Environmental and Social Impact Assessment

Phu Lac 2 Wind Power Project, Tuy Phong District, Binh Thuan Province

9 February 2021

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TBW

Thuan Binh Wind JSC

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10. ENVIRONMENTAL IMPACT ASSESSMENT

10.1 Air Quality Impact Assessment

10.1.1 Scope of Assessment

During the project development, construction stage will likely generate more recognizable impacts on ambient air quality in comparison to those that will be generated during operation phase. Key sources of air pollution in construction phase include dust suspension from planned demolition, earthworks, construction activities as well as fugitive dust and exhaust from machinery / vehicles. In operation phase, the impact on air quality is mainly from transportation activities which will be really low. Therefore, the scope for this air quality impact assessment is limited to only to the activities during the construction phase.

During the construction phase, key generators of the impacts include demolition, earthworks, construction and transportation activities[1]. Potential impacts are identified in Table 10.1 below.

Table 10.1 Potential Air Quality Impact in Construction Phase

Activity	Description	Potential impacts
Demolition	No house demolition will be carried out during the project development.	No potential impact to be expected from house demolition.
Earthworks	Site clearance and excavation works at areas to be occupied by: ■ Six turbine foundations; ■ The 22kV underground cable (7.8 km); ■ The 22/110kV step-up substation, ■ The aboveground transmission line (T-line) and safety corridor (7.34 km); and ■ The internal access roads (total length of 6 km).	Increased dust (e.g. Total suspended solid - TSP, Particulate Matters - PM_{10}, and $PM_{2.5}$) and exhaust emissions (e.g. Sulfur oxides - SO_x, Carbon Monoxide - CO, Nitrogen oxides - NO_x). Degraded ambient air quality and affect human health when concentration of these compounds exceeds the allowable limits.
Construction	■ Construction of the aforementioned project components, including turbine foundations, underground cable, step-up substation, T-line; and ■ Construction of the 6 km internal access roads.	
Trackout	Suspension of dust along the transportation routes, especially unpaved internal roads during its establishment.	Increased level of dust along the transport routes, and subsequently degradation of the air quality and health effects due to increased exposure to PM_{10}.

10.1.2 Impact Assessment

10.1.2.1 Potential Impacts

The impacts to be assessed in this section include:

[1] Institute of Air Quality Management (IAQM), Guidance on the assessment of dust from demolition and construction (2014). [Online] Available at: http://iaqm.co.uk/wp-content/uploads/guidance/iaqm_guidance_report_draft1.4.pdf.

- Impact due to dust generation from earthworks and construction activities mainly linked to the establishment of key components of the Project such as turbines, transmission line, and substation;
- Impact due to exhaust emissions from earthwork and construction activities;
- Impact due to dust suspension from establishment of and transportation on the to-be-constructed internal access road; and
- Impact from transportation on external routes.

10.1.2.2 Potential Consequences

Air emissions during construction phase of the Project have the potential to directly affect the ambient air quality by:

- Increased dust (e.g. TSP, PM_{10}, $PM_{2.5}$) and exhaust emissions (e.g. SO_x, CO, NO_x).
- Degraded ambient air quality when concentration of these compounds exceeds the permissible limits.
- Increased dust levels along the transport routes, and subsequently degradation of the air quality close to these.

In turn, such emission can adversely affect sensitive receptors (human health, vegetation and crops) if not managed properly. The potential effects and consequences of these emissions include:

- Annoyance and nuisance to the general public as a result of dust deposition on properties, crops, dwellings, cultural heritage sites and places of business;
- Increased morbidity due to exposure to NO_2, PM_{10} and $PM_{2.5}$ concentrations; and
- Plant dieback due to reduced photosynthesis.

10.1.2.3 Existing Controls

The Project is assumed to implement the mitigation measures committed in the approved Phu Lac 1 EIA report [2]. In which, the following mitigation measures have been proposed:

- Covering material stockpiles; arranging material stockpile properly for construction activities and also prohibition of dust generation;
- Using modern equipment and machinery for construction purpose;
- Prohibiting the use of vehicles that do not meet the registration standards;
- Scheduling operation of construction equipment / machinery and transporting vehicles properly to minimize construction duration;
- Watering construction site to control suspended solid during construction phase;
- Providing personal protection wears for construction workers, including masks, goggles, etc.;
- Regulating transporting vehicles, during construction phase, to:
  - Cover trucks during en-route operation;
  - Prohibit overloading truck operation;
  - Limit speed while travelling across residential areas;
  - Wash vehicles' wheels before leaving construction site;
  - Conduct regular maintenance of vehicles and machinery; and

[2] Environmental Impact Assessment (EIA) report of the Phu Lac 1 Wind Power Project.

- Stop the vehicles completely while waiting to be unloaded.

- Prioritizing grid electricity during construction, avoiding using generators, if possible;

10.1.2.4 Significance of Impact

The significance of each of the above impacts is assessed on the basis of impact magnitude and sensitivity of the human receptors, taking into account the existing controls, as follows:

Impact due to dust generation from earthworks and construction activities: the project development involves a relatively large amount of earthworks and construction, especially for the establishment of 6 turbine foundations, 7.8 km underground 22kV internal cable network. The largest work volume will likely be at the turbine foundations which are scattered around the project area with great distance (> 300 m) between each other and can be considered as individual sources. Earthwork and construction volume for each location is rather small (< 20,000 tons [1]) and the impact due to dust generation is, thus, considered small and localized. The impact magnitude will also likely be small for the establishment of the underground cable network owing to the scattering nature of the work which is along a long distance (7.8 km).

In terms of impact duration, the construction will happen in a medium-term (12 months) with 3-4 months of construction peak. The work intensity will likely be increased during the construction peak. However, as no human receptors are located within the project area but only crops and vacant land, the receptor sensitivity to dust impact is classified as low. The overall significance of the impact is therefore considered **Negligible** (Table 10.2).

Table 10.2 Impact Due to Dust Generation from Earthworks and Construction Activities

Impact Description	Impact level			
Impact Nature	Positive		**Negative**	
Impact Type	**Direct**		Indirect	
Impact Duration	Short-term	**Medium-term**	Long-term	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	One-off	Rarely	Sometimes	**Often**
Impact Magnitude	Negligible	**Small**	Medium	Large
Sensitivity/Vulnerability	**Low**	Medium	High	
Significance	**Negligible**	Minor	Moderate	Major

Impact due to exhaust emissions from earthwork and construction activities: due to the scattering nature of the construction layout, only a small number of construction vehicles / machinery will be gathering at one location at any point in time. Consequently, the exhaust emission from earthworks and construction activities are likely generated at small scale over a medium-term period (12 months) during the construction phase, and localized at different construction areas. Moreover, according to the IAQM guidance "*Experience of assessing the exhaust emissions from on-site plant (also known as non-road mobile machinery or NRMM) and site traffic suggests that they are unlikely to make a significant impact on local air quality, and in the vast majority of cases they will not need to be quantitatively assessed*." Therefore, the overall impact is considered **Negligible** following the assessment of magnitude duration, scale, intensity, etc. and the low receptor sensitivity to the impact (Table 10.3).

Table 10.3 Impact Due to Exhaust Emissions from Earthwork and Construction Activities

Impact Description	Impact level			
Impact Nature	Positive		**Negative**	
Impact Type	**Direct**		Indirect	
Impact Duration	Short-term	**Medium-term**	Long-term	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	One-off	Rarely	Sometimes	**Often**
Impact Magnitude	Negligible	**Small**	Medium	Large
Sensitivity/Vulnerability	**Low**	Medium	High	
Significance	**Negligible**	Minor	Moderate	Major

Impact due to dust suspension from establishment of and transportation on the internal access roads: the establishment of the internal access roads is the largest concern in terms of dust generation during the construction phase. The internal access roads are planned to be 5 m wide (7.5 m including the cable trench) and 6 km long. Such establishment will likely generate a substantial amount of dust due to the spreading and compacting of crushed stones. Furthermore, there is an overlapping between schedule for the new road construction and that for the turbine foundation establishment. Vehicles serving the foundation establishment will then be operating on unpaved internal roads and induce dust suspension. Such impact of dust suspension is considered having medium impact magnitude.

Nevertheless, the new road network is planned to be completed within a relatively short amount of time, i.e. 43 days. Given the absence of human receptors within the project area, hence low receptor sensitivity, the overall impact significance is considered **Minor** (Table 10.4). After completion of the access roads, the level of fugitive dust will be significantly reduced and the impact will likely become negligible.

Table 10.4 Impact Due to Dust Suspension from Establishment of and Transportation on the Internal Access Roads

Impact Description	Impact level			
Impact Nature	Positive		**Negative**	
Impact Type	**Direct**		Indirect	
Impact Duration	**Short-term**	Medium-term	Long-term	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	One-off	Rarely	Sometimes	**Often**
Impact Magnitude	Negligible	Small	**Medium**	Large
Sensitivity/Vulnerability	**Low**	Medium	High	
Significance	Negligible	**Minor**	Moderate	Major

Impact from transportation on external routes: the Project will use 10-tonne trucks for transporting construction materials and equipment. Estimated from a similar wind farm project of TBW which has a similar construction scope as the Project, the construction phase will require on average the service of 9 truck movements per day throughout the construction period of 12 months. The intensity of truck movement is more significant during the construction peak (approximately 3 months), in which the number of truck movement is expected to be tripled, i.e. 27 truck movements per day. The external transport routes include the National Highway 1A and the existing access roads of the Phu Lac 1 project.

The truck movements are expected to raise dust level along the transport routes and affect nearby households. Upon proper implementation of the existing controls, i.e. covering transport trucks, speed limit, etc., the impact from fugitive dust will likely be kept at small magnitude with localized spreading area. The impact duration is also short, within 3 months of construction peak. Outside the peak time, the transport intensity is expected to be much lower. Consequently, the transportation during construction phase is likely to generate impacts of **Minor** significance (Table 10.5).

Table 10.5 Impact from Transportation in Construction Phase

Impact Description	Impact level			
Impact Nature	Positive		**Negative**	
Impact Type	**Direct**		Indirect	
Impact Duration	**Short-term**	Medium-term	Long-term	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	One-off	Rarely	Sometimes	**Often**
Impact Magnitude	Negligible	**Small**	Medium	Large
Sensitivity/Vulnerability	Low	**Medium**	High	
Significance	Negligible	**Minor**	Moderate	Major

10.1.2.5 Additional Mitigation Measures

Although these impacts are considered of negligible to minor significance, the following additional mitigation measures are recommended as good practice based on ESIA requirements:

- Prohibiting open burning. If required, cleared vegetation should be transferred to a licensed waste contractor for composting, reusing or treatment in compliance with current regulations in force;
- Using suitable fuels for each vehicle and machinery;
- Prohibiting overloaded operation of vehicles and machinery;
- Avoiding transportation during rush hours to reduce exhaust emissions due to transportation;
- Supervising closely the construction activities, watering twice a day areas with high potentials of dust suspension, especially during dry weathers;
- Watering twice a day the internal access roads during its establishment and the external transport routes;
- Imposing speed limit to trucks and other vehicles wherein the vehicles must not exceed 10 km/h within the project boundary; and
- Arranging wheel washing facilities at site exit where heavy trucks are washed before leaving the site.

10.1.2.6 Residual Impacts

Upon proper implementation of the above mitigation measures, the residual impacts are expected to be negligible.

10.1.2.7 Monitoring and Reporting

- Monitoring ambient air quality every two months during the construction phase. The monitored parameters include NO_2, SO_2, CO, TSP, PM_{10}, $PM_{2.5}$;

- Regular inspections to monitor dust suspension; record inspection results and make an inspection log available to the local authority when asked. Increase inspection frequency during period of heavy activities occur and during prolonged dry or windy conditions;
- Keeping records of vehicle maintenance and dust control activities on site to show local authorities upon requests in case of complain or grievance.

10.2 Water Quality Impact Assessment

10.2.1 Scope of Assessment

This section discussed the potential impacts of the Project's construction activities to the adjacent water resources (surface water and groundwater). The Project plans to use water from drilled wells and nearby tributaries of the Long Song river along with the Phu Lac water supply station for construction purpose. For domestic use of construction workers, water from the Phu Lac station will be used. Key potential impacts on the local water resources likely come from:

- Discharge of domestic and construction wastewater;
- Runoff water over excavated surface and construction area; and
- Extraction of groundwater from drilled well for construction purpose.

Activities during the operation phase are unlikely to have significant impacts on water quantity and quality. Therefore, this impact assessment on the water resources is limited to activities in the construction phase.

10.2.2 Impact Assessment

10.2.2.1 Potential Impacts

The impacts to be assessed in this section include:

- Impact on surface water and groundwater quality from wastewater discharge;
- Impact on surface water and groundwater quality from rainwater runoff; and
- Impact on groundwater level due to extraction for construction purpose.

10.2.2.2 Potential Consequences

Construction and domestic wastewater discharges, if not well managed, can flow to nearby water bodies such as irrigation canals and ponds, and subsequently the tributaries of the Long Song river and affect the water quality. Rainwater runoff can wash over construction areas and take loose materials and waste to the nearby streams, canals and ponds. Soluble pollutants can be taken by the runoff to infiltrate ground surface and possibly affecting groundwater quality. Overall, the potential consequences are as follows:

- Increased contaminants such as heavy metals, oil and grease, etc. into groundwater and surrounding surface water bodies;
- Increased turbidity in streams and ponds due to suspended sediment washed into these;
- Decreased dissolved oxygen and affected aquatic ecology of surface water bodies close to the project site; and
- Decreased local groundwater level and storage.

10.2.2.3 Existing Controls

The Project is assumed to implement the mitigation measures committed in the approved Phu Lac 1 EIA report [2]. In which, the following mitigation measures have been proposed:

- Arranging sufficient portable toilets around the construction area to collect domestic wastewater from workers' activity;
- The collected domestic wastewater will be treated in 3-compartment septic tanks using anaerobic technology;
- Designing and constructing open trenches to collect rainwater runoff;
- Arranging a sedimentation tank to collect sediment from construction wastewater;
- Managing transporting vehicles properly to avoid release of oil and fuel on the ground surface;
- Managing wastes properly to avoid being washed away by rainwater runoff.

10.2.2.4 Significance of Impact

The significance of each of the above impact is assessed as follows:

- **Impact on surface water and groundwater quality from rainwater runoff**: Earthwork and construction activities can release loose earth, materials and hazardous substances (fuel, oil, etc.) on natural surfaces. In rainy days, the solid materials can be carried by runoffs to nearby irrigation open canals and streams whereas the soluble substances could possibly infiltrate to groundwater sources. As a result, the surface water and groundwater quality will be affected by suspended solid (hence increased turbidity) and chemical pollutants. Nevertheless, if the above existing controls are implemented properly, the amount of contaminated runoff is likely insignificant. Therefore, the impact intensity is likely minor, the scale localized and the overall impact significance **Minor** (Table 10.6).

Table 10.6 Impact on Surface Water and Groundwater Quality from Rainwater Runoff

Impact Description	Impact level			
Impact Nature	Positive		**Negative**	
Impact Type	**Direct**		Indirect	
Impact Duration	Short-term	**Medium-term**	Long-term	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	One-off	Rarely	Sometimes	**Often**
Impact Magnitude	Negligible	**Small**	Medium	Large
Sensitivity/Vulnerability	Low	**Medium**	High	
Significance	Negligible	**Minor**	Moderate	Major

- **Impact on surface water and groundwater quality from wastewater discharge**: the wastewater to be discharged during the construction phase mainly comprises of domestic wastewater (from workers' accommodation) and construction wastewater. Given the small number of construction workers (84 people, with the water usage of about 7 m^3/d) and the installation of portable toilets and 3-compartment septic tanks onsite, the release of domestic wastewater is likely negligible. Construction wastewater discharge is also negligible due to its small volume and scattering nature. The impact from wastewater discharge is generally localized over a medium-term period (12 months of the construction phase). As key receptor of this impact is local vegetation which is considered low in sensitivity, the overall significance is recognized as **Negligible** (Table 10.7).

Table 10.7 Impact on Surface Water and Groundwater Quality from Wastewater Discharge

Impact Description	Impact level			
Impact Nature	Positive		**Negative**	
Impact Type	**Direct**		Indirect	
Impact Duration	Short-term	**Medium-term**	Long-term	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	One-off	Rarely	Sometimes	**Often**
Impact Magnitude	Negligible	**Small**	Medium	Large
Sensitivity/Vulnerability	**Low**	Medium	High	
Significance	**Negligible**	Minor	Moderate	Major

- **Impact on groundwater level due to extraction for construction purpose**: the construction water will partially be contributed by the groundwater extracted from individual drilled wells. The extraction will draw down the groundwater level to some extent depending on the amount to be extracted. Given that construction water will be contributed from multiple sources including surface water from streams and the Phu Lac water supply station, the amount of groundwater to be extracted is expected to be small. Furthermore, the groundwater level is, in general, restorable upon sufficient recharge from upstream, and is thus considered low in sensitivity. Overall, the impact on groundwater level due to groundwater extraction is considered of **Negligible** significance (Table 10.8).

Table 10.8 Impact on Groundwater Level Due to Extraction for Construction Purpose

Impact Description	Impact level			
Impact Nature	Positive		**Negative**	
Impact Type	**Direct**		Indirect	
Impact Duration	Short-term	**Medium-term**	Long-term	Permanent
Impact Extent	**Local**	Regional	Global	
Impact Frequency	One-off	Rarely	Sometimes	**Often**
Impact Magnitude	Negligible	**Small**	Medium	Large
Sensitivity/Vulnerability	**Low**	Medium	High	
Significance	**Negligible**	Minor	Moderate	Major

10.2.2.5 Additional Mitigation Measures

Although the impacts are considered of negligible to minor significance, the following additional mitigation measures are recommended as good practice based on ESIA requirements:

- Inspecting the site regularly to detect and resolve blockages in drainage system;
- Conducting regular dredging of the trenches;
- Collecting hazardous waste in closed containers and proofed area to avoid exposing to rainy weather;
- Managing and storing correctly hazardous substances in the construction areas;
- Checking vehicles and equipment regularly for oil leakage;

- Avoiding maintenance service of vehicles and machinery on-site, or if unavoidable, conducting the service in an roofed area and with the use of trails for spills;
- Establishing internal rules and activities for environmental protection, including littering and disposal of wastes;
- Prohibiting discharging of waste and wastewater directly into freshwater bodies; and
- Clearing construction areas frequently to remove residual materials and wastes;
- Covering construction materials carefully to avoid being washed by rainwater runoff;

10.2.2.6 Residual Impacts

Upon proper implementation of all the aforementioned mitigation measures, the residual impacts are expected to be Negligible.

10.2.2.7 Monitoring and Reporting

The following monitoring program is planned for the construction phase:

- For surface water quality: sample will be taken at 01 location at a nearby surface water body (pond or stream). Details of the proposed monitoring programme are as follows:
  - Monitoring parameters: pH, TSS, TDS, BOD5, COD, DO, H_2S, oil and grease, F^-, Cl^-, NH_4^+, NO_2^-, NO_3^-, PO_4^{3-}, CN^-, As, Cd, Pb, Zn, Cu, Total Surfactants, Total Phenol, Coliform.
  - Monitoring frequency: every 3 months during the construction phase;
  - Monitoring results: to be compared with the QCVN 08-MT:2015/BTNMT – National Technical Regulation on Surface Water Quality for compliance.
  - Monitoring records: to be kept onsite for authority's inspection upon request.
- For groundwater quality: sample will be taken at 01 location at a nearby existing well. Details of the proposed monitoring programme are as follows:
  - Monitoring parameters: pH, BOD5, DO, TSS, NO_3^-, PO_4^{3-}, heavy metals and Coliform.
  - Monitoring frequency: every 3 months during the construction phase;
  - Monitoring results: to be compared with the QCVN 09-MT:2015/BTNMT – National Technical Regulation on Groundwater Quality for compliance.
  - Monitoring records: to be kept onsite for authority's inspection upon request.

10.3 Noise Impact Assessment

10.3.1 Summary of Scope of Assessment

Activities of the Project that are likely to cause elevated noise and vibration include:

During the construction phase:

- Land preparation and civil works such as land clearance, demolition, earthworks;
- Construction of substation, transmission line and laydown area;
- Operation of associated facilities such as the batching plant; and
- Transportation of equipment, workers and materials.

During the operation phase:

Activities of the Project that are likely to cause elevated noise during the operational phase are the WTGs and substation.

10.3.2 Relevant Guidelines and Criteria

10.3.2.1 Vietnamese Regulations

- QCVN 26:2010/BNTMT: National Technical Regulation on Noise; and
- QCVN 27:2010/BTNMT: National Technical Regulation on Vibration.

10.3.2.2 International Guidelines

- International Organization for Standardization (ISO) 9613-2:1996 (ISO 9613:2) - *Acoustics - Attenuation of Sound during Propagation Outdoors - Part 2: General Method of Calculation*;
- IFC Performance Standard 3: Resource Efficiency and Pollution Prevention requires the Project to consider ambient conditions and apply technically and financially feasible resource efficiency and pollution prevention principles and techniques that are best suited to avoid, or where avoidance is not possible, minimise adverse impacts on human health and the environment;
- IFC General EHS Guidelines (Section 1.7, 2007): Noise provides recommended ambient noise level and control measures;
- IFC Environmental Health and Safety Guidelines for Wind Energy (2015) provides EHS guidelines for onshore and offshore wind energy facilities. It covers environmental impacts and provides associated recommendations for mitigation measures in the areas of noise and visual impact, biodiversity, water quality, shadow flicker, etc.; and
- ETSU, Report ETSU-R-97, The Assessment and Rating of Noise from Wind Farms (1997).

Table 10.9 Scope of Noise Impact Assessment

Phases	Potential Activities	Potential Impacts	Potential Consequences	Receptor
Construction of wind farm, substation and transmission line	Land preparation and civil works such as land clearance, demolition, earthworks	■ Short-term increase in noise levels	■ Some studies suggested that long-term exposure to noise level exceeding 70 dB ($L_{Aeq, 24h}$) can cause hearing loss (WHO, 1999). Even chronic low levels of noise can cause disturbances of activity, sleep, and communication, which can trigger a number of emotional responses, including annoyance and subsequent stress (Babisch, 2012) ■ High levels of environmental noise lead to mental health symptoms (e.g., depression and anxiety) and the degree of noise annoyance may be directly associated with future development of depression and anxiety disorders as shown by community-based studies (Beutel ME, 2016). ■ Numerous studies demonstrate that noise plays a role for the development of cardiovascular as well as metabolic disease (Münzel T, 2017) and changes in immune system and birth effects.	■ Nearby residents ■ Construction workers
	Construction of substation, transmission line and laydown area			
	Operation of associated facilities such as the batching plant			
	Transportation of equipment, workers and materials			
Operation of wind farm and substation	The WTGs and the substation will be sources of noise during the operation of the Project	■ Long-term increase in noise levels		

10.3.3 Assessment of Impacts

10.3.3.1 Construction Phase

10.3.3.1.1 Potential Impact

The following sources of impact were identified:

- Site preparation and building construction works associated with any permanent facilities;
- Construction and installation of the internal electrical network (between turbines) and any associated transmission lines;
- Construction works associated with internal access roads; and
- Movement of Project vehicles to transport WTG parts, construction materials and waste.

The construction activities will involve the operation and movement of many noisy equipment, machines and vehicles such as rollers, bulldozers, excavators, cranes, generators, concrete mixer and dump trucks. Actual measured sound pressure levels generated by typical construction equipment are shown below:

Table 10.10 Noise Levels for Typical Equipment Used During Construction Phase

Equipment	Actual Measured Lmax at 15m (dBA, slow) (Samples Averaged)
Compactor (ground)	83
Air compressor	78
Concrete Mixer Truck	79
Concrete Pump Truck	81
Crane	81
Dozer	82
Dump truck	76
Excavator	81
Generator	81
Generator (<25KVA)	73
Jackhammer	89
Pumps	81
Roller	80

Source: US Federal Highway Administration 20173.

As a conservative approach, if some equipment are placed near each other and being operated concurrently, due to the combined noise effects, the maximum noise level (Lmax) at the distance of 15

[3] Construction Noise Handbook. Section 9.1: Equipment Type Inventory and Related Emission Level. Available at: https://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/handbook09.cfm. Accessed on 3 February 2021.

m from the construction site would be around 85 dBA. However, since most of population (around 9,000 inhabitants) of Phu Lac commune are living in 03 villages of Lac Tri, Phu Dien and Vinh Hanh, which are quite far from the construction sites of turbines (the nearest group of dwellings are about 500 m from the nearest WTG 05) (see Figure 10.1), due to the attenuation effect of sound, the noise levels caused by construction equipment will not likely cause significant disturbance to the habitants during the daytime, since the levels are expected to be equal or lower than the existing noise levels of around 50 dBA as measured during the baseline noise monitoring. However, the movement of Project's vehicles to transport equipment and materials will cause some elevated noise levels from time to time, especially when they pass through the densely populated town of Lien Huong.

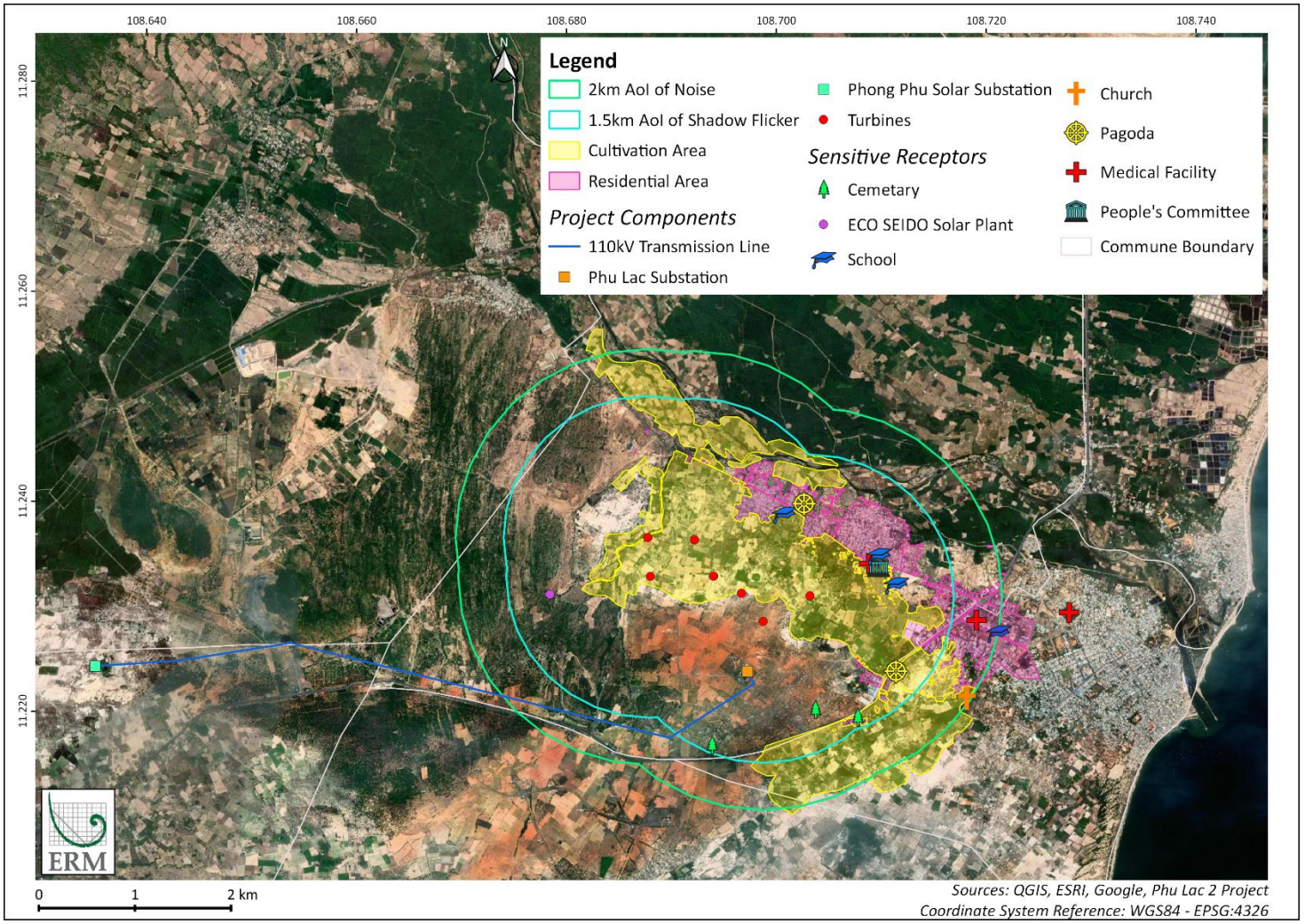


Figure 10.1 Location of Residential Areas and Sensitive Receptors of Phu Lac Commune

10.3.3.1.2 Existing Controls

Since Phu Lac 2 wind farm is an extension of Phu Lac 1 wind farm, according to Vietnamese regulations, the Project owner is not required to prepare the EIA for Phu Lac 2 project, instead, they are required to update the Phu Lac 1's EIA to cover the scope of Phu Lac 2. At the time of preparation of this ESIA, the updated EIA was not available to the Consultant, therefore, it is assumed that the Project owner will implement same control measures applied in Loi Hai 2 wind farm, which is also owned by TBW.

The following control measures are described in the regulatory EIA of Loi Hai 2 wind farm:

- Provide proper PPEs to workers who are exposed directly to the sources of loud noise;
- Avoid the operate of many noise equipment at the same time to minimise the combined effects of noise;
- Maintain equipment regularly, periodically lubricate the parts which are likely cause the high noise;
- Develop appropriate work plan which working hours are defined from 06:00 to 22:00, divided into 2 shifts to minimise the operation of too many construction equipment at the same time; and
- Noisy equipment such as graders, excavators and bulldozers are not allowed to operate during the night time (after 22:00) to avoid the disturbance to workers and people living nearby the construction sites;
- Generators will be chosen from reputable manufacturers, and will be maintained regularly to minimise the noise. Generators will also be placed in closed warehouses protected with roofs and walls.

10.3.3.1.3 Significance of Impacts

The impact of elevated noise in Construction phase will be within the villages surrounding 03 villages in Phu Lac commune, and to some extent, in some communities located along the National Highway 1A passing through Lien Huong town.

Construction of wind farm is planned to last 09 months, therefore the duration of impact is **Short-term.**

The impact magnitude is **Small** because the residential areas are relatively far from construction sites, thus high noise levels from construction activities are not anticipated in these receptors. Disturbances caused by elevated noise levels will mainly come from movement of Project's vehicles along transportation routes.

The identified receptors are residential and agricultural and they may be more vulnerable in the night time due to sleep disturbance impacts, than during the day time when most of the construction works will typically be carried out. It is noted that the baseline noise levels measured at representative receptors (47.7 to 49.6 dBA) have already exceeded the IFC standards at night time (45 dBA) due to man-made and natural source of noise. The overall vulnerability is therefore **Medium**.

Overall, the significance of impact is **Minor**.

Table 10.11 Impacts on Noise during Construction Phase

Impact	Disturbance and potential health impact				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	Global		
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Vulnerability of Receptors	Low	**Medium**	High		
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is **Minor.**				

10.3.3.1.4 Additional Mitigation Measures

The following additional measures are proposed to further reduce the impacts of noise in construction phase:

- Use of appropriate noise suppression techniques (such as silencer, noise barrier) where applicable;
- Large sources of noise such as concrete mixing plants, mobile equipment, generators, etc., shall be located at appropriate locations within the worksite, as far away from the receptors as possible;
- When necessary, advise local residents when unavoidable out-of-hours work will occur;
- Develop a traffic management plan to avoid the movement of Project's vehicles through densely populated areas where possible;
- Set traffic speed limits. Provide training and verify drivers' behaviour with respect to driving speed and safety;
- Limit working hours of workers who are exposed to excessive noise levels in accordance with applicable regulations or international best practices;
- Provide appropriate training to workers for proper operation of vehicles and construction equipment and minimize unnecessary idling; and
- If any validated noise complaints are received, the problem source and any potential noise reducing measures should be identified and evaluated for implementation during the works. If the noise complaint cannot be validated, no further mitigation or management measures are required.

10.3.3.1.5 Residual Impacts

With the implementation of the above mitigation measures, the residual impacts would be expected to be **Negligible.**

10.3.3.1.6 Monitoring and Auditing

- Daily site inspection shall be implemented to verify the compliance with mitigation measures;
- Noise monitoring shall be conducted monthly at 02 locations: one at centre of project area; and one at project boundary adjacent to nearest existing or planned residential area or other sensitive areas located in the area of influence;
- Additional noise monitoring locations near the transportation routes shall be defined in traffic management plan.

10.3.3.2 Operation Phase

10.3.3.2.1 Potential Impact

Potential nuisance impacts to humans are associated with impulsive or tonal characteristics of noise emitted from the wind farm. Similar to construction noise impacts, potential consequences to human health due to chronic exposure can vary depending on noise levels, existing human health conditions and age.

The WTGs and substation will be sources of noise during the operation phase of the Project. The WTG specifications and model (Vestas V150-4.2) were provided by the project developer. The worst case sound power levels occur when the all 06 WTGs are operating concurrently in standard power operation mode at wind speeds higher than 10 m/s with no noise reduction modes used. The worst case operating mode has been modelled.

The noise emission model used in this study to predict wind farm noise levels at sensitive receptors is based on ISO 9613.1/2 as implemented within the Predictor v2020.0 computer noise modelling

software. The model predicts noise level through spherical spreading and includes the effect of air absorption (as per ISO 9613), ground attenuation and shielding.

Predicted L_{eq} noise levels were calculated based upon sound power levels determined in accordance with the recognised standard IEC-61400-11:2002 "*Wind Turbine Generator Systems – Part 11: Acoustic Noise Measurement Techniques*", for the wind speed higher than 10 m/s with no noise reduction modes applied.

A total of 2410 nearby receptors have been identified to be within the potential area of influence of the Project (2 km buffer from the WTGs), using satellite image and through site survey. A receptor is defined as any building occupied by human, either whole-day or certain times of day, such as houses, barns, schools, medical facilities, offices, hotels, spiritual places etc. For this assessment, they have been grouped into four Noise Catchment Areas (NCA1 to NCA4), depending on their geographic locations.

Noise levels have been predicted and results provided for all receptors but the focus of the noise modelling was addressing issues at the most affected receptors within each NCA. The predicted noise of the Project at these NCAs provides an indication of worst-case impacts and any required mitigation.

The representative receptors for NCA1 to NCA4 are named NSR1 to NSR4 as described in Table 10.12.

Table 10.12 Representative Sensitive Receptors

Receptor ID	UTM WGS84 North Zone 48 (metres)		Comments
	Easting	Northing	
NSR1	902815	1245898	Operation building of Eco Seido solar farm, 620 m to the Southwest of nearest WTG
NSR2	905195	1243188	Representative of scattered properties located along National Highway 1A, about 1.3 km to the Southeast of nearest WTG (NCA2)
NSR3	904462	1244985	Representative of properties in 03 villages Lac Tri, Phu Dien and Vinh Hanh, the most populated area of Phu Lac commune (NCA3)
NSR4	902815	1245898	Representative of scattered properties about 1 km to the north of nearest WTG (NCA1)

The resultant worst-case noise levels for each RNR and comparison to the project-specific noise limits are presented in Table 10.13 below. Overall noise modelling results are shown in Figure 10.2.

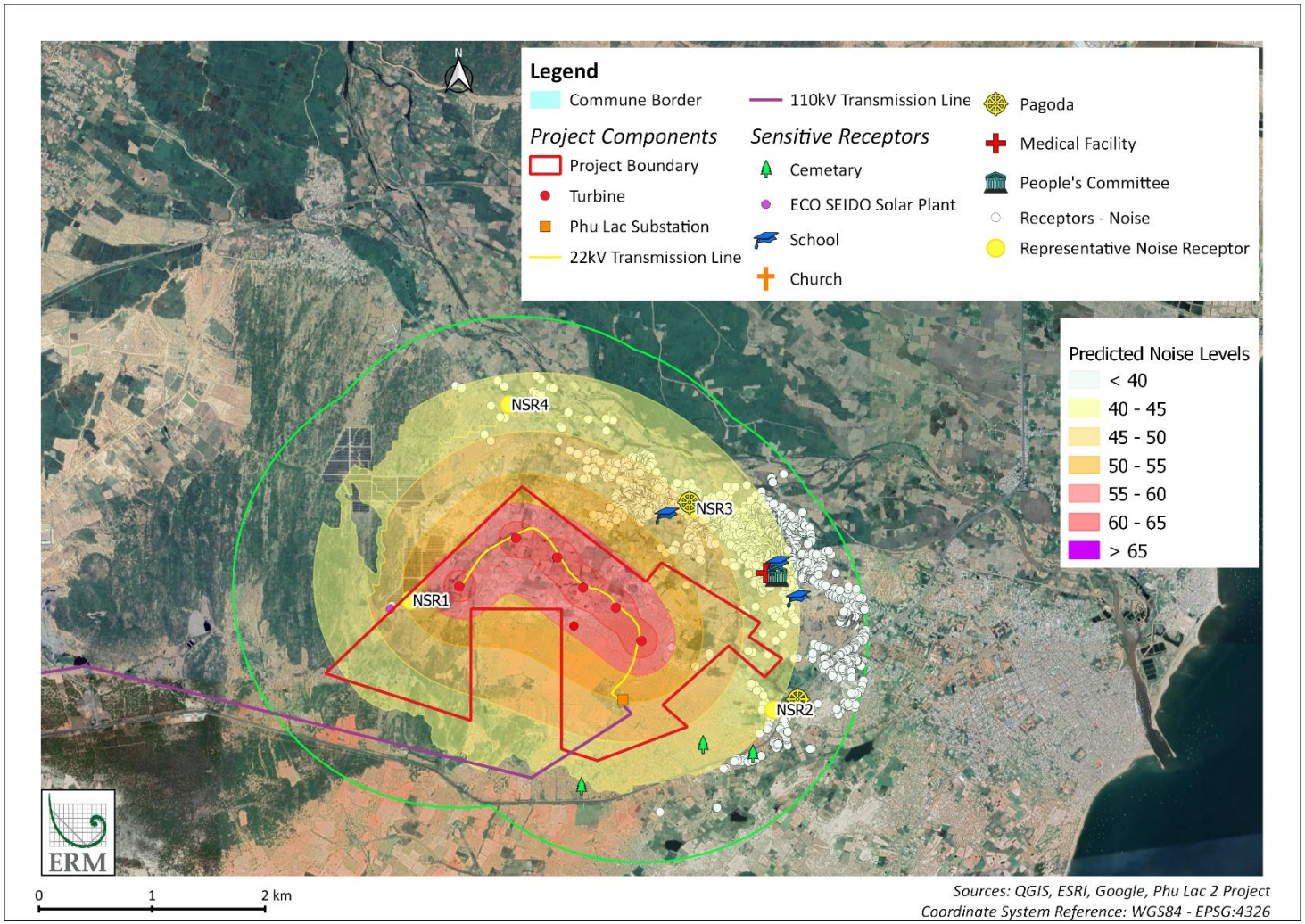


Figure 10.2 Project Locality, Noise Catchment Areas, Representative Receptors and Noise Modelling Results

Table 10.13 Predicted Operational Noise Levels at Worst Case Receptors (RNR1 – RNR3)

Receptor ID	Predicted noise level (Leq-1hr, dBA)	Compliance
NSR1	44.6	Yes
NSR2	33.7	Yes
NSR3	38.5	Yes
NSR4	38.6	Yes

The worst-case noise impact from the Phu Lac 2 Wind Farm has been predicted for receptors in NCA1, which is the operation building of a nearby solar farm, where worst-case operational noise level is predicted to be 44.6 dBA. Receptors in NCA2 have been assessed to be the most affected as they are the closest to the wind turbines within the Project, however, the predicted noise levels are still below IFC's limits. At other populated areas, the predicted noise levels are far below the permissible limits.

10.3.3.2.2 Existing Controls

The mitigation measures identified in the locally approved regulatory EIA include:

- The Vestas V150-4.2 WTGs to be installed for the Project are modern, low-noise generating turbines.

10.3.3.2.3 Significance of Impacts

- Disturbance and potential health impacts from elevated noise levels are considered **Negative**.
- The impact duration is **Long-Term** during the Project lifetime**;**
- Impacts of noise in operation phase are within the Project area;
- Operational noise levels may occur intermittently or continuously depending on wind conditions and WTG operations;
- The impact magnitude is **Small** as the predicted noise level generated by the WTGs at most affected receptor (NCA1) are slightly below IFC's limits.
- While NCA2 and NCA3 are residential areas where people have already been exposed to man-made and natural sources of noise, and the night-time baseline noise levels (47.7 to 49.6 dBA) are already considerably higher than IFC permissible limit (45 dBA). NCA1 is the operation building of a solar wind farm with proper roof and walls, therefore the indoor noise levels are not affected by by the wind farm. The overall vulnerability of receptor is **Medium**;
- The overall Significance of impact is considered **Minor**.

Table 10.14 Impacts on Noise during Operation Phase

Impact	Disturbance and potential health impact				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	Global		
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Vulnerability of Receptors	Low	**Medium**	High		
Significance	Negligible	**Minor**	**Moderate**	Major	

10.3.3.2.4 Additional Mitigation and Management Measures

The following safeguards are provided:

Prior to operation: if the turbine selection and/or layout are to be changed, noise modelling will have to be run again to verify if noise levels are to increase, and compliance with the noise limits documented in this report would need to be reassessed. Noise reduction measures, such as serrated trailing edges, should be applied where possible.

- **During operation:**
  - If the turbines change, and noise levels are anticipated to increase, then compliance with the noise limits documented in this report would need to be reassessed.
  - Routine maintenance of wind turbines should also be conducted, with specific attention to equipment degradation that may cause further noise impacts. Any equipment that is abnormally noisy should be evaluated and repaired as necessary to return emissions to typical operating performance;

10.3.3.2.5 Monitoring and Auditing

It is recommended that if any repeated/validated noise complaints are received then compliance monitoring should be undertaken to confirm predicted noise levels. Where noise monitoring occurs the work should be scoped and then conducted by a suitably experienced person. The purpose of the monitoring is to understand in-situ levels and to provide a comparison to predicted levels (from this ESIA) so that any additional controls be identified and then implemented if it is feasible, reasonable and practical to do so. If this is required:

- All Project / site noise levels should be measured in the absence of any influential source not associated with the Project.
- If the measured site noise levels are below the predicted values and comply with the applicable thresholds, limits or criteria identified for each noise aspect, no further noise control is required.
- If the measured site noise levels are above the predicted noise levels or the applicable thresholds, limits or criteria identified for each noise aspect, further noise control or management measures should be considered, such as applying Noise Reduction System operational modes, and if needed, even considering relocating the households whose owners file the complains and if within these areas noise maximum permissible limits are surpassed, or else, providing compensation packages under agreement with the owners.

In case there are no complaints, the noise levels at sensitive receptors shall be measured once every three months in accordance with Circular 24/2017/TT-BTNMT stipulating environmental monitoring techniques. Monitoring results should be reported in periodic Environmental Monitoring Report submitted to the DONRE.

10.3.3.2.6 Residual Impact

The residual impacts associated with noise from the operation of the Project WTGs are considered **Minor**.

10.4 Shadow Flickering Impact Assessment

10.4.1 Scope of Assessment

Within windfarms, shadow flickering may be one of the most significant impacts on surrounding communities, we have therefore included this section to address this particular impact. The likelihood and duration of the flickering effect depends usually upon a number of factors, including:

- The direction and distance of the property relative to the turbine (the further the observer is from the turbine, the less pronounced the effect will be);

- Turbine height and rotor diameter;
- Time of the day and year linked to climatology conditions in the area;
- Wind direction (that affect potential wind turbine orientation);
- General weather conditions (presence of cloud cover, fog, humidity reduces the occurrence of shadow flicker as the visibility itself of the turbine is reduced);
- Windows structure (e.g. window direction, window coverings, materials); and
- Topography and presence of natural or anthropic barriers (i.e. vegetation, other buildings etc.).

In general, shadow flickering effect occurs during clear sky conditions, when the sun is low on the horizon (sunrise and sunset). As the angle of elevation from the horizon of the sun during midday changes throughout the year plus the topographical relief, each location is experienced and influenced by the shadow flickering effect phenomenally different. Hence, specific shadow receptors can be disturbed in different periods of the day or year.

The theoretical number of hours of experienced shadow flickering effect each year at a given location can be calculated by utilising modelling packages (e.g. Shadow model in windPRO 3.4) incorporating the sun path, topographical relief over the Project site, and rotor diameter and hub height details of wind turbine model.

When assessing shadow flickering impacts, the worst case and/or real case impacts are determined:

- **Worst Case Scenario:** the possibility of astronomical shadow flickering duration at maximum is defined when the sun is lastingly shining during daylight hours (i.e. the sky is always clear), the wind turbine is always operating, the rotor is always is always perpendicular to the line from the WTG to the sun; and
- **Real Case Scenario:** the expected shadow flickering duration is when average sunshine hour probabilities and wind statistics at a certain region include turning off periods (low winds and high winds) are taking into account.

10.4.2 Applicable Standards

In August 2015, the World Bank Group published the Environmental, Health and Safety (EHS) Guidelines for Wind Energy. In addition, it is also applied the EHS Guidelines of IFC for Shadow Flicker impact assessment[4]. These are technical reference documents containing examples of good industry practice.

The definition adopted in the EHS guidelines states that shadow flicker occurs when the sun passes behind the wind turbine and casts a shadow. As the rotor blades rotate, shadows pass over the same point causing an effect termed shadow flicker. Shadow flicker may become a problem when potentially sensitive receptors (e.g. residential properties, workplaces, educational and/or healthcare spaces/facilities) are located nearby, or have a specific orientation to the wind energy facility.

Key points identified in the guidelines include:

- Potential shadow flicker issues are **more likely occurred at higher latitudes** where the sun is lower and closer to the skyline; therefore shadows will be casted and extended the radius in which potentially receptors will be experienced consequential shadow flicker impacts.
- In case of the possibilities of modifying the wind turbines' locations where neighbouring receptors experience no shadow flicker effects are low, it is recommended that the predicted duration of shadow flickering effects experienced at a sensitive receptor **should not exceed 30 hours per year and 30 minutes per day on the worst affected days, based on a worst-case scenario**.
- Recommended preventative and mitigative measures to avoid substantial shadow flicker impacts include **systematising wind turbines' arrangement appropriately** to avoid shadow flicker being

[4] EHS Guidelines of IFC: https://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/sustainability-at-ifc/policies-standards/ehs-guidelines

experienced or to meet duration limits of shadow casting continuously on the shadow sensitive receptor, as set out in the paragraph above, or scheduling wind turbines to **shut down at intervals where shadow flicker limits are exceeded**.

10.4.3 Receptors

The Project is located in the south of Phu Lac commune, Tuy Phong district, Binh Thuan province with most of dense residential area concentrated in Phu Dien and Lac Tri villages (approximately 300 m to the northeast of the Project). The Project location is characterised by the presence of flat terrain with most of agricultural land and bareland. There is a total of 1550 potential receptors that could potentially experience the shadow flickering event. Figure 10.3 presents the location of such receptors.

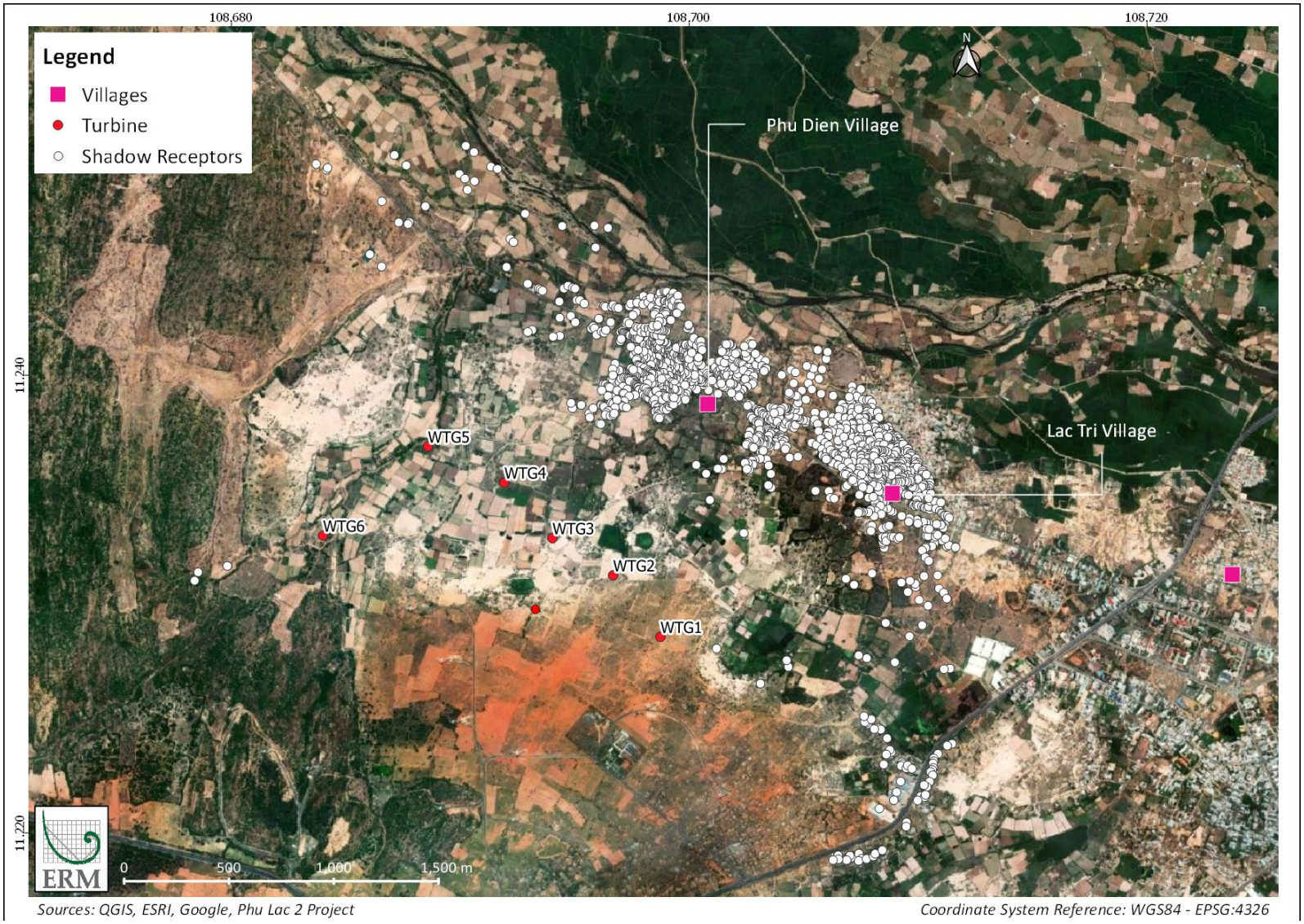


Figure 10.3 Location of Main Receptors

10.4.4 Shadow Flickering Analysis

10.4.4.1 windPRO Model: Scenarios and Input Criteria

This assessment was performed using windPRO 3.4©; a computer software which is widely used by the wind industry. The software package includes a Shadow Flicker Module (SHADOW) that calculates the frequencies and the intervals in which a specific neighbouring receptor or area will be affected by one or more wind turbines.

Two scenarios have been considered and modelled: Worst Case Scenario and Real Case Scenario.

- **Worst Case Scenario:** the calculation is based on the following key assumptions:
  - The presence of physical barriers is not considered;
  - Natural vegetation screening is not included;
  - Cloudiness, humidity are not considered;
  - The sun is shining all the day, from sunrise to sunset;
  - Rotor is always in operation and refrained from turning off during low winds or high winds, and
  - Shadow receptors are modelled using the “greenhouse” mode, meaning that shadow flicker effect to each receptor at all directions (visibility 360 degrees).
- **Real Case Scenario:** is designed by considering planned turbines, the calculations are based on a more realistic situation where publicly available dataset of sun shining probability is applied. However, it should be noted that real case scenario still ignores other relevant conditions of the local settings, which will theoretically lead to an overestimation of the shadow flickering occurrence.

All scenarios have been carried out with a chronological resolution of 1 minute (if shadow flicker is predicted to occur in any 1-minute period, the model records this as 1 minute of shadow flicker).

Independent of the selected scenario, the model calculates outputs according to the principles presented in the following Figure 10.4.

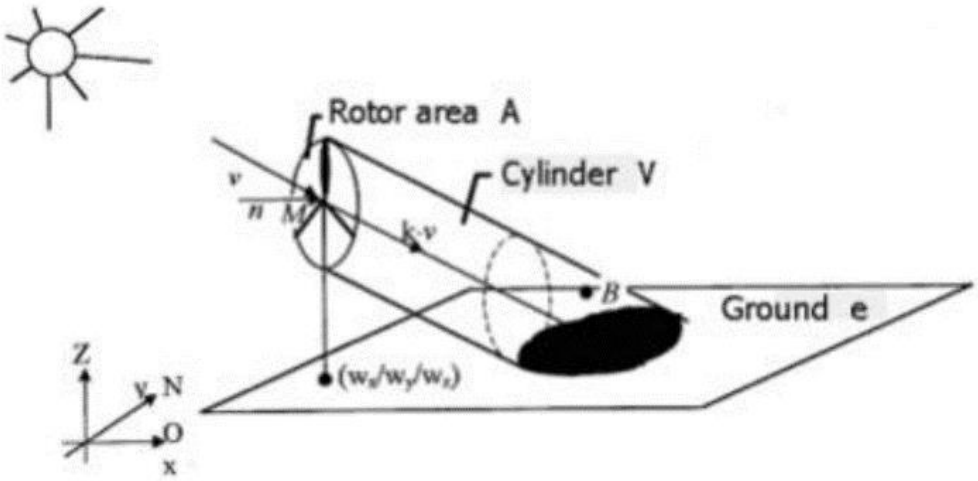


Figure 10.4 Shadow Flickering Theory

All receptors in both scenarios, assuming dwellings/groups of dwellings, within 1.5 km of Project’s WTGs have been modelled are taken into account the following characteristics:

- Single storey building. Therefore, shadow flicker has been calculated at a height of 1 m (equivalent to the ground floor windows);
- Slope of the window has been set to 90°;

- The identified receptors are simulated as fixed points with the 360° viewpoint which represented an unrealistic scenario as real windows would only face a particular direction.[5]

10.4.4.2 Worst Case Scenario

The following assumptions have been reflected in the modelling setting for the Worst Case Scenario:

- Rotors are always rotating;
- The Sun is shining all the day, from sunrise to sunset;
- Local topography has been obtained from SRTM DTM;
- No cloud cover or any other meteorological conditions that could potentially reduce visibility and the sunlight have been assumed;
- Receptors modelled using greenhouse mode;
- No physical barriers are considered.

10.4.4.3 Real Case by Statistics Scenario

The following assumptions have been considered in the modelling setting for Real Case Scenario:

- Public data of average daily sunshine hours at Phan Rang meteorological station (approximately 49 km from the Project):

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

- Local topography has been obtained from SRTM DTM;
- No cloud cover or any other meteorological conditions that could potentially reduce visibility and the sunlight have been assumed;
- Receptors modelled using greenhouse mode;
- No existing physical barriers have been considered (e.g. trees);
- Rotors are always rotating; and
- The probability distribution of wind direction according to data recorded at the Project's measurement tower at the height of 80 m from 2013 to 2016:

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
3.28 %	14.91%	14.58%	11.51%	7.59 %	3.41 %	1.71 %	1.05 %	1.59 %	3.66 %	8.49 %	6.9%	12.14%	2.25%	2.38 %	4.56 %	100%
287	1307	1277	1008	665	299	150	92	139	321	744	604	1063	197	208	399	8,760

It should be noted that even the assessment performed with such assumptions is leading to an overestimation in terms of annual number of hours of shadow flicker at a specific location mainly because of the following local conditions have not been included:

- The occurrence of cloud cover has the potential to significantly reduce the number of shadow flickering hours that the observer can be experienced;
- The presence of aerosols in the atmosphere have the ability to influence the flickering duration as the length of the shadow cast by a WTG depends on the angle of direct sunlight hits, which is strictly determined by the amount of fine solid particles/liquid droplets in between the observer and the rotor; and

[5] Worst Case Scenario in windPRO 3.4 software based on EHS Wind Energy Guidelines

- The analysis has not considered the presence of vegetation or any other physical barriers around a receptor that are able to block the view (at least partially) of the turbine.

10.4.4.4 Setting Summary of Scenarios

The following table is reporting the modelling settings adopted per each scenario. However, it should be noted that the performed calculations did not consider the actual location and orientation of windows of the possible affected houses, or the screening effects associated with existing, site-specific conditions and obstacles like other buildings, leading to potential of over-estimating the duration of occurrences when shadow flicker might be experienced at a specific location.

Table 10.15 windPRO Shadow Module Inputs (in bold the differences among Worst Case and Real Case Scenario)

	Worst Case Scenario	Real Case Scenario
Wind Turbine location	See Figure 10.3	See Figure 10.3
Rotor diameter and hub height	150m/ 125m	150m/ 125m
Wind Turbine Operation	Rotors are always rotating	Rotors are always rotating
Wind Turbine Visibility	A WTG will be visible if it is visible from any part of the receiver window (greenhouse mode)	A WTG will be visible if it is visible from any part of the receiver window (greenhouse mode)
Window stories dimensions	1m height / 1m large / 1m from the ground floor	1 m height / 1m large / 1m from the ground floor
Cloudiness	Not considered	Not considered
Physical barriers (i.e. vegetation)	Not considered	Not considered
Minimum sun height over horizon for influence	3°	3°
Day step for calculation	1 day	1 day
Time step for calculation	1-minute	1-minute
Shining period	**The sun is always shining all day, from sunrise to sunset**	**The sun is shining as per available local sunshine data (Phan Rang meteorological station)**
Height contour	SRTM DTM	SRTM DTM
Eye Height	1.5 m	1.5 m

10.4.5 Model Results

As presented above, two scenarios have been modelled using SHADOW module of windPRO software to identify the receptors potentially affected by the shadow flickering. The following sections are reporting the number of potentially affected receptors per each scenario.

10.4.5.1 Worst Case Scenario

As previously mentioned, the modelling package was calculating the predicted shadow flickering durations at receptors. Worst case scenario had considered a fully worst case scenario with unrealistic conditions which led to a potential of 642 (around 41.42 %) impacted receptors out of 1,550 mapped receptors. The key potentially impacted area is mainly located in the southwest of Phu Dien and Lac Tri villages, Phu Lac commune (account for approximately 95.95 % out of total impacted receptors). IFC maximum permissible thresholds limits have been exceeded for both parameters: hours/year and min/day at these receivers with the most impacted receptor (1547) experiences 266 hours per year (vs 30 hours per year) with the maximum of 103 minutes per shadow day (versus 30 min per day).

The following maps present the influencing areas where shadow flickering is occurring based on the Worst Case Scenario setting (Figure 10.5 to Figure 10.7).

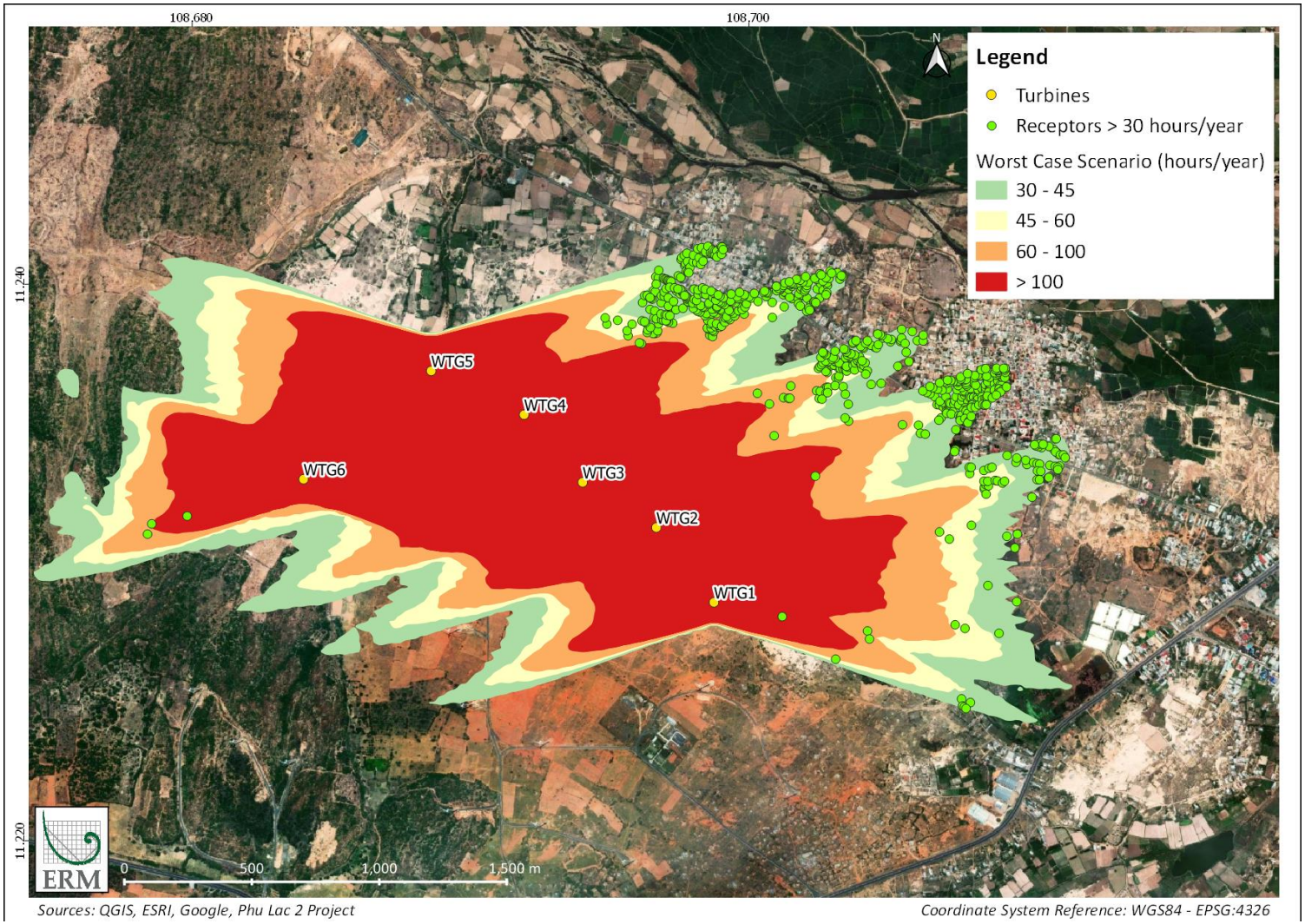


Figure 10.5 Map of Predicted Shadow Flicker (hours/year) for the Project – Worst Case Scenario

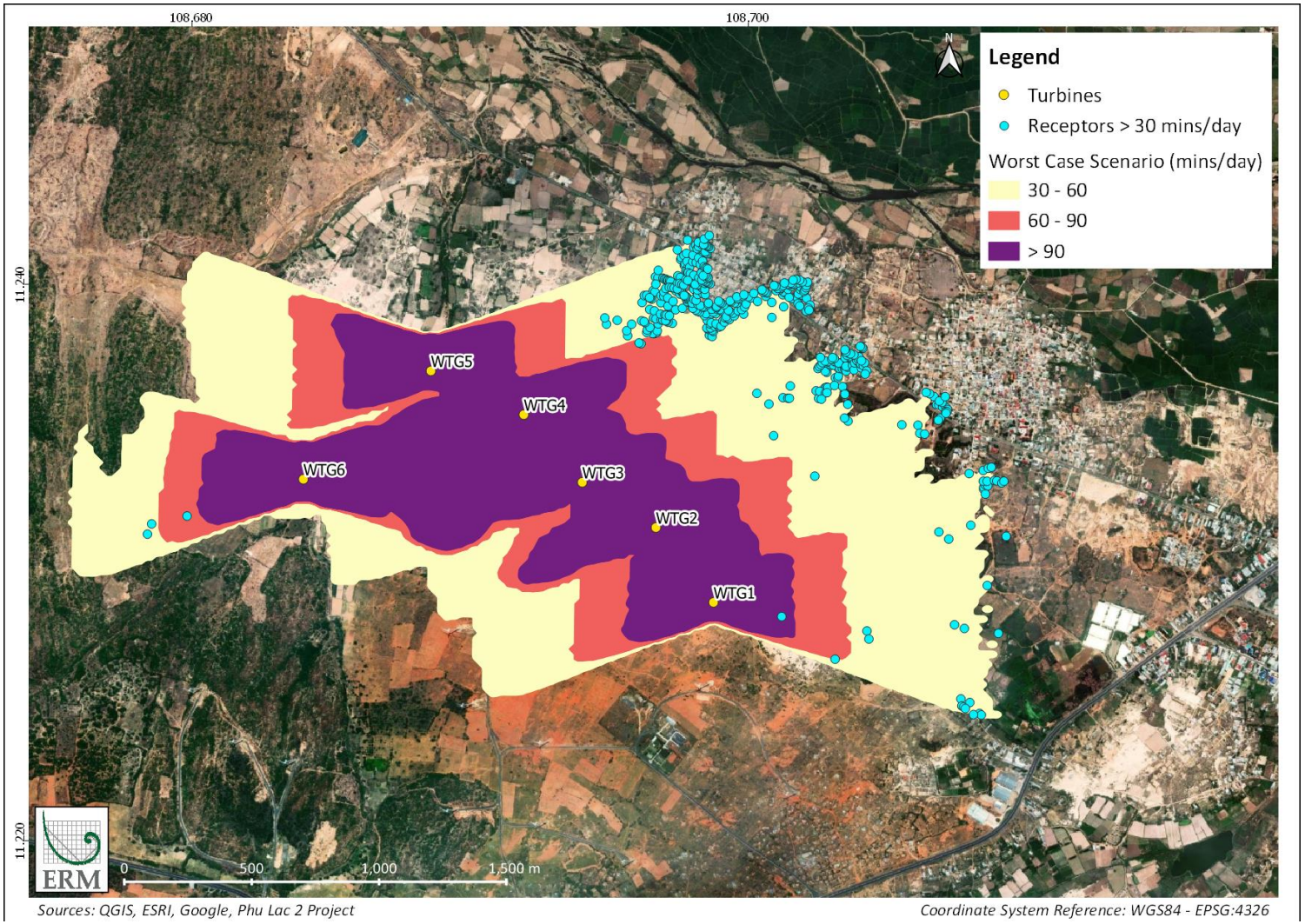


Figure 10.6 Map of Predicted Shadow Flicker (minutes/day) for the Project - Worst Case Scenario

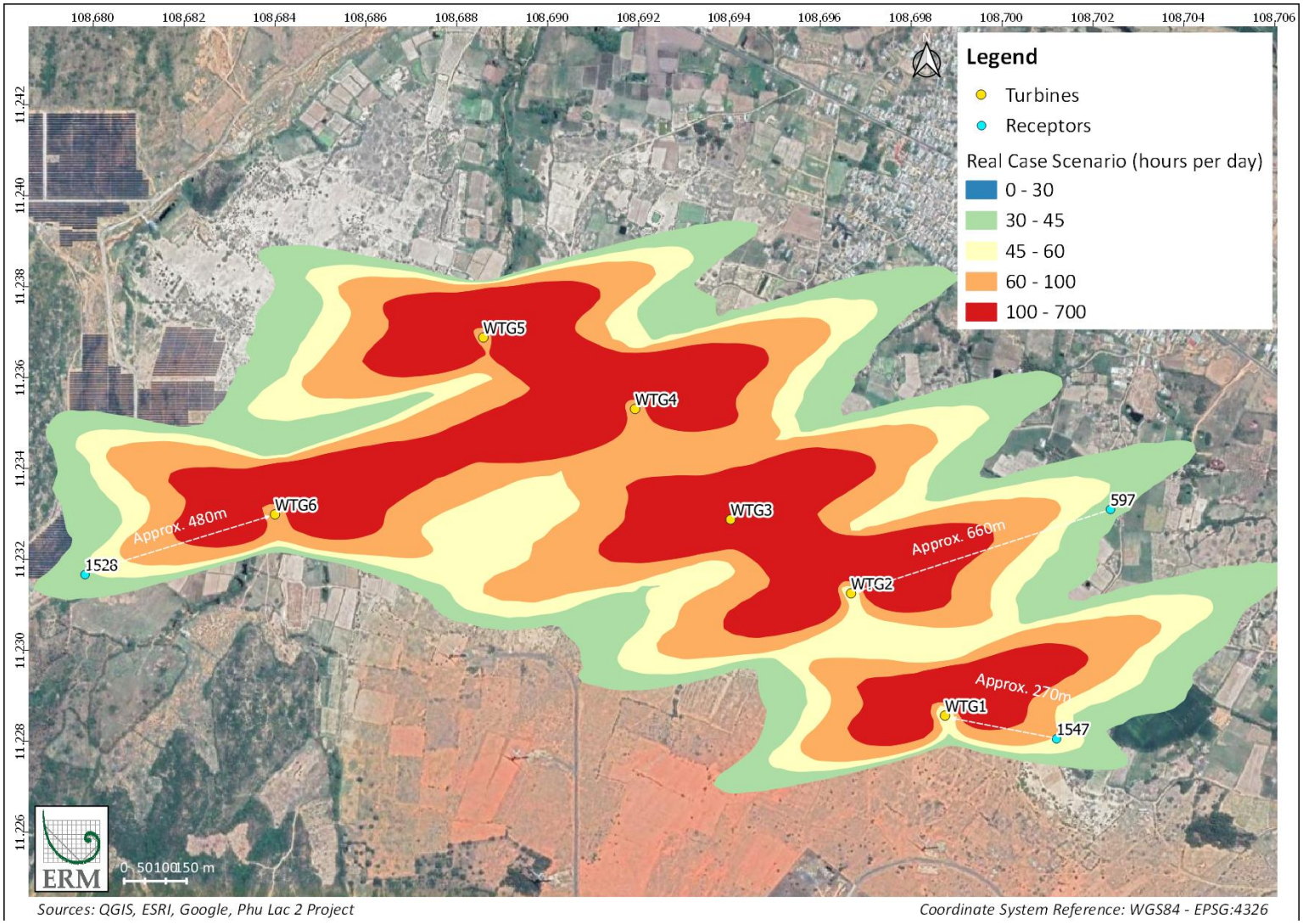


Figure 10.7 Map of Predicted Shadow Flickers (hours/year) at Receptor No. 597, 1528, and 1547 – Worst Case Scenario

10.4.5.2 Real Case by Statistic Scenario

In order to assess the shadow flickering occurrence taking into account local conditions for few parameters, a second scenario has been calculated.

The predicted shadow flicker durations at receptors are presented Figure 10.8 to Figure 10.12.

Based on Figure 10.8 to Figure 10.12, the results confirmed that with the input of local conditions (wind directions and average daily sunshine hours) on the modelling, the number of impacted receptors have been reduced to 16 instead of 642, furthermore, most of the impacted houses fall in the range of 30-45 hours per year. For further detail modelling result, please refer to Appendix A.

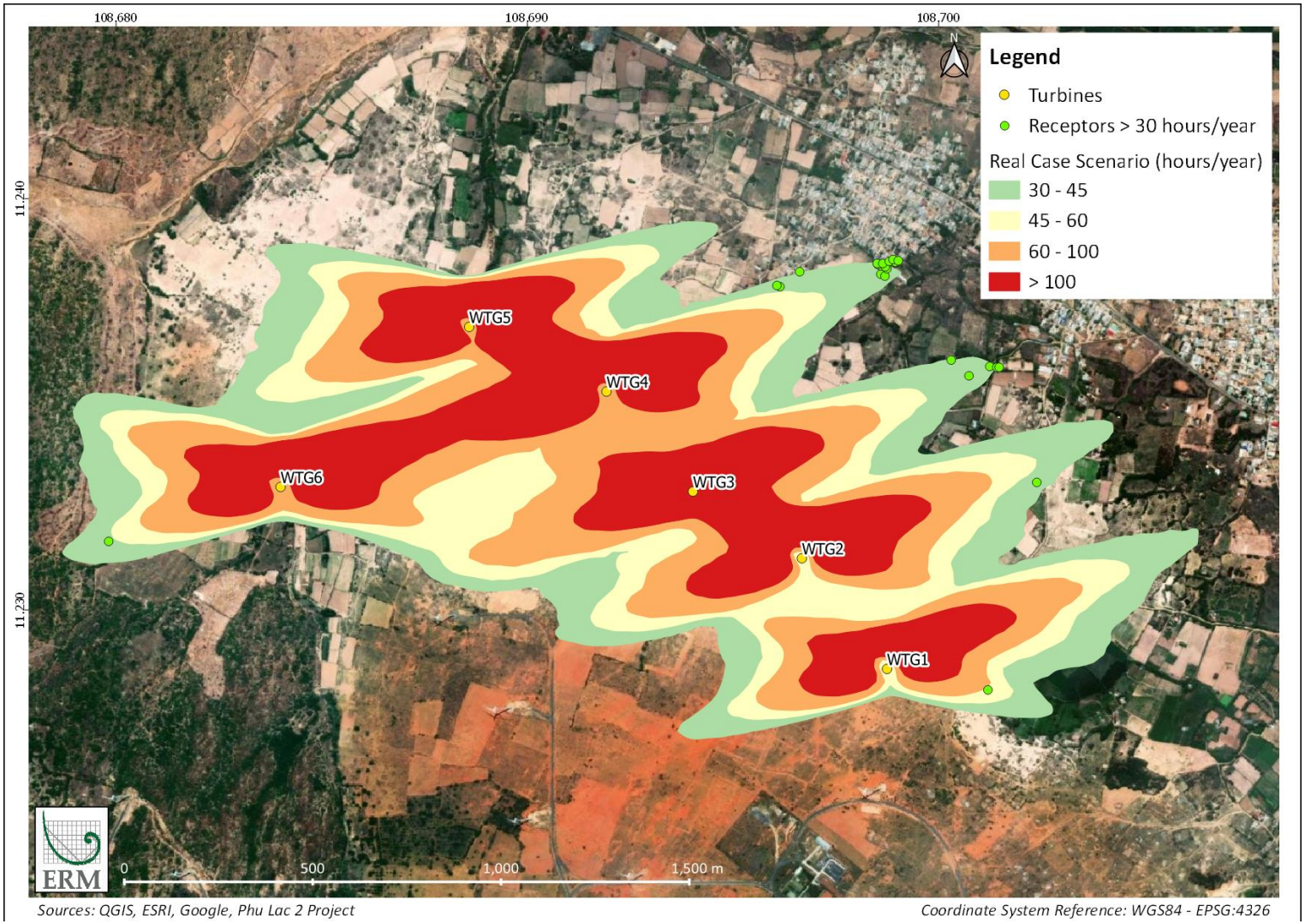


Figure 10.8 Map of Predicted Shadow Flicker (hours/year) for the Project– Real Case Scenario (range considered 1.5 km)

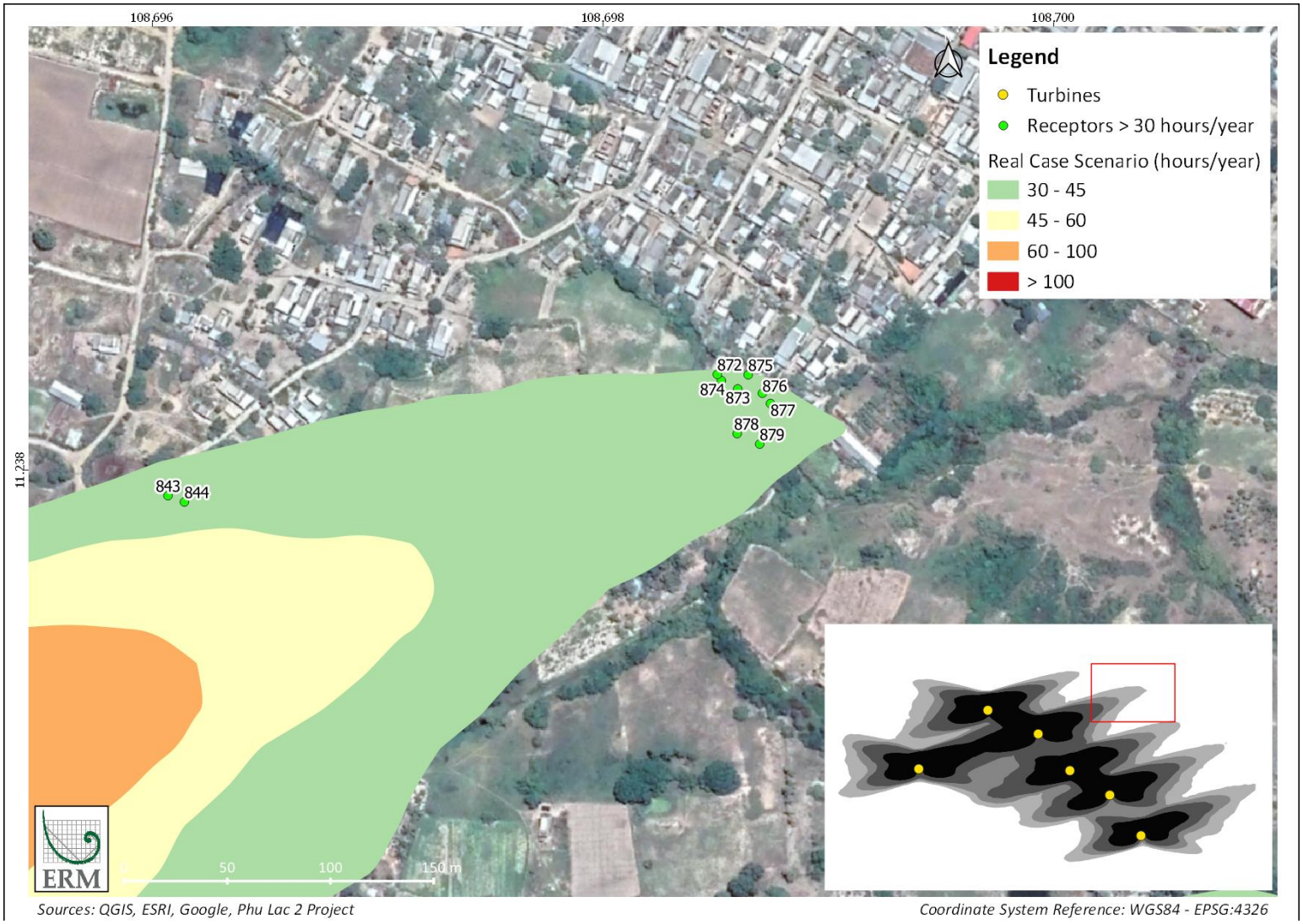


Figure 10.9 Map of Predicted Shadow Flicker at Receptors No. 843, 844, and from 872 to 879 (hours/year) – Real Case Scenario

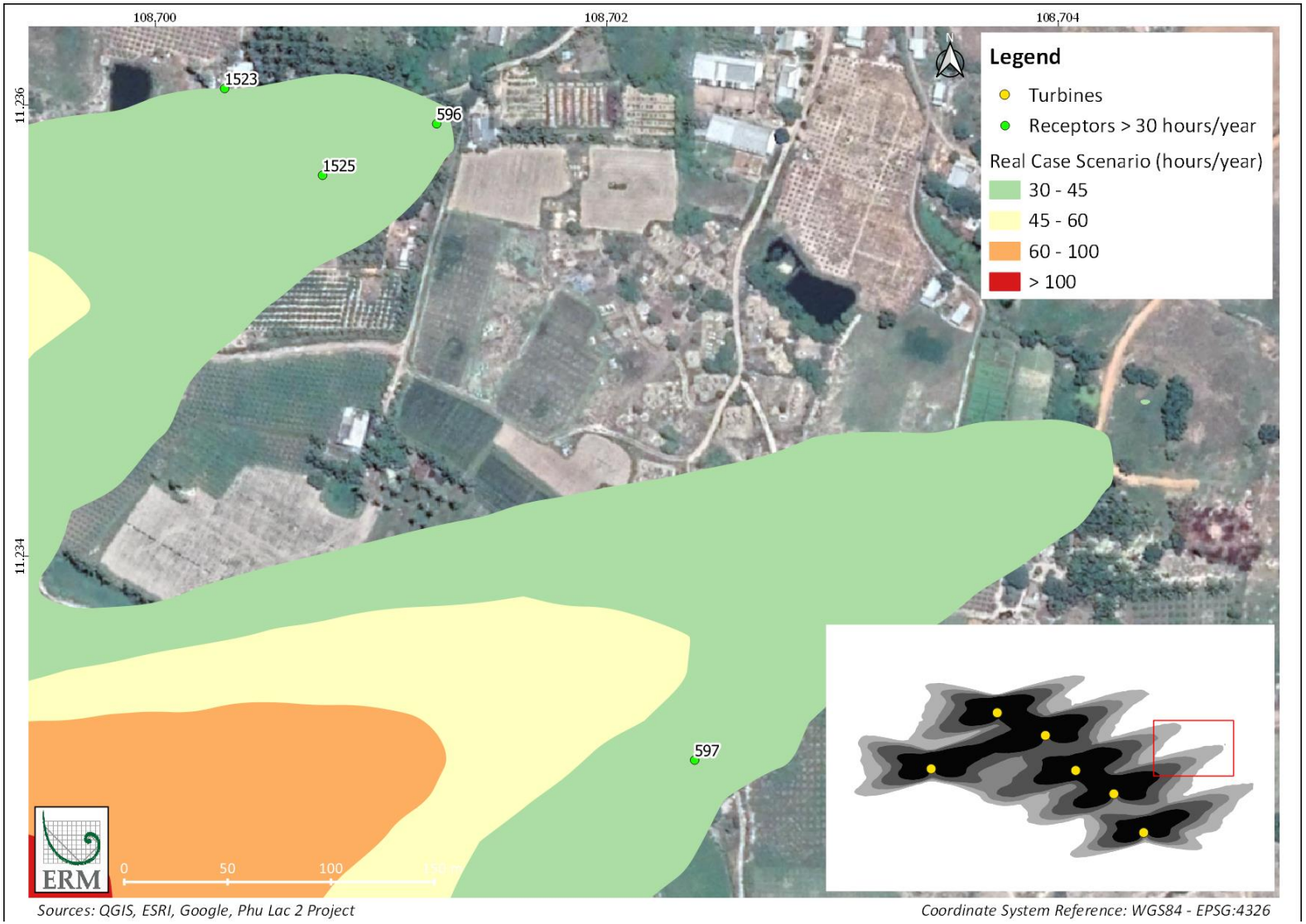


Figure 10.10 Map of Predicted Shadow Flicker at Receptors from No. 596, 597, 1523, and 1525 (hours/year) – Real Case Scenario

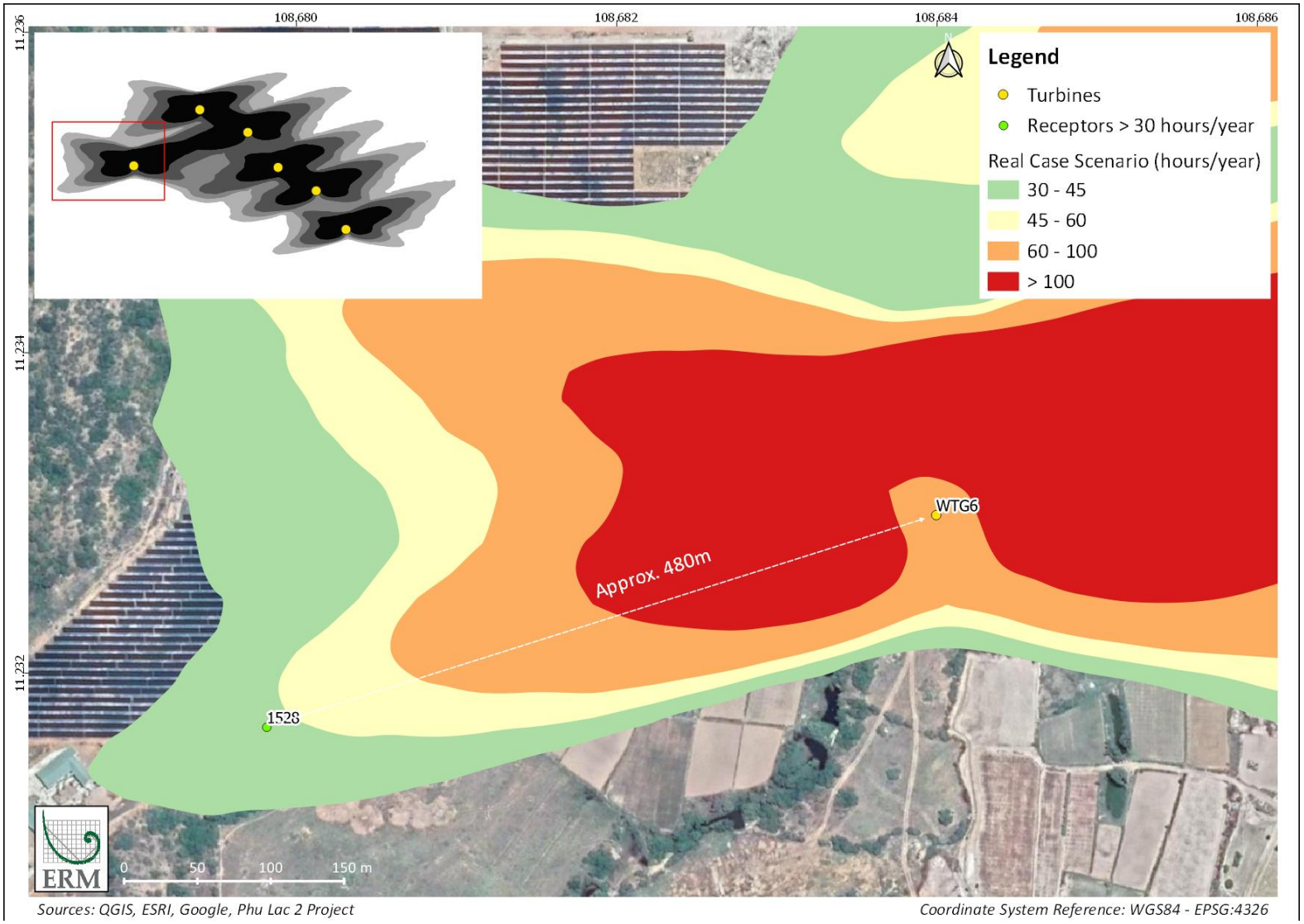


Figure 10.11 Map of Predicted Shadow Flicker at Receptors No. 1528 (hours/year) – Real Case Scenario

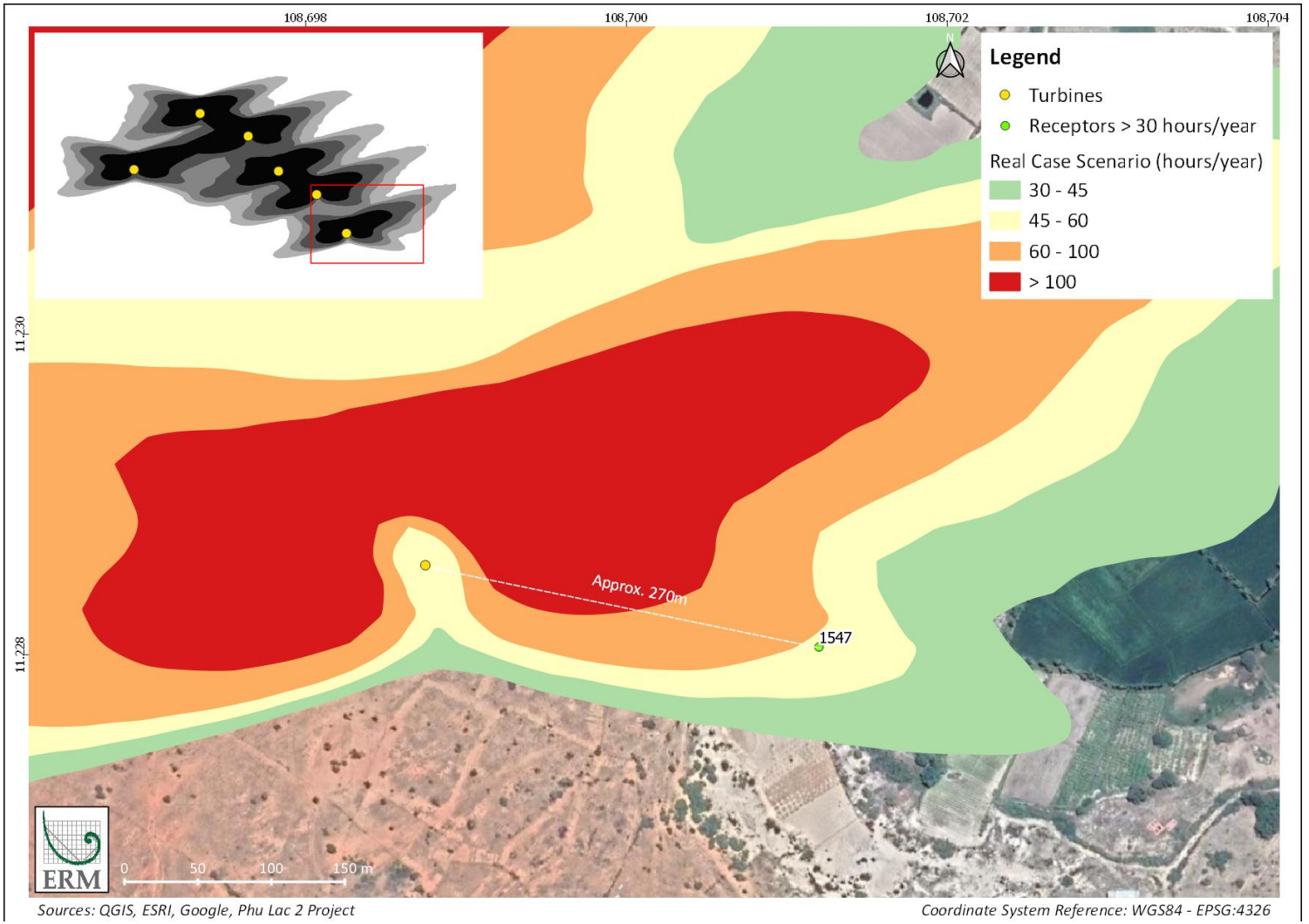


Figure 10.12 Map of Predicted Shadow Flicker at Receptors No. 1547 (hours/year) – Real Case Scenario

10.4.6 Impact Assessment

10.4.6.1 Potential Impacts

The association between shadow flicker caused by wind turbines and the effects on human health is highly debated.

Certain studies suggested that flicker from turbines poses a potential risk of inducing photosensitive seizures (Harding et al, 2008; Smedley et al., 2010).

However, in 2011, the UK Department of Energy and Climate Change concluded in their Update Shadow Flicker Evidence Base report that “On health effects and nuisance of the shadow flicker effect, it is considered that the frequency of the flickering caused by the wind turbine rotation is such that it should not cause a significant risk to health”.

Despite such conclusions, other reports state that although shadow flicker from wind turbines is unlikely to lead to a risk of photo-induced epilepsy, the potential for annoyance and disturbance are still present leading to stress and therefore, this physical phenomenon should be considered when evaluating impacts on surrounding communities (Cope et al., 2009; Minnesota Department of Health, 2009; National Research Council, 2007).

10.4.6.2 Existing/ In-Place Control

There are no suggested existing controls in the local EIA report.

10.4.6.3 Significance of Impacts

The shadow flickering assessment has considered two scenarios as previously mentioned: a worst-case scenario and a more realistic one embedding local meteorological conditions. In both scenarios, even though the amount of receptors in real case scenario had been significantly reduced comparing to worst case scenario (16 versus 642 shadow receptors), these are still considered to be potentially impacted by shadow flickering exceeding the international maximum permissible limits. It should be noted that:

- Based on available satellite imagery, the potential impacted households located within the range of impact (1.5 km from wind turbines) are characterised in one of the impacted groups by the presence of dense residential areas. However, some receptors located in agricultural area and flat terrain with neither have natural nor man-made barriers. These conditions can increase the potential for households scattered within the Project area and being directly affected and experiencing shadow flicker in real conditions (Figure 10.13 to Figure 10.16);
- In addition, it should be noted that receptors have been identified using satellite imagery and not confirmed through a dedicated site visit. Potentially some of them are not representing dwellings where people permanently resided; therefore it would be good if the affected households could be verify through fieldwork, and
- The performed calculations do not take into account the actual location and orientation of windows, as we really do not have yet that type of information, or the screening effects associated with existing, site-specific conditions and obstacles like other buildings, leading to overestimate the duration of occurrences when shadow flicker might be experienced at a specific location;

Shadow flicker impacts are considered negative, direct and long-term linked only to the Operation Phase of the Project. The impact range is within a scale of 1,500 m of the WTGs on the receptors in the northeast-southwest and south of the WTGs. Impact magnitude will vary depending on distance of receptors from the WTGs and their orientations.

Figure 10.13 Environmental Setting at Shadow Receptors No. 837, 843, 844, and from 871 to 882

Figure 10.14 Environmental Setting at Shadow Receptors from No. 594 to 597, 1523, and 1525

Figure 10.15 Environmental Setting at Shadow Receptor No. 1528

Figure 10.16 Environmental Setting at Shadow Receptor No. 1547

Table 10.16 Shadow flickering impacts during Operation Phase

Impact	Shadow flickering impacts during Operation Phase				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	Global		
Impact Frequency	The shadow flickering impact could potentially occur up to 10 hours/day				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
Receptors Sensitivity	Low	**Medium**	High		
Significance	Negligible	Minor	**Moderate**	Major	
	The significance is **Moderate**				

10.4.6.4 Additional Mitigation Measures

As per the outcomes of the modelling, with specific regards to the residual potential impacted receptors identified by the real case scenario (16 receptors) and in the event that on-site residents will be really affected by shadow-flickering once the turbines are under operation, it is suggested the Project proponent will assess the situation on a case-by-case basis and work according to the following mitigation scheme:

- Visual Screening (Natural) – Perform and assessment through field observations on potential sensitive receptors, where modelling results indicated that could exceed 30 hours per year, to have more accurate results considering the extent of possible existing natural visual screening in place. If results are confirmed and still it is noted that permissible limits are not met, then further investigations on shadow flickering impact on these households must be performed during operation, mitigation measures as natural screening (e.g. plant trees, grow hedges) could be considered to minimise the effect; and
- Visual Screening (Architectural / Structural) - If grievances are received linked to this impact or if natural visual screening at potential sensitive receptors are found to be insufficient to mitigate the shadow effect, further assessments will have to be performed and apply certain mitigation actions as installation of blinds, window shades, window tinting, awnings or fences at affected receptors, which will help to minimize the effect of shadow flicker.
- Relocation – If visual screening, both natural and architectural / structural fail to mitigate shadow flicker impact at sensitive receptors, then relocation of affected households would have to be considered and had to be openly presented to local community by the Client for prior consent. Any relocation process will have to be performed in accordance with international IFC standards / principles stip (IFC PS-5) related to resettlement. This would include as well undertaking a socio-economic census prior commencing with the windfarm construction. If applicable, any land or residence replacement, including farmland,, would have to be provided by the Client. However, it is important to have in mind, that Project developer will not be responsible for any affected settlements which are constructed after the commencement of wind farm construction and once the fieldwork to confirmed affected households has concluded.

10.4.6.5 Residual Impacts

The mitigation measures above will be implemented on the identified receptors. Residual impact following the implementation of these mitigation measures is likely to be **Minor**.

10.4.6.6 Monitoring and Audits

Periodically monitoring of the grievance mechanism and reporting needs to be performed– implementing a process to identify the real occurrence of the shadow flickering at surrounding houses located within the impacted radius (1.5 km from wind turbines) to mitigate or eliminate in the best way

possible the phenomena. In case of dwellings experienced shadow flickering, a detailed grievance mechanism should be available and displayed to local community who must be aware of how to use this mechanism to submit their complaints regarding nuisances related to shadow flicker from turbines. Ensuring performing close monitoring through enagement with local stakeholders that could be affected throughout the operational phase where there are possibilities to face these.

10.5 Electromagnetic Interference Impact Assessment

The transport of electricity through undersea inter-array cables and overhead transmission line has potential to emit a localized Electromagnetic Fields (EMF) which could potentially affect some benthic species, intertidal and subtidal habitat and human health. EMFs have both electric measured in kilovolts per metre (kV/m) and magnetic components measured in micro tesla (μT). While the direct electric field is mostly blocked with the use of conductive sheathing, the magnetic field can penetrate most materials, thus is emitted into the natural terrestrial and aquatic environment.

10.5.1 Scope of Assessment

Activities causing the potential impacts to electromagnetic interference that are likely to negatively impact receptors during the operation phase include:

- Electrical current flowing through conducting wire of the wind turbines transformers, transmission line and substation transformers when the wind turbines are in operation.

10.5.2 Relevant Guidelines and Criteria

10.5.2.1 Vietnamese Regulations

- The Law on Electricity No. 28/2004/QH11 was approved by the National Assembly of the Socialist Republic of Vietnam at its 6th session on 03 December, 2004;
- Decree No. 14/2014/ND-CP dated February 26, 2014 stipulates in detail the implementation of The Law on Electricity, especially regarding electricity safety;
- Decree No 51/2020/ND-CP dated 21 April, 2020 on amending a number of Articles of the government's Decree No 14/2014/ND-CP dated February 26, 2014 stipulating implementation of electricity law regarding electrical safety;
- Circular No. 31/2014/TT-BCT dated 02 October, 2014 regulating details on electrical safety;
- QCVN 25/2016/BYT – National Technical Regulation on Industrial Frequency Electromagnetic Fields – Permissible Exposure Level of Industrial Frequency Electromagnetic Fields in the Workplace; and
- QCVN 21:2016/BYT - National Technical Regulation on High Frequency Electromagnetic - Permissible Exposure Level of High Frequency Electromagnetic Intensity in the Workplace

10.5.2.2 International Guidelines

IFC Environmental Health and Safety Guidelines for Electric Power Transmission and Distribution (2007) provides guidelines to manage potential environmental and community health and safety impacts from power construction facilities, including electric and magnetic fields.

As mentioned in the above section, electric fields are normally measured in kilovolts per metre (kV/m), while magnetic fields are defined by magnetic flux density, measured in micro-Tesla (μT) or milli-Gauss (mG). The World Bank Group's (WBG) Environmental, Health and Safety (EHS) Guideline[6] for Power Transmission and Distribution (WBG, 2007) refers to the International Commission on Non-Ionizing

[6] EHS Guidelines for Power Transmission and Distribution, April 30, 2007

Radiation Protection (ICNIRP)[7] [8] for health and safety standards relative to exposure to EMF. The World Health Organization (WHO)[9] refers to ICNIRP EMF standards as short-term and high level exposure limits. At present, ICNIRP limits consider the scientific evidence related to possible health effects from long-term, low level exposure to EMF fields insufficient to justify lowering these quantitative exposure limits. The ICNIRP EMF exposure limits are instantaneous and not averaging and it refers to Basic Restrictions and Reference Levels for both magnetic and electric fields under General Public and Occupational exposure conditions (see Table 10.17). Basic Restrictions are the fundamental limits on exposure and are based on the internal electric currents or fields that cause established biological effects in humans. They are impractical to measure. Therefore, Reference Levels of exposure to the external fields, which are simpler to measure, are provided as an alternative means of showing compliance with the Basic Restrictions. The Reference Levels have been conservatively formulated such that the Reference Levels will ensure compliance with the Basic Restrictions. In summary, these limits can be considered as chronic exposure standards and there are no health risks associated with short-term exposure to these levels.

Table 10.17 Basic Restrictions and Reference Levels for Exposure to 50 Hz EMF at the Edge of Right of Way (ROW)

Exposure Characteristics	Electric field (kilo volts per meter, kV/m)	Magnetic flux intensity		
		Micro-Tesla (μT)	Milli-Gauss (mG)	Ampere/m (A/m)
Occupational	10 kV/m	1,000 (500 prior to 2010)	10,000 (5,000 prior to 2010)	798 (399 prior to 2010)
General Public	5 kV/m	200 (100 prior to 2010)	2,000 (1,000 prior to 2010)	160 (80 prior to 2010)

10.5.3 Assessment Methodology

The calculation of Electro Magnetic Field (EMF) is one of the factors which must be considered during the design process especially for high voltage transmission lines to determine Right of Way (ROW) of the power line such that there will not be danger for the people and surrounding environment.

An excel based software developed by EEP Portal[10] for the calculation of electromagnetic field (EMF) around transmission and distribution overhead lines was used to calculate EMF for the 110kV transmission line proposed for the current study. The tool can be used to calculate one or two circuit lines in which ground wires can be incorporated for the EMF calculations. In addition, the tool allows combining and creating examples of power lines where two independent power lines can interact on each other. The EMF calculations used in this tool uses the analytical approach described in EPRI Red Book “Transmission Line Reference Book”.

10.5.4 Impact Assessment

10.5.4.1 EMF from 110kV Overhead Transmission Line

The 110kV transmission line is single-circuit that used two types of towers, including suspension tower and tension tower, coded as D111-22A; D111-26A; D111-26B; D111-30A; D111-30B; D111-38A; D111-46B; N111- 22B; N111- 27D; N111- 31A; N111- 40A; NC111-27 (See Appendix B).

[7] The ICNIRP Guidelines (2010) for limiting exposure to time-varying electric, magnetic and electromagnetic field (up to 300GHz) (http://www.icnirp.de/PubEMF.htm)

[8] These values represent the ICNIRP occupational exposure limits.

[9] WHO 2007, Extremely Low Frequency Fields – Environmental Health Criteria, Monograph No. 238 March 2007

[10] http://electrical-engineering-portal.com/download-center/electrical-ms-excel-spreadsheets/emf-td-overhead-lines

The name of towers is explained as follows:

Code	Explanation
D	Suspension Tower
N	Tension Tower
1	Voltage level: 110kV
1	single- circuit
1	one lightning rods
32 (34; 37; 42)	Height of Tower
A, B, C, D…..	Bearing Level

Input data

The input data used for EMF calculation, setting up the transmission tower and circuit lines is given for Tower PC. I-22-190-14 shown in Table 10.18 and Tower D111-26A shown in Table 10.19. The selected circuit line is ACSR-185/29.

Table 10.18 Transmission Line Parameter for Tower PC. I-22-190.14

			X [m]	Y [m]	Umax [kV]	I[A]	rA [mm]	dA [mm]	n	Ph-seq
Line 1	Circuit 1	L1	-2.1	18.4	123	433,5	9.4	0	1	1
		L2	-2.1	15.6	123	433,5	9.4	0	1	2
		L3	-2.1	11.9	123	433,5	9.4	0	1	3
		gw	-2.1	22	0	0	4.7	0	1	0

X [m] – horizontal length from the middle of the line; Y [m] – height in which wires are suspended; Umax [kV] – maximum permissible line voltage; I [A] – maximum permissible line current (in case of bundle it is; determined for all wires); r_A [mm] – wire radius; d_A [mm] – distance between wires in bundle; n – number of wires in bundle; Ph-seq – phase sequence. 1 – L1, 2 – L2, 3 – L3, 0 – Ground Wire

Table 10.19 Transmission Line Parameter for Tower D111-26A

			X [m]	Y [m]	Umax [kV]	I[A]	rA [mm]	dA [mm]	n	Ph-seq
Line 1	Circuit 1	L1	-2.6	26	123	433,5	9.4	0	1	1
		L2	-2.6	23	123	433,5	9.4	0	1	2
		L3	-2.6	19	123	433,5	9.4	0	1	3
		Gw.	- 2.6	26.7	0	0	4.7	0	1	0

X [m] – horizontal length from the middle of the line; Y [m] – height in which wires are suspended; Umax [kV] – maximum permissible line voltage; I [A] – maximum permissible line current (in case of bundle it is; determined for all wires); r_A [mm] – wire radius; d_A [mm] – distance between wires in bundle; n – number of wires in bundle; Ph-seq – phase sequence. 1 – L1, 2 – L2, 3 – L3, 0 – Ground Wire

The proposed minimum horizontal free space for the 110 kV single-circuit is 15 m (7.5 m on either side of the transmission tower). It is expected that the tower type and land area required for the development

of 110 kV transmission line will comply with Decree No.14/2014/ND-CP, dated February 26th, 2014 on Stipulating in detail the implementation of electricity law regarding electricity safety as required.

10.5.4.1.1 Potential Impact

EMF can affect human health directly and indirectly. Direct effects result from direct interactions of fields with the body; indirect effects involve interactions with a conduction object where the electric potential of the object is different from that of the body. Exposure to low-frequency electric fields may cause well-defined biological responses, ranging from perception to annoyance, through surface electric-charge effects due to stimulation of central and peripheral nervous tissues and the induction in the retina of phosphenes, a perception of faint flickering light in the periphery of the visual field.

10.5.4.1.2 Existing Controls

There are no existing controls.

10.5.4.1.3 Significance of Impact

Operation of the Project will result in the formation of EMF along the transmission line and at the substations. Although high-voltage transmission lines do generate higher EMFs, this effect is offset by the fact that the towers are higher, the ROW is wider, and phase cancellation shielding is applied, all of which lower EMF levels, as typically measured at the edge of the ROW.

Based on the EPP model, the electric and magnetic fields calculated at the distance from the transmission line at 1m above the ground for two type of transmission towers (PC.I-22-190.14 and D111- 26A) are presented in Figure 10.17 - Figure 10.20. The maximum electric, magnetic fields are 0.74 kV/m, 0.39kV/m, 2.09 A/m and 0.94A/m respectively at 1 m above the ground.

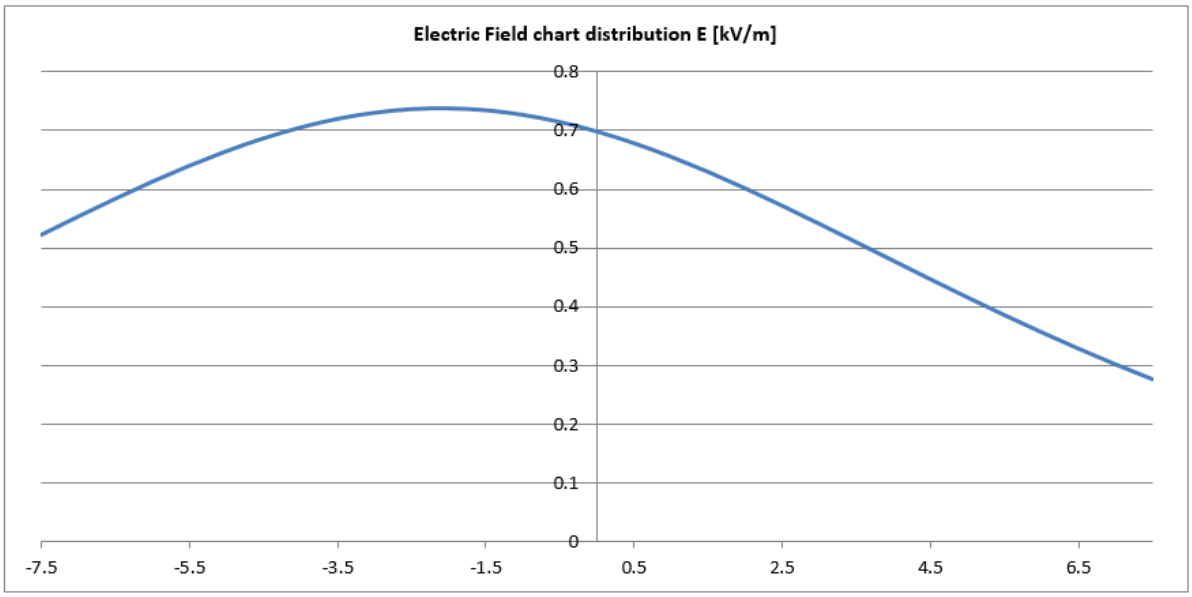


Figure 10.17 Electric Field Distribution for the PC. I-22-190-14 Transmission Tower at 1 m above the Ground

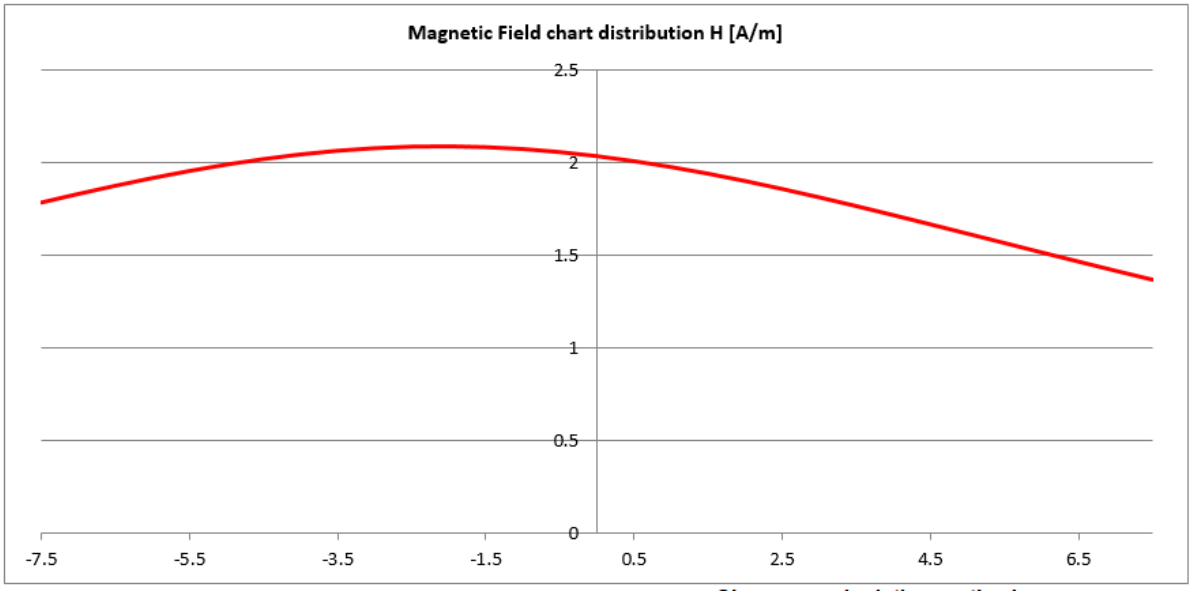


Figure 10.18 Magnetic Field Distribution for the PC. I-22-190-14 Transmission Tower at 1m above the Ground

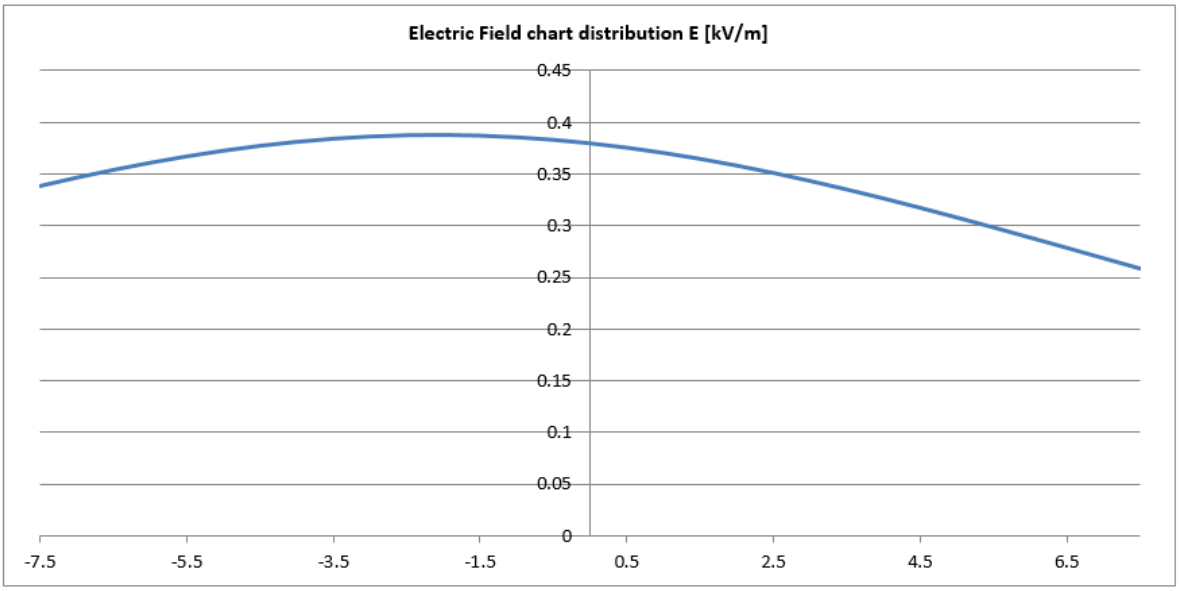


Figure 10.19 Electric Field Distribution for the D111-26A Transmission Tower at 1 m above the Ground

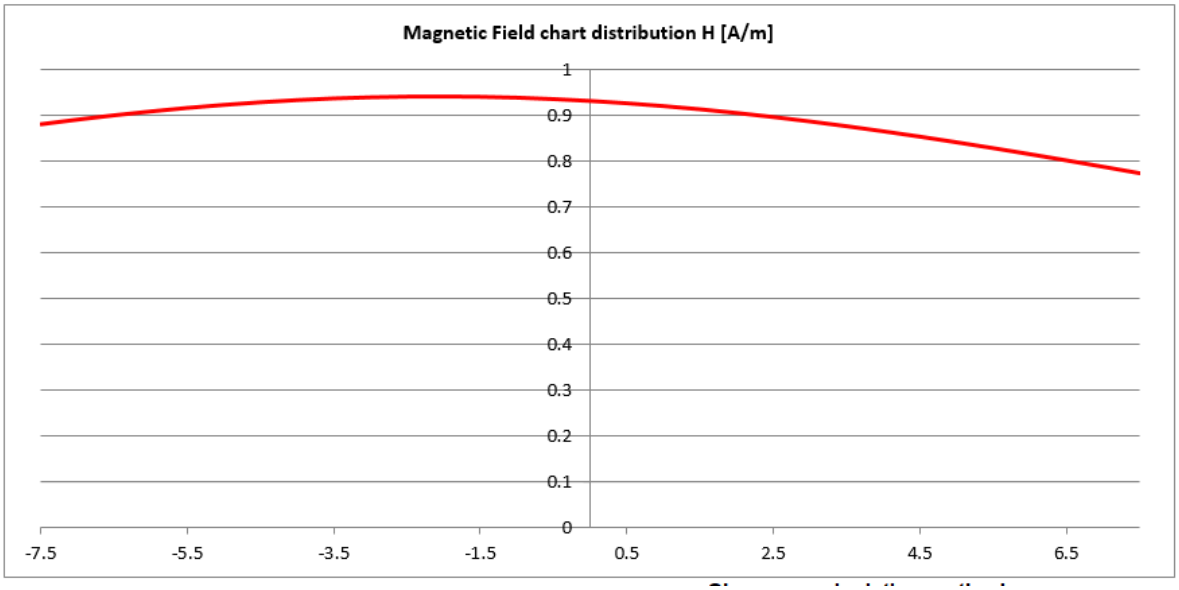


Figure 10.20 Magnetic Field Distribution for the D111-26A Transmission Tower at 1m above the Ground

The maximum calculated electric field and magnetic field inside the ROW for Transmission Tower PC. I-22-190-14 and D111-26A do not exceed the recommended ICNIRP occupational exposure limits. Additionally, the calculation were performed considering a safety corridors of 15 m within the ROW, that is 7.5m on each side and a distance from the lowest point of 110kV transmission line to the ground of at least 15m. All parameters comply with the National Regulation (Decree No.14/2014/ND-CP) on Electricity Safety.

The maximum electric and magnetic fields within the ROW for various transmission towers is shown in Table 10.20. The maximum calculated electric field occurs directly under the conductors and decreases out to the edge of the ROW. The calculated maximum electric magnetic fields for various transmission towers are below the allowable public and occupational exposure limits in accordance with ICNRP and Decree 14/2014/NĐ-CP, dated 26th February, 2014 of Government on stipulating in detail the implementation of electricity law regarding electricity safety, which requires the electricity field intensity in the areas where people regularly working must ensure the requirements not exceeding 5kV/m.

Table 10.20 Maximum Electric and Magnetic Fields for Various Transmission Tower Types at the Edge of the ROW

Tower Type	E_{max} (kV/m)	H_{max}(A/m)
D111-22A	0.54	1.33
D111-26B	0.39	0.94
D111- 30A	0.27	0.6
D111-30B	0.27	0.6
D111-38A	0.17	0.34
D111-46B	0.12	0.22
N111- 22B	1.06	3.45
N111- 27D	0.58	1.82
N111- 31A	0.41	1.24

Tower Type	E_{max} (kV/m)	H_{max}(A/m)
N111- 40A	0.23	0.64
NC111-27	0.58	1.82
ICNIRP EMF exposure limits for General public	**5**	**160**
ICNIRP EMF exposure limits for Occupation	**10**	**798**

The EMF for the proposed 110 kV tower configuration reduce rapidly with distance from the lines. The EMF caused negative and direct impact on health of residences within the ROW. The EMF impact is expected to be localized and occurs in long-term within the ROW through all its life cycle. The impact magnitude is considered as Small and limited to the ROW.

The estimated EMF level is below the recognized international exposure limits, so it does not contribute to adverse health effects. The 7.5km of the transmission line passes along agricultural lands where some people from neighbor communes may access and cultivate, nevertheless, the estimated EMF level is below the maximum permissible international exposure limit, with that said, it seems that it will not contribute to adverse health effects. So, the sensitivity of receptors is considered Low. As such, the significance of EMF caused by the Project is considered to be Negligible (See Table 10.21).

Table 10.21 Impacts of EMF during Operation Phase from the 110kV Overhead Transmission Line

Impact	**Health Impact due to EMF from 110 kV overhead Transmission Line**				
Impact Nature	**Negative**	Positive	Neutral		
	Impacts on health is considered **Negative**				
Impact Type	**Direct**	Indirect	Induced		
	Health of livelihoods or residences within the ROW				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact duration is **Long-term** within the ROW.				
Impact Extent	**Local**	Regional	Global		
	Impacts are within the ROW.				
Impact Frequency	The impact frequency is closely related to the operation of the wind farm and substation, and assumed to be **continuous** during operation as a worst case.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is **Small**.				
Sensitivity of Receptors	**Low**	Medium	High		
	The sensitivity of receptor is **Low** as explained above				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance is **Negligible**				

10.5.4.1.4 Additional Mitigation Measures

Electric fields can be easily shielded by trees, fences, buildings and most other structures. However magnetic fields are much more difficult to shield than electric fields.

Other additional mitigations measures are based on ESIA requirements to minimise impacts associated with EMF include:

- Design electrical equipment and transmission line in accordance with Vietnam Regulation (Decree No. 14/2014/ND-CP dated on 26 February 2014) including (1) the safety corridor of the 110kV line should be 8 m for the double circuits (4m of each side of the line); (2) the safety corridor for the 22kV line is 2m (1m of each side of the line); (3) the distance from the lowest point of 110kV transmission lines to the ground is at least 15m.
- When detecting any points with electric field exceeding the permitted level (5 kV/m) , it is necessary to relocate structures out of the area;
- Vehicles moving under transmission line needs to ensure that the distance from the lowest point of transmission lines to the highest point of vehicle must not be less than the permissible value according to the electricity industry standards,
- Measuring electromagnetic field in case of grievance and follow up to address grievance in the best way possible;
- Regularly check any violation in safety corridor of the high-voltage grid;
- Check, repair and maintain the power grid on time. Do not operate overloaded transmission line above houses, construction works;
- Chopping trees to ensure the safety of high-voltage grid shall be carried out by the authorized units who managing and operating the high-voltage grid and must notify the management organization prior five (05) working days by direct notification.
- Equip staffs who come in contact with electromagnetic fields (EMF), with PPE;
- Put up warning signs for high voltage areas;
- Provide staff with training on electromagnetic fields (EMF);
- Limit staff who have health problems such as cardiovascular and congenital diseases from working in areas with EMF.
- Avoid schools, hospitals, health clinics, and other similar buildings – such that the transmission line alignment avoids these sensitive buildings and maintains at least a 24 m buffer to all schools and health clinics;
- Implement all H&S measures as specified in the applicable regulations including earthing of buildings that are metal clad and directly below the transmission line;
- Conduct regular clearance of the clear zone to ensure the area is safe as required by the regulation;
- Conduct regular checking/ maintenance to ensure the safe condition of the tower and the cable;
- The proposed design indicates a free space and minimum free distance of 15 m around the transmission line (i.e. 7.5 m ROW on either side of the transmission line). Update the EMF study should the ROW width change and against the population growth surrounding the ROW every 5 years. The ROW width should ensure EMF levels meet international safety standards at the ROW edge;
- Conduct a series of H&S focused consultation activities with the affected villages and schools that are located closed to the transmission line to discuss the design, H&S management measures and their potential concerns and socialize the project's grievance mechanism to the community to enable them to submit;
- Tower Safety features – place warning signs prohibiting climbing on towers and incorporate design elements that prevent climbing of the towers; and
- Emergency contact information – provide signage at each tower with emergency phone numbers.

10.5.4.1.5 Residual Impact

The residual impact to occupational and public from the transmission of power through the proposed 110 kV voltage transmission line is considered to be **Negligible.**

10.5.4.1.6 Monitoring and Auditing

The nearest residential area (Phu Dien village) is approximately 500m from the nearest turbine (turbine No.4) and about 1.3km from 110kV transmission line. Additionally, there is no households residing within the ROW (15m buffer) of 110kV transmission line. So, there is no specific monitoring to be proposed.

In case any potential construction works will be built within the ROW, it is proposed that EMF monitoring is carried out by measuring at discrete distances from the transmission lines within the first year of the operation on a quarterly basis. Should thresholds (in compliance with ICNIRP and National Regulation Decree No.14/2014/ND-CP on Electricity Safety) be exceeded, further mitigation options should be review and considered.

10.5.4.2 EMF from 22kV Underground Transmission Line

10.5.4.2.1 Potential Impact and Consequences

Electromagnetic filed from 22kV underground transmission line.

10.5.4.2.2 Existing Control

There is no existing controls.

10.5.4.2.3 Significance of Impact

Based on Feasibility Study, the 22kV underground cables are low-voltage and are buried directly underground with a depth of 1m. The EMF emission will be highly localised in terms of spatial extent. However, the underground cables use HDPE insulation so EMF would be of limited emission to surrounding environment where they pass through cable protection materials. The Feasibility Study design has shown that electric field exists between high- voltage conductive cores and earthling amour. So there is expected no E-field leaked by the cable as a result of cable shielding. So the EMF levels expected at underground are comparatively small and the predicted magnetic fields are also expected to rapidly decrease both vertically and horizontally. Therefore, the magnitude of potential EMF impact is expected to be **Small.**

Additionally, the nearest residential area is approximately 500 m from the nearest turbine (turbine No.4). The livelihood activities of local community have been identified to be within and surround the Projects' areas such as agricultural fields. However, the 22kV underground transmission line will be built parallel with internal road within the Project site, the local community is unable to access. So, the sensitivity of receptors is considered **Low.**

In consideration of the above, the negative impact is assessed to be of **negligible** significance, as shown in Table 10.22.

Table 10.22 Impacts of EMF during Operation Phase from the 22kV Underground Transmission Line

Impact	**Health Impact due to EMF from 22kV underground Transmission Line**		
Impact Nature	**Negative**	Positive	Neutral
	Impacts on human who access to the Project site is considered **Negative**		
Impact Type	**Direct**	Indirect	Induced

Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact duration is **Long-term** within the ROW.				
Impact Extent	**Local**	Regional	Global		
	Impacts are within the ROW.				
Impact Frequency	The impact frequency is closely related to the operation of the wind farm and substation, and assumed to be **continuous** during operation as a worst case.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is **Small**.				
Sensitivity of Receptors	**Low**	Medium	High		
	The sensitivity of receptor is **Low** as explained above.				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance is **Negligible.**				

10.5.4.2.4 Additional Mitigation Measures

Some mitigation measures will be proposed in the ESIA, as follows:

- Cable specification will be used to reduce EMF emissions as per industrial standards and best practice such as relevant IEC (International Electro technical Commission) specifications;
- Place warning signs of underground power cable;
- Prohibit other construction works in safety corridors (at least 1.5m in depth and width) of underground power cables.

10.5.4.2.5 Monitoring and Auditing

It is proposed that EMF monitoring is carried out by using suitable magnetic and electric filed sensors within the first year of the operation on a quarterly basis. Should thresholds be exceeded, further mitigation options should be review and considered.

10.5.4.3 EMF from Substation

Substations are part of the electricity supply network that enables the widespread use of electricity for public and industrial use. Inside the substation, there are switches, connections and a transformer. The transformer steps up voltage coming from wind farms and transforms them to the higher voltage of 110kV used by transmission lines. Transformer is the main unit where EMF will be of similar magnitude as the transmission lines and hence it has to be located at a height similar to the transmission line and provide sufficient buffer (approximately 3.0m) around it to minimize occupational and public hazards. EMF from other elements in a substation will be small and standard mitigation methods are available to reduce both electric and magnetic fields generated by them, as described below. The electric and magnetic field (EMF) levels within the fenced area of a substation depends on the number of transformers used in the substation. However, these EMF levels decrease rapidly with distance from the transformers and other electrical equipment. Most of the time, EMF levels drop to the same as surrounding background levels at a distance of 30 to 60 m from the fenced area.

10.5.4.3.1 Potential Impact

- Electromagnetic fields from transformers in substations.

10.5.4.3.2 Existing Control

There is no existing control

10.5.4.3.3 Significance of Impact

Predicting magnetic field profiles for substations is a complex exercise given the multitude of time varying sources orientated in multiple directions. As a result, the magnetic field profile is highly dependent on the particular circumstances. In order to understand the magnetic field pattern in the proposed step up substation, similar substation modelling performed elsewhere Tarmizi et al. (2016) was identified for discussion. Tarmizi et al. modelled magnetic field variability in a substation that had the 400kV side connected to three loads, a shunt reactance and an autotransformer to step down the voltage to 220kV. The substation considered by Tarmizi et al. was 280 m long, 140 m wide and the conductors are located at the height of 12m above the ground (on the 400kV side). The normal operating currents at frequency of 50Hz for each load. The magnetic field distribution was calculated at the height of 1.7m where measurements were available for comparison. The computed results for the normal operating currents are presented in Figure 10.21.

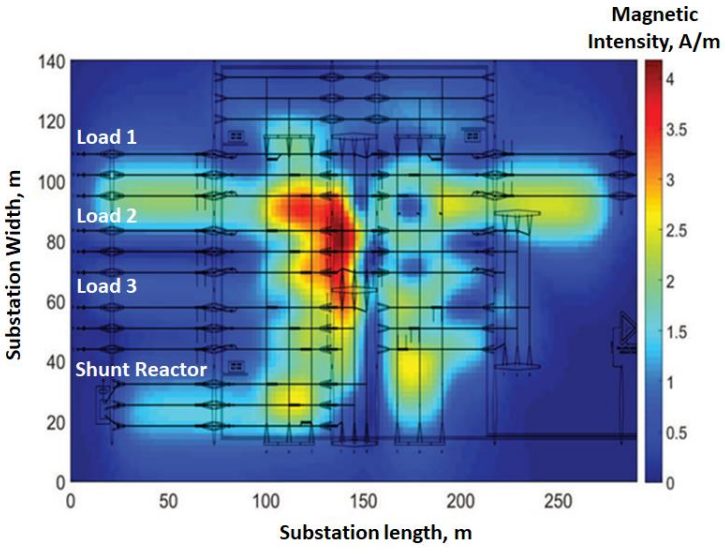


Figure 10.21 Magnetic Field Distribution in the Substation Studied by Tamrizi et al. (2016) for a 400kV Substation (280m long, 140m wide)

Figure 10.21 shows that the predicted highest value of the magnetic field was 4.164A/m located along busbar 1. For the normal operation conditions of the substation, the maximum values of the magnetic field were found to be below public exposure limits proposed by ICNIRP. In addition, it clearly shows that the magnetic field decreases rapidly within the perimeter of the substation. However, for a lightning strike scenario, the magnetic field in the substation exceeded the public and the occupational exposure limit set by ICNIRP. The voltages and size of the substation used in the study by Tarmizi et al. were much higher than the proposed substation (voltage of 123 kV; capacity 40MVA and size up to 69m long by 50m wide) and hence the EMF impact is anticipated to be contained within the substation.

Based on the analysis the assessment of impacts of EMF from substation during operation phase is shown in Table 10.23.

Table 10.23 Impacts of EMF during Operation Phase from the Substation

Impact	**Health Impact due to EMF from Substation**		
Impact Nature	**Negative**	Positive	Neutral
	Impacts on health is considered **Negative**		

Impact Type	**Direct**	Indirect	Induced		
	Health of livelihoods or residences within the substation				
Impact Duration	**Temporary**	Short-term	Long-term	Permanent	
	The impact duration is **Temporary** within the substation				
Impact Extent	**Local**	Regional	Global		
	Impacts are within the substation.				
Impact Frequency	The impact frequency is closely related to the operation of the wind farm, and assumed to be continuous during operation as a worst case.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The impact magnitude is **Small**.				
Vulnerability of Receptors	**Low**	Medium	High		
	The vulnerability of receptor is **Low** as explained above.				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance is **Negligible**				

10.5.4.3.3.1 Additional Mitigation and Management Measures

Some additional mitigation measures could be applied to reduce EMF impacts from substation to human health, as follows:

- Security fence line should be installed surrounding the substation
- Locating major magnetic field sources within the substation to increase separation distances. Key magnetic field sources include the transformer secondary terminations, cable runs to the switch room, capacitors, reactors, busbars, and incoming and outgoing feeders.
- Staff in contact with electromagnetic fields (EMF) needs to be provided with PPE;
- Place warning signs at high voltage areas;
- Use ferromagnetic and conductive materials for shielding as a barrier to reduce the field strength at the source.
- Limit staff who have health problems such as cardiovascular and congenital diseases to work in areas with EMF.

10.5.4.3.3.2 Residual Impact

With appropriate mitigation measures, the occupational and human exposure can be minimized to fall under ICNIRP standards, therefore the residual impact to occupational and public from the substation is considered to be **Negligible.**

10.5.4.3.3.3 Monitoring and Auditing

There is no specific monitoring to be proposed.

10.5.4.3.4 EMF from Wind Turbines

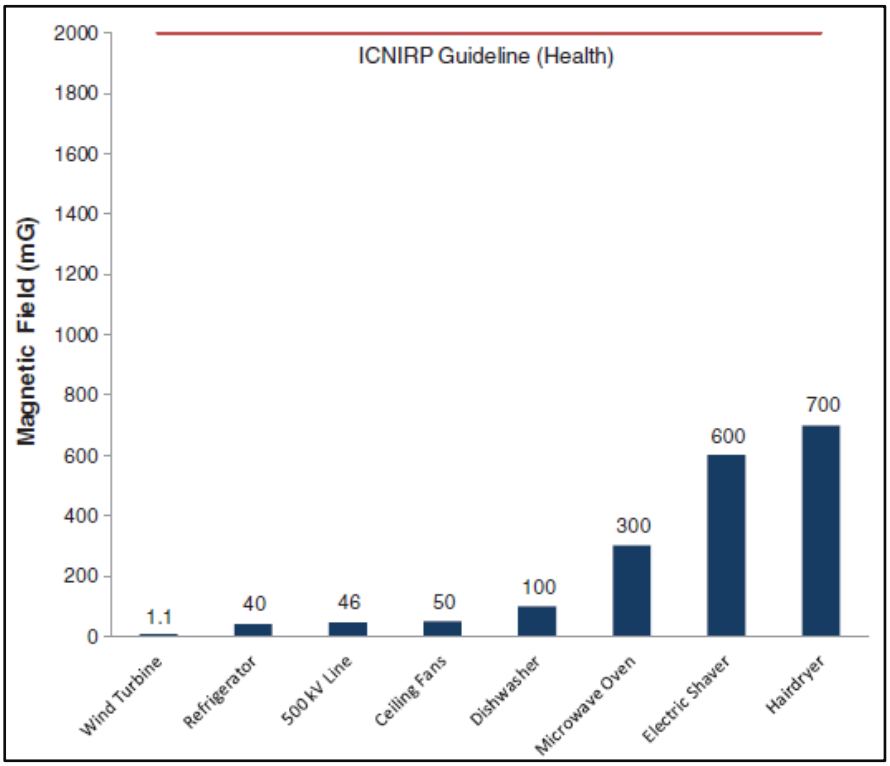
10.5.4.3.4.1 Significance of Impacts

EMF from the step up transformer either in the nacelle of the turbine rotor unit or at some height below it in wind turbines, which increases the voltage to 22kV with rated capacity of 3,200kW, are expected

to be lower than the 110kV transmission line. The maximum electric and magnetic fields are unlikely to be assessed quantitatively due to insufficient data of transformer.

However, referred to EMF results from empirical studies of Canadian 27MW wind farm by McCallum et al. (2014)[11], EMF were collected during three operational scenarios to characterize potential EMF exposure: “high wind” (generating power), “low wind” (drawing power from the grid, but not generating power), and “shut off” (neither drawing, nor generating power). Magnetic field levels detected at the base of the turbines under both “high wind” and “low wind” conditions were low (0.9 mG) and rapidly diminished with distance, become indistinguishable from background within 2m of the base. This source appeared to have no influence magnetic field level at nearby sensitive receptors as located over 1km from the closet turbine. The study also concluded that magnetic field levels in the vicinity of wind turbines were lower than those produced by many common household electrical devices (See Source: McCallum et al. 2011

Figure 10.22). Furthermore, when compared to ICNIRP guidelines, the levels of EMF measured around wind turbines were all well below levels known to cause harm to public and occupational health.



Source: McCallum et al. 2011

Figure 10.22 Magnetic Fields Comparison from Wind Turbines and 500 kV Power Lines with Common Household Electrical Devices

The maximum calculated electric field occurs directly under the base of the turbine and decreases outwards does not exceed the recommended ICNIRP occupational exposure limits. The EMF impact from the wind turbines are considered **Negligible.**

10.5.4.3.4.2 Additional Mitigation Measures

Whilst no EMF specific additional mitigation and management measures are recommended; to enhance safety, it is recommended to place warning signs prohibiting climbing on wind turbines and incorporating design elements that prevent climbing of the wind turbines. It is also recommended to provide

[11] McCallum Lindsay, Aslund M.L.W, Knopper L D, Ferguson G M and Ollson C A. 2014. Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern? Environmental Health 2014, 13:9

emergency contact information by placing signage at each wind turbine containing emergency phone numbers.

10.5.4.3.4.3 Residual Impact

The residual impact to occupational and public from the substation is considered to be negligible.

10.5.4.3.4.4 Monitoring and Auditing

No specific monitoring and auditing is recommended.

10.6 Visual Impact Assessment

A visual impact assessment is an assessment of the potential impacts of the Project on specific views and on the general visual amenity experienced by people. Landscapes are not static but are dynamic, not least due to the range of natural and human factors that define their characteristics, but also due to the many different pressures that have altered landscapes in the past and will continue to do so in the future. Therefore, determining the significance of visual effects identified can be particularly challenging.

This section provides methodology, an assessment of baseline conditions within Project site and surroundings in relation to landscape and visual amenity and then assesses the anticipated impacts throughout the Project construction and operational phases. Then, a set of management measures (including mitigation measures, additional requirements, etc.) and monitoring measures have been identified to avoid impacts or reduce them to acceptable levels.

10.6.1 Scope of Assessment

The scope of this assessment is limited to the proposed Project wind turbine design and observers in Section 10.4, including a qualitative visual aesthetics assessment and associated reporting to document the methodology, findings and any agreed mitigation measures for the proposed wind farm site or design. The assessment scope included:

- Reviewing existing project information and operational activities to understand site conditions pertaining to visual impacts;
- Identify the closest and/or potentially most affected receptors situated within the potential area of influence of the wind farm and discuss the existing conditions near these receptors.

10.6.2 Consideration and Assumptions

Visual impacts relate to changes that arise in the composition of available views as a result of changes to the landscape, to people's response to any changes, and the overall impacts with respect to visual amenity.

Based on the SRTM (Shuttle Radar Topography Mission) data, it is noted that the Project wind turbines will be located in a raised area where the elevation can be up to 100 m above sea level. It is also noted that the areas where the receptors and the wind turbines are located is distinguished by spread roughness of the terrain.

10.6.3 Assessment Methodology

Visual impacts relate to changes that arise in the composition of available views as a result of changes to the landscape, to people's response to any changes, and the overall impacts with respect to visual amenity. The methodology followed to identify and assess the significance of, and the effect of, changes resulting from the Project on both the landscape as an environmental resource in its own right, and on people's views and visual amenity is presented in the subsequent section. People have different responses to views and visual amenity depending on their context and purpose, with certain activities specifically associated with the enjoyment of the landscape (e.g., the use of footpaths and tourist routes and attractions) generally more susceptible to change. Residents are also considered to be particularly

susceptible to change and the combined effects on a number of residents within an area may also be considered.

10.6.4 Visual Baseline

The assessment has been developed according to the following tasks:

- Study area definition;
- Viewshed analysis; and
- Viewpoints and sensitive receptors identification.

10.6.4.1 Study Area Definition and Viewshed

The landscape study area is defined as the area within which the Project could be discernible by the human eye and could interfere with the main sensitives identified in the local context.

To identify the landscape study area, the Zone of Theoretical Visibility (ZTV) has been determined through computer analysis of topographical mapping to establish the theoretical distance from which the wind turbines could be visible in each direction.

This ZTV was determined through a viewshed analysis using the software QGIS 3.14. The viewshed analysis is based only on topography (i.e. digital elevation model), and represents the areas from which the wind farm could be potentially visible. For this specific assessment SRTM (Shuttle Radar Topography Mission) 30 m Digital Elevation has been utilised.

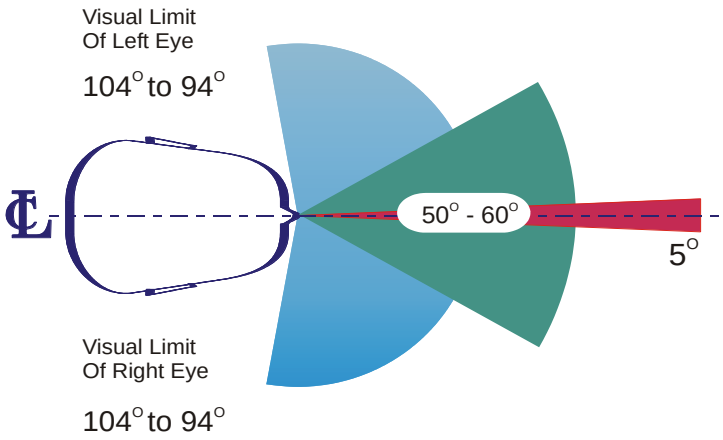
Defining an appropriate viewshed is the starting point to understand the visual impacts of the Project. The area of the viewshed will vary depending on the nature and scale of the proposed facility. The larger (and higher) the facility is, the bigger the viewshed will be, as it may be visible for a greater distance. The viewshed is therefore the area that is most likely to be visually impacted.

The following information[12] explains how a viewshed is defined and identified depending on the horizontal and vertical field of views.

A. Horizontal Field of View

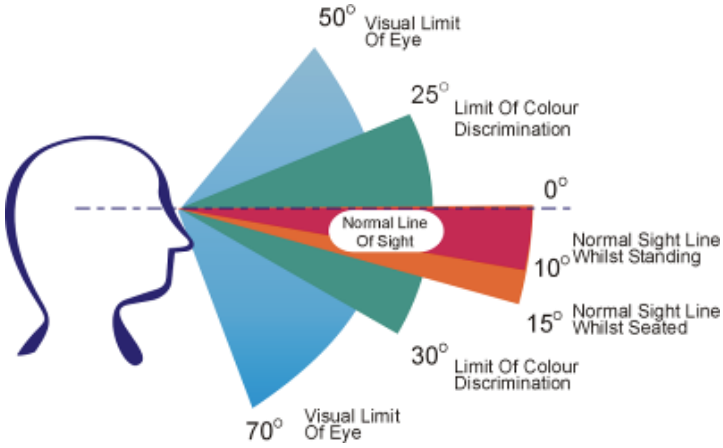
For most people, the horizontal central field of vision covers an angle of between 50° to 60°. Within this angle, both eyes observe an object simultaneously but from a slightly different angle. This creates a central field of greater magnitude than that possible by each eye separately. This central horizontal field of vision is termed the 'binocular field' (see green zone). Within this field images are sharp, depth perception occurs and colour discrimination is possible. Research suggests that the visual impact of a project component will vary according to the proportion the binocular field it occupies. Project components which occupy 5% or 2.5° or less of the horizontal central binocular field of vision are usually perceived as insignificant objects, whereas components which occupy 30° are considered to be visually dominating.

[12] Source: Human Dimension & Interior Space – A Source Book of Design Reference Standards, Julius Panero and Martin Zelnik, The Architectural Press Ltd. London, 1979



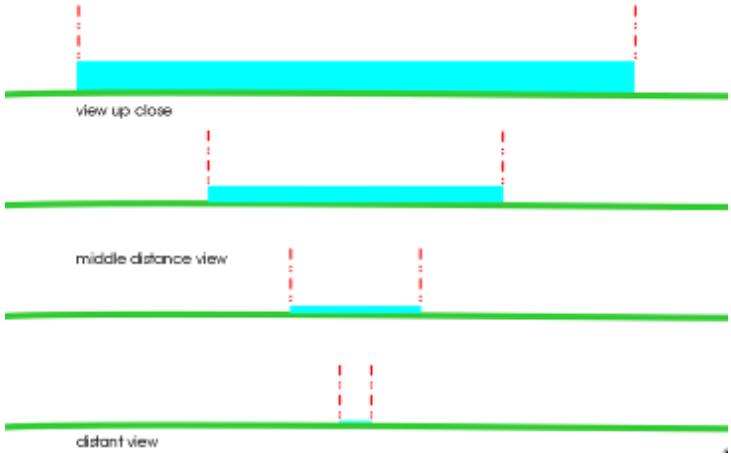
B. Vertical Field of View

The vertical central field of vision has a similar set of parameters. The vertical binocular field is normally 25° above the vertical and 30° below the vertical. When project components exceed the 50° upper visual limit of the eye, they are considered to dominate the vertical central field of vision. When project components occupy 0.5° they are not considered dominant, nor are they usually perceived as a significant change to the existing baseline condition when they are located within an anthropogenically modified landscape.



C. Horizontal versus Vertical Visibility over Distance

As a person moves further away from a project component, the visibility of the vertical dimension tends to reduce more significantly than the visibility of the horizontal dimension. This effect is illustrated below.



10.6.4.2 Visual Baseline

Visual interferences may occur when new elements are introduced into a landscape or existing elements are altered or removed leading to a change in the way that stakeholder's access, perceive or experience landscape resources.

Based on the Project characteristics the main interferences could occur from:

- Installation and operation of turbines;
- Movement of large construction vehicles.

The proposed wind turbines are the major visual element of the proposed development and may visually impact on the surrounding. As the viewer moves further away from these structures the visual impact decreases until it is no longer visible. However, before the point of non-visibility is reached, the wind turbines have reduced in scale such that they no longer have a significant visual impact.

The wind farm is comprised of a number of individual turbines of the same dimensions (200 m height and 150 m width), with relatively small separation distances between each individual turbine, less than 300 m. In assessing the visual impact of the wind turbine, it is therefore assumed that the largest horizontal component is the entire rotor, which would be a maximum of 150 m wide. It has been also evaluated the combined effect of multiple rotors throughout the landscape.

As shown in Table 10.24, calculations suggest that the impact of a 150 m wide wind turbine rotor would reduce to insignificance at about 3.4 km, as it would form less than 5% or 2.5° of the horizontal field of view.

Table 10.24 Horizontal Field of View

Horizontal Field of View	Impact	Distance from Observer to a 150 m Rotor
<2.5° of view	The development will take up less than 5% of the central field of view. The development, unless particularly conspicuous against the background, will not intrude significantly into the view. The extent of the vertical angle will also affect the visual impact.	>3.4 km
2.5° – 30° of view	The development may will have usually a moderate impact that may be not noticeable at the greatest distance of this range.	3.4 km to 280 m
>30° of view	Developments that fill more than 50% of the central field of vision will always be noticed and only sympathetic treatments will mitigate visual effects.	<280 m

A similar analysis can be undertaken based upon the vertical field of view for human vision (Table 10.25), shows the relationship between impact and the proportion that the development occupies within the vertical line of sight.

Table 10.25 Vertical Field of View

Vertical Line of Sight	Impact	Distance from Observer to a 200 m Tall Wind Turbine
< 0.5° of vertical angle	A thin line in the landscape	>22.9 km
0.5° – 2.5° of vertical angle	The degree of visual intrusion will depend on the development's ability to blend in with the surroundings	22.9 km to 4.6 km
> 2.5° of vertical angle	Usually visible, however the degree of visual intrusion will depend of the width of the object and its placement within the landscape	<4.6 km

Based on the above, it is reasonable that distances, at which the magnitude of visual impact of the wind turbine will be not significant, can be the ones greater than 22.9 km, where a fully visible wind turbine would be an insignificant element within the landscape.

Generally, the more conservative or worse case distances form the basis for the assessment of visual impacts. Therefore, this development the greater impacts would be associated with the vertical field of view and so it is therefore proposed to use the vertical field of view and extend the view shed to 22.9 km for wind farm.

QGIS 3.14 was used to determine the ZTV for the Project. The current visibility within the ZTV will vary depending on the presence of intervening local topography, and features such as vegetation and buildings. The present view shed analysis has been based solely on topography and did not take into account the potential screening granted by the local vegetation patches, which would further reduce the actual view shed. Moreover, it should be highlighted that a typical view shed assessment does not take typical meteorological conditions into account that can result in changes to real visibility. For example, rainfall and other atmospheric conditions will alter the visibility of the wind farm. The diminution of visual clarity bought about by atmospheric conditions also increases with distance and cloudy days can result in a natural attenuation of the visibility of the Project.

Similar to cloud coverage, rainy days are able to reduce the visibility as the water droplets obscure vision. This varies greatly depending on the heaviness of the precipitation, but even light rain obscures distant objects greatly.

Figure 10.23 shows the ZTV mapping from any points inside the buffer area.

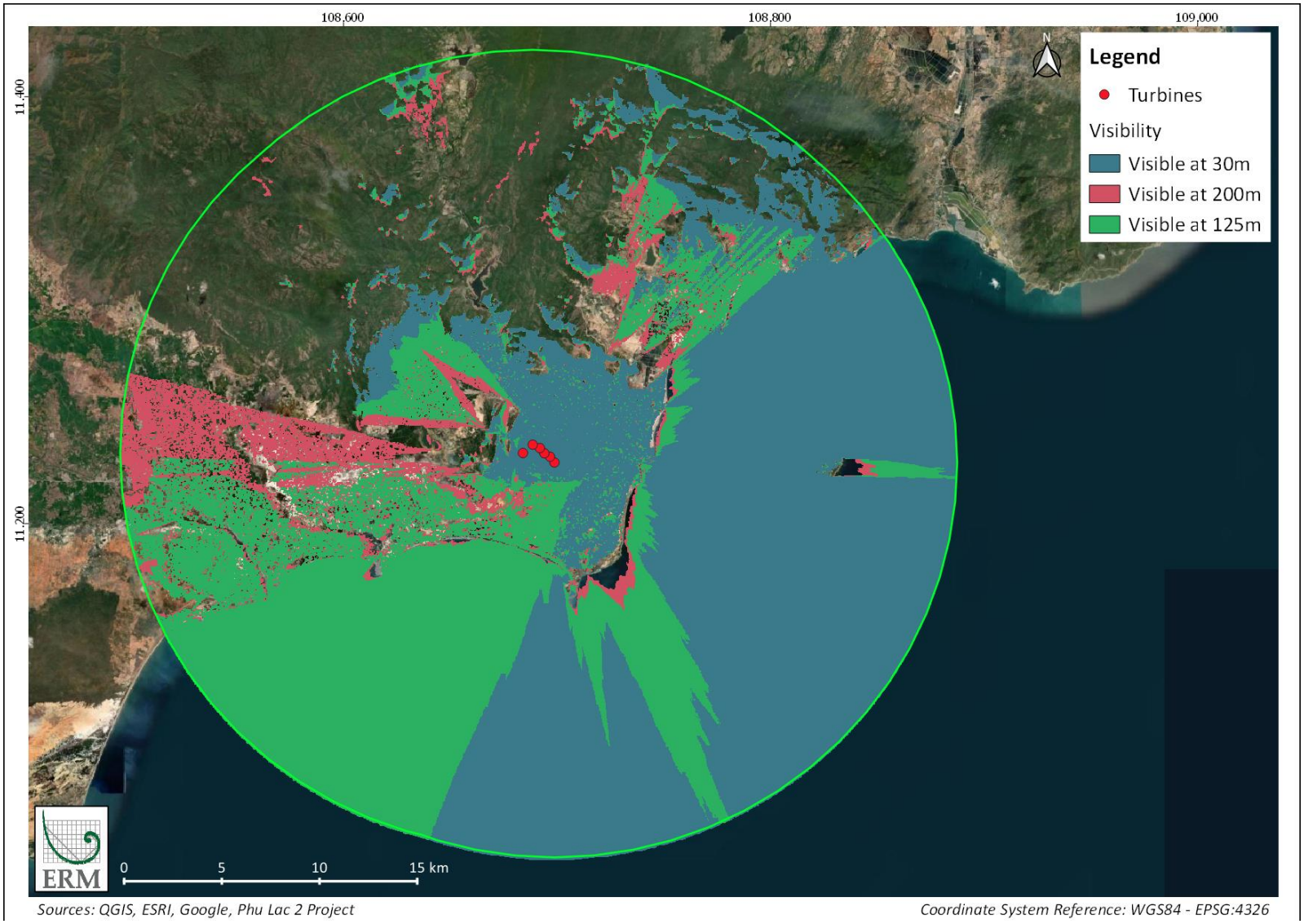


Figure 10.23 Viewshed (22.9 km buffer)

The results of the viewshed assessment as presented in Figure 10.24 show that the visibility is almost open to the whole area because of the morphology of the area. Specifically, the terrain is almost flat posing nearly no obstacles for visibility, shown by 30 m viewshed zone overlapping most of tip height viewshed zone.

It should be emphasized that intervening vegetation is not included in this mapping and is likely to significantly reduce the visibility of wind turbines, in whole or in part, and therefore reduce the impact identified. However, the Project area is analysed and classified as agricultural and bare land, where the vegetation cover is very low. Therefore, the deviation of the assessment from reality is lowered.

Considering the potential visibility from local communities, the Project components, especially the wind turbines will either wholly or partly be visible from the residential areas in vicinity such as Phu Dien and Lac Tri villages, Phu Lac Commune, Lien Huong and Phan Ri Cua townships, Tuy Phong district, Binh Thuan province. Additionally, the National Road 1A goes through the Project area, this is likely to pose a significant temporary visual impact on mobile receptors.

Various locations within the Project area have been selected as visual sensitive receptors (VSRs), in order to evaluate the significance of impact at different directions. The selection boundary is within the vertical viewshed of the wind turbine's tip (radius 22.9 km) because this is the highest part to be seen. This will cover all the visual perception of people that could be affected by the presence of the Project. After choosing the receptors, a viewshed analysis could be carried out to reflect the view of receptors toward the turbines within field of view.

In order to screen the potential sensitive receptors, the following criteria were used to assess the sensitivity of the VSRs:

- Value and quality of existing views;
- Type and estimated number of receiver population;
- Duration of frequency of view; and
- Degree of visibility.

Figure 10.24 shows the locations of the VSRs which are houses selected for analysis.

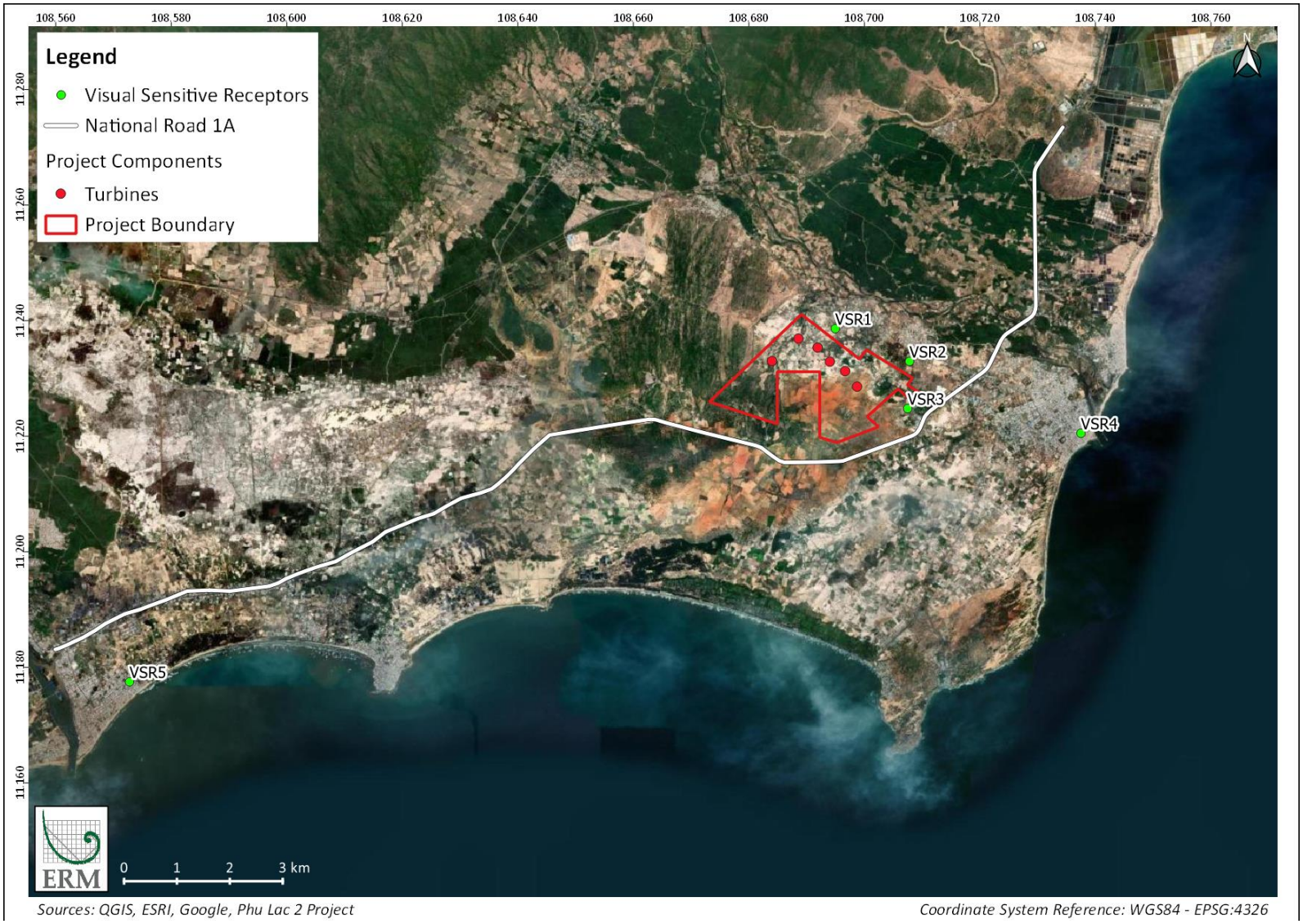


Figure 10.24 Visual Sensitive Receptors Location

10.6.5 Impact Assessment

The assessment of impacts on visual amenity was performed in accordance with accepted methodologies derived from best practice guidelines. Impact significance for visual amenity is generally derived on the basis of the following main factors:

- The quality/importance of the visual amenity as a resource/function that is potentially affected;
- The sensitivity of the visual amenity towards Project activities; and
- The magnitude of change to the receiving visual amenity as a result of the Project.

The visual impact assessment describes changes in the character of the available views to people resulting from a given Project and their visual amenity. To determine the significance of visual effects it is necessary to consider the sensitivity of the visual receptors against the magnitude of visual effects.

10.6.5.1 Methodology

10.6.5.1.1 Sensitivity of Receptors

Visual receptors are people and must be assessed in terms of their sensitivity, combining judgements on their susceptibility to the specific change proposed and the value attached to a view or their visual amenity. Susceptibility refers to the degree to which a particular visual receptor can accommodate change arising from the Project, without detrimental effects on the visual amenity, and will vary with the:

- Occupation or activity of people experiencing the view;
- Location and context of the view; and
- Extent to which their attention or interest may be focused on the view and their visual amenity.

Judgements about the sensitivity of visual receptors should be recorded on a scale (e.g., low, medium and high) with clearly stated criteria. Table 10.26 indicates the relative sensitivities of a number of visual receptors.

Table 10.26 Sensitivity of Visual Receptors

Visual Receptors	Sensitivity
Small number of visitors with interest in their surroundings. Viewers with a passing interest not specifically focussed on the landscape e.g. workers, commuters. The quality of the existing view, as likely to be perceived by the viewer, is assessed as being low	Low
Small numbers of residents and moderate numbers of visitors with an interest in their environment. Larger numbers of recreational road users. The quality of the existing view, as likely to be perceived by the viewer, is assessed as being medium	Medium
Larger numbers of viewers and/or those with proprietary interest and prolonged viewing opportunities such as residents and users of attractive and well-used recreational facilities. The quality of the existing view, as likely to be perceived by the viewer, is assessed as being high	High

10.6.5.1.2 Magnitude of visual effects

There is no standard methodology for the scale or magnitude of effects on views and visual amenity. However, it is generally based on the:

- Scale of change relating to the loss or additions of features in the view, including the proportion of the view occupied by the proposed development;
- Degree of contrast or integration of any new feature or changes in the composition of the view;
- Duration of the effect, whether temporary or permanent, intermittent or continuous;

- Angle of view in relation to the main activity of the receptor;
- Distance of the viewpoint from the Project;
- Extent of the area over which the changes would be visible;
- Variation in the degree of visibility of the Project (it is helpful to categorize those variations);
- The extent of the view that would be occupied by the Project: full, partial, glimpse etc.;
- The distance of the viewpoint from the Project and whether the viewer would focus on the Project due to proximity or the Project would form one element in a particular view;
- The proportion of the Project or particular features that would be visible: full, most, small amount, none;
- Whether the view is transient or one of a sequence of views as from a moving vehicle or footpath.

Consideration may also be given to the time of day and seasonal differences in effects. The worst case may need to be demonstrated (i.e., during dry season, when lower moisture levels increases visibility). The typical criteria and thresholds in determining the magnitude of effect on visual receptors are set out in Table 10.27.

Table 10.27 Magnitude of Visual Effect

Typical criteria and thresholds	Visual Magnitude of effect
A change which is barely or rarely perceptible, at very long distance, or visible for a short duration, perhaps at an oblique angle, or which blends in with the existing view. The change may be short term.	Negligible
A subtle change in the view, at long distances, or visible for a short distance, perhaps at an oblique angle, or which blends in with the existing view. The change may be short term.	Small
A noticeable change in the view at an intermediate distance, affecting a substantial part of the view, part a more wide-ranging, less concentrated change across an expansive area. The change may be medium to long term and may not be reversible.	Medium
A clearly evident change in the view at a close distance, affecting a substantial part of the view, continuously visible for a long duration, or obstructing important elements of the view. The change may be medium to long term and would not be reversible.	Large

10.6.5.1.3 Significance of Visual Effect

When determining the significance of visual effects, the following is taken into account:

- Large scale changes which introduce new discordant or intrusive elements into the view are more likely to be significant than small changes or changes involving features already present in the view;
- Changes in views from recognized and important viewpoints or amenity routes are likely to be more significant than changes affecting less important paths and roads; and
- Changes affecting large numbers of people are generally more significant than those affecting a relatively small group of users.

The significance matrix below illustrates the relationship between the sensitivity of a visual receptor and the magnitude of the visual effect. The significance of a visual effect may be adverse or beneficial

dependent upon the nature of the change. Each case is assessed on its own merits using professional judgement and experience, and there is no defined boundary between levels of effects. What level of effect constitutes a significant effect will vary on a project by project basis.

Table 10.28 Significance of Visual Effect

		Sensitivity of Visual Receptor		
		Low	Medium	High
Magnitude of Visual Effect	**Negligible**	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

10.6.5.1.4 Selection of Visual Sensitive Receptors

Villages and major arterial transport routes are considered to be the most sensitive receptors near the Project Area. In this regard, there are two (2) villages, two (2) townships, and one (1) major highway. Visual Sensitive Receptors were selected for assessment based on the extent to which they represent the sensitivity across the Project area. Table 10.29 lists the VSRs selected.

Table 10.29 VSRs Selected for the Visual Impact Assessment

VSR No.	Description	Rationale for Selection
VSR1	A house located in Phu Dien village, Phu Lac commune, Tuy Phong district, Binh Thuan province	Phu Dien is a village located in vicinity of the north of Project. VSR1 is a representative of Phu Dien village, a dense residential area that could be affected
VSR2	A house located in Lac Tri village, Phu Lac commune, Tuy Phong district, Binh Thuan province	Lac Tri is a village located in vicinity of the north and northeast of Project. VSR2 is a representative of Lac Tri village, a dense residential area that could be affected.
VSR3	A house located in Lac Tri village, Phu Lac commune, Tuy Phong district, Binh Thuan province	The south of Lac Tri is a village located in vicinity of the southeast of Project and next to the National Road 1A. VSR3 is a representative of a part of Lac Tri village, a small residential area that could be affected.
VSR4	A house located in Lien Huong township, Tuy Phong district, Binh Thuan province	Lien Huong is a township located in coastal area which is 4 km to the east of Project. VSR4 is a representative of Lien Huong township, a dense residential and tourist area in which there are beaches and resorts along the coast that could be affected.
VSR5	A house located in Phan Ri Cua township, Tuy Phong district, Binh Thuan province	Phan Ri Cua is a township located in coastal area which is 16 km to the southwest of Project. VSR5 is a representative of Phan Ri Cua township, a dense residential and tourist area in which there are beaches and resorts along the coast that could be affected.

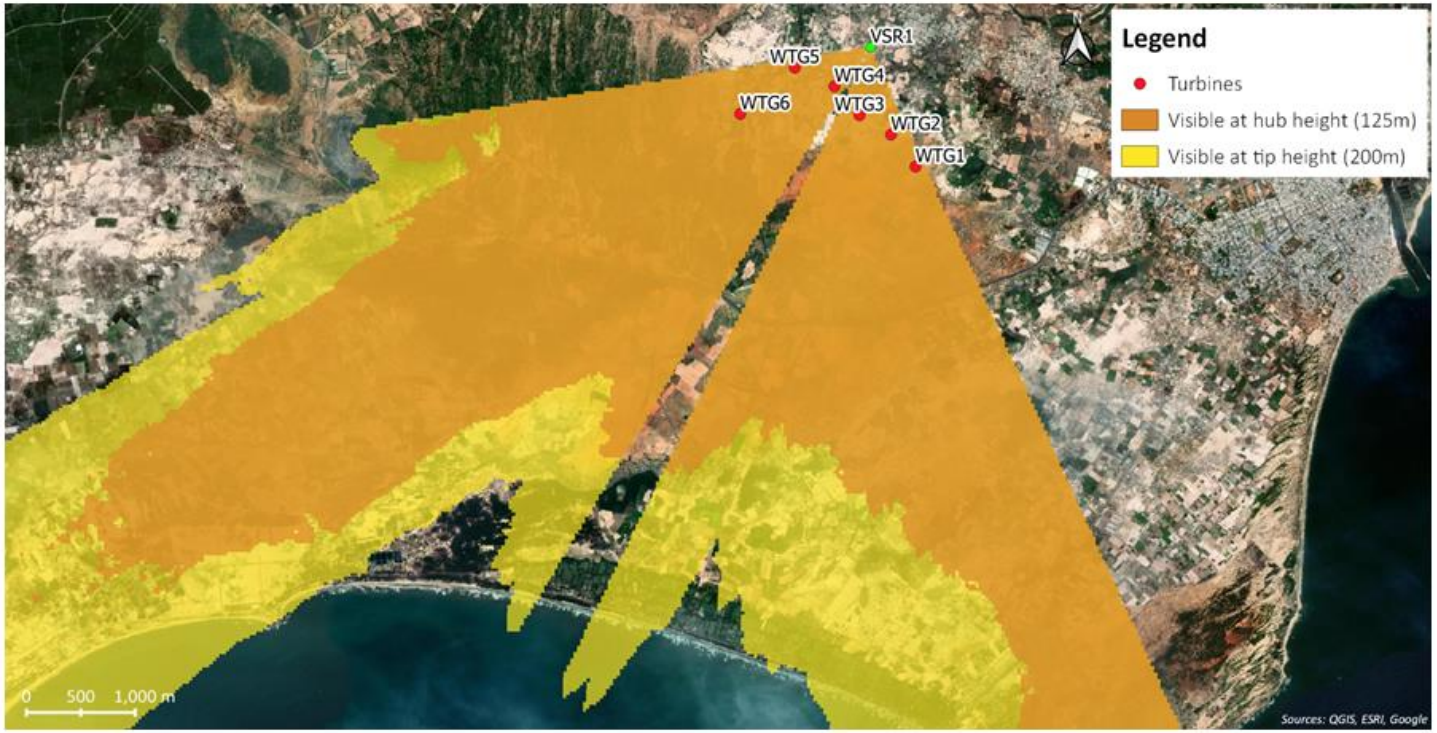
10.6.5.1.5 Identification of Visual Impact

The visual impact is a product of the magnitude of change to the existing baseline conditions, the landscape context and the sensitivities of VSRs.

Figure 10.24 shows the location of the VSRs which have been selected for the analysis and Table 10.30 shows the summary of the visual impacts of the Project at the selected VSRs.

The following pages present the Impact Assessment for each VSR previously identified.

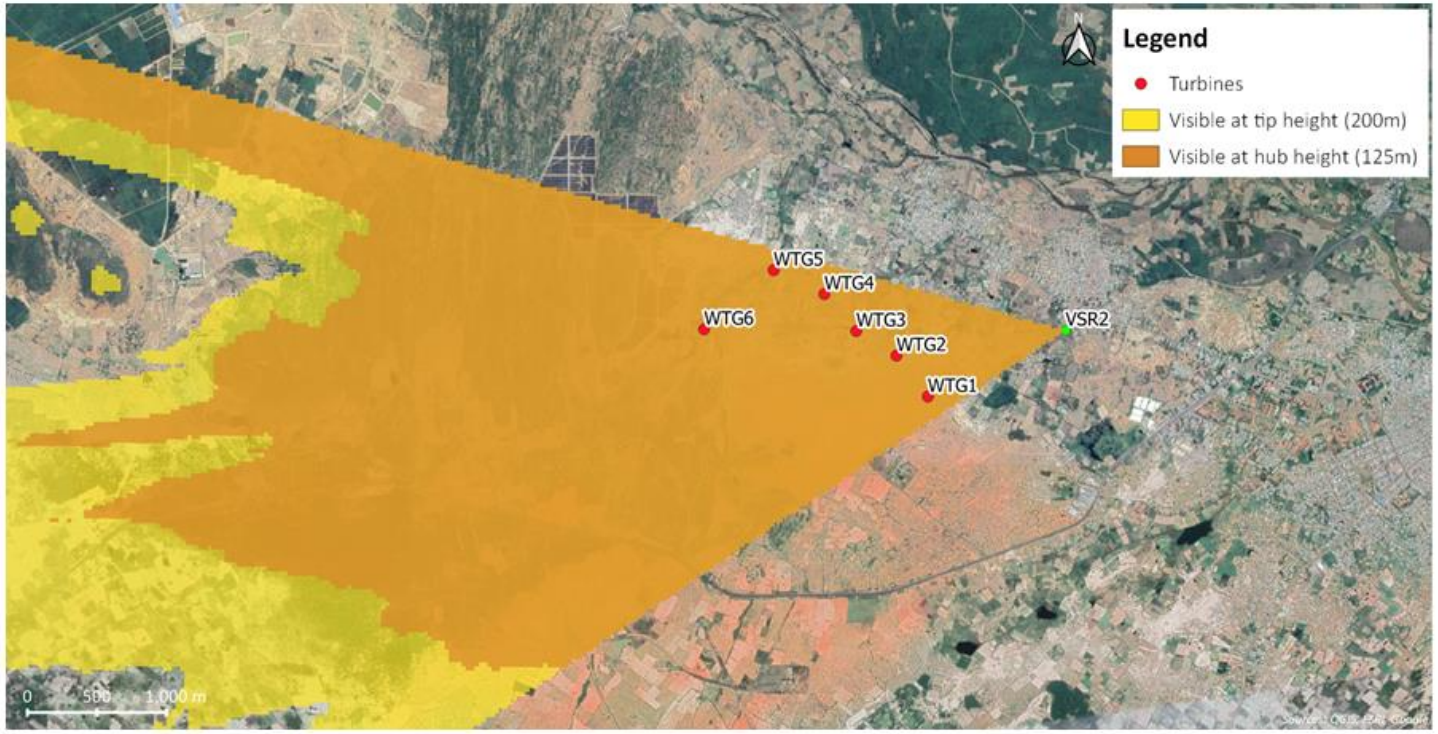
VIEWPOINT VSR01



Viewpoint Location Information									
Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
108.7078179	11.2329448	1.5	SW and SSE	50	3 for each FoV	3 for each FoV	3 for each FoV	490	1,350

Visual Sensitivity	Magnitude of Change
The view is taken from Phu Dien village, Phu Lac commune. Being an important residential area, large number of viewers with prolonged viewing opportunities are involved. The visual sensitivity is considered to be high	The change from this point of view is undeniable. The WTGs will become a substantial part of the view. Given the viewers locate outside the wind power project, it is considered that the magnitude of change is medium

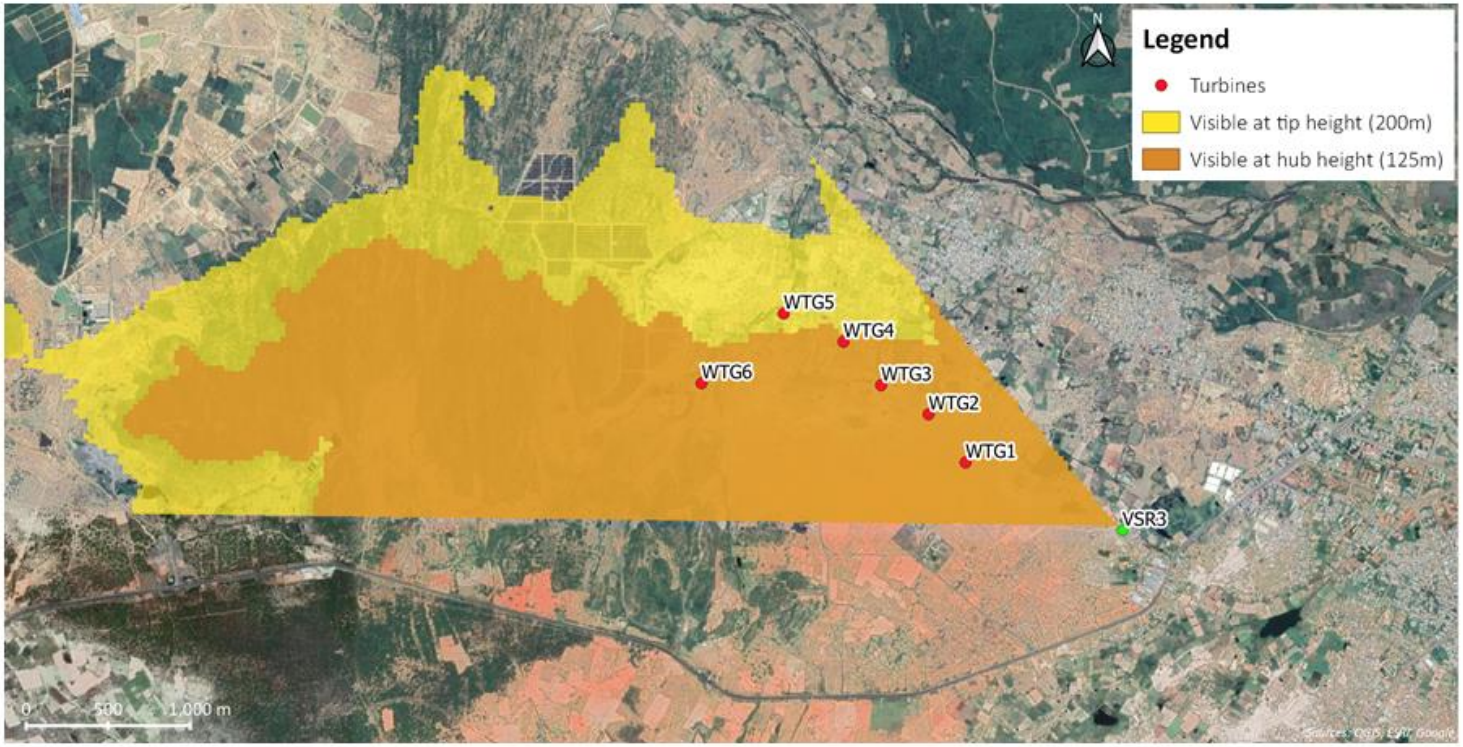
VIEWPOINT VSR02



Viewpoint Location Information									
Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
108.7078179	11.2329361	1.5	WSW	50	7	7	7	1,100	2,600

Visual Sensitivity	Magnitude of Change
The view is taken from Lac Tri village, Phu Lac commune. Being an important residential area, large number of viewers with prolonged viewing opportunities are involved. The visual sensitivity is considered to be high	Due to the topography is characterized by flat terrain and the distance, from this point of view, all wind turbines are visible. Along the view direction (WSW), WTG 3-6 are arranged in-line. Thus, it is considered that the magnitude of change is medium.

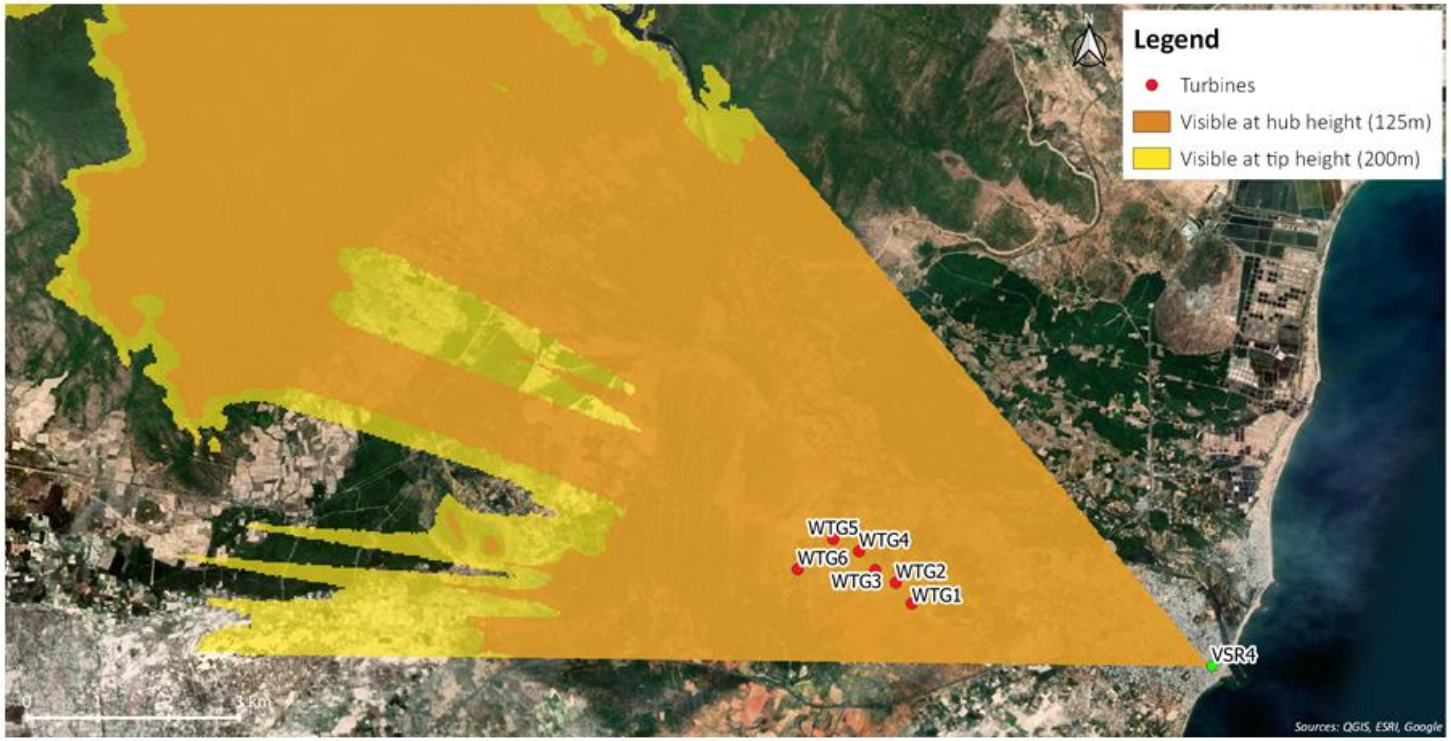
VIEWPOINT VSR03



Viewpoint Location Information									
Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
108.707496	11.224751	1.5	NW	50	7	7	6	1,050	2,730

Visual Sensitivity	Magnitude of Change
The view is taken from a residential near Lac Tri village, Phu Lac commune. Being a small residential area along the National Road 1A, moderate number of viewers with prolonged viewing opportunities are involved. The visual sensitivity is considered to be medium	Due to the topography is characterized by flat terrain and the distance, from this point of view, all wind turbines are visible. Turbines from WTG 1-6 and WTG 2-3 are arranged in-line, and therefore, visibility is reduced significantly. Thus, it is considered that the magnitude of change is medium.

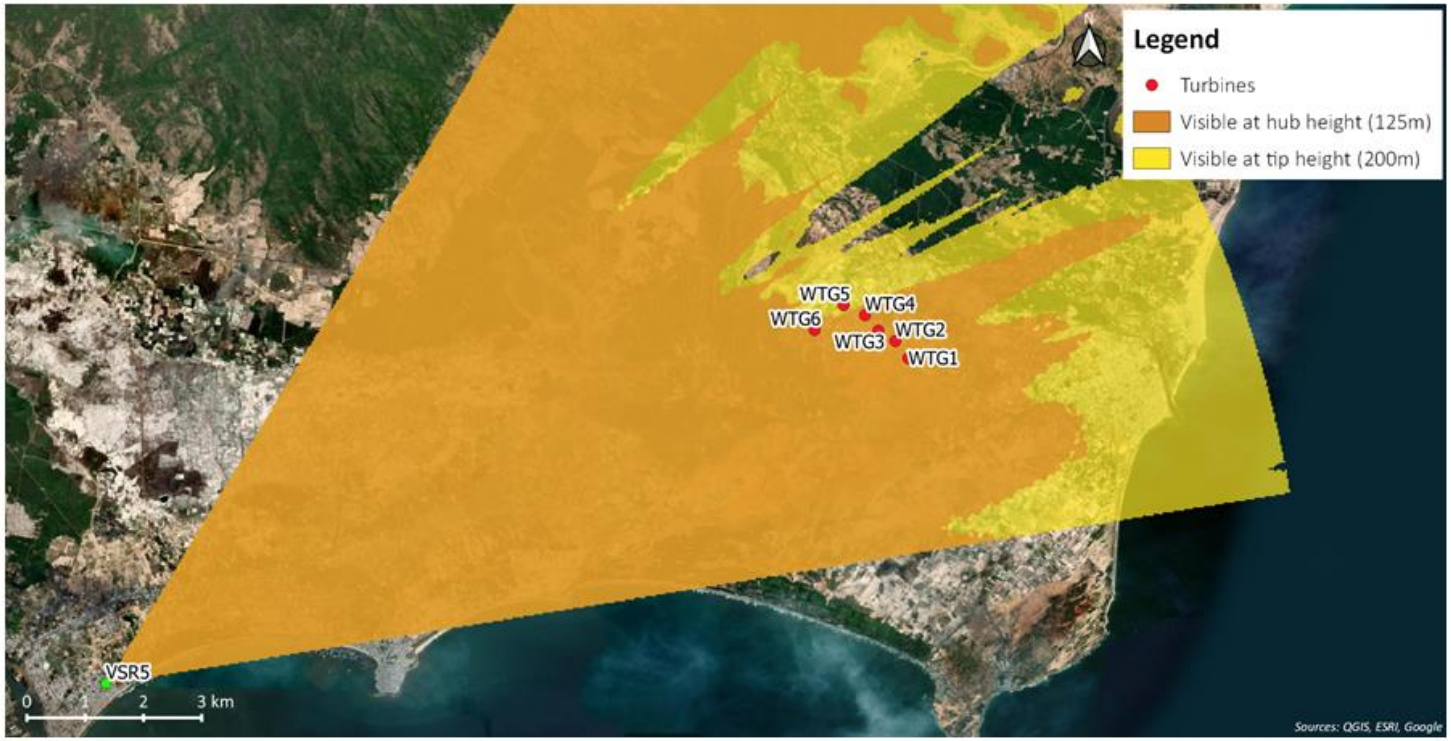
VIEWPOINT VSR04



Viewpoint Location Information									
Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
108.7375138	11.2204794	1.5	NW	50	7	7	7	4,400	6,050

Visual Sensitivity	Magnitude of Change
The view is taken from Lien Huong township, Tuy Phong district. Being an important residential and tourist area, large number of viewers and visitors with prolonged viewing opportunities are involved. The visual sensitivity is considered to be high	Due to the topography is characterized by flat terrain and the distance, from this point of view, all wind turbines are visible. Turbines from WTG 1-6 and WTG 2-3 are arranged in-line, and therefore, visibility is reduced significantly. Thus, it is considered that the magnitude of change is medium.

VIEWPOINT VSR05



Viewpoint Location Information									
Latitude	Longitude	Height above ground level (m)	Centre of Panorama – View Direction	Field of View (FoV) (°)	WTG within FoV	Visible WTG at tip height	Visible WTG at hub height	Nearest WTG (m)	Furthest WTG (m)
108.572708	11.177445	1.5	NE	50	7	7	6	13,600	14,860

Visual Sensitivity	Magnitude of Change
The view is taken from Phan Ri Cua township, Tuy Phong district. Being an important residential and tourist area, large number of viewers and visitors with prolonged viewing opportunities are involved. The visual sensitivity is considered to be high	Due to the topography is characterized by flat terrai, from this point of view, all wind turbines are visible. However, the distance from the selected VSR to the Project is long, that could reduce visibility of turbines. Thus, it is considered that the magnitude of change is small.

Table 10.30 Summary of Visual Impacts

VSR	Distance to nearest wind turbine	Project visibility	Sensitivity of Receptor	Magnitude of Visual Effect	Significance of Visual Effect – Combined Impact
VSR1	0.5 km	Visible	High	Medium	Major
VSR2	1.1 km	Visible	Medium	Medium	Moderate
VSR3	1.1 km	Visible	High	Medium	Major
VSR4	4.4 km	Visible	High	Medium	Major
VSR5	13.6 km	Visible	High	Small	Moderate

Three (3) VSRs were selected as representative of 2 villages around the Project area with Phu Lac (VSR1) and Lac Tri (VSR2 and VSR3). The VSR4 and VSR5 was selected as representative of Lien Huong and Phan Ri Cua townships respectively, both of the two are dense residential and tourist areas to verify the visibility from the area which is 4.4 km and 13.6 km from Lien Huong and Phan Ri Cua townships respectively to the Project.

It should be noted that views of the Project could be filtered through vegetation not included in the present analysis. As shown in Table 10.30, receptors located in vicinity of the Project are likely to be affected by the turbines, whilst the area located far away from the Project is not likely to be affected due to the distance and obstacles (e.g. terrain, vegetation, buildings).

The Project will be visible across an area of 35,400 ha. Within this there are 2 villages, 2 townships and 1 major highway. The five VSRs selected are broadly representative of the landscapes and sensitivities of the Project area. As noted in Table 10.30, three out of five selected VSRs were assessed as being impacted to a Major extent. The rest of two VSRs will be affected to a Morderate extent. However, as recorded information from social and other surveys, local community confirmed that there was no visual impact to them for existing wind farm projects. Therefore, overall, the significance of visual impact that will result from the installation and operation of the wind turbines has been assessed as **Moderate**.

10.6.5.2 Additional Mitigation Measures

The following identifies mitigation measures to be applied by the Project Owner and EPC contractor:

- Siting and design of roads and other infrastructure to minimize off-site visibility from visually sensitive areas should be an important consideration;
- Use of unobtrusive colors to minimize contrast is important for other project components such as operations buildings, transmission line pylons, and road surface materials. In general, darker colors are less noticeable when viewed against a vegetated background;
- Use of materials that will minimise light reflection should be used for all Project components; The replacement of wind turbines with visually different wind turbines can result in visual clutter, so replacing wind turbines with the same or a visually similar model over the lifetime of the project may be an important requirement;
- Existing vegetation should be retained to the greatest extent possible. Vegetation should be retained along roads, substations, and other Project infrastructure.

10.6.5.3 Residual Impact

Following the implementation of these mitigation measures, the significance of residual impact is considered as **Minor** to **Negligible.**

10.6.5.4 Monitoring and Audit

No specific monitoring measures are identified at this stage.

10.7 Biodiversity Impact Assessment

In accordance with IFC PS1 and PS6, the impact assessment (IA) process aims to predict and assess the Project's potential adverse impacts and risks to biodiversity values, in both its contruction and operational phase. The objectives of the biodiversity IA are to identify and quantify potential Project impacts; identify likely residual impacts; and design measures to avoid, minimise or mitigate potential adverse impacts. The direct and indirect Project-related impacts are based on the baseline studies, which have been documented in Volume 2. The key objectives of this section include:

- An IA that addresses the extent and complexity of potential adverse impacts to habitat areas and conservation significant species;
- Development of mitigation measures to avoid and minimise potential adverse impacts to biodiversity with priority given to impacts on features with significant biodiversity values; and
- Determination of residual impacts, which will determine if further mitigation measures are required.

10.7.1 Summary of Scope of Assessment

With accordance to IFC PS6, Table 10.31 describes the potential impacts to biodiversity caused by the Projects' activities and the flow diagram shown in Figure 10.25 illustrates how the impacts are directly and indirectly linked to the reduction in population size, which eventually leads to reduction in biodiversity. Table 10.32 identifies the Project's phases (construction and/or operation phases) that the effects are likely to present.

Table 10.31 Definition of Potential Impacts on Biodiversity

Impacts	Definition
Habitat loss	Permanent loss of habitats (such as foraging, breeding, wintering habitats) due to permanent or temporary land-use requirements.
Disturbance and/or Displacement	Impacts from light, noise and vibration sources on surrounding habitats causing disturbance, displacement and changes in behaviour
Direct mortality	Direct mortality events for some fauna species due to: ■ Vehicles, vessel or machinery strikes or falling debris during clearing activities. ■ Worker influx and increased hunting/ poaching pressures. Other mortality events for avifauna include: ■ Collision and electrocution with transmission line. ■ Collision with and flight through the Rotor Swept Zone (RSZ) of turbine blades.
Barrier creation, fragmentation and edge effects	■ Creation of barriers to the movements of animals, especially those with limited dispersal range. ■ Fragmentation of habitat, or permanent/ temporary severance of wildlife corridors between isolated habitats of biodiversity importance due to Project's components e.g. the transmission line and/or subsea cables. ■ Edge effects may be generated when vegetation clearing or land disturbance occurs at the boundary of two or more habitats. These effects can result in increased risk of parasitism or disease, increased risk of predation, adverse microclimate conditions (including drying out and subsequent fire risks) and competition.
Degradation	Introduction or spreading of alien species, introduction of air and water pollutants into the habitats/ ecosystems and make them less sustainable and available for many species.

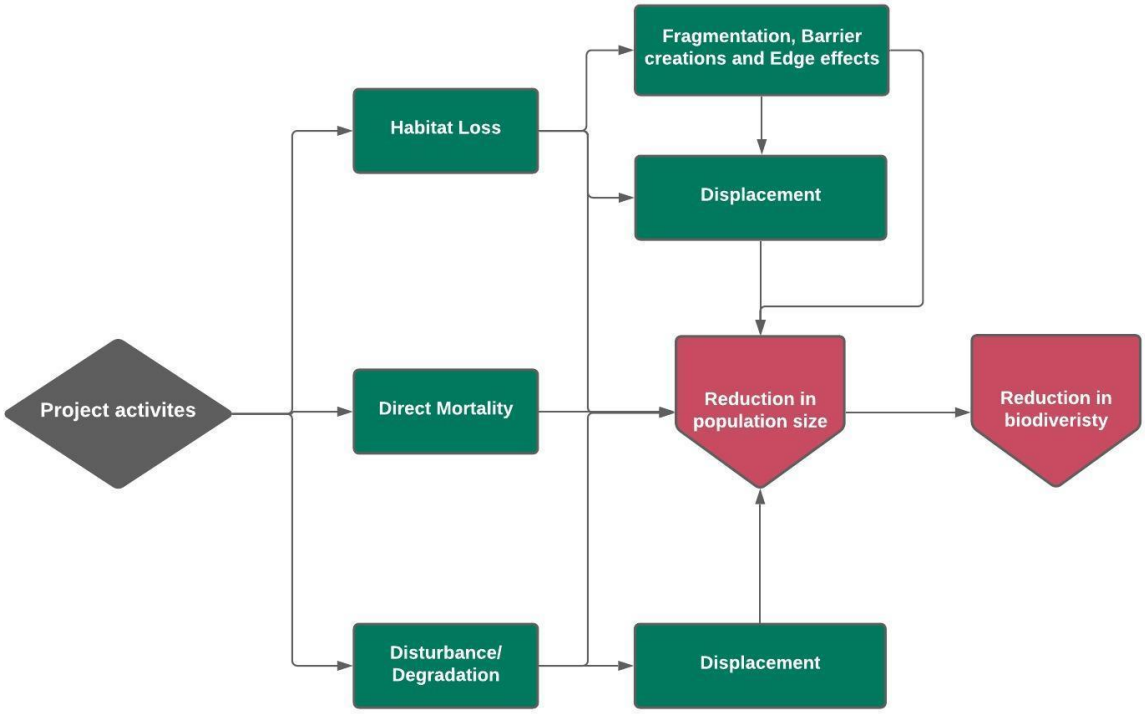


Figure 10.25 Direct and Indirect Effects of Project Activities on Species' Population Size

Table 10.32 Scoping of Impacts during Project Phases

Impacts	Construction Phase	Operation Phase
Habitat loss	Yes	Continuing from construction phase
Disturbance or displacement	Yes	Reassessed for operation phase
Barrier creation and edge effects	Yes	Continuing from construction phase
Degradation	Yes	Continuing from construction phase
Mortality	Yes	Reassessed for operation phase

Note:
***Yes**: likely to be induced by the Project activities during this phase.*
***No**: not likely to be induced by the Project activities during this phase.*
***Continuing from construction phase**: impact is likely to continue from the construction into the operation phase; thus, mitigation measures defined for the construction phase can also be applied for the operation phase.*
***Reassessed for operation phase**: impact is likely to be different during the phases. Hence, it should be reassessed and additional mitigation measures should be defined for the operation phase when appropriate.*

10.7.2 Relevant Guidelines and Criteria

10.7.2.1 Vietnamese Regulations

- The Law of Biodiversity No. 20/2008/QH12 dated November 13, 2008 on biodiversity conservation and sustainable development (according to Document 32/VBHN-VPQH, Biodiversity Law no.20/2008/QH12 dated 13 November 2008 has been approved to be combined with Law no.335/2018/QH14 dated 20 November 2018)

- The Law on Environmental Protection (LEP) No. 55/2014/QH13 dated June 23, 2014 is the main piece of environmental legislation currently in force for the local regulatory EIA;
- The Law on Forest Protection and Development No. 29/2004/QH11 dated December 3, 2004 on the management, protection, development and use of forests; and forest owners' rights and obligations;
- Decree No. 23/2006/ND-CP dated March 3, 2006 on the implementation of the Law on Forest Protection and Development;
- Decree No. 99/2010/ND-CP dated September 24, 2010 on the policy on payment for forest environment services;
- Decree No. 18/2015/ND-CP and No. 19/2015/ND-CP dated February 14, 2015 on environmental protection planning, strategic environmental assessment, environmental IA and environmental protection plans;
- Decree No. 06/2019/ND-CP dated January 22, 2019 of the Government on the management of endangered, precious and rare forest plants and animals and implementation of the Convention of International Trade in Endangered Species of Wild Fauna and Flora; and

10.7.2.2 International Guidelines

- IFC Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources recognises that protecting and conserving biodiversity, maintaining ecosystem services and sustainably managing living natural resources are fundamental to sustainable development;

Vietnam has also ratified several international conventions including:

- UNEP Convention on Conservation of Biological Diversity (CBD), ratified in 1994;
- CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora), an international agreement between governments which aims to ensure international trade in specimens of wild animals and plants does not threaten their survival. This came into force in Vietnam in 1994; and
- Ramsar (the Convention on Wetlands of International Importance), an intergovernmental treaty providing the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. This came into force in Vietnam in 1989.

10.7.2.3 Impact Assessment Criteria

In order to assess the significance of impacts due to the Project before and after mitigation, the IA matrices have been used to evaluate the severity of impacts to habitats (Table 10.33) and species (Table 10.34). The matrices outline the sensitivity of the receptors and the magnitude of effects caused by the Project.

Table 10.33 Impact Assessment Matrix for Habitat

Habitat Sensitivity/Value		Magnitude of Effect			
		Negligible	**Small**	**Medium**	**Large**
		Effect is within the normal range of variation	Affects a small area of habitat, but without the loss of viability/ function of the habitat	Affects a sufficient proportion of the habitat to the extent that the viability/ function of part of the habitat or the entire habitat is reduced, but does not threaten the long-term viability of the habitat or species dependent on it.	Affects the entire habitat or a significant proportion of the habitat to the extent that the viability/ function of the entire habitat is reduced and the long-term viability of the habitat and the species dependent on it are threatened.
Low	Habitats with no or local designation/ recognition; habitats of significance for species of Least Concern (LC); habitats which are common and widespread within the region.	Negligible	Negligible	Minor	Moderate
Medium	Habitats within nationally designated or recognised areas; habitats of significant importance to globally Vulnerable (VU), Near Threatened (NT) or Data Deficient (DD) species; habitats of significant importance for nationally restricted range species; habitats supporting nationally significant concentrations of migratory species and/or congregatory species; nationally threatened or unique ecosystems.	Negligible	Minor	Moderate	Major
High	Habitats within internationally designated or recognised areas; habitats of importance to globally Critically Endangered (CR) or Endangered species (EN); habitats of importance to endemic and/or globally restricted-range species; habitats supporting globally significant concentrations of migratory species and/ or congregatory species; highly threatened and/ or unique ecosystems, areas associated with key evolutionary species.	Negligible	Moderate	Major	Critical

Table 10.34 Impact Assesment Matrix for Species

Species Sensitivity/Value		Magnitude of Effect			
		Negligible	**Small**	**Medium**	**Large**
		Effect is within the normal range of variation.	Affects a small proportion of a population, but does not substantially affect other species dependent on it, or the populations of the species itself	Affects a sufficient proportion of a species population that it may bring about a substantial change in abundance and /or reduction in distribution over one or more generations, but does not threaten the long-term viability of that population or any population dependent on it.	Affects an entire population or species at sufficient scale to cause a substantial decline in abundance and/or change in distribution beyond with natural recruitment (reproduction, immigration from unaffected areas) so that that it may not return that population or species, or any population or species dependent upon it, to its former level within several generations, or when there is no possibility of recovery.
Low	Species which are included on the IUCN Red List of Threatened Species as Least Concern (LC).	Negligible	Negligible	Minor	Moderate
Medium	Species included on the IUCN Red List of Threatened Species as Vulnerable (VU), Near Threatened (NT) or Data Deficient (DD). Species protected under national legislation. Nationally restricted range species. Nationally important number of migratory or congregatory species.	Negligible	Minor	Moderate	Major
High	Species included on the IUCN Red List of Threatened Species as Critically Endangered (CR) or Endangered (EN). Species having a globally Restricted Range (i.e. plants endemic to a site or found globally at fewer than 10 sites, fauna having a distribution range (or globally breeding range for bird species) of less than 50,000 km^2. Internationally important numbers of migratory or congregatory species. Key evolutionary species.	Negligible	Moderate	Major	Critical

10.7.3 Assessment of Impacts

The biodiversity impact assessment will identify the effects arising from the projects, and how these may impact biodiversity receptors i.e. species and habitats. The assessment will take into account existing controls and mitigation, and identify any residual impacts on species or habitats that require additional measures.

10.7.3.1 Disturbances

10.7.3.1.1 Existing Controls

According to the local regulatory EIA, the following measures are being applied:

- Schedule operating time and locations for machines, avoiding too many machines working in a same location.
- Noisy machines will be placed in separated areas and covered/housed for better sound insulation.
- Ensure efficiencies in load bearing capabilities and depth in the design of foundations/footings; and
- Create drains of sand to reduce surface vibration
- The construction sites will be sheltered/covered.
- Spray water two times/ day for high dust-generating areas.
- The construction site will be divided into specialized areas. When the construction activities in an area are completed, the area will be handed back to the authorities to minimize dust generation

10.7.3.1.2 Significance of Impacts

10.7.3.1.2.1 Noise

During construction phase

Noise during construction phases are mainly emitted from construction machines with other sources include transporting vehicles and electricity generator. Literature review suggested that fauna responses to noise can be triggered at noise intensity as low as 45 dBA (Shannon et al. 2016). Table 10.35 presents the list of equipment used for Phu Lac, its noise level at reference measure distance (taken from the US Federal Highway Administration 2017) and how far the receptor would be expected 45 dBA from the noise point source using the Inverse Sqaure Law for Noise attenuation. The equation of the Inverse Square Law used is:

$L1 = L2 - 20 * \log(D/D_0)$[13]

where:

- L1: Known sound pressure level at the first location (reference measure distance)
- L2: Target sound pressure level (45 dBA in this case)
- D: the distance from noise source to the location of L2;
- D_0 : the reference measurement distance to L1 (15m in this case)

[13] https://www.wkcgroup.com/tools-room/inverse-square-law-sound-calculator/

Table 10.35 List of Construction Equipment, Its Average Maximum Noise Level and Distance to be Experienced

No.	Name of equipment	Noise level at 15m (Reference measure distance) in dBA	Distance where receptor experiences 45 dBA (m)
1	Compactor (ground)	83	1191
2	Air compressor	78	670
3	Concrete Mixer Truck	79	752
4	Concrete Pump Truck	81	946
5	Crane	81	946
6	Dozer	82	1062
7	Dump truck	76	532
8	Excavator	81	946
9	Generator	81	946
10	Generator (<25KVA)	73	377
11	Jackhammer	89	2378

According to Table 10.35, it is suggested that the distances for sound to attenuate to a safe level (45 dBA) ranges from 377 to 2378 meters, with jackhammer being the equipment that has the largest disturbance area.

Within 15 meters, the sound might be large enough to cause damage to species' auditory systems. The lower time being exposed to such noise source, the shorter time it takes for the auditory systems be regenerated. However, the increased human activity and visual disturbances of machines might have already displaced most species out of this zone already; and where any volant species or mammals are present, it is assumed they will leave this zone to minimize the exposure time. However, reptiles generally move slower than those above taxon and it was shown that they might 'freeze' as a species-specific response to such threat (Mancera et al. 2017). This renders a high risks of auditory damage for this taxon, which requires a Wildlife Shepherding Protocol to be applied prior to construction. After animals have been evacuated, fencing should be applied at least at 15m around the construction site to avoid re-entering.

During operation phase

During operation phase of the Project, sound is continuously produced from the running of mechanical generators in the turbine nacelles (i.e. gearboxes) and the interactions between the moving blades and air. Such sound is generally low in frequencies (Bolin et al. 2011; Carlile et al. 2018); thus it poses a masking effect that disrupts the communication of species vocalizing at low frequencies, which can lead to decreases in efficiencies of mating and alarming calls, and consequently reduced species fitness.

However, studies have shown evidences that vocalizing fauna can increase the frequencies of their calls as a response to the masking effects (Brumm 2004; Francis, Ortega & Cruz 2011; Parris, Velik-Lord & North 2009; Zhao et al. 2018). Given that the Project's turbines are located in a modified habitat, it is reasonable to assume that the fauna living in the vicinity might have already developed strategies to adapt to many sources of anthropogenic sound disturbances. The localized noise added by turbines during operation phase are unlikely to cause significant negative impacts to fauna in the area; therefore, it is considered to be Negligible.

10.7.3.1.2.2 Vibrations

Large ground-borne vibrations can be emitted through earthworks during construction phase, while smaller vibrations can be produced by the operation of wind turbines. Species that are sensitive to vibrations such as snakes (Christensen et al. 2012) and ground-dwelling species might be frightened and experience increased stress. However, the turbines are located in a modified habitats which suggests very low occurrences of, if any, snakes and ground-dwelling mammals. Additionally, considering that the vibration disturbances might only have significant biological effects within a small areas around the turbines and the construction sites, and the potential avoidance of fauna, the effect is considered to be Negligible.

10.7.3.1.2.3 Dust

Dust are mostly generated during the construction phase. Dust can settle on leaves which hinder the photosynthesis and render the vegetation unpalatable to foraging fauna. However, sand-storms which are very frequent in Binh Thuan province therefore the resident species in this area may have already adapted to such type of disturbance. The increased dust particles during construction phase are unlikely to pose significant impacts.

Table 10.36 IA of Disturbance

Impact Type	**Direct**		**Indirect**		Induced
	The impacts from noise, vibration and dust are direct.				
Impact Duration	Temporary	**Short-term**	**Long-term**		Permanent
	Impacts during construction phase are short-term and during operation phase are long-term.				
Impact Extent	**Local**		Regional		International
	Impacts on terrestrial habitat are restricted to the clearing footprint.				
Impact Frequency	The impacts during construction phase is either one-off or intermitten events, while impacts during operation phase are continous.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	The largest magnitude that disturbance effects can have is Small, which is posed by loud noise on reptiles occurring near the construction site who could be subjected to increased stress and auditory damages.				
Receptor Sensitivity	**Low**		Medium		High
	Receptors include Least Concern species.				
Impact Significance	**Negligible**	Minor	Moderate		Major

10.7.3.1.3 Additional Mitigation Measures

The additional measures are proposed as followed:

- Implement noise mitigation measures to minimise disturbance and displacement including:
  - A Wildlife Shepherding Protocol is to be used within the terrestrial Project Area to ensure that any resident species have vacated the area prior to any clearance and construction work;
  - Fencing is to be placed around major project sites during construction to restrict access to local fauna, and therefore stopping wildlife getting into project areas.
  - Use of appropriate noise suppression techniques (such as silencer, noise barrier) where applicable;
  - Regularly maintain machinery. Periodic lubrication ensures less noise and vibration.
- Use cowl, hood and shield to minimize light spill during construction and operation.

10.7.3.1.4 Monitoring and Audit Program

No additional monitoring and auditing programs are proposed.

10.7.3.1.5 Significance of Residual Impact

With the application of mitigation measures, the significance of impacts are likely to be reduced to the minimum.

10.7.3.2 Degradation

10.7.3.2.1 Existing Controls

10.7.3.2.1.1 Construction Waste

- Segregate Construction Domestic Waste (CDW) and maximise the reuse of CDW for other construction activities;
- Accumulate soil, broken bricks, gravel at temporary storage areas arranged near turbine foundations and substation, and reuse them as backfilling materials;
- Organic soils from earthwork will be reused for backfilling of turbine foundations, consolidating internal access roads, levelling of laydown areas;
- CDW, such as broken bricks and concrete, cement bags, wood waste, unused soils and stones etc., will be collected and accumulated in designated places, and will be removed every day by a licensed waste treatment company.

10.7.3.2.1.2 Domestic Waste

- Prioritise the recruitment of local workers who do not need to stay in worker's camp, and as the result, less domestic waste will be generated inside Project area;
- Establish the internal rules of order, hygiene and environmental protection, which all Project's employees have to follow; workers should be trained in proper waste segregation and disposal practices.
- Place in strategic areas waste bins within each worker's camp (03 bins, capacity 60 L each for each camp). Waste from these camps will be collected, treated and disposed in accordance with legal requirements by authorized haulers.

10.7.3.2.1.3 Hazardous Waste

- Minimise the repair and maintenance of machinery and equipment on site; if these activities are performed, ensure they are done in dedicated areas where trails for spills are available.
- Waste oil and other hazardous waste generated in Project area will be collected, treated and disposed in accordance with Circular 36/2015/TT-BTNMT on Hazardous waste management;
- Dedicated hazardous storages will be arranged next to construction waste storages, and will be built in accordance with legal requirements (the storage must be roofed, the floor must be impervious etc.). Inside the storage, hazardous waste bins will be arranged and labelled to accommodate each type of waste.

10.7.3.2.1.4 Storm-water Runoff and Wastewater

- Build drainage routes that lead to sedimentation tanks/pits for treatment before discharging into surrounding environment; and
- In areas having oil and grease, the drainage routes will lead to separator tanks for treatment.

10.7.3.2.2 Significance of Impacts

10.7.3.2.2.1 Domestic Wastewater and Rainwater Runoff

Domestic sewage contains dissolved or suspended pollutants including organic matters (mainly food waste), chemicals (e.g. detergents, soap) and disease-causing bacteria (e.g. from human/animal faecal matter), while rainwater runoff picks up solid waste, pesticides, oil and grease and other pollutants as it flows. These type of disturbances, if being discharged into the surrounding environments untreated, may trigger ecosystem degradation (especially in aquatic habitats).

However, the Project's appropriate current controls for wastewater and rainwater runoff will likely to reduce the negative effects to Negligible.

10.7.3.2.2.2 Waste

Likewise, improper management of solid domestic waste has the same potential to pollute the surrounding ecosystems. The Project's waste management measures include bin/storage arrangements, contracting with authorized waste treatment vendors, reuse and recycle these in the best way possible. The magnitude of effect is considered Negligible.

10.7.3.2.2.3 Invasive Species

The field surveys did not identify invasive species occurring in the Project's boundary. However, increased movements of vehicles and workers from and to the Project's site may facilitate the propagation of invasive species which may bring new species into the Project's area that might become significant in the future. The habitats within the Project's boundary are all modified habitats containing low biodiversity values; therefore, the receptor sensitivity is considered to be Low. Although the effects are considered to be negligible, this does not rule out the needs for invasive species controls within the Project' area as required by IFC PS6.

Table 10.37 IA of Degradation

Impact Type	**Direct**	Indirect	Induced		
	The impacts from domestic wastewater, waste and invasive species on habitats are direct.				
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
	Impacts are more significant in construction phase and the effects are likely to be negligible in operation phase				
Impact Extent	**Local**	Regional	International		
Impact Frequency	The effects are continuous within its duration				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The degradation impacts are negligible.				
Receptor Sensitivity	**Low**	Medium	High		
	No natural habitats are subjected to possible degradation caused by the Project's activities. Only modified habitats will be affected, thus receptor sensitivity is Low.				
Impact Significance	**Negligible**	Minor	Moderate	Major	

10.7.3.2.3 Additional Mitigation Measures

Control measures during operation phase can be adopted from the construction phase. Additional measures are proposed for both phases as follows:

- All disturbed lands by construction activities, that will not be occupied by aero-generators are to be rehabilitated in the best way possible through native species which are to be planted within areas under the Projects control

- Existing populations and the introduction of new invasive species into natural habitats should be managed and monitored. The measures should be outlined in an *Invasive Species Management Plan* which includes measures as:
  - The provenance of any fill material brought onto the site is to be checked regarding invasive species contamination;
  - Monitoring in revegetation area is to consist of regular inspections (three-month intervals) to determine plant establishment and invasive species control measure; and
  - Response and action plans should be devised in case of invasive species outbreak/ infestation.
- To mitigate the impacts causes by dust and other contaminant emissions, these measures need to be conducted:
  - Use of water spray in dry conditions to suppress dust disturbance on roads;
  - Develop and implement appropriate emergency spills response procedures to avoid and manage accidental spills of fuels, oils, and other hazardous chemicals used during construction activities;
  - There must be an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.
- Hours of operation of the construction site are to be limited to the hours of 6.00am to 10.00pm Monday to Sunday.
- Light spillage outside of the construction area will be controlled by the use of appropriate cowling and positioning of luminaries to direct light onto the construction area and away from natural habitat..

10.7.3.2.4 Monitoring and Audit Program

- Daily site inspection shall be implemented to verify the compliance with mitigation measures;
- Waste manifests or other records that document the amount of waste generated and its destination shall be kept and maintained throughout the construction phase;
- Planned and unplanned audits to onsite waste storage areas and waste treatment contractor's facility shall be implemented to ensure compliance with legal requirements.

10.7.3.2.5 Significance of Residual Impact

With the application of mitigation measures, the significance of impacts are likely to be reduced to the minimum.

10.7.3.3 Barrier Creations, Fragmentation and Edge Effects

10.7.3.3.1 Existing Controls

There are no existing controls outlined in the local regulatory EIA.

10.7.3.3.2 Significance of Impacts

The development of the Project's components (including both temporary and long-term) have potential to create a barrier to fauna movement and disconnect habitats that are currently linked by corridors. However, the Project's components are all located in modified habitats, where fauna movements have already been hindered and the components also do not lie in any corridors between natural habitats.

For avifauna, wind farms standing along their fly paths may cause increased travelling distances and the associated energy use to detour around the barriers. For migratory species, the extra distance to

avoid the Project's turbines compared to the whole journey they have to take is considered to be trivial; and although the effects of incurred energy costs to detour around the turbines are poorly-understood, such cost is considered Negligible in comparisons to those required for flying in unfavourable wind and weathers (Masden et al. 2009) that are more frequently encountered during the migratory trips.

Creation of new edges in a landscape has potential to cause edge effects, which make habitats to become vulnerable to threats such as weed invasion, opportunistic predation and changes in neighbouring vegetation communities. A small area in the outermost of the Tuy Phong protection forest will be lost due to the development of the transmission line; however, edge effects are negligible as the lost area is small and the protection forest is not considered a natural habitat.

Table 10.38 IA of Terrestrial Barrier Creation, Fragmentation and Edge Effects

Impact Type	Direct	**Indirect**	Induced		
	These impacts are indirect impacts resulted from habitat loss due to land clearance.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impacts may last throughout the life span of the Project.				
Impact Extent	**Local**	Regional	International		
Impact Frequency	The impact can be continuous.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	The barrier, fragmentation and edge effects are **Negligible.**				
Receptor Sensitivity	**Low**	Medium	High		
	Species that are affected include Low Concern species.				
Impact Significance	**Negligible**	Minor	Moderate	Major	

10.7.3.3.3 Additional Mitigation Measures

- The use of fencing and hoarding during construction is to be kept to a minimum around Project construction sites.
- Areas for land clearance planned for construction works shall be clearly determined and demarcated by landmarks to avoid accidental clearing
- Land rehabilitation will be undertaken using native species if natural habitat in Project's proximity is lost due to the presence of the Project. Note that modified habitat is the dominant habitat type within the Project area.
- Appropriate rehabilitation of disturbed areas using native vegetation to encourage returning the habitat for fauna to its natural stage

10.7.3.3.4 Monitoring and Audit Program

No monitoring was specified in the Feasibility Study. The following measures are proposed:

- Supervision during vegetation clearance (pre-construction) and regular checks during construction to ensure compliance with clearing within marked boundaries;
- Vegetation clearance occurring in temporary land uses (see Table 10.42) requires revegetation when usage is finished.
- Revegetation program includes:
  - Establish an on-site nursery to propagate local indigenous flora as stock for revegetation
  - The program should identify parameters of revegetation success (i.e. at least at least 75% successful coverage). Where plant establishment is determined to have failed, reasons for failure of re-establishment are to be reviewed and corrective measures (e.g. planting season,

species, soil health improvement) undertaken. A procedure for revegetation should be established to ensure success.

- Vegetation monitoring is to be carried out to determine the success of revegetation and identify early problems. Monitoring consists of quarterly inspections and can range from quick visual inspections to in-depth studies of species composition, distribution and density.

10.7.3.3.5 Significance of Residual Impact

With the application of mitigation measures, as well as monitoring and audit programs, the significance of impacts are more likely to be reduced to be the minimum.

10.7.3.4 Direct mortality of Birds

10.7.3.4.1 Existing Controls

There are no existing controls described in the local regulatory EIA.

10.7.3.4.2 Significance of Impacts

During construction

How Project activities may lead to direct mortality of fauna species are different between construction and operation phase. During construction, vehicle or machine strikes, falling debris, cutting down of trees that have juveniles nesting in them, and increased hunting or poaching conducted by workers pose risks to wildlife survival. The effects are considered to be Negligible as species within the proximity of the construction site are likely to be displaced by multiple anthropogenic disturbances before construction starts; thus numbers killed would be trivial (no differences to the natural mortality background).

During operation

For avifauna, risks of death are higher during operation phase due to potential collision with Project's facilities, mostly with turbine blades and transmission line. Transmission line risks include both collision with wires and accidental electrocution associated with perching on pylons. Raptors and heron species are more prone to electrocution on transmission lines due to their large body size that can span the distance between two energized or grounded components (e.g. two wires, or between a wire and a non-insulated pole or pole equipment such as conductors).

Collision risk with turbines may be affected by the species present, numbers present, flight behaviour, location of the project in the landscape, local topography and habitat within and surrounding the site. This may include areas of aggregation and congregation, even where these may be kilometres away from the wind farm.

The surveys in 2012 and 2017 recorded a total of 40 bird species at Phu Lac 1 (none of which is raptor) and three dead bodies of three passerine species. The landscape where Phu Lac's 1 wind turbines situated is dry and open grassland, whereas the Project is located in a mixed farmland area. The recorded species at Phu Lac 1 can still occur in the Project and mortatlity risks are likely to be the same between open grassland and farmland; thus the results from Phu Lac 1 including species presence, abundance and mortality risks can be applcable to the Project. Considering (i) all of the birds found are Least Concern (LC) in the IUCN Red List, (ii) none of them are raptors and (iii) low number of fataliities due to turbine collisions will likely to occur as extrapolated from the results from Phu Lac 1, impacts from collisions are negligible within the population backgrounds of the recorded avian receptors (in other words, mortalities are not likely to exceed 0.1% of the populations).

The impacts from electrocution from transmission line is likewise negligible due to the absence of raptors and heron species in the Project's area according to the 2012 and 2017 field surveys.

Table 10.39 IA of Bird Mortality

Impact Type	**Direct**	Indirect	Induced	
	These impacts are a direct consequence from building the Projects.			
Impact Duration	Temporary	Short-term	**Long-term**	Permanent
	The direct mortality of birds are on-going throughout the Projects' operation and construction phase.			
Impact Extent	**Local**	Regional	International	
	Impacts on terrestrial habitat are restricted to the clearing footprint.			
Impact Frequency	The threat is considered to be continous.			
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
	Mortality events are not likely to exceed 0.1% of global population of the receptors			
Receptor Sensitivity	**Low**	Medium	High	
	Only LC species are subjected.			
Impact Significance	**Negligible**	Minor	Moderate	Major

10.7.3.4.3 Additional Mitigation Measures

Construction Phase

- A *Wildlife Shepherding Protocol* is to be used within the Project Area to ensure that any resident species have vacated the area to be impacted prior commencing clearance work.
- Fencing is to be placed around major project sites during construction to restrict access to fauna.
- All vehicles are to maintain a speed of a maximum of 10-20kph14 within work sites to reduce fauna collision risk.
- Hunting and poaching shall be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws;
- Collaborate with Management Board of Tuy Phong Protection Forest to avoid the illegal hunting, poaching and wood extraction in these areas. Regular inspections are to occur at least monthly during construction basis to identify any illegal actions linked with the flora and fauna
- Where fauna is identified during regular inspections (monthly during construction phase), this is to be confiscated and photographed for recordkeeping. *Injured Wildlife Management Protocol* is to be applied when injured individuals are found. Wherever possible, fauna are to be relocated to their point of origin or similar natural adjacent areas
- Labels and signs should be placed at biodiversity controlled properties stating the *Biodiversity and Ecosystem Service policy*, outlining the prohibition of species poaching/hunting.
- *Community Engagement Procedure* is used to raise awareness of local people and collaborate with community to achieve zero tolerance policy including appropriate labels and signs. Encourage local people to avoid illegal hunting/poaching activities and discuss alternatives through proactive community engagement.
- Staff and workers should be trained and made aware of the all rules, regulations, and knowledge of biodiversity protection, as well as applicable disciplinary proceedings and actions if violation.

Operation Phase

[14] kilometres per hour

- Hunting and poaching shall be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws;
- Staff and workers should be trained and made aware of the all rules, regulations, and knowledge of biodiversity protection, as well as applicable disciplinary proceedings and actions in cases of violation;
- Food waste around the turbines and along the transmission line shall be appropriately managed to avoid attracting birds, especially raptors to such food sources;
- The transmission line will include the following measures:
  - Use of flight diverters throughout the power line. The deflectors will increase line visibility by thickening the appearance of the line for easier detection by avifauna. The diverters are suggested to be placed with a 5-10m spacing;
  - Insulators are recommended not to be attached to crossarms with metal pins or similar conductive material as this can result in a circuit grounding for birds when perching on insulators. The replacement of steel on power poles is also suggested to be an effective mitigation measure, especially of cross-arm braces. Intermediate structures with horizontal configuration of lines large enough to accommodate the wingspan (or 'wrist-to-wrist') of the largest perching bird species present in the area of interest if all three phases are above the cross-arm. Alternatively two outer conductors should be suspended below cross-arm.
  - If three conductors are positioned above cross-arm, centre conductor can be insulated to achieve necessary clearance between two outer conductors.
  - Decrease vertical laying of power lines as having lines in a horizontal plane minimises collision risk.
  - Ensure that power towers and transmission lines meet safety standards to minimise birds and bats electric shock risk
- Limit the operation of turbines when there are low winds; avoid "free-wheeling" (free spinning of rotors under low wind conditions when turbines are not generating power);
- Food waste around the turbines and along the transmission line shall be appropriately managed to avoid attracting birds, especially raptors to such food sources;
- Artificial light sources at the WTGs shall be avoided wherever possible as lights attract prey (e.g. insects) for raptors and other birds. For instances where lights are necessary, white flashlights are recommended. If lights are used, use red or white blinking or pulsing lights. Timers, motion sensors, or downward-hooded lights will be utilised to help to reduce light pollution;

10.7.3.4.4 Monitoring and Audit Program

Additional monitoring and audting programs are proposed in order to validate predicted impacts and identify if additional mitigation is required:

- Supervise the implementation of anti-hunting and poaching policy for all labour forces frequently: daily during construction phase and quarterly during operation phase.
- Conduct carcass monitoring during operation phase frequently (monthly) by trained personnel/dogs and bird experts. During the peak migration periods (March-May and August-October) each turbine and surrounds will be checked on a weekly basis. All carcasses or feather spots (remains of at least 10 feathers indicating a fatality whose carcass has been largely removed by scavengers) will be GPS referenced, photographed and notes taken on the following:
  - species (this may require investigation of remains or photographs by bat/ ornithological specialist);

- Sex and age (if known or which may require specialist input);
- Date and time collected;
- Turbine number, distance and compass direction (in degrees) from base;
- Conditions (intact - fresh and no signs of scavenging; scavenged; feather spot - 10 or more feathers at one location indicating scavenging); and
- Comments (e.g. any evidence of cause of death; recent weather conditions).

- Carcasses will be bagged and removed, and any not identified to species, age and sex held for examination, by a bird specialist.
- Periodic unannounced calibration checks will be undertaken to assess the finding efficiency (taking into account removal of carcasses by scavengers and observer variation) of observers and their dogs. These will involve the placement of 10 marked carcasses (recent evidence indicates that use of chickens and pheasants can lead to more rapid carcass removal than for raptor carcasses - Phil Whitfield *pers comm.)* and a follow up visit to assess how many were found. This should be undertaken at least twice during both migration monitoring periods to check for seasonal variation and influences (e.g. changes in crops, ground cover).
- Due to limited baseline and potential cumulative impacts (see Chapter 13), seasonal bird studies in year 2 and year 3 of operation that include vantage point surveys to inform collision risk models over the migratory seasons are suggested.

10.7.3.4.5 Significance of Residual Impact

With the implementation of existing controls and additional mitigation measures, the impact significance is expected to be Negligible. However, this may be subjective to change according to the results of carcasss monitoring.

10.7.3.5 Direct mortality of Bats

10.7.3.5.1 Existing Controls

There are no existing controls outlined in the local regulatory EIA.

10.7.3.5.2 Significance of Impacts

During construction

Threats to bats during construction phase are largely related to incidental death from clearing of vegetation when bats may be roosting in trees and buildings, or disruption of flight lines by lighting and construction disturbance.

Bat mortalities are unlikely to occur within the construction phase as bat roosts were not present at the construction sites according to the field surveys.

During operation

During operation phase, besides collision with turbine blades, barotrauma (tissue damage provoked by rapid pressure change) occurring when flying close to the blades are also another cause for bat deaths. Mortality of bats are influenced by species-, environmental- and structure-related factors (Thaxter et al. 2017).

Bats' foraging preferences are associated with different levels of fatality risk and these are described in Table 10.40. Bat fatalities can also be correlated with environmental factors, such as weathers, as most of the worldwide studies found that higher mortality rates occur on low-wind nights. Lights, colour and

the heat emissions could lure prey insects close to the turbines, which consequently lead to increased bat presences in the vicinity of the turbines.

There were six bat species found in the 2017 carcass surveys, five of whom had foraging strategy III which is associated with high colllision risk. The study also suggested number of fatalities at Phu Lac 1 to be around 39 events per turbine anually. The recorded chiropteran species can occur in the mixed farmland habitat where the Project is located, and the mortality risks are also likely to be the same with Phu Lac 1.

There is limited information about the global populations of these species available; therefore the effects of collision risks that the Project might have at the population levels are difficult to assess quantitatively. However, the global population trends of the species are noted to be stable or increasing accroding to IUCN Red List. The mortality impacts are only likely to have a Minor localised effects to the bat community in the Project's area, whereas the effects on global populations are considered to be trivial to the subjected species' natural birth and mortality rates backgrounds.

Table 10.40 Bats' Foraging Preferences and Associated Risks

Categories	Description	Collision Risk
I	Insectivorous species that forage in the highly cluttered airspace within the forest interior (or forest interior specialists).	Low
II	Insectivorous species that forage in the partially cluttered airspaces such as clearings, streams, or other tunnels within the forest or just above the canopy (edge and gap foragers).	Medium
III	Insectivorous species that forage in the unobstructed airspaces found in large clearings or high above the forest canopy (open-space foragers).	High
IV	Fruit and nectar-eating bats that fly into the partially cluttered airspaces between tree canopies, roost in small numbers and forage locally.	Low
V	Fruit and nectar-eating bats that fly in unobstructed airspaces, roost in large colonies and forage over large areas.	Low

Table 10.41 IA of Bat Mortality

Impact Type	**Direct**	Indirect	Induced		
	These impacts are a direct consequence from building the Projects.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The direct mortality of bats are on-going throughout the Projects' operation and construction phase.				
Impact Extent	**Local**	Regional	International		
Impact Frequency	The threat is considered to be continous.				
Impact Magnitude	Positive	Negligible	Small	**Medium**	Large
	Impact magnitude is considered to be Medium.				
Receptor Sensitivity	**Low**	Medium	High		
	Species which are included on the IUCN Red List of Threatened Species as Least Concern (LC).				
Impact Significance	Negligible	**Minor**	Moderate	Major	

10.7.3.5.3 Additional Mitigation Measures

The following mitigation measures are proposed:

Construction Phase

- Hunting and poaching shall be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation;
- Staff and workers should be trained and made aware of the all rules, regulations, and knowledge of biodiversity protection, as well as applicable disciplinary proceedings and actions in cases of violation;
- Any trees to be cleared will be checked for roosting bats prior to felling. These trees will be avoided where possible.

Operation Phase

- Hunting and poaching shall be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation;
- Staff and workers should be trained and made aware of the all rules, regulations, and knowledge of biodiversity protection, as well as applicable disciplinary proceedings and actions in cases of violation;
- Habitat modification mitigation measures are to be used within the Project Area to introduce deterrents and reduce bat foraging opportunities in this area. These measures are to include:
  - Removing or covering with large mesh any standing bodies of water (remove water foraging areas);
  - Using lights that have low ultraviolet wavelengths (reduce insect congregations around lights that bats forage on);
  - Removing nectar producing plants (remove bat foraging areas for nectar feeding bats);
  - Removing fruiting trees/vegetables; and
  - Removing potential bat roosts (such as dense vegetation). Trials may be needed to determine the best deterrent methods.
  - Seek advice when needed, from an appropriately qualified bat ecologist is recommended when designing and implementing these measures.
- Limit the operation of turbines when there are low winds; avoid “free-wheeling” (free spinning of rotors under low wind conditions when turbines are not generating power)
- Artificial light sources at the WTGs shall be avoided wherever possible as lights attract prey (e.g. insects) for bats. For instances where lights are necessary, red or white flashlights are recommended;

10.7.3.5.4 Monitoring and Audit Program

Additional monitoring and audting programs are proposed:

- Supervise the implementation of anti-hunting and poaching policy for all labour forces frequently: daily during construction phase and quarterly during operation phase.
- Conduct carcass monitoring within 85m radius from the turbines during operation on a monthly basis by trained personnel and bat experts (within the first year). All carcasses will be GPS referenced, photographed and notes taken on the following:
  - species (this may require investigation of remains or photographs by bat/ ornithological specialist);
  - Sex and age (if known or which may require specialist input);

- Date and time collected;
- Turbine number, distance and compass direction (in degrees) from base;
- Conditions (intact - fresh and no signs of scavenging; scavenged; feather spot - 10 or more feathers at one location indicating scavenging); and
- Comments (e.g. any evidence of cause of death; recent weather conditions).

- Carcasses will be bagged and removed, and any not identified to species, age and sex held for examination, by a bat specialist.
- Periodic unannounced calibration checks will be undertaken to assess the finding efficiency (taking into account removal of carcasses by scavengers and observer variation) of observers and their dogs. These will involve the placement of 10 marked carcasses and a follow up visit to assess how many were found. This should be undertaken at least twice during both migration monitoring periods to check for seasonal variation and influences (e.g. changes in crops, ground cover).
- Due to limited baseline and potential cumulative impacts (see Chapter 13), bat studies in year 2 and year 3 of operation including transects and live traps for bats are suggested.

10.7.3.5.5 Significance of Residual Impact

With the implementation of existing controls and additional mitigation measures, the impact significance is expected to be **Negligible**. However, this may be subjective to change according to the results of carcasss monitoring.

10.7.3.6 Loss of Habitats

10.7.3.6.1 Existing Controls

There are no existing controls outlined in the local regulatory EIA.

10.7.3.6.2 Significance of Impacts

Construction Phase

According to Table 10.42, the construction of the Project will lead to a direct loss of 12.79 ha (4.50 of which is temporary) of modified habitats comprising mainly mixed farmland and a very small area of the Tuy Phong plantation forest where transmission line will cross, where biodiversity values are considered to be low as described in the Biodiversity Baseline. The Project is located within the Southern Vietnam Low Land Dry Forest ecoregion, which is classified as Critical/Endangered by the World Wildlife Fund (WWF). However, the Project's area does not resemble the habitat that requires conservation within this ecoregion; therefore, the sensitivity of habitat is considered to be Low. Loss of farmland could result in loss of foraging and roosting grounds for fauna, however, the loss is trivial compared to the availability of farmland and other suitable habitats within the Project's vicinity (i.e. Table 1.3. in the Biodiveristy Baseline suggests nearly 600 ha of farmland are present in the EAAA2).

Table 10.42 Project's Land Uses

Project's land uses	Size (ha)	Percentage
Termed uses	**8.29**	**64.8%**
Turbine foundations (including construction site for turbines)	4.2	32.8%
Substation 22/110kV	0.06	0.5%

Project's land uses	Size (ha)	Percentage
Factory's internal road	4.03	31.5%
Temporary uses	**4.5**	**35.2%**
Laydown areas	3.5	27.4%
Construction site for other components (e.g. transmission line, transportation road)	1	7.8%

Operation Phase

During operation phase, loss of habitat mainly occurs in the form of functional loss, which refers to the loss of regulating services for the ecosystem provided by fauna. Functional habitat loss is an aftermath of increased mortality events and avoidance behaviours that stem from disturbances, degradation, and barriers caused by the Project.

Disturbance (mostly noise) from operating wind farms may not pose as much immediate risks to non-volant fauna, so they show less avoidance behaviours and can be habituate to the disturbances as well. Studies have found that non-volant fauna do not show significant avoidance behaviours to wind farms (Agha et al. 2015; Łopucki, Klich & Gielarek 2017; Łopucki & Mróz 2016; Thaker, Amod & Harshal 2018), while this behaviour were proved in some specific avian species ((Barré et al. 2018; Marques et al. 2020; Masden et al. 2009; Thaker, Amod & Harshal 2018). The reduction in the local populations of birds and bats within the Project's area (due to avoidance behaviors and mortality events) could affect the regulating services that these taxon provide, which include predatory control on prey's population (i.e. insects, reptiles) and pollination. However, since most of the habitat within the Project's area is farmland, there are many alternatives to birds and bats that can provide similar services and it is unlikely that functional loss will lead to ecosystem collapse.

10.7.3.6.3 Additional Mitigation Measures

The following additional mitigation measures are to minimise impacts associated with habitat loss on both natural and modified habitats:

Pre-construction and Construction Phases

- The planned area for vegetation clearance linked to the construction works shall be clearly identified and marked prior commencing any activities to avoid accidental clearing.
- Clearing vegetation outside of designated areas will be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation;
- Develop Zero Tolerance Policy on Possession of Wildlife and Forest Resources that prohibits the possession, purchase and trade or collection of wildlife or forest resources that are legally protected under Vietnamese Law, and/or listed by CITES or IUCN Red List.
- The Project owner shall provide training to staffs and workers on applicable rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation and/or illegal hunting or poaching activities or capturing fauna, as well as the sanctions that may be imposed if any staff or worker or other person associated with the Project violates these rules and regulations.
- Any trees to be cleared will be checked for roosting bats and bird nests prior to felling. These trees will be avoided where possible.
- Native plant species shall be prioritised for the land rehabilitation program in order to create green vegetation cover in the Project area after completion of construction works;
- Use cowl, hood and shield to minimize light spill during construction and operation.

Operation Phase

- Once construction is complete the temporary laydown areas and workers' camp will be rehabilitated to the pre-construction condition.

10.7.3.6.4 Monitoring and Audit Program

The following program is proposed to ensure the impact is maintained at Negligible level:

- Vegetation clearance occurring in temporary land uses (see Table 10.42) requires revegetation when usage is finished.
- Revegetation program includes:
  - Establish an on-site nursery to propagate local indigenous flora as stock for revegetation
  - The program should identify parameters of revegetation success (i.e. at least at least 75% successful coverage). Where plant establishment is determined to have failed, reasons for failure of re-establishment are to be reviewed and corrective measures (e.g. planting season, species, soil health improvement) undertaken. A procedure for revegetation should be established to ensure success.
  - Vegetation monitoring for the success of revegetation and to identify early problems. Monitoring consists of quarterly inspections and can range from quick visual inspections to in-depth studies of species composition, distribution and density.

10.7.3.6.5 Significance of Residual Impact

The application of the mitigation measures will potentially reduce the significant of habitat loss effect to minimum.

10.7.4 Next Steps

Based on the findings of these biodiversity impact assessments, the recommended next steps for the Project should involve:

- A Biodiversity Management Plan (BMP) to bring together all the mitigation and monitoring requirements; and
- A Bird and Bat Adaptive Management Plan (BBAMP) will be prepared. This will define carcass monitoring requirements and link finding to agreed levels of acceptable change (action triggers). Adaptive management actions will be defined (e.g. curtailment regimes) together with roles and responsibilities for initiating and maintaining such actions

10.8 Solid Waste Impact Assessment

10.8.1 Summary of Scope of Assessment

During the construction phase, the main types of waste are demolition waste, biomass waste from land clearance activities, construction waste and domestic waste from workers working on site.

In operation phase, the domestic waste will be generated from workers working in the control room and substation, and some hazardous waste, such as waste oil, used batteries, broken fluorescent tubes from the maintenance of wind turbines, substation and transmission line.

At the end of its life, the turbines, the blades and other wind farm components will become the waste, and need to be recycled, reused or disposed.

10.8.2 Relevant Guidelines and Criteria

10.8.2.1 Vietnamese Regulations

- Law No 55/2014/QH13 dated June 23rd 2014 on Environmental Protection;
- Decree No. 38/2015/ND-CP dated April 24th 2015 on management of waste and discarded materials;
- Decree No. 40/2019/ND-CP dated May 13th 2019 on amendments to Decrees on guidelines for the Law on Environment Protection
- Circular No. 08/2017/TT-BXD dated May 16th 2017 on construction solid waste management;
- Circular No. 36/2015/TT-BTNMT dated June 30th 2015 on hazardous waste management.

10.8.2.2 International Guidelines

- IFC Performance Standard 3: Resource Efficiency and Pollution Prevention;
- IFC Performance Standard 4: Community Health, Safety, and Security;
- IFC General EHS Guidelines 1.6 Waste Management;
- IFC Environmental, Health, and Safety Guidelines for Waste Management Facilities.

10.8.3 Assessment of Impacts

10.8.3.1 Construction Phase

10.8.3.1.1 Sources of Waste

According to the official survey data by Phu Lac Commune People's Committee, the Project area, including the transmission line, is dominated by cropland and scrub (3.54 ha - 56.7%) and dry - open grassland (2.71 ha - 43.3%), and there are no significant structures to be demolished. Therefore, the waste in land clearance phase will mainly be biomass as the result of removal of crops and scrubs and some temporary shelters.

During the construction of the wind farm, the main sources of waste are empty cement bags, soil waste from earthworks and groundworks excavations, sand, stones and other waste materials from construction activities.

No information about the amount of waste to generated in construction phase from the Project owner at the time of preparing this ESIA report, however, with reference from the similar-scale wind farm project in the region, such as Hoa Thang 1.2 wind farm and Loi Hai 2 wind farm, it is estimated that around 30 kg of construction waste will be generated per day.

According to the Project owner, 84 people (workers and staff) will be involved in the construction of Phu Lac 2 wind farm during the construction phase of 8 months. The domestic waste generated per person per day of Binh Thuan province is 1.21 kg in 2019 (MONRE, 2019), however workers only stay at site for 9-10 hours a day, therefore, only around 0.5 kg of waste will be generated per worker per day, and around 42 kg of domestic waste will be generated per day in total.

During this construction phase, hazardous waste, such as spent oil and oily sludge, oil-contaminated cloths, will also be generated from the maintenance of construction machinery and equipment. No information was provided by the Project owner, but as estimated from similar projects, less than 1,000 kg of hazardous waste will be generated in this phase.

10.8.3.1.2 Potential Impacts

Construction and demolition waste (CDW), if not properly managed, can cause risks to human health and environment, including transportation obstacles (i.e., CDW on roadsides and pavements) leading to accidents, impacts to the urban landscape, air pollution (due to dust), soil and groundwater contamination, degraded infrastructure (i.e., blocking sewers and canals), and waste of land. Especially, the illegal dumping of CDW on streets causes countless accidents. The dumped CDW in open canals can damage the urban drainage system, contributing to flooding events under heavy rainfall (Van Tuan Nguyen, 2018). In addition, the disposal of CDW can lead to the depletion of natural resources because major components of CDW such as soil, bricks, and concrete can be recycled and reused after proper treatment and management and can be utilized for other construction sites. The use of recycled materials contributes directly to saving natural resources, e.g., natural/virgin soil for producing clay bricks, and natural/virgin gravels and aggregates for roadbed materials and concrete manufacturing.

As reported by MONRE, in 2019, 35,624 tons of municipal waste are generated in urban areas of Vietnam every day, while in rural areas, it was 28,394 tons per day. The collection rate in urban areas was 92%, while in rural areas it was only 66%. 71% of municipal waste were dumped in the landfills, however only 20% of the landfills were considered meeting the hygienic standards (MONRE, 2019). The poor management of waste has been contaminating the world's oceans, clogging drains, generating floods, and transmitting infections via the breeding of vectors. Furthermore, it also causes rises in respiratory issues through airborne particles resulting from the burning of waste, harm to creatures that consume waste unknowingly, and effects on economic development, such as reduced tourism (Silpa Kaza, 2018)

Improper management of hazardous wastes such as oil and grease from maintenance activities, as cleaning machinery and equipment, could cause soil contamination when infiltrating into soil or bodies of water.

10.8.3.1.3 Existing Controls

It is assumed that the Project owner will apply same control measures for Phu Lac 2 project as they committed in the EIA for Loi Hai 2 project. The control measures are:

Construction waste

- Segregate CDW and maximise the reuse of CDW for other construction activities;
- Accumulate soil, broken bricks, gravel at temporary storage areas arranged near turbine foundations and substation, and reuse them as backfilling materials;
- Organic soils from earthwork will be reused for backfilling of turbine foundations, consolidating internal access roads, levelling of laydown areas;
- CDW, such as broken bricks and concrete, cement bags, wood waste, unused soils and stones etc., will be collected and accumulated in designated places, and will be removed every day by a licensed waste treatment company.

Domestic waste

- Prioritise the recruitment of local workers who do not need to stay in worker's camp, and as the result, less domestic waste will be generated inside Project area;
- Establish the internal rules of order, hygiene and environmental protection, which all Project's employees have to follow;
- Arrange waste bin for each worker's camp (03 bins, capacity 60 L each for each camp). Waste from these camps will be collected, treated and disposed in accordance with legal requirements.

Hazardous waste

- Minimise the repair and maintenance of machinery and equipment on site;

- Spent oil and other hazardous waste generated in Project area will be collected, treated and disposed in accordance with Circular 36/2015/TT-BTNMT on Hazardous waste management;
- Dedicated hazardous storages will be arranged next to construction waste storages, and will be built in accordance with legal requirements (the storage must be roofed, the floor must be impervious, secondary containment must be provided etc.). Inside the storage, hazardous waste bins will be arranged and labelled to accommodate each type of waste.

10.8.3.1.4 Significance of Impact

The impact of from generation, storage and disposal of CDW, domestic waste and hazardous waste in Construction phase will be within the villages surrounding 03 villages in Phu Lac commune, and to some extent, to the waste management service of Lien Huong town.

Construction of wind farm is planned to last 09 months, therefore the duration of impact is **Short-term.**

Considering the amount of waste to be generated, the impact magnitude is **Small**.

The identified receptors are rural residential areas, where waste has not been well managed. Only 66% of solid waste are collected in rural areas of Vietnam, and open burn of waste is still a common practice. However, the Project area is located near the administrative centre of the District. The overall vulnerability is therefore **Medium**.

Overall, the significance of impact is **Minor**.

Table 10.43 Environmental and health impacts from generation, storage and disposal of CDW, domestic waste and hazardous waste

Impact	Environmental and health impacts from generation, storage and disposal of CDW, domestic waste and hazardous waste				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	Global		
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Vulnerability of Receptors	Low	**Medium**	High		
Significance	Negligible	**Minor**	Moderate	Major	
	The significance is **Minor.**				

10.8.3.1.5 Additional Measures

The following additional measures should be implemented:

- Domestic waste shall be further categorised into 1) Recyclable/Reuse waste, 2) Organic waste and 3) Other waste. Separated bins for type of waste shall be allocated and placed at strategic areas within the project footprint;
- Avoid waste accumulation in areas close to adjacent communities;
- Waste storages shall be protected from physical elements (e.g. direct sunlight, wind, rain, storms, etc.) and kept away from natural drainage channels;
- Workers shall be trained on waste management practices (e.g. handling, storing and disposal) as a part of environmental awareness program;
- Access to hazardous waste storage areas shall be limited to employees who have received proper training.

10.8.3.1.6 Residual Impacts

With the implementation of the above mitigation measures, the residual impacts would be expected to be **Negligible.**

10.8.3.1.7 Monitoring and Auditing

- Daily site inspection shall be implemented to verify the compliance with mitigation measures;
- Waste manifests or other records that document the amount of waste generated and its destination shall be kept and maintained in accordance with the legal requirements;
- Planned and unplanned audits to onsite waste storage areas and waste treatment contractor's facility shall be implemented to ensure compliance with legal requirements.

10.8.3.2 Operation Phase

It is noted that Phu Lac 2 is t of Phu Lac 1 wind farm, therefore the admin building will be shared between operation staff of Phu Lac 1 and Phu Lac 2.

10.8.3.2.1 Sources of Waste

Domestic waste

According to TBW, it is expected that 21 staff will be working permanently throughout the operation phase of Phu Lac 1 and Phu Lac 2 wind farm.

It is estimated that each person will generate around 0.5 kg of domestic waste per day, making the sum of 10.5 kg of waste to be generated every day from the wind farm. The waste will mainly comprise of:

- Organic waste such as discarded vegetables, leftovers;
- Food and drink packaging;
- Discarded plastic and glass products;
- Metals, such as empty food cans.

Hazardous waste

The main sources of hazardous waste in operation phase are:

- Spent oil from maintenance and repair of WTGs and transformers;
- Oil-contaminated cloth:;
- Discarded ink cartridges, broken fluorescent lamps, used batteries from office activities.

The WTGs and transformers will be maintained once every four to five years. Expected amount of waste oil to be generated in each maintenance is 350 litres, while the amount of oil-contaminated cloth is estimated to be 2 kg.

Office activities are expected to generate about 2 kg of hazardous waste on a monthly basis (TBW, 2020).

10.8.3.2.2 Existing Controls

It is assumed that the Project owner will apply same control measures for Phu Lac 2 project as they committed in the EIA for Loi Hai 2 project. The waste control measures in operation phase are:

- Domestic waste will be collected and disposed every day by a local waste treatment company;
- Hazardous waste will be collected and treated by an authorised waste treatment company in accordance with legal requirements.

10.8.3.2.3 Significance of Impacts

The impacts from generation, storage and disposal of domestic waste and hazardous waste in operation phase are within project area.

The impact duration is **Long-term** because it lasts throughout the operation phase of 20 years

Considering the amount of waste to be generated, the impact magnitude is **Negligible**.

The identified receptors are rural residential areas, where waste has not been well managed. However, the Project area is located near the populated area of Lien Huong town. The overall vulnerability is therefore **Medium**.

Overall, the significance of impact is **Negligible**.

Table 10.44 Environmental and health impacts from generation, storage and disposal of domestic waste and hazardous waste in operation phase

Impact	Environmental and health impacts from generation, storage and disposal of domestic waste and hazardous waste in operation phase				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	Global		
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
Vulnerability of Receptors	Low	**Medium**	High		
Significance	**Negligible**	Minor	Moderate	Major	

10.8.3.2.4 Additional Measures

- Domestic waste shall be further categorised into 1) Recyclable/Reuse waste, 2) Organic waste and 3) Other waste. Separated bins for each type of waste shall be arranged accordingly.
- Workers shall be trained on waste management and storage practices (e.g. handling, storing and disposal) as a part of environmental awareness program;
- Before the scheduled maintenance, the waste treatment company shall be informed in advance to ensure that they are able to handle a large volume of waste oil and other hazardous waste.

10.8.3.2.5 Residual Impacts

With the implementation of the above mitigation measures, the residual impacts is expected to be **Negligible.**

10.8.3.2.6 Monitoring and Auditing

- Waste manifests or other records that document the amount of waste generated and its destination shall be kept and maintained in accordance with the legal requirements.
- Planned and unplanned audits to onsite waste storage areas and waste treatment contractor's facility shall be implemented to ensure compliance with legal requirements, especially before and after scheduled maintenance of the wind farm.

10.9 Greenhouse Gases Assessment

This Section will assess the impact of greenhouse gas emissions in construction phase and operation phase of Phu Lac 2 wind farm. Construction of Phu Lac 2 wind farm will result in emissions associated with the combustion of fuel from the transportation of materials and WTG parts to site, transportation of

excavated materials and use of construction equipment; and emissions released from biogenic carbon contained within the vegetation that is cleared for construction of foundations of WTGs and access roads. The operation of the wind farm will not produce direct GHG emissions during its entire lifetime (Ramchandra Bhandari, 2020), therefore, in terms of GHG emission, it will have positive impacts.

GHG emissions are divided into three categories, or Scopes:

- Scope 1 emissions: Direct GHG emissions; defined as those emissions that occur from sources that are owned or controlled by the reporting entity.
- Scope 2 emissions: A category of indirect emissions that accounts for GHG emissions from the generation of purchased energy products (principally electricity, steam/heat and reduction materials used for smelting) by the entity.
- Scope 3 emissions: Those emissions that are a consequence of the activities of an entity, but which arise from sources not owned or controlled by the Company. Examples of Scope 3 activities include extraction and production of purchased materials, transportation of purchased fuels, and use of sold products and services.

Scope 1 and Scope 2 emissions for the Project's Construction phase was estimated and based on conservative assumptions (e.g. maximum fuel consumption). As such, they represent the maximum expected emissions for the activities identified in this assessment. The IFC Performance Standard 3 requires projects which emit more than 25,000 t CO_2 per year to quantify direct emissions within the physical boundary and indirect emissions associated with the off-site production of energy used by the Project.

This study does not include an assessment of Scope 3 emissions associated with the production and transport of WTG parts from suppliers by sea to Cam Ranh Port in Vietnam. Emissions associated with the production and transport of WTGs could be significant, but represent a source of indirect emissions that are not under the Project's operational control (Scope 3), and at present details on the source and transport of WTGs have not yet been confirmed. Considering the information available at the time of this assessment, the likely magnitude of the different emissions sources (with the bulk of life cycle emissions likely coming from the production of WTGs), and also guidance from the IFC Performance Standards (Performance Standard 3 on Resource Efficiency and Pollution Prevention states that 'the Client will quantify direct emissions from the facilities owned or controlled within the physical project boundary, as well as indirect emissions associated with the off-site production of energy used by the Project and therefore focuses on Scope 1 and 2 emissions), this study therefore focuses on an assessment of Scopes 1 and 2 GHG emissions for the wind farm.

10.9.1 Methodology

10.9.1.1 Carbon Footprint Methodology

The latest 2019 Refinement to 2006 IPCC Guidelines for National GHG Inventories are used to estimate GHG emissions for the Project. These Guidelines are the current guidelines and further refinement of these guidelines is not scheduled to take place until 2019. It is noted that the 2006 IPCC Guidelines were advised to provide a technically sound methodological basis for evaluating national GHG inventories, and therefore fundamental revision is unnecessary. However, to maintain the scientific validity of the 2006 IPCC Guidelines, certain refinements may be required to take into account scientific and other technical advances that have been developed since 2006 (IPCC, 2018).

It is noted that Vietnam ratified the Kyoto Protocol and is an Annex I Party to the UNFCCC (UNFCCC, 2018a). The UNFCCC reporting guidelines on annual inventories for Annex I Parties (decision 24/CP.19) requires the use of the 2006 IPCC Guidelines for National GHG Inventories (UNFCCC, 2018b). As such, the 2006 IPCC guidelines are considered appropriate for estimating GHG emissions for the Project.

As the effects of GHGs are assessed on a global scale, the use of dispersion modelling does not provide a useful analysis. GHG emissions are therefore considered in terms of total emissions based on a methodology consistent with the 2006 IPCC Guidelines. These guidelines consist of a three-tier approach to estimating emissions from fossil fuel combustion, as shown in Table 10.45 below.

Table 10.45 Methodology Tiers for Estimation of GHG Emissions by Fossil Fuels

Scope	Description	Treatment in this assessment
Tier 1 Approach	Calculates emissions by multiplying estimated fuel consumed with a default emission factor. For CO_2, emission factors mainly depend upon the carbon content of the fuel and therefore emissions can be estimated fairly accurately using this method. Emission factors for CH_4 and N_2O depend on the combustion technology and operating conditions and vary significantly. As such, large uncertainties are anticipated from this method.	Approach used for CO_2, CH_4, and N_2O (e.g. mobile combustion).
Tier 2 Approach	The approach is the same as Tier 1 but country-specific emission factors are used in place of the Tier 1 defaults.	Not used in this assessment as no country-specific published data are available.
Tier 3 Approach	Technology-specific emission factors.	Approach used for CH_4, and N_2O for stationary combustion (e.g. LNG combustion).

Global Warming Potential (GWP) is a measure of the total energy that a gas absorbs over a specified period of time (usually 100 years), compared to carbon dioxide. Carbon dioxide equivalent (CO_2-e) is a metric measure used to compare the emissions from various GHGs based on their GWP (USEPA, 2017). The GWP values used for this assessment are presented in Table 10.46 and were obtained from the IPCC Fifth Assessment Report (IPCC 2014). These values are recommended for use by the Greenhouse Gas Protocol (GHG Protocol 2018).

Table 10.46 100-Year Global Warming Potential (GWP) Values

Greenhouse Gas	Global Warming Potential Values
Carbon dioxide (CO_2)	1
Methane (CH_4)	28
Nitrous oxide (N_2O)	265

Source: the IPCC Fifth Assessment Report (IPCC 2014)

10.9.1.2 Impact Assessment Methodology

A traditional impact assessment is conducted by determining how the proposed activities will affect the state of the environment prior to development of a project. In the case of GHG emissions, this process is complicated by the fact that the impact of GHG emissions on the environment cannot be quantified within a defined space and time.

The greenhouse effect occurs on a global basis and the geographical source of GHG emissions is irrelevant when considering the future impact on the climate. It is not possible to link emissions from a single source – such as the Project - to particular impacts in the broader study area.

As such, this study does not consider the physical impacts of climate change resulting from increasing GHG emissions, but instead will assess the impact of the Project's GHG emissions by way of:

- Understanding the scale of the Project's GHG emissions by comparing total emissions to GHG magnitude ratings and scales for projects (developments) that have been developed by various international lender organisations or groupings, including the IFC, the EBRD, and the EP;
- Assessing the GHG performance of the Project relative to reference benchmarks on the GHG intensity of electricity production, including the GHG intensity of Vietnam's grid electricity and of other LNG-fired power plants; and
- Understanding of the impact of the Project on Vietnam's national GHG emissions inventory, and consideration of the alignment of the Project with the country's climate policy and international GHG reduction commitments.

The Project in the context of this study refers to the proposed 3x750 MW LNG-fired Power Plant and the Project's impact, in terms of GHG emissions (and contribution to global climate change), reflects GHG emissions from the Plant throughout its life cycle.

To assess the significance of GHG emissions impacts, the following criteria are used:

- Type: indicate the relationship of the impact to the Project (in terms of cause and effect);
- Extent: indicate the 'reach' of the impact;
- Duration: indicate the time period over which a resource / receptor is affected;
- Scale: indicate the size of the impact; and
- Frequency: give a measure of the constancy or periodicity of the impact.
- Magnitude: is a function of extent, duration, scale and frequency and it describes the degree of change that the impact is likely to impart on the resource / receptor; and
- The sensitivity/vulnerability/importance of the impacted resource/receptor.

Significance is subsequently assessed on the basis of the magnitude rating of the impact, and the sensitivity/vulnerability/importance rating for the resource/receptor, and ranked as either Negligible, Minor, Moderate, or Major.

In the context of climate change impacts associated with GHG emissions from the Project (this study), extent, duration, and frequency are the same irrespective of the Project context and the scale of its GHG emissions, and therefore do not form a good basis on which to assess the significance of the impacts associated with GHG emissions. Specifically, the extent of GHG (climate change) impacts is global, the duration of the impact is permanent, and the frequency of the impact is constant since GHG emissions will be produced throughout the lifetime of the Plant.

As such, GHG impact significance is determined on the basis of the assessment of the scale of the GHG emissions from the plant using benchmarks from international lender standards, further informed by reference benchmarks on the GHG intensity of electricity production for similar facilities and according to the grid emissions factor in Vietnam, as well as an analysis of the Project's alignment with Vietnam's energy and climate change policies.

10.9.1.3 Magnitude and Scale from International Lender Standards

An additional perspective on the magnitude of the Project's GHG emissions is provided by standards that are applied to developments at an international level. Table 10.47 shows a magnitude scale for project-wide GHG emissions that is derived from, and in line with, a number of current international lender organisations or groupings, such as International Finance Corporation (IFC) standards, the European Bank for Reconstruction and Development's (EBRD) GHG assessment methodology and the Equator Principles (EP).

Table 10.47 Magnitude Scale for Project-Wide GHG Emissions Based on Wider Standards

GHG Emissions Thresholds per annum	Magnitude Rating
>1,000,000 tonnes CO_2-e	Very Large
100,000 – 1,000,000 tonnes CO_2-e	Large
25,000 – 100,000 tonnes CO_2-e	Medium
5,000 – 25,000 tonnes CO_2-e	Small
<5,000 tonnes CO_2-e	Negligible

10.9.1.3.1 IFC reporting Thresholds

The IFC's Performance Standard 3: Resource Efficiency and Pollution Prevention defines a reporting threshold for annual GHG emissions of 25,000 t CO_2-e, and requires clients to "…consider alternatives and implement technically and financially feasible and cost-effective options to reduce project-related GHG emissions during the design and operation of the Project." (IFC, 2012).

10.9.1.3.2 Equator Principles (IV)

The EPs require all project owners, in all locations, to conduct an alternatives analysis to evaluate less GHG intensive alternatives when combined Scope 1 and Scope 2 operational emissions are expected to be more than 100,000 t of CO_2-e annually. In addition, the EPs require that the Client (should) report combined Scope 1 and Scope 2 emissions, publicly on an annual basis, during the operational phase for projects emitting over 100,000 t of CO_2-e annually. It notes further that clients would be 'encouraged' to report publicly on projects emitting over 25,000 t of CO_2-e (EP IV, 2019).

10.9.1.4 Assumptions

The following should be noted with respect to any assumptions made for the purposes of this assessment:

- At the time of preparing this ESIA, the regulatory for Phu Lac 1 and Phu Lac 2 Wind Farm project is still be updated. Therefore, this study uses information and data on the Project given by the Project owner through Request for Information and Feasibility Study (VATEC, 2020). In case of no information was given, this study refers to the EIA of Loi Hai 2 Wind Farm project in Loi Hai commune, Binh Thuan province since both projects are at similar scale, using the same turbine models and owned by TBW;
- This study refers to a variety of policy documents published by the Vietnam government in order to undertake an analysis of Vietnam's energy and climate policy, to describe Vietnam's current national GHG emissions and inventory, and to project the country's GHG emissions towards 2050. In the absence of any information to suggest otherwise, the study assumes that existing policies and plans for both the energy sector and with respect to climate change mitigation will be implemented as described in existing policy documents. Any key assumptions made either in the policy documents or in any related analysis have been stated in the report;
- It is assumed that the entire biomass is removed in the year of conversion. The recommended default assumption for the Tier 1 calculation is that all carbon in biomass is released to the atmosphere through decay processes either on- or off-site.

10.9.2 Assessment of Impacts

10.9.2.1 Construction Phase

10.9.2.1.1 Site Clearance - Scope 1

According to the information provided by the Project owner, the Project will acquire 8.85 ha of land for turbine foundations, 110 kV substation, internal roads, foundations of transmission line (fixed-term occupation) and laydown area for crane and WTG parts (temporary occupation). It is assumed that all 8.85 ha of land will be cleared to execute the work.

The clearing of vegetation in this area can result in a change in carbon stocks from the removal of living biomass.

The land use category is classified to be cropland in line with the IPCC categories (IPCC, 2006). GHG emissions from land clearance is estimated using the Equation 10.1 (IPCC, 2003) and the parameters summarised in Table 10.48. Total GHG emissions from vegetation clearing are presented in Table 10.49.

Equation 10.1 Change in Biomass Carbon Stocks on Land Converted to another Land Category

$$\Delta C_{LO_{LB}} = A_{Conversion} \times \left(B_{After} - B_{Before}\right) \times CF$$

where:

$\Delta C_{LO_{LB}}$	=	Annual change in carbon stocks in living biomass in land converted to 'other land'	(t C/year)
$A_{Conversion}$	=	Area of land converted to 'other land' from some initial land uses	(ha/year)
B_{After}	=	Amount of living biomass immediately after conversion to 'other land'	(tonnes d.m./ha)
B_{Before}	=	Amount of living biomass immediately before conversion to 'other land'	(tonnes d.m./ha)
CF	=	Carbon fraction of dry matter (default = 0.5)	(tonnes C/tonnes d.m.)

Table 10.48 Amount of Living Biomass Before and After Land Conversion

Description	Amount of Living Biomass (tonnes d.m./ha)
Before	2.6 [a]
After	0 [b]

a. Carbon stock in biomass for perennial cropland for tropical, moist climate region from Table 3.3.8 from Chapter 3.3 of Good Practice Guidance for Land use, Land-use Changes and Forestry (IPCC, 2003).
b. Default assumption of 0 was assumed when converted to other land as per Section 3.7.2.1.1.1 from Good Practice Guidance for Land use, Land-use Changes and Forestry (IPCC, 2003).

Table 10.49 Annual GHG Emissions from Land Clearing in the Preparation Phase

Phase	Description	GHG Emissions (t CO_2-e/year) [c]	
		CO_2	**Total**
Preparation phase	Land clearing	11.5	11.5

Note for c. It is assumed that the entire biomass is removed in the year of conversion

10.9.2.1.2 Mobile Combustion for Site Clearance - Scope 1

No information was provided by the Project owner on fuel consumption of equipment for land clearance. However, as the land to be cleared is similar with Loi Hai 2 project (8.14 ha versus 8.84 ha), it is assumed that the daily fuel consumption is 528 liters per day. The preparation phase is expected to last

one month (30 days), making the total fuel consumption in preparation phase of 15,840 liters (or 15.84kL).

GHG emissions from mobile combustion are estimated using **Equation 10.2**, the GWP values in Table 10.46, default emissions factors and energy content factors in Table 10.50. Resultant emissions from mobile combustion during the construction phase are presented in Table 10.51.

Equation 10.2 Fuel Combustion

$$E_j = \frac{Q_i \times EC_j \times EF_{ijoxec}}{1000}$$

where:

E_j	=	Estimated emissions of gas type j (CO_2, CH_4 or N_2O) from fuel type (i)	(t CO_2-e)
Q_i	=	Estimated quantity of fuel type (i)	(kL)
EC_j	=	Energy content factor of fuel (j)	(GJ/kL)
EF_{ijoxec}	=	Emission factor for each fuel type (j)	(kg CO_2-e/GJ)

Table 10.50 Default Emissions Factors and Energy Content Factor for Diesel Combustion in Mobile Equipment and Vehicles

Description	Value	Units
Energy content factor for diesel	43 [a]	MJ/kg or GJ/t
	35.9 [b]	GJ/kL
Diesel density [c]	0.840	kg/L or t/kL
Tier 1 CO_2 emission factor - diesel [d]	74.1	kg CO_2-e/ GJ
Tier 1 CH_4 emission factor - diesel [d]	4.15	kg CH_4/ TJ
	0.12	kg CO_2-e/ GJ
Tier 1 N_2O emission factor - diesel [d]	28.6	kg N_2O/ TJ
	7.6	kg CO_2-e/ GJ

a. (IPCC, 2006) - Table 1.2 (default net calorific values (NCVs) and lower and upper limits of the 95% confidence intervals), page 1.18, Volume 2 (Energy), Chapter 1 (Introduction).
b. Estimated by ERM based on the diesel density.
c. (STAMEQ, 2018) – *TCVN 5689:2018, Table 1 (Diesel fuel oil - Specifications and test methods), Diesel density*
d. (IPCC, 2006) - Table 3.3.1 (default emission factors for off-road mobile sources and machinery), page 3.36, Volume 2 (Energy), Chapter 3 (Mobile Combustion).

Table 10.51 GHG Emissions from Mobile Combustion for Site Clearance

Description	GHG Emissions (t CO2-e)			
	CO_2	CH_4	N_2O	Total
Diesel combustion in mobile equipment	42.14	0.067	4.32	46.53

10.9.2.1.3 Mobile Combustion for Construction - Scope 1

According to the FS report, the following mobile equipment will be mobilised for the construction of Phu Lac 2 wind farm (electrical equipment are included from this list):

Table 10.52 Mobile Equipment to be Mobilised for Construction

Equipment	Quantity	Fuel consumption per unit (Litre per shift)[15]	Total fuel consumption per shift
Excavator (2.5 to 4.6 m3)	02	199	398
Grader (108 HP)	02	76	152
Compactor	05	5	25
Roller (5 - 10 tonnes)	02	26	52
Dump truck (12 - 20 tonnes)	03	17	51
Specialized truck	02	20	40
Crane truck (25 - 90 tonnes)	01	69	69
Tower crane (> 700 tonnes)	01	155	155
Tower crane (250 tonnes)	02	141	282

In the conservative case, when all equipment is operated concurrently for 02 shifts per day, the total fuel consumption of these equipment is estimated to be 2,448 of litres of diesel per day. The construction phase is expected to last 09 months (270) days, making the sump of fuel consumption of 660,960 litres (or 660.96 kL).

Using the Equation 10.2, the GHG emissions from mobile combustion for construction is as follows:

Table 10.53 GHG Emissions from Mobile Combustion in the Construction Phase

Description	GHG Emissions (t CO2-e)			
	CO_2	**CH_4**	**N_2O**	**Total**
Diesel combustion in mobile equipment	1758.28	2.85	180.34	1941.46

10.9.2.1.4 Mobile Combustion for Transportation - Scope 1

As estimated from Loi Hai 2 Project, 99 round trips will be made to transport WTG parts from Vinh Tan port to the site in Phu Lac commune (22 km). Therefore, the HGVs will travel around 4,400 km in total. The fuel consumption of HGV is estimated to be 40 litres of diesel per 100 km (ICCT, 2015), making the total fuel consumption for transportation of WTG parts of 1,760 litres.

Most of workers (80/84 persons) are locals from Phu Lac commune, therefore their daily commuting distance will be short, and as a common practice in Vietnam, they will use motorcycles to go to work. Therefore, GHG emission from workers' daily commuting to work is insignificant and not accounted.

[15] Circular 11/2019/TT-BXD of Ministry of Construction guiding the fuel consumption norms of construction equipment

Using the Equation 10.2, the GHG emissions from mobile combustion for transportation of WTG parts is:

Table 10.54 GHG Emissions from Mobile Combustion for Transportation of WTG Parts

Description	GHG Emissions (t CO2-e)			
	CO_2	CH_4	N_2O	Total
Diesel combustion for transportation of WTG parts from Cam Ranh port to construction sites	4.68	0.01	0.48	5.17

10.9.2.1.5 Purchased Electricity - Scope 2

No information about number of purchased electricity consumption was given by the Project owner, except that electricity will be supplied from the nearby national grid. Therefore, the GHG emissions from purchased electricity was not calculated.

10.9.2.1.6 Summary of Emissions

A summary of the estimated annual GHG emissions for the construction and operation phases are presented in Table 10.55.

Table 10.55 Summary of GHG Emissions in Construction Phase

Description	GHG Emissions (t CO2-e)				
Emissions in construction phase	**Site clearance**	**Mobile combustion for site clearance**	**Mobile combustion for construction**	**Mobile combustion for transportation of WTG parts**	**Total**
	11.5	46.53	1941.46	5.17	2005

10.9.2.1.7 Significance of Impacts

The ADB Environmental Safeguards require the application of pollution prevention and control technologies and practices consistent with international good practice. Pollution prevention and abatement is said to be required if the project is emitting GHGs. As such the client is required to promote the reduction of GHG emissions from the project. The Phu Lac 2 Wind Farm Project is considered as an insignificant producer of GHGs given it is emitting less than 100,000 tonnes CO_2-e during its 12-month construction period and zero emission during its operational years. IFC requires projects that are expected to produce more than 25,000 tonnes of CO_2-e annually to also quantify direct emissions from its facilities as well as indirect emissions associated with the off-site production of energy used by the project. As such, the Project is not required to quantify its GHG emissions during construction phase.

The emissions from construction phase (Scope 1 and 2) estimated from the project are anticipated to be 2005 tonnes CO_2-e over the construction period of 10 months (including land preparation phase). The Project is therefore anticipated to contribute only 0.001 percent of Vietnam's national GHG emissions (293.3 Mt CO2-e excluding LULUCF (MONRE, 2017) annually and 0 percent of global anthropogenic emissions (53,526 Mt CO_2-e excluding LULUCF (WB 2013) over the same period.

Magnitude of GHG emissions impact

The construction phase (including site clearance) is anticipated to last 12 months so the duration for GHG emissions is considered short-term. GHG emissions are greatly mobile due to its long lasting existence (up to thousands of years) in the atmosphere and high mixing capacity[12]. GHG emissions contribute to climate change that has the potential to result in significant environmental effects. Given that GHG emissions from the Project will account for less than 0.001% of the national emissions and

0% of the global emissions, the intensity of GHG emissions is assessed to be **Negligible** at both national level and global level. The magnitude of the combined effect is therefore to be **Negligible** at both national level and global level.

Sensitivity of national and global GHG emissions inventories

Total GHG emissions reported at the national and global levels are 53,526 Mt and 284 Mt CO_2-e, respectively. Therefore, GHG emissions are redundant and thereby have low irreplaceability. In addition, GHG emissions are projected to keep rising (e.g. 466 Mt CO_2-e in 2020 and 760.5 Mt CO_2-e in 2030 under the BAU scenario (MONRE, 2016) so they are resilient and in a steady growth. For this reason, the vulnerability of the national and global GHG inventories is likely to be low. Moreover, GHG emissions contributes to global warming which impacts multiple resources, human activities and ecological systems and therefore are considered providing no services, leading to its low influence. The combined sensitivity of GHG emissions is to be low at both the national and global scales.

Overall, the significance of GHG emissions impact identified by combining the magnitude of the GHG emissions impact and the sensitivity of the national global emissions inventories to be **Negligible** for the national emissions and **Negligible** for the global emissions inventory.

Table 10.56 Assessment of Increased GHG Emissions in Construction Phase

Impact	Environmental and health impacts from emission of GHG in construction phase				
Impact Nature	**Negative**	Positive	Neutral		
	Environmental and health impacts are considered **Negative**.				
Impact Type	**Direct**	**Indirect**	Induced		
	GHG emissions cause both **direct** and **indirect** environmental and health impacts.				
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
	The impact duration is **Long-term** because GHG has long-lasting effects				
Impact Extent	Local	Regional	**Global**		
	GHG impacts are considered having global effects				
Impact Frequency	Not applicable				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
	Considering the amount of GHG emissions, the impact magnitude is **Negligible**.				
Vulnerability of Receptors	**Low**	Medium	High		
	The combined sensitivity of GHG emissions is to be low at both the national and global scales.				
Significance	**Negligible**	Minor	Moderate	Major	
	The significance is **Negligible.**				

10.9.2.2 Operation Phase

In operation phase, Phu Lac 2 Wind Farm is expected to give an annual electricity output of 85 GWh. As wind power generators do not emit greenhouse gases during its operation, the Project will help to save around 78,000 $tCO_{2\text{-}e}$ annually comparing to thermal power generation[16]. Therefore, the impact nature is considered **Positive**. Considering that the scale of Project is 26 MW, while Vietnam is expected to have 1,000 MW of wind power generation by the end of 2020[17], the significance of positive impact of the Project in terms of GHG reduction is considered **Small**.

[16] Grid emission factor of Vietnam is 0.981 tCO2/ MWh as announced by Department of Climate Change in Notice No. 263/BDKH-TTBVTOD.

[17] Vietnam aims to install 1,000 MW of wind power by 2020. Voice of Vietnam, 9 April 2019. Available at https://vov.vn/kinh-te/viet-nam-phan-dau-tong-cong-suat-dien-gio-nam-2020-dat-khoang-1000mw-896030.vov. Accessed on 2 March 2021.

11. SOCIAL IMPACT ASSESSMENT

11.1 Introduction

This chapter analyses the potential socio-economic impacts that may result from the pre-construction, construction, and operation of the Phu Lac 2 Wind Power Project. The assessment has been conducted based on the impact assessment methodology detailed in Chapter 4 and social data gathered (via secondary and primary means). Baseline data covering categories such as demographics and governance of the impacted villages, income and livelihoods, land use and ownership, community health, access and quality of local services, and infrastructure has been gathered from recent secondary information and a socio-economic baseline survey conducted in September and November 2020. The baseline focus group discussions, key interviews with local authorities, and surveys were conducted with those households identified as having lost agricultural land and/or experiencing restricted land activities due to the Project development. The baseline data has been analysed and is presented in Chapter 8 of this Environmental and Social Impact Assessment (ESIA) report.

This chapter aims to:

- Define the scope of the social impact assessment, including the area of influence and receptors considered;
- Identify the potential/existing social impacts associated with the pre-construction, construction, and operation activities of the Project. Issues concerning the perceptions and values of local residents are also put into consideration;
- Present existing controls to the impacts, which the Project Owner has already developed and implemented;
- Propose meaningful and effective mitigation measures and, where possible, enhance Project benefits; and
- Recommend an appropriate monitoring and auditing schedule.

11.2 Scope of Social Impact Assessment

The social receptors are defined as communities currently residing in the Area of Influence (AoI) that the Project may impact as a result of their proximity to the Project site and/or associated facilities. Based on the scoping outcomes from Chapter 5, the Area of Influence for social impacts to the community is defined in Figure 11.1.

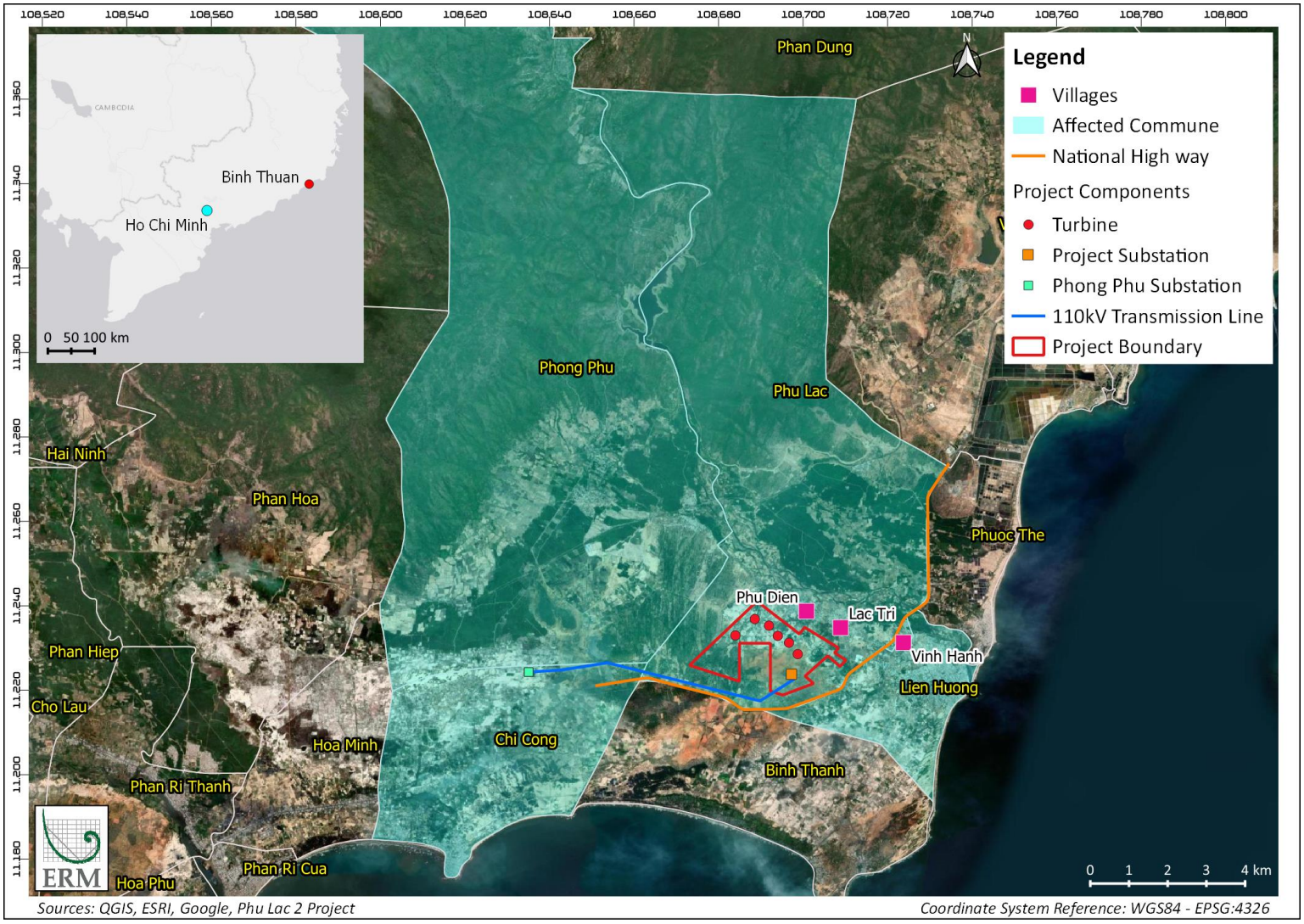


Figure 11.1 Area of Influence of Social Impacts

11.3 Approach for Assessing Social Impacts

The assessment is based on the impact assessment methodology explained in Chapter 4 and the social baseline data presented in Chapter 8 of this ESIA report. When undertaking a social and health impact assessment, several important criteria must be considered: the magnitude of impact, vulnerability of receptor, stakeholder perceptions, and Project planning and development objectives, as illustrated in Figure 11.2. The first three criteria are explained in detail in the next sections, while the latter Project planning and development activities are explained in detail in Chapter 1 of this report.

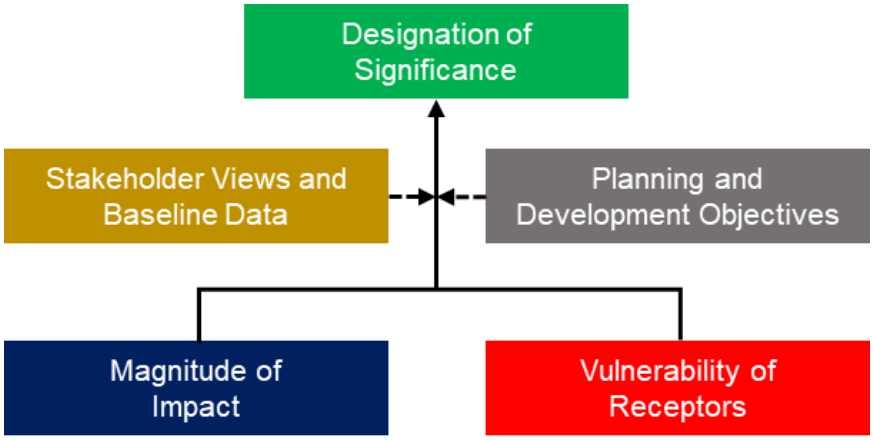


Figure 11.2 Evaluation of Social Impact Significance

11.3.1 Magnitude of Social Impact

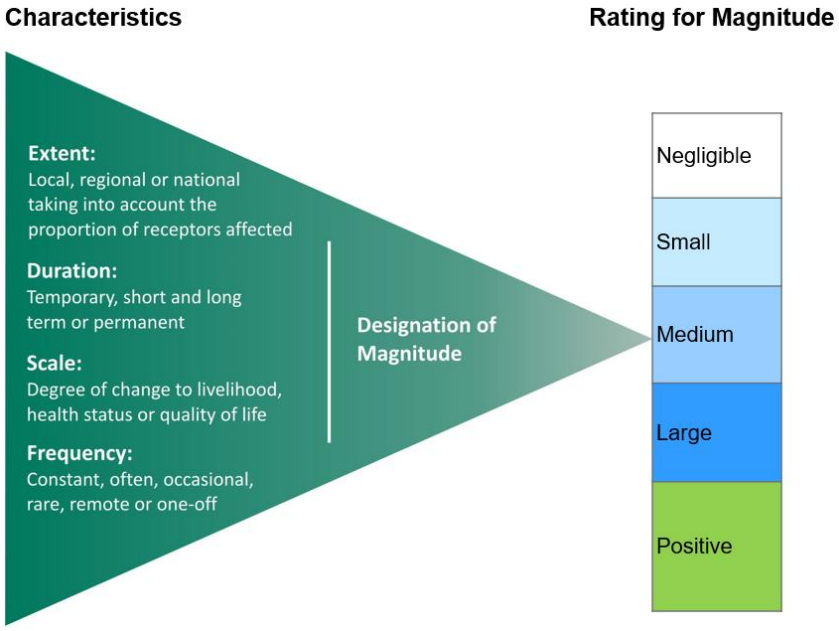


Figure 11.3 Characteristics of Social Impact Magnitude

The magnitude of social and health impacts is understood as a reflection of the “size” or degree of change caused by social and community impacts. Figure 11.2 depicts the characteristics that need to be taken into account when defining impact magnitude. A description of the social magnitude rating is provided in Table 11.1.

Table 11.1 Designation of Social Impact Magnitude

Designation of Magnitude	Description
Negligible	Change remains within the range commonly experienced within the household or community.
Small	Perceptible difference from baseline conditions. Tendency is that impact is local, rare, affects a small proportion of households, and is of a short duration.
Medium	Clear evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional, and impact may be regional in scale.
Large	Change dominates baseline conditions. Affects the majority of the area or population in the area of influence and/or persists for many years. The impact may be experienced over a regional or national area.
Positive	In the case of positive impacts, it is generally recommended that no magnitude be assigned, unless there is ample data to support a more robust characterisation. It is usually sufficient to indicate that the Project will result in a positive impact, without characterising the exact degree of positive change likely to occur.

11.3.2 Vulnerability of Receptor

In the social and community health context, vulnerability is the accepted term for describing the social receptor's sensitivity that will experience the impact. Vulnerable receptors are defined as stakeholders who:

- are less resilient than others within their socio-cultural context;
- have a reduced ability to respond to, cope with, and manage change and ‘shocks’; and
- are less able to access resources and development opportunities.

It is important to understand the vulnerability context as it will affect the social receptor's ability to adapt to any changes brought about by the Project in a direct, indirect or induced manner. A higher level of vulnerability can result in increased susceptibility to negative impacts or a limited ability to take advantage of positive impacts. A Project may also exacerbate existing vulnerabilities if individuals' and communities' status and their coping mechanisms are not adequately understood or considered. Evaluation is made based on the pre-existing status of receptors, as well as their proximity to the Project components, to define the receptor’s level of vulnerability, as presented in Table 11.2.

Table 11.2 Level of Vulnerability of Social Receptor

Ranking	Definition
Low	Minimal vulnerability; consequently, with a high ability to adapt to changes brought on by the Project and opportunities associated with it.
Medium	Some, but few areas of vulnerability; still retaining an ability to, at least in part, adapt to change brought on by the Project and opportunities associated with it.
High	Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought on by the Project and opportunities associated with it.

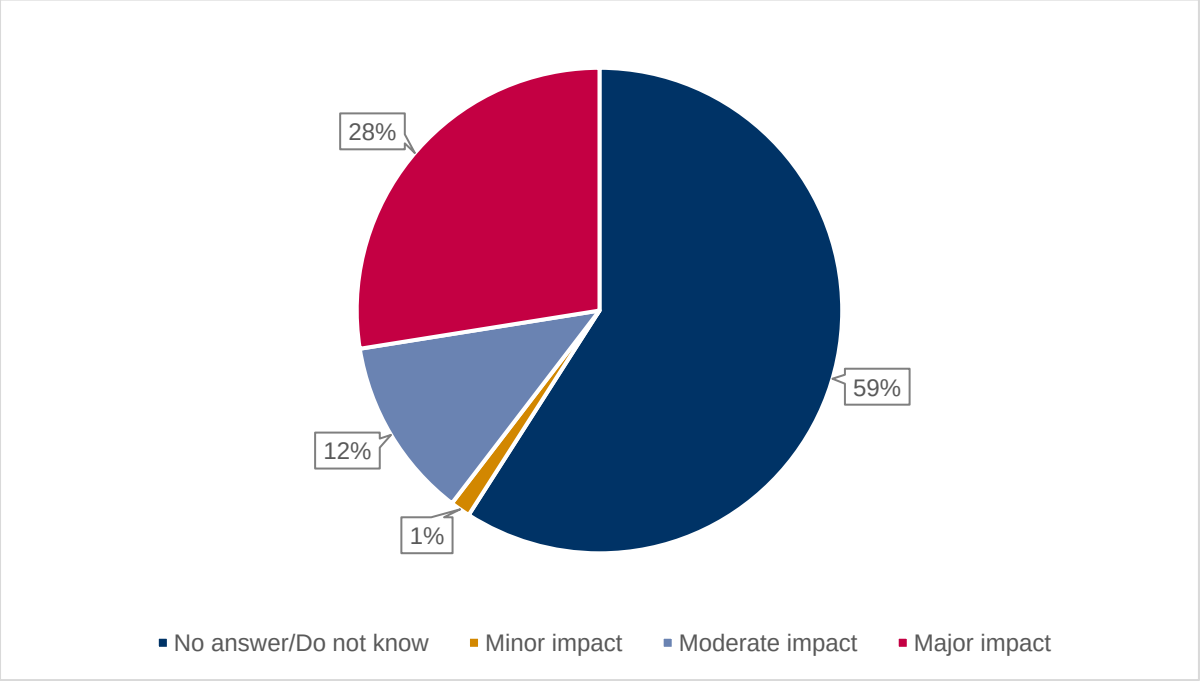
11.3.3 Integration of Stakeholder Perceptions into the Assessment Process

It is common that Project affected people have the perception that Project impacts are more significant than may actually be the case. This is referred to as perceived impacts (as opposed to actual impacts). Regardless of whether an impact is considered negligible by the Project or ESIA team, if it has been identified as significant by a stakeholder, it must be factored into the evaluation process. This may result in the development of focused mitigation and management measures that address these perceptions (such as technical health and safety briefings with the communities). It should be noted that perceived impacts are no less important than actual impacts with respect to addressing community acceptance for a Project and that failure to adequately assess such impacts and develop supporting mitigation may result in Project delays as in the case of actual impacts.

The major concerns and suggestions of the surveyed households, general public, and local authorities based on the performed interviews and observations during the site visit are presented in the next sections. The below mentioned issues are recognised as critical concerns and therefore have been taken into account within the ESIA.

11.3.3.1 Perception of Surveyed Households

Figure 11.4 provides information about the impact levels of the Phu Lac 2 Project perceived by households who participated in the socio-economic baseline survey in November 2020. Among the 149 respondents, two believed the Project would have a minor impact on their families, 18 other households perceived the Project's impact as moderate, while 41 households were afraid that they would be profoundly impacted by the Project. Around 59% of survey respondents did not provide feedback or were not aware of the Project potential impacts.



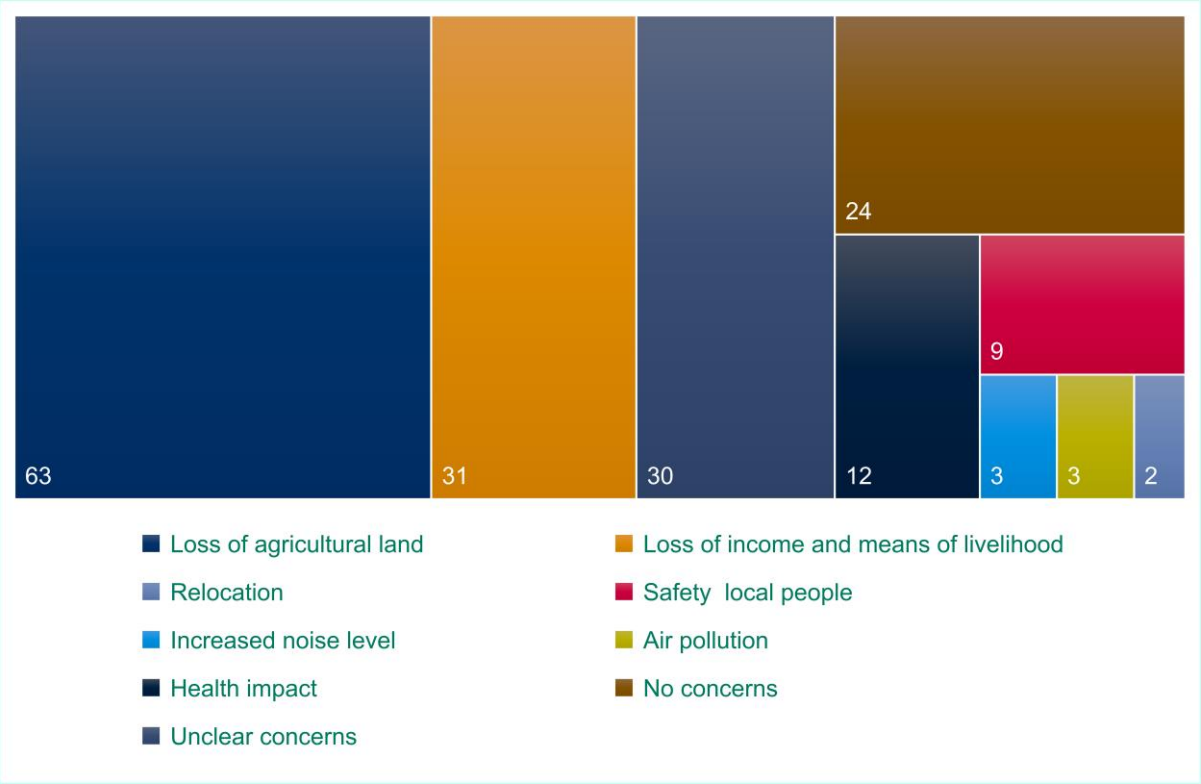
Source: Socio-economic survey conducted by ERM, 2020

Figure 11.4 Project Impact Level Perceived by Surveyed Households

Concerns shared by participated households are presented in Figure 11.5. The top three potential impacts perceived include:

- Loss of agricultural land leading to loss of production;
- Loss of income and means of livelihood; and

- Health impact.



Source: Socio-economic survey conducted by ERM, 2020

Figure 11.5 Specific Concerns from Surveyed Households

11.3.3.2 Perception of General Public from Focus Group Discussion (FGD)

According to the FGDs participants, most of the Project impacts are related to construction activities, which are inevitable but manageable through certain social and environmentally friendly practices. These impacts can be well taken care of at an early stage through proper engineering designs and adherence to best construction practices.

11.3.3.3 Perception of Local Authorities

During the consultation with local authorities at different levels, they noted general support for the Project as it is expected to benefit the province's socio-economic development, having low impacts on the environment, and creating more employment opportunities for local people. However, some concerns related to the Project implementation were raised and are recorded in Table 11.3.

Table 11.3 Concerns from Local Authorities during ESIA Engagement

Concerns from Local Authorities during ESIA Engagement
Environment
■ Concerns regarding air and noise pollution during construction
Health and safety
■ Community health, safety and security of nearby residents, especially those who live close to ancillary facilities like laydown areas and access road

■ Safety of the workers working on-site and in associated Project facilities
Social, economic, cultural issues
■ Loss of agricultural land ■ Impacts on agricultural production (cultivation and husbandry) ■ Land acquisition and compensation process
Technical issues
■ Damage to local road system due to construction work

11.3.3.4 Recommendations from Engaged Stakeholders to be incorporated into the Impact Assessment

During the engagement and consultation in November 2020, participating stakeholders from local communities and authorities also suggested specific recommendations in dealing with some of the perceived impacts, as provided in Table 11.3.

Table 11.4 Recommendations from Engaged Stakeholders Incorporated into the Impact Assessment

Recommendations from Relevant Authorities during ESIA Process	Recommendations from Local Communities during ESIA Process
■ Project Owner should implement more community development programs apart from those being offered by the local government, such as scholarship and health check-up; ■ Project Owner should give specific attention to poor households affected by the land acquisition; and ■ Project Owner should create long-term jobs for local people, including ethnic minority groups.	■ Project Owner should support livelihood restoration to affected people in the forms of training on job-skills and micro-business management, job opportunities, capital investment, husbandry support, seeding support.

11.3.4 Evaluation of Impacts

The impacts are evaluated based on the Project-specific considerations, assumptions, and social-economic/cultural data. These parameters are then used to inform the significance of the impact across the Project phase cycle (i.e. pre-construction, construction, and operation). The social impact evaluation by ERM includes the following components:

- Consideration of the interaction of Project activities with the social receptors based on data provided by Project Owner and/or presented in the Feasibility Study (FS) report as well as the regulatory Environmental Impact Assessment (EIA) report;
- Identification of the receptors, sensitivity/vulnerability and perceptions (if any) based on social-economic baseline data and consultations;
- Identification of potential impacts and benefits based on the method described above;
- Documentation of existing controls based on data provided by the Project Owner and/or presented in the Project FS and EIA reports;
- Evaluation of impact significance taking into account the vulnerability of the receptor and the magnitude of the impact;

- Development of additional mitigation/management (or enhancement) measures determined by understanding the impact and significance based on best practice; and
- Assessment of residual impact following an assumption that the mitigation and or management measures proposed are implemented effectively. In some cases, further discussion may be required to reassess Project design and/or how monitoring can play a part in the management process.

Each social impact was identified as part of the Project scoping process set out in the scoping methodology. These impacts have been selected based on a robust understanding of the proposed activities in the Project description (set out in the Project FS and EIA reports) and primary and secondary data gathered in the affected villages and by public consultation.

The significance of social and health impacts is then evaluated, taking into account the magnitude of the impact and the vulnerability of the affected receptors. The matrix provided in Chapter 5 is used to assign social and health impact significance for both negative and positive impacts. Table 11.5 shows how the different designations of significance may be interpreted from a social perspective. These are highlighted to reflect the Project context and setting, specifically reflected in planning and stakeholder views as appropriate.

While the default is not to rate the significance of positive impacts, as it is not possible to gather exact data to measure the positive impact accurately, it is important to describe how the impact may differentially benefit vulnerable groups.

Table 11.5 Description of Social and Health Impact Assessment Significance Rankings

Significance	Social Impact	Health Impact
Negligible	■ Inconvenience caused, but with no consequences to livelihoods, culture, or quality of life.	■ Receptors may experience annoyance, minor irritation, or stress associated with change with minimal impact on perceived quality of life. Does not require treatment. No long-term consequences for the health of individuals and the community.
Minor	■ Impacts are short-term and temporary and do not result in long-term reductions in livelihood or quality of life.	■ Temporary reduction to health status of certain individuals that can be easily treated and does not result in long term consequences for community health. Impacts may lead to greater health inequalities in the Project area.
Moderate	■ Adverse impacts that notably affect livelihood or quality of life at the household and community level. Impacts can mainly be reversed, but some households may suffer long-term effects.	■ High risk of diseases or injuries as well as exposure to Project operational risks to the local community. May result in long-term but reversible community health impacts.
Major	■ Diverse primary and secondary impacts that will be impossible to reverse or compensate for, possibly leading to long term impoverishment, or societal breakdown.	■ Loss of life, severe injuries or chronic illness requiring hospitalisation. Exposure to and incidence of diseases not commonly seen previously in the area. Likely to have long-term consequences for community health.

Initially, the significance of the impact has been evaluated for the “general” population. The evaluation has then taken into account whether the identified vulnerable groups will be impacted differently.

When this is the case, the impact on these vulnerable groups has been differentially stated in the assessment (i.e. an impact may receive an overall significance rating of moderate, but a high rating when considered in relation to a particular group of vulnerable receptors).

The change brought by the Project has been reflected in the frame of reference of the local setting with stakeholder views on impacts integrated into the evaluation. It is common that the Project affected people may have the perception that an impact is different (either lower or higher) than is actually likely the case. Perceived impacts have been captured and differentiated from 'actual' impacts; however, they are no less important than actual impacts with respect to addressing community acceptance for the Project. In some cases, failure to adequately assess such impacts and develop supporting mitigation is likely to result in Project delays as in the case of actual impacts.

The assessment of impacts has considered not only the magnitude of impact and vulnerability ratings but also the perceptions or sensitivities of stakeholders as well as any planning and development objectives laid out for the administrative area in which the Project is located. The impact significance has been discussed pre- and post-mitigation implementation, with the residual impact being as low as practicable. If the residual rating is still not acceptable, the impact and Project activities will require further discussion with the Project Owner to agree on a more appropriate design or technology that will result in a lower impact significance.

Impacts and benefits have been considered across the Project lifecycle (i.e. pre-construction, construction, and an operation phase of approximately 20 years).

11.3.5 Management Measures and Residual Impacts

The impacts identified during the social impact assessment will be mitigated and/or managed, aiming to reduce them to acceptable residual levels. Ideally, the Project Owner will adopt the proposed measures and implement them effectively throughout the appropriate Project phase. Often, in reality, however, the measures cannot be implemented as suggested and alternative actions are required; these are to be identified through monitoring. As such, the residual impact in some cases cannot always be determined as an acceptable level.

11.4 Potential Social Impacts, Receptors, and Areas of Influence

Project development activities causing potential impacts to stakeholders who are identified as receptors are summarised in Table 11.6. In each section, the Project's area of influence for a specific resource or receptor is described in the context of the identified impacts.

Table 11.6 Summary of Potential Impacts, Receptors and Area of Influence

Project Activities	Potential Impacts	Receptors	Areas of Influence
Pre-construction Phase			
■ Land acquisition process	Economic displacement ■ Loss of land and access to land owned by local people ■ Loss or relocation of assets on land ■ Change of land use ■ Loss of/impact on livelihood associated with loss of land resulting in full or partial loss of income	■ Agricultural land users in Phu Lac commune	■ Project footprint includes turbine foundations, internal access roads, substations, laydown areas and Right Of Way (ROW) of transmission line
Construction Phase			
■ Land clearance, lay down area usage during the construction of wind turbine pole, and construction for Project components (wind turbine pole, transmission line, substation, access road) ■ Employee recruitment during construction activities ■ Higher risk activities include working at height, lifting operations, live	Local employment and business ■ Increased local employment and income ■ Temporary direct employment for the Project and induced employment opportunities by local suppliers ■ Opportunities for small and medium local businesses ■ Community discontent due to high expectation to be hired as unskilled workers ■ Reduction of economic opportunities to local business due to employee demobilization at the end of the construction phase	■ Opportunity seeker and business owners ■ General communities in the Project location	■ Tuy Phong district ■ Phu Lac commune ■ Chi Cong commune ■ Phong Phu commune ■ Lien Huong town
	Recruitment and employment of construction workers ■ Impacts to rights of contracted workers engaged by contractors ■ Employment of children or other minors, forced or bonded labour ■ Potential for discriminatory practices to occur in the hiring process	■ Project workers	■ Construction sites ■ Worker's accommodation (their houses or hostels, camps)

electrical work, and use of vehicles/heavy equipment ■ Presence of influx and operation of worker's accommodation ■ Equipment and material transport and supply ■ Construction of turbine foundations, transmission line pylons, internal road, auxiliary works, and turbine installation ■ Wastes, emissions, and discharges generation, handling, and disposal ■ Operation of associated facilities such as concrete batching plant ■ Project vehicular movement (movement of trucks and lorries, transport of large-heavy equipment)	■ Potential for discrimination against workers that join unions (or other similar organisations) or take part in collective bargaining ■ Inappropriate or delayed payments to workers ■ Lack of clarity information on workers' rights ■ Gender inequality during contractual processes ■ Unjustified dismissals ■ Non-payment of overtime Working conditions ■ Accidents, injuries, fatalities or other health and safety risks, which can arise from inappropriate working or unsafe conditions, such as excessive working hours, lack of appropriate training, insufficient lock-out/tag-out practices as well as equipment failure ■ Higher risk activities include working at height, lifting operations, live electrical work, use of vehicles/heavy equipment Operation of worker's accommodation ■ Impacts on worker's health and safety due to poor management of worker's accommodation		■ Tuy Phong district
	Community way of life, health, safety and security due to construction activities ■ Impacts on mental health and wellbeing of people in the Project surrounding areas due to induced noise vibration, dust and gas emissions from vehicles ■ Risk of disease to the local population via contamination of groundwater (from borehole) ■ Risk of disease to the local population due to lack of proper hazardous and non-hazardous waste management ■ Risk of injury to local persons gaining unauthorised access to the construction or restricted sites	■ General communities in the Project location	■ Construction sites ■ Phu Lac commune ■ Chi Cong commune

	Community way of life, health, safety and security due to the presence of influx ■ Risk of communicable disease spread (such as sexually transmitted infections, dengue, malaria, influenza, diarrheal) ■ Increased pressure on local health facilities/capacities ■ Increased pressure on local governance ■ Tension with local communities due to issues of cultural conflict ■ Security-related impacts or concerns (such as drinking, drugs consumption, gambling, theft) ■ Risk posed by Project security arrangements to those within and outside the Project site ■ Risk of gender-based violence, violence against children, sexual harassment/abuse due to the increase in the number of non-local male workers ■ Risk to vulnerable groups as prostitution and/or child labour	■ Project workers ■ Affected communities	■ Phu Lac commune ■ Chi Cong commune ■ Phong Phu commune ■ Lien Huong town
	Traffic safety due to increased traffic volume ■ Degradation of road system ■ Increased traffic congestion due to transport of super-long super-heavy equipment ■ Increased risk of traffic accidents and interaction between Project vehicles and local communities	■ Project workers ■ Affected communities ■ Communities along the Project materials and equipment transporation route	■ Access road ■ National Highway 1A from Vinh Tan port to Phu Lac commune
	Disruption to cultural practice due to construction activities ■ Disturbance to the grave visit activities, especially in Thanh Minh festival	■ Families having their relatives buried in the grave yard adjacent to Project site	■ Phu Lac Commune

Operation phase

■ Employee recruitment and supply demand ■ General operation activities	Project positive impacts and benefit sharing ■ Direct employment for the Project ■ Opportunities for small and medium local businesses	■ Project workers ■ Affected communities ■ Business owners	■ Phu Lac commune ■ Chi Cong commune ■ Phong Phu commune ■ Lien Huong town
	Community health, safety and security ■ Impacts on mental health and wellbeing of people residing in the Project footprint and adjacent areas due to induced noise vibration and shadow flicker due to the presence of turbines ■ Visual impact due to the presence of turbines	■ Project workers ■ Affected communities	■ Phu Lac commune ■ Chi Cong commune

11.5 Pre-construction – Economic Displacement Impact due to Land Acquisition

11.5.1 Summary of the Project's Land Use

The land acquisition process is conducted three communes (Phu Lac, Lien Huong, and Phong Phu) of Tuy Phong District, Binh Thuan province. To date, the process of land acquisition in the Project site is still ongoing. By 29 December 2020, the size of land for the Project's components to be acquired is 197,442 m2. The land acquisition process is conducted to construct turbine foundations, 110kV substation, internal roads and 22kV underground cable, transmission line foundation, laydown area for blades and towers, and construction site (crane installation). The land acquisition is expected to impact 39 households in terms of economic displacement. As the land acquisition process is still ongoing, the final list of the affected households will be available by the end of February 2021.

The land acquisition process covers permanent land occupation (20 years for operation), temporary land occupation, and restricting land access due to transmission line safety zone (tower and Right of Way). Permanent land occupation process will acquire the land permanently from affected households. The temporary land occupation will acquire the land during construction and returned the land to the affected household after the construction is finished. The affected households identified to date are mentioned by the local government to have multiple land parcels located in the area where permanent and temporary land acquisition will happen. After identifying multiple land ownership, the affected households identified are 39 households and one organization, with a total population of family members of 168 Project affected people (PAP). The average family number per household is five people. During the data collection process, the social economy survey was able to reach 33 affected households out of 39 affected households. Six affected households who were identified as land legal formal land users could not be met during the survey.

Table 11.7 Land Area and Household Affected by the Project Components

Item	Number of items	Total area (m^2)	Estimated number of affected households
Fixed-term land occupation: 61,285 m^2 total			
Turbine foundations	6	3,186	6 households
110kV Substation	-	647	0
Internal roads and 22kV underground cable	1	54,748	29 households 1 organisation (Phu lac Commune People's Committee)
Transmission line foundation	33	2,704	10 households
Temporary land occupation: 27,192 m^2 total			
Laydown area (blades and towers)	7	11,058	11 households
Construction site (Crane installation area)	7	16,134	14 households
7.4km Transmission Line/Safety Corridor 108,965 m^2 total (Activities will be restricted on the land under the transmission line and in the safety corridor)			

Item	Number of items	Total area (m^2)	Estimated number of affected households
Transmission line 110kV for connection	1	108,965	17 households

***Note**: Some households are impacted by the land acquisition of more than one Project component. The estimated number includes all affected households of each component without removing the same households affected between components.*

Source: TBW Project Description December, 2020.

The land acquisition process mentioned above in Table 11.7 has been identified to only impact agricultural land. The CSR is implemented by the local government, Binh Thuan People Committee (PC) and Land Fund Development Centre of Tuy Phong District using national standards in land acquisition. There is no settlement / residential area/houses that would be impacted due to the land acquisition process. From the beginning of the land acquisition process, the Project owner has tried to avoid the physical resettlement (house).

The land Use Right Certificate (LURC) status of affected households will be determined during the government-led land acquisition process. However, according to the Phu Lac Commune, Phong Phu Commune and Chi Cong Commune PCs during the consultation meetings, this area mainly belongs to individual households' legal usage in the following location. No informal land users are identified in the Project area.

11.5.2 Potential Impacts

Potential impact of land acquisition process in the Project location are considered because of these following information:

Table 11.8 Summary of Potential Impact, Receptor, and Vulnerability

Potential Social Impact	Receptor	Vulnerability
■ Loss of income due to the Project will acquire affected households' agricultural land. ■ Loss of land asset as the government chooses to compensate affected households with cash, not with similar size land. ■ Loss of standing crops on the acquired agricultural land. ■ Restriction of crop height for agricultural land within the safety corridor of the transmission line	■ The land users of agricultural land acquired by the Project in the Project footprint. ■	■ 1 household with a family member suffer from disability ; ■ 3 households with the elderly as the main breadwinner; ■ 4 households having illiterate breadwinner; ■ 2 poor/near-poor households; and ■ 7 households with female as the main breadwinner.


Figure 11.6 Phu Lac Commune – Agricultural Land in Turbine Area

Although agriculture activities are not the main income source of all affected households (36%), the affected household will experience loss of income in various degree. With an average family size of 5 (Table 11.9), the affected household's income per capita is 4,8 million VND. This figure is much higher than the poverty threshold of the MOLISA[18] standard, which is 700,000 VND for rural or 900,000 VND for urban inhabitants[19]. This income level might change due to land-use change from agricultural land to the Project components. As such, it may reduce the agriculture production quantity, then reduce income level from agriculture activities.

Such impact will be compensated by the government during the government-led compensation, support and resettlement process. With the government-led process, land price is decided by the government based on the land price survey conducted for the Project area. The components of cash compensation have covered land and crop compensation, supports for job transition (up to 5 times of land compensation value), and supports for live stabilisation.

Table 11.9 Summary of Key Livelihood Indicators of Affected Household

Key Economic Baseline for Affected Household	Key Information
Family size (people)	5.1
HH head's average age (year old)	53
Monthly household average income (VND)	24,183,000
Monthly household average expenditure (VND)	12,519,000
Average length of stay in the surveyed area (years)	45.8

11.5.3 Existing Controls

As suggested by Circular No. 37/2014/TT-BTNMT dated June 30, 2014 of MoNRE and mentioned in local EIA: the implementation of CSR will be conducted by the local authority. Other support for the resettlement process of affected households will be needed to stabilize their livelihood.

11.5.4 Significance of Impacts

Land acquisition impact's nature is considered a negative impact as it will directly take away the people's source of livelihood. The land acquisition process will result in temporary, permanent land loss, loss of standing crops and crop height restriction. The Project will impact a small number of affected households (39 households) compared to the total population at the commune level (2,254 households).

[18] According to Decision No.59/2015/QD-TTg, dated 19/11/2015, promulgating multidimensional poverty levels application during 2016 – 2020.

[19] MOLISA, 2020, retrieved on 3rd November 2015, at http://www.molisa.gov.vn/Pages/tintuc/chitiet.aspx?tintucID=24215

Additionally, based on social baseline data collection in Phu Lac commune, the average land control per affected household is 18,216 m^2 and they will lose approximately 8.6% of their total land area (estimated based on the total permanent land acquisition showed in Table 11.7 for 39 affected households). Therefore, the land acquisition impact magnitude is predicted as small.

The vulnerability profile among affected households is considered medium as some vulnerabilities are identified in Table 11.8 and it is also noted that that the affected households' ethnicity is Kinh who are the ethnic majority. Losing their land to land acquisition can be perceived as medium impact on them as it might not be their intention to sell their land, but then only 36% of affected households sourced their income from agriculture. As the affected households also have other income streams not only from agriculture so, the affected household has low sensitivity to the economic displacement. With the small magnitude of the impact, the overall impact significant is found Minor.

Table 11.10 Economic Displacement and Loss of Livelihood

Impact Description	Economic Displacement and Loss of Livelihood				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	Long-term	**Permanent**	
Impact Extent	**Local**	Regional	International		
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	**Low**	Medium	High		
Impact Significance	Negligible	**Minor**	Moderate	Major	

11.5.5 Additional Mitigation and Management Measures

- Monitor the land acquisition process to ensure it complies with Vietnamese regulations and IFC standards. This activity should be supported by documentation recording the land acquisition process. This will be required for internal and external audits;
- Based on the CSR completion report, identify the gap between national and IFC PS 5 requirements on land acquisition and resettlement. Then formulate a Corrective Action Plan to close the gaps found;
- Implement the SEP including the GMP. GMP should be disclosed to the affected communities prior to the Project's construction implementation. As such, the affected community aware of the grievance lines of communication and understand how to submit grievance;
- Continuously coordinate with commune PC to solve any submitted grievance relevant to land acquisition activities;
- Implement the Livelihood Resettlement Plan (LRP) for those identified as the Project affected households. The LRP will be designed to ensure sustainable restoration and enhancement of income for impacted land users.
- The LRP should take into account the women and other vulnerable groups to ensure they are not overlooked during Project implementation and left worse off.

11.5.6 Residual Impacts

With mitigation measures in place, the Project may reduce the impact to negligible significance.

11.5.7 Monitoring and Audit

The following monitoring and audit programs are required:

- Preparation of a completion report for the land acquisition process.
- Monitoring of the LRP in a quarterly term.
- Preparation of a completion report for the LRP.
- Creation and maintenance of a Consultation and Grievance record in relation to land acquisition.

11.6 Construction – Local Employment and Business

11.6.1 Potential Impacts

a. Increase local employment and income;

b. Provide temporary direct employment for the Project and induced employment opportunities by local suppliers;

c. Provide opportunities for small and medium local businesses; and

d. Community discontent due to high expectation in business and worker recruitment.

Baseline information showed that 68 % of the 168 affected people in the socio-economic survey are working-age and approximately 11.4% of them are illiterate. The socio-economic survey shows that the affected people mainly have primary school education (52%) and secondary school education (26.8% of the 149 affected people population). The proportion of people achieved higher education level (highschool, college and university) is approximately 10%. It can be assumed that the education level in the Project area is at a medium level, which qualifies people for unskilled and semi-skilled workers.

The construction is expected to employ approximately 84 workers during peak times through direct hire and subcontractor recruitment. The Project Owner is committed to hiring 80 local people within Tuy Phong district, two Vietnamese from other provinces, and two foreigners for the Project construction process. Within the construction workforce, 50% are unskilled and 31% are semi-skilled positions. It is foreseen that without training, local people could meet 50% of the required number of local employment, and the increase the employment opportunities for local people, training should be considered by the Project Owner.

With the high percentage of local workers, the demand for services (e.g. groceries, restaurants, hairdressers, and transport) and induced jobs are predicted small.

By the end of the construction phase, worker demobilization will occur and only 18 local workers (85% of total workers) will be eligible to stay on. The significant reduction in workforce, as a result, will reduce the local community's income, but the skills and experience gained during the construction could remain and increase the job opportunities in other industries nearby for such local workers.

11.6.2 Significance of Impacts

Given the Project Owner's commitment to optimize local employment and procurement, the Project would likely positively impact local communities. However, the positive impact cannot be achieved without enhancing measures and could create community discontent due to high expectations to be employed and benefit from Project activities. The Project can give direct benefit to the local economy via tax to the local government. The impact during construction time is categorized as short-term impact as it is 12 months duration. Given the number of opportunities possibly created in relation to the scale of the local population, the impact magnitude is considered small. The sensitivity to economic changes of local people surrounding the Project location is considered low as they are Kinh people with good economic condition and have experience with other nearby industries such as Bac Tuy Phong Industrial Park, Vinh Tan Thermal Power Plants, ECO SEIDO Solar Power Plant, VSP Binh Thuan II Solar Power Plant and Phong Dien 1 Wind Power Plant, they have education level required for semi-skilled

(secondary education) but not skilled worker (higher education). As such, the impact significance can be considered as Negligible.

Table 11.11 Local Employment and Business during the Project Construction

Impact Description	**Local Employment and Business during the Project Construction**				
Impact Nature	Negative	**Positive**	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	**Low**	Medium	High		
Impact Significance	**Negligible**	Minor	Moderate	Major	

11.6.3 Enhancement Measures

Based on the above analysis, the Project is expected to have a positive impact in terms of employment, procurement, and induced job opportunities and increase the economic conditions of the local people. In order to enhance positive impacts, the following measures are recommended:

- Facilitate employment for local workers (e.g. un-skilled workers and provide adequate training for the tasks to be performed);
- Encourage contractors to hire local labour by the provision of a clear stipulation/commitment of using local labour, particularly in regards to economically displaced households, in the EPC contract and instruct the EPC contractors to prioritise qualified local people as construction workers in accordance with the needs of the Project;
- Communicate clear information about Project-related employment and business opportunities and prioritize local people wherever feasible. Such communication should be conducted at least two weeks before recruitment so that local people have enough time to prepare for the recruitment process (for example, preparing administration documentation for job application.);
- As locals are more likely to qualify for low-skilled jobs, the Project Owner should negotiate with Contractors to provide detailed requirements on educational qualifications and skills for each job opportunity;
- Work closely with local/relevant authorities to synchronize the Project's needs in terms of local labour as well as locals' capacity; and
- Provide grievance mechanism process from the beginning of Project construction process to manage community complaints and expectation on job hiring and purchasing process.

11.6.4 Monitoring and Audit

The following records are required to be kept:

- Number of workers hired local and non-local
- Type and frequency of information disclosure to community and government on workforce hiring
- Number of grievances received regarding workforce recruitment

11.7 Construction – Impacts on Worker Rights, Occupational Health and Safety

11.7.1 Potential Impacts

Worker's rights, either directly by the Project or within its supply chain

Approximately 84 workers are anticipated to be employed at the peak time of the Project construction phase. According to the Project Owner, around 80[20] people of the construction workforce (mostly unskilled workers) will be hired from the local community (i.e. Binh Thuan province) while the remaining four (including skilled workers and management staff) will be resourced from elsewhere in Vietnam and overseas. Without appropriate safeguards, there is potential for workers' rights to be impacted, including workers directly employed by Project Owner and the contractors engaged in delivering the Project. Increasingly there is an expectation by stakeholders that a company has not only oversight of its workers but also its contractors and those involved in its supply chain. If safeguards are not in place, a range of potential impacts can arise, including:

- Lack of awareness on worker's rights;
- Violation of worker's rights encountered by contractors;
- Potential employment of children, forced or bonded labour. This risk is often higher for vulnerable groups (e.g. migrant labour);
- Potential for discriminatory practices to occur in the hiring process;
- Potential for discrimination against workers that join unions (or other similar organisations) or take part in collective bargaining;
- Inappropriate or delayed payments to workers;
- Unjustified dismissals; and
- Risk of association with contractors (e.g. service contracts) or third parties (e.g. recruitment agents) adhering to relevant laws and international standards and guidance.

Worker's health and safety

Besides the potential impacts to worker's rights, the nature of the Project and its construction activities presents a range of health and safety risks for the workforce, including those employed by the Project Owner and their EPC Contractors. Potential workforce health and safety risks include:

- Accidents and injuries: which may occur as a result of construction activities if safe work practices are not followed. Examples include:
  - Injury/fatality risks associated with working at heights (e.g. excavation, foundation construction, pylon, scaffolding, cranes);
  - Injury/fatality in a collision due to the movement of the vehicle and large mobile plant equipment such as backhoes, bulldozers, graders and mobile cranes present health and safety risks if not handled appropriately;
  - Non-compliance with health and safety programs, poor safety culture, and inappropriate use of worker personal protective equipment (PPE) may place workers at risk of accidents and injuries;
  - A surge in vehicle usage increases the potential for an accident or injury to occur; and
  - Manual handling associated with day to day construction activities can result in injuries.

[20] TBW's information available in February 2021

The above is not an exhaustive list of potential risks and hazards but presents examples of the types of activities that could contribute to an accident or injury during construction.

- Occupational diseases: that are caused or aggravated by exposure to workplace hazards and are often categorised into the following groups - musculoskeletal disorders, mental disorders, noise-induced hearing loss, infectious and parasitic disease, respiratory diseases, contact dermatitis, cardiovascular diseases, and occupational cancer. These diseases often develop as a result of poor working conditions and poor hygiene.

  Some occupational diseases manifest shortly after exposure, while others take longer to manifest after exposure. Examples include:

  - Hearing impairment due to exposure to high noise levels during equipment transport and use of large machinery;
  - Respiratory disease due to exposure to dust and reduced ambient air quality;
  - Repetitive work movements which may cause lateral epicondylitis (i.e. tennis elbow);
- Infectious diseases are illnesses caused by a diverse range of pathogens that can be transmitted through means such as:
  - Disease vectors (e.g. mosquitos), which may result in diseases such as dengue fever or malaria;
  - Ingestion of unsanitary food and water, which may result in a parasitic infection or diseases such as salmonella, E.coli, and listeria; and
  - Human or pest contact may result in diseases such as sexually transmitted infections (STIs), tuberculosis, influenza and rabies.
- Workers' may contract infectious diseases via a number of pathways. Examples include:
  - Interactions with local community members, which can expose workers to a range of communicable diseases (e.g. STIs, influenza.);
  - Un-hygienic and unsanitary facilities; and
  - Stagnant bodies of water created during the land clearing process, which can create disease vector habitat.
- The global COVID-19 situation is fluid and the duration of the crisis is yet unknown. Potential risks of spreading virus workers, especially from migrant workers from other provinces and countries, are still expected.

Health and safety risks can impact workers in a range of ways – e.g. temporary illness to long-term health impacts. The worst-case scenario would be a fatality, or multiple fatalities, which has occurred on other large scale developments in Vietnam during the construction phase. It appears that workplace fatalities in Vietnam, particularly in the construction sector, are on the rise. In most cases, the accidents were caused by low awareness and ignorance about occupational safety regulations by employers and employees.

It should be noted that occupational health and safety hazards during the operation of wind energy facilities are generally similar to those of most large industrial facilities and infrastructure projects. They may include physical hazards, such as working at heights, lone working, working in confined spaces, working with rotating machinery, and falling objects. Prevention and control of these and other physical, chemical, biological, and radiological hazards are similar to those discussed in the assessment for the construction phase.

11.7.2 Existing Controls

Besides existing measures for air quality, noise and water usage control as mentioned in Chapter 10, several mitigation measures were included in the local regulatory EIA regarding the management of labour and working conditions. It is noted that there were no mitigation measures proposed for the management of worker's rights.

- EPC Contractors shall ensure all construction equipment and machinery have relevant technical certification and are regularly inspected;
- EPC Contractors must provide fall protection lifeline system for scaffolding and working-at-height tasks;
- EPC Contractors shall provide adequate illumination for workers working in night shifts;
- EPC Contractors shall establish health and safety internal rules and ensure worker's awareness of these rules; and
- EPC Contractors shall ensure day to day compliance with the health and safety requirements (i.e. procedures, equipment usage, PPE usage, demonstration of safe behaviours, competent personnel, compliance with work permit system).

11.7.3 Significance of Impacts

In addition to general accidents, injuries, and infectious diseases, construction sites often involve activities that generate large amounts of noise and dust, repetitive activities, and interactions with hazardous substances. Such activities can present potential occupational diseases. It is noted that the Project will be developed in Tuy Phong district where the industry is developed with existence of several large industrial projects such as Vinh Tan Thermal Power Complex and several wind power plants which are operational. The local workforce therefore is expected to have some certain awareness of the labour regulations that to protect their health, safety and well-being. As such, the vulnerability of AoI was considered as Low. As the number of workers is considered as not more than 84 workers, the magnitude of impacts on workers' rights and working conditions was ranked as Small. Therefore, the overall impact significance of human rights, health, and safety risks to workers during the construction phase was assessed as Minor.

Table 11.12 Impacts on Worker's Rights, Occupational Health and Safety

Impact Description	Impacts on Worker's Rights, Occupational Health and Safety				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Frequency	Frequent over 12 months of the construction period.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Vulnerability	**Low**	Medium	High		
Impact Significance	**Negligible**	Minor	Moderate	Major	

11.7.4 Additional Mitigation and Management Measures

In addition to the mitigation and management measures required under the regulation, the following measures are recommended in order to meet international standards:

Worker's rights

- EPC Contractors shall establish employment practices that ensure workers are paid appropriately in accordance with working hours and in a timely manner, informed by national standards and industry benchmarks;
- Project Owner and their EPC Contractors shall comply with Vietnam Labour Code requirements related to the hiring of labour and with applicable requirements from the EHS international guidelines;
- Special attention shall be given to establishing clear contractual agreements through the inclusion of particular clauses between Project Owner and all of their subcontractors to avoid child labour, forced labour, and human trafficking and other violations of human rights;
- EPC Contractors shall establish employment practices to check legal worker's age in identification document upon recruitment to ensure no child labour or forced labour and avoidance of unjustified dismissals;
- EPC Contractors shall establish employment practices that ensure workers are not discriminated against on the grounds of ethnicity, sex, religion, political opinion, social origin, age, marital or relationship status, sexual orientation, or trade union activity. As part of the hiring process, age checks will be conducted;
- EPC Contractors shall ensure workers are made aware of their rights as part of the induction process;
- EPC Contractors should implement a "zero tolerance" policy towards inappropriate behaviour from and amongst the workforce;
- EPC Contractors Ensure workers have a right to join unions;
- Project Owner and EPC Contractors shall establish a grievance mechanism for workers. This should include an option for grievances to be lodged anonymously. All workers, including those employed through the Project's supply chain, should have access to a grievance mechanism to ensure that their issues and concerns are identified and addressed. Contractors should be required to inform the Project about grievances raised;

Occupational health and safety

- Project Owner and their EPC Contractor shall ensure the inspection of critical equipment is conducted periodically;
- Project Owner and their EPC Contractors shall arrange bi-annual health checks for all workers in compliance with Decree 45/2013/ND-CP dated 10 May 2013 and Decision 959/2018/QD-EVN dated 9 August 2018 to ensure workers are fit for work;
- EPC Contractors shall provide the required PPE to workers as per regulations;
- EPC Contractors shall ensure all workers are provided with proper training on health and safety role prior to commencing work;
- EPC Contractors shall establish operation and safety procedure for each equipment and make available for the workers involved;
- EPC Contractors shall ensure that only appropriately skilled and trained employees are assigned to the operation and maintenance of the corresponding equipment and machinery;

- EPC Contractors shall perform audits of different subcontractors involved in terms of health and safety topics to ensure these companies comply with the findings and remedial action follow-up;
- EPC Contractors shall ensure safety measures are in place before workers perform high-risk tasks, such as working-at-height, loading and unloading of equipment, hot work, electrical works, use of scaffolds and heavy machinery;
- EPC Contractors shall monitor and report health and safety performance through site inspections to all involved subcontractors, using appropriate health and safety metrics, operations auditing as well as senior management review and follow-up;
- EPC Contractors shall monitor and report high-risk sites to restrict entry and prevent near misses, injuries and fatalities;
- EPC Contractors shall ensure training programs to adequately include the usage of appropriate PPE, good hygiene practices, awareness of infectious diseases, and the management of risks and hazards;
- EPC Contractors shall provide first aid box and competent first-aider at all construction sites and worker's accommodation facilities;
- Project Owner and their EPC Contractors shall conduct medical assessments of workers before they are mobilized to the site, including screening for infectious diseases and other health issues. This is to ensure workers are fit for work;
- Project Owner shall implement a system for selection and management of contractors/subcontractors/suppliers with clear criteria on required environmental and safety management capabilities;
- Project Owner and their EPC Contractors shall develop and implement a Worker Accommodation Management Plan in accordance with local regulations and IFC requirements to ensure the well-being of the workforce as well as the health, safety and security of local communities;
- EPC Contractors shall ensure the worker accommodation is constructed/leased and managed in accordance with Vietnam requirements and Worker's Accommodation: Processes and Standards developed by WBG, IFC and EBRD;
- Minimum requirements for the worker's accommodation facilities shall include:
  - Free of charge to workers, meaning that workers do not have to pay if they choose to stay in workers' camp built or owned by the Project Owner or the contractors;
  - Adequate living space for each worker;
  - At least one toilet shall be arranged for every 15 workers;
  - At least one shower/bathroom is provided for each 15 persons;
  - Wastewater, sewage, food and other waste materials shall be adequately discharged in compliance which Vietnam standard;
  - Male and female toilet/shower/bathroom shall be separated;
  - Sanitary, laundry and cooking facilities and potable water;
  - Adequate health, fire safety measures, including first aid and medical facilities;
  - Adequate heating and ventilation; and
  - Non-restrictive to workers' freedom of movement to and from the accommodation.
- Project Owner shall conduct regular audits of workers´ accommodation sites of all involved subcontractors.

11.7.5 Residual Impacts

While Project mitigation measures will help prevent impacts on workers' health and safety, there is the potential for accidents to occur as a result of human error, occupational diseases to occur as a result of work activities/conditions, and diseases to spread. To maintain the impact significance as Negligible, it will be important that the Project Owner's existing policies and procedures (designed to protect workers' health and safety) are implemented and regularly monitored to ensure that the policies and procedures are being effectively implemented.

11.7.6 Monitoring and Audit

Ongoing monitoring of the health and safety practices as well as labour contracts and management will be required. This can be conducted through regular audits, particularly of all the involved contractors, to ensure the Project Owner's expectations regarding health and safety practices are being implemented.

11.8 Construction – Impact on Community Way of Life, Health, and Safety and Security due to Construction Activities (Non-influx Issues)

11.8.1 Potential Impacts

General construction activities of an onshore wind project include land clearance, land preparation and civil work, transportation of materials and workers, construction and installation of turbines, and construction of associated facilities, including the access road and transmission line. These activities are likely to generate noise, dust, and risk to the community's health and traffic safety. Improper management of the dust, waste and wastewater, noise, and vibration generated during construction activities may cause disturbances or certain health impacts to the local communities. Potential impacts and consequences of noise, vibration, waste and wastewater as well as dust are also discussed in detail in Section 10.1, Section 10.2, Section 10.3, Section 10.8, accordingly.

Health issues as a result of noise, dust, and waste

The main sources of noise and vibration in the construction phase are transportation, mobilisation of construction material, and heavy machinery operation during the construction process (main site and transmission line), including piling activities. However, these construction activities do not represent a constant source of noise that will occur on a day-to-day basis for the duration of the construction schedule. These activities are expected to occur for only portions of the work and will not occur for entire daytime periods. As observed on-site and confirmed during the ESIA stakeholder engagement, most of the 8,972 inhabitants of Phu Lac commune are living in Lac Tri, Phu Dien and Vinh Hanh villages, which are more than 500 m away from the Project nearest wind turbine. According to the noise modelling conducted by ERM, the noise level exposed by these communities during construction is expected to be equal to or less than 50 dBA.

This value is lower than the permitted noise level of IFC (55 dBA for night time) and (60 dBA for day time) standards. However, when compared with the noise level guided by WHO for community health protection, the noise level at night slightly exceeds the threshold values not to harm the community health, as presented below:

- ≤ 70 dBA to prevent noise-induced hearing impairment;
- ≤ 55 dBA to prevent noise annoyance; and
- ≤ 45 dBA to prevent sleep disturbance.

Waste and wastewater from construction are also an impact source on community health if not managed properly. During the construction phase, the domestic waste will be generated from up to 84 workers, non-hazardous and hazardous industrial wastes from construction activities. Improper management of waste and wastewater from construction would result in potential contamination of soil, groundwater, and surface water as well as community health risks. The construction impact levels on

surface and groundwater (due to rainwater runoff and wastewater discharge) of Phu Lac commune were assessed as Low in ERM's water quality and waste impact assessment.

Meanwhile, dust may be generated during the earthworks and due to the mobilisation of construction materials to and from the Project site. Construction activities (such as soil disturbing activities, storage of materials such as concrete, and transportation of materials) without proper controls in place are likely to result in dust generation expected during the dry season. Based on the air quality impact assessment results, small-scale and centralized impacts were predicted for the exhaust emissions (from earthworks, construction activities, and transportation).

Transportation of hazardous materials and hazardous waste from the construction site to the authorised treatment locations may also cause health risks to residents living by the transportation route or commuters travelling on the same road. The hazardous materials and waste, including engine/transformer oil, solvents, paints, used batteries, discarded lubricant, and fabric, electrical waste, medical waste may be released to the environment due to inadequate containment or traffic accidents, and consequently cause risks of fire, explosion and contamination of the environment to the community. During the implementation of construction activities, flammable gas, liquid or chemicals will be stored and used. As such, an emergency, such as fire, explosion or oil spill, may occur during the construction phase and may affect the nearby communes. These will be discussed in detail in the Unplanned Event Chapter.

Unauthorized access to the Project site

Unauthorized access of people nearby, especially children or vulnerable people, to the Project site is also likely to increase the risks of injuries and fatalities of public safety. It is the Project Owner and their contractors' responsibility to take necessary steps to ensure that local people and all workers are safe from activities on construction sites.

11.8.2 Existing Controls

Refer to Chapter 10 for existing controls proposed for dust, noise, water quality, solid waste and air quality impacts. Regarding the risk of injury to local persons gaining unauthorised access to the construction or restricted sites, the regulatory EIA also proposed the following measures to be implemented:

- EPC Contractors shall implement proper fencing, use of signage and site patrolling; and
- EPC Contractors shall disclose to information regarding the restricted area and potential risks to local communities.

11.8.3 Significance of Impacts

From the assessment of dust, noise, water quality, solid waste and air quality in Chapter 10, given the short construction period (12 months) and the Project site is not in close proximity with the residential area, the magnitude of impacts on local residents were predicted to be Small. The local community's vulnerability was ranked as Medium, taking into consideration that the local communities had experienced the developments of other industrial projects such as Phu Lac 1 Wind Power Plant, ECO SEIDO Solar Power Plant which are now in operation, and several concerns on noise and air pollution were raised during the social baseline interviews with local people. Therefore, the significant impact of the community health and safety risk was assessed as Minor.

Table 11.13 Impacts on Community Health, Safety and Security due to Construction Activities

Impact Description	Impacts on Community Health, Safety and Security due to Construction Activities				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Frequency	Frequent over 12 months of the construction period.				
Impact Magnitude	Positive	Negligible	**Small**	**Medium**	Large
Receptor Vulnerability	Low	**Medium**	High		
Impact Significance	Negligible	**Minor**	Moderate	Major	

11.8.4 Additional Mitigation and Management Measures

The Project Owner should implement the following additional mitigation measures to manage the potential negative impacts associated with construction activities:

- Project Owner and their EPC Contractors shall implement the imitation measures proposed in Chapter 10 for dust, noise, water quality, solid waste and air quality impacts to control the construction impacts; and
- Project Owner shall disclose the proposed grievance mechanism to make it accessible for all villagers to report concerns associated with health and safety issues. An immediate investigation shall be undertaken when complaints on accidents or near misses are submitted.

11.8.5 Residual Impacts

As a result of implementing the proposed management measures, the impact on community health, safety, and security associated with construction activities will reduce to Negligible.

11.8.6 Monitoring and Audit

The following monitoring activities are recommended:

- On-going monitoring and periodical audit are required to check if the above mitigation measures are implemented at all levels of the Project supply chain; and
- Monitoring and audits are also required to be conducted in accordance with the schedule proposed in the management plans relating to dust, noise, water quality, solid waste, and air quality impacts management.

11.9 Construction – Impact on Community Way of Life, Health, Safety and Security due to the Presence of Influx

11.9.1 Potential Impacts

The Project will employ approximately 84 workers (peak number of workers per shift) during the construction phase of 12 months. The Project proponents will endeavour to source employees from the local area, subject to the availability of candidates with the required skills and experience. The proportion of the local workforce is 95% of the total construction workers. During construction, the EPC Contractors and subcontractors may arrange for workers to live in purpose-built accommodations. These facilities are expected to be sited, designed, and managed according to the standards specified in the IFC/WBG/EBRD guidance document.

The potential interaction between the workforce and local communities still poses the following risks:

- COVID-19 related risks;
- Increased risks of infectious diseases;
- General disturbance and tension between migrant workers and local communities; and
- Pressure on public service and infrastructure.

COVID-19 related risks

The global COVID-19 situation is fluid and the duration of the crisis is yet unknown. Potential risks of spreading the virus among the community, especially from migrant workers from other provinces and countries, are still expected.

Increased risks of infectious diseases

Results from the social baseline survey indicated that the common infectious diseases in Phu Lac commune were influenza, dengue and hepatitis. Local people in Phu Lac and Chi Cong communes, as well as Lien Huong town, receive their water supply from Tuy Phong Water Plant, wells and boreholes. During the construction phase, waste and water discharge from construction activities might lead to a risk of diseases, including:

- Water-borne disease associated with poor sanitation of construction site and worker accommodation facilities;
- Sexually transmitted infections (STIs) and HIV/AIDS; and
- Gastro-intestinal diseases and other food borne diseases such as Hepatitis A due to poor standards of food hygiene in site catering facilities including facilities provided in workers' accommodation.

General disturbance and tension between migrant workers and local communities

The EPC Contractors and subcontractors may arrange on-site accommodation facilities for non-local workers. As such, the interaction between migrant workers and the local residents will not pose a significant risk. However, the presence of a non-local workforce from other Vietnamese provinces may result in the presence of behavioural traits, habits and lifestyle in the community, which may be alien to the local community. These behavioural traits may cause discomfort/ inconvenience to the local community, including the local worker group, resulting in disagreement and conflicts. The potential impacts on the local community include:

- Risk of prostitution: Most non-local workers employed by EPC Contractors and subcontractors are males, living away from home, and most of them will be without families. Therefore, increased demand for sexual services could be possible. Poverty could be an incentive for women to get involved in sex work as an alternative livelihood option for a quick income source. Female-headed/single-mom households seem to be the most vulnerable to this risk. Furthermore, these women's vulnerability will be increased if these women have babies as a corollary of the unsafe

prostitution. In particular, given the temporary nature of contract work, it is possible that both the women and children will be abandoned when the construction phase ends and the contractors move on, leaving a new group of single female-headed households often dependent upon their extended family support networks.

- Increased tension: Conflicts among Project workers and locals can ensue from the use and treatment of local resources, establishment of settlements, and difference in treatment of new construction workers and local people. Conflicts may also arise between the local people when the local people's recruitment policy is not transparent and non-equal access to opportunities between affected villages.
- Increased alcohol and drug abuse: The presence of contractual workers may also increase alcohol and drug abuse in the area as the contractor workforce may originate from urban areas where exposure to alcohol and drugs is much more prevalent, which could then be introduced into the local area.

Pressure on public service and infrastructure

The surveyed data indicated that overall, local people in Phu Lac and Chi Cong communes and Lien Huong town were satisfied with the availability and accessibility of existing public services, including piped water, electricity, health care, market, schools, and road network. Several concerns were raised on the deterioration of communal roads and the occasional flood in the commune. Given the small number of migrant workers to be employed during the construction phase, it is not anticipated to pressure these infrastructures and services.

Security force

At the time of writing, it was unclear whether the Project will directly employ security staff or contract a private security force to protect their Project site, workers, and assets. The number of security guards to be deployed on-site was also not available. In both cases, the Project's security arrangements might pose threats to local communities in terms of potentially inappropriate use of force, unlawful detention, sexual violence/harassment against women.

11.9.2 Existing Controls

There are no mitigation measures provided in the regulatory EIA for the management of influx related impacts.

11.9.3 Significance of Impacts

The nubmer of migrant workers (4 workers) are significantly low compared to the total population of the Phu Lac commune (8,972 people) where most of the Project construction work will take place and the operational house with worker accommodation is located. Also, the presence of non-local workers in the area is relatively short (12 months of construction phase). As such, the impact magnitude of the influx-induced risks was assessed as Negligible. Given the local communities in the Project site have already had experience with the construction activities from nearby projects (i.e. Phu Lac 1 wind power and ECO SEIDO solar power plants), and the reliability and availability of local infrastructure (see further the socio-economic baseline on local evaluation public facilities and services including local health stations, schools, water and electricity supply, waste collection, local markets and roads), the vulnerability of the receptors was deemed as Low, resulting in the impact significance of the influx worker issues as Negligible.

Table 11.14 Impacts on Community Health, Safety and Security due to the Presence of Influx

Impact Description	Impacts on Community Health, Safety and Security due to the Presence of Influx				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Frequency	Frequent over 12 months of the construction period.				
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
Receptor Vulnerability	**Low**	Medium	High		
Impact Significance	**Negligible**	Minor	Moderate	Major	

11.9.4 Additional Mitigation and Management Measures

The Project Owner should implement the following additional measures to maintain the impact level associated with the presence of migrant workers:

- Project Owner and EPC Contractors should prioritize local employment for the unskilled job to minimize the number of migrant workers;
- Project Owner and their EPC Contractors shall comply with all site regulations on hygiene and safety;
- EPC Contractors shall coordinate with local authorities to manage temporary resident registration for migrant workers and monitor social security in the area where migrant workers will be accommodated;
- Project Owner and their EPC Contractors shall strictly follow the Government's instructions on COVID-19, including compulsory COVID-19 tests and quarantine for migrant workers as well as wearing of face masks;
- Project Owner should develop a COVID-19 monitoring and response team, who are tasked with outbreak tracking and protocols and procedures developments as appropriate in line with local and national requirements and guidelines;
- Project Owner and their EPC Contractors shall conduct compulsory medical examinations (i.e. bi-annual health check-ups) for Project workers, including contractors, as required by national regulations, to ensure they are fit for work and to monitor the prevalence of communicable diseases;
- Project Owner and their EPC Contractors shall ensure the health and safety of all workers and local communities by complying with relevant regulatory national requirements and international best practices on medical safety and food hygiene on the construction sites if there will be installed canteens among the working areas and in the workers´ accommodation areas that are equipped with canteens;
- The Project Environmental and Social Focal Point should assign and deliver induction training to guide requirements for culturally appropriate behaviours, and an overview of the risks to migrant

staff and workers. The training will include key cultural sensitivity awareness topics/programs to ensure workers, including security staff, do not unintentionally offend the local community;

- Project Owner and their EPC Contractors shall regularly engage with local authorities relevant to crime (i.e. local police) or other social problems (e.g. village leaders) for prevention of issues and for mitigation purposes when Project influx-related issues arise;
- A Code of Conduct, including requirements on social interaction with the local community, gender awareness, vulnerable groups and environmental protection obligations, shall be developed for all involved staff and workers within the construction site (including all subcontractors). An appropriate mechanism to address non-compliance shall also be included as part of the labour contract. All staff and workers within the construction site shall be trained and made aware of the Code of Conduct;
- Project Owner should establish and implement regulatory requirements and good practices in relation to a background check, hiring, rules of conduct, training, equipping of security personnel;
- Project Owner shall ensure that training to security force will include adequate and clear requirements in using force and appropriate conduct toward workers and affected communities. Project Owner shall not sanction any use of force except when used for preventive and defensive purposes in proportion to the nature and extent of the threat; and
- Project Owner shall implement the Stakeholder Engagement Plan and disclose a grievance mechanism for workers and affected communities to express concerns about the Project-related issues as well as security arrangements and acts of security personnel.

11.9.5 Residual Impacts

As a result of the implementation of the proposed management measures, the impact on community health, safety and security associated with a non-local presence is expected to remain Negligible throughout the Project construction period.

11.9.6 Monitoring and Audit

The following monitoring activities are recommended:

- Ongoing monitoring and periodical audit are required to check if the above mitigation measures are in implementation.

11.10 Construction – Impact on Traffic Safety due to Increased Transportation Volume

11.10.1 Potential Impacts

The traffic safety assessment considers the potential effects of construction traffic on the road network within the vicinity of Phu Lac 2 Wind Farm on the following aspects of traffic and transportation:

- The capacity of the existing road network to accommodate the traffic volumes generated by the Project; and
- Transportation safety on public roads due to Project-related traffic.

The key activities that are likely to have negative impacts on the local infrastructure and traffic safety include:

- Transport of equipment (turbines and transmission line components and material) from Vinh Tan port to the Project site; and
- Daily movement of construction workers.

The wind turbine generator parts will be imported from overseas, transported by waterways and unloaded at Vinh Tan port in Binh Thuan province, then trucked to the site via National Highway 1A and

existing access road to the Project operation house using large goods vehicles. It was expected that, on average, twenty-seven trips of 10-tonne trucks would occur in the Project site during the construction period. The travel distance is about 20 km in total. Cranes will be used at the port and Project site to unload turbine parts. Figure 11.7 shows the proposed transportation route from Vinh Tan port to the Project site.

Figure 11.7 Equipment Transport Route

Other electrical materials and equipment will be procured by contractors in Ho Chi Minh City. Construction materials, such as cement, stone, and sand, will be delivered by suppliers in Binh Thuan province or neighbouring localities. The Project Owner will utilize the existing access road which was built during the construction of Phu Lac Project phase 1 to transport all Project materials and equipment from the National Highway 1A. This road is solely used for Phu Lac Project vehicles and is barricaded to prevent unauthorized access from the public.

As such, a cumulative increase of heavy trucks presence is likely to pose potential impacts to part of National Highway 1A from Vinh Tan port to the Project site in terms of:

- Degradation of the public road infrastructure and network due to heavy load vehicle movement;
- Traffic congestion due to an increase of traffic movement; and
- Increase of traffic incidents.

11.10.2 Existing Controls

The regulatory EIA recommended the Project Owner and their EPC Contractors shall contract to ensure the transport of long and heavy equipment to be conducted by certified third parties to ensure safety and compliance with technical requirements.

11.10.3 Significance of Impacts

The transportation period will occur over a 12-month-period. During construction, 10-tonne trucks will be utilized for transporting construction materials and equipment. Estimated from a similar wind farm project of Thuan Binh wind, which has a similar construction scope, the construction phase will likely require up to 27 truck movements per day at peak times (approximately three months). The wind turbine equipment, cranes, and accompanying parts are normally transported by super-length and super-heavy trucks. These heavy trucks will likely move slower than a typical vehicle, leading to traffic congestion and delays, particularly at bends or intersections. During the transportation process, if many super-heavy trucks are used to exceed the roadbed capacity, they can cause the degradation of road infrastructure, pavement, and underground works such as the sewage system and communication system. Based on the observation from the site survey, it is noted that the Project area is connected with the National Highway 1A, which is completely asphalted and the width of those roads is quite large. Also, current Project equipment transportation plan will utilize the existing Project internal road from Phu Lac 1 to access the construction site from National Highway 1A. There are no residential areas along or within a radius of 500m from this access road. As such, interaction between the Project vehicles and local communities in Phu Lac commune is less likely. The magnitude of Project impacts to traffic density and road infrastructure as a result of increased vehicle movement during the construction phase was assessed as Small as it will only affect the users of the National Highway 1A in a short-term period. The vulnerability of the receptor was assessed as Low as the local communities along the equipment transport route have already experience dense traffic on the National Highway 1A and Phu Lac's community is located approximately 2km from the existing access road of Phu Lac 1 which will be used by this Project. Therefore, the level of impact to local communities in Phu Lac commune was ranked as Negligible.

Table 11.15 Impacts on Traffic Safety due to Increased Transportation Volume

Impact Description	Impacts on Traffic Safety due to Increased Transportation Volume				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Frequency	Frequent over 12 months of the construction period.				
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Vulnerability	**Low**	Medium	High		
Impact Significance	**Negligible**	Minor	Moderate	Major	

11.10.4 Additional Mitigation and Management Measures

The Project Owner should implement the following additional measures to ensure the low potential negative impact level associated with increased traffic volume from construction activities:

- EPC Contractors should enhance the education of traffic safety awareness for drivers;
- Project Owner and EPC Contractors should ensure traffic safety in the process of transporting equipment by super-heavy vehicles: circulation permit for overload/oversize vehicles in accordance

with Circular No. 46/2015/TT-BGTVT must be obtained, coordination with relevant agencies (i.e. the Department of Transport, the Provincial Traffic Police Department) to survey the topographic location of loading and unloading places, parking spots, driving itineraries, travel speed, travel time) to ensure safety for people, goods and traffic work;

- EPC Contractors shall schedule deliveries to the site so that disruption to local amenities and traffic is minimized, such as avoiding vehicle movement during peak hours (6am to 8am and 4pm to 6pm);
- EPC Contractors shall ensure all trucks are inspected regularly and carefully to ensure safety;
- EPC Contractors should train drivers on traffic safety and regulations. Driving under influence (DUI) is strictly prohibited;
- EPC Contractors shall install speed limit signs within the Project area and the external routes;
- EPC Contractors shall provide warning lights during movement at night;
- EPC Contractors shall plan a drive-through site to eliminate the need for vehicles to back up and ensure that mobile equipment backup alarms are audible above ambient noise levels;
- EPC Contractors shall assign a flagman at the conjunction between the National Highway 1A and the access roads to coordinate trucks entering the Project site;
- Project Owner and their EPC Contractors shall coordinate with Phu Lac commune People's Committee to organise the traffic in and near Project site when necessary; and
- Project Owner and their EPC Contractors shall develop and implement a Safety Transportation Management Plan and Traffic Management Plan.

11.10.5 Residual Impacts

As a result of the implementation of proposed additional measures, the residual impact is expected to remain Negligible throughout the construction period.

11.10.6 Monitoring and Audit

- Monitoring and audits are also required to be conducted in accordance with the schedule proposed in the Safety Transportation Management Plan and Traffic Management Plan.

11.11 Construction – Disruption of Cultural Practice Due to Construction Activities

11.11.1 Potential Impacts

The 7.4 km transmission line and access road are observed to be located near by the graveyard area (see Figure 11.8). During the social FGD process with affected households, the community stakeholders mentioned about there are possibilities that the Project may disturb the graveyard during the transmission line construction and equipment and construction materials transportation. It is noted that during Thanh Minh festival[21]-Holiday of Dead there will be more local people come to visit their ancestor graves and they might experience general disruption (noise, dust, busy access roaf) from construction activities. .

[21] The Festival occur in the 3rd month of the Lunar year. Before the Festival, family members clean and tidy the graves of their ancestors and also the surrounding areas. On the date of Thanh Minh, individuals make solemn visits to the graves with offerings of incense, food and flowers.

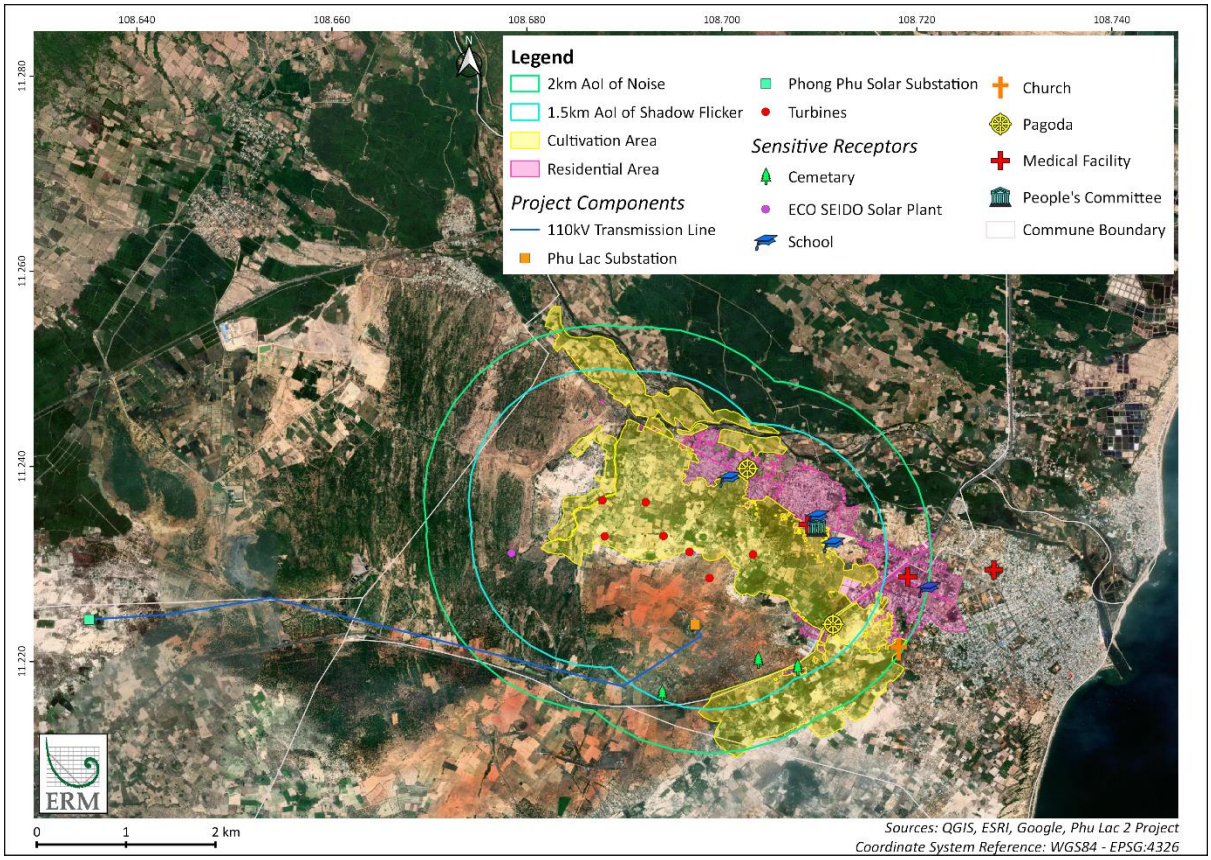


Figure 11.8 Sensitive Receptor to the Project

11.11.2 Existing Controls

No existing management measures in place.

11.11.3 Significance of Impacts

The impact nature of construction activities to the graveyard area was considered a negative impact where the Project could disturb the cultural activities of the graves visitors, especially during Thanh Minh festival. The construction process was considered as short time and the festival occurs within one month only. This impact magnitude only happened locally in the Phu Lac commune and surrounding the graveyard; as such, the impact magnitude can be considered as Small. The related stakeholders have been experienced a similar construction activities of Phu Lac 1 wind power plant, so it is assumed that receptor sensitivity is Low. Therefore, the impact significance is categorized as Neglible.

Table 11.16 Disruption of Cultural Heritage along the Transmission Line

Impact Description	Disruption of Cultural Heritage along the Transmission Line				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	**Short-term**	Long-term	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	**Low**	Medium	High		

Impact Description	Disruption of Cultural Heritage along the Transmission Line			
Impact Significance	**Negligible**	Minor	Moderate	Major

11.11.4 Additional Mitigation and Management Measures

- Inform the local authorities and communities about the construction schedule prior to the construction time;
- Limit the construction activities nearby the graveyards during Thanh Minh festival; and
- Provide culturally appropriate sign board nearby the gravesyard to show that the construction is in process. Hotline should be stated in the sign board for the people to contact if any concerns occur.

11.11.5 Residual Impacts

With mitigation measures in place, the impact will be negligible during the Project construction.

11.11.6 Monitoring and Audit

The following monitoring activities are recommended:

- On-going monitoring and periodical audit are required to check if the above mitigation measures are implemented; and
- Monitoring is also required to be conducted in accordance with the SEP and grievance procedure.

11.12 Operation – Positive Impact on Local Employment and Community Development

11.12.1 Potential Impacts

During the operational phase, the local economy will be positively influenced by an increase in taxation revenue of the Province, demand for materials and services. It is expected that the Project will employ 21 employees for the wind farm, of which 18 employees will be recruited from Tuy Phong district, Binh Thuan province, to fill the required unskilled/semi-skilled positions such as security personnel and kitchen assistants.

Most of the labourers during the operation phase will be skilled labourers, and thus, to satisfy the local employment expectation, the Project Owner should consider training local people.

With the presence of an industry in the locality, in addition to local employment, the Project would benefit the local community with its corporate social responsibility activities such as charity, education and healthcare support.

11.12.2 Significance of Impacts

Given the Project Owner’s commitment to optimise local employment and procurement, and community development, it is likely that the Project would positively impact local communities. The number of labour required for operation is low and with the current socio-economic conditions of affected communes including Phu Lac, Chi Cong, Phong Phu communes and Lien Huong town the Project's contribution to the community is expected small. Overall, the Project would bring a minor benefit to the local community and economy.

Table 11.17 Local Employment and Community Development during the Project Operation

Impact Description	Local Employment and Business during the Project Operation				
Impact Nature	Negative	**Positive**	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Magnitude	Positive	Negligible	**Small**	Medium	Large
Receptor Sensitivity	**Low**	Medium	High		
Impact Significance	Negligible	**Minor**	Moderate	Major	

11.12.3 Enhancement Measures

In order to further enhance positive impacts associated with the Project, the following additional measures are recommended:

- Facilitate employment for local workers (e.g. un-skilled workers and provide adequate training for the tasks to be performed).
- Communicate clear information about Project-related employment and business opportunities and prioritize local people wherever feasible. Such communication should be conducted at least two weeks before recruitment so that local people have enough time to prepare for the recruitment process (for example, preparing administration documentation for job application.)
- Via the LRP, provide vocational training to maximise the job opportunities for local people in other projects and the local employment rate for the Project;
- Develop and implement a Community Development Plan to contribute to enhance the living standards of the affected communities.

11.13 Operation – Health and Safety Impacts and General Disturbance to Local Community

11.13.1 Potential Impacts

During the operation phase (about 20 years), disturbance to the local communities mostly comes from the impacts from workers' presence, operation, and maintenance of the turbines and substations. The number of workers will be reduced to 21 staff/workers (of which three are non-local) for the operation phase. Hence, community health issues associated with migrant workers' presence, such as the transmission of communicable diseases or conflict between workforce and local communities, include littering and noise, fighting due to heavy drinking, and gambling, are expected to be minimal. Potential cultural conflict and tension due to the difference in culture and living style between the migrant and local people are also not expected during this phase. The risk from blade throw will be assessed in the unplanned events chapter. Operational traffic impacts will be associated with emissions from a limited number of vehicles accessing the site for maintenance or security purposes. The potential impacts on traffic from operation activities (e.g. wind turbine generator operations, inspection and maintenance) are considered negligible, so no further assessment is needed.

Noise from the operation of turbines, substation, and transformers of the Project is defined as another potential factor causing nuisance and disturbance to the surrounding community. The noise modelling and assessment for the Project's operation activities results in negligible significance. Noise levels

exposed by the nearest residential areas (approximately 500m from the closet turbines) range from 36 – 44 dBA, which are below IFC acceptable level of 45 dBA. Thus, no further measure is required.

11.13.2 Existing Controls

Refer to Chapter 10 for existing controls proposed for dust, noise, water quality, solid waste, and air quality impacts during the operation phase.

11.13.3 Significance of Impacts

The magnitude of the aforementioned impacts was predicted to be Negligible during operation as a result of the related impact assessments above. The sensitivity of the surrounding households was ranked as Low as mentioned above, residential areas are located more than 500m away from the turbine sites. Therefore, the impact significance would be assessed as Negligible.

Table 11.18 Health and Safety Impacts and General Disturbance to Local Community

Impact Description	Health and Safety Impacts and General Disturbance to Local Community				
Impact Nature	**Negative**	Positive	Neutral		
Impact Type	**Direct**	Indirect	Induced		
Impact Duration	Temporary	Short-term	**Long-term**	Permanent	
Impact Extent	**Local**	Regional	International		
Impact Magnitude	Positive	**Negligible**	Small	Medium	Large
Receptor Sensitivity	**Low**	Medium	High		
Impact Significance	**Negligible**	Minor	Moderate	Major	

11.13.4 Additional Mitigation and Management Measures

To ensure the significance of the impact remains as Negligible, the Project Owner is required to implement the additional measures as proposed in Noise Impact Assessment, Visual Impact Assessment and Shadow Flicker Impact Assessment and other measures as below:

- As part of the Project SEP implementation, Project Owner should conduct close communication with local communities on Project environmental and social risks. Future risk-communication efforts will be undertaken in the context of continuing, intense social distrust and will have to be designed in a culturally appropriate way;
- Project Owner shall implement community grievance mechanism is implemented to obtain and resolve community's feedback and concerns in a timely manner;
- Project Owner shall conduct regular compliance assessments; undertake site visits as required, identify any environment-related and social-related issues; and
- Project Owner shall document issues, propose necessary corrective actions, and prepare these in a corrective action plan.

11.13.5 Residual Impacts

Following the implementation of proposed additional measures, the residual impact is expected to remain Negligible during its operation phase.

11.13.6 Monitoring and Audit

The following monitoring activities are recommended:

- Ongoing monitoring and periodical audit as proposed in the ESMP to ensure the above mitigation measures are being effectively implemented; and
- Monitoring and audit are also required to be conducted in accordance with the schedule proposed in Sections for Noise Impact Assessment, Visual Impact Assessment, Shadow Flicker Impact Assessment and Unplanned Events.

12. UNPLANNED EVENTS

12.1 Overview

This chapter presents the probable impacts of unplanned events associated with construction and operation of the Project. The unplanned events are those that potentially arise from a technical failure, human error, or as a result of unexpected natural phenomena.

The assessment of potential impacts arising from unplanned events are based on the environmental baseline data, consultation with TBW and judgements based on ERM's professional knowledge and previous experience on similar projects. The assessment of unplanned impacts considers the happening probability and an estimation of the consequences severity. The assessment of the severity of impacts due to fire and explosion is based on the worst case scenario, where it is assumed that safety devices and associated measures fail to operate properly resulting in the incidents.

Probable unplanned events relevant to the Project, in the order of potential occurrence, which are assessed in this chapter include but not limited to:

- Fire and explosion, including bushfire and Unexploded Ordnance (UXO);
- Spillage of fuel, oil, chemicals and hazardous materials;
- Traffic accidents;
- Occupational accidents;
- Blade throw; and
- Transmission line snapping, and transmission pylon/tower collapse.

This chapter covers impact assessment of the listed events examining potential and significance of the impacts. Mitigation measures are proposed based on international good practice (as recommended under the IFC EHS Guidelines) and relevant national regulatory requirements. Afterwards, a qualitative classification is resolved for each impact with regards to its significance following the implementation of the proposed mitigation measures. Finally, a protocol for monitoring and auditing is recommended when applicable.

12.2 Relevant Guidelines and Regulatory Requirements

12.2.1 Local Regulations

- Law on Fire Prevention and Fighting No. 27/2001/QH10;
- Law No. 40/2013/QH13 Amendment and Supplement a Number of Articles in the Law on Fire Prevention and Fighting No. 27/2001/QH10;
- Decree 136/2020/NĐ-CP on guidelines for the Law on Fire safety and firefighting and the Law on amendments to the Law on Fire safety and firefighting;
- Government Decree No. 113/2017/ND-CP dated October 9, 2017 specifying and providing guidelines for implementation of certain articles of the Law on Chemicals; and
- Circular No. 32/2017/TT-BCT dated December 28, 2017 specifying and providing guidelines for implementation of certain articles of the Law on Chemicals and Decree 113/2017/ND-CP specifying and providing guidelines for implementation of certain articles of the Law on Chemicals;
- Decree No. 02/2019/TT-BCT Regulating Wind Power Development; and
- Decision No. 02/2013/QD-TTG dated 14th January 2013 promulgating the regulation on oil spill response.

12.2.2 International Standards and Requirements

The IFC Performance Standards applicable to the Project in term of unplanned events are provided in Table 12.1.

Table 12.1 Applicable IFC Performance Standards

Performance Standard	Requirements
PS1: Assessment and Management of Environmental and Social Risks and Impacts	Emergency Preparedness and Response Where the project involves specifically identified physical elements, aspects and facilities that are likely to generate impacts, the ESMS will establish and maintain an emergency preparedness and response system so that the Client, in collaboration with appropriate and relevant third parties, will be prepared to respond to accidental and emergency situations to prevent and mitigate any harm to people and/or the environment. The preparation will include the identification of area where accidents and emergency situations may occur, communities and individuals that may be impacted, response procedures, provision of equipment and resources, designation of responsibilities, communication, including that with potentially affected communities and periodic training to ensure effective response. The emergency preparedness and response activities will be periodically reviewed and revised, as necessary, to reflect changing conditions.
PS4: Community Health, Safety, and Security	Emergency Preparedness and Response The Client will also assist and collaborate with the affected communities, local government agencies, and other relevant parties, in their preparations to respond effectively to emergency situations especially when their participation and collaboration are necessary to respond to such emergency situations. If local government agencies have little or no capacity to respond effectively, the Client will play an active role in preparing for and responding to emergencies associated with the Project. The Client will document its emergency preparedness and response activities, resources, and responsibilities, and will disclose appropriate information to affected communities, relevant government agencies, or other relevant parties.

12.3 Impact Assessment Methodology

For impact assessment of the unplanned events, the consequence of impact is considered together with its likelihood of occurrence. The impact consequence is evaluated based on duration (short-term, medium-term, long-term), scale (localized, medium, or widespread), and magnitude (minor, moderate, major) of the impact. Table 12.2 presents the indicative levels of consequence from unplanned events in terms of their impacts to the physical, biological and social environments.

Table 12.2 Classification of Level of Consequence

	Incidental (A)	Minor (B)	Moderate (C)	Major (D)	Severe (E)
Physical Environment	Localized or short-term impacts on environmental media; meeting all environmental standards	Widespread, short-term impacts on environmental media; meeting all environmental standards	Widespread, long-term impacts on environmental media; meeting all environmental standards	Significant, widespread and persistent changes in environmental media; Exceeding the environmental standards.	Exceeding the environmental standards; Fine / prosecution
Biological Environment	Localized or short-term impacts on habitat or species	Localized, long-term degradation of sensitive habitat or widespread, short-term impacts on habitat or species	Localized but irreversible impacts on habitat or widespread, long-term impacts on habitat or species	Significant, widespread and persistent changes in habitat or species	Persistent reduction in ecosystem function on a landscape scale or significant disruption of a sensitive species.
Social Environment	Slight, temporary, adverse impact on a few individuals	Temporary (<1 year), adverse impacts on community but still within the international health standards	Adverse specific impacts on multiple individuals that can be restored in <1 year; or One or more non-severe injuries.	Adverse, long-term, multiple impacts at a community level, but possibly restorable; or One or more severe injuries to members of the public including permanent disability.	Adverse, long-term, varied and diverse impacts at a community level or higher, unlikely restorable; or

In addition, given the irregular and unpredictable nature of the unplanned events, the likelihood of occurrence is weighted for each impact following the scale in Table 12.3 below.

Table 12.3 Classification of Likelihood of Occurrence

Level	Description
Remote (1)	Not known in the industry
Very unlikely (2)	Known but unlikely to happen
Unlikely (3)	May occur one or more time in the Project's lifetime
Likely (4)	May occur once or twice per year
Expected (5)	May occur more than twice per year

Once the level of potential consequence and likelihood of occurrence have been identified, the overall significance of impact will be assessed using the risk matrix shown in Table 12.4.

Table 12.4 Matrix for the Risk Assessment of Potential Unplanned Events

		Likelihood of Occurrence				
		Remote (1)	Very unlikely (2)	Unlikely (3)	Likely (4)	Expected (5)
Consequence	Incidental (A)	Negligible	Negligible	Negligible	Negligible	Negligible
	Minor (B)	Negligible	Minor	Minor	Minor	Moderate
	Moderate (C)	Minor	Minor	Moderate	Moderate	Major
	Major (D)	Moderate	Moderate	Major	Major	Major
	Severe (E)	Major	Major	Major	Major	Major

12.4 Impact Assessment

12.4.1 Combustion and Explosion including Unexploded Ordnance (UXO) explosion

12.4.1.1 Potential Impacts

The potential source of impacts associated with fire and explosion would occur as a result of the following events:

- Damage of the WTGs, transmission lines, insulators or other supporting parts;
- Electrical arcs or flashovers;
- Lightning strike;
- Bushfire;
- Facility and equipment failure;
- Storage of combustible materials; and
- Uncleared UXOs.

The potential impacts from large scale fires include the release of smoke and fumes in the broader area generating health issues associated with inhalation of toxic substances and uncontrollable wildfire that would contribute to a loss of houses, crops, natural habitats and impact on the economics of the area (e.g. community and workers' jobs and incomes). In more severe cases, combustion and explosion can lead to major injuries and possible fatality of human receptors, i.e. construction workers and nearby residents, especially in cases involving bushfires or UXO explosion.

12.4.1.2 Existing Controls

The Phu Lac 1 EIA report has proposed a range of mitigation measures to prepare for the potential impacts from unplanned combustion and explosion which focus mainly on the operation phase, including:

- Technical measures:
  - Arranging fire extinguishers at suitable, visible locations around the project site;
  - Installing an automatic fire detection and firefighting systems;
  - Arranging reasonable project layout to support firefighting activity when necessary;
  - Installing protection equipment for electrical cables and equipment;

- Conducting regular inspection to the electrical cables and equipment within the project site; and
- Installing sufficient lightning rods around the project site.

- Management measures:
  - Providing training on fire prevention and fighting for operation staff and assigning responsible personnel for site inspection;
  - Installing fire warning signs and fire protection regulations at visible areas around the project site; and
  - Performing regular fire drills in collaboration with the local firefighting police force.

12.4.1.3 Significance of Impacts

The wind farm and its transmission line are to be designed in accordance with the national regulations; of these safety is the first priority so the likelihood of fire is Unlikely (class 3). Similarly, the likelihood of an UXO activation is considered Very Unlikely (class 2) following the completed UXO clearance in November. On the other hand, given the project area mainly composes of cropping areas, vacant land and bushes, the combustion and explosion hazards, upon occurrence, might affect mainly these vegetation. As a result, the consequence is expected to be Minor (class B). Moreover, the impact is generally localized and short-term until the fire is extinguished.

The overall impact significance is therefore considered Minor (3B) as in Table 12.5.

Table 12.5 Impact Assessment for Combustion and Explosion.

Unplanned Event	Cause	Consequence	Risk Ranking
Combustion and explosion	**Construction phase**: Storage of combustible materials and fuels; Construction activities (welding, machinery operating); Workers' activities (smoking, cooking); Electrical incidents; Uncleared UXO. **Operation phase**: Fuel storage; Workers' living activities (smoking, cooking); Electrical incidents. **Natural cause:** Lightning.	Affect health and wellbeing of plants' workers, staffs, and local residents; Affect local crops and vegetation; Affect plants' operation.	3B (Minor)

12.4.1.4 Additional Mitigation Measures

The following additional measures are proposed for further prevention and mitigation of the impacts from unplanned combustion and explosion events, in both construction and operation phases, including:

- During construction phase:
  - Putting warning signs at areas with high combustion risks;
  - Prohibiting smoking and sparking activities near combustion prone areas;
  - Arranging firefighting equipment including fire extinguishers, sand, shovels, etc. in several places convenient for use in case of emergency;
  - Installing fire alarm to promptly detect fires;

- Following strictly all electrical safety standards in the construction phase;
- Storing separately combustible solvents and fuels, away from sources of electric spark and flame;
- Inspecting fire protection activities at worker camps;
- Developing an emergency response and management plan and monitoring contractors to ensure consistent implementation.

- During operation phase:
  - Establishing an emergency response team to take charge of responses against combustion and explosion emergency;
  - Performing regular inspection and maintenance of firefighting equipment;
  - Setting on-off switch for all the transmission line to switch off in case of fire incident;
  - Establishing an emergency response and evacuation plan, which provides guidance on internal and external actions to take and the responsible personnel in case of combustion and explosion.
  - Installing smoke alarms and heat detectors in the control house;
  - Arranging fire extinguishers in control house and transformer station; and
  - Covering tops of turbine generators with a fire-retardant layer to prevent small fires.

12.4.1.5 Residual Impacts

With the implementation of the mitigation measures, residual impacts of fire and explosion are considered Minor (2B) for both the construction and operation phases.

12.4.1.6 Monitoring and Auditing

An audit program shall be established to check the implementation of emergency response and evacuation plan, staff training, equipment inspection, and firefighting drills.

12.4.2 Spillage of Fuel, Oil, Chemicals and Hazardous Materials

12.4.2.1 Potential Impact

The project will use a large amount of hazardous materials including fuel, oil and chemicals (paints, solvents, etc.) throughout its development. As a result, there is a risk that small volumes of these substances could be spilled on-site.

In construction phase, the Project uses large equipment powered by diesel oil and would contain relatively small reservoirs of lube oil and hydraulic oil, including cranes, excavators, heavy goods vehicles, fork-lift trucks, fuel trucks, etc. Therefore, there might be bulk storage of fuel such as diesel oil at the construction site. Meanwhile, in operation phase, chemicals including hydrocarbons will be used for operation & maintenance services. Consequently, spillage risks are relatively high in both phases.

12.4.2.2 Existing Controls

The Project has proposed to use the existing oil collecting tank of the Phu Lac 1 project to collect spilled oil at substation area of the Project. According to the Phu Lac 1 EIA report, the collected oil will be filtered and reused but not disposed to the ambient environment.

No mitigation measures have been proposed to deal with unexpected spillage of fuel, oil, chemical, and hazardous waste at other areas of the project site.

12.4.2.3 Significance of Impact

Upon normal construction and operation activities, fuels, solvents and liquid spill materials such as paints and lubricants is Likely to happen (class 4), especially during the construction phase. The impact severity will depend on a variety of factors, such as the spilled volume and the chemical characteristics of it. At worst, the spillage can damage the terrestrial environment, soil, groundwater and surrounding communities. However, given the small scale of the fuel use during the project's development, the consequence of spillage risk is more likely of Incidental nature (class A) which involves localized, short-terms impacts on the physical, ecological and social receptors.

Table 12.6 Impact Assessment for Spillage of Fuel, Oil, Chemicals and Hazardous Materials

Unplanned Event	Cause	Consequence	Risk Ranking
Spillage of fuel, oil, chemicals and hazardous materials	**Construction phase**: Storage of fuels, oils, solvents, hazardous materials etc.; Usage of machinery and transport vehicles; Construction activities like painting, building; **Operation phase**: Operation and maintenance activities; Usage of chemicals, oils at transformer area.	Affecting soil and groundwater quality; Affecting terrestrial ecosystems (fauna and flora); Affect community health and safety.	4A (Negligible)

12.4.2.4 Additional Mitigation Measures

The following additional mitigation measures are proposed to reduce the likelihood of occurrence of a spillage event of fuel, oil, chemicals, and hazardous wastes, which can be applied to both construction and operation phase:

- Maintaining an inventory of the use of hazardous substances on site during construction and operation;
- Maintaining spill kits in relevant locations where hazardous substances are used within the Project area;
- Storing hazardous materials securely in closed containers, inside a roofed, impermeable dedicated storage area equipped with a secondary containment system for spills, in compliance with applicable regulations;
- Setting up protective barriers as applicable;
- Developing procedures for loading/ unloading hazardous chemicals to minimise the risk of incidents during operations;
- Conducting routine inspections of the areas that involve the use and storage of hazardous materials and preventive maintenance for all vehicles and equipment on a regular basis to detect possible spills, leaks and the potential for such occurrences.
- Train the involved personnel in the use (management and storage) of hazardous chemicals on site.

12.4.2.5 Residual Impacts

Proper implementation of the mitigation measures might maintain the impacts from spillage of fuel, oil, chemicals and hazardous materials at Negligible (3A) by reducing the likelihood of occurrence to Unlikely.

12.4.2.6 Monitoring and Auditing

The residual impacts after implementing the mitigation measures are expected to be Negligible, so no monitoring or audit program is needed to manage this unplanned event.

12.4.3 Traffic Accidents

12.4.3.1 Potential Impacts

The traffic accidents have more potential to happen during the construction rather than during the operation stage due to heavy and long-distanced transportation of wind turbines, auxiliary equipment and construction materials. The wind turbines will be transported from the Vinh Tan port, which is approximately 19.2 km away, through the National Highway 1A and the existing access roads of the Phu Lac 1 project to the project site. Other construction materials will be acquired from within the Binh Thuan province and neighbouring localities and will also be transported to the project site via the National highway 1A and the Phu Lac 1 access roads.

As a result, the number of traffic vehicles moving in and out of the project site will be increased during the construction stage, and hence, the risk of traffic collision or accident will also increase. Key receptors of concern with regards to the impacts from traffic accidents are local residents along the external transport routes.

12.4.3.2 Existing Controls

No mitigation measures have been proposed for the mitigation of impacts due to unplanned traffic accidents during the project development.

12.4.3.3 Significance of Impact

Traffic accidents can happen during the whole project's lifecycle if rigorous management measures are not in place, with especially high occurrence potential during the construction peak. The amount of transportation during operation phase is negligible, thus, negligible potential of traffic accidents.

Following the definition shown in Table 12.3, the likelihood of occurrence is considered Likely (class 4 – can happen once or twice per year). Upon occurrence, traffic accidents can lead to a wide range of consequences, from property damage to personnel injuries and fatalities, depending on various factors including the type and size of vehicles and the moving speed at the time of collision. The consequence could thus be ranked up to Severe (class E).

Therefore, in the worst case scenario, a traffic accident happening during the project's lifetime can be ranked Major (4E) with regards to the impact significance and mitigation measures are strongly required.

Table 12.7 Impact Assessment for Traffic Accidents.

Unplanned Event	Cause	Consequence	Risk Ranking
Traffic accidents	**Construction phase**: Transportation of wind turbines, heavy equipment and construction materials.	Property damage; Injuries; Fatality.	**4E (Major)**

12.4.3.4 Additional Mitigation Measures

The following additional mitigation measures are proposed to further control the impacts from unplanned traffic accidents:

- Developing and implementing a Traffic Management Plan which set out plan for transport activities, personnel in charge, actions to be taken in case of emergency, vehicle inspection timeline, etc. All drivers must be aware of this.

- Planning the transport routes carefully to avoid potential of collision and roads crossing housing areas;
- Setting speed limits on transport routes and making sure drivers respect the set limits;
- Installing signs, signals, and sufficient lighting specially during construction, to support vehicle operation at night;
- Coordinating with the People's Committees at provincial levels (Binh Thuan province) for support during the transportation of turbine towers and blades from the Vinh Tan port to the project site;
- Coordinating with Communal People's Committee to organize the traffic in and near project site when necessary;
- Avoiding transportation during rush hours;
- Training construction workers and drivers on road safety to comply with regular laws and regulations on road safety;
- Assigning workers to guide the traffic when vehicles have to stop to load or unload materials;
- Investigating and improving road conditions prior to the heavy transports;
- Inspecting vehicles regularly for quality and safety aspects; and
- In case the transportation activities of the project cause the damage to the local roads, the Project Owner shall make compensation and restore the road condition to its original state.

12.4.3.5 Residual Impacts

The mitigation measures, if implemented effectively, can reduce both the likelihood of occurrence of traffic accidents and the severity of consequence in case of actual happening. On that basis, the impact significance can be reduced to Minor (2C).

12.4.3.6 Monitoring and Auditing

Random audits to the areas with high risk activities will be conducted on a monthly basis to ensure proper implementation of the mitigation measures and the traffic management plan. Any found deviations will be followed up until resolved.

12.4.4 Occupational Accidents

12.4.4.1 Potential Impacts

The nature of the Project presents occupational health and safety risks, which can result in direct impacts on worker's health and safety. Construction will involve a range of activities that could contribute to or present an occupational health and safety risk, resulting in an accident, injury, of even fatality, including:

- The use of large mobile equipment, such as backhoes, bulldozers, graders and mobile cranes, which could, if not managed correctly, lead to an accident or injury;
- Manual handling associated with day to day construction activities; and
- Working with heavy equipment, working at height, and working under high temperature.

12.4.4.2 Existing Controls

The Project is assumed to implement the mitigation measures committed in the approved Phu Lac 1 EIA report [2]. In which, the following mitigation measures have been proposed:

- Using only registered equipment and machinery for construction activities;
- Conducting regular inspection for the equipment and machinery proper performance;

- Equiping safeguarding equipment for workers working on height;
- Ensuring sufficient lighting at working areas, especially during night time;
- Following strictly regulations on electrical safety;
- Avoiding storage of combustible materials within the project site;
- Providing workers with proper personal protective equipment while working on site and corresponding training to operate and perform high risk equipment/activities, to raise their awareness on health, safety and hygiene;
- Supervising and regulating workers to wear and maintain personal protective equipment as required;
- Establishing and inspecting the implementation of safety regulations around the project site;
- Installing signs to prohibit access to high risk areas; and
- Preparing first aid kits and service onsite to be ready for cases of accident.

12.4.4.3 Significance of Impact

Occupational accidents are considered Likely to happen (class 4, may happen once or twice a year). However, the consequence can range widely from Incidental (class A) to Severe (class E) in case of major injury and fatality of construction workers. Therefore, the overall significance is considered Major (4E) and strategic management and mitigation measures are strongly required.

Table 12.8 Impact Assessment for Traffic Accidents

Unplanned Event	Cause	Consequence	Risk Ranking
Occupational accidents	**Construction phase**: Working with heavy equipment; Heavy handling; Working at height.	Impact on workers' health and safety; Injuries; Fatality.	**4E (Major)**

12.4.4.4 Additonal Mitigation Measures

The following additional mitigation measures are proposed to further control the impacts from unplanned occupational accidents:

- Preparing technical safety procedure for all equipment and machinery;
- Implementing sufficient protection measures while working at height, hot work activities, operation, maintenance and transport of heavy vehicles and electrical equipment, doing heavy lifting and carrying, among other high risk activities.
- Providing training to workers involved in high risk work positions/activities as needed (e.g. hot work, work at heights, operation-maintenance of heavy equipment, etc.).
- Providing training on lockout/ tagout to all employees involved in high risk activities (operation and maintenance).
- Keeping track of the vehicle / equipment inspection records, planned inspections, etc.;
- Prohibiting using old, unqualified vehicle / equipment;
- Preparing measures to prevent and respond to unplanned occurrence of occupational accidents, and when happening, perform immediate root cause analyses;
- Assigning supervisors to supervise the activities on site to ensure all safety regulations and practices are followed and the risks will be minimised;

- Ensuring all subcontractors are aware of the high risk activities to be performed on site, and ensure all workers involved have been properly trained;
- Ensuring that workers (including contractors) complete a Job Hazard Analysis (JHA) prior to undertaking construction activities, and also conduct daily toolbox discussions to ensure hazards are identified and management measures are implemented; and
- Ensuring high risk signals are placed in the working areas where required.

12.4.4.5 Additional Mitigation Measures

The mitigation measures, if implemented effectively, can reduce both the likelihood of occurrence of traffic accidents and the severity of consequence in case of actual happening. On that basis, the impact significance can be reduced to Minor (2C).

12.4.4.6 Monitoring and Audit

Random audits to the areas with high risk activities will be conducted on a monthly basis to ensure proper implementation of the mitigation measures and other internal safety procedures. Any found deviations will be followed up until resolved.

12.4.5 Blade Throw

12.4.5.1 Potential Impacts

Blade throw events have been reported worldwide occur as a result of the failure of the rotor blade which thereby results in the ejection or throwing of the rotor blade and can endanger people living/working close to the wind farm. Assessment of reports and case studies in the open domain have revealed an increasing trend to locate them in proximity of build-up areas. Therefore, it becomes strictly necessary to define setback distances and/or buffer zones to minimize the risk of damage or injury from components failure. Researches have been conducted to assess the root cause of blade throw incidents [22,23,24,25].

12.4.5.2 Considerations and Assumptions

The blade throw/ ejection incidents have been classified based on photographic evidence over the years, modelling studies by various research groups and blade test practices based on the International Electro-technical Commissions (IEC) specifications (IEC 61400-23). Key causes include:

(a) root connection failure;

(b) catastrophic structural buckling or separation;

(c) leading edge, trailing edge, or other bond separation;

(d) lightening damage;

(e) erosion;

(f) failure at outboard aerodynamic device;

22 Eggwertz S, Carlsson I, Gustafsson A, Linde M, Lundemo C, Montgomerie B, Thor S. Safety of wind energy conversion systems with horizontal axis. Technical Note HU-2229, Flygtekniska Försöksanstalten (FFA—The Aeronautical Research Institute of Sweden), Stockholm, 1981.

23 Eggers AJ, Holley WE, Digumarthi R, Chaney K. Exploratory study of HAWT blade throw risk to nearby people and property. Proceedings of the 2001 ASME Wind Energy Symposium, Reno, Nevada, 2001; 355–367.

24 Montgomerie B. Horizontal axis wind turbine blade failure, blade fragment six degrees of freedom trajectory, site risk level prediction. Fourth International Symposium on Wind Energy Systems, Stockholm, Sweden, HRA Fluid Engineering, 1982; 389–401.

25 Turner D. A Monte Carlo method for determining the risk presented by wind turbine blade failures. Wind Engineering 1986; 11: 1–20.

(g) reduction in stiffness of blades (up to 10%);

(h) superficial structural or delamination/ laminate wrinkling that eventually become permanent leading to damage; and

(h) over speeding due to failure of supervisory control and data acquisition (SCADA) to rectify the failure or high wind/ cyclonic/ meteorological conditions [26].

In general, it is difficult to attribute blade throw failure to a single attribute or a combination of attributes. Therefore, host country regulations and recommendations to define setback distances and/or buffer zones are currently being employed to minimize the risk of damage or injury from components failure.

12.4.5.3 Existing Standards for Blade Ejection / Blade Throw

In Vietnam, the level of setback distance identified to ensure safety of settlements is not defined. However, the IFC EHS Guidelines for Wind Energy [27] has recommended that "*the minimum setback distance is 1.5 x turbine height (tower + rotor radius), although modelling suggests that the theoretical blade throw distance can vary with the size, shape, weight, and speed of the blades, and the height of the turbine. It is therefore recommended that the minimum setback distances required to meet noise and shadow flicker limits be maintained with respect to sensitive residential receptors to provide further protection*."

The IFC also recommends minimising the probability of a blade failure:

- By selecting wind turbines that have been subject to independent design verification/certification (e.g. IEC 61400-1);
- Surveillance of manufacturing quality; and
- Ensuring that lightning protection systems are properly installed and maintained.

Recommendations also include carrying out periodic blade inspections and repair any defects that could affect blade integrity and equipping wind turbines with vibration sensors which can react to any imbalance in the rotor blades and shut down the turbine, if necessary.

12.4.5.4 Qualitative Blade Throw Assessment Methodology

The qualitative blade throw assessment encompasses the rationale that has been proposed by the IFC pertaining to setback distances which is 1.5 x turbine height (tower + rotor radius).

The Project comprises 6 wind turbines. The blade throw/blade ejection (BT/BE) assessment was carried out considering Vestas wind turbine specifications (proposed to be used in this Project). Technical specifications of wind turbine considered in BT/BE assessment are provided in Table 12.9:

Table 12.9 Technical Specifications of Wind Turbines.

Description	Unit	Design Data
Wind Turbine Model	-	Vestas V150-4.0/4.2
Type	-	3-bladed, horizontal axis
Rated Power	kW	4,200
Hub Height	m	105
Rotor Diameter	m	150

[26] Robinson et al. Study and development of a methodology for the estimation of the risk and harm to persons from wind turbines. 2013. Prepared by MMI Engineering Ltd for the Health and Safety Executive 2013

(7) IFC EHS guidelines for wind energy, IFC, August 7, 2015. [Online] Available at: https://www.ifc.org/wps/wcm/connect/b82d0563-b39a-42a7-b94e-0b926b4a82f9/FINAL_Aug%2B2015_Wind%2BEnergy_EHS%2BGuideline.pdf?MOD=AJPERES&CVID=mpusVXy.

No. of Blades	-	3
Swept area	m^2	17,671
Cut-in Wind Speed	m/s	3
Cut-out Wind Speed	m/s	22.5

Source: Performance Specification of V150-4.0/4.2 MW, Vestas 2020.

The theoretical setback distances of the WTGs as per IFC guidelines is presented in Table 12.10. This information was utilised to independently assess the setback distances of the receptors that were identified using the latest satellite imagery of the Project Area.

Table 12.10 Setback Distances for the Project

WTG Model	Hub Height	Rotor Radius	Minimum setback distance
Vestas V150-4.0/4.2	105 m	75 m	= 1.5 × (hub height + rotor radius) = 1.5 × (105 + 75) = 270 m

Source: EHS guidelines for wind energy, IFC, August 7, 2015.

12.4.5.5 Receptors

No human receptors are located within the impact zone of theoretical blade throw (distance of 270 m from the turbine foundations) during the project operation. Key receptors are local crops and vegetation.

12.4.5.6 Existing Controls

Technically, the blade safety has been considered in the project technical design, wherein the cut-out mode will be activated (the blades will change direction and be parallel to the wind direction, the turbines stop rotating) if wind speed exceeds the designed cut-out wind speed, especially in extreme weather conditions such as typhoon, cyclone, etc.

The Phu Lac 1 EIA report has not considered the blade throw risk, hence mitigation measures have been proposed.

12.4.5.7 Impact Assessment

Blade throw failure could result in rapid spread of fire and projectile spread of debris given the heights of wind turbines. This could result in injuries at surrounding communities, or in the worst-case fatalities, and damage to local flora and fauna. However, as no human receptors will be located within the expected impact zone, the blade throw will more likely land on cropping / vacant land which will result in Moderate consequence and affect cropping property at worst. Therefore, the overall impact of blade throw is considered Minor (2C) with worst-cast consequence of Moderate (class C) and likelihood of Very Unlikely (class 2).

The blade throw impact significance is illustrated in Table 12.11.

Table 12.11 Impact Assessment for Blade Throw.

Unplanned Event	Cause	Consequence	Risk Ranking
Blade throw	**Operation phase**: Failure of the rotor blades.	Affect people working nearby on the cropping land; Affect local crops and vegetation.	**2C (Minor)**

12.4.5.8 Mitigation / Management Measures

The blade throw impact can be avoided if there is option of altering the micro siting of the WTGs. Therefore, in order to avoid any prospective incident, it is important to adopt following mitigation measures:

- Strengthening the foundation of all WTGs;
- Providing anchors to all WTGs to delay the immediate impacts;
- Carrying out periodic blade inspections, maintenance and repair any defects that could affect the blade integrity;
- Ensuring that lightning protection systems are properly installed and maintained;
- Equipping wind turbines with vibration sensors that can react to any imbalance in the rotor blades and shut down the turbine, if necessary;
- Creating awareness amongst the residents if any about any potential impacts and bringing to immediate notice of the client any abnormal sound/changes noticed by the residents regarding operations of the turbines;
- Communicating risks in the proximity of wind turbines to the neighbouring community; and
- Monitoring any development close to the turbines within the impact zone.

12.4.5.9 Residual Impacts

The mitigation measures, if implemented effectively, can maintain the impact significance at Minor (2C).

12.4.5.10 Monitoring and Auditing

A quarterly audit program shall be established to check the implementation of regular technical inspection of the WTGs and blades' safety. Any identify gaps or areas of opportunity will be followed up after the inspection until resolved. The auditing records will be kept onsite for future review and supervision.

12.4.6 Transmission Line Snapping and Transmission Pylon/Tower Collapse

12.4.6.1 Potential Impacts

During operation, there is a possibility of lines or transmission towers/parts snapping/swaying due to the tower failing and resulting in injuries and/or fatalities. Any contacts (both intentional and unintentional) with the exposing snapped transmission line can result in electrocution. The causes are mainly poor foundation quality, tower member theft, material corrosion due to poor coating and poor quality or damaged fittings exposing the system to failure. Other natural hazards can also result in snapping incidents of transmission line such as strong wind, flash flood, land slide, etc.

The receptor sensitivity was considered high as there were households and livelihood activities within the transmission line right-of-ways. Impacts on community health and wellbeing could lead in injuries and fatalities.

12.4.6.2 Existing Controls

The Phu Lac 1 EIA report has not considered the risks of transmission tower and line failure, hence, no mitigation measures have been proposed.

12.4.6.3 Significance of Impacts

The collapse of the transmission pylon / tower and failure of transmission lines might happen at relatively high frequency due to technical and natural reasons. The likelihood of occurrence is therefore

considered Likely (class 4). In case of actual occurrence, the event can lead to injury of human receptors, loss / reduction of ecological receptors and loss / reduction of community likelihood during a short-term period. Therefore, the consequence level is considered Moderate (class C). Overall, the impact is of Moderate significance (4C).

Table 12.12 Impact Assessment for Transmission Line Snapping and Transmission Pylon/Tower Collapse

Unplanned Event	Cause	Consequence	Risk Ranking
Impact assessment for transmission line snapping and transmission pylon/tower collapse	**Operation phase**: Foundation failure; Theft; Damaged fittings; Natural hazards.	Affect community health and safety; Affect cropping activity and productivity; Loss/reduction of community livelihood.	**4C (Moderate)**

12.4.6.4 Mitigation Measures

The following mitigation measures are proposed to prepare for the risks of transmission line snapping and transmission pylon/tower collapse:

- Conducting sufficient geological surface prior to the construction;
- Aligning the turbine foundations and towers design with the geological conditions of the area;
- Supervising closely the construction of the turbine foundation and towers to make sure the foundation / tower structure follow the technical design;
- Inspecting quality of the structure regularly to promptly detect and respond to issues;
- Installing on-off switch to automatically cut off electrical connection in case of transmission line failure;
- Preparing an action plan to set out the actions to take in case of transmission line failure;
- Conducting training to operation staffs of the action plan.

12.4.6.5 Residual Impacts

Upon effective implementation of the mitigation measures, the likelihood of occurrence of the transmission line / tower / pylon failure can be reduced to Unlikely (class 3), the consequence level reduced to Minor (class B), and the overall impact significance can become Minor (3B).

12.4.6.6 Monitoring and Auditing

An audit program shall be established to check the implementation of regular technical inspection of the transmission lines and transmission pylons' safety.

12.5 Summary

In summary, a range of unplanned events can create minor to detrimental unexpected impacts during the projects' lifetime. This chapter examines the potential impacts of those events, proposes additional mitigation measures and evaluates the impact significant prior to and after implementing the mitigation measures. Table 12.13 summarizes the key findings of this chapter.

Table 12.13 Summarized Impact Ranking of the Potential Unplanned Events.

No	Unplanned event	Consequence	Likelihood	Impact significance	
				Pre-mitigation	**Post-mitigation**
1.	Combustion and explosion, including UXO explosion	Minor (B)	Unlikely (3)	Minor (3B)	Minor (2B)
2.	Spillage of fuel, oil, chemicals and hazardous materials	Incidental (A)	Likely (4)	Negligible (4A)	Negligible (3A)
3.	Traffic accidents	Severe (E)	Likely (4)	Major (4E)	Minor (2C)
4.	Occupational accidents	Severe (E)	Likely (4)	Major (4E)	Minor (2C)
5.	Blade throw	Moderate (C)	Very Unlikely (2)	Minor (2C)	Minor (2C)
6.	Transmission line snapping, and transmission pylon/tower collapse	Moderate (C)	Likely (4)	Moderate (4C)	Minor (3B)

13. CUMULATIVE IMPACT ASSESSMENT

According to IFC's Guidance Note 1, cumulative impacts are formed by combining individual potential impacts from the proposed Project, together with those of other existing projects and anticipated future projects. Cumulative impacts can become either increasingly adverse or beneficial when considered in combination with the current Project. This Chapter evaluates the significance of cumulative impacts based on the methodology described in Chapter 4.

The overall objective of this CIA is to identify and assess the contribution of the Project's impacts to existing or proposed developments within this Project's Zone of Influence (ZOI). It is based on information included in the regulatory EIA for other developments, information presented throughout this ESIA, information provided by the Client, and information available in the public domain. The specific objectives are to:

- Identify Valued Ecosystem Components (VECs) that could be impacted cumulatively in areas potentially affected by the Project, considering input from stakeholders through the consultation process and the scientific community;
- Identify other existing and planned projects and external environmental and social drivers that could cumulatively impact VECs;
- Undertake a high-level assessment of potential cumulative impacts on VECs, considering the Project and the other identified existing and planned projects and external drivers in the area; and
- Recommend a management framework for the integrated management of potential cumulative impacts.

13.1 Relevant Guidelines and Criteria

To achieve these objectives and gain an understanding of the complexities of cumulative impacts, this Chapter is prepared with reference to international best practice guidance documents, such as:

- The European Union's "Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions" (1999);
- The Canadian Environmental Assessment Agency's "Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act" (2012);
- The IFC's "Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for the Private Sector in Emerging Markets" (2013); and
- The USA NEPA Council on Environmental Quality's "Considering Cumulative Effects under the National Environmental Policy Act" (1997).

13.2 Scoping Assessment

13.2.1 Identification of VECs

According to the Resolution No. 04/2014/NQ-HDND of People's Council of Bac Binh district on the approval of the 1:5000 master development plan of Hoa Thang coastal area, the area will be planned to become a coastal service and tourist area with the estimated population is 8,600 in 2020 and 17,000 people in 2030 with a number of infrastructure development projects to support the plan. On the other hand, Binh Thuan province is one of hotspots for development of wind power projects with total capacity of 700MW in 2020 and 2500MW in 2030 (see Section 13.2.4), where Bac Binh district will be the center of the plan because of its favourable conditions such as high wind speed, vast unused land and low population density.

These developments will also generate various impacts that may interact with impacts from the Project and bring cumulative effects on the same VECs (Figure 13.1).

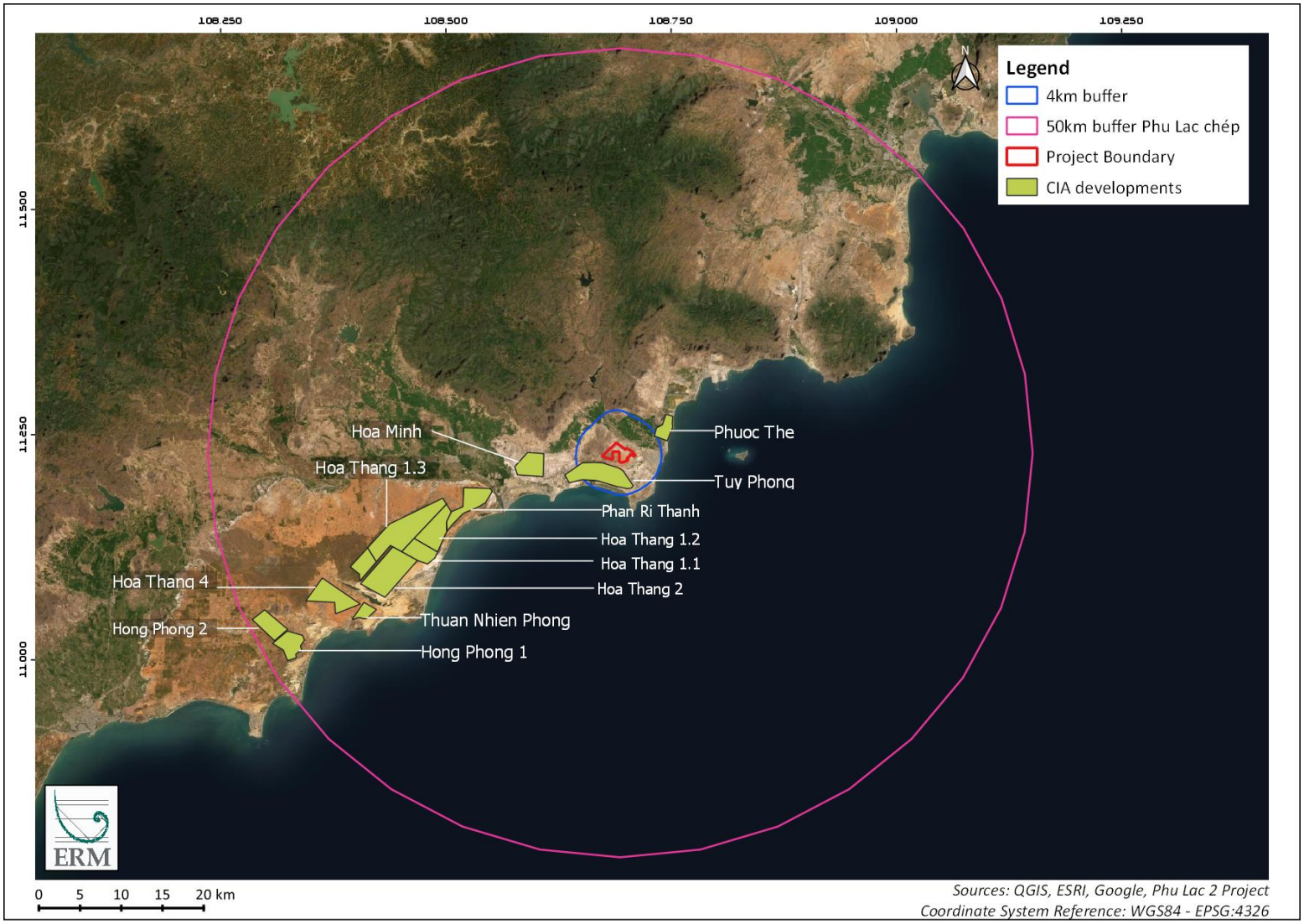


Figure 13.1 Major Developments and key VECs in the Project Region

The following VECs have been identified to be important in assessing risks caused by the Project:

- Physical features: noise emissions and visual quality;
- Wildlife populations: including avifauna at risk of collision with the turbines; and
- Biodiversity: terrestrial biodiversity and avifauna.

13.2.2 Scope of Assessment

Identification of key cumulative impacts needs to be in alignment with those assessed throughout the main body of this ESIA, and needs to include those which are recognised as important on the basis of genuine scientific concerns and the views of affected communities and other stakeholders. This allows for impacts to be appropriately grouped and added to impacts identified as likely to occur from other projects. In this regard, a largely qualitative approach was taken for the CIA. This is to enable a focus to be placed upon identification of trends across the various projects in the area, as well as their temporal and spatial interactions. Whilst impacts arising from the Project have been defined and assessed in isolation, it can be difficult to accurately quantify cumulative impacts as there can be a high degree of uncertainty in interactions with other projects and activities that may be occurring in the area as well as a lack of confirmed project information.

A cumulative screening assessment was carried out to consider the interactions of impacts from various key developers on the relevant VECs, including:

- Terrestrial habitats;
- Avifauna; and
- Noise.

Cumulative impacts that do not have major impact on the VECs or are not contributed significantly by the Project's development were scoped-out.

13.2.3 Spatial Boundaries

The main layout of the Project area will be located at the onshore area in the vicinity of Cho Lau Town. The ZOI was guided by information taken from similar projects in Vietnam and abroad (Table 13.1). This allows for a decision to be made as to whether there is the potential for overlap with the Project and other developments' impacts.

Table 13.1 Zone of Influence (ZOI)

VECs	Potential Impact	ZOI (km)
Physical features	Elevated noise from wind farm	4[28]
Ecology system	Collision of birds and bats with the turbines	50 (IFC PS6)

Key to this spatial and temporal assessment are the following elements:

- Identification of appropriate geographical boundaries. Where potentially interacting projects are not located close enough or sufficiently linked through various ecological and social processes for relevant impacts to overlap, cumulative impacts are less likely;

[28] Estimated from modelling output for similar Project

- Identification of temporal boundaries. Where the schedules of various components of projects do not overlap in time, particularly with regards to the construction phase of large projects, cumulative impacts are less likely. Additionally, where projects are going to be short-term, cumulative impacts will generally be of limited duration.

13.2.4 Existing and Planned Developments

Tuy Phong district and the surrounding region is one of the key areas for wind power development in the South Central region. According to the Decision No. 4715/QD-BCT dated August 16th 2012 of Ministry of Industry and Trade on the Approval of Wind power development plan of Binh Thuan province for 2011 – 2020 period with vision towards 2030", the wind power development plan in Binh Thuan province is divided into 06 regions as follows with the total area of 23,549ha and total estimated capacity of 1570MW.

Besides the operational wind farms, the projects that have been planned until 2030 are presented in Table 13.2. The information of some proposed wind farms regarding locations and boundaries are not yet unavailable, so some of them are not shown in Table 13.2.

Table 13.2 Planned Wind Power Projects in Binh Thuan Province until 2030

No	Name of wind power project	Capacity	Status	Shown in map
1	Tuy Phong	30MW	Approved	Yes
2	Phu Lac 2 (the Project)	24MW	Approved	Yes
3	Thuan Nhien Phong	32MW	Approved	Yes
4	Hoa Thang	100MW	Approved	Yes
5	Hoa Minh	14.5MW	Approved	Yes
6	Phuoc The	28MW	Approved	Yes
7	Hoa Thang 1.1	85.5MW	Proposed (2025)	Yes
8	Hoa Thang 1.3	20MW	Proposed (2030)	Yes
9	Hoa Thang 2	40MW	Proposed (2030)	Yes
10	Hoa Thang 4	30MW	Proposed (2030)	Yes
11	Phan Ri Thanh	30MW	Proposed (2030)	Yes
12	Hong Phong 1	40MW	Proposed (2025-2030)	Yes
13	Hong Phong 2	20MW	Proposed (2030)	Yes
14	Tien Thanh 1	20MW	Proposed (2030)	No
15	Tien Thanh 2	15MW	Proposed (2030)	No
16	Tien Thanh 3	20MW	Proposed (2030)	No
17	Ham Cuong 2	20MW	Proposed (2030)	No
18	Ham Cuong 1	20MW	Proposed (2030)	No
19	Ham Kiem 1	15MW	Proposed (2030)	No

20	Ham Kiem 2	15MW	Proposed (2030)	No
21	Phuoc Tan	30MW	Proposed (2030)	No

Source: Phu Lac 2 Feasibility Study Report, Volume 1: Main Report

On the other hand, a number of thermal power, hydropower and solar power projects are operational or have been planned. As of January 2020, there are 42 operational power projects with total 6,285 MW, consisting of 04 coal-fired thermal power plants in Vinh Tan Power Complex (4,284 MW), 07 hydropower plants (819.5 MW), 04 wind farms (100 MW), 26 solar farms (1,072 MW equals to 1,347 MWp) and 01 diesel power plant (10 MW)[29].

13.3 Cumulative Impacts on Noise Levels

Noise and vibration in both construction and operation phases of the Project were presented in Section 10.3**.** Major source of noise impact in the construction phase is from transportation, construction and installation activities whereas major noise impact during operation phase are generated from the operation of WTGs. While noise concern of construction phase and operation phase are evaluated to be minor and negligible respectively due to relative far distance (500 m) from the wind farm to the nearest residential area.

The wind farm projects surrounding Phu Lac phase 1 and 2 wind farm (see Figure 13.1) were assessed for the potential to contribute to cumulative noise effect at the residential areas in Phu Lac commune and Lien Huong town. The operational wind farm Phong Dien 1 in Binh Thanh will likely bring no impacts because of far distance (4 km) to the nearest residential areas in Lien Huong town, while the future Phuoc The wind farm will bring minor impact to residential areas in Phuoc The commune.

Potential noise is also likely to be result from other external sources such as public activities (e.g. traveling, entertainment), natural phenomena (e.g. waves or tides) and farming activities such as using machines, civil works. Given that these are random and temporary events, they are excluded from this assessment.

Overall, the cumulative impacts from 04 wind farms within 4 km from the Project of interest (Phu Lac 2) isassessed as Minor. Therefore, no further mitigation measures is required.

13.4 Cumulative Barriers to Avifauna

Multiple windfarms aligning on the flyways of birds may create a cumulative barrier effects that cause birds to adjust their trajectories, resulting in increased energy expenditures to avoid the windfarms. Although effects of extra distances taken to detour around the barriers are poorly-understood, the cumulative barrier effects are likely to be insignificant. A study by Masden et al. (2009) suggested an equivalence of 100 Nysted wind farms[30] will only bring about a reduction in 1% mass of the bird.

13.5 Cumulative Mortalities of Avifauna and Chiropteran

Given the limitations in available data pertaining to biodiversity and mortality baseline of other wind-farms in the scope, population effects from cumulative mortalities of avifauna and chiropteran will be assessed by extrapolating Phu Lac 1's baseline and mortality results. The windfarms that will be accounted include Hoa

[29] Challenges in power projects in Binh Thuan province. The Leaders Online Newspaper. Available at https://theleader.vn/nhung-nut-that-tai-cac-du-an-dien-o-binh-thuan-1612324322148.htm. Accessed on 9 February 2021.

30 Nysted windfarm is a Danish offshore windfarm built in 2003, with 72 turbines and a total capacity of 166 MW, and was the largest in the world until 2007. In 2010, a 207 MW extension for the windfarm was conducted and finished in end of 2011.

Minh, Tuy Phong and Phuoc The (see Figure 13.1), given that they are located in close proximity and same landscape to Phu Lac 1 so that the extrapolations of data are more relevant and reasonable.

In terms of avifauna, mortality surveys of Phu Lac 1 found only three carcasses belonging to three LC species (Red-collared Dove *Streptopelia tranquebarica*, Eastern Spotted Dove *Spilopelia chinensis* and the Cook's Swift *Apus cooki*). If duplicated for the other three wind farms, the total mortality events are low and unlikely to impact 0.1% of the global and even local populations of the relevant species.

For chiropteran species, the cumulative fatality events are presented in Table 13.3 below. Local reductions are likely to be the case for Javan Pipistrelle, where a minimum of 132 individuals are expected; whereas cumulative impacts on a global scale is unlikely to be significant, given their population growths are noted to be stable or increasing according to IUCN Red List.

Table 13.3 Cumulative Mortalities Extrapolations from Phu Lac 1

No.	English Name	Scientific Name	IUCN	VNRB	Foraging strategy	Number of carcasses (Phu Lac 1)	Cumulative mortalities
1	Greater Asian yellow house bat	*Scotophilus heathi*	LC	N/A	III	12	48
2	Lesser Asian yellow house bat	*Scotophilus kuhlii*	LC	N/A	III	7	28
3	Javan Pipistrelle	*Pipistrellus javanicus*	LC	N/A	III	33	132
4	Wrinkle-lipped Free-tailed Bat	*Chaerephon plicatus*	LC	N/A	III	8	32
5	Black-bearded tomb bat	*Taphozous melanopogon*	LC	N/A	III	10	40
6	Unidentified fruit bat	*Rousettus sp.*	N/A	N/A	V	1	4

13.6 Cumulative Loss of Terrestrial Habitats

Based on remote sensing, the Project and other operating projects such as Tuy Phong, Hoa Minh and Phuoc The appear to locate in the same landscape, which is the arid and open bushland landscape and mostly modified. The habitat is neither IUCN Ecosystem Red List nor in an area that needs conservation priority in the Vietnam Low Land Dry Forest ecoregion. In addition, the biodiversity baseline of Phu Lac 1 suggests low biodiversity in the landscape; therefore, the cumulative effects loss of terrestrial habitats are likely to be insignificant.

13.7 Mitigation Measures

To reduce cumulative avifauna impacts from the Project and other developments in the region, the following mitigation measures are suggested to be implemented:

- The Project is recommended to adopt a Bird Bat Adaptive Manage Plan (BBAMP) that takes into account the potential for cumulative effects and post construction monitoring through carcass surveys;

- Establish a management board with other relevant developments and government authorities in Binh Thuan province to share best practices for mitigation collisions and electrocution, and to report monitoring data on a regular basic (e.g. after every monitoring survey).

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APPENDIX A SHADOW FLICKER RESULT

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VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

Assumptions for shadow calculations

Maximum distance for influence
Calculate only when more than 20 % of sun is covered by the blade
Please look in WTG table

Minimum sun height over horizon for influence	3 °
Day step for calculation	1 days
Time step for calculation	1 minutes

Sunshine probability S (Average daily sunshine hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
6.94	7.86	6.61	6.50	5.65	5.33	4.03	4.19	3.33	4.68	5.67	6.13

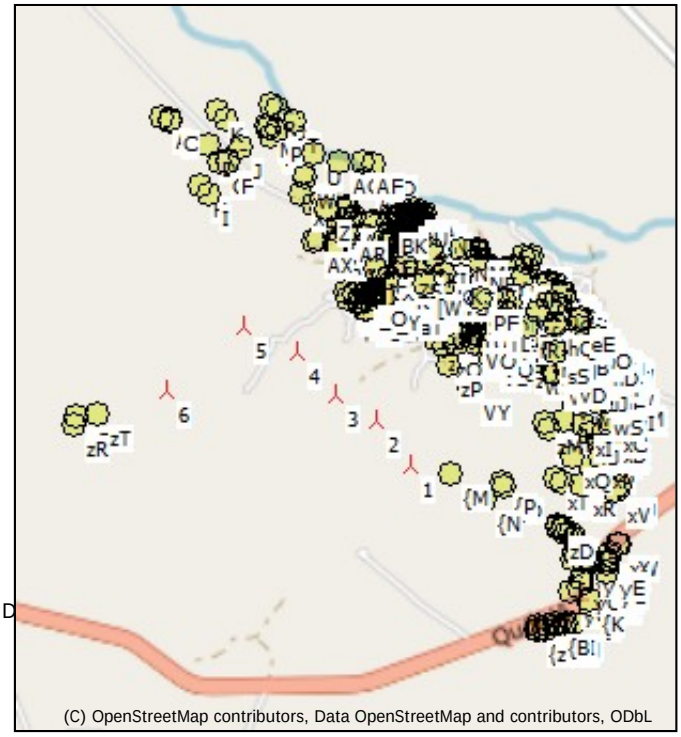
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
287	1,307	1,277	1,008	665	299	150	92	139	321	744	604

W	WNW	NW	NNW	Sum
1,063	197	208	399	8,760

A ZVI (Zones of Visual Influence) calculation is performed before flicker calculation so non visible WTG do not contribute to calculated flicker values. A WTG will be visible if it is visible from any part of the receiver window. The ZVI calculation is based on the following assumptions:
Height contours used: Project Wizard Elevation Data Grid (SRTM: Shuttle D
Obstacles used in calculation
Eye height for map: 1.5 m
Grid resolution: 1.0 m

All coordinates are in
UTM (north)-WGS84 Zone: 48



Scale 1:50,000

New WTG Shadow receptor

WTGs

	Easting	Northing	Z	Row data/Description	WTG type Valid	Manufact.	Type-generator	Power, rated	Rotor diameter	Hub height	Shadow data Calculation distance	RPM
			[m]					[kW]	[m]	[m]	[m]	[RPM]
1	904,012	1,243,793	48.8	WTG1	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4
2	903,782	1,244,089	37.0	WTG2	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4
3	903,490	1,244,265	32.5	WTG3	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4
4	903,256	1,244,531	31.9	WTG4	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4
5	902,889	1,244,701	30.0	WTG5	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4
6	902,392	1,244,263	37.4	WTG6	Yes	VESTAS	V150-4.2-4,200	4,200	150.0	125.0	1,904	10.4

Shadow receptor-Input

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]		[m]
A	902,337	1,246,063	31.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AA	903,427	1,245,463	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aA	904,005	1,244,963	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AB	903,356	1,245,495	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aB	903,976	1,244,980	28.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aC	903,977	1,244,985	28.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AC	903,517	1,245,777	16.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aD	903,996	1,244,949	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AD	903,736	1,245,771	14.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AE	903,678	1,245,675	16.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aE	903,990	1,244,942	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aF	903,990	1,244,961	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AF	903,671	1,245,781	15.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aG	903,962	1,244,935	28.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AG	903,529	1,245,475	21.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aH	903,968	1,244,943	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AH	903,508	1,245,411	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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Calculated:
1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]		[m]
aI	903,973	1,244,917	28.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AI	903,549	1,245,488	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aJ	903,989	1,244,907	28.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AJ	903,572	1,245,479	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aK	903,985	1,244,902	28.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AK	903,583	1,245,476	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AL	903,591	1,245,419	20.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aL	904,008	1,244,903	27.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AM	903,606	1,245,419	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aM	904,004	1,244,892	27.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AN	903,627	1,245,403	18.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aN	903,972	1,244,886	28.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aO	903,982	1,244,879	28.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AO	903,722	1,245,392	19.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AP	903,729	1,245,389	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aP	903,974	1,244,883	28.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AQ	903,698	1,245,331	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aQ	903,987	1,244,886	28.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aR	903,994	1,244,877	27.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AR	903,564	1,245,342	23.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aS	903,998	1,244,872	26.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AS	903,586	1,245,311	24.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AT	903,511	1,245,333	24.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aT	903,982	1,244,857	26.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AU	903,512	1,245,245	25.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aU	903,993	1,244,852	26.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AV	903,480	1,245,240	25.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aV	904,020	1,244,890	26.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aW	904,014	1,244,897	27.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AW	903,379	1,245,272	27.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AX	903,359	1,245,262	28.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aX	904,028	1,244,894	26.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AY	903,662	1,245,283	21.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aY	904,035	1,244,916	27.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
aZ	904,041	1,244,910	27.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
AZ	903,671	1,245,294	21.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
B	902,387	1,246,035	29.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bA	904,043	1,244,927	27.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BA	903,678	1,245,284	21.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BB	903,688	1,245,253	22.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bB	904,048	1,244,932	27.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bC	904,054	1,244,926	27.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BC	903,711	1,245,269	22.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bD	904,060	1,244,920	26.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BD	903,724	1,245,263	22.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BE	903,732	1,245,276	22.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bE	904,007	1,244,943	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BF	903,755	1,245,315	21.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bF	904,022	1,244,960	27.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bG	904,027	1,244,955	27.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BG	903,759	1,245,390	19.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BH	903,766	1,245,398	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bH	904,056	1,244,957	27.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BI	903,779	1,245,385	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bI	904,062	1,244,953	27.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BJ	903,791	1,245,383	19.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bJ	904,913	1,245,019	13.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bK	904,914	1,244,993	13.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BK	903,843	1,245,393	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bL	904,932	1,244,987	13.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BL	903,849	1,245,406	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bM	904,947	1,244,992	13.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
BM	903,888	1,245,423	19.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bN	904,955	1,245,006	13.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BN	903,880	1,245,410	19.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BO	903,910	1,245,443	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bO	904,949	1,244,956	14.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BP	903,923	1,245,421	18.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bP	904,936	1,244,970	13.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BQ	903,909	1,245,403	18.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bQ	904,911	1,244,937	15.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BR	903,932	1,245,413	17.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bR	904,903	1,244,955	15.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bS	904,899	1,244,967	14.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BS	903,951	1,245,391	16.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bT	904,865	1,244,932	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BT	903,968	1,245,430	17.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BU	903,962	1,245,430	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bU	904,878	1,244,915	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bV	904,869	1,244,900	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BV	903,944	1,245,437	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BW	903,978	1,245,428	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bW	904,853	1,244,904	18.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BX	903,985	1,245,443	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bX	904,786	1,244,884	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bY	904,778	1,244,882	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BY	903,991	1,245,459	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
bZ	904,821	1,244,868	18.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
BZ	904,008	1,245,468	16.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
C	902,392	1,246,045	27.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cA	904,864	1,244,861	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CA	904,015	1,245,466	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cB	904,848	1,244,870	18.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CB	904,021	1,245,465	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CC	904,001	1,245,426	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cC	904,883	1,244,867	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CD	903,990	1,245,425	17.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cD	904,883	1,244,864	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CE	903,999	1,245,415	17.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cE	904,915	1,244,913	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cF	904,913	1,244,890	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CF	903,983	1,245,399	16.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CG	903,980	1,245,378	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cG	904,911	1,244,863	18.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cH	904,945	1,244,890	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CH	903,974	1,245,379	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cI	904,945	1,244,882	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CI	903,987	1,245,416	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CJ	904,025	1,245,422	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cJ	904,943	1,244,872	18.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CK	904,010	1,245,420	18.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cK	904,936	1,244,887	17.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CL	904,015	1,245,419	18.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cL	904,943	1,244,919	15.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CM	904,026	1,245,414	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cM	904,945	1,244,908	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cN	904,965	1,244,954	14.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CN	904,009	1,245,383	18.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cO	904,988	1,244,952	14.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CO	904,016	1,245,384	18.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CP	903,962	1,245,367	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cP	904,985	1,244,952	14.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CQ	903,965	1,245,366	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cQ	904,995	1,244,954	14.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
cR	905,009	1,244,941	13.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CR	903,970	1,245,363	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CS	903,964	1,245,354	18.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cS	905,007	1,244,917	14.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CT	904,008	1,245,370	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cT	904,986	1,244,909	15.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cU	904,988	1,244,902	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CU	904,013	1,245,367	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CV	904,017	1,245,366	19.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cV	904,985	1,244,897	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cW	905,005	1,244,893	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CW	904,007	1,245,356	19.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CX	904,017	1,245,354	20.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cX	904,980	1,244,880	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cY	904,989	1,244,869	17.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CY	904,033	1,245,418	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
cZ	904,979	1,244,867	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
CZ	904,034	1,245,411	19.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
D	902,654	1,245,886	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DA	904,038	1,245,440	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dA	904,976	1,244,866	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dB	904,971	1,244,866	18.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DB	904,040	1,245,439	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DC	904,052	1,245,460	19.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dC	904,950	1,244,865	18.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DD	904,050	1,245,433	20.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dD	905,037	1,244,899	14.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dE	905,036	1,244,894	14.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DE	904,048	1,245,418	20.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dF	905,044	1,244,869	15.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DF	904,048	1,245,399	19.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dG	905,021	1,244,838	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DG	904,073	1,245,412	21.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dH	905,012	1,244,821	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DH	904,061	1,245,431	20.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dI	905,088	1,244,824	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DI	904,067	1,245,430	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dJ	905,092	1,244,808	17.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DJ	904,057	1,245,423	20.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dK	905,075	1,244,811	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DK	904,074	1,245,448	20.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dL	905,072	1,244,820	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DL	904,078	1,245,409	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DM	904,071	1,245,392	21.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dM	905,048	1,244,819	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DN	904,079	1,245,393	21.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dN	905,039	1,244,817	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DO	904,082	1,245,392	21.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dO	905,028	1,244,820	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DP	904,090	1,245,392	21.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dP	905,021	1,244,822	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dQ	905,039	1,244,801	17.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DQ	904,061	1,245,360	20.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dR	905,037	1,244,789	17.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DR	904,066	1,245,363	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dS	905,031	1,244,802	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DS	904,071	1,245,362	21.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dT	905,046	1,244,799	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DT	904,033	1,245,332	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DU	904,040	1,245,330	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dU	905,071	1,244,790	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DV	904,042	1,245,328	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
dV	905,076	1,244,785	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dW	905,100	1,244,789	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DW	903,988	1,245,339	20.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dX	905,112	1,244,783	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DX	904,001	1,245,318	22.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dY	905,117	1,244,778	17.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DY	903,986	1,245,322	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
dZ	905,130	1,244,779	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
DZ	903,875	1,245,363	20.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
E	902,787	1,245,787	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eA	905,133	1,244,769	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EA	903,860	1,245,350	20.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EB	903,829	1,245,310	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eB	905,123	1,244,759	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EC	903,834	1,245,318	21.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eC	905,118	1,244,759	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eD	905,110	1,244,768	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ED	903,844	1,245,309	21.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EE	903,802	1,245,268	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eE	905,111	1,244,758	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eF	905,099	1,244,761	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EF	903,811	1,245,273	23.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EG	903,814	1,245,265	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eG	905,089	1,244,766	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eH	905,079	1,244,765	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EH	903,818	1,245,263	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EI	903,822	1,245,260	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eI	905,088	1,244,775	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EJ	903,828	1,245,256	24.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eJ	905,049	1,244,765	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EK	903,835	1,245,258	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eK	905,042	1,244,766	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eL	905,034	1,244,759	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EL	903,841	1,245,255	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eM	905,034	1,244,767	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EM	903,845	1,245,253	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eN	905,034	1,244,776	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EN	903,848	1,245,252	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EO	903,862	1,245,248	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eO	905,044	1,244,779	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EP	903,864	1,245,241	24.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eP	904,990	1,244,830	18.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EQ	903,870	1,245,242	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eQ	904,982	1,244,835	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ER	903,874	1,245,237	24.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eR	904,970	1,244,846	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eS	904,946	1,244,839	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ES	903,879	1,245,247	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ET	903,883	1,245,235	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eT	904,918	1,244,842	19.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EU	903,885	1,245,244	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eU	904,921	1,244,837	19.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eV	904,914	1,244,835	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EV	903,892	1,245,235	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eW	904,886	1,244,833	18.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EW	903,866	1,245,272	23.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eX	904,922	1,244,812	20.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EX	903,877	1,245,293	23.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EY	903,885	1,245,291	23.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eY	904,907	1,244,796	20.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
EZ	903,900	1,245,290	23.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
eZ	904,902	1,244,796	20.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
F	902,780	1,245,778	24.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fA	904,886	1,244,802	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FA	903,902	1,245,268	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FB	903,919	1,245,267	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fB	904,886	1,244,814	19.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FC	903,920	1,245,291	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fC	904,847	1,244,822	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fD	904,856	1,244,814	18.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FD	903,938	1,245,291	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FE	903,935	1,245,291	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fE	904,854	1,244,793	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fF	904,824	1,244,821	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FF	903,937	1,245,281	23.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fG	904,819	1,244,798	18.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FG	903,944	1,245,261	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FH	903,924	1,245,216	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fH	904,800	1,244,795	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fI	904,798	1,244,846	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FI	903,935	1,245,210	24.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FJ	903,934	1,245,227	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fJ	904,821	1,244,845	18.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fK	904,755	1,244,799	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FK	903,916	1,245,207	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fL	904,792	1,244,778	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FL	903,930	1,245,201	24.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FM	903,939	1,245,199	24.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fM	904,803	1,244,776	18.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fN	904,770	1,244,760	18.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FN	903,949	1,245,192	24.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fO	904,766	1,244,762	18.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FO	903,945	1,245,205	24.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fP	904,787	1,244,743	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FP	903,947	1,245,219	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FQ	903,960	1,245,218	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fQ	904,776	1,244,699	20.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fR	904,773	1,244,713	19.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FR	903,955	1,245,218	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FS	903,957	1,245,240	23.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fS	904,775	1,244,682	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fT	904,796	1,244,694	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FT	903,961	1,245,240	23.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FU	903,966	1,245,214	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fU	904,797	1,244,701	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fV	904,804	1,244,731	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FV	903,970	1,245,211	24.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FW	903,975	1,245,209	24.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fW	904,814	1,244,708	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fX	904,829	1,244,691	22.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FX	903,962	1,245,189	24.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fY	904,837	1,244,690	22.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FY	903,968	1,245,188	24.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
fZ	904,856	1,244,685	22.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
FZ	903,970	1,245,182	25.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
G	902,735	1,245,785	24.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GA	903,982	1,245,203	24.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gA	904,866	1,244,682	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gB	904,870	1,244,701	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GB	903,981	1,245,185	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gC	904,875	1,244,710	20.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GC	903,987	1,245,181	25.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GD	903,993	1,245,180	25.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gD	904,871	1,244,720	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
GE	903,999	1,245,176	26.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gE	904,853	1,244,736	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gF	904,853	1,244,751	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GF	903,999	1,245,194	25.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gG	904,848	1,244,756	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GG	904,005	1,245,193	25.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gH	904,889	1,244,773	19.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GH	903,991	1,245,197	24.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GI	904,006	1,245,169	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gI	904,891	1,244,747	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GJ	904,013	1,245,164	26.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gJ	904,877	1,244,773	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gK	904,907	1,244,695	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GK	904,022	1,245,159	26.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GL	904,017	1,245,163	26.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gL	904,919	1,244,690	21.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gM	904,907	1,244,683	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GM	904,024	1,245,180	26.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GN	904,019	1,245,182	26.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gN	904,916	1,244,677	22.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gO	904,888	1,244,679	22.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GO	904,028	1,245,160	26.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gP	904,880	1,244,683	22.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GP	904,037	1,245,154	26.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gQ	904,880	1,244,653	23.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GQ	904,033	1,245,157	26.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gR	904,861	1,244,659	23.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GR	904,034	1,245,178	26.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GS	904,039	1,245,175	26.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gS	904,850	1,244,664	23.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GT	904,044	1,245,173	25.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gT	904,838	1,244,640	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GU	904,052	1,245,171	25.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gU	904,822	1,244,646	22.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gV	904,800	1,244,664	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GV	904,044	1,245,153	25.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gW	904,789	1,244,674	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GW	904,049	1,245,151	25.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gX	904,793	1,244,664	21.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GX	904,056	1,245,147	25.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GY	904,060	1,245,166	25.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gY	904,920	1,244,771	21.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
gZ	904,948	1,244,777	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
GZ	904,068	1,245,144	25.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
H	902,599	1,245,629	29.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hA	904,961	1,244,774	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HA	904,076	1,245,139	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hB	904,952	1,244,815	20.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HB	904,076	1,245,159	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HC	904,085	1,245,157	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hC	904,959	1,244,815	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hD	904,993	1,244,804	18.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HD	904,084	1,245,135	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HE	904,096	1,245,157	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hE	904,987	1,244,819	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hF	905,000	1,244,777	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HF	904,097	1,245,148	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hG	905,002	1,244,773	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HG	904,101	1,245,153	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hH	904,997	1,244,785	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HH	904,107	1,245,150	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HI	904,103	1,245,160	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
hI	904,983	1,244,759	20.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hJ	904,988	1,244,750	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HJ	904,105	1,245,166	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hK	904,981	1,244,751	20.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HK	904,098	1,245,176	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hL	904,977	1,244,749	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HL	904,103	1,245,174	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hM	904,973	1,244,759	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HM	904,088	1,245,188	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HN	904,080	1,245,191	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hN	904,964	1,244,760	21.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HO	904,070	1,245,196	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hO	904,951	1,244,763	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hP	904,942	1,244,758	21.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HP	904,030	1,245,199	25.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hQ	904,956	1,244,734	21.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HQ	904,026	1,245,209	24.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hR	904,947	1,244,722	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HR	904,022	1,245,211	24.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HS	904,024	1,245,218	24.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hS	904,905	1,244,742	19.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hT	904,975	1,244,724	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HT	904,007	1,245,216	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HU	904,013	1,245,223	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hU	904,968	1,244,734	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HV	904,010	1,245,224	23.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hV	904,994	1,244,726	19.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HW	903,994	1,245,227	23.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hW	904,997	1,244,717	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HX	903,990	1,245,228	23.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hX	905,002	1,244,760	19.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hY	905,011	1,244,761	18.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HY	903,959	1,245,257	23.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
HZ	903,965	1,245,257	23.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
hZ	905,002	1,244,754	19.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
I	902,656	1,245,570	27.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IA	903,977	1,245,254	23.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iA	905,017	1,244,731	18.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iB	905,028	1,244,734	17.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IB	904,000	1,245,252	23.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iC	905,047	1,244,747	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IC	904,020	1,245,275	23.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iD	905,051	1,244,733	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ID	904,010	1,245,278	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IE	904,003	1,245,277	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iE	905,042	1,244,733	17.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IF	903,997	1,245,281	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iF	905,068	1,244,738	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iG	905,111	1,244,740	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IG	903,987	1,245,280	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iH	905,107	1,244,734	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IH	903,976	1,245,282	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iI	905,113	1,244,731	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
II	903,952	1,245,288	23.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IJ	903,974	1,245,296	23.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iJ	905,119	1,244,731	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IK	903,957	1,245,300	22.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iK	905,119	1,244,725	17.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IL	903,978	1,245,302	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iL	905,116	1,244,718	17.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iM	905,111	1,244,712	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IM	904,102	1,245,212	24.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
IN	904,106	1,245,191	24.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iN	905,103	1,244,722	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IO	904,104	1,245,183	24.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iO	905,152	1,244,751	16.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IP	904,114	1,245,180	24.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iP	905,145	1,244,740	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IQ	904,124	1,245,184	24.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iQ	905,139	1,244,740	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iR	905,143	1,244,733	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IR	904,133	1,245,181	24.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iS	905,146	1,244,724	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IS	904,141	1,245,178	24.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iT	905,135	1,244,724	17.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IT	904,111	1,245,212	24.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iU	905,137	1,244,711	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IU	904,115	1,245,211	24.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iV	905,134	1,244,705	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IV	904,131	1,245,205	23.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iW	905,142	1,244,710	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IW	904,139	1,245,201	23.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IX	904,145	1,245,199	23.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iX	905,144	1,244,703	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iY	905,127	1,244,707	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IY	904,157	1,245,195	23.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
IZ	904,161	1,245,209	22.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
iZ	905,166	1,244,731	16.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
J	902,862	1,245,865	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JA	904,150	1,245,218	22.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jA	905,161	1,244,740	16.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JB	904,145	1,245,220	22.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jB	905,169	1,244,710	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JC	904,153	1,245,243	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jC	905,172	1,244,703	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JD	904,168	1,245,207	22.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jD	905,183	1,244,719	16.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JE	904,178	1,245,227	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jE	905,183	1,244,705	16.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jF	905,195	1,244,697	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JF	904,187	1,245,228	21.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jG	905,199	1,244,693	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JG	904,189	1,245,201	22.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JH	904,194	1,245,185	23.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jH	905,200	1,244,683	16.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JI	904,135	1,245,285	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jI	905,188	1,244,671	16.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JJ	904,121	1,245,290	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jJ	905,180	1,244,674	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jK	905,151	1,244,666	17.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JK	904,126	1,245,302	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jL	905,132	1,244,672	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JL	904,127	1,245,307	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jM	905,126	1,244,674	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JM	904,126	1,245,105	26.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JN	904,133	1,245,103	27.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jN	905,115	1,244,665	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JO	904,138	1,245,115	26.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jO	905,117	1,244,689	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JP	904,132	1,245,118	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jP	905,103	1,244,677	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JQ	904,142	1,245,098	27.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jQ	905,086	1,244,676	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JR	904,160	1,245,105	27.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
jR	905,077	1,244,685	17.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jS	905,084	1,244,703	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JS	904,165	1,245,103	27.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jT	905,072	1,244,708	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JT	904,147	1,245,110	27.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jU	905,059	1,244,709	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JU	904,171	1,245,098	27.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JV	904,192	1,245,090	27.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jV	905,053	1,244,709	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JW	904,198	1,245,084	27.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jW	905,045	1,244,708	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jX	905,037	1,244,711	18.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JX	904,196	1,245,073	27.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JY	904,205	1,245,094	27.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jY	905,030	1,244,703	18.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
jZ	905,026	1,244,710	18.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
JZ	904,183	1,245,113	27.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
K	902,711	1,246,111	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KA	904,191	1,245,113	27.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kA	905,024	1,244,702	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KB	904,174	1,245,129	26.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kB	904,992	1,244,694	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kC	904,986	1,244,692	20.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KC	904,168	1,245,153	25.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kD	904,970	1,244,703	20.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KD	904,176	1,245,149	25.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KE	904,119	1,245,149	25.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kE	904,953	1,244,705	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KF	904,121	1,245,155	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kF	904,971	1,244,695	20.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kG	904,920	1,244,717	20.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KG	904,125	1,245,159	24.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KH	904,131	1,245,142	25.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kH	904,922	1,244,697	20.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KI	904,144	1,245,171	24.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kI	904,941	1,244,684	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KJ	904,218	1,245,071	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kJ	904,932	1,244,689	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KK	904,225	1,245,062	25.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kK	904,930	1,244,682	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KL	904,234	1,245,058	25.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kL	904,960	1,244,687	20.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KM	904,241	1,245,055	25.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kM	904,960	1,244,682	20.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KN	904,249	1,245,047	24.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kN	904,992	1,244,682	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kO	904,992	1,244,674	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KO	904,256	1,245,041	24.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KP	904,261	1,245,047	24.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kP	904,976	1,244,662	19.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KQ	904,265	1,245,053	24.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kQ	904,961	1,244,669	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kR	904,995	1,244,668	19.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KR	904,269	1,245,059	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kS	905,009	1,244,658	19.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KS	904,243	1,245,127	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kT	905,016	1,244,656	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KT	904,256	1,245,102	24.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kU	905,030	1,244,672	19.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KU	904,267	1,245,076	24.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kV	905,021	1,244,681	19.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KV	904,275	1,245,087	23.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
KW	904,270	1,245,081	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kW	905,068	1,244,674	17.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kX	905,085	1,244,664	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KX	904,275	1,245,069	23.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kY	905,086	1,244,654	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KY	904,278	1,245,077	23.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
kZ	905,081	1,244,644	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
KZ	904,282	1,245,096	23.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
L	902,768	1,246,061	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LA	904,292	1,245,074	22.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lA	905,069	1,244,662	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LB	904,288	1,245,064	22.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lB	905,069	1,244,650	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lC	905,058	1,244,651	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LC	904,294	1,245,061	22.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lD	905,054	1,244,660	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LD	904,271	1,245,034	23.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lE	905,046	1,244,644	17.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LE	904,277	1,245,030	23.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lF	905,040	1,244,653	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LF	904,269	1,245,022	23.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lG	905,189	1,244,655	16.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LG	904,243	1,245,038	24.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LH	904,289	1,245,044	22.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lH	905,187	1,244,645	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LI	904,303	1,245,056	22.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lI	905,180	1,244,653	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LJ	904,300	1,245,069	22.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lJ	905,175	1,244,656	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LK	904,306	1,245,066	22.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lK	905,176	1,244,644	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LL	904,309	1,245,081	22.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lL	905,222	1,244,672	15.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lM	905,221	1,244,656	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LM	904,304	1,245,086	22.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lN	905,233	1,244,652	16.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LN	904,320	1,245,084	21.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lO	905,230	1,244,644	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LO	904,329	1,245,070	21.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lP	905,221	1,244,644	16.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LP	904,335	1,245,081	21.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lQ	905,183	1,244,627	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LQ	904,315	1,245,064	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LR	904,341	1,245,053	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lR	905,191	1,244,626	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lS	905,190	1,244,618	16.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LS	904,345	1,245,074	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lT	905,183	1,244,619	16.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LT	904,338	1,245,044	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lU	905,175	1,244,618	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LU	904,355	1,245,042	20.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lV	905,175	1,244,636	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LV	904,352	1,245,036	20.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lW	905,222	1,244,620	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LW	904,360	1,245,051	20.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LX	904,361	1,245,060	20.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lX	905,213	1,244,629	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LY	904,366	1,245,073	20.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lY	905,213	1,244,616	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
LZ	904,353	1,245,105	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
lZ	905,220	1,244,609	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
M	903,023	1,246,023	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]		[m]
MA	904,363	1,245,100	20.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mA	905,213	1,244,607	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MB	904,342	1,245,127	20.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mB	905,233	1,244,596	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mC	905,235	1,244,608	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MC	904,335	1,245,127	20.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MD	904,351	1,245,098	21.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mD	905,234	1,244,617	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ME	904,356	1,245,095	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mE	905,230	1,244,630	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MF	904,346	1,245,105	21.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mF	905,254	1,244,615	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MG	904,291	1,245,109	22.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mG	905,254	1,244,604	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mH	905,262	1,244,588	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MH	904,273	1,245,133	22.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MI	904,279	1,245,132	22.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mI	905,253	1,244,595	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MJ	904,301	1,245,125	21.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mJ	905,258	1,244,579	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mK	905,262	1,244,569	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MK	904,337	1,245,147	20.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ML	904,312	1,245,161	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mL	905,262	1,244,553	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mM	905,255	1,244,561	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MM	904,343	1,245,156	20.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mN	905,219	1,244,566	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MN	904,323	1,245,179	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MO	904,306	1,245,182	20.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mO	905,222	1,244,573	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mP	905,223	1,244,579	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MP	904,306	1,245,198	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mQ	905,230	1,244,580	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MQ	904,300	1,245,202	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mR	905,255	1,244,553	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MR	904,289	1,245,191	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mS	905,246	1,244,550	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MS	904,289	1,245,179	21.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MT	904,358	1,245,178	18.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mT	905,245	1,244,543	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MU	904,362	1,245,176	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mU	905,233	1,244,573	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MV	904,353	1,245,170	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mV	905,287	1,244,575	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MW	904,367	1,245,127	18.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mW	905,292	1,244,555	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mX	905,284	1,244,541	15.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MX	904,375	1,245,123	18.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MY	904,385	1,245,121	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mY	905,289	1,244,540	15.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
MZ	904,391	1,245,116	18.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
mZ	905,285	1,244,530	15.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
N	903,049	1,246,001	18.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nA	905,273	1,244,596	16.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NA	904,412	1,245,107	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NB	904,417	1,245,103	18.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nB	905,268	1,244,535	16.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NC	904,399	1,245,085	19.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nC	905,259	1,244,544	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nD	905,259	1,244,532	16.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ND	904,392	1,245,089	19.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nE	905,251	1,244,534	16.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
NE	904,424	1,245,144	15.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nF	905,285	1,244,513	15.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NF	904,406	1,245,154	15.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nG	905,283	1,244,506	14.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NG	904,401	1,245,174	15.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nH	905,272	1,244,501	15.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NH	904,422	1,245,196	15.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NI	904,428	1,245,208	16.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nI	905,296	1,244,502	14.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nJ	905,229	1,244,511	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NJ	904,424	1,245,217	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nK	905,217	1,244,532	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NK	904,434	1,245,216	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nL	905,207	1,244,535	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NL	904,395	1,245,206	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nM	905,197	1,244,556	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NM	904,336	1,245,209	18.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NN	904,326	1,245,214	18.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nN	905,201	1,244,563	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nO	905,195	1,244,581	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NO	904,323	1,245,216	18.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NP	904,304	1,245,218	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nP	905,197	1,244,586	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NQ	904,309	1,245,215	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nQ	905,197	1,244,592	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nR	905,187	1,244,603	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NR	904,436	1,245,092	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NS	904,448	1,245,089	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nS	905,189	1,244,609	16.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NT	904,458	1,245,110	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nT	905,197	1,244,610	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NU	904,452	1,245,118	16.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nU	905,179	1,244,613	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NV	904,462	1,245,151	15.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nV	905,182	1,244,593	16.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nW	905,195	1,244,575	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NW	904,468	1,245,148	15.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nX	905,194	1,244,565	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NX	904,448	1,245,170	15.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nY	905,182	1,244,559	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NY	904,497	1,245,136	15.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
NZ	904,481	1,245,112	15.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
nZ	905,169	1,244,586	16.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
O	903,062	1,245,947	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oA	905,161	1,244,604	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OA	904,496	1,245,101	16.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oB	905,122	1,244,658	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OB	904,501	1,245,098	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oC	905,136	1,244,654	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OC	904,491	1,245,087	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oD	905,148	1,244,656	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OD	904,440	1,245,071	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oE	905,155	1,244,656	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OE	904,424	1,245,078	18.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oF	905,148	1,244,646	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OF	904,416	1,245,067	18.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OG	904,442	1,245,061	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oG	905,128	1,244,646	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OH	904,425	1,245,042	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oH	905,120	1,244,643	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oI	905,103	1,244,653	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OI	904,402	1,245,047	18.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
OJ	904,440	1,245,032	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oJ	905,111	1,244,633	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oK	905,103	1,244,631	17.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OK	904,437	1,245,024	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oL	905,130	1,244,630	17.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OL	904,411	1,245,010	18.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oM	905,139	1,244,631	17.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OM	904,397	1,244,992	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ON	904,393	1,244,996	19.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oN	905,151	1,244,630	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OO	904,389	1,244,995	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oO	905,159	1,244,624	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OP	904,377	1,244,982	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oP	905,096	1,244,622	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oQ	905,111	1,244,624	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OQ	904,370	1,244,970	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OR	904,362	1,244,958	19.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oR	905,106	1,244,616	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OS	904,373	1,244,962	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oS	905,149	1,244,613	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OT	904,363	1,245,009	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oT	905,148	1,244,603	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OU	904,345	1,245,022	21.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oU	905,130	1,244,613	17.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oV	905,137	1,244,612	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OV	904,341	1,245,023	21.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oW	905,143	1,244,592	16.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OW	904,328	1,245,007	22.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oX	905,133	1,244,593	16.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OX	904,329	1,244,987	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OY	904,336	1,244,978	21.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oY	905,133	1,244,606	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
OZ	904,303	1,245,007	22.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
oZ	905,089	1,244,600	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
P	903,095	1,245,989	15.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pA	905,096	1,244,597	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PA	904,294	1,245,012	22.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PB	904,287	1,245,024	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pB	905,083	1,244,598	16.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pC	905,078	1,244,611	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PC	904,330	1,245,026	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pD	905,150	1,244,579	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PD	904,421	1,244,928	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pE	905,156	1,244,584	16.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PE	904,431	1,244,922	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PF	904,458	1,244,905	20.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pF	905,160	1,244,578	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PG	904,467	1,244,900	20.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pG	905,170	1,244,561	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PH	904,471	1,244,897	20.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pH	905,154	1,244,568	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PI	904,468	1,244,889	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pI	905,145	1,244,570	16.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PJ	904,414	1,244,918	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pJ	905,136	1,244,568	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pK	905,152	1,244,557	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PK	904,484	1,244,892	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PL	904,491	1,244,882	21.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pL	905,136	1,244,557	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pM	905,123	1,244,558	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PM	904,487	1,244,876	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pN	905,113	1,244,559	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
PN	904,495	1,244,873	22.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pO	905,106	1,244,560	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PO	904,508	1,244,869	22.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PP	904,516	1,244,854	23.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pP	905,087	1,244,554	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PQ	904,524	1,244,867	22.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pQ	905,089	1,244,566	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pR	905,093	1,244,574	16.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PR	904,530	1,244,885	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pS	905,098	1,244,584	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PS	904,523	1,244,912	19.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pT	905,106	1,244,591	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PT	904,538	1,244,911	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PU	904,547	1,244,906	19.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pU	905,242	1,244,488	16.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pV	905,229	1,244,471	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PV	904,527	1,244,847	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pW	905,115	1,244,522	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PW	904,545	1,244,836	23.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PX	904,544	1,244,831	23.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pX	905,086	1,244,533	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PY	904,553	1,244,837	23.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pY	905,070	1,244,504	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
pZ	905,076	1,244,629	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
PZ	904,551	1,244,846	23.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
Q	903,091	1,246,130	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qA	905,073	1,244,617	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QA	904,534	1,244,855	23.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qB	905,067	1,244,618	16.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QB	904,550	1,244,866	22.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qC	905,055	1,244,625	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QC	904,568	1,244,859	22.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qD	905,056	1,244,613	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QD	904,557	1,244,843	23.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qE	905,067	1,244,592	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QE	904,576	1,244,820	22.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qF	905,072	1,244,594	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QF	904,583	1,244,817	22.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qG	905,059	1,244,595	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QG	904,587	1,244,813	22.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qH	905,064	1,244,572	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QH	904,595	1,244,833	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qI	905,062	1,244,567	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QI	904,602	1,244,843	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qJ	905,059	1,244,558	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QJ	904,616	1,244,825	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qK	905,058	1,244,551	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QK	904,630	1,244,818	21.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QL	904,638	1,244,815	21.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qL	905,051	1,244,562	17.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QM	904,645	1,244,828	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qM	905,053	1,244,544	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qN	905,055	1,244,531	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QN	904,693	1,244,840	19.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qO	905,048	1,244,523	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QO	904,696	1,244,849	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QP	904,681	1,244,852	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qP	905,047	1,244,510	17.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QQ	904,663	1,244,855	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qQ	905,041	1,244,534	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QR	904,658	1,244,864	21.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qR	905,004	1,244,527	18.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
qS	904,989	1,244,538	18.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QS	904,652	1,244,868	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qT	905,000	1,244,559	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QT	904,642	1,244,870	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qU	905,014	1,244,547	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QU	904,663	1,244,897	20.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QV	904,641	1,244,904	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qV	904,993	1,244,568	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QW	904,611	1,244,868	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qW	904,983	1,244,570	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qX	904,975	1,244,551	18.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QX	904,614	1,244,875	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QY	904,605	1,244,897	20.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qY	904,971	1,244,545	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
qZ	904,997	1,244,575	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
QZ	904,618	1,244,905	20.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
R	903,051	1,246,159	18.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RA	904,608	1,244,909	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rA	904,990	1,244,581	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rB	905,000	1,244,605	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RB	904,603	1,244,910	19.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rC	905,014	1,244,583	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RC	904,600	1,244,910	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rD	905,029	1,244,583	17.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RD	904,594	1,244,907	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RE	904,587	1,244,913	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rE	905,032	1,244,591	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RF	904,573	1,244,904	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rF	905,017	1,244,593	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rG	905,018	1,244,598	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RG	904,569	1,244,892	20.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rH	905,043	1,244,593	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RH	904,542	1,244,885	21.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RI	904,649	1,244,926	18.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rI	905,039	1,244,615	16.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rJ	905,037	1,244,623	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RJ	904,655	1,244,937	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rK	905,022	1,244,623	18.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RK	904,673	1,244,995	13.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rL	905,013	1,244,622	18.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RL	904,736	1,244,890	17.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rM	905,007	1,244,622	18.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RM	904,765	1,244,980	16.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RN	904,693	1,244,951	15.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rN	905,006	1,244,631	18.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RO	904,652	1,244,966	14.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rO	904,986	1,244,648	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RP	904,646	1,244,969	14.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rP	904,988	1,244,642	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rQ	904,987	1,244,631	18.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RQ	904,612	1,244,973	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RR	904,618	1,244,978	15.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rR	904,957	1,244,652	20.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RS	904,612	1,244,984	15.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rS	904,976	1,244,648	19.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RT	904,633	1,245,030	16.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rT	904,977	1,244,624	18.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RU	904,575	1,245,069	17.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rU	904,975	1,244,610	18.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RV	904,620	1,245,093	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rV	904,953	1,244,624	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RW	904,641	1,245,083	15.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
rW	904,948	1,244,608	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RX	904,714	1,245,067	17.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rX	904,931	1,244,597	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RY	904,703	1,245,030	14.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rY	904,926	1,244,600	21.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
RZ	904,721	1,245,001	13.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
rZ	904,945	1,244,595	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
S	903,172	1,246,060	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sA	904,964	1,244,592	18.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SA	904,754	1,245,052	15.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SB	904,768	1,245,099	13.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sB	904,919	1,244,654	22.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SC	904,727	1,245,103	14.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sC	904,898	1,244,650	23.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sD	904,913	1,244,624	22.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SD	904,695	1,245,114	15.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SE	904,787	1,245,150	14.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sE	904,851	1,244,635	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SF	904,793	1,245,184	15.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sF	904,869	1,244,624	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SG	904,746	1,245,193	16.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sG	904,890	1,244,606	22.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sH	904,901	1,244,601	22.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SH	904,822	1,244,972	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sI	904,879	1,244,592	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SI	904,731	1,244,842	18.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SJ	904,733	1,244,847	18.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sJ	904,903	1,244,583	21.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SK	904,736	1,244,855	18.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sK	904,888	1,244,591	21.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SL	904,750	1,244,834	18.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sL	904,917	1,244,581	20.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sM	904,941	1,244,564	19.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SM	904,723	1,244,743	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SN	904,746	1,244,733	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sN	904,923	1,244,573	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sO	904,916	1,244,565	19.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SO	904,431	1,244,867	19.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SP	904,439	1,244,857	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sP	904,917	1,244,558	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sQ	904,935	1,244,555	19.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SQ	904,457	1,244,842	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sR	904,921	1,244,564	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SR	904,468	1,244,845	21.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SS	904,473	1,244,840	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sS	904,965	1,244,549	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ST	904,470	1,244,832	21.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sT	905,001	1,244,521	18.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sU	904,970	1,244,530	19.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SU	904,475	1,244,800	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SV	904,440	1,244,785	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sV	904,954	1,244,493	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SW	904,431	1,244,791	20.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sW	904,998	1,244,480	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sX	905,153	1,244,519	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SX	904,427	1,244,795	20.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SY	904,510	1,244,809	22.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sY	905,174	1,244,503	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
SZ	904,516	1,244,806	22.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
sZ	905,175	1,244,498	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
T	903,204	1,246,050	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TA	904,520	1,244,797	22.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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Calculated:
1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
tA	905,189	1,244,495	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TB	904,529	1,244,793	22.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tB	905,140	1,244,516	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tC	905,212	1,244,447	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TC	904,538	1,244,790	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tD	905,222	1,244,441	15.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TD	904,552	1,244,786	22.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TE	904,543	1,244,772	22.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tE	905,228	1,244,452	15.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TF	904,535	1,244,779	22.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tF	905,230	1,244,445	15.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TG	904,525	1,244,784	22.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tG	905,237	1,244,444	14.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TH	904,517	1,244,774	22.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tH	905,254	1,244,441	14.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TI	904,572	1,244,778	22.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tI	905,264	1,244,437	15.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tJ	905,269	1,244,433	15.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TJ	904,568	1,244,771	22.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TK	904,563	1,244,765	22.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tK	905,280	1,244,430	15.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TL	904,567	1,244,760	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tL	905,292	1,244,426	15.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TM	904,555	1,244,754	23.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tM	905,298	1,244,439	14.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tN	905,286	1,244,440	14.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TN	904,582	1,244,763	22.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tO	905,294	1,244,467	14.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TO	904,594	1,244,755	22.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TP	904,579	1,244,750	23.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tP	905,316	1,244,465	14.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tQ	905,321	1,244,431	15.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TQ	904,589	1,244,744	23.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tR	905,339	1,244,420	15.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TR	904,582	1,244,734	23.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TS	904,547	1,244,744	23.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tS	905,347	1,244,410	15.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TT	904,603	1,244,723	22.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tT	905,352	1,244,407	16.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tU	905,360	1,244,399	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TU	904,597	1,244,710	22.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tV	905,366	1,244,398	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TV	904,553	1,244,726	24.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TW	904,527	1,244,737	24.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tW	905,378	1,244,398	16.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tX	905,349	1,244,462	15.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TX	904,522	1,244,721	24.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tY	905,344	1,244,461	15.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TY	904,521	1,244,740	24.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
TZ	904,516	1,244,729	25.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
tZ	905,285	1,244,481	14.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
U	903,339	1,245,834	15.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UA	904,514	1,244,745	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uA	905,385	1,244,387	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UB	904,509	1,244,746	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uB	905,364	1,244,354	18.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UC	904,514	1,244,752	23.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uC	905,356	1,244,348	18.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UD	904,498	1,244,753	23.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uD	905,357	1,244,339	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uE	905,346	1,244,352	18.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UE	904,492	1,244,753	23.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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Calculated:
1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
uF	905,325	1,244,356	17.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UF	904,507	1,244,730	24.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UG	904,497	1,244,731	24.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uG	905,285	1,244,360	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uH	905,275	1,244,362	16.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UH	904,489	1,244,734	24.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uI	905,261	1,244,366	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UI	904,479	1,244,757	23.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UJ	904,474	1,244,760	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uJ	905,230	1,244,375	15.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uK	905,195	1,244,383	15.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UK	904,475	1,244,771	22.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UL	904,468	1,244,774	22.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uL	905,192	1,244,366	16.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uM	905,235	1,244,358	16.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UM	904,465	1,244,767	22.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uN	905,157	1,244,393	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UN	904,472	1,244,744	23.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UO	904,461	1,244,742	23.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uO	905,114	1,244,413	19.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uP	905,104	1,244,417	19.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UP	904,455	1,244,748	23.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UQ	904,442	1,244,753	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uQ	905,089	1,244,429	18.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UR	904,439	1,244,760	22.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uR	905,079	1,244,464	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uS	905,067	1,244,471	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
US	904,428	1,244,753	22.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uT	905,067	1,244,465	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UT	904,449	1,244,758	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uU	905,065	1,244,459	17.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UU	904,420	1,244,774	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UV	904,423	1,244,745	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uV	905,040	1,244,472	17.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UW	904,416	1,244,738	21.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uW	905,048	1,244,469	17.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UX	904,411	1,244,730	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uX	905,035	1,244,461	17.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UY	904,440	1,244,719	22.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uY	905,038	1,244,443	18.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
uZ	905,029	1,244,444	18.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
UZ	904,446	1,244,715	22.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
V	903,269	1,245,712	17.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VA	904,480	1,244,694	24.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vA	905,029	1,244,456	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vB	905,035	1,244,430	18.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VB	904,490	1,244,693	24.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vC	905,028	1,244,431	18.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VC	904,492	1,244,701	24.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VD	904,619	1,244,669	23.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vD	905,031	1,244,423	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VE	904,658	1,244,674	21.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vE	905,058	1,244,425	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vF	905,068	1,244,425	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VF	904,509	1,244,659	25.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VG	904,477	1,244,663	24.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vG	905,055	1,244,441	17.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vH	905,034	1,244,415	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VH	904,446	1,244,656	23.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vI	905,060	1,244,401	18.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VI	904,451	1,244,655	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VJ	904,439	1,244,653	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0

To be continued on next page...

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
vJ	905,026	1,244,391	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vK	905,008	1,244,421	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VK	904,518	1,244,629	25.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VL	904,448	1,244,634	25.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vL	904,998	1,244,409	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VM	904,442	1,244,633	25.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vM	904,973	1,244,411	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VN	904,419	1,244,639	24.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vN	904,962	1,244,409	21.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VO	904,405	1,244,641	24.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vO	904,953	1,244,413	21.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vP	904,950	1,244,406	21.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VP	904,303	1,244,659	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vQ	905,020	1,244,484	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VQ	904,530	1,244,589	26.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VR	904,532	1,244,522	25.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vR	905,008	1,244,344	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vS	905,016	1,244,344	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VS	904,518	1,244,534	25.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vT	905,011	1,244,319	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VT	904,426	1,244,608	27.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VU	904,415	1,244,611	27.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vU	905,076	1,244,238	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vV	905,069	1,244,257	20.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VV	904,300	1,244,610	27.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vW	905,069	1,244,265	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VW	904,294	1,244,610	27.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vX	905,074	1,244,276	20.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VX	904,275	1,244,612	28.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VY	904,404	1,244,301	27.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vY	905,067	1,244,289	20.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
VZ	904,807	1,244,509	22.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
vZ	905,082	1,244,289	20.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
W	903,285	1,245,697	16.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wA	905,085	1,244,271	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WA	904,815	1,244,477	23.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wB	905,111	1,244,293	20.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WB	904,834	1,244,474	22.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WC	904,887	1,244,530	19.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wC	905,120	1,244,291	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WD	904,895	1,244,539	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wD	905,140	1,244,283	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WE	904,273	1,244,974	22.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wE	905,148	1,244,290	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wF	905,066	1,244,332	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WF	904,227	1,244,931	21.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wG	905,086	1,244,341	20.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WG	904,226	1,244,991	23.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WH	904,202	1,245,015	24.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wH	905,098	1,244,345	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wI	905,374	1,244,249	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WI	904,208	1,245,028	24.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wJ	905,384	1,244,254	20.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WJ	904,202	1,245,030	24.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wK	905,417	1,244,245	19.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WK	904,195	1,245,036	25.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wL	905,352	1,244,277	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WL	904,191	1,245,031	25.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wM	905,367	1,244,287	20.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WM	904,187	1,245,041	25.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wN	905,314	1,244,271	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WN	904,178	1,245,044	26.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0

To be continued on next page...

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ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
wO	905,315	1,244,265	21.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WO	904,162	1,245,036	26.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WP	904,155	1,245,026	26.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wP	905,304	1,244,249	20.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wQ	905,274	1,244,245	20.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WQ	904,170	1,244,994	24.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WR	904,143	1,245,007	25.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wR	905,273	1,244,240	20.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WS	904,134	1,245,012	26.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wS	905,257	1,244,228	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WT	904,144	1,245,033	26.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wT	905,273	1,244,194	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wU	905,290	1,244,178	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WU	904,158	1,245,048	27.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WV	904,137	1,245,063	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wV	905,276	1,244,298	19.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WW	904,159	1,245,064	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wW	905,285	1,244,298	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WX	904,125	1,244,984	25.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wX	905,322	1,244,307	20.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WY	904,119	1,244,971	25.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wY	905,321	1,244,295	20.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
wZ	905,330	1,244,304	20.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
WZ	904,108	1,244,961	25.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
X	903,253	1,245,575	22.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XA	904,094	1,244,956	26.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xA	905,277	1,244,333	17.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xB	905,290	1,244,332	18.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XB	904,116	1,244,943	24.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xC	905,333	1,244,108	18.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XC	904,097	1,245,003	26.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XD	904,116	1,245,020	26.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xD	905,341	1,244,044	21.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XE	904,097	1,245,029	26.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xE	905,268	1,244,103	20.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XF	904,123	1,245,047	27.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xF	905,229	1,244,050	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xG	905,226	1,244,065	21.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XG	904,114	1,245,050	27.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xH	905,201	1,244,080	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XH	904,109	1,245,053	27.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XI	904,119	1,245,069	27.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xI	905,160	1,244,071	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xJ	905,192	1,244,025	21.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XJ	904,124	1,245,068	27.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XK	904,089	1,245,033	26.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xK	905,364	1,244,024	20.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XL	904,088	1,245,011	26.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xL	905,378	1,243,996	17.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xM	905,289	1,243,960	19.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XM	904,111	1,245,073	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xN	905,246	1,243,988	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XN	904,096	1,245,059	26.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xO	905,202	1,243,811	20.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XO	904,084	1,245,067	26.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XP	904,076	1,245,067	26.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xP	905,262	1,243,866	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XQ	904,090	1,245,080	26.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xQ	905,088	1,243,874	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xR	905,134	1,243,684	19.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XR	904,085	1,245,095	25.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XS	904,070	1,245,071	25.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0

To be continued on next page...

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ERM
Level 3, 09 Dinh Tien Hoang St
VN-DAKAO WARD, District 1

Phat Tran / phat.tran@erm.com
Calculated:
1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]		[m]
xS	905,000	1,243,702	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xT	904,961	1,243,716	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XT	904,065	1,245,075	25.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xU	905,398	1,243,657	16.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XU	904,059	1,245,081	25.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XV	904,063	1,245,095	25.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xV	905,369	1,243,654	15.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xW	905,412	1,243,293	24.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XW	904,066	1,245,102	25.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XX	904,048	1,245,080	25.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xX	905,389	1,243,284	25.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XY	904,048	1,245,112	25.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xY	905,345	1,243,243	24.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
xZ	905,325	1,243,221	23.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
XZ	904,041	1,245,117	26.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
Y	903,408	1,245,473	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yA	905,326	1,243,207	23.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YA	904,038	1,245,094	26.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YB	904,026	1,245,100	26.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yB	905,322	1,243,197	23.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yC	905,323	1,243,175	23.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YC	904,018	1,245,085	25.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yD	905,318	1,243,166	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YD	904,031	1,245,080	25.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YE	904,023	1,245,125	26.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yE	905,311	1,243,155	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YF	904,009	1,245,103	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yF	905,321	1,243,140	24.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YG	903,995	1,245,136	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yG	905,307	1,243,108	22.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YH	903,990	1,245,140	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yH	905,294	1,243,082	21.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yI	905,281	1,243,091	21.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YI	903,986	1,245,143	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yJ	905,266	1,243,037	23.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YJ	903,981	1,245,147	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YK	903,985	1,245,115	26.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yK	905,284	1,243,032	24.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YL	903,973	1,245,121	26.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yL	905,288	1,243,044	23.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yM	905,251	1,243,017	23.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YM	903,969	1,245,124	26.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YN	903,963	1,245,125	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yN	905,169	1,243,107	23.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YO	903,958	1,245,130	26.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yO	905,150	1,243,055	25.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YP	903,952	1,245,152	26.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yP	905,137	1,243,016	27.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YQ	903,943	1,245,138	26.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yQ	905,069	1,242,975	29.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YR	903,936	1,245,165	25.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yR	905,174	1,243,201	22.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YS	903,927	1,245,146	26.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yS	905,175	1,243,192	22.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YT	903,913	1,245,149	26.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yT	905,170	1,243,183	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yU	905,195	1,243,172	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YU	903,914	1,245,175	24.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YV	903,891	1,245,150	26.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yV	905,201	1,243,185	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YW	903,876	1,245,164	25.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yW	905,222	1,243,170	23.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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Calculated:
1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]		[m]
YX	903,868	1,245,165	25.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yX	905,122	1,243,249	21.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yY	905,115	1,243,259	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YY	903,875	1,245,154	25.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
YZ	903,866	1,245,157	25.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
yZ	905,098	1,243,237	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
Z	903,417	1,245,469	21.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zA	905,087	1,243,189	20.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZA	903,878	1,245,174	24.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zB	905,008	1,243,383	24.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZB	903,888	1,245,182	24.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zC	905,001	1,243,389	24.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZC	903,852	1,245,196	25.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZD	903,802	1,245,223	25.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zD	904,994	1,243,393	25.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zE	905,025	1,243,407	21.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZE	903,806	1,245,234	25.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZF	904,082	1,245,037	26.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zF	904,990	1,243,421	25.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZG	904,070	1,245,044	26.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zG	905,064	1,243,364	23.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZH	904,057	1,245,050	25.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zH	905,071	1,243,358	22.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZI	904,051	1,245,052	25.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zI	905,040	1,243,359	24.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zJ	905,101	1,243,316	22.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZJ	904,043	1,245,056	25.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZK	904,038	1,245,059	25.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zK	905,020	1,244,113	23.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZL	904,015	1,245,064	25.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zL	904,934	1,244,057	24.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zM	904,895	1,244,085	24.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZM	904,010	1,245,073	26.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZN	903,991	1,245,074	26.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zN	904,744	1,244,510	21.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZO	903,975	1,245,087	26.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zO	904,172	1,244,628	30.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zP	904,240	1,244,460	27.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZP	903,969	1,245,092	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZQ	903,970	1,245,083	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zQ	904,220	1,244,586	30.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZR	903,962	1,245,095	26.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zR	901,782	1,244,037	49.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZS	903,955	1,245,094	26.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zS	901,798	1,244,078	50.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zT	901,937	1,244,111	42.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZT	903,947	1,245,104	26.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZU	903,950	1,245,110	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zU	904,948	1,242,737	19.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zV	904,940	1,242,737	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZV	903,901	1,245,127	27.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zW	904,931	1,242,745	20.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZW	903,893	1,245,123	27.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZX	903,883	1,245,140	26.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zX	904,915	1,242,723	18.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZY	903,880	1,245,134	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zY	904,875	1,242,746	22.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
ZZ	903,886	1,245,110	28.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
zZ	904,876	1,242,727	21.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[A	903,892	1,245,107	28.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[B	903,896	1,245,105	28.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[C	903,904	1,245,101	28.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
[D	903,918	1,245,095	27.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[E	903,938	1,245,086	27.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[F	903,945	1,245,082	27.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[G	903,950	1,245,077	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[H	903,958	1,245,074	26.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[I	903,965	1,245,070	26.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[J	903,969	1,245,068	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[K	903,975	1,245,065	26.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[L	903,983	1,245,062	26.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[M	904,014	1,245,047	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[N	904,027	1,245,043	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[O	904,048	1,245,030	26.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[P	904,056	1,245,027	26.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[Q	904,064	1,245,022	26.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[R	904,090	1,245,004	26.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[S	904,113	1,245,014	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[T	904,079	1,244,935	26.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[U	904,074	1,244,946	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[V	904,089	1,244,986	26.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[W	904,080	1,244,987	26.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[X	904,065	1,244,991	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[Y	904,062	1,244,995	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
[Z	904,033	1,245,007	27.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\A	904,020	1,245,013	27.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\B	904,013	1,245,018	27.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\C	904,038	1,244,979	27.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\D	904,029	1,244,985	27.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\E	904,023	1,244,988	27.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\F	904,017	1,244,993	27.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\G	904,004	1,244,997	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\H	903,999	1,245,023	27.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\I	903,992	1,245,008	27.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\J	903,994	1,245,026	27.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\K	903,985	1,245,033	27.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\L	903,962	1,245,040	27.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\M	903,964	1,245,019	28.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\N	903,955	1,245,022	28.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\O	904,001	1,245,043	26.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\P	903,962	1,245,063	26.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\Q	903,953	1,245,067	26.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\R	903,942	1,245,054	27.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\S	903,932	1,245,057	28.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\T	903,924	1,245,059	28.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\U	903,917	1,245,062	28.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\V	903,918	1,245,040	29.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\W	903,933	1,245,037	28.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\X	903,951	1,245,045	27.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\Y	903,934	1,245,019	28.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
\Z	903,909	1,245,071	28.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]A	903,902	1,245,072	28.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]B	903,895	1,245,074	28.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]C	903,888	1,245,078	28.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]D	903,879	1,245,056	28.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]E	903,872	1,245,059	28.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]F	903,862	1,245,062	28.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]G	903,854	1,245,063	27.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]H	903,855	1,245,092	27.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]I	903,865	1,245,086	28.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]J	903,827	1,245,069	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]K	903,823	1,245,072	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]L	903,817	1,245,073	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]M	903,813	1,245,074	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
]N	903,808	1,245,078	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]O	903,802	1,245,078	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]P	903,797	1,245,082	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]Q	903,777	1,245,083	27.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]R	903,778	1,245,113	26.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]S	903,767	1,245,087	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]T	903,759	1,245,032	28.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]U	903,766	1,245,027	28.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]V	903,769	1,245,058	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]W	903,790	1,245,012	28.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]X	903,801	1,245,010	28.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]Y	903,801	1,245,027	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
]Z	903,808	1,245,041	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^A	903,822	1,245,046	27.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^B	903,832	1,245,045	27.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^C	903,841	1,245,044	27.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^D	903,846	1,245,042	27.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^E	903,854	1,245,040	27.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^F	903,863	1,245,038	28.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^G	903,869	1,245,036	28.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^H	903,868	1,245,032	28.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^I	903,875	1,245,024	28.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^J	903,864	1,245,020	28.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^K	903,849	1,245,031	27.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^L	903,817	1,245,004	28.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^M	903,875	1,245,017	28.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^N	903,881	1,245,014	28.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^O	903,886	1,245,012	28.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^P	903,891	1,245,009	29.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^Q	903,892	1,245,004	29.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^R	903,890	1,245,000	29.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^S	903,894	1,244,990	29.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^T	903,896	1,244,988	28.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^U	903,913	1,244,984	28.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^V	903,919	1,244,999	29.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^W	903,928	1,244,995	28.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^X	903,875	1,244,963	30.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^Y	903,838	1,244,990	29.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
^Z	903,724	1,245,012	29.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_A	903,734	1,245,013	29.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_B	903,745	1,245,004	29.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_C	903,748	1,245,001	29.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_D	903,754	1,244,998	29.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_E	903,790	1,244,984	29.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_F	903,818	1,244,971	30.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_G	903,823	1,244,969	30.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_H	903,848	1,244,957	31.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_I	903,806	1,244,936	31.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_J	903,812	1,244,935	31.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_K	903,824	1,244,933	31.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_L	903,765	1,244,951	30.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_M	903,746	1,244,957	30.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_N	903,716	1,244,984	30.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_O	903,715	1,244,911	32.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_P	903,725	1,244,908	31.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_Q	903,729	1,244,904	31.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_R	903,762	1,244,923	29.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_S	903,771	1,244,920	29.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_T	903,792	1,244,916	31.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_U	903,799	1,244,915	31.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_V	903,809	1,244,913	31.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_W	903,812	1,244,911	31.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0

To be continued on next page...

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Calculated:
1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Easting	Northing	Z [m]	Width [m]	Height [m]	Elevation a.g.l. [m]	Slope of window [°]	Direction mode	Eye height (ZVI) a.g.l. [m]
_X	903,819	1,244,907	32.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_Y	903,836	1,244,903	31.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
_Z	903,789	1,244,939	30.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`A	903,780	1,244,900	30.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`B	903,748	1,244,885	29.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`C	903,738	1,244,875	30.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`D	903,736	1,244,865	30.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`E	903,766	1,244,861	30.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`F	903,759	1,244,861	30.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`G	903,774	1,244,864	30.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`H	903,777	1,244,872	30.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`I	903,657	1,244,871	32.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`J	903,676	1,244,897	32.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`K	903,706	1,244,823	30.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`L	903,714	1,244,820	30.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`M	903,619	1,244,912	33.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`N	903,577	1,244,896	35.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`O	903,570	1,244,921	34.8	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`P	903,661	1,244,851	31.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`Q	903,916	1,244,964	28.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`R	903,927	1,244,957	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`S	903,933	1,244,952	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`T	903,942	1,244,949	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`U	903,936	1,244,979	28.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`V	903,945	1,244,975	28.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`W	903,954	1,244,970	28.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`X	903,960	1,244,968	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`Y	904,009	1,244,972	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
`Z	904,008	1,244,968	28.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{A	904,850	1,242,722	23.6	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{B	904,974	1,242,755	20.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{C	905,000	1,242,728	19.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{D	904,993	1,242,730	19.4	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{E	904,986	1,242,730	19.2	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{F	904,973	1,242,720	19.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{G	905,010	1,242,730	19.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{H	905,043	1,242,743	22.0	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{I	905,051	1,242,756	22.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{J	905,086	1,242,773	21.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{K	905,200	1,242,909	25.9	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{L	905,198	1,242,889	25.7	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{M	904,281	1,243,740	27.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{N	904,493	1,243,573	29.3	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{O	904,625	1,243,655	27.1	1.0	1.0	1.0	90.0	"Green house mode"	2.0
{P	904,617	1,243,687	24.5	1.0	1.0	1.0	90.0	"Green house mode"	2.0

Calculation Results

Shadow receptor

No.	Shadow, worst case: Shadow hours per year [h/year]	Shadow, worst case: Shadow days per year [days/year]	Shadow, worst case: Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
A	0:00	0	0:00	0:00
AA	0:00	0	0:00	0:00
aA	51:38	113	0:43	21:02
AB	0:00	0	0:00	0:00
aB	35:45	108	0:30	14:22
aC	33:05	107	0:30	13:17
AC	0:00	0	0:00	0:00
aD	57:19	115	0:46	23:21

To be continued on next page...

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Calculated:
1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

	Shadow, worst case			Shadow, expected values
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
AD	0:00	0	0:00	0:00
AE	0:00	0	0:00	0:00
aE	59:01	117	0:47	24:02
aF	50:40	114	0:43	20:36
AF	0:00	0	0:00	0:00
aG	60:16	118	0:48	24:29
AG	0:00	0	0:00	0:00
aH	57:11	116	0:47	23:14
AH	0:00	0	0:00	0:00
aI	67:34	121	0:49	27:26
AI	0:00	0	0:00	0:00
aJ	71:35	123	0:48	28:57
AJ	0:00	0	0:00	0:00
aK	73:21	124	0:49	29:39
AK	0:00	0	0:00	0:00
AL	0:00	0	0:00	0:00
aL	73:27	125	0:47	29:41
AM	0:00	0	0:00	0:00
aM	76:26	127	0:48	30:48
AN	0:00	0	0:00	0:00
aN	78:33	127	0:50	31:39
aO	80:32	129	0:50	32:24
AO	0:00	0	0:00	0:00
AP	0:00	0	0:00	0:00
aP	79:31	127	0:50	32:01
AQ	0:00	0	0:00	0:00
aQ	78:26	127	0:49	31:35
aR	80:16	129	0:49	32:16
AR	0:00	0	0:00	0:00
aS	81:10	131	0:49	32:35
AS	0:00	0	0:00	0:00
AT	0:00	0	0:00	0:00
aT	84:38	135	0:50	33:52
AU	0:00	0	0:00	0:00
aU	84:03	138	0:49	33:33
AV	0:00	0	0:00	0:00
aV	76:34	129	0:47	30:50
aW	75:00	127	0:47	30:15
AW	0:00	0	0:00	0:00
AX	0:00	0	0:00	0:00
aX	75:02	128	0:46	30:13
AY	0:00	0	0:00	0:00
aY	69:21	123	0:46	28:05
aZ	70:53	124	0:45	28:38
AZ	0:00	0	0:00	0:00
B	0:00	0	0:00	0:00
bA	66:22	122	0:45	26:55
BA	0:00	0	0:00	0:00
BB	0:00	0	0:00	0:00
bB	64:54	120	0:44	26:22
bC	66:42	121	0:44	27:03
BC	0:00	0	0:00	0:00
bD	68:19	123	0:44	27:39
BD	0:00	0	0:00	0:00
BE	0:00	0	0:00	0:00
bE	59:28	116	0:46	24:14
BF	0:00	0	0:00	0:00
bF	54:52	113	0:44	22:23
bG	56:28	114	0:45	23:03
BG	0:00	0	0:00	0:00
BH	0:00	0	0:00	0:00

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

	Shadow, worst case			Shadow, expected values
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
bH	57:11	116	0:43	23:21
BI	0:00	0	0:00	0:00
bI	58:50	117	0:43	24:00
BJ	0:00	0	0:00	0:00
bJ	13:00	58	0:18	5:19
bK	18:43	71	0:21	7:42
BK	0:00	0	0:00	0:00
bL	20:31	76	0:21	8:26
BL	0:00	0	0:00	0:00
bM	20:18	76	0:21	8:22
BM	0:00	0	0:00	0:00
bN	18:48	72	0:20	7:45
BN	0:00	0	0:00	0:00
BO	0:00	0	0:00	0:00
bO	24:14	86	0:21	9:56
BP	0:00	0	0:00	0:00
bP	22:46	82	0:21	9:21
BQ	0:00	0	0:00	0:00
bQ	25:36	86	0:21	10:28
BR	0:00	0	0:00	0:00
bR	23:45	81	0:22	9:44
bS	21:58	79	0:22	9:01
BS	0:00	0	0:00	0:00
bT	25:06	84	0:22	10:16
BT	0:00	0	0:00	0:00
BU	0:00	0	0:00	0:00
bU	27:16	91	0:22	11:07
bV	28:10	94	0:22	11:29
BV	0:00	0	0:00	0:00
BW	0:00	0	0:00	0:00
bW	28:03	92	0:23	11:27
BX	0:00	0	0:00	0:00
bX	29:37	91	0:24	12:05
bY	33:58	115	0:24	13:24
BY	0:00	0	0:00	0:00
bZ	30:57	99	0:23	12:35
BZ	0:00	0	0:00	0:00
C	0:00	0	0:00	0:00
cA	29:35	104	0:22	11:58
CA	0:00	0	0:00	0:00
cB	29:57	101	0:23	12:10
CB	0:00	0	0:00	0:00
CC	0:00	0	0:00	0:00
cC	28:45	105	0:22	11:38
CD	0:00	0	0:00	0:00
cD	28:26	104	0:22	11:29
CE	0:00	0	0:00	0:00
cE	27:15	95	0:21	11:06
cF	27:49	101	0:21	11:18
CF	0:00	0	0:00	0:00
CG	0:00	0	0:00	0:00
cG	24:10	94	0:21	9:43
cH	25:44	104	0:20	10:25
CH	0:00	0	0:00	0:00
cI	23:46	99	0:20	9:36
CI	0:00	0	0:00	0:00
CJ	0:00	0	0:00	0:00
cJ	22:10	89	0:20	8:55
CK	0:00	0	0:00	0:00
cK	26:15	103	0:21	10:37
CL	0:00	0	0:00	0:00

To be continued on next page...

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Shadow, worst case: Shadow hours per year [h/year]	Shadow, worst case: Shadow days per year [days/year]	Shadow, worst case: Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
cL	26:37	96	0:21	10:51
CM	0:00	0	0:00	0:00
cM	26:33	98	0:21	10:48
cN	24:16	88	0:20	9:55
CN	0:00	0	0:00	0:00
cO	24:33	92	0:20	10:02
CO	0:00	0	0:00	0:00
CP	0:00	0	0:00	0:00
cP	24:24	90	0:20	9:58
CQ	0:00	0	0:00	0:00
cQ	24:35	92	0:20	10:03
cR	24:30	95	0:20	9:59
CR	0:00	0	0:00	0:00
CS	0:00	0	0:00	0:00
cS	23:48	101	0:20	9:39
CT	0:00	0	0:00	0:00
cT	24:29	101	0:20	9:55
cU	22:38	96	0:20	9:10
CU	0:00	0	0:00	0:00
CV	0:00	0	0:00	0:00
cV	21:52	91	0:20	8:50
cW	19:48	82	0:19	7:57
CW	0:00	0	0:00	0:00
CX	0:00	0	0:00	0:00
cX	20:12	83	0:20	8:05
cY	18:50	77	0:20	7:27
CY	0:00	0	0:00	0:00
cZ	19:17	79	0:20	7:38
CZ	0:00	0	0:00	0:00
D	0:00	0	0:00	0:00
DA	0:00	0	0:00	0:00
dA	19:20	78	0:20	7:40
dB	19:34	80	0:20	7:46
DB	0:00	0	0:00	0:00
DC	0:00	0	0:00	0:00
dC	20:52	84	0:20	8:19
DD	0:00	0	0:00	0:00
dD	18:25	78	0:19	7:22
dE	18:05	76	0:19	7:13
DE	0:00	0	0:00	0:00
dF	16:26	69	0:19	6:27
DF	0:00	0	0:00	0:00
dG	16:05	68	0:19	6:16
DG	0:00	0	0:00	0:00
dH	16:04	67	0:19	6:14
DH	0:00	0	0:00	0:00
dI	13:49	63	0:18	5:20
DI	0:00	0	0:00	0:00
dJ	15:01	74	0:18	5:50
DJ	0:00	0	0:00	0:00
dK	14:01	63	0:18	5:24
DK	0:00	0	0:00	0:00
dL	14:06	63	0:18	5:27
DL	0:00	0	0:00	0:00
DM	0:00	0	0:00	0:00
dM	14:47	63	0:19	5:43
DN	0:00	0	0:00	0:00
dN	15:01	63	0:19	5:48
DO	0:00	0	0:00	0:00
dO	15:21	65	0:19	5:57
DP	0:00	0	0:00	0:00

To be continued on next page...

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

	Shadow, worst case			Shadow, expected values
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
dP	15:49	66	0:19	6:08
dQ	14:44	63	0:19	5:41
DQ	0:10	4	0:03	0:04
dR	14:39	64	0:19	5:38
DR	0:00	0	0:00	0:00
dS	14:54	65	0:19	5:44
DS	1:00	11	0:07	0:24
dT	14:28	61	0:19	5:34
DT	5:22	24	0:16	2:14
DU	7:07	28	0:19	2:58
dU	17:59	83	0:19	7:01
DV	7:58	30	0:19	3:20
dV	19:44	87	0:18	7:45
dW	20:46	92	0:19	8:12
DW	0:00	0	0:00	0:00
dX	22:57	93	0:21	9:08
DX	5:20	24	0:17	2:13
dY	24:40	99	0:22	9:51
DY	1:32	13	0:09	0:38
dZ	25:19	98	0:23	10:09
DZ	0:00	0	0:00	0:00
E	0:00	0	0:00	0:00
eA	27:21	102	0:24	10:58
EA	0:00	0	0:00	0:00
EB	0:00	0	0:00	0:00
eB	28:32	103	0:24	11:27
EC	0:00	0	0:00	0:00
eC	28:20	103	0:24	11:22
eD	26:29	102	0:23	10:36
ED	0:00	0	0:00	0:00
EE	0:00	0	0:00	0:00
eE	28:28	105	0:24	11:25
eF	27:14	100	0:24	10:54
EF	0:00	0	0:00	0:00
EG	0:00	0	0:00	0:00
eG	25:21	97	0:23	10:06
eH	24:49	96	0:22	9:52
EH	0:00	0	0:00	0:00
EI	0:00	0	0:00	0:00
eI	23:10	94	0:21	9:11
EJ	0:00	0	0:00	0:00
eJ	22:32	92	0:20	8:52
EK	0:00	0	0:00	0:00
eK	21:28	89	0:19	8:26
eL	22:46	93	0:20	8:56
EL	2:05	14	0:11	0:51
eM	20:32	88	0:19	8:02
EM	3:48	20	0:15	1:34
eN	18:01	81	0:19	6:59
EN	4:47	22	0:16	1:59
EO	9:01	31	0:22	3:47
eO	18:14	83	0:19	7:04
EP	12:14	36	0:25	5:10
eP	16:51	69	0:20	6:34
EQ	12:46	38	0:25	5:24
eQ	17:25	70	0:20	6:48
ER	15:31	42	0:28	6:35
eR	18:27	75	0:20	7:14
eS	19:10	77	0:20	7:31
ES	12:17	36	0:25	5:11
ET	17:30	44	0:29	7:26

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
eT	21:02	81	0:21	8:18
EU	14:27	40	0:27	6:07
eU	20:36	80	0:21	8:06
eV	20:56	80	0:21	8:15
EV	18:45	46	0:30	7:57
eW	22:41	84	0:22	8:58
EW	0:00	0	0:00	0:00
eX	19:03	73	0:21	7:25
EX	0:00	0	0:00	0:00
EY	0:00	0	0:00	0:00
eY	19:06	74	0:21	7:24
EZ	0:00	0	0:00	0:00
eZ	19:28	74	0:21	7:33
F	0:00	0	0:00	0:00
fA	20:29	75	0:22	7:58
FA	7:50	29	0:20	3:17
FB	10:58	34	0:24	4:37
fB	21:09	78	0:22	8:16
FC	1:56	14	0:11	0:48
fC	24:53	89	0:23	9:51
fD	23:14	83	0:23	9:08
FD	5:08	24	0:17	2:08
FE	4:32	22	0:15	1:53
fE	22:02	78	0:23	8:33
fF	27:04	95	0:23	10:47
FF	8:35	30	0:21	3:36
fG	24:46	85	0:24	9:42
FG	16:42	44	0:28	7:05
FH	27:37	60	0:32	11:40
fH	26:08	88	0:24	10:15
fI	32:39	103	0:24	13:13
FI	29:32	64	0:31	12:27
FJ	25:44	58	0:31	10:53
fJ	31:37	106	0:23	12:46
fK	37:38	136	0:25	14:23
FK	29:17	64	0:32	12:21
fL	29:16	108	0:24	10:50
FL	31:05	68	0:31	13:05
FM	31:44	70	0:31	13:20
fM	24:08	82	0:24	9:21
fN	29:44	107	0:25	10:55
FN	32:57	74	0:31	13:48
fO	30:15	108	0:25	11:08
FO	30:54	68	0:31	13:00
fP	27:23	100	0:25	9:58
FP	28:12	64	0:31	11:53
FQ	29:03	66	0:30	12:14
fQ	26:18	97	0:25	9:21
fR	27:02	99	0:25	9:41
FR	28:43	64	0:30	12:06
FS	24:13	56	0:30	10:15
fS	25:57	95	0:25	9:05
fT	21:01	71	0:24	7:49
FT	24:28	56	0:30	10:21
FU	29:50	68	0:30	12:33
fU	21:12	73	0:24	7:56
fV	21:43	73	0:24	8:17
FV	30:27	70	0:30	12:47
FW	30:43	70	0:30	12:53
fW	20:32	71	0:24	7:43
fX	20:13	79	0:23	7:30

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
FX	33:06	76	0:30	13:50
fY	21:29	84	0:23	8:03
FY	33:15	76	0:30	13:54
fZ	25:37	93	0:22	9:46
FZ	33:33	78	0:30	14:00
G	0:00	0	0:00	0:00
GA	31:33	74	0:30	13:13
gA	27:47	100	0:22	10:41
gB	22:08	87	0:22	8:22
GB	33:17	80	0:29	13:53
gC	19:53	80	0:22	7:29
GC	33:06	81	0:29	13:47
GD	32:53	82	0:29	13:41
gD	18:24	66	0:22	6:54
GE	32:30	84	0:28	13:30
gE	19:46	70	0:23	7:32
gF	20:12	72	0:23	7:44
GF	32:04	78	0:29	13:23
gG	20:37	75	0:23	7:55
GG	31:52	80	0:28	13:17
gH	19:17	71	0:22	7:25
GH	32:06	76	0:29	13:25
GI	30:57	86	0:28	12:51
gI	18:25	67	0:22	7:01
GJ	27:45	82	0:28	11:32
gJ	19:53	74	0:22	7:40
gK	28:13	99	0:23	10:58
GK	24:54	70	0:28	10:21
GL	26:37	78	0:28	11:04
gL	30:49	105	0:25	12:03
gM	31:40	106	0:26	12:23
GM	30:32	85	0:28	12:41
GN	31:19	84	0:28	13:00
gN	34:06	111	0:28	13:22
gO	30:51	105	0:25	12:00
GO	24:17	69	0:28	10:05
gP	29:01	101	0:24	11:14
GP	22:24	64	0:27	9:17
gQ	37:48	115	0:29	14:46
GQ	23:16	66	0:27	9:39
gR	34:27	111	0:27	13:24
GR	28:49	86	0:27	11:58
GS	26:25	79	0:27	10:59
gS	32:01	106	0:26	12:23
GT	24:41	72	0:27	10:16
gT	38:27	115	0:30	14:56
GU	23:31	68	0:27	9:46
gU	35:16	111	0:28	13:37
gV	26:38	95	0:24	10:01
GV	21:47	62	0:27	9:01
gW	25:20	99	0:24	8:49
GW	21:04	60	0:27	8:43
gX	29:43	116	0:24	10:35
GX	20:27	61	0:27	8:27
GY	21:55	64	0:27	9:05
gY	17:39	67	0:21	6:46
gZ	16:42	67	0:20	6:25
GZ	21:11	71	0:27	8:45
H	0:00	0	0:00	0:00
hA	16:18	66	0:20	6:16
HA	22:02	74	0:26	9:07

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No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
hB	17:50	71	0:20	6:56
HB	19:53	58	0:26	8:13
HC	19:06	56	0:26	7:54
hC	17:33	70	0:20	6:49
hD	16:03	66	0:20	6:13
HD	22:31	78	0:26	9:21
HE	18:24	54	0:26	7:36
hE	16:42	68	0:20	6:29
hF	15:22	63	0:20	5:53
HF	17:43	52	0:26	7:20
hG	15:13	63	0:20	5:49
HG	17:49	53	0:26	7:22
hH	15:36	64	0:19	5:59
HH	17:25	52	0:25	7:13
HI	18:10	55	0:26	7:30
hI	16:55	76	0:20	6:28
hJ	20:18	86	0:20	7:51
HJ	18:28	56	0:25	7:38
hK	18:54	82	0:20	7:17
HK	19:42	58	0:26	8:09
hL	18:54	81	0:20	7:16
HL	19:16	58	0:25	7:57
hM	15:41	64	0:20	5:58
HM	22:12	66	0:26	9:13
HN	23:48	73	0:26	9:54
hN	15:49	64	0:20	6:02
HO	27:39	84	0:26	11:28
hO	16:22	67	0:20	6:15
hP	16:25	65	0:20	6:16
HP	30:50	80	0:27	12:50
hQ	21:09	87	0:20	8:10
HQ	30:27	76	0:28	12:42
hR	23:52	92	0:20	9:16
HR	30:30	76	0:28	12:45
HS	29:48	74	0:28	12:28
hS	17:45	67	0:22	6:45
hT	26:17	97	0:23	10:19
HT	29:56	72	0:29	12:32
HU	29:30	70	0:28	12:22
hU	22:32	91	0:20	8:45
HV	29:24	70	0:29	12:20
hV	27:34	100	0:24	10:52
HW	28:30	66	0:29	11:59
hW	30:00	104	0:25	11:53
HX	28:25	66	0:29	11:57
hX	18:56	83	0:20	7:19
hY	19:48	86	0:19	7:41
HY	19:43	50	0:29	8:21
HZ	20:26	50	0:29	8:39
hZ	20:35	89	0:20	8:00
I	0:00	0	0:00	0:00
IA	22:28	54	0:30	9:30
iA	28:12	101	0:24	11:10
iB	28:34	104	0:25	11:21
IB	24:21	58	0:29	10:17
iC	26:42	99	0:23	10:37
IC	20:32	52	0:28	8:41
iD	30:21	107	0:25	12:06
ID	18:53	49	0:28	8:00
IE	18:33	48	0:28	7:51
iE	29:38	104	0:26	11:48

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Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
IF	16:38	46	0:27	7:03
iF	30:00	106	0:25	11:59
iG	31:12	110	0:24	12:30
IG	15:59	44	0:27	6:46
iH	31:52	112	0:24	12:45
IH	13:57	40	0:26	5:54
iI	32:24	113	0:24	12:57
II	8:26	30	0:21	3:32
IJ	8:53	32	0:21	3:44
iJ	32:33	112	0:24	13:01
IK	4:50	22	0:16	2:00
iK	33:15	116	0:24	13:16
IL	7:14	28	0:19	3:01
iL	33:45	116	0:24	13:26
iM	34:29	120	0:24	13:43
IM	26:31	83	0:25	11:00
IN	20:53	64	0:25	8:39
iN	33:28	115	0:24	13:20
IO	20:08	62	0:25	8:20
iO	26:07	86	0:23	10:53
IP	18:58	56	0:25	7:50
iP	31:40	112	0:23	12:40
IQ	18:36	56	0:25	7:41
iQ	31:37	114	0:23	12:39
iR	32:26	114	0:23	12:57
IR	17:55	55	0:25	7:23
iS	33:14	118	0:23	13:14
IS	17:15	54	0:24	7:07
iT	33:24	116	0:24	13:19
IT	25:12	84	0:25	10:28
iU	34:16	121	0:24	13:35
IU	23:46	77	0:25	9:53
iV	34:37	122	0:24	13:43
IV	20:30	64	0:25	8:30
iW	34:09	120	0:24	13:32
IW	19:14	61	0:25	7:57
IX	18:39	58	0:24	7:42
iX	34:29	123	0:23	13:40
iY	34:47	120	0:24	13:48
IY	17:27	54	0:24	7:12
IZ	18:25	59	0:24	7:36
iZ	28:13	94	0:23	11:40
J	0:00	0	0:00	0:00
JA	20:39	66	0:24	8:35
jA	27:28	91	0:23	11:24
JB	21:16	68	0:24	8:50
jB	29:30	100	0:23	12:07
JC	25:37	80	0:24	10:39
jC	29:36	102	0:23	12:07
JD	17:47	56	0:24	7:21
jD	28:50	97	0:23	11:51
JE	19:12	63	0:24	7:58
jE	29:12	102	0:23	11:57
jF	28:01	106	0:22	11:26
JF	18:35	60	0:23	7:42
jG	26:44	106	0:22	10:54
JG	16:00	53	0:23	6:35
JH	15:04	50	0:23	6:14
jH	24:07	91	0:22	9:47
JI	23:53	64	0:25	10:02
jI	23:34	88	0:23	9:32

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Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
JJ	23:02	62	0:25	9:42
jJ	24:49	92	0:23	10:04
jK	31:06	122	0:23	12:04
JK	21:21	58	0:25	9:00
jL	35:16	130	0:24	13:48
JL	20:39	56	0:25	8:43
jM	35:51	129	0:24	14:03
JM	14:40	44	0:25	6:01
JN	14:19	44	0:24	5:52
jN	36:04	131	0:24	14:06
JO	14:26	44	0:24	5:57
jO	35:54	124	0:24	14:10
JP	14:53	46	0:25	6:08
jP	36:59	126	0:25	14:33
JQ	13:54	43	0:24	5:40
jQ	37:45	128	0:25	14:51
JR	13:24	42	0:24	5:29
jR	37:24	125	0:25	14:46
jS	35:14	117	0:25	14:00
JS	13:14	43	0:23	5:24
jT	34:53	116	0:25	13:52
JT	14:02	44	0:24	5:46
jU	34:38	115	0:26	13:46
JU	12:53	41	0:23	5:15
JV	12:13	40	0:23	4:55
jV	34:31	113	0:26	13:43
JW	12:15	44	0:23	4:55
jW	34:31	113	0:26	13:42
jX	33:41	112	0:26	13:23
JX	17:00	62	0:23	6:51
JY	11:56	39	0:23	4:48
jY	34:38	113	0:26	13:45
jZ	33:25	110	0:26	13:17
JZ	12:59	42	0:23	5:19
K	0:00	0	0:00	0:00
KA	12:40	42	0:23	5:11
kA	34:36	114	0:26	13:44
KB	13:40	44	0:23	5:38
kB	34:57	114	0:27	13:51
kC	35:04	114	0:27	13:53
KC	14:45	48	0:24	6:07
kD	31:32	108	0:26	12:27
KD	14:11	45	0:23	5:53
KE	16:43	52	0:25	6:55
kE	29:42	105	0:25	11:41
KF	16:57	52	0:25	7:01
kF	33:35	111	0:27	13:17
kG	22:51	90	0:21	8:47
KG	16:48	51	0:25	6:57
KH	15:45	48	0:25	6:32
kH	29:08	102	0:24	11:23
KI	16:33	52	0:24	6:50
kI	34:00	110	0:27	13:23
KJ	21:23	70	0:23	8:42
kJ	32:09	107	0:26	12:38
KK	26:04	77	0:27	10:40
kK	33:53	110	0:27	13:19
KL	28:43	80	0:30	11:48
kL	34:42	109	0:28	13:41
KM	30:42	85	0:30	12:37
kM	35:51	115	0:28	14:09

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Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
KN	34:21	90	0:32	14:07
kN	36:58	117	0:27	14:37
kO	38:10	119	0:27	15:05
KO	37:02	93	0:33	15:13
KP	35:36	92	0:33	14:38
kP	40:01	122	0:28	15:45
KQ	33:58	89	0:32	13:58
kQ	38:37	118	0:28	15:13
kR	39:24	124	0:27	15:31
KR	32:36	88	0:31	13:25
kS	40:28	126	0:27	15:54
KS	11:50	40	0:22	4:50
kT	40:40	128	0:27	15:58
KT	15:10	58	0:22	6:09
kU	38:53	124	0:26	15:20
KU	26:28	78	0:27	10:53
kV	37:40	119	0:27	14:53
KV	23:43	74	0:26	9:44
KW	25:16	77	0:27	10:23
kW	38:34	125	0:26	15:11
kX	38:08	128	0:25	14:57
KX	30:00	84	0:30	12:21
kY	38:01	132	0:25	14:50
KY	27:40	80	0:28	11:23
kZ	37:28	134	0:25	14:34
KZ	21:29	71	0:24	8:48
L	0:00	0	0:00	0:00
LA	30:10	86	0:29	12:25
lA	39:09	130	0:26	15:21
LB	32:55	90	0:31	13:33
lB	39:10	131	0:26	15:17
lC	40:00	132	0:26	15:39
LC	34:20	90	0:32	14:08
lD	39:39	128	0:26	15:33
LD	39:41	97	0:33	16:17
lE	40:39	132	0:26	15:51
LE	41:05	100	0:33	16:51
lF	40:28	129	0:26	15:51
LF	42:29	102	0:33	17:25
lG	21:56	82	0:23	8:48
LG	36:28	91	0:33	14:59
LH	38:21	97	0:32	15:45
lH	21:25	78	0:23	8:34
LI	36:20	94	0:32	14:56
lI	22:23	82	0:23	8:59
LJ	32:24	88	0:30	13:21
lJ	22:56	84	0:23	9:13
LK	33:51	91	0:31	13:56
lK	21:54	80	0:23	8:46
LL	29:54	85	0:30	12:20
lL	21:04	79	0:22	8:28
lM	20:12	77	0:22	8:04
LM	27:48	82	0:29	11:27
lN	19:15	75	0:22	7:42
LN	30:03	84	0:30	12:24
lO	19:01	73	0:22	7:36
LO	34:35	92	0:31	14:14
lP	19:21	73	0:22	7:43
LP	32:09	88	0:30	13:15
lQ	20:36	75	0:23	8:14
LQ	34:57	92	0:31	14:23

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Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
LR	38:31	100	0:31	15:48
lR	19:58	73	0:23	7:58
lS	19:48	73	0:23	7:53
LS	34:25	92	0:30	14:10
lT	20:06	73	0:23	8:01
LT	40:04	101	0:31	16:25
lU	20:40	76	0:23	8:15
LU	40:27	104	0:30	16:34
lV	21:31	79	0:23	8:36
LV	41:10	106	0:30	16:51
lW	18:31	71	0:22	7:23
LW	39:20	103	0:30	16:07
LX	37:44	99	0:30	15:30
lX	19:11	73	0:22	7:39
LY	35:43	94	0:30	14:42
lY	18:40	72	0:22	7:26
LZ	26:55	80	0:28	11:07
lZ	18:11	69	0:22	7:14
M	0:00	0	0:00	0:00
MA	29:22	83	0:29	12:07
mA	18:20	69	0:22	7:17
MB	18:56	67	0:22	7:46
mB	17:21	66	0:22	6:53
mC	17:30	68	0:22	6:58
MC	17:56	66	0:21	7:22
MD	28:39	85	0:28	11:50
mD	17:47	68	0:22	7:05
ME	30:06	86	0:29	12:26
mE	18:26	71	0:22	7:22
MF	26:16	82	0:27	10:51
mF	17:05	69	0:21	6:48
MG	18:08	64	0:21	7:24
mG	16:48	66	0:21	6:41
mH	16:05	63	0:21	6:20
MH	11:08	38	0:21	4:33
MI	11:01	38	0:21	4:30
mI	16:39	66	0:21	6:35
MJ	13:45	57	0:21	5:36
mJ	15:58	63	0:21	6:16
mK	15:51	64	0:21	6:11
MK	11:07	47	0:20	4:33
ML	10:43	38	0:21	4:25
mL	15:30	62	0:21	5:58
mM	15:49	61	0:21	6:08
MM	10:02	37	0:20	4:06
mN	17:08	65	0:22	6:42
MN	10:49	39	0:21	4:29
MO	11:20	40	0:21	4:42
mO	17:06	65	0:22	6:43
mP	17:15	66	0:22	6:47
MP	11:44	42	0:21	4:52
mQ	17:06	66	0:22	6:44
MQ	11:52	42	0:21	4:55
mR	15:45	62	0:21	6:05
MR	11:59	42	0:21	4:59
mS	16:01	62	0:22	6:10
MS	11:38	41	0:21	4:49
MT	10:06	37	0:20	4:10
mT	16:03	62	0:22	6:10
MU	10:04	38	0:20	4:09
mU	16:44	65	0:22	6:33

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Shadow, worst case			Shadow, expected values
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
MV	9:58	36	0:20	4:06
mV	15:16	62	0:21	5:57
MW	22:02	72	0:24	9:06
mW	14:54	61	0:21	5:43
mX	14:51	59	0:21	5:39
MX	24:06	76	0:26	9:58
MY	25:48	80	0:27	10:41
mY	14:47	59	0:21	5:36
MZ	27:37	82	0:28	11:25
mZ	14:50	59	0:21	5:34
N	0:00	0	0:00	0:00
nA	15:59	64	0:21	6:20
NA	31:14	88	0:29	12:54
NB	32:13	90	0:28	13:18
nB	15:07	60	0:21	5:44
NC	34:35	95	0:29	14:14
nC	15:34	61	0:21	5:58
nD	15:22	60	0:21	5:50
ND	33:44	92	0:29	13:54
nE	15:41	62	0:21	5:58
NE	23:23	75	0:25	9:42
nF	14:47	59	0:21	5:28
NF	18:46	68	0:22	7:45
nG	14:39	58	0:21	5:22
NG	11:35	52	0:20	4:46
nH	14:52	59	0:21	5:27
NH	9:09	35	0:19	3:47
NI	9:12	36	0:19	3:49
nI	16:55	74	0:21	6:18
nJ	15:57	62	0:22	5:57
NJ	9:19	36	0:19	3:53
nK	16:36	62	0:22	6:20
NK	9:04	36	0:19	3:46
nL	17:06	65	0:22	6:34
NL	9:54	38	0:20	4:06
nM	17:41	65	0:23	6:54
NM	11:12	42	0:20	4:39
NN	11:37	42	0:21	4:49
nN	17:39	66	0:23	6:55
nO	18:18	69	0:23	7:14
NO	11:46	43	0:21	4:52
NP	12:19	44	0:21	5:06
nP	18:21	68	0:23	7:16
NQ	11:59	42	0:21	4:58
nQ	18:36	70	0:23	7:23
nR	19:22	71	0:23	7:42
NR	34:26	96	0:28	14:10
NS	34:57	98	0:28	14:21
nS	19:24	71	0:23	7:44
NT	32:34	93	0:27	13:25
nT	19:08	72	0:23	7:37
NU	31:11	89	0:28	12:53
nU	20:06	72	0:23	8:00
NV	24:48	79	0:26	10:18
nV	19:15	71	0:23	7:38
nW	18:09	67	0:22	7:10
NW	26:10	82	0:27	10:52
nX	17:54	67	0:23	7:01
NX	18:29	67	0:22	7:39
nY	18:14	66	0:23	7:08
NY	29:38	90	0:26	12:15

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
NZ	32:41	95	0:27	13:27
nZ	19:37	70	0:23	7:46
O	0:00	0	0:00	0:00
oA	20:40	74	0:24	8:14
OA	33:52	100	0:26	13:53
oB	34:21	134	0:24	13:22
OB	33:57	100	0:26	13:55
oC	30:49	118	0:24	11:53
OC	34:57	103	0:27	14:18
oD	29:34	114	0:23	11:23
OD	36:52	104	0:28	15:05
oE	28:55	112	0:23	11:06
OE	36:22	100	0:28	14:55
oF	28:19	110	0:23	10:49
OF	37:14	102	0:29	15:15
OG	37:36	107	0:28	15:21
oG	30:31	117	0:24	11:44
OH	39:04	110	0:28	15:56
oH	30:53	116	0:24	11:52
oI	36:03	133	0:24	14:02
OI	39:35	107	0:29	16:11
OJ	36:43	115	0:28	14:54
oJ	30:23	115	0:24	11:36
oK	31:03	115	0:25	11:53
OK	34:50	116	0:28	14:06
oL	28:28	108	0:24	10:47
OL	35:07	109	0:29	14:11
oM	27:48	107	0:24	10:31
OM	33:03	99	0:29	13:15
ON	34:16	102	0:29	13:48
oN	26:53	104	0:24	10:09
OO	34:37	103	0:29	13:57
oO	25:50	100	0:23	9:44
OP	33:51	98	0:30	13:33
oP	30:30	113	0:25	11:36
oQ	29:26	112	0:24	11:10
OQ	32:45	95	0:30	13:02
OR	32:15	93	0:31	12:46
oR	29:09	108	0:25	11:01
OS	31:36	90	0:30	12:31
oS	25:58	99	0:24	9:45
OT	42:19	115	0:30	17:11
oT	25:46	99	0:24	9:38
OU	42:35	109	0:31	17:23
oU	27:06	103	0:24	10:11
oV	26:38	101	0:24	10:01
OV	42:39	109	0:31	17:25
oW	25:26	98	0:24	9:28
OW	44:15	112	0:31	18:01
oX	26:04	98	0:24	9:43
OX	44:07	118	0:31	17:51
OY	40:56	122	0:31	16:29
oY	26:41	102	0:24	9:59
OZ	45:03	112	0:32	18:22
oZ	29:20	107	0:25	11:01
P	0:00	0	0:00	0:00
pA	28:34	105	0:25	10:42
PA	44:24	108	0:32	18:09
PB	42:34	104	0:33	17:26
pB	29:48	108	0:26	11:12
pC	31:11	111	0:26	11:49

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
PC	42:34	106	0:31	17:25
pD	24:31	94	0:24	9:05
PD	25:44	77	0:29	9:58
pE	24:33	95	0:24	9:08
PE	24:53	75	0:28	9:36
PF	22:52	72	0:27	8:41
pF	24:09	94	0:24	8:56
PG	22:19	72	0:27	8:25
pG	18:50	67	0:23	7:24
PH	22:00	70	0:27	8:16
pH	24:06	93	0:24	8:53
PI	22:05	71	0:27	8:14
pI	24:30	94	0:24	9:03
PJ	25:46	77	0:29	9:56
pJ	24:58	96	0:24	9:13
pK	23:47	93	0:24	8:44
PK	21:16	70	0:27	7:56
PL	20:49	70	0:26	7:40
pL	24:33	95	0:24	9:01
pM	25:12	95	0:24	9:17
PM	20:44	67	0:26	7:35
pN	25:42	98	0:25	9:28
PN	20:26	68	0:26	7:27
pO	26:16	97	0:25	9:42
PO	19:46	66	0:26	7:08
PP	20:49	79	0:25	7:29
pP	27:04	96	0:25	9:59
PQ	19:05	65	0:25	6:52
pQ	27:29	99	0:25	10:10
pR	27:35	100	0:25	10:15
PR	19:12	66	0:25	7:02
pS	27:41	100	0:25	10:20
PS	20:17	68	0:26	7:38
pT	27:36	103	0:25	10:18
PT	19:43	68	0:25	7:24
PU	19:13	66	0:25	7:09
pU	15:30	60	0:22	5:39
pV	18:31	78	0:22	6:49
PV	24:58	91	0:25	9:11
pW	24:41	94	0:25	8:53
PW	31:07	102	0:25	11:46
PX	32:42	105	0:27	12:26
pX	26:26	97	0:25	9:38
PY	31:28	103	0:25	11:56
pY	26:28	94	0:26	9:28
pZ	34:02	124	0:25	13:06
PZ	28:16	98	0:24	10:36
Q	0:00	0	0:00	0:00
qA	32:35	116	0:26	12:25
QA	22:51	86	0:25	8:20
qB	33:23	118	0:26	12:45
QB	21:09	82	0:25	7:43
qC	36:57	134	0:26	14:15
QC	25:53	93	0:24	9:41
qD	33:59	119	0:26	12:59
QD	30:14	101	0:25	11:26
qE	30:35	108	0:26	11:29
QE	38:41	113	0:30	14:56
qF	30:14	108	0:26	11:21
QF	40:04	117	0:30	15:29
qG	31:28	111	0:26	11:51

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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	Shadow, worst case			Shadow, expected values
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
QG	41:13	118	0:30	15:57
qH	29:28	106	0:26	10:57
QH	36:47	110	0:29	14:13
qI	29:11	103	0:26	10:51
QI	34:31	109	0:28	13:20
qJ	28:57	102	0:26	10:44
QJ	39:44	119	0:29	15:25
qK	28:31	101	0:26	10:32
QK	41:05	121	0:29	15:59
QL	41:58	123	0:28	16:18
qL	29:42	104	0:26	11:01
QM	39:40	120	0:28	15:27
qM	28:36	101	0:26	10:32
qN	27:59	99	0:26	10:14
QN	38:49	119	0:27	15:10
qO	28:12	101	0:26	10:16
QO	37:47	116	0:27	14:48
QP	36:53	114	0:27	14:25
qP	27:50	99	0:27	10:02
QQ	35:27	111	0:28	13:50
qQ	29:04	100	0:27	10:41
QR	33:07	107	0:27	12:52
qR	31:03	107	0:28	11:25
qS	32:56	108	0:28	12:10
QS	31:37	106	0:27	12:15
qT	33:29	113	0:28	12:28
QT	30:05	101	0:26	11:36
qU	31:32	108	0:27	11:40
QU	24:35	94	0:22	9:23
QV	19:49	81	0:22	7:24
qV	34:48	114	0:28	13:04
QW	27:47	98	0:23	10:35
qW	35:58	118	0:28	13:33
qX	34:55	116	0:28	13:01
QX	25:58	96	0:23	9:51
QY	17:46	72	0:23	6:30
qY	34:32	114	0:29	12:50
qZ	35:05	119	0:28	13:13
QZ	16:35	64	0:23	6:04
R	0:00	0	0:00	0:00
RA	16:58	62	0:23	6:14
rA	36:50	120	0:28	13:59
rB	41:37	140	0:28	16:03
RB	17:19	64	0:23	6:24
rC	34:20	115	0:27	12:58
RC	17:21	64	0:23	6:25
rD	33:06	114	0:27	12:27
RD	17:33	64	0:24	6:29
RE	18:01	65	0:24	6:41
rE	33:21	114	0:27	12:37
RF	18:10	64	0:24	6:43
rF	35:27	120	0:27	13:29
rG	36:04	123	0:27	13:46
RG	18:05	64	0:24	6:36
rH	32:43	111	0:27	12:21
RH	18:50	65	0:25	6:53
RI	16:04	63	0:22	5:57
rI	36:58	129	0:27	14:13
rJ	39:47	139	0:27	15:25
RJ	16:14	62	0:23	6:03
rK	41:39	137	0:27	16:10

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Shadow, worst case			Shadow, expected values
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
RK	16:54	65	0:23	6:36
rL	42:12	137	0:27	16:23
RL	32:05	108	0:26	12:35
rM	42:44	135	0:27	16:36
RM	13:41	59	0:20	5:11
RN	15:27	61	0:22	5:47
rN	42:52	132	0:27	16:42
RO	16:53	63	0:23	6:29
rO	42:01	126	0:28	16:29
RP	17:13	64	0:23	6:37
rP	42:26	127	0:28	16:36
rQ	43:43	132	0:28	17:04
RQ	18:23	68	0:24	7:08
RR	18:20	66	0:24	7:07
rR	41:19	123	0:28	16:13
RS	18:32	67	0:24	7:14
rS	42:03	126	0:28	16:30
RT	19:00	72	0:23	7:33
rT	44:28	133	0:28	17:20
RU	24:42	88	0:24	9:58
rU	45:01	138	0:28	17:29
RV	23:43	89	0:23	9:35
rV	44:48	131	0:29	17:28
RW	21:15	81	0:23	8:31
rW	46:17	135	0:29	17:59
RX	16:43	67	0:21	6:40
rX	47:29	137	0:29	18:26
RY	16:27	65	0:21	6:31
rY	47:32	135	0:29	18:28
RZ	15:19	61	0:21	5:57
rZ	46:45	138	0:29	18:07
S	0:00	0	0:00	0:00
sA	44:27	140	0:29	17:08
SA	15:12	65	0:20	6:03
SB	11:17	43	0:20	4:39
sB	39:40	120	0:29	15:34
SC	17:43	74	0:21	7:05
sC	39:13	117	0:29	15:21
sD	44:58	129	0:30	17:34
SD	20:02	80	0:21	8:03
SE	12:30	50	0:19	5:08
sE	40:39	117	0:30	15:50
SF	15:27	66	0:19	6:26
sF	44:20	125	0:31	17:18
SG	19:09	68	0:20	8:00
sG	47:41	131	0:30	18:33
sH	48:11	135	0:30	18:44
SH	15:27	63	0:19	6:16
sI	49:57	135	0:31	19:25
SI	38:25	121	0:26	15:03
SJ	38:19	122	0:26	15:00
sJ	49:36	139	0:30	19:13
SK	37:26	120	0:26	14:41
sK	49:52	137	0:31	19:22
SL	39:05	127	0:25	15:14
sL	48:34	141	0:30	18:47
sM	40:43	131	0:29	15:28
SM	31:58	110	0:26	11:44
SN	29:27	104	0:26	10:43
sN	47:01	143	0:30	18:06
sO	46:34	146	0:30	17:51

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
SO	23:26	71	0:29	8:36
SP	22:50	71	0:28	8:16
sP	43:28	135	0:30	16:33
sQ	39:47	126	0:29	15:02
SQ	21:33	70	0:28	7:39
sR	45:07	148	0:30	17:15
SR	21:08	68	0:27	7:30
SS	20:54	68	0:27	7:23
sS	35:34	116	0:29	13:15
ST	23:27	84	0:27	8:22
sT	30:59	104	0:28	11:21
sU	33:31	109	0:28	12:23
SU	36:40	108	0:28	13:45
SV	38:31	111	0:29	14:21
sV	32:30	106	0:29	11:46
SW	35:08	107	0:29	12:55
sW	29:34	100	0:28	10:31
sX	22:48	88	0:24	8:10
SX	32:59	103	0:29	12:01
SY	36:53	110	0:29	13:59
sY	17:29	64	0:23	6:34
SZ	38:22	113	0:30	14:37
sZ	17:26	64	0:23	6:32
T	0:00	0	0:00	0:00
TA	41:33	117	0:31	15:53
tA	16:48	62	0:23	6:14
TB	43:33	120	0:32	16:42
tB	23:15	89	0:24	8:18
tC	23:54	89	0:23	8:56
TC	44:38	123	0:31	17:07
tD	26:42	96	0:23	10:07
TD	45:51	123	0:31	17:38
TE	48:23	129	0:32	18:34
tE	24:07	92	0:23	9:04
TF	47:04	127	0:32	18:03
tF	26:24	95	0:22	10:00
TG	45:33	123	0:32	17:28
tG	27:01	97	0:22	10:17
TH	47:49	125	0:33	18:19
tH	29:18	102	0:24	11:16
TI	47:39	129	0:31	18:20
tI	30:54	102	0:25	11:56
tJ	32:05	107	0:26	12:27
TJ	48:31	131	0:31	18:37
TK	49:33	133	0:31	19:00
tK	33:22	109	0:26	12:57
TL	49:47	135	0:31	19:04
tL	34:33	111	0:26	13:28
TM	51:12	135	0:31	19:36
tM	32:16	107	0:25	12:34
tN	31:35	107	0:26	12:17
TN	49:16	135	0:30	18:53
tO	26:09	97	0:23	10:03
TO	49:29	138	0:30	18:55
TP	50:30	137	0:30	19:18
tP	28:14	100	0:24	10:58
tQ	34:47	113	0:26	13:37
TQ	50:19	142	0:30	19:11
tR	36:31	118	0:26	14:18
TR	50:41	144	0:30	19:14
TS	52:17	140	0:32	19:57

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

	Shadow, worst case			Shadow, expected values
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
tS	37:15	119	0:25	14:33
TT	44:22	140	0:30	16:37
tT	37:46	122	0:26	14:45
tU	37:44	125	0:25	14:41
TU	41:55	127	0:30	15:31
tV	37:15	126	0:25	14:29
TV	53:04	144	0:31	20:08
TW	53:39	140	0:32	20:27
tW	37:00	126	0:25	14:23
tX	30:17	105	0:25	11:51
TX	55:33	144	0:32	21:04
tY	30:18	105	0:25	11:52
TY	53:38	138	0:32	20:28
TZ	54:49	141	0:33	20:51
tZ	21:45	87	0:21	8:14
U	0:00	0	0:00	0:00
UA	52:49	135	0:33	20:09
uA	35:16	127	0:25	13:36
UB	53:11	136	0:33	20:18
uB	30:59	114	0:25	11:37
UC	52:14	133	0:33	19:58
uC	30:57	111	0:25	11:34
UD	51:55	132	0:33	19:49
uD	30:01	108	0:25	11:06
uE	32:48	118	0:26	12:20
UE	51:45	130	0:33	19:44
uF	37:45	134	0:26	14:24
UF	55:21	142	0:33	21:04
UG	55:29	139	0:33	21:08
uG	41:13	130	0:27	15:50
uH	41:43	128	0:27	16:03
UH	55:10	138	0:34	21:01
uI	42:07	126	0:27	16:13
UI	50:29	130	0:34	19:14
UJ	49:34	127	0:34	18:52
uJ	41:20	121	0:28	15:57
uK	38:50	114	0:28	14:57
UK	46:15	121	0:33	17:35
UL	44:51	119	0:32	16:59
uL	42:09	121	0:29	16:12
uM	43:15	126	0:28	16:39
UM	46:48	121	0:34	17:45
uN	33:46	106	0:26	12:52
UN	53:17	133	0:34	20:17
UO	53:43	131	0:35	20:25
uO	27:56	112	0:25	9:31
uP	25:27	103	0:25	8:29
UP	52:07	130	0:35	19:47
UQ	49:47	126	0:35	18:50
uQ	24:15	88	0:26	8:02
UR	47:24	123	0:34	17:53
uR	25:23	91	0:26	8:45
uS	26:04	94	0:26	9:04
US	48:51	124	0:35	18:25
uT	25:53	92	0:26	8:59
UT	48:44	125	0:34	18:27
uU	25:57	93	0:27	8:55
UU	40:35	114	0:30	15:05
UV	51:23	128	0:35	19:24
uV	27:14	95	0:27	9:33
UW	53:11	130	0:35	20:03

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Shadow, worst case			Shadow, expected values
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
uW	26:45	93	0:27	9:21
UX	55:32	133	0:36	20:56
uX	27:34	97	0:27	9:34
UY	58:54	139	0:35	22:20
uY	26:52	93	0:27	9:09
uZ	27:12	94	0:27	9:17
UZ	59:56	142	0:35	22:43
V	0:00	0	0:00	0:00
VA	59:56	152	0:34	22:34
vA	27:25	93	0:27	9:30
vB	26:32	92	0:27	8:54
VB	58:54	152	0:34	22:09
vC	27:03	93	0:27	9:07
VC	58:57	150	0:33	22:15
VD	35:39	112	0:29	12:40
vD	26:52	94	0:27	8:57
VE	32:47	105	0:28	11:38
vE	25:43	93	0:26	8:32
vF	25:10	91	0:26	8:20
VF	46:41	132	0:33	16:50
VG	53:28	145	0:34	19:36
vG	25:56	91	0:27	8:47
vH	26:28	93	0:27	8:44
VH	60:21	161	0:35	22:13
vI	25:55	101	0:26	8:27
VI	57:36	155	0:35	21:07
VJ	61:10	164	0:36	22:30
vJ	26:37	93	0:27	8:35
vK	27:43	96	0:28	9:16
VK	42:09	120	0:33	14:45
VL	52:13	137	0:35	18:42
vL	28:09	97	0:28	9:18
VM	53:15	140	0:36	19:04
vM	29:14	98	0:28	9:44
VN	59:59	155	0:36	21:51
vN	29:53	99	0:29	9:58
VO	66:00	164	0:37	24:15
vO	30:31	101	0:29	10:13
vP	30:25	99	0:29	10:08
VP	73:47	151	0:41	27:20
vQ	28:37	98	0:28	10:10
VQ	38:56	113	0:32	13:05
VR	58:42	152	0:35	20:46
vR	40:36	133	0:28	14:03
vS	41:36	135	0:27	14:30
VS	49:11	140	0:33	16:45
vT	49:29	143	0:31	17:37
VT	51:37	134	0:36	18:05
VU	54:05	138	0:37	19:04
vU	56:54	180	0:32	20:10
vV	60:53	172	0:32	22:00
VV	82:18	172	0:41	30:07
vW	60:43	171	0:32	21:59
VW	83:15	172	0:42	30:29
vX	59:50	166	0:32	21:46
VX	85:13	171	0:43	31:13
VY	106:53	201	0:53	35:35
vY	58:32	161	0:32	21:19
VZ	51:50	148	0:33	19:35
vZ	57:50	162	0:31	21:04
W	0:00	0	0:00	0:00

To be continued on next page...

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Shadow, worst case: Shadow hours per year [h/year]	Shadow, worst case: Shadow days per year [days/year]	Shadow, worst case: Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
wA	59:28	170	0:32	21:34
WA	44:07	124	0:33	16:09
wB	56:30	162	0:31	20:38
WB	41:46	120	0:32	15:13
WC	42:04	126	0:31	15:46
wC	56:16	164	0:30	20:32
WD	42:42	130	0:31	16:06
wD	54:27	166	0:30	19:47
WE	48:58	117	0:33	19:49
wE	49:39	141	0:30	18:43
wF	48:51	145	0:31	17:39
WF	49:47	127	0:35	19:56
wG	47:35	142	0:31	17:17
WG	47:58	109	0:35	19:36
WH	40:32	97	0:35	16:37
wH	47:10	146	0:30	17:08
wI	24:45	93	0:25	8:42
WI	36:32	90	0:33	14:59
wJ	24:12	90	0:25	8:32
WJ	35:29	89	0:33	14:33
wK	18:42	65	0:24	6:55
WK	32:21	86	0:31	13:16
wL	26:27	97	0:25	9:29
WL	33:44	87	0:32	13:49
wM	26:05	98	0:25	9:22
WM	29:24	82	0:30	12:02
wN	28:34	101	0:26	10:14
WN	26:33	79	0:27	10:49
wO	28:07	100	0:26	10:03
WO	27:41	78	0:28	11:17
WP	30:51	82	0:30	12:36
wP	28:13	97	0:27	10:00
wQ	29:46	104	0:27	10:33
WQ	44:25	100	0:36	18:11
WR	46:33	110	0:38	19:07
wR	29:29	101	0:27	10:24
WS	45:01	109	0:38	18:29
wS	30:07	101	0:27	10:32
WT	26:03	76	0:27	10:34
wT	28:24	97	0:27	9:39
wU	27:12	94	0:27	9:04
WU	21:35	70	0:24	8:42
WV	13:22	41	0:24	5:20
wV	32:57	110	0:27	12:03
WW	14:10	52	0:24	5:39
wW	32:13	110	0:27	11:46
WX	52:33	115	0:40	21:31
wX	30:00	105	0:26	10:56
WY	56:02	116	0:40	22:54
wY	29:03	102	0:26	10:32
wZ	29:13	106	0:26	10:38
WZ	58:24	116	0:41	23:49
X	0:00	0	0:00	0:00
XA	59:15	116	0:42	24:10
xA	39:48	137	0:27	15:02
xB	36:24	127	0:27	13:41
XB	62:41	121	0:41	25:27
xC	24:38	89	0:26	7:39
XC	45:13	108	0:39	18:31
XD	40:11	106	0:36	16:27
xD	23:55	88	0:26	7:05

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

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No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
XE	32:49	103	0:29	13:20
xE	27:12	94	0:27	8:29
XF	27:58	100	0:25	11:24
xF	28:45	95	0:28	8:39
xG	28:52	96	0:28	8:49
XG	26:32	99	0:25	10:49
xH	30:28	99	0:29	9:25
XH	26:26	100	0:25	10:49
XI	25:59	96	0:25	10:41
xI	32:23	101	0:30	10:00
xJ	30:32	96	0:29	9:02
XJ	13:52	41	0:25	5:34
XK	29:12	102	0:26	11:52
xK	23:07	85	0:25	6:43
XL	40:34	107	0:36	16:33
xL	18:03	62	0:25	5:18
xM	26:10	89	0:27	7:11
XM	25:59	96	0:25	10:42
xN	28:01	90	0:28	7:58
XN	26:44	96	0:26	10:59
xO	30:44	95	0:29	7:27
XO	26:58	96	0:26	11:07
XP	27:12	95	0:26	11:13
xP	27:16	89	0:28	6:56
XQ	26:09	92	0:26	10:49
xQ	37:01	103	0:32	9:27
xR	41:24	125	0:31	9:01
XR	25:41	88	0:26	10:40
XS	27:20	94	0:27	11:17
xS	57:22	145	0:35	12:28
xT	61:08	148	0:36	13:20
XT	27:13	92	0:27	11:16
xU	20:27	72	0:25	4:40
XU	26:54	90	0:27	11:09
XV	25:56	88	0:27	10:46
xV	21:32	74	0:26	4:53
xW	25:51	80	0:24	5:11
XW	25:24	86	0:27	10:33
XX	27:04	90	0:28	11:13
xX	26:59	76	0:25	5:25
XY	24:33	82	0:27	10:11
xY	20:06	56	0:25	4:00
xZ	13:22	43	0:23	2:40
XZ	23:51	79	0:27	9:53
Y	0:00	0	0:00	0:00
yA	9:28	35	0:20	1:54
YA	25:58	86	0:28	10:47
YB	25:28	82	0:28	10:34
yB	5:47	27	0:16	1:11
yC	0:00	0	0:00	0:00
YC	26:53	87	0:28	11:08
yD	0:00	0	0:00	0:00
YD	27:12	89	0:28	11:16
YE	22:22	70	0:28	9:15
yE	0:00	0	0:00	0:00
YF	25:07	80	0:28	10:24
yF	0:00	0	0:00	0:00
YG	24:15	65	0:29	10:03
yG	0:00	0	0:00	0:00
YH	25:35	70	0:29	10:38
yH	0:00	0	0:00	0:00

To be continued on next page...

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Shadow, worst case: Shadow hours per year [h/year]	Shadow, worst case: Shadow days per year [days/year]	Shadow, worst case: Max shadow hours per day [h/day]	Shadow, expected values: Shadow hours per year [h/year]
yI	0:00	0	0:00	0:00
YI	26:26	72	0:29	11:00
yJ	0:00	0	0:00	0:00
YJ	28:21	78	0:29	11:48
YK	22:52	60	0:29	9:28
yK	0:00	0	0:00	0:00
YL	24:35	64	0:30	10:11
yL	0:00	0	0:00	0:00
yM	0:00	0	0:00	0:00
YM	25:20	66	0:30	10:30
YN	26:17	68	0:30	10:55
yN	0:00	0	0:00	0:00
YO	27:53	74	0:30	11:36
yO	0:00	0	0:00	0:00
YP	35:07	86	0:30	14:36
yP	0:00	0	0:00	0:00
YQ	34:01	90	0:31	14:08
yQ	0:00	0	0:00	0:00
YR	35:41	80	0:31	14:53
yR	0:00	0	0:00	0:00
YS	36:58	86	0:31	15:22
yS	0:00	0	0:00	0:00
YT	37:34	84	0:32	15:39
yT	0:00	0	0:00	0:00
yU	0:00	0	0:00	0:00
YU	35:06	74	0:32	14:42
YV	38:06	80	0:33	15:54
yV	0:00	0	0:00	0:00
YW	36:18	74	0:34	15:14
yW	0:00	0	0:00	0:00
YX	35:54	72	0:34	15:05
yX	0:00	0	0:00	0:00
yY	0:00	0	0:00	0:00
YY	37:53	78	0:34	15:51
YZ	37:12	76	0:34	15:36
yZ	0:00	0	0:00	0:00
Z	0:00	0	0:00	0:00
zA	0:00	0	0:00	0:00
ZA	34:31	70	0:34	14:31
zB	30:39	64	0:34	6:05
ZB	33:23	68	0:33	14:03
zC	32:07	65	0:35	6:23
ZC	27:12	58	0:34	11:31
ZD	8:43	30	0:22	3:40
zD	32:46	66	0:35	6:31
zE	38:23	76	0:34	7:41
ZE	4:21	20	0:16	1:48
ZF	28:04	101	0:26	11:26
zF	40:23	78	0:35	8:05
ZG	28:27	99	0:27	11:39
zG	29:41	64	0:33	5:54
ZH	28:21	96	0:27	11:39
zH	28:25	62	0:33	5:39
ZI	28:42	98	0:28	11:48
zI	25:34	57	0:32	5:04
zJ	17:25	47	0:27	3:27
ZJ	28:45	96	0:28	11:51
ZK	28:37	95	0:28	11:48
zK	49:31	148	0:33	15:36
ZL	28:32	92	0:29	11:48
zL	58:17	161	0:37	17:38

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

	Shadow, worst case			Shadow, expected values
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
zM	64:22	172	0:38	20:11
ZM	27:51	89	0:29	11:32
ZN	27:56	88	0:29	11:34
zN	67:56	174	0:35	25:13
ZO	26:39	82	0:30	11:02
zO	85:13	176	0:47	30:43
zP	72:44	157	0:45	22:54
ZP	25:36	78	0:30	10:36
ZQ	26:53	80	0:30	11:08
zQ	99:43	202	0:46	36:14
ZR	25:00	74	0:30	10:21
zR	94:23	134	0:56	27:10
ZS	24:57	73	0:30	10:20
zS	103:07	154	0:59	29:31
zT	154:21	182	1:22	44:22
ZT	25:01	62	0:31	10:22
ZU	25:29	65	0:31	10:34
zU	0:00	0	0:00	0:00
zV	0:00	0	0:00	0:00
ZV	38:01	90	0:32	15:48
zW	0:00	0	0:00	0:00
ZW	38:25	90	0:33	15:58
ZX	39:15	84	0:33	16:21
zX	0:00	0	0:00	0:00
ZY	39:40	84	0:33	16:31
zY	0:00	0	0:00	0:00
ZZ	36:56	94	0:33	15:22
zZ	0:00	0	0:00	0:00
[A	33:22	84	0:33	13:54
[B	31:48	79	0:32	13:15
[C	29:34	72	0:32	12:18
[D	26:46	66	0:32	11:06
[E	25:36	73	0:31	10:36
[F	26:20	78	0:31	10:53
[G	27:09	81	0:30	11:14
[H	27:44	82	0:30	11:29
[I	28:23	86	0:30	11:44
[J	28:28	86	0:30	11:47
[K	28:46	88	0:30	11:54
[L	28:57	89	0:30	11:58
[M	29:28	95	0:29	12:08
[N	29:29	98	0:28	12:07
[O	29:27	102	0:27	12:00
[P	29:07	103	0:27	11:50
[Q	30:06	105	0:27	12:12
[R	44:17	109	0:39	18:08
[S	42:34	108	0:38	17:27
[T	64:32	121	0:43	26:11
[U	61:29	119	0:43	25:02
[V	50:07	111	0:41	20:32
[W	49:29	111	0:41	20:16
[X	46:29	109	0:41	19:00
[Y	44:13	110	0:39	18:03
[Z	32:15	106	0:28	13:02
\A	30:44	102	0:28	12:27
\B	30:36	100	0:28	12:27
\C	48:19	111	0:41	19:43
\D	43:53	109	0:38	17:51
\E	41:05	108	0:36	16:40
\F	36:46	106	0:31	14:52
\G	31:27	107	0:29	12:40

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
\H	31:04	100	0:29	12:42
\I	31:55	104	0:29	12:57
\J	30:58	99	0:29	12:40
\K	30:40	98	0:29	12:36
\L	30:44	94	0:30	12:40
\M	31:54	97	0:30	13:03
\N	31:57	96	0:31	13:06
\O	29:55	95	0:29	12:19
\P	29:04	88	0:30	12:01
\Q	28:27	86	0:31	11:46
\R	29:37	86	0:31	12:14
\S	29:22	87	0:31	12:08
\T	29:01	84	0:31	11:59
\U	28:24	82	0:32	11:44
\V	31:04	91	0:32	12:48
\W	31:19	92	0:31	12:55
\X	30:38	92	0:31	12:38
\Y	32:37	96	0:31	13:23
\Z	27:01	77	0:32	11:10
]A	26:50	74	0:32	11:06
]B	26:32	63	0:32	10:59
]C	27:51	66	0:33	11:32
]D	28:45	80	0:33	11:52
]E	28:09	74	0:34	11:38
]F	28:36	66	0:34	11:50
]G	29:51	68	0:35	12:22
]H	36:45	92	0:34	15:19
]I	32:12	77	0:34	13:24
]J	34:38	77	0:36	14:25
]K	36:29	82	0:36	15:13
]L	38:15	88	0:36	15:57
]M	40:39	98	0:36	16:56
]N	43:29	96	0:37	18:06
]O	44:43	96	0:37	18:37
]P	46:02	94	0:37	19:10
]Q	48:10	92	0:38	20:05
]R	44:32	80	0:38	18:39
]S	48:24	88	0:38	20:12
]T	37:45	78	0:39	15:40
]U	35:40	74	0:39	14:45
]V	45:58	100	0:38	19:09
]W	34:10	84	0:38	14:01
]X	34:37	88	0:37	14:12
]Y	32:07	77	0:37	13:14
]Z	32:05	68	0:37	13:16
^A	31:13	68	0:36	12:55
^B	29:53	66	0:36	12:20
^C	30:05	76	0:35	12:25
^D	30:34	81	0:35	12:36
^E	30:46	82	0:34	12:41
^F	31:17	86	0:34	12:53
^G	31:38	86	0:34	13:02
^H	32:15	88	0:34	13:16
^I	32:58	92	0:34	13:34
^J	33:39	91	0:34	13:50
^K	32:01	85	0:35	13:10
^L	35:48	91	0:36	14:40
^M	33:43	93	0:34	13:51
^N	34:03	94	0:33	13:59
^O	34:06	95	0:33	14:00
^P	34:15	96	0:33	14:03

To be continued on next page...

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Calculated:
1/12/2021 4:50 PM/3.4.388

SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

	Shadow, worst case			Shadow, expected values
No.	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
^Q	34:46	98	0:33	14:14
^R	35:05	99	0:33	14:21
^S	35:32	100	0:33	14:29
^T	35:41	102	0:33	14:31
^U	35:29	104	0:32	14:23
^V	34:21	101	0:32	14:01
^W	34:24	102	0:31	14:00
^X	37:43	106	0:34	15:11
^Y	36:54	96	0:35	15:06
^Z	39:36	78	0:40	16:22
_A	38:02	76	0:40	15:42
_B	35:11	74	0:39	14:27
_C	35:33	81	0:39	14:35
_D	36:05	85	0:39	14:47
_E	38:26	96	0:38	15:42
_F	39:07	101	0:36	15:54
_G	39:11	102	0:36	15:55
_H	39:02	107	0:35	15:42
_I	42:13	109	0:37	16:51
_J	41:51	110	0:36	16:40
_K	41:20	111	0:36	16:25
_L	42:30	103	0:39	17:13
_M	42:28	100	0:40	17:15
_N	38:10	84	0:41	15:37
_O	48:11	111	0:41	19:06
_P	48:17	113	0:40	19:04
_Q	48:29	114	0:40	19:03
_R	45:29	112	0:39	18:06
_S	45:24	113	0:38	17:59
_T	44:06	115	0:37	17:21
_U	43:34	113	0:37	17:06
_V	43:02	115	0:36	16:51
_W	43:05	115	0:36	16:49
_X	47:30	117	0:36	18:37
_Y	55:57	118	0:45	22:13
_Z	42:53	108	0:37	17:12
`A	45:51	117	0:38	17:48
`B	48:44	119	0:40	18:47
`C	51:47	122	0:40	19:55
`D	62:01	123	0:47	24:07
`E	75:44	125	0:58	30:04
`F	73:48	126	0:57	29:14
`G	75:00	125	0:58	29:50
`H	68:21	123	0:54	27:05
`I	55:23	120	0:44	21:18
`J	51:27	112	0:43	20:16
`K	99:11	133	1:10	39:09
`L	103:05	134	1:11	40:48
`M	51:29	106	0:46	20:39
`N	55:17	106	0:49	21:59
`O	50:50	89	0:49	20:30
`P	56:48	125	0:44	21:30
`Q	36:25	110	0:32	14:35
`R	39:38	110	0:32	15:51
`S	44:49	112	0:37	17:59
`T	48:49	113	0:42	19:41
`U	34:57	107	0:31	14:04
`V	34:49	108	0:31	13:58
`W	37:20	110	0:31	14:59
`X	39:58	109	0:32	16:04
`Y	47:34	111	0:41	19:21

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SHADOW - Main Result

Calculation: 0575020 - Worst Case Phu Lac 2

...continued from previous page

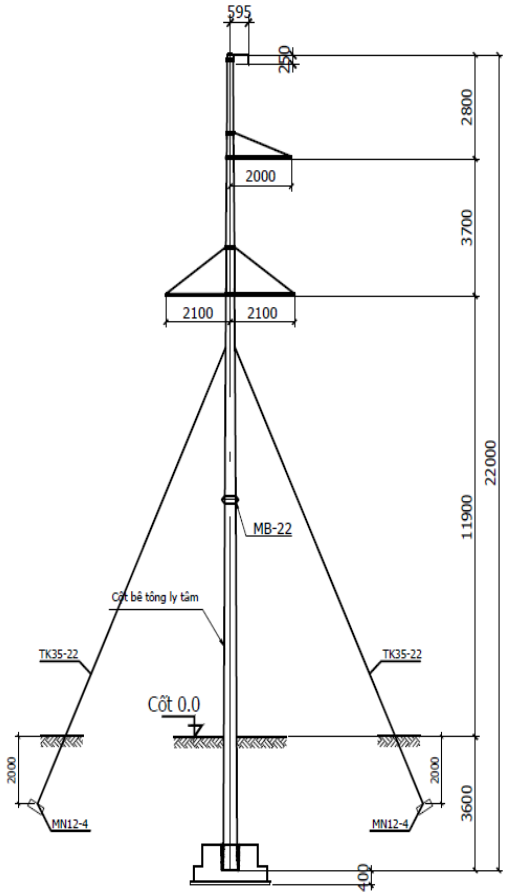
No.	Shadow, worst case Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow, expected values Shadow hours per year [h/year]
`Z	49:36	113	0:42	20:12
{A	0:00	0	0:00	0:00
{B	0:00	0	0:00	0:00
{C	0:00	0	0:00	0:00
{D	0:00	0	0:00	0:00
{E	0:00	0	0:00	0:00
{F	0:00	0	0:00	0:00
{G	0:00	0	0:00	0:00
{H	0:00	0	0:00	0:00
{I	0:00	0	0:00	0:00
{J	0:00	0	0:00	0:00
{K	0:00	0	0:00	0:00
{L	0:00	0	0:00	0:00
{M	266:21	178	1:43	58:30
{N	58:41	72	1:00	11:25
{O	70:01	101	0:55	15:23
{P	70:40	118	0:55	15:53

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	WTG1	512:01	129:26
2	WTG2	207:59	69:48
3	WTG3	203:23	68:46
4	WTG4	216:45	76:40
5	WTG5	161:04	57:18
6	WTG6	200:27	62:54

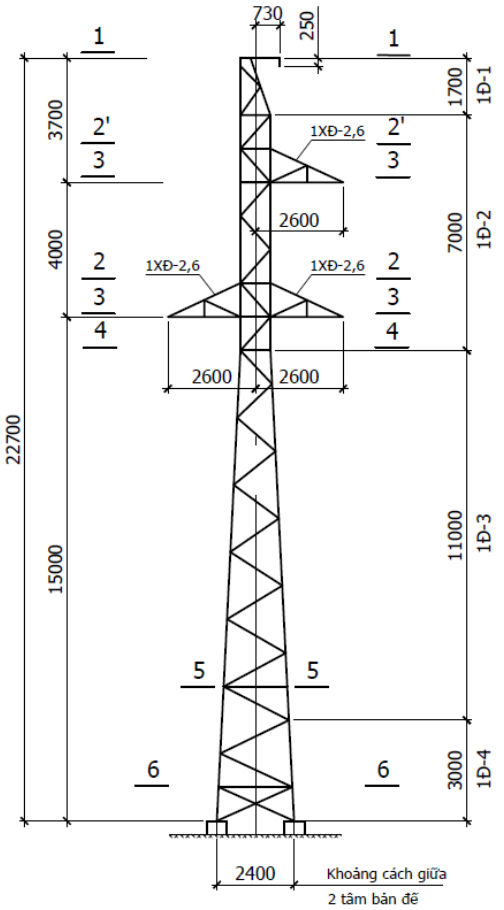
Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

APPENDIX B DIFFERENT TOWER CONFIGURATION

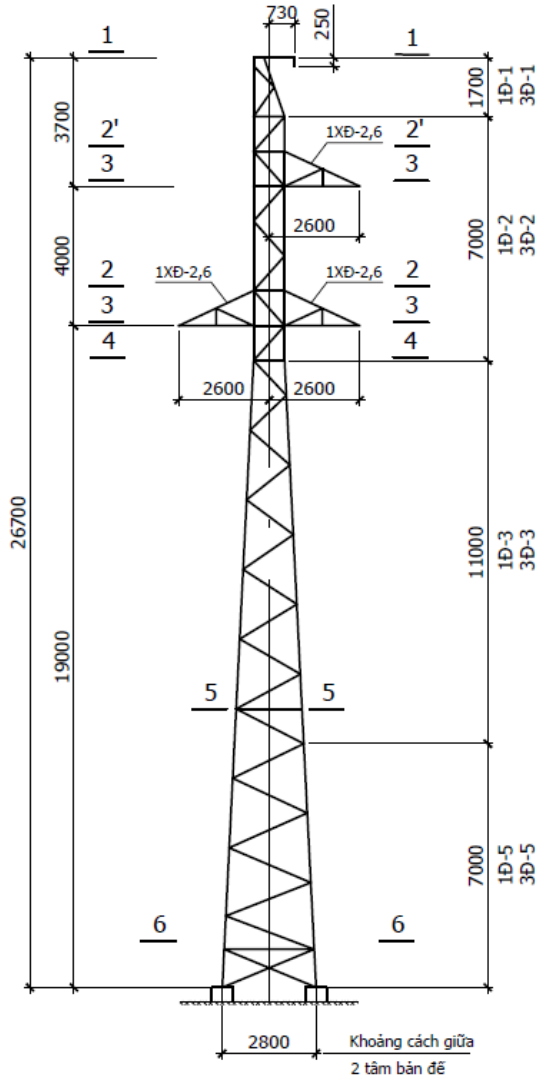


PC.I-22-190.11

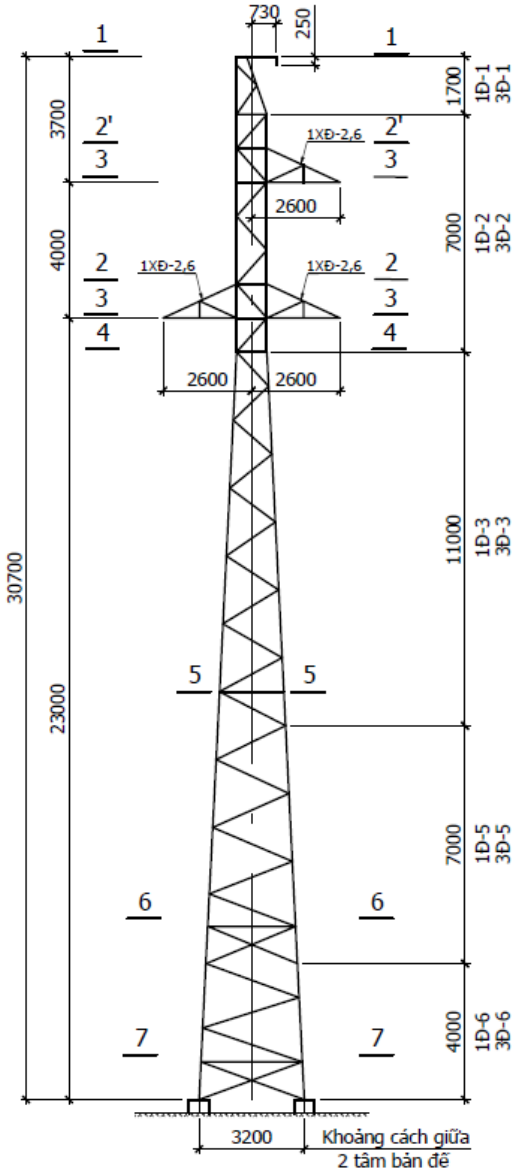
Tower PC.I-22-190.11



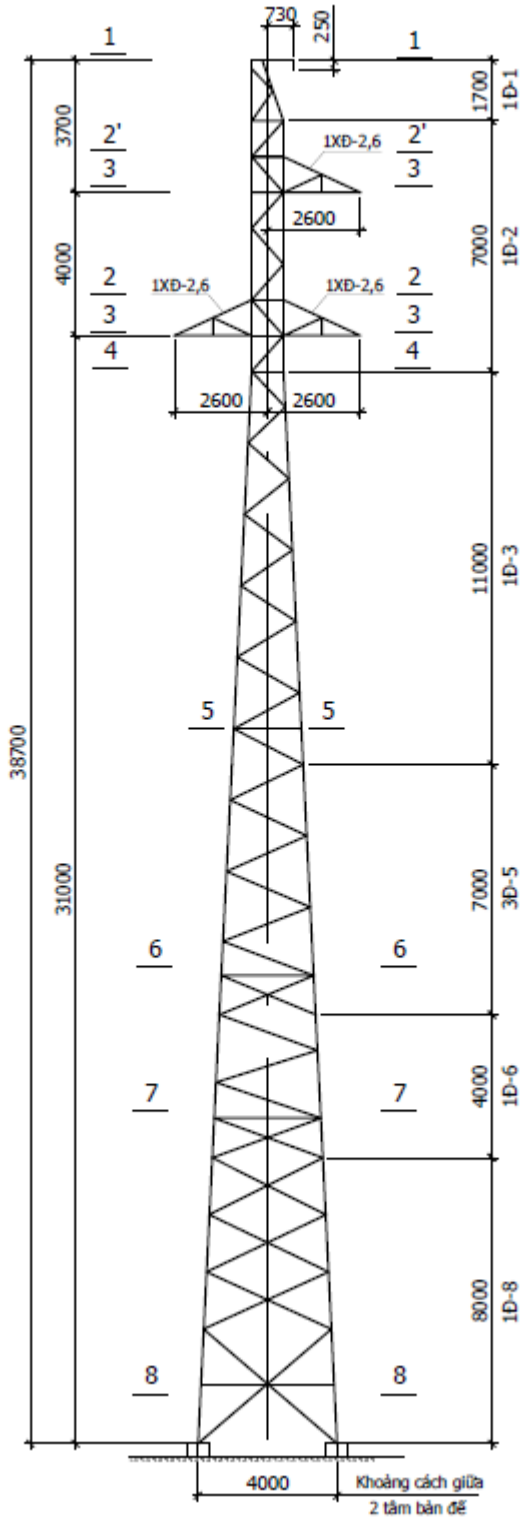
Tower D111-22A



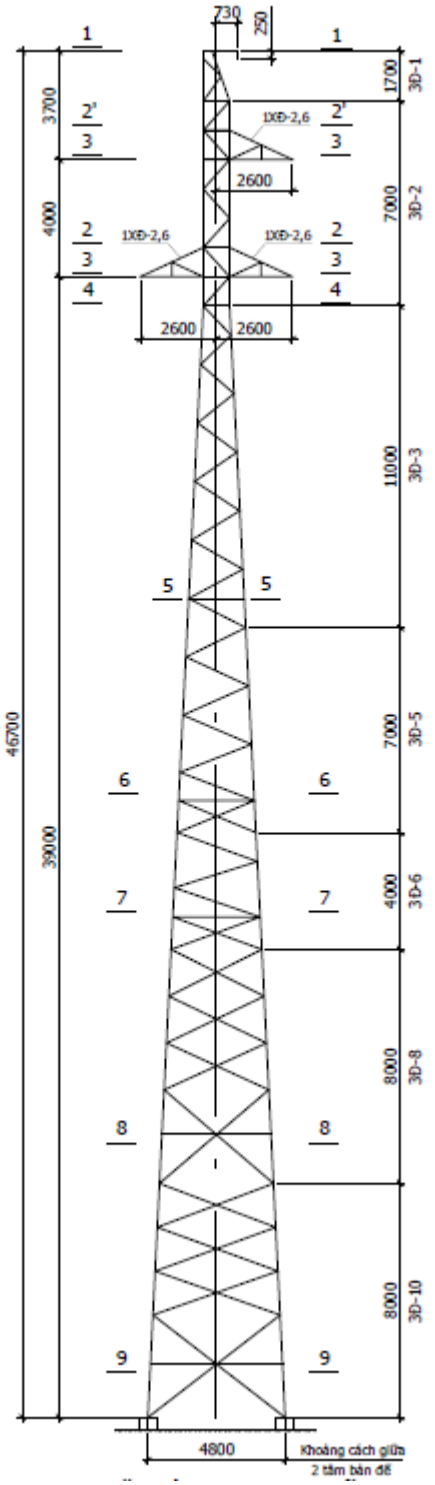
Tower D111-26A/ Tower D111-26B



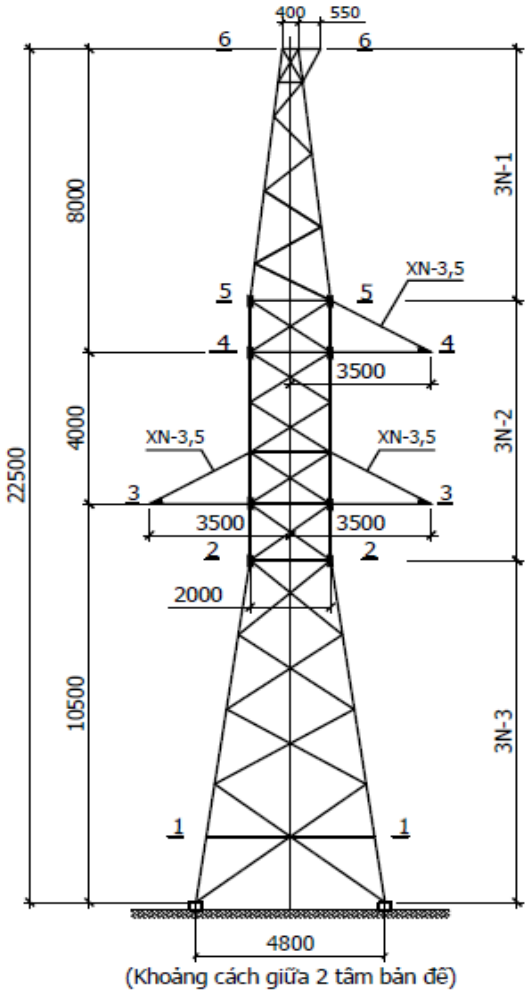
Tower D111-30A/ D111- 30B



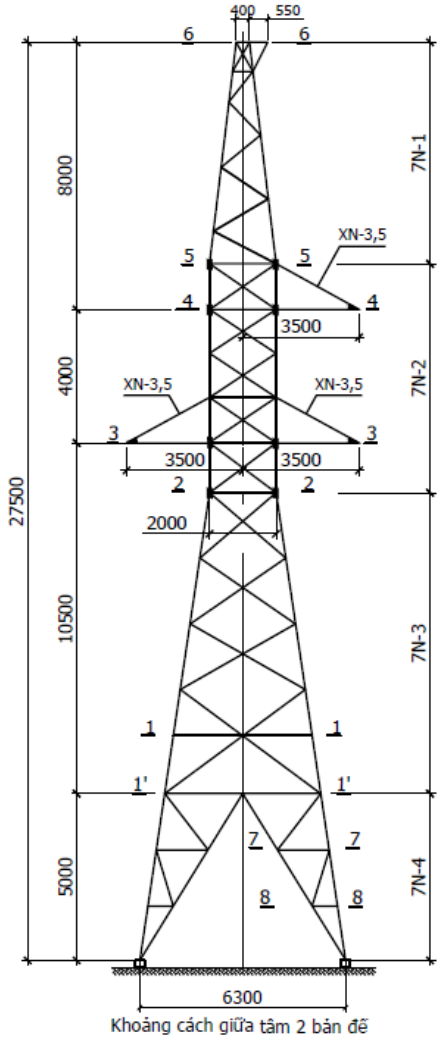
Tower D111- 38A



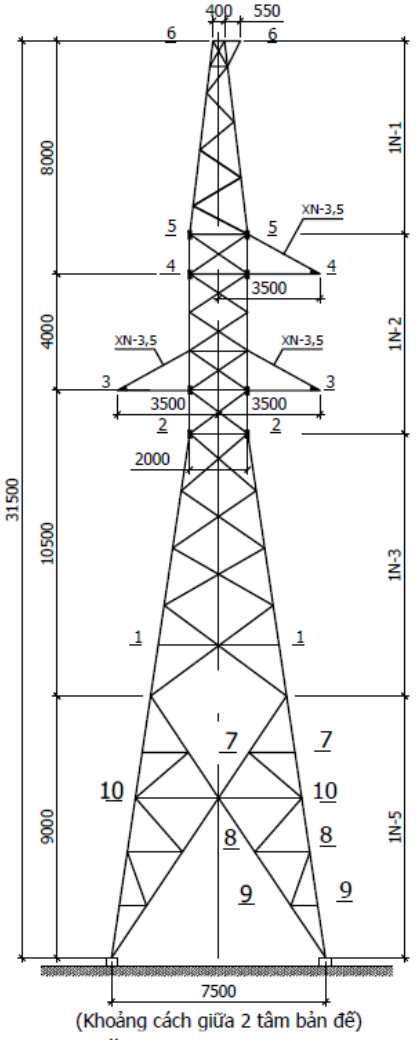
Tower D111- 46B



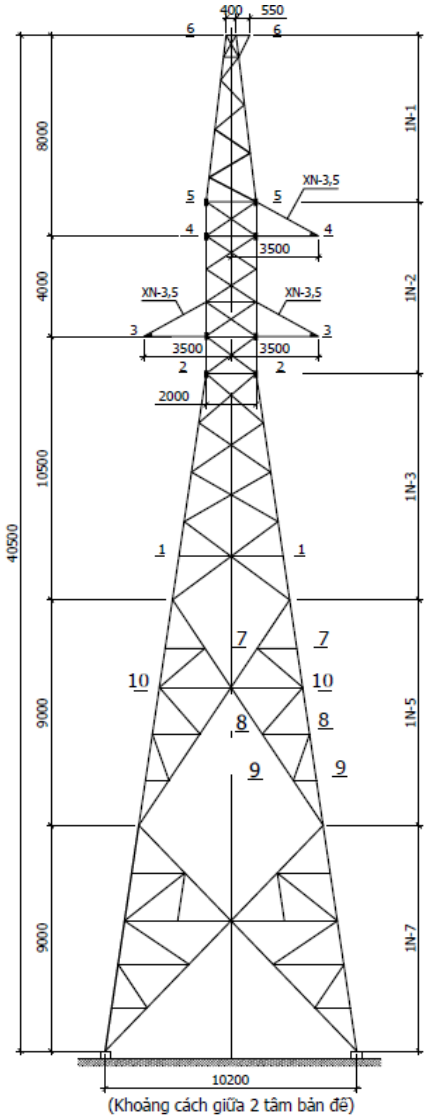
Tower N111 -22B



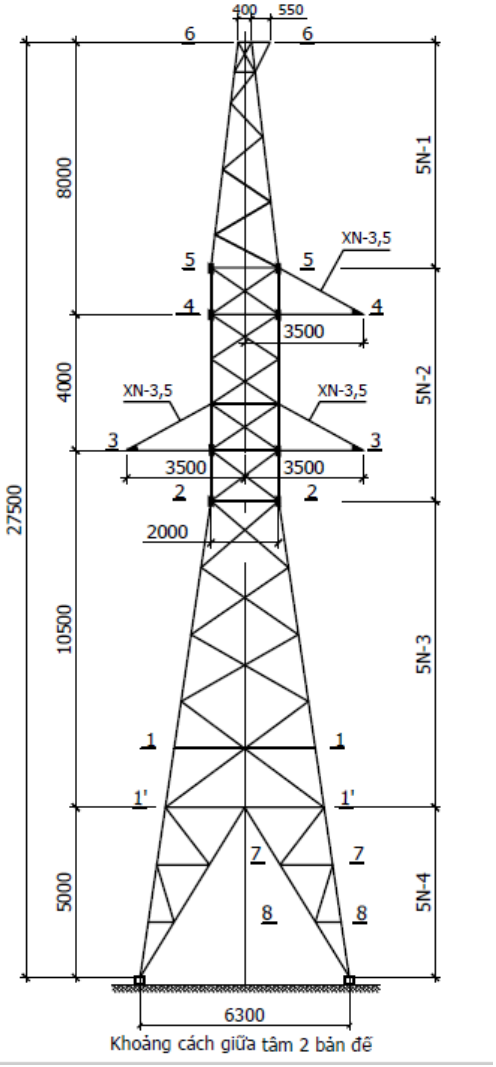
Tower N111-27D



Tower N111- 31A



Tower N111-40A



Tower NC111-27

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