



**DRAFT**

# Environmental Management and Monitoring Plan (EMMP)

*HDB Eastern 2 Development*

Submitted to:

**Housing and Development Board (HDB)**

Submitted by:

**WSP Consultancy Pte. Ltd.**

300 Beach Road, #05-00 The Concourse, Singapore 199555

+65 6533 7333

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## Distribution List

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# DEFINITIONS

## Units of Measurement

ha	Hectare
m	Metre
m <sup>2</sup>	Square metre
m <sup>3</sup>	Cubic metre
mm	Millimetre
cm	Centimetre
km	Kilometre

## Acronyms and Abbreviations

BIA	Biodiversity Impact Assessment
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COP	Code of Practice
COPPC	Code of Practice for Pollution Control
DA	Developing Agency
ECM	Earth Control Measures
ECP	East Coast Parkway
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
EPHA	Environmental Public Health Act
EPMA	Environmental Protection and Management Act
ERP	Emergency Response Plan
ERSS	Earth Retaining Structure Systems
ERT	Emergency Response Team
HDB	Housing and Development Board
IUCN	International Union for the Conservation of Nature
LTA	Land Transport Authority
MRT	Mass Rapid Transit
NEA	National Environmental Agency
NParks	National Parks Board
PUB	Public Utilities Board
QECP	Qualified Erosion Control Professional
Site/HDB Eastern 2	Bayshore Development Area
SS	Singapore Standard

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TEL	Thomson-East Coast Line
TPC	Transit Priority Corridor
TPZ	Tree Protection Zone
URA	Urban Redevelopment Authority
WMC	Wildlife Management Contractor
WRP	Wildlife Response Plan

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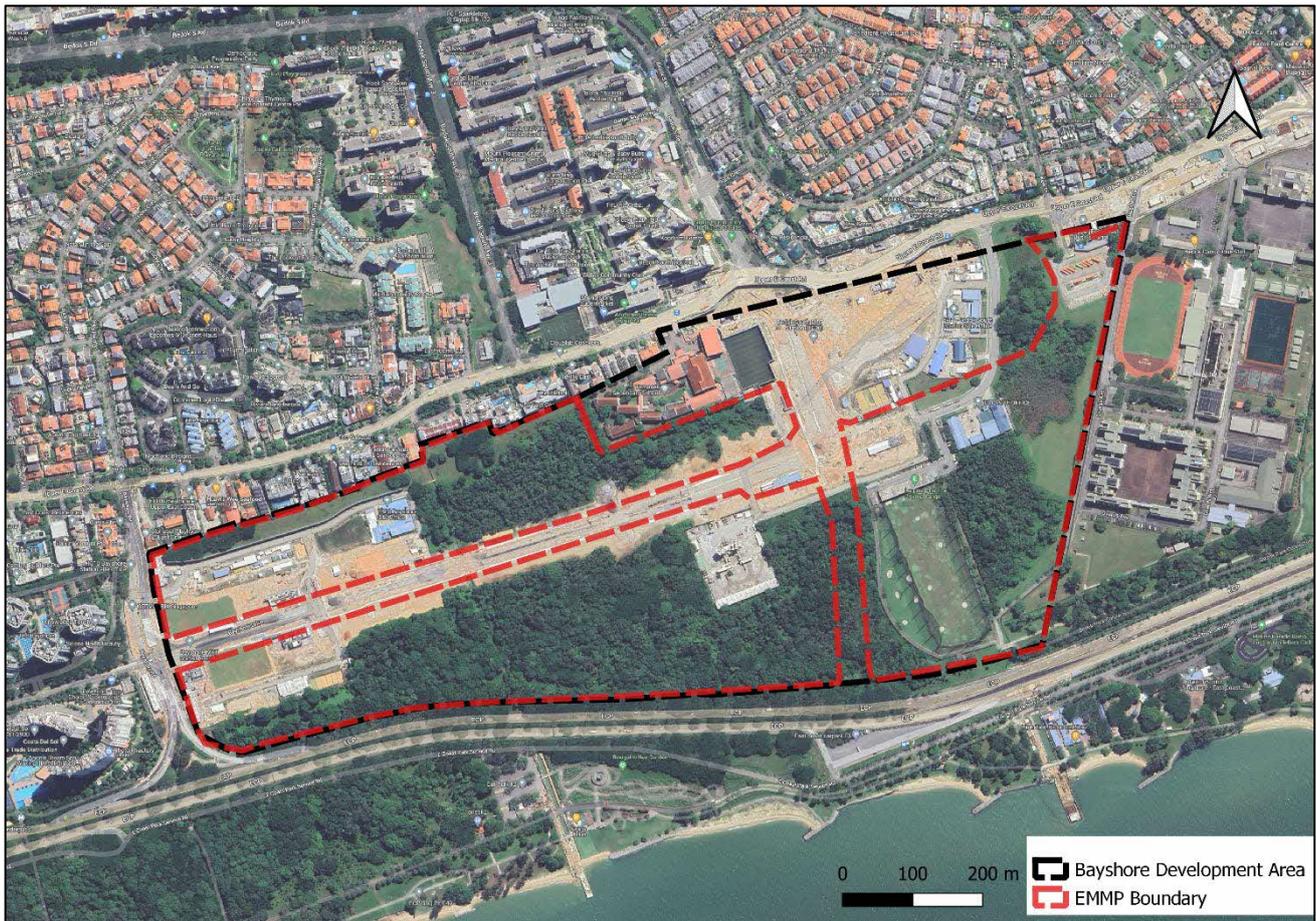
Wildlife Incident Form

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## 1 INTRODUCTION

This document provides information about the Environmental Management and Monitoring Plan (EMMP) that is to be implemented for the Housing and Development Board (HDB) development for the Bayshore Development Area (“Site”/ “HDB Eastern 2”) **Figure 1**. The Site occupies an area of approximately 45 hectares (ha). It is located in the East Coast area and is bounded by residential area then Upper East Coast Road in the north, Guards Avenue, then Bedok Camp in the east, East Coast Parkway (ECP) in the south, and Bayshore Road in the west.



**Figure 1: Bayshore Development Area and EMMP Boundary**

The development which this EMMP applies to is based on three phases (Figure 1). The northern area is approximately 11.5 ha; the southern area is approximately 19.2 ha, while the eastern area is 14.1 ha.

The proposed works include, but are not limited to, civil engineering works such as site investigation, site clearance, earthworks, road construction, box culvert construction, drainage, and sewerage works; as well as building works such as foundation, utilities/services laying and superstructure construction.

This document is considered a live document and shall be reviewed regularly and updated with site-specific information and activities. The EMMP details how the recommended mitigation measures prepared as part of

the Environmental Impact Assessment (EIA)<sup>1</sup> gazetted in February 2023 (DHI, 2023) are to be implemented and specifies recommended monitoring measures to assess the effectiveness of the mitigation measures.

## 1.1 Objective

The EMMP is a systematic approach to mitigate environmental impacts and monitor the implementation of these mitigation measures to ensure that construction will not cause any significant adverse impact to the surrounding environment. The overall objective of the EMMP is to implement mitigation measures based on the impacts identified in the EIA for the Site. The specific objectives of this EMMP are to:

- Include implementation procedures, mitigating measures and actions, flora and fauna management plan and monitoring requirements for all stages of construction.
- To set target environmental objectives and propose the corresponding mitigation measures to be implemented by the Contractor at all stages of construction (i.e., pre-construction and construction).
- Define procedures for wildlife management at various construction stages.

All contractors and subcontractors shall comply with applicable EMMP requirements. The EMMP shall be submitted and approved by NParks prior to the start of any construction activities.

## 1.2 Assumptions and Limitations

The EMMP is based on findings of the EIA, gazetted in February 2023 (DHI, 2023). In addition, the EMMP relies in whole, or in part, on data and information provided in the EIA, by HDB, ECAS Consultants Pte. Ltd. (ECAS) (as Superintending Officer Representative (SO Rep)) and Kok Tong Construction Pte Ltd (KTC), the appointed contractor for Phase 1A Infrastructure Works. The information from these parties is assumed to be accurate, complete, and reliable at the time of writing.

## 1.3 Document Structure

The EMMP is structured as follows:

- Section 1: Introduction to the EMMP - provides the scope, objectives, assumptions and structure.
- Section 2: Summary of the EIA - provides key baseline findings, identify impacts and proposed mitigating measures.
- Section 3: Project Overview - provides a summary of the development, phases and activities for each phase.
- Section 4: Applicable Legislation and Standards - provides key legislation and standards used in the EIA and EMMP.
- Section 5: EMMP Roles and Responsibilities – provides organisational chart of key personnel, as well as key training requirements.
- Section 6: EMMP – provides EMMP for flora and fauna.
- Section 7: Environmental Impact, Mitigation and Monitoring Register.
- Section 8: Emergency Response Plan (ERP) – provides actions for environmental incidents.

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<sup>1</sup> Environmental Study for Bayshore Development and Road Construction, Final Report, 1 February 2023.

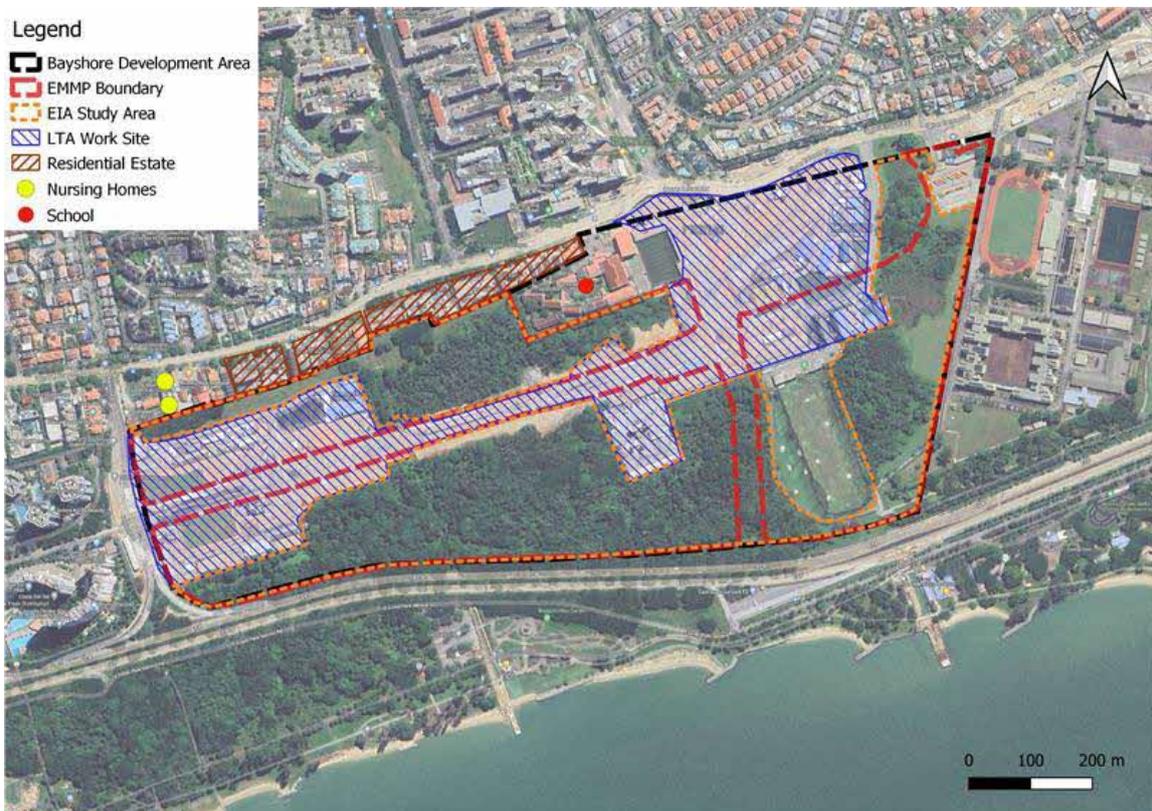
- Section 9: Reporting and Review – regular review of the EMMP and reports to be submitted as part of the EMMP.
- Section 10: Closure

## 2 SUMMARY OF EIA

### 2.1 EIA Study Area

The EIA Study Area (**Figure 2**) was limited to the forested areas within the Site. The habitat type based on the baseline study completed in July 2022 is a mix of secondary forest, unmanaged grassland and shrubbery, and includes a total area of approximately 31.4 hectares (ha) of vegetation.

The study area is in the southern part of the Bedok planning area, bounded by ECP, Bayshore Road, Upper East Coast Road and Bedok Camp. Surrounding areas include residential areas, nursing homes (Sunnyville Nursing Home and Econ Healthcare and Rehabilitation Center), Temasek Secondary School, and Land Transport Authority (LTA) worksite for the Thomson East-Coast Line (TEL).



**Figure 2: Map showing the EMMP boundary, EIA Study Area and Bayshore Development**



**Figure 3: Land Use as per URA Masterplan 2019**

Based on the URA Masterplan 2019 (**Figure 3**), land uses within the Site include residential, parks, place of worship, a sports and recreation area, open space, a health and medical care, educational institution, commercial and residential facility and road and drainage networks.

## 2.2 Summary of Findings

Baseline terrestrial flora and fauna surveys were carried out from April to July 2022. Habitat mapping and flora surveys indicated that there was approximately 31.4 ha of vegetation within the Study Area. There were six types of vegetation that include scrubland (30%), reclaimed land vegetation (25.89%), secondary forest (20.81%), urban vegetation (13.59%), abandoned land forest (8.7%), freshwater marsh (mainly ephemeral) (0.41%) [and others (infrastructure) (0.6%)] (DHI, 2023).

There were 196 flora species recorded of which 95 species were native, 91 species were exotic, 10 were cryptogenic (unknown origin). Of these species, 16 flora species of conservation were recorded. Species of conservation significance such as *Synostemon bacciformis*, *Cheilocostus speciosus*, *Fuirena ciliaris*, *Schizaea dichotoma*, *Ficus superba*, *Ardisia elliptica*, *Jasminum elongatum*, *Bridelia stipularis*, *Causonis trifolia*, *Cyperus brevifolius*, *Olea brachiata*, *Oxyceros longiflorus*, *Syzygium syzygiodes*, *Trema tomentosum*, *Neolitsea cassia* and *Planchonella obovata* were found.

The total number of fauna species recorded within the Study Area was 147, of which six are of conservation significance. Species of conservation significance recorded includes the Oriental Magpie-Robin (*Copsychus saularis*), Blue-crowned Hanging Parrot (*Loriculus galgulus*), Changeable Hawk-Eagle (*Nisaetus cirrhatu*), Red Junglefowl (*Gallus gallus*), Rusty-breasted Cuckoo (*Cacomantis sepulcralis*), and the Red-legged Crake (*Rallina fasciata*).

### 3 PROJECT OVERVIEW

The planned development comprises three phases within the Site ( **Figure 4**). The construction activities are expected to include earthworks and site clearance, and infrastructure works for future roads, drainages, sewers, service laying and road-related facilities. This is expected to be followed by site investigation and then building construction of future residential blocks. The works will be carried out in phases from 2024 to mid-2030.



**Figure 4: Overall Phasing Plan (Source: HDB)**

The Site’s conceptual development plan is shown in **(Figure 5)** below. The residential area will have several green features including the Linear Park at the northern edge and the central park, totalling approximately 3 ha. The residential area will be well-connected to two new MRT stations - Bayshore Station and Bedok South Station through a bus-only transit priority corridor (TPC). Bayshore Drive will be the main road cutting through the center of the master planning area lined with landscaped walking and cycling paths.



**Figure 5: Conceptual Development Plan (Source: HDB)**

### 3.1 Site activities

The proposed public housing development would entail civil engineering works such as site clearance (removal of existing trees and vegetation), site investigation, earthworks, construction of roads and drains, sewer works, building works, utilities/services laying and other related works.

In general, above-ground project construction works will require a construction worksite area for site offices, equipment and material storage, worker's canteens and worksite. The areas designated for these components will also support the construction foundation and drainage works during the development of the Site.

Construction phases are discussed in general in the following sub-sections.

#### 3.1.1. Pre-construction activities

Pre-construction activities will include land clearing and tree felling, construction of temporary roads and preparation of equipment and material storage areas.

The access to the project site is expected to be aligned with vehicular access from Bayshore Drive via Bayshore Road along the western boundary of the Site and from the Upper East Coast Road along the northern boundary of the Site.

Drainage associated with temporary and permanent access roads will be constructed and utilities which are shallow and likely to cause impedance to cut and cover works will be diverted first, so that there is no disruption in usage of utilities to nearby receptors. Depending on the utility to be diverted, it may involve tree felling, excavation, access road construction and concrete resurfacing works.

Land clearance and tree felling for road works may cause potential noise nuisance and dust emission to nearby human and ecologically sensitive receptors, as well as potential water quality impact to existing drains.

### 3.1.2. Site Clearance and Earthworks

Clearance of trees and vegetation, and earthworks at the construction worksite areas and access roads will be required. This will involve large machineries such as excavator, dump truck, low-bed trailer, chainsaw, and woodchipper machine, among others.

The Contractor's Qualified Erosion Control Professional (QECP) shall prepare an Earth Control Measures (ECM) Plan and obtain approval from the Public Utilities Board (PUB) prior to the start of site clearance and earthworks.

The EMMP Consultant shall map the trees on site to support tree-felling application by the Contractor. The mapping will include visual tree assessments for each tree specimen and locations of all trees at the Site that are of 1 m girth and above. Data recorded will also include tree species and approximate girth size and height. A report will then be furnished to include the construction impact assessment of each individual trees within the Site. This would determine if the tree specimens should be retained or removed if it is affected by any works from the proposed construction.

Where trees are recommended to be retained, the EMMP Consultant's Certified Arborist will provide recommendations and/or guidelines for the Contractor to ensure the viability of these trees throughout the period of construction. For trees that are recommended to be transplanted, this should be done prior to commencing site clearance.

For wildlife management, the Contractor shall adhere to the requirements in Section 6.4. Directional hoarding should be done to remove fauna from the site. All fauna that may be encountered on site will be managed in accordance with the Wildlife Response Plan (WRP) and the Contractor shall have an NParks approved Wildlife Management Contractor (WMC) ready to be activated if needed.

For areas where ground levels are generally low, soil will be topped up to meet PUB platform level requirements. This may or may not accompany ground improvement works depending on the nature of the soil in the area. Construction site debris will be temporarily stored on site and then collected by licenced third parties for offsite disposal.

Land clearance works are planned to proceed generally from west to east subject to site conditions. Tree clearance will be done concurrently and only undergrowth vegetation will be cleared in areas where trees are proposed to be retained, at both sides of the drain, south of the TPC. Subsequently, excavation, foundation works and piling works are expected and will involve the use of heavy machineries. Site investigation works are expected during the infrastructure works phase.

#### ***Proposed Retained Areas for Future Park Development***

A Linear Park is proposed at the north of the Site and trees will be retained in the area (**Figure 6**). The Linear Park will serve as a buffer for residential properties. At the south of the Site, trees will be retained along both sides of the proposed open drain, where feasible (**Figure 6**).



**Figure 6: Proposed areas to be retained**

### 3.1.3. Establishment of Temporary Worksites

Following the hoarding installation with noise barrier, temporary worksite structures will be established, including areas for site offices, container office, container meeting room, portable toilets, store container, sample room, waste management facilities and storage, rest area, ECM ponds and water treatment plants, washing bay and internal vehicle access areas for movement of vehicles and vehicle parking lot.

The construction works required, operation of machineries and increase in site vehicular traffic for the establishment of temporary worksites may cause potential noise nuisance and dust emission to nearby human and ecologically sensitive receptors.

### 3.1.4. Building Construction

#### 3.1.4.1 Foundation Works

Foundation work for substructures including piles and pile caps will be constructed. Reinforcement bars will then be installed to enhance the strength of the concrete pile. Ready-mix concrete will be transported by a concrete truck and poured into boreholes. Hacking may be required should there be excess pile head after bored piling. The pile foundation will then be sealed.

Upon completion of foundation works, excavation may be necessary. Any excavated material will be placed in dump trucks and disposed offsite or used in other areas of the Site. Additional site investigation may be required as part of building construction works. The contractor shall ensure proper handling and disposal of construction waste to avoid any potential contamination to nearby water bodies, soil and groundwater.

### **3.1.4.2 Construction of Superstructure and Finishing Works**

Following the completion of foundation works, superstructures will be constructed. Superstructure works may include forming working platforms, installation of precast, concrete works. The buildings will be constructed to its desired height using temporary formwork. Ready mix concrete will be transported to the Site for concreting works.

### **3.1.4.3 General Landscaping Works**

As the final step towards the completion of, earthworks, infrastructure and building works, the contractor shall remove all temporary works and earth retaining structure systems (ERSS) for the reinstatement of working area to its original condition and/or required conditions. Landscaping works will be conducted to maintain or present the landscape and visual amenity values to the public.

## 4 APPLICABLE LEGISLATION AND STANDARDS

The applicable legislation and other standards referred to in the EMMP are listed below:

**Table 1: List of applicable Singapore legislation, regulations, and guidelines**

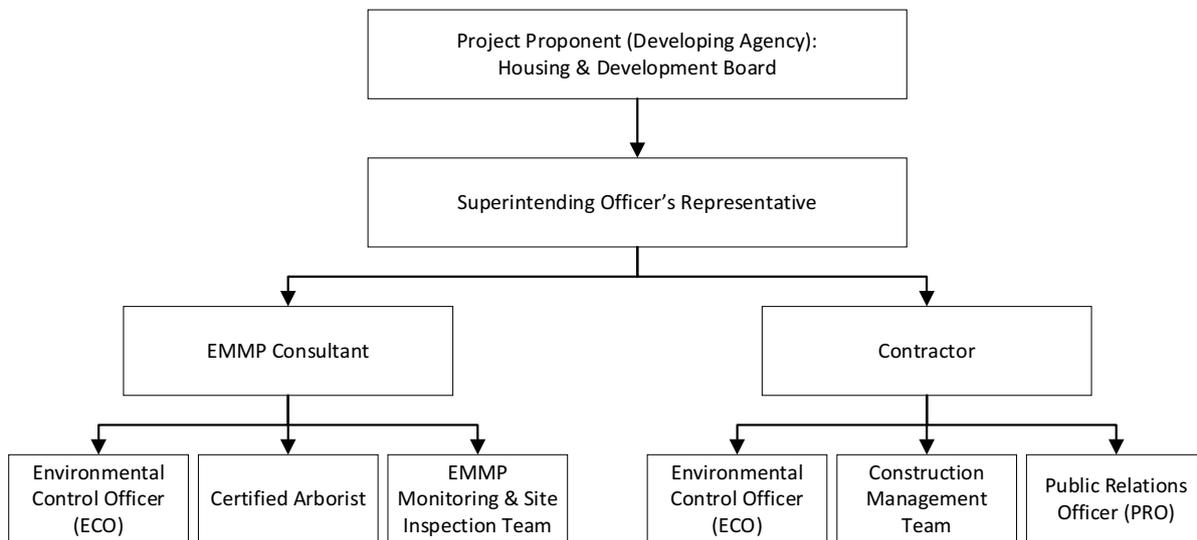
Parameter	Legislation, Regulations and Guidelines
<b>General</b>	<ul style="list-style-type: none"> <li>■ Environmental Protection and Management Act (EPMA) 1999 and Regulations</li> <li>■ Environmental Public Health Act (EPHA) 1987 and Regulations</li> <li>■ Code of Practice on Pollution Control (COPPC) SS593:2013</li> </ul>
<b>Biodiversity</b>	<ul style="list-style-type: none"> <li>■ Wildlife Act 2020</li> <li>■ Parks and Trees Act 2005 and Regulations</li> <li>■ NParks' Species List (Red Data Book List) Third Edition, 2023</li> <li>■ NParks' Biodiversity Impact Assessment (BIA) Guidelines 2021</li> <li>■ International Union for the Conservation of Nature (IUCN) Red List of Threatened Species to assess species vulnerability, 2021 (International)</li> <li>■ CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora, also known as the Washington Convention) 1983 (International)</li> </ul>

## 5 EMMP ORGANISATION

The EMMP implementation organisational chart and roles and responsibilities of each party are provided in this section.

### 5.1 Organisational Chart

An organisational chart for the implementation of the EMMP is provided below in **Figure 7**.



**Figure 7: EMMP Organisational Chart**

### 5.2 Roles and Responsibilities

The following section detail overall roles and responsibilities for the EMMP.

#### **Authorities/Agencies**

Authorities and agencies include, but are not limited to NParks, PUB, NEA, and URA. NParks will be reviewing and approving the EMMP prior to commencement of works, and where required during the course of the project. Other agencies may also review and provide comments to the EMMP where required during the course of the project.

#### **Developing Agency (DA)**

HDB, being the project owner oversees the construction phase of the project in accordance with the design. HDB, in conjunction with the SO Rep, EMMP Consultant and Contractor are required to:

- Ensure resources are available to achieve the requirements of the EMMP;
- Provide leadership in the development and implementation of the EMMP;
- Ensure all environmental incidents and near misses are promptly investigated and reported;
- Resolve any non-compliance issues;
- Record, respond to, and action any complaints from members of the public, if any, with inputs from authorities/agencies, if required;
- Reporting to the authorities/agencies regarding implementation of the EMMP;

### **SO Representative (SO Rep)**

The SO Rep refers to the engineering consultant, ECAS, employed by HDB and is responsible for overseeing the construction works undertaken by various staff, contractors, and sub-contractors. The SO Rep should ensure that the construction works are performed by the contractors and personnel in accordance with the specification, contractual requirements and EMMP. The SO Rep should also:

- Communicate the requirements of this plan to all staff, contractors and sub-contractors.
- Monitor all staff, contractor's and sub-contractor's compliance with contract specifications and regulatory requirements, including the implementation of the environmental mitigation and monitoring measures and ensure their effectiveness, and other aspects of the environmental audit program.
- Coordinate with the project's ECO to monitor and participate in the implementation of the environmental audit program and ensure that the requirements in the environmental audit program are correctly followed.
- Implement measures to reduce impacts where emission/discharge levels are exceeded.
- Coordinate with the Project Owner for submission of environmental audit reports.
- Carry out any complaint investigations.
- Resolve any non-compliance issues.
- Promote environmental awareness and responsibility and lead by example.

### **Contractor**

The term Contractor refers to all construction contractors and sub-contractors working onsite at any time. In addition to reporting to the SO Rep, the Contractor should:

- Work under the relevant contract scope, specifications, and other tender conditions.
- Ensure that the roles of ECO, Certified Arborist, and WMC are adequately resourced.
- Participate in the required environmental site audits (via the SO Rep) undertaken by the ECO and undertake any corrective actions.
- Provide up-to-date information and advice to the SO Rep, ECO, Certified Arborist, and WMC regarding any work activities which may contribute or continuously create adverse environmental conditions, or any changes to the work plan;
- Before the commencement of actual construction, the Contractor shall engage a certified QECP to prepare an ECM Plan and obtain PUB approval. During construction, QECP and Contractor shall review the effectiveness of ECM regularly to meet the changing needs of the construction activities. The Contractor shall also appoint a Registered Surveyor to map the trees on site (based on the EMMP's Consultant Certified Arborist's report) and the trees planned to be felled and obtain NParks approval. The following requirements should be noted:
  - In areas where trees are to be retained, the Contractor should apply for tree felling approval after receiving the EMMP's Consultant Certified Arborist's report on the health, species, size and conservation significance of the trees.
  - For trees that are to be retained, to clearly demarcate the Tree Protection Zones (TPZ) around these (see Section 6.3.1).

- If there are trees that must be transplanted, this should be done prior to commencing site clearance. Regarding fauna, the Contractor is required to follow the specific directions stated in this EMMP with regard to managing wildlife onsite. The Contractor shall have a Certified Animal Management Specialist to advise on the wildlife management plan and an NParks approved WMC ready to respond to any wildlife on site if needed.

An ECO shall be employed by the Contractor and be responsible for implementing the elements of the EMMP that fall within their responsibilities as outlined in the Code of Practice for Environmental Control Officers for Specified Premises dated August 2022. He/she should be a registered ECO with NEA and has at least three years' experience in environmental monitoring and auditing works. Resources to implement the environmental monitoring and audit program should be allocated. The ECO's duties include:

- Coordinate with the SO Rep to monitor and participate in the implementation of the environmental audit program, with assistance from the EMMP Consultant's ECO.
- Assist the SO Rep with the resolution of near misses/ incidents, non-compliance issues, and complaint management.
- Assist the EMMP Consultant's ECO with reporting of monitoring results to the SO Rep.

### ***DA's EMMP Consultant and ECO***

The DA's EMMP Consultant and ECO shall:

- Prepare, submit, and present (if required) to NParks, HDB and other relevant Authorities and obtain approvals on the EMMP from the Regulatory Agencies.
- Liaise and coordinate with the HDB's appointed Contractors within the Project area (tentatively four contractors) and review and develop the Overall EMMP and detailed EMMP for each of the future activities.
- Meet on regular basis, to coordinate and review the implementation of management strategies as outlined in the EMMP.
- Report potential or actual incidents and non-conformances and to propose corrective actions.
- Identify indicators, precautions, construction methods, contingency plans, provide actions to achieve desired objectives.
- Prepare, submit, and present monthly EMMP reports throughout the construction works for each of the future activities.
- Conduct briefings and trainings to all the Contractors and subcontractors within the Overall EMMP Boundary on a regular basis and throughout the construction works.
- Review, highlight, recommend measures and provide advice in consultation with DA and SO Rep when Agencies'/ public/ interest groups have feedback on environmental matters.
- Prepare materials and attend, when needed, the briefings/ presentations to stakeholders e.g., Grassroots Leaders, other interest groups/ nature group and or organization, etc.
- Assist in engaging the stakeholders and relevant nature groups and/ or organizations to address site specific concerns.

- Institute a management process on any feedback received from stakeholders throughout the construction works and ensure queries are appropriately resolved, investigated, recorded, and compiled in a report.
- Prepare and maintain an Environmental Impact and Mitigation Register which provides a summary of the project activities, sensitive receptors and potential environmental impacts, mitigation measures, timelines, and residual impacts.
- Carry out weekly site inspections and attend progress meetings to provide updates on EMMP. Site inspections will be conducted monthly in the building stage.
- Prepare, submit, and present a summary completion report on the environmental mitigation and performance (Close-off EMMP Audit Report). The Close-off EMMP Audit Report is to be prepared for each of the future activities once the works on site is completed.

## 5.3 Training and Awareness

Introduction to the EMMP has to be provided to all employees working onsite so that these can be followed, and any corrective actions identified by the Contractor ECO. Training requirements include awareness, understanding of the EMMP and importance of its implementation, and any further training for specific responsibilities. Records of attendance in trainings should be maintained by the Contractor ECO for the whole duration of the works.

### 5.3.1. General EMMP Training

A briefing of the overall EMMP structure and requirements should be given to new contractors as needed, which includes environmental impacts, identified receptors, minimum management, and monitoring requirements. Should any triggers be encountered for specific aspects of the EMMP, an EMMP Alert will also be issued to the Site for awareness, compliance and communication of any corrective action and any changes to EMMP requirements. Specific EMMP trainings will also be carried out, as detailed in the succeeding sections.

### 5.3.2. Biodiversity Awareness

Biodiversity awareness training will be provided to all site personnel by EMMP Consultant's Ecologist every six months. The objective of the training is to inform them on how to respond to any fauna encounters by adhering to the Wildlife Response Plan that has been formulated, and to emphasize on the site personnel responsibilities towards biodiversity. This includes the procedures that should be carried out before any site clearance, such as pre-felling tree inspections, to minimise the risk of fauna mortality and/or injury.

Toolbox briefings by EMMP Consultant's Ecologist will be conducted once during pre-construction as the Contractors come on board into the Project. During the construction phase, toolbox briefings will be conducted twice per year, or as needed for all Contractors as works progress. All site personnel shall undergo biodiversity awareness training provided by EMMP Consultant's Ecologist prior to commencing work at on-site, and every six months throughout the duration of the construction. Documentation of such trainings and briefings shall be maintained.

## 6 FLORA AND FAUNA MANAGEMENT PLAN

### 6.1 Key Mitigating Measures

Key mitigating and monitoring measures that shall be adopted on site focuses on careful execution of construction activities to implement control measures in place to prevent fauna from accessing or being trapped within the construction zone, as well as to prevent soil erosion into drains that is connected to nearby waterbodies. The key mitigating measures below are referenced from the EIA (DHI, 2023) and in coordination with the plans by the Contractor (**APPENDIX A**):

- Hoardings shall be erected along the existing main roads first (i.e., Bayshore Road and newly constructed Bayshore Drive), and the ECP, and shall proceed eastwards (Section 6.4.1). This is to prevent any wildlife from roaming onto the ECP and main roads during the site clearance and to avoid potential roadkill.

Tree-felling and directional vegetation clearance will be carried out for the phases of the project. (Section 6.4.3). Should there be any wildlife trapped onsite during the final stages of clearance, the Wildlife Response Plan (WRP) will be activated to rescue these wildlife (Sections **6.4.2** and Section **8.2**);

- Pre-felling wildlife inspections shall be conducted by EMMP Consultant's Ecologist before any vegetation clearance to minimise fauna injury and/or mortality. The requirements and procedure of the pre-felling fauna inspection is elaborated in Section 6.4.4. The EMMP Consultant's Ecologist shall also look out for any sensitive wildlife burrows, nesting sites, and bee hives prior to the clearance of trees and vegetation.
- The Contractor is to ensure that the use of erosion blankets (i.e., made of organic material without plastic netting to prevent animals from getting trapped in these) is implemented at the Project Site to minimise potential entrapment of fauna.
- Salvaging and/or transplantation of saplings of conservation significance that are unavoidably affected by the proposed works shall be conducted in consultation with NParks prior to the site clearance; and
- A WRP (Section **8.2**) shall be activated when any fauna is trapped, injured, or requires any form of rescue on site.
- No night works will take place during the infrastructure works. Should night works be required, a Lighting Management Plan (LMP) may be required and shall be approved by NParks.

### 6.2 Proposed Retained Areas for Future Park Development

Two areas are proposed to be retained for future park development within the EMMP Boundary - along the northern boundary of Phase 1, and in the centre of Phase 1 (**Figure 8**). Trees shall be retained as long as it does not pose any risk of failure, subject to the relevant assessments by the EMMP Consultant's Certified Arborist. For the proposed retained area that lie within the centre of Phase 1 (i.e., in the southern portion nearer to ECP expressway), undergrowth vegetation will be cleared.

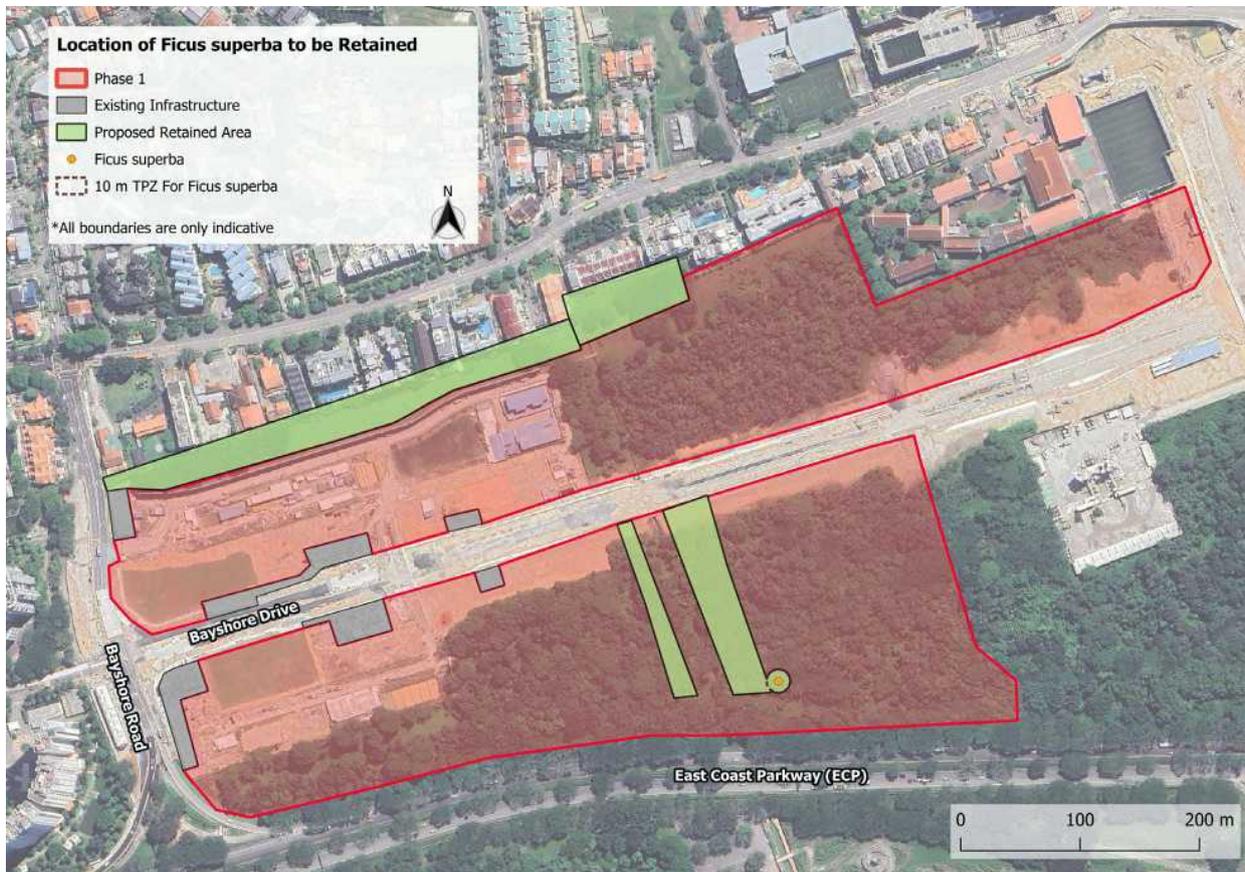
Before the commencement of site clearance, TPZs shall be erected for the proposed retained areas. The TPZ shall be demarcated clearly by the Contractor to avoid any works from encroaching into the areas to be retained. Guidelines and specifications of the TPZs is elaborated further in Section 6.3.1 and **APPENDIX B**.

### 6.3 Flora and Arboriculture

#### 6.3.1. Tree Protection Zones (TPZs)

A specimen of nationally Endangered *Ficus superba* is proposed to be retained in Phase 1 (**Figure 8**). A TPZ with a radius of 10 m shall be demarcated on site before the commencement of the hoarding installation and

any site clearance. Since the tree is in proximity to the proposed retained areas in the center of the southern parcel in Phase 1, the TPZ shall be subsumed into the boundary of the proposed retained area (**Figure 8**).



**Figure 8 Approximate Location of the Specimen of *Ficus superba* and Boundary of the 10 m Tee Protection Zone (TPZ).**

The TPZs shall be established according to the guidelines provided in **APPENDIX B**. Key guidelines that is reflected below reference to NParks' Guidelines on Greenery Provision and Tree Conservation for Developments (NParks, 2018):

- The material chosen for the TPZ fencing should be effective to prevent or, as much as possible, minimise any damages/injuries to the retained trees throughout the duration of the construction phase.
- The Contractor's Certified Arborist shall recommend and review the size and material used for the TPZ. If necessary, the certified arborist should provide alternative strategies to ensure that no damages are inflicted on the retained trees and that the survivability of the retained trees are not compromised.
- An access door providing unhindered access should be installed for each retained area to allow the EMMP Consultant's Certified Arborist to conduct the inspection of the retained trees.

If there are construction activities taking place in proximity to the retained trees owing to unforeseen circumstances (e.g., change in design plans or site access issues), a Certified Arborist appointed by the Contractor shall propose measures to shield the specimens from being damaged.

### **6.3.2. Salvaging Procedure of Species of Conservation Significance**

Three species of conservation significance have been selected by NParks for salvaging (**Table 2**), that shall be carried out prior to commencement of the hoarding installation and site clearance. The EMMP Consultant

shall assist to locate any viable specimens of these species. It should be noted that the salvaging procedure for the plant species of conservation significance are subjected to the current site assessment and other relevant assessments from EMMP Consultant's Certified Arborist. For tree specimens with girth of 0.3 m and above, salvaging is not recommended as these are more susceptible to transplantation stress. Salvaging and/or transplantation works shall be coordinated with NParks and assisted by EMMP consultant's Flora Specialist.

**Table 2: Species of conservation significance for salvaging<sup>2</sup>**

Species	Conservation Status (as per Singapore Red List, 2023)
<i>Cordia dichotoma</i>	Nationally Extinct; Re-discovered (NEx)
<i>Synostemon bacciformis</i>	Nationally Critically Endangered (CR)
<i>Schizaea dichotoma</i>	Nationally Endangered (EN)

### 6.3.3. Transplantation of Tree Specimens

If required, transplantation of any tree should be carried out before any site clearance works. Plans for transplantation should be discussed among the relevant stakeholders, including NParks and the Contractor, before being carried out. The procedure should be supervised and overseen by a Contractor's Certified Arborist. Guidelines for sapling and tree transplantation are provided in **APPENDIX C**.

### 6.3.4. Verification of Hoarding Footprint

After the setting up of TPZ and salvaging of plants are completed, external hoardings can be installed. The Contractor's Certified Arborist shall ensure no encroachment of the hoarding line into the TPZ for the proposed areas to be retained. This shall be inspected by the EMMP's Consultant's Flora Specialist and Certified Arborist.

### 6.3.5. Flora and Arboriculture Inspection

During the infrastructure works, weekly site inspections shall be carried out. As the site clearance progresses, the frequency of site inspection can be reduced to monthly since most of the vegetation will already be cleared as the proposed development progresses into the building stage. For the proposed areas to be retained for future park development located adjacent to the proposed drain reconstruction works, the frequency of site inspections will remain weekly, until all relevant works are completed.

The EMMP Consultant's Flora Specialist and Certified Arborist are to identify the following during the flora and arboriculture inspections:

- Unauthorised removal of vegetation beyond the worksites, if any.
- Vegetation removal in areas that is outside the Project Boundary.
- Forest edge effects and recommend appropriate mitigation measures, where necessary.
- Exotic fast-growing plants and provide recommendations for removal, where necessary.

<sup>2</sup> For salvaging procedure before any site clearance, subject to site and arborist assessment.

- Monitor the health of trees and/or plant specimens within the areas to be retained; and
- Monitor the health of trees that are located within 10 m outside the hoarding boundary of the Project Site. The appointed Certified Arborist shall highlight trees that may potentially fall into any active work site, or those that are deemed hazardous to the safety of the workers, and provide recommendations, where necessary.

The extent of the inspections will vary as the project progresses from site clearance to excavation and into the various construction phases. During early infrastructure works, detailed and frequent inspections are effective for management of site clearance. During excavation works, it is important to continue the inspections regularly to maintain the areas to be retained and any TPZs, as well as to monitor for any unauthorised removal of vegetation that may happen outside the hoarding boundary of the Project Site.

## 6.4 Fauna

### 6.4.1. Installation of External Perimeter Hoarding, Internal Hoarding and Temporary Barrier

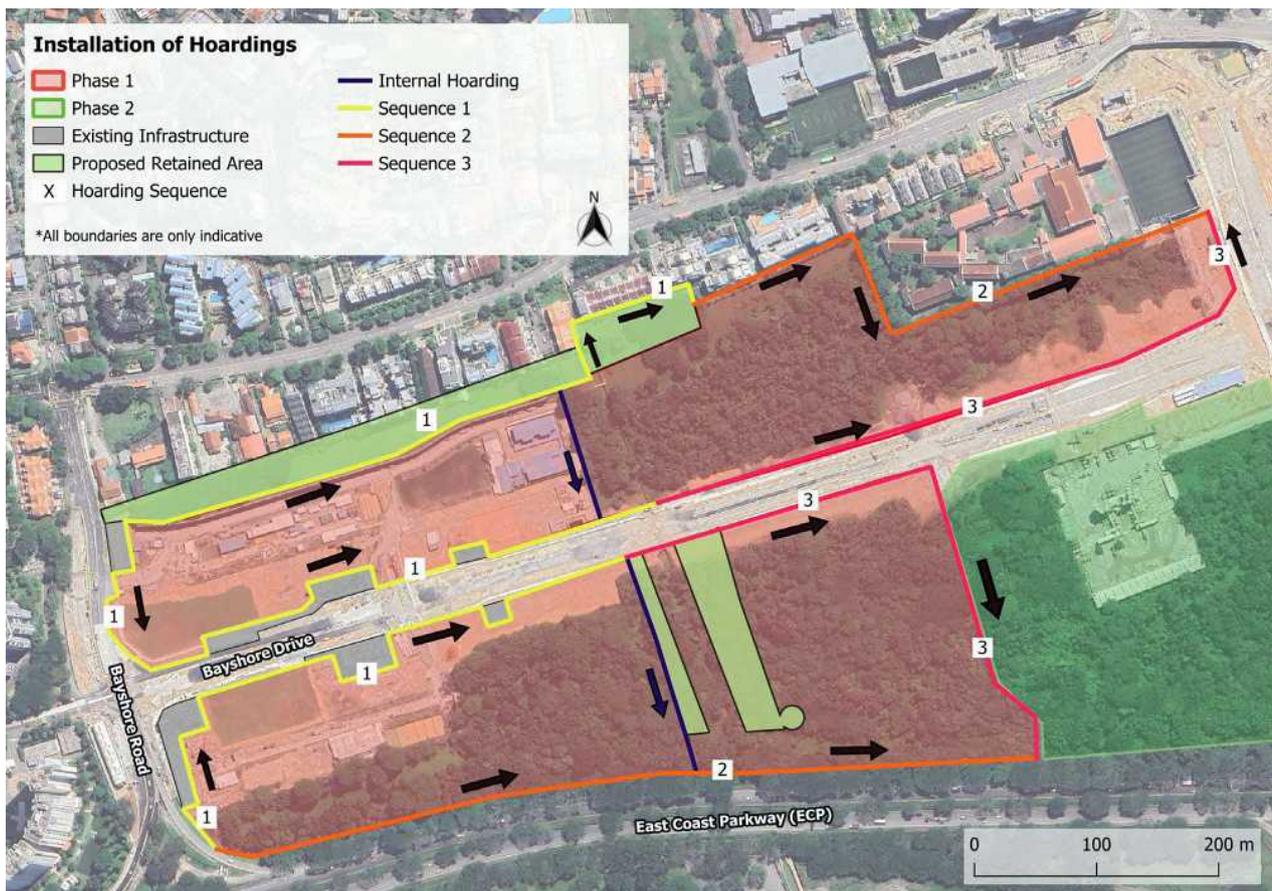
Prior to site clearance, external hoardings, internal perimeter hoarding, temporary barrier installations shall be carried out. Hoarding must be completed for the northern and southern portions before site clearance can commence respectively. Internal hoarding and/or temporary barriers of each sub-plot must also be completed before site clearance commences in that sub-plot. While site clearance is happening for certain sub-plots, installation of temporary barriers can occur concurrently for other sub-plots where site clearance is not yet happening.

The following sub-sections detail the works.

#### **External Perimeter Hoarding**

External hoardings with noise barrier shall first be installed along public roads, such as Bayshore Road, Bayshore Drive, as well as along the proposed retained area in the northern parcel of Phase 1 (i.e., Sequence 1 in **Figure 9**). Subsequently, hoardings will be installed along the ECP in the south, and along the private residential area in the northern parcel of Phase 1 (i.e., Sequence 2 in **Figure 9**). Finally, hoardings will continue along the road that extends beyond Bayshore Drive and would be connected to the hoardings along the private residential area in the northern parcel of Phase 1. As for the southern parcel, the hoarding will continue adjacent to Phase 2 and would be connected to the hoarding along the ECP (i.e., Sequence 3 in **Figure 9**).

Generally, the hoarding direction will be installed from the west to east of the Project Area. External hoardings will be 9 m height. Localised vegetation clearance is expected to be carried out to provide working space for the installation of the perimeter hoarding and perimeter drain construction. This working space is estimated to be up to 6-m wide along the hoarding alignment within the Project Boundary. For such localised vegetation clearance, pre-felling fauna inspections shall be conducted by an Ecologist provided by the EMMP Consultant, prior to the removal of any vegetation (Section 6.4.4).



**Figure 9 Hoarding Alignment, Sequence, and Direction of Hoarding Installation for Phase 1.**

### **Internal Hoardings**

After the installation of the perimeter hoarding, the internal hoarding shall be installed to demarcate the work areas of Phase 1 (**Figure 9**). These hoardings shall be in the form of zinc sheets. The internal hoarding is recommended to follow these specifications:

- at least 2.4-m high,
- light-coloured (i.e., white is ideal) surface on both sides of the panels except for the side fronting the road, so that the hoarding is visually apparent to fauna, reducing the risk of fauna colliding into the hoarding. The side of the panel fronting the road can be green, and
- not to have any gaps that to prevent any fauna from entering the worksite.

### **Temporary Barriers**

Temporary barriers shall also be erected to demarcate the sub-plots for the purpose of site clearance, and to separate the cleared and uncleared sub-plots to prevent fauna from entering the cleared areas during the site clearance and/or falling into existing drain in the Project Site (**Figure 10**). The recommended specifications of the temporary barriers are as follows:

- Barriers are at least 1.8-m high.
- Sufficient counterweight must be present to withstand impact from large animals (e.g., Eurasian wild boars, if any).

- Barriers are covered with an opaque sheet—large animals may attempt to jump over the barrier if they are able to see the other side.
- No gaps that may allow fauna to pass through.

After the installation of the hoardings and temporary barriers, the EMMP Consultant's Ecologist shall inspect the integrity of the structures to ensure that it meets the specifications listed above. Temporary barriers can only be removed once the site clearance for a sub-plot and its adjacent plot(s) are completed. The alignment of the perimeter hoarding, and temporary barriers is shown in **Figure 9** and **Figure 10**.

#### 6.4.2. Fauna Management during Site Clearance

The objective of fauna management during site clearance is to look out for any fauna from the worksite, and if necessary, to conduct translocation of fauna from the worksite before the start of construction works to prevent fauna entrapment, injury, and mortality, whilst minimising contact between human and wildlife.

Targetted fauna species which have been recorded to be present in the area include Sumatran palm civet (*Paradoxurus musangus*) and common tree shrew (*Tupaia glis*). Other fauna species to take note would be ground-dwelling mammals, such as the Eurasian wild boar (*Sus scrofa*), and the nationally Endangered smoot-coated otter (*Lutrogale perspicillata*). In addition, fauna species that may be implicated in human-wildlife conflicts, such as snakes (e.g., painted bronzeback (*Dendrelaphis pictus*) and equatorial spitting cobra (*Naja sumatrana*) during site clearance. These fauna species have been recorded near the Project Site and deemed probable to occur. Although these were not sighted within the Project Site during the EIA study, the possibility of these species occurring within the Project Site has been considered.

Prior to the start of works, the worksite should be completely hoarded. A visual survey will then be conducted to determine if there are Eurasian wild boars trapped within the hoarded areas. If Eurasian wild boars are present, NParks will be informed, and wild boar removal operations shall be conducted by certified WMCs engaged by the Contractor before site clearance commences. After the completion of the operations, site clearance should be conducted in a directional manner as much as possible, from the west to the east for each work phase.

The disturbance generated by site clearance activities is expected to encourage the target fauna to move out of the worksite on their own. At the final stages of site clearance, the Ecologist engaged by the EMMP Consultant will visually inspect the site for any presence of fauna species. If there are fauna still present and trapped on-site, the Wildlife Response Plan will be activated accordingly (Section 8.2). Biodiversity awareness training shall also be conducted to prepare the site team for fauna encounters (Section 5.3.2).

In summary, the overall sequence is as follow:

1. Hoarding installation, with pre-site clearance fauna inspection to be conducted if site clearance is required.
2. Wild boar removal operations to be conducted if there are any trapped wild boars.
3. Site clearance to proceed directionally, with pre-felling fauna inspections to be conducted prior to felling (Section 6.4.4).

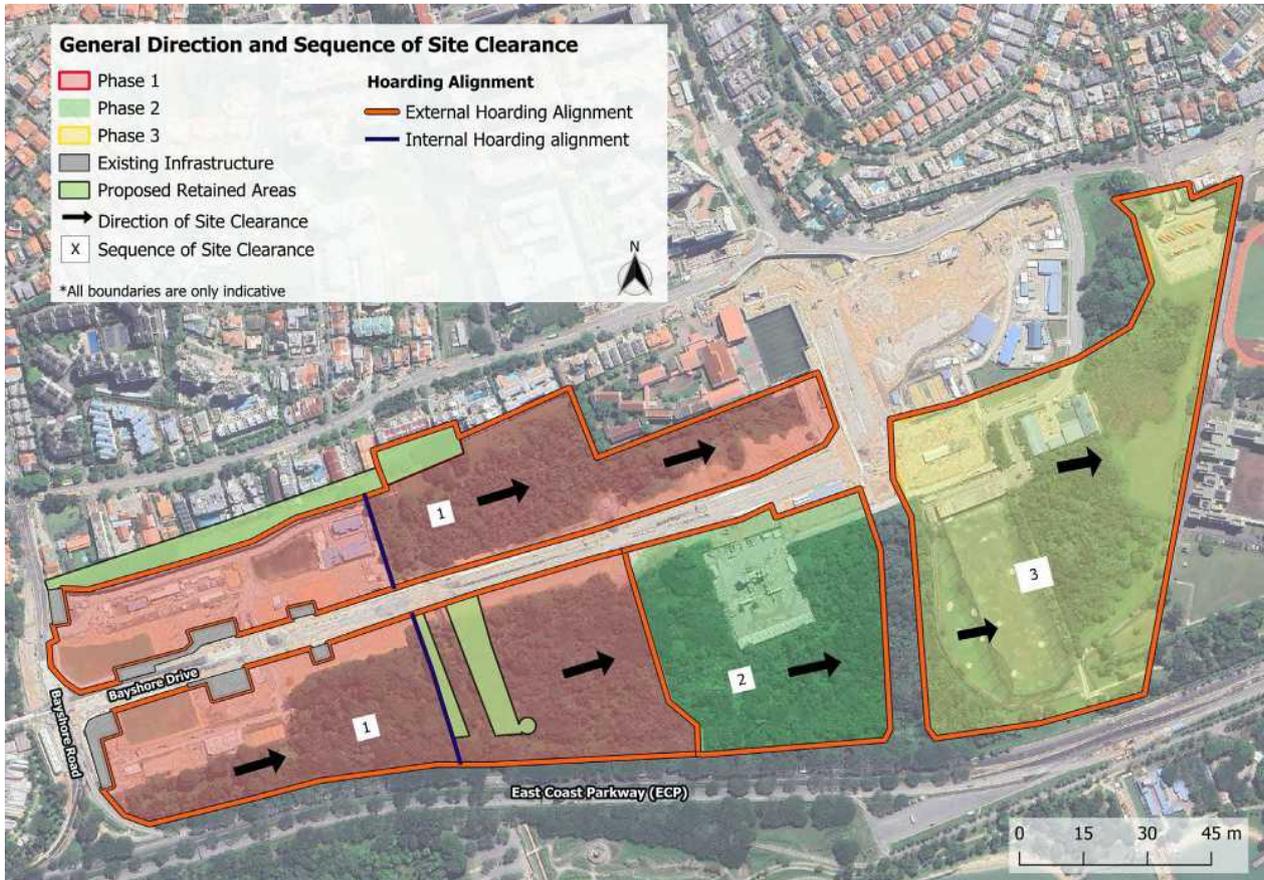
The following sub-sections detail the workflow for site clearance following the installation of perimeter hoarding and temporary barriers (Section 6.4.1).

#### 6.4.3. Directional Site Clearance

After the installation of the external and internal hoardings are completed, site clearance can commence according to the indicated sequence (**Figure 10**). The sequence of the site clearance takes into consideration

future site access, locations of the ECM ponds and sedimentation tanks, as well as other site limitations, such as existing infrastructure, that may be currently present on site.

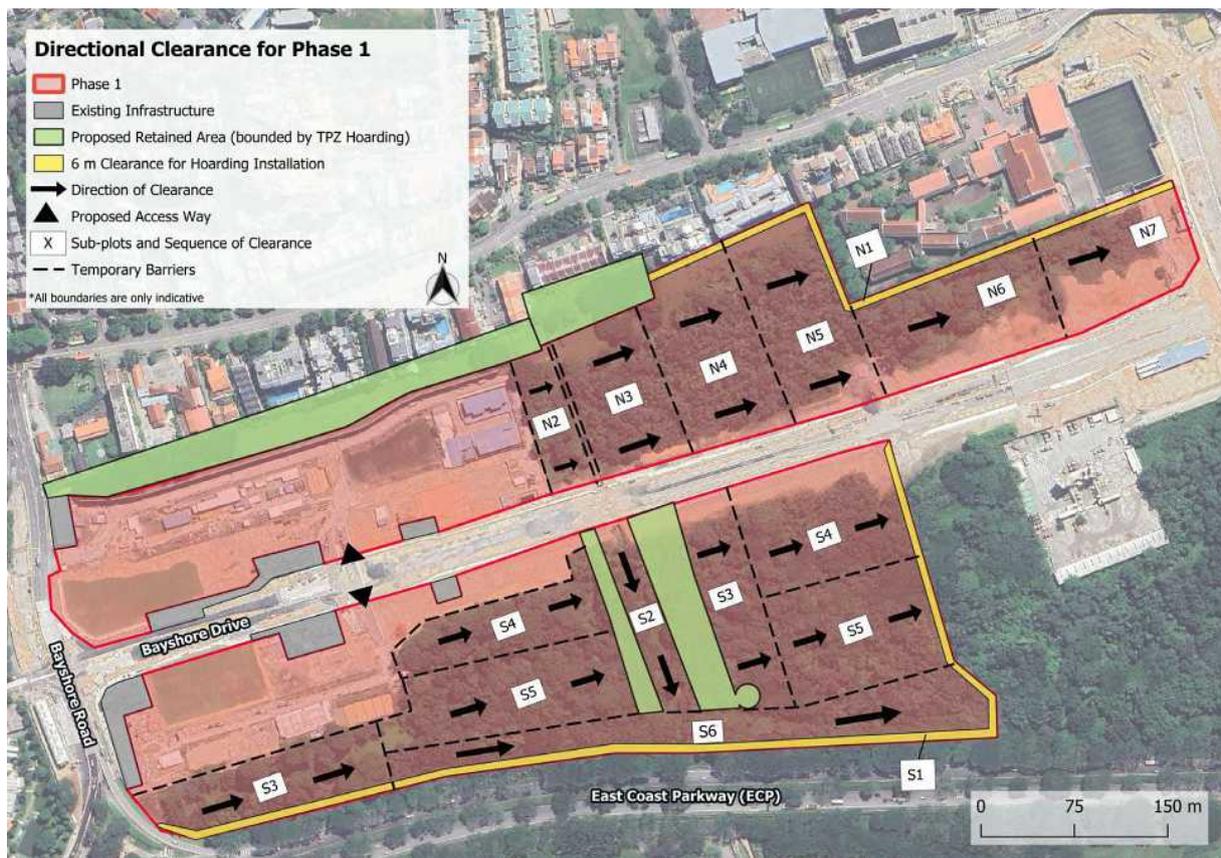
Overall, the site clearance will be carried out in phases starting with Phase 1, and moving on to Phase 2 and, lastly, Phase 3 (**Figure 10**). At the time of writing this report, detailed information of the directional clearance is only available for Phase 1.



**Figure 10 Overall Sequence and Direction of Clearance for Phase 1, 2 and 3.**

Within Phase 1, the vegetation clearance will first be conducted along parts of the hoarding alignment labelled as 'N1' and 'S1' in **Figure 11** to provide working space for the installation of the external hoarding. The direction of clearance follows the hoarding sequence reflected in Section 6.4.1. After which, the vegetated area will be divided further into smaller sub-plots, as seen in **Figure 11**. The directional clearance in the northern parcel follows the sequence from sub-plot N2 to N7. As for the southern parcel, the sequence of directional clearance follows from sub-plot S2 to S7. Site clearance in the northern and southern portions will be carried out concurrently. During clearance in sub-plots S4 and S5, precautions will be taken to safeguard the TPZ at the proposed retained areas towards the east of these. Additional details of the site clearance can be referred to in the Contractor's site clearance plan in Appendix A.

The proposed areas for the ECM ponds and water treatment tanks shall be prioritised first. For instance, the vegetation within sub-plots N2 and S2, which would be the future locations of the proposed ECM ponds and tanks, shall first be cleared by the Contractor, followed by sub-plots N3 and S3, and so forth.



**Figure 11 Sequence and Direction of Clearance for Each Sub-plot in Phase 1.**

Generally, the direction of clearance for Phase 1 will be from the west to the east<sup>3</sup>. However, sub-plot S2 will be cleared from north to south due to site access constraints. Decking will be placed over the existing drain for machinery access.

As mentioned in Section 6.4.1, each sub-plot will be bounded by temporary barriers before the start of the site clearance. Temporary barriers should still be in place when the vegetation in the adjacent sub-plot(s) has not been cleared. For example, the temporary barriers for both sub-plots S3 should remain even after its clearance, since sub-plots S5 and S6 plots are not cleared. This is to prevent any potential fauna from S5 or S6 from coming into sub-plots S3 has already been cleared.

#### 6.4.4. Pre-felling Fauna Inspection

Before any vegetation clearance, pre-felling fauna inspection will be conducted by the appointed Ecologist provided by the EMMP Consultant team, for the undergrowth and trees that are approved for felling. Depending on the density of undergrowth and trees within the area, both inspections can be conducted at the same time on the first day during each round of inspection. The overall protocol of the inspection is reflected in **Figure 12**.

Clearance of undergrowth will first be conducted prior to felling of trees. After the completion of undergrowth clearance, the inspected areas shall be left to fallow for three days to encourage arboreal fauna to leave the site. No vegetation clearance can take place within this fallow period of three days.

<sup>3</sup> KTC intends to clear sub-plots S4 and S5 from north to south, however Figure 11 shows west to east due to ongoing planning discussions with KTC.

After which, inspection for the trees can proceed. If there are no fauna and/or faunal activity observed during the inspection, the remaining trees can be cleared. Pre-felling fauna inspection is valid for seven days, i.e., if the inspected trees or vegetation are not removed within seven days of the Ecologist provided by the EMMP Consultant team inspection, the inspection will be repeated.

The pre-site clearance fauna inspections include the identification and reporting of the following:

- active bird nests, including hollows, and other forms of nesting structures utilised by birds,
- active mammal nests/burrows/roosts,
- other less-mobile animals that are at risk of injury/mortality during tree felling or vegetation removal (e.g., Sunda pangolin), and/or
- animals that may be implicated in human-wildlife conflict (e.g., snakes).

Tree trunks, branches and canopy are to be checked by the EMMP Consultant's Ecologist with binoculars from multiple angles and distances. Any cavities in tree trunks that may be utilised as nesting/roosting structures are to be noted for closer inspection if deemed potentially active. If a nest is potentially identified and activity level is uncertain, the Ecologist will conduct or supervise the closer investigation of the nest site utilising elevating equipment where required.

If animals or active nests are found, the Contractor shall:

- not disturb the animal and allow them to move away on their own before tree felling or vegetation removal, unless the Ecologist deems it necessary to relocate them,
- allow nesting birds to fledge and leave the nests on their own before tree felling or vegetation removal, and
- for other animal encounters, the Wildlife Response Plan shall be carried out (Section 8.2).

The EMMP Consultant's Ecologist will produce a pre-felling fauna inspection report, indicating any relevant information collected during the inspection, including Tree Tag ID (and/or flora location coordinates if not tagged), animal observations, recommended actions, and photographic evidence.

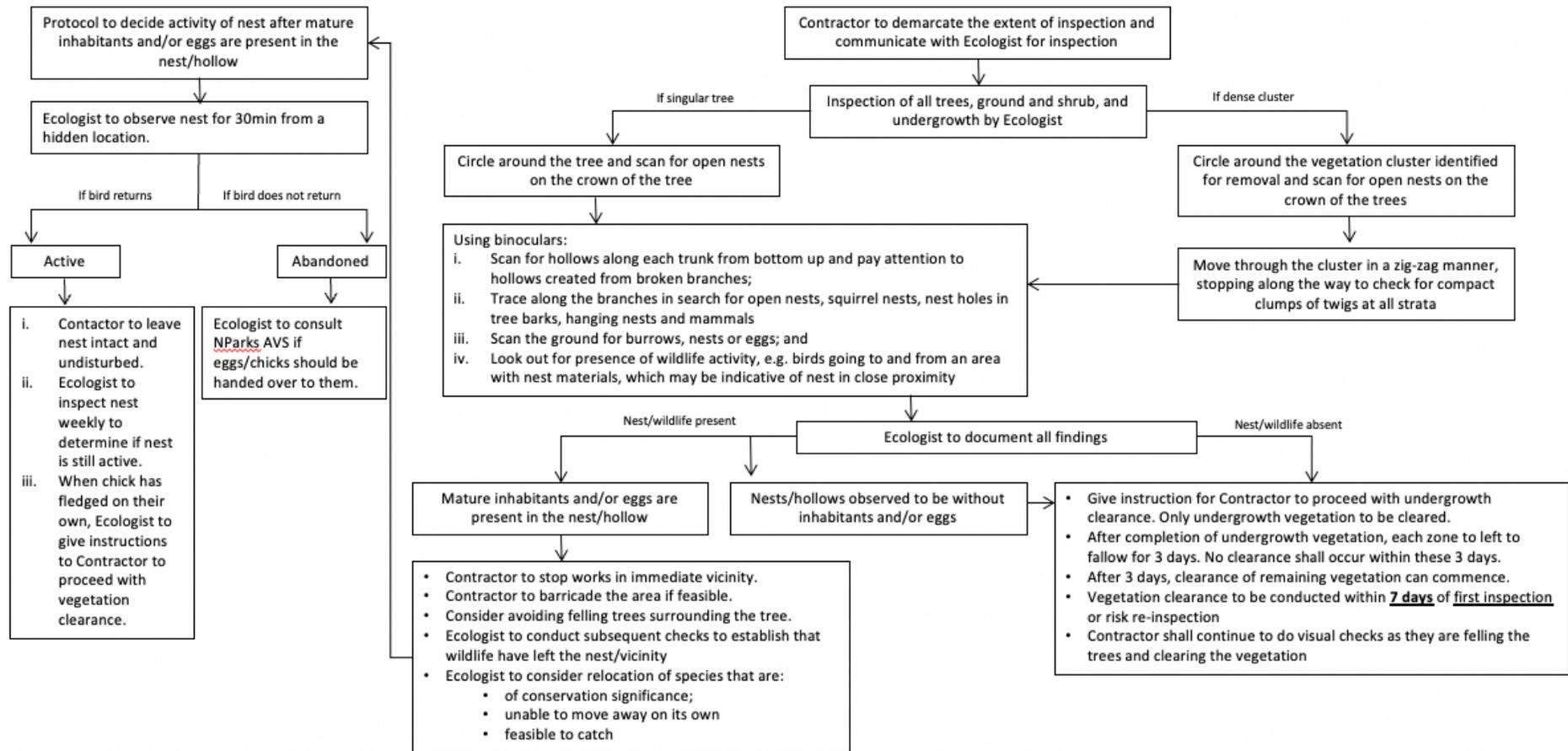


Figure 12: Pre-felling fauna inspection protocol

#### **6.4.5. Post-site Clearance Fauna Inspection**

After the site clearance has been completed for each zone, the Ecologist engaged by the EMMP Consultant will visually inspect the zone for the presence of target fauna. If there are remaining fauna within the zone, the Ecologist will develop species-specific methods to remove them in consultation with the Contractor and NParks (Section 8.2). If there are no target fauna left within the worksite after it has been completely cleared, works can proceed.

#### **6.4.6. Fauna Inspection**

Fauna inspections will be conducted by the EMMP Consultant's Ecologist within the EMMP Boundary. This is to ensure contractor's compliance and identify features that may result in fauna injury and/or mortality. The following will be noted during the inspections:

- Presence of trapped/injured/dead fauna.
- Potential fauna entrapments (e.g., ECBs, TPZs, pits, drains, ponds, trenches, tanks);
- Gaps in hoarding that may allow entry of ground-dwelling fauna; and
- Improperly disposed/stored food and food packaging.

## 7 ENVIRONMENTAL IMPACT, MITIGATION AND MONITORING REGISTER

A summary of the impacts, proposed mitigation, and monitoring requirements for each of the identified environmental impacts is provided in this section. The register is intended to be used as a checklist for weekly EMMP inspection. Depending on the phase of the works, the register/checklist will be classified into earthworks and infrastructure and building mitigation/management and monitoring requirements. Completed checklists will be provided as part of Monthly EMMP reports.

**Table 3: Summary of Environmental Mitigation, Management and Monitoring**

Environmental Aspect	Mitigation / Management Measures	Monitoring Requirements	Frequency	Responsible Party	Triggers
<b>Flora and Fauna</b>					
<b>Pre-construction</b>					
<b>Flora</b> <ul style="list-style-type: none"> <li>Loss of vegetation/habitat</li> <li>Decline in Plant Health</li> </ul>	<ul style="list-style-type: none"> <li>Prior to commencement of site works, flora monitoring and management plan should be crafted by the contractor and reviewed by the EMMP Consultant in consultation with NParks, where necessary.</li> <li>Salvaging procedure for viable specimens of the three species of conservation significance mentioned in Section 6.3.2 shall be carried out in consultation with NParks.</li> <li>Verification and review of footprints for hoarding, access roads and site investigation work by the EMMP Consultant.</li> <li>Ensure that the project boundary is clearly identified on engineering drawings and appropriately demarcated on site by the Contractor.</li> <li>Ensure that the proposed areas to be retained for future park development are properly demarcated on-site via TPZ (Section 6.3.1) by the Contractor and inspected by the EMMP Consultant</li> <li>Proper waste disposal guidelines of construction waste and hazardous material should be strictly adhered to, in order to prevent habitat pollution which impedes seedling recruitment by the Contractor.</li> </ul>	Inspection of trees and plant specimens affected by construction works	As needed prior to Site clearance	EMMP Consultant and Contractor	Non-compliance to any of the minimum controls or mitigation measures are observed on-site
<b>Arboriculture</b> <ul style="list-style-type: none"> <li>Loss of vegetation/habitat</li> <li>Habitat pollution and degradation</li> </ul>	<ul style="list-style-type: none"> <li>For each site clearance sub-plot, tree transplantation procedures and tree protection protocol should be prepared by the Contractor and reviewed by the EMMP Consultant in consultation with NParks. Transplantation and site clearance may happen concurrently for different sub-plots.</li> <li>Tree Monitoring and Management Plan to be implemented by Contractor's Certified Arborist.</li> <li>Ensure that the TPZs are properly and adequately installed in accordance with the Guideline reflected in APPENDIX B and in Section 6.3.1 before site clearance commences by the Contractor.</li> </ul>	Inspection of trees and plant specimens affected by construction works	As needed prior to Site clearance	EMMP Consultant and Contractor	Non-compliance to any of the minimum controls or mitigation measures are observed on-site
<b>Fauna</b> <ul style="list-style-type: none"> <li>Fauna mortality and injury</li> </ul>	<ul style="list-style-type: none"> <li>Prior to the commencement of site works, WRP, pre-felling procedures, and wildlife shepherding plan shall be crafted by the Contractor and reviewed by the EMMP Consultant in consultation with NParks.</li> <li>Pre-felling fauna inspections will be conducted by the EMMP Consultant</li> </ul>	Visual Inspection	As needed prior to Site clearance	EMMP Consultant, and Contractor	Non-compliance to any of the minimum controls or mitigation measures are observed on-site

Environmental Aspect	Mitigation / Management Measures	Monitoring Requirements	Frequency	Responsible Party	Triggers
	<p>prior to the removal of any vegetation. Clearance of undergrowth will first be conducted, and area shall be left to fallow for 3 days to encourage arboreal fauna to leave the site prior to felling of trees on site. The pre-felling fauna inspections for trees is valid for seven days validity, of which, the inspection will be repeated if the trees are not cleared by the contractor.</p> <ul style="list-style-type: none"> <li>■ To inspect all hoardings and temporary barriers and ensure that they are set up with no gaps before the commencement of site clearance by EMMP Consultant.</li> <li>■ Wild boar removal (if any) shall be carried out by a certified WMC engaged by the Contractor.</li> <li>■ Implementation of a traffic management plan that includes driver awareness training and imposition of speed limits (i.e., 20 km/hr within the site) to prevent possible roadkills by the contractor.</li> <li>■ Biodiversity Awareness Training by the EMMP Consultant to be carried to ensure workforce complies to the fauna response procedures, general housekeeping and understands the ecological value of site.</li> </ul>				
<b>Construction (Earthworks and Infrastructure Works)</b>					
<p><b>Flora</b></p> <ul style="list-style-type: none"> <li>■ <b>Loss of vegetation/habitat</b></li> <li>■ <b>Decline in plant health</b></li> </ul>	<ul style="list-style-type: none"> <li>■ Identify unauthorised removal of vegetation beyond the worksites (within 10 m from hoarding boundary) by the EMMP Consultant.</li> <li>■ Identify impacts to adjacent habitats as a result of construction activities, e.g., soil erosion and pollution by EMMP Consultant's ECO and Contractor ECO.</li> <li>■ Identify exotic fast-growing plants and provide recommendations for removal, where necessary by Contractor.</li> <li>■ Monitor the health plant specimens retained on site, if any by Contractor ECO.</li> </ul>	<p>Inspection of trees and plant specimens affected by construction works</p>	<ul style="list-style-type: none"> <li>■ Weekly inspections during earthworks and infrastructure.</li> </ul>	<p>EMMP Consultant, EMMP Consultant's ECO, Contractor and Contractor ECO</p>	<p>Non-compliance to any of the minimum controls or mitigation measures are observed on-site</p>
<p><b>Arboriculture</b></p> <ul style="list-style-type: none"> <li>■ <b>Loss of vegetation/habitat</b></li> <li>■ <b>Decline in plant health</b></li> </ul>	<ul style="list-style-type: none"> <li>■ Ensure trees that are reflected as to be retained in the approved tree felling plan are not cleared, unless approved by Client and the EMMP Consultant's Certified Arborist.</li> <li>■ Ensure trees in the retained areas remain viable, no trees are cleared and/or no works have encroached into these areas by Contractor.</li> </ul>	<p>Visual Inspection</p>	<ul style="list-style-type: none"> <li>■ Weekly inspections during earthworks and infrastructure.</li> </ul>	<p>EMMP Consultant and Contractor</p>	<p>Non-compliance to any of the minimum controls or mitigation measures are observed on-site</p>
<p><b>Fauna</b></p> <ul style="list-style-type: none"> <li>■ <b>Fauna mortality and injury</b></li> <li>■ <b>Human-wildlife conflicts</b></li> </ul>	<ul style="list-style-type: none"> <li>■ Implement Wildlife Response Plan, pre-felling procedures, passive wildlife shepherding plan and post-site clearance inspections by Contractor and inspected by EMMP Consultant.</li> <li>■ Pre-felling fauna inspection to minimise injury and mortality of fauna as a result of vegetation clearance by EMMP Consultant.</li> <li>■ Pre-felling fauna inspections will be conducted prior to the removal of</li> </ul>	<p>Visual Inspection</p>	<ul style="list-style-type: none"> <li>■ As needed during Site clearance; site inspection to be conducted weekly</li> </ul>	<p>EMMP Consultant, EMMP Consultant's ECO, and Contractor</p>	<p>Non-compliance to any of the minimum controls or mitigation measures are observed on-site</p>

Environmental Aspect	Mitigation / Management Measures	Monitoring Requirements	Frequency	Responsible Party	Triggers
	<p>any vegetation (including 3-days fallow period, and 7-days validity) (Section 6.4.4) by EMMP Consultant.</p> <ul style="list-style-type: none"> <li>■ Post-site clearance inspections will be conducted after completion of site clearance for each zone by EMMP Consultant</li> <li>■ Perimeter site hoardings, as well as temporary hoardings must not have gaps in order to prevent entry of animals by Contractor and inspected by EMMP Consultant.</li> <li>■ Directional site clearance must be adhered to so as to minimise fauna injury and mortality (Section 6.4.3) by Contractor.</li> <li>■ Biodiversity Awareness Training to be carried out ensure workforce complies to the fauna response procedures, general housekeeping and understands the ecological value of site by EMMP Consultant.</li> <li>■ Site inspections to be conducted weekly to minimise potential environmental impacts to fauna by EMMP Consultant's ECO.</li> </ul>				
<b>Construction (Building Works)</b>					
<p><b>Flora and Arboriculture</b></p> <ul style="list-style-type: none"> <li>■ <b>Decline in plant health</b></li> </ul>	<ul style="list-style-type: none"> <li>■ Ensure trees in the retained areas remain viable, no trees are cleared and/or no works have encroached into these areas by Contractor.</li> <li>■ Identify impacts to adjacent habitats as a result of construction activities, e.g., soil erosion and pollution by Contractor.</li> <li>■ Identify exotic fast-growing plants and provide recommendations for removal, where necessary by Contractor.</li> <li>■ Monitor the health plant specimens retained on site, if any by Contractor.</li> </ul>	Visual Inspection	<ul style="list-style-type: none"> <li>■ Inspections monthly or more frequently as needed.</li> </ul>	EMMP Consultant, ECO and Contractor	Non-compliance to any of the minimum controls or mitigation measures are observed on-site
<p><b>Fauna</b></p> <ul style="list-style-type: none"> <li>■ <b>Fauna mortality and injury</b></li> <li>■ <b>Human-wildlife conflicts</b></li> <li>■ <b>Light disturbances</b></li> </ul>	<ul style="list-style-type: none"> <li>■ Perimeter site hoardings as well as temporary hoardings must not have gaps in order to prevent entry of animals by Contractor.</li> <li>■ Biodiversity Awareness Training to be carried out ensure workforce complies to the fauna response procedures, general housekeeping and understands the ecological value of site by EMMP Consultant.</li> <li>■ Site inspections to be conducted monthly (or more frequently as needed) to minimise potential environmental impacts to fauna by EMMP Consultant.</li> <li>■ For night works (if required based on the approved LMP by NParks), an approved LMP shall be implemented on site by appointed Contractor(s) for building works.</li> </ul>	Visual Inspection	<ul style="list-style-type: none"> <li>■ Inspections monthly or more frequently as needed</li> </ul>	EMMP Consultant, ECO, and Contractor	Non-compliance to any of the minimum controls or mitigation measures are observed on-site

## 8 EMERGENCY RESPONSE PLAN (ERP)

An overall ERP is provided in this section, will be supplemented by the Contractor's site-specific ERP and emergency response team (ERT) and ERP organisation. The Plan shall include incident response, protocols and parties that need to be inform in an event of an incident, monitoring and management. The immediate response to all incidents will be to make the area safe and undertake measures to prevent further environmental harm. Regular ERP drills will be required in order to ensure that all parties are aware of responsibilities in the event of an emergency.

A general flowchart for emergency response is provided below:

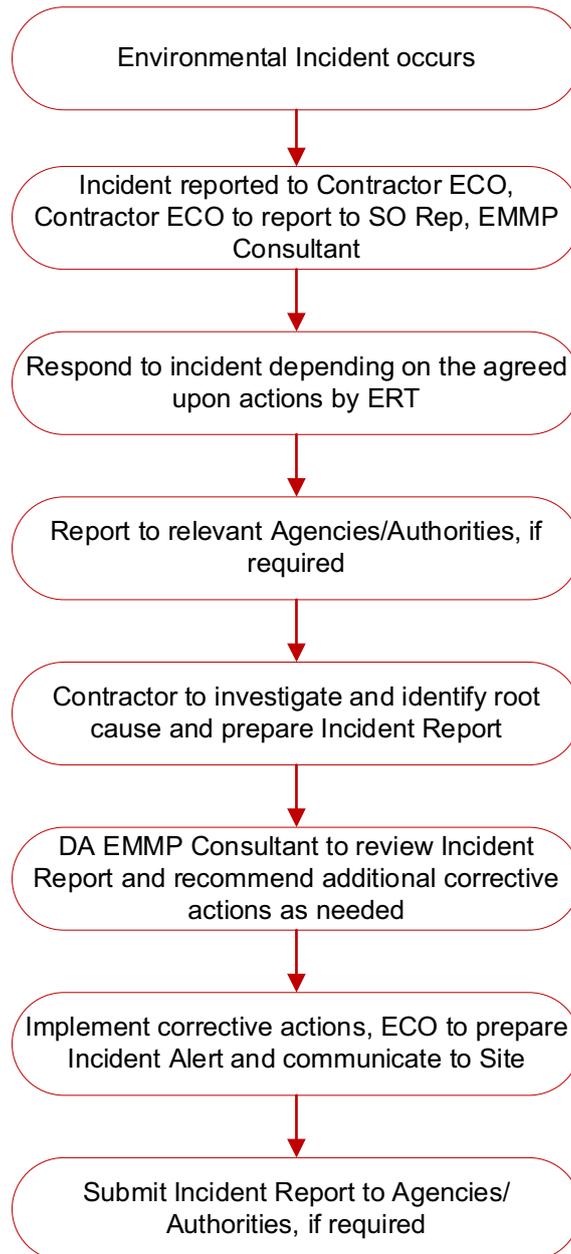


Figure 13: General Emergency Response Flowchart

## 8.1 Emergency Response Organisation

**Table 4** below lists the responsible parties for reporting, response, and notification in the event of any environmental incident:

**Table 4: Summary of responsible parties for environmental incidents**

Incident	Notification	Responsible Person
<b>All environmental incidents</b>	All environmental-related incidents should be reported by personnel to the Contractor's ECO by means of an incident report form. Contractor ECO to report to SO Rep and EMMP Consultant; Subsequent actions to be based on succeeding sections below, to be amended as needed based on Contractor's ERP	<ul style="list-style-type: none"> <li>■ All personnel</li> </ul>
<b>Encounter of dead and injured animals</b>	<ul style="list-style-type: none"> <li>■ Contractor ECO to report to EMMP Consultant and SO Rep</li> <li>■ SO Rep to report to DA</li> </ul>	<ul style="list-style-type: none"> <li>■ As with notification requirement</li> <li>■ Contractor to contact WMC</li> </ul>
<b>Fire</b>	<ul style="list-style-type: none"> <li>■ Fire wardens to report to SO Rep, Singapore Civil Defence Force (SCDF)</li> </ul>	<ul style="list-style-type: none"> <li>■ As with notification requirement</li> <li>■ SCDF</li> </ul>

## 8.2 Wildlife Response Plan

The WRP will be activated whenever a trapped/injured/dead/dangerous animal is encountered around or within the worksite. The objective of the WRP is to minimise animal injury and mortality by responding appropriately to the different scenarios in Figure 14. This will be emphasized during the toolbox briefings. All wildlife incidents shall be reported and documented in a Wildlife Incident Form (**APPENDIX D**). Sightings of fauna roadkill will also be conducted daily by appointed ECOs within the internal roads of the Project Site.

Where necessary, the WMC engaged shall be listed under NParks' public register of certified WMC and approved by NParks to carry out removal and rescue in accordance with S10 directives.

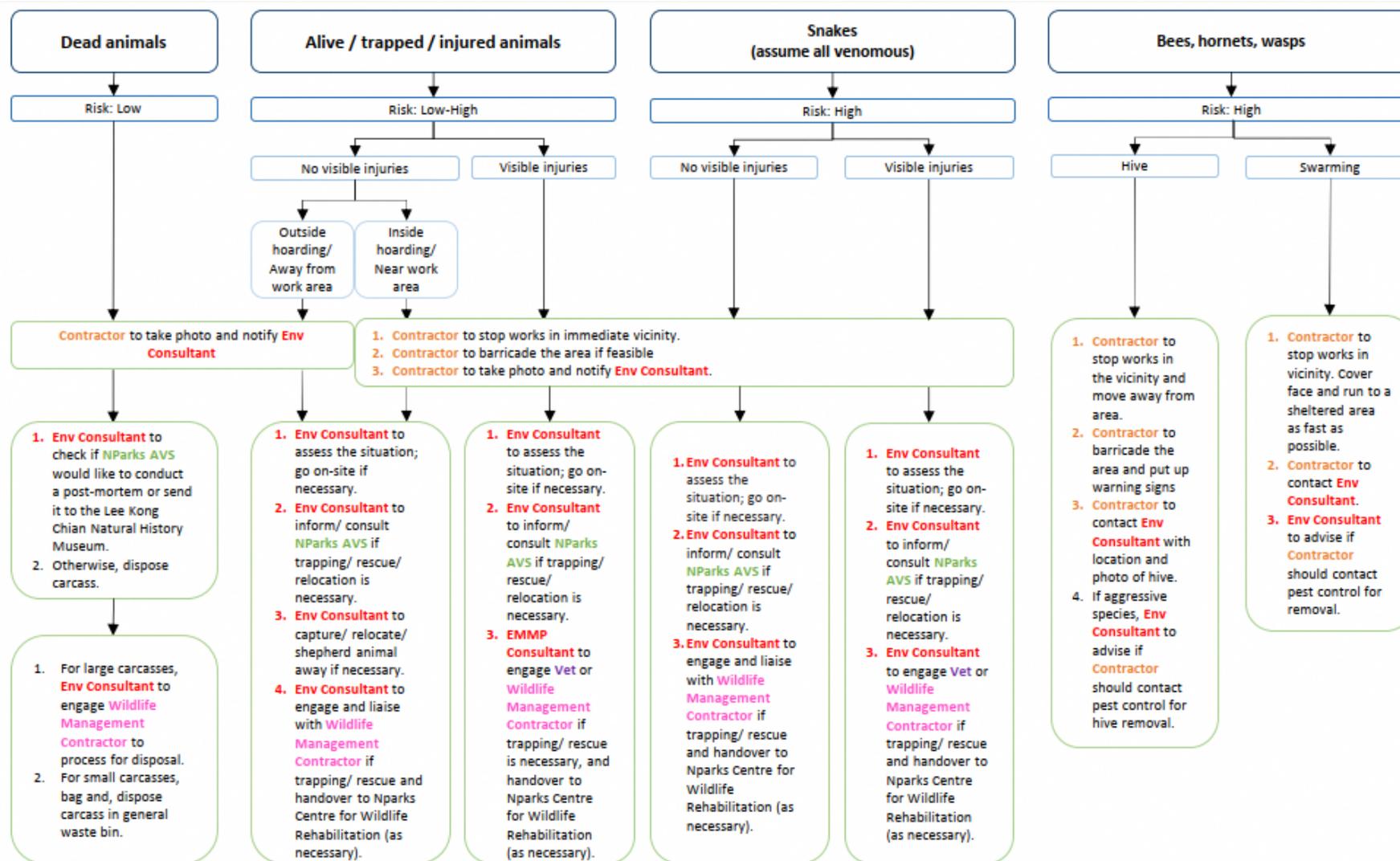


Figure 14: Wildlife Response Plan flowchart

## 9 REPORTING AND REVIEW

This section outlines the EMMP reporting requirements and review should any plans and Site conditions change, or if the proposed mitigation and monitoring need to be updated. At a minimum, the EMMP should be reviewed every six months. The required reports and reviews are as follows:

- Submission and presentation (if required) to NParks, HDB and other relevant Authorities and obtain approvals on the EMMP;
- Liaise and coordinate with HDB's appointed Contractor/s, prepare the EMMP for each of the future activities.
- Regular site inspections and progress meetings to provide updates on the EMMP implementation. Checklists for site inspections will be prepared to facilitate reporting and compilation of data throughout the project's development. A common data repository (i.e., a SharePoint site) will be designated for data storage and sharing.
- Report potential or actual incidents and non-conformances and to propose corrective actions.
- Monthly EMMP reports throughout the construction works that includes pre-felling fauna inspection reports, and any weekly inspections.
- Prepare materials and attend, when needed, the briefings / presentations to stakeholders e.g., Grassroots Leaders, other interest groups / nature group and or organization, etc;
- Prepare and maintain an Environmental Impact and Mitigation Register which provides a summary of the project activities, identified sensitive receptors and potential environmental impacts, mitigation measures, timelines, and the residual impacts.
- Prepare, submit, and present a Close-off EMMP Audit report on the environmental mitigation and performance once the works on site is completed.

Weekly (and subsequently monthly) inspections and monthly EMMP reports, identified issues and additional actions taken to mitigate these will be submitted. Each subsequent monthly EMMP report will include trends and report on successful or failed follow-up actions until an issue has been effectively mitigated.

## 10 CLOSURE

The EMMP includes flora and fauna management plans formulated in alignment with contractor plans and method statements. Contractors and subcontractors shall comply with applicable EMMP management, mitigation, monitoring, and reporting requirements. A change in the EMMP will be communicated to site personnel for compliance, and to authorities for approval, as needed.

**APPENDIX A**

**Contractor Management Plans**

# Proposed Hoarding Plan

Step	Activities	Remarks
1	Install 9m height hoarding with noise barrier at turf area along the site boundary.	
2	Install 9m height hoarding with noise barrier at northern and southern part of site.	
3	Install 9m height hoarding with noise barrier for the remaining site boundary.	
4	Install 2.4m height internal hoarding (after site clearance done).	
5	Hoarding works completed.	

# Step 1: Install 9m height hoarding with noise barrier at turf area along the site boundary.



Hoarding with noise barrier

- On-going 9m height hoarding with noise barrier
- On-going 2.4m height internal hoarding (zinc sheet)
- Bayshore MRT Entrances & Structure
- Completed 9m height hoarding with noise barrier
- Completed 2.4m height internal hoarding (zinc sheet)
- Direction of hoarding installation

## Step 2: Install 9m height hoarding with noise barrier at northern and southern part of site.



Hoarding with noise barrier

- On-going 9m height hoarding with noise barrier
- Completed 9m height hoarding with noise barrier
- On-going 2.4m height internal hoarding (zinc sheet)
- Completed 2.4m height internal hoarding (zinc sheet)
- Bayshore MRT Entrances & Structure
- Direction of hoarding installation

### Step 3: Install 9m height hoarding with noise barrier for the remaining site boundary.



Hoarding with noise barrier

- On-going 9m height hoarding with noise barrier
- Completed 9m height hoarding with noise barrier
- On-going 2.4m height internal hoarding (zinc sheet)
- Completed 2.4m height internal hoarding (zinc sheet)
- Bayshore MRT Entrances & Structure
- Direction of hoarding installation

# Step 4: Install 2.4m height internal hoarding (after site clearance done).



Internal hoarding (zinc sheet)

- On-going 9m height hoarding with noise barrier
- Completed 9m height hoarding with noise barrier
- On-going 2.4m height internal hoarding (zinc sheet)
- Completed 2.4m height internal hoarding (zinc sheet)
- Bayshore MRT Entrances & Structure
- Direction of hoarding installation

# Step 5: Hoarding works completed.



- On-going 9m height hoarding with noise barrier
- Completed 9m height hoarding with noise barrier
- On-going 2.4m height internal hoarding (zinc sheet)
- Completed 2.4m height internal hoarding (zinc sheet)
- Bayshore MRT Entrances & Structure
- Direction of hoarding installation

**CONTRACT D/040/24**  
**MAJOR INFRASTRUCTURE WORKS AT NEIGHBOURHOOD B**  
**(PHASE 1A)**

**METHOD STATEMENT**  
**FOR**  
**TREE-FELLING**

Rev	Date	Description	Prepared by	Checked by	Approved by	Reviewed by (WSHO)	Endorsed by (Arborist)
-	1 Mar 2024	For Approval	Jun Yang	Jia Hong	Aloysius	-	-
1	16 Mar 2024	For Approval	Jun Yang	Jia Hong	Aloysius	-	-
2	3 April 2024	For Approval - Review on Arboriculture	Jun Yang	Arborist Lim Hong Leong	Aloysius		

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## 1. INTRODUCTION

This method statement proposed the outline procedure of work method for tree felling and safety consideration for Contract HDBBSHO – Major Infrastructure works at Neighbourhood B (Phase 1A). The preparation of this method statement is based on the intended design and work sequence of tree felling works activities.

## 2. LOCATION PLAN

The proposed work site is located as shown in the plan below.

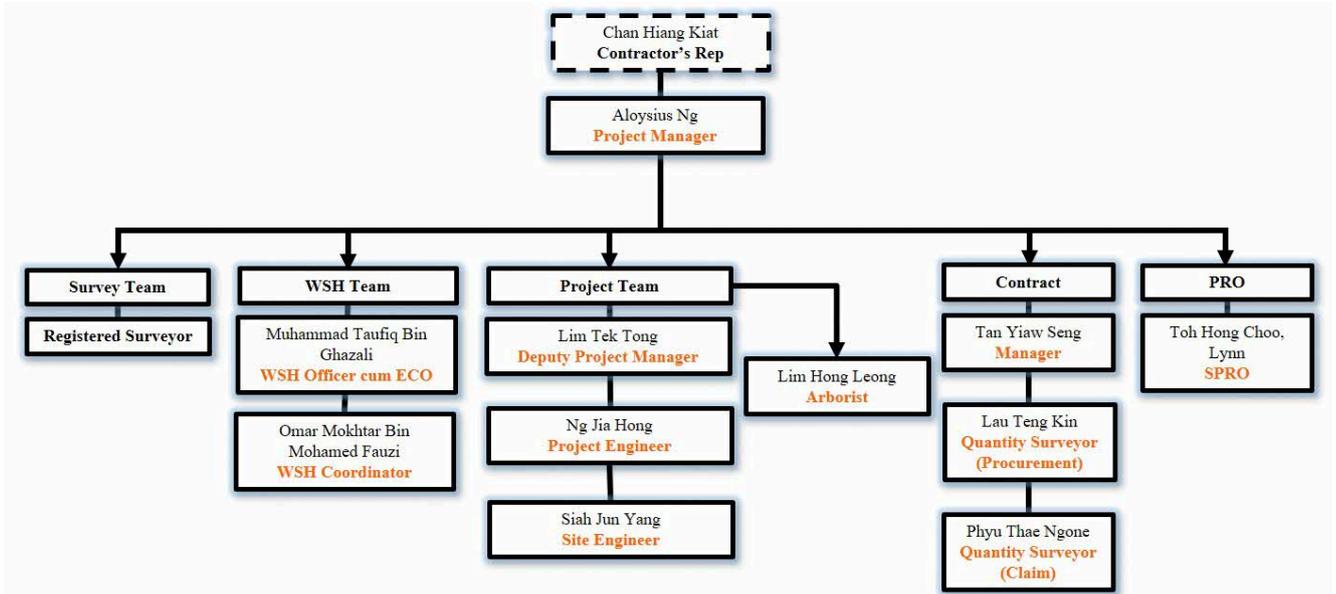


Layout plan of HDBBSHO

## 3. SITE ORGANIZATION CHART

A competent and experience team of excavation crew lead by a Project Manager will be deployed to execute the tree felling works. Besides carrying out the tree-felling activities, this team will also co-ordinate closely with the client and other sub-contractors to ensure a seamless excavation backfilling works. As safety is our paramount concern, safety officer will assign to ensure all works are accomplished safely.

## KTC Site Organization Chart



## 4. SCOPE OF WORK

The scope of works is for tree-felling works at Bayshore Neighborhood B is as follows:

- Submit method statement, risk assessment and safe work procedures.
- Cable detection work within working area activities boundary.
- To apply permit prior to tree-felling works.
- Excavation and internal transfer of tree-felling's earth fur further backfilling work.

## 5. ESTIMATED EQUIPMENT AND PLANT

The strength of workforce shall vary depending on the stage of construction and the number of construction activities being carried out within each stage of construction.

In general, the work will be carried out with aid of the equipment/plants as listed below:

S/N	Description	Capacity	Remarks
<b>Machinery and Equipment</b>			
1	Grapple Excavator	N.A	For tree-felling works
2	Skip Bin	N.A	For collecting of waste
3	30 ton Standard Arm Excavator	1.8 m3	For tree-felling works
4	20 ton Standard Arm Excavator	1 m3	For tree-felling works
5	Dump Truck	28 ton	Transfer earth within site
6	Chainsaw	N.A	For tree-felling works
7	Wood Chipper Machine	N.A	For tree shredding works

## 6. MODE OF TRANSPORTATION

The mode of transportation for soil and machinery are as below:

- Soil removal/disposal: Dump Truck
- Machinery: Low-bed Trailer

## 7. TREE-FELLING METHOD

For this project, tree-felling method will be employed and addressed in clause 7.2.

### 7.1 Cable Detection & NCE Application

Before the commencement of tree-felling work, registered licensed cable detection worker (LCDW) will be engaged to purchase services drawings and detect/identify existing underground services within the work site. All existing underground installations such as sewers, gas pipes, water pipes, and electrical conductors that may cause danger during the works must be disconnected, removed, diverted, or otherwise protected according to the requirements of the relevant authorities. Notice for commencement of earthwork (NCE) shall be applied for any telecom or power cables as required by authorities, if any.

## 7.2 Tree-Felling Works Sequence

There are up to 2 proposed methods for tree-felling work:

- Tree-Felling Method - 1 (Pushing over trees with excavator)
- Tree-Felling Method - 2 (Lumberjack one cut felling method)

### a. Proper barricading of the working area

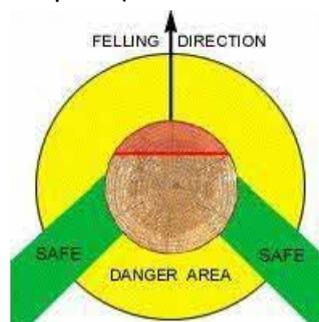
- i. Before any commencement works, workers are to erect proper signage to indicate the work area.
- ii. Workers to ensure proper signage is set up before leaving work site.

### b. Pre-checking by KTC's Arborist

- i. Prior to tree felling, KTC's Arborist will conduct on-site verification of the trees by zones as approved by NParks.
- ii. Upon discovery of dead or insecure trees, two trees' tops being connected by entwined branches or vines, structural weakness and damage in other trees and unhealthy or infected trees; the arborist will tag the trees.
- iii. The respective mitigation measures to address the risk associated with the above discoveries shall be implemented before tree felling commences.

### c. Work Sequence

- i. Checking of site and marking to identify the trees to fall in accordance with approved construction drawings.
- ii. Subdivide the tree felling into sub-zones with Tree Felling Access Routes and Safety Zones marked in layout plan (Refer to sketch below)



- iii. At the commencement portion of tree-cutting works, road diversion signs shall be set up.
- iv. Trees verification by the relevant authorities such as Narks, appointed arborist, and QP to confirm the trees to fell, if required.
- v. Submit plans and documentation to the relevant authorities for final clearance before the commencement of works, if required.
- vi. Conduct a pre-felling fauna survey prior to clearing of undergrowth and felling of tree at the site
- vii. Tag the trees to fall with "red-white" tape and brief excavator operators to ensure site personnel do not remove the wrong tree.

- viii. Safety measures and preparation of working tools.
- ix. Trimming of branches.
- x. Apply Permit to Undergrowth Clearance & Permit to Tree Felling before starting work.
- xi. Tree-felling
- xii. Provide skip bin for clearing of horticulture waste from tree felling.
- xiii. Felled Tree will be shifted to the designated tree shredding stockpile for shredding work.
- xiv. Shredded Wood chips will be gathered into a designated stockpile. When the stockpile area becomes full, the shredded wood chips will be disposed off the site.

**d. Tree-Felling Method - 1 (Pushing over trees with excavator)**

- i. Excavator shall be positioned on the stable ground/ safety zone before start of tree-felling activities. Siren shall be sounded to inform all that tree felling operation is to commence. The excavator shall then apply pressure to fall the tree in the direction opposite to where the excavator is and must be felled within the site boundary. The trees shall be pushed outwards, away from the excavator. Trees must not be felled by pushing the tree sideways or by pulling the tree towards the excavator cabin. While pushing over trees with excavator, operator should exercise care not to damage the roots of adjacent trees. Banksman is to ensure no one is standing near or directly under the area where the branches/trunk may fall. (Refer to photos no. 1 & 2 below)



Photo 1



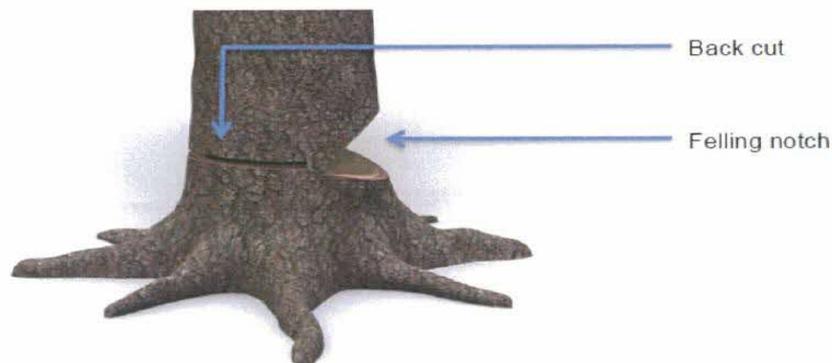
Photo 2

*Photos 1 & 2 illustrate pushing over trees.*

- ii. Prior start of tree felling, clearing of small shrubs and vegetation first to create the space for excavator.
- iii. While pushing over trees with excavator, operator should ensure not to damage roots of adjacent trees.
- iv. Excavator operator must be authorized and competent.
- v. If there are, any difficulties during the process will stop work immediately and report to relevant authorities.

**e. Tree-Felling Method - 2 (Lumberjack one cut felling method)**

- i. Prior start tree felling, clearing of small shrubs and vegetation to create access and space.
- ii. Define the tree felling zone minimum of twice of each felling tree branch length.
- iii. Use cones or “red-white” tape to demarcate the felling zone. Banksman to be stationed during tree-cutting works to ensure no one is within the felling zone.
- iv. Appointed a competent chainsaw operator to fell the tree.
- v. The supervisor shall define the tree felling escape route for the chainsaw operator and wedge fitting operator and walk the ground with them to familiarize them with the route.
- vi. The chainsaw operator is to cut a “V” mouth on the felling side that is not more than 30% of the total tree trunk diameter and an inspection of the mouth cut is to be carried out by the tree cutting supervisor to ensure the tree is safe for felling before a horizontal back cut towards the “V” mouth centre line is made. ( Diagram A)
- vii. When the chainsaw cuts deep enough for a wedge to be fitted in, the operator is to fit the first wedge directly behind the felling direction.
- viii. The wedge is to be gently tapped into the cut point when the chainsaw is cutting
- ix. The chainsaw operator will stop cutting when the cut point is parallel to the “V” mouth and a distance away from the “V” mouth.
- x. The chainsaw operator will stop and pull out the chain and the wedge operator will hit the wedge until the tree falls.
- xi. When the tree is felling, both operators are to shout “RUN” and run away from the tree as defined by the escaped route.



**Diagram A illustrates felling notch ('V' mouth) and back cut**

## **8. WOOD SHREDDING METHOD**

### **8.1 Starting up the wood shredding machine**

- Ensure the whole chipping/ shredding operations are situated at designated approved location.
- Perimeter around chipping/ shredding machine must be condoned off with barricade.
- Only approved operators are allowed into the chipping/ shredding site.
- Make sure you are set up in a safe, open area away from power lines and ditches whenever possible.
- Check for foreign objects lying on the infeed bed and engine area. Keep these areas clear.
- Place the clutch in the disengaged position and lock.
- Turn main power switch on the engine to the ON position.
- Be sure everyone is clear of the machine. Sound horn 2 or 3 times to alert all personnel and anyone else close by that you are ready to start up the power unit.
- Turn the ignition switch to the on position.
- Engage the clutch by bumping the clutch handle in and out gently, until the chipper drum is turning, then fully engage the handle.

### **8.2 Getting into the operator cabin**

- Always use grab rails and safety steps.
- Get into cab, close and latch door.
- Throttle up power unit all the way.

### **8.3 Feeding / Chipping Operation**

- Swing loader out and bring logs up onto the end of the deck.
- Begin by feeding the butt of the tree into the infeed.
- Once the tree or log starts under the feedwheel, lower it to the conveyor chain and open the grapple.
- Repeats feeding / chipping operations.

### **8.4 Machine Shut Down**

- Throttle engine down to an idle.
- Position loader on the ground or on the conveyor bed for transport.
- Close up cab. Shut off heater, a/c, fan, etc. before leaving the cab.
- Always lower and secure all equipment before dismounting.
- Dismount machine using grab rails and safety steps.
- Disengage clutch and install clutch lock.
- Allow engine to idle 3-5 minutes. Allowing engine turbos to slow and cool.
- Turn off main switch and remove ignition key.

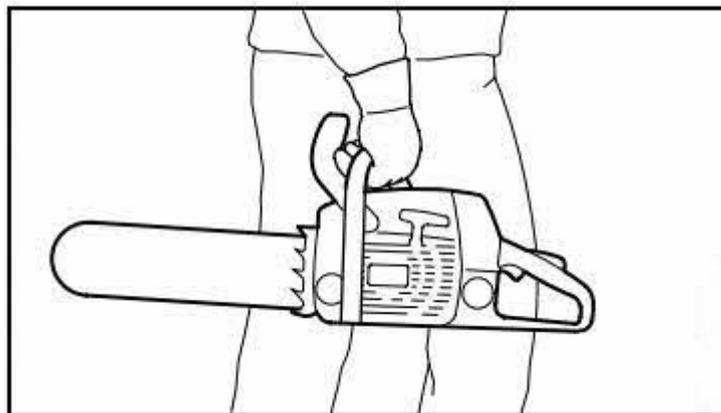
## 9. WORKPLACE ACCESS AND EGRESS

During tree-felling works, machinery, materials and workers will enter/exit the site through designated route as provided on site. All workers shall be briefed through the In-house Safety Induction Course (SIC) before commencement of work within the site.

## 10. SAFE USE OF CHAINSAW

### 1. Transporting the Chainsaw

- Before carrying the chainsaw, the engine shall be stopped, the chain brake shall be engaged, and the chain guard (scabbard) shall be fitted over the chain and guide bar.
- The chainsaw shall be carried by the front handle (handlebar).



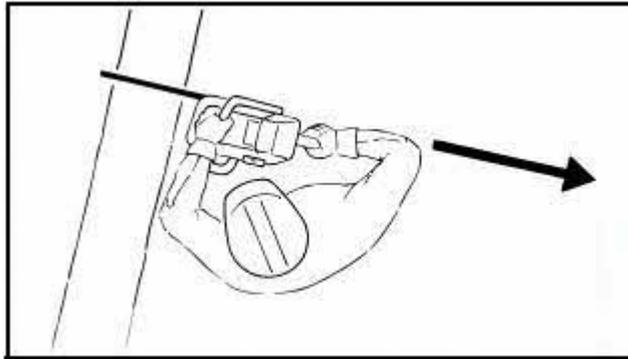
### 2. Refueling

- Refueling shall always be on the ground level and away from any naked flame.
- The engine shall always be stopped and cooled down before refueling.
- No smoking during refueling and operating the chainsaw.
- Fuel leakage shall be checked while refueling and during operation.

### 3. Chainsaw Operation

- Only certified (By NParks) chainsaw operators can operate chainsaws for tree cutting.
- The assembly and operating condition of the chainsaw shall always be checked before operation.
- No modifications to the controls and safety devices shall be allowed.
- The handles shall be kept dry and free of oil and pitch.
- The chainsaw shall be started without any assistance. It shall be a 1-person saw.
- The chainsaw shall not be left running unattended.
- No smoking for chainsaw operator while using the machine shall be strictly enforced.
- Safety goggles/face shield, dust mask, proper gloves, ear protection, and proper work cloths shall be worn aside the standard PPE.
- The chainsaw operator shall consider carefully all conditions which may affect the direction of the fall, e.g. wind direction and speed, lean of the tree, surrounding trees and obstacles, sloping ground, etc.

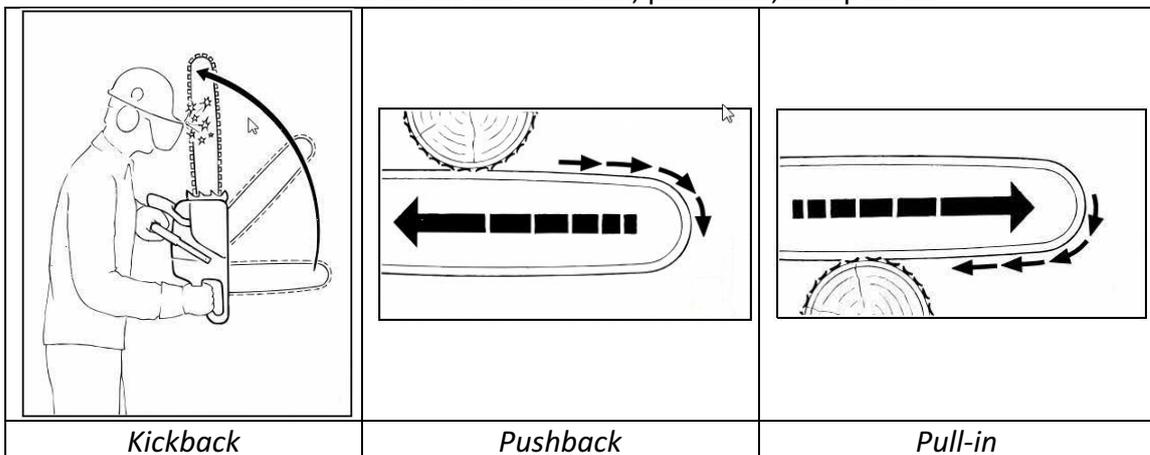
- The general condition of the tree to be cut shall be assessed before cutting. Decaying or rotting tree branches/trunks or those that are leaning and under tension could snap or split while being cut and could cause serious injury to the operator or bystanders.
- The chainsaw operator shall have a firm and safe footing when using the machine.
- The chainsaw operator shall be within calling distance of others in case of help is needed.
- The chainsaw shall stand to the side of the path of the cutting path of the saw.



- The chainsaw operator shall position himself at the windward side of the cutting operation to avoid the engine fume, heat from the engine exhaust, and sawdust.
- The chainsaw shall always be held firmly with both hands when cutting – right hand on the rear handle – and maintain a secure grip.

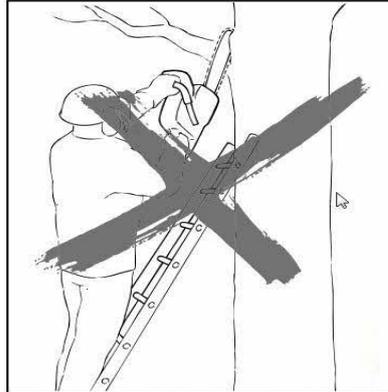


- Only one tree branch/trunk shall be cut at a time.
- Injuries may occur by reactive forces created by the chainsaw. The most common reactive forces are kickback, pushback, and pull-in.



- The chain brake of the saw shall always be engaged for every cutting to reduce the risk of kickback.

- The chainsaw guide bar shall not be twisted during cutting which may cause the material to pinch the chain.
- Ladders or any unsecured supports shall not be allowed to reach high tree branches/trunks.



- In a sloping ground, the chainsaw operator shall always stand on the uphill side of the cut tree trunk to avoid being hit by rolling tree trunk.



- The chainsaw safety manual shall always be followed during operation.

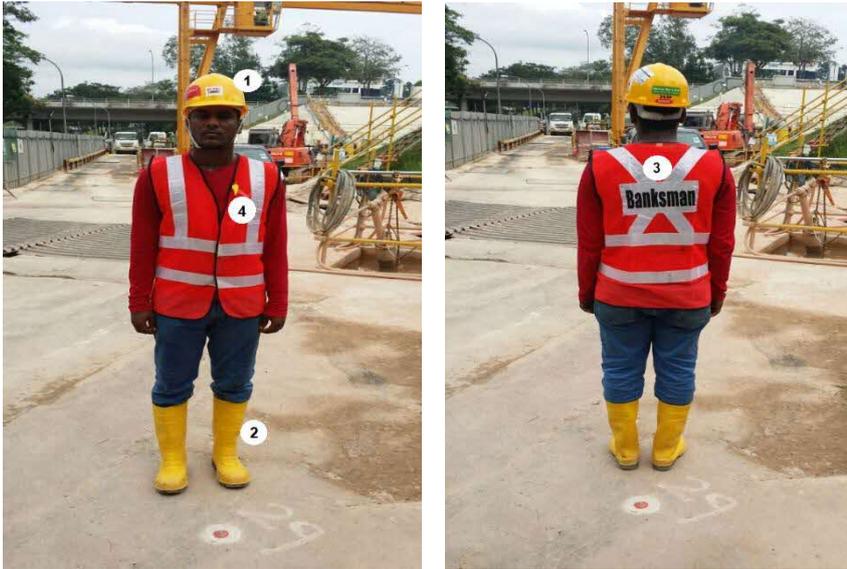
## 11. SAFETY, HEALTH AND ENVIRONMENT

All workers will attend safety induction before commencement of work on site. Personal Protection Equipment (PPE) shall be issued to all personnel involved in the works and wearing of PPE shall be enforced to the team as a whole. All site personnel shall wear the following PPE at all times:

- Safety Footwear
- Safety Helmet
- High Visibility Safety Vest
- Gloves (If required)
- Eye/Face protection (If required)
- Hearing Protection (If required)
- Full Body Safety Harness (If required)

## 11.1 Personal Protection Equipment

### 11.1.1 Banksman Attire



1. Safety Helmet
2. Safety Footwear
3. High visibility safety vest with “Banksman” initial at the back
4. Whistle

### 11.1.2 Chainsaw Users

#### 1. Helmet

A sturdy helmet is a vital piece of PPE for chainsaw users. It provides protection against falling debris, branches, and other hazards. The helmet should be equipped with a face shield or visor to shield the eyes from flying wood chips and dust. It is important to ensure that the helmet fits securely and comfortably to provide maximum protection.

#### 2. Eye Protection

When operating a chainsaw, eye protection is crucial to prevent any potential injuries caused by flying debris. Safety glasses or goggles with side shields are recommended to protect your eyes from wood chips, dust particles, and other foreign objects that may be propelled during cutting.

#### 3. Hearing Protection

The loud noise generated by power tools like chainsaws can cause long-term hearing damage if proper precautions are not taken. To safeguard your hearing, it is essential to wear earmuffs or earplugs while using a chainsaw. These protective devices help reduce the impact of high decibel levels produced by the engine’s noise.

#### 4. Gloves

Wearing gloves when operating a chainsaw provides multiple benefits. They offer protection against cuts from sharp blades and splinters from wood pieces. Gloves with an anti-vibration feature can minimize hand fatigue caused by prolonged tool usage.

## 5. Chaps or Leg Protection

To protect your legs from accidental contact with the chainsaw blade, specialized chaps designed specifically for chainsaw use should be worn. These chaps have layers of cut-resistant material that can significantly reduce the severity of injuries in case of an accidental slip or mishap.

## 11.2 Plant and Equipment

- Additional safety feature, excavator EX200/EX330 installed rear view camera



## 11.3 Environmental Protection

### 11.3.1 Environmental Impacts

- Dark smoke and excessive dust emission from machinery cause air pollution
- Travelling with muddy tyres and spillage of load on public roads during transportation causes dirt accumulation, which will affect other road users.

### 11.3.2 Mitigation Measures

- Regular maintenance of machinery
- Vehicle transporting load e.g. earth, aggregates or other loose materials shall be provided with proper cover sheet to prevent it from falling on the road.
- Provision of vehicle washing bay at entrance/exit point of the site.
- All vehicles going out from work site to pass through the washing bay for proper washing of tyres before travelling on public roads.

## 11.4 Spillage Protection

### 11.4.1 Prevention Measures

- Use steel plate to make a working platform to avoid direct contact between the tree shredding machine and the ground and to prevent spill seepage into the ground.



### 11.4.2 Mitigating Measures

- Provide temporary drip tray to contain spillage
- Provide spillage kit to clean up any spillage immediately
- Spillage to be mop up with approved absorbent material
- In case of heavy oil spillage the responsible person shall contact the relevant authority for necessary assistance
- To cordon off the affected area
- To deploy adequate traffic controller to divert oncoming vehicle and assist traffic movement at the affected area
- Deploy water truck
- To notified Main-con / authority immediately for assistance

**APPENDIX B**

**Guidelines for Tree Protection  
Zone**

## CONTENT REQUIREMENTS

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

## TREE PROTECTION AND CONSERVATION GUIDELINES

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

### PRE-DEMOLITION/PILING/CONSTRUCTION

#### 1. Pre-Construction Meeting

The attending arborist shall attend a pre-construction meeting with the project contractor or construction supervisor to explain the tree protection and monitoring requirements as outlined in this document.

In addition, the project contractor or construction supervisor shall complete the 'VERIFICATION OF TREE PROTECTION CHECKLIST' as attached in Annex A before the onset of the construction.

#### 1.1 Tree Protection Zone

Prior to any site clearing (demolition works), piling works, grading, trenching or other soil disturbance, a tree protection zone (TPZ) must be installed as follows:

- i. Type  
The barriers should be temporary, made of a hard material, 1.8-m tall and firmly installed into the ground.
- ii. Ground protection  
Mulching material (can be compost or woodchips) at 100-mm thick to be laid within the TPZ. If woodchips are used, termicide treatment is necessary to prevent the introduction of harmful termites.

Apply complete fertilizer (N:P:K 15:15:15) upon or together with the application of mulch.

iii. Signage

A readily-visible and waterproof sign shall be installed on all sides of the fencing around each individual protected tree. The size of each sign must be a minimum of 300mm wide and must contain the wording below:



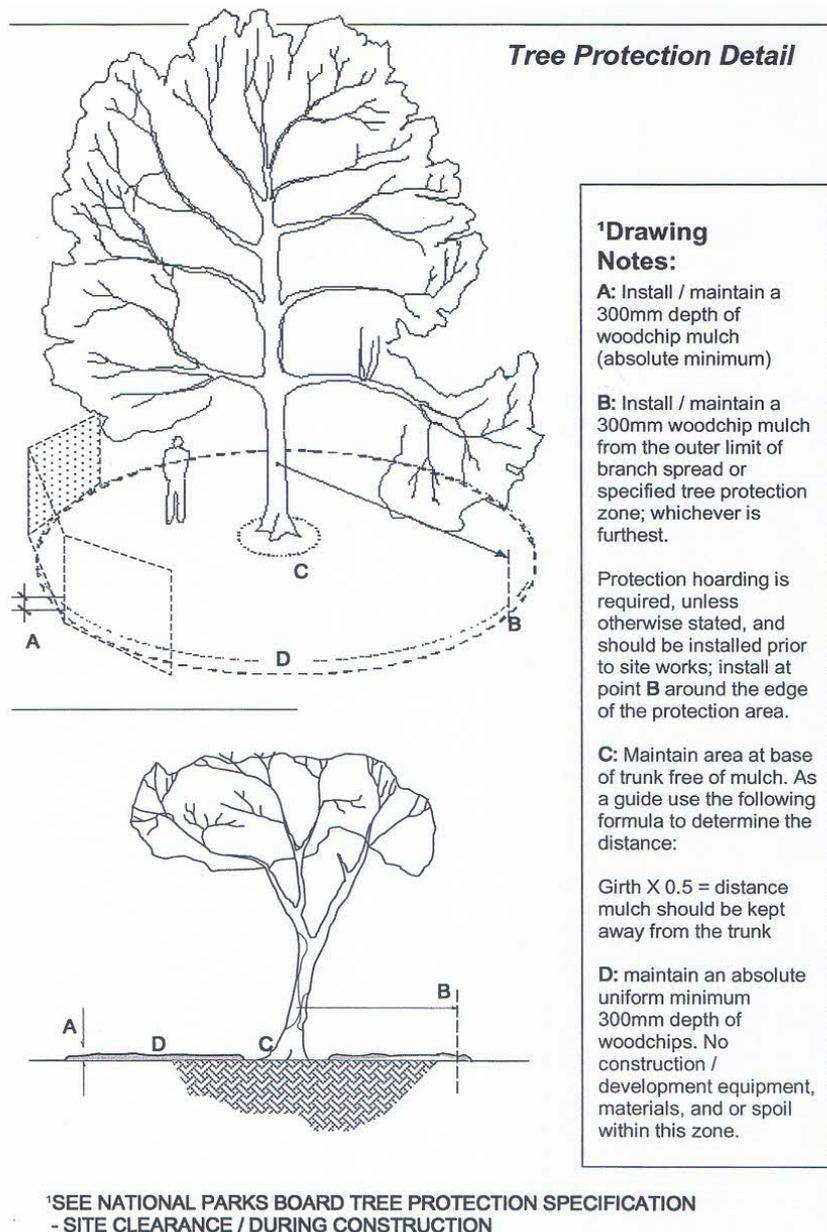
**KEEP OUT!**  
**TREE PROTECTION**  
**ZONE**

Entry prohibited. This fence shall remain in place throughout the entire construction period.

iv. Fencing installation

Installation must be approved by the attending arborists and/or the approved authority prior to construction.

A diagrammatic representation of a proper Tree protection zone is presented below.



## 1.2 Tree pruning and removal

Various trees may need to be pruned away from structures or proposed construction activity. **Construction or contractor personnel shall not attempt pruning or removal.** Consultation and written approval with attending arborist must be obtained prior to pruning.

Removal of trees adjacent to trees that are to be retained requires planning and skilled arboriculture workers. Trees should not be removed by pushing with excavators/heavy machinery or with lumberjack (one cut) methods. Directional felling methods (notch and back-cut) should be deployed during removal of trees.

Removal of trees that extend into branches or roots of protected trees shall not be attempted by the demolition or construction crew, or by grading or other heavy equipment. Before removing tree stumps, the project manager shall seek the advice from the attending arborist determine if roots are entangled with trees that are to remain. If so, these stumps shall have their roots severed before extracting them.

### 1.3 Site Clearance

To avoid lumber jack felling of trees that may severely damage the canopy of conserved trees, it is recommended that qualified (see Point 4.3 Tree Conservation Guidelines) Arboriculture contractors be engage to fell trees adjacent to protected trees to ensure that the trees (when cut) fall away from the protected trees and their associated TPZs.

Contractors carry out tree felling works near assigned TPZs of conserved trees should

- i. Employ directional felling through the use of notch and back cuts
- ii. Deploy cranes to tension trunks in the direction of the drop
- iii. Carry out pruning of canopy branches to remove entangling branches
- iv. If trees to be removed are taller than neighbouring trees to be retained, removal of branches should be carried out in a controlled manner using ropes and cranes to avoid damaging canopy of the lower trees.
- v. To avoid pruning of conserved trees at the proximity unless consultation and approval from attending arborist has been obtained.
- vi. No tree should be removed by pushing with an excavator or heavy machinery.

## DURING DEMOLITION/PILING/CONSTRUCTION

### 2. Tree Protection Zone Restrictions

- No ground disturbance, grading, trenching or other construction activities shall occur within the TPZ except as specified and/or approved by the attending arborist or authority.
- No construction material, debris, machinery (e.g. generators) or other construction waste shall be stored within the TPZ. Weight and presence of these materials increases soil compaction and reduces the area exposed for water infiltration and gaseous exchange.



**Figure 1: Construction material and heavy machinery are prohibited within the TPZ**

- Excavation works within the TPZ are strictly prohibited. Unless otherwise specified by the attending arborist, all work done within the TPZ shall be completed with manual trenching with hand tools or other hand held power tools that will not cause any root/tree damage.

If roots need to be cut, it shall be done using proper equipment (e.g. pruning saw, chain saw) under the supervision of the attending arborist.



**Figure 2: Trial trench by skilled workers using hand tools exposing root architecture**

- Nailing, tying or pasting of materials on trees is prohibited. The tree shall not be used as an anchor for supporting structures during the construction.



**Figure 3: Using tree as anchor may damage its bark.**



**Figure 4: No nails shall be driven into the tree as it promotes infiltration of pests/diseases**

- Phytotoxic materials such as fuels, oils, cement, chemicals, and paint shall be kept away and stored/mixed at least 2.5m from the tree protection zone. Such chemicals can significantly change the cation exchange capacity and pH of the soil, rendering nutrient uptake inefficient and creating an environment too toxic for the roots to grow.

Construction sludge especially from piling works should not be deposited within the TPZ. Such sludge is usually high in clay content and when layered over and within the TPZ could significantly alter the water infiltration and gaseous exchange rates of the root absorption area of the tree.

Canvass sheets/Eco-mat must be laid on the existing soil near the tree in view of soil protection during the demolition, drilling or other construction activities pertaining to concrete structures.



**Figure 5: Construction cement deposited at tree base.**



**Figure 6: Tree showing signs of decline overtime.**

- Lowering the grade around trees can have an immediate and long-term effect on trees.

Typically, most roots are within the top 1m of soil, and most of the fine roots active in water and nutrient absorption are in the top 300mm.

A) Grade changes within the TPZ are not permitted.

B) Grade changes outside the TPZ shall not significantly alter drainage.

C) Grade changes under specifically approved circumstances shall not allow more than 200mm of fill soil or allow more than 150mm of existing soil to be removed from

natural grade, unless mitigated.

D) Grade fills over 200mm or impervious overlay shall incorporate an approved permanent aeration system, permeable material, or other approved mitigation.

E) Grade cuts exceeding 150mm shall incorporate retaining walls or an appropriate transition equivalent.

**No removal of the TPZ will be permitted under any circumstances.**



**Figure 7: Inappropriate installation/maintenance of TPZ during construction.**

## 2.2 Proximity of Heavy machinery/vehicles

Heavy vehicles and machinery (e.g. excavators, piling cranes, 10 wheelers) movement should be limited near TPZs. Temporary access/passageways should be planned to avoid conserved trees.

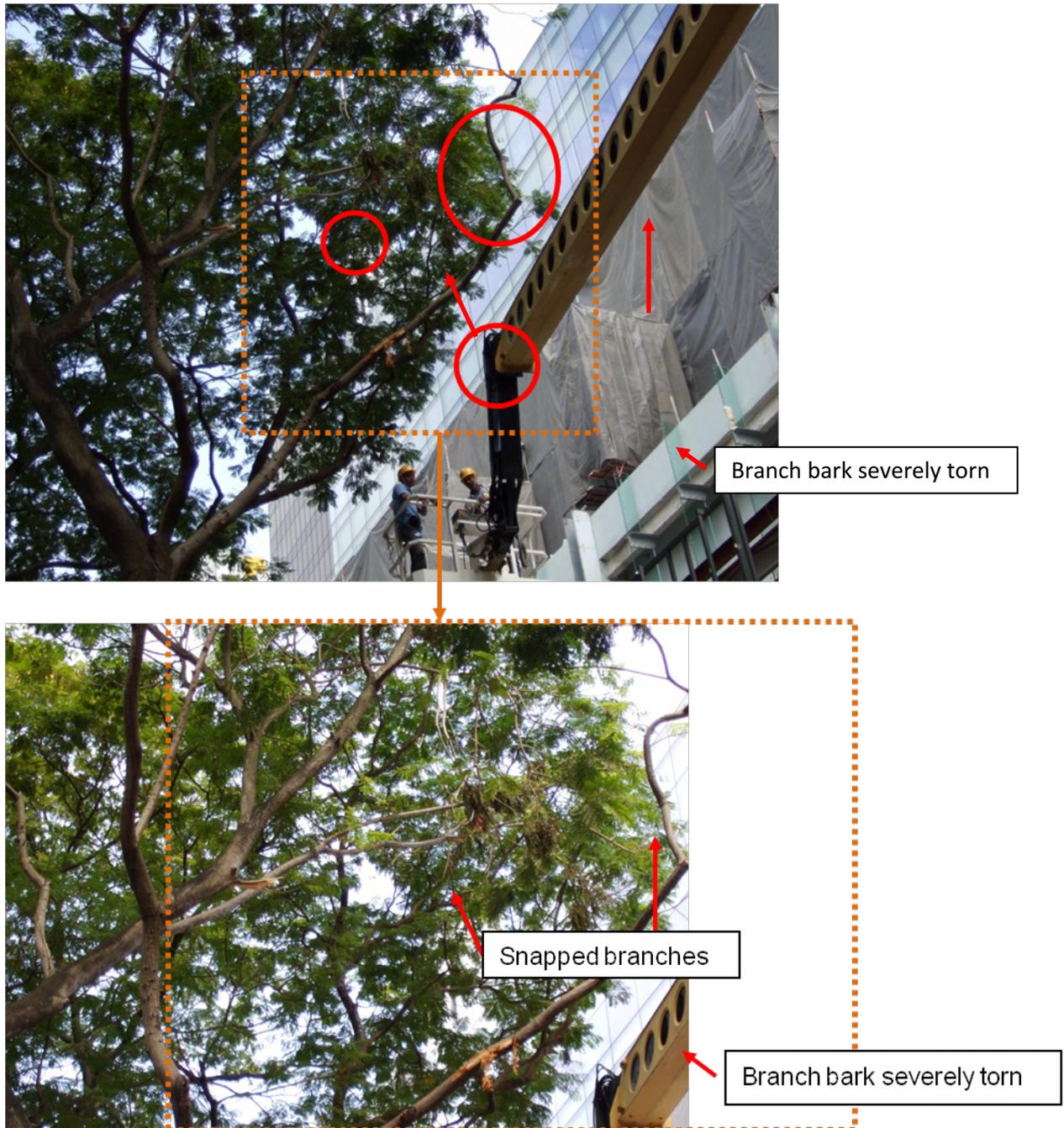


Figure 8: Tree branches were severed due to the negligence of the crane operator.

### 2.3 Drainage Considerations

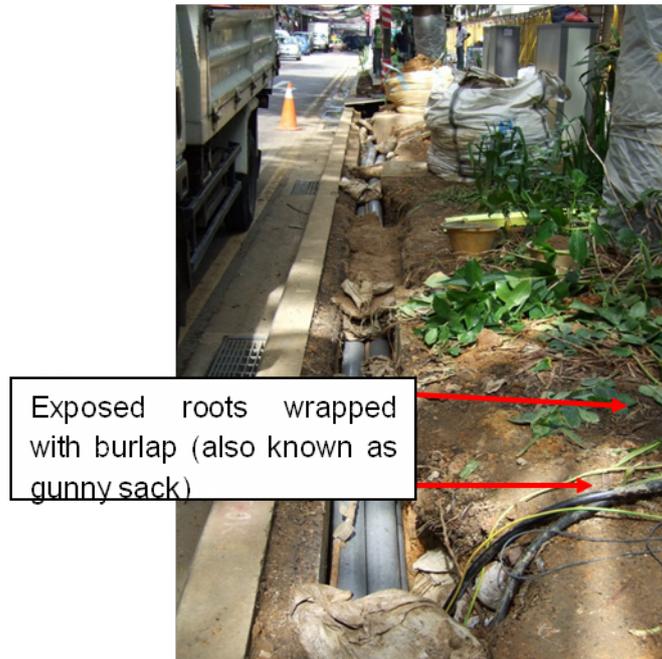
In the event that water ponding conditions develop in the course of construction due to change in grade/platform levels, construction events or any other unforeseeable factors, the contractor is required to improve drainage around or within the TPZ in consultation with the attending arborist.

### 2.4 Trenching, Excavation and Equipment use

Trenching, excavation or boring within the TPZ shall be limited to activities approved by the architect and/or attending Arborist. Explore alternatives for trenching outside the root zone. Avoid exposing roots during hot, dry weather. Backfill trenches as soon as possible with soil and soak with water the same day. Small roots can die in 10 to 15 minutes and large roots may not survive an hour of exposure. If the trench must be left open all roots must be kept moist by wrapping them in peat moss and burlap.

#### i. Root Severance

No roots greater than 0.2m in diameter shall be cut without approval of the attending Arborist. Tunneling under roots is the approved alternative. Prior to excavation for foundation/footing/walls, or grading or trenching within the TPZ, roots shall be severed cleanly outside the TPZ to the depth of the planned excavation. When roots must be cut, they shall be cut cleanly with a sharp saw to sound wood and flush with the trench site.



**Figure 9: Tunneling under roots.**

ii. Excavation

Any approved excavation, demolition, or extraction of material shall be performed with equipment that is placed outside the TPZ. Hand digging, hydraulic, or pneumatic excavation (e.g. air spading) are permitted methods for excavation within the TPZ.



**Figure 10: Root exploratory works using an air spade. Air spading avoids damage of structural and even feeder roots of the tree.**

iii. Heavy Equipment

Use of backhoes, Ditch-Witches, steel tread tractors or other heavy vehicles within the TPZ is prohibited unless approved by the attending Arborist. If allowed, a protective root buffer is required.

## 2.5 Tree Care

In the course of construction, the following measures may be necessary to reduce the effects of construction stress on protected trees. Quantum, duration and extent to be advised by attending arborist.

### (A) Fertilization

#### **A1 Vertical trenches and Nutrient Sinks**

Create vertical trenching and nutrient sinks. These nutrient sinks should go down to at least 300mm deep and should be filled with high grade compost and 12% Humic acid (dilution 1:100). These sinks will act to reduce construction stress by conditioning the soil, increasing soil microbiological activity and increasing organic matter. At least 24 numbers of vertical trenches / nutrient sinks are required for trees greater than 2m in girth. Vertical trenches for trees under 2m in girth will be determined empirically by the attending arborist and will take into account site conditions, tree species and its pre construction vigor. Top up nutrient sinks every 3 months.

#### **A2 Soil Injection of Biostimulants**

**Mandatory** if TPZ has been infringed into, soil compaction has occurred, tree condition has observed to have declined (indicators: reduction in Live crown ratios, twig die back at canopy and change in leaf colour/size/density)

- **Purpose:** To de-compact soil using a hydraulic pressurized delivery of biostimulants that both hydrates and aerates at the same time. Aim to reduce compaction to less than 400psi in the first 500mm of the soil.
- Mixed bio stimulants – serves 2 functions
  - Decompaction**
  - Humic acid – as soil conditioner and chelating agent (Nutrients are mobilized in forms that the plants can accept), facilitate release of nutrients and reduces leaching. Also improves water holding capacities of soil.
  - Liquid gypsum / Dolomite – soil conditioner, improve soil structure and facilitate release of nutrients in clay soils typical of local conditions.

**To feed and increase soil microbiology to increase tree vigor post damage. Soil microbiology helps nutrient uptake and encourages healthy root growth critical to prevent construction stress.**

- Mollases – High CE for immediate uptake,
- Fish Kelp – Protein source. Organic fertilisers
- Slow release fertilizers (Osmocote)

(B) Watering

- Water supplement during periods of drought.
- Watering duration and extent depends on site conditions and species.
- Watering is carried out until first signs of inundation are observed (i.e. water infiltration observe to slow down significantly).

(C) Myconate treatment

- To trigger and stimulate growth of existing mycorrhizae.

(D) Pesticide treatment

- To control pest (e.g. termites, borers, caterpillars etc) when it occurs.
- Fungicide or bactericide as required or as determined by attending arborist to control microbe pathogens.

(E) Additonal pruning

To be carried out in consultation with the attending Arborist. Trees are living things and may require some form of pruning during the course of the development.

- Crown cleansing- Prune to remove dead branches that may have developed through time.
- Crown lifting- Prune to lift crown to avoid new amenities.
- Crown thinning- Prune to reduce canopy branches and loading.

Structural pruning (including crown reduction) to remove branches that may obstruct new amenities and/or movement of critically necessary equipment may require the planning and standing supervision of the attending arborist.

## 2.6 Engaging Arboriculture Contractors

All arboriculture works should be carried out by skilled and trained arboriculture teams. As such, it is preferred that only Arboriculture contractors which have at least 8 years working

experience and must show previous work experience in developments of similar size or complexity. Arboriculture contractors should meet NParks safety requirements for work at height, LTA's requirements for temporary works along roadsides (where necessary) and have a certified arborist to supervise the pruning/felling/planting works.

All arboriculture workers engaged in tree climbing and chainsaw work shall possess a valid basic tree climbing certification based upon demonstrated competence in the WSQ module conducted by CUGE or an equivalent WSQ approved training organization.

Each Arboriculture crew shall possess the following VALID competences:

Operation of chainsaw for ground work (LS-MT-103E-1)

Chainsaw safety and maintenance (LS-MT-102E-1)

Perform formative pruning of young trees (LS-MT-114E-1)

Provide Arboriculture support on site (LS-MT-116E-1)

Workplace safety and health – operators (ES-WSH-101G-1)

Respond to Emergency (LS-HM-208E-1)

Perform advance rigging and climbing techniques (LS-HM-308S-1)

Perform aerial tree access and aerial rescue skills (LS-HM-204S-1)

Implement and apply appropriate risk and safety management to sector practices (LS-BP-301S-1)

Prepare risk assessment report (LS-HM-406S-1)

Operate and work from an elevated work platform (CUGE-ARB-3501)

## POST-CONSTRUCTION

### 3. Soft Landscaping

Ground works, site preparation and implementation of all landscaping near protected trees must be undertaken carefully.

TPZ barriers can only be removed at this juncture for the purpose. However, when working near trees, cultivation of soils in these areas must be cautiously handled using hand tools. Planting of shrubs shall be at a distance of at least 300mm away from existing root collar.

Avoid changes to ground levels or unnecessary compaction of soils within proximity to existing trees during the course.



Figure 10: New plantings at a minimum distance of 300mm (all round) from root collar

## ANNEX A

### VERIFICATION OF TREE PROTECTION CHECKLIST

Note: The project contractor or construction supervisor shall verify in writing that all **preconstruction** tree preservation conditions have been met as follows:

Submitted by: \_\_\_\_\_

Company/Project: \_\_\_\_\_

Date/Time: \_\_\_\_\_

S/N	Action	Checked ( <input type="checkbox"/> )	Remarks
1	Installation of tree fencing around identified trees within/near site (hard material at 1.8m tall)		
2	Tree protection zone (TPZ) dimensions meets specifications (from NParks and/or attending arborist)		
3	Warning signs prominently displayed on all sides of the fencing, including designated tree number		
4	Removal of construction material (ie machinery, debris, tools etc) within TPZ		
5	Mulching of high grade compost of 100mm thick around identified trees		
6	Completion of tree pruning (if necessary) under the supervision/written approval with the attending arborist		
7	Establishment of a tree maintenance schedule according to arborist recommendations (to be submitted to attending arborist)		

Verified by (attending arborist): \_\_\_\_\_

Date/Time: \_\_\_\_\_

**APPENDIX C**

**Guidelines for Sapling Harvesting,  
Tree Transplantation and Tree  
Maintenance**

## CONTENT REQUIREMENTS

This document outlines guidelines for sapling harvesting and tree transplantation prior to construction works, and guidelines to tree maintenance and care for retained trees during construction or other site disturbance. The content and scope of the document will vary based on the site, type of construction, tree species, tree location and other factors.

## SAPLING HARVESTING AND TREE TRANSPLANTING

This section outlines the general guidelines for sapling harvesting and tree transplanting prior to construction. Additional measures may be added by the attending arborist on a case-by-case basis.

### SPECIMEN SELECTION

Prior to site clearance works, any viable saplings and conservation significant trees that are suitable for harvesting shall be identified by the Arborist. Saplings or trees suitable for transplanting should:

- I. Exhibit good physiological health and vigour
- II. Have no structural defects
- III. Have good branch form

As a guidance, the size of the root ball that is to be extracted shall be based on the girth of the saplings or trees to be harvested

Girth (m)	Minimum root ball diameter to extract (m)
<0.1	0.4
0.1–0.2	0.6
0.2–0.3	0.8
0.3–0.4	1.2
0.4–0.5	1.5
>0.5	To be determined by Arborist

Prior to transplanting, dead branches and climbers shall be cleared from the plant and canopy load and spread will be reduced where necessary, in consultation with the Arborist. Manual trenching shall be carried out to determine the shape and size of root ball to be extracted. Where possible, feeder roots shall be retained without cutting. The root ball shall be burlapped with cellophane sheet to reduce desiccation effects. When directed by the Flora specialist or Arborist, leaves of the canopy may also need to be enclosed and covered by cellophane or clear plastic bags. The root ball shall be secured to the trunk to reduce risk of root ball disintegrating. When handling/carrying the plant, care shall be taken not to damage any vegetative parts.

Where trees and vegetation are moved or translocated within the Project area, the Arborist shall review the method statement proposed by the tree transplanting contractor and advise on additional recommendations necessary to ensure the tree's health during transplanting. The transplanting contract shall ensure in their best effort, intact and secured root balls at the point of extraction, during the lifting processes and during the installation at the receiving site. The transplant effort shall be documented for each individual tree to show intact root balls at all the stages mentioned. Transplanted trees shall be managed through adequate watering and monitoring of their health to ensure their long-term survival. Advice shall be sought from the Arborist if the tree exhibit signs of stress, e.g., peeling bark, withered leaves.

## **TREE MAINTENANCE AND CARE**

This section outlines the general guidelines for tree maintenance and care during construction works. Additional measures may be added by the attending arborist on a case-by-case basis.

Where disease outbreaks are identified, the Arborist shall advise measures to manage them. Measures can include using selected insecticides/fungicides to control outbreaks; reduction of stressors (dust, water, etc.). The plant may be removed or quarantined if it poses a threat to surrounding individuals.

Where forest edges are exposed following site clearance and where impacts to vegetation are evident (e.g., vegetation shows signs of drying out), additional watering shall be carried out to improve moisture differentials around forest edges.

The use of herbicides and pesticides shall be minimised. If herbicides or pesticides are used within the Project area, techniques that limit spray or non-target spray drift shall be used. These techniques include but are not limited to: cut and paint techniques and drilling injection. All use of herbicides and pesticides shall be conducted in accordance with the relevant Material Safety Data Sheet (MSDS). Any incidents of off label use, spillage or damage to non-target species shall be reported and investigated.

When the site experiences seven continuous days without rainfall, the Contractor shall carry out additional watering of conserved trees within the TPZs and at the forest edge (up to 10 m) around the development boundary. Post-heavy rainfall, any snapped hanging branches that pose imminent hazards to workers within the site should be removed immediately.

**APPENDIX D**

**Wildlife Incident Form**

## WILDLIFE INCIDENT FORM

Date (YYYY/MM/DD):	Time:
Description of Location:	GPS Coordinates:
Wildlife Observed:	Animal Condition: <input type="checkbox"/> Alive <input type="checkbox"/> Killed <input type="checkbox"/> Dead <input type="checkbox"/> Injured Animal Activity: <input type="checkbox"/> Moving <input type="checkbox"/> Resting <input type="checkbox"/> Trapped
Photographs Taken: <input type="checkbox"/> Yes <input type="checkbox"/> No	NParks Notified: <input type="checkbox"/> Yes <input type="checkbox"/> No  Name of NParks Staff Notified: _____
Describe Incident (e.g., activities being carried out; what animal was doing; personnel involved):   	
Actions Taken:   	
Reported by: _____	Reported to: _____
Contact #: _____	Contact #: _____
Remarks:   	

**APPENDIX E**

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