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Environmental Management and Monitoring Plan (Area A)

Housing & Development Board (HDB)

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List of Acronyms

Acronym	Definition
AECOM	AECOM Singapore Pte. Ltd.
CFU	Colony Forming Unit
CS species	Species of Conservation Significance
ECB	Erosion Control Blanket
ECM	Earth Control Measures
ECO	Environmental Control Officer
EIS	Environmental Impact Study
EMMP	Environmental Management and Monitoring Plan
ERP	Emergency Response Plan
HDB	Housing & Development Board, Singapore
NEA	National Environment Agency
NSR	Noise sensitive receptor
PM	Particulate Matter
PME	Powered mechanical equipment
PRO	Public Relations Officer
QECF	Qualified Erosion Control Professional
RAC	Recommended Area of Conservation
RTO	Resident Technical Officer
SAAQT	Singapore Ambient Air Quality Long Term Targets
SIDS	Silty Imagery Detection System
SO Rep.	Superintending Officer Representative
TPZ	Tree Protection Zone

1 Introduction

AECOM Singapore Pte Ltd has been appointed by the Housing & Development (HDB), through the Letter of Acceptance dated 15 July 2022, to carry out the development of detailed Environmental Management and Monitoring Plan (EMMP) specifications for the proposed developments located in Northern Tengah (Area A) (hereafter referred to as the "Project"). Area A is a 65-hectare site located at the northeast section of the overall Tengah Town development area (Figure 1-1). The proposed development to be constructed within Area A includes residential developments, commercial & residential developments, educational institutions, civic & community institution/ place of worship, parks and road infrastructure.

Prior to the start of this Project, an Environmental Impact Study (EIS) [R-1] was conducted for the northern area of Tengah Town development area, which is inclusive of Area A. An area of approximately 69.6 ha was proposed to be retained as the Recommended Area of Conservation (RAC). In consideration of the ecological sensitivity of these areas as well as the proximity of this site to residential areas, this EMMP details how recommended mitigation measures should be implemented to reduce ecological and human impacts as well as specify the monitoring measures required to assess the effectiveness of these mitigation measures, in order to ensure that the construction activities are carried out with minimal impacts to the surrounding ecological and human sensitive receptors.

As there will be various construction activities carried out concurrently within Area A, the construction timeline has been divided into three main stages (i.e. Stages 1, 2 and 3). An EMMP programme was developed for each of the three stages for Area A and provides management and monitoring requirements for biodiversity, surface water quality and groundwater quality, air quality, airborne noise, vibration, vector control and waste management. This EMMP is an adaptive document will be updated when there is a need to revise measures or a change in Project components. Copies of the EMMP specification must be kept on-site for reference at all times.

1.1 Project Location

Area A is a 65-hectare site located at the northeast section of the overall Tengah Town development area and is bounded by Brickland Road in the north and Bukit Batok Road in the east of the site. Choa Chu Kang residential neighbourhood borders the north of the site, while there are educational institutions, home for the aged, and Bukit Batok residential neighbourhood located in the east of the site. Area A is also currently bordered by forested areas in the west and by ongoing construction works along the southern edge of the site. At present, Area A features freshwater streams, stormwater drains and forested areas. The proposed development to be constructed within Area A includes residential developments, commercial & residential developments, educational institutions, civic & community institution/ place of worship, parks and road infrastructure. Based on the completed EIS [R-1], large patches of forested areas with a total area of 69.6 ha have been identified as the Recommended Area of conservation (RAC) and will be retained (see Figure 2-1). The overall proposed construction works to be carried out within Area A is also presented in Figure 2-1 below.



Legend

- Construction Worksites at Area A
- Recommended Area of Conservation

Note: HDB are working closely with agencies on the details and extent of the Recommended Area of Conservation to be retained.

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-	FEB 2023	CQA	Draft Report	NHT	JAG

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Project Title : **CONTRACT L/189/22
SPECIALIST CONSULTANCY SERVICES
AT HDB DEVELOPMENT (WESTERN):
ENVIRONMENTAL MANAGEMENT AND
MONITORING PLAN (AREA A)**

Designed CQA	Checked NHT	Approved JAG
	Drawn CQA	Date FEB 2023

Client: **HOUSING & DEVELOPMENT BOARD**

Figure Title : **EXPANSE OF PROPOSED CONSTRUCTION WORKSITES WITHIN AREA A**

Figure No. : 1-1	Rev. : -	Sheet : 1 of 1
CAD File Name : NA		A3

1.2 Scope of Report

This document serves to propose a detailed EMMP programme, which consists of the implementation procedures, mitigating and/or compensation measures and actions, wildlife shepherding plan/procedures, management plan and monitoring requirements based on detailed construction programme available at this stage.

Consultations with the Regulatory Agencies and Nature Groups will also be conducted (if required) to seek their feedback and suggestions on this proposed EMMP programme.

1.3 Report Structure

The structure of the report is as follows:

- **Section 1** – Introduction of the Project provides the scope of the report, report structure, study limitations, assumptions and constraints;
- **Section 2** – Summary of Environmental Impact Study (EIS) presents the key baseline findings, assessed impacts, proposed mitigation measures and recommended area for conservation;
- **Section 3** – Proposed Construction Activities and Timeline details the Project components, overall construction timeline and proposed construction activities for each stage;
- **Section 4** – Applicable Environmental Legislation provides the key legislative requirements relevant to the Project;
- **Section 5** – Environmental Management and Monitoring Organisation provides the organisation chart of the key personnel involved in the EMMP as well as their roles and responsibilities.
- **Section 6** – Standard Mitigation Measures provides a description of the standard measures to be implemented during construction as well as to outline the scope of environmental trainings which will be conducted for all site personnel;
- **Section 7** – Environmental Management and Monitoring Plan for Stage 1 details the EMMP programme during Stages 1 for biodiversity, surface water quality, groundwater, air quality, airborne noise, vibration, vector control and waste management;
- **Section 8** – Emergency Response Plan provides the objectives of the plan, key emergency contacts for environmental incidents, response plans for wildlife, drainage, surface and groundwater, air quality, airborne noise and vibration and standard procedure for accidental fire event; and
- **Section 9** – Conclusion provides a summary of the key details from this EMMP specification report.

1.4 Study Limitations, Assumptions and Constraints

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2 Summary of Environmental Impact Study

This section provides a summary of the completed Environmental Impact Study (EIS) report on the Northern Tengah site [R-1]. This includes the objective of the EIS, description of the EIS Study Area, summary of its impact assessment findings, Recommended Areas of Conservation (RAC) and outline of the environmental monitoring and management plan (EMMP) provided in that report.

2.1 EIS Objective

This EIS provided an assessment of the type and extent of environmental impacts arising from the proposed development within the EIS Study Area, with reference to the Tengah Master Plan 2019 gazetted by Urban Redevelopment Authority (URA). The assessment included consultation with various stakeholders and their inputs to formulate an outline of EMMP within the report.

2.2 EIS Study Area

The EIS Study Area included an area of 166 ha, located within the Tengah site, which is Singapore's largest remaining patch of forest that lies outside a protected area. It is a critical point of connection for fauna moving between the Central Catchment Nature Reserve (CCNR) and Western Water Catchment Area.

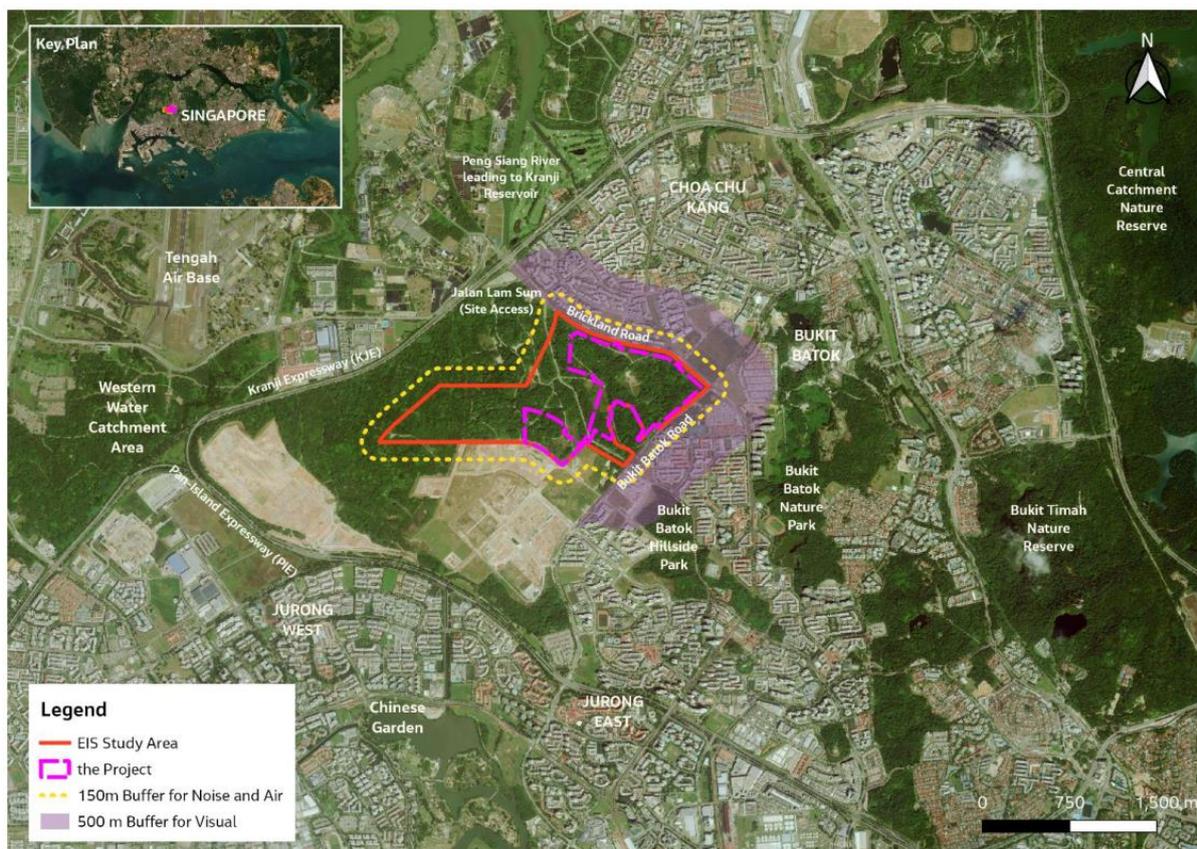


Figure 2-1 EIS Study Area (source: Northern Tengah EIS Report R-1)

The housing districts planned to be constructed within Northern Tengah include the Brickland District and a portion of Park District. The land use plan gazetted under the URA Master Plan 2019 (Figure 2-2) shows the proposed development to include residential areas, educational institution and commercial buildings with other public utilities and amenities such as road, parks, schools, places of worship, health and medical care facilities and civic & community institutions.



Figure 2-2 Proposed land use of Project Site (source: Northern Tengah EIS Report R-1)

2.3 Summary of Baseline Findings

The environmental baseline findings for biodiversity, surface hydrology and water quality, geomorphology/soil and hydrogeology, air quality, airborne noise and waste has been summarised in Table 2-1 below.

Table 2-1 Summary of Key Baseline Findings from EIS (Source: Northern Tengah EIS Report [R-1])

Environmental Parameter	Baseline Findings
Biodiversity (Figure 2-3)	<ul style="list-style-type: none"> Four main vegetation and habitat types are present within the EIS Study Area and are as follows: abandoned-land forest (57.20 ha; 34.4%), scrubland and herbaceous vegetation (49.95 ha; 30.0%), waste woodland (45.47 ha; 27.3%) and abandoned-land forest with native regeneration (1 ha; 0.6%). The remaining area consists of farms, managed vegetation, cleared land and non-vegetated areas which make up 9.77 ha (5.9%). A variety of waterbodies such as closed canopy forest streams (i.e. Earth Drain (ED) ED2 and ED7), open-country streams (i.e. Spring, ED1, ED3, ED4, ED5, ED6, ED7 and ED8), closed-canopy & semi open-country ponds (i.e. Pond3, Pond4, Pond5, Pond6) and open country ponds (i.e. Pond1, Pond2) are present. The Main Canal occupies about 1.8% (2.96 ha) of the EIS Study Area. A total of 332 plant species and 6 species groups belonging to 93 families and 1 unknown Pteridophyte species are recorded from the floristic surveys. About half of the species are native and 51 are of conservation significance (CS). Key floristics findings include <i>Leea angulata</i>, <i>Glochidion zeylanicum</i> var. <i>zeylanicum</i>, <i>Ficus apiocarpa</i> and <i>Mucuna biplicata</i>. The faunistic field findings recorded 297 species with more than half of the recorded assemblage dominated by bird (86 species) and butterfly (73 species) species. Of all species recorded, 31 species of conservation species were recorded including the straw-headed bulbul (<i>Pycnonotus zeylanicum</i>), Sunda pangolin (<i>Manis javanica</i>) and bamboo bats (<i>Tylonycteris</i> spp.). Habitats found on site support the populations of these species of conservation species including providing breeding habitats for species such as the red-wattled lapwing (<i>Vanellus indica</i>) and the blue-winged pitta (<i>Pitta moluccensis</i>). The forest streams also provide habitats for aquatic species such as the common walking catfish (<i>Clarias</i> cf. <i>batrachus</i>), dwarf wisp (<i>Agriocnemis nana</i>) and variable featherlegs (<i>Copera vittata</i>).
Surface Hydrology (Figure 2-4)	<ul style="list-style-type: none"> Various features of waterbodies were identified: Main Canal, Spring Area, eight earth drains and six ponds 94.8% falls in Kranji Catchment, with 5.2% at the southwestern tip in Jurong Catchment. Water drains to Sungei Peng Siang and ultimately to Kranji Reservoir in northerly direction

Environmental Parameter	Baseline Findings
Surface Water Quality (Figure 2-5)	<ul style="list-style-type: none"> • A total of 71 dry and 83 wet water samples were collected. • A few samples had Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS) and pH exceeded the limits for discharge into a controlled watercourse <i>EPM (Trade Effluent) regulations</i>.
Geomorphology/ Soil (Figure 2-6)	<ul style="list-style-type: none"> • Terrain elevation ranged from 5 to 35 m metres above sea level (amsl) • 10% of the EIS Study Area has high-angle slopes (9 - 21°) • Underlain by Tengah and Queenstown Fades of Jurong Formation that comprises of sequence of sedimentary rocks • Major soil type: sandy silt and sandy clay
Hydrogeology (Figure 2-7, Figure 2-8)	<ul style="list-style-type: none"> • A total of eight water standpipes were established. • General groundwater flow from ridge system towards valley area and other lower elevation regions. • Minimum variance between groundwater flow during wet and dry seasons. • Presence of perennial spring (near WSP2), active groundwater aquifer.
Air Quality (Figure 2-9)	<ul style="list-style-type: none"> • Baseline particulate matter (PM₁₀ and PM_{2.5}) sampling was carried out at three air sensitive receiver (ASR) clusters (A1 to A3) within a 150 m buffer from the EIS Study Area. • Both PM₁₀ and PM_{2.5} at A1 and A2 complied with the Singapore Ambient Air Quality Target (SAAQT) 2020, ranging from 14.4 – 40.1 µg/m³ for PM₁₀ and 7.9 – 23.2 µg/m³ for PM_{2.5}. • PM₁₀ at A3 exceeded the SAAQT 2020 standards, with the highest value of 57.8 µg/m³. PM_{2.5} at A3 complied with the SAAQT, ranging from 12.1 – 25.3 µg/m³. To determine the reason for this exceedance, other data sources were analysed such as meteorological data/wind data (i.e. to determine if vehicle emissions from Bukit Batok Road could be a source) and regional ambient air quality (i.e. to corroborate with the PM₁₀ 24-hour concentration in the west region). However, it was found that neither correlated with the baseline results. These high peaks were postulated to be related to human activities (e.g. waste burning, etc) and not from traffic sources as it was a one-time observation.
Airborne Noise (Figure 2-10)	<ul style="list-style-type: none"> • Baseline noise level measurement for parameters L_{Aeq} 5-min, 1-hour and 12-hour was conducted at three affected community noise sensitive receiver (NSR) clusters (N1, N2 and N3) and two affected fauna NSR (N4 and N5). • NSR clusters (N1, N2 and N3) for human receptors (L_{Aeq} 5-min) ranging from 74.4 – 78 dB(A) during Weekday 7am-7pm, 70.2-72.1 dB(A) during Weekend 7am-7pm, 68.7 – 76.4 dB(A) during Weekday 7pm-10pm, 65.5-69 dB(A) during Weekend 7pm-10pm, 67.6 – 73.2 dB(A) during Weekday 10pm-7am, 64.5-70 dB(A) during Weekend 10pm-7am. • NSR clusters (N4 and N5) for ecological receptors (L_{Aeq} 5-min) ranging from 75.3 – 80.7 dB(A) during Weekday 7am-7pm, 68.7-71.4 dB(A) during Weekend 7am-7pm, 61.4 – 74.5 dB(A) during Weekday 7pm-10pm, 58.5-64.4 dB(A) during Weekend 7pm-10pm, 60.7 – 68.2 dB(A) during Weekday 10pm-7am, 63.7-65.3 dB(A) during Weekend 10pm-7am • Maximum permissible noise levels generally exceeded for community NSRs due to proximity of the road and the exceedance were likely related to the road traffic. • Noise levels for fauna NSRs are high compared to thresholds found in literature reviews.
Waste	<ul style="list-style-type: none"> • Remnant general waste from previous land use are present on site. • Types of waste expected to be produced include tree trunks/branches, construction and demolition debris, hazardous/toxic industrial waste, domestic refuse and sewage.

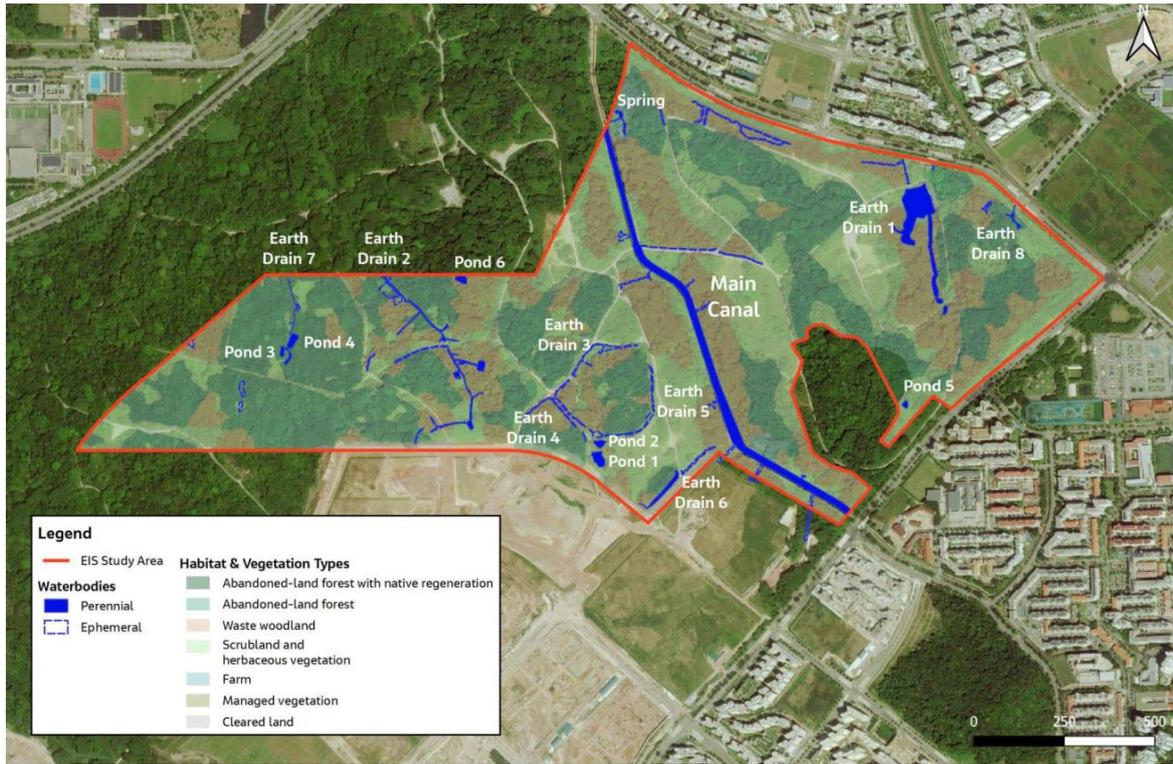


Figure 2-3 Vegetation and waterbodies map (source: Northern Tengah EIS Report [R-1])

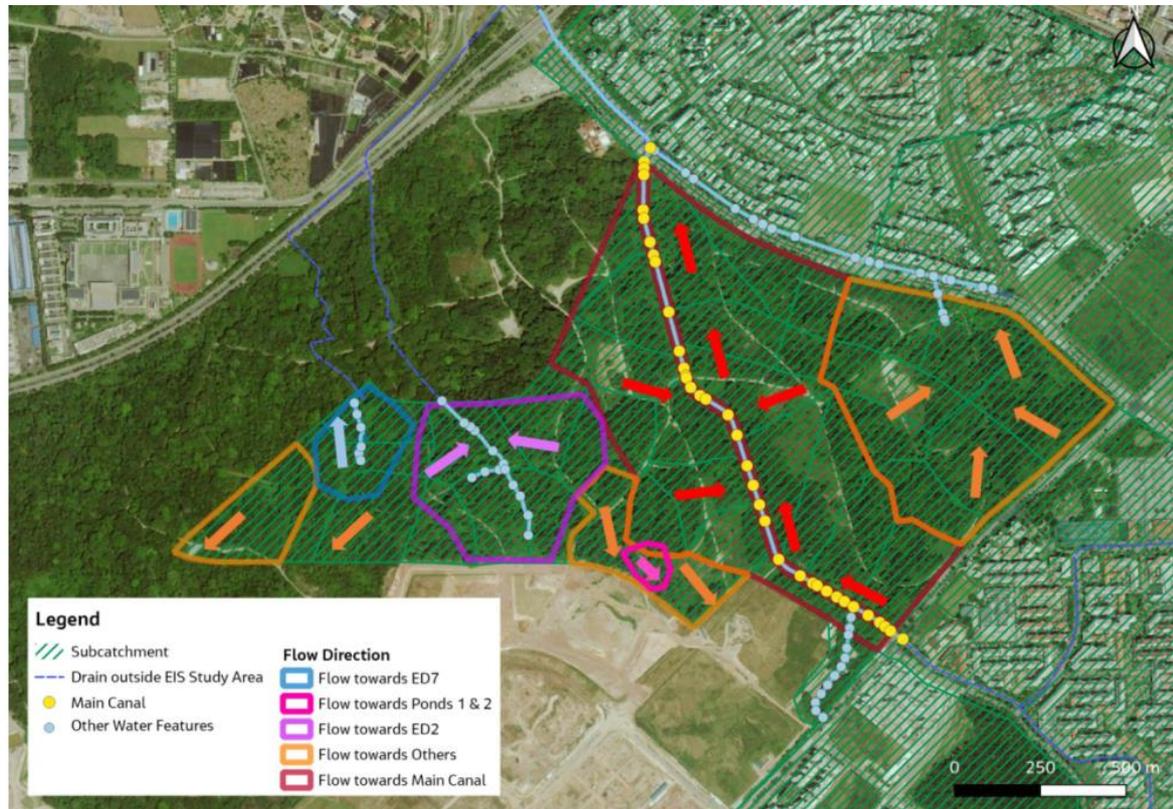


Figure 2-4 Catchment map of waterbodies with arrows to indicate flow direction (source: Northern Tengah EIS Report [R-1])

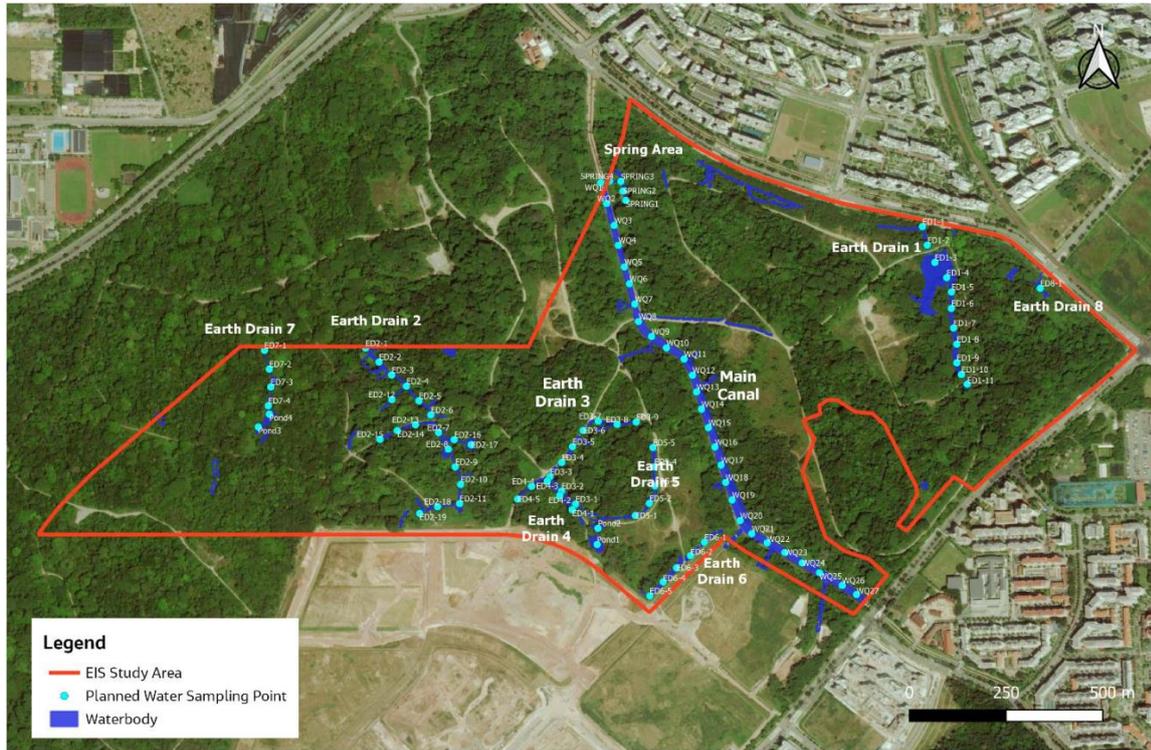


Figure 2-5 Locations of identified water quality points of every 50 m interval for dry and wet event sampling (source: Northern Tengah EIS Report [R-1])

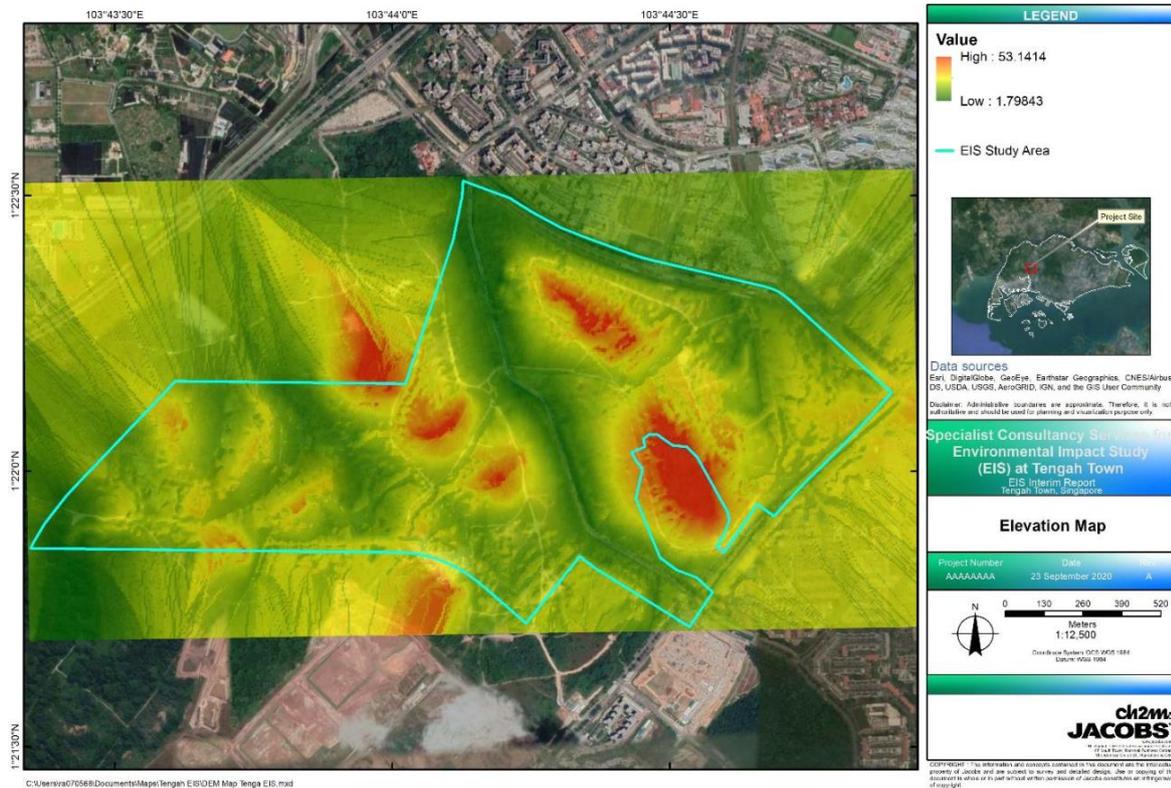


Figure 2-6 Topographic map of EIS Study Area (source: Northern Tengah EIS Report [R-1])

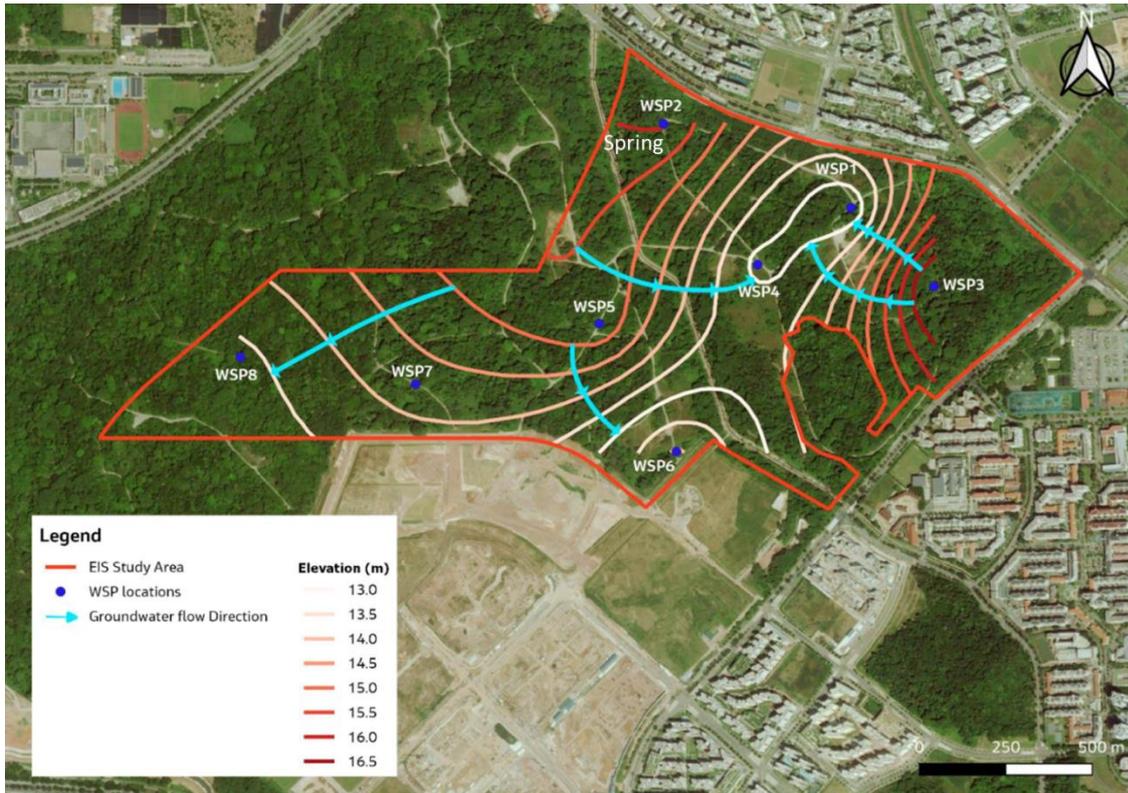


Figure 2-7 Location of water standpipes and mapped groundwater flow contour during dry weather (source: Northern Tengah EIS Report [R-1])

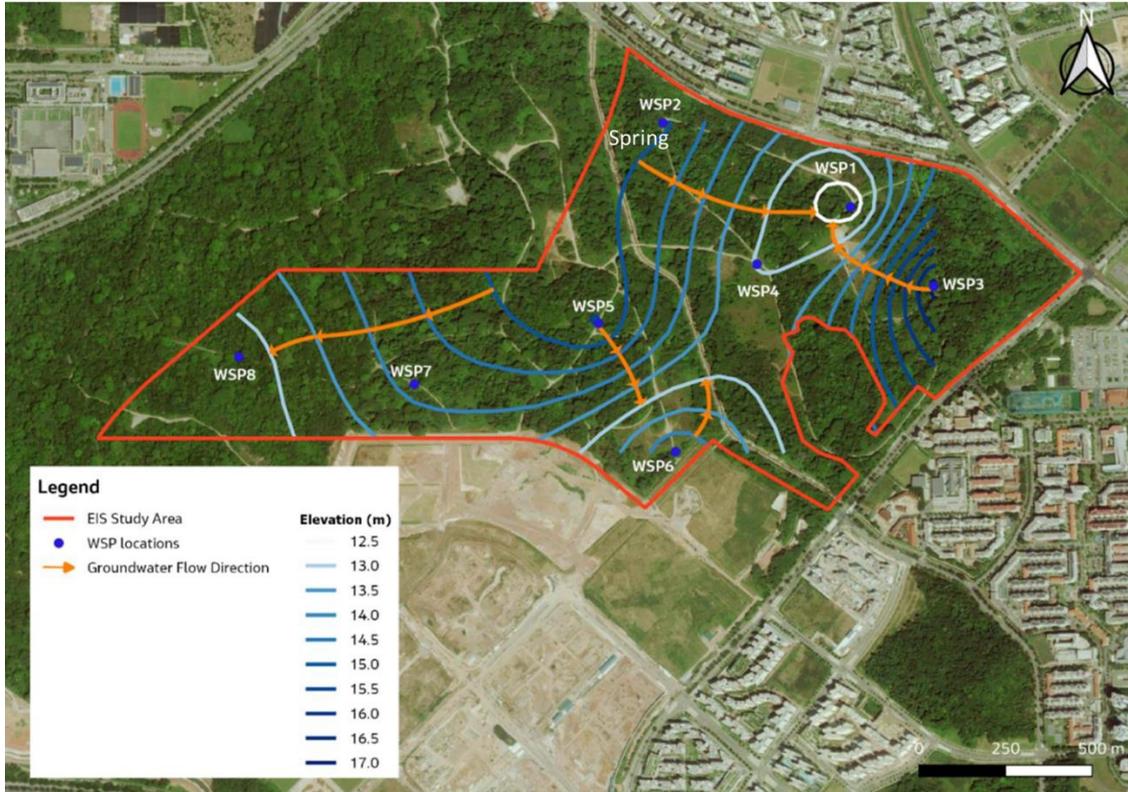


Figure 2-8 Location of water standpipes and mapped groundwater flow contour during wet weather (source: Northern Tengah EIS Report [R-1])

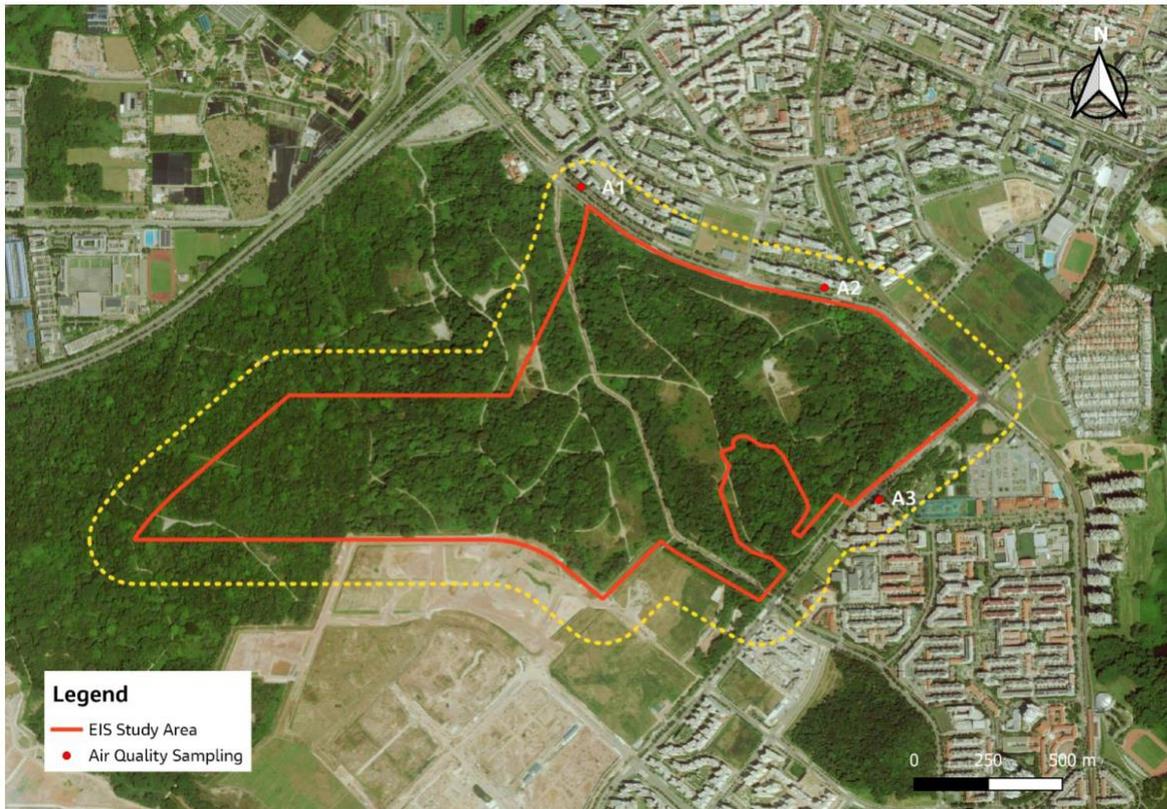


Figure 2-9 Location of ambient air quality sampling station (source: Northern Tengah EIS Report [R-1])

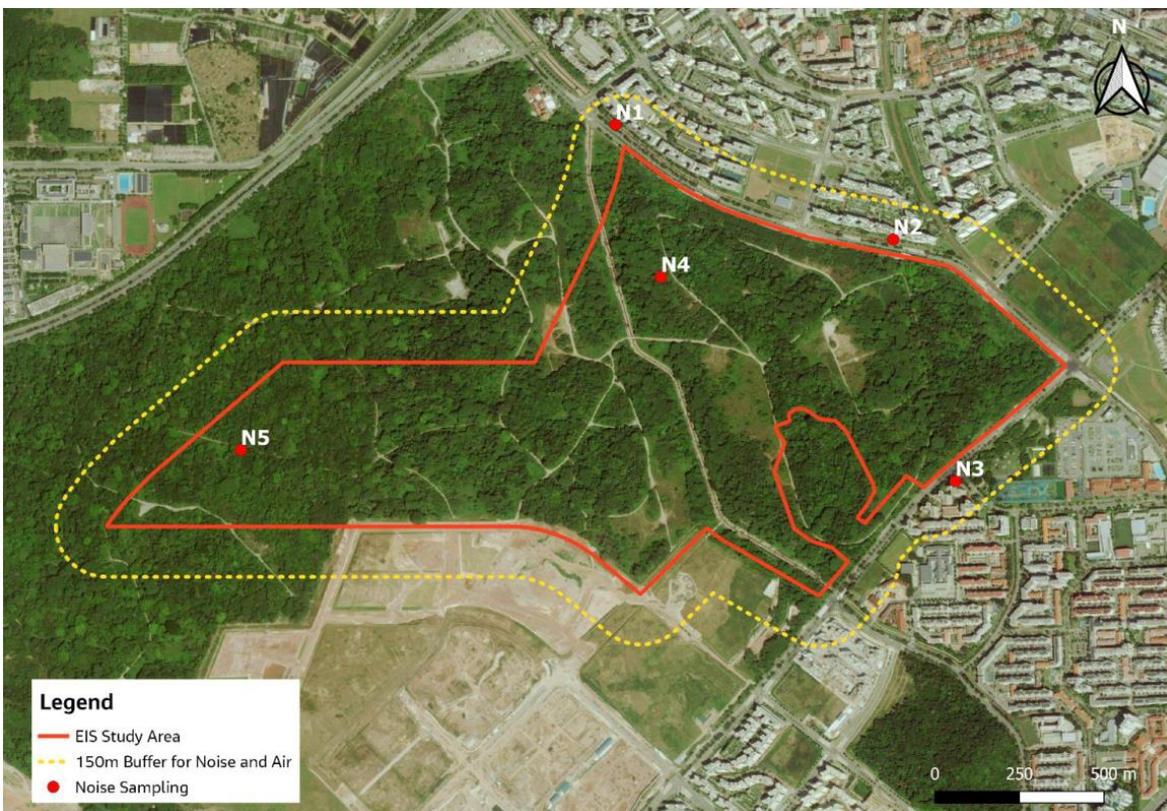


Figure 2-10 Location of baseline noise monitoring locations (source: Northern Tengah EIS Report [R-1])

2.4 Summary of Impact Assessment

2.4.1 Impact Assessment Methodology

The Rapid Impact Assessment Matrix (RIAM) (Figure 2-11) was applied to assess the overall impacts to the key environmental aspects from the Project. This is a semi-quantitative impact assessment method that applies scoring matrix (quantitative indicators) for impact evaluation in the form of Environmental Scores (ES), which ranges from extreme positive impact to critically negative impact for each project activity, in consideration of the sensitivity level of the existing baseline environmental conditions [R-1].

The impact significance of each evaluated potential impact has been categorised using a qualitative scale as shown in Figure 2-12.

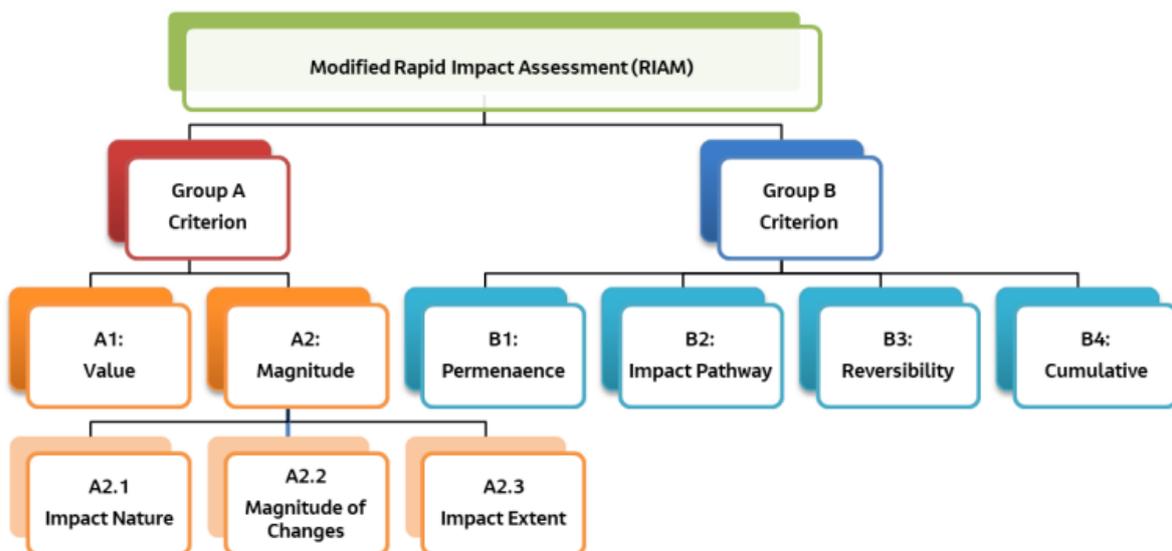


Figure 2-11 Assessment criteria for impact significance using the RIAM method [R-1]

Environmental Score (ES)	Impact Severity/ Significance	Definition
416 to 624	Extreme Positive Effect	Impact which causes great improvement or benefit to the existing environment
234 to 415	Major Positive Effect	Impact which causes major improvement or benefit to the existing environment
103 to 233	Moderate Positive Impact	Impact which causes noticeable improvement or benefit to the existing environment
13 to 102	Minor Positive Impact	Impact which causes minor improvement or benefit to the existing environment
4 to 12	Slight Positive Impact	Impact which causes slight improvement or benefit to the existing environment
-3 to 3	No Change/ Status Quo	No discernible deterioration or improvement to the existing environment
-4 to -12	Slight Negative Impact	Impact which causes slight deterioration or dis-benefit to the existing environment
-13 to -102	Minor Negative Impact	Impact which causes minor deterioration or dis-benefit to the existing environment
-103 to -233	Moderate Negative Impact	Impact which causes a noticeable deterioration or dis-benefit to the existing environment
-234 to -415	Major Negative Impact	Impact which causes major deterioration or dis-benefit to the existing environment
-416 to -624	Critically Negative Impact	Impact which causes critical deterioration or dis-benefit to the existing environment

Figure 2-12 Range of bands of Environmental Scores (ES) and the corresponding level of impact significance [R-1]

2.4.2 Impact Assessment Findings

An overview of impact assessment findings from the construction phase on the biological environment (biodiversity), humans, directly or indirectly via hydrology & water quality, geomorphology, soil and hydrogeology, air quality, airborne noise and waste, proposed mitigation measures, and its residual impacts from the EIS are summarised in Table 2-2.

Table 2-2 Summary of Impacts During Construction Phase and Key Mitigation Measures (Source: Northern Tengah EIS Report R-1)]

Environmental Parameter	Potential Environmental Impacts	Minimum Controls	Key Mitigation Measures (If any)	Residual Impact Significance
Biodiversity	<ul style="list-style-type: none"> Habitat loss; Pollution and degradation; Loss of ecological connectivity; Changes in fauna/ flora species composition 	<p><u>Pre-construction Stage</u></p> <ul style="list-style-type: none"> Arborist to clearly mark out Tree Protection Zones (TPZs) for trees to be retained. The TPZs are to be set up in accordance with NParks guidelines and no works are to be allowed here; Prior to vegetation removal, pre-felling fauna inspection should be conducted by an Ecologist to identify wildlife or nesting features that are actively used. E.g. bird nests, tree hollows and burrows; Execute wildlife response plan; and Implement soil erosion control measures. <p><u>Construction Stage</u></p> <ul style="list-style-type: none"> Implement soil erosion control measures; Situate machineries and materials that may leech harmful chemicals away from waterbodies or sensitive habitats (streams and ponds) Dust and noise levels are within approved limits; Avoid fogging by implementing preventive measures for mosquito to remove sources of stagnant water or water-bearing receptacles, e.g.: providing well-maintained pitched road, clearing discarded items daily, store materials appropriately, level up ground depression/uneven surfaces, effective drainage flow; and daily checks on site. 	<p><u>Avoidance</u></p> <ul style="list-style-type: none"> Complete retention of the abandoned-land forest with native regeneration & its 30m buffer by redesigning the road alignment; Clear demarcation of Recommended Area of Conservation (RAC) (see Figure 2-13). Do not encroach into conserved habitats and its 30m buffer. Review development plans and construction methods to minimise impacts. <p><u>Minimisation</u></p> <ul style="list-style-type: none"> Retention of 2.5 ha (4.3%) of abandoned-land forest (vegetation corridor along north-eastern boundary); Retention of 1.9 ha (4.9%) of scrubland/herbaceous vegetation (vegetation corridor along north-eastern boundary); Retention of 2.2 ha (3.7%) of waste woodland (vegetation corridor along north-eastern boundary); Provide sufficient hydrological flow within retained waterbodies; and Quarantine plant materials at external nursery before transferring to site. <p><u>Compensation</u></p> <ul style="list-style-type: none"> Creation of open-country pond (Pond 1, Pond 2) as an ABC Water Feature. <p><u>Enhancement</u></p> <ul style="list-style-type: none"> Enhancement of vegetation corridor along the north-eastern boundary; and Enhancement of conserved habitats and its buffer. 	Moderate to Major negative
Hydrology	<ul style="list-style-type: none"> Changes in surface water flow direction and flow rates; Increase flood risk; Loss of key water features on site. 	<ul style="list-style-type: none"> Provide storage tanks or reservoirs with additional 20% capacity and number to temporarily store/contain muddy surface runoff before treatment; and 	<ul style="list-style-type: none"> Undertake a detailed hydrological assessment to refine the conditions considered in the proposed design and placement of storm drains prior to the construction of these structures; Designation of non-disturbance zones or buffer zones with vegetation cover in conjunction with RAC within the EIS Study Area 	Minor Negative

Environmental Parameter	Potential Environmental Impacts	Minimum Controls	Key Mitigation Measures (If any)	Residual Impact Significance
		<ul style="list-style-type: none"> Segregate clean water flow from silty water to maximise sedimentation tank holding capacity. 	<ul style="list-style-type: none"> to compensate for the loss of open surface areas serving as recharge zones upon Project completion; Minimise the disturbance area affected by excavation and earthworks to what is only necessary in accordance with the Site Development Plan; and, Placement of temporary diversion channels strategically placed within construction or work areas to manage and direct surface flows. 	
Surface Water Quality	Water quality deterioration from soil erosion, sewage, chemical and trade effluent discharge.	<ul style="list-style-type: none"> Provide sufficient treatment units or coagulant units to treat silty water before discharging into public drain within 10 hours of rain event; Concrete and demolition debris, water used for dust control, groundwater should not be allowed to cause erosion within work area or to run offsite; Provision of secondary containment with capacity of more than 10% volume for single large container and 25% of the total volume of multiple containers should be used for all chemical stores and diesel generators to minimise spillages and contamination; and Emergency response procedures to be developed and implemented. 	<ul style="list-style-type: none"> Provide storage tanks or reservoirs with additional 20% capacity and number to temporarily store/ contain muddy surface runoff before treatment; Establish a regular maintenance work schedule to check and maintain cleanliness and functionality of sanitary facilities on site; Chemical storage areas should be adequate, on paved ground, bunded, sheltered and located away from waterways and drains; and Any soil contaminated with chemicals or oils shall be removed from site and sent to a licensed third-party toxic industrial waste collector for offsite disposal. 	Minor to Moderate negative
Geomorphology, Soil and Hydrogeology	<ul style="list-style-type: none"> Changes in soil infiltration capacity; Soil loss and erodibility; Changes to hydrogeology. 	Not Available	<ul style="list-style-type: none"> Undertake a programmatic Excavation, Cut and Fill and Earthmoving plan; Engage a Qualified Person/ Professional Engineer to conduct a slope stability and soil compaction study in areas of concern; Assign the Recommended Area of Conservation (RAC) as buffer zones or design buffer zones with vegetation cover within the EIS Study Area to compensate for the loss of open surface areas where permanent infrastructures will be built; and Alternative in-situ recharge zones can be designated within the remaining conservation areas to compensate for permanent loss of recharge areas that will be disturbed by the placement of at-grade and subsurface infrastructures. 	Minor Negative
Air Quality	<ul style="list-style-type: none"> Fugitive dust emissions from construction activities; 		<ul style="list-style-type: none"> Installation and proper maintenance of dust screen, fending or hoarding along construction site perimeter to reduce dust deposition at adjacent areas; 	Minor Negative

Environmental Parameter	Potential Environmental Impacts	Minimum Controls	Key Mitigation Measures (If any)	Residual Impact Significance
	<ul style="list-style-type: none"> Exhaust emissions from fuel burning equipment/ machinery/ vehicles. 		<ul style="list-style-type: none"> Contractor should keep extent of excavation and soil exposure areas to minimum required for construction; Exposed site shall be properly treated by compaction, turfing, vegetation planting or sealing with bituminous materials, concrete or other suitable materials as soon as practicable upon works completion; Ambient air quality parameters sulphur dioxide (SO₂), nitrogen dioxide (NO₂), carbon monoxide (CO), ozone (O₃), PM₁₀ and PM_{2.5} at Location A2, A2 and A3 are recommended to be measured prior to and during construction period under the southwest monsoon season (June to September) where the downwind receptors are likely to be impacted. However, if the construction schedule does not permit this, monitoring shall be carried out during the inter-monsoon period (late March-May); If the ambient air quality level during construction exceeds the SAAQT, contractor should investigate the cause and implement more stringent mitigation measures; and If there be any complaints from the community with regards to air quality during construction, additional ambient air quality monitoring shall be conducted. 	
Airborne Noise	Impacts to Human Receptors	<ul style="list-style-type: none"> Only well-maintained powered mechanical equipment (PME) should be operated onsite and shall be serviced regularly during construction; Reduce the number of PMEs as far as practicable when construction works are carried out near NSRs; and PME (such as trucks and cranes) that may be in intermittent use shall be shut down between work periods or shall be throttled down to a minimum if possible. 	<ul style="list-style-type: none"> Prepare a noise management plan to help to implement noise mitigation measures; Use engineering methodologies to control noise at source such as noise enclosures, noise screens/ panels, portable noise barriers and quieter construction methodologies; Use noise barrier with minimum 6 m high along the site boundary facing affected Noise Sensitive Receivers (NSRs); Conduct continuous real time noise monitoring using Type 1 sound level meter with data logging at the affected NSRs. When noise level exceeds the maximum adjusted noise level, contractor should investigate and apply appropriate mitigation measures; and Avoid noisy construction activities at night. Sundays and public holidays. 	Minor Negative
	Impacts to Ecological Receptors			Minor to Major Negative
Waste Management	<ul style="list-style-type: none"> Production of waste e.g. wood waste, construction and demolition waste, hazardous waste, municipal waste and sewage. 	<ul style="list-style-type: none"> Construction waste should be properly segregated and have set storage locations; Provide adequate garbage/trash bins with tight lids (animal-proof bins) to prevent animals from getting into it. 	<ul style="list-style-type: none"> Develop a waste management strategy to focus on waste elimination and to identify and communicate responsibilities for waste minimisation between developer, designer, project manager, contractors and suppliers; Apply waste minimisation techniques and good practices on site following waste management hierarchy; Examine the possibilities of using materials from the removal of woody trees in the EIS Study Area; 	Slight to Minor Negative (excludes climate change impacts)

Environmental Parameter	Potential Environmental Impacts	Minimum Controls	Key Mitigation Measures (If any)	Residual Impact Significance
			<ul style="list-style-type: none"> • Build for deconstruction and design to standard material sizes to allow future modification or decommissioning occurs; and • Waste concrete from demolition could also be recycled into recycled concrete aggregate which is made up of 70% demolition concrete waste with natural aggregates and used in buildings and roads in Tengah. 	

2.5 Recommended Areas of Conservation

The ecological receptors were assessed for pre-mitigation impact significance during the construction phase of the Project works. Habitats of high ecological value were identified, including the abandoned-land forest with native regeneration, abandoned-land forest and closed-canopy streams (ED2 & ED7). Accordingly, a preliminary RAC that amounts to 68.8 ha (41.5% of the EIS Study Area) was identified. Following intensive consultations and robust discussion with agencies and Nature Groups (NGs), a revised RAC was developed considering the land use limitations, incorporating as much of the preliminary RAC area as possible and providing compensatory measures where possible. The revised RAC amounts to 48.9 ha (29.5% of the EIS Study Area), and stretches across the western, central and north-eastern part of the EIS Study Area. It provides habitats and enhances connectivity across the site, strengthening connectivity through Tengah Town towards Bukit Batok/ Gombak forests along Bukit Batok Avenue 5 and Bukit Batok Hillside Park along Bukit Batok Avenue 2.

If the proposed retention of the proposed RAC and associated mitigation strategies is adopted, the residual impact significance for habitat loss at construction phase will still be moderate to major negative for almost all habitats (but with lower environmental score than unmitigated impact significance), except for the abandoned-land forest with native regeneration which is expected to be fully retained. The loss of ecological connectivity represents a moderate to major negative impact for most habitat types. While the loss of habitat during the construction phase cannot be mitigated, it may be minimised by retaining the RAC and implementing the Environmental Monitoring and Management Plan (EMMP). Compensatory measures such as temporary wildlife crossings and enhancement plantings can be considered to minimise impacts. These are summarised below and shown in Figure 2-13.

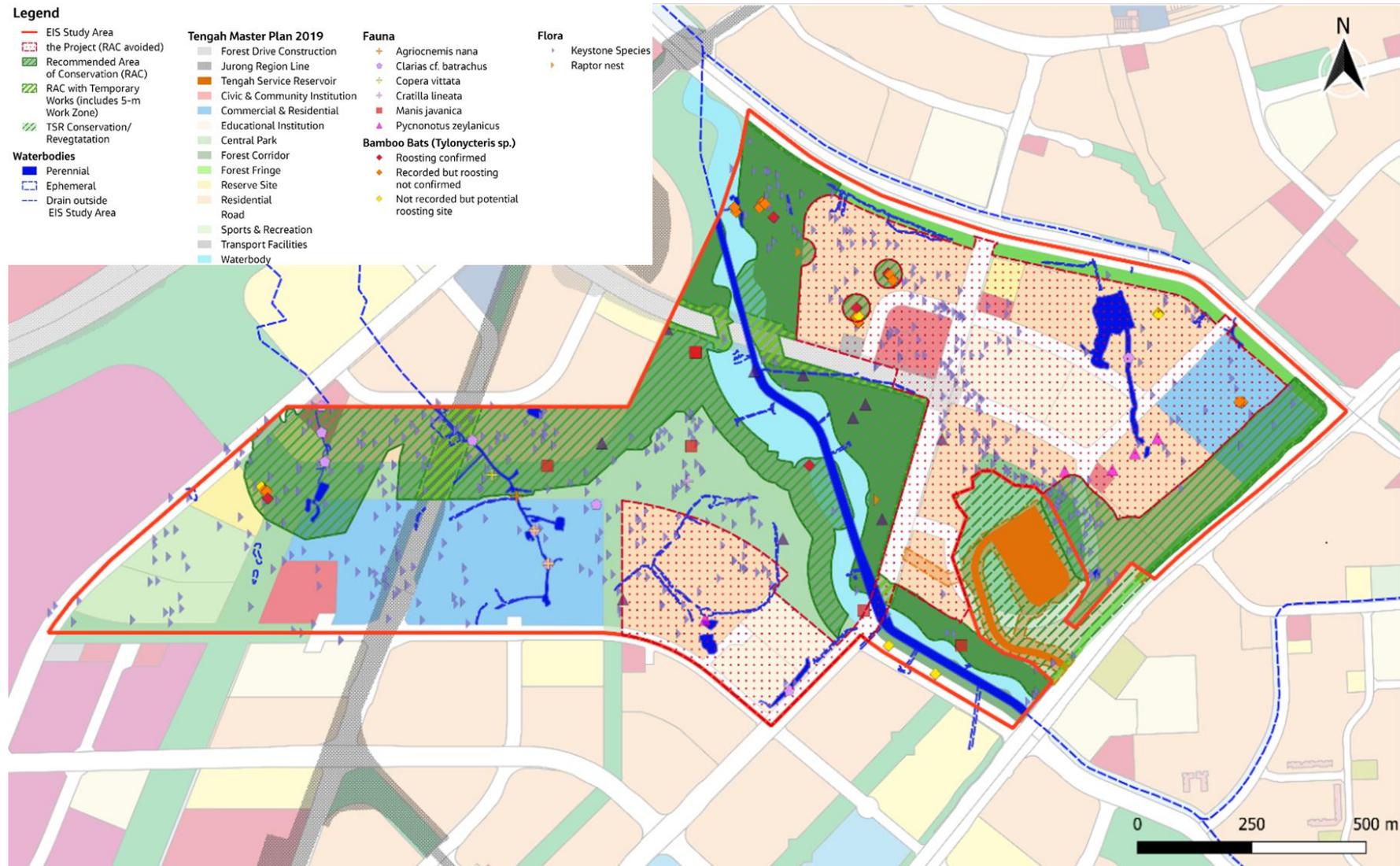


Figure 2-13 Recommended Area of Conservation with a summary of ecological considerations (source: Northern Tengah EIS Report [R-1])

3 Proposed Construction Activities and Timeline

The overall construction activities to be carried out within Area A includes site clearance and development works. The Recommended Area of Conservation (Figure 2-13) will mostly be retained and would not be cleared during construction. Detailed sequence of each sub-activities are still under discussion with NParks. Agencies are working closely on the details and extent of RAC to be retained.

3.1 Overall Construction Timeline

The staging plan for all construction activities has been summarised in Table 3-1. The detailed description of the construction activities are listed in Table 3-2.

Table 3-1 Overall Staging Plan for the Construction Activities within Area A

EMMP Stage	Construction Activity	Total Duration (Month)
Stage 1	Site clearance at 'Tengah Earthworks Phase 3' area	14
	Soil investigation [SI] works at 'Tengah Earthworks Phase 3' area	
	Outlet Drain Phase 1a	
	Tengah Roads Phase 4	
Stage 2	Site clearance and Development works	
Stage 3		

3.2 Key Potential Impacts Identified from Construction Method Statements

A summary of activities and potential environmental impacts during the construction phase which identified from the EIS report [R-1] are provided as follows:

Table 3-2 Summary of construction activities during each construction phase

Construction Works	Detailed Activities	Potential Impacts/Pollution
Advance Works	<ul style="list-style-type: none"> Tree felling, land/ vegetation clearance Site preparation (e.g. site office, worker dormitories and mobile toilets, etc.), erection of mitigation measures (i.e. Earth Control Measures facilities and noise barriers); General works (i.e. machinery maintenance, machinery/ construction material delivery, waste generation, temporary storage prior to disposal); Soil and geotechnical investigation. 	<ul style="list-style-type: none"> a) Human-wildlife conflict; b) Waste management c) Silty runoff; d) Chemical spill; e) Trampling impact on vegetation; f) Soil and water contamination; g) Dust emission; h) Vegetation waste; i) Loss of habitat/ wildlife mortality; j) Noise pollution; k) Changes to ambient temperature; l) Changes to ambient humidity; m) Loss of tree cover; n) Changes in hydrology and water table of surrounding ground area; and o) Sediment tracked onto public roads.
Earthworks	<ul style="list-style-type: none"> Demolition of existing structures; 	<ul style="list-style-type: none"> a) Human-wildlife conflict;

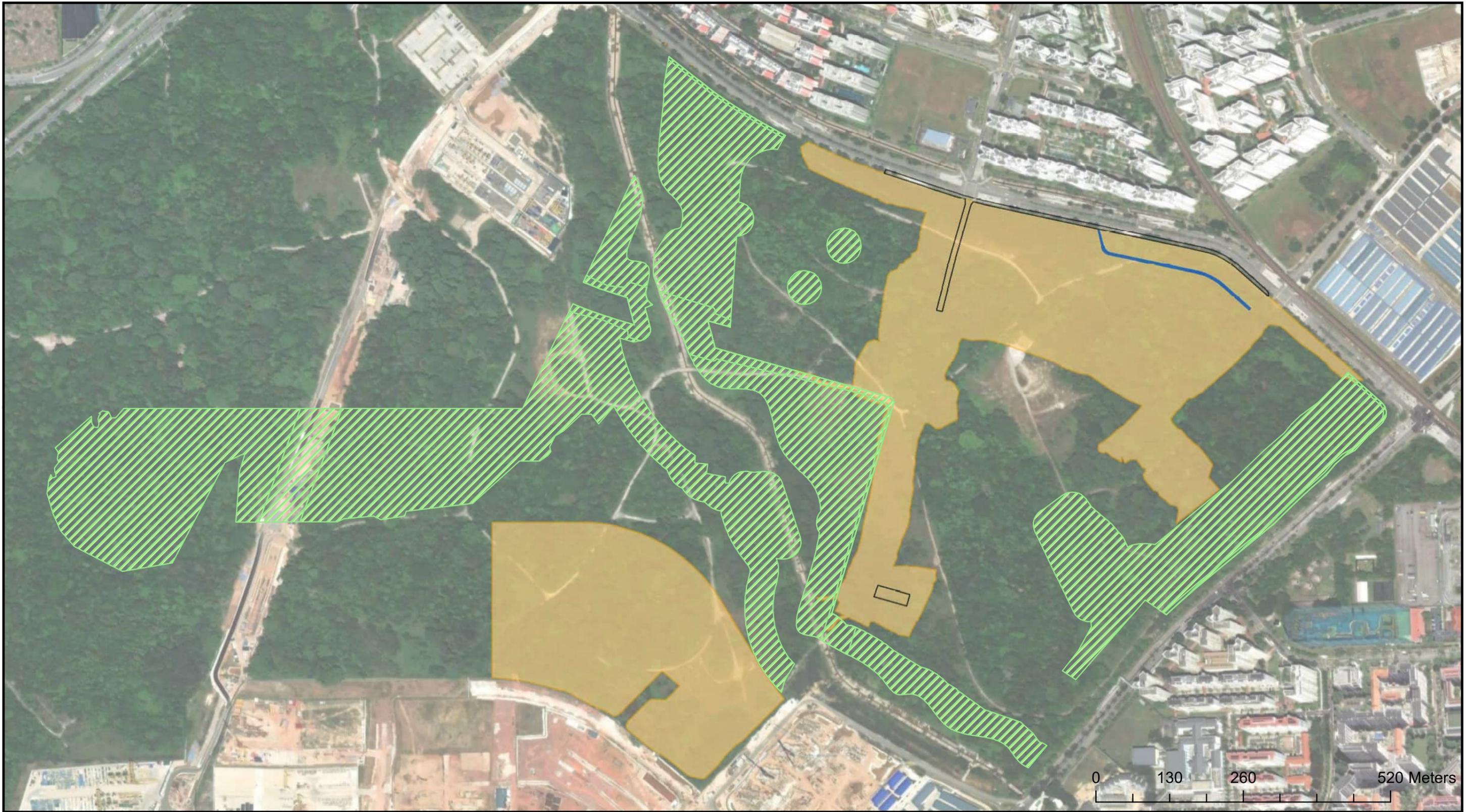
Construction Works	Detailed Activities	Potential Impacts/Pollution
	<ul style="list-style-type: none"> • Drainage and utilities diversion; • Cut and fill/ regrading/ levelling/ platforming, excavation; • Installing sheet pile/ soldier pile/ soil nail; and • General works (i.e. machinery maintenance, machinery/ construction material delivery, waste generation, temporary storage prior to disposal). 	<ul style="list-style-type: none"> b) Dust emission; c) Noise pollution; d) Chemical spill; e) Waste management; f) Silty runoff, discharge of effluent; g) Excavated material; h) Changes in hydrology and water table of surrounding ground area; and i) Sediment tracked onto public roads.
Infrastructure works	<ul style="list-style-type: none"> • Road works; • Drainage and sewerage works; • Mechanical and electrical works; and • General works (i.e. machinery maintenance, machinery/ construction material delivery, waste generation, temporary storage prior to disposal). 	<ul style="list-style-type: none"> a) Dust Emission; b) Noise Pollution; c) Silty runoff, discharge of effluent; d) Excavated material; and e) Sediment tracked onto public roads.
Building Construction	<ul style="list-style-type: none"> • Bottom up construction – substructure foundation and base slab casting; • Bottom up construction – superstructure prefabrication and installation; • Finishing and exterior work; and • General works (i.e. machinery maintenance, material and precast deliveries storage and handling, waste management). 	<ul style="list-style-type: none"> a) Dust Emission; b) Noise Pollution; c) Construction waste; d) Pollution and changes in water chemistry of groundwater and surface runoff; and e) Sediment tracked onto public roads.

3.2.1 Stage 1 of Construction

During Stage 1, construction activities such as site clearance and earthworks are planned to be conducted within the Tengah Earthworks Phase 3 worksites, Outlet Drain Phase 1a worksite and Tengah Roads Phase 4 worksites. Tengah Roads Phase 4 includes the widening of the existing Brickland Road that is north of Area A.

Site clearance for all listed worksites and the construction of the Outlet Drain Phase 1a is expected to be completed by the end of Stage 1. Tengah Earthworks Phase 3 and Tengah Road Phase 4 would extend beyond Stage 1.

The layout and expanse of the worksites during this stage is shown in Figure 3-1.



Legend

- Recommended Area of Conservation
- Construction Activities for Stage 1**
- Tengah Road-Phase4
- Earthworks-Phase3
- Proposed Outlet Drain

Note: HDB are working closely with agencies on the details and extent of the Recommended Area of Conservation to be retained.

Rev.	Date	By	Description	Chk'd	App'd
-	FEB 2023	CQA	Draft Report	NHT	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : **AECOM**

Project Title : **CONTRACT L/189/22
SPECIALIST CONSULTANCY SERVICES
AT HDB DEVELOPMENT (WESTERN):
ENVIRONMENTAL MANAGEMENT AND
MONITORING PLAN (AREA A)**

Designed CQA	Checked NHT	Approved JAG
	Drawn CQA	Date FEB 2023

Client: **HOUSING & DEVELOPMENT BOARD**

Figure Title : **EXPANSE OF CONSTRUCTION WORKSITES
DURING STAGE 1**

Figure No. : 3-3	Rev. -	Sheet 1 of 1
CAD File Name : NA		A3

3.3 Concurrent Construction Activities

The timeline of the Project also interfaces with two concurrent construction activities in the vicinity by Public Utilities Board (PUB) and the Land Transport Authority (LTA). The detailed phasing, schedule, location and footprint of each concurrent projects have been reviewed and considered in the development of this EMMP report.

4 Applicable Environmental Legislation and International References

This section provides a summary of relevant regulatory framework for EMMP. There are cases below where local environmental legislation do not define a criteria, and it was either defined and approved by technical agencies in the previous EIS conducted for the Tengah project, or are sourced from relevant international standards. In such cases, the referenced publication is provided in the sections below as it is deemed applicable in context. During implementation of EMMP, the EMMP Consultant and Contractor should adhere to the regulatory framework presented as follows:

4.1 Biodiversity

The relevant regulations that govern the adherence by the Developer and Contractor to the biodiversity-related measures stipulated in the EMMP are given in Table 4-1.

Table 4-1 Relevant Environmental Legislation

Applicable Legislation	Summary of Relevant Legal Requirement
Wildlife Act, 2020 [R-15]	An Act for the protection, preservation, and management of wildlife for the purposes of maintaining a healthy ecosystem
Parks and Trees Act, 2006 [R-16]	<ul style="list-style-type: none"> An Act to provide for the planting, maintenance and conservation of trees and plants within national parks, nature reserves, tree conservation areas, heritage road green buffers and other specified areas, and for matters connected therewith. No tree with a girth exceeding one meter (when measured 1-m from the ground) should be cut or damaged without the prior approval of the relevant authorities; and No tree or plant will be cut or damaged if located within the heritage road green buffer.

4.2 Hydrology, Surface Water and Groundwater

The legislations governing water pollution control at construction worksite are provided as in Table 4-2.

Table 4-2 Water Pollution Control Relevant Legislation Requirement

Applicable Legislation	Summary of Relevant Legal Requirement
Environmental Protection and Management Act (Chapter 9A), 2020 [R-17]	<ul style="list-style-type: none"> Any discharge (i.e., trade effluent, oil, chemical, sewage, or other polluting matters) into a watercourse should obtain a written permission from the Director-General. Any trade effluent shall be treated before discharge or dispose as per granted written permission. Any plant of treating trade effluent shall be used, worked or operated and maintained in the manner that as required by the Director-General. Any toxic substance or hazardous substance shall not be discharged/caused/permited to be discharged into any inland water.
Sewerage and Drainage Act, 2020 [R-18]	<ul style="list-style-type: none"> Any storm water drainage system or drain shall not be constructed, altered, discontinued or closed up without obtaining a clearance certificate or the approval of PUB. Any works which affect or are likely to affect direct or indirectly any storm water drainage system, drain or drainage reserve: <ul style="list-style-type: none"> ➤ shall obtain and comply the clearance certificate or the approval of the PUB.

Applicable Legislation	Summary of Relevant Legal Requirement
	<ul style="list-style-type: none"> ➤ shall notify PUB in written format before the commencement of the works. ➤ shall provide adequate silt control measures in accordance with any standards or guidelines issued by the PUB before the commencement and for the duration of the works. • Any works which could lead to discharge of silt direct or indirectly into any storm water drainage system, drain or drainage reserve: <ul style="list-style-type: none"> ➤ shall obtain and comply the clearance certificate or the approval of the PUB. ➤ shall notify PUB in written format before the commencement of the works. ➤ shall provide adequate silt control measures in accordance with any standards or guidelines issued by the PUB before the commencement and for the duration of the works.
<p>Singapore Standards 593:2013 Code of Practice for Pollution Control (COPPC) [R-25]</p>	<ul style="list-style-type: none"> • All the wastewaters are to be discharged into a public sewer shall obtain a written waiver from the relevant authority. • Any trade effluent containing Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) exceeding the allowable limits may be discharged into a public sewer shall obtain the approval of relevant authority. • Secondary containment facilities should be provided for storage tanks containing oils and chemicals to contain accidental release. The containment facility should be designed based on the volume of the largest storage tank. • The occupier or owner shall take immediate mitigating measures to control and contain any accidental release, leakage or spillage from its premises and shall notify relevant authority immediately. The occupier or owner shall clean up any land, watercourses or other areas contaminated by such release, leakage or spillage. All wastes generated from the clean-up activities shall be treated and disposed of safely.
<p>Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer. Target Values, Soil Remediation Intervention Values and Indicative Levels for Serious Contamination, 2020 [R-26]</p>	<p>A guideline for when soil/groundwater contamination is suspected on site (e.g. step-by-step risk assessment plan) and procedure on soil remediation in order to minimise the risks of spreading of contamination.</p> <p>In view of the objective to minimise the risks of spreading of contaminations in the groundwater, the following aspects are important:</p> <ul style="list-style-type: none"> ➤ The use of the soil because of the direct connection with the presence of vulnerable objects within the area that may be affected by the groundwater contamination. This concerns the risks due to spreading. ➤ The condition of the soil because of the direct connection with the presence of floating layers, sinking layers, and/or the spreading itself. This mainly concerns the risks of spreading as such, which may cause an uncontrollable situation.

4.3 Air Quality

The legislations governing air quality control at construction worksite are provided as in Table 4-3.

Table 4-3 Air Quality Control Relevant Legislation Requirement

Applicable Legislation	Legal Requirement
<p>Environmental Protection and Management Act, 2018 [R-6]</p>	<ol style="list-style-type: none"> (1) The occupier of any industrial or trade premises must maintain any fuel burning equipment and any air pollution control equipment installed in or on the premises in an efficient condition. (2) The occupier of any industrial or trade premises must ensure that any air pollution control equipment installed in or on the premises is working in a proper and efficient manner whenever the industrial plant or fuel burning equipment is being used. (3) Any owner or occupier of any industrial or trade premises who carries on any trade or industrial process, or operates any fuel burning equipment or industrial plant in or on the premises in any manner that causes, permits or allows the emission of air impurities in excess of the standard of concentration or rate of emission prescribed in respect of that industry, process, fuel burning equipment or industrial plant shall be guilty of an offence.

Applicable Legislation	Legal Requirement
Environmental Protection and Management (Air Impurities) Regulations 2015 [R-7]	<ol style="list-style-type: none"> (1) Every occupier of any industrial or trade premises in or on which any industrial plant or fuel burning equipment is situated shall, if required by the Director-General to do so, provide or install such instrument, equipment or device in or on the premises. (2) The instrument, equipment or device must be of such type and installed in such manner as will enable any person in charge of the industrial plant or fuel burning equipment to readily ascertain at all times and without leaving the boiler room, furnace room or control room, whether smoke is being discharged from any chimney on the industrial or trade premises. (3) The standards of concentration of air impurities that must be complied with in the conduct of any trade, industry or process or the operation of any fuel burning equipment or industrial plant shall be those specified in the Schedule.
Environmental Protection and Management (Off-Road Diesel Engine Emissions) Regulations 2012 [R-8]	<ul style="list-style-type: none"> • No owner of an off-road diesel engine shall use the off-road diesel engine, or cause or permit the off-road diesel engine to be used, if it does not conform to any of the standards for exhaust emission specified in the Schedule.
Environmental Protection and Management (Vehicular Emissions) Regulations 2008 [R-9]	<ol style="list-style-type: none"> (1) No person shall use or cause or permit to be used on any road any motor vehicle from which any smoke or visible vapour is emitted. (2) The driver of every motor vehicle shall, when the vehicle is stationary for reasons other than traffic conditions, stop the engine of or other machinery attached to or forming part of the vehicle.
Environmental Protection and Management (Prohibition on the Use of Open Fires) Order 2008 [R-10]	<p>The use of open fires in any industrial or trade premises is prohibited, except where such open fires are used for —</p> <ol style="list-style-type: none"> (a) the purpose of fire fighting practices; or (b) the disposal of tail gases from industrial plants.
Singapore Ambient Air Quality Targets (Long Term Targets) [W-1]	<ul style="list-style-type: none"> • Stipulates the recommended limit values for ambient concentrations of NO₂, SO₂, PM₁₀, PM_{2.5}, CO and O₃. Target values are based on World Health Organisation (WHO) 2005 Air Quality Guidelines.
UK Institute of Air Quality Management (IAQM) Guidance on the Assessment of Dust from Demolition and Construction [R-11]	<ul style="list-style-type: none"> • The document provides guidance for developers, their consultants and environmental health practitioners on mitigation measures to be carried out during different activities (including demolition and earthworks).

4.4 Airborne Noise

The legislations governing airborne noise control at construction worksite are provided as in Table 4-4 which apply for impact assessment and monitoring / criteria applicable for human receptors in the vicinity.

There are currently no guidelines or standards available to assess the noise from construction phases of the project on the respective ecological receptors. It is to be noted that ecological receptor noise impact will be assessed against project specific criteria - maximum baseline noise level as the noise criterion in this project, which was agreed from agencies and used in EIS Report for Northern Tengah [R-1]. Unattended noise monitoring (1 week) will be conducted by Contractor (refer to Section 7.5.1) prior commencement of site clearance to have a full representation of baseline noise level within/ surroundings of construction worksites. The data will be shared to the EMMP consultant for criteria calculation and re-establish project criteria to apply in all construction stages.

Table 4-4 Airborne Noise Control Relevant Legislation Requirement

Applicable Legislation	Summary of Relevant Legal Requirement
<p>Environmental Protection And Management Act, Environmental Protection And Management (Control Of Noise At Construction Sites) Regulations, 2008 [R-12]</p>	<ul style="list-style-type: none"> • The owner or occupier of any construction site shall ensure that the level of noise emitted from his construction site does not exceed the maximum permissible noise levels set out in the Second Schedule. • The Director-General may, if satisfied that there is justifiable technical reason to do so in any particular case, by notice in writing require the owner or occupier of the construction site — <ul style="list-style-type: none"> ➢ to ensure that the level of noise emitted from his construction site does not exceed such other maximum permissible noise levels as the Director-General may specify; and ➢ to comply with such other terms and conditions as the Director-General may think fit to impose. • Noise level readings shall be taken — <ul style="list-style-type: none"> ➢ one metre away from the outside of any affected building regardless of the distance between the affected building and the boundary of the construction site; or ➢ if a suitable location cannot be found one metre away from the outside of any affected building, at such other location as the Director-General may specify. • If there are other sources of noise affecting the measurement of the level of noise emitted from a construction site, the maximum permissible noise levels set out in the First and Second Schedules shall be adjusted in accordance with the Third Schedule and the adjusted value shall be taken as the maximum permissible noise level. • Construction work shall be deemed to have commenced on the date specified in a permit to carry out structural works in that construction site granted by the Commissioner of Building Control under the Building Control Act (Cap. 29). • The Director-General may, by notice in writing, require the owner or occupier of any construction site— <ul style="list-style-type: none"> ➢ to set up equipment to measure and record the level of noise emitted from his construction site over such duration as may be directed by the Director-General; and ➢ to submit the records of the noise level readings, including all relevant facts which may influence the values of the noise level readings. • The owner or occupier of any construction site located less than 150 metres from any hospital, home for the aged sick or residential building shall ensure that no construction work is carried out at his construction site on the days and during the times specified in the Fourth Schedule. • Director-General may, if he is satisfied that it is necessary in the public interest or for justifiable technical reason to do so in any particular case, permit in writing any construction work to be carried out during a prohibited period specified in the Fourth Schedule. • Any person who fails to comply with regulation 3(1) or 4A(1), or any notice issued by the Director-General under regulation 3(2) or 4, or any term or condition of a permit granted under regulation 4A(2), shall be guilty of an offence and shall be liable on conviction to a fine not exceeding \$40,000 and, in the case of a continuing offence, to a further fine not exceeding \$1,000 for every day or part thereof during which the offence continues after conviction. • Third schedule highlight the adjusted value for the maximum permissible noise level shall be obtained by adding the correction factor corresponding to the difference between the maximum permissible noise level in the First and Second Schedules and the background noise level, set out in the Table below, to the higher of the 2 noise levels. [refer to the table from R-11] • Forth schedule highlight the prohibited periods for construction work commenced on or after 1st september 2011 are as follow; <ul style="list-style-type: none"> ➢ From 10 p.m. every Saturday to 7 a.m. on the following Monday. ➢ From 10 p.m. on the eve of a public holiday to 7 a.m. on the day following the public holiday.

Applicable Legislation	Summary of Relevant Legal Requirement
SS602:2014 Code of practice for noise control on construction and demolition site [R-13]	<ul style="list-style-type: none"> To reduce noise from construction sites, particular attention should be paid to the noise levels from the site equipment (Annex E) and to the recommended method of calculating the expected levels of noise from the construction or demolition site (see Annex B). These should, as far as possible, be consistent with what could reasonably be achieved by observance of the requirements of this Code.
SS593:2013 Code of practice for pollution control (COPPC) [R-25]	<ul style="list-style-type: none"> Specific recommended pollution control requirement and good practices for preventions of noise impacts.

4.5 Vibration

There are currently no regulations for vibration on cosmetic damage and human comfort in Singapore. British standards are suggested in Table 4-5 as a reference.

Table 4-5 Reference Vibration Control Requirement

Applicable Guidelines	Summary of Relevant Guidelines
BS 7385-2:1993 Evaluation and measurement for vibration in buildings. Guide to damage levels from ground-borne vibration [R-2]	<p>Limits for transient vibration shall be kept at:</p> <ul style="list-style-type: none"> 50 mm/s at 4 Hz and above for reinforced or framed structures industrial and heavy commercial buildings; 15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz, and 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above for unreinforced or light framed structures residential or light commercial type buildings; The guide values may need to be reduced by up to 50% for continuous vibration. <p>Cosmetic damage could occur if vibration levels exceed these values.</p>
BS 5228-2 2009+A1:2014: Code of practice for noise and vibration control on construction and open sites – vibration [R-4]	The threshold of human perception to vibration is typically in the PPV range of 0.14 mm/s to 0.3 mm/s. Vibrations above these values can disturb, startle, cause annoyance or interfere with work activities.
Note: Vibration was not assessed in the Tengah North EIS Report [R-1].	

As there is currently no applicable legislation for vibration on ecological receptors, based on AECOM's past project experience, we propose the following project-specific criteria in Table 4-6 for ecological receptors. Contractor shall follow the criteria proposed throughout the construction phase.

Table 4-6 Applicable Study for Ecological Receptors

Applicable Study	Recommended Criteria
Two Case Histories of Blast- & Traffic-Induced Vibrations on the Stability of Burrows of Endangered Sensitive Ground Dwelling Animals [W-2]	<p>It is reported that at PPV, 10.0 mm/s, the motion of the ground may cause burrows of fossorial species to be damaged or collapse, causing potential entombment of the fauna and leading to loss of life. The pangolins nest in burrows and have a home range of 6 hectares. It is unclear what the vibration threshold is for a pangolin burrow to suffer damage due to the lack of information on this species. However, as a preventive measure, vibration impacts on the structural integrity of terrestrial burrows are assessed. Based on AECOM's past project experience, we proposed conservative criteria:</p> <ul style="list-style-type: none"> PPV, 5.0 mm/s to screen for high vibration generating construction activities; and PPV, 8.0 mm/s (equivalent to 80% of the vibration threshold recorded in the literature review for a different species) for assessing the structural integrity of terrestrial burrows.
Note: Vibration was not assessed in the HDB Southern Tengah EIS Report [R-1].	

4.6 Vector Control

The legislations governing vector control at construction worksite are provided as in Table 4-7.

Table 4-7 Vector Control Relevant Legislation Requirement

Applicable Legislation	Summary of Relevant Legal Requirement
Control of Vectors and Pesticides Act (Chapter 59), 2020 [R-19]	<ul style="list-style-type: none"> Any condition which favourable to the propagation or harbouring of vectors shall be not created or caused or permitted. Regulates the qualification of vector control operators, vector control technicians and vector control workers.
Part 3 Control of Infectious Diseases within Singapore, Infectious Diseases Act, 2020 [R-28]	Regulates the destruction and disposal of infected animals, food and water.
Hydrogen Cyanide (Fumigation) Regulations, 2020 [R-27]	Provides guidelines on using the hydrogen cyanide for the fumigation and its residual disposal.

4.7 Waste Management

The legislations governing waste management at construction worksite are provided as in Table 4-8.

Table 4-8 Waste Management Relevant Legislation Requirement

Applicable Legislation	Summary of Relevant Legal Requirement
Environmental Public Health Act (Chapter 95), 2020 [R-20]	<ul style="list-style-type: none"> A guideline which describing the prohibition against: <ul style="list-style-type: none"> dropping, scattering, etc., certain substances in public place dumping and disposing in a public place disposal of industrial waste in unauthorised places Proper storage of industrial waste should be provided as established in the regulation.
Environmental Public Health Act (General Waste Collection) Regulations, 2000 [R-21]	<ul style="list-style-type: none"> Regulate the cleansing and maintenance of general waste collection points. Provide guidelines on disposal of recyclable waste, incinerable waste and non-incinerable waste and the requirement of engaged disposal licensee.
Environmental Public Health (Public Cleansing) Regulations, 2000[R-22]	Provide the disposal guideline on carcasses of any animal.

5 Environmental Management And Monitoring Organisation

This section describes the EMMP organisation, its reporting lines, roles and responsibilities of the parties involved at EMMP stage and the overarching environmental management principles that are to be applied throughout the construction period.

5.1 Objectives

The overall responsibility of the parties involved in the EMMP should:

1. To ensure that the EMMP requirements are planned, implemented and maintained throughout the project in accordance with the regulations drawn by the relevant authorities;
2. To implement the procedures on monitoring and measures the effectiveness of mitigation measures undertaken;
3. To implement corrective or preventive action measures to eliminate non-compliance and environmental incidents; and,
4. To ensure action is taken on the impact to environment pollution issues.

5.1.1 Organisation Chart

The roles and responsibilities of the various parties responsible for implementing the EMMP during the construction phase are outlined in Figure 5-1. Descriptions of each responsible party are outlined below; a full list of responsibilities are provided in subsequent subsections:

- Superintending Officer Representative (SO Rep.): responsible for supervising and overseeing the construction works undertaken by various personnel, contractors and subcontractors;
- EMMP Consultant: responsible for overseeing the implementation of the EMMP by all responsible parties (e.g. Contractors);
- Environmental Control Officer: responsible for following and implementing NEA's Code of Practice for Environmental Control Officers for Construction, and to ensure all work is undertaken by all other parties in line with the Code of Practice; and,
- Contractor: any construction contractors and subcontractors working on site at any time who are responsible for implementing the EMMP.

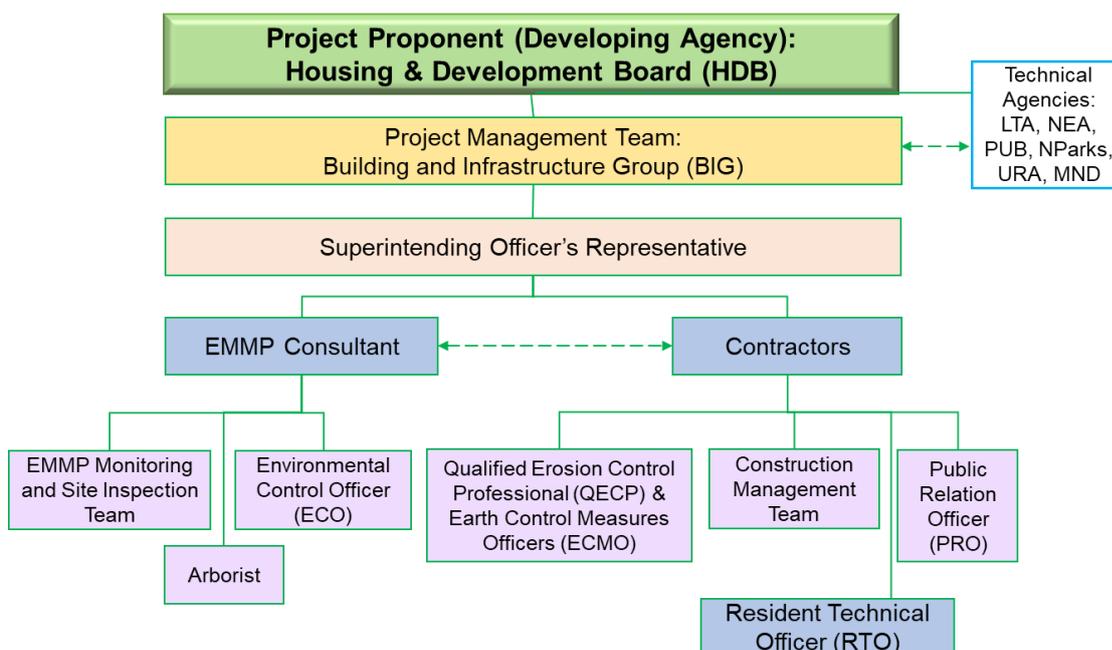


Figure 5-1 Project EMMP Implementation Organisation Chart

5.1.2 Project Proponent

The Project Proponent (PP) or the Client is Housing & Development Board (HDB). And should regularly liaise with the Project Management to review all compliances status during the EMMP implementation. HDB as PP to oversee the construction phase of the project in accordance with the design, and their responsibility include:

- a) To ensure resources are available to achieve the requirements of the EMMP;
- b) To provide guidance and advise on development and implementation of the EMMP;
- c) To ensure all environmental incidents and near misses are promptly investigated and reported;
- d) To resolve any non-compliance issues;
- e) To record, respond to, and action any complaints from members of the public, if any, with inputs from the Technical agencies, if required; and,
- f) To update the Technical Agencies regarding implementation of the EMMP.

5.1.3 Superintending Officer Representative

The Superintending Officer Representative (SO Rep.) is responsible for supervising and overseeing the construction works undertaken by various personnel, contractors and subcontractors. The SO Rep. should ensure that the construction works are performed by the contractors and personnel in accordance with the specification, contractual requirements, and EMMP. The SO Rep. should also:

1. To communicate the requirements of this plan to all staff, contractors and subcontractors;
2. To monitor all staff, contractor's and subcontractor's compliance with contract specifications and regulatory requirements, including the implementation of the environmental mitigation and monitoring measures and ensure their effectiveness, and other aspects of the environmental audit program;
3. To coordinate with the project's Environmental, Health and Safety (EHS) Officer to monitor and participate in the implementation of the environmental audit program, with assistance from the ECO, and ensure that the requirements in the environmental audit program are correctly followed;
4. To appoint third party environmental auditor to check and audit the environmental performance monitoring;

5. To ensure and confirm measures, to reduce impacts where emission/discharge levels are exceeded, are executed by the Contractor. The SO Rep. also acts as a point of contact between the Contractor and EMMP Consultant and should ensure all communications are passed between parties without delay;
6. To coordinate with the Project Proponent and Resident Technical Officer for submission of environmental audit reports;
7. To carry out any complaint investigations and report to Project Proponent;
8. To resolve any non-compliance issues; and,
9. To promote environmental awareness and responsibility and lead by example.

5.1.4 EMMP Consultant

The responsibilities of the EMMP Consultant are as follow:

- To oversee the implementation of the EMMP by all responsible parties (refer to the Organisation Chart in Section 5.1.1);
- To provide advise on environmental issues, where appropriate, or possible;
- To ensure the EMMP Consultant's subcontractors and ECO understand their responsibilities as outlined within the EMMP;
- To advise all parties (e.g. Contractors ECO, Site Engineers, Site Supervisors, Subcontractors and Site Workers, etc.) on matters related to environmental management and promote awareness within the site;
- To prepare and deliver monthly EMMP reporting to SO Rep., PP and Technical agencies (e.g. NParks, if required) based on discussed timeline;
- To carry out bi-weekly environmental site inspection by relevant specialists (air, noise, ecologists, water quality etc) depending on the ongoing activities on site; and,
- To discuss and resolve/mitigate any non-compliance or irregularities with PP/SO Rep./Technical Agencies.
- To coordinate with PP/SO Rep./Technical Agencies on environment matters.

5.1.4.1 EMMP Consultant's Environmental Control Officer (ECO)

The Environmental Control Officer (ECO) appointed by the EMMP Consultant for this Project must comply and follow NEA's Code of Practice for Environmental Control Officers for Construction Sites [R-14]. The roles and responsibilities of an ECO include:

- To assist the EMMP Consultant in undertaking the Project in an environmentally sustainable manner;
- To oversee/audit and manage the environmental impacts of the work sites and to ensure all works comply with the environmental requirements;
- To supervise the mitigation measures implemented by Contractors, identify gaps and to provide recommendation on monitoring and mitigation amendments (if any) to the plan where necessary to the EMMP Consultant;
- To train and educate all site personnel to work in a manner as to respect the surrounding environment e.g. toolbox talk;
- To identify, reporting and record potential and presenting environmental issues on site to the EMMP Consultant;
- To limit or advise to stop any Project activities if potential or presenting environmental issues are identified until rectified;
- To ensure site personnel working in the vicinity of forested area are regularly trained by specialists for biodiversity awareness;
- To notify EMMP Consultant of any such observation that's worthy of environmental concern.
- To discuss all environment incidences which may arise with the EMMP Consultant. ECO will work alongside EMMP Consultant to address incidences; and,

- To inform EMMP Consultant and Contractors to notify NParks/PUB/NEA in the event of environmental emergency (e.g. roadkill, injured animal and oil/chemical spill).

5.1.5 Contractor

The 'Contractor' refers to any construction contractors and subcontractors working on site at any time; this also includes the ECO appointed by the Contractor. Throughout this report, where the ECO is appointed by the Contractor, this is specifically stated.

In addition to reporting to the SO Rep., the Contractors should:

1. Responsible for executing the approved EMMP and mitigation measures on site, whilst ensuring that the requirements outlined in Section 6, related to standard mitigation measures and requirements are followed;
2. Work under the relevant contract scope, approved EMMP specifications;
3. Responsible to carry out works in a manner ensuring compliance to all applicable environmental legislation, environmental policy, mitigation/enhancement measures recommended in the EIS, etc., set by relevant authorities and the Project Proponent;
4. Establish method statements according to recommended mitigation measures, provide relevant information to Contract Specific EMMP Team on potential activities that create adverse environmental conditions;
5. Submit proposal for mitigation measures should there be an exceedance or environmental incident/ complaint;
6. Appoint a Public Relation Officer (PRO) to support the SO Rep. to carry out complaint log, investigation and relating corrective actions to relevant parties;
7. Visually inspect the worksite for wildlife prior to the start of construction activities each day;
8. Maintain the integrity of the worksite hoarding and repair any damages/breaches on a timely basis;
9. Respond in accordance with the Wildlife Response Plan (Section 8.3) upon encountering trapped/injured/dead/dangerous fauna;
10. Ensure that all personnel and external visitors limit their movements and activities (including non-work activities such as resting and eating) to within the worksite boundary. There shall be strictly no movements into adjacent forested areas;
11. Participate in the required environmental site audits (via the SO) undertaken by third party independent Environmental Performance Auditor and undertake corrective actions instructed by the Environmental Performance Auditor;
12. Undertake all monitoring and implement all mitigation measures recommended by the Arborist, Flora Specialist, and Ecologist, as far as practicable;
13. Post the graphical representations of but not limited to the following around the worksite:
 - a. No feeding of wildlife;
 - b. No fishing;
 - c. No littering;
 - d. No food or drinks (outside designated eating areas);
 - e. No cutting of trees or plants; and,
 - f. No smoking (outside designated smoking areas).
14. Deploy only 100% biodegradable Erosion Control Blankets (ECBs);
15. Provide designated sheltered eating areas that are wildlife-proof.;
16. Ensure that all pits, drains, ponds, trenches, tanks that are potential fauna entrapments are suitably covered (e.g., using plywood, mesh, tarpaulin) to prevent fauna from falling in;
17. Trim overhanging vegetation above the worksite hoarding to prevent arboreal fauna from entering the worksite;
18. Besides, for site and/or vegetation clearance before the commencement of actual construction, the Contractor shall engage a certified Qualified Erosion Control Professional (QECP) to prepare an Erosion Control Plan (ECP) and obtain approval from the Public Utilities Board (PUB). Appoint an ECO for designing and

implementing erosion control measures and related works as stipulated in the Code of Practice for Environmental Control Officers [R-14];

19. Obtain approval from relevant authorities before the removal of any trees;
20. Fulfil all relevant authorities' requirements including the submission of a monthly brief report for EMMP by first week of following month to SO Rep.;
21. Undertake trial trenching for the SO Rep.'s assessment, where necessary; and,
22. Install a 6m height noise barrier along the contract boundary and to submit details of the barrier and supporting structure with PE endorsement to the SO Rep. and relevant Authorities for approval and to sign-off the Certificate of Supervision.

5.1.5.1 Public Relations Officer

The Public Relation Officer (PRO) is responsible for handling complaints and managing feedback and investigative work. The PRO shall be supported by the Project Owner, EMMP Consultant's ECO, Contractor representatives, and any other relevant party.

During the construction phase, upon receipt of complaints, the PRO should undertake the following procedures:

1. Log the complaint and record the date when the complaint is received onto the complaint database and inform the Project Owner, SO Rep., and EHS Officer immediately;
2. Investigate the complaint with the ECO to determine its validity and assess whether the source of the problem is due to construction works (the target time for response to the complainant is proposed to be 48 hours);
3. If a complaint is valid and due to construction works, liaise with the ECO and EHS Officer on the mitigation measures and seek agreement from SO Rep.;
4. Review the current situation and the ECO's and SO's implementation of the mitigation measures;
5. Engage the ECO to undertake additional monitoring and auditing to verify the complaint if necessary. Ensure that any valid reasons for complaints do not re-occur by revising the work methods, procedures, machines and/or equipment, etc.;
6. Submit complaint report (as well as the implementation of mitigation measures and the effectiveness of the mitigation measures as advised by the ECO) to the Project Owner, RTO and the SO Rep.; and,
7. Log a record of the complaint, investigation, follow-up actions and the results in the environmental audit report. Management Feedback Form which should be used to capture complaints can be found in Appendix E.

The ECO, EHS Officer, and SO Rep. should provide all the necessary information and assistance to the PRO in order to complete the complaint investigation. Following the investigation, the Contractor should promptly undertake the mitigation measures. The PRO and SO Rep. should ensure that the measures have been appropriately implemented. The Contractor, RTO, and SO Rep. should also be responsible for the reporting of complaint investigation results and followed up actions to the Project Owner.

5.2 Monitoring Data Centralisation

Data recording of the Environmental Quality Objectives (EQOs), commonly known as monitoring indicators, in compliance with the EMMP are labour extensive, and could be open to human errors. To ensure that all monitoring drivers are recorded and managed in a timely manner, a system will be engaged to collect all required data which will be used for data monitoring, reporting and presentation, and analysis, for the purpose of understanding how Construction Works can impact the ecosystem and mankind and to support improved decision making.

An Environmental Data Management System (EDMS) would be developed, that requires the usage of digital software, personnel, and documentation. Implementing a database management strategy will determine the usability of the database, as the dynamic plan is to be managed without the need for additional management input.

Visualization of the EDMS will be implemented through a third-party web-based software (ArcGIS®) is used to proactively manage and confirm that any potential impacts of the Construction Works do not exceed the EQOs for

the project. The all-in-one system provides layers of data that is easily accessible and saves large amounts of time and effort. Other benefits of having an EDMS to manage all monitoring data include:

1. Consolidate monitoring and compliance details;
2. Protect sensitive habitats in close proximity to the Construction Works;
3. Avoid unnecessary delays or work stoppages due to monitoring triggers that are not originated from the Construction Works;
4. Provide transparency and confidence to stakeholders;
5. Secure online access, with customizable access and/or features;
6. Provide real-time alerts and warnings to relevant parties so that appropriate actions can be taken; and,
7. Minimize the likelihood of copy/paste errors, duplication, and other human errors.

Among the EQOs that will be monitored through the ArcGIS® Dashboard for the duration of the Project include:

- a) Biodiversity;
- b) Surface Water and Groundwater Quality;
- c) Air Quality;
- d) Airborne Noise;
- e) Vibration;
- f) Vector Control;
- g) Hazardous Materials and Waste Management;
- h) Stakeholder Engagement;
- i) Construction Progress Tracking; and,
- j) Incident Reporting.

Inputs as shown in Table 5-1 to monitor the EQOs include field data collection applications powered by ArcGIS including Collector and Survey123, raw excel data sheets, and geospatial data setup on ArcMap. These can be uploaded on a centralized platform in ArcGIS Online (AGOL) which can auto-generate reports, maintain excel databases in SharePoint and consolidate the data spatially on an Operations Dashboard. The workflow is presented in Figure 5-2.



Figure 5-2 Workflow for Data Collection and Monitoring

Table 5-1 Required Data Format for the Monitoring Data

Environmental Component	Data Format and Frequency	Data Provider
Hydrology and Surface Water	<p><u>Surface Water Quality: Online-real time TSS monitoring data</u></p> <ul style="list-style-type: none"> To provide embed website link TSS data format in mg/L 	Contractor

Environmental Component	Data Format and Frequency	Data Provider
	<ul style="list-style-type: none"> Data will be auto-updated in the system from time to time 	
	<p><u>Surface Water Quality Monitoring</u></p> <ul style="list-style-type: none"> In-situ water quality data: <ul style="list-style-type: none"> Data unit based on provided parameters in Section 7 The data result of pre-construction stage to be updated manually The data result of construction stage (monthly) to be updated manually Ex-situ water quality data: <ul style="list-style-type: none"> Data unit based on provided parameters in Section 7 The data result of pre-construction stage to be updated manually The data result of construction stage (monthly) received from laboratory testing report to be updated manually 	EMMP Consultant
	<ul style="list-style-type: none"> Any report in PDF format (e.g. complaint, incident, inspection, monitoring and audit) Coordinate of watercourse(s) (i.e. in SVY21 coordinate system format) and photo if available where any complaint/ incident happened or when conducted any inspection/ monitoring/ audit 	Contractor/ EMMP Consultant's ECO/ EMMP Consultant
Groundwater	<p><u>Groundwater Level Monitoring</u></p> <ul style="list-style-type: none"> Data unit in meter The groundwater level data result of pre-construction stage to be updated manually The groundwater level data result of construction stage (monthly) to be updated manually 	EMMP Consultant/ EMMP Consultant's ECO
	<p><u>Groundwater Quality Monitoring</u></p> <ul style="list-style-type: none"> Data unit based on provided parameters in Section 7 The groundwater quality data result of pre-construction stage to be updated manually The groundwater quality data result of construction stage (monthly) to be updated manually 	EMMP Consultant Contractor (where necessary)
	<ul style="list-style-type: none"> Any report in PDF format (e.g. complaint, incident, inspection, monitoring and audit) Coordinate of watercourse(s) (i.e. in SVY21 coordinate system format) if available where any complaint/ incident happened or when conducted any inspection/ monitoring/ audit 	Contractor/ EMMP Consultant's ECO/ EMMP Consultant
Air Quality	<p><u>Air Quality Monitoring</u></p> <ul style="list-style-type: none"> To monitor the real-time 24-hr average concentration of PM₁₀ and PM_{2.5} in µg/m³ using online web-based system The data result of pre-construction stage to be updated manually The data result of construction stage will be auto-updated in the system from time to time 	Contractor
	<ul style="list-style-type: none"> Any report in PDF format (e.g. complaint, incident, inspection, monitoring and audit) Coordinates (i.e. in SVY21 coordinate system format) if available where any complaint/ incident happened or when conducted any inspection/ monitoring/ audit 	Contractor/ EMMP Consultant's ECO/ EMMP Consultant
Noise	<p><u>Noise Monitoring</u></p> <ul style="list-style-type: none"> To monitor the real-time noise levels in terms of L_{Aeq5min}, L_{Aeq1hr}, and L_{Aeq12hr} using online web-based system The data result of pre-construction stage to be updated manually 	Contractor

Environmental Component	Data Format and Frequency	Data Provider
	<ul style="list-style-type: none"> The data result of construction stage will be auto-updated in the system from time to time Any report in PDF format (e.g. complaint, incident, inspection, monitoring and audit) Coordinates (i.e. in SVY21 coordinate system format) if available where any complaint/ incident happened or when conducted any inspection/ monitoring/ audit 	Contractor/ Consultant's ECO/ EMMP EMMP Consultant
Vibration	<p><u>Vibration Monitoring</u></p> <ul style="list-style-type: none"> To monitor the vibration levels in terms of Peak Particle Velocity (PPV) with unit in mm/s The monitoring should be in 1 minute interval The data result of pre-construction stage to be updated manually The data result of construction stage (monthly) to be updated manually 	Contractor
	<ul style="list-style-type: none"> Any report in PDF format (e.g. complaint, incident, inspection, monitoring and audit) Coordinates (i.e. in SVY21 coordinate system format) if available where any complaint/ incident happened or when conducted any inspection/ monitoring/ audit 	Contractor/ Consultant's ECO/ EMMP EMMP Consultant
Vector Control	<ul style="list-style-type: none"> Any report in PDF format (e.g. complaint, incident, inspection, monitoring and audit) Coordinates (i.e. in SVY21 coordinate system format) and photo if available where any complaint/ incident happened or when conducted any inspection/ monitoring/ audit 	Contractor/ Consultant's ECO/ EMMP EMMP Consultant
Waste Management	<ul style="list-style-type: none"> Any report in PDF format (e.g. complaint, incident, inspection, monitoring and audit) Coordinates (i.e. in SVY21 coordinate system format) and photo if available where any complaint/ incident happened or when conducted any inspection/ monitoring/ audit 	Contractor/ Consultant's ECO/ EMMP EMMP Consultant
Biodiversity	<ul style="list-style-type: none"> Monthly site inspection report in PDF format Coordinates and photo if any when conducted site inspection 	Contractor/ EMMP Consultant
Others	<ul style="list-style-type: none"> Project relevant information such as construction stages, timeline (i.e. progress of construction activities), detailed of contractor information Map/Image of worksites progress (e.g. from USGS or Google Satellite) to be updated manually from time to time 	Contractor/ SO Rep.

As the EMMP is a live document, the report will include potential site-specific impacts, mitigation measures that should be implemented, adaptive monitoring and inspection programs as well as reporting and requirement based on the EIS for Northern Tengah. Furthermore, the EQOs developed will be reviewed and updated/tailored as needed over the course of implementation, e.g., new Works are identified or changes in the overall Project scope are made through the Project duration.

Management of tasks in the EDMS is based on the "Plan-Do-Check-Act" principle. To ensure that the EDMS is structured accordingly, management of its data inputs requires the involvement and/or collaboration of the Contractors', Environmental Control Officer(s) ("ECO"), biodiversity specialists, and EMMP consultants. All involved parties stated above will be briefed on the requirements of the EDMS, including the need to inform the EMMP consultant if data inputs were not recorded on time.

Data Inputs to the EDMS will be done through the use of a mobile device with pre-loaded field forms for each EQO, following which, the data will be automatically and immediately checked for compliance to regulatory and/or EMMP limits. The field forms will adequately address the monitoring dates, observations, issues identified, and resolutions

undertaken. Through the EDMS, further checking can be done by the EMMP consultants by comparing the various data against one another with interpretation tools such as infographics, maps, graphs, reports, etc.

Following detection of a compliance breach through alerts and warnings, appropriate mitigation actions shall be undertaken by the responsible party(ies) in a swift manner, to avoid any plausible harmful environmental events. The mitigation measures implemented should be recorded in the EDMS by the responsible party(ies) through the pre-developed forms to close-out the findings.

The EDMS will aid the EMMP consultant in the preparation of the bi-monthly report which will be submitted to the Superintending Officer Representative (SO Rep.). The report would summarize the data inputs of the EQOs, exceedances and/or issues encountered, resolutions undertaken, effectiveness of mitigation measures and lessons learned (if applicable), and would include attachments such as photos, verification reports, etc.

The commitment of the stakeholders responsible for the implementation of the EMMP is bound by the conditions of contract set forth in the contract of the Contractor. As such, the contract of the contractors shall contain the appropriate environmental management provisions that will be used in for the EDMS.

6 Standard Mitigation Measures For Construction Activities and Environmental Trainings

6.1 Standard Mitigation Measures and Requirement for the Construction Activities

The standard mitigation measures and requirement for environmental components (i.e. biodiversity, air quality, airborne noise, water quality, groundwater, vibration, etc.) throughout the construction period are outlined below. Whilst all standard mitigation measures and requirements are summarised, not all measures are applicable for all stages of construction. For clarity, the demarcation for roles and responsibility for each measure are outlined in subsequent sections (i.e., Section 7 onwards).

It is the responsibility of the Contractor to execute the mitigation measures, following the outlined protocols in this Section. The EMMP Consultant's ECO is responsible for supervising the implementation of the measures.

6.1.1 Biodiversity

Standard Mitigation Measures and Requirements: Biodiversity

Flora Monitoring and Management Plan

Sapling Harvesting and Tree Transplantation

Prior to site clearance works, any viable saplings and conservation significant trees that are suitable for harvesting shall be identified by the Arborist. Guidelines for sapling harvesting and tree transplantation are detailed in Appendix A.

Salvaging of Species of Conservation Significance

During the pre-construction stage, the Flora Specialist will assist in identifying specimens of species of conservation significance (CS species) with a girth size of < 0.3 m or below that are suitable for the salvaging procedure. This procedure should be carried out before any vegetation clearance. The Flora Specialist is to work with NParks to identify viable specimens suitable for salvaging.

Verification and Review of Footprints for Hoarding, Access Roads and Soil Investigation Works

After the worksite hoarding has been installed, the Flora Specialist shall conduct an inspection to verify that the hoarding alignment is as proposed. based on the site setting out by the contractors, taking reference of the proposed hoarding footprint This is to ensure that no excessive vegetation and tree removal has occurred as a result of deviations in the hoarding alignment.

The Flora Specialist shall also review the proposed locations for the soil investigation works and the alignment of the construction access roads with the Client/Contractor. Feasible alternatives, if possible, shall be proposed to minimise vegetation and tree clearance. Prior to any vegetation clearance required for soil investigation works to take place, the Flora Specialist will need to assist in identifying suitable CS species specimens for salvaging, as detailed in the EIS and pre-site clearance fauna inspections will also be conducted.

Monthly Flora Inspections

Monthly visual inspections will be conducted in the forested area adjacent to the worksite up to 15 m from the hoarding. These areas may be forest patches that were delineated as part of the Recommended Areas of Conservation (RAC) in the Tengah North EIS Report [R-1]. The following will be achieved through the inspections:

- I. Identification of any unauthorized removal of flora within the RAC, or areas beyond the demarcated development workspace.

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- II. Identification of direct/indirect impacts to sensitive vegetation and habitats. Such impacts include soil erosion and degradation that have resulted from construction activities, and unauthorised dumping of waste material, construction debris or oil/chemical leakage.
- III. Identification of forest edge effects and recommendation of mitigation measures, where necessary.
- IV. Assessment of the status of invasive flora species and weeds and recommendation to remove them, where necessary.



Figure 6-1 Monitoring of Vegetation and Trees along the Hoarding Line for Unauthorised Vegetation Clearance and Forest Edge Effects

Tree Monitoring and Management Plan (Arboriculture)

The Contractor's method statement for site clearance, tree felling and setting up of TPZ shall be reviewed by the Arborist to ensure compliance to the specifications. The site clearance and tree removal method statements shall consider directional felling methods with a hinge and back cut. Trees shall not be removed by pushing with an excavator or other heavy machinery. Cranes shall be deployed to offset the tension of trunks in the direction of the drop. Interlocking canopy branches shall be pruned prior to tree felling.

In cases where design changes may affect additional trees or the retained trees, the Arborist shall work with the structural engineers and recommend solutions that will meet NParks guidelines. Whenever reasonable and practicable, cleared vegetation in particular at sloped areas shall be covered with mulch or with 100% biodegradable fauna-friendly ECBs to control erosion of exposed soil. Exposed ground shall be revegetated as soon as possible to stabilise surfaces and minimise re-entrainment of dust and potential for erosion of waste spoil to watercourses.

Clearance activities on-site shall not occur during rainfall or when storm events are forecast to occur within the vicinity to protect forest edge from wind throw. Where forest edges are exposed to wind, temporary measures (e.g., additional hoarding) shall be discussed with the Arborist, and put in place to protect the forest edge during storm events. During site clearance, care will be taken when removing trees in riparian zones to reduce impacts to the bed and banks of waterways. Where practicable, saplings, seeds and seed banks will be retained within the soil profiles for use in forest restoration. Horticultural waste shall be removed on the same day. This is essential to reduce risk of fauna taking refuge within the cleared waste if left overnight.

Monthly Tree Inspection

The following shall be conducted by the Arborist during the monthly tree inspection, or when necessary:

Standard Mitigation Measures and Requirements: Biodiversity

- I. Review of method statements of construction works in proximity to retained trees, if any, to determine if additional tree removal is required post-site clearance.
- II. Recommendation of solutions such as design changes, reduction of working space, reduction of TPZ area and reassessment of trees in cases of conflict with proposed works.
- III. Assessment of physiological health, vigour and structural stability of retained trees. Recommend additional mitigating measures if necessary.
- IV. Assessment of the condition of retained trees, if any, to ensure that there has been no deterioration or mechanical damage and to determine if additional tree removal is required.
- V. Where a tree exhibits signs of stress, the Arborist should inspect the tree and advise on strategies to reduce further impacts and rehabilitation measures. Where monitoring indicates that drying out or edge impacts are occurring, remediation measures shall be undertaken. These measures may be temporary (such as carrying out watering when there is seven continuous days without rainfall). Long-term solutions shall be investigated and implemented.
- VI. Where tree disease outbreaks are identified, the appointed Arborist, shall advise measures to manage them, when necessary, as part of tree maintenance and care. Guidelines are provided in Appendix A.
- VII. Inspection of the integrity of TPZs.

Fauna Monitoring and Management Plan

Fauna Management During Site Clearance

The objective of fauna management during site clearance is to remove target fauna from the worksite before construction works begin to prevent fauna entrapment, injury and mortality, whilst minimising contact between human and wildlife. Target fauna species include ground-dwelling mammals such as the Eurasian wild boar (*Sus scrofa*) and Sunda pangolin (*Manis javanica*), as well as animals that may be implicated in human-wildlife conflicts (e.g., snakes) during site clearance.

Prior to the start of works, the worksite, or the portion where works are occurring at, should be completely hoarded up. A survey will then be conducted to determine if there are Eurasian wild boars trapped within the hoarded areas. If Eurasian wild boars are detected, NParks should be informed. After the completion of the operations, site clearance should be conducted in a directional manner towards an identified forested wildlife refuge area. The disturbance generated by site clearance activities is expected to encourage the remaining target fauna to move out of the worksite on their own.

The overall sequence of events is as follows: 1) hoarding installation, with pre-site clearance fauna inspection to be conducted if site clearance is needed; 2) establishment of wildlife corridors; 3) hoarded areas will be surveyed for Eurasian wild boars; 4) NParks to be informed if there are trapped Eurasian wild boars; 5) site clearance to proceed directionally, with pre-site clearance fauna inspections to be conducted prior to felling; 6) bamboo bat rescue and release to be conducted if bamboo clusters need to be cleared. The following sub-sections detail the above steps.

Hoarding Installation

The hoarding installation should follow the below specifications:

- I. The hoarding shall be at least 2.4-m high, with the surface facing the worksite coloured in white so that it is visually apparent to fauna.
- II. Where internal hoarding will be set up to partition the site into smaller zones, the hoarding can be 1.8-m high.
- III. The hoarding must not have any gaps between the panels and are to extend at least 300 mm into the ground, in order to prevent burrowing animals from entering the site.
- IV. The sequence of the hoarding installation will be reviewed by the Ecologist to ensure that disturbance generated by the hoarding installation activities does not cause fauna to venture onto adjacent roads. Hoarding should be installed adjacent to roads first, followed by areas furthest from identified refuge areas, and finally the remaining areas.
- V. After hoarding installation is completed, the Ecologist shall inspect the hoarding to ensure its integrity and ability to prevent fauna entry/exit.

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Figure 6-2 Examples of (A) Temporary Internal Hoarding for Demarcating the Site into Smaller Zones; (B) Temporary Internal Hoarding Used as Wildlife Exit Point; and (C) Wildlife Exit Point

Pre-site Clearance Fauna Inspection

Prior to site clearance, the Ecologist shall conduct a fauna inspection in areas slated for clearance. Inspections shall also be carried out for any removal/pruning/trimming of vegetation/trees after site clearance is completed. Inspections will have the following objectives:

- I. Identify (potentially) active animal nests, hollows, burrows and other nesting structures, and any animals that may potentially get trapped/injured or die during site clearance. Animals (e.g., snakes) that may be implicated in human-wildlife conflict during site clearance will also be identified. The workflow for the inspection is shown in Figure 6-4. The validity of each inspection is seven days;
- II. Rescue and release of bamboo bats from bamboos;
- III. Report and document any fauna observations and recommend mitigating measures; and,
- IV. Coordinate the response to wildlife encounters, following the Wildlife Response Plan.

Where fauna is found to be present on vegetation to be cleared, the affected vegetation shall be marked with coloured tags/tape. The fauna shall be allowed to leave on their own prior to vegetation clearance. Where eggs, chicks, or young fauna are found in nests, they shall be allowed to fledge or leave the nests on their own prior to vegetation clearance. The Ecologist shall conduct subsequent checks to ascertain that the fauna has left prior to vegetation clearance.

Where it is not possible or ideal to allow the fauna to leave on its own (e.g., a venomous snake that is feasible to catch) relocation shall be considered and implemented by certified wildlife management contractors, in consultation with NParks and in accordance with the Wildlife Response Plan (Section 8.3).

Where the Ecologist deems there is a risk of injury/death to fauna even though there is no immediately apparent findings during the inspection (e.g., nest in good condition but fauna activity not observed/visible), the Ecologist shall be present on-site during the removal of the affected vegetation to facilitate the implementation of the Wildlife Response Plan where necessary. Elevating equipment shall be deployed where necessary and feasible to inspect nests, hollows and other nesting structures.

The Ecologist shall submit an inspection report indicating the date of the inspection, tree tag number (and/or location coordinates if untagged), observations, recommended mitigation measures, and photographic evidence within 24 h of the inspection.

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Figure 6-3 Pre-site Clearance Fauna Inspection Conducted by Ecologists to Identify Active Nests, the Presence of Fauna, and Other Habitat Structures that May Require Vegetation or Trees To Be Removed or Felled Under the Supervision of An Ecologist

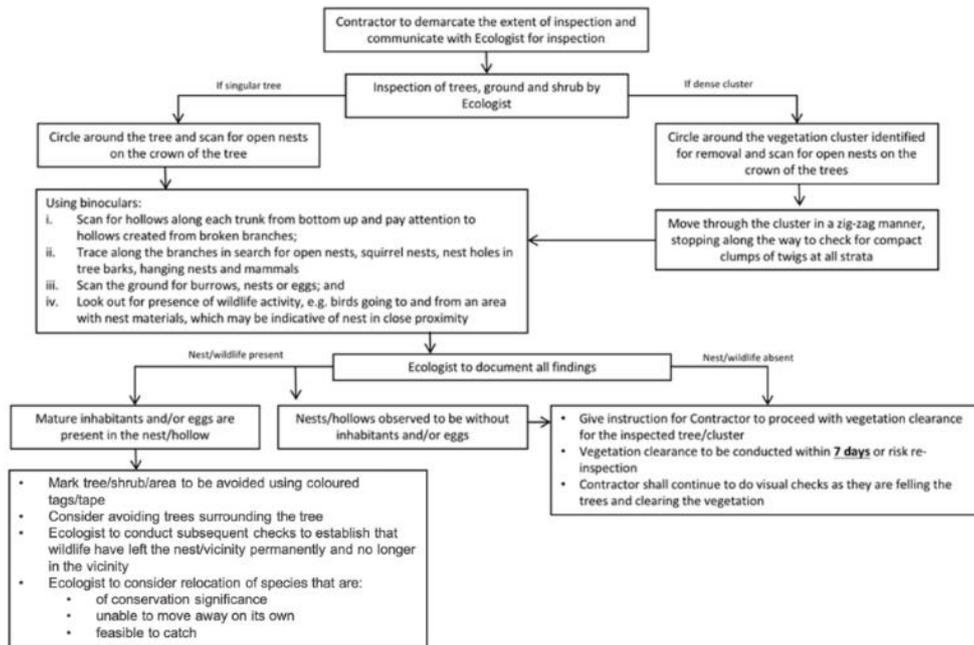


Figure 6-4 Workflow for a Pre-felling Inspection Protocol

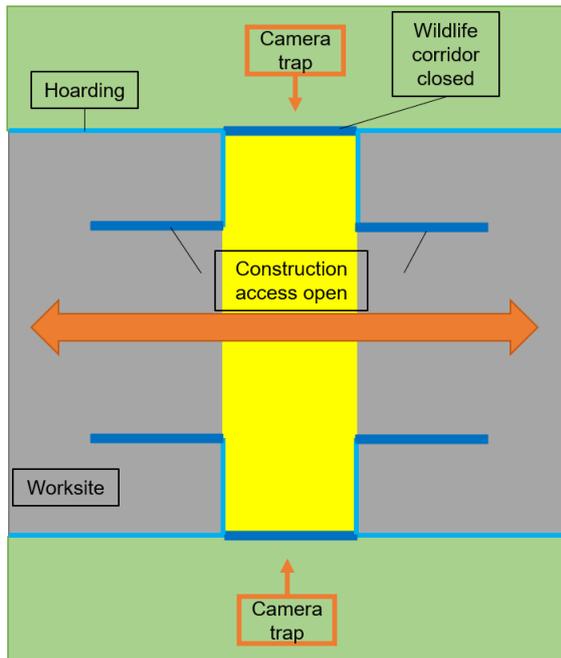
Establishment of Wildlife Corridors

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As multiple concurrent developments will take place in the area, consideration will need to be taken to maintain ecological connectivity throughout the site, and the establishment of wildlife corridors is recommended. An illustration of a wildlife corridor is provided in Figure 6-5 and detailed below:

- I. The wildlife corridor should be at least 6-m wide.
- II. The wildlife corridor should be closed during construction hours (0800–1800h) and opened after construction hours (1800–0800h) daily, or when there are no works in the area.
- III. The wildlife corridor shall be at least 1.8-m high; temporary internal hoarding can also be used to demarcate the wildlife corridor from the worksite (Figure 6-2).
- IV. Prior to the wildlife corridor being closed in the morning, Contractor to walk the entire length of the corridor and ensure that no fauna remains within the corridor; the Wildlife Response Plan to be activated if fauna is present (Section 8.3).
- V. Two camera traps will be deployed per wildlife corridor to monitor for wildlife usage, and the traps will be placed at each end of the corridor. The data from the camera trap will be retrieved monthly.

During construction hours



After construction hours

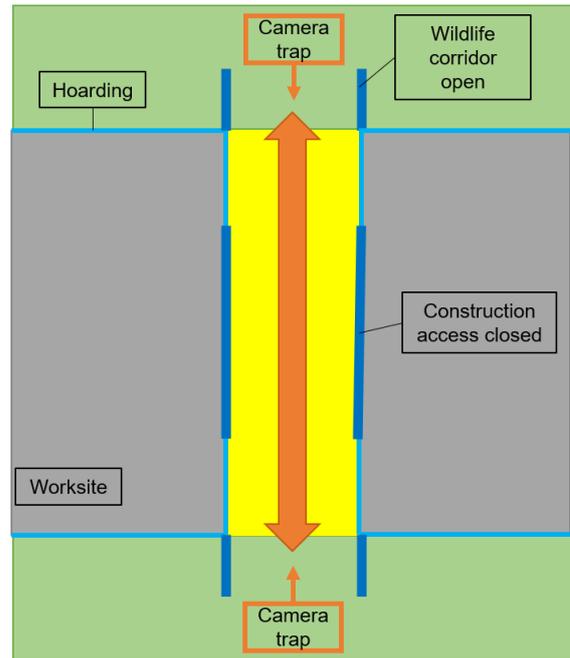


Figure 6-5 Diagrammatic representation of a wildlife corridor.

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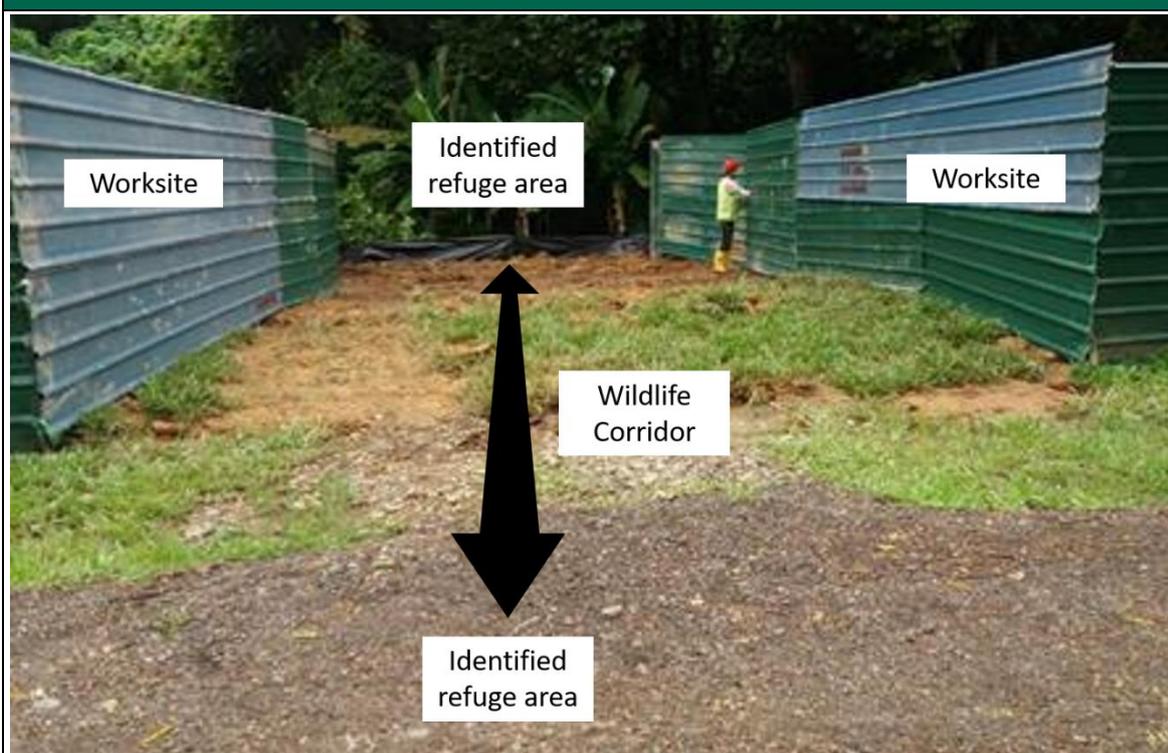


Figure 6-6 Example of a wildlife corridor when opened after construction works.

Two developments in the vicinity of the project area may affect the overall wildlife connectivity: PUB project and LTA project. Taking into consideration the timeline overlap and locations of these other projects, as well as any wildlife corridors in these developments, an overall pathway for wildlife movement has been proposed, as shown in Figure 6-12. It is important for all Development Agencies of concurrent projects to coordinate and communicate in the operation of all wildlife corridors, ensuring that the entire wildlife pathways across Tengah site is left unobstructed. Communication between Development Agencies and follow up actions will also be updated or recorded in EMMP reports as and when required.

Camera Trap Monitoring for Eurasian Wild Boar Presence (under discussion with NParks)

After the hoarding installation is complete, camera trap monitoring will be conducted to determine if any Eurasian wild boars (*Sus scrofa*) are trapped within the hoarded areas. Camera traps will be deployed at a density of one per 1 ha for a duration of seven days. Each camera trap will be positioned at least 20–30 cm above ground, or higher, depending on site conditions (Figure 6-10). The camera traps will operate 24 hours a day, and be programmed to record 10-second footage per motion trigger with a 10-second quiet period following each trigger. At the end of seven days, the data from the camera traps will be retrieved. Camera trap location, the number of individuals, and age-sex class of the individuals will be recorded for each video with a positive capture of Eurasian wild boars.

Directional Site Clearance

During site clearance, vegetation should be cleared in a specified direction towards an identified wildlife refuge area, i.e., clearance should start from furthest the refuge area, and proceed towards the refuge area. This allows more mobile fauna to exit the worksite on their own. If any fauna is trapped within the site, the Wildlife Response Plan should be activated (Section 8.3). Directional site clearance prevents isolated vegetation patches from being left on site, which may allow fauna to hide and thereby, becoming trapped on site.

Rescue and Release of Bamboo Bats

Bamboo bats (*Tylonycteris* spp.) are insectivorous bats that roost in the internodes of bamboo. The bats enter and exit the internodes via slits on the bamboo stem made by beetles, and may utilise multiple roost sites [P-1]. In Singapore, there are two species of bamboo bats—the lesser bamboo bat (*T. fulvida*) and the greater bamboo bat (*T. malayana*). Both species are listed as nationally Vulnerable [W-3]. To prevent injury and mortality to bamboo bats if they are residing in the affected bamboo clusters, as well as to safeguard the threatened population of bamboo bats in Singapore, it is recommended that they be rescued as the

Standard Mitigation Measures and Requirements: Biodiversity

bamboo clusters are being removed. The protocol detailed in this section will be activated when bamboo clusters deemed suitable for bamboo bat usage needs to be felled.

One session of bamboo bat roost emergence survey will be conducted for each affected bamboo cluster before clearance works begin to determine the presence of bamboo bats within the cluster. The surveys will occur between 1830–2100 h, during which two to three Ecologists will be stationed around each bamboo cluster to observe for bamboo bat activity, and to identify slits in the bamboo stems that are used as roosts. Torches will be used to aid in the detection. Stems bearing active slits will be marked, and the number of bats residing within each slit will be documented. A handheld acoustic detector, the Echo Meter Touch 2 Pro (Wildlife Acoustics, Inc.) connected to a mobile device or Song Meter Mini (Wildlife Acoustics, Inc.), will be used to detect the ultrasonic echolocation calls that are unique to each species and can be used to identify bats. The detector converts the ultrasonic calls to low frequency signals below 20 kHz, a range that is audible to the human ear. All bat calls are automatically recorded on either a mobile device or a tablet device.

On the day of the bamboo cluster removal, the Ecologists will seal the slits of known roosts with mesh and tape if feasible, and the section of the bamboo stem bearing the roost will be cut with a chainsaw and lowered in a controlled manner, ensuring that the section remains intact. All bamboo bats found occupying the stems will be held within the bamboo stems. If bamboo bats were not determined to be present during the roost emergence survey, the Ecologists may also be present during the removal of the bamboo cluster to inspect each stem for roosting bamboo bats.



Figure 6-7 Ecologist Sealing Slit of Known Bamboo Bat Roost with Mesh and Tape

The remaining stems of the bamboo cluster will be cut stem by stem using a chainsaw/hand saw/parang, provided this is deemed a feasible and safe method by the site clearance or tree-felling contractor. Where manual cutting is unfeasible, a grabber excavator may be used to remove the stems bit by bit from the base of the cluster. The stems shall be kept as intact as possible during felling. Each stem will be inspected by the Ecologists for holes that are possible bamboo bat roost entrances. When such a hole is identified, the Ecologist will check for the presence of bamboo bats within the internode by inserting a camera or prying open holes with a chisel and hammer. All bamboo bats found occupying the bamboo stems will be held within the bamboo stems if they are still intact. Mesh and tape will be used to seal the holes of the roosts. If the bamboo stems are too damaged to be sealed, the bamboo bats will be vacated into individual cloth bags.



Figure 6-8 Holes of the Active Roosts Sealed with Mesh and Tape, and Sections of the Bamboo Stems Bearing the Roosts Cut with a Hand Saw and Lowered in a Controlled Manner

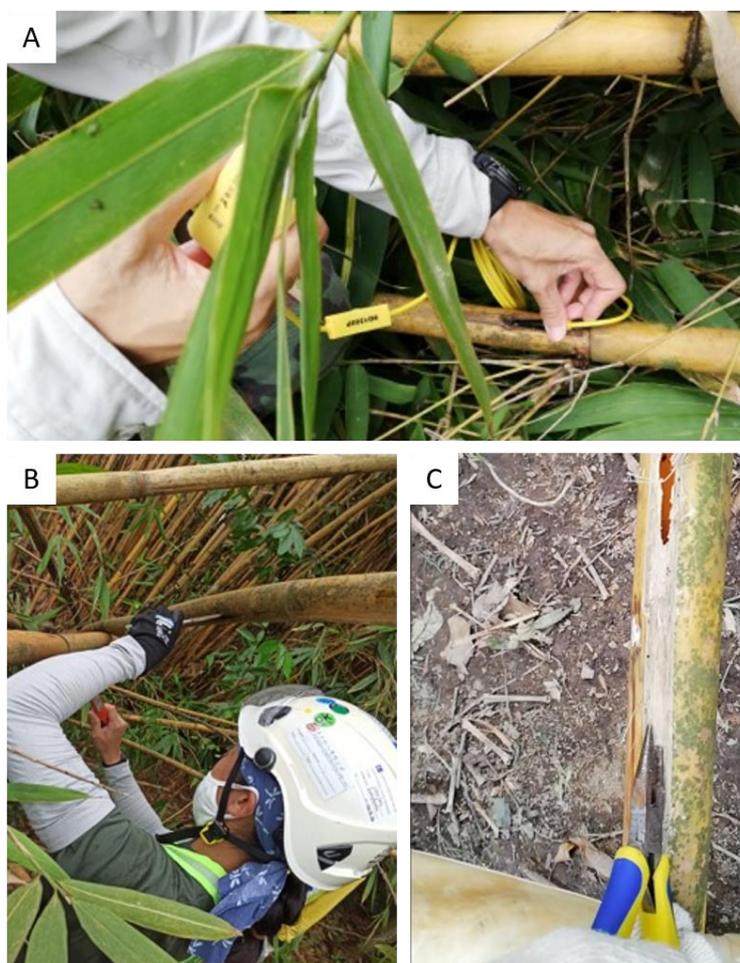


Figure 6-9 The Presence of Bamboo Bats Within Potential Roost Sites Will Be Verified by (A) Inserting A Camera Probe Into the Internode, or by Using Tools Such As (B) A Chisel and Hammer or (C) Pliers to Open Up the Internode for Inspection

After the bamboo clusters and felled stems have been completely removed from the worksite or destroyed, any rescued bamboo bats shall be released on the spot and tracked visually until out of sight. If the felling of a bamboo cluster cannot be completed by the end of the day (i.e., 1800 h), any rescued bats shall also be released. Bamboo bats are released on the spot as the bats would be familiar with the landscape, and be able to navigate directly to alternate roost sites or other refuge areas. To prevent

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released bats from utilising felled bamboo stems, the stems will either be removed from the site or destroyed (e.g., crushed using an excavator) immediately after clearance.

Should trapped/injured/dead bamboo bats be encountered, the Wildlife Response Protocol will be activated (Section 8.3). Injured bamboo bats may be held in plastic tanks lined and covered with cloth. Bat handling will be performed by experienced Ecologists properly trained in bat handling techniques and safe work practices. The Ecologists are also inoculated for rabies. The following health and safety controls are taken into consideration during bat handling process:

- I. All personnel handling bats have received pre-exposure rabies inoculations prior to handling bats and will maintain up-to-date tetanus immunisations.
- II. A first-aid kit will be brought on-site for all site work.
- III. There is a risk of rabies infection or other zoonotic diseases from bites or exposure to saliva incurred while handling bats. This risk is emphasised in written and verbal instructions to all field personnel.
- IV. Keep bats calm by using items such as towels to cover them so they are less likely to bite and scratch.
- V. As bamboo bats are very small, wearing puncture-resistant leather gloves may compromise on dexterity during handling and result in injury to the bats. Hence, surgical gloves will be worn instead. In the event personnel are bitten or scratched by bats during handling, immediately wash the wound site with water, then apply an iodine or alcohol-containing antiseptic.

Site Inspections

Site inspections will be conducted bi-weekly, i.e., once every two weeks on-site during the construction phase. Any findings on the following items will be documented;

- I. Presence of trapped/injured/dead fauna
- II. Potential fauna entrapments (e.g., ECBs, TPZs, pits, drains, ponds, trenches, tanks)
- III. Gaps in hoarding that may allow entry of ground-dwelling fauna
- IV. Improperly disposed/stored food and food packaging
- V. Proper ECM measures are put in place
- VI. Degradation of adjacent sensitive habitats (e.g., streams, forest)

Daily site inspections for the below items should also be undertaken by the Contractor on-site during the construction phase:

- I. Potential fauna entrapments (e.g., ECBs, TPZs, pits, drains, ponds, trenches, tanks)
- II. Improperly disposed/stored food and food packaging
- III. Proper ECM measures are put in place

Roadkill Surveys

During the construction phase, roadkill surveys shall be undertaken daily at major roads adjacent to the site, i.e., Brickland Road and Bukit Batok Road (Figure 6-11). This should be conducted by Environmental Control Officer, with manpower and vehicular support from the Contractor when necessary. The objective of the survey is to monitor for fauna mortality. Roadkill surveys will be conducted between 0700h to 1000h. If any live animals attempting to cross the road, injured animals or roadkill carcasses are observed, the surveyor will follow the protocol described in the Roadkill Response Plan (Section 8.4). The animal will be visually identified to species, or the next lowest taxonomic level. The timing and location of each sighting will also be recorded. The Roadkill Response Plan (Section 8.4) should also be executed if any roadkills or wildlife-vehicle collisions are observed opportunistically.

If there are more than two incidents of wildlife-vehicle collisions or roadkills involving Sunda pangolin (*Manis javanica*), leopard cat (*Prionailurus bengalensis*) and Eurasian wild boar (*Sus scrofa*) occurring within seven days of each other, the EMMP Consultant and Contractor are to investigate the cause of the incidents and carry out rectifications (e.g., review hoarding plan, reinstate damaged hoarding) within one week.

The Contractor shall also report all incidents of wildlife-vehicle collisions or roadkills inside the worksite as and when they are observed, and adhere to the Wildlife Response Plan (Section 8.3).

Fauna Monitoring

Fauna monitoring shall commence one month prior to the start of site-clearance works. The objectives of the monitoring will be to supplement baseline fauna data obtained during the EIS report [R-1]. Indicative survey locations are shown in Figure 6-11.

Faunal field surveys will target the following taxa: 1) amphibians, 2) reptiles, 3) birds, and 4) mammals (excluding bats). Each survey will be conducted by at least two surveyors. All fauna encountered will be identified to species, or to the next lowest

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taxonomic level possible, and the location of each sighting will be recorded using a handheld GPS (Garmin GPSMap® 64s). The number of individuals observed will be also documented.

Transect Surveys

Diurnal (0700h–1000h) and nocturnal (2000h–2300h) surveys along 200-m continuous transects on a sampling route will be carried out. Three survey routes have been identified, and they will all be surveyed in the pre-construction phase. Transect surveys will target (1) amphibians, (2) reptiles, (3) birds, and (4) mammals (excluding bats).

Fauna species will be located and identified either visually, aided by binoculars and/or cameras as required, or by call recognition for vocalising species. Torches and/or headlamps will be used to elicit eyeshine during nocturnal surveys. As fauna may occupy a wide range of habitat types, active searches for individuals on the ground, below rocks, logs, leaf litter and debris, in the water, within burrows and tree holes, and/or on vegetation will be conducted. Tracks, scats and holts will also be recorded. For amphibian and reptilian species that are capable of quick retreats and escapes, the individuals will be captured by hand, or using hooks, tongs, or dip nets for identification. Captured individuals will be released immediately after identification.

During the pre-construction phase, all sampling routes will be sampled once; during the construction phase, fauna monitoring will be conducted monthly. The sampling routes will be alternated between months, i.e., each sampling route will be surveyed once every two months.

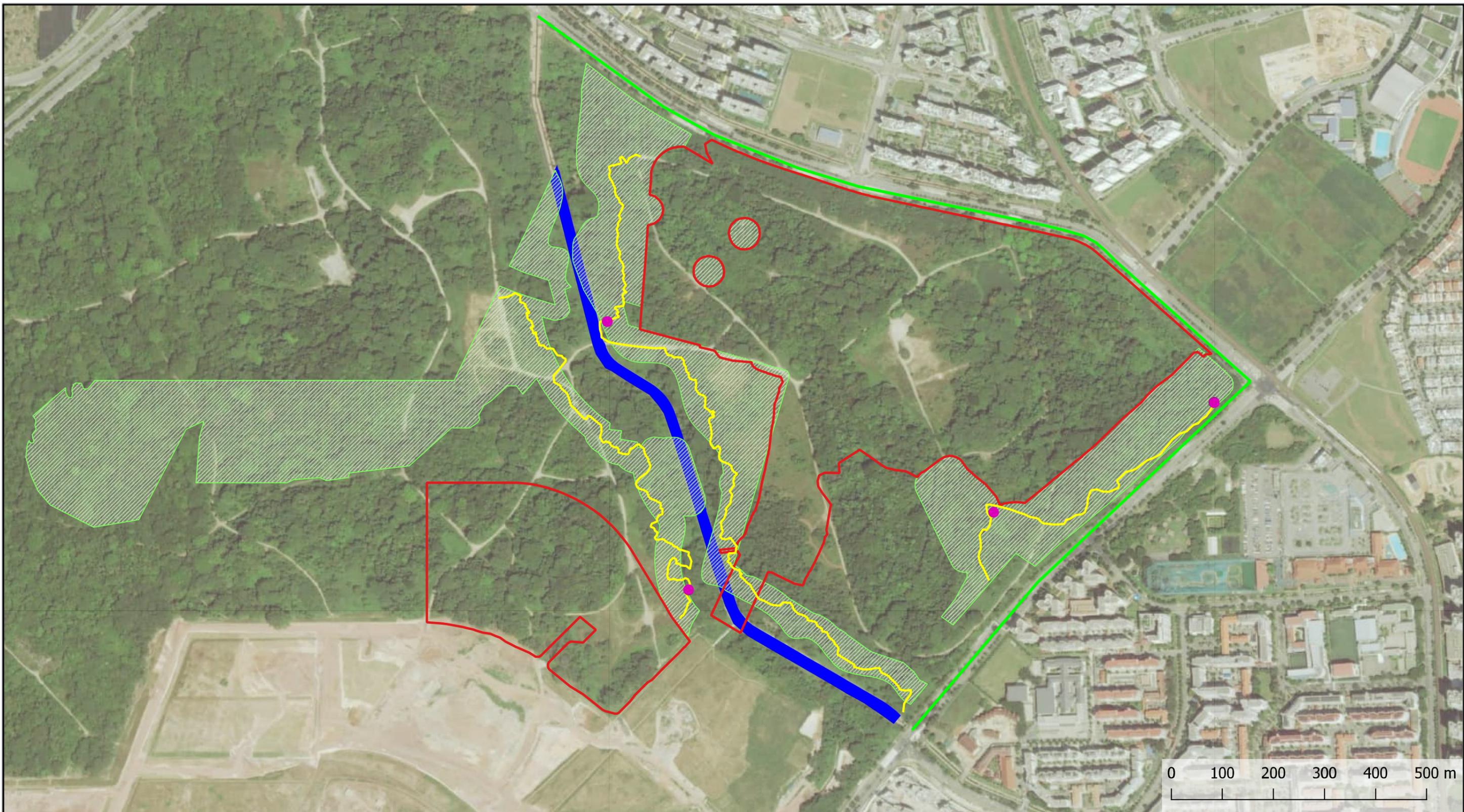
Camera Trapping (under discussion with NParks)

Each camera trap will be positioned at least 20–30 cm above ground, or higher, depending on site conditions (Figure 6-10). The camera traps will operate 24 hours a day, and be programmed to record 10-second footage per motion trigger with a 10-second quiet period following each trigger. A total of four camera trap locations have been identified (Figure 6-11). In later stages of the Project, disturbance from the Project may discourage fauna from moving through these areas, and hence camera traps will be deployed in these areas. At any time, at least four camera traps will be deployed throughout the construction stage. The data from the camera traps will be retrieved on a monthly basis.

Camera trap location, species identity, and the number of individuals will be recorded for each video with a positive capture of fauna.



Figure 6-10 Camera Trap Set-up



Legend

- EMMP boundary
- Recommended area of conservation
- Main canal

Fauna monitoring survey locations

- Camera trap locations
- Transect route
- Indicative roadkill transect

N

Rev.	Date	By	Description	Chk'd	App'd
-	JAN 2023	ISA	Final Report	NHT	JAG

Qualified Person Endorsement :
NA

URA Endorsement : NA

Consultant : **AECOM**

Project Title :
**CONTRACT L/187/22
SPECIALIST CONSULTANCY SERVICES
AT HDB DEVELOPMENT (WESTERN):
ENVIRONMENTAL MANAGEMENT AND
MONITORING PLAN (AREA A)**

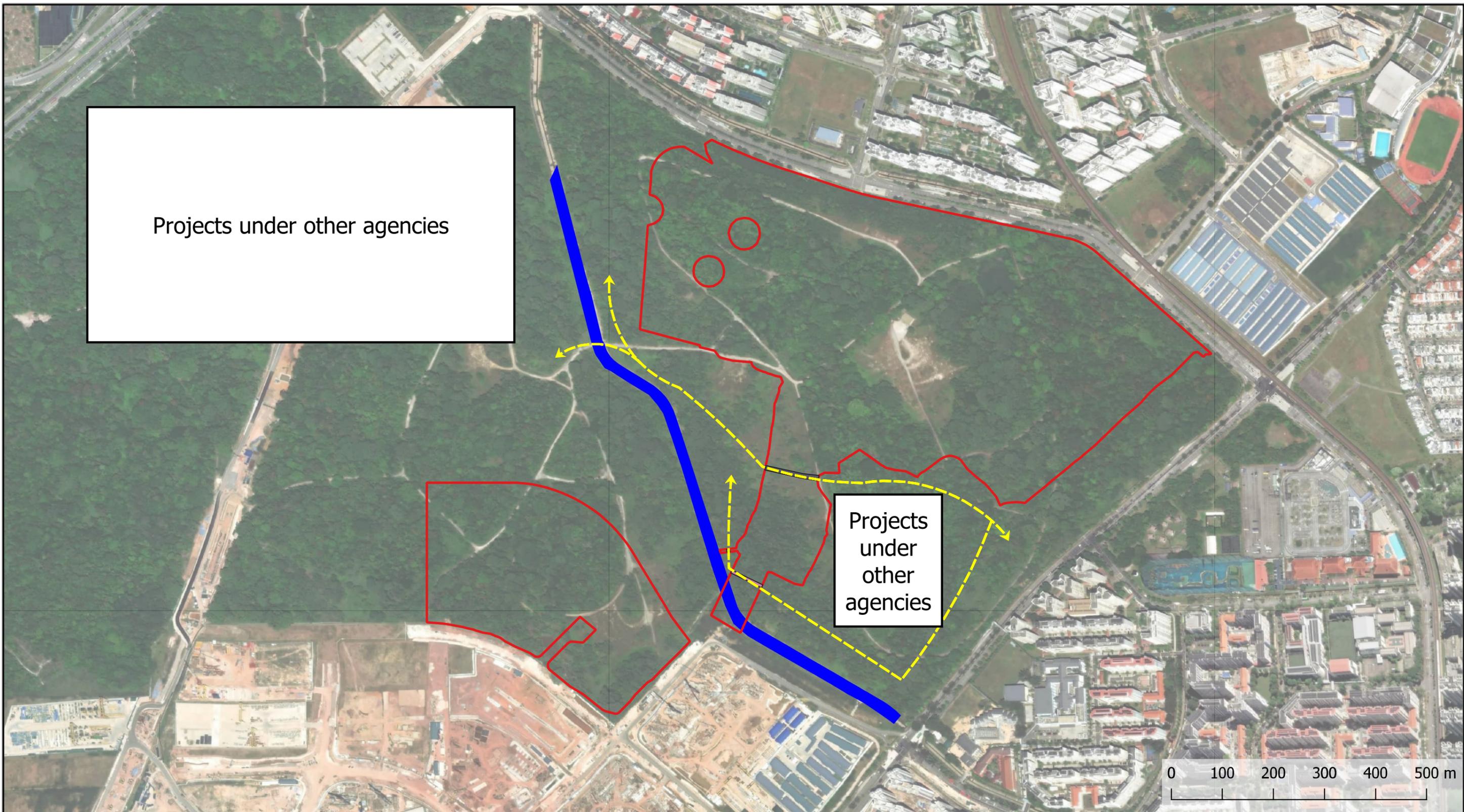
Designed ISA	Checked NHT	Approved JAG
Drawn ISA	Date JAN 2023	

Client: **HOUSING & DEVELOPMENT BOARD**

Figure Title :
INDICATIVE FAUNA MONITORING LOCATIONS

Figure No. : 6 - 11	Rev. -	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map



Projects under other agencies

Projects under other agencies



Legend

- EMMP boundary
- Recommended area of conservation
- Main canal
- Indicative wildlife pathways
- Indicative wildlife corridor 1
- Indicative wildlife corridor 2
- Indicative wildlife corridor 3
- Wildlife movement
- Projects under other agencies

N

Rev.	Date	By	Description	Chk'd	App'd
-	FEB 2023	ISA	Final Report	NHT	JAG

Qualified Person Endorsement : NA

URA Endorsement : NA

Consultant : **AECOM**

Project Title :
**CONTRACT L/187/22
 SPECIALIST CONSULTANCY SERVICES
 AT HDB DEVELOPMENT (WESTERN):
 ENVIRONMENTAL MANAGEMENT AND
 MONITORING PLAN (AREA A)**

Designed ISA	Checked NHT	Approved JAG
Drawn ISA	Date FEB 2023	

Client: **HOUSING & DEVELOPMENT BOARD**

Figure Title :
**PATHWAY FOR WILDLIFE MOVEMENT
 THROUGH THE SITE**

Figure No. : 6 - 12	Rev. -	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

6.1.2 Hydrology, Surface Water and Groundwater

Standard Mitigation Measures and Requirement: Hydrology, Surface Water and Groundwater

- The whole of planning, designing, submission of Earth Control Measures plans by a Qualified Erosion Control Professional to PUB including installation, maintenance, monitoring, reports, erosion control blankets, CCTV at discharge points, silt fences, silt trap, sedimentation tanks, ECM detention facilities to comply with clause 7.1.5 of the Code of Practice on Surface Water Drainage, etc.;
- The Contractor should moderate the earth works in tandem with the ECM provision. He shall regulate the earthworks carefully to keep the contractor from exposing more areas that he could handle;
- The CCTVs provided by the Contractor are to check the overall ECM performance from the development and link the system to Silt Imagery Detection System (SIDS) to provide auto alerts on silt discharge and no/poor images;
- Contractor should ensure that their CCTV system is properly operated and maintained at all times. It is also meant to curb Contractors from deliberately tampered with the CCTV system to mask the silty discharge;
- Biodegradable erosion blankets shall be provided to the areas with bare soil surface within the same day of the soil is exposed;
- The Contractor shall ensure that the existing drains shall not be filled or interfered without the prior approval from PUB; free flow in the existing drain is maintained at all times until the permanent diversion drain is constructed and functioning effectively. He shall carry out whatever necessary works to ensure that runoff within upstream of and adjacent to the site can be effectively drained away without causing flooding within the site and in the vicinity of the site;
- Sediment Control Plan should be prepared to include but not limited to the sealing of site hoarding, a berm shall be provided along the site hoarding to prevent silty water to leak out from the site and ramp/curb at site entrance;
- The Contractor is required to divert any existing drains that affect the works. The Contractor shall ensure that the work is carried out properly to prevent flooding of site. Any abandoned portions of the drains upon diversion are to be filled up by the Contractor;
- The Contractor shall obtain approval from the SO Rep. and/or Public Utilities Board (Drainage) on any diversion of existing drains and canals prior to commencement of the diversion work;
- All existing drains are to be desilted during pre-construction and construction stages. The Contractor shall be responsible for the cleanliness of the above drains throughout the duration of the construction;
- In view of the deep excavation for the construction of drains, sewers and manhole if any, earthworks, all associated temporary works (shoring/ protection works), methods of excavation, construction sequences and contingency plans are to be designed and duly endorsed by the Contractor's appointed Professional Engineer (Civil) [referred to as PE (Civil)] and Professional Engineer (Geotechnical) [referred to as PE (Geo)], if necessary and required under BCA Statutory Acts. The PE (Civil) and PE (Geo) shall submit plans, work-methods, safety measures, temporary works, monitoring (movement, vibration, settlement cracks, etc.) and work procedures as required by the relevant Authorities;
- The Contractor shall be required to set up adequate settlement benchmarks as deemed necessary by SO Rep. to monitor the settlement of the existing or adjoining properties/structures, if any, throughout the piling operation and excavation;
- The monitoring programme of the surveying works on settlement benchmarks shall be submitted to the SO Rep. for approval;
- When any of the following criteria is reached irrespective of whether damage has occurred, the Contractor shall notify the SO Rep. immediately:
 - 5mm settlement or movement between consecutive readings
 - 15mm total settlement of any part of a building/structure
- The Contractor shall design, supply, install and maintain real-time CCTV camera & monitors including operation, relocations, recordings & maintenance, along Site Boundary. Proposed locations & relocations of the CCTV camera shall be submitted to SO Rep. and HDB for approval before installation on site. The CCTV recordings in videos and photos format shall be submitted to SO Rep. office on a weekly basis in softcopy, stored and backed up in the server and ensure no accidental erasure throughout the construction period;
- The Contractor shall take all precautionary measures and/or protections needed for the construction of the proposed temporary roads, drains, sewers and manholes if any, earthworks and temporary works, to ensure the proposed works and existing structures (including those mentioned above) are safe, sound and in functioning conditions;
- Undertake a programmatic Excavation, Cut and Fill and Earthmoving plan. The construction work should be done accordingly in stages and programmed segments to minimise the area disturbed at any given time. By minimising the disturbance area affected by excavation and earthworks to what is only necessary, potential erosion and topsoil loss may be reduced;
- Topsoil removed will be stockpiled in a designed area and covered as necessary to prevent soil loss from secondary erosion. Soil conserved can be used for backfilling and improvement of stream vegetation for

Standard Mitigation Measures and Requirement: Hydrology, Surface Water and Groundwater

areas that lack concrete slope protection. Excess soil material should be stored properly where it can be reused.

- Use approved materials, of the same or better quality as the surrounding area, for backfilling works. All backfilled material will be free of debris, and of good material soil.
- Open canopy areas where continued soil loss may occur may need replacement of Erosion and Sediment Control (ESC) structures to capture eroded soil that can be returned back to the buffer zones for amelioration. ESC structures can likewise be strategically built adjacent to cut and fill, excavation and stockpiling sites;
- In development areas where groundwater hydrostatic pressure will be potentially high, piezometers and monitoring wells may be placed adjacent to proposed subsurface structures. Shoring and dewatering with pumps may be undertaken as needed during construction activities where increased hydrostatic pressure is expected to cause leaching into construction areas. Automatic pumps may be installed which will operate when critical piezometric levels are exceeded;
- Alternative in-situ recharge zones can be designated within the remaining conservation areas or green-belts to compensate for permanent loss of recharge areas that will be disturbed by the placement of at-grade and subsurface infrastructures. As discussed under soil loss and changes in infiltration, the designated buffer zones can partly alleviate the reduction of groundwater recharge to the aquifer system beneath the construction worksite;
- The impact on surface water features sustained by perched groundwater flow through springs and other surface conduits that can be affected by the disturbance of aquifer-hosting rock units during cut-and-fill activities can be alleviated by providing artificial recharge through installation of groundwater or diversion reinjection wells to replace the loss of surface water infiltration;
- Water Recycling: The objective is to minimise the amount of discharge from the construction site to the surface water drainage system;
- Provide storage tanks or reservoirs with additional 20% capacity and number to temporarily store/ contain muddy surface runoff before treatment;
- Whenever possible, segregate clean water flow from silty water flow to maximize the sedimentation tank holding capacity;
- Provide sufficient treatment units or coagulant units to treat silty water before discharging into public drain within 10 hours of rain event;
- Concrete and demolition debris, water used for dust control, and groundwater should not be allowed to cause erosion within the work area or to run offsite;
- Provide sufficient numbers of maintain proper sanitary facilities. It is recommended that there be one portable toilet per 10 pax and serviced 3 times per week. Appoint a NEA's Licensed Water Collector (LWC) to conduct regular collection of sewage discharges for disposal;
- Portable toilets are recommended to be installed on paved ground and bunded;
- On-site dormitories are recommended to install container toilets and secure written approval from PUB to connect into public sewers;
- Establish a regular maintenance work schedule to check and maintenance cleanliness and functionality of sanitary facilities on site, at least once a week, depending on the amount of sanitary facilities;
- Suitable containers shall be used to hold the chemical wastes to avoid leakage or spillage during storage, handling, and transport;
- Chemical waste containers shall be labelled following the Globally Harmonised System of Classification and Labelling of Chemicals in the four national languages (i.e., English, Chinese, Malay and Tamil) and other commonly used languages on site to avoid accidents. There shall also be clear instructions showing what action to take in the event of an accident;
- Chemical storage areas should be adequate, on paved ground, bunded, sheltered and located away from waterways and drains. Safety data sheets (SDS) should be kept together with the stored chemicals;
- Any construction equipment which causes pollution to the water system due to leakage of oil or fuel should be maintained or removed off-site immediately;
- Spillage or leakage of chemical waste to be controlled using suitable absorbent materials. Used absorbent materials should be disposed through a licensed third-party toxic industrial waste disposal contractor;
- Secondary containment with capacity of more than 10% volume for single large container and 25% of the total volume of multiple containers should be used for all chemical stores and diesel generators to minimize spillages and contamination of soil and surface water. Care should be taken around water channels to avoid toxic chemicals such as petrol/ diesel/ oil/ paint/ thinner leak from equipment;
- Emergency response procedures shall be developed and implemented;
- Good housekeeping practices shall be implemented to minimise careless spillage and to keep the storage and the workspace in a tidy and clean condition. Appropriate training including safety codes and relevant manuals should be given to the personnel who regularly handle the chemicals on site;

Standard Mitigation Measures and Requirement: Hydrology, Surface Water and Groundwater

- Any soil contamination with chemicals or oils shall be removed from site and sent to a licensed third-party toxic industrial waste collector for offsite disposal. The void created shall be filled with suitable materials;
- A temporary drainage channel and associated facilities shall be provided to collect the runoff generated and prevent concrete-contaminated water from entering watercourses. The trade effluent must be isolated and collected and may be treated offsite before being discharged if there are space constraints. Adjustment of pH can be achieved by adding a suitable neutralising reagent to wastewater prior to discharge. The treated water from construction activities be treated to levels prescribed by NEA/ PUB and must have written approval from NEA/ PUB if it will be discharged into public drains/ sewer;
- Appropriate concrete wash out areas shall be provided and shall not be performed in or near any of the streams;
- If on-site treatment is not feasible, wastewater must be stored separately and collected by licensed third-party toxic industrial waste collector for offsite treatment; and
- 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 Qualified Professionals (QP).

6.1.3 Air Quality

Standard Mitigation Measures and Requirement: Air Quality

GENERAL MITIGATION MEASURES TO BE IMPLEMENTED THROUGHOUT CONSTRUCTION PERIOD.

Minimum Control:

- No demolition of permanent structure is expected as part of the project.
- No concrete batching plant to be located on-site.
- Installation and proper maintenance of dust screen, fencing or hoarding along construction site perimeter to reduce dust deposition at adjacent areas.
- Access road construction or expansion is recommended to be completed first and paved before the construction of other development commences.

Communications:

- Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
- Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
- Contractor to follow up on Air Quality control measures
- Develop and implement an Air Pollution Control Plan (APCP)
- Contractor to prepare the Site Environmental Control Program in accordance with NEA's guidelines, which is to be submitted by Contractor to the Director-General of Public Health of NEA two weeks before the commencement of construction. Contractor should implement Environmental Control Programme specific to the construction works undertaken by the contractor.
- Contractor to prepare and submit bi-weekly Site Environmental Control Report to EMMP Consultant and SO Rep. in accordance with NEA's guidelines.
- Contractor should engage Public Relation Officer (PRO) to establish good rapport with the community, handle and feedback complaints from the community.

Site Management:

- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
- Make the complaints log available to the local authority when asked.
- Record any exceptional incidents# that cause dust and/or air emissions, either on-site or off- site, and the action taken to resolve the situation in the log book.
- Hold liaison meetings with other high risk construction sites within 500m of the site boundary, if any, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised.

Monitoring:

- Undertake regular (daily frequency recommended) on-site and off-site inspections and record results. The log should be made available to the NEA or other Government Agencies if required. Inspections should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary. Cleaning should be provided if necessary.
- Carry out regular site inspections to monitor and record compliance with the Air Pollution Control Plan.

Standard Mitigation Measures and Requirement: Air Quality

- Increase the frequency of site inspections during prolonged dry or windy conditions.
- Conduct monitoring for dust at suitable locations.
- If the ambient air quality level during construction exceeds the SAAQT, contractor should investigate the cause and implement more stringent mitigation measure.
- If there be any complaints from the community with regards to air quality during construction, additional ambient air quality monitoring shall be conducted.

Preparing and maintaining the site:

- The Contractor shall arrange his method of executing the works such that there shall be no dust nuisance created.
- Plan site layout so that machinery and dust causing activities are located away from receptors, where possible.
- 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.
- Fully enclose specific activities where there is a known high potential for dust production and the site will be active for an extensive period of time.
- Keep site fencing, barriers, and scaffolding clean by cleaning regularly using wet methods (dry methods may give rise to fugitive dust).
- Remove materials that have the potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site, stockpiled material should be covered, seeded, fenced or enclosed to prevent fugitive dust formation.
- The tree felling activity shall be in a way that minimise dust generation, e.g. using dust screen/ dust suppression and do not oversize the root ball trenching.
- Construction site perimeters and adjacent roads or lands shall be regularly inspected to check for dust and if necessary, remove dust deposition.
- Contractor should keep extent of excavation and soil exposure areas to minimum required for construction.
- Exposed soil and dusty material at the construction site and its boundary shall be dampened with water regularly, with the misting frequency increased during dry periods.
- Exposed site shall be properly treated by compaction, turfing, vegetation planting or sealing with bituminous materials, concrete or other suitable materials as soon as practicable after Project completion. Treat exposed earth by compaction, hydro seeding, vegetation planting, or cover with impermeable sheeting.
- Stockpiles and excavations shall be removed, backfilled or reinstated (as appropriate) by contractor as soon as practicable following excavation or unloading. If contractor needs to store excavated material on site, it will be entirely covered with impervious sheeting and the stockpile shall be removed as soon as practicable.
- Applying water to excavation areas, soil loading/unloading areas and unpaved roads.

Operating vehicle/machinery and sustainable travel:

- Any atmospheric pollution (in the form of smoke, fumes, vapours, dust and other pollutants) shall be effectively controlled. Air pollution control requirements such as the concentration and rates of omission of air pollutants shall be within legal limits. The SO Rep. reserves the right to request for a newer machine or an emission control device be installed if any machine or plant is deemed to be producing excessive greyish/ black smoke. All dusty operations must be adequately shielded and/ or arrested with water at point of impact.
- Impose and signpost a maximum-speed-limit of 25 km/hr on paved or surfaced haul roads and 15 km/hr on unpaved haul roads and work areas.
- Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.
- Ensure all vehicles and engine powered equipment comply with the legislative requirements of Singapore
- Ensure all vehicles and equipment switch off their engines when stationary – i.e. no idling vehicles or engines. Clear signs will be erected at site entrance to inform all visitors.
- Where practicable, avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment
- Maintaining all machinery, including excavators and gen-sets regularly, to minimize smoke and dust exhaust emissions.

Construction:

- 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.
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate. Use fine water sprays on equipment wherever appropriate.
- Use enclosed chutes and conveyors and covered skips wherever possible.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment.

Standard Mitigation Measures and Requirement: Air Quality

- A stringent “Clean as you go” Policy should be implemented on site to ensure no loose dry material is left exposed when not in use. Equipment should be readily available on site to clean and dry spillages, and cleaning should be conducted as soon as reasonably practicable after the event using wet cleaning methods.
- Maintaining a minimum moisture content during any rock rushing works.
- Covering soil stockpiles with erosion control blankets.

Waste Management:

- Avoid burning of waste or other materials

Trackout:

- The Contractor shall maintain sufficient workers to constantly clean all public roads where soil is deposited from the Contractor’s vehicles leaving the site.
- The Contractor shall install hard surfaced haul routes and employ suitable means of spraying with water the haulage roads across any part or parts of the site and along the public roads used by the Contractor to reduce dust nuisance to the absolute minimum.
- Load of dusty materials on a vehicle leaving a construction site shall be covered entirely with impervious sheeting by contractor. Vehicle should not be overloaded and shall be cleaned prior to leaving the site.
- Proper cover for vehicle (e.g. tipper lorry) to avoid falling of soil debris. Any skip hoist used to transport dusty materials shall be completely enclosed by impervious sheeting.
- Avoid dry sweeping of large areas. Use water-assisted dust sweeper(s) on the access and affected local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
- Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.
- Record all inspections of haul routes and any subsequent action in a site log book.
- Site access gates to be located at least 10m from receptors where possible.
- Vehicle washing facilities with high pressure water jets shall be provided by contractor at every discernible or designated vehicle exit point from construction site. Vehicle washing area and road section between washing facilities and exit point shall be paved.
- If roadways are contaminated with dusty materials from construction site, clean-up shall be conducted without delay.

ADDITIONAL R-11 MITIGATION MEASURES TO BE IMPLEMENTED DURING EARTHWORKS.

- Use Hessian, mulches or soil tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.
- Only remove the cover in small areas during work and not all at once.

6.1.4 Airborne Noise

Standard Mitigation Measures and Requirements: Airborne Noise

- Contractor to prepare the Site Environmental Control Program which is to be submitted by Contractor to the Director-General of Public Health of NEA two weeks before the commencement of construction. Contractor should implement Environmental Control Programme specific to the construction works undertaken by the contractor;
- Contractor to prepare and submit bi-weekly Site Environmental Control Report to EMMP Consultant and SO Rep;
- Contractor should engage Public Relation Officer (PRO) to establish good rapport with the community, handle and feedback complaints from the community.
- Contractor to prepare noise management plan (NMP) to help to implement noise mitigation measure. The suggested NMP template is indicated in Annex H of SS602:2014;
- Contractor to use engineering methodology to control noise such as:
 - Noise enclosure to cover stationary PME such as generator;
 - Noise screen/noise panel to partially shield noise generated from noisy PME such as crane and excavator;
 - Portable noise barrier for noisy construction activities e.g. soil investigation drilling activities and road and drainage work which are close to site boundary; and
 - Quieter construction methodology such as silent piler instead of vibratory piling, hydraulic splitter instead of concrete/rock drilling.

Standard Mitigation Measures and Requirements: Airborne Noise

- Conduct unattended noise monitoring (1 week) prior commencement of site clearance and continuous real time noise monitoring during construction using Type 1 sound level meter with data logging at the affected NSRs by contractor. When noise level exceeds the maximum adjusted noise level, contractor should investigate and apply appropriate mitigation measures. The proposed noise monitoring locations are as follow:
 - AN1: Block 805C, Keat Hong Close;
 - AN2: Block 485B, Choa Chu Kang Ave 5;
 - AN3: Ecological receptor within Tengah Forest;
 - AN4: Ecological receptor within Tengah Forest; and
 - AN5: Ecological receptor within Tengah Forest.
- Implement industrial best practices:
 - Only well-maintained PME shall be operated on-site and shall be serviced regularly during the construction;
 - The number of PMEs shall be reduced as far as practicable when construction works are carried out at areas close to the NSRs.
 - Use of alternative equipment with less noise emission such as use of rubber mallets instead of metal hammer;
 - Care shall be taken during loading or unloading, dismantling or moving materials to reduce impact noise;
 - Silencers or mufflers on PME (e.g. generator sets) shall be utilises and shall be properly maintained during the construction;
 - Mobile OME, if any, shall be sited as far from NSRs as possible;
 - PME (such as truck and cranes) that may be in intermittent use shall be shut down between work periods or shall be throttled down to a minimum possible;
 - PME known to emit noise strongly in one direction should, whenever possible, be oriented so that the noise is directed away from the nearby NSRs;
 - Noisy construction activities shall be avoided at nights and Sundays and public holidays when the noise limits are more stringent
- Consider limiting heavy construction working hours from 8am to 6pm where possible to avoid the timings when crepuscular species may be active. Toolbox meetings and winding down of work can be done outside of these hours;
- Implement progressive start of loud construction activities to gradually increase noise levels for mobile fauna who have returned to roost during the night or are in the area to move before noise levels get more intense; and
- Additional control measures such as enclosure, noise screen/noise panel, portable noise barrier are recommended for all construction stages to future reduce excessive noise impacts for the affected arboreal fauna:
- Enclosure at stationary PME such generator and it shall be of sufficient height and width to accommodate machinery/equipment housed within. The proposed enclosures should achieve noise level reduction of at least 15dB(A) (Table F.3 of SS602:2014);
- Noise screen/noise panel at movable PME such excavator and crawler/mobile crane and it shall be of sufficient height and width to shield the noisy part. The proposed screening should achieve noise level reduction of at least 10dB(A) (Table F.3 of SS602:2014);
- Portable noise barrier at construction activities e.g. soil investigation drilling activities, road and drainage work which are close to site boundary. The proposed noise barrier should achieve noise level reduction of at least 10dB(A) (Table F.3.3.4 of SS602:2014);
- Quieter construction methodology such as silent piler instead of vibratory piling, hydraulic splitter instead of concrete/rock drilling. It is estimated a 20dB(A) reduction can be achieved by substitution (based on LTA's Noise Guidance: Developing a Noise Management Plan)
- The Contractor shall note that plant, equipment and methods of work which causes pollution such as excessive noise and dust will not be allowed to be used on Site;
- The Contractor shall propose and implement on site at all times the appropriate type of monitoring methods during the contract period, subjected to the EMMP Specialist Consultant's and SO Rep.'s approval, and to provide for the sole use of the SO Rep. and EMMP Specialist Consultant appropriate measuring instruments to measure the noise, dust level or any types of pollutive elements generated by the work activities;
- The SO Rep. has the absolute discretion as and when he deems it necessary to require the Contractor to take necessary precautions to maintain or to repair such plant and equipment, to install noise suppressors, dust screens , etc. or instruct their removal from the Site;

Standard Mitigation Measures and Requirements: Airborne Noise

- Noise and duct control limits shall fully comply with the requirements as stated in the Environmental Pollution Control Act or latest requirements;
- Noise Control
 - All pilling operations and excavation works shall be carried out without unreasonable noise, vibration and disturbance.
 - The Contractor shall bear all risks and responsibilities in carrying out the pilling operations and excavation works and shall be responsible during the progress of the pilling operation and excavation works for any damage or disturbance to existing or adjoining properties, or annoyance or nuisance to Occupants of these properties;
 - The Contractor shall take necessary action to manage and control the activities within the construction site for the abatement of noise nuisance in compliance to the latest noise control regulations imposed by the Ministry of the Environment and Water Resources (MEWR) or any relevant authorities. Noisy Construction Equipment (e.g. Compressors) and installation shall be sited away from occupied residential blocks. All Construction Equipment shall be properly insulated and maintained to minimum its operating noise level;
 - The noise level reading at the nearest occupied building shall not exceed the following maximum permissible noise level and shall comply with the Environmental Pollution Control (Control of Noise at Construction Sites) (Amendment Regulations 2007 enforces by the MEWR:

Types of Affected Buildings	Applicable Period	Maximum Permissible Equivalent Continuous Noise Level Measured Over a Period of 5 Minutes in dB(A)
(a) Hospitals, schools, institutions of higher learning, homes for the aged or sick etc.	7am to 7pm	75
	7pm to 10pm	55
	10pm to 7am	55
(b) Residential buildings located less than 150 m from the construction site where the noise is being emitted	7am to 7pm	90
	7pm to 10pm	70
	10pm to 7am	55
(c) Buildings (other than those in paragraphs (a) and (b))	7am to 7pm	90
	7pm to 10pm	70
	10pm to 7am	70

- Truck movement on public road is only allowed from 9am to 5pm only from Monday to Saturday. No working on Sunday and Public Holiday. It is important to note on the daylight working hours allowed as per NParks instruction is from 8am to 6pm;
- The Contractor shall submit his proposal for the sound monitoring system, with details of the sound meter model and location of installation etc., to the SO Rep. for approval within 14 days from the date of the letter of Acceptance;
- The Sound level meter shall comply with BS 6698 (1989) or IEC 804:1985 and the following requirements and shall meet all requirements imposed by the relevant Authority;
- The integrating sound level meter shall be capable of producing equivalent continuous A-weighted sound power level for various time duration required by the SO Rep.;
- The sound level meter shall have a laboratory calibration certificate dated not more than Three (3) months before the commencement date of the contract. The integrating sound level meter shall be sent to an approved accredited laboratory for calibration at every Six (6) months interval or as and when required as decided by the SO Rep.;
- A portable calibrator shall be provided to carry out weekly calibration;
- The sound level meter shall have adequate memory to store 5-minute equivalent continuous reading on a 24-hour basis for up to 7 days; and
- Dynamic range shall be of at least 40 dB.
- The equipment shall be able to record 24-hour noise level readings and printed with the date and time of recording indicated. The printout shall be submitted to the SO Rep. on a weekly basis or at such interval as specified by the SO Rep. One Set of the noise level record shall be field and kept on site for inspection as and when required by the SO Rep. or MEWR. The Contractor shall install the Type I integrating sound level at the nearest occupied building less than 50 meters from the site boundary. The sound level meter shall be installed at a location where obstruction and other external noise interference area minimal. Where there is no suitable location outside the construction site, the Contractor may place the sound level meter within the site. The location shall be approved by the SO Rep.

6.1.5 Vibration

6.1.5.1 Vibration Impact Assessment

6.1.5.1.1 Ecological Receptors

Studies on the behaviour of ecology to vibration are less comprehensive than studies carried out on human behaviour. The vibration sensitivity of ecological receptors is complex and varies across species; thus, developing a standard criterion that fits all applications is challenging.

As recorded in the Tengah North EIS Report [R-1], the globally and nationally critically endangered terrestrial Sunda pangolin (*Manis javanica*) was found to occur in the Study Area. A study [W-2] has reported that at PPV, 10.0 mm/s, the motion of the ground may cause burrows of fossorial species to be damaged or collapse, causing potential entombment of the fauna and leading to loss of life. The pangolins nest in burrows and have a homerange of 6 hectares. It is unclear what the vibration threshold is for a pangolin burrow to suffer damage due to the lack of information on this species. However, as a preventive measure, vibration impacts on the structural integrity of terrestrial burrows are assessed. Based on AECOM's past project experience, we proposed the following conservative criteria that the Contractor should follow throughout the construction phase:

- PPV, 8.0 mm/s (equivalent to 80% of the vibration threshold recorded in the literature review for a different species).

6.1.5.1.2 Human Receptors

Based on the BS 5228-2 [R-4] guideline for human comfort, vibration levels of 0.3 mm/s might be perceptible in residential environments. During the piling activity, the predicted vibration level for the worst-case scenario indicates that the vibration level will be imperceptible to residential environments at a distance further than 20 m. Hence, it is assumed that vibration will not impact human receptors further than 20 m from the project site, and monitoring will not be required in such cases. However, it is essential to note that the assessment mentioned above is for human comfort only; the Contractor shall comply with BCA's requirements on vibration monitoring.

Furthermore, the Contractor is also responsible for the following measures:

- The Contractor shall engage a Professional Engineer to submit a vibration-monitoring plan showing the locations of the vibration monitoring devices before work commences. The plan shall state the vibration limit, considering the vulnerability of the neighbouring properties to damage and the frequency of taking readings;
- The Professional Engineer shall assess the vibration readings and take the appropriate action once the vibration limit is exceeded on site or any damage occurs in neighbouring properties. Any precautionary and contingency measures taken to safeguard the integrity of the neighbouring properties shall be borne by the Contractor;
- The Contractor shall ensure that the vibration levels for coring, rock removal, blasting, and other construction activities comply with National regulations;
- Where piling works are to be carried out close to the existing buildings or structures, the Contractor shall carry out a joint inspection with the SO Rep. and representatives of the appropriate parties, including taking photographs and notes to record the conditions of the existing buildings or structures before the commencement of the piling works. The records shall be jointly endorsed by the Contractor, SO Rep. and the representative of appropriate parties.
- In addition, the Contractor shall be required to carry out vibration monitoring at his own cost and expense when construction works are to be carried out close to the existing buildings or structures or when public complaints have been received. The numbers and locations and the duration of the vibration monitoring shall be decided by the SO Rep. The vibration monitoring shall measure the peak particle velocity (mm/s) and frequency (Hz) of the vibration. If requested by SO Rep., acceleration and displacement values shall also be derived from the measured data. The monitoring shall be read daily unless otherwise instructed by SO Rep. Three (3) sets of comprehensive reports shall be submitted to HDB weekly, and the final report shall be submitted within two (2) weeks after the completion of the monitoring works.

6.1.5.2 Standard Measures and Requirements

Standard Measures and Requirements: Vibration

General:

- Use low vibration equipment and construction techniques.
- Impose and signpost a maximum speed limit of 25 km/hr on paved or surfaced haul roads and 15 km/hr on unpaved haul roads and work areas.
- The Contractor shall engage a Professional Engineer to submit a vibration-monitoring plan showing the locations of the vibration monitoring devices before work commences. The plan shall state the vibration limit taking into account the vulnerability of the neighbouring properties to damage and the frequency of taking readings.
- The Professional Engineer shall assess the vibration readings and take the appropriate action once the vibration limit is exceeded on site or any damage occurs in neighbouring properties. Any precautionary and contingency measures taken to safeguard the integrity of the neighbouring properties shall be borne by the Contractor.
- The Contractor shall ensure that the vibration levels for coring, removal of rock, blasting etc., are comply with National regulations.
- Contractors shall be responsible to comply and implement all requirements by the laws, authorities on ground vibration pollution control.
- Place vibrating equipment (e.g., pipe jacking unit) on isolators such as spring coils.
- Route heavily loaded tipper trucks away from the vibration sensitive receptors as far away as possible.
- Operate equipment (e.g., piling equipment, compactor, hydraulic breaker, and pipe jacking machine) that emit significant vibration levels as far away as possible.
- Phased earthmoving, ground pilling and excavation operations so as not to occur at the same time at the same area, if possible, to minimize cumulative impact.
- Avoid impact pile or vibratory pile driving where possible in areas with vibration sensitive receptors. Use silent piler/press-in piler where the geological condition permits their use.
- Notify nearby vibration sensitive receptors in advance of the construction activities, particularly during installation of sheet piles and tunnelling works (e.g., pipe jacking and TBM) to allay potential concerns.
- While using vibratory compactors, shut off vibrator when reversing direction (highest level of vibrations are often generated when quickly stopping and changing direction). Utilise a vibratory compactor that can adjust the impulse energy and frequency, compact soil with static method (no vibrations); oscillation compaction in place of conventional vibratory action, as far as practicable.
- Fill in potholes and eliminate pavement discontinuities, keep haul roads smooth by periodic grading; pave existing roads to provide a smooth traveling surface, reduce speed of vehicles and weight of vehicle loads, as far as practicable.
- Ecological Receptors:
- Set up barriers to prevent road kills.
- Contractor shall conduct monitoring for vibration at ecologically sensitive areas.

Human Receptors:

- Where piling works are to be carried out close to the existing buildings or structures, the Contractor shall carry out a joint inspection with the SO Rep. and representatives of the appropriate parties including taking photographs and notes to record the conditions of the existing buildings or structures prior to the commencement of the piling works. The records shall be jointly endorsed by the Contractor, SO Rep. and the representative of appropriate parties.
- In addition, the Contractor shall be required to carry out vibration monitoring at his own cost and expense when construction works are to be carried out close to the existing buildings or structures or when public complaints have been received. The numbers and locations as well as the duration of the vibration monitoring shall be decided by the SO Rep. The vibration monitoring conducted by the Contractor shall measure the peak particle velocity (mm/s) and frequency (Hz) of the vibration. Acceleration and displacement values shall also be derived from the transducer operating range chart if requested by SO Rep. The monitoring shall be read daily unless otherwise instructed by SO Rep. Three (3) sets of the comprehensive reports shall be submitted to HDB weekly and the final report shall be submitted within two (2) weeks after the completion of the monitoring works.

6.1.6 Vector Control

Standard Measures and Requirement

- Preparation and implementation of an effective vector control plan and measures as required under LTA's SHE Specifications and LTA's Guidebook in Vector Control at LTA Sites, as well as the NEA's Code of Practice for Environmental Control Officers;
- The Contractor should clear and dispose of all rubbish, debris in the drains and side tables, surplus excavated earth, etc. and those arising from his works to approved disposal sites;
- All rubbish and debris should be cleared from the work site from time to time as and when directed by the SO Rep.;
- On completion of the Works, the Contractor should remove all his rubbish, plant and surplus materials from the works site, clean all fittings and leave the site in a clean condition;
- Contractor should adhere to Control of Vector and Pesticide Act (CVPA) and ensure good housekeeping on-site;
- 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;
- 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 infestation;
- Store food in rodent proof storage containers/ cabinets with at least 60 cm clearance above ground level;
- Thermal Fogging should only be carried out when there is a Dengue outbreak or when high mosquito population is detected at construction worksite. Regular fogging is not encouraged as it may build up the mosquitoes' resistance over time;

6.1.7 Waste Management

Standard Measures and Requirement

- The Contractor shall dispose demolished materials, debris and unsuitable excavated materials including Waste materials and Contaminated materials within the Project Boundary to disposal sites subjected to SO Rep.'s approval;
- The Contractor shall dispose acceptable excavated soft clay to Aviation Park Staging Ground (APSG) or Tanah Merah Staging Ground(TMSG) or to any other site as directed by SO Rep.;
- The use or disposal for excavated earth from the proposed work site shall be as follows:
 - Good Earth suitable for use as approved material for filling and approved by the SO Rep. shall be used for site filling up to the required platform in accordance with Section 5 of the Standard Specifications for Civil Engineering Works (2019 Edition)
 - Soft Clay acceptable by the operator of Aviation Park Staging Ground (APSG) or Tanah Merah Staging Ground (TMSG) shall be transported to Aviation Park Staging Ground (APSG) or Tanah Merah Staging Ground (TMSG); and
 - Excavated earth/material that is deemed unsuitable by SO Rep. for filling or disposal at HDB's Staging Grounds shall be transported to contractor's own disposal sites approved by the authorities;
- The Contractor shall conduct all necessary classification tests including the density tests (as per required and subjected to approval by SO Rep.);
- The Contractor shall note the classification of materials are often be in the following categories:
- The Contractor shall permit access by approved soil testing laboratories in Singapore and/or personnels from approved disposal sites to the Contractor's work site to evaluate the suitability of the excavated materials for disposal at the approved disposal sites.

Standard Measures and Requirement

- The Contractor shall take all reasonable measures to avoid mixing different types of spoils. Should two or more different types of spoils get mixed during the course of the excavation/ loading, the spoils which arrived at approved disposal sites, shall take the classification of the component that appears lowest on the following list:
 - Good Earth;
 - Soft Clay;
 - Waste Material; and
 - Contaminated Material
- In the event artificial obstructions and/or Unexploded Explosive Ordnance (UXO) are found during the course of Construction Works the Contractor shall immediately inform the Singapore Police Force (SPF), relevant authorities and the SO Rep. He shall also immediately follow up on appropriate safety measures and provision of security personal if required by SPF, relevant authorities and/or SO Rep. to ensure site safety.
- If the discovered UXO is classified by SPF or relevant Authorities as "unsafe" to remove, the removal shall be managed by SPF or relevant Authorities, working closely with the Contractor and/or SO Rep.;
- If the discovered UXO is classified by SPF or relevant Authorities as "safe" to remove, the Contractor shall engage an Explosive Ordnance Disposal (EOD) specialist with Arms and Explosive (A&E) License registered by the SPF to remove UXO. The EOD specialist shall investigate and identify the UXO correctly, evaluate, classify and obtain necessary approvals/ permits for removal, transfer, temporary storage and disposal of UXO according to the requirements by SPF or relevant Authorities.;
- All historical artifacts etc. discovered within the site are the property of the Employer and shall not be removed from the site and shall be left in an un-disturbed as far as feasible. In the event any historical artifacts such as granite boundary marker etc. is discovered on site, the Contractor shall immediately inform the SO Rep. and Employer. The Contractor shall immediately implement the necessary protection measures within the demarcated area to prevent any damage to the artifacts and shall ensure no work is carried out until the artifacts are extracted completely with proper care. Any protection and extraction measures given by the relevant Authorities shall be complied with accordingly;
- Applying waste minimization techniques and good practices on site following waste management hierarchy, i.e., source reduction, waste exchange, recycling, reuse, and waste segregation;
- Plan for timely on-site separation and collection of materials with waste stream specific schedules in place;
- All horticultural waste should be transported off-site to specialized horticultural recycling facilities where they can be grinded into wood chips which can be turned into mulch or compost. Where possible, wood recycling as wood chips into new wood products by mixing it with binders should be prioritized;
- Horticultural waste which is not suitable to be recycled should be used as fuel in biomass power plants;
- Waste concrete from demolition could also be recycled into recycled concrete aggregate which is made up of 70% demolition concrete waste with natural aggregates and used in buildings and roads in Tengah;
- Construction waste should be properly segregated and have set storage locations to extract recoverable and recyclable materials which can then be reused or recycled;
- Separate the different forms of hazardous waste, provide treatment on site if applicable and set up protocols for spillage;
- Implement strict waste handling, storage, collection, and disposal practices to prevent leakages;
- Biodigesters or composting stations could be introduced onsite to deal with food waste generated by workers, converting it into grey water or compost which can then be reused onsite. These stations are usually well sealed which also reduces the hazard of wildlife being attracted to the area;
- Provide adequate garbage/ trash bins with tight lid (animal-proof bin) to prevent animals from getting into it;
- Recycling bins should be provided alongside every trash bin with well-labelled signs and examples of common recyclables items to help workers sort their waste;
- Provide sufficient and maintain proper sanitary facilities at the worksite and connect discharge points to septic tanks and or the public sewage for disposal;
- Sewage not connected to the main sewage system has should have sufficient storage capacity and a clearance schedule that matches the volume being produced;
- Identify all types of solid waste and implement comprehensive waste management system at the site to ensure proper disposal and prevent pollution to the environment; and
- The Contractor should 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.

6.2 Environmental Trainings for Site Personnel

6.2.1 Biodiversity Awareness Training

The Ecologists shall conduct toolbox briefings to inform site personnel of, but not limited to, the following topics:

- a) Ecological value of the site and its surrounding habitats;
- b) Types of fauna present;
- c) Biodiversity protection strategies (e.g., Wildlife Response Plan);
- d) Site personnel's responsibilities towards biodiversity;
- e) How to respond to fauna encounters;
- f) No feeding of wildlife;
- g) Prevention of roadkills; and,
- h) Inspection of trees before felling.

Toolbox briefings will be conducted once pre-construction. During construction, toolbox briefings will be conducted monthly, or as needed as works progress. All site personnel shall undergo biodiversity awareness training prior to commencing work at on-site, and regularly (every six months) throughout the duration of the construction. Documentation of such trainings and briefings shall be maintained.

6.2.2 Waste Management Training

The trainings should be provided in monthly basis if necessary in order to ensure all the site personnel are well-trained and able to manage the construction wastes and vector accordingly on-site.

- a) The Contractor shall implement a comprehensive waste management system at the worksite to ensure proper disposal of waste;
- b) Illegal disposal of construction waste shall be strictly prohibited;
- c) Littering of food waste and food packaging shall be strictly prohibited and enforced by the Contractor;
- d) Disposal of construction wastes (wastewater and solid wastes) into streams, storm water channels or other waterbodies shall be strictly prohibited;
- e) The Contractor shall provide sufficient fully covered food waste bins that are secured in a manner that is wildlife-proof;
- f) All food waste shall be cleared from the worksite at least once a day;
- g) Where fauna is found to be active around waste disposal areas, the Contractor shall implement measures to reduce the source of the attractant in consultation with the Ecologist; and,
- h) The Contractor shall submit a Waste Management Plan as part of the contract-specific EMMP detailing the:
 - Types of waste generated;
 - Location and types of waste management facilities (e.g., food waste bins);
 - Frequency of disposal; and
 - Information of waste management contractors.

6.2.3 Vector Control Training

The trainings should be provided in monthly basis if necessary in order to ensure all the site personnel are well-trained and able to manage the construction wastes and vector accordingly on-site. The hierarchy of vector control shall be as follows:

- a) Source reduction, i.e., eradicate water ponding through proper housekeeping to eliminate potential breeding grounds;
- b) Monitor Dengue situation, i.e., regular screening of worker (temperature checks), quarantine measures, etc.;
- c) Deter breeding, i.e., search and destroy efforts, inspections, Bti application, etc.;
- d) Thermal fogging shall not be carried out to prevent unintended impacts to invertebrate fauna residing in the surrounding habitats;
- e) No chemical insecticides, pesticides and rodenticides shall be used for pest control; and,
- f) No sticky traps shall be used for pest control.

Environmentally friendly applications such as the use of *Bacillus thuringiensis israelensis* (Bti) shall be used to supplement source reduction.

7 Environmental Management and Monitoring Plan for Stage 1

7.1 Biodiversity

7.1.1 Construction Phase

7.1.1.1 Site-specific Measures

7.1.1.1.1 Fauna Management During Site Clearance

The following sub-sections detail the workflow for site clearance. During this stage, site clearance will take place within Tengah Earthworks Phase 3 worksites, Outlet Drain Phase 1a worksite and Tengah Roads Phase 4 worksite. For Tengah Earthworks Phase 3 & 4 Stage 1 worksite, directional site clearance should proceed westwards. For Tengah Earthworks Phase 3 (south), directional site clearance should proceed northwestwards, towards the recommended areas of conservation. Directional site clearance shall be carried out as detailed in Section 6.1.1. Clearance should take place sequentially, according to the recommended sequence in Figure 7-1. Construction works will also take place concurrently within the PUB project worksite, and the hoarding for the PUB project worksite would already be installed.

7.1.1.1.2 Hoarding Installation

Hoarding should first be set up to demarcate the entire earthworks areas. After camera trap monitoring for Eurasian wild boar presence is complete (under discussion with NParks), it is recommended for the areas slated for clearance at this stage to be subdivided into smaller site clearance parcels. Seven site clearance subzones have been recommended, as shown in Figure 7-1. The installation of hoarding is to be completed by the contractor following the specifications in Section 6.1.1, and the detailed hoarding sequence is detailed in Appendix K.

7.1.1.1.3 Wildlife Corridor

Two wildlife corridors (HDB_C1a and HDB_C2; Figure 7-1) should be established through the worksite at Stage 1 in order to maintain connectivity between the forested area to the east and west of the worksite (Figure 7-1), and should be constructed following the specifications in Section 6.1.1. Both HDB_C1a and HDB_C2 should be operational upon the completion of the hoarding installation. A camera trap will be placed at each end of the three wildlife corridors, i.e., four camera traps will be deployed.



Legend

- Tengah Earthworks Phase 3 hoarding boundary
- Recommended area of conservation
- Main canal
- Earthworks Phase 3
- Earthworks Phase 3 (South)
- Projects by other agencies

Indicative wildlife pathways

- Indicative wildlife corridor (HDB_C1a)
- Indicative wildlife corridor (HDB_C2)

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Project Title :
**CONTRACT L/187/22
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AT HDB DEVELOPMENT (WESTERN):
ENVIRONMENTAL MANAGEMENT AND
MONITORING PLAN (AREA A)**

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Figure Title :
**FAUNA MANAGEMENT DURING AREA A STAGE 1
SITE CLEARANCE**

Figure No. : 7 - 1	Rev. -	Sheet 1 of 1
CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

7.2 Hydrology and Surface Water

7.2.1 Pre-construction

7.2.1.1 Site-specific Measures

All standard measures as described in Section 6.1 should be followed by the Contractor when applicable during pre-construction stage.

The Contractor should discuss with EMMP Consultant to finalize on real-time water quality data (i.e. Turbidity) input for Environmental Data Management System (EDMS) as described in Section 5.2. The discussion includes but not limited to the data sharing method (e.g. embed data website, online transfer, etc.), required data type (e.g. mg/L for every minute or seconds) and frequency of data sharing (e.g. daily or weekly).

If visual non-compliance to any of the minimum control or mitigation measures are observed by EMMP Consultant's ECO on-site, the ECO should inform Contractor. The Contractor should conduct necessary investigation and corrective actions should be taken if necessary.

7.2.1.2 Monitoring Plan

Three (3) rounds of water quality monitoring should be conducted prior commencement of site clearance to have a full representation of baseline water quality condition within surroundings of construction worksites. Seven (7) water quality sampling locations are proposed as shown in Figure 7-2. The monitoring parameters of water quality should follow Table 7-1. All the discharge points from construction worksites (refer to Appendix K – Earth Control Measures Plan) should follow the NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse [W-9].

Prior to construction, the hydrological conditions of drainage system within construction worksite and at immediate vicinity should be monitored and inspected especially during heavy storm event to ensure no flooding or clogging.

7.2.1.3 Feedback Management

Since construction activities haven't been started, there is no feedback management provided during pre-construction stage.

7.2.2 Construction

7.2.2.1 Site-specific Measures

All standard measures as described in Section 6.1 should be applied accordingly.

In addition, the EMMP Consultant's ECO should conduct daily inspection on drainage, water quality of surface runoff and any abnormalities inside drainage system (e.g. fish kill).

In order to provide comprehensive water quality data into Environmental Data Management System as described in Section 5.2, Contractor should provide real-time monitoring data of Turbidity to EMMP Consultant based on discussion during pre-construction stage as described in Section 7.2.1.1.

If visual non-compliance to any of the minimum control or mitigation measures are observed by the EMMP Consultant's ECO on-site, the ECO should inform Contractor. The Contractor should conduct necessary investigation and corrective actions should be taken if necessary.

7.2.2.2 Monitoring Plan

Seven (7) water quality sampling locations (refer to Figure 7-2) were selected within/near the worksite to understand the existing water quality conditions during construction period and to monitor any major impact would be caused by the construction activities on the streams and drainages. All the discharge points from construction worksites should follow the NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse [W-9]. The water quality at selected locations should be sampled in monthly frequency and additional parameters to be sampled quarterly at every construction discharge outlet (refer to Appendix K – Earth Control Measures Plan) as shown in Table 7-1. Detailed monitoring regime during construction phase is still under discussion with PUB.

In addition, the surface runoff should be directed into an Earth Control Measures (ECM) pond and treated before being discharged into any watercourse as recommended in EIS Report [R-1]. ECM should be inspected and maintained by Contractor and QECP throughout the construction programmed by the QECP which will be reviewed in tandem with the progress of works. This may involve replacement of silt fences and erosion control blankets, repaving of concrete surfaces, etc. Real-time monitoring of Turbidity and implementation of CCTV including a SIDS installed at every discharge outlet should be conducted by the Contractor throughout the construction stage.

The hydrological conditions of drainage system within construction worksite and at immediate vicinity should be inspected daily by the EMMP Consultant's ECO especially during heavy storm event to ensure no flooding. EMMP Consultant/ EMMP Consultant's ECO should conduct audit on the water quality and hydrology conditions at the worksite monthly.

If any exceedance in monitored water quality parameters found from in-situ or ex-situ measurement (refer to Table 7-1) as well as any flooding or clogging issue observed on site, the EMMP Consultant's ECO and Contractor should conduct an investigation and corrective actions should be taken immediately.

If the TSS found on exceedance of 30 mg/L for 10 minutes at any discharge outlets, the Contractor should conduct investigation and corrective actions should be taken immediately.

Table 7-1 Summary of Water Quality Sampling Parameters and Frequency

Parameter	Unit	Guideline used	Guideline value	Sampling Method
Dissolved Oxygen	mg/L	-	-	In-situ sampling using multiparameter probe
Turbidity	NTU	-	-	
Conductivity	µS/cm	-	-	
Salinity	mg/L	-	-	
pH	-	NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse	6 – 9	
Temperature	°C		45	
Biochemical Oxygen Demand	mg/L		20	Ex-situ using grab sampling techniques and send to accredited lab for analysis
Chemical Oxygen Demand	mg/L		60	
Total Suspended Solids	mg/L		30	
Total Dissolved Solids	mg/L	-	1,000	
Phosphate (PO ₄) as P	mg/L	NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse	2	
Total Phosphorus	mg/L	-	-	
Nitrate (NO ₃) as N	mg/L	NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse	20	
Total Nitrogen	mg/L	-	-	
Total Alkalinity	mg/L	-	-	
Total Organic Carbon	mg/L	-	-	
Ammoniacal Nitrogen	mg/L	-	-	
<i>Enterococcus</i>	CFU/100mL	NEA Water Quality Guidelines for Recreational Beaches and Fresh Water Bodies	200	
Lead*	mg/L	NEA's Allowable Limits for Trade Effluent Discharge to	0.1	
Zinc*	mg/L		0.5	
Mercury*	mg/L		0.001	
Arsenic*	mg/L		0.01	

Parameter	Unit	Guideline used	Guideline value	Sampling Method
Barium*	mg/L	Controlled Watercourse	1	
Tin*	mg/L		5	
Iron*	mg/L		1	
Beryllium*	mg/L		0.5	
Boron*	mg/L		0.5	
Manganese*	mg/L		0.5	
Cadmium*	mg/L		0.003	
Chromium*	mg/L		0.5	
Copper*	mg/L		0.1	
Nickel*	mg/L		0.1	
Silver*	mg/L		0.1	
Metals in Total*	mg/L		0.5	
<p>Note: “-“ indicates no guideline to be referred for the parameter. * only sampled for baseline at all selected locations and quarterly at every construction discharge outlet. Detailed monitoring regime during construction phase is still under discussion with PUB.</p>				



Legend

- Proposed Water Quality Monitoring Locations
- Watercourses
- ▨ Recommended Area of Conservation

Construction Activities for Stage 1

- Tengah Road-Phase4
- Earthworks-Phase3
- Proposed Outlet Drain

Note: HDB are working closely with agencies on the details and extent of the Recommended Area of Conservation to be retained.

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Consultant : **AECOM**

Project Title : **CONTRACT L/189/22
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Figure Title : **PROPOSED WATER QUALITY MONITORING LOCATIONS DURING STAGE 1**

Figure No. : 7-2	Rev. : -	Sheet : 1 of 1
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Note: Source of basemap - Google Earth Map

7.2.2.3 Feedback Management

If receiving any complaint on surface runoff of drainage along the boundary of construction work sites such as clogging issue, silty water, etc.), the PRO, Contractor, EMMP Consultant's ECO and EMMP Consultant should manage the complaint from stakeholders such as nearby residents and visitors nearby the construction work sites. A general complaint handling system is provided as in Figure 7-3.

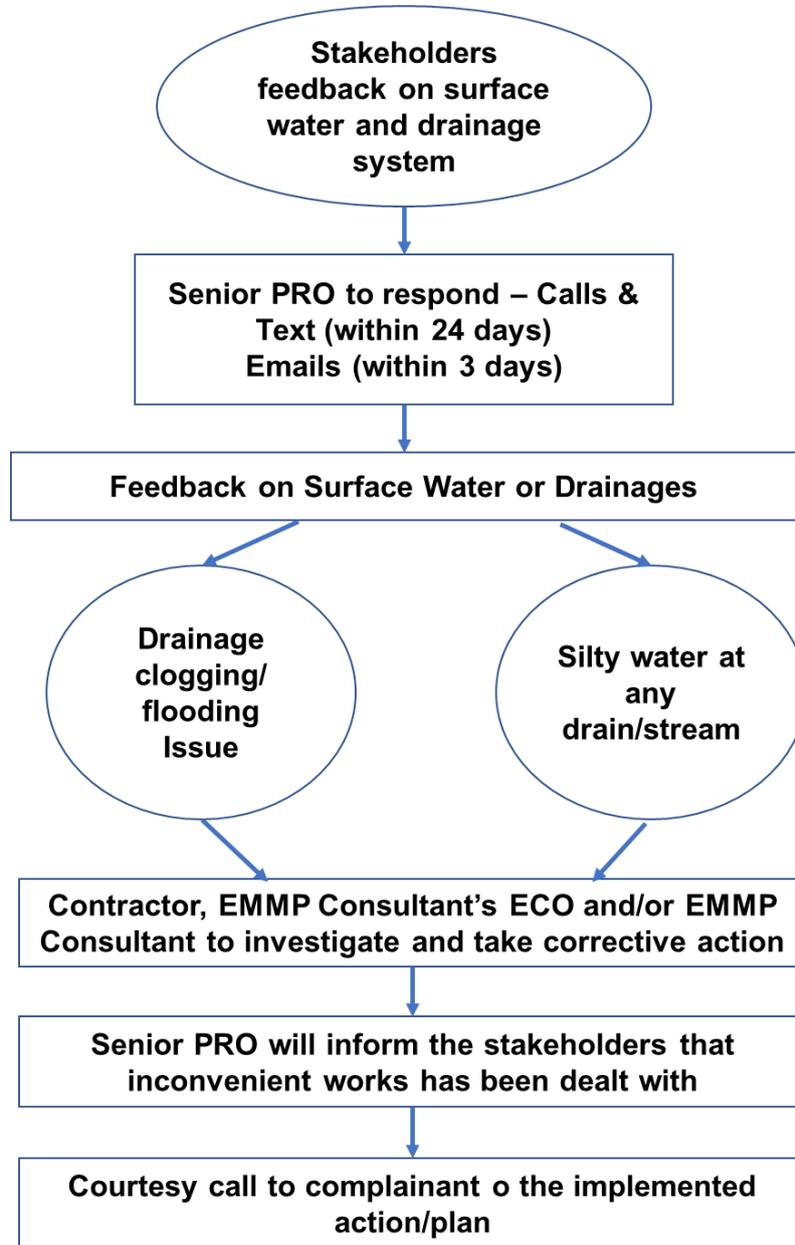


Figure 7-3 An Example of Complaint Handling System for Complaint Regarding Surface Water and Drainage System

7.3 Groundwater

7.3.1 Pre-construction

7.3.1.1 Site-specific Measures

All standard measures as described in Section 6.1 should be followed when applicable during pre-construction stage.

If visual non-compliance to any of the minimum control or mitigation measures are observed by the EMMP Consultant's ECO on-site, the EMMP Consultant's ECO should inform Contractor. The Contractor should conduct necessary investigation and corrective actions should be taken if necessary.

7.3.1.2 Monitoring plan

One-time monitoring on groundwater level and quality should be conducted prior to the commencement of site clearance to have a basic representation of baseline groundwater level and quality conditions within/ surroundings of the construction worksites. The proposed four (4) monitoring locations (i.e. AG1, AG2, AG3 and AG4) as shown in Figure 7-4 are selected accordingly by referencing to the baseline study of EIS Report [R-1]. The groundwater quality should be tested for parameters as shown in the Table 7-2.

7.3.1.3 Feedback management

If receiving any complaint due to Project activities, the Contractor should conduct investigation and propose corrective actions.

7.3.2 Construction

7.3.2.1 Site-specific Measures

All standard measures as described in Section 6.1 should be applied accordingly. In addition, the Contractor should conduct groundwater testing during dewatering process and the extracted groundwater should not be discharged into watercourses or public sewers. Any discharge of extracted groundwater from dewatering activity to any area (including drains and streams) will require an approval from the NEA and PUB for such discharge.

If visual non-compliance to any of the minimum control or mitigation measures are observed by the EMMP Consultant's ECO on-site, the EMMP Consultant's ECO should inform Contractor. The Contractor should conduct necessary investigation and corrective actions should be taken if necessary.

7.3.2.2 Monitoring Plan

During construction period, the groundwater level monitoring should be conducted monthly at proposed two (2) locations (i.e. AG2 and AG4) as shown in Figure 7-4 to understand the change of groundwater level nearby the worksites and RAC due to the ongoing construction activities.

Contractor should also monitor the groundwater level and quality as required in Singapore Building Control Regulations 2003 [R-29] weekly during dewatering process at where the excavation takes place. The required groundwater parameters for testing should follow Table 7-2. If any significant change of groundwater level found on site, an investigation and corrective actions should be taken by the EMMP Consultant's ECO and the Contractor immediately. The tolerance limit for groundwater level change (i.e. $\pm 3\text{m}$) to be confirmed by the Qualified Professionals who engaged by the Contractor when developing the piezometers installation and monitoring plan.

Contractor should conduct investigation and take corrective actions if any exceedance in groundwater quality based on guidelines listed in Table 7-2.

Table 7-2 Parameters for Groundwater Quality Monitoring

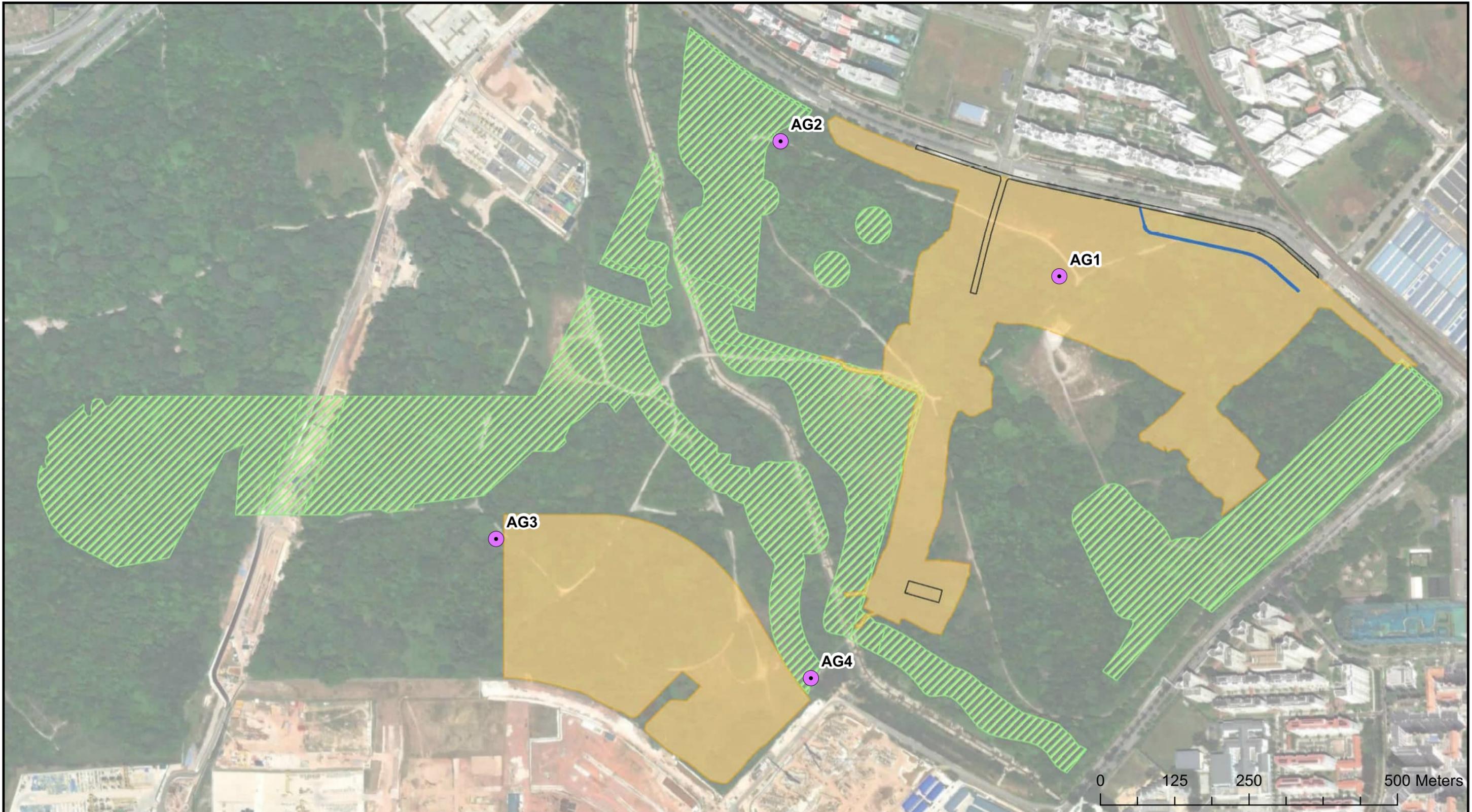
Parameter	Unit	Guideline used	Guideline value	Sampling Method
Dissolved Oxygen	mg/L	-	-	In-situ sampling using
Turbidity	NTU	-	-	

Parameter	Unit	Guideline used	Guideline value	Sampling Method
Conductivity	µS/cm	-	-	multiparameter probe
Salinity	mg/L	-	-	
pH	-	NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse	6 – 9	Ex-situ using grab sampling techniques and send to accredited lab for analysis
Temperature	°C		45	
Biochemical Oxygen Demand	mg/L		20	
Chemical Oxygen Demand	mg/L		60	
Total Suspended Solids	mg/L	30		
Total Dissolved Solids	mg/L	-	1,000	
Phosphate (PO ₄) as P	mg/L	NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse	2	
Total Phosphorus	mg/L	-	-	
Nitrate (NO ₃) as N	mg/L	NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse	20	
Total Nitrogen	mg/L	-	-	
Total Alkalinity	mg/L	-	-	
Total Organic Carbon	mg/L	-	-	
Ammoniacal Nitrogen	mg/L	-	-	
<i>Enterococcus</i>	CFU/100mL	NEA Water Quality Guidelines for Recreational Beaches and Fresh Water Bodies	200	
Lead	mg/L	NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse	0.1	
Zinc	mg/L		0.5	
Mercury	mg/L		0.001	
Arsenic	mg/L		0.01	
Barium	mg/L		1	
Tin	mg/L		5	
Iron	mg/L		1	
Beryllium	mg/L		0.5	
Boron	mg/L		0.5	
Manganese	mg/L		0.5	
Cadmium	mg/L		0.003	
Chromium	mg/L		0.5	
Copper	mg/L		0.1	
Nickel	mg/L		0.1	
Silver	mg/L		0.1	
Metals in Total	mg/L		0.5	

Note: "-" indicates no guideline to be referred for the parameter.

7.3.2.3 Feedback management

If receiving any complaint due to Project activities, the Contractor should conduct investigation and propose corrective actions.



Legend

- Proposed Groundwater Monitoring Locations
- Recommended Area of Conservation

Construction Activities for Stage 1

- Tengah Road-Phase4
- Earthworks-Phase3
- Proposed Outlet Drain

Note: HDB are working closely with agencies on the details and extent of the Recommended Area of Conservation to be retained.

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Figure Title : **PROPOSED GROUNDWATER MONITORING LOCATIONS DURING STAGE 1**

Figure No. : 7-4	Rev. -	Sheet 1 of 1
CAD File Name : NA		A3

7.4 Air Quality

7.4.1 Pre-construction

Based on the Environmental Impact Study (EIS) report [R-1], ambient air quality should be measured prior to construction to have a full representation of the construction area. Based on the approved EIS report [R-1], SO₂, CO and O₃ were not included in the assessment due to various reasons, such as vehicle compliance to Euro VI standards, age distribution of goods and other vehicle population, low sulphur fuel used and no traffic congestion expected. PM₁₀, PM_{2.5} and NO₂ is expected from exhaust emissions from fuel burning equipment and heavy vehicle/machinery. The unmitigated air quality impact from exhaust emissions is rated as Minor Negative Impact. Further details can be found in the EIS report [R-1]. Thus, the contractor shall carry out one-week monitoring for pre-construction baseline of PM₁₀ and PM_{2.5} as they are the main pollutant of concern.

The three (3) locations proposed for pre-construction monitoring are as follows:

- AA1: HDB Blk 804B Keat Hong Close;
- AA2: Ecological receptor within Tengah Forest [near Tengah Earthworks Phase 3 (south)]; and
- AA3: Ecological receptors within Tengah Forest (near Tengah Earthworks Phase 3 & 4).

The proposed monitoring locations are presented in Figure 7-5. As requested by NEA, USEPA FRM/FEM air monitoring equipment is recommended for all air monitoring activities. If non-USEPA FRM/FEM equipment is proposed for monitoring, collocation with the USEPA FRM/FEM air monitoring equipment prior to the deployment (or planned monitoring period) should be conducted to ensure the performance of the non-USEPA FRM/FEM equipment. Correction/adjustment factor obtained from this collocation study, if determined during collocation, can be applied to the data from the non-USEPA equipment to improve the accuracy of the data. However, if the correlation is poor, the non-USEPA FRM/FEM equipment should not be used and a different equipment/unit should be proposed. Guidance provided by USEPA, such as “How to Evaluate Low-Cost Sensors by Collocation with Federal Reference Method Monitors” [R-30] and “Air Sensor Guidebook” [R-31], will be referred for determining ‘passing mark’ for the collocation exercise. Based on the collocation results, equipment with lower ‘passing mark’ will be deployed at ecological area, else dust deposition monitoring will be used for these ecologically sensitive areas. Equipment with better ‘passing mark’ will be used for human receptor testing and regulatory comparison purpose.

7.4.2 Construction

7.4.2.1 Site-specific Mitigation Measures

According to the planned timeline, only earthworks will be carried out during Stage 1. Mitigation measures proposed in Section 6.1.3 shall be implemented. No site-specific mitigation measures are proposed in this stage.

7.4.2.2 Monitoring Plan

Real-time continuous monitoring of PM₁₀ and PM_{2.5} shall be carried out by the contractor during earthworks phase. As requested by NEA, USEPA FRM/FEM air monitoring equipment is recommended for all air monitoring activities. If non-USEPA FRM/FEM equipment is proposed for monitoring, collocation with the USEPA FRM/FEM air monitoring equipment prior to the deployment (or planned monitoring period) should be conducted to ensure the performance of the non-USEPA FRM/FEM equipment. Correction/adjustment factor obtained from this collocation study, if determined during collocation, can be applied to the data from the non-USEPA equipment to improve the accuracy of the data. However, if the correlation is poor, the non-USEPA FRM/FEM equipment should not be used and a different equipment/unit should be proposed. Guidance provided by USEPA, such as “How to Evaluate Low-Cost Sensors by Collocation with Federal Reference Method Monitors” [R-30] and “Air Sensor Guidebook” [R-31], will be referred for determining ‘passing mark’ for the collocation exercise. Based on the collocation results, equipment with lower ‘passing mark’ will be deployed at ecological area, else dust deposition monitoring will be used for these ecologically sensitive areas. Equipment with better ‘passing mark’ will be used for human receptor testing and regulatory comparison purpose.

The data before and after the correlation shall be shared with the EMMP Consultant and captured in the application, Survey123, to enable the EMMP Consultant to monitor the dataset. The EMMP Consultant will then conduct data analysis and compare the results with the Singapore Ambient Air Quality Long Term Targets (SAAQT) [W-1]. In the

event that the air quality does not meet the SAAQT, the contractor shall investigate the cause and implement more stringent mitigation measure. Contractor and the EMMP Consultant shall also review the workplan and conduct a site measurement using portable equipment to ensure the air quality level meets the SAAQT during construction works. If there are any complaints from the community with regards to air quality during construction, additional ambient air quality monitoring shall be conducted by the contractor.

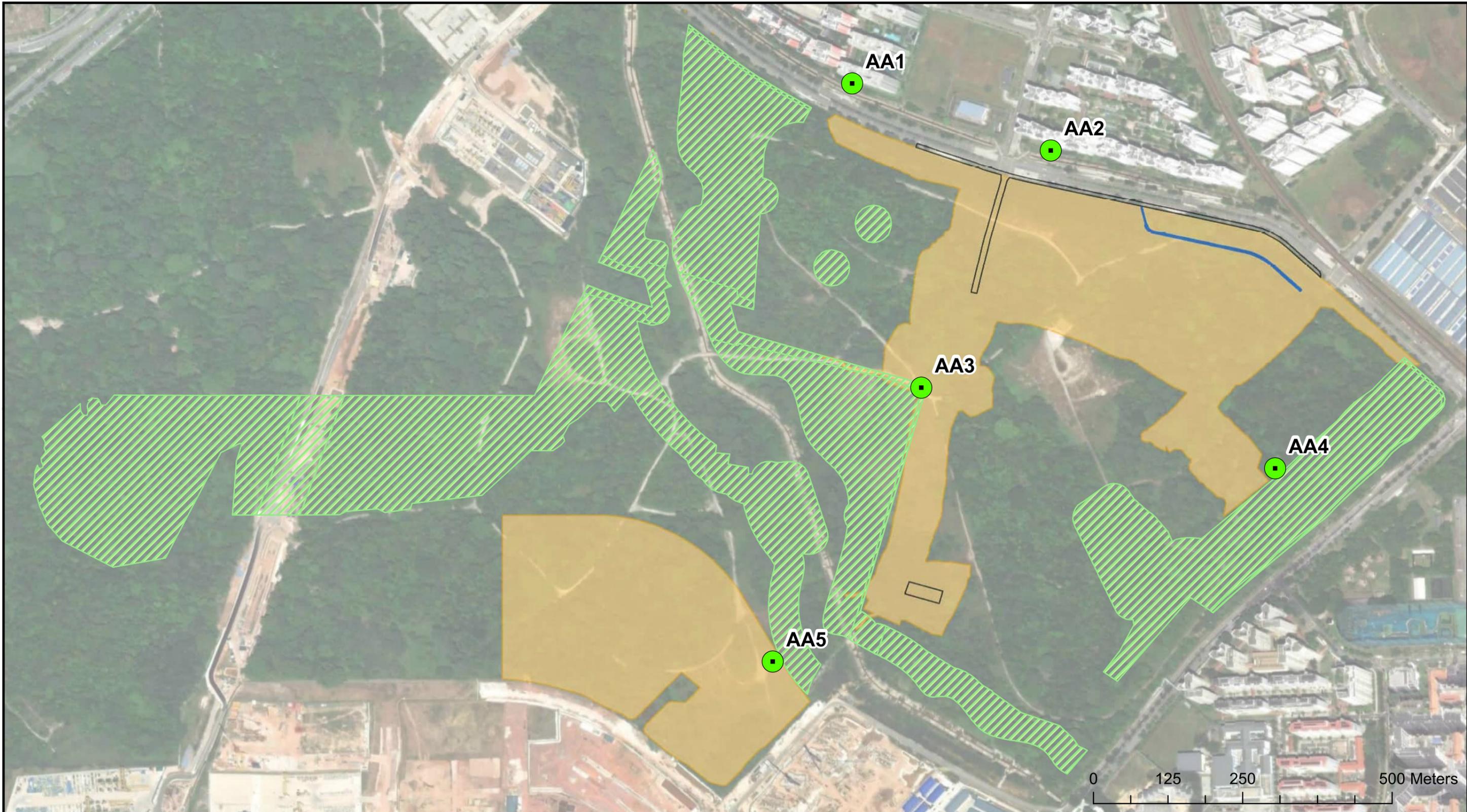
Based on the proximity to emission source, one (1) closest human receptor and two (2) ecological receptors are proposed for continuous monitoring of PM₁₀ and PM_{2.5} during earthworks phase. The three (3) proposed locations are as follows:

- AA1: HDB Blk 804B Keat Hong Close;
- AA2: Ecological receptor within Tengah Forest [near Tengah Earthworks Phase 3 (south)]; and
- AA3: Ecological receptors within Tengah Forest (near Tengah Earthworks Phase 3 & 4).

The proposed monitoring locations are presented in Figure 7-5.

Daily inspection by the ECO should also be carried out on northern and eastern boundary facing residential areas, as well as internal for ecological sensitive receptors.

Furthermore, during construction phase, the EMMP Consultant will conduct site inspection bi-weekly. Handheld air monitoring equipment (Aeroqual Series 500 Manual) will be used by the EMMP Consultant to monitor the air quality while carrying out site inspection to provide general idea, additional internal checks and understanding of ambient air quality variation/ trend around the site.



Legend

- Proposed Air Monitoring Locations
- Recommended Area of Conservation

Construction Activities for Stage 1

- Tengah Road-Phase4
- Earthworks-Phase3
- Proposed Outlet Drain

Note: HDB are working closely with agencies on the details and extent of the Recommended Area of Conservation to be retained.

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Figure Title : **PROPOSED AIR MONITORING LOCATIONS DURING STAGE 1**

Figure No. : 7-5	Rev. : -	Sheet : 1 of 1
CAD File Name : NA		A3

7.4.2.3 Feedback Management

A dedicated 24-hours Project Hotline shall be provided to receive feedback pertaining to the works. Any feedback and/or complaints received will be expeditiously and tactfully addressed to ascertain the feasibility of the needs and requests by the complainants. The case will be channelled and directed to the respective personnel for further action and will be followed up closely. The feedback and/or complaints received will also be made aware to HDB Project Team and Authority and Community Partnership Manager (MCPN). A proper and timely report of all the feedback/complaints received shall be kept and maintained. Documentation shall cover both negative and positive feedback, and include tracking of all correspondences relating to the matter. An Engagement report shall also be maintained to compile and report on all engagement activities. These reports will be incorporated in the HDB Monthly Progress Report and a copy will also be submitted to the MCPN. Feedback management system is shown in Figure 7-6. All the feedback and engagement are documented and maintained until successful work completion. Appendix E shows the example of Verbal & Written Feedback Register Form and the example of Engagement Report.

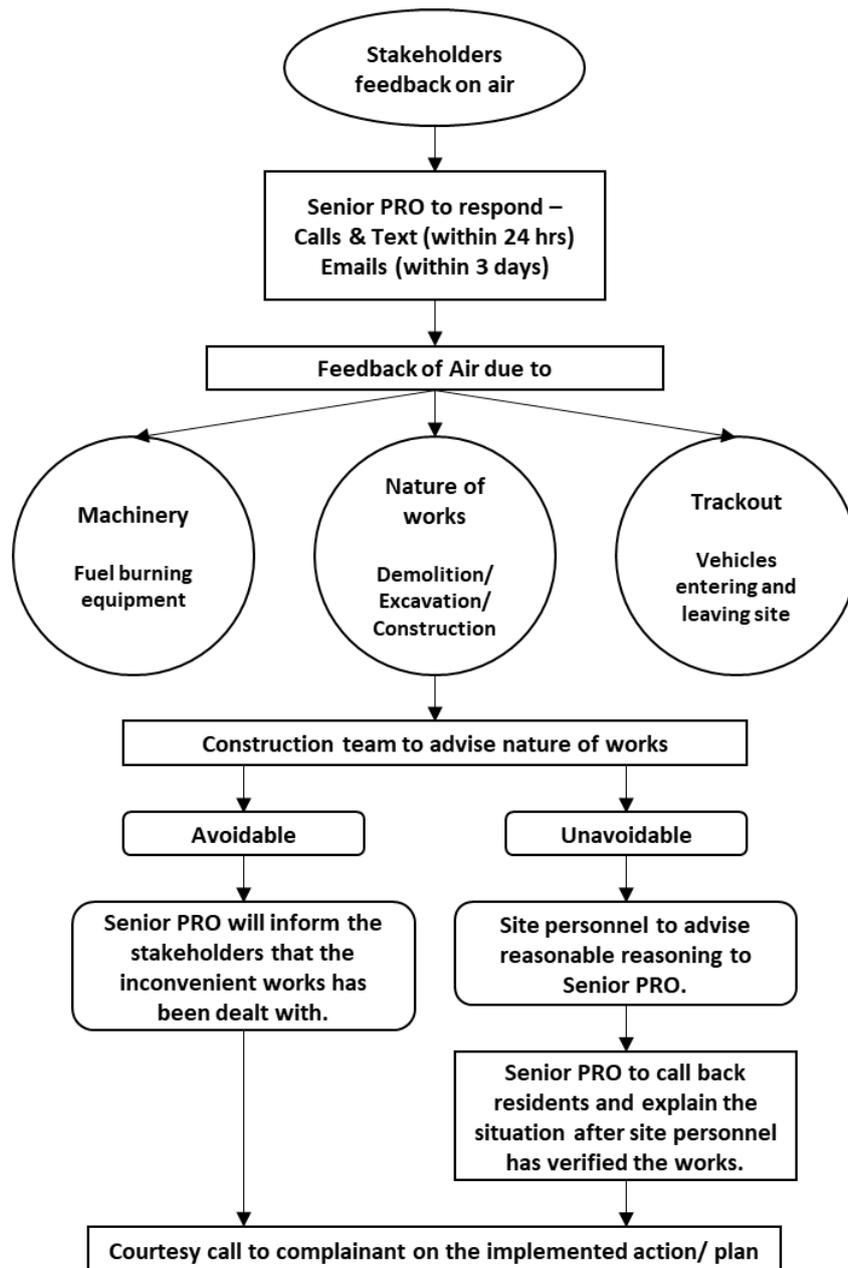


Figure 7-6 Feedback Management System

7.5 Airborne Noise

7.5.1 Pre-construction

7.5.1.1 Site-specific measures

Mitigation measures proposed in Section 6.1 shall be implemented by Contractor, if any applicable during pre-construction and unattended noise monitoring (1 week) should be conducted by Contractor prior commencement of site clearance to have a full representation of baseline noise level within/ surroundings of construction worksites.

7.5.1.2 Monitoring Plan

Unattended noise monitoring at five (5) locations (as shown in Figure 7-7) are proposed based on the baseline noise monitoring locations and worst-case impact predicted in the Environmental Impact Study (EIS) report [R-1] to establish the pre-construction baseline noise level. The five (5) locations proposed for pre-construction monitoring are as follows:

AN1: Block 805C, Keat Hong Close;

AN2: Block 485B, Choa Chu Kang Ave 5;

AN3: Ecological receptor within Tengah Forest;

AN4: Ecological receptor within Tengah Forest; and

AN5: Ecological receptor within Tengah Forest

Noise monitoring will be conducted by the Contractor for one week (weekdays and weekends) by using NEA-approved Type 1 Sound Level Meter (SLM), to capture baseline noise levels over time periods of 12 hours (long term), 1 hour, and 5 minutes (short term) at each location. The data will be shared will be shared with SO Rep., HDB and EMMP consultant. Data will be stored/synchronised into centralized platform in ArcGIS Online (AGOL).

The result will then be used to establish the maximum permitted noise level from the construction activities in accordance with the noise legislation stated in *Environmental Protection and Management (Control of Noise at Construction Sites) Regulations, 2008* [R-12] for human noise sensitive receptors. There are currently no guidelines or standards available to assess the noise from construction phases of the project on the respective ecological receptors. It is to be noted that ecological receptor noise impact will be assessed against the maximum baseline noise level as the noise criterion.

The current guidelines and standards available are used to assess the respective noise impact to humans only and will be adopted for this study for the purpose of establishing the criteria and assessing noise impacts to the identified noise sensitive receptors (human). In determining the impact of the construction noise to sensitive receptors, the baseline noise level detailed during pre-construction stage will be included in the calculation to derive a background noise correction factor to establish the maximum permitted noise level from the construction activities in accordance with the noise legislation stated in *Environmental Protection and Management (Control of Noise at Construction Sites) Regulations, 2008* [R-12].

A set of maximum allowable noise limits are prescribed for different time periods of the day and for different types of affected premises under *Environmental Protection and Management (Control of Noise at Construction Sites) Regulations, Second Schedule* (refer to Table 7-3).

Table 7-3 Maximum Permissible Noise Levels for Construction Works

Period	Types of Affected Buildings	Maximum Permissible Noise Levels in A-weighted decibels (dBA)		
		7am-7pm	7pm-10pm	10pm-7am
Monday to Saturday	(a) Hospitals, schools, institutions of higher learning, homes for the aged or sick etc.	60 (L _{Aeq} 12hr)	50 (L _{Aeq} 12hr)	
		75 (L _{Aeq} 5min)	55 (L _{Aeq} 5min)	
	(b) Residential buildings located less than 150 m from the construction site where the noise is being emitted	75 (L _{Aeq} 12hr)	65 (L _{Aeq} 1hr)	55 (L _{Aeq} 1hr)
		90 (L _{Aeq} 5min)	70 (L _{Aeq} 5min)	55 (L _{Aeq} 5min)
	I Buildings (other than those in paragraphs (a) and (b))	75 (L _{Aeq} 12hr)	65 (L _{Aeq} 12hr)	
		90 (L _{Aeq} 5min)	70 (L _{Aeq} 5min)	

Period	Types of Affected Buildings	Maximum Permissible Noise Levels in A-weighted decibels (dBA)		
		7am-7pm	7pm-10pm	10pm-7am
Sunday and Public Holiday	(a) Hospitals, schools, institutions of higher learning, homes for the aged or sick etc.	60 (L _{Aeq} 12hr)	50 (L _{Aeq} 12hr)	
		75 (L _{Aeq} 5min)	55 (L _{Aeq} 5min)	
	(b) Residential buildings located less than 150 m from the construction site where the noise is being emitted	75 (L _{Aeq} 12hr)	-	
		75 (L _{Aeq} 5min)	55 (L _{Aeq} 5min)	
	(c) Buildings (other than those in paragraphs (a) and (b))	75 (L _{Aeq} 12hr)	65 (L _{Aeq} 12hr)	
		90 (L _{Aeq} 5min)	70 (L _{Aeq} 5min)	

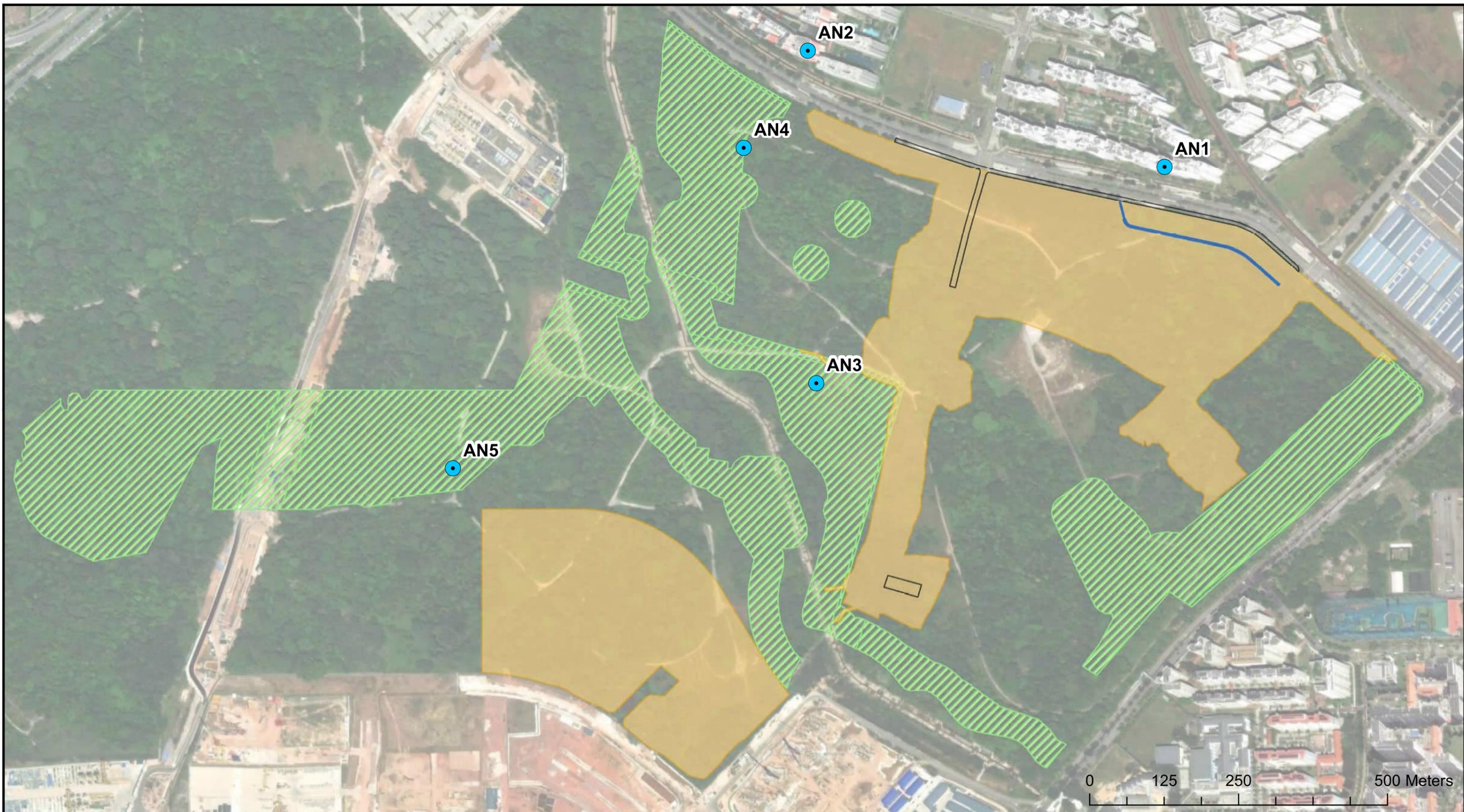
As per the legislation, if there are other sources of noise affecting the measurement of noise emitted from the construction site, the maximum permissible noise levels for construction sites are supposed to be adjusted by the addition of a correction factor to account for the existing background noise levels in the area. The correction factor corresponds to the difference between the relevant permissible level, and the background noise level and is presented in Table 7-4. The difference in the noise levels are then added to the higher of the two noise levels (background noise/ criteria as appropriate) to give the applicable noise criteria for the specified construction area.

Table 7-4 Maximum Permissible Noise Levels for Construction Works

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

7.5.1.3 Feedback Management

Not applicable during pre-construction stage.



Legend

- Proposed Noise Monitoring Locations
- Recommended Area of Conservation

Construction Activities for Stage 1

- Tengah Road-Phase4
- Earthworks-Phase3
- Proposed Outlet Drain

Note: HDB are working closely with agencies on the details and extent of the Recommended Area of Conservation to be retained.

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Figure Title : **PROPOSED NOISE MONITORING LOCATIONS
DURING PRE-CONSTRUCTION**

Figure No. : **7-7**

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Sheet : 1 of 1

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A3

7.5.2 Construction

7.5.2.1 Site-specific measures

Mitigation measures proposed in Section 6.1 shall be implemented by Contractor. Specific mitigation measures such as setting up 6m noise barriers with a minimum of Sound Transmission Class (STC) 20 around the entire construction site to reduce noise level as shown in Figure 7-8 shall be implemented by Contractor. Additional mitigation measures such as enclosure, noise screen/noise panel, and portable noise barrier are recommended for all construction stages to further reduce excessive noise impacts to the noise sensitive receptors. If required, the contractor may need to look at the permanent noise barrier and increase the height of permanent noise barrier to reduce noise level to meet the Project Criteria.

Daily inspection by EMMP Consultant's ECO should also be carried out on northern and eastern boundary facing residential areas, as well as internal for ecological sensitive receptors. EMMP Consultant will conduct site inspection bi-weekly during construction phase.

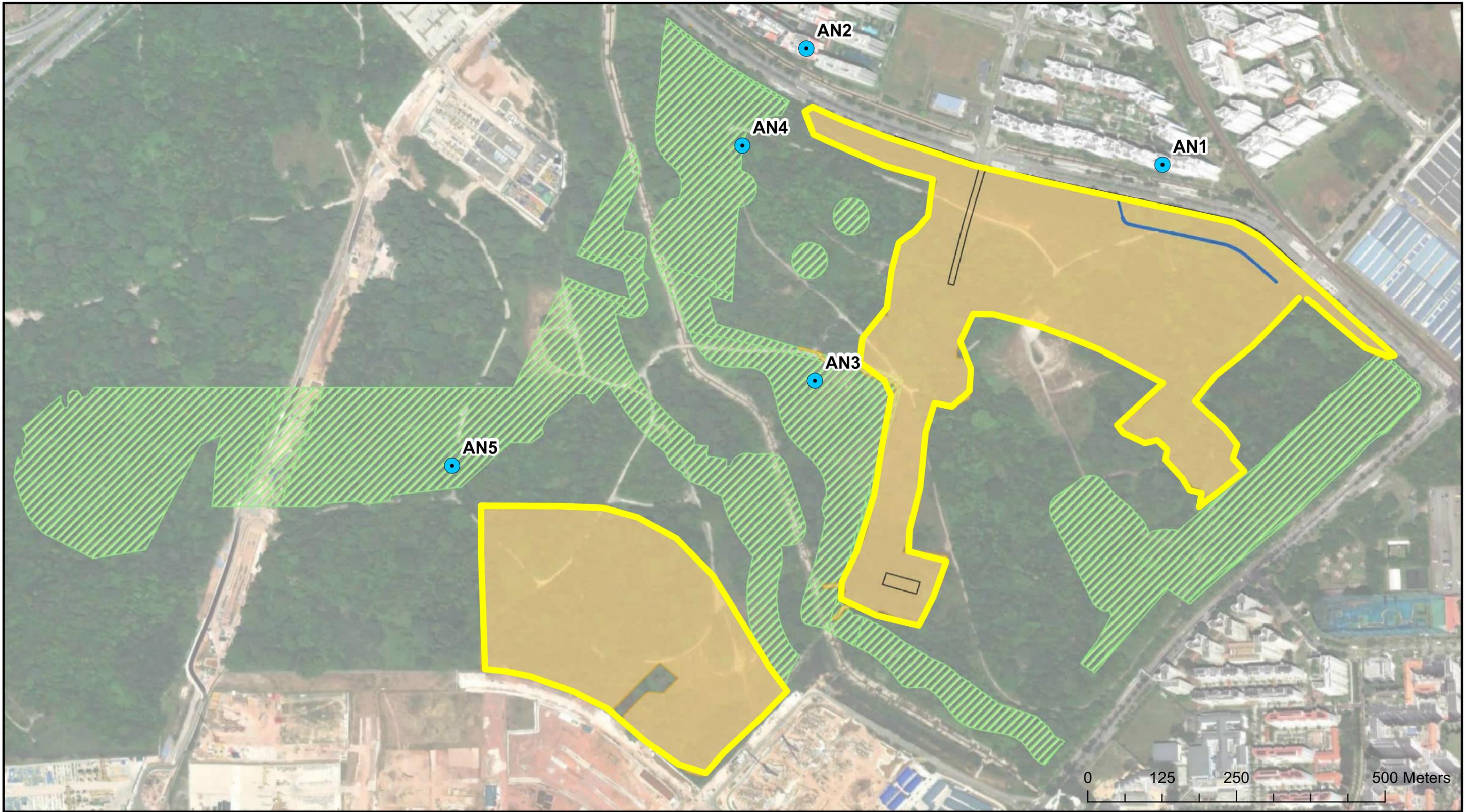
7.5.2.2 Monitoring Plan

Five (5) locations (as shown in Figure 7-8) are proposed for continuous real-time noise monitoring during Stage 1 based on the worst-case impact predicted in the Environmental Impact Study (EIS) report [R-1]. Continuous real-time noise monitoring will be conducted by the Contractor which will be the same as pre-construction baseline noise monitoring location mentioned in Section 7.5.1.2 during entire construction stage and the data will be shared with the SO Rep., HDB and the EMMP Consultant for data analysis. The proposed locations are as follows:

- AN1: Block 805C, Keat Hong Close;
- AN2: Block 485B, Choa Chu Kang Ave 5;
- AN3: Ecological receptor within Tengah Forest;
- AN4: Ecological receptor within Tengah Forest; and
- AN5: Ecological receptor within Tengah Forest.

The result will then be compared with the "adjusted maximum permitted noise level" from the construction activities in accordance with the noise legislation stated in *Environmental Protection and Management (Control of Noise at Construction Sites) Regulations, 2008* [R-12]. It is to be noted that ecological receptor noise impact will be assessed against the maximum baseline noise level as the noise criterion.

In the event of any noise level exceedance than the project criteria, the contractor shall investigate the cause and implement more stringent mitigation measure if any applicable. Contractor and EMMP Consultant's ECO shall also conduct an investigation and conduct a site measurement using portable equipment to ensure the noise level meets the project criteria during construction works. If there are any complaints from the community with regards to noise during construction, additional noise monitoring shall be conducted by the contractor.



Legend

- Proposed Noise Monitoring Locations
- Noise Barrier (6m)
- Recommended Area of Conservation

Construction Activities for Stage 1

- Tengah Road-Phase4
- Earthworks-Phase3
- Proposed Outlet Drain

Note: HDB are working closely with agencies on the details and extent of the Recommended Area of Conservation to be retained.

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Figure Title : **PROPOSED NOISE MONITORING LOCATIONS DURING STAGE 1**

Figure No. : **7-8**

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A3

7.5.2.3 Feedback Management

A dedicated 24-hours Project Hotline shall be provided to receive feedback pertaining to the works. Any feedback and/or complaints received will be expeditiously and tactfully addressed to ascertain the feasibility of the needs and requests by the complainants. The case will be channelled and directed to the respective personnel for further action and will be followed up closely. The feedback and/or complaints received will also be made aware to HDB Project Team and Authority and Community Partnership Manager (MCPN). A proper and timely report of all the feedback/complaints received shall be kept and maintained. Documentation shall cover both negative and positive feedback, and include tracking of all correspondences relating to the matter. An Engagement report shall also be maintained to compile and report on all engagement activities. These reports will be incorporated in the HDB Monthly Progress Report and a copy will also be submitted to the MCPN. Feedback management system is shown in Figure 7-9. All the feedback and engagement are documented and maintained until successful work completion. Appendix E shows the example of Verbal & Written Feedback Register Form and the example of Engagement Report.

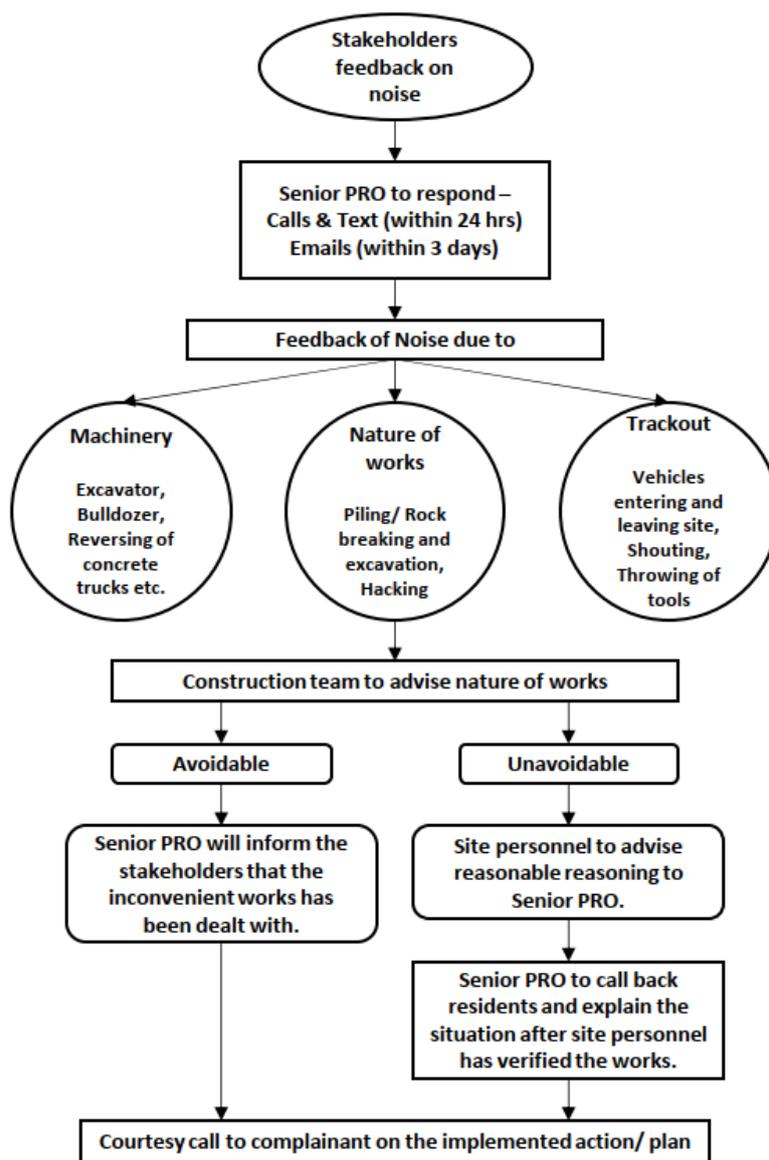
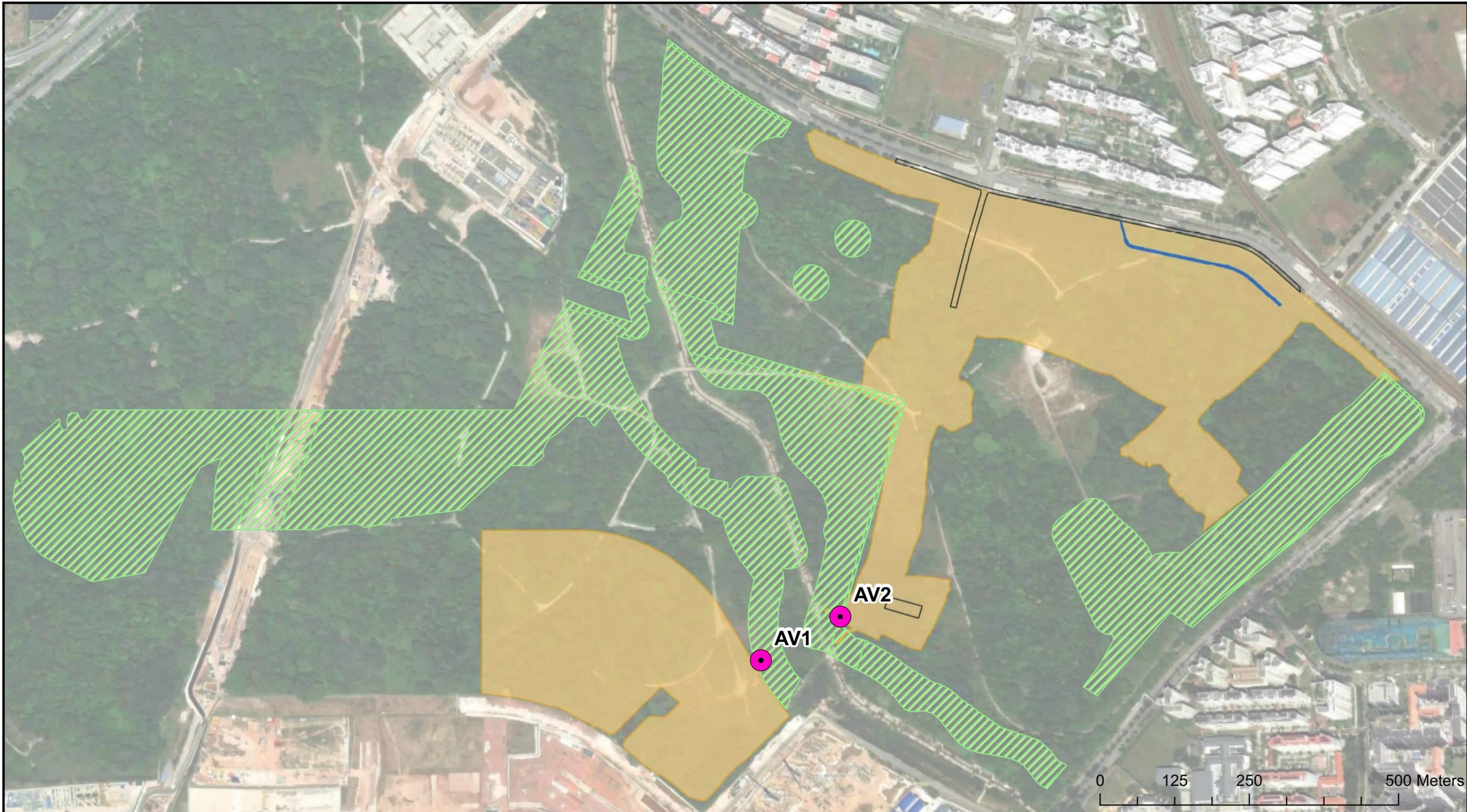


Figure 7-9 Feedback Management System (Noise)

7.6 Vibration

7.6.1 Pre-construction

AECOM proposed to monitor baseline vibration level for one (1) week prior to construction to have a full representation of the construction area. The two locations proposed for pre-construction monitoring are located at ecological receptor within forested area. The proposed monitoring locations are presented in Figure 7-10.



Legend

- Proposed Vibration Monitoring Locations
- ▨ Recommended Area of Conservation

Construction Activities for Stage 1

- ▭ Tengah Road-Phase4
- ▭ Earthworks-Phase3
- ▭ Proposed Outlet Drain

Note: HDB are working closely with agencies on the details and extent of the Recommended Area of Conservation to be retained.

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Figure Title : **PROPOSED VIBRATION MONITORING LOCATIONS
DURING PRE-CONSTRUCTION**

Figure No. : 7-10	Rev. -	Sheet 1 of 1
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Note: Source of basemap - Google Earth Map

7.6.2 Construction

7.6.2.1 Site-specific Mitigation Measures

General mitigation measures proposed in Section 6.1.5.2 shall be implemented. No site-specific mitigation measure is proposed in this stage.

7.6.2.2 Monitoring Plan

Vibration monitoring is not proposed during Stage 1, as there is no piling activity involved. However, the contractor shall carry out vibration monitoring as per BCA's requirements where applicable. If monitoring is carried out as per BCA's requirement, the contractor shall share the data with the EMMP Consultant and record in the application, Survey123, in order for the EMMP Consultant to analyse the data to ensure that the vibration levels meet the human comfort criteria. Furthermore, during the construction phase, a site inspection will be carried out by EMMP Consultant bi-weekly.

During pre-felling fauna inspections, if burrows are opportunistically detected, an endoscope camera will be used to check for signs of usage and fauna. If there are any trapped fauna, the Wildlife Response Plan will be activated (Section 8.3). If there are any complaints from the community with regards to vibration during construction, additional vibration monitoring shall be conducted by the contractor.

7.6.2.3 Feedback Management

A dedicated 24-hours Project Hotline shall be provided to receive feedback pertaining to the works. Any feedback and/or complaints received will be expeditiously and tactfully addressed to ascertain the feasibility of the needs and requests by the complainants. The case will be channelled and directed to the respective personnel for further action and will be followed up closely. The feedback and/or complaints received will also be made aware to HDB Project Team and Authority and Community Partnership Manager (MCPN). A proper and timely report of all the feedback/complaints received shall be kept and maintained. Documentation shall cover both negative and positive feedback, and include tracking of all correspondences relating to the matter. An Engagement report shall also be maintained to compile and report on all engagement activities. These reports will be incorporated in the HDB Monthly Progress Report and a copy will also be submitted to the MCPN. Feedback management system is shown in Figure 7-11. All the feedback and engagement are documented and maintained until successful work completion. Appendix E shows the example of Verbal & Written Feedback Register Form and the example of Engagement Report.

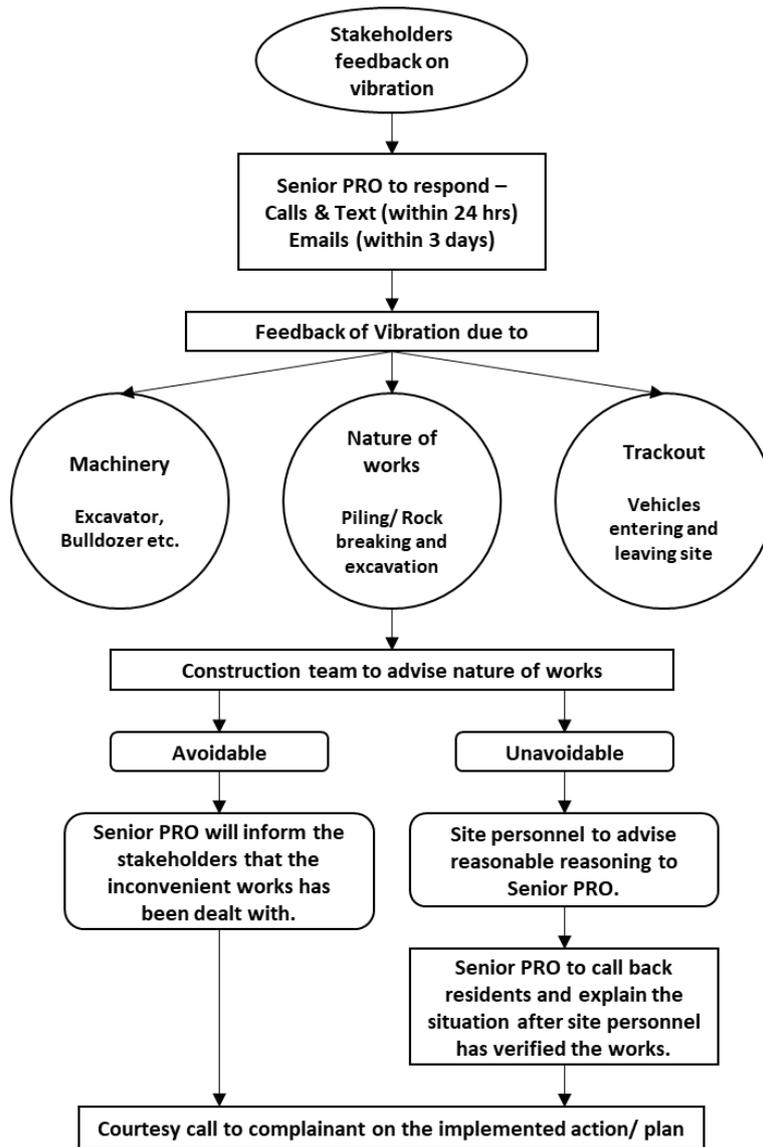


Figure 7-11 Feedback Management System

7.7 Vector Control

7.7.1 Pre-construction

7.7.1.1 Site-specific Measures

All standard measures as described in Section 6.1 should be applied accordingly.

7.7.1.2 Monitoring Plan

7.7.1.2.1 Submission of Vector Control Plan

Vector-breeding may lead to severe consequences such as the spread of virulent diseases (e.g. dengue fever) both to the workers onsite and to other people near the worksite. Aligning with NEA's Code of Practice for Vector Control Operator, Technician and Worker [W-4] and NEA's Mosquito and Rodent Control Measures [W-5, W-6], the Contractor shall submit a site-specific Vector Control Plan upon contract award, which encompassing the following elements:

- Pre-existing Conditions: To conduct a site assessment and establish vector baseline, which serves to identify high-risk areas for vectors-breeding and eliminate pre-existing vector issues before starting work;
- Zoning Method (see example in Figure 7-12): To divide the construction site into a maximum of three (3) zones for vector control and surveillance activities which to be conducted at least one (1) zone per day, where each zone will be combed at least twice a week; and,
- Dengue Contingency Plan: To develop response plan in case that any person found on site is discovered to be a carrier of vector-borne disease, and when outbreak of dengue or mosquito breeding ground is detected on site.

7.7.1.3 Feedback Management

Since construction activities haven't been started, there is no feedback management to be provided during pre-construction stage.

7.7.2 Construction

7.7.2.1 Site-specific Measures

All standard measures as described in Section 6.1 should be applied accordingly.

7.7.2.2 Monitoring Plan

7.7.2.2.1 Submission of Vector Baseline Report

As per NEA's sample contract specifications for mosquito and rodent control [W-8], the Contractor shall submit a full Vector Baseline Report with photographs (where applicable) to SO Rep./NEA by the second week after the commencement of the contract or at the beginning of each construction stage. The Vector Baseline Report shall be able to:

- Identify all potential mosquito breeding habitats and/or other relevant environmental irregularities (e.g., stagnant water, public litters at bus stop near worksite) in the required format as shown in the Annex C1 of the NEA's sample contract specifications; and,
- Identify all rat/rodent burrows, activity and/or other relevant environmental irregularities (e.g., signs of rub marks, live rodents) in the required format as shown in the Annex C2 of the NEA's sample contract specifications.

7.7.2.2.2 Submission of Vector Service Report(s)

As per NEA's sample contract specifications for mosquito and rodent control [W-8], the Contractor shall submit a Vector Service Report to SO Rep./NEA at the end of each mosquito and rodent/rat control services. The Vector Service Report shall:

- Report the performance of all mosquito control services conducted in the format as shown in Annex D1 of the NEA's sample contract specifications.
- Report the performance of all rodent/rat control services conducted in the format as shown in Annex D2-1 of the NEA's sample contract specifications. Recommend specific solutions to prevent mosquito breeding and rat/rodent infestation (e.g., building design details, repairs, housekeeping programmes, user habits) and any other factors that have direct bearing on mosquito breeding and rat/rodent infestation.
- Photos of each vector-breeding location (e.g., mosquito-breeding area, rodent burrow) or structural defect and the respective treatment shall be taken from different perspectives/angles and included in the report.
- In specific for rat/ rodent control, a Monthly Service Report shall be submitted to the SO Rep. at the end of each month, with consolidated findings and the outcomes of relevant actions undertaken for the month.

7.7.2.2.3 Implementation of Vector Control Plan and Vector Monitoring Programme On Site

For the implementation of Vector Control Plan, the licensed personnel on site should be provided as follows:

- **A NEA-licensed ECO** shall be appointed by the EMMP Consultant to draw up and implement an effective vector control programme, which outlines vector surveillance and control measures to eliminate, reduce and/or manage vector risks as stated in NEA's *Code of Practice for Environmental Control Officers (ECO)* [R-23]. The ECO which appointed by EMMP Consultant shall assist the Contractor in engaging external NEA-licensed VCO to undertake vector control measures on site.
- **A NEA-registered VCO (Vector Control Operator)**, which is a registered company formed by a team of NEA-licensed Vector Control Technicians (VCTs) and NEA-certified Vector Control Workers (VCWs), shall be engaged by the Contractor to undertake vector control measures as per the *Code of Practice for Vector Control Operator, Technician and Worker* [W-4], as well as to carry out vector control and surveillance at least once a week on site. The VCO shall lead and/or provide guidance for in-house vector control programme, if required to be formed by the Contractor, SO Rep., HDB and/or relevant authorities. The registered VCO, licensed VCT and/or certified VCW shall be able to identify potential vector-breeding grounds and propose measures to prevent propagation of vectors on site.
- **An in-house vector control team** should be led by an NEA-licensed VCT, joined by NEA-certified VCWs and/or a supporting group of individuals who have undergone vector control trainings provided by the NEA-registered VCO, NEA-licensed VCT and/or have passed other equivalent trainings (e.g., *Joint ITE-NEA Certificate in Pest Management*).
- **Note:** Under the *Control of Vector and Pesticide Act (CVPA)* [R-56], only registered VCO, licensed VCT or certified VCW under NEA can be engaged to carry out vector control works on site. The employment of any unlicensed/ uncertified vector control technicians/workers may be a potential breach of the CVPA Chapter 59 [W-8].
- **An external NEA-licensed VCO** shall be engaged by the Contractor/SO Rep. to supplement the weekly in-house vector control and surveillance routine.
- Noted as one of the minimum control measures on site, Gravitraps will normally be employed to prevent mosquito breeding. The in-house vector control team shall develop a vector control program (see example in Figure 7-12) to conduct a daily routine of "Search and Destroy"¹ activities at each zone, as well as to monitor and maintain Gravitraps using the Zoning Method.

The recommended monitoring program for vectors is summarised in Table 7-5 below.

Investigation and corrective actions (Investigation and corrective actions (i.e., Stop Work Orders) to be taken, when:

- Worksite is found to have vector-breeding habitats.
- There is an occurrence of suspected dengue outbreak cases.

¹ According to *LTA's Guidebook in Vector Control at LTA Sites*, "Search and Destroy" refers to the search for and destruction of potential mosquito breeding grounds. This includes clearing of stagnant water, removal of unwanted water-bearing receptacles and eliminating conditions that are prone to water stagnation.

Table 7-5 Recommended Monitoring Programme during Construction Phase (Vector Control)

Location	Parameters	Frequency and Duration
<p>Contractor to define vector zones (see example in Figure 7-12) for each individual construction worksite (including storage and resting areas) under this Project, as listed below:</p> <ul style="list-style-type: none"> • Worksite for Tengah Earthworks Phase 3; • Worksite for Tengah Earthworks Phase 5; • Worksite for Earthworks Phase 6; • Worksite for Outlet Drain Phase 1a and 1b construction; • Any other individual worksites set up for other supporting works (e.g., underpinning works). 	<ul style="list-style-type: none"> • Inspection of potential mosquito breeding grounds (stagnant water), rat/ rodent burrows and droppings of other vectors (e.g., cockroaches) 	<ul style="list-style-type: none"> • Daily inspection across different zones by in-house vector control team (see example in Figure 7-12) and their respective Gravitraps, with each zone inspected at least twice a week; • Weekly vector control and surveillance by the NEA-registered VCO, NEA-licensed VCT and/or NEA-certified VCWs.

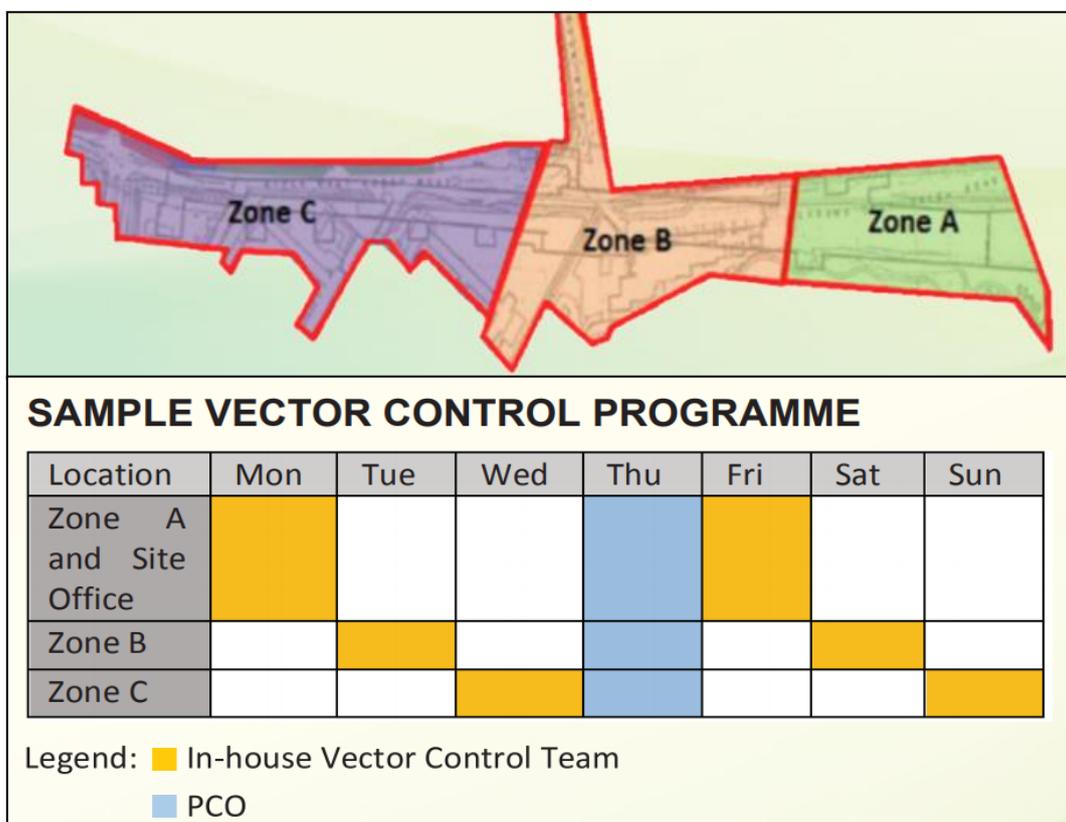


Figure 7-12 Example of Zoning Method and Vector Control Programme [R-24]

7.7.2.3 Feedback Management

If receiving any complaint about significant increase of vectors found at surrounding of worksite boundary, the in-house vector control team and VCO should conduct investigation and propose corrective actions.

7.8 Waste Management

7.8.1 Pre-construction

7.8.1.1 Site-specific Measures

All standard measures as described in Section 6.1 should be applied accordingly.

7.8.1.2 Monitoring Plan

Prior to construction, the appointed Contractor should submit a site-specific waste strategy and management plan to SO Rep. prior to execution with the aim of waste minimisation and mapping of waste types, volume and treatment methods. The plan shall provide a framework for the following:

- Specific types and projected volume of waste expected to be produced throughout the construction period.
- Recycling targets aligned with the Singapore's 2030 Recycling Target for each type of waste.
- Storage location and capacity of each type of waste/recyclables and the specific precautions taken to prevent spillage/ contamination.
- List of licensed waste collector contracted and schedule of collection for each waste type.
- Treatment methods for each type of waste (i.e. recycled, incinerated) on-site and off-site.
- Information of waste management contractors.

7.8.1.3 Feedback Management

Since construction activities haven't been started, there is no feedback management to be provided during pre-construction stage.

7.8.2 Construction

7.8.2.1 Site-specific Measures

All standard measures as described in Section 6.1.7 should be applied accordingly.

7.8.2.2 Monitoring Plan

An on-site waste management team should be appointed by the Contractor to implement daily waste management/ housekeeping works according to the established waste strategy and management plan.

A monitoring, review and reporting protocol for waste generated during construction should be developed by the Contractor to track the amount of recycling and disposal (e.g. general non-toxic, toxic and construction waste) done with a monthly report to be submitted within the periodic environmental performance monitoring reports. The report shall be used to identify gaps in standards and targets and areas of improvement and highlight waste generation areas which may have been overlooked or were more serious than expected.

Contractor should inspect daily on proper disposal of organic waste, hazardous waste, other wastes as well as any oil/chemical spill at site.

Contractor should prepare log sheet for disposal of hazardous waste if required and should inspect the hazardous chemical/substances storage condition weekly during construction phase.

Monthly audit should be conducted by EMMP Consultant/ECO to ensure the waste management quality is maintained based on established management plan.

Investigation and corrective actions to be taken, when:

- There are no/ poor records of toxic chemical waste amount and type; and
- There is evidence of poor handling/ storage of toxic chemical waste and hazardous chemical

7.8.2.3 Feedback Management

If receiving any complaint due to Project activities, the Contractor should conduct investigation and propose corrective action.

7.9 Summary of Standard and Site-specific Measures and the Responsible Parties

7.9.1 Biodiversity

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
Biodiversity: Flora				
Major Impact: <ul style="list-style-type: none"> • Site clearance • Earth works • Tree-felling works Minor Impact: <ul style="list-style-type: none"> • Pre-construction survey • Soil Investigation works • Hoarding works • Road works • Proposed outlet drain constructions 	<ul style="list-style-type: none"> • Loss of vegetation/habitat • Habitat pollution and degradation • Change in species composition • Disturbances to Flora within site, RAC and TPZs 	<ul style="list-style-type: none"> • Prior to commencement of site works, the salvaging procedures, and the flora monitoring and management plan should be crafted in consultation with NParks. 	Contractor/EMMP Consultant	EMMP Consultant's ECO/ SO Rep.*
		<ul style="list-style-type: none"> • Salvaging of viable saplings of conservation significance by relevant authorities should be carried out before site clearance begins. 	Contractor/EMMP Consultant	EMMP Consultant's ECO/ SO Rep.*
		<ul style="list-style-type: none"> • Prevent excessive or unauthorised vegetation clearance by ensuring construction works are prohibited within the RACs and TPZs. 	Contractor/EMMP Consultant	EMMP Consultant's ECO/ SO Rep.*
		<ul style="list-style-type: none"> • Monitor sensitive habitats (i.e., RAC) for forest edge effects and competition from exotic or invasive flora species at the new forest edges. 	Contractor/EMMP Consultant	EMMP Consultant's ECO/ SO Rep.*
		<ul style="list-style-type: none"> • Minimise construction impacts on sensitive vegetation (i.e., RAC). 	Contractor/EMMP Consultant	EMMP Consultant's ECO/ SO Rep.*
		<ul style="list-style-type: none"> • Proper waste disposal guidelines of construction waste and hazardous material should be strictly adhered to, in order to prevent habitat pollution which impedes seedling recruitment. 	Contractor/EMMP Consultant	EMMP Consultant's ECO/ SO Rep.*
Biodiversity: Arboriculture				
Major Impact: <ul style="list-style-type: none"> • Site clearance • Earth works • Tree-felling works 	<ul style="list-style-type: none"> • Loss of vegetation/habitat • Habitat pollution and degradation 	<ul style="list-style-type: none"> • Prior to commencement of site works, the tree transplantation procedures and tree protection protocol, should be crafted in consultation with NParks. 	Contractor/EMMP Consultant	EMMP Consultant's ECO / SO Rep.*
		<ul style="list-style-type: none"> • Implement Tree Monitoring and Management plan. 	Contractor/EMMP Consultant	EMMP Consultant's ECO / SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
Minor Impact: <ul style="list-style-type: none"> Pre-construction survey Soil Investigation works Hoarding works Road works Proposed outlet drain construction 	<ul style="list-style-type: none"> Change in species composition Disturbances to Flora within site, RAC and TPZs. 	<ul style="list-style-type: none"> Monitor trees at the new forest edges within 15 m from the hoarding boundary or trees along the RAC. 	Contractor/EMMP Consultant	EMMP Consultant's ECO / SO Rep.*
Biodiversity: Fauna				
Major Impact: <ul style="list-style-type: none"> Site clearance Earth works Tree-felling works 	<ul style="list-style-type: none"> Loss of ecological connectivity Fauna mortality and injury Roadkill occurrences Disturbance to fauna within site and adjacent recommended areas of conservation Human-wildlife conflicts Increased susceptibility of noise and light impacts 	<ul style="list-style-type: none"> Implement the Wildlife Response Plan, Roadkill Response Plan, pre-felling procedures and directional site clearance plan. 	Contractor/EMMP Consultant	Contractor
Minor Impact: <ul style="list-style-type: none"> Pre-construction survey Soil Investigation works Hoarding works Road works Proposed outlet drain construction 		<ul style="list-style-type: none"> Pre-felling fauna inspection to minimise injury and mortality of fauna as a result of vegetation clearance. 	Contractor/EMMP Consultant	Contractor
		<ul style="list-style-type: none"> Camera trap monitoring for wild boar presence to be conducted after hoarding installation is completed to determine if any Eurasian wild boars are trapped within the hoarding boundary (under discussion with NParks). 	Contractor/EMMP Consultant	Contractor
		<ul style="list-style-type: none"> Directional site clearance must be adhered to during site clearance to minimise fauna injury and mortality. 	Contractor/EMMP Consultant	Contractor
		<ul style="list-style-type: none"> As construction works occur adjacent to the RAC and TPZ, hoarding directly adjacent to the RAC should not have gaps to prevent entry of animals, and noise and light measures must be adhered to. 	Contractor/EMMP Consultant	Contractor
		<ul style="list-style-type: none"> Biodiversity Awareness Training to be carried out ensure workforce complies to the fauna response procedures, general housekeeping and understands the ecological value of site. 	EMMP Consultant	Contractor
		<ul style="list-style-type: none"> Wildlife corridors to be established and monitored via camera traps in order to ensure continued ecological connectivity. 	Contractor/EMMP Consultant	Contractor
		<ul style="list-style-type: none"> Site inspections to be conducted daily to minimise fauna entrapment, ensure proper ECM measures are in place, and ensure cleanliness of site. 	Contractor	EMMP Consultant's ECO / SO Rep.*
<ul style="list-style-type: none"> Site inspections to be conducted once every two weeks to minimise potential environmental impacts to fauna. 	Contractor/EMMP Consultant	Contractor		

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Prior to closure of the wildlife corridor, Contractor to walk along the entire length of the corridor to ensure that no fauna is trapped within the corridor. 	Contractor/EMMP Consultant	Contractor
		<ul style="list-style-type: none"> Technical agencies of this project and other concurrent projects to communicate and coordinate in the execution of wildlife corridors. 	Contractor/EMMP Consultant	Contractor
<p>Note: * The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.</p>				

7.9.2 Hydrology, Surface Water and Groundwater

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
Site clearance, spillage of oil, fuel and lubricant from vehicle and machinery, oil drips from generator, chemical spill, proposed outlet drain construction work.	<ul style="list-style-type: none"> Water quality deterioration due to soil erosion and surface runoff from construction site; Water quality deterioration due to use, storage and handling of diesel, oil and other pollutive substances on construction site; Changes in surface water flow direction and flow rate; Potential of groundwater drawdown; Water quality deterioration due to sewage discharge; Water quality deterioration due to discharge of trade effluent from construction activities; 	<u>Standard Measures</u> <ul style="list-style-type: none"> The whole of planning, designing, submission of Earth Control Measures plans by a Qualified Erosion Control Professional to PUB including installation, maintenance, monitoring, reports, erosion control blankets, CCTV at discharge points, silt fences, silt trap, sedimentation tanks, ECM detention facilities to comply with clause 7.1.5 of the Code of Practice on Surface Water Drainage, etc.; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> The Contractor should moderate the earth works in tandem with the ECM provision. He shall regulate the earthworks carefully to keep the contractor from exposing more areas that he could handle; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> The CCTVs provided by the Contractor are to check the overall ECM performance from the development and link the system to Silt Imagery Detection System (SIDS) to provide auto alerts on silt discharge and no/poor images; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Contractor should ensure that their CCTV system is properly operated and maintained at all times. It is also meant to curb Contractors from deliberately tempered with the CCTV system to mask the silty discharge; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Biodegradable erosion blankets shall be provided to the areas with bare soil surface within the same day of the soil is exposed; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> The Contractor shall ensure that the existing drains shall not be filled or interfered without the prior approval from PUB; free flow in the existing drain is maintained at all times until the permanent diversion drain is constructed and functioning effectively. He shall carry out whatever necessary works to ensure that runoff within upstream of and adjacent to the site can be effectively drained away without causing flooding within the site and in the vicinity of the site; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Sediment Control Plan should be prepared to include but not limited to the sealing of site hoarding, a berm shall be provided along the site hoarding to prevent silty water to leak out from the site and ramp/curb at site entrance; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> The Contractor is required to divert any existing drains that affect the works. The Contractor shall ensure that the work is carried out properly to prevent flooding of site. Any abandoned portions of the drains upon diversion are to be filled up by the Contractor; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> The Contractor shall obtain approval from the SO Rep.. and/or Public Utilities Board (Drainage) on any diversion of existing drains and canals prior to commencement of the diversion work; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> All existing drains are to be desilted during pre-construction and construction stages. The Contractor shall be responsible for the cleanliness of the above drains throughout the duration of the construction; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> In view of the deep excavation for the construction of drains, sewers and manhole if any, earthworks, all associated temporary works (shoring/ protection works), methods of excavation, construction sequences and contingency plans are to be designed and duly endorsed by the Contractor's appointed Professional Engineer (Civil) [referred to as PE (Civil)] and Professional Engineer (Geotechnical) [referred to as PE (Geo)], if necessary and required under BCA Statutory Acts. The PE (Civil) and PE (Geo) shall submit plans, work-methods, safety measures, temporary works, monitoring (movement, vibration, settlement cracks, etc.) and work procedures as required by the relevant Authorities 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> The Contractor shall be required to set up adequate settlement benchmarks as deemed necessary by SO Rep. to monitor the settlement of the existing or adjoining properties/structures, if any, throughout the piling operation and excavation; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> The monitoring programme of the surveying works on settlement benchmarks shall be submitted to the SO Rep. for approval; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> When any of the following criteria is reached irrespective of whether damage has occurred, the Contractor shall notify the SO Rep. immediately: <ul style="list-style-type: none"> ➢ 5mm settlement or movement between consecutive readings ➢ 15mm total settlement of any part of a building/structure 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> The Contractor shall design, supply, install and maintain real-time CCTV camera & monitors including operation, relocations, recordings & maintenance, along Site Boundary. Proposed locations & relocations of the CCTV camera shall be submitted to SO Rep. and HDB for approval before installation on site. The CCTV recordings in videos and photos format shall be submitted to SO Rep. office on a weekly basis in softcopy, stored and backed up in the server and ensure no accidental erasure throughout the construction period; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> The Contractor shall take all precautionary measures and/or protections needed for the construction of the proposed temporary roads, drains, sewers and manholes if any, earthworks and temporary works, to ensure the proposed works and existing structures (including those mentioned above) are safe, sound and in functioning conditions; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Undertake a programmatic Excavation, Cut and Fill and Earthmoving plan. The construction work should be done accordingly in stages and programmed segments to minimise the area disturbed at any given time. By minimising the disturbance area affected by excavation and earthworks to what is only necessary, potential erosion and topsoil loss may be reduced; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Topsoil removed will be stockpiled in a designed area and covered as necessary to prevent soil loss from secondary erosion. Soil conserved can be used for backfilling and improvement of stream vegetation for areas that lack concrete slope protection. Excess soil material should be stored properly where it can be reused; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Use approved materials, of the same or better quality as the surrounding area, for backfilling works. All backfilled material will be free of debris, and of good material soil. 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Open canopy areas where continued soil loss may occur may need replacement of Erosion and Sediment Control (ESC) structures to capture eroded soil that can be returned back to the buffer zones for amelioration. ESC structures can likewise be strategically built adjacent to cut and fill, excavation and stockpiling sites; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> In development areas where groundwater hydrostatic pressure will be potentially high, piezometers and monitoring wells may be placed adjacent to proposed subsurface structures. Shoring and dewatering with pumps may be undertaken as needed during construction activities where increased hydrostatic pressure is expected to cause leaching 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<p>into construction areas. Automatic pumps may be installed which will operate when critical piezometric levels are exceeded;</p> <ul style="list-style-type: none"> Alternative in-situ recharge zones can be designated within the remaining conservation areas or green-belts to compensate for permanent loss of recharge areas that will be disturbed by the placement of at-grade and subsurface infrastructures. As discussed under soil loss and changes in infiltration, the designated buffer zones can partly alleviate the reduction of groundwater recharge to the aquifer system beneath the construction worksite; The impact on surface water features sustained by perched groundwater flow through springs and other surface conduits that can be affected by the disturbance of aquifer-hosting rock units during cut-and-fill activities can be alleviated by providing artificial recharge through installation of groundwater or diversion reinjection wells to replace the loss of surface water infiltration; Water Recycling: The objective is to minimise the amount of discharge from the construction site to the surface water drainage system; Provide storage tanks or reservoirs with additional 20% capacity and number to temporarily store/ contain muddy surface runoff before treatment; Whenever possible, segregate clean water flow from silty water flow to maximize the sedimentation tank holding capacity; Provide sufficient treatment units or coagulant units to treat silty water before discharging into public drain within 10 hours of rain event; Concrete and demolition debris, water used for dust control, and groundwater should not be allowed to cause erosion within the work area or to run offsite; Provide sufficient numbers of maintain proper sanitary facilities. It is recommended that there be one portable toilet per 10 pax and serviced 3 times per week. Appoint a NEA's Licensed Water Collector (LWC) to conduct regular collection of sewage discharges for disposal; 		
			Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
			Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
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Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Portable toilets are recommended to be installed on paved ground and bunded; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> On-site dormitories are recommended to install container toilets and secure written approval from PUB to connect into public sewers; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Establish a regular maintenance work schedule to check and maintenance cleanliness and functionality of sanitary facilities on site, at least once a week, depending on the amount of sanitary facilities; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Suitable containers shall be used to hold the chemical wastes to avoid leakage or spillage during storage, handling, and transport; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Chemical waste containers shall be labelled following the Globally Harmonised System of Classification and Labelling of Chemicals in the four national languages (i.e., English, Chinese, Malay and Tamil) and other commonly used languages on site to avoid accidents. There shall also be clear instructions showing what action to take in the event of an accident; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Chemical storage areas should be adequate, on paved ground, bunded, sheltered and located away from waterways and drains. Safety data sheets (SDS) should be kept together with the stored chemicals; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Any construction equipment which causes pollution to the water system due to leakage of oil or fuel should be maintained or removed off-site immediately; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Spillage or leakage of chemical waste to be controlled using suitable absorbent materials. Used absorbent materials should be disposed through a licensed third-party toxic industrial waste disposal contractor; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Secondary containment with capacity of more than 10% volume for single large container and 25% of the total volume of multiple containers should be used for all chemical stores and diesel generators to minimize spillages and contamination of soil and surface water. Care should be taken around water channels to avoid toxic chemicals such as petrol/ diesel/ oil/ paint/ thinner leak from equipment; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Emergency response procedures shall be developed and implemented; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Good housekeeping practices shall be implemented to minimise careless spillage and to keep the storage and the workspace in a tidy and clean condition. Appropriate training including safety codes and relevant manuals should be given to the personnel who regularly handle the chemicals on site; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Any soil contamination with chemicals or oils shall be removed from site and sent to a licensed third-party toxic industrial waste collector for offsite disposal. The void created shall be filled with suitable materials; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> A temporary drainage channel and associated facilities shall be provided to collect the runoff generated and prevent concrete-contaminated water from entering watercourses. The trade effluent must be isolated and collected and may be treated offsite before being discharged if there are space constraints. Adjustment of pH can be achieved by adding a suitable neutralising reagent to wastewater prior to discharge. The treated water from construction activities be treated to levels prescribed by NEA/ PUB and must have written approval from NEA/ PUB if it will be discharged into public drains/ sewer; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Appropriate concrete wash out areas shall be provided and shall not be performed in or near any of the streams; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> If on-site treatment is not feasible, wastewater must be stored separately and collected by licensed third-party toxic industrial waste collector for offsite treatment; 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> 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 Qualified Professionals (QP). 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<p><u>Site-specific Measures</u></p> <ul style="list-style-type: none"> Contractor should discuss with EMMP Consultant to finalize on real-time water quality data (i.e., Total Suspended Solids) input for Environmental Data Management System (EDMS) as described in Section 5.2. The discussion includes but not limited to the data sharing 	Contractor and EMMP Consultant	EMMP Consultant's ECO/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<p>method (e.g., embed data website, online transfer, etc.), required data type (e.g., mg/L for every minute or seconds) and frequency of data sharing (e.g., daily, or weekly).</p> <ul style="list-style-type: none"> Contractor should provide real-time Total Suspended Solids (TSS) monitoring data to EMMP Consultant based on discussion during pre-construction stage as described in Section 7.2.1.1. Contractor should conduct groundwater testing during dewatering process and the extracted groundwater should not be discharged into watercourses or public sewers. Any discharge of extracted groundwater from dewatering activity to any area (including drains and streams) will require an approval from the NEA and PUB for such discharge. ECO should conduct daily inspection on drainage, water quality of surface runoff and any abnormalities inside drainage system (e.g., fish kill). 	<p>Contractor and EMMP Consultant</p> <p>Contractor</p> <p>EMMP Consultant's ECO</p>	<p>EMMP Consultant's ECO/ SO Rep.*</p> <p>EMMP Consultant's ECO</p> <p>EMMP Consultant/ SO Rep.*</p>
<p>Note: * The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.</p>				

7.9.3 Air Quality

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
Site clearance, machinery and generator operation, vehicle.	Air quality impact from dust nuisance from earthworks activities and gaseous emissions from the construction equipment and vehicles.	GENERAL MITIGATION MEASURES TO BE IMPLEMENTED THROUGHOUT CONSTRUCTION PERIOD.		
		<u>Minimum Control:</u>		
		<ul style="list-style-type: none"> No demolition of permanent structure is expected as part of the project. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> No concrete batching plant to be located on-site. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Installation and proper maintenance of dust screen, fencing or hoarding along construction site perimeter to reduce dust deposition at adjacent areas. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Access road construction or expansion is recommended to be completed first and paved before the construction of other development commences. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Communications:</u>		EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Develop and implement a stakeholder communications plan that includes community engagement before work commences on site. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Develop and implement an Air Pollution Control Plan (APCP) 	Contractor	EMMP Consultant's ECO, EMMP Consultant
<ul style="list-style-type: none"> Contractor to follow up on Air Quality control measures under the Code of Practice for Environmental Control Officers 	Contractor	EMMP Consultant's ECO, EMMP Consultant		

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Contractor to prepare the Site Environmental Control Program in accordance with NEA's guidelines, which is to be submitted by Contractor to the Director-General of Public Health of NEA two weeks before the commencement of construction. Contractor should implement Environmental Control Programme specific to the construction works undertaken by the contractor. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Contractor to prepare and submit bi-weekly Site Environmental Control Report to EMMP Consultant and SO Rep. in accordance to NEA's guidelines. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Contractor should engage Public Relation Officer (PRO) to establish good rapport with the community, handle and feedback complaints from the community. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Site Management:</u>		
		<ul style="list-style-type: none"> Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken. 	Contractor, PRO	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Make the complaints log available to the local authority when asked. 	Contractor, PRO	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Record any exceptional incidents# that cause dust and/or air emissions, either on-site or off- site, and the action taken to resolve the situation in the log book. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Hold liaison meetings with other high risk construction sites within 500m of the site boundary, if any, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Monitoring:</u>		

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Undertake regular (daily frequency recommended) on-site and off-site inspections and record results. The log should be made available to the NEA or other Government Agencies if required. Inspections should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary. Cleaning should be provided if necessary. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Carry out regular site inspections to monitor and record compliance with the Air Pollution Control Plan. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Increase the frequency of site inspections during prolonged dry or windy conditions. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Conduct monitoring for dust at suitable locations. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> If the ambient air quality level during construction exceeds the SAAQT, contractor should investigate the cause and implement more stringent mitigation measure. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> If there be any complaints from the community with regards to air quality during construction, additional ambient air quality monitoring shall be conducted. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Preparing and maintaining the site:</u>		
		<ul style="list-style-type: none"> The Contractor shall arrange his method of executing the works such that there shall be no dust nuisance created. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Plan site layout so that machinery and dust causing activities are located away from receptors, where possible. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> 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. 	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Fully enclose specific activities where there is a known high potential for dust production and the site will be active for an extensive period of time. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Keep site fencing, barriers, and scaffolding clean by cleaning regularly using wet methods (dry methods may give rise to fugitive dust). 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Remove materials that have the potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site, stockpiled material should be covered, seeded, fenced or enclosed to prevent fugitive dust formation. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> The tree felling activity shall be in a way that minimise dust generation, e.g. using dust screen/ dust suppression and do not oversize the root ball trenching. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Construction site perimeters and adjacent roads or lands shall be regularly inspected to check for dust and if necessary, remove dust deposition. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Contractor should keep extent of excavation and soil exposure areas to minimum required for construction. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Exposed soil and dusty material at the construction site and its boundary shall be dampened with water regularly, with the misting frequency increased during dry periods. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Exposed site shall be properly treated by compaction, turfing, vegetation planting or sealing with bituminous materials, concrete or other suitable materials as soon as practicable after Project completion. Treat exposed earth by compaction, hydro seeding, vegetation planting, or cover with impermeable sheeting. 	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Stockpiles and excavations shall be removed, backfilled or reinstated (as appropriate) by contractor as soon as practicable following excavation or unloading. If contractor needs to store excavated material on site, it will be entirely covered with impervious sheeting and the stockpile shall be removed as soon as practicable. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Applying water to excavation areas, soil loading/unloading areas and unpaved roads. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Operating vehicle/machinery and sustainable travel:</u>		
		<ul style="list-style-type: none"> Any atmospheric pollution (in the form of smoke, fumes, vapours, dust and other pollutants) shall be effectively controlled. Air pollution control requirements such as the concentration and rates of omission of air pollutants shall be within legal limits. The SO Rep. reserves the right to request for a newer machine or an emission control device be installed if any machine or plant is deemed to be producing excessive greyish/ black smoke. All dusty operations must be adequately shielded and/ or arrested with water at point of impact. 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Impose and signpost a maximum-speed-limit of 25 km/hr on paved or surfaced haul roads and 15 km/hr on unpaved haul roads and work areas. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Ensure all vehicles and engine powered equipment comply with the legislative requirements of Singapore 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Ensure all vehicles and equipment switch off their engines when stationary – i.e. no idling vehicles or engines. Clear signs will be erected at site entrance to inform all visitors. 	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Where practicable, avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Maintaining all machinery, including excavators and gen-sets regularly, to minimize smoke and dust exhaust emissions. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Construction:</u>		
		<ul style="list-style-type: none"> 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. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate. Use fine water sprays on equipment wherever appropriate. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Use enclosed chutes and conveyors and covered skips wherever possible. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment. 		
		<ul style="list-style-type: none"> A stringent "Clean as you go" Policy should be implemented on site to ensure no loose dry material is left exposed when not in use. Equipment should be readily available on site to clean and dry spillages, and cleaning should be conducted as soon as reasonably practicable after the event using wet cleaning methods. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Maintaining a minimum moisture content during any rock rushing works. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Covering soil stockpiles with erosion control blankets. 	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<u>Waste Management:</u>		
		<ul style="list-style-type: none"> Avoid burning of waste or other materials 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Trackout:</u>		
		<ul style="list-style-type: none"> The Contractor shall maintain sufficient workers to constantly clean all public roads where soil is deposited from the Contractor's vehicles leaving the site. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> The Contractor shall install hard surfaced haul routes and employ suitable means of spraying with water the haulage roads across any part or parts of the site and along the public roads used by the Contractor to reduce dust nuisance to the absolute minimum. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Load of dusty materials on a vehicle leaving a construction site shall be covered entirely with impervious sheeting by contractor. Vehicle should not be overloaded and shall be cleaned prior to leaving the site. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Proper cover for vehicle (e.g. tipper lorry) to avoid falling of soil debris. Any skip hoist used to transport dusty materials shall be completely enclosed by impervious sheeting. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Avoid dry sweeping of large areas. Use water-assisted dust sweeper(s) on the access and affected local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Record all inspections of haul routes and any subsequent action in a site log book. 	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Site access gates to be located at least 10m from receptors where possible. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Vehicle washing facilities with high pressure water jets shall be provided by contractor at every discernible or designated vehicle exit point from construction site. Vehicle washing area and road section between washing facilities and exit point shall be paved. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> If roadways are contaminated with dusty materials from construction site, clean-up shall be conducted without delay. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		ADDITIONAL MITIGATION MEASURES TO BE IMPLEMENTED DURING EARTHWORKS.		
		<ul style="list-style-type: none"> Use Hessian, mulches or soil tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable. 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Only remove the cover in small areas during work and not all at once. 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
<p>Note:</p> <p>* The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.</p>				

7.9.4 Airborne Noise

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
Excavation, demolition of existing facilities, site clearance, machinery and generator operation	Noise from construction machines and equipment (e.g. dozers, cranes, excavators, trailers, generators, etc.)	GENERAL MITIGATION MEASURES TO BE IMPLEMENTED THROUGHOUT CONSTRUCTION PERIOD.		
		<ul style="list-style-type: none"> Contractor to prepare the Site Environmental Control Program in accordance with NEA's guidelines, which is to be submitted by Contractor to the Director-General of Public Health of NEA two weeks before the commencement of construction. Contractor should implement Environmental Control Programme specific to the construction works undertaken by the contractor 	Contractor	EMMP ECO Consultant's
		<ul style="list-style-type: none"> Contractor to prepare and submit bi-weekly Site Environmental Control Report to EMMP Consultant in accordance with NEA's guidelines 	Contractor	EMMP ECO, EMMP Consultant Consultant's
		<ul style="list-style-type: none"> Contractor should engage Public Relation Officer (PRO) to establish good rapport with the community, handle and feedback complaints from the community. 	Contractor	EMMP ECO, EMMP Consultant Consultant's
		<ul style="list-style-type: none"> Contractor to prepare noise management plan (NMP) to help to implement noise mitigation measure. The suggested NMP template is indicated in Annex H of SS602:2014 	Contractor	EMMP ECO, EMMP Consultant Consultant's
		<ul style="list-style-type: none"> Contractor to use engineering methodology to control noise such as: <ul style="list-style-type: none"> ➢ Noise enclosure to cover stationary PME such as generator; ➢ Noise screen/noise panel to partially shield noise generated from noisy PME such as crane and excavator; ➢ Portable noise barrier for noisy construction activities e.g. soil investigation drilling activities and road and drainage work which are close to site boundary; and Quieter construction methodology such as silent piler instead of vibratory piling, hydraulic splitter instead of concrete/rock drilling. 	Contractor	EMMP ECO, EMMP Consultant Consultant's
		<ul style="list-style-type: none"> Contractor to use/implement the noise barrier with minimum 6m high (minimum STC 20) along the site boundary facing affected Noise sensitive receptors. 	Contractor	EMMP ECO, EMMP Consultant Consultant's

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> • Conduct unattended noise monitoring (1week) prior commencement of site clearance and continuous real time noise monitoring during construction using Type 1 sound level meter with data logging at the affected NSRs by contractor. When noise level exceeds the maximum adjusted noise level, contractor should investigate and apply appropriate mitigation measures. The proposed noise monitoring locations are as follow: <ul style="list-style-type: none"> ➢ AN1: Block 805C, Keat Hong Close; ➢ AN2: Block 485B, Choa Chu Kang Ave 5; ➢ AN3: Ecological receptor within Tengah Forest; ➢ AN4: Ecological receptor within Tengah Forest; and ➢ AN5: Ecological receptor within Tengah Forest 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> • Implement industrial best practices: <ul style="list-style-type: none"> ➢ Only well-maintained PME shall be operated on-site and shall be serviced regularly during the construction; ➢ The number of PMEs shall be reduced as far as practicable when construction works are carried out at areas close to the NSRs. ➢ Use of alternative equipment with less noise emission such as use of rubber mallets instead of metal hammer; ➢ Care shall be taken during loading or unloading, dismantling or moving materials to reduce impact noise; ➢ Silencers or mufflers on PME (e.g. generator sets) shall be utilises and shall be properly maintained during the construction; ➢ Mobile OME, if any, shall be sited as far from NSRs as possible; ➢ PME (such as truck and cranes) that may be in intermittent use shall be shut down between work periods or shall be throttled down to a minimum possible; ➢ PME known to emit noise strongly in one direction should, whenever possible, be oriented so that the noise is directed away from the nearby NSRs; • Noisy construction activities shall be avoided at nights and Sundays and public holidays when the noise limits are more stringent 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> • Consider limiting heavy construction working hours from 8am to 6pm where possible to avoid the timings when crepuscular species may be 	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<p>active. Toolbox meetings and winding down of work can be done outside of these hours</p> <ul style="list-style-type: none"> Implement progressive start of loud construction activities to gradually increase noise levels for mobile fauna who have returned to roost during the night or are in the area to move before noise levels get more intense 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Additional control measures such as enclosure, noise screen/noise panel, portable noise barrier are recommended for all construction stages to future reduce excessive noise impacts for the affected arboreal fauna: <ul style="list-style-type: none"> Enclosure at stationary PME such generator and it shall be of sufficient height and width to accommodate machinery/equipment housed within. The proposed enclosures should achieve noise level reduction of at least 15dB(A) (Table F.3 of SS602:2014); Noise screen/noise panel at movable PME such excavator and crawler/mobile crane and it shall be of sufficient height and width to shield the noisy part. The proposed screening should achieve noise level reduction of at least 10dB(A) (Table F.3 of SS602:2014); Portable noise barrier at construction activities e.g. soil investigation drilling activities, road and drainage work which are close to site boundary. The proposed noise barrier should achieve noise level reduction of at least 10dB(A) (Table F.3.3.4 of SS602:2014); Quieter construction methodology such as silent piler instead of vibratory piling, hydraulic splitter instead of concrete/rock drilling. It is estimated a 20dB(A) reduction can be achieved by substitution (based on LTA's Noise Guidance: Developing a Noise Management Plan) 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> The Contractor shall note that plant, equipment and methods of work which causes pollution such as excessive noise and dust will not be allowed to be used on Site 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> The Contractor shall propose and implement on site at all times the appropriate type of monitoring methods during the contract period, subjected to the EMMP Specialist Consultant's and SO Rep.'s approval, and to provide for the sole use of the SO Rep. and EMMP Specialist Consultant appropriate measuring instruments to measure 	Contractor	EMMP Consultant's ECO, EMMP Consultant, SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		the noise, dust level or any types of pollutive elements generated by the work activities		
		<ul style="list-style-type: none"> The SO Rep. has the absolute discretion as and when he deems it necessary to require the Contractor to take necessary precautions to maintain or to repair such plant and equipment, to install noise suppressors, dust screens , etc. or instruct their removal from the Site 	Contractor	EMMP Consultant's ECO, EMMP Consultant, SO Rep.*
		<ul style="list-style-type: none"> Noise and duct control limits shall fully comply with the requirements as stated in the Environmental Pollution Control Act or latest requirements 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Noise Control <ul style="list-style-type: none"> ➤ All pilling operations and excavation works shall be carried out without unreasonable noise, vibration and disturbance. ➤ The Contractor shall bear all risks and responsibilities in carrying out the pilling operations and excavation works and shall be responsible during the progress of the pilling operation and excavation works for any damage or disturbance to existing or adjoining properties, or annoyance or nuisance to Occupants of these properties; ➤ The Contractor shall take necessary action to manage and control the activities within the construction site for the abatement of noise nuisance in compliance to the latest noise control regulations imposed by the Ministry of the Environment and Water Resources (MEWR) or any relevant authorities. Noisy Construction Equipment (e.g. Compressors) and installation shall be sited away from occupied residential blocks. All Construction Equipment shall be properly insulated and maintained to minimum its operating noise level; ➤ The noise level reading at the nearest occupied building shall not exceed the following maximum permissible noise level and shall comply with the Environmental Pollution Control (Control of Noise at Construction Sites) (Amendment Regulations 2007 enforces by the MEWR: 	Contractor	EMMP Consultant's ECO, EMMP Consultant, SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures			Implementation Responsibility	Inspection Responsibility
		Types of Affected Buildings	Applicable Period	Maximum Permissible Equivalent Continuous Noise Level Measured Over a Period of 5 Minutes in dB(A)		
		(a) Hospitals, schools, institutions of higher learning, homes for the aged or sick etc.	7am to 7pm 7pm to 10pm 10pm to 7am	75 55 55		
		(b) Residential buildings located less than 150 m from the construction site where the noise is being emitted	7am to 7pm 7pm to 10pm 10pm to 7am	90 70 55		
		(c) Buildings (other than those in paragraphs (a) and (b))	7am to 7pm 7pm to 10pm 10pm to 7am	90 70 70		
		<ul style="list-style-type: none"> ➤ Truck movement on public road is only allowed from 9am to 5pm only from Monday to Saturday. No working on Sunday and Public Holiday. It is important to note on the daylight working hours allowed as per NParks instruction is from 8am to 6pm; ➤ The Contractor shall submit his proposal for the sound monitoring system, with details of the sound meter model and location of installation etc., to the SO Rep. for approval within 14 days from the date of the letter of Acceptance; ➤ The Sound level meter shall comply with BS 6698 (1989) or IEC 804:1985 and the following requirements and shall meet all requirements imposed by the relevant Authority: <ul style="list-style-type: none"> ➤ The integrating sound level meter shall be capable of producing equivalent continuous A-weighted sound power level for various time duration required by the SO Rep; ➤ The sound level meter shall have a laboratory calibration certificate dated not more than Three (3) months before the commencement date of the contract. The integrating sound level meter shall be sent to an approved accredited laboratory 				

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<p>for calibration at every Six (6) months interval or as and when required as decided by the SO Rep.;</p> <ul style="list-style-type: none"> ➤ A portable calibrator shall be provided to carry out weekly calibration; ➤ The sound level meter shall have adequate memory to store 5-minute equivalent continuous reading on a 24-hour basis for up to 7 days; and ➤ Dynamic range shall be of at least 40 dB. <ul style="list-style-type: none"> • The equipment shall be able to record 24-hour noise level readings and printed with the date and time of recording indicated. The printout shall be submitted to the SO Rep. on a weekly basis or at such interval as specified by the SO Rep. One Set of the noise level record shall be field and kept on site for inspection as and when required by the SO Rep. or MEWR. The Contractor shall install the Type I integrating sound level at the nearest occupied building less than 50 meters from the site boundary. The sound level meter shall be installed at a location where obstruction and other external noise interference area minimal. Where there is no suitable location outside the construction site, the Contractor may place the sound level meter within the site. The location shall be approved by the SO Rep. 		
<p>Note: * The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.</p>				

7.9.5 Vibration

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
General construction activities	Disturbance to ecology and human	<u>General:</u>		
		<ul style="list-style-type: none"> Use low vibration equipment and construction techniques. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Impose and signpost a maximum speed limit of 25 km/hr on paved or surfaced haul roads and 15 km/hr on unpaved haul roads and work areas. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> The Contractor shall engage a Professional Engineer to submit a vibration-monitoring plan showing the locations of the vibration monitoring devices before work commences. The plan shall state the vibration limit taking into account the vulnerability of the neighbouring properties to damage and the frequency of taking readings. 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> The Professional Engineer shall assess the vibration readings and take the appropriate action once the vibration limit is exceeded on site or any damage occurs in neighbouring properties. Any precautionary and contingency measures taken to safeguard the integrity of the neighbouring properties shall be borne by the Contractor. 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> The Contractor shall ensure that the vibration levels for coring, removal of rock, blasting etc., are comply with National regulations. 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		<ul style="list-style-type: none"> Contractors shall be responsible to comply and implement all requirements by the laws, authorities on ground vibration pollution control. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Place vibrating equipment (e.g., pipe jacking unit) on isolators such as spring coils. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Route heavily loaded tipper trucks away from the vibration sensitive receptors as far away as possible. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Operate equipment (e.g., piling equipment, compactor, hydraulic breaker, and pipe jacking machine) that emit significant vibration levels as far away as possible. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
<ul style="list-style-type: none"> Phased earthmoving, ground pilling and excavation operations so as not to occur at the same time at the same area, if possible, to minimize cumulative impact. 	Contractor	EMMP Consultant's ECO, EMMP Consultant		

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Avoid impact pile or vibratory pile driving where possible in areas with vibration sensitive receptors. Use silent piler/press-in piler where the geological condition permits their use. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Notify nearby vibration sensitive receptors in advance of the construction activities, particularly during installation of sheet piles and tunnelling works (e.g., pipe jacking and TBM) to allay potential concerns. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> While using vibratory compactors, shut off vibrator when reversing direction (highest level of vibrations are often generated when quickly stopping and changing direction). Utilise a vibratory compactor that can adjust the impulse energy and frequency, compact soil with static method (no vibrations); oscillation compaction in place of conventional vibratory action, as far as practicable. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Fill in potholes and eliminate pavement discontinuities, keep haul roads smooth by periodic grading; pave existing roads to provide a smooth traveling surface, reduce speed of vehicles and weight of vehicle loads, as far as practicable. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Contractors shall be responsible to comply and implement all requirements by the laws, authorities on ground vibration pollution control. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Construction works involve the use of Powered Mechanical Equipment (PME) should be restricted to daytime between 8 am and 6 pm. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Place vibrating equipment (e.g., pipe jacking unit) on isolators such as spring coils. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Route heavily loaded tipper trucks away from the vibration sensitive receptors as far away as possible. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Operate equipment (e.g., piling equipment, compactor, hydraulic breaker, and pipe jacking machine) that emit significant vibration levels as far away as possible. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Phased earthmoving, ground piling and excavation operations so as not to occur at the same time at the same area, if possible, to minimize cumulative impact. 	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Avoid impact pile or vibratory pile driving where possible in areas with vibration sensitive receptors. Use silent piler/press-in piler where the geological condition permits their use. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Notify nearby vibration sensitive receptors in advance of the construction activities, particularly during installation of sheet piles and tunnelling works (e.g., pipe jacking and TBM) to allay potential concerns. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> While using vibratory compactors, shut off vibrator when reversing direction (highest level of vibrations are often generated when quickly stopping and changing direction). Utilise a vibratory compactor that can adjust the impulse energy and frequency, compact soil with static method (no vibrations); oscillation compaction in place of conventional vibratory action, as far as practicable. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Fill in potholes and eliminate pavement discontinuities, keep haul roads smooth by periodic grading; pave existing roads to provide a smooth traveling surface, reduce speed of vehicles and weight of vehicle loads, as far as practicable. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Ecological Receptors:</u>		
		<ul style="list-style-type: none"> Set up barriers to prevent road kills. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<ul style="list-style-type: none"> Contractor shall conduct monitoring for vibration at ecologically sensitive areas. 	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Human Receptors:</u>		
		<ul style="list-style-type: none"> Where piling works are to be carried out close to the existing buildings or structures, the Contractor shall carry out a joint inspection with the SO Rep. and representatives of the appropriate parties including taking photographs and notes to record the conditions of the existing buildings or structures prior to the commencement of the piling works. The records shall be jointly endorsed by the Contractor, SO Rep. and the representative of appropriate parties. 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> In addition, the Contractor shall be required to carry out vibration monitoring at his own cost and expense when construction works are to be carried out close to the existing buildings or structures or when public complaints have been received. The numbers and locations as well as the duration of the vibration monitoring shall be decided by the SO Rep. The vibration monitoring shall measure the peak particle velocity (mm/s) and frequency (Hz) of the vibration. Acceleration and displacement values shall also be derived from the transducer operating range chart if requested by SO Rep. The monitoring shall be read daily unless otherwise instructed by SO Rep. Three (3) sets of the comprehensive reports shall be submitted to HDB weekly and the final report shall be submitted within two (2) weeks after the completion of the monitoring works. 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep*
<p>Note: * The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.</p>				

7.9.6 Vector Control

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
General construction activities	<ul style="list-style-type: none"> • Increase in the number of mosquitoes • Increase in the number of other vectors (i.e. and rodents) • Increase in the case of dengue fever 	Standard Measures <ul style="list-style-type: none"> • Preparation and implementation of an effective vector control plan and measures as required under LTA's SHE Specifications and LTA's Guidebook in Vector Control at LTA Sites, as well as the NEA's Code of Practice for Environmental Control Officers; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> • The Contractor should clear and dispose of all rubbish, debris in the drains and side tables, surplus excavated earth, etc. and those arising from his works to approved disposal sites; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> • All rubbish and debris should be cleared from the work site from time to time as and when directed by the SO Rep.; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> • On completion of the Works, the Contractor should remove all his rubbish, plant and surplus materials from the works site, clean all fittings and leave the site in a clean condition; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> • Contractor should adhere to Control of Vector and Pesticide Act (CVPA) and ensure good housekeeping on-site; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> • 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; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> • Scheduled daily housekeeping to ensure clearance of stagnant water and unwanted items are discarded properly; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> • Site entrance shall be paved to avoid ground depression; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> • Milled waste can be used to level the ground before laying steel plates; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Provide movable roof over shaft to prevent rainwater ingress; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Pump shall be deployed to clear water at areas where drainage is not possible, as well as for larger recessed surfaces; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Install pitched roof on top and/or seal up bottom of site container office; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> After trees clearance, top of tree stumps has to be either remove thoroughly or patched up 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Pipette can be used for larvae-checking at the hard-to-reach parts of a tree; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> 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 infestation; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Store food in rodent proof storage containers/ cabinets with at least 60 cm clearance above ground level; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Thermal Fogging should only be carried out when there is a Dengue outbreak or when high mosquito population is detected at construction worksite. Regular fogging is not encouraged as it may build up the mosquitoes' resistance over time; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
<p>Note:</p> <p>* The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.</p>				

7.9.7 Waste Management

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
General construction activities (including disposal of construction waste from site and adjacent roads and walkways, Disposal of organic waste, disposal of toxic waste as defined in the EPHA and EPH (Toxic Industrial Wastes) Regulations)	Deterioration of environment (e.g. visual, water quality, biodiversity impacts and air pollution)	<u>Standard Measures</u> <ul style="list-style-type: none"> The Contractor shall dispose demolished materials, debris and unsuitable excavated materials including Waste materials and Contaminated materials within the Project Boundary to disposal sites subjected to SO Rep.'s approval; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> The Contractor shall dispose acceptable excavated soft clay to Aviation Park Staging Ground (APSG) or Tanah Merah Staging Ground(TMSG) or to any other site as directed by SO Rep.; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> The use or disposal for excavated earth from the proposed work site shall be as follows: <ul style="list-style-type: none"> Good Earth suitable for use as approved material for filling and approved by the SO Rep. shall be used for site filling up to the required platform in accordance with Section 5 of the Standard Specifications for Civil Engineering Works (2019 Edition) Soft Clay acceptable by the operator of Aviation Park Staging Ground (APSG) or Tanah Merah Staging Ground (TMSG) shall be transported to Aviation Park Staging Ground (APSG) or Tanah Merah Staging Ground (TMSG); and Excavated earth/material that is deemed unsuitable by SO Rep. for filling or disposal at HDB's Staging Grounds shall be transported to contractor's own disposal sites approved by the authorities 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> The Contractor shall conduct all necessary classification tests including the density tests (as per required and subjected to approval by SO Rep.); 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> The Contractor shall permit access by approved soil testing laboratories in Singapore and/or personnel from approved disposal sites to the Contractor's work site to evaluate the suitability of the excavated materials for disposal at the approved disposal sites; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> The Contractor shall take all reasonable measures to avoid mixing different types of spoils. Should two or more different types of spoils get mixed during the course of the excavation/ loading, the spoils which arrived at approved disposal sites, shall take the classification of the component that appears lowest on the following list: <ul style="list-style-type: none"> Good Earth; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> ➢ Soft Clay; ➢ Waste Material; and ➢ Contaminated Material 		
		<ul style="list-style-type: none"> • In the event artificial obstructions and/or Unexploded Explosive Ordnance (UXO) are found during the course of Construction Works the Contractor shall immediately inform the Singapore Police Force (SPF), relevant authorities and the SO Rep. He shall also immediately follow up on appropriate safety measures and provision of security personal if required by SPF, relevant authorities and/or SO Rep. to ensure site safety; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> • If the discovered UXO is classified by SPF or relevant Authorities as "unsafe" to remove, the removal shall be managed by SPF or relevant Authorities, working closely with the Contractor and/or SO Rep.; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> • If the discovered UXO is classified by SPF or relevant Authorities as "safe" to remove, the Contractor shall engage an Explosive Ordnance Disposal (EOD) specialist with Arms and Explosive (A&E) License registered by the SPF to remove UXO. The EOD specialist shall investigate and identify the UXO correctly, evaluate, classify and obtain necessary approvals/ permits for removal, transfer, temporary storage and disposal of UXO according to the requirements by SPF or relevant Authorities; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> • All historical artifacts etc. discovered within the site are the property of the Employer and shall not be removed from the site and shall be left in an un-disturbed as far as feasible. In the event any historical artifacts such as granite boundary marker etc. is discovered on site, the Contractor shall immediately inform the SO Rep. and Employer. The Contractor shall immediately implement the necessary protection measures within the demarcated area to prevent any damage to the artifacts and shall ensure no work is carried out until the artifacts are extracted completely with proper care. Any protection and extraction measures given by the relevant Authorities shall be complied with accordingly; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> • Applying waste minimization techniques and good practices on site following waste management hierarchy, i.e., source reduction, waste exchange, recycling, reuse, and waste segregation; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Plan for timely on-site separation and collection of materials with waste stream specific schedules in place; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> All horticultural waste should be transported off-site to specialized horticultural recycling facilities where they can be grinded into wood chips which can be turned into mulch or compost. Where possible, wood recycling as wood chips into new wood products by mixing it with binders should be prioritized; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Horticultural waste which is not suitable to be recycled should be used as fuel in biomass power plants; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Waste concrete from demolition could also be recycled into recycled concrete aggregate which is made up of 70% demolition concrete waste with natural aggregates and used in buildings and roads in Tengah; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Construction waste should be properly segregated and have set storage locations to extract recoverable and recyclable materials which can then be reused or recycled; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Separate the different forms of hazardous waste, provide treatment on site if applicable and set up protocols for spillage; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Implement strict waste handling, storage, collection, and disposal practices to prevent leakages; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Biodigesters or composting stations could be introduced onsite to deal with food waste generated by workers, converting it into grey water or compost which can then be reused onsite. These stations are usually well sealed which also reduces the hazard of wildlife being attracted to the area; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Provide adequate garbage/ trash bins with tight lid (animal-proof bin) to prevent animals from getting into it; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Recycling bins should be provided alongside every trash bin with well-labelled signs and examples of common recyclables items to help workers sort their waste; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		<ul style="list-style-type: none"> Provide sufficient and maintain proper sanitary facilities at the worksite and connect discharge points to septic tanks and or the public sewage for disposal; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Sewage not connected to the main sewage system has should have sufficient storage capacity and a clearance schedule that matches the volume being produced; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> Identify all types of solid waste and implement comprehensive waste management system at the site in order to ensure proper disposal and prevent pollution to the environment; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
		<ul style="list-style-type: none"> The Contractor should 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; 	Contractor	EMMP Consultant's ECO/EMMP Consultant/SO Rep.*
<p>Note: * The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.</p>				

7.10 Summary of Monitoring Plan and the Responsible Parties

7.10.1 Biodiversity

Activity	Monitoring Plan	Frequency	Trigger for Corrective Actions	Rectification Timeline	Implementation Responsibility	Inspection Responsibility
Biodiversity: Flora						
Major Impact: <ul style="list-style-type: none"> • Site clearance • Earth works • Tree-felling works 	Monthly Flora Inspection Visual inspection for the presence of forest edge effects and new invasive weed species	Monthly throughout the construction phase	Corrective actions will need to be taken if: <ul style="list-style-type: none"> • Invasive flora species has excessively colonised the existing forest that are pre-dominantly native. • Removal of these invasive weed species along new forest edge is required. 	NA	EMMP Consultant	SO Rep.*
Minor Impact: <ul style="list-style-type: none"> • Pre-construction survey • Soil Investigation works • Hoarding works 	Monthly Flora Inspection Visual inspection for habitat degradation (e.g., any rubbish and/or construction waste) within 15m of the RAC or the new forest edge from proposed construction activities	Monthly throughout the construction phase	Corrective actions will need to be taken if: <ul style="list-style-type: none"> • The EMMP Consultant finds that habitat degradation has taken place; recommendations tailored to the finding should be adhered to. 	48 hours	EMMP Consultant	SO Rep.*
<ul style="list-style-type: none"> • Road works • Proposed outlet drain constructions 	Monthly Flora Inspection Excessive clearance of vegetation beyond the hoarding line of the Project Area	Monthly throughout the construction phase	Corrective actions will need to be taken depending on the extent of the excessive clearance: <ul style="list-style-type: none"> • Report to SO for downstream reporting to NParks. 	NA	NA	EMMP Consultant
Biodiversity: Arboriculture						
Major Impact: <ul style="list-style-type: none"> • Site clearance • Earth works • Tree-felling works 	Monthly Tree Inspections Visual inspection of the trees along 15m from the hoarding line. Some factors that will be inspected are: <ul style="list-style-type: none"> • Physiological health and structural 	Monthly throughout the construction phase	Corrective actions will need to be taken if: <ul style="list-style-type: none"> • The structure and health of the trees along the new forest edge has deteriorated and are deemed unsafe by an appointed Arborist. 	24 hr	EMMP Consultant/ Appointed Arborist	Appointed Arborist

Activity	Monitoring Plan	Frequency	Trigger for Corrective Actions	Rectification Timeline	Implementation Responsibility	Inspection Responsibility
Minor Impact: <ul style="list-style-type: none"> Pre-construction survey Soil Investigation works Hoarding works Road works Proposed outlet drain constructions 	stability of trees. <ul style="list-style-type: none"> Identify and assess trees that requires removal for the safety of the workers. 		<ul style="list-style-type: none"> Removal of these trees may be required. Encroachment into or removal of TPZs resulting in impairment of structural stability and/or physiological health of trees. 			
Biodiversity: Fauna						
Major Impact: <ul style="list-style-type: none"> Site clearance Earth works Tree-felling works 	Monthly Fauna Monitoring Conduct fauna monitoring within the Forest Corridor to monitor for construction impacts on fauna activity and presence.	Once during pre-construction phase Monthly throughout construction phase	Corrective actions will need to be taken if: Excessive disturbance generated by construction activities is detected		EMMP consultant	SO Rep.*
Minor Impact: <ul style="list-style-type: none"> Pre-construction survey Soil Investigation works Hoarding works Road works Proposed outlet drain constructions 	Daily Roadkill Surveys Surveys to monitor for roadkill incidences at major roadways adjacent to the site.	Daily throughout construction phase	Corrective actions will need to be taken if: More than two roadkill incidents involving targeted species (Sunda pangolin, leopard cat and Eurasian wild boar) occur within 7 days of each other; Contractor to check the integrity of the hoarding line along Brickland Road and Bukit Batok Road, and carry out rectification, if any.	24 hours	Contractor	EMMP Consultant
	Wildlife Corridor Camera Trap Monitoring	Monthly data retrieval	Corrective actions will need to be taken if:	24 hours for findings that	EMMP Consultant	SO Rep.*

Activity	Monitoring Plan	Frequency	Trigger for Corrective Actions	Rectification Timeline	Implementation Responsibility	Inspection Responsibility
	Conduct continuous camera trapping , with monthly data retrieval, to monitor for wildlife utilising the corridor.		If the wildlife corridor operation protocol is not adhered to, a report will be submitted to NParks by SO.	may result in fauna mortality.		

Note:

* The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.

7.10.2 Hydrology, Surface Water and Groundwater

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
Site clearance, spillage of oil, fuel and lubricant from vehicle and machinery, oil drips from generator, chemical spill, proposed outlet drain construction works.	<u>Earth Control Measures (ECM) Implementation</u> Earth Control Measures should be inspected and maintained throughout the construction programmed by the QECP which will be reviewed in tandem with the progress of works. This may involve replacement of silt fences and erosion control blankets, repaving of concrete surfaces, etc.	All stages	Investigation and corrective actions to be taken, when: <ul style="list-style-type: none"> The following documentation are found inadequate/missing: <ul style="list-style-type: none"> ECM Plan; Monitoring Log; Training Log; Audit Reports; 	Contractor/QECP	EMMP Consultant's ECO
	<u>Earth Control Measures (ECM) Implementation</u> Real-time monitoring of Turbidity and implementation of CCTV including a SIDS installed at every discharge outlet	Continuous monitoring	<ul style="list-style-type: none"> If the monitored parameters exceed applicable values of NEA Trade Effluent Discharge Limits to Controlled Watercourse; 	Contractor/QECP	EMMP Consultant/ Consultant's ECO/ SO Rep.*
	<u>Surface Water Monitoring</u> Water quality sampling at all discharge outlets of construction site to ensure the discharge water quality in accordance with NEA's Allowable Limits for Trade Effluent Discharge in a controlled watercourse.	Three (3) rounds at all proposed locations during pre-construction phase. Monthly monitoring at all locations and quarterly at construction discharge points for	<ul style="list-style-type: none"> If groundwater level change of $\pm 3m$ (to be 	Contractor/EMMP Consultant's ECO	EMMP Consultant/ Consultant's ECO/ SO Rep.*

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
		additional parameters during construction phase. Detailed monitoring regime during construction phase is still under discussion with PUB.	confirmed by Qualified Professionals);		
	<u>Groundwater Monitoring</u> Groundwater quality monitoring.	Once during pre-construction phase.	<ul style="list-style-type: none"> If any flooding or clogging issues observed; If complaints are received due to project activities; and 	Contractor/EMMP Consultant's ECO	EMMP Consultant/ EMMP Consultant's ECO/ SO Rep.*
	<u>Groundwater Monitoring</u> Groundwater level monitoring.	Monthly at AG2 and AG4 throughout construction phase.	<ul style="list-style-type: none"> If visual non-compliance to any of the minimum control or mitigation measures are observed on-site. 	Contractor/EMMP Consultant's ECO	EMMP Consultant/ EMMP Consultant's ECO/ SO Rep.*
	<u>Groundwater Monitoring</u> Groundwater level and quality monitoring as required in Singapore Building Control Regulations 2003 [R-29] during dewatering process at where the excavation take place.	One-time monitoring before dewatering process. Weekly throughout construction phase.		Contractor	EMMP Consultant/ EMMP Consultant's ECO/ SO Rep.*
	Daily inspection on perimeter drains to ensure no surface runoff flowing out from the site untreated with monthly audit.	Daily inspection; monthly audit		EMMP Consultant/ EMMP Consultant's ECO	EMMP Consultant/ SO Rep.*

Note: * The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.

7.10.3 Air Quality

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
Site clearance, and machinery	Monitoring of PM ₁₀ and PM _{2.5} at three (3) locations	Continuous monitoring during earthworks phase.	When earthworks activity starts.	Contractor	EMMP Consultant

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
generator operation, vehicle.	Daily inspection by EMMP Consultant's ECO on northern and eastern boundary facing residential areas, as well as internal for ecological sensitive receptors.	Daily	-	EMMP Consultant's ECO	EMMP Consultant
	Carry out bi-weekly site inspection during construction phase.	Bi-weekly	-	EMMP Consultant/ EMMP Consultant's ECO	EMMP Consultant/ SO Rep.*
<p>Note: * The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.</p>					

7.10.4 Airborne Noise

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
Excavation, demolition of existing facilities, site clearance, machinery and generator operation	<ul style="list-style-type: none"> Monitoring of $L_{Aeq}(12\text{ hr})$, $L_{Aeq}(1\text{ hr})$ and $L_{Aeq}(5\text{ min})$ at five (5) locations by Contractor; Compare the monitoring result with the adjusted maximum permitted noise level from the construction activities in accordance with the noise legislation stated in Environmental Protection and Management (Control of Noise at Construction Sites) Regulations, 2008. Ecological receptor noise impact will be assessed against the baseline noise level as the noise criterion. 	<p>Before commencement of any construction works (including site clearance)</p> <ul style="list-style-type: none"> One-time airborne noise monitoring for 1 week at the proposed locations, for establishment of latest baseline. <p>During Construction Phase</p> <ul style="list-style-type: none"> Continuous monitoring at the proposed locations for the entire duration of construction. Records on noise levels from construction sites should be properly kept and produced when requested. 	Ecological sensitive receptors are next to construction site	Contractor	EMMP Consultant
	Daily inspection by ECO on entire boundary facing residential areas, as well as internal for ecological sensitive receptors.	Daily	-	EMMP Consultant's ECO	EMMP Consultant
	ECO will carry out ad-hoc noise monitoring during the daily site inspection.	Daily	-	EMMP Consultant's ECO	EMMP Consultant

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
	Carry out bi-weekly site inspection during construction phase.	Bi-weekly	-	EMMP Consultant/ EMMP Consultant's ECO	EMMP Consultant/ SO Rep.*
<p>Note: * The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.</p>					

7.10.5 Vibration

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
General construction activities	<ul style="list-style-type: none"> Carry out 1-week baseline vibration monitoring at proposed location. 	1 week	<ul style="list-style-type: none"> - 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
	<ul style="list-style-type: none"> Carry out vibration monitoring at own cost and expense. The numbers and locations as well as the duration of the vibration monitoring shall be decided by the SO Rep. 	Continuous	<ul style="list-style-type: none"> Construction works are closed to the existing buildings or structures Public complaints received 	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
	<ul style="list-style-type: none"> Carry out bi-weekly site inspection during construction phase. 	Bi-weekly	-	EMMP Consultant/ EMMP Consultant's ECO	EMMP Consultant/ SO Rep.*
<p>Note: * The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.</p>					

7.10.6 Vector Control

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility	
General construction activities	Site inspection [potential mosquitoes breeding grounds (water ponding), rat/rodent burrows, cockroaches droppings, etc.]	Daily during construction phase	Investigation and corrective actions (i.e., Stop Work Orders) to be taken, when: <ul style="list-style-type: none"> • Worksite is found to have vector-breeding habitats. • There is an occurrence of suspected dengue outbreak cases. 	Implementation Responsibility	In-house vector control team	VCO
	Vector control and surveillance [potential mosquitoes breeding grounds (water ponding), rat/rodent burrows, cockroaches droppings, etc.]	Weekly during construction phase			VCO/External NEA-licensed VCO	Contractor/EMMP Consultant's ECO/EMMP Consultant/ SO Rep.*
	Submission of Vector Control Plan	Prior construction			In-house vector control team appointed by Contractor	VCO/Contractor
	Submission of Vector Baseline Report	At the beginning of each construction stage			VCO/Contractor	EMMP Consultant's ECO/EMMP Consultant/ SO Rep.*
	Submission of Vector Service Report	At the end of each mosquito and rodent/rat control services			VCO/Contractor	EMMP Consultant's ECO/EMMP Consultant/ SO Rep.*

Note:

* The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.

7.10.7 Waste Management

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility	
General construction activities (including disposal of construction waste from site and adjacent roads and walkways, Disposal of organic waste,	Site-specific waste strategy and management plan (including monitoring, review and reporting protocol)	Prior construction	Investigation and corrective actions to be taken, when: <ul style="list-style-type: none"> • There are no/ poor records of toxic chemical waste amount and type; and • There is evidence of poor handling/ storage of toxic 	Implementation Responsibility	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
	Waste management/housekeeping works	Daily during construction phase			On-site waste management team	Contractor/ EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility	
disposal of toxic waste as defined in the EPHA and EPH (Toxic Industrial Wastes) Regulations)	Environmental performance monitoring	Monthly during construction phase	chemical waste and hazardous chemical.		Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
	Inspection on proper disposal of organic waste, hazardous waste, other wastes and any oil/chemical spill and preparation of log sheet if required	Daily during construction phase			Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
	Inspection on hazardous chemical/substances storage	Weekly during construction phase			Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
	Audit on waste management/housekeeping works	Monthly during construction phase			EMMP Consultant/ EMMP Consultant's ECO	EMMP Consultant/ SO Rep.*

Note:

* The EMMP Consultant should inform and instruct the Contractor if any issue is found from the implemented measures. The EMMP Consultant should also inform the SO Rep. for further follow-up action if necessary.

8 Emergency Response Plan

8.1 Objective

In order to safeguard the environment and workers health and safety, an emergency preparedness and response plan for any emergency/ incidents/ accidents happen during construction according to the regulations/ guidelines (e.g. Environmental Protection and Management Act, Environmental Public Health Act, Building Control Act, Control of Vectors and Pesticides Act, Code of Practice on Surface Water Drainage, National Heritage Board Act, Parks and Trees Act and Sewerage and Drainage Act).

The Emergency Response Plan (ERP) was developed to provide guidance and strategies for wildlife encounter and other environmental incidents. If any environmental incident happened on site, the Contractor/EMMP Consultant's ECO should conduct the investigation on the incident immediately and should record and report the incident using the attached form as in Appendix D. The ERP include information regarding procedures on encounter of specific animal, procedure during forest fire and procedure during chemical/hazardous substance spill as provided in following sections.

8.2 Emergency Contact Summary for Environmental Incident

Table 8-1 Summary of Responsible Parties for Environmental Incident

Incident	Responsible Person
All environmental incident	<ul style="list-style-type: none"> Contractor EMMP Consultant's ECO EMMP Consultant
Encounter of dead animals	<ul style="list-style-type: none"> Contractor EMMP Consultant's ECO EMMP Consultant
Encounter of injured animals	<ul style="list-style-type: none"> EMMP Consultant Animal Response Centre
Fire event	<ul style="list-style-type: none"> Singapore Civil Defence Force (SDCF)
Chemical/Oil spill	<ul style="list-style-type: none"> Contractor EMMP Consultant's ECO EMMP Consultant

8.3 Wildlife Response Plan

The Wildlife Response Plan will be activated whenever a trapped/injured/dead/dangerous animal is encountered around or within the worksite. The objective of the Wildlife Response Plan is to minimise animal injury and mortality by responding appropriately to the different scenarios in Figure 8-1. This will be emphasized during the toolbox briefings (Section 6.2.1). All wildlife incidents shall be reported and documented in a Wildlife Incident Form (Appendix C).

Where species of conservation significance are affected by development, relocation works may be planned (e.g., bamboo bats; see Section 6.1.1). Where fauna is trapped on-site, species-specific methods (e.g., partitioning site, one-way flap doors) shall be formulated to remove them, in consultation with NParks.

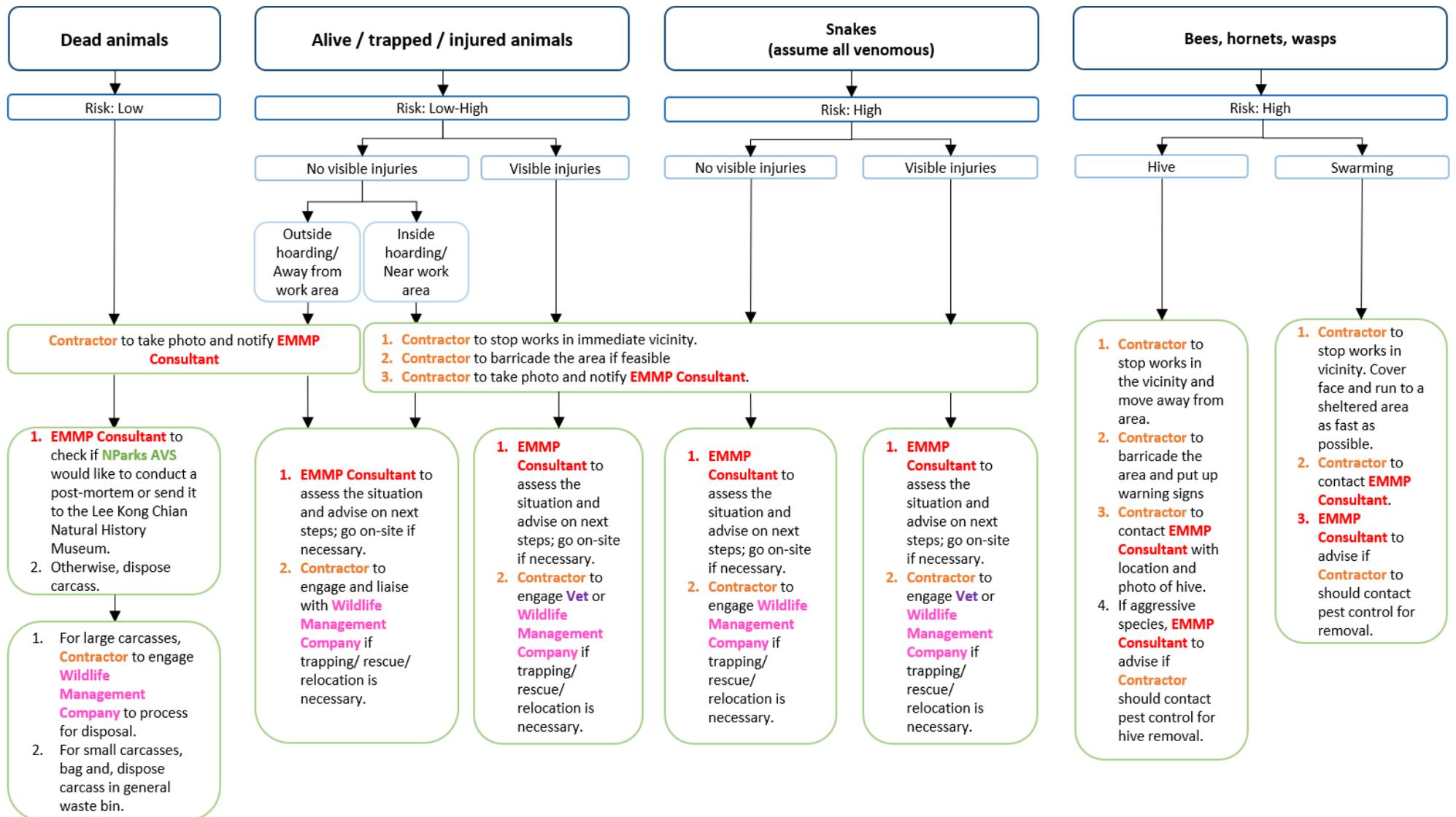


Figure 8-1 A Flowchart of the Wildlife Response Plan. An Approved Wildlife Management Company [W-11] Needs To Be Engaged by the Contractor

8.4 Roadkill Response Plan

The Roadkill Response Plan will be activated whenever an injured animal or animal carcass is encountered either opportunistically or during roadkill surveys at public roads directly adjacent to the worksite. The objective of the Roadkill Response Plan is to minimise animal injury and mortality by responding appropriately to the different scenarios (Figure 8-2). All wildlife incidents shall be reported and documented on the EDMS platform (Section 5.2).

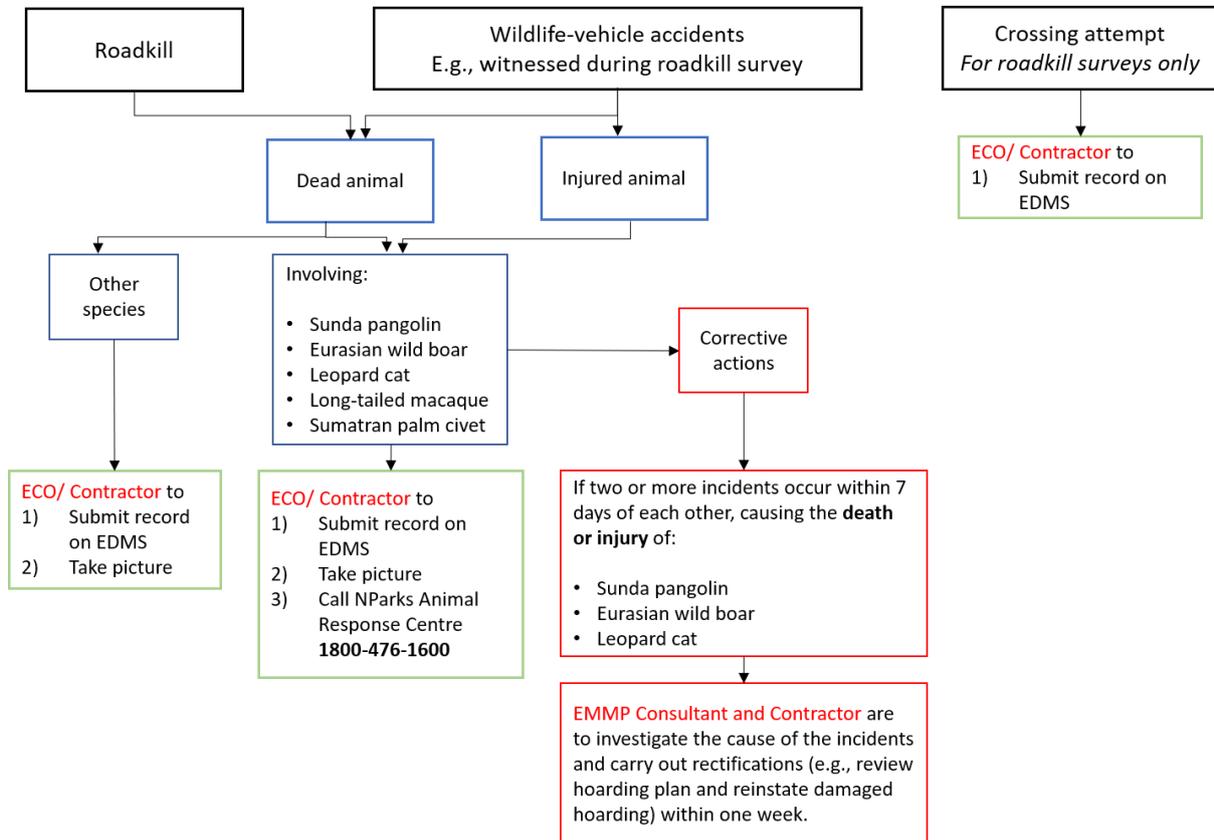


Figure 8-2 Response Plan and Corrective Actions to be Taken for Three Wildlife-Vehicle Scenarios

8.5 Response Plan for Drainage, Surface Water and Groundwater Incidents

The response plan (refer to Figure 8-3) will be initiated when there is any relevant drainage, surface water or groundwater incidents occurred around or within the worksite. All incidents should be reported and documented in an Incident Form (Appendix D).

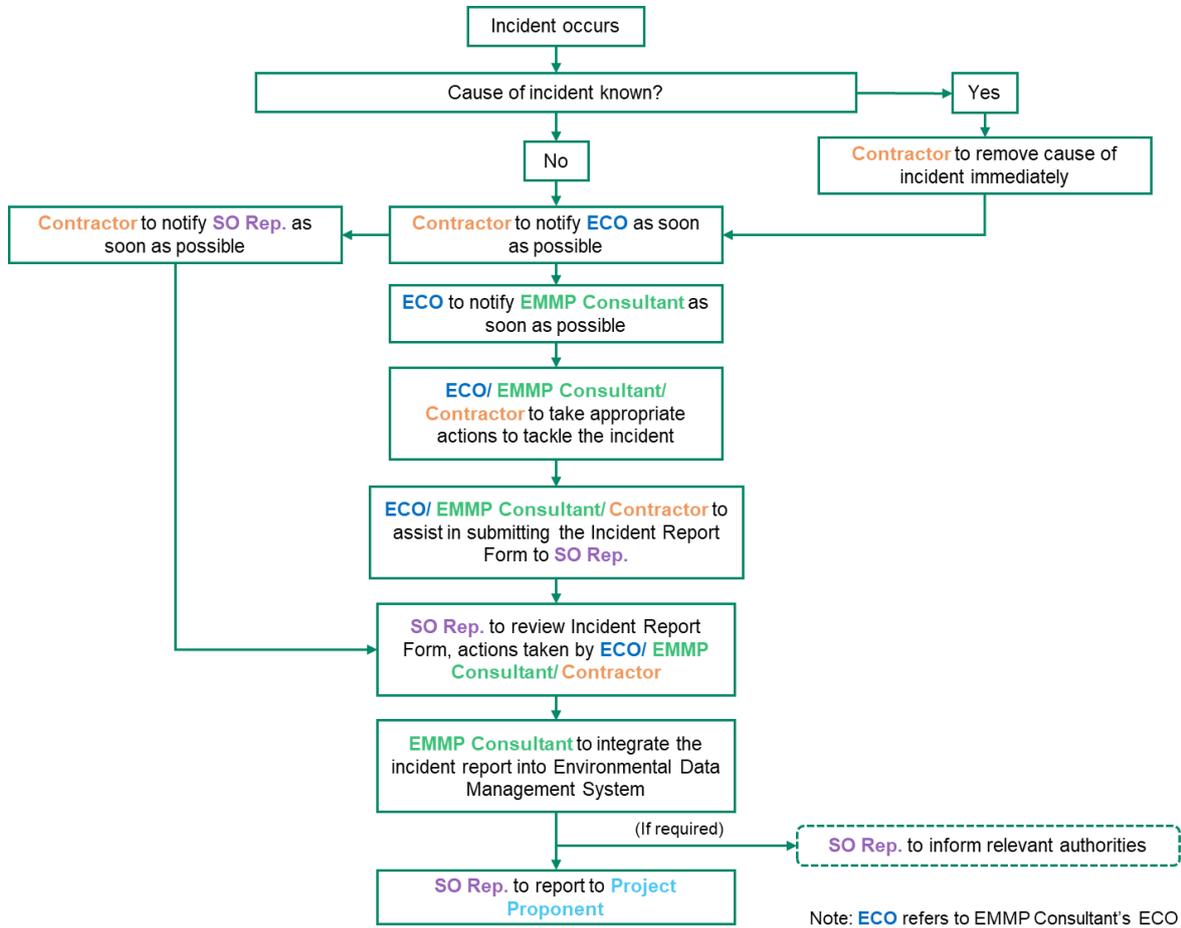


Figure 8-3 Flowchart of Drainages, Surface Water and Groundwater Incidents Response Plan

8.6 Response Plan for Relevant Air Quality Incidents

In the event that an abnormal amount of smoke/ dust/ odour is released from the project site, the Contractor shall follow the procedure as shown in Figure 8-4. The template of the Incident Report Form is as attached in Appendix D. The report shall be submitted to the SO Rep. by EMMP Consultant.

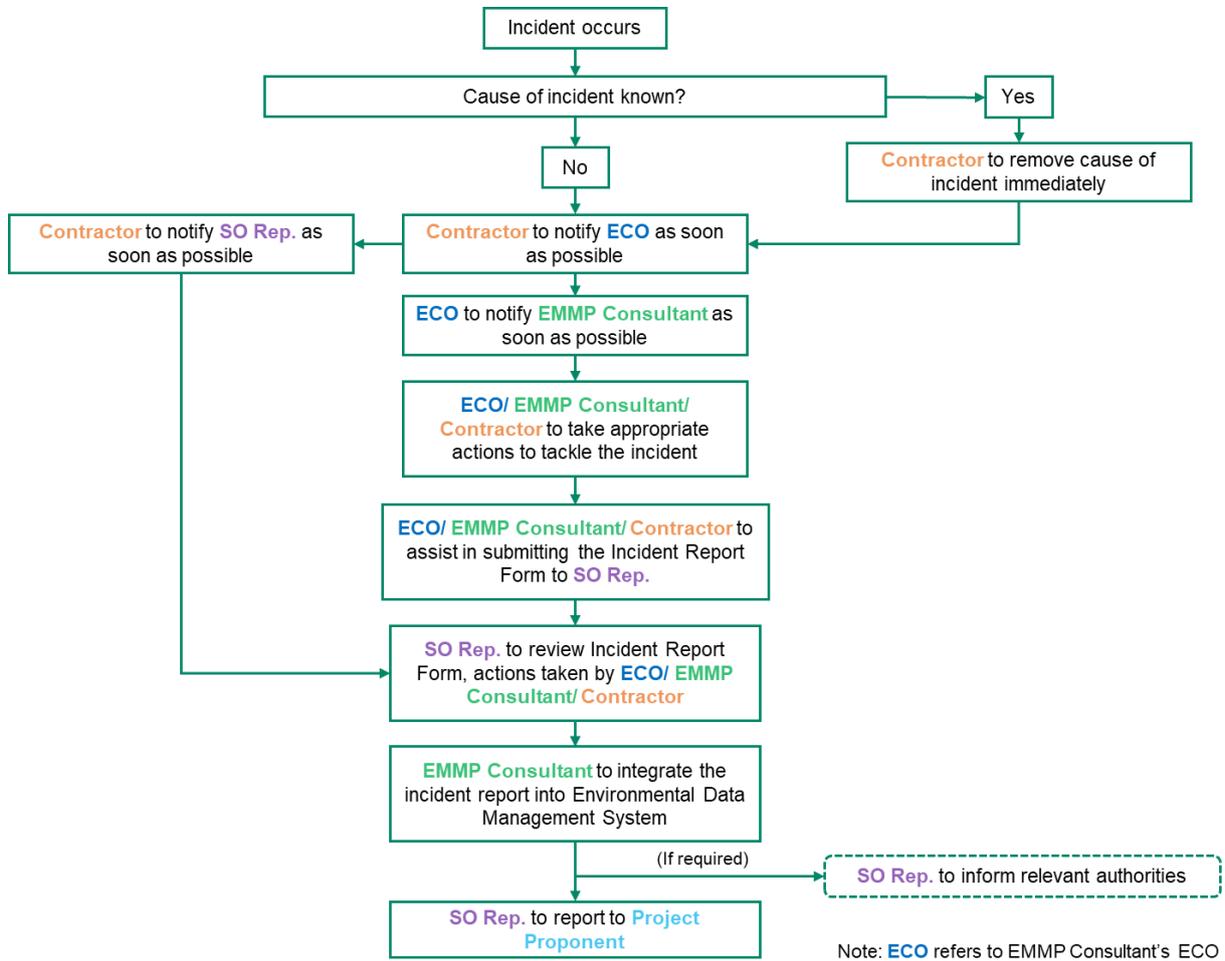


Figure 8-4 Flowchart of Incident Reporting

8.7 Response Plan for Relevant Airborne Noise Incidents

In the event that an abnormal level of airborne noise is felt from the project site, the Contractor shall follow the procedure as shown in Figure 8-5. The template of the Incident Report Form is as attached in Appendix D. The report shall be submitted to the SO Rep. by the EMMP Consultant's ECO/EMMP Consultant.

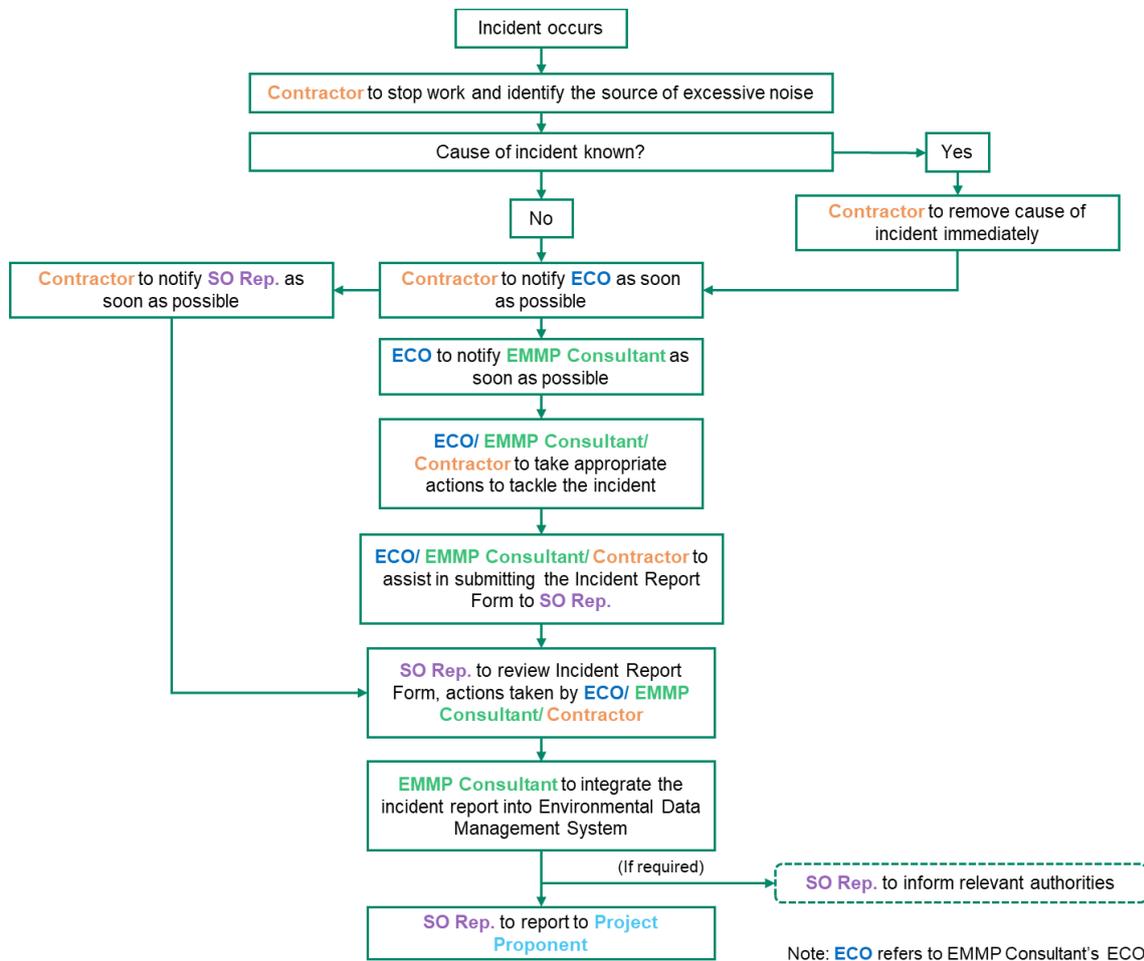


Figure 8-5 Flowchart of Incident Reporting

8.8 Response Plan for Relevant Vibration Incidents

In the event that an abnormal level of vibration is felt from the project site, the Contractor shall follow the procedure as shown in Figure 8-6. The template of the Incident Report Form is as attached in Appendix D. The report shall be submitted to the SO Rep. by EMMP Consultant.

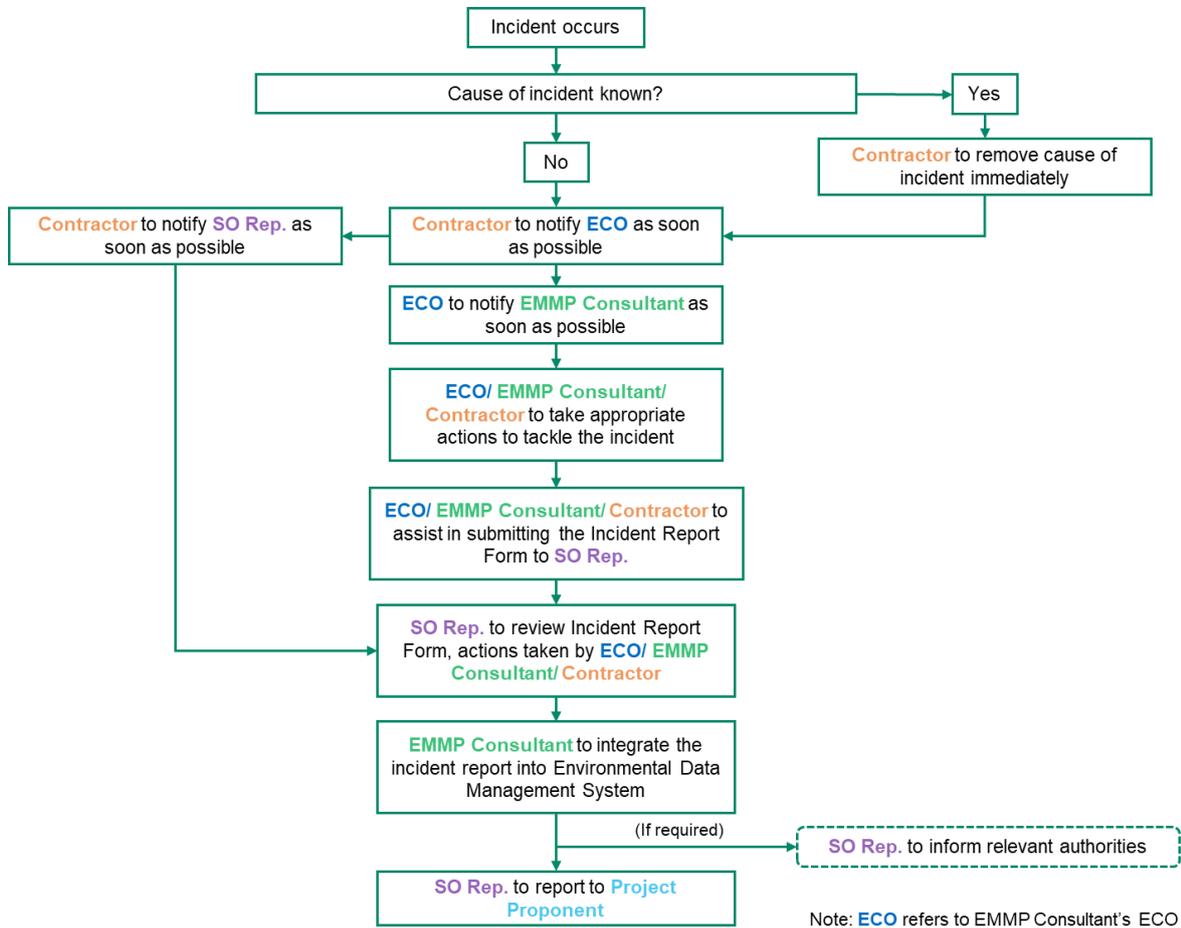


Figure 8-6 Flowchart of Incident Reporting

9 Conclusion

The overall EMMP has been developed based on the completed EIS of Northern Tengah, discussion with SO Rep., HDB and Technical Agencies (i.e. NEA, NParks and PUB) and the available information from Client.

The overall timeline for whole construction is approximately sixty-two (62) months. Recommended Area of Conservation will be retained and would not be cleared during construction. The EMMP Specification has been developed for respective construction stages (i.e. Stage 1, Stage 2, and Stage 3) and the responsibilities for involved personnel in every construction stage have been described accordingly.

The EMMP is a 'live document' that detailed out the identification of potential site-specific impacts, mitigation measures that should be implemented, adaptive monitoring and inspection programs as well as reporting and requirement based on the EIS for Northern Tengah. It has taken into account the baseline conditions at work site, Project components, activities and experience in similar development projects.

In order to ensure the information in the EMMP are up-to-date in the event of any possible changes, it is recommended that the EMMP to be updated when necessary for use by all parties that involved in this Project.

The environmental management governing this Project shall set up a proper policy that displays their commitment to ensure the environment is properly preserved and taken care of whilst the Project is carrying out. The appointed Contractors should ensure that all the compulsory environmental controls and measures are implemented accordingly during construction of the Project.

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Appendix A
Guidelines for Sapling Harvesting
and Tree Transplantation and
Tree Maintenance

Appendix A

Guidelines for Sapling and Tree Transplantation and Tree Maintenance

CONTENT REQUIREMENTS

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

SAPLING HARVESTING AND TREE TRANSPLANTING

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

SPECIMEN SELECTION

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

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

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

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

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

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

TREE MAINTENANCE AND CARE

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

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

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

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

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

Appendix B
Methods Statement for
Tree Protection and
Conservation Guidelines

APPENDIX B

METHOD STATEMENT FOR TREE PROTECTION AND CONSERVATION GUIDELINES

By

Derek Yap

Lead Arborist

Camphora Pte Ltd

ISA certified

SG-0117A

CONTENT REQUIREMENTS

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

TREE PROTECTION AND CONSERVATION GUIDELINES

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

PRE-DEMOLITION/PILING/CONSTRUCTION

1. Pre-Construction Meeting

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

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

1.1 Tree Protection Zone

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

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

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

iii. Signage

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



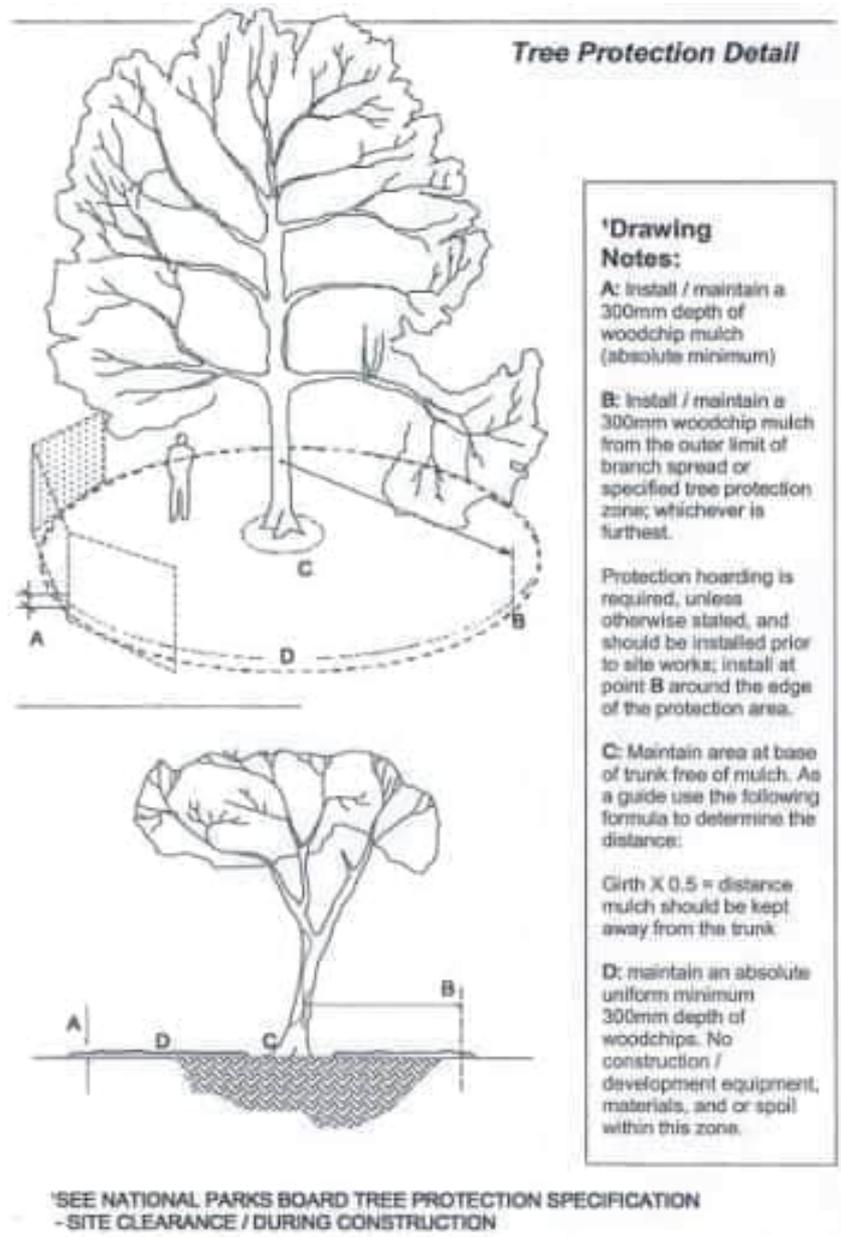
KEEP OUT!
TREE PROTECTION
ZONE

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

iv. Fencing installation

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

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



1.2 Tree pruning and removal

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

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

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

1.3 Site Clearance

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

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

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

DURING DEMOLITION/PILING/CONSTRUCTION

2. Tree Protection Zone Restrictions

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



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

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

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



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

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



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



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

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

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

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



Figure 5: Construction cement deposited at tree base.



Figure 6: Tree showing signs of decline overtime.

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

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

A) Grade changes within the TPZ are not permitted.

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

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

natural grade, unless mitigated.

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

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

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



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

2.2 Proximity of Heavy machinery/vehicles

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

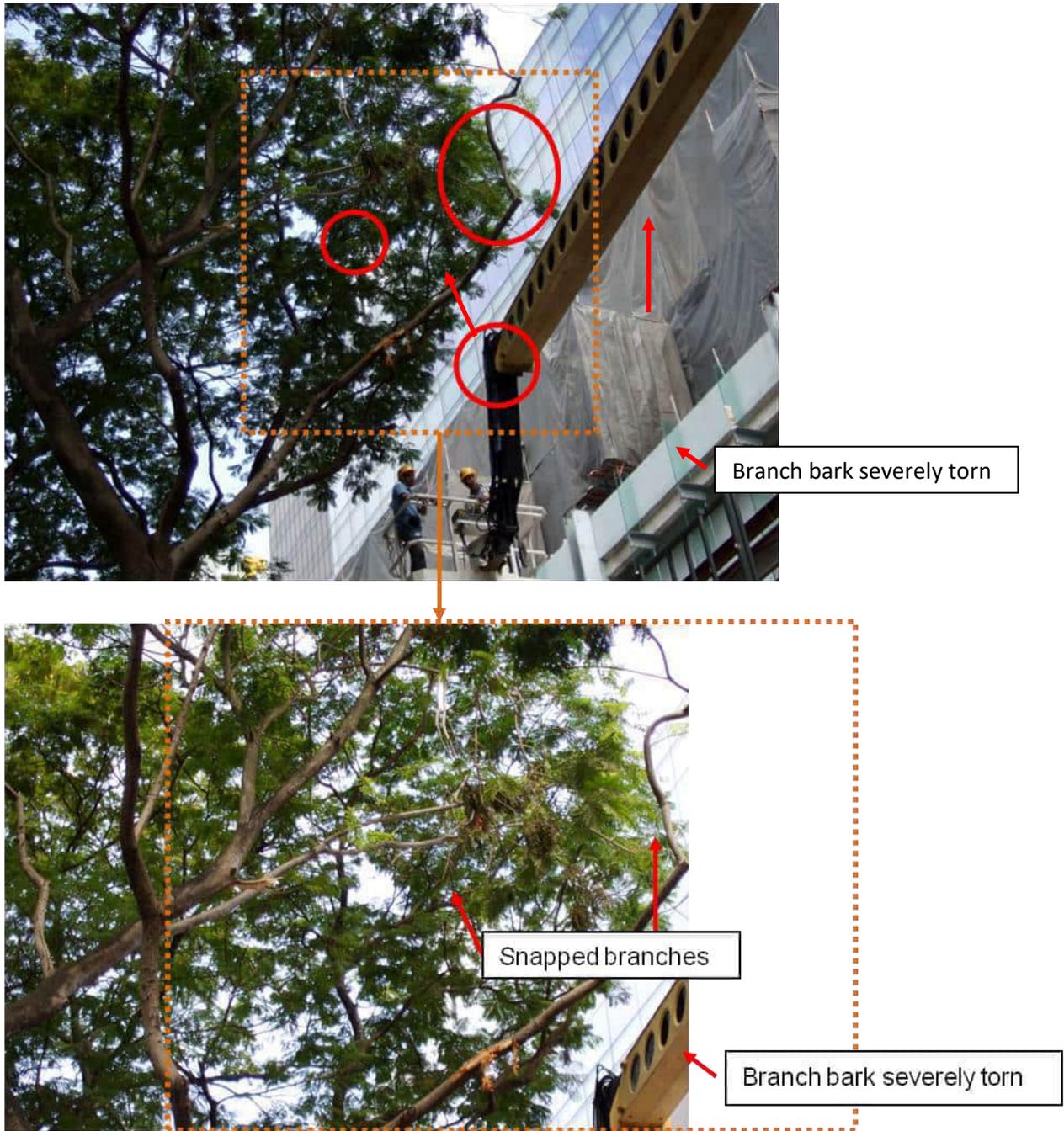


Figure 8: Tree branches were severed due to the negligence of the crane operator.

2.3 Drainage Considerations

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

2.4 Trenching, Excavation and Equipment use

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

i. Root Severance

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

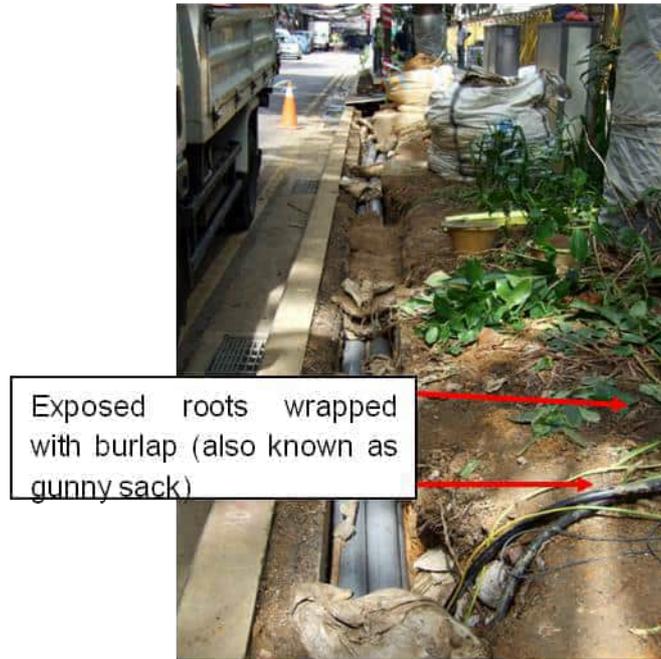


Figure 9: Tunneling under roots.

ii. Excavation

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



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

iii. Heavy Equipment

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

2.5 Tree Care

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

(A) Fertilization

A1 Vertical trenches and Nutrient Sinks

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

A2 Soil Injection of Biostimulants

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

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

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

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

(B) Watering

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

(C) Myconate treatment

- To trigger and stimulate growth of existing mycorrhizae.

(D) Pesticide treatment

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

(E) Additonal pruning

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

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

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

2.6 Engaging Arboriculture Contractors

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

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

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

Each Arboriculture crew shall possess the following VALID competences:

- Operation of chainsaw for ground work (LS-MT-103E-1)
- Chainsaw safety and maintenance (LS-MT-102E-1)
- Perform formative pruning of young trees (LS-MT-114E-1)
- Provide Arboriculture support on site (LS-MT-116E-1)
- Workplace safety and health – operators (ES-WSH-101G-1)
- Respond to Emergency (LS-HM-208E-1)
- Perform advance rigging and climbing techniques (LS-HM-308S-1)
- Perform aerial tree access and aerial rescue skills (LS-HM-204S-1)
- Implement and apply appropriate risk and safety management to sector practices (LS-BP-301S-1)
- Prepare risk assessment report (LS-HM-406S-1)
- Operate and work from an elevated work platform (CUGE-ARB-3501)

POST-CONSTRUCTION

3. Soft Landscaping

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

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

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



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

ANNEX A

VERIFICATION OF TREE PROTECTION CHECKLIST

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

Submitted by: _____

Company/Project: _____

Date/Time: _____

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

Verified by (attending arborist): _____

Date/Time: _____

Appendix C
Wildlife Incident Form

WILDLIFE INCIDENT FORM

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

Appendix D
Environmental
Incident Form

INCIDENT REPORT

Date: 06 August 2018

To _____ :
Contract Name /Phase:
Contract Period :

I wish to report the following incident.

- a) **Location**
xxx
- b) **Branch Office / Town Council**
xxx
- c) **Constituency / Division**
xxxx
- d) **Type of Works & Incident Location**
xxx
- e) **Date and Time of Incident**
Date:
Time:
- f) **Description of Incident**
xxxx
- g) **Likely Cause of Incident**
xxxx
- h) **Implication to resident**
xxx
- i) **Presence of Journalists (based on available information on site)**
* Yes / No
- j) **Action Taken by Consultant / Contractor**
Contractor:
xxxxx
Consultant:
xxxxxx
- k) **Any Implications / Follow-up Actions**
xxxxxxx
- l) **Contact Person for Follow-Up (Name, Tel, etc)**
Name:
Designation:
H/P:

m) **Scanned Images**

Provide a picture of the location of the incident with some description of what happen

Attached the following documents

records of injured person hospital visit with diagnosis and a brief description of what happen

n) **Remarks**

xxxxxxx

Report submitted by Safety Officer

Name / Designation / Signature of WSHO

Date:

Time:

*To delete accordingly.

Appendix E
Feedback Management
Form

Appendix E – Feedback Management Form

Table 1 Verbal Feedback Register Form

S/N	Date	Contract Site	Location and Problem	Follow-Up Action	1 st Response
SAFETY					
DAMAGE TO PROPERTY					
DRAINAGE AND WATER					
AIR					
NOISE & VIBRATION					
HOUSEKEEPING					
INCONVENIENCE TO PUBLIC					
REQUESTS/OTHERS					
ROAD DIVERSIONS/TRAFFIC					

Table 2 Written Feedback Register Form

S/N	Date	Contract Site	Location and Problem	Follow-Up Action	1 st Response
SAFETY					
DAMAGE TO PROPERTY					
DRAINAGE AND WATER					
AIR					
NOISE & VIBRATION					
HOUSEKEEPING					
INCONVENIENCE TO PUBLIC					
REQUESTS/OTHERS					
ROAD DIVERSIONS/TRAFFIC					

Table 3 Stakeholders' Engagement Report

Contract	<u>Engagement Activities</u>	<u>Remarks</u>	OIC
	<p>Circulars</p> <ul style="list-style-type: none"> • Sent XX circular on Date to who for <purpose> • Display XX circular on Date at where for <purpose> <p>Phone Calls/SMS/Emails</p> <ul style="list-style-type: none"> • Sent email on Date to Who of What for <purpose> • Sent SMS on Date to Who of What for <purpose> • Call Who on Date for <purpose> <p>Face-To-Face Engagement</p> <ul style="list-style-type: none"> • Date, Who, Where and Details <p>Event</p> <ul style="list-style-type: none"> • Organized/Conducted what event on Date at Where for/to <purpose> 	<p>Names of Project Team members present</p>	

Appendix F
Dust Control Plan

CONTRACT NO: D/336/22

- (A) SITE PREPARATION WORKS AT TENGAH TOWN
(PHASE 3)**
- (C) CONSTRUCTION OF OUTLET DRAINS AT TENGAH
TOWN (PHASE 1a)**

DUST CONTROL PLAN

Description	Prepared By	Approved By
Name:	Lin Tin	Huang Wenhui
Designation:	WSHO cum ECO	Project Manager
Signature:		
Date:	07 October 2022	07 October 2022
Revision No./ Date:	0.0	-

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3	Site Layout Plan	4
4	Dust Generation Sources	5
5	Dust Control Team	5
6	Dust Control Equipment	5
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8	Additional Control Measures	6
9	Feedback Management	7
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(1) Introduction

This Dust Control Plan (DCP) is to identify the measures that will be taken to reduce the potential for particulate emissions associated with demolition activities, Earth works, vehicle movement, machineries movement and all other construction activities at HDB Project Contract No.: D/336/22 as below:

- a) Site Preparation Works at Tengah Town (Phase 3)
- c) Construction Of Outlet Drains at Tengah Town (Phase 1a)

This report will emphasize on the areas of construction within construction stages.

(2) Objective

The purpose of this plan is to identify the steps that will be taken to reduce the potential for particulate emissions during construction activities. The plan includes activity-specific dust control criteria and dust suppression procedures. Best dust control practices will be implemented throughout the project. Dust control practices include wetting active demolition areas & vehicle access minimizing or ceasing activity during periods of high wind, sweeping or wetting paved areas, wetting unpaved areas, application of dust suppressant materials as well as covering stockpiles. The DCP provides specific information about the generation and control of dust emissions during the demolition, stockpiling, and other activities associated with. The following sections detail potential dust sources and dust control methods.

(3) Site Layout Plan

Site Layout Plan

A. SITE PREPARATION WORKS AT
TENGAH TOWN (PHASE 3)

C. CONSTRUCTION OF OUTLET
DRAINS AT TENGAH TOWN (PHASE
1a)



(4) Dust Generation Sources

- *Sand and aggregate piles* that are disturbed will cause fine sand dust to be entrained into the air and especially during dry weather.
- *Machinery movement* on site
- *Concrete mixing* utilizes sand, aggregates, cement and water in the process of introducing sand and cement into the mixer, sand and cement dusts can be entrained into the air.
- *Vehicles or mechanical plant* use diesel oil as fuel emits soot particles due to incomplete combustion of diesel fuel.
- *Illegal open burning* of building materials such as timber, paper, plastic, cardboards, etc. creates dust in the form of fine ashes and soot particles.
- *Land clearing and earthworks, demolition, excavation, piling* causes dust to be entrained in the air and aggravates in case of dry weather.

(5) Dust Control Team

Dust control team consist of the following members

- ✓ Environment Control Officer
- ✓ Site Supervisors and Forman
- ✓ Water Truck Drivers
- ✓ Environmental Workers

(6) Dust Control Equipment

- ✓ Canvas Sheets to cover stockpiles and bare earths
- ✓ Water pumps and enough water hose to wetting dry ground and site access
- ✓ Water Truck with sprinklers

(7) Dust Control Measures

Measures include the following:

- Cover or water daily any on-site stockpiles of debris, dirt or other dusty material.
- Use adequate water and/or other dust palliatives shall be used on all disturbed areas in order to avoid particle blow-off.
- To make all vehicle tires are washed before exiting from site
- To set the maximum speed limit for all vehicle as low as 15km/h
- Wash down or sweep paved access as necessary to control track out or fugitive dust.

- Cover or tarp all vehicles hauling dirt or spoils on public roads if sufficient freeboard is not available to prevent material blow-off during transport.
- Ground cover would be re-established through watering on the disturbed parts of the construction area
- Storage of sand & aggregates placed in proper pits and covered to prevent excessive entrainment of fines by strong winds or when large heavy vehicle pass by and Storage periods should be as short as possible. During hot dry weather, the sand heaps should be wetted regularly to keep dust down.
- Disposal of cement bags, solvent, paint and fuel containers to prevent residual dust and fumes emanating from these sources.
- Removal of refuse and construction debris on a daily basis to avoid sources for generation of dust.
- To workers and staffs need to be educated on dust control method.
- Hoarding/ screen will be erected around dusty activities and at site boundary wherever possible.
- Site fencing and barriers will be kept clean by cleaning regularly using wet methods.
- Use cutting, grinding or sawing equipment fitted with, or in conjunction with, suitable dust suppression techniques such as water sprays or local extraction whenever possible.

(8) Additional Control Measures

- ❖ Water truck is engaged full time to wet access continuously.
- ❖ Gatekeeper is deployed to monitor and control traffic flow.
- ❖ Earth works and Hardcore crushing works should be carried out according to the wind blow conditions.
- ❖ More Speed warning signage installed along the site access to make all driver aware on speed control.
- ❖ All truck drivers are instructed by lorry controller to only drive by designated site root.
- ❖ Gate keeper was instructed to make the cleanness of exiting vehicles.
- ❖ Neighbor contractors who are shared our site access also been remained to comply with KTC site standard on environmental control.

(9) Feedback Management

Any feedback received will be informed to ECO,

- ❖ Details of the caller would be noted down, e.g. Name, contact, residential address
- ❖ From the information, the region would be traced and located
- ❖ The work activities around the region would be required to stop.
- ❖ The dust control Team will be activated to cease the dust and take necessary actions to prevent the reoccurrence.

(10) **Appendix** – Some Good practices on Dust Control at Worksites



Water trucks to wetting of site access and bare ground



Covering of Stockpiles to prevent dust Generation



Display of Speed Limit 15km/h and Slow Down Warning Signage



Provision of Washing bay



Speed hump provided to control vehicle speed to manage the dust generated

Appendix G
Noise Management
Plan



CONTRACT NO: D/336/22

- (A) SITE PREPARATION WORKS AT TENGAH TOWN
(PHASE 3)**
- (C) CONSTRUCTION OF OUTLET DRAINS AT TENGAH
TOWN (PHASE 1a)**

NOISE MANAGEMENT PLAN

Description	Prepared By	Approved By
Name:	Lin Tin	Huang Wenhui
Designation:	WSHO cum ECO	Project Manager
Signature:		
Date:	07 October 2022	07 October 2022
Revision No./ Date:	0.0	-



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B	Model and Type of Noise Meter	12
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1. Introduction

This Noise Management Plan (NMP) is for the HDB Project Contract No.: D/336/22 as below;

- a) Site Preparation Works At Tengah Town (Phase 3)
- c) Construction Of Outlet Drains At Tengah Town (Phase 1a)

This noise management plan is prepared to detailed information on the implementation of noise management plan and mitigation measures for different stages of the project.

2. Objective

This NMP has been developed to address potential noise impacts on sensitive receivers and to satisfy the regularity requirement and includes information on the following:

- Relevant legislation and guidelines for noise generated during construction of the Project.
- Potential sensitive receivers who may be affected by noise and vibration generated by the Project.
- Noise vibration impacts potentially arising from the Project.
- Safeguards, mitigation measures and monitoring to manage noise and vibration impacts during construction.
- Roles and responsibilities of those involved in the design and implementation of noise management controls.
- An effective monitoring, auditing and reporting framework to assess the effectiveness of the controls implemented

3. Scope

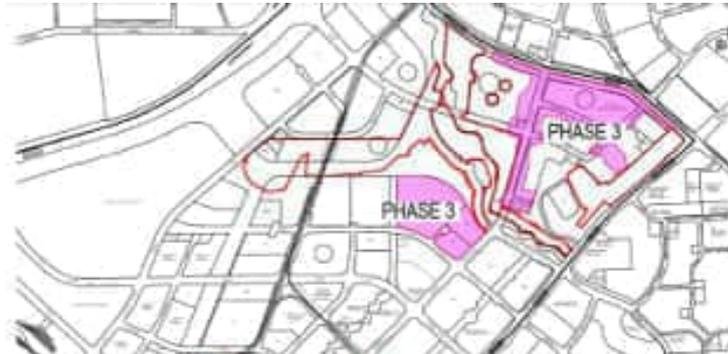
This Noise management plan will emphasize on the areas within phases of construction for the whole duration of construction project. Noise meter have to be installed to detect the noise levels prior the commencement of the construction work, during construction work and to monitor if there will be significant increasing before and after the commencement of construction work and whether the set limits are exceeded.

4. Site Layout Plan

Site Layout Plan

A. SITE PREPARATION WORKS AT
TENGAH TOWN (PHASE 3)

C. CONSTRUCTION OF OUTLET
DRAINS AT TENGAH TOWN (PHASE
1a)



5. Legislative and Regulatory Compliance

1. Code of Practice on Pollution Control
2. Guidelines on noise control - Ministry of Manpower
3. WSH (Noise) Regulation 2011
4. Environmental protection and management (boundary noise limits for factory premises) regulations
5. Environmental Protection and Management (Control of Noise at Construction Sites) Reg 2008
6. SS 602 : Code of Practice for Noise Control on Construction and Demolition Sites 2014

6. Noise Monitoring

The instrumentation and monitoring engineering company will be engaged to assist us in managing our noise monitoring process.

Construction Noise Control

Maximum permissible noise levels for construction work commenced on or after 1 October 2007

Monday to Saturdays

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

Sundays and public holidays

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

¹ reckoned as the equivalent continuous noise level over the specified period, i.e. 5 mins, 1 hr or 12 hrs.

No-work rule on Sundays and public holidays

In addition to establishing permissible noise limits, NEA has also implemented rules which prohibit work on Sundays and public holidays for construction sites located within 150m of residential premises and noise-sensitive premises. The rules are as follows:

a) Construction work commenced on, or after 1 September 2010

- No work is allowed from 10pm on Saturdays or eves of public holidays to 10am on Sundays or public holidays.

b) Construction work commenced on, or after 1 September 2011

- No work is allowed from 10pm on Saturdays or eves of public holidays to 7am on the following Mondays or days after public holidays.

From 1 January 2017, NEA will allow selected construction sites to carry out quieter forms of work on selected Sundays and public holidays. Contractors must obtain a permit from NEA before carrying out such works, which will be granted only for specific construction phases and on a case-by-case basis, subject to stringent conditions.

7. Type of Noise Meter

The type and model of the noise meter typically used for continuous monitoring is as attached in Appendix B. The monitoring equipment shall be calibrated as per the manufacturer's recommendation and procedures and shall be inspected regularly to ensure its effective functioning. Actual locations of noise meter will be advised.

8. Methods for Noise Pollution Control

Methods that can be adopted include:

(a) Quieter Equipment or Mechanical Plant

- ✓ Select equipment or mechanical plants that emit less noise.
- ✓ Use electrical supply from the PUB grid to power all machinery. Use of generator should be minimized.
- ✓ Use mufflers or exhaust silencers to reduce exhaust noise.
- ✓ Metal tool bits shall be damped to reduce the impact noise on rigid surfaces.
- ✓ Use flexible mountings or rubber gaskets for stationary plant such as generators to reduce the vibration noise.

(b) Maintenance of Mechanical Plant and Vehicles

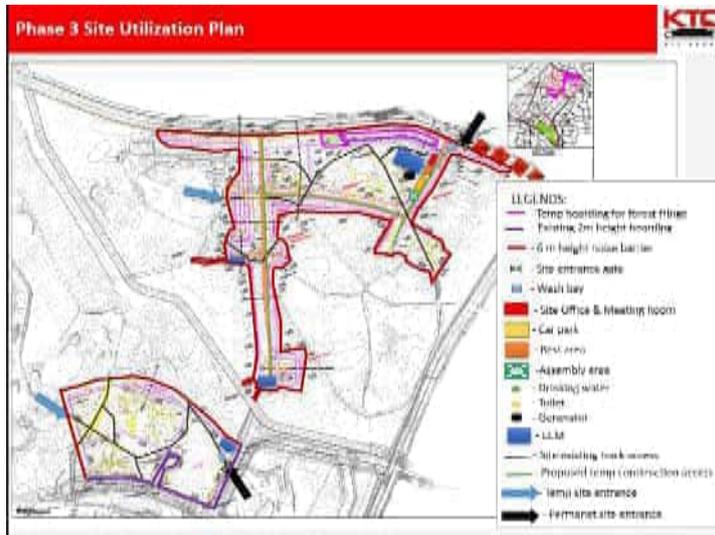
- ✓ To Schedule periodic preventive maintenance and service of construction equipment, mechanical plant and vehicles.
- ✓ Take machines/equipment for servicing whenever there is abnormal noise noticed emanating from the machine/equipment.

(c) Noise Barriers

- ✓ Where possible, enclose noisy machines in acoustical enclosures lined with sound absorbent materials.
- ✓ Erect barriers around the site to further prevent noise transmission to surroundings residential areas.
- ✓ Use visual screens or safety nets to help screen off noisy work.

- ✓ Place site facilities such as vehicular wash-bays, access routes, concrete batching plants, workers' quarters, canteen and passenger hoists as far away from residential buildings as a possible.

Noise barrier (Please refer to the below utilization plan)



Noise Sensitive Area



(d) Scheduling of Noisy Activities

- ✓ Schedule noisy activities sequentially to avoid excessive noise.
- ✓ Ensure that noisy activities such as piling, demolition or concreting are carried out as much as possible in the day time.

(e) Education

- ✓ Educate employees of the consequences of noise generation and methods for reduction.

(f) Other measures

- ✓ Use precast concrete elements as it minimizes both in-situ concreting and noise generation.
- ✓ Keep residents informed of what is planned and being done so that they are more likely to accept any noise.

9. Actual work schedule and anticipated noise levels, together with proposed noise mitigation Measures

Processes	Machineries involved	Noise level at source	Proposed noise mitigation measures
Excavation works (Cut & Fill)	Excavator	80	<ul style="list-style-type: none"> - Maintain and service all machineries at regular intervals to reduce noise generated - Release the load from excavator closer to truck to reduce noise generated
	Lorry truck	80	
	Roller	80	
	Articulated truck	80	
	Bulldozer	80	
Silt trap construction	Concrete truck	80	
	excavator	80	

10. Public engagement activities

Contacts:

- Site office Hotline : 9655 2378
- Project Manager : 9655 2378
- ECO : 8289 8573
- HDB Project Team Hotline: TBA
- HDB Hotline : TBA

11. Feedback Management

Close community liaison will be maintained to ensure that local residents are aware of the times and durations when they may be affected by construction noise and to provide an avenue for communication between the community and the construction team. In addition to the noise mitigation measures outlined above, construction will deal with noise complaints that may arise from construction activities. Each complaint will be investigated and where the noise in question is in excess of allowable limits, appropriate noise engagement measures will be put in place to mitigate future occurrences. If any feedback received will be informed to ECO.

- Details of the caller would be noted down, e.g. Name, contact, residential address
- From the information, the nearest noise meter installed near to the region of the resident would be traced and located
- Noisy activity around the region of the noise meter location would be required to stop from the respective engineer in charge.
- During the period, ECO with the engineer would proceed to inspect the noise meter and check the reading if it exceed the permissible level within the stipulated timing.

Appendixes

Appendix A: Location Plan of the position of the Noise Meter

TBC

Appendix B: Model and Type of Noise meter to be fixed for noise monitoring

Precision Sound Level Meter TYPE-6224

Measuring noise really does not have to be complicated, even for the novice, and the TYPE 6224 (Class 1) Integrating sound level meter is designed with this in mind.

The meter is ideally equipped for carrying out Noise at Work Risk Assessments, as well as the majority of environmental survey work. The range of parameters measured, the wide measuring capability of the meter and the ease of use, mean that this equipment is suitable for anything from aircraft noise to lawnmower design, and from construction sites to laboratories.

Noise at Work Measurements

The TYPE 6224 provides the essential measurements required by the Control of Noise at Work Regulations 2006, including Leq (equivalent continuous level) in 'A' and 'C' weightings, and Cpeak.

The meter can data-log any of these parameters in up to 10,000 data-memories, making it more than powerful enough for the task in hand.

Environmental Monitoring

Also ideally suited to environmental monitoring, the TYPE 6224 can measure 5 selectable percentile values and sound exposure (LE).

Most environmental measurements require Leq and L90 plus possibly one or two other measurements.

These can all be measured simultaneously with the TYPE 6224 and data-logged into its 10,000 data-point memory.

Multi-purpose Measurement

Many sound measuring tasks require the measurement of Leq (equivalent continuous level), Lmax (Maximum rms level), LE (Sound Exposure) or percentiles,

and all of these can be completed using the TYPE 6224 with its accessories.

Operation

The TYPE 6224 (Class 1) Integrating Sound Level Meter has an easy to follow menu system and clearly marked keys, all designed to make the meter simple-to-use.

The back-lit LCD display is also very clear with large figures and a quasi-analogue display bar to show the changes in sound level as they happen.

Features

Equivalent continuous level (Leq)

5 user selectable percentile values (Ln)

Wide Linearity range of 90dB

RS232 for data output to optional software

Memory storage for 10,000 datapoints

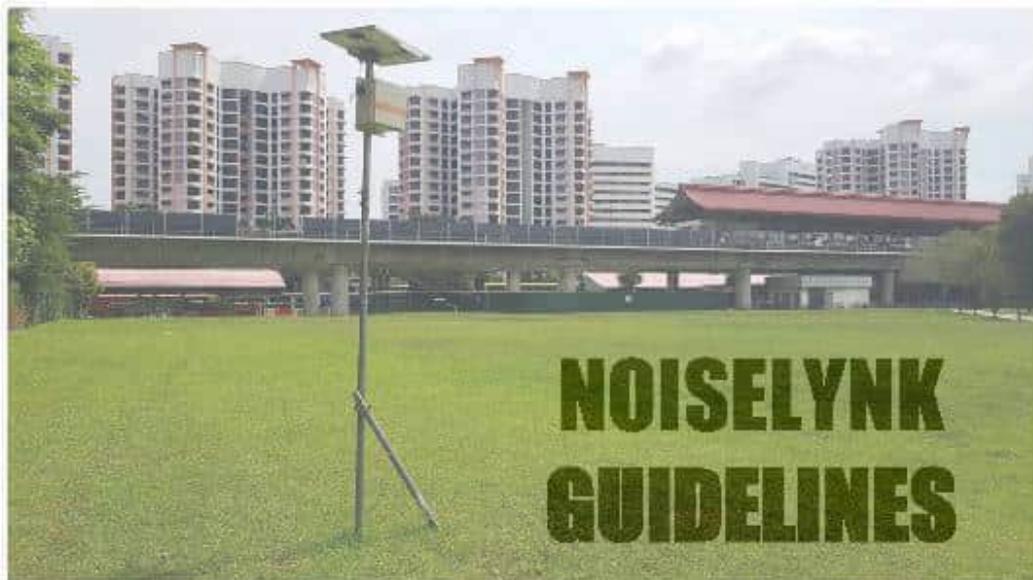
Back-lit LCD display



Appendix C: Noise Meter User Guide



ABSOLUTE INSTRUMENT
SYSTEMS



11 Kallang Place
#06-03
Singapore 339155



Tel: +65 6296 8012
Fax: +65 6296 3242



Email: sales@alsys.com.sg
Website: www.alsys.com.sg

Updated on 04 May 2018



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Login Page

1) LOGIN TO NOISELYNK WEBSITE

URL: <http://www.noiselynx.com/noiselynx/Login.aspx>
(User ID and Password will be given upon installation)

If you have lost the user ID/password or wish to reset the password, please kindly email to sales@aisys.com.sg for assistance.

2) VIEW PAST HISTORY

Step 1: Select the month, which you wished to view the history

Step 2: Click **Select**

Step 3: Key in the User ID and Password given

Step 4: Click **Login**

NoiseLYNK™

Real-Time Noise Monitoring Web-Site

brought to you by



Remember to save this new link.

User ID	<input type="text"/>
Password	<input type="password"/>
	<input type="button" value="Login"/>
View your past history	<input type="text" value="- select a month -"/> <input type="button" value="Select"/>



Noise Log Report

1) VIEW THE READINGS

Step 1: Choose the **Date Range** that you wished to view the reports

Step 2: Select the location of the system under **Device**

Step 3: Select the **Report Type** that you wished to view the reports

Step 4: Click **Display** to view



2) REPORT TYPE

12hrs Report

Date and Time	Leq5min	Leq1hr	Leq13hr	Date and Time	Leq5min	Leq1hr	Leq13hr	Date and Time	Leq5min	Leq1hr	Leq13hr
29-04-2018 07:00	63.3	64.9		29-04-2018 11:00	65.0	65.5		29-04-2018 15:00	65.3	65.2	
29-04-2018 07:05	63.1			29-04-2018 11:05	65.1			29-04-2018 15:05	65.7		
29-04-2018 07:10	67.0			29-04-2018 11:10	63.8			29-04-2018 15:10	64.7		
29-04-2018 07:15	65.9			29-04-2018 11:15	65.0			29-04-2018 15:15	64.8		
29-04-2018 07:20	64.4			29-04-2018 11:20	65.3			29-04-2018 15:20	65.4		
29-04-2018 07:25	63.4			29-04-2018 11:25	64.4			29-04-2018 15:25	65.4		
29-04-2018 07:30	63.9			29-04-2018 11:30	64.7			29-04-2018 15:30	65.9		
29-04-2018 07:35	66.5			29-04-2018 11:35	66.2			29-04-2018 15:35	64.4		
29-04-2018 07:40	64.2			29-04-2018 11:40	66.1			29-04-2018 15:40	64.7		
29-04-2018 07:45	63.8			29-04-2018 11:45	65.1			29-04-2018 15:45	64.8		
29-04-2018 07:50	65.8			29-04-2018 11:50	65.2			29-04-2018 15:50	65.7		
29-04-2018 07:55	66.1			29-04-2018 11:55	66.1			29-04-2018 15:55	64.9		

If you wish to download the 12hrs Report, select "12hrs Report Download" and it will be downloaded as pdf file.

Full List

Report Count: 383

Account	Device	Date/Time	Leq5 min	Leq1 hr	Current Leq13hr	Leq13hr (%)	Max Allowable 13hr	Date/Time	Voltage	
		29-04-2018 10:24:21	66.2	66.0	66.1	6.9	75.0	14 100 25 111	29-04-2018 10:24:02	12.7
		29-04-2018 10:42:01	64.3	66.0	65.4	6.3	75.0	14 100 4 111	29-04-2018 10:52:14	10.2
		29-04-2018 10:44:01	66.1	65.9	65.4	6.8	75.0	14 100 25 208	29-04-2018 10:44:02	11.8
		29-04-2018 10:50:01	66.4	65.8	65.6	6.7	75.0	14 100 24 208	29-04-2018 10:50:01	13.2
		29-04-2018 10:54:01	67.8	66.7	66.6	6.8	75.0	14 100 25 208	29-04-2018 10:54:02	13.2
		29-04-2018 10:59:01	66.9	65.8	66.3	6.5	75.0	14 100 25 208	29-04-2018 10:59:01	12.9
		29-04-2018 10:34:01	67.6	65.4	65.3	6.4	75.0	14 100 25 208	29-04-2018 10:34:02	13.0
		29-04-2018 10:19:01	65.1	65.3	65.3	6.5	75.0	14 100 25 208	29-04-2018 10:19:02	13.1
		29-04-2018 10:14:00	66.1	65.1	66.1	6.2	75.0	14 100 25 208	29-04-2018 10:14:00	10.4
		29-04-2018 10:08:00	66.6	65.2	65.3	6.1	75.0	14 100 25 208	29-04-2018 10:08:02	13.8
		29-04-2018 10:04:00	66.2	66.2	66.2	6.0	75.0	14 100 25 208	29-04-2018 10:04:02	13.8



3) ALERTS

A) Calibration

 **Calibration Reminder - Last calibration date: 13/04/2017**

- Calibration is due, need to arrange/send meter for re-calibration

If required any assistance, please email to service@alsys.com.sg

B) Low Voltage

 **Low Voltage Alert - Voltage: 11.31**

- Battery's voltage on the system is low
- Check system battery/solar panel, ensure is in working condition

If required any assistance, please email to sales@alsys.com.sg



Admin

1) Device

You may search certain device by keying either one of the following:

- MPN Card No
- Redac Serial No
- IMEI
- Meter Serial No



A) Full Details of Device

To view full details of the device, you may click "Details"



Sample of full details of the device:



B) Update of Location

If the system is relocated, do kindly update the following:

- Latitude
- Longitude
- Postal Code
- Location

*For type (hospital/residential/others),
please email to sales@abys.com.sg if you required to change.*

C) Email for 12H LEQ P Alert

Key in the email address of the personnel under 12H LEQ Alert Email

2) DEVICE RECIPIENT



A) ADD RECIPIENT FOR SMS ALERT

Step 1: Click "Add Recipient"

Step 2: Key in the details of the recipient (Name and Contact)

Step 3: Select the type (SMS/Email)

Step 4: Click "Add" once completed



Step 5: New Recipient's details will reflect on Device Recipient

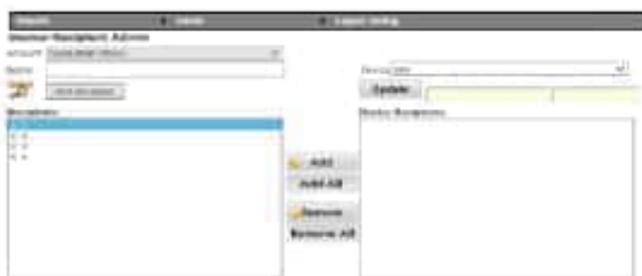




Step 6: Select the "Device" which you want to add the New Recipient



Step 7: Select the Recipient → Click "Add" to add to the device



Step 8: Once done, click "Update" → The date and person who updated the recipient will be reflected



Do note that **maximum 3 recipients** are allowed per device.

*For additional recipients there will be additional charges.
If required any assistance, please email to sales@alvix.com.sg*

B) DELETE RECIPIENT FOR SMS ALERT

Select the Recipient → Click "Remove" to remove the recipient from the device



If you wish to delete the recipient from the account permanently,

- 1) Select the recipients



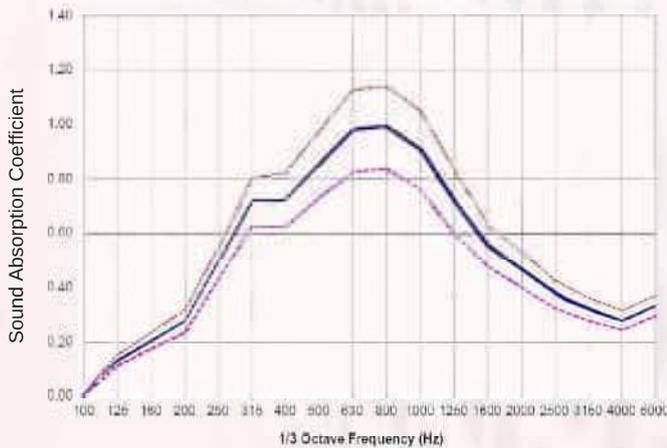
- 2) Right-Click on the recipients
- 3) Select "Delete"



- 4) Click "Ok" to proceed to delete the recipients from the account

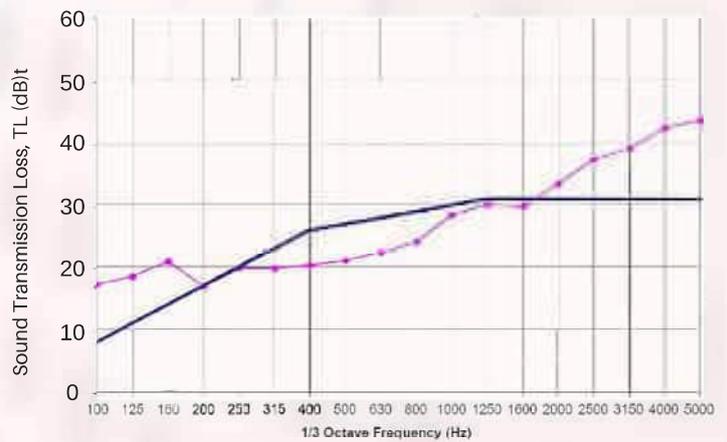


NOISE CONTROL BARRIER



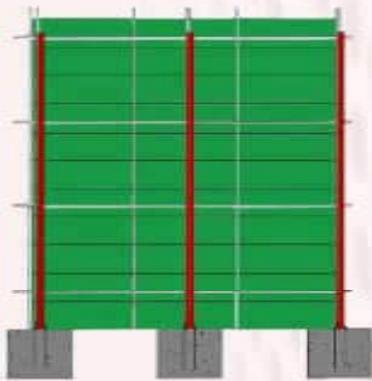
NRC = 0.7

[A Noise Reduction Coefficient is an average rating of how much sound an acoustic product can absorb.]



STC = 27

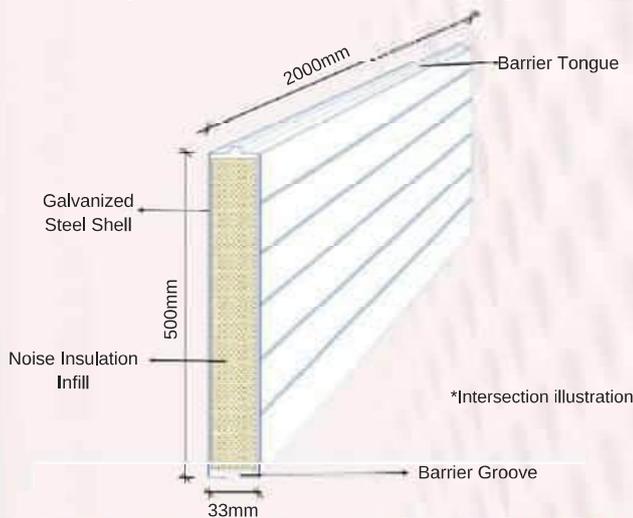
[An STC rating is a unit measurement of how much noise is stopped. The STC ratings allow accurate 'apple to apple' comparisons.]



Typical Elevation Of Noise Control Barrier System

Hebei Jinbiao's Noise Mitigation system is cleverly engineered to fit the needs of most site situation. The usage of C-Channel and Fixed Coupler allows the fixtures on the system to be adjusted on site.

The typical design shows how the system is being supported by I-Beams and it may go as high as 12m or more subjected to P.E calculation. (as done by us for an M.O.H. project in Yishun)



Cost Effective System

Our Temporary Noise Control Barriers are suitable to be reused for consecutive projects once the need is fulfilled. Most of our panels on site will still produce acceptable mitigation performance capability and is an investment good for future usage - a cost-effective plan.



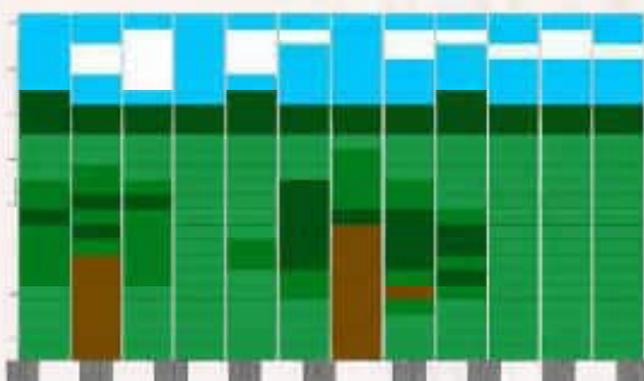
C Channel



Fixed Coupler

Inspirational Ideas

Where the mitigation wall has to be high due to close work proximity to dwellers, arts are infused into the barrier to create a view that could please the 'affected' people.



Panel Nominal Thickness: 33mm

Panel Shell Thickness: 0.5mm (Galvanized Steel)

Nominal Dimension: 2000mm x 500mm

Appendix H
Public Communication
Plan

(A&B) SITE PREPARATION WORK AT TENGAH (PHASE 3 & 4);
(C&D) CONSTRUCTION OF OUTLET DRAIN WORK AT TENGAH (PHASE 1A &1B);
(E) SITE PREPARATION WORK AT BUKIT BATOK TOWN (PHASE 5)



PROJECT PUBLIC COMMUNICATIONS PLAN

CONTRACT NO: D/336/22

- 1) SITE PREPARATION WORKS AT TENGAH TOWN (PHASE 3)
- 3) CONSTRUCTION OF OUTLET DRAINS AT TENGAH TOWN (PHASE 1a)

PREPARED BY: KTC CIVIL ENGINEERING & CONSTRUCTION PTE LTD
DOCUMENT NO: KTC-HDBTGP3-PR-001

Rev.	Date	Description	Prepared	Checked	Approved
0	13-10-2022	Issued for Approval	LinTin 	Tosh 	Huang WH

(A&B) SITE PREPARATION WORK AT TENGAH (PHASE 3 & 4);
 (C&D) CONSTRUCTION OF OUTLET DRAIN WORK AT TENGAH (PHASE 1A &1B);
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03	PUBLIC RELATIONS PROGRAMME (SITE WORKS)	10
04	PROCEDURES FOR HANDLING OF PUBLIC FEEDBACK	12
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1. PROJECT BRIEF

Site preparation work at Tengah(phase 3) located along Brickland Road. The scope of works will include extensive site clearance,excavation of earth. Demolition & removal of existing structure, backfilling with approved earhand all ancillary works.

This project also includes the construction of earth slope, access road and precast drain.

2. PR PROGRAMME OBJECTIVE

The objectives are as follows:

- a) To establish contacts and maintain good relationships with the stakeholders;
- b) To garner support and understanding from the stakeholders;
- c) To pre-empt feedback and inform the stakeholders in advance of works that will cause inconvenience to them;
- d) To empathize with the stakeholders' situation and address their concerns raised promptly;
- e) To engage the stakeholders regularly to keep them updated on the progress and development of the project; and
- f) To provide a communication channel for the stakeholders to raise their suggestions or feedback to KTC Civil Engineering & Construction Pte Ltd and HDB

The List of Stakeholders is illustrated in **Annex – 05**.

3. PROPOSED PUBLIC RELATIONS PROGRAMME

The contractor to liaise and assist SO regarding all public relation matters.

Public Relations implementation schedule including Monthly Newsletters to the owners of adjacent developments and report on public related matters shall be submitted to the SO and CCG.

The workflow for the preparation to approval of the statement and programme is illustrated in Procedure for Preparation of Public Relation Works prior to Major Works - **Annex - 01**.

With regard to works that will impede or pose inconveniences to the public, the contractor shall inform SO with schedules relating to night works, traffic diversions, closures of roads etc at least 2 weeks in advance. The contractor shall work with HDB on the plans accompanying circulars or press releases for effective dissemination of information to the public at least (3) working days before commencement of that particular work.

The Procedure for Facilitation of Night Works / Traffic Diversions / Closure of Roads is illustrated in Annex - **02**, and the Public Relations Program (Site Works) is set out in **Annex - 03**.

4. EXTERNAL COMMUNICATIONS

4.1 Press Releases, Monthly Newsletters & Queries

The contractor shall assist and coordinate with SO to implement and review all external communications, including press releases, statements and printed materials if necessary.

All external communication materials, including press releases, statements and printed materials are to be drafted by the contractor and to be cleared by SO.

4.2 Media Support

The Contractor shall render all necessary assistance and cooperation to the SO with regard to all functions and events e.g. Community talks for residents, any photo-taking, video filming and site visits by the Authorities' photographer, film maker or Authority accompanied press.

4.3 Dialogue with Stake Holders

The Contractor shall serve as secretary to all meeting/dialogue sessions and briefings to stakeholders (affected property owners, residents, management corporations, resident committees, citizen's consultative committee (CCC), etc.). Report shall be prepared and submitted to the SO within 3 days after each session.

5. PUBLIC FEEDBACKS

Dedicated enquiry hotline number and e-mail address shall be set up specifically for public feedback. These shall form the avenue of communication between the public and the Contractor.

The Contractor will initiate an effective and professional approach for the handling of all public feedbacks and shall ensure that all feedbacks are thoroughly investigated and attended to by the Contractor.

The SO shall be informed immediately of all public feedbacks received. Reports and recommended actions are to be submitted to the SO within 2 working days for oral feedback and 7 working days for written feedback.

Feedback provided by the SO must also be attended to as soon as possible.

All feedbacks shall be properly registered, monitored and reported on a monthly basis to the SO. The actions taken and measures implemented shall also be registered to prevent recurrence.

The Procedures for handling Of Public Feedback is illustrated in **Annex – 04** and the Form for Site Work Feedback & Stakeholders Engagement Report are illustrated in **Annex – 06**.

6. Public Relations Approach

Following are the PR strategies for:

Mitigation strategies for such potential negative impacts have been summarized as:

- Ample directional signs to be displayed in advance to inform and guide motorists.
- To take reasonable precautions to avoid dust emissions
- No damage shall be caused to any existing cables, service pipes and any part of the existing property.
- To provide and install noise meters/barriers/enclosures where necessary, to keep the noise level within NEA's permissible level.
- Provision of safe alternative/additional access to be provided where necessary.
- Directions will be provided to direct users.
- Traffic controllers will be stationed to guide motorist during lane closures / diversion
- Restriction of workmen to prevent trespass into adjoining properties and existing buildings

Conservation of the environment

- Promote and encourage sustainable environment protection and gracious practices.
- Raise awareness of environment issues through briefings, posters, practices etc.
- Minimize pollution, reduce wastage, health and safety hazard.
- To communicate environment policies to all employees, sub-cons and suppliers to promote a shared green commitment.
- To use equipment with the Singapore Green Label where possible.
- To reduce smoke emission from machinery through regular servicing and maintenance.
- To conserve and protect all trees and practice replanting where possible.
- To carry out shepherding according to approved plan

Feasible control measures for the wellbeing of all individuals, including the pedestrians at the vicinity:

- Place additional lighting only in areas deemed necessary for safety. Use directional lighting to minimize night time glare to surrounding areas and assure that all construction lighting is shielded and directed away from sensitive uses.
- Reschedule construction operations to avoid periods of noise annoyance identified in the complaint.
- Conduct awareness education for construction workers to avoid unnecessary disturbances to the surrounding area.

- Maintain a clean and green environment in the vicinity.

Safer Road / Traffic Environment:

- ❖ Ensure safety to motorists, cyclists and members of the public.
- ❖ Pedestrian crossing at egress/ingress to be free from visual obstruction.
- ❖ Provide reasonable accessibility for pedestrians.

Public Accessibility:

The following will be provided where necessary:

- ✦ Signboards will be displayed at strategic locations.
- ✦ Display contact/hotline and channel for public feedback.
- ✦ Carry out regular checks of the hoarding, gate, signages, etc by the Supervisor.
- ✦ To ensure that the footpath is free from obstruction at all times.

Noise Pollution Control Measures:

We will work with key stakeholders to regularly review the management of construction and traffic noise, taking into account public feedback and best practice.

Measures which will be implemented include:

- ◆ Use electrical supply from Power Grid rather than generator where feasible.
- ◆ Maintain and service equipment and machineries regularly to keep noise low
- ◆ Exhaust fumes from machinery are diverted away from public infrastructure.
- ◆ Minimizing idling of power equipment
- ◆ Installation of noise meter to monitor the noise level

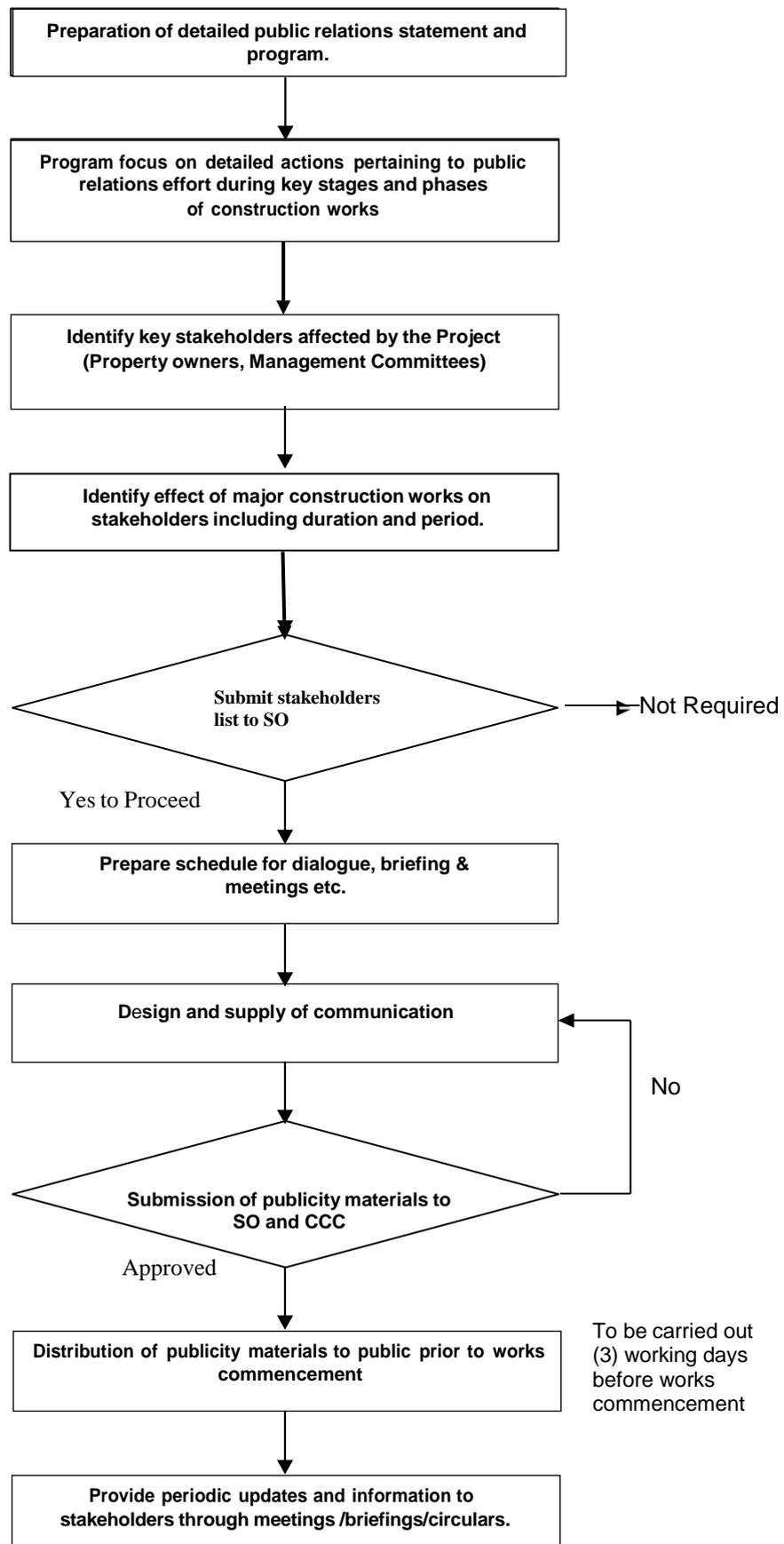
Environmental Control Measures

Mindful of the many dengue outbreaks around Singapore, we take a forceful approach:

- ✦ To conduct daily checks on worksites to make sure there are no hidden puddles of water that will encourage mosquito breeding.
- ✦ Good housekeeping practice would minimize mosquito breeding areas.
- ✦ Ensuring that silt discharges as well as oil leaks from machinery will not pollute the public drains and waterways.
- ✦ To take reasonable precautions to avoid dust emissions

ANNEX - 01

PROPOSAL FOR PREPARATION OF PUBLIC RELATIONS WORKS PRIOR TO MAJOR WORKS



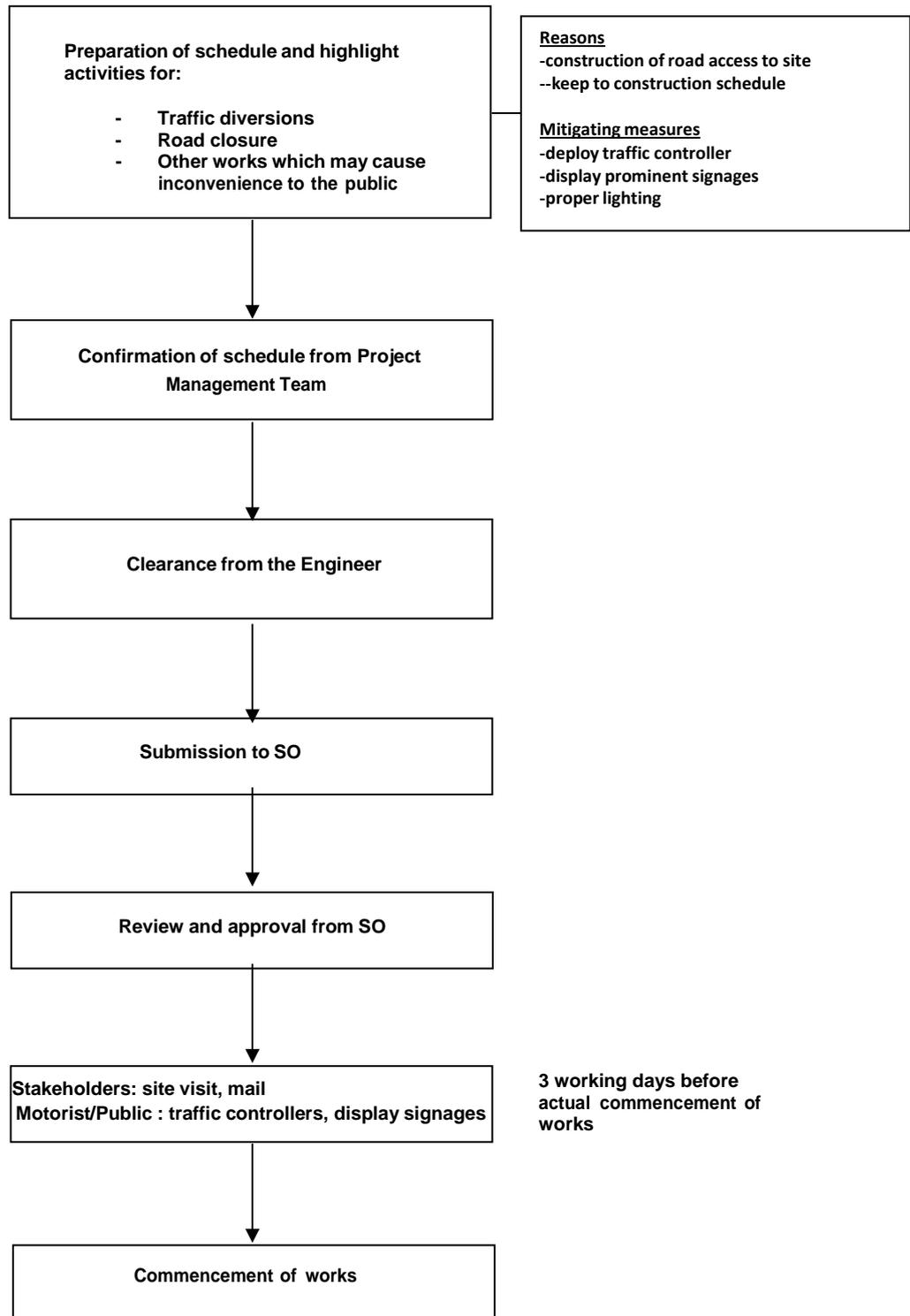
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(C&D) CONSTRUCTION OF OUTLET DRAIN WORK AT TENGAH (PHASE 1A &1B);
(E) SITE PREPARATION WORK AT BUKIT BATOK TOWN (PHASE 5)



ANNEX - 02

PROPOSAL FOR FACILITATION OF TRAFFIC DIVERSIONS / CLOSURE OF ROADS

(A&B) SITE PREPARATION WORK AT TENGAH (PHASE 3 & 4);
(C&D) CONSTRUCTION OF OUTLET DRAIN WORK AT TENGAH (PHASE 1A &1B);
(E) SITE PREPARATION WORK AT BUKIT BATOK TOWN (PHASE 5)



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ANNEX - 03

PUBLIC RELATIONS PROGRAMME **(SITE WORKS)**

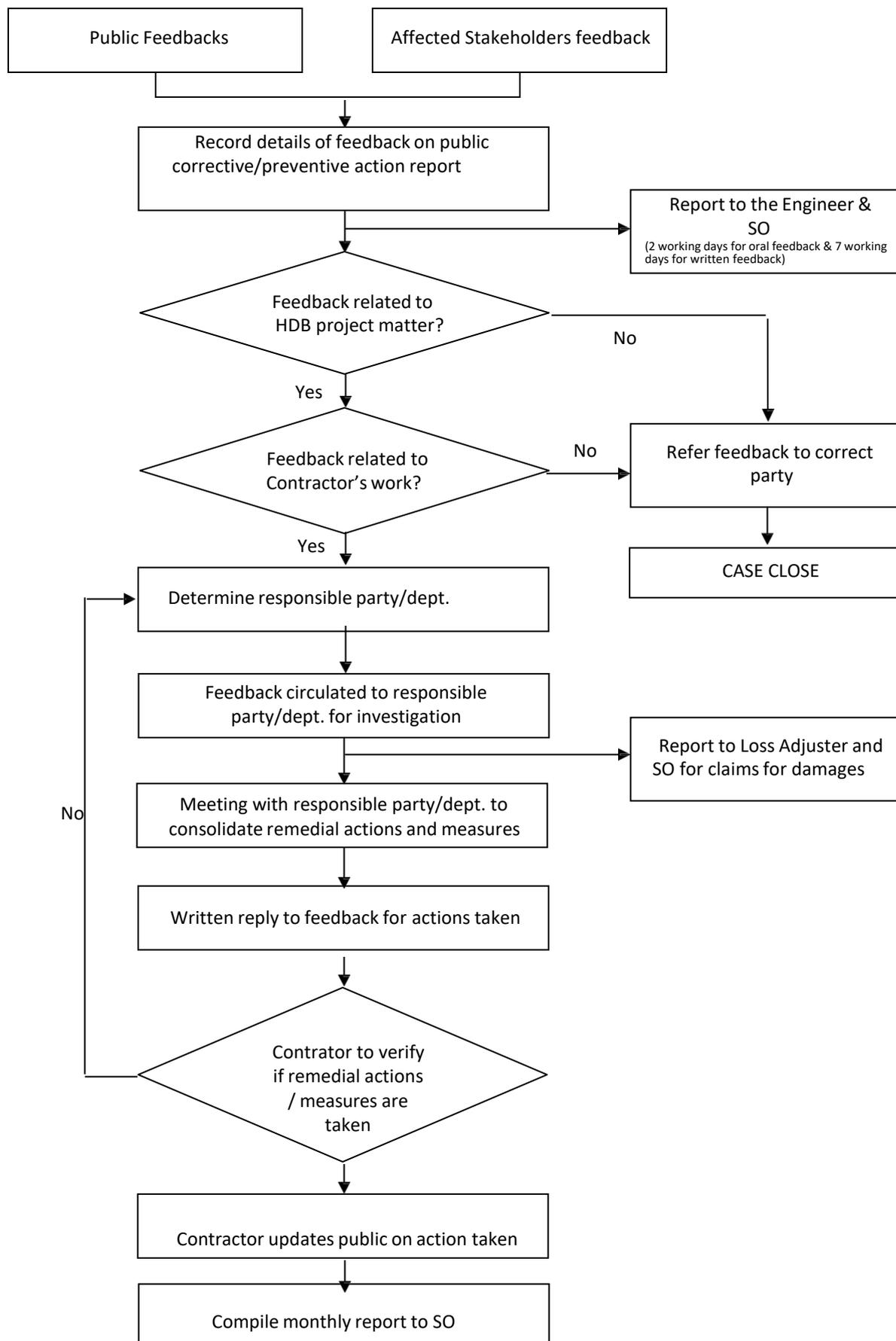
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PUBLIC RELATIONS PROGRAMME (SITE WORKS)

S/N	Works Details	Time Duration (Month)	Impact - List of stakeholders					Public Relation Mitigation Measures							
			Motorists	Nearby Residents	Commercial & Public Offices	Pedestrian	Public Transport provider	Status (Commence Period to distribute)	Notice by the roads	Flyers to Residents	Notice at HDB Blocks	LTA Website	Regular Update Meeting	Circular	Proposal for PR Strategy
a	Site preparation work	Oct 2022 – Feb 2025		√					√				√		

ANNEX - 04

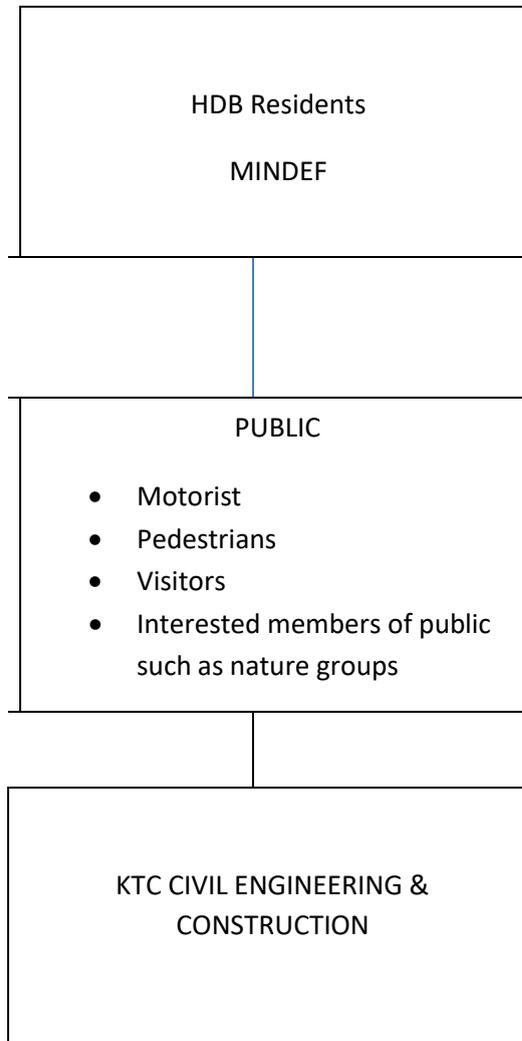
PROCEDURES FOR HANDLING PUBLIC FEEDBACK



ANNEX - 05

LIST OF STAKEHOLDERS

List of Stakeholders



ANNEX - 06

FORMS

Appendix I
Lighting Management
Plan

Lighting Management Plan During Night-time Construction Works

PURPOSE

This document outlines guidelines for the selection, placement, installation and operation of all lights during night-time construction works. Its function is to regulate the use of artificial light at night (ALAN) in the construction site in a way that prioritises the safety of staff while minimising the impact of such light on adjacent forested areas and wildlife. In general, lighting should only be deployed (1) when it is needed, (2) where it is needed, (3) in the appropriate light levels for a specific construction task, and (4) with the appropriate wildlife-friendly spectrum.

This document applies to all stages of the Construction Phase. This document also applies to all site personnel and construction activities in their execution of work for the Project.

SCOPE OF WORKS

Night works are only allowed for safety-critical works that cannot be conducted in the daytime. Night works are defined as works before and beyond the stipulated working hours of 0800 h to 1800 h.

The permission to work at night must be obtained from the relevant authorities (i.e., NParks) before night-time construction works can be carried out. The Contractor will need to craft and submit their application for works, including a works-specific lighting management plan, to the relevant Authorities for approval. The requirements set out by the authorities, if any, should be adhered to when executing night-time construction works.

GENERAL MEASURES

Prior to the start of night-time construction works, the Contractor will need to craft a works-specific lighting management plan for the works they are planning to undertake. This is to confirm the timing and implementation of the agreed works and the implementation of the lighting management measures. Night-time construction work can only commence after the lighting management plan has been agreed with the EMMP Consultants, and approval to start work from relevant authorities have been obtained.

The following general management measures will be implemented:

- The Contractor should schedule construction activities such that all works that can be carried out in the day are conducted in the day. Night-time construction works should only take place for works that cannot be conducted in the daytime (e.g., safety-critical works).
 - Night-time construction works should avoid the peak breeding periods for resident birds (March to July).
- The Contractor should prepare a works-specific lighting management plan, which describes (1) site lighting plan, (2) light monitoring plan for the night-time construction works, and (3) the relevant construction method statements. These should be reviewed by the EMMP Consultant before works begin, and when necessary (e.g., when there are major changes to the lighting plan).
- The Contractor should conduct light monitoring prior to night works to establish baseline light levels.

- A dedicated briefing for night works should be conducted for staff involved in the night works before the works begin, to educate staff on safety measures, and wildlife response.
- The EMMP Consultant will be on call, and will be notified immediately should any fauna incidences occur during the night works.

LIGHTING MANAGEMENT MEASURES

The level of lighting provided should be just sufficient to perform the construction or maintenance task, while still catering for safety and security purposes. There should be no over-provisioning of lighting, excessive light spillage to the surrounding establishments and forested areas should be minimised, to reduce impact to humans, and disturbances to environmentally sensitive receivers. In general, lighting should only be deployed (1) when it is strictly needed; (2) where it is needed; (3) in the appropriate amount for a specific task; and (4) with the appropriate spectrum.

The Contractor should incorporate or practice the following measures:

- For lighting equipment, consider:
 - Using warm lighting where possible during construction works after 1800 h (i.e., soft white and warm white light bulbs, preferably at < 2,700 K).
 - Avoid using high UV and broad-spectrum lights (except for safety reasons).
- Minimise light spillage into adjacent sensitive areas, by ensuring the following, when safe to do so:
 - Ensure that lighting is only used where really necessary; worksite to remain dark as much as possible.
 - Ensure that no light sources are directly visible from the forest edge as much as possible.
 - Ensure that lighting used for construction works are pointed away from forested areas and directed downwards as much as possible to prevent any disturbance to wildlife.
 - Ensure that lighting used for construction works are directed/placed such that there is no unintended reflection of light towards the nature areas.
 - If necessary, temporary enclosures / barriers will be erected at the work area to reduce light spillage.
 - An opaque hoarding/screen should be installed at the Project/night works area adjacent to forested areas in order to reduce light spillage and to prevent wildlife from entering the worksite.
 - During indoor construction works, keep windows and doors closed, and/or seal windows or openings, especially those facing forested areas, with acoustic sheets at designated worksites to prevent light spillage out of the building (and provide screening effects to noise generated from the construction works).
 - When doors and/or windows are opened for the safety of workers using welding tools or during other works requiring ventilation (e.g., painting, wallpapering, etc.), it is recommended that tarps be very loosely fitted around openings to reduce artificial light from escaping buildings while still allowing for sufficient air flow.
 - Use light attenuating structures and/or materials (e.g., curtains, tarps, blackout coverings, etc.) to cover glass walls as well as windows and doorways in rooms where construction activities are being carried out.
 - Ensure temporary lighting equipment is turned off when not in use, when safe to do so, and after the end of night works.

- For emergency situations, such as life safety, construction safety and health hazard, rescue operations and securing the safety of the site and personnel is paramount. All available lights & equipment will be used for rescue operations.
- If possible, restrict outdoor movements by workers to use of designated sanitary facilities (or in the case of an emergency, evacuation from buildings). When workers step outside of buildings, flashlights/headlamps for walking to and from sanitary facilities for safety purposes will be kept pointed towards the ground and away from forested areas.
- Light monitoring will be conducted using a light meter to monitor and document light levels around the worksite once every night during the night works. In areas where light levels exceed that of the baseline light levels, the site lighting plan should be reviewed to reduce light levels.
- If there are any wildlife encounters during night works (e.g., trapped, injured and dead birds by the site lighting), the Wildlife Response Plan should be activated.

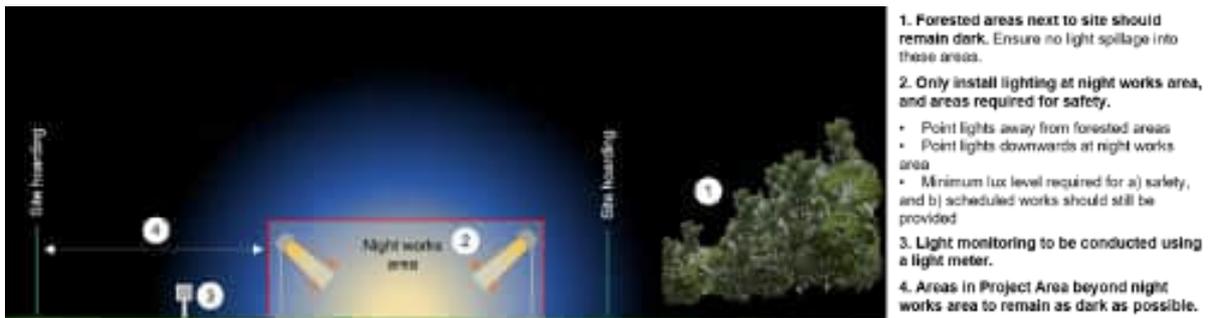


Figure 1 Summary of key lighting management measures within a construction setting.

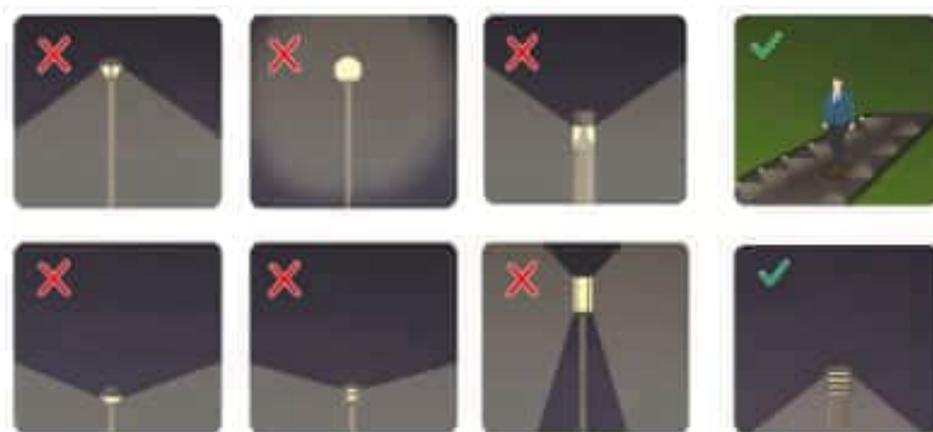


Figure 2 Lighting should be directed to ensure only the intended area is lit (figures adapted from Witherington & Martin 2003).

SAFETY AND RISK

Risk assessment and standard work procedures will be conducted/developed prior to the start of night works. The Contractor will follow the processes highlighted in the Emergency Response Plan of the Environmental Management and Monitoring Plan.

In case of any wildlife encounters, the Wildlife Response Plan will be adhered to, similar to daytime works.

REFERENCES

Witherington BE & Martin RE (2003) Understanding, assessing, and resolving light-pollution problems on sea turtle nesting beaches. Florida Marine Research Institute.

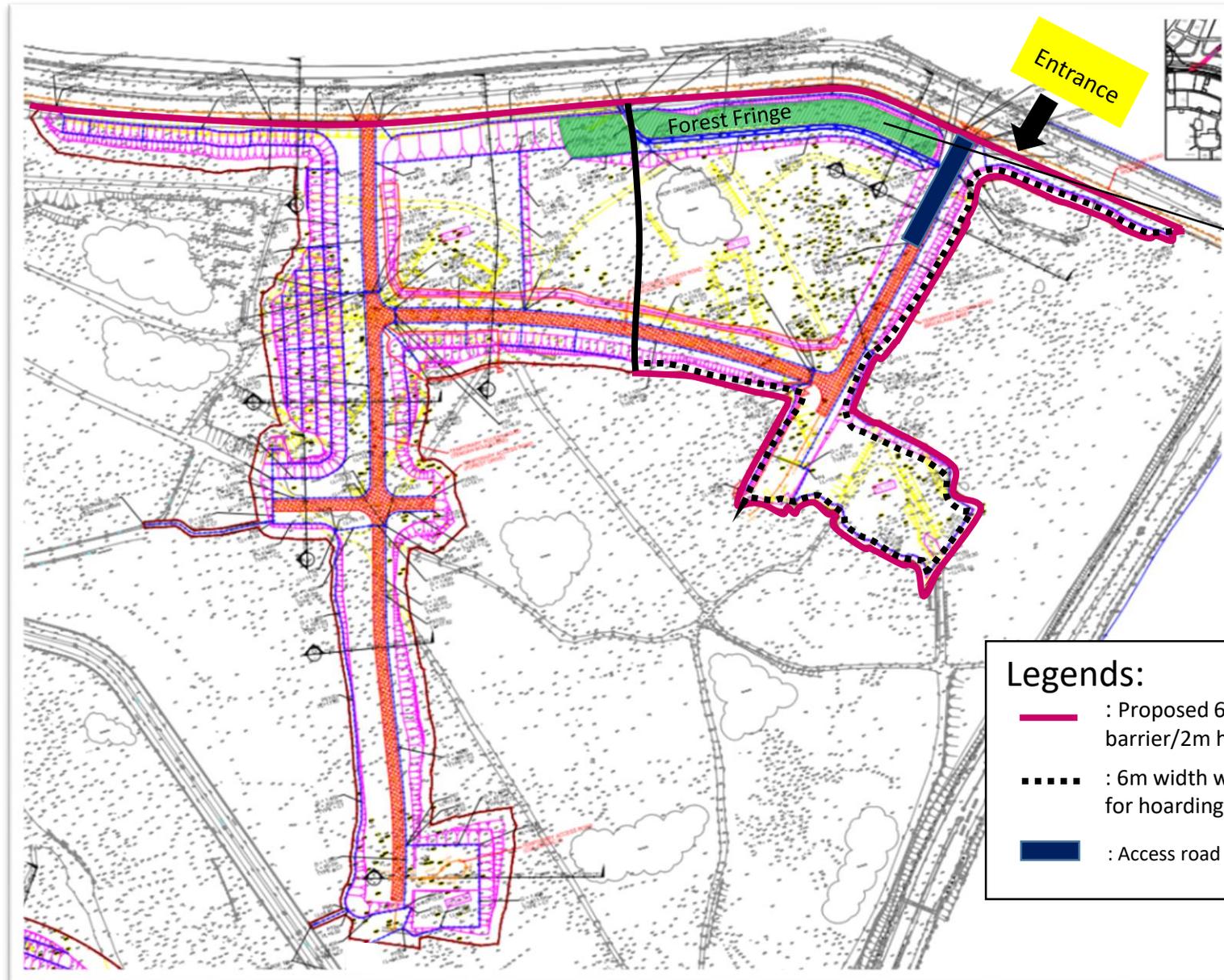
Appendix J
Hoarding Plan

D/336/22

**Hoarding Plan for Tengah Phase 3
Update**



Phase 3A- Step 1: Install 6m noise barrier/ 2m hoarding along the boundaries

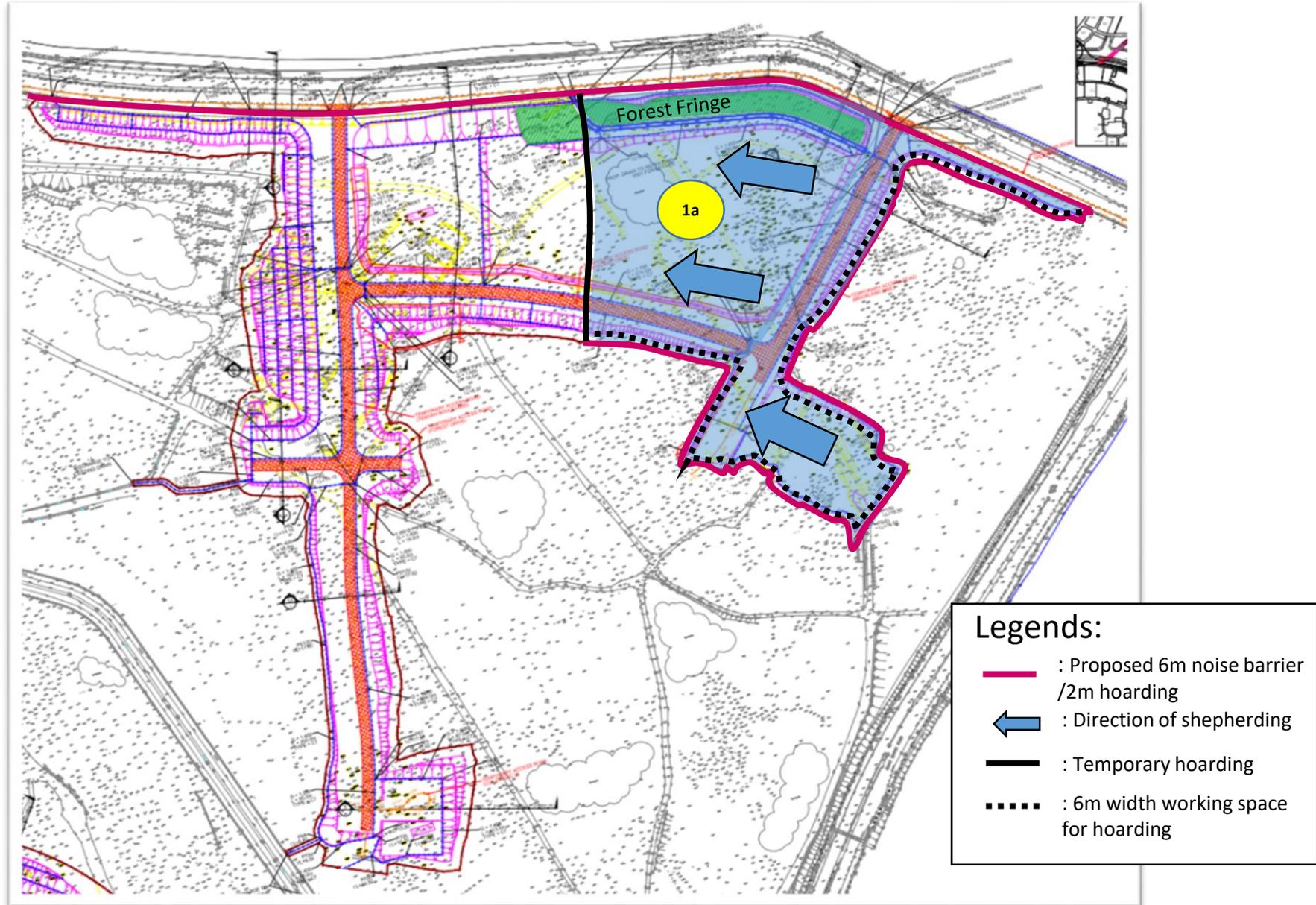


As per last meeting with Nparks on 16th Dec 22, the platform level of forest fringe will be cut down. Therefore no need provide any TPZ.

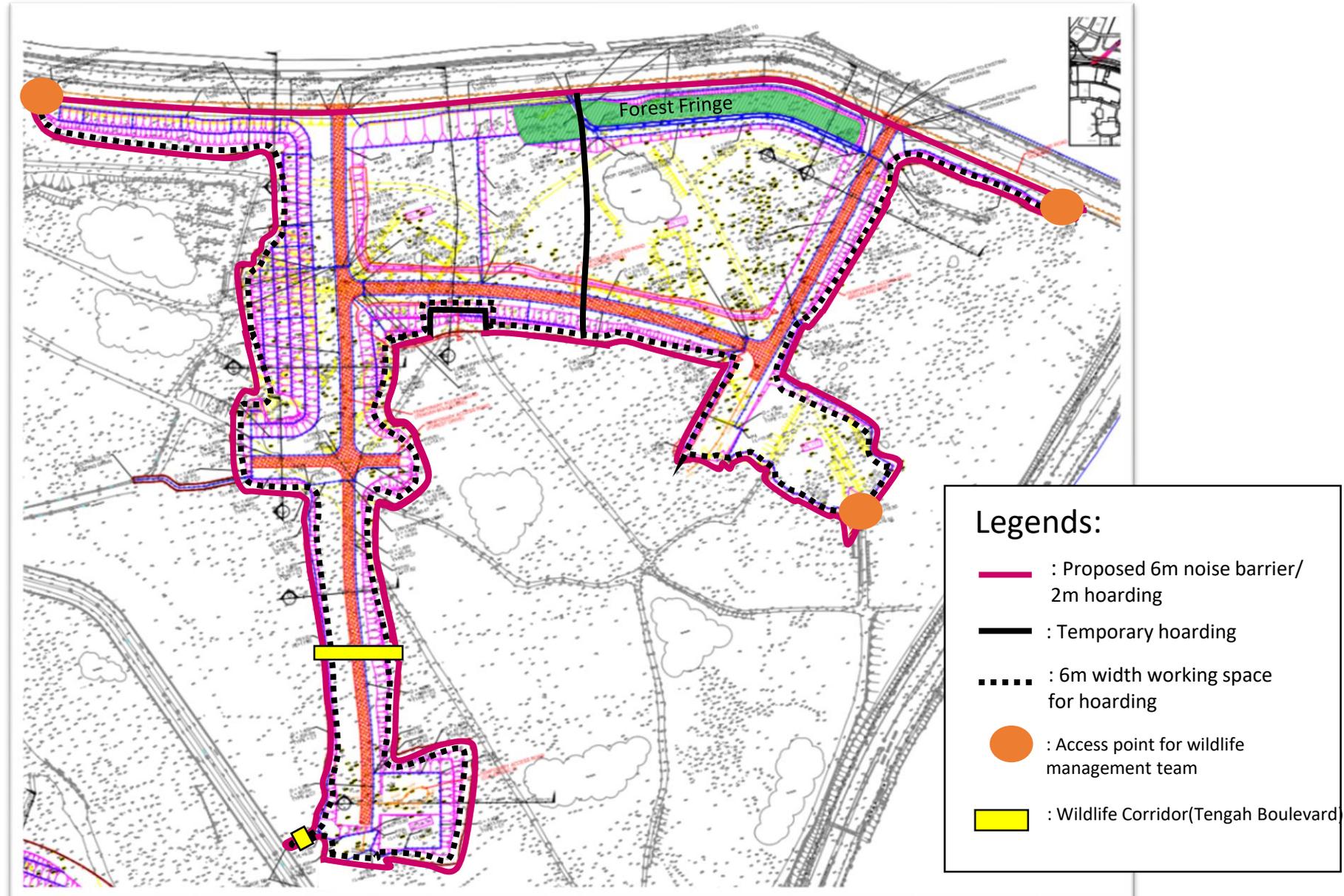
Legends:

- : Proposed 6m noise barrier/2m hoarding
- - - - : 6m width working space for hoarding
- : Access road

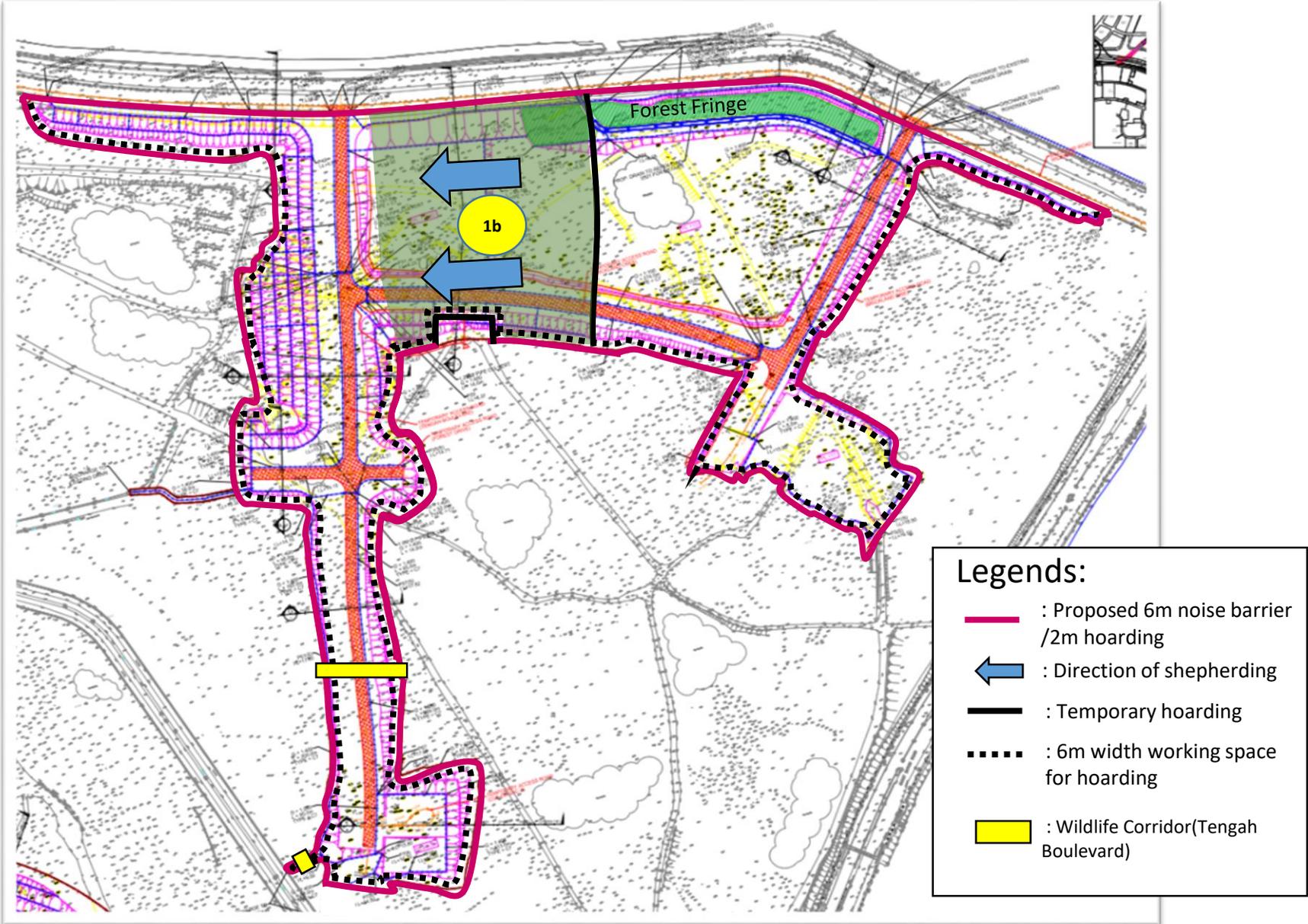
Phase 3A- Step 2: Site clearance and shepherding zone 1a (Timeline for shepherding: 30days)



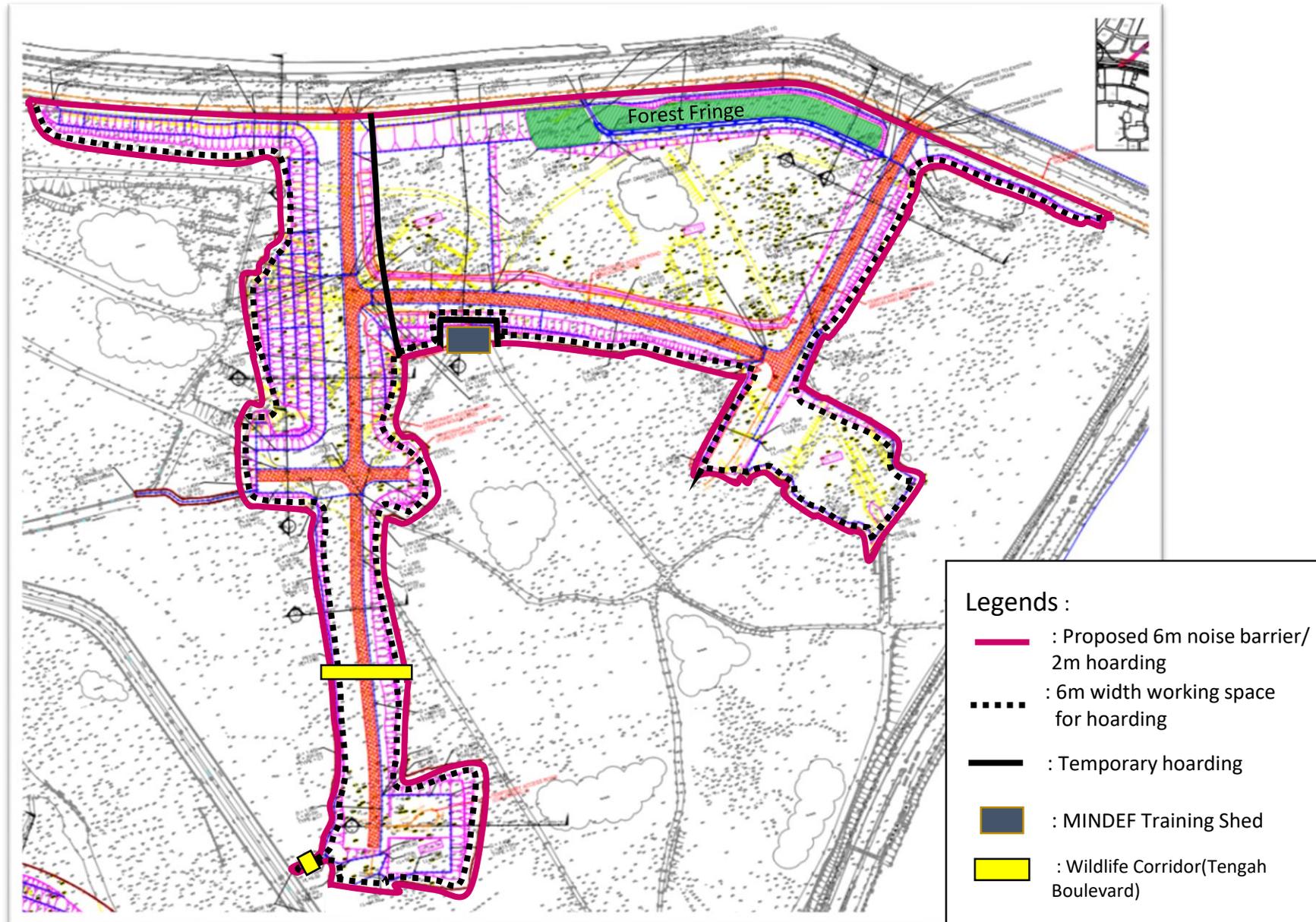
Phase 3A- Step 3: Hoard up entire boundaries with 6m noise barrier/ 2m hoarding and temporary hoarding



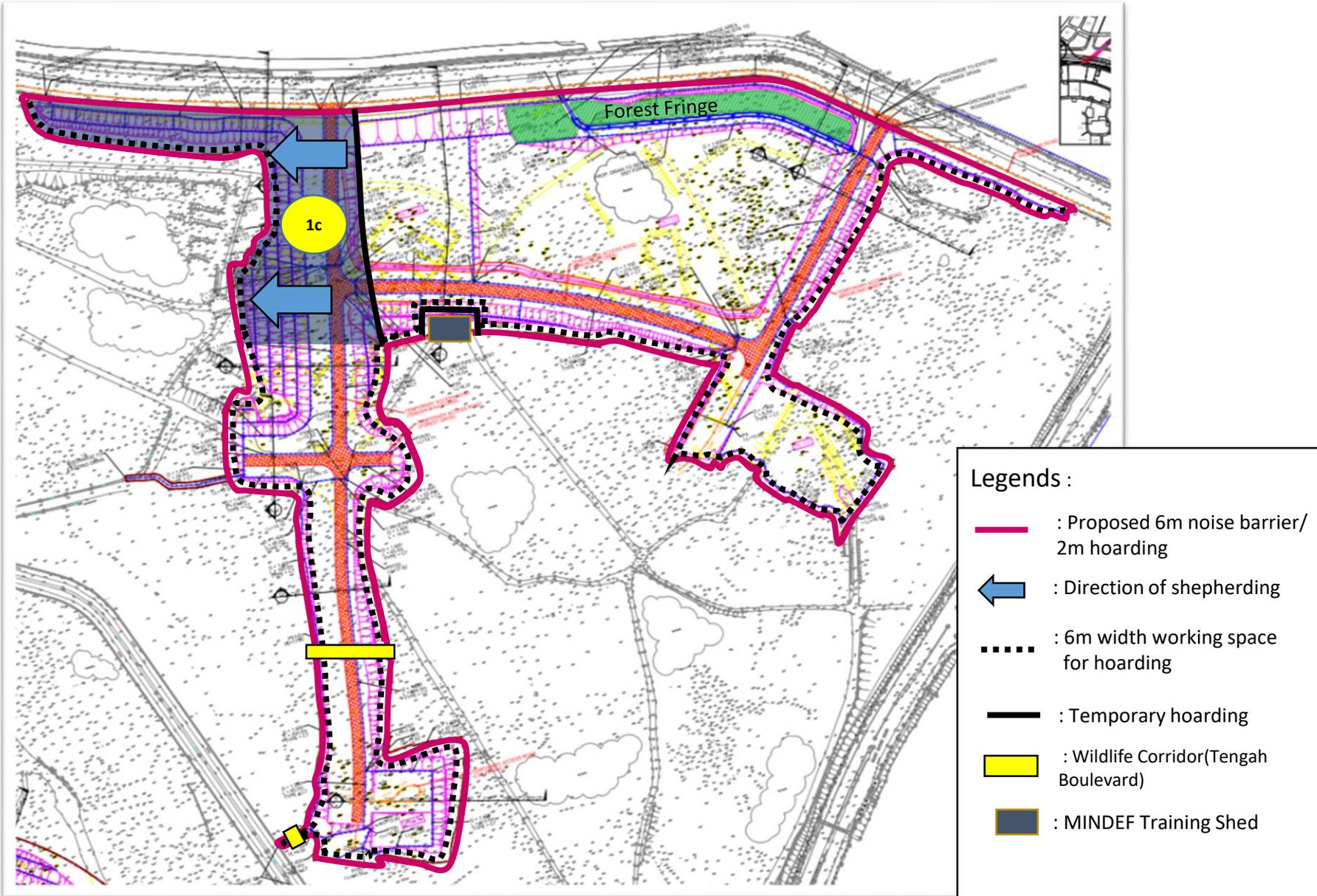
Phase 3A- Step 4: Site clearance and shepherding zone 1b (Timeline for shepherding:19days)



Phase 3A- Step 5: Install temporary hoarding

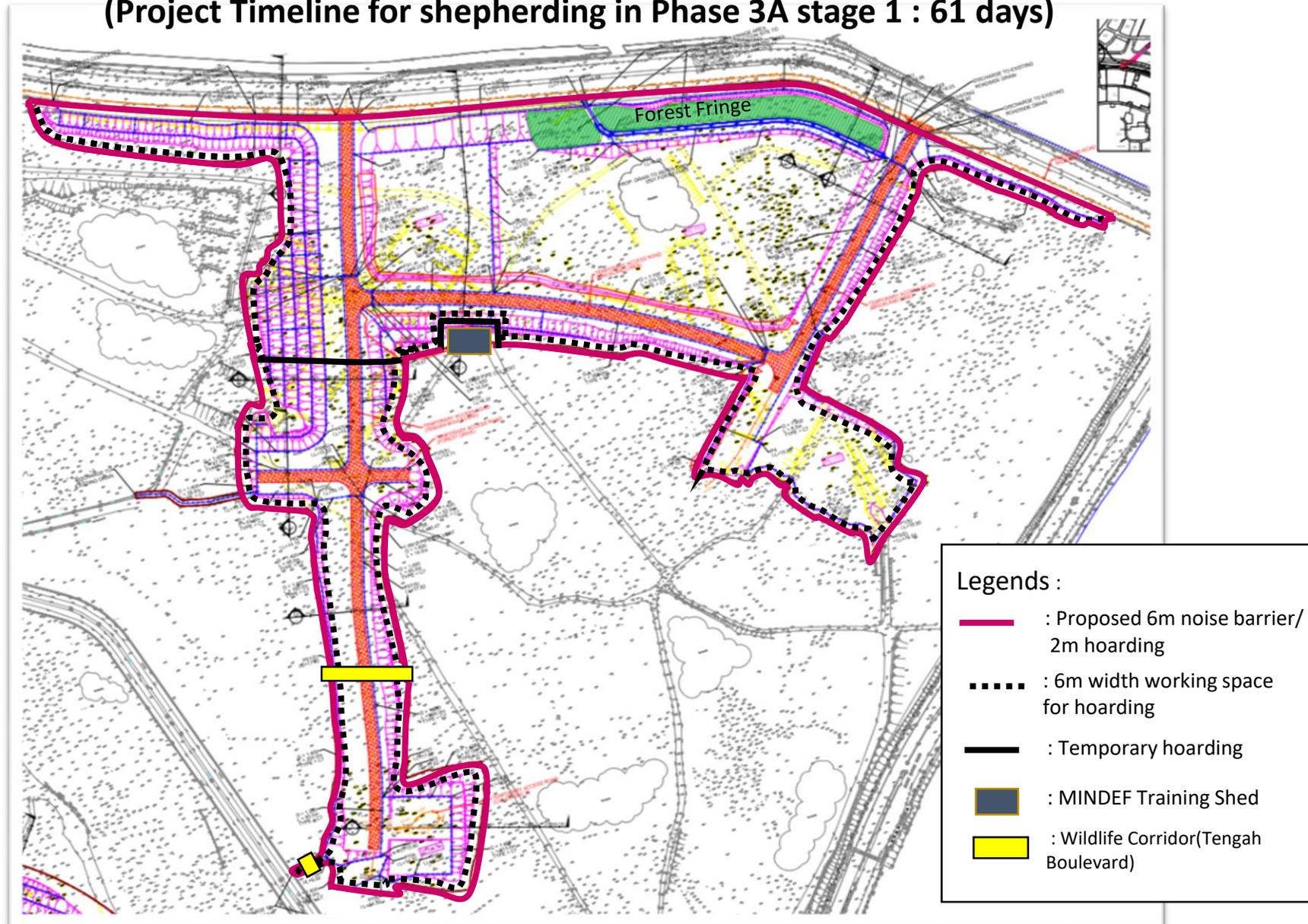


Phase 3A- Step 6: Site clearance and shepherding zone 1c (Timeline for shepherding:12days)

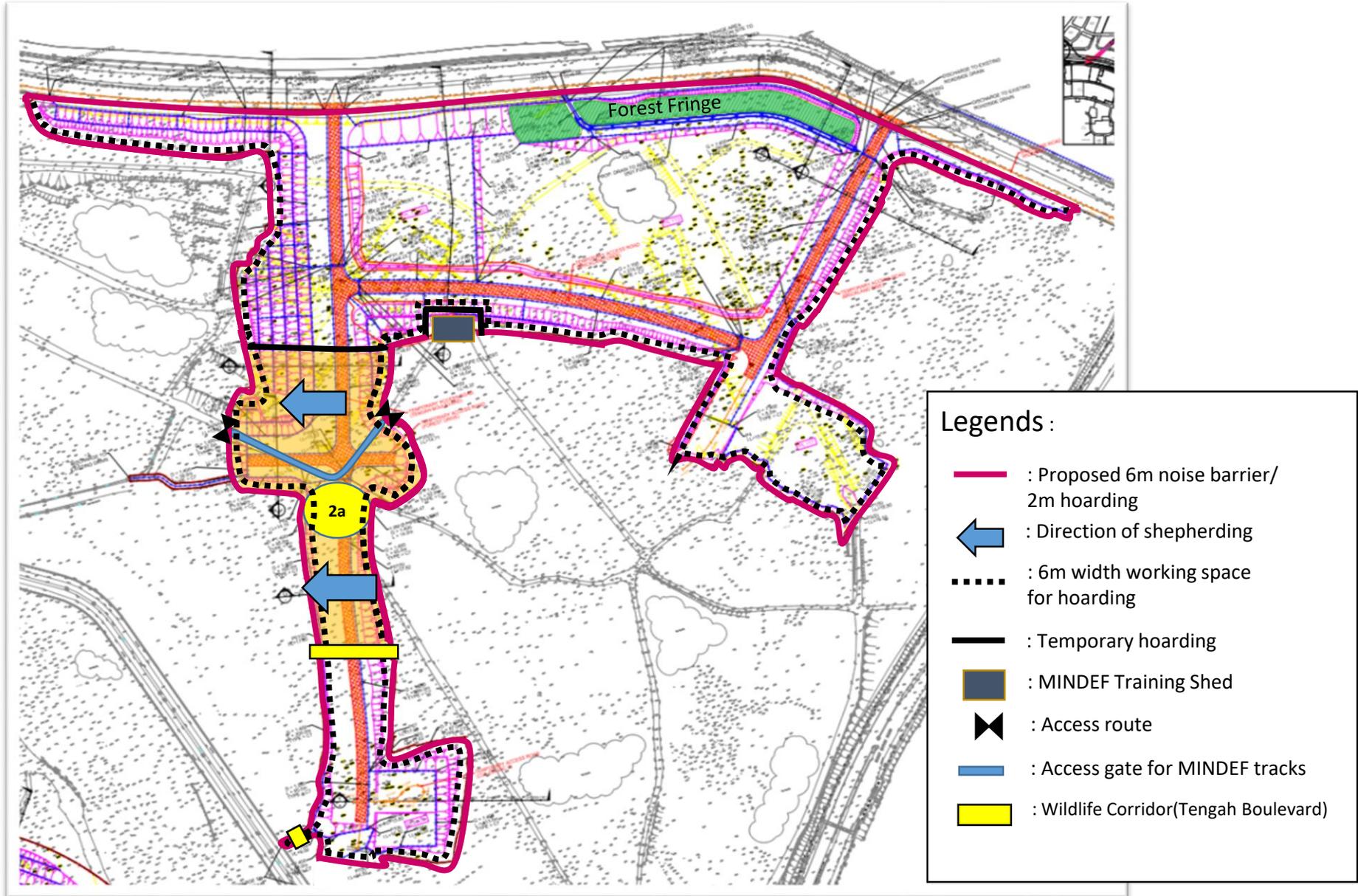


Phase 3A- Step 7: Install temporary hoarding

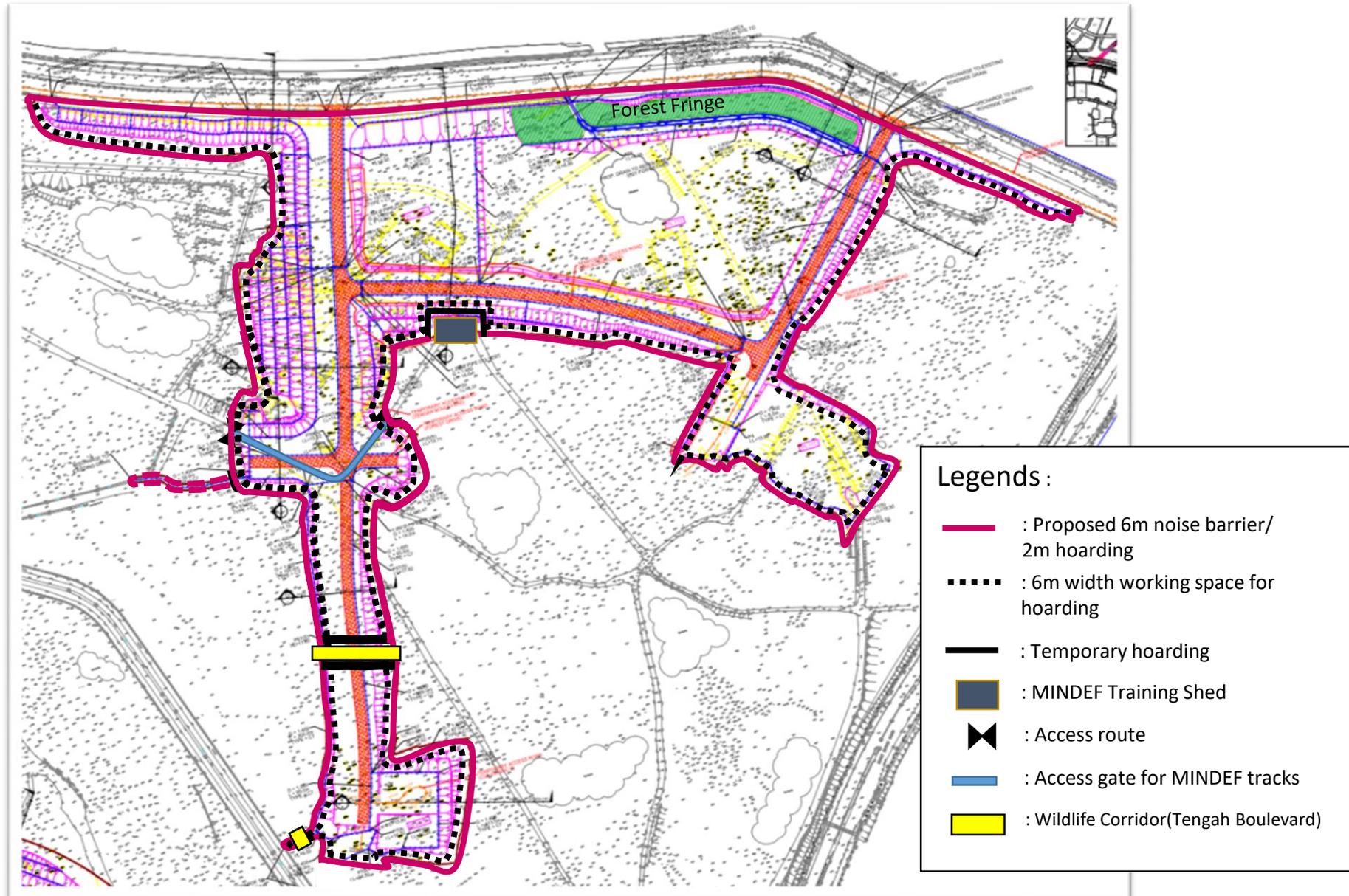
(Project Timeline for shepherding in Phase 3A stage 1 : 61 days)



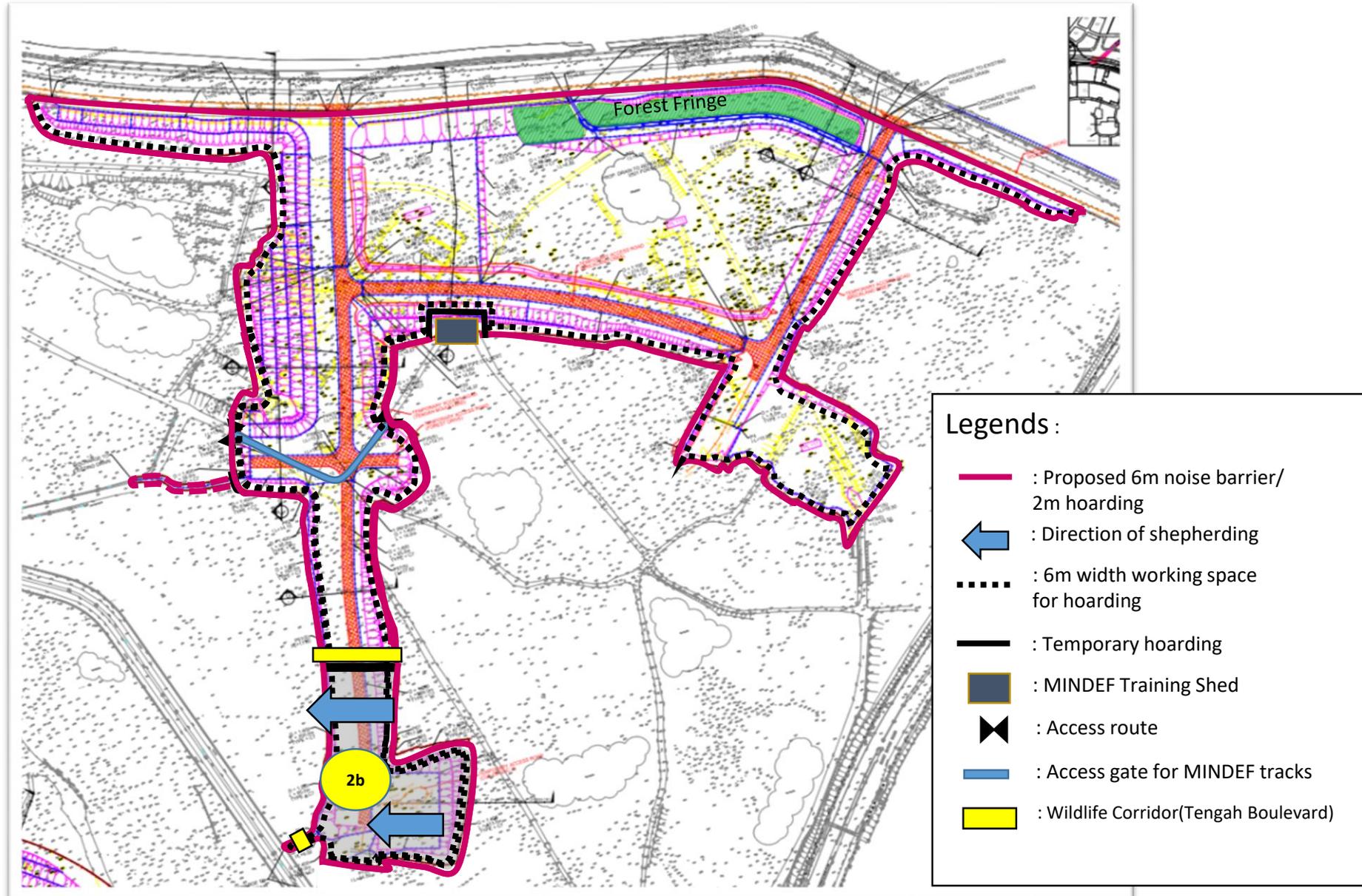
Phase 3A- Step 8: Site clearance and shepherding zone 2a (Timeline for shepherding: 13days)



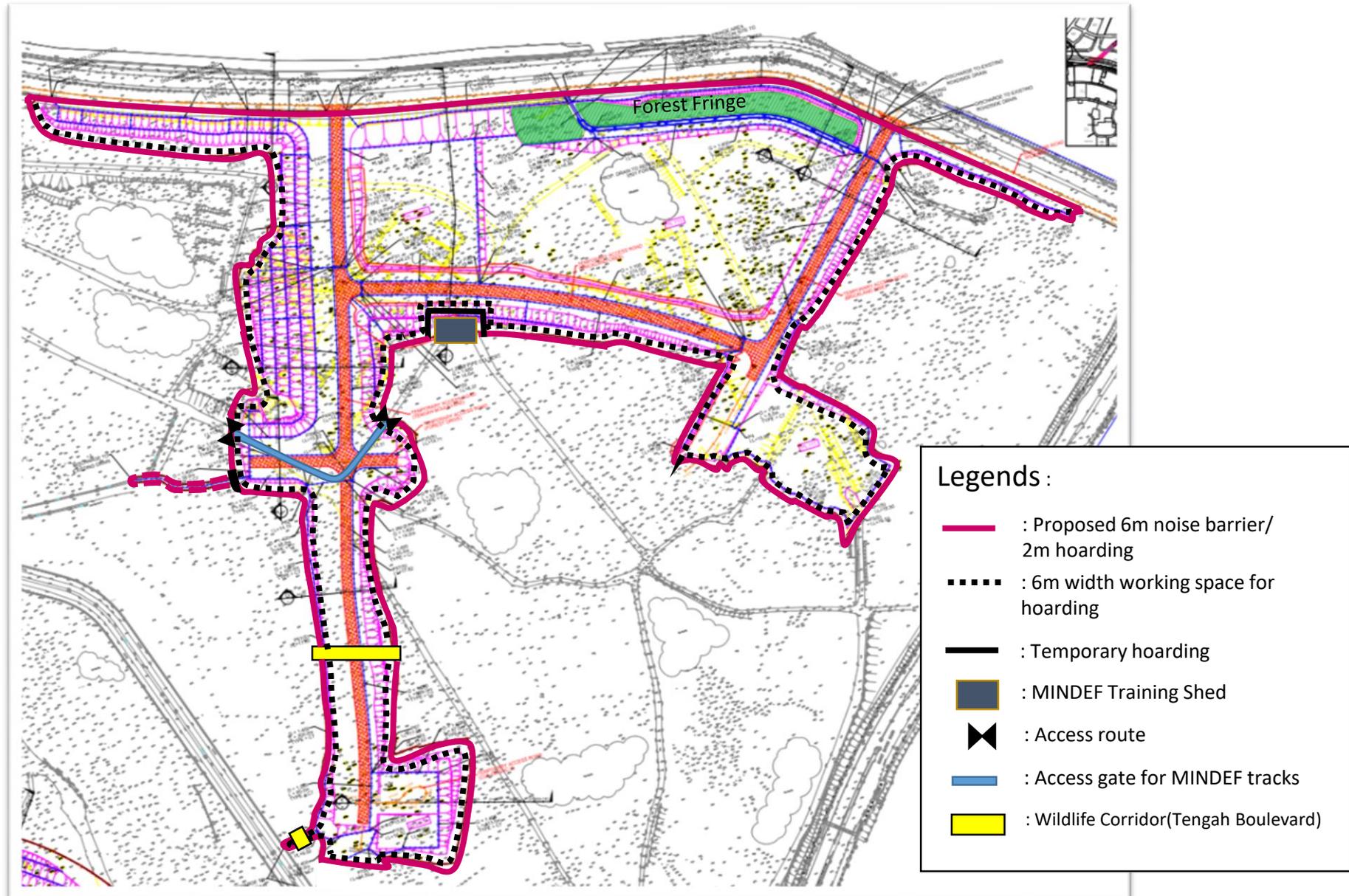
Phase 3A- Step 9: Install temporary hoarding



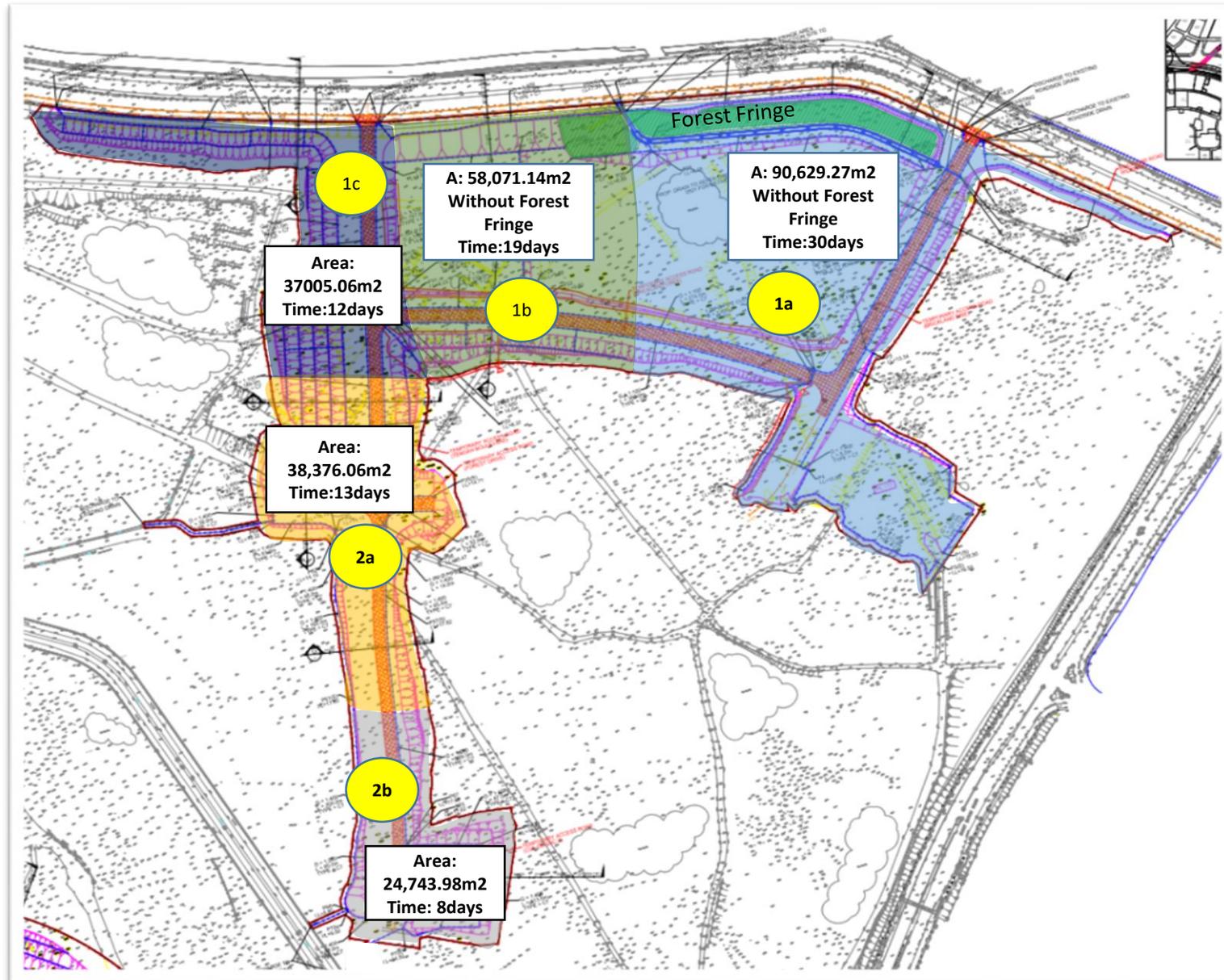
Phase 3A- Step 10: Site clearance and shepherding zone 2b (Timeline for shepherding: 8days)



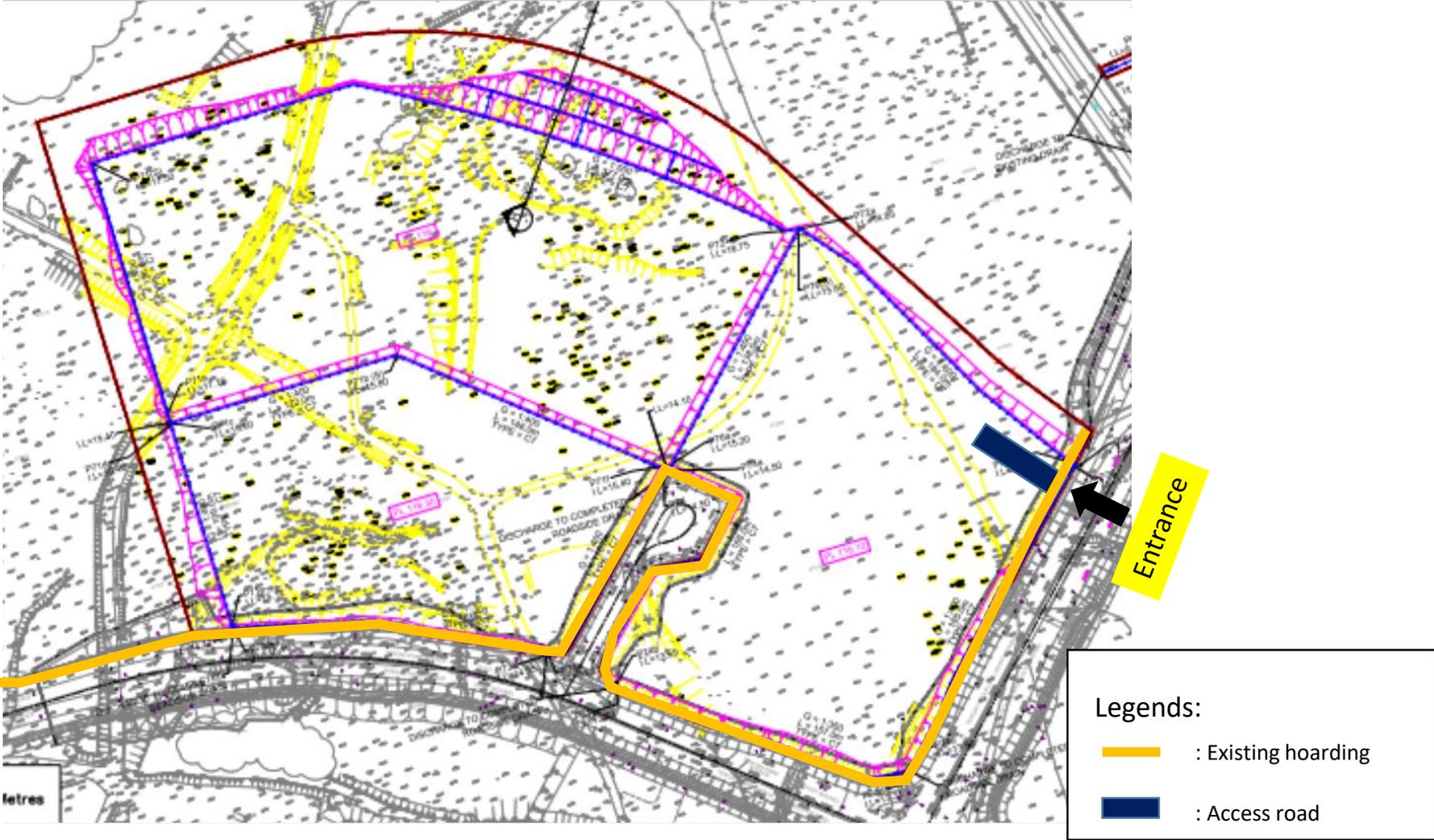
Phase 3A (Project timeline for shepherding in Phase 3A stage 2: 21days)



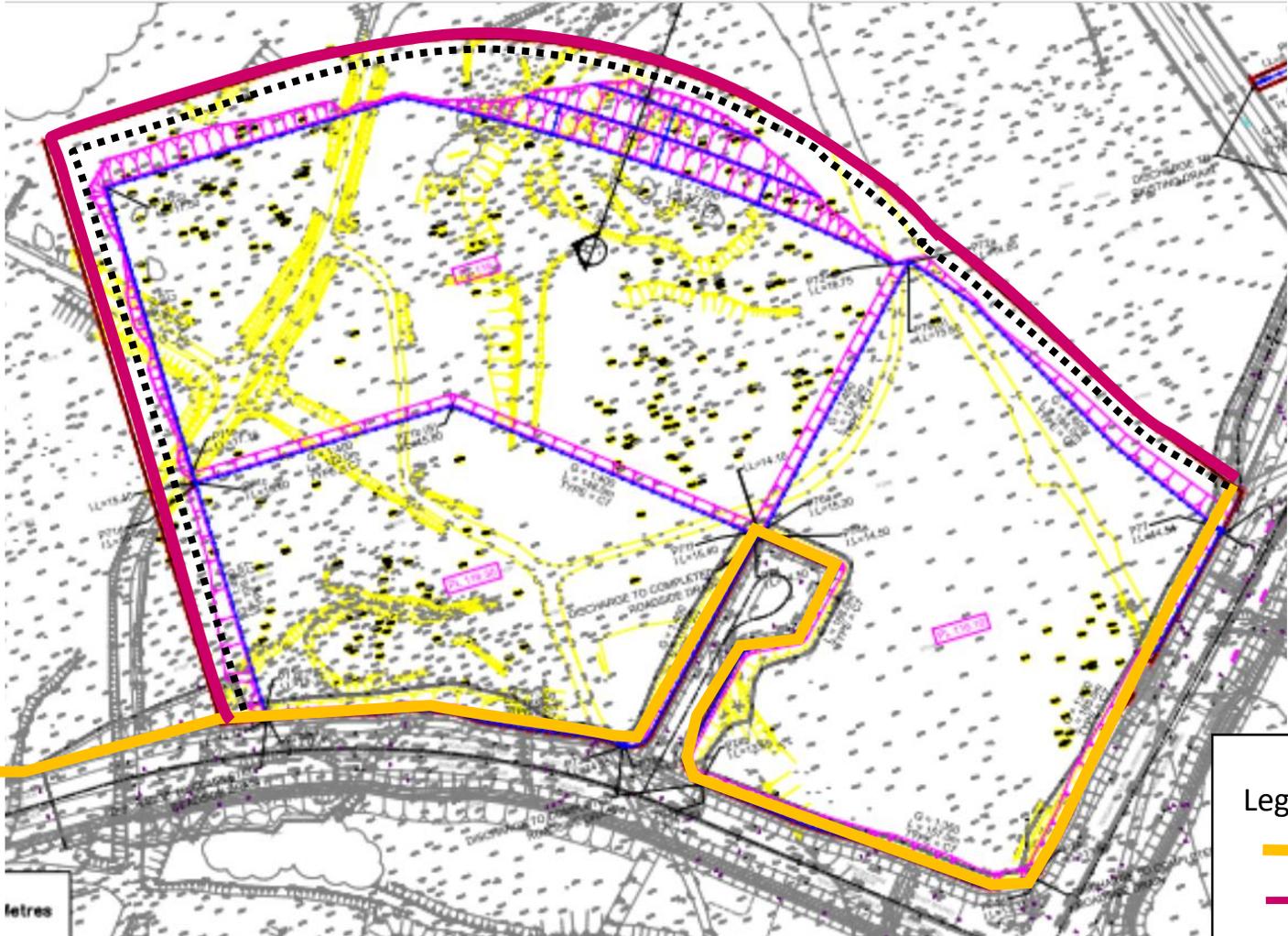
Site Clearance Zone - Phase 3A (Stage 1&2)



Phase 3B- Step 1: Check existing hoarding



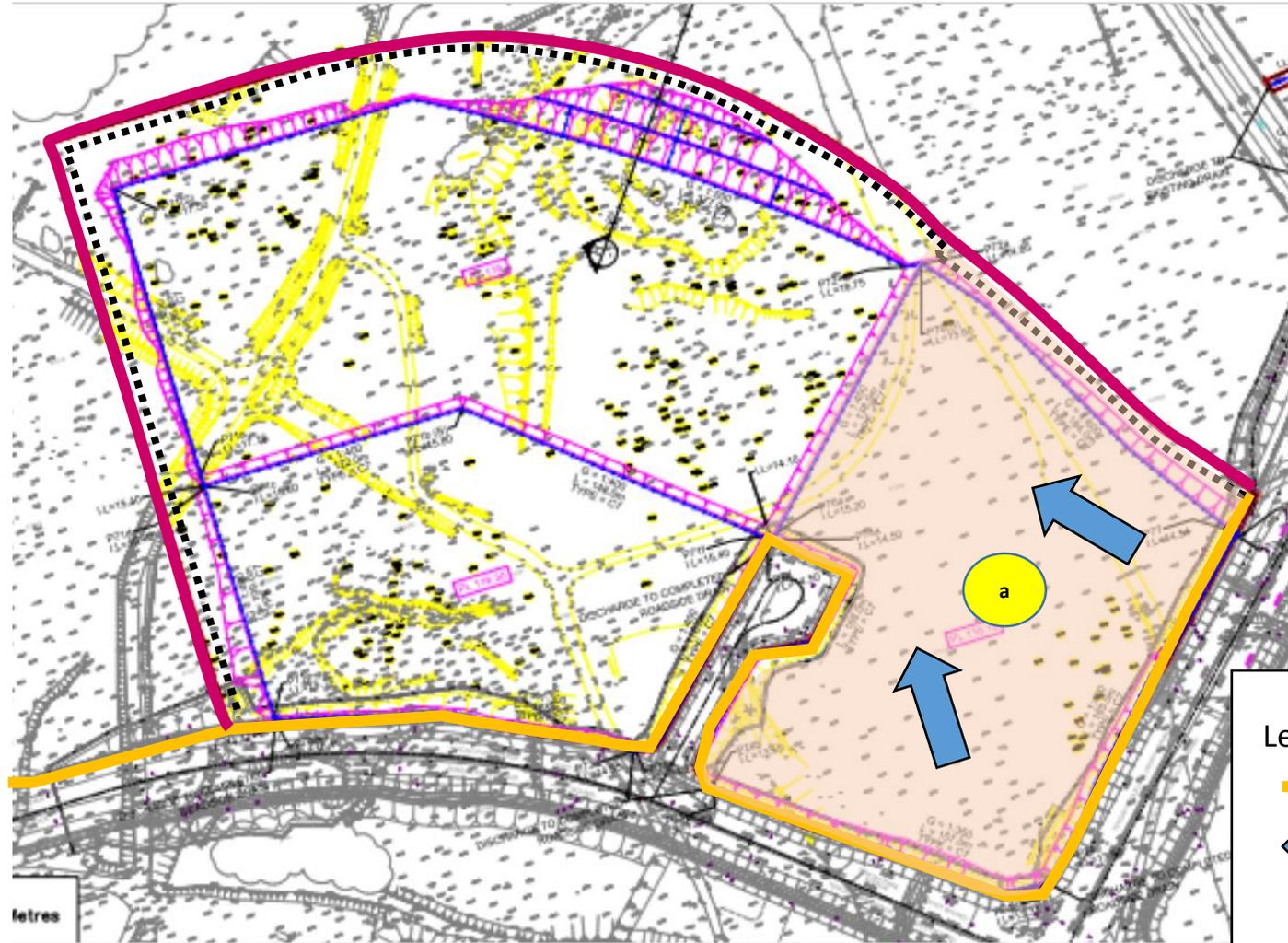
Phase 3B- Step 1: Install 6m noise barrier/ 2m hoarding along the boundaries



Legends:

-  : Existing hoarding
-  : Proposed 6m noise barrier/ 2m hoarding
-  : 6m width working space for hoarding

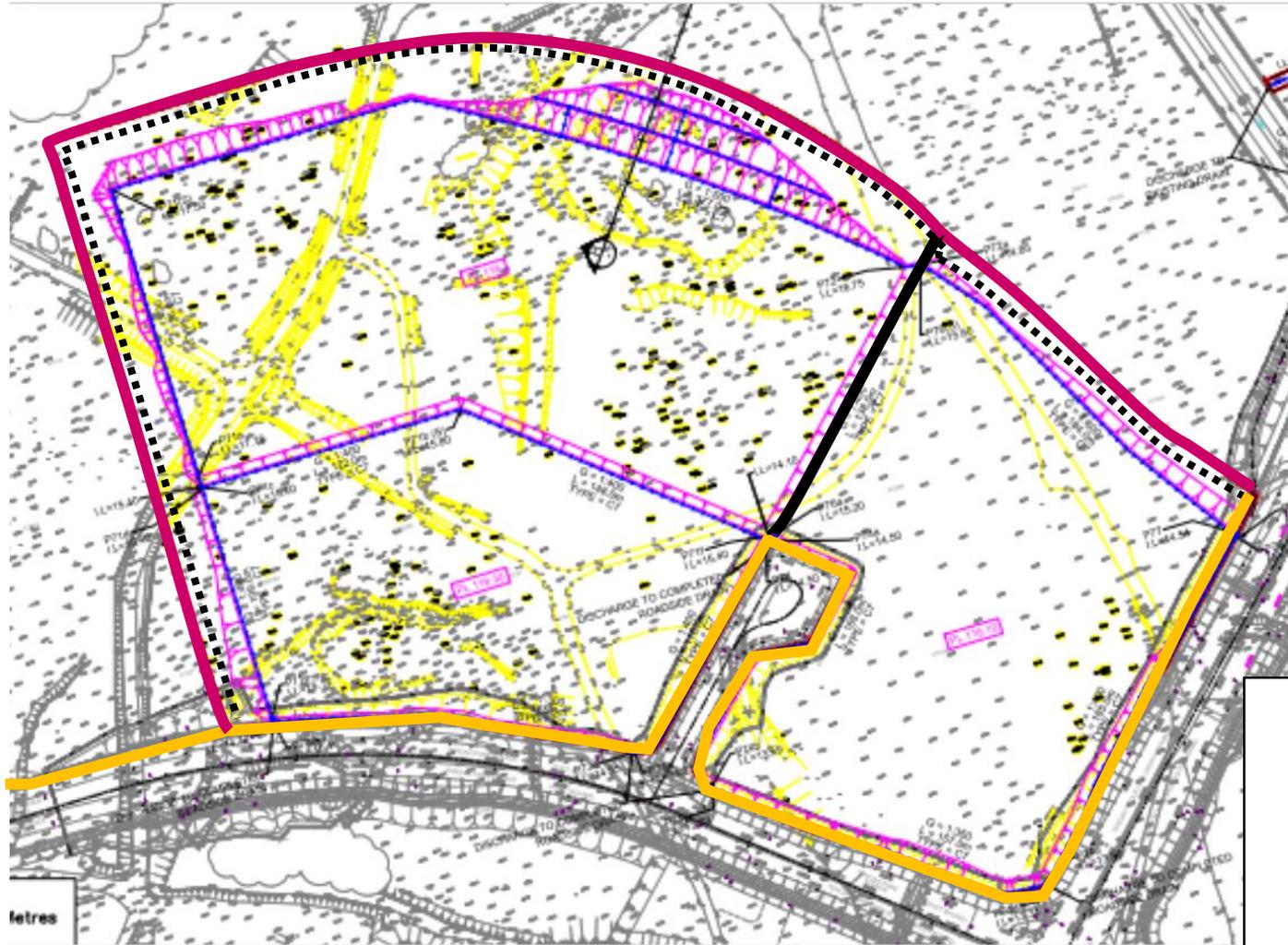
Phase 3B- Step 2: Site clearance and shepherding zone 1a (Timeline for shepherding: 14days)



Legends:

-  : Existing hoarding
-  : Direction of shepherding
-  : 6m width working space for hoarding
-  : Proposed 6m noise barrier/ 2m hoarding

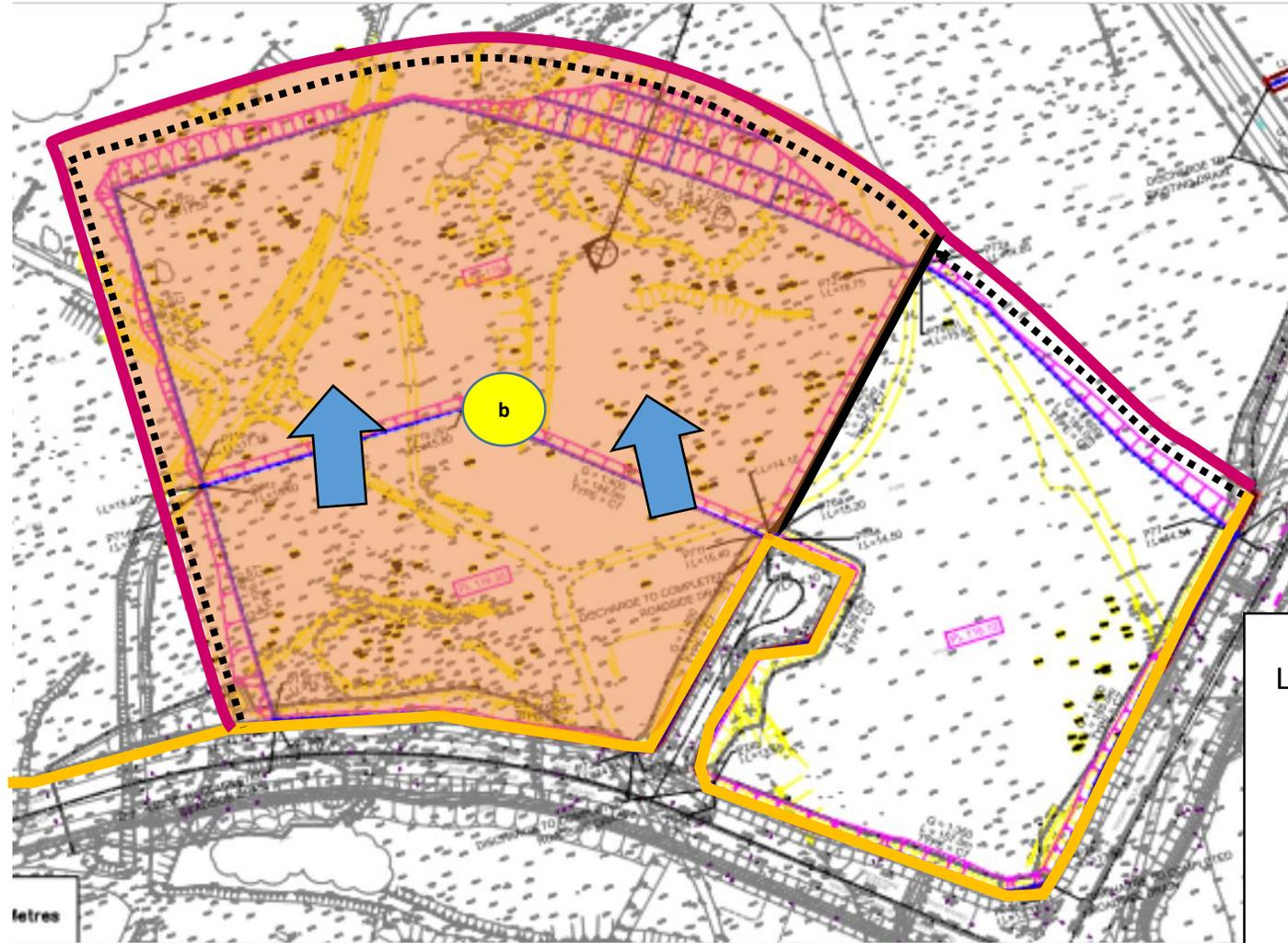
Phase 3B- Step 3: Install temporary hoarding



Legends:

- : Existing hoarding
- : 6m width working space for hoarding
- : Proposed 6m noise barrier/ 2m hoarding
- : Temporary hoarding

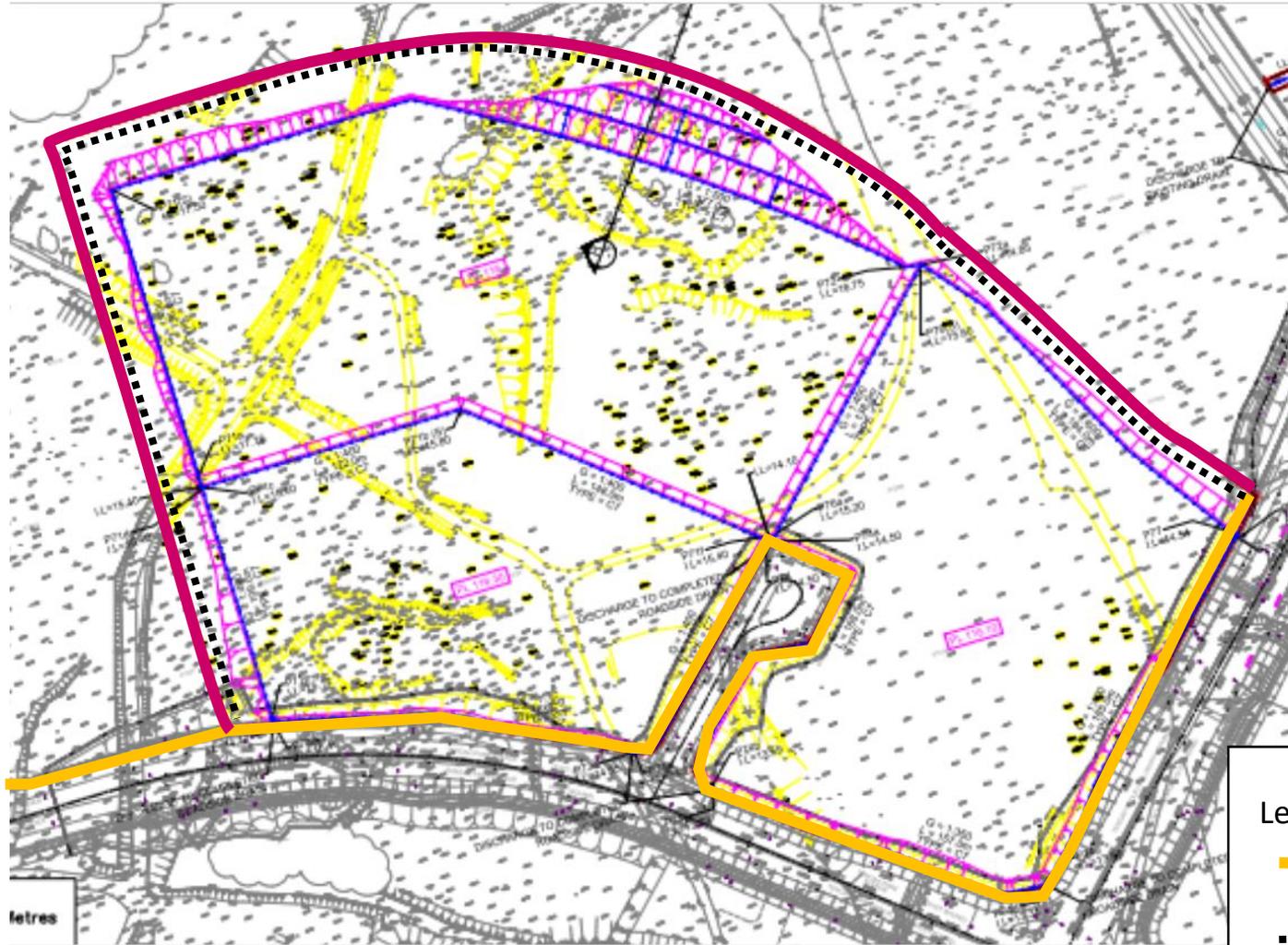
Phase 3B- Step 4: Site clearance and shepherding zone 1b (Timeline for shepherding: 31 days)



Legends:

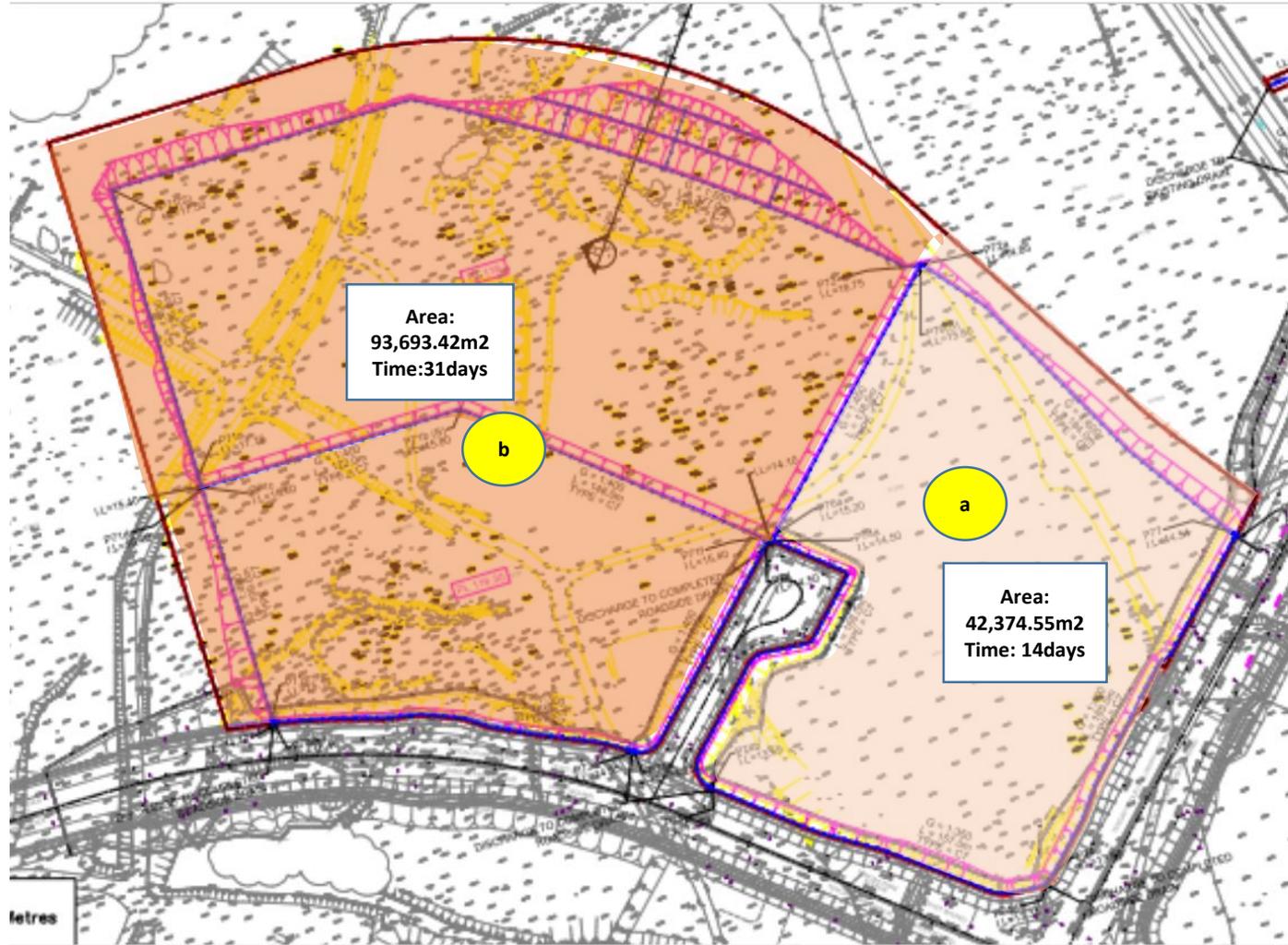
-  : Existing hoarding
-  : Direction of shepherding
-  : 6m width working space for hoarding
-  : Proposed 6m noise barrier/ 2m hoarding
-  : Temporary hoarding

Phase 3B (Project Timeline for shepherding in Phase 3B: 45days)



- Legends:
-  : Existing hoarding
 -  : 6m width working space for hoarding
 -  : Proposed 6m noise barrier

Site Clearance Zone - Phase 3B



Hoarding – 6m High Noise Barrier

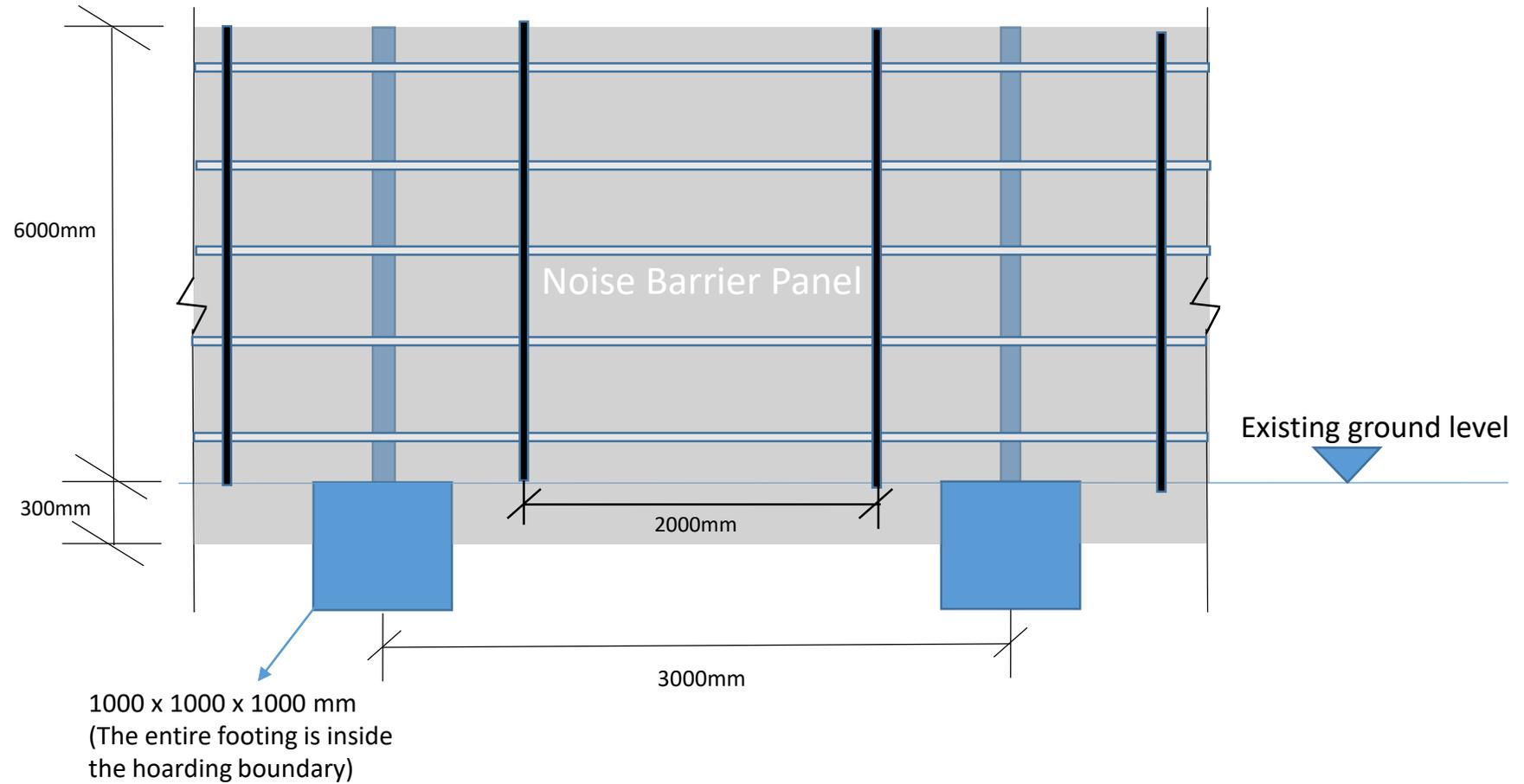
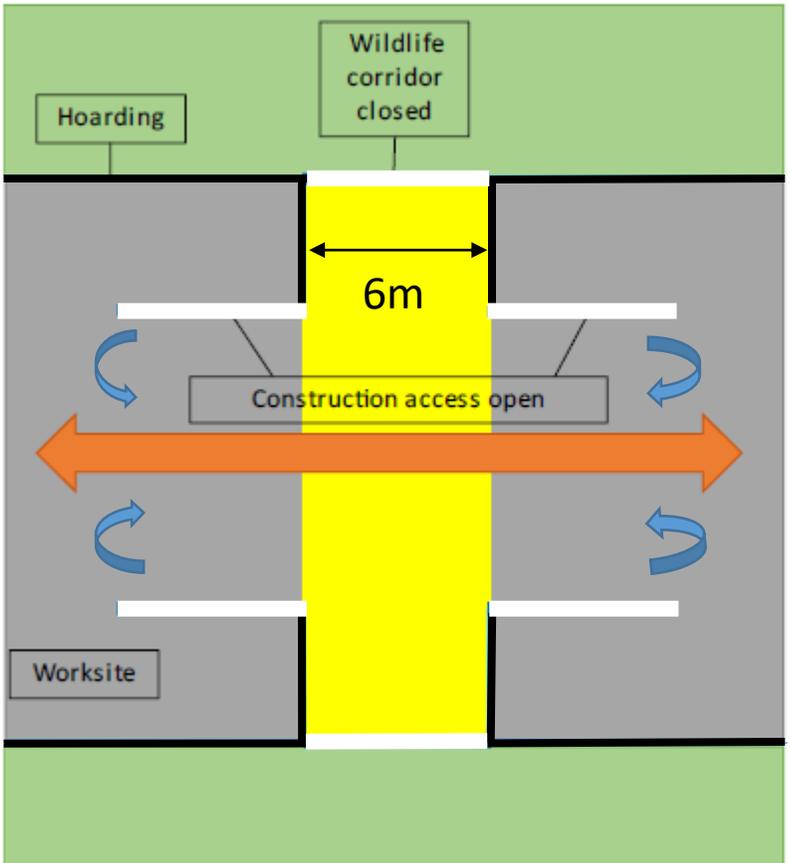
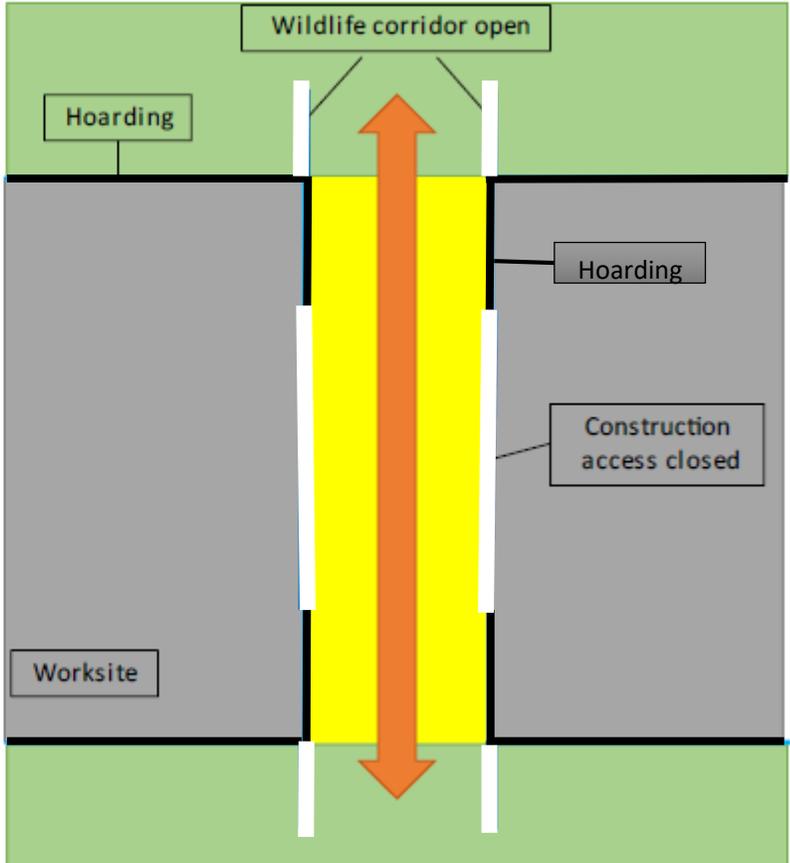


Diagram of Wildlife Corridor 6m Wide

During construction hours



After construction hours



Legends:

-  : Barricade fencing
-  : Hoarding

KTC Wildlife Corridor Barricade Fencing & Temporary Hoarding



KTC will use 2 types of temporary hoarding

- i) Yellow barricade with plastic sheet in flat surface.
- ii) 1.8m height temporary metal sheet hoarding in terrain.

Appendix K
Earth Control Measures
Plan

BUILDING AND CONSTRUCTION AUTHORITY
 JERUSALEM (AREA 5000) & P.O. BOX
 9000 JERUSALEM 4520010

Project Ref. No : E.3478-01026-2022
 E.3478-01026-2022
 E.3478-01027-2022

for Consideration of Building Control

FOR APPROVAL

REV	DATE	NAME	SUBJECT	CHK'D

Town of Land:
 THIS DRAWING IS COPYRIGHT
 © 2022



ARCHITECT:

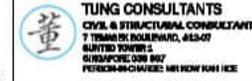
CONTRACTOR:
 KTC CIVIL, ENGINEERING & CONSTRUCTION PTE LTD
 PERSON IN CHARGE: MR. HUSAIN WAFIQ

PROJECT TITLE:
[REDACTED]

LOT NO. 1	MAXIMUM NO. 1

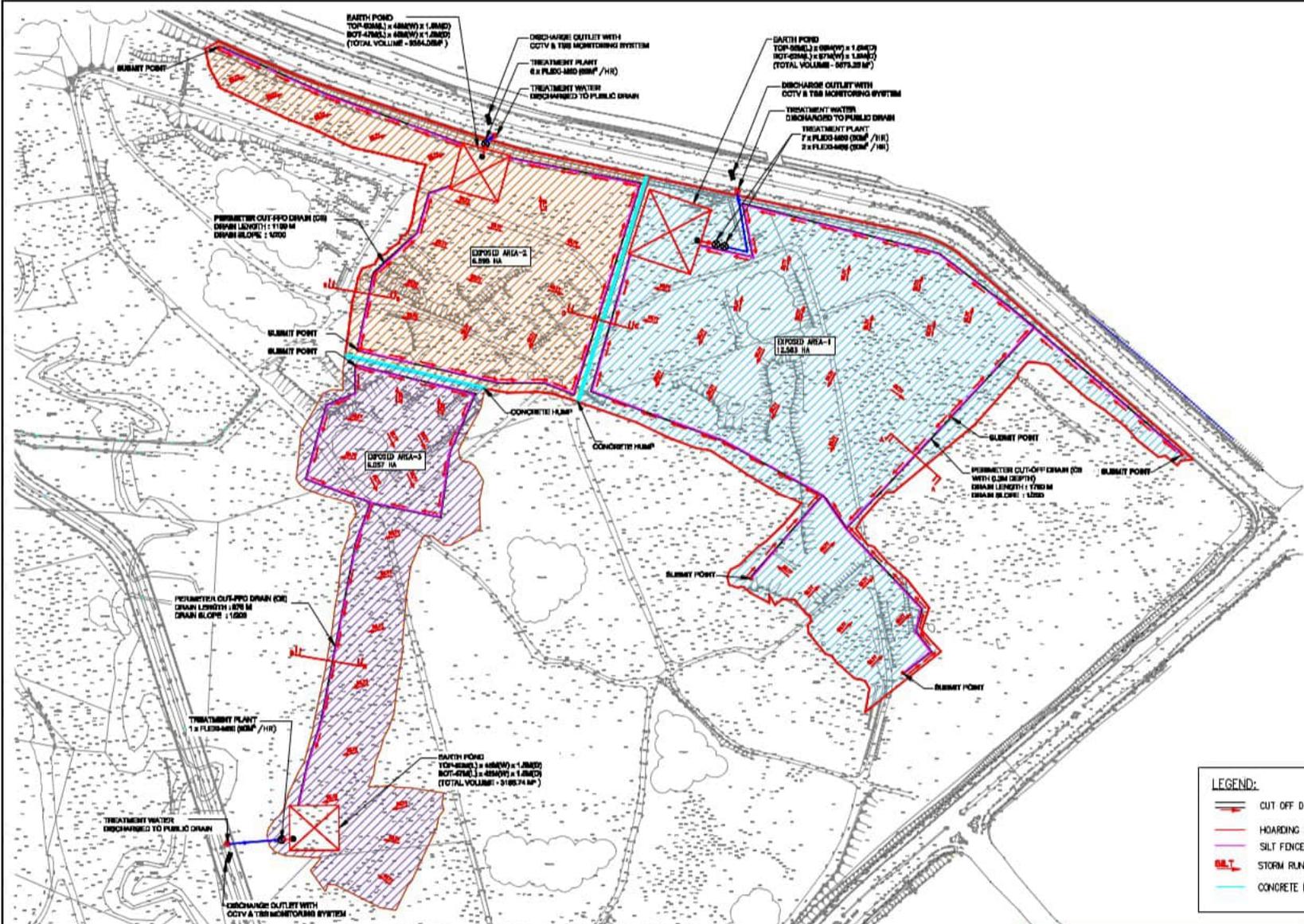
DRAWING DESCRIPTION:
 EXPOSED AREA, HOARDING AND SILENT FENCE FROM EXISTING BOUNDARY A

ENGINE CONSULTANTS & SURV:



SCALE: AS SHOWN

DATE	BY	REVISION
DECEMBER 2022	HH	
DECEMBER 2022	JL	
DECEMBER 2022	HH	
DECEMBER 2022	HH	



EARTH CONTROL MEASURE PLAN
 SCALE 1 : 4 M

ECM DESIGN SUMMARY

Area	Total Site Area (ha)	Max Exposed Area (ha)	Total Runoff Volume (m3)	CB-Drain Volume (m3)	Storage Tank Volume (m3)	Total Storage Volume (m3)	Min. Portable Pump (or equivalent)	Water Treatment Plant provided (m3/hr)	TSS (mg/L) Without ECM	TSS (mg/L) ECM
AREA 1	12.583	12.583	6543.16	1425.29	5673.25	6998.53	KTZ31.5	7xM80 + 2xM60	7552	< 50 PPM
AREA 2	6.895	6.895	3428.40	634.35	3384.00	4018.35	KTZ31.5	6xM60	6888	< 50 PPM
AREA 3	6.057	6.057	3148.64	500.55	3166.74	3666.29	KTZ31.5	6xM60	6918	< 50 PPM

EXPOSED AREA = 25.2355HA
TOTAL SITE AREA = 25.2355HA

NOTE:
 - NO CONSTRUCTION WORKS, EARTH WORKS, AND BUILDING WORKS ARE TO COMMENCE BEFORE THE APPROVAL OF ECM.
 - ALL STORM WATER SHALL BE TREATED WITHIN 10HRS TO ENSURE SUFFICIENT STORAGE AVAILABLE FOR THE NEXT STORM.

