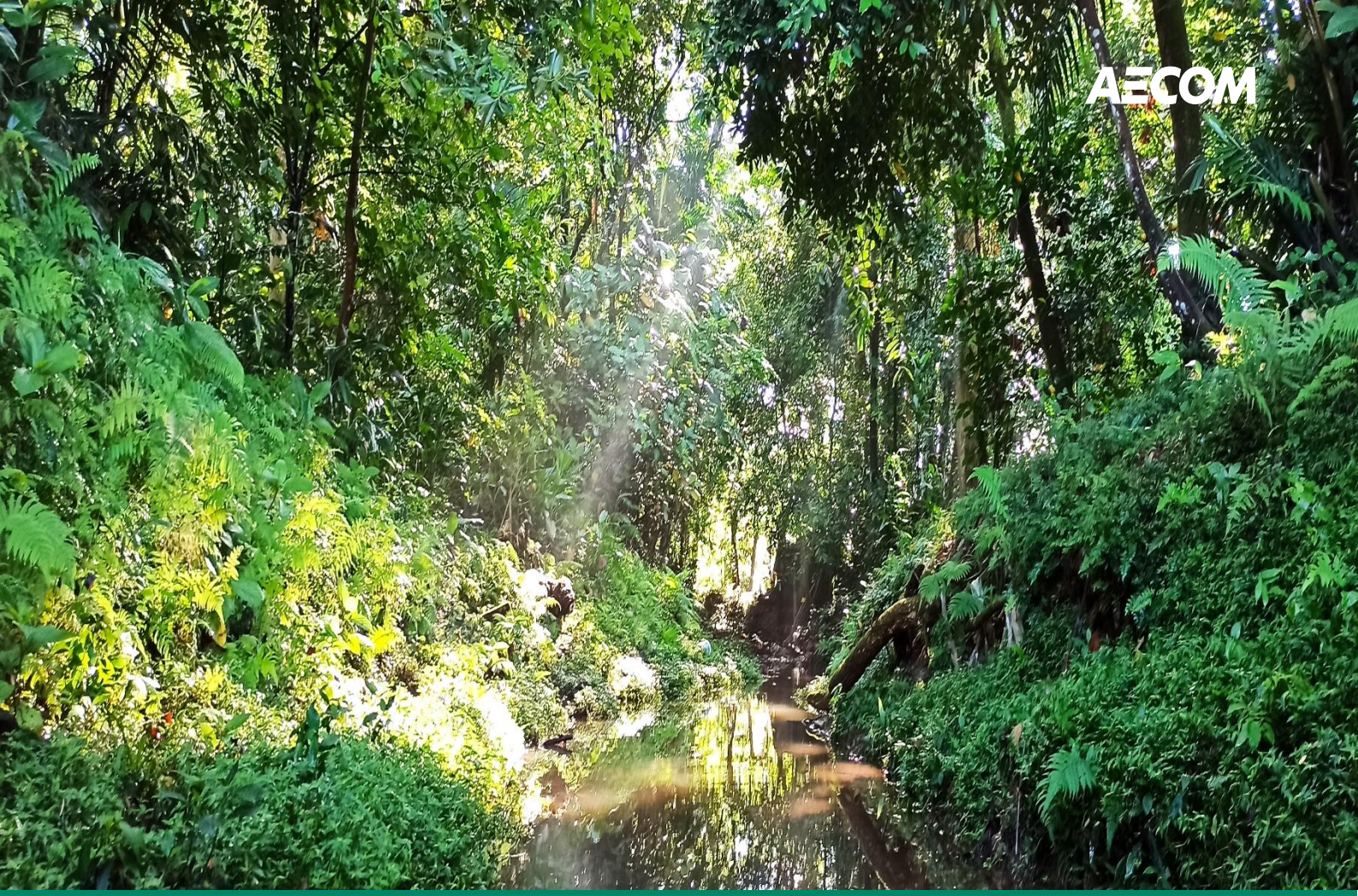

SPECIALIST CONSULTANCY SERVICES AT HDB DEVELOPMENT (WESTERN)

Environmental Management and Monitoring Plan (Area C)

Housing & Development Board (HDB)

Date: 15 March 2023

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Appendix H Public Communication Plan

Appendix I Lighting Management Plan

Appendix J Hoarding Plan

Appendix K Earth Control Measures Plan

List of Acronyms

Acronym	Definition
AECOM	AECOM Singapore Pte. Ltd.
BCA	Building and Construction Authority
CCTV	Closed Circuit Television
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
QECP	Qualified Erosion Control Professional
QP	Qualified 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 Executive Summary

Project Description

AECOM Singapore Pte Ltd was 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 Bukit Batok Hillside Park Area (Area C) (hereafter referred to as the "Project"). Area C, is a 3-hectare site (the worksite also known as Bukit Batok N4-C28) located within the southeast of Bukit Batok Hillside Park Area and is bounded by Bukit Batok West Avenue 5 in the south of the site and Bukit Batok West Avenue 2 in the east of the site. Area C is also currently bordered by forested areas. Currently, the site mostly consists of secondary forest, a freshwater stream (Stream B) and the site is surrounded by residential developments and educational institutions along the east of the site. The site will be developed for residential development. Based on the completed EIS [R-1], an endangered mature *Ficus vasculosa* tree and its Tree Protection Zone (TPZ) were identified as the Recommended Area of Conservation (RAC) and will be retained.

Figure 1-1 Proposed Construction Worksites and Recommended Area of Conservation at Area C

Proposed Construction Timeline and Activities

The overall construction activities to be carried out within Area C includes site clearance, soil investigation (SI) works and building/infrastructure construction works. The detailed construction activities has been outlined in Table 1-2. The overall construction will be commenced from November 2022 till December 2027. For Stage 1, upon completion of hoarding for entire development area, SI works within working space of hoarding will commence. SI works and earthworks will then be conducted concurrently for eight (8) months duration. There will be no tree

felling required for soil investigation works as it will be carried out where the tree felling activities have been completed for the hoarding erection and earthworks. The overall staging plan is shown in Table 1-1.

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

EMMP Stage	Construction Activity	Total Duration (Month)
Stage 1	Soil Investigation Works	8
	Earthworks (including site clearance)	
Stage 2	Development works	

Table 1-2 Summary of construction activities

Construction Stage	Activities	Potential Impacts/Pollution
Stage 1: Advance Works and Earthworks	• Shepherding of wildlife from construction footprint; • Erection of temporary hoarding • Erection of Tree Protection Zone (TPZ) and perimeter hoarding; • 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. • Demolition of existing structures; • Drainage and utilities diversion; • Cut and fill/ regrading/ levelling and excavation to achieve required platform levels; • Earth Retaining and Stability Structures: Bored piling works – installation of bored piles with the use of temporary/permanent casing and bentonite slurry; and • General works (i.e. machinery maintenance, machinery/ construction material delivery, waste generation, temporary storage prior to disposal).	a) Human-wildlife conflict; b) Waste management c) Chemical spill; d) Trampling impact on vegetation; e) Soil and water contamination; f) Dust emission; g) Vegetation waste; h) Loss of habitat/ wildlife mortality; i) Noise pollution; j) Changes to ambient temperature; k) Changes to ambient humidity; l) Loss of tree cover; m) Changes in hydrology and water table of surrounding ground area; n) Sediment tracked onto public roads. o) Silty runoff, discharge of effluent; and p) Excavated material.

Environmental Management and Monitoring Organisation

Clear and well-defined roles for each party, are essential for ensuring all EMMP requirements are planned, implemented and maintained throughout the project in accordance with the regulations drawn by the relevant authorities. Parties are also responsible for implementing procedures on monitoring, measuring the effectiveness of measures undertaken, and implementing corrective/preventive action measures to eliminate non-compliance and environmental incidents.

The roles of the key parties responsible for implementing the EMMP during the construction phase are as follows:

- 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 undertaking 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.

Comprehensive descriptions for each role and respective role responsibilities are provided in Section 6, as are details relating to Environmental Quality Objectives (EQOs). The organisation chart for the project is shown in Figure 6-1.

Key Standard Measures for 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. It is the responsibility of the Contractor to execute the mitigation measures, following the outlined protocols while the EMMP Consultant's ECO is responsible for supervising the implementation of the measures.

Environmental Component	Key Standard Measures for Construction Activities
Biodiversity	Standard biodiversity measures as detailed in Section 7.1.1 should be carried out when applicable across all Stages.
Hydrology, Surface Water and Groundwater	• Planning, designing, submission of Earth Control Measures (ECM) by a Qualified Erosion Control Professional to PUB to comply with clause 7.1.5 of the Code of Practice on Surface Water Drainage, etc.; • Contractor should moderate the earthworks in tandem with the ECM provision; • Contractor should ensure that their CCTV system is properly operated and maintained at all times sites as per the Public Utilities Board of Singapore's (PUB) circular on Preventing Muddy Waters from the Construction Sites (October 2015). It is also meant to curb Contractors from deliberately tempered with the CCTV system to mask the silty discharge; • Erosion control 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; • 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; • Contractor is required to divert any existing drains properly that affect the works; • 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; • 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) and Professional Engineer (Geotechnical), if necessary and required under BCA Statutory Acts; • Where excavation is more than 1.5m during earth works and excavation works, plan submission by Qualified Professional (QP) to BCA shall be done during the design and construction stage. If the depth is more than 4m, Accredited Checker (AC) shall be engaged for independent check as required by BCA; • 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

Environmental Component	Key Standard Measures for Construction Activities
	• 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; • Access path, road or site office area, if any, should be paved up; • Contractor should maintain a gentle slope during site clearance and earthwork/ soil cutting to prevent slope failure. Temporary slope shall be maintained maximum at 1:2 during earth works and other excavation/construction works; • Where existing slope is steep, measures such as geotextile or temporary retaining structures should be put in place during the site clearance, tree/root removal and earth cutting works to prevent slope failure; • For weak soil at stream A and stream B, extra attention should be given to avoid risk of worker falling into swampy soil. Slope failure control measures and extra care need to be put in place to prevent risk of safety during construction works; • The site clearance and earthwork should be planned in phases to ensure that not so large area is exposed at a time, and the runoff from the exposed area is within capacity of the ECM; • Proper drainage system should be designed to accommodate additional runoff from the site during different stages of the construction works. The capacity of the drainage should be designed for runoff co-efficient from C=0.45 (existing site condition) to C=0.65 during site clearance and earthwork, and C=1 during building construction and post construction stage; • Capacity of the existing downstream drainage that will take additional runoff from the site should be reviewed to ensure sufficiency. If the existing downstream drainage capacity is not sufficient, additional drainage should be provided to prevent flooding at the downstream areas; • Concrete trucks and other equipment should be washed out to prevent concrete from hardening within. This washout should not be discharged directly into any drainage system but collected as wastewater for treatment; • Humps should be installed at the site entrances to prevent any silted storm water from exiting via this pathway; • Bare earth areas should be isolated with silt fences, and bare earth area should be covered after work; • 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; • 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; • Topsoil removed will be stockpiled in a designed area and covered as necessary to prevent soil loss from secondary erosion; • 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; • 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; • 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;

Environmental Component	Key Standard Measures for Construction Activities
	• 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; • 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 functionability 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, Transplantation 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; • Emergency response equipment, e.g., spill kits, absorbent booms, clean spade, and buckets must be well-prepared for use and be in close vicinity to the chemical storage area; • 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. Water-proof sheets must be used to cover the secondary containment in rainy periods to prevent spill-over; • Preparation of an emergency response plan, training of the emergency response team (ERT) to be competent in the response mechanism and provision of response kits for any spillages; • 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; • 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 nay 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; • Development of a Standard Operation Procedure (SOP) for safe handling, transfer, storage, and disposal of solid waste; • Provision of enclosed bins and waste disposal facilities cleared up as often as necessary to prevent build-up. Housekeeping checks will be carried out once a day to ensure all litter is cleared from site;

Environmental Component	Key Standard Measures for Construction Activities
	• Consignment notification/tracking system and transport emergency response plan for transport of toxic waste; • Appropriate disposal of toxic waste as per required in the Environmental Public Health (Toxic Industrial Waste) Regulations by licensed waste operator/collector; • A full inventory of all anticipated wastewater streams and volumes should be finalised before the onset of the construction works; • No unmanaged discharge of wastewater stream permitted; • Containment ponds will be of impervious material and be designed with sufficient capacity to hold volumes of wastewater produced on-site, as well as allowance for stormwater runoff and potential fire-fighting wastewater; • Temporary storage volumes should be provided for overflow situations. Temporary storage to be of sufficient capacity to capture any additional volumes that may be expected to ensure untreated wastewater is not released to watercourses unless it complies with Singapore NEA Guidelines on trade effluent discharge concentrations; • Daily record volume of wastewater, as well as volumes of sludge and other produced wastes; • The containment ponds, as well as wastewater generating areas on-site, to be equipped with spill clean-up kits; • Implement a construction EMMP and ensure full preparation of associated plans and procedures including the following: - EMMP to include SOPs, an Emergency Response Plan (ERP), an inventory of wastewater streams, training of staff as well as an inspection, maintenance and audit schedule; and - Full development of EMMP Wastewater Management Procedures to include dedicated management and monitoring procedures that covers all eventualities related to the proper operation of the detention ponds, or any other wastewater discharge location/equipment. • Regular and dedicated procedures for the inspection and maintenance of wastewater collection, storage, and treatment infrastructure, such as pipes, oil water separators, silt screens, etc.; - Regular and dedicated procedures for the management of stormwater collection, settling, testing and eventual discharge of ‘clean’ water to watercourses. This should also include associated measures required (e.g. silt curtains) to prevent high sediment concentration stormwater drainage to watercourses; and - A training programme for all on-site workers, including sub-contractors, in relation to their obligations for ensuring proper water quality management. • Adequate drainage, piping and/or channelling of stormwater runoff to be assured through detailed design for capture and treatment before discharge into surface watercourses; • Regular and dedicated procedures for the inspection and maintenance of stormwater collection, storage, and treatment infrastructure, such as pipes, oil water separation, silt screens, etc.; • Regular and dedicated procedures for the management of stormwater collection, settling, testing and eventual discharge of ‘clean’ water to surface waters. This should also include associated measures required to prevent high sediment concentration stormwater drainage to surface waters; • Effective ECM and monitoring implemented as recommended in the Code of Practice on Surface Water Drainage to ensure that discharge into stormwater drainage system does not contain TSS in concentrations greater than the prescribed limits under the Sewerage and Drainage (Surface Water Drainage) Regulations; • ECM measures include but are not limited to minimisation of formation of bare soil, coverage of all bare/erodible surfaces, concrete cut-off drains, silt fences/traps along the perimeter cut-off drain, turbidity curtains for works adjacent to water bodies (canals, drains, streams), etc. • Runoff within, upstream of, and adjacent to the work site shall be effectively drained away without causing flooding in the vicinity; • Manholes should always be adequately covered and temporarily sealed; • Protection of stockpiles with biodegradable erosion blanket coverage and proper scheduling of the demolition and earthworks to reduce the quantity of stockpiles to be stored onsite; • Coverage of temporary/open storage of excavated materials;

Environmental Component	Key Standard Measures for Construction Activities
	• All vehicles should run via wheel washing process before leaving the site to ensure no earth, mud, debris, etc., deposited on roads and the wastewater hence generated should be stored and removed for treatment and disposal off-site by an approved Waste Management Contractor; • Potential increase of peak-flow due to the change in the land use at the worksite can be mitigated by providing detention tanks or ponds within the Study Area. Detention tanks or ponds can capture stormwater during heavy storm events to reduce the peak runoff; • Geotechnical aspect of site's slope stability (such as Earth Retaining and Stabilising structures (ERSS) to be included in detailed design engineering for the construction stage; • The design engineers for detailed design may need to ensure that Earth Retaining Stabilisation structures (ERSS) are proposed when the site is cleared and excavated. Concurrently the ECO must ensure that these measures are implemented in the construction phase, as cutting of slopes may result in slope instability; • Groundwater monitoring to comply with Building Control Regulations 2003 as part of its instrumentation and monitoring plan to be endorsed by Qualified Professionals (QP); • Proper Earth Retaining Stabilising Structures (ERSS) should be selected and designed to limit groundwater settlement; • Schedule the proposed development in phases in order to minimize the volume of dewatering at any one time; and, • Use recharge wells as necessary during the excavation (if with basements) to limit the potential groundwater drawdown. • All works to be conducted by the Contractor including dewatering or recharging of groundwater, are to be planned and implemented to have minimal impact to the hydrological conditions of the streams, including any changes to the groundwater or affecting soil or slope structural stability of the conserved areas and the adjacent Bukit Batok Hillside Park area. Groundwater levels and quality of surface and groundwater within the stream or catchment of the conserved areas should be monitored throughout the duration of the development works. No slope works, installation of retaining structures or drainage should affect areas and habitat outside of the development boundaries.
Air Quality	GENERAL MITIGATION MEASURES TO BE IMPLEMENTED THROUGHOUT CONSTRUCTION PERIOD. <u>Minimum Control:</u> • 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. <u>Communications:</u> • 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.

Environmental Component	Key Standard Measures for Construction Activities
	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 incident number 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. • 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:

Environmental Component	Key Standard Measures for Construction Activities
	• 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 surfaces 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. <u>Construction:</u> • 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. • 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. <u>Waste Management:</u> • Avoid burning of waste or other materials. • Where possible, horticultural waste should be upcycled as wood material for products. • As much as possible, horticultural waste should be transported offsite by licensed waste management contractors to horticultural waste recycling facilities where the wood waste can be grinded into wood chips for horticultural reuse (i.e. compost or mulch). <u>Trackout:</u> • 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.

Environmental Component	Key Standard Measures for Construction Activities
	• 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.
Airborne Noise	• All machinery and equipment used will be labelled with a weather-proof sticker clearly indicating its noise emission level (at source) under normal operating conditions; • All machinery and equipment used on site will be sound reduced, as far as is practicable in accordance with Annex G of SS 602:2014, for each equipment, the contractor should have a sound power level for each equipment obtained from the equipment supplier. That sound power level needs to compare with BS standard or EIS assumption. And it should be less than the BS standard or EIS assumption; • Stationary noisy equipment will be housed in enclosures (refer to F.3 SS 602:2014 and LTA Guidebook for best environmental practices (Noise Control at LTA Sites)) on site where necessary; • Machine operators and workers will be trained and briefed on quieter work techniques; • Noise awareness briefing will be conducted once in 3 month regularly/ as in when noise exceedance found in the monitoring equipment around the site. As highlighted, this briefing will include best practices on site, corrective action to be taken etc. depending on the situation. This will include a discussion of the noise mitigation measures such as the position of machinery, making use of portable noise barriers if necessary, dos and don'ts for use of machinery, behavioral practices including no shouting, no loud stereos/ radios on site, no dropping of materials from height, no throwing of metal items etc.; • Ad-hoc noise monitoring will be carried out when work progresses during noisy operations; • Additional noise measures will be implemented when noise monitoring indicates the noise levels are approaching or exceeding permissible noise levels and 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; • Control of noise sources at the source from construction site – Analyse construction inventory list and check equipment causing high noise levels. The equipment with lower noise level shall be prioritized; • Where controlling noise sources at the source is not feasible, acoustic enclosures or sheds are to be introduced to mitigate noise at the source. Typical acoustic enclosure covers the machine as fully as possible (with or without ventilation where applicable) to provide sound insulation; • The contractor shall review the equipment to be used on site and erect localised noise barriers prior to undertaking high noise generating work; • Machines (such as trucks) that may be in intermittent use shall be shut down between work periods or shall be throttled down to a minimum; • Only well-maintained construction plants shall be utilized on-site, and plants shall be serviced regularly during the entire construction period; • The number of PMEs shall be reduced as far as practicable when construction works are carried out at areas close to the noise sensitive receivers; • Consider use of silencers or mufflers on construction equipment which are properly maintained during the construction programme while facing sensitive receptors; • Behavioural practices including no shouting, no loud stereos/ radios on site, no dropping of materials from height, no throwing of metal items shall be ensured; • Construction respite: Restrict high noise generating drilling activities only in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block, if possible; • Periodic noise monitoring by an independent third party, to establish compliance with requirements and to advise on equipment causing concern, and additional potential mitigation measures;

Environmental Component	Key Standard Measures for Construction Activities
	• Plan the layout of the site by considering using materials and other large structural equipment as noise barriers; • Plant known to emit noise strongly in one direction shall, wherever possible, be orientated so that the noise is directed away from the nearby NSRs; • Material stockpiles and other structures shall be effectively utilized, wherever practicable, in screening noise from on-site construction activities; • Acoustic sheds should be provided at the locations of the noise generating activity such as operation of hand-held breaker; • No work allowed from 10.00pm on Saturday/eve of Public Holiday to 7.00am on the following Monday/day after the Public Holiday; • 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: ▪ CN1: Block 304 HDB Bukit Batok; ▪ CN2: Within the Conservation Area; ▪ CN3: Dazhong Primary School; and ▪ CN4: 467a Bukit Batok West Ave 9. • Contractor to prepare the Site Environmental Control Program in accordance with NEA 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 Guidelines; • 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 • 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; • 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. Al Construction Equipment shall be properly insulated and maintained to minimum its operating noise level;

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<tr><th>Environmental Component</th><th>Key Standard Measures for Construction Activities</th></tr>
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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:

<table>
<tr><th>Types of Affected Buildings</th><th>Applicable Period</th><th>Maximum Permissible Equivalent Continuous Noise Level Measured Over a Period of 5 Minutes in dB(A)</th></tr>
<tr><td rowspan="3">(a) Hospitals, schools, institutions of higher learning, homes for the aged or sick etc.</td><td>7am to 7pm</td><td>75</td></tr>
<tr><td>7pm to 10pm</td><td>55</td></tr>
<tr><td>10pm to 7am</td><td>55</td></tr>
<tr><td rowspan="3">(b) Residential buildings located less than 150 m from the construction site where the noise is being emitted</td><td>7am to 7pm</td><td>90</td></tr>
<tr><td>7pm to 10pm</td><td>70</td></tr>
<tr><td>10pm to 7am</td><td>55</td></tr>
<tr><td rowspan="3">(c) Buildings (other than those in paragraphs (a) and (b))</td><td>7am to 7pm</td><td>90</td></tr>
<tr><td>7pm to 10pm</td><td>70</td></tr>
<tr><td>10pm to 7am</td><td>70</td></tr>
</table>

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 14dyas 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.

</td></tr>
<tr><td>Vibration</td><td>
<u>General:</u>

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.

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</table>

Environmental Component	Key Standard Measures for Construction Activities
	• 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., comply with National regulations. • Contractors shall be responsible for complying with and implementing all laws' requirements and 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 coincide in the same area, if possible, to minimize cumulative impact. • Avoid impact pile or vibratory pile driving 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 the installation of sheet piles and tunnelling works (e.g., pipe jacking and TBM), to allay potential concerns. • While using vibratory compactors, shut off the vibrator when reversing direction (the 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 a static method (no vibrations), and 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 travelling surface; reduce the speed of vehicles and weight of vehicle loads as practicable. <u>Ecological Receptors:</u> • Set up barriers to prevent road kills. • The contractor shall conduct monitoring for vibration in ecologically sensitive areas. <u>Human Receptors:</u> • 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, 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 instructed by SO Rep. Three (3) sets of comprehensive reports shall be submitted to HDB weekly. The final report shall be submitted within two (2) weeks after the completion of the monitoring works.
Vector Control	• 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 regularly and when directed by the SO Rep.;

Environmental Component	Key Standard Measures for Construction Activities
	• 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; • Area selected for site office should be fumigated before works take place; • Existing vegetation or undergrowth within 6 m of any stream, seepage, running or standing water should be cleared without prior approval from NEA, before construction works commence to in line with CVPA; • Providing a clear boundary for insect and vector control where populations will be monitored within the construction site; • Remove any pooled water in less than a week, as the Aedes mosquito eggs can develop into adult mosquitoes in less than a week in optimal conditions, by following measures: - Any water ponding on-site (from potholes, puddles, and locations of earthworks) should be backfilled with compacted soil immediately after inspection, or when construction activity in that area is ceased; - Granular insecticide should be applied into any water found to be collected in perforated bricks; - Any choked drains or channels used to direct water should be cleared of blockages; - Concrete should be placed in the gaps of any corrugated roofs; - Any material stored on-site should be raised 60 cm to ensure that the pest control team and the licensed pathogen vector control operator can see and remove vector populations; - Any receptacles located on-site that have the purpose of storing water should be emptied at the end of each day; - Any receptacles which can catch and hold rainwater should be stored in an undercover tool storage area or waste storage area; and, • Any free hanging tarpaulins on-site should be taught to prevent water containment.
Waste Management	• 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.;

Environmental Component	Key Standard Measures for Construction Activities
	• 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 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. • 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. 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 wastes should be transported off-site to specialized horticultural recycling facilities where they can be grinded into wood ships 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; • Construction waste should be properly segregated and have set storage locations to extract recoverable and recyclable materials which can then be reused or recycled;

Environmental Component	Key Standard Measures for Construction Activities
	• 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; • Appropriate disposal of any waste listed in the Environmental Public Health (General Waste Collection) Regulations by licensed waste operator/collector; • Development of SOP for safe handling, transfer, and storage of toxic waste; housekeeping checks once a day to ensure all toxic waste is cleared from site; • Appropriate construction material for toxic waste storage containers with leak detection tests conducted periodically; • Provision of secondary containment for all toxic waste stored in bulk as per the requirements in the COPPC/SS593; • Hazardous wastewater, such as oily water, thinners, solvents, or paints, are to be stored and removed for treatment and disposal off-site by an approved Waste Management Contractor. Hazardous liquids to be handled as Hazardous Waste; • Daily record volume of wastewater, as well as volumes of sludge and other produced wastes; • Inspections and audits to ascertain the hygienic conditions onsite; • Training of workers on the best practices to contribute to environmental protection; • Appropriate location of toilet facilities away from any nearby watercourses. • The contractor should ensure that information in the waste management plan that is applicable to individual site workers is disseminated to them; • Waste storage facilities should be fit for purpose by ensuring that waste containers/ storage areas are capable of containing predicted waste volumes, for each waste type, in a manner unlikely to cause damage to the environment or harm to human health; • Waste designated for off-site recycling or disposal will only be transferred to such parties that can demonstrate that they are licensed to transport and/or treat or dispose of the waste in accordance with relevant Singapore Regulations; • Portable toilets for construction workers must be placed inside each construction area, with the sewage pumped away regularly by an appropriately licensed waste disposal company; and, • All containers which were previously used to store pesticides and other chemicals should be bored with holes to ensure that these containers are not reused.

Summary of Proposed Management and Monitoring – Pre-construction/Stage 1

- **Biodiversity, Flora** – Pre-construction: Standard Measures should be conducted when applicable as detailed in Section 7.1.1. Before site clearance begins, salvaging procedures and flora monitoring and management plan should be crafted by the EMMP Consultant in consultation with NParks and the relevant authorities will carry out any salvaging of viable saplings of conservation significance.

  Construction: Standard Measures should be conducted when applicable as detailed in Section 7.1.1. The SO Rep. should conduct monthly flora inspections under the oversight the EMMP Consultant, which includes visual inspections for the presence of forest edge effects, new invasive weed species and for any rubbish and/or construction waste within 15m of the RAC. The EMMP Consultant should look out for any excessive clearance of vegetation beyond the hoarding boundary of the Project Area during the monthly flora inspections.

  Post-construction: Fauna monitoring would continue for two months after the completion of construction works.

- **Biodiversity, Tree (Arboriculture)** – Standard Measures should be conducted when applicable as detailed in Section 7.1.1. 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.

  Construction: Standard Measures should be conducted when applicable as detailed in Section 7.1.1. The Appointed Arborist should carry out monthly inspections of the health and integrity of TPZ and the transplanted trees throughout construction phase.

- **Biodiversity, Fauna** – Standard Measures should be conducted when applicable as detailed in Section 7.1.1. Before site clearance, the SO rep./Contractors should work under the supervision of the EMMP Consultants to ensure that the hoarding boundary and internal hoarding are set up as detailed in Section 7.1.1. Directional Site Clearance will be carried out in an orderly sequence as detailed in Section 8.1.1.1.1.

  Construction: Standard Measures should be conducted when applicable as detailed in Section 7.1.1, including monthly monitoring surveys will be carried out by EMMP Consultants during the course of construction works.

- **Hydrology and Surface Water–** Pre-construction: Standard mitigation measures should be followed and applied accordingly by the Contractor when applicable. The 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). 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. Three (3) rounds of water quality monitoring for two (2) locations should be conducted prior commencement of site clearance. All the discharge points from construction worksites should follow the NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse.

  Construction: Standard mitigation measures should be followed and applied accordingly by the Contractor when applicable. 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). Contractor should provide real-time Total Suspended Solids (TSS) monitoring data to EMMP Consultant based on discussion during pre-construction stage. If visual non-compliance to any of the minimum control or mitigation measures are observed by EMMP Consultant's ECO on-site, EMMP Consultant's ECO should inform Contractor. The Contractor should conduct necessary investigation and corrective actions should be taken if necessary. The proposed monitoring locations should be sampled monthly and additional parameters sampled quarterly at all the construction discharge outlets and to follow NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse [W-9]. 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 Environmental Impact Study (EIS) on Bukit Batok Hillside Park Area [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. Permanent TSS monitor and implementation of CCTV including a SIDS installed at every discharge outlet should be conducted by the Contractor throughout the construction stage. If the real-time TSS found on exceedance of 30 mg/L for 10 minutes at any discharge outlets, any exceedance in monitored water quality parameters as well as any flooding or drain clogging issue observed on site, the Contractor should conduct investigation and corrective actions should be taken immediately. The hydrological conditions of drainage system within construction worksite and at immediate vicinity should be inspected daily

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

- **Groundwater –** Pre-construction: Standard mitigation measures should be followed and applied accordingly by the Contractor when applicable. One-time groundwater level monitoring at downstream of Stream A will be conducted prior commencement of site clearance to have a representation of baseline data. Before carrying any excavation or dewatering activities, one-time monitoring on groundwater level and quality should be conducted. The groundwater quality should follow NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse.

  Construction: Standard mitigation measures should be followed and applied accordingly by the Contractor when applicable. The groundwater level monitoring at downstream of Stream A will be conducted monthly in order to monitor the groundwater changes due to potential construction works. Contractor should conduct groundwater monitoring 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. Contractor should monitor the groundwater level and quality as required in Singapore Building Control Regulations 2003 [R-29] weekly during dewatering process at where the excavation take place and The required groundwater parameters to follow NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse [W-9]. Contractor should conduct investigation and take corrective actions if any exceedance in groundwater quality based on the above-mentioned guideline. If receiving any complaint due to Project activities, the Contractor should conduct investigation and propose corrective actions.

- **Air Quality –** Pre-construction: One-week monitoring of PM_{10} and $PM_{2.5}$ is proposed to be undertaken by the contractor at two (2) locations before commencement of construction phase. The two locations selected including one (1) human receptor (i.e., HDB Blk 304 Bukit Batok Street 31) and one (1) ecological receptor (i.e., ecological receptor within forested area).

  Construction: In Stage 1, only soil investigation and earthworks will be carried out, general mitigation measures shall be applied. Additionally, site-specific mitigation measures for earthworks shall also be implemented. The summary of the mitigation measures applicable to Stage 1 is presented in Table 1-3. Real-time continuous monitoring of PM_{10} and $PM_{2.5}$ shall be carried out by the contractor during earthworks phase at one (1) human receptor (i.e., HDB Blk 304 Bukit Batok Street 31) and one (1) ecological receptor (i.e., ecological receptor within forested area). The data shall be shared with the EMMP Consultant. The EMMP Consultant shall conduct data analysis and compare the results with the Singapore Ambient Air Quality Long Term Targets (SAAQT). Daily inspection by the EMMP Consultant's ECO should also be carried out on eastern boundary facing residential areas and also internal for ecological sensitive receptors. Furthermore, during construction phase, the EMMP Consultant will conduct site inspection bi-weekly. Handheld air monitoring equipment 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. A dedicated 24-hours Project Hotline shall be provided to receive feedback pertaining to the works. The case will be channelled and directed to the respective personnel for further action and will be followed up closely. A proper and timely report of all the feedback/complaints received shall be kept and maintained. An Engagement report shall also be maintained to compile and report on all engagement activities. All the feedback and engagement are documented and maintained until successful work completion.

- **Airborne Noise –** Pre-construction: Based on review of sensitive receptors around the Project construction site in the Environmental Impact Study (EIS) [R-1], unattached one-week noise monitoring (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 is proposed to be undertaken by the Contractor at four (4) locations before commencement of construction phase. The four selected locations are Block 304 HDB Bukit Batok, Dazhong Primary School and 467a Bukit Batok West Ave 9 for human receptor and one within the Conservation Area for ecological sensitive receptors.

  Construction: During the Stage 1, general mitigation measures proposed in Section 7.1 shall be applied and no site-specific mitigation measures are proposed, since there were no noise exceedances predicted on noise sensitive receptors based on the worst-case impact predicted in the Environmental Impact Study (EIS) report [R-1]. The summary of the mitigation measures applicable to Stage 1 is presented in Table 1 1. As part of pre-

emptive measures to assess potential impacts that may arise from uncontrolled/unpredicted events, continuous real-time noise monitoring shall be carried out by Contractor at four (4) locations (Block 304 HDB Bukit Batok, Dazhong Primary School and 467a Bukit Batok West Ave 9 for human receptor and one within the Conservation Area for ecological sensitive receptors) during Stage 1 to assess the effectiveness of minimum control measures on site. The Contractor shall use the pre-construction baseline (refer to Section 8.5.1.2) to calculate and set Project criteria with "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.* which shall apply for construction works in all stages. It is to be noted that ecological receptor noise impact will be assessed against the maximum baseline noise level as the noise criterion. This data will be shared with the SO Rep., HDB and the EMMP consultant. Daily inspection by EMMP Consultant's ECO should also be carried out on entire boundary facing noise sensitive receptors. Furthermore, during construction phase, the EMMP Consultant will conduct site inspection bi-weekly. A dedicated 24-hours Project Hotline shall be provided to receive feedback pertaining to the works. The case will be channelled and directed to the respective personnel for further action and will be followed up closely. A proper and timely report of all the feedback/complaints received shall be kept and maintained. An Engagement report shall also be maintained to compile and report on all engagement activities. All the feedback and engagement are documented and maintained until successful work completion.

- **Vibration –** Pre-construction: AECOM proposed to monitor baseline vibration level for one (1) week at one (1) location within forested area prior to construction to have a full representation of the construction area.

  Construction: As presented in Table 1-1, general mitigation measures shall be implemented. No site-specific mitigation measure is proposed in Stage 1. Vibration monitoring is not required during Stage 1, as no piling activity is involved. However, the contractor shall carry out vibration monitoring as per BCA requirements where applicable. Furthermore, during the construction phase, a site inspection will be carried out by EMMP Consultant bi-weekly. A dedicated 24-hours Project Hotline shall be provided to receive feedback about the works. The case will be channelled and directed to the respective personnel for further action and followed up closely. A proper and timely report of all the feedback/complaints received shall be kept and maintained. An Engagement report shall also be maintained to compile and report on all engagement activities. All the feedback and engagement are documented and maintained until successful work completion.

- **Vector Control –** Pre-construction: Standard mitigation measures should be followed and applied accordingly by the Contractor when applicable. Contractor shall submit a site-specific Vector Control Plan upon contract award, which encompassing the following elements: Pre-existing Conditions, Zoning Method and Dengue Contingency Plan.

  Construction: Standard mitigation measures should be followed and applied accordingly by the Contractor when applicable. Contractor should 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 should be able to identify all potential mosquito breeding habitats and/or other relevant environmental irregularities as well as all rat/rodent burrows, activity and/or other relevant environmental irregularities. Contractor should submit a Vector Service Report to SO Rep./NEA at the end of each mosquito and rodent/rat control services. Contractor should implement Vector Control Plan and Vector Monitoring Programme on site during construction period. 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.

- **Waste Management –** Pre-construction: Standard mitigation measures should be followed and applied accordingly by the Contractor when applicable. 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.

  Construction: Standard mitigation measures should be followed and applied accordingly by the Contractor when applicable. 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 done with a monthly report to be submitted within the periodic environmental performance monitoring reports. 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/EMMP Consultant's ECO to ensure the waste management quality are 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 as well as any evidence of poor handling/ storage of toxic chemical waste and hazardous chemical. If receiving any complaint due to Project activities, the Contractor should conduct investigation and propose corrective action.

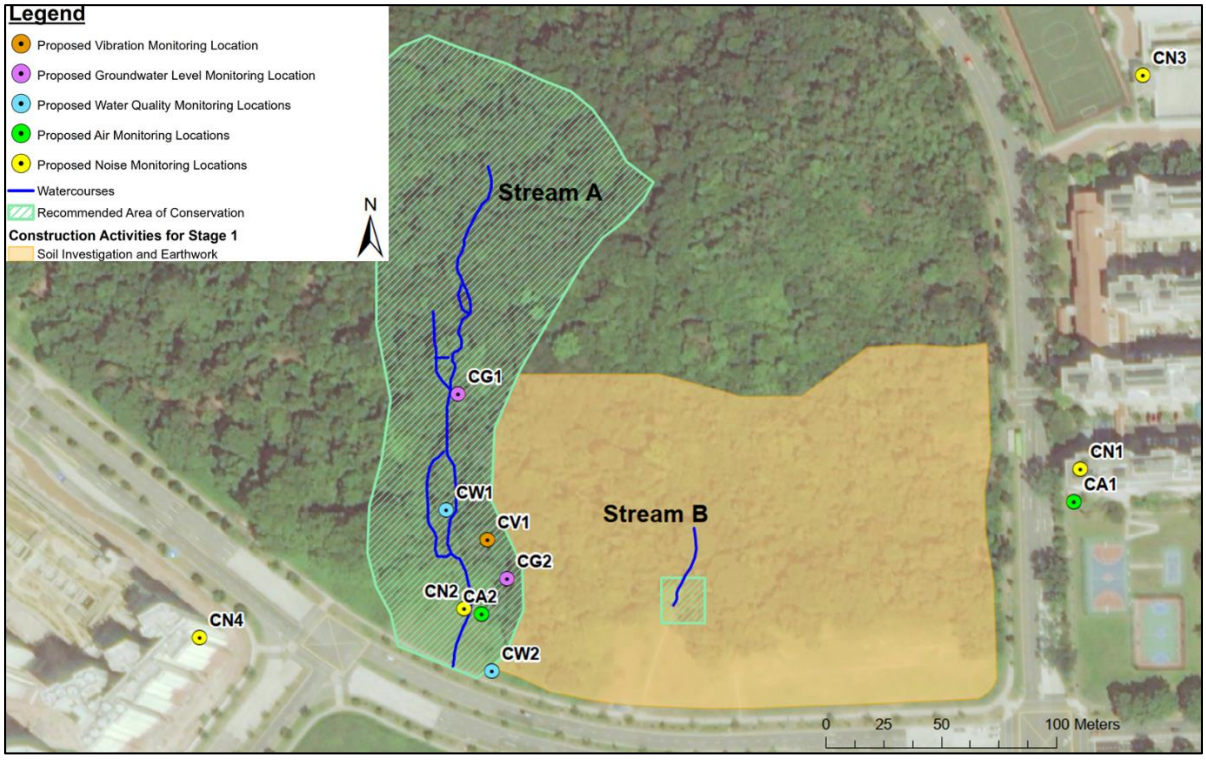

Figure 1-2 Summary of All Monitoring Points during Pre-construction and/or Stage 1

Table 1-3 Summary of Standard and Site-specific Measures and Responsible Parties

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
Biodiversity: Flora				
Major Impact: • Site clearance • Earth works • Tree-felling works Minor Impact: • Pre-construction survey • Soil Investigation works • Hoarding works • Road works	• Loss of vegetation/habitat • Habitat pollution and degradation • Change in species composition • Disturbances to Flora within site, RAC and TPZs	• 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.*
		• 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.*
		• 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.*
		• 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.*
		• Minimise construction impacts on sensitive vegetation (i.e., RAC).	Contractor/EMMP Consultant	EMMP Consultant's ECO/ SO Rep.*
		• 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: • Site clearance • Earth works • Tree-felling works Minor Impact: • Pre-construction survey	• Loss of vegetation/habitat • Habitat pollution and degradation • Change in species composition • Disturbances to Flora within site, RAC and TPZs.	• 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.*
		• Implement Tree Monitoring and Management plan.	Contractor/EMMP Consultant	EMMP Consultant's ECO / SO Rep.*
		• 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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
• Soil Investigation works • Hoarding works • Road works				
Biodiversity: Fauna				
Major Impact: • Site clearance • Earth works • Tree-felling works Minor Impact: • Pre-construction survey • Soil Investigation works • Hoarding works • Road works	• 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	• Implement the Wildlife Response Plan, Roadkill Response Plan, pre-felling procedures and wildlife shepherding plan.	Contractor/EMMP Consultant	Contractor
		• Pre-felling fauna inspection to minimise injury and mortality of fauna as a result of vegetation clearance.	Contractor/EMMP Consultant	Contractor
		• 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
		• 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
		• 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.*
		• Site inspections to be conducted once every two weeks to minimise potential environmental impacts to fauna.	Contractor/EMMP Consultant	Contractor
Hydrology, Surface Water and Groundwater				
Site clearance, spillage of oil, fuel and lubricant from vehicle and machinery, oil drips from	• Water quality deterioration due to soil erosion and surface runoff from construction site; • Water quality deterioration due to use, storage	**General (to be implemented in Stage 1):**		
		• 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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
generator, chemical spill.	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.	• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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.*
		• 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.*
		• Where excavation is more than 1.5m during earth works and excavation works, plan submission by QP (ST) to BCA shall be done during the design and construction stage. If the depth is more than 4m, Accredited Checker (AC) shall be engaged for independent check as required by BCA;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*
		• 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.*
		• 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	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		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;		
		• Access path, road or site office area, if any, should be paved up;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Contractor should maintain a gentle slope during site clearance and earthwork/ soil cutting to prevent slope failure. Temporary slope shall be maintained maximum at 1:2 during earth works and other excavation/construction works;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Where existing slope is steep, measures such as geotextile or temporary retaining structures should be put in place during the site clearance, tree/root removal and earth cutting works to prevent slope failure;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• For weak soil at stream A and stream B, extra attention should be given to avoid risk of worker falling into swampy soil. Slope failure control measures and extra care need to be put in place to prevent risk of safety during construction works;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• The site clearance and earthwork should be planned in phases to ensure that not so large area is exposed at a time, and the runoff from the exposed area is within capacity of the ECM;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Proper drainage system should be designed to accommodate additional runoff from the site during different stages of the construction works. The capacity of the drainage should be designed for runoff co-efficient from C=0.45 (existing site condition) to C=0.65 during site clearance and earthwork, and C=1 during building construction and post construction stage;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Capacity of the existing downstream drainage that will take additional runoff from the site should be reviewed to ensure sufficiency. If the existing downstream drainage capacity is not sufficient, additional drainage should be provided to prevent flooding at the downstream areas;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Concrete trucks and other equipment should be washed out to prevent concrete from hardening within. This washout should not be discharged directly into any drainage system but collected as wastewater for treatment;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Humps should be installed at the site entrances to prevent any silted storm water from exiting via this pathway;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Bare earth areas should be isolated with silt fences, and bare earth area should be covered after work;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		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;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Water Recycling: The objective is to minimise the amount of discharge from the construction site to the surface water drainage system;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Provide storage tanks or reservoirs with additional 20% capacity and number to temporarily store/ contain muddy surface runoff before treatment;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Whenever possible, segregate clean water flow from silty water flow to maximize the sedimentation tank holding capacity;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Provide sufficient treatment units or coagulant units to treat silty water before discharging into public drain within 10 hours of rain event;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Portable toilets are recommended to be installed on paved ground and bunded;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*
		• Establish a regular maintenance work schedule to check and maintenance cleanliness and functionability 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.*
		• 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.*
		• 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.*
		• 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.*
		• Emergency response equipment, e.g., spill kits, absorbent booms, clean spade, and buckets must be well-prepared for use and be in close vicinity to the chemical storage area;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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.*
		• 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.*
		• Preparation of an emergency response plan, training of the emergency response team (ERT) to be competent in the response mechanism and provision of response kits for any spillages;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*
		• 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.*
		• 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.*
		• Appropriate concrete wash out areas shall be provided and shall not be performed in or near nay of the streams;	Contractor	EMMP Consultant 's ECO/ EMMP

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
				Consultant/ SO Rep.*
		• 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.*
		• Development of a Standard Operation Procedure (SOP) for safe handling, transfer, storage, and disposal of solid waste;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Provision of enclosed bins and waste disposal facilities cleared up as often as necessary to prevent build-up. Housekeeping checks will be carried out once a day to ensure all litter is cleared from site;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Consignment notification/tracking system and transport emergency response plan for transport of toxic waste;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Appropriate disposal of toxic waste as per required in the Environmental Public Health (Toxic Industrial Waste) Regulations by licensed waste operator/collector;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• A full inventory of all anticipated wastewater streams and volumes should be finalised before the onset of the construction works;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• No unmanaged discharge of wastewater stream permitted;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Containment ponds will be of impervious material and be designed with sufficient capacity to hold volumes of wastewater produced on-site, as well as allowance for stormwater runoff and potential fire-fighting wastewater;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Temporary storage volumes should be provided for overflow situations. Temporary storage to be of sufficient capacity to capture any additional volumes that may be expected to ensure untreated wastewater is not released to watercourses unless it complies with Singapore NEA Guidelines on trade effluent discharge concentrations;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Daily record volume of wastewater, as well as volumes of sludge and other produced wastes;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• The containment ponds, as well as wastewater generating areas on-site, to be equipped with spill clean-up kits;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Implement a construction EMMP and ensure full preparation of associated plans and procedures including the following: – EMMP to include SOPs, an Emergency Response Plan (ERP), an inventory of wastewater streams, training of staff as well as an inspection, maintenance and audit schedule; and – Full development of EMMP Wastewater Management Procedures to include dedicated management and monitoring procedures that covers all eventualities related to the proper operation of the detention ponds, or any other wastewater discharge location/equipment.	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Regular and dedicated procedures for the inspection and maintenance of wastewater collection, storage, and treatment infrastructure, such as pipes, oil water separators, silt screens, etc.; – Regular and dedicated procedures for the management of stormwater collection, settling, testing and eventual discharge of 'clean' water to watercourses. This should also include associated measures required (e.g. silt curtains) to prevent high sediment concentration stormwater drainage to watercourses; and – A training programme for all on-site workers, including sub-contractors, in relation to their obligations for ensuring proper water quality management.	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Adequate drainage, piping and/or channeling of stormwater runoff to be assured through detailed design for capture and treatment before discharge into surface watercourses;	Contractor	EMMP Consultant 's ECO/ EMMP

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
				Consultant/ SO Rep.*
		• Regular and dedicated procedures for the inspection and maintenance of stormwater collection, storage, and treatment infrastructure, such as pipes, oil water separation, silt screens, etc.;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Regular and dedicated procedures for the management of stormwater collection, settling, testing and eventual discharge of 'clean' water to surface waters. This should also include associated measures required to prevent high sediment concentration stormwater drainage to surface waters;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Effective ECM and monitoring implemented as recommended in the Code of Practice on Surface Water Drainage to ensure that discharge into stormwater drainage system does not contain TSS in concentrations greater than the prescribed limits under the Sewerage and Drainage (Surface Water Drainage) Regulations;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• ECM measures include but are not limited to minimisation of formation of bare soil, coverage of all bare/erodible surfaces, concrete cut-off drains, silt fences/traps along the perimeter cut-off drain, turbidity curtains for works adjacent to water bodies (canals, drains, streams), etc.	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Runoff within, upstream of, and adjacent to the work site shall be effectively drained away without causing flooding in the vicinity;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Manholes should always be adequately covered and temporarily sealed;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Protection of stockpiles with biodegradable erosion blanket coverage and proper scheduling of the demolition and earthworks to reduce the quantity of stockpiles to be stored onsite;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Coverage of temporary/open storage of excavated materials;	Contractor	EMMP Consultant 's ECO/ EMMP

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
				Consultant/ SO Rep.*
		• All vehicles should run via wheel washing process before leaving the site to ensure no earth, mud, debris, etc., deposited on roads and the wastewater hence generated should be stored and removed for treatment and disposal off-site by an approved Waste Management Contractor;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Potential increase of peak-flow due to the change in the land use at the worksite can be mitigated by providing detention tanks or ponds within the Study Area. Detention tanks or ponds can capture stormwater during heavy storm events to reduce the peak runoff;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Geotechnical aspect of site's slope stability (such as Earth Retaining and Stabilising structures (ERSS) to be included in detailed design engineering for the construction stage;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• The design engineers for detailed design may need to ensure that Earth Retaining Stabilisation structures (ERSS) are proposed when the site is cleared and excavated. Concurrently the ECO must ensure that these measures are implemented in the construction phase, as cutting of slopes may result in slope instability;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Groundwater monitoring to comply 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.*
		• Proper Earth Retaining Stabilising Structures (ERSS) should be selected and designed to limit groundwater settlement;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Schedule the proposed development in phases in order to minimize the volume of dewatering at any one time;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Use recharge wells as necessary during the excavation (if with basements) to limit the potential groundwater drawdown.	Contractor	EMMP Consultant 's ECO/ EMMP

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
				Consultant/ SO Rep.*
		• All works to be conducted by the Contractor including dewatering or recharging of groundwater, are to be planned and implemented to have minimal impact to the hydrological conditions of the streams, including any changes to the groundwater or affecting soil or slope structural stability of the conserved areas and the adjacent Bukit Batok Hillside Park area. Groundwater levels and quality of surface and groundwater within the stream or catchment of the conserved areas should be monitored throughout the duration of the development works. No slope works, installation of retaining structures or drainage should affect areas and habitat outside of the development boundaries.	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		Site-specific (to be implemented in Pre-construction):		
		• 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 6.2. 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).	Contractor and EMMP Consultant	EMMP Consultant/ SO Rep.*
		Site-specific (to be implemented in Stage 1):		
		• 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 8.2.1.1.	Contractor and EMMP Consultant	EMMP Consultant/ SO Rep.*
		• 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.	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		• ECO should conduct daily inspection on drainage, water quality of surface runoff and any abnormalities inside drainage system (e.g., fish kill).	EMMP Consultant's ECO	EMMP Consultant/ SO Rep.*
Air Quality				

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
Site clearance, machinery and generator operation, vehicle, construction works.	Air quality impact from dust nuisance from earthwork, construction activities and gaseous emissions from the construction equipment and vehicles.	**General (to be implemented in Stage 1):**		
		<u>Minimum Control:</u>		
		• No demolition of permanent structure is expected as part of the project.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• No concrete batching plant to be located on-site.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• 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>		
		• Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• Develop and implement an Air Pollution Control Plan (APCP)	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Contractor to follow up on Air Quality control measures.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Contractor to prepare the Site Environmental Control Program in accordance with the NEA's guidelines, which is to be submitted by Contractor to the Director-General of Public Health of NEA	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		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	EMMP Consultant's ECO, EMMP Consultant
		• 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>		
		• 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
		• Make the complaints log available to the local authority when asked.	Contractor, PRO	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• 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>		
		• 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
		• Carry out regular site inspections to monitor and record compliance with the Air Pollution Control Plan.	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Increase the frequency of site inspections during prolonged dry or windy conditions.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Conduct monitoring for PM_{10} and $PM_{2.5}$ at suitable locations.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• 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>:		
		• 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
		• Plan site layout so that machinery and dust causing activities are located away from receptors, where possible.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• 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
		• 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
		• 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

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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
		• 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
		• Contractor should keep extent of excavation and soil exposure areas to minimum required for construction.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• 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
		• 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
		• 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>		
		• 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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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
		• Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Ensure all vehicles and engine powered equipment comply with the legislative requirements of Singapore	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• 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
		• 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>		
		• 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
		• 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
		• Use enclosed chutes and conveyors and covered skips wherever possible.	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• Maintaining a minimum moisture content during any rock rushing works.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Covering soil stockpiles with erosion control blankets.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Waste Management:</u>		
		• Avoid burning of waste or other materials.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Where possible, horticultural waste should be upcycled as wood material for products.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• As much as possible, horticultural waste should be transported offsite by licensed waste management contractors to horticultural waste recycling facilities where the wood waste can be grinded into wood chips for horticultural reuse (i.e. compost or mulch).	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Trackout:</u>		
		• 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

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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
		• 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
		• 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
		• 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
		• 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
		• Record all inspections of haul routes and any subsequent action in a site log book.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Site access gates to be located at least 10m from receptors where possible.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• If roadways are contaminated with dusty materials from construction site, clean-up shall be conducted without delay.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		Site-specific mitigation measures (to be implemented in Stage 1)		
		ADDITIONAL MITIGATION MEASURES FOR EARTHWORKS		
		• 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
		• Only remove the cover in small areas during work and not all at once.	Contractor	EMMP Consultant's ECO, EMMP Consultant
Airborne Noise				
Excavation, earth work, site clearance, machinery and generator operation	Noise from construction machines and equipment (e.g. dozers, cranes, excavators, trailers, generators, etc.)	**To be implemented in Stage 1**		
		GENERAL MITIGATION MEASURE TO BE IMPLEMENTED THROUGHOUT CONSTRUCTION PERIOD		
		• All machinery and equipment used will be labelled with a weather-proof sticker clearly indicating its noise emission level (at source) under normal operating conditions	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• All machinery and equipment used on site will be sound reduced, as far as is practicable in accordance with Annex G of SS 602:2014, for each equipment, the contractor should have a sound power level for each equipment obtained from the equipment supplier. That sound power level needs to compare with BS standard or EIS assumption. And it should be less than the BS standard or EIS assumption	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Stationary noisy equipment will be housed in enclosures (refer to F.3 SS 602:2014 and LTA Guidebook for best environmental practices (Noise Control at LTA Sites)) on site where necessary	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Machine operators and workers will be trained and briefed on quieter work techniques	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Noise awareness briefing will be conducted once in 3 month regularly/ as in when noise exceedance found in the monitoring equipment around the site. As highlighted, this briefing will include best practices on site, corrective action to be taken etc. depending on the situation. This will include a discussion of the noise mitigation measures such as the position of machinery, making use of portable noise barriers if necessary, dos and don'ts for use of machinery, behavioural practices including no shouting, no loud stereos/ radios on site, no dropping of materials from height, no throwing of metal items etc	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Ad-hoc noise monitoring will be carried out when work progresses during noisy operations	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Additional noise measures will be implemented when noise monitoring indicates the noise levels are approaching or exceeding permissible noise levels and 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	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Control of noise sources at the source from construction site – Analyse construction inventory list and check equipment causing high noise levels. The equipment with lower noise level shall be prioritized	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Where controlling noise sources at the source is not feasible, acoustic enclosures or sheds are to be introduced to mitigate noise at the source. Typical acoustic enclosure covers the machine as fully as possible (with or without ventilation where applicable) to provide sound insulation	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• No work allowed from 10.00pm on Saturday/eve of Public Holiday to 7.00am on the following Monday/day after the Public Holiday	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		adjusted noise level, contractor should investigate and apply appropriate mitigation measures. The proposed noise monitoring locations are as follow: – CN1: Block 304 HDB Bukit Batok; – CN2: Within the Conservation Area; – CN3: Dazhong Primary School; and – CN4: 467a Bukit Batok West Ave 9.		
		• Contractor to prepare the Site Environmental Control Program in accordance with NEA 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
		• Contractor to prepare and submit bi-weekly Site Environmental Control Report to EMMP Consultant and SO Rep. in accordance with NEA Guidelines	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• 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 Consultant's ECO, EMMP Consultant
		• Construction prohibition period should be followed, as per fourth schedule of Environment Protection and Management regulation	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Prepare a Construction Noise Management Plan, to establish pre-construction baseline monitoring, plan for monitoring during the construction phase, and procedure for complaint handling	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• The contractor shall review the equipment to be used on site and erect localised noise barriers prior to undertaking high noise generating work	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Machines (such as trucks) that may be in intermittent use shall be shut down between work periods or shall be throttled down to a minimum	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Only well-maintained construction plants shall be utilized on-site, and plants shall be serviced regularly during the entire construction period	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• The number of PMEs shall be reduced as far as practicable when construction works are carried out at areas close to the noise sensitive receivers	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Consider use of silencers or mufflers on construction equipment which are properly maintained during the construction programme while facing sensitive receptors	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Behavioural practices including no shouting, no loud stereos/ radios on site, no dropping of materials from height, no throwing of metal items shall be ensured	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Construction respite: Restrict high noise generating drilling activities only in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block, if possible	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Periodic noise monitoring by an independent third party, to establish compliance with requirements and to advise on equipment causing concern, and additional potential mitigation measures	Contractor	EMMP Consultant's ECO
		• Plan the layout of the site by considering using materials and other large structural equipment as noise barriers	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Plant known to emit noise strongly in one direction shall, wherever possible, be orientated so that the noise is directed away from the nearby NSRs	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Material stockpiles and other structures shall be effectively utilized, wherever practicable, in screening noise from on-site construction activities	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Acoustic sheds should be provided at the locations of the noise generating activity such as operation of hand-held breaker	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• 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	Contractor	EMMP Consultant's ECO, EMMP Consultant, SO Rep.*
		• 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.*
		• 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
		• 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. Al 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.*

<table>
<tr><th>Activity</th><th>Potential Environmental Impacts</th><th>Mitigation Measures</th><th>Implementation Responsibility</th><th>Inspection Responsibility</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th>Types of Affected Buildings</th><th>Applicable Period</th><th>Maximum Permissible Equivalent Continuous Noise Level Measured Over a Period of 5 Minutes in dB(A)</th></tr>
<tr><td rowspan="3">(a) Hospitals, schools, institutions of higher learning, homes for the aged or sick etc.</td><td>7am to 7pm</td><td>75</td></tr>
<tr><td>7pm to 10pm</td><td>55</td></tr>
<tr><td>10pm to 7am</td><td>55</td></tr>
<tr><td rowspan="3">(b) Residential buildings located less than 150 m from the construction site where the noise is being emitted</td><td>7am to 7pm</td><td>90</td></tr>
<tr><td>7pm to 10pm</td><td>70</td></tr>
<tr><td>10pm to 7am</td><td>55</td></tr>
<tr><td rowspan="3">(c) Buildings (other than those in paragraphs (a) and (b))</td><td>7am to 7pm</td><td>90</td></tr>
<tr><td>7pm to 10pm</td><td>70</td></tr>
<tr><td>10pm to 7am</td><td>70</td></tr>
</table>

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 14dyas 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

</td><td></td><td></td></tr>
</table>

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		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.		
Vibration				
General construction activities	Disturbance to ecology and human	**To be implemented in Stage 1**		
		<u>General:</u>		
		• Use low vibration equipment and construction techniques.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• 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 is, taking into account the vulnerability of the neighbouring properties to damage and the frequency of taking readings.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• The Contractor shall ensure that the vibration levels for coring, removal of rock, blasting etc., comply with National regulations.	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Contractors shall be responsible for complying with and implementing all requirements by the laws and authorities on ground vibration pollution control.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Place vibrating equipment (e.g., pipe jacking unit) on isolators such as spring coils.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Route heavily loaded tipper trucks away from the vibration sensitive receptors as far away as possible.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• Phased earthmoving, ground pilling and excavation operations so as not to occur at the same time in the same area, if possible, to minimize cumulative impact.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• Notify nearby vibration sensitive receptors in advance of the construction activities, particularly during the installation of sheet piles and tunnelling works (e.g., pipe jacking and TBM), to allay potential concerns.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• While using vibratory compactors, shut off the vibrator when reversing direction (the highest level of vibrations are often generated when quickly stopping and changing direction). Utilize a vibratory compactor that can adjust the impulse energy and frequency, compact soil with a static method (no vibrations), and oscillation compaction in place of conventional vibratory action, as far as practicable.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Fill in potholes and eliminate pavement discontinuities; keep haul roads smooth by periodic grading; pave existing roads to provide a smooth travelling surface; reduce the speed of vehicles and weight of vehicle loads as far as practicable.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Ecological Receptors:</u>		

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Set up barriers to prevent road kills.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Contractor shall conduct monitoring for vibration at ecologically sensitive areas.	Contractor	ECO, EMMP Consultant
		<u>Human Receptors:</u>		
		• 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.*
		• 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.*
Vector Control				
General construction activities	• Increase in the number of mosquitoes • Increase in the number of other vectors (i.e. rodents) • Increase in the case of dengue fever	**General (to be implemented in Stage 1):**		
		<u>Standard Measures</u> • 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.*
		• 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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• Scheduled daily housekeeping to ensure clearance of stagnant water and unwanted items are discarded properly;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Site entrance shall be paved to avoid ground depression;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Milled waste can be used to level the ground before laying steel plates;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Provide movable roof over shaft to prevent rainwater ingress;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• 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.*
		• Install pitched roof on top and/or seal up bottom of site container office;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• Area selected for site office should be fumigated before works take place;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Existing vegetation or undergrowth within 6 m of any stream, seepage, running or standing water should be cleared without prior approval from NEA, before construction works commence to in line with CVPA;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Providing a clear boundary for insect and vector control where populations will be monitored within the construction site;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Remove any pooled water in less than a week, as the Aedes mosquito eggs can develop into adult mosquitoes in less than a week in optimal conditions, by following measures: - Any water ponding on-site (from potholes, puddles, and locations of earthworks) should be backfilled with compacted soil immediately after inspection, or when construction activity in that area is ceased; - Granular insecticide should be applied into any water found to be collected in perforated bricks; - Any choked drains or channels used to direct water should be cleared of blockages; - Concrete should be placed in the gaps of any corrugated roofs;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		- Any material stored on-site should be raised 60 cm to ensure that the pest control team and the licensed pathogen vector control operator can see and remove vector populations; - Any receptacles located on-site that have the purpose of storing water should be emptied at the end of each day; - Any receptacles which can catch and hold rainwater should be stored in an undercover tool storage area or waste storage area; and - Any free hanging tarpaulins on-site should be taught to prevent water containment.		
Waste Management				
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)	**General (to be implemented in Stage 1):**		
		<u>Standard Measures</u> • 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.*
		• 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.*
		• 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	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• 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.*
		• 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.*
		• 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	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		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;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• 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.*
		• 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.*
		• 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.*
		• 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
		• 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.*
		• All horticultural waste should be transported off-site to specialized horticultural recycling facilities where they can be grinded into wood ships 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.*
		• 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.*
		• 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.*
		• 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.*
		• Implement strict waste handling, storage, collection, and disposal practices to prevent leakages;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• 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.*
		• 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.*
		• 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
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• Appropriate disposal of any waste listed in the Environmental Public Health (General Waste Collection) Regulations by licensed waste operator/collector;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Development of SOP for safe handling, transfer and storage of toxic waste; housekeeping checks once a day to ensure all toxic waste is cleared from site;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Appropriate construction material for toxic waste storage containers with leak detection tests conducted periodically;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Provision of secondary containment for all toxic waste stored in bulk as per the requirements in the COPPC/SS593;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Hazardous wastewater, such as oily water, thinners, solvents, or paints, are to be stored and removed for treatment and disposal off-site by an approved Waste Management Contractor. Hazardous liquids to be handled as Hazardous Waste;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Daily record volume of wastewater, as well as volumes of sludge and other produced wastes;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Inspections and audits to ascertain the hygienic conditions onsite;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Training of workers on the best practices to contribute to environmental protection;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Appropriate location of toilet facilities away from any nearby watercourses.	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• The contractor should ensure that information in the waste management plan that is applicable to individual site workers is disseminated to them;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Waste storage facilities should be fit for purpose by ensuring that waste containers/ storage areas are capable of containing predicted waste volumes, for each waste type, in a manner unlikely to cause damage to the environment or harm to human health;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Waste designated for off-site recycling or disposal will only be transferred to such parties that can demonstrate that they are licensed to transport and/or treat or dispose of the waste in accordance with relevant Singapore Regulations;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Portable toilets for construction workers must be placed inside each construction area, with the sewage pumped away regularly by an appropriately licensed waste disposal company;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• All containers which were previously used to store pesticides and other chemicals should be bored with holes to ensure that these containers are not reused.	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.				

Table 1-4 Summary of Monitoring plan and the Responsible Parties

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
Biodiversity: Flora					
Major Impact: • Site clearance • Earth works • Tree-felling works Minor Impact: • Pre-construction survey • Soil Investigation works • Hoarding works • Road 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: • 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.	EMMP Consultant	EMMP Consultant/ SO Rep.*
	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: The EMMP Consultant finds that habitat degradation has taken place; recommendations tailored to the finding should be adhered to. Rectification: 48 hours	NA	EMMP Consultant
	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: • Report to SO Rep. for downstream reporting to NParks.	NA	EMMP Consultant

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
Biodiversity: Arboriculture					
Major Impact: • Site clearance • Earth works • Tree-felling works Minor Impact: • Pre-construction survey • Soil Investigation works • Hoarding works • Road works	**Monthly Tree Inspections** Visual inspection of the trees along 15m from the hoarding line. Some factors that will be inspected are: – Physiological health and structural stability of trees. – Identify and assess trees that requires removal for the safety of the workers.	Monthly throughout the construction phase	Corrective actions will need to be taken if: • The structure and health of the trees along the new forest edge has deteriorate and are deemed unsafe by an appointed Arborist. • 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. Rectification: 24 hours	EMMP Consultant/ Appointed Arborist	Appointed Arborist
Biodiversity: Fauna					
Major Impact: • Site clearance • Earth works • Tree-felling works Minor Impact: • Pre-construction survey • Soil Investigation works • Hoarding works • Road works	**Monthly Fauna Monitoring** Conduct fauna monitoring within the future Bukit Batok Hillside Nature Park to monitor for construction impacts on fauna activity and presence.	• Once during pre-construction phase • Monthly throughout construction phase • Twice in post-construction phase	Corrective actions will need to be taken if: Excessive disturbance generated by construction activities is detected	EMMP Consultant	EMMP Consultant/ SO Rep.*
	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 of ground-dwelling mammal(s) occur within 7 days of each other; Contractor	Contractor	EMMP Consultant

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
			to check the integrity of the hoarding line along Bukit Batok West Avenue 2 and Bukit Batok West Avenue 5 and carry out rectification, if any. Rectification: 24 hours		
Hydrology, Surface Water and Groundwater					
Pre-construction					
Site clearance, spillage of oil, fuel and lubricant from vehicle and machinery, oil drips from generator, chemical spill.	<u>Surface Water Monitoring</u> Water quality sampling at proposed locations and 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 proposed locations during pre-construction phase.	Investigation and corrective actions to be taken, when: • The following documentation are found inadequate/missing: - ECM Plan; - Monitoring Log; - Training Log; - Audit Reports; • If the monitored parameters exceed applicable values of NEA Trade Effluent Discharge Limits to Controlled Watercourse; • If groundwater level change significantly; • If any flooding or clogging issues observed;	Contractor/EMMP Consultant's ECO	EMMP Consultant/ EMMP Consultant's ECO/ SO Rep.*
	<u>Groundwater Monitoring</u> Groundwater level monitoring at Stream A	One-time monitoring during pre-construction phase.		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.		Contractor	EMMP Consultant/ EMMP Consultant's ECO/ SO Rep.*

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
			• If complaints are received due to project activities; and • If visual non-compliance to any of the minimum control or mitigation measures are observed on-site.		
Stage 1					
Site clearance, spillage of oil, fuel and lubricant from vehicle and machinery, oil drips from generator, chemical spill.	<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: • The following documentation are found inadequate/missing: - ECM Plan; - Monitoring Log; - Training Log; - Audit Reports; • If the monitored parameters exceed applicable values of NEA Trade Effluent Discharge Limits to Controlled Watercourse; • If groundwater level change significantly;	Contractor/QECP	EMMP Consultant's ECO
	<u>Earth Control Measures (ECM) Implementation</u> Permanent TSS monitor and implementation of CCTV including a SIDS installed at every discharge outlet	Continuous monitoring		Contractor/QECP	EMMP Consultant/ EMMP Consultant's ECO/ SO Rep.*
	<u>Surface Water Monitoring</u> Water quality sampling to ensure the discharge water quality in accordance with NEA's Allowable Limits for Trade Effluent Discharge in a controlled watercourse.	Monthly at all locations for all parameters and quarterly for additional parameters at construction discharge outlet		Contractor/EMMP Consultant's ECO	EMMP Consultant/ EMMP Consultant's ECO/ SO Rep.*
	<u>Groundwater Monitoring</u> Groundwater level monitoring at Stream A	Monthly		Contractor/EMMP Consultant's ECO	EMMP Consultant/ EMMP Consultant's ECO/ SO Rep.*
	<u>Groundwater Monitoring</u> Groundwater level and quantity monitoring as required in Singapore Building Control	Weekly		Contractor	EMMP Consultant/ EMMP Consultant's ECO/ SO Rep.*

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
	Regulations 2003 [R-29] during dewatering process at where the excavation take place.		• If any flooding or clogging issues observed; • If complaints are received due to project activities; and • If visual non-compliance to any of the minimum control or mitigation measures are observed on-site.		
	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.*
Air Quality					
Stage 1					
Site clearance, machinery and generator operation, vehicle.	Monitoring of PM_{10} and $PM_{2.5}$ at two (2) locations	Continuous monitoring during earthworks phase.	When earthworks activity starts.	Contractor	EMMP Consultant
	Daily inspection by EMMP Consultant's ECO on eastern boundary facing residential areas and also internal for ecological sensitive receptors.	Daily	-	EMMP Consultant's ECO	EMMP Consultant
	Carry out bi-weekly environmental audit during construction phase.	Bi-weekly	-	EMMP Consultant	EMMP Consultant/ SO Rep.*
Airborne Noise					
Stage 1					
Excavation, earth work, site clearance, machinery and generator operation	• Monitoring of $L_{Aeq(12\ hr)}$ $L_{Aeq(1\ hr)}$ and $L_{Aeq(5min)}$ at four (4) 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.	Before commencement of any construction works (including site clearance) • One-time airborne noise monitoring for 1 week at the proposed locations, for establishment of latest baseline. During Construction Phase	Ecological sensitive receptors are next to construction site	Contractor	EMMP Consultant

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
	Ecological receptor noise impact will be assessed against the baseline noise level as the noise criterion.	• 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.			
	• Daily inspection by the 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
	• Carry out bi-weekly site inspection during construction phase.	Bi-weekly	-	EMMP Consultant/ EMMP Consultant's ECO	EMMP Consultant/ SO Rep.*
Vibration					
Stage 1					
General construction activities	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	• Construction works are closed to the existing buildings or structures • Public complaints received	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
	Carry out bi-weekly site inspection during construction phase.	Bi-weekly	-	EMMP Consultant	EMMP Consultant/ SO Rep.*
Vector Control					
Pre-construction					
General construction activities	Submission of Vector Control Plan	Prior construction	-	In-house vector control team appointed by Contractor	VCO/Contractor
Stage 1					
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:	In-house vector control team	VCO

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
	Vector control and surveillance [potential mosquitoes breeding grounds (water ponding), rat/ rodent burrows, cockroaches droppings, etc.]	Weekly during construction phase	• Worksite is found to have vector-breeding habitats. • There is an occurrence of suspected dengue outbreak cases.	VCO/External NEA-licensed VCO	Contractor/EMMP Consultant's ECO/EMMP Consultant/ SO Rep.*
	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.*
Waste Management					
Pre-construction					
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)	Site-specific waste strategy and management plan (including monitoring, review and reporting protocol)	Prior construction	-	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
Stage 1					
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	Waste management/housekeeping works	Daily during construction phase	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.	On-site waste management team	Contractor/ EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
in the EPHA and EPH (Toxic Industrial Wastes) Regulations)	Environmental performance monitoring	Monthly during construction phase		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.					

Emergency Response Plans

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, relevant drainage issue and water incidents, any abnormal amount of smoke/ dust/ odour releasing, abnormal level of airborne noise and vibration incident were outlined in Section 9.3 - 9.8.

2 Introduction

AECOM Singapore Pte Ltd was 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 Bukit Batok Hillside Park Area (Area C) (hereafter referred to as the "Project"). Area C is a 3-hectare site located at the Bukit Batok, a residential town located in the West of Singapore (Figure 2-1). Currently, the site mostly consists of secondary forest, a freshwater stream (Stream B) and the site is surrounded by residential developments and educational institutions along the east of the site.

Prior to the start of this Project, an Environmental Impact Study (EIS) [R-1] was conducted for Bukit Batok Hillside Park, which completed in December 2020 and is inclusive of Area C. Within Area C, an endangered mature *Ficus vasculosa* tree and its Tree Protection Zone (TPZ) were proposed to be retained as the Recommended Area of Conservation (RAC). In consideration of the ecological sensitivity of the existing land use, the retained RAC as well as the proximity of this site to residential areas and educational institutions, 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 C, the construction timeline was divided into two (2) main stages (i.e. Stages 1 and 2). An EMMP programme was developed for each of the stages for Area C and provides management and monitoring requirements for biodiversity, hydrology, surface water and groundwater, 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.

2.1 Project Location

Area C, is a 3-hectare site (the worksite also known as Bukit Batok N4-C28) located within the southeast of Bukit Batok Hillside Park Area and is bounded by Bukit Batok West Avenue 5 in the south of the site and Bukit Batok West Avenue 2 in the east of the site (Figure 2-1). Area C is also currently bordered by forested areas. Currently, the site mostly consists of secondary forest, a freshwater stream (Stream B) and the site is surrounded by residential developments and educational institutions along the east of the site. The site will be developed for residential development. Based on the completed EIS report [R-1], an endangered mature *Ficus vasculosa* tree and its Tree Protection Zone (TPZ) were identified as the Recommended Area of Conservation (RAC) and will be retained. The overall proposed construction works to be carried out within Area B is also presented in Figure 2-1 below.

Legend

- EIS Study Area
- EMMP Site Boundary and Construction Worksite for Area C
- Recommended Area of Conservation
- Watercourses

N

Rev.	Date	By	Description	Chk'd	App'd
-	SEP 2022	CKL	Draft Report	NHT	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

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

Figure Title :

EXPANSE OF PROPOSED CONSTRUCTION WORKSITE WITHIN AREA C

Designed	Checked	Approved
CKL	NHT	JAG
	Drawn: CKL	Date: SEP 2022

Figure No. : 2-1 | Rev. : - | Sheet : 1 of 1

CAD File Name : NA | A3

Note: Source of basemap - Google Earth Map

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2.2 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.

2.3 Report Structure

The structure of the report is as follows:

- **Section 1** – Executive Summary provides a concise summary of the EMMP;
- **Section 2** – Introduction of the Project provides the scope of the report, report structure, study limitations, assumptions and constraints;
- **Section 3** – Summary of Environmental Impact Study (EIS) presents the key baseline findings, assessed impacts, proposed mitigation measures and Recommended Area for Conservation (RAC);
- **Section 4** – Proposed Construction Activities and Timeline details the Project components, overall construction timeline and proposed construction activities for each stage;
- **Section 5** – Applicable Environmental Legislation provides the key legislative requirements relevant to the Project;
- **Section 6** – 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 7** – 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 8** – Environmental Management and Monitoring Plan for Stage 1 details the EMMP programme during Stages 1 for biodiversity, hydrology, surface water, groundwater, air quality, airborne noise, vibration, vector control and waste management;
- **Section 9 -** Emergency Response Plan provides the objectives of the plan, key emergency contacts for environmental incidents, response plans for wildlife, drainage, surface water and groundwater, air quality, airborne noise and vibration; and,
- **Section 10** – Conclusion provides a summary of the key details from this EMMP specification report.

2.4 Study Limitations, Assumptions and Constraints

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3 Summary of Environmental Impact Study

This section provides a summary of the completed Environmental Impact Study (EIS) report on the Bukit Batok Hillside Park Area [R-1]. This includes the objective of the EIS, description of the 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 the EIS report.

3.1 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 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

3.2 EIS Study Area

The EIS Study Area included an area of 17 ha, located in Bukit Batok, a residential town located in the West of Singapore., It is currently a secondary forest of approximately 17 ha and part of it is known as the Bukit Batok Hillside Park. The Bukit Batok Hillside Park and its extension are approximately 7.6 ha and are zoned as 'Park' in the Master Plan 2019 (Figure 3-1). Approximately half of the project area along the Bukit Batok West Avenue 5 is earmarked for residential development, in accordance with Master Plan 2019. The proposed residential buildings will be about 14-18 storeys per building.

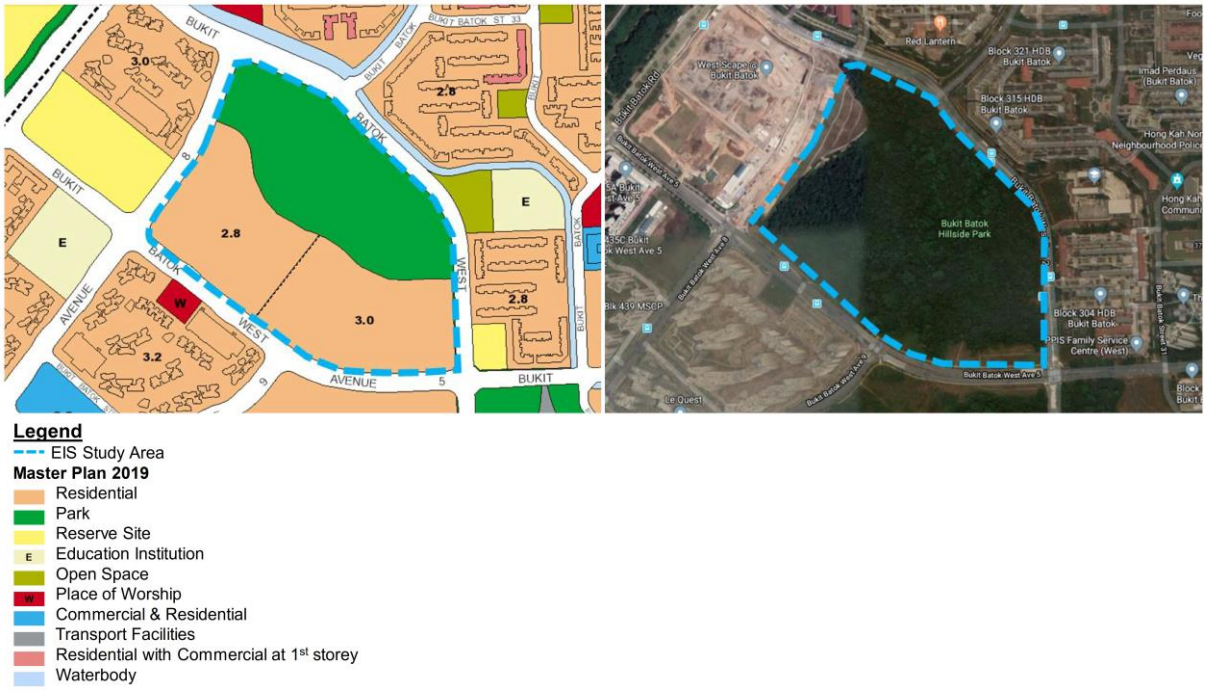


Figure 3-1 EIS Study Area (source: Bukit Batok Hillside Park Area EIS Report [R-1])

3.3 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 3-1 below.

Table 3-1 Summary of Key Baseline Findings from EIS (Source: Bukit Batok Hillside Park Area EIS Report [R-1])

Environmental Parameter	Baseline Findings
Biodiversity (Figure 3-2; Figure 3-3)	• Fauna – A total of 81 fauna species were recorded which comprised of 29 bird species, 5 mammal, 6 reptile, 7 amphibians, 6 fish, 15 butterfly and 13 odonate species. 5 birds have conservation concern – 3 Endangered and 2 Vulnerable. No Critically Endangered species were recorded during the surveys. • Flora – A total of 74 plant species were identified, of which 10 have conservation concern. 7 out of 10 are thought to have originated from cultivation and are most likely the progeny of cultivated specimens with the seeds having been distributed by birds and bats.
Surface Water Hydrology - Stream Mapping (Figure 3-5)	• There are two permanent streams on site, which will be referred to as Stream A (185m in length) and Stream B (15m in length) in this report. Both streams had been modified and an aquaculture pond on Stream B had been filled at the time of the survey. The flow rate of both streams is approximately 1.7 – 1.8 litres/s.
Surface Water Quality (Figure 3-4)	• Water samples collected over wet and dry periods at 50m intervals along the streams shows that all results are within the Allowable Limits for Trade Effluent Discharge to Watercourse, except for pH which ranged from 3.69 to 4.72. Slightly acidic water may be due to the local soils or historical use of fertilizers and pesticides.
Air Quality (Figure 3-7)	• Secondary data was obtained from the Department of Statistics Singapore and used as the baseline data. The data shows that the Annual Mean and Maximum 1-hour Mean for PM_{10} and $PM_{2.5}$ is above the 2020 Target Value while the Maximum 24-hour Mean for Sulphur Dioxide and Maximum 8-hour Mean for Ozone is above the 2020 Target Value.
Airborne Noise (Figure 3-6)	• Baseline noise level measurement for parameters L_{Aeq} 5-min, 1-hour and 12-hour was conducted at two affected human noise sensitive receiver (BB_N1 and BB_N2) • BB_N1 for human receptors (L_{Aeq} 5-min) ranging from 53.9 – 76.6 dB(A) during 7am-7pm, 53.9-73.1 dB(A) during 7pm-10pm, 43.9 –62.3 dB(A) during 10pm-7am • BB_N2 for human receptors (L_{Aeq} 5-min) ranging from 53.1 – 74.3 dB(A) during 7am-7pm, 56.5-71.3 dB(A) during 7pm-10pm, 42.2 –65.3 dB(A) during 10pm-7am • Maximum permissible noise levels generally exceeded for community NSRs due to proximity of the Bukit Batok West Avenue 2 and the exceedance were likely related to the road traffic.

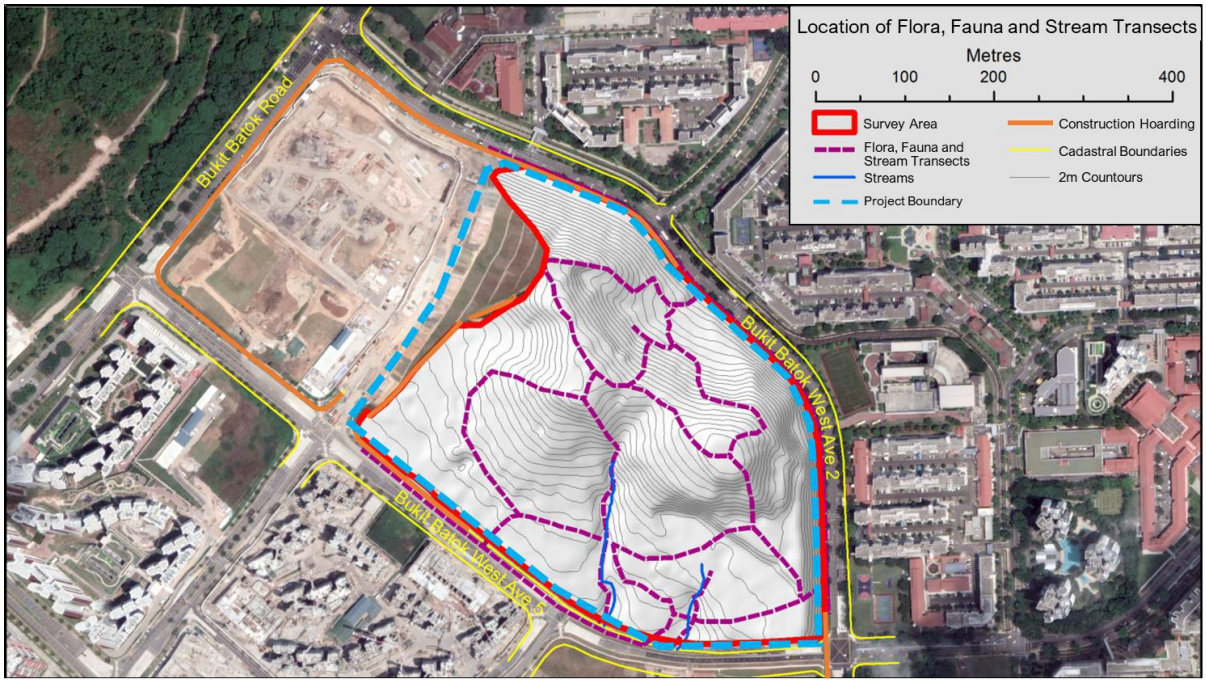


Figure 3-2 Flora, Fauna and Stream Transect Locations (source: Bukit Batok Hillside Park Area EIS Report [R-1])

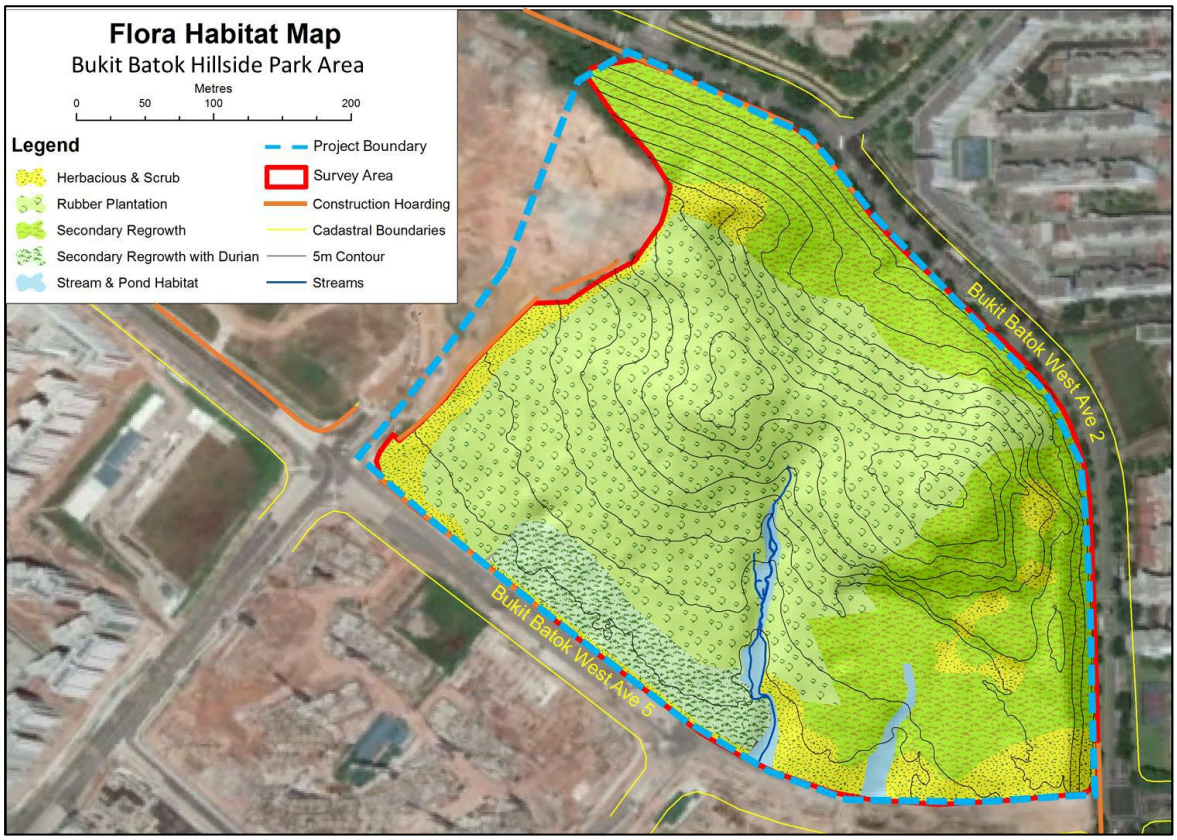


Figure 3-3 Flora Habitat Map (source: Bukit Batok Hillside Park Area EIS Report [R-1])

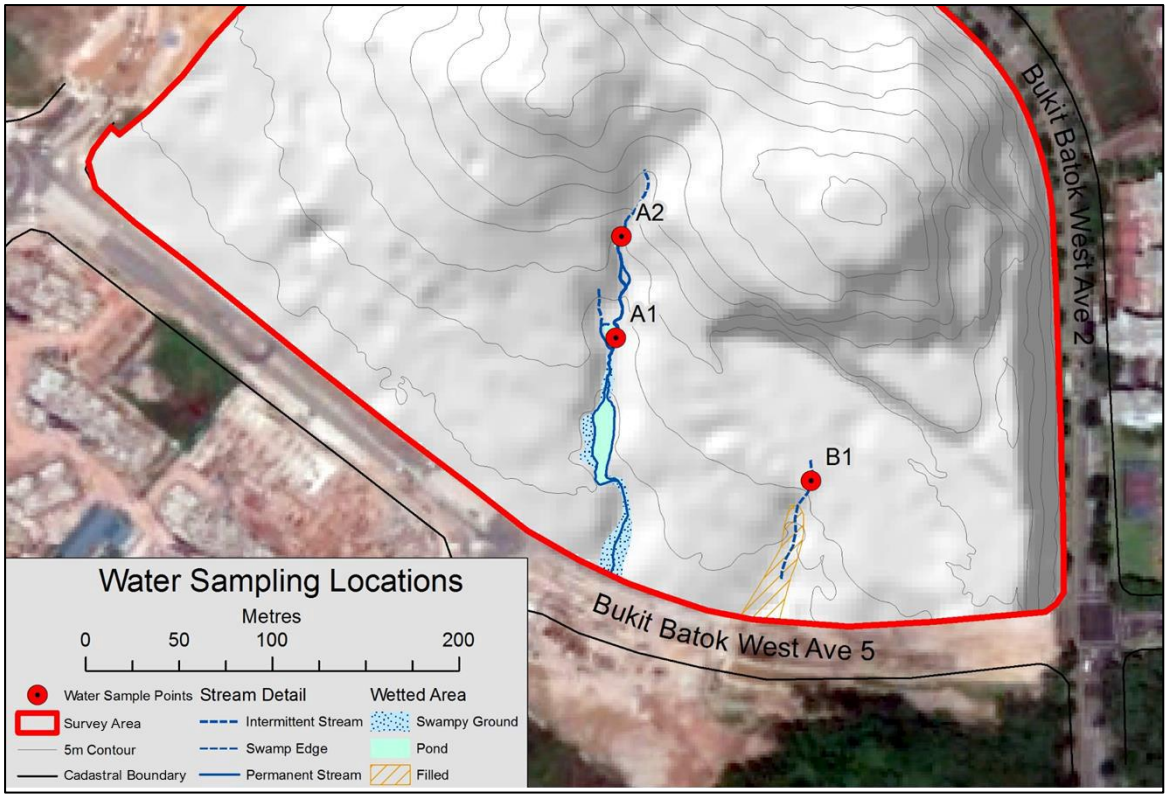


Figure 3-4 Locations of Surface Water Sampling (source: Bukit Batok Hillside Park Area EIS Report [R-1])

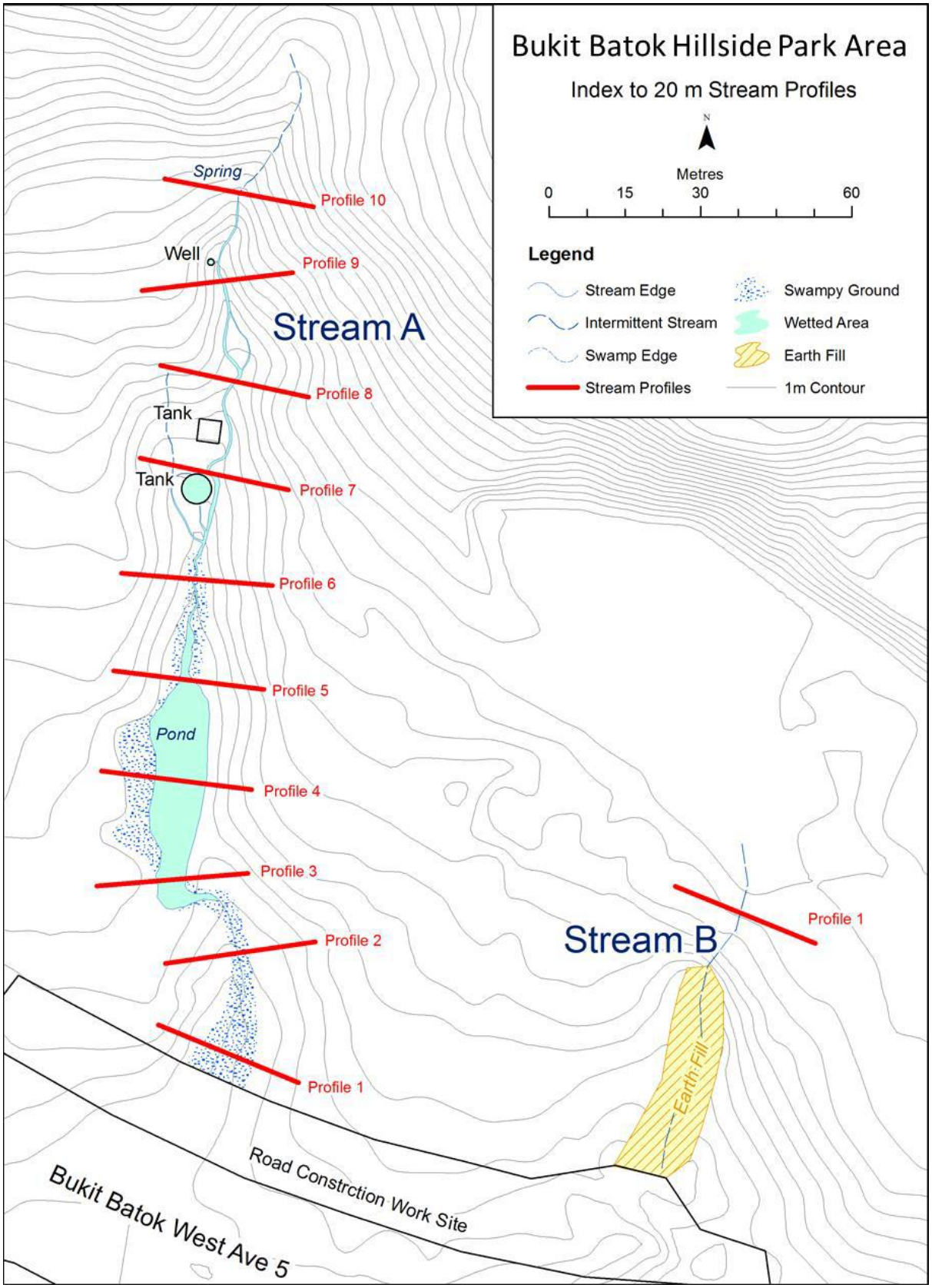


Figure 3-5 Stream Profile Index Map (source: Bukit Batok Hillside Park Area EIS Report [R-1])

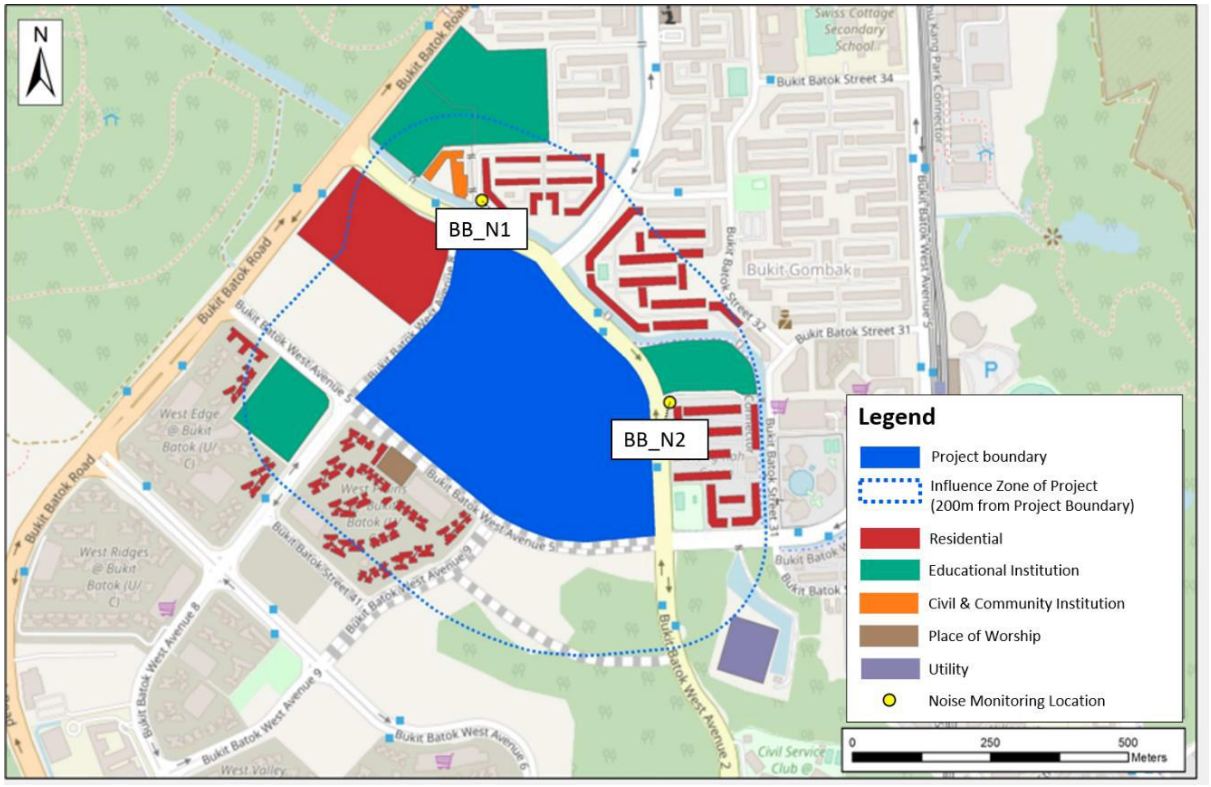


Figure 3-6 Location of baseline noise monitoring locations (source: Bukit Batok Hillside Park Area EIS Report [R-1])

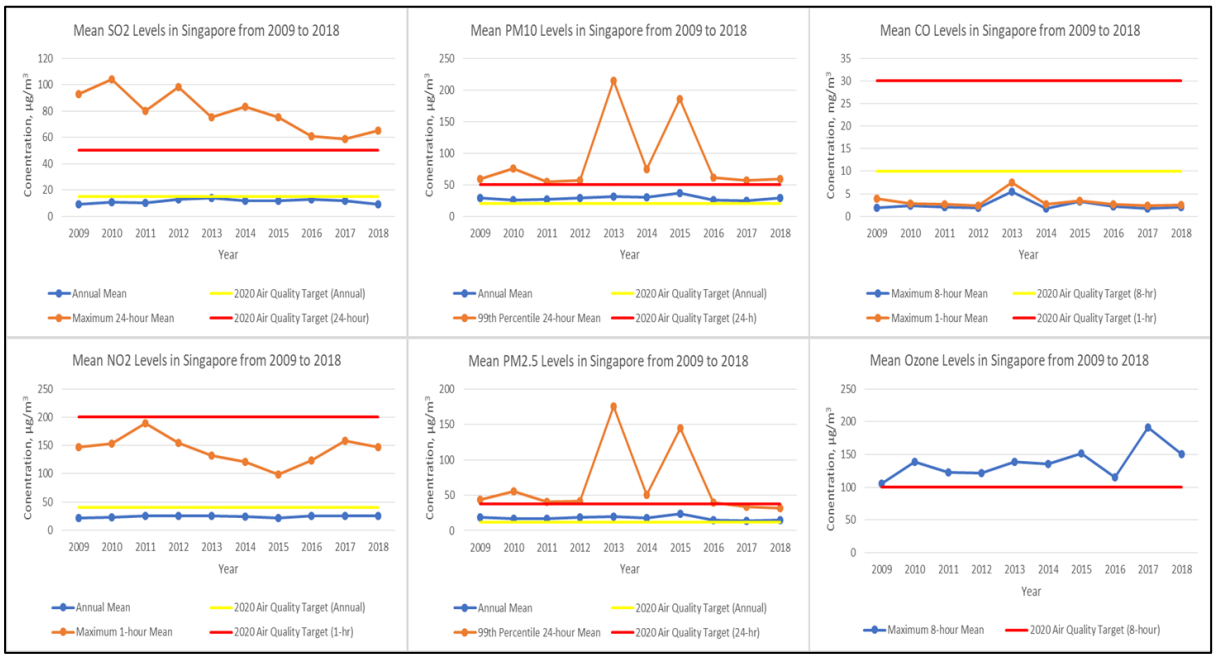


Figure 3-7 Annual Mean Air Quality Levels in Singapore from 2009 – 2018 (source: Bukit Batok Hillside Park Area EIS Report [R-1])

3.4 Summary of Impact Assessment Findings

The impact assessment was characterised as the product of the degree of change predicted (the magnitude of impact) and the sensitivity of receptors to the change. The potential significant environmental impacts has been identified initially based on provided information of construction activities. A generic criteria for determining sensitivity of receptors are outlined in Table 3-2. Sensitivity is specific to each aspect and the environmental resource affected, and assessed using the baseline information. The assessment of impact magnitude subjects to two steps: firstly is the identified impact categorisation (i.e. beneficial or adverse) and secondly is impact categorisation based on consideration of various parameter (Table 3-3). Other considerations that contribute to the impact magnitude include:

- Spatial extent of the impact – for instance, within the site boundary, regionally, nationally, and/or internationally;
- Likelihood of impact – ranging from “occurring regularly under typical conditions” to “unlikely to occur”; Compliance with relevant legal standards and established professional criteria – ranging from “substantially exceeds national standards or international guidance” to “meets the standards” i.e. impacts are within predicted range.

The impact significance of each evaluated potential impact has been categorised by following the impact assessment matrix as shown in Table 3-5.

Table 3-2 Sensitivity Criteria for Receptors [R-1]

Category	Description
High	Receptor (human, physical or biological) with little or no capacity to absorb proposed changes and/or minimal opportunities for mitigation.
Medium	Receptor with little capacity to absorb proposed changes and/or limited opportunities for mitigation.
Low	Receptor with some capacity to absorb proposed changes and/or reasonable opportunities for mitigation.
Negligible	Receptor with good capacity to absorb proposed changes or and good opportunities for mitigation.

Table 3-3 Definition of Environmental Impact Category [R-1]

Environmental Impact Category	Definition
Positive	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.
Direct	• Direct impacts are caused by the project itself – result from a direct interaction between a planned project activity and the receiving environment/ receptors. • Direct impacts are generally easier to assess and control than indirect impacts since the cause-effect relationship is usually obvious.
Indirect	• Indirect impacts are usually linked closely with the project – result from other activities that are encouraged to happen as a consequence of the project. • Indirect impacts are more difficult to measure but can ultimately be more important. Over time they can affect larger geographical areas of the environment than anticipated.
Permanent	Permanent impacts are those which are irreversible – the affected system will not return to its previous state on a human timescale.
Temporary	Temporary impacts are those whose occurrence is not lasting, and which will eventually reverse themselves, the affected system having returned to its previous state.

Environmental Impact Category	Definition
Short-term	Short-term impacts are those which appear during or shortly after construction, and may last for a very short period (< 3 months)
Medium-term	Medium-term impact may arise during construction, but many of their consequences appear during the operational phase, and may last for months (3 months – 1 year)
Long-term	Long-term impacts may arise during construction, but many of their consequences appear during the operational phase, and may last for decades (> 1 year)

Table 3-4 Magnitude Criteria for Impact Significance [R-1]

Category	Description (adverse impacts
Major	• Fundamental change to the specific conditions assessed resulting in long term or permanent change, typically widespread in nature and requiring significant intervention to return to baseline; would violate national standards or Good • International Industry Practice (GIIP) without mitigation. • Certain or very likely that an incidence will occur under normal operating conditions.
Moderate	• Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change. • Likely to occur at some time under normal operating conditions.
Minor	• Detectable but small change to the specific conditions assessed. • Unlikely to but may occur at some time under normal operating conditions.
Negligible	• No perceptible change to the specific conditions assessed. • Very unlikely to occur under normal operating conditions but may occur in exceptional circumstances.

Table 3-5 Impact Assessment Matrix [R-1]

Sensitivity		Magnitude			
		Adverse/Beneficial			
		Major	Moderate	Minor	Negligible
	High	Major	Major	Moderate	Negligible
	Medium	Major	Moderate	Minor	Negligible
	Low	Moderate	Minor	Negligible	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible

Table 3-6 Summary of Impacts During Construction Phase and Key Mitigation Measures (Source: Bukit Batok Hillside Park Area EIS Report [R-1])

Activity	Environmental Aspect	Environmental Impacts	Minimum Controls	Impact Significance	Recommended Mitigation Measures	Residual Impact Significance
Land clearance and earthworks	Biodiversity - Flora	Removal of trees/plants	Not applicable.	Major	• Contractor needs to prepare a general clearance and tree felling plan with NParks' approval. Some trees that were requested to be preserved includes the mature *Ficus vasculosa* (White Fig) should be retained on site if possible; • Even though there are ten (10) species of conservation concern species are identified, most of them are cultivated and common in any old agriculture areas. Hence, contractor should consult NParks whether any trees should be transplanted. An ISA certified arborist should be engaged to prepare and submit a vegetation clearance plan and detailed method statement to NParks and obtain agreement prior to proceeding with any tree removal and transplanting. The method statement shall detail the proposed tree removal/ transplanting process and the measures to be taken to minimise any risk of damage to the trees during the process; • If transplantation is required by NParks, contractor should appoint an ISA certified arborist familiar with native flora to assess the tress/ plants to be transplanted, plan and supervise the transplanting process, as well as ensure that the transplanted trees/ plants survive the minimum 6 months maintenance period following transplanting; • As the site is hilly, proposed development will require cut and fill to form new contour for the development. The contour and platform should be designed to provide a gentle slope at the boundary of the Bukit Batok Hillside Park which will be remained and developed by NParks. Trees and vegetation at the remaining park facing the development boundary should be surveyed and identified tree/vegetation protection zone by a certified arborist. Slope and tree/vegetation protection should be integrated into the design to ensure tree/vegetation health; and, • Permanent earth retaining structure should be constructed to prevent soil erosion at the boundary toward the park area that may cause root damage and tree collapse.	Moderate
	Biodiversity - Fauna	Habitat Loss		Major	➢ As the Project area is an isolated secondary forest, provision of green corridor to relocate the wildlife would be challenging. It is vital to maintain the forested area at the remaining half of the site where residential developments are not planned for the fauna to move to; ➢ Stream A and Stream B should be preserved as much as possible, or at least Stream A, as they are a couple of forest-dependent frog species. The stream can be retained as natural water features within the housing area. Some vegetation along	Moderate

Activity	Environmental Aspect	Environmental Impacts	Minimum Controls	Impact Significance	Recommended Mitigation Measures	Residual Impact Significance
					the stream should also be retained as habitat for the frogs. Gentle slope and earth retaining measures such as geotextile should be designed along the remaining stream if it is remained; ➢ Stream A can be retained by retaining its catchment area, which is approximately 1.91ha in land area; ➢ Site clearance to be carried out progressively from the southwest towards the northeast direction. Animals should be given sufficient time to move to the remaining forest that is not planned to be developed for residential development; ➢ Site clearance should be commenced avoiding nesting period of Changeable Hawk Eagle between December and April and bird migratory period of Nov – Feb if possible, to avoid potential impact to birds at the site; and, ➢ If there is presence of an active animal nest (e.g. bird nest with chicks) on vegetation to be removed, contractor should wait and only remove vegetation when the animal has left on its own accord.	
		Human – wildlife conflict		Minor	• Workers and residents should be educated not to disturb, irritate or kill wild animals; • Workers on site should be carefully briefed about taking care when encountering wild animals, not to feed any of the wildlife, ensuring that all edible waste is carefully housed in suitable containers and that no wildlife must be harmed in any way; • Place rubbish bin at proper location with monkey-proof rubbish bin; and, • Educate residents at nearby housing estates on how they should behave when encountering animals such as wild boars, monkeys etc.	Minor
		Roadkill		Minor	➢ Provide hoarding to prevent animals from getting onto the roads and direct them to move to the remaining forest instead; ➢ Put on road sign and implement speed control if animals are likely to cross the road (Bukit Batok West Avenue 2).	
	Vectors and Insects	Disease Transmission and Insect Breeding	• Surveillance program, education and research to prevent the mosquitoes from breeding. • Proper hygiene and waste management.	Minor	• Develop proper insect and vector management plan before any site clearance and construction activities. The insect and vector management plan should cover all the stages of the construction works; • Area selected for site office should be fumigated before works take place; • Other vector populations (such as rats) should also be removed from this area, to prevent the transmission of disease;	Minor

Activity	Environmental Aspect	Environmental Impacts	Minimum Controls	Impact Significance	Recommended Mitigation Measures	Residual Impact Significance
					• Weekly search and destroy operations and fumigation should be undertaken by an NEA licensed pathogen vector control operators/competent pest control company; • Providing a clear boundary for insect and vector control where populations will be monitored within the construction site; • Store food in rodent-proof storage containers/cabinets with at least 60 cm clearance above ground; • Remove food waste daily and clean the bins regularly; • Remove any pooled water in less than a week, as the Aedes mosquito eggs can develop into adult mosquitoes in less than a week in optimal conditions, by following measures: - Any water ponding on-site (from potholes, puddles, and locations of earthworks) should be backfilled with compacted soil immediately after inspection, or when construction activity in that area is ceased; - Granular insecticide should be applied into any water found to be collected in perforated bricks; - Any choked drains or channels used to direct water should be cleared of blockages; - Concrete should be placed in the gaps of any corrugated roofs; - Any material stored on-site should be raised 60 cm to ensure that the pest control team and the licensed pathogen vector control operator can see and remove vector populations; - Any receptacles located on-site that have the purpose of storing water should be emptied at the end of each day; - Any receptacles which can catch and hold rainwater should be stored in an undercover tool storage area or waste storage area; and, - Any free hanging tarpaulins on-site should be taught to prevent water containment. • Form in-house insect and vector control team to ensure there are no breeding areas around the construction site. Visual monitoring on daily basis in the morning and evening; • Application of anti-mosquito oil and insecticides into any areas where stagnant water may accumulate (such as drains); • In line with the Control of Vectors and Pesticides Act existing vegetation or undergrowth within 6 m of any stream, seepage, running or standing water should be cleared without prior approval from NEA, before construction works commence.	

Activity	Environmental Aspect	Environmental Impacts	Minimum Controls	Impact Significance	Recommended Mitigation Measures	Residual Impact Significance
	Soil	Removal of plants will result in soil erosion	• Design slopes will be of sufficient gradient as to minimise risk of slope failure. • Design slopes should be vegetated or otherwise covered to minimise erosion impacts which may ultimately result in downstream siltation. • Earth control measure (ECM) has to be designed and signed off by a Qualified Erosion Control Professionals (QECP), and Earth Retaining or Stabilising Structure (ERSS) has to be designed and submitted to BCA by a Qualified Person (QP) for slope greater than 1.5m depth. • Professional Engineer (PE Geo) to be engaged for design and BCA submission on temporary and permanent earth retaining structures for steep slopes, particularly for the slope cutting like along Bukit Batok West Avenue 2.	Minor	▪ Contractor should maintain a gentle slope during site clearance and earthwork/ soil cutting to prevent slope failure. Temporary slope shall be maintained maximum at 1:2 during earth works and other excavation/construction; ▪ Where existing slope is steep, measures such as geotextile or temporary retaining structures should be put in place during the site clearance, tree/root removal and earth cutting works to prevent slope failure; ▪ Where excavation is more than 1.5m during earth works and excavation works, plan submission by QP (ST) to BCA shall be done during the design and construction stage. If the depth is more than 4m, Accredit Checker (AC) shall be engaged for independent check as required by BCA; ▪ For weak soil at stream A and stream B, extra attention should be given to avoid risk of worker falling into swampy soil. Slope failure control measures and extra care need to be put in place to prevent risk of safety during construction works; ▪ QP should be engaged to design temporary earth retaining structure and permanent retaining wall at relevant locations to prevent slope failure during construction; and, ▪ A Qualified Erosion Control Professional (QECP) should be engaged to design Earth Control Measures (ECM) including a discharge treatment system.	Minor
	Hydrology	Higher surface runoff and water volume	• A proper drainage system, including perimeter drains surrounding the site boundary, to be designed and constructed with sufficient capacity to fully collect the runoff and discharge it into the canals and reservoir.	Moderate	➢ The site clearance and earthwork should be planned in phases to ensure that not so large area is exposed at a time, and the runoff from the exposed area is within capacity of the ECM; ➢ Cut-off drain around the site boundary should be provided. Temporary drain should be constructed around the expose area to collect the runoff and divert to the ECM or retention pond; ➢ Proper drainage system should be designed to accommodate additional runoff from the site during different stages of the construction works. The capacity of the drainage should be designed for runoff co-efficient from C=0.45 (existing site condition) to C=0.65 during site clearance and earthwork, and C=1 during building construction and post construction stage; ➢ Capacity of the existing downstream drainage that will take additional runoff from the site should be reviewed to ensure sufficiency. If the existing downstream drainage capacity is not sufficient, additional drainage should be provided to prevent flooding at the downstream areas;	Minor
	Water Quality	Pollution of nearby watercourse	• Earth control measure (ECM) to be adopted to reduce the contamination of water.	Minor		Minor

Activity	Environmental Aspect	Environmental Impacts	Minimum Controls	Impact Significance	Recommended Mitigation Measures	Residual Impact Significance
					➢ Contractor is to ensure the discharge treatment system of the ECM proposed by a QECP is reviewed before implementation. This will ensure the treatment method is suitable and adequate. The ECM must be submitted to and approved by PUB; ➢ Separate drainage systems should be provided for contaminated water if there is any, and clean storm water during construction. All areas in the construction site where potential sources of wastewater or contaminated runoff should be paved and provided with appropriate bunds to enable the wastewater and contaminated storm water from the entire site to be directed to an onsite settling pond. Contaminated water should be treated prior to discharge into public drainage or sewer; ➢ A TSS meter and CCTV camera should be installed at the entrance to any public drains on-site. This is to ensure that parameters of any discharged water are below allowable limits for discharge to public drainage or watercourse, or within permissible levels in any approval letter; ➢ Daily monitor turbidity during the construction period should be carried out on site; ➢ Soil stockpiles should be covered with erosion control blankets at the end of each working day; ➢ A washing bay should be installed to prevent dust from exiting construction sites. Any collected water should then either be re-used in the washing facility or disposed of after being treated by ECM; ➢ Concrete trucks and other equipment should be washed out to prevent concrete from hardening within. This washout should not be discharged directly into any drainage system but collected as wastewater for treatment; ➢ Humps should be installed at the site entrances to prevent any silted storm water from exiting via this pathway; ➢ Bare earth areas should be isolated with silt fences, and bare earth area should be covered after work; ➢ Access path, road or site office area, if any, should be paved up; ➢ Any chemical containers being used on site outside of the storage area must be placed inside a secondary containment vessel with sufficient capacity to handle the spilled volume. Water-proof sheets must be used to cover the secondary containment in rainy periods to prevent spill-over; ➢ Emergency response equipment, e.g. spill kits, absorbent booms, clean spade and buckets must be well-prepared for use and be in close vicinity to the chemical storage area;	

Activity	Environmental Aspect	Environmental Impacts	Minimum Controls	Impact Significance	Recommended Mitigation Measures	Residual Impact Significance
					➢ Regularly inspect and clean out in-ground wedge pits should be conducted to maintain adequate sediment holding capacity; ➢ Water quality monitoring should be carried out on a regular basis.	
Use of construction vehicles and equipment and general construction activities	Air	Increased vehicle emissions resulting in lower air quality	• Off-road diesel engines include equipment such as power generators which are used during the construction phase.	Minor	• Maintaining a minimum moisture content during any rock rushing works; • Applying water to excavation areas, soil loading/unloading areas and unpaved roads; • Creating a wheel wash at entrances to public roads; • Covering soil stockpiles with erosion control blankets; • Using hoarding to attenuate winds and therefore reduce likelihood of wind-blown dust; • Implementing speed controls on-site; • Ensuring that the cab of all soil storage trucks is covered with tarpaulins; • Water spraying regularly for dusty static construction areas/ materials/ operations; • Controlling lorries loading capacity to avoid spillage; • Engaging an ECO to follow up on Air Quality control measures under the Code of Practice for Environmental Control Officers; • Ensuring that trucks used on site comply with the EURO V emission standards for NOx and PM10 as specified in the EC Directive 98/69/EC-B (2005) for passenger cars and light duty vehicles, and EC Directive 1999/96/EC-B1(2005) for heavy vehicles with maximum laden weight more than 3,500 kg; • Ensuring construction machinery used complies with the USEPA Tier 4 emission standards for NOx and PM10; • Maintaining all machinery, including excavators and gen-sets regularly, to minimize smoke and dust exhaust emissions; • Using Ultra Low Sulphur Diesel Fuel with a maximum Sulphur concentration of 15 parts per million for diesel run construction equipment; and, • Fully switching off vehicles when they are not in use.	Minor
	Noise	Increase ambient noise level	• The generated noise should not exceeded the NEA noise limits.	Minor	• Engaging an ECO to follow up on Noise pollution control measures under the Code of Practice for Environmental Control Officers; • Continuous monitoring during the construction to ensure the noise levels do not exceed the stipulated noise limit; • Scheduling vehicle movement to avoid accumulated noise from vehicles;	Minor

Activity	Environmental Aspect	Environmental Impacts	Minimum Controls	Impact Significance	Recommended Mitigation Measures	Residual Impact Significance
					• Providing silencer for noisy equipment/ machinery; and, • Adopting good practice for construction site – regular maintenance of vehicles and machinery, proper training to operators.	
	Waste	Sewage Solid wastes due to increase in local human population	• Contractor to segregate waste for composting, recycling, disposal or treatment by toxic waste licensed collector. • Waste handling facilities are able to cope with the generated quantity of waste.	Minor	• A waste management plan should be created that provides further technical details and implementation for all mitigation measures highlighted in this Table, and adopts the principle of Reduce, Reuse, Recycle; • The contractor should ensure that information in the waste management plan that is applicable to individual site workers is disseminated to them; • In order of preference (most preferable is no.1), waste should be disposed of in the following ways: 1. Minimise initial waste generation wherever possible; 2. Items for waste disposal should be re-used if safe and appropriate (i.e., not hazardous waste containers); and 3. When not re-used on site, waste should be taken to an off-site recycling facility; and, 4. Non-recyclable waste should be disposed of appropriately in line with local regulations at a pre-defined off-site location. • All wastes stored on site should be segregated by type, ensuring that incompatible wastes are stored separately; • Waste storage facilities should be fit for purpose by ensuring that waste containers/ storage areas are capable of containing predicted waste volumes, for each waste type, in a manner unlikely to cause damage to the environment or harm to human health; • Waste designated for off-site recycling or disposal will only be transferred to such parties that can demonstrate that they are licensed to transport and/or treat or dispose of the waste in accordance with Singaporean Regulations; • Portable toilets for construction workers must be placed inside each construction area, with the sewage pumped away regularly by an appropriately licensed waste disposal company; • All containers which were previously used to store pesticides and other chemicals should be bored with holes to ensure that these containers are not reused.	Minor

3.5 Recommended Areas of Conservation

In order to minimise major habitat loss impact due to fundamental change in site conditions during site clearance, the following is recommended to be considered in the planning and design stages of developments:

- Conserving catchment area around Stream A;
- Retaining the large *Ficus vasculosa* with conservation status of **Endangered** and some seedlings is situated on higher ground immediately next to the stream B;
- Retaining any tree which falls under the following categories where possible:
  - Cluster of trees with girth between 1.5 m to 2.0 m; and
  - Sole or singular tree retention for tree girth more than 2 m girth.
- Salvaging and transplanting affected trees with high conservation value (after seeking advices from NParks and subject to the assessment of ISA certified arborist);
- Avoiding site clearance as much as possible during the bird nesting period of December to April and bird migratory period of Nov – Feb; and
- Retain as much of the surrounding habitats as possible.

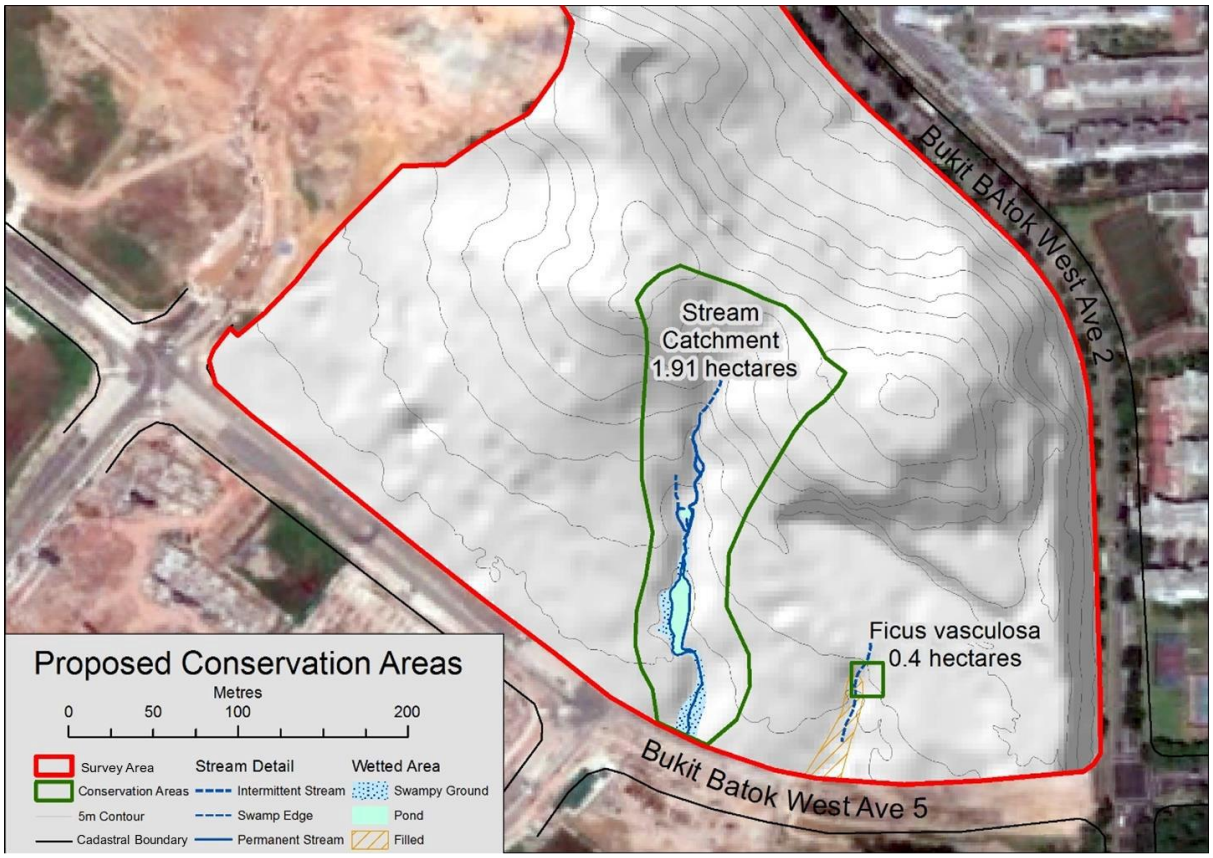


Figure 3-8 Recommended Area of Conservation (source: Bukit Batok Hillside Park Area EIS Report [R-1])

4 Proposed Construction Activities and Timeline

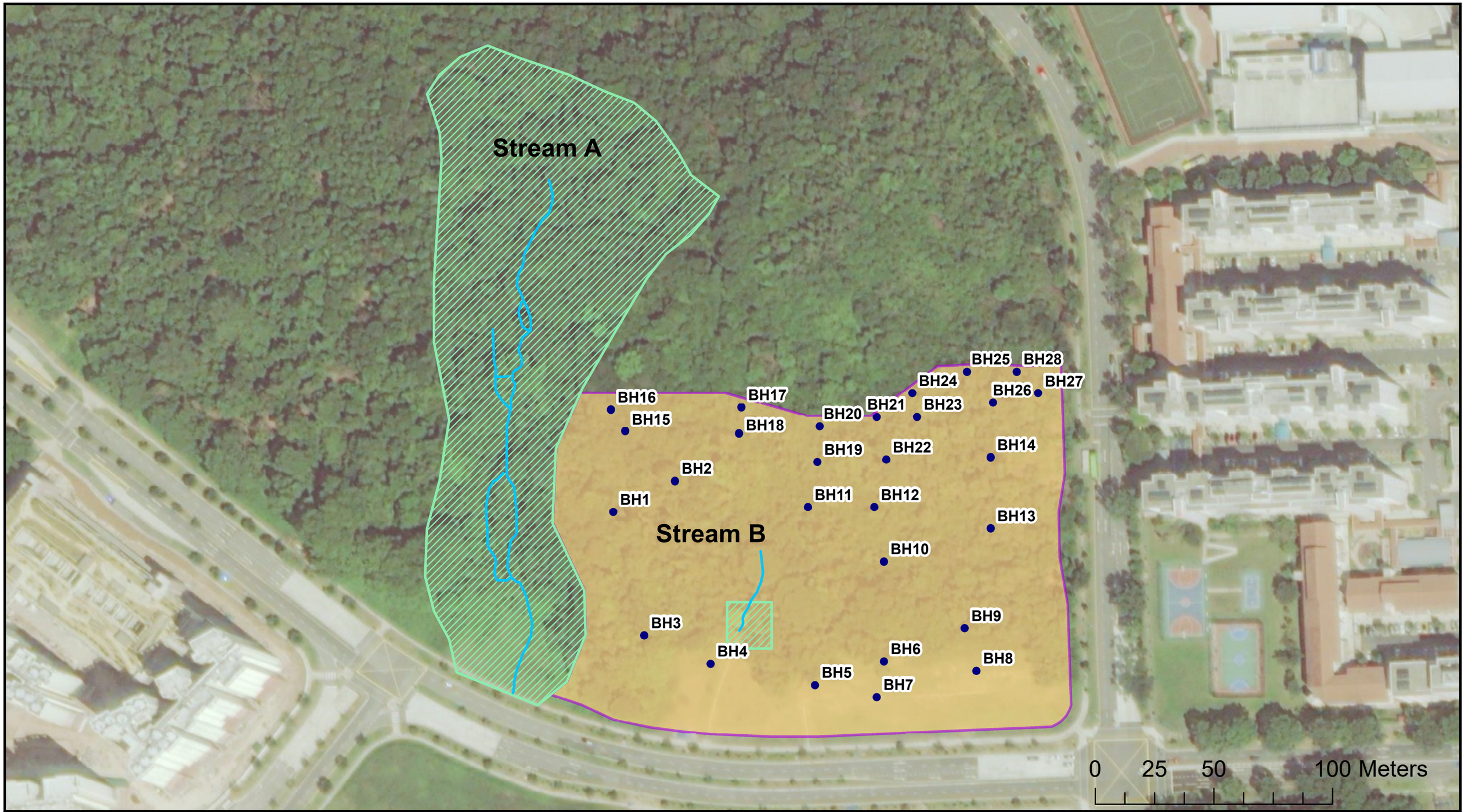
The overall construction activities to be carried out within Area C (Bukit Batok N4-C28) includes site clearance, soil investigation (SI) works and building/infrastructure construction works. The Recommended Area of Conservation (Figure 3-8) will be retained and would not be cleared during construction.

4.1 Overall Construction Timeline

The staging plan for all construction activities has been summarised in Table 4-1 and Figure 4-1. For Stage 1, upon completion of hoarding for entire development area, SI works within working space of hoarding will commence. SI works and earthworks will then be conducted concurrently for eight (8) months duration (starting from 2023 onwards). There will be no tree felling required for soil investigation works as it will be carried out where the tree felling activities have been completed for the hoarding erection and earthworks. The detailed description of the construction activities has been listed in following Table 4-2.

Table 4-1 Overall Staging Plan for the Construction Activities within Area C

EMMP Stage	Construction Activity	Total Duration (Month)
Stage 1	Soil Investigation Works	8
	Earthworks (including site clearance)	
Stage 2	Development work	



Legend

- Recommended Area of Conservation
- Watercourses

Construction Activities for Stage 1

- Soil Investigation Works and Earthworks
- Proposed Borehole for Soil Investigation Works

N

Rev.	Date	By	Description	Chk'd	App'd
-	SEP 2022	CKL	Draft Report	NHT	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

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

Figure Title :

OVERALL CONSTRUCTION ACTIVITIES

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
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4.2 Key Potential Impacts Identified from Construction Method Statements

A summary of activities and potential environmental impacts during the different construction stages which referred to the existing EIS report [R-1] are provided in Table 4-2. The construction activities as described in Table 4-2 for Stage 1 and Stage 2 will be conducted for the same worksite of Area C as shown in Figure 4-1. For Stage 1, upon completion of hoarding for entire development area, SI works within working space of hoarding will commence. SI works and earthworks will then be conducted concurrently for eight (8) months duration. There will be no tree felling required for soil investigation works as it will be carried out where the tree felling activities have been completed for the hoarding erection and earthworks.

Table 4-2 Summary of construction activities

Construction Stage	Activities	Potential Impacts/Pollution
Stage 1: Advance Works and Earthworks	• Shepherding of wildlife from construction footprint; • Erection of temporary hoarding • Erection of Tree Protection Zone (TPZ) and perimeter hoarding; • 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 investigation; • Demolition of existing structures; • Drainage and utilities diversion; • Cut and fill/ regrading/ levelling and excavation to achieve required platform levels; • Earth Retaining and Stability Structures: Bored piling works – installation of bored piles with the use of temporary/permanent casing and bentonite slurry; and • General works (i.e. machinery maintenance, machinery/ construction material delivery, waste generation, temporary storage prior to disposal).	q) Human-wildlife conflict; r) Waste management s) Chemical spill; t) Trampling impact on vegetation; u) Soil and water contamination; v) Dust emission; w) Vegetation waste; x) Loss of habitat/ wildlife mortality; y) Noise pollution; z) Changes to ambient temperature; aa) Changes to ambient humidity; bb) Loss of tree cover; cc) Changes in hydrology and water table of surrounding ground area; dd) Sediment tracked onto public roads. ee) Silty runoff, discharge of effluent; and ff) Excavated material.

4.3 Concurrent Construction Activities

There is no concurrent construction in the vicinity of Area C based on available information.

5 Applicable Environmental Legislation

This section to provide a summary of relevant regulatory framework for EMMP. During implementation of EMMP, the EMMP Consultant and Contractor should adhere to the regulatory framework presented as follows:

5.1 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 5-1.

Table 5-1 Relevant Environmental Legislation

Applicable Legislation	Legal Requirement
Wildlife Act, 2020 [R-14]	• An Act for the protection, preservation, and management of wildlife for the purposes of maintaining a healthy ecosystem
Parks and Trees Act, 2006 [R-15]	• 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.

5.2 Hydrology, Surface Water, and Groundwater

The legislations governing water pollution control at construction worksite are provided as in Table 5-2.

Table 5-2 Water Pollution Control Legislation Requirement and Penalty

Applicable Legislation	Summary of Relevant Legal Requirement
Environmental Protection and Management Act (Chapter 9A), 2020 [R-16]	• 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/permitted to be discharged into any inland water.
Sewerage and Drainage Act, 2020 [R-17]	• 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: ➢ 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. • Any works which could lead to discharge of silt direct or indirectly into any storm water drainage system, drain or drainage reserve: ➢ 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.

Applicable Legislation	Summary of Relevant Legal Requirement
Singapore Standards 593:2013 Code of Practice for Pollution Control (COPPC) [R-26]	• 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.
Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer. Target Values, Soil Remediation Intervention Values and Indicative Levels for Serious Contamination, 2020 [R-27]	• 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. • In view of the objective to minimise the risks of spreading of contaminations in the groundwater, the following aspects are important: ➢ 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.

5.3 Air Quality

The legislations governing air quality control at construction worksite are provided as in Table 5-3.

Table 5-3 Air Quality Control Legislation Requirement and Penalty

Applicable Legislation	Legal Requirement
Environmental Protection and Management Act, 2018 [R-5]	(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.
Environmental Protection and Management (Air Impurities) Regulations 2015 [R-6]	(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.

Applicable Legislation	Legal Requirement
Environmental Protection and Management (Off-Road Diesel Engine Emissions) Regulations 2012 [R-7]	• 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-8]	(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-9]	The use of open fires in any industrial or trade premises is prohibited, except where such open fires are used for — the purpose of firefighting practices; or the disposal of tail gases from industrial plants.
Singapore Ambient Air Quality Targets (Long Term Targets) [W-1]	• Stipulates the recommended limit values for ambient concentrations of NO_2, SO_2, PM_{10}, $PM_{2.5}$, CO and O_3. 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-10]	• 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).

5.4 Airborne Noise

The legislations governing airborne noise control at construction worksite are provided as in Table 5-4 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. Unattended noise monitoring (1 week) will be conducted by Contractor (refer to Section 8.4.1) prior commencement of site clearance to have a full representation of baseline noise level within/ surroundings of construction worksites. The Contractor will use the pre-construction baseline to calculate and set Project criteria which shall apply for construction works in all stages. This data will be shared with the SO Rep., HDB and the EMMP consultant.

Table 5-4 Airborne Noise Control Legislation Requirement and Penalty

Applicable Legislation	Summary of Relevant Legal Requirement
Environmental Protection And Management Act, Environmental Protection And Management (Control Of Noise At Construction Sites) Regulations, 2008 [R-11]	• 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 — ➢ 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 — ➢ 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

Applicable Legislation	Summary of Relevant Legal Requirement
	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— ➢ 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; ➢ 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.
SS602:2014 Code of practice for noise control on construction and demolition site [R-12]	• 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-26]	• Specific recommended pollution control requirement and good practices for preventions of noise impacts.

5.5 Vibration

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

Table 5-5 Vibration Control Guidelines for Human Comfort and Cosmetic Damage

Applicable Guidelines	Summary of Guidelines
BS 7385-2:1993 Evaluation and measurement for vibration in buildings.	Limits for transient vibration shall be kept at: • 50 mm/s at 4 Hz and above for reinforced or framed structures industrial and heavy commercial buildings;

Applicable Guidelines	Summary of Guidelines
Guide to damage levels from ground-borne vibration [R-1]	• 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. Cosmetic damage could occur if vibration levels exceed these values.
BS 5228-2 2009+A1:2014: Code of practice for noise and vibration control on construction and open sites – vibration [R-3]	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 Bukit Batok Hillside Park Area 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 5-6 for ecological receptors. The Contractor shall follow the criteria proposed throughout the construction phase.

Table 5-6 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]	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: • 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 Bukit Batok Hillside Park Area EIS Report [R-1].	

5.6 Vector Control

The legislations governing vector control at construction worksite are provided as in Table 5-7.

Table 5-7 Vector Control Legislation Requirement and Penalty

Applicable Legislation	Summary of Relevant Legal Requirement
Control of Vectors and Pesticides Act (Chapter 59), 2020 [R-18]	• 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-25]	Regulates the destruction and disposal of infected animals, food and water.
Hydrogen Cyanide (Fumigation) Regulations, 2020 [R-24]	Provides guidelines on using the hydrogen cyanide for the fumigation and its residual disposal.

5.7 Waste Management

The legislations governing waste management at construction worksite are provided as in Table 5-8.

Table 5-8 Waste Management Legislation Requirement and Penalty

Applicable Legislation	Summary of Relevant Legal Requirement
Environmental Public Health Act (Chapter 95), 2020 [R-19]	• A guideline which describing the prohibition against: ➢ 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-20]	• 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-21]	Provide the disposal guideline on carcases of any animal.

6 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.

6.1 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.

6.1.1 Organisation Chart

The roles and responsibilities of the various parties responsible for implementing the EMMP during the construction phase are outlined in Figure 6-1. 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 undertaking 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.

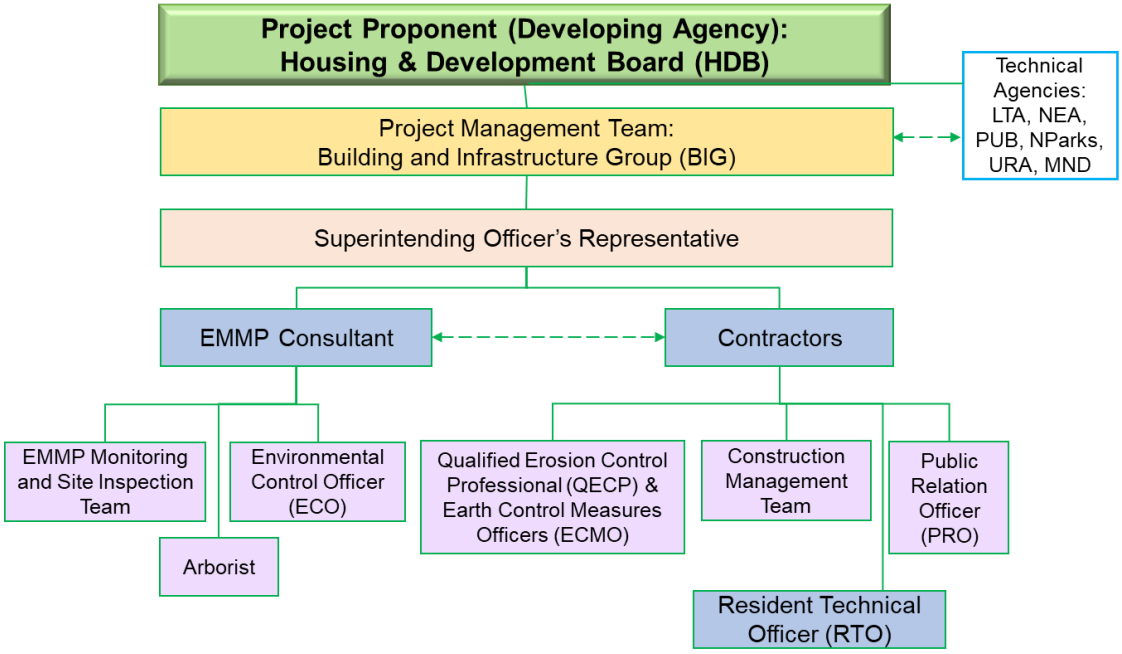

Figure 6-1 Project EMMP Implementation Organisation Chart

6.1.2 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.

6.1.3 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.

6.1.4 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 6.1.1);
- 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;
- To discuss and resolve/mitigate any non-compliance or irregularities with PP/SO Rep./Technical Agencies; and,
- To coordinate with PP/SO Rep./Technical Agencies on environment matters.

6.1.4.1 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-13]. 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 discuss all environment incidences which may arise with the EMMP Consultant. ECO will work alongside EMMP Consultant to address incidences;
- To notify EMMP Consultant of any such observation that's worthy of environmental concern; 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).

6.1.5 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 7.1, 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 9.3) 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-13];
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.

6.1.5.1 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.

6.2 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 6-1 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 6-2.

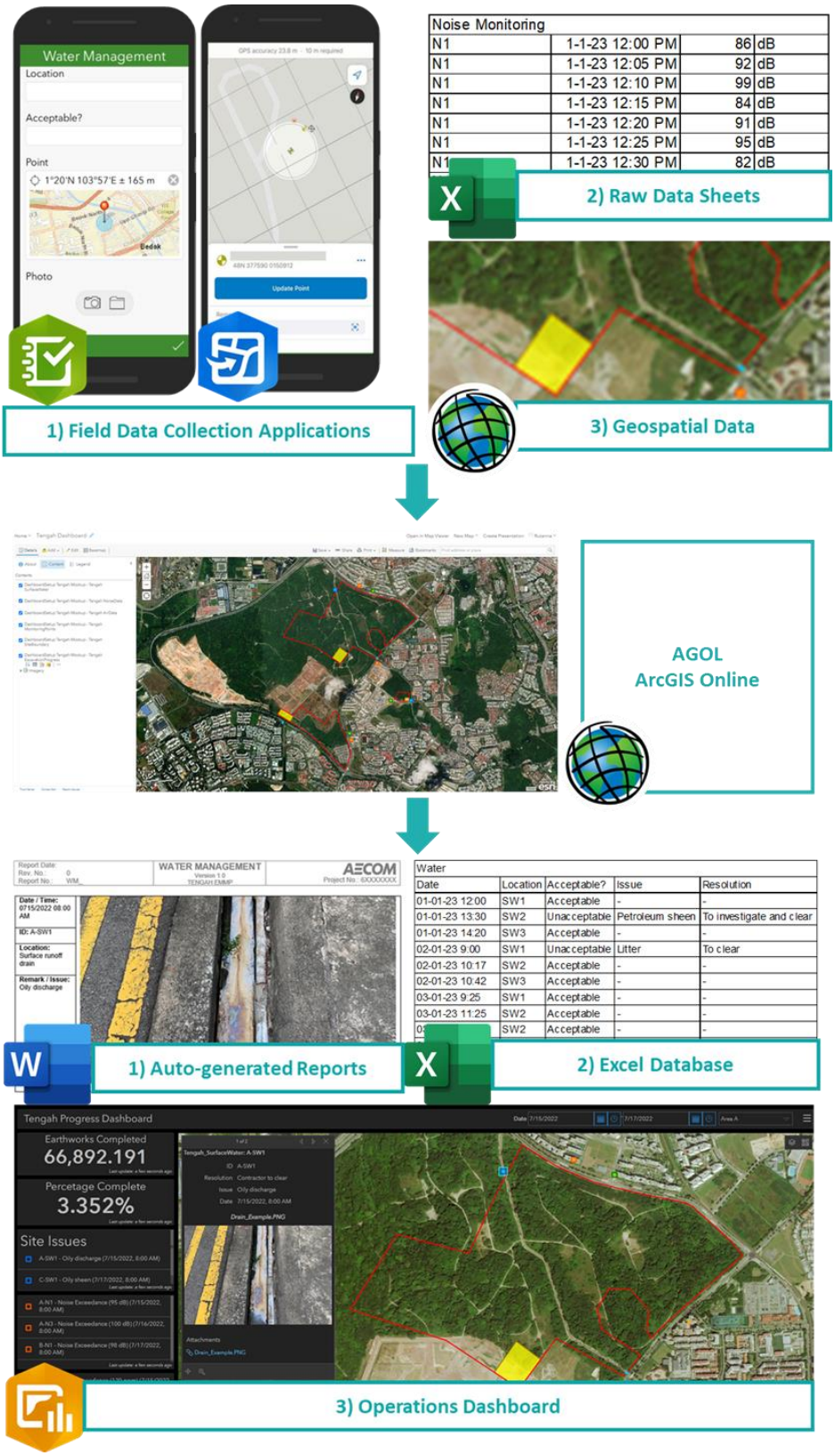

Figure 6-2 Workflow for Data Collection and Monitoring

Table 6-1 Required Data Format for the Monitoring Data

Environmental Component	Data Format and Frequency	Data Provider
Hydrology and Surface Water	<u>Surface Water Quality: Online-real time TSS monitoring data</u> • To provide embed website link • TSS data format in mg/L • Data will be auto-updated in the system from time to time	Contractor
	<u>Surface Water Quality Monitoring</u> • In-situ water quality data: ▪ 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: ▪ 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
	• 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	<u>Groundwater Level Monitoring</u> • 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	Contractor
	<u>Groundwater Quality Monitoring</u> • 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	Contractor
	• 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	<u>Air Quality Monitoring</u> • To monitor the real-time 24-hr average concentration of PM_{10} and $PM_{2.5}$ in $\mu g/m^3$ 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
	• 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	<u>Noise Monitoring</u>	Contractor

Environmental Component	Data Format and Frequency	Data Provider
	• 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 • 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/ EMMP Consultant's ECO/ EMMP Consultant
Vibration	<u>Vibration Monitoring</u> • 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
	• 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
Vector Control	• 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/ EMMP Consultant's ECO/ EMMP Consultant
Waste Management	• 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/ EMMP Consultant's ECO/ EMMP Consultant
Biodiversity	• Monthly site inspection report in PDF format • Coordinates and photo if any when conducted site inspection	Contractor/ EMMP Consultant
Others	• 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 Bukit Batok Hillside Park Area [R-1]. 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, EMMP Consultant and EMMP Consultant's Environmental Control Officer ("ECO"). t. 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.

7 Standard Mitigation Measures and Environmental Trainings

7.1 Standard Mitigation Measures and Requirements 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.

7.1.1 Biodiversity

Standard Mitigation Measures and Requirements: Biodiversity

Flora Monitoring and Management Plan

Sapling Harvesting and Tree Transplantation

Prior to the 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 footprint is as proposed, and that no excessive vegetation and tree removal has occurred as a result of deviations in the hoarding alignment.

The Flora Specialist shall review the proposed locations for the soil investigation works and the alignment of the construction access roads with the Client/Contractor (Figure 4-1). Feasible alternatives, if possible, shall be proposed to minimise vegetation and tree clearance.

Monthly Flora Inspection

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 Bukit Batok Hillside Park [R-1]. The following will be achieved through the inspections:

a) Identification of any unauthorized removal of flora within the RAC, or areas beyond the demarcated development workspace.
b) 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.
c) Identification of forest edge effects and recommendation of mitigation measures where necessary.
d) Assessment of the status of invasive flora species and weeds and recommendation to remove them, where necessary.
e) Inspection of areas cleared of weeds to detect any seedlings of invasive species.

Standard Mitigation Measures and Requirements: Biodiversity

Figure 7-1 Monitoring of Vegetation and Trees along the Hoarding Line for Unauthorised Vegetation Clearance and Forest Edge Effects

Tree Monitoring and Management Plan (Arboriculture)

Site Clearance and Tree Felling

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 Monitoring

Monthly Tree Inspection

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

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.

Standard Mitigation Measures and Requirements: Biodiversity

III. Assessment of physiological health, vigour and structural stability of retained trees. Recommend additional mitigating measures if necessary.
IV. Verify locations of tree species of conservation significance to be retained (e.g. *Ficus vasculosa*).
V. 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.
VI. 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.
VII. 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.
VIII. 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, or the portion where works are occurring at, the worksite should be completely hoarded up. If Eurasian wild boars are observed within the hoarded areas, 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) NParks to be informed if there are trapped Eurasian wild boars; 3) site clearance to proceed directionally, with pre-site clearance fauna inspections to be conducted prior to felling; 4) 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 installation of hoarding is to be completed by the contractor prior to the start of site clearance, following the below specifications:

- 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.
- Where internal hoarding will be set up to partition the site into smaller zones, the hoarding can be 1.8-m high.
- 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.
- 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.
- After hoarding installation is completed, the Ecologist shall inspect the hoarding to ensure its integrity and ability to prevent fauna entry/exit.

Standard Mitigation Measures and Requirements: Biodiversity

Figure 7-2 Example of Temporary Internal Hoarding for Demarcating the Site into Smaller Zones

An indicative site clearance subzone and hoarding installation sequence has been provided (Figure 8-1). Areas slated for clearance have tentatively been subdivided into smaller site clearance subzones; finalised zonation will be crafted with input from the Contractor.

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 7-4. 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 9.3).

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.

Standard Mitigation Measures and Requirements: Biodiversity

Figure 7-3 Pre-site Clearance Wildlife 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

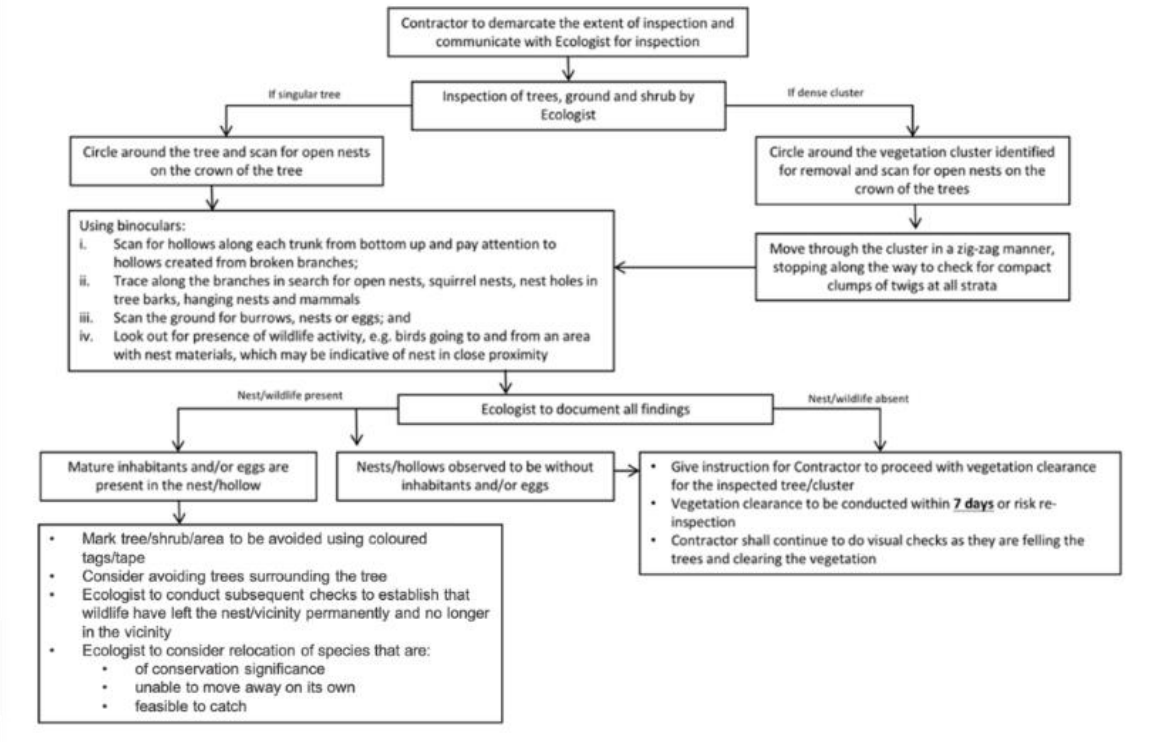

Figure 7-4 Workflow for a Pre-felling Fauna Inspection

Standard Mitigation Measures and Requirements: Biodiversity

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 9.3). 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 [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 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 7-5 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

Standard Mitigation Measures and Requirements: Biodiversity

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 7-6 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 7-7 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

Standard Mitigation Measures and Requirements: Biodiversity

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 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 9.3). 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., Bukit Batok West Avenue 2 and Bukit Batok West Avenue 5 (Figure 7-8). This should be conducted by the 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 9.4). 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 9.4) 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 9.3).

Fauna Monitoring

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Fauna monitoring shall commence one month prior to the start of construction works and be carried out on a monthly basis throughout the construction stage, and conclude two months after the completion of construction. The fauna monitoring's objectives are to 1) monitor for the continued usage of the adjacent habitats by faunal species, and 2) to monitor for excessive disturbance to fauna (e.g., noise and light pollution). Indicative survey locations are shown in Figure 7-8.

Faunal field surveys will target the following taxa: 1) fish, 2) odonates, 3) amphibians, 4) reptiles, 5) birds, and 6) mammals (excluding bats). Table 7-1 summarises the surveys that will be carried out for each taxon. Each survey will be conducted by at least two surveyors. All fauna encountered will be identified to species, or to the next lowest 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 (Figure 7-8). One survey routes have been identified, and they will both 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.

Aquatic Surveys

Aquatic surveys will take place at Stream A, and consist of (1) a 20-minute point count, targeting odonates, and (2) a 20-minute netting event, to be conducted by two surveyors, targeting fish, decapod crustaceans, and molluscs. Adult odonates will be identified visually (with binoculars where necessary), and photographed, if required. Fish, decapod crustaceans and molluscs will be located and caught using scoop nets and hand nets, and captured individuals will be released immediately after identification.

Table 7-1 Summary of Monitoring Surveys for Fauna

Survey Type	Taxon	Timing (h)	Duration/ Frequency	Sampling Unit*	Technique	Equipment	Data Collected
Diurnal and nocturnal transects	Herpetofauna (amphibians and reptiles)	0700–1000; 2000–2300	20–30 minutes per transect/once during pre-construction stage and monthly during construction stage	200-m continuous transects along a sampling route	Visual and auditory; up to 50 m left, right, and front of surveyor	Camera, binoculars, torches	Location, species, quantity, date, time
	Birds						
	Mammals						
Aquatic Surveys	Odonates	0900–1500	20 minutes per sampling event with two surveyors/once during pre-construction stage, monthly during construction stage, two months post-construction	Sampling points	Visual only; up to 25 m from sampling point	Camera, binoculars	Location, species, quantity, date, time
	Fish, decapod crustaceans and molluscs				Visual and netting; up to 25 m from sampling point	Camera, scoop-netting: hand nets (net size 25 × 18 cm; 2 mm mesh)	

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

Legend

- EMMP boundary
- Soil Investigation and Earthwork
- Areas of high conservation value
- Stream A

Monitoring survey locations

- Indicative roadkill transect
- Fauna monitoring transect
- Aquatic sampling point

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

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

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

Figure Title :

INDICATIVE FAUNA MONITORING SURVEY LOCATIONS

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
ISA	NHT	JAG	7 - 9	-	1 of 1
	Drawn ISA	Date JAN 2023	CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

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7.1.2 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 sites as per the Public Utilities Board of Singapore's (PUB) circular on Preventing Muddy Waters from the Construction Sites (October 2015). It is also meant to curb Contractors from deliberately tempered with the CCTV system to mask the silty discharge;
- Erosion control 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;
- Where excavation is more than 1.5m during earth works and excavation works, plan submission by QP (ST) to BCA shall be done during the design and construction stage. If the depth is more than 4m, Accredit Checker (AC) shall be engaged for independent check as required by BCA;
- 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;
- Access path, road or site office area, if any, should be paved up;
- Contractor should maintain a gentle slope during site clearance and earthwork/ soil cutting to prevent slope failure. Temporary slope shall be maintained maximum at 1:2 during earth works and other excavation/construction works;
- Where existing slope is steep, measures such as geotextile or temporary retaining structures should be put in place during the site clearance, tree/root removal and earth cutting works to prevent slope failure;
- For weak soil at stream A and stream B, extra attention should be given to avoid risk of worker falling into swampy soil. Slope failure control measures and extra care need to be put in place to prevent risk of safety during construction works;
- The site clearance and earthwork should be planned in phases to ensure that not so large area is exposed at a time, and the runoff from the exposed area is within capacity of the ECM;
- Proper drainage system should be designed to accommodate additional runoff from the site during different stages of the construction works. The capacity of the drainage should be designed for runoff co-efficient from C=0.45 (existing site condition) to C=0.65 during site clearance and earthwork, and C=1 during building construction and post construction stage;
- Capacity of the existing downstream drainage that will take additional runoff from the site should be reviewed to ensure sufficiency. If the existing downstream drainage capacity is not sufficient, additional drainage should be provided to prevent flooding at the downstream areas;

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

- Concrete trucks and other equipment should be washed out to prevent concrete from hardening within. This washout should not be discharged directly into any drainage system but collected as wastewater for treatment;
- Humps should be installed at the site entrances to prevent any silted storm water from exiting via this pathway;
- Bare earth areas should be isolated with silt fences, and bare earth area should be covered after work;
- 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;
- 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 areas that lack concrete slope protection. Excess soil material should be stored properly where it can be reused;
- 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;
- 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 functionability 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;
- Emergency response equipment, e.g., spill kits, absorbent booms, clean spade, and buckets must be well-prepared for use and be in close vicinity to the chemical storage area;
- 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. Water-proof sheets must be used to cover the secondary containment in rainy periods to prevent spill-over;
- Preparation of an emergency response plan, training of the emergency response team (ERT) to be competent in the response mechanism and provision of response kits for any spillages;
- 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;
- 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;

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

- Appropriate concrete wash out areas shall be provided and shall not be performed in or near nay 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;
- Development of a Standard Operation Procedure (SOP) for safe handling, transfer, storage, and disposal of solid waste;
- Provision of enclosed bins and waste disposal facilities cleared up as often as necessary to prevent build-up. Housekeeping checks will be carried out once a day to ensure all litter is cleared from site;
- Consignment notification/tracking system and transport emergency response plan for transport of toxic waste;
- Appropriate disposal of toxic waste as per required in the Environmental Public Health (Toxic Industrial Waste) Regulations by licensed waste operator/collector;
- A full inventory of all anticipated wastewater streams and volumes should be finalised before the onset of the construction works;
- No unmanaged discharge of wastewater stream permitted;
- Containment ponds will be of impervious material and be designed with sufficient capacity to hold volumes of wastewater produced on-site, as well as allowance for stormwater runoff and potential fire-fighting wastewater;
- Temporary storage volumes should be provided for overflow situations. Temporary storage to be of sufficient capacity to capture any additional volumes that may be expected to ensure untreated wastewater is not released to watercourses unless it complies with Singapore NEA Guidelines on trade effluent discharge concentrations;
- Daily record volume of wastewater, as well as volumes of sludge and other produced wastes;
- The containment ponds, as well as wastewater generating areas on-site, to be equipped with spill clean-up kits;
- Implement a construction EMMP and ensure full preparation of associated plans and procedures including the following:
  - EMMP to include SOPs, an Emergency Response Plan (ERP), an inventory of wastewater streams, training of staff as well as an inspection, maintenance and audit schedule; and
  - Full development of EMMP Wastewater Management Procedures to include dedicated management and monitoring procedures that covers all eventualities related to the proper operation of the detention ponds, or any other wastewater discharge location/equipment.
- Regular and dedicated procedures for the inspection and maintenance of wastewater collection, storage, and treatment infrastructure, such as pipes, oil water separators, silt screens, etc.;
  - Regular and dedicated procedures for the management of stormwater collection, settling, testing and eventual discharge of ‘clean’ water to watercourses. This should also include associated measures required (e.g. silt curtains) to prevent high sediment concentration stormwater drainage to watercourses; and
  - A training programme for all on-site workers, including sub-contractors, in relation to their obligations for ensuring proper water quality management.
- Adequate drainage, piping and/or channeling of stormwater runoff to be assured through detailed design for capture and treatment before discharge into surface watercourses;
- Regular and dedicated procedures for the inspection and maintenance of stormwater collection, storage, and treatment infrastructure, such as pipes, oil water separation, silt screens, etc.;
- Regular and dedicated procedures for the management of stormwater collection, settling, testing and eventual discharge of ‘clean’ water to surface waters. This should also include associated measures required to prevent high sediment concentration stormwater drainage to surface waters;
- Effective ECM and monitoring implemented as recommended in the Code of Practice on Surface Water Drainage to ensure that discharge into stormwater drainage system does not contain TSS in concentrations greater than the prescribed limits under the Sewerage and Drainage (Surface Water Drainage) Regulations;
- ECM measures include but are not limited to minimisation of formation of bare soil, coverage of all bare/erodible surfaces, concrete cut-off drains, silt fences/traps along the perimeter cut-off drain, turbidity curtains for works adjacent to water bodies (canals, drains, streams), etc.
- Runoff within, upstream of, and adjacent to the work site shall be effectively drained away without causing flooding in the vicinity;
- Manholes should always be adequately covered and temporarily sealed;
- Protection of stockpiles with biodegradable erosion blanket coverage and proper scheduling of the demolition and earthworks to reduce the quantity of stockpiles to be stored onsite;
- Coverage of temporary/open storage of excavated materials;
- All vehicles should run via wheel washing process before leaving the site to ensure no earth, mud, debris, etc., deposited on roads and the wastewater hence generated should be stored and removed for treatment and disposal off-site by an approved Waste Management Contractor;
- Potential increase of peak-flow due to the change in the land use at the worksite can be mitigated by providing detention tanks or ponds within the Study Area. Detention tanks or ponds can capture stormwater during heavy storm events to reduce the peak runoff;
- Geotechnical aspect of site’s slope stability (such as Earth Retaining and Stabilising structures (ERSS) to be included in detailed design engineering for the construction stage;
- The design engineers for detailed design may need to ensure that Earth Retaining Stabilisation structures (ERSS) are proposed when the site is cleared and excavated. Concurrently the ECO must ensure that these measures are implemented in the construction phase, as cutting of slopes may result in slope instability;
- Groundwater monitoring to comply with Building Control Regulations 2003 as part of its instrumentation and monitoring plan to be endorsed by Qualified Professionals (QP);
- Proper Earth Retaining Stabilising Structures (ERSS) should be selected and designed to limit groundwater settlement;
- Schedule the proposed development in phases in order to minimize the volume of dewatering at any one time;

Standard Mitigation Measures and Requirement: Hydrology, Surface Water and Groundwater
• Use recharge wells as necessary during the excavation (if with basements) to limit the potential groundwater drawdown. • All works to be conducted by the Contractor including dewatering or recharging of groundwater, are to be planned and implemented to have minimal impact to the hydrological conditions of the streams, including any changes to the groundwater or affecting soil or slope structural stability of the conserved areas and the adjacent Bukit Batok Hillside Park area. Groundwater levels and quality of surface and groundwater within the stream or catchment of the conserved areas should be monitored throughout the duration of the development works. No slope works, installation of retaining structures or drainage should affect areas and habitat outside of the development boundaries.

7.1.3 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.
- 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.

Standard Mitigation Measures and Requirement: Air Quality

- 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.
- 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.
- Where possible, horticultural waste should be upcycled as wood material for products.
- As much as possible, horticultural waste should be transported offsite by licensed waste management contractors to horticultural waste recycling facilities where the wood waste can be grinded into wood chips for horticultural reuse (i.e. compost or mulch).

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.

7.1.4 Airborne Noise

Standard Mitigation Measures and Requirements: Airborne Noise

- All machinery and equipment used will be labelled with a weather-proof sticker clearly indicating its noise emission level (at source) under normal operating conditions;
- All machinery and equipment used on site will be sound reduced, as far as is practicable in accordance with Annex G of SS 602:2014, for each equipment, the contractor should have a sound power level for each equipment obtained from the equipment supplier. That sound power level needs to compare with BS standard or EIS assumption. And it should be less than the BS standard or EIS assumption;
- Stationary noisy equipment will be housed in enclosures (refer to F.3 SS 602:2014 and LTA Guidebook for best environmental practices (Noise Control at LTA Sites)) on site where necessary;
- Machine operators and workers will be trained and briefed on quieter work techniques;
- Noise awareness briefing will be conducted once in 3 month regularly/ as in when noise exceedance found in the monitoring equipment around the site. As highlighted, this briefing will include best practices on site, corrective action to be taken etc. depending on the situation. This will include a discussion of the noise mitigation measures such as the position of machinery, making use of portable noise barriers if necessary, dos and don'ts for use of machinery, behavioral practices including no shouting, no loud stereos/ radios on site, no dropping of materials from height, no throwing of metal items etc.;
- Ad-hoc noise monitoring will be carried out when work progresses during noisy operations;
- Additional noise measures will be implemented when noise monitoring indicates the noise levels are approaching or exceeding permissible noise levels and 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;
- Control of noise sources at the source from construction site – Analyse construction inventory list and check equipment causing high noise levels. The equipment with lower noise level shall be prioritized;
- Where controlling noise sources at the source is not feasible, acoustic enclosures or sheds are to be introduced to mitigate noise at the source. Typical acoustic enclosure covers the machine as fully as possible (with or without ventilation where applicable) to provide sound insulation;
- The contractor shall review the equipment to be used on site and erect localised noise barriers prior to undertaking high noise generating work;
- Machines (such as trucks) that may be in intermittent use shall be shut down between work periods or shall be throttled down to a minimum;
- Only well-maintained construction plants shall be utilized on-site, and plants shall be serviced regularly during the entire construction period;
- The number of PMEs shall be reduced as far as practicable when construction works are carried out at areas close to the noise sensitive receivers;
- Consider use of silencers or mufflers on construction equipment which are properly maintained during the construction programme while facing sensitive receptors;
- Behavioural practices including no shouting, no loud stereos/ radios on site, no dropping of materials from height, no throwing of metal items shall be ensured;
- Construction respite: Restrict high noise generating drilling activities only in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block, if possible;
- Periodic noise monitoring by an independent third party, to establish compliance with requirements and to advise on equipment causing concern, and additional potential mitigation measures;
- Plan the layout of the site by considering using materials and other large structural equipment as noise barriers;
- Plant known to emit noise strongly in one direction shall, wherever possible, be orientated so that the noise is directed away from the nearby NSRs;
- Material stockpiles and other structures shall be effectively utilized, wherever practicable, in screening noise from on-site construction activities;
- Acoustic sheds should be provided at the locations of the noise generating activity such as operation of hand-held breaker;
- No work allowed from 10.00pm on Saturday/eve of Public Holiday to 7.00am on the following Monday/day after the Public Holiday;
- 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:
  - CN1: Block 304 HDB Bukit Batok;
  - CN2: Within the Conservation Area;
  - CN3: Dazhong Primary School; and
  - CN4: 467a Bukit Batok West Ave 9.
- Contractor to prepare the Site Environmental Control Program in accordance NEA 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 Guideline;
- Contractor should engage Public Relation Officer (PRO) to establish good rapport with the community, handle and feedback complaints from the community;

Standard Mitigation Measures and Requirements: Airborne Noise

- 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
- 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;
- 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 Recourses (MEWR) or any relevant authorities. Noisy Construction Equipment (e.g. Compressors) and installation shall be sited away from occupied residential blocks. Al 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 14dyas 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.

7.1.5 Vibration

7.1.5.1 Vibration Impact Assessment

7.1.5.1.1 Ecological Receptors

Studies on the behaviour of ecology to vibration are less comprehensive compared to the 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.

While not recorded in the Bukit Batok Hillside Park Area EIS Report [R-1], the globally and nationally critically endangered terrestrial Sunda pangolin (*Manis javanica*) was deemed likely to occur in the Study Area and has been recorded from similar secondary forest habitats elsewhere in Bukit Batok. 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 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 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).

7.1.5.1.2 Human Receptors

Based on the BS 5228-2 [R-3] 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, 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., 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, 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 instructed by SO Rep. Three (3) sets of comprehensive reports shall be submitted to HDB weekly. The final report shall be submitted within two (2) weeks after the completion of the monitoring works.

7.1.5.2 Standard Measures and Requirements

Standard Measures and Requirements

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., comply with National regulations.
- Contractors shall be responsible for complying with and implementing all laws' requirements and 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 coincide in the same area, if possible, to minimize cumulative impact.
- Avoid impact pile or vibratory pile driving 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 the installation of sheet piles and tunnelling works (e.g., pipe jacking and TBM), to allay potential concerns.
- While using vibratory compactors, shut off the vibrator when reversing direction (the 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 a static method (no vibrations), and 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 travelling surface; reduce the speed of vehicles and weight of vehicle loads as practicable.

Ecological Receptors:

- Set up barriers to prevent road kills.
- The contractor shall conduct monitoring for vibration in 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 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, 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 instructed by SO Rep. Three (3) sets of comprehensive reports shall be submitted to HDB weekly. The final report shall be submitted within two (2) weeks after the completion of the monitoring works.

7.1.6 Vector Control

Standard Mitigation Measures and Requirement: Vector Control
• 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 regularly 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; • Area selected for site office should be fumigated before works take place; • Existing vegetation or undergrowth within 6 m of any stream, seepage, running or standing water should be cleared without prior approval from NEA, before construction works commence to in line with CVPA; • Providing a clear boundary for insect and vector control where populations will be monitored within the construction site; • Remove any pooled water in less than a week, as the Aedes mosquito eggs can develop into adult mosquitoes in less than a week in optimal conditions, by following measures: - Any water ponding on-site (from potholes, puddles, and locations of earthworks) should be backfilled with compacted soil immediately after inspection, or when construction activity in that area is ceased; - Granular insecticide should be applied into any water found to be collected in perforated bricks; - Any choked drains or channels used to direct water should be cleared of blockages; - Concrete should be placed in the gaps of any corrugated roofs; - Any material stored on-site should be raised 60 cm to ensure that the pest control team and the licensed pathogen vector control operator can see and remove vector populations; - Any receptacles located on-site that have the purpose of storing water should be emptied at the end of each day; - Any receptacles which can catch and hold rainwater should be stored in an undercover tool storage area or waste storage area; and - Any free hanging tarpaulins on-site should be taught to prevent water containment.

7.1.7 Waste Management

Standard Mitigation Measures and Requirement: Waste Management

- 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 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.
- 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. 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 wastes should be transported off-site to specialized horticultural recycling facilities where they can be grinded into wood ships 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;
- 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 in order to ensure proper disposal and prevent pollution to the environment; and

Standard Mitigation Measures and Requirement: Waste Management
• 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; • Appropriate disposal of any waste listed in the Environmental Public Health (General Waste Collection) Regulations by licensed waste operator/collector; • Development of SOP for safe handling, transfer, and storage of toxic waste; housekeeping checks once a day to ensure all toxic waste is cleared from site; • Appropriate construction material for toxic waste storage containers with leak detection tests conducted periodically; • Provision of secondary containment for all toxic waste stored in bulk as per the requirements in the COPPC/SS593; • Hazardous wastewater, such as oily water, thinners, solvents, or paints, are to be stored and removed for treatment and disposal off-site by an approved Waste Management Contractor. Hazardous liquids to be handled as Hazardous Waste; • Daily record volume of wastewater, as well as volumes of sludge and other produced wastes; • Inspections and audits to ascertain the hygienic conditions onsite; • Training of workers on the best practices to contribute to environmental protection; • Appropriate location of toilet facilities away from any nearby watercourses. • The contractor should ensure that information in the waste management plan that is applicable to individual site workers is disseminated to them; • Waste storage facilities should be fit for purpose by ensuring that waste containers/ storage areas are capable of containing predicted waste volumes, for each waste type, in a manner unlikely to cause damage to the environment or harm to human health; • Waste designated for off-site recycling or disposal will only be transferred to such parties that can demonstrate that they are licensed to transport and/or treat or dispose of the waste in accordance with relevant Singapore Regulations; • Portable toilets for construction workers must be placed inside each construction area, with the sewage pumped away regularly by an appropriately licensed waste disposal company; • All containers which were previously used to store pesticides and other chemicals should be bored with holes to ensure that these containers are not reused.

7.2 Environmental Trainings for Site Personnel

7.2.1 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

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.

7.2.2 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.

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
- Information of waste management contractors

7.2.3 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.

f) No sticky traps shall be used for pest control.

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

8 Proposed Management and Monitoring – Stage 1

8.1 Biodiversity

8.1.1 Pre-construction Phase

8.1.1.1 Site-specific Measures

8.1.1.1.1 Fauna Management During Site Clearance

The following sub-sections detail the workflow for site clearance. During Stage 1, site clearance will take place within the EMMP boundary. For this stage, directional site clearance should proceed from southeast to northwest towards the future Bukit Batok Hillside Park, and shall be carried out as detailed in Section 7.1.1. Clearance should take place within the site clearance subzones sequentially, according to the recommended sequence (Figure 8-1).

8.1.1.1.2 Hoarding Installation

Hoarding should first be set up to demarcate the entire earthworks areas, and a hoarding installation sequence has been provided (Figure 8-1). It is recommended for the areas slated for clearance at this stage to be subdivided into smaller site clearance parcels. Four site clearance subzones have been tentatively recommended, as shown in Figure 8-1. The installation of hoarding is to be completed by the contractor following the specifications in Section 7.1.1, and the detailed hoarding sequence is given in Appendix J.

Legend

- Soil Investigation and Earthwork

Stage 1 fauna management

- Direction of site clearance
- Internal hoarding
- Site clearance zone number

Hoarding installation sequence

- 1
- 2
- 3

N

Rev.	Date	By	Description	Chk'd	App'd
-	NOV 2022	ISA	Final Report	NHT	JAG

Qualified Person Endorsement : NA

URA Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

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

Figure Title :

FAUNA MANAGEMENT DURING AREA C STAGE 1 SITE CLEARANCE

Designed	Checked	Approved	Figure No. :	Rev.	Sheet
ISA	NHT	JAG	8 - 1	-	1 of 1
	Drawn ISA	Date NOV 2022	CAD File Name : NA		A3

Note: Source of basemap - Google Earth Map

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8.2 Hydrology and Surface Water

8.2.1 Pre-construction

8.2.1.1 Site-specific Measures

All standard measures as described in Section 7.1 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. Total Suspended Solids) input for Environmental Data Management System (EDMS) as described in Section 6.2. 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 ECO on-site, ECO should inform Contractor. The Contractor should conduct necessary investigation and corrective actions should be taken if necessary.

Based on EIS Report for Bukit Batok Hillside Park Area, it was suggested the tree (i.e. a large *Ficus vasculosa* with identified as Endangered species and some seedlings) grown on higher ground next to Stream B should be conserved.

8.2.1.2 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. Two (2) water quality sampling locations are proposed as shown in Figure 8-2. The monitoring parameters of water quality should follow Table 8-1. 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 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.

8.2.1.3 Feedback Management

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

8.2.2 Construction

8.2.2.1 Site-specific Measures

All standard measures as described in Section 7.1 should be applied accordingly.

In addition, 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 6.2, 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 8.2.1.1.

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

8.2.2.2 Monitoring Plan

Two (2) water quality sampling locations (as shown in Figure 8-2) 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 8-1.

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 the 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. Permanent TSS monitor 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 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 8-1) as well as any flooding or clogging issue observed on site, , EMMP Consultant's ECO and Contractor should conduct an investigation and corrective actions should be taken immediately.

If the real-time 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 8-1 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	-	-	
Enterococcus	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	

Parameter	Unit	Guideline used	Guideline value	Sampling Method
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. * Only sampled for baseline at all selected locations and quarterly at every construction discharge outlet				

Legend

- Prooposed Water Quality Monitoring Locations
- Watercourses
- Recommended Area of Conservation

Construction Activities for Stage 1

- Soil Investigation and Earthwork

N

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

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

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

Figure Title :

PROPOSED WATER QUALITY MONITORING LOCATIONS DURING STAGE 1

Designed	Checked	Approved
CKL	NHT	JAG
	Drawn: CKL	Date: JAN 2023

Figure No. : 8-2 | Rev. : - | Sheet : 1 of 1

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8.2.2.3 Feedback Management

If receiving any complaint on surface runoff of drainage along the boundary of construction worksites 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 worksites. A general complaint handling system is provided as in Figure 8-3.

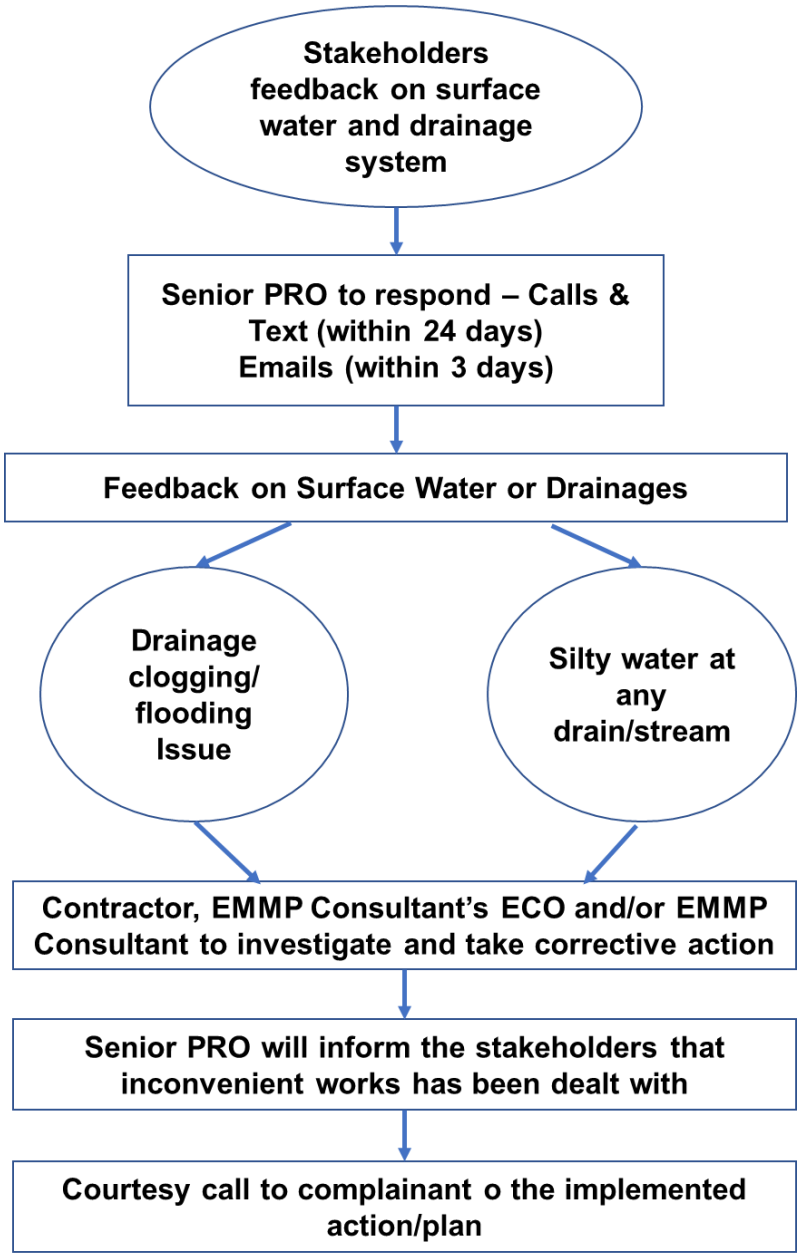

Figure 8-3 An Example of Complaint Handling System for Complaint Regarding Surface Water and Drainage System

8.3 Groundwater

8.3.1 Pre-construction

8.3.1.1 Site-specific Measures

All standard measures as described in Section 7.1 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 EMMP Consultant's ECO on-site, EMMP Consultant's ECO should inform Contractor. The Contractor should conduct necessary investigation and corrective actions should be taken if necessary.

8.3.1.2 Monitoring plan

One-time groundwater level monitoring at downstream of Stream A (refer to Figure **8-4**) will be conducted prior commencement of site clearance to have a representation of baseline data.

Before carrying any excavation or dewatering activities, one-time testing on groundwater level and quality should be conducted by the Contractor to have a basic representation of baseline groundwater quality conditions at the construction worksites. The groundwater quality should be tested for parameters as shown in the Table 8-2.

8.3.1.3 Feedback management

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

8.3.2 Construction

8.3.2.1 Site-specific Measures

All standard measures as described in Section 7.1 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 EMMP Consultant's ECO on-site, EMMP Consultant's ECO should inform Contractor. The Contractor should conduct necessary investigation and corrective actions should be taken if necessary.

8.3.2.2 Monitoring Plan

The groundwater level monitoring at downstream of Stream A (refer to Figure **8-4**) will be conducted monthly in order to monitor the groundwater changes due to potential construction works.

Contractor should monitor the groundwater level and quality as required in Singapore Building Control Regulations 2003 [R-28] weekly during dewatering process at where the excavation take place. The required groundwater parameters for testing should follow Table 8-2.

Contractor should conduct investigation and take corrective actions if any exceedance in groundwater quality based on guideline of Table 8-2.

Table 8-2 Parameters for Groundwater Quality Monitoring

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	-		6 - 9	

Parameter	Unit	Guideline used	Guideline value	Sampling Method
Temperature	°C	NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse	45	Ex-situ using grab sampling techniques and send to accredited lab for analysis
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	-	-	
Enterococcus	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.				

8.3.2.3 Feedback management

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

Legend

- Proposed Groundwater Monitoring Locations
- Watercourses
- Recommended Area of Conservation

Construction Activities for Stage 1

- Soil Investigation and Earthwork

N

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Figure Title :

PROPOSED GROUNDWATER MONITORING LOCATION DURING STAGE 1

Designed	Checked	Approved
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8.4 Air Quality

8.4.1 Pre-construction

Based on the approved EIS report [R-1], the use of construction vehicles and equipment during construction and material handling activities will decrease the air quality and increase local dust levels. Movement of heavy vehicles and material handling will increase the concentration of dust and increase concentration of pollutants such as CO, NO_2 and SO_2, while earthworks and construction activities will increase concentration of dust (i.e., PM_{10} and $PM_{2.5}$). However, a variety of mitigation measures are available to control the dust released from the construction site. The EIS report [R-1] concluded that this contributes to Temporary, Negative air quality impact that is of Minor Significance.

Although no monitoring point was proposed in the EIS report [R-1], AECOM proposed to monitor ambient air quality prior to construction to have a full representation of the construction area. Pre-construction baseline monitoring of PM_{10} and $PM_{2.5}$ shall be carried out as they are the main pollutant of concern.

The two (2) locations proposed for pre-construction monitoring are as follows:

- CA1: HDB Blk 304 Bukit Batok Street 31; and
- CA2: Ecological receptor within forested area.

The proposed monitoring locations are presented in Figure 8-5. 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.

8.4.2 Construction

8.4.2.1 Site-specific Mitigation Measures

According to the planned timeline, only soil investigation and earthworks will be carried out during Stage 1. General mitigation measures proposed in Section 7.1.3 shall be implemented. Additionally, during earthworks phase, the following site-specific mitigation measures adapted from the IAQM [R-10] shall be implemented:

- 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.

8.4.2.2 Monitoring Plan

Real-time continuous monitoring of PM_{10} 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 shall 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 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 one (1) ecological receptor are proposed for continuous monitoring of PM_{10} and $PM_{2.5}$ during earthworks phase. The proposed locations are as follows:

- A1: HDB Blk 304 Bukit Batok Street 31; and
- A2: Ecological receptor within forested area.

The proposed monitoring locations are presented in Figure 8-5.

Daily inspection by EMMP Consultant’s ECO should also be carried out on eastern boundary facing residential areas and also 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

- Soil Investigation and Earthwork

N

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-	SEP 2022	TTR	Draft Report	NHT	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

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

Figure Title :

PROPOSED AIR MONITORING LOCATIONS DURING PRE-CONSTRUCTION AND STAGE 1

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8.4.2.3 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 8-6. 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.

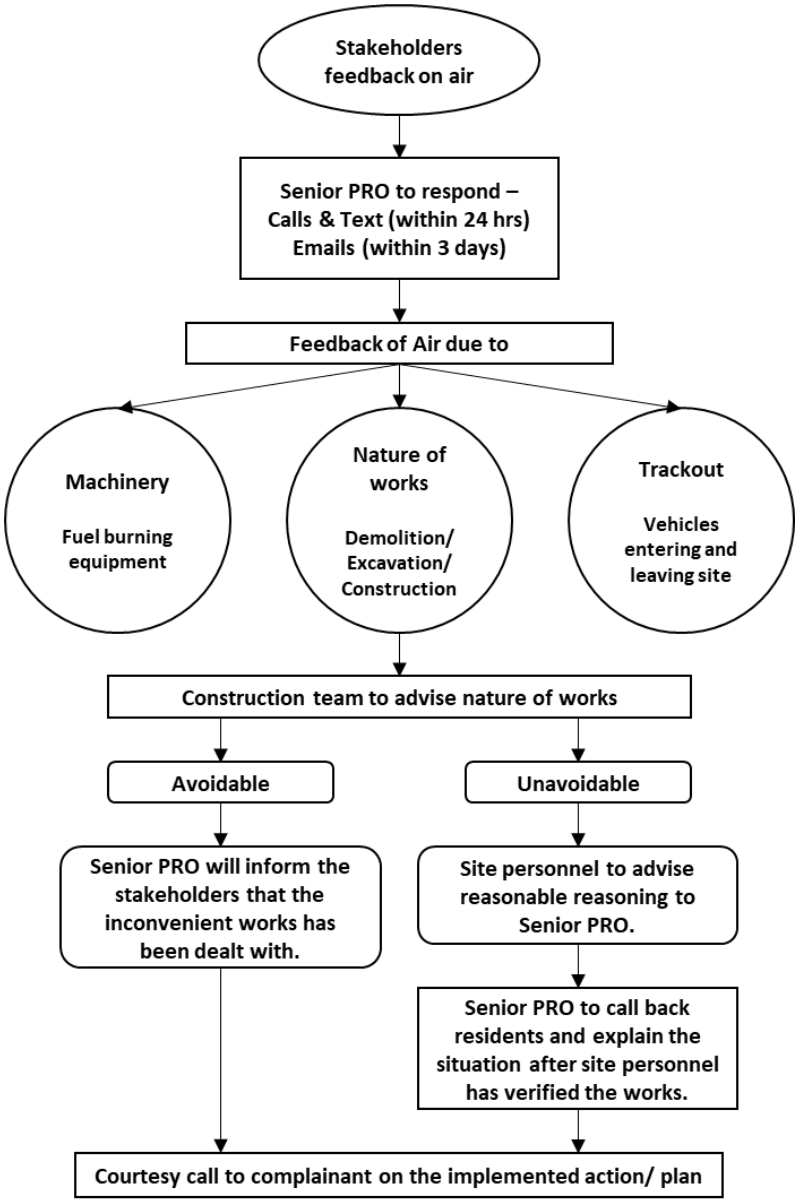

Figure 8-6 Feedback Management System

8.5 Airborne Noise

8.5.1 Pre-construction

8.5.1.1 Site-specific measures

Mitigation measures proposed in Section 7.1 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.

8.5.1.2 Monitoring Plan

Unattended noise monitoring at four (4) locations (as shown in Figure 8-7) are proposed based on review of sensitive receptors around the Project construction site in the Environmental Impact Study (EIS) report [R-1] to establish the pre-construction baseline noise level. The four (4) locations proposed for pre-construction monitoring are as follows:

- CN1: Block 304 HDB Bukit Batok;
- CN2: Within the Conservation Area;
- CN3: Dazhong Primary School; and
- CN4: 467a Bukit Batok West Ave 9.

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 Contractor will use the pre-construction baseline to calculate and set Project criteria which shall apply for construction works in all stages. This data will be shared with the SO Rep, HDB and the 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-11] 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-11].

A set of maximum allowable noise limits are prescribed for different time periods of the day and for different types of affected premised under *Environmental Protection and Management (Control of Noise at Construction Sites) Regulations, Second Schedule* (refer to Table 8-3).

Table 8-3 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 ($L_{Aeq12hr}$)	50 ($L_{Aeq12hr}$)	
		75 ($L_{Aeq5min}$)	55 ($L_{Aeq5min}$)	
	(b) Residential buildings located less than 150 m from the construction site where the noise is being emitted	75 ($L_{Aeq12hr}$)	65 (L_{Aeq1hr})	55 (L_{Aeq1hr})
		90 ($L_{Aeq5min}$)	70 ($L_{Aeq5min}$)	55 ($L_{Aeq5min}$)
	(c) Buildings (other than those in paragraphs (a) and (b))	75 ($L_{Aeq12hr}$)	65 ($L_{Aeq12hr}$)	
		90 ($L_{Aeq5min}$)	70 ($L_{Aeq5min}$)	

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 ($L_{Aeq12hr}$)	50 ($L_{Aeq12hr}$)	
		75 ($L_{Aeq5min}$)	55 ($L_{Aeq5min}$)	
	(b) Residential buildings located less than 150 m from the construction site where the noise is being emitted	75 ($L_{Aeq12hr}$)	-	
		75 ($L_{Aeq5min}$)	55 ($L_{Aeq5min}$)	
	(c) Buildings (other than those in paragraphs (a) and (b))	75 ($L_{Aeq12hr}$)	65 ($L_{Aeq12hr}$)	
		90 ($L_{Aeq5min}$)	70 ($L_{Aeq5min}$)	

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 8-4. 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 8-4 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

8.5.1.3 Feedback Management

Not applicable during pre-construction stage.

Legend

- Proposed Noise Monitoring Location

Construction Activities for Stage 1

- Soil Investigation and Earthwork

N

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Consultant : AECOM

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SPECIALIST CONSULTANCY SERVICES AT HDB DEVELOPMENT (WESTERN): ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN (AREA C)

Figure Title :

PROPOSED NOISE MONITORING LOCATIONS DURING PRE-CONSTRUCTION

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PNZ	NHT	JAG	8-7	-	1 of 1
	Drawn PNZ	Date NOV 2022	CAD File Name : NA		A3

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8.5.2 Construction

8.5.2.1 Site-specific measures

Mitigation measures proposed in Section 7.1 shall be implemented by Contractor. No site-specific mitigation measures are proposed, since there were no noise exceedances predicted on noise sensitive receptors based on the worst-case impact predicted in the Environmental Impact Study (EIS) report [R-1]. In case if there is any noise exceedance during construction stage, the contractor may need to look at the permanent noise barrier or additional mitigation measures such as enclosure, noise screen/noise panel, and portable noise barrier are recommended for all construction stages to future reduce excessive noise impacts to the noise sensitive receptors.

The Contractor will use the pre-construction baseline (refer to Section 8.5.1.2) to calculate and set Project criteria which shall apply for construction works in all stages. This data will be shared with the SO Rep., HDB and the EMMP consultant.

Daily inspection by EMMP Consultant's ECO should also be carried out on entire boundary facing noise sensitive receptors. EMMP Consultant will conduct site inspection bi-weekly during construction phase.

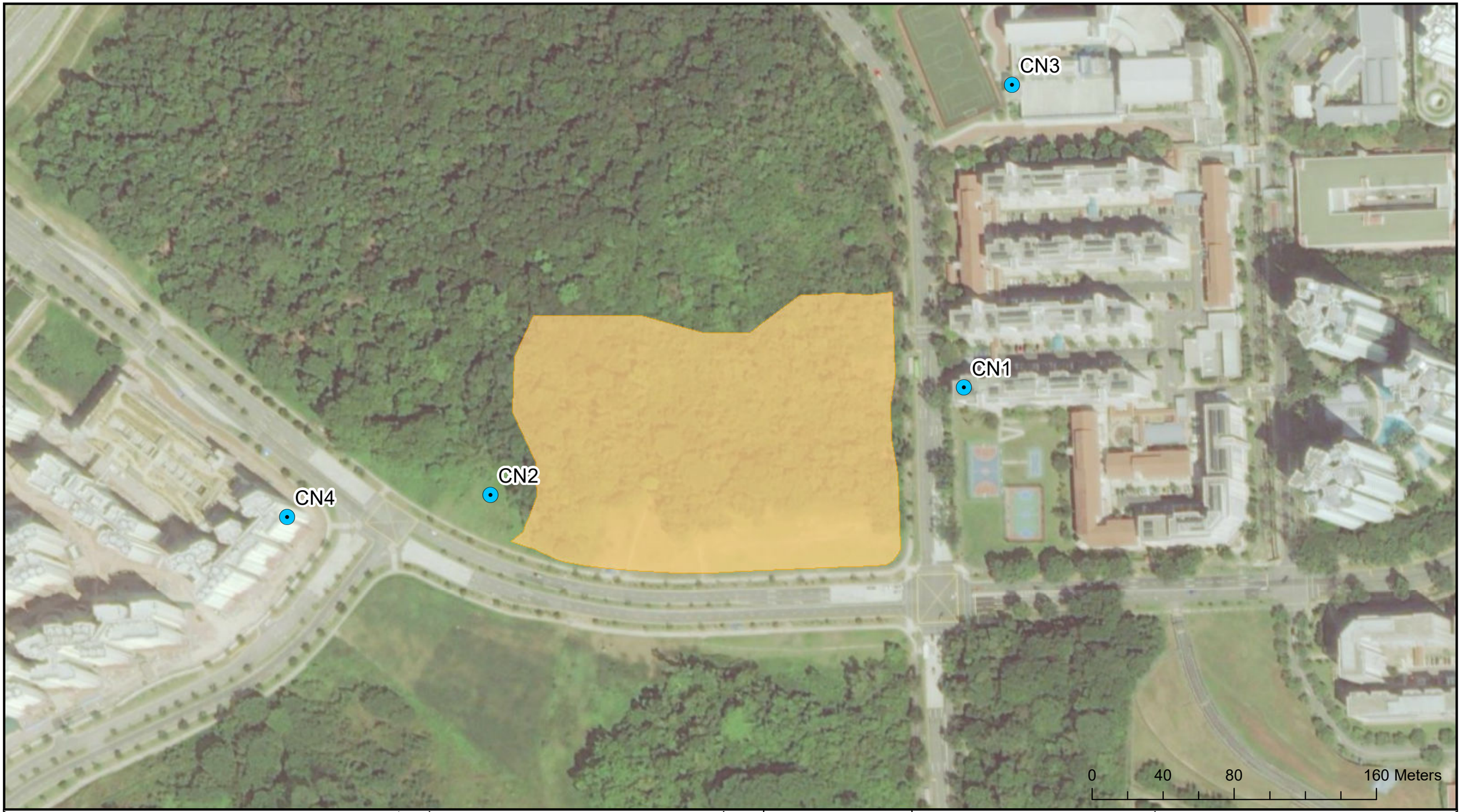
8.5.2.2 Monitoring Plan

Four (4) locations (as shown in Figure 8-8) are proposed for continuous real-time noise monitoring during Stage 1 based on the review of sensitive receptors around the Project construction site and 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 mention in Section 8.5.1.2 during entire construction stage and the data will be shared with the SO Rep., HDB and the EMMP Consultant for data analysis. The four (4) proposed locations are as follows:

- CN1: Block 304 HDB Bukit Batok;
- CN2: Within the Conservation Area;
- CN3: Dazhong Primary School; and
- CN4: 467a Bukit Batok West Ave 9.

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-11]. 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 Location

Construction Activities for Stage 1

- Soil Investigation and Earthwork

N

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SPECIALIST CONSULTANCY SERVICES AT HDB DEVELOPMENT (WESTERN): ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN (AREA C)

Figure Title :

PROPOSED NOISE MONITORING LOCATIONS DURING STAGE 1

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PNZ	NHT	JAG
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8.5.2.3 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 8-9. 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.

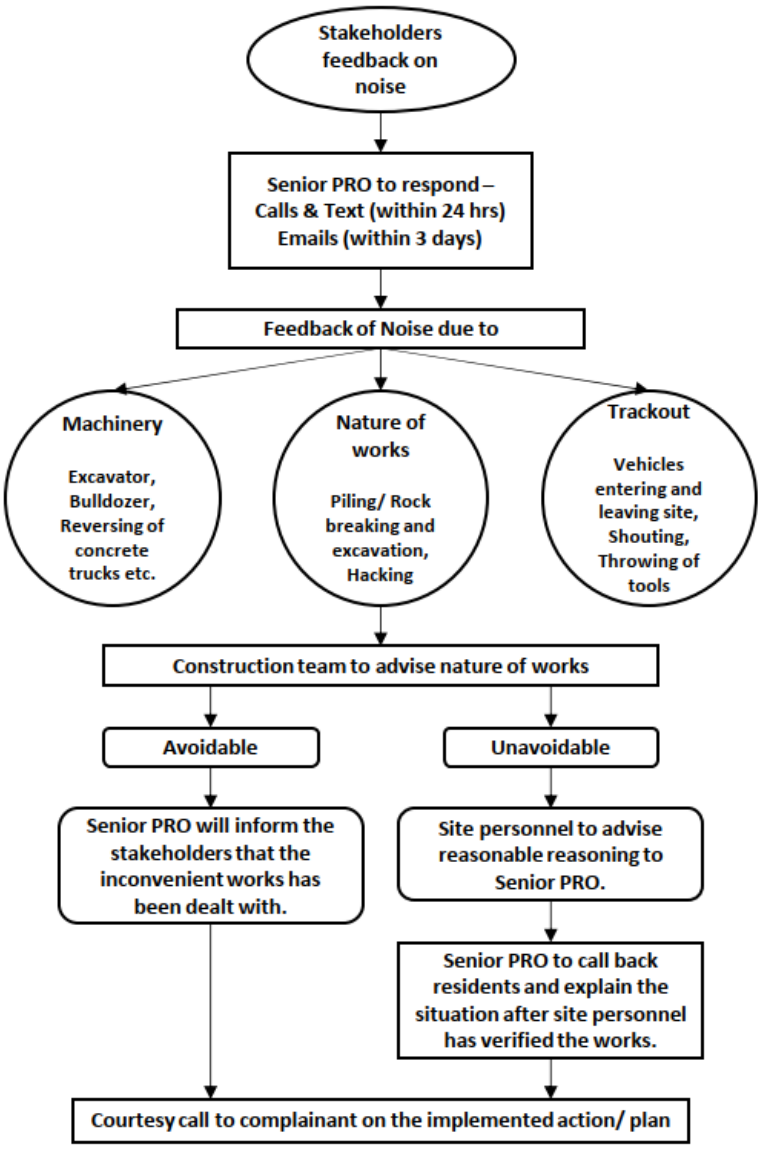


Figure 8-9 Feedback Management System (Noise)

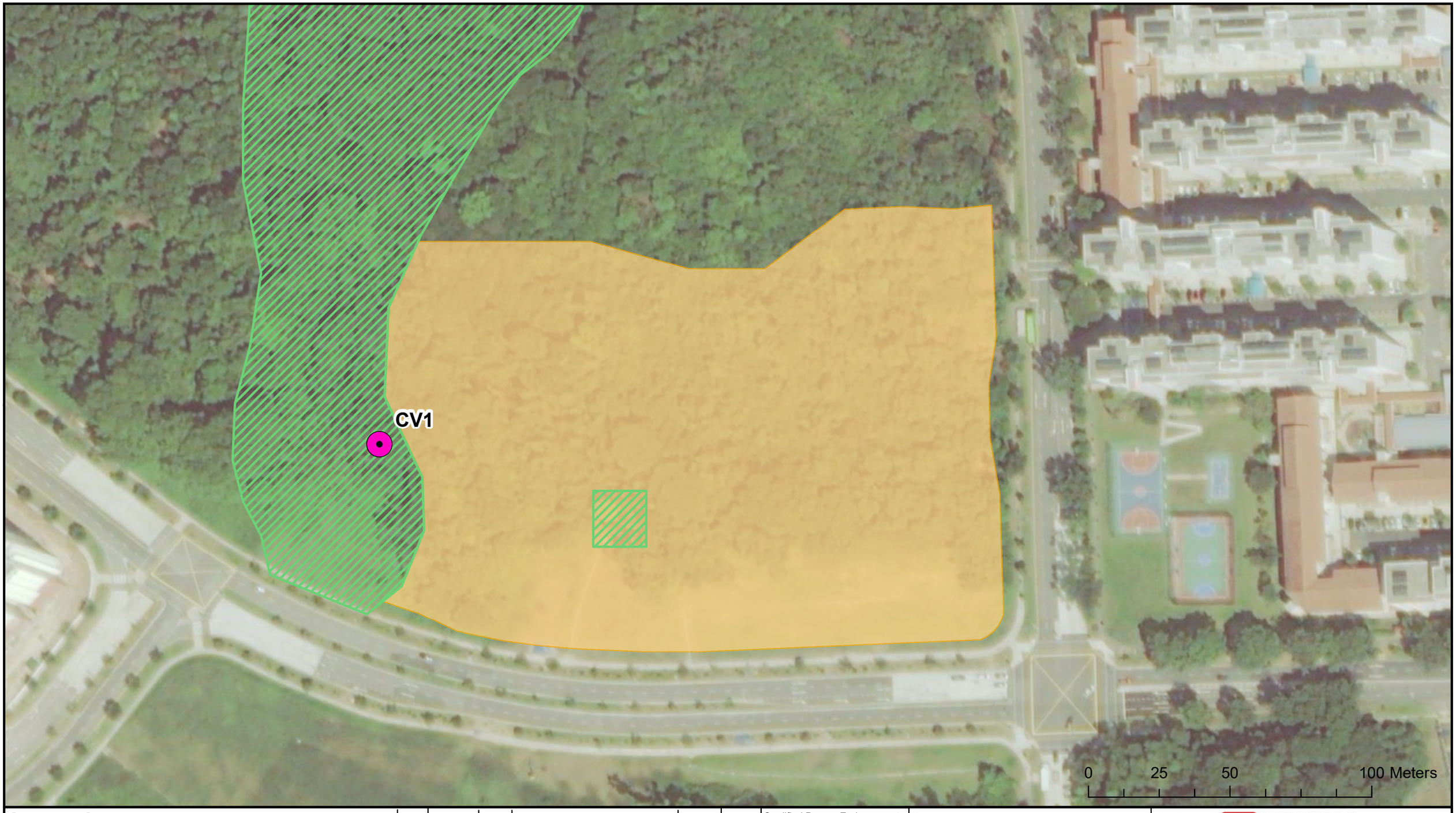
8.6 Vibration

8.6.1 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 location proposed for pre-construction monitoring are as follows:

- CV1: Ecological receptor within forested area.

The proposed monitoring location is presented in Figure 8-10.



Legend

- Proposed Vibration Monitoring Location
- Recommended Area of Conservation

Construction Activities for Stage 1

- Soil Investigation and Earthwork

N

Rev.	Date	By	Description	Chk'd	App'd
-	NOV 2022	TTR	Final Report	NHT	JAG

Qualified Person Endorsement : NA

HDB Endorsement : NA

Consultant : AECOM

Client: HOUSING & DEVELOPMENT BOARD

Project Title :

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

Figure Title :

PROPOSED VIBRATION MONITORING LOCATION DURING PRE-CONSTRUCTION

Designed	Checked	Approved
HHL	NHT	JAG
	Drawn: TTR	Date: NOV 2022

Figure No. :	Rev.	Sheet
8-10	-	1 of 1

CAD File Name : NA — A3

Note: Source of basemap - Google Earth Map

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8.6.2 Construction

8.6.2.1 Site-specific Mitigation Measures

General mitigation measures proposed in Section 7.1.5.2 shall be implemented. No site-specific mitigation measure is proposed at this stage.

8.6.2.2 Monitoring Plan

Vibration monitoring is not required 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 9.3). If there are any complaints from the community with regards to vibration during construction, additional vibration monitoring shall be conducted by the contractor.

8.6.2.3 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 of 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. The feedback management system is shown in Figure 8-11. All the feedback and engagement are documented and maintained until successful work completion. Appendix E shows the example of the Verbal & Written Feedback Register Form and the example Engagement Report.

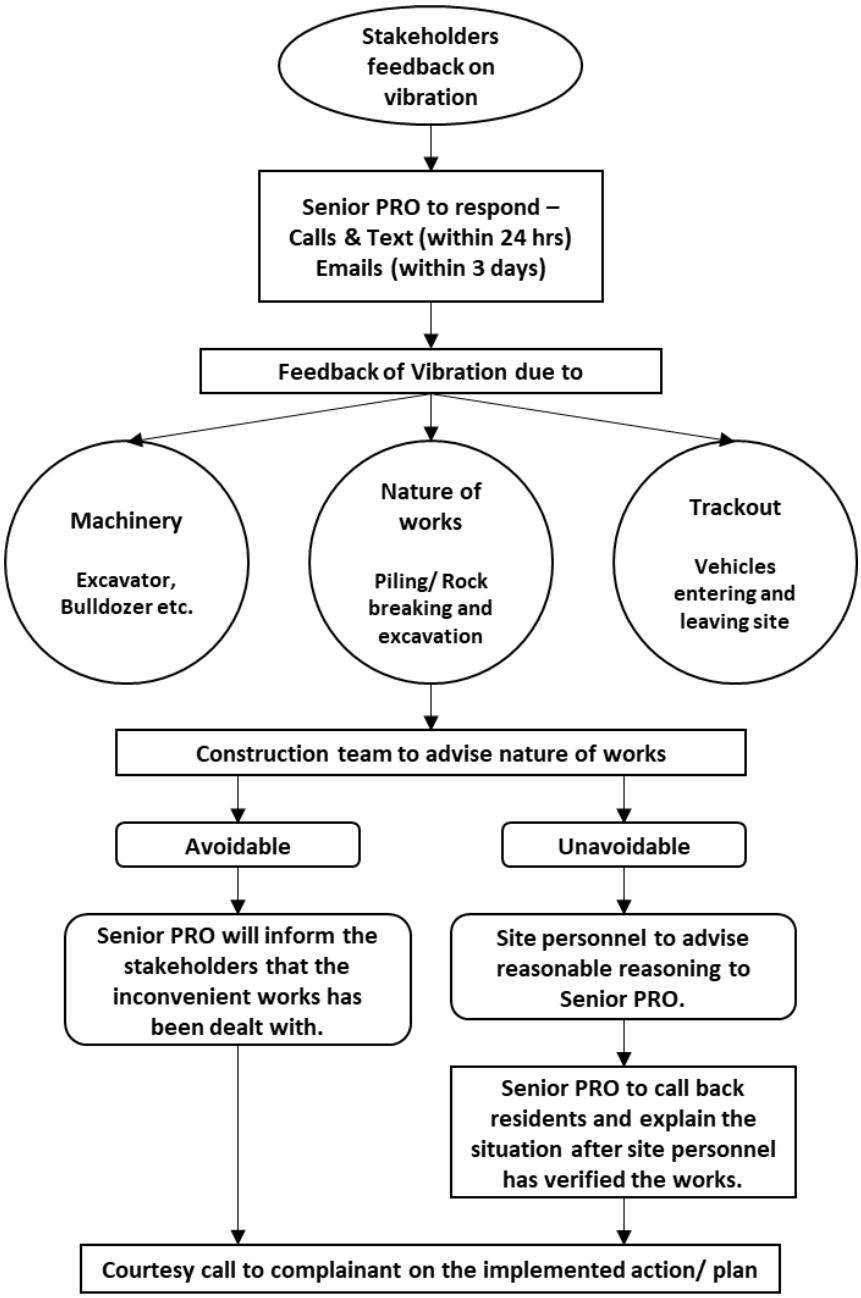

Figure 8-11 Feedback Management System

8.7 Vector Control

8.7.1 Pre-construction

8.7.1.1 Site-specific Measures

All standard measures as described in Section 7.1.6 should be applied accordingly.

8.7.1.2 Monitoring Plan

8.7.1.2.1 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 8-12): 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.
- 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.

8.7.1.3 Feedback Management

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

8.7.2 Construction

8.7.2.1 Site-specific Measures

All standard measures as described in 7.1.6 should be applied accordingly.

8.7.2.2 Monitoring Plan

8.7.2.2.1 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.
- 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.

8.7.2.2.2 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.

8.7.2.2.3 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-22]. 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-18], 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, Gravitas will normally be employed to prevent mosquito breeding. The in-house vector control team shall develop a vector control program (see example in Figure 8-12) 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 8-5 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 8-5 Recommended Monitoring Programme during Construction Phase (Vector Control)

Location	Parameters	Frequency and Duration
Contractor to define vector zones (see example in Figure 8-12) for each individual construction worksite (including storage and resting areas) under this Project, as listed below: • Worksite for site clearance, soil investigation and building construction; • Any other individual worksites set up for other supporting works (e.g., underpinning works).	• Inspection of potential mosquito breeding grounds (stagnant water), rat/ rodent burrows and droppings of other vectors (e.g., cockroaches)	• Daily inspection across different zones by in-house vector control team (see example in Figure 8-12) 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.

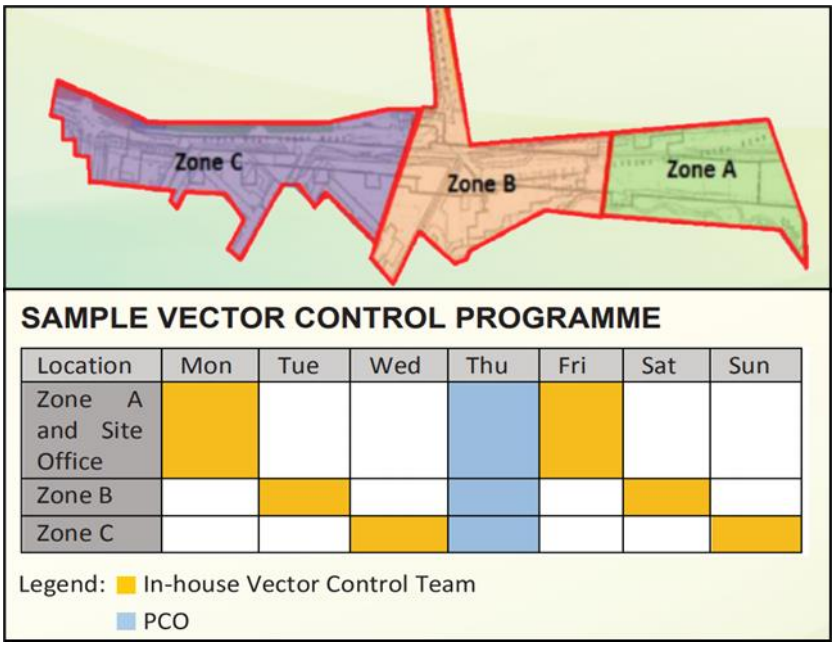

Figure 8-12 Example of Zoning Method and Vector Control Programme [R-23]

8.7.2.3 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.

8.8 Waste Management

8.8.1 Pre-construction

8.8.1.1 Site-specific Measures

All standard measures as described in Section 7.1.7 should be applied accordingly.

8.8.1.2 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 or each type of waste (i.e., recycled, incinerated) on-site and off-site.
- Information of waste management contractors.

8.8.1.3 Feedback Management

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

8.8.2 Construction

8.8.2.1 Site-specific Measures

All standard measures as described in Section 7.1.7 should be applied accordingly.

8.8.2.2 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 generations 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 are 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

8.8.2.3 Feedback Management

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

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

8.9.1 Biodiversity

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
Biodiversity: Flora				
Major Impact: • Site clearance • Earth works • Tree-felling works Minor Impact: • Pre-construction survey • Soil Investigation works • Hoarding works • Road works	• Loss of vegetation/habitat • Habitat pollution and degradation • Change in species composition • Disturbances to Flora within site, RAC and TPZs	• 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.*
		• 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.*
		• 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.*
		• 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.*
		• Minimise construction impacts on sensitive vegetation (i.e., RAC).	Contractor/EMMP Consultant	EMMP Consultant's ECO/ SO Rep.*
		• 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: • Site clearance • Earth works • Tree-felling works •	• Loss of vegetation/habitat • Habitat pollution and degradation • Change in species composition • Disturbances to Flora within site, RAC and TPZs.	• 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.*
		• 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: • Pre-construction survey • Soil Investigation works • Hoarding works • Road works		• 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: • Site clearance • Earth works • Tree-felling works Minor Impact: • Pre-construction survey • Soil Investigation works • Hoarding works • Road works	• 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	• Implement the Wildlife Response Plan, Roadkill Response Plan, pre-felling procedures and directional site clearance plan.	Contractor/EMMP Consultant	Contractor
		• Pre-felling fauna inspection to minimise injury and mortality of fauna as a result of vegetation clearance.	Contractor/EMMP Consultant	Contractor
		• After hoarding installation is completed, NParks to be informed if Eurasian wild boars are trapped within the hoarding boundary.	Contractor/EMMP Consultant	Contractor
		• Directional site clearance must be adhered to during site clearance to minimise fauna injury and mortality.	Contractor/EMMP Consultant	Contractor
		• 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
		• 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
		• 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.*
		• Site inspections to be conducted once every two weeks to minimise potential environmental impacts to fauna.	Contractor/EMMP Consultant	Contractor
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.				

8.9.2 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.	• 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> • 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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.*
		• 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.*
		• Where excavation is more than 1.5m during earth works and excavation works, plan submission by QP (ST) to BCA shall be done during the design and construction stage. If the depth is more than 4m, Accredit Checker (AC) shall be engaged for independent check as required by BCA;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*
		• 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.*
		• 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	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*
		• Access path, road or site office area, if any, should be paved up;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Contractor should maintain a gentle slope during site clearance and earthwork/ soil cutting to prevent slope failure. Temporary slope shall be maintained maximum at 1:2 during earth works and other excavation/construction works;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Where existing slope is steep, measures such as geotextile or temporary retaining structures should be put in place during the site clearance, tree/root removal and earth cutting works to prevent slope failure;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• For weak soil at stream A and stream B, extra attention should be given to avoid risk of worker falling into swampy soil. Slope failure control measures and extra care need to be put in place to prevent risk of safety during construction works;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• The site clearance and earthwork should be planned in phases to ensure that not so large area is exposed at a time, and the runoff from the exposed area is within capacity of the ECM;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Proper drainage system should be designed to accommodate additional runoff from the site during different stages of the construction works. The capacity of the drainage should be designed for runoff co-efficient from C=0.45 (existing site condition) to C=0.65 during site clearance and earthwork, and C=1 during building construction and post construction stage;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Capacity of the existing downstream drainage that will take additional runoff from the site should be reviewed to ensure sufficiency. If the existing downstream drainage capacity is not sufficient, additional drainage should be provided to prevent flooding at the downstream areas;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Concrete trucks and other equipment should be washed out to prevent concrete from hardening within. This washout should not be discharged directly into any drainage system but collected as wastewater for treatment;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Humps should be installed at the site entrances to prevent any silted storm water from exiting via this pathway;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Bare earth areas should be isolated with silt fences, and bare earth area should be covered after work;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Water Recycling: The objective is to minimise the amount of discharge from the construction site to the surface water drainage system;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Provide storage tanks or reservoirs with additional 20% capacity and number to temporarily store/ contain muddy surface runoff before treatment;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Whenever possible, segregate clean water flow from silty water flow to maximize the sedimentation tank holding capacity;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Provide sufficient treatment units or coagulant units to treat silty water before discharging into public drain within 10 hours of rain event;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*
		• Portable toilets are recommended to be installed on paved ground and bunded;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*
		• Establish a regular maintenance work schedule to check and maintenance cleanliness and functionability 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.*
		• 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.*
		• 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.*
		• 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.*
		• Emergency response equipment, e.g., spill kits, absorbent booms, clean spade, and buckets must be well-prepared for use and be in close vicinity to the chemical storage area;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*
		• 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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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.*
		• Preparation of an emergency response plan, training of the emergency response team (ERT) to be competent in the response mechanism and provision of response kits for any spillages;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*
		• 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.*
		• 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.*
		• Appropriate concrete wash out areas shall be provided and shall not be performed in or near nay of the streams;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• 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.*
		• Development of a Standard Operation Procedure (SOP) for safe handling, transfer, storage, and disposal of solid waste;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Provision of enclosed bins and waste disposal facilities cleared up as often as necessary to prevent build-up. Housekeeping checks will be carried out once a day to ensure all litter is cleared from site;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Consignment notification/tracking system and transport emergency response plan for transport of toxic waste;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Appropriate disposal of toxic waste as per required in the Environmental Public Health (Toxic Industrial Waste) Regulations by licensed waste operator/collector;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• A full inventory of all anticipated wastewater streams and volumes should be finalised before the onset of the construction works;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• No unmanaged discharge of wastewater stream permitted;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Containment ponds will be of impervious material and be designed with sufficient capacity to hold volumes of wastewater produced on-site, as well as allowance for stormwater runoff and potential fire-fighting wastewater;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Temporary storage volumes should be provided for overflow situations. Temporary storage to be of sufficient capacity to capture any additional volumes that may be expected to ensure untreated wastewater is not released to watercourses unless it complies with Singapore NEA Guidelines on trade effluent discharge concentrations;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Daily record volume of wastewater, as well as volumes of sludge and other produced wastes;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• The containment ponds, as well as wastewater generating areas on-site, to be equipped with spill clean-up kits;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Implement a construction EMMP and ensure full preparation of associated plans and procedures including the following: - EMMP to include SOPs, an Emergency Response Plan (ERP), an inventory of wastewater streams, training of staff as well as an inspection, maintenance and audit schedule; and - Full development of EMMP Wastewater Management Procedures to include dedicated management and monitoring procedures that covers all eventualities related to the proper operation of the detention ponds, or any other wastewater discharge location/equipment.	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Regular and dedicated procedures for the inspection and maintenance of wastewater collection, storage, and treatment infrastructure, such as pipes, oil water separators, silt screens, etc.; - Regular and dedicated procedures for the management of stormwater collection, settling, testing and eventual discharge of 'clean' water to watercourses. This should also include associated measures required (e.g. silt curtains) to prevent high sediment concentration stormwater drainage to watercourses; and - A training programme for all on-site workers, including sub-contractors, in relation to their obligations for ensuring proper water quality management.	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Adequate drainage, piping and/or channeling of stormwater runoff to be assured through detailed design for capture and treatment before discharge into surface watercourses;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Regular and dedicated procedures for the inspection and maintenance of stormwater collection, storage, and treatment infrastructure, such as pipes, oil water separation, silt screens, etc.;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Regular and dedicated procedures for the management of stormwater collection, settling, testing and eventual discharge of 'clean' water to surface waters. This should also include associated measures required to prevent high sediment concentration stormwater drainage to surface waters;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Effective ECM and monitoring implemented as recommended in the Code of Practice on Surface Water Drainage to ensure that discharge into stormwater drainage system does not contain TSS in concentrations greater than the prescribed limits under the Sewerage and Drainage (Surface Water Drainage) Regulations;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• ECM measures include but are not limited to minimisation of formation of bare soil, coverage of all bare/erodible surfaces, concrete cut-off drains, silt fences/traps along the perimeter cut-off drain, turbidity curtains for works adjacent to water bodies (canals, drains, streams), etc.	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Runoff within, upstream of, and adjacent to the work site shall be effectively drained away without causing flooding in the vicinity;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Manholes should always be adequately covered and temporarily sealed;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Protection of stockpiles with biodegradable erosion blanket coverage and proper scheduling of the demolition and earthworks to reduce the quantity of stockpiles to be stored onsite;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Coverage of temporary/open storage of excavated materials;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• All vehicles should run via wheel washing process before leaving the site to ensure no earth, mud, debris, etc., deposited on roads and the wastewater hence generated should be stored and removed for treatment and disposal off-site by an approved Waste Management Contractor;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Potential increase of peak-flow due to the change in the land use at the worksite can be mitigated by providing detention tanks or ponds within the Study Area. Detention tanks or ponds can capture stormwater during heavy storm events to reduce the peak runoff;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Geotechnical aspect of site's slope stability (such as Earth Retaining and Stabilising structures (ERSS) to be included in detailed design engineering for the construction stage;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• The design engineers for detailed design may need to ensure that Earth Retaining Stabilisation structures (ERSS) are proposed when the site is cleared and excavated. Concurrently the ECO must ensure that these measures are implemented in the construction phase, as cutting of slopes may result in slope instability;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Groundwater monitoring to comply 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.*
		• Proper Earth Retaining Stabilising Structures (ERSS) should be selected and designed to limit groundwater settlement;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Schedule the proposed development in phases in order to minimize the volume of dewatering at any one time;	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• Use recharge wells as necessary during the excavation (if with basements) to limit the potential groundwater drawdown.	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*
		• All works to be conducted by the Contractor including dewatering or recharging of groundwater, are to be planned and implemented to have minimal impact to the hydrological conditions of the streams, including any changes to the groundwater or affecting soil or slope structural stability of the conserved areas and the adjacent Bukit Batok Hillside Park area. Groundwater levels and quality of surface and groundwater within the stream or catchment of the conserved areas should be monitored throughout the duration of the development works.	Contractor	EMMP Consultant 's ECO/ EMMP Consultant/ SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		No slope works, installation of retaining structures or drainage should affect areas and habitat outside of the development boundaries.		
		<u>Site-specific Measures</u> • 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 6.2. 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).	Contractor and EMMP Consultant	SO Rep.*
		• 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 8.2.1.1.	Contractor and EMMP Consultant	SO Rep.*
		• 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.	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
		• ECO should conduct daily inspection on drainage, water quality of surface runoff and any abnormalities inside drainage system (e.g., fish kill).	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.				

8.9.3 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 **R-10**MITIGATION MEASURES TO BE IMPLEMENTED THROUGHOUT CONSTRUCTION PERIOD.		
		<u>Minimum Control:</u>		
		No demolition of permanent structure is expected as part of the Project.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		No concrete batching plant to be located on-site.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		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
		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
		Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		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
		Contractor to follow up on Air Quality control measures.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		Develop and implement an Air Pollution Control Plan (APCP)	Contractor	EMMP Consultant's ECO, EMMP Consultant
		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	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		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	EMMP Consultant's ECO, EMMP Consultant
		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>		
		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
		Make the complaints log available to the local authority when asked.	Contractor, PRO	EMMP Consultant's ECO, EMMP Consultant
		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
		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>		
		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
		Carry out regular site inspections to monitor and record compliance with the Air Pollution Control Plan.	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		Increase the frequency of site inspections during prolonged dry or windy conditions.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		Conduct monitoring for PM_{10} and $PM_{2.5}$ at suitable locations.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		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
		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
		Preparing and maintaining the site:		
		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
		Plan site layout so that machinery and dust causing activities are located away from receptors, where possible.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		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
		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
		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
		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

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		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
		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
		Contractor should keep extent of excavation and soil exposure areas to minimum required for construction.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		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
		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
		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
		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>		
		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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		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
		Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		Ensure all vehicles and engine powered equipment comply with the legislative requirements of Singapore	Contractor	EMMP Consultant's ECO, EMMP Consultant
		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
		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
		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>		
		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
		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
		Use enclosed chutes and conveyors and covered skips wherever possible.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment.	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		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
		Maintaining a minimum moisture content during any rock rushing works.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		Covering soil stockpiles with erosion control blankets.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Waste Management:</u>		
		Avoid burning of waste or other materials	Contractor	EMMP Consultant's ECO, EMMP Consultant
		Where possible, horticultural waste should be upcycled as wood material for products.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		As much as possible, horticultural waste should be transported offsite by licensed waste management contractors to horticultural waste recycling facilities where the wood waste can be grinded into wood chips for horticultural reuse (i.e. compost or mulch).	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Trackout:</u>		
		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
		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

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		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
		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
		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
		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
		Record all inspections of haul routes and any subsequent action in a site log book.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		Site access gates to be located at least 10m from receptors where possible.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		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
		If roadways are contaminated with dusty materials from construction site, clean-up shall be conducted without delay.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		ADDITONAL 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.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		Only remove the cover in small areas during work and not all at once.	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Impacts	Environmental	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
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.					

8.9.4 Airborne Noise

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
Excavation, earth work, site clearance, machinery and generator operation	Noise from construction machines and equipment (e.g. dozers, cranes, excavators, trailers, generators, etc.)	GENERAL MITIGATION MEASURE TO BE IMPLEMENTED THROUGHOUT CONSTRUCTION PERIOD		
		• All machinery and equipment used will be labelled with a weather-proof sticker clearly indicating its noise emission level (at source) under normal operating conditions	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• All machinery and equipment used on site will be sound reduced, as far as is practicable in accordance with Annex G of SS 602:2014, for each equipment, the contractor should have a sound power level for each equipment obtained from the equipment supplier. That sound power level needs to compare with BS standard or EIS assumption. And it should be less than the BS standard or EIS assumption	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Stationary noisy equipment will be housed in enclosures (refer to F.3 SS 602:2014 and LTA Guidebook for best environmental practices (Noise Control at LTA Sites)) on site where necessary	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Machine operators and workers will be trained and briefed on quieter work techniques	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Noise awareness briefing will be conducted once in 3 month regularly/ as in when noise exceedance found in the monitoring equipment around the site. As highlighted, this briefing will include best practices on site, corrective action to be taken etc. depending on the situation. This will include a discussion of the noise mitigation measures such as the position of machinery, making use of portable noise barriers if necessary, dos and don'ts for use of machinery, behavioral practices including no shouting, no loud stereos/ radios on site, no dropping of materials from height, no throwing of metal items etc.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Ad-hoc noise monitoring will be carried out when work progresses during noisy operations	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Additional noise measures will be implemented when noise monitoring indicates the noise levels are approaching or exceeding permissible noise levels and 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	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Control of noise sources at the source from construction site – Analyse construction inventory list and check equipment causing high noise levels. The equipment with lower noise level shall be prioritized	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Where controlling noise sources at the source is not feasible, acoustic enclosures or sheds are to be introduced to mitigate noise at the source. Typical acoustic enclosure covers the machine as fully as possible (with or without ventilation where applicable) to provide sound insulation	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• No work allowed from 10.00pm on Saturday/eve of Public Holiday to 7.00am on the following Monday/day after the Public Holiday	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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: ▪ CN1: Block 304 HDB Bukit Batok; ▪ CN2: Within the Conservation Area; ▪ CN3: Dazhong Primary School; and ▪ CN4: 467a Bukit Batok West Ave 9.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Contractor to prepare the Site Environmental Control Program in accordance with NEA 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
		• Contractor to prepare and submit bi-weekly Site Environmental Control Report to EMMP Consultant and SO Rep. in accordance with NEA Guidelines.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• 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 Consultant's ECO, EMMP Consultant
		• Construction prohibition period should be followed, as per fourth schedule of Environment Protection and Management regulation	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Prepare a Construction Noise Management Plan, to establish pre-construction baseline monitoring, plan for monitoring during the construction phase, and procedure for complaint handling	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• The contractor shall review the equipment to be used on site and erect localised noise barriers prior to undertaking high noise generating work	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Machines (such as trucks) that may be in intermittent use shall be shut down between work periods or shall be throttled down to a minimum	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Only well-maintained construction plants shall be utilized on-site, and plants shall be serviced regularly during the entire construction period	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• The number of PMEs shall be reduced as far as practicable when construction works are carried out at areas close to the noise sensitive receivers	Contractor	EMMP Consultant's ECO, EMMP Consultant

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Consider use of silencers or mufflers on construction equipment which are properly maintained during the construction programme while facing sensitive receptors	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Behavioural practices including no shouting, no loud stereos/ radios on site, no dropping of materials from height, no throwing of metal items shall be ensured	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Construction respite: Restrict high noise generating drilling activities only in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block, if possible	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Periodic noise monitoring by an independent third party, to establish compliance with requirements and to advise on equipment causing concern, and additional potential mitigation measures	Contractor	EMMP Consultant's ECO
		• Plan the layout of the site by considering using materials and other large structural equipment as noise barriers	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Plant known to emit noise strongly in one direction shall, wherever possible, be orientated so that the noise is directed away from the nearby NSRs	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Material stockpiles and other structures shall be effectively utilized, wherever practicable, in screening noise from on-site construction activities	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Acoustic sheds should be provided at the locations of the noise generating activity such as operation of hand-held breaker	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• 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	Contractor	EMMP Consultant's ECO, EMMP Consultant, SO Rep.*
		• 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.*
		• 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

<table>
<tr><th>Activity</th><th>Potential Environmental Impacts</th><th>Mitigation Measures</th><th>Implementation Responsibility</th><th>Inspection Responsibility</th></tr>
<tr><td></td><td></td><td>
• 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. Al 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:
<table>
<tr><th>Types of Affected Buildings</th><th>Applicable Period</th><th>Maximum Permissible Equivalent Continuous Noise Level Measured Over a Period of 5 Minutes in dB(A)</th></tr>
<tr><td rowspan="3">(a) Hospitals, schools, institutions of higher learning, homes for the aged or sick etc.</td><td>7am to 7pm</td><td>75</td></tr>
<tr><td>7pm to 10pm</td><td>55</td></tr>
<tr><td>10pm to 7am</td><td>55</td></tr>
<tr><td rowspan="3">(b) Residential buildings located less than 150 m from the construction site where the noise is being emitted</td><td>7am to 7pm</td><td>90</td></tr>
<tr><td>7pm to 10pm</td><td>70</td></tr>
<tr><td>10pm to 7am</td><td>55</td></tr>
<tr><td rowspan="3">(c) Buildings (other than those in paragraphs (a) and (b))</td><td>7am to 7pm</td><td>90</td></tr>
<tr><td>7pm to 10pm</td><td>70</td></tr>
<tr><td>10pm to 7am</td><td>70</td></tr>
</table>
➢ 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
</td><td>Contractor</td><td>EMMP Consultant’s ECO, EMMP Consultant, SO Rep.*</td></tr>
</table>

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		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 14dyas 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.		
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.				

8.9.5 Vibration

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
General construction activities	Disturbance to ecology and human	General:		
		• Use low vibration equipment and construction techniques.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• 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
		• 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
		• The Contractor shall ensure that the vibration levels for coring, removal of rock, blasting etc., comply with National regulations.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Contractors shall be responsible for complying with and implementing all requirements by the laws and authorities on ground vibration pollution control.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Place vibrating equipment (e.g., pipe jacking unit) on isolators such as spring coils.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Route heavily loaded tipper trucks away from the vibration sensitive receptors as far away as possible.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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
		• Phased earthmoving, ground pilling and excavation operations so as not to occur at the same time in the same area, if possible, to minimize cumulative impact.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• 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

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Notify nearby vibration sensitive receptors in advance of the construction activities, particularly during the installation of sheet piles and tunnelling works (e.g., pipe jacking and TBM), to allay potential concerns.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• While using vibratory compactors, shut off the vibrator when reversing direction (the highest level of vibrations are often generated when quickly stopping and changing direction). Utilize a vibratory compactor that can adjust the impulse energy and frequency, compact soil with a static method (no vibrations), and oscillation compaction in place of conventional vibratory action, as far as practicable.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Fill in potholes and eliminate pavement discontinuities; keep haul roads smooth by periodic grading; pave existing roads to provide a smooth travelling surface; reduce the speed of vehicles and weight of vehicle loads as far as practicable.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Ecological Receptors:</u>		
		• Set up barriers to prevent road kills.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		• Contractor shall conduct monitoring for vibration in ecologically sensitive areas.	Contractor	EMMP Consultant's ECO, EMMP Consultant
		<u>Human Receptors:</u>		
		• 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.*
		• 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 comprehensive	Contractor	EMMP Consultant's ECO, EMMP Consultant, SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		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.		

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.

8.9.6 Vector Control

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
General construction activities	• Increase in the number of mosquitoes • Increase in the number of other vectors (i.e. rodents) Increase in the case of dengue fever	<u>Standard Measures</u> • 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• Scheduled daily housekeeping to ensure clearance of stagnant water and unwanted items are discarded properly;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Site entrance shall be paved to avoid ground depression;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Milled waste can be used to level the ground before laying steel plates;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Provide movable roof over shaft to prevent rainwater ingress;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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.*
		• Install pitched roof on top and/or seal up bottom of site container office;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• Area selected for site office should be fumigated before works take place;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Existing vegetation or undergrowth within 6 m of any stream, seepage, running or standing water should be cleared without prior approval from NEA, before construction works commence to in line with CVPA;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Providing a clear boundary for insect and vector control where populations will be monitored within the construction site;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Remove any pooled water in less than a week, as the Aedes mosquito eggs can develop into adult mosquitoes in less than a week in optimal conditions, by following measures: - Any water ponding on-site (from potholes, puddles, and locations of earthworks) should be backfilled with	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		compacted soil immediately after inspection, or when construction activity in that area is ceased; - Granular insecticide should be applied into any water found to be collected in perforated bricks; - Any choked drains or channels used to direct water should be cleared of blockages; - Concrete should be placed in the gaps of any corrugated roofs; - Any material stored on-site should be raised 60 cm to ensure that the pest control team and the licensed pathogen vector control operator can see and remove vector populations; - Any receptacles located on-site that have the purpose of storing water should be emptied at the end of each day; - Any receptacles which can catch and hold rainwater should be stored in an undercover tool storage area or waste storage area; and - Any free hanging tarpaulins on-site should be taught to prevent water containment.		
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.				

8.9.7 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> • 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.*
		• 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.*
		• 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	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• 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.*
		• 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.*
		• 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.	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• 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.*
		• All horticultural waste should be transported off-site to specialized horticultural recycling facilities where they can be grinded into wood ships 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.*
		• 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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• 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.*
		• 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.*
		• Implement strict waste handling, storage, collection, and disposal practices to prevent leakages;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• 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.*
		• 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.*
		➢ 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.*
		• 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.*
		• 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.*
		➢ 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.*
		• 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.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Appropriate disposal of any waste listed in the Environmental Public Health (General Waste Collection) Regulations by licensed waste operator/collector;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Development of SOP for safe handling, transfer and storage of toxic waste; housekeeping checks once a day to ensure all toxic waste is cleared from site;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Appropriate construction material for toxic waste storage containers with leak detection tests conducted periodically;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Provision of secondary containment for all toxic waste stored in bulk as per the requirements in the COPPC/SS593;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Hazardous wastewater, such as oily water, thinners, solvents, or paints, are to be stored and removed for treatment and disposal off-site by an approved Waste Management Contractor. Hazardous liquids to be handled as Hazardous Waste;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Daily record volume of wastewater, as well as volumes of sludge and other produced wastes;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Inspections and audits to ascertain the hygienic conditions onsite;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Training of workers on the best practices to contribute to environmental protection;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Appropriate location of toilet facilities away from any nearby watercourses.	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• The contractor should ensure that information in the waste management plan that is applicable to individual site workers is disseminated to them;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Waste storage facilities should be fit for purpose by ensuring that waste containers/ storage areas are capable of containing predicted waste volumes, for each waste type, in a manner unlikely to cause damage to the environment or harm to human health;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*

Activity	Potential Environmental Impacts	Mitigation Measures	Implementation Responsibility	Inspection Responsibility
		• Waste designated for off-site recycling or disposal will only be transferred to such parties that can demonstrate that they are licensed to transport and/or treat or dispose of the waste in accordance with relevant Singapore Regulations;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• Portable toilets for construction workers must be placed inside each construction area, with the sewage pumped away regularly by an appropriately licensed waste disposal company;	Contractor	EMMP Consultant 's ECO/EMMP Consultant/SO Rep.*
		• All containers which were previously used to store pesticides and other chemicals should be bored with holes to ensure that these containers are not reused.	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.				

8.10 Summary of Monitoring Plan and the Responsible Parties

8.10.1 Biodiversity

Activity	Monitoring Plan	Frequency	Trigger for Corrective Actions	Rectification Timeline	Implementation Responsibility	Inspection Responsibility
Biodiversity: Flora						
Major Impact: • Site clearance • Earth works • Tree-felling works Minor Impact: • Pre-construction survey • Soil Investigation works • Hoarding works • Road 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: • 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	EMMP Consultant/ SO Rep.*
	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: • The EMMP Consultant finds that habitat degradation has taken place; recommendations tailored to the finding should be adhered to.	48 hours	EMMP Consultant	EMMP Consultant/ SO Rep.*
	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: • Report to SO for downstream reporting to NParks.	NA	NA	EMMP Consultant
Biodiversity: Arboriculture						
Major Impact: • Site clearance • Earth works • Tree-felling works Minor Impact:	**Monthly Tree Inspections** Visual inspection of the trees along 15m from the hoarding line. Some factors that will be inspected are: – Physiological health and	Monthly throughout the construction phase	Corrective actions will need to be taken if: • The structure and health of the trees along the new forest edge has deteriorated and are deemed unsafe by an appointed Arborist. • Removal of these trees may be required.	24 hr	EMMP Consultant/ Appointed Arborist	Appointed Arborist

Activity	Monitoring Plan	Frequency	Trigger for Corrective Actions	Rectification Timeline	Implementation Responsibility	Inspection Responsibility
• Pre-construction survey • Soil Investigation works • Hoarding works • Road works	structural stability of trees. – Identify and assess trees that requires removal for the safety of the workers.		• Encroachment into or removal of TPZs resulting in impairment of structural stability and/or physiological health of trees.			
Biodiversity: Fauna						
Major Impact: • Site clearance • Earth works • Tree-felling works Minor Impact: • Pre-construction survey • Soil Investigation works • Hoarding works • Road works	**Monthly Fauna Monitoring** Conduct fauna monitoring within the future Bukit Batok Hillside Nature Park to monitor for construction impacts on fauna activity and presence.	• Once during pre-construction phase • Monthly throughout construction phase • Twice in post-construction phase	Corrective actions will need to be taken if: Excessive disturbance generated by construction activities is detected		EMMP consultant	EMMP Consultant/ SO Rep.*
	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 of ground-dwelling mammal(s) occur within 7 days of each other; Contractor to check the integrity of the hoarding line along Bukit Batok West Avenue 2 and Bukit Batok West Avenue 5 and carry out rectification, if any.	24 hours	Contractor	EMMP Consultant
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.						

8.10.2 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.	<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: • The following documentation are found inadequate/missing: - ECM Plan; - Monitoring Log; - Training Log; - Audit Reports; • If the monitored parameters exceed applicable values of NEA Trade Effluent Discharge Limits to Controlled Watercourse; • If groundwater level change significantly; • If any flooding or clogging issues observed; • If complaints are received due to Project's activities; and • If visual non-compliance to any of the minimum control or mitigation measures are observed on-site.	Contractor/QECP	EMMP Consultant's ECO
	<u>Earth Control Measures (ECM) Implementation</u> Permanent TSS monitor and implementation of CCTV including a SIDS installed at every discharge outlet.	Continuous monitoring		Contractor/QECP	EMMP Consultant/ EMMP Consultant's ECO/ SO Rep.*
	<u>Surface Water Monitoring</u> Water quality sampling at proposed locations and 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 proposed locations during pre-construction phase. Monthly monitoring at all locations and quarterly at construction discharge outlet for additional parameters during construction phase.		Contractor/EMMP Consultant's ECO	EMMP Consultant/ EMMP Consultant's ECO/ SO Rep.*
	<u>Groundwater Monitoring</u> Groundwater level monitoring at downstream of Stream A.	One-time monitoring during pre-construction phase. Monthly monitoring during construction phase.		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.*

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
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.					

8.10.3 Air Quality

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
Site clearance, machinery and generator operation, vehicle.	• Monitoring of PM_{10} and $PM_{2.5}$ at two (2) locations	Continuous monitoring during earthworks phase.	When earthworks activity starts.	Contractor	EMMP Consultant
	• Daily inspection by EMMP Consultant's ECO on eastern boundary facing residential areas and also 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.*
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.					

8.10.4 Airborne Noise

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
Excavation, earth work, site clearance, machinery and generator operation	• Monitoring of $L_{Aeq(12\,hr)}$ $L_{Aeq(1\,hr)}$ and $L_{Aeq(5min)}$ at four (4) 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.	Before commencement of any construction works (including site clearance) • One-time airborne noise monitoring for 1 week at the proposed locations, for establishment of latest baseline. During Construction Phase • 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 the ECO on entire boundary facing residential areas, as well as internal for ecological sensitive receptors.	Daily	-	EMMP Consultant's ECO	EMMP Consultant

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
	• ECO will carry out ad-hoc noise monitoring during the daily site inspection	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.*
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.					

8.10.5 Vibration

Activity	Monitoring Plan	Frequency	Triggers	Implementation Responsibility	Inspection Responsibility
General construction activities	• Carry out 1-week baseline vibration monitoring at proposed location.	1 week	-	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
	• 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	• Construction works are close to the existing buildings or structures • Public complaints received	Contractor	EMMP Consultant's ECO/ EMMP Consultant/ SO Rep.*
	• Carry out bi-weekly site inspections during the construction phase.	Bi-weekly	-	EMMP Consultant/ EMMP Consultant's ECO	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.					

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

8.10.7 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, disposal	Site-specific waste strategy and management plan (including monitoring, review and reporting protocol)	Prior construction	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	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
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.					

9 Emergency Response Plan

9.1 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.

9.2 Emergency Contact Summary for Environmental Incident

Table 9-1 Summary of Responsible Parties for Environmental Incident

Incident	Responsible Person
All environmental incident	• Contractor • EMMP Consultant's ECO • EMMP Consultant
Encounter of dead animals	• Contractor • EMMP Consultant's ECO • EMMP Consultant
Encounter of injured animals	• EMMP Consultant • Animal Response Centre
Fire event	Singapore Civil Defence Force (SDCF)
Chemical/Oil spill	• Contractor • EMMP Consultant's ECO • EMMP Consultant

9.3 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 9-1. This will be emphasized during the toolbox briefings (Section 7.2.1). 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 7.1.1). 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.

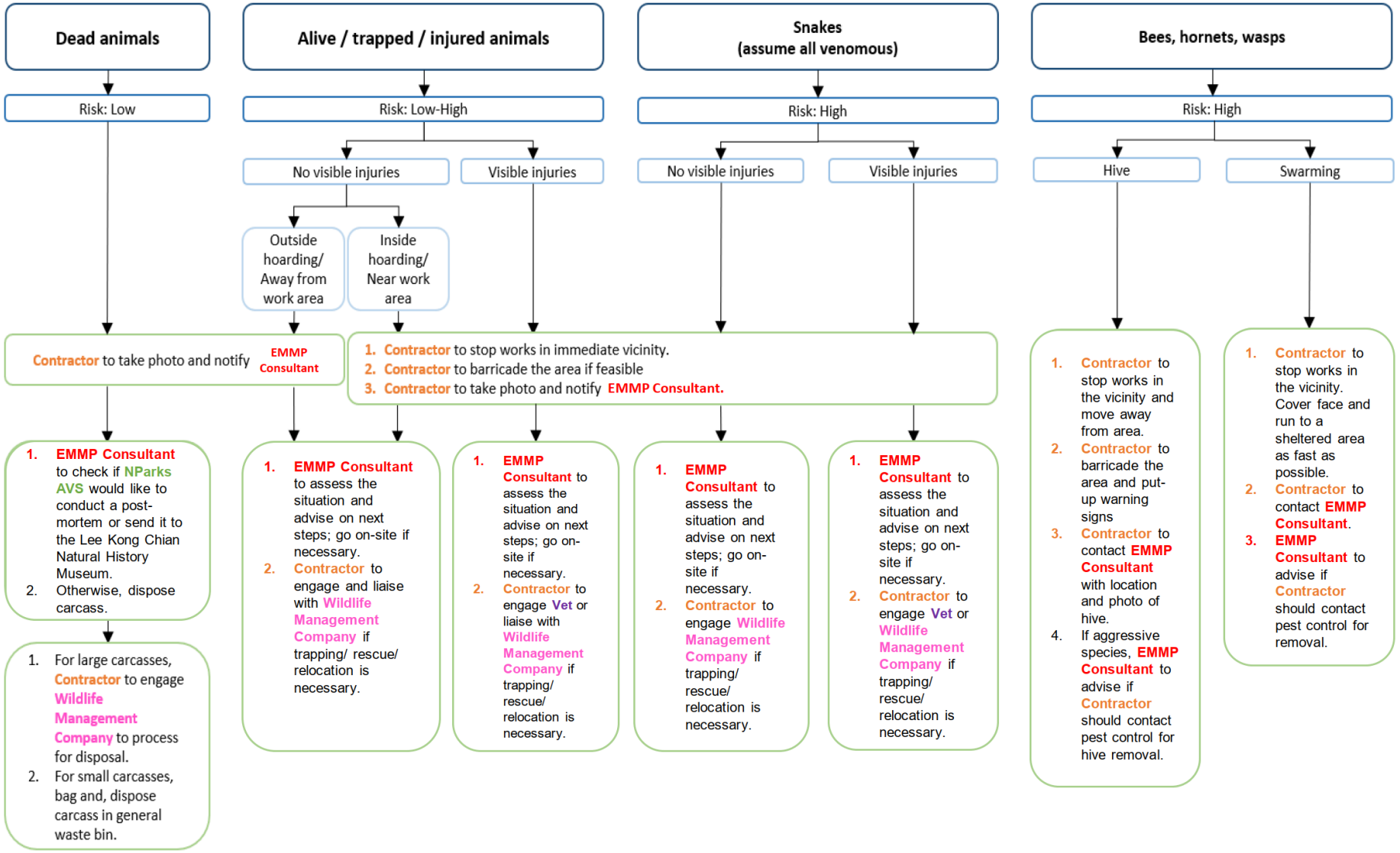

Figure 9-1 A Flowchart of the Wildlife Response Plan. An Approved Wildlife Management Company [W-11] Needs To Be Engaged by the Contractor

9.4 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 9-2). All wildlife incidents shall be reported and documented on the EDMS platform (Section 6.2).

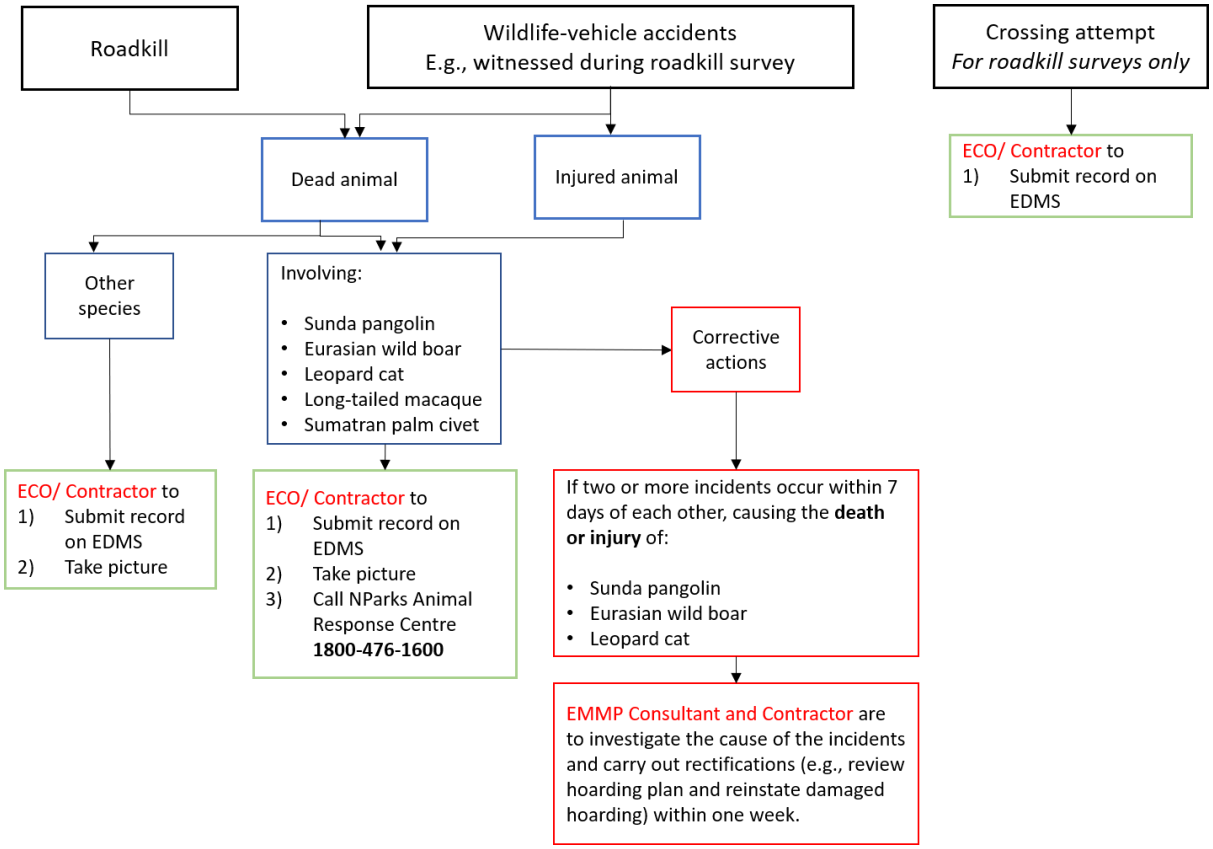

Figure 9-2 Response Plan and Corrective Actions to be Taken for Three Wildlife-Vehicle Scenarios

9.5 Response Plan for Drainage, Surface Water and Groundwater Incidents

The response plan (refer to Figure 9-3) 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).

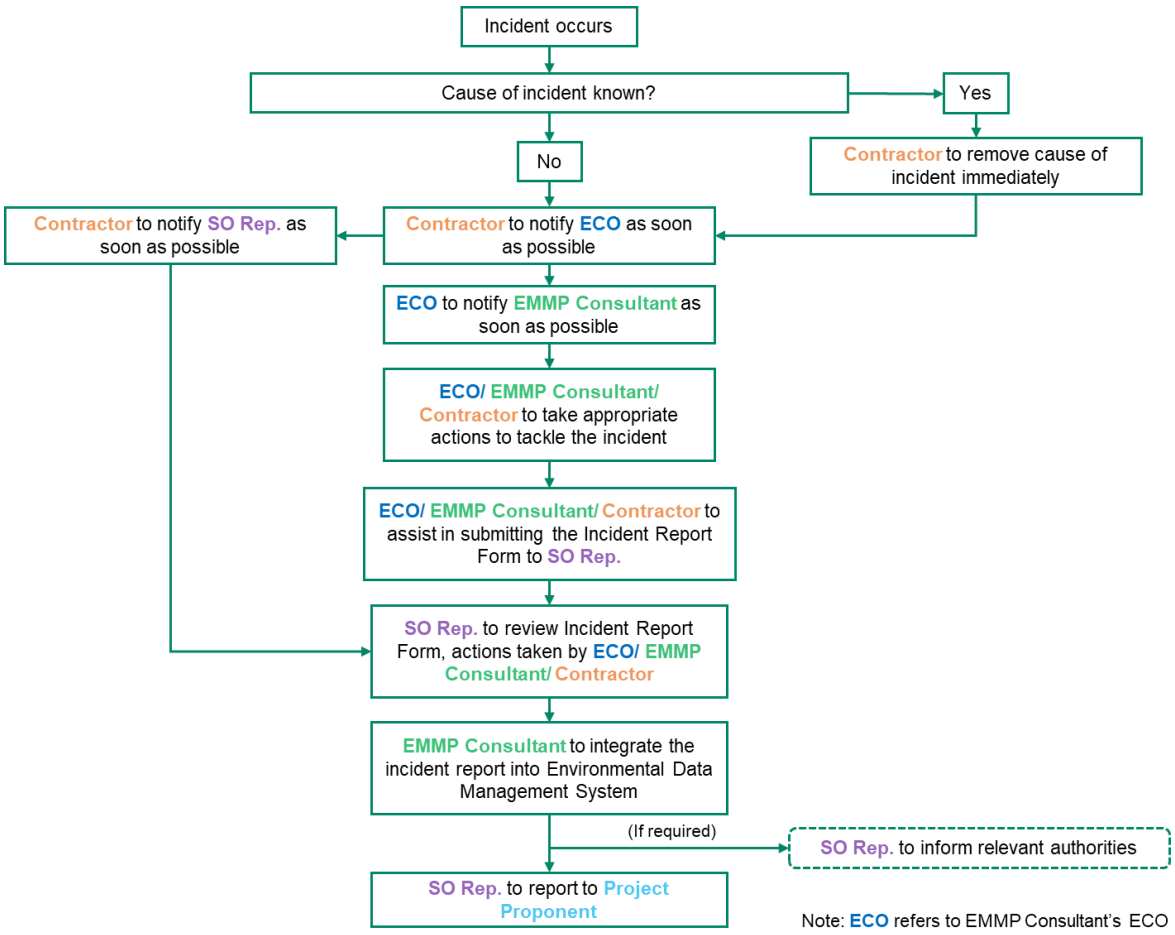

Figure 9-3 Flowchart of Drainages, Surface Water and Groundwater Incidents Response Plan

9.6 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 9-4. 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.

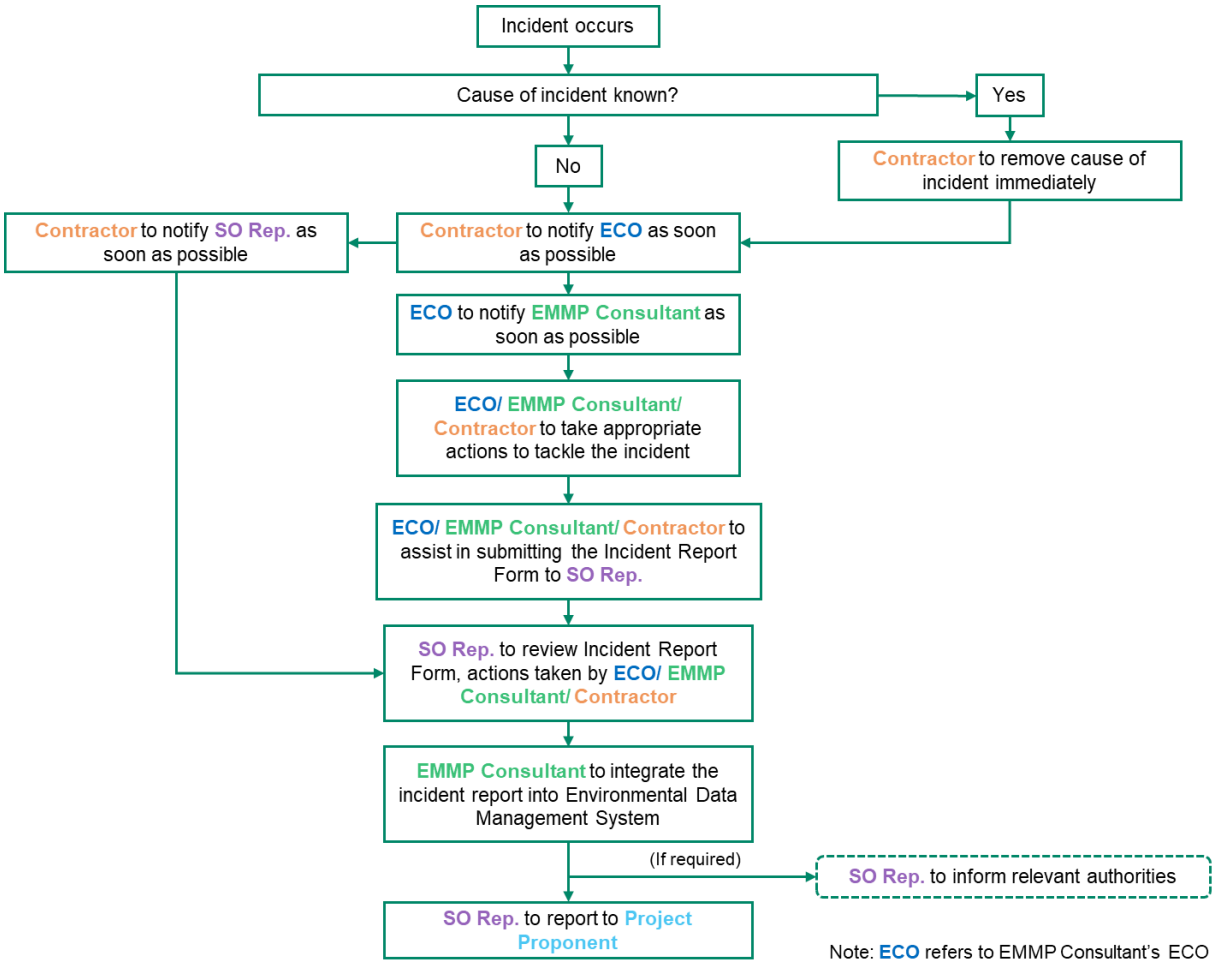

Figure 9-4 Flowchart of Incident Reporting

9.7 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 9-5. 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.

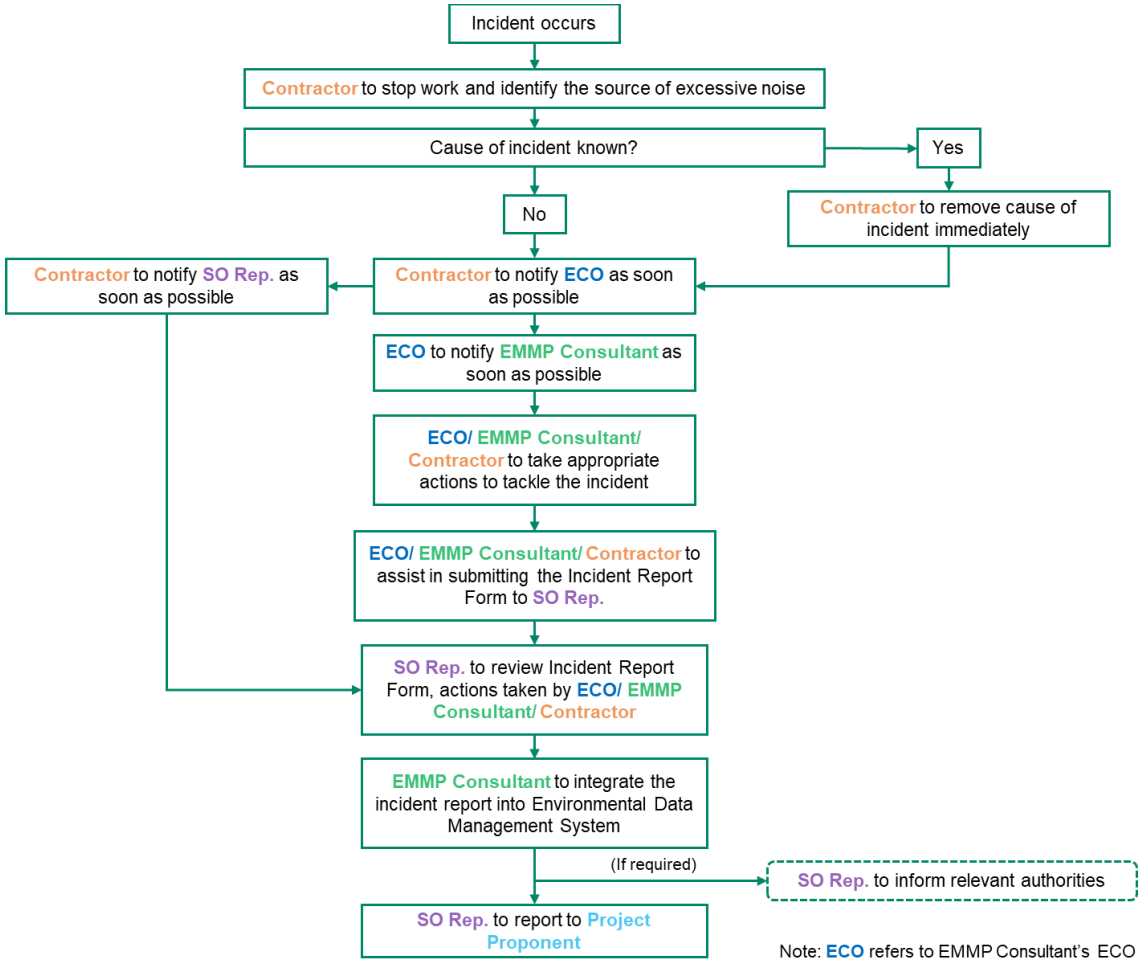

Figure 9-5 Flowchart of Incident Reporting

9.8 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 9-6. 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.

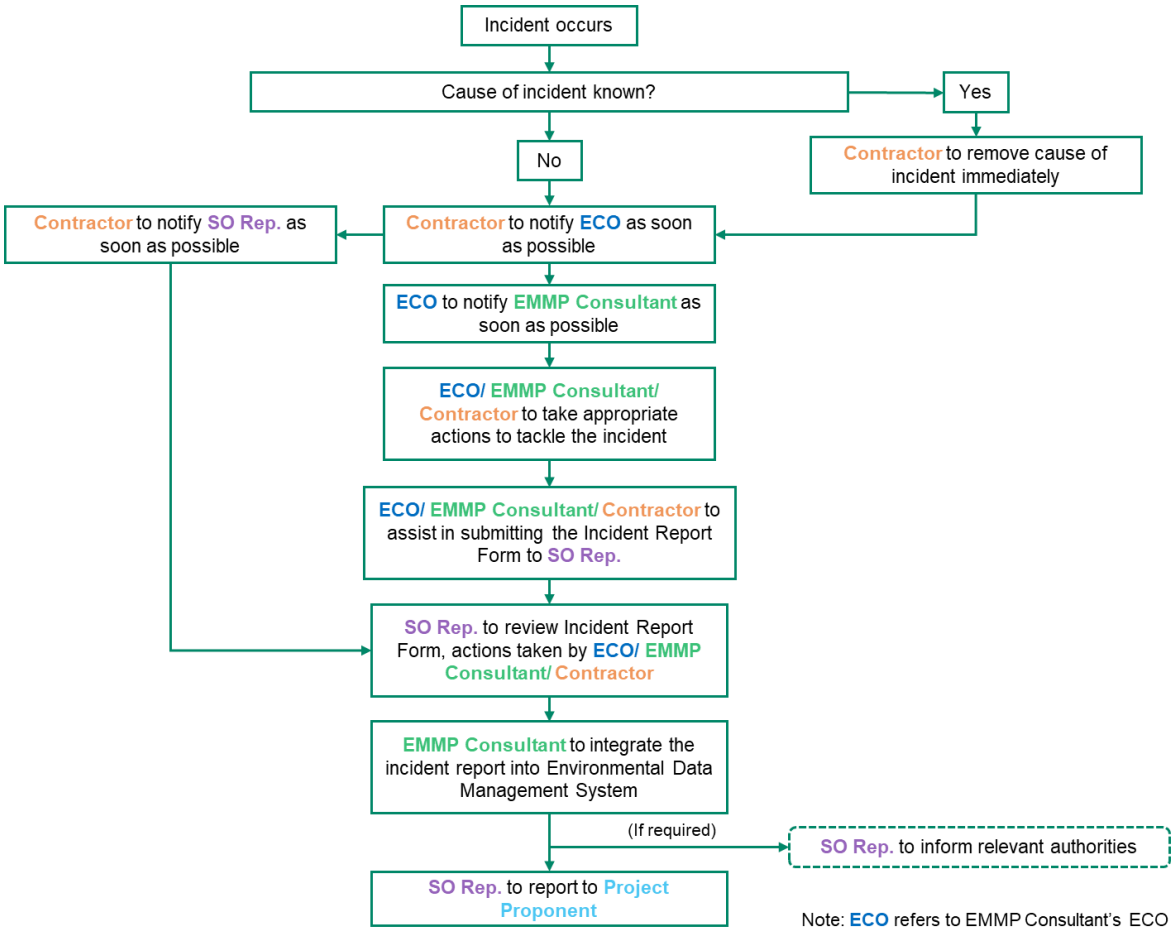

Figure 9-6 Flowchart of Incident Reporting

10 Conclusions

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

The duration for whole construction is approximately sixty (60) months. Generally, construction activities at all worksites will include site clearance and development works. 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 and Stage 2) 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 of Bukit Batok Hillside Park Area. 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

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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

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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:

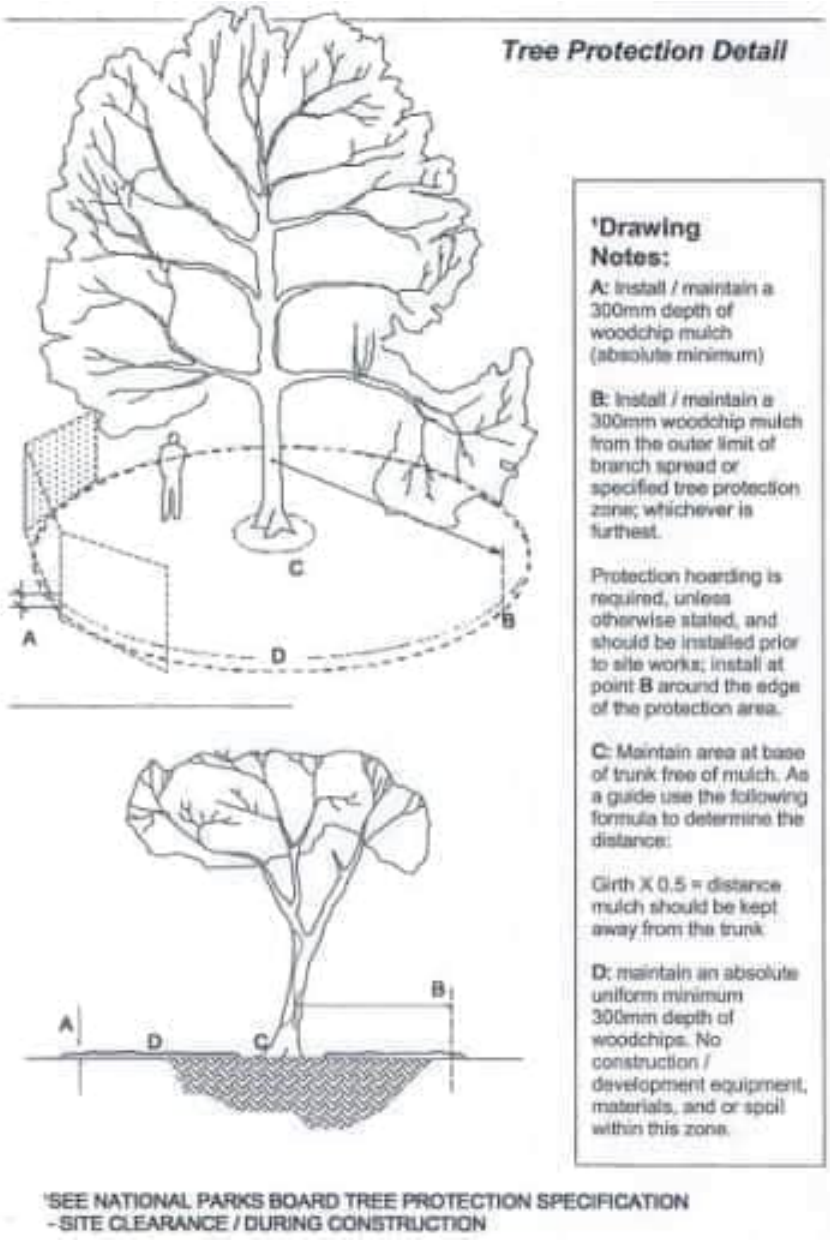
KEEP OUT!
TREE PROTECTION ZONE

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

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

Figure 5: Construction cement deposited at tree base.

Figure 6: Tree showing signs of decline overtime.

- Lowering the grade around trees can have an immediate and long-term effect on trees.
  Typically, most roots are within the top 1m of soil, and most of the fine roots active in water and nutrient absorption are in the top 300mm.

  A) Grade changes within the TPZ are not permitted.

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

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

natural grade, unless mitigated.

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

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

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

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

2.2 Proximity of Heavy machinery/vehicles

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

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

2.3 Drainage Considerations

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

2.4 Trenching, Excavation and Equipment use

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

i. Root Severance

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, steal 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 (☑)	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

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WILDLIFE INCIDENT FORM

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

Appendix D
Environmental Incident Form

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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

xxxxxx

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

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Appendix E – Feedback Management Form

Table 1 Verbal Feedback Register Form

S/N	Date	Contract Site	Location and Problem	Follow-Up Action	1st 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	1st 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	Engagement Activities	Remarks	OIC
	Circulars • Sent XX circular on Date to who for <purpose> • Display XX circular on Date at where for <purpose> **Phone Calls/SMS/Emails** • 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> **Face-To-Face Engagement** • Date, Who, Where and Details **Event** • Organized/Conducted what event on Date at Where for/to <purpose>	Names of Project Team members present	

Appendix F
Dust Control Plan

Delivering a better world

CONTRACT NO: D/336/22

(E) SITE PREPARATION WORKS AT BUKIT BATOK TOWN (PHASE 5)

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
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7	Dust Control Measures	5-6
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:

e) Site Preparation Works at Bukit Batok Town (Phase 5)

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

E. SITE PREPARATION WORKS AT BUKIT BATOK (PHASE 5)

(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

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CONTRACT NO: D/336/22

(E) SITE PREPARATION WORKS AT BUKIT BATOK TOWN (PHASE 5)

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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1. Introduction

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

e) Site Preparation Works At Bukit Batok Town (Phase 5)

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

E. SITE PREPARATION WORKS AT BUKIT BATOK (PHASE 5)

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

Mondays to Saturdays

Types of affected buildings	7am – 7pm	7pm – 10pm	10pm – 7am
(a) Hospital, schools, institutions of higher learning, homes for aged sick, etc	60 dBA (Leq 12 hrs)	50 dBA (Leq 12 hrs)	
	75 dBA (Leq 5 mins)	65 dBA (Leq 5 mins)	
(b) Residential buildings located less than 500m from the construction site	75 dBA (Leq 12 hrs)	65 dBA (Leq 1 hr)	55 dBA (Leq 1 hr)
	90 dBA (Leq 5 mins)	70 dBA (Leq 5 mins)	55 dBA (Leq 5 mins)
(c) Buildings other than those in (a) and (b) above	75 dBA (Leq 12 hrs)	65 dBA (Leq 12 hrs)	
	90 dBA (Leq 5mins)	70 dBA (Leq 5 mins)	

Sundays and public holidays

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

[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.

(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	- 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 meterand 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.

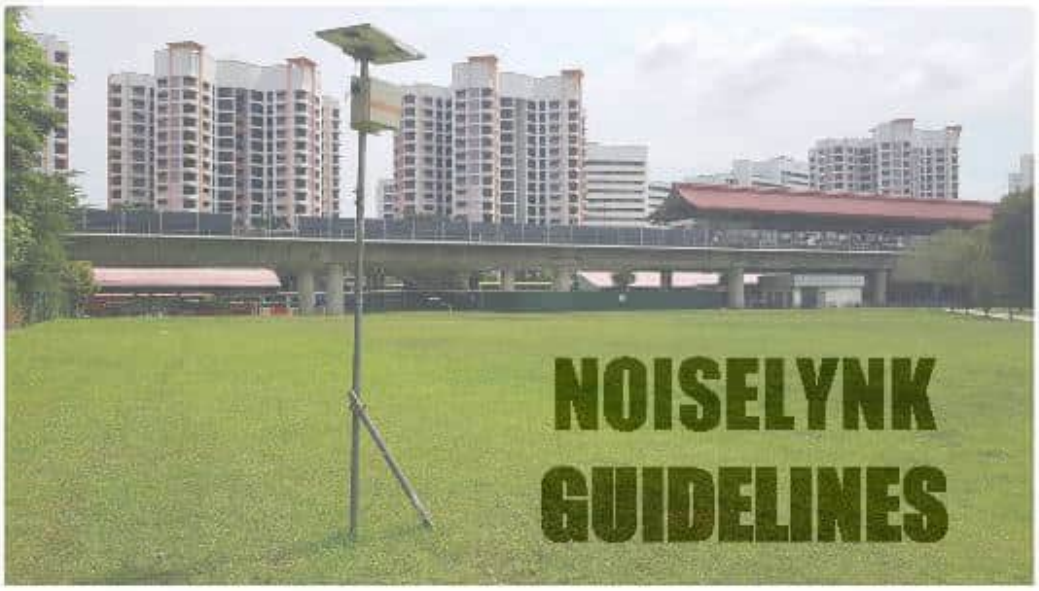
Operation
The TYPE 6224 (Class 1) Integrating Sound Level Meter has an easy to follow menu system and clearly marked keys, all designed to make the meter simple-to-use.
The back-lit LCD display is also very clear with large figures and a quasi-analogue display bar to show the changes in sound level as 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@aisys.com.sg
Website: www.aisys.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**

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	Leq12hr	Date and Time	Leq5min	Leq1hr	Leq12hr	Date and Time	Leq5min	Leq1hr	Leq12hr
29-04-2018 07:00	63.3	64.9	-	29-04-2018 11:00	65.0	65.5		29-04-2018 15:00	65.2	65.2	
29-04-2018 07:05	63.1			29-04-2018 11:05	65.3			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	65.5			29-04-2018 11:35	65.2			29-04-2018 15:35	64.4		
29-04-2018 07:40	64.2			29-04-2018 11:40	65.1			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	65.6			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	69.1			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

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@aisys.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@aisys.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@alsys.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.

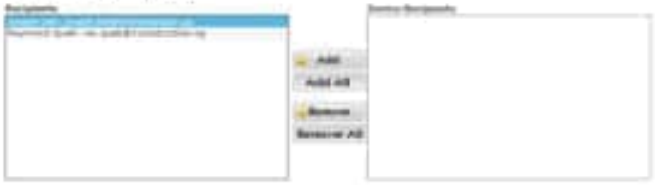
For additional recipients there will be additional charges.
If required any assistance, please email to sales@aisys.com.sg

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 form the account permanently,

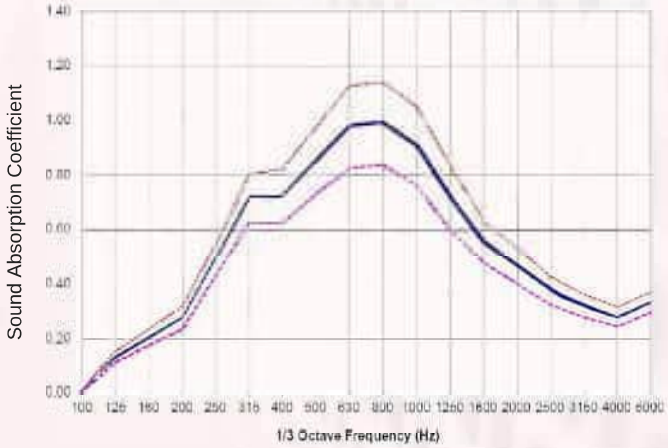
1) Select the recipients



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

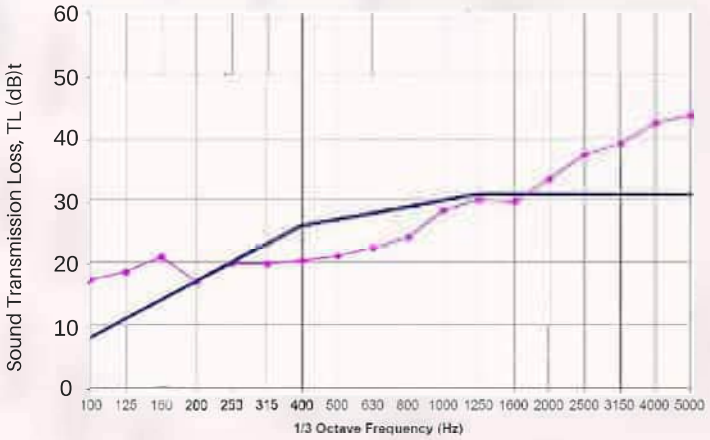
4) Click "Ok" to proceed to delete the recipients from the account

NOISE CONTROL BARRIER



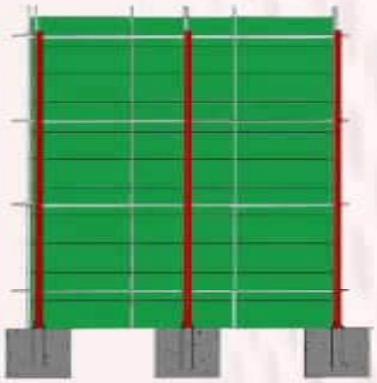
NRC = 0.7

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



STC = 27

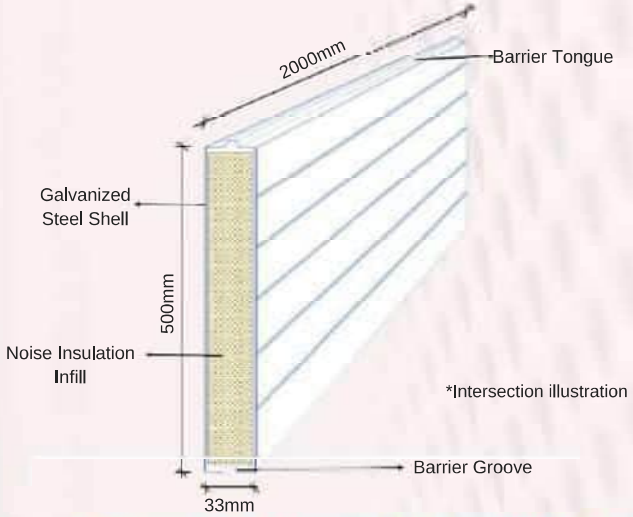
[An STC rating is a unit measurement of how much noise is stopped. The STC ratings allow accurate 'apple to apple' comparisons.]



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)

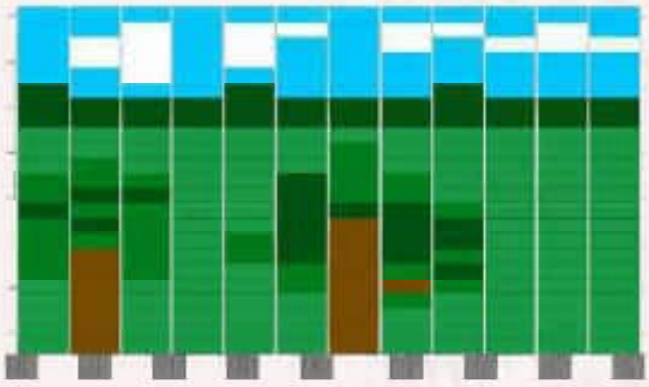


Cost Effective System

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

Delivering a better world

PROJECT
PUBLIC COMMUNICATIONS PLAN

CONTRACT NO: D/336/22

5) SITE PREPARATION WORKS AT BUKIT BATOK TOWN(PHASE 5)

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

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1. PROJECT BRIEF

Site preparation work at Bukit Batok phase 5located at Bukit Batok West Ave 5. The scope of works will include extensive site clearance,excavation of earth. Demolition & removal of existing structure, backfilling with approved earthand 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:

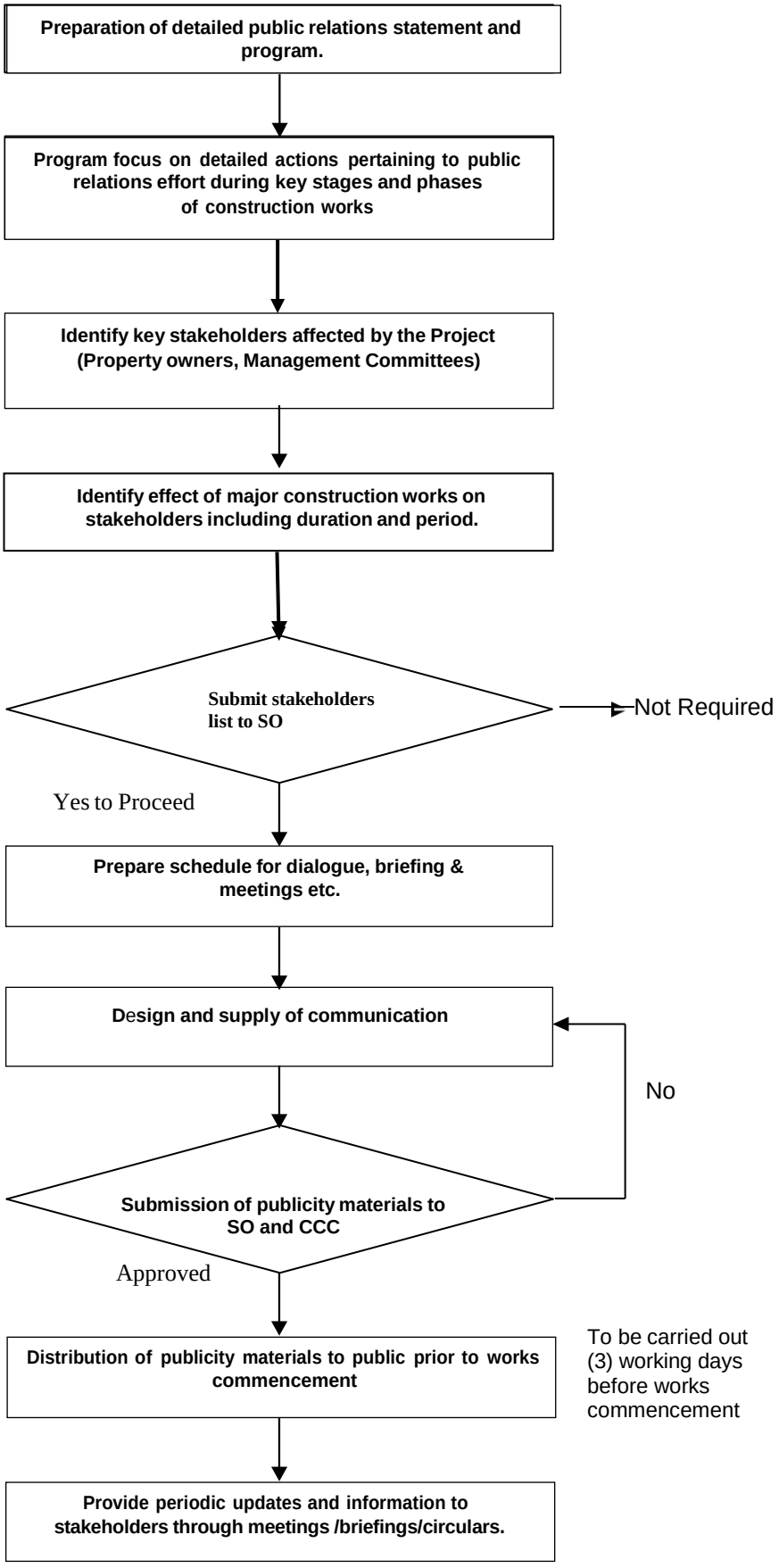
- Use electrical supply from Power Grid rather than generator where feasible.
- Maintain and service equipment and machineries regularly to keep noise low
- Exhaust fumes from machinery are diverted away from public infrastructure.
- Minimizing idling of power equipment
- Installation of noise meter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

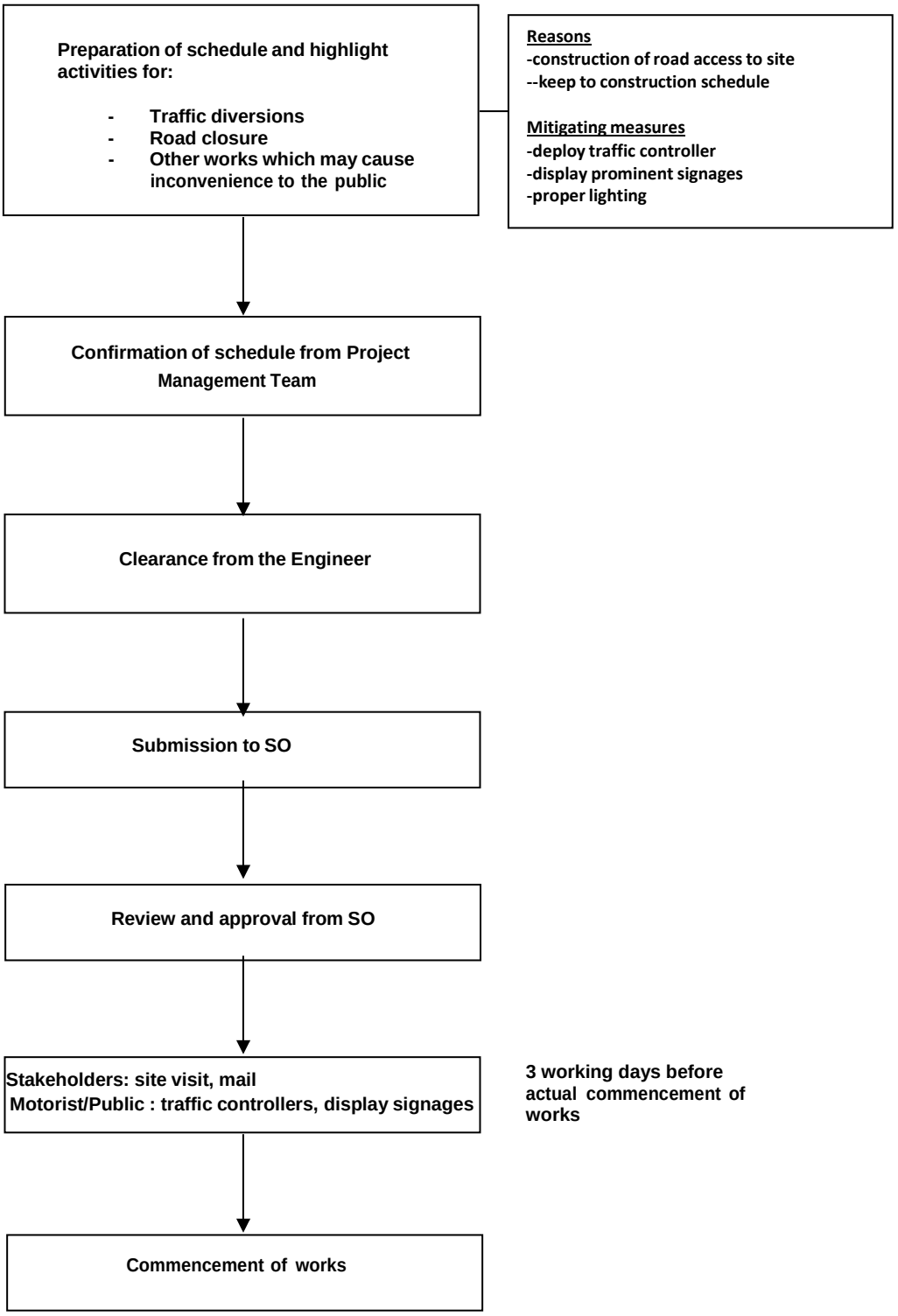
ANNEX - 01

PROPOSAL FOR PREPARATION OF PUBLIC RELATIONS WORKS PRIOR TO MAJOR WORKS


Preparation of detailed public relations statement and program.
Program focus on detailed actions pertaining to public relations effort during key stages and phases of construction works
Identify key stakeholders affected by the Project (Property owners, Management Committees)
Identify effect of major construction works on stakeholders including duration and period.
Submit stakeholders list to SO
Not Required
Yes to Proceed
Prepare schedule for dialogue, briefing & meetings etc.
Design and supply of communication
No
Submission of publicity materials to SO and CCC
Approved
Distribution of publicity materials to public prior to works commencement
To be carried out (3) working days before works commencement
Provide periodic updates and information to stakeholders through meetings /briefings/circulars.

ANNEX - 02

PROPOSAL FOR FACILITATION OF TRAFFIC DIVERSIONS / CLOSURE OF ROADS


Preparation of schedule and highlight activities for:
- Traffic diversions
- Road closure
- Other works which may cause inconvenience to the public
Reasons
-construction of road access to site
--keep to construction schedule
Mitigating measures
-deploy traffic controller
-display prominent signages
-proper lighting
Confirmation of schedule from Project Management Team
Clearance from the Engineer
Submission to SO
Review and approval from SO
Stakeholders: site visit, mail
Motorist/Public : traffic controllers, display signages
3 working days before actual commencement of works
Commencement of works

ANNEX - 03

PUBLIC RELATIONS PROGRAMME (SITE WORKS)

ANNEX 3.

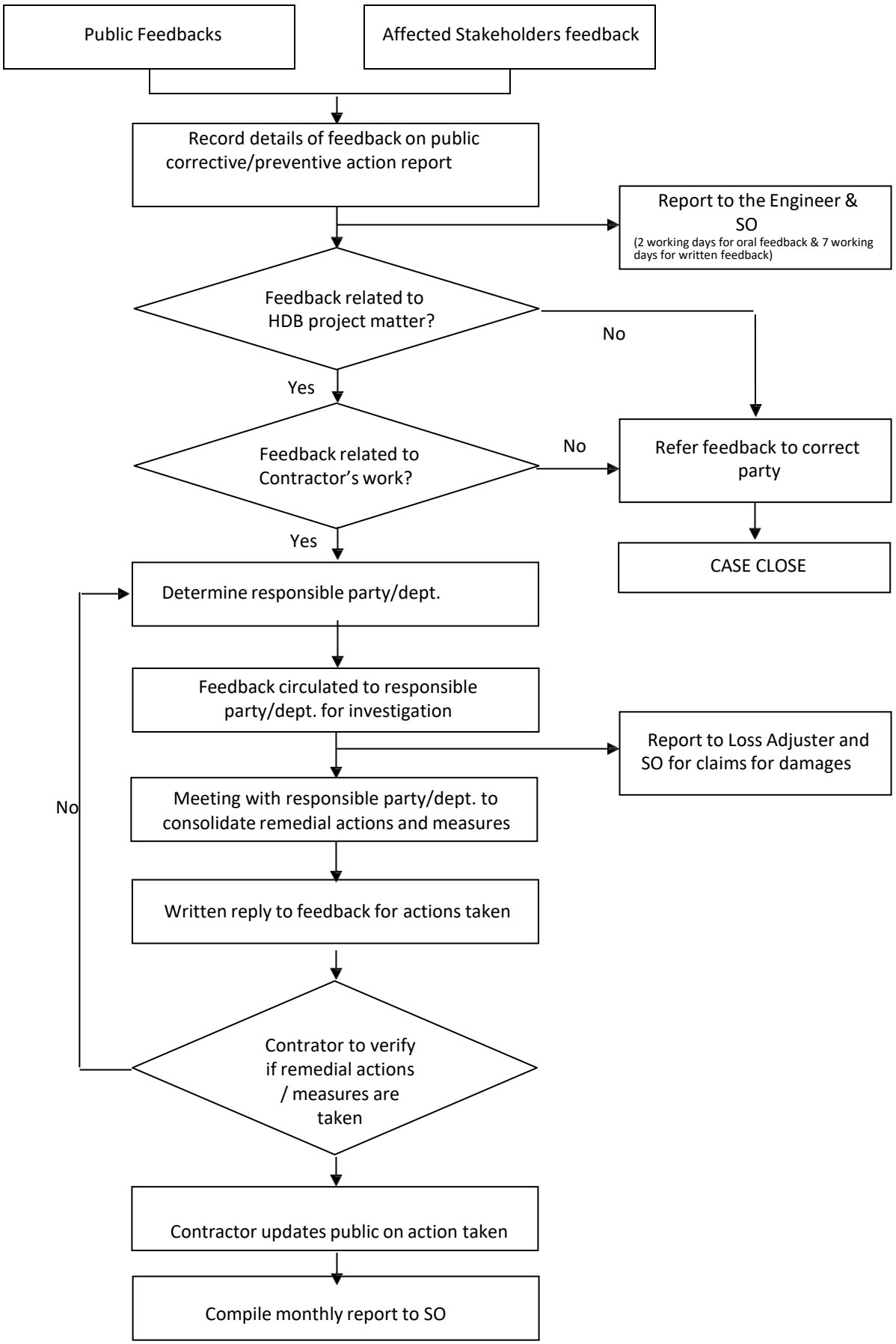
(A&B) SITE PREPARATION WORK AT TENGAH (PHASE 3 & 4);
(C&D) CONSTRUCTION OF OUTLET DRAIN WORK AT TENGAH (PHASE 1A &1B);
(E) SITE PREPARATION WORK AT BUKIT BATOK TOWN (PHASE 5)

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

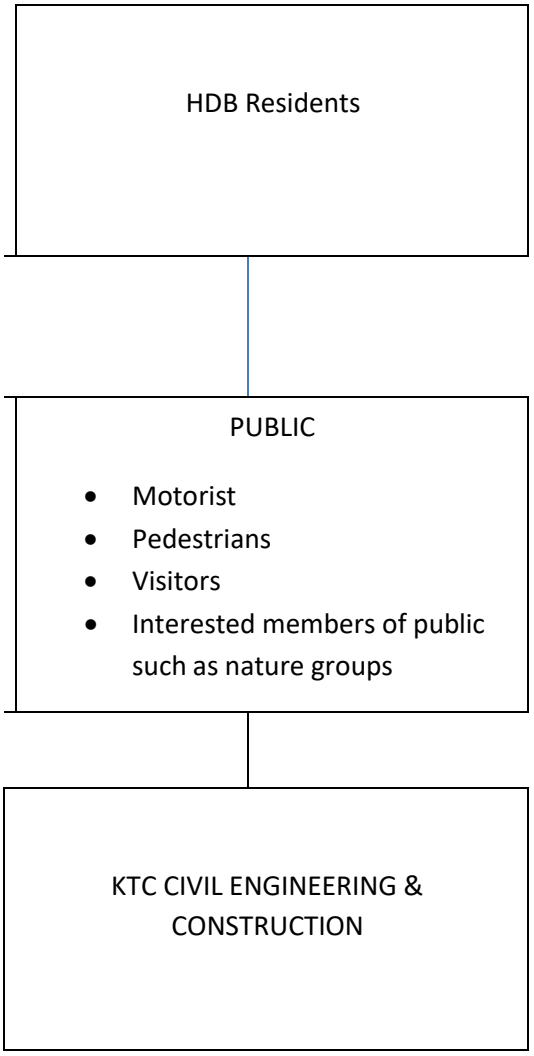
PROCEDURES FOR HANDLING PUBLIC FEEDBACK


Public Feedbacks
Affected Stakeholders feedback
Record details of feedback on public corrective/preventive action report
Report to the Engineer & SO
(2 working days for oral feedback & 7 working days for written feedback)
Feedback related to HDB project matter?
No
Yes
Feedback related to Contractor's work?
No
Refer feedback to correct party
CASE CLOSE
Yes
Determine responsible party/dept.
Feedback circulated to responsible party/dept. for investigation
Report to Loss Adjuster and SO for claims for damages
Meeting with responsible party/dept. to consolidate remedial actions and measures
No
Written reply to feedback for actions taken
Contrator to verify if remedial actions / measures are taken
Contractor updates public on action taken
Compile monthly report to SO

ANNEX - 05

LIST OF STAKEHOLDERS

List of Stakeholders



ANNEX - 06

FORMS

ANNEX 6A

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

SITE WORKS FEEDBACK REPORT

S/No	Date	Location/Problem	Follow-up Action	Response Time	
				2 days (oral feedback)	7 days (written feedback)

ANNEX 6B

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

STAKEHOLDERS ENGAGEMENT REPORT

S/No	Date	Engagement Activities	Notice by the road	Email/ Calls	Face to Face meeting	Remarks/Persons attending (Name/Designation)

Appendix I
Lighting Management Plan

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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.

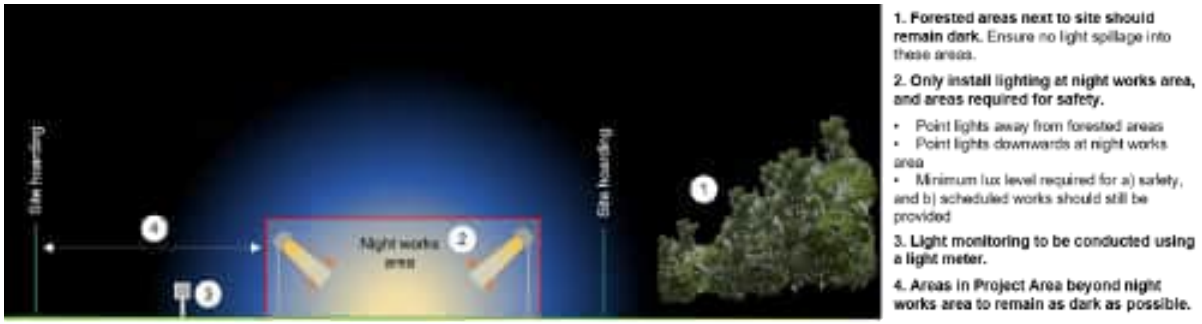


Figure 1 Summary of key lighting management measures within a construction setting.

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

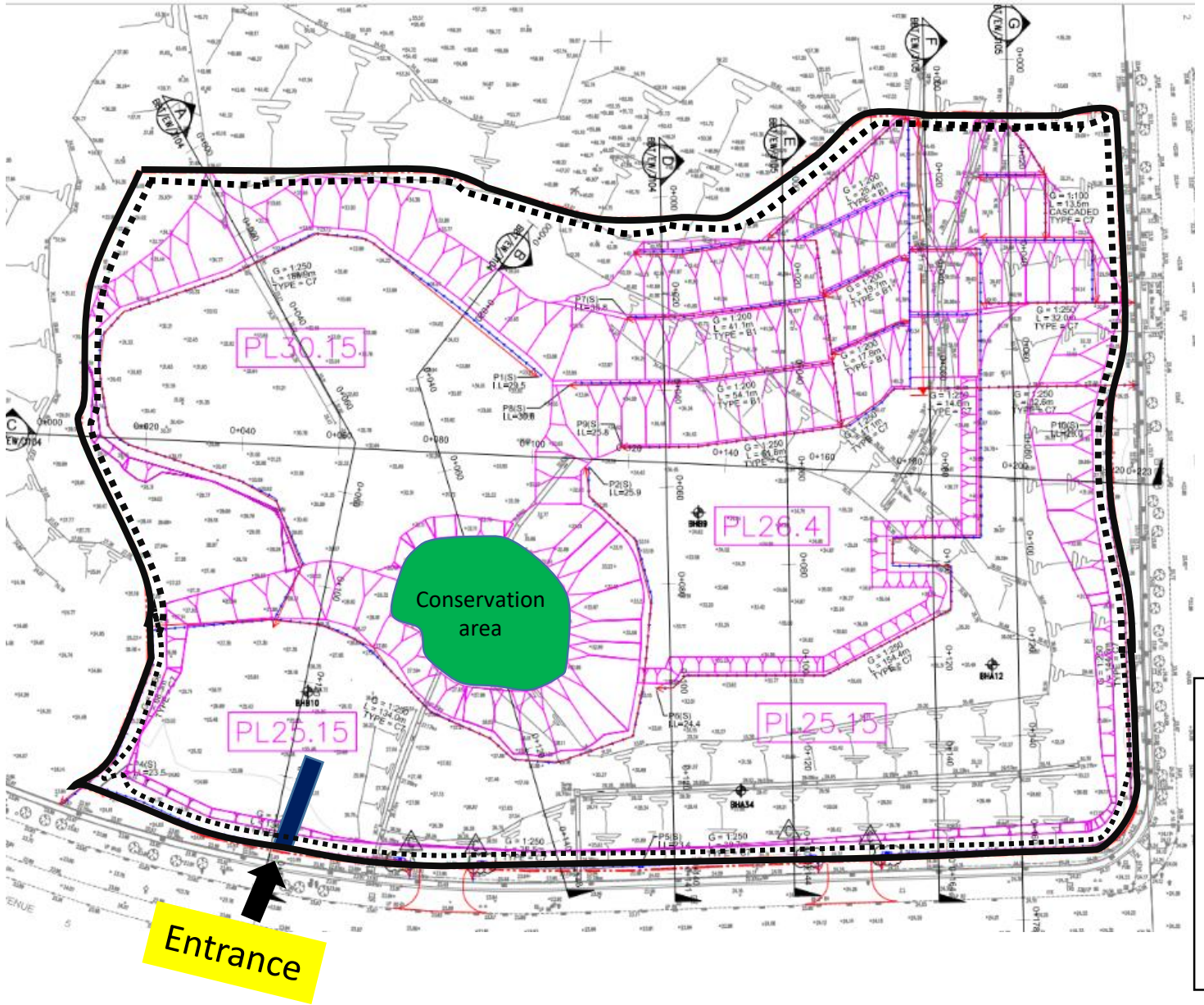
Delivering a better world

D/336/22

Hoarding Plan for Bukit Batok Phase 5 Update

KTC GROUP

Phase 5- Step 1: Hoard up entire boundaries with 2m hoarding



Legends:

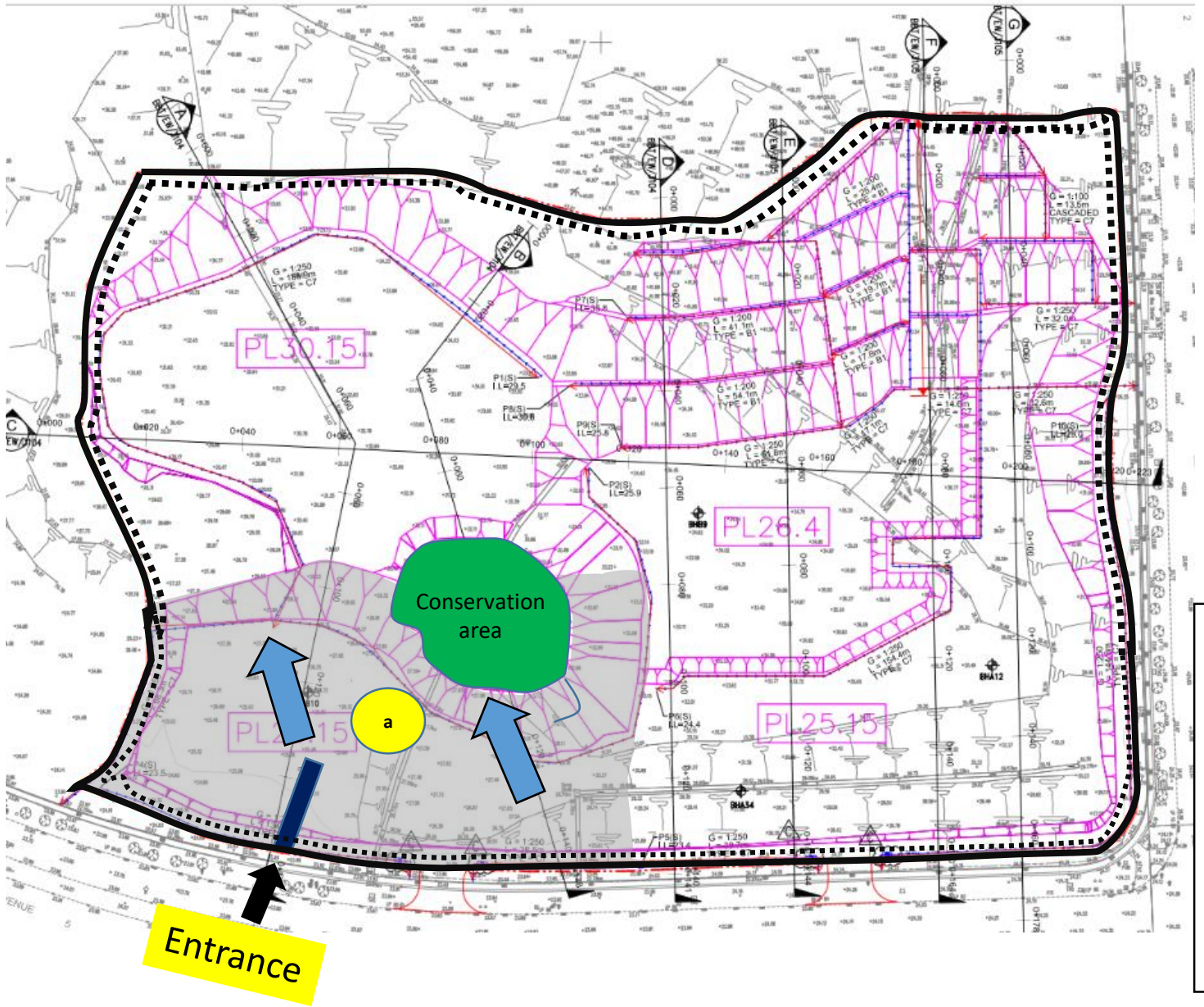
: Proposed 2m hoarding

: 6m width working space for hoarding

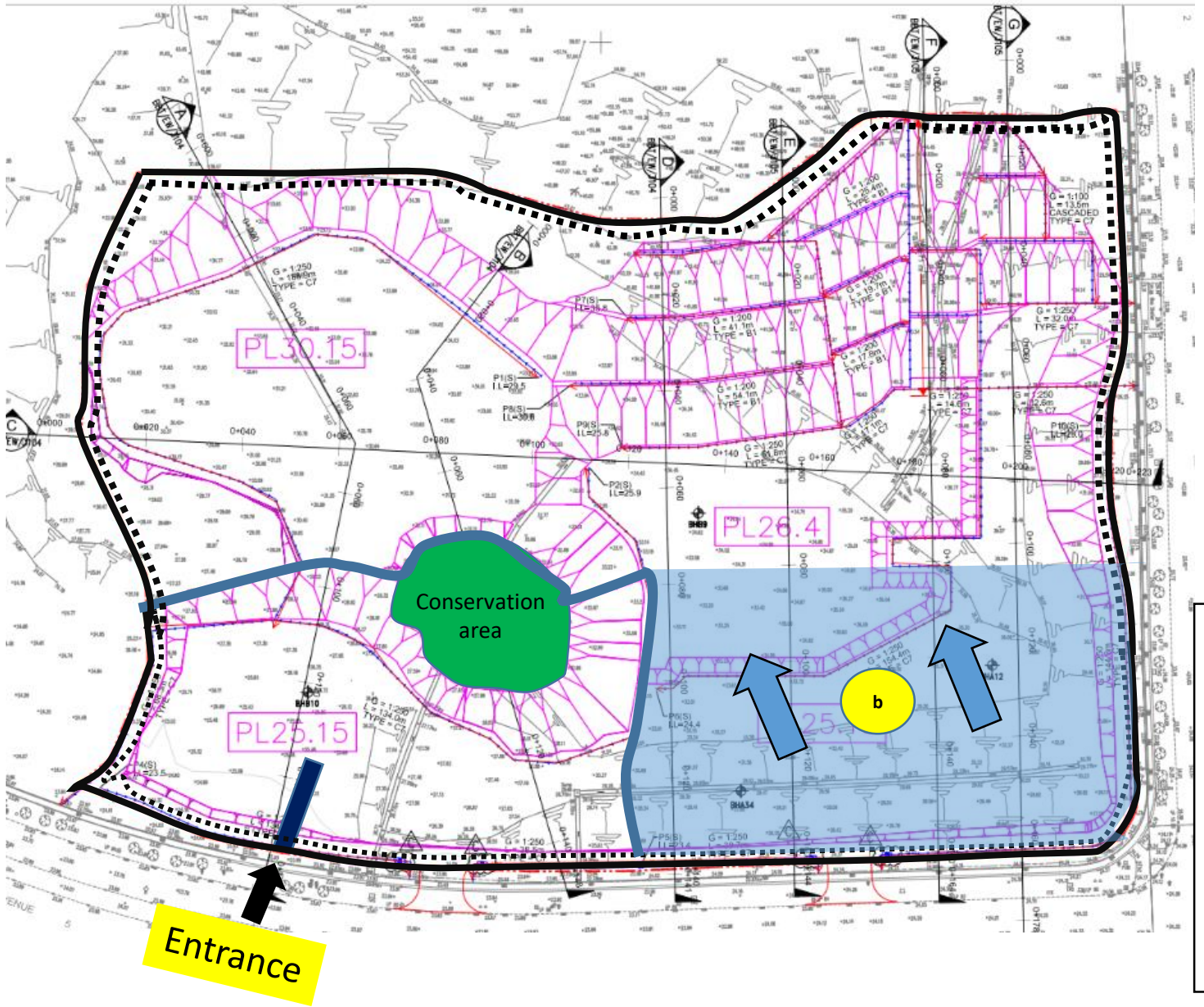
: Access road

: Temporary Hoarding

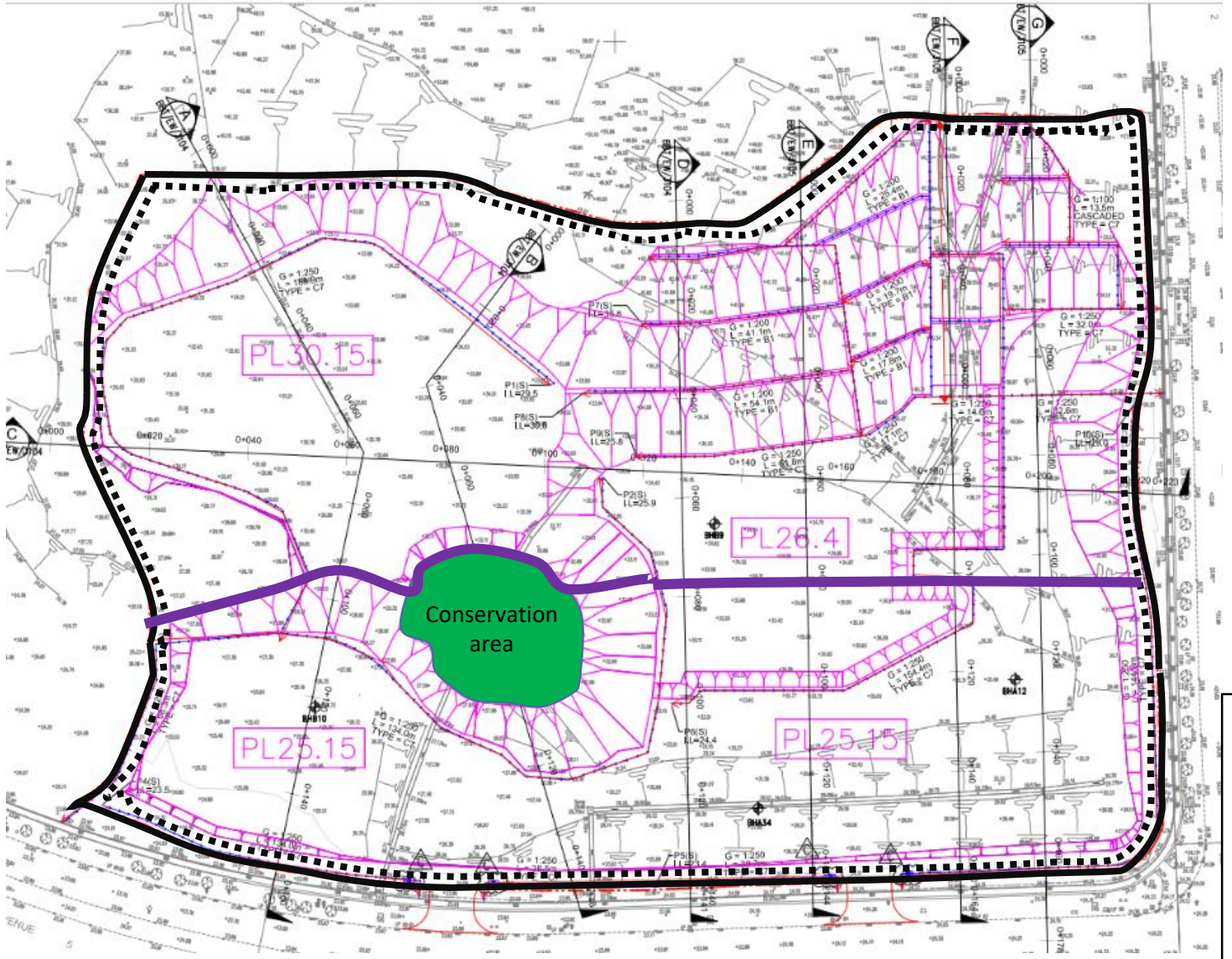
Phase 5- Step 2: Site clearance and shepherding zone 1a (Timeline for shepherding: 2days)



Phase 5- Step 3: Install temporary hoarding; Then Site clearance and shepherding zone 1b (Timeline for shepherding: 2days)



Phase 5- Step 4: Install temporary hoarding



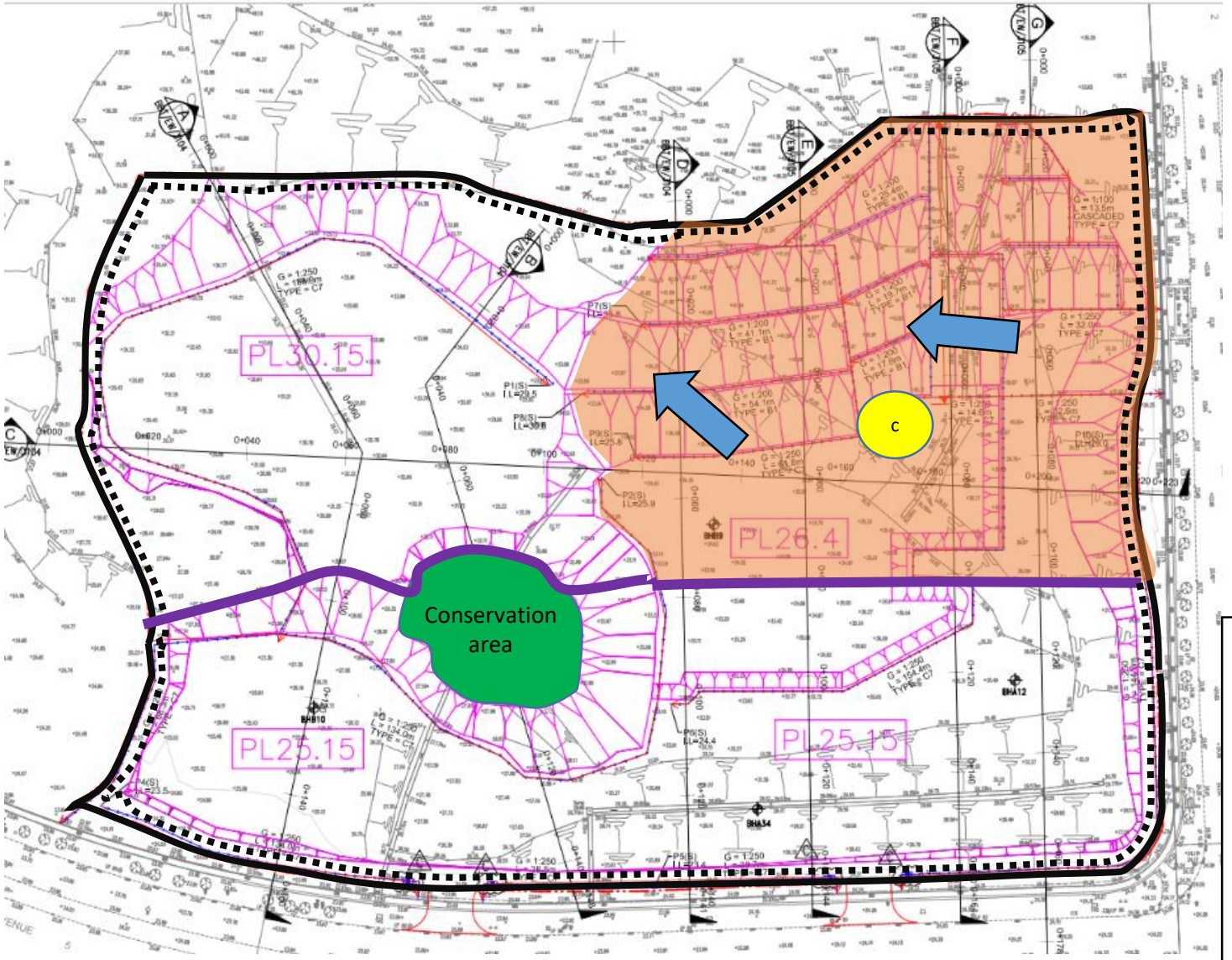
Legends:

: Proposed 2m hoarding

: 6m width working space for hoarding

: Temporary Hoarding

Phase 5- Step 5: Site clearance and shepherding zone 1c (Timeline for shepherding: 3days)



Legends:

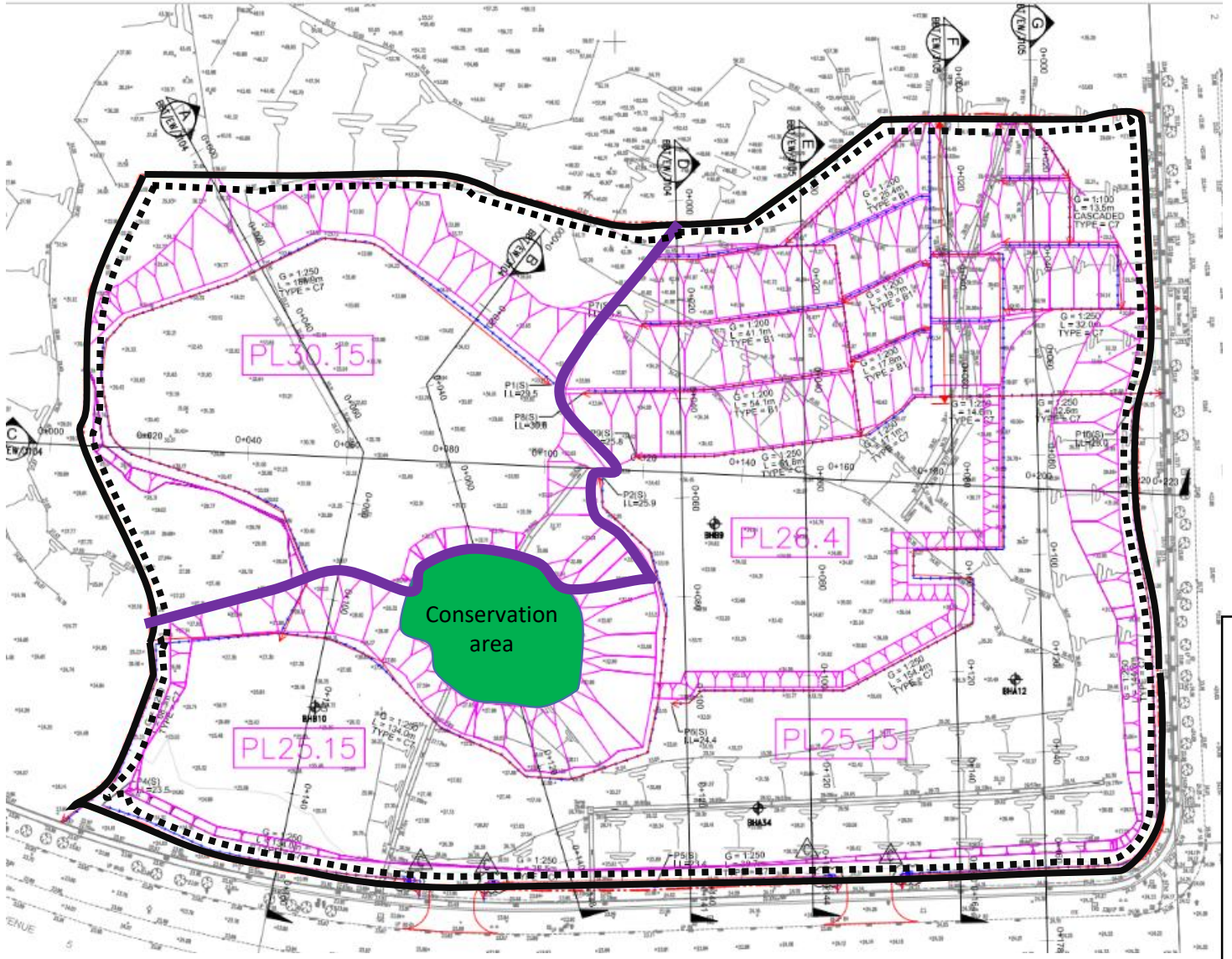
: Proposed 2m hoarding

: Direction of shepherding

: 6m width working space for hoarding

: Temporary Hoarding

Phase 5- Step 6: Install temporary hoarding



Legends:

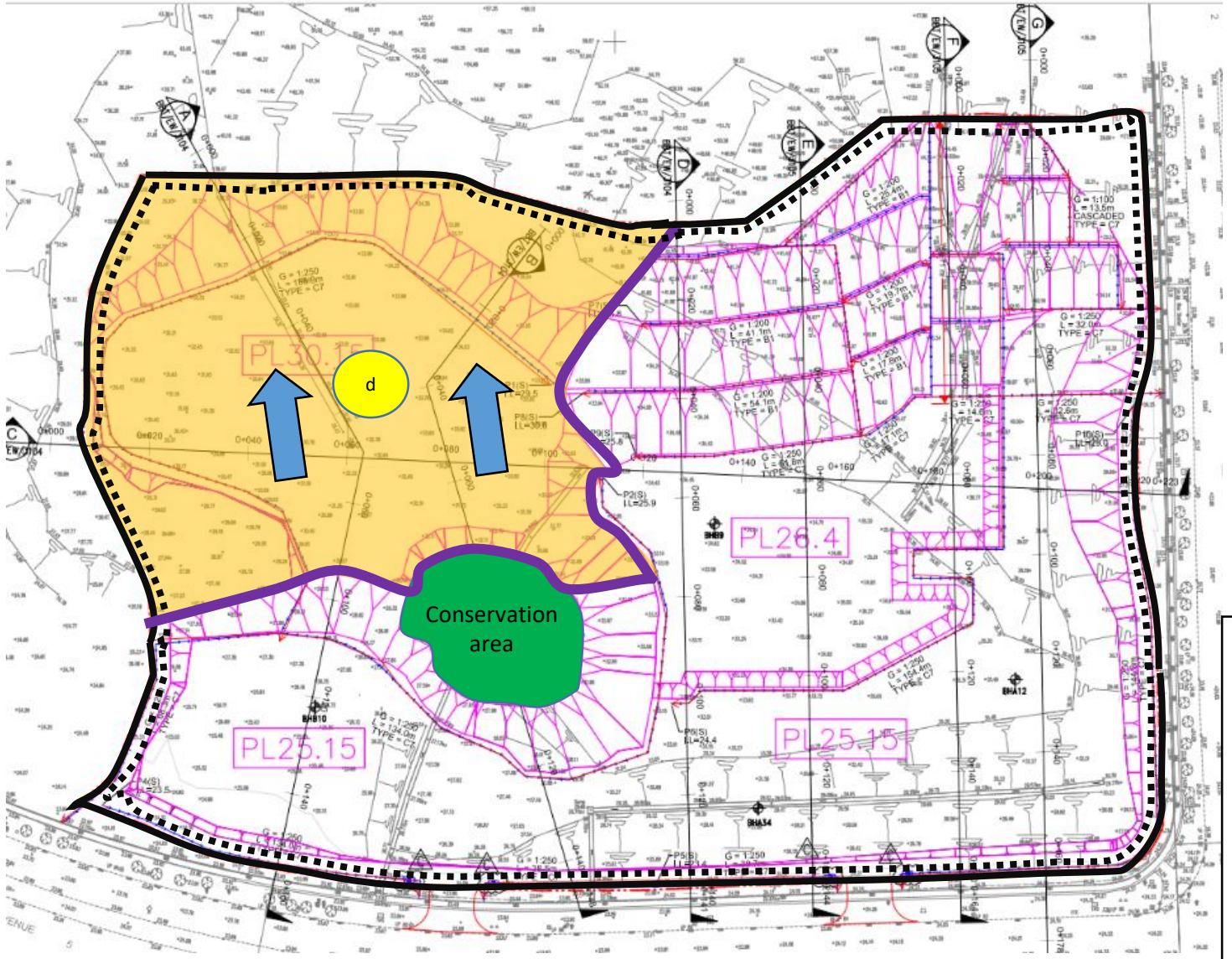
: Proposed 2m hoarding

: Direction of shepherding

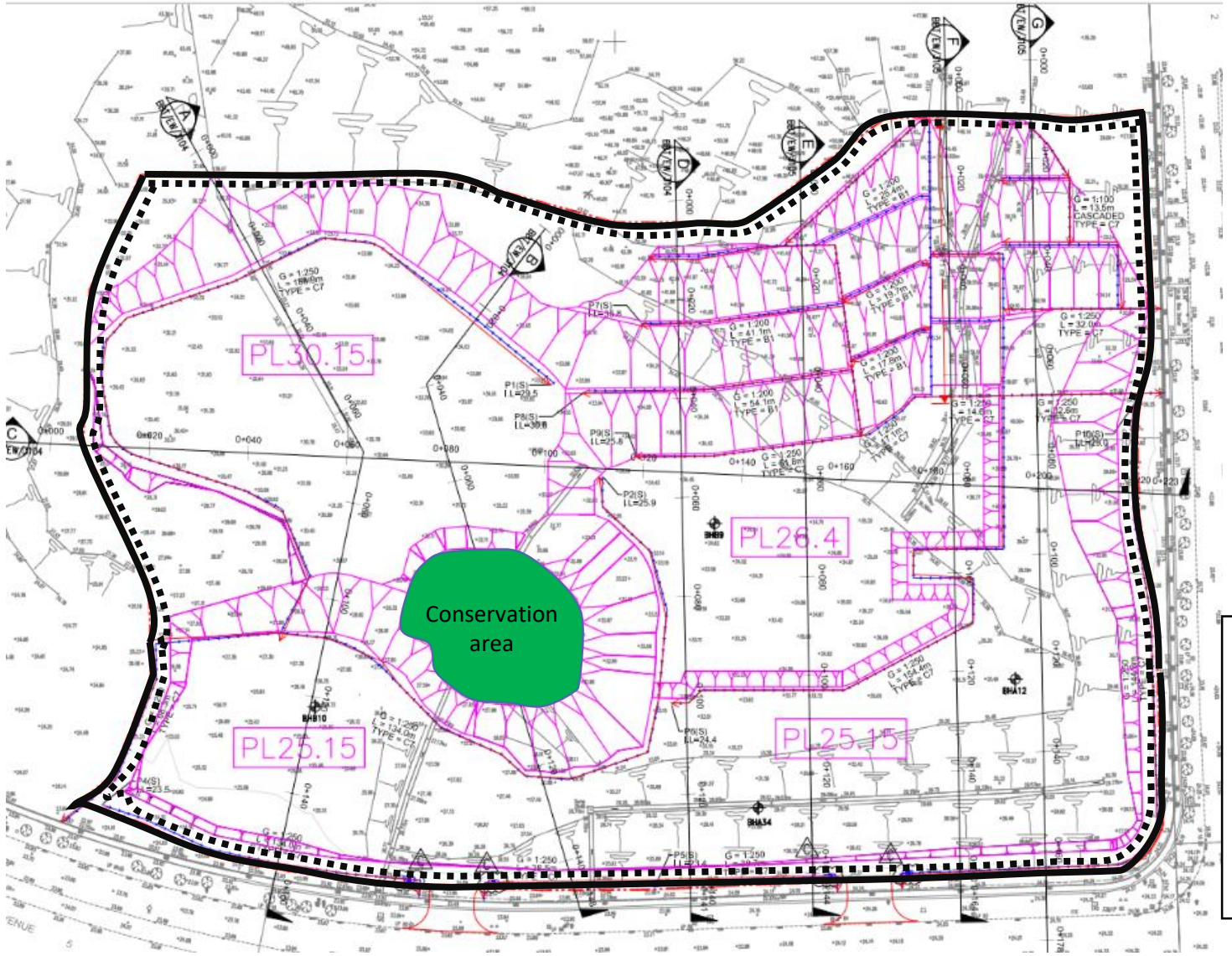
: 6m width working space for hoarding

: Temporary Hoarding

Phase 5- Step 7: Site clearance and shepherding zone 1d (Timeline for shepherding: 3days)



Phase 5 (Project Timeline for shepherding in Phase 5: 10days)

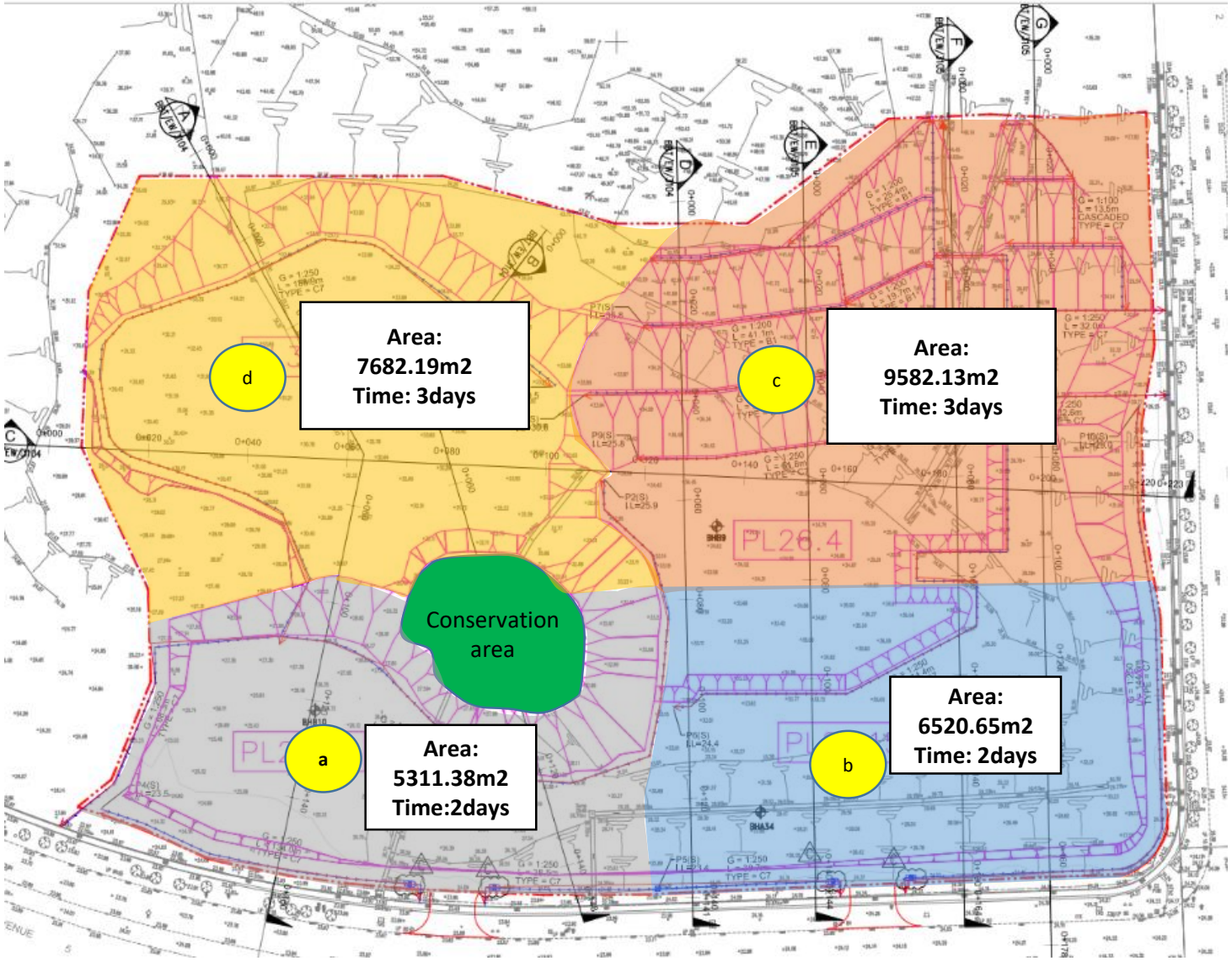


Legends :

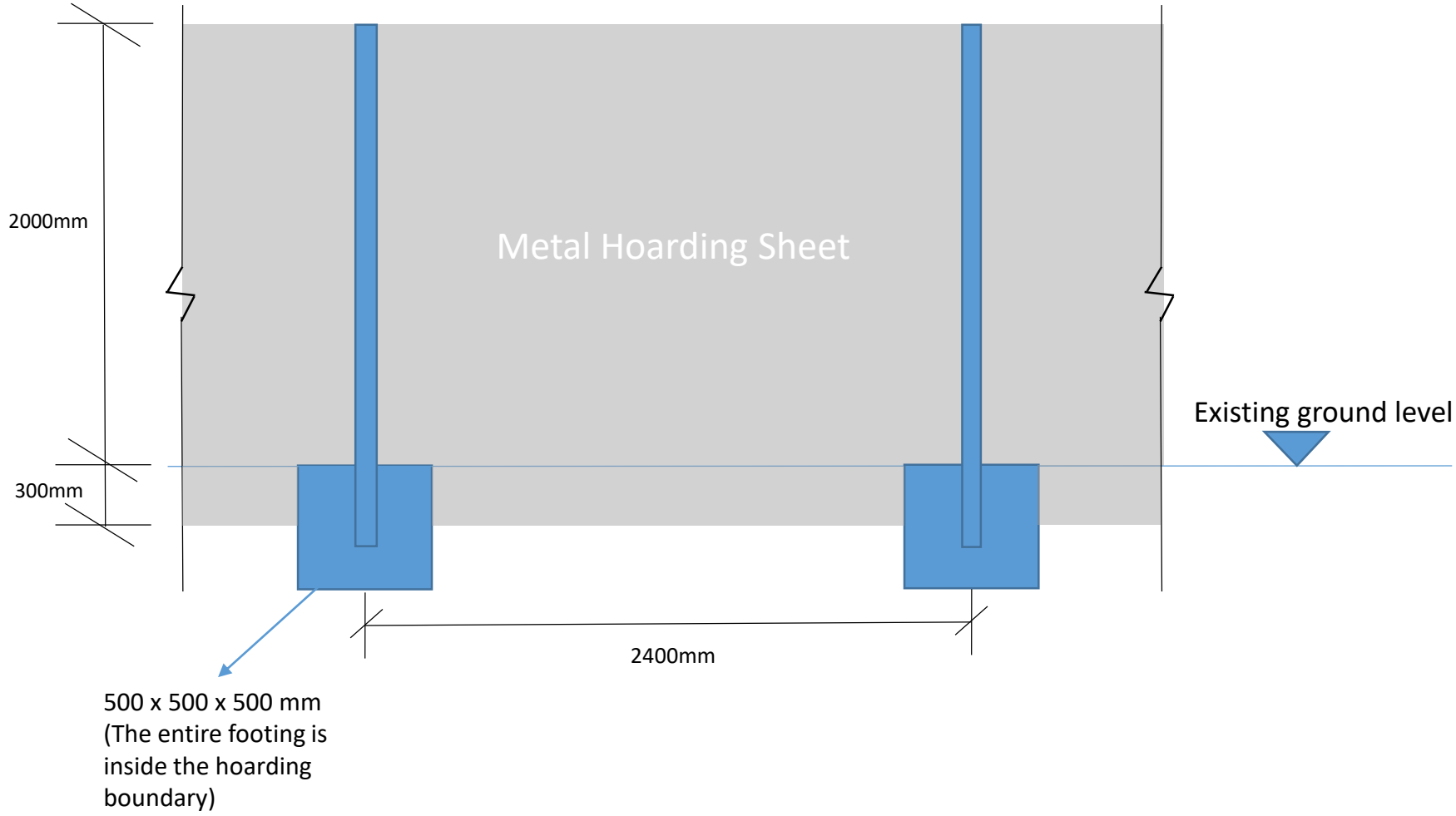
: Proposed 2m hoarding

: 6m width working space for hoarding

Site Clearance Zone - Phase 5



Hoarding – 2m High Metal Hoarding



Appendix K
Earth Control Measures Plan

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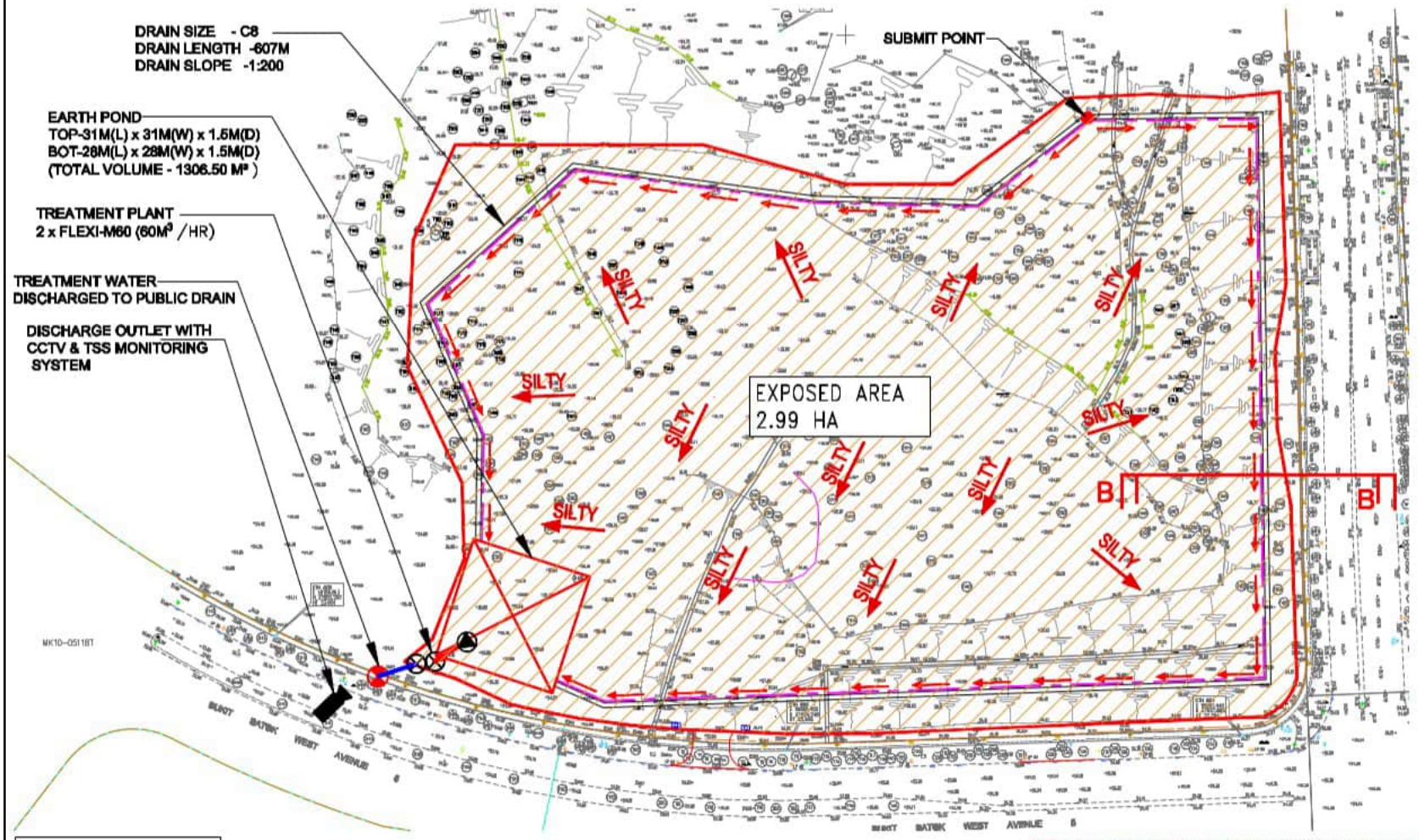
EXPOSED AREA = 2.99HA

TOTAL SITE AREA = 2.99HA

ECM DESIGN SUMMARY

Area	Total Site Area(ha)	Max Exposed Area(ha)	Total Runoff Volume (m3)	C8-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	2.99	2.99	1554.80	346.67	1306.50	1653.37	KTZ31.5	2xM60	2xM80	< 50 PPM



EARTH CONTROL MEASURE PLAN

SCALE 1 : 1 M

LEGEND:

- CUT OFF DRAIN (TYPE C8)
- HOARDING ALONG BOUNDARY
- SILT FENCE

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.

01 sheet of 07

BUILDING AND CONSTRUCTION AUTHORITY

Project Ref. No :
E3478-01005-2022
E3478-01006-2022
E3478-01007-2022

for Commissioner of Building Control

FOR APPROVAL

REV	DATE	NAME	SUBJECT	C'KD
AMENDMENTS				

Tenure of Land

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DRAWING DESCRIPTION:

C&S CONSULTANTS & QP(C):

TUNG CONSULTANTS

CIVIL & STRUCTURAL CONSULTANTS

SCALE	AS SHOWN		
		BY	DATE
DRAWN		HH	DECEMBER 2022
DESIGNED		JSL	DECEMBER 2022
CHECKED		KKH	DECEMBER 2022
APPROVED		KKH	DECEMBER 2022

JOB NO.	SECTION	DRAWING NO.	REVISION
-	E	01	-

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