Intended for
Housing & Development Board

Document type
TAC/22101/EMMP/RT03

Date
20 July 2023

SPECIALIST CONSULTANCY SERVICES AT HDB DEVELOPMENT (SOUTH)

Environmental Management and Monitoring Plan for Earthworks

Submitted by:

TEMBUSU
Asia

Description **Environmental Management and Monitoring Plan for Specialist Consultancy Services at HDB Development (South)**

Project Ref **TAC/22101**

Rev. No.	Date	Description	Prepared by	Checked by	Approved by
00	11/07/2023	Submission of Environmental Management and Monitoring Plan (EMMP)	ML	SP	SCT
01	20/7/2023	Revised based on client's comments	ML	SP	SCT

TEMBUSU Asia Consulting Pte Ltd
1 Commonwealth Lane
#06-06, One Commonwealth
Singapore 149544
T +65 6238 4009
F +65 6570 5254
Co. Reg. No. 201732581C

CONTENTS

ABBREVIATIONS 6

1 INTRODUCTION 8

1.1 Project Background 8

1.2 Purpose of the EMMP 9

1.3 General Scope of the EMMP 9

1.4 Summary of Environmental Impact Study (EIS) 9

1.5 Document Structure 22

2 PROJECT OVERVIEW 23

2.1 Project Location 23

2.2 Project Scope and Implementation Schedule 23

2.3 Construction Approach 24

2.4 Construction Activities Associated with Proposed Project 25

2.5 Site Utilisation 26

3 APPLICABLE LEGISLATIONS AND GUIDELINES 27

4 ENVIRONMENTAL MANAGEMENT & MONITORING FRAMEWORK 29

4.1 Objectives 29

4.2 Organization Chart and Roles & Responsibilities 29

4.3 Training and Awareness 32

4.4 Environmental Incidence Protocol 32

5 BIODIVERSITY MANAGEMENT PLAN 34

5.1 Applicable Legislations 34

5.2 Wildlife Management Plan 34

5.3 Flora Management Plan 53

6 ENVIRONMENTAL MANAGEMENT PLANS 67

6.1 Air Quality Management Plan 67

6.2 Noise Control Plan 70

6.3 Water Pollution Management Plan 73

6.4 Vibration Management Plan 76

6.5 Waste Management Plan 79

6.6 Vector Control Management Plan 80

7 ENVIRONMENTAL MONITORING PLAN 83

8 EMMP REPORTING 94

8.1 Site Environmental Control Report by Environmental Control Officer 94

8.2 Monthly Environmental Performance Report 94
8.3 Environmental Close-off Report 94
9 REFERENCES 95
APPENDIX A – WILDLIFE / FAUNA INCIDENT FORM 96

FIGURES

Figure 1.1. Boundary of development area and EMMP study area 8
Figure 1.2. Areas of high conservation value (shaded in red) as identified by AECOM (2022). 13
Figure 2.1. Project location plan 23
Figure 2.2 Earthworks phases 25
Figure 4.1. EMMP Organization Chart 29
Figure 4.2. Environmental incidence reporting flowchart 33
Figure 5.1. Location of hornet and wasp nests recorded at project site 41
Figure 5.2. Directional clearance phasing layout 42
Figure 5.3 Hoarding before directional clearance commences 42
Figure 5.4 Example of the permanent hoarding 43
Figure 5.5 Example of using tarpaulin to cover fencing 43
Figure 5.6 Directional clearance in the first interval (Phase 1A) 44
Figure 5.7 Directional clearance in the following intervals (Phase 1A) 45
Figure 5.8 Completion of directional clearance in Phase 1A 45
Figure 5.9 Directional clearance in Phase 1B 46
Figure 5.10 Completion of directional clearance for Phase 1B 46
Figure 5.11. Hoarding before directional clearance for Phase 2 47
Figure 5.12. Directional clearance in Phase 2 48
Figure 5.13. Completion of directional clearance for Phases 1A, 1B, and 2 49
Figure 5.14. Layout showing identified flora species of high conservation value and proposed retained areas 54
Figure 5.15 Retained trees along northern parkland and retained heritage tree boxed in red. 55
Figure 5.16 Tree Protection Zone Diagram 58
Figure 5.17 Illustration of a notch cut 60
Figure 7.1. Monitoring locations during construction phase 83

TABLES

Table 1.1. Summary of key mitigation measures to be implemented from AECOM (2022) .. 14
Table 1.2. Summary of residual impacts from AECOM (2022) 20
Table 2.1 Proposed implementation schedule of project (earthworks) 23
Table 2.2 Proposed implementation schedule of project Earthwork Plan 24
Table 3.1. List of applicable Singapore legislations, regulations, and guidelines 27
Table 5.1. Details of refreshing training and daily toolbox briefings 36
Table 5.2 List of identified target species 38
Table 5.3. Wildlife response and rescue plan 50
Table 5.4 TPZ size required for different girth range 57
Table 5.5 Tree Replacement Ratio 57
Table 5.6 Parameters to take note during monthly tree inspections 60
Table 5.7 Parameters to take note during for plants monitoring 61

Table 7.1. Environmental monitoring plan for construction phase 84
Table 8.1. Monthly Environmental Performance Report framework..... 94

ABBREVIATIONS

Abbreviation	Definition
ALARP	As low as reasonably practicable
BMP	Best Management Practices
CBP	Concrete Bored Pile
CCTV	Closed-circuit television
EMMP	Environmental Management and Monitoring Plan
dB(A)	A-weighted decibel
ECM	Earth Control Measure
ECO	Environmental Control Officer
EIA/S	Environmental Impact Assessment/Study
EMMP	Environmental Management and Monitoring Plan
EPH	Environmental Public Health
EPHA	Environmental Public Health Act
EPM	Environmental Protection and Management
EPMA	Environmental Protection and Management Act
GPS	Global Positioning System
HDB	Housing & Development Board
hr	hour
ISA	International Society of Arboriculture
IUCN	International Union for the Conservation of Nature
km	kilometre
Leq	equivalent continuous noise level
m	meter
m^2	meter square
mg/L	milligram per litre
mins	minutes
NEA	National Environment Agency
NParks	National Parks Board
PRO	Public Relations Officer
PM_{10}	particulate matter with diameter ≤ 10 micrometres
$PM_{2.5}$	particulate matter with diameter ≤ 2.5 micrometres
PME	Powered mobile equipment
PPE	Personal Protective Equipment
ppm	parts per million
QECP	Qualified Erosion Control Professional
s	seconds
SHD	Singapore Height Datum
SS	Singapore Standards
SSO	Singapore Statutes Online
TAC	TEMBUSU Asia Consulting Pte Ltd

Abbreviation	Definition
TPZ	Tree Protection Zone
TSS	Total Suspended Solid
VCO	Vector Control Operator
VSR	Vibration Sensitive Receptor

1 INTRODUCTION

1.1 Project Background

The Housing & Development Board (HDB) and Urban Redevelopment Authority (URA) are developing future residential infrastructure in the Telok Blangah Area. The development area (~48 ha) is located on the former Keppel Club which included a golf course and former PSA Club compound at 3 Bukit Chermin Rd. The site consists of several man-made ponds, overgrown grass from the greens and other vegetation such as trees, shrubs, etc. It has since been occupied by diverse fauna such as butterflies, grey and purple heron, and smooth-coated otters. The site lies adjacent to Berlayer Creek, a natural mangrove stream which hosts fauna that live in brackish water.

An Environmental Impact Study (EIS) was conducted by AECOM (2022) detailing the likely impacts of this project on the natural environment and outlining an Environmental Management and Monitoring Plan (EMMP). An Environmental Management and Monitoring Plan (EMMP) is required to minimise the impacts on the project area's environment and biodiversity through implementation of appropriate mitigation measures. This EMMP Document utilises the mitigation measures developed by AECOM (2022) and covers the earthworks phase of the development. It is recommended that separate EMMP documents are developed for each phase of the development.

Figure 1.1. Boundary of development area and EMMP study area.

1.2 Purpose of the EMMP

The Environmental Management and Monitoring Plan (EMMP) is a systematic approach to mitigate environmental impacts and monitor the implementation of these mitigation measures to ensure that proposed project being implemented within sensitive area will not cause any significant adverse impact to the site's environment and its surrounding. It is also a useful tool to assess whether the mitigation measures taken are effective to reduce or mitigate potential impacts caused by this project to minimal and acceptable levels during the construction phase.

1.3 General Scope of the EMMP

Before the start of construction works, the Client (HDB) is required to establish a detailed EMMP for each of the construction phases. The EMMP is to be adhered to throughout the construction duration. This document presents the EMMP for the earthworks phase of the development and ensures that environmental protection measures fulfil regulatory requirements.

The EMMP includes identified mitigation measures from the approved EIS Report and considers the methodology of construction works prior to their commencement. The EMMP is prepared in consultation with an environmental and ecological specialist to consider and implement applicable mitigation measures recommended in the EIS Report. Roles and responsibilities of all stakeholders (e.g., Environment Control Officer / EMMP In-charge, EMMP Consultant, EMMP Specialist, Vector Control Operator, QECP, PRO) during the EMMP implementation during the construction phase are also established.

Environmental monitoring will comprise of compliance inspections for the prescribed mitigation measures and collection of environmental quality data. The environmental monitoring activities will ensure that the project does not cause any significant long-term environmental impacts. An environmental monitoring checklist is developed as part of the EMMP to monitor and record its implementation on site. An Environmental Performance Report (EPR) with all the monitoring results (compliance checks and environmental quality data) and list of actions taken to implement the EMMP will be submitted monthly to Authorities throughout the construction phase.

1.4 Summary of Environmental Impact Study (EIS)

Prior to developing the EMMP, an EIS was conducted by AECOM (2022) as part of the "Environmental Impact Study for Keppel Club, PSA Club, Bukit Chermin, Berlayer Creek and Former BP Oil Refinery Site" study. The study provides a baseline assessment of the project site, validate the previous impact assessment conducted based on project information, and recommended appropriate mitigation measures to reduce the residual impacts to acceptable levels. The potential impacts on the following environmental aspects have been considered in AECOM (2022):

- Biodiversity
- Hydrology & Water Quality
- Soil Quality

- Noise
- Ambient Air Quality
- Vector Control

Overall, environmental impacts from this development project are expected from activities associated with vegetation clearance and earthworks during the construction phase, which may impact flora and fauna within and around the site, as well as the human receptors around the site. During the operation phase, main impacts are those associated with increase in human presence as well as changes in the natural landscape of the site. The impacts are of negligible to major levels. With the diligent implementation of mitigation measures, these impacts can be reduced to mostly minor levels, with some unavoidable major impacts such as habitat clearance.

The main findings of each environmental aspect studied has been summarised as follows. The summary includes all the mitigation measures recommended in the previous EIS (AECOM, 2022). However, given that this document is purposed for the earthworks phase, only the mitigation measures for the construction phase are relevant.

Biodiversity

The project site is located between Telok Blangah and Labrador Park MRT stations, where the western edges border a natural mangrove stream, Berlayer Creek, which leads out to the sea. Field survey methodologies include habitat and vegetation mapping, general walking floristic surveys and tree mapping for flora, visual fauna transects, camera trapping, netting and trapping of aquatic fauna, quadrat sampling and transect surveys of marine fauna, roost emergence surveys and acoustic bat recording.

Floristically, more than 390 species were observed. The most prevalent habitat type consisted of terrestrial habitats, including urban vegetation, followed by native-dominated secondary forest (coastal) and mangrove forest. Marine habitats include sandy seabed, seagrass meadows, rocky shore and soft-sediment seabed. Some areas are freshwater bodies, which provided habitat for specialized freshwater species. There were some species of conservation value, including three threatened seagrass species (i.e. *Halophila ovalis*, *Halodule* sp. and *Enhalus acoroides*). Additionally, Albizia (*Falcataria falcata*) trees within the project site, while not native, provided suitable habitat for animals, particularly nesting raptors and other birds. One heritage tree (*Tamarindus indica*) was also recorded within the golf course.

A total of 384 fauna species (birds, mammals, reptiles, amphibians, butterflies, odonates, freshwater fish, crustacean and molluscs) were recorded within the project study area. There were several threatened species across taxonomic groups, including the straw-headed bulbul (*Pycnonotus zeylanicus*), the spotted wood owl (*Strix seloputo*), and the smooth-coated otter (*Lutrogale perspicillata*). Additionally, the main species of conservation value in the marine environment were molluscs, The surveys also found several locally conservation significant marine species including the estuarine seahorse (*Hippocampus kuda*), jewelled chiton (*Acanthopleura gemmata*) and mangrove horseshoe crab (*Carcinoscorpius rotundicauda*). Many of these threatened species, especially the horseshoe crab, depend on specific habitat requirements for their

continued survival. The site provided nesting areas for raptors, including the white-bellied sea eagle (*Haliaeetus leucogaster*).

Impacts from project activities may have undesirable impacts to biodiversity, especially to species of conservation value found within and around the project site. With the implementation of appropriate mitigation measures, including the erection of hoarding around the site, salvaging of plants and translocation of fauna, and measures to avoid human-wildlife conflict, it is expected that any such impacts will be reduced to mostly minor levels and below, with a few unavoidable major impacts (such as habitat clearance).

Hydrology & Water Quality

The project site has 13 water catchment areas consisting of the freshwater ponds within the Keppel Club golf course, concrete drain D5 in the east of Study Area, Berlayer Creek, the Marine Area and roadside drains. In general, the surface water quality of these stream showed exceedances from the applicable standards during wet weather, likely due to runoff discharged from urbanized area and surrounding turf soils, and from fertilizer used for the trees and golf course lawns indicating that the watercourses may have conditions that are less favourable for aquatic life. Possible impacts from the construction phase includes disturbances to local hydrological pattern due to land use change and impact to water quality due to stormwater runoff and trade effluent discharge. Recommended mitigation measures – such as properly implementing Earth Control Measures (ECMs) and managing trade effluent/sewage discharge – will help to reduce the impact on water quality of project area.

Berlayer Creek will be retained due to its value as an important mangrove habitat that is home to a diverse group of fauna and flora. The main source of flow within the stream is from the upstream catchment area, the Former BP Oil Refinery site. By ensuring that upcoming construction works on this site does not alter the flow and water quality of the stream during the construction of the project, the impacts on water quality are likely to be minimal.

Groundwater

A total of 7 samples were collected weekly over 12 weeks. The groundwater level within the project site exhibited minimal fluctuations and variations over time. While metals were detected in some of the samples, no impacts on the ecological receptors were reported or known to be caused by the detected concentrations. Based on the data, it can be inferred that the groundwater flow is directed towards Berlayer Creek and the Marine Area.

Soil Quality

A total of 16 soil samples were collected from seven boreholes, revealing that the soil profile mainly comprised of silty clay. All detected parameters were noted to be below their respective Dutch Intervention Values (DIV). However, the sources of the parameters that exceeded their respective limits of reporting could not be conclusively determined. The occurrence of metals, PAHs, and TPHs is a common phenomenon in urban soils exposed to human activities. Additionally, certain parameters, like metals, are naturally occurring elements in the environment, and their presence in soil can be

attributed to the soil weathering process. Since the detected parameters are below their respective DIVs, they are unlikely to pose unacceptable risk to sensitive receptors.

Noise

Four locations were subject to continuous noise monitoring for a period of seven days, operating 24 hours a day, 7 days a week. The study concluded that the baseline noise levels were generally in compliance with Singapore's noise regulations. However, the noise levels were found to be notably higher along West Coast Highway and Telok Blangah Road due to road traffic. It is expected that during the construction phase, noise from vehicle movements as well as high-impact stationary and mobile equipment will be the primary sources of noise. The project study area is adjacent to sensitive receptors such as flora and fauna in forested areas of Berlayer creek and humans in nearby premises. The impact of noise on these receptors has been evaluated as significant, but it can be reduced to minor or below by implementing recommended noise mitigation measures.

Ambient Air Quality

A seven-day continuous (24x7) air monitoring was carried out at one location to establish baseline air quality levels. The baseline air quality levels are within Singapore’s air quality targets and project study area enjoys good air quality. There are sensitive receptors located adjacent to project study area, including flora and fauna in forested areas of Berlayer creek and humans in the nearby premises. The air quality will potentially be affected by activities associated with construction of treatment units, especially from an increase in airborne particulates and heavy-vehicle exhaust emissions. Mitigation measures are recommended to reduce the direct impact on local air quality to minor levels.

Vector Control

The primary impact of the construction phase of the project is the potential increase in the immediate vector population. Secondary to this, an increase in the number of vectors has the potential to increase the likelihood of vector-borne diseases affecting humans. Key mitigation measures include source reduction and effective drainage through implementation of vector control plan. With its implementation, it is expected that these impacts can be reduced to an insignificant level.

Three areas of high conservation value were identified – Berlayer Creek (1), Bukit Chermin (2) and the marine areas (3) (Figure 1.2), all of which are not within the proposed development area and thus are only expected to receive minor impacts if any (AECOM 2022)

Table 1.1 summarises the proposed mitigation measures from the EIS (AECOM, 2022), and Table 1.2 summarises the impact pre- and post-mitigation.

Figure 1.2. Areas of high conservation value (shaded in red) as identified by AECOM (2022).

Table 1.1. Summary of key mitigation measures to be implemented from AECOM (2022)

Environmental aspect	Key mitigation measures	
	Pre-construction & Construction Phase	**Operation Phase**
Biodiversity	• The future development should avoid impacts to areas with high value habitats. • The proposed 30 m buffer to Berlayer Creek and areas of high conservation value should be observed at all times. • Enhance ecological connectivity through the provision of ecological corridors. • Pre-felling fauna inspection should be conducted before felling any trees or removing any vegetation. • Implement Arboriculture Monitoring Programme and Flora Monitoring Programme <u>Flora</u> • Ensure there are no works and disturbances to areas outside of work site, especially into areas of high conservation value. • Ensure any associated slope stabilisation and grading works will not impact topography of areas outside work site and, water quality and hydrology of the waterbodies within the Study Area. • Care should be taken to prevent siltation into ecologically sensitive areas such as Berlayer Creek and Bukit Chermin. • Works should not encroach on these areas, nor should there be clearance, trampling or vegetation damage to these areas. • Consider engaging arborists and flora specialists to clearly mark out areas and plants with conservation value before the start of works. • Transplant or harvest trees/saplings of conservation significance instead if they are to be cleared. • Erect Tree Protection Zones (TPZs) to prevent encroachment of construction activities and excessive vegetation clearance around retained trees or areas (if any). • Conduct regular inspections to ensure contractor compliance and identify any impacts to the adjacent forest areas. <u>Fauna</u> • Minimise felling trees and clearing vegetation during the peak bird breeding season (March to July).	• Forest species composition in planting scheme should be as similar to adjacent forest patches and include as many native species as possible. • Placing educational signboards within or near green areas across the entire estate, particularly along the Nature Ways. • Regular site inspections in the initial phase (first 12 months) to ensure proposed mitigating measures are effective. <u>Flora</u> • Retain fruit and fig trees, which are known food sources. Some examples are *Leea indica*, *Bridelia tomentosa*, *Clausena excavata*, *Dillenia suffruticosa* and *Ficus* sp. • Include fruit and fig trees, which are known food sources for birds, as part of the native planting palette when replanting the area in the operational phase. • Avoid felling trees and clearing vegetation during the bird breeding season (January to September). <u>Fauna</u> • Implement traffic calming measures to help minimise roadkill accidents. • Culverts and road calming measures to mitigate for mortality and/or injury roadkill impacts for ground-dwelling fauna. • Conduct biodiversity survey to monitor construction impacts on fauna activity and presence.

Environmental aspect	Key mitigation measures	
	Pre-construction & Construction Phase	Operation Phase
	• Wildlife shepherding via directional clearing should be adopted over the usual site clearance. This entails clearing the site from Keppel Club towards Berlayer Creek. • Quieter construction machinery/equipment should be used over loud and noisy machinery/equipment whenever possible. • Night-time works should be avoided to prevent disturbance to nocturnal fauna; recommended to restrict working hours to 0700–1800h. • Retain ground cover for as long as possible before removal. When ground cover is removed, earth control measures (ECM) are to be in place. • Use only fully biodegradable erosion control blankets (ECB) to avoid trapping fossorial fauna such as snakes. • Adopt road calming measures such as speed bumps, and other mitigation measures such as restriction on speed of vehicles and working time, to minimise roadkill accidents. • Train site personnel on biodiversity awareness and actions to take when encountering wildlife. • Ensure good housekeeping controls such as provision of wildlife proof bins and eating areas. • Execute fauna response and rescue protocol when fauna is found on-site. • Monitor the water quality and aquatic faunal community in retained streams and streams adjacent to the construction areas. • Ensure silt fences or other silt control measures along the site hoarding are installed and maintained properly. • Practice due diligence in proper storage and handling of machinery to prevent leaching of oil or harmful materials such as bentonite slurry. • Store and handle harmful materials well away from water bodies. • Engage a Qualified Erosion Control Professional (QECP) to formulate and implement ECM plan in accordance with PUB requirements. • Implement dust control measures such as dust screens and water suppression systems.	

Environmental aspect	Key mitigation measures	
	Pre-construction & Construction Phase	Operation Phase
	• Implement acoustic barriers to reduce noise pollution outside worksites.	
Hydrology, Hydrodynamic and and Surface Water Quality	• Monitor water quality following Singapore NEA's Allowable Limits for Trade Effluent Discharge to Sewer / Watercourse / Controlled Watercourse • Surface runoff from the construction site should be drained to the ECM treatment system to be filtered and to reduce peak runoff. • The hoarding and perimeter drains should be inspected daily to ensure no surface runoff flowing out from the site untreated and no clogging which would affect the flow capacity of the drains/streams. • During heavy storm event, site inspection should be carried out to ensure no flooding. • Monthly audit on the site should be carried out by EMMP consultant. • For any construction activities that may alter the alignment of block drains, implement appropriate measures such as watercourse diversion to avoid localised flooding. • The design should follow PUB Code of Practice on Surface Water Drainage, and the diverted flow shall be treated to meet NEA Trade Effluent Discharge Limits prior to discharge. • Provide silt curtains at each of the main outlets which discharges flow from the proposed construction sites into the surrounding watercourses. • Maintain minimum dry weather discharge of 0.03 m^3/s for sustainability of Berlayer Creek. <u>In-situ</u> • Conduct real time monitoring for TSS at the discharge point location at all the construction sites throughout the construction period. • Monthly monitoring for temperature, pH, conductivity, TDS and DO at all the discharge point locations at the construction sites throughout the construction period. <u>Ex-situ</u> • Monthly monitoring for all the ex-situ parameters at the discharge point if discharging during construction period.	• Monitor water quality following Singapore NEA's Allowable Limits for Trade Effluent Discharge to Sewer / Watercourse / Controlled Watercourse • During operational phase, drainage system within the site and at immediate vicinity should be inspected especially during heavy storm event to ensure no flooding. • Monthly audit on the site should be carried out by EMMP consultant during the first three (3) months of operation period. • Provide ABC Waters Design features (wetland, bioretention swales, rain garden, etc.) or more softscape areas • To increase seepage of surface water into the soil in pervious areas to reduce peak flow and flooding risks within the development. • To create green areas around watercourses to buffer against the edge effect of future development. • To design protection structures at proposed stormwater outlets discharging from the development to Berlayer Creek to minimise local scouring at mangrove area along Berlayer Creek. <u>In-situ</u> • Monthly monitoring for all the in-situ parameters at the main outlets/drains of the project footprint, during the first three (3) months of operation period. <u>Ex-situ</u> • Monthly monitoring for all the ex-situ parameters at the main outlets/drains of the project footprint during the first three (3) months of operation period.

Environmental aspect	Key mitigation measures	
	Pre-construction & Construction Phase	Operation Phase
Soil and Groundwater	• Install piezometers to monitor the changes in groundwater level in compliance with Building Control Regulations 2003 as part of its instrumentation and monitoring plan to be endorsed by the Qualified Professional; • Conduct a construction risk assessment and prepare a comprehensive construction health, safety and environment plan. • If health impacts to workers are foreseen due to the handling of such waste, necessary precautionary measures as per the safety data sheets (SDS) including personal protective equipment should be implemented on site.	• Incorporate more pervious surfaces in the development plan; • Installation of recharge wells, if necessary; • Ensure no trade effluent other than that of a nature or type approved by NEA Director-General shall be discharged into any watercourse or land; • Conduct regular inspections on waste storage system within the Project to prevent system's clogging and leachate entering the underlying soil and/or surrounding watercourses, if any.
Noise	• Noise barriers of up to 8 - 12 m height are proposed at the construction boundary fronting noise sensitive receptors • Noise barriers should be erected along boundary of worksites facing noise sensitive receptors (where necessary). • Use equipment with lower noise levels; • Access routes should avoid facing receptors; • Where controlling noise sources at the source is not feasible, acoustic enclosures or sheds are to be introduced to mitigate noise at the source for static equipment or machineries (i.e. Genset). Typical acoustic enclosure covers the machine as fully as possible (with or without ventilation where applicable) to provide sound insulation.	• Utilize noise attenuators and other Best Available Technology (BAT) and Best Environmental Practice (BEP) to mitigate potential noise from air conditioning and mechanical ventilation (ACMV) systems; • Utilize low speed postings, speed humps, speed limit signages at drop-off points and parking areas to mitigate noise from increased road traffic; • Consider alternative siting of roads away from areas with noise sensitive receptors.
Ambient Air Quality	• Implement dust control measures e.g., dust screens, equipment with dust suppression etc. • Install hard surfaced haul routes. • Impose and signpost maximum speed-limit of 25km/hr on paved roads and 15 km/hr on unpaved roads and work areas. • Closed turfing to the exposed areas where possible and maintain proper storage of soil stockpiles. • Conduct monitoring for PM10 and PM2.5 at suitable locations • Erect hoarding around dusty activities and at the site boundary wherever possible. Boundary screens should be at least as high as any stockpiles or dust emission sources on site. • Stockpiled material should be covered, seeded, fenced or enclosed to prevent fugitive dust formation. • Where practicable, avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment.	No mitigation measures to be proposed as the predicted increase in air quality pollutant levels is likely to be insignificant

Environmental aspect	Key mitigation measures	
	Pre-construction & Construction Phase	Operation Phase
	• Only use cutting, grinding or sawing equipment fitted with, or in conjunction with, suitable dust suppression techniques such as water sprays or local extraction e.g. local exhaust ventilation system. • Avoid scabbling (roughening of concrete surfaces) if possible. • Avoid burning of waste or other materials. • Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery. • For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust. • Avoid dry sweeping of large areas.	
Vector Control	• Adhere to Control of Vector and Pesticide Act (CVPA) and ensure good housekeeping on-site. • Preparation and implementation of an effective vector control plan and measures as required under NEA's Code of Practice for Environmental Control Officers. • Ensure water-bearing receptacles, gaps on grounds and equipment (e.g. openings at concrete barriers), as well as stockpiled areas are covered or sheltered, especially during the northeast monsoon season between November to January. • Scheduled daily housekeeping to ensure clearance of stagnant water and unwanted items are discarded properly. • Site entrance shall be paved to avoid ground depression. • Milled waste can be used to level the ground before laying steel plates. • Provide movable roof over shaft to prevent rainwater ingress. • Pump shall be deployed to clear water at areas where drainage is not possible, as well as for larger recessed surfaces. • Install pitched roof on top and/or seal up bottom of site container office. • After trees clearance, top of tree stumps has to be either remove thoroughly or patched up. • Pipette can be used for larvae-checking at the hard-to-reach parts of a tree.	• Adhere to Control of Vector and Pesticide Act (CVPA) and ensure good housekeeping on-site/in the development. • Weekly inspections for potential breeding sites should be conducted for areas such as unused containers in open areas and under bushes, open and closed drains, gully traps, tree holes and bifurcations between branches, leaf axils of banana trees, Travellers Palms and other palms, outdoor litter bins etc; • Fortnightly application of sand granular insecticides gully traps, manhole cover handle depressions, lightning conductor pits, stop-cock pits, valve chambers, and sumps; • Immediate application of insecticide should be conducted to destroy breeding habitats identified during inspections and to immediately eliminate the identified potential breeding habitats (i.e. source of stagnant water or waste). Proper recording of these incidents should also be conducted once the breeding habitats or potential breeding grounds have been eliminated; • Thermal Fogging is not recommended, due to its proximity to areas of high ecological value. Instead, preventive methods such as inspections and good housekeeping practices should be adhered to instead, in order to ensure no mosquito breeding occurs onsite. Monthly routine pest control checks should be conducted at all locations; • Fortnightly application of sand granular insecticide to sources of stagnant water in schools and boarding schools

Environmental aspect	Key mitigation measures	
	Pre-construction & Construction Phase	Operation Phase
	• Food disposal should be clearly allocated and disposed of on a daily basis to discourage rodents from establishing nests on site and to prevent cockroaches/ flies' infestation. • Store food in rodent proof storage containers/ cabinets with at least 60 cm clearance above ground level. • Thermal Fogging is not recommended onsite, due to its proximity to areas of high ecological value. Instead, preventive methods such as inspection and good housekeeping practices should be adhered to instead, in order to ensure no mosquito breeding occurs onsite.	(e.g., toilet bowls, cisterns, and gully traps in toilets), during school vacation.

Table 1.2. Summary of residual impacts from AECOM (2022)

Environmental aspect		Impacts before mitigation		Impacts after mitigation	
		Construction Phase	**Operation Phase**	**Construction Phase**	**Operation Phase**
Biodiversity	Habitats	Negligible – Major	Negligible – Major	Negligible – Major	Minor
	Flora	Negligible – Major	Negligible – Major	Negligible – Major	Minor
	Fauna	Negligible – Major	Negligible – Major	Negligible – Minor	Minor
Hydrology and Surface Water Quality	Land Use Change (Hydrology)	Minor - Moderate	-	Minor	-
	Solid & Toxic Wastes Generation	Minor - Moderate	-	Minor	-
	Improper Management of Chemical Substances, Liquid and Solid Wastes	Minor - Moderate	Minor	Minor	Minor
	Liquid Effluent Generation and Stormwater Runoff	Minor - Moderate	-	Minor	-
	Storage and Disposal of Domestic Liquid and Construction Solid Wastes	Minor - Moderate	-	-	-
	Sediment Plume Impact	No impact - Minor	-	-	
	Altered Stormwater Runoff (Hydrology)	-	Minor - Moderate		Positive – (Negative) Minor
	Stormwater Runoff Contamination	-	Minor - Moderate		Positive – (Negative) Minor
	Flooding Impact	-	Negligible impact	-	-
	Hydrodynamic Impact	-	No impact	-	-

Environmental aspect		Impacts before mitigation		Impacts after mitigation	
		Construction Phase	Operation Phase	Construction Phase	Operation Phase
	Morphological Impact	-	No impact	-	-
	Salinity Impact	-	No impact	-	-
Soil and Groundwater	Groundwater Level Decrease	Negligible	Negligible	No residual impact assessment has been undertaken as no Moderate or Major impact significance on sensitive receptors were assessed.	
	Adverse impact on human health due to direct or indirect exposure to contaminated soil and groundwater	Minor	Minor		
	Disturbances in habitats and/or reduction in size of species' population and threat to species' long-term viability	Negligible – Minor	Negligible – Minor		
Noise	Ecological Receptors	Minor – Major	Negligible – Minor	Negligible – Moderate	Negligible – Minor
	Human Receptors	Minor – Major	Negligible – Minor	Negligible – Major	Negligible – Minor
Ambient Air Quality	Ecological Receptors	Major	Minor	Minor	Minor
	Human Receptors	Major	Minor	Minor	Minor
Vector Control	-	-	-	-	-

1.5 Document Structure

The EMMP is structured as follows:

- Chapter 1 introduces the purpose and general scope of EMMP.
- Chapter 2 provides the project overview and site utilisation.
- Chapter 3 outlines applicable legislation, regulations, and guidelines to EMMP.
- Chapter 4 provides the EMMP management framework.
- Chapter 5 outlines Biodiversity Management Plan, covering Wildlife Management Plan and Wildlife Rescue Protocol.
- Chapter 6 presents Environmental Management Plans for various environmental aspects.
- Chapter 7 discusses the Environmental Monitoring Plan
- Chapter 8 presents the EMMP reporting requirements.
- Chapter 9 presents the references cited.

2 PROJECT OVERVIEW

2.1 Project Location

The project site is located in the south of Singapore, comprising of the former location of the Keppel Club and its golf course. It is bounded by the West Coast Highway to the north, Berlayer Creek/Boardwalk to the southwest, Bukit Chermin Road to the south, and Keppel Bay View Road to the East.

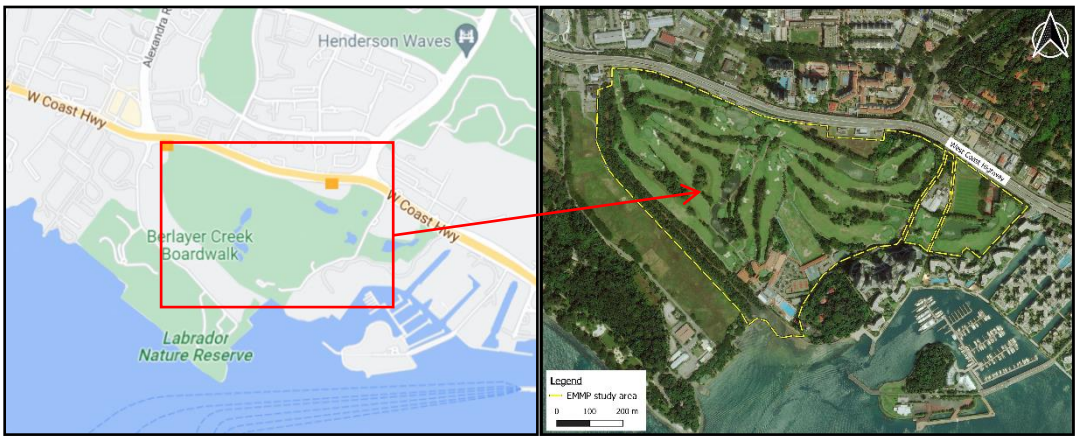

Figure 2.1. Project location plan

2.2 Project Scope and Implementation Schedule

The project site is located in the Telok Blangah area, adjacent to Berlayer Creek. The site covers approximately 48 hectares. At present, the site features 7 fresh waterbodies, urban vegetation, and scrubland. As the existing terrain is undulating, the proposed public housing development would entail civil engineering works such as site clearance (removal of existing trees and vegetation), earthworks cutting/filling within site to achieve desirable platform levels required for the proposed development, construction of roads, construction of drains, sewer works, building works, utilities/services laying, maintenance access and other related works.

After the commencement of earthworks, other works including roadworks, sewer works, and building works would likely run consecutively adjacent to the earthworks. The proposed implementation schedule is provided in Table 2.1. Separate EMMP documents will be developed for later phases of the project.

Table 2.1 Proposed implementation schedule of project (earthworks)

No.	Activity	Timeline
1.	Earthworks	Within 60 months

As the earthworks contractor is not yet on board, the detailed works sequence and construction methodology are not available at this stage. Nevertheless, the proposed work scope and preliminary plan have been developed and the proposed implementation of the earthworks schedule is as shown in Table 2.1. The appointed contractor will follow the proposed work activities and plan to the best of their abilities. If any amendments are

required an updated plan will be provided accordingly and the updated EMMP document will be submitted for approval to the relevant authorities (e.g., NEA, NParks, PUB, etc). Wherever necessary, the standard construction industry practices applicable are taken as references to assess the impacts associated with the proposed project.

2.3 Construction Approach

The project site is shown in Figure 2.1 .Construction activities described below.

Earthworks and Civil Works

The phased construction plan of the earthworks and civil works stage of the project will be conducted in the initial stages of the development. All earthwork activities are expected to be completed within 60 months from the project's date of commencement. The implementation schedule is provided in Table 2.2.

Works in Phase 1 (Phase 1A & 1B) include site clearance & earthworks for residential parcels, construction of Outlet Drain 1, and demolition of a concrete bored pile (CBP) wall. Earthworks will commence in Phase 1A once site clearance is completed and take place concurrently with Phase 1B site clearance.

Phase 2, which will commence together with (or shortly after commencement of) Phase 1, will include site clearance and earthworks for the remaining parcels, demolition of the former PSA Club compound and the construction of Outlet Drain 2.

Figure 2.2 illustrates the earthworks phases.

Table 2.2 Proposed implementation schedule of project Earthwork Plan

Phase	Description of Works	Estimated Completion Time from the Date of Commencement of Works
1	Earthworks Phase 1	30 months
	Earthworks Phase 2	30 months

Figure 2.2 Earthworks phases

2.4 Construction Activities Associated with Proposed Project

The following construction activities are expected to take place during the earthworks phase of the proposed housing project:

Site Clearance and Earthworks

Site clearance will take place over two phases, with the first area concentrated in the middle of the project site, and the second phase focusing on the east and west of the site. Tree felling will be conducted by the means of chainsaw, excavator, and lorry operations. As the terrain is uneven, earthworks including cut-and-fill works will be conducted to even out the platform levels. The vegetation clearance plan will be submitted to and approved by NParks prior to removal of shrubs and trees in the project site.

Temporary Construction Access Road

A site access gate will be created along Bukit Chermin Road/Telok Blangah Road. Access roads will be developed to allow easier transport of construction resources into the works areas and thus contribute to timely completion of the construction activities.

Construction of Outlet Drains

Two outlet drains will be constructed. Outlet Drain 1 will discharge into the midstream section of Berlayer Creek, while Outlet Drain 2 will discharge into the upstream section of Berlayer Creek. Excavation will proceed in accordance with the approved construction drawings.

Demolition of Existing Retaining Wall

An existing CBP retaining wall along Telok Blangah Road will be demolished. Platform levels for the proposed developments will be prepared in compliance with PUB's Code of Practice on Surface Water Drainage.

2.5 Site Utilisation

The site utilisation includes the following:

- Boundary Hoarding – A hoarding to be installed along the project boundary line to demarcate the project worksite and to control the access.
- Proposed temporary storage basin – three sets of water treatment units that comes with CCTV monitoring to be installed per approved ECM Plan endorsed by QECP
- Washing Bay – to be installed at each Gate.
- Site office
- Access Roads and Gates – A access road running through whole worksite to provide construction access.
- Workers' toilets

3 APPLICABLE LEGISLATIONS AND GUIDELINES

The table below lists relevant legislations, regulations, and guidelines which govern the various environmental parameters within Singapore, which are to be complied during the implementation of EMMP.

Table 3.1. List of applicable Singapore legislations, regulations, and guidelines

Parameter	Legislation, Regulations and Guidelines
General	• Environmental Protection and Management Act, 1999 • Environmental Public Health Act, rev. 2020 • Code of Practice on Pollution Control (SS 593, 2013)
Biodiversity	• The Wildlife Act 2020 • The Parks and Trees Act 2005 • The Parks & Trees Regulations 2006 • The Parks & Trees Preservation Order 1998 • Parks & Trees (Composition of Offences Regulations) 2006 • Parks & Trees (Planning Areas) Notifications 2006 • Parks & Trees (Heritage Road Green Buffers) Order 2006 • Singapore Red Data Book, Second Edition, 2008 • Singapore Red Data Book, Third Edition (online), 2021 • IUCN Red List of Threatened Species to assess species vulnerability (2009) • CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora, also known as the Washington Convention) 1983 • NParks Biodiversity Impact Assessment (BIA) Guidelines (2021)
Noise	• Environmental Protection and Management Act 1999, Part VIII Noise Control • Environmental Protection and Management (Control of Noise at Construction Sites) Regulations 2008 • Environmental Protection and Management (Boundary Noise Limits for Factory Premises) Regulations 2008 • Code of Practice on Pollution Control SS 593 (2013) • Code of Practice for Noise Control on Construction and Demolition Sites SS602 (2014)
Surface Water Quality	• Sewerage and Drainage Act 2001 • Sewerage and Drainage (Surface Water Drainage) Regulations 2007 • Sewerage and Drainage (Trade Effluent) Regulations revised 2007 • Environmental Protection and Management Act 2002, Part V on water pollution • Environmental Protection and Management Act (Trade Effluent) Regulations 2008 • PUB Code of Practice on Surface Water Drainage (2018) • PUB Handbook on Managing Urban Runoff (2013) • PUB Guidebook on Erosion and Sediment Control at Construction Sites (2018)
Ambient Air Quality	• Environmental Protection and Management Act 2002, Part IV on Air Pollution Control • Environmental Protection and Management (Vehicle Emissions) Regulations 2008 • Environmental Protection and Management (Prohibition on Use of Open Fires) Order 2008

Parameter	Legislation, Regulations and Guidelines
	• Environmental Protection and Management (Air Impurities) Regulations 2008 • NEA Singapore Ambient Air Quality Targets (Long Term Targets) • Code of Practice on Pollution Control SS 593 (2013)
Waste Management	• Environmental Protection and Management Act 2002, Part VII on Hazardous Substances • Environmental Protection and Management (Hazardous Substances) Regulations 2008 • Environmental Public Health (General Waste Collection) Regulations 2000 • Environmental Public Health (Toxic Industrial Waste) Regulations 2000 • Code of Practice on Pollution Control SS 593 (2013)
Vector Control	• NEA Guidelines on Rainwater Collection System and Mosquito Prevention (2011) • Control of Vectors and Pesticides Act 2002 • Environmental Public Health Act (EPHA) 2002

For this project, the developer was also issued directives under section 10(2) of the Wildlife Act (Cap. 351). As part of these directives, the developer is to ensure the proper implementation of a hoarding plan, conduct wildlife rescue operations, develop an EMMP, implement measures stated in the EMMP, allow NParks to conduct plant salvaging, and conduct pre-felling checks for wildlife nests.

4 ENVIRONMENTAL MANAGEMENT & MONITORING FRAMEWORK

4.1 Objectives

The objectives of this EMMP are to:

- Ensure compliance with legislation and guidelines.
- Verify environmental performance through information on impacts as they occur.
- Provide feedback for continual improvement in environmental performance.
- Monitor actual impacts of the Project activities on sensitive receptors so that impacts not anticipated in the EIS or long-term impacts which exceed the levels anticipated in the EIS can be identified and appropriate mitigation measures can be adopted in time.

4.2 Organization Chart and Roles & Responsibilities

The EMMP organization chart is as under.

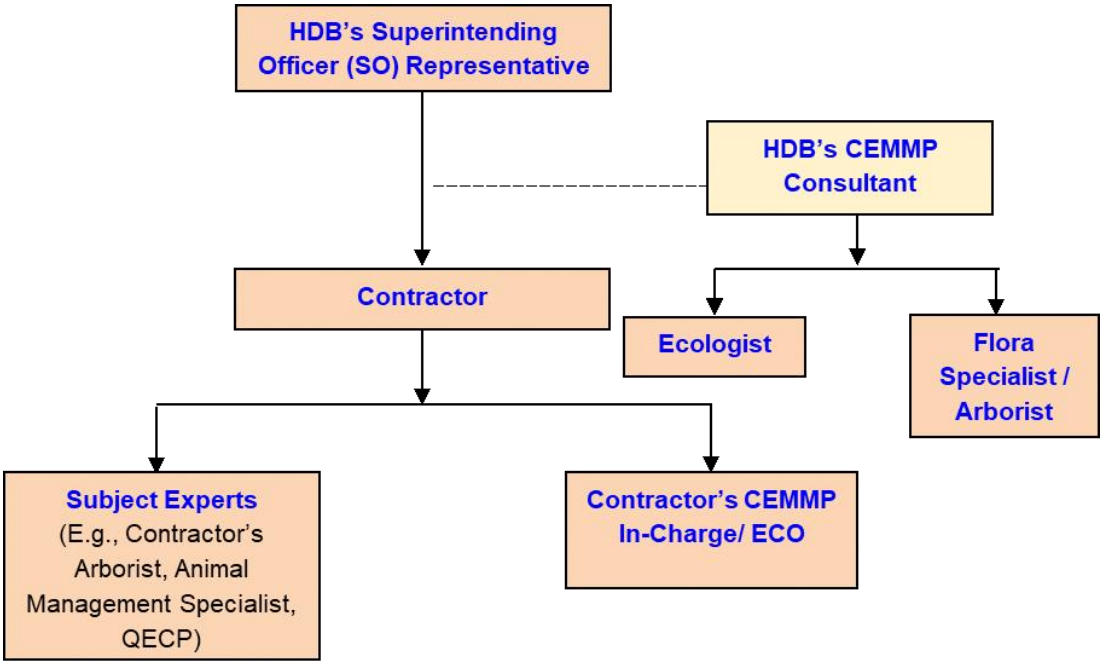

Figure 4.1. EMMP Organization Chart

The roles and responsibilities of key stakeholders are as follows.

4.2.1 HDB's Superintending Officer's (SO) Team

- ***HDB's SO Representative***
  - To be the point of contact for HDB.
  - To oversee implementation of the EMMP for the duration of the construction phase.
  - To liaise with authorities for EMMP consultation as and when required.
  - To manage the EMMP Consultant and the Contractor in the implementation of the EMMP

4.2.2 HDB's EMMP Consultant Team

- ***EMMP Consultant***
  - To prepare the EMMP document in consultation with Contractor during the pre-construction phase.
  - To assist in obtaining authority approval for EMMP.
  - During construction phase, review the physical monitoring results (Air, Water, Noise) provided by the Client as per approved EMMP.
  - To conduct one site visit per fortnight during construction phase to monitor the implementation of mitigation measures for biodiversity.
  - To prepare a monthly monitoring report upon receiving all the data, which includes highlighting and advising on any potential issues regarding the EMMP implementation.
  - To report to HDB and SOR on the status and compliances of the Contractor's EMMP implementation
  - To conduct training covering EMMP requirements as well as Biodiversity & Environmental Awareness prior to the commencement of activities on site

- ***Consultant's EMMP In-charge / Environmental Control Officer***
  - To be the point of contact for the Consultant.
  - To act as EMMP in-charge and lead the reporting requirements of EMMP during the construction phase.
  - To compile monitoring reports and fulfil reporting requirement.
  - To prepare monthly Site Environmental Performance Reports.
  - To coordinate with EMMP Consultant Team/ EMMP team members for advice on specific issues related to EMMP implementation.

- ***EMMP Specialist (Flora) / Arborist***
  - To support Contractor in implementing environmental mitigation measures for flora aspect as per EMMP.
  - To conduct site visits for flora monitoring to monitor the implementation of flora-related mitigation measures.
  - To assist in reporting requirements of EMMP during construction phase.

- ***EMMP Specialist (Fauna) / Ecologist***
  - To support Contractor in the implementation of environmental mitigation measures for fauna aspects as per EMMP.
  - To conduct fortnightly site inspections to assess implementation of mitigation measures.
  - To train and guide the contractor regarding wildlife management.
  - To determine if fauna habitats have been degraded beyond authorised working area and to recommend contingency plans if mitigating measures are ineffective.
  - To assist in reporting requirements of EMMP during construction phase.

4.2.3 Contractor's Team

- ***Contractor's Project Manager***
  - To implement a EMMP for the duration of construction phase.
  - To ensure all necessary EMMP measures are adhered to.
  - To ensure daily compliance checks on all environmental aspects as per
  - EMMP requirements are met relevant legislation, guidelines and best practice.
  - To report to HDB and SOR on the status and compliances of the Contractor's EMMP implementation
  - To liaise with authorities for EMMP consultation as and when required

- ***Contractor's EMMP In-charge / Environmental Control Officer***
  - To act as EMMP in-charge and lead the implementation and reporting requirements of EMMP during construction phase.
  - To conduct all necessary EMMP monitoring and fulfil reporting requirement.
  - To carry out daily compliance checks on all environmental aspects as per EMMP requirements.
  - To conduct daily toolbox meetings with construction workers including sub – contractors.
  - To monitor ECM performance and coordinate with QECP on specific issues.
  - To coordinate with EMMP Consultant Team/ EMMP team members for advice on specific issues related to EMMP implementation.

- ***Contractor's Qualified Erosion Control Professional (QECP)***
  - To design and endorse the ECM Plan.
  - To verify the implementation of ECM Plan as per the design.
  - Periodic monitoring of the performance of ECM Plan.

- ***Contractor's Arborist***
  - To implement environmental mitigation measures for flora aspect as per EMMP.
  - To set up Tree Protection Zones (TPZ) for trees to be retained within the site.
  - To conduct fortnightly site visits for flora monitoring to monitor the trees retained within the project site.
  - To monitor all clearance and tree felling activities as and when applicable.
  - To provide monthly reports to the EMMP Consultant Team.
  - To implement recommendations pertaining to tree protection from the EMMP Consultant's arborist.
  - To assist in reporting requirements of EMMP during construction phase.
  - To liaise with NParks on addressing any comments/ requirements related to flora implementation measures.

- ***Contractor's Animal Management Specialist (NParks-certified)***
  - To manage any ad-hoc wildlife encounters during construction phase.
  - To liaise with NParks on appropriate areas for translocation of wildlife within the project site.

4.3 Training and Awareness

To ensure effective implementation of mitigation and monitoring measures, all relevant construction personnel (i.e., Project Manager, Construction Manager, EMMP In-charge / ECO, Site Supervisor, Foreman, Construction Worker Team Leader, etc.) will be made aware of the EMMP requirements prior to commencement of on-site work.
The biodiversity awareness briefing is to be conducted for all key construction personnel:

- Prior to commencement of activities on site;
- Daily toolbox meetings for construction workers should include reminders on wildlife encounters and environmental protection; and
- Monthly during the construction phase.

Every training session shall be documented and reported as part of best practices.

4.4 Environmental Incidence Protocol

4.4.1 Response Procedure

The monthly environmental monitoring may result in observations of failed or inadequate mitigation measures. Also, a public complaint/observation may be received. In the event that a failure is discovered, that failure must be reported to the Contractor's EMMP In-charge / Project Manager within the shortest possible time.

The Contractor's EMMP In-charge / Project Manager will then be responsible for ensuring adequate follow-up activities. This may include:

- Consultation with the EMMP Specialists / QECP / VCO / PRO.
- Arranging an immediate appropriate response on guidance of EMMP Specialists / QECP / VCO as necessary.
- Reporting and consultation with the relevant authorities (i.e., NEA, NParks, PUB) if required.

In the event of violation of relevant standards/regulations/complaints, the environmental management practices at site are to be reviewed immediately with appropriate mitigation actions taken immediately to reduce impacts to acceptable levels.

4.4.2 Incidence Reporting Flowchart

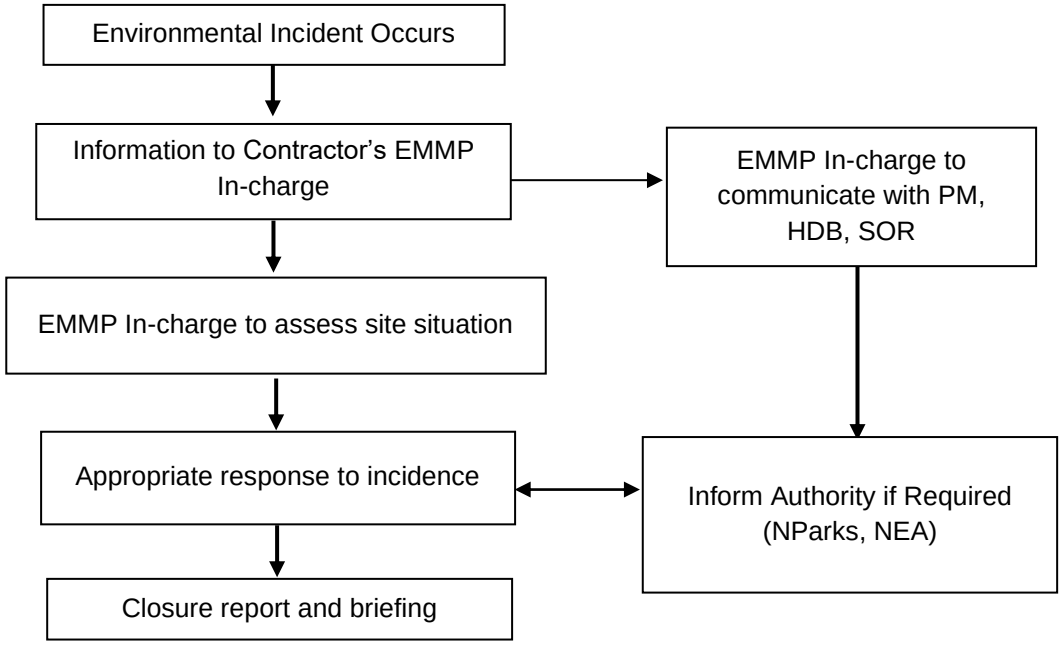

Figure 4.2. Environmental incidence reporting flowchart

Communication Details

Authorities / Relevant Contacts	Contact Number
NParks Animal Response Center (24hr)	1800 476 1600
ACRES Wildlife Rescue Hotline	9783 7782
PUB Hotline	1800 2255 782
NEA Hotline	6225 5632
BCA	1800 3425 222

5 BIODIVERSITY MANAGEMENT PLAN

An EIS was carried out by AECOM (2022) for the project site that established baseline conditions within study area, assessed the impacts, and recommended the mitigation measures. The following management plans provide the potential impacts and mitigation measures for biodiversity that are to be implemented during construction phase. These management plans utilise the impacts and mitigation measures from AECOM (2022). However, where necessary based on site context or existing legislation, additional mitigation measures have been included.

It is recommended to review the biodiversity management plans every quarter to update or adjust the applicable mitigation measures and monitoring requirements based on the various site considerations such as work progress, site utilisation, change in work methods, environmental incident, failure of mitigation measures etc.

5.1 Applicable Legislations

- The Wildlife Act 2020
- The Animals and Birds Act 2002
- Fisheries Act 2002
- Endangered Species (Import and Export) Act 2017
- The Parks and Trees Act 2006
- The Parks & Trees Regulations 2006
- The Parks & Trees Preservation Order 1998
- Parks & Trees (Composition of Offences Regulations) 2006
- Parks & Trees (Planning Areas) Notifications 2006
- Parks & Trees (Heritage Road Green Buffers) Order 2006
- Singapore Red Data Book, Second Edition, 2008
- IUCN Red List of Threatened Species to assess species vulnerability 2020
- CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora, also known as the Washington Convention) 1983
- NParks Biodiversity Impact Assessment (BIA) Guidelines (2021)

5.2 Wildlife Management Plan

Given the importance of this location as a natural wildlife corridor, it is necessary to minimise impacts to fauna species on the site. The development of a proper Wildlife Response and Rescue Plan will help to reduce impacts to fauna, while also reducing the risk of human-wildlife conflict, which may pose a human health and safety issue if not managed.

Wildlife management should commence prior to construction works. This is to ensure that animals within the site are safely moved outside the working boundaries, either by passive shepherding or active relocation. A Wildlife Rescue and Response Plan should then be put in place for the duration of the construction period for animals that may get trapped or injured within the construction site.

All construction personnel are to be sufficiently trained on biodiversity issues on the site and how to respond to sightings of fauna.

Additionally, the Contractor shall engage an NParks Certified Animal Management Specialist that can be mobilised immediately when the Consultant's EMMP Specialist (Fauna)/ Ecologist recommends the relocation of fauna species at any stage during the project. The Animal Management Specialist must be a third-party contractor that has been given approval from the Director-General of Wildlife Management to conduct specific activities that are restricted by the Wildlife Act.

5.2.1 Recommended Mitigation Measures

The following list includes the recommended mitigation measures for fauna protection during the pre-construction and construction phases of the project.

- Implement hoarding around project boundaries. During the earthworks phase, hoarding of at least 2.4m should be installed along the proposed 30m buffer boundary of Berlayer Creek. Hoarding along Telok Blangah Rd & Bukit Chermin Road should be at least 2.4m. Otherwise, hoarding should be at least 4m with noise barrier fronting the private condo, and contain no gaps.
- After earthworks when the platform has been levelled to the proposed level, hoarding along Berlayer Creek should be 10–12 m high to protect mangrove trees from wind.
- Prior to demolition of CBP wall, the fences installed on the wall are to be covered with tarpaulin.
- The proposed 30 m buffer to Berlayer Creek and areas of high conservation value should be observed at all times. This is with the exception for the land where the 2 outlet discharge connects to Berlayer Creek, to which there would be tree felling.
- Minimise felling trees and clearing vegetation during the peak bird breeding season (March to July).
- Pre-felling fauna inspection should be conducted before felling any trees or removing any vegetation.
- Wildlife shepherding via directional clearing to be adopted during tree-felling. This entails clearing the site from Keppel Club towards Berlayer Creek.
- Quieter construction machinery/equipment should be used over loud and noisy machinery/equipment whenever possible.
- All works are to be conducted during 8am – 7pm as far as practicable. When night works needs to be carried out approval must be given by the relevant authorities (e.g., NEA, NParks).
- Retain ground cover for as long as possible before removal. When the ground cover is removed, earth control measures (ECM) are to be in place.
- Use only fully biodegradable erosion control blankets (ECB) to avoid trapping fossorial fauna such as snakes.
- Check ECBs on a daily basis for entrapped fauna.
- Adopt road calming measures such as speed bumps, and other mitigation measures such as restriction on speed of vehicles and working time, to minimise

roadkill accidents.

- Train site personnel on biodiversity awareness and actions to take when encountering wildlife.
- Ensure good housekeeping controls such as provision of wildlife proof bins and eating areas.
- Execute fauna response and rescue protocol when fauna is found on-site.
- Monitor the water quality and aquatic faunal community in streams adjacent to the construction areas.
- Ensure silt fences or other silt control measures along the site hoarding are installed and maintained properly.
- Practice due diligence in proper storage and handling of machinery to prevent leaching of oil or harmful materials such as bentonite slurry.
- Store and handle harmful materials well away from water bodies.
- Engage a Qualified Erosion Control Professional (QECP) to formulate and implement ECM plan in accordance with PUB requirements.
- Implement dust control measures such as dust screens and water suppression systems.
- Implement acoustic barriers where appliable to reduce noise pollution outside worksites.
- Conduct biweekly inspections to ensure contractor compliance and identify any impacts to fauna species.

5.2.2 Biodiversity Awareness Training

Prior to any construction activities, all construction personnel are to attend a biodiversity awareness training by the EMMP consultant. This training should impart important information on the ecological importance of the site, and the importance of minimising impacts to the natural environment. Also, they should be trained on the common fauna species they may encounter, and what to do should they have any wildlife encounters.

After the initial training, refresher training and toolbox briefings are to be conducted with the details specified in the following Table 5.1.

Table 5.1. Details of refreshing training and daily toolbox briefings

Training Schedule	Training Topics	Conducted By	Target Audience	Frequency
Prior to commencement of activities on site	EMMP Requirements Biodiversity & Environmental Awareness	EMMP Consultant	Environmental Manager/ ECO/ Project Manager / Construction Manager/ Construction Engineers/ Site Supervisors/ Sub-contractors	Once
Refresher training	Biodiversity & Environmental Awareness	EMMP Consultant	Site Personnel including Sub-contractors	Monthly during construction

Training Schedule	Training Topics	Conducted By	Target Audience	Frequency
	Briefing			phase
Toolbox meetings	Briefing to include reminders on wildlife encounters and environmental protection	EMMP In-charge/ ECO	Construction Workers including Sub-contractors	Daily

5.2.3 Wildlife Management during Site Clearance

Wildlife management during tree clearance is a requirement for the project site. Directional clearance will allow for the passive shepherding of mobile fauna species, while active relocation of animals found within the project site may be required for other species. This is done in order to:

- Minimise the risk of road hazards and kills from the terrestrial fauna that are displaced from the project site onto adjacent roads.
- Minimise the risk of human-wildlife conflict from animals remaining within the project boundaries
- Encourage wildlife movement into designated forested areas located outside of the project site's boundary.

Site clearance to be conducted in the following steps:

- Setting up of TPZs for trees to be maintained prior to the start of any works;
- Permanent hoarding along proposed working boundary along Bukit Chermin Road and part of Telok Blangah Road to prevent entrance of fauna species into construction area and prevent animals from running onto the road;
- Inspection of trees and tree holes for arboreal fauna in phases, and relocation by qualified agencies and/or specialists;
- Felling of trees within each phase in one direction.

Upon completion of the tree felling in the project area, the permanent hoarding will cover the full perimeter of the project worksite. The detailed sequence can be found in the section '
Spatial Visualisation of Directional Clearance'.

5.2.3.1 Target Species

A list of target fauna species has been developed based on the findings of the EIS. Besides species encountered during the baseline surveys, other probable species that exist on the site were also included. This list was developed with the following considerations:

- probable presence of species in the Project area prior to construction;
- risks to species from being in close proximity to construction activities;
- practicality of relocating species from the construction site;
- conservation significance of species; and

- risk of road kills, road hazards, and/or human-wildlife conflict arising from uncontrolled species displacement from the project area.

The target species in the list in Table 5.2 have been categorized into two groups depending on their habits, and thus the approach required for wildlife shepherding. Fauna species in the first category are in general highly mobile species in which a passive approach is recommended, while fauna species in the second category are less mobile and would require a more active approach to shepherding. Due to the isolation of the project site in particular the eastern segment of Phase 2 (Figure 5.2). An active approach would involve the capture-and-release method. Optimal release sites are to be determined with consultation with NParks.

Table 5.2 List of identified target species

Category	Species	Active Hours
Passive Shepherding	Long-tailed macaque Common palm civet Smooth-coated otter	Diurnal Nocturnal Diurnal
Capture-and-release	Black spitting cobra Clouded monitor Malayan water monitor Reticulated python Bamboo bat Other snake species	Diurnal Diurnal Diurnal Nocturnal Nocturnal Diurnal and nocturnal

For wild boars found at or around the site at any time during the project, NParks is to be informed as soon as possible at nparks_wildlife_management@nparks.gov.sg for advice and subsequent action. An approved wild boar removal contractor must also be engaged to trap and remove the said animals, the process of which may take about 4–8 weeks.

5.2.3.2 Methodology and Approach

Directional tree clearance should only be conducted during 8am to 6pm. It may include a combination of the following activities:

- Installation of hoarding along project boundaries, which would help to guide target terrestrial fauna in the intended direction of movement and as a barrier to prevent wildlife displacement onto adjacent roads;
- Installation of temporary hoarding to along width of cleared areas to prevent wildlife from re-entering the cleared areas;
- Systematic pattern of tree clearance in the site in order to encourage wildlife to encourage wildlife to move in an intended direction of movement towards adjacent refuge habitats, and;
- Careful survey to check for the presence of target fauna species and any active nests or dens.

Prior to any tree felling, the site is to be inspected by an ecologist to ensure that no target fauna and active nests or dens remain. After clearance of undergrowth, cleared areas

should be hoarded up to prevent target terrestrial fauna from returning to the site.

The wildlife inspection prior to tree felling and vegetation clearance will also check for any entrapped animals within the hoarded area to be cleared. This inspection will be valid for 7 days only, during which the trapped animals have to be translocated from the site and clearance must be conducted. If more than 7 days have passed and site clearance is not done yet, the inspection should be carried out again.

In the event that any target fauna listed in Table 5.2 are encountered during this process, the following actions which have been developed in consideration of reducing stress to fauna while ensuring the effectiveness of the shepherding exercise shall be taken:

i) Passive Shepherding: These are highly mobile species where passive shepherding is likely to be effective. When species in this category are encountered, personnel should allow the animal to move on its own accord. If necessary, personnel may talk loudly or make some noise by clapping their hands together to encourage the animal to move. If any individual fauna does not move on its own after sufficient time (i.e., up to one hour) has passed, the EMMP team is to make a decision on whether to call NParks' Animal Response Centre or ACRES for the appropriate removal of the animal.

   Should the team encounter a visibly injured animal, NParks' Animal Response Centre or ACRES should be called immediately for the next course of action.

   No attempt should be made by the EMMP team, workers, or other unqualified personnel at any point to handle animals on site. Handling animals without appropriate certification is illegal under the recent Wildlife Act of June 2020.

ii) Capture-and-release: Species in this group are less mobile and/or venomous, and a passive shepherding approach is deemed to be ineffective and/or unsafe. A capture-and-release approach will be needed to ensure safe relocation of these fauna from the site prior to construction. In the event that these species are encountered, NParks' Animal Response Centre or ACRES should be called immediately for the next course of action. Capture-and release of animals encountered should be conducted by a NParks' licensed animal management company.

For trees that are subjected to removal, it is necessary to check for the presence of fauna species before each individual tree is felled.

The ecologist shall inspect the tree for the presence of fauna, including birds, bats, arboreal mammals, and arboreal herpetofauna. The ecologist should do the following:

- Check the crown of the tree for bird nests
- Check along the trunk from the bottom up for holes in which animals could be nesting
- Scan the trunk and all the branches for animals using the tree
- Scan the ground for potential nests, eggs, or burrows

Photographs of all nests, tree holes, and burrows should be taken for recording purposes. In the event that the presence of birds, bats, arboreal mammals, and herpetofauna are found on the tree, tree felling, or transplanting must be postponed until the animal has left the tree on its own accord.

Tree felling or transplanting should be minimized during prime breeding season for birds in Singapore, between the months of mid-March to July. In the event that this period is unavoidable for tree-felling, the frequency of pre-felling fauna inspections shall be increased, and an ecologist should be on site when the contractor is felling trees with existing nests. Outside these months, if active nests are detected on the tree, nests shall be left undisturbed until the young birds have fledged. Inactive nests should be removed to minimize the possibility of a new nesting attempt. Tree felling or transplanting shall occur only when no active nests are present on the tree.

Once tree felling is completed, the tree should be inspected again for any animals that were not detected earlier. Should an animal be detected after felling, NParks Animal Response Centre or ACRES should be contacted immediately, especially since the animal might be injured.
Through the undertaking of general approach, a register shall be maintained to record:

- the activities that were carried out,
- the species, numbers, GPS locations, dates, timings, and actions taken (if any) for each target fauna which was identified, and
- the description, GPS location, and actions taken (if any) for each burrow, inhabited tree hole and nest that was identified.

<u>Hornet and wasp nests</u>
There is a presence of hornet and wasp nests within the project site, which may result in human-wildlife conflict during the construction phase. Prior to the commencement of works, the hornet and wasp nests should be removed and relocated out of the construction site to reduce the risk of any injury.

Figure 5.1. Location of hornet and wasp nests recorded at project site

5.2.3.3 Spatial Visualisation of Directional Clearance

The figures below illustrate the overall scheduled phasing for directional clearance. These activities should take place during 8am to 6pm and a minimum of one rest day (i.e., Sunday) per week should be provided to reduce disturbance to wildlife.

The appointed contractor is to implement the directional clearance plan to the best of their abilities, the plan may be subject to change if unforeseen site circumstances are encountered. The proposed directional site clearance plan shall be subjected to NParks' final approval prior to actual clearance works. Directional clearance shall be conducted in the 3 phases – Phase 1A (south), Phase 1B (north), and Phase 2. The Contractor shall maintain a 30 m buffer along Berlayer Creek. This is with the exception for the land where the 2 outlet discharge connects to Berlayer Creek, to which there would be tree felling. TPZs are to be set up before any works (including the installation of hoarding) to ensure there is no damage to the trees.

Figure 5.2. Directional clearance phasing layout

Figure 5.3 Hoarding before directional clearance commences

After TPZs have been set up, permanent hoarding is to be erected along the green lines

in Figure 5.3. Temporary hoarding is to be erected along the orange lines in Figure 5.3. It is understood that there is a fence above the retaining wall in the northeastern corner of the site. In order to prevent animals from going over or through the fence, tarpaulin sheet is to be placed over the fence, demarcated by the yellow line in Figure 5.3. There are to be no gaps at the bottom and along sides of each tarpaulin sheeting to prevent animals from squeezing through or getting trapped in the fence. Site clearance should commence from the Keppel Club area and proceed towards the west in intervals of 100m.

An example of the permanent hoarding and tarpaulin covering fencing above retaining wall along Telok Blangah Road is illustrated in Figure 5.4 and Figure 5.5 below.

Figure 5.4 Example of the permanent hoarding

Figure 5.5 Example of using tarpaulin to cover fencing

Prior to any vegetation clearance in the first interval, all tree holes, nests, and burrows should be inspected for wildlife. Directional clearance should be conducted in 100 m intervals as demarcated by the dashed white lines, and should encourage fauna to move towards Berlayer Creek. The first cleared area should be temporarily hoarded up, as indicated by the dashed orange lines in Figure 5.6.

Figure 5.6 Directional clearance in the first interval (Phase 1A)

Prior to any vegetation clearance in the next 100 m interval, all tree holes, nests, and burrows should also be inspected for wildlife. Directional clearance should take place in the direction of the black arrow, to encourage fauna to move towards Berlayer Creek and the vegetated areas on the west. After the area has been cleared, temporary hoarding should be installed to prevent fauna from re-entering the cleared area.

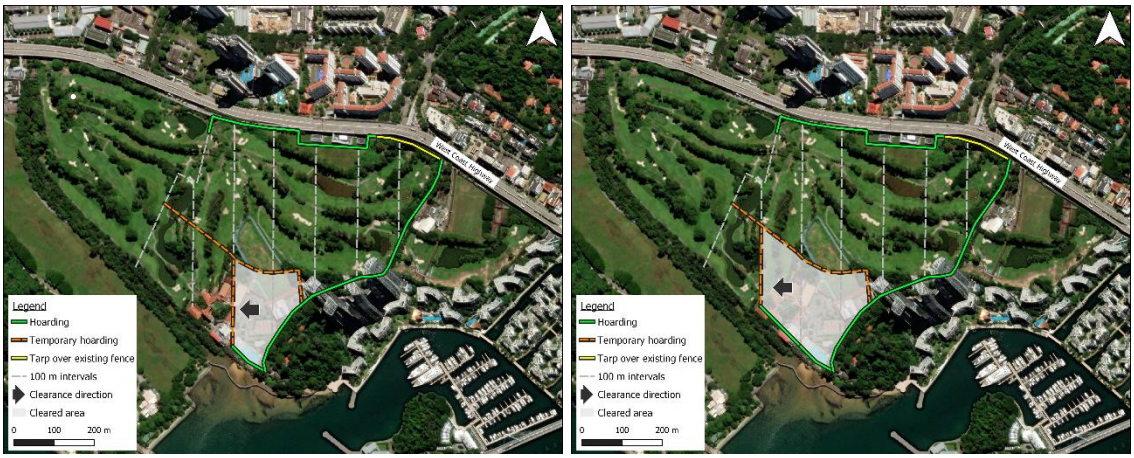

Figure 5.7 Directional clearance in the following intervals (Phase 1A)

Directional clearance should continue towards the west following the intervals demarcated by the dashed white lines. Prior to any vegetation clearance, all tree holes, nests, and burrows should be inspected for wildlife. In the event of any wildlife incidences, a wildlife contractor should be engaged. After each 100 m interval has been cleared, the area should be temporarily hoarded along the dashed orange lines. Permanent hoarding should also be installed along the green line at Berlayer Creek.

Figure 5.8 Completion of directional clearance in Phase 1A

Figure 5.8 shows the end of the directional clearance in Phase 1A (south section). Upon completion of directional clearance in the south section, permanent hoarding (green line) should be erected along the western and southern boundary of the cleared area. Directional clearance shall then commence in Phase 1B (north section).

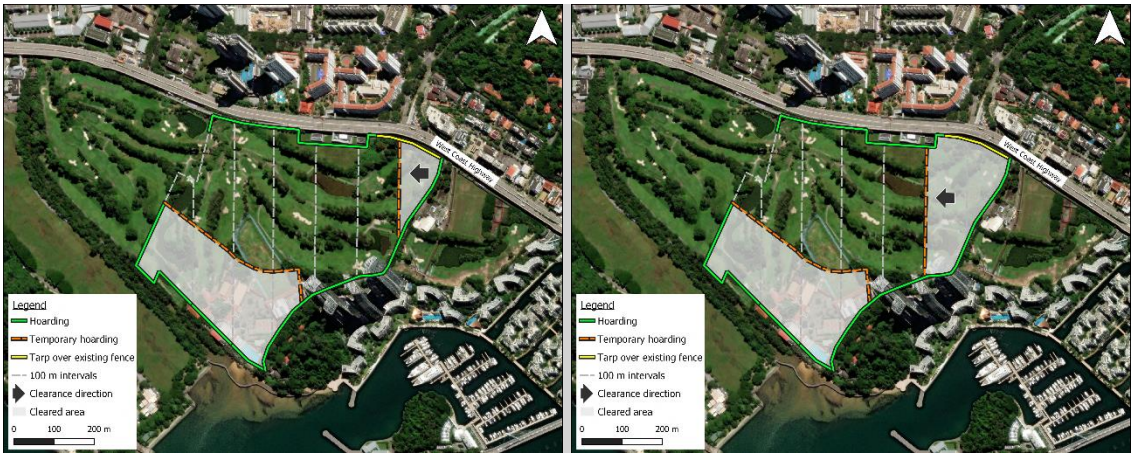

Figure 5.9 Directional clearance in Phase 1B

Temporary hoarding (dashed orange line) should remain between northern and southern sections. There should be no gaps between hoarding to prevent fauna species from entering the site. After each 100 m interval has been cleared, the area should be temporarily hoarded along the dashed orange lines.

In the north section, directional clearance should continue towards the west following the intervals demarcated by the dashed white lines. Prior to tree felling in each interval, all tree holes, nests, and burrows should be inspected for wildlife. In the event of any wildlife incidences during tree felling, an NParks-approved wildlife contractor should be engaged.

Figure 5.10 Completion of directional clearance for Phase 1B

Once directional clearance has been completed for Phase 1B, the full working area should be hoarded up with permanent hoarding following the contract boundary as shown in Figure 5.10. There should be no gaps between hoarding to prevent fauna from entering the site.

After the existing wall in the northeast corner of Phase 1B has been demolished, permanent hoarding shall be installed along the contract boundary to prevent fauna from entering the site.

The following figures describe the steps in directional clearance for Phase 2.

Figure 5.11. Hoarding before directional clearance for Phase 2

Prior to clearance for Phase 2, permanent hoarding is to be erected along the green lines shown in Figure 5.11. These include permanent hoarding along the entire eastern segment, as well as along Telok Blangah Road. Apart from Berlayer Creek, the whole contract boundary should be hoarded up. The boundary between Phase 2 and Berlayer Creek shall be left open with no hoarding to encourage animals to move towards Berlayer Creek.

Prior to any vegetation clearance in the first interval, all tree holes, nests, and burrows should be inspected for wildlife.

Directional clearance may commence on the east and west segments concurrently. The directional of clearance should follow the black arrows in Figure 5.12. In the west segment, site clearance is to start from the northern edge and proceed southwards. In the east segment, site clearance is to start from Bukit Chermin Road and proceed

eastwards. Directional clearance should be conducted in 100 m intervals as demarcated by the dashed white lines.

Figure 5.12. Directional clearance in Phase 2

After each 100 m interval is cleared, the cleared area should be temporarily hoarded up, as indicated by the dashed orange lines in Figure 5.12. Permanent hoarding should also be erected along Berlayer Creek as indicated by the green lines in Figure 5.12.

Prior to any vegetation clearance in the next 100 m interval, all tree holes, nests, and burrows should also be inspected for wildlife. Directional clearance should take place in the direction of the black arrows. This is to encourage fauna to move towards Berlayer Creek in the west segment. As the east segment is isolated active translocation of wildlife is to be carried out. In the event of any wildlife incidences, an NParks-approved wildlife contractor should be engaged.

Figure 5.13. Completion of directional clearance for Phases 1A, 1B, and 2

Once directional clearance has been completed, the permanent hoarding separating Phase 1 and Phase 2 (excluding those along Bukit Chermin Road) may be removed. The full working area should be hoarded up with permanent hoarding following the contract boundary. There should be no gaps between hoarding to prevent fauna species from entering the site.

5.2.4 Wildlife Response and Rescue Plan

Even upon the completion of wildlife shepherding works, it is highly probable that animals might be able to enter the site and get trapped, particularly burrowing or climbing animals. Whenever fauna is encountered within the working areas, all construction activities should be stopped immediately, and the Wildlife Response and Rescue Plan should be followed. Workers are to notify their supervisor, who will in turn contact the designated ecologist. The ecologist will then decide the next appropriate course of action.

All documentations of wildlife are to be captured in photographs, and a Wildlife Incident Form provided in **Appendix A** is to be filled.

Table 5.3. Wildlife response and rescue plan

Particular	**Within the project site**					**Outside project site**
Timeframe	During working hours					Any time
Animal type	Highly mobile animals (e.g., wild boar, feral dog, smooth-coated otters, and long-tailed macaques)		Non-large animals			Any
			Venomous / poisonous (e.g., king cobra, black spitting cobra)		Non-venomous / -poisonous (e.g., Malayan water monitor)	
Animal condition	Alive / Moving / Resting	Dead	Alive / Moving / Resting	Dead	Any	–
Risk To human	High	Low	High	Low	Low	–
Response	a. Stop work on work site b. Report to PM c. PM to report to EMMP In-charge d. EMMP In-charge to inform EMMP Consultant (Ecologist), who will contact NParks for next steps if	a. Barricade affected area b. Report to PM c. PM to report to EMMP In-charge d. EMMP In-charge to inform EMMP Consultant (Ecologist). e. If required, Contractor to assist	a. Stop work at affected area; if possible, barricade affected area b. Report to PM c. PM to report to EMMP In-charge d. EMMP In-charge to inform EMMP Consultant	a. Barricade affected area b. Report to PM c. PM to report to EMMP In-charge d. EMMP In-charge to inform EMMP Specialist (Fauna). e. If required, Contractor to assist with transporting of	a. Stop work at affected area; if possible, barricade affected area Report to PM b. PM to report to EMMP In-charge c. EMMP In-charge to inform EMMP Consultant (Ecologist), who will	a. Notify NParks Animal Response Centre/ ACRES hotline if necessary

Particular	Within the project site					Outside project site
	necessary e. EMMP In-charge to inform Wildlife Specialist, who will trap and remove/translocate animal if necessary.	with transporting of the Wild Animal to Disposal Location	(Ecologist), who will contact NParks for next steps if necessary e. EMMP In-charge to inform Wildlife Specialist, who will trap and remove/translocate animal if necessary.	Wild Animal to Disposal Location	contact NParks for next steps if necessary d. EMMP In-charge to inform Wildlife Specialist, who will trap and remove/translocate animal if necessary.	
Remarks	• No attempts shall be made by Contractors to handle the animal • Contractor to take photograph of the animal if possible. • Contractors shall allow the animal to leave the site without harassment / handling • If animal is trapped, notify NParks Animal Response Centre or ACRES hotline • For wild boars found at or around the site, NParks is to be informed as soon as possible at for advice	• Contractor to take photograph of the animal	• No attempts shall be made by Contractors to handle the animal • Contractor to take photograph of the animal if possible. • Contractors shall allow the animal to leave the site without harassment / handling • If animal is trapped, notify NParks Animal Response Centre hotline	• Contractor to take photograph of the animal.	• No attempts shall be made by contractors to handle the animal • Contractor to take photographs of the animal if possible. • Contractors shall allow the animal to leave the site without harassment / handling • If animal is trapped, notify NParks Animal Response Centre hotline	• Contractor is encouraged to report • Reports could be from Public and/or Contractor's Staff • If required, EMMP In-charge to contact PM for assistance of transferring Wildlife Animal Carcass to Disposal Location

Particular	Within the project site					Outside project site
	and subsequent action. An approved wild boar removal contractor must also be engaged to trap and remove the animal.					

5.3 Flora Management Plan

The scope of works requires the clearance of all trees and vegetation on site except for the areas of conservation value shown in Figure 1.2 and selected plants to be salvaged. A Flora Management Plan has been developed to lay out the details on the salvaging plants, how to carry out tree protection works, the required components of tree assessments and monthly monitoring, etc. The tree protection and assessment duties should come under an ISA Certified Arborist.

Within the areas to be cleared, trees to be retained will be identified and confirmed during pre-construction phase. Protection of retained trees should be done though the establishment of appropriate TPZs. Additionally, permanent hoarding is to be set up around the adjacent areas of the project site to prevent unnecessary vegetation damage particularly along the Berlayer Creek.

5.3.1 Recommended Mitigation Measures

Flora

- Implement hoarding around project boundaries. During the earthworks phase, hoarding of at least 2.4m should be installed along the proposed 30m buffer boundary of Berlayer Creek. Hoarding along Telok Blangah Rd & Bukit Chermin Road should be at least 2.4m. Otherwise, hoarding should be at least 4m with noise barrier fronting the private condo, and contain no gaps.
- Prior to demolition of CBP wall, the fences installed on the wall are to be covered with tarpaulin.
- After earthworks when the platform has been levelled to the proposed level, hoarding along Berlayer Creek should be 10–12 m high to protect mangrove trees from wind.
- The proposed 30 m buffer to Berlayer Creek and areas of high conservation value should be observed at all times. This is with the exception for the land where the 2 outlet discharge connects to Berlayer Creek, to which there would be tree felling.
- Ensure there are no works and disturbances to areas outside of the work site, especially in areas of high conservation value, particularly the Berlayer Creek area.
- Ensure any associated slope stabilisation and grading works will not impact topography of areas outside work site, as well as water quality and hydrology of the waterbodies within the Study Area.
- Care should be taken to prevent siltation into ecologically sensitive areas such as Berlayer Creek. Works should not encroach on these areas, nor should there be clearance, trampling, or vegetation damage to these areas.
- An arborist and flora specialist should clearly mark out areas and plants with conservation value before the start of works.
- Transplant or harvest trees/saplings of conservation significance if they are to be cleared.
- Erect Tree Protections Zones (TPZs) to prevent encroachment of construction activities and excessive vegetation clearance around retained trees or areas

prior to any vegetation clearance.

- Conduct biweekly inspections to ensure contractor compliance and identify any impacts to the adjacent forest areas.

5.3.2 Salvaging Native Plants

NParks has requested for access to the site to salvage any native plants. The site has some plants that may be suitable for transplanting, including *Ardisia elliptica, Olea brachiate, Antiaris toxicaria, Ipomoea pes-tigridis and Macrosolen retusus,* most of which do not fall under the proposed retained areas (Figure 5.14). The finalised list of plants to be salvaged or transplanted will be developed with consultation with NParks.

Figure 5.14. Layout showing identified flora species of high conservation value and proposed retained areas

Smaller trees or climbers should be transplanted whenever possible. As such, NParks should be informed prior to vegetation clearance to facilitate plant salvaging. These salvaged plants will be housed and maintained in NParks-approved locations.

It is important that all individuals involved in the salvaging works are qualified persons to conduct the required works (i.e., relevant experience and professional expertise in the

landscaping industry). Preferably, they shall have good local flora (trees, shrubs) identification skills as well as hands on experience in the operational aspects such as transplanting techniques and nursery management knowledge to ensure a higher success rate in the transplanting process.

5.3.3 Assessment and Monitoring of Trees to be Protected

It is to be noted that a *Tamarindus indica* (Asam) that had been identified as a Heritage Tree under the NParks Heritage Tree Scheme and is to be retained. This tree is located at the northern side of project site, adjacent to Telok Blangah Road. To be earmarked as a heritage tree, this subjected Asam is a well-matured specimen and has value in terms of botanical, historical, and aesthetical. Therefore, efforts shall be taken to protect it during the construction period.

There is also a particular sector, adjacent to the project boundary closer to Labrador MRT Station which is proposed as a park area. Trees within this area will be retained.

Additionally, HDB will be implementing a 30 m buffer between Berlayer Creek and the upcoming development. Within this area, no trees are to be felled except for the land where the 2 outlet discharge connects to Berlayer Creek, to which there would be tree felling.

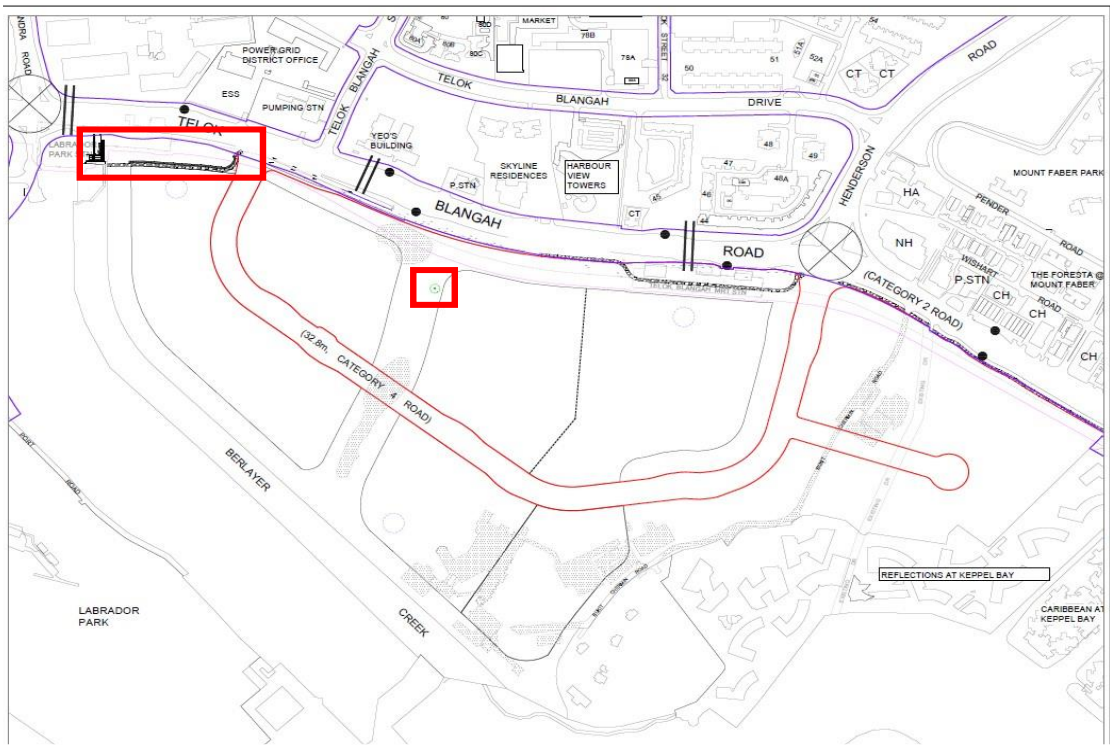

Figure 5.15 Retained trees along northern parkland and retained heritage tree boxed in red.

Species such as *Ficus microcarpa, Ficus benjamina, Ficus kerkhovenii* as well as fruit tree species found in localised sections of the studied area can be considered for conservation as they are either very large specimens and / or useful specimens which can improve the aesthetic value and biodiversity ecosystem i.e., birds, bees attracting of

the vicinity. Based on past and existing flora studies, other species that may be considered for retention or salvaging include also to species such as *Antiaris toxicaria, Barringtonia asiatica, Barringtonia racemose, Calophyllum inophyllum, Dolichandrone spathacea, Rapanea porteriana,* and *Syzygium claviflorum var. claviflorum* found as they are recognized as either native and / or has conservation significance. If they can be considered for retention, these trees should be tagged, and Tree Protection Zones (TPZs) should be set up (See Section 5.3.5 for details).

Before any construction activity begins (including both planned and ad-hoc site clearance), the Arborist shall perform pre-construction tree assessment for trees at proposed development site. The Arborist should utilise Site Layout Plan and Topography Plan to determine extent of tree roots and tree crown affected by the development. Based on site observation, construction drawing and design, estimated work area boundary, the Arborist shall produce tree assessment report recording tree information such as site condition, tree photos, species, height, girth, crown spread, tree health, form, structure. He / She will then conclude whether the tree will be affected by proposed development footprint and if thus so, what are the perceived construction impacts and recommended mitigation measures to mitigate these impacts. This tree assessment report will then serve as a record as the pre-development tree condition, and the Arborist will have to refer to this report as benchmark when performing monthly monitoring for trees.

Mitigation actions such as crown cleaning to remove damaged and dead branches, and apply appropriate pest and disease control should be the first line of measures. Tree Support Systems such as Tree Guying and Root Anchoring must be considered if the tree is deemed to be susceptible to wind throw. Furthermore, active regular monitoring of defects such cavity with wounded wood development by the Arborist will also be useful in early detection of hazardous trees.

5.3.4 Tree Protection Zones (TPZ)

It is possible to retain large and significant trees within construction footprint with a thorough and carefully thought-out pre-construction planning such as rerouting underground pipelines, altering footpath direction and repositing hardscape infrastructures etc. pavilion to avoid a native / mature tree within or at the border of such site. However, if these measures or plans proved to be impossible to put into place and works near / around a large, retained tree is unavoidable, a minimal TPZ needs to be demarcated to protect individual trees, so as to minimize the impacts of construction activities (including root cuts, mechanical trunk damage, branches breakage, damage due to soil compaction, etc.) on the tree. NParks (2018) has included some guidelines on TPZs in their Guidelines on Greenery Provision and Tree Conservation for Developments.

As the project site is in close vicinity to mangrove trees, these trees have distinct morphological and physiological adaptations such as branched cable root systems and prop roots, which will affect the TPZ size. TPZs in mangrove areas can be set up 2m radius away from visible pencil, conical, or prop roots.

TPZ size varies depending on tree size as shown in Table 5.4. In general, the remaining space should be sufficient for implementation of design and required infrastructures. In the event the Contractor require extra spacing during the construction period for necessary works, the adjacent areas should be surveyed for native species / trees to be retained and possibly salvaged to interim nursery before any clearance. If any materials spill into TPZ, the spillage should be cleaned up immediately and the Arborist must be informed. The Contractor is also required to notify the Arborist immediately if retained trees are observed to have been damaged. If the tree suffers from substantial damage and are in a state of irreversible deterioration as determined by the Arborist, if any Contractor should replace the tree of the same species at a minimum girth size of 0.2m with the default replacement ratio as shown Table 5.5.

Table 5.4 TPZ size required for different girth range

Girth	Recommended TPZ (radius)
<0.5m	1 m
>0.5m but less than 1m	2 m
>1m but less than 1.5m	3 m
>1.5m but less than 2m	4 m
>2m	5 m
Fig trees and Trees with Critically Endangered status	Prescribed individually by Arborist on a case-by-case basis
Mangrove Trees	2m away from visible pencil, conical, or prop roots

Table 5.5 Tree Replacement Ratio

Girth of Trees to be Replaced	Recommended Replacement (NO)
<0.4m	1
≥0.4m but ≤ 2m	3
>4m	5

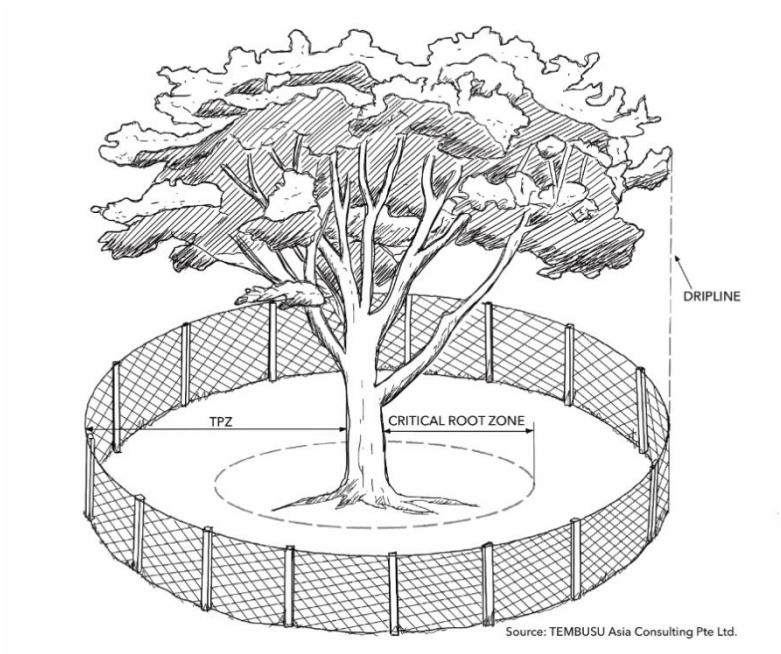

Figure 5.16 Tree Protection Zone Diagram

The following specifies guidelines for construction activities within and outside the TPZ, extracted from NParks (2018).

Inside TPZ

- There must be no excavation, raising or lowering of soil level, compaction or any form of construction activities including temporary works within the hoarded area.
- Dumping of debris, excavated materials and/or storage of construction materials and equipment are not allowed within the TPZ.
- The demolition of drains and structures within the TPZ should be carried out manually and backfilled with Approved Soil Mixture (ASM) immediately.
- Trees are to be watered regularly if rainfall is inadequate.
- Trees are to be fertilised if soil tests or deficiency symptoms indicate they are nutrient stressed.

Outside TPZ

- If major roots are encountered during excavation, the applicant may like to seek advice from a Certified Arborist, as cutting of major roots may affect the stability of the tree. Where possible, alternative proposals should be explored to avoid the need to cut the roots.
- In cases where the trees are managed by NParks (e.g., trees within the park connector planting verge), or are required by NParks to be conserved (e.g., trees with girth >1.0m within TCA or vacant land), approval from NParks must be obtained before the major root can be cut. If approval is granted by NParks to cut the roots, this must be done with a clean cut using a chainsaw.
- All building debris and chemical waste should not be burned or buried within green verges on the site.

5.3.5 Tree Felling Within Forested Areas

Before felling trees, the Arborist must ensure the identified and / or tagged native saplings have already been transplanted to interim nursery. The Arborist must also survey, identify, and confirm the trees to be protected in the surrounding areas have the necessary protection measures put in place as well as establishing a tree felling / drop zone based on site condition and tree crown spread.

The trees to be felled shall be inspected for any fauna as per guidelines provided in wildlife management plan (Section 5.2). Such trees will be marked with red & white tape and no tree felling operation shall be carried out within 5 m from the said tree until further instruction.

Before commencing tree felling works, personnel forming the tree felling team shall scout the area a final time to ensure that the tree felling / drop zone is clear of all activities, while the Consultant's EMMP Specialist (Fauna)/ Ecologist shall inspect the zone to ensure that the site is free of wildlife activities. Once the areas are cleared, the banksman should signal the excavator operator to commence work for trees felling. The excavator operator should first clear off the shrubs and small trees (<5 m height) to create a clear line of sight for the whole area and to keep away blind spot areas which are blocked by small trees or tall shrubs. The excavator operator shall operate cautiously and fell all small trees and shrubs in a controlled manner, aware of the locations of protected trees.

When the opening is completed, the excavator operator should clear off small trees and shrubs along the path into the site to demark the area that they are supposed to work within. When the paths are cleared, the operator should then move inward to fell trees within the area. If the operator faces a tree with height between 5 and 7 m, they should clear off shrubs in the surrounding area so that the foreman can move closer to the tree. The recommended tree cutting method should be the notch cut (Figure 5.16). The foreman shall determine the direction of falling and ensure the tree does not land on any property, cause injury, or damage nearby Trees to be Protected. To avoid trees leaning in an unintended direction when performing a third cut, the excavator should assist to prevent fall back and guide the tree to fall into the intended direction. Once the tree has been felled, the tree cutter shall cut the tree trunk into shorter lengths for easier loading during clearing of the debris from site.

If the tree has a height greater than 7 m, the tree height should have its crown reduced with a lorry crane or manual tree climbers first, depending on site accessibility. Before the lorry crane can enter the site, the Contractor must prepare proper access for the lorry crane to enter the site and access the tree location. The Contractor must ensure that the access ground is firm and stable enough to allow the lorry crane to deploy its outrigger to carry out the works safely. When the access is ready, the Contractor will then mobilize the lorry crane to enter the site to reduce tree height to 7 m to adopt the notch cut method for trees less than 7 m in height.

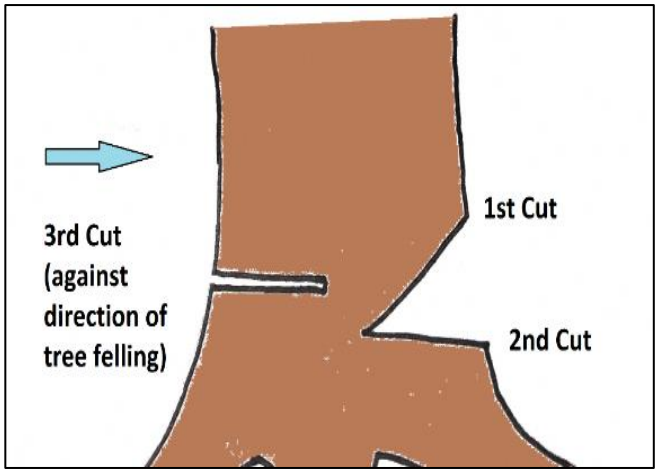

Figure 5.17 Illustration of a notch cut

5.3.5.1 Arboriculture Monitoring Plan

During the construction period, all retained trees will need to be protected from the side effects of major work activities. It is more vital for this subjected project as a handful of trees i.e., heritage species, conservation valued species had been earmarked to be conserved and remain as part of the future plans. Therefore, it is recommended for the Certified Arborist to conduct at least a Level 2 visual assessment (VTA), minimally on a six-month cycle to ensure that the retained trees are not gravely affected by ongoing construction activities. During the assessment, the Certified Arborist will need to do a basic ground level assessment of every individual tree with general hand tools and produce an arborist report thereafter. The arborist report will document photo(s) of the specific tree and include information such as the general appearance, abnormalities and/or defects observed due to the construction activities, and follow-up recommendations to be taken (e.g., pruning/felling). The arborist report should generally covers 2 main components: (i) Overall tree health and (ii) TPZ condition with the criteria listed in the table below.

Table 5.6 Parameters to take note during monthly tree inspections

Tree Health	TPZ Condition
• Foliage colour (Normal, Chlorotic, Necrotic) • Foliage density (Normal, Sparse, Dense) • Leaf size (Normal, Small) • Vigour (Good, Average, Poor) • Lean (Self corrected, Unnatural) • Diebacks and Dead branches (%) • Cracks • Cavities / Conks / Fungi • Roots collar buried / not visible • Pest / Disease Infestation • Damaged / Cut roots • Root plate lifting	• TPZ barriers installed/good condition • Evidence of illegal encroachment • Evidence of damage to tree • Evidence of toxic splash • Evidence of illegal compaction • Evidence of materials storage • Evidence of machinery, equipment and vehicle storage

Tree Health	TPZ Condition
• Site Changes (None, Grade change, Site Clearing) • Soil Condition (Limited volume, Saturated, Compacted, Pavement over roots) • Wind Exposure (Protected, Partial, Full, Funnelling)	

It is critical for the Certified Arborist to be proactive in his / her inspection checks to manage the trees well, thus preventing the trees from consequential death and / or failure (i.e., snapping, uprooting). The Certified Arborist should also recommend routine maintenance such as deadwooding and formative pruning to be done periodically to keep the trees structurally safe and sound.

5.3.5.2 Flora Monitoring Plan

Being near to a nature reserve (Labrador Nature Reserve) and bordering Tree Conservation Area (Telok Blangah / Pasir Panjang), the ecological sensitivities of the area are high. Additionally, a vegetated buffer of 30 m will be retained between the development and Berlayer Creek except for the land where the 2 outlet discharge connects to Berlayer Creek, to which there would be tree felling. Fortnightly checks should be conducted by qualified persons (i.e., Flora specialist and / or Certified Arborist) to ensure that all the mitigation measures are implemented and effective in the protection of all plants and trees during the construction phase. Flora inspections shall be conducted within the worksite boundary and in forested areas adjacent to the worksite up to 15 m from the hoarding.

The general criteria that the Flora Specialist can use to monitor the plants' condition during his / her periodic checks are presented in the table below.

Table 5.7 Parameters to take note during for plants monitoring

Signs of poor plant health	Signs of healthy plant
Wilting	Vigorous growth
Change in colour	Uniform colour
Dropping leaves / needle without reason	Open and not curled growth
Brittle leaves	Upright appearance
Brown splotches or white powdery growth on leaves	
Uncharacteristic slow growth	

The Flora Specialist will need to pay attention to stressed plants within conserved areas, especially those infested by diseases and pests as such infestation may potentially spread fast and wide throughout the entire area or cluster.

5.3.6 Monitoring Requirements

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
Biodiversity Monitoring • Avoiding clearance of vegetation outside working boundaries • Minimisation of disturbance to sensitive species • Minimisation of disturbance to sensitive habitats • Avoiding human wildlife conflict	<u>On-site Visual and Compliance Monitoring</u>							
	Habitat Loss and Degradation	• Implement hoarding around project boundaries. During the earthworks phase, hoarding of at least 2.4m should be installed along the proposed 30m buffer boundary of Berlayer Creek. Hoarding along Telok Blangah Rd & Bukit Chermin Road should be at least 2.4m. Otherwise, hoarding should be at least 4m with noise barrier fronting the private condo, and contain no gaps. • After earthworks when the platform has been levelled to the proposed level, hoarding along Berlayer Creek should be between 10-12 m high. • The proposed 30 m buffer to Berlayer Creek and areas of high conservation value should be observed at all times. This is with the exception for the land where the 2 outlet discharge connects to Berlayer Creek, to which there would be tree felling. • Monitor the water quality and	• Visual monitoring • Compliance check • Water quality monitoring (refer to Water Pollution Management Plan) • Monitoring of aquatic faunal community	Entire project site (near / within future Nature Park)	• Proper installation of hoarding • Absence of construction works in 30 m buffer except for the land area with specified two outlet discharge • Absence of vegetation clearance outside working boundaries	• Fortnightly during construction phase • Monthly water quality monitoring • Quarterly monitoring of aquatic faunal community	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge • Ecologist • Arborist

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
		aquatic faunal community in streams adjacent to the construction areas. • Ensure silt fences or other silt control measures along the site hoarding are installed and maintained properly. • Practice due diligence in proper storage and handling of machinery to prevent leaching of oil or harmful materials such as bentonite slurry. • Store and handle harmful materials well away from water bodies. • Engage a Qualified Erosion Control Professional (QECP) to formulate and implement ECM plan in accordance with PUB requirements. • Implement dust control measures such as dust screens and water suppression systems.						
	Species Disturbance and Mortality	• Implement hoarding around project boundaries. During the earthworks phase, hoarding of at least 2.4m should be installed along the proposed 30m buffer boundary of Berlayer Creek. Hoarding along Telok Blangah Rd & Bukit Chermin Road should be at least 2.4m. Otherwise, hoarding should be at least 4m	• Visual monitoring • Compliance check	Entire project site	• Proper TPZ installation • Retention of tree health • Absence of mechanical damage on trees • Absence of nesting birds	• Prior to vegetation clearance (for wildlife translocation and fauna inspection) • Monthly during construction	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge • Ecologist • Arborist

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
		with noise barrier fronting the private condo, and contain no gaps. • The proposed 30 m buffer to Berlayer Creek and areas of high conservation value should be observed at all times. This is with the exception for the land where the 2 outlet discharge connects to Berlayer Creek, to which there would be tree felling. • Minimise felling trees and clearing vegetation during the peak bird breeding season (March to July). • Pre-felling fauna inspection should be conducted before felling any trees or removing any vegetation. • Wildlife shepherding via directional clearing to be adopted during tree-felling where possible. This entails clearing the site from Keppel Club towards Berlayer Creek. For the area bounded by Keppel Reflections and Bukit Chermin Road, active translocation would be carried out. • Quieter construction machinery/equipment should be used over loud and noisy machinery/equipment whenever possible.			• Absence of large mammal species • Absence of entrapped fauna	phase • Daily for fauna entrapment		

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
		• All works are to be conducted during 8am – 7pm as far as practicable. When night works needs to be carried out approval must be given by the relevant authorities (e.g., NEA, NParks). • Use only fully biodegradable erosion control blankets (ECB) to avoid trapping fossorial fauna such as snakes. • Check ECBs on a daily basis for entrapped fauna. • Adopt road calming measures such as speed bumps, and other mitigation measures such as restriction on speed of vehicles and working time, to minimise roadkill accidents. • Monitor the water quality and aquatic faunal community in streams adjacent to the construction areas. • Engage a Qualified Erosion Control Professional (QECP) to formulate and implement ECM plan in accordance with PUB requirements. • Implement dust control measures such as dust screens and water suppression systems. • Implement acoustic barriers to reduce noise pollution outside worksites.						

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
	Human-wildlife Conflict	• Ensure good housekeeping controls such as provision of wildlife proof bins and eating areas. • Execute Wildlife Response and Rescue Plan when fauna is found on-site. • Train site personnel on biodiversity awareness and actions to take when encountering wildlife.	• Visual monitoring • Compliance check	Entire project site (near forested area)	No injuries due to wild animals	• Continuous • As and when required for Wildlife Response and Rescue Plan	• Monthly Environmental Performance Report • As and when a wildlife incident occurs	• Contractor PM • Contractor ECO / EMMP In-charge • Ecologist

6 ENVIRONMENTAL MANAGEMENT PLANS

An EIS was carried out by AECOM (2022) for the project site that established baseline conditions within study area, assessed the impacts, and recommended the mitigation measures. The following management plans provide the potential impacts and mitigation measures that are to be implemented during construction phase. These management plans utilise the impacts and mitigation measures from AECOM (2022). However, where necessary based on site context or existing legislation, additional mitigation measures have been included.

It is recommended to review the whole environmental management plan every quarter to update or adjust the applicable mitigation measures and monitoring requirements based on the various site considerations such as work progress, site utilisation, change in work methods, environmental incident, failure of mitigation measures etc.

6.1 Air Quality Management Plan

6.1.1 Applicable Legislations and Guidelines

- Environmental Protection and Management Act 1999, Part IV on Air Pollution Control
- Environmental Protection and Management (Vehicle Emissions) Regulations 2008
- Environmental Protection and Management (Prohibition on Use of Open Fires) Order 2008
- Environmental Protection and Management (Air Impurities) Regulations 2008
- Singapore Ambient Air Quality Targets (Long Term Targets)

6.1.2 Identified Impacts and Recommended Mitigation Measures

Identified Impacts	Recommended Mitigation Measures
<u>Earthworks</u> Dust from construction sites deposited on vegetation can reduce photosynthesis, respiration,	• To implement dust suppression plan e.g., dust screens, equipment with dust suppression etc • Use of hoarding at project boundary to minimise dust generation by attenuating wind forces. • Install hard surfaced haul routes • Closed turfing to the exposed areas where possible and maintain proper storage of soil stockpiles • Impose and signpost maximum speed-limit of 25km/hr on paved roads and 15km/hr on unpaved roads and works areas to prevent dust being stirred up • To avoid stockpiles of soil and dusty materials within work areas as far as possible.

Identified Impacts	Recommended Mitigation Measures
transpiration, and allow phytotoxic gaseous pollutants to penetrate. Dust can also leech chemicals into the soil. Deposition of concrete dust can increase surface alkalinity, which can hydrolyse lipids and wax components, penetrate the cuticle, and denature proteins, causing leaves to wilt. <u>Gaseous emissions from construction equipment, vehicle, and off-road diesel exhaust</u> Emissions occur throughout the site, but impacts are usually localised within the worksite and are short-term (only during equipment operation)	• If unavoidable, stockpiles of soil should be located away as far as possible from sensitive receptors (i.e., flora and fauna receptors within Berlayer Creek as well as residential areas located along Bukit Chermin Road). • Provide additional dust screen at project boundary near sensitive receptors (i.e., flora and fauna receptors within Berlayer Creek as well as residential areas located along Bukit Chermin Road). • Conduct monitoring for PM10 and PM2.5 at suitable locations • Any soil or stockpiles of dusty material should be properly stored, covered entirely with impervious sheeting or dampened with water to maintain entire surface wet by contractor. Stabilize/cover all stockpiled materials for longer than one month by turfing, erosion blanketing or other method. • Where practicable, avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment • Only use cutting, grinding or awing equipment fitted with, or in conjunction with, suitable dust suppression techniques such as water sprays or local extraction e.g., local exhaust ventilation system • Avoid scabbling (roughening of concrete surfaces) is possible. • Open burning of construction and other wastes are not allowed at the worksite as this is an offence under the Environmental Pollution Control regulation. • Material transport of inert solids (excavated materials) should be enclosed using impervious sheeting, minimising the visual dust impacts as well. • For smaller supplies of fine powder materials, ensure bags are sealed after use and stored appropriately to prevent dust • Avoid dry sweeping of large areas • Excavations should be backfilled or reinstated as soon as practicable following completion of the construction work. • Use of regular watering to reduce dust emissions from exposed site surfaces, particularly during dry weather on open areas. • Personal protective equipment such as mask shall be worn during the severe air pollution and/or dust exposure periods by construction personnel. • Avoid soil disturbing works during dry and/or windy conditions. • Carry out regular site inspections to monitor and record compliance with the Air Pollution Control Plan • Plan site layout so that machinery and dust causing activities are located away from receptors, where possible. • Use enclosed chutes and conveyors and covered skips wherever possible. • Provide vehicle washing facilities before the construction site exit. • Proper maintenance of construction vehicles and fuel burning equipment. • Intermittently-used vehicles and machinery are to be shut down between work periods to minimum exhaust emission.

6.1.3 Monitoring Requirements

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
Air Quality Monitoring • Minimization of human health & biodiversity impacts due to dust pollution • Minimization of human health impacts due to exhaust emissions	<u>On-site Visual and Compliance Monitoring</u>							
	Fugitive dust emissions	• Implementation of dust suppression plan • Watering to reduce dust emissions from exposed areas • Washing bay • Implementation of vehicular speed limit • Covered stockpiles • Use of PPE (face mask) by construction personnel	• Visual monitoring • Compliance check	All construction areas	Approved dust suppression plan	During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge
	Exhaust emission from construction machineries operations	Maintenance frequency of vehicles and machineries	• Visual monitoring • Compliance check	All construction areas	No visible exhaust plume, dark smoke etc.	During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge
	<u>On-site Air Quality Monitoring</u>							
	Particulate matter emission from construction activities	$PM_{2.5}$ and PM_{10}	Air monitoring equipment (e.g., USEPA FRM/FEM equipment[1])	2 locations	Singapore Ambient Air Quality Targets	• 24hr (1 day) continuous monitoring • Once a Month (When most of the dust-generating activities are conducted)	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge

[1] It is recommended that air quality monitoring be conducted using USEPA FRM/FEM equipment. The list of designated reference and equivalent methods can be found at https://www.epa.gov/system/files/documents/2022-12/List_of_FRM_and_FEM.pdf. If a non-USEPA FRM/FEM equipment is used, the Monthly Environmental Performance Report can consider including information on the co-location or calibration carried out with a USEPA FRM/FEM equipment to ensure the equipment's performance prior to deployment at the project site.

6.2 Noise Control Plan

For the earthworks phase of this project, the Contractor has confirmed that no nightworks will be conducted. This noise control plan provides an overall management framework for mitigation measures and monitoring requirements. A detailed Noise Management Plan (NMP) in accordance with NEA requirement is to be prepared incorporating below information as well as additional information such as baseline noise levels, and corrected noise standard limits.

6.2.1 Applicable Legislations

- Environmental Protection and Management Act 2002, Part VIII Noise Control
- Environmental Protection and Management (Control of Noise at Construction Sites) Regulations 2008
- NEA Code of Practice on Pollution Control SS 593 (2013)
- Code of Practice for Noise Control on Construction and Demolition Sites SS602 (2014)

6.2.2 Identified Impacts and Recommended Mitigation Measures

Identified Impacts	Recommended Mitigation Measures
Disturbance of flora and fauna species and human receptors.	• All works are to be conducted during 8am – 7pm as far as practicable. When night works needs to be carried out approval must be given by the relevant authorities (e.g., NEA, NParks) • Use powered mechanical equipment with lower noise levels to mitigate noise at the source • Noise barriers to be placed along Berlayer Creek (without causing additional vegetation clearance beyond construction worksites) to mitigate noise impacts to ALARP • Noise barriers are to be used along the boundary of worksites facing noise sensitive receptors (where necessary) • Where controlling noise sources at the source is not feasible, acoustic enclosures or sheds are to be introduced to mitigate noise at the source for static equipment or machineries (i.e. Genset). Typical acoustic enclosure covers the machine as fully as possible (with or without ventilation where applicable) to provide sound insulation. • Acoustic dampening of compressors and generators (if necessary) • Enclosure panels closed, engines not exposed, and manufacturer-installed silencers for engine exhausts to be installed and maintained for earth-moving plants • Machines (such as trucks) that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum

Identified Impacts	Recommended Mitigation Measures
	• The number of PMEs should be reduced as far as practicable when construction works are carried out at areas close to the noise sensitive receivers: Silencers or mufflers on construction equipment should be utilized and should be properly maintained during the construction programme • Behavioural practices including no shouting, no loud stereos/ radios on site, no dropping of materials from height, no throwing of metal items should be ensured • Construction respite: Restrict high noise generating drilling activities only in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block, if possible • Construction plants known to emit noise strongly in one direction should, wherever possible, be orientated so that the noise is directed away from the nearby noise sensitive receptors • All handheld percussive breakers and air compressors used on site will comply with local legislation and requirements • Noise awareness briefing should be conducted regularly and highlighted the noise mitigation measures such as position of machinery and making use of portable noise barriers. • If noise remains an issue even after implementation of recommended mitigation measures such as noise barriers, contractor should consider implementation of proprietary noise barriers of high noise reduction capabilities to further reduce noise to acceptable levels. • Personnel are to wear appropriate Personal Protective Equipment (PPE) at all times while on the construction site • Quieter equipment and vehicles with low noise levels to be used where possible • To consider erection of temporary acoustic barriers around piling equipment • For piling work (if any), to consider the use of quieter piling methods • Noise level monitoring throughout all phases to ensure that the construction noises remain within acceptable limits

6.2.3 Monitoring Requirements

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
Noise Monitoring • Minimization of biodiversity disturbance due to construction noise • Minimization of nuisances to human due to construction noise	<u>On-site Visual and Compliance Monitoring</u>							
	Disturbance to biodiversity and human due to construction noise	• Noise barriers around construction work areas (used along Bukit Chermin Road and along the boundary of Keppel Golf club) • Noise barriers to be placed along Berlayer Creek (without causing additional vegetation clearance beyond construction worksites) • Utilization of quieter equipment and vehicles with low noise levels • PPE use by construction personnel at all times while on the construction site	• Visual monitoring • Compliance check	Entire project site	Environmental Protection and Management (Control of Noise at Construction Sites) 2008	Monthly during entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge
	<u>On-site Noise Monitoring</u>							
	Noise generated from construction work	• Leq 12 hrs • Leq 1 hr • Leq 5 mins	Sound level meter	3 locations	Environmental Protection and Management (Control of Noise at Construction Sites) 2008	• Continuous (24x7) boundary noise monitoring • During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge

6.3 Water Pollution Management Plan

6.3.1 Applicable Legislations

- Sewerage and Drainage Act 2001
- Sewerage and Drainage (Surface Water Drainage) Regulations 2007
- Sewerage and Drainage (Trade Effluent) Regulations revised 2007
- Environmental Protection and Management Act 2002, Part V on water pollution
- Environmental Protection and Management Act (Trade Effluent) Regulations 2008
- PUB Code of Practice on Surface Water Drainage (2018)
- PUB Handbook on Managing Urban Runoff (2013)
- PUB Guidebook on Erosion and Sediment Control at Construction Sites (2018)

6.3.2 Identified Impacts and Recommended Mitigation Measures

Identified Impacts	Recommended Mitigation Measures
<u>Surface water quality</u> Changes in water quality due to solid and toxic waste generated by construction and daily routine activities. Changes in water quality due to liquid effluent generated by construction and daily routine activities. Changes in water quality due to accidental spillage and release	<u>Earth Control Measures (ECM)</u> • Prepare and endorse ECM plan by a Qualified Erosion Control Professional (QECP) before the commencement of construction works in all Areas. • ECM should only be removed after completion of the works. The QECP should authorize removal of the ECM. • During heavy storm events, site inspection should be carried out to ensure no flooding. • Hoarding and perimeter drains should be inspected daily to ensure no surface runoff flowing out from the site untreated and no clogging which would affect the flow capacity of the drains/streams. • For any construction activities that may alter the alignment of block drains, implement appropriate measures such as watercourse diversion to avoid localized flooding. • Monthly audit on the site should be carried out by EMMP consultant. • Maintain minimum dry weather discharge of 0.03 m^3/s for sustainability of Berlayer Creek. <u>Soil and Groundwater</u> • Install piezometers to monitor the changes in groundwater level in compliance with Building Control Regulations 2003 as part of its instrumentation and monitoring plan to be endorsed by the Qualified Professional • Conduct a construction risk assessment and prepare a comprehensive construction health, safety and environment plan • If health impacts to workers are foreseen due to the handling of such waste, necessary precautionary measures as per the safety data sheets (SDS) including personal protective equipment should be implemented on site. <u>Trade Effluent Management</u> • Surface runoff from the construction site should be drained to the ECM treatment system to be filtered to reduce peak runoff.

Identified Impacts	Recommended Mitigation Measures
Changes in water quality due to contaminated stormwater runoff <u>Hydrological</u> Change in dry weather flow conditions. Flooding during wet weather	• Contractor to provide sampling point and inspection for collection of trade effluent to be tested for parameters stipulated in the Regulations, depending on the discharge point (i.e., sewer, watercourse, controlled watercourse). • Regular water quality monitoring is to be conducted according to the proposed Environmental Monitoring Plan during construction and post-construction stage. Water quality sampling is to be conducted during ebb tide (i.e., when tides are receding). • Contractor should install and maintain trade effluent treatment facilities (e.g., slurry treatment plant, grease trap and suspended solid settling tank) as per NEA's requirements. • The design should follow PUB Code of Practice on Surface Water Drainage, and the diverted flow shall be treated to meet NEA Trade Effluent Discharge Limits prior to discharge. • Provide silt curtains at each of the main outlets which discharges flow from the proposed construction sites into the surrounding watercourses. • Area where trade effluent is being transported out to be kerbed to minimise spills. <u>Oil & Fuel Spillage and Waste Disposal</u> • To ensure that bentonite is contained within the working area and does not enter any watercourses or surface water drains. • Storage tanks for slurry and supply lines should be located as far as possible from surface water drains or watercourse. • Storage silos and micropile storage tanks should have secondary containment. • Areas where bentonite is mixed are to be surrounded with a small boundary wall or contained within a bund. This action will help to control the slurry produced and prevent it from entering surface water drains or watercourses. • Waste bins to be provided within the construction work area for proper disposal of construction debris and rubbish. Foreign material should not be illegally disposed of in the water bodies but removed from site by a licensed waste collector. • All liquids should be properly labelled and stored in appropriate containers at a safe location on site (i.e., under a shelter with a surrounding kerb). Personnel handling these liquids should also be suitably trained. • Vehicle fuelling and major maintenance to be minimised within the project area. • Appropriate concrete wash bays should be provided and should not be used in or near any water body. • Water used for dust control should not be allowed to cause erosion within the work area or to run offsite. • Excess loose soil and rock to be contained prior to the commencement of the works. • Emergency spill kits should be provided by the Contractor on site in the event of any chemical spillage. Emergency response team should also be trained in the use of these spill kits.

6.3.3 Monitoring Requirements

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
Water Quality Monitoring • Minimization of impact to waterbodies due to contaminated site run-off • Minimization of impact to terrestrial habitats due to erosion of topsoil	<u>On-site Visual and Compliance Monitoring</u>							
	ECM non-compliance	• Verify implementation of ECM Plan • Perimeter cut-off drains, perimeter silt fence, silt traps, sedimentation basin and silt treatment system	• Visual monitoring • Compliance check • ECM checklist	Construction area with earthworks	ECM Plan designed by a Qualified Erosion Control Professional (QECP)	• Daily compliance monitoring • During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge • QECP
	<u>On-site Water Quality Monitoring</u>							
	ECM discharge (sediment runoff)	Total Suspended Solids (TSS)	Implementation of TSS monitor and CCTV including a Silty Imagery Detection System (SIDS)	• Final ECM discharge points • 2 discharge outlets upstream & midstream of Berlayer Creek • 1 point downstream of Berlayer Creek	• Less than 50 mg/L for TSS • Sewerage and Drainage (Surface Water Drainage) Regulation 2007	Real-time continuous during entire construction phase	• TSS report • Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge
	Contamination of water resources through trade effluent discharge and/or Degradation of stream habitat	• All parameters identified in EPM (Trade Effluent) Regulations for Controlled Watercourse • Additional parameters: Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammoniacal Nitrogen (NH4-N), Total Nitrogen	In-situ and ex-situ monitoring	• At every discharge outlet, including the 2 discharge outlets upstream & midstream of Berlayer Creek • 1 location downstream of	• EPM (Trade Effluent) Regulations for Controlled Watercourse • ASEAN Marine Water Quality Criteria (Downstream	• Monthly during construction phase • To be sampled during ebb tide (i.e., when tides are receding)	Monthly Environmental Performance Report	• Contractor ECO / EMMP In-charge

		(TN), Nitrate (NO3-N), Total Phosphorus (TP), Orthophosphate (PO4), Total Organic Carbon (TOC), Oil & Grease (Total), Oil & Grease (Hydrocarbon), Lead (Pb), Zinc (Zn), Mercury (Hg), Enterococcus		Berlayer Creek	of Berlayer Creek)			
Groundwater monitoring	On-site Groundwater Monitoring							
	Changes to groundwater level	Groundwater level	Piezometer	3 monitoring wells	Building Control Regulations 2003	Monthly during construction phase	Monthly Environmental Performance Report	• Contractor ECO / EMMP In-charge

6.4 Vibration Management Plan

Specific vibration mitigation measures were not included in AECOM (2022). However, as this is an important component for management given the sensitive receptors in the area, this Vibration Management Plan has been developed as a requirement for the construction phase EMMP monitoring.

6.4.1 Applicable Legislations and Guidelines

- NEA Code of Practice on Pollution Control SS 593 (2013)
- Code of Practice for Noise Control on Construction and Demolition Sites SS602 (2014)

6.4.2 Identified Impacts and Recommended Mitigation Measures

Identified Impacts	Recommended Mitigation Measures
Disturbances to the fauna due to vibration	• All works are to be conducted during 8am – 7pm as far as practicable. When night works needs to be carried out approval must be given by the relevant authorities (e.g., NEA, NParks) • Use of equipment or method which generate lower vibration levels, where possible.

Identified Impacts	Recommended Mitigation Measures
from construction activities	• Route heavily loaded trucks away from the VSRs (i.e., flora and fauna receptors within Berlayer Creek as well as residential areas located along Bukit Chermin Road) where possible. • To plan and phase excavation, earth- moving, and ground pilling activities in staggered manner • Control speed of vehicle movement at the worksite • Notify nearby VSRs (e.g., residential buildings) in advance of the construction activities • Keep access roads within project work site in good condition

6.4.3 Monitoring Requirements

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementa-tion
Vibration Monitoring • Minimize vibration impacts from construction	<u>On-site Visual and Compliance Monitoring</u>							
	Disturbances to the fauna due to vibration from construction activities	• All works are to be conducted during 8am – 7pm as far as practicable. When night works needs to be carried out approval must be given by the relevant authorities (e.g., NEA, NParks) • Use of equipment or method which generate lower vibration levels, where possible. • Control speed of vehicle movement at the worksite • Keep access roads within project work site in good condition	• Visual monitoring • Compliance check	Entire project site	• NEA Code of Practice on Pollution Control SS 593 (2013) • Code of Practice for Noise Control on Construction and Demolition Sites SS602 (2014)	• During entire construction phase	Monthly Environmental performance report	• Contractor PM • Contractor ECO / EMMP In-charge
	<u>On-site Vibration Monitoring</u>							

	Vibration generated from construction work	• PPV (mm/s)	• Vibration meter	2 locations	Refer to instrumentation monitoring plan as advised by QPs	Refer to instrumentation monitoring plan as advised by QPs	Monthly Environmental performance report	• Contractor PM • Contractor ECO / EMMP In-charge

6.5 Waste Management Plan

A specific Waste Management Plan was not included in AECOM (2022). However, as this is an important component for environmental management given the sensitive receptors in the area, as well as the fact that this component is expected as part of an ECO's Site Environmental Control Report, this Waste Management Plan has been developed as a requirement for the construction phase EMMP monitoring.

6.5.1 Applicable Legislations

- Environmental Protection and Management Act 2002, Part VII on Hazardous Substances
- Environmental Protection and Management (Hazardous Substances) Regulations 2008
- Environmental Public Health (General Waste Collection) Regulations 2000
- Environmental Public Health (Toxic Industrial Waste) Regulations 2000

6.5.2 Identified Impacts and Recommended Mitigation Measures

Identified Impacts	Recommended Mitigation Measures
Degradation of habitats and pollution due to: • Disposal of cut vegetation • Disposal of excavated material • Disposal of general waste material	• To develop a solid waste management plan. • Timber/wood to be recovered for use in the wood industry as far as possible. • Surplus excavated material to be reused within project site as fill, landscaping, erosion control and restoration wherever practicable. • Scrap metals to be recovered and sent for recycling as scrap. • Inert general waste is to be collected and disposed through an NEA-licensed waste collector. • All non-hazardous waste is to be handled and disposed of in accordance with EPH (General Waste Collection) Regulations. • Any hazardous wastes that are generated must be handled and disposed of in accordance with the requirements of the EPHA and the EPH (Toxic Industrial Wastes) Regulations. • Disposal of hazardous waste must be through a licensed waste collector for hazardous waste.

6.5.3 Monitoring Requirements

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementation
Waste Management Monitoring • Minimizing the impacts due to improper disposal of hazardous and general waste	On-site Visual and Compliance Monitoring							
	Improper disposal of hazardous waste leading to land pollution	• Engagement of NEA licensed waste collector for hazardous waste • Record of waste disposal	• Visual monitoring • Compliance check	Entire project site	• Environmental Public Health (Toxic Industrial Wastes) Regulation, 2000	• During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge • QECP
	Improper disposal of construction waste leading to land pollution	• Verify implementation of solid waste management plan • Engagement of NEA licensed general waste collector • Record of waste disposal	• Visual monitoring • Compliance check	• Construction waste storage location • General waste storage location	• Environmental Public Health (General Waste Collection) Regulation, 2000	• During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge

6.6 Vector Control Management Plan

6.6.1 Applicable Legislations

- Control of Vectors and Pesticides Act 2002
- NEA guidelines on “Rainwater Collection System and Mosquito Prevention

6.6.2 Identified Impacts and Recommended Mitigation Measures

Identified Impacts	Recommended Mitigation Measures
• Increase in the number of	• Adhere to Control of Vector and Pesticide Act (CVPA) and ensure good housekeeping on-site. • Contractor to engage an NEA-registered vector control operator to prepare and implement vector management plan.

Identified Impacts	Recommended Mitigation Measures
mosquitoes may cause irritation to people residing nearby • Increase in the number of vectors may cause irritation to people residing nearby • Increase in incidence of dengue fever and vector-related diseases (secondary impact)	• An in-house vector control team to check construction sites for breeding of mosquitoes. • Ensure water-bearing receptables, gaps on grounds and equipment (e.g., openings at concrete barriers), as well as stockpiled areas are covered or sheltered, especially during the northeast monsoon season between November to January. • Construction worksite to be kept free of litter; construction wastes shall be disposed promptly into bulk waste containers and the containers shall be emptied daily. • Thermal Fogging is not recommended for areas in close proximity to areas of high ecological value (ie Berlayer Creek). Preventive methods such as inspection and good housekeeping practices should be adhered to (where possible), in order to ensure no mosquito breeding occurs onsite. • Anti-mosquito oil and insecticides including BTI shall be applied into stagnant water at least once a week. The application should be repeated after rain as the oil and insecticides would be washed away by the rain. • Provide movable roof over shaft to prevent rainwater ingress. Pump shall be deployed to clear water at areas where drainage is not possible, as well as for larger recessed surfaces. • Install pitched roof on top and/or seal up bottom of site container office. • Pipette can be used for larvae-checking at the hard-to-reach parts of trees to be inspected. • Schedule daily housekeeping to ensure clearance of stagnant water and unwanted items are discarded properly. • The worksite shall be kept litter-free and refuse bins shall always be covered tightly. • Construction workers' food provisions shall be stored in rodent-proof rooms or cabinets. • In-house vector control team and vector control operator to check for rodent burrows every week. • To aid the authorities to investigate outbreaks of vector-borne diseases if required.

6.6.3 Monitoring Requirements

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementa-tion
Vector Monitoring • Minimizing the impacts due to increase in vector related diseases	<u>On-site Visual and Compliance Monitoring</u>							
	Increase in the Incidence of vectors & related diseases	• Verify implementation of vector control management plan • Engagement of NEA registered vector control operator • Appointment of an in-house vector control team • Avoid thermal fogging along areas of high ecological value (e.g., Berlayer Creek)	• Visual monitoring • Compliance check	Entire project site	• Vector control management plan • Control of Vectors and Pesticides Act, 2002	During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge

7 ENVIRONMENTAL MONITORING PLAN

The summary of the proposed Environmental Monitoring Plan is presented in this chapter. Environmental monitoring parameters are to follow the locations identified in Figure 7.1.

Figure 7.1. Monitoring locations during construction phase

HDB's Superintending Officer (SO) Representative is to oversee the implementation of the EMMP throughout the entire construction phase. It is recommended to review the monitoring plan and locations every quarter to update or adjust the monitoring requirements based on the various site considerations such as work progress, site utilisation, change in work methods, environmental incident, failure of measures etc.

Table 7.1. Environmental monitoring plan for construction phase

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementa-tion
Biodiversity Monitoring • Avoiding clearance of vegetation outside working boundaries • Minimization of disturbance to sensitive species • Minimization of disturbance to sensitive habitats • Avoiding human wildlife conflict	<u>On-site Visual and Compliance Monitoring</u>							
	Habitat Loss and Degradation	• Implement hoarding around project boundaries. During the earthworks phase, hoarding of at least 2.4m should be installed along the proposed 30m buffer boundary of Berlayer Creek. Hoarding along Telok Blangah Rd & Bukit Chermin Road should be at least 2.4m. Otherwise, hoarding should be at least 4m with noise barrier fronting the private condo, and contain no gaps. • After earthworks when the platform has been levelled to the proposed level, hoarding along Berlayer Creek should be between 10-12 m high. • The proposed 30 m buffer to Berlayer Creek and areas of high conservation value should be observed at all times. This is with the exception for the land where the 2 outlet discharge connects to Berlayer Creek, to which there would be tree felling.	• Visual monitoring • Compliance check • Water quality monitoring (refer to Water Pollution Management Plan) • Monitoring of aquatic faunal community	Entire project site (near / within future Nature Park)	• Proper installation of hoarding • Absence of construction works in 30 m buffer except for the land area with specified two outlet discharge • Absence of vegetation clearance outside working boundaries	• Fortnightly during construction phase • Monthly water quality monitoring • Quarterly monitoring of aquatic faunal community	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge • Ecologist • Arborist

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementa-tion
		• Monitor the water quality and aquatic faunal community in streams adjacent to the construction areas. • Ensure silt fences or other silt control measures along the site hoarding are installed and maintained properly. • Practice due diligence in proper storage and handling of machinery to prevent leaching of oil or harmful materials such as bentonite slurry. • Store and handle harmful materials well away from water bodies. • Engage a Qualified Erosion Control Professional (QECP) to formulate and implement ECM plan in accordance with PUB requirements. • Implement dust control measures such as dust screens and water suppression systems.						
	Species Disturbance and Mortality	• Implement hoarding around project boundaries. During the earthworks phase, hoarding of at least 2.4m should be installed along the proposed 30m buffer boundary of Berlayer Creek. Hoarding along Telok Blangah Rd & Bukit Chermin Road should be at least 2.4m. Otherwise, hoarding should be	• Visual monitoring • Compliance check	Entire project site	• Proper TPZ installation • Retention of tree health • Absence of mechanical damage on trees • Absence of nesting birds	• Prior to vegetation clearance (for wildlife translocation and fauna inspection) • Monthly during construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge • Ecologist • Arborist

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementa-tion
		at least 4m with noise barrier fronting the private condo, and contain no gaps. • After earthworks when the platform has been levelled to the proposed level, hoarding along Berlayer Creek should be between 10-12 m high. • The proposed 30 m buffer to Berlayer Creek and areas of high conservation value should be observed at all times. This is with the exception for the land where the 2 outlet discharge connects to Berlayer Creek, to which there would be tree felling. • Minimise felling trees and clearing vegetation during the peak bird breeding season (March to July). • Pre-felling fauna inspection should be conducted before felling any trees or removing any vegetation. • Wildlife shepherding via directional clearing to be adopted during tree-felling where possible. This entails clearing the site from Keppel Club towards Berlayer Creek. For the area bounded by Keppel Reflections and Bukit Chermin Road, active translocation would			• Absence of large mammal species • Absence of entrapped fauna	• Daily for fauna entrapment		

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementa-tion
		be carried out. • Quieter construction machinery/equipment should be used over loud and noisy machinery/equipment whenever possible. • All works are to be conducted during 8am – 7pm as far as practicable. When night works needs to be carried out approval must be given by the relevant authorities (e.g., NEA, NParks). • Use only fully biodegradable erosion control blankets (ECB) to avoid trapping fossorial fauna such as snakes. • Check ECBs on a daily basis for entrapped fauna. • Adopt road calming measures such as speed bumps, and other mitigation measures such as restriction on speed of vehicles and working time, to minimise roadkill accidents. • Monitor the water quality and aquatic faunal community in streams adjacent to the construction areas. • Engage a Qualified Erosion Control Professional (QECP) to formulate and implement ECM plan in accordance with PUB requirements. • Implement dust control						

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementa-tion
		measures such as dust screens and water suppression systems. • Implement acoustic barriers to reduce noise pollution outside worksites.						
	Human-wildlife Conflict	• Ensure good housekeeping controls such as provision of wildlife proof bins and eating areas. • Execute Wildlife Response and Rescue Plan when fauna is found on-site. • Train site personnel on biodiversity awareness and actions to take when encountering wildlife.	• Visual monitoring • Compliance check	Entire project site (near forested area)	No injuries due to wild animals	• Continuous • As and when required for Wildlife Response and Rescue Plan	• Monthly Environmental Performance Report • As and when a wildlife incident occurs	• Contractor PM • Contractor ECO / EMMP In-charge • Ecologist
Noise Monitoring • **Minimization of biodiversity disturbance due to construction noise** • **Minimization of nuisances to human due to construction noise**	<u>On-site Visual and Compliance Monitoring</u>							
	Disturbance to biodiversity and human due to construction noise	• Noise barriers around construction work areas (used along Bukit Chermin Road and along the boundary of Keppel Golf club) • Noise barriers to be placed along Berlayer Creek (without causing additional vegetation clearance beyond construction worksites) • Utilization of quieter equipment and vehicles with low noise levels • PPE use by construction personnel at all times while on the construction site	• Visual monitoring • Compliance check	Entire project site	Environmental Protection and Management (Control of Noise at Construction Sites) 2008	Monthly during entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementa-tion
	<u>On-site Noise Monitoring</u>							
	Noise generated from construction work	• Leq 12 hrs • Leq 1 hr • Leq 5 mins	Sound level meter	3 locations	Environmental Protection and Management (Control of Noise at Construction Sites) 2008	• Continuous (24x7) boundary noise monitoring • During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge
Water Quality Monitoring • **Minimization of impact to waterbodies due to contaminated site run-off** • **Minimization of impact to terrestrial habitats due to erosion of topsoil**	<u>On-site Visual and Compliance Monitoring</u>							
	ECM non-compliance	• Verify implementation of ECM Plan • Perimeter cut-off drains, perimeter silt fence, silt traps, sedimentation basin and silt treatment system	• Visual monitoring • Compliance check • ECM checklist	Construction area with earthworks	ECM Plan designed by a Qualified Erosion Control Professional (QECP)	• Daily compliance monitoring • During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge • QECP
	<u>On-site Water Quality Monitoring</u>							
	ECM discharge (sediment runoff)	Total Suspended Solids (TSS)	Implementation of TSS monitor and CCTV including a Silty Imagery Detection System (SIDS)	• Final ECM discharge points • 2 discharge outlets (upstream & midstream of Berlayer Creek) • 1 point downstream of Berlayer Creek	• Less than 50 mg/L for TSS • Sewerage and Drainage (Surface Water Drainage) Regulation 2007	Real-time continuous during entire construction phase	• TSS report • Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementa-tion
	Contamination of water resources through trade effluent discharge and/or Degradation of stream habitat	• All parameters identified in EPM (Trade Effluent) Regulations for Controlled Watercourse • Additional parameters: Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammoniacal Nitrogen (NH4-N), Total Nitrogen (TN), Nitrate (NO3-N), Total Phosphorus (TP), Orthophosphate (PO4), Total Organic Carbon (TOC), Oil & Grease (Total), Oil & Grease (Hydrocarbon), Lead (Pb), Zinc (Zn), Mercury (Hg), Enterococcus	In-situ and ex-situ monitoring	• At every discharge outlet, including the 2 discharge outlets (upstream & midstream of Berlayer Creek) • 1 point downstream of Berlayer Creek	EPM (Trade Effluent) Regulations for Controlled Watercourse	• Monthly during construction phase • To be sampled during ebb tide (i.e., when tides are receding)	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge
Groundwater Monitoring	<u>On-site Groundwater Monitoring</u>							
	Changes to groundwater level	Groundwater level	Piezometer	3 monitoring wells	Building Control Regulations 2003	Monthly during construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge
Air Quality Monitoring • **Minimization of human health & biodiversity impacts due to dust pollution**	<u>On-site Visual and Compliance Monitoring</u>							
	Fugitive dust emissions	• Implementation of dust suppression plan • Watering to reduce dust emissions from exposed areas • Washing bay • Implementation of vehicular speed limit • Covered stockpiles	• Visual monitoring • Compliance check	All construction areas	Approved dust suppression plan	During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementa-tion
• **Minimization of human health impacts due to exhaust emissions**		• Use of PPE (face mask) by construction personnel						
	Exhaust emission from construction machineries operations	Maintenance frequency of vehicles and machineries	• Visual monitoring • Compliance check	All construction areas	No visible exhaust plume, dark smoke etc.	During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge
	<u>On-site Air Quality Monitoring</u>							
	Particulate matter emission from construction activities	$PM_{2.5}$ and PM_{10}	Air monitoring equipment (e.g., USEPA FRM/FEM equipment[1])	2 locations	Singapore Ambient Air Quality Targets	• 24hr (1 day) continuous monitoring • Once a Month (When most of the dust-generating activities are conducted)	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge
Vibration monitoring • **Minimize vibration impacts from construction**	<u>On-site Visual and Compliance Monitoring</u>							
	Disturbances to the fauna due to vibration from construction activities	• All works are to be conducted during 8am – 7pm as far as practicable. When night works needs to be carried out, approval must be given by the relevant authorities (e.g., NEA, NParks). • Use of equipment or method which generate lower vibration levels, where possible. • Control speed of vehicle movement at the worksite • Keep access roads within	• Visual monitoring • Compliance check	All construction sites	• NEA Code of Practice on Pollution Control SS 593 (2013) • Code of Practice for Noise Control on Construction and Demolition Sites SS602 (2014)	During entire construction phase	Monthly Environmental performance report	• Contractor PM • Contractor ECO / EMMP In-charge

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementa-tion
		project work site in good condition						
	<u>On-site Vibration Monitoring</u>							
	Vibration generated from construction work	• PPV (mm/s)	• Vibration meter	2 locations	• Refer to instrumentation monitoring plan as advised by QPs	• Refer to instrumentation monitoring plan as advised by QPs	Monthly Environmental performance report	• Contractor PM • Contractor ECO / EMMP In-charge
Vector Monitoring • **Minimizing the impacts due to increase in vector related diseases**	<u>On-site Visual and Compliance Monitoring</u>							
	Increase in the Incidence of vectors & related diseases	• Verify implementation of vector control management plan • Engagement of NEA registered vector control operator • Appointment of an in-house vector control team • Avoid thermal fogging along areas of high conservation value (e.g., Berlayer Creek)	• Visual monitoring • Compliance check	Entire project site	• Vector control management plan • Control of Vectors and Pesticides Act, 2002	During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge
Waste Management Monitoring • **Minimizing the impacts due to improper disposal of hazardous and general waste**	<u>On-site Visual and Compliance Monitoring</u>							
	Improper disposal of hazardous waste leading to land pollution	• Engagement of NEA licensed waste collector for hazardous waste • Record of waste disposal	• Visual monitoring • Compliance check	Entire project site	Environmental Public Health (Toxic Industrial Wastes) Regulation, 2000	During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-charge • QECP
	Improper disposal of construction waste leading to land pollution	• Verify implementation of solid waste management plan • Engagement of NEA licensed general waste collector • Record of waste disposal	• Visual monitoring • Compliance check	Construction waste & general waste storage location	Environmental Public Health (General Waste Collection) Regulation, 2000	During entire construction phase	Monthly Environmental Performance Report	• Contractor PM • Contractor ECO / EMMP In-

Monitoring Category	Impact	Monitoring Parameters	Monitoring Method	Location	Standards / Criteria	Time / Duration / Frequency	Reporting	Implementa-tion
								charge

[1] It is recommended that air quality monitoring be conducted using USEPA FRM/FEM equipment. The list of designated reference and equivalent methods can be found at https://www.epa.gov/system/files/documents/2022-12/List_of_FRM_and_FEM.pdf. If a non-USEPA FRM/FEM equipment is used, the Monthly Environmental Performance Report can consider including information on the co-location or calibration carried out with a USEPA FRM/FEM equipment to ensure the equipment's performance prior to deployment at the project site.

8 EMMP REPORTING

8.1 Site Environmental Control Report by Environmental Control Officer

As per Code of Practice for Environmental Control Officers for Construction Sites, ECO shall prepare the Site Environmental Control Programme before work commences at the worksite. Further, ECO shall submit the Site Environmental Control Report (SECR) to Project Manager covering assessment of the environmental efforts carried out and review the effectiveness of these measures.

The ECO shall inspect the construction activities regularly and routinely to ensure that the appropriate environmental protection and pollution control mitigation measures are properly and timely implemented based on the EMMP's recommendations. ECO shall record all observations and actions taken to report them in the SECR. This SECR should form part of EMMP monthly performance report described in next section.

8.2 Monthly Environmental Performance Report

A monthly Environmental Performance Report is to be prepared by EMMP In-charge in assistance with EMMP Team and to be submitted to SO, project management team, PUB, NParks, and other relevant authorities. The Performance Report is to include the description of the project activities being carried out at site during the month and status of implementation of EMMP including information on environmental incidence if any. Table 8.1 provides the reporting framework.

Table 8.1. Monthly Environmental Performance Report framework

Sr. No.	Item	Description
1.	Project Status	Update on project activities within project area
2.	EMMP Implementation Status	Daily observations and actions taken, ECO report, ECM performance checklist, Biodiversity specialists' observations and recommendations, Physical monitoring results (Noise, Air, Surface water quality, ECM discharge) and assessment, Vector control report, Waste disposal record
3.	Environmental Awareness Training	Record of periodic biodiversity awareness training/ toolbox briefings
4.	Environmental Incidence	Environmental Incident report and corrective actions, public feedback & response
5.	Authority Inspection & Findings	Record of Authority inspection visits (i.e., NParks, NEA, PUB) and corrective actions

8.3 Environmental Close-off Report

A final environmental close-off report should be prepared after construction work is completed to confirm that no residual impacts are observed.

9 REFERENCES

AECOM. (2022). *Environmental Impact Study for Keppel Club, PSA Club, Bukit Chermin, Berlayer Creek and Former BP Oil Refinery Site.*

Agriculture and Resource Management Council of Australia and New Zealand. (2000). Australian Guidelines for Urban Stormwater Management. Canberra, Australian Capital Territory, Australia. Retrieved from https://www.waterquality.gov.au/sites/default/files/documents/australian-guidelines-urbanstormwater.pdf

American Public Health Association. (2017). *Standard methods for the examination of water and wastewater* (23rd ed.). Washington, DC: American Public Health Association.

Australia Department of the Environment and Energy. (2019). *National Light Pollution Guidlines for Wildlife.* Australia: Australian Government.

Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ). (2000). *Guidelines for Fresh and Marine Water Quality*. Retrieved from https://www.waterquality.gov.au/anz-guidelines/resources/previous-guidelines/anzecc-armcanz-2000

Chong, K. Y. (2009). *Checklist of the Total Vascular Plant Flora of Singapore.* Singapore: Raffles Museum of Biodiversity and Research and Department of Biological Sciences, National University of Singapore.

Department of Environment, Malaysia. (2005). *National Water Quality Standards For Malaysia.*

Dutch Ministry of Infrastructure and Water Management. (1 July, 2013). *Soil Remediation Circular 2013.* Retrieved from http://enviroeng.eu/wp-content/uploads/2022/01/LISTA-HOLANDESA-2013.pdf

Greenery & Development Planning Branch. (2018). *Guidelines on Greenery Provision and Tree Conservation for Developments* (Version 2 ed.). Singapore: National Parks Board. Retrieved from https://www.nparks.gov.sg/-/media/nparks-real-content/partner-us/developers-architects-and-engineers/gdp-handbook-2018-apr-3.pdf

Institute of Air Quality Management (IAQM). (2014). *Guidance on the Assessment of Dust from Demolition and Construction.* Retrieved from https://iaqm.co.uk/text/guidance/construction-dust-2014.pdf

Legislation Division of the Attorney-General's Chambers. (n.d.). *Singapore Statutes Online*. Retrieved June, 2021, from Singapore Statutes Online: https://sso.agc.gov.sg/

Lindsay, S. M.-G. (2022). Flora of Singapore: Checklist and bibliography. *Gard. Bull. Singapore 74(Suppl. 1): 3–860*.

Ministry of Natural Resources and Environment of Vietnam. (12 December, 2011). *Circular No. 43/2011/TT-BTNMT of December 12, 2011, providing for national technical standards on environment.* Retrieved 27 August, 2020, from Legal document search & search system: https://vanbanphapluat.co/circular-no-43-2011-tt-btnmt-providing-for-national-technical-standards

National Environment Agency (NEA). (2016). *Technical Guideline for Land Traffic Noise Impact Assessment.* Retrieved from https://www.nea.gov.sg/docs/default-source/our-services/technical-guidelines-for-noise-impact-assessment-.pdf

National Environment Agency (NEA). (2018). *Technical Guideline on Boundary Noise Limits for Air Conditioning and Mechanical Ventilation Systems in Non-Industrial Buildings.* Retrieved from https://www.nea.gov.sg/docs/default-source/default-document-library/technical-guideline-on-boundary-noise-limit-for-air-conditioning-and-mechanical-ventilation-systems-in-non-industrial-buildings---feb-2018.pdf

National Environment Agency. (15 February, 2021). *Air Quality*. Retrieved from The National Environment Agency: https://www.nea.gov.sg/our-services/pollution-control/air-pollution/air-quality

National Environmental Agency (NEA). (2011). *Guidelines on mosquito prevention in domestic rainwater collection system for non-potable uses.* Retrieved from https://www.nea.gov.sg/docs/default-source/resource/guidelines-on-mosquito-prevention-in-domestic-rainwater-collection-system-for-non-potable-uses.pdf

National Parks Board. (2021). *Biodiversity Impact Assessment (BIA) Guidelines.* National Parks Board, Singapore.

National Parks Board. (19 January, 2023). *National Parks Board*. Retrieved 19 January, 2023, from Species List (Red Data Book List): https://www.nparks.gov.sg/biodiversity/wildlife-in-singapore/species-list

PHILMINAQ. (2014). Water Quality Criteria and Standards for Freshwater and Marine Aquaculture. *Mitigating Impact from Aquaculture in The Philippines*. Retrieved from http://aquaculture.asia/files/PMNQ%20WQ%20standard%202.pdf

Public Utilites Board (PUB). (2013). *Handbook on Managing Urban Runoff.*

Public Utilities Board (PUB). (2018). *Code of Practice on Surface Water Drainage (PUB COP)* (7th ed.).

Public Utilities Board (PUB). (2018). *Guidebook on Erosion and Sediment Control at Construction Sites.*

Public Utilities Board (PUB). (2018b). *Engineering Procedures for ABC Waters Design Features.*

Secretariat, A. S. E. A. N. (2008). *ASEAN Marine Water Quality: Management Guidelines and Monitoring Manual.* Australia: Australia Marine Science and Technology Ltd. (AMSAT). Retrieved from https://www.h2i.sg/wp-content/uploads/ASEAN-MarineWaterQualityManagementGuidelinesandMonitoringManual.pdf

Secretariat, Association of Southeast Asian Nations (ASEAN). (2005). *ASEAN Strategic Plan of Action on Water Resources Management.* ASEAN Secretariat: Jakarta, Indonesia.

Singapore Standard. (2013). *Code of practice for pollution control SS 593.*

Singapore Standard SS602. (2014). *Code of Practice for Noise Control on Construction and Demolition Sites.*

United Nations Economic Commission for Europe (UNECE). (1994). Standard Statistical Classification of Surface Freshwater Quality for the Maintenance of Aquatic Life. *Readings in International Environment Statistics*.

United States Environmental Protection Agency (USEPA). (2017). *Water Quality Standards Handbook*. Retrieved from https://www.epa.gov/wqs-tech/water-quality-standards-handbook

World Health Organization (WHO). (n.d.). *Guidelines for drinking-water quality.*

APPENDIX A – WILDLIFE / FAUNA INCIDENT FORM

WILDLIFE INCIDENT FORM

Part A – Wildlife Incident Details

The EMMP In-charge is to complete the Form and submit to PM within 24 hours of reporting incident. Note:

Reference No. (by EMMP In-charge)			
Personnel	**Reporting Person**	**Witness**	
Name:			
Contact Number:			
Title / Company:			
Time / Date of Wildlife Encounter	**Date**	**Time**	
Affected Area			
Weather:	☐ Clear	☐ Overcast	☐ Thunderstorm
	☐ Sunny	☐ Others (To Describe):	
Actual Location:			
Description of Area:	☐ Vegetated area	☐ Non-vegetated area	
	☐ Excavated area	☐ Others (to describe):	
Activities Carried Out Nearby at Time of Incident:	If there are no active works near wildlife encountered, please state so.		

Details of Animal			
Animal:	Where identifiable, please provide [Common Name (Scientific Name)] If animal cannot be identified, carcass to be described to the best of ability.		
Animal Condition:	☐ Active	☐ Outwardly injured (e.g. bleeding, limping)	☐ Flattened
	☐ Stationary	☐ Decomposed	☐ Trapped
	☐ Others (to describe):		
Photographs:	1) Close-up of Animal ☐ No Close-up available Please provide reason here if close-up photographs could not be obtained, e.g. unsafe to approach		
	2) Animal with surroundings or showing full width of road (if roadkill), indicating where the animal is.		
	☐ No photographs available. Reason: e.g. animal moved away too quickly		

Incident Details	
Incident Summary: To be filled by reporting party	Briefly describe when, what, who, where and how the incident happened. *Sample incident summary:* *[Personnel] was conducting [activity] on [date/time] when he observed an [animal] at [location]. The animal was observed to be [condition]. [Personnel] reported the incident to [contractor representative] who contacted the WMO. While awaiting wildlife response, [contractor] barricaded the area and continued monitoring for movement of animal.* If EMMP Specialist (Fauna) visited site: Recommended actions
Follow-up Actions: To be filled by EMMP In-charge	☐ Animal rescued to NParks Shelter ☐ Immediate relocation ☐ Carcass transported to disposal location ☐ Others:_____
	☐ No Action Taken by CEMMP In-charge

Part B – Closure of Incident

Possible Causes What is/are the possible cause/s of the incident? (Man / Machine / Management / Medium / Mission)		
Preventive/Corrective Actions To be filled by EMMP In-charge	**Close-up** To be filled by reporting party	
1)	Close-up Action.	Close-up Date
2)		Close-up Date

Closure of Incident Report	
Date of Closure of Incident Report:	
Acknowledged by PM (Name/Title):	