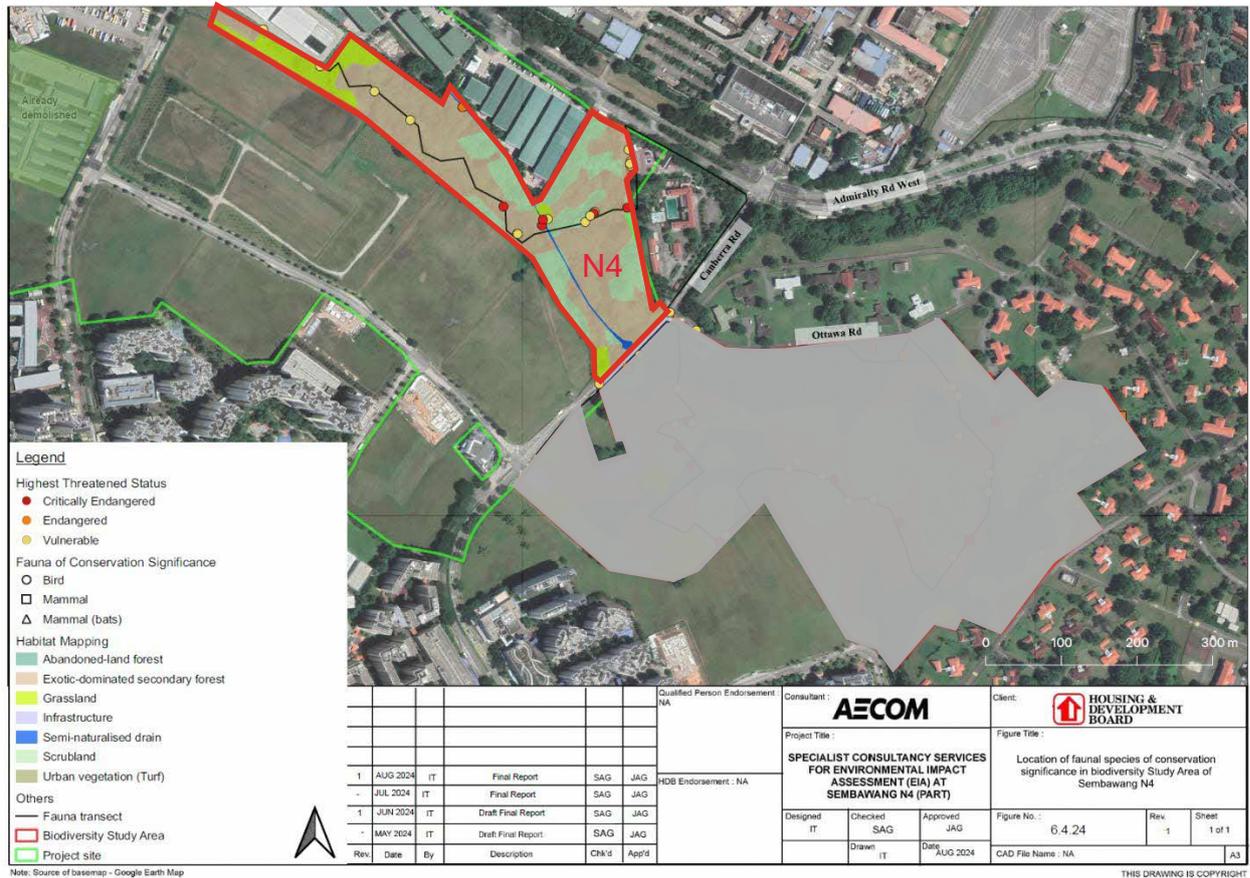


Figure 2-5 Distribution of Fauna of Conservation Significance (AECOM, 2024)

Table 2-3 Faunal Species of Conservation Significance Recorded within N4 & N5 Forested Areas

Taxon	Scientific Name	Common Name	National Status (SRDB3)	Global Status (IUCN)
Bird	<i>Collocalia affinis</i>	Plume-toed Swiftlet	VU	LC
Bird	<i>Copsychus saularis</i>	Oriental magpie-robin	VU	LC
Bird	<i>Corvus macrorhynchos</i>	Large-billed Crow	VU	LC
Bird	<i>Ketupa ketupu</i>	Buffy Fish Owl	VU	LC
Bird	<i>Nycticorax nycticorax</i>	Black-crowned night heron	EN	LC
Bird	<i>Nishaetus cirrhatus</i>	Changeable hawk eagle	VU	LC
Bird	<i>Ploceus philippinus</i>	Baya weaver	VU	LC
Bird	<i>Psittacula longicauda</i>	Long-tailed parakeet	NT	VU
Bird	<i>Pycnonotus zeylanicus</i>	Straw-headed bulbul	EN	CR
Bird	<i>Zosterops simplex</i>	Swinhoe's white-eye	VU	LC
Mammal (Nonvolant)	<i>Macaca fascicularis</i>	Long-tailed macaque	LC	EN
Mammal (Nonvolant)	<i>Manis javanicus</i>	Sunda pangolin	CR	CR
Mammal (Nonvolant)	<i>Lutrogale perspicillata</i> ¹	Smooth-coated otter	VU	EN
Bat	<i>Tylonycteris spp.</i> ^{2,3}	Bamboo bat	VU	NA

¹ While the otter record was not identified to species-level, it is presumed to be the smooth-coated otter.

² Both bamboo bat species are nationally Vulnerable.

³ This was not identified to species level.

2.3.4 Hydrology and Surface Water Quality

2.3.4.1 Hydrological Conditions

One concrete drain (D1) and one semi-naturalised drain (D2) were identified as key watercourses within N5 and N4 Forested Areas respectively. Other watercourses within the N4 development area consist of smaller, roadside concrete drains, which were noted to have ephemeral flow. The catchments within the N5 Forested Area discharges water into a concrete drain, which subsequently releases the water into a semi-naturalised drain via a culvert below Canberra Road. In addition to the water discharge from N5, the semi-naturalised drain also collects water from the largest catchment area within N4 (Figure 2-6). All water from the EIA site eventually discharges into the sea.

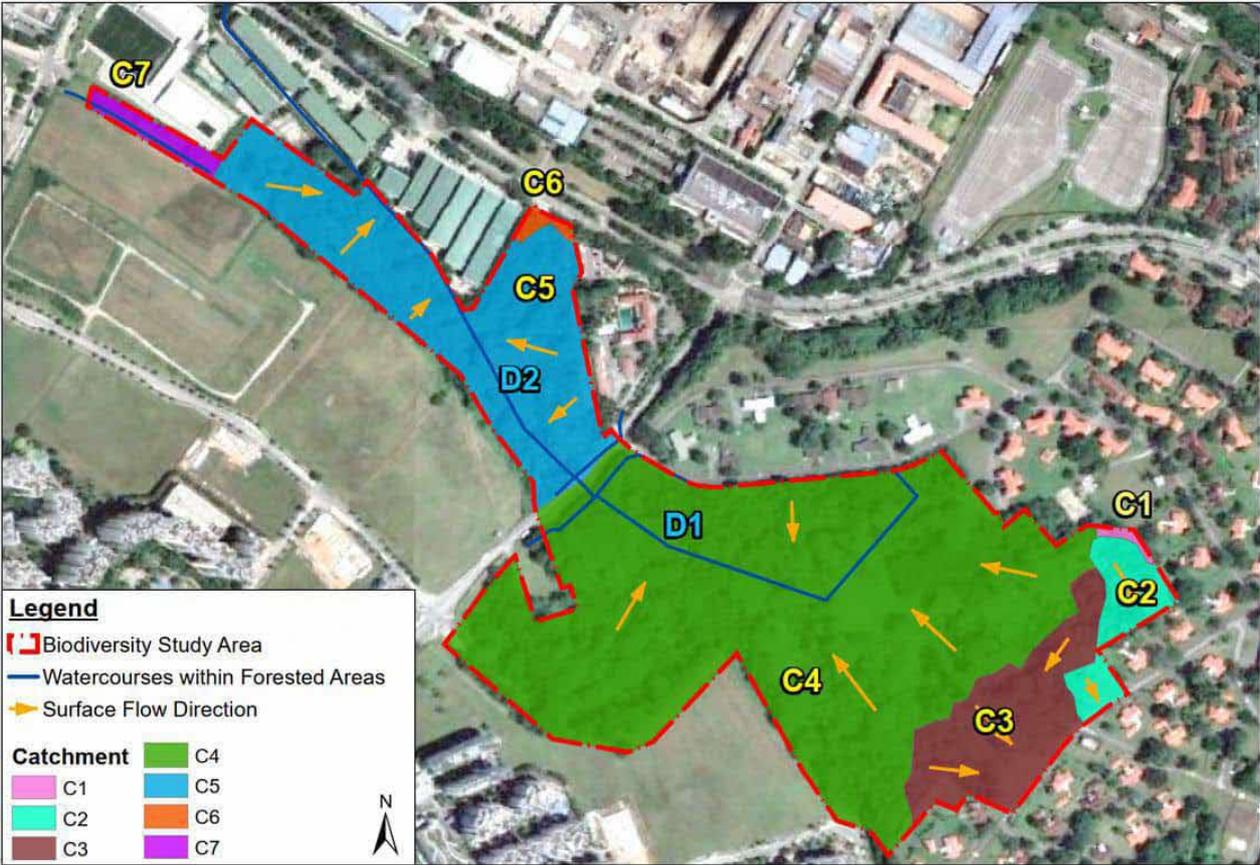


Figure 2-6 Hydrology and Watercourses within the EBS Study Area (AECOM, 2024)

2.3.4.2 Water Quality

The surface water quality conditions were established based on surface water sampling events conducted across a total of eleven (11) locations during both dry and wet weather conditions and across three (3) watercourses – (i) the concrete drain within N5 Forested Area, (ii) semi-naturalised drain within N4 Forested Area and (iii) Sungei Sembawang (Figure 2-7). Slight exceedances of nutrients such as phosphorous and nitrogen were noted along the watercourses and was noted to be a common occurrence in heavily vegetated areas due to dead and decomposing matter (i.e., detritus) from vegetation in the water courses, thereby releasing the nutrients in the water body.

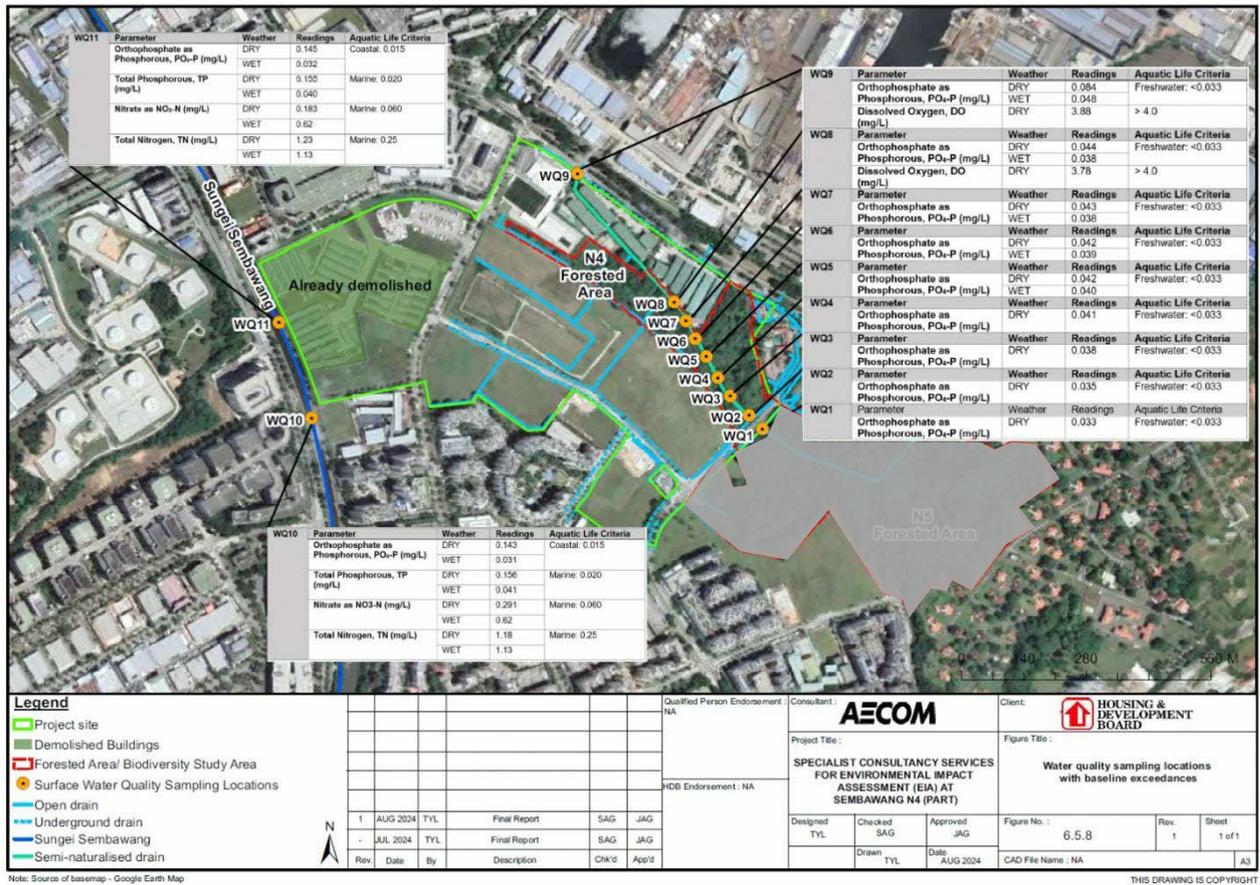


Figure 2-7 Water Quality Sampling Stations within the EIA N4 Project Site (AECOM, 2024)

2.3.5 Airborne Noise

One (1) noise monitoring station was placed in the N5 Forested Area with the aim of assessing impact to fauna residing within it (Figure 2-8). The L_{Aeq} was recorded at 12 hour, 1 hour, and 5 min intervals.

Based on the baseline monitoring results, the airborne noise levels recorded in the N5 Forested Area are considerably low ranging from 44 – 54 dB(A) and are below the most-stringent NEA construction noise criteria. This is reflective of an isolated and vegetated nature of this area. One exceedance (i.e. max L_{Aeq} (5 mins) 7pm-10pm) was observed over the course of one week, which was potentially due to air traffic noise from the nearby Sembawang Air Base.



Figure 2-8 Baseline Airborne Noise Monitoring Locations (AECOM, 2024)

3 Project Overview and Description

3.1 EMMP Scope and Work Areas

The EMMP boundary (also contract boundary) follows the white line as shown in Figure 1-1. However, it is to be noted that there are demolition works ongoing in the Cochrane Recreation Centre and its outlet drain. Additionally, part of the existing Sembawang Recreation Centre will be demolished while some blocks will be retained for future development (Figure 1-1). Within the overall EMMP boundary, a separate boundary delineating the site clearance works from the ongoing demolition work areas and retained area will be presented in a separate figure in Section 5.4, where the proposed wildlife shepherding plan (Figure 5-6) will be presented and discussed.

3.2 Proposed Construction Plan & Timeline

The works for this Project are split into two (2) main stages – Stage 1 will cover the advance works that include soil investigation works, cable detection, pre-condition survey, hoarding installation, site access formation, site clearance and earthworks (e.g. site levelling works; Figure 3-1) as well as utilities and road works etc. Stage 1 will also include the advance site clearance/preparation of the C24 BTO parcel (designated as Parcel A1 in wildlife shepherding plan) to facilitate urgent development works (see Figure 3-2). Stage 2 will cover residential infrastructure and building works.

The Construction Master Programme for both stages will be provided by the appointed contractor(s). Additionally, it is to be noted that the planned earthworks programme (Stage 1) and sequence of works are subject to inputs and finalised schematic from other agencies, specifically LTA's final road scheme, HDB's final parcellation of the Project boundary, as well as PUB's review and approval of the final drainage scheme. As significant cut-and-fill works are expected for the Project, soil investigation (SI) works will be required. The notional site utilisation plan has also been presented in Figure 3-2 for reference.

The tentative timeline for this Project is as follows:

- Stage 1 – Approximately 34 months
- Stage 2 – Approximately 55 months

3.2.1 Stage 1 – Expected Work Activities & Potential Risks and Impacts

Specific construction activities at Stage 1 with regards to environmental aspects are presented in Table 3-1 below. The associated potential risks and impacts with the activities are also stated.

Table 3-1 Stage 1 Activities and Associated Environmental Impacts

Process / Activity	Impacts / Pollution
Site Clearance and Preliminary Works	
Cable detection works and trial trenching, as well as soil investigation (borehole) works	<ul style="list-style-type: none">• Dust emission• Noise pollution
Delivery of materials (e.g. steel plates, scaffolding, hoarding boards, etc.)	<ul style="list-style-type: none">• Soil erosion
Pre-condition survey and soil investigation works	

Process / Activity	Impacts / Pollution
Construction of diversion drain for semi-naturalised canal D2, including ECM measures, C7 drains and detention ponds	<ul style="list-style-type: none"> • Dust emission • Noise pollution • Soil erosion • Loss of habitat and tree cover • Movement of wildlife to new areas may lead to roadkill / Wildlife mortality • Human-wildlife interaction – animals may stray into nearby populated areas to seek new foraging grounds • Silty discharge; increased runoff volume, rate, and duration
Site clearance and removal of vegetation (trees, shrubs, etc.) within N4 Forested Area and roadside trees	
Hoarding installation, construction of access temporary roads and other infrastructure required for construction activities (e.g. site office, workers dormitory, etc.)	
Demolition of existing structures and accompanying infrastructures which are not intended to be retained (from adjacent ongoing demolition works; Figure 3-1)	<ul style="list-style-type: none"> • Dust emission • Noise pollution • Soil erosion • Generation of construction waste
Removal of foundation, soils, and debris	
Earthworks	
Soil dewatering (i.e. groundwater extraction and pumping of rainwater)	<ul style="list-style-type: none"> • Dust emission • Noise pollution • Water Pollution • Groundwater pollution • Sedimentation • Silty discharge, increase runoff volume, rate, and duration
Soil excavation, cut and fill to platform levels	
Soil levelling to obtain planned platform levels, construction of CBP retaining wall and slope cutting works	
Soil excavation for foundations, provision of subsoil piping at slope bottoms	
Cable detection and trial trenching works for demobilisation and diversion of existing utilities	
Turfing and reinstatement works	

3.2.2 Stage 2 – Expected Work Activities & Potential Risks and Impacts

Specific construction activities at Stage 2 with regards to environmental aspects are presented in Table 3-2 below. The associated potential risks and impacts with the activities are also stated. It is to be noted that the finalised construction programme, layout and site utilisation for Stage 2 works will be updated for this EMMP in an addendum at a later stage.

Table 3-2 Indicative Stage 2 Activities and Associated Environmental Impacts

Process / Activity	Impacts / Pollution
Foundation and Earthworks	
Soil Excavation, cut and fill	
Site levelling to obtain planned platform levels	
Soil boring works	
Stage excavation	
Utility laying	

Process / Activity	Impacts / Pollution
Construction of drainage and sewage infrastructure	<ul style="list-style-type: none"> • Dust emission • Noise pollution • Water Pollution • Groundwater pollution • Sedimentation • Silty discharge, increase runoff volume, rate, and duration
Stage excavation with walers and struts	
Installation of bore casings	
Installation of rebar cage and tremie pipe	
Concreting works – construction of piles and pile caps	
Pile head hacking/removal	
Soil dewatering	<ul style="list-style-type: none"> • Noise pollution • Water Pollution • Groundwater pollution • Sedimentation • Silty discharge, increase runoff volume, rate, and duration
Spoil and slurry removal	
Delivery and erection of construction machinery (i.e. crawler crane for lifting operations and boring rig for soil drilling)	<ul style="list-style-type: none"> • Dust emission • Noise pollution
Delivery of steel sections	
Hoisting of walers and struts	
Hot works – welding of steel beams, brackets, etc.	<ul style="list-style-type: none"> • Noise pollution • Construction waste
Superstructure Works (Prefabrication Installation)	
Soil dewatering	<ul style="list-style-type: none"> • Noise pollution • Water Pollution • Groundwater pollution • Sedimentation • Silty discharge, increase runoff volume, rate, and duration
Spoil removal	
Establishment of power supply (for site equipment)	
Excavation below ground surface	<ul style="list-style-type: none"> • Dust emission • Noise pollution • Water Pollution • Groundwater pollution • Sedimentation • Silty discharge, increase runoff volume, rate, and duration
Rebar handling and positioning	<ul style="list-style-type: none"> • Dust emission • Noise pollution
Hoisting of falsework	
Setting up and tearing down scaffolding	
Formwork construction and cleaning before casting	<ul style="list-style-type: none"> • Dust emission • Noise pollution • Changes in illumination
Casting of concrete	
Finishing works (e.g. plastering, waterproofing, tiling, etc.)	<ul style="list-style-type: none"> • Noise pollution • Water Pollution
Landscaping Works	
General landscaping activities	

Process / Activity	Impacts / Pollution
Construction of landscape amenities/ constructions (e.g. gazabos, pathways, etc.)	<ul style="list-style-type: none"> • Dust emission • Noise pollution • Water Pollution • Silty discharge, increase runoff volume, rate, and duration
Removal of Temporary Structures and Reinstatement	
Removal of Earth Retaining and Stabilizing Structures (ERSS)	<ul style="list-style-type: none"> • Dust emission • Noise pollution • Water Pollution • Silty discharge, increase runoff volume, rate, and duration
Reinstatement of the area to original (or required) condition	<ul style="list-style-type: none"> • Dust emission • Noise pollution
Utilities Infrastructure Works	
Culvert construction and drain diversion	<ul style="list-style-type: none"> • Dust emission • Noise pollution • Water Pollution • Groundwater pollution • Sedimentation • Silty discharge, increase runoff volume, rate, and duration
Pipe jacking	
Laying of PWCS pipes, utility ducts, manholes and crossings (i.e., sewer works)	
Construction of roads, bus shelters, cycling paths and ancillary structures (e.g., traffic lights and lamp posts)	
Land reinstatement and turfing works	



Figure 3-1 Example of Site Levelling Works

4 Applicable Environmental Legislation

This section outlines the legislations and guidelines in Singapore relevant to the implementation of the EMMP.

4.1 Summary of Environmental Legislation

The following sections provides the legislative framework for the control of environmental pollution and biodiversity protection measures. The scope covers biodiversity protection, air pollution, water pollution, land pollution, noise pollution, and hazardous substances control. Section 10 of the Wildlife Act stipulates the requirement for an EMMP. Some sections which play an important part are those related to noise from construction and other works, trade effluent discharge limits into watercourse, prevention of pollution from construction site, and the pollution control studies. The Acts, subsidiary regulations, action plans, and guidelines relevant to environmental protection are summarised in Table 4-1 below:

Table 4-1 Summary of Environmental Acts, Subsidiary Regulations, Action Plans and Guidelines

Environmental Aspects	Relevant Local Acts / Regulations / Action Plans	Acronyms	Jurisdiction/ Enforcement Agencies
Air Pollution	Environmental Protection and Management (Vehicular Emission) Regulation 2008	EPMA (Vehicular Emission)	NEA
	Environmental Protection and Management (Air Impurities) Regulation 2008	EPMA (Air Impurities)	
	Environmental Protection and Management (Off-Road Diesel Engine Emissions) Regulation 2012	EPMA (Off-Road Diesel Engine Emission)	
	Environmental Protection and Management (Prohibition on the Use of Open Fires) Order 2008	EPMA (Prohibition on the Use of Open Fires)	
	Singapore Ambient Air Quality Targets	-	
Water Pollution	Environmental Protection and Management (Trade Effluent) Regulations 2008	EPMA (Trade Effluent)	PUB
	Sewerage and Drainage Act (and its subsidiary legislation) 2001	Sewerage and Drainage Act	
	Public Utilities (Reservoir and Catchment Areas) Regulations 2006	Public Utilities Act	
Noise Pollution	Environmental Protection and Management (Control of Noise at Construction Sites) Regulations 2008	EPMA (Control of Noise at Construction Sites)	NEA
	Environmental Pollution Control (Control of Noise at Construction Sites) (Amendment) Regulations 2007	Environmental Pollution Control Act	
Waste Management	Environmental Public Health Act	EPHA	NEA
	Environmental Public Health (Toxic Industrial Waste) Regulation 2000	EPH (Toxic Industrial Waste)	
	Environmental Public Health (General Waste Collection) Regulations 2000	EPH (General Waste Collection) Regulations	
Vectors	Infectious Diseases Act 2020	IDA	NEA
	Control of Vectors and Pesticides Act 2002	CVPA	
	Environmental Public Health (Employment of Environmental Control Officers) (Amendment) Orders 2021	EPH (Employment of Environmental Control Officers)	
Biodiversity	Parks and Trees Act 2020	Parks and Trees Act	NParks
	Wildlife Act 2020	Wildlife Act	
	National Biodiversity Strategy and Action Plan	NBSAP	
	Nature Conservation Masterplan	-	
	NParks Biodiversity Impact Assessment Guidelines	-	

4.2 Specific Environmental Legislation

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

4.2.1 Biodiversity

The main legislation relevant to the protection, preservation and management of biodiversity within Singapore are the Parks and Trees Act 2020, Planning Act 2020 and the Wildlife Act 2020, which was originally the Wild Animals and Birds Act 1985, with specific amendments. This is reinforced by Singapore's various commitments and guidelines aimed at promoting biodiversity conservation, such as the National Biodiversity Strategy and Action Plan (NBSAP) in 2009 and updated in 2019 based on the Convention on Biological Diversity Strategic Plan, and the Aichi Targets for 2011-2020.

4.2.1.1 Tree Conservation Area (TCA) and Heritage Road

The *Tree Conservation Area (TCA) and Heritage Road Act* provides for the planting, maintenance and conservation of trees and plants within different designated zones/areas within Singapore. Such protected spaces include National Parks, Nature Reserves, Tree Conservation Area (TCA), and Heritage Road Green Buffer.

4.2.1.2 Wildlife Act

The *Wildlife Act* has been in effect since June 1, 2020. Table 4-2 provides a summary of the relevant sections to this Project based on the current version. All site personnel will be briefed on the relevant legal requirements and penalty from the Wildlife Act during the Biodiversity Awareness Briefing, prior to work at site.

Table 4-2 Summary of Wildlife Act 2020

Activity	Applicable Section	Legal Requirement	Penalty
Feeding of wildlife	5A	<i>A person must not intentionally feed any wildlife in any place unless the person has the Director-General's written approval to do so</i>	<i>For a first offence, to a fine not exceeding \$5,000 For a second or subsequent offence, to a fine not exceeding \$10,000</i>
Releasing of wildlife	5B	<i>(1) A person must not intentionally release any wildlife in any place unless the person has the Director-General's written approval to do so. (2) A person who has the Director-General's written approval mentioned in subsection (1) must comply with the conditions of the approval.</i>	<i>A person who contravenes subsection (1) or (2) shall be guilty of an offence and shall be liable on conviction to a fine not exceeding \$5,000.</i>
Killing, trapping, taking or keeping of wildlife	5C	<i>A person must not intentionally kill, trap, take or keep any wildlife in any place unless the person has the Director-General's written approval to do so.</i>	<i>In the case where the offence is committed in respect of a protected wildlife, to a fine not exceeding \$50,000 or to imprisonment for a term not exceeding 2 years or to both.</i>

Activity	Applicable Section	Legal Requirement	Penalty
Wildlife-related measures for development or works	10	<i>The Director-General may direct a person to implement, in respect of any development or works being carried out, or to be carried out, by or on behalf of the person, any wildlife related measure that the Director-General considers necessary to safeguard</i>	<i>A person who, without reasonable excuse, contravenes subsection (3) shall be guilty of an offence and shall be liable on conviction to a fine not exceeding \$50,000 or to imprisonment for a term not exceeding 6 months or to both.</i>

4.2.2 Water Pollution

4.2.2.1 Water Quality

The Pollution Control Department (PCD) of National Environment Agency (NEA) is responsible for the control of water pollution, hazardous substances, and toxic industrial wastes in Singapore. The main legislative instruments governing water pollution are the *EPMA (Part V – Water Pollution Control)*, the *EPMA (Trade Effluent)* and the *Sewerage and Drainage Act*. The Director-General of Environmental Protection is responsible for the implementation and administration of the EPMA regulations, while PUB is responsible for the administration of the Sewerage and Drainage Act. The provisions given under each of these Acts or Regulations are described below, whilst a summary of allowable limits for trade effluent discharge applicable to a watercourse is presented in Table 4-3 below. EPMA (Part V – Water Pollution Control) 2008 includes the following measures to protect water bodies from pollution:

- Penalties for the discharge of polluting matter into inland waters;
- Licensing requirements for the treatment and discharge of trade effluent, oil, chemical, sewage or other polluting matters; and Licensing is only applicable for storage, removal and disposal of toxic industrial waste and trade effluent:
- Measures to be undertaken to prevent water pollution due to storage or transportation of toxic substances or other polluting matters.
- A written permission is required from the Director-General for any person who discharges, or causes or permits to be discharged, any trade effluent, oil, chemical, sewage or other polluting matters into any drain or land.

The *EPMA (Trade Effluent)* Regulations establish regulatory control over industrial, trade premises and other activities that may have adverse impacts on water quality. The Regulations provide details on trade effluent quality standards for discharge of trade effluent into watercourses or land but does not cover the discharge of trade effluent into the public sewer system (as it is covered under the Sewerage and Drainage (Trade Effluent) Regulations). The Regulations state that no trade effluent shall be discharged into watercourses or land without obtaining NEA permission. Trade effluent standards and permitting requirements are stipulated in the Regulations and all trade effluent must be treated to the stipulated standards prior to discharge, with standards being applied depending on the watercourse being discharged into. Controlled watercourses have particularly stringent standards, as these are located within water catchment areas.

The *Public Utilities (Reservoirs, Catchment Areas and Waterway)* Regulations may also be referred to for the definitions of water catchment areas, and activities prohibited within Catchment Area Parks.

Table 4-3 Allowable Limits for Trade Effluent Discharge

S/N	Items of Analysis	Watercourse	Controlled Watercourse
		(Units in milligram per litre or otherwise stated)	
1	Temperature of discharge	45°C	45°C
2	Colour	7 Lovibond Units	7 Lovibond Units
3	pH Value	6- 9	6- 9
4	BOD (5 days at 20°C)	50	20
5	COD	100	60
6	Total Suspended Solids	50	30
7	Total Dissolved Solids	-	1000
8	Chloride (as chloride ion)	-	250
9	Sulphate (as SO ₄)	-	200
10	Sulphide (as sulphur)	0.2	0.2
11	Cyanide (as CN)	0.1	0.1
12	Detergents (linear alkylate sulphonate as methylene blue active substances)	15	5
13	Grease and Oil	10 (Total) 10 (Hydrocarbons)	1 (Total)
14	Arsenic	0.1	0.01
15	Barium	2	1
16	Tin	-	5
17	Iron (as Fe)	10	1
18	Beryllium	-	0.5
19	Boron	5	0.5
20	Manganese	5	0.5
21	Phenolic Compounds (expressed as phenol)	0.2	Nil
22	*Cadmium	0.1	0.003
23	*Chromium (trivalent and hexavalent)	1	0.05
24	*Copper	0.1	0.1
25	*Lead	0.1	0.1
26	*Mercury	0.05	0.001
27	*Nickel	1	0.1
28	*Selenium	0.5	0.01
29	*Silver	0.1	0.1
30	*Zinc	1	0.5
31	*Metals in Total	1	0.5
32	Chlorine (Free)	1	1
33	Phosphates (as PO ₄)	5	2
34	Calcium (as Ca)	-	150
35	Magnesium (as Mg)	-	150
36	Nitrate (as NO ₃)	-	20

Note:

1 Controlled Watercourse refers to a watercourse from which water supplied by PUB under the Public Utilities Act is obtained but does not include a watercourse from which water is pumped into a main of the PUB.

2 *Where two or more of the metals listed in the table are present in the trade effluent, the total concentration of the metals shall not exceed: (i) 1 milligram per litre, if discharged into watercourse other than controlled watercourse; and (ii) 0.5 milligrams per litre, if discharged into controlled watercourse.

3 "-" No specified maximum concentrations under the Regulations.

4.2.2.2 Construction Surface Water Runoff

Under the requirements stipulated by PUB in the *Sewerage and Drainage Act*, effective Earth Control Measures (ECM) shall be implemented at all construction sites to prevent silty discharge from construction sites.

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

4.2.3 Noise Pollution

Operating under the *EPMA (Part VIII – Noise Control) 2008*, the *EPMA (Control of Noise at Construction Sites)* sets acceptable noise limits for construction activity within Singapore, including corrections based on ambient background noise levels. The accepted construction noise levels provided in Table 4-4 below are recommended to be followed for any construction works.

Table 4-4 Maximum permissible noise levels for construction work commenced on or after 1 October 2007 (Sunday and Public Holiday)

Type 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)	

In addition to the maximum permissible noise limits, Contractors must also comply with rules on the prohibition work on Sundays and Public Holidays for construction sites located within 150 m of residential premises and near to noise sensitive premises as follows:

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

The Singapore Standard CP 49:1998 (Code of Practice for Noise Control on Construction and Demolition Sites) was developed by SPRING Singapore in 1998 to complement the *EPMA (Control of Noise at Construction Sites) Regulations*. There is no specific regulation for vibration impact assessment in Singapore. The German Standards (DIN) 4150-2:1999 (Structural Vibration – Human Exposure to Vibration in Buildings) and DIN 4150-3:1999 (Structural Vibration – Effects of Vibration on Structures) are used as references for vibration impact assessments.

As per the abovementioned legislations, if there are other sources of noise affecting the measurement of noise emitted from the construction site, the maximum permissible noise levels for construction sites are supposed to be adjusted by the addition of a correction factor to account for the existing background noise levels in the area. The correction factor corresponds to the difference between the relevant permissible level, and the background noise level and is presented in Table 4-5. The differences in the noise levels are then added to the higher of the two noise levels (background noise/ criteria as appropriate) to give the applicable noise criteria for the specified construction area.

Table 4-5 Maximum Permissible Noise Limits for Construction Works

Difference between Permissible & Background Noise Levels (dB(A))	Correction Factor to be Added to the Higher of the Two Noise Levels, (dB(A))
Below 2	3
2 to 4	2
4 to 10	1
10 and above	NIL

4.2.4 Waste Management

4.2.4.1 Environmental Public Health Act (EPHA) 2020

The *Environmental Public Health Act (EPHA) 2020* contains specific provisions relating to industrial waste and its disposal. The Commissioner for Public Health may require the owner or occupier of any workplace to furnish information on the amount, type and nature of any industrial waste found on his premises. The owner or occupier may also be required to treat the industrial waste at their own expense before disposal.

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

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

4.2.5 Vector Control

4.2.5.1 NEA Guidelines on Rainwater Collection System and Mosquito Prevention (2011)

The NEA Guidelines on Rainwater Collection System and Mosquito Prevention (2011) provide recommendations for effectively collecting and managing rainwater while preventing mosquito breeding. They

emphasize proper design, filtration, and maintenance of harvesting systems to ensure water quality and prevent stagnation. By following these guidelines, users can achieve efficient rainwater collection and effective mosquito control, promoting public health.

4.2.5.2 Control of Vectors and Pesticides Act 2002

The Control of Vectors and Pesticides Act 2002 is legislation aimed at regulating the handling, distribution, and use of pesticides to control vector populations, such as mosquitoes, that pose health risks. The Act establishes a framework for the registration of pesticides, ensuring they are safe and effective for public health. It includes provisions for licensing and monitoring of pest control operators, as well as guidelines for public awareness and safety measures. Overall, the Act seeks to safeguard public health and the environment while managing vector control effectively.

4.2.5.3 Environmental Public Health Act (EPHA) 2002

The Environmental Public Health Act (EPHA) 2002 is legislation aimed at promoting and protecting public health and the environment in relation to environmental hazards. It establishes frameworks for the regulation of environmental health issues, including waste management, sanitation, pollution control, and vector management. The Act empowers authorities to enforce health standards, conduct inspections, and implement public health initiatives to mitigate risks and ensure community well-being. Overall, it seeks to create a healthier living environment for the public.

5 Environmental Management and Monitoring Plan (EMMP)

5.1 Summary of Environmental Monitoring and Mitigation Plans

5.1.1 Management and Mitigation Plans

The proposed mitigation and monitoring portion of this detailed EMMP has been developed in Table 5-1 to provide a holistic framework for the management of environmental impacts during pre-construction, construction and post-construction stages. This includes measures to reduce potential impacts from excessive noise, light, particulate matter, or pollution arising from the development of the area, and to ensure the wildlife and surrounding sensitive receptors are protected.

Table 5-1 Summary of Management and Mitigation Plans

Parameter	Mitigation Measures	Section
Pre-construction		
Biodiversity	Wildlife Shepherding (including during SI and access road works) <ul style="list-style-type: none"> – Pre-felling Inspections prior to tree felling – Prohibition of additional clearance or tree felling for site access and set-up to worksite, unless otherwise permitted and/or necessary – Drilling rigs, mobilisation and demobilisation activities shall be kept minimally 5m away from trees (>1.0m in girth), to protect roots and tree structures 	5.3 5.4.1
	Biodiversity Awareness Trainings <ul style="list-style-type: none"> – To ensure all personnel are aware of the do's and don'ts pertaining to wildlife encounters 	
	Installation of Hoardings <ul style="list-style-type: none"> – To prevent unauthorised encroachment outside of project boundary 	
	Installation of ECMs <ul style="list-style-type: none"> – To minimise surface runoff and erosion – To ensure proper wastewater treatment before discharge into public watercourses – To prevent and minimise pollution of waterways 	
Construction		
Biodiversity	Fauna Management Plan	5.4.1
	Flora and Arboriculture Management Plan	
Airborne Noise	Airborne Noise Management and Mitigation Plan	5.5.3

Parameter	Mitigation Measures	Section
Water Quality	Water Quality Management and Mitigation Plan	5.6.2
Vector Control	Vector Management and Mitigation Plan	5.7.2
Waste Management	Waste Management and Mitigation Plan	5.8.2

5.1.2 Monitoring Schedule

Routine monitoring will be conducted throughout the duration of works. During site clearance, Aurecon will closely monitor the progress of vegetation clearance done and conduct pre-fell check on a weekly basis. Once site clearance works are completed, monitoring frequency will be reduced to monthly and visual site inspections will be conducted. Post-construction monitoring will also be done for terrestrial fauna and water quality. Refer to Table 5-2 for the monitoring schedule.

Table 5-2 Monitoring Schedule

Monitoring	Frequency	Section	Responsible Party
Pre-construction			
Pre-felling Inspection	During SI works and site access works, and subsequently weekly during site clearance	5.3 5.4.1	Aurecon / Ecologist
Baseline Arborist Survey	Once-off		
Construction			
Fauna / Wildlife / Flora	Monthly site inspection for trapped fauna and implementation of proposed biodiversity mitigation measures	5.4.2	Aurecon / Ecologist
	Regular biodiversity surveys/monitoring (if necessitated by authorities)	-	Contractor
Airborne Noise Monitoring	Continuous	5.5.2	Contractor
Water Quality (visual inspection & TSS monitoring)	Monthly/Continuous	5.6.1	Contractor
Vector Monitoring	Monthly	5.7.1	Contractor
Waste Management (visual inspection)	Monthly	5.8.1	Contractor
Bi-weekly Visual Site Inspection	Bi-weekly	5.9.4	Aurecon
Post-construction			
Closed-off Audit Report	During final month of Project, when all works are completed A total of two (2) Closed-off Audit Report shall be furnished upon the completion of each stage of works (i.e., infrastructure and building works)	5.9.2	Aurecon

5.2 Summary of Environmental Tolerance Limits and Quality Objectives (EQOs)

The allowable amount of released environmental parameters will take reference from the tolerance limits stipulated in this EMMP, the past EIA, and the latest Regulatory Agencies' requirements. The impacts on the

various environmental receptors will then be classified according to the following levels shown in Table 5-3 below.

Table 5-3 Summary of Impact Level Classifications on Environmental Receptors

Impact Level	Description
No Impact	Changes are below the level of model reliability or are significantly below recognised tolerance levels, so that no change to the quality or functionality of a receptor will occur.
Slight Impact	Changes can be resolved by the numerical models but are unlikely to be detectable in the fields, for example, a change in living status. Typically, slight impacts are associated with changes that cause stress, but not mortality to stream/aquatic ecosystems. Slight impacts may be recoverable once the stress factor is removed.
Minor Impact	Changes are identified by the predictive tools at a level where change (e.g. mortality) can be expected to be identifiable in the field. Changes are limited in spatial extent and are unlikely to have any secondary consequences.
Moderate Impact	Changes are at a level that can be classified as locally significant and may result in secondary impacts. From a physical perspective, a moderate impact would typically require a change in operating procedure for the continued safe use of an existing facility.
Major Impact	Changes are often related to a complete loss of local habitat with consequent secondary impacts on liked ecosystem processes. From a physical perspective, a major impact would typically be associated with an impact that prevented the use of an existing facility.

5.2.1 Tolerance Limits

The respective tolerance limits EQOs prescribed for each monitoring parameter will be detailed in their respective sections. The general qualitative tolerance limits proposed for each parameter are as shown:

- Suspended sediment impact on aquatic plants, animals, or hydrophytes;
- Sedimentation impact on aquatic plants, animals, or hydrophytes;
- Suspended sediment impact on stream / aquatic habitat;
- Sedimentation impact on stream / aquatic habitat;
- Noise and dust impact on animals / aquatic habitat, or hydrophytes;
- Minimum amount of water flow required to maintain the stream's current condition; and to support existing aquatic biodiversity.

5.2.2 Environmental Quality Objectives

The respective tolerance limits and/or EQOs prescribed for each monitoring parameter will be detailed in their respective sections. The general qualitative environmental quality objectives (EQOs) are summarised below:

- No harm or significant disturbance to wildlife
- No significant water quality impact
- No significant impact on the aquatic plants, animals or hydrophytes located within the potential impact area
- No significant impact on stream / aquatic habitat within the potential impact area
- No significant impact on water intakes within the potential impact area

5.2.3 Emergency Contacts for Environmental Incidents/Exceedances

Table 5-4 provides a summary of the emergency contacts for the environmental incident(s):

Table 5-4 Emergency Contacts for Environmental Incident

Incident	Responsible Party	Person-in-charge	Contact
All environment incidents	ECO	TBC	HP: TBC
Encounter of dead animals	CEMMP Consultant	Mr. Shane Chiok	HP: 6256 6188
Encounter of injured animals	CEMMP Consultant	Mr. Shane Chiok	HP: 6256 6188
	Animal Response Centre	TBC	HP: TBC Animal Response Centre Hotline: 1800 476 1600
Fire events	Contractor	TBC	HP: TBC
Chemical/oil spills	Contractor	TBC	HP: TBC
	CEMMP Consultant	Mr. Shane Chiok	HP: 6256 6188

5.3 Measures for Advance Works

Advance works as detailed in Table 3-1, monitoring and mitigation detailed in Table 5-1 shall be implemented and adhered to during this initial phase. Primarily for site clearance and tree felling for soil investigation, access road and site office setup, hoarding and ECM installation works shall be conducted prior to the main site clearance. The proposed mitigations for the aforementioned advance works are detailed in Section 5.3, followed by the general mitigation measures pertaining to fauna during site clearance in Section 5.4.1.

5.3.1 Soil Investigation

The purpose of Soil Investigation (SI) works is to obtain geotechnical information on the subsurface condition, which is crucial for ascertaining subsurface soil composition, groundwater levels, penetration resistance etc. for advanced and in-depth engineering analyses. The detailed methodology shall be appended to this EMMP at a later juncture, when available. Nonetheless, the following biodiversity mitigation measures are proposed as shown in Table 5-5 below. Should site clearance and tree felling works be unavoidable and necessary, the following mitigation measures described in Section 5.4.1 shall be referenced and adhered to.

Table 5-5 Mitigation Measure for Soil Investigation Works

Mitigation Measure	Description
Biodiversity	<ul style="list-style-type: none"> ■ All effort shall be made to ensure borehole locations are kept within the project boundary, ideally within developed areas (e.g. recreational land or turfed areas). Entry into forested areas shall be prohibited during this stage. ■ Borehole locations and the worksite footprint shall be kept minimally 5m away from trees with >1m girth, to protect the integrity of tree structures and its root systems. ■ Minimal or no additional site clearance shall be conducted for the proposed borehole locations. Where necessary, undergrowth clearance and pre-clearance inspections shall be conducted to facilitate formation of access routes to borehole locations. ■ Access paths and the overall routes shall be clearly demarcated (including the path widths) to prevent unauthorised encroachment into the forested areas.

Mitigation Measure	Description
	<ul style="list-style-type: none"> Where applicable and practicable, mini excavator(s) and portable drilling rig(s) of small statures shall be employed to minimise disturbance to surrounding habitats during advance works. Soil investigation works and related ancillary works shall only be conducted during daylight hours and only during workdays.
Noise Management	<ul style="list-style-type: none"> SI work sites shall be clearly demarcated with portable hoarding and enclosed with acoustic barriers/screens. The noise from the operation of the drilling rigs shall be further mitigated by deploying noise blankets enclosing the rig, as well as addition noise insulating materials (e.g. wooden boards or noise insulation foam) where necessary (see for Figure 5-2 example).
Waste Management	<ul style="list-style-type: none"> All waste arising from the SI works (be it solid or liquid, construction, drilling or human/food waste), such as slurry, shall be kept in proper containment structures and disposed of properly by licensed waste disposal contractors. There shall be no discharge of slurry or disposal of waste within or around the SI work areas. Sandbags and/or silt fencing shall be deployed around the perimeter of the worksite(s) to prevent discharge of waste into surrounding area. Food and drinks shall be consumed outside of the worksite and in proper designated zone(s).



Figure 5-1 Sample for Soil Investigation Worksite Setup (Source: TODAY)

5.3.2 Site Access Works & ECM Setup

Where applicable and feasible, site access works and ECM setup necessitating site clearance shall adhere to the mitigation measures described above in Section 5.3, Table 5-5 and in Section 5.4.1. The detailed fauna management and mitigation measures are described in the following section below.

5.3.3 Roadside Tree Removal

Apart from the N4 Forested Area, there are also isolated and roadside trees that have been planned to be felled for roadworks within the EMMP boundary (Figure 5-4). These trees are proposed to be felled independently of the overall wildlife shepherding plan as it is unfeasible to conduct wildlife shepherding for said trees (and therefore excluded from the site clearance boundary; Figure 5-6). Nonetheless, pre-felling inspections shall still be conducted and general biodiversity mitigation measures (as described in Section 5.4.1) still apply.

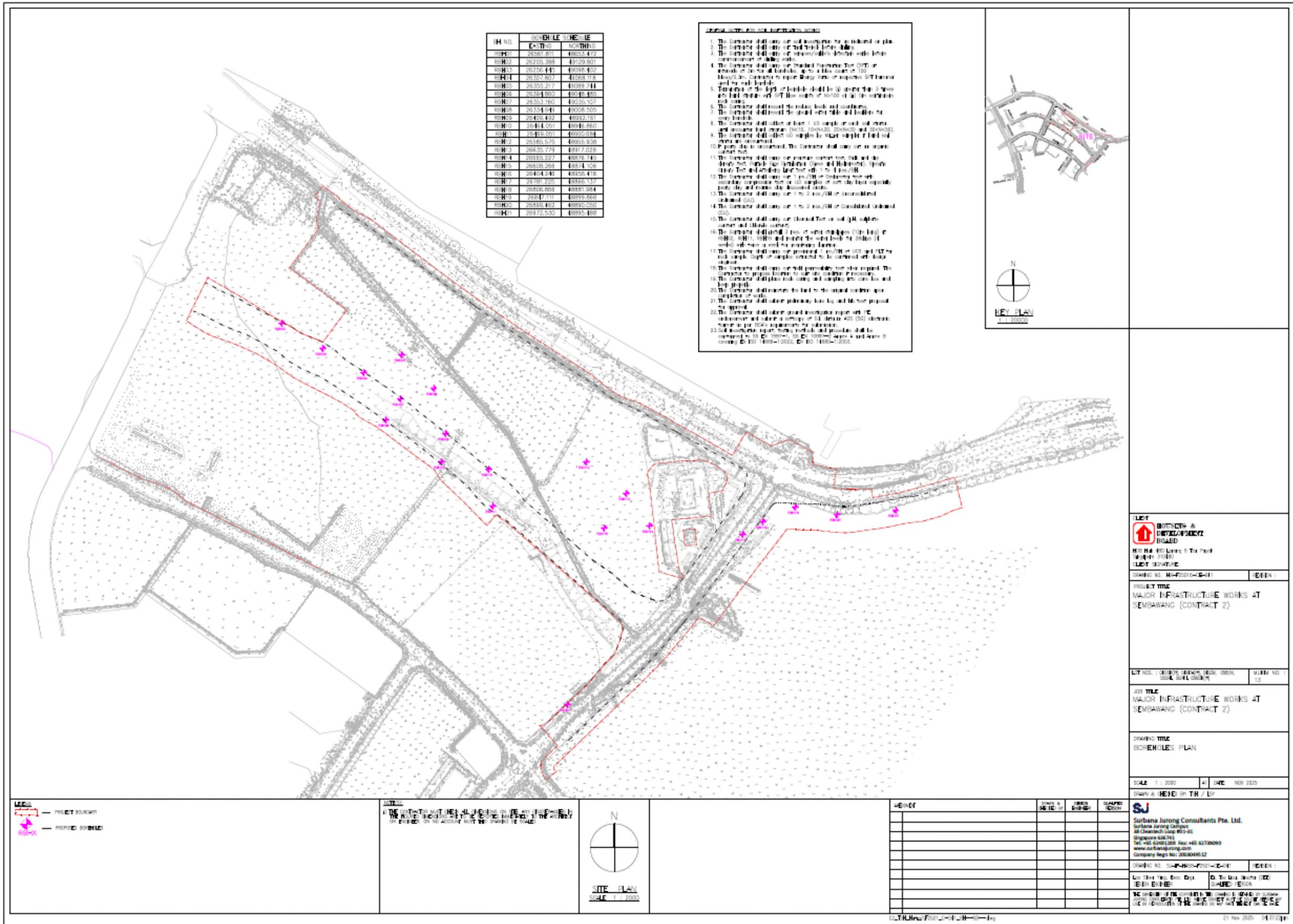


Figure 5-2 Indicative Borehole Locations for Soil Investigation Works (Source: SJ)



Figure 5-3 Indicative Tree-felling Plan (Source: SJ)

5.4 Biodiversity

5.4.1 Biodiversity Management and Mitigation Plans

5.4.1.1 Fauna Management Plan

Given the significance of this area as a natural wildlife corridor, it is essential to minimize impacts on local fauna. Developing a Wildlife Response Plan can mitigate these impacts and lower the risk of human-wildlife conflicts that could threaten safety. Wildlife management should begin before construction to safely move animals out of the work area, either through passive shepherding or active relocation. Additionally, a Wildlife Response Plan should be implemented during construction to assist any animals that become trapped or injured on-site.

The Contractor shall also engage an NParks-certified Wildlife Management Contractor who can be promptly deployed upon the EMMP Specialist's recommendation to relocate fauna during the project. Wildlife Management Contractor should be an approved third-party contractor authorized by the Director-General of Wildlife Management to perform activities regulated by the Wildlife Act.

5.4.1.1.1 Fauna Management during Site Clearance

The objective of fauna management during site clearance is to effectively remove wildlife from the worksite before construction activities begin. This approach is crucial for preventing fauna entrapment, injury, and mortality, in particular animals such as snakes that may pose human-wildlife conflicts during the clearance process, with the aim of minimizing interactions between humans and wildlife.

Prior to commencing any work, the area designated for construction should be fully enclosed by hoarding to contain the worksite and protect surrounding habitats. An inspection of the hoarded area will be conducted to assess the presence of wildlife. This inspection should occur before any site clearance activities take place. The EMMP Consultant's Ecologist shall carry out a thorough survey within the hoarded area specifically aimed at detecting any wildlife that may be trapped.

Once the area has been secured and inspected, site clearance activities should be carried out in a directional manner, moving towards a designated forested wildlife refuge area. This approach aims to encourage any remaining wildlife to vacate the worksite naturally due to the disturbances caused by the clearance activities. Prior to the felling of any trees, additional pre-site clearance fauna inspections must be conducted to ensure that no fauna remain in the vicinity.

Hoarding Installation

The Contractor is responsible for completing the installation of hoarding prior to the commencement of site clearance activities. The hoarding must adhere to the following specifications:

- The hoarding shall be a minimum of 2.4 m in height. Both sides of the hoarding should be painted white to enhance visibility for fauna, thereby minimizing the likelihood of accidental contact.
- In areas where internal hoarding is required to partition the site into smaller zones, the hoarding may be reduced to a height of 1.8 m.

- It is crucial that the hoarding panels are installed without any gaps, ensuring they form a continuous barrier. The base of the hoarding must extend at least 300 mm into the ground to deter burrowing animals from accessing the site.
- The sequence of the hoarding installation will be reviewed by the EMMP Consultant's Ecologist to ensure that the disturbances caused by the installation do not drive fauna onto adjacent roads. The optimal installation order will be:
 - First, install hoarding adjacent to roadways;
 - Next, address areas that are furthest from identified wildlife refuge areas; and
 - Finally, complete the installation in the remaining sections of the site.
- Note that the majority of canal D2 is to be retained during the initial site clearance stage, and is only to be backfilled upon the following: (i) full site clearance, (ii) the construction of the box culvert, and (iii) diversion of the existing waterflow towards the new drain/box culvert.
 - Hoarding shall therefore be installed on both ends of canal D2, clearly demarcating the boundary to prevent encroachment and unintended clearance.
 - Silt fencing shall also be installed to prevent soil erosion and sedimentation from affecting D2.
- Once the hoarding installation is complete, the EMMP Consultant's Ecologist will conduct an inspection to assess the integrity of the hoarding. This inspection will confirm that the hoarding effectively prevents the entry and exit of fauna, ensuring that the site remains secure for the duration of the clearance and construction activities.

Pre-site Clearance Fauna Inspection

Prior to site clearance, the EMMP Consultant's Ecologist is responsible for conducting thorough fauna inspections in areas designated for clearance, as well as for any subsequent removal, pruning, or trimming of vegetation and trees. The inspections will aim to fulfil the following objectives:

- The inspection will focus on identifying potentially active animal nests, hollows, burrows, and other nesting structures. It will also aim to detect any animals that may be at risk of being trapped, injured, or killed during site clearance. This includes recognizing animals that could potentially lead to human-wildlife conflicts, such as snakes. Each inspection will remain valid for a period of seven (7) days.
- The EMMP Consultant's Ecologist will report and document all fauna observations made during inspections. Recommendations for mitigating measures will also be included based on these observations.
- In the event of wildlife encounters, the EMMP Consultant's Ecologist and Contractor's Wildlife Specialist will coordinate actions in accordance with the designated Wildlife Response Plan.
- Additionally, as the Asiatic softshell turtle (*Amyda cartilaginea*) had been spotted previously within the N4 forested area (Chen & Luqmanul, 2024), there is a need to account for its potential encounter during site clearance and backfilling works. The wildlife encounter protocol for this species has therefore been included in Table 5-8 and in Asian Softshell Turtle Management Plan.

If fauna is found on vegetation slated for clearance, the affected vegetation will be marked with coloured tags or tape. Wildlife will be allowed to vacate the area on their own prior to any clearance activities. In cases where eggs, chicks, or young animals are present in nests, these will also be allowed to fledge or leave the nests naturally before site clearance. The EMMP Consultant's Ecologist will conduct follow-up checks to confirm that all faunas have departed prior to any vegetation removal. If it is impractical or unsafe for certain fauna to leave on their own (e.g., a venomous snake that cannot be safely captured), relocation efforts will be considered and executed by the Contractor's Wildlife Management Contractor and Wildlife Specialist. This will be done in consultation with NParks and in alignment with the Wildlife Response Plan outlined in Figure 5-10.

Should the EMMP Consultant's Ecologist determine that there is a risk of injury or death to fauna – even in the absence of visible signs during the inspection (e.g., a bird nest but no observable activity) – the EMMP Consultant's Ecologist or Contractor's Wildlife Specialist shall be present on-site during the removal of the affected vegetation. This presence will ensure the implementation of the Wildlife Response Plan as needed. To aid in inspections of nests, hollows, and structures, elevating equipment will be deployed where necessary.

The Ecologist is required to submit an inspection report within 24 hours of conducting the inspection. This report will include the following information:

- Date of the inspection;
- Tree tag number (or location coordinates if untagged);
- Observations made during the inspection;
- Recommended mitigation measures; and
- Photographic evidence of the findings.

Pre-felling Fauna Inspection

The main objective of the pre-felling fauna inspection is to prevent and mitigate fauna mortality during the clearing of the forest habitat. The key considerations for clearing of the forested land are in compliance with the National Parks Board (NParks) *Technical Note on Wildlife Shepherding and Pre-felling Fauna Inspection* (NParks, 2024c):

- Clearance shall be phased from the most disturbed area (usually the side nearest to roads or existing developments) towards the **least disturbed area** (where applicable and practicable);
- Clearance shall also take place from **high to low ground** (where applicable and practicable);
- An **unobstructed escape route** shall be designed to channel wildlife out of the development site; and
- Clearance of the development site can be broken up into **zones** (where applicable and practicable), where each zone is isolated from the next either by natural barriers that prevents animal movement or permanent hoarding structures.

The proposed site clearance and tree-felling will take into consideration the existing Project boundary, and obstacles (e.g. terrain) that might impede wildlife movement. The site clearance and tree-felling shall follow that of the proposed wildlife shepherding plan (Figure 5-6 and Appendix A). Notwithstanding, the hoarding plan (to be updated when Contractor has been onboarded) will highlight the hoarding layout, whilst Biodiversity Awareness Trainings [Appendix B] will be carried out before any clearance can commence. To ensure workers are reminded on the contents discussed during the Biodiversity Awareness Training, regular refreshers, such as during toolbox briefings will be conducted.

Regular Site Inspection

To ensure effective wildlife management and environmental protection during the construction phase, a structured site inspection regime will be implemented, comprising bi-weekly inspections by the EMMP Consultant and daily inspections by the Contractor.

The EMMP Consultant will conduct site inspections every two weeks to document findings related to the following key items:

- Degradation of adjacent sensitive habitats;
- Implementation of proper ECM measures;
- Food and waste management;
- Gaps in hoarding;
- Potential fauna entrapments; and
- Presence of injured/trapped/dead animals.

Daily inspections will be performed by the Contractor and Contractor's ECO on-site. These inspections will focus on the following critical items:

- Proper ECM measures;
- Food management practices; and
- Potential fauna entrapments.

5.4.1.1.2 General Site Clearance Sequence

The sequence of site clearance and tree-felling general adheres to the following stages:

- Step 1: Biodiversity Awareness Trainings;
- Step 2: Installation of Hoardings;
- Step 3: Installation of ECMs;
- Step 4: Undergrowth Clearance; and
- Step 5: Tree Felling.

In summary, site clearance and tree-felling follow these steps:

- Biodiversity Awareness Training shall be conducted for all construction personnel.
- Put up perimeter hoardings, perimeter drains, ECMs, and silt fences around the site. This shall be set up to prevent wildlife from entering the road and Project area. A work area of 5m width is allocated for establishing the perimeter hoarding.
- Pre-felling inspections are conducted to identify any nests, burrows, and wildlife. If active nests are detected, further monitoring will be needed with a provision of a vegetative buffer. For animals that cannot be guided out safely, relocation may be considered. Abandoned nests or burrows with no discernible activities shall be removed ASAP to prevent animals from returning.
- Pre-felling inspections shall be conducted within seven (7) days prior to clearing.
- Clearing of the undergrowth vegetation (if applicable).
- Minimum three (3) days of buffer between clearance of undergrowth and the eventual clearance of trees (≥ 1 m girth).
- Clearance of trees (≥ 1 m girth).
- Close up of sections without any vegetation with temporary barriers.
- Upon completion of all site clearance, the perimeter hoarding shall be set up covering the full perimeter of the Project.

Step 1: Training

Training sessions on biodiversity awareness will be conducted prior to setting up of hoardings. The main objective of the training is to educate the workers and construction personnel on the site clearance and tree-felling procedures, types of wildlife they may encounter, and the dos and don'ts if an animal is sighted. After the initial training, annual refresher trainings will be conducted. Daily reminders on biodiversity awareness will be briefed during toolbox meetings as well. Personnel involved in site clearance and tree-felling works will also be briefed on how to handle encounters with wildlife.

Summary of the Training:

- This training is conducted for all staff working at the site (Contractor, sub-contractor etc). This shall be incorporated into the safety induction course, toolbox meetings, and communicated to the workers.
- Information on potential wildlife sightings and what to do when wildlife is encountered shall be put up and available at site office notice boards accessible by all workers.
- The training will include the dos and don'ts to minimise attracting wildlife (E.g., Proper housekeeping, no feeding of wildlife, or indiscriminate discarding of food items.).
- Injured or stranded wildlife shall not be provoked, caught or handled by anyone. Appointed licensed wildlife Contractors are to be contacted to handle relocation or removal of the animal.
- Supervisor or assigned workers moving in front of excavators during vegetation clearance shall undergo a detailed course by the ecologist/wildlife specialist on how to look out for animals in the undergrowth, burrows or trees.
- Refer to Appendix B for Biodiversity Awareness Training Deck.
- Refer to Table 5-8 for Wildlife Encounter Protocol
- Refer to Figure 5-10 for Wildlife Response Plan

Training sessions will also be conducted to brief the relevant personnel involved on the EMMP, to ensure that they are clear on the mitigation measures in place. This includes site personnel and Contractors. The briefing will be conducted for workers who are involve in the following activities (where applicable):

- Wildlife encounter and site clearance;
- Installation of perimeter hoarding;
- ECM works;
- Cut and fill works;
- Demolition works;
- Sewer pipe jacking works;
- Approved night works; and
- Any other key activities, which might cause nuisance to the biodiversity.

During the construction phase, refresher trainings involving the aforementioned content shall be conducted every 6 months by the EMMP Consultant.

Step 2: Installation of Hoardings

The hoardings shall take into consideration the existing hoardings around the development so as to prevent wildlife from being trapped. Two kinds of hoardings are typically utilised, perimeter hoardings which will be

used to demarcate the construction boundary, and temporary barriers used as short-term hoardings in between shepherding sections (if applicable). Examples and specifications of each hoarding is included in Table 5-6 below. In general, hoardings shall be made of opaque, non-reflective materials.

The Contractor shall demarcate and peg the site boundary at least four (4) weeks prior to the start of site clearance. Perimeter hoardings will first be implemented around the Project site to prevent unnecessary vegetation damage outside the Project area. Installation of the perimeter drain, and appropriate placement of silt fences will occur after putting up the Perimeter Hoarding. This will minimise the impact to the necessary work area. A working space of not more than 5 m width (ideally lesser) along the boundary of the Project is recommended for the setting up of the perimeter hoarding and drains, where applicable and practicable.

If access gates are to be installed, silt fence/covering shall be attached to the bottom of the gates as shown in Table 5-6 to reduce the gap between the gate and the ground. The gate shall also remain closed during site clearance, and whenever it is not in use. There shall be no opening greater than 50 mm for the access gate to prevent wildlife from entering through these openings, where applicable and practicable.

The Contractor shall note that hoarding and silt fencing (alternatively BRC mesh) are to be installed along canal D2, to prevent encroachment and unintended clearance.

The notional Site Hoarding Plan will be along the boundary line provided in Figure 5-6, and the finalized proposed hoarding plan and specifications will be included in the EMMP once the contractor has been onboarded. Pre-felling/site clearance inspections shall be carried out for these advance clearings (i.e. setting up of preliminary hoardings and ECMs) if there are trees along the proposed hoarding route.

Step 3: Localised Site Clearance for Installation of ECM

Where applicable, a localised site clearance will be conducted prior to the installation of ECMs. The methods are similar to Step 5 and Step 6 below. The area required for site clearance is dependent on the size of the ECM ponds and tanks. The earth drains will require a working area of 4 m width. The route will be from the existing access road and extend all the way down from the earth drains towards the ECM facilities.

Step 4: Installation of ECMs

Earth Control Measures (ECM) shall be implemented prior to site clearance to prevent silty discharge into the surrounding streams, roads and forests. A detailed ECM Plan (to be provided by the contractor when onboarded) will be prepared and endorsed by the Qualified Erosion Control Professional (QECP). The ECM Plan shall be approved by PUB prior to the site clearance.

Perimeter Earth Drain and Silt Fences are advised to be set up in tandem with the hoardings to minimize the working space required. The ECM shall only be set up after the hoardings have been set up. Holding Pond / Detention Tank shall have Water Barriers and subsequently a permanent fence with toe boards along the bottom of the fence will be set up to prevent wildlife from entering the pond/tank (Figure 5-5). If any animals are spotted in the holding pond, the approved wildlife management contractor will be informed. The site clearance for ECM Water Treatment Plan will be cleared from the roadside.



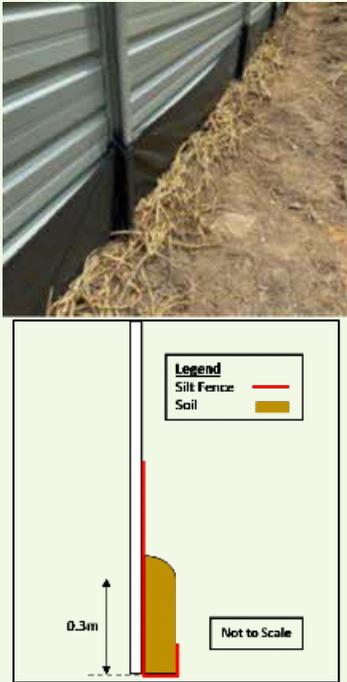
Figure 5-4 Overall Example of ECM Holding Pond with Surrounding Fence and Toe Boards

Step 5: Undergrowth Clearance (if applicable)

This step follows the typical site clearance methods recommended by NParks (2024c). Extra consideration is given to the wildlife in the habitat, and time is provided for the wildlife to move away from the areas to be cleared. Clearance will also be scheduled during daylight hours (8am to 6pm). Site clearance is thus conducted in systematic steps as follows:

- Each Site (A1 to A5), is subdivided into smaller subzones, depending on the terrain and tree density per subzone (Figure 5-6). Site clearance is to be done in the direction shown in Figure 5-6, and can take place concurrently at different sites.
- Clearing of undergrowth is typically conducted manually or with a small excavator. Workers and operators shall generate noise (i.e., using a whistle or clapping of hands) or use a stick to disturb the surrounding vegetation and encourage the wildlife to move. This is done in a systematic manner, and towards the shepherding direction (if applicable).
- A worker will walk ahead of the excavator to scan the ground of any fauna - such as snakes in holes, bird nests, mammals in burrows, and other terrestrial animals. Workers shall alert the Ecologist/Wildlife Specialist if active nests and burrows are found. If no nest or burrows were detected on the ground, clearing of undergrowth and low-lying vegetation may commence.
- The clearing shall be done while avoiding the trees with 1 m girth and above. No trees with 1 m girth and above are to be felled during this process. The rate of clearance in each area will be predetermined based on the section identified. Markings (i.e., on the perimeter hoarding) can be adopted to demarcate the zones/sections. A maximum of two (2) excavators shall be used.
- Once the undergrowth is cleared, a buffer of three (3) full days is given for arboreal wildlife to migrate from the site. The day on which the undergrowth is completely cleared is considered as Day 1

Table 5-6 Hoarding Specifications

Perimeter Hoarding	Temporary Barriers	Access Gate(s)	Wildlife Exit(s)
<p>Utilised to prevent wildlife from entering the construction site and preventing wildlife entering roads.</p> <p>Some existing requirements:</p> <ul style="list-style-type: none"> At least 1.8m or as per contract requirement in height (hoarding will eventually be replaced by noise barrier) Sufficient counterweight to withstand impact Embedded at least 300mm into the ground; or Concrete flooring / foundation Smooth top edge Opaque and non-reflective 	<p>Utilised for short-term boundary function. These may be temporary fixtures which can be moved to allow access or before perimeter hoardings are set up.</p> <p>For water barriers, there shall be no gap in between water barriers. Fence netting is applicable only for sections where terrain is challenging and not feasible for water barrier.</p>	<p>Access gate(s) should have bottom gap of no more than 50 mm</p> <p>To reduce gaps between access gates and the ground, rubber flaps can be installed as a mitigation measure</p>	<p>Wildlife exits with the one-way flow designs shown below (NParks, 2024c) shall be installed at 30m intervals on hoarding along the forested edge, where practicable.</p> <p>These exits will facilitate the one-way flow (preventing back entry) of wildlife during site clearance and shepherding, and should be sealed up once the clearance for each subzone has been completed.</p>
<p>Examples:</p> 	<p>Examples:</p> 	<p>Examples:</p> 	<p>Examples:</p> 

Step 6: Tree Felling

Pre-felling fauna inspections can be conducted during the 3-day buffer period or prior to tree felling. The ecologist/ wildlife specialist shall check for the following:

- Crown of the tree for nest, tree trunk for crevices used by wildlife, or bees' nest on the tree trunk. The objective is to determine if there are any active roosting/nesting sites by birds. This allows for the establishment of sufficient buffer (if necessary) to ensure the nesting sites are protected until the young are able to leave.
- If animals are found to be trapped within the site and cannot be guided out safely, an approved wildlife management company (a registry is available at www.nparks.gov.sg/avs/animals/animal-related-businesses/animal-managementcompanies/public-registry-of-certified-animal-management-specialists) must be engaged to rescue the trapped wildlife (NParks, 2024c).
- If an active nest was found, it shall be monitored by an ecologist/wildlife specialist who will ensure that the nest has been vacated before clearance (NParks, 2024c).
- Assessed trees with active nests shall be flagged and labelled to indicate tree is to be retained temporarily. Tree number, location and photographs of tree and nest are to be reported in the weekly pre-felling report.
- Pre-felling inspections shall be conducted prior to tree felling. Clearing of trees shall be conducted within seven (7) days from the inspection. If more than seven (7) days have passed from the inspection and tree felling has not commenced, the inspection shall be carried out again.

After the three (3) days buffer has passed and no active nests are detected, trees can be felled. Temporary hoardings shall be put up after all the trees of each section has been cleared. This will prevent wildlife from re-entering the cleared sections and allow the Contractor to begin earthworks within the completed cleared section. As site clearance progresses, temporary hoarding placed between two cleared sections can be removed.

After the vegetation in all sections have been cleared (both undergrowth and trees), the temporary hoarding along the Project boundary shall be replaced with perimeter hoardings/noise barrier to prevent wildlife from re-entering. The Site will eventually be hoarded up entirely, as based on the Project boundary.

Notes:

- All works are to be within the Project boundary. No workers or machinery shall venture into forested areas outside the contract boundary. Working space used to erect the hoarding prior to site clearance shall only be 5 m.
- If there are any large trees encountered along the hoarding line, Contractors are to avoid the trees by going around the trees while keeping within the Project boundary and continue hoarding according to the Project boundary beyond that.
- Hoarding to be implemented around the Project site to prevent unnecessary vegetation damage outside the Project area. Similarly, vegetation outside the Project site shall not be damaged.
- Work around the immediate vicinity shall stop if animal is witnessed on site, dead or alive, until full investigation or relocation is completed. Refer to Figure 5-10 of the EMMP for the wildlife encounter protocol.

5.4.1.1.3 Proposed Wildlife Shepherding/Site Clearance Sequence

Due to the necessity of prioritising land preparations for a near-term development at parcel A1 along Canberra Road, site clearance will commence from this parcel in advance. As Parcel A1 will be cleared in advance (via passive shepherding), the parcel boundary will be hoarded up with 2.4m height hoarding and the latter will be maintained for the remainder of the site clearance/wildlife shepherding works. In addition, the affected sections of the semi-naturalised canal D2 will be temporarily diverted within the site. The diverted stream will be maintained until the permanent roadside drains are constructed and commissioned – after which, the remainder of the canal will be backfilled and aquatic fauna trapped/translocated where applicable (see Appendix C). To facilitate this process, the internal hoarding delineating the parcels has been aligned accordingly to ensure proper segregation (Figure 5-6). Generally, the direction of shepherding from west to east adheres to the recommendations in the EIA. The external hoarding boundary remains unchanged (Figure 5-8).

It is noted that the comments from the nature group engagement during the EIA recommended for the culvert to be used. However, given that parcel A1 is to be cleared first and water flow will not be diverted from culvert, it will therefore not be feasible to utilise the existing underground culvert connecting N4 and N5 across Canberra Rd. Instead, trapping and translocation of animals are proposed at each stage of site clearance (see Appendix C). For clarity the sequence will be described in the following phases:

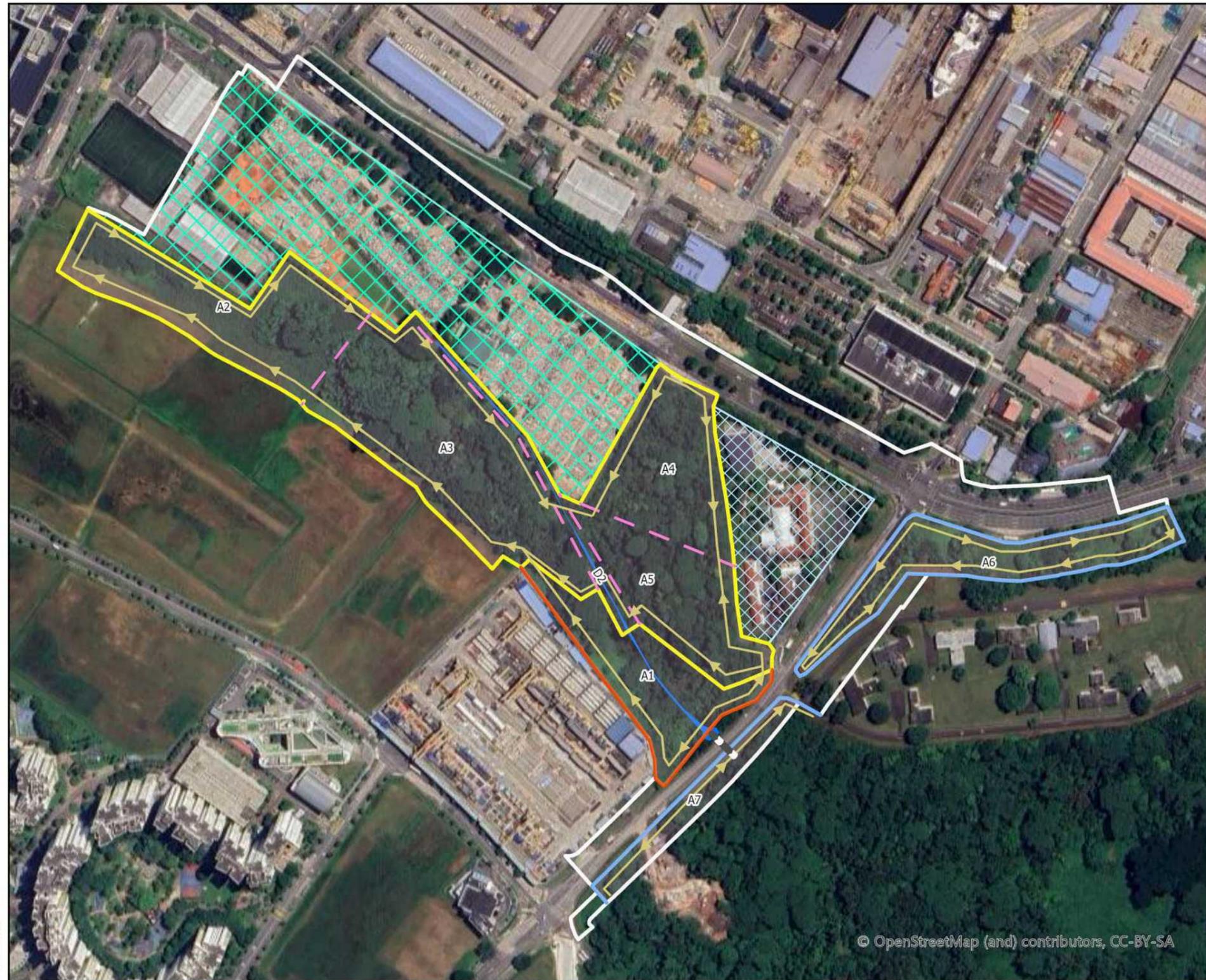
- Phase 1 (refer to Figure 5-7):
 - Site clearance (minimal or avoided) for Parcel A1 (C24 BTO) via passive shepherding into N4 forest (no trapping), with concurrent partial diversion of culvert and backfilling of D2 (within affected area in A1; see Figure 5-8 for indicative diversion plan)
 - Includes trapping and translocation of aquatic fauna (if any)
 - Partial hoarding of the A1 parcel to be erected prior to passive shepherding
 - Followed by perimeter hoarding installation and D2 temporary hoarding for remainder of site (with minimal site clearance), ECMs and drainage, site office and site access setup
 - Perimeter hoarding shall then be adjusted to exclude C24 BTO / Parcel A1 after clearance has been completed (Figure 5-7 & Figure 5-8)
- Phase 2 (refer to Figure 5-8):
 - Clearance of Parcel A2 and A3, with adherence to Fauna Management during Site Clearance and General Site Clearance Sequence; but note that active trapping and translocation points for animals indicated on the map in Figure 5-7 shall be implemented
- Phase 3 (refer to Figure 5-9):
 - Clearance of Parcel A4 and A5, followed by full backfilling of D2 upon completion of final diversion and box culvert construction
- Phase 4 (refer to Figure 5-10):
 - Clearance of Parcel A6 and A7. Note that A7 will involve passive shepherding as well into the N5 forest (no trapping), and that the planned works for Phase 4 will only occur in September 2026.

At any stage/parcel where animals are planned to be trapped at the designated points, the Contractor shall inform the EMMP Consultant and activate their NParks-certified Animal Management Contractor to conduct the trapping and translocation, in accordance with NParks procedures (refer to Appendix C for SOP).



Legend

- Temporary Hoarding (1.8m)
- Phase 1 Hoarding (2.4m)
- Phase 2 & 3 Hoarding (2.4m)
- Phase 4 Hoarding (2.4m)
- Hoarding Direction
- Shepherding Area
- Semi-naturalised Canal D2
- Underground Culvert
- EMMP Boundary
- Demolished Area
- Recreation Centre (partially-retained)



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A4 scale: 1:137,421
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Project Code: P529383
Coordinate System: SVY 21

Date: 2/12/2025

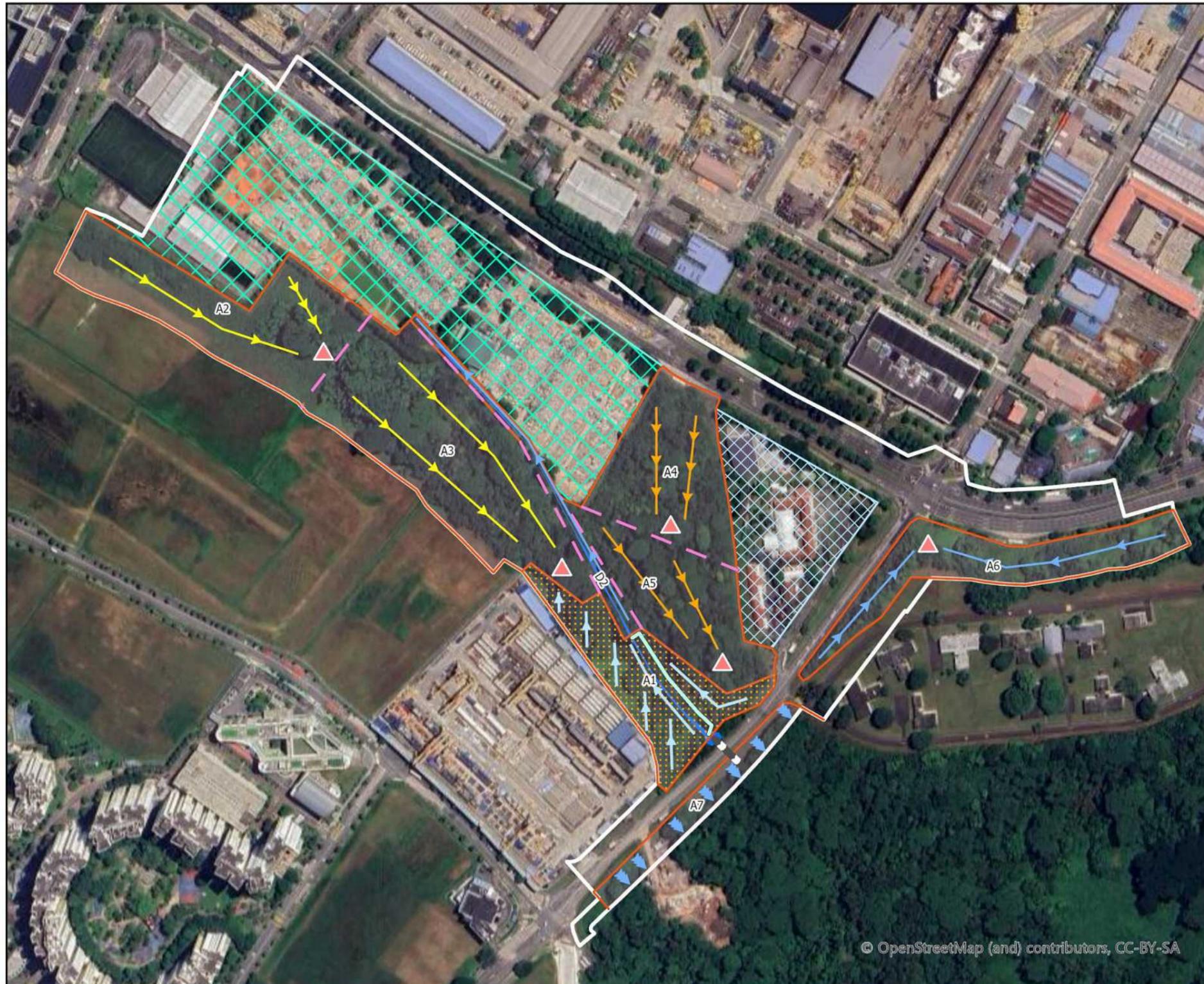
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Figure 5-5 Indicative Hoarding Plan



Legend

- Temporary Hoarding (1.8m)
- Hoarding Boundary (2.4m)
- Shepherding Area
- Semi-naturalised Canal D2
- ▲ Trapping & Translocation
- Underground Culvert
- EMMP Boundary
- Demolished Area
- Recreation Centre (partially-retained)
- Canal Diversion
- Shepherding & Canal Backfill Direction (Phase 1)
- Shepherding Direction (Phase 2)
- Shepherding & Canal Backfill Direction (Phase 3)
- Shepherding Direction (Phase 4)
- Parcel A1 C24 BTO



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Figure 5-6 Proposed Overall Wildlife Shepherding Plan



Legend

-  Phase 1 Hoarding (2.4m)
-  Shepherding Area
-  Semi-naturalised Canal D2
-  Underground Culvert
-  EMMP Boundary
-  Demolished Area
-  Recreation Centre (partially-retained)
-  Canal Diversion
-  Shepherding & Canal Backfill Direction (Phase 1)
-  Parcel A1 C24 BTO



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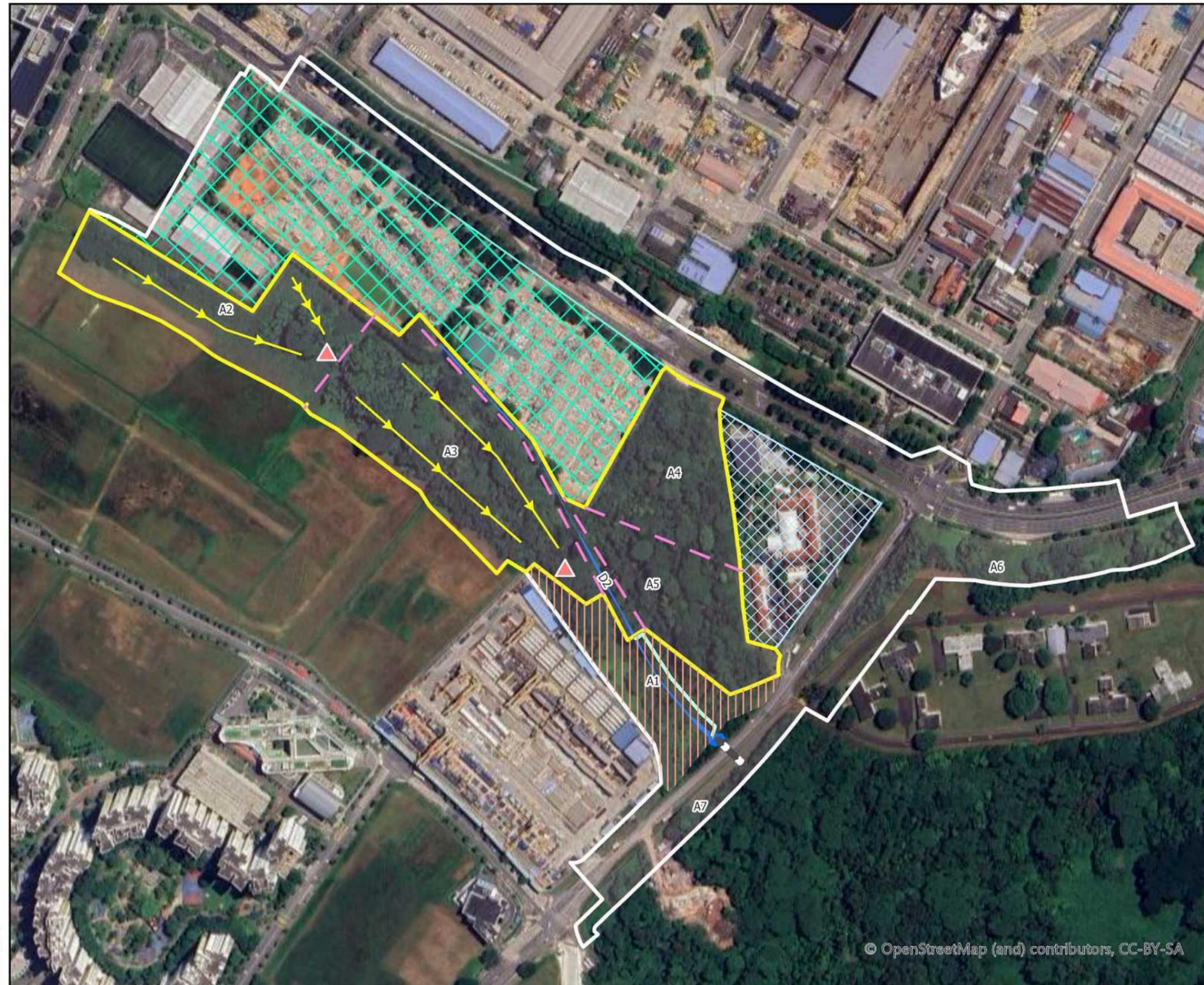
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Figure 5-7 Wildlife Shepherding Plan (Phase 1)



Legend

- Temporary Hoarding (1.8m)
- Phase 2 & 3 Hoarding (2.4m)
- Shepherding Area
- Semi-naturalised Canal D2
- Underground Culvert
- EMMP Boundary
- Demolished Area
- Recreation Centre (partially-retained)
- Canal Diversion
- Shepherding Direction (Phase 2)
- Trapping & Translocation
- Cleared Parcels



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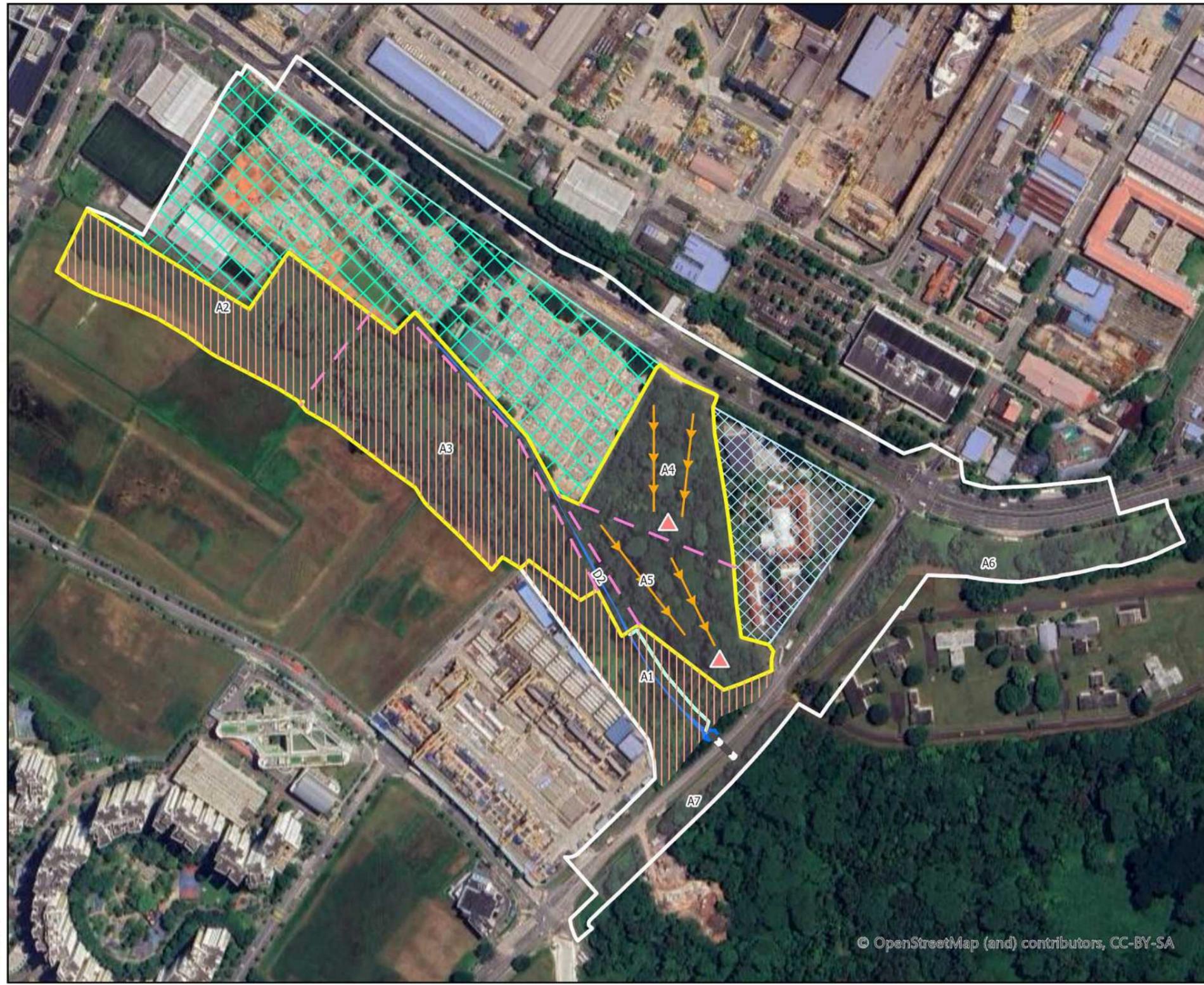
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Figure 5-8 Wildlife Shepherding Plan (Phase 2)



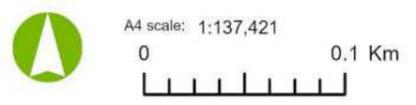
Legend

- Temporary Hoarding (1.8m)
- Phase 2 & 3 Hoarding (2.4m)
- Shepherding Area
- Semi-naturalised Canal D2
- Underground Culvert
- EMMP Boundary
- Demolished Area
- Recreation Centre (partially-retained)
- Canal Diversion
- Shepherding & Canal Backfill Direction (Phase 3)
- Trapping & Translocation
- Cleared Parcels



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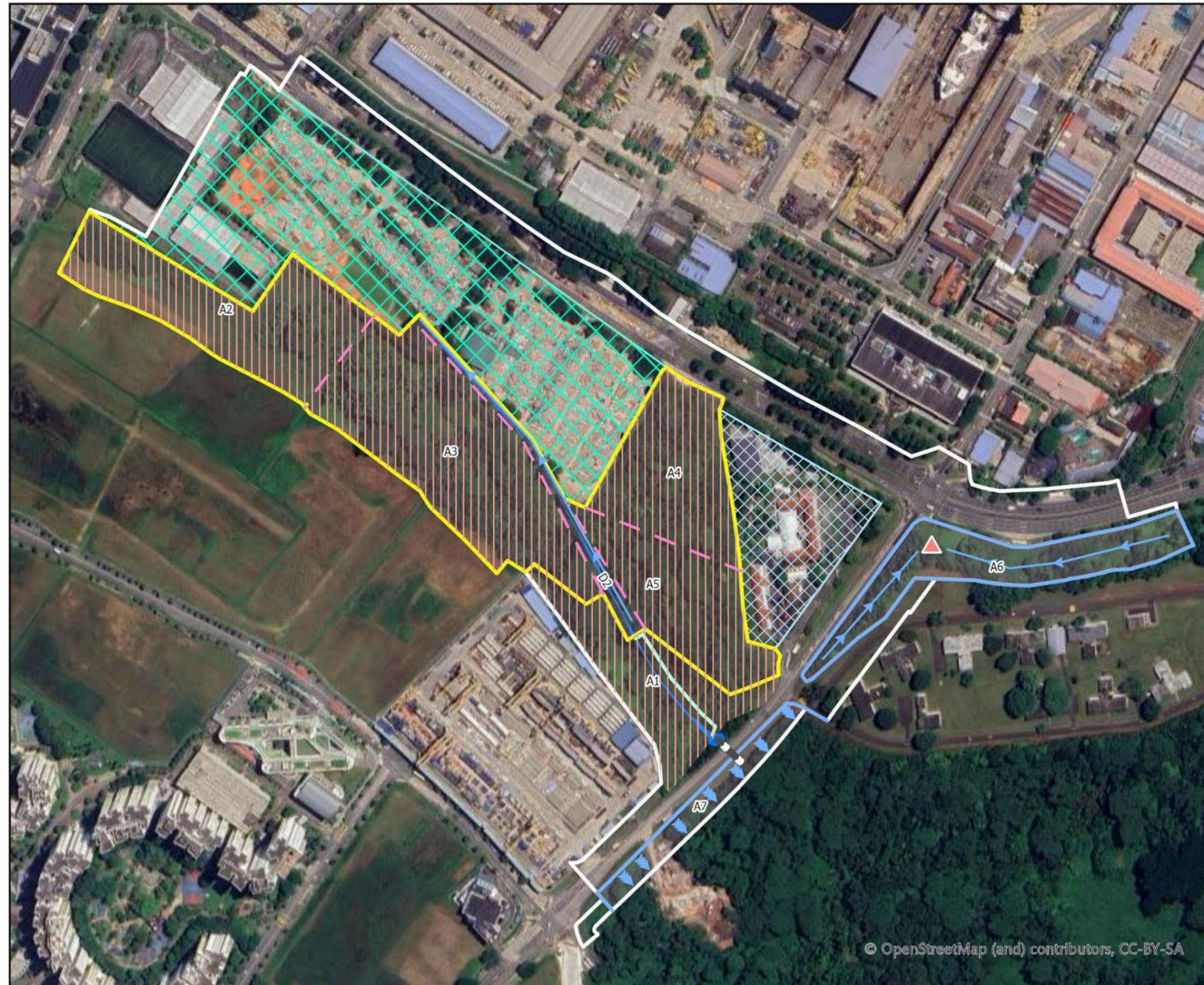
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Figure 5-9 Wildlife Shepherding Plan (Phase 3)



Legend

- Temporary Hoarding (1.8m)
- Phase 2 & 3 Hoarding (2.4m)
- Phase 4 Hoarding (2.4m)
- Shepherding Area
- Semi-naturalised Canal D2
- — ● Underground Culvert
- EMMP Boundary
- Demolished Area
- Recreation Centre (partially-retained)
- Canal Diversion
- ➔➔➔ Shepherding Direction (Phase 4)
- ▲ Trapping & Translocation
- Cleared Parcels



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0 0.1 Km

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Figure 5-10 Wildlife Shepherding Plan (Phase 4)

5.4.1.1.4 Asian Softshell Turtle Management Plan

While the EIA did not record the Asian softshell turtle (*Amyda cartilaginea*), an individual was spotted previously within canal D2 of the N4 forested area (Chen & Luqmanul, 2024). As the species is listed as Vulnerable (VU) in the Third Edition of the Singapore Red Data Book (SRDB3), there is therefore a need to formulate a species-specific management plan during site clearance and backfilling works. The detailed Wildlife Translocation Plan can be referred to in Appendix C – which details the proposed plan for relocation of the turtle, should it be encountered during the course of works.

5.4.1.1.5 Bamboo Bat Management and Mitigation Plan (if applicable)

Existing bamboo clusters on site (if any) are known to be potential bamboo bat roosts. Therefore, the engagement of approved wildlife management company certified in handling mammals is required to check for the presence of active bamboo bat roosts prior to any bamboo felling works. If an active bat roost (as indicated by the presence of bamboo bats or sonogram records) is detected in a particular bamboo cluster, appropriate relocation measures should be taken. The following mitigation measures shall be undertaken for the bamboo clusters found within the Project Site:

- Prior to any site clearance and bamboo felling, the Ecologist / Wildlife Management Specialist will first conduct roost emergence surveys between 1900hrs – 2100hrs to ascertain the presence of bamboo bats.
- The presence of bamboo bats will be ascertained using a mixture of visual inspection and call recordings (if any) via bioacoustics monitoring devices (e.g., Echo Meter Touch 2 Pro or equivalent).
- If bamboo bats are absent, the bamboo clusters to be felled shall still undergo pre-felling fauna inspections by the Ecologist.
- Should any bamboo bats be detected, an NParks-approved wildlife management company certified in handling mammals will be engaged to conduct the rescue, release and/or translocation of said bats in affected bamboo cluster(s).
- Should any trapped or injured bamboo bat(s) be encountered, the Wildlife Encounter Protocol and Wildlife Response Plan (Figure 5-10) shall be activated.
- The Ecologist/Wildlife Management Specialist and NParks-approved wildlife management company shall work with NParks to determine the best course of action.

5.4.1.1.6 Lighting Management and Mitigation Measures

A standalone Light Management Plan (LMP) [Draft LMP provided in Appendix D] for ambient and task lights will be prepared at a later stage, and its objectives are provided below:

- Artificial lights will be managed so that fauna is able to undertake critical behaviours such as foraging, reproduction and dispersal outside of the project boundary; and
- Mitigate the impacts of artificial lighting on the surrounding environment as far as reasonably practicable.

During site clearance stage, only lighting for ECM facilities is required. Public Utilities Board (PUB) requires that construction sites (> 0.2 ha) implement 24-hour continuous CCTV monitoring at the discharge outlet at the public drain or canal to monitor the surface runoff discharge. Therefore, the discharge outlet will be illuminated with white light throughout the night to provide a clear image under dark conditions. The white light will be pointed only at the discharge outlet (Figure 5-9).



Figure 5-11 Example Day Time Image and Night Time Image of ECM Discharge Outlet

For ad hoc night works, task lighting will be utilised at specific areas to create a safe workspace, and the required illuminance will vary depending on the type of activity to be undertaken. The following measures will be adopted for ad hoc night works:

- Scheduling of activities during nightworks;
- Turn off all unnecessary lights outside working hours;
- Provide at least a 10 m width dark buffer zone from the hoardings (only at the edge between construction site and forest);
- Use portable LED spotlights;
- Shine only on the objects or areas intended – keep lights close to the ground, directed, and shielded to avoid light spills;
- Ensure that lights are tilted downwards, facing away from any forest, mounted below height of hoarding as much as possible.
- Install hoardings or shields to prevent spillage of light into sensitive habitats;
- Limit the hours of lighting – only be used during specific times at specific locations and portable units with manual switching should be provided; and
- Localised control of lighting – lights should not be centralised and must be able to be switched off when not required.

5.4.1.1.7 Biodiversity Awareness Training

The Ecologist will carry out biodiversity awareness training and toolbox briefings to all site personnel prior to commencing work on-site, and regularly (every six months) throughout the duration of the construction phase.

The Ecologist will provide an account of common wildlife found on site and educate the staff on appropriate behaviour and procedures (e.g., dos and don'ts) to be taken when encountering wildlife. The Ecologist will also

supply presentation materials for the main staff to conduct subsequent workshops with new staff on their own. The training and toolbox briefing will include (but not limited to):

- Ecological value of the project site and its surroundings
- Wildlife/Fauna types present within and around the site
- Strategies to protect biodiversity
- Site personnel's responsibilities towards biodiversity
- Fauna response and rescue plan
- The laws protecting wildlife in Singapore (e.g., no feeding nor killing or poaching of wildlife)
- Roadkill prevention
- Pre-felling inspection of trees for wildlife

The Ecologist will conduct 6-monthly fauna orientation workshop for all site personnel, who will undergo said training and maintain relevant documentation. The Wildlife Response Plan (Figure 5-10) procedure shall be followed if there is any sighting of entrapped wildlife. Similarly, the appointed ECO and the EMMP consultant shall be notified immediately. Subsequently, NParks will also be informed. Refer to Appendix B for the Biodiversity Awareness Training Deck.

To ensure effective implementation of mitigation and monitoring measures, all relevant construction personnel (i.e., Project Manager, Construction Manager, EMMP In-charge, ECO, Site Supervisor, Foreman, Construction Worker Team Leader, etc.) will be made aware of the EMMP requirements prior to commencement of on-site work. The Contractor shall ensure that trainings are conducted before starting the construction work and at a regular interval during construction phase for the site personnel. Every training session shall be documented and reported as part of best practices. The recommended training program is provided in Table 5-7.

Table 5-7 Training Programme for Site Personnel

Training Schedule	Training Topics	Conducted by	Target Audience	Frequency
Prior to commencement of activities on site	EMMP requirements & Biodiversity Awareness Training	EMMP Consultant	Environmental Manager/ ECO/ Project Manager / Construction Manager/ Construction Engineers/ Site Supervisors/ Sub-contractors	Once
Refresher training	Biodiversity Awareness Training	Contractor's EMMP In-charge / ECO	Site Personnel including Sub-contractor	Every six months during construction phase
Toolbox	Briefing to include reminders on wildlife encounters and environmental protection	Contractor's EMMP In-charge / ECO	Construction Workers	Daily

5.4.1.1.8 Wildlife Encounter Protocol for Specific Animals

Table 5-8 below shows the summary of recommendations to be implemented for encounter of specific animals (live):

Table 5-8 Wildlife Encounter for Specific Animals

Animal Encounter	Procedure
<ul style="list-style-type: none"> ■ Bird nest ■ Beehive 	<ul style="list-style-type: none"> ■ Do not start work if there is a bird nest with eggs or chicks and beehive in the immediate vicinity of site clearance. ■ Keep a safe distance and refrain from disturbing the bird nest/beehive. ■ Site supervisor to inform CEMMP Consultant for further action.
<ul style="list-style-type: none"> ■ Wild boars 	<ul style="list-style-type: none"> ■ Be calm and move slowly away from the animal. Do not approach or attempt to feed the animal. ■ Keep a safe distance, do not provoke the animal (e.g., using flashlight) ■ If encounter adults with young piglets, leave them alone. They are potentially more dangerous because they may attempt to defend their young. ■ If the wild boar is running towards you, move out of the way immediately. ■ Refer to Section 5.4.1.1.9 if wild boar is sighted within the Project site.
<ul style="list-style-type: none"> ■ Macaques 	<ul style="list-style-type: none"> ■ Stop work (only at the immediate vicinity) if monkeys approach during work. ■ Do not make sudden movements and do not maintain direct eye contact with the monkeys. ■ If site personnel are holding an object which is attracting the monkeys, conceal or discard it. ■ Resume work after the monkeys have left.
<ul style="list-style-type: none"> ■ Snakes 	<ul style="list-style-type: none"> ■ Stop work (only at the immediate vicinity) if a snake is sighted. ■ Do not attack with any object. ■ Do not confront the snake and keep a safe distance away from the snake. ■ The snake may try to look for dark and secure areas and site personnel shall observe where it hides, inform the site supervisor only if the snake is hiding within the immediate vicinity of construction works. ■ Site supervisor to inform CEMMP Consultant for further action. ■ If the snake is still in the immediate vicinity of the construction site and disruptive to the work, Contractor shall arrange a licensed wildlife management company to relocate the snake. ■ If site personnel are bitten by a snake, do not chase after the snake. Take a photo of the snake, if possible, inform site supervisor and seek medical care immediately. ■ Resume work after the immediate site is cleared of snakes.
<ul style="list-style-type: none"> ■ Bats 	<ul style="list-style-type: none"> ■ Where there is bamboo of culm more than 3cm in width to be felled, inspection shall be done to observe for bamboo bats. These bats may roost within the internodes which they enter through a slit visible externally on the bamboo culm. ■ Manual removal of bamboo culms with a chainsaw or hand saw is preferred and all cuts shall be made as close to the ground as possible. Care shall be taken during vegetation clearance, and no excavator shall be used. The individual bamboo culms shall be lowered in a controlled manner and checked for slits. ■ Bamboo culms with identified slits will be set aside, under shade, for the duration of bamboo felling. If stalks are too long to be managed, cross sectional cuts can be made as close to the node as possible. ■ At the end of felling operations, all bamboo culms with slits will be transported to the next nearest bamboo cluster unaffected by ongoing works, identified beforehand and propped against the unaffected bamboo cluster. All slits observed on the bamboo culms shall be placed furthest away from ground level and facing outwards. ■ If any trapped/injured/dead bats are observed during the bamboo felling operation, an approved wildlife management company (a registry is available at www.nparks.gov.sg/avs/animals/animal-related-businesses/animal-management-

Animal Encounter	Procedure
	<p>companies/public-registry-of-certified-animal-management-specialists) must be engaged to safely relocate or remove the bats from site.</p>
<ul style="list-style-type: none"> ■ Stray dogs ■ Stray cats 	<ul style="list-style-type: none"> ■ Do not guide the dog / cat out from the site. ■ Do not allow the dog / cat to flee from the site. ■ Supervisor / ECO to call Wildlife Management Contractor to capture the dogs / cats and surrender to NParks Animal Management Centre (AMC), 57 Sungei Tengah Road , S699013 immediately during operating hours (https://www.nparks.gov.sg/avs/who-we-are/our-centres/animal-management-centre). ■ If the company cannot deliver during AMC’s operating hours, they must have a suitable safe and sheltered location to hold the animal. Food and clean drinking water must be provided to the animal. ■ Supervisor / ECO to inform CEMMP Consultant. ■ CEMMP Consultant to notify NParks Animal Response at 1800-476-1600 and via online feedback form at https://www.nparks.gov.sg/avs/feedback.
<ul style="list-style-type: none"> ■ Otters and/or crocodiles 	<ul style="list-style-type: none"> ■ Where otters and/or crocodiles are sighted where works are to be carried out (whether at the Site or in the vicinity of the Site), the Contractor must ensure that the works are halted until the animals have passed or are no longer in the vicinity of the Site. Also, the Contractor must ensure that all visitors to the Site, and all consultants, employees and staff (including all construction workers who are working on the Project) are aware of this requirement. ■ Wildlife must not be disturbed at any time and not interacted with unless in an emergency.
<ul style="list-style-type: none"> ■ Asiatic softshell turtle 	<ul style="list-style-type: none"> ■ Should the Asian softshell turtle(s) be encountered where works are to be carried out (particularly during the backfilling of canal D2), the Contractor must ensure that the works are halted until the NParks-certified Wildlife Management Contractor has successfully trapped and translocated the individual before works can resume. ■ Refer to the Asian Softshell Turtle Management Plan for more details.
<ul style="list-style-type: none"> ■ Other animals 	<ul style="list-style-type: none"> ■ Do not be alarmed. ■ Most animals are shy and will not attack human. ■ Do not touch, chase or corner them. ■ Refer to Section 5.4.1.1.9 if animal cannot be guided out safely/flee away from the site.

5.4.1.1.9 Wildlife Response Plan

The Wildlife Response Plan will be activated whenever a trapped, injured, dead, or dangerous animal is found in or around the worksite. The main aim of this plan is to reduce animal injury and mortality by responding appropriately to various scenarios as illustrated in Figure 5-12. This will be highlighted during toolbox briefings. All wildlife incidents shall be reported and recorded using a Wildlife Incident Form [Appendix E].

Wildlife Response Plan

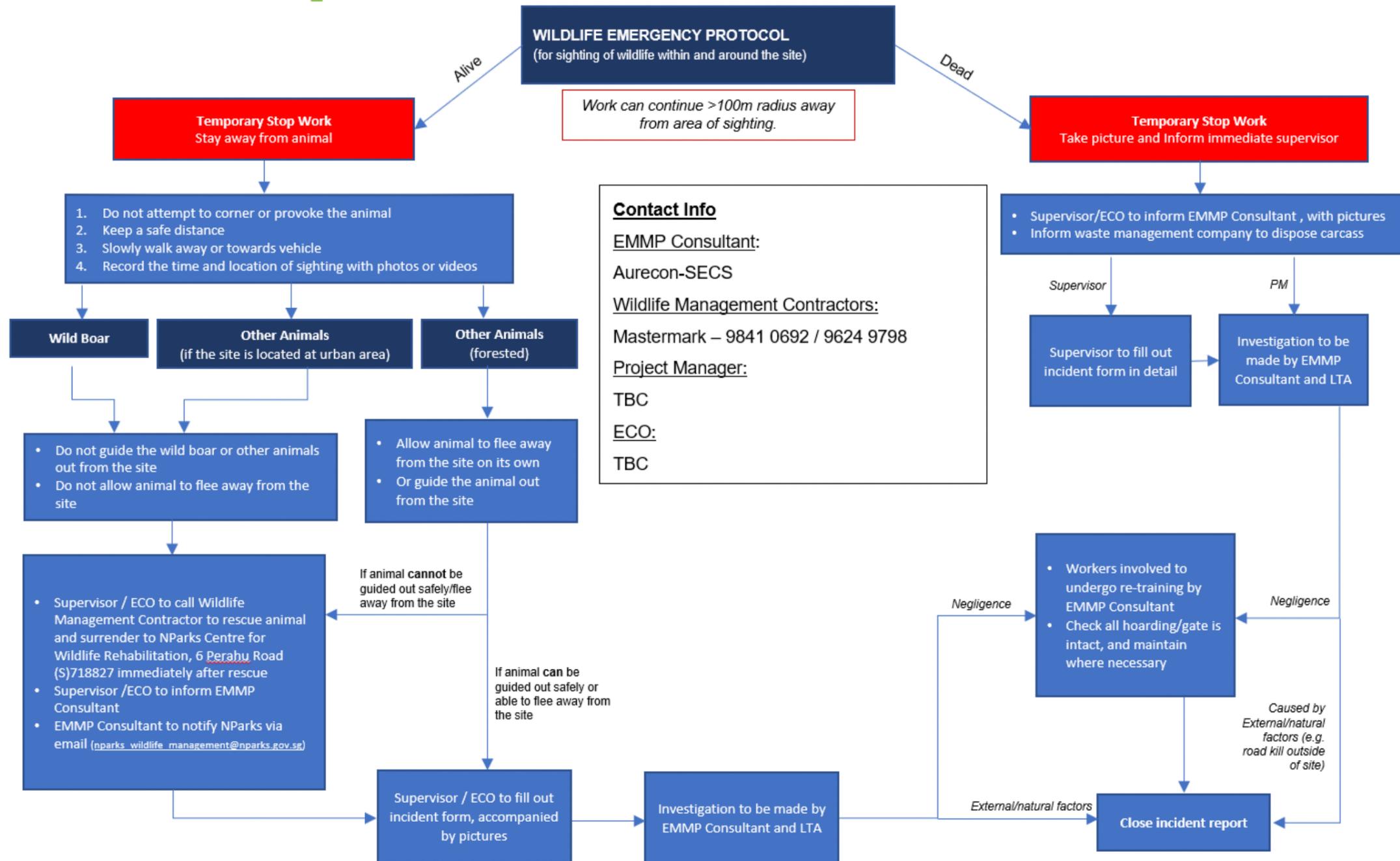


Figure 5-12 Wildlife Response Plan and Flowchart

5.4.1.1.10 Other General Biodiversity Mitigation Measures

Apart from the above-mentioned measures, the Contractor shall also be responsible in implementing the other general biodiversity management measures which include:

- The Contractor shall implement and adhere to all mitigation measures recommended by the Arborist, Flora Specialist, and Ecologist, as far as practicable, and where feasible.
- The Contractor shall conduct daily visual inspections of the worksite for wildlife prior to the start of construction activities.
- The Contractor shall maintain and ensure the integrity of the worksite hoarding by repairing any reported damages/breaches on a timely basis.
- Upon encountering trapped/injured/dead/dangerous fauna, the Contractor shall respond in accordance with the Fauna Response and Rescue Plan.
- The Contractor shall ensure that all personnel and external visitors limit their movements and activities (including non-work activities such as resting and eating) to within the worksite boundary. There shall be strictly no movements into adjacent forested areas.
- Graphical representations of but not limited to the following shall be posted around the worksite:
 - No feeding of wildlife
 - No fishing
 - No littering
 - No food or drinks (outside designated eating areas)
 - No cutting of trees or plants
 - No smoking (outside designated smoking areas)
- The Contractor shall procure and deploy only 100% biodegradable erosion control blankets.
- The Contractor shall construct and maintain designated sheltered eating areas that are wildlife proof.
- The Contractor shall procure and deploy fully covered and wildlife-proof food storage areas including wildlife-proof refuse bins.
- The Contractor shall ensure that all pits, drains, ponds, trenches, tanks that are potential fauna entrapments are suitably covered (e.g., using plywood, mesh, tarpaulin) to prevent fauna from falling in.
- The Contractor shall conduct periodical checks and trim overhanging vegetation above the worksite hoarding to prevent arboreal fauna from entering the worksite (if applicable).
- The Contractor shall instil discipline and raise awareness amongst all personnel on measures and mitigations to prevent damage to retained and protected trees throughout construction by including reminders on tree conservation guidelines within their daily toolbox briefings to workers and crane/excavator operators.
- Exposed/unused land areas shall be returned to earth ground and properly treated by compaction, turfing, vegetation planting or sealing with bituminous materials, concrete or other suitable materials as soon as practicable after site clearance, as instructed by the development agency / SLA. Turfed land will also reduce surface runoff, sedimentation/siltation, and erosion to adjacent sites.

5.4.1.2 Flora/Arboriculture Management Plan

5.4.1.2.1 Pre-site Clearance Salvaging of Identified Species of Conservation Significance

During the pre-site clearance period, the Arborist shall work with NParks in identifying species of conservation significance found within the work site, that are viable for salvaging (i.e., specimens with girth size of < 0.3 m). Salvaging procedures should be carried out prior to site clearance, where applicable and if necessary.

In the pre-construction phase, the Flora Specialist will help identify conservation-significant species (CS species) that have a girth size of less than 0.3 m and are suitable for salvaging. The Flora Specialist will collaborate with NParks to ensure the identification of viable specimens for this process.

5.4.1.2.2 Site Clearance and Tree Felling

The Arborist will review the Contractor's method statement for site clearance, tree felling, and the establishment of TPZs (if any) to ensure it meets the required specifications. The method statements for site clearance and tree removal shall incorporate directional felling techniques using a hinge and back cut. Trees should not be removed by pushing with an excavator or any other heavy equipment. Instead, cranes will be used to offset the tension on the trunks in the direction of the intended fall. In addition, any interlocking canopy branches must be pruned before the trees are felled.

- Tree felling method statements, where feasible, shall involve directional felling methods that utilize hinge and back cutting.
- Tree removal via pushing by excavator shall not be permitted, unless stated otherwise by technical and/or development agencies.
- Where necessary, cranes shall be deployed offset trunk tension with reference to the felling direction.
- Trees exhibiting interlocking canopies shall be pruned prior to felling.

When design changes have the potential to impact additional trees or those designated for retention, the Arborist will collaborate with the structural engineers to propose solutions that adhere to NParks' Guidelines on Greenery Provision and Tree Conservation for Developments. Whenever feasible, cleared vegetation, especially in sloped areas, should be covered with 100% biodegradable, fauna-friendly ECBs to mitigate soil erosion. The bare ground will be revegetated promptly to stabilize the surfaces and reduce dust re-entrainment, as well as the risk of erosion of waste materials into watercourses.

Clearance activities on-site will be prohibited during rainfall or when storm events are forecast in the vicinity to protect the forest edge from wind throw. In cases where forest edges are vulnerable to wind, the Arborist will collaborate on implementing temporary measures, such as additional hoardings, to provide protection during storm events. Careful consideration will be given to the removal of trees in riparian zones to minimize impacts on the bed and banks of waterways. Whenever possible, saplings, seeds, and seed banks will be preserved within the soil profiles for future forest restoration efforts.

Horticultural waste arising from tree felling and site clearance works shall be cleared on the same day. The latter is crucial as the pile-up of horticultural waste can potentially become a refuge and attract fauna if left uncleared overnight. The Contractor and the attending Arborist shall adhere to the stipulated guidelines for tree protection and conservation.

5.4.1.2.3 Tree Mapping and Assessment

The ISA-certified Arborist shall carry out tree inspection works for trees within 5m of the Project Area boundary. The Arborist will first conduct a tree inception survey before construction starts to establish a baseline for trees within the Project Area, adopting ISA TRAQ Level 1 Assessment. All trees with a girth of 1m and above will be assessed, and any smaller trees with 0.3m girth and above of high conservation value (vulnerable status and above according to SRDB3).

The Arborist shall conduct the tagging of trees (with unique identifiers) within the overall work boundary, as well as trees situated along construction access roads. The GPS coordinates of the trees inspected will be captured using a Differential-GPS (dGPS) device for sub-meter accuracy, and mapped onto Google Earth to produce a KML file. The trees will also be tagged with labels and photographed as part of the Tree Inception Survey Report. The tree data recorded are as follows:

- Tree Bio-Data (ID, Botanical name, girth height, crown diameter etc.);
- Tagging and assessment of tree species that are identified to be of conservation significance – species listed in Lindsay et al. (2022) as Nationally Vulnerable, Endangered, Critically Endangered or Presumed Extinct – with ≥ 0.3 m girth or spread.
- Assessment of the physiological health, presence of pests or diseases and structural stability of all trees, including single-stemmed palms and strangling Ficus species of ≥ 1.0 m girth or spread.
- Conservation status and spatial coordinates of the trees
- Photographic documentation to be appended in the Arborist's report.
- Assessment of trees to be retained or felled shall be reviewed by the Arborist.
- It is to be noted that no trees shall be felled without the prior approval from NParks.

The updated Arborist's report (including the tree protection and management plan detailed the in following section) shall reference the trees to be felled and retained within the tree felling plan provided by the QP and will be appended to this EMMP as an update when available.

Additionally, due to the expansion of the project boundary for CBP wall works – specifically the forested area bounded by Admiralty Road West and Bermuda Road (part of parcel A6; Figure 5-6) – there is therefore a need to conduct tree mapping surveys for said expansion area. The preliminary tree list for the expansion area will be sent to NParks and will be incorporated into the overall Arborist's report, to facilitate the QP's tree felling plan for DC submission. The standard biodiversity mitigation measures (i.e. pre-felling inspections and plant salvaging, if applicable) shall also be implemented for the expansion area.

5.4.1.2.4 Tree Protection and Management Plan

It is to be noted that a full site clearance is expected for this project, and as such, there are no trees to be retained. The Arborist shall therefore only be activated if additional site clearance is necessitated, or if the felling of trees outside the project boundary is required. Nonetheless, the following sections on tree protection and management are included for reference.

The Arborist shall propose tree protection, management, maintenance or care plans for identified retained trees (if any) to adhere to NParks' Guidelines on Greenery Provision and Tree Conservation for Developments (i.e., tree care, pruning and TPZs; NParks, 2018).

- This includes the formulation of tree maintenance or care plans that involve subsequent remediation upon identification of issues (i.e., diseased trees, disease outbreaks etc.)
- The implementation of remediation measures such as herbicides or pesticides, while permitted, should be kept to a minimum. The affected plants can also be quarantined and removed from the site if necessary.

The Arborist shall plan and carry out tree transplanting and sapling harvesting where necessary and feasible. Where trees and vegetation are moved or translocated within the relevant work area, the Arborist shall review

the method statement proposed by the tree transplanting Contractor and advise on additional recommendations necessary to ensure tree health (and its continued survival) during and after transplanting.

5.4.1.2.5 Post-hoarding Worksite Footprint Verification and Review

Upon completion of hoarding installation, the Arborist and/or EMMP Consultant shall conduct a site inspection to verify that the hoarding line complies with the proposed footprint, with no excessive encroachment nor intrusion into surrounding areas. To further inspect and verify if additional trees or vegetation are cleared due to deviations of the hoarding line.

Once the worksite hoarding is in place, the Flora Specialist will carry out an inspection to confirm that the footprint is as planned and that no excessive vegetation or tree removal has occurred due to any misalignments in the hoarding. The Flora Specialist will also assess the proposed locations for soil investigation (SI) works and the alignment of construction access roads in conjunction with the Client or Contractor. If feasible, alternatives will be suggested to minimize the clearance of vegetation and trees. Before any vegetation clearing is conducted for SI, the Flora Specialist will assist in identifying suitable CS species for salvaging, as outlined in the EIA. Additionally, pre-site clearance fauna inspections will be conducted, and fauna inspections will also take place during the SI works.

5.4.1.2.6 Weed and Invasive Species Management

The EMMP Consultant shall recommend and assist in implementing the removal and management of weeds and invasive species within the worksite, where practicable and applicable. Worksite shall be inspected and cleared of any weeds or invasive species regularly (i.e., via approved herbicides and/or hand weeding). Transport of horticultural waste or matter shall be disposed of properly at a licensed waste disposal facility.

5.4.2 Biodiversity Construction Monitoring

5.4.2.1 Fauna Monitoring

Upon completion of the wildlife shepherding, monthly inspection of fauna management and mitigation measures will be included in the Monthly EMMP Report until the end of construction. The following shall be noted during the inspections:

- Daily checks by ECO will be conducted on site for trapped fauna and roadkill
- Presence of trapped/injured/dead fauna
- Potential fauna entrapments (e.g., ECBs, 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
- Use of 100% biodegradable ECBs to prevent snake entrapment

5.4.2.2 Flora Monitoring

The flora monitoring regime during the construction phase should include the following:

- Monthly flora inspections shall be conducted within the Project boundary and in forested areas with a 15m buffer from the hoarding (where applicable & practicable)
- Identification of any unauthorised removal of flora within areas of conservation or outside the designated Project worksite (where applicable & practicable)
- Identification of both direct and indirect effects on vulnerable vegetation and habitats. These effects encompass soil erosion and degradation caused by construction activities, as well as the unauthorized disposal of waste materials, construction debris, or leaks of oil and chemicals.
- Identification of forest edge effects and recommendation of mitigation measures where necessary.
- Evaluation of the current situation regarding invasive plant species and weeds, along with recommendations for their removal when needed. Examination of previously cleared areas for any signs of invasive species seedlings.
- Monitoring of the health of all retained and planted flora, including identification of diseases and recommendations for treatment

5.4.2.3 Arboriculture Monitoring (if applicable)

It is to be noted that a full site clearance is expected for the N4 Forested Area within the project boundary, and as such, there are no trees to be retained, and there will be no newly formed forest edge as a result of the clearance. Monthly arboriculture monitoring, if deemed necessary by the Arborist (or otherwise instructed by Authority), for trees outside of the N4 Forested Area and retained roadside trees (if any) will be conducted, if applicable and practicable. Otherwise, the Arborist shall be activated if additional site clearance is necessitated, or if the felling of additional trees outside the project boundary is required. Nonetheless, the following sections on arboriculture monitoring are included for reference.

The Arborist will inspect and monitor the retained trees on site (if any). Trees to be retained shall have a TPZ around them. When a tree or vegetation exhibits signs of stress, the Arborist will inspect the tree or vegetation and advise on measures to further reduce impacts and rehabilitation or rectification measures. The Contractor (including the Tree Felling Subcontractor) will need to carry out the rehabilitation or rectification measures within a week (7 working days), barring special circumstances where materials or equipment need to be delivered. After the rehabilitation or rectifications measures have been carried out, the tree health shall be monitored to see if there is any improvement, and the findings will be incorporated into the Monthly EMMP Report.

5.4.2.3.1 Retained Trees (if applicable)

During the construction stage, the Arborist will continue to monitor the retained trees identified (if any) in the Tree Inception Survey Report via monthly site inspections where applicable and if necessary. The resultant monthly report produced will be incorporated into the Monthly EMMP Report, and includes the above-mentioned tree data, checks on the Tree Protection Zone (TPZ), and recommendations on any mitigation/remedy measures necessary for trees based on the site inspection, where applicable and if necessary.

The Arborist is to conduct regular inspection of the surrounding trees and TPZs at the edge of Project boundary, where applicable and if deemed necessary. The Arborist is to assess and determine the health of the trees and should any action be necessary. This includes and is not limited to determining if the tree crown might pose a threat to the hoardings, or if the climbers on the hoarding are to be removed. The condition of

the TPZs shall also be assessed, and recommendations be made should any remediation be needed. Table 6-8 below lists parameters which the arborist will inspect.

Photos of each tree are to be included in the Monthly EMMP Report, where applicable and relevant. Past or current maintenance activities will also be reflected in the report (such as last tree pruning date) during the development period.

Table 5-9 Parameters for Monthly Tree Inspections (for retained trees)

Tree Health and Bio-Data	TPZ Condition
Foliage colour (Normal, Chlorotic, Necrotic)	TPZ barriers installed/good condition
Foliage density (Normal, Sparse)	Potential signs of Illegal Encroachment
Leaf size (Normal, Small)	Potential signs of Damage to Tree
Epicormic shoots (Yes, No)	Potential signs of Toxic Splash
Twig dieback (Yes, No)	Potential signs of Illegal Compaction
Wound wood roll development (Good, Average, Poor, None)	Potential signs of Materials Storage
Vigour (Good, Average, Poor)	Potential signs of Machinery, Equipment, and Vehicle Storage
Pests/Diseases (Yes, No)	

5.4.2.3.2 Monthly Tree Monitoring (if applicable; for retained trees)

The Arborist will perform the following tasks during the monthly tree inspection where applicable and if necessary:

- **Tree Condition Monitoring:** Monitor the condition of trees at the new forest edge to assess their physiological health and structural stability. This is crucial as edge effects can lead to canopy dieback as well as branch and structural failures.
- **Method Statement Review:** Review the method statements associated with construction activities near retained trees to evaluate whether additional tree removals are needed following site clearance.
- **Recommendation of Solutions:** Propose solutions in cases where there are conflicts with the proposed works, including design changes, reductions in working space, modifications to the TPZ (if any), and reassessment of the impacted trees.
- **Health and Stability Assessment:** Evaluate the physiological health, vigour, and structural stability of retained trees. Recommend any additional mitigation measures if deemed necessary.
- **Condition Assessment of Retained Trees:** Check the condition of retained trees to ensure there has been no deterioration or mechanical damage and determine if additional tree removal is required.
- **Stress Inspection:** Inspect trees that display signs of stress and provide advice on strategies to mitigate further impacts and implement rehabilitation measures. If monitoring indicates drying out or edge impacts, immediate remediation measures will be carried out, such as providing supplemental watering during dry spells (e.g., seven (7) consecutive days without rainfall). Long-term solutions will also be investigated and implemented.
- **Disease Management:** If tree disease outbreaks are detected, the Arborist will recommend necessary management measures as part of the ongoing tree maintenance and care.
- **TPZ Integrity Inspection:** Conduct inspections to ensure the integrity of the TPZs is maintained and that they continue to provide effective protection for retained trees.

5.5 Airborne Noise

5.5.1 Airborne Noise Pre-construction Baseline

As recommended in the EIA (AECOM, 2024), the Contractor shall refer to the EIA pre-construction baseline results (Table 5-10) to calculate and establish the Project criteria by deriving a background noise correction factor to establish the maximum permitted noise level in accordance with the noise legislation stated in Environmental Protection and Management (Control of Noise at Construction Sites) Regulations (2008), which will be applied for construction works in all stages.

Table 5-10 Airborne Noise Baseline Levels during EIA (AECOM, 2024)

Location	Monitoring Date	LAeq(12hrs), dB(A)		LAeq(1hr), dB(A)						LAeq(5mins), dB(A)								
		7am-7pm	7pm-7am	7pm-10pm			10pm-7am			7am-7pm			7pm-10pm			10pm-7am		
				Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
Overall (Mon-Sun/PH) – Applicable to Ecological Receptors																		
NM01	8 – 15 Aug 2023	54	44	43	55	45	51	48	44	42	78	50	41	61	45	40	51	43

5.5.2 Airborne Noise Construction Monitoring

The main causes of noise pollution are likely to come from earthworks and foundation works (piling works) and vehicular movement. The use of high-impact stationary and mobile equipment (e.g., excavators, piling rig and dump trucks) might cause spikes in the noise level around the surrounding areas. The airborne noise monitoring data at the single proposed location (NM01; Figure 5-11) will be compared against the pre-construction baseline data and adjusted guideline limits stipulated by Environmental Protection and Management (Control of Noise at Construction Sites) Regulations (2008) and the Airborne Noise EQO to determine the impact of construction noise on the nearby NSRs. The locations of noise meters may be shifted due to site-specific conditions and construction work phases. The latest locations will be updated in the Monthly EMMP Reports, if necessary.

Table 5-11 Airborne Noise Limits for Ecological Receptors – N5 Forested Area (AECOM, 2024)

Ecological Receptor	LAeq(12hrs), dB(A)		LAeq(1hr), dB(A)		LAeq(5mins), dB(A)		
	7am-7pm	7pm-7am	7pm-10pm	10pm-7am	7am-7pm	7pm-10pm	10pm-7am
Overall (Mon-Sun/PH) – Applicable to Ecological Receptors							
N5 Forested Area	54	44	45	44	50	45	43

5.5.2.1 Airborne Noise EQO

The permissible limits for airborne noise levels shall adhere to the adjusted limits based on the baseline noise monitoring results, as well as the NEA-approved noise management plan submitted by the Contractor's Noise Specialist. For any exceedance of permissible limits, the Contractor shall investigate the causes of exceedance and take immediate steps to address the sources of pollution. On-site visual inspection of noise mitigation

measures will be conducted during the entire construction phase. The response plan for exceedances in airborne noise limits in Figure 5-15 shall be implemented.

5.5.3 Airborne Noise Management and Mitigation Plans

Key mitigation measures are summarised in the pointers below. The full mitigation measures and minimum controls are detailed in the EMMP register table (Table 6-1).

- Label all machinery and equipment with a weather-proof sticker clearly indicating its noise emission level (at source) under normal operating conditions.
- Consider implementing staggered building heights to minimise the duration of noisy activities close to sensitive receptors.
- Ensure that access routes do not directly face these NSRs.
- Employ equipment and machinery that operates at lower noise levels (i.e. sound-reduced) as far as practicable.
- Conduct trainings and briefings on quieter work techniques for machine operators.
- Noise barriers of 6m height (hoarding + noise barrier top up to required height) to be deployed at the locations shown in Figure 5-13 and Figure 5-14.
 - The perimeter noise barriers shall have STC 20dB properties (NEA, 2024)
 - No additional vegetation clearance shall be conducted for noise barrier installation
- Additionally, the following mitigation measures shall be employed:
 - Noise curtain(s) containing sound absorbing material (STC 15)
 - Plant, machine noise and rotary head enclosures
 - Acoustic silencer(s) or muffler(s)
 - Vibration absorption, isolation or damping device(s)
- Use low-speed limits, speed bumps, and signage indicating speed limits at drop-off points and parking areas to reduce noise from increased road traffic.
- Explore alternative locations for roads to keep them away from areas with NSRs.
- Limit construction working hours involving noisy machinery to within daylight hours (i.e. 0800hrs to 1800hrs) and minimise noise generating construction activities and the use of noisy machinery during night works, as far as practicable.
- Where practicable and feasible, brief all site personnel to avoid shouting, whistling, sirens, or similar loud intermittent noises, particularly at construction zones near the N5 Forested Area, which has been identified as an ecologically sensitive receptors that can potentially be impacted by such disturbances.
- Establish a Noise Management Plan (to be provided by the contractor when onboarded).



Figure 5-13 Photo Showing Sample Hoarding + Noise Barrier (top up to 6m) Setup



aurecon



Legend

-  Hoarding Boundary (2.4m)
-  Semi-naturalised Canal D2
-  Underground Culvert
-  EMMP Boundary
-  Demolished Area
-  Recreation Centre (partially-retained)
-  Noise Barrier (6m)
-  Noise Meter

Author: SC



A4 scale: 1:137,421
0 0.1 Km

Project Code: P529383
Coordinate System: SVY 21

© OpenStreetMap (and) contributors, CC-BY-SA

Date: 1/12/2025

P529383 EMMP at Sembawang N4 EMMP Report

Figure 5-14 Indicative Airborne Noise Baseline and Monitoring Locations and Proposed Locations for Noise Barriers

5.5.3.1 Response Plan for Relevant Airborne Noise Incidents

If excessive noise levels are detected at the Project site, the Contractor shall follow the procedures as shown in Figure 8-4. All incidents shall be reported and documented in an Environmental Incident Form [Appendix F]. The report shall be submitted to the S.O. Rep by the ECO or CEMMP Consultant.

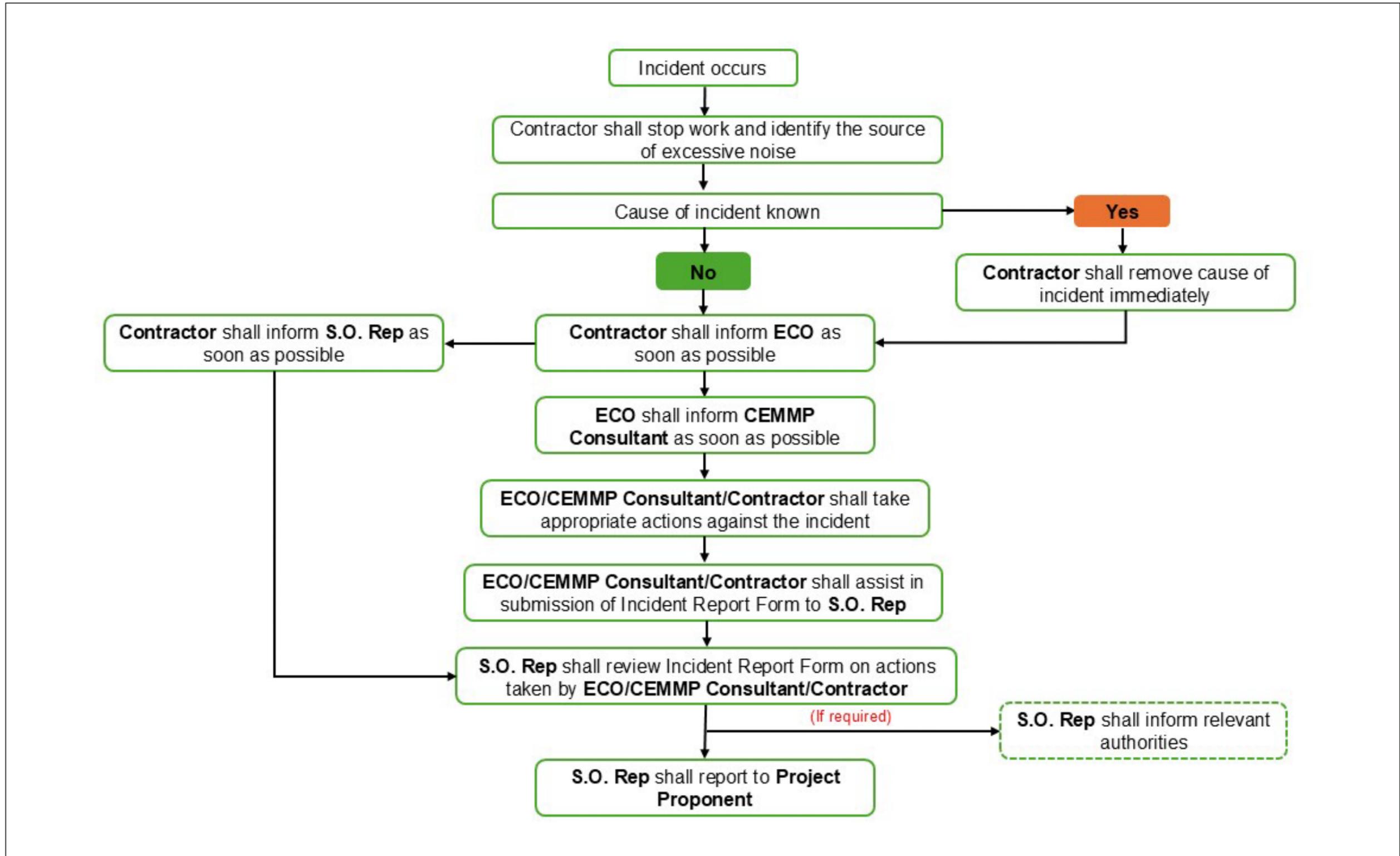


Figure 5-15 Response Plan for Airborne Noise Incidents

5.6 Water Quality

5.6.1 Water Quality Monitoring

During the construction phase, water quality monitoring will be conducted at all discharge points monthly. Continuous Total Suspended Solids (TSS) monitoring and CCTV including a Silt Imagery Detection System (SIDS) will be implemented at the final discharge point(s) of ECM to ensure the concentration of TSS is < 50 mg/L before being discharged into public drainage.

In-situ measurements will be conducted on site using a multi-parameter probe. The probe will be placed within the waterbody (1 m from water surface) to obtain readings. For ex-situ sampling, grab sampling will be done to collect samples into sampling bottles provided by the laboratory which will then be stored in ice and sent to the SAC-SINGLAS accredited laboratory for analysis.

5.6.1.1 Water Quality EQO

The water quality results will be compared with NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse, the International Aquatic Life Criteria from other countries (i.e. United States (USEPA), Australia & New Zealand, Canada, Philippines, and Malaysia), The parameters to be tested for and EQOs shall follow that of Table 5-12. In the event that water quality exceedances are detected, the response plan in Figure 5-14 will be followed.

Separately, if (i) any flooding or clogging issues are observed on site, (ii) complaints are reported due to Project activities or (iii) If visual noncompliance to any of mitigation measures are observed on-site, the response plan shall be implemented as well.

5.6.2 Water Quality Management and Mitigation Plans

- Direct clean water towards ecologically sensitive watercourses/bodies that are significantly affected by catchment loss (such as pond D4, natural stream D7, and earth drain D14).
- Ensure that no discharges occur from the construction site into the retained ecologically sensitive watercourses/bodies (including D1, D7 and D14).
- Construct a berm or an equivalent structure upstream of the tributary feeding into natural stream D1 and earth drain D14 before starting any construction activities (such as backfilling).
- Complete drainage diversion construction before it connects with natural stream D7.
- Install silt curtains or similar measures when linking natural stream D7 to the drain diversion.
- Cover all exposed and erosion-prone surfaces as quickly as possible once work is finished or if heavy rain is expected, and work shall be paused. This indicates that tarp or other protective materials shall be readily available next to any bare soil.
- Direct clean water into the retained ecologically sensitive watercourses/bodies experiencing significant catchment loss (like pond D4, natural stream D7, and earth drain D14) to enhance the flow into these areas.

Table 5-12 Water Quality Parameters and Guideline Limits

Parameters	Unit	NEA Trade Effluent Limits (controlled watercourse)	International Aquatic Life Criteria ¹
In-situ			
Temperature	°C	45	-
pH	-	6 – 9	6 – 9
Conductivity	µS/cm	-	-
Turbidity	NTU	-	2 – 200
Dissolved Oxygen (DO)	mg/L	-	> 4
Ex-situ			
Biochemical Oxygen Demand (BOD)	mg/L	20	30
Chemical Oxygen Demand (COD)	mg O ₂ /L	60	125
Total Suspended Solids (TSS)	mg/L	30	150
Total Ammonia Nitrogen (NH ₄ -N and NH ₃ -N)	mg/L	-	1
Total Nitrogen (TN)	mg/L	-	8
Nitrate (as NO ₃)	mg/L	20	7
Total Phosphorus (TP)	mg/L	-	0.1
Orthophosphate (as PO ₄)	mg/L	2	0.033
Total Organic Carbon (TOC)	mg/L	-	25
Oil & Grease (Total)	mg/L	1	0.1
Oil & Grease (Hydrocarbon)	mg/L	1	-
Lead (Pb)	mg/L	0.1	Acute:0.065 Chronic: 0.025
Zinc (Zn)	mg/L	0.5	Acute: 0.12 Chronic: 0.12
Mercury (Hg)	mg/L	0.001	Acute: 0.0014 Chronic: 0.00077
Enterococcus ²	cfu/100mL	-	-
Notes:			
<ul style="list-style-type: none"> ■ ¹ The sources of international water quality criteria for aquatic life includes United Nations Economic Commission for Europe, World Health Organization, United States Environmental Protection Agency, Australian & New Zealand, Canada, Philippines, and Malaysia. ■ ² Singapore's Water Quality Guidelines for Recreational Beaches and Fresh Water Bodies requires that the Enterococcus count should be less than or equal to 200 counts per 100 millilitres of water at 99% of the time. 			

5.6.2.1 Response Plan for Drainage, Surface Water and Groundwater Incidents

The response plan (refer to Figure 8-2) will be initiated when there is any relevant drainage, surface water or groundwater incidents occurred around or within the worksite. All incidents shall be reported and documented in an Environmental Incident Form [Appendix F].

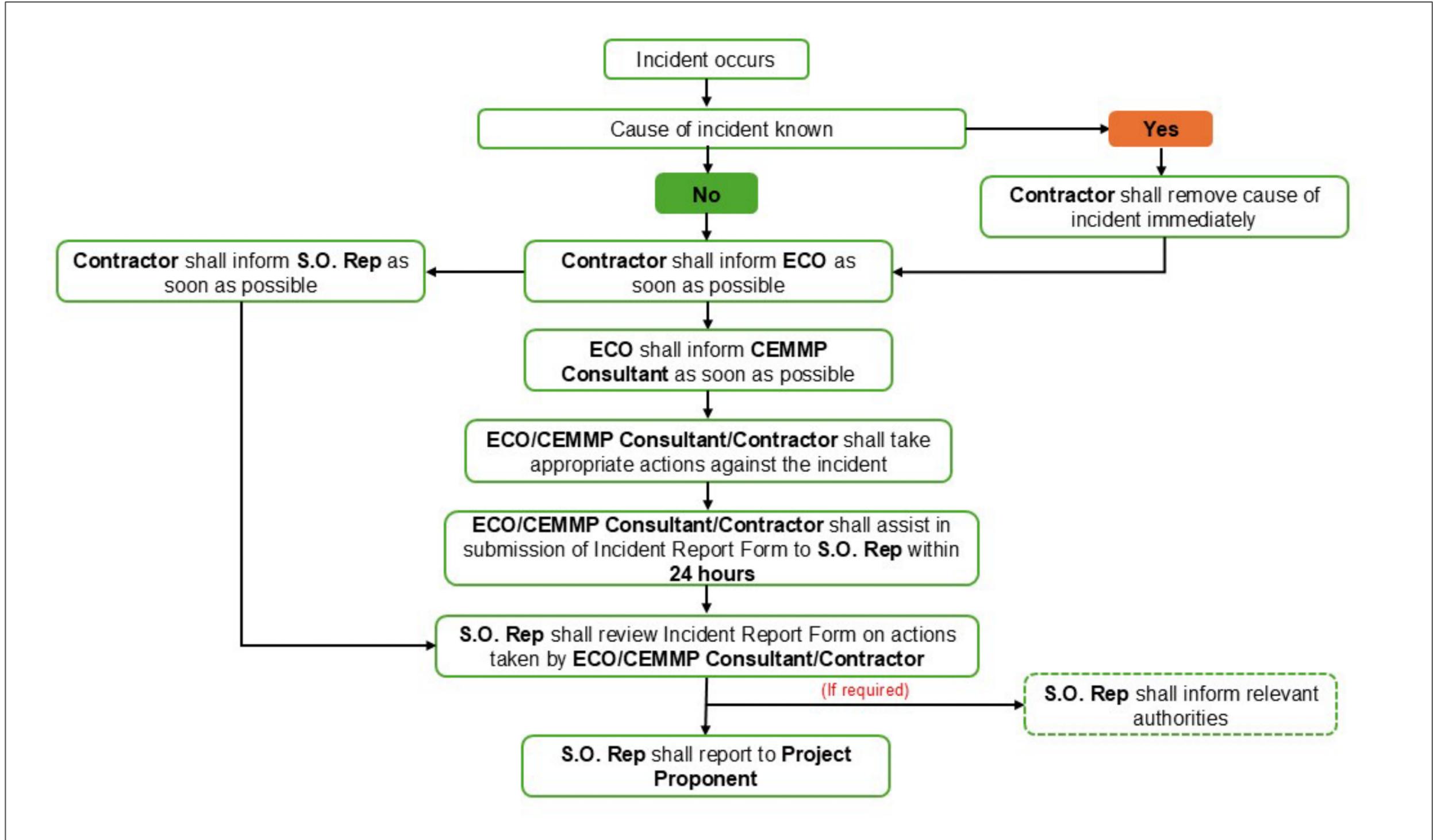


Figure 5-16 Response Plan for Drainage, Surface Water and Groundwater Incidents

5.7 Vector Control

5.7.1 Vector Monitoring

The Contractor's VCO and ECO/EMMP In-Charge shall work together to implement the vector monitoring plan as detailed in Table 5-13 below.

Table 5-13 Summary of Vector Monitoring Plan

Location	Monitoring Parameters and Frequency	Responsible Party
All works sites within Project boundary	Daily inspection of potential mosquito breeding grounds (stagnant water), rodent burrows and droppings of other vectors (e.g. cockroaches, flies).	ECO, Contractor
	Daily inspection and housekeeping across the construction site.	
	Weekly inspection by an external NEA-licensed Pest Control Operator.	VCO

5.7.2 Vector Management and Mitigation Plans

The Contractor shall prepare a Project-specific Vector Control Plan upon award, in accordance with NEA's Code of Practice for Vector Control Operator, Technician and Worker, as well as NEA's Mosquito and Rodent Control Measures. The Contractor shall also engage an NEA-licensed Vector Control Operator (VCO) to carry out vector control management. Below are key mitigation measures to be employed for the Project:

- To conduct a baseline assessment to ascertain pre-existing conditions on Project site prior to works, and identify area of potential vector breeding grounds to be removed/addressed prior to commencement of works
- Conduct daily housekeeping to remove stagnant water and ensure that unwanted items are disposed of correctly.
- Install a movable roof over shafts to prevent rainwater from entering
- Use pumps to remove water in areas where drainage is not feasible, as well as on larger recessed surfaces.
- Designate specific areas for food disposal, ensuring it is done daily to deter rodents from nesting on-site and to avoid infestations of cockroaches and flies.
- Store food in rodent-proof containers or cabinets with a clearance of at least 60 cm from the ground.
- Refrain from using fogging
- Refrain from using chemical pesticides and conventional physical traps

5.7.2.1 Vector Control Training

Training sessions shall be conducted monthly, if needed, to ensure that all site personnel are adequately trained to manage vectors effectively on-site. The following vector control measures will be implemented:

- Eliminate stagnant water through good housekeeping practices to remove potential breeding sites.
- Conduct regular worker screenings for dengue monitoring, including temperature checks and quarantine measures where necessary.
- Implement search and destroy efforts, conduct inspections, and apply *Bacillus thuringiensis israelensis* (Bti) that is more environmentally friendly.
- Thermal fogging will not be used to avoid harming invertebrate fauna in neighbouring habitats.

- The use of chemical insecticides, pesticides, and rodenticides is not permitted.
- Sticky traps are not allowed for pest control

5.8 Waste Management

5.8.1 Waste Monitoring

Waste generated from construction works are typically segregated into three main forms: (i) general waste, (ii) toxic waste and (iii) waste generated from excavation soil/groundwater (i.e., potential land contamination).

The Contractor and ECO/EMMP In-Charge shall work together to implement the waste monitoring plan as detailed in Table 5-13 below.

Table 5-14 Summary of Waste Monitoring Plan

Location	Monitoring Parameters and Frequency	Responsible Party
All works sites within Project boundary	Ensure wildlife-proof waste bins are deployed sufficiently across the entire project site, food waste is disposed of regularly and bins are labelled clearly	ECO, Contractor
	Monitor for discharge of extract groundwater to be direct to an NEA-approved disposal site	
	Regular inspection to ensure all waste generated from project are disposed of proper and in regular intervals with NEA-licensed waste collectors, and if necessary, contaminated waste to be disposed of at approved sites	
	Regular inspection of all leaks and other potentially faulty components that may result in contamination of soil or groundwater	
	Ensure all sludge, wastewater and toxic chemical waste are stored under shelter and/or within approved containment structures, and discharged/disposed of in accordance with the stipulated procedures	
	Ensure spill trays are provided for all relevant equipment, and waste contains to prevent leaching	
	Regular inspections to ensure housekeeping is done properly	

5.8.2 Waste Management and Mitigation Plans

Training sessions shall be conducted monthly, if needed, to ensure that all site personnel are adequately trained to manage construction waste effectively on-site.

- The Contractor will establish a thorough waste management system at the site to facilitate proper waste disposal.
- Illegal disposal of construction waste is strictly forbidden.
- Littering of food waste and packaging is prohibited and will be enforced by the Contractor.
- It is strictly prohibited to dispose of construction waste (both wastewater and solid waste) in streams, stormwater channels, or other bodies of water.
- The Contractor shall provide adequate wildlife-proof, covered food waste bins.
- Food waste shall be removed from the site at least once daily.

- If wildlife is observed around waste disposal areas, the Contractor is required to consult with the Ecologist / Wildlife Specialist to take steps to minimize attractants.
- The Contractor shall submit a Waste Management Plan as part of the EMMP, detailing:
 - Types of waste generated;
 - Locations and types of waste management facilities;
 - Disposal frequency; and
- Details of waste management contractors

5.9 Reporting & Communication Plans

As part of the EMMP, routine reports in Table 5-15 will be provided to the Contractor for onward submissions to relevant agencies e.g. HDB and NParks.

Table 5-15 Routine Reporting

S/N	Document / Report	Frequency
1.	Biodiversity Awareness Training	Once prior to start of works Every 6 months upon commencement of works
2.	CEMMP Document	Once at the beginning of the Project (Live document) Addendums/revised version(s) will be provided if required
3.	Pre-felling Inspection Report	Per inspection
4.	CEMMP Implementation Audit and Monitoring Report Monthly inspection of: <ul style="list-style-type: none"> ■ Wildlife / Fauna mitigation measures ■ Health of retained trees and TPZs (if applicable) ■ On-site visual inspection ■ Compilation of other relevant reports from Contractor (e.g., ECO SECR report, air and noise monitoring data etc.) ■ Documentation of any non-compliance, follow-up actions, and progress of past follow-up actions if unrectified 	Monthly (during construction/demolition stage)
5.	Incident Reports	As required
6.	Minutes of Meetings	As required
7.	Environmental Close-off Audit Report	Once at the end of each stage of works (Stages 1 and 2)

5.9.1 Monthly EMMP Reporting

The EMMP Consultant shall prepare Monthly EMMP Reports (also referred to as Environmental Performance Report 'EPR') and submit to SO Rep, HDB and relevant Agencies by the 3rd working day of each month, to report on different aspects of the EMMP implementation in the preceding month for the whole Project construction phase, unless otherwise instructed by the Employer / SO Rep.

The contents of the Monthly EMMP Reports shall include

- (a) Projects monitored and inspected for the prevailing month;
- (b) Types of relevant mitigation and management works implemented corresponding to the specific project stage/activities;
- (c) Performance of the mitigation and management works;
- (d) Environmental and biodiversity monitoring results and findings, corresponding to the specific project stage/activities;
- (e) Incidents on site including incident investigation, root cause and corrective actions;
- (f) Assessment of results against environmental standards; and
- (g) Further recommendations and corrective measures and / or remedy or restoration or compensation actions, if any.

A Monthly EMMP Report will be prepared and record the effectiveness of mitigation measures and pollution controls implemented during the construction period (estimated duration of 88 months, from September 2025 onwards). Where any environmental non-compliance is observed on site, recommendations will be provided to the Main Contractor for Rectification. Potential or actual incidents / non-conformances will also be highlighted to HDB and the SO Rep immediately. The contents of the report will include:

- Projects monitored and inspected for the prevailing month;
- Types of relevant mitigation and management works implemented corresponding to the specific project stage / activities;
- Performance of the mitigation and management works;
- Environmental and biodiversity monitoring results and findings (to be obtained from the Main Contractor), corresponding to the specific project stage / activities;
- Incidents on site including incident investigation, root cause, and corrective actions;
- Assessment of results against environmental standards and baseline levels; and
- Further recommendations and corrective measures and / or remedy or restoration or compensation actions, if any.

5.9.2 Close-off EMMP Audit

A Close-Off Environmental Audit Report will be prepared and submitted upon completion of each stage of the construction works (i.e. Stages 1 and 2), to report on the satisfactory completion of the different aspects of the EMMP implementation across the whole construction phases. The Close-Off Audit report serves to document the post-construction phase environmental conditions which shall include the results of water quality, sediment quality, noise, air and ecological habitat surveys, as compared to the baseline conditions, where applicable and relevant. The report will include the following (where applicable):

- The environmental impacts occurring during the construction phase
- Compliance with the relevant regulatory and EMMP requirements during the construction phase
- The results of the control monitoring throughout construction and audit stages
- The results of habitat monitoring throughout construction and audit stages

5.9.3 Public Communication Plan

The Contractor shall engage a Public Relations Officer (PRO) to foster positive relationships with the community and to manage and respond to community complaints and propose a response feedback plan (Figure 5-15). Some of the responsibilities and outputs of the PRO shall include and is not limited to:

- The Contractor’s PRO shall prepare info sheets detailing the name and contact information of the individuals responsible for managing issues on-site, which may include the environmental manager/engineer, the ECO or the site manager.
- The PRO shall prepare a Stakeholder Communications Plan to address all potential issues and complaints from stakeholders affected by the works

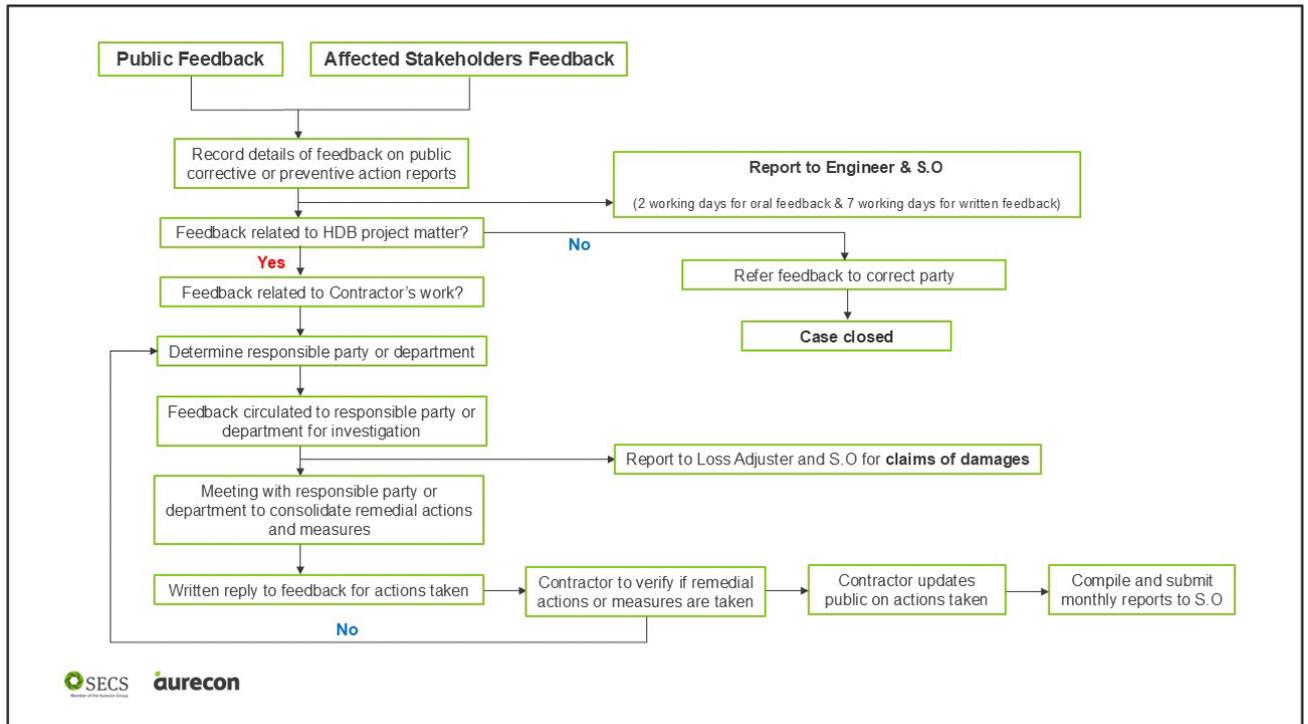


Figure 5-17 Response Feedback Plan

5.9.4 Site Inspection Checklist

The environmental site inspection plays an important role to oversee the construction activities and assess the effectiveness of protection and mitigation measures on-site. This is to ensure compliance with EMMP requirements and verify that measures are adequate to protect the surrounding environment. The visual site inspection will be conducted bi-weekly throughout the construction phase. The sample checklist below will be incorporated with representative photos into the Monthly EMMP Report.

Date of Inspection:	
Conducted By:	

S/N	Inspection Item	Implementation			Comment	Follow-up Action / Recommendation
		Yes	No	N.A.		
Biodiversity						
1.	Has the biodiversity awareness training been conducted for the key staff and workers prior to land clearance?					
2.	Are there wildlife emergency protocols and biodiversity awareness information displayed on site?					
3.	Has the pre-felling check been conducted before felling any trees or removing any vegetation?					
4.	Are the construction zones and retained areas clearly demarcated before commencement of works?					
5.	Are the hoardings properly installed and maintained with no gap between the panels and between the bottom of hoarding and ground?					
6.	Are biodegradable erosion control blankets (ECBs) used to cover exposed areas?					
7.	Is there any incident of roadkill or entrapped fauna?					
8.	Are there any designated eating houses/ canteens/ rest areas? Any wildlife-proof bins provided for daily food waste collection and disposal?					

S/N	Inspection Item	Implementation			Comment	Follow-up Action / Recommendation
		Yes	No	N.A.		
9.	Has regular monitoring been carried out to assess the tree condition alongside the construction boundary?					
Water Quality						
10.	Has silt fence / curtain been provided before commencement of works?					
11.	Any there any visible sediment plume(s) observed outside of silt curtains or construction boundary?					
12.	Have Perimeter Drains, Silt Fences, and ECMs (i.e., Holding Ponds, Treatment Tank) been set up? (where applicable)					
13.	Are ECMs maintained regularly i.e., replacement of silt fences and biodegradable ECBs, re-paving of concrete surfaces, etc?					
14.	Is continuous monitoring and recording system (CCTV) set up at the final discharge points of ECM to monitor water quality of discharges i.e., to comply guideline limit of 50 mg/L for total suspended solids (TSS)?					
15.	Are exposed areas/ bare slopes/ stockpiles covered, concreted, and/or turfed properly? (where possible)					
16.	Is the fuel and chemical storage area located away from the mangrove area and properly secured i.e., provision of concrete bunded base and/or secondary containment (110% of the largest volume stored)?					
17.	Is spill control kit (or sand) readily available on site?					
18.	Are engines/generators provided with secondary containment to prevent spillage?					
19.	Has regular monitoring been carried out to ensure the discharges from the site are in accordance with NEA's allowable limits for trade effluent discharge?					
Air Quality						
20.	Have the exposed soil/ stockpiles been covered under canvas sheets or biodegradable ECBs?					
21.	Is regular water bowing conducted at temporary unpaved areas during ambient dry periods?					

S/N	Inspection Item	Implementation			Comment	Follow-up Action / Recommendation
		Yes	No	N.A.		
22.	Is wheel washing facility provided to clean the construction vehicles before entering the public roads?					
23.	Are the truck loads carrying dry materials (i.e., cement, sand, aggregate, soil, etc.) covered properly?					
24.	Is maximum-speed-limit for all construction vehicles imposed within the site?					
Noise Level (applicable to both day and night works)						
25.	Has continuous noise monitoring been carried out to monitor the noise from construction activities?					
26.	Have the noise control measure at sources (e.g., silencer/ noise blanket/ portable noise barrier) for noisy equipment or machineries been provided?					
27.	Are equipment, machinery and vehicles switched off when not in use?					
28.	Are equipment, machinery and heavy vehicles used properly maintained on a regular basis?					
Waste Management						
29.	Does the site have proper segregation and storage of waste to extract recoverable and recyclable materials?					
30.	Are waste storage areas located away from the mangrove areas?					
31.	Is food waste collected using garbage/ trash bins with tight lid (animal proof bin) and disposed off from the site on daily basis?					
32.	Are hazardous waste stored in properly covered locations with secondary containment, and disposed off routinely by a NEA licenced hazardous waste contractor?					
33.	Have suitable/unsuitable excavated materials from the site been collected and disposed off at designated dumping ground location by NEA licensed waste contractor?					
Illumination						
34.	Are all lights directed away from forest areas?					

S/N	Inspection Item	Implementation			Comment	Follow-up Action / Recommendation
		Yes	No	N.A.		
35.	Are all light fixtures directed downwards and towards the construction activities and to be switched off at all non-essential areas?					
36.	Are all lights below the height of hoardings?					
Vectors						
37.	Are designated rest areas and wildlife-proof bins provided to prevent animals from scouring food?					
38.	Are domestic/ food waste collected and removed from the site on daily basis?					
39.	Have the empty containers been kept indoor and the building materials been stored under shelter and off the ground?					
40.	Have the housekeeping practices been conducted regularly to remove any stagnant water and keep the site in a clean and tidy condition?					
Tree Health & TPZ Integrity						
41.	Any trees exhibiting visual signs of stress or abnormal appearance?					
42.	Are the integrity of TPZs maintained?					
43.	Any encroachment on TPZs?					

6 Environmental Impact and Mitigation Registry (EMMP Table)

6.1 EMMP Register

The management actions and monitoring actions for works during the construction phase where applicable and practicable are shown in the Environmental Impact and Mitigation Registry table below (Table 6-1).

Table 6-1 EMMP Register

Environmental Issues	Management/Mitigation Actions	Monitoring Actions	Frequency	Responsibility
During Construction				
Biodiversity				
<ul style="list-style-type: none"> Impacts on flora and vegetation 	<ul style="list-style-type: none"> Demarcation of site boundary. Establish TPZs around trees and other plants to be retained on site (if any). Tag trees meant for protection and transplantation to prevent accidental removal. 	<ul style="list-style-type: none"> Document the locations, species, and number of transplant candidates impacted by construction activities (if applicable). 	<ul style="list-style-type: none"> Prior to site clearance 	<ul style="list-style-type: none"> Aurecon
	<ul style="list-style-type: none"> Check the integrity of the TPZ hoarding (if applicable). Determine physiological health and vigour of trees. Assess trees with mechanical damage that leads to instability. Review method statements of construction work nearby retained trees. Conduct mitigation measures for soil erosion when vegetation has been removed, and soil is exposed. 	<ul style="list-style-type: none"> Assess instances of excessive or unauthorized tree removal. Identify trees that need management and maintenance, including care and pruning. Check for any unauthorized removal of plants in conservation areas, if applicable, or outside the designated worksite. Identify locations experiencing soil erosion and degradation caused by construction activities. Investigate any unauthorized disposal of waste materials, construction debris, or oil/chemical spills that could contaminate the soil and water sources or harm vegetation. Identify areas showing negative responses because of development. 	<ul style="list-style-type: none"> Monthly during construction 	<ul style="list-style-type: none"> Aurecon Contractor
<ul style="list-style-type: none"> Impacts on fauna 	<ul style="list-style-type: none"> Implementation of pre-site clearance fauna inspection, passive wildlife shepherding and directional clearing <ul style="list-style-type: none"> Directional clearing shall begin from the side of development nearest to the road i.e. to start hoarding from boundary nearest to Admiralty Road West first then move inwards towards Canberra Road 	<ul style="list-style-type: none"> Implement fauna inspection prior to site clearance. 	<ul style="list-style-type: none"> Prior to site clearance 	<ul style="list-style-type: none"> Aurecon Contractor
	<ul style="list-style-type: none"> Ensure that machinery that may leak harmful chemicals and fuel-powered equipment is stored correctly. Keep the faulty equipment away from water bodies and sensitive habitats. 	<ul style="list-style-type: none"> Evaluate the condition of habitats (such as water quality and excessive vegetation removal). Look for trapped, injured, or deceased animals, potential entrapment hazards for wildlife, and any gaps in the site hoarding. Carry out toolbox meetings to raise awareness about biodiversity. 	<ul style="list-style-type: none"> Monthly during construction 	<ul style="list-style-type: none"> Contractor
	<ul style="list-style-type: none"> Ensure adherence to the minimum noise control measures outlined in the Airborne Noise section. 	<ul style="list-style-type: none"> Check for non-compliance on a regular basis 	<ul style="list-style-type: none"> Monthly during construction 	<ul style="list-style-type: none"> Contractor
	<ul style="list-style-type: none"> Installation of site hoardings <ul style="list-style-type: none"> The hoarding must not have any gaps between the panels and are to extend at least 300 mm into the ground; The access gates, when shut, must not have any gaps between the panels and must be flush as close to the ground as possible Use of biodegradable erosion control blankets on exposed soils 	<ul style="list-style-type: none"> Document the frequency of human-wildlife conflict incidents. Conduct regular toolbox briefing on biodiversity awareness to remind workers not to feed wildlife on site and enforce proper trash management and disposal. 	<ul style="list-style-type: none"> Continuous 	<ul style="list-style-type: none"> Contractor

Environmental Issues	Management/Mitigation Actions	Monitoring Actions	Frequency	Responsibility
	<ul style="list-style-type: none"> ■ Daily checks by ECO on site for trapped fauna and roadkill ■ Execute wildlife response plan when a trapped/ injured/ dead/ dangerous animal is encountered around or within the worksite according to Section 10 of Wildlife Act 			
Surface Water Quality				
<ul style="list-style-type: none"> ■ Stormwater runoff and contamination ■ Chemical leakage ■ Domestic waste ■ Solid waste ■ Wastewater from construction activities 	<ul style="list-style-type: none"> ■ Implement the construction Environmental Management and Monitoring Plan (EMMP) and ensure complete preparation of associated plans and procedures. ■ The drainage diversion for the watercourse affected by this development, Stream D2 within N4 Forested Area, shall be installed before any construction work begins. ■ Ensure undisrupted free flow of water in the existing drain D2 until the permanent diversion drain is operational. ■ The Contractor must not fill or interfere with the existing drains without prior approval from PUB, including for any diversion of existing drains and canals before beginning the diversion work. ■ Design adequate drainage systems, including cut-off drains, sump pit, road kerb, piping and toe walls to channel construction process wastewater streams (e.g. wash water) and stormwater runoff separately through detailed design to capture and treatment in the containment pond(s)/ kerb(s). Where applicable, include oil-water separators. ■ Runoff from within, upstream, and surrounding the construction site will be effectively managed to prevent flooding in the area. ■ Any potential increase in peak flow resulting from land use changes at the site can be alleviated by installing detention tanks or ponds on the premises. These facilities will collect stormwater during intense rainfall events to help minimize peak runoff. ■ The geotechnical considerations regarding slope stability, including ERSS, shall be incorporated into the detailed engineering design for the construction phase. ■ Design engineers responsible for the detailed plans should ensure that ERSS are proposed during site clearing and excavation. At the same time, the ECO shall verify that these measures are executed during construction, as slope cutting can lead to instability. ■ ECM measures encompass a variety of strategies, including but not limited to reducing bare soil exposure, covering all bare or erodible surfaces, implementing concrete cut-off drains, installing silt fences or traps along perimeter cut-off drains, and utilizing turbidity curtains for operations near watercourses (such as drains and streams). ■ Thorough designs must ensure adequate drainage, piping, and/or channelling of stormwater runoff for collection and treatment in ECM tanks or ponds before discharging into watercourses. ■ Consistent and dedicated procedures shall be established for the inspection and maintenance of stormwater collection, storage, and treatment infrastructure, such as pipes and oil-water separators. ■ Regular procedures for managing stormwater collection, settling, testing, and the eventual release of 'clean' water into watercourses shall be implemented, including measures to prevent high sediment concentrations in stormwater discharges. 	<ul style="list-style-type: none"> ■ Permanent TSS monitor installed at every discharge outlet ■ Implementation of CCTV including a SIDS at every discharge outlet to monitor the surface run-off discharges from the sites, in accordance with the PUB's guidelines on Preventing Muddy Waters from Construction Sites (October 2015). ■ Daily inspections of drains within Project boundary as well as perimeter and public drains surrounding Project site to be conducted, to check for blockage or visual changes in water quality ■ Regular inspections and audits shall be conducted to assess on-site hygienic conditions, and environmental management procedures. ■ Regular inspection and maintenance procedures shall be established for wastewater collection, storage, and treatment infrastructure, including pipes, oil-water separators, and silt screens. ■ Monthly water quality monitoring for all discharge point locations ■ All exposed or erodible surfaces shall be monitored and covered as soon as possible once work is finished or at the onset of heavy rain, necessitating that tarpaulins or other impervious materials be readily available next to the exposed soil. ■ Investigation and corrective actions to be taken as per the response plan (Figure 5-14). 	<ul style="list-style-type: none"> ■ Daily/Continuously ■ Monthly during construction 	<ul style="list-style-type: none"> ■ Contractor ■ Aurecon

Environmental Issues	Management/Mitigation Actions	Monitoring Actions	Frequency	Responsibility
	<ul style="list-style-type: none"> ■ A SOP should be developed for the safe handling, transfer, and storage of hazardous waste, with daily housekeeping checks to ensure the site is clear of any toxic waste. ■ Appropriate testing is required to determine the presence or absence of contamination in excavated soil and sand. ■ A fully sheltered storage area is necessary for chemical substances, with a storage capacity of at least 110% of the largest volume of chemicals held (the area must be curb-contained on at least three sides, covered, and properly ventilated). ■ Toxic waste storage containers shall be constructed with appropriate materials, with periodic leak detection tests conducted. ■ Secondary containment shall be provided for all bulk-stored toxic waste, adhering to COPPC/SS593 requirements. ■ An emergency response plan should be developed, with training for the ERT to ensure they can execute the response mechanism, including having response kits for spill incidents. ■ A consignment notification and tracking system, alongside a transport emergency response plan for moving toxic waste, should be established. ■ Toxic waste disposal shall comply with the Environmental Public Health (Toxic Industrial Waste) Regulations through licensed waste operators or collectors. ■ Portable toilets and an on-site septic tank shall be provided, with regular maintenance to clean the toilets and remove sanitary waste. ■ Toilet facilities shall be appropriately sited away from any nearby watercourses, ensuring they are at least 30 m from such areas. ■ Workers shall receive training on best practices for contributing to environmental protection. ■ Waste disposal shall follow the Environmental Public Health (General Waste Collection) Regulations, utilizing licensed operators regardless of whether the waste is sent off-site or to the public sewer. ■ Unmanaged discharge of wastewater streams is prohibited. ■ The principles of reducing, reusing, and recycling shall be applied to on-site wastewater management. ■ No hazardous liquids shall be directed to the detention pond or tank. ■ Hazardous wastewater, including oily water, thinners, solvents, or paints, shall be stored on a hardstand, sheltered, and surrounded by a curb. This wastewater shall be treated and disposed of off-site by an approved Waste Management Contractor, with all hazardous liquids handled as Hazardous Waste. ■ Containment ponds and kerbs shall be made of impervious material and designed to handle the volumes of wastewater generated on-site, including potential fire-fighting water runoff. ■ ECM tanks and ponds shall be sized adequately to store turbid stormwater before treatment at the ECM treatment facility. ■ Temporary storage capacities shall be established to manage overflow situations involving untreated wastewater. This temporary storage shall be large enough to accommodate any anticipated excess volumes and to ensure that untreated wastewater is not discharged into watercourses unless it meets Singapore's NEA Guidelines for trade effluent discharge concentrations. 			

Environmental Issues	Management/Mitigation Actions	Monitoring Actions	Frequency	Responsibility
	<ul style="list-style-type: none"> ■ ECO shall be responsible for overseeing the proper functioning of the containment pond and kerbs while adhering to 'Good Housekeeping' practices. This area shall be meticulously maintained to prevent spills, leaks, and odour concerns, with daily inspections of the containment pond/kerbs to verify their functionality. ■ Daily logs shall be kept to document the volumes of wastewater, sludge, and other waste produced. ■ The Contractor must obtain approval from the relevant authorities (i.e., PUB and NEA) in accordance with PUB Sewerage and Drainage (Trade Effluent) Regulations for discharging wastewater into the public sewer or for compliance with NEA's Trade Effluent Discharge Limits if the treated trade effluent will be disposed of into surface watercourses. If approvals are not granted, the trade effluent will need to be stored, treated, or recycled on site before being disposed of off-site. ■ The Contractor shall seek feedback and approval from the authorities (e.g., SCDF and NEA) regarding the use of treated wastewater for firefighting purposes. ■ Discharging pumped dewatered groundwater or other wastewater into sensitive aquatic habitats is strictly prohibited. ■ Effluent from tunnel washing shall be directed to containment ponds/kerbs, from which it will be manually collected by a contracted private wastewater collector for transfer to a treatment plant. ■ Containment ponds/kerbs and areas generating wastewater on-site shall be equipped with spill clean-up kits. ■ Comprehensive drainage systems, including cut-off drains, sump pits, road kerbs, piping, and toe walls, shall be designed to separately channel construction wastewater (e.g., from concrete batching or wash water) and stormwater runoff for capture and treatment in the containment ponds/kerbs. Where necessary (e.g., near liquid storage or refuelling zones), this infrastructure shall feature oil-water separators to manage any spills or leaks of oils or greases. ■ The EMMP shall incorporate Standard Operating Procedures (SOPs), an Emergency Response Plan (ERP), an inventory of wastewater streams, staff training, and a schedule for inspections, maintenance, and audits; ■ Comprehensive development of Wastewater Management Procedures that detail management and monitoring practices for the effective operation of containment ponds/kerbs or other wastewater discharge points/equipment. ■ A training program shall be developed for all on-site personnel, including Subcontractors, focusing on their responsibilities for maintaining proper water quality management. ■ SOPs for the safe handling, transfer, storage, and disposal of solid waste shall be created. ■ Effective ECM and monitoring shall be implemented, as recommended in the Code of Practice on Surface Water Drainage, to ensure that discharges into the stormwater drainage system do not exceed the prescribed TSS limits outlined in the Sewerage and Drainage (Surface Water Drainage) Regulations. ■ ECM measures encompass a range of strategies, including minimizing the exposure of bare soil, covering all bare or erodible surfaces, ensuring slope stability, installing concrete cut-off drains, setting up silt fences or traps along perimeter cut-off drains, and using turbidity curtains for activities near watercourses. 			

Environmental Issues	Management/Mitigation Actions	Monitoring Actions	Frequency	Responsibility
	<ul style="list-style-type: none"> ■ Enclosed bins and waste disposal facilities will be provided and emptied as needed to prevent waste accumulation, with daily housekeeping checks to ensure all litter is removed from the site. ■ Hazardous materials and toxic waste shall be stored on a hard surface, under shelter, and surrounded by a curb to contain any spills. ■ All waste shall be disposed of at designated waste disposal facilities, where trained personnel will sort and label different types of waste (including reusable, recyclable, toxic, and non-toxic). ■ Surface Water Drainage plans must be approved by a QECP and submitted to PUB. ■ The ECM plan should be put into action before commencing any construction activities. ■ Manholes shall always be properly covered and temporarily sealed. ■ Stockpiles shall be protected with erosion blankets, and demolition and earthworks shall be scheduled appropriately to minimize the amount of stockpiled materials on-site. ■ Temporary or open storage of excavated materials shall also be covered. ■ All vehicles shall pass through a wheel washing process before leaving the site to prevent dirt, mud, and debris from being deposited on roadways; any wastewater generated during this process shall be collected and disposed of off-site by an approved Waste Management Contractor. 			
Waste Management (Soil and Groundwater)				
<ul style="list-style-type: none"> ■ Imported and excavated soil/stockpile ■ Extracted groundwater ■ Generation of runoff and potential contamination ■ Chemical substances ■ Household waste ■ Wastewater from construction activities ■ Solid waste ■ Leaks or spills from construction machinery and vehicles 	<ul style="list-style-type: none"> ■ Identify all forms of solid waste and establish a thorough waste management system at the site to ensure proper disposal and mitigate environmental pollution. The Contractor shall carry out a construction risk assessment and develop a detailed health, safety, and environment plan for construction. If there are anticipated health risks to workers from handling such waste, appropriate precautionary measures, in accordance with the safety data sheet (SDS), including the provision of personal protective equipment, must be implemented on site. ■ Following the receipt of results indicating that tested parameters (chemicals, heavy metals) exceed regulatory limits, the Contractor shall further evaluate the potential inhalation and dermal contact risks associated with these exceeded parameters for site workers exposed to areas with identified soil and/or groundwater contamination. This risk assessment shall be conducted prior to the commencement of construction, with the findings incorporated into the Contractor's construction risk assessment, and health, safety and environment plan. Should health risks to workers be anticipated, precautionary measures as outlined in the respective chemical SDS, shall be enforced on site. ■ A site management plan ought to encompass protocols for the safe handling, transfer, and storage of excavated soils. ■ Bentonite slurry (if applicable) will be directed to the slurry treatment plant for recycling, cleaning, and removal of native cut materials. The treatment processes at the slurry treatment plant will include de-sanding (e.g., using cyclones) and filtration. ■ All categories of toxic chemical waste shall be identified, and a comprehensive waste management system shall be established on-site to ensure proper disposal and prevent environmental contamination. 	<ul style="list-style-type: none"> ■ Conduct regular inspections to ensure that approved materials for backfilling that are of equal or better quality than the surrounding area are utilised. All backfill material shall be free of debris and consist of suitable soil. ■ Handle excavated soils and identify potential contamination areas. If a site is identified as a Potential Area of Contamination (PAC), the soils shall be tested for exceedances in defined intervention values (DIVs). If these tests reveal exceedances, the soils can be either disposed of by toxic waste collectors or undergo treatment. Soils that have been treated to meet acceptable standards, such as the DIV, can be disposed of at the staging ground or through a general waste collector, depending on contaminant levels determined during staging ground testing. ■ Inspections to ensure that the discharge of extracted groundwater is directed to a location approved for disposal by the NEA. It is advisable for the Contractor to remain attentive to site conditions and conduct regular tests on extracted groundwater, particularly if it exhibits oily sheens or noticeable odours. ■ Prior to site entry, inspect all equipment for issues such as fuel/hydraulic line leaks, leaking tanks, and other potentially faulty components that may result in contamination of soil or groundwater. ■ Regular monitoring to ensure that all toxic chemical waste is stored under shelter within concrete bund walls or in well-ventilated storage containers. Spill trays should be supplied for all waste containers and maintained regularly to prevent rain from leaching out pollutants. 	<ul style="list-style-type: none"> ■ Continuous monitoring 	<ul style="list-style-type: none"> ■ Contractor

Environmental Issues	Management/Mitigation Actions	Monitoring Actions	Frequency	Responsibility
	<ul style="list-style-type: none"> ■ Dispose of all construction debris (falling under the category of construction and demolition waste) at designated Government dumping grounds or at other locations as directed by the NEA. ■ Ensure appropriate disposal of toxic waste in accordance with the Environmental Public Health (Toxic Industrial Waste) Regulations by a Licensed Waste Operator/Collector. ■ Ensure appropriate disposal of any waste listed in the Environmental Public Health (General Waste Collection) Regulations by a licensed waste operator. ■ Provide a sufficient number of proper sanitary facilities and ensure their maintenance. It is recommended to have one portable toilet per 10 individuals, serviced three times per week by NEA's Licensed Waste Collector (LWC) for regular sewage disposal. <ul style="list-style-type: none"> – If on-site dormitories are present, it is advised to install container toilets and obtain written approval from PUB to connect them to public sewers. ■ Be aware that ECM are intended for the containment and treatment of silty discharges resulting from rainwater and are not designed for the treatment of wastewater from construction activities (such as pipe-jacking and bore-piling), which must be treated in accordance with current legislative requirements. ■ Wastewater resulting from construction activities shall be stored and removed for off-site treatment and disposal by an approved Waste Management Contractor. ■ Remove any hazardous substances or chemicals if safer alternatives are available. ■ Ensure all hazardous substance and chemical containers are clearly labelled, returning them to designated storage areas when not in use. ■ Review the SDS for all hazardous substances and chemicals prior to their entry on-site to assess their suitability concerning safety, health, and environmental hazards, while also considering safer alternatives. ■ Ensure that no trade effluent, apart from that of a type or nature approved by the NEA Director-General, is discharged into any watercourse or onto land. ■ Ensure that all activities related to repair, servicing, engine overhauls, and similar operations are conducted in an adequately contained area (for instance, a concreted space with proper containment and sumps), and all waste should be directed for suitable treatment or disposal in accordance with regulations. ■ Seek approval from relevant authorities (i.e. PUB and NEA) in accordance with PUB Sewerage and Drainage (Trade Effluent) Regulations, if the wastewater is planned to be disposed to public sewer, or NEA's Trade Effluent Discharge Limits to watercourse if disposal to surface watercourses is intended. If such discharges are not approved, the trade effluent will be stored, treated or recycled on site and finally disposed off-site. 			
Air Quality				
<ul style="list-style-type: none"> ■ Dust disturbances from construction activities and gaseous emissions produced by construction machinery and vehicles. 	<ul style="list-style-type: none"> ■ The construction area must be enclosed with hoardings on all sides. ■ A concrete batching plant is not permitted on-site. ■ It is advisable to finish and pave the access road or expansion before starting any other development activities. <p>The following are general mitigation measures to be implemented by the Contractor during construction:</p>	<p>Monitoring</p> <ul style="list-style-type: none"> ■ Conduct regular inspections (daily is recommended) both on-site and off-site, and record the findings. Inspections shall include regular checks for dust soiling on surfaces such as street furniture, vehicles, and windowsills within 100 m of the site boundary, with cleaning provided as necessary. 	<ul style="list-style-type: none"> ■ Not Applicable 	<ul style="list-style-type: none"> ■ Contractor

Environmental Issues	Management/Mitigation Actions	Monitoring Actions	Frequency	Responsibility
	<p>Communication</p> <ul style="list-style-type: none"> ■ Display the name and contact information of the individual(s) responsible for handling air quality and dust concerns at the site boundary. This may be the environmental manager/engineer or site manager. ■ Develop and implement an Air Pollution Control Plan (APCP). <p>Site Management</p> <ul style="list-style-type: none"> ■ Document all complaints related to dust and air quality, identify the causes, take timely action to minimize emissions, and record the measures implemented. ■ Provide access to the complaints log to local authorities upon request. ■ Log any unusual incidents that cause dust and/or air emissions, whether on-site or off-site, along with the actions taken to address the situation. ■ Hold coordination meetings with other high-risk construction sites within 500 m of the site boundary, if applicable, to ensure aligned plans and minimised dust and particulate emissions. <p>Site Preparation and Maintenance</p> <ul style="list-style-type: none"> ■ Organise the site layout to position machinery and dust-generating activities away from sensitive receptors whenever possible. ■ Install hoarding around activities that generate dust and at the site boundary wherever feasible. Boundary screens shall be at least as tall as any stockpiles or sources of dust emissions on-site. ■ Completely enclose specific activities with a high potential for dust generation, especially if these areas will be active for an extended duration. ■ Keep site hoarding, barriers, and scaffolding clean by regularly using wet cleaning methods (dry cleaning may lead to the release of fugitive dust). ■ Remove any materials that could generate dust from the site as quickly as possible, unless they are to be reused on-site. If materials are being reused, they should be covered, seeded, fenced, or enclosed to prevent the creation of fugitive dust. <p>Operating Vehicles/Machinery and Sustainable Travel</p> <ul style="list-style-type: none"> ■ Establish and display a maximum speed limit of 25 km/h on paved haul roads and 15 km/h on unpaved roads and work areas. ■ Develop a Construction Logistics Plan to oversee the sustainable delivery of goods and materials. ■ Ensure that all vehicles and engine-powered equipment adhere to Singapore's legislative requirements. ■ Require all vehicles and equipment to turn off their engines while stationary to prevent idling. Clear signs shall be placed at the entrance to inform visitors. ■ When feasible, refrain from using diesel or petrol generators and instead utilise mains electricity or battery-operated equipment. <p>Construction</p>	<ul style="list-style-type: none"> ■ Perform routine site inspections to monitor any visual noncompliance. ■ Increase the frequency of inspections during extended dry or windy conditions. 		

Environmental Issues	Management/Mitigation Actions	Monitoring Actions	Frequency	Responsibility
	<ul style="list-style-type: none"> ■ Utilise cutting, grinding, or sawing tools equipped with appropriate dust suppression methods, such as water sprays or local extraction systems. ■ Ensure there is a sufficient water supply on-site for effective dust and particulate matter control, using non-potable water when suitable. ■ Employ enclosed chutes and conveyors, as well as covered skips, whenever possible. ■ Limit drop heights from conveyors, loading shovels, hoppers, and other handling equipment, and apply fine water sprays on these tools as needed. ■ Implement a strict “Clean as you go” policy to prevent loose dry materials from being left exposed when not in use. Cleaning equipment shall be readily available on-site to address spills, and cleanup shall occur as soon as feasible using wet cleaning methods. ■ Refrain from scabbling (roughening of concrete surfaces) whenever possible. ■ Ensure that sand and other aggregates are kept in bunded areas and do not dry out, unless necessary for a specific process. ■ Ensure that bulk cement and other fine powdered materials are delivered in enclosed tankers and stored in silos equipped with suitable emission control systems to prevent material spillage and overfilling during delivery. ■ For smaller quantities of fine powder materials, make sure that bags are sealed after use and stored properly to avoid dust release. <p>Waste Management</p> <ul style="list-style-type: none"> ■ Avoid the burning of waste or other materials. <p>Mitigation Measures for Earthworks</p> <ul style="list-style-type: none"> ■ Implement closed turving in exposed areas whenever feasible and ensure proper storage of soil stockpiles to stabilize surfaces promptly. ■ Use Hessian, mulches, or soil tackifiers in situations where revegetation or topsoil application is not possible, as soon as practical. Soil erosion blankets can also be utilised as an alternative. ■ Remove the cover only in designated working areas, rather than removing it all at once. <p>Mitigation Measures for Trackout</p> <ul style="list-style-type: none"> ■ Utilize water-assisted dust sweepers on access roads and nearby local roads to remove any materials tracked out from the site as needed. This may necessitate the continuous operation of the sweeper. ■ Refrain from dry sweeping over large areas. ■ Ensure that vehicles entering and exiting the site are adequately covered to prevent material loss during transport. ■ Regularly inspect on-site haul routes for any damage and promptly initiate necessary repairs to the surface. ■ Document all haul route inspections and any resulting actions in a site logbook. ■ Set up hard-surfaced haul routes that are routinely dampened with either fixed or mobile sprinkler systems or mobile water bowsers and maintain them through regular cleaning. 			

Environmental Issues	Management/Mitigation Actions	Monitoring Actions	Frequency	Responsibility
	<ul style="list-style-type: none"> ■ Establish a wheel washing system that includes rumble grids designed to dislodge accumulated dust and mud before vehicles leave the site. ■ Ensure there is a sufficient stretch of hard-surfaced road between the wheel washing facility and the site exit, based on site size and layout constraints. ■ Position site access gates at least 10 m away from sensitive receptors whenever possible. 			
Airborne Noise				
<ul style="list-style-type: none"> ■ Noise generated by construction machinery and equipment, particularly from rotational and vibratory devices such as dozers, cranes, excavators, trailers, generators, and others. 	<ul style="list-style-type: none"> ■ Intermittently used machines, such as trucks, shall be shut off during breaks or operated at a minimum throttle. ■ Only well-maintained construction equipment shall be used on-site, with regular servicing throughout the construction period. ■ The number of plant machinery equipment (PMEs) shall be limited as much as feasible when working near noise-sensitive locations. ■ Silencers or mufflers shall be installed on construction machinery and maintained properly during the project. ■ Workers shall maintain quiet conduct by refraining from shouting, using loud radios, dropping materials from heights, or throwing metal objects. ■ For construction respite, high-noise drilling activities shall be limited to three-hour continuous sessions, followed by a minimum one-hour break, if possible. ■ An independent third party shall conduct periodic noise monitoring to ensure compliance with regulations and to provide advice on noisy equipment and potential additional mitigation strategies. ■ Limit construction works involving noisy machinery to daylight hours, from 8 am to 6 pm and minimise noisy construction activities during night works period. <ul style="list-style-type: none"> – Night work, excluding approved activities or site clearance, shall be prohibited after 6 pm to minimize disturbances to nocturnal wildlife. ■ Control noise sources directly at the construction site by analysing the construction inventory list and identifying equipment that generates high noise levels. Prioritize the use of equipment that produces lower noise levels. ■ When it is not possible to control noise at the source, implement acoustic enclosures or sheds to reduce noise emission. An effective acoustic enclosure will cover the machinery as completely as possible (with or without ventilation, as appropriate) to provide sound insulation. ■ Consider using buildings of varying heights, with shorter structures placed near noise-sensitive areas to lessen the duration of noise impacts. ■ Avoid situating access routes close to or directly facing NSRs to minimise sound leakage along the worksite boundaries and to prevent increased noise from road traffic due to a potential rise in heavy-duty vehicle (HDV) traffic. ■ Noise barriers shall be installed at the construction perimeter facing NSRs or residential areas, guided by noise modelling and the management plan provided for contract-specific objectives. <ul style="list-style-type: none"> – Noise barriers of 6 m height (noise barrier + hoarding top up to required height) are proposed at the construction boundary fronting noise sensitive receptors (Figure 5-12). ■ Construction machinery that emits directional noise shall be oriented, whenever feasible, to direct sound away from nearby NSRs. 	<ul style="list-style-type: none"> ■ Continuous monitoring of noise levels for LAeq(12 hrs), LAeq(1hr), and LAeq(5 mins), at the N5 Forested Area (see Figure 5-11) for the entire duration of construction. 	<ul style="list-style-type: none"> ■ Monthly during construction ■ Continuous monitoring 	<ul style="list-style-type: none"> ■ Contractor

Environmental Issues	Management/Mitigation Actions	Monitoring Actions	Frequency	Responsibility
	<ul style="list-style-type: none"> All handheld percussive tools and air compressors used on-site shall comply with local laws and regulations. Personnel operating the plant or equipment shall use appropriate hearing protection that reduces sound exposure to levels below 85 dB (A). Signs will be displayed in noisy work areas to remind staff to wear hearing protection. Options for hearing protection include earplugs for sound levels below 100 dB (A), earmuffs for levels between 100 dB (A) and 120 dB (A), and a combination of earplugs and earmuffs for levels above 120 dB (A). Regular noise awareness training shall be held to emphasize noise mitigation strategies, including machinery placement, the use of portable noise barriers, and guidelines for nighttime machinery use. Implement additional noise measures when noise monitoring indicates that levels are approaching or exceeding permissible limits. <ul style="list-style-type: none"> If noise issues persist despite implementing recommended measures such as noise barriers, the Contractor shall explore the use of proprietary high-performance noise barriers to further mitigate noise to acceptable levels. 			
Vector Control				
<ul style="list-style-type: none"> Build-up of stagnant water Inadequate housekeeping practices Incorrect management or disposal of solid waste (particularly food waste) 	<ul style="list-style-type: none"> Comply with the Control of Vector and Pesticide Act (CVPA) and maintain proper housekeeping on-site. Develop and implement an effective vector control plan and measures in accordance with NEA's Code of Practice for Environmental Control Officers. Ensure that water-holding containers, gaps in the ground and equipment (such as openings in concrete barriers), as well as stockpiled areas are covered or sheltered, particularly during the northeast monsoon season from November to January. The site entrance shall be paved to prevent ground depression. Recycled waste can be utilized to level the ground prior to placing steel plates. After clearing trees, ensure that tree stumps are either thoroughly removed or effectively patched. Install a pitched roof on top of site container offices or seal the bottom to prevent water ingress. A pipette can be used for checking larvae in unreachable parts of trees. Thermal fogging is not recommended on-site due to its proximity to areas of high ecological value. Instead, focus on preventive methods such as regular inspections and maintaining good housekeeping practices to ensure that mosquito breeding does not occur on-site. 	<ul style="list-style-type: none"> Conduct daily housekeeping to remove stagnant water and ensure that unwanted items are disposed of correctly. Install a movable roof over shafts to prevent rainwater from entering Use pumps to remove water in areas where drainage is not feasible, as well as on larger recessed surfaces. Designate specific areas for food disposal, ensuring it is done daily to deter rodents from nesting on-site and to avoid infestations of cockroaches and flies. Store food in rodent-proof containers or cabinets with a clearance of at least 60 cm from the ground. 	<ul style="list-style-type: none"> Continuous monitoring 	<ul style="list-style-type: none"> Contractor
Post-Construction				
Biodiversity				
<ul style="list-style-type: none"> Impacts on flora and vegetation 	<ul style="list-style-type: none"> NIL 	<ul style="list-style-type: none"> NIL 	<ul style="list-style-type: none"> Not Applicable 	<ul style="list-style-type: none"> Not Applicable
<ul style="list-style-type: none"> Impacts on fauna 	<ul style="list-style-type: none"> NIL 	<ul style="list-style-type: none"> NIL 		
Surface Water Quality				
<ul style="list-style-type: none"> Stormwater runoff and contamination Unmanaged liquid and solid waste 	<ul style="list-style-type: none"> Establish procedures for the inspection and maintenance of stormwater collection, storage, and treatment systems, including pipes, oil-water separators, silt screens, and so forth. 	<ul style="list-style-type: none"> Same monitoring parameters and locations (where applicable) as per construction phase. 	<ul style="list-style-type: none"> Monthly inspection for the surface water quality and hydrology, especially during heavy storm events for hydrological conditions during 	<ul style="list-style-type: none"> Contractor

Environmental Issues	Management/Mitigation Actions	Monitoring Actions	Frequency	Responsibility
	<ul style="list-style-type: none"> ■ Implement regular protocols for managing stormwater collection, settling, testing, and the eventual discharge of 'clean' water into surface waters. This shall also involve measures to prevent the drainage of stormwater with high sediment concentrations into surface waters. ■ Consider increasing the amount of soft landscape in the development design to lower the runoff coefficient, which will help decrease peak flow and minimise flood risk in downstream areas. Active, Beautiful, Clean (ABC) Water design approach can be considered. ■ The potential increase in peak flow resulting from changes in land use at new developments can be mitigated by incorporating detention ponds within the Project Site. These ponds can accumulate stormwater during heavy rainfall events to help reduce peak runoff. The retained water can then be released back into the system after the storm. As per PUB requirements, the storage system shall ensure that peak flow during operation is equal to or less than the current condition. ■ Introduce more permeable surfaces to enhance the infiltration of surface water into the soil. ■ The geotechnical aspects concerning the stability of the site's slopes (such as ERSS) shall be incorporated into the detailed design engineering for the operational phase. ■ Ensure adequate disposal bins are provided around the Project site to prevent improper waste disposal. ■ Conduct regular inspections of the waste storage system associated with the Project. ■ Regular CCTV monitoring of the proposed water features and its surroundings shall be implemented to ensure that no contamination occurs. ■ Create an ERP and provide sufficient training for maintenance workers to manage accidental water contamination. ■ Enhance awareness among various stakeholders through initiatives (such as signage and warning signs). 		first three (3) month of operational period.	
Airborne Noise				
<ul style="list-style-type: none"> ■ Noise generated from traffic. 	<p>Minimum Controls for Traffic Noise</p> <ul style="list-style-type: none"> ■ Explore alternative locations for new road networks to minimise proximity to NSRs during the pre-design phase (if applicable). ■ Consider using low-noise pavement materials for segments of new road networks situated near NSRs. ■ Because there is insufficient data at this reporting stage, the appointed Noise Consultant will provide assessments, minimum controls, and mitigation strategies during the preliminary design phase, following NEA's Technical Guidelines for Land Traffic Noise Impact Assessment. 	<p>Mitigation Measures for Traffic Noise</p> <ul style="list-style-type: none"> ■ Traffic noise at drop-off zones and parking lots will be reduced by implementing low speed limits, speed bumps, and speed limit signage. These speed control measures are expected to decrease noise levels, as vehicles will be traveling at lower speeds. ■ Locate roads in areas that are further away from NSRs where practicable. 	<ul style="list-style-type: none"> ■ Not Applicable. 	<ul style="list-style-type: none"> ■ Not Applicable.

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Appendices



Appendix A – Wildlife Shepherding Plan

Wildlife Shepherding Plan (Rev 2)

EMMP Specialist Consultancy
Services for Sembawang N4



Wildlife Shepherding Guidelines (NParks, 2024)

Below are the guidelines* of wildlife shepherding:

1. Clearance should be phased from the most disturbed area (usually the side nearest to roads or existing developments) towards the **least disturbed area**.
2. An **unobstructed escape route** should be designed to channel wildlife out of the development site.
3. Clearance of the development site can be broken up into **zones**, where each zone is isolated from the next either by natural barriers that prevents animal movement or permanent hoarding structures.
4. Opaque **temporary hoarding** without gaps should be installed for each subzone that is being worked on, leaving the side furthest from the disturbed area open for fauna to exit the site

*Credit: *Technical note on Wildlife shepherding and pre-felling fauna inspection* (NParks, 2024)

Overall Wildlife Shepherding Areas

- Parcels to be cleared (exclude building area or demolished area):
 - Phase 1
 - Area 'A1'
 - Phase 2
 - Area 'A2'
 - Area 'A3'
 - Phase 3
 - Area 'A4'
 - Area 'A5'
 - Phase 4
 - Area 'A6'
 - Area 'A7'

- Passive shepherding for A1 & A7
 - Area 'A1' towards north direction
 - Area 'A7' towards southeast direction
- Designated trapping points at parcels A2-A6



Overall Wildlife Shepherding Process

Shepherding is divided into 3 main phases:

- Installation of Hoardings and ECM
- Phased Clearing
- Monitoring

Typical Shepherding timeline is illustrated here.

1. Trainings for the site personnel
2. Installation of hoardings, perimeter drains and clearing for access roads
3. Installation of ECM
4. Undergrowth clearance
5. Tree Felling
6. Closing up of Cleared Area
7. Commencement of Earthworks



*Localised wildlife shepherding is similar to Step 5 and 6

Trainings

Shepherding Steps

Step 1: Trainings

Before the start of shepherding:

- Site personnel should be trained on how to respond when encountering wildlife (*Biodiversity Awareness Training*)
- Site personnel should also be trained on how to conduct wildlife shepherding (*Wildlife Shepherding Training*)
- Training documents should be incorporated into the safety induction course and regular toolbox meeting.

FAUNA AWARENESS AND RESPONSES

 <p>Lesser Mousedeer (<i>Tragulus kanchi</i>)</p>	 <p>Clouded Monitor (<i>Varanus nebulosus</i>)</p>	 <p>Wild Boar (<i>Sus scrofa</i>)</p>
 <p>Asian Palm Civet (<i>Paradoxurus hermaphroditus</i>)</p>	<p>1) <u>Do not approach animal.</u></p> <p>2) <u>Leave the area, leaving the hoarding or pathway open to allow the animal to leave naturally.</u></p> <p>3) <u>Workers to inform their immediate supervisor.</u></p> <p>4) <u>Supervisor is to request assistance from NParks at the Ranger Station.</u></p> <p>5) <u>NParks to inspect situation and advise on follow up action.</u></p>	 <p>Sunda Pangolin (<i>Manis javanica</i>)</p>

 <p>Wagler's Pit Viper (<i>Tropidolaemus wagleri</i>)</p>	 <p>King Cobra (<i>Ophiophagus hannah</i>)</p>
<p>1) After sighting of ANY SNAKE, stop work within that immediate area.</p> <p>2) Monitor the location of the snake from afar.</p> <p>3) <u>At least 10m berth to be given for snakes</u>, both venomous and non-venomous, workers should not attempt to remove themselves.</p> <p>4) If snake does not move, cordon off the area; do not touch or harm the animal. If possible, safely take a photo of the animal from <u>10m away</u>.</p> <p>5) Inform ECO, PM and also Park Ranger with relevant documentation.</p> <p>6) NParks should remove the snake if it does not move on its own.</p>	

 <p>Long-tailed Macaque (<i>Macaca fascicularis</i>)</p>
<p>1) Stop whatever you are doing immediately.</p> <p>2) <u>Remain calm and quiet.</u> Do not make sudden movements and <u>do not maintain direct eye contact</u> with the monkeys.</p> <p>3) <u>Look away and back off slowly.</u> Do not turn away from the monkeys and run.</p> <p>4) If you are holding an object which is attracting the monkeys, conceal or discard it.</p> <p>5) <u>Do not try to hit the monkeys.</u></p> <p>6) Keep away from the area until the monkeys have left.</p>

 <p>NO TRAPPING OR CAPTURE OF ANIMALS</p> <p>Fine Up to \$5000</p>	 <p>NO LITTERING</p> <p>Fine Up to \$5000</p>
 <p>NO FEEDING OF ANIMALS</p> <p>Fine Up to \$5000</p>	 <p>NO SMOKING OR FIRES</p> <p>Fine Up to \$1000</p>
 <p>NO REMOVAL OR DAMAGE TO PLANTS</p>	 <p>STAY ON THE DESIGNATED PATHS</p>



Installation of Hoarding

Shepherding Steps

Step 2: Installation of Hoardings

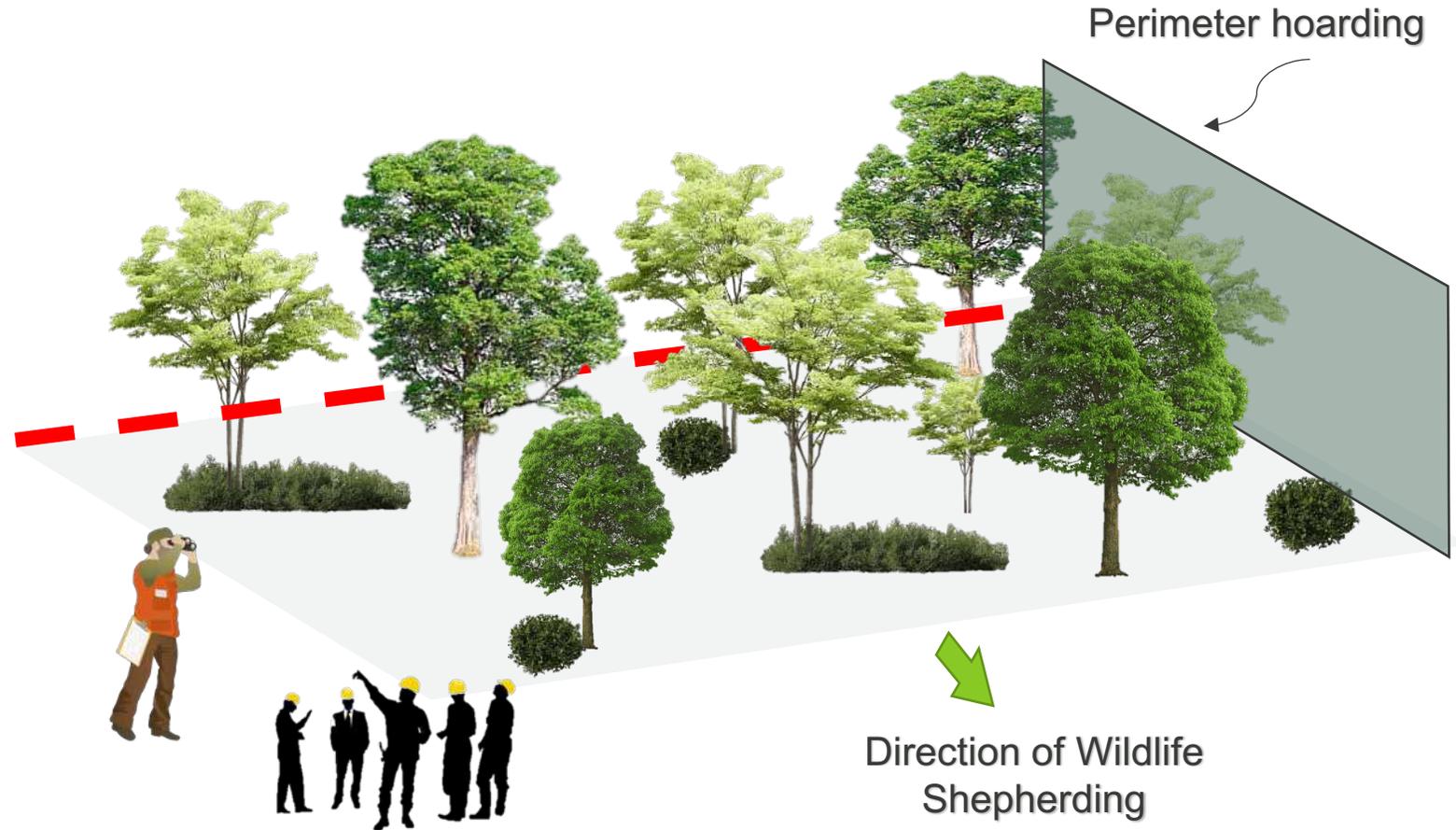
Before the start of shepherding:

- Installation of perimeter hoardings to prevent animals moving towards roads.
- 2 - 4 m working space for the installation of hoardings

Step 3: Installation of ECM

Before the start of shepherding:

- Setting up of Perimeter drain, Silt Fences, and ECM



Installation of Preliminary Hoardings and Speed Calming Measures

The Project boundary at each Area should be hoarded up with preliminary hoarding as per indicated in the map. Hoarding set up should start make use of existing access road.

During shepherding, Contractor should coordinate with the Wildlife Management Contractor to determine trapping locations for each parcel. The perimeter hoardings are positioned at the site boundary.

Perimeter Hoardings:

- 2 - 4 m working space, where appropriate
- 2.4 m minimum height (1.8m for temporary/internal hoarding)
- Smooth edge
- Perimeter drain
- Silt fence
- Embedded 300 mm into the ground

The clearing of 10 m access road should be cleared first, and subsequently installation of preliminary hoardings and ECM should occur before Phased Clearing. In addition, installation of hoardings should also occur before installation of ECM.

A Pre-Felling Check should be carried out for these advance clearings (i.e., 10 m access road, setting up of hoarding and ECM) if there are trees along the proposed hoarding route.

Speed Calming Measures:

- Animal crossing and speed limit signages would be installed to warn drivers to be wary of animal crossing the roads.
- Speed limit of 15km/h along construction access road



Legend

- Temporary Hoarding (1.8m)
- Phase 1 Hoarding (2.4m)
- Phase 2 & 3 Hoarding (2.4m)
- Phase 4 Hoarding (2.4m)
- Hoarding Direction
- Semi-naturalised Canal D2
- Underground Culvert
- EMMP Boundary
- Demolished Area
- Recreation Centre (partially-retained)

Author: SC

© OpenStreetMap (and) contributors, CC-BY-SA

Date: 1/12/2025



Project Code: P529383
Coordinate System: SVY 21

P529383 EMMP at Sembawang N4 EMMP Report

Types of Hoardings

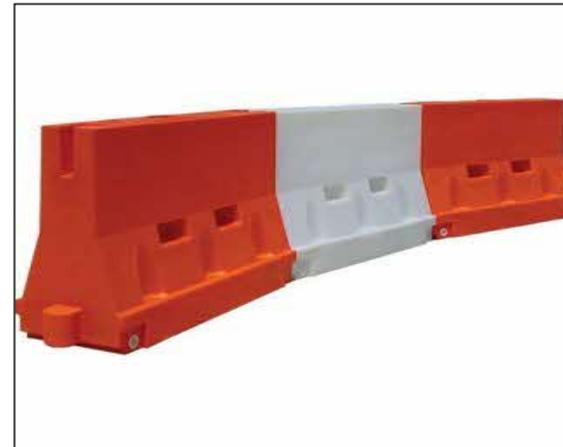


Fixed / Permanent hoarding

- Smooth top edge and silt fence weighted down towards the ground.
- Minimum height of 1.8 m, and opaque.
- The hoarding should also be embedded 300 mm into the ground.
- Perimeter hoarding prior to Phased Clearing should follow the above hoarding specifications.
- Noise barriers after Phased Clearing should also follow the hoarding specifications as above.



Gate with silt fence below
(Openings should not be larger than
50 mm)



Interlocking Water barrier
(without openings), as form of
temporary barrier can be used in
between sections



Fence netting for sections where
terrain is challenging and not
feasible for water barrier.

Clear Demarcation and Marking of Hoarding

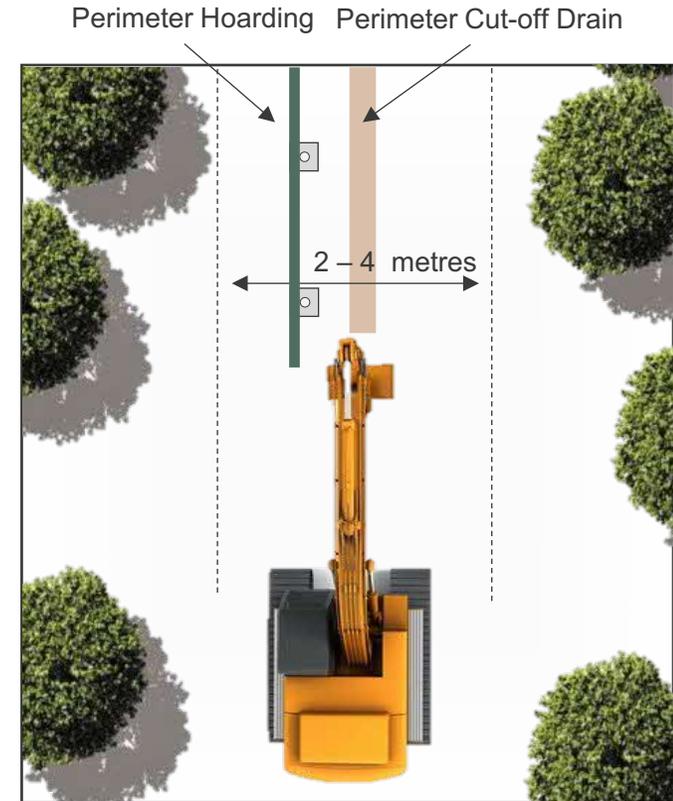
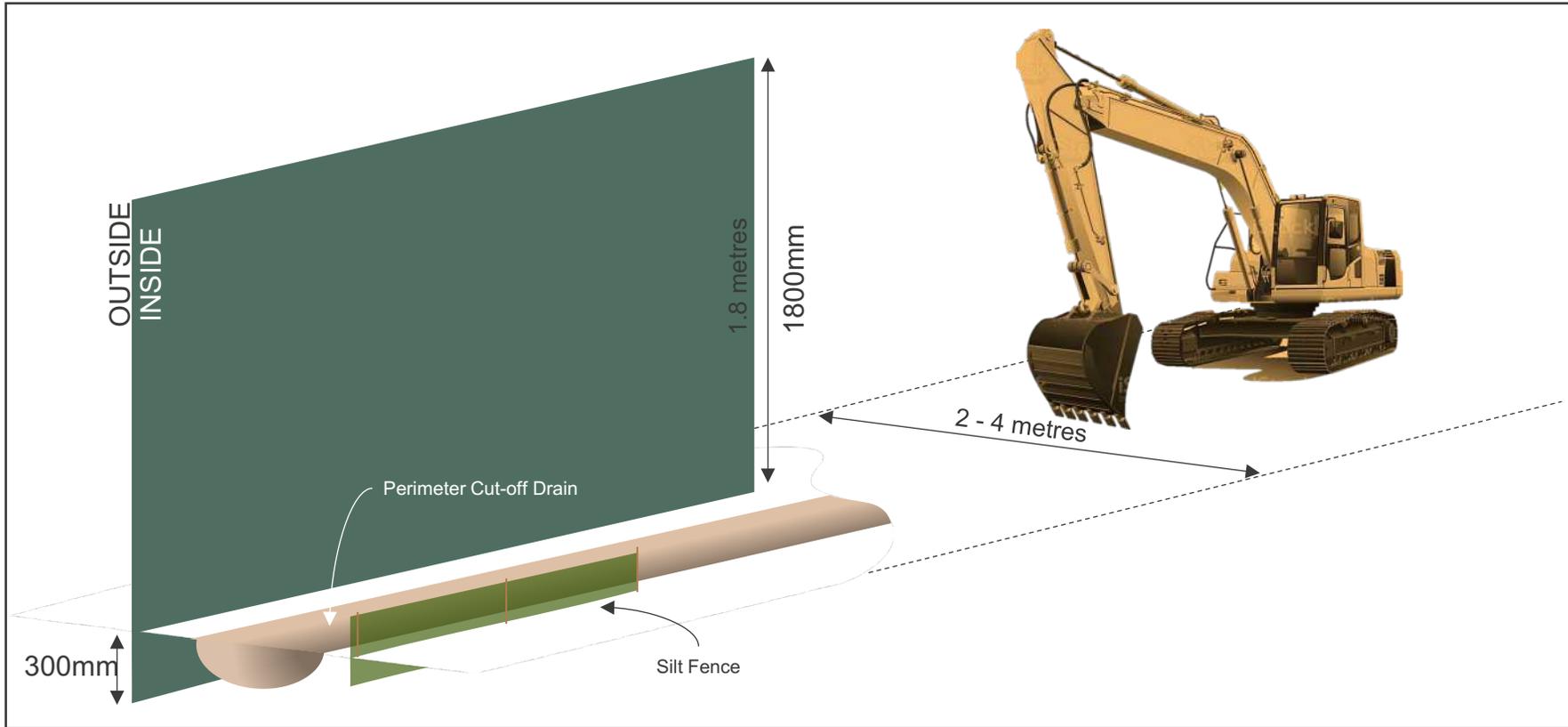


Spray paint is used on the initial hoarding to mark out wildlife shepherding sections. This ensures vegetation clearing is kept to the stipulated ~2,500 – 3,500 m² per day.



Clear demarcation of shepherding sections prior to any clearing. This can be done using red/white tape, or pegs in the ground. This ensures no excessive clearing beyond the intended boundary is carried out.

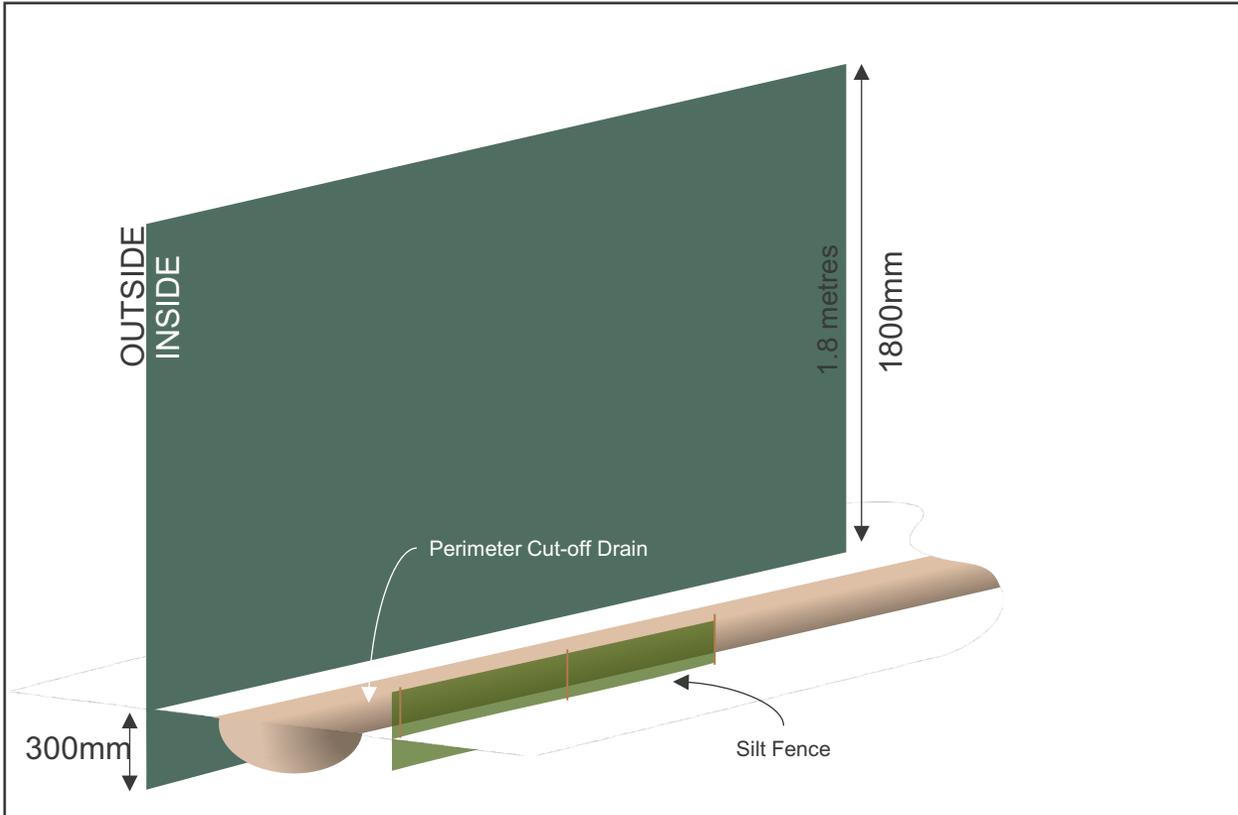
Preliminary Hoarding / Permanent Hoarding



Perimeter hoarding is to be set up around the site. This should be done before wildlife shepherding (Hoarding to be set up along the intended sides of the development)

Should setting up of the **perimeter hoarding** require any vegetation to be cleared, a pre-felling check should be conducted prior to the clearing. The clearing width should also not exceed 4 m. Use of a small excavator is ideal.

Preliminary Perimeter Hoarding Setup



Perimeter drains, 300mm embedded hoardings, silt fence, and ECM are to be in place before Phased Clearing commences. This ensures silty water does not exit the site during shepherding phase



Examples of **Permanent hoardings** placed along the perimeter. The installation of concrete bund or embedded silt fence may be tailored to better suit the site conditions.

Earth Control Measures (ECM)

Earth Control Measures (ECM) should be implemented prior to site clearance. This is to prevent silty discharge into the surrounding drain and canal. A detail ECM Plan will be prepared and endorsed by the Qualified Erosion Control Professional (QECP). The ECM Plan should be approved by PUB prior to the site clearance.

Perimeter Earth Drain and Silt Fences are advised to be set up in tandem with the hoardings to minimize working space. The ECM should only be set up after the hoardings have been set up. Holding Pond / Detention Tank should have Water Barriers and subsequently a permanent fence to prevent wildlife from entering the pond/tank. The site clearance for ECM facilities (treatment tank and sediment pond) will be cleared from the road side.



Water Barriers around Holding Pond



Perimeter Drain

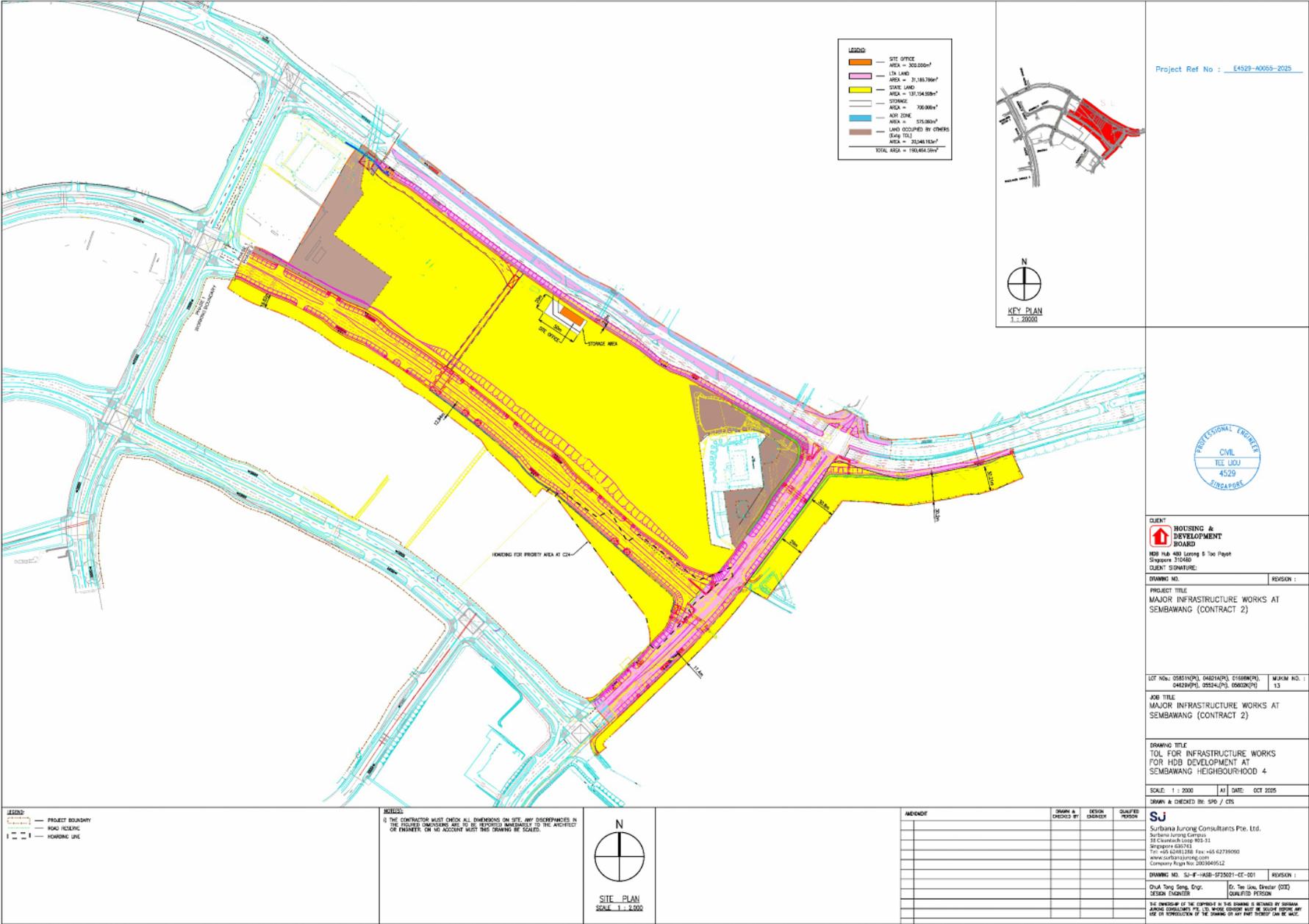


Treatment Tank



Silt Fences

Earth Control Measures (ECM)



Project Ref No : E4529-40055-2025



CLIENT
HOUSING & DEVELOPMENT BOARD
 HDB Hub 400 Lorong 8 Toa Payoh
 Singapore 310460
 CLIENT SIGNATURE

PROJECT TITLE
MAJOR INFRASTRUCTURE WORKS AT SEMBAWANG (CONTRACT 2)

JOB TITLE
MAJOR INFRASTRUCTURE WORKS AT SEMBAWANG (CONTRACT 2)

DRAWING TITLE
TOL FOR INFRASTRUCTURE WORKS FOR HDB DEVELOPMENT AT SEMBAWANG HEIGHSOURHOOD 4

SCALE: 1 : 2000 | DATE: OCT 2025

DESIGNED BY: **SJ**
 SURBANA JURONG CONSULTANTS PTE. LTD.
 31, Cross Street, #03-01, Singapore 048743
 Tel: +65 62412188 Fax: +65 62739000
 www.surbana-jurong.com
 Company Reg No. 2003046512

Wildlife Shepherding Plan – Phase 1 (Parcel A1 / C24 BTO)

Wildlife Shepherding is conducted through staged directional clearing of the site.

Aim:

- Passively shepherd wildlife to N4 forested area
- Shepherd wildlife towards northern direction
- Reduce mortality
- Reduce stress on wildlife from constantly moving

Partial perimeter hoarding should be erected according to map. Partial diversion of D2 will also be conducted concurrently, with trapping and translocation of aquatic fauna (if any).

Shepherding is limited to 8am – 6pm.

General progress per section:

Day 1: Undergrowth and shrub and grass clearance

Day 2 – 4: Buffer period for wildlife to move from the site

Day 5: Tree felling



Wildlife Shepherding Plan – Phase 2 (Parcels A2 & A3)

Wildlife Shepherding is conducted through staged directional clearing of the site.

Aim:

- Shepherd wildlife to designated trapping points
- Shepherd wildlife towards one direction
- Reduce mortality
- Reduce stress on wildlife from constantly moving

Temporary hoardings (e.g. water barriers) should be installed around each section (within an opening towards the shepherding direction) similar to a perimeter hoarding prior to any clearing.

Perimeter hoarding to be adjusted accordingly A1 / C24 BTO boundary (refer to map). Perimeter hoarding surrounding A2, A3, A4 & A5 should be erected prior to clearance.

Shepherding is limited to 8am – 6pm.

General progress per section:

Day 1: Undergrowth and shrub and grass clearance

Day 2 – 4: Buffer period for wildlife to move from the site

Day 5: Tree felling



Wildlife Shepherding Plan – Phase 3 (Parcels A4 & A5)

Wildlife Shepherding is conducted through staged directional clearing of the site.

Aim:

- Shepherd wildlife to designated trapping points
- Shepherd wildlife towards one direction
- Reduce mortality
- Reduce stress on wildlife from constantly moving

Temporary hoardings (e.g. water barriers) should be installed around each section (within an opening towards the shepherding direction) similar to a perimeter hoarding prior to any clearing.

Shepherding is limited to 8am – 6pm.

General progress per section:

Day 1: Undergrowth and shrub and grass clearance

Day 2 – 4: Buffer period for wildlife to move from the site

Day 5: Tree felling



Wildlife Shepherding Plan – Phase 4 (Parcels A6 & A7)

Wildlife Shepherding is conducted through staged directional clearing of the site.

Aim:

- For A6 – Shepherd wildlife to designated trapping point
- For A7 – Passively shepherd wildlife into N5 forested area
- Shepherd wildlife towards one direction
- Reduce mortality
- Reduce stress on wildlife from constantly moving

Hoarding for A6 & A7 to be adjusted once clearance has been completed.

Shepherding is limited to 8am – 6pm.

General progress per section:

Day 1: Undergrowth and shrub and grass clearance

Day 2 – 4: Buffer period for wildlife to move from the site

Day 5: Tree felling



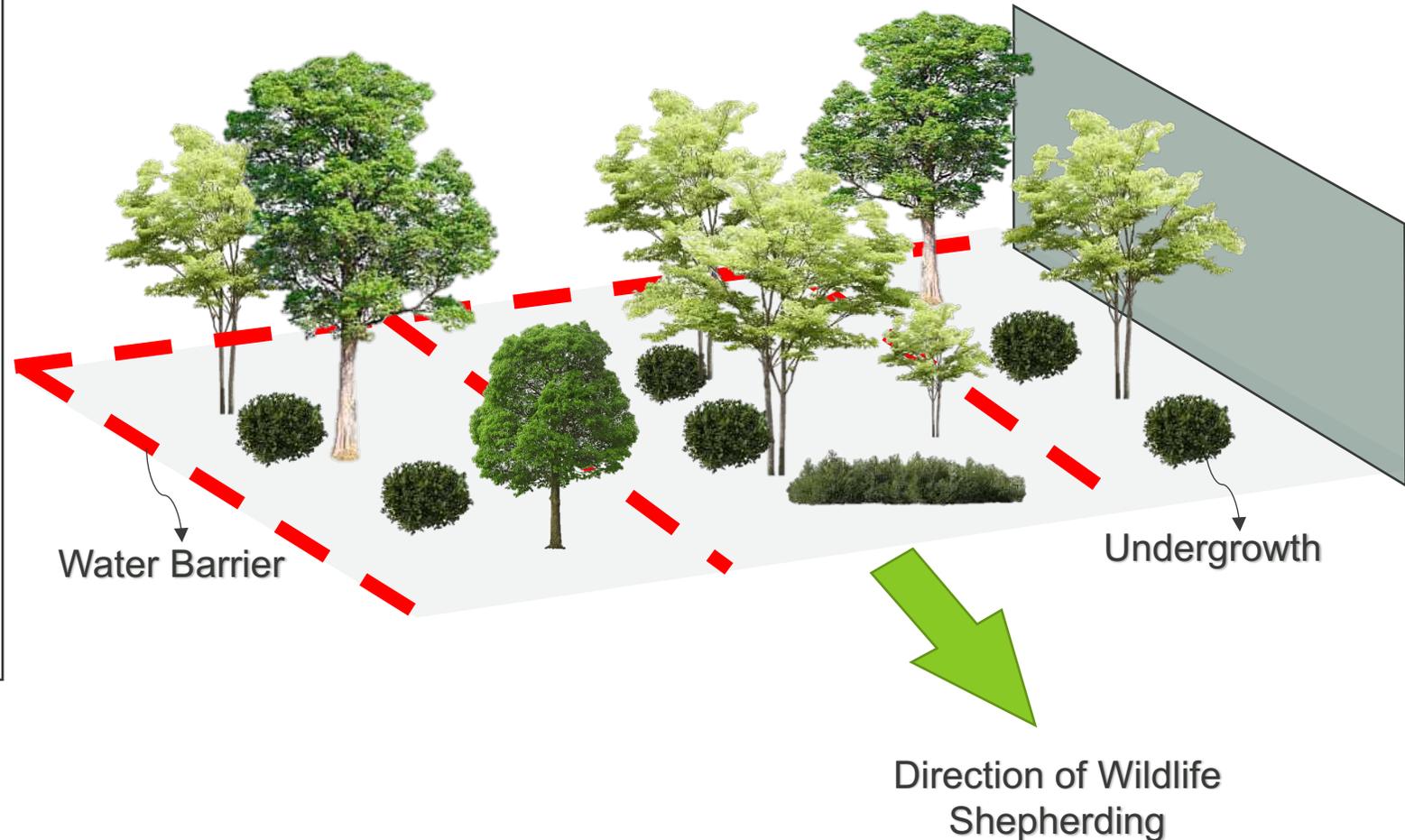
Wildlife Shepherding

Shepherding Steps

Step 4: Undergrowth Clearance

During shepherding:

- Contractors to clear the undergrowth (i.e., shrubs, grass)
- Undergrowth define as flora height $\leq 3\text{m}$
- Directional Clearing encourages arboreal wildlife to migrate to similar habitat
- Reduce stress on wildlife from constant moving
- Aurecon will be onsite weekly to observe the shepherding



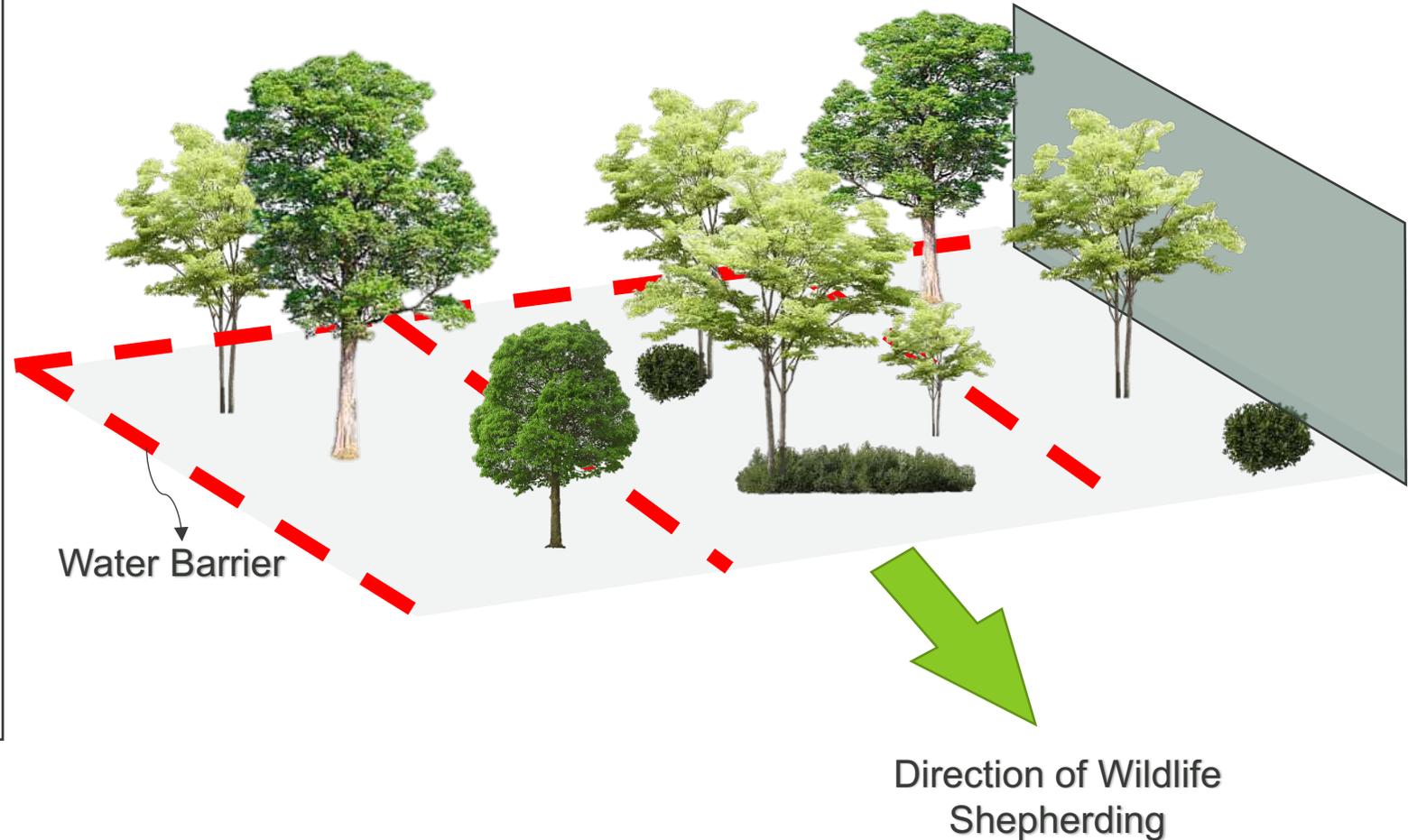
Wildlife Shepherding

Shepherding Steps

Step 4: Undergrowth Clearance

During shepherding:

- Worker can use whistle (to create noise) and stick (to disturb the vegetation) to shepherd wildlife away from the site.
- Excavator can knock the ground (to create vibration) to shepherding wildlife away from the site.
- Care should be taken during this stage, especially near trees.
- Workers are to look out for nest / burrows. If discovered, supervisor and Aurecon should be informed.



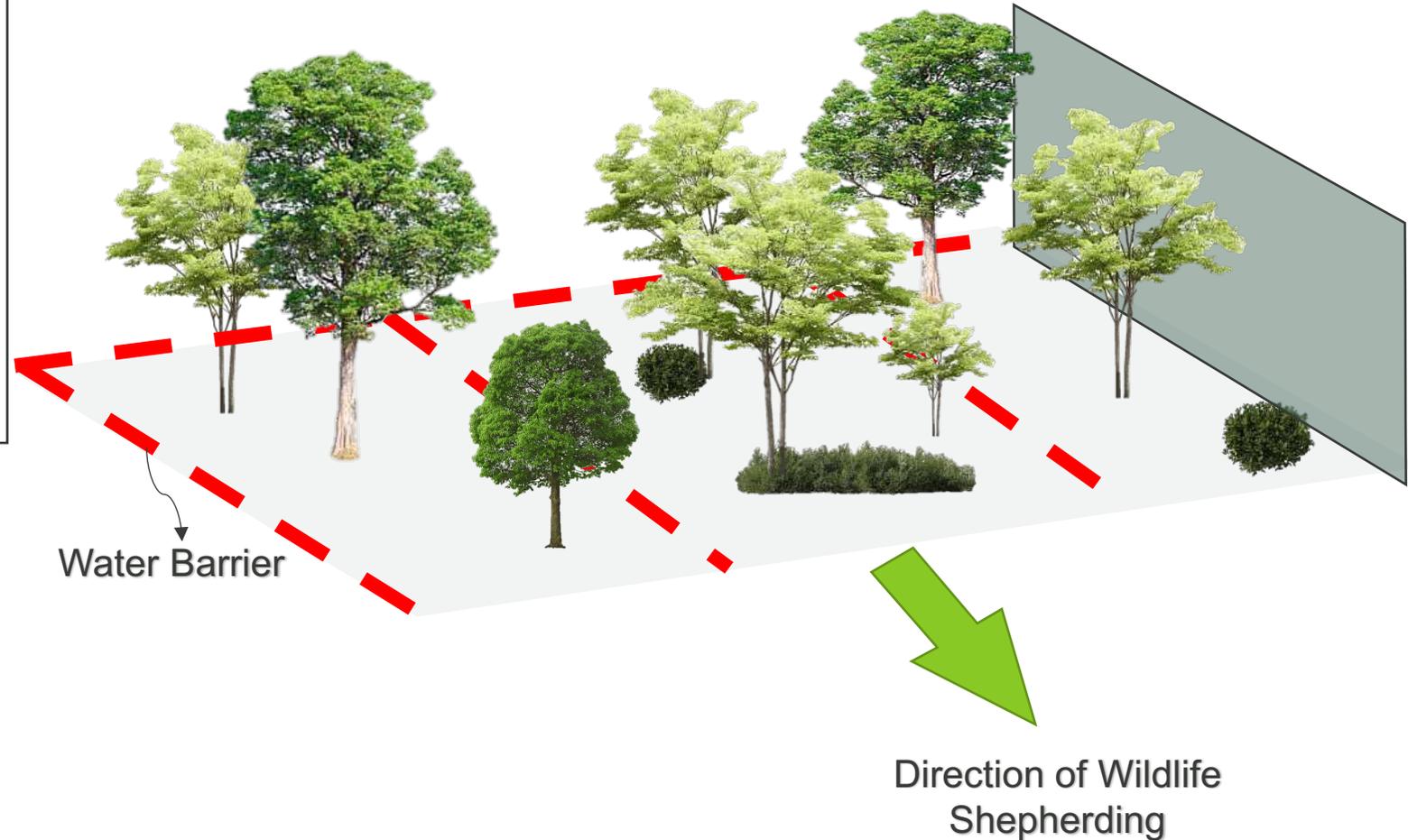
Wildlife Shepherding

Shepherding Steps

Buffer of 3 days

During shepherding:

- 3 days buffer after clearing would allow arboreal wildlife (tree dwelling wildlife) to move out of the site.
- During this period, no other clearing should be carried out.
- Movement of construction equipment through the buffer section is allowed.



Wildlife Shepherding

Shepherding Steps

Pre-Fell Check

- Aurecon would conduct survey of the area to be cleared. This is to check for nests, animals that may be burrowed, arboreal animals, or any sensitive species.
- Pre-Felling Check is only valid for ≤ 7 days.
- If a nest is detected, further assessment and eventually cordoning of the area around the nest.
- Assessed trees with active nests should be flagged and labelled to indicate tree is to be retained temporarily. Tree number, location and photographs of tree and nest are to be reported in the weekly pre-felling report.



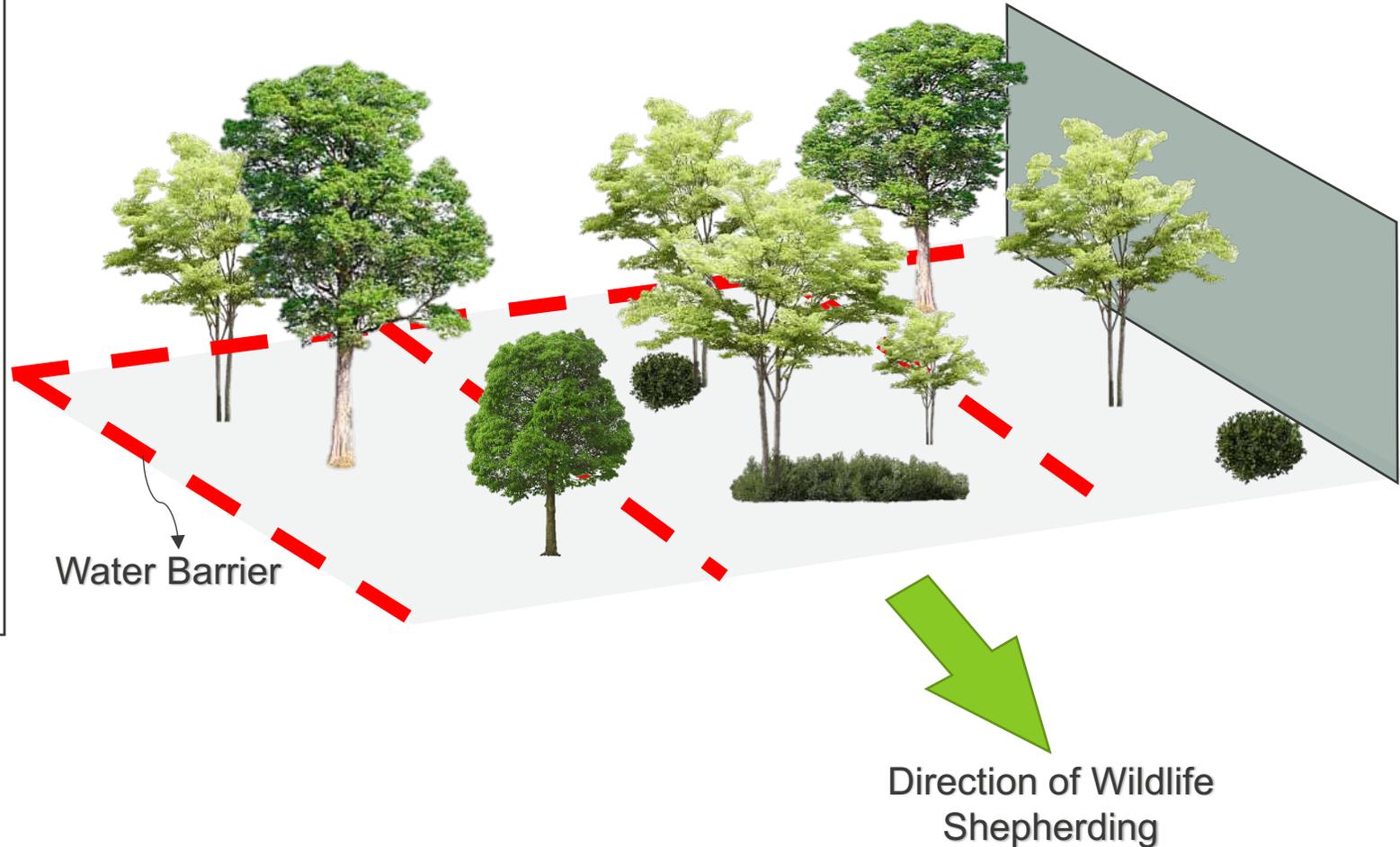
Critically Endangered Bamboo bats living within the bamboo internodes

Wildlife Shepherding

Shepherding Steps

Step 5: Tree Felling

- After buffer period has concluded and pre-fell checks have been completed, trees can be felled.
- Felled trees should be removed
- Should a nest be discovered during this stage, works are to halt immediately.
- Areas which are fully cleared should be entirely hoarded up by the end of the day. This is to prevent wildlife from reentering the site.



Wildlife Shepherding

Shepherding Steps

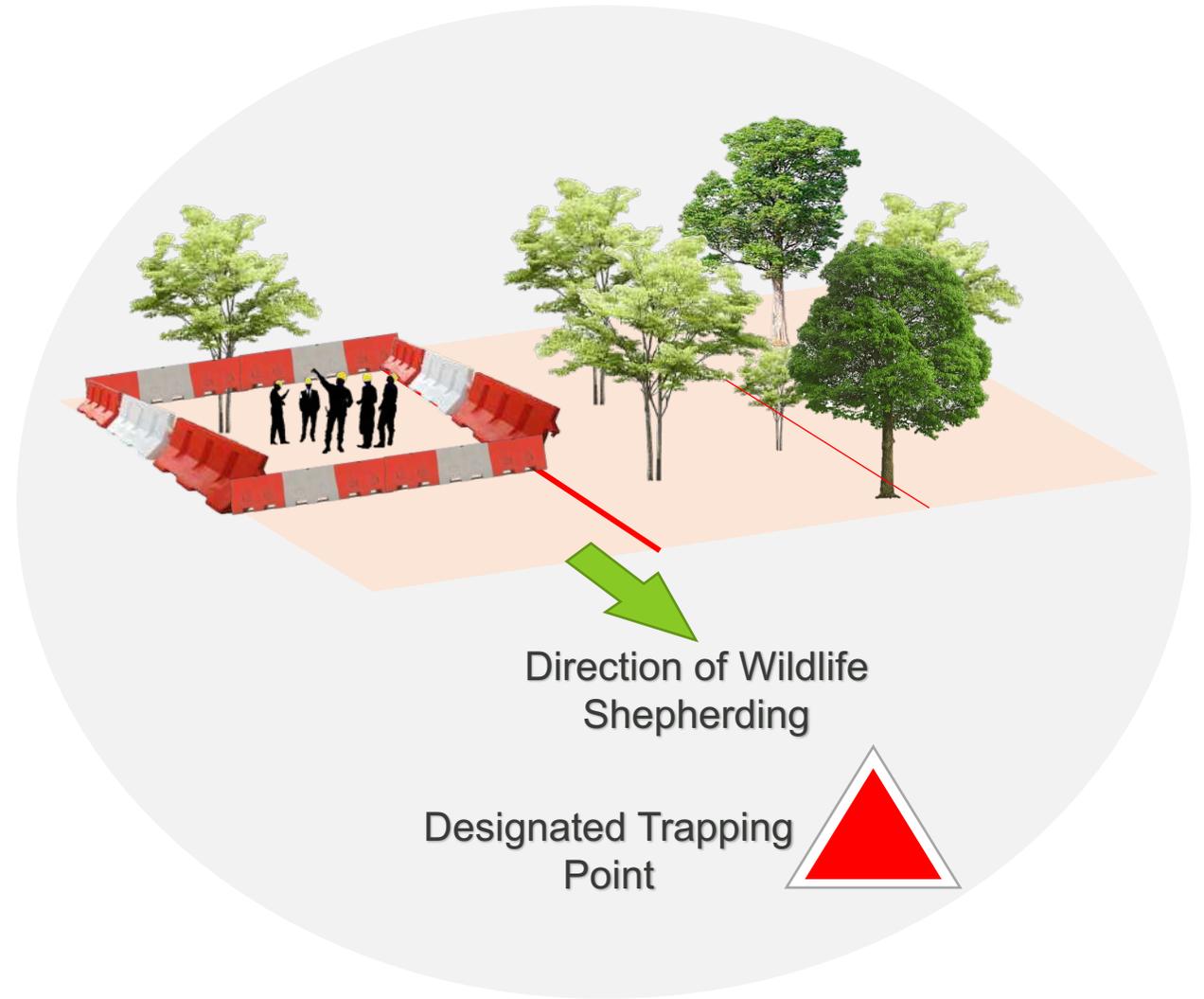
Step 5: Tree Felling

During shepherding:

- Should more time be required to remove either trees, or felled trees, any area that does not contain any trees should be fully hoarded up at the end of the day.

Step 6: Trapping Points

- The Contractor shall work with their engaged Wildlife Management Contractor to establish trapping points at each parcel during site clearance.
- Refer to Appendix C – Wildlife Translocation Plan for detailed info.

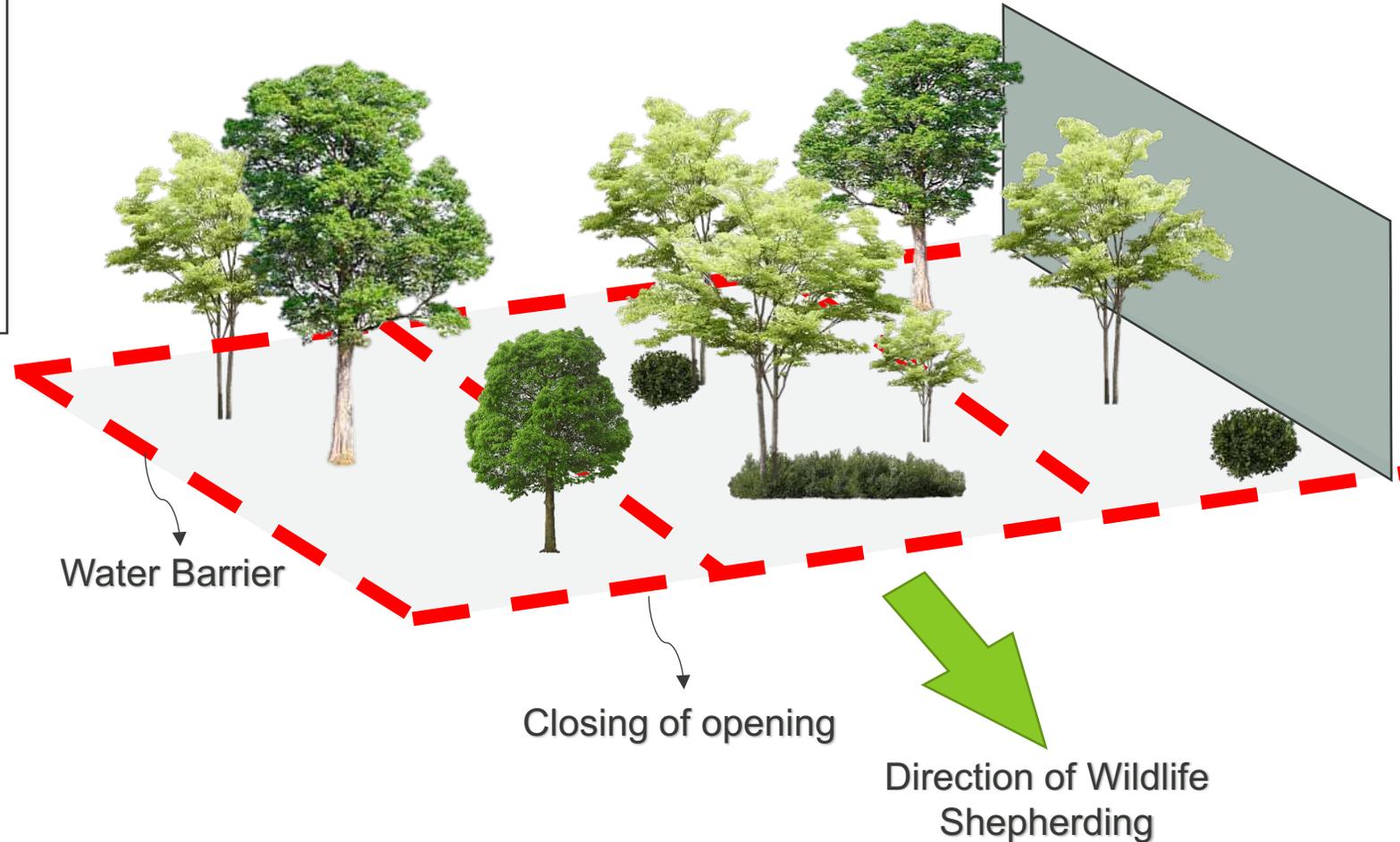


Wildlife Shepherding

Shepherding Steps

Step 7: Closing of Opening

- Water barriers may be used as a temporary barrier to prevent wildlife entry into cleared sites.
- Subsequently, water barrier should be replaced by proper hoarding/noise barrier.



Monitoring and Reporting

- Daily Checks by Contractor for wildlife entrapped within the development site (conducted at the start of the day).
- These checks should be along drains and at areas where ECBs are utilized.
- If trapped animal is found, proper procedure should be followed.
- Daily Checks by Contractor along access and adjacent roads. This is aimed at to identifying any roadkills or unnatural wildlife death (conducted at the start of the day).
- If carcass is found, proper disposal and reassessment of the mitigation measures.



Monitoring and Reporting

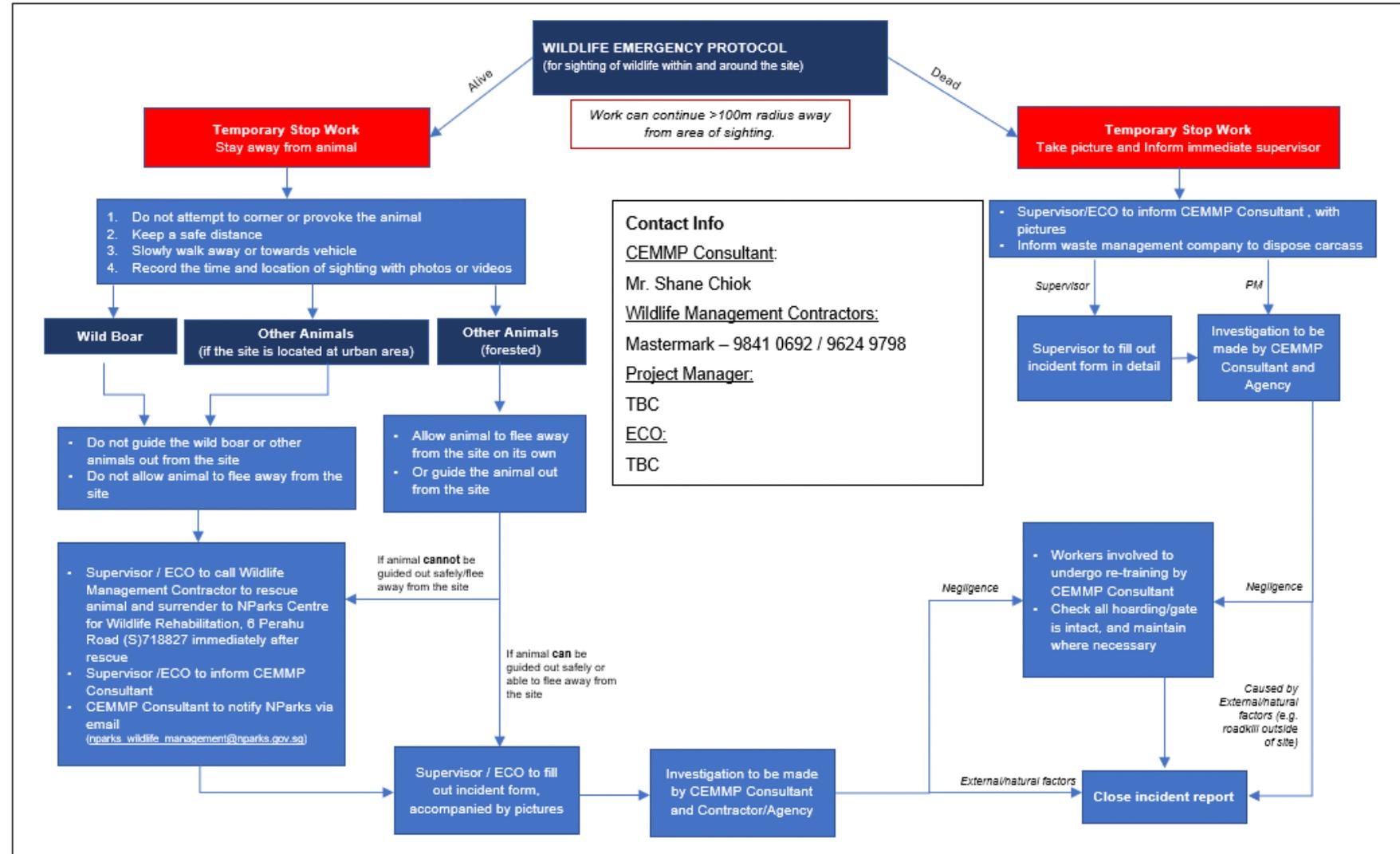
- Proper documentation of all shepherding sections and pre-felling checks by Aurecon.
- Weekly Wildlife Shepherding Report would be submitted by Aurecon.
- Weekly inspection by Aurecon would also be conducted

Sample Weekly Wildlife Shepherding and Inspection Report

Checks-List		Conducted by:	Date				
Hoarding and ECM Pre-Felling Check		xxx	20/12/2023				
Hoarding and ECM Installation		xxx	21/12/2023 – 31/01/2023				
Shepherding Training and Biodiversity Awareness Training		Xxx	01/01/2023				
Total Number of Sections : 5							
Sections	Pre-Fell Check Date:	Undergrowth Clearing			Tree Felling		
		Planned	Actual date	Comment	Planned	Actual date	Comment
1	1/1	2/1	2/1	On Schedule	6/1	6/1	On Schedule
2	1/1	3/1	3/1	On Schedule	7/2	7/1	On Schedule
3	1/1	4/1	4/1	On Schedule	8/2	10/1	Delayed

Wildlife Response Plan

- Should any trapped fauna be encountered during wildlife shepherding and trapping, the Wildlife Response Plan should be activated





Bringing
ideas
to life

 [linkedin.com/company/Aurecon](https://www.linkedin.com/company/Aurecon)

 [youtube.com/user/AureconGroup](https://www.youtube.com/user/AureconGroup)

 twitter.com/Aurecon

 [facebook.com/Aurecon](https://www.facebook.com/Aurecon)

 [instagram.com/Aurecon](https://www.instagram.com/Aurecon)

 [aurecongroup.com/podcast](https://www.aurecongroup.com/podcast)

Appendix B – Biodiversity Awareness Training Deck

Wildlife Response Plan and Awareness Training



Objectives

- Ensure all construction activities are conducted in a manner consistent with the **laws and regulations**, including applicable regulatory approval conditions from relevant authorities and agencies;
- Ensures proper and effective **mitigation measures** are taken with proper monitoring during the construction phase.
- Establish **emergency response** procedures for environmental incidents, including roadkill, trapped animal found at site and ensure effective corrective action is taken

General Biodiversity Awareness



Do not pluck flowers



Do not litter



Do not trap or kills animals



Do not feed the animals



Do not fish



Do not smoke



No naked flames

General Fauna Awareness and Responses

At the sight of any wildlife:

- **Stay** away
- **Leave** the particular area
- Document (with **photo/video**)
- **Inform** person in charge

1



2



3



Dangers of snakes

- **Stop** work (only at the immediate vicinity) if snake is sighted.
- **Do not** provoke or confront the snake (i.e., using broom/stick) and keep a safe distance away from the snake.
- The snake may try to look for dark and secure area and site personnel should observe where it hides, **inform** site supervisor only if the snake is hiding within the immediate vicinity of construction works.
- If the snake is still in the immediate vicinity of construction site and disruptive to the work, a **licensed** wildlife management contractor should be arranged to relocate the snake.
- Resume work after the immediate site is cleared from snake.
- Site supervisor to **inform** CEMMP consultant for documentation and reporting.



Dangers of Macaques / Monkeys

1. **Stop** work
2. Stay **calm and quiet**
3. **DO NOT** look at the monkey's eyes
4. **Hide or discard** any object with you
5. Back off **slowly**
6. **DO NOT** run
7. **DO NOT** hit the monkeys
8. **Stay away** from the area until monkey has left



Dangers of Wild Boar

1. **Stop** work
2. **DO NOT** go near the wild boars
3. Back off **slowly**
4. **DO NOT** feed the wild boars
5. If you see adult with **young piglets**,
leave them alone
6. Call approved **Wildlife Contractor** to remove wild boar if the animal is not able to be guided out safely from the site



Monitor Lizard

If you see any monitor lizard,

1. **DO NOT** touch / chase / corner it
2. Slowly move away and keep a safe distance
3. **Seek medical attention** immediately if you are bitten
4. Risk of **bacterial infection**



Bee/Wasp

If a bee / wasp lands on you?

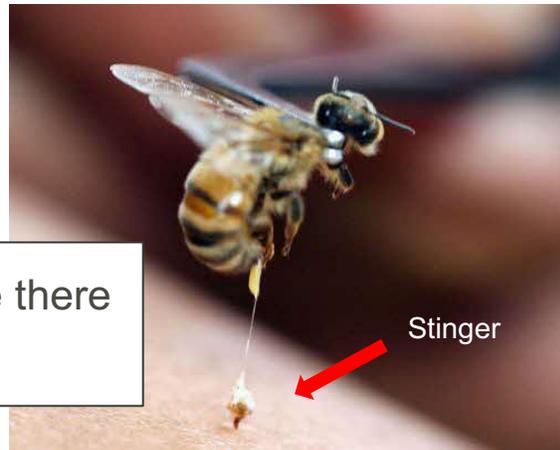
1. **DO NOT** smack the insect!
2. **Calmly move** the part of your body that the insect is resting on
3. If not, **gently** brush it off



- By a honey bee, a stinger will be there
- By a wasp, no stinger to remove

If you have been stung by a bee / wasp?

1. **DO NOT** pull the stinger with your fingers!
2. Scrape the stinger out using the edge of the card
3. **Wash** wound with soap and water
4. Apply **ice pack** and monitor for allergic reactions
5. Seek immediate **medical attention**



Bee/Wasp

If you are swarmed by bees / wasps?

1. **Cover head and move away** from hive
2. Move towards **shelter** to disorient the attacking bees
3. **DO NOT** swat at the insect
4. **DO NOT** jump into water



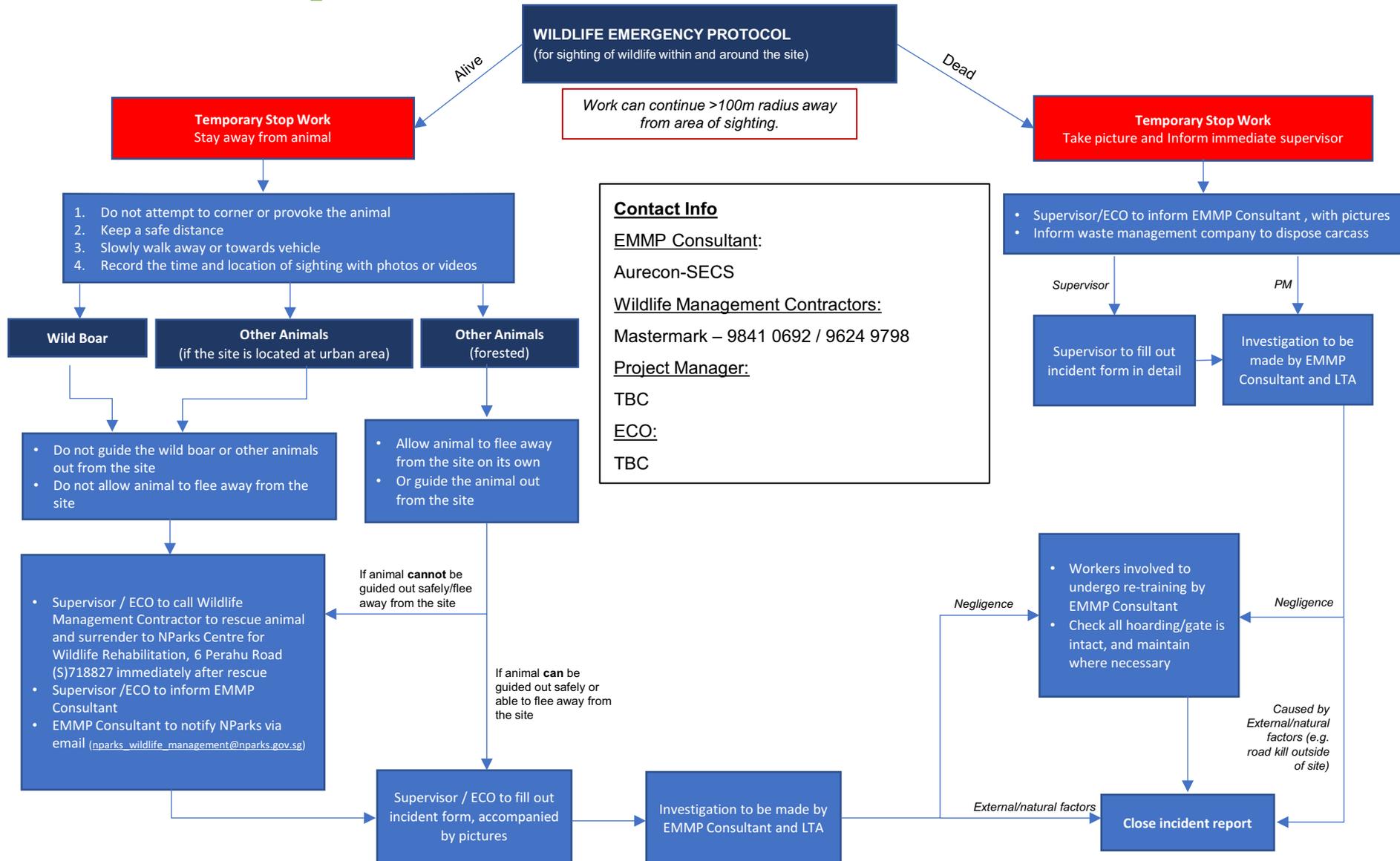
Bird Nests

If you see any bird nests,

1. **Stop** work
2. **Inform** CEMMP consultant
3. CEMMP consultant will arrange fauna specialists to **check** the nest
4. If an **active** bird nest is detected in a particular tree or vegetation patch at the Site at any time of the project, **stop** work in the immediate vicinity until there is no discernible activity at the said nest.



Wildlife Response Plan



Other Rules

No Exiting the Project Work Boundary

- No walking outside the Project Work Boundary
- Unless emergency



No Eating inside the Forest

- No consumption of food inside the forest



Equip Trash Bins with Buggy cords

- Install Buggy cords on trash bins near nature areas to prevent wildlife from rummaging through it



Erosion Control Blankets (ECB)



Only 100% Biodegradable **Erosion Control Blankets (ECBs)** is allowed to be used.

Some examples includes ECBs made of coconut husks



Non-biodegradable **ECBs** such as with nylon nets, could trap and cause injuries to small animals (i.e., snakes, pangolins, porcupines, and frogs)

In addition, Non-biodegradable ECBs takes a longer time to break down if left unattended in the forest

Public Registry of Certified Animal Management Specialists

A list of certified Animal Management Specialists is available for download:

<https://www.nparks.gov.sg/-/media/avs/am-public-registry-listing-19102022.ashx?la=en&hash=BED4DD1AE943902378346C0AAD30A9CFA3B4193D>

Animal Management Professional Certification Programme - Basic & Intermediate Practises (R - Reptile; B - Birds; M - Mammals)											
S/N	Full Name of CAMS	Cert No	B	R	M	Company Name	UEN	Company Address	Company Email	Contact #	DG-approved species to trap & take
1	Agnès Teong Suan Li	CAMS20001	B								
2	Fazli Bin Buang	CAMS20002	B	R	M	1800NESTS Pte Ltd	201222694E	9010 Tampines Street 93 #02-93, Tampines Industrial Park A, Singapore 528844	enquiry@1800nests.com.sg	62446926	Reptiles (Lizards, Snakes, Green iguana)
3	Kam Chia Huat (Gan Jialfa)	CAMS20003	B	R	M						
4	Tee Chea Chi	CAMS20004	B								
5	Soh Chiang Song	CAMS22037	B			800 Super Waste Management	198601155H	17A Senoko Way, Singapore 758056	enquiries@800super.com.sg	NIL	NIL
6	Lim Hoon Kok	CAMS22020	B								
7	Cheryl Chong Min	CAMS21089	B	R	M						
8	Hu Jian, Jerry	CAMS20005	B	R	M						
9	Mohamad Nazree Bin Suhaimi	CAMS21090	B	R	M						
10	Mohammad Fauzee Bin Othman	CAMS21091	B	R	M						
11	Muhammad Nazmi Bin Osman	CAMS20006	B	R	M						
12	Chia Kok Tieng	CAMS21152	B	R	M						
13	Tan Gee Kee	CAMS21153	B	R							
14	Muhammad Dzuhairyan bin Dzulkifli	CAMS21154	B	R							
15	Ramlan Bin Mustaga	CAMS21155	B	R	M	Aardwolf Pestkare (S) Pte Ltd	199700791R	26 Third Lok Yang Road, Singapore 628015	enquiries@aardwolfpestkare.com	62681771	Reptiles (Lizards, Snakes, Green iguana), Mammals (Common palm civet, Bats)
16	Mohammad Muzee bin Abdul Karim	CAMS21156	B	R	M						
17	Iswadi Bin Abdul Kadir	CAMS21157	B	R	M						
18	Muhammad Hafiz bin Saberan	CAMS21158	B	R	M						
19	Roger Tan Gak Chun	CAMS22033	B								
20	Lim Boon San	CAMS22029	B								
21	Nashrudin Bin R Azman	CAMS22034	B								
22	Ahmad Bin Wahib	CAMS22026	B								
23	Abdullah Uhaq Bin Abdul Karim	CAMS22031	B								
24	Tay Lian Chai Martin	CAMS22007	B								
25	Ng Jun Wei Dominic Pierre	CAMS22009	B			ArborCulture Pte Ltd	200209320W	53 Stirling Rd, Singapore 141053	info@arborculture.com	67920261	NIL
26	Rushan bin Abdul Rahman	CAMS22011	B								
27	Kalei Vanan	CAMS20007	B	R	M	ACRES	701500121K	91 Jalan Lekar, Singapore 698917	info@acres.org.sg	68929821	Birds (All), Amphibians (Frogs), Reptiles (Lizards, Snakes, Green iguana, Red-eared slider, Malayan box turtle), Mammals (Bats, Common palm civet, Squirrel, Treeshrew, Monkey, Cologos)
28	Neo Kar Chuan Terry	CAMS22028	B			All Out Pest Management Pte Ltd	202130083C	160 Robinson Road, #14-04 Singapore 068014	NIL	83660993	NIL
29	Mohamed Azhar Bin Mohamed Abdullah	CAMS22019	B			All Maintenance Pte Ltd	199707550Z	413 Tagore Industrial Avenue, Sindo Industrial Estate, Singapore 787803	NIL	68413128	NIL
30	Subash Gopal Pillai	CAMS22032	B			ARAS Development Pte Ltd	200904375D	2 Kaki Bukit Avenue 1, #07-01, Singapore 417938	enquiries@araspr.com	67822140	NIL
31	Ahmed Anik	CAMS22015	B			ARAS Development Pte Ltd					
32	Bahar Affandi Bin Abdullah	CAMS20008	B	R		Anticimex Pest Management Pte Ltd	198400909C	3A International Business Park #11-01/05, ICDN@IBP, Singapore 609935	pestfree@anticimex.com.sg	68523828	Reptiles (Lizards, Snakes, Green iguana)
33	Mohamad Hisham Bin Noh	CAMS20009	B	R							
34	Ku Ahmad Fitri Bin Ku Azmi	CAMS20046	B								
35	Muhammad Haikal Bin Razali	CAMS20047	B			Asia White Ant Control Co Pte Ltd	11003500C	334 Kreta Ayer Road #02-02, Singapore 080334	enquiries@asiawhiteant.com.sg	68412023	Reptiles (Lizards, Snakes, Green iguana)
36	Chong Ming Yan	CAMS20038	B	R	M						
37	Koh Teck Fong Terence	CAMS20039	B	R	M	System Pest Control Pte Ltd	199004930W	10 Ubi Crescent #06-81 Ubi Tech Park, Singapore 408564	singapore@systempest.com	67488966	Birds (All but Protected Wildlife Species), Reptiles (Lizards, Snakes, Green iguana), Mammals (Bats, Common palm civet)
38	Adlam Shah Bin Alias	CAMS20010	B	R	M	Azartz Services Pte Ltd	201905000W	37 Delu Lane 10 #05-79 Singapore 539214	enquiries@azartz.com	62846956	Birds (All but Protected Wildlife Species), Reptiles (Lizards, Snakes, Green iguana) Mammals (Common palm civet)
39	Muhammad Arafat	CAMS20021	B								
40	Sakthivelan S/O Nararajah	CAMS22036	B			Ban Chuan Trading and Engineering Pte Ltd	199000185N	637 Veerasamy Rd, #02-123, Singapore 200637	banchuan@banchuan.com.sg	62965118	NIL
41	Soh Jun Hua, Humphrey	CAMS20011	B			Bird Management Pte Ltd	201301277E	2 Gambas Crescent #03-08, Nordcom Two, Singapore 757044	birdmanagementsingapore@gmail.com	98981191	NIL
42	Goh Ioon Huat	CAMS21184	B			BION Environmental Pte Ltd	202017635C	21 Toh Guan Road East #08-03 Toh Guan Centre Singapore 608609	raymond.goh@bion.com.sg	90701438	Reptiles (Lizards, Snakes, Green iguana)

Emergency Contacts

Incident	Responsible Party	Person-in-charge	Contact
All environment incidents	Environmental Control Officer	(TBC)	HP: TBC
Encounter of dead animals	CEMMP Consultant	Mr. Shane Chiok	HP: 9362 4611
Encounter of injured animals	CEMMP Consultant	Mr. Shane Chiok	HP: 9362 4611
	Animal Response Centre	(TBC)	HP: TBC Animal Response Centre Hotline: 1800 476 1600
Fire events	Contractor	(TBC)	HP: TBC
Chemical/oil spills	Contractor	(TBC)	HP: TBC
	CEMMP Consultant	Mr. Shane Chiok	HP: 9362 4611

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Appendix C – Wildlife Translocation Plan

Specialist Consultancy Services for EMMP at Sembawang N4

Wildlife Translocation Plan

Housing and Development Board (HDB) Singapore

Reference: P529383

Revision: 3

2025-12-31



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1 Introduction

1.1 Project Site

Singapore Environmental Consultancy Services Pte. Ltd. (SECS; now part of Aurecon Singapore Pte Ltd and hereafter Aurecon) has been appointed by the Housing & Development (HDB) (Contract No. L/333/25), to carry out the development of Environmental Management and Monitoring Plan (EMMP) specifications for the proposed developments located in the Sembawang N4 area (hereafter referred to as the “Project”). The Sembawang N4 forest and its adjacent area – which has largely been slated for residential development to cater for housing needs – is an approximately 20.9 hectares (ha) site bounded by Admiralty Road to the north, Canberra Road to the east and Sembawang Drive to the west (see Figure 1 1; demarcated as “EMMP Boundary”).

The Project development area is situated near the forested tracts of Sembawang Airbase and the Simpang forested area. At present, the Project site features a semi-naturalised canal and forested areas, as well as the Sembawang and Cochrane Recreation Centres that are adjacent to the Project site. Eastwards of the Project area lies the Sembawang N5 forested area (not part of this contract), and the colonial houses along Ottawa and Bermuda Roads. The proposed development is to be constructed within the Sembawang N4 Project area (EMMP Boundary), involving site clearances, earthworks, construction of drains, road works, sewer, drain and road related facilities (e.g. bus shelters), construction and demolition works concurrently. The overall works for the Project can be segregated into two main stages of work: Stage 1 – for land clearance and infrastructure development; Stage 2 – infrastructure works for residential development.

An Environmental Impact Assessment (EIA) (full EIA is available online here) was previously conducted for the N4 Project site (‘Project’ defined in EIA approximately 53ha), as reported by AECOM in 2024. Taking into account the ecological sensitivity of these areas, including the proximity of the Project site to residential areas and educational institutions, this EMMP therefore provides: (i) recommendations for mitigation measures to be implemented to reduce ecological and human impacts; and (ii) provide specific monitoring measures with associated environmental quality objectives (EQOs) to assess the effectiveness of said mitigation measures. The adherence to, and implementation of said measures are vital to ensure that the construction activities will be conducted with minimal impacts to the surrounding ecological and human sensitive receptors.

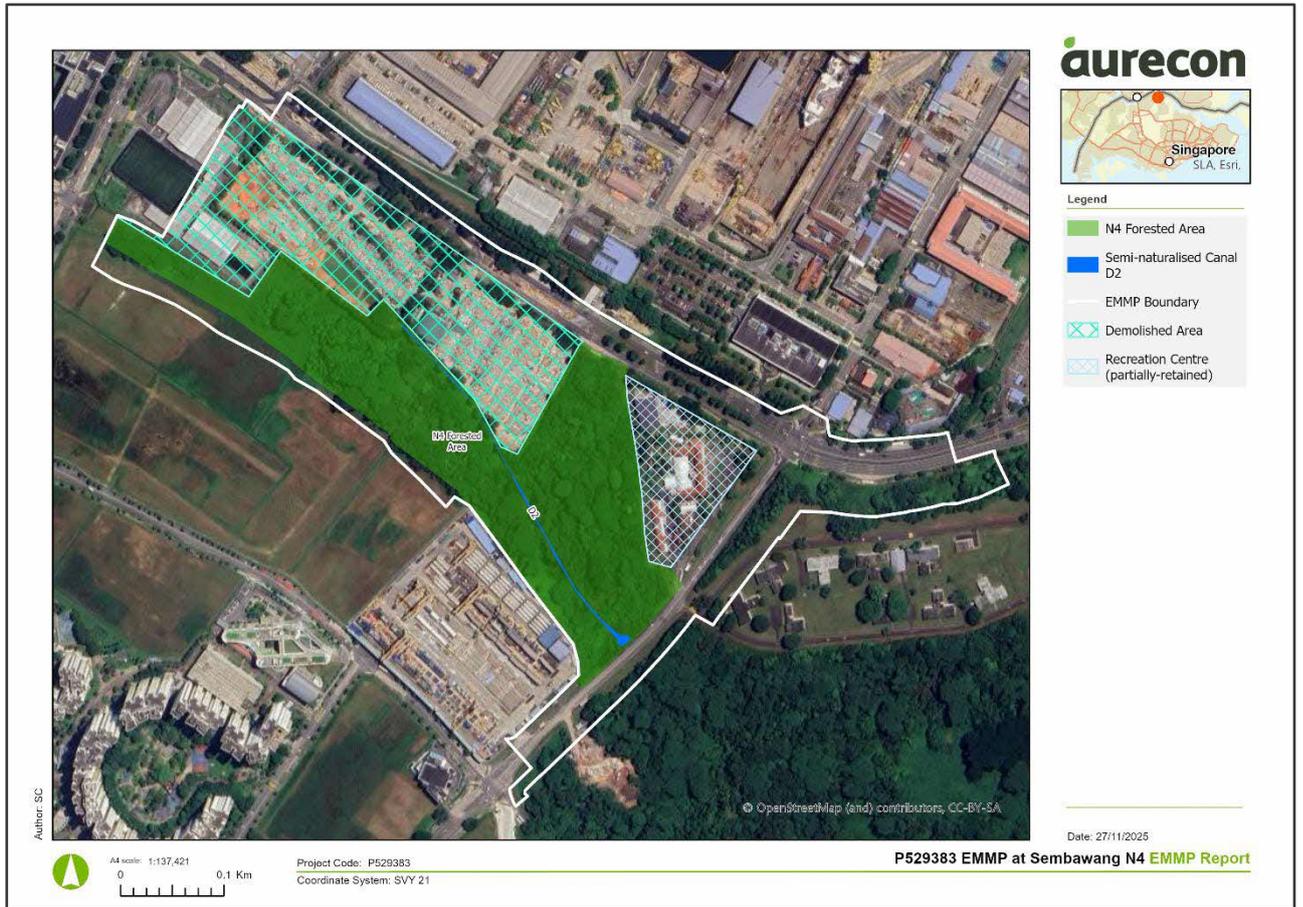


Figure 1-1 Sembawang N4 EMMP Project Boundary

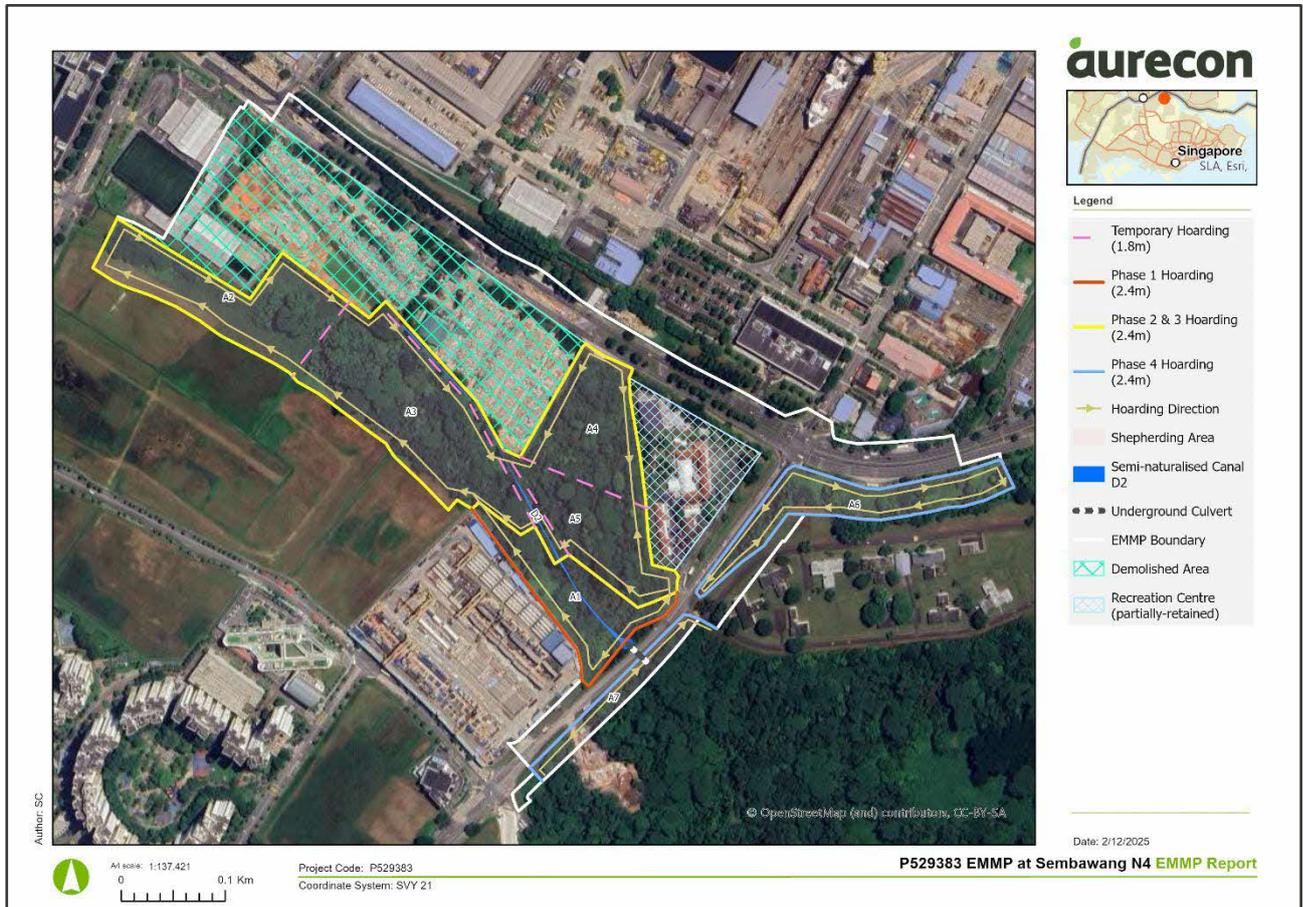


Figure 1-2 Proposed Hoarding Plan

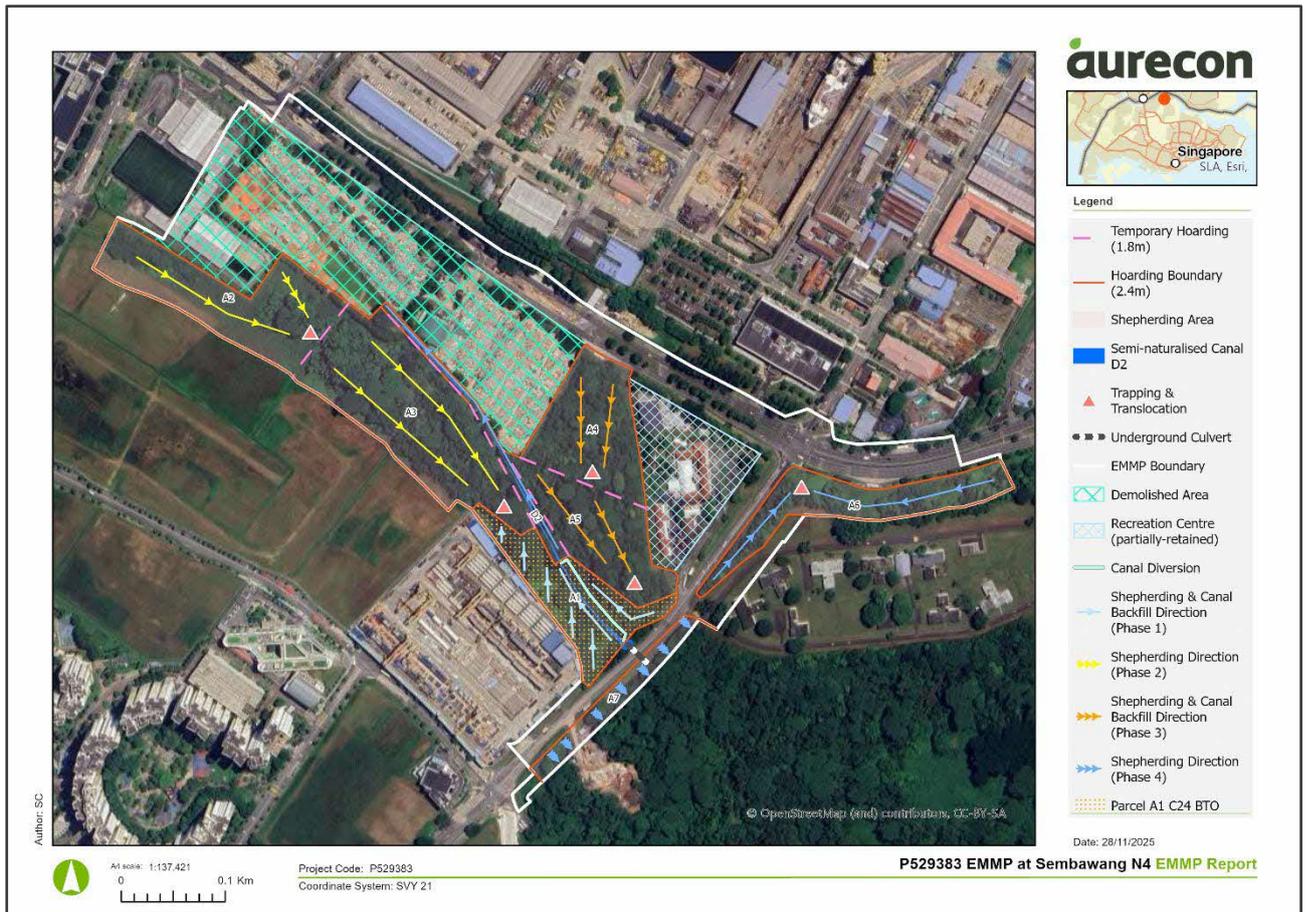


Figure 1-3 Proposed Wildlife Shepherding Plan

1.1 Objective

The objective of this Wildlife Translocation Plan is to provide an overview of the necessary Standard Operating Procedures (SOP) that shall be adhered to by the Contractor during the course of site clearance and wildlife shepherding for the Sembawang N4 EMMP Project. The relevant administrative and legal requirements are also stated, and specific considerations for locally threatened Asian softshell turtle are included.

1.2 Wildlife Shepherding Plan

1.2.1 Proposed Wildlife Shepherding/Site Clearance Sequence

Due to the necessity of prioritising land preparations for a near-term development at parcel A1 along Canberra Road, site clearance will commence from this parcel in advance. As Parcel A1 will be cleared in advance (via passive shepherding), the parcel boundary will be hoarded up with 2.4m height hoarding and the latter will be maintained for the remainder of the site clearance/wildlife shepherding works. In addition, the affected sections of the semi-naturalised canal D2 will be temporarily diverted within the site. The diverted stream will be maintained until the permanent roadside drains are constructed and commissioned – after which, the remainder of the canal will be backfilled and aquatic fauna trapped/translocated where applicable (see Appendix C). To facilitate this process, the internal hoarding delineating the parcels has been aligned accordingly to ensure proper segregation (Figure 1-2; Figure 1-3). Generally, the direction of shepherding from

west to east adheres to the recommendations in the EIA. The external hoarding boundary remains unchanged (Figure 1-2; Figure 1-3).

It is noted that the comments from the nature group engagement during the EIA recommended for the culvert to be used. However, given that parcel A1 is to be cleared first and water flow will not be diverted from culvert, it will therefore not be feasible to utilise the existing underground culvert connecting N4 and N5 across Canberra Rd. Instead, trapping and translocation of animals are proposed at each stage of site clearance. For clarity the sequence will be described in the following phases:

- Phase 1:
 - Site clearance (minimal or avoided) for Parcel A1 (C24 BTO) via passive shepherding into N4 forest (no trapping), with concurrent partial diversion of culvert and backfilling of D2 (within affected area in A1; see Figure 1-3 for indicative diversion plan)
 - Includes trapping and translocation of aquatic fauna (if any)
 - Partial hoarding of the A1 parcel to be erected prior to passive shepherding
 - Followed by perimeter hoarding installation and D2 temporary hoarding for remainder of site (with minimal site clearance), ECMs and drainage, site office and site access setup
 - Perimeter hoarding shall then be adjusted to exclude C24 BTO / Parcel A1 after clearance has been completed
- Phase 2:
 - Clearance of Parcel A2 and A3, with adherence to Fauna Management during Site Clearance and General Site Clearance Sequence; but note that active trapping and translocation points for animals indicated on the map in Figure 1-3 shall be implemented
- Phase 3:
 - Clearance of Parcel A4 and A5, followed by full backfilling of D2 upon completion of final diversion and box culvert construction
- Phase 4:
 - Clearance of Parcel A6 and A7. Note that A7 will involve passive shepherding as well into the N5 forest (no trapping), and that the planned works for Phase 4 will only occur in September 2026.

At any stage/parcel where animals are planned to be trapped at the designated points, the Contractor shall inform the EMMP Consultant and activate their NParks-certified Animal Management Contractor to conduct the trapping and translocation, in accordance with NParks procedures.

1.2.2 General Biodiversity

The Contractor and their engaged Wildlife Management Contractor shall note the legislative requirements for handling of wildlife in Singapore (see 2.1.1.1 Wildlife Act). The Wildlife Management Contractor shall propose the detailed trapping methodology, during their application for approval to the Director General of NParks. This document serves as a guidance. The proposed trapping procedure is described in the section on Wildlife Trapping and Translocation Plan.

The list of protected wildlife species shall be noted, and all necessary requirements shall be adhered to.

1.2.2.1 Asian Softshell Turtle (*Amyda cartilaginea*)

While the EIA (AECOM, 2024) did not record the Asian softshell turtle (*Amyda cartilaginea*), in the N4 Forested Area and within the semi-naturalised canal D2 (Figure 1-1), an individual was spotted within canal D2 (Figure 1-3) of the N4 forested area (Chen & Luqmanul, 2024). As the species is listed as Vulnerable in the Third Edition of the Singapore Red Data Book, there is therefore a need to formulate a species-specific management plan during site clearance and backfilling works.



Figure 1-4 Photos of Asian softshell turtle documented by Chen & Luqmanul, (2024).

2 Administrative and Legislative Requirements

2.1 Biodiversity Legislations

The main legislation relevant to the protection, preservation and management of biodiversity within Singapore are the Parks and Trees Act 2020, Planning Act 2020 and the Wildlife Act 2020, which was originally the Wild Animals and Birds Act 1985, with specific amendments. This is reinforced by Singapore's various commitments and guidelines aimed at promoting biodiversity conservation, such as the National Biodiversity Strategy and Action Plan (NBSAP) in 2009 and updated in 2019 based on the Convention on Biological Diversity Strategic Plan, and the Aichi Targets for 2011-2020.

2.1.1.1 Wildlife Act

The *Wildlife Act* has been in effect since June 1, 2020. Table 2-1 provides a summary of the relevant sections to this Project based on the current version. All site personnel will be briefed on the relevant legal requirements and penalty from the *Wildlife Act* during the Biodiversity Awareness Briefing, prior to work at site.

It is essential to obtain the (NParks) Director-General of Wildlife Management's written approval to be obtained prior to any works being carried out.

Table 2-1 Summary of Wildlife Act 2020

Activity	Applicable Section	Legal Requirement	Penalty
Feeding of wildlife	5A	<i>A person must not intentionally feed any wildlife in any place unless the person has the Director-General's written approval to do so</i>	<i>For a first offence, to a fine not exceeding \$5,000 For a second or subsequent offence, to a fine not exceeding \$10,000</i>
Releasing of wildlife	5B	<i>(1) A person must not intentionally release any wildlife in any place unless the person has the Director-General's written approval to do so. (2) A person who has the Director-General's written approval mentioned in subsection (1) must comply with the conditions of the approval.</i>	<i>A person who contravenes subsection (1) or (2) shall be guilty of an offence and shall be liable on conviction to a fine not exceeding \$5,000.</i>
Killing, trapping, taking or keeping of wildlife	5C	<i>A person must not intentionally kill, trap, take or keep any wildlife in any place unless the person has the Director-General's written approval to do so.</i>	<i>In the case where the offence is committed in respect of a protected wildlife, to a fine not exceeding \$50,000 or to imprisonment for a term not exceeding 2 years or to both.</i>
Wildlife-related measures for development or works	10	<i>The Director-General may direct a person to implement, in respect of any development or works being carried out, or to be carried out, by or on behalf of the person, any wildlife related measure that the Director-General considers necessary to safeguard</i>	<i>A person who, without reasonable excuse, contravenes subsection (3) shall be guilty of an offence and shall be liable on conviction to a fine not exceeding \$50,000 or to imprisonment for a term not exceeding 6 months or to both.</i>

2.2 NParks-certified Wildlife Management Contractor

The Contractor shall engage an NParks-certified Wildlife Management Contractor (see following [link](#) for list of certified companies). Should wildlife and/or turtle(s) be encountered, the rescue operations shall be conducted with the presence of a personnel/staff from the NParks-certified Wildlife Management Contractor that has undergone the [Animal Management Professional Certification Programme \(PCP\) – Mammal/Reptile Module](#), where feasible.

3 Safety and Logistical Requirements

3.1 Safety Precautions

- Personnel should wear gloves when handling turtles to avoid scratches or bites and to prevent the turtles or canal from being contaminated by repellents.
- Hands must always be kept behind the midpoint of the carapace (top shell) or sides of the turtle's shell.
- When restraining turtles, staff should maintain a steady and secure grip without using excessive force, which may injure the animal.
- In case of a bite, handlers should stay calm and avoid pulling away forcefully to prevent further injury. The turtle will eventually release on its own.
- Hands must always be washed after handling turtles.

- Capture, handling, and transport should be carried out quickly and efficiently to minimize stress to the turtles.
- Holding containers must have sufficient ventilation holes and should be opaque to reduce stress.
- Transport vehicles must remain well-ventilated and kept cool throughout the journey.

3.2 Equipment

- Non-powdered latex gloves
- Thick bite-proof gloves (to be worn over latex glove or alone) and/or rubber-coated gloves
- A disinfected holding container
- Towel for lifting and handling the turtle

4 Wildlife Trapping and Translocation Plan

The Contractor and their engaged Wildlife Management Contractor shall refer to the Wildlife Shepherding Plan to execute the site clearance in conjunction with wildlife trapping. All wildlife/animals that are trapped at each stage/parcel of the site clearance shall adhere to the following procedures:

- 1) Notify NParks at least one week prior to the start of works.
- 2) Ensure perimeter hoarding has been setup.
- 3) Carry out a pre-felling fauna inspection of trees to be felled.

Halt all works immediately if trapped animals are detected. Enact the Wildlife Response Plan. Conduct wildlife rescue operations whenever trapped animals are discovered. Proceed with works only if no trapped animals are found.
- 4) Begin vegetation clearance towards designated trapping point. Execute the rescue and translocation methodology and enact the Wildlife Response Plan where necessary.
- 5) Repeat Steps 3 & 4 for subsequent parcels. Ensure temporary hoarding with sealed bases are constructed upon clearance of parcels, to prevent backflow of wildlife.

4.1.1 Trapping and Translocation Methodology

If Asian softshell turtles are found during surveys, diversion, or backfilling, they will be rescued and handed over to NParks. This would minimise the mortality and injury of the turtles along the canal. The rescue of these turtles includes: 1) handling. 2) transportation and 3) handover of the captured turtle.

Handling and Capture

- Turtles should first be guided into an enclosed space (e.g., using a fish net).
- Surveyors must wear bite-proof gloves and prepare the holding container before capture.
- Approach turtles slowly and calmly to avoid startling them.
- Once captured, maintain a secure but gentle grip. The animal should be held with:
 - An appropriate tool (e.g. snake hook) or if unavoidable, with hands
 - One hand under the body between the hind legs, and the other hand on the top.
 - Alternatively, a towel can be used to lift the animal safely.
- Transfer the animal to the holding container immediately, keeping handling to a minimum.

- Each animal should be kept in an individual, ventilated carrier/cloth bag or tank with canal water (if necessary). Carriers/Tanks should be covered with opaque cloth to reduce stress (Figure 4-1).

Transportation

- Use a clean, disinfected holding container with a secure cover.
- Containers must have ventilation holes smaller than the animals' head.
 - Only one animal per container, unless they are mother-child.
- Transport vehicle must remain cool and well-ventilated.
- Containers should be washed and disinfected after use to avoid spreading disease.

Handover

- After capture, inform Animal & Plant Health Centre (Figure 4-2)
 - If immediate transfer is not possible (max. 2 days delay), animals must be kept indoors in the same container/carrier setup.
 - If same-day handover is possible, capture animals must be delivered to the Animal & Plant Health Centre (APHC), 6 Perahu Road, Singapore 718827 (via the designated gate) or another NParks-directed location.
- NParks will take over the rescued/trapped animals and conduct health checks. After which, the translocation destinations will be determined by NParks.
- For the Asiatic softshell turtle, refer to the species-specific section.

Safe transport with minimum delay

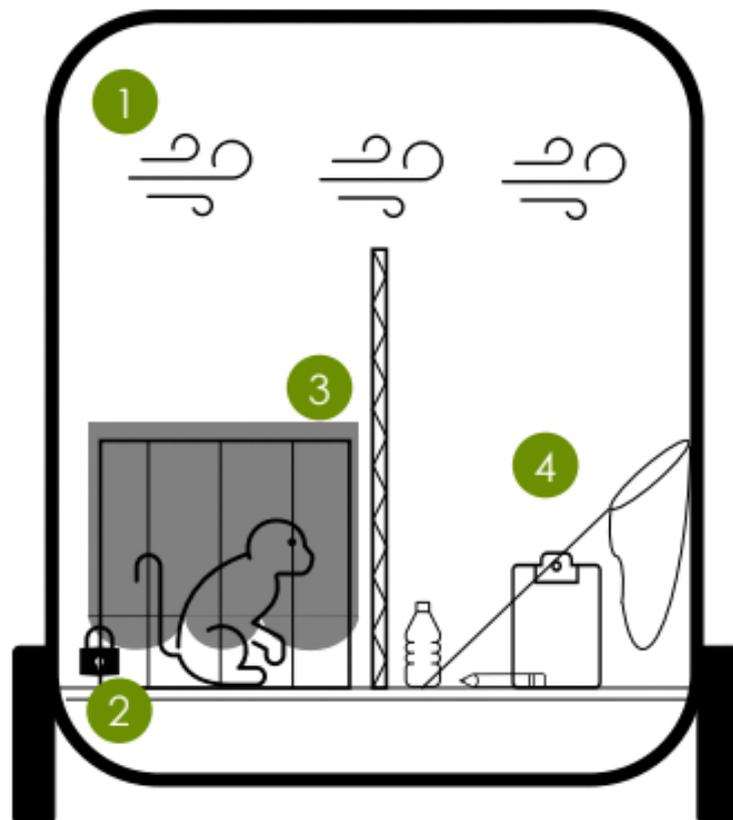


Figure 4-1 Sample Photo of Container House Provisions (Source: NParks)

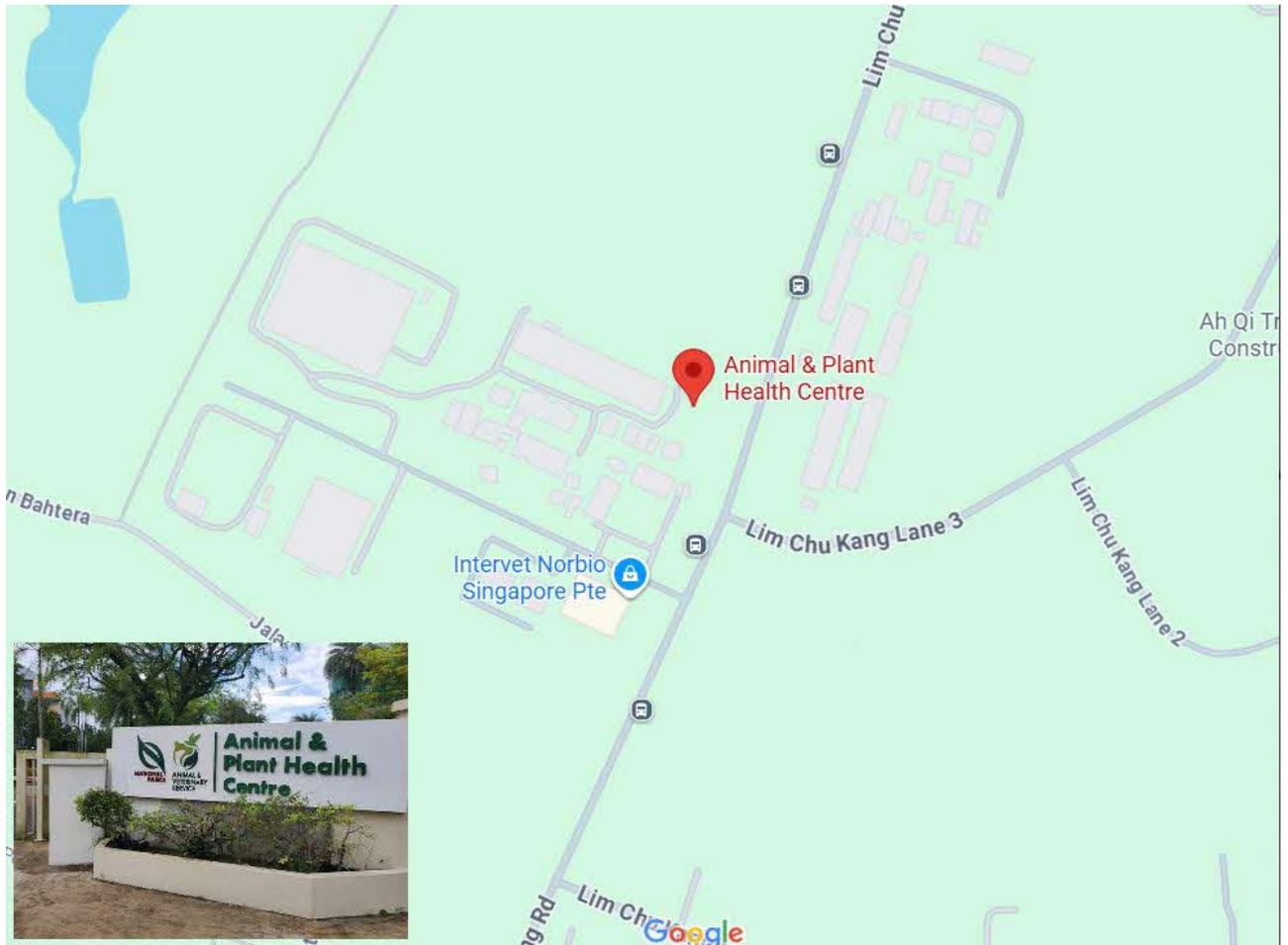


Figure 4-2 Location for Animal & Plant Health Centre

4.2 Turtle Rescue Plan

4.2.1 Rescue Operations Procedure

This section details the procedures relating to canal diversion and backfilling works. Before any canal diversion or backfilling works, the Contractor must inform the EMMP Consultant and NParks at least one week in advance. The broad sequence of events are as follows:

Stage 1

- 6) Notify NParks at least one week prior to the start of works.
- 7) Divide the canal into sections using BRC mesh.
- 8) Conduct a night survey of accessible areas in the canal.
- 9) Carry out a pre-backfilling inspection.
- 10) Begin vegetation clearance. If any Asian softshell turtles are found, **all works must be halted immediately.**

Stage 2

- 11) Notify NParks again at least one week before works begin.
- 12) After bund wall construction, separate the canal into sections using BRC mesh.

13) Inspect the canal.

14) Proceed with works only if no turtles are found. **Halt all works immediately** if turtles are detected.

15) Conduct turtle rescue operations whenever softshell turtles are discovered.

4.2.1.1 Nocturnal Survey

- To identify canal zones where Asian softshell turtles are present, since they are most active around dawn and dusk (Auliya et al., 2016).
- At least one day before vegetation clearance, the Contractor installs BRC mesh to divide the canal into zones (Figure 4-3).
- The appointed Wildlife Management Contractor or EMMP Consultant's Ecologist will conduct the survey between 1930–2100 hrs.
 - Help to prioritise the rescue of the Asian softshell turtles from these zones during the canal inspection
- Surveyors will walk along the canal, visually searching for turtles using binoculars and/or cameras.
 - Torches or headlamps will be used to detect eyeshine at night.



Figure 4-3 BRC material installed across a stream (Source: AECOM)

4.2.1.2 Pre-backfilling Canal Inspection

- Before backfilling, the inspection area must be enclosed (e.g., using BRC mesh).
- The appointed Wildlife Management Contractor and/or EMMP Consultant's Ecologist will walk through the canal channel, visually checking for turtles.
- Poles will be used to disturb the substrate to flush out turtles that may be buried.
- Any softshell turtles detected will be rescued.

- Other trapped or injured aquatic animals will also be rescued, especially when water levels are lowered during diversion.
- The inspection SOP generally follows the Fauna Management Plan in the EMMP.

4.2.1.3 Rescue Methodology

If Asian softshell turtles are found during surveys, diversion, or backfilling, they will be rescued and handed over to NParks. This would minimise the mortality and injury of the turtles along the canal. The rescue of these turtles includes: 1) handling. 2) transportation and 3) handover of the captured turtle.

Handling and Capture

- Turtles should first be guided into an enclosed space (e.g., using a fish net).
- Surveyors must wear bite-proof gloves and prepare the holding container before capture.
- Approach turtles slowly and calmly to avoid startling them.
- Once captured, maintain a secure but gentle grip. The turtle should be held with:
 - One hand under the body between the hind legs, and
 - The other hand on the top shell.
 - Alternatively, a towel can be used to lift the turtle safely.
- Transfer the turtle to the holding container immediately, keeping handling to a minimum.
- Each turtle should be kept in an individual, ventilated tank with canal water. Tanks should be covered with opaque cloth to reduce stress (Figure 4-4).

Transportation

- Use a clean, disinfected holding container with a secure cover.
- Containers must have ventilation holes smaller than the turtle's head.
 - For adults: Add a shallow layer of water (no more than 1 inch deep) to prevent dehydration without drowning risk (Ontario Ministry of Environment, Conservation and Parks, 2018).
 - For juveniles: Place damp towels at the bottom; never transport juveniles in water (Ontario Ministry of Environment, Conservation and Parks, 2018).
 - Only one turtle per container.
- Transport vehicle must remain cool and well-ventilated.
- Containers should be washed and disinfected after use to avoid spreading disease.

Handover

- After capture, inform Singapore Botanic Gardens (Figure 4-5):
 - Contact: Jolene Lim (Manager)
- The Gardens will confirm if they can accept the turtles.
 - If immediate transfer is not possible (max. 2 days delay), turtles must be kept indoors in the same tank setup.
 - If same-day handover is possible, turtles must be delivered to the Tyersall Bin Centre, 1 Cluny Road, Singapore 259569 instead or another NParks-directed location.

- Should Singapore Botanic Gardens be unable/unavailable to receive the turtles, the wildlife management contractor shall surrender the wildlife to NParks Animal & Plant Health Centre (as per Figure 4-2)
- For other aquatic fauna (e.g., red-eared sliders), follow the Wildlife Response Plan.



Figure 4-4 Sample Photos of Containers to House Rescued Turtle

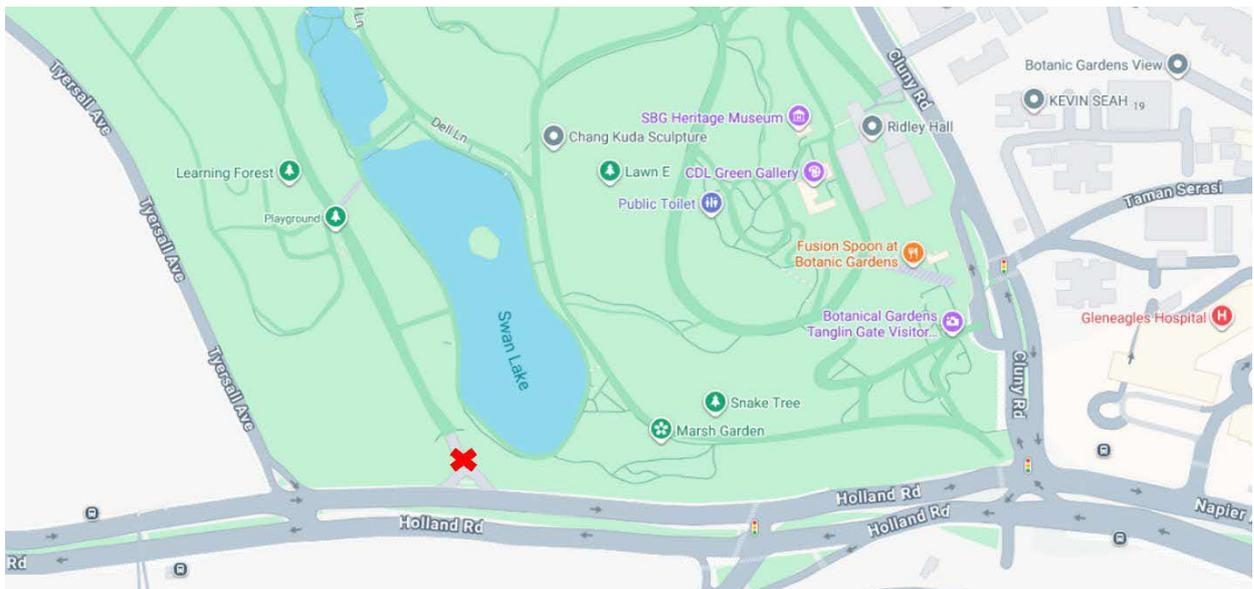


Figure 4-5 Entry gate to Tyersall Bin Centre within Singapore Botanical Gardens

4.2.1.4 Backfilling Works

A dedicated spotter shall be present during water diversion and backfilling of **canal D2** to minimize fauna mortality.

4.2.1.4.1 During Water Diversion

1. Ensure a fine wire-mesh is fitted at the pump inlet to stop animals from being sucked in.
2. Watch for presence of aquatic fauna, including softshell turtles.
3. Stop work immediately and activate the Wildlife Response Plan if turtles are sighted.

4.2.1.4.2 During Backfilling

4. Conduct backfilling gradually, starting upstream and moving downstream, to minimize harm to fauna.

- 5. Continue monitoring for turtles and other aquatic animals.

4.3 Wildlife Response Plan

In general, the Wildlife Response Plan will be activated whenever a trapped, injured, dead, or dangerous animal is found in or around the worksite. The main aim of this plan is to reduce animal injury and mortality by responding appropriately to various scenarios as illustrated in Figure 4-6. This will be highlighted during toolbox briefings. All wildlife incidents shall be reported and recorded using a Wildlife Incident Form as per the main EMMP.

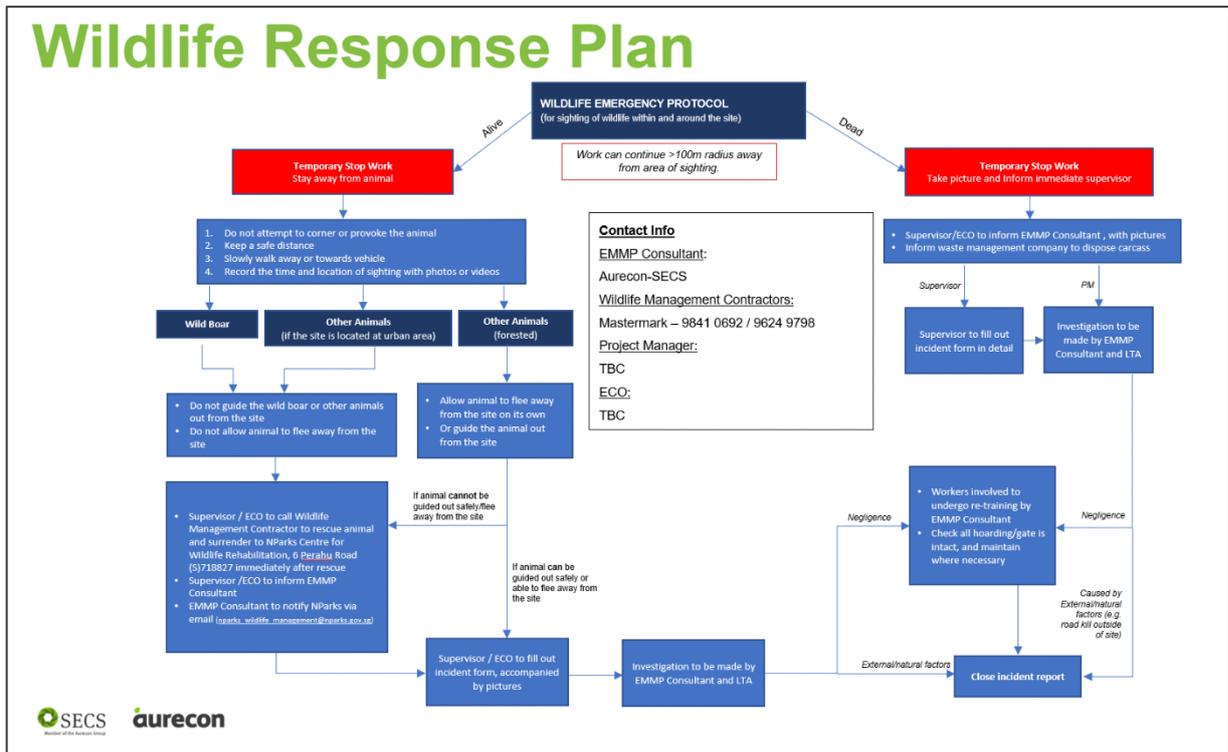


Figure 4-6 Wildlife Response Plan and Flowchart

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Appendix D – Light Management Plan

EMMP Specialist Consultancy Services for Sembawang N4

Light Management Plan

Housing and Development Board (HDB) Singapore

Reference: P529383

Revision: 1

2025-10-31



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1 Introduction

The HDB-appointed Contractor (hereinafter referred to as “Contractor”) has been engaged by the Housing Development Board (“HDB”) to carry out development at the Sembawang N4 area (hereafter referred to as the “Project”). The Sembawang N4 area – which has largely been slated for residential development to cater for housing needs – is an approximately 20.9 hectares (ha) site bounded by Admiralty Road to the north, Canberra Road to the east and Sembawang Drive to the west. The Project development area is situated near the forested tracts of Sembawang Airbase and the Simpang forested area. At present, the Project site features a semi-naturalised canal and forested areas, as well as the Sembawang and Cochrane Recreation Centres that are adjacent to the Project site. Eastwards of the Project area lies the Sembawang N5 forested area (not part of this contract), and the colonial houses along Ottawa and Bermuda Roads. Singapore Environmental Consultancy and Solutions Pte Ltd (hereinafter referred to as “SECS”), a member of Aurecon Group, has been appointed as the Environmental Management and Monitoring Plan (EMMP) consultant during the construction phase by the Contractor.

As stipulated in the S10 Directions to Implement Environmental and/or Wildlife-Related Measures for Development or Works (NParks Ref No. to be updated), development works shall only be conducted during daylight hours (i.e. from 8 am to 6pm, known as “Daylight Hours”). Construction works are likely to extend beyond the stipulated daylight hours. During night time, construction works will need ample light to illuminate the site at night. Therefore, this Light Management Plan (LMP) serves as a follow-up to the S10 Directions on the detail implementation of the proposed mitigation measures for night works between 6 pm – 8 am. It provides guidance on the selection, placement, installation, and operation of all new and retrofitted lights at the site for the Contractor to conduct night works and ensure that the proposed artificial lightings comply with NParks requirement for light installation and minimise impacts to wildlife. The main EMMP has provided a brief Light Management Plan for ad hoc night work and lights for ECM facilities, with reference to NParks’ Technical Note on Light Management in Night Works (NParks, 2024).

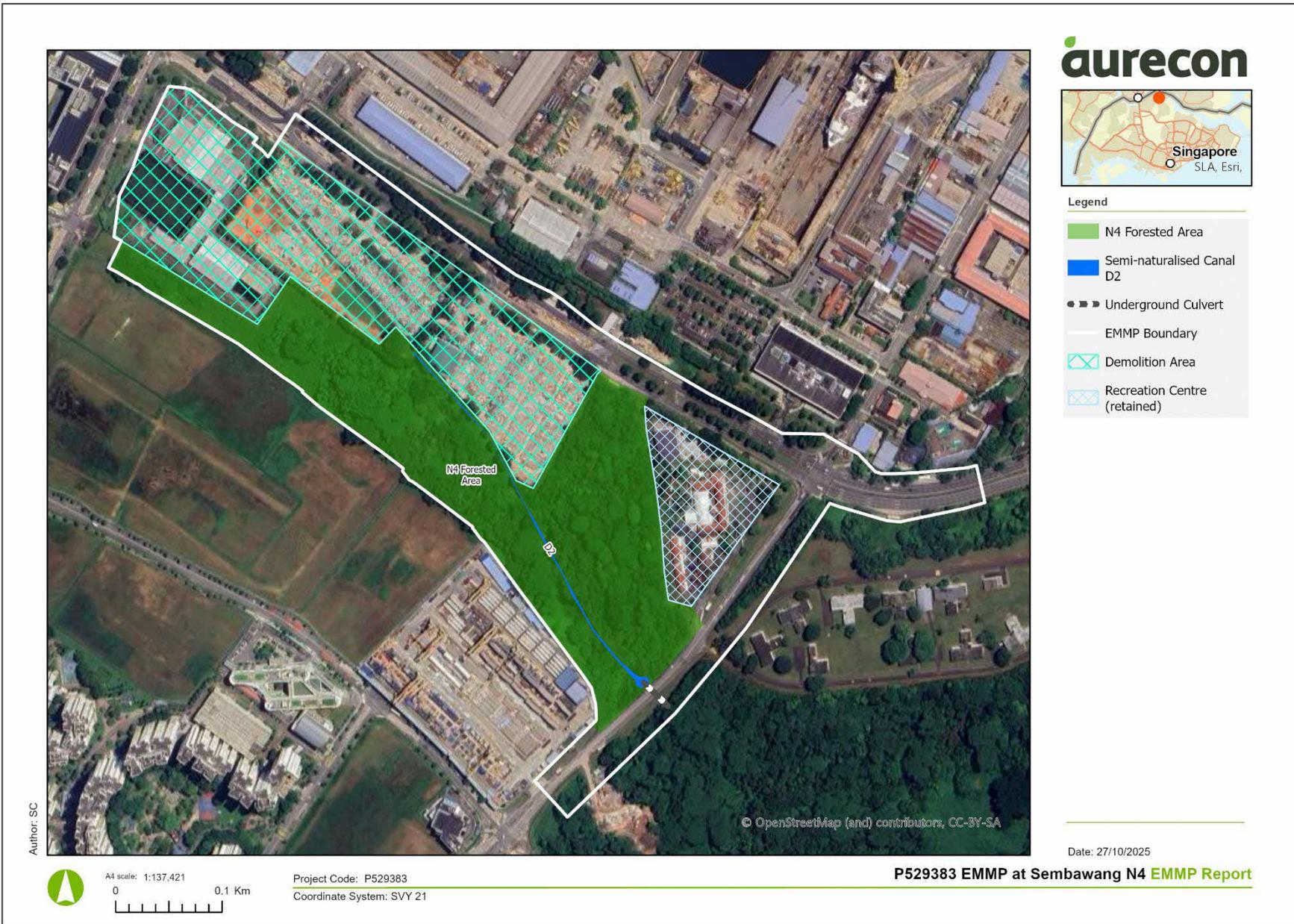


Figure 1-1 Location Plan of the Project

1.1 LMP Objectives

This document serves to define the mitigation measures proposed for the construction works and ambient light for access roads. It serves the following objectives:

- Light will be managed so that fauna is able to undertake critical behaviours such as foraging, reproduction and dispersal outside of the project boundary;
- Mitigate the impact of artificial lighting on the surrounding environment as far as reasonably practicable;
- Define roles and responsibilities for LMP;
- Guiding document for contractors and site users on light management & monitoring;
- Ensure the construction works are conducted in a manner consistent with NParks requirement;
- Provide a framework to track, document and monitor environmental compliance to ensure full LMP compliance is achieved;
- Set out the monitoring frequency and procedures for environmental monitoring; and
- Define reporting and submission requirements.

1.2 Location of Night Works

Night works are planned to take place within the overall Project area (Figure 1-1).

2 LMP Roles and Responsibilities

The responsibility of the parties involved in the LMP should:

- Ensure that the LMP requirements are planned, implemented and maintained throughout the Project in accordance with the requirement by NParks;
- Implement the procedures on monitoring and measures the effectiveness of mitigation measures undertaken;
- Implement corrective or preventive action measures to eliminate non-compliance and incidences; and
- Ensure action is taken on light pollution issues.

The following sub-sections (below) provide the parties involved and their roles in the LMP.

2.1 Developer

The developer for this Project is the Housing and Development Board (HDB) and Surbana Jurong (SJ) is the consultant for HDB. The HDB Project Coordinator and Director, as well as the Consultant Project Coordinator shall be the point of contacts for this Project. More details can be found in the main EMMP document.

2.2 Contractor

The HDB-appointed contractor shall provide sufficient manpower and resources to implement the requirement of the LMP. The Contractor's Project Manager is the team leader responsible for the implementation of the LMP. Appropriate personnel should be appointed by the Contractor to look after all implementation and reporting. The ECO is to be stationed full time on site during the construction stage, and to assist the Project Manager in implementing the LMP.

The Contractor and ECO are also required to regularly liaise with the environmental consultant involved for monthly monitoring and site inspection. More details can be found in the main EMMP document.

1) Project Manager – TBC

- To ensure implementation of all LMP mitigation measures and monitoring procedures;
- To comply with environmental legislation and contractual requirements applicable to this Project;
- To carry out planning on all project activities throughout project planning, budgeting, execution and completion of LMP;
- To provide solutions of significant construction matters if his sub-ordinates are unable to decide;
- To liaise with Environment Consultant and Developer on environmental matters; and
- Keeping track of project costs and expenditures to implement the LMP.

2) Environmental Control Officer (ECO) – TBC

- Perform the role of ECO stipulated in the Code of Practise for Environmental Control Officers;
- Implement and monitor the LMP implementation on-site and recommend any monitoring and mitigation amendments to the plan where necessary to the environmental consultant;
- Assist the Project Manager in undertaking the Project in an environmentally sustainable manner;
- Train and educate all site personnel to work in a manner to respect the surrounding environment;

- Continually identify, report, record potential, and present environmental issues on-site to the Environmental Consultant;
- Limit/Stop any activities if potential/presenting environmental issues are identified until rectified;
- To report any environmental incidence to Environmental Consultant and provide support to address the incidence; and
- Inform LTA and environmental consultant in the event of an environmental emergency (e.g. trapped animals).

2.3 Environmental Consultant

The responsibilities of the Environmental Consultant are as follows:

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

3 Light Management Plan

The Light Management Plan (LMP) is prepared in accordance to NParks requirement and with reference from *National Light Pollution Guidelines for Wildlife by Australian Government – Department of the Environment and Energy* (Australian Government, 2020). The Contractor shall adhere to the following light management principles:

- **Minimise Disturbance to Wildlife:**

- At the edge between construction site and forest, the Contractor should, where practicable or feasible, aim to provide at least **10 m buffer (no task work light)** from the hoarding. This is not applicable for the 5 m access roads and ambient lights.
- There should be no night work **at least 20 m radius** of active bat roosting site.

- **Direction:**

- Light only the object or area intended - keep lights close to the ground, directed, and shielded to avoid light spill.

- **Duration*:**

- Limit the hours of lighting – only use during specific times and at specific locations and will typically be provided by portable light units with manual switching.
- Any illumination that is required for the equipment and machinery during operational times for safety to be switched off when it is not in use except for obstacle-avoidance lighting/safety purposes.

- **Localised Control*:**

- Lights should not be centralised and should be able to be switched off when not required.

*Do note that duration and localised control only apply for the use of lights with colour temperature 5000K and above for all night construction activities. Ambient lights for the access road and footpath (colour temperature of 3000K and below) will be switch on every night when there are night works, beyond 12 midnight for the construction period.

3.1 Light Requirement

In general, lighting is required to provide a safe working environment. Lights will be illuminated at the construction site or area intended during night work (Task Lighting) and along the hoarding (Ambient Lighting). All lights will be close to the ground, directed and shielded to avoid light spill unless is inevitable due to safety reasons. There is no specific height for the task lights but will be subject to working requirements with a minimum hoarding height approved by NParks. Lighting for night works shall be situated in the work area such that a safe working environment is provided for the workers.

3.2 Ambient Light

Ambient lighting will be constant and typically provided to aid the safe access and will be placed along the hoarding. Ambient lighting will be switched on only at areas where works are conducted that evening. The following measures will be implemented for all ambient lighting:

- Warm white light with 3000 Kelvin (K) (refer Figure 3-1 below):

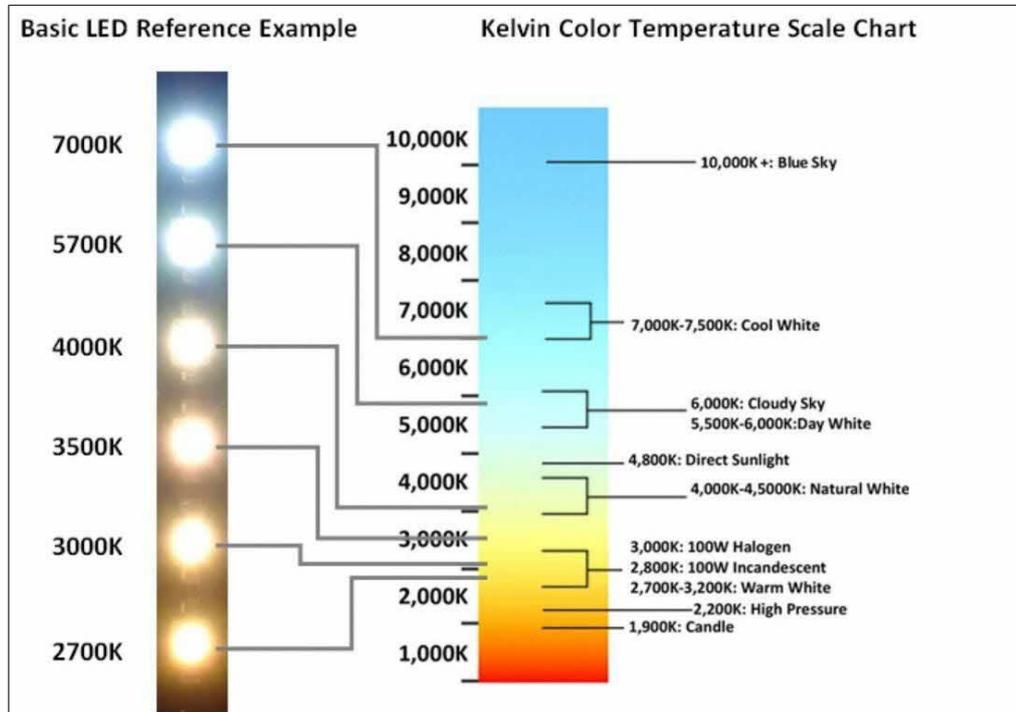


Figure 3-1 Colour Temperature of LED Light

- All light fittings should be directed or shielded (Figure 3-2) to avoid lighting anything but the target object or area except lighting for safety and security purpose.

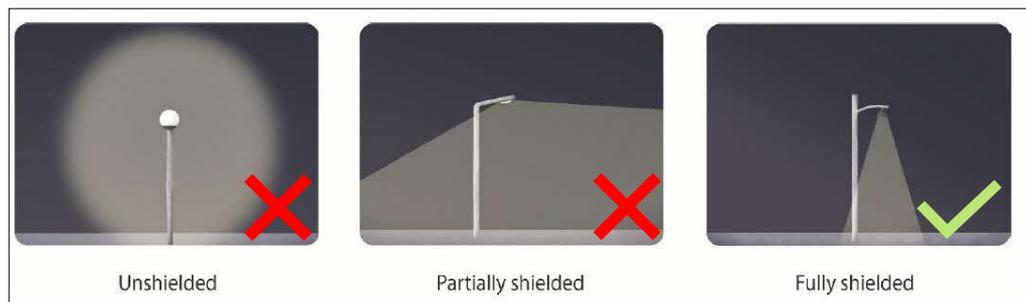


Figure 3-2 Recommended Light Fitting adapted from Witherington and Martin (2003)

- Ambient lighting should not exceed the height of hoarding (2.4 m). Use the possible lowest lighting where practicable except for safety and security purposes.
- Higher site hoarding should be installed in the vicinity of potential bat roosting site (if applicable).

The Contractor shall propose the ambient lighting to be used on site and provide the specifications. It has been confirmed with the supplier that the colour temperature will be 3000K. The Contractor shall indicate the specific lighting fixtures that are planned to be deployed within the Project site.

3.3 Task Light

Task lighting will be provided for night works and the required levels will vary depending upon the type of activity being undertaken. Higher lux level of average 100 lux is typically needed for a safe working environment. The task lights will have a colour temperature of 3000K. Task lighting is typically required only when work is required in a specific area, and the following measures shall be adopted for night works:

- Limit the hours of lighting – only use when required and utilise portable light units which will have manual switches;
- Localised control of lighting – lights should not be centralised and should be able to be switched off when not required; and
- Direct luminaires into the area to be lit (light from the boundary inwards).
- All task lights will point downwards, with **no more than 45 degrees** (Figure 3-3) to prevent light spill from the site.
- The maximum height of the task lights will not go higher than the hoarding.

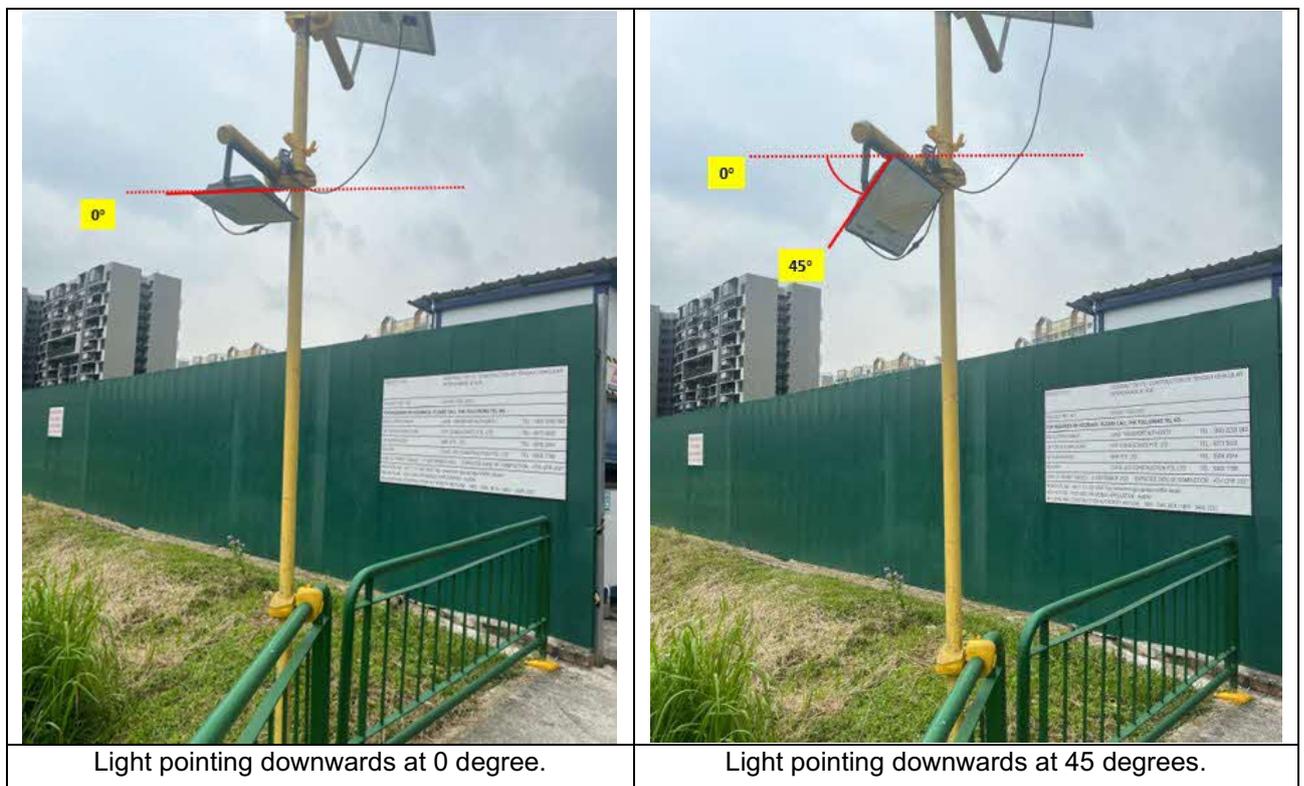


Figure 3-3 Example of Task lights pointing downwards at 0 degree and 45 degrees respectively

The Contractor shall also propose the appropriate task lights to be used on site and provide the relevant specifications. The Contractor shall only use 3000K light bulbs for the task light, unless otherwise approved with NParks. When the lights are in use, the lights will be pointing downwards and not shine over the hoarding to prevent light spill from the site. The Contractor shall also furnish the lighting layout plans that illustrate the different types of night work lighting to be deployed on site.

3.4 Night Work Activities

The following construction night works will be carried out concurrently within the time periods proposed by the Contractor and are expected to continue beyond the normal stipulated hours of 8 am – 6 pm. Below are some examples of night works to be conducted:

- Excavation Until 8:00 pm
- Piling Until 10:00 pm
- Pipe laying Until 10:00 pm
- Rebar Until 8:00 pm
 installation

With reference to the layout plan above (Figure 3-4), not all ambient and task lights will be switched on at the same time. For example, only smaller subsections in Area A1 will have their lights switched on, dependent on the type and location of night works planned for that night.

4 Implementation of Light Management Plan

4.1 Training of Site Personnel

All site personnel shall be briefed on the Lightning Management Plan to ensure that they are aware of the site requirements.

4.2 Close Supervision

All site supervisors shall ensure that the Light Management Plan is followed. They should plan their daily work activities and minimize night work. If night works are to be conducted, supervisors are to ensure that all lights do not point at the forested areas and should be turned off immediately after work is completed.

4.3 Night Work Audit

Monthly audits will be undertaken to assess the effectiveness of mitigation measures and for contractor to held accountable of the implementation of the LMP. A monthly night work audit will be conducted at night by the EMMP consultant. The monthly findings on the light management will be incorporated in the existing monthly EMMP compliance report. The following checklist in Table 4-1 will used during the night work audit.

Table 4-1 Sample Checklist for Night Work Audit

Location/Zone:		Date:		
No.	Environmental Inspection Items	Verification	Observation(s) (State specific locations of observed non-compliance)	Follow-up action(s)
1	Are works being done correspond to the night works schedule?			
2.	Is ambient lighting in the observed area directed or shielded to avoid lighting spill?	-	-	-
3.	Is lighting exceeding the height of noise barriers or hoarding?	-	-	-
4.	Any observation of task lighting for the construction of viaduct/other construction works? Is the illumination necessary for the specific task?	-	-	-
5.	Any observation of bat roosting site?	-	-	-
6.	Is task lighting able to be switched off when not required?	-	-	-
7.	Any illuminated crane/machinery that is not in use?	-	-	-
8.	Any other observations?	-	-	-

4.4 Corrective Action

Corrective actions must be undertaken where mitigation measures or validated complaints indicate the environmental outcomes or Imposed Conditions are not achieved in relation to particular works, because the mitigation measures have not been implemented. Where corrective actions become necessary, the specific works that do not achieve the environmental outcomes or meet the Imposed Conditions must cease (at the immediate area only) until the corrective actions have been developed and implemented.

4.5 Communication

The environmental consultation will prepare a presentation to highlight the mitigation measures required from the LMP in an easily understandable manner with graphics and important information for site personnel including site supervisor and workers. This will be presented prior to the commencement of night works.

5 References

Australian Government. (2020). National Light Pollution Guidelines for Wildlife (p. 111). <https://www.dcceew.gov.au/sites/default/files/documents/national-light-pollution-guidelines-wildlife.pdf>

NParks (2024). Light management in night works. National Parks Board Biodiversity Impact Assessment (BIA) guidelines | Technical notes. Retrieved from: [https://www.nparks.gov.sg/-/media/urban-biodiversity/technical-note_light-management-\(may-2024\).pdf](https://www.nparks.gov.sg/-/media/urban-biodiversity/technical-note_light-management-(may-2024).pdf)

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Appendix E – Wildlife Incident Form

Wildlife Incident Form

Incident Information

Date of Incident: _____

Time of Incident: _____

Location of Incident: _____

Project Name: _____

Reported By (Name): _____

Contact Number: _____

Type of Incident (check all that apply)

- Trapped Animal
- Injured Animal
- Dead Animal
- Dangerous Animal
- Other (please specify): _____

Description of the Incident

- Species Identified:** _____
- Number of Animals Involved:** _____

Condition of Animal(s) (check one):

- Healthy
- Injured
- Deceased
- Unknown

Detailed Description of the Incident:

Response Actions Taken

Actions Taken:

Was Wildlife Response Plan Activated?

- Yes
- No
- If yes, please specify the actions taken: _____

Additional Notes

Photographic Evidence (if applicable):

- Yes (attach photos)
- No

Further Actions Required:

Reporting

Name of Person Completing Form: _____

Position: _____

Date of Form Completion: _____

Signature: _____

Appendix F – Environmental Incident Form

Environmental Incident Form

Incident Details

Incident Report Number: _____

Date of Incident: _____

Time of Incident: _____

Location of Incident: _____

Reported By: _____

Contact Information: _____

Type of Incident (Please tick applicable category):

- Spillage
- Leakage
- Release of Hazardous Substances
- Waste Management Incident
- Environmental Damage
- Other (please specify): _____

Description of Incident

Please provide a detailed description of the incident, including what happened, how it happened, and the substances involved:

Immediate Actions Taken

Please outline any immediate actions taken to mitigate the incident (e.g., containment, notifications, clean-up):

Environmental Impact

Please describe any known or potential environmental impacts as a result of the incident:

Witnesses

Please provide names or contact information for any witnesses to the incident:

Photographic Evidence

Please attach photographs documenting the incident. Include descriptions of each photograph below:

1. Photo 1 Description: _____
[Insert Photo Here]
2. Photo 2 Description: _____
[Insert Photo Here]
3. Photo 3 Description: _____
[Insert Photo Here]

Follow-Up Actions Required

Please outline any follow-up actions necessary (e.g., further investigations, reporting to authorities, monitoring):

Additional Notes

Any other relevant information about the incident can be noted here:

Sign-Off

Completed By: _____

Signature: _____

Position: _____

Date: _____

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