# Environmental Impact Assessment for Redevelopment of the Former Turf Club at Bukit Timah

Non-Technical Summary

## Overview

The Former Turf Club at Bukit Timah has been largely zoned for residential use to cater to future housing needs since the Master Plan 1998. As the planned housing estate, henceforth referred to in the summary as "Bukit Timah Turf City", currently has some patches of vegetated areas and is adjacent to other vegetated areas, including the Central Catchment Nature Reserve (CCNR), there is a rich and diverse biodiversity habitat and connectivity link that may be affected. Additionally, the former Bukit Timah Turf Club sits adjacent to residential areas. This Environmental Impact Assessment (EIA) study will assess the impacts from the proposed developments in terms of biodiversity, hydrology and water quality, soil and groundwater, air quality and airborne noise on the surrounding ecological and human receptors.

## This Document

**This Document** presents a Non-Technical Summary (NTS) of the findings from the Environmental Impact Assessment (EIA) for Redevelopment of the Former Turf Club at Bukit Timah as shown in *Figure 1*.

## Scope and Objective of EIA

The **Scope of the EIA** covers the construction and operational impacts on the environment (i.e., biodiversity, hydrology and surface water quality, soil and groundwater, air quality, airborne noise). Additionally, where impacts were deduced to be "**Moderate**" or "**Major**", appropriate mitigation measures were also recommended, along with the proposed Environmental Monitoring and Management Plan (EMMP) to manage these impacts.

The **Objective of EIA** is to present an assessment of the potential environmental impacts arising from, and associated with, the construction and operation of Bukit Timah Turf City based on the information available at the current master planning stage. The study of pre-construction environmental baseline conditions within the Study Area was conducted and included as part of the EIA.

# The Project

## Project Site and Components

The Former Turf Club situated between Pan Island Expressway (PIE) and Dunearn Road is proposed to be developed for residential use with supporting amenities, although majority of the forested areas within the Project Site, including Bukit Tinggi and Eng Neo Avenue Forest, will be retained as forests with trails (see *Figure 2*). The total area for development, also referred to as the "Project Site", is approximately 176ha.

The Project Site will be developed, and the expected activities within are listed below.

<u>During construction phase</u>

- Demolition of existing structures that are not planned to be retained, and site and vegetation clearance;
- Earthworks and utilities diversion;
- Construction of new roads and utilities;
- Construction works including foundation and earthworks, superstructure works, landscaping works and habitat creation; and
- Removal of temporary structures post-construction and reinstatement of the Project Site.

<u>During operational phase</u>

- Upon completion of the construction works, occupants of the development will move in and there will be an increase in human activity such as traffic movement and light disturbance.

The construction of the Project Site is expected to occur in two phases; while the works on the upcoming Cross Island Line (CRL) are being carried out, and after, the CRL works are completed within the site. Upon completion of the first phase, occupants of the first phase will move into the Project Site while construction of the second phase is still ongoing. The development and operation of the Project Site are hereby referred to as the Project.

The impacts of the CRL works, which occur concurrently with the Project construction, and include tunnelling works as well as construction of the CR14 MRT station, have been assessed separately in other impact assessment studies.

## Study Area

As the Project Site lies between the CCNR and Rifle Range Nature Park (RRNP), the areas studied in this EIA (referred to as Study Area) included the vegetated areas adjacent to the Project Site, totalling to approximately 193 ha (see *Figure 1*). The Study Area was divided into 6 zones, Sites A to F. Sites A, B, C, D and F were vegetated areas, while Site E was primarily urbanised land. The additional areas included in the Study Area outside of the Project Site have no known plans for developments in the near-term.

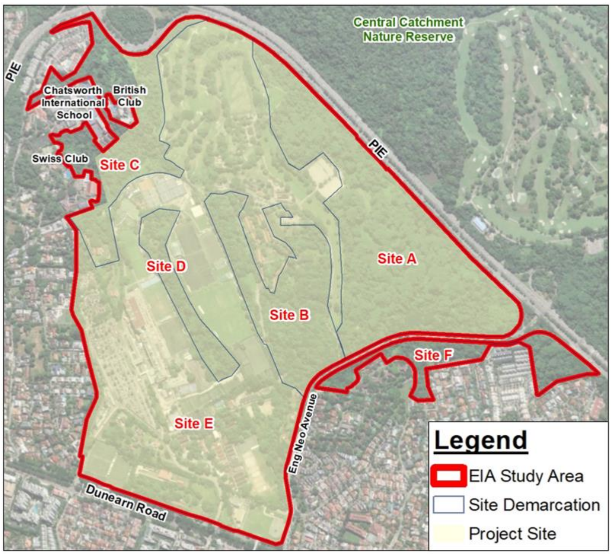



*Figure 1: Project Site and Study Area*

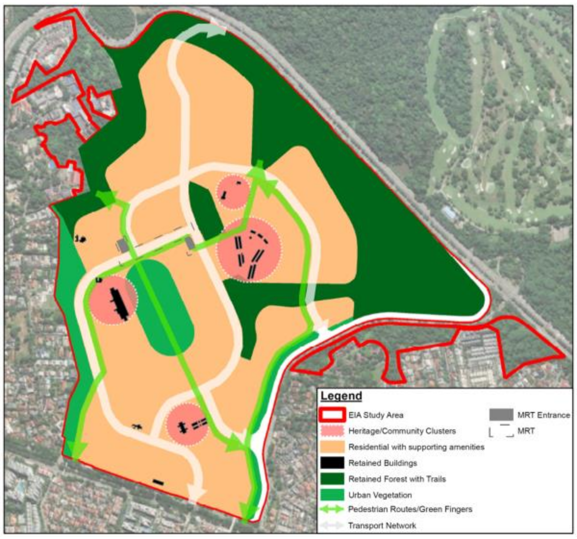



*Figure 2: Proposed Preliminary Land Use Plan of the Project Site*

## Environmental Consultation Process and Stakeholders Engagement

The scope of this EIA was finalised and approved after discussion with relevant agencies (i.e. National Parks Board, NParks; Public Utilities Board, PUB; National Environment Agency, NEA; and Urban Redevelopment Authority, URA) and documented in the form of an Inception Report.

During the course of the study, members of the nature community were also engaged over a few sessions on the EIA methodology, baseline findings, as well as the impact assessment and other key biodiversity issues related to this Project. The suggestions or issues raised during the engagement sessions were reviewed and included in the study where relevant.

## Overview of Assessment Methodology

The assessment was undertaken by identifying the Study Area, categorising the sensitive receptors within the Study Area, followed by predicting and evaluating of impacts, and then recommending mitigation measures and EMMP where relevant. The environmental impacts studied were direct impacts to biodiversity, or indirectly via other environmental aspects such as air quality, airborne noise, hydrology and water quality and soil and groundwater. Impacts to human receptors were also assessed.

### Identification of Sensitive Receptors

The ecological sensitive receptors identified for this EIA were mainly flora and fauna or their habitats within the Study Area (see *Figure 1*), while the human sensitive receptors identified were within and/or surrounding the Project Site, up to 350m and 150m away from the Project Site (for air quality and airborne noise impacts respectively). The sensitive receptors were classified into Priority 1, 2 and 3, defined differently within each environmental discipline (biodiversity, air, noise, hydrology and surface water quality, and soil and groundwater) and detailed in the EIA.

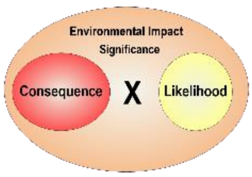
The assessment criteria for each parameter was established based on the similar sources of local and international guidelines or precedent reports and are detailed in the EIA.

### Baseline Data Collection

To establish the baseline conditions of the Study Area, pre-construction environmental baseline data was collected from both primary sources (e.g., on-site surface water and soil sampling, air and noise monitoring, site survey) and secondary sources (e.g., review of available environmental surveys, soil and groundwater baseline reports, publicly available data such as maps and weather data from online database, existing literature, books, etc.). Both primary and secondary sources of information were used to establish the baseline conditions of the Study Area of biodiversity, hydrology and surface water quality, soil and groundwater, air quality, and airborne noise.

### Prediction and Evaluation of Impact

Impacts were evaluated based on their significance, which is a measure of the weight that should be given to each impact in decision making and if it warrants impact management. It was assessed with consideration of two main factors: Impact Consequence and Likelihood of Occurrence.




Impact Consequence is a function of a range of considerations including impact spread, impact duration, impact intensity and nature, legal and guideline compliance. Likelihood of Occurrence refers to how likely an event would occur during the Project's construction and operational phases, which considers the probability of the event happening as well as duration of the event.

In general, a simple risk-based matrix was used for summation of Impact Consequence and Likelihood of

Occurrence as shown in *Figure 3*. The full definitions of impact assessment terms and methodology were detailed in the EIA.

| Consequence / Likelihood | Imperceptible | Very Low | Low | Medium | High |
|---|---|---|---|---|---|
| Unlikely/ Remote | Negligible | Negligible | Negligible | Negligible | Negligible |
| Less Likely/ Rare | Negligible | Negligible | Minor | Minor | Minor |
| Possible/ Occasional | Negligible | Minor | Minor | Moderate | Moderate |
| Likely/ Regular | Negligible | Minor | Moderate | Moderate | Major |
| Certain/ Continuous | Negligible | Minor | Moderate | Major | Major |

*Figure 3: Impact Significance Matrix*

## Impact Mitigation, Monitoring and Management

The mitigation, monitoring and management approach was defined in line with the NParks Biodiversity Impact Assessment (BIA) 2020, and the international risk assessment guidelines adopted in Singapore, as shown in *Figure 4*.

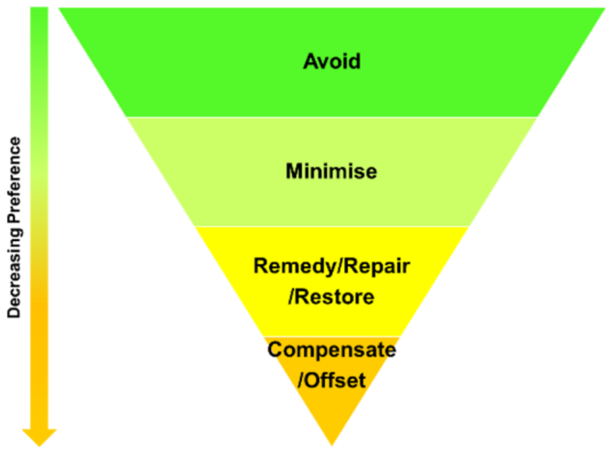



*Figure 4: Mitigation Hierarchy*

# Baseline Environment

## Biodiversity

The Study Area is largely non-vegetated and/or occupied by urban vegetation. These comprise more than 50% of the total area. One of the key findings is the rich and diverse native-dominated secondary forest. The largest continuous patch of native forest was recorded in Site C, but scattered fragments of equally diverse native patches were also recorded in all other sites. Altogether, native forest makes up close to 10% of the total area. The other habitat types recorded in the Study Area are abandoned-land forest, exotic-dominated secondary forest, scrubland, and waterbodies. The forested area of Site A is referred to as Eng Neo Avenue Forest and the forested area of Site C is referred to as Bukit Tinggi.

A total of 646 flora species were recorded in the Study Area, half of which are native species and approximately one-third are non-native species. Of these, 177 species were of conservation significance—occurring mainly in the native-dominated secondary forest. The native forest in Site C was the most diverse and concentrated with nationally threatened plants, with close to 100 threatened species recorded in this site alone. The forest also showed signs of maturity, as rare species like the *Daphniphyllum griffithianum* were fruiting and flowering during surveys. The *Vanilla griffithii*, which mainly grows in primary rainforests and freshwater swamp forests, which was thought to only exist within the CCNR in Singapore, was also recorded on site as two fairly large and healthy populations. Site A had the second highest concentration of threatened species, with up to 560 individuals and clusters of specimens recorded especially in the northern half of the Site. The rarer species include the Critically endangered *Memecylon floridum* and *Prunus arborea* var. *stipulacea*. Sites B, E and F had similar number of specimens of conservation significance (130 – 160 in each site). In Site B, some species of interest were found growing on a rain tree *(Samanea saman)*. This was the pteridophyte *Phlegmariurus carinatus, and a fern Asplenium nitidum.* Both were previously thought to be Nationally Extinct but recently re-classified as Critically Endangered in the latest Red Data Book 3. The largest specimen of the nationally endangered strangler, *Ficus kerkhovenii* was also recorded in Site B with a 14m wide girth. A notable species recorded in Site E is the nationally Critically Endangered climber, *Cyclea laxiflora.* It was fruiting and flowering throughout the strip of abandoned land forest near Swiss Road, which was the only forest in the Study Area where the species was recorded and widespread. Additionally, several large specimens of the slow-growing tembusu trees (*Cyrtophyllum fragrans)* with girths exceeding 3m were located across the Study Area and in the former golf course in Site E. Site D had the fewest number of conservation significance specimens in the whole Study Area, at only 20 counts, with many of species also existing in Site B.

A total of 407 fauna species were documented in the Study Area, dominated by birds (111 species) and butterflies (101 species). Of the recorded species, 25 were of conservation significance. Some species of conservation were found throughout the Study Area, such as the Critically Endangered Sunda pangolin (*Manis javanica),* the straw-headed bulbul (*Pycnonotus zeylanicus),* long-tailed macaque *(Macaca fascicularis*), long-tailed parakeet *(Psittacula longicauda)* and common birdwing *(Troides helena cerberus)*. The nationally threatened bamboo bats (*Tylonycteris sp*.) were also detected in most sites except Site D. Although the Sunda colugo (*Galeopterus variegatus*) is not a species of conservation significance, it was considered a notable species and was recorded across the Study Area, with the highest number of encounters in Site C. Site A recorded the highest number of fauna species likely due to it being the largest continuous forest, followed by Sites E, C, and B. Site A also recorded 18 fauna species of conservation significance, which is the highest across all sites. The stream and pond in Site A are home to several species of conservation significance such as the crescent betta (*Betta imbellis*) and most notably, a thriving population of Fiery coraltail (*Ceriagrion chaoi*) with up to 8 mating pairs observed. This was a significant sighting as this is an uncommon species in Singapore with a very limited reported distribution. Of the birds recorded, 24 were migratory/visitor, which includes a rare accidental visitor, the Sakhalin leaf warbler (*Phylloscopus borealoides)* in Site A. The brown shrike (*Lanius cristatus*) was a winter visitor that was recorded in Site E and is a nationally Vulnerable species. Other Near Threatened migratory birds recorded included the green-backed flycatcher (*Ficedula elisae*) in Site A, streaked bulbul (*Ixos malaccensis*) and orange-headed thrush (*Geokichla citrina*) in Site C, and Siberian blue robin (*Larvivora cyane*) in most of the sites. Overall, the Study Area's proximity to the Bukit Timah Nature Reserve and CCNR, and the presence of good habitat, gives it a good probability of expecting rare fauna species here.


*Figure 5: Photos of observed flora in the Study Area*


*Figure 6: Photos of observed fauna in the Study Area*

Based on the baseline findings, the majority of Sites A, C, and F, parts of Sites B, D and some of the vegetated patches in Site E (within the golf course and the linear strip of forest near Swiss Club Road) were classified as areas of high biodiversity value. These areas were identified as they contained a high density of conservation significant species, and/or sensitive habitats such as streams and native-dominated secondary forest. Taking into consideration the proposed preliminary land use as well as the areas of high biodiversity value, the recommended areas of conservation (RAC) are shown in *Figure 7*. The RAC focused on securing larger patches of forest, ensuring connectivity between retained forest, and creating a 100 m ecological corridor through the former golf course area that would connect Site A and Site C.

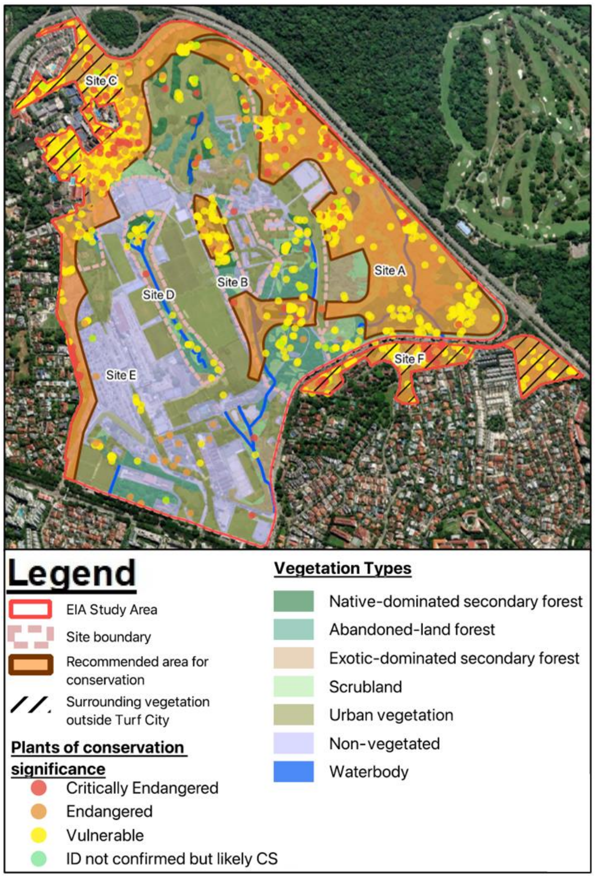



*Figure 7: Summary of Biodiversity Baseline Findings and Recommended Areas of Conservation in the Study Area*

## Hydrology and Surface Water Quality

The hydrological baseline survey aimed to identify watercourses present in the Study Area including their location, water flow conditions and bank characteristics. Based on topographic survey data, site survey as well as PUB's water catchment map, twenty-seven (27) catchments and sixteen (16) watercourses/bodies were identified within the Study Area (see *Figure 8*) and all water from the identified drains/streams in the Study Area eventually flow to Marina Reservoir, which stores water for drinking.

To study the baseline water quality within the Study Area, watercourses/bodies within the Study Area, two (2) dry and/or one (1) wet weather samples were taken from each of the thirty-five (35) locations at the watercourses/bodies within the Study Area, where possible. Water samples were tested for both physical and chemical parameters including temperature, pH, conductivity, turbidity, dissolved oxygen (DO), total dissolved solids (TDS), total nitrogen (TN), total phosphorous (TP), nitrates ($NO_3$-N), total ammonia nitrogen (TAN; $NH_4$-N and $NH_3$-N), orthophosphates ($PO_4$-P), total suspended solids (TSS), total organic carbon (TOC), metals (aluminium, antimony, arsenic, barium, beryllium, boron, cadmium, chromium, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, tin, and zinc), cyanide, sulphide and *Enterococcus*. Results were compared with both NEA discharge guidelines in Singapore and identified international criteria for aquatic life, which include guidelines/ criteria from various countries and organisations.

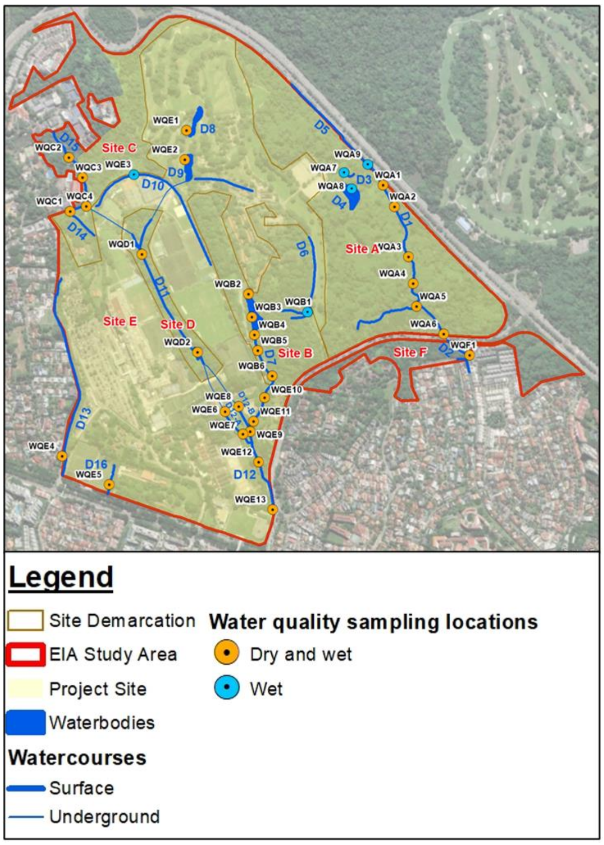



*Figure 8: Watercourses and Water Sampling Locations in Study Area*

## Site A

At Site A, an ephemeral natural stream (D1), unmanaged pond (D4), perennial earth drain (D3) and concrete drain (D5) were identified and sampled. Water samples in Site A generally had minimal exceedances of NEA Trade Effluent Discharge Limits (NEA Limits) and international aquatic life criteria (IALC). Phosphorus exceedances was observed at most locations, while metals aluminium, iron and manganese exceedances were occasionally observed. These are likely from the high nutrient content within the forest and from soil minerals respectively. Pond D4 had high amount of decomposing organic matter, contributing to its low DO and high TOC. Despite the exceedances within Site A, natural stream D1 and pond D4 was found to support aquatic life.

## Site B

One perennial roadside drain D6 and one naturalised stream D7 were identified and sampled in Site B. The roadside drain D6 collected runoff from the surrounding forest and only had aluminium exceedance, which could have come from natural soil. However, D7 had poorer water quality with more parameter exceedances, including high turbidity due to visible bacteria films, low DO as it has slow flow, and arsenic exceedance at its upstream location, which could be due to the vehicular emissions from the nearby Turf Club Road.

## Site C

One perennial earth drain D14 and one perennial naturalised stream D15 were identified and sampled in Site C. The waters in Site C were generally found to be of better quality with less exceedances in dry weather than in wet weather. In dry weather, low DO and high iron was observed in D14, which were likely observed together from iron-utilising bacteria, while for D15, pH was lower likely due to humic acids from the forest. In wet weather, metals copper, nickel and lead exceeded in a few locations, and could have come from traffic or infrastructure nearby. These watercourses have limited fauna, but are located within the high ecological value forest of Bukit Tinggi.

## Site D

One perennial man-made earth drain D11 exists in Site D, and was found to have high phosphorus and aluminium content, having likely come from forest nutrients and soils respectively. During wet weather, high TSS was detected. D11 is located within a ravine, and the high sediment runoff during storm events are likely the cause of the TSS increase.

## Site E

There are seven watercourses/bodies in Site E, each with their own water quality. These include two ponds located within the golf course, D8 and D9, one ephemeral roadside drain along Turf Club Road, D10, three perennial naturalised streams, D7 (coming from Site B), D12, (which also merges with D7) and D16 (along Merlion Sports Field), and one perennial concrete drain D13 near Swiss Club Road. Aluminium and iron exceeded at some locations within the site, and may be leaching from natural soil minerals. There was also generally high phosphate content measured in the water, except at the drains which collect water from lesser/minimally forested areas (i.e. D10 and D13), implying that the phosphates were mainly coming from the forested areas. Consequently, there was high TP at some of the monitoring locations. Low DO occured frequently where the watercourses were close to stagnant, including the ponds D8 and D9 in dry weather.

### Site F

Only one concrete drain D2 was identified and sampled in Site F. The water was generally clear but found to have arsenic, iron, aluminium and phosphate exceedance. As D2 collects water from both natural stream D1 in Site A as well as runoff from drains along roads such as Eng Neo Avenue, it is possible that arsenic could have originated from the vehicular emissions, while the phosphate was likely to have originated from the natural stream D1 in forested areas of Site A. On the other hand, aluminium was likely leaching from natural soil.

## Soil and Groundwater

The soil profile underneath the Study Area generally consisted of clayey silt, with layers of silt and silty sand encountered.

Soil samples were collected from three locations within the site. The soil samples were tested against the Dutch Intervention Values (DIVs). As no groundwater samples were collected and tested, existing groundwater data from 17 monitoring wells from previous studies of the Study Area were analysed.

Metals (i.e., arsenic, antimony, barium, cadmium, chromium, cobalt, copper, mercury, lead, molybdenum, nickel and zinc), polyaromatic hydrocarbon (PAHs) fluoranthene, and other pollutants (dibutylphthalate (DBP) and di(2-ethylhexyl)phthalate (DEHP) and total petroleum hydrocarbons (TPHs) (i.e. C10 – C36, mineral oils) were detected in soil samples from the Study Area, but were all below their respective DIVs. Hence, the soil does not pose potentially unacceptable risks to future construction workers and residents of the proposed development. The sources of these detections cannot be ascertained but may have come about due to the site's historical land use.

For groundwater, all metals were above reporting limit. However, only two samples had DIVs exceedances for lead. TPH ($C_{10}$-$C_{14}$ and $C_{15}$-$C_{28}$) were above the reporting limit in some groundwater samples, although none of the detections exceeded the DIVs. As the recent land use of the Study Area was non-pollutive it is possible that the TPH detections are from historical activities. It should also be noted that the reported metals are also naturally occurring elements in the environment. Overall, the groundwater analytical results do not indicate presence of unacceptable risk to humans (and ecology) and are likely background levels.

## Air Quality

In order to assess the current baseline air quality in the Study Area, primary baseline air quality data was collected from eleven (11) monitoring locations for 1 week (see *Figure 9*). The air quality ranged from 12.0 – 44.4 µg/m$^3$ and for $PM_{10}$, which complied with Singapore Ambient Air Quality Long Term Target (50 µg/m$^3$). The average $PM_{2.5}$ was in compliance with Singapore Ambient Air Quality Long Term Target (25 µg/m$^3$). However, $PM_{2.5}$ air quality ranged from 7.7 – 25.9 µg/m$^3$, with the maximum concentration of 24-hour average $PM_{2.5}$ at AQ01, AQ04, AQ05 and AQ07 exceeding the Singapore Ambient Air Quality Long Term Target. This may be due to traffic emissions near to the monitoring locations.

Additionally, secondary air quality monitoring data from a previous study was collected from one (1) location within the Study Area (see *Figure 9*). Ambient air quality ranged from 14.6 – 25.5 µg/m$^3$ and 10.0 – 16.9 µg/m$^3$ for $PM_{10}$ and $PM_{2.5}$ concentration respectively. Both are in compliance with the Singapore Ambient Air Quality Long Term Targets.

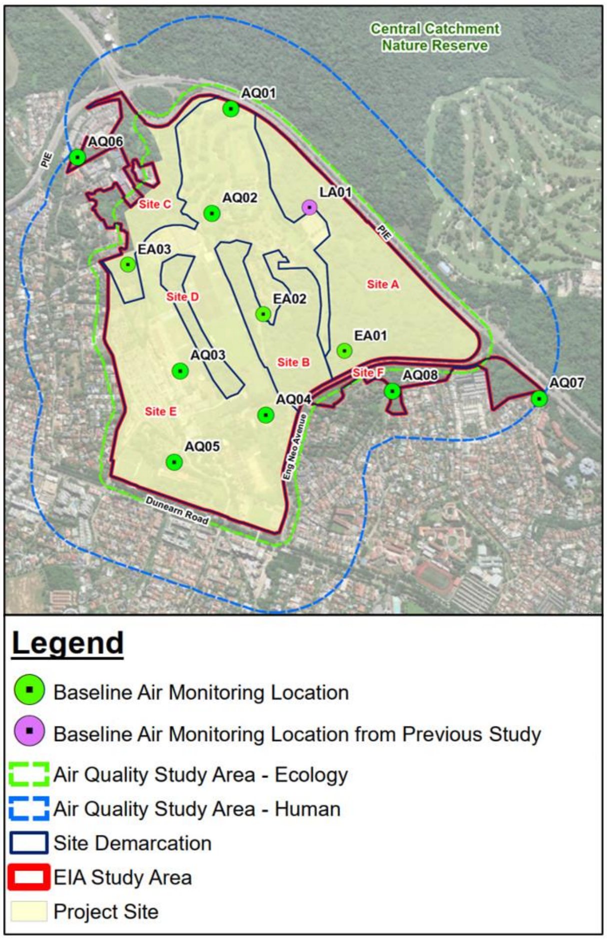



*Figure 9: Air Baseline Monitoring in the Study Area*

## Airborne Noise

Baseline noise monitoring was carried out at sixteen (16) locations, in the vicinity of the Study Area. An additional four (4) monitoring locations were secondary sources extracted from previous studies as baseline references (see *Figure 10*). Sound level meters were used to record the baseline noise levels over time periods of 12 hours (long term), 1 hour, 15 minutes and 5 minutes (short term) at each location. This pre-construction baseline serves to develop the specific construction and operation noise criteria for this Project.

Twelve (12) monitoring locations had noise levels less than 60 dB(A) during both day and night-time, and the monitoring locations that exceeded this value (NN01 and NN05) were mainly due to nearby vehicular traffic (PIE and Dunearn Road). Generally, majority of the monitoring locations recorded higher noise levels in the day than at night, except NM04 which had higher noise levels at night. This monitoring location was located near the former Champions Golf Academy and British Club, and had more visitors in the evening and night time than in the day time. The average baseline noise levels for weekdays 7am – 7pm were recorded at $L_{eq(12hours)}$ 48 – 68 dB(A) and $L_{eq(5mins)}$ 47 – 67 dB.

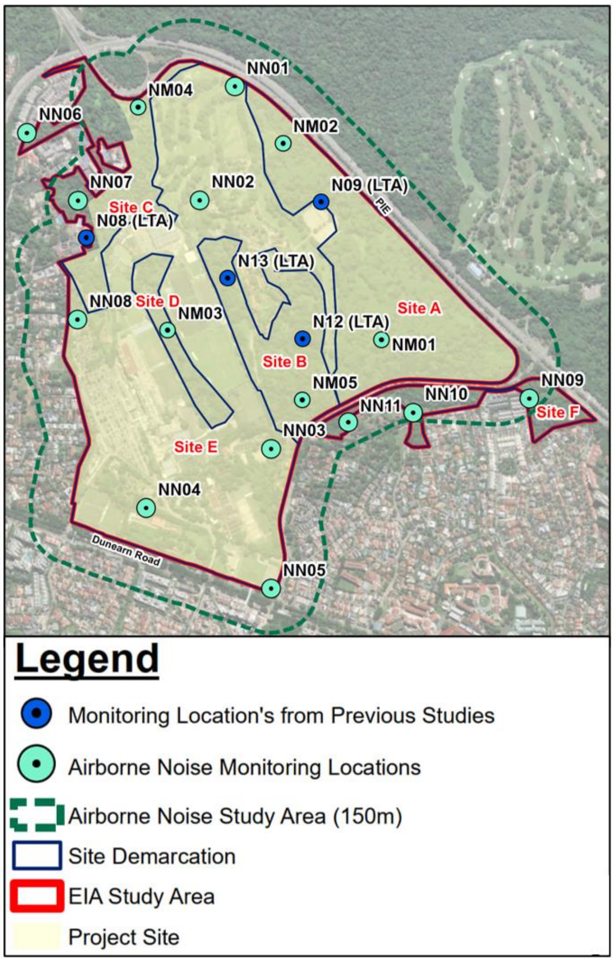



*Figure 10: Noise Baseline Monitoring in the Study Area*

# Minimum Controls

Minimum controls are non-site-specific measures which comprise of common best site practices mandatory for implementation at all construction worksites, as well as basic practices required under local regulations and guidelines. As per the impact assessment methodology, minimum control measures were considered as the basis of impact prediction and evaluation. In other words, the impact of all assessed environmental parameters in the EIA was first evaluated based on the proposed preliminary land use plan, along with the consideration of minimum controls (sometimes known as upstream mitigation measures). The additional mitigation measures proposed for environmental parameters with **Moderate** and **Major** impacts were then incorporated as part of the residual impact assessment, where relevant.

## Key Minimum Controls in Construction Phase

A list of minimum control measures was summarised for each assessed environmental parameter in the EIA, in which some key examples for construction phase are listed below:

- Prepare Safety Operational Procedures (SOPs) and Emergency Response Plans on site, which include Wildlife Response Plan, Noise Management Plan (NMP), Erosion Control Measures (ECM) plan, Air Pollution Control Plan (APCP) and other plans (e.g., for chemical storage and handling, waste storage and handling, etc.) to avoid and minimise environmental impacts. A quantitative noise impact assessment should be conducted once detailed construction information is available to help develop the noise management plan;
- Hoarding of construction sites on all sides;
- Engage arborists, flora and fauna specialists to clearly mark out the Tree Protection Zones, identify plants with conservation value and wildlife or nesting structures that are active before the start of works;
- Engage a qualified erosion control professional (QECP) to formulate and implement an ECM plan (e.g., install silt fences along site hoarding) in accordance with PUB requirements to eliminate risk of discharging construction wastewater into natural streams, where the robust ECM plan should include but not be limited to:
  - Practice due diligence in proper handling and storage of all construction wastes including hazardous wastewater (e.g., oily wastewater, thinners, solvents, paints from surface run-off and machinery), as well as ensure proper disposal by authorised dealers or licensed waste collectors;
  - Install CCTV monitoring including Silty Imagery Detection System (SIDS) at the public drains to monitor surface run-off discharge to these drains;
  - Include ECM tanks/ponds prior to discharge of treated effluent (only storm water runoff); treated water to be tested prior to discharge;
  - Design adequate drainage, cut off drains, sump pit, road kerb, piping and toe wall for channelling of construction process wastewater and storm runoff separately.
- Design and implement proper Earth Retaining Stabilizing Structures to limit impact from unstable slopes and groundwater settlement;

- Use only approved materials for backfilling works;
- Implement Reduce, Reuse and Recycle hierarchy for solid waste and wastewater generated onsite; and
- Adopt construction methods and use construction equipment that generate less noise and dust, which include but are not limited to the following:
  - Construct paved access roads where possible before starting work on site;
  - Reduce the number of operating powered mechanical equipment (PME) used. The operating schedule should also be optimised to minimise intermittent noise from machines; and
  - Direct equipment emitting directional noise away from ecologically sensitive receptors.

### Key Minimum Controls in Operational Phase

Similarly, some key examples of minimum controls for the operational phase are listed below:

- Permanent drainage systems should be designed in accordance with the requirements in PUB's Code of Practice on Surface Water Drainage.
- 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., as well as eventual discharge of treated water;
- Proper handling, storage and disposal of hazardous and non-hazardous new or used chemicals during operational process. Provide spill kit where necessary;
- Acoustic enclosures should be provided for outdoor equipment; and
- Use of low-noise pavement mix for sections of new road networks near noise-sensitive receptors.

## Impact Assessment Findings

### Overview of Impact Assessment

In summary, the impact of all assessed environmental parameters in the EIA was first evaluated based on the proposed preliminary land use plan, along with the consideration of minimum controls. Thereafter, additional mitigation measures (including mitigated scenarios of worksites) were provided for **Moderate** and **Major** impacts and incorporated as part of the residual impact assessment, where relevant.

### Biodiversity

*Table 1: Summary of Biodiversity Impact Assessment*

| Sensitive Receptor | Impact Significance with Minimum Controls | Residual Impact Significance with Mitigation Measures (if required) |
|---|---|---|
| **Construction Phase** | | |
| Habitat | Negligible to Major | Negligible to Major |
| Flora | Minor to Major | Negligible |
| Fauna | Moderate to Major | Negligible to Major |
| **Operational Phase** | | |
| Habitat | Negligible to Major | Negligible to Moderate |
| Flora | - | - |
| Fauna | Negligible to Major | Negligible to Moderate |

Following the mitigation hierarchy, design optimisation was applied to further avoid or minimise impact to ecologically sensitive receivers. Where such impact could not be avoided, minimisation and compensatory measures were applied. Areas of high biodiversity concentration were avoided where possible and demarcated as recommended areas for conservation (RAC) in *Figure 7*. If there should be a need to develop within the RAC, development should be in less sensitive habitats with a suitable buffer from waterbodies.

During construction phase, it was deduced that there would be some **Major** impacts to habitats, primarily due to the loss of habitat in native-dominated secondary forest and abandoned land forest. It was also deduced that there would be Moderate impacts to habitats arising from the formation of edge effects. Site inspections to ensure no unauthorised vegetation removal outside the agreed working space would be an important mitigation measure to reduce the impact of habitat degradation and formation of edge effect.

It was also deduced that there would be some **Major** impacts to flora during construction due to mortality as 37 species of conservation significance are located within the proposed worksite. Removal of plants of conservation significance should be avoided. Where the retention of plants is not possible, such plants should be salvaged where possible to reduce impacts on flora due to mortality.

It was deduced that there would be some **Major** impacts to fauna during construction as well, due to accidental injury or mortality, loss of/reduction in habitats and food sources, and light disturbance. To mitigate against accidental injury or mortality, road calming measures near forested site, directional site clearance and biodiversity awareness training should be conducted for site personnel who may encounter wildlife. Construction sites should also have proper waste management plans such as securing dustbins near forested area to reduce the risk of human-wildlife conflict. Habitat enhancement and creation could mitigate some loss in habitats and food sources. Night works should be avoided. If night works are unavoidable, lighting strategies such as pointing light away from the forest and avoiding broad spectrum lights would also reduce the potential **Major** impacts from light disturbance to **Minor**.

During the operational phase, it was deduced that the risk of introducing exotic species to the native-dominated secondary forest could bring about **Major** impact on the habitat receptor. Impacts from habitat degradation are expected to have a **Moderate** impact on some of the habitat types. No potential impacts to flora could be assessed, as impacts during operational phase could arise due to multiple events not relating to this development. Therefore, it would not be feasible to assess if impacts were resultant from the development or other unrelated events. Light-sensitive fauna may experience **Major** impacts from light disturbance during the operational phase as well as other **Moderate** impacts from accidental injury, human-wildlife conflict, loss of ecological connectivity and poaching.

For both the fauna and habitat, mitigation measures targeting the operation of parks and nature trails include the installation of educational signboards to educate visitors on the appropriate behaviour when visiting the park and conducting random patrols to deter unwanted behaviours such as straying off trails. Near the retained forest, important mitigation measures include having bird-friendly building designs, implementing road calming measures, making use of lighting strategies to reduce light disturbance, and keeping building heights low.

Mitigation measures specific to certain fauna species are also recommended. For the straw-headed bulbul (*Pycnonotus zeylanicus*), fruit and fig trees are important food source that should be retained where possible. These species could also form part of the native planting palette during replanting works. The long-tailed macaque (*Macaca fascicularis*) is highly adapted to urban areas and often involved in human-wildlife conflict. To avoid such conflicts, various macaque-proof building designs could be incorporated, such as having smooth pillars and invisible grills on balconies, to prevent entry into residential areas. Paired with proper waste management and educating residents on the dos and don’ts, conflicts with this species could be reduced. Otters are another species that have adapted to the urban environment giving rise to human-wildlife conflict. Otter-proofing housing premises with fencing, particularly in areas with fishponds, could reduce such incidents.

Apart from the mitigation measures mentioned above, it is important to maintain ecological connectivity both within the Project Site and outside the Project Site. Therefore, the following mitigation measures were recommended (1) developing a 100 m ecological corridor in the northern periphery of the Study Area which would connect the forests in Site A and Site C, (2) having grade-separated crossings at selected areas to allow fauna movement under roads, (3) incorporating urban greenery through streetscape and planting flowering shrubs, (4) studying possible connectivity with CCNR and RRNP potentially via an ecolink and culverts respectively, and (5) installing of connectivity structures such as colugo poles and culverts to facilitate fauna movement across Eng Neo Avenue and within the 100 m ecological corridor.

As the CRL construction works have already been accounted for within the proposed preliminary land use plan of the Project Site, there would be no additional impacts for habitat loss and flora mortality. However, there would be an increase in air and noise disturbances, but this could be mitigated through proper directional site clearance (towards retained forest) and phasing of construction works. Overall, the cumulative impacts would not significantly increase. During the operational phase, the increase in traffic, light and noise from the CR14 MRT station could result in a slight increase in impact to fauna within the Study Area.

## Hydrology and Surface Water Quality

*Table 2: Summary of Hydrology and Water Quality Impact Assessment*

| Sensitive Receptor | Impact Significance with Minimum Controls | Residual Impact Significance with Mitigation Measures (if required) |
|---|---|---|
| **Construction Phase** | | |
| Hydrology (Human) | Negligible | N.A. |
| Hydrology (Ecology) | Minor to Major | Minor |
| Water Quality (Human) | Negligible | N.A. |
| Water Quality (Ecology) | Negligible to Major | Negligible to Moderate |
| **Operational Phase** | | |
| Hydrology (Human) | Minor | N.A. |
| Hydrology (Ecology) | Minor to Major | Minor |
| Water Quality (Human) | Negligible to Minor | N.A. |
| Water Quality (Ecology) | Negligible to Minor | N.A. |

**Note:**
N.A. – Not Applicable; no Moderate or Major Impacts have been identified, hence no mitigation measures proposed beyond minimum controls

During the construction phase, it was deduced that the potential sources of hydrology and surface water quality impacts would mainly be from changes in land use, surface run-off from construction site, wastewater construction activities, improper handling during storage and disposal of solid wastes and liquid wastes, accidental spill and leaks from domestic wastes.

During the operational phase, it was deduced that the potential sources of hydrology and surface water quality impacts would mainly be from stormwater run-off which contains pollutants built-up in the new developed area during heavy rain events, improper management of liquid and solid wastes, increased runoff peak flow that drains into the stream or drains during storm events, as well as reduced baseflow (i.e. sub-surface water discharge) due to a change in land use of the new development.

The ecological receptors for hydrology and water quality were identified to be retained watercourses/bodies with ecological significance; namely natural stream D1 and unmanaged pond D4 in Eng Neo Avenue Forest, naturalised stream D7 next to Turf Club Road, and naturalised stream D15 and earth drain D14 within Bukit Tinggi. The human receptors were identified to be all local residents and visitors for surface water quality, while for hydrology it was future residents and visitors in the vicinity of the Project Site.

During the construction phase, site clearance would occur, together with modifications to the existing terrain to match proposed platform levels. This could alter water catchments within the Project Site. Hence, the Impact Significance for hydrology on ecological receptors were assessed to be **Minor to Major**. As such, clean water from elsewhere was proposed to be directed to significantly affected catchments (D4, D7, and D14) as a mitigation measure. This would reduce the Impact Significance for hydrology on ecological receptors to **Minor**. The construction worksite located nearby and on top of retained watercourses/bodies could also pose a contamination risk to the retained watercourses/bodies, and as such, the Impact Significance for water quality on ecological receptors was assessed to be **Negligible to Major**. Thus, mitigation measures including (1) providing a berm structure where worksites exist over tributaries of retained watercourses (watercourses D1 and D14), (2) providing completed drain diversion to retained watercourses (D7) prior to its connection and providing silt curtains or equivalent during the connection, and (3) preventing any discharge from the construction sites from entering the retained ecologically sensitive watercourses (watercourses/body D1, D4, D7, D14 and D15). Additionally, as silty discharge is often observed at construction sites, tarps or other coverings are recommended to be on standby near bare soil in case of rain, so that they may quickly be covered to prevent silty runoff. This could reduce the Impact Significance for water quality on ecological receptors to **Negligible to Moderate**. **Moderate** impacts would still be expected on naturalised stream D7 due to the direct construction on top of its downstream section. For human impacts, the minimum controls such as ECM, proper SOP for solid, liquid, waste and chemicals management, and peak runoff reduction through detention ponds or similar, were assessed to be sufficient for the Impact Significance on hydrology and water quality to remain at **Negligible**.

During the operational phase, it was deduced that the altered topology and hence water catchments of the Project Site would cause **Minor to Major** Impact Significance for hydrology on ecological receptors. Similar to the construction phase, clean water is proposed to be directed into affected watercourses/bodies (D4, D7 and D14) to lower the Impact Significance down to **Minor**. Human receptors were assessed to experience **Minor** Impact Significance for hydrology as the minimum controls of drainage designs with sufficient capacity should be incorporated to prevent flooding. For water quality, the minimum controls (e.g. SOP for management of solid and liquid wastes) were assessed to be sufficient to maintain a **Minor** or **Negligible** Impact Significance on ecology and human.

CRL construction works and this Project are not expected to occur concurrently in the same location/vicinity, and hence would not affect the same watercourses concurrently. Hence, there would be no cumulative impacts.

## Soil and Groundwater

*Table 3: Summary of Soil and Groundwater Impact Assessment*

| Potential Source of Impact | Impact Significance with Minimum Control | Residual Impact Significance with Mitigation Measures (if required) |
|---|---|---|
| **Construction Phase** | | |
| Soil and groundwater contamination due to seepage of contaminants originating from excavated soil, extracted groundwater, chemicals and waste stored on the site | • Human: Negligible to Minor<br>• Ecological: Minor | N.A. |
| **Operational Phase** | | |
| Soil contamination due to seepage and leakage of contaminants originating from generated waste and chemicals stored and/or used on the site | • Human: Minor<br>• Ecological: Negligible to Minor | N.A. |
| **Note:** N.A. – Not Applicable; no Moderate or Major Impacts have been identified, hence no mitigation measures proposed beyond minimum controls | | |

Minimum control measures for soil and groundwater which are commonly implemented in Singapore have been included as part of measures implemented prior to the impact assessment. Regular inspection and workers' training must be conducted to ensure these measures are inculcated in the behavior and practice of all the staff on site.

The potential impacts on soil resources associated with the activities conducted during the construction phase of the Project include intrusive activities such as excavation as well as potential use of imported backfill soil. Soil and groundwater quality could also be affected due to seepage of contaminants from excavated contaminated soil (if encountered) or extracted groundwater, soil erosion, surface runoff as well as leakage of toxic chemical waste and chemicals. As the baseline study has shown that the soil and groundwater do not pose potentially unacceptable risks, it is deduced that there is likely to be **Negligible to Minor** Impact Significance on human receptors and **Minor** Impact Significance to ecological receptors. This is because the minimum controls, such as periodical removal of excavated soil and debris, and a proper SOP and storage of chemicals is sufficient to minimise impacts. Additionally, the limited quantity of toxic wastes on site would prevent excessive spillage, making it unlikely to reach ecological receptors located further away.

During the operational phase of the Project, it is anticipated that the impact on soil quality would be limited as use of chemicals and generation of toxic chemical waste is expected to be of limited quantities. Increase of impervious surfaces within the Project Site are expected to reduce potential for contamination of underlying soil and groundwater from aboveground sources. Hence, Impact Significance during operational phase would be **Minor** to human receptors and **Negligible to Minor** to ecological receptors.

As the impacts during both construction and operational phase of the Project would be **Negligible to Minor**, no additional mitigation measures were proposed.

The concurrent CRL construction works will result in impacts that are not significantly different that those of the Project. With the minimum controls, cumulative impacts from both worksites would be adequately addressed.

## Air Quality

*Table 4: Summary of Air Quality Impact Assessment*

| Potential Source of Impact | Impact Significance with Minimum Control | Residual Impact Significance with Mitigation Measures (if required) |
|---|---|---|
| **Construction Phase** | | |
| Dust emissions generated by earthworks processes and construction of new structures, as well as from the transport of dust and dirt by dumper trucks (trackout) | • Human: Moderate to Major<br>• Ecological: Major | Minor |
| **Operational Phase** | | |
| Gaseous and particulate emissions from vehicle exhaust due to the increased traffic | • Human: Minor<br>• Ecological: Minor | N.A. |
| **Note:**<br>N.A. – Not Applicable; no Moderate or Major Impacts have been identified, hence no mitigation measures proposed beyond minimum controls | | |

During construction phase, potential impacts to the neighbouring sensitive receptors mainly include emissions from the heavy vehicular exhaust and dust emitted from the demolition, earthworks, construction and trackout activities. During the operational phase, emissions from vehicle exhaust due to increased traffic in the vicinity of the proposed development were identified as the predominant air emission source.

Air quality impact assessment for construction phase were undertaken in accordance with the UK IAQM Guidance on the Assessment of Dust from Demolition and Construction. Pursuant to which, 50m and 350m Assessment Area for ecological and human receptors respectively were considered for demolition, earthworks, construction and trackout activities. Dust generated during construction works could have adverse effects upon vegetation restricting photosynthesis, respiration, and transpiration. Furthermore, it could lead to phytotoxic gaseous pollutants penetrating the plants. The overall effect could be a decline in plant productivity. For human receptors, the dust and gaseous emissions might cause respiratory problems and diseases in human health.

The results of the assessment deduced that unmitigated impacts were classified as **Moderate to Major** on human receptors, **Major** on ecological receptors, and would have the potential to affect the receptors near the construction footprint unless mitigation measures are put in place. This was largely because of the large extent of the construction worksite located very close to the neighbouring sensitive human and ecological receptors. The EIA report pulled together mitigation measures that could be implemented by the contractor as administrative or management measures, sourcing from best practice measures internationally, which when applied successfully, the Impact Significance was anticipated to be reduced to **Minor**. The key control and mitigation measures include but are not limited to development and stringent implementation of air pollution control plan, dust control measures on site, site hoarding, planning of dust causing activities-location and timing, reinstating land upon completion of works amongst several others.

The construction contractor is recommended to prepare an air quality management plan incorporating a range of monitoring and mitigation measures as detailed in the EIA.

During the operational phase of the Project, it is anticipated that there will be an insignificant increase in air quality pollutant levels in the vicinity of proposed project, considering the implementation of Euro emission standard on new vehicles and current large traffic volume along existing roads. Moreover, some green areas will not be disturbed by the project. Hence, impacts during operational phase are **Minor** to both ecological receptors and human receptors.

As the impacts during operational phase of the Project on receptors are **Minor**, no additional mitigation measures have been proposed, hence the residual Impact Significance is **N.A.** (Not Applicable).

The concurrent CRL construction works during the Project will result in a larger worksite, and hence may result in higher impact. Hence, the cumulative construction impact will remain as **Moderate to Major**. Upon strict implementation of mitigation measures detailed in the EIA, the Impact Significance may be reduced to be **Minor to Moderate**. For operational phase, as the CR14 MRT Station is expected to result in an overall decrease in traffic volume in the Project Site by providing alternative transport modes to future residents apart from private vehicles, the cumulative operational impact is expected to be **Minor**, while taking into consideration the usage of electric trains which will not result in air quality impact.

## Airborne Noise

*Table 5: Summary of Airborne Noise Impact Assessment*

| Sensitive Receptor | Impact Significance with Minimum Control | Residual Impact Significance with Mitigation Measures (if required) |
|---|---|---|
| **Construction Phase** | | |
| Ecological Receptors | Moderate to Major | Moderate to Major |
| Human Receptors | Negligible to Major | Negligible to Major |
| **Operational Phase** | | |
| Ecological Receptors | Negligible to Minor | N.A. |
| Human Receptors | Negligible to Minor | N.A. |
| Note:<br>N.A. – Not Applicable; no Moderate or Major Impacts have been identified, hence no mitigation measures proposed beyond minimum controls | | |

Noise impact from the construction and operation of the proposed project were assessed on noise sensitive receptors (NSRs) in the vicinity of the Study Area.

For the construction phase, qualitative noise impact assessment was carried out for the worst-case noisiest construction activity deduced as **Construction Activity 1: Foundation and Earthworks**, deduced based on the construction activities and construction schedules to assess noise impact arising from proposed developments within the proposed construction worksites. This assessment was divided to assess the impact on both ecological and human receptors with both receptors separated into distinct groups aimed at providing fair assessment of noise impact on receptors subjected to different conditions. The airborne noise assessment area for the construction phase was defined as 150 m from the Project proposed construction worksite viz Project Site.

AECOM strove to develop project-specific construction noise criteria through baseline monitoring and analysis to identify $L_{Aeq(12\ hours)}$, $L_{Aeq(1\ hour)}$ and $L_{Aeq(5\ mins)}$ baseline noise levels and therefore develop the corresponding criteria that need to be met at construction stage. The Project-specific construction noise criteria were used to inform the noise impact assessment to assess noise impact arising from construction activities on the NSRs. As the project is in the master planning stage only, the construction methodology is not yet determined, and hence only qualitative noise impact assessment was carried out in this report. Hence, when the design firms up in the detailed design stage, AECOM recommends appointing Noise Consultant(s) by the developer/ developing agent to conduct quantitative studies on construction noise impact assessment.

Following the agreement to conduct qualitative noise impact assessment at this stage, an assessment matrix relating the perceivability and noticeability of noise emissions to the Impact Intensity of noise experienced by the NSRs were defined for ecological and human receptors respectively. As discussed in the EIA, the distance of receptors to the proposed construction worksites (i.e. noise source) as well as overall effective sound power levels of the powered mechanical equipment involved in **Construction Activity 1: Foundation and Earthworks** were considered as a gauge to determine how perceivable and noticeable noise levels would be experienced by the different receptors at varying locations with considerations of current existing conditions such as existing road noise.

With the considerations of current pre-existing conditions and noise contributing factors from **Construction Activity 1: Foundation and Earthworks**, the Impact Intensity was qualitatively assessed as **High** for ecological receptors. This corresponds to overall Impact Consequences to be from **Low to High.** When assessing the Impact Consequence in relation to the Likelihood of Occurrence being **Certain/Continuous**, it was deduced that the maximum overall Impact Significance stemming from the proposed construction activities associated with the assessment scenario **(Construction Activity 1: Foundation and Earthworks**) would fall within the range of **Moderate to Major.**

Considering the shortest distances between the human receptors and the overall construction worksites along with the corresponding sensitivities of the receptors, the Impact Intensities were deduced as **Negligible to Low**. These Impact Intensities corresponded to Impact Consequence from **Imperceptible to High.** When assessing the Impact Consequence in relation to the Likelihood of Occurrence being **Certain/Continuous**, it was deduced that the maximum overall Impact Significance stemming from the proposed construction activities associated with the assessment scenario **(Construction Activity 1: Foundation and Earthworks**) would fall within the range of **Negligible to Major.**

Various mitigation strategies, including constructing buildings of varying heights, installing noise barriers, and implementing noise control at the source, have been proposed. However, it is anticipated that despite the implementation of the noise barriers, the reduction in noise levels experienced by NSRs will be minimal. The lack of effectiveness of noise barriers to achieve a significant noise reduction is due to the barriers' incapacity to completely block the direct line of sight to the intended construction areas, which is caused by the close proximity of these sites to NSRs. Consequently, the expected Impact Significance is unlikely to be altered. However, due to limited information being available during this preliminary phase, accurately estimating the noise reduction provided by noise barriers is not feasible. AECOM recommends that quantitative noise impact assessment with and without barrier through noise modelling by a 3D simulating software such as SoundPLAN and CadnaA be conducted by Noise Consultant(s) appointed by Contractor (s) be it roadworks/ earthworks/ construction contractor prior to commencement of construction works as required by NEA regulations for human impacts on residents, but also for ecological receptors and embed that part in the contract-specific EMMP for this Project site to be submitted to NParks before commencement of construction works.

As part of qualitative impact assessment for operational noise impact on ecological and human receptors, the Impact Intensity was deduced to be **Negligible** with corresponding Impact Consequence determined to range from **Imperceptible to Very Low**. The consequent Impact Significance of operational noise on ecological and human receptors were deduced to range from **Negligible to Minor** following a **Possible/Occasional** likelihood dependant on human activities and frequency of use of ACMV systems and roads. It should be noted that this qualitative assessment for operational phase is not definitive and as re-emphasised, it is mandatory for proposed developments to comply with NEA's guidelines. Hence, AECOM recommends that the developer/ developing agent to perform installations of ACMV systems at later stages of the Project development, conduct a boundary noise impact assessment and monitoring at the operational stage for non-industrial buildings with ACMV systems in accordance with NEA regulations.

The concurrent CRL construction works during the Project will result in a larger worksite, and hence may result in higher impact. Hence, the cumulative construction impact will remain as **Negligible to Major**. As the activities of the operational phase of the CR14 MRT station are not significantly different than that of the Project's operational phase, the cumulative operational impact is expected to be **Negligible to Minor**.

# Environmental Monitoring & Management Plan (EMMP)

## Overview

An EMMP was proposed to monitor and manage environmental impacts of the construction and operational phases associated with the Project. The EMMP also aimed to provide an overall picture of the potential roles and responsibilities required during each phase of the Project. The coverage of the proposed EMMP involved environmental parameters that were assessed in this EIA study, namely biodiversity, hydrology and surface water quality, soil and groundwater, air quality, and airborne noise. The EMMP details how recommended mitigation measures prepared for the impact assessment are to be implemented and specifies recommended monitoring measures to assess the effectiveness of the mitigation measures.

## EMMP for Construction Phase

The proposed EMMP before and during the construction phase includes the following, but not limited to:

- Flora and fauna monitoring and management programme includes items such as conducting pre-site clearance inspection (including pre-felling tree inspections) to minimise fauna injury and mortality during site clearance, monitoring of vegetation along the hoarding line for unauthorised vegetation clearance and forest edge effects, enacting wildlife response plan when trapped/dead/dangerous animals are encountered around or within the worksite, identifying gaps in hoarding to be patched up, reporting any improper disposal or storage of food, and any degradation of adjacent sensitive habitats, monitoring of fauna through diurnal and nocturnal surveys at sites near retained forest etc;
- Arboriculture monitoring programme to monitor the condition of trees at the new forest edge, determine the physiological health and structural stability of trees as edge effects, inspect the integrity of TPZs and the condition of retained trees to determine if trees with poor health require removal;

*Figure 11: Example of Flora Monitoring Along Hoarding*

- Environmental Control Officer on site to conduct daily roadkill surveys along roads adjacent to the worksite, inspect hoarding and perimeter drains daily to ensure no discharge of untreated surface runoff and no clogging;
- Perform site inspection during heavy storm event to ensure no flooding;
- Weekly monitoring records of toxic chemical waste generation and inspection of storage conditions;
- Perform online real-time monitoring for TSS, as well as conduct in-situ water quality monitoring for the remaining in-situ parameters (i.e., Temperature, pH, Conductivity, TDS and DO) at discharge points of construction sites (suggested monthly) and at the retained sensitive watercourses/bodies nearby construction sites (e.g. natural stream D1 and pond D4 in Eng Neo Avenue Forest, earth drain D14 in Bukit Tinggi, and naturalised stream D7) throughout construction period;
- Perform ex-situ water quality monitoring for all the ex-situ parameters (i.e., $BOD_5$, COD, TN, Nitrates, TAN, TP, Orthophosphates, Oil and Grease Total, Oil and Grease (Hydrocarbon), Lead, Zinc, Mercury, Aluminium, Antimony, Arsenic, Barium. Beryllium, Boron, Cadmium, Chromium, copper, Cyanide, Iron, Manganese, Molybdenum, Nickel, Selenium, Silver, Sulphide, Tin, *Enterococcus*, TOC), at discharge points of construction sites (suggested monthly) and at the nearby retained sensitive watercourses;
- Perform monitoring of $PM_{10}$ and $PM_{2.5}$ at recommended locations (detailed in the EIA), 1 week prior to site clearance, averaged over 1-day period and continuous monitoring of during site clearance and earthworks and bi-annual monthly monitoring during roadworks and building construction works;
- Conduct quantitative noise impact assessment at the detailed design stage; and
- Perform continuous airborne noise monitoring of $L_{Aeq(12\ hours)}$, $L_{Aeq(1\ hour)}$, and $L_{Aeq(5\ min)}$ throughout the construction period at the recommended locations (detailed in the EIA).

## EMMP for Operational Phase

The proposed EMMP during operational phase include but not limited to:

- In general, regular site inspection and environmental audit during the start of the operational phase, especially on:
  - Drainage system within and in the vicinity of the facility building, especially during heavy storm event;
  - Log of waste generation and condition of storage of hazardous chemicals;
- Regular monthly inspections for both flora and fauna (within Bukit Timah Turf City and in adjacent forests) in the first year of operational phase to be conducted to evaluate any impact from the development;
- Monthly water quality monitoring (temperature, pH, conductivity, TDS, TSS, Turbidity, DO, $BOD_5$, COD, TAN, TN, Nitrates, TP, Orthophosphates, TOC, Lead and *Enterococcus*) at retained sensitive watercourses/ bodies (D4 and D7) for the first three months; and
- Perform noise impact assessment for noises arising from operational phase related activities such as air conditioning and mechanical ventilation and traffic as a part of the detailed design process of the Project in accordance with the NEA guidelines.

The detailed lists of EMMP for construction and operational phases are provided in the EIA.

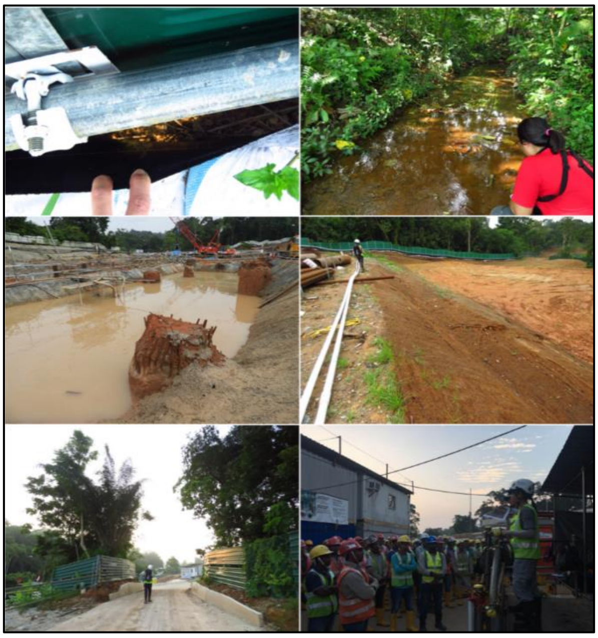


*Figure 12: Examples of Photographs Showing Monthly Monitoring and Inspection On-site*

## Conclusion

The EIA was carried out based on the relevant local and international guidelines. Minimum controls were formed by referring to these guidelines and the common best practices in the industry, incorporated as the basis of impact assessment. Where the implementation of minimum controls was insufficient to alleviate any significant environmental construction or operational impacts (with "**Moderate**" to "**Major**" impacts), additional general and Project-specific mitigation measures were further proposed to mitigate the potential environmental impacts to as low as reasonably practicable. The summary of unmitigated Impact Significance and potential residual impact significance of the assessed environmental aspects for both construction and operational phases are presented in the following table.

Overall, the assessment findings demonstrated that while the development of Bukit Timah Turf City may have some **Major** impacts on human and ecological receptors nearby and within the Project Site, the impacts can be reasonably mitigated through the aforementioned measures.

A comprehensive EMMP was then provided in the EIA, detailing the environmental monitoring and management plans to review the effectiveness of the proposed mitigation measures during the construction and operational phases.

*Table 6: Summary of Impact Assessment*

| Potential Source of Impact | Impact Significance with Minimum Control | Residual Impact Significance with Mitigation Measures (if required) |
|---|---|---|
| **Construction Phase** | | |
| Biodiversity | Negligible to Major | Negligible to Major |
| Hydrology and Water Quality | • Human: Negligible | • Human: N.A. |
| | • Ecological: Negligible to Major | • Ecological: Negligible to Moderate |
| Soil and Groundwater | • Human: Negligible to Minor | N.A. |
| | • Ecological: Minor | |
| Air Quality | • Human: Moderate to Major | • Human: Minor |
| | • Ecological: Major | • Ecological: Minor |
| Airborne Noise | • Human: Negligible to Major | • Human: Negligible to Major |
| | • Ecological: Moderate to Major | • Ecological: Moderate to Major |
| **Operational Phase** | | |
| Biodiversity | Negligible to Major | Negligible to Major |
| Hydrology and Water Quality | • Human: Negligible to Minor | • Human: N.A. |
| | • Ecological: Negligible to Major | • Ecological: Negligible to Minor |
| Soil and Groundwater | • Human: Minor | N.A. |
| | • Ecological: Negligible to Minor | |
| Air Quality | • Human: Minor | N.A. |
| | • Ecological: Minor | |
| Airborne Noise | • Human: Negligible to Minor | N.A. |
| | • Ecological: Negligible to Minor | |