

SPECIALIST CONSULTANCY SERVICES AT HDB DEVELOPMENT (WESTERN)

Tengah North EMMP Consolidated Addendum (Area A)

Housing & Development Board (HDB)

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1 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 Northern Tengah (Area A) (hereafter referred to as the "Project"), supervision of implementation of EMMP on sites and to issue EMMP addendums on deviations or changes on site / site activities as appropriate.

Prior to the start of this Project, an Environmental Impact Study (EIS) including a Preliminary EMMP [R-1] was conducted for the northern area of Tengah Town development area, which is inclusive of Area A. An area of approximately 69.6 ha was proposed to be retained as the Recommended Area of Conservation (RAC). In consideration of the ecological sensitivity of these areas as well as the proximity of this site to residential areas, contract specific detailed EMMP was developed to detail 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. This contract specific EMMP for Area A was approved on 27 January 2023.

Based on email exchanges between AECOM and National Parks Board (NParks) on 8 February 2023 and 5 April 2024 and AECOM and National Environment Agency (NEA) on 10 April 2023, as the construction and development proceeds, there would be new works that are not covered in the previously approved EMMP or deviating from the approved EMMP. It was agreeable that specific plans to each stage of additional development works should be documented in the form of EMMP Addendum Report which is then reviewed by technical agencies. This EMMP Addendum Report details the changes and additional works not covered in the previously approved EMMP.

1.1 Scope and Objectives

The scope of this EMMP Addendum report covers the following items detailed in Table 1-1.

Table 1-1 Scope and objective of this EMMP Addendum

No	Description	Change/ New	Relevant Section in approved EMMP Report for Area A dated 27 Jan 2023	Date of Agreement with Agencies	Remarks / Justification
1	Reduction of RAC within Area A at 4 locations	Change	Section 2.5	8 August 2023	Based on interagency discussions and engagement with stakeholders (i.e., Nature Groups) on Tengah North Land Use, the presence of the corridor may instead attract wildlife to the junction of Bukit Batok Road and Brickland Road, which could increase incidences of roadkill in that area as there is no feasible crossing. It was therefore agreed that the RAC along Bukit Batok Road should be tapered from 100m to a 25m-wide Forest Fringe instead to funnel wildlife towards a wildlife crossing across Bukit Batok Road along Bukit Batok West Avenue 7 instead.

No	Description	Change/ New	Relevant Section in approved EMMP Report for Area A dated 27 Jan 2023	Date of Agreement with Agencies	Remarks / Justification
					The RAC within Site A is also not to be retained. Prior to any site clearance, if bamboo bats are detected in the affected bamboo clusters, they will be translocated to another location with suitable receptor bamboo clusters that is agreed on with NParks. There are also 3 small reductions of RAC due to updated development plot. This is a deviation to the RAC presented in Section 2.5 of the approved EMMP Report Area A. The changes are detailed in Section 2 of this EMMP Addendum report.
2	Revised water monitoring plan	Change	Sections 7.2.2.2, 8.2.2 and 9.2.2	11 March 2023	Based on email from Public Utilities Board (PUB) on 11 March 2023, the frequency of sampling for heavy metals was adjusted from monthly to quarterly for heavy metals. Sampling for heavy metals is to be conducted for construction discharge outlet only. Also, the water monitoring locations have been adjusted to match the actual construction discharge outlets. The changes are detailed in Section 3 of this EMMP Addendum report.
3	Revised bamboo bat rescue protocol	Change	Section 6.1.1	12 and 24 May 2023	Based on discussion with NParks, to reduce the risk of bamboo bats returning to the yet-to-be cleared bamboo clusters, rescued bamboo bats was proposed to be relocated ex situ. The changes are detailed in Section 4 of this EMMP Addendum report.
4				5 April 2024	Based on comments from NParks on 5 April 2024, consultants are to conduct translocation of rescued bats at pre-approved locations only, and to ensure that post-release monitoring of translocated bats are conducted. The changes are detailed in Section 4 of this EMMP Addendum report.
5	Update on forest fringe within Area A along Brickland Road (Tengah	Change	Section 2.5	19 December 2022	Based on email exchange between HDB and NParks dated 19 December 2022, NParks is agreeable to the proposed platform level for BTO plot and

No	Description	Change/ New	Relevant Section in approved EMMP Report for Area A dated 27 Jan 2023	Date of Agreement with Agencies	Remarks / Justification
	Earthworks Phase 3)				proposed terraced design for the Forest Fringe. Also, NParks requested HDB to study a covered linkway design. After the assessment done by HDB, some trees would need to be cleared to facilitate the terraced design. This is a deviation to the approved EMMP Report for Area A as there was no plan for vegetation clearance within the Forest Fringe. The changes are detailed in Section 5 of this EMMP Addendum report.
6	Additional Earthworks and Site Investigation (SI) works within Area A (Tengah Earthworks Phase 3)	New	Section 2.5	13 January 2023	Based on email exchange between HDB and NParks on 13 January 2023, it was detailed that due to the terrain within Tengah Earthworks Phase 3, certain extent of additional earthworks are required on the northern side of Tengah Earthworks Phase 3. Subsequently, SI works will also be required on the northern side of Tengah Earthworks Phase 3. NParks provided in-principle no objection for the same. This is a deviation to the approved EMMP Report for Area A as there was no plan for vegetation clearance within this area. The changes are detailed in Section 6 of this EMMP Addendum report.

1.2 Study Limitations, Assumptions and Constraints

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2 Reduction of Recommended Area of Conservation at 4 locations

To balance development needs and environmental concerns, HDB has worked with agencies and stakeholders (i.e., Nature Groups) on the proposed revisions to the land use plan in Tengah North in response to the recommendations published in the Tengah North EIS.

Based on interagency discussions and engagement with stake holders (i.e., Nature Groups) on Tengah North Land Use following the publication of the Tengah North EIS on 5 Nov 2021, the presence of the corridor may instead attract wildlife to the junction of Brickland Road and Bukit Batok Road, and as there are difficulties ensuring wildlife connectivity across the major road junction, this could increase incidences of roadkill in that area as there is no feasible crossing. It was therefore agreed, in consultation with stakeholders, that the RAC along Bukit Batok Road should be tapered from 100m to a 25m-wide Forest Fringe [R-2] instead to funnel wildlife towards a wildlife crossing across Bukit Batok Road along Bukit Batok West Avenue 7 instead.

The RAC within Site A is also not to be retained. Prior to any site clearance, if bamboo bats are detected in the affected bamboo clusters, they will be translocated to another location with suitable receptor bamboo clusters that is agreed on with NParks. There are also 3 small areas of reductions of RAC due to updated development plot.

This is a deviation to the RAC presented in Section 2.5 of the approved EMMP Report Area A. Kindly refer to Figure 2-1 on the change of RAC described above.

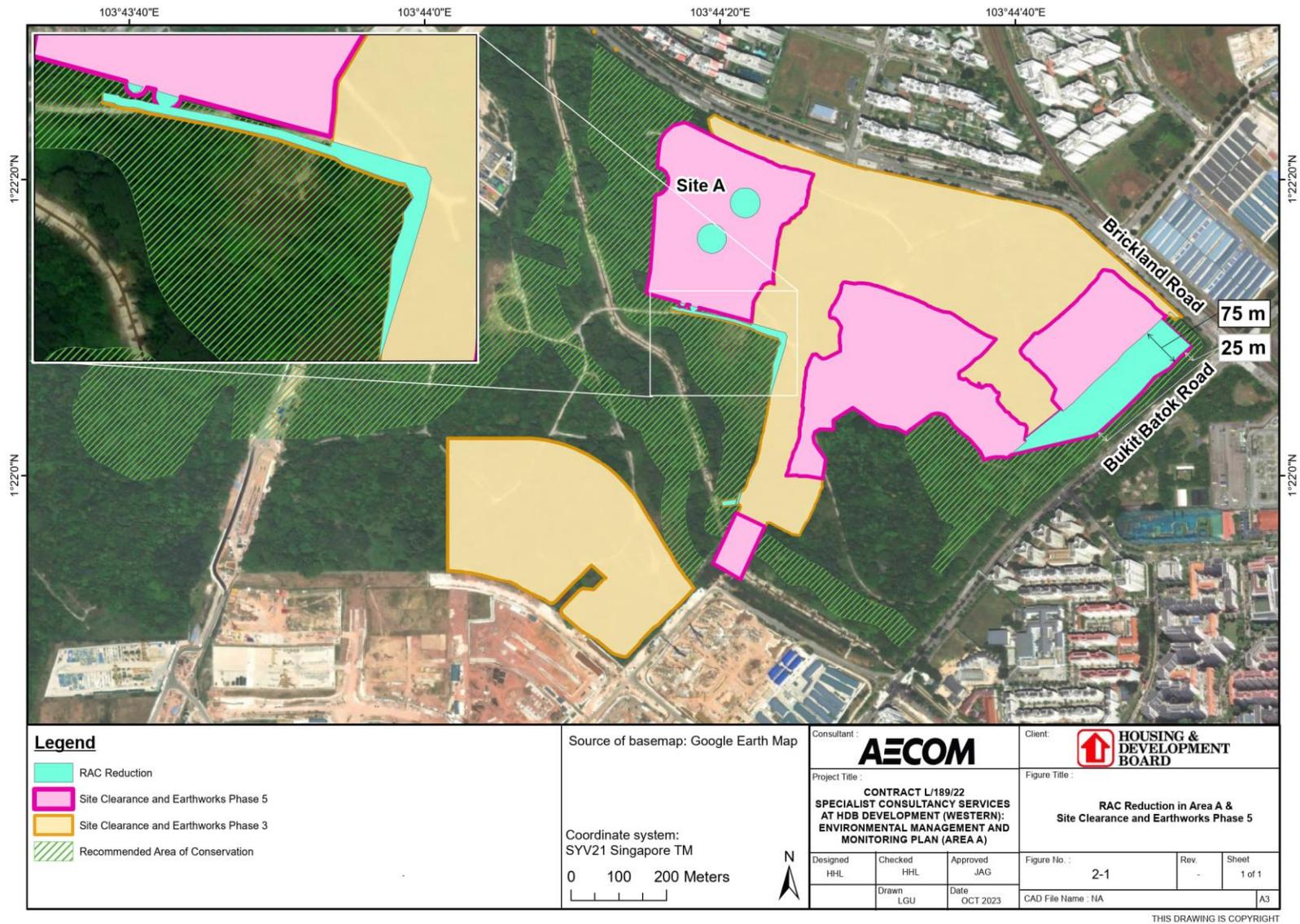


Figure 2-1 RAC Reduction in Area A & Site Clearance and Earthworks Phase 5

2.1 Existing Conditions

The affected habitats are summarised in Table 2-1 and Figure 2-2. Specific receptors that may be impacted or are close to affected areas include:

1. Bamboo bats (*Tylonycteris* sp.) roosting within the bamboo clusters of Site A RAC
2. The rediscovered Hairy jewel ground orchids (*Hetaeria oblongifolia*) within and in close proximity to the RAC [R-3]

Table 2-1 Summary of habitat types lost

Location of RAC	Reason for Removal	Habitat Type Lost	Area (ha)	Specific sensitive receptors
Within Site A	Platform level changes are required for the future development, and retaining the platform levels within the RAC limits the ability to optimise the development.	Abandoned land forest	0.375	Eight bamboo clusters will be affected, of which bamboo bats (<i>Tylonycteris</i> sp.) were recorded roosting in three of the clusters
		Scrubland	0.221	
RAC along Bukit Batok Road	As the existing proposed RAC is located in proximity to major roads (i.e., junction of Bukit Batok Road and Brickland Road), this forested corridor could result in increased road kill and human-wildlife conflict along the major roads. This is because the corridor may lead to ground-dwelling fauna utilising the area and attempting crossings at the junction. A taper is therefore adopted to discourage fauna from approaching the junction.	Abandoned land forest	0.842	A population of hairy jewel ground orchids (<i>Hetaeria oblongifolia</i>) was detected in the forest patch within the remaining RAC to be retained and is not affected by the reduction
		Exotic-dominated secondary forest	1.671	
		Scrubland	0.225	
3 minor reductions south of Site A	Updated development plot	Exotic-dominated secondary forest	0.212	—
		Scrubland	0.039	

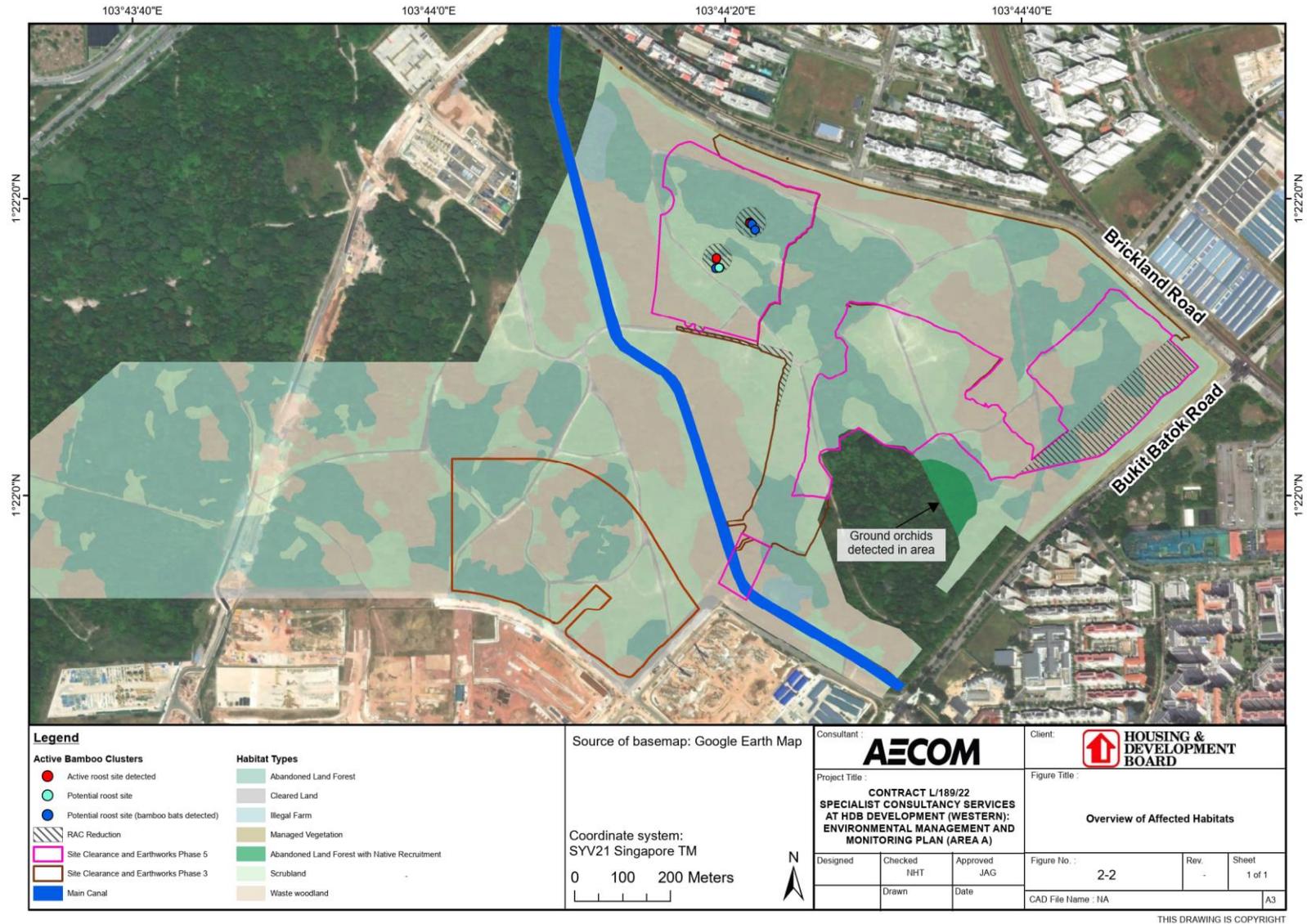


Figure 2-2 Overview of Affected Habitats

2.2 Mitigation Measures

Recommendations in the EIS report [R-1], overall EMMP report [R-4], and any report addendums should be adhered to during the construction and operational phases. In addition to the above, the below additional measures are recommended:

1. RAC along Bukit Batok Road
 - a. In contrast to the key recommendations listed in the EIS Report with regards to in-fill planting and landscaping, since roadkills and human-wildlife conflict is a concern in the area, it is recommended that during operational phase, any future landscaping or planting along the edges of the RAC along Bukit Batok Road should not be densely planted to avoid facilitating ground-dwelling fauna close to the busy road junctions.
 - b. Wildlife-attracting plant species, such as fruit trees that provide as a source of food for ground-dwelling fauna species, should also be avoided.

For specific sensitive receptors:

1. Bamboo bats (*Tylonycteris* sp.)
 - a. Due to the presence of bamboo clusters with bamboo bat roost sites, bamboo bat rescue and relocation should be conducted, as detailed in the overall EMMP report [R-4].
 - b. Clearance of bamboo clusters should be avoided between February to May, as bamboo bats have been recorded to give birth during this period [R-5], and the disturbance from site clearance may result in adults abandoning their pups.
2. Ground orchids (*Hetaeria oblongifolia*)
 - a. NParks has requested that prior to site clearance, forested areas that is adjacent to the patch of abandoned-land forest with native recruitment should be surveyed to look for any additional self-sown ground orchids, and to be informed if any are detected so that they may conduct salvaging works before land clearance for Phase 5.

3 Revised Water Monitoring Plan

3.1 Revised Monitoring Plan

Based on email from PUB on 11 March 2023, the frequency of sampling for heavy metals was adjusted from monthly to quarterly for heavy metals. Sampling for heavy metals is to be conducted for construction discharge outlet only. Also, according to the updated ECM plan, the water quality sampling locations have been revised to monitor the ECM discharge points. The revised plan serves to better represent the necessary water sampling points for this project site.

Five (5) water sampling points (refer to Figure 3-1) were selected within the worksite to assess the water quality of the treated ECM effluent that is being discharged to public drains. All the discharge points from construction worksites should follow the NEA's Allowable Limits for Trade Effluent Discharge to Controlled Watercourse (for all parameters unless otherwise specified here) to assess whether the discharged effluent is in compliance with the regulation [W-1]. In addition, the Singapore's Water Quality Guidelines for Popular Recreational Beaches will be used as a reference for *Enterococcus* only [W-2]. The water quality at selected locations to be sampled in monthly frequency and additional parameters to be sampled quarterly at every construction discharge outlet (refer to revised ECM plan in Appendix A as shown in Table 3-1).

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

The hydrological conditions of drainage system within construction worksite and at immediate vicinity should be inspected daily by the EMMP Consultant's Environment Control Officer (ECO) and Contractor'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 biweekly.

If any exceedance in monitored levels of water quality parameters found from in-situ or ex-situ measurement (refer to Table 3-1) as well as any flooding or clogging issue observed on site, the EMMP Consultant's ECO and Contractor should conduct an investigation and corrective actions should be taken immediately.

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

Table 3-1 Summary of water quality sampling parameters and frequency

Parameter	Unit	Guideline used	Guideline value	Sampling Method	Sampling Frequency during Construction Stage
Dissolved Oxygen	mg/L	-	-	In-situ sampling using multiparameter probe	Monthly
Turbidity	NTU	-	-		
Conductivity	µS/cm	-	-		
Salinity	mg/L	-	-		
pH	-	NEA 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			

Parameter	Unit	Guideline used	Guideline value	Sampling Method	Sampling Frequency during Construction Stage
Total Dissolved Solids	mg/L	-	1,000		
Phosphate (PO ₄) as P	mg/L	NEA Allowable Limits for Trade Effluent Discharge to Controlled Watercourse	2		
Total Phosphorus	mg/L	-	-		
Nitrate (NO ₃) as N	mg/L	NEA Allowable Limits for Trade Effluent Discharge to Controlled Watercourse	20		
Total Nitrogen	mg/L	-	-		
Total Alkalinity	mg/L	-	-		
Total Organic Carbon	mg/L	-	-		
Ammoniacal Nitrogen	mg/L	-	-		
<i>Enterococcus</i>	CFU/100mL	Singapore's Water Quality Guidelines for Popular Recreational Beaches	200		
Lead	mg/L	NEA Allowable Limits for Trade Effluent Discharge to Controlled Watercourse	0.1		Quarterly
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.					

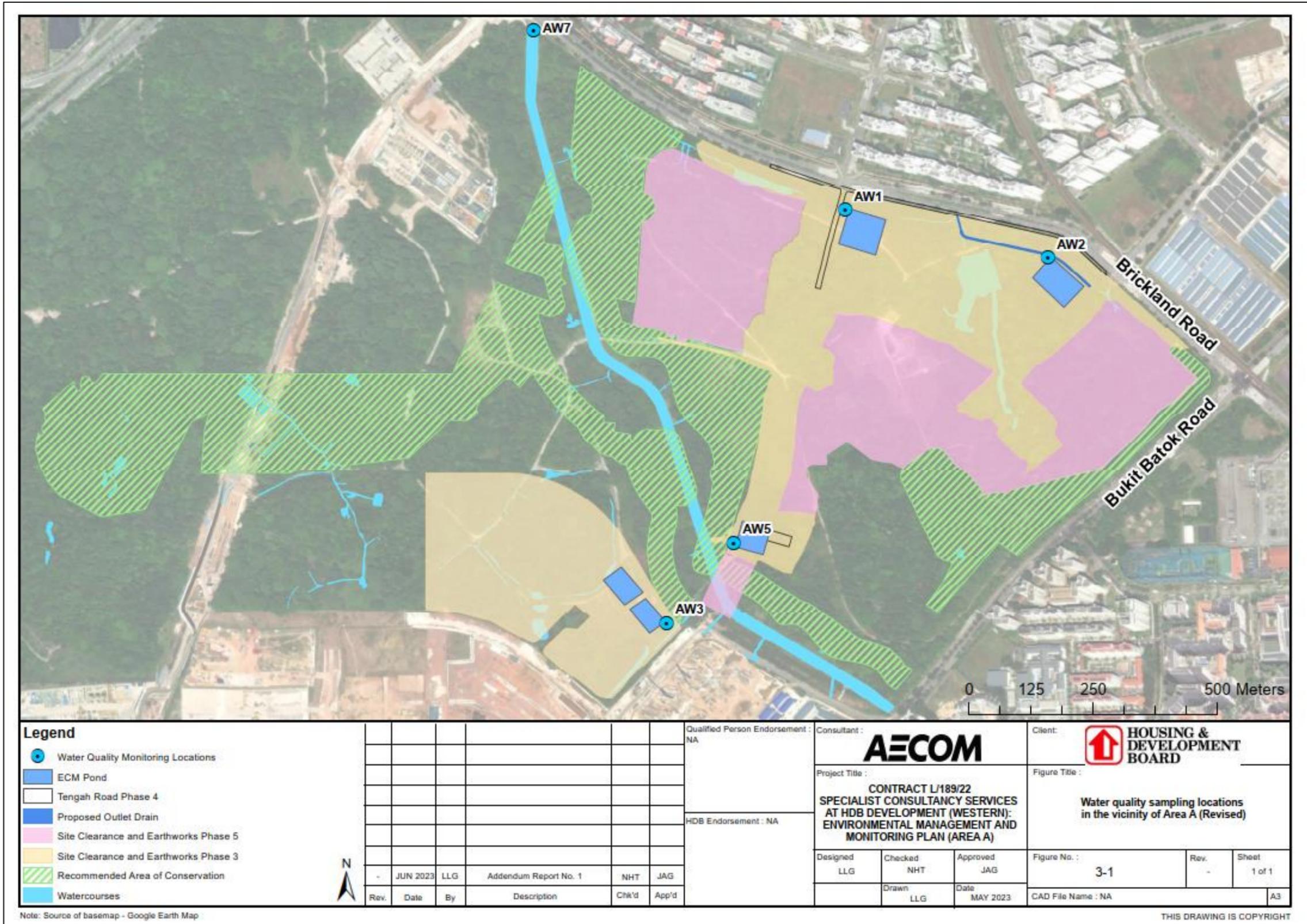


Figure 3-1 Water quality sampling locations in the vicinity of Area A (Revised)

3.2 Rationale for Revised Monitoring Plan

Table 3-2 Comparison of surface water quality sampling locations from Approved EMMP Report and Addendum EMMP Report

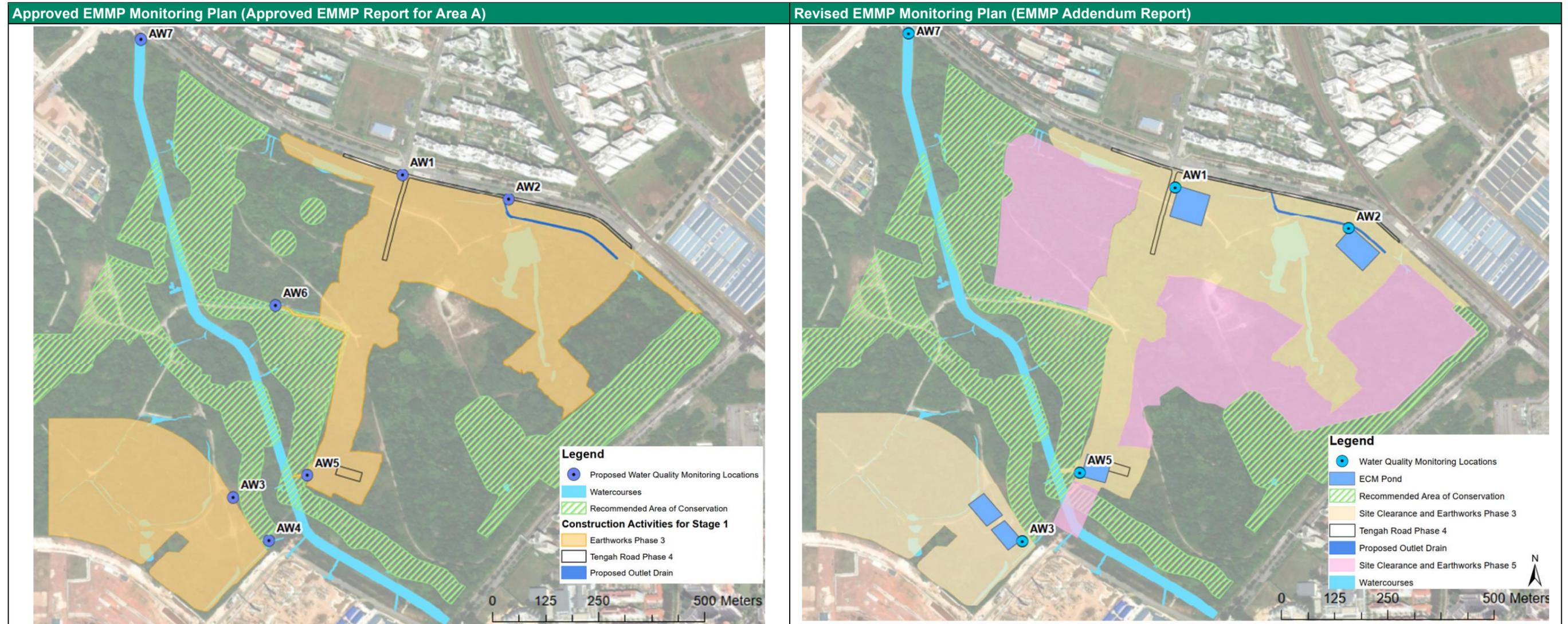


Table 3-3 Rationale for revision of surface water quality sampling locations

No.	Surface Water Quality Sampling Location	Justification for Revision	Rationale for Selection of Sampling Location
1	AW1	With reference to the hoarding plan [updated as of 2 nd May 2023], there was a change in location of the ECM pond, ECM plant and discharge outlet from the PUB-approved ECM plan. The sampling location will be moved accordingly to sample the discharge from ECM plant.	To monitor the water quality of discharge from the ECM plant
2	AW2	With reference to the on-site ECM provisions and hoarding plan [updated as of 2 nd May 2023], there was a change in location of the ECM pond, ECM plant and discharge outlet from the PUB-approved ECM plan. As the discharge outlet into the public drain is underground and inaccessible, the sampling location was moved to sample the final discharge from the ECM plant accordingly.	To monitor the water quality of discharge from the ECM plant
3	AW3	With reference to the on-site ECM provisions, two (2) ECM ponds are connected by a pipe, and the treated discharge from the ECM plants is currently discharged through a single discharge outlet. AW3 and AW4 are now considered as a single sampling location, AW3.	To monitor the water quality of discharge from the ECM plant
4	AW4		
5	AW5	No revision from approved EMMP Report.	To monitor the water quality of discharge from the ECM plant
6	AW6	The planned outlet drain was removed from the PUB-approved ECM plan (Appendix A). As such, the sampling location was removed accordingly.	-
7	AW7	No revision from approved EMMP Report.	To monitor the water quality downstream of canal as requested by PUB.

4 Revised Bamboo Bat Rescue Protocol

Changes on bamboo bat rescue protocol was also sought from NParks on 12 May 2023 with regards to relocating rescued bamboo bats *ex situ*. To reduce the risk of bamboo bats returning to the yet-to-be cleared bamboo clusters, we are proposing to relocate the rescued bamboo bats *ex situ*. Rescued bamboo bats will be kept within their original bamboo internodes as far as possible. Sawn sections of the bamboo stems bearing the internode with bats will be attached onto/near the bamboo cluster at the release site. If the original bamboo internodes get damaged during the felling process, the bamboo bats will be extracted and released directly at the release site. The release sites should (1) be as far off-site as feasible to reduce the risk of homing, (2) be within Nature Parks or wooded estates that are not planned to be cleared, (3) have bamboo clusters that are known or potential roosting sites for bamboo bats. Repeated releases at the same site will be avoided to prevent over-population.

For bat release sites, NParks is agreeable for the release of the bats in the sites listed below with suitable bamboo patches present. Prior to release, AECOM is to reach out to the respective NParks officers-in-charge (OICs), or to follow any other protocol otherwise agreed on with NParks. A rough population estimate will be provided to NParks beforehand, if possible, to help assess if there are sufficient areas for the bats.

- Bukit Timah Nature Reserve
- Rifle Range Nature Park
- Zhenghua Nature Park

On 24 May 2023, it was also clarified by NParks that for future *ex situ* bat translocations, at every new site, a written approval from the Director-General of Wildlife Management shall be obtained from the Form.gov.sg link, and shall include the details of the release sites after getting approval from the respective site managers. An amendment should also be submitted for the BIOME permit to include post-release monitoring if there are no objections from the site managers. The objective of the post-release monitoring is to ensure that 1) there are no injured bats within the translocated stems, as far as we can tell, and 2) ensure that the stems are in a suitable location. The post-release monitoring will follow protocol as below:

- Follow-up visits to be conducted for seven consecutive weekdays after the translocation
- An endoscope camera will be used to see if translocated bats are still present within the stems
- If bats that are clearly injured are encountered:
 - Injured bat in a stem with no other bats: bat will be extracted and handed over to NParks
 - Injured bat in a stem with other bats: bat will be extracted and handed over to NParks
 - Injured bat in a stem containing a bamboo bat pups: bat will not be extracted, as the disturbance may prompt the adults to abandon their pups
- Post-release monitoring will be discontinued if:
 - There are no bats in the stem observed, i.e., bats have left of their own accord
 - The bamboo stem is no longer suitable for use by the bats (e.g., if insects have started using the translocated stems)

Following further comments from NParks on 5 April 2024, Consultant are to conduct translocation of rescued bats at pre-approved locations only, and to ensure that post-release monitoring of translocated bats are conducted. Consultants are to seek approval from NParks officers-in-charge and site managers prior to any translocation operations. The following items should be provided to NParks at least one week prior to any bamboo felling works:

- Exact bamboo cluster (“receptor cluster”) where the bats will be released at
- Details on how the Consultants will access the receptor cluster
- Approximate time of release

- SOP of how the release will be conducted
- Approximate number of bats
- When the post-release monitoring will be, and if any further access is needed

Should a longer post-release monitoring be needed, the Consultant should inform the NParks site manager. Once post-release monitoring has concluded, the Consultant will also notify the NParks site manager, and provide a summary/log of relocation activities at the site.

5 Update on Forest Fringe within Area A along Brickland Road (Tengah Earthworks Phase 3)

Based on email exchanges between HDB and NParks dated 19 December 2022, NParks is agreeable to the proposed platform level for BTO plot and the adjacent forest fringe, and NParks proposed terraced design for the Forest Fringe to ensure slope stability and increase area of planting. Also, NParks requested HDB to study a covered linkway design that would fit the terraced Forest Fringe design and not hinder animal movement through Forest Fringe. After the assessment done by HDB's earthworks consultant for Tengah Earthworks Phase 3, some trees would need to be cleared to facilitate the terraced design. This is a deviation to the approved EMMP Report for Area A as there was no plan for vegetation clearance within the Forest Fringe.

During this additional clearance, relevant mitigation measures applicable to Tengah Earthworks Phase 3 in Sections 6, 7 and 10 of the approved EMMP Report for Area A will apply to this additional area. If any wildlife is encountered during the clearance, wildlife response plan shall be adhered to. Tree felling approval for these additional trees will be obtained separately by HDB's earthworks consultant. Kindly refer to Appendix B on affected trees planned to be cleared within the Forest Fringe.

6 Additional Earthworks and SI works within Area A (Tengah Earthworks Phase 3)

Due to the terrain within Tengah Earthworks Phase 3, certain extent of additional earthworks are required on the northern side of Tengah Earthworks Phase 3. Subsequently, SI works will also be required on the northern side of Tengah Earthworks Phase 3. Refer to Figure 6-1 on the additional earthworks worksite area required. Due to the additional worksite, additional tree clearance would be required. This is a deviation to the approved EMMP Report for Area A as there was no plan for vegetation clearance within this area.

Relevant mitigation measures applicable to Tengah Earthworks Phase 3 (vegetation clearance and earthworks activities) in Sections 6, 7 and 10 of the approved EMMP Report for Area A will apply to this additional area. If any fauna is encountered during the clearance, wildlife response plan shall be adhered to. Tree felling approval for these additional trees will be obtained separately by HDB's earthworks consultant. Affected trees planned to be cleared is provided in Appendix C.

With regards to SI works, there will not be any deviation from the previously agreed arrangement with NParks. SI works will start for areas that have been already cleared by earthworks contractor. No additional clearance to be done for SI boreholes worksites or access routes. The location of SI boreholes is provided in Appendix C.

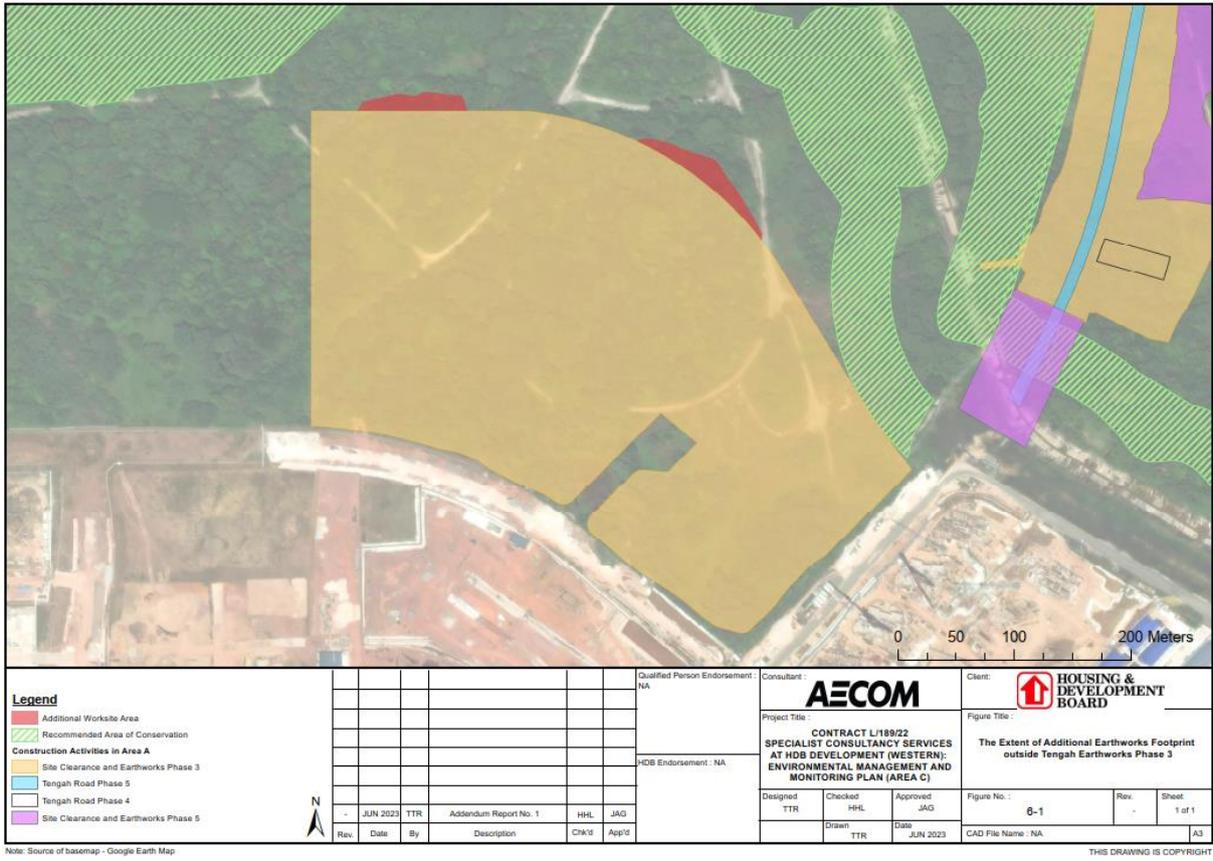


Figure 6-1 The Extent of Additional Earthworks Footprint outside Tengah Earthworks Phase 3

7 Conclusion

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

In order to ensure the information in the EMMP are up-to-date in the event of any possible changes, it was recommended that the EMMP to be updated when necessary for use by all parties that involved in this Project. Thus, this EMMP Addendum has been developed based on the changes in development works and additional development works.

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.

8 References

8.1 Reports

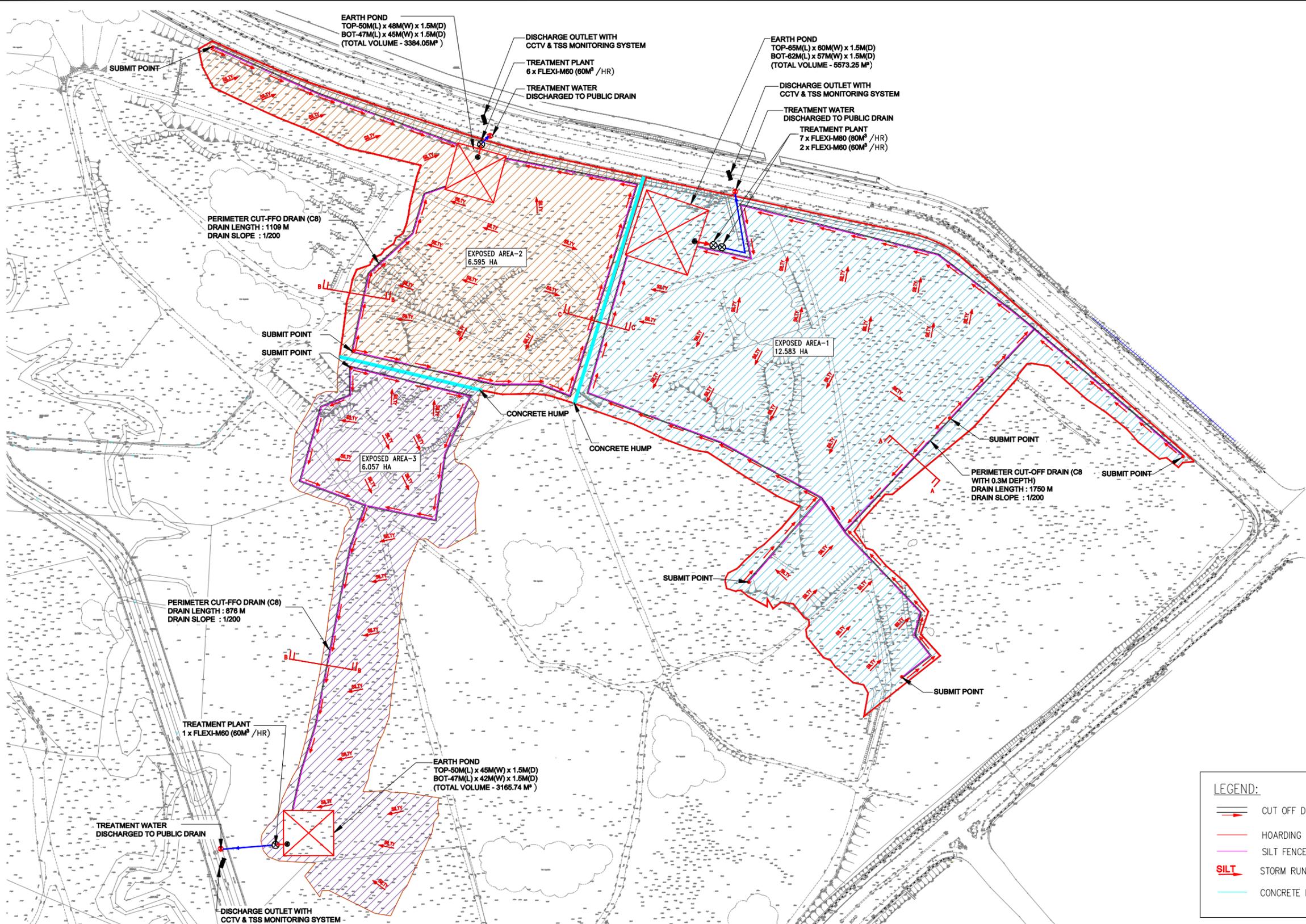
- R-1. CH2M Hill Singapore Pte Ltd, Specialist Consultancy Services for Environmental Impact Study at Tengah Town – Environmental Impact Study (EIS) Report – Revision 04, Report prepared for HDB, Singapore. 2021
- R-2. Housing Development Board (2023) Proposed Amendments to the Approved Tengah Maser Plan [Tengah Brickland District (Part)] Drawing No: HB-RPG-22-127B
- R-3. Leong PKF, Lua HK & Yam TW (2021) The rediscovery of *Hetaeria oblongifolia* Blume (Orchidaceae) in Singapore. Nature in Singapore, 14: e2021019. DOI: 10.26107/NIS-2021-0019.
- R-4. AECOM Singapore Pte Ltd, Specialist Consultancy Services at HDB Development (Western) Environmental Management and Monitoring Plan (Area A) prepared for HDB, Singapore, 2023
- R-5. Medway L & Marshall AG (1972) Roosting associations of flat-headed bats, *Tylonycteris* species (Chiroptera : Vespertilionidae) in Malaysia. Journal of Zoology, 168 (4):463–482.

8.2 Website

- W-1. National Environment Agency (2022). Allowable Limits for Trade Effluent Discharge to Watercourse or Controlled Watercourse.
[NEA | Allowable Limits for Trade Effluent Discharge to Watercourse or Controlled Watercourse](#)
- W-2. National Environment Agency (2023). Singapore's Water Quality Guidelines for Popular Recreational Beaches.
[NEA | Singapore's Water Quality Guidelines for Popular Recreational Beaches](#)

Appendix A PUB Approved ECM Plan

FOR APPROVAL



EARTH CONTROL MEASURE PLAN
 SCALE 1 : 4 M

LEGEND:

- CUT OFF DRAIN (TYPE C7)
- HOARDING ALONG BOUNDARY
- SILT FENCE
- STORM RUN-OFF
- CONCRETE HUMP

EXPOSED AREA = 25.2355HA
TOTAL SITE AREA = 25.2355HA

NOTE:

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

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 1	12.583	12.583	6543.16	1425.29	5573.25	6998.53	KTZ31.5	7xM80 + 2xM60	7552	< 50 PPM
AREA 2	6.595	6.595	3429.40	634.35	3384.00	4018.35	KTZ31.5	6xM60	6989	< 50 PPM
AREA 3	6.057	6.057	3149.64	500.55	3165.74	3666.29	KTZ31.5	6xM60	6918	< 50 PPM

REV	DATE	NAME	SUBJECT	CHK'D

AMENDMENTS

Tenure of Land:

THIS DRAWING IS COPYRIGHT OWNER:

HOUSING & DEVELOPMENT BOARD
 HDB HUB 480 LORONG 6 TOA PAYOH SINGAPORE 310480
 PERSON-IN-CHARGE: CHONG YING JIE

ARCHITECT:

CONTRACTOR:

KTC CIVIL ENGINEERING & CONSTRUCTION PTE LTD
 PERSON IN CHARGE: Mr HUANG WENHUI

PROJECT TITLE:

A) SITE PREPARATION WORKS AT TENGAH TOWN (PHASE 3)
 B) SITE PREPARATION WORKS AT TENGAH TOWN (PHASE 4)
 C) CONSTRUCTION OF OUTLET DRAINS AT TENGAH TOWN (PHASE 1a)
 D) CONSTRUCTION OF OUTLET DRAINS AT TENGAH TOWN (PHASE 1b)
 E) SITE PREPARATION WORKS AT BURIT BATAK TOWN (PHASE 6)

LOT NO :	MUKIM NO :
06207T PT, 04627M PT, 00149P PT, 05210T PT, 05297W PT, 04151A PT, 09629M, 03578A PT, 03724T PT, 03721W PT, 05271P PT, 02626N PT, 03550T PT, 03579C, 03720M, 03718W PT, 03722V PT, 03716C PT, 00479T PT, 04155L PT	MK 10

DRAWING DESCRIPTION:

EARTH CONTROL MEASURE (ECM) FOR PHASE 3 SITE A

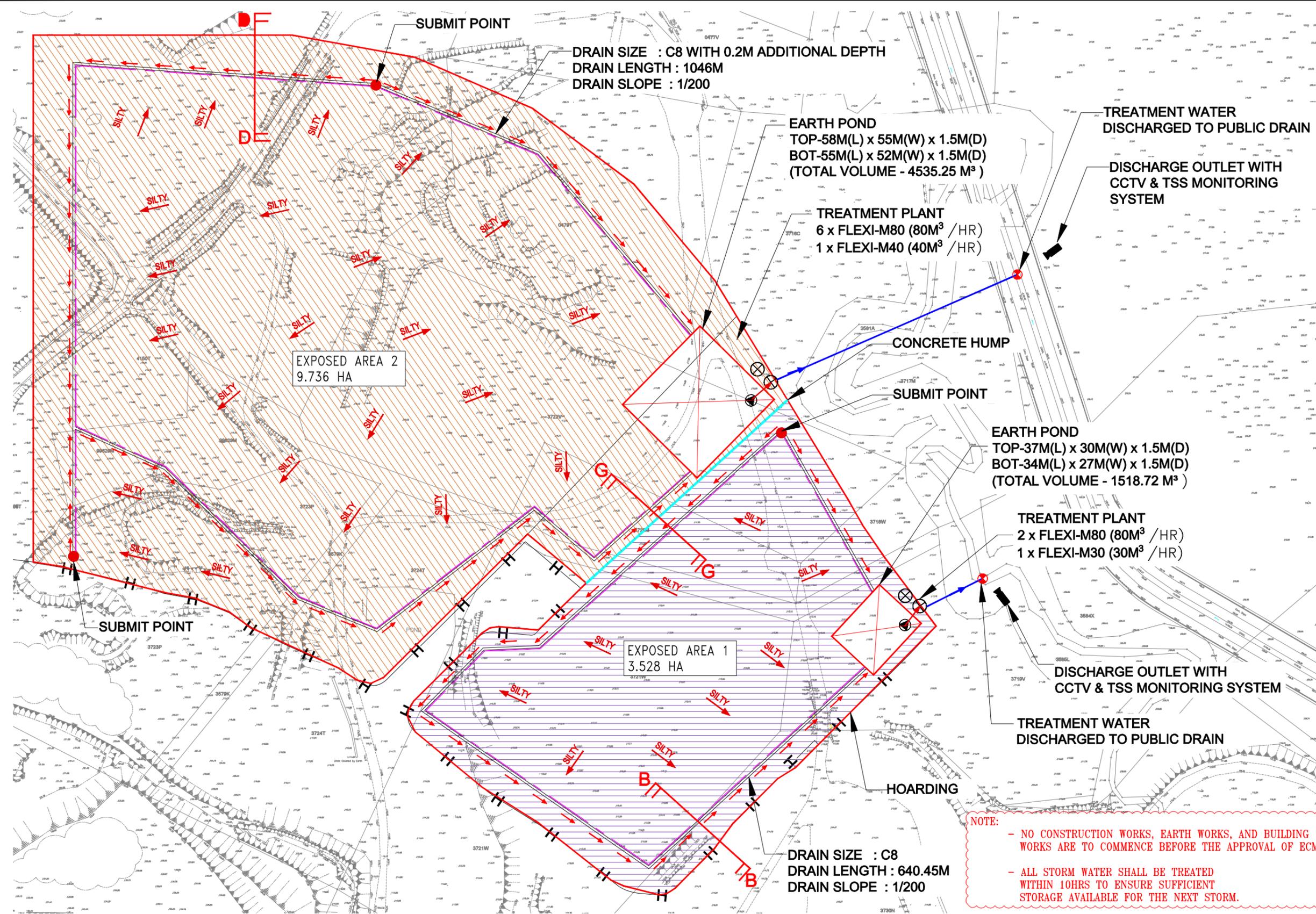
C&S CONSULTANTS & QECP

TUNG CONSULTANTS
 CIVIL & STRUCTURAL CONSULTANTS
 7 TEMASEK BOULEVARD, #12-07
 SUNTEC TOWER 1
 SINGAPORE 038 987
 PERSON-IN-CHARGE: MR KOW KAH HOE

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

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

FOR APPROVAL



EARTH CONTROL MEASURE PLAN

SCALE 1 : 2 M

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 1	3.528	3.528	1834.56	365.98	1518.72	1884.71	KTZ31.5	2xM80 + 1xM30	6483	< 50 PPM
AREA 2	9.866	9.866	5130.48	767.18	4535.25	5302.43	KTZ31.5	6xM80 + 1xM40	7335	< 50 PPM

LEGEND:

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

EXPOSED AREA = 13.2662HA
TOTAL SITE AREA = 13.2662HA

REV	DATE	NAME	SUBJECT	CHK'D

AMENDMENTS

Tenure of Land:

THIS DRAWING IS COPYRIGHT

OWNER:



ARCHITECT:

CONTRACTOR:

KTC CIVIL ENGINEERING & CONSTRUCTION PTE LTD
PERSON IN CHARGE: Mr HUANG WENHUI

PROJECT TITLE:

- A) SITE PREPARATION WORKS AT TENGAH TOWN (PHASE 3)
- B) SITE PREPARATION WORKS AT TENGAH TOWN (PHASE 4)
- C) CONSTRUCTION OF OUTLET DRAINS AT TENGAH TOWN (PHASE 1a)
- D) CONSTRUCTION OF OUTLET DRAINS AT TENGAH TOWN (PHASE 1b)
- E) SITE PREPARATION WORKS AT BURIT BATOK TOWN (PHASE 6)

LOT NO :	MUKIM NO :
06207T PT, 04027M PT, 00149P PT, 05210T PT, 05297W PT, 04151A PT, 04629M, 03578A PT, 03724T PT, 03721W PT, 05271P PT, 02621N PT, 03607 PT, 03579C, 03720M, 03718W PT, 03722V PT, 03716C PT, 00479T PT, 04155L PT	MK 10

DRAWING DESCRIPTION:

EARTH CONTROL MEASURE (ECM) FOR PHASE 3 SITE B

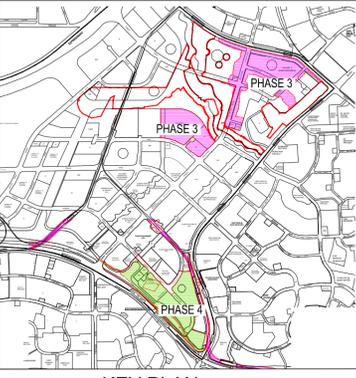
C&S CONSULTANTS & O&CP

TUNG CONSULTANTS
CIVIL & STRUCTURAL CONSULTANTS
7 TEMASEK BOULEVARD, #12-07
SUNTEC TOWER 1
SINGAPORE 038 987
PERSON-IN-CHARGE: MR KOW KAH HOE

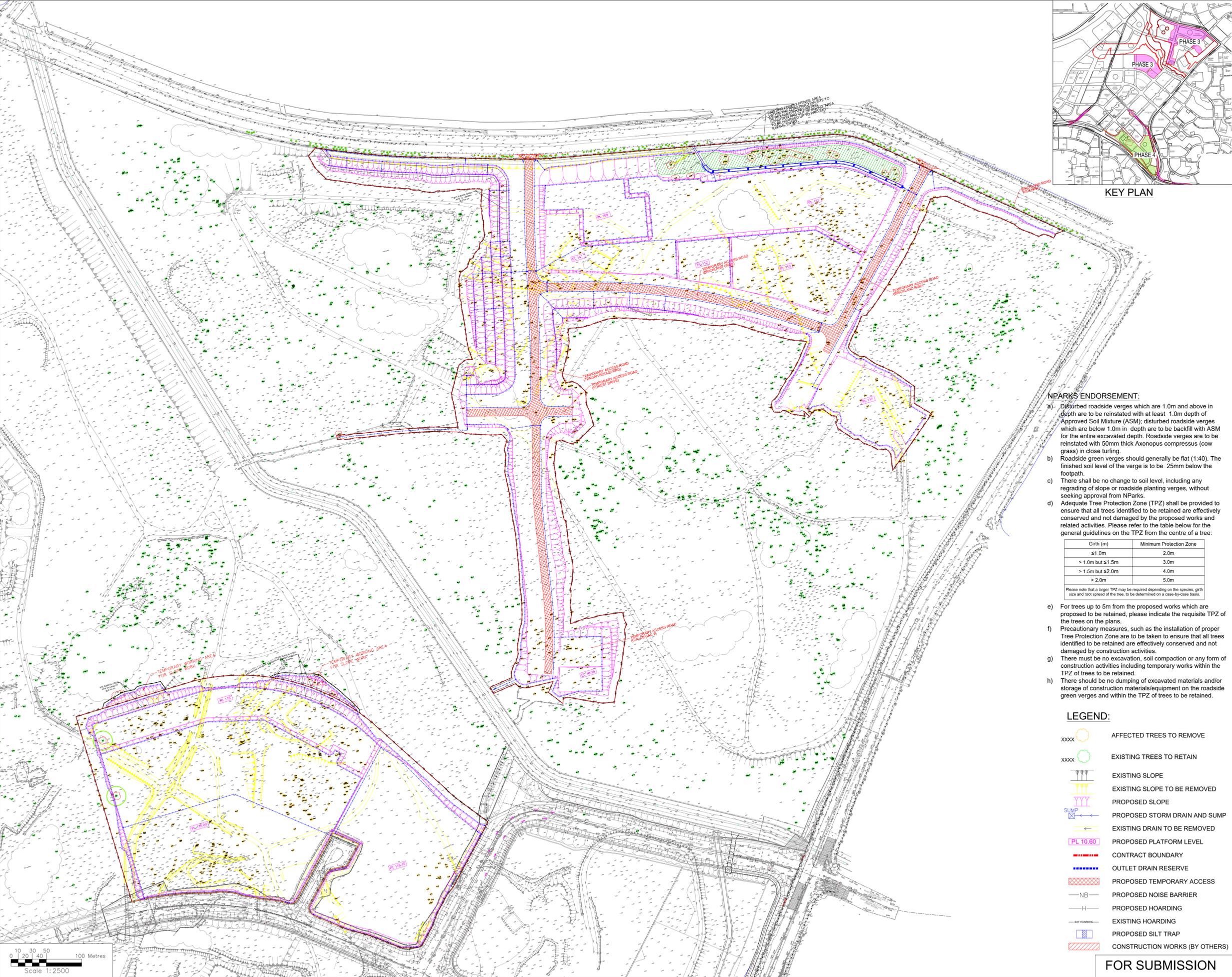
SCALE	AS SHOWN	BY	DATE
DRAWN	NN	DECEMBER 2022	
DESIGNED	JSL	DECEMBER 2022	
CHECKED	KKH	DECEMBER 2022	
APPROVED	KKH	DECEMBER 2022	
JOB NO.	DISCIPLINE	DRAWING NO.	REVISION
-	E	01	-

Appendix B Affected Trees within Forest Fringe

Appendix C Affected Trees within RAC near Tengah Earthworks Phase 3 and SI Boreholes Location



KEY PLAN



NPARKS ENDORSEMENT:

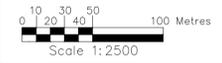
- a) Disturbed roadside verges which are 1.0m and above in depth are to be reinstated with at least 1.0m depth of Approved Soil Mixture (ASM); disturbed roadside verges which are below 1.0m in depth are to be backfill with ASM for the entire excavated depth. Roadside verges are to be reinstated with 50mm thick Axonopus compressus (cow grass) in close turfing.
- b) Roadside green verges should generally be flat (1:40). The finished soil level of the verge is to be 25mm below the footpath.
- c) There shall be no change to soil level, including any regrading of slope or roadside planting verges, without seeking approval from NParks.
- d) Adequate Tree Protection Zone (TPZ) shall be provided to ensure that all trees identified to be retained are effectively conserved and not damaged by the proposed works and related activities. Please refer to the table below for the general guidelines on the TPZ from the centre of a tree:

Girth (m)	Minimum Protection Zone
≤1.0m	2.0m
> 1.0m but ≤1.5m	3.0m
> 1.5m but ≤2.0m	4.0m
> 2.0m	5.0m

Please note that a larger TPZ may be required depending on the species, girth size and root spread of the tree, to be determined on a case-by-case basis.
- e) For trees up to 5m from the proposed works which are proposed to be retained, please indicate the requisite TPZ of the trees on the plans.
- f) Precautionary measures, such as the installation of proper Tree Protection Zone are to be taken to ensure that all trees identified to be retained are effectively conserved and not damaged by construction activities.
- g) There must be no excavation, soil compaction or any form of construction activities including temporary works within the TPZ of trees to be retained.
- h) There should be no dumping of excavated materials and/or storage of construction materials/equipment on the roadside green verges and within the TPZ of trees to be retained.

LEGEND:

- xxxx (Yellow circle) AFFECTED TREES TO REMOVE
- xxxx (Green circle) EXISTING TREES TO RETAIN
- EXISTING SLOPE (Yellow hatched)
- EXISTING SLOPE TO BE REMOVED (Red hatched)
- PROPOSED SLOPE (Blue hatched)
- PROPOSED STORM DRAIN AND SUMP (Blue line with arrows)
- EXISTING DRAIN TO BE REMOVED (Red dashed line)
- PROPOSED PLATFORM LEVEL (Pink dashed line)
- CONTRACT BOUNDARY (Red dashed line)
- OUTLET DRAIN RESERVE (Blue dashed line)
- PROPOSED TEMPORARY ACCESS (Red hatched)
- PROPOSED NOISE BARRIER (Grey line)
- PROPOSED HOARDING (Grey line)
- EXISTING HOARDING (Grey line)
- PROPOSED SILT TRAP (Blue hatched)
- CONSTRUCTION WORKS (BY OTHERS) (Red hatched)



FOR SUBMISSION

Rev.	Description	Date	Designed By
C	Replied to Nparks WD	26.06.2023	MCL
B	Additional Trees Removal	17.04.2023	MCL
A	Replied to Nparks WD	10.08.2022	MCL

Qualified Person Endorsement :

CLIENT:

HDB HUB 480 LORONG 6 TOA PAYOH
SINGAPORE 310480

CLIENT SIGNATURE : _____
DRAWING NO. _____ REVISION: _____
PRECINCT NAME : _____ BUILDING _____
PROJECT TITLE : _____

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

LOT NO : _____ MUKIM NO : _____
062077 PT, 045276 PT, 021489 PT, 026210 PT, 052876 PT, 045814 PT, 046206 PT, 032784 PT, 032741 PT, 032738 PT, 032737 PT, 032818 PT, 032807 PT, 032796 PT, 032720 PT, 032718 PT, 032722 PT, 032762 PT, 024791 PT, 041552 PT, _____
MK 10

SITE PREPARATION WORKS AT TENGAH TOWN (PHASE 3)

DRAWING TITLE :
OVERALL AFFECTED TREES PLAN

SCALE : AS SHOWN DATE : DEC 2021
DRAWN BY : BYM CHECKED BY : GT

Consultant:

MEINHARDT INFRASTRUCTURE PTE LTD
168 JALAN BUKIT MERAH
#12-01 CONNECTION ONE
SINGAPORE 150168
TEL: 63778700 FAX: 63778733

DRAWING NO. 208009-01-F1904-TGT-LS-0901 REVISION: C
BYM DESIGN ENGINEER FSL QUALIFIED PERSON

