CHAPTER 8: ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACTS AND MITIGATION MEASURES

8.1 INTRODUCTION

The environmental and social impacts of the project were assessed: to help determine the acceptability of the project, and to ensure that all impacts are properly identified and addressed with the appropriate mitigation measures. The process involved taking into account the environmental baseline features, uniqueness, and potential vulnerabilities, along with the nature, location, and duration of the construction activities, and the project design features in force throughout the operation.

This ESIA examines all possible interactions between all project components, in all phases, i.e., pre-construction, construction, operation and maintenance. The environmental and socioeconomic features of interest are those within the area of influence of the 177 km transmission line (i.e., 500 m on either side of the transmission line, 50 m on either side of access roads, and the Btg. Rajang and Btg. Baleh river corridor south of the transmission line).

8.2 IMPACT ASSESSMENT AND METHODOLOGY

EIA is a process which identifies the environmental effects (both negative and positive) of development proposals and aims to avoid, minimise, mitigate and compensate any adverse impacts. Identification of impacts, predicting their magnitude, and evaluating their significance is the core exercise of impact assessment. Once identified and assessed to define the level of potential risk they present to the environment, such risks can be removed or reduced through design or the adoption of operational measures (mitigation).

The methodology that was used to identify and assess the potential impacts resulting from the BMTLP can be summarized by the following steps:

1. **Identification and prediction** of potential key environmental and social impacts associated with each phase of the project and activities undertaken.

2. **Evaluation** of the importance and significance of the predicted impacts in terms of its various characteristics (e.g., type, extent, duration, scale and frequency).

3. Development of **mitigation measures** that will eliminate or limit negative significant impacts where practicable and enhance positive impacts.

4. Evaluation of the significance of the **residual impact** after taking into account how mitigation will reduce a predicted impact.

8.2.1 Impact Identification and Prediction

The objective of impact prediction is to identify the magnitude and other dimensions of identified change in the environment due to project activities or action in comparison with the situation without the project or action.

For each of the identified issues, attempt is made to predict, in as much detail as possible, the likely effects of the project activities. This needs to be done in a quantified way, if possible, and should also consider the time over which impacts are expected to develop.

Impact predictions may reveal that the environmental effects identified during the scoping stage are not as great and may not be significant, hence the process can loop back to the scoping phase to amend the ESIA accordingly.

8.2.2 Impact Evaluation

The purpose of impact evaluation is to assign relative significance to the predicted impacts associated with the project, and thus, determine the priority order in which impacts are to be avoided, minimised, mitigated or compensated.

Each of the predicted potential impacts will be described and evaluated in terms of its various **characteristics**. The significance of any potential impact is determined through the use of an assessment matrix approach, which characterize the impacts based on **type, duration, extent, scale and frequency**.

The terminology and designations used to describe impact characteristics are shown in **Table 8.2.1**.

Table 8.2.1: Impact Characteristic Terminology

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the potential impact to the project (in terms of cause and effect)	**Direct** (direct interaction with resource/ receptor, e.g., land acquisition) **Indirect** (indirect interaction with resource/ receptor, e.g., impact of transmission line towers on use of agriculture machinery) **Induced** (impacts due to other activities not part of the project, e.g., additional road network)
Duration	The time period over which a resource / receptor is potentially affected	**Temporary** (occur only during pre-construction and construction phase or at infrequent intervals during operation phase) **Short-term** (recovery in days to months) **Long-term** (impacts that exist as long as the transmission line is in place) **Permanent** (irreversible)
Extent	The "reach" of the potential impact (e.g., confined to a small area around the project footprint, projected for several kilometres, etc.)	Site specific (transmission line ROW) Local (Kapit/ Kanowit) State/ Regional (Sarawak) International
Scale	The size of the potential impact (e.g., the size of the area with the potential to be damaged or impacted, the fraction of a resource that could potentially be lost or affected, etc.)	No fixed designations; intended to be numerical value or a qualitative description of "intensity"
Frequency	A measure of the constancy or periodicity of the potential impact	No fixed designations; intended to be numerical value or a qualitative description

8.2.3 Assessment of Significance

The significance of each impact is determined by categorising the **Magnitude** of the impact and the **Sensitivity** of the receptor or resources. Once impact characteristics are defined, the next step in the impact assessment phase is to assign each potential impact a **'magnitude'**. Magnitude describes the intensity of

the change that is predicted to occur in the resource/receptor as a result of the potential impact. The magnitude designations are:

Table 8.2.2: Designation for Magnitude of Impact

Magnitude	Description
Large	Loss of resource and/or quality and integrity; severe damage to key characteristics, features or elements. A major impact is usually large scale, permanent and irreversible.
Medium	Significant impact on the resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements. Moderate impacts usually extend above the site boundary, and are usually permanent, irreversible or cumulative.
Small	Some measurable change in attributes quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristic, features or elements. Minor impacts usually are only noticeable within the site and are temporary and reversible.
Negligible	Very minor loss or detrimental alteration to one or more characteristics, features or elements.
Positive	No magnitude designation is assigned for positive impact.

The other principal impact evaluation step is definition of the environmental value (sensitivity/ vulnerability/ importance) of the impacted resource/ receptor. The environmental value of the resources or receptors has been defined by using the criteria below:

Table 8.2.3: Environmental Value (Sensitivity/ Vulnerability/ Importance) of Resource / Receptor

Value	Description
Low	Low or medium importance and rarity on a local scale. The receptor is not significantly impacted and shows a large spare carrying capacity. Impacts are not likely to generate any noticeable stress on the existing environment. Locations that show a low vulnerability to the environmental impact under consideration (e.g., logged over areas).
Medium	High or medium importance and rarity on a regional scale, limited potential for substitution. The receptor is already significantly impacted, but it is not close to reaching its carrying capacity. Further impacts will increase the stress on the existing environment, but evidence does not suggest that it is about to reach a critical point. Locations or groups that are relatively vulnerable to the environmental impact under consideration (e.g., commercial areas).

Value	Description
High	High importance and rarity on a national scale, and limited potential for substitution. The receptor is closed to reaching its carrying capacity, so a further impact may lead to a significant damage to the system that it supports. Locations or communities that are particularly vulnerable to the environmental impact under consideration (e.g., longhouses, schools, cultural heritage site, vulnerable/ marginalized groups).

Once **Magnitude** of impact and environmental **Value** (sensitivity/ vulnerability/ importance) of resource/ receptor have been characterised, the **significance** can be assigned for each impact. The significance of effects is a combination of the environmental value of a receptor or resource and the magnitude of the project impact value (change). **Table 8.2.4** below shows the criterion used for determining the impact significance. Definitions of each significance category are provided for in **Table 8.2.5**.

Impact prediction and evaluation take into account any embedded controls (i.e., physical or procedural controls that are already planned as part of the project design, regardless of the results of the ESIA process). This avoids the situation where an impact is assigned a magnitude based on a hypothetical version of the project that considers none of the embedded controls.

Table 8.2.4: Determining Impact Significance

		Magnitude of Impact			
		Negligible	**Small**	**Medium**	**Large**
Environmental Value of Resource/ Receptor	**Low**	Insignificant	Minor	Minor	Moderate
	Medium	Insignificant	Minor	Moderate	Major
	High	Insignificant	Moderate	Major	Major

Table 8.2.5: Definition of Impact Significance

Significance Category	Description
Insignificant	Where a resource/receptor (including people) will essentially not be affected in any way by a particular activity or the predicted effect is deemed to be 'imperceptible' or is indistinguishable from natural background variations. Insignificant impacts will not be considered further in the ESIA report. No mitigation is required.
Minor	Environmental Resources: The project effect low sensitivity/ vulnerability/ importance receptor of localised plants or wildlife over a short time period. Minor impacts usually are only noticeable within the site and are temporary and reversible. Social Values: Resource use of local community experience minor disturbance, but recovery is relatively quick. Local issue unlikely to be of importance in the decision-making process.
Moderate	Environmental Resources: The project affects a portion of a population or habitat but not adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements. These impacts, while important at a local scale, are not likely to be key decision-making issues. The impact magnitude is within applicable standards, but falls somewhere in the range from a threshold below which the impact is minor, up to a level that might be just short of breaching a legal limit. Social values: Resource use of local community experience moderate disturbance, but recovery is expected within 3 to 6 months. They represent issues where effects will be experienced but mitigation and management measures and detailed design work may ameliorate or enhance some of the consequences upon affected communities or interests. Some residual effects will still arise.
Major	Environmental Resources: Loss of the entire population or species, resource and/or quality and integrity; severe damage to key characteristics, features or elements. Accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. Impact is usually large scale, permanent and irreversible. Social Values: Project affects a subsistence or commercial resource use, business activity, or social behaviour to the degree that the wellbeing of the user or local community is affected over the long term. Mitigation and management measures and detailed design work are unlikely to remove all of the effects upon the affected communities or interests. Major impact may become key factors in the decision-making process.

Once the matrix is established, the ESIA gives a precise description of each significant impact in the matrix. The matrix shows activities in connection with the environment, which are particularly significant or sensitive. Once the impacts have been assessed, appropriate mitigation measures will be applied to each area of impact with the aim of reducing the level of significance to Not Significant.

Impacts have been identified based on the project activities as described in **Chapter 2**. Potential environmental impacts of the project during pre-construction, construction as well as operation and maintenance phases are presented in a matrix form - **Table 8.2.6** below. The project features and activities that could be a source of impact were identified and these have been listed on the horizontal axis. The resources/receptors relevant to the baseline environment have been listed across the vertical axis of the matrix.

Table 8.2.6: Interaction Matrix

ENVIRONMENTAL RESOURCES / RECEPTORS		PROJECT ACTIVITIES AND PHASES									
		PRE-CONSTRUCTION			CONSTRUCTION					OPERATION AND MAINTENANCE	
		Land acquisition and Land Conversion	Access point establishment	Transportation of machineries, equipment, material & workers	Onsite support facilities	ROW Clearing	Cut & Fill	Foundation preparation, raising of towers & stringing	Waste generation & disposal	Transmission line maintenance and surveillance	Row, access roads & slopes maintenance
Physical	Soil Erosion		Minor	Insignificant	Insignificant	Minor	Minor	Minor	Insignificant	Insignificant	Insignificant
	Water Quality & Resources		Minor	Minor	Minor	Minor	Minor	Minor	Moderate	Insignificant	Insignificant
	Flooding										
	Geology and Seismology										
	Air Quality		Minor	Minor	Minor	Insignificant	Minor	Insignificant	Insignificant	Insignificant	Insignificant
	Noise		Minor	Minor	Minor	Minor	Minor	Minor		Insignificant	Insignificant
	Greenhouse Gasses			Minor		Minor	Minor	Minor		Insignificant	Insignificant
	Waste		Insignificant	Insignificant	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Minor
	Land Use	Minor									
	Fire Risk					Minor				Minor	
Biological	Terrestrial Flora & Habitats	Minor	Insignificant	Insignificant	Insignificant	Minor				Insignificant	Insignificant
	Terrestrial Fauna	Minor	Minor	Minor		Minor	Minor	Minor		Insignificant	Insignificant
Socio-Economic and Cultural Heritage	Land, Livelihood and Access to Customary Land	Major	Minor			Major					
	Community Utilised Forest	Minor				Minor					
	Employment & Economy		Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive	Positive
	Influx of Non-local Workers				Moderate						
	Influx of Camp Followers				Minor						
	Infrastructure & Services		Insignificant	Insignificant	Insignificant						
	Visual Impact				Minor	Minor	Minor	Minor		Minor	Minor
	Cultural Heritage	Insignificant				Insignificant					
	Public Health & Safety			Minor	Minor	Minor	Minor	Minor		Insignificant	Insignificant
	Communicable Diseases				Major						
	Electromagnetic Field									Insignificant	Insignificant
	Occupational Health & Safety		Medium Risk	Medium Risk	Medium Risk	Medium Risk	Medium Risk	Medium Risk	Medium Risk	Medium Risk	Medium Risk
	Water Quality		Minor	Minor	Minor	Minor	Minor	Minor	Moderate	Insignificant	Insignificant
	Air Quality		Minor	Minor	Minor	Insignificant	Minor	Insignificant	Insignificant	Insignificant	Insignificant
	Noise level		Minor	Minor	Minor	Minor	Minor	Minor		Insignificant	Insignificant
	Traffic		Minor	Minor	Minor	Minor	Minor	Minor	Minor	Insignificant	Insignificant
	Cumulative Impact		Insignificant	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant	Minor	Insignificant	Minor

Key Positive | Insignificant | Minor | Moderate | Major | No further assessment required

8.2.4 Impacts Screened Out

Some aspects of the environment that are not expected to be significantly affected by the transmission line project development have been screened out and will not be mentioned further in the impact assessment process (see **Table 8.2.7**).

Table 8.2.7: Impacts Screened out from Impact Assessment and Evaluation

Impacts	Justification
Flooding	The transmission line is located on generally hilly area, further inland from the banks of Btg. Baleh and Btg. Rajang, therefore, not prone to flood.
Geology and Seismicity	Earthwork activities will not be large enough to affect these features. The earthquake records show local seismicity in Sarawak to be about average by normal stable continental levels. The distant earthquakes are far enough away to produce very low hazard in Sarawak and the project site.
Aquatic Flora / Fish	The project does not directly alter flow or quality of the tributaries crossed by the transmission line. Tagang areas are located on tributaries on the southern bank while along Btg. Baleh, they are 5 km directly north of the transmission line. The Rajang and the Baleh may be used for some transport but the impact will be indiscernible considering the level of suspended solids already present due to large scale logging and land conversion. The tributaries may be crossed by light machinery during stringing only. This will create a local, very temporary plume of suspended solids in the stream. It will, however stay for few days only. Transmission line towers will not be sited close to the tributaries. Experience from similar transmission lines show, there is no significant direct impact on aquatic habitats.
Invasive Species	The transmission line project per se will not introduce any new species, which may be a threat to the natural habitats. The transmission line may introduce plantings in the form of turfing or leguminous cover crops on exposed slopes. These species are commonly used on roadsides and in oil palm plantations and are not known to spread uncontrollably into neighbouring natural vegetation. Local, secondary species are expected to invade the ROW soon after clearing. This is a natural succession, that does not threaten adjacent habitats. As there has been frequent movement in the area before, additional movement is not expected to cause any spread of non-local invasive species.

Impacts	Justification
Avian	Avian collision with transmission lines can occur in large numbers if located within daily flyways or migration corridors, which is not the case of the project area. There are no peculiar bird breeding areas/ migration routes or any natural habitats considered to be either critical or fragile identified along the transmission line. Based on SEB's experience in managing and maintaining transmission lines in the whole of Sarawak, such collision is low and rare. Therefore, impact of avian collision is considered insignificant and will not be assessed further.

8.2.5 Development of Mitigation Measures

Mitigation is the process of providing solutions to avoid, minimise, mitigate or compensate for identified significant adverse environmental and social impacts to acceptable levels, throughout the project life cycle. The objectives of mitigation are:

- To enhance the environmental and social benefits of a project;
- To avoid, minimize, mitigate or compensate the adverse impacts; and
- To ensure that the residual adverse impacts are kept within acceptable levels.

It should be recognised that the project already includes a variety of mitigation measures as outlined in the project description. Such mitigation measures ensure that impacts and the required regulations are complied with, for instance, avoiding titled land lots, settlements, gravesites, etc. The projects impact assessment process as outlined above therefore takes into consideration those mitigation measures included to the project design.

Recommendation of mitigation measures for the identified potential environmental impacts shall consider the following order of preference:

1. Avoidance of impacts altogether (e.g., avoidance of line passing through titled land lots, human habitation such as towns/ bazaars, longhouses (individual or cluster), structures or built-up areas, gravesites, steep slopes).
2. Minimisation and mitigation of impacts where unavoidable (e.g., soil erosion control, pollution control equipment, traffic controls, relocation of affected species).

3. Restoration to their original state (e.g., restoration, reinstatement of rented land used for base camps, storage areas, access roads, jetties).

4. Compensation for any residual, unavoidable damage (e.g., land and crops compensation, damaged land and crops during construction phase).

8.2.6 Residual Impacts

Residual impacts are defined as those impacts that remain following the implementation of mitigation measures. The significance of residual impacts is based upon the same criteria used to determine the impact significance in **Section 8.2.2** above.

8.3 PHYSICAL RESOURCES AND IMPACTS

8.3.1 Project Siting and Conversion of Land Use

The BMTLP route is characterized by a patchwork of farmland, including shifting cultivation, plantations and permanent agriculture; secondary brush and forest, frequently interspersed with rubber and fruit trees; scattered longhouses and villages. Population densities are low in relation to the extent of land and forest available.

As part of SEB's route selection criteria, special care was taken when surveying the transmission line route to minimise the proportion of the route passing through titled land lots (private land), and to avoid settlements, built-up areas, gravesites, religious or cultural heritage sites, common property resources and public utilities.

No longhouses, schools, structures, cultural heritage sites have been identified as requiring removal in the ROW. The final alignment will be fine-tuned to avoid to the maximum extent possible longhouses, schools, sensitive cultural heritage sites, and other sensitive locations such as unacceptably steep sites with the potential for erosion problems.

The transmission line will require permanent acquisition of approximately 885 ha. of land for the ROW and tower bases (177 km x 50 m ROW). Of this, about 225 ha. (or 26%) fall on titled land area (SEB, 2021). The direct impact of project land acquisition requires compensation for loss of land and loss of crops. Compensation will prevent any additional vulnerabilities for the affected households. Therefore, the direct and unavoidable impacts which will result from land acquisition are:

- Loss of land (permanent) for tower bases and ROW.
- Loss of access to land and crops including economic trees, within the ROW so as to establish and maintain required conductor clearances.

Given that the total amount of land required is minimal and that there are provisions in the Law for providing compensation, the impact of permanent project land acquisition is deemed to be acceptable and minor.

Impact	**Project Siting and Conversion of Land Use**				
Nature	**Negative**	Positive	Neutral		
	Impact on land and crop is negative.				
Type	**Direct**	Indirect	Induced		
	Impact on land and crop is direct.				
Duration	Temporary	Short-term	Long-term	**Permanent**	
	Land required for the transmission line ROW and tower bases will be permanently acquired for the project.				
Extent	**Local**	Regional	International		
	177 km long transmission line and 50 m ROW or approximately 885 ha. of land in Kapit Division.				
Scale	The land converted will be the 177 km transmission line and 50 m ROW (approximately 885 ha.).				
Frequency	Permanent conversion of land use for the transmission line ROW.				
Magnitude	Positive	Negligible	Small	**Medium**	Large
	885 ha converted.				
Receptor sensitivity	**Low**	Medium	High		
	The area has low population density and there are abundant land resources; therefore, the receptor sensitivity is considered low.				
Significance	Insignificant	**Minor**	Moderate	Major	
	The impact is considered to be **Minor** as competition for land use in the area is low.				

Temporary land is required for setting up Contractor's facility establishment, storage site and worker camps. This only amounts to 0.8 ha. and will not be acquired but shall be taken on lease from the private land owners.

Overall, environmental impacts related to project siting are small scale and localized, and can be mitigated. The impact of loss of land for livelihoods is addressed in **Section 8.5.1**.

8.3.2 Soil Erosion

Soil erosion is a natural occurring process in which the topsoil is carried away by physical sources such as wind and water. In this process, the soil particles are loosened or washed away into waterways far away from land. This has been worsening due to human activities such as agriculture and deforestation.

Soil erosion is a continuous process that occurs either slowly or at an alarming rate. It results in a continuous loss of topsoil, ecological degradation, clogging of waterways, etc. It is a complex process that depends on soil properties, ground slope, vegetation, rainfall amount and intensity.

8.3.2.1 Construction Phase

Soil erosion during site preparation and construction phase is expected as it will involve site clearing and earthworks activities. Site clearing of the ROW for transmission line involves the felling of vegetation such as trees and the trimming of other vegetation to an acceptable height from the ground surface. With the exception of access road construction and where transmission towers are required to be built, ground vegetation within most of the ROW will be generally left in place. Thus, the soil loss calculation for the ROW and access road (the alignment is not confirmed at this stage) were excluded.

The loss of primary and secondary forest cover along the transmission line ROW, combined with soil disturbance during construction of access roads, tracks and transmission line towers, will increase soil erosion, sedimentation and turbidity in nearby waterways. Sedimentation may increase flood potential, degrade downstream water quality affecting end users of the water, clogging drainage/stream or alter aquatic ecosystems by changing streambed conditions.

Soil eroded from the project area during clearing, earthwork and construction phase may be expected to be mostly deposited on the foot of slopes and depressions, where it will remain in temporary storage, and partly carried off and discharged into nearby waterways. This is dependent on the characteristics of the rainfall and the velocity of flow across the exposed soil surface. Fine sediment of clay and silt are expected to be removed by runoff and will remain in suspension when carried into stream, whereas sand and coarser material will be deposited as riverbed load.

The assessment of the potential soil erosion and sedimentation impacts covers the proposed activity within the transmission line ROW including the access roads,

with the main focus at the proposed angle towers (AT1 to AT35). An Erosion and Sediment Control Plan (ESCP) was prepared with the details of the design references, soil loss estimation and sediment yield estimation, for the proposed angle towers (details **in Appendix 8.3.1a**). The assessment was done for the angle tower work area with the steepest slope, at AT5, and the lowest slope steepness, at AT35. The soil loss projection calculated for AT5 and AT35 is shown in **Table 8.3.1**. The sediment yield estimation for the angle tower AT5 and AT35 is tabulated in **Table 8.3.2**.

Table 8.3.1: Soil Loss Projection – RUSLE[1]

Soil Loss, A (tonnes/ha/yr)	Angle Tower	
	AT5	AT35
Pre-Development	1,595.97	2.39
Earthwork and Construction (without ESCP BMPs)	53,198.89	79.64
Earthwork and Construction (with ESCP BMPs)	6,383.87	9.56
Post-Development	531.99	0.80

Table 8.3.2: Sediment Yield Estimation – MUSLE[2]

Sediment Yield (tonnes)	Angle Tower	
	AT5	AT35
Pre-Development	3.665	0.008
Earthwork and Construction (without ESCP BMPs)	149.249	0.335
Earthwork and Construction (with ESCP BMPs)	17.910	0.040
Post-Development	1.466	0.003

From the outcome of the soil loss modelling results and sediment yield estimation, it is shown that with the proposed ESCP BMPs in place, the soil loss and sediment yield from the angle tower work area will be greatly reduced.

With the implementation of the recommended control measures, the magnitude of the soil erosion and sedimentation are considered to be small and temporary. The sensitivity for human health within the general population is considered as “minor” as majority of the identified sensitive receptors are located quite a distance away from the transmission line ROW. The overall impact significance during the construction is considered **minor**.

[1] RUSLE – Revised Universal Soil Loss Equation
[2] MUSLE – Modified Universal Soil Loss Equation

Impact	**Soil Erosion and Sedimentation during Construction Phase**			
Nature	**Negative**	Positive	Neutral	
	Loss of soil impacting water quality of receiving water-ways.			
Type	**Direct**	**Indirect**	Induced	
	Amount of soil runoff is directly related to the ROW clearing activity and the construction of the tower base foundation			
Duration	Temporary	**Short-term**	Long-term	Permanent
	Impacts are considered short term, as the construction will last for only 36 months.			
Extent	**Local**	Regional	International	
	While the erosion risk stretches over a 177 km long line, each transmission tower site is still very local.			
Scale	Risk of erosion due to vegetation clearing within the 50 m right-of-way, specially at tower sites of the 177 km transmission line. The impacts are expected to be minor provided that all proposed mitigations are implemented and maintained at its best condition.			
Frequency	Throughout construction period, until the exposed land is stabilised.			
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered to be small, as the impact will be reduced with the proper implementation of the proposed ESCP BMPs. There is also sufficient separation distance together with natural buffer between the right-of-way and the nearest sensitive receptors. Locally, erosion may be serious but overall, this is a minor issue.			
Receptor sensitivity	**Low**	Medium	High	
	The receptor sensitivity is considered low, as the transmission line is located in a remote area, quite a distance away from the nearest waterway or population centre.			
Significance	Insignificant	**Minor**	Moderate	Major
	Erosion risk mitigation is an integral part of the project implementation. While a slope failure locally may be serious, the rare and very localised risk makes the overall significance **Minor**.			

To ensure proper implementation of all recommended best management practices (BMPs), quarterly water quality monitoring and site auditing are recommended throughout the construction period. Details of the environmental monitoring programme should be referred to in **Chapter 9**.

8.3.2.2 Mitigation Measures

The following proposed BMPs shall be implemented during the site clearing, earthwork and construction phase:

Site Clearing and Earthworks

- Site clearing and earthwork shall be carried out in stages. It shall be carried out during dry weather.
- If vegetation clearing is required on stream banks, vegetation will be cut near or at ground level to leave root mass in the ground. This helps to reinforce soil stability and reduce erosion.
- Vegetative wastes shall be properly stacked at site for natural degradation. It can also be used as mulches over undeveloped area and slope area to prevent rain from reaching the soil.
- Temporary drainage shall be constructed along the perimeter of the work area to intercept surface runoff.
- For steep slope area, where perimeter drainage is not possible to be constructed, erosion control blanket can be utilised to provide cover for bare soil.
- Laying of crusher run above the internal road is recommended to prevent direct exposure to rain.

Check Dams

- Rock filter check dams shall be installed prior to the final discharge of the temporary drain to slow down the flow of runoff, allowing sediment to settle out (refer to **Appendix 8.3.1b** for specific BMPs proposed for the work area of the angle towers, AT1 to A35).
- The accumulated sediment behind the check dam shall be removed once sediment reaches **1/3 of the check dam's height**.

Stabilisation of Surface

- Protection of all unpaved surface shall be achieved through application of a layer of crusher run to reduce surface erosion.

- Undeveloped surface shall be turfed within 7 days after work completion. Slope shall be turfed as well upon completion of slope work.
- Finished surface shall be temporary covered with geotextile or similar material within 7 days to reduce the rainfall contact with exposed surface.
- Compact and remove excess soil/earth from tower bases or laid out in areas that do not interfere with local drainage pattern.
- Erosion controls must be regularly inspected and maintained throughout the construction phase until exposed soil has been stabilized.

Temporary Earth and Perimeter Drainage

- Proper earth or perimeter drainage system shall be constructed and checked for blockage or siltation regularly in order to channel the surface runoff properly (refer to **Appendix 8.3.1b**).
- It is recommended the 1:300 (Vertical: Horizontal) invert level of the drainage be adopted to create ideal hydraulic gradient to facilitate the flow.

Stockpile (if any)

- Stockpile of earth/construction material shall not be allowed at area which is located less than 20 m from any riverbanks.
- Sediment fence of woven / non-woven geotextile shall be erected at the lower area of the stockpile area (i.e., semi-hemisphere) to contain the runoff from the stockpile.
- Stockpile that will be left untouched for 7 days shall be covered with suitable material (i.e., geotextile of woven / non-woven or plastic sheets, etc.).

8.3.2.3 Residual Impact

With the implementation of BMPs and with adequate monitoring, residual impacts associated with soil erosion and sedimentation from construction activities are minor.

8.3.2.4 Operation and Maintenance Phase

During operation and maintenance phase, impact from soil erosion and sedimentation would result from the following activities:

i. Maintenance clearing of vegetation along the ROW – trees shall be maintained at a height below 6.0m;

ii. Bench or contour access roads and laydown areas so as to minimise surface water runoff and soil runoff;

iii. Regular maintenance on permanent and temporary access roads; and

iv. Slope stability maintenance.

Any maintenance activity that requires the clearing of ground cover and land will be minimal and localised during this phase. Only the work area where the maintenance work needs to be worked on shall be cleared. The cleared area shall be immediately stabilised once the maintenance work is completed. Therefore, potential impacts associated with operation and maintenance phase are considered to be negligible and **insignificant**, as long as related BMPs listed in **Section 8.3.2.2** are implemented around the work area. A comprehensive list of action plans to mitigate soil erosion can be found in the Environmental and Social Management Plan (ESMP) to in **Chapter 9**.

8.3.3 Water Quality

The assessment of potential impacts related to surface water is based on the baseline condition, socio-economic baseline data and information available from the Proponent at the time of writing. Focus is on surface water as the sensitive receptor. It is recognised that any changes to surface water may potentially impact people who utilise these surface water resources.

8.3.3.1 Construction Phase

Sources of water pollution during construction phase will mostly be sediments from surface runoff during vegetation removal which involves the ROW and construction of access roads and towers bases. Other potential pollutants are transportation of construction materials and machinery by river, untreated wastewater, sewage and improper waste disposal from the site offices and onsite base camps.

Project activities will interact with water resources in the following ways:

- There will be direct interaction during clearing and construction near to or in surface water bodies. There will be indirect interaction in the case of erosion of soils into water bodies.

The BMTLP crosses numerous rivers and streams along its 177 km length. All of them are tributaries of Btg. Baleh and Btg. Rajang. Clearing of vegetation and earthworks (cut and fill) near these rivers will have direct effect on the surface water. There is a potential of soil runoff into the water bodies, increasing sediment load which could lead to increase in TSS level and turbidity of receiving waters. This in turn may have a detrimental effect on water quality and effect surface water users.

Generally, turbidity and TSS levels of water samples collected from Btg. Rajang and its tributaries were higher (exceeded Class IIB level) compared to Btg. Baleh and its tributaries. Data from JBALB and NREB long-term monitoring showed similar trend for turbidity along Btg. Rajang and Btg. Baleh, which showed generally higher turbidity and TSS than the stipulated limit in the NWQSM Class IIB (50 NTU for turbidity and 50 mg/l for TSS).

The soil erosion impact of the project is expected to be minor and short-term (see **Section 8.3.2**). In addition, in tropical area, cleared areas will revegetate naturally with shrubs and grasses within a few weeks thereby further limiting erosion. Given the elevated turbidity and TSS levels of the rivers and streams along the transmission line, any additional sediment load from the project is expected to be minor, local and temporary with proper implementation of the proposed BMPs as recommended in **Section 8.3.2** above.

- There will be direct interaction from the transportation of construction materials and machinery by river.

  Btg. Rajang and Btg. Baleh still play an important role as the main transportation medium which includes the transportation of construction materials and machinery for various constructions along the rivers. Accidental spill of construction materials and oil from machineries into the rivers may lead to increase in oil, TSS level and turbidity of receiving waters. However, this can be minimised or avoided with the proper measures.

- There will be direct interaction from the abstraction of water from surface water bodies for construction (e.g., concreting, dust control).

  Water required for camps' domestic requirements and construction activities (estimated water requirement of 142,825 L/Day) will be sourced from rivers and streams either via direct extraction or gravity feed and supported by rainwater harvesting. The rate of abstraction especially from the main river is not expected to adversely affect ecological functions and do not impede

access to water of existing users as water resources are in abundance in the area.

- There will be direct interaction from the discharge of untreated wastewater, sewage, spillage of oil, fuel and other hazardous materials, causing contamination of surface water. The downstream water in river can be polluted making it unfit for bathing or potable water.

  Untreated sewage and indiscriminate disposal of wastes from the workers' camps and work site into nearby stream or river may further degrade the water quality. Of concern are impact on existing water intake points and water catchments for gravity feed systems that are located close to the towers and ROW, and onsite support facilities. However, it is a requirement for the Contractors to provide proper sanitary facilities for the workers. No direct discharge of sewage is allowed.

With the implementation of the recommended control measures, the magnitude of the water quality impact is considered to be minor, local and short-term. The sensitivity for human health within the general population is considered as "medium" as the identified sensitive receptors are considered as residential. The overall impact significance during the construction is considered **minor**.

Impact	**Water Pollution**			
Nature	**Negative**	Positive	Neutral	
	Eroded soils and wastewater, accidental spill of construction materials and oil (during river transport) entering rivers and streams.			
Type	**Direct**	Indirect	Induced	
	Impact directly results from project activities.			
Duration	Temporary	**Short-term**	Long-term	Permanent
	The construction activities will last approximately 36 months. The duration of potential impacts is therefore short-term.			
Extent	**Local**	Regional	International	
	Potential impacts would be limited to the project site footprint, as well as areas downstream of the project site, and hence would be considered local.			
Scale	The water quality impact would affect existing water intake points and gravity feed system located downstream of the project site.			
Frequency	Impacts to water quality from the project activities could occur intermittently but repeatedly throughout the day for the duration of the construction phase.			

Impact	**Water Pollution**				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to water quality in the project area are expected to be small magnitude if all BMP is implemented.				
Receptor sensitivity	Low		**Medium**	High	
	Surface water quality analysis from the baseline surveys indicated that the water quality index is categorized as class I and II, Slightly Polluted (W14), Clean (all other samples). There are water intake points for water treatment plants and gravity feeds along Btg. Rajang and Btg. Baleh and its tributaries. Therefore, overall sensitivity is rated as Medium.				
Significance	Insignificant	**Minor**	Moderate	Major	
	Considering the impact magnitude is small and the sensitivity is medium, the overall significance of impact is considered to be **Minor**.				

Sewage Discharges

Sewage discharge and runoff during the construction phase may lead to contamination of freshwater sources if not managed properly. Septic tanks will be provided to treat the sewage from temporary toilets at the construction site and workers' quarters. The septic tanks will need to be adequately designed so that untreated sewage due to leakages or overflows do not have the potential to enter surface and ground water.

Raw sewage can impact surface water quality by promoting the growth of algae and delivering pathogens that may be harmful to human and ecological receptors. Sewage is generally characterised as having a high concentration of suspended and dissolved solids, biochemical oxygen demand (BOD), chemical oxygen demand (COD), nutrients (nitrogen, ammonia) and faecal coliform counts. The organic substances are decomposed in water and the decomposition of organic matter will reduce the oxygen content dissolved in water.

Quantities of sewage discharge for the project are not yet known, but estimates can be made based on the number of workers. Based on the recommended PE factor, the estimated PE is shown in **Table 8.3.3**. The estimation of BOD for untreated, Standard B sewage and its possible impacts on the water quality is shown in the same table. The BOD Loading Calculation is attached in **Appendix 8.3.2**.

Table 8.3.3: Estimation of BOD Loading for Untreated and Treated Sewage

	BOD Loading
Estimated Population	245
Estimated BOD Loading / person (kg/day)	
Untreated sewage, BOD = 250 mg/l	2.45
Treated to Standard B, BOD = 50 mg/l	0.489
Instantaneous Increase of BOD_5 level (mg/l)	
Untreated sewage, BOD = 250 mg/l	0.0566
Treated to Standard B, BOD = 50 mg/l	0.0113

Note: Estimated PE is based on 0.3 PE per staffs for factory setting (1 PE = 40 L/day of sewage) according to Section 9 Appendix B, Table B.1: Recommended PE Factors in Guideline for Developers Vol. 1, Sewerage Policy for New Developments, published by Ministry of Housing and Local Government and Sewage Services Dept, Malaysia

The location of the toilets with septic tanks are not confirmed at the time of report writing. The existing BOD concentrations at the baseline sampling locations are relatively low at <1.0 mg/L. Therefore, with the peak sewage instantaneous increase of BOD concentration at 0.0113 mg/L, the BOD concentration would still comply with the stipulated limit of 3 mg/L (Class IIB of NWQSM).

Potential impacts to surface water quality are expected to be short-term and localized in nature, and can be controlled when the septic tanks are adequately designed and implemented. The significance of potential impacts to surface water due to sewage discharges during the construction phase is assessed below.

Impact	**Impact to Surface Water Quality due to Treated Sewage Discharges**			
Nature	**Negative**	Positive	Neutral	
	Untreated sewage entering surface water bodies.			
Type	**Direct**	Indirect	Induced	
	Impacts to surface water would be direct impacts from project activities.			
Duration	Temporary	**Short-term**	Long-term	Permanent
	The construction activities will last approximately 36 months. The duration of potential impacts is therefore short-term.			
Extent	**Local**	Regional	International	
	Potential impacts would be limited to the project site footprint, as well as areas downstream of the project site, and hence would be considered to be local.			

Impact	**Impact to Surface Water Quality due to Treated Sewage Discharges**				
Scale	The total approximate quantities of sewage that could be a potential source of impact during the peak construction phase is approximately 9,780 L/day of treated sewage.				
Frequency	Impacts to surface water from sewage discharges could occur intermittently but repeatedly throughout the day for the duration of the construction phase (36 months).				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts to surface water quality in the project area from sewage discharges are expected to be of small magnitude as sewage will be treated using septic tanks before discharge. The instantaneous increase of BOD levels with the baseline levels of the treated sewage discharge will comply with the BOD limits stipulated in Class IIB of the NWQSM.				
Receptor sensitivity	Low	Medium	**High**		
	Surface water quality analysis from the baseline surveys indicated that the BOD concentration of the rivers around the project site is relatively low at an average of <1.0 mg/L. The project is within a rural setting and the river system around the project site is used for fishing and gravity feed water supply. Areas near the Song and Kapit towns are within 8 km of the raw water intake points. Therefore, the overall sensitivity is rated as High.				
Significance	Insignificant	Minor	**Moderate**	Major	
	The combination of a high resource sensitivity and small impact magnitude will result in an overall **Moderate** impact.				

8.3.3.2 Mitigation Measures

Mitigation measures recommended for soil erosion in **Section 8.3.2** and waste management in **Section 8.3.6** will also mitigate impact on water quality. The following are additional measures to further reduce water pollution:

- Ensure no overcapacity of construction materials during transportation to prevent accidental spillage into rivers.
- All river transport vehicles e.g., barges and construction related machinery being transported are in tip-top condition, devoid of leaks and damages.
- All containers used to transport oil-based products must be capped tightly.
- Refuelling of equipment and vehicles must be carried out in designated areas on hard standing ground to prevent seepage or any spillage to ground. Collection systems will be installed in these areas to manage any spills and properly disposed off.

- A detailed Oil Spill Response Plan (ORSP) which includes community notifications of any significant spills that have the potential to affect communities should be developed and cascaded to all Contractors and sub-contractors.

- Existing vegetative buffers should be left undisturbed or minimally disturbed, whenever possible. For areas where construction impacts cannot be avoided, low-growing native tree and shrub buffers along these streams should be allowed to regrow and/or so as to maintain the pre-construction water quality in the streams.

- The Proponent and Contractors must at all times keep waterways cleared of any kind of waste or debris originating from their activities.

- GFS intake catchments should be preserved as much as possible. Where possible, the stream or river source of the GFS intake should be left undisturbed, except where crossings are required.

- GFS pipelines along and near the work zone shall be identified and marked clearly. Where it is necessary to cross these pipelines, consent shall be obtained from the owner. SEB or the Contractors shall bear the cost and act promptly on any damages caused by the project activities.

- Carry out regular check, inspection and water quality monitoring at potentially sensitive areas such as water intake points and rivers located downstream of the project site to ensure the effectiveness of all recommended water pollution control measures.

Sewage

- Provision of adequate washing and toilet facilities by the Contractors to the workers should be made obligatory.

- Untreated sewage will not be discharged into the existing waterways. Sewage generated from the toilets should be treated with individual septic tanks or prefabricated small sewage treatment system (such as ECOPASS) treated to the requirement of Standard B of the Environmental Quality (Sewage) Regulations, 2009 prior to discharge.

- Design and sizing of septic tanks to be installed shall be in accordance with the "Sarawak Urban Sewerage System Guidelines No. 1: The Design and

Construction of Septic Tanks" issued by Sewerage Service Department Sarawak.

- Regular desludging of the septic tanks is recommended to be carried out to ensure efficiency of system. If this is not feasible, replacement of septic tanks will be required. Reference shall be made to Local Authority (Compulsory Desludging of Septic Tanks) By Laws, 1998.
- The toilets should be located at least 100 m from surface water bodies.

8.3.3.3 Operation and Maintenance Phase

Impacts from both soil erosion and sedimentation during the operation phase are anticipated to be insignificant as most of the ROW will be over grown with low level shrubs and grasses that ensures that soils are protected and surface erosion is minimised.

During the operation phase, no significant wastewater is generated since there are no site office or workers' quarters within the ROW.

As such, potential impacts associated with project operation are considered to be negligible and **insignificant**, and mitigation measures are not required.

8.3.3.4 Residual Impact

With implementation of the proposed mitigation measures, impact on water quality will reduce to insignificant. Nevertheless, it is crucial for monitoring information to be obtained to demonstrate this minimum impact situation and to secure the Project Proponent or Contractors from claims relating to impacts from third party pollution, which is beyond the control of the proposed project activities over the course of the project development period.

8.3.4 Air Quality

8.3.4.1 Construction Phase

Construction activities can be grouped into those occurring on-site and off-site:

- Air pollutant emissions during **on-site** construction would principally consist of fugitive particulate matter (dust) generated from travel on unpaved surfaces, material handling, and exhaust emissions from mobile diesel and fuel-powered construction equipment. Any soil disturbance from construction equipment

would generate PM_{10} emissions. The quantity of PM_{10} emissions can vary depending on the level of activity, the specific activities taking place, and weather and soil conditions.

- **Off-site** exhaust emissions would result from the workers commuting to staging areas, transporting workers from staging areas to the transmission line work sites, trucks hauling materials (e.g., concrete, tower materials, and conductors) to the work sites, and dump trucks hauling away construction debris (e.g., dirt displaced by new tower foundations and ground excavation).

The assessment of the potential construction air quality impacts on sensitive receptors has been focused within the transmission line corridor including access roads (500 m on either side of the transmission line and access routes along the southern bank to be used by construction traffic (50 m on either side). Along the route there are a number of settlements (longhouses), schools, scattered along the riverbanks, some of which construction traffic will pass through. The transmission line does not directly pass-through any urban centre, densely populated area, heavily trafficked roads or ecologically sensitive habitat. Kanowit, Song and Kapit, the main urban centres in the area are all located at the southern bank of Btg. Rajang. For this project, the receptors sensitivity are as follows:

Table 8.3.4: Air Quality – Receptors Sensitivity (ASR)

Receptor	Sensitivity	Justification
Settlement (Longhouse) Schools	High	Longhouse and school are very sensitive to ambient air quality due to the permanent occupation by human.
Urban Area Commercial Area	Medium	Commercial premises have a medium sensitivity as they are only occupied for a portion of the day.
Farms / Plantation Jungle Rivers (fishing, washing)	Low	Farms, plantation and jungle have low sensitivity as people are only at these places for a short period of the day for work or collect jungle produce.

The sensitive receptors that will potentially experience air quality impacts from activities during the construction phase have been identified. The locations of the identified potential sensitive receptors are listed in **Table 8.3.5**.

Table 8.3.5: Potential Sensitive Receptors

No.	Location	Type of Uses	Distance to ROW or Access Road
1.	Rh. Asun, Lepong, Sg. Mujong	Longhouse	~ 300 m to ROW
2.	Rh. Timothy, Balai Lepong, Sg. Mujong	Longhouse	~ 300 m to ROW
3.	Rh. Latit (Nanga Semulong), near NAT20	Longhouse	~ 200 m to ROW
4.	Rh. Ibau, Bukong Baroh, near NAT20	Longhouse	~ 300 m to ROW
5.	Rh. Liang, Bukong Atas, near NAT20	Longhouse	~ 400 m to ROW
6.	Rh. Jacob (Nanga Leon)	Longhouse	~ 300 m to ROW
7.	Rh. Pioh (Nanga Paku)	Longhouse	~ 300 m to ROW
8.	Rh. Gerinsa (Nanga Sepayang)	Longhouse	~ 450 m to ROW
9.	Rh. Achai (Nanga Selubok)	Longhouse	~ 450 m to ROW
10.	Rh. Ngitar (Lubok Rirong)	Longhouse	~ 450 m to ROW
11.	Rh. Timban (Emperan Munti)	Longhouse	~ 450 m to ROW
12.	Rh. Chiry (Emperan Munti)	Longhouse	~ 450 m to ROW
13.	Villa Kendawang Ak Besi	House	~ 200 m to ROW
14.	Rh. Pinin	Longhouse	~ 300 m to AP6
15.	Rh. Nyanggau	Longhouse	~ 300 m to AP6
16.	Rh. Bantin Emperan (Sg. Iran)	Longhouse	~ 100 m to AP12 (access road)
17.	Rh. Sandai	Longhouse	~200 m to AP16 (access road)
18.	Rh. Selunggang	Longhouse	Along AP16 (access road)
19.	SK. Nanga Balingiau	School	Along AP16 (access road)

Fugitive dust impact is localized within about 100 m area due to relatively large particle size of fugitive dust. As the surrounding areas are still covered by vegetation, this would provide filter effect for protecting any nearby residence from any potential construction dust impacts.

With the implementation of the recommended control measures, the magnitude of the construction dust impact is considered to be small and short-term. Although the sensitivity for human health within the general population is considered as “high” as the identified sensitive receptors are considered as settlement and school, the overall impact significance during the construction is considered **minor**. This is because there is only one longhouse and one school located along

(less than 100 m) the access road – Rh. Selunggang and SK. Nanga Balingiau. However, once the transmission line is built and operational and the ROW reinstated, no significant effects on air quality are anticipated.

The impact assessment is summarized below.

Impact	**Air Quality Impact during Construction**			
Nature	**Negative**	Positive	Neutral	
	Air quality may deteriorate (dusty) due to transport of materials to the tower sites, dust from vehicle movement, and exhaust fumes.			
Type	**Direct**	Indirect	Induced	
	Impact on human health within the general population is direct.			
Duration	Temporary	**Short-term**	Long-term	Permanent
	Impacts are considered short term as it will occur at infrequent intervals during transportation and construction activities.			
Extent	**Local**	Regional	International	
	Impact will only affect workers that are directly involved in the construction activities or residents along the shared access roads.			
Scale	The fugitive dust impacts are expected to be limited, localized (within 100 m from the worksite boundary and access roads) and temporary (i.e., throughout the construction period of 36 months for each phase).			
Frequency	Intermittent during working hours, throughout construction period.			
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered to be small, as the fugitive dust impact will be reduced as much as possible after the proper implementation of all in-place dust suppression measures and good site practice. There is also moderate separation distance between the project site boundary and the air sensitive receptors.			
Receptor sensitivity	Low	**Medium**	High	
	The receptor sensitivity is considered medium, they are identified to be residential type located along the access roads.			
Significance	Insignificant	**Minor**	Moderate	Major
	Significance of impact is considered to be **Minor** as only two sensitive receptors are located along the access road (AP16).			

To ensure proper implementation of all recommended dust suppression measures and good site practices, quarterly air quality monitoring is recommended throughout the construction period. Details of the environmental monitoring programme should be referred to in **Chapter 9**.

8.3.4.2 Mitigation Measures

- The Proponent and its Contractors shall provide advance notice, between two and four weeks prior to construction, to all residents or property owners within 100 m of the transmission line ROW and access roads. The announcement shall state specifically where and when construction will occur in the area.
- Notices shall inform of health impacts of dust and provide tips on reducing dust impact, for example, by closing windows facing the planned construction work area.
- Access roads should be sprayed with water as necessary to suppress dust near sensitive receptors.
- Truckloads should be covered, with the exception of on-site trips within the ROW.
- A speed limit of 30 km/hr shall be imposed for vehicles travelling within the construction site. On public roads, vehicles should adhere to the speed limits imposed by the authorities and all traffic laws.
- All construction vehicles and generators will be maintained to ensure that exhaust fumes comply with regulations - Environmental Quality (Control of Emission from Diesel Engines) Regulations, 1996.
- Cut and fill should be balanced to the maximum extent possible at each site in order to minimize the need for fill and for spoil disposal.
- Soil and temporary spoil piles should be covered or sprayed if generating dust. Piles that are not going to be used in the short-term should be allowed to develop vegetation cover.
- Revegetate exposed areas as soon as practical possible.
- Open burning is prohibited unless with written permission from the NREB. Open burning of biomass wastes is prohibited unless with written permission from the NREB.
- Monitor ambient air quality level within the construction site to determine compliance with the DOE stipulated limit (100 µg/m^3), the Malaysia Ambient Air Quality Guidelines.

- Proponent and its Contractors shall provide a public liaison person before and during construction to respond to concerns of local communities about dust and other construction disturbance. Procedures for reaching the public liaison officer via telephone or in person shall be included in notices distributed to the community in accordance with first point above.
- Record all dust complaints from the local communities and take appropriate measures to solve the issue.

8.3.4.3 Residual Impact

With the implementation of suitable mitigation and with adequate monitoring, residual impacts associated with dust (PM_{10}, $PM_{2.5}$) and exhaust emissions from construction activities are **insignificant** and negligible.

8.3.4.4 Operation and Maintenance Phase

During operation and maintenance phase of the project, operation emissions would be generated by vehicles used to carry out periodic inspections, maintenance, and repairs of project components. The quantity of emissions that would be caused by project vehicular traffic for inspection and maintenance activities would be insignificant.

Direct emissions from project vehicular traffic for maintenance activities would cause a negligible impact. There would be no stationary sources of emissions related to the transmission line. Transmission lines may produce Ozone gas, but this has no known health effects. Therefore, potential impacts associated with project operation are considered to be negligible and minor, and mitigation measures are not required.

8.3.5 Noise

Within the area where the transmission line will be located, there are currently no noise emissions sources, so the use of heavy machinery, equipment and vehicles during site preparation, construction and operation (maintenance activities) phase will generate noise levels which may disturb workers at the site, communities living along the access roads and fauna living in the nearby forest (see **Section 8.4.2.1.2**).

8.3.5.1 Construction Phase

Based on the project activities outlined in Chapter 2, there are various activities which may contribute to potential noise impacts, such as the clearance of vegetation or trees, upgrading of access roads and jetties, establishment of on-site facilities (e.g., base camps, laydown areas), earthworks for tower footing and access roads within the ROW and transportation of equipment and machineries.

Before the main construction works on the transmission line begins, on-site facilities such as the base camps will be established to provide living quarters and other temporary infrastructures to accommodate site workers. This involves minor construction works which may have minor noise impact depending on the location of the temporary facilities, as they may be within close proximity to settlement.

In the case where an additional access road is needed, this road shall be used for heavy vehicles access to transport materials and equipment pertinent to the project. Heavy machineries that are commonly used in road construction such as crawler excavator, road roller, asphalt mixing plant, and wheel loader may be used in this process. However, they are unlikely to contribute to significant noise impacts as all additional access road will be within the 50 m transmission line ROW.

Commencement of construction for the transmission line development consist of land clearance, excavation and earthworks on areas where the towers will be built. Clearing or trimming of trees and vegetation which involves hand tools such as chainsaws and grass cutters will result in noise and vibration effect exposures to workers. Long hours exposure of these equipment (i.e., exceeding the recommended exposure limit) may affect human health in terms of physical and psychological stress, and also cause severe occupational health effects (i.e., permanent hearing loss, high blood pressure, slow neural reactions, etc.).

Another activity which may influence noise impacts is the transportation of heavy stringing machineries. This impact is however temporary and intermittent, only when there is transportation activity and dependent on the access route used.

Similar to air pollution, the potential construction noise impact on sensitive receptors is focused within the transmission line ROW including access roads (500 m on either side of the transmission line and access points/routes to be used by construction traffic (50 m on either side). The locations of the identified potential sensitive receptors are settlements located within 500 m from the access roads and ROW as listed in **Table 8.3.5**.

Construction equipment operations can vary from intermittent to fairly continuous, with multiple pieces of equipment operating concurrently. The typical noise level from construction equipment that may be used in construction phase of the proposed project is presented in **Table 8.3.6** below.

Table 8.3.6: Typical Noise Level from Various Types of Construction Equipment

Construction Equipment	Noise level at 15 m, dB(A)*			Projected distance (in m) for noise level of			
	Min	Typical	Max	90 dB(A)	75 dB(A)	65 dB(A)	55 dB(A)
Dump truck	83.2	88.2	94.2	12.2	68.6	216.8	685.6
Concrete mixer (truck)	75.2	85.2	88.2	8.6	48.5	153.5	485.4
Jack hammer	81.2	88.2	98.2	12.2	68.6	216.8	685.6
Scraper	80.2	88.2	94.2	12.2	68.6	216.8	685.6
Dozer / tractors	76.2	87.2	96.2	10.9	61.1	193.2	611.1
Paver	87.2	89.2	90.2	13.7	76.9	243.3	769.3
Generator	71.2	76.2	81.2	3.1	17.2	54.5	172.2
Pile driver	95.2	101.2	106.2	54.5	306.3	968.5	3,062.6
Pump	69.2	76.2	83.2	3.1	17.2	54.5	172.2
Pneumatic tools	83.2	85.2	89.2	8.6	48.5	153.5	485.4
Backhoe	71.2	85.2	93.2	8.6	48.5	153.5	485.4

**(Source: Alfredson and May, 1978)*

Assuming a peak construction period noise would generally be about 94 dBA at 15 meters (50 feet) from the construction site, the predicted noise level at the vicinity of construction site is given in **Table 8.3.7**. The nearest receptor is SK Nanga Balingiau and Rh. Selunggang located about 50 m from the access road, will experience occasional episodes of noise levels around 83.5 dB(A) during peak construction period. Settlements between 100 to 200 m will experienced predicted noise levels of between 71 to 77.5 dB(A).

Effects of noise on sensitive receptors are varied and may include interference with speech communication, disturbance of work or leisure activities, disturbance of sleep, annoyance and possible effects on mental and physical health. In any neighbourhood, some individuals will be more sensitive to noise than others.

Normally the noise levels from the construction activities will not be continuous throughout the day and will generally be restricted to daytime hours and subject to attenuation effects from man-made barriers, natural barriers and vegetation.

Table 8.3.7: Noise Levels Expected in the Vicinity of Construction Site

Receptor Distance (m)	Noise Level at Receptor (dB(A))	Receptors
50	83.5	Rh. Selunggang SK. Nanga Balingiau
100	77.5	Rh. Bantin Emperan (Sg. Iran)
200	71.5	Rh. Sandai Villa Kendawang Ak Besi Rh. Latit (Nanga Semulong), near NAT20
300	68.0	Rh. Asun, Lepong, Sg. Mujong Rh. Timothy, Balai Lepong, Sg. Mujong Rh. Ibau, Bukong Baroh, near NAT20 Rh. Jacob (Nanga Leon) Rh. Pioh (Nanga Paku) Rh. Pinin Rh. Nyanggau
400	65.5	Rh. Liang, Bukong Atas, near NAT20
450	64.5	Rh. Gerinsa (Nanga Sepayang) Rh. Achai (Nanga Selubok) Rh. Ngitar (Lubok Rirong) Rh. Timban (Emperan Munti) Rh. Chiry (Emperan Munti)

NOTES: *The following formula and assumptions were used:*

$$L_p = 20 \log_{10}\left(\frac{P}{P_0}\right) \; dB$$

Where

L_P = sound pressure level

P = measured sound pressure

P_0 = reference sound pressure (20×10^{-6} Pa)

Reference noise level = 94 dB(A).

Distance for reference noise level = 15 meters (50 feet).

Attenuation effects from man-made barriers, natural land barriers, dense vegetation, and buildings are not included in the calculations. These barriers will substantially reduce noise when they intervene between the source and receivers.

The table below shows a summary impact caused by noise generated during site preparation and construction of proposed project. The magnitude of impact is considered to be medium to a localized extent and scale. Considering that, presence of natural attenuation (existing vegetation) and the control measures which will be implemented, the duration of impact is expected to be short term. The sensitivity for human health within the general population is considered as

"medium" as the site is sparsely populated. The overall impact significance during the construction is considered Minor.

Impact	**Noise Impact during Site Preparation and Construction**				
Nature	**Negative**	Positive	Neutral		
	Noise quality may deteriorate slightly due project activities. Noise and soil vibrations disrupts periods of rest for humans as well as wildlife. Soil vibrations can have dire consequences for soil fauna as they will feel threatened and their rest interrupted.				
Type	**Direct**	Indirect	Induced		
	This is a direct Impact as a result mainly from transportation activities along access roads shared with the community, land clearing and tower construction.				
Duration	Temporary	**Short-term**	Long-term	Permanent	
	Impacts are expected to be temporary and short-term during construction phase at infrequent intervals during working hours. Situation will return to normal when there are no work activities.				
Extent	**Local**	Regional	International		
	Noise has only local dispersion. Impact will only affect workers that are directly involved in the project activities or settlements in the vicinity of construction sites or located along the access roads.				
Scale	Noise and vibration limited within 500 m ROW and tower work area along the 177 km transmission line and access roads. The impacts are also anticipated to be temporary (i.e., throughout the construction period of 36 months).				
Frequency	Intermittent during working hours, throughout construction period.				
Magnitude	Positive	Negligible	Small	**Medium**	Large
	Magnitude of impact originating from this project is considered medium.				
Receptor sensitivity	Low	**Medium**	High		
	The receptor sensitivity is considered medium as they are identified to be residential type located along the ROW and access roads.				
Significance	Insignificant	**Minor**	Moderate	Major	
	Medium magnitude and sensitivity would make this a moderate impact. With mitigation measures and the presence of natural buffer in the form of forest vegetation, as well as health and safety measures in place, significance of impact would be reduce to **Minor**.				

8.3.5.2 Mitigation Measures

- The public, which includes all communities that are within close proximity (within 100 m of the transmission line right-of-way, access roads and jetties) to the work site shall be notified of any commencement of project activities, between two and four weeks prior to construction. They should be informed of health impacts of noise to prevent effect of psychological distress (e.g., uneasiness, irritability, etc.) caused by the noise from the project.

- Construction activities shall only be carried out during the day under the usual working hours (7:00 am to 7:00 pm).

- In case where noise levels are expected to be higher than the acceptable threshold limit of 55 dB, the Proponent and Contractors shall be responsible for taking immediate steps to reduce such noise to the acceptable noise level. Put up highly visible noise warning signs at strategic locations that tells workers or communities on occurrence of high-level noise.

- Employees shall not be exposed to the daily noise exposure level exceeding the threshold limit of 85 db(A) for more than 8 hours a day as specified in the Occupational Safety and Health (Noise Exposure) Regulations 2019.

- Employees should be properly trained and instructed on proper usage of personal hearing protectors such as earplugs and mufflers. These protective devices should be those approved by the DOSH.

- Transportation of materials and equipment via roads will be required to adhere to traffic rules (e.g., no unnecessary honking or revving of engine) and speed limits specified.

- Include environmental specifications in contract documents for Contractors and machine operators for noise reduction in construction, hours of operation, material haulage routes and permissible noise standards.

- Noise monitoring shall be carried out in order to determine the noise level resulted from the construction activities so that additional measures can be taken to minimize the impacts.

- Proponent and its Contractors shall provide a public liaison person before and during construction to respond to concerns of local communities about noise, and other construction disturbance. Procedures for reaching the public liaison

officer via telephone or in person shall be included in notices distributed to the community in accordance with first point above.

- Record and act on all relevant complaints by the surrounding communities and institutions promptly.

8.3.5.3 Residual Impact

Residual impacts associated with noise emission from heavy machineries and equipment operation, and noise generation from construction activities are minor, as long as proper mitigation measures are implemented. Standard mitigation measures specified above are also applicable to the residual impacts, if any.

8.3.5.4 Operation and Maintenance Phase

Similar to the evaluation made for air quality impact, noise emissions generated in the operational and maintenance phases will be from the use of vehicles that are necessary to carry out periodic inspection, maintenance, and repair of the project components. However, these sources of noise will have minor to no impact to the general population.

In addition to that, during the operational phase of the transmission line, audible noise generation by electric discharge is expected. The acoustic noise produced by transmission lines is greater with high voltage power lines (400-800 kilo volts [kV])]). Corona from the operation of high voltage transmission line can make audible noises, often described as “hissing,” in the vicinity of the ROW. Under fair weather conditions, the audible noise from corona is minor and rarely noticed. During wet and humid conditions, water drops collect on the conductors and increase corona activity. Under these conditions, a crackling or humming sound may be heard in the immediate vicinity of the transmission line. Though this noise is audible to those very close to the transmission line, it quickly dissipates with distance and is easily drowned out by typical background noises. The sound of rain typically masks the increase in noise produced by the transmission lines. Study shows the noise from the transmission line are unlikely to have significant impact on human or wildlife.

Furthermore, the transmission line route has been planned and designed to be sited away (at least 500 m) from any human settlement. The impact of noise is considered to be insignificant at this phase. Therefore, further mitigation measures are not required for this phase of the project.

8.3.6 Wastes

During the construction and operational phase, a range of project activities have the potential to generate liquid and solid hazardous and non-hazardous waste streams. This section identifies in detail the various types of waste that will be generated and the potential impacts associated with their generation and disposal.

The key potential impacts due to solid waste generation identified arise from the following activities:

Construction Phase:

- Biomass wastes from clearance activities;
- Solid waste generation (such as scraps of cable, wooden cable spools, steel bar scrap, concrete debris and wooden insulator crates, etc.), storage and disposal;
- Domestic waste generated by the construction workforce (including paper, plastics, bottles, cans and putrescible wastes) requiring to be stored and disposed of;
- Scheduled wastes generation (i.e., spent insulating oils, fuels and lubricants), storage and disposal; and
- Sewage discharge from on-site sanitary facilities.

Operational and Maintenance Phase:

- Domestic waste generated by the operations and maintenance workforce (including paper, plastics and putrescible wastes) requiring to be stored and disposed of;
- Waste materials associated with routine and non-routine maintenance;
- Scheduled wastes such as spent insulating oil.

The resources (physical, biological and human environment) and receptors that may be impacted in relation to waste generation and management are detailed within **Table 8.3.8**.

Table 8.3.8: Resources and Receptors for Waste Management

Resources	Receptors
• Physical environment including land, air quality and water resources (addressed in the sections above) • Biological environment, primarily being the terrestrial environment • Human environment including subsistence resources, community health, welfare, amenity and safety, employment and incomes, business and economic activity, existing government services, land use and traffic	• Construction and maintenance workers • Contractors and sub-contractors to the site • Residents within the area of impact • Government bodies/businesses providing waste management services

8.3.6.1 Construction Phase

Construction of the proposed project will be carried out by the Contractors appointed by the Proponent. The construction phase is expected to continue for 36 months. The number of workers per day for civil, mechanical and electrical works is expected to be at a maximum of 815 during peak month. During the construction phase, potential impacts will likely arise associated with the generation, storage and disposal of solid waste. The following impacts are anticipated during the construction phase:

- Impacts due to improper disposal of biomass wastes;
- Impacts due to improper storage and disposal of solid wastes (quality of surface and ground waters, odour generation, and introduction of pest species);
- Impact associated with the generation, storage and disposal of construction hazardous and non-hazardous waste.

Impacts due to Improper Biomass Storage and Disposal

The project site can generally be described as shifting cultivation and secondary forest. These vegetation within the right of way will need to be removed prior to construction works. The removal of vegetation represents a solid waste stream, which needs to be disposed of. It is estimated that up to 249,821 tonnes dry matter (d.m) of biomass (see **Table 8.3.9**) such as trees, shrubs, grass and overhanging vegetative matter will be removed.

Table 8.3.9: Above Ground Biomass Estimation

Land Cover	Area (Ha)	Above-Ground Biomass (Tonnes d.m ha^{-1})	Above-Ground Biomass (Tonnes d.m)
Forest	665.1	350	232,785
Tree crop, shifting cultivation	138.6	120	16,632
Grass and bushes, paddy	65.2	6.2	404.24
		Total	**249,821.24**

Source: IPCC, 2006

Indiscriminate disposal of biomass wastes can lead to aesthetic impacts as well as the degradation of water quality. Entry of biomass wastes into the waterways lead to restricted flow, decrease in dissolved oxygen and increase in biochemical oxygen demand.

As the project area has limited municipal waste disposal options, the removed vegetation can be gathered into piles within the ROW and/or used as mulching for erosion controls.

The significance of potential impacts to improper disposal of biomass during the construction phase is assessed below.

Impact	**Impacts Due to Improper Disposal of Removed Biomass**			
Nature	**Negative**	Positive	Neutral	
	Potential impacts associated with improper disposal of biomass are considered to be negative.			
Type	**Direct**	Indirect	Induced	
	Impacts to surface water quality, soil quality, and visual impacts would be direct.			
Duration	Temporary	**Short-term**	Long-term	Permanent
	The construction phase will last approximately 36 months; however, any impacts associated with biomass management would be experienced within the initial phase only.			
Extent	**Local**	Regional	International	
	Potential impacts would likely be limited to the location where biomass is stored and disposed of.			
Scale	The anticipated tonnes of biomass to be removed and requiring management is up to 259,552 tonnes d.m.			
Frequency	It is likely that this impact will occur a few times only depending on site clearing schedule.			

Impact	**Impacts Due to Improper Disposal of Removed Biomass**				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Potential impacts due to inappropriate biomass disposal can result in a small change in water quality when measured at nearby receptors.				
Receptor sensitivity	Low	Medium	**High**		
	The water quality of the surrounding waterways is categorised as "clean" based on DOE's Water Quality Index and are used by the nearby communities as gravity water supply. Therefore, the receptor/resource sensitivity is high.				
Significance	Insignificant	Minor	**Moderate**	Major	
	The combination of a high resource sensitivity and small impact magnitude will result in an overall **Moderate** impact.				

Impacts of Waste Generation, Storage and Disposal

During the construction phase, a range of waste materials will be generated due to the daily activities of the construction workforce (e.g., generation of putrescible waste) as well as a range of general construction waste during the civil works phase of construction. Whilst most of these are likely to be non-hazardous, some of these may be hazardous including used paint, engine oils, hydraulic fluids, spent batteries, spent insulating oil etc. It is noted that the improper storage of waste on-site can give rise to a number of impacts. These include:

- Indirect impacts to community and worker health and safety due to contamination of surface water, accidental leaks or spills of oil, fuel or other hazardous materials; and
- Soil may be contaminated by pollution from spills or leaks of fuel, oil and other hazardous liquid wastes which are incorrectly stored.

The estimated quantity of domestic wastes that could be a potential source of impact (maximum of 815 workers per day during peak period) is 570.5 kg/day of domestic waste (calculated based on a generation rate of 0.7 kg per person per day). It is noted that the peak period will last for approximately 12 months of the total construction period.

The significance of potential impacts to improper disposal of waste during the construction phase is assessed below.

Impact	**Impacts of Improper Solid Waste Generation, Storage and Disposal**				
Nature	**Negative**	Positive	Neutral		
	improper storage and disposal of solid wastes and hazardous wastes can impact public health and water quality of nearby water bodies				
Type	**Direct**	Indirect	Induced		
	Impacts to the pollution of the environment would be direct.				
Duration	Temporary	**Short-term**	Long-term	Permanent	
	The construction phase will last approximately 36 months.				
Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area.				
Scale	Construction activities will take place within the project area. The scale of potential impacts due to release of waste is potentially large due to the quantities present during this stage, particularly when considered in light of the limited waste management network in the area.				
Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the construction phase.				
Magnitude	Positive	Negligible	Small	**Medium**	Large
	Potential impacts due to inappropriate waste disposal are expected to be of medium magnitude.				
Receptor sensitivity	Low	**Medium**	High		
	The nearest receptors of inappropriate waste disposal would be the workers and may pose unhealthy environment for workers.				
Significance	Insignificant	Minor	**Moderate**	Major	
	The combination of a medium resource sensitivity and medium impact magnitude will result in an overall **Moderate** impact.				

8.3.6.2 Mitigation Measures

Biomass Wastes

- Confine clearing to the ROW only. Avoid felling of trees beyond the ROW.
- Strictly prohibit the dumping of removed vegetation into the waterways and drainage system.
- Open burning of biomass wastes is prohibited unless with written permission from the NREB.

- Project Proponent should engage with the local community to ensure that they are provided with priority access to all of the biomass. The biomass should be stored at a designated area where the local community have easy access to it.
- Any biomass not taken by the local community is to be appropriately stored (at least 5 m away from water courses) or immediately mulched for later use within site stabilisation and erosion controls activities.
- Disposal to other location outside the project site should be with approval from the relevant local authority.

Non-Hazardous Wastes

- Select locations for onsite support facilities, material storage yards and workshops established away from any environmental sensitive areas.
- Provide training to workers for waste disposal in designated areas.
- Implement proper storage of the construction materials and wastes to minimise the potential damage or contamination of the materials.
- Implement construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period.
- Minimise generation of solid waste by sound planning of material usage, using reusable items and encourage 3Rs (Reuse, Reduce and Recycle) concept among workers.
- Any steel waste can be sold as scrap, and wooden crates and spools can be returned to the supplier. Concrete waste of inert nature will be stored in a laydown area and will be reused where possible.
- Segregate scheduled wastes and non-hazardous waste and provide appropriate containers for the type of waste type (e.g., enclosed bins for putrescible materials to avoid attracting pests and vermin, and to minimise odour nuisance).
- Sufficient refuse bins should be provided for construction workers and staff at strategic locations, such as where food is consumed, and accessible by scavenging trucks.

- Maintain good housekeeping within the base camps and the overall cleanliness of construction site.
- Construction materials and debris should be kept away from drains.
- A major clean-up should be conducted to clear the construction site of all construction wastes and temporary structures at the end of all construction works.
- Refer to **Appendix 8.3.3** for Guidelines on Construction Waste Management (CIDB), **Appendix 8.3.4** for Guidelines on Temporary Permit Application for Building for Workers' Quarters Within Construction Sites (Ministry of Local Government and Housing Sarawak).
- No open burning of solid wastes shall be allowed at the project site.

Scheduled Wastes

- Used oil shall be stored in designated drums, properly stored with updated inventory record showing the quantity and movement of material. The disposal of used oil and any other scheduled waste is to be in accordance with the Environmental Quality (Scheduled Wastes) Regulations, 2005.
- Ensure that the storage area for scheduled wastes have impermeable floor and containment, of capacity to accommodate 110% of the volume of the largest waste container. The Project Proponent shall refer to the Guidelines for Packaging, Labelling and Storage of Scheduled Wastes in Malaysia.
- Temporary fuel storage facilities and refuelling activities should be located at least 100 m from any water course.
- Oil-absorbent material, tarps, and storage drums will be used to contain and control any minor releases of oil and grease.
- Limit access to scheduled waste storage areas to employees who have received proper training.
- Conduct periodic inspections of waste storage areas and document the findings.
- Repair and maintenance of vehicle is to be carried out at workshop area only. The workshop shall have a concrete floor bunded with oil and grease trap.

- Dispose of scheduled waste by DOE approved licensed Contractors.

8.3.6.3 Operation and Maintenance Phase

The assessment of operational phase impacts includes those arising from both routine operations and maintenance of the proposed project. Whilst most of the wastes generated during maintenance are likely to be non-hazardous, some of these may be hazardous, for example, used paint, engine oils, spent lubricating oil, spent solvents, spent insulating oil, etc.

The significance of potential impacts to improper disposal of waste during the operational and maintenance phase is assessed below.

Impact	**Impacts of Solid Waste Generation, Storage and Disposal**				
Nature	**Negative**	Positive	Neutral		
	Potential impacts associated with improper storage and disposal of solid wastes are considered to be negative.				
Type	**Direct**	Indirect	Induced		
	Impacts would be direct.				
Duration	**Temporary**	Short-term	Long-term	Permanent	
	The routine maintenance will only last for few days; therefore, the duration is temporary.				
Extent	**Local**	Regional	International		
	Potential impacts would likely be restricted to the local area.				
Scale	Operation and maintenance activities will take place within the project area. The scale of potential impacts due to release of waste is potentially small due to the quantities present during this phase.				
Frequency	Impacts would occur intermittently but repeatedly throughout the day for the duration of the operational and maintenance phase.				
Magnitude	Positive	Negligible	Small	**Medium**	Large
	Potential impacts due to inappropriate waste disposal are expected to be of medium magnitude.				
Receptor sensitivity	Low	**Medium**	High		
	The nearest receptors of inappropriate waste disposal would be the workers and may pose unhealthy environment for workers.				
Significance	Insignificant	Minor	**Moderate**	Major	
	The combination of a medium resource sensitivity and medium impact magnitude will result in an overall **Moderate** Impact.				

8.3.6.4 Mitigating Measures

The mitigation measures during the construction stage will be applicable for the operation and maintenance phase as well. Refer to **Section 0**.

8.3.6.5 Residual Impacts

If the recommended mitigation measures are implemented, residual impact significance would be negligible.

8.3.7 Greenhouse Gases

The key potential impacts on greenhouse gas during the construction phase identified arise from the removal of vegetation and direct emission mainly from construction site equipment and site vehicles and vessel transportation. During construction, the project will involve the movement of equipment in the construction area such as excavator, piling machines, soil investigation machines, cement mixer truck, generator and boats.

Greenhouse Gas Emission from Biomass Removal

Biomass will be generated from the clearing of disturbed dipterocarp forest and shifting cultivation/secondary forest.

The wasted biomass from clearing 657 ha disturbed dipterocarp forest over five years will release a total of 226,446 tons of CO_2 equivalent through natural decomposition. This is 45,289 t CO_2 eqv per year. The calculations are shown below.

Forest Type	Open Dipterocarp Forest		
Area to clear (ha)	657		
Commercial volume (m^3)	-	Using IPCC 200 Guidelines BCEFs	0.95
Above ground tons dry weight biomass/ha	200		
Carbon: dry weight biomass ratio	0.47		
Of the wasted material in the cleared area:			
Proportion aerobic decomposition/ burning (%)	100%	Years for decomposition:	5

Proportion anaerobic decomposition (%)	0%	Years for decomposition:	30

Total biomass stored in the vegetation	131,400	Tonnes
Biomass to be wasted	131,400	Tonnes
Carbon stored in the wasted biomass	61,758	Tonnes
Carbon released per year from aerobic decomposition	12,351.6	Tonnes
C per year over 5 years as carbon dioxide	45,289.2	Tonnes
Total CO_2 equivalent	226,446	Tonnes

The wasted biomass from clearing 94.5 ha open *belukar* (shifting cultivation/secondary forest) over five years will release a total of 8,142 tons of CO_2 equivalent through natural decomposition. This is 1,628 t CO_2 eqv per year.

Forest Type	Open *Belukar*		
Area to clear (ha)	94.5		
Commercial volume (m^3)	-	Using IPCC 200 Guidelines BCEFs	0.95
Above ground tons dry weight biomass/ha	50		
Carbon: dry weight biomass ratio	0.47		
Of the wasted material in the cleared area:			
Proportion aerobic decomposition/ burning (%)	100%	Years for decomposition:	5
Proportion anaerobic decomposition (%)	0%	Years for decomposition:	30

Total biomass stored in the vegetation	4,725	Tonnes
Biomass to be wasted	4,725	Tonnes
Carbon stored in the wasted biomass	2,221	Tonnes
Carbon released per year from aerobic decomposition	444.15	Tonnes
C per year over 5 years as carbon dioxide	1,628.55	Tonnes
Total CO_2 equivalent	8,142	Tonnes

Greenhouse Gas Emissions from Direct Emission

Greenhouse gas (GHG) emissions calculation is based on the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories, 2006. GHG emissions are estimated using emission factors for the three (3) main greenhouse gases (CO_2, CH_4 and N_2O) and converted to CO_2 equivalent using global warming potential (GWP). **Table 8.3.10** presents the GWPs on a 100-year time horizon relative to CO_2 for ozone-depleting substances and their replacements (IPCC, 2007).

Table 8.3.10: Global Warming Potential (GWP) Values Relative to CO_2

Name	Chemical Formula	GWP Values for 100-year Time Horizon
Carbon Dioxide	CO_2	1
Methane	CH_4	28
Nitrous Oxide	N_2O	265

Source: IPCC, 2014

GHG emissions are estimated in terms of CO_2 equivalent (CO_2e) according to the following equation:

$$Emissions_{GHG,fuel} = Fuel\ Consumption_{fuel} \times Emission\ Factor_{GHG,fuel}$$

Where:

$Emissions_{GHG,\ fuel}$ = z

$Fuel\ consumption_{fuel}$ = amount of fuel combusted (TJ)

$Emission\ Factor_{GHG,fuel}$ = default emission factor of a given GHG by type of fuel (kg of greenhouse gas/TJ)

The type of fuel used for all equipment is diesel. To convert the consumption of diesel in volume (litres) to energy (TJ), the following conversion factors can be applied:

- 1 kg = 10^{-3} tonne = 10^{-6} Gg
- 1 litre = 10^{-3} m^3

- Default net calorific value for gas/diesel oil = 43.0 TJ/Gg[3]
- Density of diesel = 874.31 kg/m^3[4]

Fuel consumption for diesel (in terms of TJ of energy) can therefore be calculated as follows:

Fuel consumption (TJ) = Diesel Use (l) × Diesel Density (kg/m^3) × Net Calorific Value (TJ/Gg) × 10^{-9} (Gg/kg)

= Diesel Use (l) × 43.0 (TJ/Gg) × 874.31 (kg/m^3) × 10^{-9} (Gg/kg)

= Diesel Use (l) × 3.67×10^{-5} (TJ/l)

It is assumed that the mobile construction equipment for the project is medium size load with an average horsepower of 200 hp. The diesel fuel consumption rate is approximately 21.86 L/hr [5]. For stationary generators, the diesel fuel consumption rate is assumed to be 15 kg/hr.

It is expected that construction activities will be completed in 36 months. Construction hours are anticipated to be 8 hours per day, 6 days per week. Therefore, total days for construction are approximately 936 days.

GHG emissions from construction equipment are estimated following the approach of the IPCC and converted to CO_2e using GWP with fuel consumption of 21.86 litres/hr and emission factor for diesel mobile combustion (see **Table 8.3.11** below).

Table 8.3.11: Default Emission Factors (kg of Greenhouse Gas per TJ on a Net Calorific Basis)

Sources/Fuel	CO_2	CH_4	N_2O
Stationary Combustion			
Gas/Diesel Oil	74100	3.0	0.6
Mobile Combustion			
Road Transport – Gas/Diesel Oil	74100	3.9	3.9
Water-Borne Navigation – Gas/Diesel Oil	74100	7	2

Source: IPCC, 2006

[3] *Table 1.2 in Chapter 1 of Volume 2, IPCC (2006)*
[4] *Table 3-8 Density of distillate oil (diesel), API (2009)*
[5] *Estimated using FAO's formular http://www.fao.org/docrep/t0579e05.htm#3 calculation of machine rates*

The release of GHG emissions (scope 1 emissions, i.e., those from emissions directly on-site) in CO_2 equivalent is estimated to be at 23.8 Gg, as shown in **Table 8.3.12**. This estimation is considered conservative as it assumes the number of construction equipment and machinery at peak construction phase operating continuously throughout the entire construction period.

Malaysia ratified the United Nations Framework Convention on Climate Change (UNFCCC) on 13 July 1994 as a Non-Annex I Party. Malaysia's commitment in reducing GHG emissions as outlined in the Malaysia INDC include a reduction in GHG emissions intensity of GDP by 45% by 2030 relative to the emissions intensity of GDP in 2005. This includes 35% on an unconditional basis and a further 10% is condition upon receipt of climate finance, technology transfer and capacity building from developed countries. In relation to the national GHG emission, the estimated GHG emission from the proposed project (biomass removal and direct emission) equates to approximately 0.07% of the total GHG emissions of 317,626.83 Gg CO_2eq in 2014 (MESTECC, 2018).

The significance of potential impacts from GHG emission during the construction phase is assessed. Magnitude is considered small as emissions contribution is accounted for 0.07% of national GHG emissions in 2012. Receptor sensitivity is considered low because the local atmosphere is not expected to be any more or less sensitive to potential impacts to GHG. Therefore, the significance of the impact is considered insignificant.

Table 8.3.12: Estimated GHG Emission During Construction Phase

Source Type	Quantity	Activity Data			Total Fuel Consumption		GHG Emission (kg CO_2e)				Total GHG Emission (Gg CO_2e)
		Fuel Consumed (L/hr)	Working Hours (Hr)	Working Day (Day)	Litre	TJ	CO_2	CH_4	N_2O	Total	
Material Transport Lorry	6	21.86	8	936	982,126.1	36.9	2736020.5	4032.0	38160.3	2778212.9	2.8
Boat	2	21.86	8	936	327375.4	12.3	912006.8	2412.3	6523.1	920942.3	0.9
Excavator	8	21.86	8	936	1309501.4	49.2	3648027.4	5376.0	50880.4	3704283.8	3.7
Soil Investigation Machine	4	21.86	8	936	654,750.7	24.6	1824013.7	2688.0	25440.2	1852141.9	1.9
Piling Machine	8	21.86	8	936	1,309,501.4	49.2	3648027.4	5376.0	50880.4	3704283.8	3.7
Cement Mixer Truck	6	21.86	8	936	982,126.1	36.9	2736020.5	4032.0	38160.3	2778212.9	2.8
Generator for Camp	10	17.16	10	936	1,606,176.0	60.4	4474507.5	5072.3	960.2	4489181.0	4.5
Generator for Tower Erection	6	17.16	8	936	770964.5	29.0	2147763.6	2434.7	4608.6	2154806.9	2.2
Conductor Payout Machine	4	17.16	8	936	513976.3	19.3	1431842.4	1623.1	3072.4	1436537.9	1.4
Total GHG Emissions During Construction Phase											**23.8**

Impact	**Potential Impacts on Climatic Condition Due to GHG Emissions**			
Nature	**Negative**	Positive	Neutral	
	Conversion of carbon stock into CO_2 and other greenhouse gasses contributes to current negative climate changes and degradation of the airshed.			
Type	**Direct**	Indirect	Induced	
	Potential impacts would likely be direct impacts through the release of emissions from combustion process of construction equipment and machineries as well as decomposition of biomass from clearing.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	Many of the major greenhouse gases can remain in the atmosphere for tens to hundreds of years after being released.			
Extent	Local	Regional	**International**	
	GHG can potentially affect the Earth's climate.			
Scale	The emissions from construction phase are calculated to be 258.4 Gg CO_2eq. Compared to Malaysia's CO_2 release of 317,627 Gg CO_2eq in 2014, the total GHG releases from the project are insignificant (approximately 0.07%).			
Frequency	Emissions will be released intermittently, but repeatedly throughout the construction period and brief period after clearing.			
Magnitude	Positive	Negligible	Small	**Medium**	Large
	Minor direct emissions of GHG will be emitted as a result of the project. The GHG emission from biomass removal is approximately 46,917.8 tonnes CO2e per year and the GHG emission from direct sources is approximately 7939.5 tonnes CO_2e per year. The total GHG emission from the project is approximately 54,857.25 tonnes CO_2e per year and is considered as significant according to IFC PS3 (25,000 tonnes CO_2e per year). Magnitude is therefore considered medium. Relatively, this is a small project compared with other ongoing land conversion activities.				
Receptor sensitivity	**Low**	Medium	High	
	GHG is a global pollutant. The greenhouse effect is enhanced by GHG emissions of anthropogenic nature. Minor emissions of GHG will be emitted as a result of the project, but not likely to significantly change atmospheric GHG concentrations. Receptor/resource sensitivity is rated as Low as no direct, immediate impacts will be noticeable by humans or wildlife.			
Significance	Insignificant	**Minor**	Moderate	Major
	While the concern is global, the combination of a low receptor sensitivity and medium impact magnitude of this project will result in an overall **Minor** impact.			

8.3.7.1 Mitigation Measures

- Implement the same mitigation measures as stated in **Section 8.3.4** to minimize impacts to air quality.
- Develop and implement preventive maintenance plan for generators, machines and engines to ensure combustion efficiency.
- The use of sulphur hexafluoride (SF6) – used as a gas insulator in electrical switching equipment, cables, tubular transmission lines, and transformers – will be avoided, or if unavoidable, equipment with low leakage will be used. SF6 is a greenhouse gas with a significantly higher global warming potential (GWP) than CO_2.
- Quantify GHG emissions annually in accordance with internationally recognized methodologies and good practice.

8.3.8 Traffic and Transportation

8.3.8.1 Construction Phase

8.3.8.1.1 Land Traffic

Equipment and machinery will be mobilized to the site which will temporarily increase traffic loadings. As for construction material, transportation shall be done as and when required, because the quantity of materials required are limited to tower structure materials like steel lattice, insulators, conductors and accessories, the impact on the communities is not foreseen. Nevertheless, it is required to ensure safety during transportation and mobilization of machineries and materials.

Temporary link road accesses would be constructed where the project site is not accessible by existing roads. However, the upgrading or construction of access roads may create some potential traffic conflicts if the access roads are sited at locations with poor alignments where adequate intersection sight distance cannot be achieved. The road sections at the survey points are expected to face maximum V/C of 0.20 during peak periods in Year 2024 except for TS4. TS4 would face maximum V/C of about 0.70 due to high percentage of heavy vehicles (36% to 97%).

8.3.8.1.2 Riverine Traffic

The mobilisation and demobilisation activities are relatively short and therefore would not pose significant impact to the existing riverine traffic condition. However, throughout the duration of construction, the activities will provide less room for boats plying at that section of the river and may cause potential conflict when "barge" and "cargo" reaches that section. However, the hourly number of boats plying at the survey points is quite minimal. RS1 and RS3 at Btg. Rajang have about 10 to 12 boats per hour while RS4 and RS5 at Btg. Baleh have about 3 boats per hour. The overall impact significance during the construction phase is considered **Minor**. The impact assessment is summarized below.

Impact	**Traffic Impact during Construction**				
Nature	**Negative**	Positive	Neutral		
	Traffic impact is negative.				
Type	**Direct**	Indirect	Induced		
	Traffic movement may be disrupted by the construction activities.				
Duration	**Temporary**	Short-term	Long-term	Permanent	
	Impacts are considered temporary, as it only happens during pre-construction and construction phases.				
Extent	**Local**	Regional	International		
	Impacts would be confined to access roads identified for use of the project (most of them are existing logging roads) and to the main river to be used for transportation of machinery and equipment.				
Scale	The traffic impacts are expected to happen at every river and road crossings, localized (within 10 – 20m from the worksite boundary) and temporary (i.e., throughout the construction period of 36 months). The traffic impacts are expected to be small provided that all mitigation measures and good site practices are implemented.				
Frequency	Throughout construction period, during working hours.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered to be small as long as the Contractors and sub-contractors follow all regulations and procedures to ensure safety.				
Receptor sensitivity	**Low**	Medium	High		
	The receptor sensitivity is considered low as there are no high-density villages nearby.				
Significance	Insignificant	**Minor**	Moderate	Major	
	Significance of impact is considered to be **Minor** in terms of traffic.				

8.3.8.2 Mitigation Measures

To ensure minimal negative impact to the commuters, several Mitigation measures are recommended to be carried out to reduce the foreseen traffic impact.

Land Traffic Safety:

- Ensure that all vehicles are certified road worthy prior to being mobilized for work activities.
- All Contractors and sub-contractors shall comply with the safety procedures and regulation as stipulated by the relevant authorities. Speed limit and other traffic laws should be strictly observed.
- The Proponent and its Contractors will identify all access restrictions expected to occur during construction. Affected land owners, community, farmers, shall be notified. A plan shall be prepared to ensure adequate access at all times. This plan may involve alternate access, detours, or other temporary mitigations.
- Install appropriate warning and traffic guidance signages and barricades along the access roads and rivers to facilitate traffic movements, provide directions and warn public approaching the construction site.
- Install traffic speed regulation devices, such as speed bumps, and signage at sensitive locations including in the vicinity of school, longhouse, base camps, busy intersections or before the sharp bend.
- Spur roads to the transmission tower and substation should be sited at locations with adequate sight distance from the main road to upgrade the safety of maintenance vehicles.
- Avoid overloading of construction material transportation trucks. Truck load should be covered and secured to prevent the load from dislodging during the transportation of materials.
- Stop and park the machineries properly at places that would not obstruct the existing traffic movements while carrying out construction works.
- Flagman shall be engaged to control traffic especially during the entering and existing of heavy vehicles at the access points.

- The Contractors shall immediately repair and/or compensate for any damage caused by the project to public access roads, properties and community facilities.

- Proponent and its Contractors shall provide a public liaison person before and during construction to respond to concerns of local communities about traffic, and other safety-related concerns. Procedures for reaching the public liaison officer via telephone or in person shall be included in notices distributed to the community in accordance with first point above.

- Community complaints register and other means will be adopted for the community to complain about non-adherence of project traffic to speed limits, safe driving and other safety-related concerns.

Riverine Traffic Safety:

- Strict compliance with the Sarawak Rivers Ordinance, 1993 – Section 12(b), (c) and (d), Sarawak Rivers (Traffic) Regulations, 1993 – Regulation 50 and Sarawak Rivers (Cleanliness) Regulations, 1993 – Regulation 15.

- The Contractors shall ensure that their activity will not cause any obstruction or danger to traffic on the river and adequate lights, signs or warnings shall be displayed.

- Avoid construction activities in close proximity to existing jetties or to relocate the jetties to a strategic location.

- No construction and or construction works shall be carried out between the hours of sunset (1800 hrs) and sunrise (0600 hrs), without prior written approval of the Controller. All the construction activity along the river and vessel movement/anchorage shall be carried out in accordance with the regulations cited in Sarawak Rivers (Traffic) Regulations, 1993.

- The Proponent / Contractors shall notify The Controller of the Sarawak Rivers Board before commencement of works.

- The vessel engaged in the operation shall have valid River Transport Permit, insurance and exhibit appropriate signs and signals to indicate the nature of operations.

8.3.8.3 Operation Phase

8.3.8.3.1 Land Traffic

During the operational phase of this project, there would be very minimal impact to the road network as it is anticipated that only maintenance vehicle would come into the substation and transmission tower sites to carry out the maintenance work. It is also envisaged that this maintenance work would not happen frequently and therefore would not impose any significant impact to the surrounding road network.

8.3.8.3.2 Riverine Traffic

There would be no significant impact foreseen during operational phase.

8.3.8.4 Mitigation Measures

- Transportation vehicles should be maintained and examined before each maintenance work trip.
- Avoid speeding and adjust speed accordingly.
- Provide parking spaces that do not obstruct moving vehicles while carrying out maintenance works.

8.4 BIOLOGICAL RESOURCES

8.4.1 Habitats and Threatened Flora Species

Loss of or degradation of habitat, and thereby also increased threats to threatened flora species, arise from the removal of vegetation for the construction of any components of the project. These include:

- Clearance of the ROW
- Construction of access roads
- Transmission Towers
- Conductor tensioning and splicing sites
- Construction staging and laydown areas
- Operational access roads

- Temporary access roads

Each of these activities would cause the removal of existing vegetation and disturbance of surface soils. Permanent loss of habitat would occur where new tower foundations are installed. The direct impacts to the natural environment of the transmission line may during the construction be:

- Increased decline of threatened and endangered species
- Loss and fragmentation of habitat
- Risk of fire due to accumulated vegetation from ROW clearing

8.4.1.1 Increased Decline in Threatened Flora Species

By clearing the ROW, some existing biologic resources will be lost. Timbers may be salvaged but will in most cases be harvested at a time when it will not be optimal to do so, either because they are immature or because other resources were more opportune at that time.

Shifting cultivation or various forms of timber harvesting have removed old stands leaving a mosaic of agricultural land, secondary forest or at best regenerating logged forest. Flora and vegetation in logged over and cultivated areas are unlikely to have any conservational significance, except for some forest patches at steep and difficult to access areas.

Nevertheless, there will be some non-timber resources used by local communities such as fruits, medicinal herbs, rattan etc. Flora species of importance include Dipterocarpus oblongifolius (Ensurai), Shorea macrophylla (Engkabangs) and all figs (Ficus spp.). These plant species are protected under Sarawak WLPO but classified as 'Least Concern' by the IUCN. Other protected species potentially presence in the area are Eurycoma longifolia (Tongkat Ali) and Goniothalamus velutinus (Kayu Hujan Panas), both of which play prominent medical and spiritual roles for the local communities.

The transmission line, however, is aligned at some distance to settlements, wherefore these resources are not likely to be for daily use. Overall, the project site is not unique in terms of biodiversity or located in a protected area, and little is known of the conservation status of threatened flora species in the area.

The impact is local, reversible and insignificant.

Impact	**Increased Decline in Threatened Flora Species**			
Nature	**Negative**	Positive	Neutral	
	Permanent removal of vegetation and conversion of habitat loss in the ROW and other sites may directly remove individuals of threatened species and reduce habitat availability for these species. Threatened species may also be affected by the fragmentation of habitat resulting from a 50 m ROW.			
Type	**Direct**	Indirect	Induced	
	Individuals of threatened species or their habitat of these species will be directly removed along the ROW of the transmission line and in other sites.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	Apart from some deeper valleys and river banks, the ROW will remain cleared throughout the duration of the project.			
Extent	**Local**	Regional	International	
	There may be cumulative effects locally as land conversion takes place in the region. The present project is, however, minute.			
Scale	Loss of individuals of threatened species and habitat is expected to be limited, within the 50 m ROW of the 177 km transmission line or approximately 657 ha of forest.			
Frequency	Permanent. Throughout project existence through clearance and maintenance.			
Magnitude	Positive	Negligible	Small	**Medium**	Large
	The presence of individuals of threatened species in the areas to be cleared is not known. The extent of habitat to be cleared will be minimised, and focused on the transmission towers and access roads mainly.			
Receptor sensitivity	Low	**Medium**	High	
	Threatened species are of at least Medium sensitivity, and possibly High, depending on whether they are endangered or critically endangered.			
Significance	Insignificant	**Minor**	Moderate	Major
	The quantity and quality of the resources are low, loss is reversible and localised.			

8.4.1.2 Loss and Fragmentation of Habitat

The clearing of the ROW, especially along Btg Baleh, will leave a scar in the habitat as the habitat there is less fragmented than along the Btg. Rajang, although it is patchy in appearance and density. This will not necessarily cause any major loss in living space/feeding areas for the existing wildlife populations but will present a

barrier to the movement of canopy dependent animals. This is further dealt with under **Section 8.4.2**.

It is expected that secondary or invasive species will invade the ROW but that these species, including grasses, sedges and ferns, will spread further is unlikely. Such invasion is part of the natural succession, and the secondary species will remain there as long as the area is not allowed to turn back into primary forest. The secondary species are by nature light demanding and therefore do not spread into adjacent, closer vegetation. There is a small probability that the cleared ROW will present a barrier to pollinators or animals that contribute to seed dispersal.

The impact is local, reversible but cumulative with similar impacts from the adjacent access roads.

Impact	**Loss and Fragmentation of Habitat**				
Nature	**Negative**	Positive	Neutral		
	The loss of habitat, i.e., vegetative cover, will create a 50 m scar that to some extent may prevent gene exchange between the two sides of the transmission line. This, however, is primarily applicable in the areas of dipterocarp forest.				
Type	**Direct**	Indirect	Induced		
	The change is abrupt and direct as the habitat is simply removed and converted into grassland.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The change will last as long as the ROW is maintained as a cleared line for maintenance purpose. It is, however, reversible.				
Extent	**Local**	Regional	International		
	The change is within the ROW and access roads but cumulative.				
Scale	Abrupt change of habitat is expected to be insignificant outside the 657 ha cleared dipterocarp forest.				
Frequency	ROW clearing is once off activity.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	The magnitude of the loss is small but locally noticeable due to its cumulative nature.				
Receptor sensitivity	Low	**Medium**	High		
	Although the transmission line will cross forested areas, these forests have been subjected to pass logging and current shifting cultivation activities. There are no gazetted, legally protected areas, i.e., national parks, wildlife sanctuaries, nature reserves, within 50 km of the transmission line ROW.				

Impact	**Loss and Fragmentation of Habitat**			
Significance	Insignificant	**Minor**	Moderate	Major
	Overall, the impact of loss of habitat is small due to the scale of the project. However, as the loss may contribute to fragmentation of habitat, the overall level is raised to **Minor**.			

8.4.1.3 Mitigation Measures

- Implement the mitigation measures proposed in relation to land acquisition water quality, air quality and noise as mentioned earlier.
- Minimise vegetation clearance to the strictly-necessary areas around the transmission tower footers and lines, and do not clear the entire ROW.
- Before commencement of clearing works, areas to be cleared shall be demarcated clearly; and Contractors will not be permitted to remove vegetation beyond these areas.
- Trees of threatened species and trees that are keystone species (e.g., *Ficus* spp) will be identified prior to felling, and all options should be considered to avoid their felling.
- Only manual tree felling i.e., using handheld equipment such as chainsaws, brush cleaners, parangs etc., will be carried out with no or minimum destruction to ground covers, the herbaceous and shrub plants.
- All felling must be within the ROW after which debris, to the extent it cannot be contained within the ROW, may be pushed to the side in a manner that does not harm neither stems nor roots of standing trees.
- Clearing operations shall avoid felling of tall trees into neighbouring areas, where they may damage canopies and stems (the bark) when falling.
- Roots and stumps will be left in situ and the cut vegetation stacked or cut/chipped or mulched to increase ground contact for a speedy decomposition.

8.4.1.4 Risk of Fire due to Accumulated Vegetation from ROW Clearing

All vegetation that may interfere with the transmission line and towers will be cleared. During land clearing, large quantities of vegetative biomass will be generated. If burned, there is a risk that wild fires may escape into the adjacent forest areas causing further loss and fragmentation of habitat for natural flora fauna.

Due to government regulations that prohibit open burning, intentional burning of biomass accumulations is discouraged. However, accidental fires may occur due to sparks from welding or other work activities of from workers' other activities.

Impact	**Risk of Fire**				
Nature	**Negative**	Positive	Neutral		
	Potential fire risk associated with improper disposal of vegetative wastes generated from ROW clearing is considered to be negative.				
Type	**Direct**	Indirect	Induced		
	Loss of habitat due to fire would be direct.				
Duration	**Temporary**	Short-term	Long-term	Permanent	
	Any impacts associated with biomass management would be experienced within the initial phase only, and only on a minor scale during maintenance.				
Extent	**Local**	Regional	International		
	If burned there is a risk that wild fires may escape into the adjacent forest areas.				
Scale	Local				
Frequency	Brief period after clearing.				
Magnitude	Positive	Negligible	Small	**Medium**	Large
	If burned or accidental fire take place, loss of habitat, impact on air quality, damage and loss of properties can take place beyond the ROW.				
Receptor sensitivity	**Low**	Medium	High		
	The remnant and regenerating dipterocarp forest are moist and there is little evidence of previous wildfires. Even so, Dipterocarp fires are normally ground based and regeneration capacity is high.				
Significance	Insignificant	**Minor**	Moderate	Major	
	The combination of a low receptor sensitivity and medium impact magnitude will result in an overall **Minor** Impact.				

8.4.1.5 Mitigation Measures

- No open burning shall be allowed within the ROW or and surrounding the site without written permission from NREB.
- Risk of wild fire can be managed by encouraging land clearing personnel, including shifting cultivators adjacent to the ROW, to use alternative means to clear vegetation; for example, mulching before composting, etc. This will reduce the risk wild fire damage to transmission line, infrastructure, nearby forest; protected species; habitat, etc. It will also significantly reduce the negative environmental impacts related to the release of GHG emissions and associated global warming and climate change.

8.4.2 Threatened Fauna Species

The project activities that have an impact on wildlife include:

i. Clearing of vegetation for the transmission line ROW.

ii. Clearing of vegetation and earthworks for access road to towers.

iii. Construction of towers and their foundation and stringing of transmission line.

Two main impacts on wildlife are:

i. Physical changes to their habitat; and

ii. Temporary disturbance due to the presence of construction workers and machinery.

The severity of impact depends on the condition of existing environment and whether endemic species or species of conservation importance are present in the affected area. This will lead to increased decline of threatened species due to:

i. The loss of suitable habitat;

ii. The fragmentation of their populations; and

iii. The reduction in habitat quality due to fragmentation

As stated in Chapter 6, several CR and EN species are potentially present in the area since they have been recorded in Pelagus about 20 km from the project area. These are Helmeted Hornbill – CR, White-crowned Hornbill and Greater Green

Leafbird – EN; Sunda Pangolin – CR, Bay Cat – EN). Other threatened species (Straw-headed Bulbul - CR and Slow Loris – EN) were reported from Upper Baleh about 70 km up-river from Putai.

8.4.2.1 Construction Phase

8.4.2.1.1 Loss of Fauna due to Loss of Suitable Habitat due to Habitat Fragmentation

As mentioned in Chapter 6, all forest areas near the transmission line have been disturbed one way or another over the decades. Access provided by timber extractions companies provide access to the local people to farm, hunt and collect jungle produce.

Suitable habitat for the threatened species mentioned include old secondary forest, regenerating logged forest and patches of primary forest where it is too steep to log. A small amount of these habitats will be lost during construction by activities such as ROW clearing and earthworks for access roads, towers and transmission line ROW.

Wildlife habitat will be fragmented through the creation of transmission line ROW, construction of towers and access roads to the towers. Habitat alteration will be a permanent feature of the transmission line as transmission line ROW and access roads are maintained free of tall vegetation during the operational phase. Altered habitats also reduces the overall quality of wildlife habitat at the landscape level.

Construction activities also affect terrestrial fauna directly impacting them through injury and death if they are unable to move away from the worksite and indirectly through loss of habitat for refuge, foraging, resting and nesting.

The direct impact during construction phase on terrestrial fauna is predicted to be minor on birds and bats because they are expected to move away as soon as they are disturbed by construction noise. It is predicted to be moderate on herpetofauna (reptiles and amphibians) because their speed of movement away from the source of disturbance is comparatively slower, and they tend to seek refuge in holes and crevices in the ground rather escaping.

The indirect impact on terrestrial fauna during construction phase, which is loss of habitat for refuge, foraging, resting and nesting is also predicted to be minor because similar habitat is available near to the project site. The linear nature of transmission line ROW and access road to towers means that similar habitat is available within 25 meters, which is well within the home range of all the major

species recorded and therefore familiar habitat to the affected individual. Upon the modification of their habitat, they will have to move to the surrounding area and adjust to new territories.

However, any individuals moving into other habitat nearby likely will find that habitat already occupied by competing individuals of their own and other species. Due to competition for food, nest spaces and breeding partners the individuals that moved will more likely die or at least have vastly reduced survival or fecundity, or alternatively that the individuals in the habitat they move into will.

Under PS6 (IFC 2012)[6], critical habitats are (1) habitat of significant importance to Critically Endangered (CR) and/ or Endangered (EN) species; (2) habitat of significant importance to endemic and/ or restricted-range species; (3) habitat that supports significant global concentrations of migratory species and/ or congregatory species; (4) highly threatened and/ or unique ecosystems; and/ or (5) areas associated with key evolutionary processes.

The loss of suitable habitat for CR and/ or EN species is small compared to what is available to them. The fact that we were not able to see any of these threatened species or that the local people failed to report them meant that these threatened species seldom use the area affected by the project, and therefore is not of significant importance (Criteria 1). The endemic species reported in **Chapter 6** are endemic to Borneo and not to the area affected by the project (Criteria 2). No congregation of migratory species was reported within the project site, most sightings were either one or two individuals (Criteria 3). There was no unique ecosystem identified in the region, and the ecosystems are typical of rural areas in Sarawak (Criteria 4).

Based on this, the impact is considered direct but local, of small magnitude and minor significance, with similar impacts from the adjacent access road.

[6] IFC (International Finance Corporation). 2012. Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. World Bank Group, Washington, DC. 7pp

Impact	**Loss of Threatened Fauna**				
Nature	**Negative**	Positive	Neutral		
	For fauna this is loss of habitat for refuge, foraging, resting and nesting, albeit in a small scale. Habitat alteration, even at small scale, will degrade the overall quality of habitat at the landscape level.				
Type	**Direct**	Indirect	Induced		
	The change is abrupt and direct as the habitat is simply removed.				
Duration	Temporary	Short-term	Long-term	**Permanent**	
	The change will last as long as the ROW is maintained as a cleared line.				
Extent	**Local**	Regional	International		
	The change is local but cumulative.				
Scale	Change of habitat is expected to be limited within the narrow 50 m ROW of the 177 km transmission line or approximately 885 ha. The linear nature of transmission line ROW and access road to towers mean that similar habitat is available within 25 m. This is well within the home range of all the species recorded and therefore familiar habitat to the affected individual.				
Frequency	Throughout construction period, during working hours.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	The magnitude of the loss is insignificant but locally noticeable due to its cumulative nature.				
Receptor sensitivity	Low	**Medium**	High		
	Receptor sensitivity is Medium as there was no unique ecosystem identified in the region, and the ecosystems are typical of rural areas in Sarawak.				
Significance	Insignificant	**Minor**	Moderate	Major	
	Overall, the impact on threatened fauna is **Minor** due to the scale of the project. There is similar habitat suitable for them within 25 m of the ROW.				

8.4.2.1.2 Mitigation Measures

The most important impact to terrestrial fauna that need to be addressed is habitat fragmentation. Habitat fragmentation occurs through the creation of transmission line ROW, construction of towers and road access to the towers. Habitat fragmentation is a permanent feature of transmission lines where the ROW and access roads are maintained during the operational phase. General mitigation measures include avoidance of sensitive areas such as totally protected areas, salt licks and fauna breeding areas. Neither the study team nor the local people found

evidence of hornbill nests near the project area. All works will be performed gradually, which will enable wildlife to escape or migrate towards neighbouring areas.

- Clearing of riparian areas should be kept to a minimum. Felling of keystone species of tree, providing important food or other resources for fauna, will be avoided if possible (e.g., *Ficus* spp).

- Injured animals during land clearing should be treated at the nearest Veterinary Clinic, which is in Sibu town. To reduce such injury and to allow the animals to escape to nearby forest, land clearing should be unidirectional in nature to avoid trapping wildlife.

- Areas to be cleared will be inspected in advance of clearance for active nesting sites. Nest with eggs and young or chicks encountered during ROW clearing shall be protected and left where found rather than translocated because the mother bird will not tend to their nest if this is placed in another location.

- Identify and check burrows for signs of occupation by mammal. If the burrows are active or occupied, then all reasonable means must be taken to retain them.

- After the construction phase is over, a low vegetative cover (maximum 1 m above ground)[7] inside the ROW should be allowed to regenerate so as to provide habitat for terrestrial fauna as soon as possible. Such regenerated areas are favoured by small mammals (rodents) and, herbivores (eg. Sambar deer) and open area birds (bulbuls, munias, prinia, green pigeon).

- Where possible, installation of transmission lines above existing vegetation to avoid land clearing is recommended.

- Small native trees and shrub which bear fruits for birds and mammals to eat should be permitted to grow to the maximum height permitted by the operational safety guidelines.

- Use of herbicide to remove vegetation shall be avoided because of its potential impact on non-target species and potential off-site land or water effect.

[7] SEB Procedures & Guidelines For Transmission Line Vegetation Management, 2019

- If the transmission line crosses daily flyways and migration routes, e.g., at major river and valley crossings, visibility enhancing objects should be installed.
- Site workers shall be strictly prohibited from hunting, poisoning and killing any animals, at the project site and surrounding areas.
- Company staff and workers should not keep shot guns or any other hunting paraphernalia in their premises; this is for the sake of their own safety as well as to prevent hunting.
- Site workers shall be educated on totally protected and protected species. Wildlife Conservation posters should be put up at site offices and workers quarters (see **Figure 8.4.1** below). The consequences of hunting such species shall be clearly communicated.
- Sarawak Forestry Corporation (SFC) shall be notified on any discovery of protected flora and fauna.
- Debris that may attract animals shall be removed from the project area on a regular basis; organic waste, which should be stored in enclosed containers, shall be removed from the site on a regular basis, and disposed of at a suitable waste facility.

Figure 8.4.1: Poster of Totally Protected Wildlife of Sarawak

8.4.2.1.3 *Disturbance from Noise, Movement and Presence of Construction Workers and Machinery*

Noise from people (workers), machinery and construction activities are also expected to affect the fauna community. The presence and movement of construction workers and their machinery will affect fauna behaviour.

The impact will be localised and temporary and insignificant or minor.

Impact	**Noise Disturbance**				
Nature	**Negative**	Positive	Neutral		
	Noise disrupts periods of rest for wildlife and scares them away during foraging.				
Type	**Direct**	Indirect	Induced		
	This is a direct impact during clearing and tower construction.				
Duration	Temporary	**Short-term**	Long-term	Permanent	
	Impacts are expected to be temporary and short-term during construction phase at infrequent intervals during working hours. Situation will return to normal when there are no work activities.				
Extent	**Local**	Regional	International		
	Noise has only local dispersion near individual towers being constructed or in the vicinity of construction sites.				
Scale	Noise and vibration limited within 50 m ROW and tower work area along the 177 km transmission line. The impacts are also anticipated to be temporary (i.e., throughout the construction period of 36 months).				
Frequency	Intermittent during working hours, throughout construction period.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	The magnitude of noise originating from this project depend on the distance from source to the animal. It is expected to be small.				
Receptor sensitivity	**Low**	Medium	High		
	While sensitivity may be high, this will only be felt by fauna that are close to the worksite.				
Significance	Insignificant	**Minor**	Moderate	Major	
	Due to the remoteness of the project and the very localised sources of noise, this is considered **Minor**.				

8.4.2.2 Operation Phase

During the operation phase, the transmission line ROW will be maintained as a permanently converted habitat. For example, the existing environment under transmission line ROW near the Mapai Substation (already in operation for few years) are distinctly different from nearby habitat. It consists of small and short trees, shrub and grass, and maintained as such by manual cutting of trees. The actual maintained width of the transmission line ROW seems to be considerably narrower and only the area directly beneath the transmission line (about 20 meters wide) is affected. Despite being a permanent feature of the landscape the impact on terrestrial fauna is predicted to be minor and insignificant. The converted habitat is narrower than the home range of all the major wildlife species listed as present, and the remaining nearby habitat should be familiar to individuals affected by the project.

Young vegetation that is expected to grow rapidly in exposed areas such as ROW will provide fodder to herbivorous animals. Some animals may even use the ROW and the access road to move from one area to another. However, as mentioned above being in such an open area increase the exposure of the animals to both their natural predators as well as human hunters.

Combination of height and electrical current in the transmission line can be fatal to birds and bats through collisions and electrocution, especially if the lines transverse daily flyways or migrating route. However, electrocution will only occur if birds and bats touches energised and neutral wires simultaneously. Death to birds and bats due to collision and electrocution are considered minimal due to the wide spacing between the energized components and grounded hardware. SEB's encounters with such cases while maintaining and operating other existing transmission lines in the State will be taken into consideration.

During the operational phase the high voltage current passing through the transmission lines emit electric and magnetic fields but the impact of this on wildlife has not been well documented. Studies by WHO (WHO 2007) concluded that no substantive health issues could be associated with extremely low frequency (ELF) fields, so electric and magnetic fields originating from the overhead transmission lines is unlikely to have an impact on terrestrial or arboreal animals either.

8.5 SOCIO-ECONOMIC IMPACTS

8.5.1 Loss of Agricultural Land, Crops and Livelihood

Compulsory land acquisition will be enforced on the 50 m width strip of lands along the 177 km transmission line route. Most of the affected lands are fallowed (i.e., covered by secondary bushes and forests, termed *temuda* by the locals). Others are cultivated with hill/wet-rice fields, short-term crops (vegetables, banana, corns etc.), cash crops (oil palms, rubber) and fruit trees. The acquisition of these lands, especially the cultivated lands could adversely affect the social and economic well-being of the affected households and the vulnerable groups. Acquisition of land for ROW could also result in the creation of small, fragmented lands (termed 'orphaned lands') which are no longer economical to develop, and can be considered a loss to the landowners.

Loss of crop could also occur due to temporary project uses such as access roads, worker camps and jetties, river crossings, both onsite and at the adjacent lands. These activities could affect community access to farmlands, fishing and hunting/ foraging grounds; hence, could also cause loss of livelihood to the affected households. Improper earthworks could hamper the drainage of adjacent lands causing permanent waterlogging or ponding, and death of the affected crops; and/or can triggered landslides that can damage local crops on the downslopes of the work sites. Tree crops adjacent to ROW could also be permanently lost if they pose danger and be removed.

Of concerns are the elderly/ sick/ disabled people, single-parent and low-income households as well as the dependent children from these households who are particularly vulnerable to the loss of livelihood.

The following is an estimated loss to oil palm plantation due to the project. The plantation is an initiative through community- private partnership, whereby the land owners (i.e., project participants) lease their NCR lands to the private company to develop into oil palm plantation[8]. As illustrated in **Figure 6.2.9 (Chapter 6)** and **Table 6.2.1**, the area under oil pam plantation on the 50 m wide transmission line

[8] Under this development concept, the developer will develop the NCR lands into an oil palm plantation, operate and manage it for a period of not less than 60 years, or such terms permitted under the lease. The lands will be reverted to the landowners upon expiry of development agreement. The developer is obligated to pay rent for single oil palm grown, to the NCR landowners based on the agreed rates and frequency. A participant's return (i.e., the amount of rent paid by the developer) will be based on the numbers of oil palms planted on his/her NCR lands.

ROW is about 46.2 ha. This area would be permanently acquired for the transmission line ROW. The financial impact to plantation owners is estimated as shown in the following text box: i.e., RM554,400 in establishment costs, and RM1,963,500 in annual net revenues, for a total of **RM2,517,900.00**.

ESTIMATED ECONOMIC COST OF NEGATIVE IMPACTS ON OIL PALM PLANTATIONS

- Oil palm is generally planted at a density of 125 trees per ha.
- Establishment costs average about RM12,000 per ha. 46.2 ha x RM12,000/ha = RM554,400
- At full production (*after 5 years) about 5 tons of CPO are produced per ha
- CPO value: RM3,200 per ton.
- Operating costs: RM1,500 per ton
- Net revenue of RM1,700 per ton, or RM8,500 per ha/yr.
- 46.2 ha x RM8,500/ha/year x 5 years = RM1,963,500.00 /ha
- Oil Palm Plantation Value Impacted by Transmission Line: RM1,963,500+RM554,400 = +/- RM2,517,900.00

The significance of loss of agricultural lands and crops, and livelihood is major to the affected households.

Impact	**Loss of Land, Crops and Livelihood**			
Nature	**Negative**	Positive	Neutral	
	Land acquisition, loss of crops and project activities may lead to loss in livelihood.			
Type	**Direct**	Indirect	Induced	
	Impact on land and/ or crop owners and households utilizing natural resources is direct.			
Duration	Temporary	Short-term	Long-term	**Permanent**
	Acquired lands and associated crops; lands affected by permanent access roads; and crops removed for the construction of temporary access roads, worker camps and jetties, or removed due the danger they posed will be permanently lost.			
Extent	**Local**	Regional	International	
	All lands within 50m ROW along 177 km long transmission line and downstream areas of the affected rivers/streams. All impacts are site specific and within Kapit Division.			

Impact	**Loss of Land, Crops and Livelihood**				
Scale	Total size of the land loss is considered small and only limited to 50 m strip of ROW along the 177 km transmission line; and access roads, and sites of worker camps and jetties. Loss of livelihood is small and limited to 50 m strip of ROW along the 177 km transmission line, access roads; and potentially downstream areas of the affected rivers/streams. Out of approximately 877 ha of the affected lands, approximately 652 ha belong to an estimated 330 households from the affected communities within the project AOI. The others 225ha are titled lands, mostly belong to private companies (oil palm companies and logging concessioners).				
Frequency	Permanent loss of lands, crops and livelihood associated with the establishment of the ROW and access roads.				
Magnitude	Positive	Negligible	Small	Medium	**Large**
	Impact magnitude is large as the lands to be acquired include agriculture plots and also loss of livelihood.				
Receptor sensitivity	Low	Medium	**High**		
	Receptor sensitivity is high as a result of loss of agricultural plots and loss of livelihoods.				
Significance	Insignificant	Minor	Moderate	**Major**	
	Overall impact significance is considered as **Major**.				

8.5.2 Mitigation Measures

Mitigation of these impacts require actions in two areas:

- Acquisition of planned land requirements, with corresponding compensation and livelihood restoration support, under a Land Acquisition and Livelihood Restoration Plan (LALRP), prepared and implemented to international standards;
- Minimisation of unplanned land requirements, and, when this is unavoidable, acquisition under the LALRP to the same standards.

Additional mitigation measures recommended include:

- The Proponent should work with the local communities, particularly the owners of affected farmlands early in the design process as is appropriate to help identify potential impacts on local livelihood strategies, well in advance of construction.

- Local communities, particularly the affected land owners and Proponent may work out solutions that include minor changes to specific tower locations and access roads, construction timing, payment to temporarily suspended farming activities and other significant land use concerns

- Suitable routes for temporary access roads shall be decided in advance to avoid multiple failed attempts to build such roads which could potentially cause damage to adjacent lands and crops. Contractors shall follow the predetermined routes as close as possible. Should new routes be decided, the Contractor shall inform the affected landowner in advance.

- Earthworks at sloping areas should be mindful of the potential damages to adjacent lands and crops, particularly in the downslopes. Inform the landowners of the adjacent lands of project activities prior to actual work onsite. Should damages incurred to the adjacent lands and crops, the damages should be assessed, and compensation be paid accordingly.

- If the acquisition of part of the land makes the rest of the land significantly smaller or fragmented (i.e., orphan lands) and that way the economic interest of the owner to use the rest of the land decreases, then those parts of land may also be acquired at the request of the owner.

- Intensively engage/ communicate with the affected communities in order to enable the affected persons to create new opportunities for incomes.

- Provide assistance to severely affected land owners and vulnerable households when necessary. This can be additional cash and in-kind assistance. Alternative income earning opportunities should also be provided, such as credit facilities, training, cash, or employment opportunities.

- Prioritize compensation payments for immediate loss of crops as compensation for the permanent acquisition of land is only paid upon the survey of the completed project. Rate of compensation shall take note of the prevailing economic situation, labour costs, materials and the conditions of the specific crops and the market price for crops.

- All the compensation process should be completed before the actual start of the project on the ground. All agreements reached should be documented and no verbal agreements should be made.

- If the characteristics of the lands associated with temporary project uses are destroyed by the temporary occupation so it cannot be used in the manner and for the purpose it has been used before the temporary occupation, compulsory land acquisition may be required. Negotiation shall be carried with the landowners, and complete acquisition of those land should be carried out before the day of ending the temporary occupation.

- Construction related activities will be organized in a way to avoid and minimize economic displacement, by ensuring accesses are retained to agricultural lands, fishing or hunting/ foraging grounds. Damages to such accesses should be restored as soon as possible.

- Issue of uncompensated loss of the affected lands within the Baleh HEP catchment raised by the communities of Nanga Sepanggil (Rh. Jamit), Nanga Entelawan (Rh Jack, Rh Samon), Nanga Serenggat (Rh Sintau) and Nanga Entelangau (Rh. Jantai) shall be investigated. SEB is to engage these communities and reach agreeable resolution to the issue. The rightful claimants shall clearly be defined and explained to the affected communities. Compensation shall be paid to rightful claimants accordingly. Failure to find win-win solution to the issue could risk project delay as the people may resort to confrontational actions such preventing project related activities on their lands.

- Unsettled compensations for lands acquired for tower bases and damages incurred in the construction, including damages due the construction of access roads for the SEB's previous transmission line on the southern bank of Btg. Rajang should be investigated; the affected communities be clarified of these issue and rightful claimants be compensated accordingly. This is important as some of these communities also have lands potentially affected by the proposed BMTLP; hence, could act in such ways that may cause the delay of the project if the existing land and compensation issues are not clarified and resolved.

8.5.3 Impact on Community Utilised Forest

Based on the land cover information on the transmission line (**Chapter 6**), secondary forest cover approximately 657.7 ha (76%) of the transmission line ROW. This will have impacts on nearby communities who use the forest for collection of non-timber forest products (NTFP's) and hunting. Based on the surveys, collections of NTFP's are usually carried out by womenfolk and the types

of materials collected are food products, such as wild fruits[9] and vegetables[10], for own consumption. Usually, the forest they frequented are those within their longhouse territory or forests closer to river/ accessible by longboats because of advantages of time saving and avoidance of carrying heavy loads of the forest products collected.

Many use-value species, such as wild fruits and vegetables, palms, rattans and bamboos may be cleared, reducing their availability for local communities. Moreover, creation of access roads may expose forest areas to increased human activities. Social survey indicated high percentage of utilization of forest resources among local communities. Hence, the project may affect the availability of these resources to local communities. For these reasons, impact is considered as **moderate**.

Impact	**Impact on Community Utilised Forest**				
Nature	**Negative**	Positive	Neutral		
	Impact on land and crop owners is negative. Loss of the strip of secondary forest may result in loss of NTFP to some local communities.				
Type	**Direct**	**Indirect**	Induced		
	Impact on community forest is direct.				
Duration	Temporary	Short-term	Long-term	**Permanent**	
	Affected community forests within the 50 m ROW and the permanent access roads will be permanent.				
Extent	**Local**	Regional	International		
	Only community forests within 50 m ROW along the 177 km long transmission line and the routes/ sites of project associated uses will be affected. All impacts are site-specific and within Kapit Division.				
Scale	Total size of the affected community forests is small and limited to 50 m strip of ROW along the 177 km transmission line, and sites for routes of the access roads.				
Frequency	Permanent loss of community forests in the ROW and permanent access roads.				
Magnitude	Positive	Negligible	**Small**	Medium	Large

[9] Wild fruits - green longan/ *Dimocarpus longana var. malesianus*, dabai / *Canarium odontophyllum*, durian kuning/ *Durio kutejensis*, terap/ *Artocarpus odoratissimus* embawang/ *Mangifera pajang*, etc.

[10] Wild vegetables - bamboo shoots, ferns /*Diaplazium esculentum (pakis*) / *Stenochlaena palustris (Midin*), *daun ensabi, terung pipit / Solanum torvum*, wild bananas, wild ginger, *bunga kantan/ Ethingera elatoir*, tapioca leaves / *Manihot esculenta*, *kamibit / Passiflora foetida* etc.

Impact	Impact on Community Utilised Forest			
	Impact magnitude is small due to the distance of the settlements from the transmission line.			
Receptor sensitivity	Low	**Medium**	High	
	Some affected areas are important to forest-based livelihoods, and may have historical and cultural links with local communities; hence, the receptor sensitivity is considered medium.			
Significance	Insignificant	**Minor**	Moderate	Major
	Significance of impact is considered as **Minor**.			

8.5.4 Mitigation Measures

- Estimate the actual areas of communal forest that may be lost on a community-by-community basis, identify actual household users, and estimate the yields/ returns they obtain from these forests.
- Include loss of communally held resources in the LALRP.
- Demarcate the ROW and routes of access roads clearly before commencement of works onsite.
- Limit clearing of vegetation within the demarcated ROW, and the routes of access roads.
- Local communities should be allowed to collect useful forest resources such as timber and non-timber resources such as fruits, medicinal herbs, rattan etc. from the affected community forests within the ROW.
- Project workers shall be strictly prohibited from collecting locally important forest resources or hunting at the project site and surrounding areas.

8.5.5 Creation of Direct and Indirect Employment

8.5.5.1 Construction Phase

During site preparation and construction phases, an important staff team will be required. For this project, an estimated total number of 817 workers are required. In particular, qualified staff with experience in construction of transmission lines will be required for construction of transmission line towers and stringing. Nevertheless, for site clearing activities and access roads construction, local

people living in the area will be hired so as to contribute to the creation of temporary jobs in the region.

The staff demand during the different phases of the project will cause direct and indirect jobs, which shall demand services from communities nearby such as accommodation, food, recreation, vehicles, machinery and equipment, waste disposal thus triggering the local and regional economy.

In terms of raw material suppliers, it is anticipated that steel for the transmission towers and electrical cables will be sourced locally.

Impact	**Creation of Direct, Indirect Employment and Local Supply Chain**				
Nature	Negative	**Positive**	Neutral		
	Direct employment of the locals to work in the project. Indirect employments are also expected in local businesses that provide supports and services to the project. Local suppliers of steel and electrical cable are expected to benefit from this project as well as supply chain opportunities for local business and entrepreneurs.				
Type	**Direct**	**Indirect**	Induced		
	Impacts will be both direct and indirect to local residents, local suppliers and businesses.				
Duration	**Temporary**	Short-term	Long-term	Permanent	
	Impact is temporary, which mostly will occur during pre-construction and construction phase (36 months), and periodical during operation phase.				
Extent	Local	**Regional**	International		
	Direct and indirect employments will benefit the residents from nearby settlements, as well as from those other settlements and towns in Sibu and Kapit Divisions. Will benefit raw material suppliers from Sibu and Kuching and supply chain opportunities for (small-scale) local business and entrepreneurs.				
Scale	Employments will be created largely during the pre-construction and construction phases; and subsequently, in periodic maintenance and transmission works associated line operation phase.				
Frequency	Mostly during pre-construction and construction phases; and at periodic intervals during operation phase.				
Magnitude	**Positive**	Negligible	Small	Medium	Large
	Impact is positive as the project will create employment opportunities locally and regionally. Local raw material suppliers will benefit as well.				

Impact	Creation of Direct, Indirect Employment and Local Supply Chain			
Receptor sensitivity	**Low**	Medium	High	
	Impacts are beneficial, and anticipated by the people and local businesses; hence, receptor sensitivity is low.			
Significance	Insignificant	Minor	Moderate	Major
	No significance designation is assigned for positive impact.			

8.5.5.1 Operation Phase

During operational phase, specialized labour will be required specifically for maintenance and transmission line operation tasks. However, this will consist of Proponent's existing surveillance team with experience and specific skills in the task.

8.5.6 Mitigation Measures

Employment and business opportunities created by the proposed project can be realised provided the members of local communities are able to participate in these opportunities. In order to enhance local employment and business opportunities associated, the following measures should be implemented:

- Develop and implement a Local Employment and Content Plan to maximise the employment of local labour and Malaysian nationals. This plan should include provisions for equal opportunity (non-discrimination by gender, ethnicity, religion, and age). This plan should also facilitate identification and selection of qualified local companies to provide needed supplies and services.

- Recruitment policy should place first priority to employ local residents who are interested to work in the project whenever applicable, especially in the semi- and low-skilled job categories such as drivers, general workers, security guards, cleaners, tree fellers etc. The recruitment of foreign workers should be the last resort in accordance with the needs of the project.

- Recruitment package for local workers should include the provision of relevant trainings to equip the local workers with required skills. These include some forms of on-the-job trainings so that the required skills can be transferred.

- Project Proponent, in consultation with local authorities should develop a database of local companies, especially those that qualify as potential service providers (e.g., construction companies, transportation, security, suppliers).

This should be done prior to the commencement of the tender process for construction Contractors. These companies should be notified and invited to bid for the project-related works.

- Project Proponent should make as procurement policy that, that the suppliers maximize their local content, and the percentage of their local content should be an important criterion used when assessing supplier bids.
- Information on availability of employment and business opportunities should be disseminated through the longhouse/village headmen and/or the committee.

8.5.7 Influx and Interaction with Project Staff and Non-Local Workers

It is estimated that 802 workers will be hired during the pre-construction and construction phase, excluding 15 SEB personnel. Although the recruitment of local Sarawakians workforce, especially from the nearby communities is emphasized, workers from other parts of Sarawak, other States and foreigners is expected. These non-local workers will either be from the existing workforce or new recruits, hired for their skill in specialized works such as tower erection and stringing.

With the likelihood to influx of non-local workers, the main concerns include:

- Possible social instability (poor mingling of workers from outside the State or country with local communities could cause uneasiness and worries among the local population).
- Risk of communicable diseases spreading in the local community.
- Health concerns in the camps (communicable diseases).
- Security issues at work sites and camps.
- Unruly behaviours and harassment.

Impact	**Influx and Interaction with Project Staff and Non-Local Workers**			
Nature	**Negative**	Positive	Neutral	
	Non-local workers could instil insecurities and worries among local residents, potentially conflicting with local people. There are also possibilities of harassment to local women and girls.			
Type	Direct	**Indirect**	Induced	
	Impact is indirect to local residents.			
Duration	**Temporary**	Short-term	Long-term	Permanent
	Impact is temporary, which occur infrequently during pre-construction and construction phases; and rarely during operation phase.			
Extent	Local	**Regional**	International	
	The presence of non-local workers can be felt mostly at or near the work sites, and to some extent, at the nearby towns within Kapit and Sibu Divisions.			
Scale	There will be about 817 workers at the peak construction period split into 2 camps. This represents about 3% of the total population within the AOI. Encounters with non-local workers have the possibilities of creating strong feeling of insecurity, worries and harassment to local people, especially women and girls.			
Frequency	Infrequently during pre-construction and construction phases, and rarely during operation phase.			
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is small as the presence of outside workers are likely to be confined to the project site and camps for the duration of the construction phase. The workforce represents about 3% of the population within the AOI or 0.1% of Kapit's population.			
Receptor sensitivity	Low	Medium	**High**	
	Receptor sensitivity at individual level is high, especially among women and girls.			
Significance	Insignificant	Minor	**Moderate**	Major
	The impact is considered as **Moderate**.			

8.5.8 Mitigation Measures

- Prioritise and maximise hiring of qualified locals from Kapit Division before sourcing for workers from outside the Division or State.
- To communicate and enforce Sarawak Energy's contracts and procurement criteria and processes, procedures and guidelines to all Contractors including details of Labour Engagement and Work Permit requirements.

- Project Proponent and Contractors shall ensure compliance to work processes that screen workers, and this includes weekly manpower reporting and regular onsite audits to verify the validity of work passes. This may be carried out together with the Immigration Department and Police.
- The Proponent and Contractors shall be mandated to brief the foreign workers on the rules and regulations of the country including the code of conduct and regulation on occupational safety and health and waste management.
- If there is an issue of employee misconduct, the case should be dealt with in accordance with proper and impartial disciplinary procedures.

8.5.9 Community Safety: Construction Sites

Construction sites may not be fenced during construction phase, and machineries and equipment are likely be left at work sites until completion of the works. The risk of trespass is expected to be the highest when the construction sites are closest to settlements and farmed areas. Trespassing on the construction sites, particularly tower sites at night could result in accidents leading to injuries or even fatalities. This is due to the presence of large machineries, tower construction parts and open excavations for tower erection (which could be partly filled with water). Local hunters, young people, elders and children particularly, are most at risk of being injured.

Impact	**Public Risk of Injury and Fatalities at Construction Sites**			
Nature	**Negative**	Positive	Neutral	
	The presence of unfenced working areas near local settlements may result in trespassing and potential injuries.			
Type	**Direct**	Indirect	Induced	
	Impact is direct to local residents from nearby settlements.			
Duration	**Temporary**	Short-term	Long-term	Permanent
	Impact is temporary, which occur during pre-construction and construction phases; and rarely during operation phase.			
Extent	**Local**	Regional	International	
	Impact is limited to the local settlements in the project area of influence, especially those located close the work site.			
Scale	The scale is considered as low due to the remoteness of the transmission line and the distance of settlements to the transmission line ROW.			

Impact	Public Risk of Injury and Fatalities at Construction Sites				
Frequency	Infrequently during pre-construction and construction phases, and rarely during operation phase.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Magnitude is considered to be small.				
Receptor sensitivity	Low		**Medium**		High
	The sensitivity of the receptors is considered medium.				
Significance	Insignificant	**Minor**		Moderate	Major
	The impact is considered as **Minor**.				

8.5.10 Mitigation Measures

- Ensure that work sites (particularly tower sites) are fenced, and signs are put up around construction sites advising people of the risks associated with trespass. When work sites are less than 100 metres from local settlements or houses, employ security guards to prevent trespass. Security guards are preferably from the affected communities.

- Engage the affected communities to inform or educate them the risks of trespassing onto construction sites, the meaning of signs, and the dangers of playing at construction especially on or near equipment or entering fenced areas.

8.5.11 Community Safety: Traffic Movements on Roads and River

During construction there will be an increase in traffic movements of heavy machinery and light vehicles along the access roads and Btg. Rajang and Btg. Baleh. This will mostly be trucks and barges transporting tower structure materials like steel lattice, insulators, conductors and construction materials such as aggregates, cement and sand required for towers construction.

Frequent traffic movements could increase the risk of road traffic accidents and potential injuries to public road users, especially longhouses residents staying close to the access roads.

Barges used to transport construction machineries and materials can create waves that can be dangerous to smaller watercrafts, especially the longboats both in stationary position (knocking) and moving (capsizing). Transportation activities, however, are expected to be infrequent and only for short period of time. Furthermore, the number of boats plying these rivers is very minimal (10 to 12

boats per hour – See **Section 8.3.8.1.2**). As such, this activity is not expected to pose significant impact to local river transportation or uses.

During the operational phase, low volume of traffic will be generated from maintenance vehicle carry out the maintenance works of the transmission line. As the maintenance works would be carried out infrequently; it would not impose any significant impact to the surrounding road network.

Impact	**Community Safety: Traffic Movements on Roads and River**				
Nature	**Negative**	Positive	Neutral		
	Increased traffic during the construction period may increase risk of road traffic accidents near settlements. Waves generated by barges may endanger locals using small longboats, or carrying out fishing activities.				
Type	**Direct**	Indirect	Induced		
	Impacts are direct to local residents along transportation routes and rivers due to project construction and transportation activities				
Duration	**Temporary**	Short-term	Long-term	Permanent	
	Impact is temporary, which occur during pre-construction and construction phases (36 months) at infrequent intervals and rarely during operation phase.				
Extent	**Local**	Regional	International		
	Impact is largely limited to the settlements in the project AOI, and to some extent, along the roads and rivers used as transportation routes within Sibu and Kapit Divisions.				
Scale	The impact is considered as medium scale.				
Frequency	Occasionally during pre-construction and construction phases, and rarely during operation phase.				
Magnitude	Positive	Negligible	Small	**Medium**	Large
	Impact magnitude is considered to be medium considering the potential consequences of accidents.				
Receptor sensitivity	**Low**	Medium	High		
	The sensitivity of the receptors is considered low as the project area is sparsely populated, while identified access roads are most the existing logging/ plantation, while barges will ply the existing main waterways (Bg. Rajang and Btg. Baleh) which has very low hourly traffic.				
Significance	Insignificant	**Minor**	Moderate	Major	
	The impact is considered as **Minor**.				

8.5.12 Mitigation Measures

- Implement mitigation measures as recommended in **Section 8.3.8**.
- Proponent and its contractors shall provide a public liaison person before and during construction to inform and/or to respond to concerns of local communities about traffic, and other safety-related concerns. Procedures for reaching the public liaison officer via telephone or in person shall be included in notices distributed to the community.
- Notify all land owners, community, farmers, affected by any access restrictions during construction. A plan shall be prepared to ensure adequate access at all times. This plan may involve alternate access, detours, or other temporary mitigations.
- Install appropriate warning and traffic guidance signages and barricades along the access roads and rivers to facilitate traffic movements, provide directions and warn public approaching the construction site.
- Barge/vessel shall move at a safe speed; reduce speed when passing other vessels, especially smaller watercrafts (longboats).
- Avoid performing other tasks while manoeuvring the vessel.

8.5.13 Influx of Camp Followers with Anti-social Behaviour

Anti-social behaviours could be defined as persistence behaviours which are unacceptable, non-criminal or minor criminal behaviour that could result in distress, or worst, harassment to others. These behaviours may include noise nuisance, shouting, swearing, intimidation through threats or actual violence etc. which sometimes associated with heavy drinking or drug use. Anti-social behaviours of camp followers may cause distress, fears or anger to local communities which could possibly lead to conflicts.

Impact	**Camp Followers with Anti-Social Behaviours**			
Nature	**Negative**	Positive	Neutral	
	Anti-social behaviours of camp followers may cause distress, fears or anger to local communities.			
Type	**Direct**	Indirect	Induced	
	Impacts are direct to local communities along the transmission line ROW, especially in area where large numbers of worker are concentrated such as in worker's camp close to local settlements.			
Duration	**Temporary**	Short-term	Long-term	Permanent
	During pre-construction and construction phases.			
Extent	**Local**	Regional	International	
	Limited to project area especially worker's camps that are close to local settlements.			
Scale	Impact is limited to worker's camps that are close to local settlements.			
Frequency	Throughout pre-construction and construction phases			
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered to be small with the implementation of Worker's Code of Conduct.			
Receptor sensitivity	**Low**	Medium	High	
	The sensitivity of the receptors is considered low as the project area is sparsely populated, and worker's camps or construction site shall be sited away from local settlement.			
Significance	Insignificant	**Minor**	Moderate	Major
	The impact is considered as **Minor**			

8.5.14 Mitigation Measures

- Implement and ensure that the worker's Code of Conduct is followed to regulate the performance and behaviour of all workers, including provision for disciplinary actions for anti-social behaviours.
- Ensure that all workers are housed in accommodation camps rather than in the local settlements in order to minimize interaction with local communities.
- Worker camps shall be sited away from local settlements.

8.5.15 Access to Infrastructure and Services

The potential impacts on existing infrastructure and services by the project development are foreseen to be minimal as the proposed transmission line mainly passes through rural forested land which is sparsely populated and lack of infrastructures and services.

As discussed in **Section 8.3.8**, potential impact to existing infrastructure such as the public roads are deemed to be insignificant as the mobilization of construction equipment, machinery and materials will only be done as and when required. Potential traffic conflicts are more likely to occur during the construction of temporary link road accesses especially for those connecting to the existing roads. However, the impact is also deemed insignificant as the existing traffic volume is low. Moreover, the preferred mode of transportation by the locals is river transportation. Locals usually travel to the nearest clinic, school or town by longboat or express boat.

The available healthcare facilities in the project area may experience additional pressure as a result of potential occupational health and safety incidents, traffic accidents and an increase in infectious diseases such as Covid-19, malaria, tuberculosis, etc. However, the impact on healthcare facility will be temporary as the workers will move on to the next place as the work on the transmission line progresses.

The potential pressure on local sources of water is deemed insignificant since the Project will bring in own water supply through JBALB, or source from the nearby rivers via direct extraction or gravity-feed system, depending on the location of the construction sites and base camps. As discussed in **Chapter 2**, **Section 2.5.2.1.2**, the estimated daily and monthly water requirement of the Project is 142,825 L and 4,284,752 L respectively.

Purpose	**No of Workers**	**Amount Used L/Day**	**Water Required L/Day**	**Water Required L/Month**
Project Staff Requirement	15	165	2,475	74,250
Contractor facility and workers	802	165	132,330	3,969,900
Construction works (concreting)	-	-	8020	240,602
TOTAL WATER REQUIRED			**142,825**	**4,284,752**

Similar to water supply, depending on the location of the construction sites and base camps, the power supply will be tapped from the existing SESCO power supply or from the fuel powered generator sets.

Impact	**Impact to the Access of Infrastructure and Services**				
Nature	**Negative**	Positive	Neutral		
	The potential impacts do not significantly affect the convenience of the community to access to the existing infrastructure and services.				
Type	**Direct**	Indirect	Induced		
	Direct impact to the community during project mobilization and construction phase.				
Duration	**Temporary**	Short-term	Long-term	Permanent	
	The traffic impacts are only temporary during the construction of temporary link road accesses. The pressure on each healthcare facility is also temporary.				
Extent	**Local**	Regional	International		
	Impact is limited to local Kapit and Kanowit areas.				
Scale	Traffic disruption is only expected at the public roads i.e., Song-Kapit Road, Melekun-Nanga Mujong Road, Nibong-Tada Road and the under-construction Nanga Mujong-Baleh Road. Increased healthcare pressure is expected at the health clinics as well as Kanowit and Kapit Hospital.				
Frequency	The frequency is considered to be occasional.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Traffic disruption and workplace accidents are unlikely to happen frequently with proper traffic and safety management in place.				
Receptor sensitivity	**Low**	Medium	High		
	Receptor sensitivity is low as the impacts are temporary and short terms, and not foreseen to happen frequently.				
Significance	**Insignificant**	Minor	Moderate	Major	
	Overall, the impact to the access of infrastructure and services are **Insignificant** as long as the traffic and safety management is implemented properly.				

8.5.16 Mitigation Measures

- Implement the mitigation measures proposed in relation to land acquisition, water quality, traffic and transportation and community health, safety and security as mentioned in previous sections.

- Any damaged to farm, or residential access roads shall be repaired.

8.5.17 Visual Impacts

Visual impacts are generally considered significant where they affect large numbers of people and tourists. Visual impacts generally refer to the changes to the visual character of landscape views. The project may cause obstruction of existing pleasant views, or removal of screening elements (native vegetation) thereby exposing viewers to unsightly views (road scars, eroded slopes). It will also introduce new elements into the views of the visual receptors. The most prominent and intrusive features to be introduced into the viewshed of landscape features will be the large cable structures with towers at regular intervals.

During construction phase, visual impact will be the results of clearance of vegetation along the ROW; the presences of construction yards, access roads, large construction vehicle and equipment; dust emission from construction activities; and road traffic. These impacts are largely temporal and limited to the ROW. The magnitude of the impact is small and the sensitivity is considered low due to sparsely populated local area. Hence, the significance of impact during construction phase is considered negligible.

At the operational phase, permanent clearance of tall vegetation along the ROW and the presence of transmission line infrastructures, especially the towers, will permanently altered the visual quality of the area. Some local communities (16 longhouses) in close proximity (i.e., within 500 m) of the ROW will be able to perceive the presence of the project features; hence, will be more sensitive to the visual intrusion. However, the proposed project site which can be classified as disturbed areas, are mostly covered by vegetation (secondary forests, and crops), while local settlements are mostly more than 500 m away from the transmission line. Hence, visual impact at operational phase is considered of minor significance.

Impact	**Visual Impact - Operational phase**			
Nature	**Negative**	Positive	Neutral	
	Changes in visual characters of local landscapes due to the presence of transmission towers.			
Type	Direct	**Indirect**	Induced	
	Impact to people from nearby settlements is direct.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	Impact will persist for long-term, likely more than 50 years.			

Impact	**Visual Impact - Operational phase**				
Extent	Local	**Regional**	International		
	Impact is localized within Sibu and Kapit Division.				
Scale	Visual impact will be experienced by local communities as well as the people traveling along Kanowit/ Kapit and Kapit/ Putai (Baleh HEP site) roads.				
Frequency	Impact is throughout the operational phase.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	The transmission line will only be visible when one gets close to the area.				
Receptor sensitivity	**Low**	Medium	High		
	Receptor sensitivity is considered low due to the low population density and disturbed nature of the surrounding areas.				
Significance	Insignificant	**Minor**	**Moderate**	Major	
	The impact is considered as **Minor**.				

8.5.18 Mitigation Measures

- Towers and structures should be painted with non-reflective paints.
- Revegetate all cleared areas no longer used for project activities to minimize visual impacts.
- Maintenance clearing along the ROW will be kept to minimum.
- At locations close to local settlements, locals should be allowed to grow fruit or timber trees (i.e., outside ROW and does not pose risk to transmission line) to reduce visual impacts.

8.5.19 Loss of Indigenous Peoples' Access to Customary Lands

Their loss of access to customary lands is primarily due to compulsory land acquisition for the transmission line ROW. Impacts of land acquisition is addressed in **Section 8.3.1**, while loss of agricultural lands and crops, and livelihood associated with these lands were addressed in **Section 8.5.1**. Some of the acquired lands are also sources of NTFPs, and the impacts of the project on the utilization these forests/NTFPs are addressed in **Section 8.5.3**. Impact on their cultural heritage is addressed in **Section 8.6** below.

8.6 CULTURAL HERITAGE

Existing cultural and religious practices will be respected and, to the maximum extent preserved. The potential impacts on cultural heritage by the BMTLP development are foreseen to be minimal as there are no registered cultural heritage assets within the proposed transmission route.

Care has been taken during the survey work to avoid gravesites of the community by realigning the transmission route, and social surveys found that there are no sites of local cultural significance (such as sacred rocks or features) in the ROW. At the time of report writing, four (4) gravesites identified along the transmission line were avoided by realignment of the line route.

Impact	**Impact on Cultural Heritage**				
Nature	Negative	Positive	**Neutral**		
	There are no registered cultural heritage assets within the transmission line. Locations with gravesite are avoided as best as possible by realignment of the proposed transmission line.				
Type	Direct	Indirect	Induced		
	No impact since there are no known cultural heritage assets along the proposed transmission line route. Gravesites are being avoided by realignment of the proposed transmission line route.				
Duration	Temporary	Short-term	Long-term	Permanent	
	No impact since there are no known cultural heritage assets along the proposed transmission line route. Gravesites are being avoided by realignment of the proposed transmission line route.				
Extent	**Local**	Regional	International		
	It will be a local agenda if grave relocation is required.				
Scale	If grave relocation is inevitable, the scale of impact is only among the next of kins, community of the deceased and longhouses nearby the gravesites.				
Frequency	Throughout construction period, during working hours.				
Magnitude	Positive	**Negligible**	Small	Medium	Large
	The magnitude of the loss is insignificant as there are no known cultural heritage assets along the proposed transmission line. Gravesites are being avoided by realignment of the proposed transmission line.				
Receptor sensitivity	**Low**	Medium	High		
	Low since there is no known impact on cultural heritage assets and gravesites are being avoided by re-alignment of proposed line.				

Impact	Impact on Cultural Heritage			
Significance	**Insignificant**	Minor	Moderate	Major
	Overall, the impact of loss of cultural heritage and gravesites is **Insignificant** since there are no known cultural heritage assets and gravesites are being avoided by deviating the ROW.			

8.6.1 Mitigation Measures

- Identification of cultural heritage assets should be carried out through active engagement with stakeholders such as Sarawak Museum Department, Council for Native Customs and Traditions, Resident Office, District Office, and the communities. At pre-construction phase, there is no known nor gazetted cultural heritage sites at the proposed transmission line area.

- Impacts on land, structures and other fixed assets should be minimised where possible by exploring all alternative options to maximise the avoidance of buildings and structures, burial grounds, cultural sites, settlements, and agricultural areas to the extent possible.

- Gravesites relocation should be avoided at best as it will disrupt the social wellbeing of the community.

- If grave relocation is deemed as necessary and unavoidable, careful planning that prioritise the decisions of affected kins and community must be undertaken.

- The customary ways of the local affected community must be respected and upheld.

- The community's right or the indigenous people's right should always be upholded in matters pertaining to their cultural beliefs, practices and sites deemed sacred or legendary. In other words, the impact of the project on Indigenous People's right should be minimised in order for the community to carry on with their livelihood in an environment they believed should achieve a harmonious balance between the human and spiritual world.

- The advice and facilitation from agencies such as Sarawak Museum, Council for Native Customs and Traditions, Resident office, District office, could be solicited, but the decisions and customs of the local affected community must be respected and prioritised.

- The Guidelines for Grave Relocation is provided at **Appendix 8.6.1**.
- During construction phase, if there is suspected find of cultural heritage asset by on-site Contractors, worker or local people, the Chance Find Procedure (refer to **Chapter 9**) must be adhered to.
- Work at site must stop immediately with notification to Site Supervisor, Site Manager, Project Manager.
- Protection measures at the site of find must be established.
- Notification must be sent immediately to relevant authorities (District Office, Sarawak Museum Department).
- The service of an on-site or on-call cultural specialist will be acquired to perform preliminary evaluation on the Chance Find.
- If the find is determined to be a cultural heritage asset or site, a report will be submitted to relevant authorities.
- Discussion with relevant authorities will be initiated on the measures to be taken for the protection and safeguarding of the cultural heritage of the people.

8.7 PUBLIC HEALTH IMPACT ASSESSMENT

Health Impact Assessment (HIA) is the process of estimating the potential impact of a chemical, biological, physical or social agent on a specified human population system under a specific set of conditions and for a certain time frame (EnHealth Council, 2001, DOE, 2012).

The main approach in this HIA is to assess the impacts of the proposed BMTLP, on the health of residents in the impacted communities within the zone of impact of the proposed project that may emanate from environmental impacts. The assessment reported here is based on the Guidance Document on HIA in EIA published by the Department of Environment Malaysia (DOE, 2012). The impacts of the proposed project on workers' health are included but not extensively discussed in this HIA as they are not within the scope specified in the Guidance Document.

Health Risk Assessment (HRA) is a component of HIA. There are two forms of HRA, namely qualitative and quantitative HRA. Qualitative HRA merely characterizes or compares the hazard of a chemical or physical agent relative to

others, or in comparison to reference values or standards, or defines the hazard in only qualitative terms such as mutagen or carcinogen, which connotes certain risk or safety procedures. In qualitative HRA, only subjective and comparative assessment of environmental hazards are attempted without generating any quantitative estimate of the risks involved.

Quantitative HRA can be applied for a chemical or physical hazard, and is a methodological approach in which the toxicities of a chemical or physical agent are identified, characterized, analysed for dose-response relationships, and the data generated are applied to a mathematical model to produce a numeric estimate representing a guideline or decision concerning allowable exposure (James, 1985). Quantitative HRA generates a numerical measure of the risk or safety of a chemical or physical agent exposure. The numerical measure of the risk generated is compared against a guideline value or an acceptable risk level. When conducting a quantitative HRA, there are two categories of risks being assessed, namely non-carcinogenic and carcinogenic health risk.

For the purpose of this HRA, only the qualitative HRA was employed.

This HRA describes the potential public health impacts and risks on the population residing in the vicinity of the proposed project during its construction and operational phases. The main health hazard will be exposure to electromagnetic radiation from the high-voltage electrical transmission line.

Reference on health guidelines for allowable public and workers' exposures to electromagnetic radiation was made to the International Commission on Non-Ionizing Radiation Protection's (ICNIRP) Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic and Electromagnetic Fields (up to 300 GHz) and the International Finance Corporation's (IFC) Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution.

There are six steps involved in the HRA methodology.

8.7.1 Issues Identification

This first step explores the source-pathway-receptor link, the component of each is essential in the expression of risk. Health impacts are mainly secondary impacts upon the human community that emanate from primary impacts upon the physical (air, water and soil); biological (animals and plants) and social environments. In the case of this proposed project, the main health impacts will emanate from human exposure to the electromagnetic field (EMF).

8.7.2 Hazard Identification

This second step in HRA involves the identification of potential environmental hazards and characterization of their innate adverse health effects. The purpose is to scope for potential environmental and health hazards that may emanate from construction and operation of the proposed project. The review indicated that the major environmental hazards from the proposed project will be mainly EMF during the project operational phase. Among the health issues of concern are listed below.

8.7.2.1 Construction Phase

Some dust is expected to be generated during the construction phase of the proposed project especially from the movement of vehicles on-site. However, dust pollution due to the construction activities is temporary and the local air quality is expected to return to its normal ambient levels when construction ceases (see **Section 8.3.4** on air quality).

Vehicle exhaust emissions on the local road network will be intermittent and transient in nature where associated impacts are considered minor. Exhaust emissions from diesel engine driven equipment is also expected to result in insignificant impacts on air quality. Generally, the exhaust emissions from the proposed project during construction will be minor (see **Section 8.3.4** on air quality).

8.7.2.2 Operational Phase

The main health impacts will be during the project operational phase. The major health impacts are listed below:

i. Hazardous materials in this sector include insulating oils or gases, polychlorinated biphenyls [PCB], sulphur hexafluoride [SF6], fuels, and herbicides for right-of-way vegetation maintenance.

ii. Occupational health and safety hazards specific to electric power transmission and distribution projects primarily include live power lines, working at height, electric and magnetic fields and exposure to chemicals.

iii. Public health and safety hazards from operation of live power distribution lines and substations may generate industry-specific impacts such as electrocution, electromagnetic interference, visual amenity, noise and ozone and aircraft navigation safety.

iv. Exposure of workers and public to EMF.

8.7.3 Dose-Response Assessment

Since this a qualitative HRA, this step is not applicable.

8.7.4 Exposure Assessment

8.7.4.1 Exposure to Air Pollutants during Construction Phase

As mentioned earlier, the project construction phase is not foreseen to be a major contributor to air pollution for this proposed project.

8.7.4.2 Exposure to EMF during Operational Phase

The main health hazard to workers and the public during the project operational phase will be exposure EMF from the high-voltage transmission line. EMF are invisible lines of force emitted by and surrounding any electrical device (e.g., power lines and electrical equipment). Electric fields (E) are produced by voltage and increase in strength as the voltage increases. Electric field strength is measured in volts per meter (V/m). Magnetic fields (H) result from the flow of electric current and increase in strength as the current increases. Magnetic fields are measured in units of gauss (G) or tesla (T), where 1T equals 10,000G. Electric fields are shielded by materials that conduct electricity, and other materials, such as trees and building materials. Magnetic fields pass through most materials and are difficult to shield. Both electric and magnetic fields decrease rapidly with distance.

Extremely low frequency electromagnetic field (ELF-EMF) refers to low frequency electric and magnetic fields in the frequency range of 30 to 300 hertz (Hz) in Europe and 0 to 100 Hz in USA. (IPCS, 1992). ELF-EMF exists from natural sources which include activity of the sun, fields from the earth, and fields emitted by the human body. However, these are very weak. Those of man-made origins are much stronger. The strongest of the man-made ELF-EMF are those produced by high-voltage transmission lines at 50 or 60 Hz (50 Hz in Malaysia), distribution lines and transportation systems that operate at 30 Hz and below. The generation, transmission and use of electricity have resulted in far greater and increasing exposures over the last 120 years. These exposures are now synonymous with modern life, and there has been concern raised as to the potential adverse health effects from these exposures (Ahlbom et al., 2001).

The main concern with high-voltage transmission lines is with regards to exposure to its electric field. The electric field strength within a high-voltage transmission line corridor can range up to about 10 kV/m. The field strength decreases to a background level of 10-4 V/m at approximately 1000 m away. The electric field strength within the corridor is several magnitudes higher than that which is generated from typical home appliances (IPCS, 1996).

Exposure to magnetic field from high-voltage transmission lines is not excessive when compared to other sources in our environment. However, there is some health concerns with chronic exposure to low level magnetic field, especially with respect to childhood cancers. Under the centre line at the mid-span of 1100 kV transmission lines, the 60 Hz magnetic field strength at 1 m above the ground is less than 0.035 mT. This is weaker than the magnetic field strength of up to 2.5 mT that occur close to common household appliances (IPCS, 1996).

Table 8.7.1 shows the electric and magnetic field strength typically observed at 30 m and 60 m from a 115 kV to a 500 kV transmission line. For a 500 kV transmission line, the electric and magnetic field strength typically observed at a 30 m distance from the line are 1.0 V/m and 12.6 μT, respectively. This would then be typical field strength observed at the boundary of a 60 m transmission ROW. This field strength is very much lower than the prescribed electric and magnetic field exposure limits set by the IFC (2007) and ICNIRP (1998), as shown in **Table 8.7.2**.

Table 8.7.1: Typical Electric and Magnetic Field Strength from High-Voltage Transmission Lines at Distances of 30 m and 60 m

Transmission line	Electric field (V/m) at 30m/60m	Magnetic field (μT) at 30m/60m
115 kV	0.07 / 0.01	0.17 / 0.04
230 kV	0.3 / 0.05	0.71 / 0.18
500 kV	1.0 / 0.3	1.26 / 0.32

Source: Hafemeister (1996).

Table 8.7.2: ICNIRP Exposure Limits to Public and Occupational Exposure to EMF Up To 300 GHz

Exposed group	Frequency (Hz)	Electric field (V/m)	Magnetic field (μT)
Public	50	5,000	100
	60	4,150	83
Workers	50	10,000	500
	60	8,300	415

Source: IFC (2007), referring to ICNIRP (1998).

A monitoring of baseline EMF strength was conducted at 10 locations along the proposed transmission line alignment (**Table 8.7.3**). As can be seen, both the baseline electric and magnetic field readings are currently very low. Therefore, the introduction of the proposed transmission line is not expected to elevate both the electric and magnetic field strength to above the public exposure limits as shown in **Table 8.7.2** above.

Table 8.7.3: Monitoring of Baseline Electromagnetic Fields at Various Location Along the Proposed Transmission Line Alignment

Monitoring location	Distance from transmission line (meter)	Direction from transmission line	Electric field (V/m)	Magnetic field (μT)
EMF 1	900	South	2.0	0
EMF 2	1,700	South	2.0	0
EMF 3	3,300	South	2.0	0.01
EMF 4	1,800	South	5.0	0
EMF 5	2,800	South	2.0	0.02
EMF 6	480	South	2.0	0
EMF 7	2,200	South	2.0	0
EMF 8	700	South	2.0	0
EMF 9	950	South	2.0	0
EMF 10	835	South	2.0	0

It is a hypothesis that electromagnetic radiation from transmission lines has an impact on the development of all living things. It has not been proven that such impact is strong enough to be discernible in human living under or near the proposed transmission line.

Impact	**Impact of Electromagnetic Radiation**				
Nature	Negative	Positive	**Neutral**		
	The introduction of the proposed transmission line is not expected to elevate both the electric and magnetic field strength to above the public exposure limits as shown.				
Type	**Direct**	Indirect	Induced		
	The impact is a direct impact of the electricity being conducted during project operation.				
Duration	Temporary	Short-term	**Long-term**	Permanent	
	The issue will exist as long as the project operates the transmission lines but will disappear when operation stops.				
Extent	**Local**	Regional	International		
	The effect of electromagnetic interference is only expected to reach a few hundred meters.				
Scale	Along a transmission line ROW, the electromagnetic field will form a continuous wall.				
Frequency	Certain, continuous during operation phase.				
Magnitude	Positive	**Negligible**	Small	Medium	Large
	The electromagnetic field strength will be below the exposure limits.				
Receptor sensitivity	**Low**	Medium	High		
	Humans often live very near transmission lines and not bothered by EMF. However, the project site is sparsely populated and surrounded by forest.				
Significance	**Insignificant**	Minor	Moderate	Major	
	For a 500 kV transmission line, the electric and magnetic field strength typically observed at a 30 m distance from the line are 1.0 V/m and 1.26 μT, respectively. This field strength is very much lower than the prescribed electric and magnetic field exposure limits prescribed for the public by the IFC (2007) and ICNIRP (1998) of 5000 V/m and 100 μT. There are no conclusive scientific results showing the effects of electromagnetic fields from transmission lines.				

8.7.5 Risk Characterisation

The project site is sparsely populated and surrounded by forest. Therefore, the direct health impacts on the public are expected to be minimal, unless there is public intrusion into prohibited areas. Indirect health impacts from introduced

communicable diseases can occur through social interactions between workers and the public.

8.7.5.1 Electrocution

The ROW is there to prevent the public from entering the area or conducting activities like farming or rearing animals. Even though it is very unlikely, transmission lines can break, fall, and electrocute those who come into contact with them. Lack of knowledge and awareness about the danger of carrying out activities within ROW, particularly near or at tower bases or the points where transmission lines are closest to ground surface, could lead to contact with high voltage electricity. The result of such contacts is electrocution which can cause severe injuries or fatalities.

Impact	**Public Safety: Electrocution**				
Nature	**Negative**	Positive	Neutral		
	Accidental contact with electric conductor/ live lines could result in serve injuries or fatalities.				
Type	**Direct**	Indirect	Induced		
	Impacts are direct to persons who gets in contact with high voltage electricity.				
Duration	Temporary	Short-term	Long-term	**Permanent**	
	Impact is presence as long as the transmission line is in operation.				
Extent	**Local**	Regional	International		
	Impact is limited to the ROW of transmission line area.				
Scale	Impact is considered as low scale as it is considered as rare incidence.				
Frequency	Expected to be very rarely, only during operational phase.				
Magnitude	Positive	Negligible	**Small**	Medium	Large
	Impact magnitude is considered to be small, as its occurrence is very rare or unlikely. However, if it occurred it could result in severe injuries or fatality.				
Receptor sensitivity	**Low**	Medium	High		
	The sensitivity of the receptors is considered low as the area is sparsely populated, and the transmission line ROW is located away from settlements.				
Significance	Insignificant	**Minor**	Moderate	Major	
	The impact is considered as **Minor**				

8.7.5.2 Mitigation Measures

- Implement the mitigation measures proposed in relation to air quality (**Section 8.3.4**), noise (**Section 8.3.5**), traffic (**Section 8.3.8**), clearing of ROW (**Section 8.4.1**) and OSH (**Section 8.8**).

- The 50 m ROW prescribed for the high-voltage transmission line should provide adequate protection for the public against excessive exposure to electric and magnetic field. This ROW should be maintained throughout the transmission route.

- The communities living close to the transmission line should be informed about the safety risks related to the high voltage electricity, the do's and don'ts in the ROW and the response measures in place, when an incident happens (refer to ERP in **Chapter 9**). Sign boards will be placed on the towers to warn about the electrocution risk.

- Notification signage is to be erected along the transmission line alignment, within 50 m, notifying visitors to the area of the hazard of non-ionizing radiation from the operating proposed transmission line.

- Public must be prohibited from entering the areas under construction or maintenance works.

- Power lines crossing major roads or rivers must be demarcated with clearly visible spheres or other devises.

- No activity which would result in human exposure should be allowed within the ROW. Activities which tend to encroach into the ROW include squatter homes, farming and plant nursery.

- Development along the established transmission line alignment is to be restricted by the land use planning structure to an area of greater than 50 m from the centre line of the transmission line.

8.7.5.3 Communicable Diseases

Communicable diseases may be introduced into the local communities by workers coming into the project area. There will be a total of 817 workers during the height of the project construction phase staying in 2 main base camps. Most of them will be non-local workers including foreigners. Therefore, there is always a possibility

of introduction of communicable diseases such as COVID-19, tuberculosis, malaria and sexually-transmitted diseases.

Impact	**Public Safety: Communicable Diseases**			
Nature	**Negative**	Positive	Neutral	
	Communicable diseases such as Covid-19, tuberculosis, malaria might be brought in by influx of workers into the area. Interaction between locals and workers may potentially increase transmission of the communicable diseases.			
Type	**Direct**	Indirect	Induced	
	Impacts are direct to local communities in close contact.			
Duration	**Temporary**	Short-term	Long-term	Permanent
	The impact is will last throughout the construction phase of 36 months, but to lessen during operational phases.			
Extent	**Local**	**Regional**	International	
	Impact is limited to the transmission line AOI and potentially to nearby town and regionally if it involves Covid-19.			
Scale	Covid-19 has the potential to spread rapidly to other areas if not controlled.			
Frequency	Continuous throughout the construction phase.			
Magnitude	Positive	Negligible	Small	**Medium**	Large
	Impact magnitude is small for other communicable diseases such as tuberculosis and malaria. However, impact can be large for Covid-19 if SOP is not observed.			
Receptor sensitivity	Low	Medium	**High**	
	The Covid-19 pandemic has been the most serious communicable disease affecting the region, country and world since 2020. Infections have been and still are recorded at a high rate. As long as there is no cure for Covid-19, receptor sensitivity is high.			
Significance	Insignificant	Minor	Moderate	**Major**
	The impact is considered as **Major**			

8.7.5.4 Mitigation Measures

- The clearing of vegetation should not generate any land depression and waterlogged areas which may create suitable habitats for the breeding of disease-carrying mosquitoes. A sudden change in the ecology of the area may promote breeding of these vectors which may subsequently lead to increased incidences of vector borne diseases. Morbidity statistics from the 3 nearby districts indicate that Malaria is very prevalent in the area.

- If, there are water storage tanks, they should be properly screened to prevent the breeding of mosquitoes.
- To further prevent mosquito-related diseases, the workers' quarters should be adequately covered with protective netting at the windows and other ventilation open spaces or corridors.
- Camp areas should be well drained so that water does not pond or create mosquito breeding areas. The Vector-borne Disease Control Programme and Guidelines for the Control of Aedes Mosquitoes at Construction Sites are attached in **Appendix 8.7.1**).
- A pre-employment medical examination will need to be carried out for all employees, both as a fitness for work assessment as well as a baseline for monitoring any deterioration or changes in health status. All workers should be medically screened for infectious diseases including COVID-19, tuberculosis and sexually-transmitted diseases. This should then be supplemented with periodic medical surveillance done at least annually. First aid and emergency response programme (ERP) will need to be planned and implemented. Guidance on first aids and first aid equipment as provided in the DOSH Guidelines on First Aid in the workplace will need to be followed. An ERP to handle possible on-site emergencies should be drawn up.
- In the event of any outbreak of illness of an epidemic / pandemic nature, the Proponent should comply with and carry out such regulations, orders, instructions, rules and SOPs as may be made by the State Government, State Disaster Management Committee (SDMC), Ministry of Health, State Health Department, local medical and health authorities.
- All Project workers must be fully vaccinated before they are allowed to work on the Project.

8.7.5.5 Chronic Diseases due to EMF Exposure

Adult Leukaemia

There is a small increased risk of leukaemia associated with occupations related to electricity. Relative risk estimates ranged from 1.2 for chronic myeloid leukaemia (CML) to 1.4 for chronic lymphocytic leukaemia (CLL). Nevertheless, the evidence supporting a role for EMF in the etiology of adult leukaemia is weak (Ahlbom *et al.*, 2001).

Brain Tumours

Most studies tend to show a small increase in the risk of brain cancer among electrical workers, with a pooled relative risk estimate of 1.2. The association was stronger for studies that presented results restricted to gliomas, a type of primary brain tumour, with a relative risk of 1.4, as well as for the profession of electrical engineers with a relative risk of 1.7. However, the evidence for supporting a role for EMF in the etiology of brain cancer is weak. There is insufficient data to identify particular exposure sources, patterns or disease subtypes associated with larger relative risks (Ahlbom *et al.*, 2001).

Amyotrophic Lateral Sclerosis

Amyotrophic lateral sclerosis (ALS) is a progressive peripheral nerve disorder that begins with weakness, often in the hands and less frequently in the feet, and usually more on one side of the body. Over time, muscle spasticity (stiffness) develops. Two cohort studies based on electric utility workers, one in the U.S. and one in Denmark, provided strong evidence of the association between EMF exposure and ALS. The combined results from the two studies show a clear increase in ALS mortality with a combined relative risk of 2.7 and a 95 % confidence interval of 1.4 to 5.0 (Ahlbom *et al.*, 2001).

Impact	**Chronic Diseases due to EMF Exposure**			
Nature	Negative	Positive	**Neutral**	
	The introduction of the proposed transmission line is not expected to elevate both the electric and magnetic field strength to above the workers exposure limits as shown.			
Type	**Direct**	Indirect	Induced	
	The impact is a direct impact of the electricity being conducted during project operation.			
Duration	Temporary	Short-term	**Long-term**	Permanent
	The issue will exist as long as the project operates the transmission lines but will disappear when operation stops.			
Extent	**Local**	Regional	International	
	The effect of electromagnetic interference is only expected to reach a few hundred meters.			

Impact	**Chronic Diseases due to EMF Exposure**				
Scale	Along a transmission line ROW, the electromagnetic field will form a continuous wall.				
Frequency	Certain, continuous during operation phase.				
Magnitude	Positive	**Negligible**	Small	Medium	Large
	The electromagnetic field strength will be below the exposure limits.				
Receptor sensitivity	**Low**	Medium	High		
	Workers doing maintenance works at or near the transmission line will be exposed to EMF. However, the activities is infrequent and PPE will be provided.				
Significance	**Insignificant**	Minor	Moderate	Major	
	For a 500 kV transmission line, the electric and magnetic field strength typically observed at a 30 m distance from the line are 1.0 V/m and 1.26 μT, respectively. This field strength is very much lower than the prescribed electric and magnetic field exposure limits prescribed for the public by the IFC (2007) and ICNIRP (1998) of 10000 V/m and 500 μT. There are no conclusive scientific results showing the effects of electromagnetic fields from transmission lines.				

8.7.5.6 Mitigation Measures

- Train workers in the identification of occupational EMF levels and hazards.
- Implement action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by ICNIRP. Personal exposure monitoring equipment should be set to warn of exposure levels that are below occupational exposure reference levels.
- Action plans to address occupational exposure may include limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, or the use of shielding materials.

8.7.5.7 Attack by Wildlife

Wildlife in the project area will migrate out when the ROW is being cleared even though the area involved will not be very large. The project area and surrounding areas are largely disturbed, covered mostly by secondary forests as well as some plots farmland (shifting cultivation). Hence, other than some potential encounters

with poisonous insects, encounter with big mammals which are also games (wild pigs, deers, sun bears, bear cats), are expected to be rare.

The Ibans livelihood revolves around the environment surrounding them, ranging from collection of jungle produce to hunting of wildlife. Should the wildlife venture into their settlement areas, they are likely to be hunted or caught by the locals.

8.8 OCCUPATIONAL SAFETY AND HEALTH

The Project Proponent and its Contractors have a responsibility under the Occupational Safety and Health Act 1994 (Act 514) to ensure that the workplace, during the construction and operational phases, are occupationally safe for site-based staff and site visitors.

The following assessment presents the potentially significant impacts associated with occupational health and safety and worker during the construction and operation phases. The potential for occupational health and safety incidents throughout the life cycle of the project is higher during construction phase.

Potential safety and health risks, during both construction and operational phases, are:

- Heat stress
- Traffic accidents
- Machinery accident
- Falling from height
- Musculoskeletal injury / ergonomic problems
- Electrocution / electric shock
- Occupational noise
- Animal Bites and Stings

Risk assessment can be made based on the following table:

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Risk Involved</td><td>The type of risk expected from the activity conducted.</td></tr>
<tr><td>Severity</td><td>Severity is outcome from an event such as severity of injury or health of people, or damage to property, or insult to environment, or any combination of those caused by the event. The severity level can be divided into five (5) categories:
A. Negligible refers to first aid type injury, such as minor abrasions, bruises or cuts.
B. Minor refers to an injury or illness that is disabling but not permanent, for example sprains or fainting.
C. Serious refers to a non-fatal injury or illness that causes permanent disability such as loss of limbs and chronic cancer.
D. Fatal refers to cases where one single fatality is expected, such as the result of a high voltage electric shock or poisoning due to a toxic substance.
E. Catastrophic refers to an accident that cause numerous fatalities and major property damage such as an explosion.</td></tr>
<tr><td>Likelihood</td><td>Likelihood is an event likely to occur within the specific period or in specified circumstances. The likelihood level can be divided into five (5) categories as follow:
1. Inconceivable refers to an incident that is practically impossible and has never occurred.
2. Remote refers to a rare incident but has not been known to occur after many years.
3. Possible refers to an incident that might occur at some time in future.
4. Likely refers to an event or incident that has a good chance of occurring and is not unusual.
5. Very Likely refers to the most likely result of the hazard or event being realized.</td></tr>
<tr><td>Risk Rating</td><td>The risk level can be divided into three (3) category – High, Medium and Low.
<table>
<tr><th colspan="2">RISK MATRIX</th><th colspan="5">LIKELIHOOD</th></tr>
<tr><th colspan="2"></th><th>1
Inconceivable</th><th>2
Remote</th><th>3
Possible</th><th>4
Likely</th><th>5
Very Likely</th></tr>
<tr><th rowspan="5">SEVERITY</th><th>A
Negligible</th><td>A1
Low</td><td>A2
Low</td><td>A3
Low</td><td>A4
Low</td><td>A5
Medium</td></tr>
<tr><th>B
Minor</th><td>B1
Low</td><td>B2
Low</td><td>B3
Medium</td><td>B4
Medium</td><td>B5
Medium</td></tr>
<tr><th>C
Serious</th><td>C1
Low</td><td>C2
Medium</td><td>C3
Medium</td><td>C4
Medium</td><td>C5
High</td></tr>
<tr><th>D
Fatal</th><td>D1
Low</td><td>D2
Medium</td><td>D3
Medium</td><td>D4
High</td><td>D5
High</td></tr>
<tr><th>E
Catastrophic</th><td>E1
Medium</td><td>E2
Medium</td><td>E3
High</td><td>E4
High</td><td>E5
High</td></tr>
</table>
A high risk requires immediate action to control the hazard as detailed in the hierarchy of control.</td></tr>
</table>

Item	Description
	A **medium risk** requires a planned approach to controlling the hazard and applies temporary measure if required. A **low risk** is considered as acceptable and further reduction may not be necessary.
Mitigation Measure	Mitigation measure means the action to eliminate the hazard or reduce the risk rating to such extend that is considered as tolerable level.

8.8.1 Heat Stress

Malaysia is a country with an equatorial climate where hot weather and rainfall are evenly distributed throughout the year. Therefore, exposure to hot weather is a common condition for construction workers in Malaysia. With daily temperature that may reach up to 30 degrees Celsius, the workers are likely to be exposed to heat stress. Factors that can affect body temperature include air temperature, radiant temperature, humidity, wind velocity, physical activity and clothing worn by the workers.

Heat stress is a condition in which the body's ability to regulate body temperature is affected due to prolonged exposure to a heat source, for example from the sun radiation or heat emitted by the machinery. When the stress is combined with physical activities, dehydration and fatigue can lead to internal body disruptions, especially when exposed to high air humidity at the same time.

Risk Involved	**Heat Stress**				
Severity	A-Negligible	B-Minor	**C-Serious**	D-Fatal	E-Catastrophic
	The impact of heat stress to human body is varied, ranging from heat rash, heat cramps, heat exhaustion to heat stroke. The most serious consequence is heat stroke which could lead to death if not receiving immediate treatment.				
Likelihood	1-Inconceivable	2-Remote	**3-Possible**	4-Likely	5-Very Likely
	The likelihood of a worker exposure to heat stress during construction and operation phases is Possible. The worker will expose to hot weather for 8 hours a day.				
Risk Rating	The risk rating for heat stress is **C3** or **Medium Risk**.				

8.8.2 Mitigation Measures

- Provide shaded rest area and drinking water for employees.
- Establish work schedules, rest breaks and rotations for workers exposed to heat sources.
- Wear light coloured clothing while at work.
- Perform heavy tasks during cooler time of the day in morning and evening.
- Acclimatize new workers to their new surroundings.

8.8.3 Traffic Accidents

Using vehicle to transport workers, building materials, tools, equipment or machinery is a common activity during the Construction and Operations phases. Traffic accidents usually occur due to factors, such as:

- Defects on vehicle and carriageway.
- Bad weather.
- Driver competency and experience.
- Health condition and sanity of the driver.

Risk Involved	**Traffic Accidents**				
Severity	A-Negligible	B-Minor	**C-Serious**	D-Fatal	E-Catastrophic
	The impact of traffic accident to the workers involve varies depending on several factors such as the speed and type of vehicle involved. The likelihood of a road traffic accident increases with increasing speed – the greater the speed, the more severe the consequences when an accident occurs.				
Likelihood	1-Inconceivable	2-Remote	**3-Possible**	4-Likely	5-Very Likely
	The likelihood of a worker expose to traffic accident during construction and operation phases is possible. Malaysia has the third highest fatality rate from road traffic accidents in Asia and ASEAN, behind Thailand and Vietnam.				
Risk Rating	The risk of traffic accidents during the construction phase, if all control measures are taken into account and practiced is **C3** or **Medium Risk**.				

8.8.4 Mitigation Measure

Mitigation measures recommended for Traffic and Transportation in Section **8.3.8** are also applicable. The following are additional measures to further reduce traffic impact.

- Establish Journey Management Procedure to reduce transportation-related risks.
- Conduct regular vehicle inspections and preventive maintenance.
- Ensure that the driver has a valid driving license, according to the class or category of vehicle as specified in the Road Transport Act 1987 (Reg. 18, Building Operation and Work of Engineering Construction) (Safety) Regulations 1986).
- Conduct random drug and alcohol tests on drivers before commencing work.
- Comply with the speed limits, traffic signs and any other traffic rules that have been set
- Ensure all drivers and passengers follow vehicle safety rules including the wearing of seatbelts, no cell phone use while driving, no distraction of the driver, vehicle safety checks prior to long journeys, no night driving etc.

8.8.5 Machinery, Equipment and Mobile Plant Vehicles

Accidents resulting in fatality or injury can occur from the use of hand tools and power tools, as well as vehicle movement and crane operation. The use and operating of these tools and machinery exposed workers to noise levels that may put their hearing at risk. Accidents and noise exposure involving machinery or equipment are due to:

- Illegal modifications on equipment or machinery.
- Incompetent or inexperienced machine operators.
- Health condition and sanity of the operator.
- Equipment or machinery is operated exceeding the design capabilities.
- No inspection and maintenance on equipment or machinery performed.
- Other factors such as size and layout of the building and weather condition.

Risk Involved	**Machinery Accident**				
Severity	A-Negligible	B-Minor	**C-Serious**	D-Fatal	E-Catastrophic
	The impact of a machinery accident on workers varies depending on the type of machine operating. However, workers involved in accidents involving heavy machinery are more likely to suffer serious injuries.				
Likelihood	1-Inconceivable	2-Remote	**3-Possible**	4-Likely	5-Very Likely
	The likelihood of a worker to expose to machinery accident during construction and operation phases is possible.				
Risk Rating	The risk of machinery accident during the construction phase is **C3** or **Medium Risk**.				

8.8.6 Mitigation Measure

- Establish a safe operating procedure for all activities involving the use of heavy machinery and power tools. These include the use of PPE (such as hard hats, goggles, ear plugs, well-insulated safety boots, proper work gloves and safety belts), ensuring the operation and maintenance of the equipment being used is sufficient, operation specific practices to prevent negative occupational health outcome as determined by guidance and industry best practice are complied with.

- Operators are not to be under the influence of any pharmaceuticals (prescribed or otherwise), alcohol, or any other stimulant when operating any machinery or equipment Carry out regular inspection and preventive maintenance on all machinery.

- All machinery and equipment are to have appropriate safety protection measures and devices fitted, such as shielding of moving parts, cut off systems in case of emergency, reversing siren and lights.

- Ensure all machinery are registered and has a valid certificate of fitness issued by the DOSH. All machinery and equipment are to be inspected on a periodical basis, for general repair, performance and safety issues.

- Ensure all machine operator has a valid certificate of competency and are recognized by the DOSH. Provide training and refresher courses for machinery operators.

- Manage work activities to ensure that the workload does not exceed the capability of the machinery.

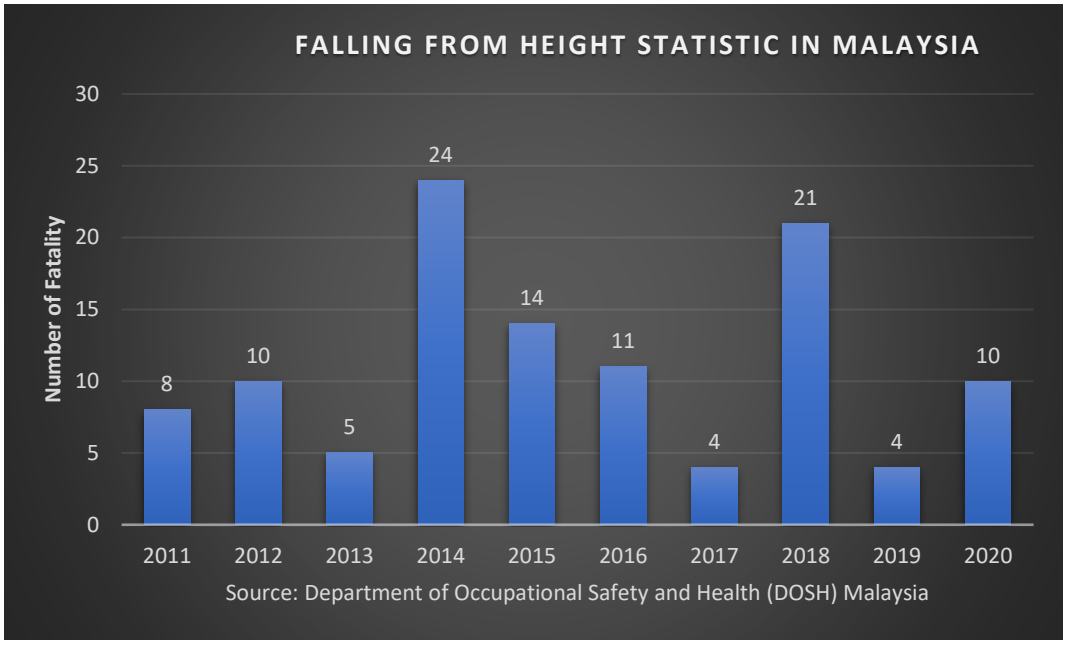
8.8.7 Working at Height

Working at height is defined as performing a task at an elevated area of two meters or more from the ground level. Nationally, falls from height are a significant threat to the construction fields and are one of the leading causes of a fatal accident to construction workers.

Activity that requires working at height during the construction and operation phases is for the installation and maintenance of the transmission tower, or pylon. All pylon and cables are expected to be a maximum of 55 meter from the ground. This constitutes the occupational hazard of personnel working at height, during both the construction and operation stages of the proposed project. Falling from height is usually caused by:

- Lack of planning for activities performed on elevated area.
- No inspection and maintenance of the working platform and fall arrest system performed.
- The working platform is not designed according to approved standards.
- Untrained or experienced workers.
- The absence or failure of a fall arrest device, such as body harness, life line, etc.

The following are statistics of fatal accident cases involving falls from height that occurred at construction sites from 2011 to 2020:



Risk Involved	**Falling from height**				
Severity	A-Negligible	B-Minor	C-Serious	D-Fatal	E-Catastrophic
	The effect of falling from a height on an employee varies depending on the height level of the fall. However, workers involved is likely to suffer from serious injuries.				
Likelihood	1-Inconceivable	2-Remote	3-Possible	4-Likely	5-Very Likely
	The likelihood of a worker to expose to falling from height is likely without mitigation measures. In the construction industry, falls from height are among the most common causes of serious work-related accidents and deaths.				
Risk Rating	The risk of falling from height is **C4** or **Medium Risk**.				

8.8.8 Mitigation Measure

- Conduct risk assessment and to implement adequate control measure for on any activity performed at height.
- Develop the safe work procedure for working at height, applicable to transmission tower construction and line maintenance e.g., harnesses and tethering etc.
- Install physical barrier to secure open edges.
- Ensure the work platform is designed according to the approved standard, installed and inspected by competent person.

- Ensure all workers were given adequate training and supervision. This includes training in climbing techniques and use of fall protection measures; inspection, maintenance, and replacement of fall protection equipment; and rescue of fall-arrested workers.
- Use of proper PPE for workers (i.e., full body harness), safety protocols during work process must be observed.
- Signs and other obstructions should be removed from structures prior to undertaking work.
- The Proponent will ensure proper design of tower structure to avoid accidents due to toppling (partially or fully) takes place during erection and stringing due to uneven stringing loads, severe wind conditions, etc.

8.8.9 Musculoskeletal Injury / Ergonomic Problems

Musculoskeletal injuries are caused by vibration, static or sustained posture, forceful and sustained exertions, repetitive motion and awkward posture. Manual lifting, carrying, pushing and pulling of construction materials and equipment can create tremendous stress and strain on the human body. If the loads are excessive and the manual tasks are carried out frequently and repetitively, workers will place themselves at increased risk of low back pain and musculoskeletal disorders. This risk increases if these movements are associated with twisting and bending.

Risk Involved	**Musculoskeletal Injury**				
Severity	A-Negligible	B-Minor	C-Serious	D-Fatal	E-Catastrophic
	The effect of musculoskeletal injury on an employee varies depending on the type of activity performed. However, musculoskeletal injuries are temporary and will fully recover over a period of time.				
Likelihood	1-Inconceivable	2-Remote	3-Possible	4-Likely	5-Very Likely
	The likelihood of a worker to expose to musculoskeletal injury is possible. This is because labour work involves physical activities that require active body movements.				
Risk Rating	The risk of musculoskeletal injury is **B3** or **Medium Risk.**				

8.8.10 Mitigation Measure

- Provide training on proper techniques in manual handling including lifting, carrying, pushing and pulling. Ensure proper manual handling technique is practice.

- Identify ergonomic risk factor and implement control measure to reduce the risk. To overcome ergonomic problems associated with manual handling, lifting equipment could be used.

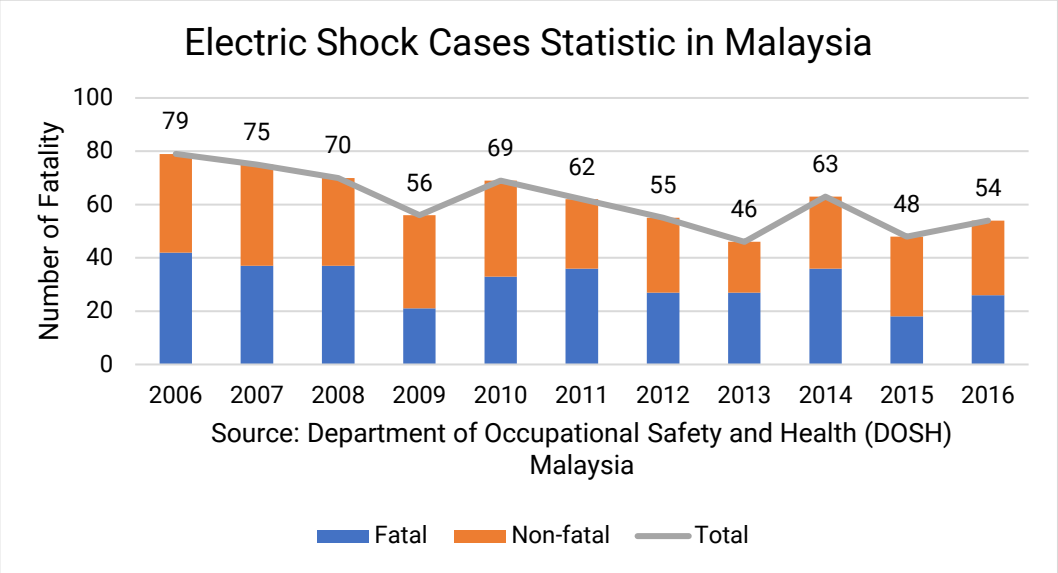
8.8.11 Electrocution / Electric Shock

Electrical hazards exist during the use of electric-powered equipment during the construction phase, and or the maintenance of transmission lines during the operation phase. These include contacts with cranes, aerial lift trucks, scaffolds and aluminium ladders.

When working near transmission line, electrical contact can occur, even if direct physical contact is not made, because electricity can arc across an air gap. As a general precaution, no one should be on an object or in contact with an object that is taller than 4.5 to 5 m while under a high-voltage electric line. Electric shock can occur if a person touches a conductor that has an electric current and becomes part of an electrical circuit. This could happen if:

- Illegal wiring and the use of unapproved and low-quality electrical equipment.
- Defects or modifications of electrically powered equipment or machinery.
- Earth cable is not properly connected.
- Lack of knowledge and awareness about the dangers of carrying out activities around the prohibited area.

According to Electrical Safety Performance Report published by Energy Commissioner (EC) in Year 2016, a total of 54 cases of accidents due to electricity were recorded and 28 of them were fatal cases. That number has shown an increase by 12.5% compared to Year 2015.



Severities of electrical injuries are depending on these factors:

- Electricity (the higher electricity will increase risk of death).
- Duration (increase duration of electrical shock will increase of death).
- The flow of electricity in human body (if the flow of electricity pass through the heart, the risk of death is very high).
- Voltage (high voltage).

Risk Involved	**Electric Shock**				
Severity	A-Negligible	B-Minor	C-Serious	D-Fatal	E-Catastrophic
	The worst effect of an electric shock on an employee is death.				
Likelihood	1-Inconceivable	2-Remote	3-Possible	4-Likely	5-Very Likely
	The likelihood of a worker to expose to electric shock during construction and operation phases is possible. Based on DOSH statistics from 2011 to 2017, 19 prosecution cases related to death cases involving electrical sources were conducted.				
Risk Rating	The risk of electric shock during the construction phase, if all control measures are taken into account and practiced, is **D3** or **Medium Risk**.				

8.8.12 Mitigation Measure

- Transmission lines will be deactivated and grounded prior to work on, or near, transmission lines.
- Place warning signs in a conspicuous place if an installation or equipment has electrical hazards.
- Where the transmission lines are within reach of machinery (cranes, cement pumps) on construction sites, these must be clearly demarcated as above.
- Provide regular training for all workers who exposed to electrical hazards.
- Ensure proper PPEs are worn by workers and safety protocols for earthing, accessories and installation of earth wire are followed.
- Ensure that the electrical appliances or machines purchased are genuine and certified by the Energy Commission and SIRIM.
- Use Earth Leakage Circuit Breaker (ELCB) for any temporary electrical installation at the construction site.
- Modification to the electrical equipment is strictly prohibited.
- Repairing electrical equipment can only be done by trained individuals recognized by the energy commission.

8.8.13 Occupational Noise

In Malaysia, the most occupational disease reported is occupational noise-induced hearing loss (NIHL). Occupational noise at construction sites is usually caused by structural or material cutting activities, or piling.

Risk Involved	**Occupational Noise**				
Severity	A-Negligible	B-Minor	**C-Serious**	D-Fatal	E-Catastrophic
	The impact of occupational noise to human varies, depending on the source and magnitude of noise generated. The effect of Occupational Noise Related Hearing Disorder (ONRHD) is cumulative, permanent and irreversible. The effect may lead to communication difficulties, impairment of interpersonal relationship, social isolation and deterioration in quality of life				

Risk Involved	Occupational Noise				
Likelihood	1-Inconceivable	2-Remote	**3-Possible**	4-Likely	5-Very Likely
	The likelihood of a worker exposure to occupational noise during construction and operation phases is Possible. Worker is likely to expose to noise during the piling work.				
Risk Rating	The risk rating for occupational noise is **C3** or **Medium Risk**.				

8.8.14 Mitigation Measures

- Identify noisy activities and conduct monitoring to determine the level of noise. Upon the identification, Contractor shall appoint a Noise Risk Assessor to carry out noise risk assessment by competent person registered with Director General of DOSH.
- Noisy area shall be marked with the words “HEARING PROTECTION ZONE”. The work area shall be demarcated and identified by an appropriate warning sign.
- The Contractor shall provide hearing protection devices such as earplugs or earmuffs to their workers.
- Send workers for audiometric test Implement a comprehensive hearing conservation program (HCP) to prevent ONRHD

8.8.15 Animal Bites and Stings

Construction and maintenance workers working on the transmission lines may be exposed to the danger of animal bites by monkeys, bats, rodents, snakes and centipedes, as well as stings from bees, wasps, scorpions and spiders. Animals, even those in close association with humans, such as dogs, can attack if they feel threatened, are protecting their young or territory, or are injured or ill.

Saliva from these animals (monkeys, dogs, bats, and rodents) can be contaminated so heavily with pathogens that a bite or contact with pre-existing cut or scratch may cause human infection. Infections of wounds may result in serious illness or death.

Risk Involved	**Animal Bites and Stings**				
Severity	A-Negligible	B-Minor	C-Serious	**D-Fatal**	E-Catastrophic
	Severe injuries are likely to be caused by attacks by ferocious reptiles such as crocodiles and snakes. Attacks of stray animals such as dogs and cats are also potentially fatal as such animals may be infected with diseases such as Rabies.				
Likelihood	1-Inconceivable	**2-Remote**	3-Possible	4-Likely	5-Very Likely
	The proposed construction location is located further inland away from bigger rivers. Therefore, crocodile attack is unlikely. However, the likelihood of being attacked by a venomous snake is possible. Vaccination programs to prevent Rabies has been carried out by local authorities but the possibility of attack by stray rabid animals cannot be ruled out. However, no case has ever been reported.				
Risk Rating	The risk rating for heat stress is **C3** or **Medium Risk.**				

8.8.16 Mitigation Measures

- Workers should be aware of their surroundings while performing works at site. Watch for signs of the presence of wild and dangerous animals before starting any work. If wild animals is encountered, immediately notify a colleague and leave the area immediately.
- Do not try to catch or confront any wild animals.
- Workers should never try to pet, handle, or feed unfamiliar animals (domestic or wild) particularly in areas where rabies is enzootic.
- Seek immediate medical attention at the nearest clinic or hospital any time a sting or envenomation occurs.

8.9 SUMMARY OF IMPACTS

The environmental and social impacts of the proposed BMTLP is summarized in table below.

Table 8.9.1: Summary of Project Activities and Significance of Potential Impacts during Site Preparation, Construction and Operational Phases

Aspects	Phase	Activities and Potential Impacts	Impact Significance	Impact Duration
Land Use Conversion	Pre-construction	Loss of land and crops for tower bases and transmission line right-of-way	Minor	Permanent
Soil Erosion	Construction	Increase soil loss, sedimentation and turbidity of waterways near construction work site – access points, onsite support facilities, right-of-way and cut and fill activities	Minor	Short-term
	Operation and Maintenance	Soil disturbance from access road and slope maintenance	Insignificant	-
Water Quality	Construction	Deterioration of water quality due to soil runoff, oil and grease spillage and other wastes	Minor	Short-term
		Deterioration of water quality due to wastewater discharge	Moderate	Short-term
	Operation and Maintenance	Deterioration of water quality	Insignificant	-
Air Quality	Construction	Fugitive dust and PM_{10} pollution due to traffic and transportation activities along unpaved access road surface Vehicles exhaust emission	Minor	Short-term
	Operation and Maintenance	Vehicles exhaust emission	Insignificant	-
Noise	Construction	Noise from transportation activities along access roads and construction at tower sites	Minor	Short-term
	Operation and Maintenance	Operation of transmission line and maintenance work	Insignificant	-
Wastes	Construction	Improper disposal of removed biomass Improper solid Waste generation, storage and disposal	Moderate	Short-term
	Operation and Maintenance	Solid waste generation, storage and disposal	Moderate	Temporary
Greenhouse Gasses	Construction and Operation	Climatic condition due to GHG emissions	Minor	Long-term
Traffic and Transportation	Construction	Community safety due to transportation and construction activities	Minor	Temporary
		Riverine traffic	Minor	Temporary

Aspects	Phase	Activities and Potential Impacts	Impact Significance	Impact Duration
	Operation and Maintenance	Land and riverine traffic movement	Insignificant	Short-term
Biological Resources	Construction and Operation	Increased decline in threatened flora species	Minor	Long-term
		Loss and fragmentation of habitat	Minor	Long-term
		Risk of fire	Minor	Temporary
		Loss of threatened fauna	Minor	Long-term
		Noise impact on fauna behaviour	Minor	Short-term
Social Resources	Construction Operation and Maintenance	Loss of customary land, crops and livelihood	Major	Permanent
		Community utilised forest products	Minor	Permanent
		Employment opportunities and capacity building	Positive	Temporary
		Influx and interaction with construction workforce (non-local)	Moderate	Temporary
		Public risk of injury and fatalities at construction site	Minor	Temporary
		Public traffic safety	Minor	Temporary
		Camp followers and anti-social behaviour	Minor	Temporary
		Access to infrastructure and services	Insignificant	Temporary
		Visual impact	Minor	Long-term
Cultural Heritage	Pre-construction Construction Operation and Maintenance	No registered cultural heritage assets within the ROW Avoidance of gravesites	Insignificant	-
Public Health, Safety and Security	Construction	Electrocution	Minor	Permanent
		Communicable disease (Covid-19)	Major	Temporary
		Attack by wildlife	Insignificant	-
	Operation	EMF exposure and related chronic diseases – adult leukaemia and brain tumours	Insignificant	Long-term
Occupational Safety and Health	Construction	Heat stress	Medium risk	Temporary
		Traffic accidents	Medium risk	Temporary
		Machinery, equipment and vehicles accident	Medium risk	Temporary
		Falling from height	Medium risk	Temporary

Aspects	Phase	Activities and Potential Impacts	Impact Significance	Impact Duration
		Musculoskeletal Injury	Medium risk	Temporary
		Electrocution / electric shock	Medium risk	Temporary
		Occupational noise	Medium risk	Temporary
		Animal bites and stings	Medium risk	Temporary

8.10 CUMULATIVE IMPACTS

Cumulative impacts are the result of multiple activities whose individual direct impacts may be relatively minor but in combination with others result are significant environmental effects. IFC in its Good Practice Handbook: Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (2013) defines cumulative impacts as follow:

> *"Cumulative impacts are those that result from the successive, incremental, and/ or combined effects of an action, project, or activity (collectively referred to in this document as "developments") when added to other existing, planned, and/ or reasonably anticipated future ones.*

The aim of the Cumulative Impact Assessment (CIA) is to determine whether activities are likely to significantly affect the viability or sustainability of the existing environmental and social receptors and resources. These are referred as Valued Environmental and Social Components (VECs).

What are VECs?

VECs are environmental and social attributes that are considered to be important in assessing risks; they may be:

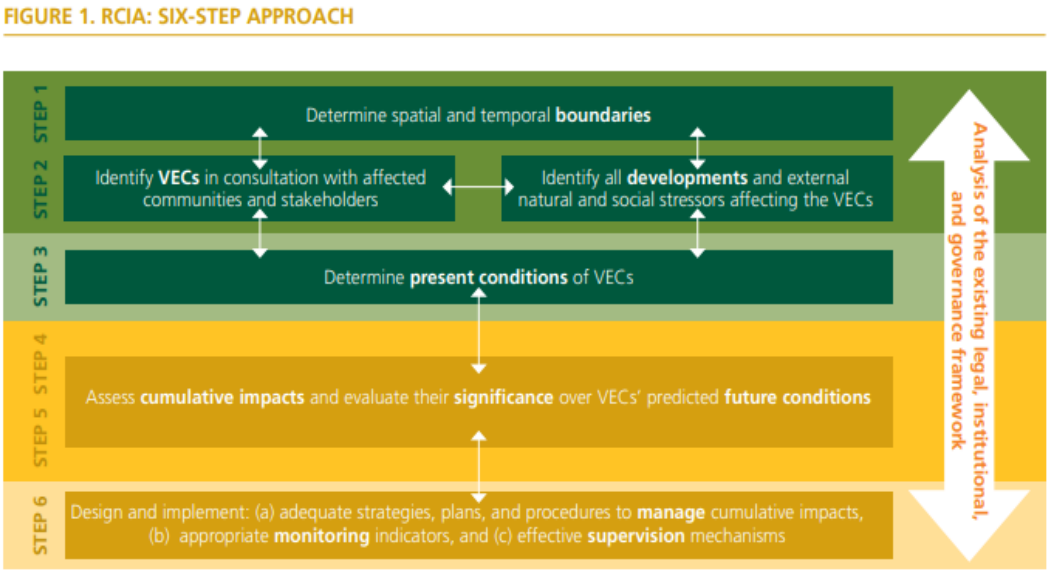
- physical features, habitats, wildlife populations (e.g., biodiversity),
- ecosystem services,
- natural processes (e.g., water and nutrient cycles, microclimate),
- social conditions (e.g., health, economics), or
- cultural aspects (e.g., traditional spiritual ceremonies).

Source: Good Practice Handbook: Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (IFC, 2013)

Figure 8.10.1 What are VECs?

8.10.1 Approach

Figure 8.10.2 outlines the approach to CIA by IFC. This assessment focussed on potential cumulative effects on Valued Environmental and Social Components (VECs). For this project, VECs adversely impacted by significant project impacts only (i.e., **Moderate** or **Major**) will be assessed. VECs predicted with Minor or Insignificant will not be assess further on the grounds that the project will not significantly contribute to any cumulative effects.



Source: Good Practice Handbook: Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets (IFC, 2013)

Figure 8.10.2 IFC's Approach to Cumulative Impact Assessment

8.10.2 Cumulative Impact Assessment

8.10.2.1 Step 1: Determine Spatial and Temporal Boundaries

The spatial boundaries will be confine within the BMTLP impact zone and AOI as described in **Chapter 3**, **Section 3.7**.

The temporal boundaries would be the construction phase as most significant impacts occur during the construction phase and potential for significant cumulative impacts is highest.

8.10.2.2 Step 2(a): Identify VECs

Receptors and resources affected by significant adverse impacts (i.e., **Major** or **Moderate**) from the project were assessed to determine if they are considered to be a VEC (**Table 8.10.1**).

Table 8.10.1: VECs Identification

Aspects	Phase	Activities and Potential Impacts	Impact Significance	Impact Duration	VECs
Water Quality	Construction	Deterioration of water quality due to wastewater (sewage) discharge	Moderate	Short-term	Ecosystem services, natural processes
Wastes	Construction	Improper disposal of removed biomass Improper solid Waste Generation, Storage and Disposal	Moderate	Short-term	Natural processes (water quality, soil quality, and visual impacts)
	Operation and Maintenance	Solid waste generation, storage and disposal	Moderate	Temporary	Natural processes (water quality, soil quality, and visual impacts)
Social Resources	Construction Operation and Maintenance	Loss of customary land, crops and livelihood	Major	Permanent	Social conditions (land conversion)
		Influx and Interaction with construction workforce (non-local)	Moderate	Temporary	Social conditions (safety, security)
Public Health, Safety and Security	Construction	Communicable disease (Covid-19)	Major	Temporary	Social conditions (health) *Cumulative effects not assessed as everyone has to abide by all regulations, orders, instructions, rules and SOPs made by the State Government, State Disaster Management Committee (SDMC), Ministry of Health, State Health Department.*
Occupational Safety and Health	Construction	Heat stress	Medium risk	Temporary	Social conditions (Occupational health and safety) *No potential for cumulative effects as workforce will only be used for Project*
		Traffic accidents	Medium risk	Temporary	
		Machinery accident	Medium risk	Temporary	
		Working at height	Medium risk	Temporary	
		Musculoskeletal Injury	Medium risk	Temporary	
		Electric shock	Medium risk	Temporary	

Following identification of VECs above, the CIA will focus of the following VECs:

- Water resources
- Wastes generation and management
- Social conditions (land and livelihood)

8.10.2.3 Step 2(b): Identify Developments and External Natural and Social Stressors Affecting the VECs

8.10.2.3.1 Water Resources

Chapter 5 (**Section 5.8**) have described the existing river system, protected water catchment areas (including GFS dependent settlements), surface water quality and common pollutants based on field visit and analysis of water samples. The results of water quality analysis are provided in **Table 5.8.4** and **Table 5.8.5**.

Oil palm plantations, logging and forest plantations, ongoing construction of new roads and Baleh HEP Dam are among major land uses and activities within and the vicinity of the transmission line project (**Section 5.8.4**). These activities are suspected as the major contributors to high turbidity and suspended solid levels recorded at existing water quality monitoring stations along Btg. Rajang and Btg. Baleh (**Section 5.8.7**).

8.10.2.3.2 Waste Generation and Management

Chapter 5 (**Section 5.13**) described the existing waste facilities within the Kapit region and beyond. Besides this transmission line project, there are no other developments or stressors identified.

8.10.2.3.3 Social Conditions (Land and Livelihood) of Affected Communities

Chapter 7 described the social condition of the affected communities. There are 159 settlements sparsely scattered along the northern bank of Btg. Rajang and Btg. Baleh, between Baleh HEP up to Mapai Substation, but no urban centres. Oil palm plantations, forest plantations, logging operations, coal mining and ongoing construction of new roads and Baleh HEP Dam are some of developments activities noted in the region of the proposed transmission line project.

8.10.2.4 Step 3: Determine Present Condition

Determining the present environmental and social conditions is part of this ESIA study. The scope includes collecting primary and secondary baseline environmental and social data to determine the existing conditions as well as the sensitive receptors. The full description of the existing environment and social conditions is given in **Chapter 3**, **Chapter 4, Chapter 5**, **Chapter 6** and **Chapter 7**.

8.10.2.5 Step 4 – 6: Assess and Management Cumulative Impacts

8.10.2.5.1 Water Resources

Freshwater resources crossed by the transmission line particularly during construction stage may potentially impact the availability and quality of water resources for GFS dependent longhouses along the transmission line route. However, these impacts are short-term, local and the project residual impact is expected to be insignificant with the proper implementation of proposed mitigation measures above (see **Section 8.3.3.2**).

As the measures above already include provision for water monitoring and mitigation measures, any cumulative effects from other developments would be inherently managed through the Project Proponent's commitment to remediate to acceptable water quality levels (i.e., compliance with national and World Bank EHS Guidelines).

On this basis, no additional measures are proposed.

8.10.2.5.2 Waste Generation and Management

Besides this transmission line project, there are no other developments identified that will contribute to cumulative effects on wastes in the immediate vicinity of the ROW.

With the mitigation measures recommended in **Section 8.3.6.2, 8.3.6.4** and **Waste Management Plan in Chapter 9**, no additional measures are proposed.

8.10.2.5.3 Social Conditions (Land and Livelihood) of Affected Communities

Besides the transmission line project, new road and Baleh HEP Dam constructions, oil palm and forest plantations, logging operation and coal mining are some of the developments or activities noted in Kapit. Cumulative impacts of these developments or activities have cause deterioration of in water quality due to high sedimentation rates in local rivers. Large scale forest conversion to oil palm and

forest plantations, as well as logging operations also have contributed to the scarcity of timber resources and NTFPs available to local communities.

Proposed project could contribute to cumulative effects on the livelihoods of the households who depend on forest and river resources. Should there be issue with regards to land and livelihood due to this project, it will be dealt with the procedures as outlined in the **Stakeholder Engagement Plan** and **Land Acquisition and Livelihood Restoration Plan** in **Chapter 9**.

As such, no additional measures are proposed.

Appendix 8.3.1a

Erosion and Sediment Control Plan (ESCP)

Erosion and Sediment Control Plan (ESCP)

1 OVERVIEW

This section covers the details of the temporary measures that will be implemented during the site preparation, earthwork and construction phases, to control the environmental impacts of erosion and sedimentation.

The ESCP addresses the sediment discharge implications associated with the proposed site activities during site preparation, earthwork and construction phase. Best Management Practises (BMPs) for erosion and sediment controls shall be proposed on all land development projects to prevent and minimise, the transport of sediment along the proposed TL ROW, resulting from clearing and grading, or other land-disturbing activities. BMPs shall be maintained in good working condition at all times and shall be kept in place, until the disturbed areas have been permanently stabilised.

2 DESIGN REFERENCES

The ESCP has been prepared by following the references (wherever applicable) laid out by the documents below:

a. Urban Stormwater Management Manual for Malaysia, MSMA 2nd Edition, Year 2012 by Department of Irrigation and Drainage Malaysia.

b. Guideline for Erosion & Sediment Control in Malaysia, October 2010 by Ministry of Natural Resources and Environment, Malaysia and Department of Irrigation and Drainage Malaysia.

3 ESCP OBJECTIVES

ESCP's main objectives are to minimise and control the environmental impacts of erosion and sedimentation, to protect the environmental quality at the Project site and its surrounding areas, through a proper and systematic planning, implementation, monitoring and auditing of the proposed mitigation measures on-site.

4 ESCP PRINCIPLES

The five (5) general principles of ESCP consists of:

1. To ensure that erosion and sediment control measures are fully integrated into the development sequence;

2. ESCP is part of the engineering documents for the construction contractor and be part of the final engineering design drawings for documentation in Schedule of Rates and Bill of Quantities;

3. To ensure that all control structures are maintained at all stages of the development, such as during grading works, site preparation, foundation and construction works;

4. To ensure that there is a system of continuous monitoring of the parameters identified in the ESCP, to control erosion throughout the Construction of the Project; and

5. To prepare an emergency plan for immediate implementation, if any of the erosion and sediment control measures fail, due to unforeseen circumstances, such as severe rainstorms overtopping or breaching sediment basins.

5 SOIL LOSS ESTIMATION – RUSLE

The rate of soil loss from the Site is estimated using the Revised Universal Soil Loss Equation (RUSLE). The essence of modelling soil loss with RUSLE is to evaluate each factor that influence soil loss and quantify its effect with a numerical unit.

The equation is presented in the form of: -

A = R x K x (L x S) x C x P

Where: -

A = soil loss in tons per ha per year.

R = rainfall erosivity index – a number which indicates the erosivity of the rainfall on a scale based on the Morgan Method (1974).

K = soil erodibility factor- a number which reflects the liability of a soil type to erosion.

L = the length factor – a ratio which compares the soil loss with that from a field of specified length.

S = the slope factor – a ratio which compares the soil loss with that from a field of specified slope.

C = crop management factor – a ratio which compares the soil loss with that from a field under a standard treatment.

P = conservation practice factor - a ratio that compares the soil loss with that from a field with no conservation practice.

All values of parameters in the above equation are obtained using data for Malaysian climate condition as presented in Chapter 3 of The Guidelines for Erosion and Sediment Control in Malaysia (Oct, 2010).

The application of this numerical equation is to predict soil erosion losses in a given environment. In a given situation the value of each factor is fixed. For each of these factors the appropriate numerical value is selected, and when multiplied together they give the amount of erosion predicted to occur in this given situation. Changes in the soil loss can be predicted by altering the conditions (hence values) of any of the above factors.

Based on the RUSLE equation above, with the work area for all angle towers (AT1 – AT35) assumed to be 50m x 50m (0.25 ha), all other factor coefficients identical, the only variable factor is the slope gradient. The slope gradient for all angle tower ranges from 1.9% (AT35) to 115.8% (AT5). The soil loss projection is calculated for AT5 and AT35 as shown in **Table 5.1** and the soil loss calculation is further appended in **Annex A**.

Table 5.1: Soil Loss Projection – RUSLE

Soil Loss, A (tonnes/ha/yr)	**Angle Tower**	
	AT5	**AT35**
Pre-Development	1,595.97	2.39
Earthwork and Construction (without BMPs)	53,198.89	79.64
Earthwork and Construction (with BMPs)	6,383.87	9.56
Post-Development	531.99	0.80

From the outcome of the soil loss modelling results, it is shown that with the proposed BMPs in place, the soil loss from the angle tower work area will be greatly reduced.

6 SEDIMENT YIELD ESTIMATION – *MUSLE*

To estimate the sediment yield at the Site, the Modified Universal Soil Loss Equation (MUSLE) is used. The equation is given below:

$$\mathbf{Y = 89.6\ (V\ Q_p)^{0.56}\ (K.LS.C.P)}$$

Where:-

Y = Sediment yield per storm event (tonnes)

V = Runoff volume in cubic meter

In order to estimate the sediment yield for the Site, the peak discharge Q_p is determined based on the Rational Method (DID, 2012), as recommended in the Urban Stormwater Management Manual (MSMA), 2nd Edition (DID, 2012).

$$\mathbf{Q_p = C*I*\ A\ /\ 360}$$

Where:-

Q_p = Peak discharge flow (m3/s)

C = Runoff coefficient

$^{Y}I_t$ = Y year Average Rainfall Intensity (ARI) over time of concentration (10-year ARI)

A = Drainage area (ha)

The runoff coefficients during the pre-development, cleared & earthwork as well as post-Rehabilitation are obtained from Table 2.5 of MSMA 2012 Guidelines. The rainfall intensity is determined with the Hydrological Procedure. The calculation of peak surface runoff is appended in **Annex B**.

The sediment yield for the angle tower AT5 and AT35 at different stages is tabulated in **Table 6.1**.

Table 6.1: Sediment Yield Estimation – *MUSLE*

Sediment Yield (tonnes)	Angle Tower	
	AT5	AT35
Pre-Development	3.665	0.008
Earthwork and Construction (without BMPs)	149.249	0.335
Earthwork and Construction (with BMPs)	17.910	0.040
Post-Development	1.466	0.003

7 BEST MANAGEMENT PRACTICES (BMPS)

Best Management Practices (BMPs) can be grouped into two (2) categories:

a. **Erosion prevention** is the use of practices designed to protect the surface of the soil from the force of rain, wind and other runoff, so the soil particles will not dislodge (erode) and be transported off the construction site as sediment. These particles include establishing a vegetative cover, controlling stormwater runoff, and/or providing protective covers for exposed soils.

b. **Sediment control** is the use of practices designed to capture soil particles after they have been dislodged and become sediment and the attempt to retain the sediment on-site. These practices include installing sediment fencing, sediment traps or sediment basins.

Both erosion prevention and sediment control have appropriate users, but erosion prevention BMPs are more effective in preventing soil particles from exiting the construction site. Once the soil is dislodged, there are very difficult to recover.

7.1 BMP Categories and Objectives for ESCP

The BMPs categories and objectives for the ESCP are as listed in **Table 7.1**. The BMPs are to be planned out and subsequently installed at affected areas based on the information acquired from the earthwork and survey plan made available to the ESCP designer. The designer shall also acquire the topography information and determine the runoff flow direction to ensure whatever BMPs planned on-site shall be workable and practical. Should there be any modifications on-site upon implementation, it shall also be dictated on the plan to ensure that the Proponent and relevant agencies be informed of the changes.

Table 7.1: BMPs Categories and Objectives for ESCP

BMP Category	BMP Objectives						
	Practise Good Housekeeping	Contain Waste	Minimise Disturbed Area	Stabilise Disturbed Area	Project Slopes and Channels	Control Site Perimeter	Control Internal Erosion
Site Planning Considerations							
Scheduling	√	√	√	√	√	√	√
Preservation of Existing Vegetation			√	√	√	√	
Physical Stabilisation							
Dust Control	√		√	√		√	
Temporary Waterway Crossing	√		√	√	√		
Construction Road Stabilisation	√		√	√	√		
Construction Access Stabilisation	√		√	√		√	
Drainage	√		√		√	√	
Rock Filter Check Dam	√		√	√	√		√
Silt Fence	√		√	√			√

7.2 Construction Phase and its BMP Implementation

The timing of soil-disturbing activities and the timing of the implementation of BMPs are both crucial to the prevention of accelerated erosion and transport of sediment out of the site. The scheduling of grading should take into account of the rainy season and should minimise the length of time the soil is left exposed, and to reduce the total area of exposed soil during the rainy season.

Consideration should be made to the phasing of grading and construction activities, so that critical areas (such as highly erodible soils, areas adjacent to waterways, etc.) are not disturbed until the non-rainy season, and so the entire area that is disturbed at any one time, is kept to a size that can be managed effectively. **Table 7.2** shows the action to be taken for BMP implementation and sequencing prior to earthwork phase.

Table 7.2: BMP Implementation and Sequencing

Step No.	Description	What to DO
1)	Before Construction	Identify, mark and protect (by fencing off or other means) critical riparian areas and vegetation including important trees and associated rooting zones, as well as vegetation areas to be preserved. Identify vegetative buffer zones between the sites and sensitives areas, e.g., wetlands, and other areas to be preserved, especially in perimeter areas. Hold a pre-construction meeting to discuss the specific erosion and sediment control measures and construction limits.
2)	Site Access Areas (construction entrances)	Stabilise site entrances and access roads prior to commencement of construction activities.
3)	Runoff Control	The next phase is to stabilise streambanks and construct the primary runoff control measures to protect areas from concentrated flows.

7.3 Diversion Channel / Earth Drain

Temporary diversion channel/ temporary earth drain may be used to divert off-site runoff around the construction site, divert runoff from stabilised areas around disturbed areas, and direct runoff to check dams. Diversion channels should be installed when the site is initially graded and remain in place until permanent BMPs are installed and/or slopes are stabilised.

The temporary drainage system features are designed for hydraulic efficiency and also for easy maintenance.

a.	Design Storm	2 years ARI
b.	Dimension	Sides slope: 1(V):2(H) Minimum base width is 0.5m Minimum freeboard is 50mm

c.	Velocities, V	0.6 m/s ≤ V ≤ 2 m/s
d	Roughness Coefficient	0.03 (rock rip-rap liner); 0.015 (reinforced concrete)
e	Scour Protection	Inlet and outlet protected by rock rip-rap Channel bed stabilised by rock rip-rap

Berm drain and cascading drain shall be provided at the cascade terracing area to divert and slow down surface runoff as well as to protect slope from fast surface runoff.

7.4 Sediment Fence

A sediment fence is a temporary sediment barrier consisting of filter fabric stretched across and attached to supporting ports, entrenched and depending upon the strength of the fabric used, backed by a wire fence for support. This measure does not filter runoff but acts as a linear barrier creating upstream ponding that allows soil particles to settle out, thereby reducing the amount of soil leaving a disturbed area.

Design Storm	First 40mm rainfall for site < 2 years construction period First 50mm rainfall for site ≥ 2 years construction period
Maximum Contributing Area	0.4 hectares
Hydraulic	• For any point along the fence, • Concentrated flow shall not exceed 50l/s • Maximum water depth shall not exceed 600mm
Sitting of facility	• SHALL NOT be installed in areas receiving concentrated flow, i.e., stream or ditches • Maximum length of each fence segment shall not exceed 30m • The ends of each segment (at least 1m) shall be turned uphill to prevent runoff flowing around the fence
Slope	• Slope drainage to fence shall be 1:1 or flatter • Length of draining to fence shall not exceed 60m

The details for the sediment fence are appended in **Annex C.**

7.5 Rock Filter Check Dam

A rock filter check dam is a small temporary dam constructed across a diversion channel or swale. It reduces the velocity of concentrated stormwater flows, thereby reducing erosion of the channel and promote sedimentation behind the

dam. Small barriers consisting of rocks or earth berms are suitable as check dams. Other products such as gabions and sands bags can be used effectively as check dams too.

Design Storm	2-year ARI, unless specified otherwise by Authorities
Overspill	All flow greater than 2-year ARI shall safely bypass the crossing
Flood Protection	Ensure upstream/downstream flooding condition not aggravated.
Dimension	• Height (centre) of dam shall not exceed 1m • For rock check dam • Upstream slope: 2:1 or flatter • Downstream slope 4:1 or flatter • Centres of the dam shall be notched to centre to promote concentrated flow (approx. 0.15m) • Outer sides of dam shall be at least 0.5m higher than centre to avoid undermining. • Spill crest shall be of at least 100m in width parallel to flow
Intervals	Series of check dam can be placed such that the height of the subsequent check dam must be equal or lower than the base of the check dam before it
Geotextile	Check dam with height more than 450mm shall be laid with geotextile to avoid seepage or structural failure
Scour Protection	• Structure shall withstand sheer force induced by a 2-year ARI flow. Materials (rocks, earth, gabion) must be selected to meet the requirement. • Additional scour protection downstream of check dam shall be provided if deemed necessary.

The details for the rock filter check dam are appended in **Annex C**.

8 IMPLEMENTATION OF EROSION AND SEDIMENT CONTROL

Implementation of erosion and sediment control is to be carried out in order to contain erosion and siltation during site preparation phase for the Project site,

mainly from the clearing of ROW, earthwork and construction activities at the foundation works of the proposed transmission tower.

The outline of the erosion and sediment control for the establishment of the Project site is as follows:

8.1 Erosion and Sediment Control for Clearing of ROW and Foundation Work Area for the Transmission Line and Transmission Towers

This phase involves the mobilisation of equipment and machineries to the Project site, the clearing of vegetation along the ROW of the proposed TL ROW, and construction activities at the foundation area of the proposed transmission towers, of about 176 km in length. It is anticipated that work at multiple tower locations will be ongoing at any given time.

The outline of the erosion and sediment control for the establishment of the Project site is as follows:

- Chainage for the ROW shall be 50 m for the width of the rentice from Mapai substation to Baleh substation of about 176 km in length. Prior to beginning the removal of vegetation, the limits of clearing will be established and identified in accordance with the drawings. All clearing shall be confined to within the ROW as shown in the drawings.

- Prior to any commencement of work, construction entrance stabilisation (CES) shall be constructed at the entrance/exit point to the public sealed road (if any), to minimise the impact of sediment being washed onto the public road and existing drain, as well as to act as a dust control measure.

- Biomass generated from the clearing activities shall be temporary stockpiled at designated areas along the ROW.

- Follow the mitigation measures proposed in the ESIA – Chapter 8.

- The ESCP for the transmission towers can be referred in **Appendix 8.3.1b** of the ESIA.

- Details of the BMPs can also be referred in **Annex C**.

8.2 Erosion and Sediment Control at Waterway Crossings for Transmission Line and Transmission Towers

- There are a few waterway crossings (i.e., earth drains and river) along the transmission alignment of the Project site as shown in the drawings.
- For river crossings, there would be no major impact of soil erosion and sedimentation to the rivers as there are no major earthwork activities within the river reserve.

8.3 Erosion and Sediment Control at Road Crossings for Transmission Line and Transmission Towers

- There are a few earth road crossings along the transmission alignment of the Project site as shown in the drawings.
- For road crossings, there would be no major impact of soil erosion and sedimentation to the roads as there are no major earthwork activities within the road reserve.

8.4 Overall Erosion and Sediment Control

- ESCP is COMPULSORY to be followed accordingly and maintained by a qualified person to ensure that only the allowable quality and quantity of water to be discharged out from the Project site.
- All contractors shall be informed of their responsibilities in minimising the risk of soil erosion and pollution, resulting from the earthwork and construction activities.
- A temporary access road may be left open temporarily to allow access by construction traffic to enable the temporary BMPs to be installed, regularly inspected and maintained. When the temporary access is no longer required, it must be stabilised.
- After the site is stabilised, remove all temporary BMPs and install permanent vegetation on the disturbed areas.
- Follow the mitigation measures proposed in Section 8 of the ESIA.
- The ESCP for the transmission towers can be referred in **Appendix 8.3.1b** of the ESIA.

- Details of the BMPs can be referred in **Annex C**.

9 INSPECTION AND MAINTENANCE PROGRAMME

The Project Manager shall appoint an on-site Environmental Officer (EO) to oversee the execution of ESCP mitigation measures and its BMPs effectiveness. The EO is responsible to plan for regular inspection, routine monitoring and record keeping of ESCP on-site. However, due to the Project site spanning over a stretch of 176 km, with multiple active work area at the same time, it is encouraged to have each active area to appoint its individual environmental inspector. The environmental inspector can conduct routine end-of-day maintenance check and keeping of on-site records.

9.1 Water Quality Monitoring

Water quality monitoring location shall be proposed at the nearest waterway to the Project site. The parameter to be monitored is Total Suspended Solids (TSS).

9.2 Site Inspection

A self-auditing programme will be established based on an inspection checklist. A site inspection using the checklist will be made by the management:

- At least daily, weekly, bi-weekly or monthly; and
- Immediately after a storm event.

A qualified person will be required to oversee the installation and maintenance of all erosion and sediment control measures on-site. The responsible person will ensure that:

- The ESCP is being implemented properly;
- Repairs for the Best Management Practices (BMPs) are undertaken as required; and
- Essential modifications are made to the ESCP, if and when necessary.

9.3 Maintenance of Best Management Practices (BMPs)

Proposed maintenance programmes and the maintenance requirement for the proposed BMPs are shown in **Table 9.1** and **Table 9.2**. Sample of an ESCP maintenance checklist can be referred in **Annex D**.

Table 9.1: Maintenance Programmes for the Proposed BMPs

Particular	Activity	Monitor / Inspection Cycle			
		Daily	Weekly-Bi-Weekly	Monthly/ Quarterly	After Storm Event
Erosion & Sediment Control / ESCP	• Review with Contractor			■	
	• Modify/ improve soil erosion prevention			■	
1. BMPs	• Construction Entrance Stabilisation			■	■
	• Temporary Waterway Crossing (if any)		■		■
	• Drainage		■		■
	• Rock Filter Check Dam		■		■
2. Water Quality	• Nearest stream from the Project site				
	• Water analysis (Turbidity & TSS)			■	
	• Visual inspection	■			■

Table 9.2: Maintenance Requirements for the Proposed BMPs

BMP	Maintenance Requirements
Drainage	• Inspect weekly and after each rainfall. • Ensure no siltation or blockage in the drainage system.
Rock Filter Check Dam	• Inspect weekly and after each rainfall. • Replace lost aggregate when necessary. • Remove accumulated sediment once sediment reaches 1/3 of the check dam's height.
Silt Fence (if any)	• Inspect weekly and after each rainfall. • Replace damaged fence whenever necessary. • Periodically remove the sediment accumulated behind the fence.
Temporary Waterway Crossing (if any)	• Inspect weekly and after each rainfall. • Periodically remove silt from crossings. • Replace lost aggregate from inlets and outlets of culverts.

9.4 Keeping of Log Book

Logbook shall always be kept on-site for inspection by DID, DOE or local authority officers with entries made at least weekly on:

1. Dates of installation and removal of BMPs;
2. Repair of any damage to BMPs;
3. Rainfall depths, duration and times;
4. Condition of BMPs, structures and stabilised surfaces; and
5. Water quality monitoring report (e.g., TSS and Turbidity).

ANNEX A

Calculation Sheet		Job No.:	Sheet No.: 1	Rev. No. :
CHEMSAIN KONSULTANT SDN. BHD.		Dwg. No. :	Date : 4/2/2021	
Consulting Engineers		Designed by :	Chew Wee Giap	0
Project :	Soil Loss and Sediment Yield for Baleh-Mapai TL (AT5)	Checked by :	Ir. Brian S.H. Chong	Remark :

SOIL LOSS ESTIMATION WITH RUSLE

RUSLE will be used to assess the erosion risk of the site under four conditions, i.e. pre-development (undisturbed), earthwork and construction (no BMPs),earthwork and construction (with BMPs), post-development.

Project Area AT5 = **0.25** ha

Determination of Rainfall Erosivity, R Factor

Figure 3.6 (Guideline for ESC in Msia)

R = **11,250** MJ.mm/ha.hr.yr

Determination of Soil Erodibility, K Factor

$K = [1.0 \times 10^{-4}(12\text{-}OM)M^{1.14} + 4.5(s\text{-}3) + 8.0(p\text{-}2)] / 100$

Whereby:-

M = (% silt + % very fine sand) x (100 - % Clay)

OM = % of Organic Matter

s = Soil Structure Code

p = Permeability Class

The average PSD is assumed based on SI data from the Baleh Main Dam Site:

Depth	Particle Size Distribution (%)				M
	Clay	Silt (0.006 mm)	Sand (0.06 - 2 mm)	Organic Matter (OM)	
D1	18.0	45.0	23.0	0.5	5,576.00

**SI work along the TL is still on-going*

Depth	Structure Code (s)	Permeability Code (P)	K Factor
1	3	3	**0.039**

Calculation Sheet		Job No.:		Sheet No.: 2	Rev. No. :
	CHEMSAIN KONSULTANT SDN. BHD.	Dwg. No. :		Date : 4/2/2021	
Consulting Engineers		Designed by :	Chew Wee Giap		**0**
Project :	Soil Loss and Sediment Yield for Baleh-Mapai TL (AT5)	Checked by :	Ir. Brian S.H. Chong		Remark :

Determination of LS Factor

The LS factor can be calculated using methodology suggested in Chapter 15, MSMA (DID,2000) which applied the equation defined by Wischmeier (1975);

$LS = (\lambda / \Psi)^m \times (0.065 + 0.046s + 0.0065s^2)$

Whereby, λ = sheet flow path length (m or feet)

Ψ = 22.13 for SI Units and 72.6 for English Units (BU)

s = average slope gradient (%)

m = 0.2 for s < 1,
= 0.3 for 1≤ s <3,
= 0.4 for 3≤ s <5,
= 0.5 for 5≤ s <12 and
= 0.6 for s ≥12%

From the Lidar survey plan

Horizontal Slope length, λ = 35 m

Slope steepness, s = 115.8 % (clearing, earthwork and construction)
= 115.8 % (post-development)

Table 12.3 By using linear interpolation,

LS = 121.86 (clearing, earthwork and construction)
= **121.86** (post-development)

Table 12.4 **Determination of Cover Management, C Factor**

C =	0.03	(Forest/tree - 100% cover - pre-development)
=	1.00	(Bushes / Scrub 50% cover - clearing, earthwork and construction without BMPs)
=	0.25	(Mulch 50% cover - clearing, earthwork and construction with BMPs)
Table 12.5 =	0.02	(Grass seeding or turfing ≥90% cover - post development)

Determination of Support Practice, P

P =	1.00	(None - clearing, earthwork and construction w/o BMPs)
=	0.48	(Check dam and grass buffer strip 0-11% - with BMPs)
=	0.50	(post development)

Eq 12.1 **Determination of Soil Loss**

Estimation of Soil Loss, A

$A = R \times K \times LS \times C \times P$

= **1,595.97**	**tonnes/ha/yr**	(pre-development)
= **53,198.89**	**tonnes/ha/yr**	(earthwork and construction - w/o BMPs)
= **6,383.87**	**tonnes/ha/yr**	(earthwork and construction - with BMPs)
= **531.99**	**tonnes/ha/yr**	(post-development)

Calculation Sheet		Job No.:	Sheet No.: 3	Rev. No. :
CHEMSAIN KONSULTANT SDN. BHD.		Dwg. No. :	Date : 4/2/2021	
Consulting Engineers		Designed by :	Chew Wee Giap	**0**
Project :	Soil Loss and Sediment Yield for Baleh-Mapai TL (AT5)	Checked by :	Ir. Brian S.H. Chong	Remark :

Table 1.3

Sediment Yield Estimation

1) Determination of Runoff Parameters

a) Design Storm (Earthwork and Construction)

Site	Design Storm	Catchment Area, Ha	Tc, min (1)	D, min (2)	I, mm/h (3)
Project Area	5	0.25	4.94	60	82.37

(1) Refer to detail calculation of time of concentration, Tc in Peak Surface Runoff worksheet

(2) Duration of storm = 60 minutes (assume 1 hour)

(3) Refer to detail calculation of intensity, I in Peak Surface Runoff worksheet

Design Chart 14.4

b) Calculate Peak Discharge

Rational Method, Qp = C x I A / 360

Runoff Coefficient, C = **0.4** (grass cover - earthwork and construction)

Qp = 0.023 m^3/s **5 Yrs ARI**

c) Calculate Runoff Volume

Rational Method Hydrograph Method (Type 2)

V = 0.5 x (2 x Tc) x (Qp)

Site	Runoff volume, V (m^3/s) - 5 Yr ARI
AT5	6.782

Eq.12.4

Calculation of Sediment Yield

$Y = 89.6 (VQ_p)^{0.56}(K.LS.C.P)$

Condition	Runoff Volume, V (m^3), 5 Yrs ARI	Peak Discharge, Qp(m^3/s)	K Factor	LS Factor	C Factor	P factor	Sediment Yield, Y (tonne)
Pre-development	6.385	0.02	0.039	121.86	0.03	1.00	3.665
E &C (w/o BMPs)	6.782	0.02	0.039	121.86	1.00	1.00	149.249
E &C (w BMPs)	6.782	0.02	0.039	121.86	0.25	0.48	17.910
Post-development	7.512	0.02	0.039	121.86	0.02	0.50	1.466

Calculation Sheet		Job No.:	Sheet No.: 1	Rev. No. :
CHEMSAIN KONSULTANT SDN. BHD.		Dwg. No. :	Date : 4/2/2021	
Consulting Engineers		Designed by :	Chew Wee Giap	0
Project :	Soil Loss and Sediment Yield for Baleh-Mapai TL (AT35)	Checked by :	Ir. Brian S.H. Chong	Remark :

SOIL LOSS ESTIMATION WITH RUSLE

RUSLE will be used to assess the erosion risk of the site under four conditions, i.e. pre-development (undisturbed), earthwork and construction (no BMPs),earthwork and construction (with BMPs), post-development.

Project Area AT35 = **0.25** ha

Determination of Rainfall Erosivity, R Factor

Figure 3.6 (Guideline for ESC in Msia)

R = **11,250** MJ.mm/ha.hr.yr

Determination of Soil Erodibility, K Factor

$K = [1.0 \times 10^{-4}(12\text{-}OM)M^{1.14} + 4.5(s\text{-}3) + 8.0(p\text{-}2)] / 100$

Whereby:-

M	=	(% silt + % very fine sand) x (100 - % Clay)
OM	=	% of Organic Matter
s	=	Soil Structure Code
p	=	Permeability Class

The average PSD is assumed based on SI data from the Baleh Main Dam Site:

Depth	Particle Size Distribution (%)				M
	Clay	Silt (0.006 mm)	Sand (0.06 - 2 mm)	Organic Matter (OM)	
D1	18.0	45.0	23.0	0.5	5,576.00

**SI work along the TL is still on-going*

Depth	Structure Code (s)	Permeability Code (P)	K Factor
1	3	3	**0.039**

Calculation Sheet		Job No.:	Sheet No.: 2	Rev. No. :
CHEMSAIN KONSULTANT SDN. BHD.		Dwg. No. :	Date : 4/2/2021	
Consulting Engineers		Designed by :	Chew Wee Giap	**0**
Project :	Soil Loss and Sediment Yield for Baleh-Mapai TL (AT35)	Checked by :	Ir. Brian S.H. Chong	Remark :

Determination of LS Factor

The LS factor can be calculated using methodology suggested in Chapter 15, MSMA (DID,2000) which applied the equation defined by Wischmeier (1975);

$LS = (\lambda / \Psi)^m \times (0.065 + 0.046s + 0.0065s^2)$

Whereby, λ = sheet flow path length (m or feet)

Ψ = 22.13 for SI Units and 72.6 for English Units (BU)

s = average slope gradient (%)

m = 0.2 for s < 1,
= 0.3 for 1≤ s <3,
= 0.4 for 3≤ s <5,
= 0.5 for 5≤ s <12 and
= 0.6 for s ≥12%

From the Lidar survey plan

Horizontal Slope length, λ = 25 m

Slope steepness, s = 1.9 % (clearing, earthwork and construction)
1.9 % (post-development)

Table 12.3 By using linear interpolation,

LS = 0.1824 (clearing, earthwork and construction)
= **0.1824** (post-development)

Table 12.4 **Determination of Cover Management, C Factor**

C =	0.03	(Forest/tree - 100% cover - pre-development)
=	1.00	(Bushes / Scrub 50% cover - clearing, earthwork and construction without BMPs)
=	0.25	(Mulch 50% cover - clearing, earthwork and construction with BMPs)
Table 12.5 =	0.02	(Grass seeding or turfing ≥90% cover - post development)

Determination of Support Practice, P

P =	1.00	(None - clearing, earthwork and construction w/o BMPs)
=	0.48	(Check dam and grass buffer strip 0-11% - with BMPs)
=	0.50	(post development)

Eq 12.1 **Determination of Soil Loss**

Estimation of Soil Loss, A

$A = R \times K \times LS \times C \times P$

= **2.39**	**tonnes/ha/yr**	(pre-development)
= **79.64**	**tonnes/ha/yr**	(earthwork and construction - w/o BMPs)
= **9.56**	**tonnes/ha/yr**	(earthwork and construction - with BMPs)
= **0.80**	**tonnes/ha/yr**	(post-development)

Calculation Sheet		Job No.:	Sheet No.: 3	Rev. No. :
CHEMSAIN KONSULTANT SDN. BHD.		Dwg. No. :	Date : 4/2/2021	
Consulting Engineers		Designed by :	Chew Wee Giap	**0**
Project :	Soil Loss and Sediment Yield for Baleh-Mapai TL (AT35)	Checked by :	Ir. Brian S.H. Chong	Remark :

Table 1.3

Sediment Yield Estimation

1) Determination of Runoff Parameters

a) Design Storm **(Earthwork and Construction)**

Site	Design Storm	Catchment Area, Ha	Tc, min (1)	D, min (2)	I, mm/h (3)
Project Area	5	0.25	10.46	60	81.17

(1) Refer to detail calculation of time of concentration, Tc in Peak Surface Runoff worksheet

(2) Duration of storm = 60 minutes (assume 1 hour)

(3) Refer to detail calculation of intensity, I in Peak Surface Runoff worksheet

Design Chart 14.4

b) Calculate Peak Discharge

Rational Method, Qp = C x I A / 360

Runoff Coefficient, C = **0.4** (grass cover - earthwork and construction)

Qp = 0.023 m^3/s **5 Yrs ARI**

c) Calculate Runoff Volume

Rational Method Hydrograph Method (Type 2)

V = 0.5 x (2 x Tc) x (Qp)

Site	Runoff volume, V (m^3/s) - 5 Yr ARI
AT35	14.151

Eq.12.4

Calculation of Sediment Yield

$Y = 89.6 (VQ_p)^{0.56}(K.LS.C.P)$

Condition	Runoff Volume, V (m^3), 5 Yrs ARI	Peak Discharge, Qp(m^3/s)	K Factor	LS Factor	C Factor	P factor	Sediment Yield, Y (tonne)
Pre-development	13.484	0.02	0.039	0.18	0.03	1.00	0.008
E &C (w/o BMPs)	14.151	0.02	0.039	0.18	1.00	1.00	0.335
E &C (w BMPs)	14.151	0.02	0.039	0.18	0.25	0.48	0.040
Post-development	15.864	0.02	0.039	0.18	0.02	0.50	0.003

ANNEX B

Calculation Sheet		Job No.:		Sheet No.: 1	Rev. No.:
		0			
CHEMSAIN KONSULTANT SDN. BHD.		Dwg. No. :		Date : 4-Feb-21	0
Consulting Engineers		Designed by :	*Chew Wee Giap*		
Project :	Peak Surface Runoff - AT5	Checked by :	*Ir. Brian S.H. Chong*		Remark:

AEP and ARI

Hydrologic events are described by stating the Annual Exceedance Probability (AEP) or the Average Recurrence Interval (ARI). The AEP is the probability that an event of specified magnitude, or volume and duration, will be exceeded in a time period, is the average length of time between events that have the same magnitude, or volume and duration. A flood with a discharge of say $50m^3/s$ may have an AEP of 0.01, meaning that on the average there is a 1% chance that a flow of $50m^3/s$ will be equally or exceeded in any year.

Coefficient of the IDF Equation

Table 2.B1

ƛ =	89.9724	**(refer to Nanga Entawau DID Station ID: 1836042, nearest to Baleh Dam Site)**
κ =	0.1378	
ɵ =	0.4507	Storm Duration : 60 mins
ⁿ =	0.8333	: 1 hours

a) Pre Development

S =	115.80	%
n=	0.0600	Manning's roughness value for the surface
∫ =	35.00	Overland Flow (m)
L =	30.00	Flow in Open Drain
V=	3	(range from 1.0 m/s - 4.0 m/s acceptable)

b) Earthwork / Operation

S =	115.80	%
n=	0.0350	Manning's roughness value for the surface
∫ =	35.00	Overland Flow (m)
L =	30.00	Flow in Open Drain
V=	3	(range from 1.0 m/s - 4.0 m/s acceptable)

c) Post Development

S =	115.80	%
n=	0.0450	Manning's roughness value for the surface
∫ =	35.00	Overland Flow (m)
L =	30.00	Flow in Open Drain
V=	3	(range from 1.0 m/s - 4.0 m/s acceptable)

Design Storm ARIs for Urban Stormwater Systems

Table 1.1

Minor system design ARI =	0.25	2	5	10	20	years	
Major system design ARI =	50	100				years	

Calculation Sheet		Job No.:		Sheet No.: 2	Rev. No.:
		0			
CHEMSAIN KONSULTANT SDN. BHD.		Dwg. No. :		Date : 4-Feb-21	0
Consulting Engineers		Designed by :	*Chew Wee Giap*		
Project : Peak Surface Runoff - AT5		Checked by :	*Ir. Brian S.H. Chong*		Remark :

$T_c = T_o + T_d$ whereby :

T_c = Time of concentration
T_o = Time of overland flow
T_d = Time of channel flow

$$T_o = \frac{107.n.L^{1/3}}{S^{1/5}}$$ whereby :

T_o = Overland sheet flow travel time (mins)
L = Overland sheet flow path length (m)
n = Manning's roughness value for the surface
S = Slope of overland surface (%)

$$T_d = \frac{L}{V}$$

$$V = \frac{1.R^{2/3}.S^{1/2}}{n}$$

or

$$T_d = \frac{n.L.}{60R^{2/3}.S^{1/2}}$$

Whereby :
T_d = Time of channel flow
L = pipe length (m)
V = average pipe velocity (m/s)
S = Slope of overland surface (%)
R = hydraulic radius (m)
n = Manning's roughness value for the surface

a) Pre-Development

T_o (seconds)	T_o (Minutes)	T_d (seconds)	T_d (Minutes)	T_c (minutes)
487.12	8.12	10.00	0.17	8.29

Thus, the total of concentration, T_c, = $T_o + T_d$
= **8.29** minutes

b) Earthwork / Operation

T_o (seconds)	T_o (Minutes)	T_d (seconds)	T_d (Minutes)	T_c (minutes)
284.15	4.74	12.00	0.20	4.94

Thus, the total of concentration, T_c, = $T_o + T_d$
= **4.94** minutes

c) Post-Development

T_o (seconds)	T_o (Minutes)	T_d (seconds)	T_d (Minutes)	T_c (minutes)
365.34	6.09	10.00	0.17	6.26

Thus, the total of concentration, T_c, = $T_o + T_d$
= **6.26** minutes

Impirical IDF Curve

Equation 2.2

$$i = \frac{\lambda T^{k}}{(d+\theta)^{\eta}}$$

whereby :
i = Average rainfall intensity (mm/hr)
t = Average Recurrence Interval - ARI
d = Storm durations (hours), $0.0833 \le d \le 72$; and
$\lambda, \kappa, \theta, \eta$ = Fitting constants dependents on the raingauge location

ARI	0.25	2	5	10	20	50	100
Intensity	54.51	72.60	82.37	90.63	99.71	113.13	124.47

Calculation Sheet		Job No.:		Sheet No.: 3	Rev. No.:
		0			
CHEMSAIN KONSULTANT SDN. BHD.		Dwg. No. :		Date : 4-Feb-21	0
Consulting Engineers		Designed by :	*Chew Wee Giap*		
Project :	Peak Surface Runoff - AT5	Checked by :	*Ir. Brian S.H. Chong*		Remark :

Runoff coefficient, C

Condition	0.25	2	5	10	20	50	100
Pre-Development	0.3	0.3	0.3	0.3	0.4	0.4	0.4
During Development	0.4	0.4	0.4	0.4	0.5	0.5	0.5
Post Development	0.35	0.35	0.35	0.35	0.45	0.45	0.45

Area, A

Drainage Area for: AT5 = **0.25** hectares

DETERMINATION OF PEAK FLOW, Q_{peak}

$$Q_{peak} = \frac{C.{}^{Y}I_t.A}{360}$$

where by:

Q_{peak} = year of ARI peak flow (m^3/s)

C = dimensionless runoff coefficient

${}^{Y}I_t$ = Y year ARI average rainfall intensity over time of concentration, t_c (mm/hrs)

A = drainage area (ha)

Condition	Q_{peak} (m^3/s)						
	0.25	**2**	**5**	**10**	**20**	**50**	**100**
Pre-Development	0.011	0.015	0.017	0.019	0.028	0.031	0.035
During Development	0.015	0.020	0.023	0.025	0.035	0.039	0.043
Post Development	0.013	0.018	0.020	0.022	0.031	0.035	0.039

Calculation Sheet		Job No.:		Sheet No.: 1	Rev. No.:
		0			
CHEMSAIN KONSULTANT SDN. BHD.		Dwg. No. :		Date : 4-Feb-21	0
Consulting Engineers		Designed by :	*Chew Wee Giap*		
Project :	Peak Surface Runoff - AT35	Checked by :	*Ir. Brian S.H. Chong*		Remark:

AEP and ARI

Hydrologic events are described by stating the Annual Exceedance Probability (AEP) or the Average Recurrence Interval (ARI). The AEP is the probability that an event of specified magnitude, or volume and duration, will be exceeded in a time period, is the average length of time between events that have the same magnitude, or volume and duration. A flood with a discharge of say $50m^3/s$ may have an AEP of 0.01, meaning that on the average there is a 1% chance that a flow of $50m^3/s$ will be equally or exceeded in any year.

Coefficient of the IDF Equation

Table 2.B1

λ =	87.4288	**(refer to , DID Station ID: 2021036, nearest to Kanowit)**
κ =	0.1698	
ϴ =	0.4725	Storm Duration : 60 mins
ⁿ =	0.8981	: 1 hours

a) Pre Development

S =	1.90	%
n=	0.0600	Manning's roughness value for the surface
∫ =	25.00	Overland Flow (m)
L =	50.00	Flow in Open Drain
V=	1	(range from 1.0 m/s - 4.0 m/s acceptable)

b) Earthwork / Operation

S =	1.90	%
n=	0.0350	Manning's roughness value for the surface
∫ =	25.00	Overland Flow (m)
L =	50.00	Flow in Open Drain
V=	1	(range from 1.0 m/s - 4.0 m/s acceptable)

c) Post Development

S =	1.90	%
n=	0.0450	Manning's roughness value for the surface
∫ =	25.00	Overland Flow (m)
L =	50.00	Flow in Open Drain
V=	1	(range from 1.0 m/s - 4.0 m/s acceptable)

Design Storm ARIs for Urban Stormwater Systems

Table 1.1

Minor system design ARI =	0.25	2	5	10	20	years
Major system design ARI =	50	100				years

Calculation Sheet		Job No.:		Sheet No.: 2	Rev. No.:
		0			
CHEMSAIN KONSULTANT SDN. BHD.		Dwg. No. :		Date : 4-Feb-21	0
Consulting Engineers		Designed by :	*Chew Wee Giap*		
Project : Peak Surface Runoff - AT35		Checked by :	*Ir. Brian S.H. Chong*		Remark :

$T_c = T_o + T_d$ whereby :

T_c = Time of concentration
T_o = Time of overland flow
T_d = Time of channel flow

$$T_o = \frac{107.n.L^{1/3}}{S^{1/5}}$$ whereby :

T_o = Overland sheet flow travel time (mins)
L = Overland sheet flow path length (m)
n = Manning's roughness value for the surface
S = Slope of overland surface (%)

$$T_d = \frac{L}{V}$$ Whereby :

T_d = Time of channel flow
L = pipe length (m)
V = average pipe velocity (m/s)
S = Slope of overland surface (%)
R = hydraulic radius (m)
n = Manning's roughness value for the surface

$$V = \frac{1.R^{2/3}.S^{1/2}}{n}$$

or

$$T_d = \frac{n.L.}{60R^{2/3}.S^{1/2}}$$

a) Pre-Development

T_o (seconds)	T_o (Minutes)	T_d (seconds)	T_d (Minutes)	T_c (minutes)
990.64	16.51	50.00	0.83	17.34

Thus, the total of concentration, T_c, = $T_o + T_d$

= **17.34** minutes

b) Earthwork / Operation

T_o (seconds)	T_o (Minutes)	T_d (seconds)	T_d (Minutes)	T_c (minutes)
577.87	9.63	50.00	0.83	10.46

Thus, the total of concentration, T_c, = $T_o + T_d$

= **10.46** minutes

c) Post-Development

T_o (seconds)	T_o (Minutes)	T_d (seconds)	T_d (Minutes)	T_c (minutes)
742.98	12.38	50.00	0.83	13.22

Thus, the total of concentration, T_c, = $T_o + T_d$

= **13.22** minutes

Impirical IDF Curve

Equation 2.2

$$i = \frac{\lambda T^{k}}{(d+\theta)^{\eta}}$$

whereby :

i = Average rainfall intensity (mm/hr)
t = Average Recurrence Interval - ARI
d = Storm durations (hours), $0.0833 \le d \le 72$; and
$\lambda, \kappa, \theta, \eta$ = Fitting constants dependents on the raingauge location

ARI	0.25	2	5	10	20	50	100
Intensity	48.81	69.48	81.17	91.31	102.72	120.01	135.00

Calculation Sheet		Job No.:		Sheet No.: 3	Rev. No.:
		0			
CHEMSAIN KONSULTANT SDN. BHD.		Dwg. No. :		Date : 4-Feb-21	0
Consulting Engineers		Designed by :	*Chew Wee Giap*		
Project :	Peak Surface Runoff - AT35	Checked by :	*Ir. Brian S.H. Chong*		Remark :

Runoff coefficient, C

Condition	0.25	2	5	10	20	50	100
Pre-Development	0.3	0.3	0.3	0.3	0.4	0.4	0.4
During Development	0.4	0.4	0.4	0.4	0.5	0.5	0.5
Post Development	0.35	0.35	0.35	0.35	0.45	0.45	0.45

Area, A

Drainage Area for: AT35 = **0.25** hectares

DETERMINATION OF PEAK FLOW, Q_{peak}

$$Q_{peak} = \frac{C.{}^{Y}I_{t}.A}{360}$$

where by:

Q_{peak} = year of ARI peak flow (m^3/s)

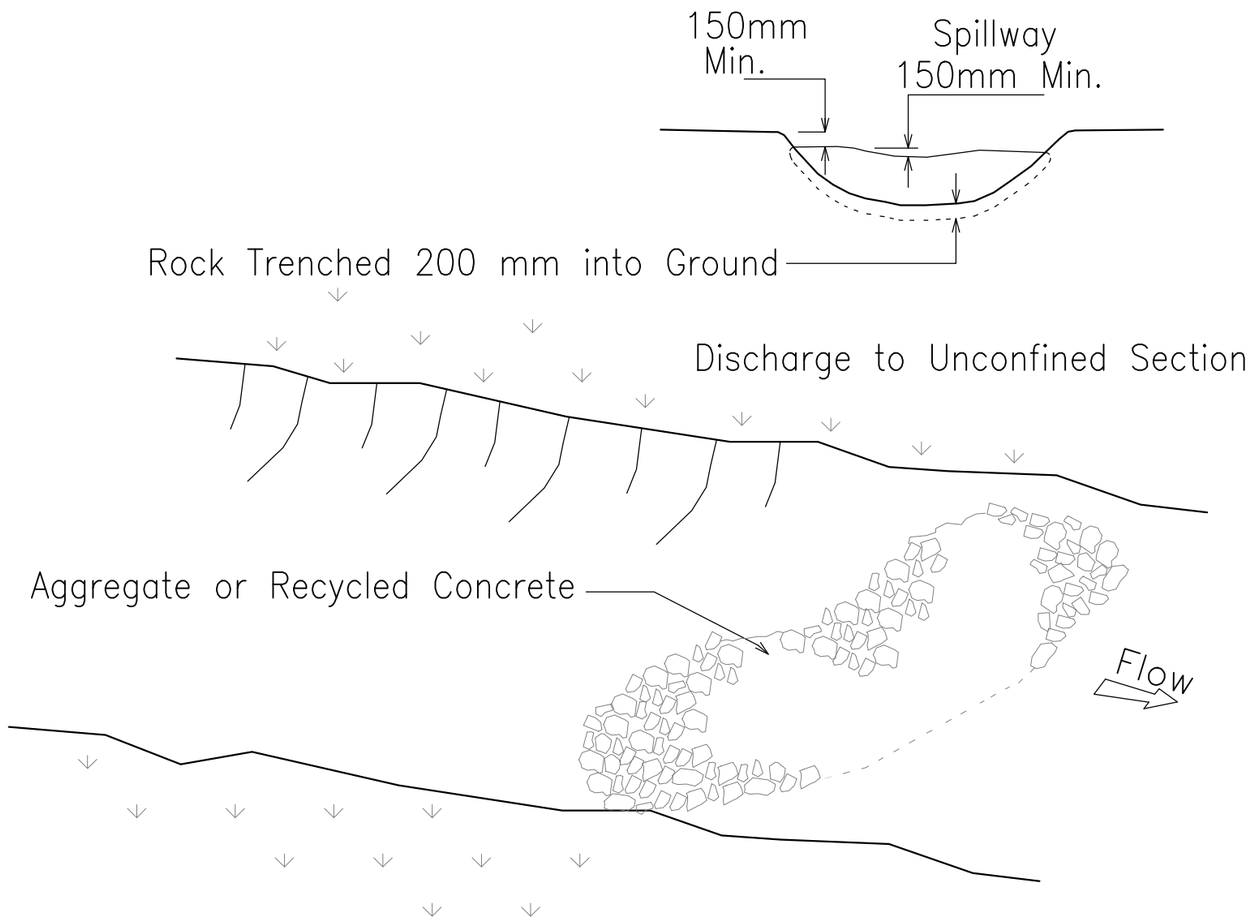
C = dimensionless runoff coefficient

${}^{Y}I_{t}$ = Y year ARI average rainfall intensity over time of concentration, t_c (mm/hrs)

A = drainage area (ha)

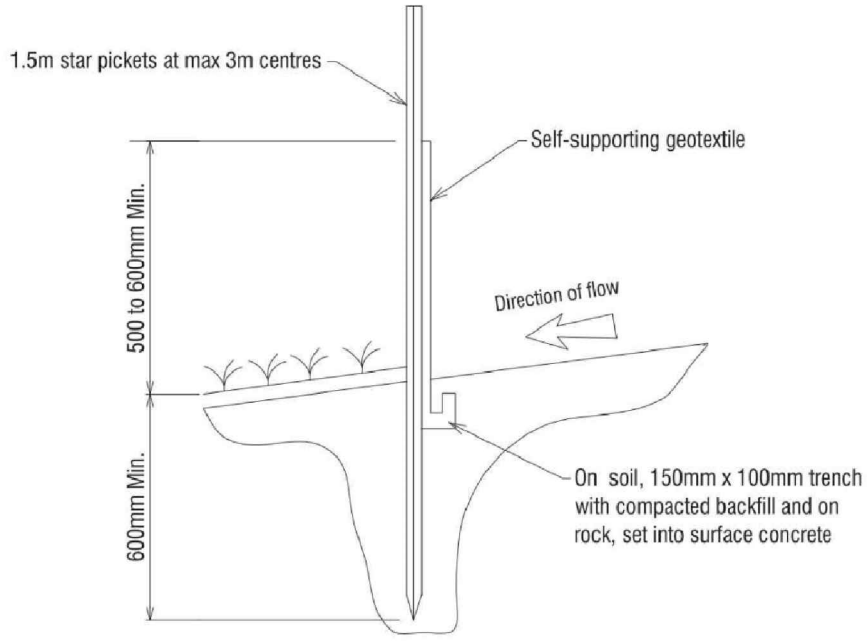
Condition	Q_{peak} (m^3/s)						
	0.25	**2**	**5**	**10**	**20**	**50**	**100**
Pre-Development	0.010	0.014	0.017	0.019	0.029	0.033	0.037
During Development	0.014	0.019	0.023	0.025	0.036	0.042	0.047
Post Development	0.012	0.017	0.020	0.022	0.032	0.038	0.042

ANNEX C

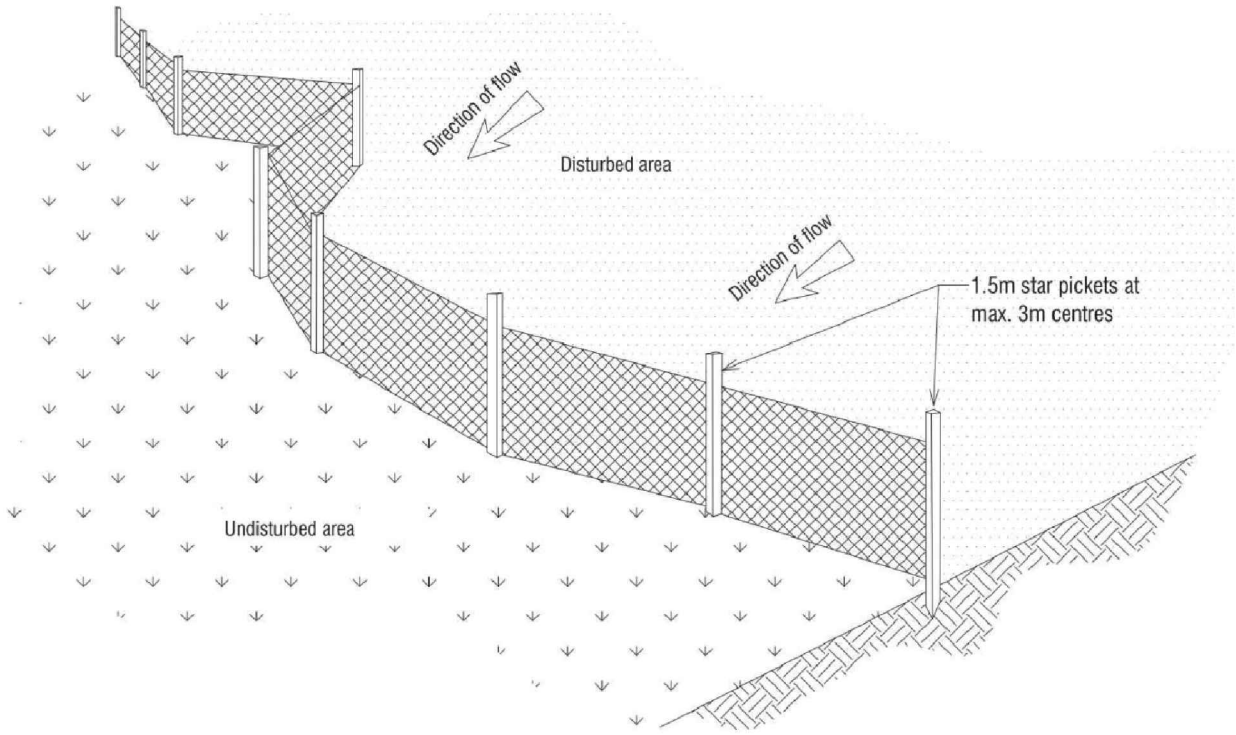


CONSTRUCTION NOTES:

1. Trench Structure 200 mm into Ground Surface wherever the Structure Contacts the Gully Base. Fill Trenches to 100 mm Above Ground Surface to Reduce Risk of Undercutting.
2. Ensure Height of Spillway is Less than 1 Metre Above the Gully Floor.
3. Space Checks so the Toe of the Upstream Dam is Level with the Spillway of the Next Downstream Dam.



SECTION DETAILS



MAINTENANCE NOTES:

1. Inspect weekly and after each rainfall.
2. Repair wherever fence is damaged.
3. Removed sediment when it reached one-third of the height of the fence.

CONSTRUCTION NOTES:

1. Construct sediment fence as close as possible to parallel to the contours of the site.
2. Drive 1.5m long star pickets into ground, 3m apart.
3. Dig a 150mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
4. Backfill trench over base of fabric.
5. Fix self-supporting geotextile to upslope side post with ties or as recommended by geotextile manufacturer.
6. Joint sections of fabric at a support post with a 150mm overlap.

Source: NSW Department of Housing (1998)

APPENDIX D: MAINTENANCE CHECK SHEETS

INSPECTION CHECK SHEET

Sheet ___of ___

GENERAL INFORMATIONS

Project Name: _____ File No._____

Developer Name: _____ Contractor Onsite:_____

Inspection Date: _____ Time:_____ Weather:_____ mm of Rain Last Week:_____
Inspection Type: { } Routine Weekly { } Pre-Rain { } During Rain { } Post Rain

STAGE OF CONSTRUCTION

{ } Pre-Construction Conference; { } Clearing and Grubbing; { } Rough Grading;
{ } Finish Grading; { } Building Construction; { } Final Stabilization;

INSPECTION CHECKLIST

Yes	No	NA (Not Applicable)	
Part 1: Inspection on Erosion Controls Measures			
{ }	{ }	{ }	Is the clearing of the construction area carried out in phases?
{ }	{ }	{ }	Are the areas which designated to be preserve of the existing vegetation intact is not disturbed?
{ }	{ }	{ }	Are all erosion control devices in-place and functioning in accordance with the erosion control plan?
{ }	{ }	{ }	Are all temporary stockpiles or construction material located in approved areas and protected from erosion?
{ }	{ }	{ }	Are soil stockpiles adequately stabilized with seeding and/or sediment trapping measures?
{ }	{ }	{ }	Have all denuded areas requiring temporary or permanent stabilization been stabilized? Seeded? yes/no Mulched? yes/no Gravelled? yes/no
{ }	{ }	{ }	Does permanent vegetation provide adequate stabilization?
{ }	{ }	{ }	Are all exposed slopes protected from erosion through the implementation of acceptable soil stabilization practices?
{ }	{ }	{ }	Are finished cut and fill slopes adequately stabilized?
{ }	{ }	{ }	Is there any evidence of erosion of cut or fill slope?
Part 2: Inspection on Sediment Controls Measures			
{ }	{ }	{ }	Have sediment-trapping facilities been constructed as a first step in stripping and grading?
{ }	{ }	{ }	For perimeter sediment trapping measures, are earthen structures stabilized?
{ }	{ }	{ }	Are sediment basins, sediment traps, sediment fence/barriers and check dam/rock weir installed where needed as per ESC Plan?
{ }	{ }	{ }	Are sediment basins, sediment traps, sediment fence/barriers and check dam/rock weir properly maintained, repairs and sediment was regularly removed and clean as per ESC Plan maintenance schedule?
{ }	{ }	{ }	Are sediment controls in place at site perimeter and storm drains inlets?
{ }	{ }	{ }	Is the water from the construction site adequately prevented from directly entering the permanent drainage system unless it is relatively sediment free (i.e. the catchment area has been permanently landscaped and/or any likely sediment has been treated)?

{ } { } { } Are the sediment controls measure onsite adequately installed and the sediment are effectively treated from the stormwater runoff from the construction site?

{ } { } { } Is there any evidence that the sediment is leaving the construction site without adequately treated?

Part 3: Inspection on Conveyances and Flows Controls Measures

{ } { } { } Are on-site channels, inlet and outlet are adequately stabilized and protected?

{ } { } { } Do all operational storm drainage inlets have adequate inlet protection?

{ } { } { } Are stormwater conveyance channels adequately stabilized, protected and lined with suitable material at badly eroded stretches?

{ } { } { } Are stormwater conveyance channels, culvert, conduit, roadside ditches, toe of slopes etc. adequately stabilized and with proper inlet/outlet protection and energy dissipater?

{ } { } { } Are the outlet of sediment basins and sediment traps are adequately stabilized with proper outlet protection and energy dissipater?

{ } { } { } Are adequate check dam/rock weir or any others energy dissipater method which are used to reduce the erosive effects of flows velocity in the stormwater conveyance channels

{ } { } { } Are temporary stream crossings of non-erodible material installed where applicable?

{ } { } { } Are the stormwater conyevance channels, the riprap, check dam, rock weir, stream crossing, etc. properly maintained, repairs and deposited sediment was regularly removed and clean as per ESC Plan maintenance schedule?

Part 4: Others

{ } { } { } Are properties and waterways downstream from development adequately protected from erosion and sediment deposition due to increases in peak stormwater runoff?

{ } { } { } Are soil and mud kept off public roadways at intersections with site access roads?

{ } { } { } Are utility trenches stabilized properly?

{ } { } { } Is there any self-auditing of ESCP was carried out onsite (based on onsite records of inspection check sheets and inspection log book)

{ } { } { } Have all temporary control structures that are no longer needed been removed?

{ } { } { } Do any structural BMPs practices require repair or clean-out to maintain adequate function? If yes, indicate in details.

{ } { } { } Does the ESCP require revisions? If yes, explain:

Comments:

Inspected by: _____ Developer's Representative: _____

Position: _____ Position: _____

Signature: _____ Signature: _____

EROSION AND SEDIMENT INSPECTION LOG

Site: _____ **Contractors on Site:** _____

Heavy Equipment on Site:_____ **Activities on Site:**

Date:_____ **Weather:** _____ **mm of rain in last week:** _____

Note condition of the following measures and sediment levels where applicable:

MEASURE	CONDITION/LOCATION	SEDIMENT LEVEL	ACTION REQUIRED YES/NO	TYPE OF ACTION	ACTION COMPLETED (DATE)	INITIALS
Silt fences						
Temporary Storage Facilities						
Outlet of Temporary Storage Facilities						
Interceptor Swales						
Steeper Slopes						
Cover of Rough Grades						
Catchbasins Filtering Controls						
Dust Control						
Mud Tracking						
Debris Control						

Other Comments (Summarize):

_____

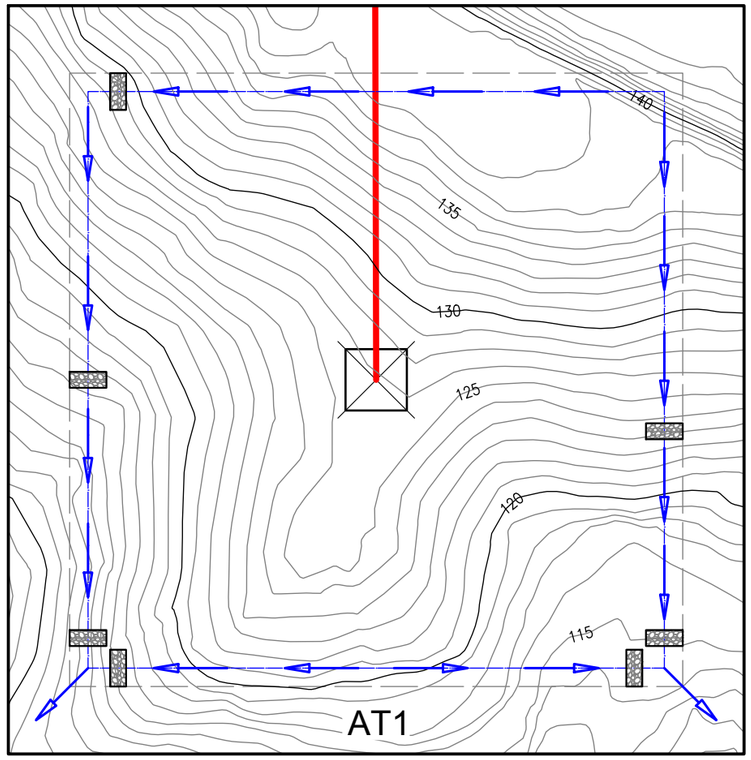
_____

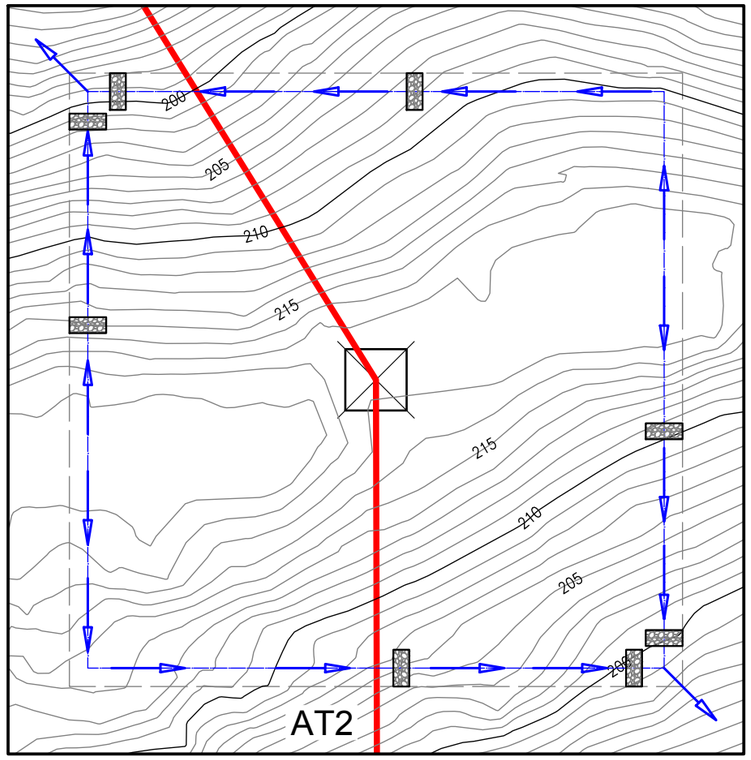
_____

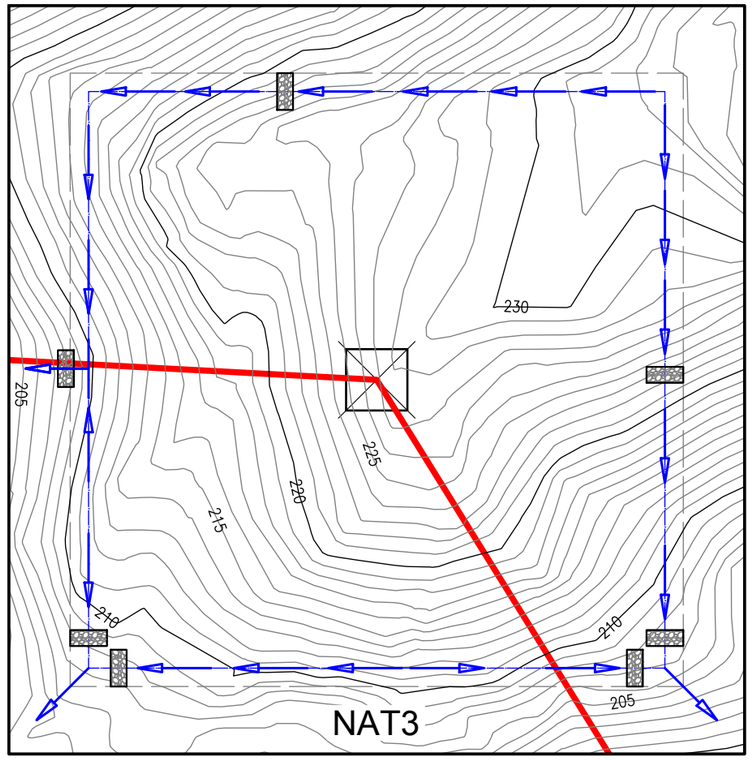
Inspectors Signature: _____ **Inspectors Name** _____

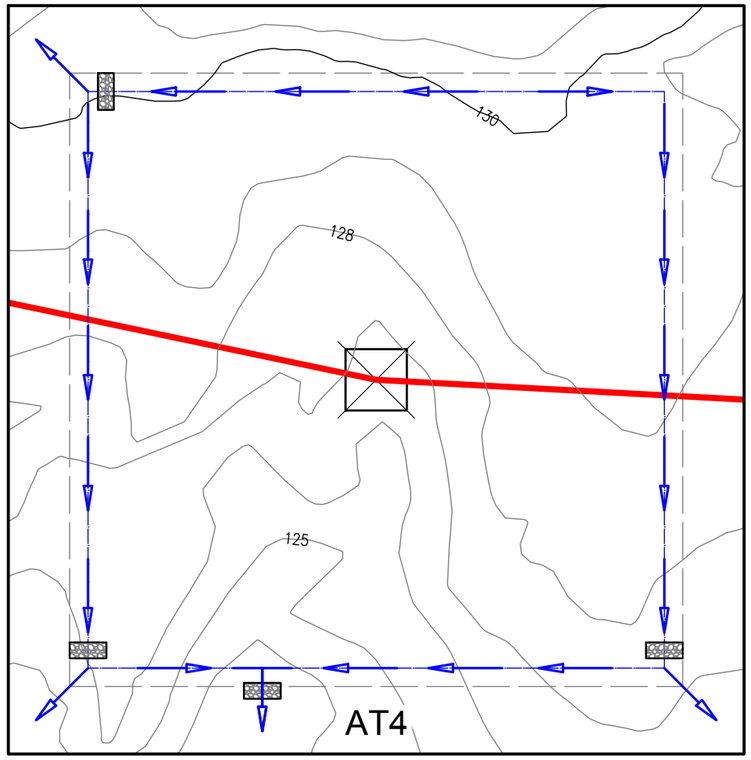
Appendix 8.3.1b

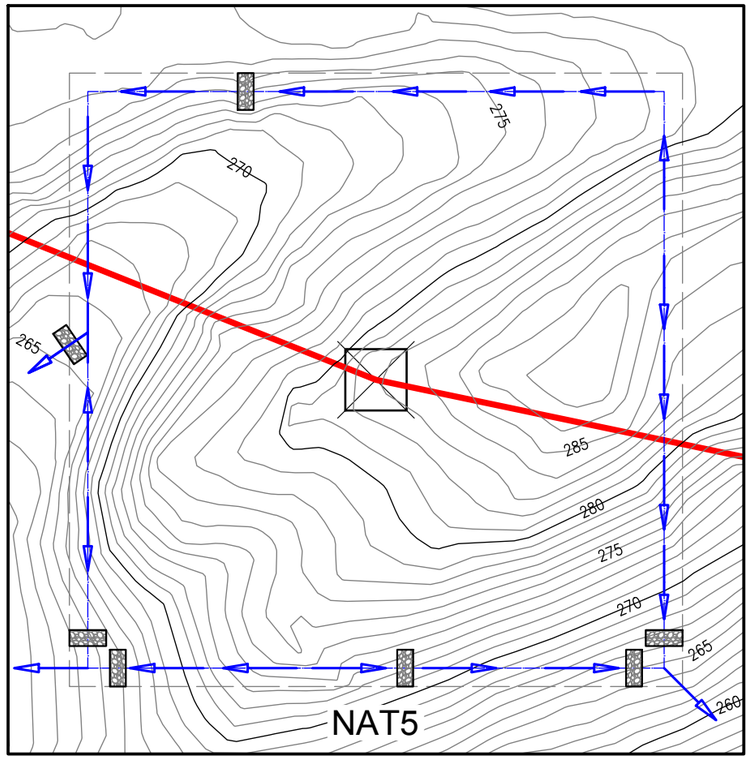
ESCP Check Dam at Towers

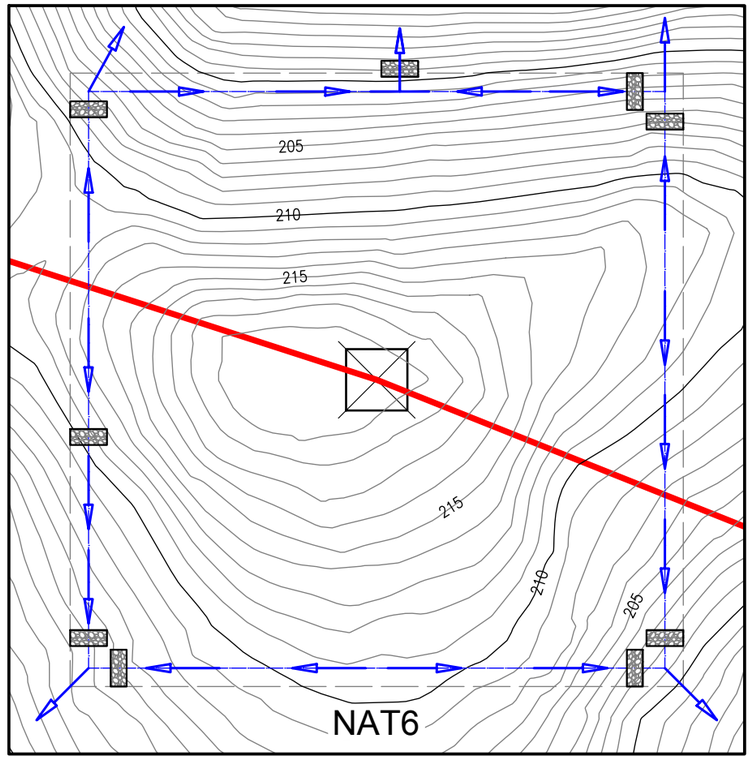












LEGEND:

- PROPOSED TRANSMISSION LINE ROUTE
- ANGLE TOWER CENTER POINT (AT1 - AT35)
- CONTOUR LINES IN METRES
- DRAINAGE
- ROCK FILTER CHECK DAM

N

0 5 10 15 20 25m

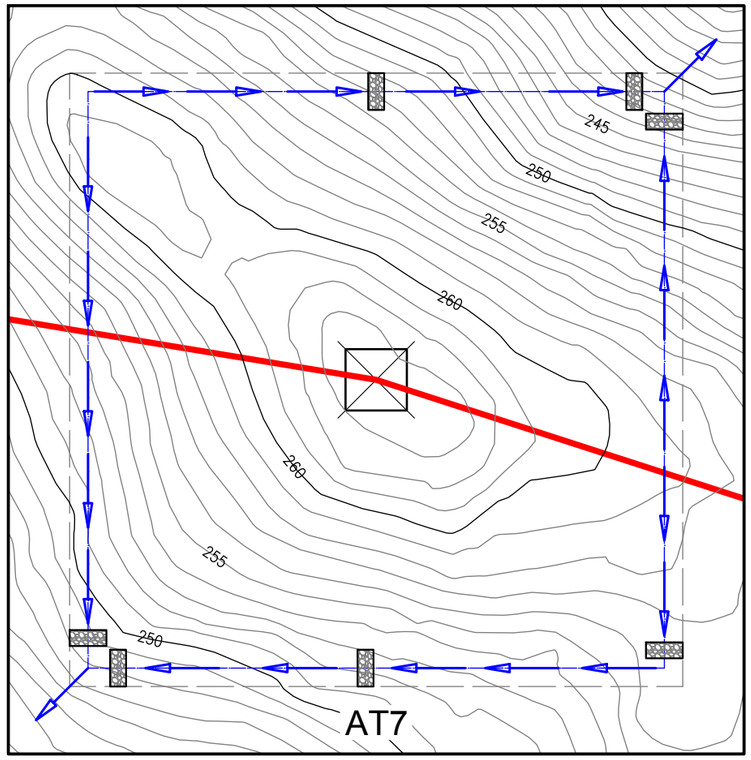
SCALE IN METRES (1:500) – A3 MEDIUM

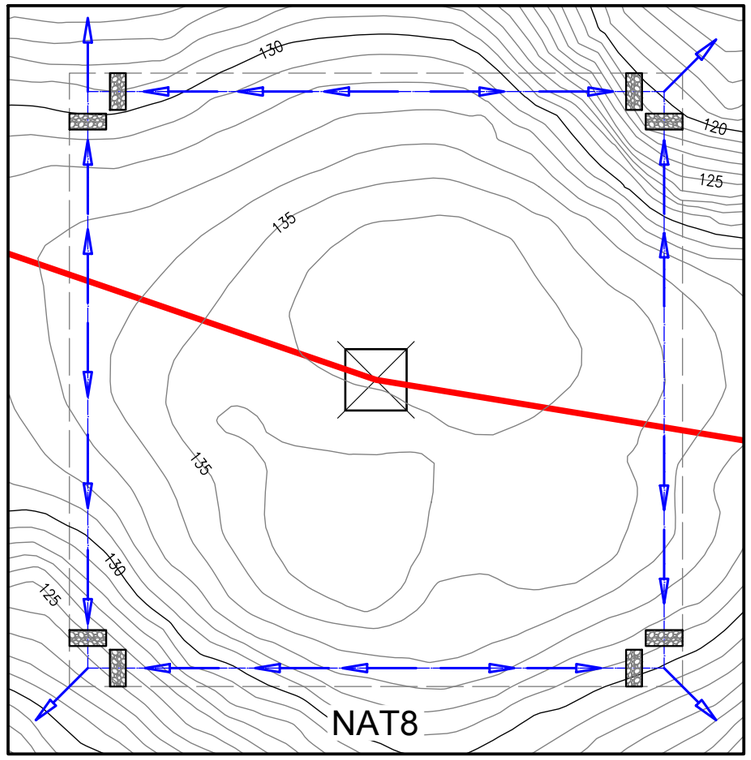
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY FOR THE PROPOSED BALEH-MAPAI 500 KV TRANSMISSION LINE PROJECT

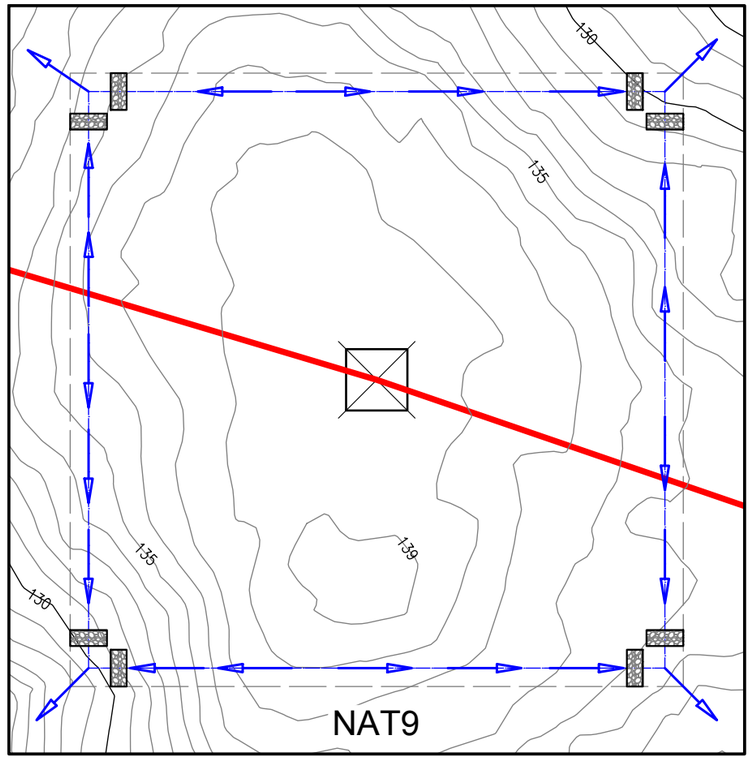
PROPOSED ESCP MITIGATION MEASURES

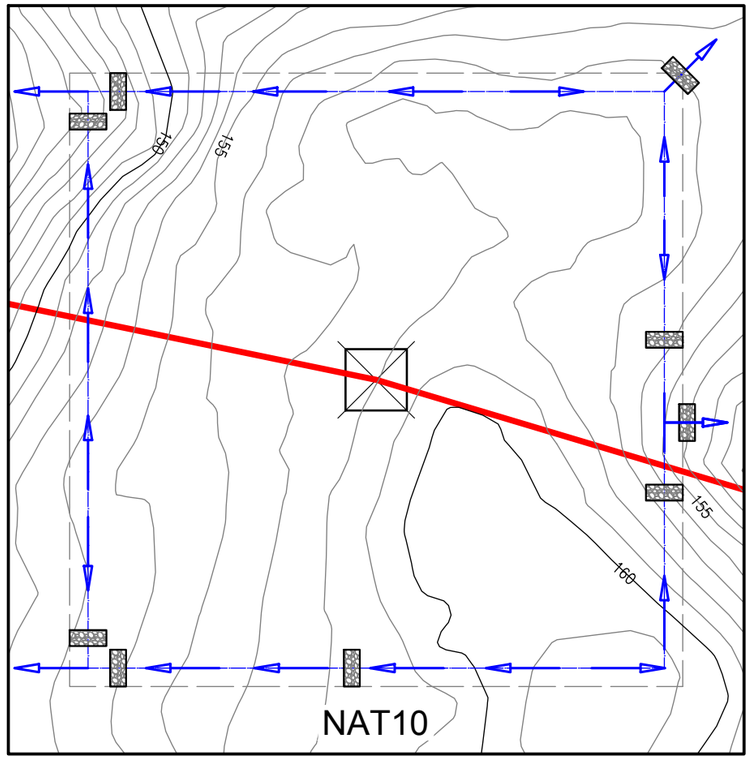
FIGURE: 1

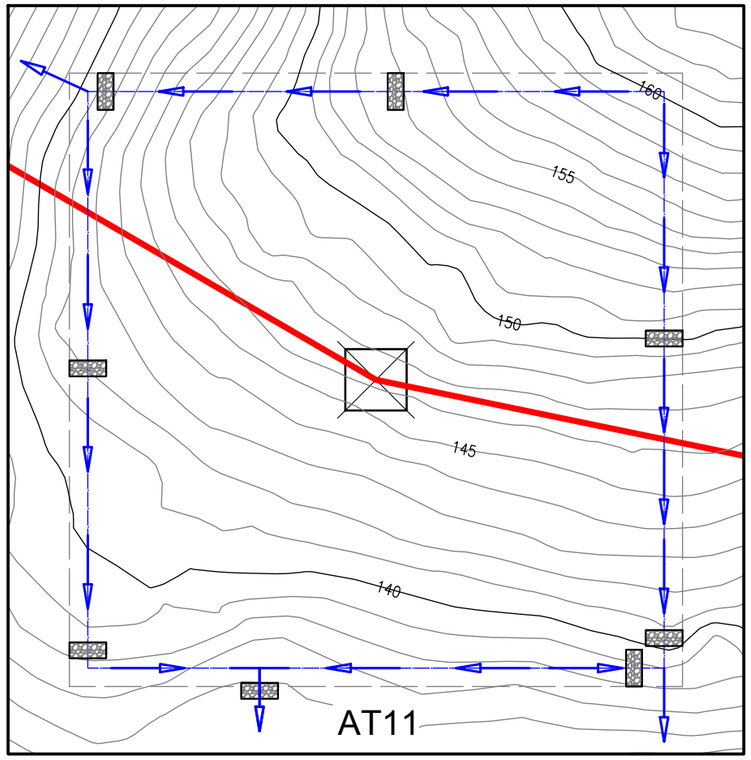
D:\ACAD\DRAWINGS\EV103\792\APPENDIX\FIG-1_6.DWG

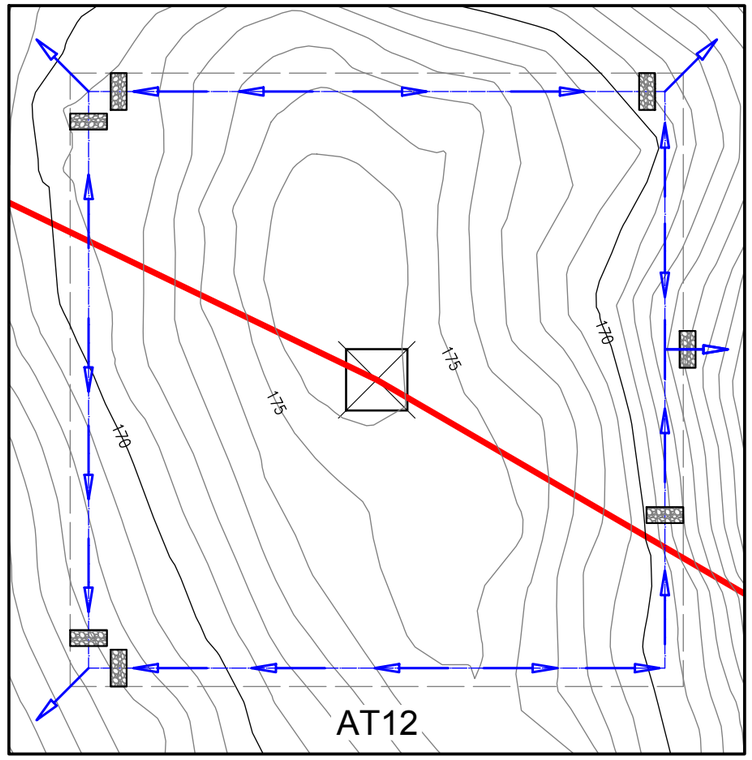












LEGEND:

- PROPOSED TRANSMISSION LINE ROUTE
- ANGLE TOWER CENTER POINT (AT1 - AT35)
- CONTOUR LINES IN METRES
- DRAINAGE
- ROCK FILTER CHECK DAM

N

0 5 10 15 20 25m

SCALE IN METRES (1:500) – A3 MEDIUM

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY FOR THE PROPOSED BALEH-MAPAI 500 KV TRANSMISSION LINE PROJECT

PROPOSED ESCP MITIGATION MEASURES

FIGURE: 2

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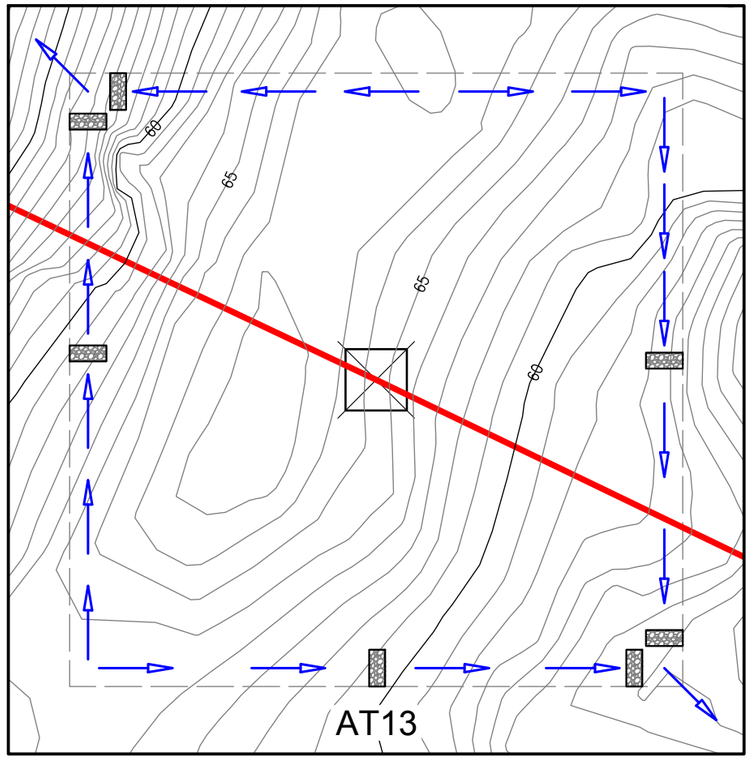

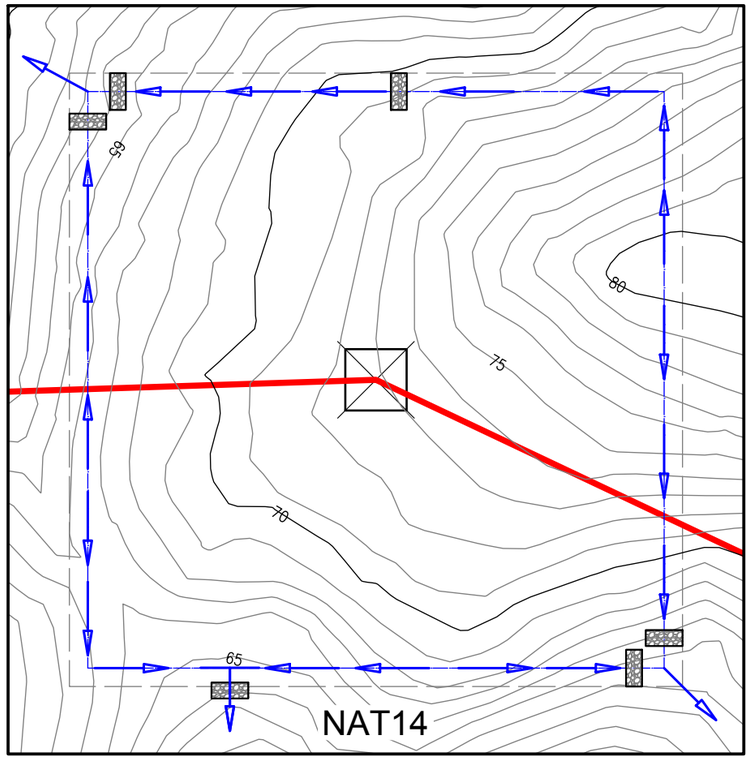

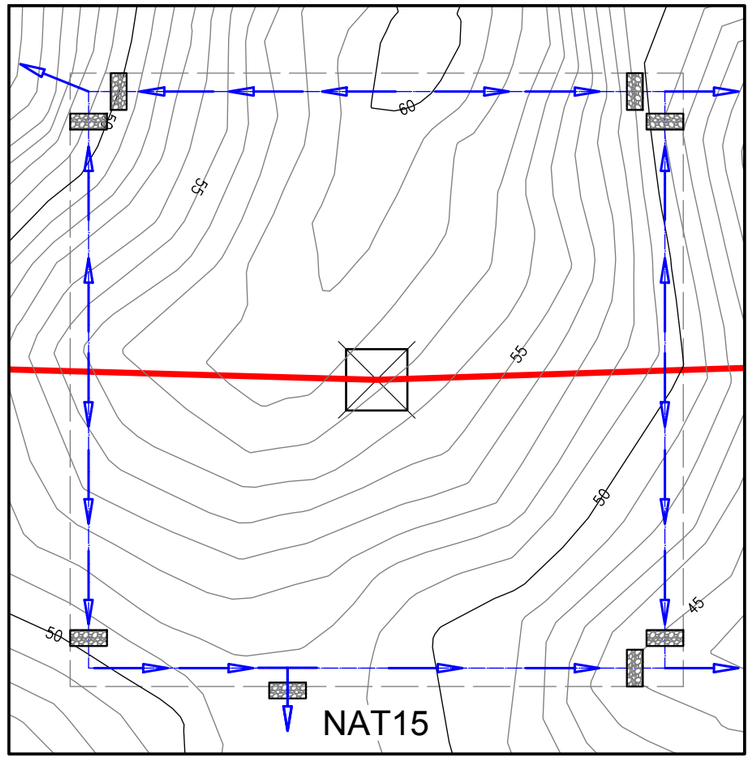

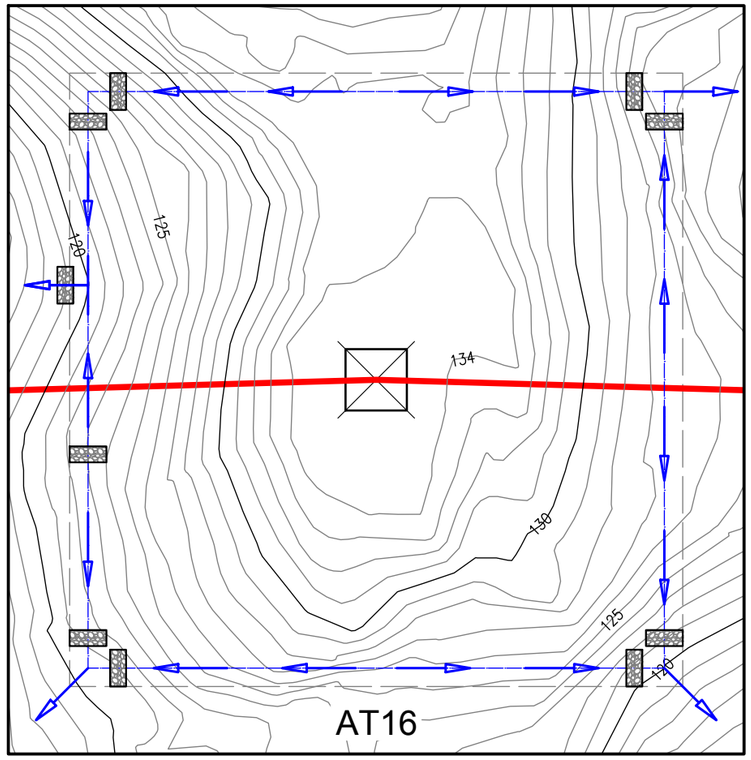

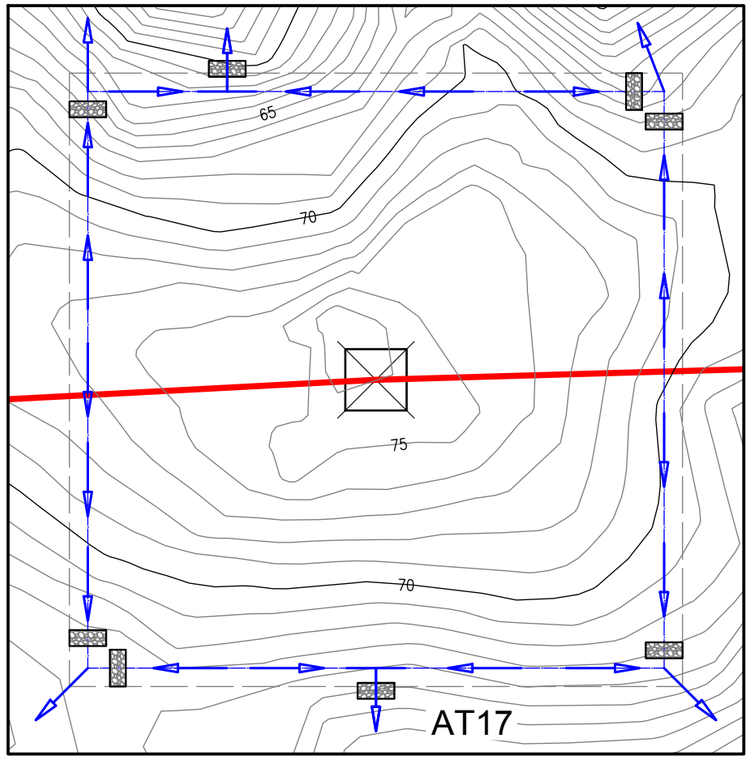

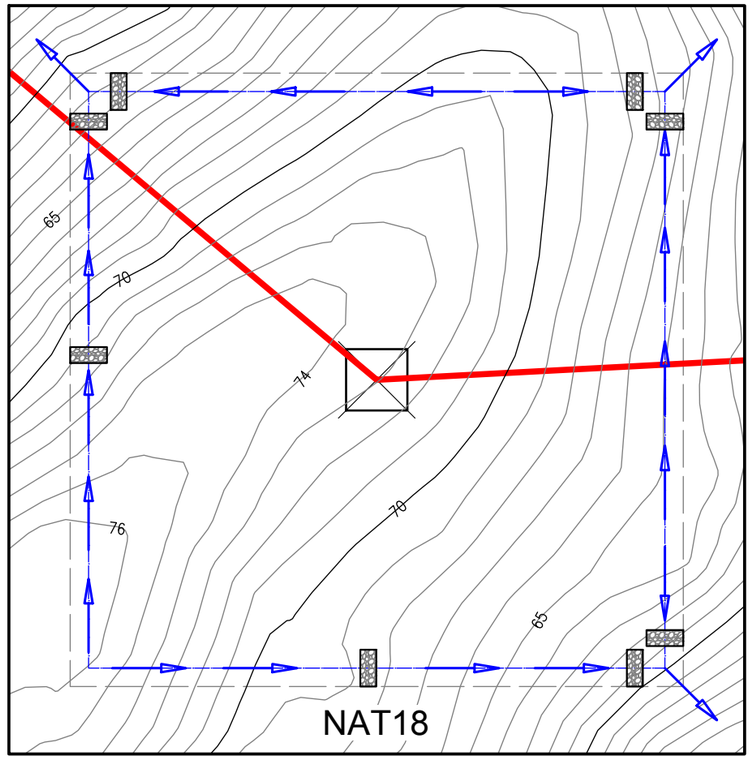

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY FOR THE PROPOSED BALEH-MAPAI 500 KV TRANSMISSION LINE PROJECT

PROPOSED ESCP MITIGATION MEASURES

FIGURE: 3

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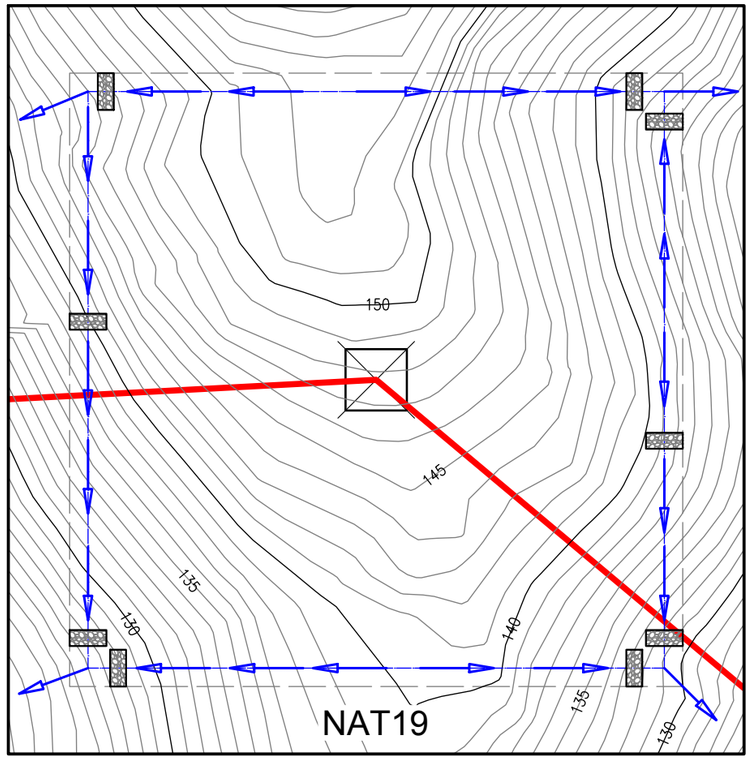

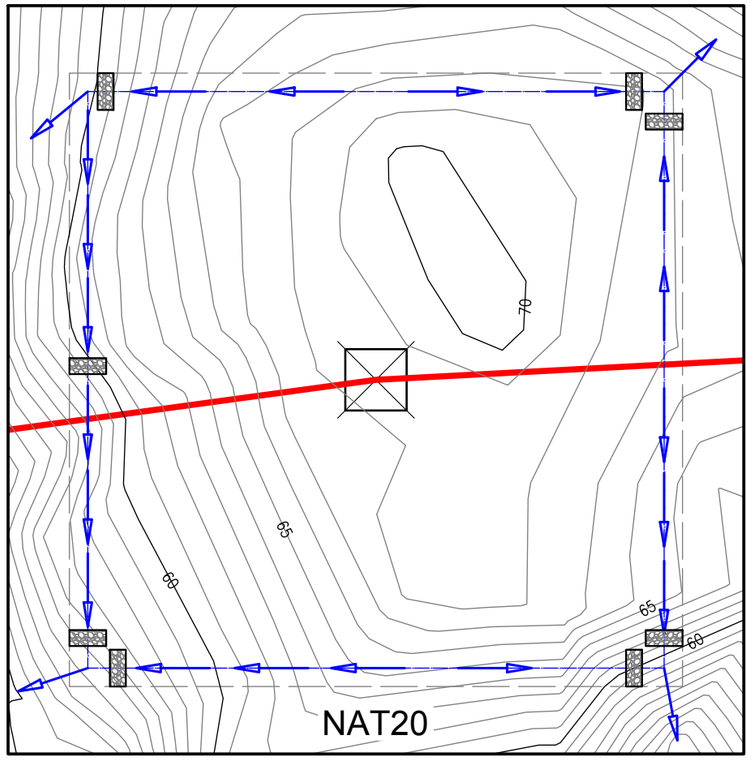

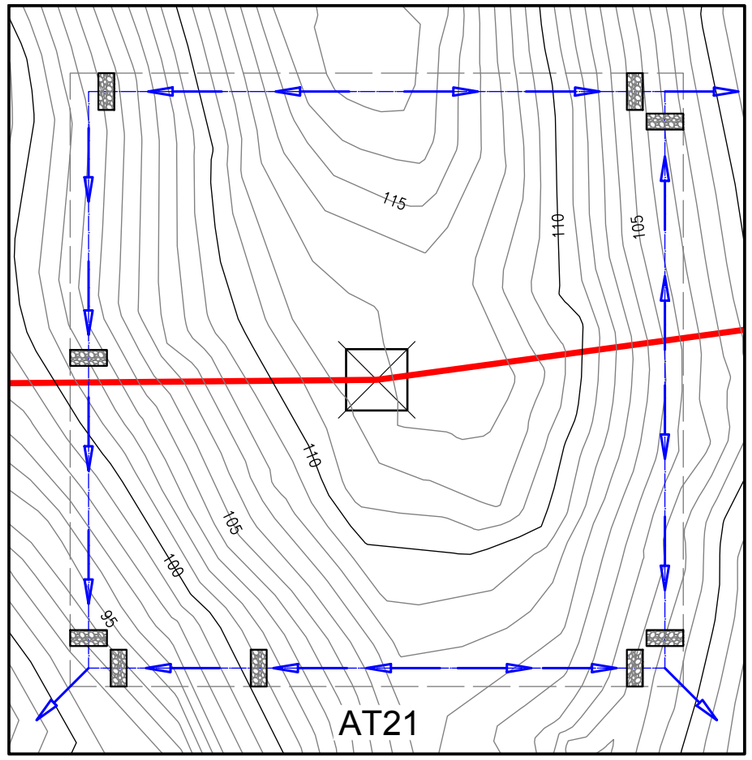

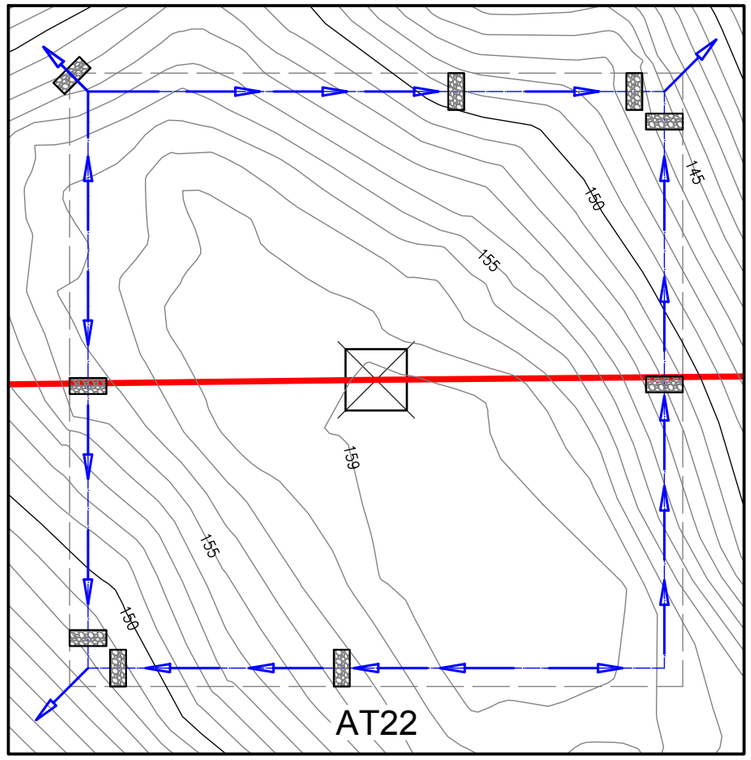

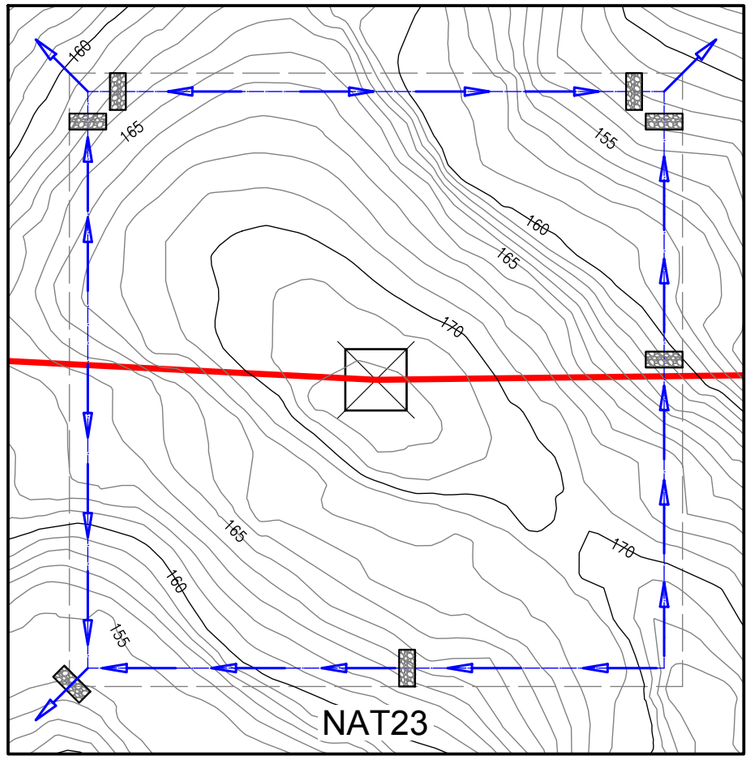

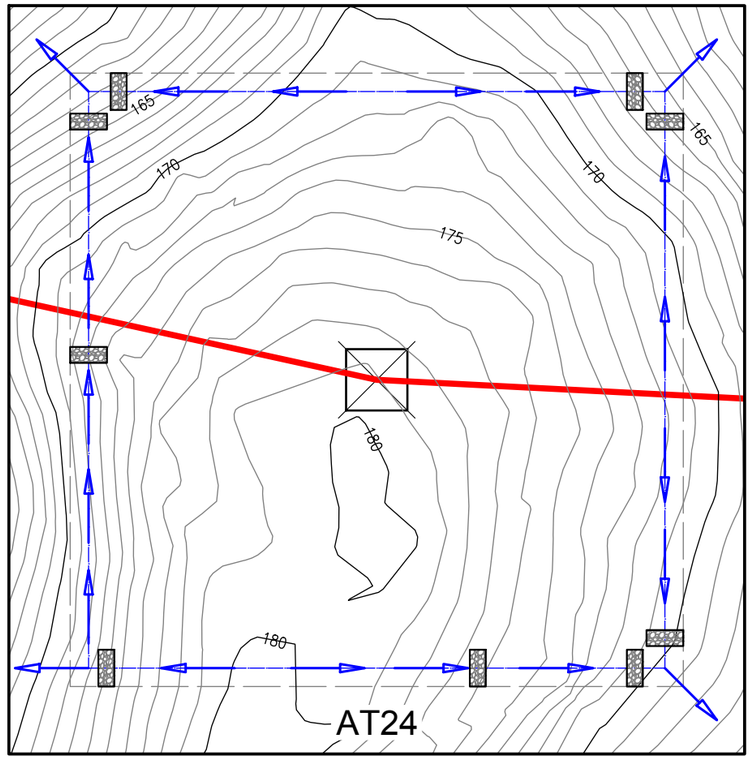

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY FOR THE PROPOSED BALEH-MAPAI 500 KV TRANSMISSION LINE PROJECT

PROPOSED ESCP MITIGATION MEASURES

FIGURE: 4

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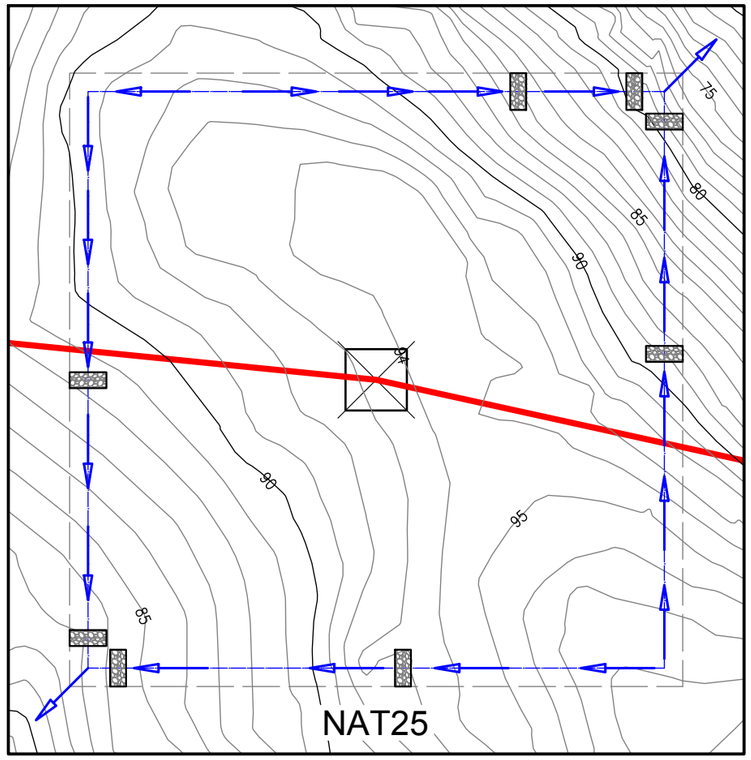

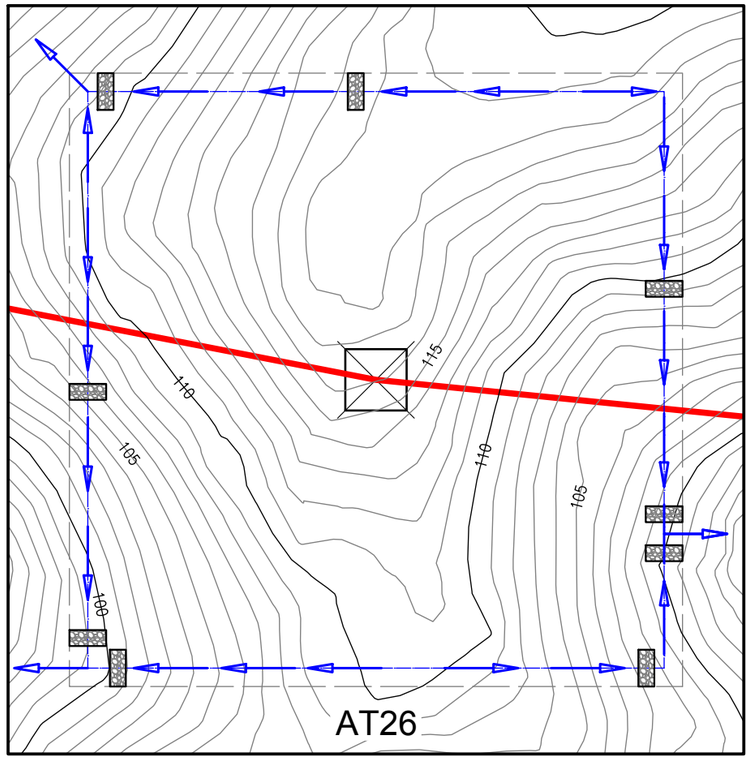

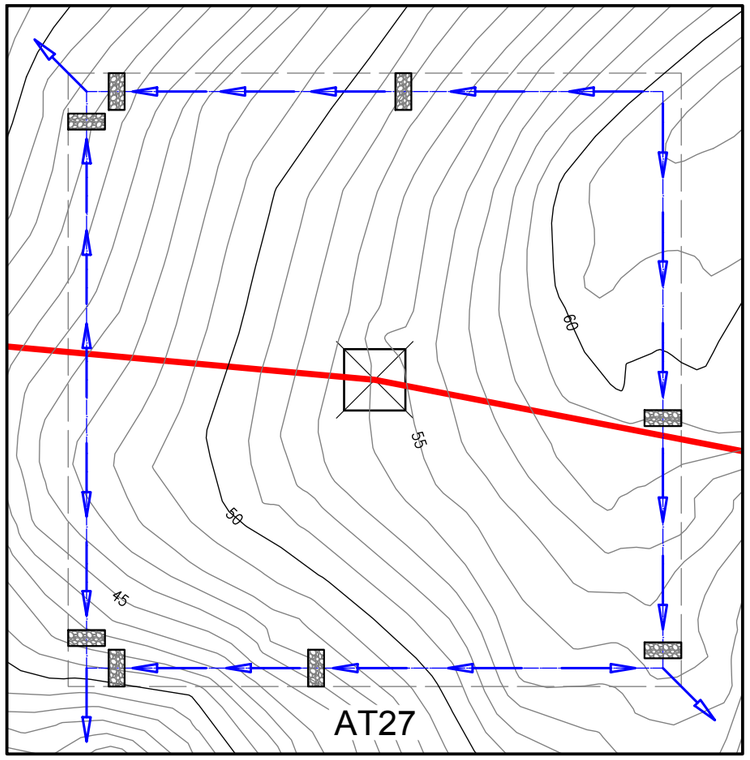

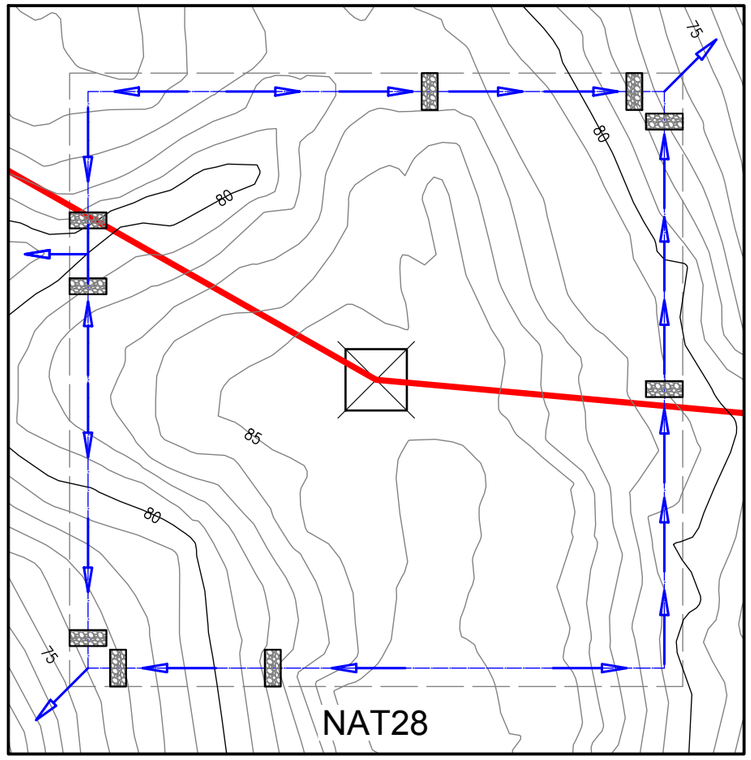

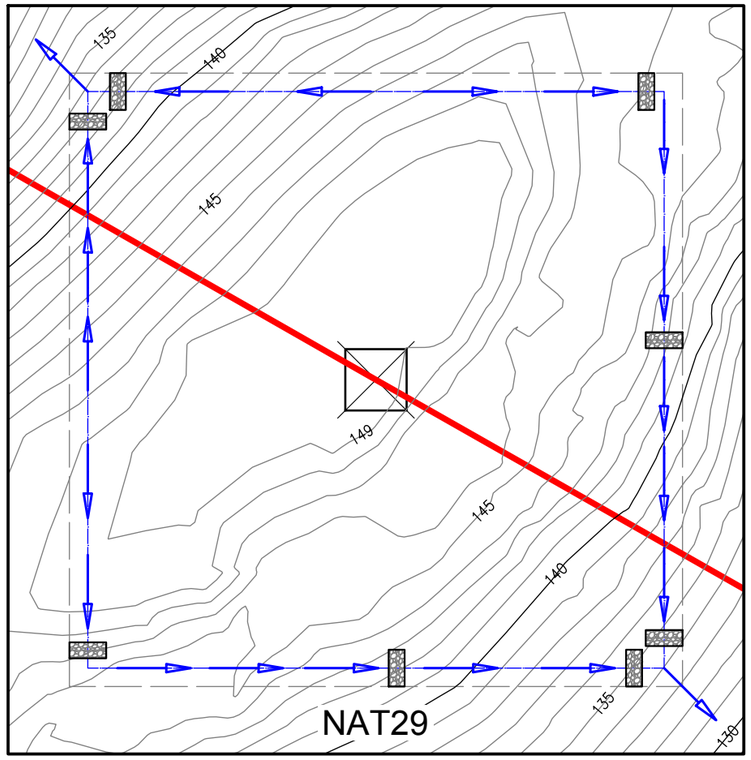

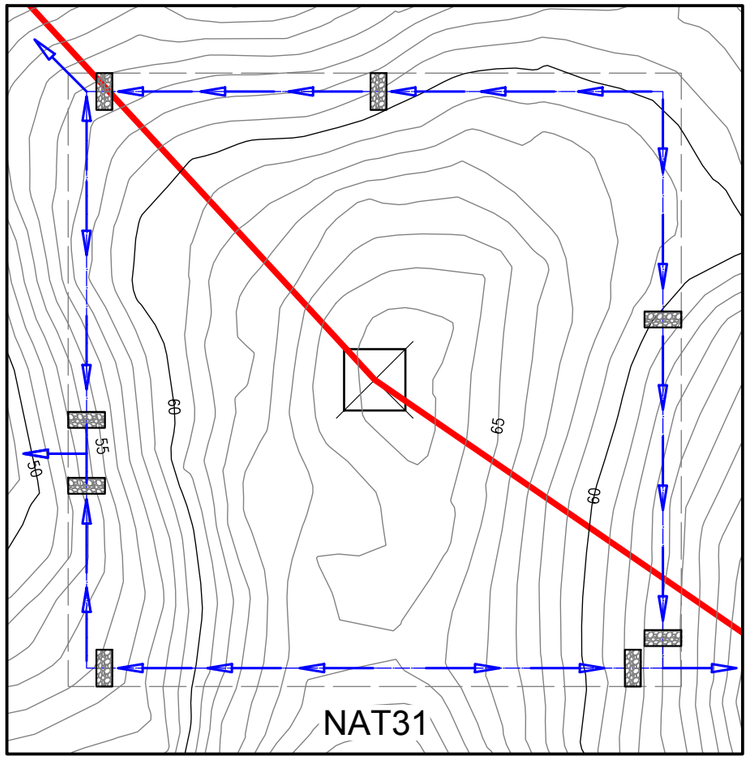

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SCALE IN METRES (1:500) – A3 MEDIUM

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) STUDY FOR THE PROPOSED BALEH-MAPAI 500 KV TRANSMISSION LINE PROJECT

PROPOSED ESCP MITIGATION MEASURES

FIGURE: 5

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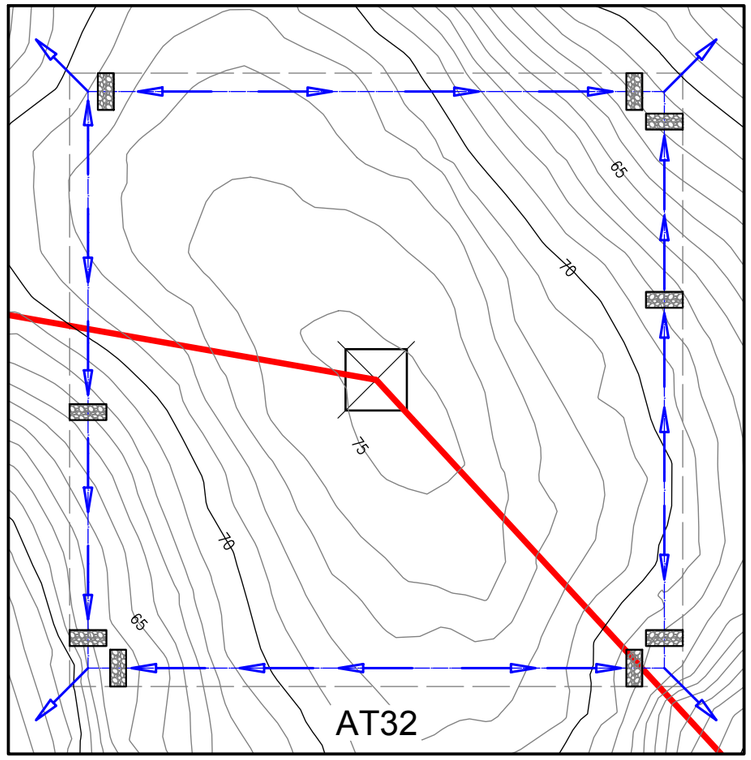

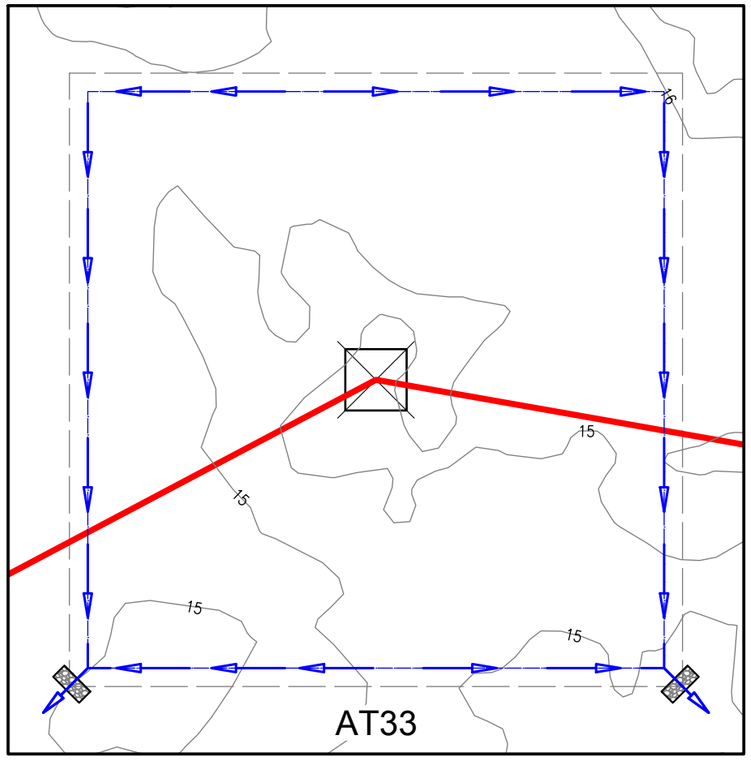

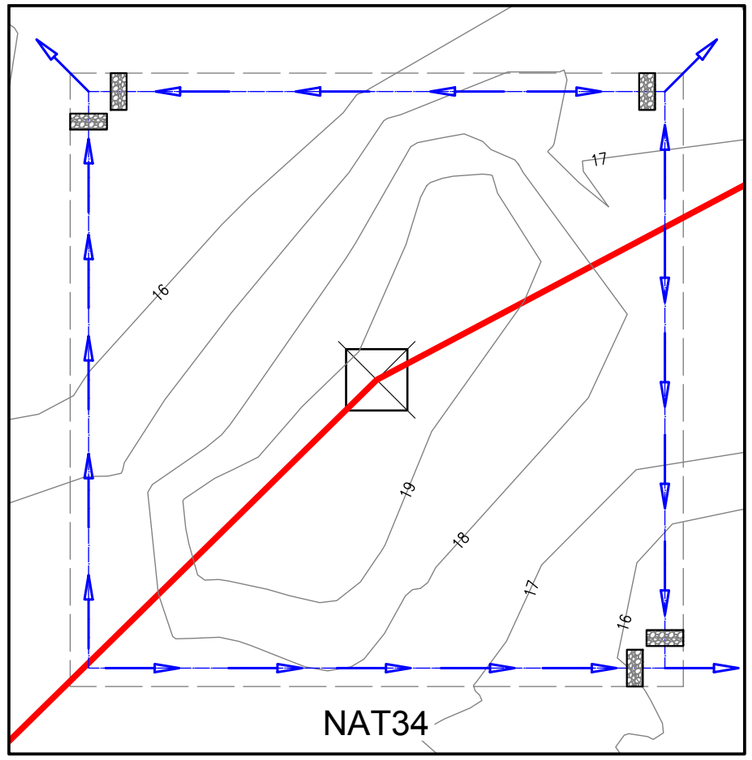

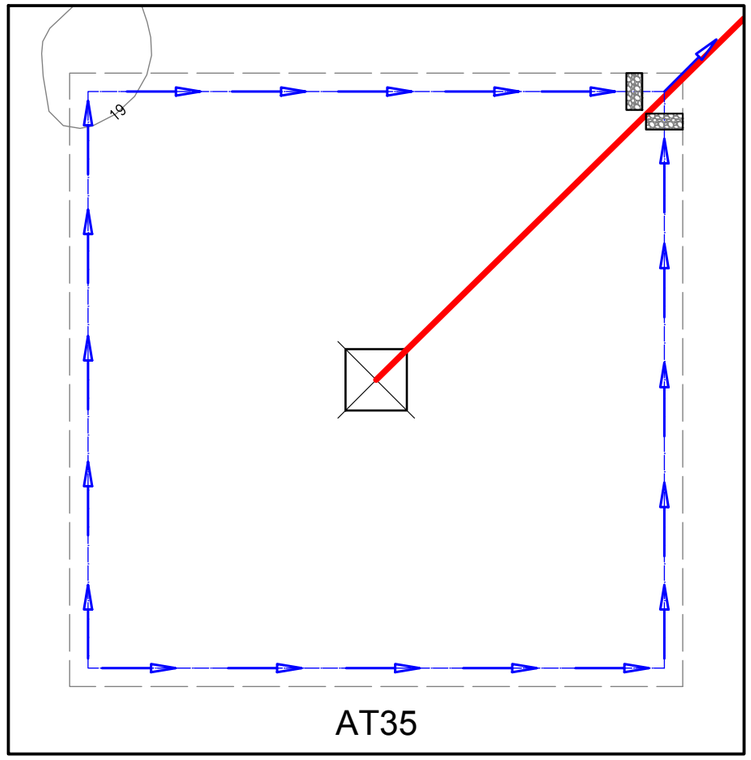

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SCALE IN METRES (1:500) – A3 MEDIUM

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT
(ESIA) STUDY FOR THE PROPOSED BALEH-MAPAI 500 KV
TRANSMISSION LINE PROJECT

PROPOSED ESCP MITIGATION MEASURES

FIGURE: 6

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Appendix 8.3.2

PE Equivalent and BOD Loading Calculations

Type of Premise	Unit	PE / Unit	PE
Residential	0	5 per house	0
Commercial			
Offices (floor area?)	0	3 per 100m^2 gross area	0
Shopping complex	0	3 per 100m^2 gross area	0
Recreational centre	0	3 per 100m^2 gross area	0
Restaurants, cafeteria, theatre	0	3 per 100m^2 gross area	0
Schools/Educational Institutions:			
Day schools/institutions	0	0.2 per student	0
Fully residential	0	1 per student	0
Partial residential	0	0.2 per student (non residential)	0
	0	1 per student (residential)	0
Hospitals	0	4 per bed	0
Hotels (with dining and laundry facilities)	0	4 per room	0
Factories (excluding process water)	815	0.3 per staff	245
Market (wet type)	0	3 per stall	0
Market (dry type)	0	1 per stall	0
Petrol kiosks/Service Station	0	18 per service station	0
Bus terminal	0	4 per bus bay	0
Taxi Terminal	0	4 per taxi bay	0
Mosque	0	0.5 person	0
Church/Temple	0	0.2 per person	0
Stadium	0	0.2 per person	0
Swimming Pool/Sports Complex	0	0.5 per person	0
Public Toilet	0	16 per wc	0
Airport	0	0.2 per passenger per day	0
	0	0.3 per employee	0
Laundry	0	10 per machine	0
Prison	0	1 per person	0
Golf Course	0	20 per hole	0
TOTAL			245

Assume:

Per capita discharge of wastewater = 225 litres/day

Per capita discharge of sewage (blackwater) = 40 litres/day

Complete mixing of the stream for instantaneous increase of BOD load

Lowest river flow rate 0.5 m^3/s

PE	Effluent Characteristics	mg/l	Loading, kg/day	of BOD_5 level (mg/l)
245	Untreated sewage BOD	250	2.45	0.0566
245	Treated to Standard B - BOD	50	0.489	0.0113
245	Treated to Standard A - BOD	20	0.196	0.0045

BOD Loading for 245 PE

Total PE	=	245			
BOD concentration	=	250	mg/l		
BOD after treatment (Standard B)	=	50	mg/l		
BOD after treatment (Standard A)	=	20	mg/l		
Sewage discharge per person	=	40	l/d		
Total Sewage Discharge per day	=	40 l/d	x	245	
	=	9780	l/d		
a) Amount BOD discharge per day without treatment	=	9780	l/d	x 250	mg/l
	=	2445000	mg/d		
	=	**2.4450**	**kg/d**		
b) Amount BOD discharge after treatment (standard B)	=	9780	l/d	x 50	mg/l
	=	489000	mg/d		
	=	**0.4890**	**kg/d**		
c) Amount BOD discharge after treatment (standard A)	=	9780	l/d	x 20	mg/l
	=	195600	mg/d		
	=	**0.1956**	**kg/d**		

Assummed

River Flowrate	=	0.5	m^3/sec			
Instantaneous increase for (a)	=	$\frac{2.445}{0.5}$	kg/d cu-m/sec	x	$\frac{1}{86400}$	sec
	=	0.0000566	kg/cu-m			
	=	**0.0566**	**mg/l**			
Instantaneous increase for (b)	=	$\frac{0.4890}{0.5}$	kg/d cu-m/sec	x	$\frac{1}{86400}$	sec
	=	1.13194E-05	kg/cu-m			
	=	**0.0113**	**mg/l**			
Instantaneous increase for (c)	=	$\frac{0.1956}{0.5}$	kg/d cu-m/sec	x	$\frac{1}{86400}$	sec
	=	4.52778E-06	kg/cu-m			
	=	**0.0045**	**mg/l**			

Appendix 8.3.3

Guidelines on Construction Waste Management (CIDB)

GUIDELINES ON CONSTRUCTION WASTE MANAGEMENT

All enquiries regarding this document should be forwarded to:

Chief Executive
Construction Industry Development Board Malaysia
7th Floor, Grand Seasons Avenue
72, Jalan Pahang
53000 Kuala Lumpur
Malaysia

Tel : 603-2617 0200
Fax : 603-4045 1808
Website: www.cidb.gov.my

CONTENTS

Page

Foreword v

SECTION 1: INTRODUCTION

1.0 Construction Waste 1

1.1 Management of waste in construction….. 2

1.2 Malaysian Perspective…. 2

1.3 Objectives of this guideline….. 2

SECTION 2: ROLES AND RESPONSIBILITIES OF CONSTRUCTION INDUSTRY PLAYERS

2.0 Client, Consultants and Contractors 4

2.1 Client 4
2.1.1 Design Stage 4
2.1.2 Pre-Construction Stage 4
2.1.3 Construction Stage 4

2.2 Consultants (Architects/ Engineers) 5
2.2.1 Design Stage 5
2.2.2 Pre-Construction Stage 5
2.2.3 Construction Stage 6

2.3 Contractors/ Sub-contractors 6
2.3.1 Pre-Construction Stage 6
2.3.2 Construction Stage 7

2.4 Concluding Remark 7

SECTION 3: WASTE MANAGEMENT PLAN (WMP)

3.0 Introduction 7

3.1 Concept and Strategy 9

3.2 Objectives 9

3.3 Waste Management Hierarchy 10
3.3.1 Waste Minimisation/ Reduction 11
3.3.2 Reuse 13
3.3.3 Recycle 15

3.4 Waste Management Plan 15
3.4.1 Identifying and Exploration of Waste Minimisation Opportunities 16
3.4.2 Implementation of the Waste Management Plan 16
3.4.3 Disposal Facilities/ Recyclers 16
3.4.4 Monitoring and Modifying the Plan 16

3.5 Overall Implementation 17
3.5.1 Staff Awareness Programs 17
3.5.2 Training Programs 17
3.5.3 Safety and Health 17
3.5.4 Contractual/ Obligations 17

3.6 Onsite Monitoring and Auditing 18

3.7 Transportation and Disposal System 18
3.7.1 Transportation 18
3.7.2 Disposal System 18

SECTION 4: LEGISLATIVE AND ADMINISTRATIVE REQUIREMENTS

4.0 Introduction 19

4.1 Legal Requirements by Related Agencies 19
4.1.1 Department of Environment (DOE) 19
4.1.2 Department of National Solid Waste Management 21
4.1.3 Local Authority 24
4.1.4 State Regulatory Bodies 27
4.1.4.1 Land Office 27
4.1.4.2 Selangor Water Management Authority (LUAS) 27

SECTION 5: GOOD MANAGEMENT PRACTICES

5.0 Introduction 28

5.1 Waste Management System in Putrajaya 28

5.2 Good Practices by Contractors in Putrajaya 28

Tables

1 Composition of construction and demolition waste disposed of at landfills in 1995 (Source EPD 1995) 2

Figures

1 An example of a well-planned site layout 7
2 Roles of Client, Consultant and Contractor during different stage of construction. 8
3 A Hierarchy of Waste Management 10
4 The elements of integrated Waste Management (Mc Dougall et al., 1999) 11

Annex A Sample Waste Management Plan 30

Annex B Construction Waste Management 32

Bibliography 41

Acknowledgements 42

FOREWORD

As we move towards becoming an industrialised nation, Malaysians are beginning to realise that environment and development are the opposite sides of the same coin. Renewable resources are fast becoming depleted or rendered economically useless due to the unsustainable manner in which they have been exploited. The construction industry is one of the major sectors that has played and will keep on playing a very important role in driving Malaysia towards the achievement of *Vision 2020*. However, environmental degradation resulting from construction activities has been widely reported by the media. There is no denying that general practices in the construction industry pay very little attention to principles of sustainable development. To avoid irreversible damage to the environment, the Construction Industry Development Malaysia (CIDB) emphasises this issue in the Malaysia Construction Industry Master Plan (CIMP) 2006-2015. The plan identifies seven Strategic Thrusts to be included for the duration of this 10-years Master Plan. Strategic Thrust No.3 exhorts us to strive for the highest standard of quality, occupational safety and health, and environmental practices.

With respect to environmental degradation resulting from construction activities, one of the major concerns is the production of construction and demolition (C&D) wastes. Though there is no reliable record of the actual amount of C&D wastes generated and disposed off in Malaysia, estimates from researches, practitioners and regulators have led us to believe that the C&D wastes constitute more than 30 % of the total wastes generated in the country. This large amount of C&D wastes clearly indicates that the construction industry is not efficient and does not utilize resources in a sustainable manner. There is a need to review current practice in the construction industry in order to improve procedures, so that better and more efficient design, construction, operation and maintenance can be affected, thus resulting in less waste. This guideline has been prepared to assist stakeholders in the construction industry to understand the concepts of integrated waste management and waste minimisation; to assist stakeholders in identifying measures that can be adopted in their projects towards minimising waste and moving towards sustainable construction practices. The roles of major players namely, the Client, the Consultants and the Contractors in implementing waste minimisation in construction projects are outlined, and the importance of sharing a common view towards sustainability is highlighted. Various regulatory instruments related to the construction industry and waste disposal are also included. Finally, some descriptions of good practices found in Malaysia are documented in the guideline for the stakeholders' reference.

I sincerely believe that this guideline will be immense value to various stakeholders in the Malaysian construction industry, in our efforts to achieve a sustainable environment. I wish to extend my heartfelt gratitude to all members of the technical committee for their guidance and to the Working Group 6 (WG6) for their contributions.

Datuk Ir. Hamzah Hasan
Chief Executive
Construction Industry Development Board (CIDB) Malaysia

GUIDELINES ON CONSTRUCTION WASTE MANAGEMENT

SECTION 1: INTRODUCTION

1.0 Construction Waste

For the purposes of this guide, "Construction Waste" is defined as materials that are unwanted or being generated during construction or demolition activities, including improvement, preparatory, repair or alteration works. Many factors contribute to the generation of construction waste at a site. Waste may have one cause or a combination of causes. Gavilian and Bernold (1994) organised the causes of construction waste into six categories:

1. Design - e.g. Improper initial design can lead to wastage;

2. Procurement - e.g. Over-ordering of materials;

3. Handling of materials - e.g. Material damage on site, resulting from mishandling and/or careless delivery;

4. Operation - e.g. Lack of recording of material supplied and used on site;

5. Residual - e.g. Excess materials left on site after completion of job; and

6. Others - e.g. Vandalism.

Construction, demolition and land-clearing activities all produce construction waste, which may include, but not be limited to the following:

Acoustic ceiling tiles	Drywall	Wood
Asphalt	Fluorescent lights	Plastic from packaging
Asphalt shingles	Insulation	Window glass
Bricks	Cardboard	Land-clearing debris
Carpet and pad	Metals	Paint
Concrete	Dirt	Plaster
Glass containers	Stones	Steel
Earthworks		

Component	Road Work Materials	Excavated Soil	Demolition Waste	Site Clearance	Renovation Waste
Soil/ sand	23.0	73.8	21.5	33.0	19.4
Concrete/ Mortar	16.9	1.2	10.8	4.6	7.4
Rock/ Rubble	14.4	12.5	27.7	15	38.8
Reinforced Concrete	14.2	0.4	5.8	0.9	7.0
Bricks/ tiles	0.8	0.4	12.1	1.4	9.6
Slurry and mud	1.8	9.7	1.5	1.0	3.1
Asphalt	24.7	0	0	0.2	0
Cement Contaminated	1.7	0.4	3.2	15.6	3.3
Wood	0.6	0.9	10.5	13.3	7.1
Ferrous metals	0.5	0	0.6	1	1.3
Non-ferrous metals	0	0	0.7	0.2	0.1
Others (glass etc)	1.4	0.7	5.6	13.8	2.9
Total	100.0	100.0	100.0	100.0	100.0
% of total quantity of C & D waste landfilled	5.2	59.4	8.5	14.6	12.3

Table 1. Composition of construction and demolition waste disposed of at landfills in 1995 (Source EPD 1995)

1.1 Management of waste in construction

Management of construction waste entails reducing waste generation during the design and construction phases of a project.

Waste management, especially with respect to waste minimisation, can contribute towards significant efficiency and environmental savings. Savings in purchasing cost are another benefit derived from proper waste management, gained through reusing and recycling of construction waste. When proper waste management methodology is implemented, there are savings in transport costs and landfill charges, as well as revenue from the sale of recyclable construction waste. Other benefits encompass reduced legal liability due to environmental law issues and improved workplace safety. Furthermore, by practicing good waste management, there may be environmental benefits such as fewer chances of soil and ground water contamination.

1.2 Malaysian perspective

The breakdown of waste generation according to a study by Mohd Nasir in 1998 showed that on average, industrial and construction waste account for 28 % of total waste generation. Normally construction waste in Malaysia is finally disposed of in landfills.

1.3 Objectives of this guideline

In line with the Construction Industry Master Plan (CIMP) Strategic Thrust No. 3, which is to "Strive for the highest standard of quality, occupational safety and health and environmental

practices” the objectives, have been devised to mirror CIMP’s initiatives.

The main objective for developing this guideline for waste management is:

a) to establish proper construction waste management practice in Malaysia;

b) to identify roles and responsibilities of construction industry players;

c) to provide guidance on waste management plans; and

d) to list legislative requirements associated with waste management.

SECTION 2: ROLES AND RESPONSIBILITIES OF CONSTRUCTION INDUSTRY PLAYERS

2.0 Clients, Consultants and Contractors

The three main players in the construction industry supply chain are the "Client", "Consultant" and the "Contractor". Each of them plays an important role and has responsibilities in the management of waste in the construction industry.

2.1 Client

Clients, being the initiator of projects, should be pro-active and must give clear instructions that waste associated with their projects should be minimised and wherever possible such wastes are to be recycled on site or off site.

Waste management and minimisation will result in cost savings, construction of better quality, reduced duration of the projects and greater site safety. Waste management and minimisation must be planned meticulously from the inception stage. Such planning needs support and commitment from clients; their Environmental Policy should reflect the waste management initiatives. Details of construction waste management must be clearly included in the project brief given to consultants.

2.1.1 Design Stage

Clients should establish requirements for waste reduction and make it clear to consultants that they expect green designs. These intentions should be spelled out to the consultants in the project brief. Consultants should be selected from those who have sound environmental policies and/ or in-house best-practice documents.

Meetings with consultants during the pre-tender stage should focus on the specifications that ensure waste minimisation at construction sites.

2.1.2 Tender Stage

During the tender stage, clients, in collaboration with consultants, should hold technical briefing sessions where waste minimisation concepts and objectives are declared and clarified to the tenderers. Expectations of compliance need to be made clear to all parties.

Clients should ensure that tender documents address the need for waste minimisation. Technical specifications regarding materials to be used, technology to be adopted and methods of waste removal from sites must be clearly stated. Stipulations for manufacturers and material suppliers to remove packaging from sites should also be included. An example on technical aspects of construction waste specification can be found at Resource Venture's Website. See note for details of the website.

Note: There is a standard template of technical specifications for construction waste management in Microsoft Word document format which can be downloaded (www.resourceventure.org). The document can be modified to suit individual projects.

2.1.3 Construction Stage

When the project is underway, clients in collaboration with consultants should establish a clear set of performance indicators to be used in monitoring and evaluating the effectiveness of the measures implemented to minimise construction waste. A system of rewards and/ or

penalties can be introduced to encourage contractors to meet the waste minimisation objectives set for the project. Clients should be represented by senior management personnel during site meetings. A walkabout session a few days before the site meeting will lead to more focused criticism that will help contractors to improve their performance.

Most importantly, clients should have no reservations in accepting the "apparent initial costs" associated with the provision of additional infrastructure on site. These apparent costs will eventually be paid off by the benefits gained through the minimisation of wastes-producing activities on site.

Clients' Roles and Tasks:

- Proactive
- Planning
- Establish EH & S requirements
- Set project brief
- Set criteria for selecting Consultants
- Monitoring, assessment and evaluation
- Rewards and Penalties

2.2 **Consultants** (Architects/Engineers)

A client's good intentions to reduce construction waste from sites will not materialise unless consultants provide professional services that will ensure the client's intentions are realised.

2.2.1 Design Stage

Architects and engineers must focus on green design concepts and identify opportunities for waste reduction. Consultants should consider a policy of standardised design as this helps to reduce waste. Specifying components in sizes that can be used without wastage produced by cutting will substantially reduce wastage and save costs. Standardisation will enable components to be pre-fabricated and later transported to sites for assembly.

The choice of materials should favour those that will cause less damage to the environment and results in longer service life of the project. Choosing more durable materials will result in lower maintenance costs, thus realising monetary benefits for Clients in the long run.

Consultants should also adopt a flexible type of design where the function of the facilities can be easily changed with minor renovations, thus preventing facilities from being demolished prematurely. Designs should also consider the most effective way of decommissioning facilities, should the need arise. Decommissioning procedures should facilitate removal of toxic and non-toxic components in such a way that non-toxic components can be easily separated and recycled.

For better quality control and less wastage, consultants may recommend a modular approach to construction, where components can be pre-fabricated and assembled on site.

Consultants should also consider using construction waste management specifications to ensure that efforts to reduce waste are successful.

2.2.2 Pre-Construction Stage

Consultants are to work closely with clients in guiding/coercing contractors into adopting practices that will contribute towards not only towards successful completion of the projects, but also towards minimising of wastes from construction activities. Consultants may need to mentor contractors and may also need to provide contractors with a directory of potential customers for recyclable waste.

Consultants should be opened to comments and ideas from contractors and sub- contractors on improvements in construction methods that will lead to further waste minimisation. It would

be to everybody's advantage that policies or work procedures to be used on sites are jointly drawn up and mutually agreed upon by Clients, Consultants and Contractors.

2.2.3 Construction Stage

Policies on waste management on site, including the monitoring and record keeping of wastes leaving the site, must be formulated and reviewed periodically in light of developments during construction.

Designated locations where wastes are sorted and dumped in separate compartments make recycling feasible, since less effort is required to separate wastes. Policies on packaging material can drastically reduced the amount of waste generated on site; for example, material suppliers can be required to remove such packaging for final disposal or for recycling.

Consultants need to consider:

- Green Design Concepts
- Standardisation
- Flexible and Adaptable Design
- Materials Specifications
- Design for decommissioning and/ or recycling
- Modularisation and Prefabrication
- Construction Waste Management Specifications

2.3 Contractors/ Sub-Contractors

The construction industry in Malaysia has been relying heavily on traditional construction methods. Such labour-intensive procedures inevitably caused inconsistencies in the quality of works produced. To contractors, time and money are the main factors in determining the construction method. Low priority is given to the organised disposal of construction waste, since dumping of such waste is relatively inexpensive.

2.3.1 Pre-Construction Stage

Contractors must study the tender documents carefully and formulate a waste management plan to identify potential waste. Contractors should seek clarifications from Clients and Consultants on matters related to the projects so that any additional costs caused by requirements for waste minimisation can be included in the overall cost.

Desk study to identify inert waste disposal sites/ landfill and lists of waste recyclers should be conducted to effectively manage and dispose of or cash in on site wastes. Ministry of Housing and Local Government has published a list of recyclers. A list of inert landfills can be obtained from the respective Local Authorities.

Contractor should also appoint an officer to be responsible for waste minimisation and management on site. Proper site planning together with a practical site layout is needed to ensure that construction activities and waste minimisation requirements are not in conflict. A location for on-site waste storage is needed, preferably with separate compartments for different types of materials that have sufficient volume and value for recycling. Figure 1 illustrates a well-planned construction site where the waste storage area allows for separation of waste before removal from the site.

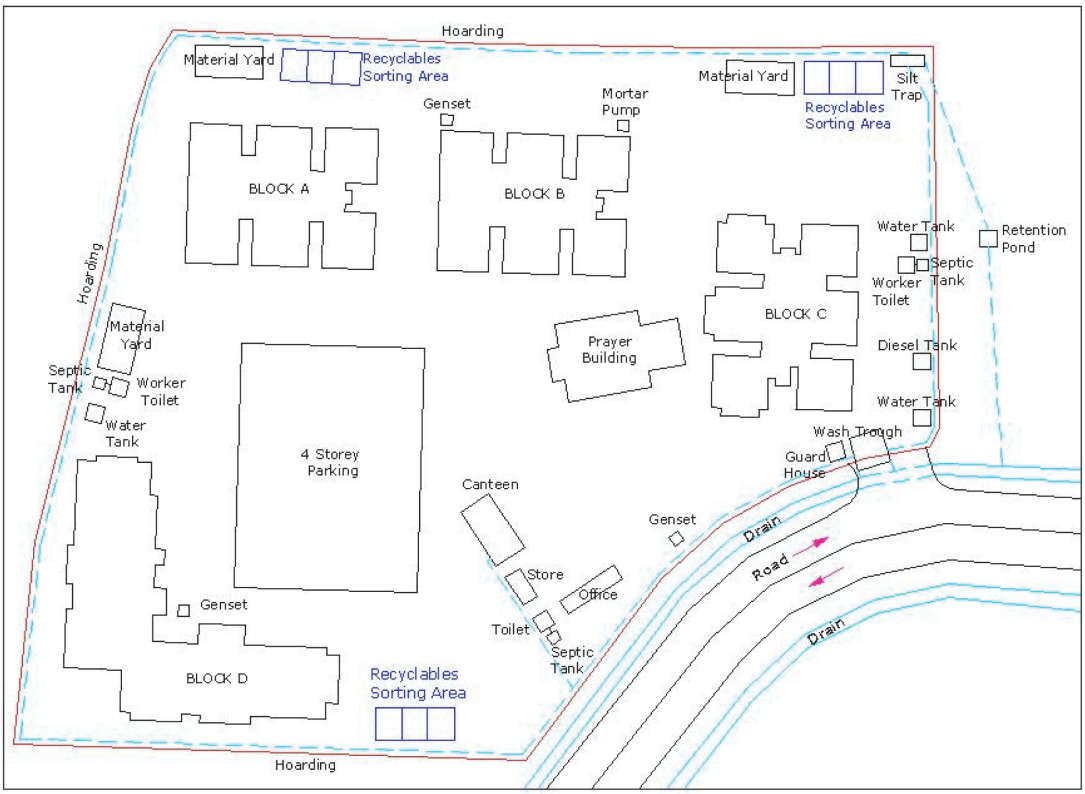

Figure 1. An example of a well-planned site layout

2.3.2 Construction Stage

Contractors should be encouraged to develop/ propose new construction methods in order to reduce the production of waste.

There should be regular meetings and reports regarding waste management and waste minimisation. These should be held weekly or monthly depending on whether they involve only the contractor, or the contractor and the consultant, or all parties involved in the project.

Training for workers and site supervisors should be systematically scheduled. Incentives or awards should be given to employees or sub-contractors who best achieve specified waste minimisation objectives. Concomitantly, if employees or sub-contractors fail to comply with waste minimisation policies, a penalty should be imposed.

2.4 Concluding remarks

Waste management has become a vital element in the construction industry in Malaysia. Clients, Consultants and Contractors play a very important role in ensuring sustainable development. Figure 2 summarises the roles of these key players in the waste management hierarchy through out the different phases of construction.

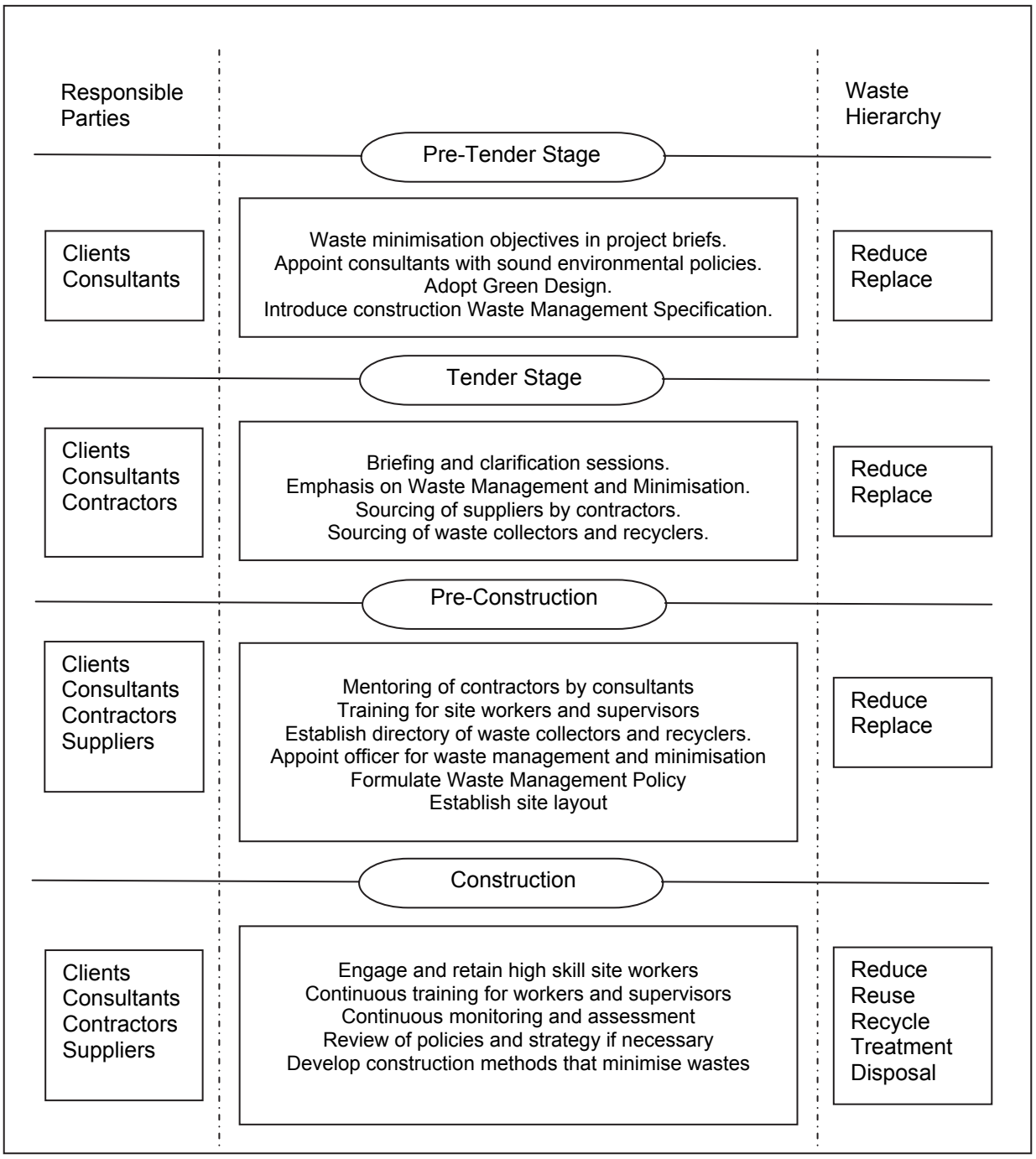

Figure 2. Roles of Client, Consultant and Contractor during different stage of construction.

SECTION 3: WASTE MANAGEMENT PLAN (WMP)

3.0 Introduction

The requirement for a WMP should be incorporated in the tender document and the WMP must be developed at a very early stage of a project i.e. before commencement of work. The WMP shall provide an overall framework for waste management and reduction. The WMP should:

1) Prepare Organization Chart which shows responsibilities for waste management.

2) Estimate the quantities and types of wastes generated.

3) Identify the waste destinations and transport modes.

4) Set a target and find ways to track resources.

5) Produce a layout showing the location of designated sorting and storage areas for new/ used materials.

6) Ensure that everyone on site is familiar with the objectives of the plan.

7) Carry out meetings, monitoring and auditing programmes.

From this WMP, specifications can be developed for the bid/ contractor document, outlining procedures for reduction, re-use and recycling. A comprehensive WMP must incorporate both concept and strategies and should be able to meet the objectives as stated below. Sample of WMP is shown in Annex 3.1.

3.1 Concept and Strategy

a) Priorities based on internationally accepted Solid Waste Management Hierarchy.

b) Cradle to Grave Concept.

c) Environmentally Friendly System.

d) To identify local waste contractors/recyclers in order to determine the types of waste that can be recycled and have market value.

3.2 Objectives

a) To minimise waste generation at construction sites, where possible.

b) To maximise recovery of recyclable materials from construction sites through segregation at site.

c) To minimise waste disposal and reduce disposal cost by disposing of only non-recyclable items at landfills.

d) To prevent illegal dumping activities.

e) To promote and create markets for recyclable construction materials.

3.3 Waste Management Hierarchy

The *Solid Waste Management Hierarchy* concept, as illustrated in Figure 3 is internationally accepted and places emphasis, in order of priority on waste prevention, reduction, reuse, recycling, waste treatment and disposal. The SWM Hierarchy places 'Waste Minimisation' and the 3R; 'Reduce', 'Reuse', 'Recycle', as the highest priority, followed with, 'Treatment' (including Composting and Thermal Treatment) and the least priority is given to 'Disposal' that includes land filling.

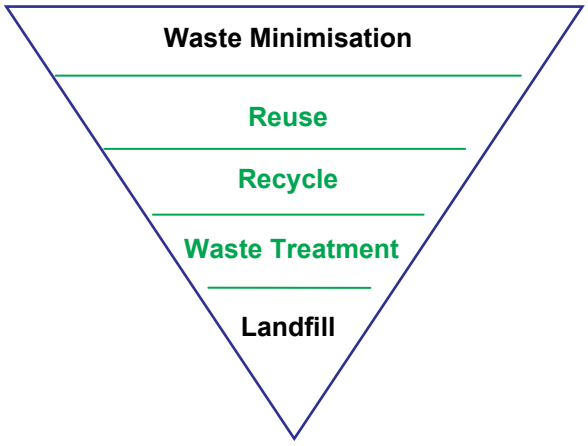

Figure 3. A Hierarchy of Waste Management

Though the concept of Waste Hierarchy is well accepted, recent thinking and understanding on Integrated Waste Management recommend that the Waste Hierarchy should not be used as a rigid guideline (DOE, 1995; UNEP, 1996; Brisson, 1997). The Waste Hierarchy on its own does not address the use of a combination of waste minimisation approaches, nor costs neither analysis of economic affordability nor the high variability of options due to various local conditions and the availability of treatment and disposal facilities.

In place of a hierarchy of preferred waste management options, as shown in Figure 3, there should be an integrated approach, which recognises that all options have a role in waste management towards a sustainable environment. The integrated approach shown in Figure 4, illustrates the inter-relationships of the various elements of the system. Each option needs to be assessed with the objective of optimising the effectiveness of the whole system, rather than its parts, to make it environmentally and economically sustainable and socially acceptable. Further information on the concept of integrated waste management can be found in Mc Dougall et al. (1999)

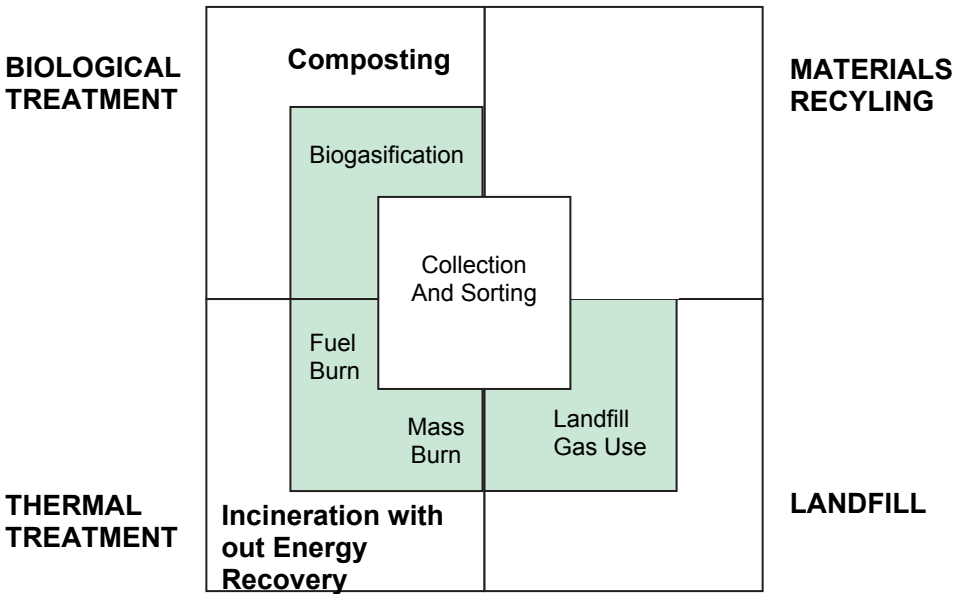

Figure 4. The elements of integrated Waste Management (Mc Dougall et al., 1999)

3.3.1 Waste Minimisation/ Reduction

Waste minimisation in construction makes good business sense and has additional environmental benefits. Waste reduction activities will reduce material expense and cut disposal costs. Environmental benefits of minimising construction waste include:

a) Less dependence on natural resources, such as trees, oil and minerals.

b) Less pollution from manufacturing and transportation related emissions.

c) Lower energy and water consumption.

d) Lower greenhouse gas emissions.

Waste Minimisation Activities

It is recommended that a holistic approach to waste minimisation/ reduction is adopted. There are three key project stages where waste minimisation activities should be introduced.

Stage 1: Contractual

Stage 2: Design Stage

Stage 3: Site Operation Stage

Tips that can help architects, contractors and developers to reduce resource waste and costs are:

1. Before designing.

a) Study the site - Understand the features and limitations of building site, record the microclimate, wind directions, sun angles, slopes, vegetation, neighbouring roads, buildings etc. Think what will change at different seasons.

b) Question the size of the building in 10, 20 or even 50 years time – Build a flexi home with durable materials so that you will not face unnecessary costs for future repairs and alteration to suit future family needs.

c) Consult the project team – Involve the entire team and discuss how to tune the design to minimise waste and evaluate whether the things you want are practical. Communication is the key to successful implementation.

d) Research – Find out about new practices and materials which may reduce wastage by talking to many people, reading books and searching the internet.

2. During the design.

a) Design buildings in harmony with their surroundings – Reduce the clearing of vegetation, earthworks, driveway length and paved surfaces. Consider using piles or poles, especially on sloping sites, to avoid excessive excavation.

b) Consider module sizes in the design – Design room-sizes to coordinate with the size of floor, roof and external cladding panels. The overall cost of a building can be reduced significantly if fewer panels need to be cut.

c) Service Efficiency – Grouping wet areas, such as kitchens, laundries and bathrooms close together will result in major savings due to reduced pipe work lengths and sharing of gully traps. Also work out efficient circuits for electrical and telephone cabling.

d) Use pre-fabricated and pre-cut components – Wall framing and roof trusses can be pre-cut, pre-nailed, and delivered as a correctly sized unit ready to be installed. Construction is faster, and no waste is generated on site. Resource use is more efficient at the factory than at a building site, where off-cuts are often dumped and burnt.

e) Less is more – Design for simplicity and user-friendliness. Find low technology and simple solutions because simple solutions are far less likely to breakdown or require maintenance. They also cost less and use fewer resources.

f) Use fewer finishes by choosing materials which do not need applied finishes, such as wood ceilings, bricks and tiles, pigmented concrete or plaster, or roofing steel with the colour baked on at the mill. Fewer materials are used, labour costs are lower and there is no maintenance later. Reducing the use of paints and varnishes, which are often quite toxic, means fewer health and environmental risks.

g) Consult and plan well – Take all the time you need to plan the project carefully. Talk the design through with your project team and ask them to find ways that use fewer materials and produce less waste. Have an intensive brainstorming session with all parties involved. Time invested in the planning stage will be paid back during the construction and lifetime of the building. Making changes during construction or after can be very costly.

h) Document your design – Keep records of all details of the design, to ease future repairs and maintenance and ensure that less waste is created trying to locate leaking pipes or faulty cables. The “house-book” should stay with the house when ownership changes.

i) Design for the future – Use durable and low maintenance materials. Design houses to make alterations and repairs easy. Choose materials and components that can be reused and install them in a way that allows disassembly use screws instead of nails.

j) Design for green living – Design homes in a way that will make ‘green’ living easy. Allow room for storage of recyclables and provide space for a compost pile.

3. Dealing with contractors

a) Finding the right people - Negotiate waste minimisation issues before contracts are signed to avoid re-negotiation which later may result in additional costs. One session to brief all interested bidders can save time and ensure that all parties have understood the issues. Contractors should submit a WMP prior to commencement of work.

b) Get advice about building maintenance from the contractors; this information should be included in the “house-book”. Their advice will help to increase the life-span of the building.

c) Cost out waste minimisation options to gain maximum benefit from your efforts. Issues concerning costs and benefits should be sorted out before contracts are signed.

4. The building site

a) Make sure the building site is kept tidy. Provide a suitable area to store material and this should be covered, if possible. Waste should be separated and recycled if it can’t be reused. Ask suppliers to take back packaging materials. A tidy site will reduce loss and damage of materials and increase safety because workers are less likely to trip over things.

b) Materials should be cut and their off-cuts stored at a central location. It is much easier to re-use off-cuts if you don’t have to hunt for them all over the site. This technique has reduced waste by 15 %.

c) Reuse temporary works such as scaffolding and formwork for concrete. This is particularly useful when building several identical houses. Select more durable materials, such as metal, to avoid waste. Reusable crates are better than plastic or cardboard wrapping.

d) Estimate materials correctly and arrange for them to arrive just in time to avoid materials being damaged during storage.

e) Contractors should segregate and sort waste materials at designated location or use a company that sorts waste after collection and sells recyclable and re-usable materials.

f) It is important that work is documented ‘as built’ in the ‘house-book’, with special markings for those details changed from the original plans. Attach photos, if possible.

g) Learn from experience – Visit the building site and conduct a waste audit. Analyse the savings obtained by reducing waste.

3.3.2 Reuse

Materials that can be reused on site include, but are not limited to, the following:

▪ Doors, patio and French door sets ▪ Electrical and HVAC supplies ▪ Faucets and plumbing fixtures ▪ Fencing ▪ Flooring – carpet and vinyl (new) ▪ Flooring – wood ▪ OSB and masonite ▪ Plywood and chipboard ▪ Shelving and racking ▪ Siding and shutters ▪ Mirrors and mirror tiles ▪ Kitchen cabinet sets ▪ Kitchen fixtures ▪ Gutters ▪ Hinges and other hardware ▪ Insulation, new or gently used ▪ Windows – wood and vinyl, especially newer energy – efficient windows ▪ Stained glass	▪ Bathtubs (mainly white or neutral colour) ▪ Sinks – kitchen/bath (no chips), utility/lab ▪ Lumber (clean, denailed, min. 4 ft. long) ▪ Glass, sheet and plexiglass (min. 4 sq. ft.) ▪ Claw-foot or antique tubs ▪ Columns, pillars, and posts ▪ Concrete blocks and products ▪ Countertops, straight, neutral colours ▪ Displays and display fixtures ▪ Doors, especially solid wood door ▪ Tile (most types and quantities) ▪ Toilets (low flow, pre-40's, no cracks) ▪ Tubs (mainly white or neutral colour) ▪ Store fixtures	▪ Brick and paving stones ▪ Cabinetry – wood ▪ Corbels ▪ Trim and mouldings ▪ Tile board ▪ Wood beams ▪ Architectural features ▪ Bath vanities ▪ Banisters ▪ Bath fixtures ▪ Bookcases, files, library shelves ▪ Lighting fixtures ▪ Lockers ▪ Radiators and registers ▪ Roof tiles ▪ Sandstone ▪ Slate, granite and marble

Materials which are not acceptable for re-use are as follows:

▪ Appliances older than 5 years ▪ Ceiling fans ▪ Commercial 200 volt electric equipment ▪ Commercial bath fixtures ▪ Commercial ducting and vent covers	▪ Commercial flashing ▪ Commercial shelving missing parts ▪ Countertops – L-shaped or dated colours ▪ Doors – damaged, commercial or hollow	▪ Fireplace doors ▪ Fluorescent light fixtures, bulbs ▪ Gutters: leaking, rotted ▪ Mini-blinds ▪ Electric baseboard heaters ▪ Used carpet ▪ Windows – aluminium	▪ Open bags of cement, mortar, drywall mud ▪ Room dividers missing parts ▪ Shower doors, except high-end ▪ Sinks – wall hung, cultured marble, dated	▪ Tile with heavy grout ▪ Wood: shorter than 4', rotten/bug-damaged, contaminated or nailed ▪ Wood-burning equipment, unless antique

How to reuse?

- Insulation materials can be placed in attic space.
- Larger rigid insulation scraps can be used under concrete floors.
- Cosmetically damaged finished products can go to non-profit organisations and taken as a tax-exempt charitable donation.

3.3.3 Recycle

Recycling construction materials saves money by cutting disposal costs. It reduces waste going to the landfill, facilitates a cleaner and safer construction site. There are two methods of recycling waste:

1) Source separation: Recyclable materials are collected in separate containers as they are generated; and

2) Co-mingled recycling: Recyclable materials are collected in one container as they are generated.

The following strategies should be adopted:

1) Set a goal that establishes a minimum level of performance required.

2) Select a contractor with proven recycling experience, determine if they have track record of past performance by looking at the WMP and documentation verifying the recycling rate on past projects.

3) Use a Construction Waste Management Specification – refer Annex 3.2 (sample taken from 'Resource Venture').

4) Monitor the waste reduction program by imposing a requirement on the contractor to submit a waste management report with the application for progress payment. To include waste reduction program in the project meetings.

Some recyclable materials found at construction site and how to recycle them are described briefly below:

? What can be recycled onsite?

Most residential construction waste is recyclable including wood (solid sawn and engineered products), drywall, corrugated cardboard, metal and some plastics.

? How to recycle?

Wood – can be used for mulch in composting operations, animal bedding, and landfill cover, as an industrial fuel source.

Drywall – can be used for some type of animal bedding or applied as a soil amendment. Waste drywall can be cut and stack into uninsulated wall cavities.

Cardboard – can be sold to local recyclers

Siding – vinyl and metal siding cut-off waste can be sold to local recyclers or sent to central collection area such as a siding or building supply distributor.

3.4 Waste Minimisation Plan

Waste minimisation is about a change of attitude and common sense, rather than new technologies. Often waste minimisation options cost nothing to implement and give benefits straight away with little or no effort.

3.4.1 Identifying and Exploration of Waste Minimisation Opportunities

The process flow in identifying waste minimisation opportunities can be summarised as follows:

1) Identify waste composition on site during construction and alteration. For example see table below.

Identification of Waste	
Bricks	reusable
Concrete	recyclable
Plaster Boards	recyclable
Packaging	used for landscaping purposes
Insulation material	nil
Paint	reused
Timber	recyclable/ reusable
Pipe work	recyclable

2) Identify the end users/ recyclers for recyclable waste materials

3.4.2 Implementation of the Waste Management Plan

a) Separate recyclable materials by type from waste materials to the maximum extent possible.

b) Provide containers, clearly labelled by type for recyclable materials. The containers should not contain more than 10 % of non-recyclable material, by volume. Provide other storage methods for managing recyclable materials until they are removed from the project site if this 10 % is exceeded.

c) Separate inert from non-inert materials for reclamation and site formation use.

d) Higher grade use e.g. a road sub-base of inert waste is also feasible, provided that the relevant specifications are met.

3.4.3 Disposal Facilities/Recyclers

Contractors have to ensure that their wastes are being disposed of at sites approved by the Local Authorities. List of approved sites for disposal of construction waste shall be referred to the Local Authorities nearest to the project site.

For recyclable materials, the contractors can sell to local recyclers. For a list of recyclers, refer to web site Ministry of Housing and Local Government, www.kitarsemula.com or Direktori Kitar Semula 2006/ 2007.

3.4.4 Monitoring and Modifying the plan

Monitoring can be carried out by conducting an environmental site review at regular intervals. The plan has to be modified after changes have been proposed during the monitoring.

3.5 Overall Implementation

An organisational chart with responsibilities shall be prepared. A designated on-site waste manager (or the Safety, Health and Environment Manager or a site manager) shall be appointed. His responsibilities are as follows:

1) Overseeing the management of building wastes.

2) Managing waste reduction initiatives.

3) Coordinating the activities of other employees.

4) Carrying out various programs include staff awareness programs, training programs, safety and health activities.

3.5.1 Staff Awareness Programs

The key factor for successful implementation is the acceptance of change by the employees. Therefore it is very important to make them aware of all activities to be implemented on site so their commitment can be obtained. Awareness and communication programs shall involve staff of all levels.

3.5.2 Training Programs

It is recommended to use a training module prepared by CIDB which comprises legal aspects, impacts of construction on the environment, construction waste management and also good practices on site. The training programs shall be conducted for the entire workforce.

3.5.3 Safety and Health

All staff shall be briefed on the safety and health aspects of all construction activities, especially those activities related to waste management. Procedures on handling, segregating and transporting construction wastes shall incorporate safety and health measures.

3.5.4 Contractual Obligations

Clients, consultants and contractors can play an important role at the contractual stage of the project to minimise waste. The following points are recommended:

a) Agree upon the type of contract.

b) Identify the type of materials used.

c) Identify the team and workforce for the project.

d) Identify construction methods and techniques.

e) Identify potential source of waste.

3.6 Onsite Monitoring and Auditing

Material and waste audits should be carried out in order to identify areas that can be improved in subsequent projects. The procedure for carrying out a material and waste audit is as follows (*source: C.S. Poon, T.W.Yu and L.H. Ng, Research Centre for Urban Environmental Technology and Management, Department of Civil and Structural Engineering, The Hong Kong Polytechnic University*) :

? Record the quantities of materials employed on construction sites

? Record the storage for the materials periodically,

? Record the quantities of work done using each material periodically,

? With the data available, monitor the material wastage level periodically by comparing the quantities of materials used with the corresponding quantities of work done,

? Investigate the causes of material wastage,

? Evaluate the effectiveness of corrective measures,

? Compare with the company material wastage level standard,

? Recommend preventative measures to reduce material wastage levels,

? Recommend methods to reduce construction waste, and

? Set up a computerised data collection system for material and waste audit purposes.

3.7 Transportation and Disposal System

3.7.1 Transportation

Transportation of construction waste shall use suitable and appropriate containers and trucks as specified by the local authorities. The waste collector shall ensure there is no spillage and waste should be covered at all times during transport to the approved disposal site.

3.7.2 Disposal System

The waste shall be disposed of at approved sites. List of approved sites can be obtained from nearby Local Authorities or Ministry of Housing and local Government.

SECTION 4: LEGISLATIVE AND ADMINISTRATIVE REQUIREMENTS

4.0 Introduction

The construction industry embraces every aspect of the natural and built environment from the procurement of raw materials to the operation of buildings or structures. This wide range of activities has significant environmental implications at every stage of the construction life cycle. In order to ensure that the negative impacts on the environment arising from the development activities are mitigated, our government has introduced a number of legislative and regulatory environmental management control mechanisms, and provided legislation through government agencies such as Department of Environment, Ministry of Housing and Local Government, Local Authority and Land Office as well as legal requirements by other related agencies. Some laws are specifically targeted at protecting the environment e.g. the Environmental Quality Act 1974, whilst others incorporate environmental legislation as part of a wider range of laws involving areas such as health and safety, building control and planning. The industry in turn, is affected by increasing environmental legislation. Owing to the nature of operational activities within the construction industry, the main concerns regarding environmental legislation relate to waste management and pollution prevention.

4.1 Legal Requirements by related Agencies

4.1.1 Department of Environment (DOE)

i) Environmental Quality Act 127, 1974 and Subsidiary Legislations, (EQA)

EQA is an Act relating to the prevention, abatement and control of pollution and enhancement of the environment, and for purposes connected therewith. It was enacted in 1974 and applies to whole of Malaysia.

No.	Section	Sub Title and Description	Legal Impact
1	**Section 22**	**Restrictions on pollution of the atmosphere** Emission or discharge of any environmentally hazardous substances, pollutants or wastes into the atmosphere.	A fine of RM100 000.00 or 5 years jail or to both. A further fine RM1 000.00 for each day the offence is continued after a notice requiring compliance has been served.
2	**Section 24**	**Restrictions on pollution of the soil** Polluting soil or land surface by: a) depositing any matter, whether liquid, solid or gaseous in or on soil, or place where it may gain excess to soil; b) establishing on land a refuse dump, garbage dump, soil/ rock disposal site, sludge deposit etc.	A fine of RM100 000.00 or 5 years jail or both A further fine RM1 000.00 for each day the offence is continued after a notice requiring compliance has been served
3	**Section 25**	**Restrictions on pollution of inland waters** Emission, discharge or deposit of wastes into inland waters: a) placing wastes in or on waters or place where they may gain access to waters; b) Placing wastes in positions where they may fall into waters.	A fine of RM100 000.00 or 5 years jail or both A further fine of RM1 000.00 for each day the offence is continued after a notice requiring compliance has been served.
4	**Section 29**	**Prohibition of discharge of wastes into Malaysian waters** Discharge of environmentally hazardous substances, pollutants or wastes into Malaysian waters	A fine of RM500 000.00 or 5 years jail or both
5	**Section 29A**	**Prohibition on open burning** No person shall allow or cause open burning on any premises	Compound of RM2 000.00 A fine of RM500 000.00 or 5 years jail or both

No.	Section	Sub Title and Description	Legal Impact
6	**Section 29B**	**Owner or occupier of premises liable for open burning** Owner or occupier of premises where open burning occurs shall be deemed to have contravened Section 29A	Compound of RM2000.00 Fine RM500 000.00 or 5 years jail or both
7	**Section 34B**	**Prohibition against placing, depositing, etc. of scheduled wastes** No person shall: a) place, deposit or dispose of, or cause or permit to place, deposit or dispose of, except at prescribed premises, any scheduled wastes on land or into Malaysian waters b) receive or send any scheduled wastes in or out of Malaysia c) transit or cause or permit the transit of scheduled wastes	A fine RM500 000.00 or 5 years jail or both

4.1.2 Department of National Solid Waste Management

i) Solid Waste and Public Cleansing Management Act 2007 (Act 672)

This Act provides for and regulates the management of controlled solid waste and public cleansing for the purpose of maintaining proper sanitation. The Act allows the Federal Government to have executive authority with respect to all matters relating to the management of solid waste and public cleansing. Under this Act, controlled solid waste is variously categorised as commercial solid waste, construction solid waste, household solid waste, industrial solid waste, institutional solid waste, imported solid waste and public solid waste. This Act applies throughout Peninsular Malaysia and the Federal Territories of Putrajaya and Labuan.

No.	Section	Sub Title and Description	Legal Impact
1	**Section 8**	**Construction or alteration of prescribed solid waste management facilities.** No person shall construct or undertake any alteration of any prescribed solid waste management facilities unless the relevant plans or specifications which require the approval of the Director General have first been approved in writing by the Director General. Failure to comply with the court's order to alter the prescribed solid waste management facilities so as to comply with the approved plans and specifications.	A fine RM100 000.00 or 5 years jail or both. A further fine RM5 000.00 for every day or a part of a day in which the offence continues after conviction.
2	**Section 12**	**Application to close any prescribed solid waste management facilities** Any owner or occupier who intends to close any prescribed solid waste management facilities may apply to the Director General by submitting a written application and a proposed closure plan to the Corporation.	A fine of RM100 000.00/ 5 years jail or both.
3	**Section 14**	**Requirement for licence** Subject to Section 16, no person shall: (a) undertake or provide any solid waste management services; or (b) manage or operate any solid waste management facilities, unless he holds a license granted under this Act.	A fine of RM50 000.00/ 5 years jail or both. A further fine RM5 000.00 for every day or a part of a day which the offence continues after conviction.
4	**Section 20**	**Compliance with license conditions** A licensee shall comply with the conditions imposed by the Director General on the license.	Fine RM25 000.00/ 2 years jail or both. Further fine RM2 500.00 for every day or a part of a day which the offence continues after conviction.

No.	Section	Sub Title and Description	Legal Impact
5	**Section 71**	**Prohibition against unauthorized depositing, treatment, etc., of controlled solid waste.** No person shall deposit, separate, store, keep, collect, transfer, transport, treat or dispose of any controlled solid waste, or cause such controlled solid waste to be or permit to be deposited, separated, stored, kept, collected, transferred, transported, treated or disposed of otherwise than in accordance with this Act.	Fine RM10 000.00/ 6 months jail or both.
6	**Section 72**	**Prohibition against unauthorized escape of any controlled solid waste** Any person who has in his possession any controlled solid waste shall take all reasonable measures to prevent the escape of such controlled solid waste.	Fine RM10 000.00/ 5 years jail or both.
7	**Section 76**	**Power to direct removal of unlawful depositing or disposing of controlled solid waste** If any controlled solid waste is deposited or disposed of in contravention of this Act, the Director General may, by notice in writing served on – a) the owner or occupier of the premises; b) the person who deposited or disposed the controlled solid waste; or c) the solid waste generator, direct him to remove the controlled solid waste from the premises within a period of not more than date of the service of the notice.	Fine RM10 000.00/ 6 months jail or both

No.	Section	Sub Title and Description	Legal Impact
8	**Section 108**	**Regulations** Regulations may be made for prescribing the standards and specifications for the design, construction, operation and maintenance of any prescribed solid waste management facilities.	Fine RM10 000.00/ 6 months jail or both

4.1.3 Local Authority

i) Street, Drainage and Building Act 133, 1974

Street, Drainage and Building Act is an act to amend and consolidate the laws relating to street, drainage and building in local authority areas in West Malaysia. Its purpose is to ensure uniformity of law and policy with regard to local government matters relating to streets, drainage and buildings. It was enacted in 1974 and applies only to West Malaysia.

No.	Section	Sub Title and Description	Legal Impact
1	**Section 42**	**Materials not to be deposited without permission.** No person shall deposit any building materials or make a hole in any street or back-lane without prior written permission of the local authority.	A fine of RM1 000.00 A further fine of RM100.00 for every day the offence is continued after 24 hours notice from the local authority has been given, or The defaulting persons shall bear the expenses incurred by local authority.
2	**Section 44**	**Duty of owner or occupier to keep street clean.** Owner or occupier of premises shall clean such portion of the street as abuts his premises up to the centre of the street.	A fine of RM100.00 each day the non-compliance continues; or The defaulting persons shall bear the expenses incurred by local authority
3	**Section 47(2)**	**Depositing dirt on streets, etc.** Any person who, during construction or erection, alteration or demolition of building a) deposits any building materials onto public place; or b) fails to take precautions to prevent danger to life, health etc.	Offender may be arrest without warrant by police or officer of a local authority and shall be liable to: A fine of RM1 000.00; and A fine RM2 000.00 for second or subsequent conviction.

ii) Local Government Act 171, 1976

Local Government Act is purposely for ensuring uniformity of law with respect to local government. It was enacted in 1976 and shall apply only to West Malaysia.

No.	Section	Sub Title and Description	Legal Impact
1	**Section 69**	**Committing nuisance in streams, etc.** Any person who commits a nuisance or deposits any filth in or upon the bank of any stream, etc. within the local authority area. shall be liable to	A fine of RM2 000.00/ 1 year jail or both. A further fine of RM500.00 for each day the offence is continued. The defaulting persons shall bear the expenses incurred by local authority
2	**Section 70**	**Pollution of streams with trade refuses, etc.** Within or outside limits of local authority area, a) pollute waters etc., b) solid or liquid sewage, and c) laundry trade,	A fine of RM5 000.00/ 2 years jail or both. A further fined RM500.00 each day the offence is continued The defaulting persons shall bear the expenses incurred by local authority

iii) Uniform Building By-laws 1984

Uniform Building By-laws are made in exercise of powers conferred by Section 133 of the Street, Drainage and Building Act 133, 1974. These By-laws came into force in 1984 and shall apply only to West Malaysia.

No.	By-law	Sub title and description	Legal Impact
1	**By-law 21**	**Materials not to be deposited in a street without permission.** No person shall deposit any building materials in any street without a temporary permit.	A fine of RM2 000.00. A further fine of RM100.00 for every day the offence is continued after conviction.

iv) Putrajaya Management Guide

The Environmental Department, Putrajaya Corporation has produced the Environmental Management Guide (EMG) 1998 for the purpose of mitigating environmental impacts from development activities. Since it is only a guideline and no enforcement shall be made to ensure compliance, Putrajaya Corporation through its Department of Town Planning has incorporated conditions to comply with EMG as one of its Development Order (D.O) conditions for developers in Putrajaya and thus, has made the EMG come into force.

No.	Chapter	Sub title and description
1	**5.0** **Item 5.4.4.2 (a)**	**Earthwork** No excess earth from earthworks is to be disposed of outside Putrajaya. No open burning of vegetation is allowed. Cut vegetation is to be collected for composting at the Putrajaya Bio-Mass Centre.
2	**5.0** **Item 5.4.4.7 (f)**	**Solid Waste** 1) No open burning. Sort solid waste into two types, that which can be recycled and that which is to be disposed off. 2) Dispose of non-scheduled waste at Local Authority approved disposal sites. Keep records and documents for audit. 3) Include 'Detailed Solid Waste Management Plan' in Environmental Management Compliance Plan (EMCP) consisting of this a) to f) list: a) Identify type of solid waste to be generated. b) Classify into recyclable and non-recyclable. c) For each identified solid waste, define its handling process in a flow chart, from the time it is generated at source to the time of disposal. d) Details of recycling and disposal contractors. e) Details of responsible project staff. f) Details of administrative procedures, documents and forms to be completed for audit purposes.

4.1.4 State Regulatory Bodies

4.1.4.1 Land Office

i) Water Act 418, 1920

No.	Section	Sub title and description	Legal Impact
1	**Section 7A**	**Prohibition of pollution of rivers** No person shall cause to enter or discharge into any water source: a) any poisonous matter etc.; b) any matter which by virtue of its temperature etc.; c) any matter which by virtue of its physical nature etc.; d) oil of any nature etc.	A fine of RM1 000.00

4.1.4.2 Selangor Water Management Authority (LUAS)

i) LUAS Enactment 1999 and Subsidiary Legislations

No.	Section	Sub title and description	Legal Impact
1	**Section 79**	**Prohibition of pollution of a water source** No person shall cause to enter or discharge into any water source: a) any poisonous matter etc., b) any matter which by virtue of its temperature etc., c) any matter which by virtue of its physical nature etc., d) oil of any nature etc.	A compound of RM25 000.00 A fine of RM100 000.00 or 3 years jail or both A further fine of RM5 000.00 for each day the offence is continued after a notice requiring compliance has been served

SECTION 5: GOOD MANAGEMENT PRACTICES

5.0 Introduction

At present, few contractors/ developers in Malaysia have implemented good waste management systems, which explain the rampant illegal dumping of construction wastes. Some large developers/ contractors, in their attempt to manage/ minimise the environmental impact of their activities, have attempted to ensure compliance with legal requirements in terms of waste disposal. It is also noted that the Industrialised Building System (IBS) has slowly become a common option for high rise building projects.

5.1 Waste Management System in Putrajaya

Putrajaya Holdings Sdn Bhd is the developer entrusted by the government to construct the Federal Government Administration Capital of Putrajaya. An environmental management unit was set up to manage and monitor all matters related to environmental management in construction. Waste management was one of the issues to be addressed by this unit.

Putrajaya Holdings Sdn Bhd implements a waste management system starting at the planning stage and covering the planning approval and tender briefing stage. The need to plan an effective waste management system was conveyed to all contractors through its project kick off meeting and the Environmental Management Compliance reports. A waste tracking system is also implemented via project audit and monitoring, enforcement and surveillance.

The current waste management practices in Putrajaya emphasise two major issues: i.e.

? ensuring legal disposal at approved dumpsites; and

? ensuring no open burning of construction wastes at site.

The monitoring mechanisms adopted by Putrajaya Holdings Sdn Bhd were:

? scheduled site audits and day to day site monitoring and surveillance;

? tracking records and documentation;

? enforcement; and

? awareness promotion and training.

5.2 Good Practices by Contractors in Putrajaya

Amongst other good practices carried out by PHSB are:

1. Management of concrete wastes and water at its batching plants

Excess concrete was used to produce concrete barriers, concrete blocks used for piling load tests. Waste water from drums and plants washing was reused (for road wetting etc.), in order to maintain zero discharge compliance. These batching plants have also attempted to start initiatives to charge environmental disposal fee for excess concrete return, which will reduce the amount of excess concrete returned to the plants.

2. Introduction of the IBS to minimise the wood waste generated via usage of formworks

A substantial numbers of high rise apartment's construction projects in Putrajaya have adopted the IBS. In addition to more rapid project completion, this method has reduced significantly the quantity of wood wastes generated at construction sites.

3. Reselling of scrap metal

As scrap metal is actually a commodity of high commercial value, there are high demands for this waste. Putrajaya contractors do practise segregation and selling of the scrap metals.

4. Implementing proper handling of waste oil and used diesel.

PHSB has set requirements for its contractors to abide by rules for proper storage and disposal of used oil/ diesel. Training and awareness promotion to educate the contractors were emphasised. Nevertheless, compliance is at a low level due to difficulty in disposing of small volumes of oil.

As one of its efforts to promote good environmental practices in the construction industry, CIDB has recorded these good practices in a publication entitled "Construction Industry Good Practices Series – Construction Waste Management". Users of this guide are recommended to refer to it for further details.

ANNEX A
(Informative)

SAMPLE WASTE MANAGEMENT PLAN

Company :
Project :
Designated Recycling Coordinator :

Waste Management Goals:

- This project will recycle or salvage for reuse xx % [e.g. 75 %] by weight of the waste generated on-site.

Communication Plan:

- Waste prevention and recycling activities will be discussed at each safety meeting.
- As each new subcontractor comes on-site, the recycling coordinator will present him/her with a copy of the Waste Management Plan and provide a tour of the recycling area.
- The subcontractor will be expected to make sure all their crews comply with the Waste Management Plan.
- All recycling containers will be clearly labelled.
- Lists of acceptable/unacceptable materials will be posted throughout the site.

Expected Project Waste, Disposal and Handling

The following charts identify waste materials expected on this project, their disposal method and handling procedures.

Demolition Phase

Material	Quantity	Disposal Method	Handling Procedure
Asphalt from parking lot	100 tons	Ground on-site, reuse as fill	
Wood Framing	6 tons	Recycle – Wood Recycling Northwest	Separate ‘clean wood’ in clean wood bin.
Decorative Wood Beams	300 bd. Ft.	Salvage – Timber Frame Salvaging	Remove by hand, store on-site, palletize for pickup
Remaining Materials	8 tons	Landfill – Sound Disposal	Dispose in trash dumpster

Construction Phase

Material	Quantity	Disposal Method	Handling Procedure
Concrete	2 tons	Recycle – Pacific Concrete	Rebar OK
Forming Boards		Reuse as many times as possible then recycle – Wood Recycling NW	Stack next to supply of new form boards for reuse. Recycle clean unusable forms in wood recycling bin.
Clean Wood Scrap	12 tons	Scraps reused for formwork, fire breaks, etc. Remaining recycled – Wood Recycling NW	Stack reusable pieces next to saw for reuse. Place unusable clean wood in wood recycling container
Scrap Metal	5 tons	Recycle – Seattle Metals	Deposit all metals in metal container
Drywall	10 tons	Subcontractor will recycle and submit receipt	Either provide container or collect in vehicle for recycling
All other wastes	14 tons	Landfill – Sound Disposal	Dispose of in trash dumpster

ANNEX B
(Informative)

MASTER
SECTION 017419 [01524]
CONSTRUCTION WASTE MANAGEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes: Administrative and procedural requirements for construction waste management activities.

1.2 DEFINITIONS

A. Construction, Demolition, and Land clearing (CDL) Waste: Includes all non-hazardous solid wastes resulting from construction, remodelling, alterations, repair, demolition and land clearing. Includes material that is recycled, reused, salvaged or disposed as garbage.

B. Salvage: Recovery of materials for on-site reuse or donation to a third party.

C. Reuse: Making use of a material without altering its form. Materials can be reused on-site or reused on other projects off-site. Examples include, but are not limited to the following: Grinding of concrete for use as sub-base material. Chipping of land clearing debris for use as mulch.

D. Recycling: The process of sorting, cleaning, treating, and reconstituting materials for the purpose of using the material in the manufacture of a new product.

E. Source-Separated CDL Recycling: The process of separating recyclable materials in separate containers as they are generated on the job-site. The separated materials are hauled directly to a recycling facility or transfer station.

F. Co-mingled CDL Recycling: The process of collecting mixed recyclable materials in one container on-site. The container is taken to a material recovery facility where materials are separated for recycling.

G. Approved Recycling Facility: Any of the following:

a. A facility that can legally accept CDL waste materials for the purpose of processing the materials into an altered form for the manufacture of a new product.

b. Material Recovery Facility: A general term used to describe a waste-sorting facility. Mechanical, hand-separation, or a combination of both procedures, are used to recover recyclable materials. Take co-mingled containers to **<insert name of approved Material Recovery Facility(s) from the King County Solid Waste Division Report of Co-mingled Recycling Facilities at www.metrokc.gov/dnrp/swd/construction-recycling/comingled.asp#rates>**

1.3 SUBMITTALS

A. Waste Management Plan: Submit [**3**] <**Insert number**> copies of plan within [**7**] **[14]** [**30**] <**Insert number**> days of date established for [**commencement of the Work**] [**the Notice to Proceed**] [**the Notice of Award**].

B. Waste Management Report: Concurrent with each Application for Payment, submit [**3**] <**Insert number**> copies of report. [**Include separate reports for demolition and construction waste.**]

1.4 PERFORMANCE REQUIREMENTS

A. General: Divert a minimum of **[50 %] [75 %] <insert number>** CDL waste, by weight, from the landfill by one, or a combination of the following activities:

1. Salvage
2. Reuse
3. Source-Separated CDL Recycling
4. Co-mingled CDL Recycling

B. CDL waste materials that can be salvaged, reused or recycled include, but are not limited to, the following:

1. Acoustical ceiling tiles
2. Asphalt
3. Asphalt shingles
4. Cardboard packaging
5. Carpet and carpet pad
6. Concrete
7. Drywall
8. Fluorescent lights and ballasts
9. Land-clearing debris (vegetation, stumpage, dirt)
10. Metals
11. Paint (through hazardous waste outlets)
12. Wood
13. Plastic film (sheeting, shrink wrap, packaging)
14. Window glass
15. Wood
16. Field office waste, including office paper, aluminum cans, glass, plastic, and office cardboard.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Conduct construction waste management activities in accordance with State of Washington RCW 39.04.13, Seattle Municipal Code Chapter 21.36 and all other applicable laws and ordinances.

B. Preconstruction Conference: Schedule and conduct meeting at Project site prior to construction activities.

1. Attendees: Inform the following individuals, whose presence is required, of date and time of meeting.
    a. Owner.
    b. Architect.
    c. Contractor's superintendent.
    d. Major subcontractors.
    e. **<Insert the appropriate municipality representative. For projects in King County, outside the city of Seattle insert [**King County Construction Recycling and Green Building program representative (206) 296-4466**]. For projects within the City of Seattle insert [**Resource Venture representative (206) 389-7304**].>**
    f. Other concerned parties.

2. Agenda Items: Review methods and procedures related to waste management including, but not limited to, the following:
    a. Review and discuss waste management plan including responsibilities of Waste Management Coordinator.
    b. Review requirements for documenting quantities of each type of waste and its disposition.
    c. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
    d. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
    e. Review waste management requirements for each trade.
    f. Review and distribution of the following publications and programs (request copies by calling the King County Solid Waste Division at (206)296-4466):
        1) Construction Recycling Directory for Seattle/King County.
        2) Contractors Guide: Save money and resources through job-site recycling and waste prevention
        3) Construction Works program for Seattle/King County.
        4) King County Solid Waste Division Report of Co-mingled Recycling Facilities (available at www.metrokc.gov/dnrp/swd/construction-recycling/comingled.asp#rates).
    3. Minutes: Record discussion. Distribute meeting minutes to all participants within 3 days.

1.6 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste types, quantity by weight, methods of disposal, handling and transportation procedures. Include separate sections in plan for demolition and construction waste.

B. Organize the waste management plan in accordance with the sample plan included at end of Part 3, including the following information:

1. Types and estimated quantities, by weight, of CDL waste expected to be generated during demolition and construction.
2. Proposed methods for CDL waste salvage, reuse, recycling and disposal during demolition including, but not limited to, one or more of the following:
    a. Contracting with a deconstruction specialist to salvage materials generated,
    b. Selective salvage as part of demolition contractor's work,
    c. Reuse of materials on-site or sale or donation to a third party.
3. Proposed methods for salvage, reuse, recycling and disposal during construction including, but not limited to, one or more of the following:
    a. Requiring subcontractors to take their CDL waste to a recycling facility,
    b. Contracting with a recycling hauler to haul recyclable CDL waste to an approved recycling or material recovery facility,
    c. Processing and reusing materials on-site
    d. Self-hauling to a recycling or material recovery facility.
4. Name of recycling or material recovery facility receiving the CDL wastes.
5. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labelling, and designated location on Project site where materials separation will be located.

1.7 WASTE MANAGEMENT REPORT

A. Waste Management Report: Submit a cumulative waste management report on the form included at end of Part 3 with each Application for Payment with the following attachments:

1. A record of the type and quantity, by weight, of each material salvaged, reused, recycled or disposed.
2. Total quantity of waste recycled as a percentage of total waste.
3. Disposal Receipts: Copy of receipts issued by a disposal facility for CDL waste that is disposed in a landfill.
4. Recycling Receipts: Copy of receipts issued by an approved recycling facility.
   a. For co-mingled materials, include weight tickets from the recycling hauler or material recovery facility and verification of the recycling rate for co-mingled loads at the facility.
5. Salvaged Materials Documentation: Types and quantities, by weight, for materials salvaged for reuse on site, sold or donated to a third party.

PART 2 - PRODUCTS (Not used)

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT, GENERAL

A. Provide containers for CDL waste that is to be recycled clearly labelled as such with a list of acceptable and unacceptable materials. The list of acceptable materials must be the same as the materials recycled at the receiving material recovery facility or recycling processor.
B. The collection containers for recyclable CDL waste must contain no more than 10 % non-recyclable materials, by volume.
C. Provide containers for CDL waste that is disposed in a landfill clearly labelled as such.
D. Use detailed material estimates to reduce risk of unplanned and potentially wasteful cuts.
E. To the greatest extent possible, include in material purchasing agreements a waste reduction provision requesting that materials and equipment be delivered in packaging made of recyclable material, that they reduce the amount of packaging, that packaging be taken back for reuse or recycling, and to take back all unused product. Insure that subcontractors require the same provisions in their purchase agreements.
F. Conduct regular visual inspections of dumpsters and recycling bins to remove contaminants.

3.2 SOURCE SEPARATION

A. General: Separate recyclable materials from CDL waste to the maximum extent possible. Separate recyclable materials by type.
1. Provide containers, clearly labelled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from weather.

3.3 CO-MINGLED RECYCLING

A. General: Do not put CDL waste that will be disposed in a landfill into a co-mingled CDL waste recycling container.

3.4 REMOVAL OF CONSTRUCTION WASTE MATERIALS

A. Remove CDL waste materials from project site on a regular basis. Do not allow CDL waste to accumulate on-site.

B. Transport CDL waste materials off Owner's property and legally dispose of them.

C. Burning of CDL waste is not permitted.

END OF SECTION

WASTE MANAGEMENT PROGRESS REPORT				
	DISPOSED IN MUNICIPAL SOLID WASTE LANDFILL	**DIVERTED FROM LANDFILL BY RECYCLING, SALVAGE OR REUSE**		
MATERIAL CATEGORY		Recycled	Salvaged	Reused
1. Asphalt (cu yds)				
2. Concrete (cu yds)				
3. Porcelain Plumbing Fixtures (lbs)				
4. Ferrous Metals (lbs)				
5. Non-Ferrous Metals (lbs)				
6. Wood (lbs)				
7. Glass (lbs)				
8. Clay Brick (lbs)				
9. Bond Paper (lbs)				
10. Newsprint (lbs)				
11. Cardboard (lbs)				
12. Plastic (lbs)				
13. Gypsum (lbs)				
14. Paint (gal)				
15. Insulation (lbs)				
16. Other (insert description)				
17. Other (insert description)				
Total (In Weight)		(TOTAL OF ALL THE ABOVE VALUES - IN WEIGHT)		
	Percentage of Waste Diverted	(TOTAL WASTE DIVIDED BY TOTAL DIVERTED)		

SAMPLE WASTE MANAGEMENT PLAN

Company:
Project:

Designated Recycling Coordinator:

Waste Management Goals:

- ❑ This project will recycle or salvage for reuse xx % [e.g. 75 %] by weight of the waste generated on-site.

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- ❑ Waste prevention and recycling activities will be discussed at the beginning of each safety meeting.
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- ❑ The subcontractor will be expected to make sure all their crews comply with the Waste Management Plan.
- ❑ All recycling containers will be clearly labelled.
- ❑ Lists of acceptable/unacceptable materials will be posted throughout the site.

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The following charts identify waste materials expected on this project, their disposal method, and handling procedures.

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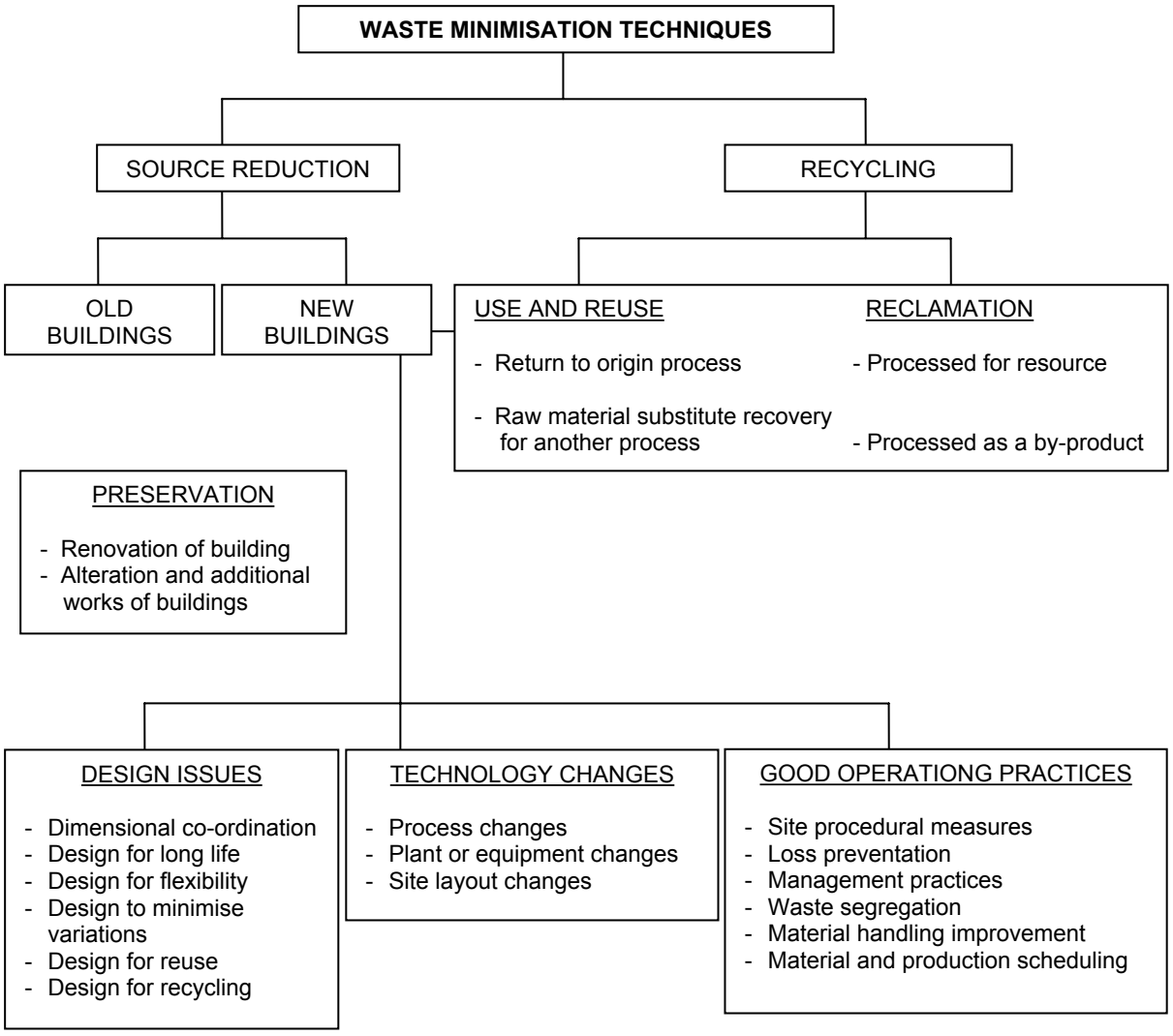
Decorative Wood Beams	300 bd. ft.	Salvaged - Timber Frame Salvaging	Remove by hand, store on-site, load on pallets for pickup
Remaining Materials	8 tons	Landfill - Sound Disposal	Dispose in "trash" dumpster

Construction Phase

Material	Quantity	Disposal Method	Handling Procedure
Concrete	2 tons	Recycle - Puget Sound Concrete	Break up any wastes or mistakes and put in concrete bin. Rebar OK
Forming Boards		Reuse as many times as possible then recycle - Wood Recycling NW	Stack next to supply of new form boards for reuse. Recycle clean unusable forms in wood recycling bin
Clean Wood Scrap	12 tons	Scraps reused for formwork, fire breaks, etc. Remaining recycled - Wood Recycling NW	Stack reusable pieces next to saw for reuse. Place unusable clean wood in wood recycling dumpster
Scrap Metal	5 tons	Recycle - Seattle Metals	Deposit all metals in metal dumpster
Drywall	10 tons	Subcontractor will recycle and submit reports to recycling coordinator	Either provide container or collect in vehicle for recycling

WASTE MINIMISATION TECHNIQUES IN CONSTRUCTION
(Modified from Ciambrone, 1996)



Source: C.S. Poon, “A Guide for managing and minimizing building and demolition waste”, The Hong Kong Polytechnic University

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Encik Abdul Aziz Long	SIRIM QAS International Sdn Bhd
Encik David Yap/ Dr Ahyar Idris	Association of Environmental Consultants and Companies of Malaysia
Encik Patrick Tan Hock Chuan/ Encik Charanpal Singh	Jabatan Alam Sekitar
Ir Ahmad Fuad Embi/ Cik Anita Ainon	Jabatan Pengairan dan Saliran
Puan Geetha P Kumaran	Persatuan Pengurusan dan Penyelidikan Alam Sekitar Malaysia
Puan Tan Choo Lan	Jabatan Kerajaan Tempatan
Ir Abu Harith Shamsuddin	Jabatan Kerja Raya
Ir Prof Dr Ruslan Hassan	The Institution of Engineers Malaysia
Ir Tan Gee Hoi/ Encik Lim Len Wei	Persatuan Pemborong Binaan Malaysia
Encik Tiah Oon Ling	Persatuan Pemaju Hartanah dan Perumahan Malaysia
Puan Winnie Ng Guat Poh	Association of Consulting Engineers Malaysia
Puan Norliza Hashim	Malaysia Institute of Planners
Puan Chui Yuet Yue	Putrajaya Holdings Sdn Bhd
Ir Dr Zuhairi Abd Hamid	Construction Research Institute of Malaysia

WORKING GROUP ON GUIDELINE ON CONSTRUCTION WASTE MANAGEMENT (WG 6)

Puan Chui Yuet Yue (Chairman)	Putrajaya Holdings Sdn Bhd
Cik Siti Khadijah Bt Satari (Secretary)	Institut Alam Sekitar dan Pembangunan (LESTARI) Universiti Kebangsaan Malaysia
Encik Hari Sundar R Hari Dass (Secretary)	Construction Industry Development Board
Puan Nor Hamiza Zahar	Construction Industry Development Board
Ar Voon Wan Lin	Pertubuhan Arkitek Malaysia

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Puan Sharifah Yaacob	Alam Flora Sdn Bhd
Cik Raihani Che Mamat/ Encik Muhamad Zaini Bin Hasnan	Jabatan Kerajaan Tempatan
Puan Azrida Abdul Manab	Lembaga Urus Air Selangor
Encik Patrick Tan Hock Chuan	Jabatan Alam Sekitar
Encik Alias Mohd Zain	Jabatan Perumahan Negara
Encik Tiah Oon Ling	Persatuan Pemaju Hartanah dan Perumahan Malaysia
Encik Lim Len Wei	Persatuan Pemborong Binaan Malaysia

Appendix 8.3.4

Guidelines on Temporary Permit Application for Building for Workers' Quarters Within Construction Sites (Ministry of Local Government and Housing Sarawak).

GUIDELINES ON TEMPORARY PERMIT APPLICATION FOR BUILDING FOR WORKERS' QUARTERS WITHIN CONSTRUCTION SITES

KEMENTERIAN KERAJAAN TEMPATAN DAN PERUMAHAN SARAWAK

CONTENT

1. PURPOSE
2. BACKGROUND
3. OBJECTIVES
4. DEFINITIONS
    i. Worker's House / Worker's Quarters
    ii. Temporary Building
    iii. Temporary Permit
    iv. Qualified Person / Submitting Person
5. LEGAL PROVISIONS
6. METHODS AND PROCEDURE
7. KEY INISIATIVES
8. DOCUMENT CHECKLISTS FOR BUILDING'S TEMPORARY PERMIT APPLICATION
9. APPLICATION FLOW CHART
10. BOMBA REQUIREMENTS CHECKLISTS FOR BUILDING'S TEMPORARY PERMIT
11. ENFORCEMENT DATE
12. APPLICATION FORM AND TEMPORARY PERMIT CONDITIONS

1. PURPOSE

The guideline aims to provide specific guidance on the process of application for the temporary permit on the construction of temporary workers' quarters within the construction site. The SOP shall be applied and coordinated in the process of application for building plan approval in the Local Authority (PBT) area.

2. BACKGROUND

Following the outbreak of the COVID-19 pandemic in the country since March 2020, several cluster cases of construction sites have been detected and indicated that construction site workers especially foreigners are those at risk of being infected with COVID-19. The risk of contagion is increasingly serious due to mass accommodation methods or crowded in one residential unit besides low levels of premises hygiene. Enforcement of the provision of housing facilities, accommodation and workers' health facilities by employers of all sectors including the construction sector is expected to prevent the outbreak of diseases either COVID-19 or vector-bored diseases in accordance with Recommendation 115 (Employee Housing Recommendation 1961) International Labour Organisation (ILO).

3. OBJECTIVES

There are three main objectives as outlined to ensure that the objectives of the guidelines preparation will be achieved as follows;

i. Ensuring that the application procedures and requirements provided are in accordance with and conforming to the requirements of the

regulations and legislations that are currently in force to be implemented and complied with by all relevant parties;

ii. Coordinate existing rules and provisions to explore proposed improvements through the implementation of new incentives to facilitate the construction industry by improving the government service delivery system especially at PBT;

iii. Increase the level of compliance and accountability of stakeholders especially the construction industry players on the health and safety aspects of the construction sites.

4. DEFINITIONS

i. Worker's House / Worker's Quarters

Defined as other residences i.e. accommodation for residential purposes other than any premises contained in Group I and II in Schedule E, Building By-Laws, 1994.

ii. Temporary Building

Includes any building constructed wholly or in part of materials which are, in the absence of special care, liable to rapid deterioration, or are otherwise unsuitable for use in the construction of permanent buildings, and may include any house or building the erection of which is permitted under license issued by the local authority for a limited period to be specified upon the expiration of which the building shall be demolished – SBO, 1994;

iii. Temporary Permit

A temporary permit for a limited period where required may be issued by the local authority – By-Law 15(1), Building By-Laws, 1994.

iv. Qualified Person / Submitting Person

Means any registered architect, registered building draughtsman, registered engineer or any person holding such qualifications as may be approved by the local authority and who submits plans to the relevant authority for approval – SBO, 1994;

5. LEGAL PROVISIONS

In accordance with the requirements of Section 8 of the Building Ordinance, 1994, a building proposed to be erected must first obtain the building plan approval from PBT. Such requirements must be complied with including on the construction of workers' houses or buildings for workers' quarters either on construction sites or on off-site construction whilst Section 2 of the Building Ordinance, interprets temporary building as to '*includes any building constructed wholly or in part of materials which are, in the absence of special care, liable to rapid deterioration, or are otherwise unsuitable for use in the construction of permanent buildings, and* ***may include any house or building the erection of which is permitted under licence issued by the local authority for a limited period to be specified upon the expiration of which the building shall be demolished'***. Sketch plans for minor erection or temporary building may be submitted in lieu of approved plans.

Therefore, PBTs may grant approval in the form of a Temporary Permit to erect a building to replace the building plan approval for the erection of worker's house or workers' quarters within the construction site. The provisions and powers of the PBTs are in accordance with By-Law 15(1)(b) of the Building By-Laws, 1994 as follows;

> ***Temporary permits***
>
> *15.—(1) Subject to the payment of the fees prescribed in Schedule A and a deposit as the local authority may require, a temporary permit for a limited period where required may be issued by the local authority for the following purposes—*
>
> *(b) the erection of a builders' working shed or a store or other shed to be used in connection with the building works;*

6. REQUIREMENTS AND PROCEDURES

Based on the above provisions, the components of workers' houses including workers' quarters for use in construction sites are categorised as temporary construction and will only be inhabited with a limited period (during the construction period). The components and any structure associated thereon shall be demolished after construction work is completed. Following are the requirements and procedures required;

i. The developer must ensure 2 main conditions are fulfilled before submitting the application of the Temporary Permit to PBT as follows;
    a. The proposed development on the construction site must have obtained the planning approval from the State Planning Authority; and

b. Building Plan on the proposed development on the construction site has been submitted or a Temporary Permit application for the construction of workers' quarters submitted simultaneously with the application of the Building Plan for approval.

ii. Temporary Permit approval for temporary buildings must be obtained from local authorities prior to construction of workers' quarters components erected on construction sites. In accordance with Schedule A of the Building By-Laws, the building's Temporary Permit approval period is for 6 months per shed or part thereof and must be renewed before the expiry date*.

iii. As an additional initiative, other components of construction sites such as item 15(1)(d), (e) and (f) of Building By-Laws, 1994 which are for the erection of staging, framework, platform or superstructure of any kind on a roof abutting a street, erection of the scaffolding and hoarding are also not required to obtain planning approval but shall obtain the approval of the Temporary Permit from the PBT.

iv. When giving consideration for the approval of the Temporary Permit of the temporary building, the PBT reserves the right to prescribe the conditions to be complied with by the applicant. Among the aspects to be given priority by PBT are as follows;

a. management of sewage and sewerage systems;

b. management of garbage and waste management of the construction industry;

c. management and control of dengue and COVID-19 (latest) infectious diseases;

d. prevention of elements of public nuisance such as road congestion and social activities of construction workers;

e. cleanliness, egress and ingress for the construction site, canteen, depositing of building materials at road side and project signboard.

v. Applicants are required to comply with all aspects of fire prevention outlined in the checklist provided by the Fire and Rescue Department of Malaysia (JBPM) Sarawak before submitting the application to PBT.

vi. All Temporary Permit applications must be submitted by the Qualified Person to PBT.

vii. This guidelines applies only to the proposed construction of workers' quarters to be built on construction sites only as per Article 6(i) above.

7. KEY INITIATIVES

Six (6) major initiatives have been outlined to facilitate and expedite the approval process of the temporary building's Temporary Permit as follows;

i. Preparation of uniform document checklist (Table 1) and application flow chart synchronization (Figure 1);

ii. Special permission to commence building operations simultaneously with the application of the Temporary Permit;

iii. Preparation of compliance checklist for fire requirements (Table 2) prior to submission of application to PBT;

iv. Exemption of Temporary Permit plan submission reference to Fire and Rescue Department of Malaysia (JPBM) Sarawak for comments.

v. Determination of KPI approval period of 14 working days;

vi. Delegation of power to approve the application to Section Head of PBT Building Department / Section Head of PBT Public Health Department;

The implementation of incentives (ii) above is subject to the authority of PBTs to grant a special permission to commence building operation in accordance with By-Law 9 of Building By-Laws 1994. However, the applicant must first submit the Temporary Permit application to the Local Authority and shall indicate in writing the proposal and application for such special permission from the PBT.

8. DOCUMENTS CHECKLIST OF BUILDING TEMPORARY PERMIT APPLICATION

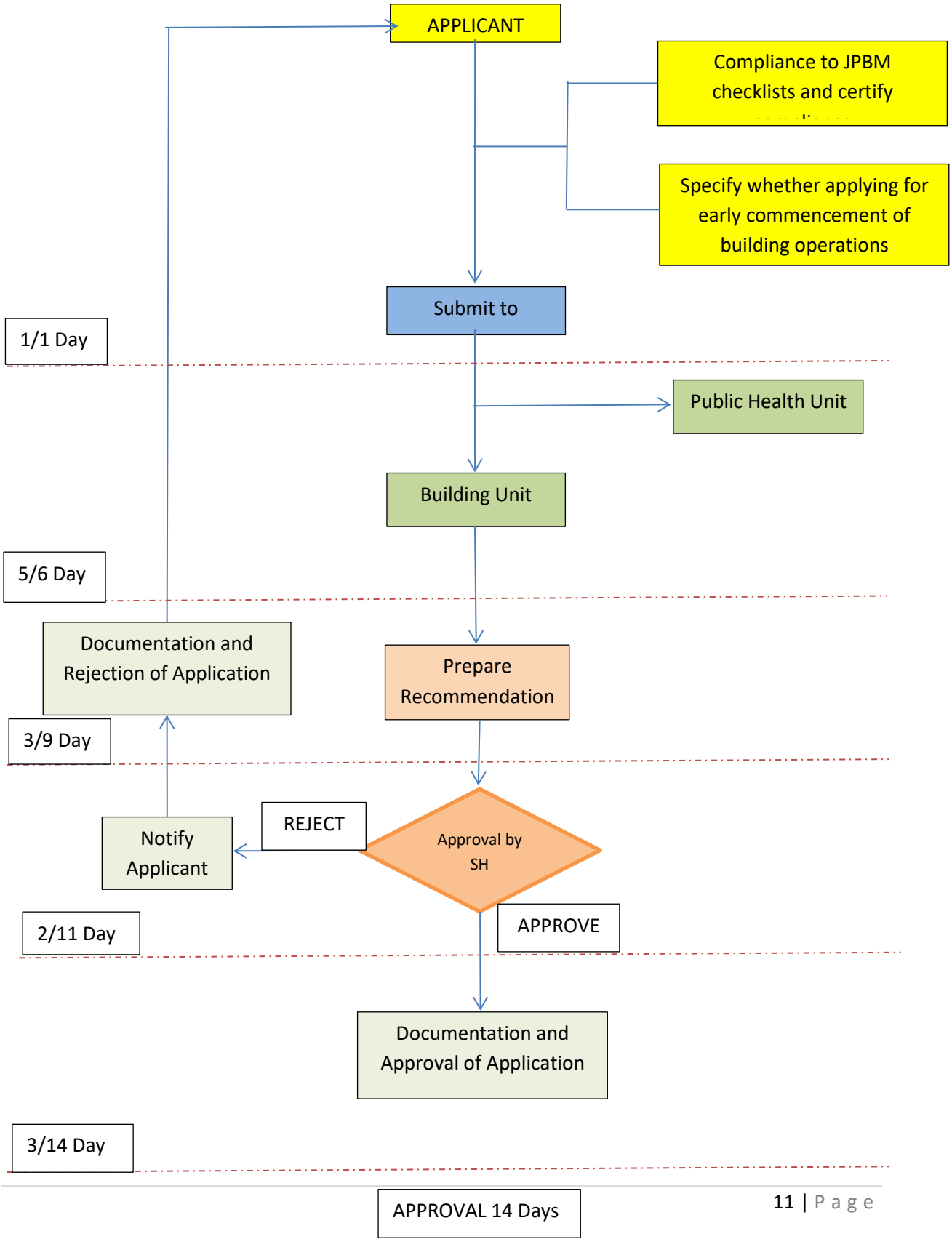
Table 1 Documents Checklist of Temporary Permit Application for Workers' Quarters

NO	DOCUMENTS	REMARKS
1	Application Letter and Temporary Permit Form 1 and 'A'	
2	Key Plan / Locality Plan / Temporary Permit Plan	
3	Copy of Valid Planning Approval	
4	Copy of Valid Building Plan Approval or Proof of Building Plans Submission	
5	Temporary Permit Processing Fees	
6	Temporary Permit Fees	
7	Current Assessment Rate Receipt (if applicable)	
8	Deposit Payment / Trust Fund	
9	Plan, Site Photo, Drawings and Details	
10	Copy of Contractor All Risk (CAR) Insurance *	

* Permit to be granted based on the duration of CAR

9. APPLICATION FLOWCHART

Figure 1: Flowchart for Workers' Quarters Temporary Permit Application.



10. CHECKLIST OF FIRE REQUIREMENTS FOR TEMPORARY PERMITS FOR TEMPORARY BUILDINGS

Table 2: Fire Requirements Checklists.

BOMBA REQUIREMENTS	SINGLE STOREY WORKERS' QUARTERS	DOUBLE STOREY WORKERS' QUARTERS
A SITE PLAN		
1. Provide double head BOMBA pillar with outlet capacity of 1135 litre per minute per pillar at a distance of 90 metre.	✓	✓
2. Provide access road with the minimum width of 6 metre and slope of not more than 1:12	✓	✓
B OTHER REQUIREMENTS		
1. Provide break glass fire alarm	✓	✓
2. Provide adequate fire extinguishers	✓	✓
3. Provide self contained type smoke detector	✓	✓
4. Provide adequate and appropriate exit access	✓	✓
5. Provide 'KELUAR' sign with dual power supply		✓
6. Provide emergency lights that are powered by dual power supply		✓
7. Submitting Person / Applicant to be responsible for the design, exit and safety of the occupants		✓

11. ENFORCEMENT DATE

This guideline takes effect immediately.

12. SAVINGS

All requirements under Federal Emergency Act 446 on Employees' Minimum Standard of Housing, Accommodation and Amenities shall be taken into consideration during the effective date of the Emergency.

APPLICATION FORM FOR ERECTION OF WORKERS' QUARTERS TEMPORARY STRUCTURES/MINOR ERECTION (BY LAW 14 & 15)

Building Plan Reference No. .....

Approved Building Plan Reference No.....
(For purpose of permit extension)

Applicant name: .....

I.C. No.: .....

Property owner name: .....

I.C. No.: .....

Correspondence Address: .....

Telephone No.: .....

A. Type of application:

☐ New Workers' Quarters structures

☐ Existing structures (Please specify type of structures):

.....

☐ Renewal (Please state previous approval no.)

.....

☐ Other: Please specify:

.....

B. Locality:

☐ Commercial Construction Site

☐ Residential Construction Site

☐ Other:

.....

☐ Address: Please state Location of temporary structure

.....

☐ Sketch plan: To show location of site, plan, elevation and section.

C. Declaration and consent from property owner and / or applicant

I/We am/are the owner(s) and developer of the above property and hereby give my/our consent to the developer for the said application. Subsequently, I/We shall be jointly responsible and liable and shall indemnify the Council or her personnel against any claim, suit, actions or demands made against the Council by any member of the public for any damage or injury caused by the said structure, in consequence of or attributable to any act, omission, neglect or default by us, our employees, workers, staffs or agents.

I/We hereby undertake to remove the structures at my/our own cost and expenses within 1 week upon receipt of a notice or such period as may be specified in the notice, the state government or any other government agency requiring me/us to do the same and that by doing so I/We shall forfeit all rights to claim for any loss, damage or injury I/We may suffer as a result thereof.

I/We understand and shall abide to the conditions as stated overleaf.

Applicant's signature: .....

Applicant name: .....

I.C. No: .....

Date: .....

Property Owner's signature: .....

Property owner name: .....

I.C. No: .....

Date: .....

Submitting Person Signature:
Name, Registration & Date:

Checklist:

- ☐ Application form
- ☐ 2 sets of sketch plan
- ☐ Processing Fee @ RM 50.00 per application
- ☐ Refundable deposit - (Deposit rate of RM1,000.00 / shed or RM1.00/ft^2 whichever is higher)
- ☐ Extract of title/ development agreement / tenancy agreement and to be certified true copy

Conditions & Responsibility of Person Granted Temporary Permit:

The person to whom a temporary permit is issued shall be responsible for the following:

(a) taking such measures as are necessary to keep the roadside drain clear of obstruction to the satisfaction of the local authority;

(b) adjustments of existing cables, pipes and other service or utility or equipment and for their reinstatement on completion of the works in accordance with the requirements of the relevant authorities;

(c) painting the ends of the hoarding white and for having the ends of hoardings and railings suitably marked by red warning lights throughout the night;

(d) any accident and damage to property or persons, directly attributable to the hoardings or railings;

(e) ensuring that hydrant points and any other existing utility service installations are not obstructed by such hoardings of materials;

(f) providing suitable openings with handrails at the end of the hoarding to permit easy means of access and egress over the roadside drain, to and from the adjoining verandah-ways;

(g) the maintenance of the hoarding to the satisfaction of the local authority;

(h) exercising due care not to damage any existing service mains by overloading the ground or by any temporary construction;

(i) removing the hoarding together with all materials and debris on completion of the works; and

(j) to reinstate any damage to roads, drains, footways and verandah-ways and leaving the site and drains in a clean and tidy condition.

(k) to sign a Letter of Indemnity to indemnify the council against any claim, suit, actions or demand made against the council, by any member of the public for any damage or injury caused to him or his property, in consequence of or attributable to any act, omission, neglect or default by the Permit Holder, his employees, workers, staff or agents

(l) To sign Letter of Undertaking to remove the structures at his own cost and expenses within 1 week upon receipt of a notice or such period as may be specified in the notice, the state government or any other government agency requiring the Permit Holder to do the same and that by doing so the permit holder shall forfeit all rights to claim for any loss, damage or injury he may suffer as a result thereof.

(m) To maintain the structure in clean and safe condition at all time

(n) To pay a refundable deposit at a minimum sum of RM1,000.00 per shed.

(o) The permit holder is responsible to renew the permit and pay permit fees before the expiry date.

(p) The permit holder shall comply to any other conditions as may be imposed by the Council from time to time.

(q) Where the person to whom a temporary permit is issued fails to comply with any of the above stated conditions, the local authority may, without prejudice to any other remedy, undertake the work or perform any act so required and

may recover from the person the expenses and costs incurred in such work. If default is made by the person in the payment, the sum so due may be withdrawn by the local authority from the deposit.

(r) When the person to whom the temporary permit is issued has no actual physical control over the building and maintenance of the temporary works, responsibility shall rest with the building owner or land owner.

(s) Failure to comply with any conditions imposed will render the permit to be revoked.

(t) To provide proper sanitary toilet and bath facilities within the construction site.

(u) To pay for the cost of removal of solid waste generated by the workers or construction site.

(v) To provide proper location for the refuse bins and shall be accessible by the scavenging trucks.

Cancellation of temporary permit

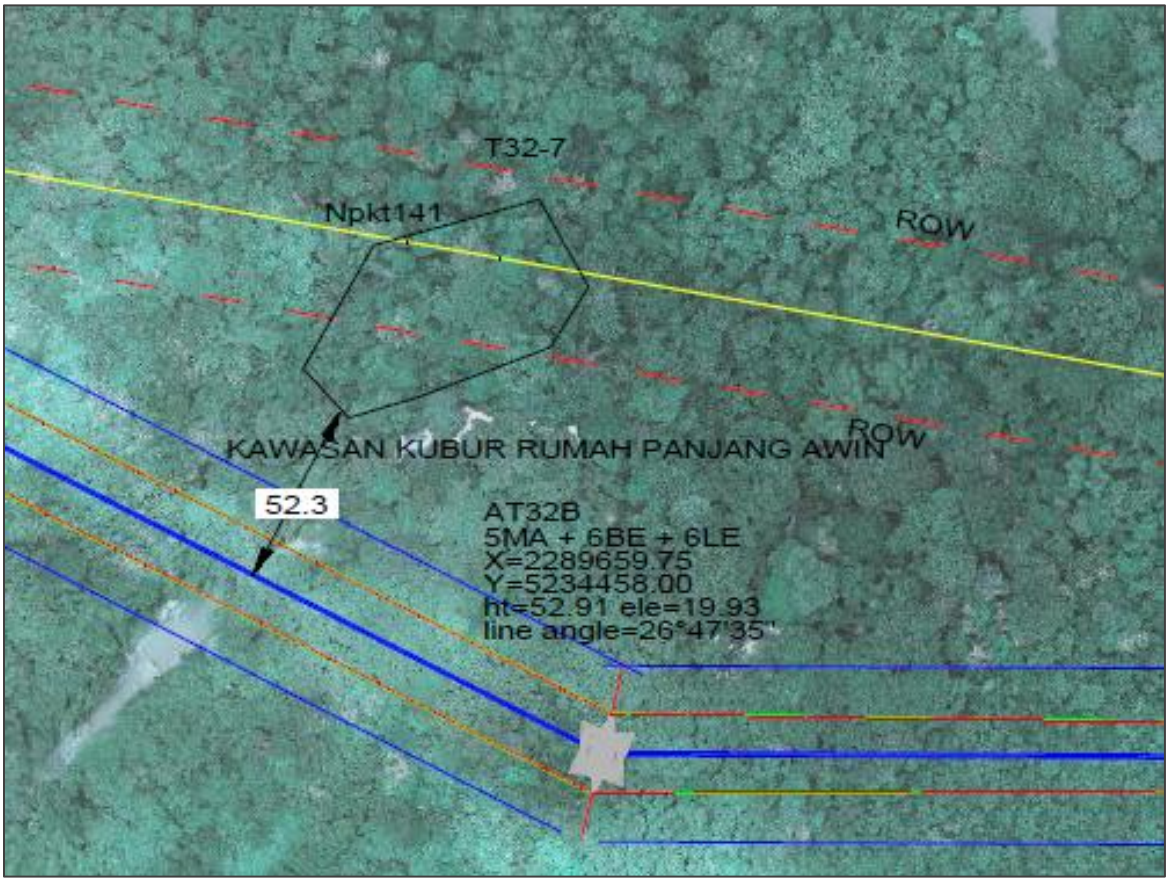
The local authority shall have the right to cancel the temporary permit for breach of any of the foregoing conditions or for any reason it thinks fit and the applicant shall within one week of receipt of such notice have the temporary building and all other materials connected therewith under application be removed and demolished.

Appendix 8.6.1

Guidelines for Grave Relocation

GUIDELINES FOR GRAVE RELOCATION

ESIA for BMTLP



Dr. Elena Gregoria Chai Chin Fern

TABLE OF CONTENTS

INTRODUCTION **1**

RITUALS **2**

Miring Ngintu Diri or *Nyukul* (Soul Keeping Ritual) 2
Miring Melasi Menua (Land Blessing Ritual) at Old Grave Site 2
Miring Melasi Menua (Land Blessing Ritual) at New Grave Site 3
Upacara Belian Ngempung Semangat (Soul Keeping Ritual) 3
Upacara Nyukul for Longhouses Nearby Old and New Grave 3

INTRODUCTION

For Iban communities, relocation of old graves or reburial is not an encouraged practice as it will disturb the spiritual world. The harmonious balance between the human and spiritual world will be affected. However, if due to dreams, mysterious happenings experienced by the next of kins or the longhouse community or due to unavoidable development plan such as the BMTLP, relocation of graves is negotiable.

The process would entail the next of kins of the affected graves to be invited to a discussion. The community and Tuai should also be invited to discuss about the exhumation, relocation etc. The longhouse community represent an entity that is inseparable from the past, ancestors, gods, spiritual beings that guide over the surrounding and the wellbeing of the community. The advice from *Majlis Adat Istiadat Sarawak* (MAIS) could be sought and the District office and Resident office can be invited to be witness or facilitator for the negotiation process.

When the grave of an ancestor or close relative is affected, it doesn't only affect the next of kins. It affects the entire longhouse community. The community believe once the harmony between human and spiritual world is disturbed, the longhouse will become 'hot' (*angat*). When this happens, misfortunes, untoward happenings will occur. People in the longhouse might suffer illnesses, accidents, or the farms or fields will not yield good harvest, etc.

Thus, discussion on how, who, when, where to exhume the graves must be planned properly. The Project Proponent should remain open for suggestion from the next of kins, longhouse community and the *Tuai*.

Under the Adat Iban 1993 Section 191,

a) For the excavation or exhumation, the offender shall be fined three *pikul*. In addition, the offender shall provide a *tunggu* of 250 *mungkul*, per human remains and shall pay for the costs of making good the graveyard or any damage done and also *Pelasi Menua* consisting of a pig, *kering semengat* and *kurung semengat*.

b) If the exhumation is ordered by the Court for any reason, the relevant Department shall provide *Pelasi Menua* consisting of a pig, *kering semengat* and *kurung semengat* and shall pay for the costs of making good the graveyard and also compensate for any damage done.

c) If the excavation or exhumation is done in order to take the deceased's belonging, the offender shall be dealt with as under section 191(a) thereof."

RITUALS

In general, four rituals involving ritual fines, ritual offerings of appeasement, forgiveness and blessing would be initiated in matters related to exhumation and grave relocation. The rituals are:

Miring Ngintu Diri or *Nyukul* (Soul Keeping Ritual)

The ritual is conducted at the longhouse of the next of kins. It is usually hosted by the next of kins. The ritual is to seek pardon from the deceased. Through this ritual, the souls of the next of kins are hope to stay intact and not to be disturbed. It is also hope that the longhouse community can go on their daily livelihood as usual and not experiencing any unfortunate events.

> According to the guideline of MAIS this ritual would entail the cost of about RM2500. However, this is only a general guideline. The final decision on the types of offerings, ritual fines, etc is subject to the collective decision of the longhouse community.

Miring Melasi Menua (Land Blessing Ritual) at Old Grave Site

This ritual is to be held before the exhumation activity starts. It takes place at the old grave site. The forgiveness of the deceased are sought through the ritual offering. It is hoped that the deceased will not be angered by the exhumation and no untoward happenings will occur to those who are present, to the next of kins, the longhouse community and nearby longhouse community. Usually, the service of a ritual specialist (*lemambang*) will be acquired for this ritual.

> According to the guideline of MAIS, this ritual would entail the presence of seven (7) persons. Each are with special ritual roles. However, MAIS guideline only serves as a reference. The suggested ritual fine by MAIS is about RM5560. Rajang-Baleh community have their own preference in conducting the ritual. The rites and rituals are also depending on the ritual specialists involved.

Miring Melasi Menua (Land Blessing Ritual) at New Grave Site

This ritual is conducted when transferring the remains of the deceased to the new grave site. The ritual is conducted to seek forgiveness and permission from the 'residents' at the new grave site. It is to ensure that the transfer of the remains of the deceased (bones, belongings) will be done smoothly without any interruption. If the grave site is a totally new site without any existing grave, another type of ritual must be performed, the *Miring Mungkal Pendam*.

> According to the guideline of MAIS this ritual would entail the cost of about RM4000. However, this is only a general guideline. The final decision on the types of offerings, ritual fines, etc is subject to the collective decision of the longhouse community.

Upacara Belian Ngempung Semangat (Soul Keeping Ritual)

After the successful relocation of the grave, a cleansing ritual is held to ward off pollutions that might have been acquired through contact with the world of the deceased. The ritual is also to serve the purpose of keeping the souls of all involved to be strong and intact. Through this ritual, blessing from the gods, heroes, etc are sought to ensure the happiness and prosperity of the community remain unchanged like before. The service of a *manang* (ritual specialist) is usually acquired for this ritual.

> According to the guideline of MAIS this ritual would entail the cost of about RM2500. However, this is only a general guideline. The final decision on the types of offerings, ritual fines, etc is subject to the collective decision of the longhouse community. Some community prefer to organise a *Gawai* instead.

Upacara Nyukul for Longhouses Nearby Old and New Grave

The Project Proponent must also inform the longhouse(s) nearby the old graves and new grave site on the plan of exhumation and relocation. It is believed that the spiritual world must be appeased so that no untoward happenings befall the community(ies) nearby. Therefore, if there are several longhouses nearby, the longhouses must be informed and be provided the ritual fine. The MAIS guideline denotes the ritual fine for such purpose is 300 *mungkul* (RM300) per ritual.

The Project Proponent needs to be cautious in dealing with graves matters. The effect from the disturbance cause to the deceased world will evoke displeasing events for the

living, especially those directly connected to the affected grave. Discussion must be made in thorough. No parties should be left out of discussion. The discussion might be lengthy as the identification of the next of kins might take longer than usual if it involves old graves. The next of kins also require time to discuss their decision on their ancestor or relative's grave relocation. The longhouse community's opinion must be held too as they will be affected too. The longhouse near the graves (old and new) must be informed and consent must be sought as well. The ritual fines, offerings, paraphernalia, service of ritual specialist are all subject to the decision of the next of kin and longhouse community. The advice of MAIS can be sought as reference. The decision of the directly affected community must be respected.

The cost of new graves must also be borne by the Project Proponent, according to the Adat Iban 1993 Section 191(b). If a totally new grave site is proposed, the question of land ownership, land acquisition would need to be considered and solved amicably between all those involved.

Grave relocation is not a simple task and solution. It will entail a long process of discussion, planning and execution. The graves are the homes of the deceased. By proposing a relocation plan, it would disturb the deceased world. It has the potential to offset or create a series of untoward happenings such as illnesses, accidents, drowning, etc., caused by the imbalance of harmony between the human and spiritual world. Caution must be exercised if grave relocation is the only solution for the project.

Appendix 8.7.1

Vector Disease Control Guidelines (Aedes) and
Vector Borne Disease Control Programme

GUIDELINES FOR THE CONTROL OF AEDES MOSQUITOES AT CONSTRUCTION SITES

VEKTOR CONTROL UNIT
VEKTOR BORNE DISEASE SECTION
MINISTRY OF HEALTH
Third Reprint 2002

CONTENT

		Page
1.	Purpose of guideline	1
2.	Background	1
3.	Aedes mosquito breeding sites	1
4.	Prevention and control of Aedes breeding	2
5.	Role of developers/contractors in preventing mosquito breeding	6
6.	Role of Health Ministry/Local Authority	7
7.	References	7
8.	Appendix	9
9.	Editorial Committee	15

GUIDELINES FOR THE CONTROL OF 'AEDES' MOSQUITOES AT CONSTRUCTION SITES

1. Purpose of guideline

To provide information and procedures for the developers and contractors of construction sites to institute appropriate vector control measures for the prevention and propagation of the ***Aedes*** mosquitoes.

2. Background

Construction sites have recently been identified the main source of ***Aedes*** breeding in the country especially in the urban areas. Many dengue outbreaks are related and traced to the breeding of ***Aedes*** mosquitoes at construction sites. A survey of 452 construction sites in 1995 indicated that 71 (15.7%) of them had ***Aedes*** breeding at their premises. In 1996 a total of 2,672 construction sites were inspected out of which 294 (11.0%) were found to have ***Aedes*** breeding.

3. *Aedes* mosquito breeding sites

The two main species of ***Aedes*** mosquitoes involved in the transmission of dengue are ***Aedes aegypti*** and ***Aedes albopictus***. They breed in a variety of containers both indoors and outdoors. They generally breed in clean, clear and unpolluted water. The

life cycle of the ***Aedes*** mosquitoes involves 4 stages namely eggs, larvae, pupae and adult mosquitoes. The first 3 stages occur in the water medium. The complete life cycle from eggs to addults takes 8-13 days. Generally, the immature stages of ***Aedes*** mosquitoes will require about 7 days before adult emergence in a tropical environment.

Contruction sites with their varieties of water holding receptacles and structures are ideal and conducive for ***Aedes*** breeding.

The main ***Aedes*** breeding sites detected in and around the construction sites are:

- basements
- lift wells
- floor
- balconies
- foundation pits
- trenches
- drains/channels
- borrow pits
- cement mixer
- excavator backhoes
- wheel barrow
- wash trough
- mould
- drums
- tanks
- canvas/tampolin cover
- tin cans
- paint cans
- bottles
- styrofoam lunch pack box
- scrap metal
- bricks
- any other water holding receptacles

4. Prevention and control of *Aedes* breeding

4.1 **Mechanical:** To prevent stagnation to water especially during the rainy season. Water is to be pumped out regularly from flooded basements, lift wells, foundation pits and floors.

4.2 **Physical:** In the design of building ensure that structures will not be able to collect water and become breeding sites for mosquitoes. Ensure that there is a good gradient in the roof and at all floor levels for water to drain out. Also ensure proper drainage of water in and around the construction sites.

4.3 Source reduction

Provide adequate rubbish bins and collection points for the workers to dispose empty tins, bottles, plastic bags, styrofoam lunch boxes and other water holding receptacles. Ensure there is regular collection of domestic waste. Cleanliness and sanitation should be maintained at the work sites at all times.

4.4 Chemical control

4.4.1 Larviciding

Use mosquito larvicides such as Abate 1% SG (10 gms Abate 1% SG into 20 gallons water) or Vectobac G (1 gm/100 litre) which can prevent ***Aedes*** breeding up to 3 months for Abate 1% SG and 14 days for Vectobac G and use them in areas such as water tanks/water drums for drinking purposes. Apply Abate 500E larvicide (at a dose of 1ml Abate 500E to 1000ml water or 125-250ml/ha) using a suitable compression sprayer such as Hudson-X-pert into flooded basements and various floor levels of building which are exposed to rain. The application of Abate 500E has to be done every 1-2 months intervals in order to achieve effective control. Alternatively Bacillus thuringiensis Israelensis (Bti) such as VECTOBAC 12AS can be applied as a larvicide at a dose of 1 litre per hectare using a suitable ULV sprayer such as IGEBA ULV sprayer. The application of Bti has to be done every 14 days in order to achieve maximum control. Diesel/engine oil can also be applied with the aid of a motorized blower/sprayer. Malaria Larviciding Oil (MLO) can also be used.

4.4.2 Adulticiding

Adulticiding i.e. to kill the adult ***Aedes*** mosquitoes can be done by fogging using a suitable insecticide formulation and fogging machine. Some examples of insecticides.

1. Resigen
   Dilution rate 1:300 with water or diesel for thermal fogging (3 ml Resigen into 1 litre water or diesel) 1:16 with diesel for ULV fogging (60 ml Resigen into 1 litre diesel).

2. Malathion 96% TG
   Dilution rate 1:25 with diesel (thermal fogging) (40 ml malathion into 1 litre diesel) Technical undiluted 96% for ULV fogging.

3. Sumithion L40S
   Dilution rate 1:20 with diesel (thermal fogging). (50 ml Sumithion into 1 litre diesel). Undiluted Sumithion L40S for ULV fogging.

Some examples of fogging machines

1. Thermal foggers: Agrofog AF 40 (series)
   Swingfog SN 50 (series)
   Pulsfog K10 (series)

2. ULV machines: Leco ULV HD
   Dynafog Maxi Pro 4 ULV
   Igeba U 15M (series)

Adulticiding measures are not residual and need to be repeated on a weekly basis. The insecticides dispensed kill the insects by contact and therefore the operator must ensure that all accessible areas must be fogged.

4.4.3 Adulticiding and Larviciding

The present trend of chemical control of dengue vectors should incorporate both larviciding and adulticiding in the same operation. This can be achieved in the following ways:

(i) For thermal fogging-use of Resigen, Aqua-Resigen, Sumithion L40S or other insecticides

that have shown to exhibit both larvicidal and adulticidal activities.

(ii) For ULV application use of mixture of Bacillus thuringiensis H-14 such as Vectobac 12AS and malathion 96% TG. Others pyrethroids and Bti can be mixed for fogging purposes.

For the construction sites field trials had indicated that a mixture of 9 parts of VECTOBAC 12AS (36 litres) and 1 part of malathion 96% TG (4 litre)(9:1) gave effective control of ***Aedes*** up to 14 days. Dosage is 1-1.5 l/hectare. However if cost is a limiting factor, a dilution of 7 parts of VECTOBAC 12AS (28 litres) and 3 parts of malathion 96% TG (12 litres)(7:3) could be used to give effective control up to 14 days. Dosage is 1-1.5 litre/hectare.

(Note: Please refer to insecticide labels and manufacturers specifications in the application of larvicides and adulticides. Also refer to research studies done by the Institute for Medical Research)

4.5 Enforcement

Under the Destruction of Disease-Bearing Insects Act 1975 there are provisions provided for to direct or take measures to destroy disease bearing insects such as the ***Aedes*** mosquitoes and prohibit the creation of conditions likely to propagate or harbour disease-bearing insects. Section 8 of the Act gives general power to direct or take measures to destroy disease bearing insects (Appendix 1 gives the details of Section 8). Section 13 of the Act is on the prohibition on creating conditions likely to propagate or harbour disease-bearing insects. (Appendix II gives the details of Section 13). Section 23 of the Act deals with the penalty on conviction (Appendix III gives the details of Section 23). Section 25 of the Act is on the compounding of Offences (Appendix IV).

4.5.1 Stop-work order

Under the Prevention and Control of Infectious Disease Act 1988 there are provisions for the closure of construction site until the premises have been throughly disinsected. Section 18 of the Act is on disinfection and closure of premises. (Appendix V gives the details of Section 18).

5. Role of developers/contractors in preventing mosquito breeding

It is the responsibility of the developers/contractors to ensure that all premises at the construction sites are free of ***Aedes*** breeding grounds by carrying out the following activities.

5.1 To form on-site or in-house search and destroy teams for eliminating breeding grounds of ***Aedes*** (source reduction) at construction sites (both construction waste as well as domestic containers) and at the workers quarters (kongsi) on a daily basis.

5.2 Carry out larviciding and fogging operations especially in inaccessible areas and large areas like flooded basement to prevent ***Aedes*** breeding (Please refer Section 4.4) Apply insecticides or anti mosquito oils to all stagnant water and water-bearing receptacles at ground level and in upper floors weekly. Repeat application after the rain as the insecticide or oil will be washed off. Fog the construction site including all the upper floors every week and whenever required to reduce mosquito nuisance problems and to prevent disease outbreak.

5.3 Developers/contractors are encouraged to engage the services of Pest Control Operators (PCO) if they do not have enough manpower to do the work themselves. Ensure that the Pest Control Operators are reliable, competent and experienced in vector control work. In your contract specification, you should have a scope of works which is adequate for effective mosquito control.

5.4 Create awareness and motivate the construction workers on proper environmental sanitation and vector control measures in and around the work sites.

5.5 Use mosquito coils and aerosols to prevent mosquito bites.

5.6 Screen windows and doors or sleep under mosquito nets.

5.7 Consult the health authorities for advice and guidelines for the prevention and control of mosquitoes especially during dengue outbreaks.

6. Role of Health Ministry/Local Authority

The main functions of the Ministry of Health and the Local Authority are for the education and dissemination of information, carry out disease and vector surveillance and carry out enforcement activites at construction sites, including the following:

6.1 Preparation and dissemination of health education materials and guidelines.

6.2 Monitor and check the construction sites of ***Aedes*** breeding (both inside and outside the construction sites).

6.3 Enforce the Destruction of Disease Bearing Insects Act 1975, especially section 8, section 13, section 23 and section 25. (Please refer Appendix I, II, III & IV).

6.4 Institute appropriate outbreak control measures.

6.5 Meet regularly with the housing developers, architects and engineers on ways to prevent and control ***Aedes*** in construction sites including the proper design of buildings.

7. References

- Ministry of Health 'checklist' on mosquito control at construction sites.
- Johore guidelines on mosquito control at construction sites.
- DBKL guidelines on mosquito control at construction sites.
- Singapore guidelines on mosquito control at construction sites.
- Relevant manufacturers specifications on pesticides.
- Institute for Medical Research/Local universities studies.

Appendix I

Destruction of Disease Bearing Insects Act 1975

Section 8

General Power to direct or take measure to destroy etc. disease bearing insects

(1) Where it appears to the Director General or a Medical Officer of Health that any premises or anything therein is likely to propagate or harbour any disease-bearing insects, he may in writing order such owner or occupier to take specified measures or to do any work with regard to the premises or for the treatment, destruction or removal of anything therein as to make the premises or conditions therein unfavourabe to the propagation or harbouring of the disease-bearing insects.

(2) Without prejudice to the generality of the powers specified in subsection (1) the Director General or a Medical Officer of Health may in writing order the owner or occupier of any premises to take or do any of the following measures or work–

(a) to destroy disease-bearing insects wherever found;

(b) to collect and remove empty tins, cans, bottles or other receptacles in which disease-bearing insects may breed;

(c) to cut down and remove any grass, bamboo stumps, fern or undergrowth in which disease-bearing insects are likely to breed or harbour;

(d) to cover and keep continously covered any tank, cistern, receptacle or other container within the premises;

(e) to construct drainage of the premises;

(f) to fill up inequalities in the surface of the premises;

(g) to apply insecticide to any pond, well, pool or other body of water, vessel, stable, pigsty, cattle shed, chicken coop or other place used for the shelter of animals; and

(h) generally to prevent the propagation or harbouring of disease-bearing insects.

Appendix II

Destrucion of Disease Bearing Insects Act 1975

13. Prohibition on creating conditions likely to propagate or harbour disease-bearing insects.

(1) No person shall do or perform any act which may, or is liable to, create such conditions as may likely to propagate or harbour disease-bearing insects or permit or allow such conditions to arise or continue.

(2) Any person who contravenes subsection (1) shall be quilty of an offence under this Act.

Appendix III

Destruction of Disease Bearing Insects Act 1975

23. General penalty. Any person quilty of an offence under this Act or any regulation made thereunder for which no specific penalty is provided shall be liable on conviction -

(a) in respect of a first offence to a fine not exceeding one thousand dollars or to imprisonment for a term not exceeding three months or to both;

(b) in respect of a second or subsequent offence to a fine not exceeding two thousand dollars or to imprisonment for a term not exceeding one year or to both;

(c) in respect of continuing offence to a further fine not exceeding fifty dollars for every day that the offence is continued.

Appendix IV

Destruction of Disease Bearing Insects Act 1975

Compounding of offences

25. The Director General or a Medical of Health or any public officer authorised in writing in that behalf by the Minister may compound any offence commited under this Act or any regulations made thereunder and which by regulations has been prescribed to be compoundable by accepting from a person reasonably suspected of having committed such offence a sum of money not exceeding one hundred dollars.

Appendix V

Prevention and Control of Infectious Disease Act 1988

Section 18

Disinfection and closure of premises

(1) If an authorised officer has reason to believe that there has been a person with an infectious disease on any premises, or that there exist on any premises conditions likely to lead to the outbreak or spread of any infectious disease, he may do any or all of the following:

(a) examine or cause to be examined any person found on the premises with a view to ascertaining if the person is suffering or has been suffering from an infectious disease;

(b) examine the premises and any article or animal on the premises with a view to ascertaining of they are contaminated or infected, as the case may be;

(c) order the premises or any part thereof to be disinfected, disinsected and deratted;

(d) order the premises or any part thereof to be closed until the premises have been thoroughly disinfected, disinsected and deratted;

(e) order the disinfection of all contaminated articles and infected or contaminated animals on the premises or, if such article or animals is incapable of being thoroughly disinfected, order its destruction;

(f) do any order act to prevent the outbreak or the spread of any infectious disease.

(2) An authorised officer may at any time enter any premises for the purpose of exercising the powers conferred upon him by subsection (1).

Editorial Committee
"Guidelines For The Control Of Aedes Mosquitoes At Construction Sites"

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(e) memerintahkan supaya dibasmi kuman segala barang yang tercemar dan binatang yang dijangkiti atau yang tercemar dan binatang yang dijangkiti atau yang tercemar di premis itu, atau, jika barang atau binatang itu tidak berupaya dibasmi kuman dengan sempurnanya, memerintahkan pemusnahannya; dan

(f) melakukan apa-apa tindakan lain bagi mencegah merebaknya sesuatu penyakit berjangkit.

(2) Seseorang pegawai yang diberi kuasa boleh memasuki mana-mana premis pada bila-bila masa bagi maksud menjalankan kuasa-kuasa yang diberikan kepadanya oleh subseksyen (1).

VECTOR-BORNE DISEASES CONTROL PROGRAMME

VECTOR-BORNE DISEASE SECTION
DISEASE CONTROL DIVISION
MINISTRY OF HEALTH MALAYSIA
(Reprint 2001)

CONTENT

1. Introduction 1
2. Background 1
3. Objectives of VBDCP 4
4. Functions of VBDCP Headquaters at National Level 5
5. Epidemiology and Laboratory 7
6. Vector Control 9
7. Health Education and Training 13
8. Records and Documentation 15
9. Research 15
10. Administration 16

Organisation Chart of Ministry of Health Malaysia 17

Organisation Chart Vector-Borne Diseases Control Programme 18

VECTOR-BORNE DISEASES CONTROL PROGRAMME

1. INTRODUCTION

In line with the objectives of the Ministry of Health to facilitate every individual to achieve and maintain a standard of health to enable him/her to live productively in the social and economic fields, various programmes have been drawn up. The Vector-Borne Diseases Control Programme (VBDCP) is one of them.

The VBDCP Headquarters which co-ordinates the implementation of activities under this programme is one of the Federal Medical Institutions under the Ministry of Health, Malaysia. (Please see Appendix I)

The Vector-Borne Diseases Control Programme in Malaysia covers activities in the prevention and control of vector-borne diseases such as malaria, dengue, filariasis, typhus, Japanese encephalitis, Kala-azar, Chikungunya, plague and yellow fever.

2. BACKGROUND

The occurrence of the first case of malaria in Peninsular Malaysia is not known. From records available (IMR 1976), this disease was brought in by immigrants when Penang was founded.

2.1 Pre-Malaria Eradication Programme

2.1.1 In 1960, a malaria eradication pilot project (MEPP) was launched by the Ministry of Health with aid from the World Health Organization (WHO). Its aim was to evaluate the feasibility of carrying out a malaria eradication programme. The pilot project ended in 1964. The results of the project showed that it can be carried out both from the technical as well as the administrative aspects.

2.1.2 From 1965 to 1966, a pre-eradication survey for malaria was carried out. The aim of this survey was to evaluate the actual malaria situation in Peninsular Malaysia.

2.1.3 Similarly, a malaria eradication pilot project was started in 1953 in Sabah and in 1956 in Sarawak.

2.2 Malaria Eradication Programme (MEP)

2.2.1 In 1967 a malaria eradication programme was established with the main aim of eradicating malaria from Peninsular Malaysia by the year 1982.

2.2.2 Malaria eradication programmes in Sabah and Sarawak were started in 1961.

2.2.3 In 1978 WHO suggested that the Malaria Eradication Programme be restructured

after it was found that the original objectives could not be achieved. The malaria eradication programme was then changed to malaria control.

2.3 Vector-Borne Diseases Control Programme (VBDCP)

In 1981, at the beginning of the Fourth Malaysia Plan, the scope of MEP was expanded to cover other vector-borne diseases and this was implemented in three phases:-

2.3.1 Phase One (1981-1982)

All eradication activities and malaria control services were combined to form the Anti-Malaria Programme.

2.3.2 Phase Two (1983-1984)

Dengue fever (DF), dengue haemorrhagic fever (DHF) and filariasis were include under the VBDCP.

2.3.3 Phase Three (1985 Onwards)

VBDCP was further expanded to include typhus, Japanese encephalitis, yellow fever and plague.

At the beginning of the Fifth Malaysia Plan in 1986 the prevention and control of vector borne diseases in Sabah and Sarawak were incorporated into the programme. The objectives and

the organisation were streamlined accordingly to follow that in Peninsular Malaysia. (Please see VBDCP organization chart in Appendix II). In the sixth Malaysia Plan the VBDCP was placed under the Disease Control Divison. The Vector-Borne Disease Section then takes charge of VBDCP.

3. OBJECTIVES OF VBDCP

3.1 Objectives

(i) To reduce the morbidity and mortality due to vector-borne diseases so that they no longer pose a public health problem in Malaysia.

(ii) To prevent the occurrence of vector-borne diseases in areas which have no outbreaks at present.

(iii) To prevent the re-introduction of plague into Malaysia.

(iv) To prevent the importation of yellow fever into Malaysia.

(v) To prevent the importation and establishment of Kala-azar and Chikungunya into Malaysia.

The achieve the objectives of the VBDCP, a number of units were established in the VBDCP headquarters at national level:-

(i) Epidemiology and Laboratory

(ii) Vector Control

(iii) Health Education and Training

(iv) Records and Documentation

(v) Administration

4. FUNCTIONS OF VBDCP HEADQUARTERS AT NATIONAL LEVEL

4.1 Formulation of policies

Formulation of new policies besides reviewing and updating existing policies from time to time.

4.2 Planning

Overall planning including determining the scope, dimension, trend and programme components. Specifying targets and identifying resources that are needed.

4.3 Setting standards and preparation of guidelines

Setting standards, determining indicators and preparation of guidelines to assist staff at the implementation level.

4.4 Coordinating VBDCP activities

Coordinating VBDCP activities throughout the country related to approaches and implementation methods. Deployment of manpower,

identification and study of projects, utilisation of resources besides giving technical advice.

4.5 Management of resourses

Identifying and obtaining resources such as spraying equipment, insecticides and health education materials.

4.6 Monitoring activities

Monitoring all activities carried out by states and other agencies.

4.7 Programme evaluation

Evaluation of VBDCP activities is done quarterly. Evaluation is also done at mid-term and at the end of every Malaysia Plan.

4.8 Establishment of a documentation and reference centre including a vector museum

Collecting and updating of reference material at VBDCP library and vector collectibles in the museum.

4.9 Cooperation among agencies

Obtaining cooperation from agencies involved in the VBDCP.

4.10 Advisory service

Providing technical advice pertaining to prevention and control of vector-borne diseases to the states, institutions and other agencies.

4.11 Training

Identifying training needs, planning and co-ordinating training courses with relevent institutions.

4.12 Operational research

Planning, coodinating and cooperating with relevent authorities in carrying out operational research.

5. EPIDEMIOLOGY AND LABORATORY

5.1 Activities at Headquarters and State Level

Responsible for monitoring epidemiological activities of vector-borne diseases, identifying disease trends, analysing outbreaks and preparing guideline regarding control measures.

5.2 Activities at district level

5.2.1 Active case detection (ACD)

For malaria control, case detection activity is through house visits in malarious areas. This task is carried out by a canvasser who takes blood slides and gives presumptive treatment to those with fever or with a history of fever.

For filariasis control, active case detection is carried out through probe surveys if there is a case in any particular area.

5.2.2 Passive case detection (PCD)

For malaria surveillance, case detection is through medical and health facilities. Blood slides for the detection of disease is taken from patients who are suspected to be having malaria when they come for treatment at hospitals, health centres, community clinics, midwives clinics and also at primary health care posts.

5.2.3 Mass blood survey (MBS)

For malaria control, this activity is carried out by the special team and multi-purpose team in the following areas:-

(a) Where there is an abnormal increase in the number of malaria cases.

(b) Where there are a large number of immigrant workers who come from malarious areas or countries.

(c) Where there are aborigines living in the hinterland.

(d) Where focal outbreaks occur in non-malarious and malaria prone areas.

5.2.4 Laboratory diagnosis

The aim of carrying out laboratory diagnosis besides quality control, is to detect the disease and to identify parasite species using definite laboratory methods.

5.2.5 Treatment

All positive cases are given full treatment while cases which have complications are referred to hospital for further treatment.

5.2.6 Case investigations/case follow-up

All diseases which come under the control of VBDCP and which are reported are investigated. The objective is to identify sources of infection so as to confirm whether it is an indigenous case or otherwise. Follow-up action is carried out for all diseases according to schedule.

6. VECTOR CONTROL

6.1 Activities at headquarters and state levels

Responsible for planning, co-ordinating and analysing vector control activities at all levels. This unit also monitors, reviews and analyses the effectiveness of vector control activities such as spraying, source reduction, treated

bed-nets, use of insecticides, anti-larval operations and law enforcement. This is done through entomological investigations and evaluation.

6.2 Activities at district level

6.2.1 Geographical reconnaissance

Is carried out in the field by public health assistants. It involves mapping of the area, taking the population/house census, marking the location of houses and public utilities in the operational area. Mapping is done to facilitate spraying operations, tracing of cases and for other control measures.

6.2.2 Spraying operations

(a) Malaria control

The aim is to break the chain of transmission of diseases by killing definitive vectors. Three types of spraying are carried out namely:-

(i) Regular spraying is carried out six-monthly in malarious areas.

(ii) Special spraying is carried out once in three months in land development schemes, timber camps and interior aboriginal areas.

(iii) Focal spraying is carried out in malaria prone and non-malarious areas whenever a malaria case is reported.

(b) Dengue control

For dengue vector control, fogging is carried out. There are two types of fogging namely:-

(i) Thermal fogging whenever a single case of dengue is reported.

(ii) Ultra Low Volume (ULV) fogging when there is an outbreak of dengue.

(c) Plague control

Fumigation using hydrogen cyanide and methyl bromide is carried out on ships, godowns and rodent breeding places at seaports and international airports. This is to eradicate rodents and fleas in the control of plague.

(Fumigation in ships, godowns and other areas is carried out by the private sector and supervised by the health department).

6.2.4 Anti-larval operations

(a) Malaria control

Anti-larval operations are carried out in malaria control areas. Among the activities carried out are spraying of Abate 500E larvicide in earth and cement drains, rodding of subsoil drains and clearing of grass and weeds along the side of drains. Besides these, larval control is also carried out through construction of automatic siphons, tidal and sluice gates.

(b) Dengue control

For dengue control, inspection for aedes larvae is carried out from house to house. This is done within the premises and the surrounding areas to look for breeding places. Other areas such as construction sites, schools and factories are given emphasis.

(c) Yellow fever

For yellow fever, control work for aedes aegypti is carried out in ports and international airports. Activities involved are the set-

ting-up of ovitraps and checking for breeding places.

(In conformity with WHO requirements under the International Health Regulations 1969 (revised 1989)).

6.2.5 Entomological Surveillance and Investigations

The aim of entomological surveillance is to study the habits of vectors and the effectiveness of insecticides in killing vectors. Standard WHO entomological techniques and parameters are used in the assessment.

7. HEALTH EDUCATION AND TRAINING

7.1 Health Education

Health education is an integral component of VBDCP and plays an important role in helping VBDCP achieve its objective. Activities implemented are aimed at prevention and control of vector-borne diseases.

Various methods are used to instill awareness among the public to elicit their cooperation. The methods used include talks, small group discussions, demonstrations and exhibitions.

For dengue control health education activities are intensified during the campaign

months i.e. during the months of January, April, July and October.

7.2 Training

All staff in the VBDC Programme are given basic in-service training. Basic training is carried out at four Rural Health Training Schools, especially for Public Health Assistant.

In-service training such as orientation and refresher courses are carried out at various levels. At the national level, it is carried out by the Institute for Medical Research and the Public Health Institute (PHI) with technical input from VBDCP headquarters. At the state level, training is done by state VBDCP with manpower assistance and lecturers from headquarters if necessary. At the local level, training is carried out by the health districts themselves.

7.3 Primary Health Care Approach – PHC

Primary Health Care is one of the methods used by VBDCP to obtain community participation. PHC posts are managed by local volunteers.

It is the first level contact between the people and health services where health care is brought as close as possible to where they live or work.

The volunteers are chosen from among the local people according to certain criteria. They

are appointed with the approval of the village committee or local authority such as the manager of a land scheme, estate etc. Orientation training to these people is given by staff of VBDCP.

Activities that are carried out include taking of blood slides for detection of malaria, giving presumptive treatment, health education and keeping records.

8. RECORDS AND DOCUMENTATION

All VBDCP activities carried out at sector, district, state and national levels are recorded and documented. The records include epidemiological data, vector control, administration and health education activities.

The records are compiled, analaysed and are used at all levels of implementation. At state level, reports are compiled, analysed and forwarded to the national level. At the national level, available information is compiled and analysed to assess programme achievement for the whole country. Annual reports, guidelines, guidebooks and vector journals are published and distributed.

9. RESEARCH

The types of research carried out by VBDCP are basic and operational. VBDCP headquarters with the cooperation of the Institute for Medical Research carries out collaborative research in various aspects such as usage of malarial and filarial drugs,

impregnated bed-nets, effectiveness of insecticides and studies on vector behaviour. VBDCP at state level also carries out KAP studies on various aspects of the programme and tests on the effectiveness of insecticides.

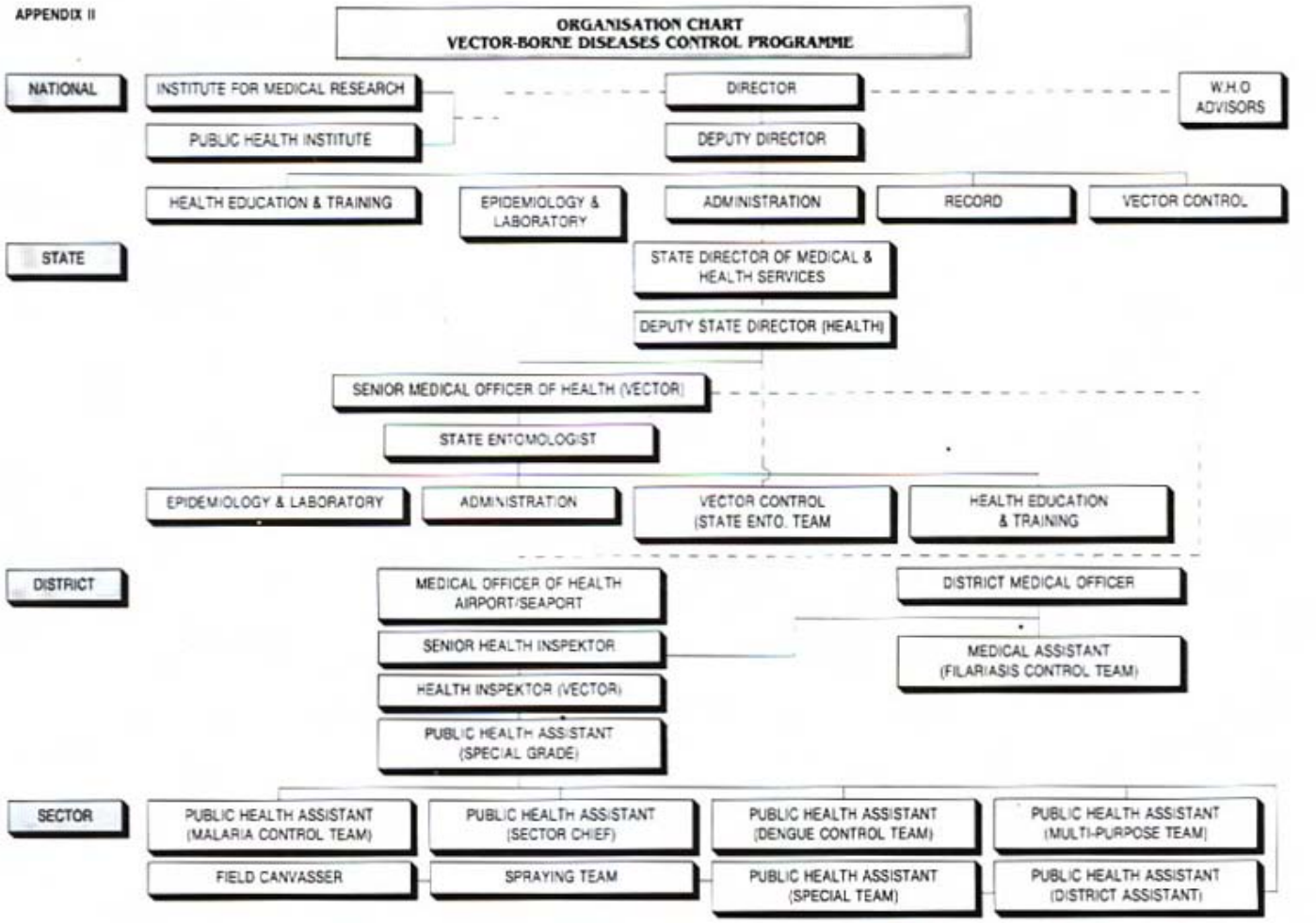
10. ADMINISTRATION

10.1 Responsible for managing and coordinating service and establishment matters.

10.2 Responsible for preparation of programme budget, allocation of funds, monitoring of expenditure of VBDCP and logistics and supplies. (insecticides and equipment)

APPENDIX II

ORGANISATION CHART
VECTOR-BORNE DISEASES CONTROL PROGRAMME



APPENDIX I

ORGANISATION CHART OF MINISTRY OF HEALTH MALAYSIA