KINGDOM OF CAMBODIA
NATION RELIGION KING
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FINAL REPORT
ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA)
ON THE CONSTRUCTION OF NEW PHNOM PENH INTERNATIONAL AIRPORT (NPPIA)

On a total land area of 2,600 hectares in Kandal Province's Kandal Steung District and Sa'ang District, and Takeo Province's Bati District

Project Owner

CAMBODIA AIRPORT INVESTMENT CO., LTD (CAIC)
Building 315, Canadia Tower Floor 28, Preah Monivong Bvld., Sangkat Wat Phnom, Khan Daun Penh, Phnom Penh, Cambodia
Tel: (+855) 23 868 222

Consultant

E&A CONSULTANT
#69, Street 111, Sangkat Boeung Prolet, Khan 7 Makara, Phnom Pneh
Tel: (+855) 23 212 124

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Executive Summary

1. Introduction

The Cambodia Airport Investment Co., Ltd, hereafter referred to as "CAIC", has collaborated with the Royal Government of Cambodia to develop "New Phnom Penh International Airport" on an area of 2,600 hectares, located in Kandal province and Takeo province. The development of the project will contribute to improving domestic and international air transportation, as well as promoting tourism and investment in the region and the country as a whole.

The project implementation could also potentially cause negative effects that require a prudent assessment study. According to Sub-decree 72 of the Environmental Impact Assessment 1999, the New Phnom Penh International Airport project must have a full environmental and social impact assessment report. The company needs to prepare the report in accordance with the 2018 announcement by the Ministry of Environment on the implementation of the working conditions model for infrastructure and toursim sectors.

Therefore, in order to comply with all relevant legal frameworks as well as ensuring environmental and social protection, CAIC cooperated with a local consulting firm (E&A Consultant) to prepare the full Environmental Impact Assessment (EIA) of the New Phnom Penh International Airport project, and the Ministry of Environment subsequently approved the terms of reference on 17 January 2019.

The main objectives of this report are:

- To study the project with a focus on the planned activities that potentially affect the environment;
- To collect baseline data on the natural and social environment in the study area that may be potentially affected by the project presence;
- To provide an opportunity for the public to participate in the process of environmental and social impact assessment;
- To identify and assess potential impacts, and to propose appropriate and effective mitigation measures;
- To develop an appropriate and effective environmental management plan to respond to the potential impacts caused by the project activities;
- To conduct economic and environmental value analyses due to project presence;
- To organise environmental and social funds to sustain and restore the environment.

2. Scope and Methodology

This chapter indicates the scope and study methodology of full environmental and social impact assessment (ESIA) on the establishment of New Phnom Penh International Airport situated on an area of 2,600 ha, with a focus on a runway (4,000-metres long and 60-metres-wide), a passenger terminal, and other supporting infrastructures. The assessment covers three project phases: pre-operation phase, operational phase I and operational final phase II. The assessment focuses on three types of resources within a 3 kilometre radius of the project site: physical (geology, topography, soil classification and nutrients, soil quality, air quality and greenhouse gases, noise and vibration, and surface and ground water quality), biological (forest, wildlife, bird, and fish), and socio-economic (land use, fishing activity, tourism, traffic, public health and safety, aircraft accident risk, and accidental fire and explosion). The economic and environmental value analysis assess 1) economic and social benefits, 2) socio-economic and environmental losses, and 3) costs and benefits.

The methodology of the project's environmental and social impact assessment complies with the general guidelines for the preparation of initial and full environmental and social impact assessment issued by

the Ministry of Environment in 2009[1]. The study examines the interaction between the existing environmental data and the project's past and planned activities in order to identify potential environmental and social impacts and relevant mitigation measures. The data collection was undertaken in the project and study areas through direct observation, analysis, noise calculation, and interviews with villagers, representatives of the project owner, authorities, local communities, and specialised institutions/departments. Secondary data collection included legal framework, project description, and existing environmental resources (e.g. geology, topography, soil classification, climate, and hydrology). Primary data collection includes air quality, noise, vibration, surface water quality, ground water quality, soil quality, and socio-economic resources received from household surveys.

Impact identification uses three methods: a checklist, a matrix, and the ArcGIS application (overlay method) used to map potentially affected area. The estimation of level of impact relies on five criteria: type, extent, duration, scale, and frequency. There are three levels of impact: low, moderate, and high.

3. Legal Framework

The relevant legal framework to the development of the project's full environmental and social impact assessment includes:

- The Constitution of the Kingdom of Cambodia;
- Law on Environmental Protection and Natural Resource Management;
- Law on Investment of the Kingdom of Cambodia and Law on the Amendment of Law on Investment of the Kingdom of Cambodia;
- Law on land management, urban planning, and construction;
- Law on water resources management in the Kingdom of Cambodia;
- Law and Land
- Law on Fisheries
- Law on Road
- Law on Labour and the law on amendment of the law on Labour (new Article 139 and 144);
- Law on Water Resource Management of Kingdom of Cambodia
- Law on Fire Prevention and Fire Fighting
- Law on Social Security Schemes for Persons Defined by the Provisions of Labour Law
- Sub-decree on environmental impact assessment process;
- Sub-decree on air pollution control and noise disturbance;
- Sub-decree on water pollution control;
- Sub-decree on solid waste management;
- Sub-decree on the establishment of environmental and social funds;
- Vienna Convention on Ozone Layer Protection (1985);
- Montreal Protocol on Ozone Layer Depletion Substances (1987);
- Kyoto Protocol of the United Nations Framework Convention on Climate Change (1997).

4. Project Description

4.1. Project Owner

Cambodia Airport Investment Co., Ltd. (CAIC) was established by the State Secretariat of Civil Aviation (SSCA) and the Overseas Cambodian Investment Corporation (OCIC). CAIC is a company responsible for project implementation and is a private limited liability company. The company's investment capital is US $ 1,850 million (US $ 1,500 million in construction capital and US $ 350 million in investment property value). The company is registered with the Ministry of Commerce with a registered capital of 480,000,000,000 Riels (four hundred and eighty billion Riel), equivalent to $ 120,000,000 (one hundred and twenty million US dollars). SSCA owns 10% of the registered capital, while OCIC owns 90%. Oknha

[1] 2009 Announcement on General Guidelines for EIA/IEIA issued by Ministry of Environment.

Pung Kheang Se, a Cambodian national, is CAIC's board president. The company address is C2 Olympia Building, 5A Floor, Monireth (217) Street, Sangkat Velvong, Khan 7 Makara, Phnom Penh, Cambodia. The approved duration of the company's activities is 99 years, starting from 2017.

4.2. Project Location

The project site is about 23 km from Phnom Penh. The total land area is 2,600 hectares, located in Kandal's province Kandal Stung district and Sa'ang district, and Takeo province's Bati district. The project site has the following borders:

- Boueng Rean lake to the north-east;
- Boueng Cheung Loung lake to the south-east;
- Agricultural land in Kandal Stung district to the north-west;
- Farmland in Pot Sor commune, Bati district, Takeo province to the south-west.

4.3 Relevant Legal Document of Project

The relevant legal document for this project is Notification No. 1319 dated 21 December 2017 issued by the Office of the Council of Ministers on the approval of Cambodia Airport Investment Co., Ltd, a public-private partnership company.

4.4 Land Use

According to the airport master plan, the new Phnom Penh International Airport is a Category 4F airport capable of operating and receiving all current aircraft types, and is divided into two main phases covering a combined area of 1,638 hectares, with a reserved area of 962 hectares. In both Phase 1 and Phase 2, the main infrastructures include:

- Construction of two runways each being 4,000-metres long and 60 metres wide;
- A parking apron: 86,564metres^2 in 2030 and 206,867 square metresin 2050;
- A dual taxiway system, running parallel to each runway, with an area of 186,500 square metres in 2030 and 373,000 square metres in 2050;
- Passenger terminal with an area of 118,000 square metres in 2030 and 320,000 square metres in 2050.

4.5 Project activities and life cycle overview

The project life cycle analysis identifies the key issues and concerns that are likely to evolve over the entire lifespan of a project. In the case of the proposed Project, these issues may arise during the pre-construction, construction and operation phases. The following sub-sections identify the key activities to be completed over the lifetime of the Project:

4.5.1. Construction Phase

The construction phase (2020-2023) will consist of the following main activities, which will be described further in sub-sections below:

- Mobilization of machinery;
- Site Preparation;
- Soil Settlement Process;
- Construction of Runway Extension and Civil Works;
- Human resources and accommodation; and
- Construction plan.

4.5.2. Operational Phase

At the end of 2022, after the completion of the 1st runway and supporting infrastructures, the airport will be operational and capable of handling upto 13 million passengers per year. The final phase II, to cater for 30 million passengers will commence at some point before 2050.

- Airport capacity: The airport is designed to readily accommodate and facilitate a number of types of aircrafts such as B777-300ER B78-8 B787-9 A330-243 B747-8 and A380-841.
- International destinations would include China (Beijing, Shanghai, Guanzhou, and Shenzhen), South Korea (Seoul), Viet Nam (Ho Chi Minh City), Thailand (Bangkok), Singapore, Hong Kong, Taiwan, etc.
- The airport's forecast passenger numbers are 13 million per year by 2030, and 30 million per year by 2050.

a) Power Supply and Source

- Construction phase: During the construction phase, there are two main sources of electricity: the national transmission line and the diesel generators. The main source of electricity supporting construction activity is the 115kV transmission line that will be supplied to the site bythe national supplier, Electricity of Cambodia. The company also has two generators with about 500KVA for usein case there are power cuts or for work in the field, such as lighting, welding or metal work.
- Operational phase: At this stage, there will be two main electrical power sources at the airport: transmission line (115 kV and 22 kV) and a solar panel power supply. The total power consumption of the project is estimated to be 10.2 megawatts by 2030 and 19.10 megawatts by 2050. The airport has identified the need for 2 separate sub-stations on the site, one in the north and one in the south.
- The project will link its power line to the state grid, a high-voltage transmission line (greater than 35KV). The voltage of the transmission will be stepped down to medium voltage (0.6KV) by the sub-station. Then, when the electricity is distributed to different parts of the entire project area, the average voltage will be stepped down again by the sub-station in the project area to the lower voltage (as small as 0.6KV).

b) Source and Water Consumption

- Construction Phase: According to the project plan, during the construction phase, the total number of staff and workers is estimated to be as high as 2,000, with the maximum amount of water available to staff and workers at approximately 150 litres per person per day. Therefore, the maximum water consumption of the staff and workers at the site can be 300,000 litres per day, equal to 300 cubic metres per day. In-house applications such as road maintenance and cleaning can be approximately 65 cubic metres per day. Overall, the maximum amount of water needed for the construction phase can be a total of 365 cubic metres per day.
- Operational Phase: During the operational phase, water use is available at key locations such as water usage at each building in the airport, especially within the passenger terminal such as washrooms, toilets, canteen, restaurants, air conditioning, fire extinguishers, and so on.
- Based on the airport master plan, the water demand is divided into three main sections based on the purpose of use, which includes potable water for passengers, non-portable water for cleaning and other work purpose and fire system requirements. As shown in the table below, potable water needs 1,800m^3/day in 2030 and 3,500m^3/day in 2050. Non-potable water for cleaning and other jobs is estimated to be 1,488 m^3/day in 2030 and 3,178 m^3/day by 2050. The water supply for firefighting will be 4,755 m^3 in 2030 and 4,317 m^3 in 2050.

c) **Waste Management**

Solid waste management

It is estimated that the amount of solid waste generated by the daily activities of employees and workers is expected to be around 0.5 kg per person per day. As planned, at the construction stage there could be a maximum 2,000 employees/workers, so the amount of solid waste generated could be around 1,000 kg perday.

According to the Master Plan, the amount of solid waste generation in the operational phase would be 14,400 kg per day or 19 m3 perday and 20,830 kg per day or 37 m^3 per day in 2030 and 2050, respectively. In order to effectively manage solid waste, the project is planning to transport waste from the airport area to a solid waste storage site (1,800m^2 for 2030 and 3,500m2 for 2050) within the airport boundary. Waste disposal vehicles must be capable of carrying 12m^3 of waste and making 2 trips/day in 2030 and 4 trips/day in 2050.

Wastewater management

During the construction phase, the wastewater that can be generated from the project activities comes from the water use of the staff and workers on the construction site only. At that stage, the maximum water consumption of staff and workers can be around 150 litres/person/day. According to the project plan, during the construction phase, the total number of staff and workers is estimated to be 2,000, with the total daily water demand being approximately 300,000 litres/day (300 m^3/day). Assuming that 80% of the total water consumed becomes liquid, the amount of liquid generated by the accommodation of staff and workers can be approximately 240 m^3/day. Also, this waste is the only domestic wastewater that may come from everyday use such as washing, bathing and other uses. At this stage, the project will have installed a Septic Tank in each building of the residence of staff and workers to manage the waste.

During the execution phase, the wastewater comes from two main locations: the airport terminal building (from clean water) and the wastewater from the aircraft. According to the Master Plan, the amount of wastewater in 2030 is 1,312 m^3/day by 2050, 2,549 m^3/day. All the waste will go through a liquid treatment tank with a capacity of 4,800m^3 per day for the first phase and 9,340m^3 of treatment per day for the second phase. The project requires a total area of 2,400m^2 (2030) and 4,700m^2 (2050) to build the wastewater treatment plant. Some recycled wastewater will be used for cleaning the aircraft, watering the garden, cleaning the road, etc.

Wastewater Treatment Plant

The wastewater treatment plant will be fully designed during the detailed design sage of the project and that will take no more than eight months. In principle, the design of the wastewater treatment facility is envisaged to utilise a bio-wastewater treatment method which enable water reuse ensuring water resource sustainability at the project site. Wastewater generated from each building at the airport and from the aircraft will be collected by a sewerage system (separately from stormwater) into the treatment system. The treated airport wastewater is then drained into the storage pond and pumped into the reservoir for distribution to other locations such as lawns, gardens and toilet use.

In the estimations provided above, several retention periods have been applied:

- Primary Settlement: 6 hours;
- Secondary Settlement: 8 hours;
- Aeration Basin: 24 hours.

5. Existing Environment

5.1 Physical Resources

- Geology: The geology of the project area is of Quaternary era. The Quaternary period is the inal period of 4 cycles of a geological period and its extent dates back to 2.6 million years.
- Topography: The results show that the project site is located in the lowlands contact area with a low elevation of 8 to 10 metres and two high elevations of 15 to 20 metres above mean sea level.

- Soil type: According to D. Crocker's 1963 soil type data, the study found that the study area (3 km around the project site) has two types of soil: Alluvial Soils and Cultural Hydromorphics.
- Soil quality: Soil quality in the project area was analysed in two locations, focusing on the physical and chemical characteristics of the soil. The first site containing Alluvial Soils is in the village of Prasat, and the second containing Cultural Hydromorphics is in Khla Kon village. The soil quality at Prasat in the first site is better than the second in terms of acidity and soil nutrients.
- Climate and Meteorology: According to the temperature data in Phnom Penh over the last 10 years from 2009 to 2018, the lowest average temperature during the last 10 years occurs in December when it iss 16.7 °C. Monthly maximum temperatures in Kandal over the last 10 years from 2009 to 2018 occur in April with the average highest temperature of 38.21 °C. According to the precipitation data in Kandal over the last 10 years from 2009 to 2018, the average annual precipitation is 1,289.64 mm. The lowest average annual precipitation in 2015 (960.5mm) and the highest average annual precipitation is in 2016 (1,638 mm). The average highest humidity level ccurs in September (83.03%). Meanwhile, in 2018, the average annual humidity level is 76.58% which is higher than any other year during the last 10 years. The wind direction is divided into 16 wind directions and 6 levels of wind speed (blowing from). Mostly wind blew from the north. The average wind speed over the last 10 years was 11.10 m/s.
- Air quality: According to the test results obtained at four separate locations in the study area, almost all parameters were within the standard as stipulated in the Sub-decree on air pollution control and noise disturbance (2000) and Announcement (Prokas) on TOR guideline preparation of EIA report for infrastructure and tourism sector issued by Ministry of Environment in 2018. However, only O_3 parameter in the construction site (0.23 mg/m^3), PM10 in Peam Sala village (0.068 mg/m^3) and Cherng Prey village (0.094 mg/m^3) and PM2.5 in Cherng Prey village (0.037 mg/m^3) slightly exceeded the standards, but they were insignificant.
- Noise and vibration: the test results show that the average noise and vibration levels for daytime, evening, and nighttime fall within the standards.
- Surface water quality: surface water quality samples were collected twice (wet season and dry season) from four locations: SW-01 (within the project area), and SW-02, SW-03, and SW-04 (within the study area).
    - Dry season: The test results show that most parameters for Boueng Cherng Loung (SW-01) are within the standards, except for Total Suspended Solid (TSS) and Oil & Grease. Most parameters for SW-02, SW-03, and SW-04 are within the standards, except for DO (SW-02), Oil & Grease (SW-02, SW-03, and SW-04), Total Nitrogen (TN) and Total Phosphous (TP) (SW-04).
    - Wet season: The test results show that most parameters for Boueng Cherng Loung (SW-01) are within the standards, except for TSS, Chemical Oxygen Demand (COD), TN, TP, and Oil & Grease. Most parameters for SW-02, SW-03, and SW-04 are within the standards, except for TN, Coliform, Oil & Grease (SW-03, and SW-04), and TP (SW-02, SW-03, and SW-04).
- Groundwater quality: Groundwater samples were taken from two locations. The first location was sampled from a hand-tube well in Preak Khmer village. The second location was taken from a hand-tube well in Pot Sor village. Most parameters are within the National Drinking Water Quality Standard of the Ministry of Industry and Handicrafts (2004), except for As and Fe-Total. This may be due to various geographical conditions; it should be noted that Kandal province is known as one province which has higher levels of arsenic in groundwater when compared to other provinces in Cambodia. High levels of Fe, on the other hand, may be due to the natural occurrence of groundwater, but it may also be due to the dissolution of components from hand-tube wells or pumps.

5.2 Biological Resources

5.2.1 Forest

In general, the study found that there are 44 species of vegetation and trees in the study area—Beoung Cheung Loung anad Beoung Rean and their surroundings. All species found in the area are not in the classification list of IUCN, meaning that there are no significant or endangered species.

The vegetation in the study area consists of aquatic plants, flooded trees and shrub/tree around the lake area. Most flood forest growth is found in the western part of the 2 lakes: Beoung Cheung Loung and Beoung Rean. The outstanding flooded forest vegetation in the area are Sea Poison Tree, Phnom Phneng, Tlerm Andek, Giant sensitive tree, and Rice Flatsedge. Most Sea Poison Trees, a type of flooded forest species, were seen to grow in the area between Beoung Cheung Loung and Beoung Rean lakes, with the height varying from 3 to 4 metres. Most of the aquatic vegetation like Rice Flatsedge was seen to be scattered across the 2 lakes, with high density in the upper part of the Beoung Cheung Loung Lake and most areas of Beung Rean Lake. It is noted that some species (Flatsedge, Smao Antouk Tek, Smao Ampov Deap etc.) which are smaller types of vegetation prevail in the area only in the wet season. In addition, the vegetation communities in the area have been under threat with the presence of Giant Sensitive Tree (Mimosa Pigra) which is an extremely invasive species and can degrade the whole diversified vegetation communities in the area. The Giant Sensitive Tree prevails across the study area.

5.2.2 Mammals

The study found 8 mammal species in the study area. The presence of these mammals has a close relationship with the availability of their food sources such as crabs, shellfish, flowers, trout, etc. One mammal species (Fishing Cat) are classified as “vulnerable” and three species (Small Asian Mongoose, Crab-eating Mongoose, and Common Palm Civet) are classified as “nearly threatened” as defined by CITIES.

5.2.3 Birds

The study area is a wetland which is favourable for birds. Bird presence has been found across the area, especially within the water areas of Beoung Rean and Beoung Cheung Loung . The study has identified 60 bird species in the study area. No bird species identified in the area falls in the “endangered” classification defined by CITES. Among the species, 3 are in the status of “nearly threatened”, 5 are “vulnerable”. There are 22 bird species that have always been present in the study area (Beoung Cheung Loung and Beoung Rean).

5.2.4 Reptiles

Seventeen reptile species were found in and around the study area. Among the reptile species, 5 species are in the vulnerable status as defined by the Convention on International Trade in Endangered Species (CITES).

5.3 Socio-Economic Resources

5.3.1 Type of Occupation

The main types of occupations in the study area are farmer, poultry, vendor, repairer, factory-worker, civil servants, transportation, construction worker, fisherman, NGO staff, work for agricultural and others. The main occupation of most households is farming (25%) or retailing (19%).

5.3.2 Fisheries

The study found that only one third of the fishermen who are living in the study area fish in Beoung Cheung Loung and Boueng Rean. The ratio of fishermen in Sala Ta Prum village is high (about 90%) and this village is located inside proposed project location; the fishing area of this village is in Beoung Cheung Loung mostly inside the proposed area for airport development. Fishermen use traditional fishing gear

and some use illegal gear (electrocution, tiny mesh net…). The use of illegal gear is one of the main causes of fish resource depletion.

All fishing activities in the study area are small scale and fall into two categories: Type 1-subsistence-commercial fishing, and Type 2-subsistence fishing. In Type 1, fishing is undertaken throughout the year by villages that are living close Beoung Rean and Beoung Cheung Loung. Fishers use plastic boats and wooden boats with small engines. The fishing schedule is divided into 2 time phases as follows: 1) from 3 am to 6 am and 2) from 6 am to 3 pm. The average daily catch is between 10 and 15 kg per day of diversified fish, but the types that are most caught are Mozambique Tilapia, Siamese Mud Carp, Moonlight Gourami, Climbing Perch, Trey Slat, and Snail Eating Barb. The fish is sold to a middle man or fish sellers who distribute fish in the local markets and in Phnom Penh.

For Type 2, fishing activities spread across the area, but with a lower profile; most fishermen who do subsistence fishing are from the 3 community fisheries located in the southern part of Beoung Cheung Loung. The study found that the main fishing season is the period from March to April, during which people can catch a lot of fish. On average, people can catch between 2 to 3 kg per day. The average fish price is from 11,600 riel in the rainy season to 17,400 riel per kilogram in the dry season.

5.3.3 Sensitive receptors in the study area

A school is also one of the sensitive receptors of noise for the project. The study has found that within 3 km from the project boundary, there are 7 schools. The nearest school is Sok An Cham Bork Bet Meas Secondary School located less than 1km southwest of the project. In addition, within the area of 3km from the project boundary, there are certain cultural sites such as pagodas and spiritual sites. The main cultural area for the people is a Buddhist pagoda. There are a total o 15 cultural sites located outside the project location. Among those 15 sites, pagodas are the main sensitive receptors to noise. The nearest pagoda to the project boundary is Botoum Sauriya pagoda located around 0.3 km south of and outside of the project boundary.

5.3.4 Local Waste Management

The management and storage of solid waste (garbage) in the study area has not improved as the area does not yet have a solid waste collection service. People generally choose the burn-in method to handle all solids. The study area is located in areas where no sewage drainage infrastructure exists within people's homes. They drain the wastewater from the kitchen and bathroom around the house with a water surface. As for the waste management of the toilet, the toilet is built over the appropriate sized septic storage tank which is drained every for two to three years.

5.3.5 *Traffic*

The study shows that traffic flow at both weekends and weekdays is moderate, meaning that there are no traffic jams at the moment. However, concern was raised over the increase of traffic during the construction and operation of the project. The following is the summarised result of the traffic study:

Description	Intersection of National Road 2 and Samdech Techo Hun Sen Blvd		National Road 2 at Beoung Khyang	
	Weekday	Weekend	Weekday	Weekend
Average hourly traffic flows in PCE	839	1,148	967	1,099
Hourly maximum traffic flow in PCE	1,062	1,244	1,236	1,259
Road capacity per hour in PCE	2,000	2,000	2,000	2,000
The highest ratio of traffic flow and road carrying capacity, and interpretation	0,53	0,62	0,61	0,57
	Moderate traffic flow	Moderate traffic flow	Moderate traffic flow	Moderate traffic flow

6. Public Participation

Public participation consisted of three stages: (1) information dissemination at the project site, (2) interviews with local authorities, affected communities and stakeholders, and (3) consultation workshops.

Suggestions of villagers:

- Suggest the company do not dump untreated wastewater into the lake, which can affect water quality (for agriculture) and the lake biodiversity may be detrimentally altered due to water pollution.
- Suggest the company does not close the waterway flowing from Tonle Bati to Boueng Cheung Loung because it is the main water source for the lake. If it's closed, the lake will lack water and other biodiversity will disappear.
- The project should offer opportunities for local people to work inside the new airport
- The project should provide villagers with additional training, so that they could work for the airport.

Suggestions of consultation workshop's participants:

- Build a road surrounding the lake and plant trees to make it more attractive for tourists.
- Provide training to staff before job placement.
- Before operation, the project owner shall notify the public once again.
- The project needs to provide appropriate compensation to displaced people.
- The project should continue discussions with relevant institutions with regard to water supply.
- The project should have a strict work procedure for dump truck activity.
- The project should contribute to the protection and rehabilitation of the environment.

7. Environmental Impacts and Mitigation Measures

7.1 Negative Impacts and Mitigation Measures

The results of the full environmental and social impact assessment suggest that the project activities in the construction phase and operational phase potentially affects 17 resources with a varying level of impact from low to high. In the construction phase, most adverse impacts are low. The level of impact on topography is high, while the impacts on hydrology, air quality, noise, vibration, and wildlife are moderate. In the operational phase, most adverse impacts are low. The levels of impact on birds and wildlife are high, while the impacts on air quality, noise, and vibration are moderate. The details of mitigation measures are presented in Chapter 7 of this report.

7.2 Benefits

Apart from the above negative impacts, the project would bring long-term benefits to the national economy through the influx of capital, tax revenues, job creation (both direct and indirect), increased tourism, local infrastructure development, technical capacity development, and the rehabilitation of the lakes.

8. Environmental Management Plan

To effectively implement the environmental management plan (EMP), the participation of all relevant stakeholders is required. The project owner, CAIC, is the EMP implementer, while the Ministry of Environment and other relevant stakeholders monitor the implementation. The monitoring bodies have two levels: national, and sub-national.

1. Monitoring bodies overseeing the implementation results of environmental management plan and provide comments. They are:

a. National level: the Ministry of Environment (EIA Department, and other relevant Departments of the General Department of Environmental Protection) and the State Secretariat of Civil Aviation.
b. Sub-national level: Kandal Provincial Department of Environment, Kandal Provincial Administration, relevant Provincial Departments, and local authorities.

2. The responsible institution implements the environmental management plan: in this case it will be CAIC and all of its sub-contractors.

CAIC will annually contribute USD 700,000 to the environmental and social funds of the Ministry of Environment, starting from 2021. The project will prepare and submit an EMP implementation progress report twice a year.

9. Economic and Environmental Values Analysis

9.1 National Income

The project will provide significant national income through various taxes such as tax on tourists who travel via the airport, a tax on profits, and a tax on staff salaries, based on the laws and contracts between the project owner and Royal Government of Cambodia.

9.2 Promoting National Economic Growth

The new Phnom Penh airport will invest in site preparation, machinery, equipment, materials, and other services provided by Cambodian and foreign companies. Such expenses will nurture new business opportunities and improve Cambodia's economic status.

9.3 New Jobs and Income Generated by Project

In the design and planning phase, the project creates a lot of job opportunities for engineers, architects, financial consultants, administrative staff, legal experts, and coordination and communication experts.

In the operational phase, the project creates a lot of job opportunities for Cambodians including team leaders, technicians, engineers, administrative officers, financial officers, vendors and security guards. Upon completion of the project, the airport will serve domestic and international flights. Based on the project plan, the forecast passenger will be 15 million by 2030 and 30 million by 2050. The presence of those passengers will create indirect jobs opportunities for the local people who live around the project site through various services such as sale of food and groceries, hotel provision and transportation opportunities.

9.4 Increase of Tourist Arrivals

Based on CAIC's strategic plan, 13 million passengers are expected to arrive in the first phase (the start of operations -2030) and 30 million passengers in the second phase (2030-2050). The forecasd tourist arrivals will contribute to the national economy through the payments of airport tax and tourist's purchase of goods and services during their stay.

10. Conclusion and Recommendations

10.1 Conclusion

The results of the environmental and social impact assessment on the project indicate that the implementation of the project activities (pre-execution phase, execution phase and final phase) could affect 17 environmental resources, with the level of impact being low to strong. However, these adverse effects will be prevented or minimised through the implementation of Environmental Management Plan. In addition, the Company intends to follows the mitigation measures and environmental management plans proposed in Chapters 7 and 8 of this report.

The project has developed a specific Environmental Management Plan (EMP) which is a tool to manage the impacts associated with the project activities and to ensure compliance with standards of best practice during the project implementation.

Moreover, consultation with the public has shown that all institutions and people applaud the presence of the project because the project can provide a number of benefits such as: 1) economic growth in the local as well as the national economy; 2) improving the air transportation sector; 3) Increase in appearance and aesthetics both in and outside the airport location; 4) Provide jobs for the people of the village and earn money directly and indirectly; 5) land price increase.

In conclusion, the study found that no serious impacts were expected to occur on either natural or socioeconomic resources, and that any such impact would be consistently reduced to a minimum. The Company (CAIC) requests the Ministry of the Environment to support and issue a permit to the company for implementation of its construction plan.

10.2 Recommendations

In addition to the mitigation measures and environmental management plans described in Chapters 7 and 8, the project recommendation as well as the implementing company shall carry out a number of activities as a result of the following public studies and recommendations:

- Due to the high volume of water demand and release of waste from the project, the company must prepare a wastewater treatment tank capable of storing and cleaning the waste in accordance with the Ministry of Environment's permit so that it does not affect the quality Surface water, soil quality and population protests around the area.
- The design of fire extinguishers in the project area shall be detailed and submitted to Ministry of Interior (Ministry of Interior) for review and approval.
- CAIC is developing a road around the lake that restores land for airports and plantations to develop the lake area into a tourist attraction and preserve the state's lake land.
- CAIC must provide on-the-job training for each staff member before the airport commences operations to ensure that the staff can do the technical requirements and high standards, for example cleaning staff.
- Before the project starts the implementation phase, the project owner must undertake to inform the public about the project.
- CAIC must fully resolve the land-related issues to ensure that the project is not subject to complaints or delayed due to these issues.
- For the provision of a safe water supply, CAIC must have detailed discussions with technical teams and professional ministries / departments (Ministry of Industry and Handicrafts) to obtain a water supply.
- CAIC must have strict internal regulations concerning safety, especially for trucks.
- CAIC shall have funds for reasonable conservation and restoration of natural resources around the project area, such as fish, and participation in the preservation of some flooded forests in the Boueng Cheung Loung and Boueng Rean.

Chapter 1 Introduction

1.1 Introduction

The National Strategic Development Plan 2019-2023 of the Royal Government of Cambodia raised the importance of developing and implementing a master plan for transport infrastructure development in order to strengthen and expand connectivity in various parts of Cambodia as well as connecting with neighbouring countries through the development of integrated transport systems, including land, water, and airway. The development plan also emphasises the importance of public and private sector participation in airport infrastructure development and air services, especially in promoting direct and indirect private sector investment (Infrastructure and Regional Integration TWG, 2015).

In terms of air transport field, until present, Cambodia has 11 airports including 3 international airports and 8 domestic airports located in 11 provinces/cities. Phnom Penh International Airport is currently located in the city of Phnom Penh and serves as a civil and military airport capable of receiving 4D aircraft (based on the website information of the Phnom Penh International Airport 2018) and has been rebuilt and operational since 1995.

According to Phnom Penh International Airport annual report, the number of passengers is currently over 4.2 million / year by 2017 (Cambodia Airport, 2019). The airport was opened more than 20 years ago, and the number of passengers is steadily increasing but the current location of the airport cannot be expanded because of the downtown area, which has residences, factories, and other commercial facilities. Therefore, the Royal Government of Cambodia has decided to build the New Phnom Penh International Airport in response to the growth of air transport and affordability of welcoming 4F aircraft.

The project is being fundedby Cambodia Airport Investment Co., Ltd. The Cambodia Airport Investment Co., Ltd, hereafter referred to as “CAIC”, has decided to invest and partner with the Royal Government of Cambodia to develop “New Phnom Penh International Airport” (NPPIA). The selected site consists of 2,600 hectares, with the majority of the project area being located in Kandal province and a small part in Takeo province. The development of the project will contribute to improving domestic and international air transportation, as well as promoting tourism and investment in the region and the country as a whole.

As well as economic and social benefits, the implementation of the project can also cause negative effects that require careful study. According to Sub-decree 72 on the Environmental Impact Assessment 1999, the CAIC project for NPPIA must have a complete environmental and social impact assessment report. The company needs to be prepared in accordance with Prakas No 120 on EIA Term of Reference for infrastructure and tourism field development projects, dated 11 April 2018.

Therefore, in order for its activities to comply with all relevant legal frameworks, especially so that the implementation of its activities on the airport project ensures environmental and social protection, CAIC has employed the local consulting firmsE&A Consultant to undertake a full EIA of the project and the Ministry of Environment approved the working conditions, on 17 January 2019.

1.2 Objective of the Study

The main objectives of this report are:

- To study the project with a focus on activities that are planned and that may affect the environment

- To collect data related to (1) original data on the natural and social environment in the study area that may be affected by the project presence, and (2) to provide the public with full participation in the process of assessing the environmental and social impact of the project
- To identify and assess the impact and propose appropriate and effective mitigation measures
- To develop an appropriate and effective environmental management plan to respond to the potential impacts of project activities implementations.
- For economic analysis and environmental value due to project presence and
- To organise environmental and social funds to sustain and restore the environment and promote socio-economic development in the target areas.

Chapter 2 Scope and Methodology

2.1 Introduction

This chapter indicates the scope and study methodology of a full environmental and social impact assessment (ESIA) on the establishment of New Phnom Penh International Airport situated on an area of some 2,600 ha. Basically, this assessment examines the interaction between existing baseline data of environmental resources (both in the project area and study area and the project's activities that have been ongoing) and will be determining the potential impact which might occur on both on natural and social economic resources, both negative and positive. The study uses both secondary and primary data of physical resources, biological resources, and social-economic resources through key informant interview, survey, direct observation, and laboratory analysis, review of the project's technical documents and other desk reviews.

To conduct a comprehensive assessment, accurate data about the existing environment is essential. Therefore, the study has the following scope and methodology.

The main points of this chapter include:

- Scope and methodology of the study
- Public consultation
- Impact identification and assessment, and mitigation measures
- Cumulative impact assessment
- Environmental management plan
- Economic and environment value analysis
- Report compilation

2.2 Scope of the Study

This project has been approved by the Royal Government of Cambodia on a total area of 2,600 hectares which will be developed in three phases: Design and Construction Phase (2018-2025), Operational Phase I (2023 - 2030), and Operational Phase II (2031 - 2050). Therefore, the project's ESIA includes all three phases and the area within 3km around the project area. The study focuses on natural resources (physical and biological resources) and socio-economic resources that may be affected by the project's activities.

2.2.1 Assessment Methodology

To obtain comprehensive information, the study uses quantitative and qualitative data collection based on secondary data (i.e. legal framework, project description, climate data, and other local administrative data…) and primary data (i.e. physical data, biological data, socio-economic data, traffic situation, land use, etc.).

2.2.2 Existing Environmental Resource

2.2.2.1 Physical Resource

a) Soil Study

- ***Geology***

The geological study in the study area focuses on the parent rock of soil and its era both in the project area and an area within 3 km surrounding the project site. The study is based mainly on the existing data

(geological data of Cambodia), established by the Japan International Cooperation Agency (JICA) in 2002. The study used ArcGIS to create geological maps in the project and the overall study area.

- ***Topography***

The topographical study focuses on the altitude and slope classification within the site and 3 km around the project site. The study is based mainly on existing data (contour line data), created by the Japan International Cooperation Agency (JICA) in 2002. The study used ArcGIS to develop a topographical map in the project and the overall study area.

- ***Soil Type and Soil Fertility Classification***

The study of soil type and soil fertility classification focuses on soil type and soil fertility (low, medium, high) and soil suitability for crops within the site and also 3km around the project area. The study based mainly on Dr. Crocker's data in 1963. The study used the following methods:

- ArcGIS software and Cambodia soil type and soil fertility data of Dr. Crocker in 1963;
- GPS tool to extract main components of the project area, and
- Field observation.
- Soil quality and texture.

The soil type in the project area is alluvial soil, while there are two soil types (alluvial soil, and cultural hydromophic) within the 3 km of the project site.

The study of soil quality and soil texture focuses on the physical and chemical properties of the soil in the project area. Soil sampling was collected from two locations (see table below) in accordance with the guidelines of the Soil Quality Laboratory of the General Department of Agriculture of the Ministry of Agriculture, Forestry and Fisheries. The soil quality analysis focused on the main parameters as shown in the table below. In addition, the results of the analysis were compared against to the soil fertility rating of the General Department of Agriculture of the Ministry of Agriculture, Forestry and Fisheries.

Table 1: Soil Sampling Location

No	Datum: WGS1984 48N		Location	Commune	District	Province
	X	Y				
1	490795	1252162	Prasat Village	Preak slaeng	Kandal Stoueng	Kandal
2	487690	1251710	Klakon Village	Pot Sor	Bati	Takeo

Table 2: Main Parameters for Soil Quality Analysis

No	Soil Properties	Parameter
1	Physical properties	Moisture
		Clay %
		Fine Silt %
		Coarse Silt %
		Fine Sand %
		Coarse Sand %
2	Chemical properties	Total Nitrogen (N)
		Potassium (K)
		Calcium (Ca)
		Magnesium (Mg)
		Sodium (Na)
		Organic Matter
		C/N Ratio
		Total phosphorus
		Available phosphorus

No	Soil Properties	Parameter
		Cation exchange capacity (CEC)
		pH
		Electrode Conductivity

- ***Geotechnical Investigation***

The geotechnical investigation study focuses on soil strata, soil permeability and geographical feature condition in the project area. This study is based mainly on the geology study which was conducted by the project owner in collaboration with contractors. To achieve a safe and durable runway/taxiway/infrastructure, it is crucial to assess soil physical and mechanical properties. These studies provide key inputs to foundation design (type, size, length, and number of foundation). Geotechnical study uses two methods: penetration test; and soil test conducted in laboratory. This study was conducted by Beijing Urban Construction Group Co., Ltd.

Drilling: To assess soil physical and mechanical properties as well as to design the foundation of runway/taxiway/airport infrastructure, geologists drilled 40 holes, measured at 100 mm of diameter and 9-25 meters of depth.

Penetration test: In addition to the drilling, penetration test is conducted in the holes at every 1.5 meter of depth. During the test, an object (63.5 kg of weight) freely falls from a height of 760 mm on a metal tube (50.80 mm of diameter). The count of hits on the metal tube is conducted at every 150 mm, for three times in a row.

Table 3: Penetration test and clay compaction

Index SPT (N)	Soil compaction
0-2	Very soft
2-4	Soft
4-8	Medium stiff
8-15	Stiff
15-30	Very stiff
Over 30	Hard

Source: CAIC (2019)

Table 4: Penetration test, Sand and gravel

Index SPT (N)	Soil compaction
Below 4	Very loose
4-10	Loose
10-30	Medium dense
30-50	Dense
Over 50	Very dense

Source: CAIC (2019)

Table 5: RQD results and rock quality

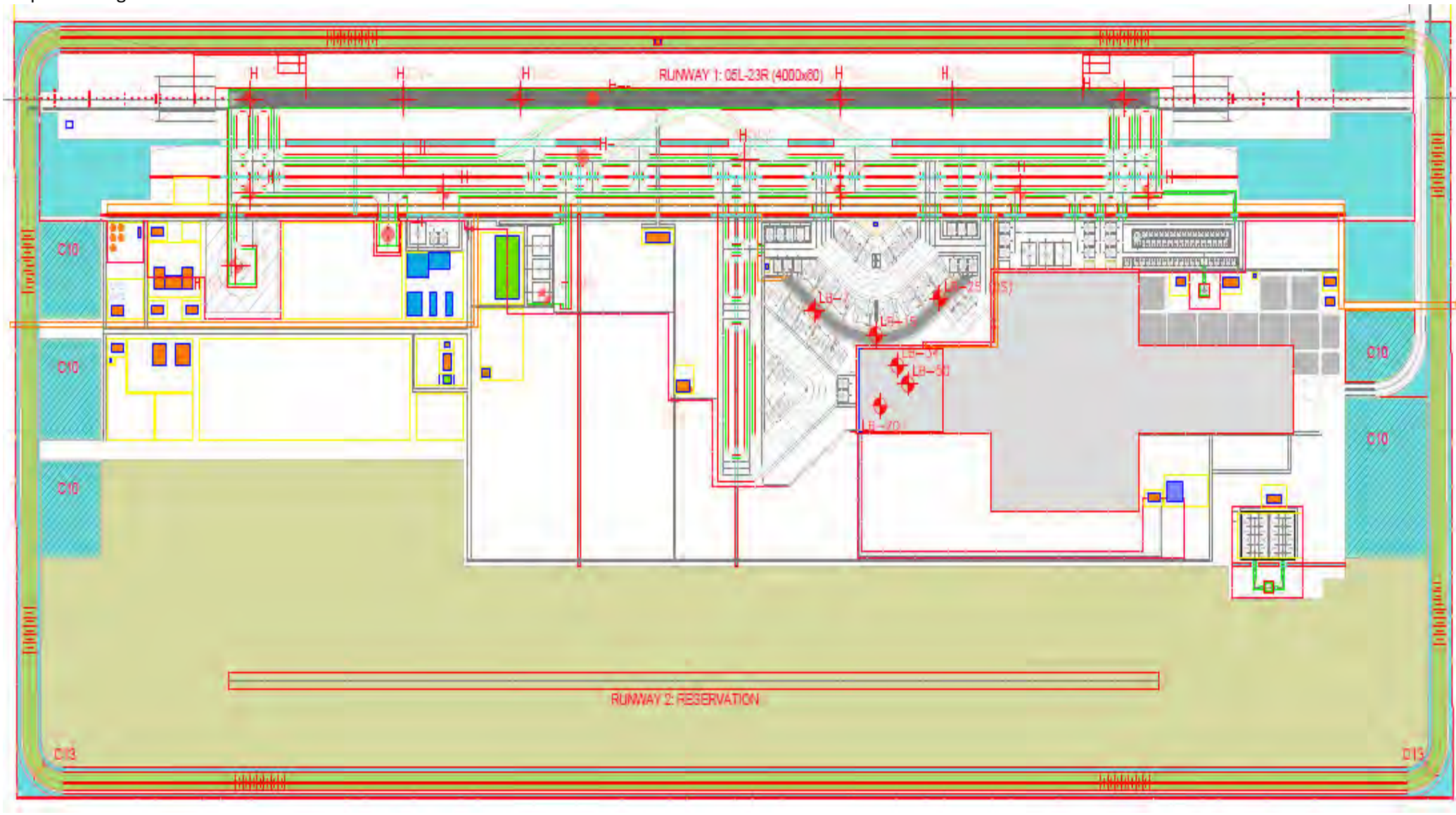
Rock quality	RQD (%)
Very poor (complete erosion)	<25%
Poor (high erosion)	25-50%
Medium (moderate erosion)	51-75%
Good (hard rock)	76-90%
Very good (no erosion)	91-100%

Source: CAIC (2019)

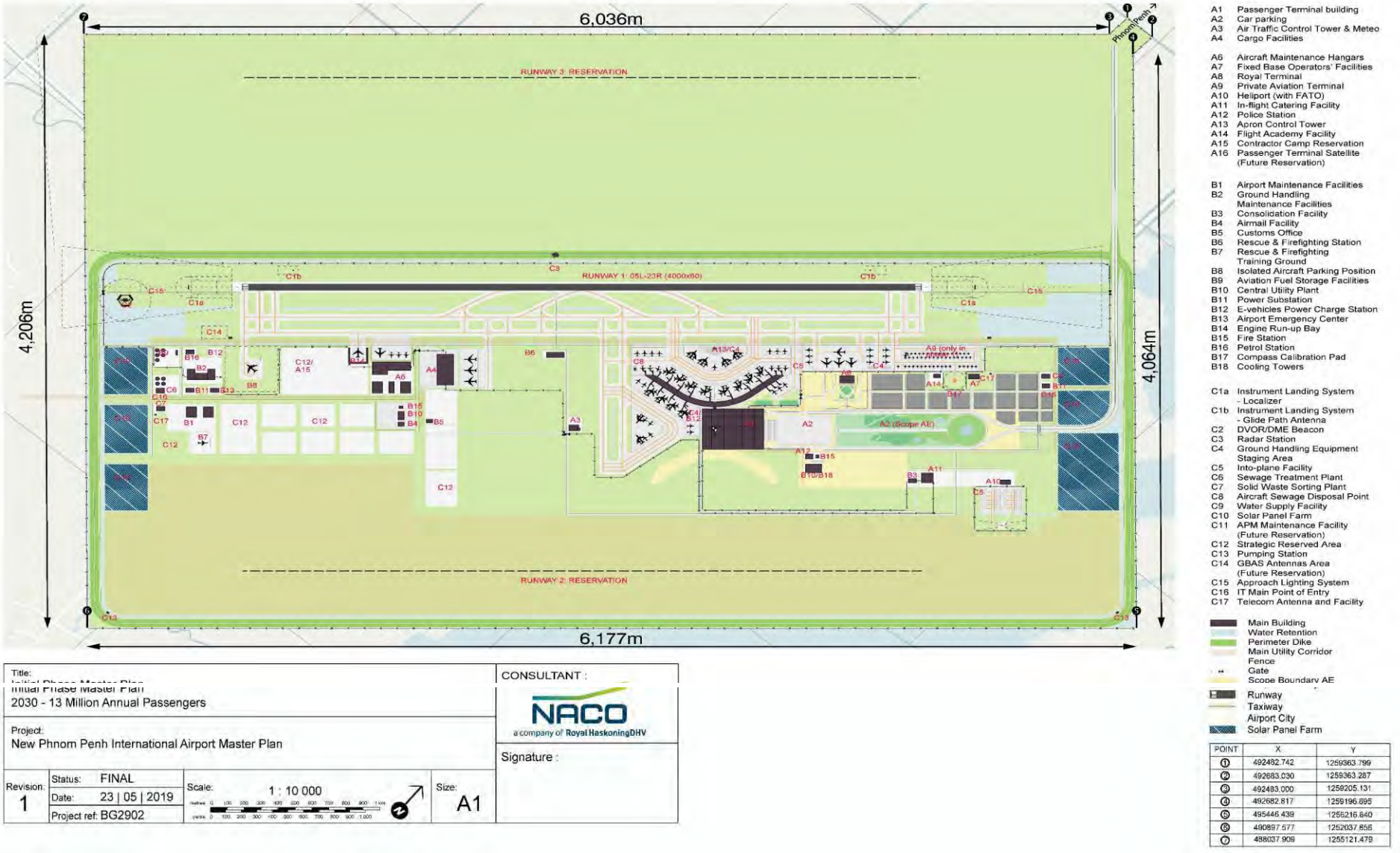
Soil test in laboratory and subsurface study: soil sample is taken from the drilled hole. There are two types of soil samples: disturbed and undisturbed sample.

- Undisturbed sample: Natural structure of the soil and material properties remain preserved. Thin-walled tube sampler is used to take this type of sample. Undisturbed sample is taken from clay and clay/sand mix.
- Disturbed sample: Natural structure of the soil and material properties get modified. This type of sample is taken from all types of soil and every soil layer at a depth of 1.5 meter.

Map 1: Drilling Locations



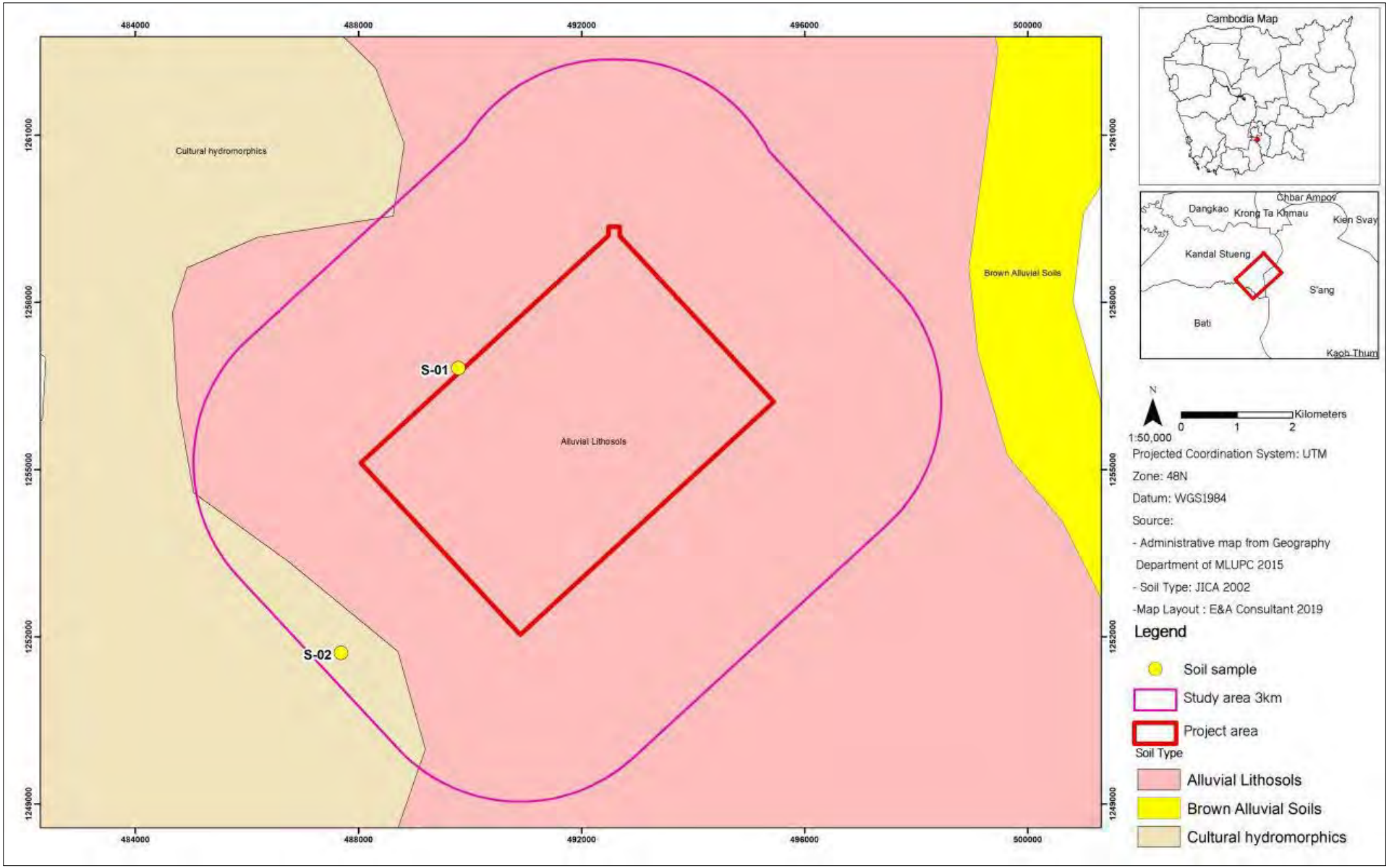
Map 2: Project's Land Use Map



POINT	X	Y
①	492482.742	1259363.799
②	492683.030	1259363.287
③	492483.000	1259205.131
④	492682.817	1259196.895
⑤	495446.439	1256216.840
⑥	490897.577	1252037.856
⑦	488037.909	1255121.479

Source: CAIC (2019)

Map 3: Soil Sampling Location



Source: E&A Consultant (2019)

b) Climatic Study

The climate study focused on Kandal and Phnom Penh climate and meteorology baseline data for 10 years (2009 to 2018). The study used the existing climatic and meteorology data which was retrieved from the meteorological station of the Ministry of Water Resources and Meteorology. The study focused mainly on four parameters: temperature, rainfall, moisture, and wind speed and wind direction.

c) Air Quality

Air quality impacts are identified and evaluated through air quality analysis in the project site and residential areas near to the project area. The analysis focused on eight major parameters include: Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), Ozone (O_3), Mercury (Pb), Total Suspended Particle (TSP), 10-micron Particulate matter (PM10) and 2.5-Micron Particulate Matter (PM2.5).

The analysis was conducted for 24 hours' measurement (excluding CO measured within 8 hours and O_3 measured in 1 hour) at four different locations as shown in the table below:

Table 6: Air Quality Sampling Location

Location	Coordinate (Meter) Datum: WGS1984 48N		Location	Commune	District	Province
	X	Y				
ANV1	491617	1254210	In the project area	Boeng Kjang	Kandal Stoeung	Kandal
ANV2	488937	1253580	Potsor village	Potsor	Bati	Takeo
ANV3	496685	1254320	Peam Sala village	Sa'ang Phnom	Sa'ang	Kandal
ANV4	488901	1257380	Cherng Prey village	Ampov Prey	Kandal Stoeung	Kandal

The results of analysis were compared against the Air Quality Standards of MoE's Sub-decree on air pollution control and noise disturbance (2000) and MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018).

Table 7: Main parameters and Air Quality Analysis Method

No	Parameter	unit	Standard*	Duration
1	CO	mg/m^3	20	8 hours
2	NO_2	mg/m^3	0.1	24 hours
3	SO_2	mg/m^3	0.3	24 hours
4	O_3	mg/m^3	0.2	1 hour
5	Pb	mg/m^3	0.005	24 hours
6	TSP	mg/m^3	0.33	24 hours
7	PM10	mg/m^3	0.05	24 hours
8	PM2.5	mg/m^3	0.025	24 hours

*Note: Standard *: Air Quality Standards of MoE's Sub-decree on air pollution control and noise disturbance (2000) and MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018).*

d) Noise and Vibration

The noise and vibration measurement were carried out through the noise and vibration sampling on four different locations for 24 hours' measurement as detailed in the table below.

The noise and vibration sampling was conducted for 24 hours at each location by the E&A consultant using RION-NL-52EX NL-52 for noise test and using RION VM-55EX Vibration Level Meter for vibration test. The noise analysis is compared against two maximum noise standards:

- For the noise test in the project area (Location ANV1), use the maximum noise standard allowed in light manufacturing and residential area.

- For noise tests outside the project area (Location ANV2, ANV3, ANV4), use the maximum noise standard allowed in residential area.

The result of the noise and vibration analyses were used to compare against the maximum noise and vibration standard permitted in public areas and residential areas of the MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018) and MoE's Sub-decree on air pollution control and noise disturbance (2000)

Table 8: Noise and Vibration Sampling Location

No	Coordinate (Meter) Datum: WGS1984		Location	Commune	District	Province
	X	Y				
1	491617	1254210	Project area	Ampov Prey	Kandal Stoeung	Kandal
2	488937	1253580	Potsor village	Potsor	Bati	Takeo
3	496685	1254320	Peam Sala village	Sa'ang Phnom	Sa'ang	Kandal
4	488901	1257380	Cherng Prey village	Ampov Prey	Kandal Stoeung	Kandal

Table 9: Parameter and Method for Noise Sampling

Parameters	Duration	Method	Duration	Standard[1]	Standard[2]
Noise	24hours	Sound Level Meter	6:00am - 18:00pm	75dB(A)	60dB(A)
			18:00pm - 22:00pm	70dB(A)	50dB(A)
			22:00pm - 6:00am	50dB(A)	45dB(A)

Remark: - Standard1: The maximum noise standard permit in commercial area, service and mixed area of the MoE's Sub-decree on air pollution control and noise disturbance (2000) and MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018).
- Standard2: The maximum noise standard permit in residential area (hotel, administration area, villa and flat) of the MoE's Sub-decree on air pollution control and noise disturbance (2000) and MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018).

Table 10: Parameters and Method for Vibration Sampling

Parameters	Duration	Method	Duration	Standard*
Vibration	24 hours	Vibration Level Meter	6:00am - 18:00pm	65dB
			18:00pm - 6:00am	60dB

Remark: Standard: Vibration standard of the MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018).*

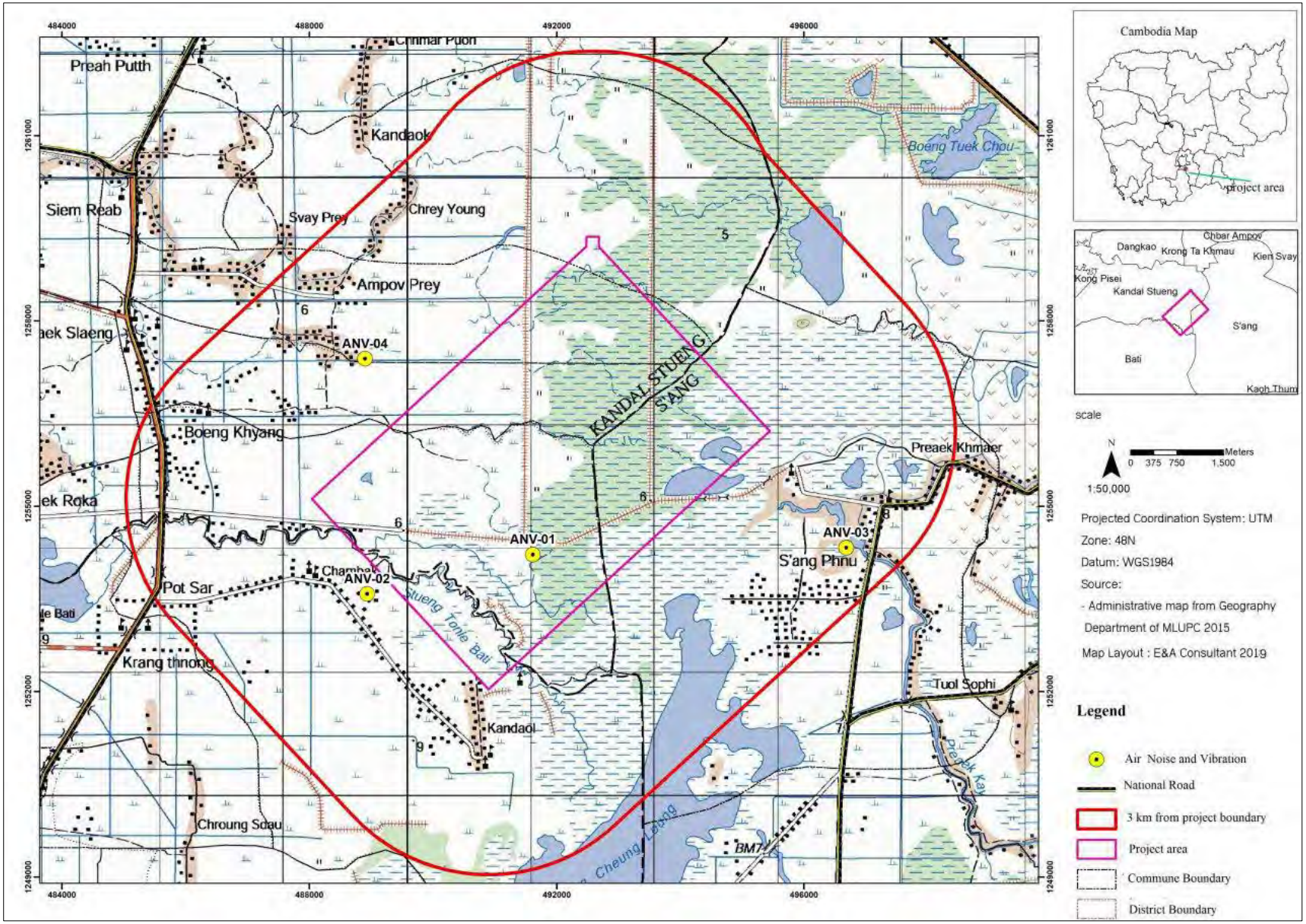
❖ Noise Modelling

Noise generated by aircraft movements may impose a negative impact on the surrounding local communities. Therefore, noise impact which is created by the project's activities is the main impact to be taking into account for this type of project.

The study on noise was conducted by Noise Modelling in order to estimate the volume of noise emitted by the aircraft movements (take-off and landing) and the distance that the noise would have an effect on local people or other sensitive receptors. Noise modelling was carried out using AEDT 2.0d in the project area and within 5km from the project site under the landing or flight path. Noise modelling requires below key data:

- Topographical map
- Land use map
- Aircraft type
- Ambien noise measurement
- Climate data
- Noise standard of Cambodian Ministry of Enviornment.

Map 4: Air Quality, Noise and Vibration and Soil Quality Sampling Location



e) Hydrology

- ***Existing Hydrological System Around the Project Area***

The geographical features of the project area and the surroundings area are the wetland which consists of lakes and streams. The direct observation on November 17, 2018 and primary consultations with local authorities showed that within 3km around the project area there are four major hydrological systems as follows:

- Boueng Cheung Loung Lake: a natural lake with water available in both dry and wet seasons, located to the south-east of the project area.
- Preak Ta Hor stream: located to the north of the project area. It is the stream that connects Stoeng Prek Thnot River and Boueng Cheung Loung Lake.
- Stoeung Tonle Bati River: located to the south of the project area. It flows from Takeo province to Boueng Cheung Loung Lake.
- Other outflowing canals such as Canal No. 92, Canal No. 57, and Canal No. 58.

According to the interviews with local fishermen and direct observation on 17 November 2018, the above hydrological systems play important roles as the source of water for rice production and fishing. The hydrological study takes into account the size, current flow, and function of each hydrological system around the project area through interviews with local authorities, direct observation and the use of GPS devices to mark major stream's locations and other streams, if any. The collected data was then incorporated into the ArcGIS software to create hydrological maps which indicated flow direction, size, etc.

f) Surface Water Quality

The surface water quality analysis was conducted to determine the baseline data on current water quality in each stream, lake and canal within and around the project area. The surface water quality sampling was carried out at four different locations (both in the dry and wet seasons as shown in Tables 8 and 9 below). The surface water sample was collected in compliance with the laboratory guidelines, and analysis at the MoE's water quality laboratory. The analysis results were compared against the water quality standards of the MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018) as shown in the table below:

Table 11: Surface Water Sampling Location

No.	Coordinate (Meter) Datum: WGS1984 48N		Location
	X	Y	
SW01	493299	1252180	In Boeung Cheung Loung, located to the south-east of the project area
SW02	491536	1252354	In lower part of Tonle Bati River, located to the south-west of the project area
SW03	493513	1259352	In upper part of Preak Ta Hor, to the north-east of the project area
SW04	489848	1257382	In canal No 57, to the south-west of the project area

Table 12: Surface Water Quality Parameters for Analysis

No.	Parameter	Unit	Standard*	
			River	Lake and reservoir
1	pH	-	6.5-8.5	6.5-8.5
2	Total Dissolved Solids (TDS)	mg/l	<1,000	<1,000
3	Total suspended solids (TSS)	mg/l	25-100	1-15
4	Dissolved oxygen (DO)	mg/l	7.5-2.0	7.5-2.0

No.	Parameter	Unit	Standard*	
			River	Lake and reservoir
5	Biochemical oxygen demand (BOD_5)	mg/l	1 - 10	<30
6	Chemical oxygen demand (COD)	mg/l	<50	1-8
7	Oil & Grease	mg/l	<5.0	<5,0
8	Detergent	mg/l	<5.0	<5,0
9	Sulphate (SO_4)	mg/l	<300	<300
10	Total Nitrate (TN)	mg/l	0.1-0.6	0.1-0.6
11	Total phosphorous (TP)	mg/l	0.005-0.05	0.005-0.05
12	Lead (Pb)	mg/l	<0.01	<0.01
13	Arsenic (As)	mg/l	<0.01	<0.01
14	Cadmium (Cd)	mg/l	<0.001	<0.001
15	Iron (Fe)	mg/l	<1	<1
16	Mercury (Hg)	mg/l	<0.0005	<0.0005
17	NH3	mg/l	-	-
18	Total Coliform	MPN/100ml	<5,000	<1,000

Note: Standard: Surface water quality standards for lake, reservoirs and seawaters of the MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018).*

g) Groundwater Quality Analysis

Direct observation and consultations with local authorities on November 17, 2018 showed that most of residential areas within 3 km around the project area (especially residential areas in the western and southern part of the project) used ground water supplied by open-wells or hand-tube wells.

The sampling was conducted on two different locations from open-wells and hand-tube wells in the residential areas to the western and eastern part of the project site as detailed in the table below. Water sampling was collected in compliance with MOE laboratory's guidelines. The sample was analysed at the MoE's water quality laboratory. The analysis focused on main groundwater parameter as listed in the below table.

Table 13: Ground Water Sampling Location

No.	Coordinate Datum: WGS1984 48N		Location
	X	Y	
GW01	495823	1255480	In Preak Khmer village, Sa'ang Phnom comment, Sa'ang district, Kandal province, about 1km to the east of the project.
GW02	488936	1253030	In Potsor village, Potsor commune, Bati district, Takeo province, about 1km to the west of the project.

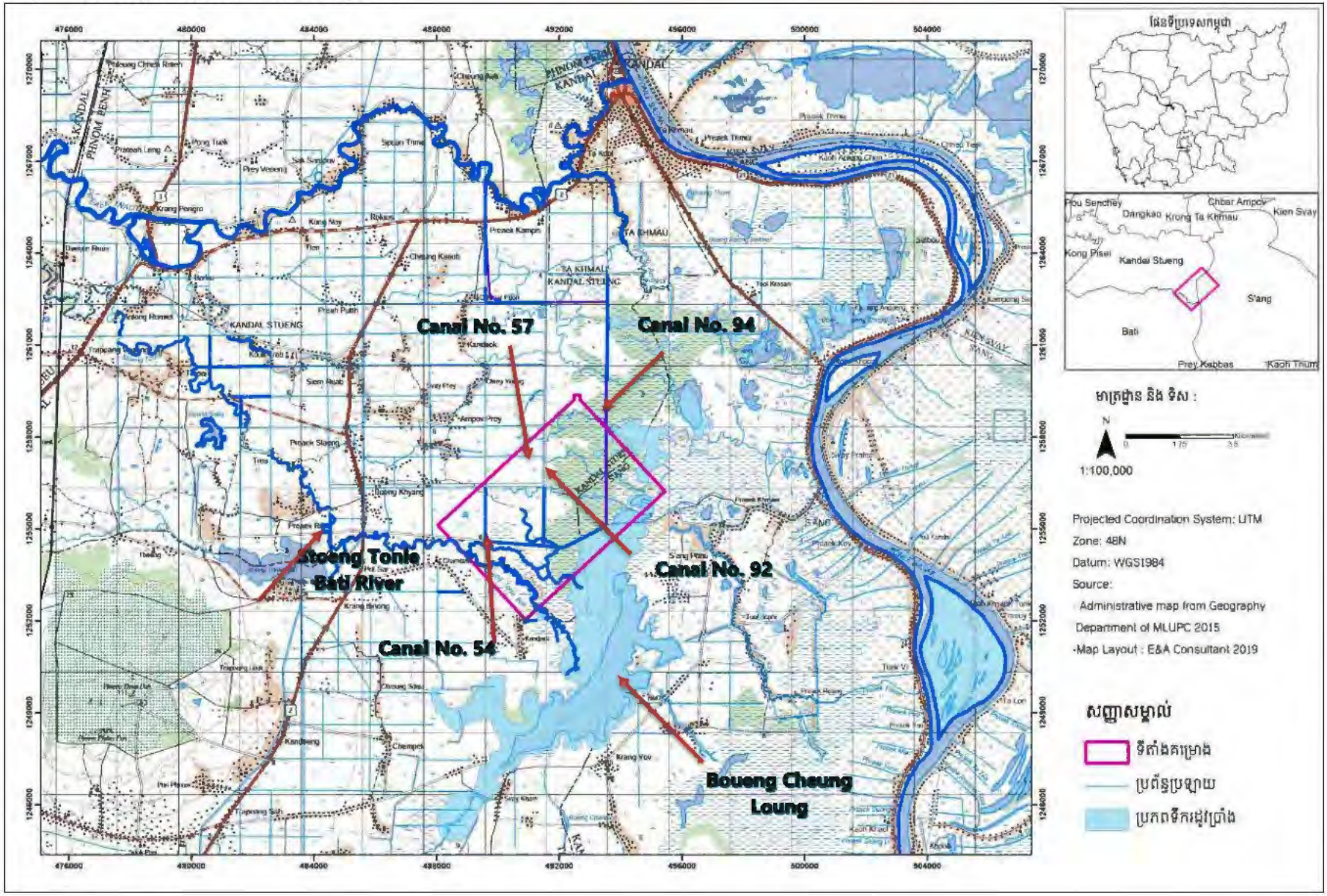
Table 14: Main Groundwater Quality Parameters for Analysis

No	Parameter	Unit	Standard*
1	pH	-	6.5-8.5
2	Turbidity	NTU	5
3	Electricity conductivity (EC)	NTU	500-1,500
4	Total Dissolved Solids (TDS)	mg/l	800
5	Total Hardness (as $CaCO_3$)	mg/l	300
6	Chloride (Cl)	mg/l	250
7	fluoride (F)	mg/l	1.5
8	Nitrate (NO_3)	mg/l	50

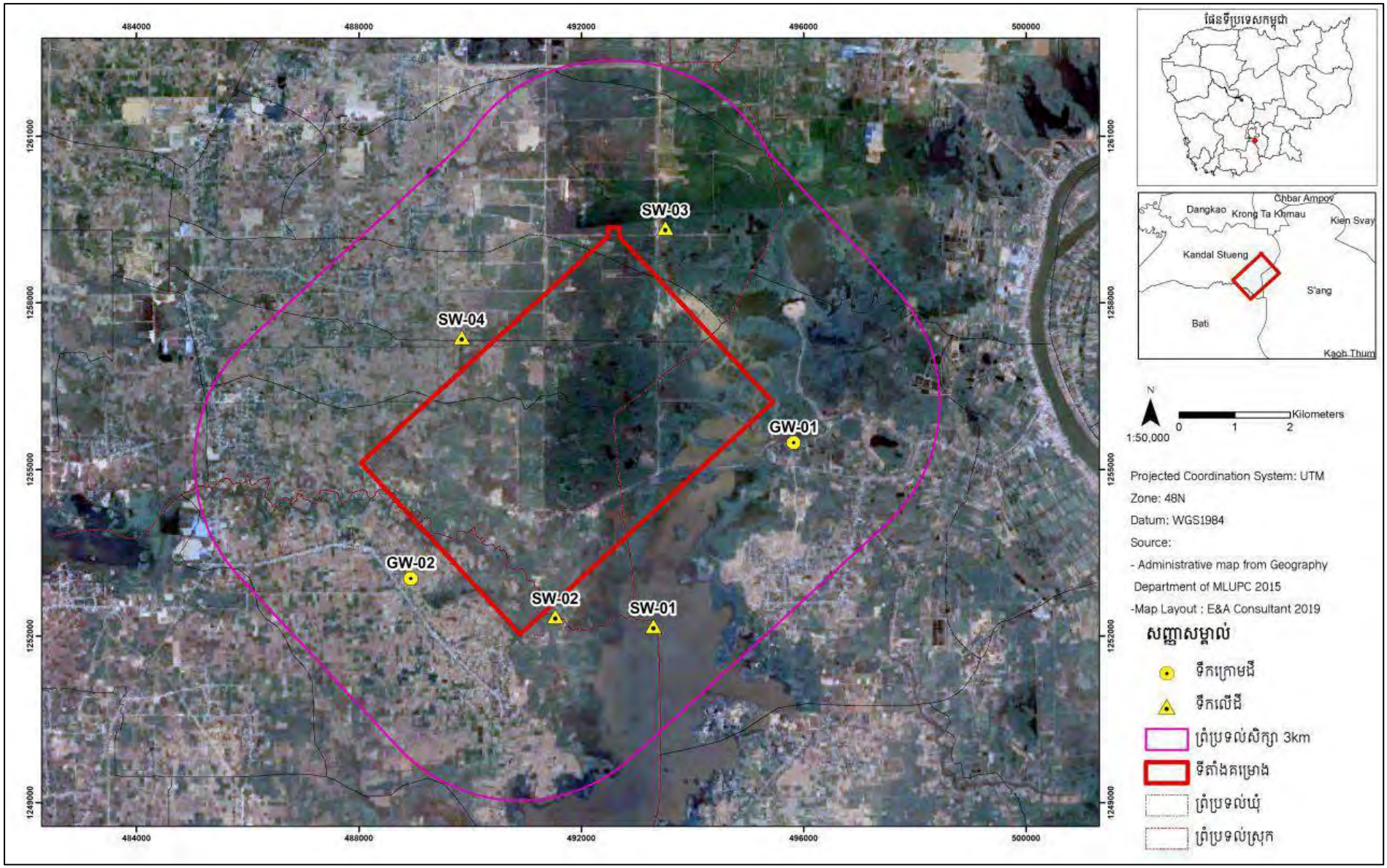
No	Parameter	Unit	Standard*
9	Sulphate (SO_4)	mg/l	250
10	Iron (Fe)	mg/l	0.3
11	Arsenic (As)	mg/l	0.05
12	Mercury (Hg)	mg/l	0.001
13	Chromium (Cr)	mg/l	0.05
14	Manganese (Mn)	mg/l	0.1
15	Aluminium (Al)	mg/l	0.2
16	Cadmium (Cd)	mg/l	0.003
17	Total Coliform	MPN/100ml	0
18	E-Coli	MPN/100ml	0

Note: Standard: Groundwater Quality Standard of the MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018)*

Map 5: Hydrological System in the Study Area



Map 6: Sampling Location of Surface Water Quality and Ground Water Quality



2.2.2.2 Biological Resources

a) *Forestry (Flooded Forest)*

The Forestry Administration's 2010 Forest Cover Map (below map) shows that the project area has non-forest cover (both the project area and its vicinity). Field observations on November 17, 2018 showed that about 14% of the project area is covered by flooded forest, 83.77% by paddy fields, 1.84% by pond, and 0.39% by residential area. The study focused on the type of existing forest in the project area. The purpose of the study was to identify the forest species, existence, classification, density and the vulnerability of those forest resources. The forest study used the following methodology:

- Lots and transect lines: Between the middle part of the project area and the northern as well as the western parts lie a lot of aquatic plants such as Mimosa Pigra, Mimosa Pisdica, Barringtonia asiatica, and Gmelina asiatica. Therefore, three sample lots and two transect lines with 4km in each transect lines were selected (Map 6).
    - Lot Locations and Area

Lot	Area	Coordinates
Lot 1	5 meters x 10 meters	X:492980; Y:1255249
Lot 2	5 meters x 10 meters	X:493704; Y:1254932
Lot 3	5 meters x 10 meters	X:494237; Y:1258907

    - Lot sample

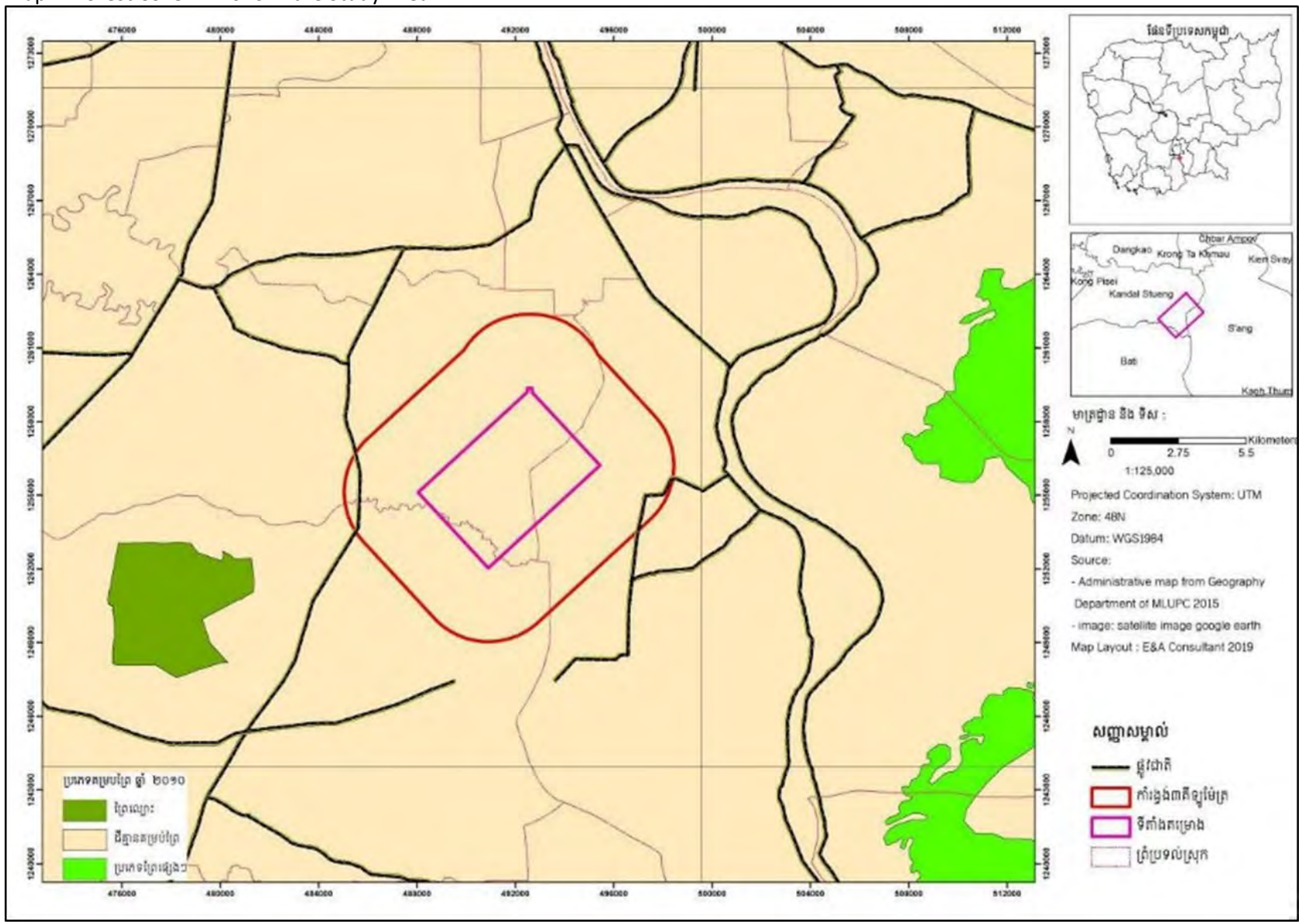
5 meters

10 meters

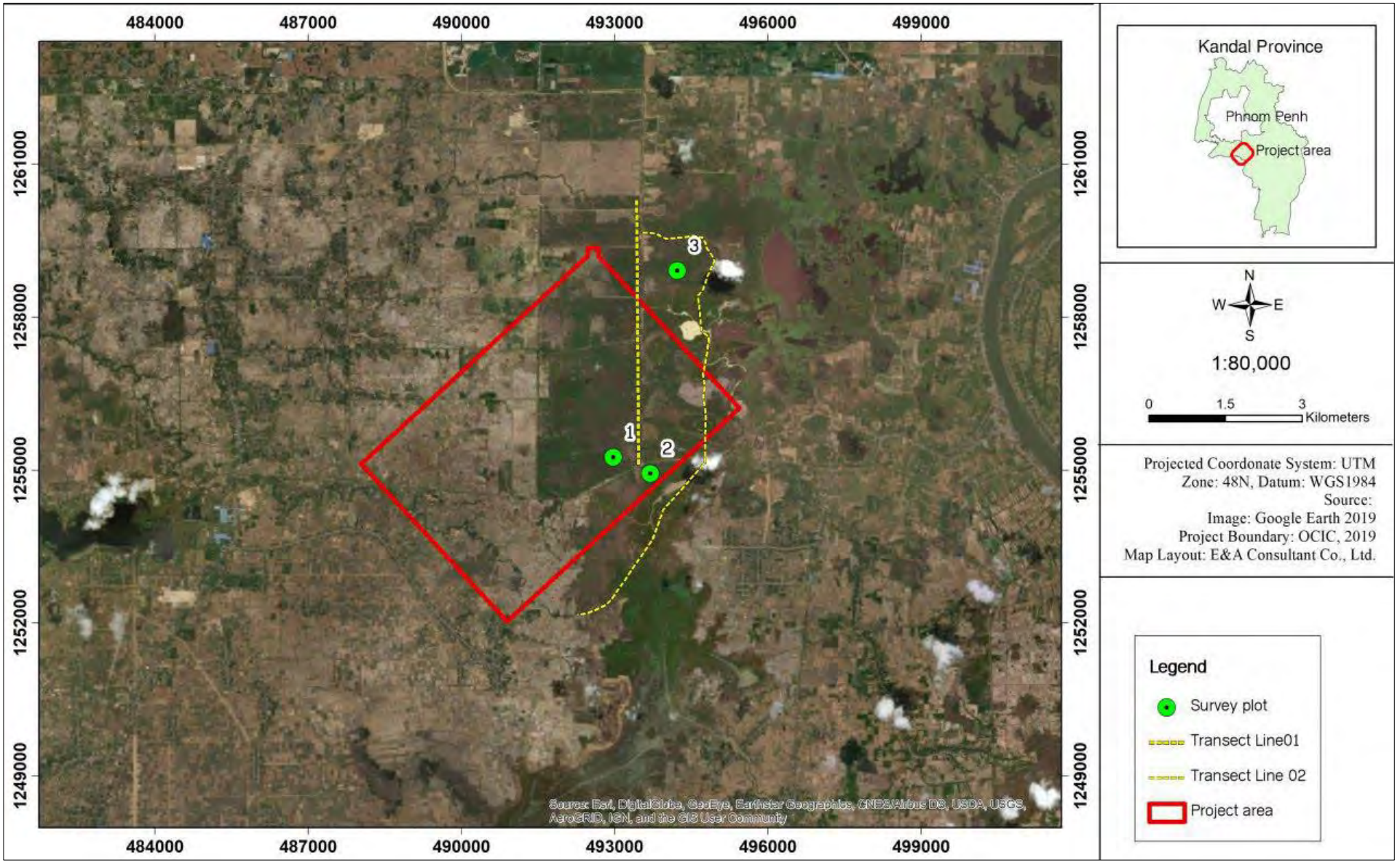
    - Record: separate record sheet for each lot. Plant inventory shall include all types of plants both surface and aquatic.
- Interviews with local people by using a Checklist
- Use of the 2010 forest cover map and 2018 google map
- Use of a drone to capture current forest situation and for the the production of maps
- Tool for study:
    - Digital cameras to capture the photo of trees and plants
    - Garmin GPS 62S to mark the location of the wild mammal species found
    - Datasheet to record the species found in the study area
    - Map to point the locations and geography of the study area
    - Compass to direct where to go for transact walk
    - Knife to help make forest path

Note that the details of flooded forest are included in the project's full environment and social impact assessment report.

Map 7: Forest Cover in 2010 in the Study Area



Map 8: Transect Line for Forest Observation



b) Wildlife Resources

- ***Study of Mammals***

The study of mammals was conducted to i) identify the existing mammal species and IUCN's red list categories (rare, threatened and endangered species) for the current baseline information, and for monitoring mammal species in the construction and operational phase of the project; ii) mammal distribution, and iii) corridors, food sources, migration and habitat, etc.

The mammal study covered an area within 3 km around the project area - using the following methods:

- Key informant interviews with local villagers (who are familiar with the forest and know mammals and their habitats well), experts and conservation staff based on the prepared species checklist which included pictures and the mammal's name;
- Direct observation and transect walks on 2 transect lines each of 4 km length (as shown in the map below) to identify mammal habitat and food sources through direct sight, sound, footprint, stool, or another scar;
- Tools for mammal survey were:
    - Wildlife guidebook
    - Digital cameras to capture the photo of wild mammal found and study activities
    - GPS to mark the location of the wild mammal species found
    - Datasheet to records the wild mammal species found
    - Map to point the locations and geography of the study area
    - Compass to direct where to go for transact walk
    - Binoculars to zoom in and out for species where our naked eyes cannot focus
    - Knife to help make forest path

- ***Amphibian Study***

The study of amphibian was conducted to i) identify the existing amphibian species and IUCN's red list categories (rare, threatened and endangered species) for the current baseline information, and for monitoring the species in the construction and operational phase of the project; ii) amphibian distribution, and iii) corridors, food sources, migration and habitat, etc.

The amphibian study covered an area within 3 km around the project area - using the following methods:

- Key informant interviews with local villagers (who are familiar with the forest and know amphibians and their habitats well), experts and conservation staff based on the prepared species checklist which included pictures and the amphibian name;
- Direct observation and transect walks on 2 transect lines each of 4 km length (as shown in the map below) to identify amphibian's habitat and food sources through direct sight, sound, footprint, stool, or another scar;
- Tools for amphibian survey were:
    - Wildlife guidebook
    - Digital cameras to capture the photo of wild mammal found and study activities
    - GPS to mark the location of the wild mammal species found
    - Datasheet to records the wild mammal species found
    - Map to point the locations and geography of the study area
    - Compass to direct where to go for transact walk
    - Binoculars to zoom in and out for species where our naked eyes cannot focus
    - Knife to help make forest path

- ***Bird Study***

The bird study was conducted in order to i) identify the species in IUCN's red list categories (rare, threatened and endangered species) for the current baseline information and for monitoring bird species in the construction and operational phase of the project; ii) determine the direct and indirect impact on bird, and iii) identify food source, habitat, fly direction, fly attitude, etc.

The bird study covered an area within 3 km around the project area using Avian survey method of Blackewell et al (2013). The bird study focused on five locations (see table and map below) using the following methods:

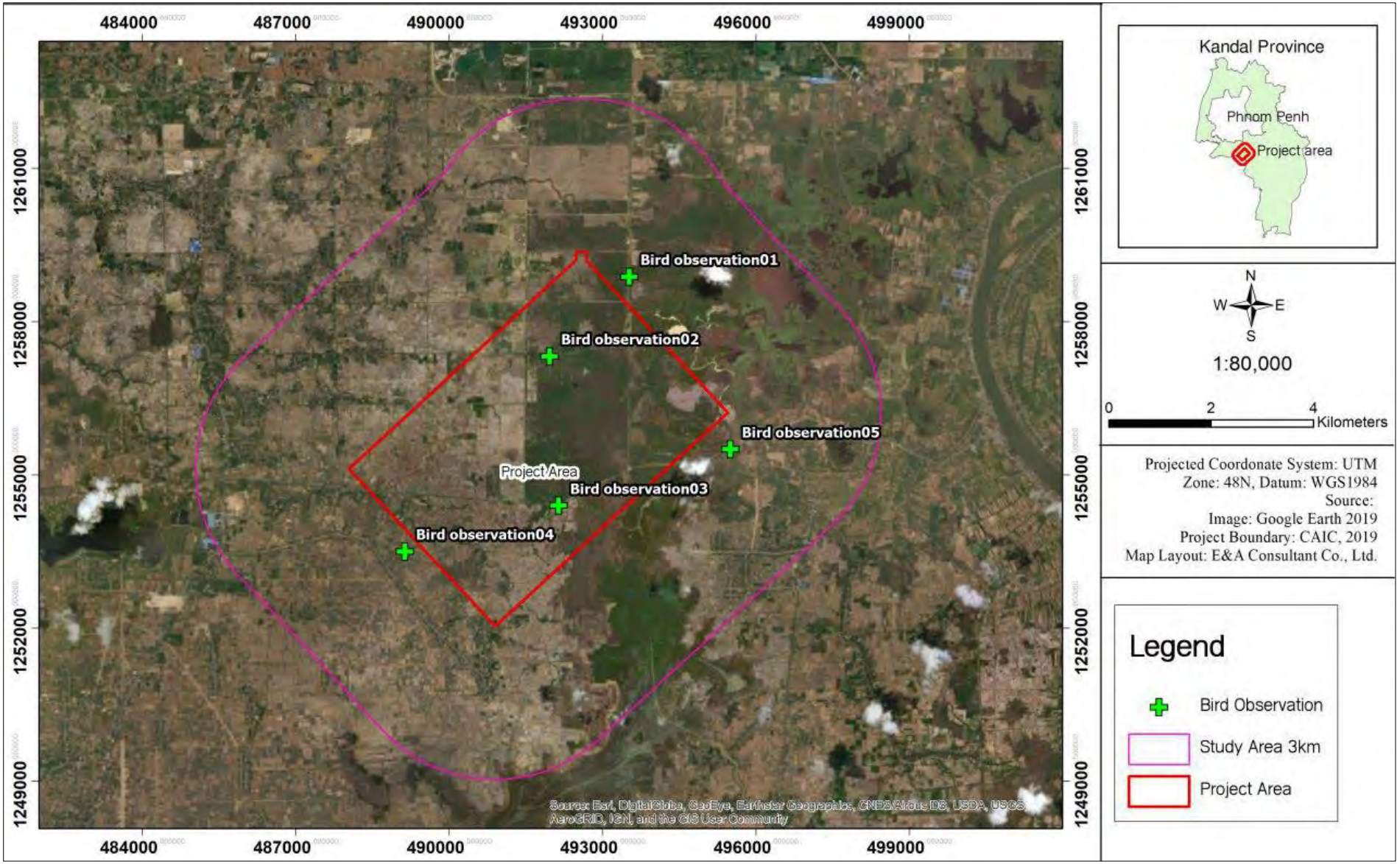
- Review of other research or databases which are relevant to bird species in the study area
- Identification of bird species through interviews with local villagers who are familiar with the bird species, and experts based on the prepared species checklist which consisted of bird picture and name;
- Direct observation at five locations for two days both in the morning and evening as detail below:
    - Morning: start from 8:00am to 10:00am
    - Evening: start from 16:00pm onward about 30mm after sunset.
    - Use GPS, Binoculars and drone.

Table 15: Coordinate Point for Bird and Wildlife Observation

No.	Coordinates WGS1984 48N	
	X	Y
1	493524	1258875
2	491970	1257318
3	492145	1254394
4	499134	1253497
5	495506	1255500

Figure 1: Tools for Wildlife and Bird Survey

Map 9: Bird Observation Location



Source: E&A Consultant (2019)

c) Fisheries and Biodiversity

The study of fisheries and biodiversity resources focused on fisheries resources in Boeung Cheung Loung, streams and canals within and around the project area. The study aims to identify i) fish species and distribution ii) IUCN's red list categories (rare, threatened and endangered species) for the current baseline information, and iii) the existence of food sources and vulnerability.

The study of fisheries and biodiversity covered Boeung Cheung Loung Lake and the canal systems within 3km of the project area using the following methods:

- Identify fisheries species through interviews with local fisherman who used to catch fish in Boeung Cheung Loung, streams and canals within the study area through using the prepared species checklist which consisted of fish pictures and names;
- Direct observation at fishing locations, fishing gear (netting or hooks, etc.)
- Tools for fisheries resource survey were:
    - Fisheries resources guidebook in Cambodia
    - Digital cameras to capture the photo of fisheries resources, fisheries species, and fishing gears found
    - GPS to mark the location of fishing ground
    - Datasheet for recording.

2.2.2 Socio-Economic Resources

According to a direct observation on 17 November 2018, there are residences of local villagers along the village roads within an area of 3 km around the project area. Base on the geographical feature, the household surveys were conducted in 32 villages within an area of 3 km around the project area.

a) Household Survey

The study collected the following information:

- Demographics
- Resettlement
- Road infrastructure
- Land use and registration
- Occupation and economic activity (income, expenditure and poverty)
- Physical infrastructure
- Water consumption
- Energy consumption
- Public health (illness, health, sanitation, etc.)
- Education
- Tourism area
- Land dispute solving mechanism

b) Scope and Methodology

To create a socio-economic baseline data, the study focused on households potentially affected by the project (directly and indirectly). The socio-economic survey involved household survey using a questionnaire to collect both quantitative and qualitative data, required for socio-economic analysis.

c) Sample Identification

- ***Sample Size Calculation***

Thirty Two (32) villages located within an area of 3 km from the project area were selected as follows:

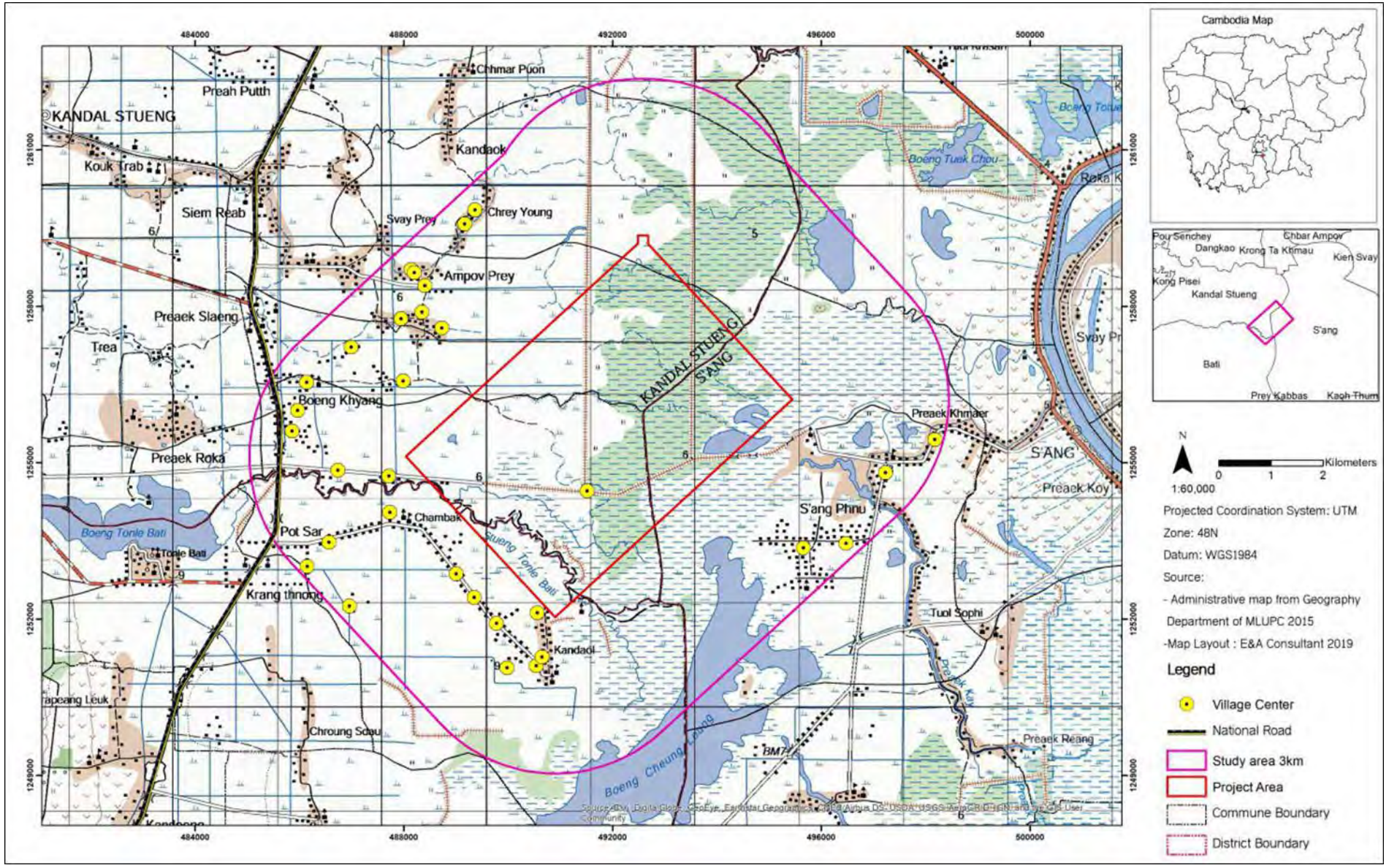
Table 16: Total Households within an Area of 3 km from the Project Area

Province	District	Commune	Village	Total Household	Population
Kandal	Kandal Stoeung	Ampov Prey (6 villages)	Ta Dol 1	225	795
			Ta Dol 2	216	946

Province	District	Commune	Village	Total Household	Population
			Ta Dol 3	205	748
			Cheung Prey 1	162	986
			Cheung Prey 2	205	824
			Cheung Prey 3	146	624
		Boeung Kjang (6 villages)	Boeung Kjang	335	1,393
			Prey Tatoch	422	1,697
			Srokchek	297	1,258
			Kampong Talong	293	1,201
			Brolay	300	1,208
			Salataprom	78	340
		Kondoak (2 villages)	Svay Prey	289	1,201
			Chrey Royong	305	1,154
		Prek Sleng (2 villages)	Prey Tathok	220	909
			Prasat	393	1,831
	Saang	Saang Phnom (5 villages)	Toul Sala	434	1,845
			Prek Khmer	376	1,881
			Peam Sala	416	2,078
			Veal	417	2,013
			Tanou	486	2,212
Takeo	Bati	Potsor (11 villages)	Prey Sva	197	887
			Kroch	200	915
			Kraing Po	296	1,766
			Tropeang Trav	345	1,703
			Chombok	331	1,364
			Potsor	455	1,834
			Taing Reussey	202	881
			Khlaing Sambath	258	1,214
			Kondoal	157	794
			Kvan Meas	179	995
			Khla Kon	132	663
2 provinces	**3 districts**	**6 communes**	**32 villages**	**8,972**	**40,160**

Source: Commune data, 2016

Map 10: Socio-Economic Survey Map



The sample size selection was determined by using Yamane Taro's 1967 sample selection equation (Yamane Taro, 1967), selecting 95% reliability (error 5%).

$$n = \frac{N}{1+(N\times e^2)}$$

Which,

- n: Total sample size
- N: Total household in the study area
- e: 5% error (95% reliability)

- ***Sample Distribution Calculation***

Total sample size is btained for each target village, based on total numbers of households in each village through using Tamane Taro (1973) equation as below:

$$n_i = \frac{n \times N_i}{N}$$

Which,

- n_i: Sample size in each village
- n: Total sample size
- N_i: Total household in each village
- N: Total household in study area

By using the above formula, the total number for household surveys was 383 samples. The samples by village are in the table below:

Table 17: Household survey samples by village

Province	District	Commune	Village	Total Household	Population	Samples
Kandal	Kandal Stoeung	Ampov Prey (6 villages)	Ta Dol 1	225	795	10
			Ta Dol 2	216	946	9
			Ta Dol 3	205	748	9
			Cheung Prey 1	162	986	7
			Cheung Prey 2	205	824	9
			Cheung Prey 3	146	624	6
		Boeung Kjang (6 villages)	Boeung Kjang	335	1,393	14
			Prey Tatoch	422	1,697	18
			Srokchek	297	1,258	13
			Kampong Talong	293	1,201	13
			Brolay	300	1,208	13
			Salataprom	78	340	3
		Kondoak (2 villages)	Svay Prey	289	1,201	12
			Chrey Royong	305	1,154	13
		Prek Sleng (2 villages)	Prey Tathok	220	909	9
			Prasat	393	1,831	17
	Saang		Toul Sala	434	1,845	19

Province	District	Commune	Village	Total Household	Population	Samples
		Saang Phnom (5 villages)	Prek Khmer	376	1,881	16
			Peam Sala	416	2,078	18
			Veal	417	2,013	18
			Tanou	486	2,212	21
Takeo	Bati	Potsor (11 villages)	Prey Sva	197	887	8
			Kroch	200	915	9
			Kraing Po	296	1,766	13
			Tropeang Trav	345	1,703	15
			Chombok	331	1,364	14
			Potsor	455	1,834	19
			Taing Reussey	202	881	9
			Khlaing Sambath	258	1,214	11
			Kondoal	157	794	7
			Kvan Meas	179	995	8
			Khla Kon	132	663	6
2 provinces	**3 districts**	**6 communes**	**32 villages**	**8,972**	**40,160**	**383**

Source: E&A Consultant (2019)

d) Sample Selection Method for Household Survey

To ensure that the selected samples are both random and represent the total number of households in the target area, the study used the systematic sample selection method for selecting the household for interview. In each village, the interviewer starts with the first household and then interviews every twelveth household in consecutive order. In case the twelveth household is not available, or are not able to respond to the questionnaire, the interviewer has to select the thirteenth household for interviewing instead. This method is applied to all the villages, in the same way, to make sure that the survey is random and representative of the total household in each village.

Two focus group discussions were held, with 15-20 participants (both male and female) per group.

e) Data Analysis

The collected data was properly checked, revised, and entered into Excel or SPSS program for analysis. Furthermore, ArcGIS was also used for producing map including hydrological systems, land use maps, and other relevant maps.

f) Traffic Study

For this project the traffic assessment was studied at two different locations in which the first location is on the intersection between the National Road No. 2 (Preak Ho) and Mahavithei Samdach Hun Sen (also called Road 60m) while the second location is on the National Road No. 2(in front of the Wat Boeung Kjang gate). The study took place on two days (5-6 May 2019): a working day and a holiday.

Photo 1: Traffic Count Activities

Intersection between the National Road No. 2 (Preak Ho) and Mahavithei Samdach Hun Sen

National Road No. 2 (Wat Boeung Kjang gate)

Traffic assessment

Passenger car equivalent (PCE) and carrying capacity of road are used to assess traffic flow.

Table 18: Passenger Car Equivalent

Car type	PCE
Sedan and taxi	1
12-seat van	1.25
24-seat van	1.5
44-seat bus	2
Light cargo truck	1.5
Six-ten wheeled cargo truck	1.75
Lorry	2
Three-wheeled motorcycle	0.2
Motorcycle	0.33

Source: Transport, September 2012

According to Mr. Puopong (1997), the calculation of traffic ratio is as follows:

$$Ratio = \frac{Traffic\ Volume}{Carrying\ Capacity\ of\ Respective\ Road}$$

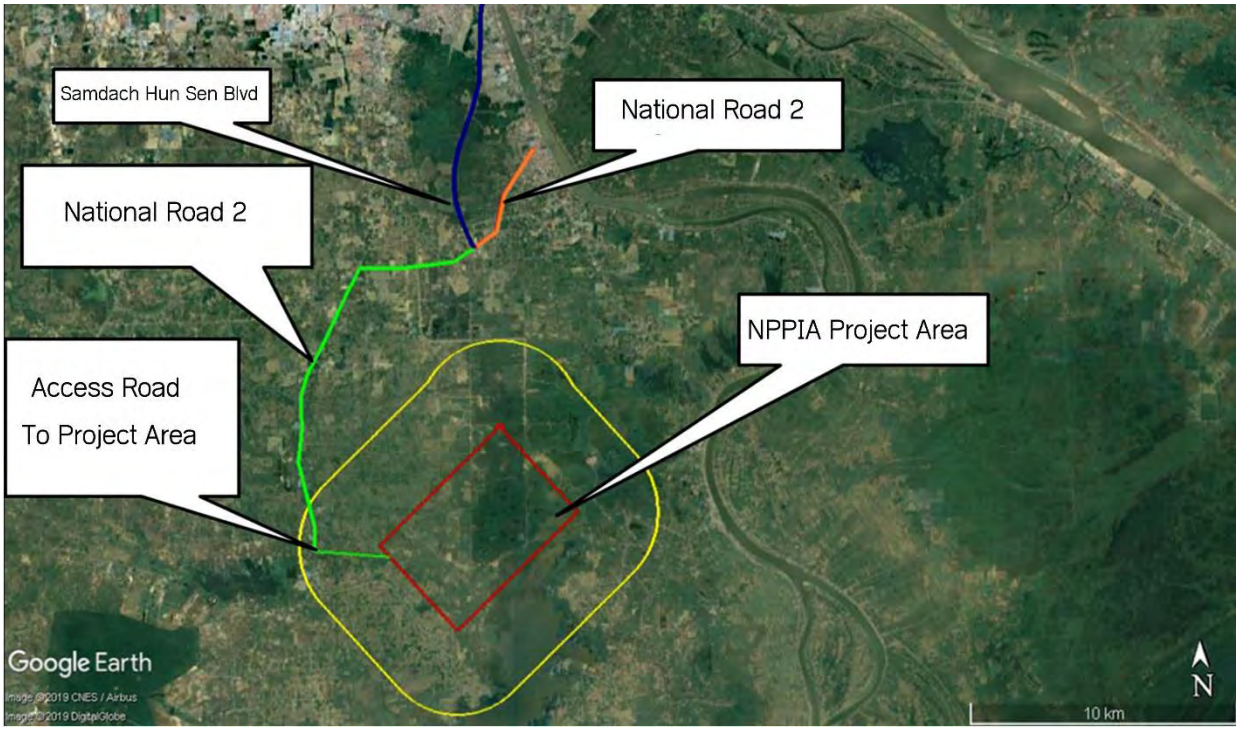
Carrying capacity of respective road based on Highway Capacity Manual (HCM, 2000)
The results of traffic flow are divided into five types in accordance with the traffic ratio.

Table 19: Ratio and Results

Ratio	Results
0.88-1.00	Very congested traffic
0.67-0.88	Congested traffic
0.52-0.67	Moderate traffic
0.36-0.52	Good traffic
0.20-0.36	Very good traffic

Source: Puopong (1997)

Figure 2: Traffic Observation Location



2.2.3 Legal Frameworks

The study will took into account national legal frameworks which relate to the project. Those legal frameworks include: the Constitution of the Kingdom of Cambodia, relevant laws, sub-decrees, Prakas, and other international treaties.

- Constitution of the Kingdom of Cambodia
- Law on Environmental Protection and Natural Resource Management
- Law on Civil Aviation
- Land Law
- Tax Law
- Tourism Law
- Law on Water Resources Management in the Kingdom of Cambodia
- Law on Forestry
- Law on Road Traffic
- Law on Investment of the Kingdom of Cambodia
- Law on the Amendment to the Investment Law of the Kingdom of Cambodia
- Labor Law
- Road Law
- The Law on Social Security is for those who are subject to the provisions of the Labor Law
- Law on Fisheries
- Sub-Decree on Environmental Impact Assessment Process
- Sub-Decree on the Establishment of Social and Environmental Funds
- Sub-Decree on Solid Waste Management
- Sub-Decree on Water Pollution Control
- Sub-Decree on the Control of Air Pollution and Noise Disturbances
- Prakas on General Guidelines for Developing Initial and full Environmental Impact Assessment Reports
- The Rectangular Strategy-Phase 4 of the Royal Government
- Relevant international treaties

2.2.4 Public Participation

Local people, local authorities and relevant institutions were encouraged to participate in this project's ESIA. The public participation was designed to disclose project information, project owner, preliminary results of the project's ESIA, potential impact, mitigation measure, and provide public's opportunities to raise their comments, concerns, suggestions, and recommendations related to the results of the ESIA. There are three phases of public participation:

- Disclosure phase at the project area;
- Interview phase with local authorities, relevant departments and stakeholders, and
- Public consultation workshop phase at provincial level.

2.2.4.1 Disclosure Phase at the Project Area

At this stage, the study disseminated the project information, and project's ESIA to relevant stakeholders both within and around the project area, in particular, local people and local authorities through household survey and consultations. Key informant interviews (KII) with local people and authorities and relevant institutions were held separately at each institutional location or another public site in the study area. The participants are from:

- Relevant communes;
- Relevant villages;
- Key relevant local communities

2.2.4.2 Interview Phase with Local authorities, Relevant Departments and Stakeholders stage

At this stage, there were interviews with local authorities, relevant departments, and stakeholders, which were conducted separately and divided into two levels as follows:

a) Interviews with Local Authorities and Relevant Provincial Departments

Consultation with local authorities and relevant provincial departments were conducted in order to disseminate project information including he project's activities plan, project proponent, project's ESIA, and provide them the opportunity to their concern, comments, and recommendations on project's activities especially on mitigation measures on potential negative impact.

b) Consultation with Local Authorities, Sensitive Receptors and Stakeholders

Consultation with local authorities, sensitive receptors, stakeholders, and local authorities were conducted for the purpose of: i) disseminating project information and the project owner; ii) the project's ESIA; iii) to find out the current livelihoods of the households in the study area, and iv) to get comments, concerns, and recommendations about project activities. During this phase, consultations with sensitive receptors, local authorities, and stakeholders were conducted in the form of focus group discussion (FGD).

2.2.4.3 Public Consultation Workshop

A Public consultation (PC) workshop at the provincial level was held in order to disseminate the project's ESIA draft result, project activities, key environmental resource impact and significance of each impact and mitigation measures. This PC provided the opportunities for transparency to relevant provincial technical departments and publics to understand about the project, raise comments, concerns, and suggestions regarding the project's ESIA result and activities.

Table 20: Consultation with Relevant Stakeholders

Consultation	Participants
KII with local authorities and institutions	Relevant communes (6) including Put Sor commune, Bati District, Takeo Province
	Relevant villages (32)
	Pagodas (3)
	Health Centers (3)
	Schools (3)

Consultation	Participants
	Non-government organization
	Other local communities
KII with provincial authorities and departments	Provincial governing board
	District governing board (3 districts) including Bati District, Takeo Province
	Department of Environment
	Department of Tourism
	Department of Water Resources and Meteorology
	Department of Land Management, Urbanization and Construction
	Department of Rural Development
	Department of Planning
	Department of Public Work and Transportation
	Department of Agriculture, Forestry and Fishery
	Department of Labour and Vocational Training
	Department of Industry and Handicraft
	Department of Cults and Fine Art
	Department of Women Affairs
	Firefighting Unit
Public Consultation	Provincial governing board
	District governing board (3 districts)
	Department of Environment
	Department of Tourism
	Department of Water Resources and Meteorology
	Department of Land Management, Urbanization and Construction
	Department of Rural Development
	Department of Planning
	Department of Public Work and Transportation
	Department of Agriculture, Forestry and Fishery
	Department of Labour and Vocational Training
	Department of Industry and Handicraft
	Department of Cults and Fine Art
	Department of Women Affairs
	Firefighting Unit
	Civil Society in Kandal Province
	Officials from Department of Environmental Impact Assessment

2.2.5 Potential Impacts Assessment and Mitigation Measures

The potential impacts assessment was assessed though three main steps i) potential negative impact identification, ii) impacts assessment, and iii) mitigation measures determination.

2.2.5.1 Potential Impact Identification

Potential impact identification used three main tools as follows:

- Matrix: to illustrate interactions between the project activities and environmental resources.
- GIS: use overlay method to determine locations and receptors potentially affected by project activities.
- Checklist: to identify potential impacts on receptors.

2.2.5.2 Impact Assessment

Defining level of impact is based on parameter analysis in quantitative approach, in which impacts are quantifiable, and in qualitative approach. The levels of impact assessment also depend on five criteria as shown below:

- Type: refers to the type of direct and indirect impacts created by project activities.
- Extent: refers to the extent of impacts created by project activities, whether it is at local, regional, or international level.
- Duration: refers to the duration of impacts created by project activities, whether it is temporary, short or long.
- Scale: refers to the scale of impacts created by project activities.
- Frequency: refers to the frequency of impacts created by project activities.

This impact assessment focused on the potential impact on physical, biological and socio-economic resources on each project phase such as design, construction and the operational phases.

2.2.5.3 Determining Mitigation Measures

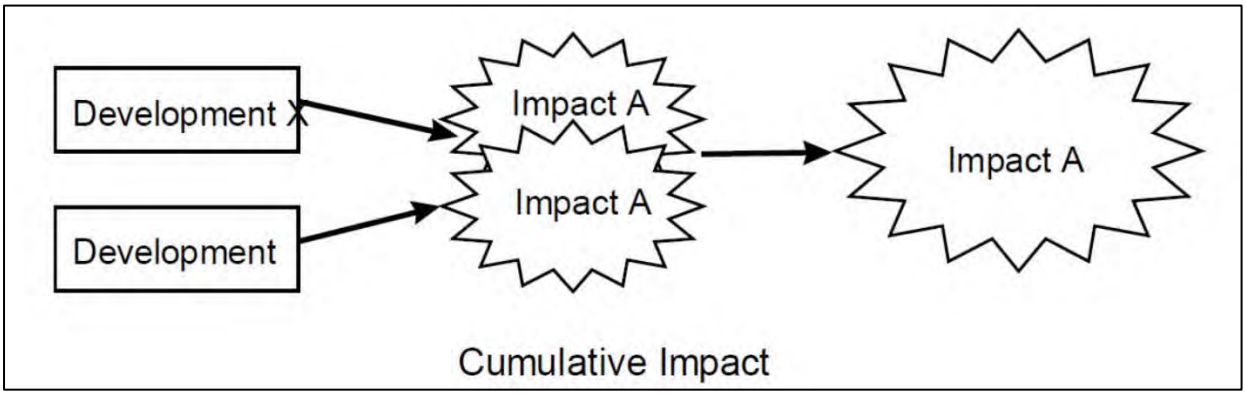
Mitigation measures primarily involves avoidance, reduction, repair/restore, and compensation issues.

- Avoidance: avoid or reduce project activities that may create impacts through the design of project activities;
- Reduction: use devices to reduce impacts;
- Adaptation: If any of the project activities negatively affect environmental resources and can be adapted, the study can propose the adaptation measures; and
- Compensation: If any of the project activities affect, and no mitigation measures are taken effectively, but these activities are a must; the study can propose the project owner a compensation plan to those affected with prior consent of all concerning stakeholders.

2.2.6 Cumulative Impact Assessment

The cumulative impact assessment refers to the impact which could be posed by the combination of the impact of the project under ESIA and other existing project activities, planned, and/or reasonably anticipated future ones (European Commission, 1999). The below figure illustrates the concept on cumulative impact study:

Figure 3: Concepts on cumulative impact study



Source: European Commission (1999)

The scope of the cumulative impact is detailed as follow:

- Spatial scale: cumulative impact study focused on any project's activities within 5 km around the project area (see map below), that may pose negative impact on environmental resources include: physical, biological, and socio-economic resources.

- Project's activities: Projects/activities that are currently in progress or projects that may construct in the future.

The methodology for the cumulative impact study includes: direct observation and consultation with stakeholders; using the structural questionnaire and methodology of each environmental resource studies and geographic Information Systems (ArcGIS) using Overlay tool; expert judgment; and matrix. The criteria for determining the cumulative impact's mitigation measures includeboth the project level and regional level.

2.2.7 Environmental Management Plan

The environmental management plan (EMP) for this project is designed in compliance with the MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018). The study has developed an EMP for monitoring environment resources in each phase of the project, namely: design, construction and the operational phases. The main contents of the project's EMP are as follows:

1. Introduction;
2. Monitoring and Responsible institution arrangement;
   - National level;
   - Sub-national level;
   - Responsible institution;
3. Summary of the negative impact and mitigation measures;
4. Training program;
5. Monitoring program;
   - Identify environmental resources, locations, parameters, and method for monitoring;
   - Identify institution, the responsibility body, and comparing the national and technical standards;
6. Budget plan for monitoring program;
7. Reporting;
8. Environmental and Social Funds: This fund is in compliance with the Sub-decree No. 238 dated November 21, 2016, on the establishment of environmental and social funds.

2.2.8. Economic and Environmental value analysis

The study of cost and benefit analysis is made to estimate the benefits and loss of environmental resources caused by the project in term of economic impact (for each impact which can calculated as economic costs). The study analysed the economic and environment resource values which are caused by the project's activities as follows:

- **Cost and Benefit Analysis**

The cost and benefit analysis of the project was conducted by focusing on the project's economic benefits and environmental resource losses. The project's economic benefits and losses were calculated by using the following two equations:

$$PV = FV\frac{1}{(1+r)^t}$$

$$NPV = \sum_1^t FV(1+r)^{-t} - \sum_1^t C_t(1+r)^{-t}$$

Where,

- PV : Present Value
- FV : Future Value

- r : Discount Rate
- t : Investment Period
- NPV: Net Present Value

- **Benefit on Economic and Environmental and Social Loss**
  - Economic and Social benefit
  - Environmental and social loss within 3km around the project area.

2.3 Study Team

The ESIA team consists of 20 experts as follows:

Table 21: Study Team

No.	Name	Specialization	Nationality	Position
1.	Mrs. Sao Sambath Morakath	Urban environmental management	Cambodian	Project Team Leader
2.	Mr. Sien Teamhy	Environment	Cambodian	Environmental Impact Assessment for Airport
3.	Mr. Hay Samchan	Socio-Economic and Public Consultation	Cambodian	Expert
4.	Dr. Sao Vibol	Environmental pollution control and environmental health	Cambodian	Expert
5.	Mrs. Sarinthorn Soksaard	Noise modelling	Thai	Expert
6.	Mr. Soun Taingoun	Hydrologist, GIS	Cambodian	Expert
7.	Mr. Thean Sengcheng	Traffic study	Cambodian	Expert
8.	Mr. Kong Vathanak	Forestry and Wildlife	Cambodian	Project Assistant
9.	Ms. Chea Sodaneth	Environment	Cambodian	Project Assistant
10.	Ms. Doung Sokleap	English literature	Cambodian	Project Assistant
11.	Socio-economic survey numerators (10 persons)			

E&A Consultant collaborated with Mrs. Sarinthorn Soksaard, a Thai noise modelling expert.

2.4 Project Activity Schedule

The project activity schedule is below:

Table 22: Project Activity Schedule

No.	Activity	2018		2019									
		11	12	1	2	3	4	5	6	7	8	9	10
1	TOR developed and approved												
2	Data collection												
2.1	Biological data collection												
2.2	Physical data collection and analysis in the dry season												
2.3	Physical data collection and analysis in the wet season												
2.4	Socio-economic data collection												
2.5	Report compilation												
3	Consultation with provincial departments and local authorities												
4	Provincial-level consultation												

No.	Activity	2018		2019									
		11	12	1	2	3	4	5	6	7	8	9	10
5	Submission of report to the Ministry of Environment												
5.1	Technical meeting with EIA Department												
5.2	Official comments by MOE												
5.3	Report revision based on MOE's official comments												
6	Submit report to MOE for Inter-Ministerial meeting												

2.5 Report Format

This ESIA is developed based on the MoE's Prakas on Common Guidelines of the Initial/full Environmental Impact Assessment Report Preparation (2009) and MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018). The main content of this report is listed below:

- Content
- List of Tables
- List of Photographs
- List of Figures
- List of Maps
- List of Abbreviations
- Executive Summary
- Chapter I: Introduction
- Chapter II: Scope and Assessment Methodology
- Chapter III: Legal frameworks
- Chapter IV: Project Description
- Chapter V Description of Existing Environmental Resources
- Chapter VI: Public Participation
- Chapter VII: Environmental Impacts and Mitigation Measure
- Chapter VIII: Environmental Management Plans
- Chapter IX: Cost and Benefit Analysis
- Chapter X: Conclusion and Recommendation
- Reference
- Appendices

Chapter 3 Legal Framework

3.1 Introduction

This chapter outlines the legal, regulatory, and other frameworks related to a full environmental and social impact assessment for the New Phnom Penh International Airport project which covers an area of 2,600 ha. The study of the legal framework is important to ensure that the project's performance is in compliance with the legal framework, regulations and regulatory framework of the Kingdom of Cambodia, and international conventions, in particular ensuring environment protection, public health and safety, occupational health and safety, and public order.

Key sections of this chapter include the Constitution of the Kingdom of Cambodia, laws, sub-decrees, declarations and guidelines, and relevant international conventions, as briefly described in the following sections.

3.2 The Constitution of the Kingdom of Cambodia

The Constitution of the Kingdom of Cambodia was adopted by the Senate on September 21, 1993 and then officially promulgated by Royal-Kram on September 24, 1993. The Constitution of Kingdom of Cambodia is the supreme law and the most important legal basis for the Cambodian nation and Khmer people in the practice of preserving the environment for balancing the natural wealth for the sustainable livelihoods in the Kingdom of Cambodia. This law contains a number of important articles containing provisions relating to the rights of the people and the right to be protected by the society, the state property, and the state's obligation to preserve the environment and balance the natural wealth of the people with sustainable living in the Kingdom of Cambodia.

Article 36: Khmer citizens of either sex shall enjoy the right to choose any employment according to their ability and the needs of the society. Khmer citizens of either sex shall receive equal pay for the same work. Housework shall have the same value as work outside the home. Khmer citizens of either sex shall have the right to obtain social security and other social benefits as determined by law. Khmer citizens of either sex shall have the right to form and to be members of trade unions. The organization and functioning of trade unions shall be determined by law.

Article 58: State property comprises land, underground mineral resources, mountains, sea, undersea, continental shelf, coastline, airspace, islands, rivers, canals, streams, lakes, forests, natural resources, economic and cultural centers, bases for national defense and other buildings determined as State property. The management, and practice on state’s property will be determined in the law.

Article 59: The State shall protect the environment and the balance of natural resources and establish a precise plan for the management of land, water, airspace, wind, geology, ecological systems, mines, oil and gas, rocks and sand, gems, forests and forestry products, wildlife, fish and aquatic resources.

3.3 Cambodian Laws

3.3.1 Law on Environmental Protection and Natural Resource Management

The Law on Environmental Protection and Natural Resource Management was adopted on November 18, 1996, at the 7th session of the first legislature and was promulgated by Royal Decree No. 1296.36 dated December 24, 1996. This law contains the following relevant articles:

Article 6: An environmental impact assessment shall be done on every private or public of the project and activity and shall be reviewed and evaluated by the Ministry of Environment before being submitted to the Royal Government for decision. This assessment shall also be done for existing and in-process activities that have not yet been assessed for environmental impacts. The procedures of the environmental impact assessment process shall be determined by Sub-decree following a proposal of the Ministry of Environment. The proposed type, project size, and activity, existing activity, and in-process activity of the private and public, whose impacts must be environmentally and socially assessed, will be determined by sub-decree proposed by the ministry of environment.

Article 7: All investment project applications and all projects proposed by the State shall have an initial environmental impact assessment or an environmental impact assessment as specified in article 6 of this law. The Ministry of Environment shall review and provide recommendations on the initial/full social and environmental impact assessment to competent institutions within the period determined in the Law on Investment of the Kingdom of Cambodia.

Article 8: The natural resources of the Kingdom of Cambodia, which include land, water, airspace, air, geology, ecological systems, mines, energy, petroleum and gas, rocks and sand, precious stones, forests and forest products, wildlife, fish, and aquatic resources, shall be conserved, developed, and managed and used in a rational and sustainable manner.

Article 9: The Ministry of Environment, in collaboration with concerned ministries, shall conduct research, assess environmental impacts on natural resources, and provide the concerned ministries with recommendations to ensure that the natural resources as specified in article 8 are conserved, developed, and managed and used in a rational and sustainable manner.

Article 13: The prevention, reduction, and control of airspace, water and land pollution, noise and vibration disturbances, as well as waste, toxic substances, and hazardous substances, shall be determined by Sub-decree following a proposal of the Ministry of Environment.

Article 14: The Ministry of Environment shall collaborate with concerned ministries to require the owners or responsible persons of factories, pollution sources, industrial sites, or sites of natural resource development activity:

- To install or use monitoring equipment,
- To provide samples,
- To prepare or maintain and submit for review records and reports.

3.3.2 Law on Land Management, urban Planning and Construction (1994)

The Law on Land Management, Urban Planning, and Construction was adopted by the national assembly dated May 24, 1994 and was promulgated by Royal Kram No. 04/94 dated August 10, 1994. The objective of the law is to promote the organisation and embellishment of the urban and rural areas throughout the Kingdom of Cambodia with the purpose of assuring development of this country:

Article 1:

- Respecting both common and individual interests, private rights, observing laws and regulations, and overseeing on the construction matters.
- Assuring the development has equilibrium between the cities/towns and rural areas

based on their geographical conditions and special characteristics.

- Assuring the value of natural and cultural wealth, ensuring the development of the economy and tourism sectors and maintaining the quality of the environment.

Article 4: All documents related to the Land Management, Urban Planning and Construction shall be classified according to each specific case, and according to the particular conditions of the land of each province, municipality and region, in the spirit of protecting the patrimony, environment and protecting natural resources as well as development of the economy.

Article 7: Land use master plan shall clearly indicate the area to be allocated for national defense, agriculture, commerce, industry, handicraft, culture, tourism, religion, and administrative buildings and public facilities. These plans shall also specify of the possibility for construction.

Article 12: Any individuals and private institutions as well as public authority are banned from conducting any constructions on the public yard-field or lands as defined hereunder:

- Water reservoir and water dams.
- The reserve mining fields and the forests zones.
- The archaeological and historical resort sites.
- The gardens and public parks and development zones.
- The land reserved for the roads constructions or the lands reserved for the road- sides, and the lands kept for the construction of railroads projects.
- The rivers, seas, streams and their banks.

Article 17: No construction permit shall be issued if it is not compliance to the Master Plan and to the Land Use Plan and Construction, because it can harm public security, environment, public hygiene, any construction or property which have value in archeology, history, culture, beauty, technique or natural resources were affected by such construction.

- Respecting both common and individual interests, private rights, observing laws and regulations, and overseeing on the construction matters.
- Assuring the development has equilibrium between the cities/towns and rural areas based on their geographical conditions and special characteristics.
- Assuring the value of natural and cultural wealth, ensuring the development of the economy and tourism sectors and maintaining the quality of the environment.

Article 25: All parts of the factory must be sufficiently lighted and ventilated, and ensuring no harms come from radiation, vibration, light, smell steam, heat, fumes, dust, and other pollutants.

Article 26: Factories must have fire prevention systems which include: fire alarm systems, firefighting methods, fire caution signs where necessary, at least two rescue doors on each floor, rescue roads for ambulances, other means of emancipation, and other emergency evacuation plans.

Article 27: The machine or its parts that are accidentally dangerous shall have a cover or protective device, and the parts of the factory, which are extremely hazardous must be enclosed.

3.3.3 Law on Investment and Law on Amendment to the Law on Investment of the Kingdom of Cambodia

The Law on Investment was adopted by the National Senate on August 04, 1994 at the extraordinary session of the 1st legislature and Promulgated by Royal-Kram No. 03/94 on August 04, 1994. The Amendment to the Law on Investment of the Kingdom of Cambodia was adopted by National Assembly

on February 03, 2003 during its 09th Ordinary Session of 2nd Legislature and was issued by the National Senate without modification on February 27, 2003 during its 09th Ordinary Session of 1st Legislature. This law was promulgated by Royal-Kram No. 0303/009 dated on March 24, 2003. This law contains the following relevant articles:

Article 1-New: The Law governs all qualified investment projects and defines procedures by which any person establishes a qualified investment project. Only qualified investment projects are entitled to the benefits subject to the scope of this Law.

Article 12- New: The Royal Government does not define the production cost or other service charges of the QIP.

Article 14-New: Incentives provided for in Article 13 shall include as follow:

1. A QIP shall be entitled to exemption from the tax on profit imposed under the Law on Taxation by obtaining a profit tax exemption period. The tax exemption period is composed of a Trigger Period +3 years + Priority Period. Priority Period shall be determined in the Financial Management Law.

2. The QIP is entitled to get incentives based on paragraph 1 as long as that projects obtain from an annual certificate of obligation fulfilment for the State which is specified by the Sub-Decree.

Article 16-New: Ownership of land by investors for the purpose of carrying on a QIP shall be vested in natural persons holding Cambodian citizenship or in Cambodia Entities. Use of land shall be permitted to investor including land concessions unlimited leases and limited leases which are renewable in reNewable in compliance with the provisions of the land Law.

Investors shall have the right to own and pledge as security and transfer the real and personal property situated upon the land and which the QIP uses for a period no longer than the period determined in a land concession contract or land lease agreement as permitted by law. Investor cannot transfer or pledge any longer the land concession which has not been in operation.

3.3.4 Law on Land (2001)

The Law on Land was adopted by the National Assembly on July 20, 2001 during the sixth session of its second legislature and was adopted completely on the form and its legal substances by the Senate on August 13, 2001 during the fifth session of its first legislature. This law was officially promulgated by the Royal Kram No 0810/14 dated on August 30, 2001. This law contains some important articles related to the project as follows:

Article 1:

This law has the objective to determine the regime of ownership for immovable properties in the Kingdom of Cambodia for the purpose of guaranteeing the rights of ownership and other rights related to immovable property, according to the provisions of the 1993 Constitution of the Kingdom of Cambodia.

Article 3:

All persons shall respect the property of the State and legally acquired private property. The management of the cadastral administration of immovable property belonging to the State and the competence to issue titles related to immovable property throughout the Kingdom of Cambodia are under the authority of the Ministry of Land Management, Urban Planning and Construction. The regulations and procedures for the administration of State immovable properties will be determined by sub-decree.

Article 16:

State public property is inalienable and ownership of those properties is not subject to prescription. State public properties cannot be acquired by the special acquisition provision of the chapter 4 of this law. However, when state public properties lose their public interest use, they can be listed as private

properties of the state by law on transferring of state public property to state private property.

Article 17:

The property belonging to the private property of the State and of public legal entities may be the subject of sale, exchange, distribution or transfer of rights as it is determined by law. Such property may be leased out and it may be the subject of any contract made properly according to the law

Article 43:

In no case can the public property of the State be the subject of acquisition of ownership.

Article 144:

Lower land shall receive waters flowing naturally from upper land. The owner of the lower land may not build dams, dikes, barriers, or other works to impede the water flow. The owner of the upper land may not do anything that would aggravate the easement of the lower land.

Article 145: The owner of the upper land has the right to use and dispose of rainwater that falls on his land as well as waters from sources that are found thereon, except in the case of the provisions of the last paragraph of article 144.

Article 146: The owners of lands situated along running waters shall allow the waters to flow to the neighboring lands and the owners of neighboring land, in turn, are subject to the same obligation with respect to lands that are further away, depending on their agricultural needs.

3.3.5 Law on Fisheries (2006)

The Law on Fisheries was adopted by National Assembly on March 30, 2006 on fourth plenary session of third legislative and was ratified as the Senate does not have time to review and comment on the text of this law in accordance with the new constitution's Article 113 the Senate. This law was officially promulgated by the Royal Kram No 0506/011, dated on May 21, 2006. This law contains some important articles as follows:

Article 1:

This law aims to ensure fisheries and fishery resource management, to enhance aquaculture development, the management of production and processing, and to promote the livelihood of people in local communities for the social-economic and environmental benefits, including the sustainability of the conservation of biodiversity and natural culture heritages in the Kingdom of Cambodia.

Article 11:

The Marine Fishery domain refers to marine water or brackish water that extends from the coastline at the highest high tide of the coastal lines to the outer limits of the exclusive Economic Zone of the kingdom of Cambodia.

The marine fishery domain is divided into:

- Inshore fishing area, which extends from the coastline at higher tide to the 20- meter-deep line.
- Offshore fishing area, which extends from the 20-meter-deep line to the outer limits of the exclusive Economic Zone of the kingdom of Cambodia.
- Fishery conservation area, sea grass area, and coral reef area which are habitats for marine aquatic animals and plants.
- Mangrove forest area including mangrove and forest zone, which are important feeding and breeding habitats for aquatic animals, and protected inundated areas.

Article 12:
All types of fishing areas, fishery conservation areas, sea grass areas, coral reef areas, flooded areas in the wet season, and inundated forest and mangrove forest areas as defined in article 10 and 11 of this law are fishery management areas.

The creation or nullification of a fishery management area shall be defined by the proclamation of the Minister of Agriculture, Forestry and Fisheries. The legal procedure for the creation or nullification of the fishery management area shall be determined by sub-decree.

Article 18:
Fishery Management Areas comprise inter alia, rapids and deep pools located in rivers, Tonle Sap Great Lake, lakes, inundated forests, group of islands, sea grass areas, coral reef area, and mangrove forests, which are of importance for the sustainability of fishery resources and are classified as Protected and Conservation Areas for Fishery Resources.'

Article 22:
Prohibit disposal, liter, drainage or dispersing into sewage areas of liquid or toxic solid waste determined by laws and regulations of the Kingdom of Cambodia and international treaties or conventions on environmental pollution or conducting activities that poison or harm animal and plant life.

Article 25:
Building or dumping dams/dikes across lakes, streams, rivers and digging canals, ponds, holes, artificial and natural reservoirs in large scale and other New constructions or pumping that could cause significant damage to fishery resources in the fishery domain will be studied or evaluated by the Ministry of Agriculture Forestry and Fisheries and concerned institutions.

3.3.6 Law on Water Resources Management of the Kingdom of Cambodia (2007)

The Law on Water Resource Management in the Kingdom of Cambodia was promulgated by the National Assembly on May 22, 2007, at the 6th Session of the Third Legislature and was completely adopted by the Senate on its forms and principles without modification on June 11, 2007, of 3rd plenary session of the Senate, second legislature. This Law was official promulgated by the Royal Kram No 0607/016 dated June 29, 2007. This law contains some important articles as follows:

Article 1:

The general purpose of this Law is to foster the effective and sustainable management of the water resources of the Kingdom of Cambodia to attain socio-economic development and the welfare of the people. This Law determines:

- The rights and obligations of water users,
- The fundamental principles of water resources management,
- The participation of users and their associations in the Sustainable Development of Water Resources.

Article 11:

Every person has the right to use water resources for his/her vital human need including drinking, washing, bathing, and other domestic purposes including watering for animal husbandry, fishing and the irrigation of domestic gardens and orchards, in a manner that will not affect other legal right of others. The fore-mentioned uses are not subject to the licensing.

Article 21:

Any person who discovers groundwater and aquifer in the course of mining, or other activities, shall

report to the MOWRAM.

Article 22:

The discharge, disposal or deposit of polluting substances which are likely to deteriorate the quality of water and to endanger human, animal and plant health shall be subject to water license or authorization. The fore-mentioned polluting substances and the technical standards for handling them shall be determined by the Government Sub Decree. In performing this Article, the MOWRAM shall consult with the concerned ministries.

Article 23:

The MOWRAM may declare contingency or protected "water use" zones in the following cases:

- When surface or underground water sources seriously affect their quantity, quality or ecological balance;
- When watershed is degraded by human activities or natural cause;
- When water is hazardous to the people health, the geographical scope of such zones shall be established on a case-by-case basis by way of the MOWRAM regulations.

3.3.7 Labor Law and the Law on Amendment of Article 139 and Article 144 of Labor Law (2007)

The Law on Amendment of Article 139 and Article 144 of Labor Law which was adopted by the National Assembly dated on June 08, 2007 at its sixth plenary session of the third legislature and was fully adopted by the Senate as to its form and legal concepts without any corrections dated on June 29, 2007 at its third plenary session of the second legislature. This law was officially promulgated by the Royal Kram No 0707/020 dated on July 20, 2007. This law contains some important articles as follows:

Article 1:

This law governs relations between employers and workers resulting from employment contracts to be performed within the territory of the Kingdom of Cambodia, regardless of where the contract was made and what the nationality and residences of the contracted parties are.

Article 17:

All employers to whom this labor law is applied, shall make a declaration to the Ministry in charge of Labor when opening an enterprise or establishment. This declaration, called a declaration of the opening of the enterprise or establishment, must be made in writing and be submitted to the Ministry in charge of Labor before the actual opening of the enterprise or establishment.

Employers who employ fewer than eight workers on a permanent basis and who do not use machinery, shall make and submit this declaration to the Ministry in charge of Labor within thirty days following the actual opening of the enterprise or establishment.

Article 21:

Every employee must make the declaration to the Ministry in charge of Labor each time when hiring or dismissing a worker. This declaration must be made in writing within fifteen days at the latest after the date of hiring or dismissal. This period is extended to thirty days for agriculture enterprises. The declaration of hiring and dismissal is not applied to:

- Casual employment with a duration of less than thirty continuous days.
- Intermittent employment for which the actual length of employment does not exceeded three months within twelve consecutive months.

Article 22:

Every employer of an enterprise or establishment, set out in Article 17 above, who employs at least eight workers shall always establish an internal regulation of the enterprise.

Article 24:

The internal regulations must be established by the manager of enterprise after consultation with workers' representatives, within three months following the opening of the enterprise, or within three months after the promulgation of this law if the enterprise already exists.

Before coming into effect, the internal regulations shall be visaed by the Labour Inspector. This visa shall be issued within a period of sixty days.

Article 137:

In all establishments of any nature, whether they provide vocational training, or they are of a charitable nature or liberal profession, the number of hours worked by workers of either sex cannot exceed eight hours per day, or 48 hours per week.

Article 138:

The work schedule is set by each enterprise for different jobs based on the nature of their activities and organization of work. When the work schedule consists of split shifts, the enterprise's management can normally set up only two shifts, one in the morning and the other in the afternoon.

Article 162:

In case the public holiday coincides with a Sunday, workers will have the following day off. Time off for holidays cannot be the reason for reducing monthly, bi-monthly, or weekly wages.

Article 163:

Workers paid by the hour, the day, or by the amount produced shall be entitled to an indemnity equal to the wage lost as a result of holidays as defined in Article 161. This indemnity shall be paid by the employer.

Article 248:

An accident is considered to be work related, regardless of the cause, if it happens to a worker working or during the working hours, whether or not the worker was at fault; it is the accident inflicted on the body of the worker or on an apprentice with or without wage, who is working in whatever capacity or whatever place for an employer or a manager of an enterprise.

Equally, accidents happening to the worker during the direct commute from his residence to the work place and home are also considered to be work-related accidents as long as the trip was not interrupted nor a detour made for a personal or non-work-related reason.

All occupational illness, as defined by law, shall be considered a work-related accident and shall be remedied in the same manner.

Article 249:

Managers of enterprise are liable for all work-related accidents stipulated in the Article above regardless of the personal status of each worker.

The same liability applies to:

- Directors of private hospitals, but solely for the personnel they employ;
- Professionals, solely for their employees;
- Craft shops, only for workers other than the wife and the children of the craftsman;
- Property owners, only for their domestic workers;

- Agricultural enterprises, for their workers.

Apart from the categories expressly mentioned in the preceding paragraph, any person who engages the services of a worker for a specific, occasional work is required to make reparation for accidents that victimised the worker during the work.

Article 250: Every manager of enterprise shall manage or have someone take all appropriate measures to prevent work-related accidents

3.3.8 Law on Road (2014)

The Law on Road adopted by the National Assembly on December 5, 2014 at the third ordinary session of the five legislatures and approved by the Senate to its entire form and legality on December 30, 2014 at its sixth extraordinary session of the three legislature and includes the following provisions

Article 2: The law is aimed at:

- Maintaining order and safety in road trafficking, which allowed for public traffic throughout the Kingdom of Cambodia?
- Protecting human and animal lives and environment
- Curbing the effect on human health and the damage of the state and private properties, and
- Curbing the offenses stemmed from the use of the roads

Article 7: Driving all kinds of vehicles in the Kingdom of Cambodia shall always keep to the right side of the road.

A good loaded vehicle weighting more than sixteen (16) tons or a vehicle loading thirty five (35) passengers and more shall have one (1) drivers and one assistant driver, both holding appropriate driving licenses relevant to the vehicle and road types, distance, and travelling time.

Article 8: Drivers of all kinds of vehicles shall implement the following measures:

- All drivers of vehicles with an engine cyclinder size of 49 cc and above shall possess appropriate driving licenses relevant to the vehicle types.
- Whlist driving their vehicles, dirvers shall always be precautious and in a comfortable position that allows easy and fast manipulation of the vehicles, and particularly the possibility to move witohut any disturbance.
- Drivers shall not be allowed to cause any unecessary disturbanceto other road users and roadside residents.
- Consumption of liquor with the alcoholic rate og 0.25 mg per liter of the air or 0.50 mg per liter of blood and above shall be banned when driving.
- Vehicles with caterpillar tracksare banned from being driven directly on the roads. Such vehicles have to be transported on others vehicles with rubber tires.
- Using a cellphone without hand-free accessories whlist driving shall not be allowed.
- No passengers, goods, or other items are allowed to be loaded in way that bloack the drivers's eyesight.
- A motorcycle may be allowed to load two adults and a chil. The motorcycle driver, the passengers, and the child a tthree years of age and above, all shall properly wear helmets. All drivers of tri-motorcycles and motorcycles with trailers shall properly wear heltmets
- Inside towns or densely populated areas, the driver and passengers, who sit at the front seats of a vehicle, must wear their safety seabelts.
- Outside towns or densely populated areas, the driver and all passengers of the vehicle must wear their safety seatbelts as stipulated in the Article 90 of this Law.
- Babies under ten months of age must be placed inside the baby seats, which are firmly tied to the vehicle's backseats.

- Childern between the ages of ten months and four years must sit in the baby seats, which shall be firmly tied to the vehicle's backseats.
- Children under 10 years of age shall not be allowed to sit in the front seats of the vehicles.

Article 16: Driving speeds are defined in accordance with the following criteria:

- Driving speed definition shall be determined by a sub-decree.
- Drivers shall not be allowed to drive in an abnormally slow speed without proper reasons that interrupts other vehicles. Drivers in such a slow speed shall keep to the right to allow other drivers in a higher speed to overtake easily on the left. Any drivers, who are forced to slow down in an abnormal manner, shall alert the other drivers by using the emergency light, and shall keep driving to the most right side of the roadway.
- Speed regulations shall not apply to any drivers of police or military convoys, delegate or senior leader processions, fire trucks, ambulances, and other vehicles equipped with siren and special light on duty.

3.3.9 Law on Fire Prevention and Fire Fighting

Law on Fire Prevention and Fire-Fighting, which was approved by the National Assembly on May 07, 2013 on 9th Assembly Summit, Session 4th and the Senate has agreed on legal forms without any modification on May 17, 2013 at the General Meeting, Session 3rd, with the details as follows:

Article 1: The law aims to promote the prevention and firefighting to protect life, property, environment, social security, public order, and social safety.

Article 2: The goal of this law is to determine the responsibility of everyone and the conditions, measures to prevent and extinguish the fire.

Article 3: Scope of this law is to cover all activities on fire prevention and firefighting in Kingdom of Cambodia.

Article 5: Any action that may cause a fire is prohibited.

Article 8: Person in charge of each destination must directly responsible for prevention and firefighting operation.

Unit of fire prevention police and firefighters are to respond on request or intervention immediately to all locations where fire occurred. Conditions and measures on prevention and firefighting at destination and the fire prevention in each home is to be determined by the Prakas of Ministers of Ministry of Interior.

3.3.10 Law on Social Security Schemes for Persons Defined by the Provisions of Labor Law (2002)

The Law on Social Security Schemes for Persons Defined by the provisions of the Labor Law adopted by the National Assembly of the Kingdom of Cambodia on August 15, 2002 at the 8th session of the National Assembly.

Article 1-This law aims at organizing the Social Security Schemes for persons defined by provisions the provisions of the Labour Law of the Kingdom of Cambodia as follows:

1. Pension scheme which is in charge of providing old age benefit, invalidity benefit and survivors' benefit.

2. Occupational risk which is in charge of providing employment injury and occupational disease benefit.

Article 3: The Social Security Schemes prescribed by this law shall be under the Management of the National Social Security Fund. This National Social Security Fund has its acronym "NSSF" The National Social Security Fund is the public establishment which is formulated by Sub-decree in accordance with Royal Kram No CS/RKM/06561/03 dated June 15, 1996 promulgated the law on General Statute of Public Enterprise and Royal Decree No. NS/RKT/ 1297/91 dated December 31, 1997 on Judicial Statute of Public Establishments.

Article 4: persons covered by the Social Security Schemes in this law regardless of nationality, race, sex belief religion, and political opinion, national extraction, social origin, membership of trade union or act in trade union is:

- All workers defined by the provisions of the Labour Law, if those persons perform work in the territory of the kingdom of Cambodia for the benefit of an employer or employers, regardless of nature, form and validity of the contract done of kind and amount of the wage received by the person thereof
- State workers, public workers and every personnel who is not governed by the Common Statute for Civil Servants or by the Diplomatic statue as well as officials who are temporarily appointed in the public service.
- Trainee person who is attending for rehabilitation center and apprentice shall deem as workers providing in paragraph 1 of this article. Prakas of the Ministry in charge of Social Security Schemes shall determine terms of implementation of these provisions.
- Persons work in self-employed profession. Prakas of the Minister in charge of Social Security Schemes shall determine provisions in this paragraph.
- Seasonal or occasional workers. Prakas of the Minister in charge of Social Security Schemes shall determine other particular necessary terms of implementation of the provisions after consulting with the Technical Council and the Governing Body of National Social Security Fund. The composition and function of the Technical Council shall be determined by Sub-decree.

Article 8: Each NSSF member who is 55 years of age is entitles to old age pension provided that he or she has fulfilled the following conditions:

- To be registered in NSSF in a period of at least twenty years.
- To pay in contribution at least for sixty qualifying months for Social Security Schemes during the period of least ten years up to the date of eligibility of the pension.
- Each NSSF member who has fulfilled such conditions specified within the precedent paragraph and reaches a premature worn state, whether mental physical, before the age of 55 that cause loss of earning capacity, may request to have an early pension. Terms of findings and examination of the premature worn state before the age of 55 shall be issued by Prakas of the Minister in charge of Social Security Schemes after consulting with the NSSF Governing Body.
- Old age and early pensions come into force at the first day of calendar month following the date that the person concerned has duly fulfilled the conditions already, provided that he or she applied to NSSF within the period of 12 months after the above mentioned date. In case of the application form for the pension has submitted after the above mentioned date, it will come into force at the first day of the calendar month following the date of receipt of the claim.
- Each NSSF member who is 55 years of age has paid contribution less than 60 qualifying months for Social Security Schemes and has finished all wage-related works, but has not fulfilled other conditions in order to get old age pension is entitled to have old age allowance which shall be paid as a lump sum.
- Having fulfilled for six qualifying months for Social Security Schemes within the last 12 months up to the date of beginning of the incapacity leading to the validity.

Article 10: In case of the death of any holder of old age or invalidity or early pension, as well as in case of the death of any NSSF member who, at the date of his or her death, has fulfilled required conditions for enjoying old age or invalidity pension or has already proved for one hundred eighty qualifying months for Social Security Schemes, the beneficiaries shall be entitled to get survivors' pension.

Article 11: If any NSSF member who may be not entitled to an invalidity pension as well as has not yet justified for one hundred eighty qualifying months for Social Security Schemes up to the date that she/he died, husband or wife, whether disabled or not, and also orphanage of the person concerned shall be entitled to enjoy survivors' allowances that shall be provided as a lump sum in the amount of not less than monthly old age pension for the NSSF member hereof

Article 12: An accident is considered to be employment injury, the accident inflicted on the body of the worker, regardless of the cause, if it happens to worker working or during the working hours, whether or not the worker was fault, it is the accident inflicted on the body of the worker or an apprentice with or without wage, who is working in whatever capacity or whatever place for an employer or manager of an enterprise.

Equally, accidents happening to the worker during the direct commute from his residence to the work place and home are also considered to be employment injury as long as the as the trip was not interrupted nor detour made for a personal or non-work-related reason.

Article 13: Occupational disease is also considered as occupational risk. The Minister in charge of the Social Security Schemes and the Minister of Health, after consulting with the Technical Council, shall issue a Joint Prakas concerning identification of the occupational disease list vis-à-vis with list of employment regarding to physical work, exposure to toxic substance and other employment performs in insalubrious conditions or areas in which cause various diseases.

1- This list shall be revised periodically for advance technical improving and promoting the medical awareness as basis means preventing occupational diseases.

2- A disease declared as occupational risk after the date that worker stopped working, is also pave the right for the victim has the occupational risk benefit, if the declaration is done during the period shown in the occupational disease list as prescribed in the paragraph 1 of this article.

Article 14: A victim caused by employment injury or commuting accident or occupational disease shall promptly inform to employer's representative about the accident inflicted on his/her except in the event of force majeure or in complete accessibility or has other thoughtful reasons. The beneficiaries, if there is a fatal accident, shall carry out such obligation.

Employer shall notify to NSSF within the period of less than forty-eight hours about employment injury or commuting accident or occupational diseases inflicted on workers working in their enterprise. This notification shall be made through the modality, which determined by Joint Prakas of the Ministry in charge of Social Security Schemes and Ministry of Health as proposed by the Governing Body of NSSF.

The method of investigation and duty of the victim of employment injury or commuting accident or occupational diseases shall be determined by joint Prakas of the Ministry in charge of Social Security Schemes and Ministry of Health.

Article 15: Benefit for occupational risk are:

A-Medical care services for occupational risk caused by employment injury or commuting accident or occupational diseases whether the accident interrupt the work or not.

b- Provide daily allowance for employment injury or commuting accident or occupational diseases causing temporary disability.

c- Provide disabled pension or allowance for employment injury or commuting accident or occupational diseases causing permanent disability.

d- Provide funeral benefits and survivors' pension.

Article 16: This article specifies medical care and treatment as a result of accidents or occupational disease injury as mentioned below:

- Medical treatment, surgery, dentistry, X-ray photograph, laboratory examination and other analysis.
- Supplying pharmaceutical and incidental products for treatment.
- Providing allowance for victim caring in hospital or other places.
- Supply, maintenance and repair of prostheses limbs or orthopedic necessities required by a doctor designated or recognized by the NSSF or any kind of improving work rehabilitation or vocational retraining.
- Work rehabilitation, vocational retraining, and job reclassification based on the conditions set by Prakas of the Minister in charge of Social Security Schemes.
- Transport of the victim from accident site to the treatment places or his/her residence.

Article 19-When having the occupational risk and causing the victim died the National Social Security Fund shall provide funeral benefits and pension for survivors.

3.3.11 Law on Cultural Heritage Protection (1996)

The Law on Cultural Heritage Protection adopted by the National Assembly at the fifth ordinary session of the first mandate and promulgated by the royal proclaimation No. 0196/26, dated 25 January 1996.

Article 1:
The purpose of this law is to protect national cultural heritage and cultural property in general against illegal destruction, modification, alteration, excavation, alienation, exportation or importation.

Article 2:
The national cultural heritage comprises cultural property created or discovered on national territory.

Article 3:
This law shall apply to movable and immovable cultural property, whether publicly or privately owned, whose protection is in the public interest. Except as otherwise provided elsewhere in this law, it shall apply only to cultural property that forms part of the national cultural heritage.

Article 6:
Protected sites containing archaeological reserves or other sites of archaeological, anthropological or historic interest may be established.
The boundaries of such protected sites shall be defined by kret at the proposal of the SCNC.

Article 19:
Classified cultural property is imprescriptable.

Article 20:
Any classified cultural property of public ownership or belonging to public legal entities is inalienable.

Article 21:
Anyone who alienates private cultural property proposed for classification or already classified shall, on pain of nullity of the act of alienation:

- Inform the beneficiary of the status of the property before completion of the act of alienation,

- Inform the competent authority within fifteen days of the act of alienation by communicating to it the surname, first name and domicile of the person to whom ownership of the property has been transferred, as well as the date of the alienation.

Article 37:
When construction work or any other activity bring to light cultural property such as monuments, ruins, ancient objects, remains of inhabited sites, ancient burial sites, engravings or any property likely to be of interest in the study of prehistory, history, archaeology, ethnology, paleontology or other branches of science dealing with the past or of human sciences in general, the person finding the property and the owner of the site where it was discovered are obliged to stop the construction work and immediately make a declaration to the local police, who shall transmit it to the Governor of the province without delay. The Governor shall in turn in turn inform the competent authority and shall take the measures necessary to ensure the protection of the objects and the site.

Article 39:
Movable cultural property found by chance is public property. The competent authority shall provide within three weeks a reward to the finder of the discovery, the amount of which is to be fixed by agreement or by expert opinion.

3.3.12 Law on Forestry
The Law on Forestry was adopted by the National Assembly on 30 July, 2002 during its 8th Ord-Session of 2nd Legislature and has been issued by the Senate on 15 August, 2002 during its 7th Ord-Session of 1st Legislature. Articles of this law relevant to the Project include:

Article 1:
This law defines the framework for the management, harvesting, use, development and conservation of forests in the Kingdom of Cambodia.

The objective of this law is to ensure the sustainable management of these forests for their social, economic and environmental benefits, including conservation of biological diversity and cultural heritage.

Article 2:
This law applies to all forests, whether natural or planted.

The State ensures customary user rights of forest products & by-products for local communities and as provided in the provision of this Law or other relevant laws.

Article 4:
This law will be implemented to ensure public participation in any government decision that has the potential for significant impact on concerned general citizens, livelihoods of local communities, and forest resources in the Kingdom of Cambodia.

Consistent with the Cambodian code of forest management and the Environmental Protection and Natural Resources Law, an Environmental and Social Impact Assessment will be prepared for any major forest ecosystem related activity that may cause adverse impact on society and the environment. Copies of the Environmental and Social Impact Assessment will be made available for public comment.

Any final decisions by the Royal Government on major forest ecosystems related activities must consider the recommendations of the final Environmental and Social Impact Assessment. The Royal Government can publicly announce any final decisions under this article.

Article 31:

The clearing of forestland for the purpose of public road construction in the Permanent Forest Reserves will be prohibited, unless approved by the Royal Government upon request of the Ministry of Public Works and Transport after consultation with the Ministry of Agriculture, Forestry and Fisheries.

The clearing of forestland for the purpose of forest road construction in the Permanent Forest Reserves will be prohibited, unless approved by the Minister of Agriculture, Forestry and Fisheries upon request of the head of the Forestry Administration.

All projects for public and forest road construction within the Permanent Forest Reserves will be subject to consultation with local authorities and communities and an Environmental & Social Impact Assessment pursuant to Article 4 of this law will be required. New settlements along public or forest roads in the Permanent Forest Reserve will be prohibited without the prior permission of the Royal Government of Cambodia.

Article 32:
The forests will be protected against damaging activities caused by excessive exploitation, abusive forest clearing, forest ecosystem pollution, forest fires, shifting cultivation, diseases, noxious insects, and the import of harmful forest vegetation and wildlife species.

The following activities that may damage forests will be prohibited to:

i. Displace, remove, or destroy the boundary posts or distinctive signs demarcating the forest boundary;
ii. Grid bark, poison, destroy, clear or uproot a tree without a technical need;
iii. Use harvest rights for forest products and by-products in a manner different from those authorized by permit;
iv. Use various means or allow unleashed or leashed livestock within an area with tree seedlings or recent growth after harvesting, or forest fires, or in areas recently planted; and
v. Establish yellow vine or other forest by-products' processing facilities that may cause significant pollution or destruction to the forest ecosystem.

Article 33:
Unless otherwise stated in Articles 31, 35, and 37 of this law, all forest clearing activities will be prohibited within the Permanent Forest Reserve.

Article 35:
In addition to other laws concerned, quarrying, soil and sand excavation, mining, and other natural resources extraction conducted within the Permanent Forest Reserves will require a prior study-evaluation from the Ministry of Agriculture, Forestry and Fisheries, authorized by the Royal Government of Cambodia, and be in compliance with Article 4 of this law.

Such authorization will state the protection and restoration measures of the site for quarrying, soil and sand excavation, and will be responsible to:

1- Avoid causing mining and exploitation of other natural resources whereby the holder of such rights will aggravate soil erosion, damage to growing vegetation, damage to the hydrologic systems and the quality of water;
2- After project completion, to restore the site of quarrying, soil and sand excavation, mining, or other natural resources extraction, to their original state within the timeframe set by the permit.

Article 36:
It is prohibited to set fires in the Permanent Forest Estates. Fires or use of fires are only allowed by the Forestry Administration to benefit silviculture or forest hygiene.

Guidelines to determine areas for forest fire control, forest fire prevention and creation of Forest Fire-Fighters Committees will be determined by a Prakas of the Ministry of Agriculture, Forestry and Fisheries (as a rule for implementation in all forest areas). Citizens, armed forces, and authorities of all levels will have the obligations for forest maintenance and protection, fire prevention and fighting against forest fires.

Article 48:
All kinds of wildlife species in the Kingdom of Cambodia are State property and components of forest resources, including species of mammals, birds, reptiles, amphibians, insects, other invertebrates, and their eggs or offspring. Such wildlife is under the management, research and conservation of the Forestry Administration, except for fish and animals that breed in water.

Article 49: It is strictly prohibited to hunt, harm or harass all wildlife:

1- Using all types of dangerous means;
2- Hunting during the prohibited season;
3- Hunting in protected zones and special public areas.

The Forestry Administration, upon the agreement with the Ministry of Agriculture, Forestry and Fisheries, has the authority to issue a permit involving rare and endangered species for the following purposes:

1- For educational or scientific research;
2- In support of a Captive Breeding Program;
3- To exchange wildlife species pursuant to international cooperation agreements.

It will be prohibited to commit the following activities against rare and endangered wildlife species.

1- Harass or harm any such species or its habitat;
2- Hunt, net, trap or poison such species;
3- Possess, stock or maintain such species in a zoo or in a family house;
4- Transport such species;
5- Trade such species;
6- Export-Import such species.

The rules on activities related to all types of wildlife species will be determined by Joint-Prakas between the Ministry of Agriculture, Forestry and Fisheries and Ministry of Environment.

Article 86:
An individual who commits a forestry offense as stated in this law will be responsible for their own action.

Individuals who are state employees or employees of the private sector, who have used means from relevant State offices or private companies to commit forestry offenses, will be penalized or have their employers penalized as described in the provisions of this law.

Article 87:
Any foreigner, or legal foreign entity that commits a forestry offense, will be subject to the provisions of this law.

3.4 Sub-Decrees, Prakas and Policies

3.4.1 Sub-Decree on Environmental Impact Assessment Process (1999)

Sub-decree No. 72 on Environmental Impact Assessment process was officially adopted by the Royal Government of Cambodia dated on August 11, 1999. This sub-decree contains some relevant article as follow:

Article 1: The main objectives of this sub-decree are:

a) To determine an Environmental Impact Assessment (EIA) upon every private and public project or activity, and it must be reviewed by the Ministry of Environment (MoE), prior to the submission for a decision from the Royal Government.
b) To determine the type and size of the proposed project(s) and activities, including existing and ongoing activities in both private and public prior to undertaking the process of EIA.
c) Encourage public participation in the implementation of EIA process and take into account of their conceptual input and suggestion for re-consideration prior to the implementation of any project.

Article 3: MoE has responsibility as following:

a) Scrutinized and review the report of the Environmental Impact Assessment in collaboration with other concerned ministries;
b) Follow up, monitor and take appropriate measures to ensure a project owner will follow the Environmental Management Plan (EMP) while project construction is taking place and accede to their EIA report's approval.

Article 4: Institution and ministries who are responsible for proposed project, shall have the right to examine and approve any project (s) that stated in the annex of this sub-decree, after the MoE has reviewed and committed on their EIA report.

Article 7: A project owner must apply to the MoE for reviewing their full report of EIA report and pre-feasibility study, in case a project tends to cause a serious impact to the natural resources, ecosystem, health and public welfare.

Article 8: a project owner must apply to the MoE for reviewing their full report of EIA report and pre-feasibility study, in case a project tends to cause a serious impact to the natural resources, ecosystem, health and public welfare.

Article 11: A project owner must cover all the fee's service for reviewing and monitoring upon their project. These service fees shall be approved by the Ministry of Economy and Finance following the proposal of the MoE. The said fee shall be incorporated into the national budget.

Article 12: A project owner must contribute a donation to the Environmental Endowment Fund as describe in Article 19 of chapter 8 of the law on Environmental Protection and Natural Resource Management

Article 16: when a project is requested to submit a full report of EIA, as described in Article 8, the project owner/responsible person shall submit it to the MoE along with their application for project' s investment with the project Approval Ministry/Institution.

Article 17: The MoE will review the report, as described in Article 16 and will provide finding and recommendations back to the Project owner and to project approval Ministries/ Institution within 30 work-days, commencing from the date of the receipt of their EIA report and pre-feasibility study report.

Article 20: a project owner must acknowledge the findings and recommendations of their IEIA or/and EIA report(s) which have been approved by the MoE, before they can proceed their project's implementation.

Article 22: Project owner/Responsible person must compile a full report of EIA within 6 months in accordance to the requirement in Chapter 3 and 4 of this sub-decree and must submit it to the MoE, after the MoE reviewed their existing/ongoing activities is needed to submit a full report of EIA.

Article 23: A project owner/responsible person must carry out the EMP as stated in the EIA for period of 6 calendar months, commencing from the date of the MoE confirmation of their EIA report that duly fulfils the criteria of this sub-decree.

Article 25: A project owner/responsible person must compile a full report of EIA within 6 months in accordance to the requirement in Chapter 3 and 4 of this sub-decree and must submit it to PEO, after the PEO reviewed their existing/ongoing activity is needed to submit a full report of EIA.

Article 26: A project owner/responsible person must carry out the EMP as stated in the EIA for period of 6 calendar months, commencing from the date of the PEO confirmation of their EIA report duly fulfilled the criteria of this sub-decree.

Article 27: The Project Approval Ministry/Institution shall provide some guidelines to Project Owner/Responsible Person on the EMP, in which is described in the EIA' guidelines prepared and approved by the MoE.

3.4.2 Sub-Decree on the Air Pollution Control and Noise Disturbance (2000)

Sub-Decree No. 42 on the Air Pollution Control and Noise Disturbance was adopted by the Royal Government of Cambodia, dated on August 11, 2000. This sub-decree contains some relevant article as follow:

Article 1: The sub-decree has a purpose to protect the environment quality and the public health from air pollution and noise pollution through monitoring, curb and mitigation activities.

Article 2: The sub-decree applies to all movable sources and immovable sources of air and noise pollution.

Article 4: The standard of maximum quality of hazardous substances permitted in the air is specified in the Annex-1 and shown on the table below.

Article 5: The standard of maximum into the atmosphere shall be specified in the annex - 3 of this sub-decree. This standard of smoke emission from movable source shall be specified in the annex -4 of this sub-decree.

Article 7: The standard of noise emission from various sources like vehicle, manufacturing place and the standard for maximum noise emission for public and residential areas shall be specified in the annex 5, Annex 6 and Annex 7 of this sub-decree

Article 8: The emission of pollutants into the atmosphere which exceeds the standard as stipulated In the Annex3 and Annex4 of this sub-decree will be strictly prohibited.

Article 9: Noise emission, which exceeds the standard as stipulated in the Annexes 5, 6and 7 of this sub-decree, will be strictly prohibited.

Article 10: The importation and production of flammable substances containing S.Pb. C.H. Hydro-carbon shall be complied with the standard which stipulated in the Annex-8 of this sub- decree.

Article 11: The importation, utilization, production of vehicle and all kinds of machinery in Cambodia, which emit pollutants and noise exceeding the standard as stipulated in the Annex4 and Annex 5 of this sub-decree, will be strictly prohibited.

Article 12: The discharge or leakage of various flammable substances, fuel-oil, radioactive or chemical substances into the atmosphere, water and land will be strictly prohibited.

Article 13: The emission of pollutants and noise from immovable source into the atmosphere will be authorized by the Ministry of Environment and a copy such application will be sent to the relevant ministries and institutions.

Article 15: The asking for discharge permission as stipulated in the Article 13 if the sub- decree shall be carried out for New project and ongoing Assessment's report

Article 24: The owner or person who is responsible for a pollution source will:

- Be responsible for procurement and installation of any equipment to purify toxic substances and to reduce noise and vibration in order to respond to air pollution standard;
- Be responsible for installing the equipment for measurement of the amount of pollutants contained in his/her pollution sources and maintain the result in its record, a report of which will be sent to the Ministry of Environment every 3 months;
- Choose one environmental expert to be responsible for managing environmental affairs and preparing environmental protection plans for their institution for which the ministry of environment provides training at the request of the owner.

Article 31: In case of serious accident or imminent danger resulting from air pollution at public water area, the Ministries of Environment shall make urgent inspection on the above problem and shall inform the concerned ministries and local authority.

Table 23: Appendix 1 Air Quality Standard

Parameter	1 hour average (mg/m^3)	8 hours average (mg/m^3)	24 hours average (mg/m^3)	1 year average (mg/m^3)
Carbon monoxide (CO)	40	20		
Nitrogen Dioxide (NO_2)	0.3		0.1	
Sulfur Dioxide(SO_2)	0.5		0.30	0.10
Ozone(O_3)	0.2			
Lead (Pb)			0.005	
Total Suspended Particulate (TSP)			0.33	0.10

Note:

- Standard applicable for evaluation of general air quality and for investigation of air pollution.
- Methods for air quality analysis are determined by the guideline of the Ministry of Environment.
- TSP = Total Suspended Particulate

Table 24: Appendix 6 Maximum Noise Standard Permitted in Public and Residential Areas (dB (A))

No.	Location	Period		
		From 6:00-18:00	From 18:00 -22:00	From 22:00-6:00
1	Quiet area - Hospital, library, school	45	40	35

No.	Location	Period		
		From 6:00-18:00	From 18:00 -22:00	From 22:00-6:00
	and kindergarten			
2	Residential area - Hotel and administrative area - Manson and flat	60	50	45
3	Commercial, service, and mixed zones	70	65	50
4	Light industry mixed in residential area	75	70	50

Table 25: Appendix 7 the Standard Setting level for Noise Control in the Factories and Industries Zone

Noise Level (dB (A))	Maximum period of time (Hour)	Level
75	32	Support ear prevention equipment to worker in place has 80 (dB(A)) over noise.
80	16	
85	8	
90	4	
95	2	
100	1	
105	0.5	
110	0.25	
115	0.125	

3.4.3 Sub-Decree on Water Pollution Control (1999)

Sub-Decree No. 27 on Water Pollution Control was officially approved by the Royal Government of Cambodia dated on April 06, 1999. This sub-decree contains the relevant article as follow:

Article 1: The purpose of this sub-decree is to regulate the water pollution control in the order to prevent and reduce the water pollution of the public water area so that the protection of human health and the conservation of bio-diversity should be ensured.

Article 2: The sub-decree applied to all sources of pollution and all activities that cause pollution of the public water areas.

Article 4: Standards for effluent discharge from any sources of pollution shall be specified in the annex 2 of this sub-decree.

Table 26: Appendix 2 the Standard Limit for the Release of Wastewater from Sources of Pollutants into Public Waters or into Drainage Network

No.	Parameter	Unit	Quantity of pollutants permitted for discharging	
			Protected public water	Public water and drainage systems
1	Temperature	oC	<45	<45
2	pH		6 –9	5 – 9
3	BOD5	mg/l	<30	<80
4	COD	mg/l	<50	<100
5	Total suspended solids	mg/l	<60	<120
6	Dissolved solid	mg/l	<1000	<2000

No.	Parameter	Unit	Quantity of pollutants permitted for discharging	
			Protected public water	Public water and drainage systems
	substance			
7	Fuel or fat	mg/l	<5.0	<15
8	Detergent	mg/l	<5.0	<15
9	Phenol	mg/l	<0.1	<1.2
10	Nitrate	mg/l	<10	<20
11	Free chloride	mg/l	<1.0	<2.0
12	Chloride ion	mg/l	<500	<700
13	Sulphate	mg/l	<300	<500
14	Sulphide	mg/l	<0.2	<1.0
15	Phosphate	mg/l	<3.0	<6.0
16	Cyanide (CN-1)	mg/l	<0.2	<1.5
17	Barium (Ba)	mg/l	<4.0	<7.0
18	Arsenic (As)	mg/l	<0.10	<1.0
19	Tin (Sn)	mg/l	<2.0	<8.0
20	Iron (Fe)	mg/l	<1.0	<20
21	Boron (B)	mg/l	<1.0	<5.0
22	Manganese (Mn)	mg/l	<1.0	<5.0
23	Cadmium (Cd)	mg/l	<0.1	<5.0
24	Chrome (Cr)-3	mg/l	<0.2	<1.0
25	Chrome (Cr)-6	mg/l	<0.05	<0.5

Article 6: The discharge of waste water from any sources of pollution that is not consistent with the standards for effluent discharge as mentioned in the article 4 and article 5 of this sub- decree shall be strictly prohibited.

Article 8: The disposal of solid waste or any garbage or hazardous substances into public water areas or into public drainage systems shall be strictly prohibited. The storage or disposal of solid waste or any garbage and hazardous substances that lead to the pollution of water of the public water areas shall be strictly prohibited.

Article 9: The discharge of sewage from dwelling and public building into public water areas without passing through public sewerage systems and other treatment systems shall be strictly prohibited.

Article 10: The discharge or transport of wastewater from any sources of pollution to other places for any purpose is subject to prior permit from the Ministry of Environment. The application for this permit shall be copied to the concerned ministries or agencies

Article 18: The monitoring on the discharge or transportation of effluent from any sources of the pollution is the responsibility of the Ministry of Environment.

Article 25: The water quality standard of public water areas for the purpose of the conservation of the bio-diversity is stipulated in the Annex 4 of this sub decree. The water quality standard of public water areas for the purpose of the protection of the public health is stipulated in the Annex 5 of this sub-decree.

Table 27: Appendix 4 Standard Limit for Water Quality in Public Water Areas for the Conservation of Biodiversity in Water

A. For river

No.	Parameter	Unit	Standard
1	pH		6.5 -8.5

No.	Parameter	Unit	Standard
2	BOD5	mg/l	1 -10
3	Suspended solids (SS)	mg/l	25 -100
4	Dissolved oxygen (DO)	mg/l	7.5 -2.0
5	Coliform	MPN/100ml	<5000

B. For lake and reservoir

No.	Parameter	Unit	Standard
1	pH		6.5 -8.5
2	COD	mg/l	1 -8
3	Suspended solids (SS)	mg/l	1 -15
4	Dissolved oxygen (DO)	mg/l	7.5 -2.0
5	Coliform	MPN/100ml	<1000
6	Total Nitrogen	mg/l	0.1 -0.6
7	Total Phosphorus	mg/l	0.005 -0.05

Table 28: Appendix 5 Water Quality Standard in Public Water Areas for Public Health Protection

No.	Parameter	Unit	Standard
1	Carbon tetrachloride	µg/l	< 12
2	Hexachloro-benzene	µg/l	< 0,03
3	DDT	µg/l	< 10
4	Endrin	µg/l	< 0.01
5	Diedrin	µg/l	< 0.01
6	Aldrin	µg/l	< 0.005
7	Isodrin	µg/l	< 0.005
8	Perchloroethylene	µg/l	< 10
9	Hexachlorobutadiene	µg/l	< 0.1
10	Chorofrom	µg/l	< 12
11	1,2 Trichloroethylene	µg/l	< 10
12	Trichloroethylene	µg/l	< 10
13	Trichlorobenzene	µg/l	< 0.4
14	Hexachloroethylene	µg/l	< 0.05
15	Benzene	µg/l	< 10
16	Tetrachloroethylene	µg/l	< 10
17	Cadmium	µg/l	< 1
18	Total mercury	µg/l	< 0.5
19	Organic mercury	µg/l	0
20	Lead	µg/l	< 10
21	Chromium, valent 6	µg/l	< 50
22	Arsenic	µg/l	< 10
23	Selenium	µg/l	< 10
24	Polychlorobioheny1	µg/l	0
25	Cyanide	µg/l	< 0.005

3.4.4 Sub-Decree on Solid Waste Management (1999)

Sub-Decree No. 36 on Solid Waste Management was officially approved by the Royal Government of Cambodia dated on April 27, 1999. This sub-decree contains the relevant article as follow:

Article 1: The purpose of this sub-decree is to regulate the solid waste management with proper technical manner and safe way in order to ensure the protection of human health and the conservation of bio-

diversity.

Article 2: This sub-decree applies to all activities related to disposal, storage, collection, transport, recycling, dumping of garbage and hazardous waste.

Article 7: The disposal of waste in public sites or anywhere that is not allowed by the authorities shall be strictly prohibited.

Article 13: The owner of the hazardous waste shall be responsible for temporary storage of his/her waste in proper technique and in safe manner.

Article 14: The owner of the hazardous waste shall make a quarterly report on his/her waste and forward it to the Ministry of Environment. The report includes:

- Type and amount of the waste,
- Temporary storage method, and
- Treatment or elimination method.

Article 15: The storage, transportation and disposal of the hazardous waste shall be performed separately from the household waste which will be stipulated by the Prakas of the Ministry of Environment. The disposal of hazardous waste into public site, public drainage systems, public water area, rural area and forest area shall be strictly prohibited.

Article 17: The transportation or construction of storage place or landfill of hazardous waste from factories and manufacturing site shall be subject to permit from the Ministry of Environment.

Article 18: The owner or responsible person of storage place or landfill of the hazardous waste shall make quarterly report on the hazardous waste which is transported for disposal of or for storage and forward this report to the Ministry of Environment. The report shall include as follows:

a) Type and amount of the waste,
b) Sources of the waste,
c) Packing and transport facility, and
d) Process and management of the waste inside his/her location and forward this report to the Ministry of Environment.

Article 23: The Ministry of Environment shall take sample of the Hazardous waste at every point enumerated in the article 22 of this sub-decree. The owner or person responsible for the site mentioned in the paragraph one of article 23 of this sub-decree shall collaborate and facilitate the environment official who comes to take the waste sample so that they can carry out their technical task.
Type of the hazardous waste such as:

a) Sludge waste from factory waste water treatment and product manufacturing.
b) Paper waste from paper-mill industry
c) Plastic waste from production or use of plasticizers
d) PCB waste from use of PCB contained in discarded air conditioners, TVs and Microwaves.
e) Rubber waste from production or use of resins and latex;
f) Oil waste from oil refinery and oil machine
g) Waste from production or use of battery
h) Explosive waste
i) Soot and dust waste from incineration facilities, treating exhaust gas.
j) Waste from treatment of polluted soil

3.4.5 Sub-Degree on Construction Permit (1993)

Sub-decree No. 86 on Construction Permit, which was adopted on December 19, 1993, covers management of construction work, work safety, and public welfare.

Article 1: All private or public person, physical or legal shall have the rights to construct a building on their own titled land and such rights shall be protected by this Anukret. Any Construction Permit issued prior the construction start- up shall be considered as legal document of the Construction. The process of permit application shall be described in the 1st Section of this sub-decree.

Article 2: All constructions in the cities or provincial towns shall be subjected to construction permits. All New constructions shall be subject to construction permits. Reconstruction, expansions and floor additions of existing building shall be subjected to construction permit.

Article 3: Construction not subject to the construction permit

- The population small habitations located in the rural areas or far away from the national roads, rail roads, tourism resorts, national patrimony and protected areas, regardless of its size or construction materials.
- Maintenance and repair works, which do not modify the structure or the characteristics of the construction, are not subject to the construction permit. The following constructions shall be subjected to a simple preliminary declaration to the local authority:
- Place of cult
- The "salas " " salas chha tien" (public accommodation places)
- Small state constructions necessary to provide public functional supports to the sites, hangars the Khmer version is the official versions of this document/

Article 7: No building permit may be issued if the construction permits do not comply with the master plan and land use plan (in the case of these two layout), or if there is no such layout, the permit shall comply with the general regulations on the use of land. People such as public or private legal entities must respect this measure.

Article 8: The construction permits applications shall be deposited for Phnom Penh and the other municipalities at the construction permit office (urban planning and construction unit), for provinces at the office of 'Srok' chief or the governor of the province (construction unit). A receipt of the deposit the construction permits shall be issues to all applicants when the application file is completed.

Article 24: All construction started before the assurance of the construction permits by the competent authorities

Article 27: Construction permits shall be refused if these constructions by their situation, their nature or their dimensions are of such nature as to adversely affect the health or the public security or are exposed to pollution or to risks.

Article 28: Construction permits shall be refused or shall be granted only under special orders if these constructions can by their nature, their dimensions or their situation, compromise the conservation or the exploitation of an urban or natural site, or archaeological and historical vestiges.

Article 29: Construction permits shall be refused on terrains that would not be served by public roads, private roads, lanes or passages whose width would be in proportion the importance and the purpose of the building. All ways, passages or lanes servings one or several constructions shall not be having a dimension less than 3.5m for access of fire vehicle. The vehicles parking spaces which correspond to the needs of the building shall not infringed on the public access. Norms for parking are fixed by the municipal and provincial administrations for no less than the followings:
For hotels:

- Space for every 5 bedrooms
- Car space for every 30 bedrooms for private officers and public administrations

- Space for 250 m^2 of floor surface.

Article 38: The construction permits shall be denied for constructions, which by their situation, their architecture, their size, or their external chrematistic of such nature landscape, the serenity of out places, the archaeological or historical sites, the palace and royal monuments.

Article 39: The construction permits shall be denied if the public health is at risk, all living quarters shall be ventilated and have at least one window. The natural lighting area per living quarters shall be at least 1.5m^2.

Article 40: Industrial constructions can be subjected to special conditions or building adjustments so as to ensure their good integration with the landscapes and urban or natural sites.

3.4.6 Sub-Decree on the Establishment of Environmental and Social Funds

The Royal Government of Cambodia issued the sub-decree no. 238 on the establishment of environmental and social funds on 21 November 2015.

Article 1: The objective of this sub decree is the "Establishment of Social and Environmental Funds", which will fall under the management and authority of the Committee Governing the Establishment of Social and Environmental Funds.

Article 2: The sub decree aims to manage the efficient, effective, transparent, and accountable usage of social and environmental fund in order to safeguard environmental protection and preservation, and to enhance environmental conservation and biodiversity in Cambodia.

Article 3: The sub-decree governs all activities in relation to the handling and usage of social and environmental funds.

Article 6: The social and environmental fund governing committee has a secretariat in the General Department of Environmental Protection. The roles and structure of the secretariat is defined by the Ministry of Environment's Prakas.

Article 8: The social and environmental funds will be collected using the following means:

- Gains received from private and public project owners, as reflected in the environmental management plan of an environmental impact assessment report and of an environmental protection agreement;
- Profits gained through environmental preservation, ecology services and biodiversity conservation;
- Donations or funds raised from charitable organizations, developer partners, and national or international private institutions;
- Other services from the environmental sector; and
- Other sources.

Article 9: The social and environmental funds must be deposited in an account of the National Bank of Cambodia or other commercial banks permitted by the Ministry of the Economy and Finance.

Article 10: The social and environmental funds will be used for the following purposes:

- Environmental protection, sustainable biodiversity and ecosystem conservation;
- Rehabilitate environment and improve biodiversity and ecosystem countrywide;
- Develop infrastructure and improve people's livelihoods residing within and surrounding project ares or other areas;
- Conduct technical and scientific research on biodiversity and ecosystem;
- Conduct technical and scientific research on environment;

- Raise awareness on environment;
- Support the establishment of nature protection community, and other environment-related community;
- Build human resources in the environment and natural resources sectors;
- Raise awareness on protected area

Article 11: The procedures for collecting social and environmental funds will be defined in an inter-ministerial prakas from the Ministry of the Environment and the Ministry of the Economy and Finance.

3.4.7. Subdecree on Plastic Waste Management (2017)

The Government of the Kingdom of Cambodia issued the Sub-Decree No. 168 on Plastic Bag Management on 10 October 2017. The sub-decree has the following main articles:

Article 1: This sub-decree aims at promoting the efficiency of reduction, importing, production, distribution, and use of plastic bag to ensure public health, environment, and beauty protection.

Article 2: This sub-decree comprises of the following objectives:

- Determine roles and responsibilities of ministries, institutions, technical organizations, and sub-national administrations in relation to the importing, production, distribution, use, and recycling of plastic bags;
- Determine plastic bag management measures;
- Determine fee to charge customers for plastic bags;
- Educate, raise awareness, and promote public participation in plastic bag reduction programme throughout Cambodia;
- Encourage private sector to recycle local plastic bag waste and to produce biodegradable plastic materials.

Article 3: This sub-decree covers the importing, production, distribution, and use of thin plastic bag with handles and the recycling of local plastic bag waste in the Kingdom of Cambodia.

Article 10: Capital city and provincial administration may delegate necessary and appropriate responsibilities to municipal, district, khan, and commune/sangkat administrations in order to implement plastic bag reduction measures within their jurisdictions.

Article 11: Municipal and Provincial Department of Environment act as the secretariat for sub-national administrations in relation to plastic bag management, and have the following responsibilities:

- Raise public awareness of the impacts of the use of plastic bag;
- Promote the implementation of plastic bag reduction activities at all targeted plastic bag production and distribution facilities;
- Promote plastic bag recycling activities and make a proposal to establish a plastic bag-free zone; and
- Monitor and implement legal procedures against any violation of this sub-decree, and monitor and evaluate the performance of plastic bag reduction programme.

Article 12: All citizens are required to participate in the plastic bag reduction programme in any possible way, such as the re-use of plastic bag or the use of substitutes for plastic bag.

Article 13: Owners of business establishments and other services that provide plastic bags to their customers are encouraged to participate in the plastic bag reduction programme;

Article 14: Halt the importing, local production, distribution, and use of thin plastic bag with handles, except the following:

- Plastic bags thicker than 0.03 millimeters, to be determined by inter-ministerial Prakas (Declaration) between the Ministry of Environment and relevant ministries; Plastic bags bigger than 25 centimeter or 10 inch wide

- All importing and local production of plastic bags mentioned in the above A and B sections shall have the permit from the Ministry of Environment, except for the importing of less than 100 kilograms for non-commercial purposes.

3.4.8. Subdecree on Management of Waste Electrical and Electronic Equipment (2016)

The Government of the Kingdom of Cambodia issued the Sub-Decree No. 16 on Plastic Bag Management on 1 February 2016. The sub-decree has the following main articles:

Article 1: The purpose of this sub decree is to management of waste electrical and electronic equipment with environmental safety.

Article 2: The objectives of this sub decree are:

- Manage on waste electrical and electronic equipment, since production until the final disposition time.
- Prevent the importation of electrical and electronic equipment in purpose for disposition.
- Reduce the importation of used electrical and quality for usable electronic equipment.
- Prevent the spread of toxic substances from waste of electrical and electronic equipment into environmental water, land, and air.

Article 3: This sub decree scopes for applied in all waste electrical and electronic equipment activities of Kingdom of Cambodia.

Article 6: Ministries and relevant institutions shall participate on the management of waste electrical and electronic equipment as requested from ministry of environment.

Article 7: All waste electrical and electronic equipment dispositions into water sources or landfill or other public spaces, and burning or disassembling on waste electrical and electronic equipment caused risks on environment or public health shall be prohibited.

Article 8: Technical guidelines on the management of waste electrical and electronic equipment to ensure environmental safety shall issue by the declaration of ministry of environment.

Article 14: Any person who has waste electrical and electronic equipment shall be responsible as following:

a) Storage the waste at safety place and put it separately from home waste.
b) Disposing waste to recycling place or waste electrical and electronic equipment collection sites accordance the determined of responsible institutions.

3.6. National Policy

3.6.1. Rectangle Strategy-Phase IV of the Royal Government of Cambodia, 2018

The Rectangular Strategy was designed to increase employment, equity and efficiency in Cambodia, Phase III of the Royal Government of Cambodia 5th Legislature of the National Assembly. This strategy is set up by the Royal Government of Cambodia in 2018. Overall, the components of the Rectangular Strategy Phase 4 are as follows:

- Rectangle 1: Promotion of Agriculture Sector
    - Side 1: Improved Productivity, Diversification and Commercial-zation
    - Side 2: Promotion of Livestock Farming and Aquacuture

  - Side 3: Land Reform and Clearance of Mines and UXO
  - Side 4: Sustainable Management of National Resources
- Rectangle II: The development of Physical Infrastructure
  - Side 1: The development of Transport and Urban Infrastructure
  - Side 2: Water Resources and Irrigation Management
  - Side 3: Electricity Power Development
  - Side 4: Development of Information and Communication Technology
- Rectangle III: Private Sector Development and Employment
  - Side 1: Strengthening the private Sector and Promoting Investment and Business
  - Side 2: Development of Industry and Small and Medium Enterprises (SMEs)
  - Side 3: Development of Labour Market
  - Side 4: Banking and Financial Sector Development
- Rectangle IV: Capacity Building and Human Resource Development
  - Side 1: Strengthening and Enhancing Education, Science and Technology, Technical Training
  - Side 2: Promotion of Health Nutrition
  - Side 3: Development of Social Protection System
  - Side 4: Enhanced Implementation of Population Policy and Gender Equity.

3.6.2 National Strategic Plan on Green Growth 2013-2030

This National Strategic Plan aims at green growth, ensuring politic and macroeconomic stability to reach to a status of a developed country. Moreover, the National Strategic Plan is to promote a national economy with growth stability, reduction and prevention of environment pollution, safe ecosystem, poverty reduction, and promotion of public health service, educational quality, natural resources management, and sustainable land use and water resources management to increase energy efficiency, ensuring food safety and glorify the national culture.

Chapter 5.2 is involve with preparation and implementation of the National Strategic plan to respond to green growth principles require active participation of the public sector, the private sector, civil society, and public to wards effective green growth with balance among economy, environment, society and culture. The National Strategic Plan on Green Growth 2013-2030 needs to improve green growth by focusing on a strategic direction, includes:

1. Green Investment and Green Jobs Creation
2. Green Economy Management in balance with Environment
3. Blue Economy Development with Sustainability
4. Green Environment and Natural Resources Management
5. Human Resource Development and Green Education
6. Effective Green technology Management
7. Promotion of a Green Social Safety System
8. Uphold and Protection of Green Cultural Heritage and National Identity
9. Good Governance on Green Growth

3.5 International Law Frameworks and Protocols

The Royal Government of Cambodia has ratified the international conventions and protocols related to the mechanism of protecting the ozone layer and mitigating climate change to minimize negative impacts on natural resources, ecosystems, and socio-economic conditions, and people's lives as well as collaboration with all countries in the world for the survival of humanity and sustainability of the global environment by means of human activities, industry and investment activities to the connecting international obligation for all projects involved.

3.5.1 VIENNA Convention Layer on the Protection of the Ozone Layer, 1985

This convention was adopted in National Assembly on October 26, 2006 on its fifth plenary session of its third legislature, and was fully adopted by the Senate as to its form and legal concepts without any corrections and was officially promulgated by the Royal Kram No. 1206/032 dated on December 22, 2006.

This convention consists of 21 articles that focus on the general obligation research and the surveillance of cooperation in science of law and technology to resolve the dispute. This convention has become an important legal tool for the government of Cambodia in the implementation of environmental protection and natural resources to achieve sustainable development. The main points of this convention make all the country members who are exploitation on their resource according to national environmental policy, and all of them must be responsible to ensure that all activities are under its authority or control and will not cause damage to the environment of other countries or areas which are not controlled. They should be considering to set out preventive measures on the Protection of the Ozone Layer at both national level and international level to protect human health and environment, against the negative effects caused by volatility of the ozone layer.

3.5.2 Montreal on Substances Destroying the Ozone Layer, 1987

The Convention was adopted in Parliament on October 26, 2006 at its fifth plenary session of its third legislature and was fully adopted by the Senate as to its form and legal concepts without any corrections, and was promulgated by Royal Kram No. 1206/034 dated December 26, 2006.

The Convention has 20 articles which generally focus on research obligation. This convention has become an important legal tool for the government in the implementation of environmental protection and natural resources to achieve sustainable development. Surveillance of cooperation in scientific importance of this convention is to make all the members who are exploiting its resources according to our environmental policies of national nevertheless must have a responsibility to ensure that activities under the authority or control. And it would not cause any damage to the environment. Meanwhile, a region that is outside the authority needs to address the protection of ozone layer, which is considered already both at national level and at the international level in order to protect human health and the environment against the negative impact caused by the variation of Ozone layer.

3.5.3 Kyoto Protocol of the UN Framework Convention on Climate Change, 1997

This protocol was adopted by the National Assembly on October 26, 2006 at its fifth plenary session of its third legislature and was fully adopted by the Senate as to its form and legal concepts without any corrections, and was promulgated by Royal Kram No. 1206/033 dated December 22, 2006.

This Protocol contains 24 articles, which focus on reducing or eliminating a bias of marketing, financial incentives, tax exemption, assistance in any sector that has greenhouse emission opposite to the convention objectives, marketing measures, and implementation of policies and measures to restrict or reduce greenhouse gas emissions which is not stated in the Montreal Protocol, as well as the restriction measures in reducing greenhouse gas emissions, which is not stated in the Montreal Protocol in the transport sector and to restrict and / or reduce methane emissions by reinstating download and use in waste management, as well as in the production, transport and distribution of energy.

Chapter 4 Project Description

4.1. Introduction

This chapter provides a general description of the physical characteristics, the key activities of the airport infrastructure development, and the action plans of the New Phnom Penh International Airport. As shown in the master plan, the project of the New Phnom Penh International Airport was organized with the following two main phases:

- Operation Phase 1: 2023-2030
- Operation Phase 2: 2031-2050

The key information presented in this chapter are company background and experience, project and investment, key infrastructure, roject Health and Safety phase, human resource planning, energy efficiency and waste management (solid and liquid) as follows.

4.2. Project background and company profile

4.2.1. Project background and rationale

The existing Phnom Penh International Airport is currently located in the capital city of Phnom Penh; it is a civil and military airport operating to ICAO category 4D and has been renovated and operational since 1995. According to the existing Phnom Penh International Airport report, the annual passengers were in excess of 4.2 million in 2017 (Cambodia Airport, 2019). The airport as been operating for over 20 years, and the number of passengers is steadily increasing but the current location cannot be expanded because the airport is a residential area with housing and other commercial space. Therefore, the Royal Government of Cambodia has decided to build the New Phnom Penh International Airport in response to the growth of air transport and expanding access to larger aircraft and operating the airport to ICAO category 4F.

The Project Owner (CAIC) has received permission from the Royal Government of Cambodia to invest in the construction of a new national airport under the name "New Phnom Penh International Airport" situated on aplot with a total area of 2,600 hectares in Kandal Stung District, Kandal Province whisch is located 23 km to the south of Phnom Penh. The New Phnom Penh International Airport is aimed at increasing travel access, increasing air traffic capacity, and it is anticipatedthat by 2023, the New Phnom Penh International Airport will be open and operational.

The 2,600-hectare project site is located in Kandal and Takeo provinces. The proposed location of the new airport is an available open space with access to electricity, communication, water and other services, making it possible for construction activities to happen. The airport equipment features sufficient capacity to accommodate international flights, in compliance with international security standard.

4.2.2. Project owner & investment capital and type of the project

4.2.2.1. Project Owner

Cambodia Airport Investment Co., Ltd. (CAIC) was established by the State Secretariat of Civil Aviation (SSCA) and the Overseas Cambodian Investment Corporation (OCIC). CAIC is a company responsible for project implementation and a private limited liability company. The company is registered with the Ministry of Commerce with a registered capital of 480,000,000,000 Riels (four hundred and eighty billion

Riel), equivalent to $ 120,000,000 (one hundred and twenty million US dollars), and has two investment stocks, SSCA, have 10% registered capital and OCIC with 90% registered capital. CAIC is registered with the Ministry of Commerce, having Oknha Pung Kheav Se, who is a Cambodian national, as the chairman of board of directors. The company's investment capital is US $ 1,850 million (US $ 1,500 million in construction capital and US $ 350 million in investment property value). The company's address is at C2 Olympia Building, 5th floor, Monireth Blvd, Sangkat Velvong, Khan 7 Makara, Phnom Penh, Cambodia. The duration of the activities of the company which was approved during the registration period is 99 years from the 2017 registration year.

4.2.2.2. Project Investment Cost

The total investment cost of the project is 1,500 million US Dollars. About 27% (400 million US Dollars) of the total investment comes from the project owner, while the remaining (1,100 milliion US Dollars or 73%) is funded by the China Development Bank.

4.2.3. Relevant Legal Document of Project

- Certificate of Incorporation No. 001M/2018 in 2018 of the Ministry of Commerce
- Letter No. 1319 dated on 21 December 2017 from Office of Council of Ministers granting approval of Cambodia Airport Investment Co., Ltd as a state parner enterprise.
- Letter No. 13 dated on 13 February 2019 from the Office of Council of Ministers on the establishment of new Phnom Penh airport site preparation committee
- Notice dated 28 Febraury 2019 of the Ministry of Land Management, Urban Planning, and Construction.

4.3. Project location

The project site is about 20 km from Phnom Penh (Figure 4-1). To reach the project site, one has to travel along National Road 2, 5 km away from the intersection of Samdech Hun Sen Blvd (60km) and National Road 2 (traffic direction from town) Takhmao to Takeo Province Then turn right onto the Tbong Wan pagoda, Bunly Island, take the laterite road for more than 3km and reach the border of the project site. The total land area of 2,600 hectares is located in, Kandal Stung, Sa'ang District, Kandal Province and Bati District. The project site has the following borders:

- Boeng Rean lake to the north-east;
- Boeng Chernglong lake to the south-east;
- Agricultural land of Kandal Steng district to the north-west;
- Agricultural land of Pot Sor commune, Bati District, Takeo province, to the south-west.

The project site is a lowland area (between 1.3 meters and 8 meters above the sea level), flooded during the wet season. Villagers cultivates rice and do fishing during the dry season. The coordinates of the project site is described in the table below:

Table 29: Coordinates of the Project Site (UTM WGS1984 48N)

Point	X	Y	Point	X	Y
1	492482.742	1259363.799	5	495446.439	1256216.840
2	492683.030	1259363.287	6	490897.577	1252037.856
3	492483.000	1259205.131	7	488037.909	1255121.479
4	492682.817	1259196.895			

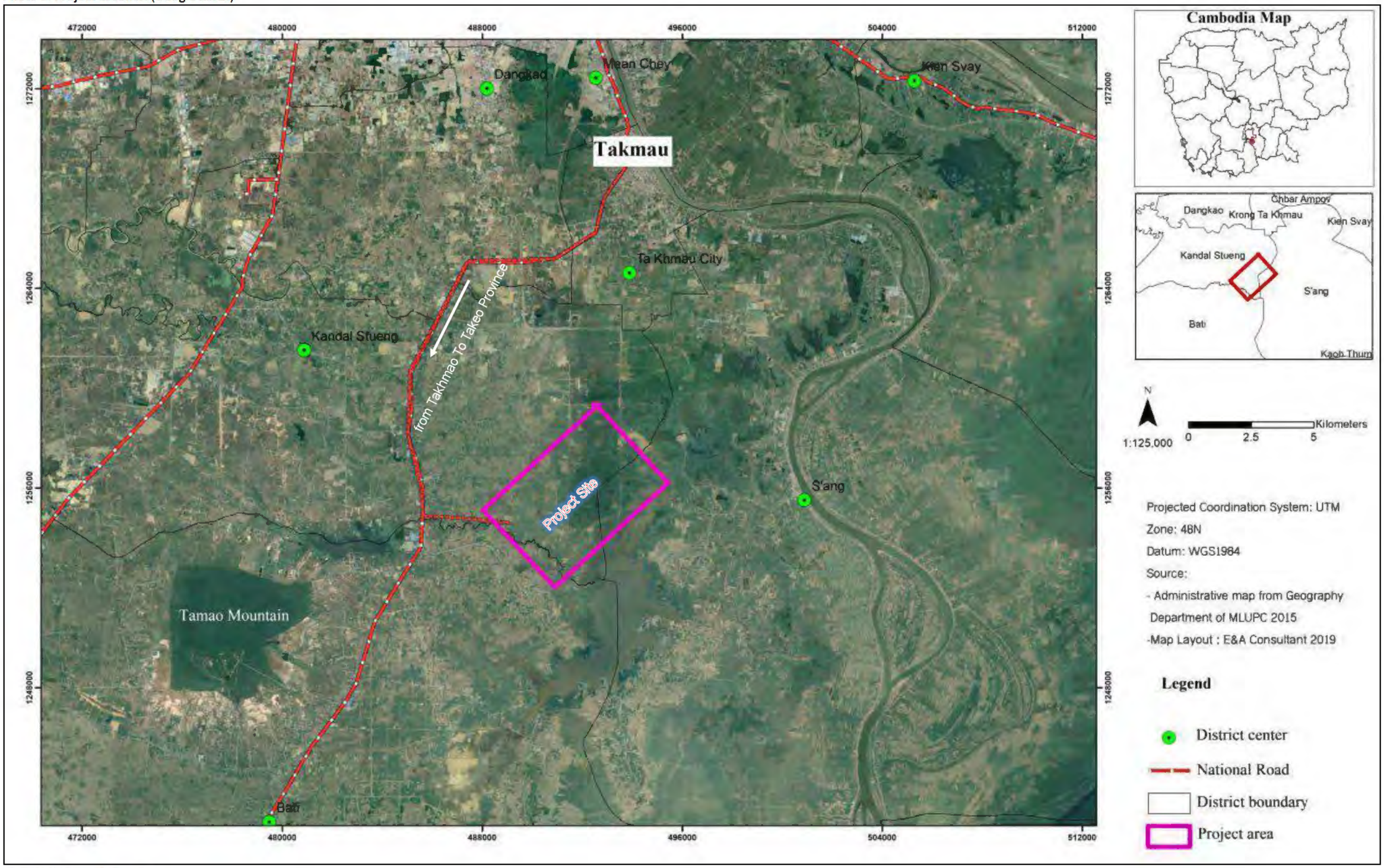
Source: CAIC 2019

About 25.8% (or 670.3 ha) of the project site belongs to CAIC. The remaining area consists of the following:

- About 16.9% (or 439.2 ha) belongs to eight other companies
- About 0.036% (or 0.94 ha) is the state land

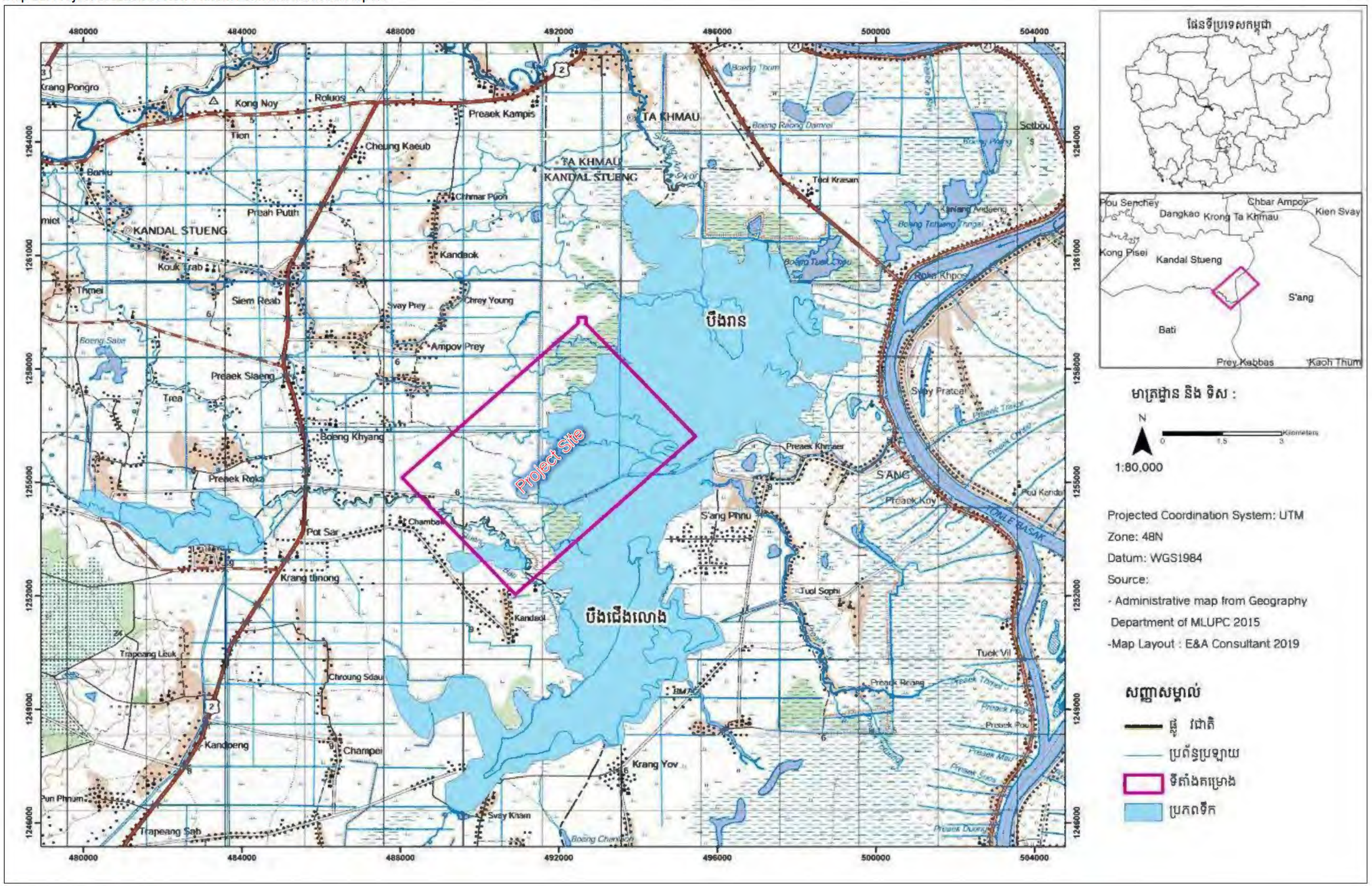
- About 47.2% (or 1,225.92 ha) belongs to villagers
- About 10.1% (or 263.64 ha) is the public land (road, lake, stream, canal, etc) and unknown of owners.

Photo 2: Project Location (Google Earth)



Source: E&A Consultant, 2019

Map 11: Project Location of New Phnom Penh International Airport



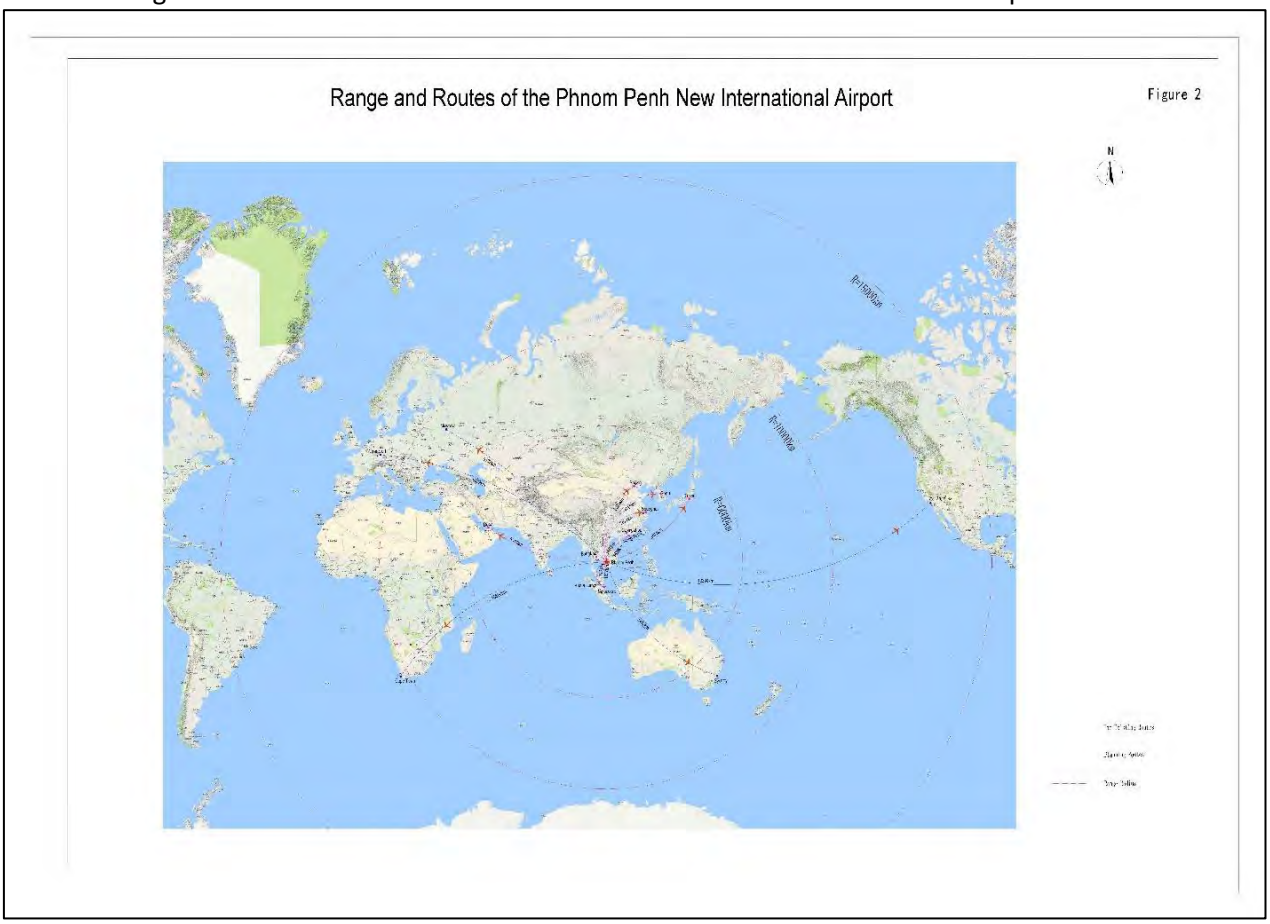
Source: E&A Consultatnt 2019

4.4. Scope and type of the project

The New Phnom Penh International Airport project is a joint venture betweenthe Royal Government of Cambodia in partnership with OCIC who seek to develop the project. The project is jointly owned by the Cambodian government with 10% share and OCIC with 90% share.

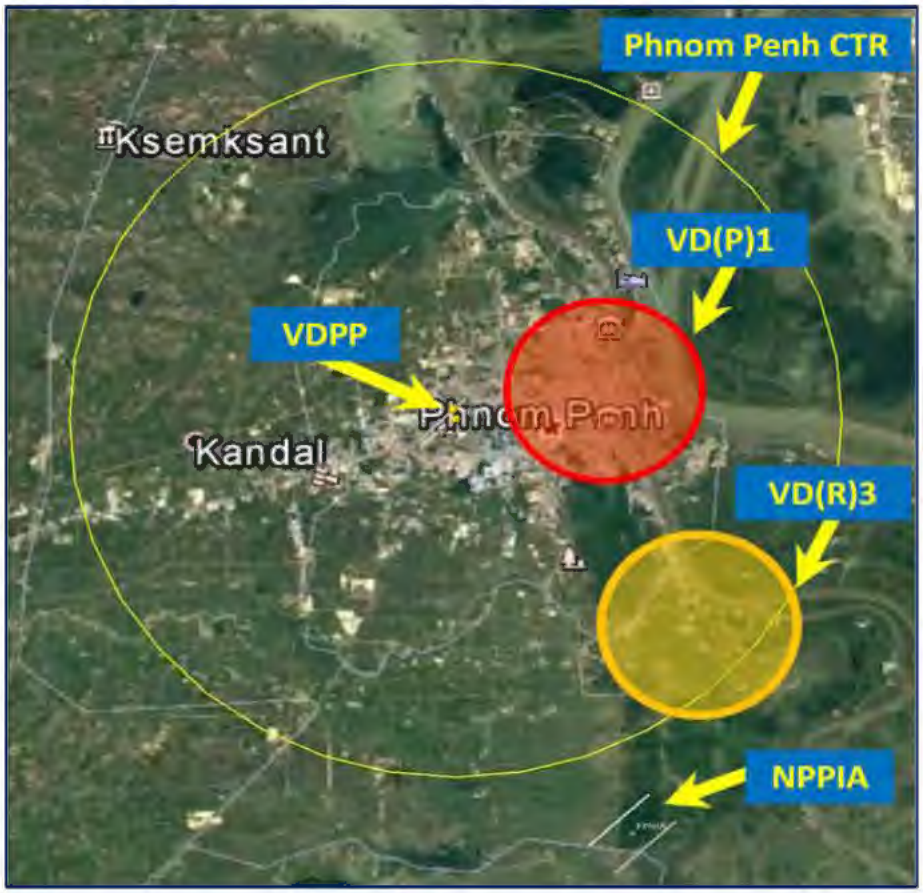
New Phnom Penh International Airport is an ICAO code 4F[2] international airport which is, therefore, capable of enabling aircraft to fly from European countries directly to Cambodia and will be built in accordance with International Civil Aviation Organisation (ICAO) regulations and other internationaly recongnized bodies. The airport will be built on an area of 2,600 hectares, accessible to 4C[3] and 4E aircraft types both within and around the country, within a radius of about 4,000 kilometres, including South Asia, Southeast Asia and Central Asia as shown in the figure below.

Photo 3: Range & Routes and Restrict Area of the New Phnom Penh International Airport



Source: CAIC, 2019

[2] An international airpot with a runway length range between 3,200 and 4,000 meters, which could accommodate long-range flight (over 4,000 kilometers).
[3] An airport with runway length of 2,500 meters, which could accommodate small and medium aircrafts on a short-range flight.



Note:

- NPPIA: New Phnom Penh International Airport
- VDPP: Current Phnom Penh International Airport
- VD (P)1: The Royal Palace
- VD (R)3: The Prime Minister's House

Source: CAIC, 2019

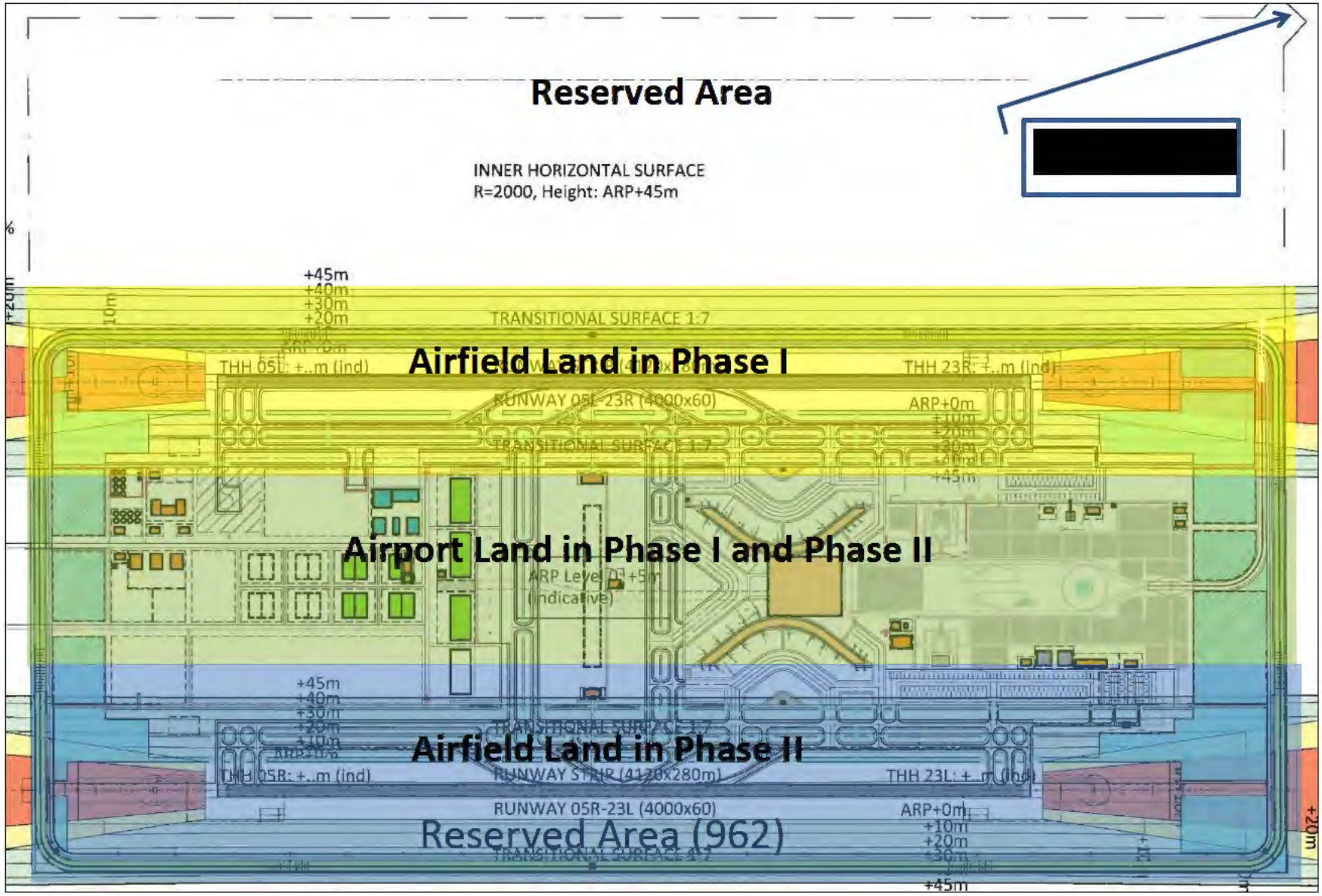
4.5. Project land use

The New Phnom Penh International Airport has acquired land of 2600 ha in area; this comprises airport cover of 1,259 ha in Phase I (2030), 379 ha is reserved for airport in Phase II (2050), and 962 ha remaining in a reserved area.

For Phase I and Phase II, land use for construction of airport infrastructure is as follows:

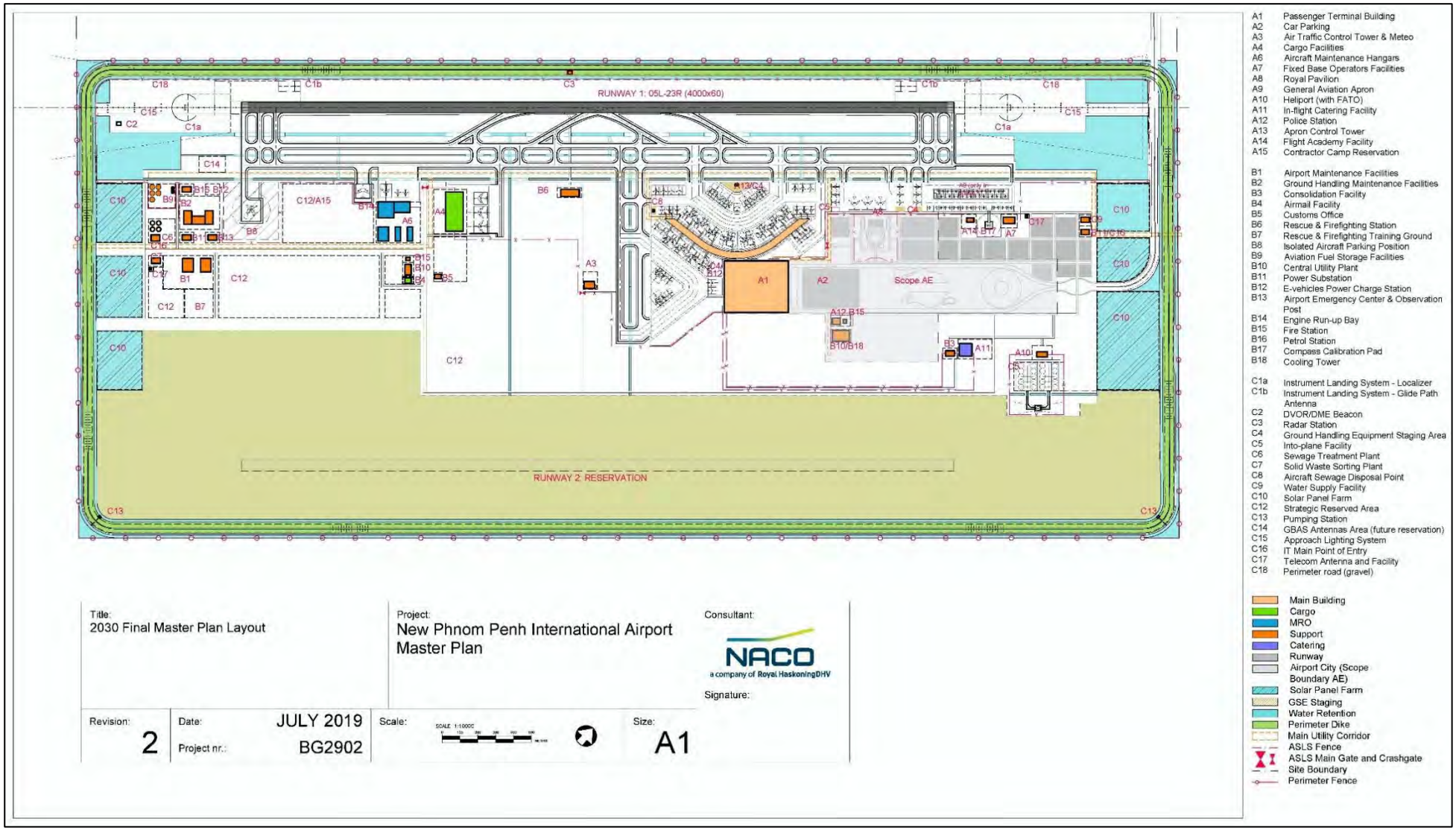
- Two parallel runways. The runways will measure 4,000 meters in length and 60m in width.
- Taxiway, parallel with runways, with 186,500 square metres in 2030 and 373,000 square metres by 2050.
- Aircraft parking apron: 86,564 square metres in 2030 and 206,867 square metres by 2050
- Passenger Terminal: 118,000 square metres in 2030 and expanded to 320,000 square metres by 2050.

Photo 4: Land Use Planning in each Project Phase



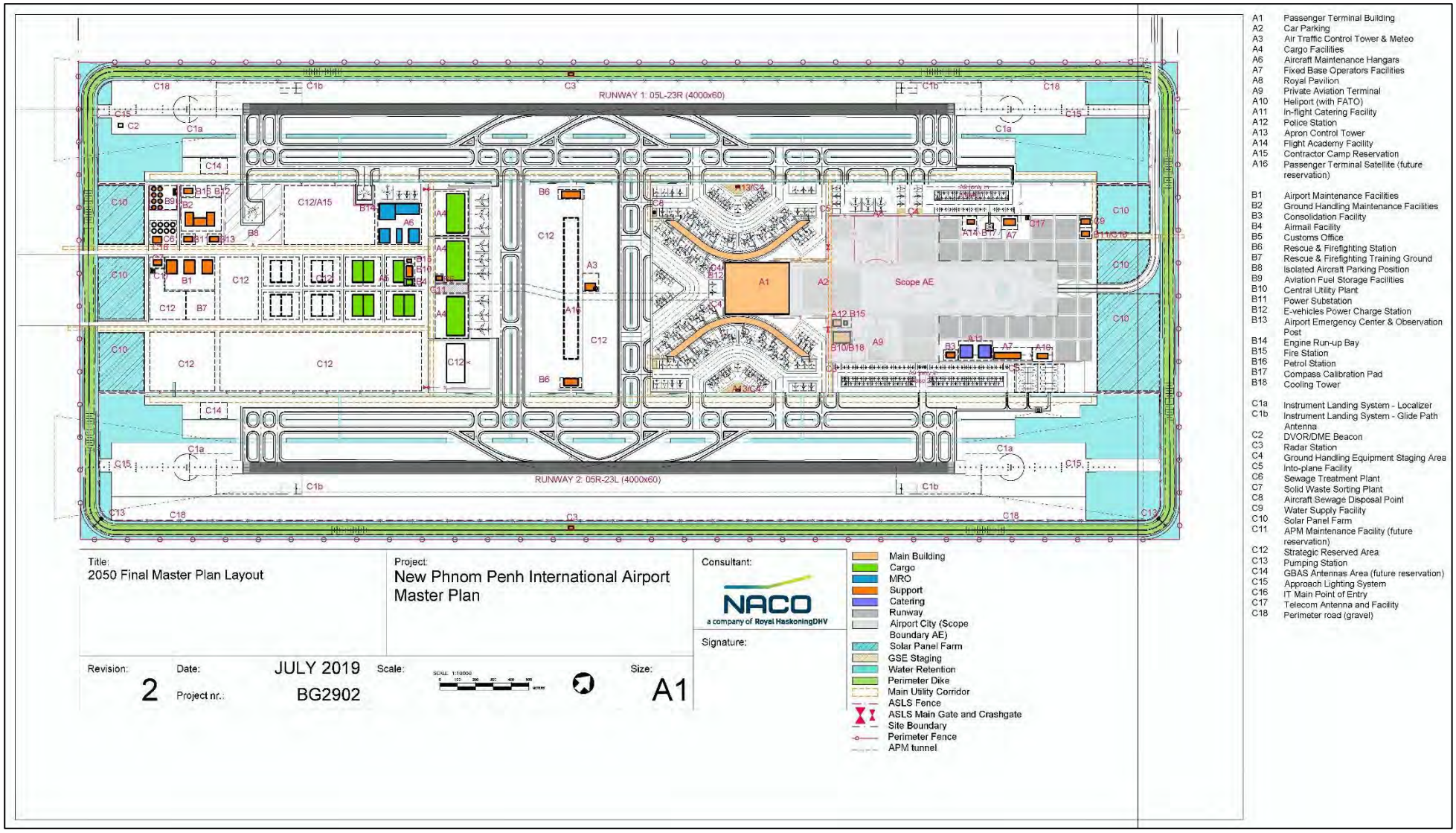
Source: CAIC, 2019

Photo 5: Final Master Plan Layout Phase 1 (2030)



Source: CAIC, 2019

Photo 6: Final Master Plan Layout Phase 2 (2050)



Source: CAIC, 2019

A summary of all site requirements –approximate plot sizes of the airport facilities described in this section is provided in the following tables and figure.

Table 30: Sumary Table of Plot Size Requirements

Airport Infrastructure	2030 (ha)	2050 (ha)
1. Airfield Configuration		
Runway	28.05	56.10
Taxiway	18.65	37.30
Aircraft Parking Apron	8.66	20.69
Airport Terminal Area	11.80	32.00
Warehouse Area	4.59	9.47
Subtotal (1)	**67.16**	**146.09**
2. Airport Main Facilities		
Cargo Terminals	4.30	12.78
Airmail Facilities	720	0.21
Forwarder Facilities 2nd line	3.44	10.22
MRO Facilities	4.60	5.60
Fixed Base Operator Facilities	0.42	0.96
Sub-total (2)	**12.83**	**29.77**
3. Main Airport Support Facilities		
In-flight Catering Facilities	1.92	3.21
Central GSE Staging Area	1.60	2.30
GSE Maintenance Facilities	1.88	2.48
Airport Maintenance Facilities	4.00	7.72
Rescue & Firefighting Stations	1.92	3.20
Rescue & Firefighting Training Ground	2.71	2.71
Police, Security & Customs Facilities	1.14	1.14
Air Traffic Control Facilities	0.90	0.90
Meteorological Station	0.58	0.58
Consolidation Centre	0.30	0.58
Sub-total (3)	**16.94**	**24.82**
Grand Total (1+2+3)	**96.93**	**200.68**
4. Other land uses such as pond, green area, road system, and other non-infrastructure area	**1,541.07**	**1,437.32**
5. Reserve area	**962**	**962**
Sub-total other land uses and reserve area	**2,503.07**	**2,399.32**
Grand Total Area of Project Site	**2,600**	**2,600**

Source: CAIC, 2019

4.6. Project activities and life cycle overview

Project life cycle analysis identifies the key issues and concerns that are likely to evolve over the entire lifespan of a project. In the case of the proposed Project, these issues may arise during the pre-construction, construction and operational phases. The following sub-sections identify the key activities to be completed over the lifetime of the Project

4.6.1. Pre-construction and Construction Phase

❖ Pre-Construction Phase (2018 – 2019)

During this phase, the main work includes:

- Topographic study
- Feasibility study

- Flood study
- Flood management study
- In collaboration with the Royal Government of Cambodia, resolve resettlement issues
- Demine the project site in collaboration with CMAC.
- Geological study
- Environmental impact assessment
- Passenger Terminal Layout design, etc.
- Detailed design for passenger terminals, etc. or a detailed design study, the project pays attention to the construction of the runway building, taking into account the adaptation to the weather and the study of the surrounding air and atmosphere that can affect the aircraft (Atmosphere and temperature prevent degradation which result longer take-off). The passenger terminal is equipped with mirrors that help reduce energy consumption, etc.

❖ Construction Phase (2020-2022)

The construction phase will consist of the following main activities, which will be described further in sub-sections below:

- Construction bidding
  - Mobilisation;
  - Site Preparation;
  - Construction of Runway Extension and Civil Works; and
  - Cleaning construction site and other infrastructure.
- Monitor and test flight

Photo 7: Demining activities

Searching activity

Unexploded ordnance

Source: CAIC, 2019

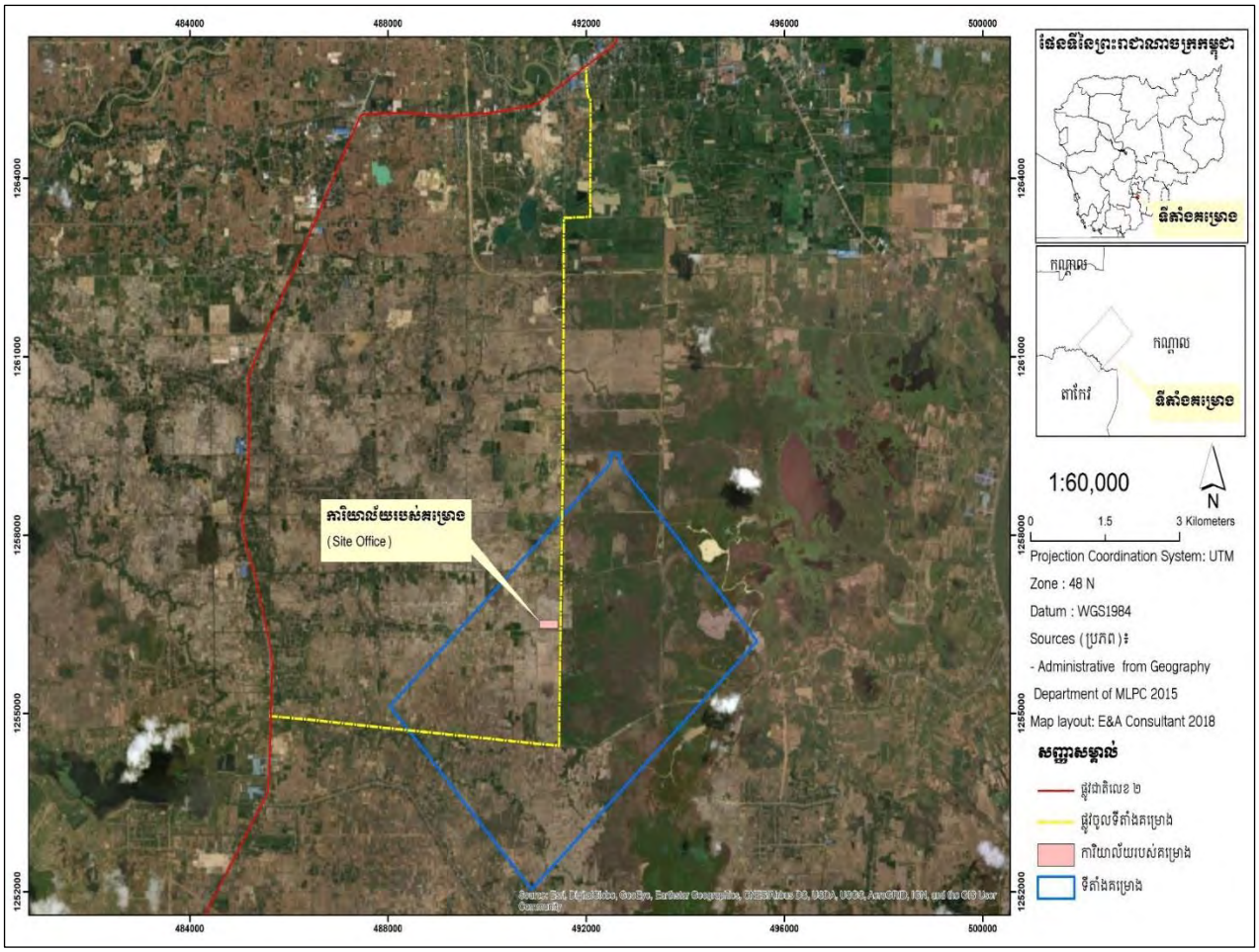
4.6.1.1. Mobilization

Machinery, equipment, and materials will be mobilized to support the construction activities in the project site. The project selected two access roads: the first one located south-west of the project site (Tomnob 54 Road), and the other one located north-west of the project site (Tomnob 92 Road). Both roads have below directions:

- The first road: from Takeo province to the south-west of project site.
- The second road: from Phnom Penh/Takhmao to the north-west of project site.

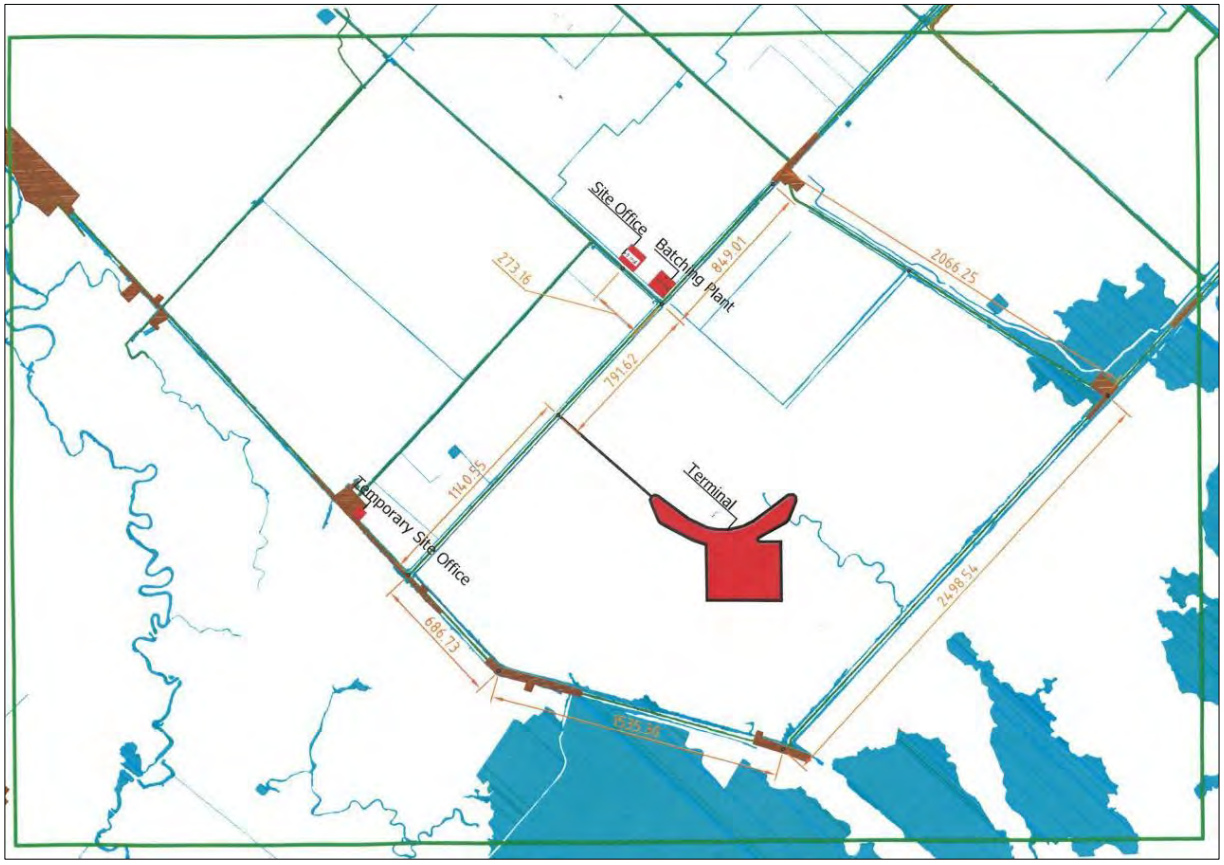
The lists of machinery and materials are described in details in Section 4.6.1.6.

Map 12: Access Roads during Project Construction Phase



Source: E&A Consultant, 2019

Photo 8: Project Site Preparation during Construction Phase



4.6.1.2. Site Preparation

Site preparation works include clearing, backfilling, and soil compactment, which take six months to complete.

A. Clearing and backfilling

A1. Soil Formation Design

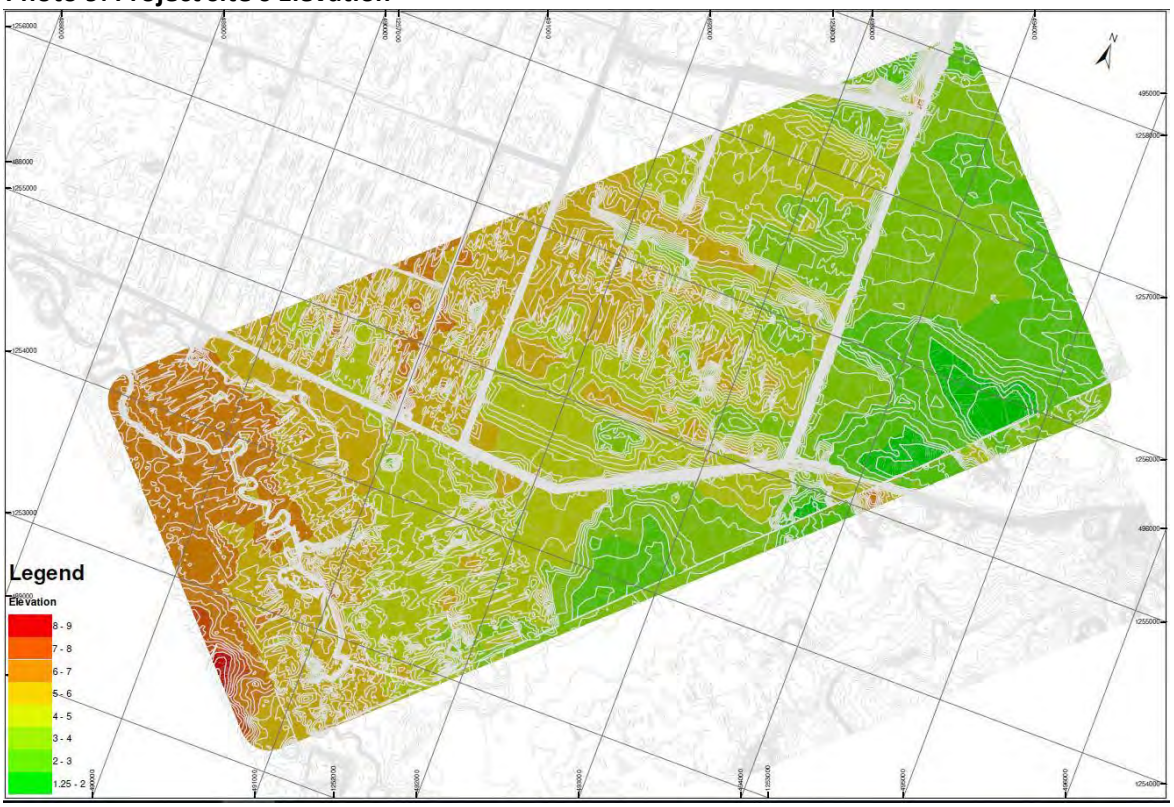
Ove Arup & Partners Hong Kong Ltd ("Arup")[4] conducted the soil formation work. The proposed development site is located at a relatively low-lying area of land adjacent to Bassac River. This area is prone to flooding in the wet season. The proposed development will be constructed within a ring dike. There is a layer of soft alluvial clay under the ground, which will be improved to reduce the possible ground settlement.

In 2018, Key Consultant (Cambodia) conducted the topographic study. The elevation is illustrated in Photo 9. The project site is generally flat, with an elevation range between 1.3 meters and 8 meters above the sea level. The site's south-west area has a high elevation (6 to 8 meters above the sea level), while the site's north-west area has a low elevation (1.3 meters to 2 meters above the sea level). There are several streams and canals crossing the project area to the south-east and the north-west (Photo 10). It is difficult to build a dike at a point where water flows.

A2. Ground investigation

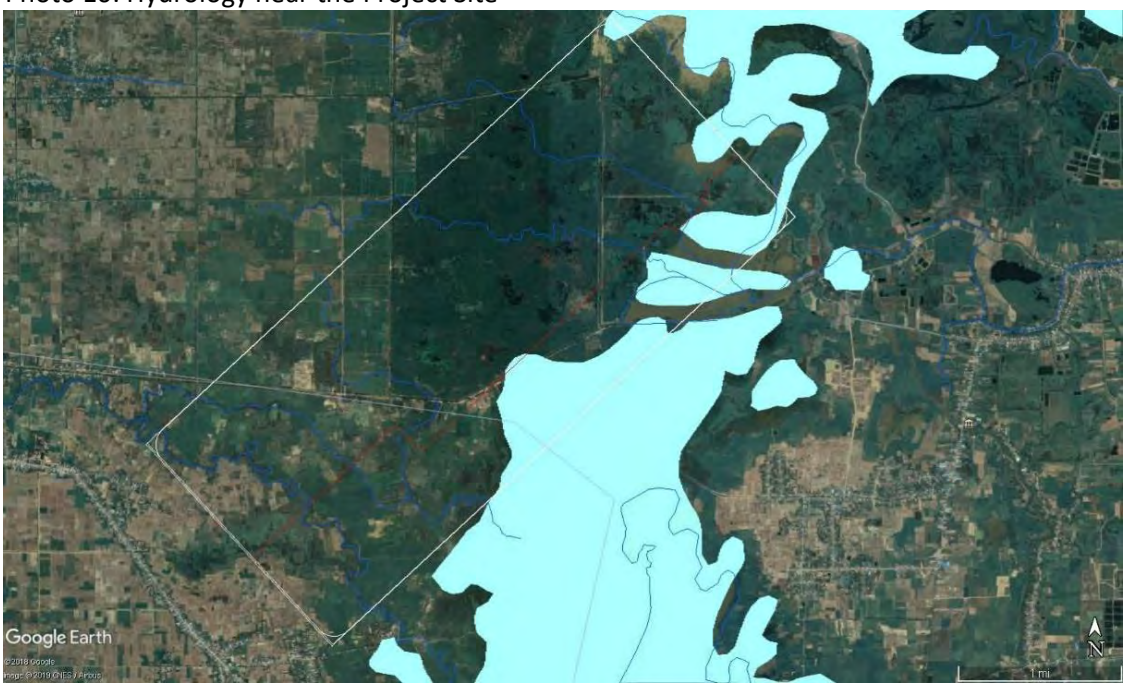
Ground investigation (GI) has been undertaken at the site by Beijing Urban Construction Group Co. Limited (BUCG) since March 2019. Some Stage 1 GI have not been completed (particularly at the dike areas) due to site constraint and Stage 2 GI is on going. A draft geotechnical report was prepared by Arup based on the available GI results up to 24 September 2019. Photo 4-11 illustrates the locations of soil test.

Photo 9: Project site's Elevation



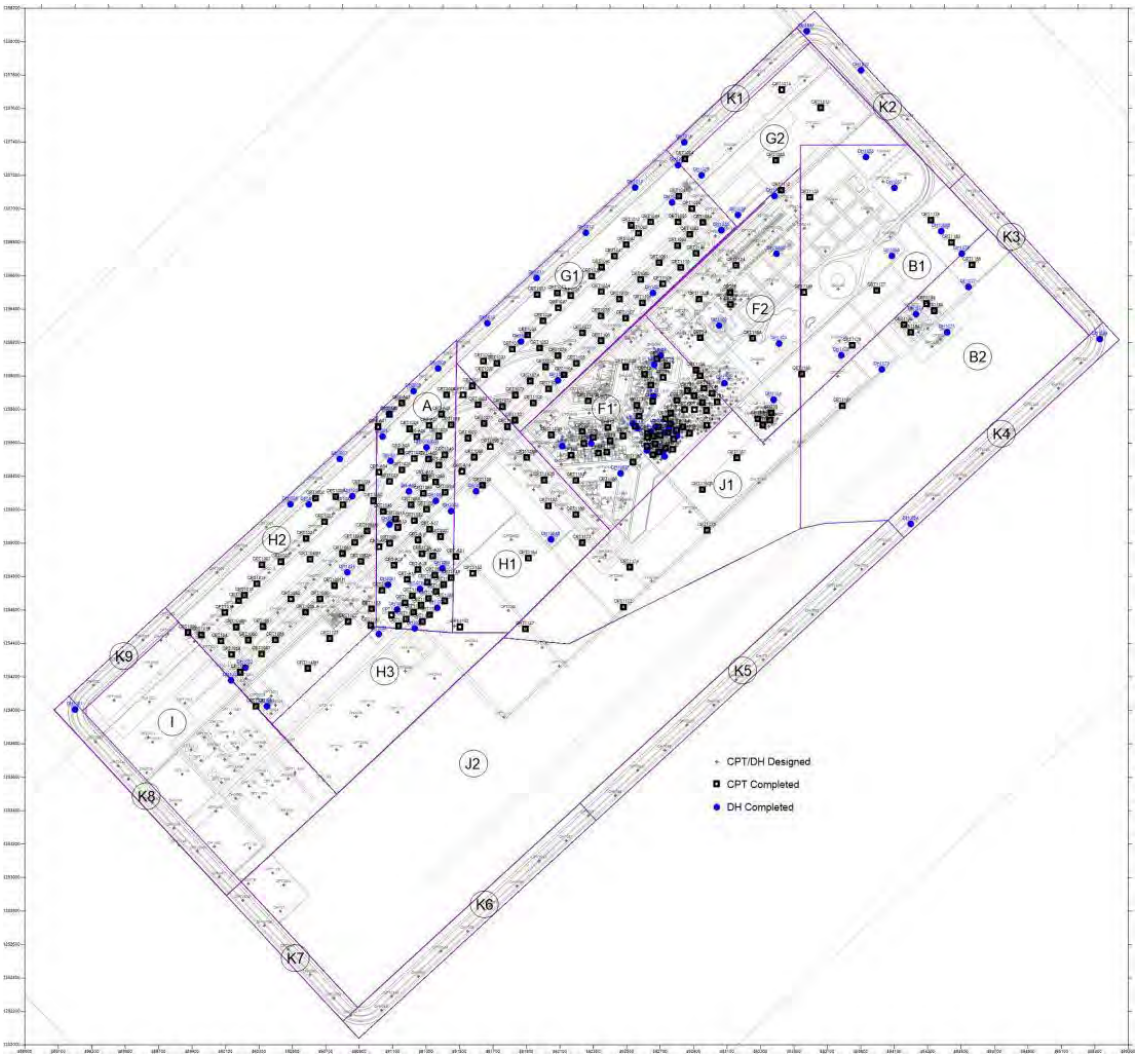
[4] Ove Arup & Partners Hong Kong Ltd ("Arup") was commissioned by the Cambodian Airport Investment Co., Ltd ("CAIC") on 13th February 2019 to undertake Consultancy Services for Phase I of Site Formation Works for the New Phnom Penh International Airport ("NPPIA"). The Phase I work is based on the master plan layout upto 2030 by NACO.

Photo 10: Hydrology near the Project Site



Source: Key Consultant (Cambodia) 2018

Photo 11: Soil Test Locations



Source: Beijing Urban Construction Group Co. Ltd (BUCG) 2019

A3. Geological Model

The soil stratum of proposed development site is composed of desiccated silty to clayey crust, soft to stiff alluvial clays, alluvial sands, sandstone/claystone/granite/ breccia. Clays and sands form alternate layers on site and the thickness of this alluvial soil layer range from ground level to 15m to 30m varying at the site. Claystone and breccia occurs in the completely weathered to highly weathered rock layer. Sandstone and granite is found in all weathering state at different depth below the soil layer. Rockhead is typically found at around 35-55m below ground level with moderately weathered sandstone.

The preliminary drillhole results indicate that alluvial clay at the depth of 5m to 15m below ground level tend to be very soft with SPT N values less than 8. A desiccated crust of about 5 metre thickness is present at the majority of the site. Stiffer sandy or silty clays with SPT N values of around 10 to 40 can be found in some drillholes. The completely weathered rocks below the soil layer typically are with a SPT N value of around 50 to refusal value.

A4. Material Descriptions

The soil materials encountered from the ground investigation boreholes is described as follows:-

Alluvial

The generalized alluvium layer consisted of three types of soil with distinguished materials and properties the upper alluvium, the soft alluvial clay and the lower alluvium. The base level of the alluvium layer is elevated from -10m to -53m in general where it shows a descending trend from west to east of the site.

The thickness of alluvium layer ranged from 7m to 56m where the west portion of the site is evident with thicker alluvium layer. The average thickness of the alluvium layer is about 30m thick.

The geological properties of the alluvium layers are given below:

- The upper alluvium: firm to very stiff brownish grey, bluish grey, blackish grey, yellowish brown clay or silty clay. Organic materials are occasionally found.
- The alluvial clay: very soft to firm bluish grey, brownish grey, yellowish brown, whitish grey, yellowish brown, clay. Organic materials are occasionally found.
- The lower alluvium: medium dense to loose yellowish grey, whitish grey, grey, bluish grey, brownish grey silt, clay or sand

A5. Groundwater Condition

The project site is in a rural area about 7.5 km west of the Bassac River. It is located in the floodplain of Mekong/Bassac River. The average ground level is low at about 1.3-8msl.

In the Flood Management Study Report by NACO (18 January 2019), average groundwater level is assumed to be +1.5msl to determine the lowest water-/bottom levels of retentions. However, latest ground investigation work indicates that the stable groundwater level within the GI boreholes is generally 2-5m below ground surface (by BUCG), which is equivalent to +2 ~ +4msl during dry season. While, the flooded water level is +5~+6msl during the wet season. Groundwater level is still monitored by standpipe and piezometer.

Flood Management Study Report by NACO (18 January 2019) proposed the flooding level of the NPPIA. The combined setup for year 2040 and 2060 are proposed. As per discussion with CAIC, the dike design will be designed to year 2040. The combined setup 2040 is as Figure 3.4. The 1 in 10,000 year water level is +8.6msl.

Table 31: Flood study

	NE section	SE section	NW section
Combination 1			
1 in 10,000 year water level [m+MSL]		MSL+8.55m	
1 in 10 year Wind setup [m]	0.1	0.0	0.0
1 in 10 year Wave setup [m]	1.0	1.0	0.5
Total setup [m]	1.1	1.0	0.5
Total setup [m+MSL]	**MSL+9.7m**	**MSL+9.6m**	**MSL+9.1m**
Combination 2			
1 in 100 year water level		MSL+8.20m	
1 in 1,000 year Wind setup [m]	0.1	0.0	0.1
1 in 1,000 year Wave setup [m]	1.2	1.3	0.7
Total setup [m]	1.3	1.3	0.8
Total setup [m+MSL]	MSL+9.5m	MSL+9.5m	MSL+9.0m

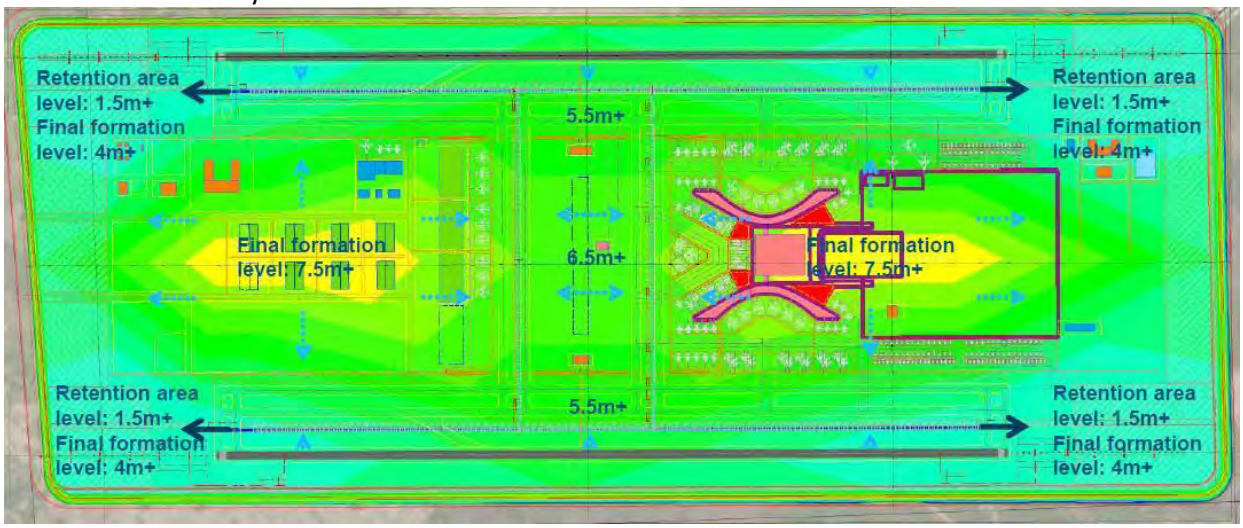
Source: NACO (2019)

Soil will be transported from Beoung Choung Leoung lake and Boeung Rean lake as illustrated in Map 4-3. The estimated quantity of fill material is 13.9 cubic meters over a period of 3 years. Upon fill completion, the project site's elevation will be 7.50 meters above the sea level (Photo 12).

Construction Conseque:

- NACO final formation level (18 Jan 2019) is adopted (See Figure 4-7)
- Top soil removal is 1 m deep and required at all airfield paved areas (i.e. Runway, Taxiways and Aprons), PTB areas and dike areas;
- Sand blanket material is 1 m thick at all ground treatment areas (airfield paved areas and PTB areas);
- Sand fill is required for all airfield paved areas, dike and PTB areas
- NACO final formation level is considered to be the finish level of site formation, excluding pavement thickness. This is because the ground settlements are expected during pavement construction and adequate fill levels shall be maintained;
- Dike top level at +11.0 msl with 1:3 slopes to existing ground level;
- All cut material (including 1 m top soil) is assumed to be appropriate general fill after treatment. The actual material needs to be reviewed;
- Quantity of surcharge materials (which require Sand Fill and General Fill) is considered as a separate item, as shown in Table 6.2. As the ground treatment schemes have not been finalised, fill quantities are estimated for two scenarios – PVD and surcharge scheme is adopted for 100% and 50% of ground treatment areas. The values are to be updated once ground treatment schemes are finalised.

Photo 12: Preliminary Site Formation Level



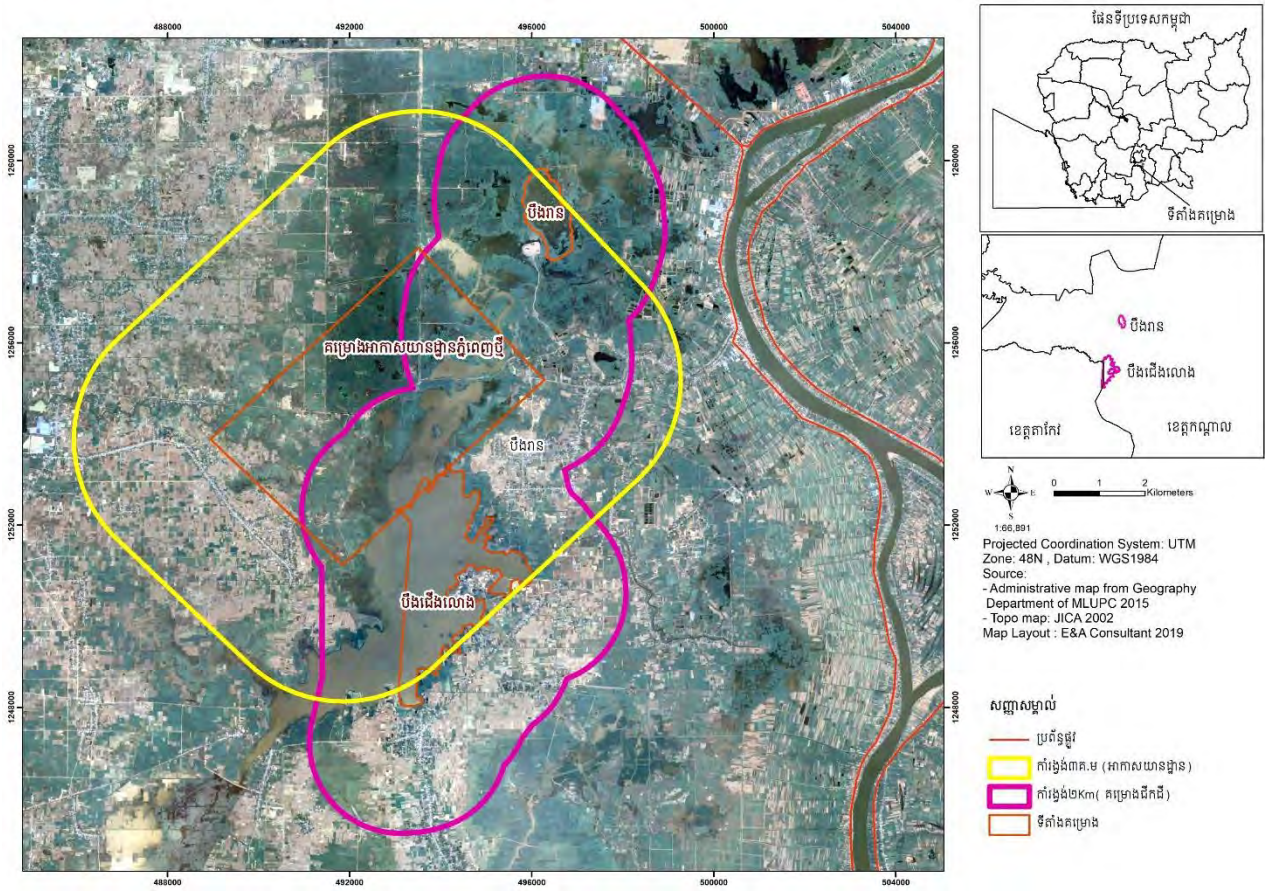
Source: CAIC (2019)

The volume of fill material is approximately 13.9 Mm^3, excluding the surcharge material. About 8.4 Mm^3 is Sand Fill or Sand Blanket materials, which are to be imported. The volume of cut material is about approximately 9.5 Mm^3. This is from three main sources as follows:

- Excavation to final formation level where the existing ground level is high;
- Excavation of the water retention pits;
- Excavation of the 1m top soil at airfield paved areas, dikes and PTB areas

The cut materials are expected to be predominantly the upper alluvium, which may be used as General Fill and/or Clay Core, provided the materials satisfy the specified requirements. Using the excavated in-situ materials as the General Fill for the site formation work is driven by the objective of cost effectiveness for the project. However, it should be pointed out that the soils at the surface of the site are predominantly silts and clays, which usually cannot be compacted properly. Long-term settlements are expected due to creep of these materials. The magnitude of creep of clayey soils is expected to be at least twice of that of uncompacted sands.

Map 13: Locations of Fill Material Sources



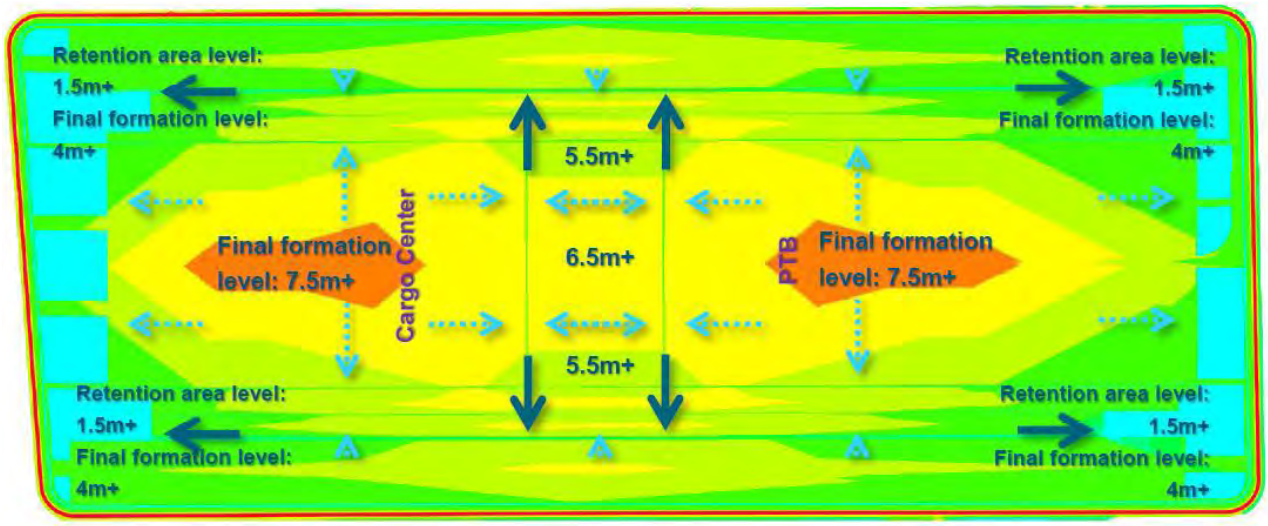
B. Soil Compactment

Upon backfilling, soil will be compated by vertical method (dropping 60 tons of weight from 30 meters of height) and machinery such as bulldozer and soil compactor (for six months) to ensure it could sustain aircraft running on runway.

The site formation works within the dike is composed of non-paved area such as green area, paved area of strategical elements such as runway, taxiway, apron and road.

Site Formation Level. Since the site formation level of air field and PTB designer is not agreed by clients yet. NACO's site formation level (Figure 4-13) is used in the draft design report and the site formation level shall be updated in the final site formation design report and drawings.

Photo 13: Soil elevation preparation



Source: CAIC (2019)

Settlement Criteria: The criteria was provided by the Designers for the airfield and the PTB areas. It is noted that the requirements for the PTB areas are more stringent (i.e. 100mm to 300mm) that the airfield pavements. Following these requirement, ground treatment is required for the PTB areas. Further to our discussion with the Client in the workshop in early November 2019, we were instructed that the design criteria for the PTB areas are to be reviewed by the Landside Designer.

The important settlement criteria are listed in the Table 33.

Table 32: Settlement Criteria Provided by Airfield and PTB Designers

Zones		Settlement (mm)	Differential settlement (mm)	Subgrade modulus (MN/m^3)	CBR (%)
Paved area	Runway	300	1:667 in 50m	-	≥10
	Taxiway	300	1:667 in 50m	-	≥10
	Apron	300	1:667 in 50m	50	≥10
Unpaved area in airfield	Runway Strip	500	1:667 in 50m	-	≥15-20
	General	500	1:667 in 50m	-	-
Roads		300	-	-	≥10
PTB areas		To be decided by the Landside Designer			
Green areas		-	-	-	-

Source: ARUP (2019)

- **Total settlement:** Total settlement of ground under a loading from fill, surcharge or dikes is composed of three components:

  $ST = Si + Sc + Ss$

Where:

ST is the total settlement.

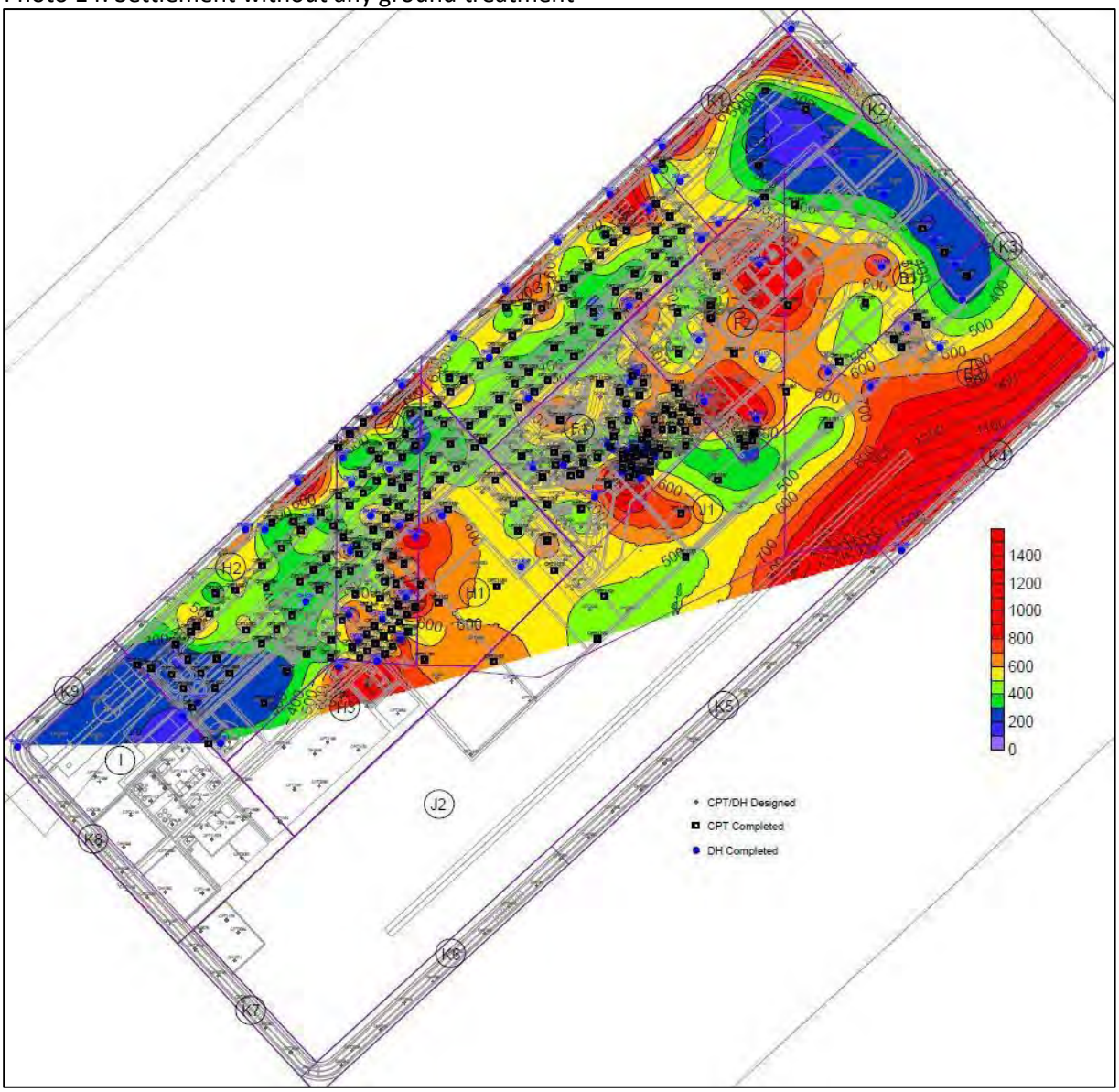
Si is the immediate settlement; it is caused by the rearrangement of grains due to changing stress, resulting in a reduction in void ratio and instant settlement. The settlement can be calculated from elastic theory.

Sc is the consolidation or primary settlement, it is the gradual re arrangement of grains as water is expelled. This component of settlement is usually dominant in fine-grained saturated clays.

Ss is the secondary settlement or creep, it represents time-dependent settlement, or creep, that occurs under a constant effective stress. It is usually assumed that the secondary consolidation settlement commences when 95% of the primary consolidation is reached.

The total settlement based on the available boreholes data is shown in the Photo 14.

Photo 14: Settlement without any ground treatment



From the settlement estimation, most strategic airfield paved areas such as runway, taxiways, aprons require ground treatment.

- Ground Treatment Scheme: To reduce the post construction settlement induced by soft clay for such large area, Prefabricated Vertical Drain (PVD) with surcharge preloading is one of the most cost-effective ground treatment methods. Based on the available GI data (not completed yet), the ground treatment could be divided into two zones: pink zone and green zone (Photo 4-15).

Photo 15: Ground Treatment Zones in the Pink

The Pink Zones: PVD + surcharge preloading. This zone is composed of upper alluvium clay and soft alluvium clay, lower alluvium clay. The soft clay needed to be treated to accelerate the consolidation process. PVD spacing 1.0m (Photo 16), lowest level to the top of low alluvium clay and 0.5m above the sand blanket. The height of surcharge fill is 4m, slope gradient 1:2 (Photo 17).

Photo 16: Typical layout of PVD

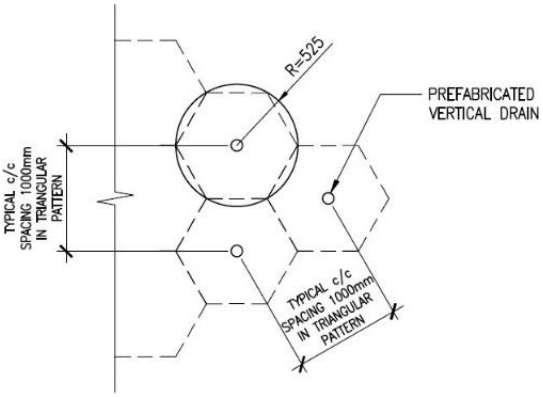
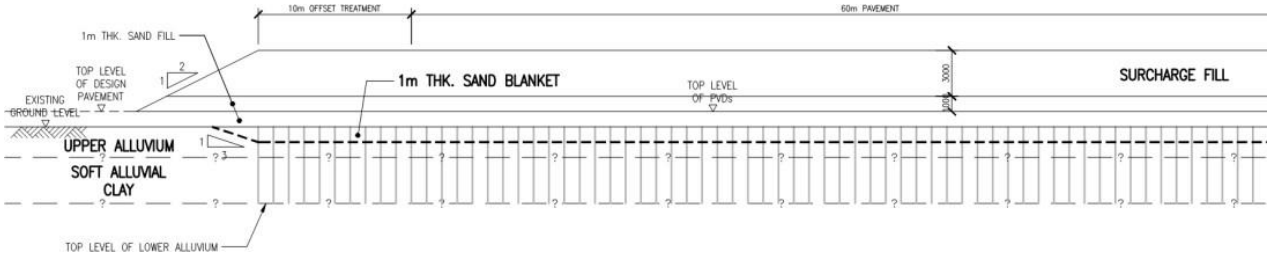


Photo 17: Typical Section of PVD + Surcharge Preloading (Runway)



- Green Zones: Surcharge preloading or dynamic compaction. This zone is mainly composed of silty sand and sandy silty from the CPT tests, and there is no soft clay or the soft clay is very thin of about 1m thick. Surcharge preloading is recommended at current stage.
- Dynamic Compaction could be an alternative option subjected to the updated GI field tests and laboratory tests results, and the environmental impacts since dynamic compaction will induce vibration and noise

Construction Sequence. The site formation works for the proposed development is recommended to be undertaken following the sequence set out below:

1. Commence the works in the first available dry season to ensure the driest possible conditions for working.
2. Set out the boundary of the portion of the site to be developed.
3. Provide a temporary dike around the site area to control the water inside the site and to prevent any external flooding from entering the site.
4. Construct internal drainage and sumps within the site area. For the higher ground, cut the ground to final pavement surface level, place 1m sand blanket, install PVD1. For lower ground, remove any existing berms / water / loose top soil and vegetation, place 1m sand blanket, install PVD, place and compact sand fill to final pavement surface level.
5. Place the surcharge fill with appropriate compaction to reach target density. Surcharge fill should be placed uniformly with controlled speed to prevent slope failure.
6. Place the surcharge fill to design height and then cover with plastic membrane to prevent fill scouring by rainfall.
7. The surcharge fill is held for several months with settlement monitoring.
8. The surcharge fill is removed when the degree of consolidation reaches 85-90%.
9. Compact the subgrade to designed CBR and modulus, trim the ground level to final site formation level.
10. Spread and dry the surcharge fill and excavated Alluvial Clay material across the open platform area and mix with the imported granular fill using soil mixing plant/excavators in the proportions determined from on-site soils testing. The mixed backfill material shall be tested to verify its compliance with the required fill properties.

4.6.1.3. Runway Construction, Airfield Lighting System and Other Infrastructure Construction

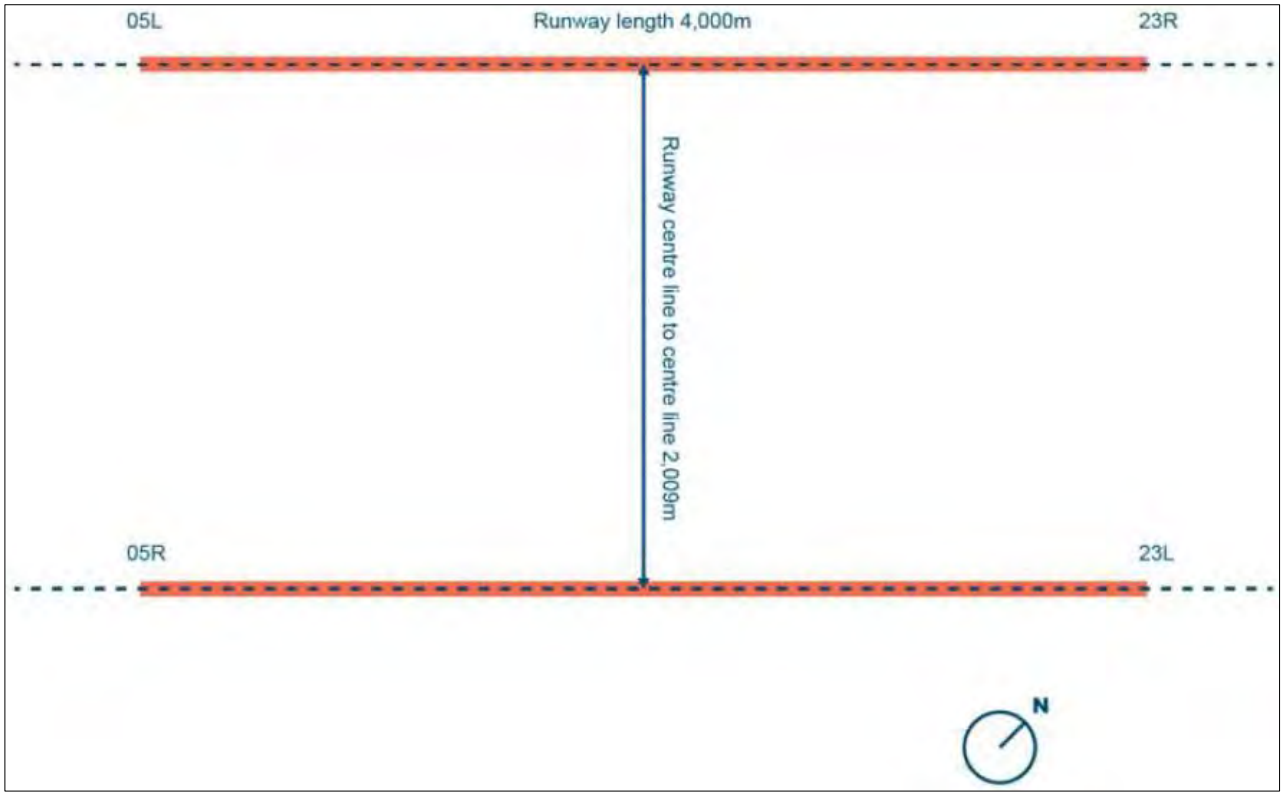
a) Runway Construction

- ***Runway System***

The runway system consists of one set of two parallel independent runways with a 2,009m spacing between the centerlines. This is shown in Figure below.

As advised by Cambodia Civil Aviation Authority, the runway of the New Phnom Penh International Airport adopts the magnetic heading 046°-226° and directions of 05L-23R and 05R-23L. The runways have a measure of 4,000 meters in length and 60 meters in width, composed of 0.5 meter of concrete and 0.1 meter of asphalt. The runway's elevation is 7.5 meters above sea level.

Photo 18: Runway System



Source: CAIC, 2019

- ***Runway Length***

Runway construction entails in the airport master plan in order to serve direct flights from various regions of the world. A runway length is determined by the size and type of aircraft as shown in below table.

Table 33: Aircraft and Requirement Runway

Type of Aircraft	B777-300ER	B787-8	B787-9	A330-243	B747-8	A380-841
Machine	GE90-115BL	GENX-1B64	TRENT-1000K	TRENT772B	GENX-2B67	TRENT970
Max. Flight Load (Kg)	61682	38873	53436	48000	61682	83572
Number of plane Seat	309	228	288	266	309	555
Class	**Class E**				**Class F**	

Source: CAIC, 2019

- ***Runway Width***

Both planned runways are designed in compliance with the aerodrome reference code: 4F. The required runway width is shown in the table below. The runway width including the shoulder will remain at 60m.

Table 34: Width of the runway pavements and shoulders (ICAO Annex 14, July 2018)

Runway	Runway width	Runway width including shoulders
05L-23R	45	75
05L-23L	45	75
CAIC	60	75

Source: CAIC, 2019

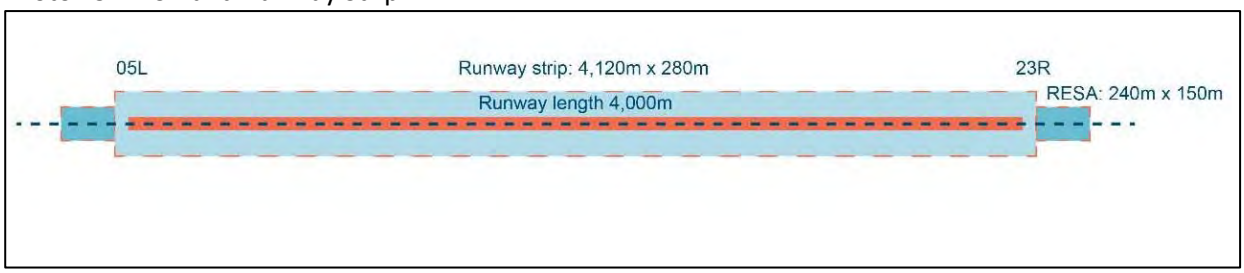
- Runway Strip and Runway End Safety Area (RESA)

Runway strip is defined as the area extended on both ends of the runway. Runway strip should be at least 140 meters in width. The length and width of runway strip are as follows:

- Runway 1 (05L-23R): runway strip's width (280 meters) and length (4,120 meters).
- Runway 2 (05L-23L): runway strip's width (280 meters) and length (4,120 meters).

Runway End Safety Area (RESA) is defined as an area symmetrical about the extended runway centre line and adjacent to the end of the strip primarily intended to reduce the risk of damage to an aeroplane undershooting or overrunning the runway. An object situated on RESA that may endanger aeroplanes should be regarded as obstacle and should be removed.

Photo 19: RESA and Runway Strip



Source: CAIC, 2019

b) Taxiway

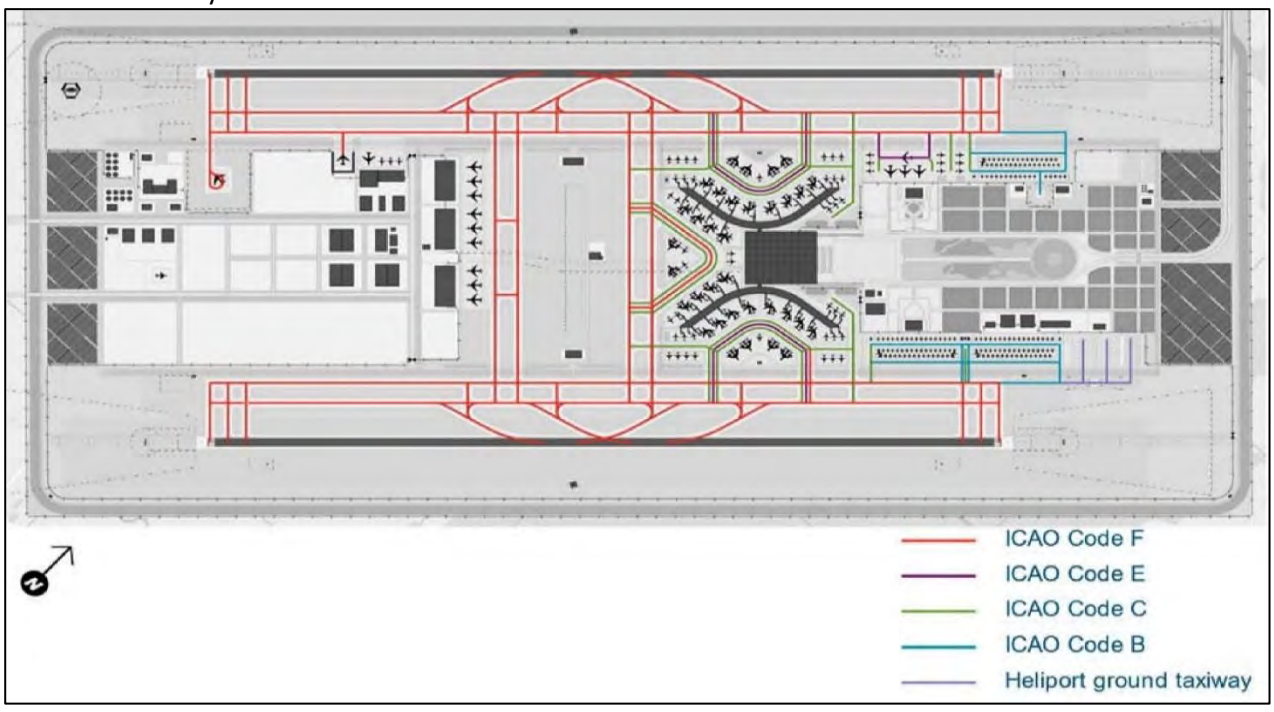
Taxiway is determined by the forecasted annual and daily flight frequency as well as the peak period. The project will construct two taxiways parallel to runways, which connect the apron. Each taxiway will have a width of 25 meters to 45 meters, subject to the aircraft size.

Table 35: Taxiway Including Sholder Width

Aircraft code Letter	Taxiway including shoulder width
Code B	-
Code C	25 meters
Code E	38 meters
Code F	44 meters

Source: CAIC, 2019

Photo 20: Taxiway



Source: CAIC, 2019

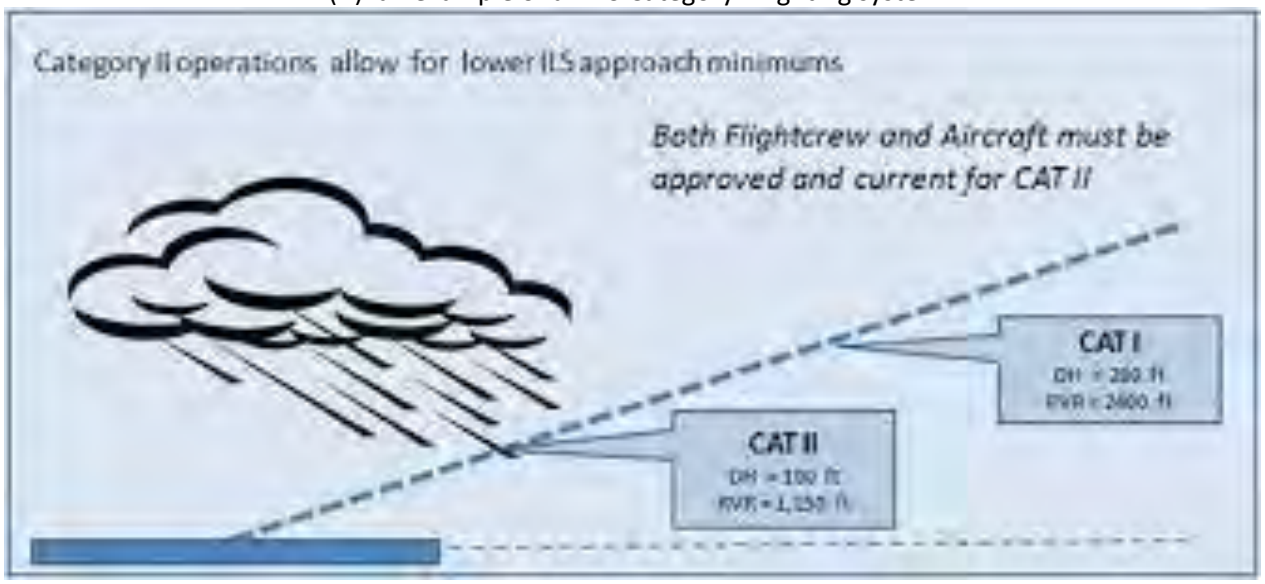
c) Airfield Lighting System

- **Precision Approach Lighting System**

On the basis of meteorological data, a precision approach lighting system (appropriate to an ILS Category II system) with a length of 900 m in both directions of the approach will be mounted. Primarily including central line barrettes, which shall be 4 m in length consisting 5 single lamps at intervals of 1m, shall be placed at longitudinal intervals of 30 m with the innermost light located 30 m from the threshold. A crossbar 300 from the runway threshold and sequenced flashing lights (30 pieces). The center line and crossbar lights of a precision approach category lighting system shall be fixed lights showing variable white, whose intensities can be classified in 5 levels, while that of the sequenced flashing lights can be classified in 3 levels below.

Figure 4: Precision Approach Lighting System

(A). an example of an ILS Category II lighting system



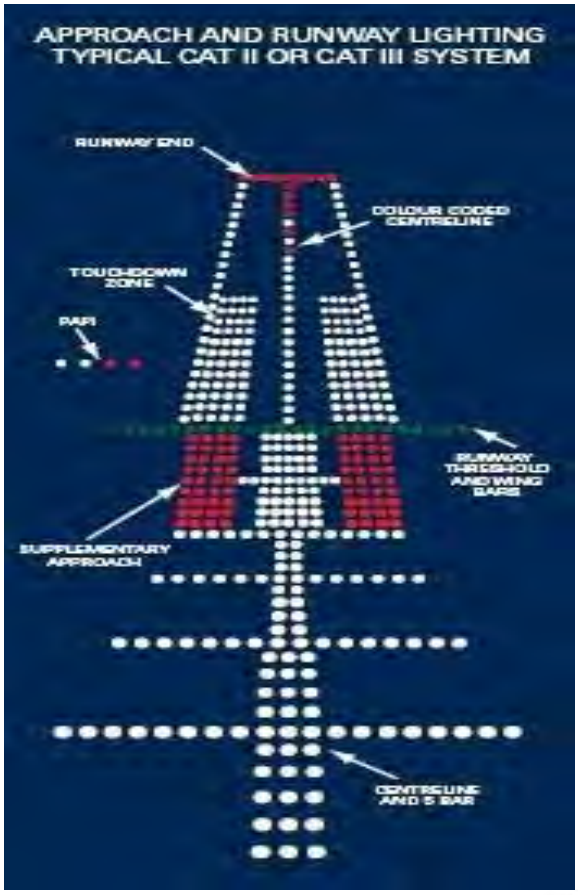
(B). A typical ILS installation

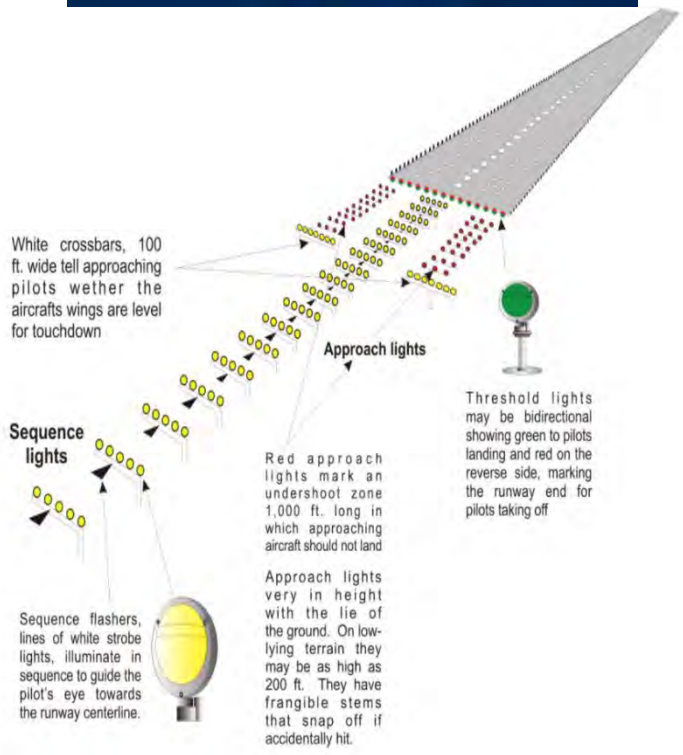
Source: CAIC, 2019

- Runway Lighting System

Runway lighting system of this airport includes runway entrance light, runway entrance wind bar light, runway end light, runway central light, runway edge light, and precision approach path indicator (PAPI).

Figure 5: Runway Lighting





- Taxiway lighting system

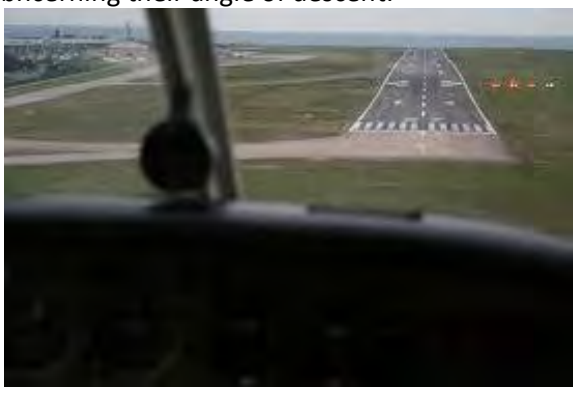
Taxiway lighting system includes illuminated windsock, runway guard light, and taxiway edge light. Taxiway edge light consists of a row of light parallel with taxiway. The interval of light is 60 meters, and become narrower at corners.

Photo 21: Taxiway Lighthing System

Additionally, major airports will provide illuminated windsocks to assist pilots flying at night or in poor visibility:

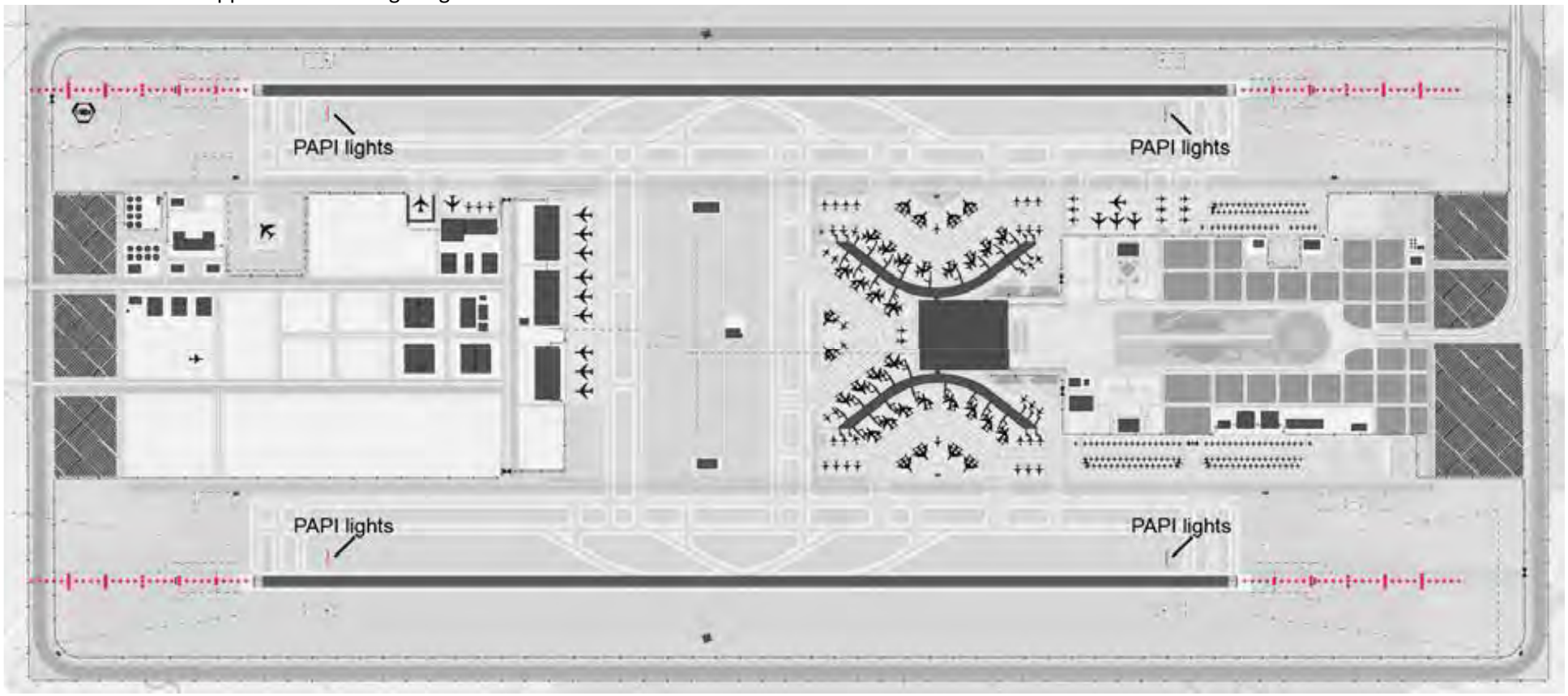
Lighting systems knowns a Precision Approach Path Indicators (PAPIs) will be placed at the side of the runways to provide pilots with visual guidance cobncerning their angle of descent:

PAPI installation on the ground



PAPIs seen from the air (to the right of the runway)

Photo 22: Location of Approach & PAPI Lighting in the Master Plan



Source: CAIC, 2019

d) Parking Apron

The new Phnom Penh International Airport has the following parking apron:

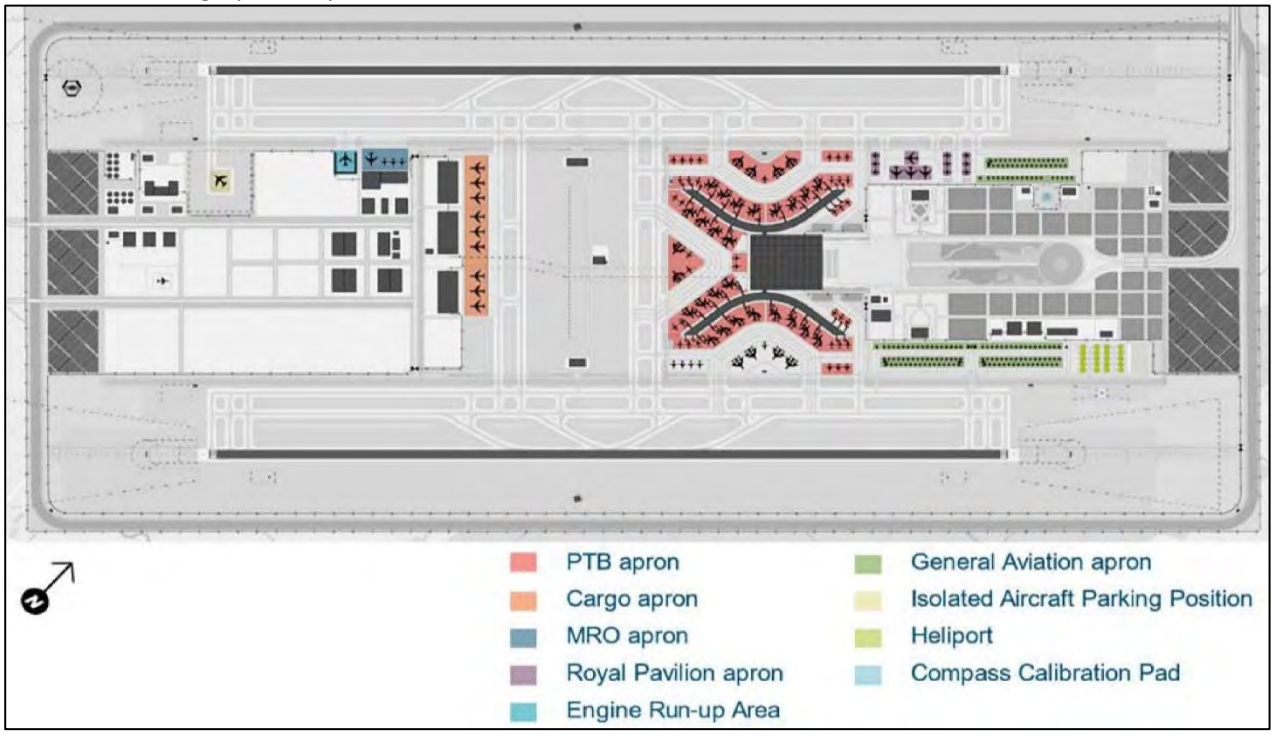
- Passenger Terminal Building Apron
- Cargo Apron
- MRO Apron
- General Aviation Apron
- Royal Pavilion Apron
- Heliport
- Isolated Aircraft Parking Apron.

- Parking apron functions: Preferably each apron should be intended for one particular function, i.e. for the processing of passengers or cargo, for maintenance, general aviation, or long-term parking, because each function has it owns specific demands. Mixing functions may result in loss of safety and efficiency.
- Locations. In general, aprons and related functions should, where practicable be located adjacent to each other in order to optimise operations (i.e. cargo apron and the cargo terminal building).
- Geometry. The following aircraft parking stand dimensions have been taken into consideration for the design of the aprons.

Table 36: Dimensions of Aircraft Stand

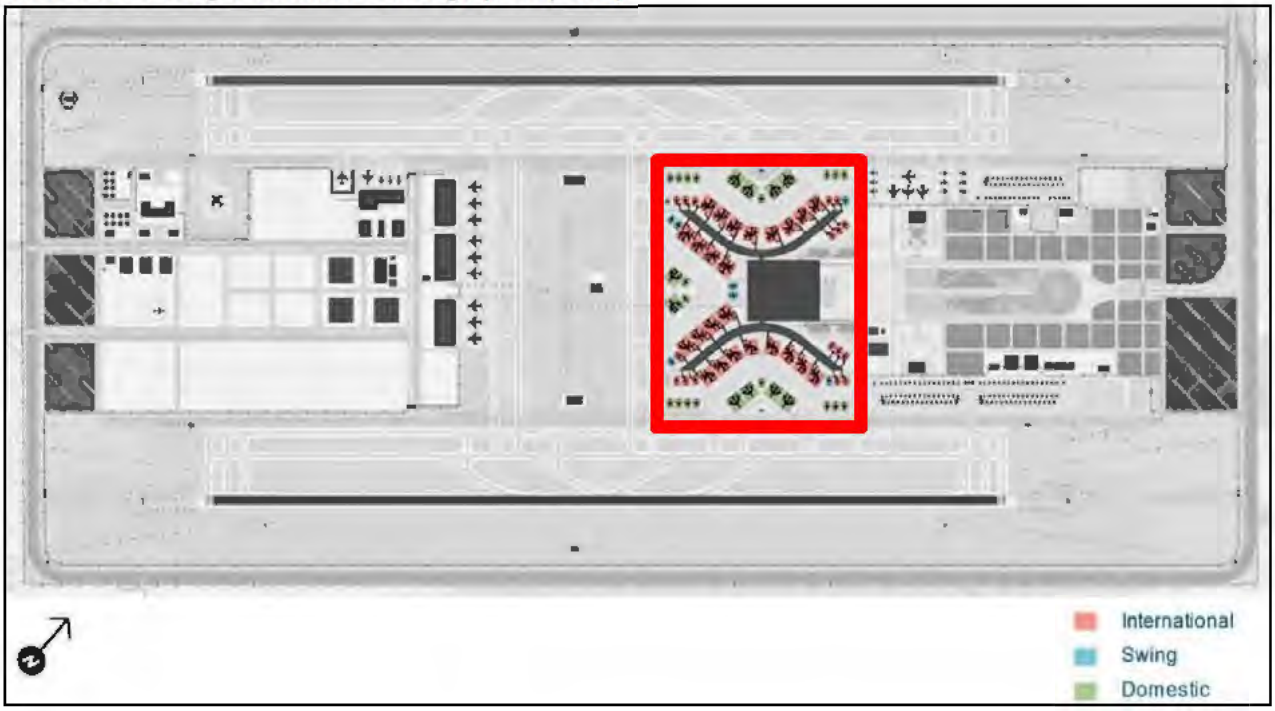
Aircraft Category	Length (meter)	Width (meter)	Aircraft model
Category B	30	24	Gulfstream G450 (G-V), Dassault Falcon 900, Gulfstream G200
Category C	45	36	B737, A321
Category E	75	65	B747-400, B787, A350, B777
Category F for gassenger apron	80	80	B747-8, A380-800
Category F for cargo apron	76.25	68.4	B747-8F, B777F
Mars (E and Two C)	75	76.5	B747-400, B787, A350, B777
Mars (F and Two C)	80	80	A380-800

Photo 23: Parking Apron Layout



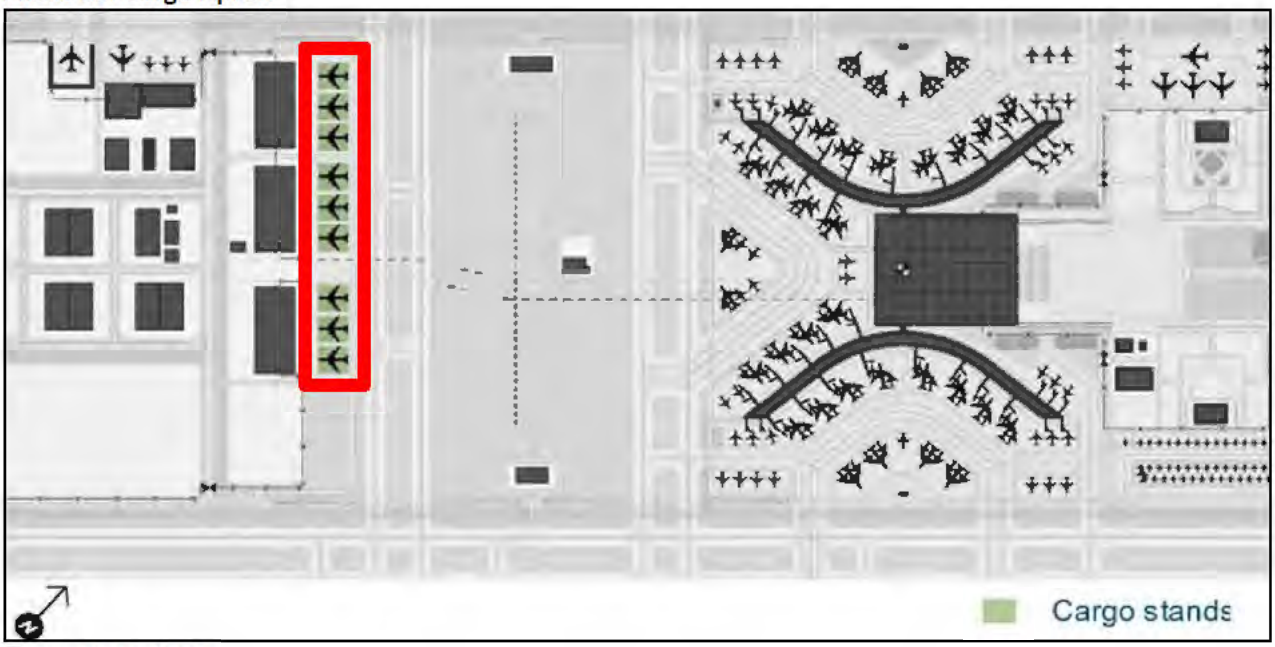
Source: CAIC, 2019

Photo 24: Passenger Terminal Building Apron (2050)



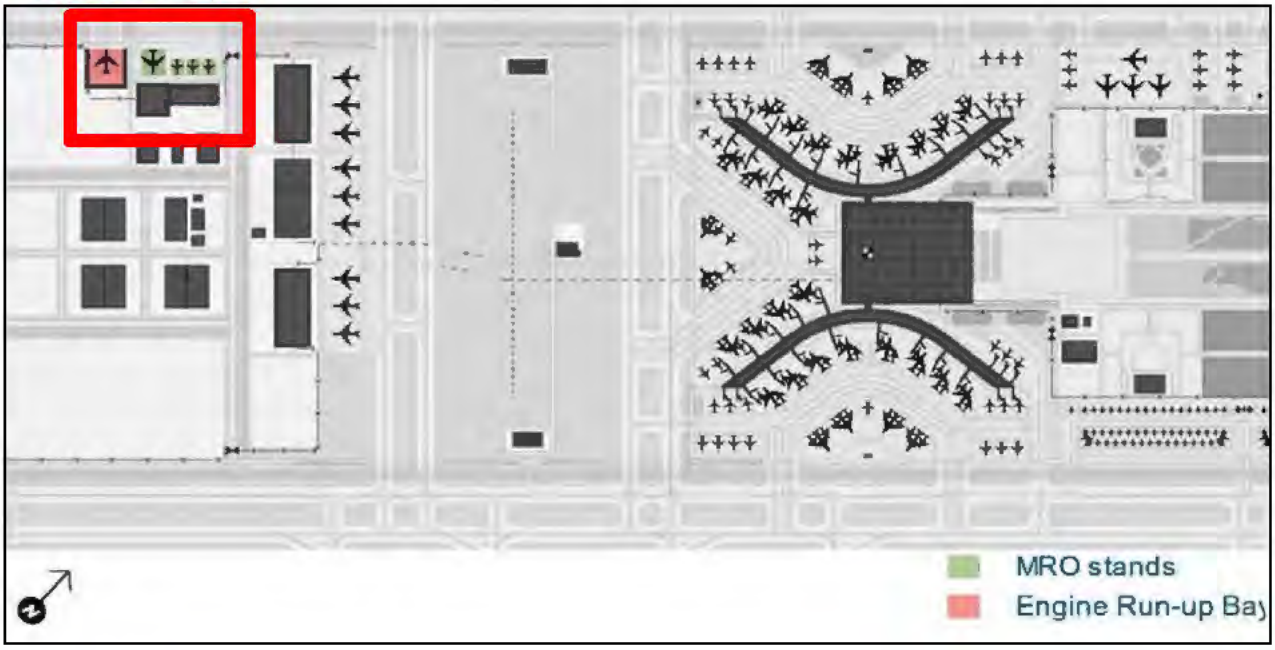
Source: CAIC, 2019

Photo 25: Cargo Apron



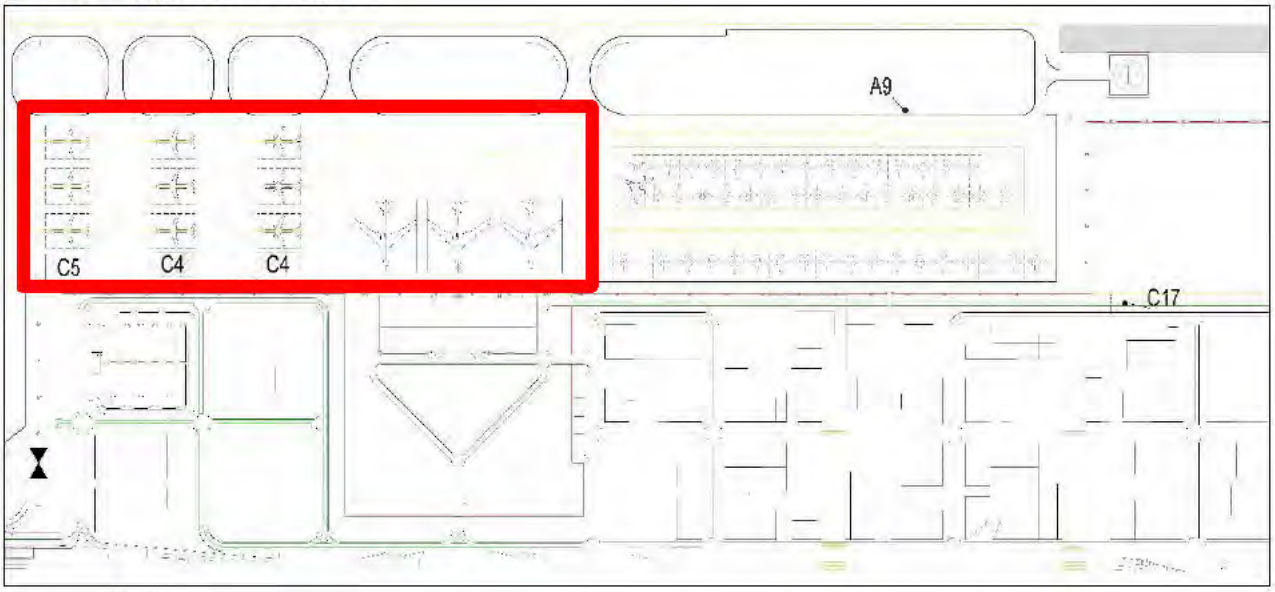
Source: CAIC, 2019

Photo 26: MRO Apron



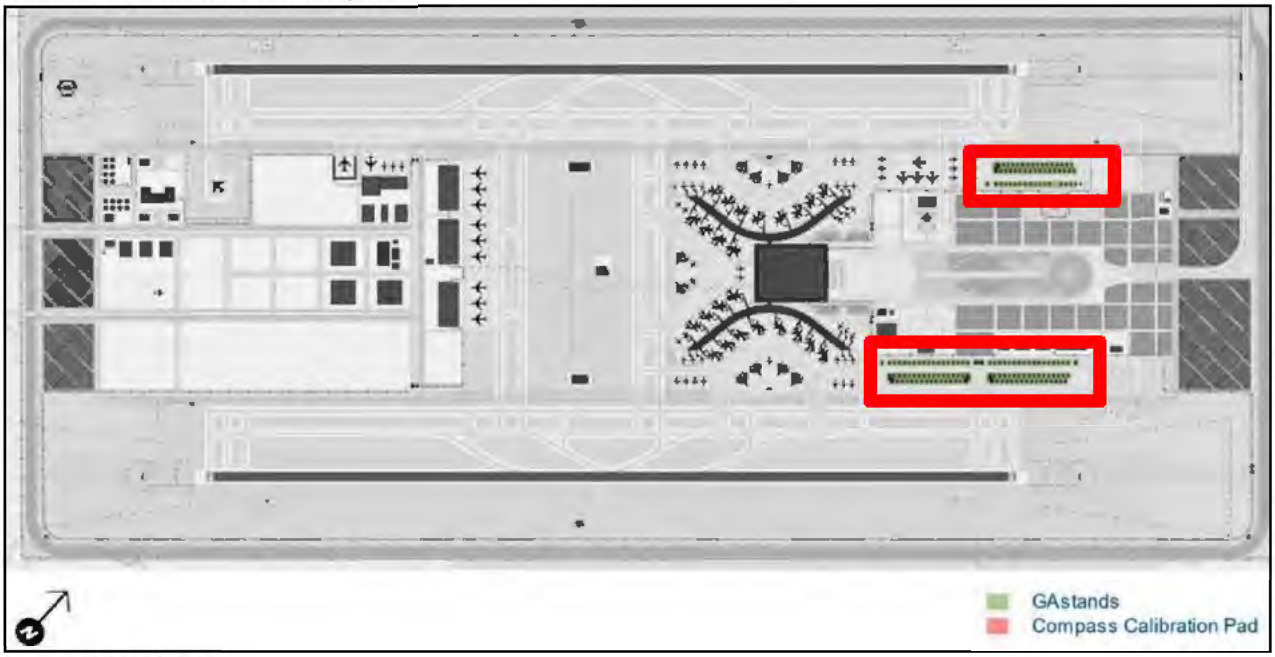
Source: CAIC, 2019

Photo 27: Royal Pavillion Apron



Source: CAIC, 2019

Photo 28: General Aviation Apron

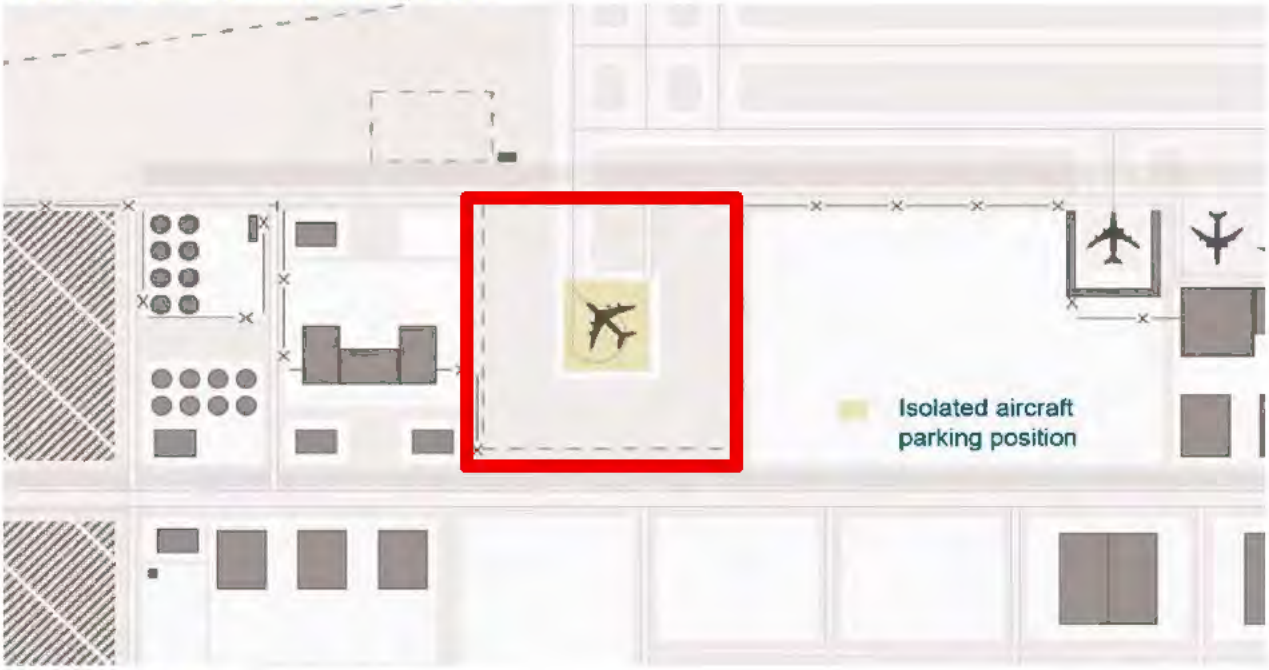


Source: CAIC, 2019

Photo 29: Heliport

Source: CAIC, 2019

Photo 30: Isolated Aircraft Parking Apron

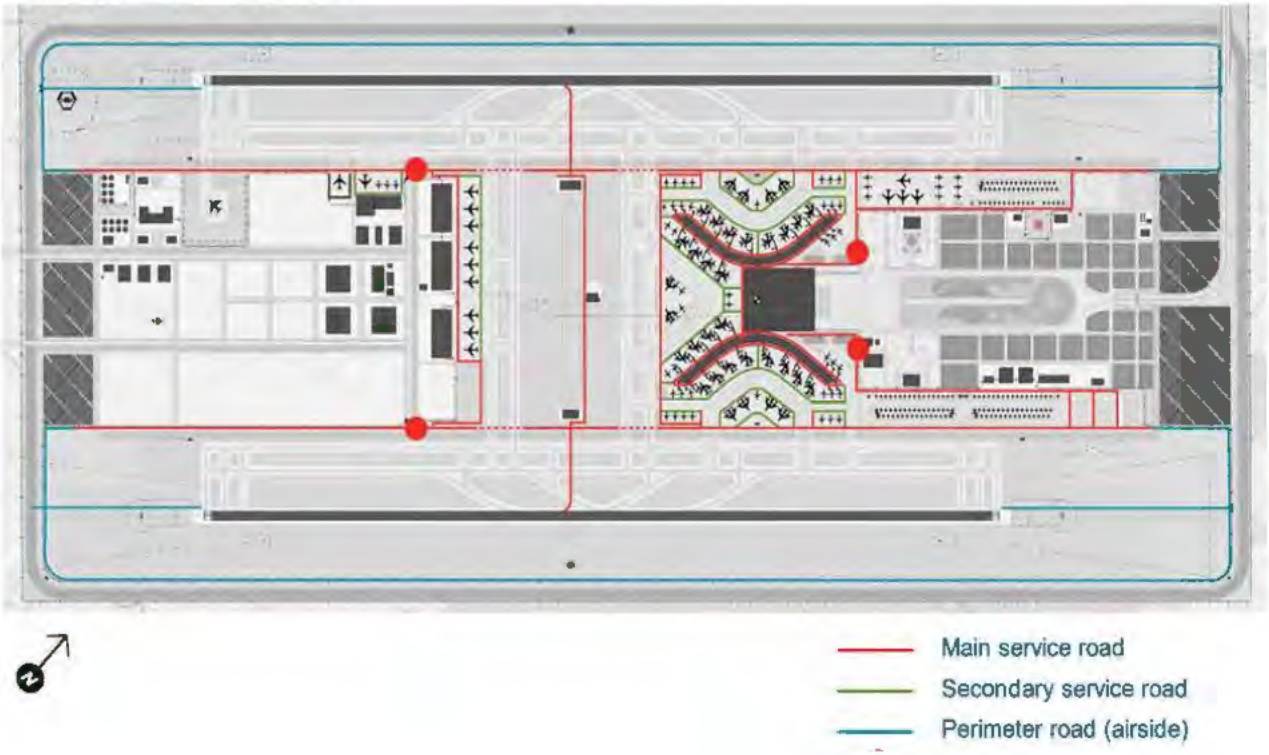


Source: CAIC, 2019

e) Service Road

In the airport, there are three lines of service road: the main service road, the secondary service road, and the perimeter roads

Photo 31: Airside service road



f) Main Airport Facilities

The main infrastructure in the project area is passenger terminal and the airport supporting facilities including cargo facilities, aircraft maintenance facilities, general aviation terminal and royal pavilion, and fixed-based operator facilities (See Figure 32).

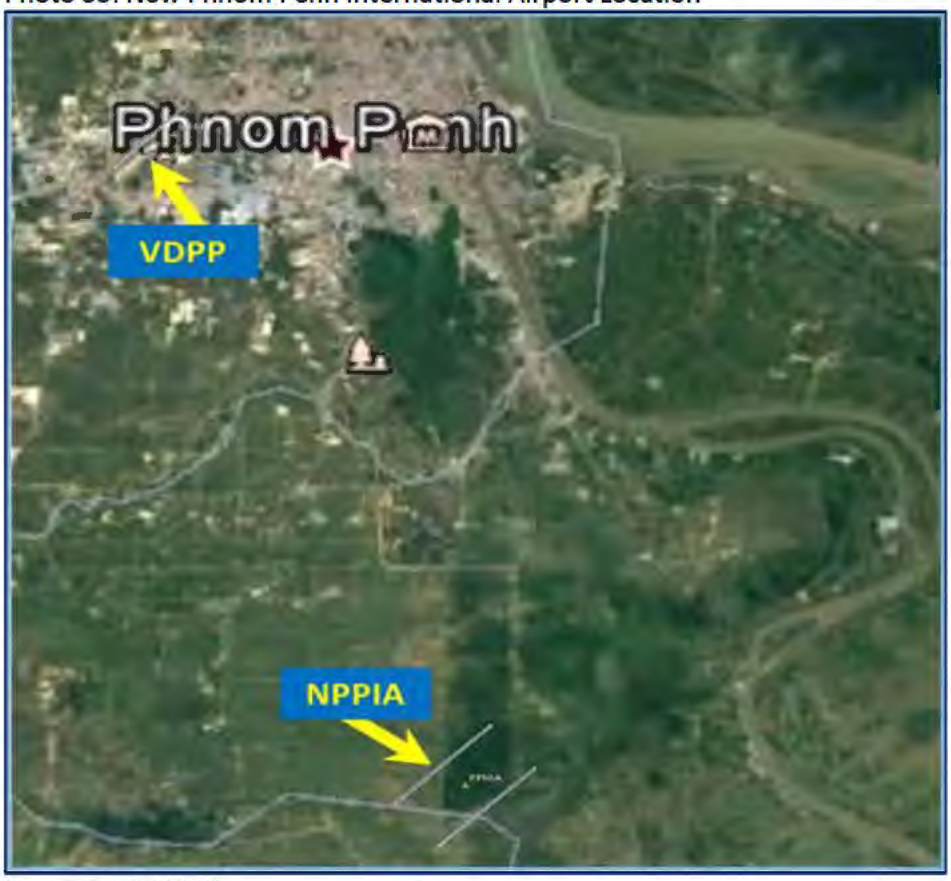
Photo 32: Main Airport Facilities

Source: CAIC, 2019

- ***Aircraft landing/take-off directions***

The New Phnom Penh International Airport is situated south of the city of Phnom Penh. Its location is indicated in figure 33. The new airport has two parallel runways, with the same direction as the current airport (05-23). A schematic presentation of the NPPIA layout is given in Photo 34.

Photo 33: New Phnom Penh International Airport Location



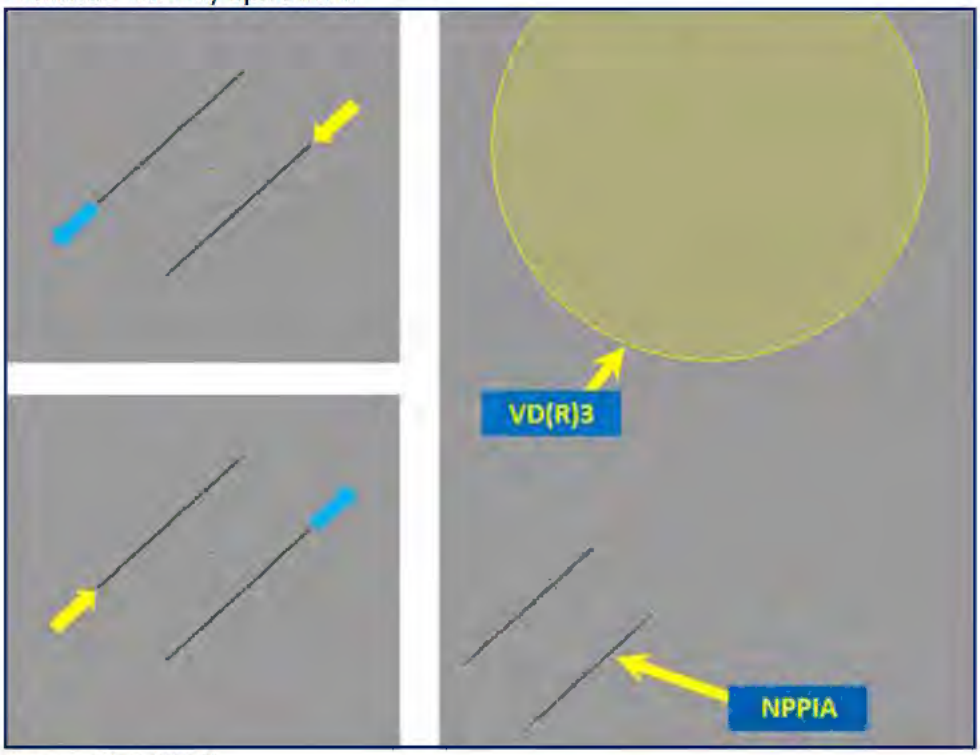
Source: CAIC (2019)

Photo 34: New Phnom Penh International Airport Layout

Source: CAIC (2019)

For the NPPIA operations it is assumed that the runways are used in segregated mode: one runway dedicated to arrivals, the other runway dedicated to departures. For runway 23 operations, runway 23L is selected for arrivals and thus runway 23R for departures. For runway 05 operations, runway 05L is selected for arrivals and runway 05R thus for departures.The rationale for this choice is that in this way aircraft will be kept away from the restricted area VD(R)3 (see Photo 35).

Photo 35: Runway operations

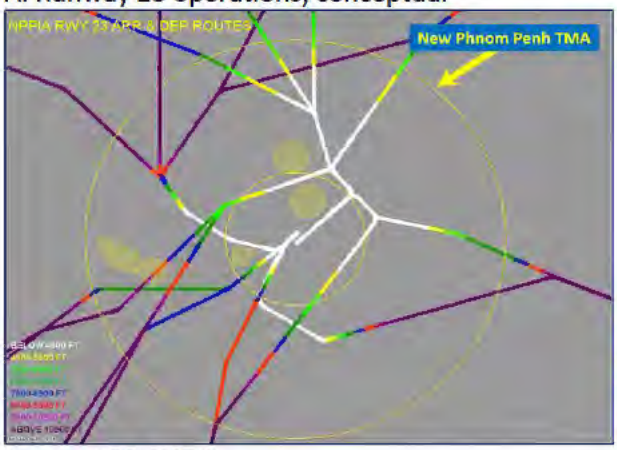


Source: CAIC (2019)

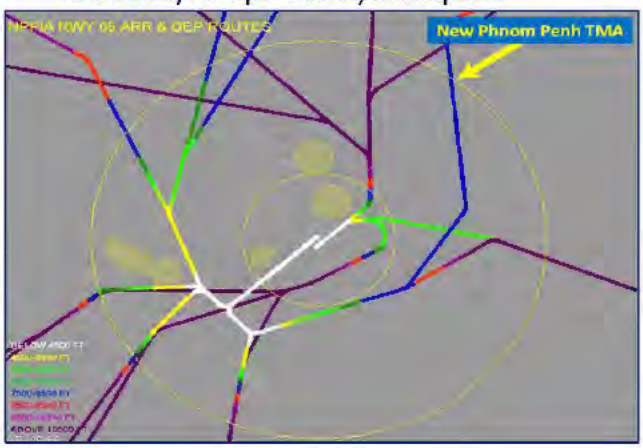
They show that, similar to the current arrival and departure procedures, several crossing points of routes exist. As these crossing points are a potential source of conflicts, altitude restrictions have been added to the STARs and SIDs in such a way that there always is a sufficiently large vertical separation between arriving and departing aircraft (similar to current procedures). Photo 36 show the arrival and departure routes combined (for runway 23 and runway 05 operations respectively), but with colours indicating the altitude ranges along the routes. Different colours identify different altitude ranges: white for altitudes below 4,500 ft, yellow for altitudes between 4,500 and 5,500 ft, bright green for altitudes between 5,500 and 6,500 ft, and so on with finally deep purple for altitudes above 10,500 ft.

Photo 36: Altitude restrictions on NPPIA arrival and departure routes

A. Runway 23 operations, conceptual



B. Runway 05 operations, conceptual



Source: CAIC (2019)

- ***Passenger Terminal Building***

For the Phase I (until 2030), the passenger terminal will be constructed with 118,000 square metres, and for the second phase (up to 2050), the passenger terminal will be expanded to 320,000 square metres by the additional of a second pier. The following table shows the number of passengers and the required terminal size, while the figure below shows the location of the terminal.

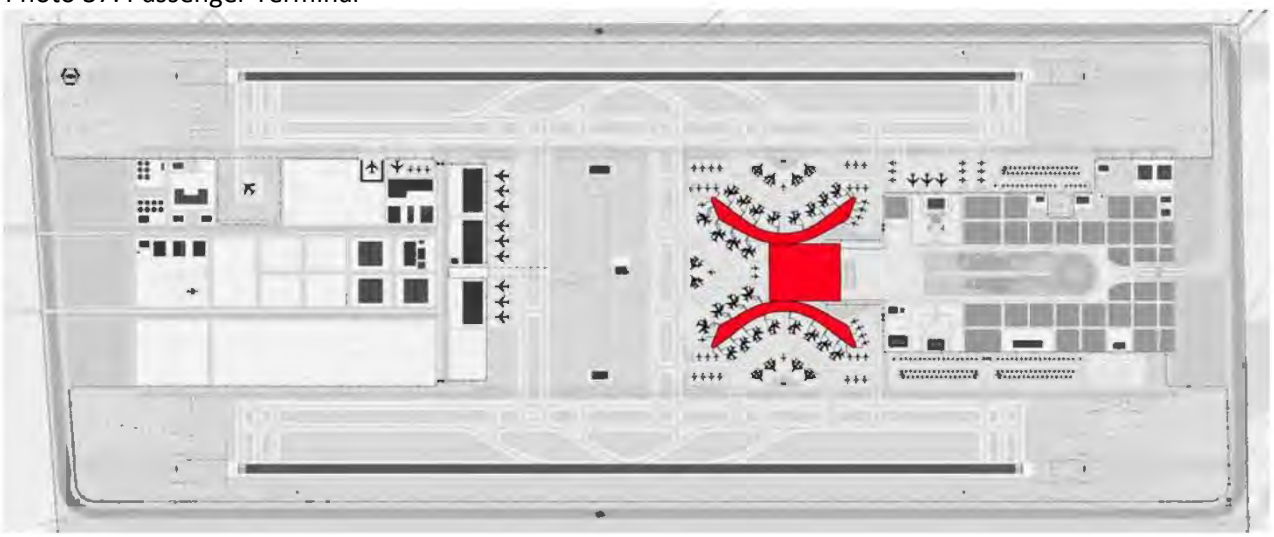
Table 37: Terminal Area Forecast

Year	Flight	Persons in Peak Hours (Persons)	Average Area (m^2)	Terminal Area (m^2)	Recommended Area (m^2)
2030	International	3,139	35	109,865	110,000
	Domestic	316	26	8,216	8,000
	Total	*3,455*		*118,081*	*118000*
2050	International	7,527	40	301,080	300,000
	Domestic	904	28	25,312	20,000
	Total	*8,431*		*326,392*	*320,000*

Source: CAIC, 2019

The passenger terminal's floor area is 94,400 square meters with a height of 16.65 meters, as shown in Photo 37. As illustrated in Photo 38 and Photo 39, the terminal consists of two floors. The first floor with a height of 5 meters consists of key sections such as office space, waiting room, commercial area, storage, departure/arrival terminals, baggage reclaim area, and green area. The second floor with a height of 11 meters consists of key sections such as office space, reserved storage, and machine control room. The terminal could accommodate both domestic and international passengers up to 36,000/day (13 million/year) and 82,000/day (30 million/year) in 2030 and 2050, respectively.

Photo 37: Passenger Terminal



Source: CAIC, 2019

Photo 38: Passenger Terminal Cross Section

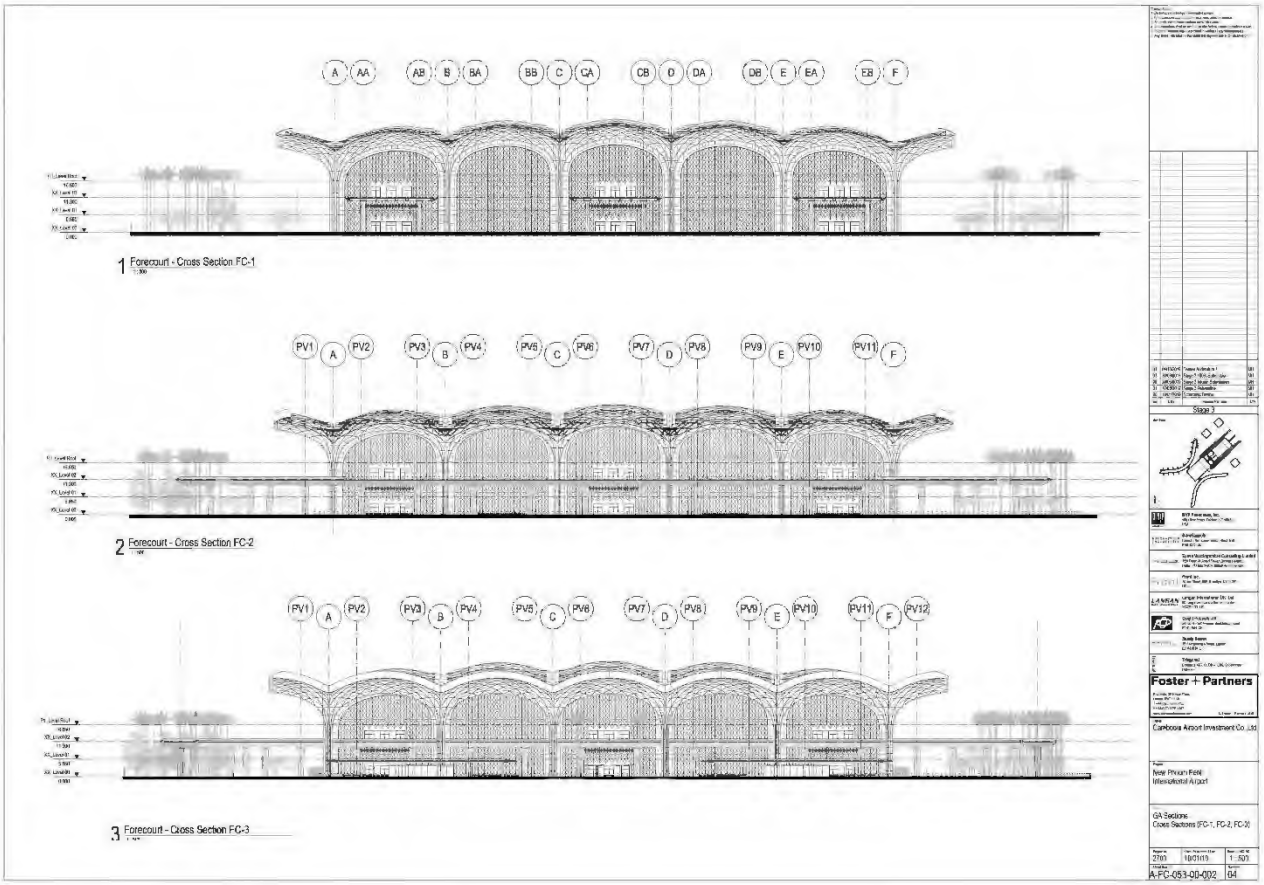


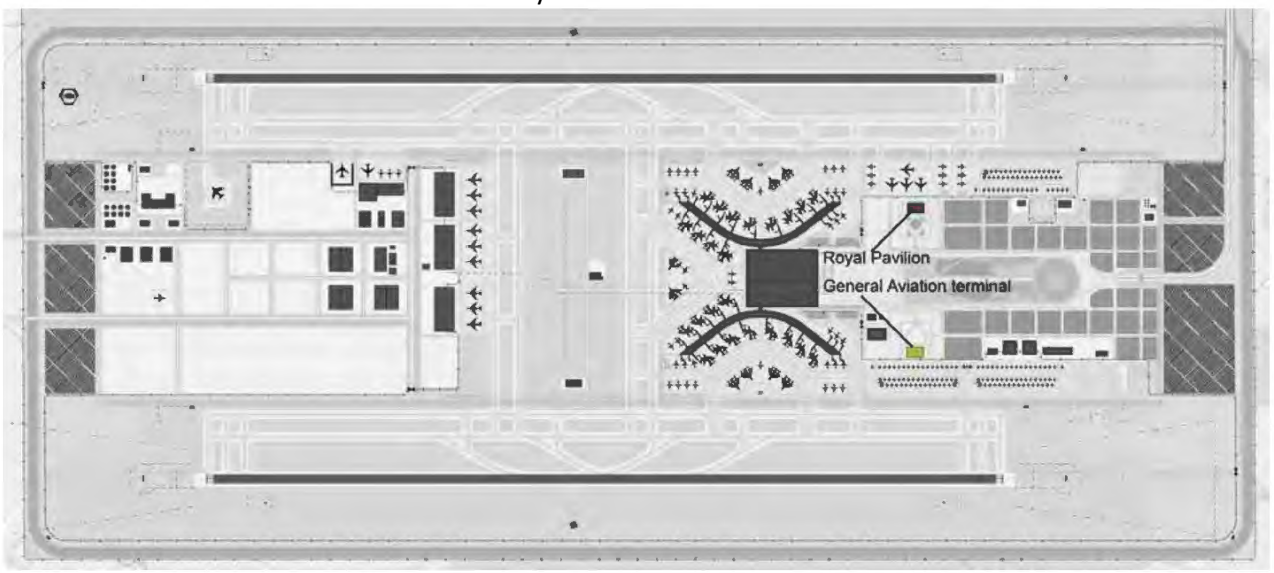
Photo 39: Passenger Terminal in 3D

Source: CAIC (2020)

- **General aviation terminal and royal pavilion**

The project plans to build general aviation terminal and royal pavilion. The required area will be determined during the detailed layout preparation stage.

Photo 40: General Aviation Terminal and Royal Pavilion

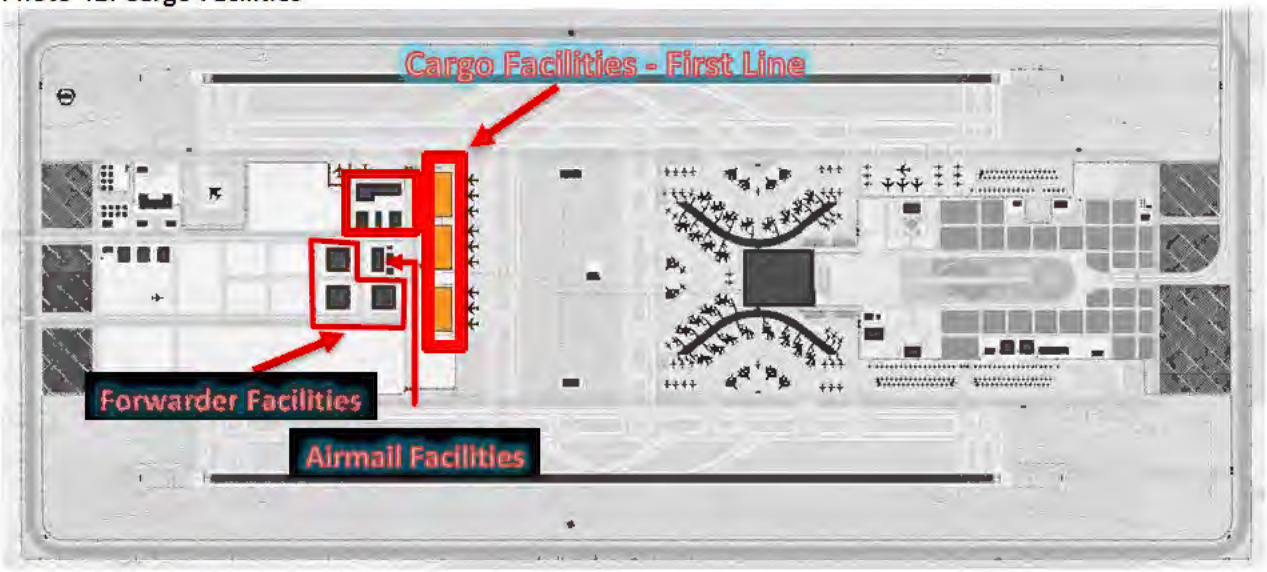


Source: CAIC, 2019

- ***Cargo Facilities***

Cargo facilities include cargo facilities first line, airmain facilities, and forwarder facilities second lane.

Photo 41: Cargo Facilities

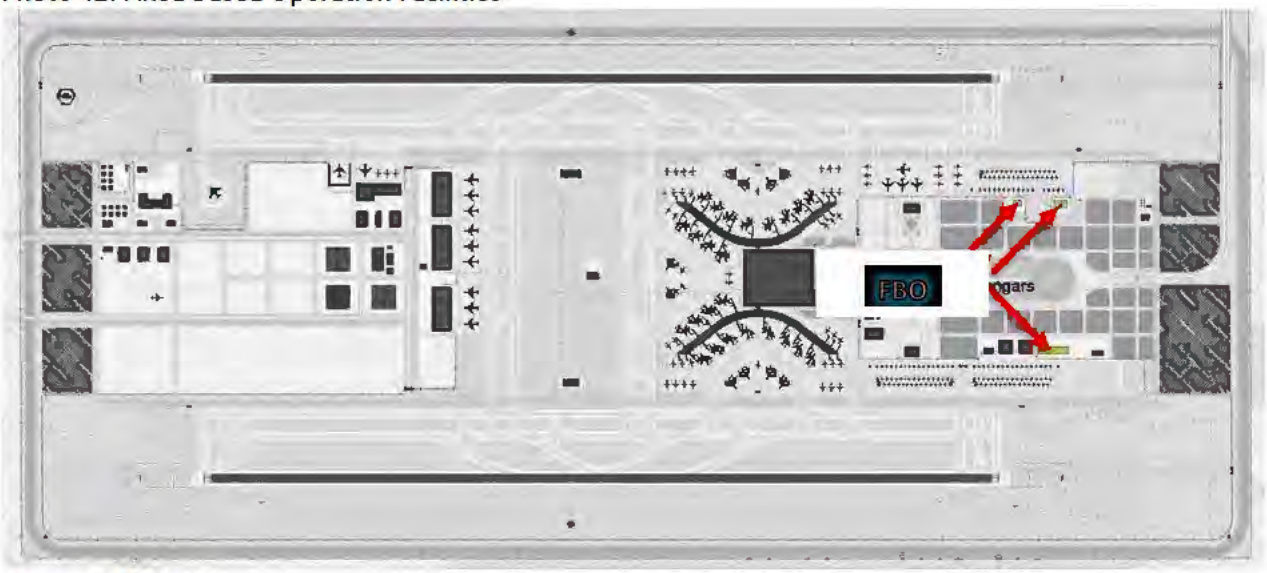


Source: CAIC, 2019

- ***Fixed Base Operation Facilities – FBO***

Fixed base operators (FBO) provide comprehensive corporate and private aviation services such as vehicle parking and aircraft maintenance. In the master plan, the reserved area for FBO is 4,200 square meters and 9,600 square meters in 2030 and 2050, respectively.

Photo 42: Fixed based Operation Facilities



Source: CAIC, 2019

- ***Parking Area***

For the Phase I, the parking lot will be built with approximately 8 hectares (2030) and 20 hectares (2050). Therefore, in the master plan, 293,431 square metres have been reserved for the construction of the car park.

Table 38: Area Forecast of Needed Parking Lots

Year	Vehicle	Vehicles Entering the Parking Lots (Unit)	Parking Time of Each Vehicle (h)	Area of Each	Total Requirement Area
2030	Taxis	215	1.5	30	9,675
	Car	1609	1.5	30	72,405
	Bus	64	1	60	3,840
	Motorbike	161	0.4	10	644
	Total	**2,049**			**86,564**

Year	Vehicle	Vehicles Entering the Parking Lots (Unit)	Parking Time of Each Vehicle (h)	Area of Each	Total Requirement Area
2050	Taxis	523	1.5	30	23,535
	Car	3,925	1.5	30	176,625
	Bus	79	1	65	5,135
	Motorbike	393	0.4	10	7,572
	Total	**4,920**			**206,867**
Grand Total					**293,431**

Source: CAIC, 2019

g) Airport Support Facilities

Airport support facilities are located in the airside, the landside, and the airport access gates. They are listed below:

Table 39: Required area for airport support facilities

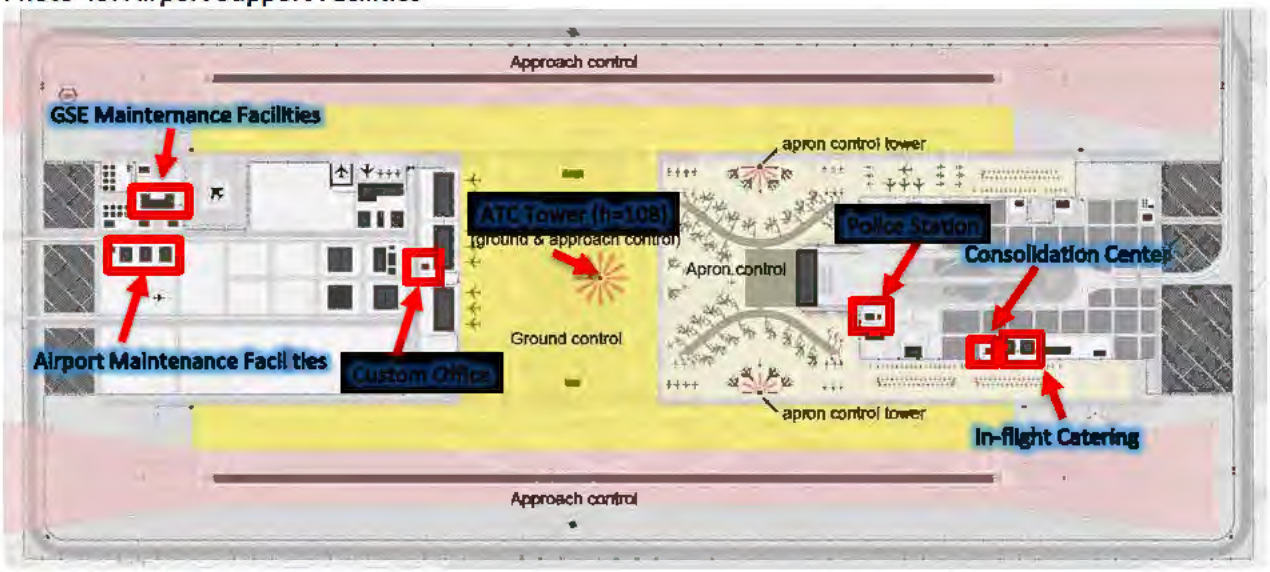
Airport Main Facilities	Unit	2030	2050
In-flight Catering Facilities	m^2	19,200	32,100
Central GSE Staging	m^2	16,000	23,000
GSE Maintenance Facilities	m^2	18,800	24,800
Airport Maintenance Facilities	m^2	39,960	77,220
Rescue & Firefighting Stations	m^2	19,200	32,000
Rescue & Firefighting Training Ground	m^2	27,100	27,100
Police, Security & Customs Facilities	m^2	11,400	11,400
Air Traffic Control Facilities	m^2	9,000	9,000
Meteorological Station	m^2	5,750	5,750
Consolidation Center	m^2	3,000	5,800
Pond and Green Area	Ha	160	160
The required area for concrete mixing plant is one hectare.			

Note: GSE = Ground Support Equipment

Source: CAIC, 2019

- **The air traffic control tower**, located close to passenger terminal, is a critical piece of airport infrastructure. It houses not only the visual and radar approach facilities but also airport engineering staffs, the meteorology office and flight information systems and facilities. It will be built in the centre of the airport site to ensure maximum visibility of aerial and ground operations. The tower will be erected at a location that will ensure that the air traffic control is able to see all aspects of the runway, the taxiways and aprons. The air control visual control room room is at the highest level of the tower. The size of the land required for the construction of the control tower is 9,000 square metres.
- **Service road geometry** is described in the above Section E. Service Road. The dike construction is described in the below Section 4.10.2 Drainage and Flood Prevention System.
- The new airport has two parallel runways, with the same direction as the current airport (05-23). A schematic presentation of the NPPIA layout is given in Photo 4-37 of Section E1. Aircraft's landing/take-off direction.

Photo 43: Airport Support Facilities



Source: CAIC, 2019

Photo 44: Air Traffic Control Tower

Source: CAIC (2020)

4.6.1.4. Firefighting System Management of NPPIA

a) ***Airport Rescue and Firefighting Facility:*** The initial airside fire station for Phase 1 will be 19,200 square metres and an additional station will be added later making a total of 32,000 square metres allocated for the second phase. The initial fire station will be constructed near runway 1, the second fire station will be near runway 2.

Table 40: Number of Firefighting Vehicle and Personnel

No.	Firefighting Vehicle	Number of Vehicle	Number of Personnel
1	Quickly Mobilised Vehicle	1	3
2	Main foam Vehicle	2	6
3	Dry Powder Vehicle	1	3
4	Heavy foam Vehicle	2	12
5	Middle foam Vehicle	-	
6	Fire Field Vehicle	1	3
7	communication Command vehicle	1	2
8	Security Vehicle	1	2
9	Wrecker Vehicle	1	5
Total		**10**	**36**

Source: CAIC, 2019

b) Firefighting System at Passenger Terminal Building

In the passenger terminal, the project will install fire extinguishers and fire hoses at key locations that are easily visible to ensure that the fire service and trained staff project respond to these risks in a timely manner. In addition, Fire Alarms, Exit signs and automatic sprinklers on the ceiling are also installed.

c) Firefighting System at Apron Area

The terminal is an important location that also requires major and appropriate fire protection. A fire hydrant sytem is to be installed at NPPIA that can distribute water for fire prevention and firefighting to the passenger terminals, parking aprons, cargo and maintenance buildings, offices and other areas in the airport. The fire hydrant sytem designed to supply the entire airside site will comprise of a series of vertical pipes with a diameter of 100 mm, height of not more than 1.2 metres as shown in the Figure 46 on page 108 below:

Within the terminal building hose reel hydrants will be installed approximately 120 metres apart, providing a protection circle of not more than 150 metres (see example below Figure). The hoses are capable of supplying water to three sprinklers at a time, each with a capacity of no less than 15 liters / second. The system is capable of discharging 30 litres of water per second with a pressure of at least 0.15MPa. Additionally, the project will install fire-extinguisher points between each fire hose in the terminal. Each fire extinguisher contains at least 55 kilograms of fire extinguishing fluid or compound.

Furthermore, the project's fire emergency response system will be able to respond to any fire risk within the entire airport airside area no later than 3 minutes after the fire alarm is raised.

Photo 45: Example of Firefighting Equipment

Outdoor hydrant system

Indoor Hydrant System

Water Cannon System

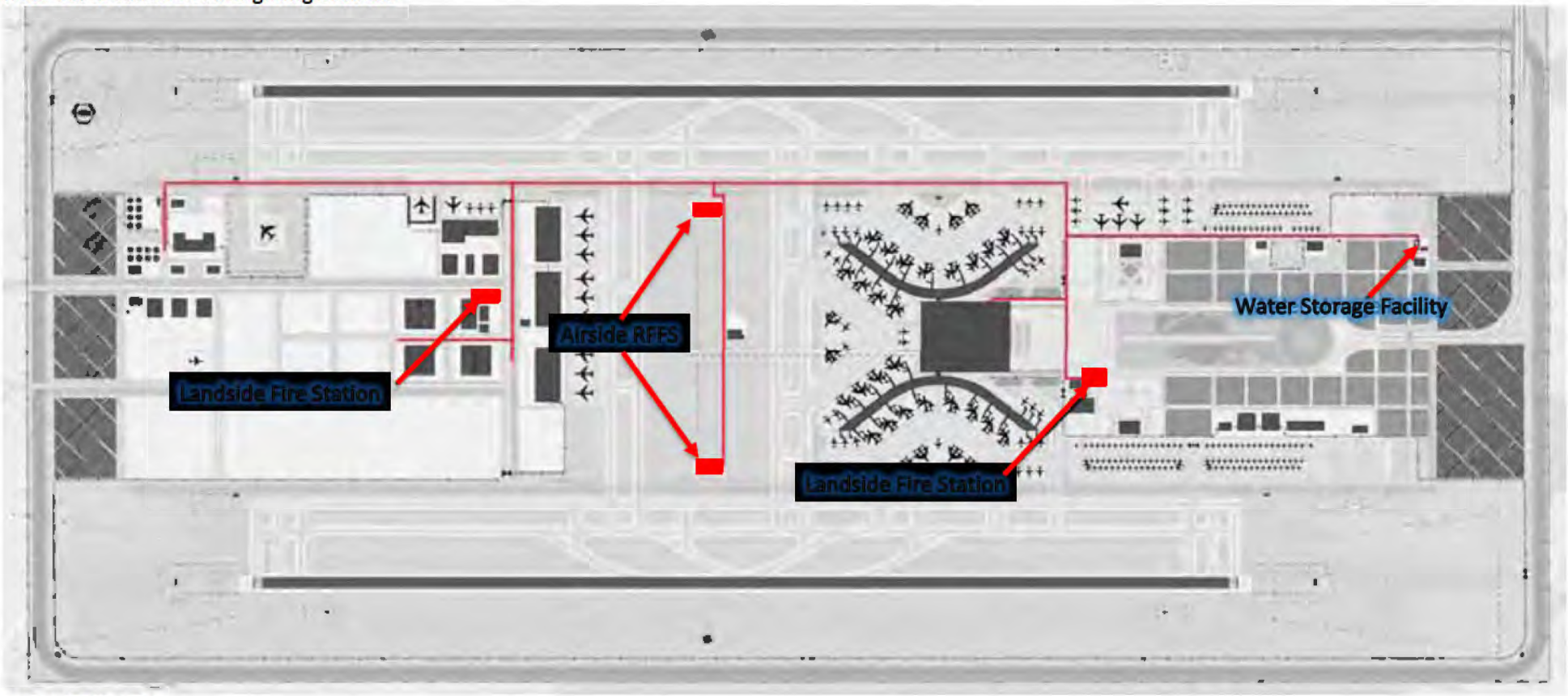
Automatic Sprinkler Fire Extinguishing System

Firefighting Extinguisher

Firefighting Vehicle

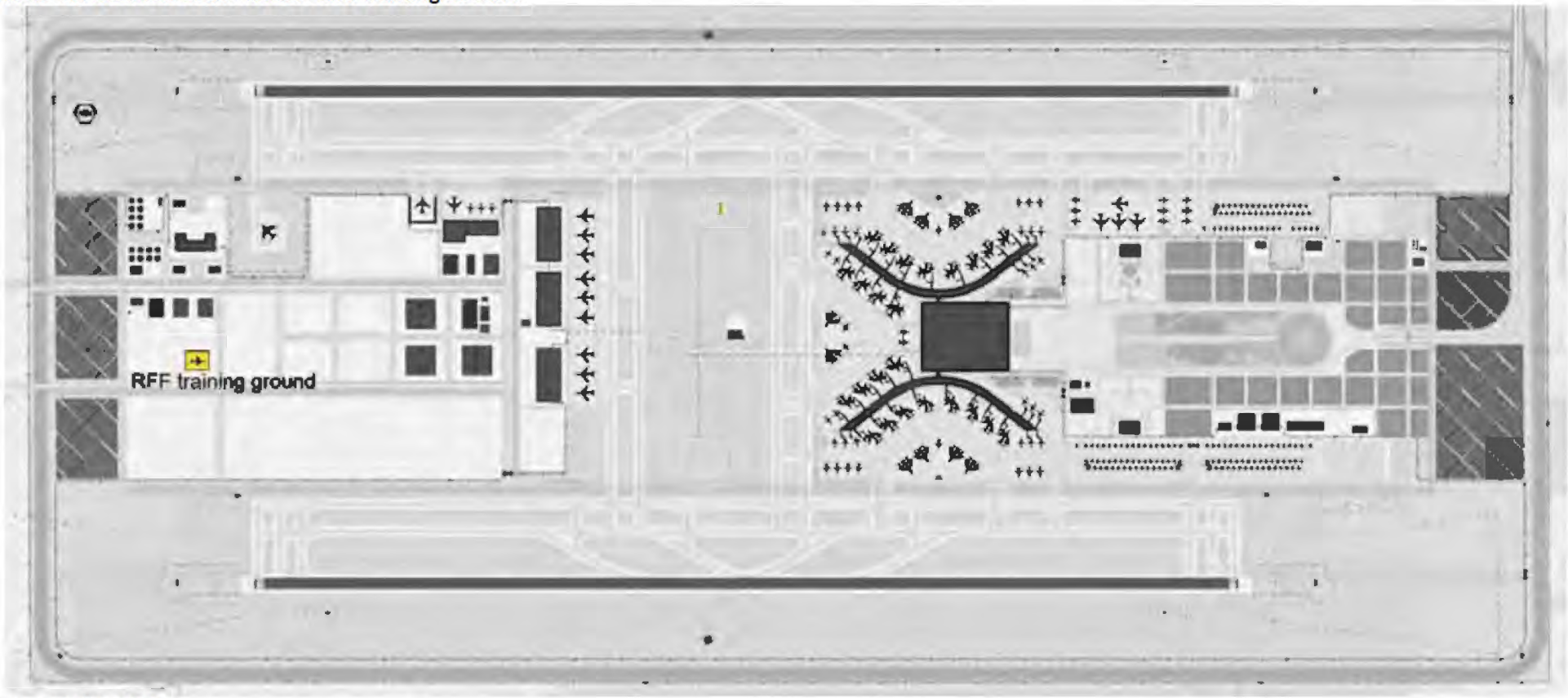
Source: CAIC, 2019

Photo 46: Location of Firefighting Stations



Source: CAIC, 2019

Photo 47: Location of the Rescue and Training Ground



Source: CAIC, 2019

4.6.1.5. Fuel Supply System

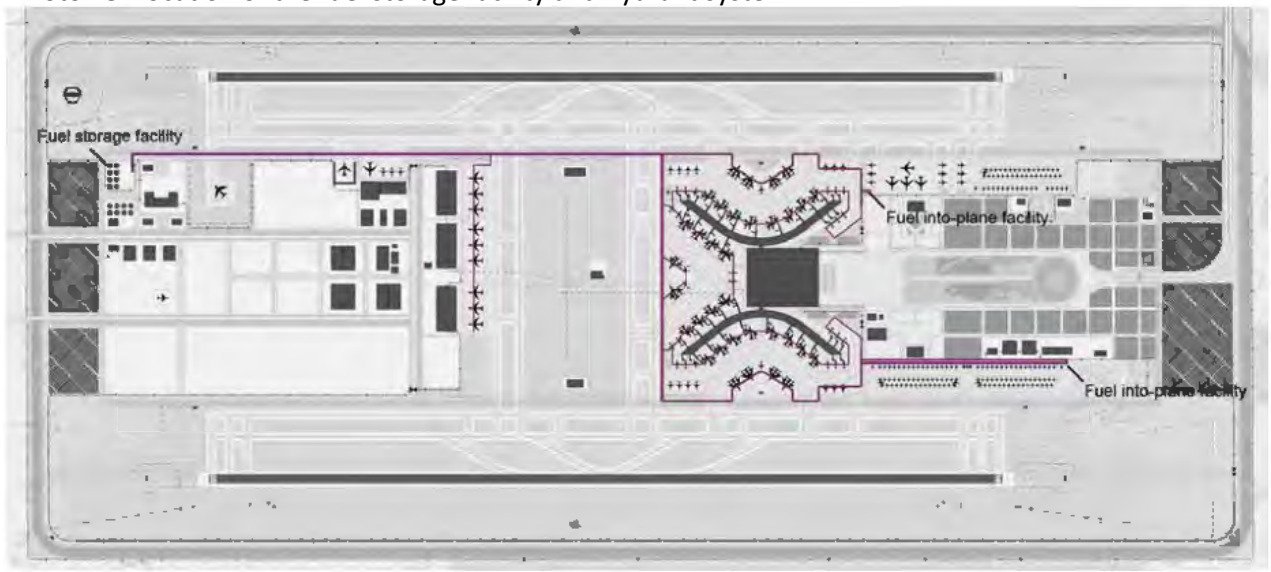
The project will build an oil terminal (JET A-1) with 8,000 m^2 for the Phase I (up to 2030) and 14,000 m^2 for the Phase II up to 2050), which includes the staffing and workstation of the fuel tank, the location of the fuel injection station and the checkpoint at the gate.

Table 41: Aviation Fuel Demand Estimations

Nº	Aviation Fuel	Unit	2030	2050
1	Annual Aircraft Movements		109,800	184,900
2	Peak Day Aircraft Movements (1-way)		178	300
3	JET A-1 fuel Consumption	m^3/day	1,170	1,980
4	Fuel Storage Demand	m^3	16,000	28,000
5	Fuel Storage Facility Plot Size	m^2	8,000	14,000

Source: CAIC, 2019

Photo 48: Location of the fuel storage facility and hydrant system



Source: CAIC, 2019

4.6.1.6. Machinery for Construction

An estimated units of machinery required for construction is 570.

Table 42: Machinery for construction

No.	Machinery	Number of Unit
1.	Grader	20
2.	Bulldozer	40
3.	Cement mixing truck	40
4.	Cement pump truck	10
5.	Cement compactor	30
6.	Dirt truck	250
7.	Excavator	30
8.	Generator	30
9.	Road roller	30
10.	Road roller with rubber tire	20
11.	Compactor	30
12.	Cleaning truck	20
13.	Water cannon truck	20
Total		**570**

Source: CAIC, 2019

4.6.1.7. Human Resources and Worker Camp

According to the action plan of the project, during the construction phase, the total staff capacity is estimated to be more than 2,000, including foreigners (10% about 200 staff) and Cambodians (90% about 1,800 staff).

The accommodation of foreign staff/workers will be in the project area, which the company plans to have, as well as accommodation, cafeteria and health office. The project reserves one hectare of land for below facilities:

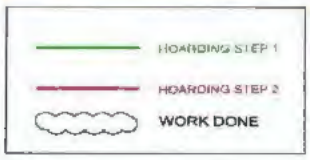
- Worker camps and bathrooms: five buildings (each has two (2) floors and 10 rooms). Bathrooms are shared.
- Staff camps and bathrooms: three buildings (each has a single floor and five rooms with private bathroom).
- Warehouse and workshop: 20 meters x 40 meters
- Cafeteria: 12 meters x 24 meters
- Solid waste storage: 8 meters x 10 meters
- Office
- 40 car parking bays
- Office of the land conflict settlement committee.

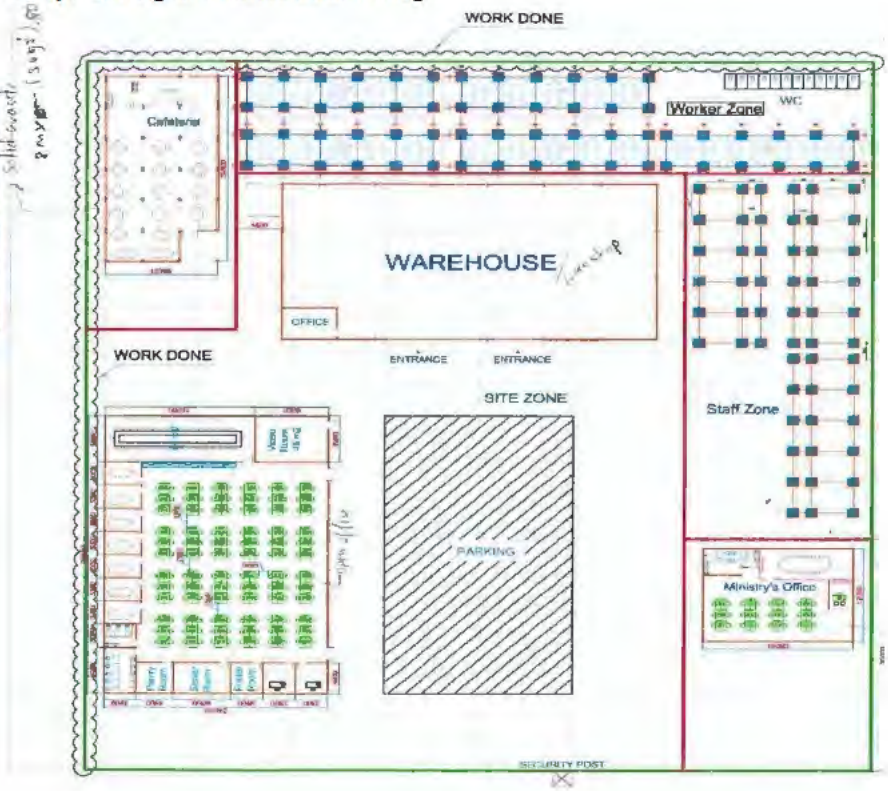
As the number of staff/worker increases (possibly up to 3,500) along with the construction activities, the project plans to provide additional worker camps and other services.

Table 43: Staff during the construction phase

No.	Position	Monthly Salary (USD)	Number of Staff
1.	Team Leader	2,000	55
2.	Engineer	2,200	68
3.	Technician	1,800	30
4.	General staff	700	8
5.	Expert	1,500	745
6.	Worker	300	2,595
		Total	**3,500**

Photo 49: Office and worker camps during the construction stage





The project will have specialized staff in charge of the environment to be responsible for monitoring the implementation of environmental safety and health protection. This staff has the following roles: 1-Monitor the implementation of mitigation measures, 2-Coordinate and liaise with the Ministry of Environment and the Ministry of Labor and Vocational Training and 3-Cooperate with the team to train staff in the work of protect the environment, health and safety.

4.6.2. Operation Phase

After the completion of construction of the first runway and supporting infrastructure by the end of 2022, the project will become operational in early 2023. Immediately afterwards the Intermediate phase will commence and a second runway and supporting taxiway system will be constructed. The second pier to the passenger terminal and additional taxiways will be created according to passenger and traffic demand before 2050.

4.6.2.1. Passenger Destination

After the operational opening in early 2023, the airport will receive flights from other parts of the world. The airport is capable of allowing a variety of aircraft to land and fly safely such as B777-300ER, B78-8, B787-9, A330-243, B747-8, and, A380-841 for both domestic and international flights. The envisaged initial destinations of international flights is shown in the table below:

Table 44: Target forecasts of international flights and distances

No.	City	Country	Distance from NPPIA (km)
1	Beijing	China	5,511
2	Sydney	Australia	7,250
3	Moscow	Russia	8,137
4	Frankfurt	Denmark	9,879
5	Cape Town	South Africa	10,590
6	Los Angeles	USA	13,394

Source: CAIC, 2019

4.6.2.2. Passenger Forecasting

According to the project plan, by 2030, the number of passengers traveling through the airport could reach 13 million per year and could increase to about 30 million per year by 2050. An estimated 80% of passengers will be international, while the other 20% will be domestic.

By 2030, the total number of flights is estimated to be 80,087 flights per year, with 10,390 domestic and 69,697 international flights. By 2050, the total number of flights could be 186,755 flights per year, with 29,412 domestic flights and 157,343 international flights, as detailed in the below table.

Table 45: Forecasting of Passenger

No.	Description	Flight	2030	2050
1	Through Passenger (1,000 person)	Domestic	2,600 (20%)	6,000 (20%)
		International	10,400 (80%)	24,000 (80%)
		Total	**13,000**	**30,000**
2	Aircraft Movement (times)	Domestic	10,390	29,412
		International	69,697	157,343
		Total	**80,087**	**186,755**
3	Cargo (10 thousand tone)	Domestic	2,000	5,500
		International	198,000	544,500
		Total	**200,000**	**550,000**

Source: CAIC, 2019

4.6.2.3. Ground Service Equipment

According to the plan, in the implementation phase, the project will provide special vehicles to operate in the airport: 1) ground service vehicles, 2) airfield service vehicles, 3) fire trucks, and 4) ambulances. A total of 274 vehicleswill be utilised delivered. The table below shows the number of vehicles in each category.

Table 46: Ground Service Equipment in Airport

No.	Vehicles	Number
1	Ground Service Vehicles	229
2	Airfield Service Vehicle	23
3	Firefighting Vehicle	13
4	Emergency Vehicle	9
Total		**274**

Source: CAIC, 2019

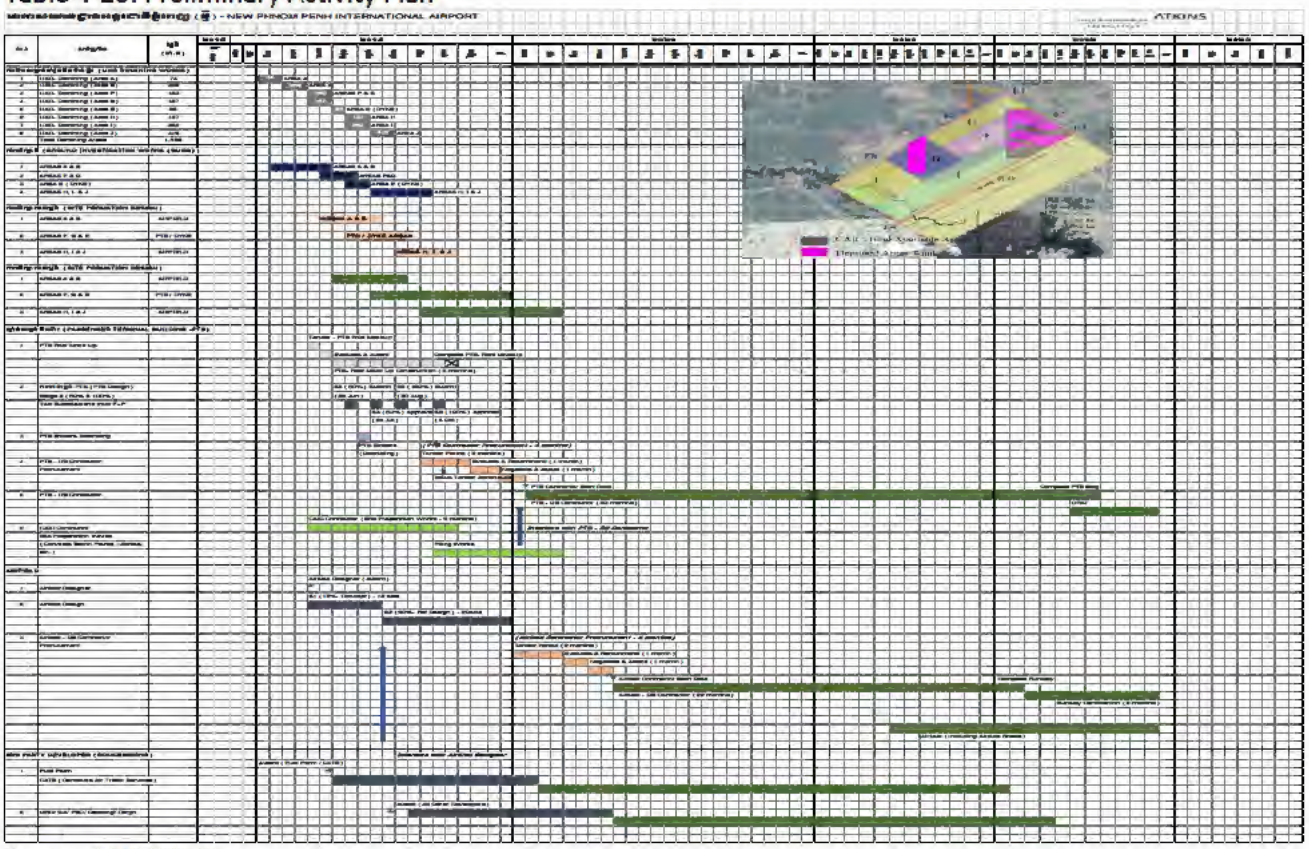
4.6.2.4. Human Resources and Accommodation in Operation Phase

According to the plan, after the launch, the project will recruit approximately 2,200 staff, both foreign and Khmer, to work daily at the airport. This number is only the initial plan and is likely to increase when implemented, or at a later stage of the project.

4.6.3. Preliminary activity plan

The table below illustrates the preliminary activity plan from the construction phase until the flight test.

Table 4-20: Preliminary Activity Plan



Source: CAIC (2019)

4.7. Power Supply and Source

4.7.1 Construction Phase

During the construction phase, there are two main sources of electricity: the national grid transmission line and local diesel generators. The main source of electricity supporting the construction activity will be the

115kV transmission line that the company is connected to the Electricity of Cambodia grid. The company also has two generators (providing about 500KVA) for use when there are power cuts or for work in the field, such as lighting, welding or metal work.

4.7.2. Operational Phase

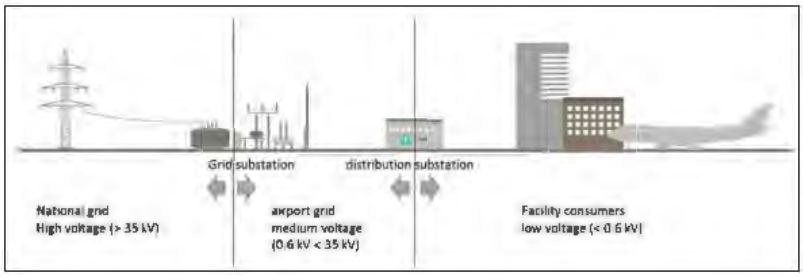
It is envisaged that when the airport is operational the airport will rely upon two diverse sources of electricity: national grid transmission line (115 kV and 22 kV) and a major solar panel power supply. The total power consumption of the project is estimated to be 10.2 megawatts by 2030 and 19.10 megawatts by 2050. The airport site will contain two electrical sub-stations. The picture below shows the power transmission system in the project.

Transmission line: The project will link its power line to the state grid, a high-voltage transmission line (greater than 35KV). The voltage of the transmission will be converted to medium voltage (0.6KV) by the sub-station. Then, when the electricity is distributed to different parts of the entire project area, the average voltage will be converted again by the sub-station in the project area to the lower voltage (as small as 0.6KV).

Solar panel power supply: The project will have a solar power plant. The solar panel will be installed at two sites (See Photo 4-53). The first site is in the south-west (UTM 48P X: 489955, Y: 1253728), and the second site in the northeast (UTM 48P X: 493448, Y: 1257912). The solar panel will be floated on pond of the airport over a total area of 6 hectares (see Photo 4-54). The solar power capacity is 17 megawatts, and will primarily supply to the airport.

At the same time, the company will use energy-saving electrical equipment, and at the passenger terminal, which is spacious and well-lit, the company will use Glass Curtain with advanced headting / cooling and ventilation system to save demand energy and environmental impact.

Photo 50: Typical power supply network scheme



Source: CAIC, 2019

In this stage, two sub-stations will be built to supply electricity to the airport.

Photo 51: Power supply network and location of central utility plant

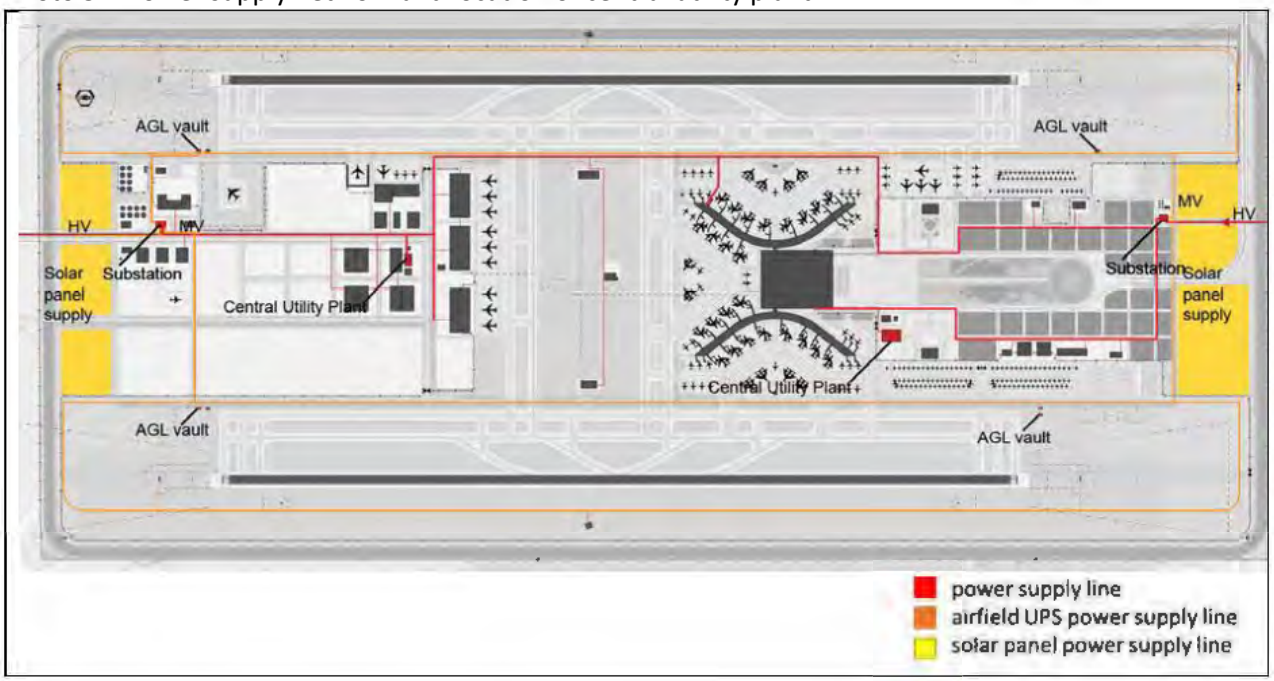


Photo 52: Sample of Floated Solar Panel

4.8. Water Consumption and Sources

4.8.1. Construction Phase

During the construction phase, there are two main water requirements: (1) staff and worker water use at the construction site and (2) other uses in the construction site. Water use by staff and workers at the site includes bathing, washing or washing and cooking. Water uses in the field will include road watering, mixing concrete, and cleaning.

According to the project plan, during the construction phase, the maximum amount of water required is approximately 150 litres/person/day. Therefore, the maximum water consumption of the staff and workers (max. 2,000) at the site can be 300,000 litres/day, equal to 300 cubic metres per day, for the construction stage.

In-house applications such as cement mixing can be approximately 1,700 cubic metres per day (250 litres of water required for a cubic meter of cement mixing). Overall, the maximum amount of water needed for this phase can be a total of 2,000 cubic metres per day.

4.8.2. Operational Phase

During the operational phase, water use will be available at at each building in the airport, and notably in the passenger terminal in the washrooms, toilets, canteen, restaurants, air conditioning, fire extinguishers, and so on. External area will be irrigated as required.

As shown in the table below, the total is 3,288 m^3/day and 6,680 m^3/day in 2030 and 2050, respectively. Besides, the required amount of water for firefighting is 4,755 m^3/day and 4,817 m^3/day in 2030 and 2050, respectively. For the treated wastewater, the company will drain the water in the pond in the airport (160 hectares) for reuse for irrigation, garden cleaning, road cleaning, etc.

Table 47: Water Demand and Supply During Operation Phase

Water Consumption	Unit	Quantity (2030)	Quantity (2050)
1. Potable Water Supply (1)	m^3/day	1,800	3,500
2. Non-potable Water			
- Aircraft non-potable Water	m^3/day	49	97
- Home Carrier base Aircraft Cleaning	m^3/day	30	42
- Chiller Plant	m^3/day	1,008	2568

Water Consumption	Unit	Quantity (2030)	Quantity (2050)
- Irrigation Water Demand	m^3/day	401	472
Sub-total (2)	m^3/day	**1,488**	**3,178**
Total amount of water (1+2)	m^3/day	**3,288**	**6,680**
Minimum Potable Water Storage	Day	7	7
Minimum non-potable Water Storage	Day	2	2
Total plot size – water supply facilities	m^2	9,000	15,200
3. Firefighting	m^3	**4,755**	**4,817**

Source: CAIC, 2019

4.9. Waste Management

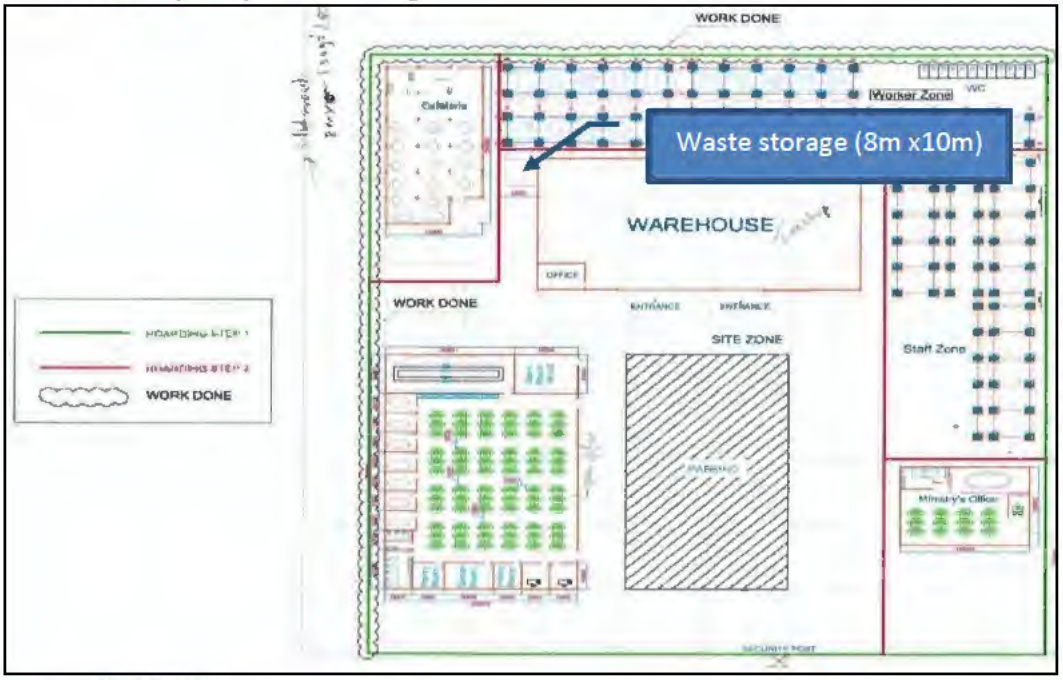
4.9.1. Solid Waste Management

4.9.1.1. Construction Phase

There are two types of solid waste generated by the project activities; construction waste (mainly sand, gravel, plastic, wood chunks, cement, kitchen and demolishing waste) and hazardous waste (mainly lubricant, paint containers, batteries and accessories). During the construction phase, there are two main sources of solid waste generated by the workers'accommodation and the solid waste generated by the construction site.

It is estimated that the amount of solid waste generated by daily activities of employees and workers is expected to be around 0.5 kg/person/day. As planned, at this stage there can be a maximum 2,000 employees/workers, so the amount of solid waste generated can be around 1,000 kg/day. In particular, the various solids that may arise from construction activities in the construction site include iron, demolished infrastructure, stone and wood. These residues will be handled through recycling (for scrap metal and wood) and compressed milling at the construction site (for sand, stone and gravel). Specific types of hazardous waste that may occur during the construction phase include batteries, storage tanks, lubricants, fuel residues and other chemicals used for the maintenance of vehicles and machinery. The amount of these hazardous wastes is expected to be small and these will be left with proper packaging and storage facilities. The project will work with the contractor to transport and require all staff and workers in the landfill to separate waste, hazardous waste, recyclable and non-recyclable waste into recyclable bins Set. For food waste or organic waste, the project will be composted for agricultural purposes. Particularly for non-recyclable solids, CAIC will transfer a temporary storage (See Photo 53). All collected waste will be temporary storage on site before sending to certified waste collector.

Photo 53: Temporary Waste Storage



Source: CAIC (2019)

4.9.1.2. Operational Phase

The airport operatorwill collect and transport the solid waste within the airport premises to a central point. A reservation for a solid waste handling facility is, therefore, required on the airport premises. From there, solid waste is collected by a trash compactor truck and dumped in a designated area outside the airport in accordance with national regulations.

The production of solid waste on an airport is based on the number of handled passengers on an average day. On average, the production rate per passenger is about 0.3 kg per passenger per day. For the storage of the solid waste however, the volume of the waste is more critical than its waste. The planning parameter of volume to weight ratio applied is approximately 4 liter/kg. If the waste is compacted in a hydraulic compactor, the volume can be reduced by a factor 3. Furthermore, the following key performance indicators have been used:

- Garbage truck capacity: 12 m^3;
- Garbage storage floor area per volume of waste per day: 30 m^2/m^3/day;
- Waste sorting area floor area per volume of waste per day: 30 m^2/m^3/day.

According to the Master Plan concerning solid waste in 2030, 14,400 kg/day or 19 m^3/day and 20,830 kg/day or 37 m^3/day. In order to effectively manage solid waste, the project is planning to transport waste created on site to a designated and approved solid waste sorting plant (1,800m^2 for 2030 and 3,500m^2 for 2050). The vehicles to be used must capable of carrying 12m^3 of waste and making 2 trips/day in 2030 and 4 trips/day in 2050.

The company will install bins at many locations in the passenger terminal and other key locations in the airport itself. The solid waste generated by the project activities will be collected in the bins and stored in a waste transfer station and then routed to the company's landfill (See Photo 4-56). Solid waste will be disposed of by a certified waste collection agency.

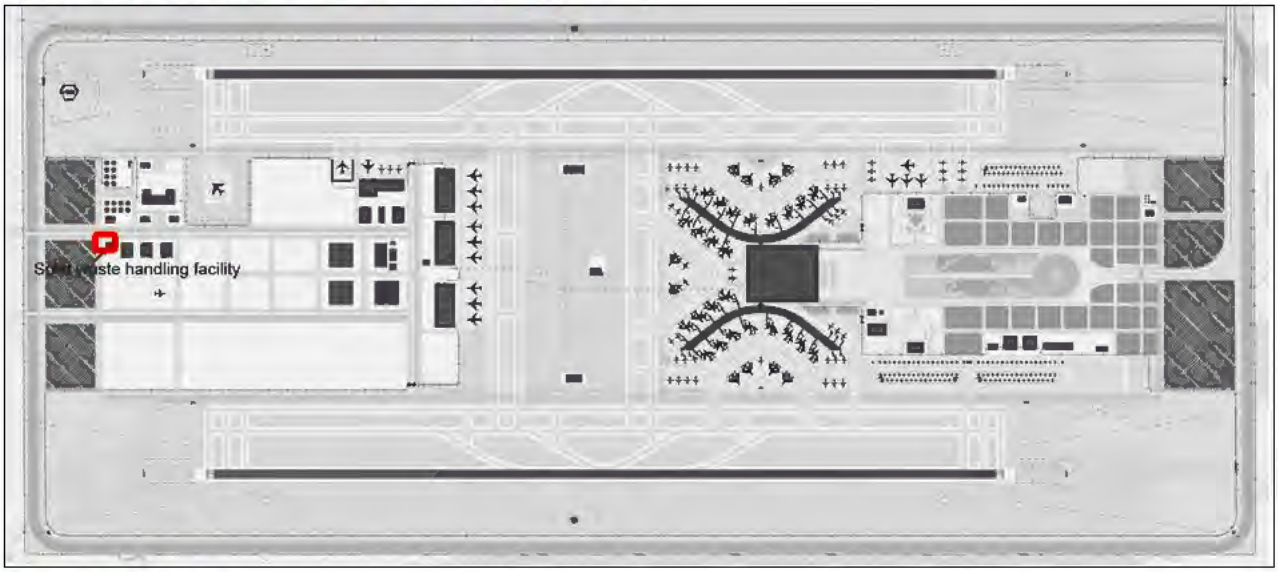
In case of an increase the amount of waste, the company will add more truck for transporting waste from the building / airport to the temporary storage area. For adding the truck at least, 1 unit for hazardous waste, 1 unit for recyclable waste, 1 unit for organic waste and 1 unit for non-recyclable waste. The company will implement the waste collection as daily in 2030 to ensure timely delivery. The company will also promote the implementation of 3R measures in activities that may have an impact on the environment.

Table 48: Solid Waste Production and Disposal

Solid waste	Unit	2030	2050
Peak Day Waste Production	kg/day	14,400	27,830
Solid Waste Volume Per Day	m^3/day	19	37
Number of garbage truck movements per day		2	4
Total plot size	**m^2**	**1,800**	**3,500**

Source: CAIC, 2019

Photo 54: Location of the Solid Waste Handling Facility



Source: CAIC, 2019

4.9.2. Wastewater Management

4.9.2.1. Construction Phase

During the construction phase, the solid waste that can be generated from the project activities comes from the water use of the staff and workers on the construction site only. At that stage, the maximum water consumption of staff and workers can be around 150 litres/person/day. According to the project plan, during the construction phase, the total number of staff and workers is estimated to be 2,000, with the total daily water demand being approximately 300,000 litres/day (300 m^3/day). Assuming that 80% of the total water consumed becomes liquid, the amount of liquid generated by the accommodation of staff and workers can be approximately 240 m^3/day. Also, that liquid waste is the only Domestic Wastewater that may come from everyday use such as washing, bathing and other uses. At this stage, the project will have installed a septic tank in each building of the staff and workers accommodation to manage the waste.

4.9.2.2. Operational Phase

The total required amount of water in 2050 is 6,680 m^3/day (potable and non-potable water). Non-potable water is for aircraft (140 m^3/day), and chiller plant and cleaning (3,040 m^3/day). The used water from chiller plant and cleaning will be naturally evaporated, whereas the used water from aircraft will be transported to wastewater treatment plant. The total amount of wastewater in the operational phase is 2,550 m^3/day (water loss rate: 30%).

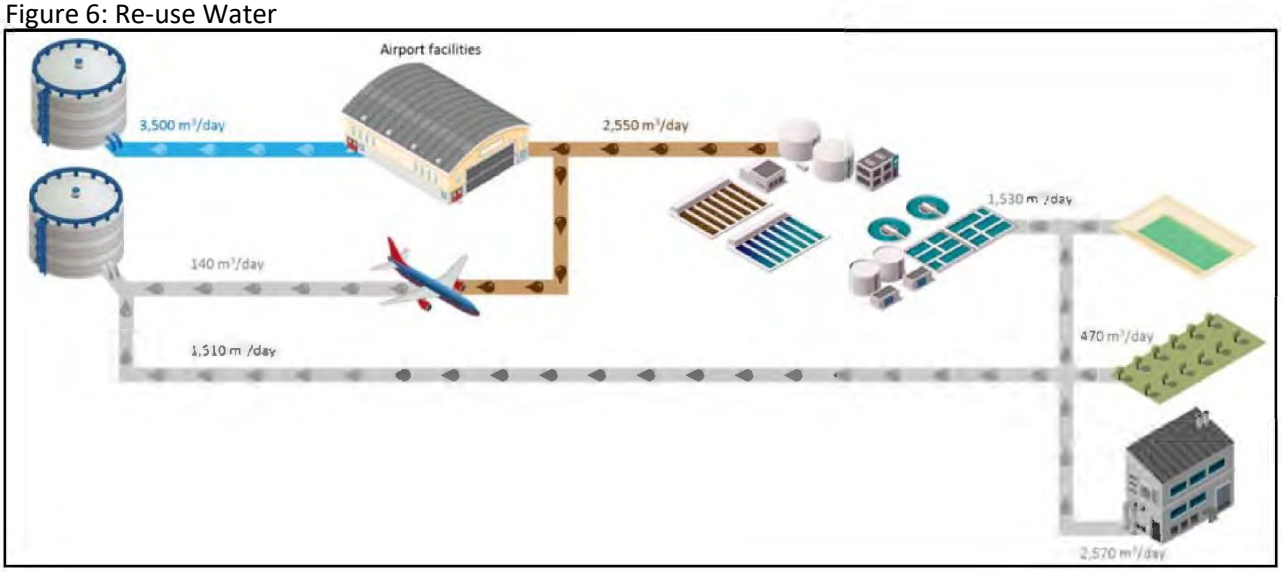
The project will re-use treated wastewater, which is approximately 1,530 m^3/day. The details of wastewater amount and management are illustrated in Table 50.

Table 49: Wastewater estimation and management in the operational phase (2030 and 2050)

Water use	Unit	Water Requirement		Wastewater		Treated wastewater
		2030	2050	Quantity	Management	
1. Potable water	m^3/day	1,800	3,500	2,450	Wastewater Treatment	1,530 (Re-use)
2.Non-potable water						
- Aircraft non-potable water (Home carrier base aircraft cleaning)	m^3/day	79	140	100	Wastewater Treatment	
- Chiller plant	m^3/day	1,008	2,570		Evaporated	
- Irrigation water demand	m^3/day	401	470		Evaporated	
Total	**m^3/day**	**3,288**	**6,680**	**2,550**	-	**1,530**

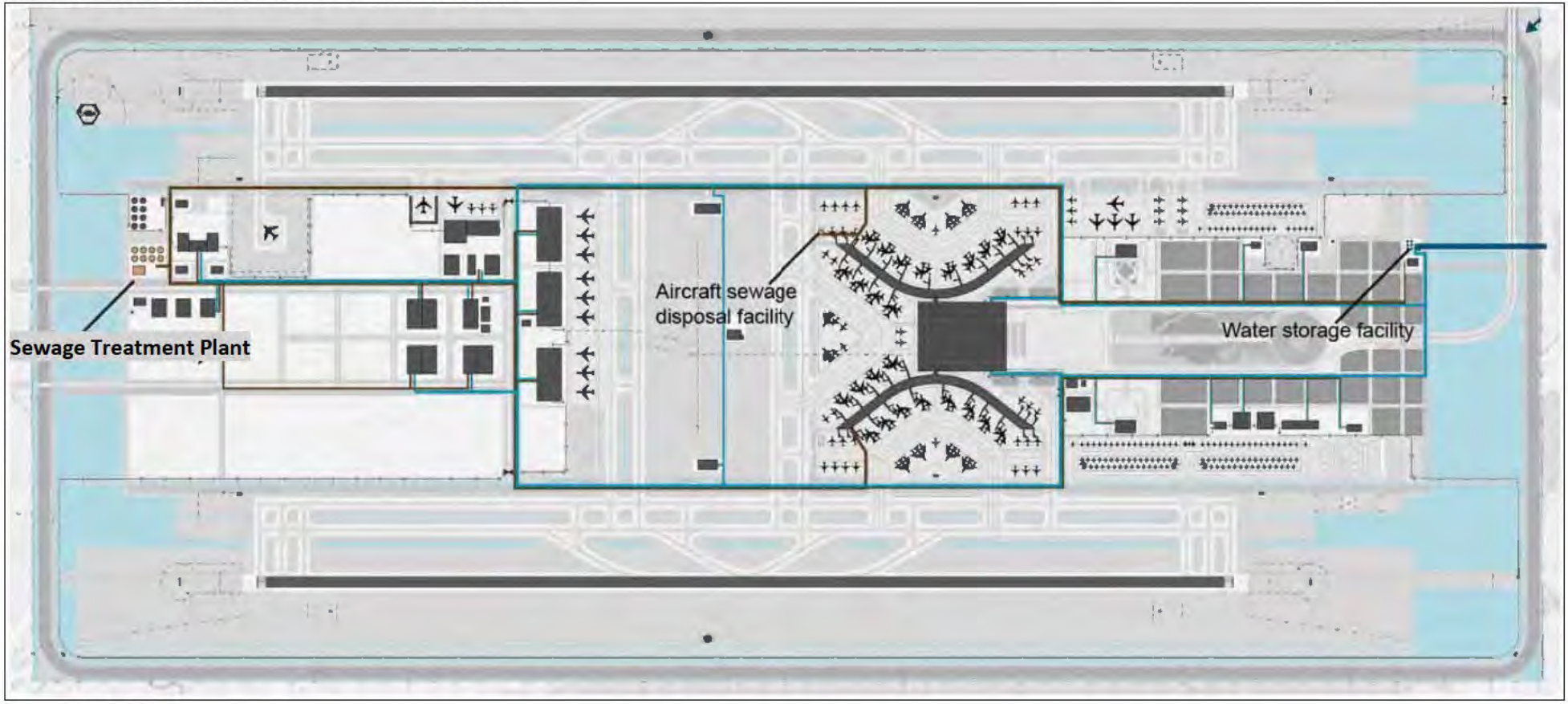
Source: CAIC, 2019

Figure 6: Re-use Water



Source: CAIC, 2019

Photo 55: Water Supply Network and Sewerage System



Source: CAIC, 2019

4.10. Waste Water Treatment Plant and Drainage System

4.10.1. Wastewater Treatment Plant

The wastewater treatment plant will be designed during the detailed airfield design stage that will take eight months. In principle, the wastewater treatment facility will be designed using a biological treatment method and be based on water reuse to ensure water resources sustainability at the project site. As shown in Figure 24 below, wastewater is generated from common use in each building of the airport and each aircraftand is then collected by the sewer system (separated from stormwater) into the treatment system. With regards to the airport wastewater, the effluent is then drained into a storage pond and pumped into the reservoir for distribution to other locations such as lawns, gardens and toilet use. In the estimations provided above, several retention periods have been applied:

- Primary Settlement: 6 hours;
- Secondary Settlement: 8 hours;
- Aeration Basin: 24 hours.

Note that the sewage treatment plant will be located to the south-west of the project area (Photo 4-58) on an area of 1,750 square meters, and 20,250 square meters in 2030 and 2050, respectively. The details of treatment capacity will be studied.

4.10.2. Drainage System and Flood Protection

In order to ensure flood protection at the airport, the project site was created as a result of land leveling and a polder flood protection system which will result from a combination of the following activities which are described below in detail 1) Final Formation Grading; 2) Dike & Ring Drain 3) Collection Drains 4) Retention Ponds and 5) Pump Stations.

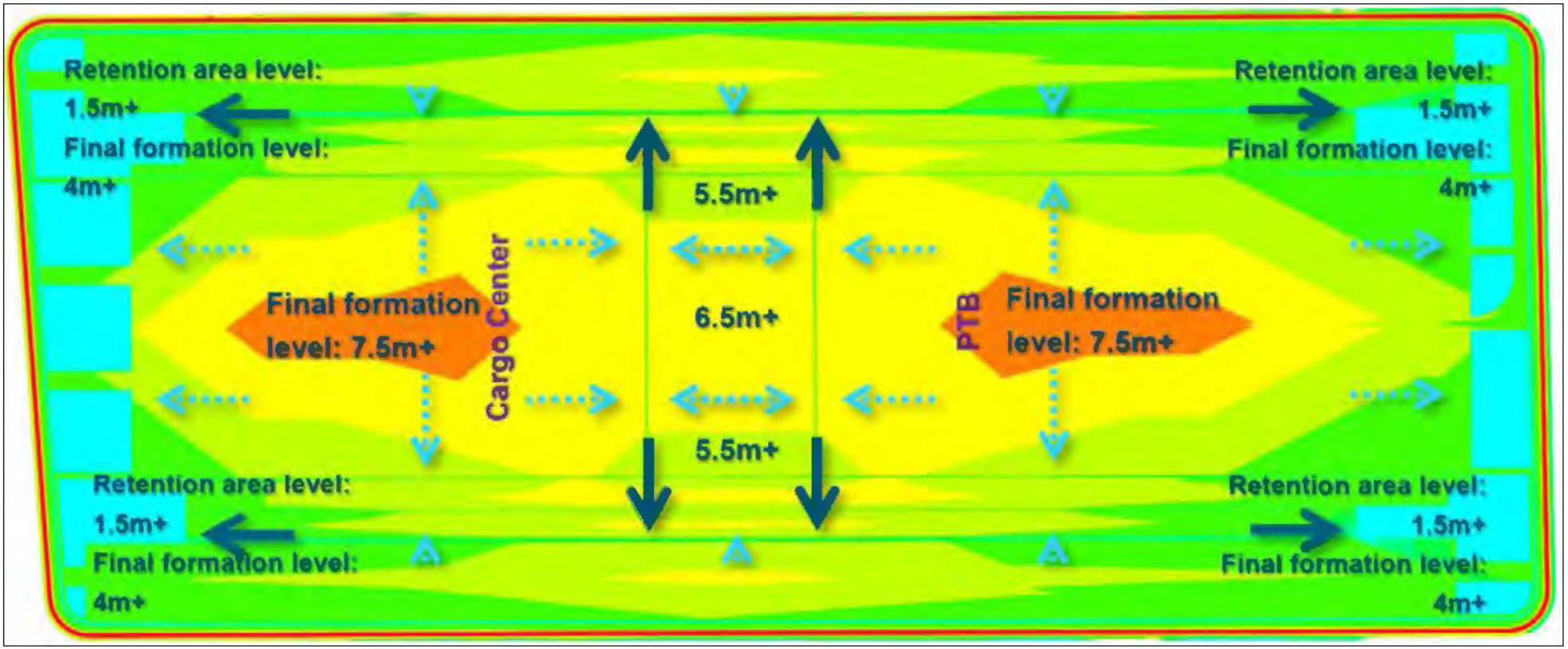
- Final Formation Grading: The fact that the NPPIA is constructed inside a polder means that the existing topography is less of a factor than it would otherwise be. It means that the grading can be done in such a way that it suits the drainage concept. Starting at MSL+1.5m bottom level of the retention ponds and taking a water depth of 2m with freeboard of 0.5m, the final formation level around the retention ponds is MSL+4m (1.5+2+0.5). The furthest point on the site from the retention ponds following the drainage channels is at the central area around the PTB and around the cargo center. The run-off from these areas has to travel ~5km to the retention ponds. With an average minimum gradient of ~1:1,500, the level of these central areas needs to be ~3.5m higher than around the retention ponds. Because the discharge level at the retention ponds is at least 0.5m lower than formation level (due to freeboard) and the surface level of pavement is assumed to be at least 0.75m higher than formation level (due to thickness of foundation and pavement) the minimum hydraulic gradient thus achievable is ~1:1,000. The resulting final formation levels are shown in Figure below.
- Dike and Ring Drain: Along the inside of the dike, a reservation is made for a ring drain with top width 15m, 1:2 side slopes and a bottom level of MSL+1.5m to connect the retention ponds with each other and to the pumping stations.
- Collector Drain: The project will build a concrete canal on either side of the runway and a canal around the airport to release rainwater. Between the two parallel runways, a collector drain with a top width of 6.5 m, 1:2 side slopes and a minimum depth of 1.5 m starting at the retention pond rising to a depth of 1.0m at the connection to the main (secondary) cross drain collects the run-off from between the two parallel taxiways (peak flow ~7m^3/s)
- Retention Ponds: 160 ha reserve for retention ponds.
- Pump Stations: Pumping is required to remove excess pluvial water (rainfall) and this will be executed in an environmentally effective manner. Water pumping from the project area will only be done if the water in the project area is above the capacity of the project water retention capability.

The photos below show the various graded levels across the site and also demonstrates the flow directions of water across the site – all of which is channeled away to retention ponds ideally for recycling. Rainwater stored in these ponds will be reused, especially for use in toilets, fire hydrant system and for irrigating green areas.

4.10.2.1. Water diversion

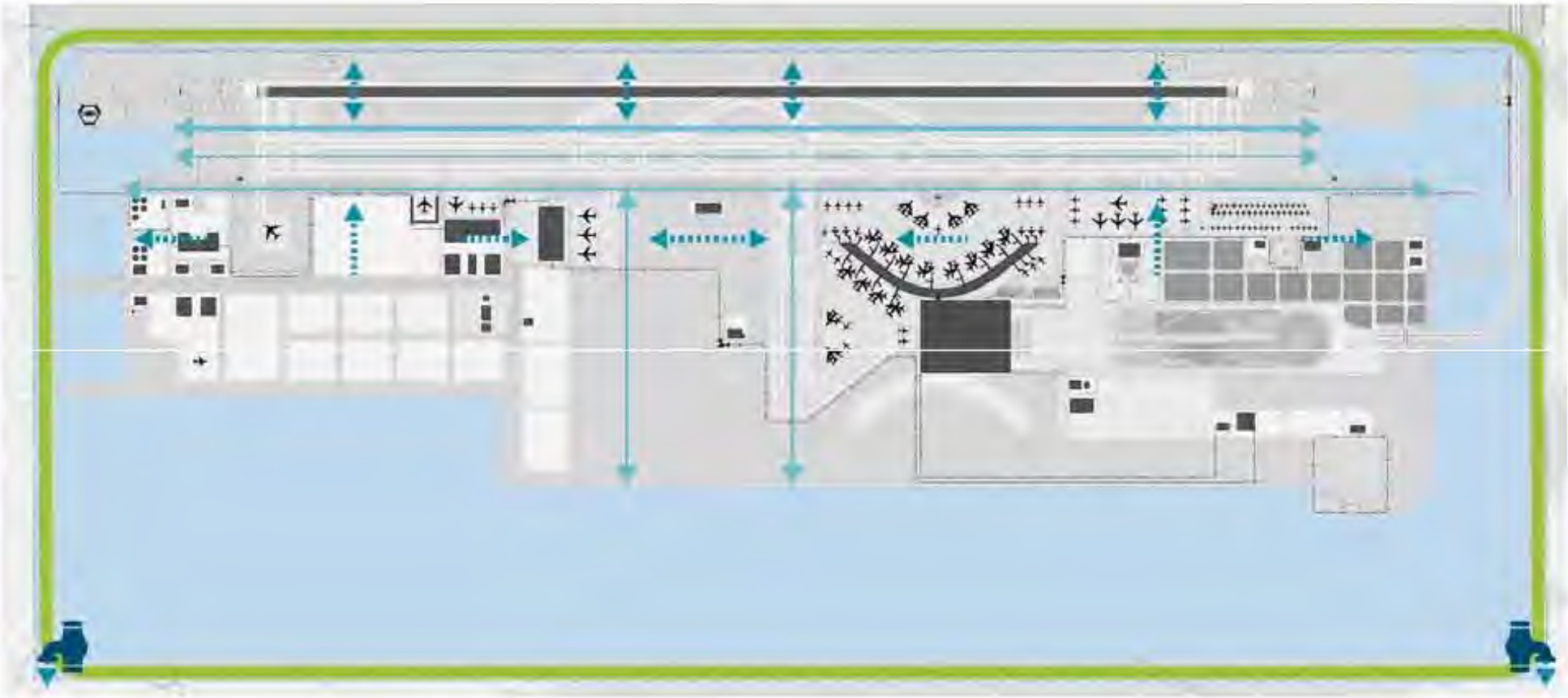
According to the study, Boueng Cheung Loung is a natural lake, located southeast of the project site, which contains water in both the dry and the rainy season. Preak Ta Hor canal is located north of the project site and connectsg Preak Tnoth to Boueng Cheung Loung and Tonle Bati in the southern part of project site. The other canals that flow through the project site (such as canal 92, canal 57 and canal 58) e flow from the wesern area into Boueng Cheung Loung through canal 92 and those canals providing water for irrigation. Only Tonle Bati (at the end of Cheurng Prey village, Potsor commune until the Boueng Cheung Loung) and part of canal 92, canal 57 and canal 58 are actually located inside project site (see Photo below). Therefore, soil backfilling to serve the construction of airport will affect the water flow and interrelationship with Boueng Cheung Loung.

Photo 56: Final Formation Grading and Water Direction Flow



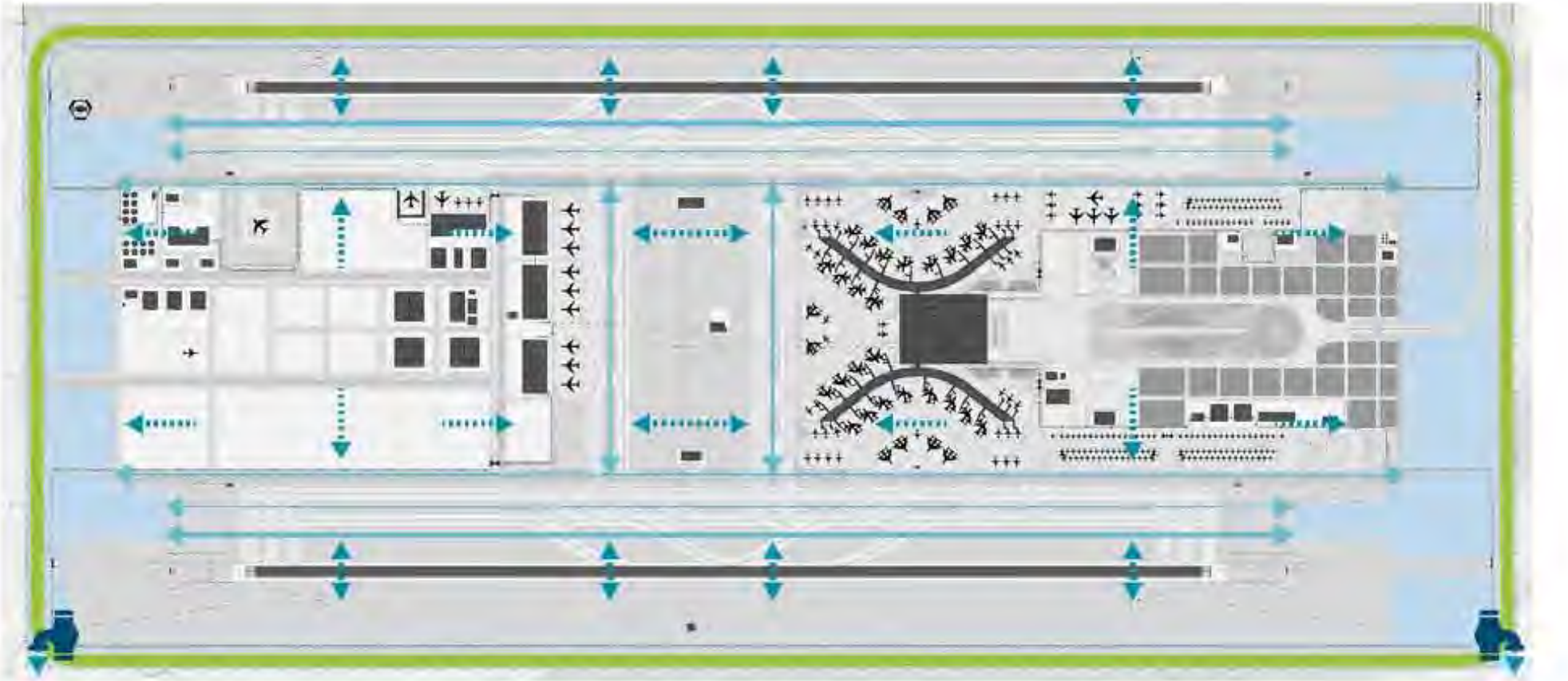
Source: CAIC, 2019

Photo 57: Drainage System of New Phnom Penh International Airport (2030)



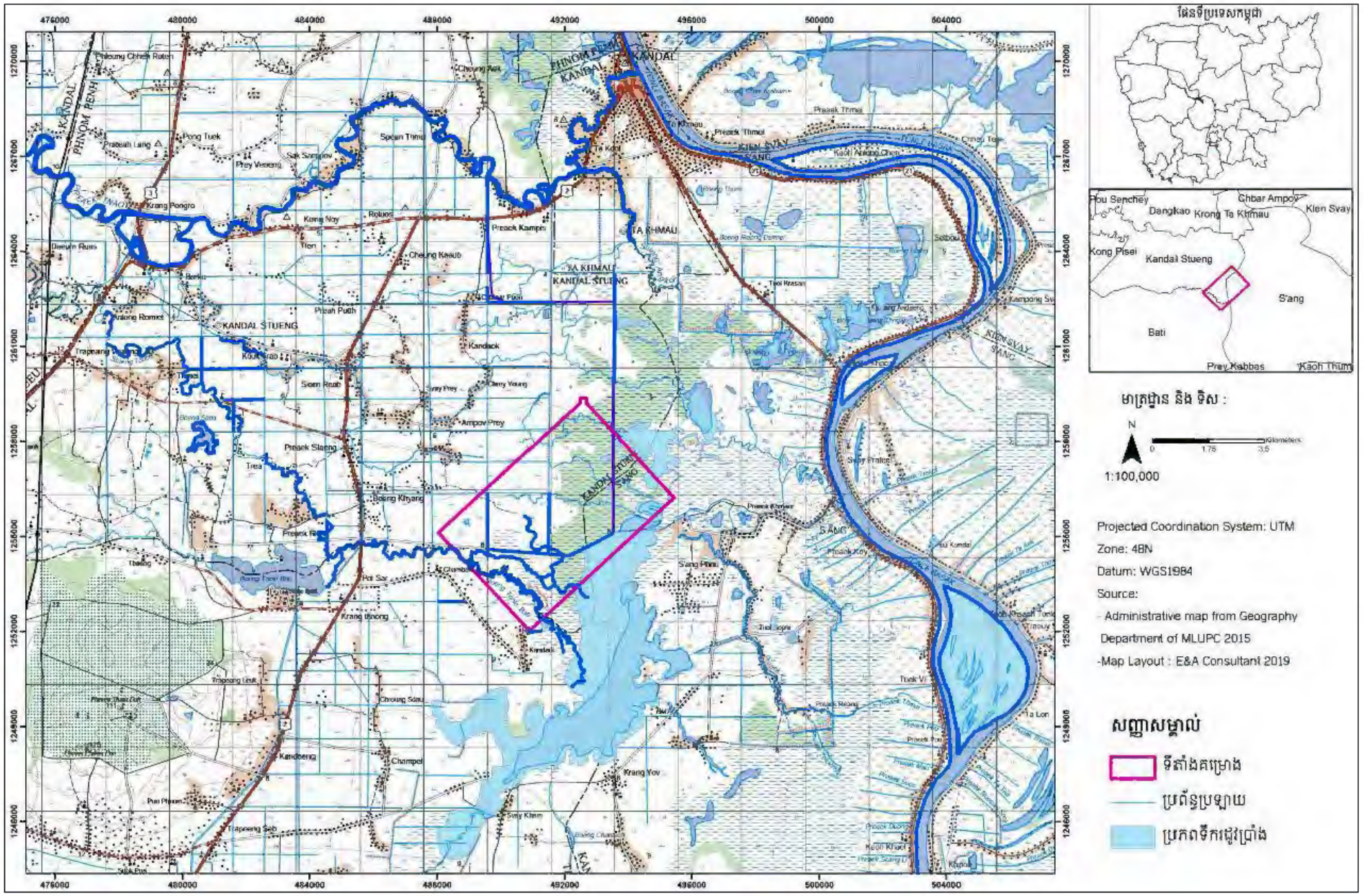
Source: CAIC, 2019

Photo 58: Drainage System of New Phnom Penh International Airport (2030)



Source: CAIC, 2019

Photo 59: Hydrology in the project area and Proposed Water Diversion



4.10.2.1 Formation of Ring Dikes

Engineering options have been developed for the permanent boundary dikes which are required around the full perimeter of the site to provide protection against flooding and to maintain the water levels within the site area. During the design coordination workshops held between the Client, the PMC and the site formation Designer in August 2019, the following criteria were agreed and have been adopted for the current design of the dikes:

- There are no any heavy structures/utilities or transportation road on the crest and the width of crest is set to a minimum of 2m;
- The recommended minimum design height for 2040 by NACO, i.e. +9.7msl for all dike sections, is set as the target design level for the dikes;
- There is no specific long settlement limit set for the dikes, but the NACO minimum level for 2040 shall be maintained. This requires lifting up the construction level of the dikes to compensate the long term settlements. The construction level is therefore set to be approximately +11.0msl. Ground treatment is not going to be carried out for reducing the long term settlements;
- The dikes are designed to meet stability and seepage requirements;
- Regular monitoring of long-term settlements of the dikes is recommended.

The existing ground level at the perimeter of the site varies from about +2msl to +8msl, as shown in Photo 4-63. The dike heights therefore vary with the ground levels. The dikes are divided into 4 types according to the height of dike from existing ground level as shown in the Table 51 and Photo 60 to Photo 64. For the northeast and southeast portions of the dike (Type 4) where the existing ground is the lowest, a portion of dike Type 4 may be located in flooding area throughout a year (i.e. in the lake). Depending on actual site conditions during the construction of the dike Type 4, a clay core may not be able to compacted properly. As an alternative option, a different dike section, dike Type 4 (Option B) is proposed and is shown in Photo 65.

Table 50: Summary of Dike Types

Dike	Height (m)	Crest width (m)	Slope gradient	Chainage (m)	Length (m)	Ground Condition
1	3 ~ 5	2	1:2	0 ~ +3000	3000	Land
2	About 5	2	1:3	+3000 ~ +6000	3000	Land
3	About 7	2	1:3	+6000 ~ +7500 +15000 ~+17038	3500	Land
4	8 ~ 9	2	1:3	+7500 ~ +15000	7500	Lake/Land

Source: CAIC (2019)

Photo 60: Dike Layout

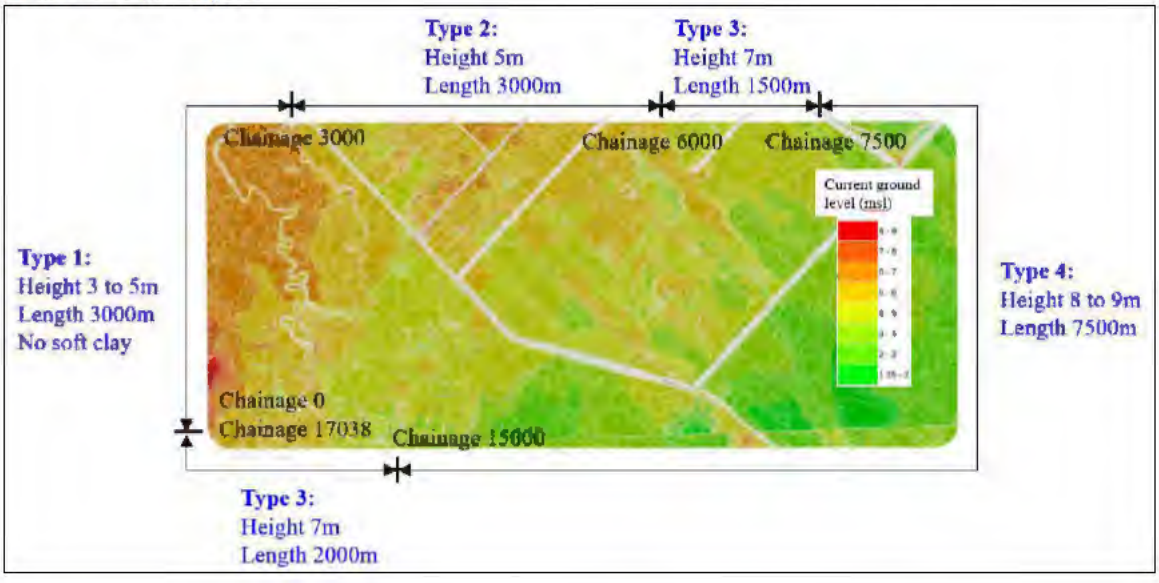


Photo 61: Dike Type 1

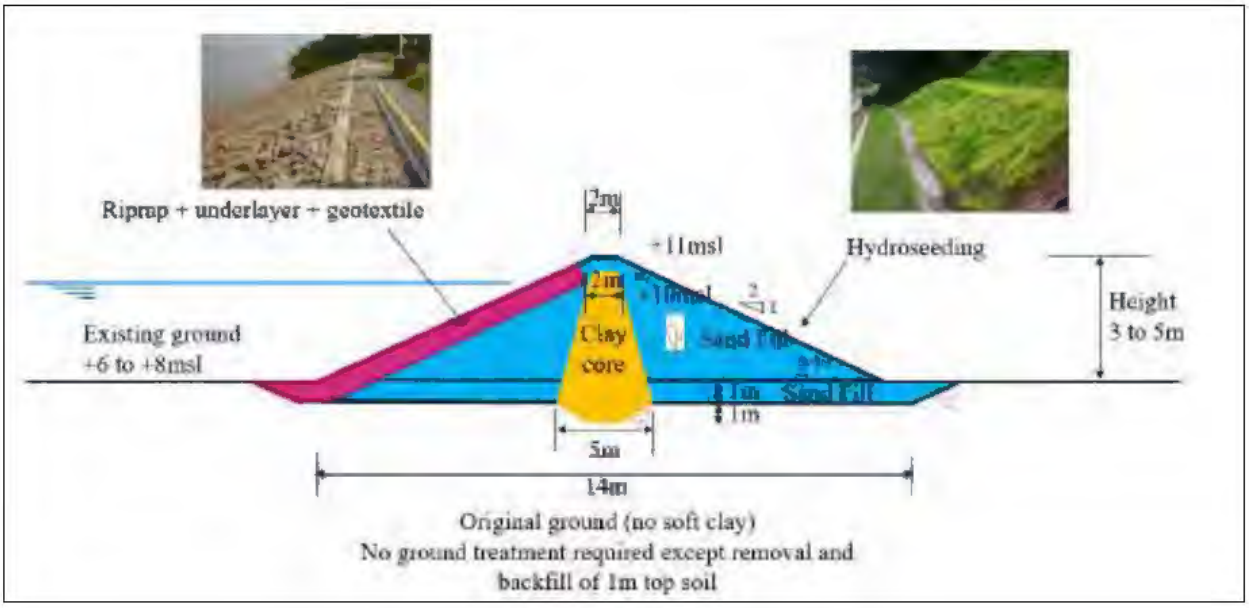


Photo 62: Dike Type 2

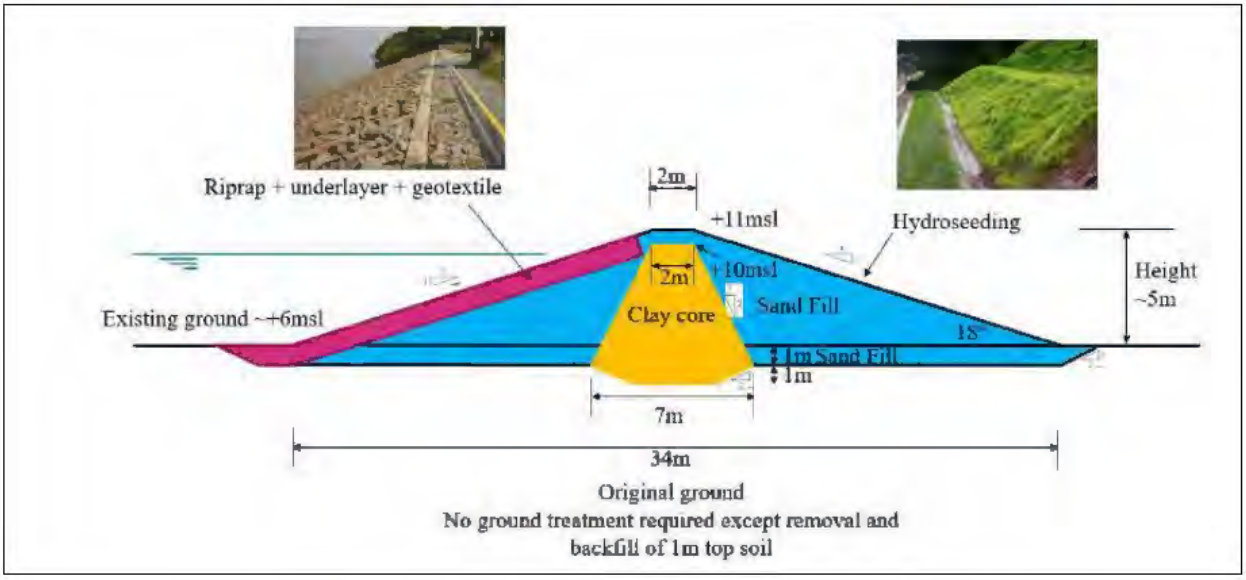


Photo 63: Dike Type 3

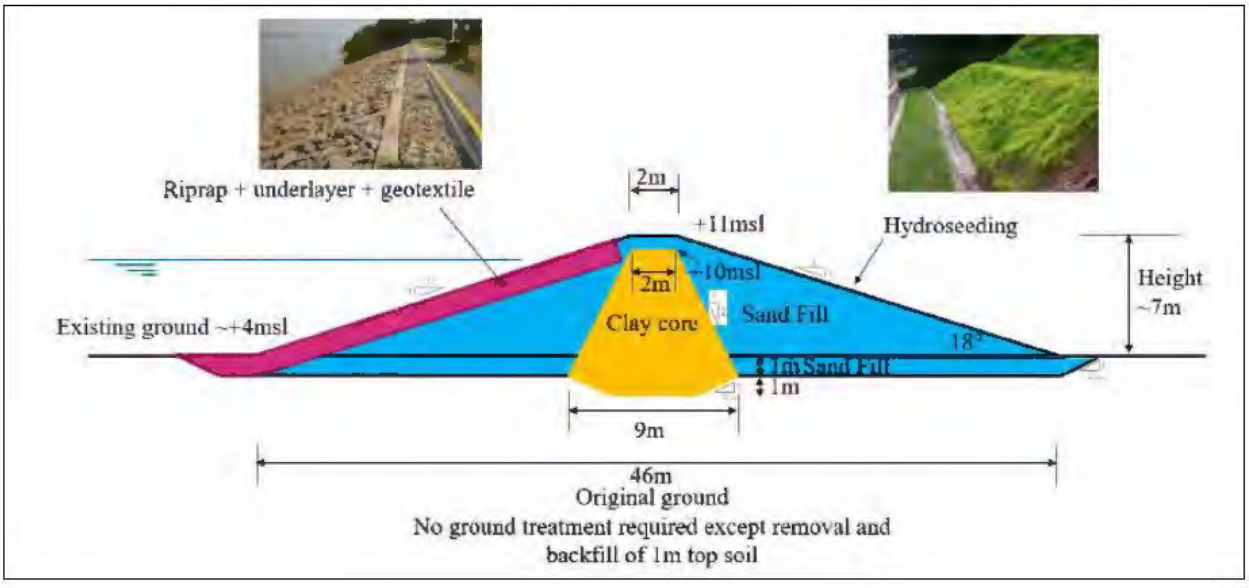


Photo 64: Dike Type 4 Option A

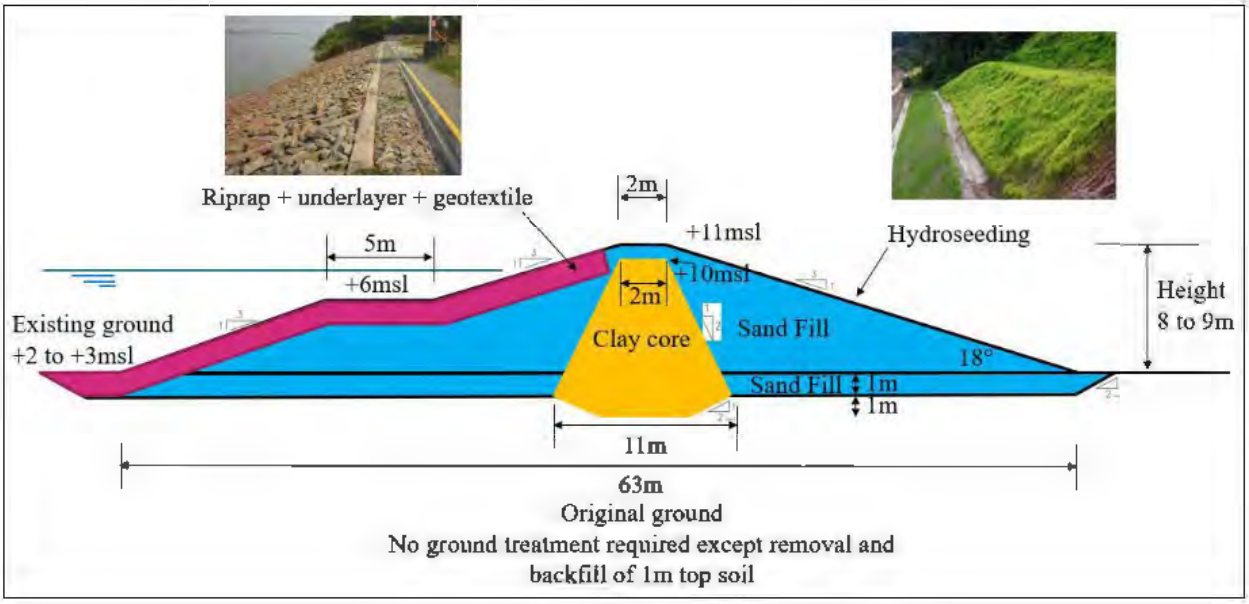
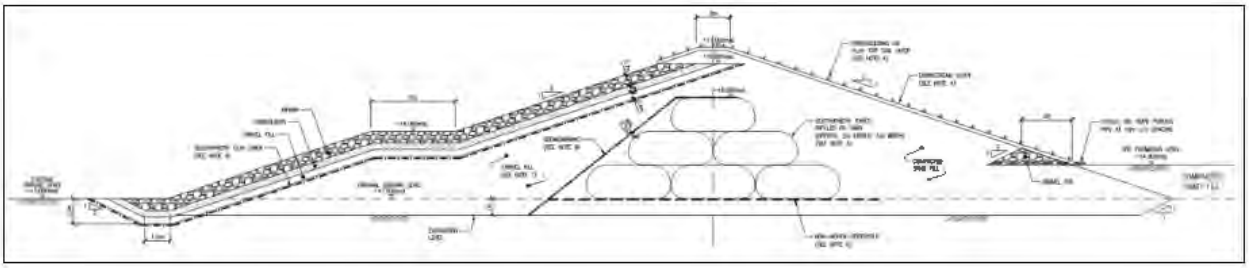


Photo 65: Dike Type 4 Option B



As there are no any heavy structures/utilities or transportation road on the crest, settlement/differential settlement is not a critical issue for the design of the dikes. Subject to long term monitoring of the dike performance, the dike could be topped up if there is obvious differential settlement, or crest level is lower than +9.7msl by 2040. Clay core is to be formed as a portion of dike body to reduce the amount of water seepage during flooding to an acceptable range. The stability of dike is essential to the design of the dike.

4.10.2.2. Dike construction

Construction Sequence of Dike on land: The construction sequence of boundary ring dike on land is described and illustrated as below:

1. Remove the top muddy soil and soil with vegetation, and back fill with sand fill.
2. Construct the dike up to +8msl in accordance with the designed sections by compacting the sand fill and the clay core. Fill and compact sand fill and clay core in 150 to 300mm thick1 layers to achieve 95% of the relative compaction.
3. Keep monitoring the ground and dike movements and pore pressure data for a period of at least 3 months, subject to the review of the Employer's Representative.
4. Once instructed by the Employer's Representative, construction the dike to the design crest level.
5. Trim the overfilling to form final surface of the dike with designed slope gradient.
6. Form the riprap and underlayer as the upstream slope protection. Form the hydroseeding slope as the downstream slope protection.

Construction Sequence of Dike in lake: The construction sequence of boundary ring dike in lake is described and illustrated as below, based on actual site conditions: Dike Type 4 (Option A): form the dike Type 4 (Option A) similar as dike Types 1 to 3 on land. This may require forming a temporary water cutoff and drainage system outside the permanent ring dike alignment. Dike Type 4 (Option B): form the

core of the dike body using geosynthetic tubes infilled by sand-water mixture and use surface geosynthetic clay liner (GCL) as permanent water cutoff system, with the following construction sequence:

1. There no specific temporary works to be considered.
2. Lay a layer of non-woven geotextile at the location of the tube as filter layer avoiding scouring during the filling process.
3. A high strength woven geosynthetic reinforcement (optional) can be designed to improve the safety against deep slope failure or bearing failure.
4. Place geosynthetic tubes on the non-woven geotextile. Fill the tube with sandwater mixture. The recommended tube dimensions are approximately height of 2m and width of 6.5 m.
5. Place the geosynthetic tubes one by one and form the core of dike to +8msl, which is above the annual flooding level.
6. Depending on actual programme, a temporary water cutoff system in the form of a geomembrane may be required, in order to prevent the flooding of the site during construction in the wet seasons.
7. Form the dike at lake side with gravel fill and sand fill at land side up to a level of +8msl.
8. Keep monitoring the ground and dike movements and pore pressure data for a period of at least 3 months, subject to the review of the Employer's Representative. Once instructed by the Employer's Representative, construction the dike to the design crest level.
9. Trim the overfilling to form final surface of the dike with designed slope gradient. Place Geosynthetic Clay liner (GCL) as permanent water cutoff system for long term flood protection.
10. Form the riprap and underlayer as the upstream slope protection. Form the hydroseeding slope as the downstream slope protection.

It should be noted that for the construction of the dikes both on land and in the lake, the dike is recommended to be built up to +8msl and a hold period of at least 3 months is introduced. Monitoring of the dike settlement and ground movements is required during this hold period. The hold period with monitoring data is deemed important for the reasons as follows:

- The ground investigation (GI) points are typically 200m spacing at the dike alignment, including both Stages 1 and 2 GI. Adverse ground conditions between the GI points may result in risks for the dike construction.
- The GI points are at the centreline of the dike alignment. Adverse ground conditions along the transverse direction of the dike may result in risks for the dike construction.
- A number of the Stage 2 CPTs at the dike area were changed to drillholes due to site condition constrains experienced by the GI Contractor, particularly when the water level was high. In terms of defining soil layer thickness the CPT data are preferred. Adverse thickness or elevations of the soft clay layer may result in risks for the dike construction.

For the reasons above, we recommend to introduce a hold period of at least 3 months after the dike is constructed to +8msl, which is above the annual flood level and is able to protect the site from annual flooding. Stability of the constructed dike should be assessed from the monitoring data, before the dike is further topped up to the final level.

4.11. Worker and Public Health and Safety Management Plan

4.11.1. Construction Phase

To ensure work safety and to improve the effectiveness of hazard prevention as well as to achieve "zero accident", the project will implement all relevant technical standards and safety guidelines. Several measures will be implemented as follows:

4.11.1.1. Personal Protective Equipment

Personal protective equipment (PPE) will be provided to all workers and employees during the construction phase. All protective equipment will be distributed to workers and employees according to their type of work. Examples of PPE and other safety equipment are shown in Photo 66 below. There will also be an on-site health facility providing first aid to workers during the construction phase. The Project also has a detailed Emergency Response Plan.

Photo 66: Personal Protective Equipment to be used during Construction

1. Ear plugs and ear defenders

2. Protective Gloves

3. Protective Cap

4. Safety Boots

5. Traffic Cones

6. Safety belts and badges

Source: CAIC, 2019

4.11.1.2. Security management in the construction site

The construction site manager will oversee the work safety and security within the site. All relevant personnel shall be responsible in their own roles as follow:

- Supervise worker's performance and safety;
- Safety and occupational health management plan in the site;
- Training on work safety rules and machinery operation in the site;
- Techniques of using equipment and risk mitigation measures such as landslide, the fall of objects from high places on worker, loading materials in high places, operating cranes, electrocution, and personal protective equipment; and
- Daily implementation of work safety.

4.11.1.3. Safety of Traffic Control Tower Erection and other infrastructures

The safety rules are as follows:

- Warning signs in the site;
- Strictly monitor any transfer of material using crane;
- Ensure there are personnel giving out signs at low and high places;
- Proper interval between a crane and another;
- Scaffold shall be properly installed; and
- There are covers to protect objects or debris from falling on workers.

4.11.1.4. Machinery operation

The safety rules are as follows:

- Crane operating techniques;
- Management and checking techniques of objects to be hoisted;
- Giving out signs when in operation;
- Machinery operation techniques for excavator, compactor, welding machine, etc;
- Cement mixing and pumping techniques; and
- Techniques for operating other machinery.

4.11.1.5. Transport

The safety rules are as follows:

- Use required truck to transport heavy load;
- Cover truck transporting materials, objects, or wastes that potentially emit dust;
- Regularly maintain truck;
- Implement the instructions on road use issued by the provincial Department of Public Work and Transport; and
- Follow the road traffic law.

4.11.1.5. Dust management

The safety rules are as follows:

- Cover builidngs form the ground floor to the top floor during construction stage;
- Regularly spray water, particularly in the dry season, in the site;
- Cover truck transporting materials such as sand, rock, and gravel; and
- Spray water on the wastes that potentially emit dust.

4.11.1.5. Noise manegement

Every major airport has Noise Abatement Procedures (NAPs), which are designed to reduce the impact of aircraft noise on the community. They include procedures for runway use and flight paths to reduce flights over residential areas, as well as the designation of noise abatement areas (areas that aircraft will try to avoid such as hospitals, schools, historic sites).

This is accompanied by the ongoing development and adoption of aircraft, soundproofing and buyouts of buildings near airports, operational flight control measures (altering flight paths and climb and descent profiles to reduce both noise and environmental pollution) , and land use planning strategies. Whilst no aircraft can fly closer than 500 feet to any person, vessel, vehicle, or structures - in reality the distances are significantly greater and airports will proactively endeavor to keep noise to an absolute minimum. Furthermore, noise monitoring, both at the airport and adjacent to it, is normally a constant and ongoing process to ensure that NAPs are appropriate.

The way aircraft are operated in day-to-day operations may also present impacts in terms of the noise that reaches the ground. ICAO assists on the development and standardization of low noise operational procedures that are safe and cost-effective. The possibilities include noise preferential runways and routes and noise abatement procedures for take-off and landing. The appropriateness of any of these measures depends on the physical lay-out of the airport and its surroundings, but in all cases the procedure must give priority to safety considerations.

The International Civil Aviation Organisation (ICAO) recommendations on operational procedures are contained in several documents:

Doc 8168 (*Procedures for Air Navigation Services — Aircraft Operations* (PANS-OPS)) Part I –provides guidance on noise preferential runways and routes, displaced thresholds, approach and landing operating procedures, and Noise Abatement Departure Procedures (NADPs).

Doc 8168 (Procedures for Air Navigation Services — Aircraft Operations (PANS-OPS)) Part II –includes the consideration of noise aspects on the planning and definition of departure routes, including the compromise involved in concentrating or spreading aircraft noise with the routes definition

Doc 9931 - Continuous Descent Operations (CDO) Manual and Doc 9993 - Continuous Climb Operations (CCO) Manual provide guidance on CDO and CCO operations that may present benefits at both noise and emissions aspects.

Doc 9888 – *Review of noise abatement research and development and implementation projects* contains a summary of two surveys of key aviation stakeholders conducted in 2006 and 2008.

Doc 10031 Guidance on Environmental Assessment of Proposed Air Traffic Management Operational Changes provides environmental assessment guidance to support sound and informed decision making when analysing proposed air traffic management (ATM) operational changes.

SSCA, as the State regulator, will seek to ensure that all ICAO recommendations will be met in Cambodia.

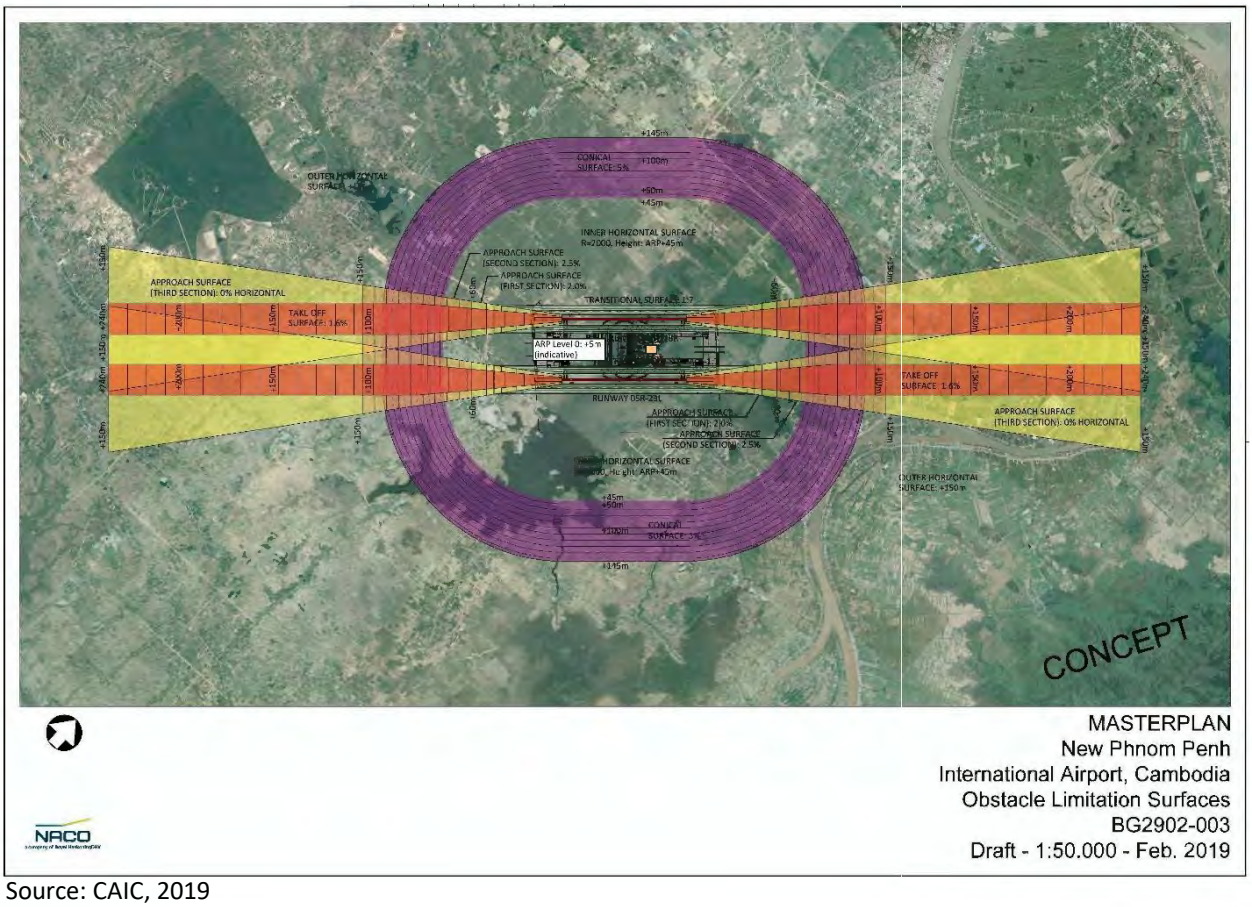
4.11.2. Operational Phase

4.11.2.1. Obstacle Limitation Surface

Obstacle limitation surface has been identified in the project's master plan, and shall be further elaborated in the detailed layout. Its purpose is to determine building height restriction in the airport's vicinity. The calculation follows ICAO Annex 14, 8th edition, July 2018 and ICAO Airport Service Manual Part 6 Control of Obstacle (2nd Edition, 1983).

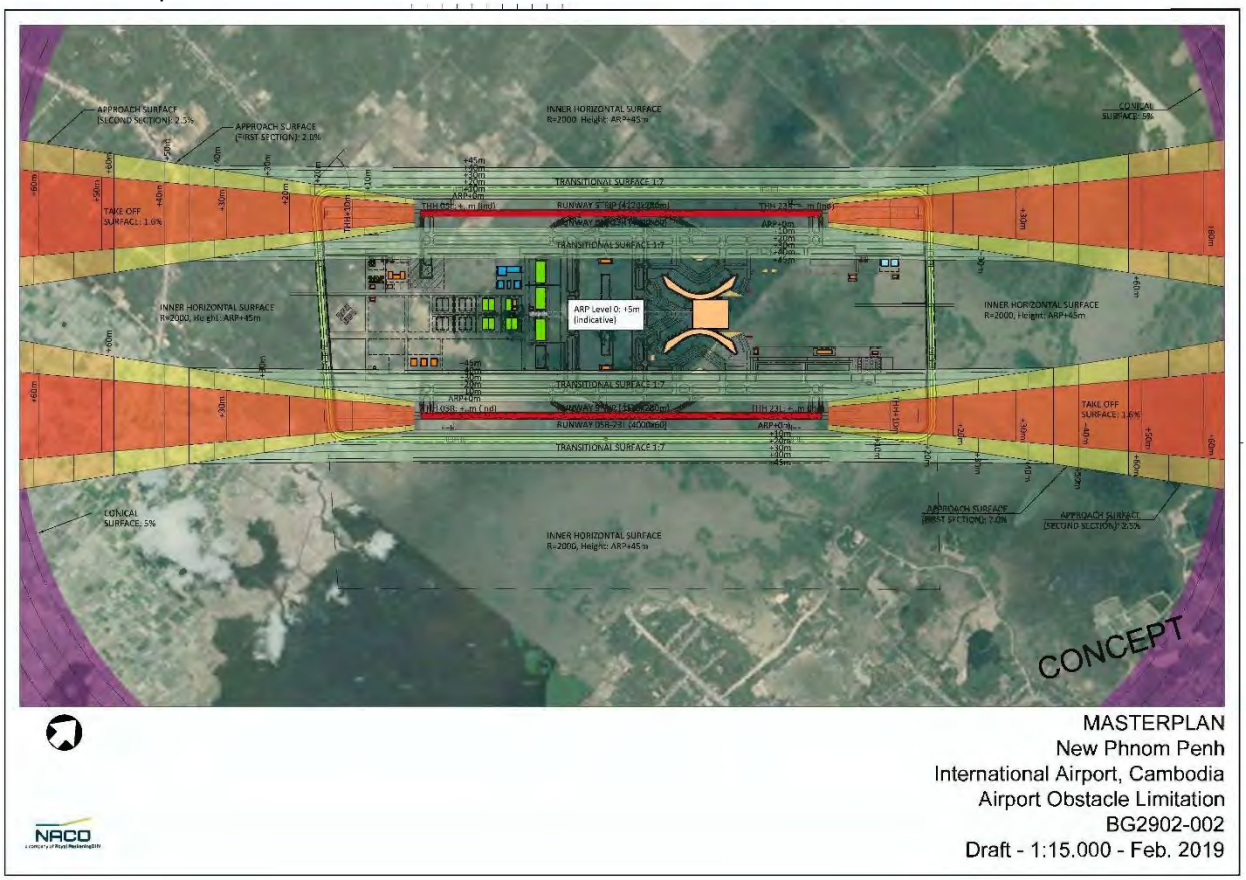
The main purpose of inner horizontal and conical surface is to protect the approach, take-off, and visibility. Obstacle limitation surface will be finalized based on the approval of Civil Aviation Secretariat. If the airport's elevation is 5 meters, the height of proposed building in the airport shall be less than 50 meters AMSL.

Photo 67: Obstacle Limitation Surface



Source: CAIC, 2019

Photo 68: Airport Obstacle Limitation



Source: CAIC, 2019

4.11.2.2. First Aid System

- First Aid Room: A first-aid room is to be located in the passenger terminal adjacent to the area of passenger flow concentration, which will meet the requirement of rescue time. The number of first-aid rooms is calculated by one per 60,000 – 100,000 m^2 of terminal area, or the maximum interval of passenger flow less than 600m. In Phase I, the terminal area is 118,000 m^2, so two first-aid rooms will be set up there with 55 m^2 of space allocated to each one. The first-aid room consists of a diagnosis room, and a rescue room with 40 m^2 in total, and a lounge with 15m^2.

- First Aid Station: There will be a first-aid station in the terminal. In Phase I, a first-aid station is set up in the terminal, withan allocated area of 165 m^2, which includes a diagnosis room with 20 m^2, a treatment room with 20 m^2, a rescue room with 40 m^2, an isolated observation room with 30 m^2, three lounges with 45 m^2 in total, two restrooms with 10 m^2 .

- First Aid Centre: The airport first aid centre is responsible for emergency rescue management of the airport and commands the emergency medical services of the first aid stations and first aid rooms. The first aid centre with an allocated area of 2,000m^2 is set up in the short term, and will include an emergency rescue supplies reserve room with 100m^2 and nine ambulance garages with 300 m^2.

Table 51: Emergency Medical Vehicles

No.	Vehicles	Number
1	Ordinary Ambulance	3
2	Resuscitation Ambulance	3
3	Emergency Command Vehicle	1
4	Medical Personnel Truck	1

5	Emergency Rescue Supplies Reserve (4 ton – 5 ton)	1
	Total	**9**

Source: CAIC, 2019

4.11.2.3. Airport Emergency Response Plan

The project will create an emergency response plan for the airport. The plan will be developed in accordance with nternational (ICAO) and national (SSCA) rules, regulations and standards. The plan will establish a health office responsible for responding to emergencies within the airport, managing the situation and improving medical services.

The plan ensures effective rescue and reduction of accidents in cases of emergency need at the airport. Emergency medical personnel will must implement this plan at NPPIA. The plan includes the following key principles:

- Employment Policy: Airport emergency services will adhere to the principle of saving lives and reducing property loss to a minimum.
- Emergency Rescue Area: The size of the area where the emergency work is within the aiport boundary unless special permission is given.
- Emergency and Responsibility Unit: Director of Airport Health Office, Chief of Physicians and Medical Staff, etc.
- Responsibilities of the unit and emergency medical personnel:
    - Emergency Commission responsibilities
    - Responsible for emergency care in the Emergency Room at the Airport
    - Responsibility of the First Aid Center at the airport
    - Hospital responsibilities
    - Ministry of Health's Centres for Disease Control and Prevention located at the airport
    - Emergency personnel responsibilities
- Procedures for Transfer of Medical Assistance Directive (Level 1, Level 2 and Level 3 Leaders)
- Emergency classification
    - Classification of emergencies (aircraft in violation of the law, such as bomb threat and hijackings, collisions with another aircraft, aircraft problems due to obstruction and emergency associated with Airplanes
    - Non-aircraft related emergencies (threat of putting explosives in airport buildings, fires in buildings, pollution from natural disasters.
- Communication during emergency response
    - Communication means
    - Level of response
    - Procedure of notification
    - Procedures of personel and material mobilization
    - Rescue and recovery operation
    - Reporting
    - Rescue standards.

Chapter 5 Existing Environment

5.1 Introduction

This chapter describes the existing environmental resources (physical, biological, and socio-economy resources), available within and surrounding the project area (3km around the project area), potentially affected by the project. The study collects both primary and secondary data through laboratory's test results (i.e. air quality, noise and vibration, surface water quality, ground water quality, and soil quality), direct observation, household survey and sensitive receptor interview, consultation with local authorities and other relevant authorities.

The chapter is organised by types of resources including physical resources (geology, topography, soil type, soil quality, hydrological system, surface and groundwater quality, climate and meteorology, air quality, and noise/vibration), biological resources (forest, wildlife, bird, and fisheries) and socio-economic resources (demography, settlement, living standard, migration, land ownership, land use, water consumption, infrastructure, education, healthcare and sanitation, and cultural heritages) as listed in the following section.

5.2 Natural Environmental Resource

5.2.1 Physical resources

5.2.1.1 Soil

a) Geology

Geology is the study of the earth and its physical formation. Anderson's Earth History research states that the earth's surface is made up of layers of rock that are sand and mud, formed by water and air or glaciers, and that the oldest layer is the bottom and the New layer is at the top. Cambodia was first a continent under the sea and covered with many continental debris. Then, in the first era, the area was heavily influenced by the Kraveanh Mountains, with the emergence of old rocks such as granite, rock, coal, oil and metal. In the second era, the area was once again submerged. Debris rocks overflow with flora and fauna, forming numerous mountains, especially the Kraveanh Mountains, the Dangrek Mountains, and the northeast plateau. In the third era, there is a series of young mountains eruptions and volcanic eruptions, which in turn form the basaltic basin and the eastern plateau. In the fourth era, there are numerous waterways, especially the Mekong and the sea, and they bring sediment to the Gulf as the earth moves and the sea level forms the old sediments mountainous areas in Cambodia and New sediments in the Tonle Sap. Old and New sediments form the central plains today. According to map below, using JICA's 2002 data, the geology of the project area is of Quaternary era. The Quaternary period is the latest in the fourth cycle, with a geological period and its extent dating to 2.6 million years (National Geographic Partners, LLC, 2015).

b) Topography

Cambodia is divided into three distinct zones: The Lowlands, the Highlands, and the Mountains. The Lowlands are geographically along the Mekong River and the Tonle Sap Lake, with an altitude of not more than 100 metres above sea level. The highlands are located in the north and northeast, between 50 and 200 metres high, while the plateau is between 8 and 20 metres above sea level (JICA, 2002).

c) Elevation

Map 16 shows the elevation in the project area within the 3 km around the project area using JICA's 2002 Contour Line. The result shows that the project site is located in the lowest area with the elevation of 2 m – 8 m relative to sea level.

d) Slope Level

Map 5-3 shows the projected slope level within the project area within 3 km study area around the project site based on DEM slope level data from the USGS (METI & NASA, 2011). The results indicate that the gradient in the project area flows from west to east and the slope (0–0.4 degrees) is weak. Therefore, the area is not vulnerable to landslides, especially during the rainy season.

e) Seismic and tsunami

The Earthquake Intensity Risk Zones in accordance with the 1956 version of the Mercalli Scale describes the effects of earthquakes on the Earth's surface and incorporates several parameters such as the duration of the earthquake. The United Nations Office for the Coordination of Humanitarian Affairs (OCHA) study of seismic risk intensity divided seismic levels into five main categories, using the Mercalli Scale (Modified Mercalli Scale) as follows: Level I-V: Instrumental to Rather Strong

- Level VI: Strong
- Level VII: Very Strong
- Level VIII: Destructive
- Level IX-XII: Ruinous to Catastrophic

Map 5-4 below also shows that there are no records of earthquakes or tsunamis in Cambodia. All areas in Cambodia are classified as having a depletion density below the Mercalli Scale in the range of "I-V", the lowest level of the earthquake.

f) Soil Type

According to the study by D. Crocker on soil classification in Cambodia, published in 1963 with a scale of 1/1.000.000 by the Ministry of Agriculture, Forestry, and Fishery; there are 16 soil types in Cambodia.

Table 52: Soil Type and Size in Cambodia

No.	Soil Type	Size (Trichit, 1981)	
		KM^2	Percentage (%)
1.	Red yellow podzols	22,763	12.5
2.	Latosols	7,123	3.93
3.	Planosols	1,666	0.92
4.	Plinthite podzols	17,147	9.47
5.	Cultural hydromorphics	12,896	7.13
6.	Grey hydromorphics	17,252	9.53
7.	Plenthitic hudromorphics	1,275	0.71
8.	Brown hydromorphics	6,701	3.72
9.	Alumisols	2,782	1.53
10.	Regurs	6,570	3.63
11.	Acid lithosols	45,271	25.00
12.	Basic lithosols	3,418	1.90
13.	Alluvial soils	17,064	9.43
14.	Brown alluvials	2,764	1.53
15.	Lacustrine alluvials	10,373	5.73
16.	Coastal complex	2,229	1.23
Total (Land)		**177,295**	**-**
Water		**3,721**	**2.06**
Grand Total		**181,035**	**100**

Source: D. Crocker (1963)

By using D. Crocker's 1963 soil type data, the study found that in the study area (3 km around the project site), there are two types of soil: Alluvial Soils and Cultural Hydromorphics as shown in below map. The characteristics of each soil type are described below:

- Alluvial Soils: This is a deep (> 2 m), but relatively shallow, fallow soil. In addition, soil fertility in the study area was found to be Medium Fertility Soil.

- Cultural Hydromorphic: This is an ancient sedimentary rock - an alkaline material on lowlands. An important feature of this soil proton is the presence of the above hippocampus, about the weight of plow that plowed in water for centuries. The sheath layer at a depth of about 15 cm to 20 cm, 5cm thick makes it difficult to pour water, thus important for the production characteristics of the soil. This plume weight can be found in many types of soil and can change the properties of the soil.

g) Soil Quality

Soil quality in the project area was analysed in two locations, focusing on the physical and chemical characteristic of the soil. The first site is the Alluvial Soils in the village of Prasat, and the second is the Cultural Hydromorphics in Khla Kon. The soil sampling was conducted on January 31, 2019, by analysing the soil quality laboratory of the Department of Agriculture of the Ministry of Agriculture, Forestry and Fisheries (see Table below). The soil quality analysis results were released by the Agricultural Quality Laboratory of the General Department of Agriculture on February 15, 2019 as shown in the table below. For the interpretation of the results, the analysis of soil quality is undertaken using the table of comparisons of the Ministry of Agriculture, Forestry and Fisheries.

Photo 69: Soil Samples

Source: E&A Consultant (2018)

Map 14: Soil Type

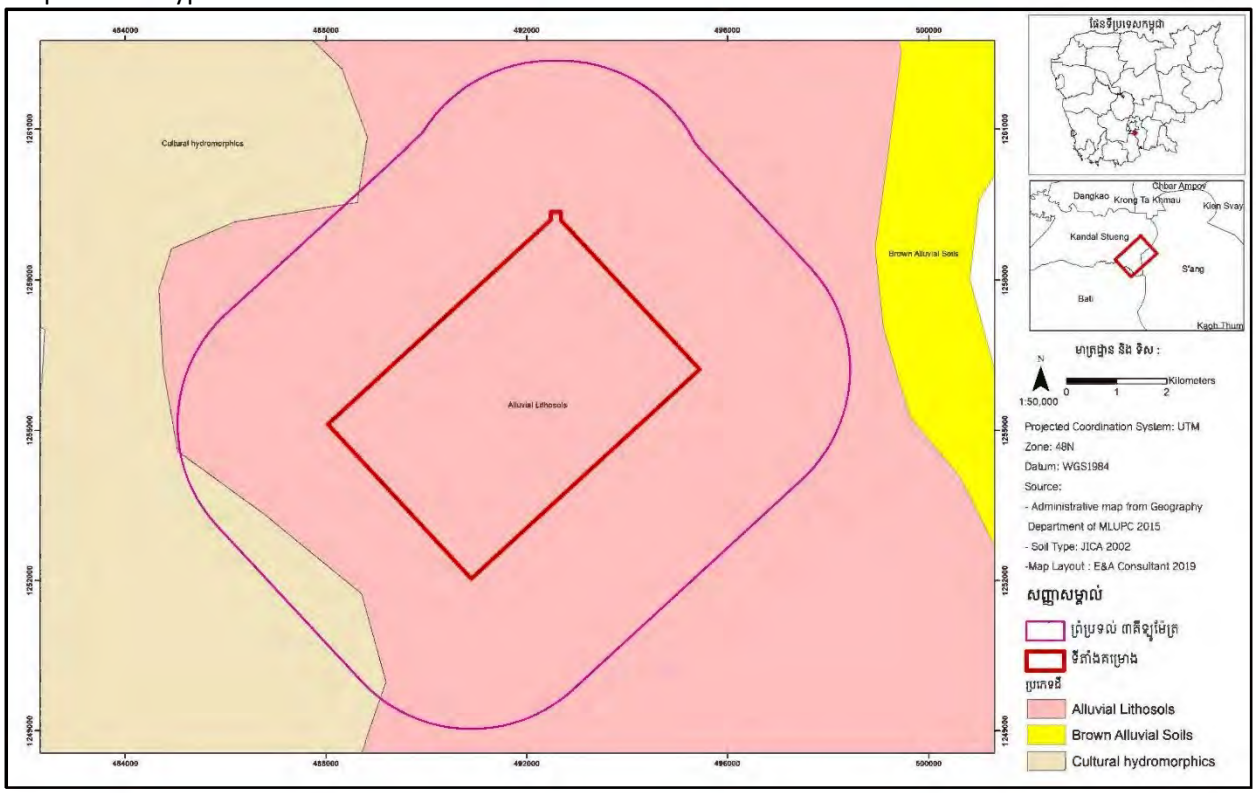


Table 53: Result of Soil Quality Analysis

Parameters		Site 1	Site 2
Particle Size (Pipette Method)	(< 0.002mm) Clay %	12,75	19,36
	(0.002-0.02 mm) Fine Silt, %	24,65	22,15
	(0.02-0.05mm) Coase Silt, %	25,83	15,12
	(0.05-0.2mm) Fine Sand, %	30,09	19,21
	(0.02-2mm) Coase Sand, %	5,45	23,57
Moisture % (Moisture, % / 105 ^{o}C)		1,02	1,37
Electrode Conductivity 1:5 (Soil: water) µs/cm		77,60	18,40
Total Carbon, (Black & walkey Method), C %		1,63	1,80
Total Nitrogen, (Kjeldal Sulfuric Method), N %		0,14	0,16
C/N Ratio (Unit)		12	11
Organic Matter (OM) %		2,80	3,09
Total Phosphorus (Nitric Digestion), P%		0,049	0,025
Available Phosphorus (Olsen & Dalbin or Bray II) P ppm		1,32	32
Cation Exchange Capacity C.E.C m.e/100g Soil (1M Ammonium Acetate at pH=7 & Leach with 10% NaCl Method)		16,80	15,50
Exchangeable Cation (m.e/100g Soil) (Method, 1M Ammonium Acetateat pH=7)	Calcium Ca	8,40	6,40
	Magnesium Mg	2,80	2,01
	Sodium Na	0,43	0,22
	Potasium K	0,46	0,35
Total Exchangeable Bases (m.e/100g soil)		12,09	8,98
Bass Saturation %		72	58
Exchange Acidity, (m.e/100g Soil)		5,40	9,27
Exchange Al, (m.e/100g Soil)		0,15	0,24
pH H_2O, (1:5 Soil and water)		7,12	5,12
pH KCL, (1:5 Soil and 1N KCL)		6,16	4,11

Source: National Laboratory of Agriculture of Department of Agriculture

Particle sizes are five (5) classifications such as clay, fine silt, coarse silt, fine sand, and coarse sand. The experiment results in Location 1 indicated fine silt content of 24.65%, coarse silt content of 25.83%, fine sand content of 30.09%, and coarse sand content of 5.45%. The experiment results in Location 2 indicated fine silt content of 22.15%, coarse silt content of 15.12%, fine sand content of 19.21%, and coarse sand content of 23.57%.

Moisture is the humidity level in soil particle gap which is necessary for plants growth. Moisture has role to speed up the dissembling of the other organism available in soil particularly it can keep soil nutrition balance and ensure plants growth (Tony, L.,James, L., Andrew, W.,& Rodge, G.,2004). The experiment results indicated 1.02% and 1.37% of moisture in Location 1 and Location 2, respectively.

Electrode Conductivity has closely connected with particle sizes (Robbert. Mark, David, & Wade, 2009). It leads us to understand soil features such as soil capacity, organic level, salt level, and ground soil layer features which might be impacts on crops productive. It changes depending on the amount of moisture generated from soil particle. The analysis results indicated the concentration of electrode conductivity of 77.70 µs/cm and 18.40 µs/cm in Location 1 and Location 2, respectively. Therefore, they are classified as the lowest level if compared with soil nutritious quality level of ministry of agriculture, forestry and fishery.

Total Carbon: according to the general department of agriculture (2015), total carbon standard in soil was subdivided into 5 scale such as: 1) Highest >20%, 2) High ranges from 17%-20%, 3) moderate ranges from 8%-17%, 4) Low ranges from 4%-7% and 5) lowest <4%. The results show the carbon level in the location 1 and the location 2 is 1.63%, and 1.8%, respectively.

Total Nitrogen is very important for agriculture crops especially it can help in processing of seed crops growth. Based on the experiment results illustrated that soil in study area has total nitrogen as following 1st location (0.14%), and 2nd location (0.16%), considered the lowest if comparing with soil nutritious quality level of ministry of agriculture, forestry and fishery.

CN (C/N Ratio) is a factor showing about soil paludiculture particularly it is main factor for determining the way and decompose level of other soil organic materials by bacteria (Sam,A., 2015). The results indicated that 1st and 2nd soil sampling location has the C/N ratio of 12 and 11, respectively, which is good paludiculture soil for agriculture crops depending on the standard level of soil nutritious quality (8.0 to 13) of ministry of agriculture, forestry and fishery.

Organic matter leads us to understand the nutritious level, organic matter level, level of each layer which helps crops growth (Bohgal, 2009). The experiment results shown 1st soil location has organic matter equal 2.8% and 2nd location 3.09%, which have high organic matter if compared with the nutritious quality standard level of ministry agriculture, forestry and fishery.

Total Phosphorous is the nutrition demanded by organism for main life processes that this substance was faced in rock, soil, and organic matters. Total Phosphorous is important for planting and it is available in all alive organism included both plants and animals. Phosphorous strongly attached with soil particle and was used by plants (Syers, 2008). The experiment results shown 1st soil location has Total Phosphorous equal 0.049% and 2nd location 0.025%, under the lowest level if compared with standard level of soil nutritious quality of ministry of agriculture, forestry, and fishery.

Available Phosphorous P2O5 of Location 1 and Location 2 are 132 ppm and 32 ppm, respectively, based on the analysis result. This result illustrated that soil available Phosphorous P2O5 in Location 1 was under highest level, while Location 2 under moderate level if compared with standard level of ministry of agriculture, forestry, and fishery.

Cation Exchange Capacity was consumed for measuring soil nutrition, soil notorious balance, and protecting groundwater from other pollutants (Cornell University Cooperation Extension, 2007). The experiments results indicated that Location 1 has Cation Exchange Capacity of 16.80 me. /100g soil, and Location 2 of 15.50 me. /100g soil. This meant that Cation Exchange Capacity in study area was under moderate level compared with standard level of soil nutritious quality of ministry of agriculture, forestry, and fishery.

Cation Exchange has main substances as Calcium (Ca), Magnesium (Mg), Sodium (Na), and Potassium (K). This team has capacity to absorb high nutritious and help to speed up plants or crops growth (Michael Astera, 2015). According to the experiment results illustrated that soil in study area has concentration of Calcium at 1st location equal 8.40 me./100g soil and 2nd location 6.40 me./100g which was under moderate level.

Magnesium (Mg) at the 1st location is 2.08 me. /100g, and at the 2nd location is 2.01 me./100g, was under moderate level if comparing with determined standard of general department of agriculture.

Sodium (Na) at the 1st location is 0.43 me. /100g under the moderate level, and at the 2nd location is 0.22 me./100g under lowest level if compared with determined standard of general department of agriculture.

Potassium (K) at the 1st location is 0.46 me. /100g, and at the 2nd location is 0.35 me./100g, under the lowest level if compared with determined standard of general department of agriculture.

Total Exchangeable Bases refers to basic total carbon which can change the formation of those Calcium, Magnesium, Potassium, and Sodium (Arden, D. Kenneth, Day Ludeke, L., 1993). According to the soil quality experiment result in study area, 1st location and 2nd location were 12.09 me. /100g soil and 8.98 me. /100g soil, respectively. This result indicated that soil in study area has moderate level Total Exchangeable Bases if compared with the standard level of soil nutritious quality of ministry of agriculture, forestry and fishery.

Bass Saturation has connected with Exchangeable Cation Capacity that it is one of those exchangeable cation such as Calcium, Magnesium, Potassium, and Sodium. Whenever Bass Saturation is high level so it meant that the acid level in soil would be shortly neutralize rather than soil with low level of Bass Saturation (Arden, D. Kenneth, Day Ludeke, L., 1993). According to this experiment result soil quality in study area at 1st location was 72% and 58% at 2nd location. This result indicated soil in study area has moderate level of Bass Saturation if compared with determined standard of ministry of agriculture, forestry and fishery.

Exchange Acidity refers to the amount of Hydrogen Ionic (H+) on Exchangeable cation of those soil clay types and organic matter in soil, and it defines the amount of necessary Aglime substance for extension soil PH (Beegle, D., Lingenfelter, D., 2001). According to the experiment result soil quality, the 1st and 2nd location have concentrations 5.40 and 9.27 me. /100g soil, respectively. This result shown that soil in study area has low level of Exchange Acidity if compared with soil notorious quality level of ministry of agriculture, forestry and fishery.

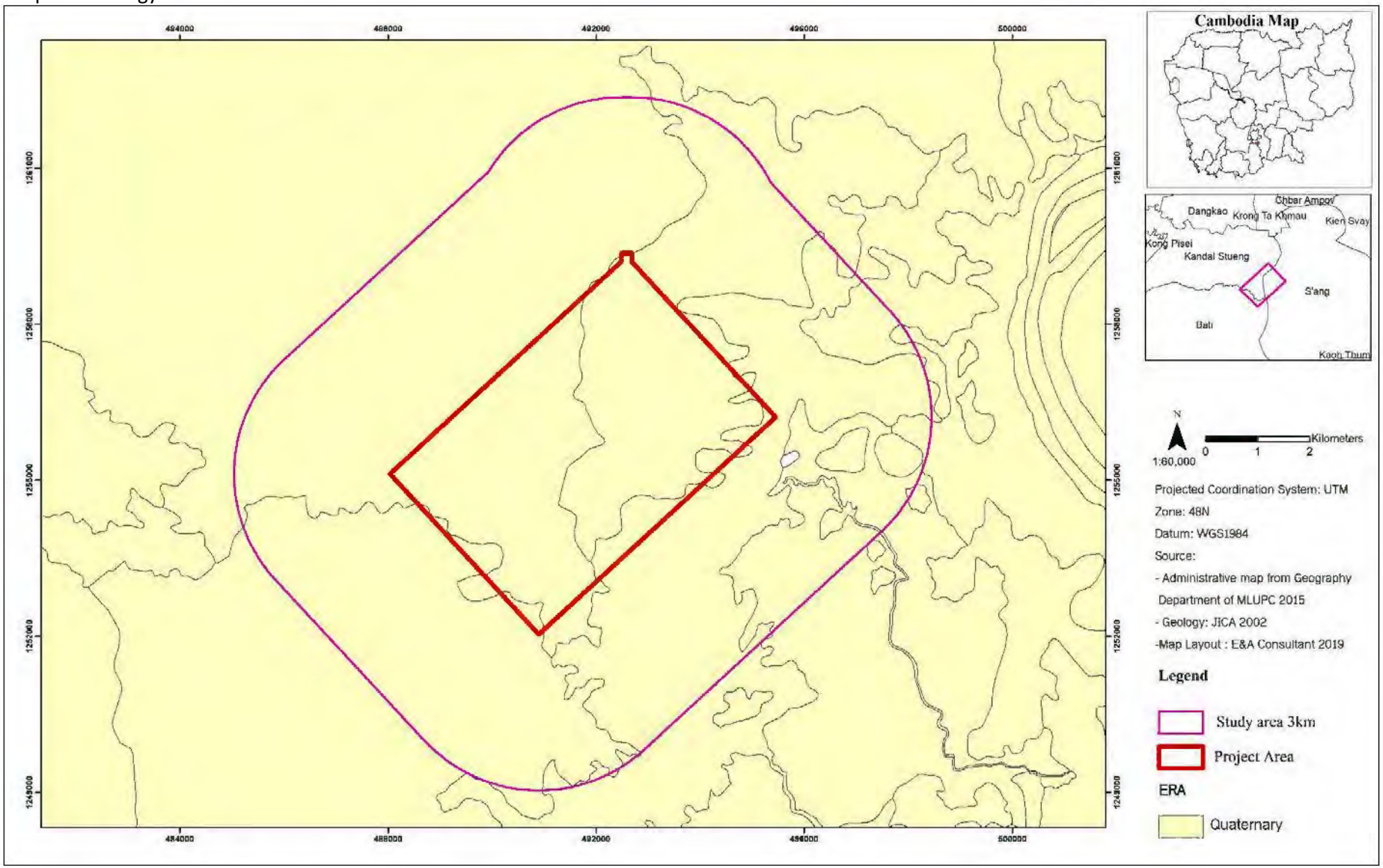
Exchange Al is a main factor which affected on agricultural crops productions in Tropical climate area. Exchange Al has connected with soil quality as whenever it has high level meant that soil in that area would has low quality (Cassio Hamiton Abreu Jr. 2003). Accordance the experiment result soil quality, the 1st and 2nd location have concentrations 0.15 and 0.24 me. /100g soil, respectively. This result illustrated that soil in study area has low level of Exchange Al if compared with soil nutritious quality level of ministry of agriculture, forestry and fishery.

PH H_2O is main factor for measurement to evaluate on the potential of nutrition and pollutants on plants. Most plants grew best in PH ranging from 5.7 to 7 (Sikora, F., &Kissel, D., 2015). As the experiment results indicated soil in the 1st Location and the 2nd Location have PH value equal 7.12 and 5.12, respectively.

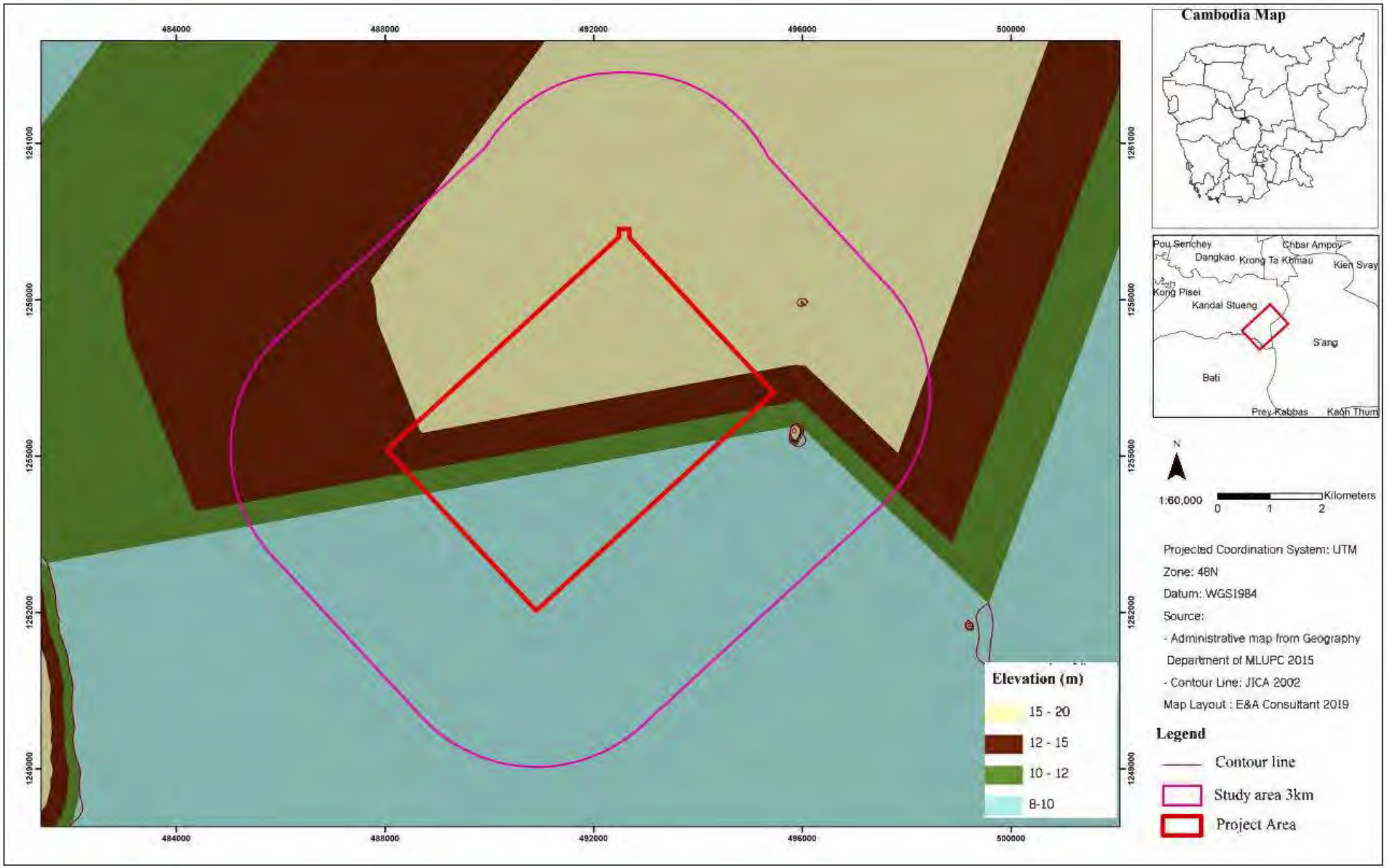
PH KCL of the soil in the 1st location and the 2nd location are 6.16 and 4.11, respectively.

In conclusion, the soil in the 1st Location is fine sand and coarse silt with moderate nutrition as well as good pH. On the other hand, the soil in the 2nd Location is coarse sand and fine silt with moderate nutrition as well as low pH. Therefore, the soil in the 1st location has better quality than the 2nd location.

Map 15: Geology



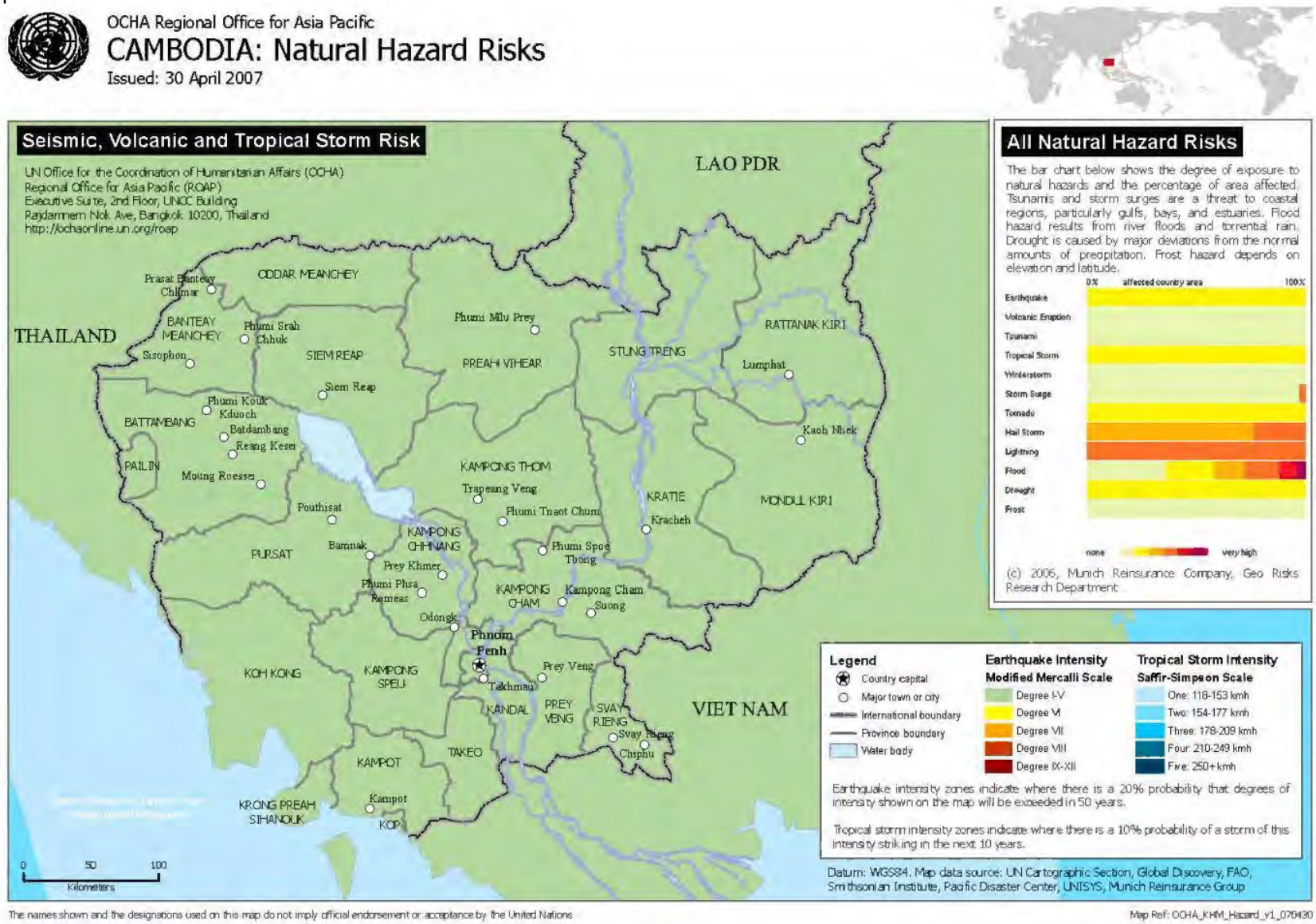
Map 16: Elevation



Map 17: Slope

480000
484000
488000
492000
496000
500000
504000
1264000
1261000
1258000
1255000
1252000
1249000
1246000
ផែនទីប្រទេសកម្ពុជា
Pou Senchey
Chbar Ampov
Dangkao
Krong Ta Khmau
Kien Svay
Kong Pisei
Kandal Stueng
S'ang
Bati
Prey Kabbas
Kaoh Thum
N
មាត្រដ្ឋាន និង ទិស :
1:80,000
Kilometer
0
1.5
3
Projected Coordination System: UTM
Zone: 48N
Datum: WGS1984
Source:
- Administrative map from Geography Department of MLUPC 2015
- Contour Line: JICA 2002
Map Layout : E&A Consultant 2019
Slope (degree)
0 - 0.4
0.4 - 1.3
1.3 - 4.0
4.0 - 8.7
8.7 - 14.0
Legend
Contour line
Study Area 3km
Project Area

Map 18: Natural Hazard Risks



Map 19: Soil Type

5.2.1.2 Climate and Meteorology

The climate in Cambodia comprises of two distinct seasons: the dry season (November to April) and the rainy season (May to October). The studies of weather focused on five weather parameters: temperature, precipitation, humidity and wind direction/wind speed measured by the Kandal Meteorological Station. However, Kandal had no data for temperature, wind direction and wind speed, and humidity in the last 10 years. Therefore, the team used data measured in nearby Phnom Penh instead because the project area in Kandal Stoueng district of Kandal province is only 20 km from Phnom Penh.

a) Temperature

The Tables below shows monthly minimum temperatures in Phnom Penh over the last 10 years from 2009 to 2018. The lowest average temperature during the last 10 years is in December which is 18.5 °C on average.

Table 54: Minimum temperature level in Phnom Penh for 9 years from 2010 to 2018

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
2009	**17.5**	**21.5**	**18.9**	**24.0**	**25.0**	**23.3**	**23.0**	**23.0**	**24.5**	**22.5**	**20.5**	**18.4**	**21.84**
2010	21.4	22.7	23.1	24.1	24.5	23.5	23.8	22.4	23.3	22.3	22.2	20	**22.78**
2011	18.5	20.8	21.5	22.5	23.5	23.2	22.8	22.5	23.3	23.5	22.5	19.4	**22.00**
2012	22.4	23.3	20.9	24	22.6	24.8	23.8	24	23.7	25.3	23.8	22	**23.38**
2013	20.5	22.8	23.3	23.6	24.7	23	23.3	23.4	24	23	23	18.7	**22.78**
2104	15.3	20.3	22.6	22.8	24.8	23.8	23.9	23	23	34.5	33.8	-	**22.32**
2015	19	20.2	23.8	21.8	25	24.5	23.3	23	23.2	23.8	24	21	**22.72**
2016	18.4	16.5	23	24.5	24.5	23.2	23	24	23.3	21	24	24.638	**22.50**
2017	19.2	16.5	22.8	22.8	24	24	23.8	23.8	22.6	23.3	22	17.5	**21.86**
2018	19.8	19.3	23	21.5	23.6	23.2	24	23.5	22.3	23	22.8	23.5	**22.46**
Average	**19.2**	**20.4**	**22.3**	**23.2**	**24.2**	**23.7**	**23.5**	**23.3**	**23.3**	**24.2**	**23.9**	**18.5**	**22.5**

Source: Meteorology Department of Ministry of Water Resource and Meteorology 2019

Figure 7: Average minimum temperature in Phnom Penh over the last 10 years (2009-2018)

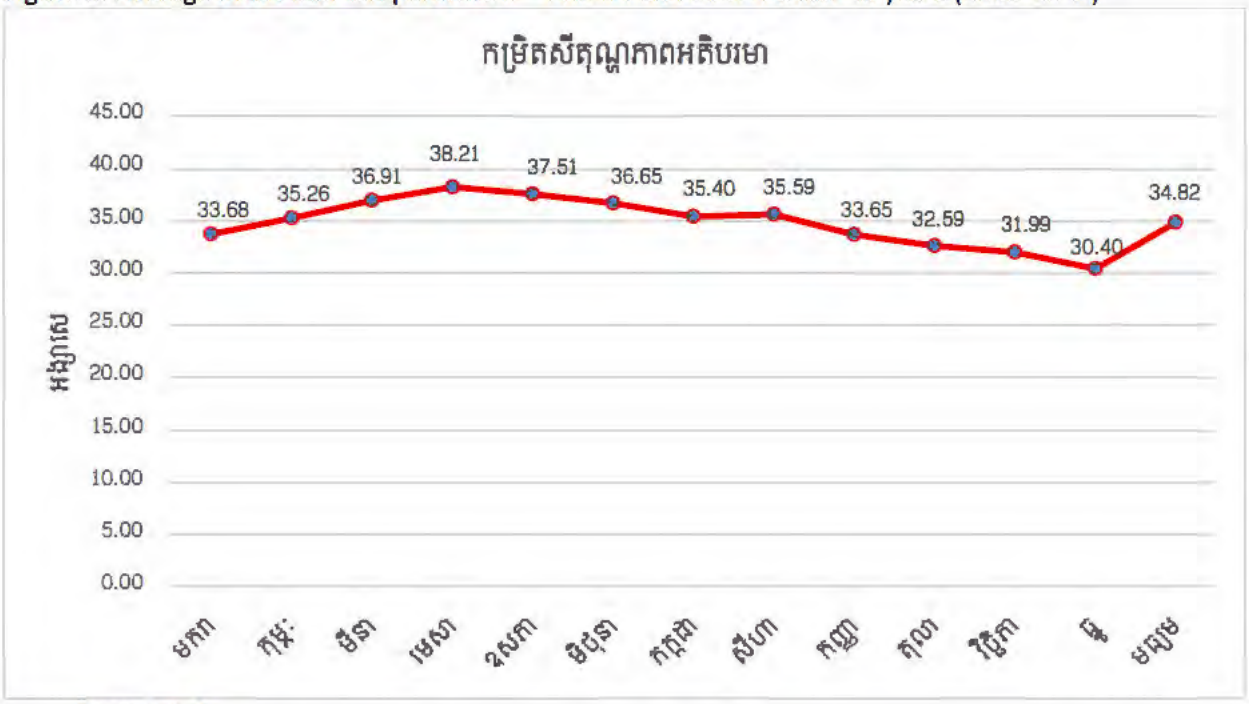
Table 55: Maximum temperature level in Phnom Penh for 9 years from 2010 to 2018

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
2009	34	36	37	38	37	37	35	36	35	35	34	35	**35.7**
2010	35	38	40	39	40	39	36	35	35	34	33	33	**36.3**
2011	35	35	35	39	37	35	35	35	34	33	33	37	**35.3**
2012	34	35	36	38	37	37	35	37	34	34	34	35	**35.4**

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
2013	34	37	38	39	38	37	35	36	35	33	33	33	**35.6**
2014	33	34	37	37	38	38	36	37	25	23	23	-	**29.9**
2015	31	33	35	36	37	36	35	34	33	33	33	33	**34.0**
2016	35	36	39	41	40	38	37	36	35	34	34	33	**36.3**
2017	34	36	37	38	36	36	35	36	35	34	30	33	**34.9**
2018	34	35	36	38	36	35	35	35	35	34	34	34	**34.8**
Average	**33.68**	**35.26**	**36.91**	**38.21**	**37.51**	**36.65**	**35.40**	**35.59**	**33.65**	**32.59**	**31.99**	**30.40**	**34.82**

Source: Meteorology Department of Ministry of Water Resource and Meteorology 2019

Figure 8: Average maximum temperature in Phnom Penh over the last 10 years (2009-2018)



b) Rainfall

The Tables below shows monthly and annual precipitation in Kandal province over the last 9 years from 2009 to 2018. During this period, the average annual precipitation was 1,289.64 mm. The lowest average annual precipitation in 2015 (960.5mm) and the highest average annual precipitation is in 2016 (1,638 mm).

Table 56: Rainfall level in Kandal province for 10 years from 2009 to 2018

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
2009	15.3	1.4	0	164.7	143.5	31	109.7	218.2	272.5	197.2	26.5	0	**1180.0**
2010	13	0	53	135.5	71.1	235.4	81.7	102.3	174	741.9	94.2	9.1	**1711.2**
2011	0	7	16.9	27.6	90.9	92.2	235.4	227.1	260.6	225.9	62.2	2.5	**1248.3**
2012	73.8	30	18.7	85	179.3	95.4	257.7	43.5	270	261.3	149.8	0	**1464.5**
2013	0	0	8.9	67.6	65.2	253.8	117.6	148.5	232.8	239.2	169.6	14.3	**1317.5**
2014	0	0	0.7	52.5	114.6	130.6	153.9	170.4	148.9	191.7	207.4	23.5	**1194.2**
2015	0	0	0	28.9	85.6	46	49.6	165.6	232.6	190.5	119.7	42	**960.5**
2016	0	0	0	1	74.9	211.8	120	59.6	432.5	356.1	328.4	53.7	**1638**
2017	16	0.2	4.6	182.4	133.2	130.6	127.6	109.5	182.43	144.2	70.5	55.1	**1156.33**
2018	29.7	15.6	1	10.3	127.6	116.7	76.3	96.1	221.8	201.6	85.3	43.9	**1025.9**
Average	**14.78**	**5.42**	**10.38**	**75.55**	**108.59**	**134.**	**132.95**	**134.08**	**242.81**	**274.96**	**131.36**	**24.41**	**1289.643**

Source: Meteorology Department of Ministry of Water Resource and Meteorology 2019

Figure 9: Rainfall in Kandal province for 10 years from 2009 to 2018 (mm)

c) **Humidity**

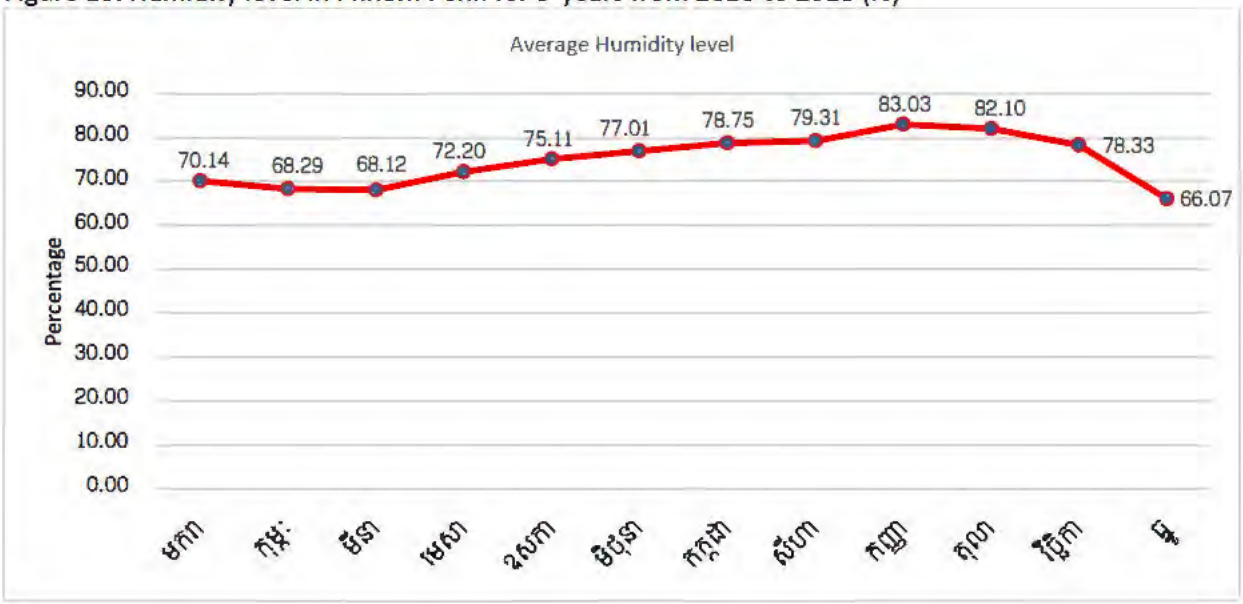
The Table below shows the average monthly and yearly humidity in Phnom Penh over the last 9 years from 2009 to 2018. The average highest humidity level was in September (83.03%). Meanwhile, in 2018, the average annual humidity level is 76.58% which is higher than any other year during the last 9 years.

Table 57: Monthly humidity level in Phnom Penh for 10 years from 2009 to 2018

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average
2009	67.00	71.00	68.00	75.00	79.00	75.00	78.00	79.00	84.00	82.00	75.00	70.00	**75.25**
2010	71.70	70.10	65.80	68.20	69.00	79.20	79.90	81.50	82.90	84.10	77.30	74.60	**75.36**
2011	67.9	70.60	67.10	72.30	77.40	77.50	79.50	82.20	83.30	81.50	78.40	73.10	**75.90**
2012	73.2	73.70	71.70	73.50	78.60	74.90	80.00	77.30	84.00	81.90	82.40	74.50	**77.14**
2013	70.00	67.00	68.00	76.00	75.00	81.00	81.00	81.00	84.00	82.00	79.00	71.00	**76.25**
2014	68.00	70.00	68.00	77.00	73.00	77.00	79.00	78.00	82.00	82.00	77.00	-	**69.25**
2015	69.00	67.00	67.00	70.00	69.00	72.00	73.00	78.00	82.00	81.00	78.00	73.00	**73.25**
2016	70.87	61.38	66.16	64.40	70.61	76.20	79.81	76.97	82.90	85.94	80.43	75.60	**74.27**
2017	70.10	61.40	69.70	75.30	80.20	77.20	79.90	79.30	81.90	80.50	79.00	71.00	**75.46**
2018	73.60	70.70	69.70	70.30	79.30	80.10	77.40	79.80	83.30	80.10	76.80	77.90	**76.58**
Average	**70.14**	**68.29**	**68.12**	**72.20**	**75.11**	**77.01**	**78.75**	**79.31**	**83.03**	**82.10**	**78.33**	**66.07**	**74.87**

Source: Meteorology Department of Ministry of Water Resource and Meteorology 2019

Figure 10: Humidity level in Phnom Penh for 9 years from 2010 to 2018 (%)



d) Direction - Wind speed

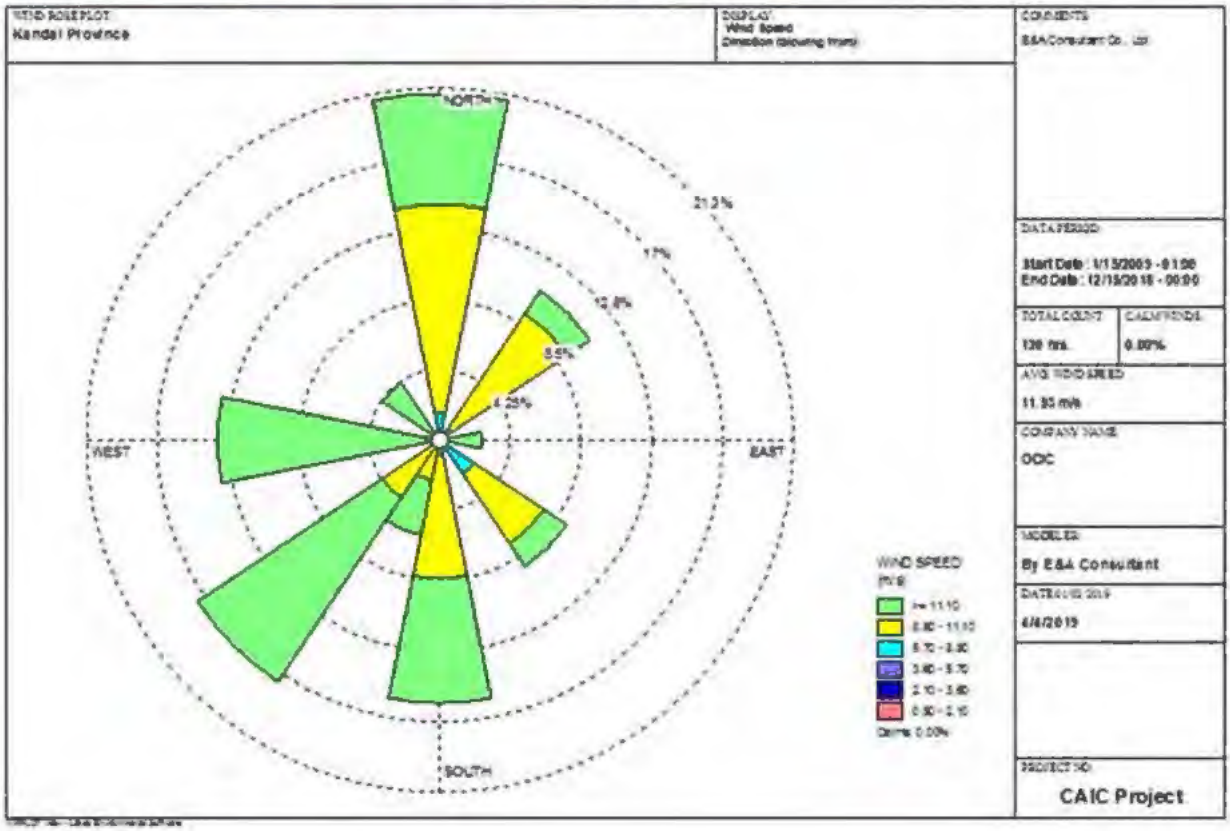
The Table and Graphic below show the wind direction and wind speed over the last 9 years from 2009 to 2018 recorded at the Pochentong Station of the Ministry of Water Resources and Meteorology. The wind direction is divided into 16 wind directions and 6 levels of wind speed (blowing from). Mostly wind blew from the north. The average of wind speed over the last 10 years was 9.525 m/s.

Table 58: Direction - Wind speed in Kandal for 10 years (2009-2018)

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Average	Year
2009	W-dd	N	SE	NE	SE/N	SW/N	N	W	W	W	SW/W	S	N	
	W-ss	11	10	10	8	13	16	14	18	13	10	16	11	12.50
2010	W-dd	NE	SE	NE	S	SE	W	SW	SW	NW	S/N	N/NE	NE/NW	
	W-ss	10	10	10	12	14	15	13	13	12	10	10	10	11.58
2011	W-dd	NE	NE	NE/N	SE/S	SW	W	W	SW/NE	S/W	E	N	N	
	W-ss	10	10	10	8	17	18	19	12	12	16	13	12	13.08
2012	W-dd	SSW	S	SSW	SSW	SW	SW	SW	SSW	SW	SW	N	N	
	W-ss	11	8	13	14	15	12	10	10	10	10	8	10	10.92
2013	W-dd	N	N	S	S	SW	S	SW	SSW	SSW	E	N	N	
	W-ss	11	8	10	10	15	13	13	14	10	12	10	11	11.42
2014	W-dd	N/NE	SE	S	NW	SW/W	SW	W	S	SW/W	N	N	N	
	W-ss	10	8	10	12	14	12	12	12	10	10	13	10	11.08
2015	W-dd	N	S/N	SE	NE	W	S	SW	SW/NW	SW	N	S	N	
	W-ss	10	10	10	12	14	13	14	12	12	14	16	10	12.25
2016	W-dd	N	N/E	S	S/N	SW/SE	SW	W	NW/W	W	S	SE	NE	
	W-ss	12	12	10	10	12	12	16	12	17	16	10	7	12.17
2017	W-dd	N	N	SE/S	NW	NW	W	W	W	N	N	S/SE	N	
	W-ss	10	12	10	16	14	15	12	15	16	10	10	12	12.67
2018	W-dd	N	SE	S	N	SSW	W	W	S	W	NE	SE	N	
	W-ss	10	12	10	10	14	16	12	16	10	10	10	10	11.67
Average		8.4	8	8.3	9.2	11.5	11.1	10.8	10.3	9.7	9.8	9	8.2	9.525

Source: Meteorology Department of Ministry of Water Resource and Meteorology 2019

Figure 11: Direction - Wind speed in Kandal for 10 years (2009-2018)



5.2.1.3 Air quality

The Air Quality Standard of Cambodia is defined by Sub-Decree No. 42 in 2000 on air pollution and noise disturbance. This sub-decree indicates the maximum limit of the hazardous substances in the air by the type and duration of the release of those hazardous substances.

Air quality tests for New Phnom Penh International Airport were conducted in four different locations (within and surrounding the project area) for 24 hours consecutively (except parameter CO was conducted in only 8 hours, and parameter O_3 was only one hour) from 24-26 January 2019. The analysis was conducted by the Ministry of Environment's Laboratory with the results as shown in Table41 below. The key parameters for this analysis include CO, NO_2, SO_2, lead (Pb), O_3, TSP, PM10 and PM2.5.

The official test results from the Ministry of Environment on 13th February 2019 were compared to air quality standard as stipulated in the Sub-decree on air pollution control and noise disturbance (2000) and announcement on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).

Table 59: Result of the Air Quality Study

No	Parameters	Result				Standard*
		In Project area	Pot Sor village	Peam Sala village	Cherng Prey village	mg/m³ for 24hours
1	CO	0.52	0.26	0.62	0.78	20[(8)]
2	NO_2	0.014	0.011	0.015	0.017	0.10
3	SO_2	0.011	0.008	0.013	0.013	0.30
4	O_3	**0.23**	0.06	0.04	0.02	0.2[(1)]
5	Pb	ND	ND	ND	ND	ND
6	TSP	0.094	0.081	0.146	0.205	0.33
7	PM10	0.035	0.041	**0.068**	**0.094**	0.05
8	PM2.5	0.019	0.016	0.028	**0.037**	0.025

Noted: - [(8)] Average 8 hours standard

- [(1)] Average 1-hour standard

- Standard: Air quality standard of Sub-decree on air pollution control and noise disturbance (2000) and announcement on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).*

Source: E&A Consultant (2019)

According to the test results of those four locations, almost all parameters were within the standard as stipulated in the Sub-decree on air pollution control and noise disturbance (2000) and announcement on the implementation of the working conditions model for infrastructure and tourism sector issued by Ministry of Environment in 2018. However, only O_3 parameter in the construction site (0.23 mg/m^3), PM10 in Peam Sala village (0.068 mg/m^3) and Cherng Prey village (0.094 mg/m^3) and PM2.5 in Cherng Prey village (0.037 mg/m^3) slightly exceeded the standards because explosive disposal experts were clearing vegetation, but the figures were insignificant.

5.2.1.4 Noise and Vibration

a) Noise

In Cambodia, the noise standard is defined by Sub-Decree No 42 on Air Pollution Control and Noise Disturbance (2000). This sub-decree specified the noise disturbance standard based on the nurture of each area and time.

Noise sampling for the New Phnom Penh International Airport project were conducted in four different locations (within and surrounding the project area) for 24 hours from 22-25 February 2019. This noise and vibration testing was conducted by E&A Consultant using the RION-NL-52EX NL-52 for noise testing and RION VM-55EX Vibration Level Meter for vibration test.

The official test results from the Ministry of Environment were compared with the air quality standard as stipulated in the Sub-decree on air pollution control and noise disturbance (2000) and report on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018). The test results are as follows:

- **Noise Level in Project's Construction Site**

Table 42 below illustrates the noise test results conducted for 24 hours in the project's construction site on 24 February 2019. The results were compared with the maximum noise standard allowed in commercial, service, and mixed areas as stipulated in the sub-decree on air pollution control and noise disturbance (2000) and report on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).

The result shows that the average noise level was 44.11dB (A), the minimum average was 34.93 dB (A), and the maximum average was 66.05 dB (A). In overall, the average noise levels for morning, afternoon, and evening were all within the acceptable standard.

Figure 12: Noise test result in Project's Site

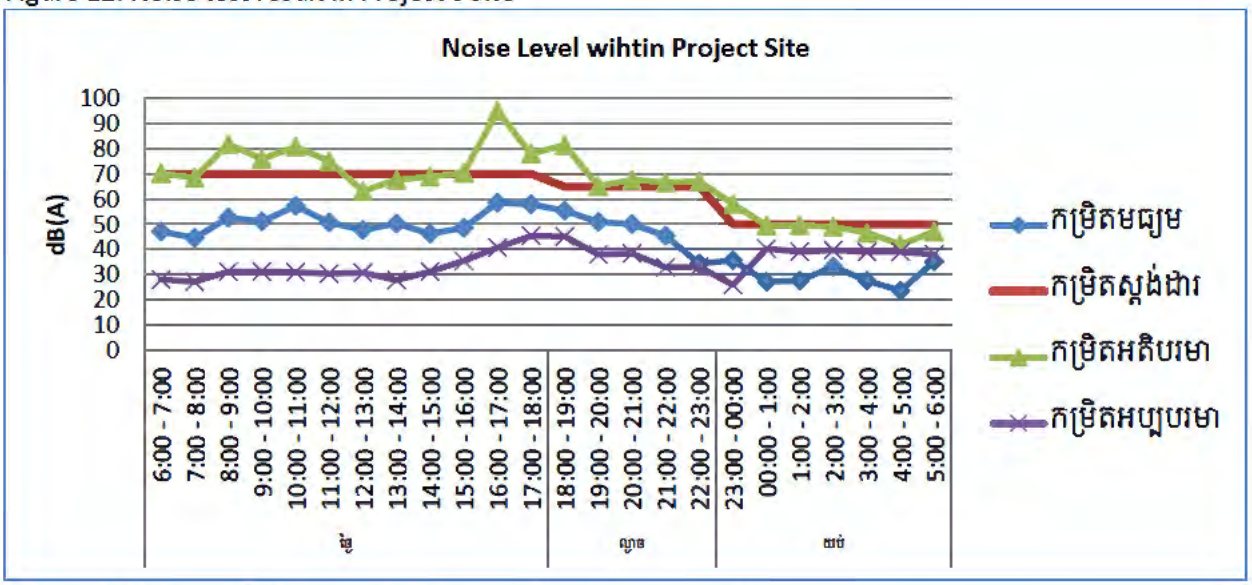


Table 60: Noise analysis result in the project's construction site

Survey		Noise Level dB(A)			
		L_{Aeq}	Standard*	L_{max}	L_{min}
Day	6:00 - 7:00	47.1	70	70.2	28
	7:00 - 8:00	44.5		68.5	27.1
	8:00 - 9:00	52.7		81.8	31.2
	9:00 - 10:00	51.2		76	31.1
	10:00 - 11:00	57.3		80.7	30.9
	11:00 - 12:00	50.7		75.1	30.3
	12:00 - 13:00	47.8		63.1	30.7
	13:00 - 14:00	50.2		67.6	27.8
	14:00 - 15:00	46.2		69	31.2
	15:00 - 16:00	48.6		70.4	35.5
	16:00 - 17:00	58.6		94.9	40.8
	17:00 - 18:00	58.0		78.0	45.3
Evening	18:00 - 19:00	55.3	65	81.5	45.1
	19:00 - 20:00	50.9		65.1	38.0
	20:00 - 21:00	50.1		67.6	38.4
	21:00 - 22:00	45.3		66.5	32.8
Night	22:00 - 23:00	34.4		67.1	33.1

Survey		Noise Level dB(A)			
		L_{Aeq}	Standard*	L_{max}	L_{min}
	23:00 - 00:00	35.6	50	58.2	25.8
	00:00 - 1:00	27.1		49.5	40.4
	1:00 - 2:00	27.5		49.7	39.1
	2:00 - 3:00	33.1		49.0	39.7
	3:00 - 4:00	27.6		46.7	39.0
	4:00 - 5:00	23.6		41.9	39.1
	5:00 - 6:00	35.2		47.1	37.9
Average in 24 hours		**44.11**		**66.05**	**34.93**

Noted: Standard: Noise standard limits allowed in commercial area and service and a mix area of Prakas on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).*
Source: E&A consultant (2019)

- **Noise Levels in the Residential Area of Pot Sor Village**

The table below (43) illustrates the noise test results conducted for 24 hours in the residential area in Pot Sor village on 23rd February 2019. The results were compared with the maximum noise standard allowed in hotels, administration areas, villas, and flats as stipulated in the sub-decree on air pollution control and noise disturbance (2000) and the announcement on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).

The result shows that noise level within 24hours is in average noise level 45.37 dB(A), the minimum average was 39.3 dB(A), and the maximum average was 67.83 dB(A). In overall, for the afternoon, evening, and night, the average noise level is within the acceptable noise standard limit.

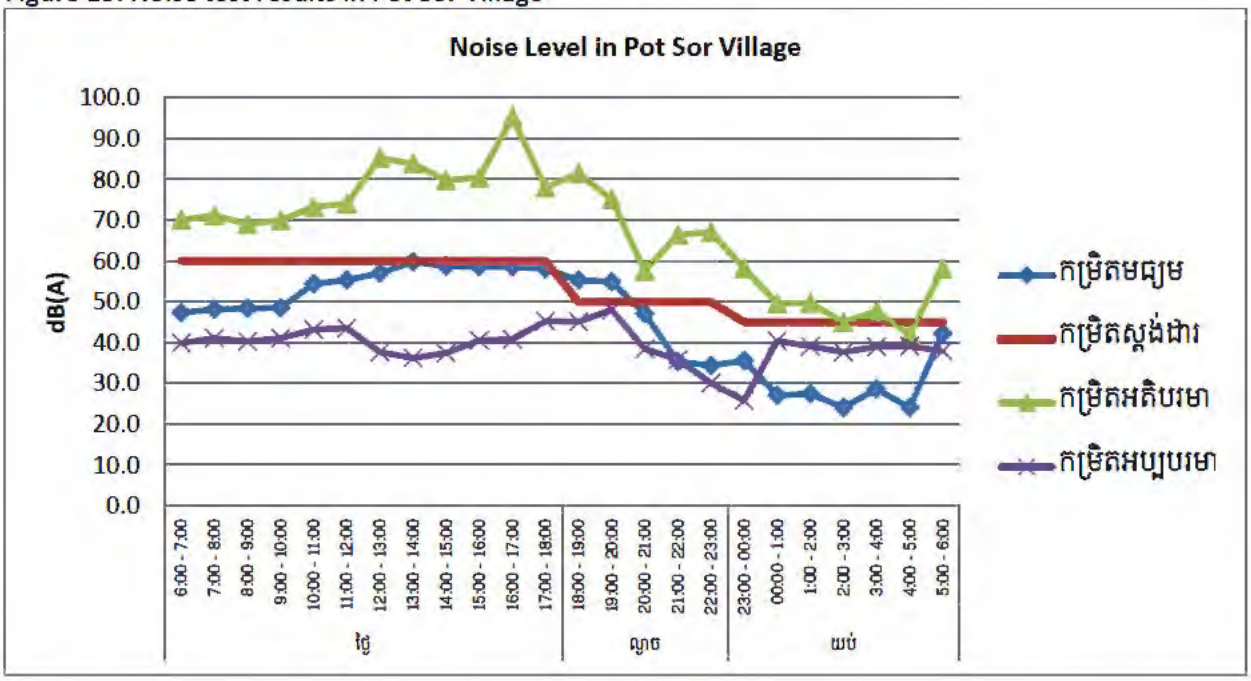
Table 61: Noise analysis result in Pot Sor village

Survey		Noise Level dB(A)			
		LAeq	Standard*	Lmax	Lmin
Afternoon	6:00 - 7:00	47.3	60	70.1	39.9
	7:00 - 8:00	48.1		71.2	41.1
	8:00 - 9:00	48.4		69.0	40.3
	9:00 - 10:00	48.5		70.0	41.0
	10:00 - 11:00	54.4		73.3	43.1
	11:00 - 12:00	55.3		74.0	43.5
	12:00 - 13:00	57.0		85.3	37.6
	13:00 - 14:00	59.8		83.8	36.2
	14:00 - 15:00	58.7		79.8	37.4
	15:00 - 16:00	58.6		80.4	40.5
	16:00 - 17:00	58.6		95.2	40.8
	17:00 - 18:00	58.0		78.0	45.3
Evening	18:00 - 19:00	55.3	50	81.5	45.1
	19:00 - 20:00	54.9		75.1	48.0
	20:00 - 21:00	47.1		57.6	38.4
	21:00 - 22:00	35.3		66.5	35.8
Night	22:00 - 23:00	34.4	45	67.1	30.1
	23:00 - 00:00	35.6		58.2	25.8
	00:00 - 1:00	27.1		49.5	40.4
	1:00 - 2:00	27.5		49.7	39.1
	2:00 - 3:00	24.1		45.0	37.7
	3:00 - 4:00	28.6		47.7	39.0
	4:00 - 5:00	24.0		41.9	39.1

Survey		Noise Level dB(A)			
		LAeq	Standard*	Lmax	Lmin
	5:00 - 6:00	42.2		58.1	37.9
Average in 24 hours		**45.37**		**67.83**	**39.30**

Noted: Standard*: Noise standard limits allowed in commercial area and service and a mix area of announcement on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).
Source: E&A consultant, 2019

Figure 13: Noise test results in Pot Sor Village



- **Noise Levels In the Residential Area of Peam Sela Village**

The table below (44) illustrate the noise analysis results conducted for 24 hours in Peam Sela village on 22nd February 2019. The results were compared with the maximum noise standard allowed in hotels, administration areas, villas, and flats as stipulated in the sub-decree on air pollution control and noise disturbance (2000) and Prakas on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).

The result shows that noise level within 24hours is in average noise level was 52.40 dB (A), the minimum average was 36.71 dB (A), and the maximum average was 74.86 dB (A). Overall, the average noise levels in the afternoon were within the noise standard limit allowed, only during the night time was the standard exceeded by 1 – 7 dB(A).

Table 62: Noise analysis results in the residential area in Peam Sela Village.

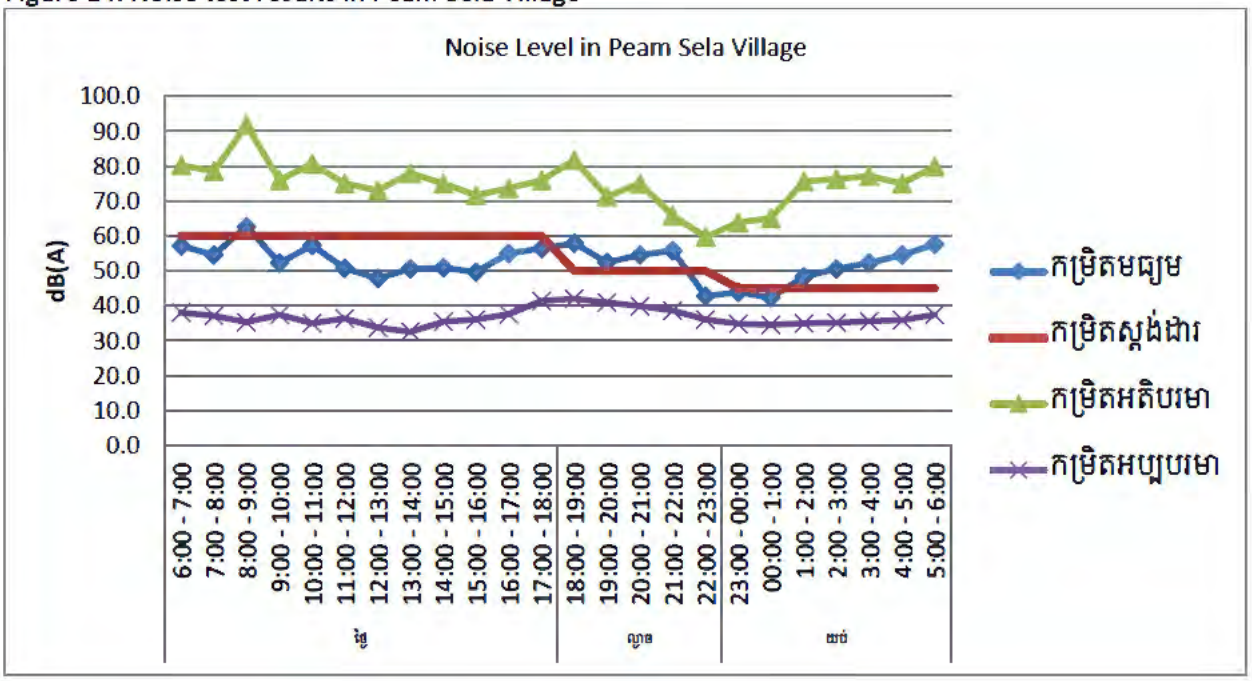
Survey		Noise Level dB(A)			
		LAeq	Standard*	Lmax	Lmin
Day	6:00 - 7:00	57.1	60	80.2	38.0
	7:00 - 8:00	54.5		78.5	37.1
	8:00 - 9:00	62.7		91.8	35.2
	9:00 - 10:00	52.2		76.0	37.4
	10:00 - 11:00	57.3		80.7	34.9
	11:00 - 12:00	50.7		75.1	36.3
	12:00 - 13:00	47.8		73.1	33.7
	13:00 - 14:00	50.6		78.0	32.5
	14:00 - 15:00	50.9		75.0	35.5
	15:00 - 16:00	49.7		71.7	36.0

Survey		Noise Level dB(A)			
		LAeq	Standard*	Lmax	Lmin
	16:00 - 17:00	55.0		73.7	37.5
	17:00 - 18:00	56.4		76.0	41.4
Evening	18:00 - 19:00	57.9	50	81.8	42.0
	19:00 - 20:00	52.4		71.3	40.9
	20:00 - 21:00	54.5		75.0	39.8
	21:00 - 22:00	55.8		65.9	38.6
Night	22:00 - 23:00	42.7	45	59.7	36.0
	23:00 - 00:00	43.8		63.9	34.8
	00:00 - 1:00	42.3		65.1	34.5
	1:00 - 2:00	48.2		75.7	34.9
	2:00 - 3:00	50.5		76.2	35.1
	3:00 - 4:00	52.3		77.2	35.6
	4:00 - 5:00	54.6		75.1	35.9
	5:00 - 6:00	57.6		79.9	37.4
Average in 24 hours		**52.40**		**74.86**	**36.71**

Noted: Standard: Noise standard limits allowed in commercial area and service and a mix area of Prakas on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).*

Source: E&A consultant (2019)

Figure 14: Noise test results in Peam Sela Village



- **Noise Level In the Residential Area in Cherng Prey Village**

The table below (45) illustrate the noise analysis results conducted for 24 hours in the residential area in Cherng Prey village on 25th February 2019. The results were compared with the maximum noise standard allowed in hotels, administration areas, villas, and flats as stipulated in the sub-decree on air pollution control and noise disturbance (2000) and announcement on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).

The result shows that noise level within 24hours is in average noise level was 49.03 dB (A), the minimum average was 37.16 dB (A), and the maximum average was 70.26 dB (A). Overall, the average noise levels in the afternoon and evening, was mostly within the noise standard limit allowed, except the night time (23:00-1:00) when it exceeded the standard.

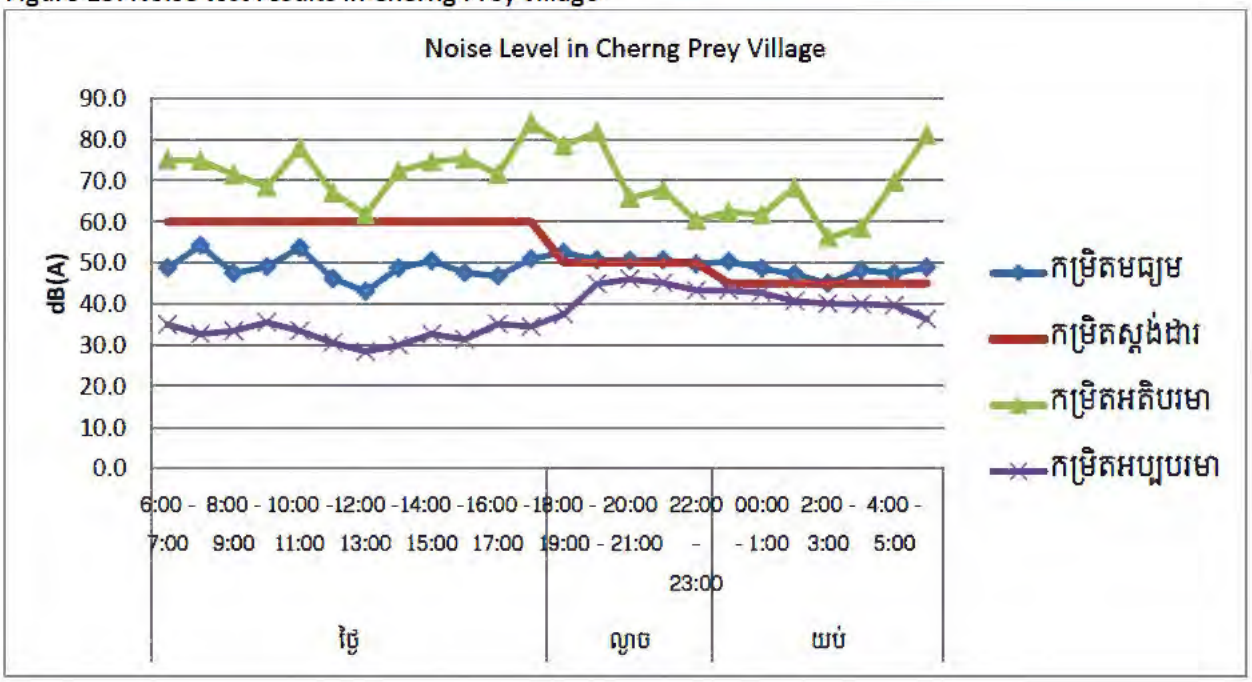
Table 63: Noise analysis result in Cherng Prey village

Survey		Vibration level (dB)			
		LAeq	Standard*	Lmax	Lmin
Day	6:00 - 7:00	48.8	60	75.0	35.0
	7:00 - 8:00	54.2		74.8	32.7
	8:00 - 9:00	47.4		71.5	33.4
	9:00 - 10:00	49.0		68.5	35.5
	10:00 - 11:00	53.7		78.0	33.4
	11:00 - 12:00	46.1		67.0	30.6
	12:00 - 13:00	43.0		61.8	28.4
	13:00 - 14:00	48.7		72.2	29.9
	14:00 - 15:00	50.4		74.6	32.7
	15:00 - 16:00	47.6		75.4	31.3
	16:00 - 17:00	46.8		71.6	35.1
	17:00 - 18:00	51.0		84.0	34.5
Evening	18:00 - 19:00	52.5	50	78.5	37.4
	19:00 - 20:00	50.7		81.7	44.9
	20:00 - 21:00	50.6		65.8	46.0
	21:00 - 22:00	50.7		67.7	45.1
Night	22:00 - 23:00	49.6	45	60.3	43.3
	23:00 - 00:00	50.3		62.4	43.3
	00:00 - 1:00	48.6		61.7	42.7
	1:00 - 2:00	47.2		68.4	40.7
	2:00 - 3:00	45.0		56.1	40.0
	3:00 - 4:00	48.3		58.5	39.9
	4:00 - 5:00	47.5		69.6	39.7
	5:00 - 6:00	48.9		81.1	36.3
Average in 24 hours		**49.03**		**70.26**	**37.16**

Noted: Standard*: Noise standard limits allowed in commercial area and service and a mix area of announce on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).

Source: E&A consultant (2019)

Figure 15: Noise test results in Cherng Prey village



b) Vibration

Vibration testing for the New Phnom Penh International Airport was conducted in four different locations (within and surrounding the project area) for 24 hours from 22nd -25th February 2019. The Ministry of Environment's Laboratory conducted testing by using Vibration Level Meter VM-53A. The official analysis results from the Ministry of Environment were compared with the vibration standard as stipulated in report on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).

- **Vibration Levels in Project Site**

The table below (46) illustrates the noise test results conducted for 24 hours in the project's construction site on 24 February 2019. The average vibration level within 24 hours was 20.32 dB (A), the minimum average was 34.84 dB (A), and the maximum average was 31.94 dB (A). Overall, the vibration levels on the construction site for both daytime and night time, were under the vibration standard and so were acceptable.

Figure 16: Vibration test Results in Project Site

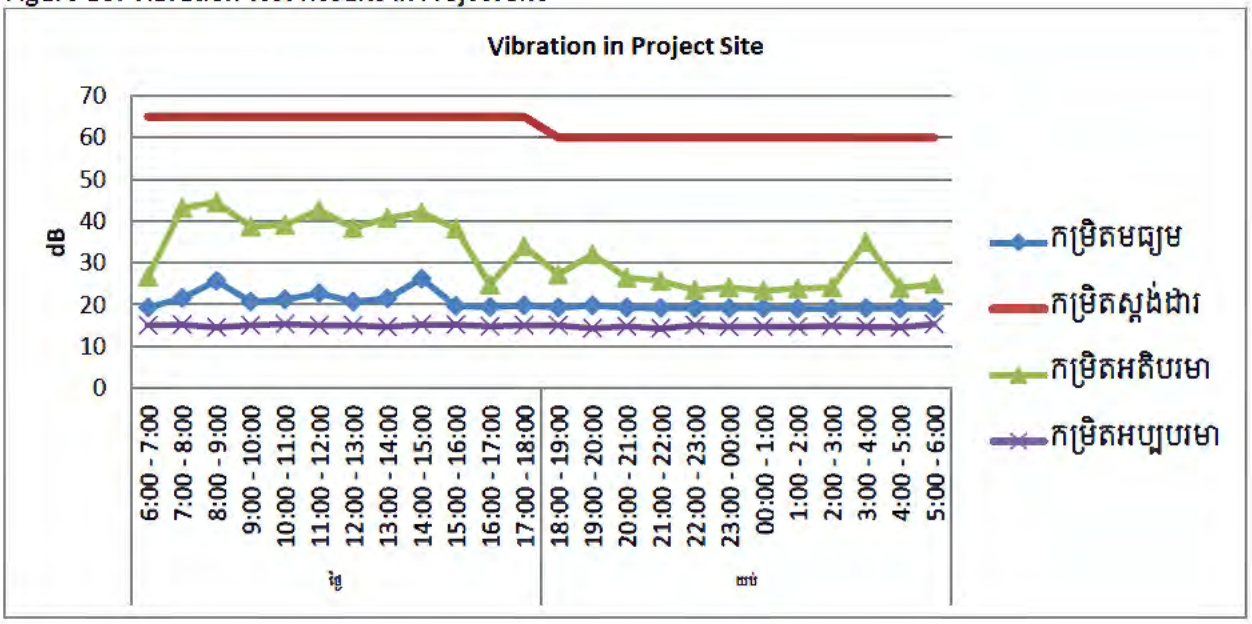


Table 64: Vibration analysis result in Project Site

Survey		Vibration level (dB)			
		LAeq	Standard*	Lmax	Lmin
Day	6:00 - 7:00	19.3	65	26.6	15
	7:00 - 8:00	21.5		43.2	15.1
	8:00 - 9:00	25.7		44.5	14.5
	9:00 - 10:00	20.6		38.7	15
	10:00 - 11:00	21.2		39.1	15.3
	11:00 - 12:00	22.7		42.6	15
	12:00 - 13:00	20.6		38.3	15
	13:00 - 14:00	21.4		40.7	14.7
	14:00 - 15:00	26.2		42	15.1
	15:00 - 16:00	19.6		38.2	15.2
	16:00 - 17:00	19.4		24.8	14.8
	17:00 - 18:00	19.7		34	15
Night	18:00 - 19:00	19.3		27.2	15
	19:00 - 20:00	19.7		32	14.3
	20:00 - 21:00	19.2		26.4	14.8

	21:00 - 22:00	19.1		25.6	14.2
	22:00 - 23:00	19.1		23.5	15
	23:00 - 00:00	19.1	60	24.1	14.6
	00:00 - 1:00	19.1		23.3	14.6
	1:00 - 2:00	19		23.8	14.7
	2:00 - 3:00	19		24.1	14.9
	3:00 - 4:00	19.1		35	14.7
	4:00 - 5:00	19		24	14.5
	5:00 - 6:00	19.1		24.9	15.3
Average in 24 hours		**20.32**		**31.94**	**14.85**

Source: E& A consultant 2019

- **Vibration Levels in the Residential Area of Pot Sor Village**

The table below (47) illustrates the vibration test results conducted for 24 hours in the residential area in Pot Sor Village on 23rd February 2019. The results were compared with the vibration standard stipulated in report on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).

The average vibration level over 24 hours was 28.32 dB (A), the minimum average was 16.61 dB (A), and the maximum average was 43.75 dB (A). Overall, the vibration levels in Pot Sor village for both daytime and night time were under the standard and were acceptable.

Figure 17: Vibration results in Pot Sor Village

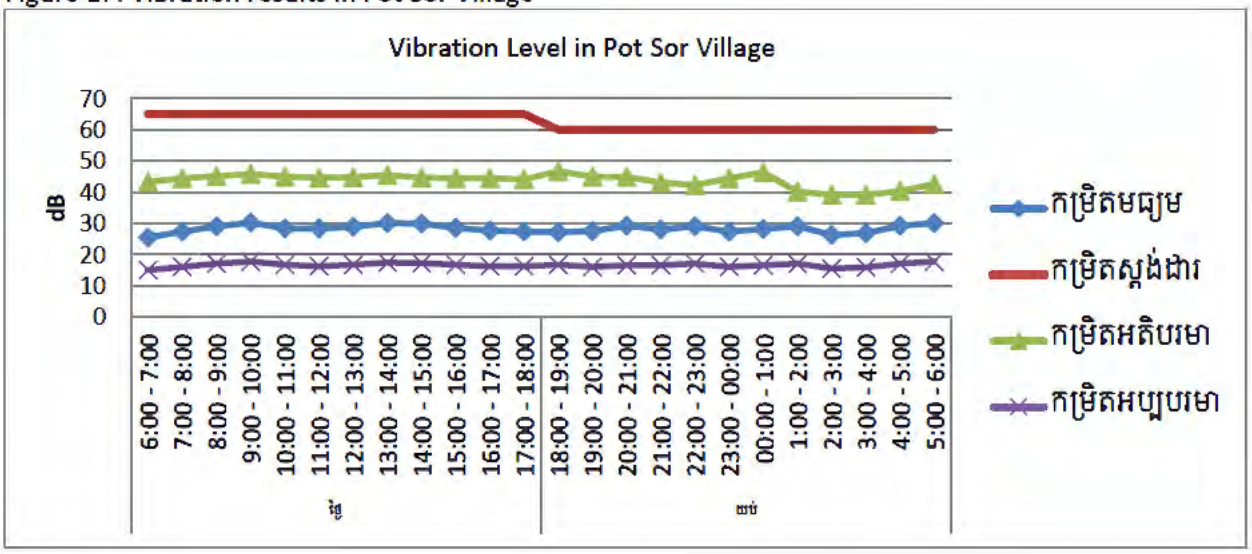


Table 65: Vibration analysis results in Pot Sor Village

Survey		Vibration level (dB)			
		LAeq	Standard*	Lmax	Lmin
Day	6:00 - 7:00	25.5	65	43.2	15.0
	7:00 - 8:00	27.3		44.5	16.1
	8:00 - 9:00	29.1		45.1	17.1
	9:00 - 10:00	30.2		45.8	17.8
	10:00 - 11:00	28.4		44.9	16.7
	11:00 - 12:00	28.4		44.7	16.3
	12:00 - 13:00	28.9		44.8	16.8
	13:00 - 14:00	30.1		45.5	17.4
	14:00 - 15:00	29.9		44.7	17.3
	15:00 - 16:00	28.5		44.5	16.8

Survey		Vibration level (dB)			
		LAeq	Standard*	Lmax	Lmin
	16:00 - 17:00	27.7		44.4	16.2
	17:00 - 18:00	27.3		44.1	16.2
Night	18:00 - 19:00	27.1	60	46.7	16.7
	19:00 - 20:00	27.6		44.9	16.1
	20:00 - 21:00	29.3		44.9	16.6
	21:00 - 22:00	28.1		43.1	16.5
	22:00 - 23:00	29.1		42.3	17.1
	23:00 - 00:00	27.3		44.4	16.1
	00:00 - 1:00	28.2		46.3	16.6
	1:00 - 2:00	29.1		40.1	17.1
	2:00 - 3:00	26.4		39.2	15.5
	3:00 - 4:00	26.9		39.1	15.8
	4:00 - 5:00	29.2		40.3	17.2
	5:00 - 6:00	30.1		42.6	17.7
Average in 24 hours		**28.32**		**43.75**	**16.61**

Noted: Standard: Vibration standard of announcement on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).*
Source: E& A consultant (2019)

- ***Vibration Levels in the Residential Area in Peam Sala Village***

The table below (48) illustrates that the vibration analysis results conducted for 24 hours in the Residential area in Peam Sala village on 22nd February 2019. The results were compared with the vibration standard stipulated in report on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).

The average vibration level over 24 hours was 21.1 dB (A), the minimum average was 16.4 dB (A), and the maximum average was 31.4 dB (A). Overall, the vibration levels in the residential area of Peam Sala village for both daytime and night time were under the standard and were acceptable.

Figure 18: Vibration results in Peam Sala Village

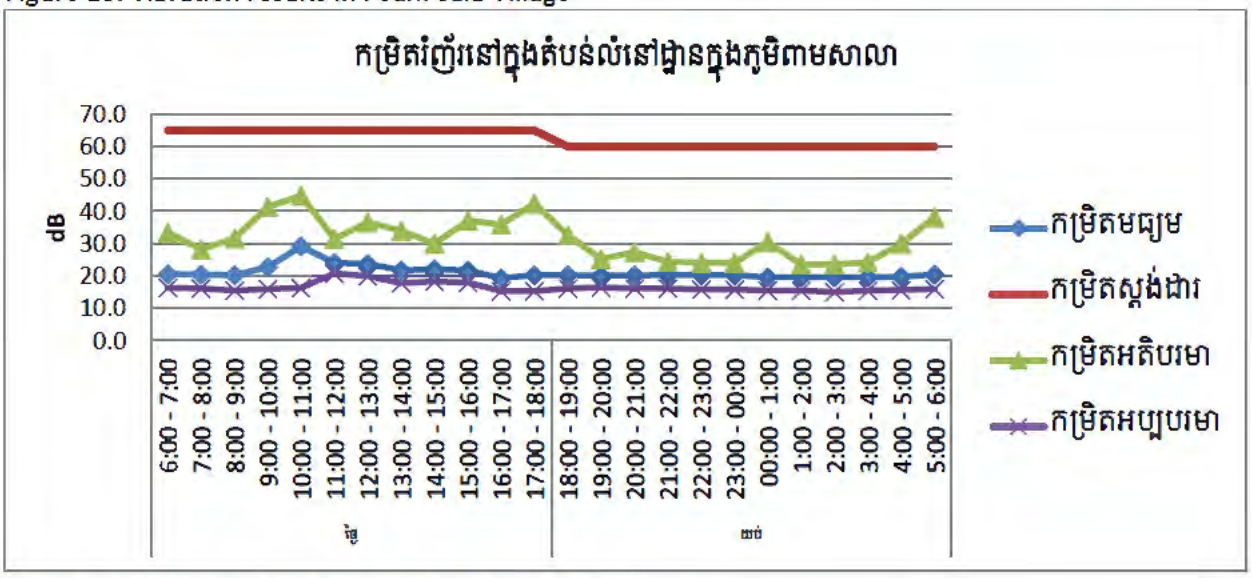


Table 5-15: Vibration Analysis result in Peam Sala Village

Survey		Vibration level (dB)			
		LAeq	Standard*	Lmax	Lmin
Day	6:00 - 7:00	20.6		33.4	16.2
	7:00 - 8:00	20.4		28.1	16.1
	8:00 - 9:00	20.3		31.7	15.5

	9:00 - 10:00	22.7		41.4	15.9
	10:00 - 11:00	29.1		44.8	16.3
	11:00 - 12:00	24.0	65	31.5	20.8
	12:00 - 13:00	23.7		36.6	19.9
	13:00 - 14:00	21.8		34.0	17.7
	14:00 - 15:00	22.0		30.0	18.2
	15:00 - 16:00	21.8		37.1	17.9
	16:00 - 17:00	19.3		35.9	15.3
	17:00 - 18:00	20.3		42.3	15.3
Night	18:00 - 19:00	20.2		32.6	16.1
	19:00 - 20:00	20.1		25.2	16.4
	20:00 - 21:00	20.2		27.3	16.1
	21:00 - 22:00	20.3		24.4	16.1
	22:00 - 23:00	20.2		24.1	15.7
	23:00 - 00:00	20.2	60	24.1	15.7
	00:00 - 1:00	19.6		30.5	15.4
	1:00 - 2:00	19.6		23.5	15.4
	2:00 - 3:00	19.5		23.6	15.0
	3:00 - 4:00	19.6		24.2	15.4
	4:00 - 5:00	19.7		30.0	15.6
	5:00 - 6:00	20.4		38.0	16.0
Average in 24 hours		**21.1**		**31.4**	**16.4**

Noted: Standard: Vibration standard of announcement on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).*

Source: E&A consultant (2019)

- ***Vibration Levels in the Residential Area of Cherng Prey Village***

The below table illustrates that the vibration analysis results conducted for 24 hours in the Residential area in Cherng Prey village on 25th February 2019. The results were compared with the vibration standard stipulated in report on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).

The average vibration level over 24 hours was 21.3 dB (A), the minimum average was 15.9 dB (A), and the maximum average was 34 dB (A). In overall, the vibration levels in residential area in Cherng Prey village for both daytime and night time were under the standard and were acceptable.

Table 66: Vibration analysis result in Cherng Prey Village

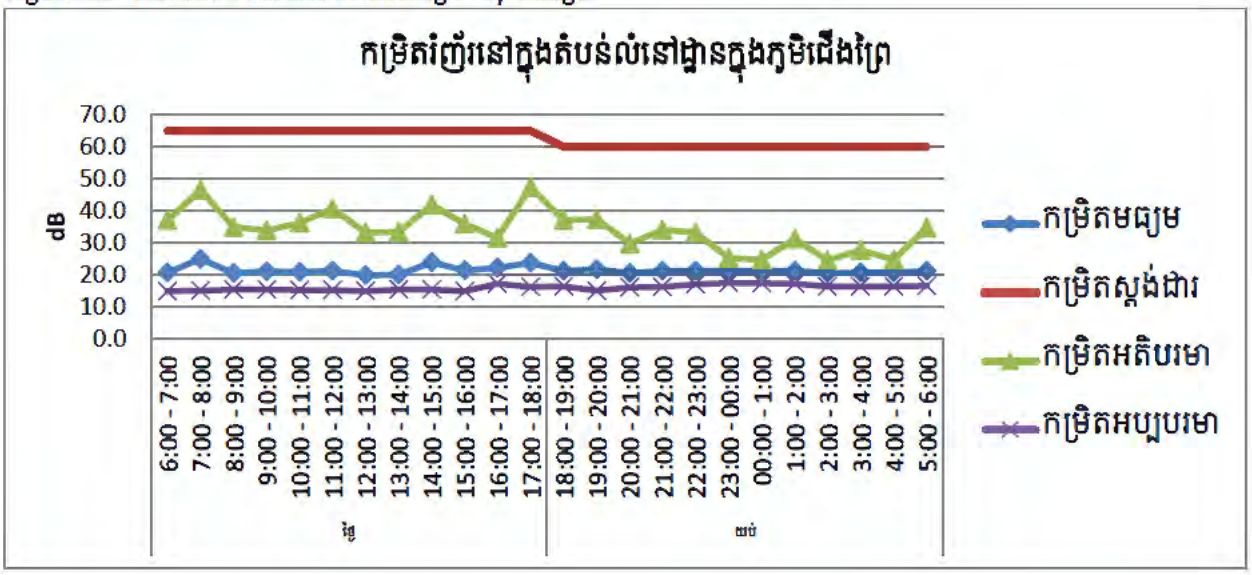
Survey		**Vibration level (dB)**			
		LAeq	**Standard***	**Lmax**	**Lmin**
Day	6:00 - 7:00	20.7	65	37.0	14.9
	7:00 - 8:00	24.9		46.6	15.0
	8:00 - 9:00	20.5		34.8	15.3
	9:00 - 10:00	21.0		33.8	15.4
	10:00 - 11:00	20.8		36.2	15.2
	11:00 - 12:00	21.1		40.7	15.1
	12:00 - 13:00	19.8		33.2	14.8
	13:00 - 14:00	20.0		33.4	15.3
	14:00 - 15:00	23.8		41.8	15.4
	15:00 - 16:00	21.4		35.9	14.9
	16:00 - 17:00	22.2		31.5	17.1
	17:00 - 18:00	23.7		47.3	16.2
Night	18:00 - 19:00	21.2		37.0	16.3
	19:00 - 20:00	21.7		37.3	15.0

Survey	Vibration level (dB)			
	LAeq	Standard*	Lmax	Lmin
20:00 - 21:00	20.5	60	29.6	16.0
21:00 - 22:00	21.1		34.0	16.2
22:00 - 23:00	21.2		33.1	17.0
23:00 - 00:00	21.1		25.2	17.4
00:00 - 1:00	21.1		24.6	17.3
1:00 - 2:00	21.1		31.1	17.2
2:00 - 3:00	20.5		24.5	16.4
3:00 - 4:00	20.6		27.7	16.4
4:00 - 5:00	20.6		24.7	16.3
5:00 - 6:00	21.2		34.6	16.5
Average in 24 hours	**21.3**		**34.0**	**15.9**

Noted: Standard: Vibration standard of announce on the implementation of the working conditions model for project development, infrastructure and tourism of Ministry of Environment (2018).*
Source: E&A consultant (2019)

The results of the four high-level studies indicate that the third testing station was located near Sa'ang district, Sa'ang, Siem Reap. Air and non-descending direction of plane

Figure 19: Vibration results in Cherng Prey village



5.2.1.5 Hydrology System

The geographical features of the project area and the surroundings area are the wetland which consists of lakes and streams. Within 3km around the project area there are major hydrological systems as follows:

- Boueng Cheung Loung Lake: a natural lake with water available in both dry and wet seasons, located to the south-east of the project area.
- Preak Ta ThokHor stream: located to the north of the project area. It is the stream that connects Stoeng Prek Thnot River and Boueng Cheung Loung Lake.
- Stoeung Tonle Bati River: located to the south of the project area. It flows from Takeo province to Boueng Cheung Loung Lake.
- Other outflowing canals such as Canal No. 92, Canal No. 57, and Canal No. 58.

- As discussed in the Flood Study for New Phnom Penh International Airport Feasibility Study, final report, February 2018 by Key Consultant (Cambodia): the existing drainage systems around the NPPIA site are open earth channels, trapezoidal with non-uniform dimensions. The

main inflow to the project area in the north comes from Stung Prek Tnot River, which originates in Kampong Speu province. Prek Tnot flow diverts to Prek Tahor canal and flows directly towards the project area. Another inflow comes from Tonle Bati in the west, located in Takeo province. All the inflows gather in Sa'ang Phnum Reservoir. The reservoir connects to the Bassac River through 10 tertiary canals.

- Source of flooding: There are no recent records of flooding at or around the study area. However, through site visits and interviews with local people at and nearby the study area, it was found that the study area was affected by flash floods caused by local extreme rainfall, rather than the flood from the Prek Tnot River and Mekong River System. The project area was inundated only once by the flood from the Prek Thnot River in 1991. But, since the headwork and flood control dikes were built in 2001, the flood waters from the river did not reach the area. The existing major flood map, shows that the highest flood in 2000 reached the study area as shown in Figure 28 on page 106.

- As mentioned in the paragraph above, local rainfall also caused a flood. According to the residents, the annual floods in the study area amount to approximately 1m depth. The project area is located in the flooded area, the water is stored in Beoung Sa'ang Phnom reservoir. Drainage lines are connected to the Tonle Bassac River (Outlets) from the reservoir. The outlets are situated along National Road 21 seen by the bridges and culverts, which are linked to Tonle Bassac River. The Tonle Bassac River is connected to the junction of the Mekong River and Tonle Sap Lake, where the flow comes from the upper part of Cambodia, while the Tonle Sap Lake gathers flow from the tributaries of surrounding sub- basins.

The results of the field investigation and hydrological study on the existing layout of the project area can be summarised as follows:

- The annual rainfall data was recorded over a 3-decade periods (1981-2015) in Pochentong Station. The annual average of precipitation is 1,385.9 mm with a minimum of 1,064.7mm and a maximum of 2,147 mm (year 2000). 90% of the rainfall occurs in the period between May and November. September is considered as the wettest month with 473 mm of monthly precipitation. The 24-hour daily rainfall reached above 180 mm and the average is 92.37mm.

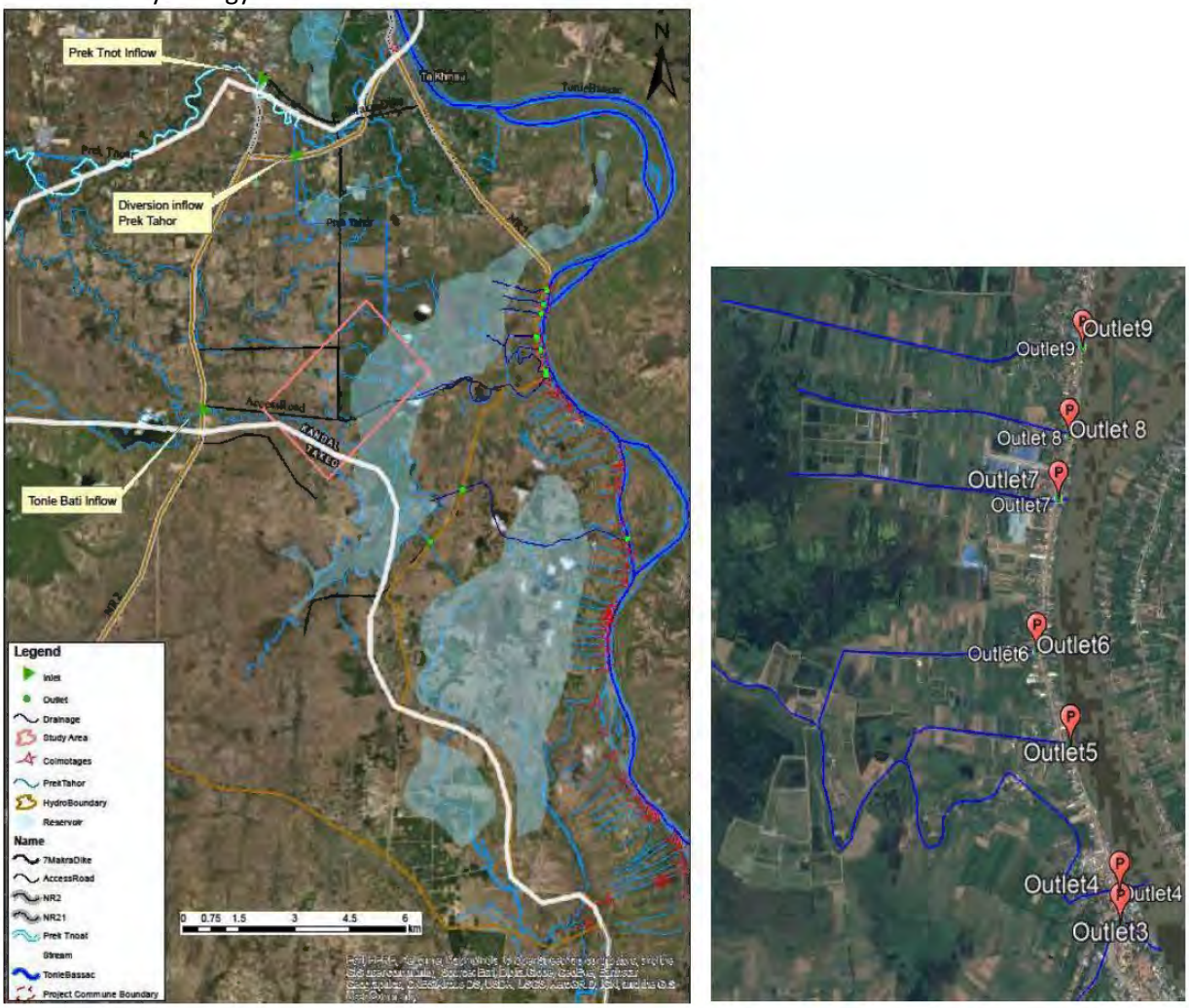
- The project area had some drainage systems, but no sewerage system at all. The drainage lines are represented by the canal, secondary canals, and tertiary canals which drain the water from the inlets and runoff water from the paddy field and village territory and store it in Sa'ang Phnom reservoir.

- The maximum flood level in the proposed project site is approximately 8.2m (m.sl), and flooded period is 5-10 days. The flooding in the area is mainly caused by flash floods from the upper catchment area at the west of the National Road No3, and the limited capacity of the drainage system in the project area. The more frequent floods happened here due to both global/regional climate change and land use and infrastructure changes in the project area.

- The project site is affected by the Mekong flood event with the maximum flood happened in 2000. The year 2000 flood could happen once in a period of 75 years, according to historical record and hydrological analysis.

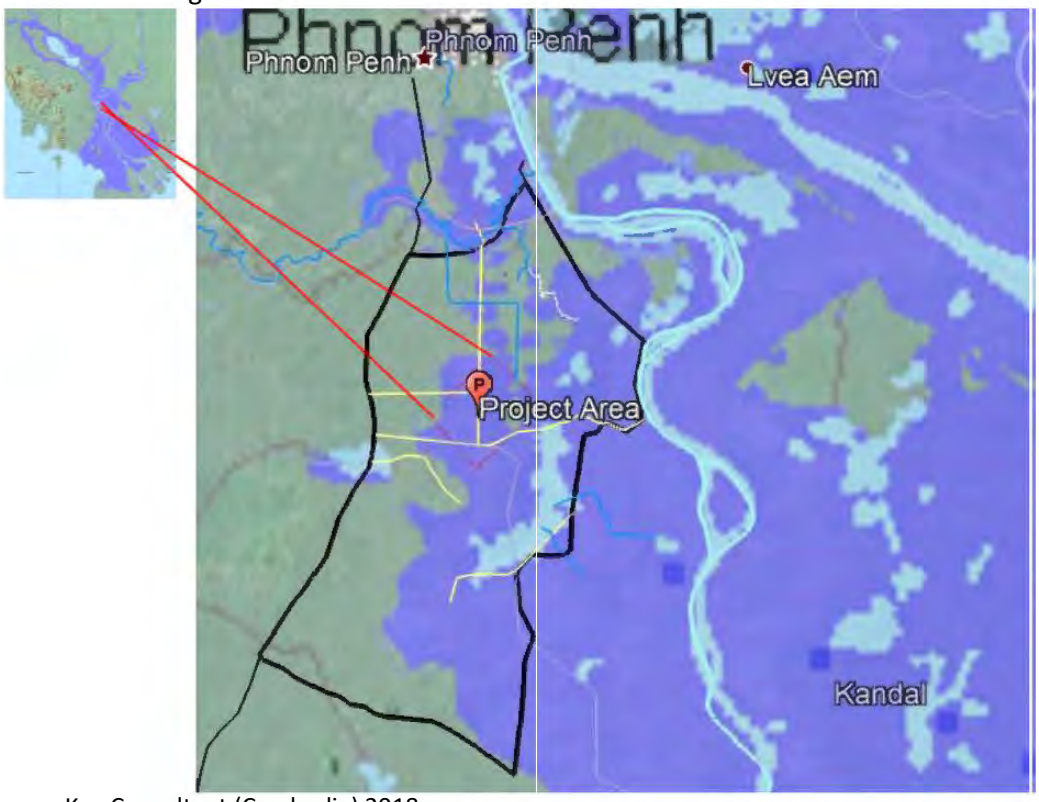
- Based on the rainfall intensity and frequency analysis for the return period of 100 year and 200 year, the water depth reaches to 1 and 1.5 above the existing layout separately without any breach.

Photo 70: Hydrology



Source: Key Consultant (Cambodia) 2018

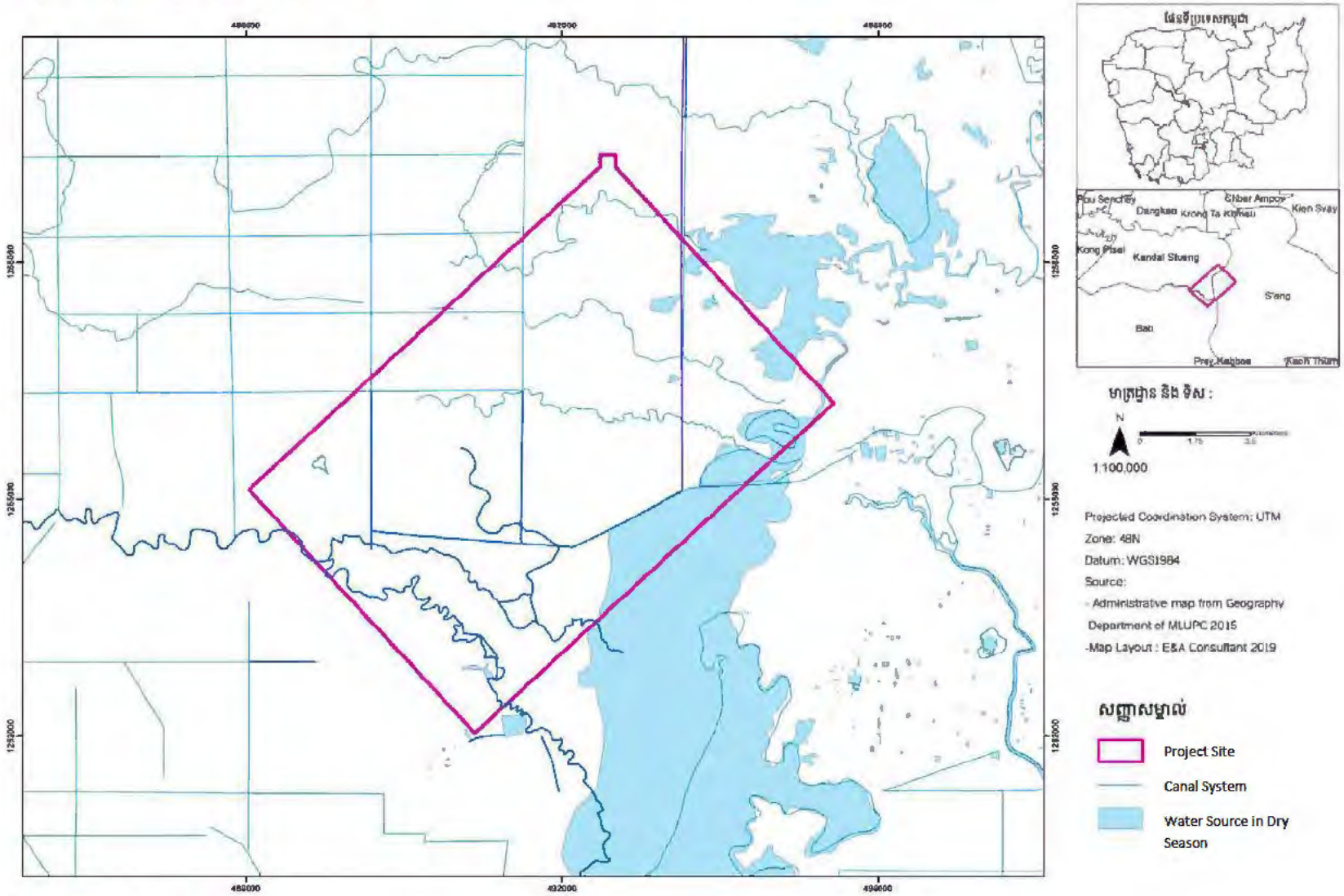
Photo 71: Flooding Water Level in 2001



Source: Key Consultant (Cambodia) 2018

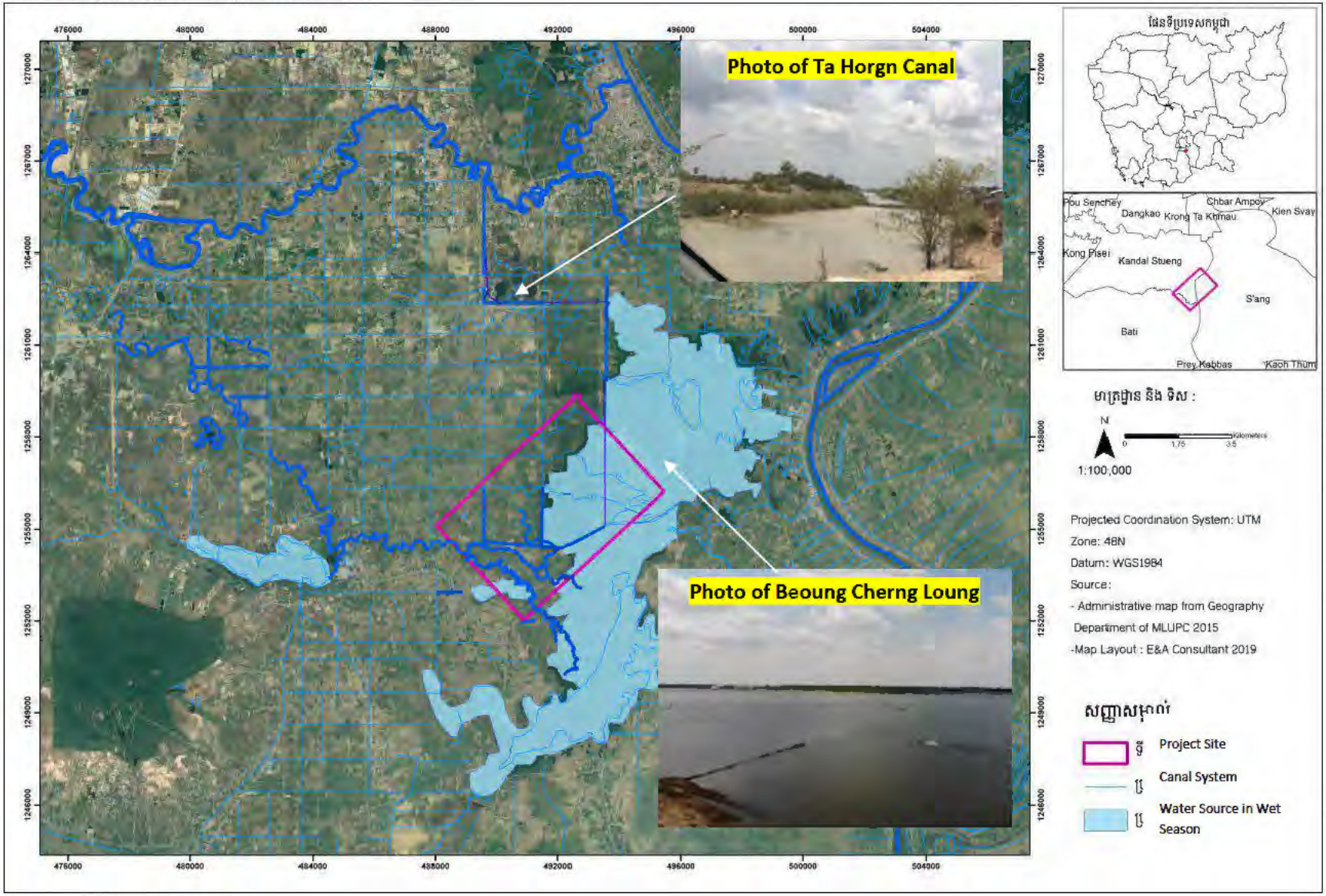
The flood study describes the interrelationship between Boueng Cheung Loung lake and other main water bodies crossing the project area. As shown above, Tonle Bati River and Stoeng Prek Tnot River bring water from the upstream to Boueng Cheung Loung Lake. The proposed NPPIA requires backfilling some lower parts of Tonle Bati River, a confluence of Tonle Bati River and Boueng Cheung Loung lake. The areas surrounding the lower Tonle Bati River are Bati District's Potsor Commune, and Kandal Stoeung District's Boeung Khyang commune are potentially flooded. Sa'ang District's Sa'ang Phnom Commune could potentially face water shortage due to the blockage of upper Tonle Bati River.

Map 20: Hydrology Map in Dry Season



Source: E&A Consultant

Map 21: Hydrological Map in Wet Season



Source: E&A Consultant, 2019

5.2.1.6 Water Quality

The water quality study foused on two main water sources: surface water (lake, stream and canal) and ground water (hand-tube wells). The surface water quality were study for both dry and rainy season. The results of water quality sampling in each season are described in the following sections.

a) Surface Water Quality

- **Surface water quality in dry season**

Four samples of surface water were taken from lake, stream and canal on January 31, 2019 (see Tables 68 ad 69 below). The sample were analysed at the Ministry of Environment's Laboratory Department . The results of the water quality for Boeung Chernglong (SW-01) were compared against the water quality standard in public water body for aquatic biodiversity conservation (for lake and reservior) as stipulated in the sub-decree on water pollution control (1999) and the Ministry of Environment's announcement on the implementation of the working conditions model for infrastructure and toursim sectors (2018). The results of the water quality of SW-02, SW-03 and SW-04 were compared against the water quality standard in public water body for aquatic biodiversity conservation (for rivers) as stipulated in the sub-decree on water pollution control (1999) and the Ministry of Environment's announcement on the implementation of the working conditions model for infrastructure and toursim sectors (2018).

Table 68 below illustrates the dry season water quality test results issued by the Ministry of Environment's Laboratory on Febraury 28, 2019. Main parameters are listed in the following table:

Table 67: Dry Season's Surface Water Quality Sampling Results in Dry Season

No.	Parameter	Unit	Surface water quality tested				Standard*	
			SW-01	SW-02	SW-03	SW-04	Lake and Reservoir	River
1	pH	-	6.92	6.61	7.04	7.08	6.5-8.5	6.5-8.3
2	DO	mg/l	6.40	1.60	3.80	2.40	7.5-2.0	7.5-2.0
3	TDS	mg/l	46	48	109	36	<1000	<1,000
4	TSS	mg/l	38	42	52	37	1 - 15	25-100
5	BOD5	mg/l	2.80	3.15	2.98	3.18	<30	1 - 10
6	COD	mg/l	5.48	8.23	6.66	7.84	1 - 8	<50
7	Oil & Grease	mg/l	**29**	**12.80**	**19.70**	**17.60**	<5.0	<5.0
8	NH_3	mg/l	0.02	0.06	0.08	0.06	NV	NV
9	Detergent	mg/l	ND	0.02	0.03	0.04	<5.0	<5.0
10	SO_4	mg/l	0.86	1.06	1.26	1.83	<300	<300
11	TN	mg/l	0.64	0.68	0.65	0.72	0.1-0.6	0.1-0.6
12	TP	mg/l	0.03	0.05	0.05	0.06	0.005-0.05	0.005-0.05
13	As	mg/l	0.006	0.007	0.005	0.007	<0.01	<0.01
14	Cd	mg/l	ND	ND	0.0003	0.0004	<0.001	<0.001
15	Fe	mg/l	0.09	0.14	0.34	0.10	<1	<1
16	Pb	mg/l	ND	ND	ND	ND	<0.01	<0.01
17	Hg	mg/l	0.0001	0.0003	0.0002	0.0001	<0.0005	<0.0005
18	Coliform	MPN/100ml	$9.2x10^3$	$2.3x10^3$	$4.3x10^3$	$2.3x10^3$	<1000	<5000

Note: Standard: Surface water quality standards for river, lake, and reservoirs of the MoE's announcement on the implementation of the working conditions model for infrastructure and tourism sectors (2018)*

- *ND: No Detect*
- *SW-01: water quality in Boeung Chernglong*
- *SW-02: water quality in downstream of Tonle Bati stream*
- *SW-03: water quality upper stream of Preak Taho*
- *SW-04: water quality in Canal No 57*

Source: Ministry of Environment's Laboratory (2018)

Boeung Cheung Loung's water quality test result (SW-01) showed that most parameters were within the acceptable standard (the water quality standard in public water body for aquatic biodiversity conservation (for lake and reservoir) as stipulated in the sub-decree on water pollution control (1999) and the Ministry of Environment's announcement on the implementation of the working conditions model for infrastructure and toursim sectors (2018). But TSS and Oil and Grease parameters exceeded the standard. Boeung Cheung Loung is a natural lake that s used for fishing activities by local fisherman. Therefore, the high concentration of TSS and oil and grease parameters are likely to be caused by leakages or the spillage of engine oil or lubricants from local fishing boats. In addition, other runoff through rainfall from the flooded forest and other surrounding agricultural activities are also the main factors that may contribute to the increase of TSS.

For water quality in steams, Preak and canal (for locations SW-02, SW-03 and SW-04), most parameters were within the water quality standard in public water body for aqua biodiversity conservation (for river) stipulated in the sub-decree on water pollution control (1999) and the Ministry of Environment's announcement on the implementation of the working conditions model for infrastructure and toursim sectors (2018). But Dissolved Oxygen (DO) of SW-02, Oil and Grease of all locations, and TN and TP of SW-04 exceeded the standard. The high concentration of these parameters may have caused by the degradation of decay of a variety of leaves or plants growing on the banks of the lake, streams, and canals, and the discharge of contaminated water or kitchen waste from dwellings on rivers and streams. But the excess was very minor and was deemed to be insignificant.

Photo 72: Surface water sampling activities

Surface water sampling in the dry season

Surface water in the rainy season

Source: E&A Consultant 2019

- **Surface Water Quality in the Rainy Season**

The water sampling during the rainy season was conducted on May 27, 2019. Four surface water samples were collected at the same location as thse collected during the dry season. The results of the water quality for Boeung Chernglong (SW-01) were compared against the water quality standard in public water body for aquatic biodiversity conservation (for lake and reservoir) as stipulated in the sub-decree on water pollution control (1999) and the Ministry of Environment's announcement on the implementation of the working conditions model for infrastructure and toursim sectors (2018). The results of the water quality at SW-02, SW-03 and SW-04 were compared against the water quality standard in public water body for aquatic biodiversity conservation (for river) as stipulated in the sub-decree on water pollution control (1999) and the Ministry of Environment's announcement on the implementation of the working conditions model for infrastructure and toursim sectors (2018).

The following Table 69 lists the results of surface water quality testing for the rainy season which was issued by the Ministry of the Environment on June 19, 2019. Main parameters are listed in the following table:

Table 68: Wet season's surface water quality sampling results

No.	Parameter	Unit	Surface water quality tested				Standard*	
			SW-01	SW-02	SW-03	SW-04	Lake and Reservoir	River
1	pH	-	7.54	6.21	6.88	6.82	6.5-8.5	6.5-8.3
2	DO	mg/l	6.80	3.20	3.94	3.10	7.5-2.0	7.5-2.0
3	TDS	mg/l	81.00	158.00	122.00	178.00	<1000	<1,000
4	TSS	mg/l	**99.00**	53.00	71.00	102.00	1 - 15	25-100
5	BOD_5	mg/l	5.40	3.60	3.40	4.20	<30	1 - 10
6	COD	mg/l	**14.47**	10.15	10.07	8.72	1 - 8	<50
7	Oil & Grease	mg/l	**17.00**	3.87	**32.00**	**16.40**	<5.0	<5.0
8	NH_3	mg/l	1.34	1.46	1.34	1.46	NV	NV
9	Detergent	mg/l	ND	ND	ND	ND	<5.0	<5.0
10	SO_4	mg/l	28.00	52.00	42.00	24.00	<300	<300
11	TN	mg/l	**3.09**	1.56	**1.89**	**3.66**	0.1-0.6	0.1-0.6
12	TP	mg/l	**0.44**	**0.08**	**0.27**	**0.43**	0.005-0.05	0.005-0.05
13	As	mg/l	0.004	0.005	0.002	0.001	<0.01	<0.01
14	Cd	mg/l	ND	ND	ND	ND	<0.001	<0.001
15	Fe	mg/l	0.11	0.06	0.08	0.05	<1	<1
16	Pb	mg/l	ND	ND	ND	ND	<0.01	<0.01
17	Hg	mg/l	ND	ND	ND	ND	<0.0005	<0.0005
18	Coliform	MPN/100ml	$3.6x10^2$	$7.4x10^2$	**$2.1x10^4$**	**$9.3x10^3$**	<1000	<5000

Note: Standard: Surface water quality standards for river, lake, and reservoirs of the MoE's Prakas on the adoption of terms of references for infrastructure and tourism sectors (2018), ND: No Detect*

SW-01: water quality in Boeung Chernglong, SW-02: water quality in downstream of Tonle Bati stream, SW-03: water quality upper stream of Preak Taho, SW-04: water quality in Canal No 57

Source: Ministry of Environment's Laboratory (2018)

The result of the rainy season's surface water quality tests showed that most parameters of SW-01 were within the standards (the water quality standard in public water body for aquatic biodiversity conservation (for lake and reservoir) as stipulated in the sub-decree on water pollution control (1999) and the Ministry of Environment's announcement on the implementation of the working conditions model for infrastructure and toursim sectors (2018), except TSS, COD, TN, TP and oil and grease parameter which exceeded the standard. Surface water sampling was conducted in the rainy season; therefore, the high concentration of these parameters are likely to be caused by any runoff from the surounding agricultural activities which use chemical fertiliser and pesticide as well as any leakage or spill of engine oils or lubricants from local fishing boats. In addition, the influx of water into the lake through the canals and streams around the lake, which brings with it wildlife's manure, debris, household waste from the residential areas, and the decay of the vegetation are also factors that can cause these parameters to exceed the standard.

For river, stream, and canal water quality (SW-02, SW-03 and SW-04) most parameters were within the water quality standard (the water quality standard in public water body for aquatic biodiversity conservation (for river) as stipulated in the sub-decree on water pollution control (1999) and the Ministry of Environment's announcement on the implementation of the working conditions model for infrastructure and toursim sectors (2018), except Oil and Grease, TN and total Coliform of SW-03 and SW-04, and TP of SW-03 which exceeded the standard. Surface water sampling was conducted in the rainy season; therefore, the exceeding of these parameters may be due to various runoffs caused by the rainfall, resulting in the decay of a variety of vegetation growing on the banks of the lake, streams, and canals, and the discharge of contaminated water from business areas, and gray water from residental areas along the stream or river into these water, nearby stream or canals. Moreover, any runoff through rainfall from the agricultural areas may also be a cause of higher total nitrogen (TN) and total phosphate (TP).

b) Ground Water Quality

Groundwater sample was taken from two locations. The first location took samples from a hand-tube well in Preak Khmer village. The second location took samples from a hand-tube well in Pot Sor village. Both groundwater sample were taken on January 31, 2019. These two hand-tube wells are being used by local people and located nearby the project area.

The sample were analysed in the Ministry of Environment's Laboratory Department. The test results were compared with the National Drinking Water Quality Standard of Ministry of Industry and Handicrafts (2004). Table 70 below illustrates the groundwater test results issued by The Ministry of Environment's laboratory on February 28, 2019. Main parameters of groundwater quality are shown in the following table:

Table 69: Groundwater Sampling Results in Project Area

No.	Parameter	Unit	Result		Standard*
			GW-01	GW-02	
1	pH	-	6.71	7.40	6,5-8,5
2	EC	µs/cm	116.00	123.00	500-1500
3	TDS	mg/l	78.00	98.00	<800
4	Turbidity	NTU	0.00	0.00	<5
6	as $CaCO_3$	mg/l	38.90	46.40	<300
6	Cl	mg/l	0.02	0.01	250
7	F	mg/l	0.15	0.18	<1,5
8	NO_3	mg/l	0.39	0.48	<50
9	SO_4	mg/l	2.35	2.65	<250
10	Al	mg/l	ND	ND	<0,2
11	As	mg/l	0.12	0.14	<0,05
12	Cd	mg/l	ND	ND	<0,003
13	Cr	mg/l	ND	0.003	<0,05

No.	Parameter	Unit	Result		Standard*
			GW-01	GW-02	
14	Fe	mg/l	0.04	0.006	<0,3
15	Mn	mg/l	0.001	0.003	<0,1
16	Hg	mg/l	ND	ND	<0,001
17	E-Coli	MPN/100ml	0	0	0
18	Total Coliform	MPN/100ml	0	0	0

Noted: Standard: national drinking water quality standard of Ministry of Industry and Handicraft (2004) and Prakas on the adoption of terms of references for infrastructure and tourism sectors of MoE (2018)*

- *ND: Not Detected*
- GW-01: Groundwater sampling in Prek Khmer village
- GW-02: Groundwater sampling in Pot Sor village

Source: Ministry of Environment's Laboratory (2019)

The test resulst show that most parameters of groundwater qualities were within the Cambodian Ministry of Industry and Handicraft's national drinking water quality standard (2004), except Arsenic (As) and Iron (Fe-total) which exceeded the standard. This excess may be due to various geographical conditions. It should be noted that Kandal province is known as a province where higher levels of Arsenic in groundwater is found as compared to other provinces in Cambodia. High level of Fe, on the other hand, may be due to the natural occurrence of groundwater, but it may also be due to the dissolution of components from hand-tube wells or pumps.

Photo 73: Groundwater Sampling

Groundwater sampling activities at location 1

Groundwater sampling activities at location 2

Source: E&A Consultant 2019

5.2.1.7. Conclusion

In conclusion, the study of physical resources determined the type of geology, soil pattern and type, topography, hydrology, and climate within and around the project area. The soil is suitable for vertical foundation. The test results of air quality, noise, and vibration show that most of them are within the Ministry of Environment's standards.

The surface water quality tests for both dry season (conducted in February 2019) and wet season (conducted in May 2019) show that almost all parameters in the four locations are within the Ministry of Environment's standards. For Location 1 at Boeung Cheung Loung (SW-01), the water quality test result show that TSS, Oil and Grease, COD, TN, and TP parameters exceeded the standards. Boeung Cheung Loung is a natural lake that s used for fishing activities by local fisherman. Therefore, the high concentration of TSS and oil and grease parameters are likely to be caused by leakages or the spillage of

For the other three locations (SW-02, SW-03 and SW-04), the water quality test results show that DO, Oil and Grease, TN, TP, and Coliform exceed the standards. The high concentration of these parameters may have caused by the decay of a variety of leaves or plants growing on the banks of the lake, streams, and canals, and the discharge of contaminated water or kitchen waste from dwellers on rivers and streams. But the excess is very minor and is deemed insignificant.

According to the surface water quality test results, most parameters of both locations are within Cambodia's national drinking water standards of the Ministry of Industry and Handicraft (2004). Only Arsenic (As) and Fe-total exceed the standards. The reason may have been due to Kandal's relatively higher content of Arsenic and Fe-total compared with other provinces of Cambodia. Furthermore, the decay of materials used to build well may contribute to the increase of metal composition.

5.2.2 Biological resources

The biological study was conducted within three kilometres around the project area. The team reviewed existing fish resources, wildlife, and vegetation as well as observing the general situation in the study area. In addition to a comprehensive desk review, the study was conducted through observation and interviews with fishermen and elders in the study area, based on a checklist of Cambodian birds and mammals for identifying the species of all animals and plants in and around the project area.

5.2.2.1. General situation in the study area

The study area is a flooded area, consisting of rivers, lakes, creeks, and canals and is covered by flooded forest, rice fields and other natural resources. The major part of the area is flooded only during the rainy season. This area has many natural lakes which are shelters and food sources to many important species of birds and fish. The availability of these resources is important for some people who are fishermen.

The project area is flooded in the wet season, receiving water from the Mekong River. The project area is not designated as a fishing lot, flooded forest, fishery conservation area or reserved fishing area. The study found that the project area consists of grass, paddy fields, and low land.

5.2.2.2. Vegetation and Plants

In general, the study found that there are 44 species of vegetation and trees in the study area—Beoung Cheung Loung and Beoung Rean and their surrounding wetlands (see Table 53 below). All species found in the area are not in the classification list of the International Union for Conservation of Nature (IUCN), meaning that there is no significant or endangered species.

The vegetation in the study area consists of aquatic plants, flooded trees and shrub/tree around the lakes. Most flood forest growthis in the western part of the two lakes. The outstanding species of the flooded forest in the area are Sea Poison Tree, Phnom Phneng, Tlerm Andek, Giant Sensitive Tree, and Rice Flatsedge. Most Sea Poison Trees, a type of flooded forest species, was seen to grow in the area between Beoung Cheung Loung and Beoung Rean, with the height varying from 3 to 4 metres. Most of the aquatic

vegetation, especially, Rice Flatsedge was seen to scatter across the two lakes, with high density in the upper part of the Beoung Cheung Loung and a large part of Beung Rean. It is noted that some species (Flatsedge, Smao Antouk Tek, Smao Ampov Deap etc.) which are smaller types of vegetation prevail in the area but only in the wet season. In addition, the vegetation communities in the area have been under threat with the present of Giant Sensitive Tree (Mimosa Pigra) which is an extremely invasive species and can degrade the whole diversified vegetation communities in the area. This Giant Sensitive Tree prevails across the study area.

Table 70: Vegetation in the Study Area and Project Area

No.	Type of Plant	*Scientific Name*	Status	Remark
1	Giant sensitive tree	*Mimosa Pigra*	Abundant	Found
2	Tlerm Anderk	-	Abundant	Found
3	Shrinking	*Mimosa Pisdica*	Abundant	Found
4	Sea poison tree	*Barringtonia asiatica*	Moderate	Found
5	Phnom Phneng	*Hymnocardia wallichii*	Moderate	Found
6	Caudated croton	*Croton caudatus*	Moderate	Found
7	Asian Bushbeech	*Gmelina asiatica*	Moderate	Found
8	Kowli seeds	*Croton joufra*	Moderate	Found
9	Sneng Krobei	*Desmondium heterocarpon*	Moderate	Found
10	Swamp bushwillow	*Combretum trifoliatum*	Moderate	Found
11	Tmenh Trey	*Bridelia ovata, Var: Curtisis*	Abundant	Found
12	Tmenh Trey Nhi	*Bridelia cambodiana*	Moderate	Found
13	Terminalia	*Terminalia cambodiana*	Moderate	Found
14	Water olive	*Hydrolea zeylanica*	Moderate	Found
15	North Indian rosewood	*Dalbergia herrida, Var: glabrescens*	Moderate	Found
16	Black creeper	*Inhnocarpus frutescens*	Moderate	Found
17	Dalbergia heterophylla Willd	*Derris trifolia*	Moderate	Found
18	Ivy woodrose	*Memrremia hederacea*	Moderate	Found
19	Asthma-plant	*Euphorbia hirta*	Moderate	Found
20	Fox grape	*Cayratia trifolia*	Moderate	Found
21	Cammelina	*Cammelina Salicifolia*	Moderate	Found
22	Knotgrass	*Polygonum tomentosum*	Abundant	Found
23	Garlic pear tree	*Crateva andansonii subsp odorata*	Moderate	Found
24	Water caltrop	*Trapa bicornis*	Abundant	Found
25	Bladderwort	*Utricularia aurea*	Abundant	Found
26	Duckweed	*Lemna minor*	Abundant	Found
27	Waterthyme	*Hydrilla verticillata*	Moderate	Found
28	Cape periwinkle	*Catharanthus roseus*	Abundant	Found
29	Water hyacinth	*Eichhornia crassipes*	Abundant	Found
30	Water primrose	*Ludwigia adscendens*	Abundant	Found
31	Swampy	*Phoenix paludosa*	Moderate	Found
32	Water spinach	*Ipomoea aquatica*	Abundant	Found
33	Star Lotus	*Nymphaca lotus*	Moderate	Found
34	Smao Antouk Tek	-	Moderate	Found
35	Prolit Duong	-	Moderate	Found
36	Smao Ampov Deap	-	Moderate	Found

No.	Type of Plant	*Scientific Name*	Status	Remark
37	Red and Blue water lily	*Nymphaca nouchali*	Moderate	Found
38	Rice flatsedge	*Cyperus elatus*	Moderate	Found
38	Nut grass	*Cyperus Kyllingia nemoralis*	Moderate	Found
40	Lotus	*Nelumbo nucifera*	Moderate	Found
41	Robust marshwort	*Nymphoides indica*	Moderate	Found
42	Water mimosa	*Neptunia oleracea*	Moderate	Found
43	Willow-leaved water croton	*Homonoia riparia Lour*	Moderate	Found
44	Yelloweyed grasses	*Xyris indica*	Moderate	Found

Source: E&A Consultant, 2019

Photo 74: Type of Vegetation in the Study Area

Giant sensitive tree

Sea poison tree

Water caltrop

Water hyacinth

Rice Flatsedge

Tlerm Andek

Source: E&A consultant, 2019

5.2.2.3 Wildlife

a) Birds

The study area is a wetland which is favourable for birds. Bird presence has been found generally, across the area, especially within the water areas of Beong Rean Lake and Beoung Chheung Loung Lake (see Map 18 on page 119 below). The study identified 60 bird species in the study area. No species identified in the area falls in the "endangered" classification defined by CITES. Among the species, 3 are in classified as "nearly threatened", 5 are "vulnerable". There are 22 bird species that have always been present in thestudy area (Beoung Cheung Loung Lake and Beoung Rean Lake). Bird species present in the study area are shown in Table 71 below:

Table 71: Bird Species in the Study Area

No.	Name	*Scientific name*	CITES	IUCN	Source of information*
1	Little Cormorant	*Phalacrocorax niger*		LC	Found
2	Indian Cormorant	*Phalacrocorax fuscicollis*		LC	Found
3	Great Cormorant	*Phalacrocorax carbo*		LC	Found
4	Dater	*Anhinga melanogaster*		NT	Interviewed
5	Grey Heron	*Ardea cinerea*		LC	Interviewed
6	Great-billed Heron	*Arder sumatrana*		LC	Interviewed
7	Great Egret	*Egretta alba*	III	LC	Found
8	Intermadiate Egret	*Egretta intermedia*	III		Found
9	Little Egret	*Egretta garzetta*		LC	Found
10	Cattle Egret	*Bubulcus ibis*	III	LC	Found
11	Javan Pond-Heron	*Ardeola speciosa*		LC	Found
12	Black-crowned Night Heron	*Nycticorax nycticorax*		LC	Interviewed
13	little Heron	*Butorides striatus*			Interviewed
14	Yallow Bittern	*Ixobrychus sinensis*		LC	Found
15	Cinnamom Bittern	*Ixobrychus cinnamomeus*		LC	Interviewed
16	Lesser Whistling Duck	*Dendrocygan javanica*		LC	Interviewed
17	Garganey	*Anas querquedula*		LC	Interviewed
18	Spot-billed Duck	*Anas poecilorhyncha*		LC	Interviewed
19	Cotton Pygmy-goose	*Nettapus coromandelianus*		LC	Interviewed
20	Little Grebe	*Tachybaptus ruficollis*		LC	Interviewed
21	Spot-billed Pelican	*Pelecanus Philippensis*		NT	Interviewed
22	Peregrine Falcon	*Falco peregrinus*		LC	Interviewed

No.	Name	*Scientific name*	CITES	IUCN	Source of information*
23	Grey-headed Fish Eagle	*Ichthyophaga icthyaetus*	II	NT	Interviewed
24	Lesser Fish Eagie	*Ichthyophaga humilis*	II	NT	Interviewed
25	Pallas's Fish Eagle	*Haliaeetus leucoryphus*	II	EN	Interviewed
26	Brahminy Kite	*Haliastur indus*	II	LC	Interviewed
27	Black kite	*Milvus migrans*	II	LC	Interviewed
28	Greater Spotted Eagle	*Aquila changa*		VU	Interviewed
29	Black-winged Stilt	*Himantopus himantopus*		LC	Interviewed
30	Great Thick-knee	*Esacus recurvirotris*		NT	Interviewed
31	Red-wattled Lapwing	*vanellus indicus*		LC	Interviewed
32	Grey-headed Lapwing	*Vanellus cinereus*		LC	Interviewed
33	River Lapwing	*Vanellus duvaucelii*		NT	Interviewed
34	Little Tern	*Sterna albifrons*		LC	Found
35	Whiskered Tern	*Chlidonias hybridus*		LC	Found
36	Black-bellied Tern	*Sterna acuticauda*		EN	Found
37	River Tern	*Sterna auramtia*		NT	Found
38	Great Crested Tern	*Sterne bergii*		LC	Found
39	Caspian Tern	*sterne Caspia*		LC	Found
40	Indian Skimmer	*Rhynchops albicollis*		VU	Found
41	Christmas Island Frigatebird	*Fregata andrewsi*		CR	Interviewed
42	Dusky Warbler	*Phylloscopuspus fuscatus*		LC	Interviewed
43	Manchurian Reed Warbler	*Acrocephalus tangorum*		VU	Interviewed
44	Black-browed Reed warbler	*Acrocephalus bistrigiceps*		LC	Interviewed
45	Lanceolated Warbler	*Locustella lanceolta*		LC	Interviewed
46	Oriental Reed Warbler	*Acrocephalus Orientalis*		LC	Interviewed
47	Striated Grassbrid	*Megalustris palustris*			Interviewed
48	Plain Prinia	*Prinia ionrnata*		LC	Interviewed
49	Zitting Cisticola	*Cisticola juncidis*		LC	Interviewed
50	Paddyfield Pipit	*Anthus rufulus*		LC	Interviewed
51	Bluethroat	*Luscinia svecia*		LC	Interviewed
52	Copper-throated Sunbird	*Nectarinia calacostetha*		LC	Interviewed
53	Mekong Wagtail	*Motacila samveasna*		NT	Interviewed
54	Plain Martin	*Riparia paludicola*		LC	Interviewed
55	Sand Martin	*Riparia riparia*		LC	Interviewed
56	Wire-tailed Swallow	*Hirundo smithii*		LC	Interviewed
57	Red Avadavat	*Amandava amandava*		LC	Interviewed
58	Baya Weaver	*Ploceus Philippinus*		LC	Interviewed
59	Streaked Weaver	*Ploceus manyar*		LC	Interviewed
60	Asian Golden Weaver	*Plaecus hypoxanthus*		NT	Interviewed

*Note: I = endangered species, II = vulnerable species, III = nearly threatened; LC = Least Concern; NT = Near Threatened; VU = Vulnerable; CR = Critically Endangered; EN = Endangered, *Source of information is through (i).observation and found and (ii). Inteviewed with local people and/or key person.*

Source: E&A consultant 2019

Photo 75*: Bird Species Present in the Study Area*

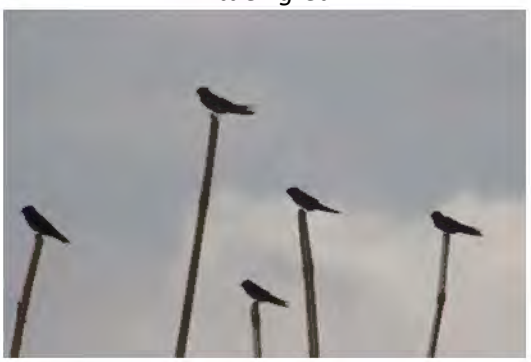
Little Tern

Intermediate Egret

Indian Cormorant

Little Egret

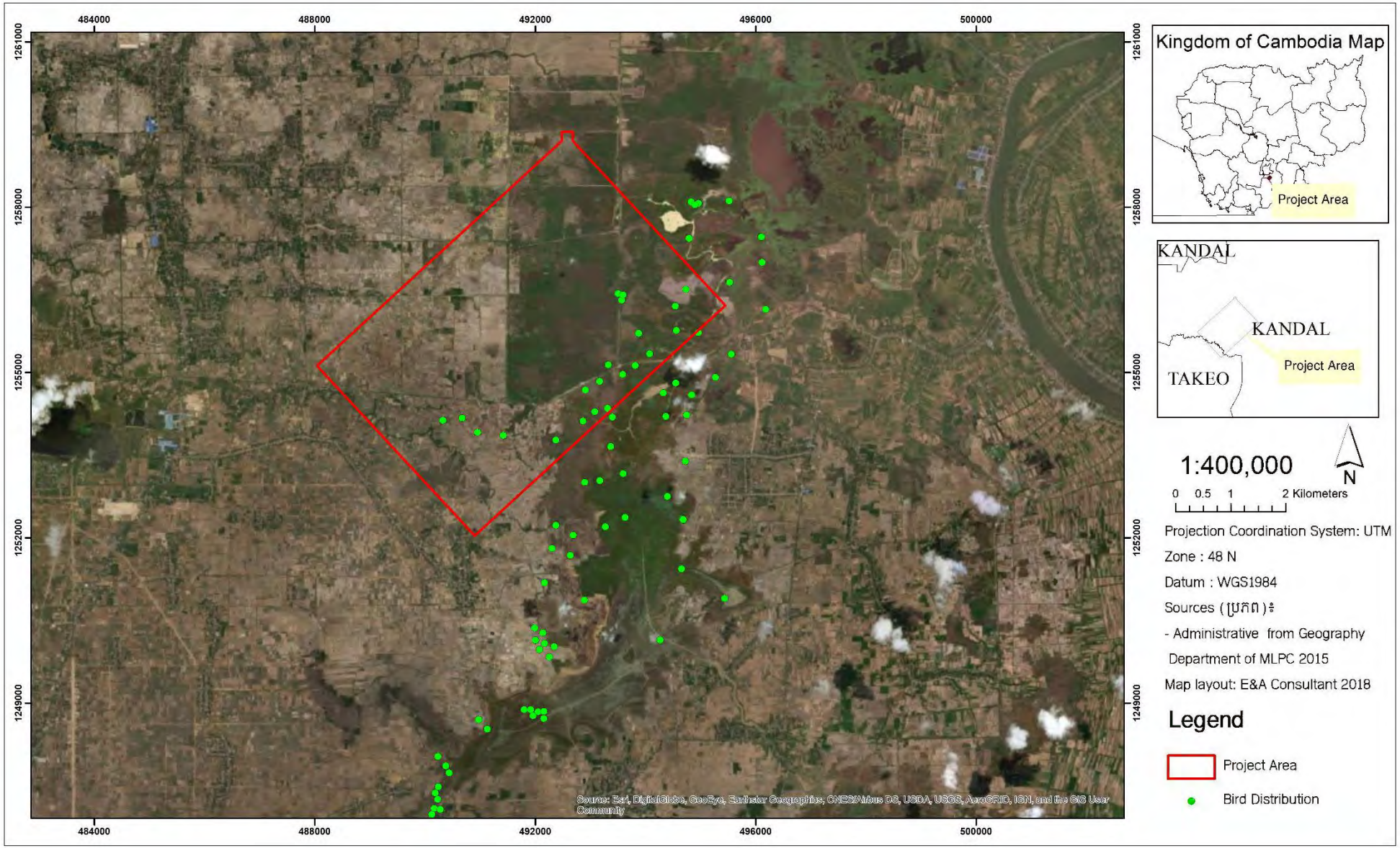
Javan Pond-Heron



Wire-tailed Swallow

Source: E&A Consultant 2019

Map 22: Distribution of Birds in the Study Area



b) Reptile

Seventeen reptile species were found in and around the study area. Among the reptile species, 5 species are in vulnerable status as defined CITES. Reptile species as shown as table below:

Table 72: Retile Species Present is the Study Area

No.	English Name	*Scientific name*	Classification in Cambodia	IUCN	CITES	Source of Information*
1	Striped Keel back	*Amphiesma stolata*	Moderate	DD		Interviewed
2	Reticulated Python	*Python reticulatus*	Moderate	DD	II	Interviewed
3	Burmese Python	*Python molurus bivittatus*	Moderate	VU	II	Interviewed
4	King Cobra	*Ophiophagus hannah*	Rare	VU	II	Interviewed
5	Monocled Cobra	*Naja koouthia*	Rare	LC	II	Interviewed
6	Yellow spotted water snake	*Xenochrophis flavipunctatus*	Moderate	LC		Interviewed
7	Indochinese Spitting cobra	*Naja siamensis*	Rare	VU	II	Interviewed
8	Black-yellow banded krait	*Bungarus fasciatus*	Moderate	LC		Interviewed
9	Indo-Chinese Rat Snake	*Ptyas korros*	Moderate	DD		Interviewed
10	Black Copper Rat Snake	*Coelognathus flavolineatus*		LC		Interviewed
11	Bocourt's water snake	*Enhydris bocourti*		DD		Interviewed
12	Inornate Kukri Snake	*Oligodon inomatus*	Moderate	DD		Interviewed
13	Common Wolf Snake	*Lycodon capucinus*	Moderate	LC		Interviewed
14	Rainbow Water Snake	*Enhydris enhydris*				Interviewed
15	Gecko	*Gekko gecko*	Moderate	DD		Found
16	Bengal Monitor	*Varanus bengalensis*	Moderate	DD	I	Interviewed
17	Water Dragon	*Physignathus cocincinus*	Moderate	DD		Interviewed
18	Iguana	-		DD		Found

*Note: I = endangered species, II = vulnerable species, III = nearly threated; LC = Least Concern; NT = Near Threatened; VU = Vulnerable; CE = Critically Endangered; EN = Endangered; DD = Data-Deficient, *Source of information is through (i).observation and found and (ii). Inteviewed with local people and/or key person.*

Source: E&A consultant

c) Mammals

The study identified 8 mammal species (Berdmore's squirrel, Burmese hare, Long-tailed Macaque, Small Asian Mongoose, Crab-eating Mongoose, Grey-bellied squirrel, and Common palm civet), classified as least concern, and two mammals (Rat and Fishing Cat), classified as data-deficient in the IUCN Red List, in the study area. Two mammals (Long-tailed Macaque and Fishing Cat) are classified as "vulnerable" and three species (Small Asian Mongoose, Crab-eating Mongoose, and Common Palm Civet) are classified as "nearly threatened" as defined by CITES.

Table 73: List of Mammal Species

No.	English Name	Scientific Name	Classification in Cambodia	IUCN	CITES	Remark
1	Berdmore's Squirrel	*Menetes berdmorei*	Moderate	LC		Interviewed
2	Burmese Hare	*Lepus peguensis*	Fair	LC		Interviewed
3	Rat	*Rat spp.*	Moderate	DD		Interviewed
4	Fishing Cat	*Prionailurus viverrinus*	Moderate	DD	II	Interviewed

No.	English Name	Scientific Name	Classification in Cambodia	IUCN	CITES	Remark
5	Small Asian Mongoose	*Herpestes Javanicus*	Moderate	LC	III	Interviewed
6	Crab-eating Mongoose	*Herpestes urva*	Moderate	LC	III	Interviewed
7	Grey Bellied Squirrel	*Callosciurus caniceps*	Moderate	LC		Interviewed
8	Common Palm Civet	*Paradoxurus hermaphroditus*	Moderate	LC	III	Interviewed

Note: I = endangered species, II = vulnerable species, III = nearly threatened; *LC = Least Concern; NT = Near Threatened; VU = Vulnerable; CE = Critically Endangered; EN = Endangered; DD = Data-Deficient*

5.2.2.4 Fish Resources

A. Importance and status of fisheries

Fish and rice are the most essential food of many Cambodians. Cambodian people have a tradition of eating fish for daily life. Cambodians eat an average of 62.95 kilograms of fish per person per year, of which 40.3 kg are freshwater fish, 16.2 kg are sea fish, 13.5 kilograms come from aquaculture, and 5.1 kg are other aquatic species (IFReDI, 2012). Typical foods from these fish include dried fish, grilled fish, Prohok, Paa'ak, Mam, fish sauce, etc.

Fish, the most important source of protein in people's diets, contributes about 80% of the daily diet of Cambodian people (Hortle, K.G., S. Lieng and J. Valbo-Jorgensen, 2004). Fish's proteins contain the most dissolved amino acids (Haas, 1992). A diet of balanced protein is essential for the growth and development of cells. Fish also provides other important minerals, including iron, zinc (Roos, 2003) and many vitamins, especially vitamin A. Fresh fish contains about 75% of water and the rest is mostly protein. Fat is the third most common ingredient in fish cells, which provides an important source of energy. Fish oils contain acid such as omega-3 PUFA, which is high in quantity and have health benefits such as reducing heart disease (AHA, 2002), boosting brain function (Kalmijn, S., PJ van Boxtel, M.Ouk, WMM Verschuren, D. Kromhout and LJ Launer., 2004) and reducing the impact of arthritis (Larsen, 2004).

Freshwater fish and rice have long been important to the Cambodian people since the historical time and have sustained the famous Angkor empire period in the central of Siem Reap province from the 9th to the 15th centuries of the Christ Era. Many statues on the walls of Bayon and other temples describe the fish and fishing (Roberts, 2002).

Mr. Zhou Daguan, a Chinese tourist to Cambodia in the years 1296-1297 of the Christ Era, described the diversity of fisheries resources in the Tonle Sap, such as fish, frog, turtle, soft-shelled turtle, newt, giant lobsters, crocodiles, and lamellibranch, (Zhou, 2002). A French scientist in the 19th-century also commented on the abundance of fish, and the ease of catching large fish or large quantities of fish along the Mekong River and its tributaries and he also elaborated how the Vietnamese successfully performed the fishing business in Tonle Sap lake (Garnier, 1996).

Freshwater fish has been an important resource for food, household income, and long-term exports. In 1910, about 50,000 tons of fish were exported as dried fish or ingredient fish, fish oil, Prohok or fresh fish (Petillot, 1911). In the 1930s, about 100,000 tons of fish per year were caught from Tonle Sap Lake. Of which 25,000 tons were processed as mostly dried fish or ingredient fish, and of which 23,000 tons/ year were exported to Java city (Chevey, 1935).

Later, Chevey and Le Poulain estimated that the fish output was approximately 120,000 tons/year in 1940, 147,000 tons/year in 1939, and 130,000 tons/year in 1957 (Bardach, 1959). By 1973, the Cambodia's fish output was estimated at 125,000-160,000 tons/year, with commercial fisheries

estimated at 85,000 tones/year (Lagler, 1976). At the time of the Khmer Rouge (1975-1979), there were no reports of fishing because the infrastructure and commercial system were destroyed and the people only cultivated rice (Degen, P. and T. Nao, 2000). After 1979, the fishing activity was on the rise again, and the fishing in 1979-1988 was estimated at 18,000-66,000 tones/year (Nguyen, ND, Vu, VA, Doan VT, Lam, N .Ch and Nguyen V.Ph., 2008). Between 2000 and 2013, the output of freshwater fish in Cambodia was at its lowest, at 245,000 tons in 2000 and highest at 528,000 tons in 2013 (Annual Report of Fisheries Administration), valued at approximately $ 300 million, which contributed from 8% to 12% of GDP. In 2013, the estimates by the Research and Freshwater Fisheries Development Institute indicated that the fisheries sector was worth up to the US $ 1 billion per year (the price of fish $ 1.6 / kg) with no yet of adding the additional value of export and labor costs, etc (IFReDI, 2012).

In Phnom Penh 2014, according to the annual report of Phnom Penh Fisheries Administration, the total annual catch was 4,370 tons. Of these 0.575 tons were family fishing, and 0.11 tons were field fishing. The fishing materials are hoop-net, dip net, hook, trap, cast net, and large fishnet, etc. The species of fish include Chpork, Por, Pra, Chrokaeng, Kes, Klanghay, Kbok, etc.

B. Shelter and its importance

The fish habitats in Cambodia are diverse and intricate. These habitats include rivers, lakes, reservoirs, flooded plains, paddy fields, creeks, streams, pits, and canals. Different species of fish live in different habitats seasonally. The abundance of fish resources depends on environmental and habitat conditions, plant, and food resources. The environmental habitat is favorable for living and breeding.

C. Fish species

Fourty six (46) species of fish were found in the study area, 20 of which were of little concerned. Among the species of fish recorded, Hypsibarbus lagleri and Cirrhinus microlepis are among the critically endangered species listed in the IUCN Red List. In addition, the richest fish species of lakes are Henicorthynchus lobatus and Thynnichthys thynnoides, all of which are abundant throughout the year, from November to April. The following table shows the fish species present in the study area:

Table 74: Fish Species in the Project Area

No.	*Scientific Names*	ICUN Red list	Remark
1	*Morrulius chrysophekadion*	-	Found, Interviewed
2	*Ompok hypophthalmus*	-	Found, Interviewed
3	*Trey Kror Poth*	-	Found, Interviewed
4	*Henicorthynchus lobatus*	-	Found, Interviewed
5	*Anabas testudineus*	DD	Interviewed
6	*Trichogaster microlepis*	-	Interviewed
7	*Trichogaster trichopterus*	LC	Interviewed
8	*Oxyeleotris marmorata*	LC	Interviewed
9	*Prabarbus labeamajor*	-	Interviewed
10	*Hampala dispar*	LC	Interviewed
11	*Osteochilus wanndersii*	-	Interviewed
12	*Ampala dispar*	-	Interviewed
13	*Puntioplites proctozysron*	-	Interviewed
14	*Rabora myersi*	-	Found, Interviewed
15	*Rasbora hobelmani*	-	Interviewed
16	*Hypsibarbus lagleri*	VU	Interviewed
17	*Cirrhinus microlepis*	VU	Interviewed
18	*Cyclocheilichthys lagleri*	LC	Found, Interviewed

No.	*Scientific Names*	ICUN Red list	Remark
19	*Cyclocheilichthys mekngensis*	-	Interviewed
20	*Thynnichthys thynnoides*	LC	Interviewed
21	*Labiobarbus siamensis*	LC	Interviewed
22	*Cyclocheilichthys repasson*	LC	Found, Interviewed
23	*Esomus longimanus*	-	Interviewed
24	*Chitala ornata*	LC	Interviewed
25	*Notopterus notopterus*	LC	Found
26	*Pristolepis fasciata*	LC	Found, Interviewed
27	*Anabas testudineus*	-	Found, Interviewed
28	*Xenentodon cancila*	LC	Found, Interviewed
29	*Macrognathus taenaigaster*	-	Found, Interviewed
30	*Macroganathus siamensis*	-	Interviewed
31	*Channa micropeltes (Giant snakehead)*	-	Interviewed
32	*Channa striata(Striped snakehead)*	LC	Interviewed
33	*Hemibagrus nemurus*	LC	Interviewed
34	*Hemibagrus spilopterus*	LC	Interviewed
35	*Mystus albolineatus*	LC	Interviewed
36	*Mystus rhegma*	-	Interviewed
37	*Pseudomystus siamensis*	LC	Interviewed
38	*Clarias batrachus*	LC	Interviewed
39	*Clarias macrocephalus*	NT	Interviewed
40	*Pangasianodon hypophthalmus*	I	Interviewed
41	*Pangasius larnaudii*	LC	Interviewed
42	*Pangasius macronema*	LC	Interviewed
43	*Belodontichthys truncatus*	LC	Interviewed
44	*Micronema bleekeri*	-	Interviewed
45	*Micronema cheveyi*	-	Interviewed
46	*Kjeng*	-	

Note: I: Interviewed, F: Found

IUCN Redlist (LC= Least Concerned EN = Endangered, NT = Near Threatened, DD = Data Deficient VU = Vulnerable, CE = Critically Endangered)

Source: E&A Consultant, 2019

Photo 76: Fish Species Present in the Study Area

Morrulius chrysophekadion

Pristolepis fasciata

Rabora myersi

Ompok hypophthalmus

Anabas testudineus

Source: E&A Consultant, 2019

Map 23: General Overview of Forestry, Wildlife, and Fisheries in the Study Area

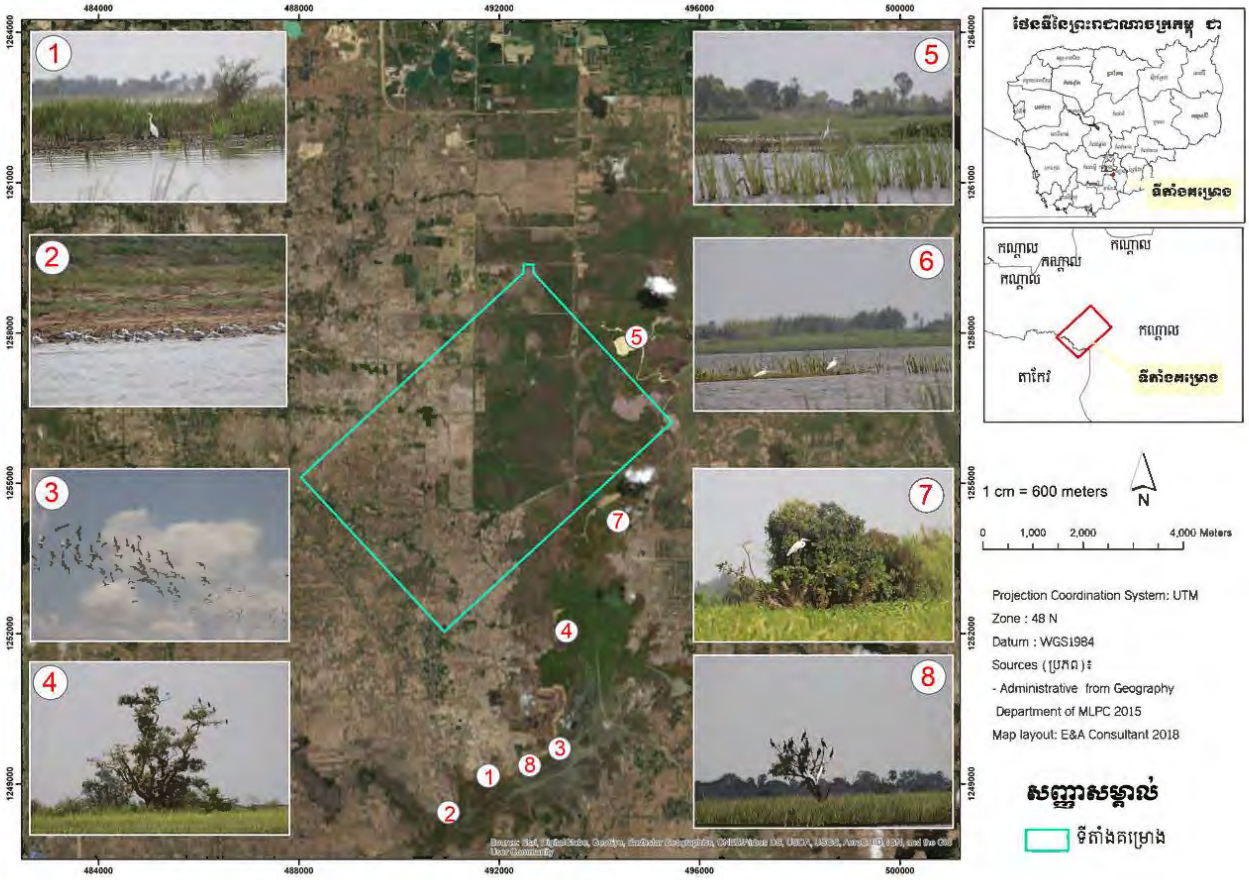


Photo 77: Pictoral of Study Activity

5.2.2.5. Conclusion

The study area is a flooded plain, consisting of rivers, lakes, creeks, and canals, and is covered by flooded plants, rice fields, and natural resources. As a result, 44 species of aquatic plants are present in the study area, and all of them are neither economically valuable nor endangered. 46 species of fish were found in the study area, 20 of which were of little concern. Among the species of fish recorded, Hypsibarbus lagleri and Cirrhinus microlepis are among the critically endangered species listed in the IUCN Red List. In addition, the richest fish species of lakes are Henicorthynchus lobatus and Thynnichthys thynnoides, all of which are abundant throughout the year, from November to April.

The wildlife study focused on birds, reptiles, and mammals. The results are as follows:

- The study identified 62 species of birds present in the vicinity of the project, 43 of which are of little concerned, eight of which are endangered in the future, the other four species are in the vulnerable category and another one is critically endangered (Swallow). There are 22 species of birds that have always been present in Cherng Loang Lake, where many of these birds live in the flooded forest areas and find food on the flooded plains.

- Eighteen (18) species of reptiles were found in and around the study area. Of the five species considered to be of little concerned (Monocled Cobra, Yellow-spotted water snake, Black-yellow banded krai, Black Copper Rat Snake, and Common Wolf Snake). Three species were classified as vulnerable (Burmese Python, King Cobra, and Indochinese Spitting cobra) and nine other species are data-deficient.
- Of the nine mammals present in the study area, seven species (Berdmore's squirrel, Burmese hare, Long-tailed Macaque, Small Asian Mongoose, Crab-eating Mongoose, Common Palm Civet, and Grey Bellied Squirrel) are of little concerned and the other two species (rat and fishing cat) are data-deficient in the IUCN Red List. In addition, two species of mammals (chimpanzees and leopards) are classified in appendix 2 of the CITIES Convention while three species (Small Asian Mongoose, crab-eating Mongoose, and common palm civet) are classified in appendix 3 of the CITIES Convention. Currently, these animals are in danger and are vulnerable to habitat loss and disturbances due to the people's invasion of flooded forest area, and animal traps.

5.3 Socio-economic Resources

The socio-economic resources were studied within 3 km from project site. The study focuses on demography, settlement, land use, occupational and economic activities, physical infrastructure, electricity and water usage, solid waste and waste management, public welfare, education, tourism area, and cultural sitse by complying with the guidelines of the Ministry of Environment.

5.3.1 Demography

The project is located in Kandal and Takeo provinces. The 3km area around the project area covers 32 villages, 6 communes and 3 districts in Kandal and Takeo provinces. In Kandal province, there is Kandal Stung district (4 communes and 16 villages and, Sa'ang district (1 commune and 5 villages). Takeo province has only one district which is Bati district, Pot Sor commune (a total of 11 villages).

According to the 2018 Commune/Sangkat data, the study area had a total of 8,972 families, 40,160 people (20,453 women). Ta Nu village of Sa'ang Phnom commune has the highest population of 2,212 people, while Sala Ta Prohm village of Boeung Khyang commune has only 340 people. Sa'ang Phnom commune's Ta Nu village has the most population (1,149) aged between 18 and 60, compared with other villages in the study area. Beoung Khyang commune's Prey Ta Toch village has the most widows (328). Most female head of household are poor and less educated, so they are not capable to earn a lot of money. Almost all households are Buddishts.

Table 75: Demography 3km around Project Area

Province	District	Commune	Village	Family	Population	Female	Population (Age 18-60)	Female Head of Household
Kandal	Kandal Stung	Ompov Prey	Ta Daol 1	225	795	411	501	54
			Ta Daol 2	216	946	490	550	33
			Ta Daol 3	205	748	405	377	45
			Cherng Prey 1	162	986	330	518	11
			Cherng Prey 2	205	824	422	497	56
			Cherng Prey 3	146	624	316	385	129
		Beoung Khyang	Beoung Khyang	335	1,393	757	865	23
			Prey Ta Toch	422	1,697	893	1,005	328
			Srok Chek	297	1.258	638	791	64
			KampongTa Long	293	1.201	604	690	58

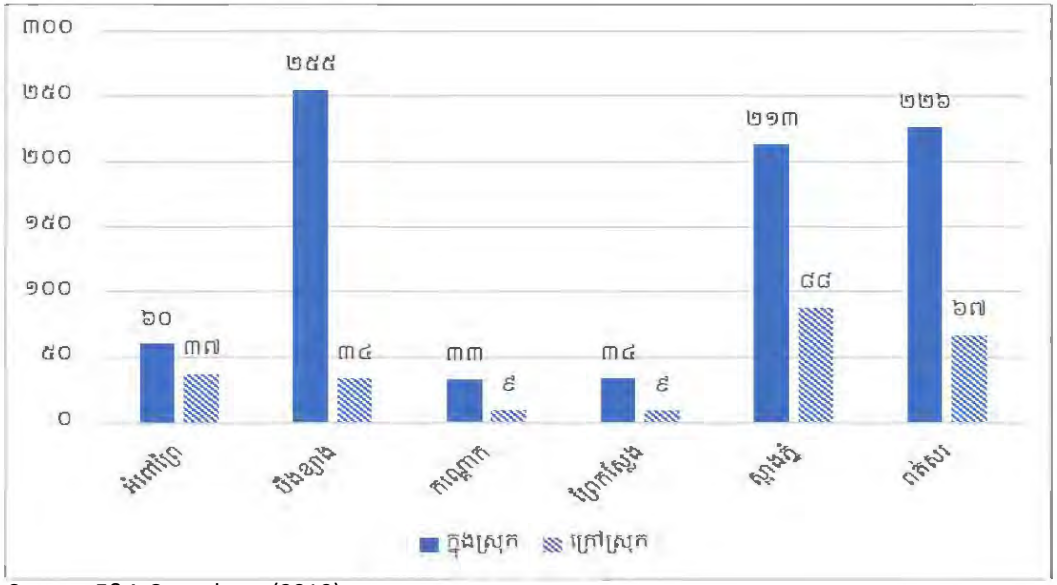
Province	District	Commune	Village	Family	Population	Female	Population (Age 18-60)	Female Head of Household
			Prolay	300	1.208	615	780	67
			Sala Ta Prum	78	340	160	174	20
		Kandoak	Svay Prey	289	1.201	628	607	42
			Chrey Ro yong	305	1.154	609	701	58
		Prek Slaeng	Prey Ta Thok	220	909	457	559	43
			Prasat	393	1,831	967	900	48
	Sa'ang	Sa'ang Phnom	Tuol Sala	434	1,845	954	1,111	81
			Prek Khmer	376	1.881	841	984	41
			Peam Sala	416	2,078	1,092	940	97
			Veal	417	2.013	1,060	1,129	58
			Ta Nu	486	2,212	1,083	1,149	135
Takeo	Bati	Pot Sor	Prey Sva	197	887	441	478	12
			Krouch	200	915	448	522	42
			Krang Por	296	1,766	926	818	65
			Tropeang Trav	345	1.703	877	972	169
			Chambok	331	1,364	680	859	142
			Pot Sor	455	1,834	955	961	49
			Tang Russie	202	881	435	503	35
			Klang Sombatt	258	1,214	666	712	36
			Kandaol	157	794	421	507	17
			Khvan Meas	179	995	532	600	38
			Kla Kuon	132	663	340	334	40
2	**3**	**6**	**32**	**8,972**	**40,160**	**20.453**	**22,479**	**2,136**

Source: Commune/Sangkat 2018

5.3.2 Migrants

The national migration trend of the over-18-year olds in Boeung Khyang commune is higher (255 people) than those in the other 5 communes in the study area. Oversea migration in Pot Sor commune was higher than in other communities (226 people). The reasons that make people migrate include searching for work and income and family-relocation.

Figure 20: Number of Migrants (over 18 years old) in the Study Area



Source: E&A Consultant (2019)

5.3.3 Settlement

Household settlements in all study villages mostly lie along the national and local roads (ribbon development). The majority of households in the study arealine in homes constructed of zinc roofs and walls or with a tile roof. The type of housing in the study commune appears to demonstrate a more comfortable standard of living of the families in the study area compared to others in the remote areas.

Table 76: Type of Houses in the Study Area

Commune/Type of house	Zinc-roofed	Zinc-roofed (fewer than 20 zinc sheets)	Tile-roof	Concrete	Flat
Ampov Prey	56%	6%	30%	7%	1%
Beoung Khyang	43%	7%	29%	14%	6%
Kondoak	53%	7%	28%	9%	2%
Prek Sleng	37%	5%	52%	5%	1%
Sa'ang Phnom	69%	9%	17%	5%	0%
Pot Sor	49%	4%	38%	8%	1%

Source: Commune data (2018)

Photo 78: Types of House in the Study Area

Zinc-roofed house

Zinc-roofed house Tile-roofed house

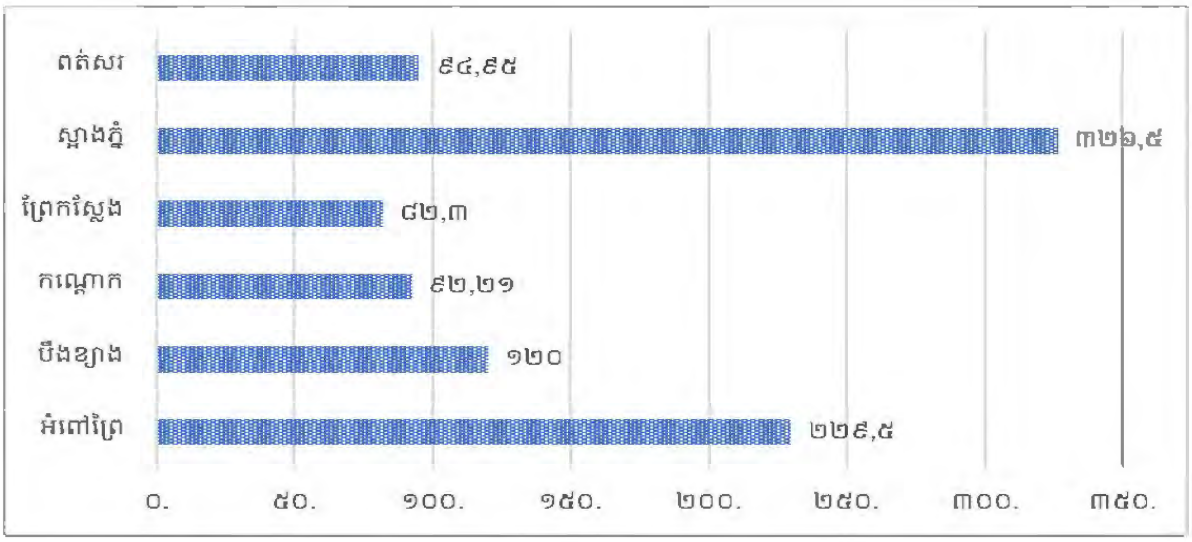
Source: E&A Consultant (2019)

5.3.4 Land use and land registration

a) Residential areas

Sa'ang Phnom commune has the total largest residential area among the six study areas. Sa'ang Phnom commune has the largest residential area of 326.5 hectares and there are nine villages with a total number of households of 3,384. The commune which has smallest residential area is Prek Slaeng. This commune has four (4) villages and total of 1,012 families.

Figure 21: Residential Land Size (ha)

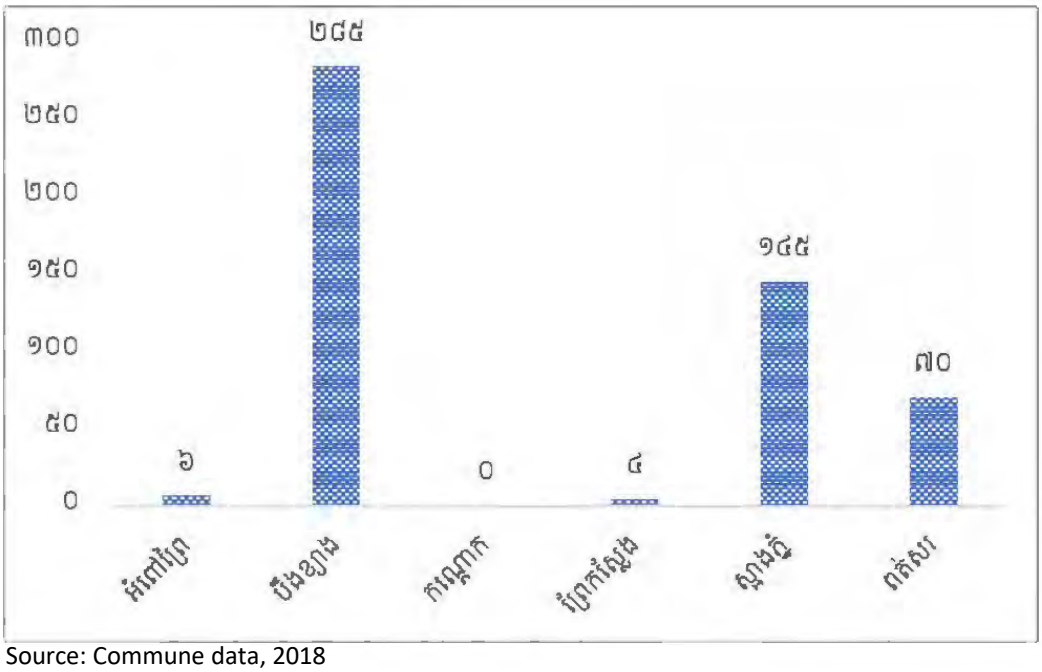


Source: Commune Data, 2019

Commune/Sangkat data also shows the number of households residing on state public land without a certificate/title. Approximately 16.5% (285 families) of the total number of households living in Boeung Khyang commune are residing on public land (land around the lake or along the canal). Kan Daok commune has no household data showing residences on public land.

Boeung Khyang commune's Sala Taprom village is entirely located in the project area. The villagers live on the canals (Canal No. 94). There are 78 households, equivalent to 340 people (160 female; 20 female heads of household).

Figure 22: Number of households living on the state-owned land



Source: Commune data, 2018

b) Agricultural Land

Agriculture remain an important sector for a lot of people although the national economy grows fast. Agricultural land in the study area is divided into two types: there are crop-lands and rice fields. Family farming in the area cultivates rice twice a year in the rainy season and the dry season because the study area is very favourable as it benefits from access to rivers, Bati River, Prek Tnot steam and also utilises rainwater harvesting, and canal and water extraction from Boueng Cheung Loung for agricultural purposes in Pot Sor commune.

According to Commune/Sangkat data 2018, the total rice land area in all six communes is 9,094.7 hectares and crop-land (short-term crops) 131.7 hectares. Dry season rice land has a total area of 4,219.6 hectares and rainy season rice land is 4,875.09 hectares. Most families' crop-lands are located in Sa'ang commune, with more than 80% of the population growing short-term crops or vegetables to supply their own needs and exporting the surplus to the Phnom Penh city.

Table 77: Size of Land by Type in each Commune

Description	Paddy field		Crop-land
	Dry season (ha)	Rainy season (ha)	
Ompov Prey	9.6	306.1	22.05
Beoung Khyang	626	633	0
Kandaok	117	557	16.8
Prek Slaeng	400	552	0.7
Sa'ang Phnom	1,717	955	77.13
Pot Sor	1,350	1,871.99	15
Total area	**4,219.6**	**4,875.09**	**131.7**

Source: Commune/Sangkat 2018

Photo 79: Paddy Field and Crop Land

Paddy field

Short-term crop

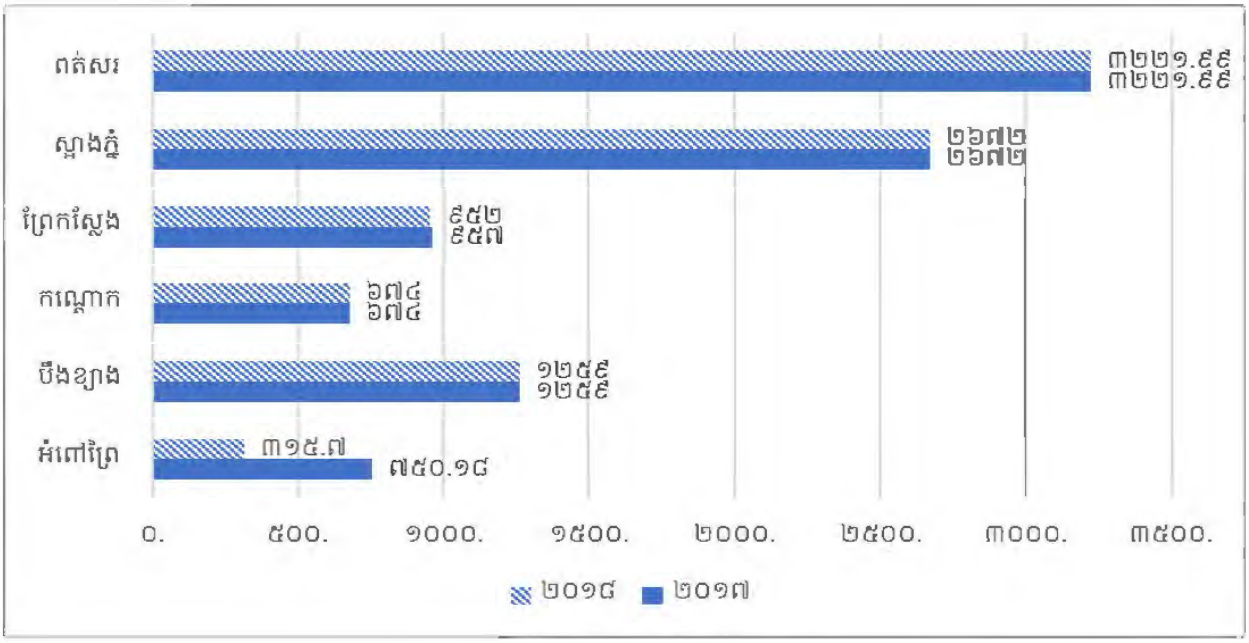
Residential land

Settlement on canal (Sala Taprom village)

c) Changes of agricultural land in the study area

According to commune data in 2018, the agricultural land area decreased if compared with that in 2017. Ampov Prey commune saw a significant decrease from 750.18 ha to 315.7 ha; while Prek Sleng commune down from 957 ha to 952 ha in 2018. Other communes remained the same. The decrease may have been due to urbanization leading to increases of population and infrastructure development.

Figure 23: Agricultural Land Area in 2017 and 2018 (ha)



Source: Commune data, 2018

d) Land used in study area

The land use study in 2019 uses aerial photos obtained from Google Earth in 2019 with verification on the ground. The land use in the study area include residential area (910.21 ha), agricultural area (10,348.08 ha), and lake (453.96 ha). The overlapping area over the project area include agricultural area (2,178 ha), flooded forest (364 ha), lake (48 ha), and residential area (10 ha).

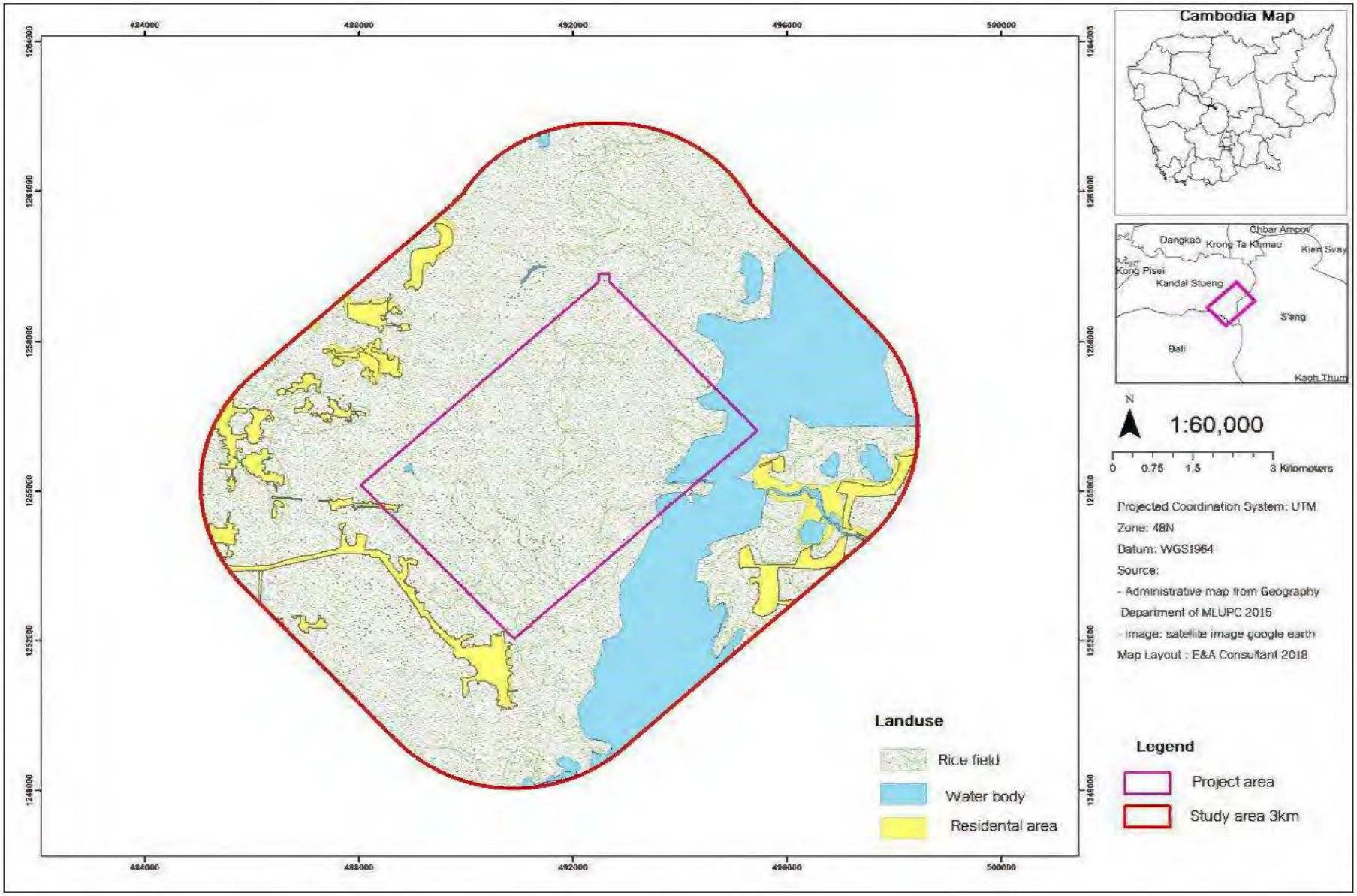
Table 78: Land Used in Study Area

No.	Land Use Type	Area (ha)		Percentage (%)	
I.	**Study Area**				
1	Residential Area	910.21		7.77	
2	Agricultural Area	10348.08		88.35	
3	Lake	453.96		3.88	
II.	**Project Area***	**Sa'ang District (ha)**	**Kandal Stung District (ha)**	**Bati District (ha)**	**Total Area (ha)**
1	Agricultural Area	307	1571	137	2015
2	Residential Area	0.8	7	-	7.8
3	Public Area (Lake, Flooded Forest …)	249.2	307.2	203.8	760.2
3.1.	*Water body*	*46*	*2*	*12*	*60*
3.2.	*Flooded forest*	*172*	*200.2*	-	*372.2*
3.3.	*Other Public Area*	*31.2*	*105*	*8.82*	*145.02*
	Total Area by district	**557**	**1885.2**	**157.8**	2600
	% of Total area by district	**21.42**	**72.51**	**6.07**	**100**

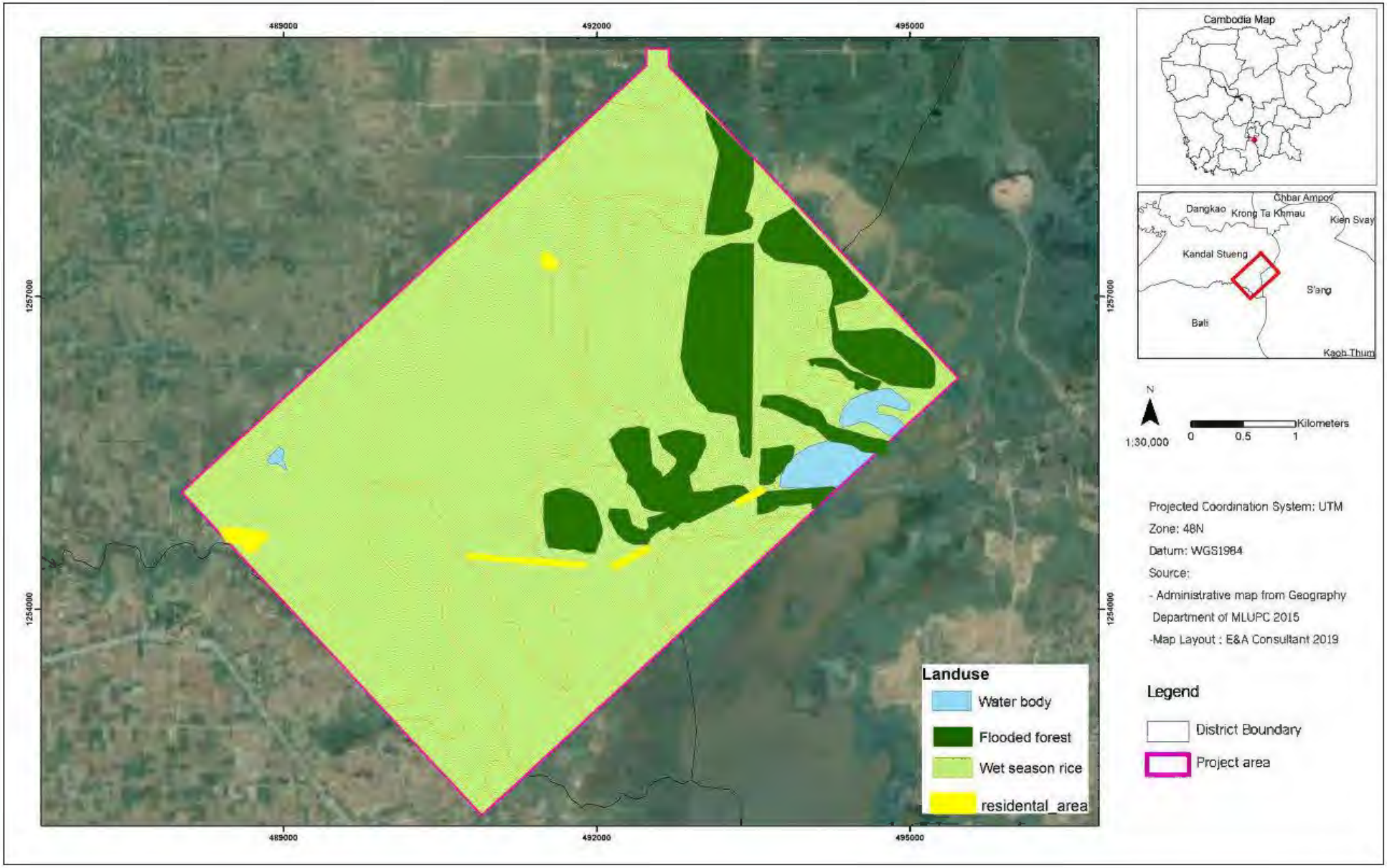
Note: *Based on Committee of Land Acquisation

Source: Commune/Sangkat 2018

Map 24: Land Use



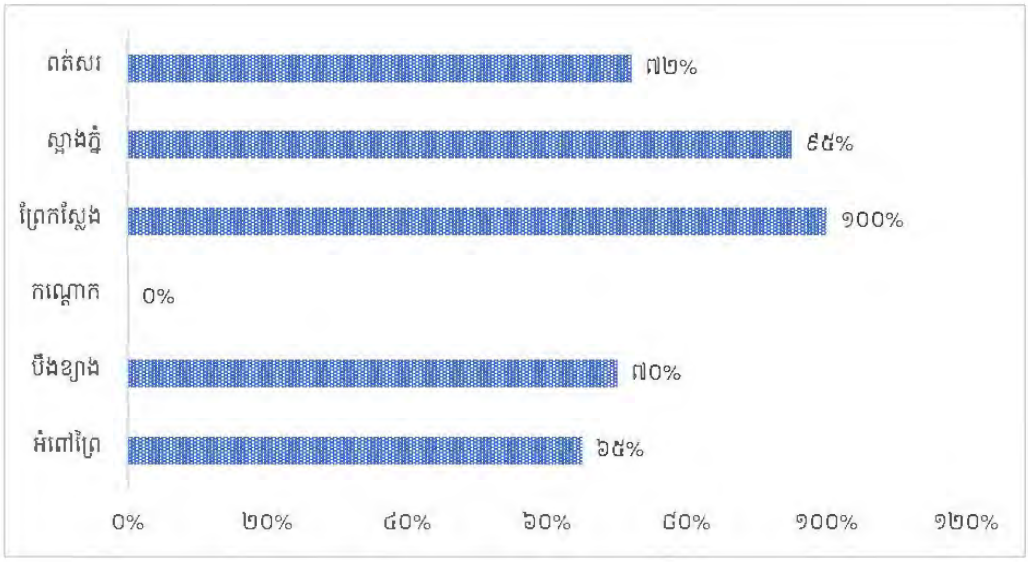
Map 25: Land use



e) Land registration

According to the commune/Sangkat data, the number of households in the study area registered and receiving land title is 8,594 of 12,439 (69%), while the other 31%are not yet registered or do not had proper land tenure. 100% of the households in Kan Daok commune are not yet registered to make official land title claims.

Figure 24: Household with land title in each commune



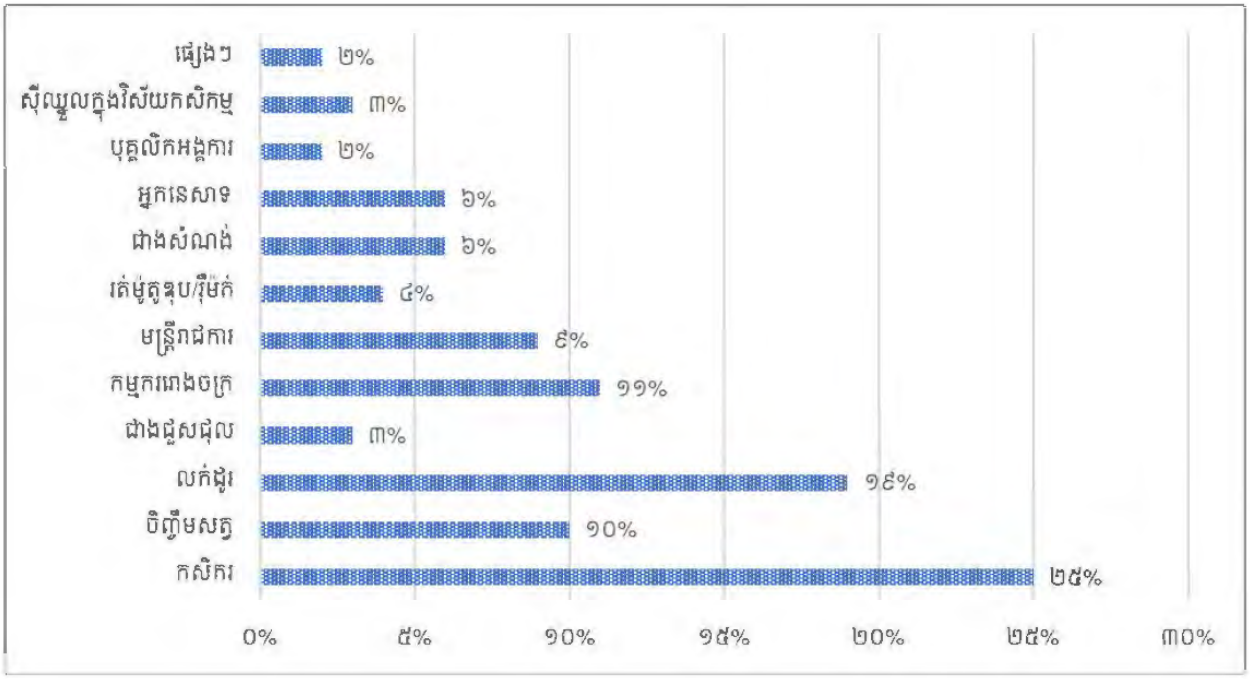
Source: Commune data (2018)

5.3.5 Occupational and Economic activities

a) Occupations

There are twelve main types of occupation in the study area: farmer, poultry, vendor, repairer, factory-worker, civil servants, transportation workers, construction worker, fisherman, NGOs staff, agricultural labourers and others. The major occupation of the households are farmer (25%) and vendor (19%). Although households in the study area have other main occupations, many of them still undertake farming as their secondary occupation.

Figure 25: Occupations



Source: E&A Consultant (2019)

Photo 80: Occupations

Rice production

Short-term crop

Fish trading

Cricket farm

Retailing

Repair shop

Source: E&A Consultant (2019)

b) Fishing

The study area encompasses natural lakes, in which Boueng Cheung Loung is considered the largest lake with fishing potential. Six percent (or 538 households) of all households in the study area are fishermen. The ratio of fishermen is high (about 90% or 70 households) in Sala Ta Prum village which is located inside the proposed project location. Fishermen use traditional fishing gears and some use illegal gears. The use of illegal gear is one of the main causes of fish resource depletion.

All fishing activities in the study area are small-scale and comprise two types: Type 1-subsistence-commercial fishing, and Type 2-subsistence fishing. In Type 1, fishing is carried out throughout the year by villages that are living close Boueng Rean and Boueng Cheung Loung. Fishers use plastic boats and wooden boats with small engines. The fishing schedule is divided in two times as following: 1) from 3 am

to 6 am and 2) from 6 am to 3 pm. The average daily catch is between 10 and 15 kg per day of diversified fish, but the most caught fish are Mozambique tilapia, Siamese mud carp, Moonlight gourami, Climbing perch, Trey Slat, and Snail Eating Barb. The fish are sold to a middle man or to commercial fish sellers who distribute fish in the local markets and in Phnom Penh.

Type 2 fishing activities are spread across the area, but with a lower profile; the majority of fishermen who carry out subsistence fishing are from fishery community located in the southern part of Cheoung Loung Lake. The study found that the main fishing season is the period from March to April, during which people can catch a lot of fish. On average, people can catch between 2 to 3 kg per day. The average fish price is from 11,600 riel in the rainy season to 17,400 riel per kilogram in the dry season.

Photo 81: Fishing Activity and Gear

Source: E&A Consultant (2019)

Table 79: Fish Species and Fishing Season

No.	Name	season	Gear	Location
1	Long Long Carp	From April to May	Net	Cherng Lorng and Rean lake
2	Ta Aon	From early November to May	Net	Cherng Lorng and Rean lake
3	Kra Poat	From early November to May	Net	Cherng Lorng and Rean lake
4	Lesser Silver Mud Carp	Full year	Net	Cherng Lorng and Rean lake
5	Climbing Perch	From April to May	Net	Cherng Lorng and Rean lake
6	Dusky Sleeper	From April to May	Net	Cherng Lorng and Rean lake
7	Thicklip Barb	From April to May	Net	Cherng Lorng and Rean lake
8	Spotted Hampala Barb	Full year	Net	Cherng Lorng and Rean lake
9	Siamese Long Fin Carp	From April to May	Net	Cherng Lorng and Rean lake
10	Spotted Hampala Barb	From early November to May	Net	Cherng Lorng and Rean lake
11	Reddis Sheatfish	From April to May	Net	Cherng Lorng and Rean lake
12	Myer's Silver Rasbora	From early November to May	Net	Cherng Lorng and Rean lake
13	Java/Silver Barb	From early November to May	Net	Cherng Lorng and Rean lake
14	Small Scale Carp	From early November to May	Net	Cherng Lorng and Rean lake
15	Trey Lenh	Almost year-round	Net	Cherng Lorng and Rean lake
16	White Eye Barb	From early November to May	Net	Cherng Lorng and Rean lake
17	Long-fin Flying Minnow	From early November to May	Net	Cherng Lorng and Rean lake
18	Bronze Featherback	From early November to May	Net	Cherng Lorng and Rean lake
19	Pristolepis Fasciata	From early November to May	Net	Cherng Lorng and Rean lake
20	Climbing Perch	From early November to May	Net	Cherng Lorng and Rean lake
21	Congaturi Halfbeak	From early November to May	Net	Cherng Lorng and Rean lake
22	Peacock Eel	From early November to May	Net	Cherng Lorng and Rean lake
23	Giant Snakehead	From early November to May	Net	Cherng Lorng and Rean lake
24	Striped Snakehead	From early November to May	Net	Cherng Lorng and Rean lake
25	Blacktail Catfish	From early November to May	Net	Cherng Lorng and Rean lake
26	White-line Catfish	Almost year-round	Net	Cherng Lorng and Rean lake
27	Boomblebii Catfish	From early November to May	Net	Cherng Lorng and Rean lake
28	Walking Catfish	From early November to May	Net	Cherng Lorng and Rean lake

No.	Name	season	Gear	Location
29	Bighead Working Catfish	From early November to May	Net	Cherng Lorng and Rean lake
30	Striped Catfish		Net	Cherng Lorng and Rean lake
31	Spotted-Ear Catfish	From early November to May	Net	Cherng Lorng and Rean lake
32	Twisted-Jaw Sheatfish	From early November to May	Net	Cherng Lorng and Rean lake
33	Trey Kes	From early November to May	Net	Cherng Lorng and Rean lake
34	Eyespot Spiny Eel	From early November to May	Net	Cherng Lorng and Rean lake
35	Mixed- fish	Full year	Net	Cherng Lorng and Rean lake

Source: E&A Consultant 2019

Table 80: Fish price Sell to middle-man

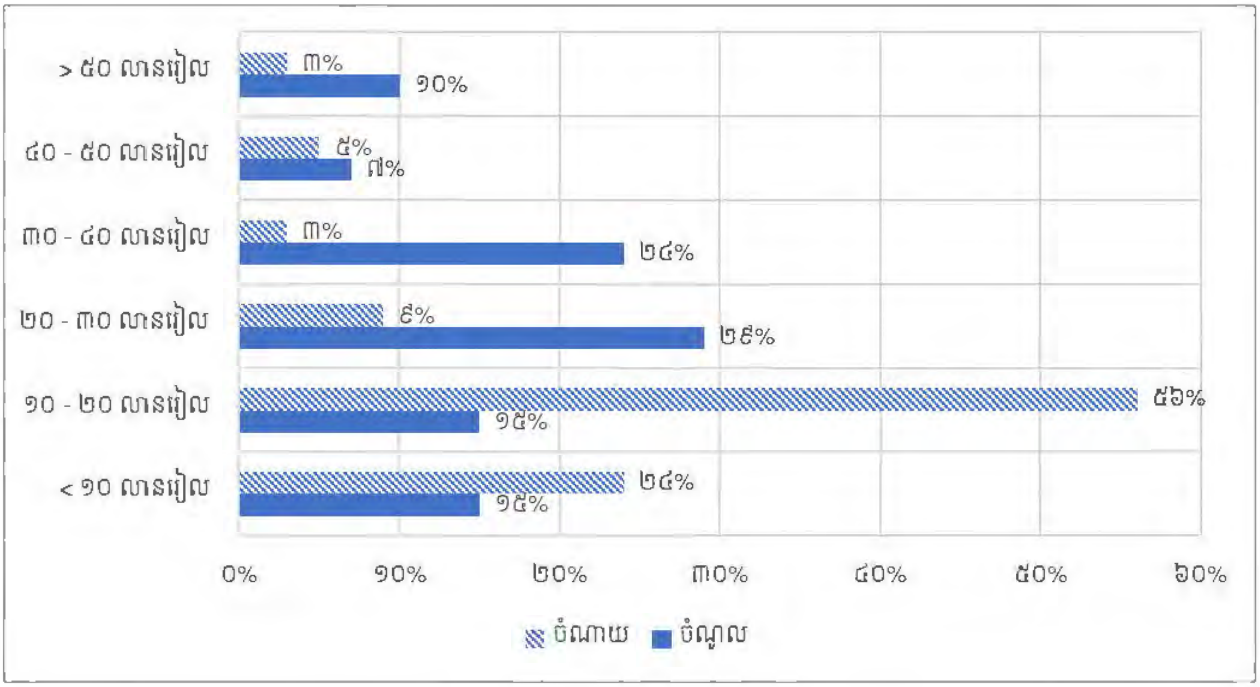
No.	Name	Fish price in rainy season (Riel/kg)	Fish price in Dry season (Riel/Kg)
1	Long Long Carp	1,100 to 1,200	9,000 to 12,000
2	Trey Tro An	11,000	25,000
3	Trey Kro Port	9,000 to 12,000	25,000 to 30,000
4	Lesser Silver Mud Carp	800	8,000 to 10,000
5	Climbing Perch	18,000	18,000
6	Dusky Sleeper	25,000	40,000
7	Thicklip Barb	15,000 to 35,000	15,000 to 35,000
8	Spotted Hampala Barb	12,000	12,000
9	Simese Long Fin Carp	800 to 8,000	800 to 8,000
10	Spotted Hampala Barb	12,000	12,000
11	Reddish Sheatfish	12,000	12,000
12	Myer's Silver Rasbora	7,000	8,000
13	Java/Silver Barb	18,000	20,000
14	Small Scale Carp	13,000	40,000
15	Trey Lenh	800	8000
16	White Eye Barb	1,600	1,600
17	Long-fin Flying Minnow	5,000	5,000
18	Bronze Featherback	7,000	20,000
19	Pristolepis Fasciata	17,000	30,000
20	Climbing Perch	17,000	30,000
21	Congaturi Halfbeak	18,000	30,000
22	Peacock Eel	18,000	25,000
23	Giant Snakehead	12,000	12,000
24	Striped Snakehead	15,000	15,000
25	Blacktail Catfish	16,000	17,000
26	White-line Catfish	4,500	10,000
27	Boomblebii Catfish	4,500	10,000
28	Walking Catfish	12,000	13,000
29	Bighead Working Ccatfish	14,000	16,000
30	Striped Catfish	7,500	7,500
31	Spotted-ear Catfish	9,000	9,000
32	Twisted-jaw Sheatfish	6,000	7,000
33	Trey Kes	12,000	25,000
34	Eyespot Spiny Eel	40,000	50,000
35	Mixed- fish	1,000	5,000

Source: E&A Consultant 2109

c) Income and Expenditure

Vending, poultry raising and factory works are the main sources of income for households in the study area plus some incomes from other secondary occupations. Household incomes need to cover the daily expenses of food, medical, transportation, electricity, and education. The level of expenditure also depends on the number of family members.

Figure 26: Annual household income and expenditure



Source: E&A Consultant (2019)

Table 81: Annual household income and expenditure

Description	Average annual income (Riel)	Average annual expenditure (Riel)
Maximum	65,760,000	57,500,000
Medium	28,572,926	16,549,930
Minimum	6,880,000	2,405,000

Source: E&A Consultant 2019

The study area is an active economic area thanks to its proximity to Phnom Penh, making it easy for the villagers to make a living. As shown above, the average annual income is Riel 28,572,292; while the average annual expenditure Riel 16,549,930. Therefore, the standard living is good.

d) Poverty

The study used the 2013 poverty data from the Ministry of Planning for comparison as the Ministry has not yet updated the data. The national poverty line is 1,412,915 riels/year/person or equal to 3,871 riels/day/person. The results show that all households in the study area are generally living above the poverty line with average income of 28,572,926 riel/year/household or equal to 5,714,585 riel/year/person and 15,656 riel/day/person.

5.3.6 Physical Infrastructure

In the study area, there are a variety of roads like paved roads, gravel roads and concrete roads that ease the people's travel for business as well as accessing public services and education. Apart from this, there is also a main irrigation system named Hun Sen Pot Sor irrigation system which was constructed in 2011. This irrigation system is located in Khlang Sambath village of Pot Sor commune and contributes to the improvement of the agricultural sector in the commune by supporting farmer to cultivate twice per year. The physical infrastructure in the project area include: 1) Canal no. 92, Canal no. 57, Canal no. 94; 2) bridge over the canals; 3) Bati River's downstream.

Photo 82: Physical infrastructure in the study area and the project area

Laterite road in Sala Taprom (Canal no. 54 Road)

Road (Pot Sor village)

Concrete road (Kla Kon village)

Old concrete bridge (Kroch village)

Hun Sen Pot Sor Irrigation

The part of Canal no. 92 within the project area

Source: E&A Consultant, 2019

5.3.7 Electricity usage

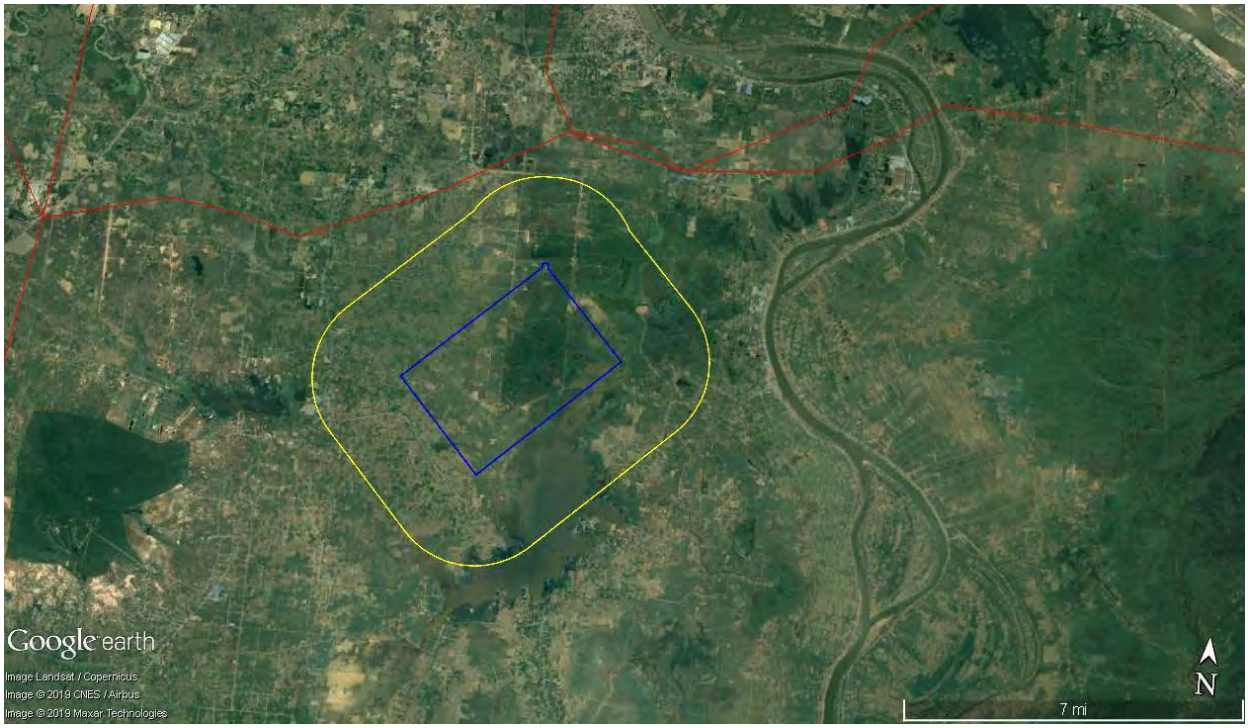
a) Lighting power

All communes can access Electricite Du Cambodge (EDC) for their daily use. Electricity is used for lighting and other electrical appliances such as TVs, fans, and so on. Energy consumption per kWh costs 680 riels to 720 riels or even more depending on the amount of energy consumed. On average, households in the study villages spend between 20,000 and 50,000 riels per month for energy.

Photo 83: Transmission Lines

Source: E&A Consultant, 2019

Photo 84: High-voltage Transmission Line



Source: E&A Consultant (2019)

b) Cooking energy sources

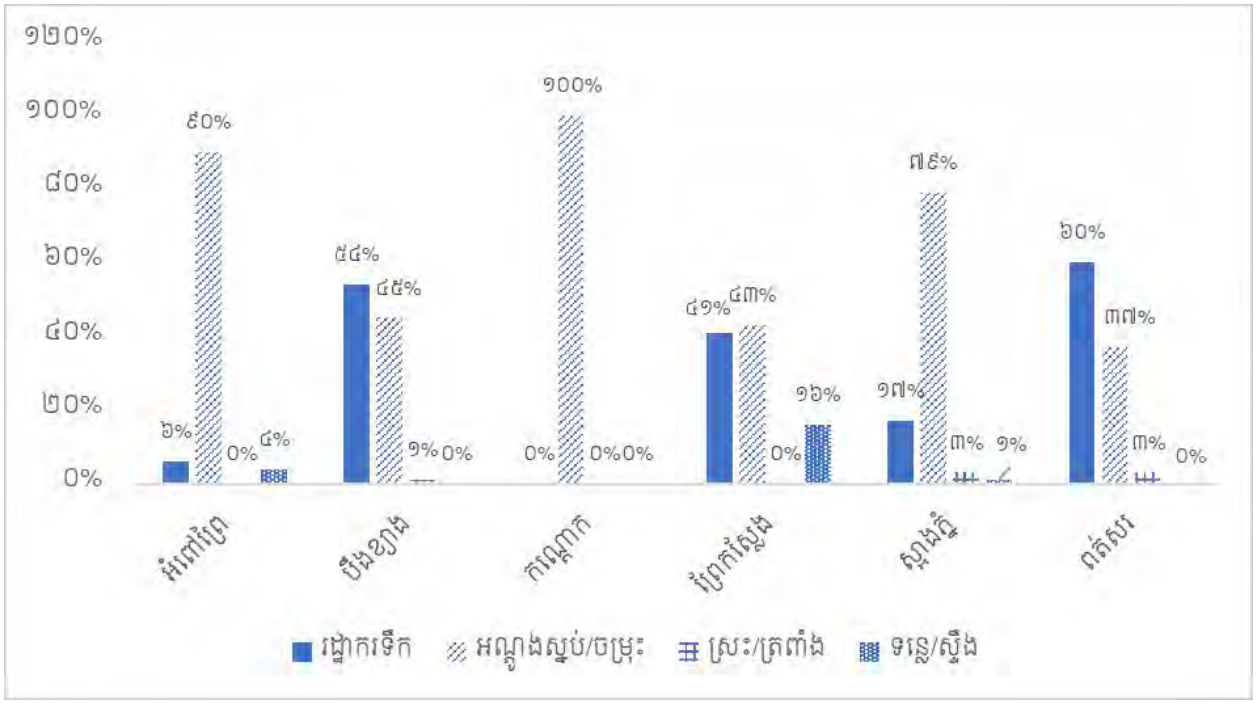
Sources of cooking energy in the study area were divided into three main categories such as cooking gas (73.7%), coal (18%), and firewood (8.3%). Cooking gas is the main source of energy for cooking because it is easier and saves more time than using wood and charcoal.

5.3.8 Water Consumption

a) Daily water consumption

Water is very important for everyday life. Clean water and the accessibility of water indicates safe and clean livelihoods. In the study area, there are 4 main types of water sources: water from the Water Authorities, the tube wells/ring wells, ponds and rivers/streams. Water consumption from tube wells is very high (100% in Kandoak commune, 90% in Ampov Prey commune, 45% in Boeung Khyang, 43% in Prek Sleng commune, 79% in Sa'ang Phnom commune, and 37% in Pot Sor commune). There is very little use of surface water, lake, or river. Water is mainly used for cooking, bathing, and cleaning.

Figure 27: Water Consumption in the Study Area



Source: E&A Consultant (2019)

Photo 85: Water consumption in the study area

Clean water

Pumping machine

Pond

Rainwater harvesting

b) Water used in Agriculture

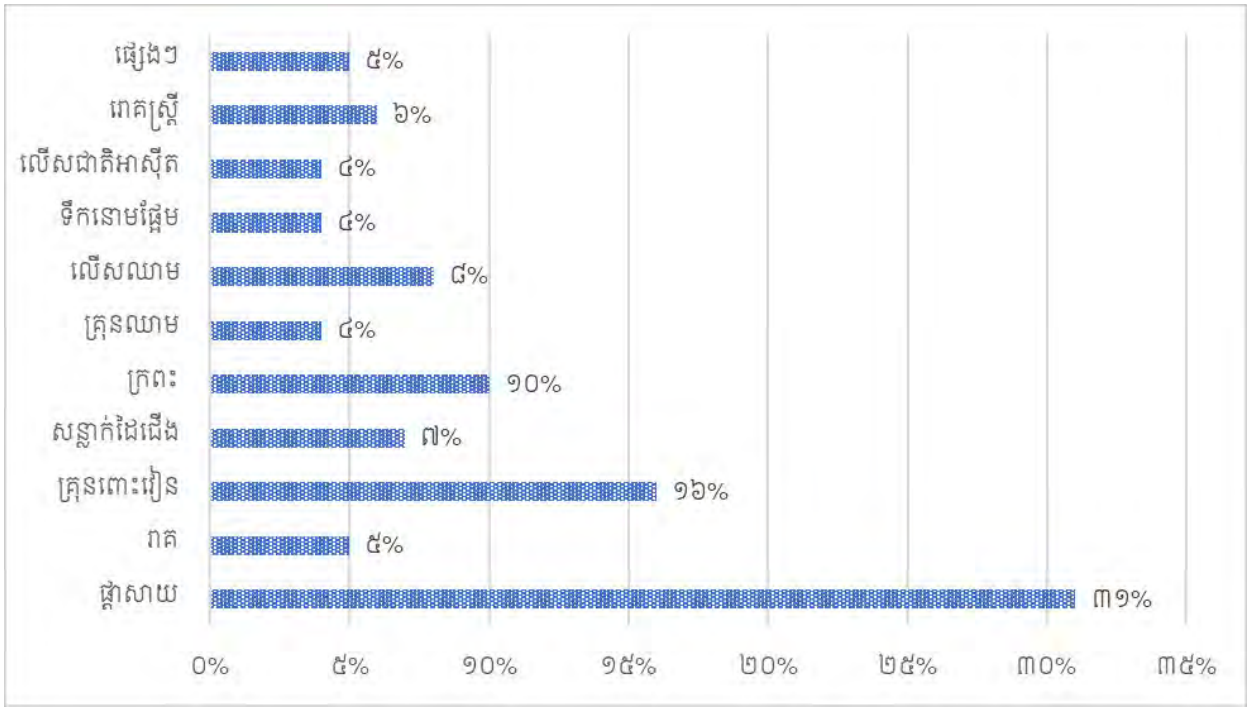
Irrigation sources are important for agriculture. The favourable factors of the local climate and infrastructure of the irrigation system in the commune have been supporting farming activities. The rice production in the wet season is rain-fed, while that in the dry season depend on water from the Tonle Bati and Stung Prek Tnot rivers (Kandal Steung district) while the farmers in Potsor commune use water from the Hun Sen Potsar irrigation system, water originally from the Tonle Bati river.

5.3.9 Public Welfare

a) Disease

The study found that the most prevalent illnessis, Common Flu while other illnesses like polycystic ovary syndrome, high blood pressure, diarrhoea, and pelvic arthritis, are still significant.

Figure 28: Diseases Reported in the Last six Months



Source: E&A Consultant (2019)

Table 82: Number of deaths

Description	Ampov Prey	Boeung Khyang	Kandoak	Prek Sleng	Sa'ang Phnom	Pot Sor
AIDS	0	2	0	0	1	0
Dengue fever	0	1	0	0	0	0
Tuberculosis	0	0	0	0	0	2
Malaria	0	0	0	0	0	0

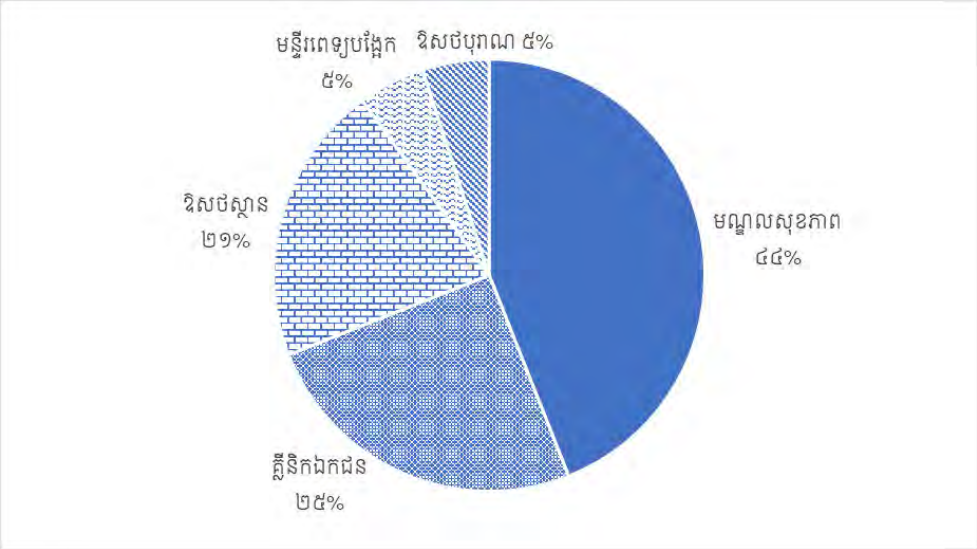
Source: Commune data (2018)

b) Treatment services

As the country development moves ahead, efforts are being made to further improve the provision of public services (health centres), especially to those living in the provinces. Health clinics play a significant role in providing health care services to families living in the commune effectively and quickly. The study found that 44% of interviewed households use public health services at the health centre for illnesses such as Influenza, coughs, fevers, diarrhoea and, of course, childbirth, while 25% of families chose healthcare services at private clinics to treat serious illness or matters requiring surgery. 21% of families

buy their own medicines from the village pharmacy in the village where they live and only 3% of families are receiving treatment from the Ta Khmao Referral Hospital.

Figure 29: Treatment Services



Source: E&A Consultant (2019)

Photo 86: Treatment Services

Source: E&A Consultant (2019)

c) Drinking water

Water is essential for all living things to maintain a healthy balance in the body. Clean drinking water can avoid a variety of diseases, especially Typhoid. The drinking water sources in the study were divided into three categories: pure drinking water, filtered water and boiled water. Most families in the study district popularly drink boiled water compared to other sources, except for Sa'ang Phnom commune where 72% of the people consumed pure water.

Table 83: Drinking water sources

Description	Purified water	Filtered water	Boiled water
Ampov Prey	14%	24%	63%
Boeung Khyang	36%	27%	37%
Kandoak	18%	40%	42%
Prek Sleng	36%	18%	45%
Sa'ang Phnom	71%	17%	12%
Pot Sor	46%	16%	38%

Source: Commune data (2018)

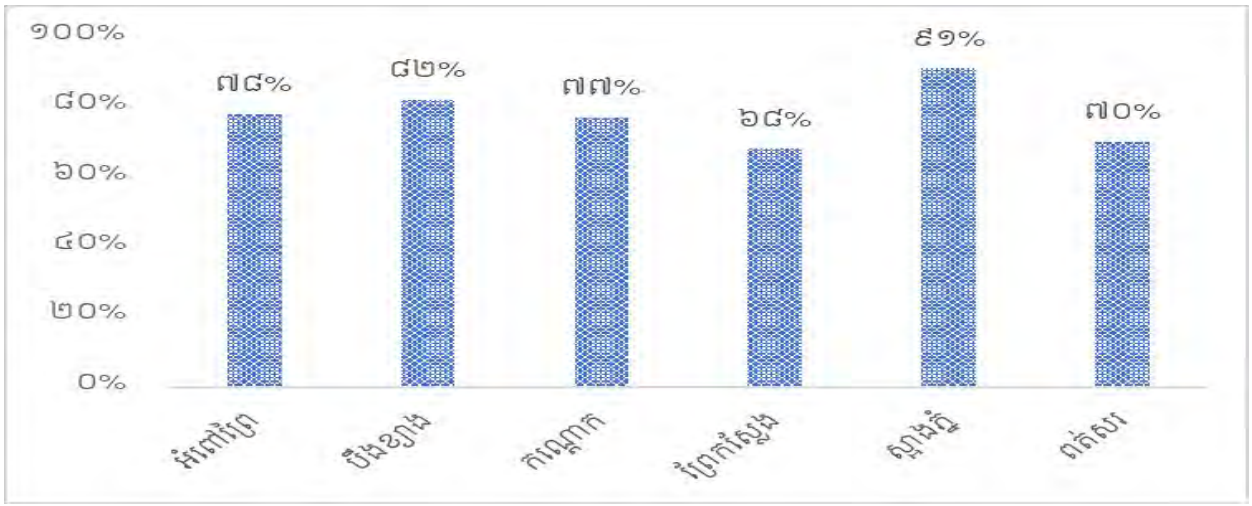
Photo 87: Drinking Water Sources

Source: E&A Consultant (2019)

d) Latrine

The graph below illustrates the status of latrine in the study area. Most families in Sa'ang Phnom commune (91%) has latrine (the highest among all communes), while 68% of families in Prek Sleng commune has one (the lowest among all communes).

Graph 1: Latrine



Source: Commune data (2018)

5.3.10 Education

Education is among the leading sectors spearheading economy and poverty reduction through human resource development. The Royal Government is striving to increase academic institutions in both rural and urban areas.

Table 85 shows that the study area has 7 schools, located between 0.93 km and 2.76 km from the project area. The nearest school to the project area are Sok An Cham Bak Bet Secondary School, Prey Chea Primary School, and Kampong Ta Long Primary School.

Sok An Cham Bak Bet Secondary High School (X: 488132; Y: 1253818) is located in Cham Bak village, Pot Sor commune, Bati district, Takeo province. It is 0.93 km to the southwest of the project area. It is built in 1992 as a primary school, and upgraded to secondary school in 2002 with support from Excellency Sok An who provided additional buildings. Currently, the school has 7 buildings (26 classrooms), 14 teachers (6 female), and 672 pupils (368 female).

Hun Sen Prey Chea Primary School (X: 490898; Y: 1250985) is located in Cham Bak village, Pot Sor commune, Bati district, Takeo province. It is 1.11 km to the south of the project area. Samdech Hun Sen built the school in 1980. Currently, the school has 3 buildings (15 classrooms), 6 teachers (2 female), and 172 pupils (84 female).

Kampong Ta Long Primary School (X: 488132; Y: 1253818) is located in Kampong Ta Long village, Pot Sor commune, Bati district, Takeo province. It is 1.27 km to the west of the project area. It is built in 2003 as a primary school and kindergarten. Currently, the school has 3 buildings (12 classrooms), 6 teachers (3 female), and 158 pupils (75 female).

Table 84: List of all School within 3km from the Project Boundary

No.	Name	Coordinate	Distance from project (km)	Location
1	Sok An Cham Bak Bet Secondary School	X: 488132; Y: 1253818	0.93	Southwest
2	Hun Sen Prey Chea Primary School	X: 490898; Y: 1250985	1.11	South
3	Kampong Ta Long Primary School	X: 488132; Y: 1253818	1.27	West
4	Kok Chih Primary School	X: 488823; Y: 1258299	1.83	Northwest
5	Boeng Khyang Secondary and Primary School	X: 486318; Y: 1256487	2.28	Northwest
6	Sa'ang Phnom Secondary and Primary School	X: 497423; Y: 1255084	2.46	Northeast
7	Sa'ang Srea Primary School	X: 495736; Y: 1252630	2.76	Southeast

Source: E&A Consultant 2019

Photo 88: Academic institutions

Source: E&A Consultant (2019)

5.3.11 Tourist Attractions

Tourism is considered as one of the priority sectors in the Royal Government's Rectangular Strategy V. Tourism is in the fulcrum for developing private sector and employment; it is the 'green gold' that creates employment opportunities to directly generate income for the people, indirectly promoting exports to boost economic growth, increasing national income, and contributing to poverty reduction following the political agenda of the Royal Government of Cambodia.

Within a three-kilometre radius around the project site, the study observed that there is the historical-cultural site called Sa'ang Phnom resort. It is a natural cultural resort located in Peam Sala village, Sa'ang Phnom commune, Sa'ang district, Kandal province. The resort is about 20 km from Takhmao town, Kandal province, about 30 km from Phnom Penh and about 3 km south-eastern part of the project site. Sa'ang

Phnom resort was rebuilt during 1985-1986 after it was almost completely destroyed during the Pol Pot era. And today, the mountain has become a popular cultural place for domestic tourists to relax and celebrate during festival seasons. There is a pagoda on the top of the Sa'ang Mountain, where visitors pay their respect to the spirits and admire the surrounding scenery.

5.3.12 Cultural site

5.3.12.1. Pagoda

The study found that, within the area of 3km from the project boundary, there are certain cultural sites which are pagodas and spiritual sites. The table below shows that the study area has 11 pagodas, located between 0.3 km and 2.75 km from the project area. The nearest pagodas to the project area (below 0.5 km distance) are Botum Sorya and Preah Ream Pot Sar.

Botum Sorya Pagoda, also known as Kroch Pagoda, is located in Kroch village, Pot Sar commune, Bati district, Takeo Province (WGS 1984 48N X: 491407; Y: 1252109) 0.3 km to the south of project area. It was built over 100 years ago. Currently, there are six monks and six nuns. Regular Buddhists who visit the pagoda are from Kroch village and other families in Pot Sar commune.

Preah Ream Pot Sar Pagoda is located in Pot Sar village, Pot Sar commune, Bati district, Takeo Province (WGS 1984 48N X: 488977; Y: 1253592) 0.37 km to the southwest of project area. Historically, it was known as Preah Ream Pot Thnou Sar Pagoda, but then changed to Preah Ream Pot Sar Pagoda to date. Currently, there are nine monks, four nuns, and two laymen. Regular Buddhists who visit the pagoda are from Pot Sar village and other families in Pot Sar commune.

Table 85: List of all Pagoda within 3km from the Project Boundary

No.	Name of Pagoda	Location	Coordinate	Distance from project (km)	Origin of Buddhists who visit the pagoda
1	Botoum Sauriya	Krauch village, Potsor commune (south of the project area)	X: 491407 Y: 1252109	0.3	Potsor commune
2	Preah Ream Potsar	Potsor village, Potsor commune (south-west of the project area)	X: 488977 Y: 1253592	0.37	Potsor commune
3	Sa'ang Phnom	Prek Khmer village, Sa'ang Phnom commune (east of the project area)	X: 495796 Y: 1255620	0.68	Sa'ang Phnom commune
4	Chambok Bet Meas	Chambok village, Potsor commune (south-west of the project area)	X: 487983 Y: 1253873	0.89	Potsor commune

No.	Name of Pagoda	Location	Coordinate	Distance from project (km)	Origin of Buddhists who visit the pagoda
5	Prey Chea	Prey Sva village, Potsor commune (south of the project area)	X: 490854 Y: 1250916	1.12	Potsor commune
6	Kos Bunly	Kampong Ta Long village, Potsor commune (west of the project area)	X: 486977 Y: 1254407	1.39	Potsor commune
7	Kok Chih	Cheung Prey 1 village (north-west of the project area)	X: 488823 Y: 1258299	1.83	Ampov Prey commune
8	Boeng Khyang	Boeng Khyang village, Boeng Khyang commune (west of the project area)	X: 486318 Y: 1256487	2.26	Boeng Khyang commune
9	Tuol Snay	Prey Ta Thok village (north-west of the project area	X: 487531 Y: 1257807	2.33	Prek Sleng commune
10	Tuol Ta Mak Mean Chey	Kandoal commune (north of the project area)	X: 493135 Y: 1261838	2.59	Kandoak commune
11	Sa'ang Sre	Veal Sa'ang Phnom village (south-east of the project area)	X: 495704 Y: 1252752	2.75	Sa'ang Phnom commune

Source: E&A Consultant 2019

Photo 89: Pagodas in the project area

Preah Ream Potsor Pagoda

Prey Chea Pagoda

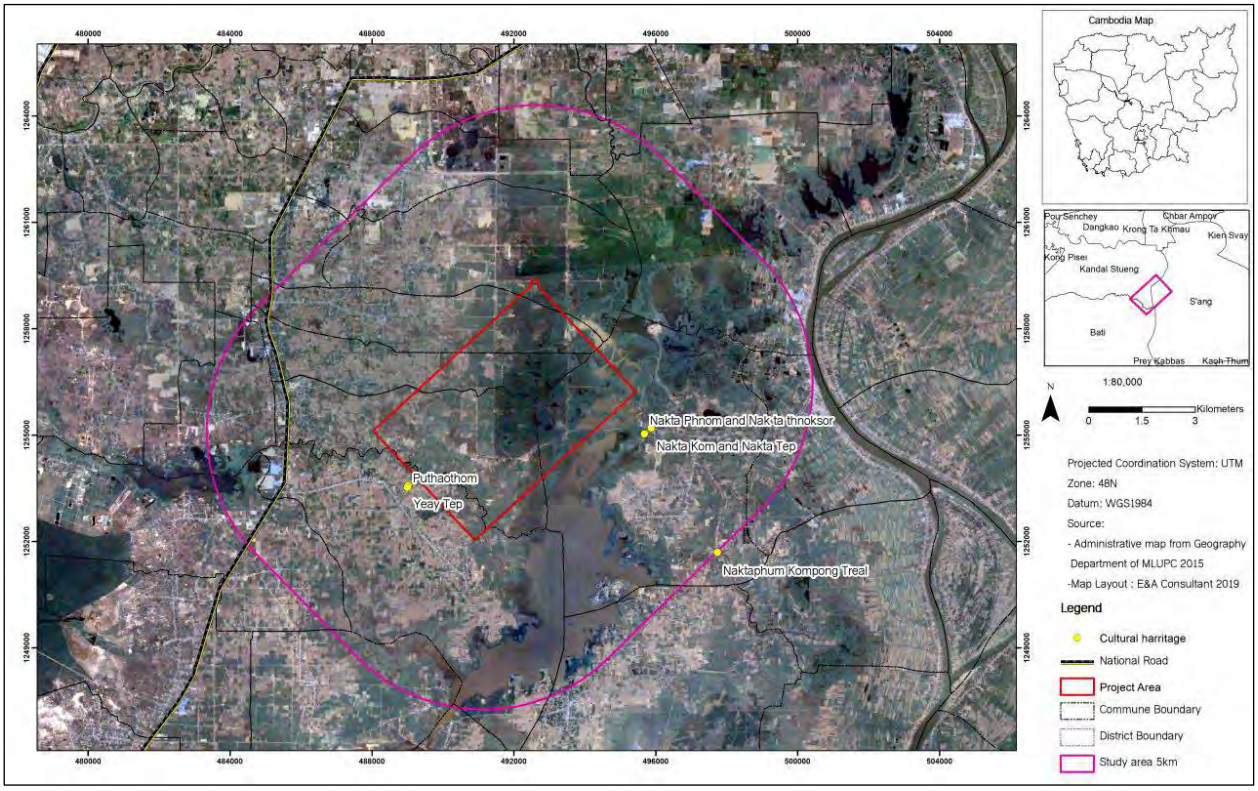
Source: E&A Consultant 2019

5.3.12.2. Heritage/Sacred Sites

There are five heritage sites near the project area including:

- Neak Ta Kom and Neak Ta Tep, close to Phnom Sa'ang mountain in Sa'ang Phnom commune, Sa'ang district.
- Neak Ta Phnom and Neak Ta Thnou Sor, close to Phnom Sa'ang mountain in Sa'ang Phnom commune, Sa'ang district.
- Neak Ta Kampong Treal in Kampong Treal village.
- Neak Ta Pou Thav Thom in Potsor Pagoda, Potsor commune.
- Yeay Tep in Potsor Pagoda, Potsor commune.

Map 26: Cultural sites (heritage and sacred sites) in the project area



Source: E&A Consultant (2019)

5.3.13 Local Environmental Pollution Management

a) Local Solid Waste Management

Solid waste refers to any solid materials, solid substances, products or debris that are no longer needed and disposed of, intended to be disposed of or required to be disposed of. Garbage is a part of non-toxic or hazardous solid waste that is discharged from residences, public buildings, factories, markets, hotels, commercial buildings, restaurants, transportation facilities, recreation facilities (Sub-decree of solid waste management, 1999).

Solid waste is a source of infection and causes serious harm to the environment and social welfare in the short- and long-run. However, the management and storage of solid waste (garbage) in the study area has not improved as the area does not yet have a solid waste collection service. People generally choose the burn-in method to handle all the solids. Also, in villages near their homes, people still dispose of their garbage in a disorderly fashion as shown below:

Photo 90: Solid Waste Management Situations of Household in the Study Area

Source: E&A Consultant 2019

b) Local Wastewater Management

Wastewater refers to water that has changed its original function after use, including wastewater from the kitchen, bathroom, laundry or cleaning and wastewater from toilets, including urine and faeces discharged from individual houses, compound housing, satellite towns, commercial buildings, services and resort areas, or recreational facilities (sub-decree on sewerage system and wastewater treatment management, 2017).

The study area is located in a location where there is no sewage drainage infrastructure attached to people's homes to take the sewage awy to a central sewage plant. Instead, currently households on the site drain the wastewater from the kitchen and bathroom around the house with a water surface. As for the waste management of the toilet, they create septic tank below the toilet fcaility which is drained approximately every two to three years.

5.3.14 Traffic studies

Photo 91: Traffic Counting Activities in the Study Area

The intersection of National Road 2 and Samdech Hun Sen Street

National Road No. 2

Source: E&A Consultant 2019

a) Traffic condition on the intersection of National Road 2 and Samdech Hun Sen Street (60m Road)

- **Traffic on weekday**

Workday traffic results (Monday, May 06, 2019) show that within 10 hours, starting from 7:00 am to 6:00 pm, the traffic flow of motorcycles (10,189) is greater than that of other vehicles, followed by small cars (3,080). The busiest hours of traffic flow is the period between 5 pm and 7 pm, due to commuters who would be employee-workers, businessmen, construction workers, company employees, and civil servants. The lowest traffic flow was at the period between 12 noon and 1 pm.

- **Traffic on weekend**

Observations was also arried out on a weekend (Sunday, May 05, 2019) within a similar 11 hour period as described above. Overall, the numbers of weekend traffic arebusier than the working day because, at the weekends, civil servants, company employee, students and other business people take breaks from work, study and business, and travel to the resorts or visit their hometowns, etc. Most of the vehicles on this road are motorcycles (11,547) and small cars (4,618).

Table 86: Number of vehicles passing through the intersection of National Road No. 2 (Prek Ho) and Samdech Techo Hun Sen Boulevard (Street 60 meters) on weekday

Time	Motorbike		Remorque		Sedan		Van		Bus (16-44 seats)		Light truck		Heavy truck		Lorry	
Direction	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
7-8	370	1115	53	134	124	162	5	15	11	1	21	24	24	46	1	4

Time	Motorbike		Remorque		Sedan		Van		Bus (16-44 seats)		Light truck		Heavy truck		Lorry	
Direction	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
8-9	384	586	64	97	155	133	3	14	30	0	17	32	11	48	0	6
9-10	415	425	84	81	191	115	0	10	0	1	6	31	36	75	0	11
10-11	330	401	40	78	145	110	0	11	0	0	10	29	27	70	0	9
11-12	360	361	35	55	150	105	0	10	0	1	7	17	17	64	0	11
12-13	283	513	88	74	121	119	4	13	0	4	5	23	72	52	0	3
13-14	290	421	66	61	130	149	11	12	0	2	85	24	35	58	0	5
14-15	280	405	60	67	135	157	2	14	6	1	16	21	27	77	0	15
15-16	300	395	71	62	140	151	7	13	0	0	20	27	24	71	0	14
16-17	686	540	73	63	153	140	15	20	1	1	25	30	19	70	1	13
17-18	705	624	67	79	145	150	17	18	1	0	20	28	17	52	0	6
Total	**10,189**		**1,552**		**3,080**		**214**		**60**		**518**		**992**		**99**	

Note: 1 = Ta Khmao to Kour Srov Roundabout 2= Kour Srov Roundabout to Ta Khmao
Source: E&A Consultant (2019)

Table 87: Number of vehicles passing through the intersection of National Road no. 2 (Prek Ho) and Samdech Techo Hun Sen Boulevard (Street 60 meters) on weekend

Time	Motorbike		Remorque		Sedan		Van		Bus (16-44 seats)		Light truck		Heavy truck		Lorry	
Direction	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
7-8	589	784	95	98	223	215	8	6	2	0	30	36	78	89	1	0
8-9	552	759	93	132	269	206	16	19	0	0	31	40	58	59	0	1
9-10	551	483	95	67	275	172	6	14	2	1	48	26	57	75	0	2
10-11	549	419	96	68	266	216	19	18	0	0	43	34	68	69	0	1
11-12	573	376	100	53	193	193	12	19	0	0	56	27	60	87	2	5
12-13	389	357	73	78	151	148	8	7	0	0	28	17	18	21	0	1
13-14	488	384	81	71	178	161	1	2	0	0	21	34	50	67	0	3
14-15	403	428	65	58	189	235	12	13	0	0	39	25	58	85	1	3
15-16	469	379	79	56	161	250	8	13	0	6	49	45	56	69	2	1
16-17	691	614	87	89	191	278	6	3	0	3	23	29	50	83	9	8
17-18	682	628	60	63	144	304	7	12	2	0	22	28	21	54	6	6
Total	**11,547**		**1,757**		**4,618**		**229**		**16**		**731**		**1,332**		**52**	

Note: 1 = Ta Khmao to Kour Srov Roundabout 2= Kour Srov Roundabout to Ta Khmao
Source: E&A Consultant (2019)

b) Traffic Situation on National Road 2 at Wat Boeng Kyang

- Traffic on weekday

Results of the weekday traffic count (Monday, May 06, 2019) indicates that within 11 hours, starting from 7:00 am to 6:00 pm, the traffic flow of motorcycles is greater than the other vehicles, followed by small cars. Total motorcycles were 11,547 and small cars 4,618. The busiest hours of traffic flow were between 7 am- 8 am, and 4pm-5pm due to commute time of people, employee-workers, businessmen, construction workers, company employees, and civil servants. The lowest traffic flow was between 12 noon and 1 pm due to lunchtime. The details are described in Table 89.

- Traffic on weekend

Weekend traffic observation on National road 2 at Wat Boeng Kyang on Sunday, May 5, 2019, was carried out ata similar times to the weekday study. The results show that traffic flowat weekends is not as busy as the workday. Most of the vehicles on this road are 11,763 motorcycles and 5,087 small cars. There are also container trucks, light trucks, 44-seat buses, 12-wheelers, heavy trucks (concrete rollers, trucks), three-wheeled tuk-tuks and bicycles. The details are described in Table 90.

Table 88: Number of vehicles passing through the National Road no. 2 (at Wat Boeng Kyang) on weekday

Time	Motorbike		Remorque		Sedan		Van		Bus (16-44 seats)		Light truck		Heavy truck		Lorry	
Direction	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
7-8	730	729	92	89	162	189	48	52	6	5	34	38	22	34	4	3
8-9	585	427	73	48	141	165	85	50	1	7	29	42	19	28	8	6
9-10	424	400	59	55	157	171	92	65	3	0	28	32	35	40	5	15
10-11	363	417	58	70	165	159	61	55	1	0	21	36	21	37	11	8
11-12	400	434	43	59	127	136	36	38	0	1	15	25	24	32	12	18
12-13	147	390	28	56	63	130	17	35	0	0	7	35	17	30	6	9
13-14	250	330	32	70	160	152	49	64	0	1	20	46	36	20	18	6
14-15	244	320	148	55	148	146	34	72	0	1	32	22	19	22	10	6
15-16	398	371	32	62	162	132	37	68	1	1	25	35	33	18	8	3
16-17	674	370	48	48	213	205	27	50	1	5	34	41	29	23	7	9
17-18	546	578	38	36	167	154	28	34	2	1	28	35	25	21	4	7
Total	**9,527**		**1,299**		**3,404**		**1,097**		**37**		**660**		**585**		**183**	

Note: 1 = Kour Srov Roundabout to Boeng Kyang 2= Boeng Kyang to Kour Srov Roundabout
Source: E&A Consultant (2019)

Table 89: Number of vehicles passing through the National Road no. 2 (at Wat Boeng Kyang) on weekend

Time	Motorbike		Remorque		Sedan		Van		Bus (16-44 seats)		Light truck		Heavy truck		Lorry	
Direction	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
7-8	478	484	54	49	183	171	19	25	2	1	26	24	25	21	2	1
8-9	297	386	29	35	153	149	25	31	0	1	11	12	9	13	2	1

Time	Motorbike		Remorque		Sedan		Van		Bus (16-44 seats)		Light truck		Heavy truck		Lorry	
Direction	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**	**1**	**2**
9-10	429	351	56	61	159	323	82	33	2	1	25	24	16	22	7	5
10-11	427	438	41	76	178	337	45	41	1	1	23	25	18	31	6	5
11-12	408	567	43	84	166	275	50	49	1	1	12	13	17	25	10	13
12-13	370	450	37	60	162	230	46	30	2	0	13	15	19	30	8	1
13-14	345	470	50	62	231	200	43	63	4	2	14	16	23	20	11	5
14-15	461	463	54	55	302	210	44	61	0	0	22	20	24	18	5	13
15-16	807	525	48	40	381	214	47	56	3	0	26	14	21	22	7	11
16-17	1,134	724	52	62	363	200	39	43	1	1	24	18	7	21	12	9
17-18	1,129	620	50	40	350	150	32	40	5	2	15	10	9	17	6	8
Total	**11,763**		**1,138**		**5,087**		**944**		**31**		**402**		**428**		**146**	

Note: 1 = Kour Srov Roundabout to Boeng Kyang 2= Boeng Kyang to Kour Srov Roundabout
Source: E&A Consultant (2019)

c) Traffic study conclusion

The results of the traffic ratio calculations in the two study areas show moderate traffic flow conditions as shown in Table 91 below:

Table 90: Traffic Flow in the Study Area

Description	Intersection of National Road 2 and Samdech Techo Hun Sen Blvd		National Road 2 at Wat Beoung Khyang entrance	
	Weekday	**Weekend**	**Weekday**	**Weekend**
Average hourly traffic flows in PCE	839	1,148	967	1,099
Hourly maximum traffic flow in PCE	1,062 (7 am-9 am)	1,244 (4pm-5pm)	1,236 (7am-8am)	1,159 (4pm-5pm)
Road capacity per hour in PCE	2,000	2,000	2,000	2,000
The highest ratio of traffic flow and road carrying capacity, and interpretation	0,53	0,62	0,61	0,57
	Moderate traffic flow	Moderate traffic flow	Moderate traffic flow	Moderate traffic flow

Source: E&A Consultant 2019

Traffic flow studies have shown that the traffic flow was moderate on both weekends and weekdays. As a result of traffic flow studies in both locations, the number of traffic stops is 1- on the holiday (the intersection of National Road 2 (Prek Toal) and Samdech Hun Sen Blvd (60m)). Traffic and busyness are higher than the second location because the 60m is a roundabout for Phnom Penh traffic to National Road 2 (resorts). Also, on weekdays, traffic conditions in location 2 are busier (staff arriving at work / factory). Also, National Road 2, the main road, has only two lanes. Therefore, based on the results of the study and the estimated traffic volume of the project, traffic jams may need to be considered for remedial measures.

5.3.15 Study of Unexploded Ordnance

CAIC is cooperating with Cambodian Mine Action Authority to clear UXOs from the area.

5.3.16 Land and Construction Settlement Mechanism

The Royal Government of Cambodia has set up a committee for the preparation of the project's construction site of the New Phnom Penh International Airport. The committee is chaired by His Excellency Chea Sophara and was created according to the Council of Ministers' letter No.13, dated 18 February 2019. Excellency Chea Sophara chaired the first committee meeting, held on 28 February 2019, with participatns from Excellency Mao Havanal, Minister in charge of State Secretariat of Civil Aviation, Excellency Mao Phirun, Kandal Provincial Governor, and other members of the committee as well as representatives of CAIC. The meeting outcomes are as follows:

1. The government's approval of construction of the new Phnom Penh International Airport (4F, over an area of 2,600 ha) in Kandal Province.
2. Task Excellency Mao Havanal to prepare consultation with stakeholders and to request a permit from the government to sign an agreement with CAIC as well as to determine flight safety area.
3. Task support team to determine coordinates, to demarcate borders, to determine building height restriction, and to develop comprehensive urban and infrastructure planning.
4. Agree to use Datum WGS 84 for mapping.
5. Kandal and Takeo Provincial Administation shall cooperate with contractors to support the construction activities.
6. Task Kandal and Takeo Provincial Administation and the General Department of Cadastre to identify plots of land owned by villagers based on actual ownership and relevant documents, as a basis to compensate them. If necessary, prohibit any activities that hinder the project construction activities.
7. Suggest all relevant agencies to incorporate all supporting infrastructure development in one go (such as water supply pipe, electricity, sewage, optic cable, wastewater treatment, antenna, etc.).
8. Suggest the company to build temporary worker camp on site and recruit local villagers deemed suitable. Then, recruit additional workers from outside.
9. Encourage the company to use available local human resources (both skilled and unskilled workers) as much as possible.

In Boeugn Kjang commune's Sala Taprom village, there are 94 households who live on canals and do not have official land ownership documents (see Section 5.3.4). According to the Land Settelment Committee, the data is as follows:

- Agricultural land: 2015 ha (77.5%)
- Residential land: 7.8 ha (0.3%)
- Public land (commune land, road, lake, canal …): 577.2 ha (22.20%)

The land settlement mechanisms are as follows:

- Land Swap:This mechanism is used by the villagers living illegally on Canal No. 54, Canal No. 92, and Canal No. 94 (a total number of 143 households; please see Photo 5-25). Based on the villager's request and the project owner's consent, each household receives a plot of land (5m x 20m) to build a new house in Boeung Khyang commune (please see photo 5-26). Water pipe and electricity facilities will be constructed. The photo below illustrates the house layout.
- Cash payment: this mechanism is used by the villagers that have land ownership. The committee is negotiating the price.

Photo 92: House Location on Canal No. 54, Canal No. 92, and Canal No. 94

Source: CAIC (2019)

Photo 93: Land Plot Layout

5.3.17 Conclusion

- Education: The local villagers completed primary school (38.9%), junior high school (16.7%), and high school (2.8%). Illiteracy rate is 25%, while people who can read a little are 16.7%.
- Occupations: The most common primary occupations of local villagers are farmers (21.9%), and construction workers (10.7%). The most common secondary occupations is livestock raising such as water buffalo, chicken, and duck (30.7%).
- The average size of residential land is 0.5 ha/household, while the average size of agricultural land is between 2 and 3 ha/household.
- Almost all communes in the study area have residential and agricultural land ownership certificates (hard title), except Boeung Kjang commune's Sala Prom village because villagers are living on the state land along canals.
- Almost all households have land ownership certificates including hard title (92.7%), and local authority's certified ownership (7.3%).
- 81.8% of villagers own a plantation with an area between one and three hectares; 9.1% own less than one hectare; and another 9.1% own more than one hectare.
- Electricity use: 72.2% of villagers in the study area are connected to the national grid (EDC); 2.8% uses solar power; and 16.7% uses batteries.
- Water use: Most households in the study area use rainwater (40.6%), obtain water from open well (29.7%), tube well (9.4%), lake (7.5%), and bottled water (12.8%).
- Public Health: According to the disease status of each family in the last one year in the study area, the people suffered from flu (47%) and typhoid fever (22.7%). With regard to treatment, the majority of people went to health centers (47.2%), private clinics (25.5%), referral hospitals (4.5%), and pharmacies (20%).

Chapter 6 Public Participation

6.1. Introduction

In this chapter, the study describes the public consultations with all relevant stakeholders, including local people, local authorities, schools, pagodas, health centres and relevant provincial departments, involved in the project. Thes consultations aimed to interface with the individuals and institutions who may be affected by the construction of the New Phnom Penh International Airport by CAIC and, as a result, the consultant team collected the feedback, suggestions and recommendations from the interviewees in order to analyze, compile and review the full report of environmental and social impacts assessment. In addition, it sought to get all stakeholders informed about the project and gave them an opportunity to offer their opinions and monitor the implementation of the project.

This consultation process was fully applicable to all target groups and interested people (i.e. local people and families who already owned land in the project area) and stakeholders involved in the project. Additionally, this consultation offered the opportunity to local people and stakeholders to express their opinions concerning the project in terms of development and environmental protection. The objectives of the public consultation were:

- To disseminate project information to local people, local authorities and stakeholders to be informed about the project.
- To explain project activities to the participants (stakeholders) and allow them to discuss and comment on the project.
- To seek the positive and negative impacts of the project in order to prepare the mitigation measures reducing the adverse impacts to the minimum level.
- To collect data, comments and recommendations from all stakeholders in general and numbers of issues related to the proposed development project aiming to prepare a quality full report of environmental and social impacts assessment.

6.2. Public Participation

According to Prakas No. 120 Pr.B.St, issued by Ministry of Environment on April 11, 2018, on the deployment model of working conditions for infrastructure and tourism development, the planning of public participation consist of three stages: (1) information dissemination at the project site, (2) the interviews with local authorities, affected communities and stakeholders, and (3) the consultation workshops.

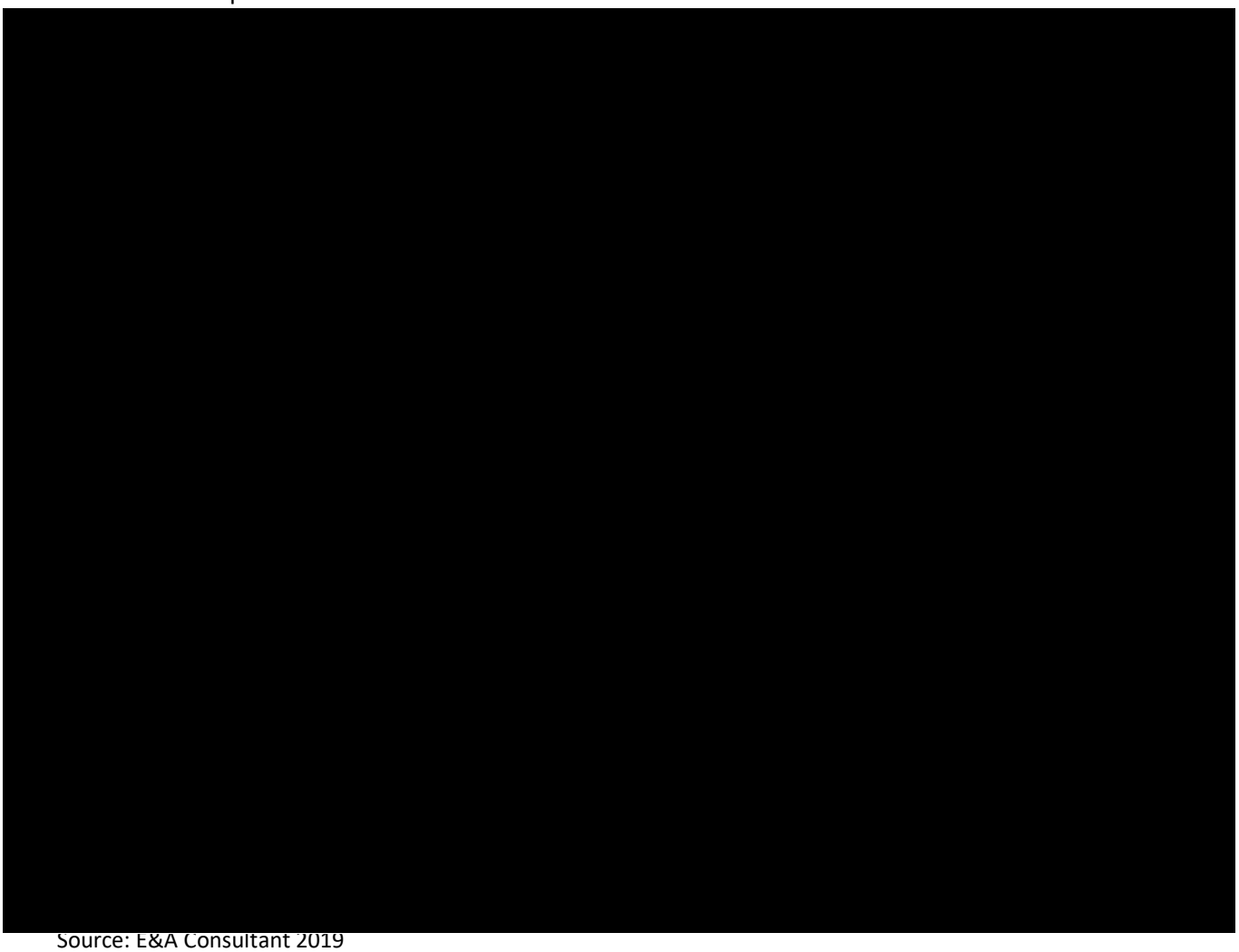
6.2.1. Information Dissemination at the Project Site

The information dissemination at the project site was made through household surveys with target villages and also through consultations with local authorities. Household survey and consultation workshops aimed to (1) disseminate the information related to the project in general, project owner, scope of project and the environmental impact assessment of the project, as well as obtaining preliminary data and information from relevant local authorities and affected people (2) provide opportunities to the involved local authorities, local people, local institutions and stakeholders, to be aware of the project, raise concerns, suggestions and recommendations to the consultant team in order to complement the full report of the environmental and social impacts assessment.

Household surveys were carried out in 32 villages situated within 3 km around the project site, in which 375 households were interviewed within 07 days from 4-10, May 2019, as listed in Chapter 5 on the

socio-economic resources. Tthe consultationswith the Local authorities were held on the same dates. The detailed consultation outcomes are presented in Table 92 below.

Photo 94: Consultation workshops with local people, local authorities, pagoda representatives and health center representatives



Source: E&A Consultant 2019

Table 91: Results from the Interviews of Local Authorities and Local Institutions

Name/Institutions	Comments/Concerns	Suggestions
- 6 commune/district representatives, including Put Sor Commune, Bati District, Takeo Province - 32 representatives of village chiefs/vice village chiefs - 2 monk representatives (Prey Chea Pagoda and	As the local authorities, they are happy with the project because it would make some positive impacts, such as: - creating jobs to people directly and indirectly - contributing to the national economic development - making the communities more developed as the airport would be nearby - the prices of real estates would increase	- If it affects paddy/farmland and houses of local people, it is suggested that the company should provide appropriate compensation - resolve compensations as soon as possible to make it easier for people to resettle in new places - If the roads are damaged through transporting construction materials, the company should repair the roads - To water the roads regularly in order to avoid dusts affecting local people and houses - Do not ban the people who depend on fishing in Beoung Chueng Loung - Do not close off any fences, leaving any part for the people to go fishing - Request sponsorships from the company to pagodas and schools

Name/Institutions	Comments/Concerns	Suggestions
Kraing Yov Pagoda) - 3 representatives from healthcare centers - 3 representatives from schools (1) Samdech Hun Sen Kraing Yov High School, (2) Prey Chea Primary School, (3) Kompong Talong Primary School	- In the construction stage, dust pollution and traffic congestion could happen. - Villagers could no longer go fishing. - Accidents may happen when students break as the project's trucks transport construction materials. - Overspeeding around school area. On the other hand, they expressed some concerns including: - affect on people's land and housing - the dust is rising to people and commuters through transporting trucks - noise disturbance may affect the nearby pagodas and schools - affect to fish in the lake, and affect people whose livelihoods depend on fishing -	- Give the priority to local people to work in the project - Request to take care of the surrounding environment so that it will not affect the water sources and people's paddy/farmland - Build and repair roads in the village - The company should minimize the adverse impacts to the environment and people living nearby the project area - The company must speed up the construction process as quick as possible - Allow people to access to the fishing areas - The project should contribute to community development (rebuild schools, roads and pagodas) - Any conflicts should be avoided - Cambodia Airport Compay is suggested to contract with waste collection company - Request sponsorships from the company to pagodas and schools - Speed up the construction and development as quick as possible - Take a good care of environment - Do not fill up the whole lake because people's livelihoods depend on it - The company is suggested to build monasteries (cathedrals, pagodas) if can afford to do so

Source: E&A Consultant 2019

6.2.2. Interviewing Stages with Local Authorities, Relevant Departments and Stakeholders

6.2.2. 1. Interviews and Focus Group Discussions with Communities and Local People

The discussions with local authorities, affected communities and stakeholders took place from 7-8 May 2019 in the form of focus group discussions (FGD) with two groups (see Photo 8 on page 138). The discussions aimed to (1) disseminate information about the project, project owner, and the scope of the project, and the environmental and social impacts assessment of the project, (2) explore the trend of local people's livelihoods and other infrastructure development projects; and (3) seek feedback and give the floor to the community representatives and affected persons to raise their concerns, suggestions and recommendations to the project owner and consulting team.

a) Focus group discussion with local people and Kraing Yov Community Fisheries, Kandal Province

On May 7, 2019, the discussion took place at local people's houses in Kraing Yov Commune, Sa'ang District, Kandal Province. The meeting was attended by representatives of local people, senior citizens, fishermen of Kraing Yov Community Fisheries and E&A Consultant Co Ltd Company, with 17 participants in total.

<u>According to the discussions:</u>

- Kraing Yov Community Fisheries was created in 1990 covering two communes: Kraing Yov and Sa Ang Phnom. This community was registered and under the management of Fisheries Administration.
- Until 2000s, the main occupation of the local people in these two communes was fishing (80%). Since the development activities in this area - such as garment factories and road construction/improvement - is growing, people have changed their jobs from fishing to garment factory workers, etc. Nowadays, only around 50% of villagers in Kraing Yov Commune remain fishermen. On the other hand, people at Sa Ang Phnom gave up fishing completely.
- Water Utilisation at Beoung Chueng Loung: local people depend on this lake for water for their rice fields. People don't use this water for drinking because pure drinking water is consumed instead.
- Fisheries of Beoung Chueng Loung: local people noted that during rainy season this lake allows the floodwater to flow from Prek Hor waterway and Tonle Bati River into Koh Khel in October, and the water flows from Prek Ambel waterway into Beoung Chueng Loung in May. Local people could not confirm the specific size of the lake for releasing waterflow because the lake, called the "500 Lakes", is a series of lakes and stretches.
- Local people are aware of the plan of constructing a New Phnom Penh International Airport, located near Beoung Chueng Loung and Beoung Rean in Kandal Steung District. The participants in the meeting supported the investment project of constructing a New Phnom Penh International Airport.

Suggestions:

- It was suggested that the company do not close the waterway flowing from Tonle Bati to Beoung Chueng Loung because it is the main water source for the Lake. If it's closed, the Lake will lack water and accordingly biodiversity will disappear.
- It was uggested that the e company do not dump untreated wastewater into the Lake, which can affect water quality (for agriculture) and the lake biodiversity may be lost due to water pollution.

Photo 95: Focus Group Discussions

Source: E&A Consultant 2019

b) Focus Group Discussion with fishing villagers in Sala Taprom village

On May 9, 2019, discussions took place at local people's houses in Sala Taprom village, Boeung Khnang commune, Kandal Stung district, Kandal province. The meeting was attended by representatives of local people, senior citizens, and fishermen of Kraing Yov Community Fisheries, living along the Dike (Tomnub) 92 and in the project area, and E&A Consultant Co Ltd Company, with 19 participants in total.

According to the discussions:

- Occupations: People living in Sala Ta Prum village are mostly regular fishermen. They mentioned that they have started fishing along Boueng Cheung Loung since the Pol Pot Regime. Their fishing tools consist of fishing poles, sticks, nets, traps, etc. Fishing activities normally take place in two periods: early night and early morning. The fish harvest yields for each household are around 10-15 kg in average and may up to 25-40 kg in high season. The fish is sold to local middlemen based on the price range of each specie. In addition, they mentioned that fish harvesting happens for a whole year, although February is the most productive period. They added that they knew about the upcoming development project in their living areas.
- Local people are aware of the plan to construct the New Phnom Penh International Airport, located near Boueng Cheung Loung Lake and Boueng Rean in Kandal Steung District. The participants in the meeting supported the investment project of constructing a New Phnom Penh International Airport.

At the same time, people also raised the following concerns:

- The project will likely endanger the fisheries and their livelihoods,
- In the meantime, the project needs to infill the site area with soil to construct an airport which can affect fisheries resources (eg. fish loss), and
- Conflicts between the people and the project owner (CAIC) may occur and it will cause people to lose their homes.

Suggestions:

- The project needs to provide appropriate compensation to displaced people.
- People requested rgar CAIC does not ban them from accessing the nearby fishing areas or Boueng Cheung Loung area.
- The project should offer opportunities for local people to work inside the new airport and provide additional or necessary training.

6.2.2.2. The Interviews with Local Authorities and Provincial Departments

Key Informants Interview (KII) with local authorities and relevant provincial departments took place on 18-20 May, 2019 at each units and departments. The purposes of these interviews were to (1) disseminate project information including project owner, the scope of the project, and the environmental and social impact assessment of the project, (2) give the opportunities for local authorities and relevant provincial departments raising their concerns, suggestions and recommendations to project owner and the consulting team to improve the environmental and social impacts assessment report. The interview results are detailed in the table below.

Photo 96: Consultation Meetings with Local Authorities and Provincial Department

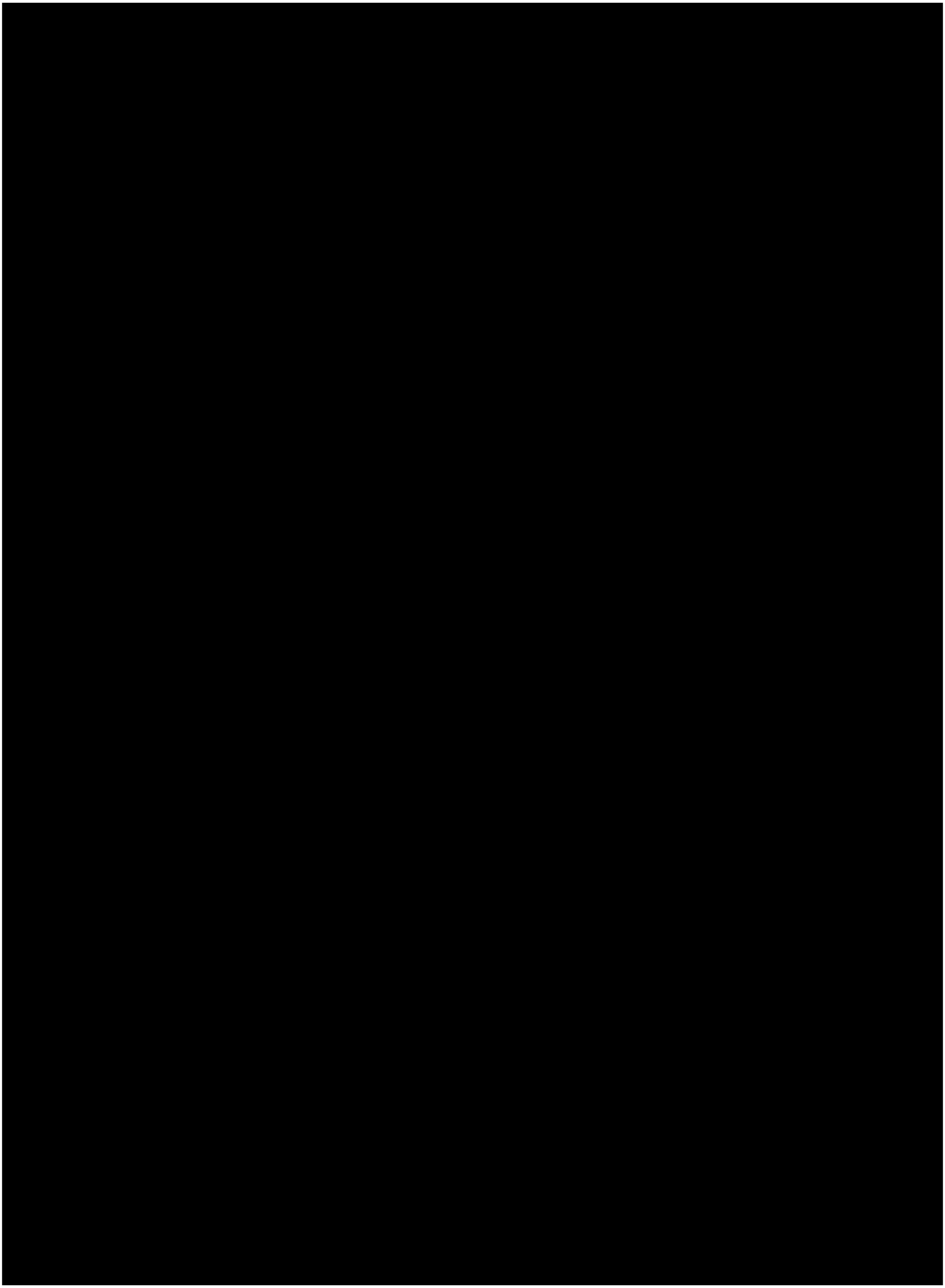


Table 92: Consultation Meetings with Local Authorities and Relevant Provincial Departments

No.	Date	Name/Organizations	Comments/Concerns	Suggestions
1	May 02, 2019	Interview with Mr. Tout Lim, Bati District Governor	During the consultation meeting, he mentioned that he was aware of the upcoming project of constructing the New Phnom Penh International Airport of Cambodia Airport Investment Co Ltd, and he has supported the project. At the same time, he mentioned the following benefits and concerns from the project: ❖ **Negative Impacts and Concerns** - The construction may cause some road damages - Water gates would be cut off (wells gateway) which are the water storage for using during dry season rice farming - Loss of agricultural land and fishing areas of local people - There is a concern that the project owner buy the land below market values - Building height restriction may affect villager/investor. - Noise disturbance from traffics and the take-offs and landing of the airplanes - Aircraft accidents due to technical issues, climate, or other risks. ❖ **Positive Impacts of the Project** - Provides employment to people in the project area indirectly (e.g. vending, houses rental, services, etc), and directly (e.g. working in the airport) - Land prices will rise and spur growth in the area.	On behalf of Bati District Council, he had some suggestions as following: - The company should offer jobs to local people based on their qualifications and experiences - The company should solve land conflicts before implementing the project - Suggest developing the villages and communes near the project area
2	May 03, 2019	Interview with Mr. Nhim Vandim, Sa'ang District Governor	During the consultation meeting, he mentioned that he was aware of the upcoming project of constructing a New Phnom Penh International Airport of Cambodia Airport Investment Co Ltd (CAIC) through information dissemination and government documents, and he did field observation about the current situation of New airport construction area. Under the name of Sa'ang District administration, he has supported the project because it would offer numbers of positive impacts including: - Local economic growth, as well as, national economic growth - Enhance the development of aviation sector	On behalf of Sa'ang District Council, he had some suggestions as following: – The company should offer jobs to local people based on their qualifications and experiences - The company should solve land conflicts before implementing the project

No.	Date	Name/Organizations	Comments/Concerns	Suggestions
			- Improve the status and beauty of Sa'ang District which is close to the New airport - Offer job opportunities for local people directly and indirectly - Land prices would increase In the meantime, he also raised some concerns including: - Some waterways may be affected, especially the canals in the project areas - Loss of agricultural land and affect the fishing areas of local people - Land conflicts may occur between the residing people	
3	May 03, 2019	Interview with Mr. Bonareth, Kandal Steung District Governor	During the consultation meeting, he mentioned that he was aware of the upcoming project of constructing a New Phnom Penh International Airport of Cambodia Airport Investment Co Ltd (CAIC) through information dissemination and government documents, and he did field observation about the current situation of New airport construction area. Under the name of Kandal Steung District administration, he has supported the project because it would offer numbers of positive impacts including: - There would be more employment opportunities and people moving in the area around the project - Offer job opportunities for local people directly and indirectly - Land prices would increase In the meantime, he also raised some concerns including: - A number of private companies have been occupying 2,600 hectares of land area within the project site while CAIC has yet to resolve any land acquisitions by private companies or individuals. The resolutions have been handled by the Land Conflicts Commission. - The construction may cause some road damages - Some waterways would be lost and replaced - Loss of agricultural land and affect the fishing areas of local people - Noise disturbance from traffics and the take-offs and landing of the airplanes	On behalf of Kandal Steung District Council, he had some suggestions as following: - Suggest the company to have good cooperation with local authorities - The company should solve land conflicts before implementing the project - Suggest developing the villages and communes nearby the project area

No.	Date	Name/Organizations	Comments/Concerns	Suggestions
4	May 03, 2019	Interview with Mr. Choup Sorphoan, Director of Kandal Provincial Tourism Department	During the consultation meeting, he mentioned that he was aware of the upcoming project of constructing a New Phnom Penh International Airport of Cambodia Airport Investment Co Ltd (CAIC) through information dissemination and government documents. On behalf of Kandal Provincial Tourism Department, he has supported the project because it would offer numbers of positive impacts including: - This New airport will improve tourism sector - Local economic growth, as well as, national economic growth - Enhance the development of aviation sector - Improve the status and beauty of Sa'ang District which is close to the New airport - Offer job opportunities for local people directly and indirectly In the meantime, he also raised some concerns including: - During construction, the dusty atmosphere would affect the beauty and tourism in the area because tourists want to enjoy clean environment and fresh air, also there is "Sa Ang Phnom Resort", a natural and cultural tourism site, which people regularly visit. - The other issue in tourism sector of Kandal Province is the lack of understanding and awareness related to health, hygiene, wastes and environment; hence, solid waste management should be well-managed. - The increase of traffics should be considered in the project.	On behalf of the Kandal Provincial Tourism Department, he requested the following: - The company needs to consider about health safety management and proper solid waste management. - The company must comply with the principles and plans set out by the government and relevant departments.
5	May 03, 2019	Interview with Mrs. Moung Sarim, Director of Kandal Provincial Culture and Fine Arts Department	During the consultation meeting, she mentioned that she was aware of the upcoming project of constructing a New Phnom Penh International Airport of Cambodia Airport Investment Co Ltd (CAIC) through information dissemination and government documents. On behalf of Kandal Provincial Culture and Fine Arts Department, she has supported the project because it would offer numbers of positive impacts including: - Numbers of tourist would increase - Land prices would increase - Local people would have more employment opportunities from the project - Local economy would grow rapidly	On behalf of Kandal Provincial Culture and Fine Arts Department, she requested the following: - The company should provide information to the Department so that the technical team can inspect and excavate the ancient artefacts to preserve them.

No.	Date	Name/Organizations	Comments/Concerns	Suggestions
			In the meantime, she also raised some concerns including: - In Kandal Steung District, she mentioned, there are numbers of tangible heritage sites including 2 temples, 331 ancient hills, 6 historical sites, 206 ancient houses, 68 ancient pagodas, 33 ancient monasteries, 20 ancient stupas, 4 ancient ponds, 1 museum, and 1 archaeological site. There are 10 ancient hills in Prolay village (Lok Ta Kes hill and Kdouch hill), Chrey Yong village (Kok Dongkor hill and Thmor hill), Ampov Prey village (Ta Ngil hill), Tork Ma village (Kontork hill and Mok Khmao hill), Teuk Nim village (Por Snay hill), Ta Dorl 3 village (Nak Ta Tong hill), and Ta Dorl 2 village (Ta Chey hill), Kandal Steung District, Kandal Province. - Noise disturbance - from the airplane take-offs and landings – would affect some nearby pagodas.	- The company should take the conservation of heritage sites into consideration.
6	May 09, 2019	Interview with Mr. Pha Tham, Deputy Director of Agriculture, Forestry and Fisheries Department	During the consultation meeting, he mentioned that he was aware of the upcoming project of constructing a New Phnom Penh International Airport of Cambodia Airport Investment Co Ltd (CAIC) through information dissemination and government documents. He added, according to the geography, the project land area would cover 4 communes, which the total cultivated rice fields are 2,469 hectares, ranging from Canal 92 to Canal 94, and the small-scale cultivated farmlands are only 21.5 hectares. Nowadays, the land areas of cultivated rice fields are slowly disappearing in each commune since numbers of housing and land development projects have increased; on top of that, agriculture labor have declined as people have preferred to work in factories over the farmlands. Therefore, the impacts of the project on the cultivated area is limited. On behalf of Kandal Provincial Agriculture, Forestry and Fisheries Department, he has supported the project because it would offer numbers of positive impacts including: - The new airport would improve the agriculture sector and increase international supply rapidly - Land prices would increase	On behalf of Kandal Provincial Agriculture, Forestry and Fisheries Department, he had several suggestions in the following: - The company should resolve any impacts with all the stakeholders. - The project should benefit both the company and local people.
7	May 09, 2019	Interview with Mr. Su Tyro, Deputy Director of Kandal Provincial Public	During the consultation meeting, he mentioned that he was aware of the upcoming project of constructing a New Phnom Penh International Airport of Cambodia Airport Investment Co Ltd (CAIC) through information dissemination and government documents. Kandal Province, he added, will have an investment on water treatment system from	On behalf of Kandal Provincial Public Works and Transportation Department, he had several suggestions in the following:

No.	Date	Name/Organizations	Comments/Concerns	Suggestions
		Works and Transportation Department	Korean company near a New Phnom Penh International Airport. Currently, the consultant team is studying site selection for the project. Nowadays, the Department of Public Works and Transportation has not yet released any details on the project. On behalf of Kandal Provincial Public Works and Transportation Department, he has supported the project because it would offer numbers of positive impacts including: - There will be more road infrastructure development, as well as, the increase of hotels, restaurants, commercial areas and the improvement of people's economy. - Direct flights to major countries will increase Along with the positives mentioned above, he was concerned that the presence of the new airport would produce noise disturbance to the public, especially those living near the airport.	- The project needs to design a large and capable drainage system to avoid garbage congestion - The project must include a wastewater treatment tank to prevent the discharge of potentially hazardous waste - The project needs to resolve or find a suitable transport route in order not to affect people's farmland - The project must widen the airport gateway to avoid future traffic congestion
8	May 09, 2019	Interview with Mr. Teat Sar, Deputy Director of Land Management Urban Planning and Construction Department	During the consultation meeting, he mentioned that he was aware of the upcoming project of constructing a New Phnom Penh International Airport of Cambodia Airport Investment Co Ltd (CAIC) through information dissemination and government documents. He added that Sa'ang District was Kandal Province's first district to systematically register land titles, therefore more than 98% of residents had land titles. Land Titling is defined as a solid legal certificate under the administration of 2001 Land Law or it is defined as Landlord Certificate - a highest certificate. Since this New airport project will produce adverse impacts related to land, the Royal Government has issued a decision to set up a Commission on Site Selection of New Phnom Penh International Airport on February 18, 2019, presided by H.E. Chea Sophara. Currently, the Commission is working on land issues in which some local people have encroached the buffer zone near the Lake and taken ownership over the area. On behalf of Kandal Provincial Land Management Urban Planning and Construction Department, he has supported the project because it would offer numbers of positive impacts including:	On behalf of Kandal Provincial Land Management Urban Planning and Construction Department, he had several suggestions in the following: - The project must resolve land issues based on the current market prices for people - All construction work of the project should be carried out according to plan and technical work properly.

No.	Date	Name/Organizations	Comments/Concerns	Suggestions
			- The New airport would improve the agriculture sector and increase international supply rapidly - The information of New airport construction will make the land prices increase In the meantime, he also raised some concerns including: - Following the news of the upcoming airport construction, various disputes over land grabbing have occurred through the competition over land purchase and sales, provoking uproar and disputes. - Moreover, due to the incidence of land disputes and the establishment of clear land demarcation, the land in Kandal Steung District and relevant districts has been set aside (prohibiting land purchases and sales temporarily) based on the decision of the Royal Government. Therefore, this embargo will affect the economy of some people. - The rise of land prices makes people leave the land idle/unused. - The flow of sewage from the airport into the lake would affect the lake quality.	
9	May 09, 2019	Interview with Mr. Om Phat, Director of Kandal Provincial Environment Department	During the consultation meeting, he mentioned that he was aware of the upcoming project of constructing a New Phnom Penh International Airport of Cambodia Airport Investment Co Ltd (CAIC) through information dissemination and government documents. Kandal Province, he mentioned, does not yet have a National Park or Protected Area. Moreover, no project or organisation has ever studied or initiated a plan to protect the natural resources such as birds and wildlife in this area. Overall, the project site is a flood plain, in which local people do their farm work during the dry season. He also expressed his support for the project of constructing a New Phnom Penh International Airport because it will produce some positive impacts, including: - The project of constructing a New Phnom Penh International Airport needs to be filled up, according to the master plan, the company will restore Boueng Cheung Loung and Boueng Rean in order to access and consume the excavated dirt . Therefore, the excavation of these two lakes would enable the lakes to be deeper and more resilient for storing a huge volume of water.	On behalf of Kandal Provincial Environment Department, he had several suggestions as following: - The company needs to design a capable wastewater treatment facility - The company should consider planting trees around the airport - The company must provide appropriate compensation to the affected people

No.	Date	Name/Organizations	Comments/Concerns	Suggestions
			- This project will also support the economic improvement of the people around the project area through other commercial activities Along with the positive impacts mentioned above, he is concerned that the new airport establishment could lead to surface water pollution (lake quality) through the drainage of untreated sewage into the lake. On the other hand, the wastewater from the project would be released in numbers of cubic meter volumes, and if the drainage rurns at a fast pace, it can affect the natural resources of the lake.	
10	May 09, 2019	Interview with Mrs. Lao Vannaroth, Director of Kandal Provincial Women's Affairs Department	During the consultation meeting, she mentioned that she was aware of the upcoming project of constructing a New Phnom Penh International Airport of Cambodia Airport Investment Co Ltd (CAIC) through information dissemination and government documents. She also expressed his support for the project of constructing a New Phnom Penh International Airport because it will produce number of positive impacts not only to Kandal Province but also the whole country, including: Along with the positives, she was concerned that the new airport establishment would affect women's mental health as well as the safety and mental health of children as the area's environment might be changed in a way that women and childen cannot cope with, including the effects from some project activities such as transportation, construction and so on.	On behalf of the Kandal Provincial Women's Affairs Department, she requested the following: - The project should have a proper protection plan for public health and safety. - The company should take into account women's mental state since women physically are not able to work as much as men, especially when they have families.
11	May 10, 2019	Interview with Mr. Lim Sarom, Director of the Labor Inspection and Dispute Unit of the Kandal Provincial Labor and Vocational Training Department	During the consultation meeting, he mentioned that he was aware of the upcoming project of constructing a New Phnom Penh International Airport of Cambodia Airport Investment Co Ltd (CAIC) through information dissemination and government documents. He also expressed his support for the project of constructing a New Phnom Penh International Airport because it will produce some positive impacts, including: - Local and sub-urban residents can find jobs close to home - Kandal Province may become a satellite city with high rise buildings and commercial complexes which it is going to keep it up with Phnom Penh City - It may become a growing hub of trade and tourism and have many kinds of shopping malls	On behalf of the Kandal Provincial Vocational Training and Youth Rehabilitation Department, he requested the following: - Provide information on the number of construction workers, accommodations and other information to the Department of Labor within 30 days of the construction process.

No.	Date	Name/Organizations	Comments/Concerns	Suggestions
			At the same time, he raised some concerns that the project should pay attention to, including: - Land disputes with people and the company - The safety of construction workers in using personal safety equipment - The healthiness of construction workers in food and water consumption - The healthand safety of construction workers in their living conditions at the labour camps, etc.	- The project should utilise the local labour force as much as they can before recruiting outside workers. Also, the project needs to consider the equal labor allocation of male and female workers. - The project must abide by the rules of the Labour Law - The project must cooperate with the Labour Department at every labour inspection.
12	May 13, 2019	Interview with Lt. Gen. Eav Chamroeun, Commissioner of Kandal Province	During the consultation meeting, he mentioned that he was aware of the upcoming project of constructing a New Phnom Penh International Airport of Cambodia Airport Investment Co Ltd (CAIC) through information dissemination and government documents. He also expressed his support for the project of constructing a New Phnom Penh International Airport because it will produce some positive impacts, including: - The presence of the airport can improve local people's livelihoods through more job opportunities and incomes - The presence of the airport would make Ta Khmao an economically viable city - The presence of the airport will raise land prices	

6.2.3. The Results of Consultation Workshops

On Friday morning, July 19, 2019, a public consultation workshop took place at the meeting hall of Kandal Provincial Environment Department – joined by the representatives from other relevant departments of Kandal Province – aiming to complement more inputs for the preparation of the full report on environmental and social impacts for New Phnom Penh International Airport Project, which is developed by Cambodia Airport Investment Co Ltd (CAIC). The company is located at Building No. 315, Canadia Palace, 28th Floor, Monivong Blvd, Sangkat Wat Phnom, Khan Daun Penh, Phnom Penh. This consultation workshop was joined by 28 people (2 company representatives, 2 project owners, 4 people from E&A Consultant and 22 representatives of relevant technical departments and Ministry of Environment).

a) The Survey Results of Supporting the Development of this Project

The analysis revealed that 100% of the participants in the meeting supported the project by highlighting 3 major benefits of the project including: (1) the contribution to the air transportation: both air freight and air travel (2) tourism growth (3) raising Cambodia up to international level for having a standard and huge international airport. Along with the support, the company must comply with the environmental and social impacts assessment report to mitigate the current and future impacts to the minimum level.

b) Concerns

- Since the project requires large volumes of clean water, Ta Khmao Water Supply does not have enough capability to supply clean water.
- Wastewater from the project may be drained into water sources (Boueng Cheung Loung and Boeung Rean) which could affect people around the area.
- The nearby residents may be affected from the noise disturbance of airplane takeoffs and landings.

c) Suggestions

- It was suggested that CAICshould construct a road around the Lake, from which the soil is excavated to be used as infill for constructing the airport. Also, the company should plant more trees to turn the lake area into a tourist attraction and protect the State's lake area.
- The company must provide on-job training to the staffs in every unit before starting off their duties at the airport. This to ensure that the staff, for example, sanitary workers and cleaners, can perform wel,l based on agreed standards.
- Prior to the project implementation phase, the project owner must organise a dissemination forum to inform the public about the project.
- The company must fully resolve all land issues related to the project to ensure that the project implementation will not be subject to complaints or suffer delays due to those issues.
- With regard to the clean water supply, the company must have detailed discussions with the technical teams and relevant ministries/departments (e.g. Ministry of Industry and Handicrafts) to ensure an adequate water supply.
- The company must have strict internal regulations, particularly for transporting trucks in which they necessarily need to be covered with plastic/wrapper to prevent dust swirling or dirt dropping onto the roads.
- The company needs to reserve funds for the conservation and restoration of the natural resources around the project area, such as the purchase of small fish, the budget for flooded forests conservation along the Boueng Cheung Loung and Boueng Rean.

6.3. Conclusions and Suggestions from the Public Consultation Workshop

The public consultation workshop to which all participants contributed greatly was a helpful forum to allow local people, local authorities, relevant departments, and other stakeholders the opportunity to give inputs, review and comment on the results of the environmental and social impacts assessment report and proposed the measures and suggestions for the project owner to consider implementing.

As a result, local people, local authorities, relevant departments, and other stakeholders expressed their 100% support for the project since it would produce 3 major benefits such as: (1) the contribution to air transportation both : air freight and air travel (2) tourism growth (3) increase national awareness and prestige.

To improve the proposed project, local people, local authorities, relevant departments, and other stakeholders made the following suggestions:

a) Suggestions from local people:

- Do not drain any wastewater generated from the airport into the natural lake.
- Do not close the waterway of Bati River because it is the main source of water flowing into the lake area.
- Give priority to the people living near the project area to be employed at the airport.
- Provide additional training to people living near the project area so that they can work at the airport.

b) Suggestions from participants in the consultation workshop:

- It was suggested that CAIC should construct a road around the lake,from which the soil is excavated to provide infill for the airport construction. Also, the company should plant more trees to turn the lake area into a tourist attraction and protect the State's lake area.
- The company must provide on-the-job training to the staff in every unit before starting off their duties at the airport. This to ensure that the staff, for example, sanitary workers and cleaners, can perform well based on agreed standards.
- Prior to the project implementation phase, the project owner must organize a dissemination forum to inform the public about the project.
- The company must fully resolve all land issues related to the project to ensure that the project implementation will not be complained or delayed due to those issues.

- Regarding the clean water supply, the company must have detailed discussions with the technical teams and relevant ministries/departments (e.g. Ministry of Industry and Handicrafts) to get adequate water supply.
- The company must have strict internal regulations, particularly for transporting trucks in which they necessarily need to be covered with plastic/wrapper to prevent dust swirling or dirt dropping onto the roads.
- The company needs to reserve funds for the conservation and restoration of the natural resources around the project area, such as the purchase of small fish, the budget for flooded forests conservation along the Boueng Cheung Loung and Boueng Rean.

Chapter 7 Impact and Mitigation Measures

7.1 Introduction

This chapter presents the results of the impact assessment particularly on natural resources (physical and biological resources) and socio-economic resources that may potentially affect by the construction activities of the New Phnom Penh International Airport Project of Cambodia Airports Investment Co., Ltd (CAIC) in three different phases: design, construction, and operational phases. Each impact is identified and evaluated by the study using existing environmental conditions in the study area, the project activities plan, the consultation with the local authorities, the local people and the relevant institutions using the method as detailed in chapter II of this ESIA report.

In addition, appropriate and effective mitigation measures have been proposed in order to mitigate, reduce and prevent any adverse impacts that may occur from the implementation of the project activities and to increase the positive effects for local communities who are living near the project area. Each mitigation measure has been developed and revised based on (1) the action plan of the project, (2) consultation with experts, (3) consultation with local authorities and public consultation with key government institutions.

This chapter indicates the following sections: i) project phase determination; ii) a summary table of significant level of negative impacts; iii) details of each significant negative impact, and impact mitigation measures in each phase; iv) assessment of cumulative impact, and v) significant positive impact generated by the project.

7.2 Project Phase Determination

In the project implementation, the total project area is 2,600 hectares which the company has divided into two phases: the Phase I (2023-2030), and Phase II (2031-2050). In implementing the project to build a new Phnom Penh International Airport, the company is committed and plans to increase the green space or green garden in the field by choosing plants that absorb more toxins, green space and shade. Preservation of green space The Company has arranged for the monitoring and approval of the Ministry of Land, Urban Planning and Construction (30% of the total construction area).

The project activities during the construction phase up to the completion of the project are summarised below:

7.2.1 Design and Construction Phase

7.2.1.1 Design Phase (2018-2019)

Based on the project master plan, the pre-construction phase is two years with some study activities including:

- Feasibility study
- Geological study
- Master plan
- Land issues and resettlement
- Detailed airport design
- Construction design

At the same time, the project needs to study altitude, topography and other topics in order to obtain detailed data for further studies and designs. The project area contains unexploded ordnance (UXO) and, consequently CAIC has appointed a demining agency to eradicate the issue.

7.2.1.2 Construction phase (2020-2025)

The construction phase will consist of the construction of Runway 1 and supporting infrastructure from 2020 up to the trial flight in 2023. The main activities of this phase are as follows:

- Design and construction bidding
- Mobilization of machinery to the project site
- Site preparation such as vegetation clearance and soil backfilling
- Runway construction activities, electrical system and other infrastructure
- Cleaning up construction site and other infrastructure
- Construction quality review and transfer and trialflight

7.2.2 Operational phase

- Phase 1 (2023-2030): operate runway 1 (4,000 metres long x 60 metres wide), passenger terminal and other infrastructure which can handle 13 million passengers / year.
- Phase 2 (2031-2050): operate runway 2 (4,000 metres long x 60 metres wide), increase size and capacity of the passenger terminal and other infrastructure to enable it to handle up to 30 million passenger / year.

7.2.3 Closure phase

In this report, the project closure phase is the phase when the project owner will consider that all the plan activities on the airport site have been realized. At which point, the environmental and social impact assessment on the project will need to be updated.

Overall the project master plan for the New Phnom Penh International Airport will be developed and operated in two phases as follow:

Table 93: Summary of Project Implementation Phases

Phase	Aircraft Category	Period	Infrastructure	Passengers	Flights
1. Pre-Operational Phase					
Design Phase		2018-2019	- Master plan design		
Construction Phase		2020-2025	- Two runways; - Four taxiways; - Supporting infrastructure for Phase 1 and Phase 2		
2. Operation Phase					
Phase 1	4 F	2023-2030	- Runway 1 (4,000 m. long x 60m. wide) - 2 Parallel taxiways in line with runway 1 - Passenger terminal and other infrastructure	13 million passengers/year	80,087
Phase 2	4 F	2031-2050	- Runway 2 (4,000 m. long x 60m. wide) - 2 parallel taxiways in line with runway 2 - Increased Passenger terminal and other infrastructure	30 million passengers/year	186,755

Closure Phase	All project activities over the total land area (2,600 ha) have been identified and assessed (post 2050). In the closure phase, CAIC shall transfer the NPPIA operation to the Royal Government of Cambodia.

Source: CAIC (2019)

7.3 Summary Table of Significant Level of Negative Impacts

To determine the level of potential impact in each phase, this assessment is based on the project's activities plan and the existing environmental data in the study area. The level of impact is divided into three main levels: low, moderate and high in each phase relying on each physical, biological and socio-economic resources as listed in Table 95 below:

Table 94: List of negative impact caused by project activities

No.	Environmental Resources	Project Cycle		
		Pre-construction phase	Operational Phase	Closure Phase
a. Physical Resources				
1.	Geology	-	-	-
2.	Topography	√	-	-
3.	Soil quality	√	-	-
4.	Mineral resources	-	-	-
5.	Climate	-	-	-
6.	Air quality	√	√	-
7.	Noise and vibration	√	√	-
8.	Hydrology	√	-	-
9.	Surface water quality	√	√	-
10	Ground water quality	√	-	-
b. Biological Resources				
11	Forest (flooding forest and vegetation)	√	-	-
12	Wildlife	√	-	-
13	Bird	√	√	-
14	Fish	√	√	-
15	Protected area	-	-	-
c. Socio-economic Resources				
16	Demography	-	-	-
17	Settlement	√	-	-
18	Land Use	√	-	-
19	Fishing	√	-	-
20	Public infrastructure	√	-	-
21	Electricity consumption	-	-	-
22	Water consumption	-	-	-
23	Public health and safety	√	√	-
24	Education	-	-	-
25	Tourist site	-	-	-
26	Landscape	-	-	-
27	Culture	-	-	-
28	Land Traffic	√	√	-
29	Other risks (fire, flooding etc.)	√	√	-

Note: "√" means impact, " - " means No impact.

7.4 Major Negative Impact and Mitigation Measure

7.4.1 Construction Phase

This section describes the potential negative impacts on physical biological and socio-economic resources through the implementation of construction activities in the construction phase. Impacts on each resource are identified and assessed, and appropriate mitigation measures are proposed in the following sections of this phas.

7.4.1.1 Physical Resources

a) Topography

In the construction phase, project activities may pose a potential negative impact on topography in the project area including soil layers, natural form of soil, and shrub cover in the project area, The project area's topography can be affected by a number of project activities including site clearance activities, soil backfilling, soil settlement and other project's infrastructure construction activities. The project site will require land clearance and soil backfilling.

In 2018, Key Consultant (Cambodia) conducted the topographic study. The elevation is illustrated in Photo 4-0. The project site is generally flat, with an elevation range between 1.3 meters and 8 meters above the sea level. The site's south-west area has a high elevation (6 to 8 meters above the sea level), while the site's north-west area has a low elevation (1.3 meters to 2 meters above the sea level). There are several streams and canals crossing the project area to the south-east and the north-west (Photo 4-10). It is difficult to build a dike at a point where water flows.

Soil will be transported from Beoung Choung Leoung lake and Boeung Rean lake as illustrated in Map 4-3. The estimated quantity of fill material is 13.9 cubic meters over a period of 3 years. Upon fill completion, the project site's elevation will be 7.50 meters above the sea level (Photo 4-12).

Construction Design and Method:

- NACO final formation level (18 Jan 2019) is adopted.
- Top soil removal is 1 m deep and required at all airfield paved areas (i.e. Runway, Taxiways and Aprons), PTB areas and dike areas;
- Sand blanket material is 1 m thick at all ground treatment areas (airfield paved areas and PTB areas);
- Sand fill is required for all airfield paved areas, dike and PTB areas
- NACO final formation level is considered to be the finish level of site formation, excluding pavement thickness. This is because the ground settlements are expected during pavement construction and adequate fill levels shall be maintained;
- Dike top level at +9 msl with 1:3 slopes to existing ground level;
- All cut material (including 1 m top soil) is assumed to be appropriate general fill after treatment. The actual material needs to be reviewed;
- Quantity of surcharge materials (which require Sand Fill and General Fill) is considered as a separate item. As the ground treatment schemes have not been finalised, fill quantities are estimated for two scenarios – PVD and surcharge scheme is adopted for 100% and 50% of ground treatment areas. The values are to be updated once ground treatment schemes are finalised.

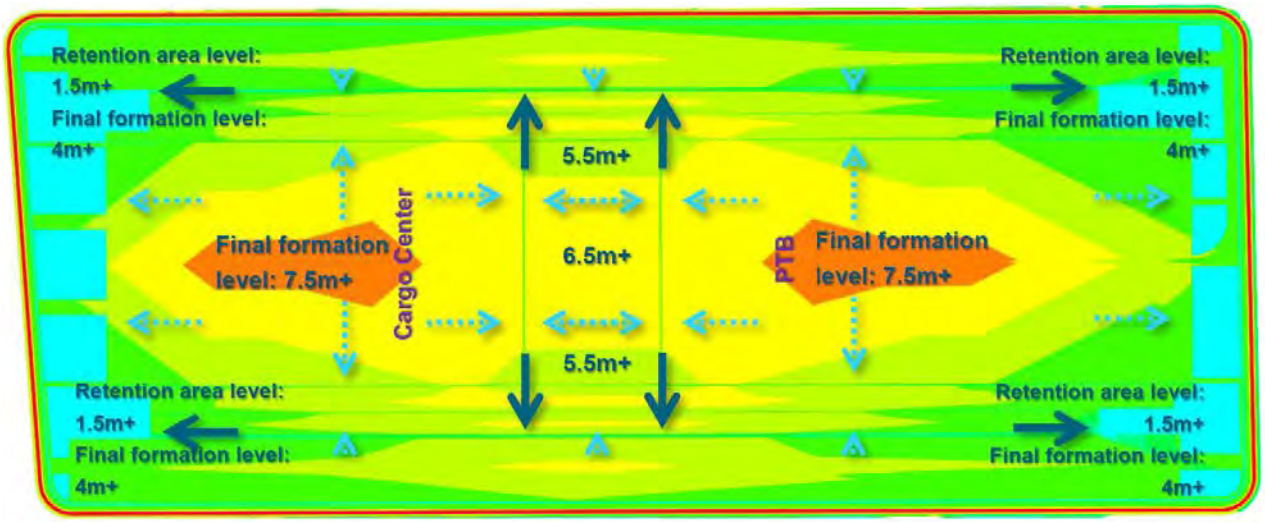
The volume of fill material is approximately 13.9 Mm^3, excluding the surcharge material. About 8.4 Mm^3 is Sand Fill or Sand Blanket materials, which are to be imported. The volume of cut material is about approximately 9.5 Mm^3. This is from three main sources as follows:

- Excavation to final formation level where the existing ground level is high;
- Excavation of the water retention pits;
- Excavation of the 1m top soil at airfield paved areas, dikes and PTB areas

The cut materials are expected to be predominantly the upper alluvium, which may be used as General Fill and/or Clay Core.

Photo 98 shows the levels and gradients of the project site to be filled:

Photo 98: Levels and Gradientsat the Airport Site



Source: CAIC, 2019

According to the study, Boueng Cheung Loung is a natural lake, located southeast of the project site, which contains water in both the dry and the rainy season. Preak Ta Hor canal is located north of the project site and connectsg Preak Tnoth to Boueng Cheung Loung and Tonle Bati in the southern part of project site. The other canals that flow through the project site (such as canal 92, canal 57 and canal 58) e flow from the wesern area into Boueng Cheung Loung through canal 92 and those canals providing water for irrigation. Only Tonle Bati (at the end of Cheurng Prey village, Potsor commune until the Boueng Cheung Loung) and part of canal 92, canal 57 and canal 58 are actually located inside project site (see photo below). Therefore, soil backfilling to serve the construction of airport will affect the water flow and interrelationship with Boueng Cheung Loung.

The potential loss area of Boueng Cheung Loung is only 306 ha. So, due to the clearance activities and short duration of soil backfilling in the project area the topography variations impact is rated as "moderate" which requires effective mitigation as following:

Mitigation Measure:

- The company collaborates with the Ministry of Water Resources and Meteorology to assess the dike and concrete canal construction to divert water from Tonle Bati River and Ta Hor canal.
- The company reserve a landplot to the south-west of the project area in order to divert water flow from Tonle Bati River.
- Before the start of clearance activities, the company shall build dyke and drainage system to avoid runoff.

- The company will avoid any unnecessary clearance in the project area.
- Soil waste and other debris created by clearance activities will be properly kept by avoiding any mess pile in an area where easily block water way or/and cause any erosion to pollute the surface water around the project.
- Clearance activities and soil backfilling will follow the clearance plan of the proposed project.
- The company shall prevent runoff from entering nearby water bodies.
- Engineering options have been developed for the permanent boundary dikes which are required around the full perimeter of the site to provide protection against flooding and to maintain the water levels within the site area. During the design coordination workshops held between the Client, the PMC and the site formation Designer in August 2019, the following criteria were agreed and have been adopted for the current design of the dikes:
    - There are no any heavy structures/utilities or transportation road on the crest and the width of crest is set to a minimum of 2m;
    - The recommended minimum design height for 2040 by NACO, i.e. +9.7msl for all dike sections, is set as the target design level for the dikes;
    - There is no specific long settlement limit set for the dikes, but the NACO minimum level for 2040 shall be maintained. This requires lifting up the construction level of the dikes to compensate the long term settlements. The construction level is therefore set to be approximately +11.0msl. Ground treatment is not going to be carried out for reducing the long term settlements;
    - The dikes are designed to meet stability and seepage requirements;
    - Regular monitoring of long-term settlements of the dikes is recommended.
    - The existing ground level at the perimeter of the site varies from about +2msl to +8msl, as shown in Photo 4-63. The dike heights therefore vary with the ground levels. The dikes are divided into 4 types according to the height of dike from existing ground level as shown in the Table 4-24 and Photo 4-63 to Photo 4-68. For the northeast and southeast portions of the dike (Type 4) where the existing ground is the lowest, a portion of dike Type 4 may be located in flooding area throughout a year (i.e. in the lake). Depending on actual site conditions during the construction of the dike Type 4, a clay core may not be able to compacted properly. As an alternative option, a different dike section, dike Type 4 (Option B) is proposed. Details and photos of the cross section of each type of the dike are presented in the Section 4.10.2 Drainage and Flood Prevention System.

b) Air quality

According to the test results, all air pollutants but fine particles (Total Suspended Particulates and other gases (i.e. CO, NO_2, and SO_2, etc.)) did not exceed the Ministry of Environment's standards.

The air quality in the project is likely to be affected by two major factors: dust and smoke emission generated by enginesduring construction phase.Potential impacts to air quality may occur due to the following project activities during the construction phase:

- Machinery mobilization;
- Site preparation activities;
- Transportation of earth materials, backfilling, and compacting soil; and
- Activities of transporting workers in or out project site
- Construction activities for airport runway, passenger terminals, and other supporting infrastructures.

- Dust dispersion due to transportation

At this phase, those who may be affected include: staffs/workers in the project site, public transporters near the project site, people who are living near or adjacent project site and other natural resources such as wildlife, plants, tree and bird because the project site is afloodplain and floods every year. Two access roads have been identified: Canal No. 54 Road (to the south-west of the project area) and Canal No. 92 Road (to the north-west of the project area). Their directions are as follows:

- Road 1: from Takeo province to the the south-west of the project area.
- Road 2: from Phnom Penh/Takhmao to the north-west of the project area.

There are houses, pagodas, and schools along both roads, located in Boeung Khyang commune and Kondoak commune.

- Dust dispersion from the project area

During the construction phase over Phase 1 and Phase 2 (covering an area of 1,638 ha), there are a lot of activities such as backfilling, clearing, transportation, and excavation contributing to dust pollution, which further deteriorate air quality and human/animal health.

To estimate the dust concentration "C" in Hanoi in 2009, Pham Ngoc Ho uses the Fixed-Box Model (Ho, Bach, & Manh, 2009). The model considers a few indicators such as emission factor for large construction site as determined by EPA (EPAa, 1995), and actual dust concentration in the project area. According to EPA, the dispersion rate of the construction activity is 98.8 kg/ha/day. Thus, the total quantity "Q" in the project area would be 161,834.4 kg/day. This value is appropriate for a moderate-level construction activity on moderate silt and semi-dry climate. Cambodia is hot and dry, so the dispersion is not as strong as the semi-dry country. Therefore, the above value represents the worst-case scenario.

The Fixed-Box Model has the following formula:

$$C = b + \frac{Q}{uHW}$$

Where;

b = actual dust concentration in the air (mg/m^3)

Q = Dust quantity in the project area (kg/day)

W = Width of the project area (m)

u = average wind speed (m/s) in the project area from 2009 to 2018 (please refer to the Climate Section in Chapter 5)

H = Height of the mixing layer (m) (No data available in Cambodia, but use Thailand's worst-case scenario 500 meters (PCD, 2012)

The dust concentration in the air "C" is compared with the Cambodia's air quality standard as follows:

Size	Width	Project's Contribution	Existing TSP (b)*	TSP during the construction phase (C)	Standard**
1,638 ha	2,630 m	0.0013 (mg/m^3)	0.094 (mg/m^3)	0.095 (mg/m^3)	0.33 (mg/m^3)

Note: (*) Please refer to Air Quality Section in Chapter 5.
(**) Standards as prescribed in the Sub-Decree on Air Quality and Noise Disturbance Control (2000)

- Dust dispersion from concrete mixing plant

The pile of soil at the concrete mixing plant combining with wind blow may cause dust pollution affecting the public health in surrounding villages of Beougn Khyang commune, Prek Sleng commune, Pot Sor commune, and others. Strong wind blow, however, happens particularly from November to May. The dust dispersion will stop happening when the construction activities start.

As the above table shows, the highest TSP level during the construction phase is 0.095 mg/m^3 , which is lower than the maximum level allowed (0.33 mg/m^3). Therefore, the air quality impact is rated as "moderate".

Mitigation Measures:

- The project will spray water and regularly monitor where dust is observed, such as watering the runway, terminal area and other access road to minimize any dust.
- The project will dampen the pile of soil or sand reserved for backfilling and concrete mixing, particularly during the period of strong wind blow.
- Maintain vehicle and equipment according to manufacturers' specifications. In particular, maintenance of vehicles and other machinery, such as oil changes or repairs, will be made according to the schedule of manufacturers' specifications.
- The project team will ensure engines or machinery are not run unnecessarily.
- Whilst infill material is being transported the project team will not allow higher loads than the height of the cage or the connecting cage of the vehicle, with regular checks to prevent dust on the local population near the project site.
- The project team will prepare and implement regular maintenance for all vehicles and machinery to ensure fuel efficiency.

c) Noise and Vibration

During the construction phase, construction equipment and vehicles may generate elevated noise and vibration levels. Noise and vibration can result in disturbances to nearby communities, as well as result in stress to wildlife, potentially impacting behavior and breeding patterns. According to the survey, there are presence of building near the project area. Within 3 km radius from the project area, there are the following receptors:

- Among the seven schools, the nearest one to the project border is Sok An Chambok Bet Meas Secondary School, located 1 km to the south-west.
- Among the 15 pagodas, the nearest one to the project border is Botum Sorya Pagoda, located 0.3 km to the south.
- Among the 32 villages, Boeung Khyang commune's Sala Taprom village is inside the project area, while other villages are outside.

Overall, due to the short duration of project activities, the vulnerable location is far away, the construction work will be conducted during the day time, noise and vibration levels caused by heavy machinery will be limited and of minimal levels, thus the potential negative impact of noise and vibration posed by project activities are rated as "low".

Mitigation measures:

- Equipment to be operated will be maintained in accordance with manufacturer specifications.
- The construction activities that produce high noise and vibration emission level shall be conducted during daytime (from 7 am. - 6 pm.). In case of nigh-ttime work, the project team will inform the local authority and local people before work commences.
- CAIC will construct a fence around its construction site to reduce noise and vibration.

- CAIC will set up a mechanism to respond to any complaint from local residents regarding noise and vibration.
- Where possible, the project will schedule the operation of noisy construction equipment so that it is staggered and does not all occur at the same time.
- CAIC or its nominated sub-contractors will install sound reduction to all machinery that produces high noise levelsto ensure that emitted noise will be reduced.
- CAIC or its nominated sub-contractors will provide workers with Personal Protective Equipment (PPE) such as ear protectors, eyeglass and other materials according to project safety standard. No employee is to be exposed to noise above 85 dB(A) for more than eight hours a day without wearing ear protection.

d) Hydrology

The hydrology of streams, lakes and canals in the project site is focused on the main points such as (1) water flow and the interrelationship between other lake and (2) water storage and release functions as follows:

- **Water flow and the interrelationship between Boeung Cheung Loung, Tonle Bati and other irrigation canals**

According to the study, Boueng Cheung Loung is a natural lake, located southeast of the project site, which contains water in both the dry and the rainy season. Preak Ta Hor canal is located north of the project site and connectsg Preak Tnoth to Boueng Cheung Loung and Tonle Bati in the southern part of project site. The other canals that flow through the project site (such as canal 92, canal 57 and canal 58) e flow from the western area into Boueng Cheung Loung through canal 92 and those canals providing water for irrigation. Only Tonle Bati (at the end of Cheurng Prey village, Potsor commune until the Boueng Cheung Loung) and part of canal 92, canal 57 and canal 58 are actually located inside project site (see photo below). Therefore, soil backfilling to serve the construction of airport will affect the water flow and interrelationship with Boueng Cheung Loung.

- **Water storage and release functions**

In the construction phase, land preparation work such as clearance, soil digging, soil backfilling and ground compression will change the hydrology in the project area. According to the study, the potential impact of hydrological changes such as water flow altering and the impact of new drainage system design, loss of water retention capacity in the project site by the clearance of soil and trees in order to facilitate the airport construction. Engineering work is required take into account the drainage system to divert water flow where site clearance occurs. Tree clearance in the construction phase can also lead to changes of hydrology due to reduced evaporation and water retention capacity that can cause more water runoff and also make alterations to the water flow. These project activities may affect the water flow and interrelationship between the lake and the drainage system and are rated as “high”.

Mitigation measures:

- Project was organizing the master plan and including flood management plan (see Photo 7-3) inside and outside the project site. Project design to divert water from Tonle Bati by allowing the like between Tonle Bati and Boueng Cheung Loung to keep the same flow (see Photo 7-2).
- The project has reserved a land plot to the south-west of the project area to divert Tonle Bati River.
- Clearance activities and soil backfilling will be conducted technically by construction of a drainage system to prevent flooding or discharge into the project site.
- Project will ensure that the drainage system has adequate capacity to accept heavy rainfall that flow on to impermeable surfaces.
- Feasibility study of Boueng Cheung Loung and Boueng Rean soil removal for backfilling at the airport site to show that both lakes will have greater storage capacity for water.

Photo 99: The location of stream, lake and canal in the project site

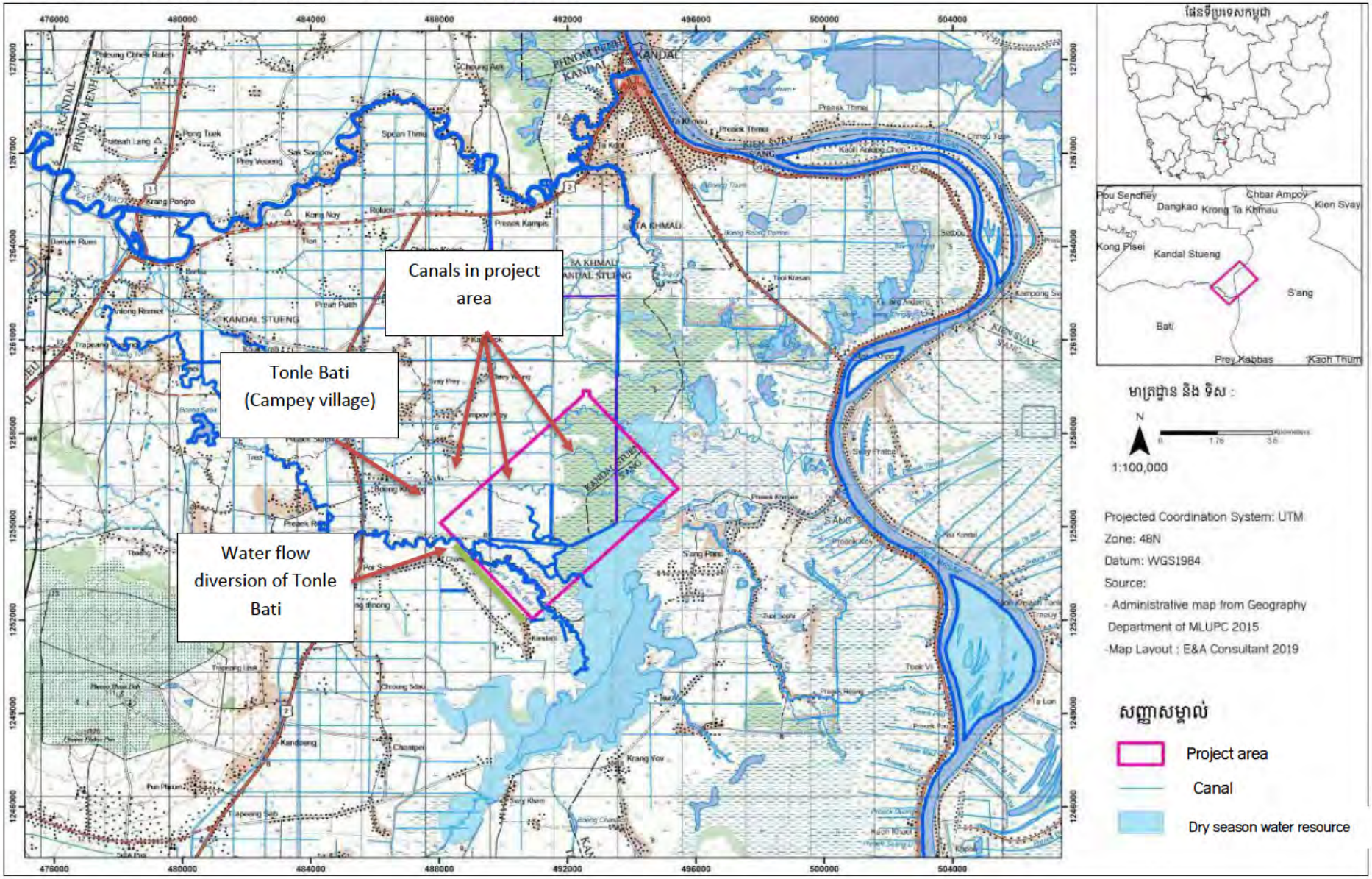
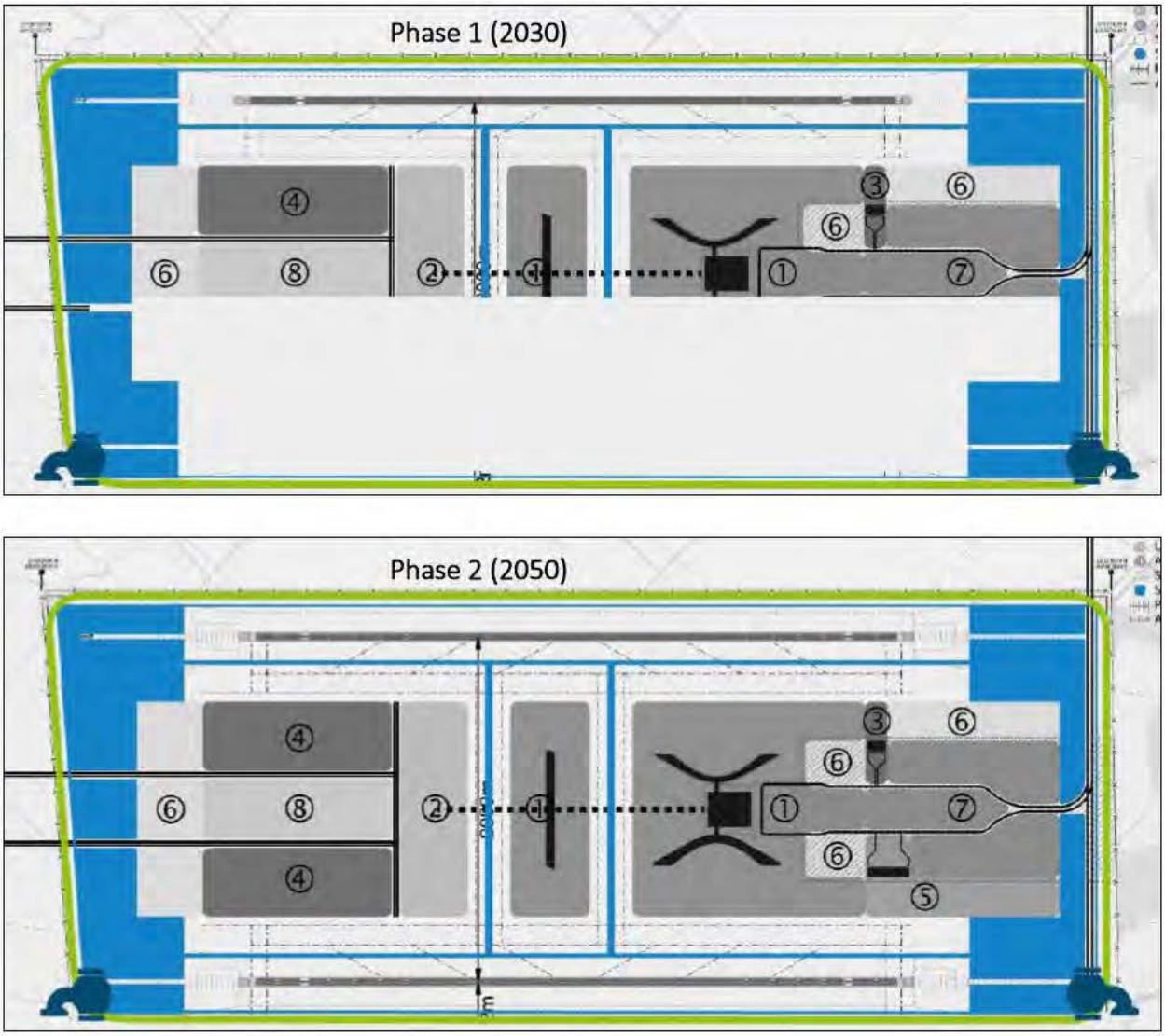


Photo 100: Preparation of drainage system in project area



e) Surface Water Quality

Construction activities may have the potential to impact the physical and chemical properties of local surface water and water bodies. Water quality parameters are commonly used to indicate the health or suitability of surface water for various functions. The surface water quality may be potentially affected by soil erosion and fuel runoff during rainfall due to below project activities:

- Land clearance and preparation activities;
- Soil and construction material transportation;
- Construction activities for runway and other airport infrastructure;
- Solid, liquid, and hazardous waste management;
- Another runoff.

The sensitive receptors/resources that may be affected by potential impacts to surface water in the Project area are the small streams and river near the Project site including Tonle Bati, other canals (canal 92, canal 54 and canal 57) and the adjacent Boueng Cheung Loung lake) near the project site.

In the construction phase, clearance activities, land preparation, soil transportation, soil backfilling and other construction works can cause soil erosion and other debris that can lead to runoff when it rains. Debris runoff into water, in and around the project site, such as Boueng Cheung Loung and Tonle Bati will lead to increased total suspended solids (TSS), at which point that water source becomes translucent. In addition, improper storage and management of solid and liquid wastes and hazardous waste may cause water quality changes near the project site.

According to the master plan, the project will require s around 2,000 workers and most of them will reside within the project site. Assume that each person will produce wastewater of about 150 litres/day, so the total amount of wastewater that could be generated would be around 30,000 litres/day (or equivalent to 300 cubic metres per day). This wastewater will be stored in the existing reservoir at the project site. If the wastewater is not properly managed it can affect the water quality around the project area, particularly when rainfall occur. This wastewater will have an impact on both humans and animals.

Due to the short duration of the project (36 months), the total labour demand in the construction phase is envisaged to reach a maximum of around 2,000 persons and the waste will be properly managed, therefore the potential impact on the surface water quality is considered “moderate”.

Mitigation Measures

- The project will construct a dike to prevent accidental leakage of wastewater into water bodies.
- The project will construct a sedimentation pond.
- The project will have a secondary container to prevent accidental leakage of engine oil into water bodies.
- The project will provide on-site mitigation measures.
- The project will maintain sanitation and construct a septic tank.
- The project will manage the potential water runoff caused by soil backfilling and concreting.
- The project will conduct regular inspections of waste and sanitation areas to ensure there are no leakages, especially forbidding the construction of waste disposal sites, hazardous substances or latrines located adjacent to the existing waterway near the project site without adequate containment measures.
- The project will segregate and store waste in appropriate, secure, and properly labelled containers. Organic waste will be composted. Other solid waste will be dumped in the project’s landfill.
- For hazardous waste and other hazardous material, the project will properly manage hazardous waste storage and handling, and ensure that it is properly labelled.
- The project will minimise the need to leave construction materials upon completion of construction.
- The project will maintain spill kits/equipment, and post spill procedures on site, especially spill or leak response plans.
- The project will keep a register of all hazardous substances on site and ensure that relevant Material Safety Data Sheets (MSDS) are readily accessible for reference.
- Refueling and machinery maintenance is to be undertaken in a designated, sealed, bunded area with appropriate closed drainage and oil traps.
- The project will maintain the vegetation presence around the project site where feasible, particularly the vegetation around the backfilling area to prevent erosion.
- The project will prepare a wash area at the entrance point.

f) Groundwater Quality

The sampling was conducted on two different locations from open-wells and hand-tube wells in the residential areas to the western and eastern part of the project site. Most parameters are within the National Drinking Water Quality Standard of the Ministry of Industry and Handicrafts (2004), except for As and Fe-Total. This may be due to various geographical conditions; it should be noted that Kandal province is known as one province which has higher levels of arsenic in groundwater when compared to other provinces in Cambodia.

The construction period is 36 months. All types of waste will be properly managed. The exposure perimeter is within the project area only. Therefore, the potential impact to the groundwater quality is considered "low".

Mitigation Measures

- The project will segregate and store waste in appropriate, secure, and properly labelled containers.
- For hazardous waste and other hazardous material, the project will properly manage hazardous waste storage and handling, and ensure that it is properly labelled and undertaken in a designated, sealed, bunded area with appropriate closed drainage and oil traps
- The project will conduct regular inspections of waste and sanitation areas to ensure there are no harms to the groundwater quality.
- The project will clean up immedietly if there are any spills/leakages, and properly pack and store contaminated materials.
- The project will keep a register of all hazardous substances on site and ensure that relevant Material Safety Data Sheets (MSDS) are readily accessible for reference.

g) Soil Quality

In the construction phase, soil quality can be affected by changes in the soil structure (E.g. soil backfilling or ground compression). The release of soil fertilizer will discharge various chemicals used in the project activities. The main project activities that may affect soil and groundwater quality are as follows:

- Site preparation, backfilling, and construction activities

Clearance activities, soil backfilling and ground compression may alter the soil structure. The soil in the project area is potentially eroded due to vegetation clearance and backfilling to prepare the site for runway and passenger terminal construction. Ground compression and top-soil erosion may alter the hydrological conditions as well as its permeability.

- Contaminated fill materials

Soil quality (through runoff) may potentially be contaminated through the importing of contaminated fill materials (eg. Arsenic). About 52 Mm^3 of fill materials obtained from Boeung Choung Loung lake and Boeung Rean lake, about 2 km away from the project site, will be required for backfilling.

- Land pollution due to solid/liquid/hazardous waste

Soil quality (through runoff) may potentially be contaminated through inappropriate management of wastewater/sanitation facilities, waste storage and disposal, and storage and handling of hazardous substances such as fuel and oil. Potential effects regarding hazardous substances, especially hydrocarbon substances such as engine oil and lubricant, can have long-term impacts on soil quality (underground water quality through penetration).

The construction period is 36 months. All types of waste will be properly managed. The exposure perimeter is within the project area only. Therefore, the potential impact to the soil quality is considered "low".

Mitigation Measures:

- The project will analyze the soil quality before backfilling.
- The project will regularly check weather, especially in the rainy season. Any earthwork activities will be temporary stopped during heavy rain.
- The project will segregate and store waste in appropriate, secure, and properly labelled containers.
- For hazardous waste and other hazardous material, the project will properly manage hazardous waste storage and handling, and ensure that it is properly labelled and undertaken in a designated, sealed, bunded area with appropriate closed drainage and oil traps
- The project will conduct regular inspections of waste and sanitation areas to ensure there are no harms to the groundwater quality.
- The project will clean up immedietly if there are any spills/leakages, and properly pack and store contaminated materials.
- Refueling and machinery maintenance is to be undertaken in a designated, sealed, bunded area with appropriate closed drainage and oil traps.
- The project will maintain spill kits/equipment, and post spill procedures on site, especially spill or leak response plans.
- The project will compress the ground at the important sites such as runway, passenger terminal and other main roads.
- The project will treat wastewater to ensure that key parameters are within Cambodian wastewater disposal standards before discharge.
- Hazardous storage sites will be constructed (possibly by concreting) to prevent any leakage into soil and groundwater sources, and the project will advise its workers about waste disposal at a designated location.
- The project's construction machinery will be monitored regularly, with regularly change of engine oil in accordance with the manufacturer's recommendations. Any machinery deemed by the project to bein a bad condition will stop operating and be appropriately repaired before proceeding.
- Spills or leaks (i.e. of fuel or lubricants) shall be cleaned up immediately, and contaminated rags or other material shall be disposed of properly.
- Below principles shall be adhered to when there are soil pile or other construction materials:
    - The project should fence the storage to reduce erosion or dust dispersion.
    - The height of the soil pile shall not exceed 2 meters.

7.4.1.2 Biological Resources

a) Forest

Forest study in the project area shows that there are many plants growing in the floodplain area such as *Mimosa Pigra, Barringtonia asiatica, Mimosa Pisdica, Barringtonia asiatica and Gmelina asiatica.* The baseline assessment identified 44 plant species present in the project area and these aquatic plants have no economic value or conservation requirement.

In the construction phase, aquatic plants will be impacted by the clearance of the site to enable for the airport construction. The main activities of the project that may impact these plants is as follows:

- Clearance activities and land preparation
- Soil backfilling activities
- Infrastructure construction activities

Given the short duration of construction period and the absence of high value timber in the construction site, the potential impacts to forest vegetation is considered "moderate".

Mitigation Measures:

- Project will avoid forest clearance at unnecessary sites
- Project will educate workers to not undertake tree clearance present around the project area, particularly in Boueng Cheung Loung to maintain the vegetation and green space.
- Collaborate with Kraing Yov fishing community and Kandal Fishery Administration to launch an off-set program to restore flooded forest in Boueng Cheung Loung.

b) Wildlife

The assessment of potential impacts to wildlife due to the project activities in the construction phase mainly focused on birds, mammals and reptiles. The study found 18 reptile species in the study area. Among these species, 5 species were considered to be of least concern (Monocled Cobra, Yellow spotted water snake, Black-yellow Banded Krai, Black Copper Rat Snake and Common Wolf Snake), 3 species were considered to be vulnerable (Burmese Python, King Cobra and Indochinese Spitting Cobra) according to IUCN's Red List.

Potential impacts to wildlife may occur due to the following project activities during construction:

- Land preparation activities;
- Soil Backfilling activities;
- Construction activities for airport infrastructure; and
- Waste and wastewater management.

Construction activities will have the following impacts to mammals and reptiles:

- Habitat loss (if any);
- Disturbance or displacement of individuals (Light, noise and vibration impacts) from construction activities;
- Barrier creation, and fragmentation from fencing;
- Degradation of habitat (forest clearing, dust pollution, water pollution); and
- Mortality (vehicle strike, hunting and poaching) at the work site.

The construction period is 36 months. Althought habitat and food sites will be affected, the potential impact to mammals and reptiles is considered "moderate".

Mitigation Measures:

- The project, in collaboration with MOE, will launch an off-set program.
- Project will check at the soil backfilling site to identify vulnerable biodiversity before clearance vegetation.
- Where a wildlife habitat is discovered, the vegetation clearance will immediately stop and cooperation will occur with the appropriate authority (Ministry/Department of Environment) to find a solution.
- Project will conduct standard clearance to ensure that wildlife will leave before land clearing and soil backfilling.
- The project will collaborate with local authorities to prevent wildlife poaching and hunting. The project will also advise workers not to destroy vegetation and not to hunt wildlife in the project's vicinity.

c) Birds

Based on interviews with local villagers, the study found 62 bird species including 43 species of least concern, 8 species in nearly threatened species, 4 species in vulnerable and 1 species in critical rare (Chrismas Island Frigatebirb). 22 species of birds are always presenting in the project area, especially in Boueng Cheung Loung. Potential impacts to bird may occur due to the following Project activities during construction:

- Land preparation activities;
- Backfilling activities;
- Construction activities for airport infrastructure; and
- Waste and wastewater management.

Construction activities will have the following impacts to birds:

- Disturbance or displacement of individuals (noise and vibration impacts) from construction activities;
- Degradation of habitat (forest clearing, dust pollution, water pollution).

The five bird species listed in IUCN Red List that may be potentially affected are Manchurian Reed Warbler, Indian skimmer, Black-bellied tern, Greater spotted eagle, and Pallas's fish eagle. The construction period is 36 months, and the project site has no forest cover and is not a bird habitat or a source of their food (i.e. pond, and other water bodies). Therefore, the potential impact to birds is considered "low".

Mitigation Measures:

- Soil backfilling and clearance will be conduct within the airport construction phase
- Signs demanding' No Hunting' will be installed in the project area. Bird hunting is prohibited and illegal.
- All lights used within the Project Area are to focus away from areas of Natural Habitat, particularly in Boueng Cheung Loung.
- Untreated wastewater or hazardous waste discharge into nearby public water bodies will be prohibited.
- The project will collaborate with local authorities to prevent bird poaching and hunting. The project will also advise workers not to destroy vegetation and not to hunt birds in the project's vicinity.

d) Fisheries

There are two main lakes in the project area, namely Boueng Cheung Loung (south-east of the project site) and Boueng Rean (north-east of the project site) which is an important fish habitat (3 km. around the project area). There are 46 fish species present in these lakes where 20 fish species are of least concern. Hypsibarbus lagleri and Cirrhinus microlepis are among the endangered species, based on IUCN Red List. Potential impacts to fish may occur due to the following Project activities during construction:

- Land preparation activities;
- Soil backfilling activities;
- Construction activities for airport infrastructure; and
- Waste and wastewater management.

The construction period is 36 months. The project does not plan to backfill these lakes or directly discharge wastewater to the water sources, so the potential impacts to fish is considered "low".

Mitigation Measures

- Soil backfilling and clearance activities will be conducted at the airport construction site, there is no backfilling of streams or vegetation clearing in the project's vicinity.
- The project will regularly inspect construction machinery and vehicles to prevent any engine oil leakage during operations, which would potentially affect water quality due to runoff.
- The project will develop management plans for all types of waste to ensure the project's waste will not affect fish in the study area.
- The Project will ensure that no discharge of wastewater or hazardous waste into the water sources within the project area.

7.4.1.3 Socio-Economic Resources

a) Land Use

Land use can be affected by two main activities: (1) the changing from agricultural land to airport land (About 2015 ha or 77.5% of the project total area is classified as agricultural land) (2) soil backfilling at the construction site. For soil backfilling, the company has received a concession from the Royal Government of Cambodia to remove soil and deepen Boueng Cheung Loung and Boueng Rean. In addition, according to consultations with the Department of Agriculture has been reduced due to a lack of labour as most rural people are moving away to work at factories.

The construction period is 36 months, lakes restoration and other land issues have been solved by the land resettlement committee. Therefore, the potential impacts to land use are considered "low".

Mitigation Measures:

- The remaining land issues, project will continue to work with local authority for future resolution.
- Project will not prohibit any farming activities outside the project.
- Land clearance will be conducted inside the project site only.

b) Fishing activities

During the construction phase, the project will backfill an area of 306 hectares of Beoung Choung Loeung lake. This will affect the fishing area of 70 fishing families in Sala Taprom village. The subsistence fishing is conducted near the lake's bank and use small fishing gears. Fishing activities happen all year over the entire Beoung Choung Loeung. Potential impacts to fishing activities may occur due to the following Project activities during construction:

- Land preparation activities;
- Backfilling activities;
- Construction activities for airport infrastructure;
- Engine oil storage and maintenance garage;
- Cement mixing area; and
- Waste and wastewater management.

The potential impacts to fishing activities are considered "low".

Mitigation Measures:

- The project will construct a dike to prevent accidental leakage of wastewater into water bodies.
- The project will construct a sedimentation pond.
- The project will have a secondary container to prevent accidental leakage of engine oil into water bodies.
- The project will maintain sanitation and construct a septic tank.
- The project will conduct regular inspections of waste and sanitation areas to ensure there are no leakages, especially forbidding the construction of waste disposal sites, hazardous substances or latrines located adjacent to the existing waterway near the project site without adequate containment measures.
- The project will segregate and store waste in appropriate, secure, and properly labelled containers. Organic waste will be composted. Other solid waste will be dumped in the project's landfill.
- For hazardous waste and other hazardous material, the project will properly manage hazardous waste storage and handling, and ensure that it is properly labelled.
- The project will maintain spill kits/equipment, and post spill procedures on site, especially spill or leak response plans.
- The project will keep a register of all hazardous substances on site and ensure that relevant Material Safety Data Sheets (MSDS) are readily accessible for reference.
- Refueling and machinery maintenance is to be undertaken in a designated, sealed, bunded area with appropriate closed drainage and oil traps.

c) Traffic

In the construction phase, local traffic may be affected by transportation activities (Example: transport of workers, land and construction materials) of the project. The traffic situation on the intersection of

National Road No. 2 and Samdech Hun Sen Boulevardis busy both throughout the week (including at weekends) with all kind of vehicles. However, an assessment of traffic flow on the National Road No. 2 did not raise the issue of serious congestion. The access road to the project site (Canal No. 54 Road) is a non-busy village road.

Based on the master plan, the project itself will have 332 vehicles operating to a regulated speed of 30 kilometres/hour.

The construction period is 3 years, the land transport will not affect the National Road No. 2. Therefore, the potential impacts to traffic are considered “low”.

Mitigation Measures:

- Project will provide the schedule to the local community regarding land transport to project site.
- A detour road will be constructed to avoid traffic passing along National Road No. 2 and other laterite roads.
- Project will avoid transporting materials during rush hour and those times material transport could create any dust dispersion when driving on public roads.
- All transport vehicles of the project will be in good condition with the project's safety standards, especially driving in compliance with the Road Traffic Law.
- The project will display traffic signs on key spots such as entrance gates, road curves, and install road marking.
- The project will notify the project’s drivers to slow down when arriving sensitive spots such as schools, temples, health centres and hospitals.
- The following risk mitigation measures in relation to material and worker transportation will be adopted:
    - Limit vehicle speed to below 30 km/hour
    - Drivers shall have a valid driving license and driving experiences
    - Prohibit overweight trucks
    - Prohibit the use of drugs and alcohol during driving

d) Public infrastructure

Public infrastructure may be affected by project activities such as transportation of staffs and workers, land and construction. The project will work with the Ministry of Water Resources and Meteorology to divert water flow of each canal within the project area. The project will place additional pressure on infrastructure and other existing public services in the locality. According to the report of the impact committee of Phnom Penh International Airport's new construction project, the affected public land covers 577,20 hectares, or 22.20% of the total land area. The affected include communal land, roads, lakes, streams, canals etc.

The construction period is 3 years. The maximum of workers around 2,000 persons. There is limited transportation. Therefore, the potential impacts to public infrastructure are considered “low”.

Mitigation Measures:

- The project has developed a master plan considering the establishment of relevant supporting infrastructure.
- Project will provide a worker’s camp to enable all workers stay on the project site thus reducing the pressure on local infrastructure and other local services.
- Trucks will not be overloaded and comply with the law to minimise damage to the roads.
- Project will provide healthcare to workers/employees without adding pressure to the existing facilities.
- Project will maintain and repair public or private roads.
- Project will have separate water and electricity facilities.

e) Public Health and Safety

In the construction phase, the project's activities may pose a potentially negative impact to local communities through the increase of air pollutant emissions and increased noise levels associated with land preparation and construction activities, as well as the issues of labour influx. These activities could potentially cause traffic accidents, eye diseases, respiratory diseases, and other diseases.
Public health and safety may be affected by the project activities:

- Clearance activities, land transportation and site preparation
- Airport construction activities
- Workers and materials transportation
- All waste management
- The retention and disposal of hazardardous waste
- Movement of workers across the site.

Increased emissions of air pollution and increased noise levels caused by the project's transportation schedule, equipment mobilisation, project site preparation, and construction activities in the construction phase have the potential to disrupt local communities, especially those living near the project site. In addition, the project's increasing mobilisation activities could lead to a higher incidence of road traffic accidents. Improper solid waste management through spills, leakages and especially hazardous waste disposal could affect the surrounding community's health and safety.

As discovered by interview, there are a number of communicable diseases prevalent in the project area, which are contributing to the current rates of morbidity and mortality. This includes Influenza, Diarrhoea, Typhoid Fever, and Hypertension. Local villagers have access to various medical treatment facilities such as health centees, referral hospitals, private health clinics, pharmacies, and traditional medicine outlets. The closest local communities to the project site may potentially have a greater impact than other more-distant communities. With regard to traffic intensity and levels, the observation found medium amounts of traffic volume on National Road No. 2. Therefore, the potential impacts to public health and safety are considered "moderate".

Mitigation Measures:
With regard to air quality management in the construction phase, the measures are as follows:

- The project will limit the driving speed of its vehicles in residential areas
- All transport vehicles of the project will be in good condition with the project's safety standards, especially driving in compliance with the Road Traffic Law.
- During transportation of construction material by trucks, construction material which could pose any dust dispersion (i.e. sand and stone transportation, etc.), should be covered and regularly monitored before transportation to ensure that the project's transportation activities do not pose any dust dispersion issues to the public road user.
- The project will regularly spray water in the project site in those areas where dust dispersion may occur.
- Personal protective equipment will be provided to staff/workers.

With regard to traffic management in the construction phase, the measures are as follows:

- A detour road will be constructed to avoid traffic passing along National Road No. 2 and other laterite roads.
- Project will provide the schedule to the local community regarding land transport to project site.
- Project will avoid transporting materials during rush hour and those times material transport could create any dust dispersion when driving on public roads.
- The project will display traffic signs on key spots such as entrance gates, road curves, and install road marking.
- The project will notify the project's drivers to slow down when arriving sensitive spots such as schools, temples, health centres and hospitals.
- The following risk mitigation measures in relation to material and worker transportation will be adopted:

  - Limit vehicle speed to below 30 km/hour
  - Drivers shall have a valid driving license and driving experiences
  - Prohibit overweight trucks
  - Prohibit the use of drugs and alcohol during driving
  - Prohibit the use of mobile phone while driving
  - Prohibit reckless driving
- The project site is to be partially fenced and manned at all times to prohibit unauthorised entry.

With regard to waste management in the construction phase, the measures are as follows:

- The project will construct a dike to prevent accidental leakage of wastewater into water bodies.
- The project will construct a sedimentation pond.
- The project will have a secondary container to prevent accidental leakage of engine oil into water bodies.
- The project will maintain sanitation and construct a septic tank.
- The project will maintain spill kits/equipment, and post spill procedures on site, especially spill or leak response plans.
- The project or contractor will educate its workers about communicable diseases and their symptoms.
- The project will provide regular health check-ups to all workers.
- The project will organize awareness campaigns on sanitation.

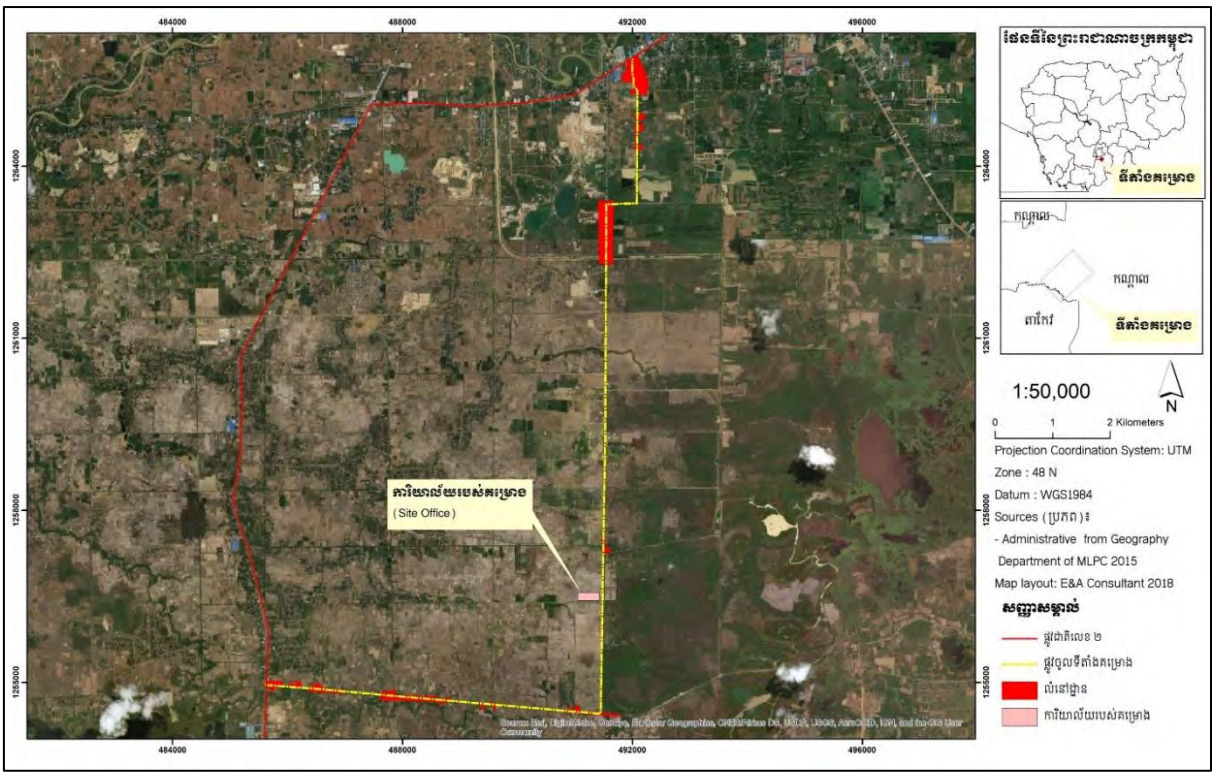
f) Other Risks

Other risks involved in the construction phase include: 1) accidents and 2) natural disasters. These risks can potentially affect worker/employee safety and also members of the public near the project site. However, these risks are assessed to be "low" due to the application of occupational safety standards to the project site.

Mitigation Measures:

- The project will construct a dike to prevent flooding.
- Store flammable gas in closed space to prevent accidental explosion.
- Before construction, a detailed study of the technical layout, the design, the action plan, the capacity and the experience of all staff and workers will be undertaken to ensure that the construction activities of the site are correct, appropriate and secure.
- On the construction site, qualified engineers will be regularly be present to monitor and advise on all construction activities.
- Earth work will be operated in accordance with technical procedures to ensure that there is no incidence of collapse orerosion; a drainage system will be installed to prevent any runoff.
- The project will provide fire extinguishers in each potentially flammable location.

Map 27: Residential area along the access road



Source: E&A Consultant (2019)

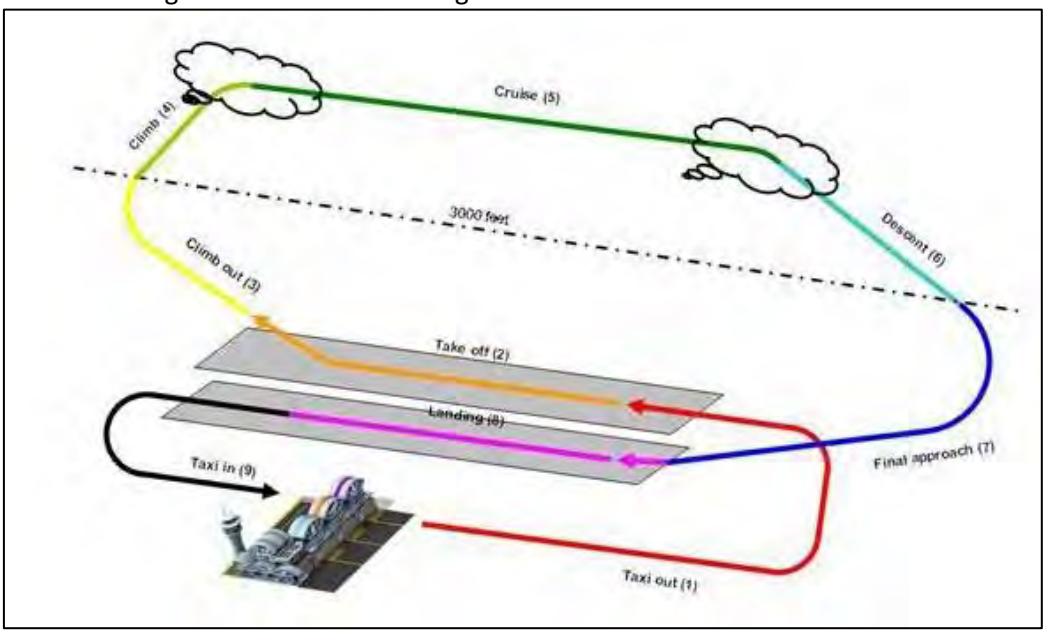
7.4.2 Operational Phase

7.4.2.1 Physical Resources

a) Air Quality

During the operational phase, air quality may be potentially affected due to dust dispersion, air pollutants, and increased greenhouse gas emissions from fuel combustion of project activities such as aircraft take-offs and landings, and passenger commuting via taxis, buses or private cars. The main gases emitted by aircraft include non-GHG emissions (CO, HC, NOx, SOx), Green House Gas (GHG) emissions (N_2O CH_4 and CO_2), and Particulate Matter (PM).

Photo 101: Flight's take-off and landing



Source: E&A Consultant (2019)

- ***Non-GHG Air Pollutants***

Aircraft arrivals and departures and other mobilisation activities within the airport would emit non-GHG emissions (CO, HC, NOx, SOx), and Particulate Matter (PM). The emissions could potentially affect the air quality in the surrounding communities. These gas emissions from aircraft depend on the type of aircraft, its number of engine, and journey distance and duration.

The airport expects to receive approximately 13 million passengers and 30 million passengers and 220 flights/day (80,087 flights/year) in 2030. The airport expects to receive approximately 30 million passengers and 512 flights/day (186,755 flights/year).

The calculation of non-GHG emissions follow Finland's flight emission factor per passenger 2008 as shown in below table:

Table 95: Finland's flight emission factor per passenger 2008

Type of Flight	Emission factor per passenger per kilometer (g/pkm)			
	CO	HC	NOx	SOx
Domestic, short distance, less than 463 km	0.49	0.03	1.1	0.083
Domestic, long distance, greater than 463 km	0.54	0.038	0.67	0.056
Long distance flights	0.095	0.007	0.45	0.036

Note: g/pkm = gram/passenger-km

Source: LIPASTO (2009)[13]

According to the project forecast, the proportion of flight arrivals at the New Phnom Penh International Airport are as follows:

- Domestic 13% (2030) and 16% (2050)
- International 87% (2030) and 84% (2050)

Flights are classified as follows:

- Domestic flights are considered as "Domestic, short distance" from Siem Reap, a distance of approximately 350 km;
- ASEAN flights are considered as "Domestic, long distance", from an average distance of 1,500 km (which would be a relatively long journey within ASEAN region); and
- Other Asia, Africa and Europe flights are considered "Long distance", from an average distance of 3,500 km (which would be a relatively long journey within Asia, roughly the distance from Beijing to Phnom Penh).

In 2030, the airport expects to receive 13 million passengers per year including 8% of domestic passengers (28 flights/day or 10,390 flights/year) and 92% of international passengers (191 flights/day or 69,697 flights/year). In 2050, the airport expects to receive 30 million passengers per year including 10% of domestic passengers (80 flights/day or 29,412 flights/year) and 90% of international passengers (431 flights/day or 157,343 flights/year). Assume there are two types of international flights: ASEAN flights, and Outside ASEAN flights (Table 97).

Table 96: Annual share of flights and passengers

Type of flight		2030		2050	
		Passenger (pax.)	%	Passenger (pax.)	%
Domestic flight	Domestic flights are considered as "Domestic, short distance"	800,000	8	2,500,000	10
International	ASEAN flights are considered as "Domestic, long distance"	2,500,000	25	7,500,000	30

Type of flight		2030		2050	
		Passenger (pax.)	%	Passenger (pax.)	%
	Other Asia, Africa and Europe flights are considered "Long distance"	6,700,000	67	15,00,000	60

The calculations of annual emissions per passenger are as follows:

Table 97: Annual non-GHG emissions (Ton/year)

Type of flight	Annual non-GHG emissions (Ton/year)							
	2030				2050			
	CO	HC	NOx	SOx	CO	HC	NOx	SOx
"Domestic, short distance" less than 350 km (8%)	137.2	8.4	308	23.2	428.9	26.3	962.5	72.6
Domestic, long distance; greater than 1,500 km (25%)	2,025	142.5	2,512.5	210	6,075	427.5	7,537.5	630
Long distance flights; 3,500 km (67%)	2,227.8	164.2	10,552.5	844.2	4,987.5	367.5	23,625	1,890
Total	**4,390**	**315.1**	**13.373**	**1,077.4**	**11,491.3**	**821.3**	**32,125**	**2,592.6**

By 2030, the annual non-GHG emissions would be as follows: 4,390 tons/year of CO, 315.1 tons/year of HC, 13.373 tons/year of NOx, and 1,077.4 tons/year of SOx. By 2050, the annual non-GHG emissions would be as follows: 11,491.3 tons/year of CO, 821.3 tons/year of HC, 32.125 tons/year of NOx, and 2,592.6 tons/year of SOx. Note that this calculation uses the worst case scenario assuming that the airport would receive 10 million passengers with 80,087 flights/year and 25 million passengers with 186,755 flights/year in 2030 and 2050, respectively.

The results indicate that the non-GHG emissions from flight take-off and landing in this airport is minor, if compared with other major international airports.

These gas emissions from aircraft depend on the type of aircraft, its number of engine, and journey distance and duration. The calculation of GHG emissions follow Finland's flight emission factor per passenger 2008[5]. The calculations of CO_2 Equivalent (CO_2eq) per passenger per kilometer are as follows:

Table 98: GHG emissions as per Finland's flight emission factor per passenger 2008

Type of Flight	Emission factor per passenger per kilometer (g/pkm)			
	CH_4	N_2O	CO_2	CO_2eq*
Domestic, short distance, less than 463 km	0.0018	0.007	257	259
Domestic, long distance, greater than 463 km	0.0012	0.0048	177	178
Long distance flights	0.00078	0.0031	113	114

Note: g/pkm = gram/passenger-km

- ** Global warming potentials (100 year time horizon): CO_2 = 1; CH_4 = 23; N_2O = 310*

Source: LIPASTO (2009)

Assuming that all flights have the above assumed journey distance, the calculations of annual GHG emissions per passengers are as follows:

[5] http://lipasto.vtt.fi/yksikkopaastot/henkiloliikennee/ilmaliikennee/ilmae.htm

Table 99: Annual GHG Emissions for all Passengers (Ton/year)

Type of flight	Annual GHG emissions (Ton/year)							
	2030				2050			
	CH_4	N_2O	CO_2	CO_2eq*	CH_4	N_2O	CO_2	CO_2eq*
"Domestic, short distance" less than 350 km (8%)	0.5	2	17,960	71,962.5	1.6	6.1	224,875	224,882.7
Domestic, long distance; greater than 1,500 km (25%)	4.5	18	663,750	663,772.5	13.5	54	1,991,250	1,991,317.5
Long distance flights; 3,500 km (67%)	18.3	71.7	2,649,850	2,649,941	41	162.8	5,932,500	5,932,703.7
Total	**23.3**	**92.7**	**3,385,560**	**3,385,676**	**56**	**222.9**	**8,148,625**	**8,148.625**

The annual GHG emissions would be 3,385.67 kt CO_2eq and 8,148.62 kt CO_2eq in 2030 and 2050; respectivley. Note that this calculation uses the worst case scenario assuming that the airport would receive 13 million passengers with 80,087 flights/year and 30 million passengers with 186,755 flights/year in 2030 and 2050, respectively.

For vehicular traffic, the overall impact to GHG and non-GHG air emissions from the increased vehicle traffic is expected to be minimal due to relatively small increases in traffic because most tourists will commute as groups on buses. Therefore, impacts to GHG can be considered "moderate".

Mitigation Measures:

- The project has a plan to utilise solar power as a supplementary power source (75 MW).
- Switch off unnecessary machinery.
- Both GHG and non-GHG emissions shall not exceed the international standards.
- The project will maintain vegetation, wherever possible, within the site.
- Aircraft emissions from combustion are unavoidable, but the project will ensure that fuel suppliers provide the best quality fuel possible.
- Airport access road will be built in accordance with international standards to reduce potential traffic congestion.

b) Noise and Vibration

Potential impacts to noise disturbance include aircraft descent and climb, traffic within the airport, and other operations in the airport. In the operational phase, the main activities that emit significant noise disturbance toward surrounding communities are aircraft take-offs and landings. Increased noise and vibration disturbances may potentially affect the surrounding communities and wildlife's behavior and breeding patterns.

- ***Noise***

Baseline noise level conditions show that the average daytime noise level (12 hours period), the average afternoon noise level (four hours period), and the average nighttime noise level (eight-hour period) are 48.37 dB(A), 45.38 dB(A), and 38.37 dB(A) respectively. The noise levels are below the Cambodia's noise standards (daytime 70 dB(A), afternoon 65 dB(A), and nighttime 50 dB(A)). In addition, the noise test results in the surrounding communities are also below the the standards.

- ***Vibration***

Baseline vibration level conditions show that the average daytime vibration level and the average nighttime vibration level are 13.82 dB, and 12.84 dB respectively. These vibration levels are below Cambodia standards (65 dB for day time, and 60 dB for nighttime).

The Aviation Environmental Design Tool (AEDT 2d) is used to measure the aircraft noise. For the purpose of noise modelling, there are two scenarios: 1) average daily flight, and 2) forecasted annual flight.

Number of flight: In 2030, the forecasted flight would be 80,087 per year and the average flight is 219 per day.

Table 100: Forecasted passengers and flights

No.	Description	Type	2030	2050
1	Passenger (1,000 pax.)	Domestic passenger	2,600 (20%)	6,000 (20%)
		International passenger	10,400 (80%)	24,000 (80%)
		Total	**13,000**	**30,000**
2	Flight (arrival and departure)	Domestic flight	10,390	29,412
		International flight	69,697	157,343
		Total	**80,087**	**186,755**
3	Cargo flight (ton)	Domestic cargo	2,000	5,500
		International cargo	198,000	544,500
		Total	**200,000**	**550,000**

Source: CAIC (2019)

Aircraft type: For Phase 1 (2030), the aircraft types that will operate at the New Phnom Penh International Airport include Category "C" (71.10%), Category "E" (26.30%), and Category "F" (2.6%). The aircraft A380-861 will also be included in the AEDT modelling.

Table 101: Aircraft type in Phase 1 (2030)

Aircraft type	Required amount
C	27
E	10
F	1

Source: CAIC (2019)

Future Aircraft Fleet mix phase 1 (2030): the aircraft data in 2030 is used for the noise modelling exercise.

Table 102: The comparison between fleet mix of baseline 2019 and phase 1 (2030)

Category	AEDT-AIRCRAFT	A/D	Baseline (2019)		Phase 1 (2030)	
			Day	Night	Day	Night
C	737400	A	0.714286	0.000000	0.859059	0.000000
C	737400	D	0.714286	0.000000	0.859059	0.000000
C	737800	A	8.857143	0.714286	10.652330	0.859059
C	737800	D	8.285714	1.428571	9.965083	1.718118
C	A319-131	A	5.285714	1.142857	6.357036	1.374494
C	A319-131	D	6.428571	0.285714	7.731530	0.343624
C	A320-211	A	34.428571	7.571429	41.406637	9.106024
C	A320-211	D	35.285714	6.571429	42.437507	7.903341
C	CRJ9-ER	A	0.428571	0.000000	0.515435	0.000000
C	CRJ9-ER	D	0.428571	0.000000	0.515435	0.000000
C	DO328	A	5.571429	0.000000	6.700659	0.000000
C	DO328	D	4.714286	0.857143	5.669788	1.030871
E	747400	A	0.285714	0.000000	1.479654	0.000000
E	747400	D	0.142857	0.142857	0.739827	0.739827
E	777300	A	1.000000	0.142857	5.178791	0.739827

Category	AEDT-AIRCRAFT	A/D	Baseline (2019)		Phase 1 (2030)	
			Day	Night	Day	Night
E	777300	D	0.142857	0.857143	0.739827	4.438963
E	7878R	A	1.000000	0.000000	5.178791	0.000000
E	7878R	D	0.000000	1.000000	0.000000	5.178791
E	A330-301	A	1.142857	0.000000	5.918618	0.000000
E	A330-301	D	1.285714	0.000000	6.658445	0.000000
E	A330-343	A	1.000000	0.000000	5.178791	0.000000
E	A330-343	D	1.000000	0.000000	5.178791	0.000000
E	A340-642	A	1.000000	0.000000	5.178791	0.000000
E	A340-642	D	1.000000	0.000000	5.178791	0.000000
F	A380-861	A	-	-	2.852414	0.000000
F	A380-861	D	-	-	2.852414	0.000000
Total			120.14286	20.7142857	185.9835	33.432938
Avg. Annual day				140.857143		219.41644
Annual flight operations				51,413		80,087

Source: E&A Consultant (2019)

Airport location: the location of runways are in the following table.

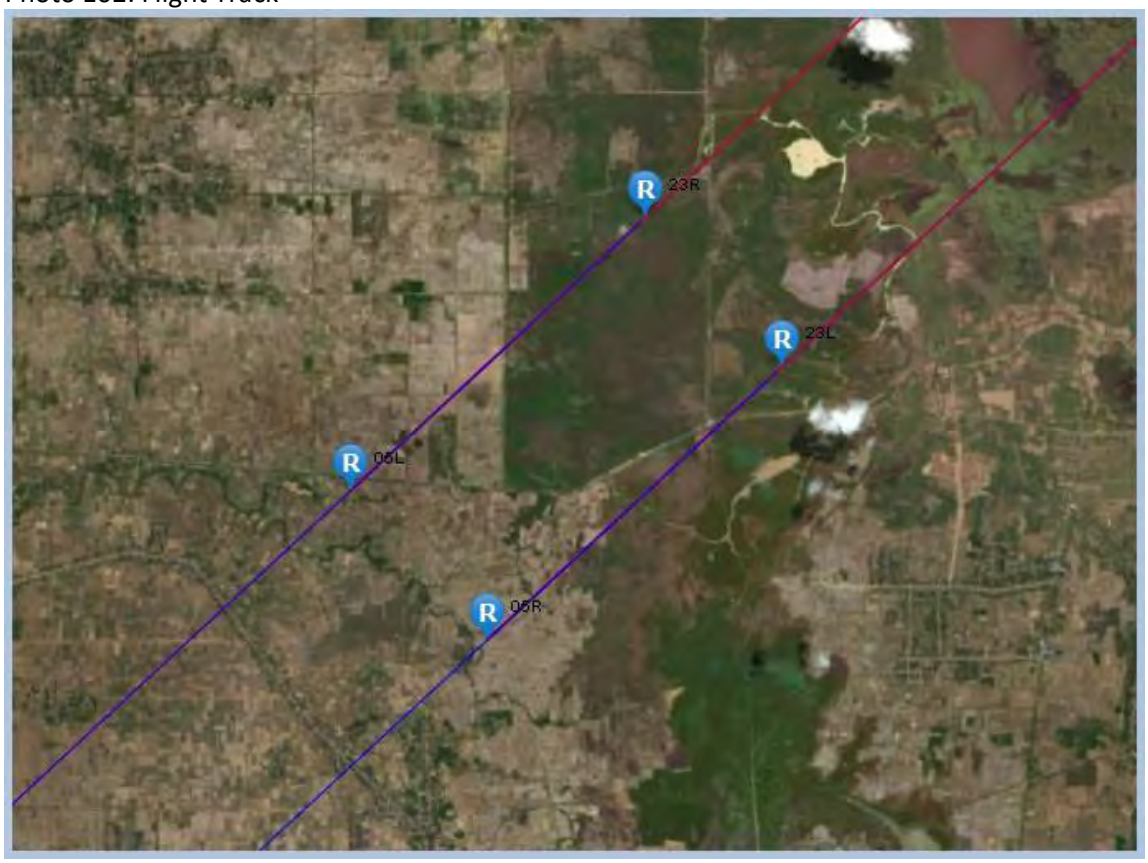
Table 103: Runway and Elevation

Runway	Location	Elevation (m AMSL)
23R	11.372243423843875N, 104.93475359109877E	+/-5m
05L	11.347762555506119N, 104.90776305032787E	+/-5m
23L	11.358866085601612N, 104.94721340919574E	+/-5m
05R	11.334386328360878N, 104.92022305644859E	+/-5m
Airport elevation datum (ARP)		To be defined by relevant authorities

Source: CAIC (2019)

Flight tracks:

Photo 102: Flight Track



Source: CAIC (2019)

Preferential runway use is determined based on wind direction (Photo 102). Therefore, the noise modelling is determined based on two scenarios:

Scenario 1: Wind flow from the south-west

Descent: Runway 23L and 23R

Take-off: Runway 23L and 23R

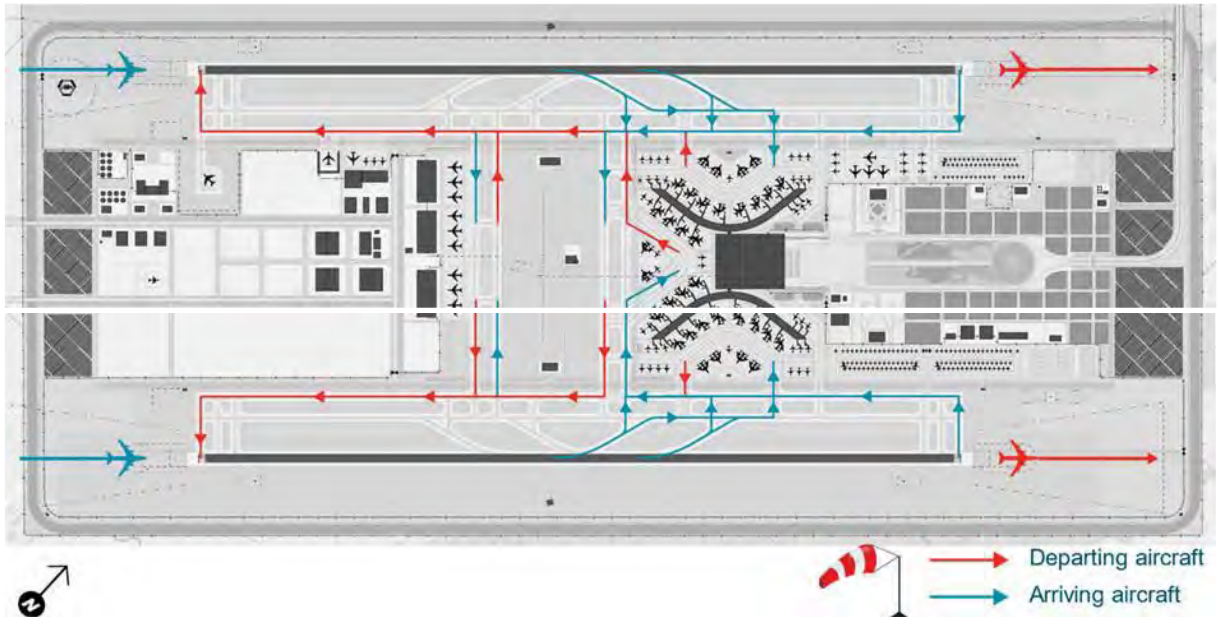
Scenario 2: Wind flow from the north-east

Descent: Runway 05L and 05R

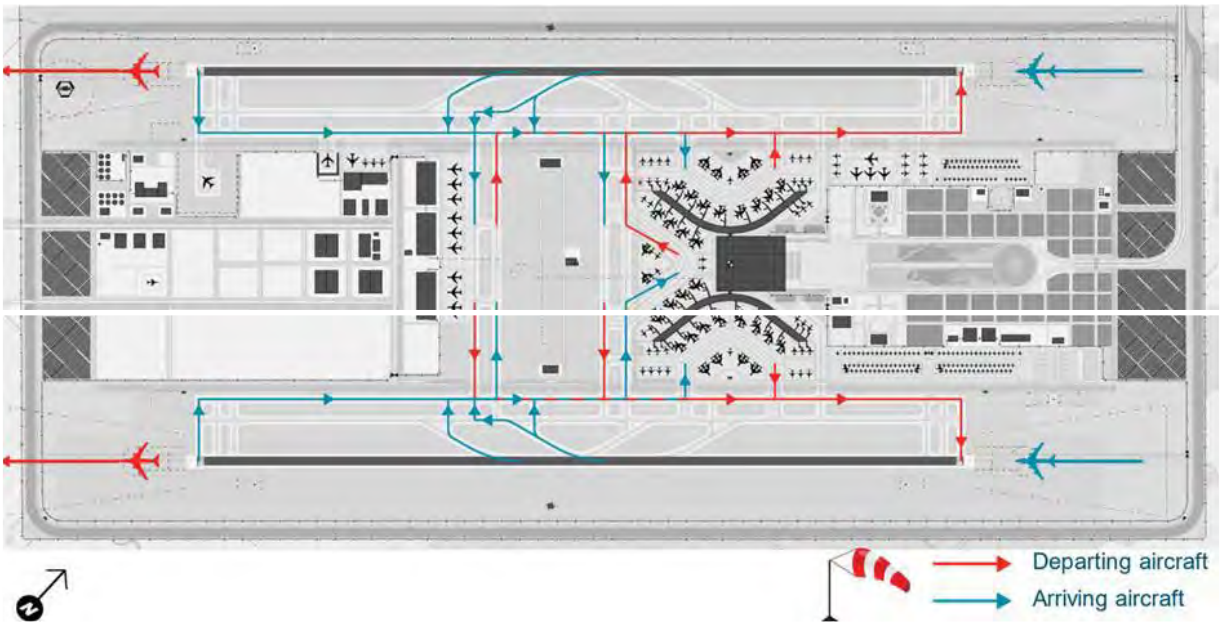
Take-off: Runway 05L and 05R

The runway use is divided 50% between the left and right runway.

Photo 103: Preferential runway use



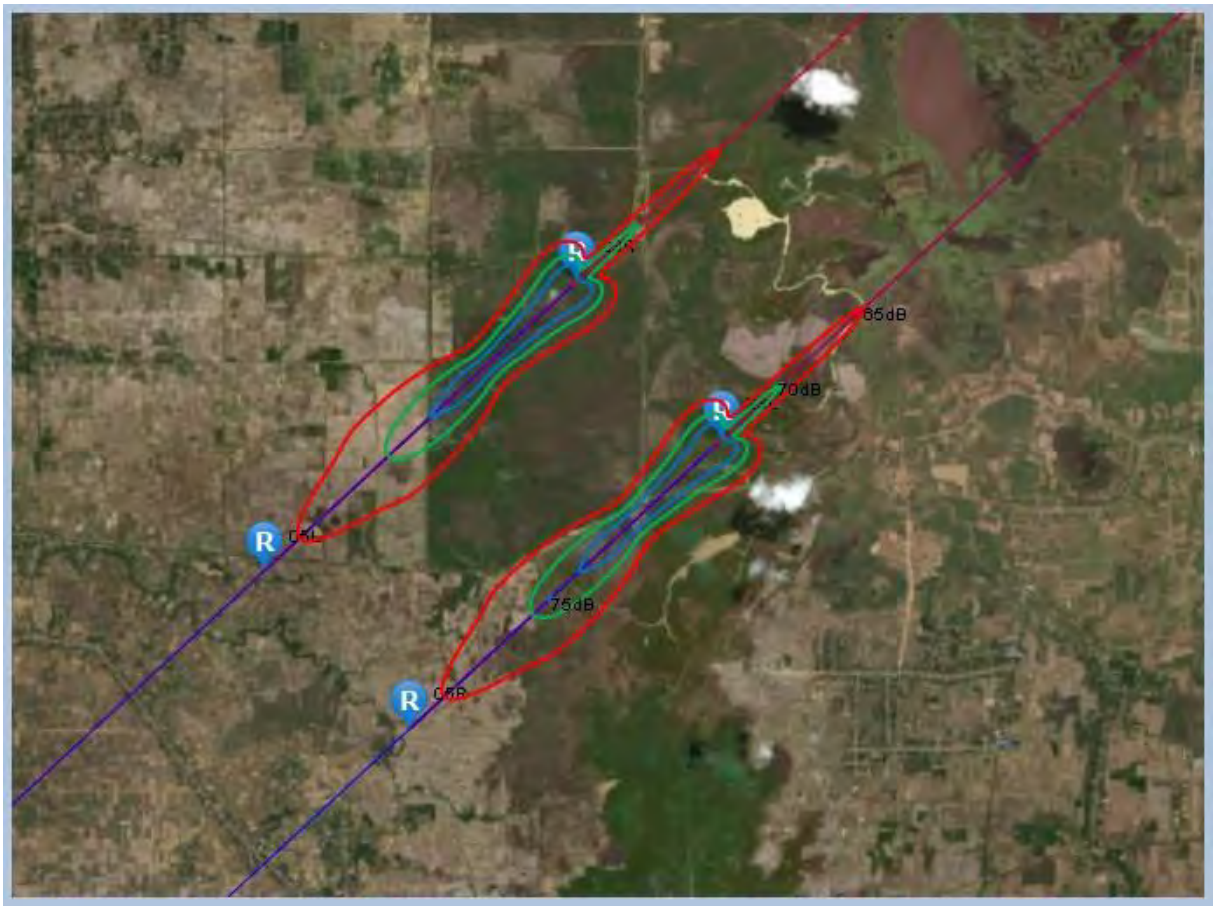
Scenario 2: Wind flow from the south-west (05 Operation)



Scenario 1: Wind flow from the north-east (23 Operation)
Source: CAIC (2019)

AEDT Modelling results: Average Day-Night Noise Level is a measurement of noise contour emitted by aircraft (Photo 104 and Photo 105).

Photo 104: Noise contour for Scenario 1 (DNL contour for scenario 1 south western wind (landing 23L and 23R, departure 23L and 23R))



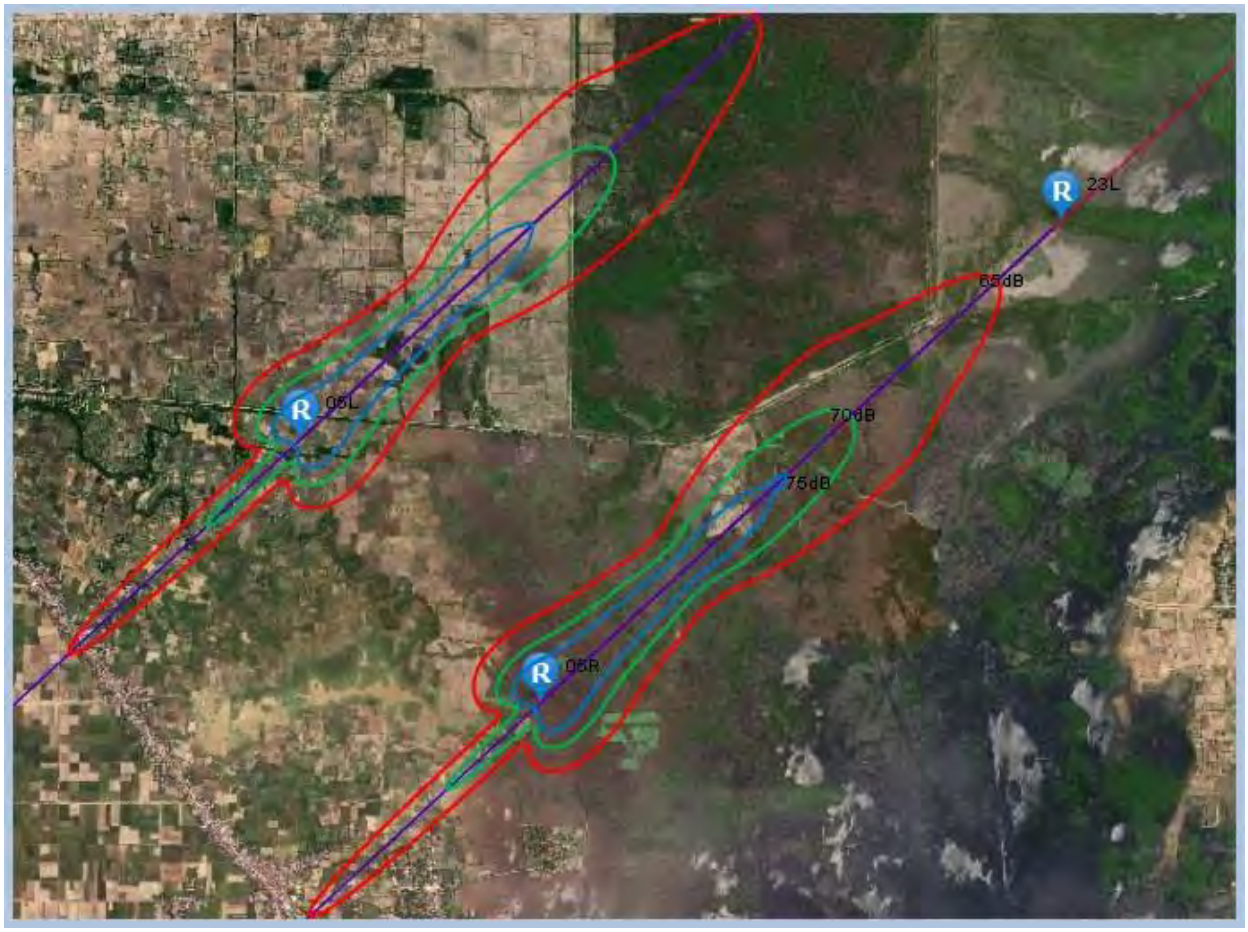
Source: E&A Consultant (2019)

Table 104: Shape Area

Metric Name	Contour (dB)	Shape Area (sq km)
DNL	65	5.36186902
DNL	70	2.061407722
DNL	75	0.823598237

Note: DNL = Day-Night Level
Source: E&A Consultant (2019)

Photo 105: Noise contour for Scenario 2 (DNL contour for scenario 2 northeastern wind (landing 05L and 05R, departure 05L and 05R))



Source: E&A Consultant (2019)

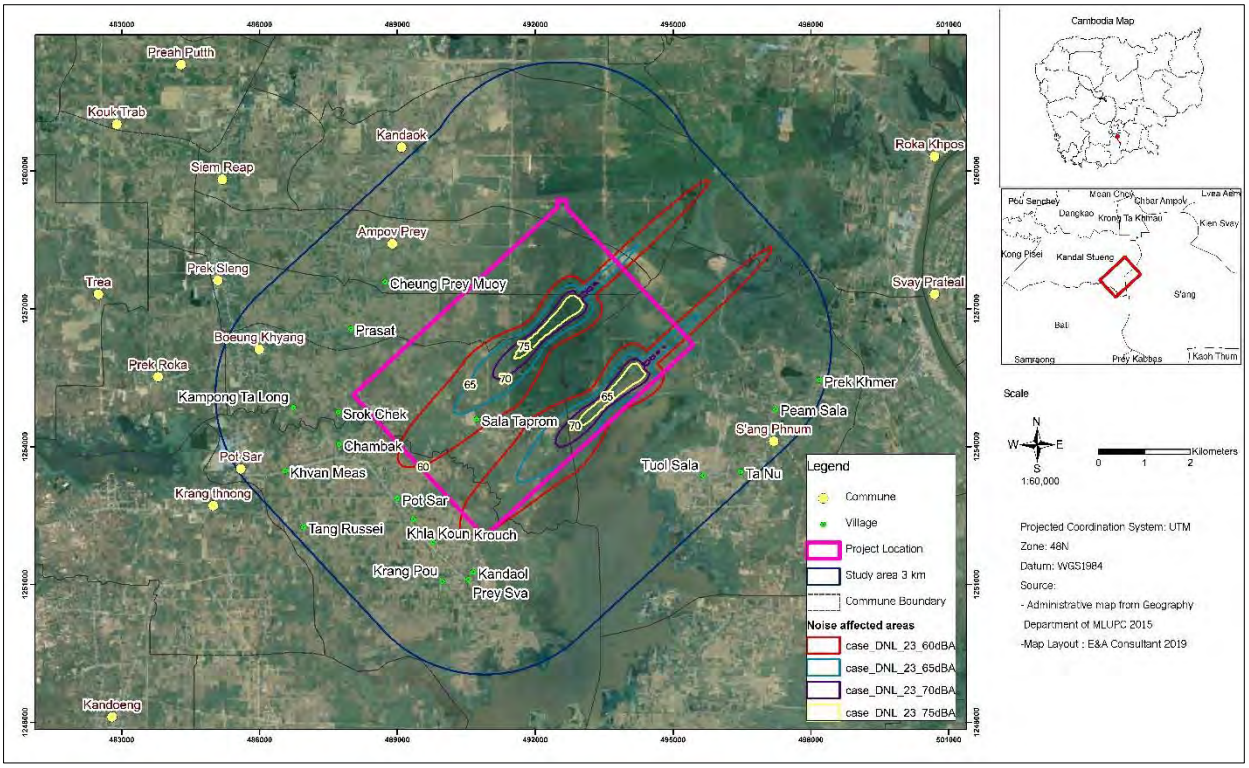
Table 105: Shape area

Metric Name	Contour (dB)	Shape Area (sq km)
DNL	65	5.399744
DNL	70	2.076382
DNL	75	0.835648

Note: DNL = Day-Night Level
Source: E&A Consultant (2019)

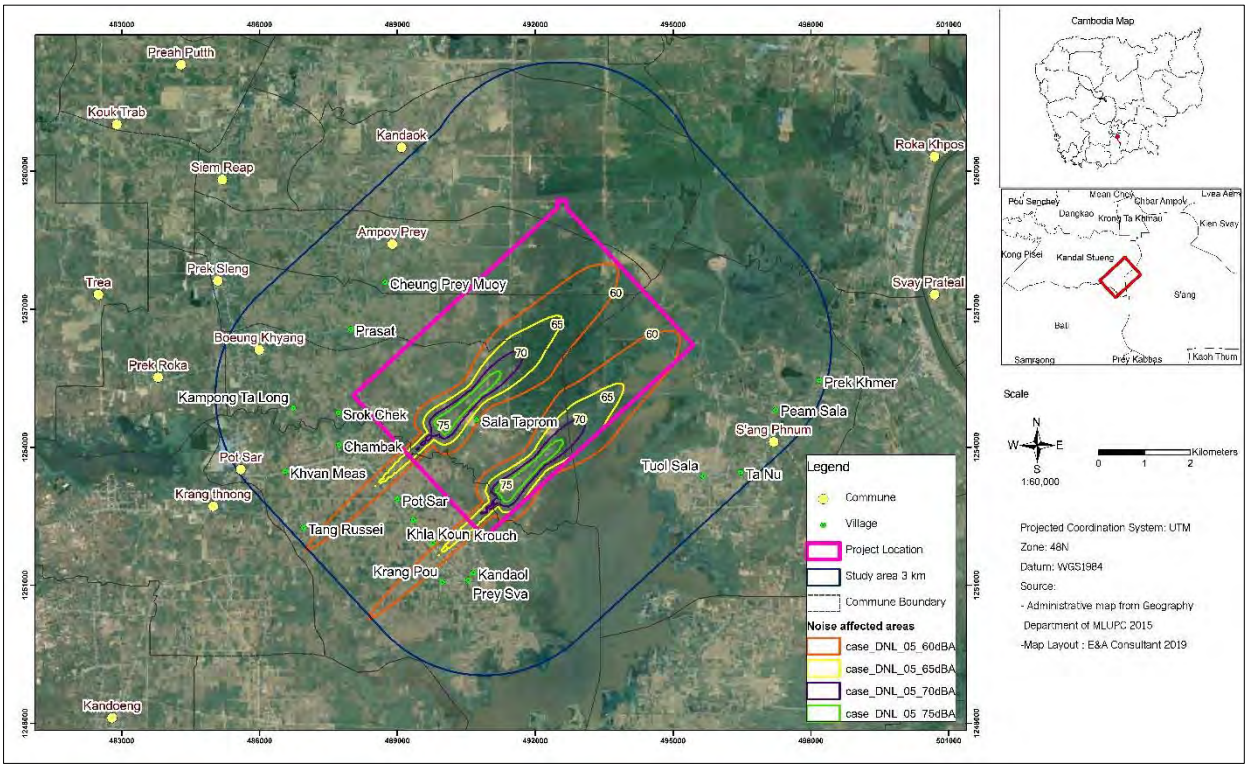
Location of Noise Disturbance from Project Activities:

Map 28: Location of Noise Disturbance from Project Activities (Scenario 1 – Runway-23)



Source: E&A Consultant (2019)

Map 29: Location of Noise Disturbance from Project Activities (Scenario 2 – Runway-05)



Source: E&A Consultant (2019)

Table 106: Summary of Area Disturbed by Noise and Measures

DNL (dB)	Area (ha)		Type of Area Disturbed by Noise	Measures*
	Within the Project Area	Outside the Project Area		
Scenario 1 (Case_DNL_23)				
< 65	1,253.21	194.31	- Lake: 174.31 ha - Farmland: 18.70 ha - Residential: 1.3 ha (13 houses)	N/A
65 - 70	520.22	25.30	- Lake - Location: Kandoak commune and Sa'ang Phnom commune, Kandal Province	noise insulation shall be applied (compensation for noise insulation)
70 - 75	206.40	0	-	-
>75	86.40	0	-	-
Scenario 2 (Case_DNL_05)				
< 65	1,264.52	194.31	- Residential: 20.84 ha (approximately 220 houses) - Farmland: 105.67 ha - Lake: 67.86 ha	N/A
65 - 70	526.18	25.30	Pot Sor commune - Residential: 6.14 ha - Farmland: 19.16 ha	noise insulation shall be applied (compensation for noise insulation)
70 - 75	209.42	0	-	-
>75	84.79	0	-	-

Note: DNL = Day-Night Level
Source: E&A Consultant (2019)

According to the modelling results, the noise contour (65-70 dB(A)) potentially affect an area of 25.30 ha outside the project area for both scenarios. For Scenario 1, the potentially affected area (25.30 ha) covers some parts of Kandal province's Kondoak commune and Sa'ang Phnom commune, most of which is floodplain. For Scenario 2, the potentially affected area (25.30 ha including 6.14 ha of residential area and 19.16 ha of farmland) covers Kandal province's Pot Sor commune. This shows that the extent of noise disturbance outside the project area is small. Therefore, potential impacts to noise and vibration are considered "moderate".

Mitigation Measures:

- Collaborate with the local authorities and relevant instiutions to identify area vulnerable to noise disturbance and specific mitigation measures agreed by both the project owners and the affected villagers, particularly those in Pot Sor commune.
- Control all activities in the airport to avoid loud noise.
- Collaborate with the Traffic Police to facilitate the traffic at the airport access road.
- Switch off unnecessary machinery.
- Schedule aircraft movements further away from each other can help reduce the amount of continuous noise exposure to nearby receptors.

c) Surface Water Quality

The surface water quality may be potentially affected by soil erosion, fuel runoff, and wastewater runoff from the airport during rainfall. The sensitive receptors/resources that may be affected by potential

impacts to surface water in the project area are the water bodies near the Project site such as Boueng Cheung Loung and Boueng Rean.

Land preparation and construction activities could cause erosion and sedimentation, which could lead to runoff of unconsolidated sediments during rainfall. The generation of sediment-laden run off could be transferred to the nearby water bodies, which could increase total suspended solids and turbidity in the receiving waters. The discharge of untreated wastewater, and hazardous waste have the potential to result in changes to the water quality of the receiving water bodies.

Solid waste produced in passenger terminals shall be segregated by placing separate trash bins for different types of waste. Wastewater shall be treated before being released into the airport sewage system. A drainage system is to be built to accommodate rainwater runoff from both the runway and passenger terminal. Therefore, the potential impacts to surface water quality is considered “low”.

Mitigation Measures

- The airport will have separate wastewater and rainwater management systems.
- The airport will regularly monitor all waste, particularly treated wastewater, which is required to meet the MOE’s wastewater standards before being released into public water bodies or the sewage system.
- The airport will segregate and store waste in an appropriate, secure, and properly labeled containers. Organic waste will be composted. Other solid waste will be placed in an appropriate approved landfill.
- For hazardous waste storage site, the project will be appropriately managed and sign posted.
- Fuel and hazardous substance tank will be stored in a bunded wall.
- The airport will maintain spill kits/equipment, and post spill procedure notices, on site.
- The drainage system will be built to accommodate rainwater runoff from the runway and passenger terminal before being released into the airport’s retention ponds.

7.4.2.2 Biological Resources

a) Forest

The assessment on forest impact is conducted only in the pre-operational phase because there are land clearance and filling activities. However, aircraft movements during the operational phase do not affect the forest.

b) Wildlife

The assessment on wildlife impact is conducted only in the pre-operational phase because there are land clearance and filling activities. However, aircraft movements during the operational phase do not affect wildlife.

c) Bird

The main risk in the operational phase is the possibility of an aircraft collision with a bird during descent or take-off. The study did not find any significant or large bird species. The project site does not cover any habitats or landscape that pose significant risks to birds.

Two sites that are home to birds have been identified: one located to the northeast of the project site (Boueng Rean) and the other one located to the south-east of the project site (Boueng Cheung Loung).

A few bird species classified as least concern in IUCN’s Red List may pose risks to the aircraft safety in the case of collision during descent and take-off. Birds may be present in two areas: the northeast of the project site (Beoung Rean lake) and the south-east of the project site (Beoung Choung Loung lake).

The study found three bird species (smaller than 25 grams) with very few numbers of such birds being identified on site. The size of bird that poses a high risk to an aircraft is one that is larger than 700 grams. The study did not find any large-sized bird (over two kilograms of weight) in the study area.

Table 107: Bird species with high density existing below or near aircraft routes

Location	Bird species	Weight (gram)	Amount	IUCN Red List
• north-east of the project site	Black-winged Stilt (*Himantopus himantopus*)	<50	105	LC
• south-east of the project site	Plain Prinia (*Prinia inornata*)	<9	201	LC
	Little Egret (*Egretta garzetta*)	<700	41	LC

Given the project area's proximitiy to wetland, it is attractive to migratory birds that dive into the sea to catch food, so they pose a risk of aircraft accident during descent and take-off. Aircraft collision with bird would result in bird death and aircraft damage. Although such accident is rare, it would result in high repair cost. In severe case, such collision would damage the aircraft engine or injure passengers

Assume that the number of daily flight is 219 for both descent and take-off in 2030. It is not considered as a disturbance to birds. However, it would be an issue if the number of daily flight increases. Other man-made developments may also potentially affect the birds. Hazardous leakage or spill may pose risks to terrestrial and aquatic biodiversity. Yet, the scale of impact is not expected to be significant compared with the existing amount of flight. Therefore, potential impacts to bird are considered to be "low" and this requires effective mitigation as follows:

Mitigation Measures:

- The airport will prohibit the clearance of vegetation, which is the source of food and habitat for birds and mammals.
- The airport will train its air traffic control tower staff to identify risks related to a swarm of birds and be aware of those birds that like to cruise high in the aircraft route (eg. Hawkeye) and warn pilots to delay landing or take-off.
- The airport will chase birds away from hangars and surrounding sites through emitting noise, light, and the use of ground radar or other effective approved method.
- Regularly review the presence of birds (every six months) in the airport and flight tracks.
- Launch an off-set program to rehabilitate affected natural resources.

d) Fishery

In the operational phase, potential impacts to fishery resources may occur due to inappropriate management of solid waste, wastewater, and hazardous waste, affecting water quality through runoff. Solid waste and hazardous waste will be separated and stored at designated places. Wastewater will be treated before being discharged into the drainage system. Rainwater runoff from the hangars and passenger terminal will flow into the drainage system and ponds instead of the river. Therefore, the potential impacts to fishery resource are considered to be "low".

Mitigation Measures

- The project will construct ae drainage system where there is potential runoff to reduce soil erosion.
- The project will regularly monitor the management of all types of wastes, including the wastewater which discharges from the wastewater treatment plant. This treated water will be required to meet the MoE's standard, which allows the release of wastewater from polluted sources into protected public waters, or the public water areas and drainage system of the sub-decree on the water pollution control in 1999 of the MoE.

- The airport will carefully separate and store solid waste, with clear markings on trash bins according to each type of trash and manage solid waste through composting, reuse, recyclng or burning in the incinerator or placement in a landfill.
- For hazardous wastes and other hazardous substances handling, the airport will be properly managed and undertake regular monitoring.

7.4.2.3 Socio-Economic Resources

a) Traffic and Public Infrastructure

In the execution phase, increased traffic will put pressure on the existing roads particularly the intersection between the National Road No. 2 and Samdech Hun Sen Boulevard. According to the assessment, the current amount of traffic on the National Road No. 2 is considered moderate. The airport's forecasted flight frequency is 219 flights per day by 2030. In the operational phase, it is expected there will be an increased volume of vehicular traffic, and tourists. Most tourists travel in groups on buses. As the amount of current traffic and the expected number of flights are high, and the street width could be expanded further to accommodate the increased traffic, the potential impacts to traffic are considered "high".

Mitigation Measures:

- The project will conduct a study to build a dedicated access road for the execution phase.
- The airport will display traffic signs at key spots such as weight limit, speed limit, and road marking.
- The airport will clearly mark the airport entrance and exit to reduce traffic congestion.
- All airport's vehicles will need to be in good condition and comply with the airport's safety standards, especially driving in compliance with the Road Traffic Law of the Kingdom of Cambodia. All airport's drivers shall have a valid driving licence and respect the traffic laws
- A driving safety code for airport's staff and workers and other airport equipment transportation will be implemented to ensure road safety while driving, especially to ensure that airport activities do not cause any potential traffic accidents or affect to other public road users. This code will include: driving behavior, driving speed limits (≤40 km/h) in residential areas, horn use, speed limits applicable to sensitive areas such as schools, temples, health centres and hospitals, etc.

b) Public Health and Safety

In the operational phase, a communities' health and safety can be impacted through the increase of air pollutant emissions and increased noise levels associated with aircraft landing and taking-off. Noise disturbance during landing and taking-off can potentially disturb the nearby communities causing sleep disturbances, affecting children's studies, causing hypertension, heart disease or other illnesses, etc., but this particular disturbance lasts a short period.

As the noise disturbance outside the project area is low and all activities that may disturb the public have been identified, the potential impacts to public health and safety are considered "low".

Mitigation Measures:

- Collaborate with the local authorities and relevant instiutions to identify area vulnerable to noise disturbance and specific mitigation measures agreed by both the project owners and the affected villagers, particularly those in Pot Sor commune.
- Control all activities in the airport to avoid loud noise.
- Collaborate with the Traffic Police to facilitate the traffic at the airport access road.
- Switch off unnecessary machinery.
- Schedule aircraft movements further away from each other can help reduce the amount of continuous noise exposure to nearby receptors.
- Develop waste management plans including waste and hazardous substance management procedures, waste collection schedules, and reuse/recycling programmes.

- The airport company will need to provide training on driving safety standards to its staff to ensure that traffic incidents or accidents while using local roads are reduced or limited and don't have an adverse impact on the local community
- During transportation of all materials (including waste by trucks and loads which potentially pose any dust), the material will be properly covered before transportation to prevent dust emissions when driving on public roads.
- Collaborate with Kandal Provincial Department of Public Work and Transport to install pedestrian crossing signs on the National Road No. 2, particularly at the airport entrance.

c) Aircraft Accident Risk

Like any other aerodrome around the world, there exists a probability for an aircraft to encounter an accident. These accidents can take many forms, and can occur anytime when the aircraft is operational, such as during takeoff, and landing.

Aircraft accidents at airports can occur in various manners and can be categorized into two specific phases, which are takeoff, and landing. The main risk from aircraft accidents is to the health and safety of flight crew and passengers; other potential receptors include airport ground staff and other employees, local communities, and wildlife.

Takeoff is a phase when the aircraft accelerates on the ground to gain enough lift to fly; this is also when the aircraft is most vulnerable as it contains added weight from fuel. There are many factors than can lead to a failed takeoff, such as miscalculations of pre-flight preparations, engine failure, temperature, air density, wind, aircraft configuration, airframe contamination etc. This may cause the aircraft to overrun the runway, or if the aircraft is already airborne but fails to gain enough lift and/or thrust, the aircraft may crash further away from the airport.

The landing phase is when the aircraft is making its approach to land on a runway. The aircraft is also considered vulnerable during this phase, despite the reduced fuel weight; this is due to the various factors involved that affects the performance of landing, and the reduction in speed necessary for landing. Factors that affect landing performance include deviating from normal descent gradient, deviation from calculated final approach speed and landing distance, tailwind or crosswinds during approach, and flare/roll, and runway condition (wet, dry).

When a crash occurs on the airport or in a position which poses a safety risk to other inbound and outbound aircraft, air traffic control may have to cease air traffic operations at the given airport, and divert incoming aircraft to other nearby airports. This will result in increased air traffic and delays. A damaged runway can also cause further delays and cancelled flights; during the first operational phase NPPIA will only have one runway, and the airport may have to cease operations for the duration of the repair or whilst the damaged aircraft is being removed.

Given that the aircraft becomes involved in an accident, the magnitude of the event can be potentially very large. In the worst-case scenario, during either takeoff or landing, the aircraft may break apart from the crash, or fuel from the plane can be ignited. A fire or explosion that occurs from jet fuel being ignited is potentially fatal to flight crew and passengers. Force of impact from a plane crash can also be potentially fatal depending on the nature of the crash, which involve factors such as weight, speed, approach gradient, etc.

There is a continuous decreasing global trend in aircraft accidents per year, as well as for aircraft accidents per million flights. According to the accident rate of Figure34, the probability of an accident occurring to a single scheduled commercial flight is 0.00024%. The total forecast aircraft movement at New Phnom Penh International Airport will be 80,087 per year in 2030 and 186.755 per year in 2050; therefore, given the global commercial flight accident statistic, the probability of an incident occurring at New Phnom Penh International Airport would be very unlikely at 0.26 accidents per year.

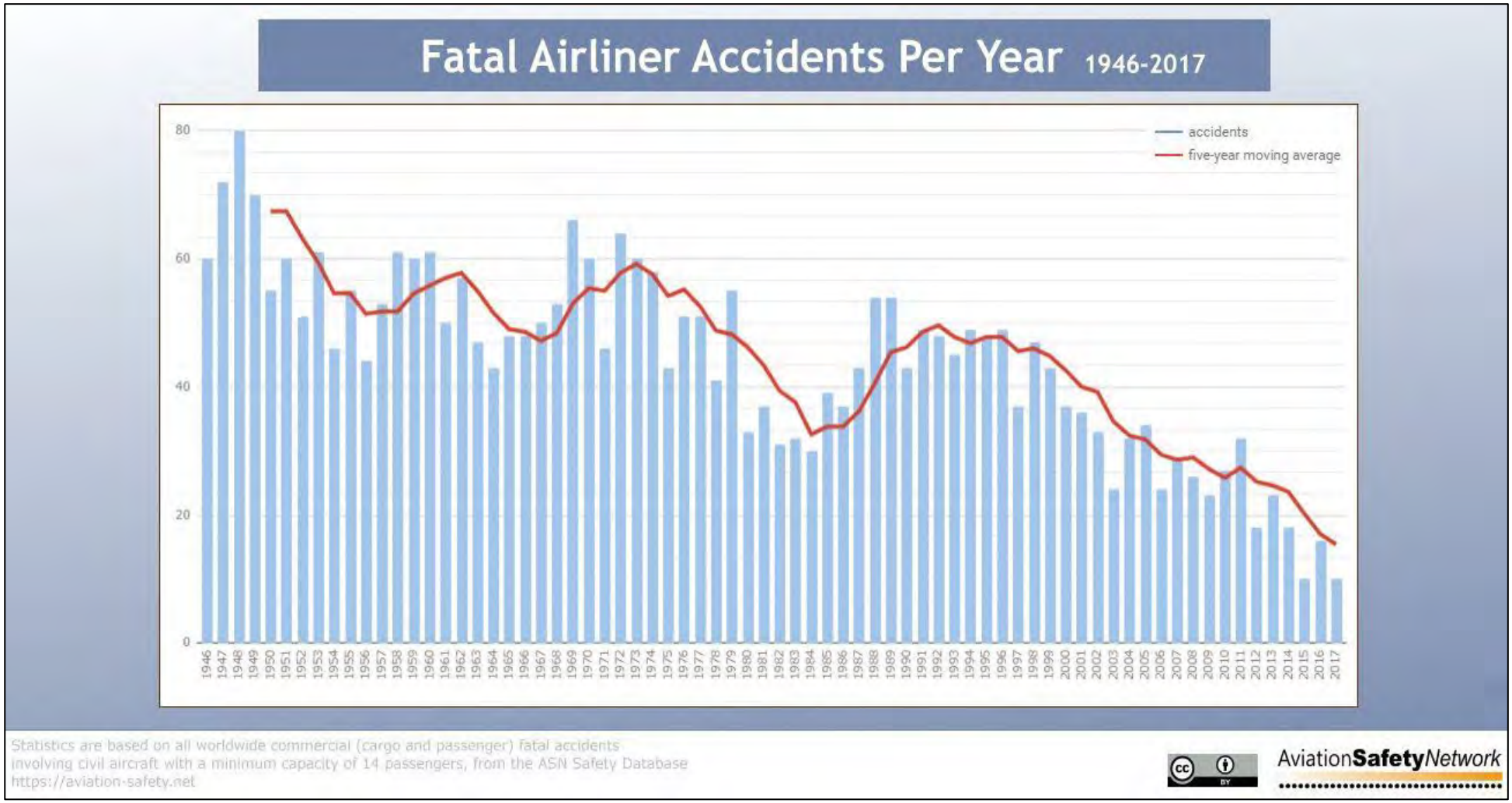
New Phnom Penh International Airport is an international airport that complies with international safety standards, and it has a firefighting station, fire suppression vehicles as well as an ambulance. Therefore, the potential impacts of aircraft accident are considered "low".

Mitigation Measures:

- The airport's firefighting station will be built with international standards, with enough fire suppression vehicles to cope with any risks that may happen.
- Notify aircraft bound for the airport about bad weather.
- Ensure appropriate training and validation of all air traffic control staff
- Ensure appropriate level of navigation aids, regularly checked and serviced
- Carry out regular training emergency exercises, desk top and real-time
- Monitor the runway's humidity and dryness in accordance with specification by airport's inspector.
- Collaborate with Cambodian authorities of all levels in case there is any aircraft accident to ensure timely rescue.
- Comply with Cambodia Civil Aviation Authority's guidelines and the standards and recommended practices (SARPs) of the International Civil Aviation Organization (ICAO)

- Collaborate with the local authorities and the Civil Aviation State Secretariat to set below height restrictions:
    - Approach path/take-off climb zone: the height of building and tree, existing between the edge of runway to 15,000 meters away, shall be below 150 meters.
    - Transitional zone: the height of building and tree, existing between 150 meters from the runway axis and 465 meters from the runway axis, shall be below 45 meters.
    - Inner Horizontal/Conical/Outer Horizontal zone:
        - For 4,000 meter perimeter from the runway axis: the height of building and tree shall be below 45 meters.
        - For 4,000 meter to 6,000 meter perimeter from the runway axis: the height of building and tree shall be below 45 meters-145 meters.
        - For 6,000 meter to 15,000 meter perimeter from the runway axis: the height of building and tree shall be below 150 meters.
-

Graph 2: Fatal Airliner Accidents per Year from 1946-2017[6]

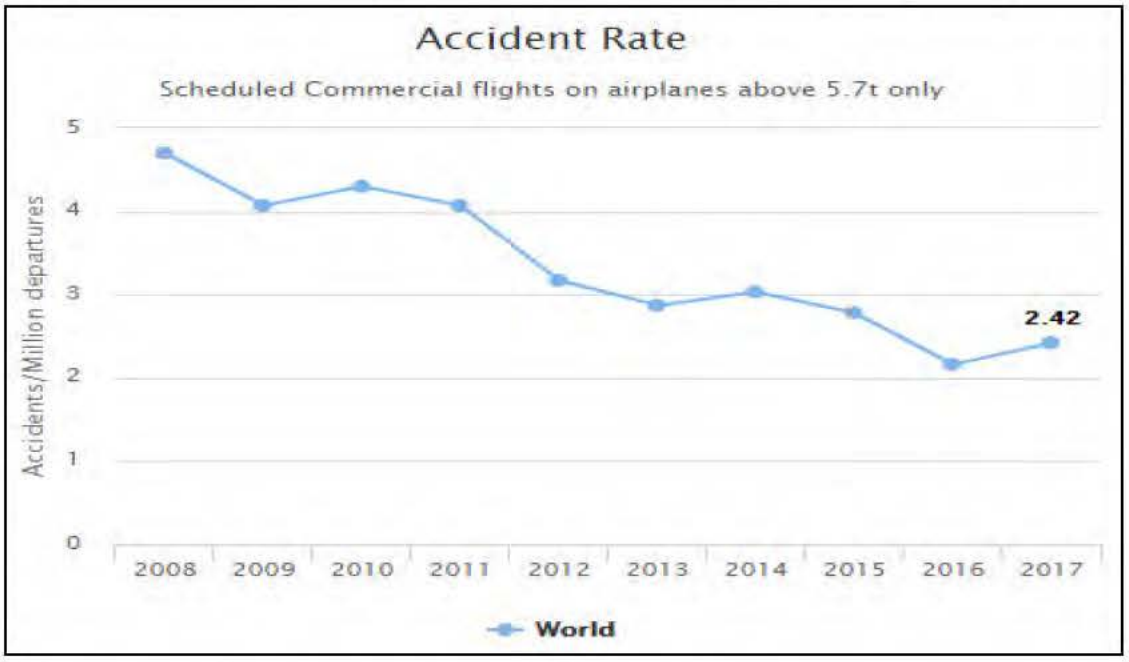


[6] Aviation Safety Network, 2018; https://aviation-safety.net/statistics/

Graph 3: Airliner Accidents per 1 Million Flights on 1977-2017[7]

[7] Aviation Safety Network, 2018; https://aviation-safety.net/statistics/

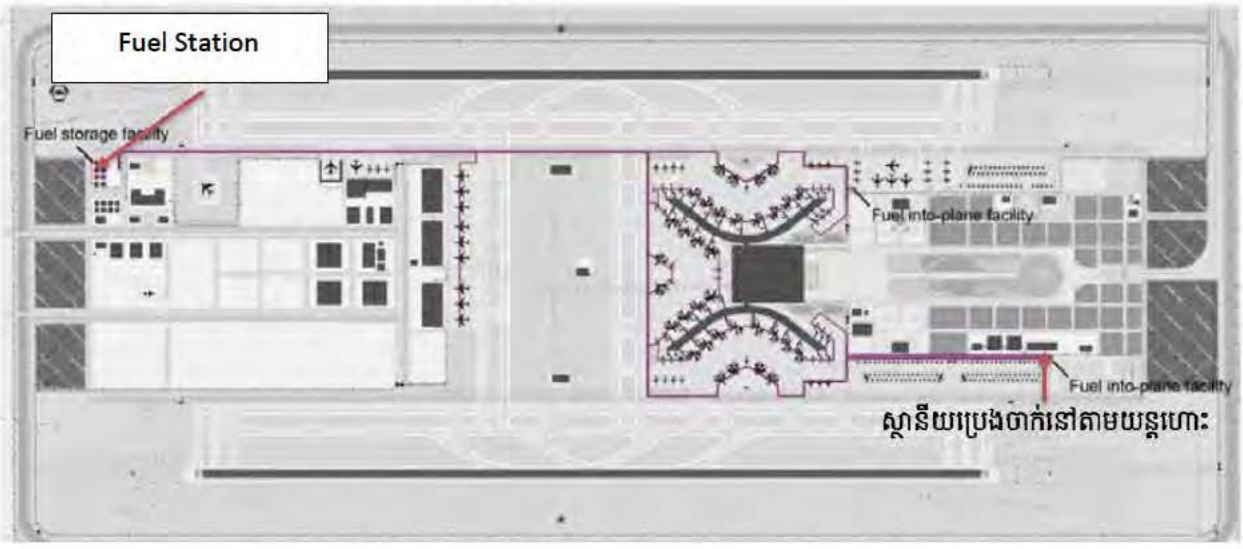
Graph 4: Accident rate for scheduled commercial flights on airplanes above 5.7 tons



d) Accidental Fire and Explosion (not due to Aircraft Accident)

During the operational phase, it is expected that flammable material will be used at the airport; the most obvious case would be the use and storage of jet fuel, fueling trucks, and in aircraft. Like any other aerodrome around the world, there is a probability for these flammable materials to leak and/or ignite. A fuel storage facility is planned to be located to the south-west, and a petrol filling station for vehicles nearby (Photo 106).

Photo 106: Fuel storage facility and filling station



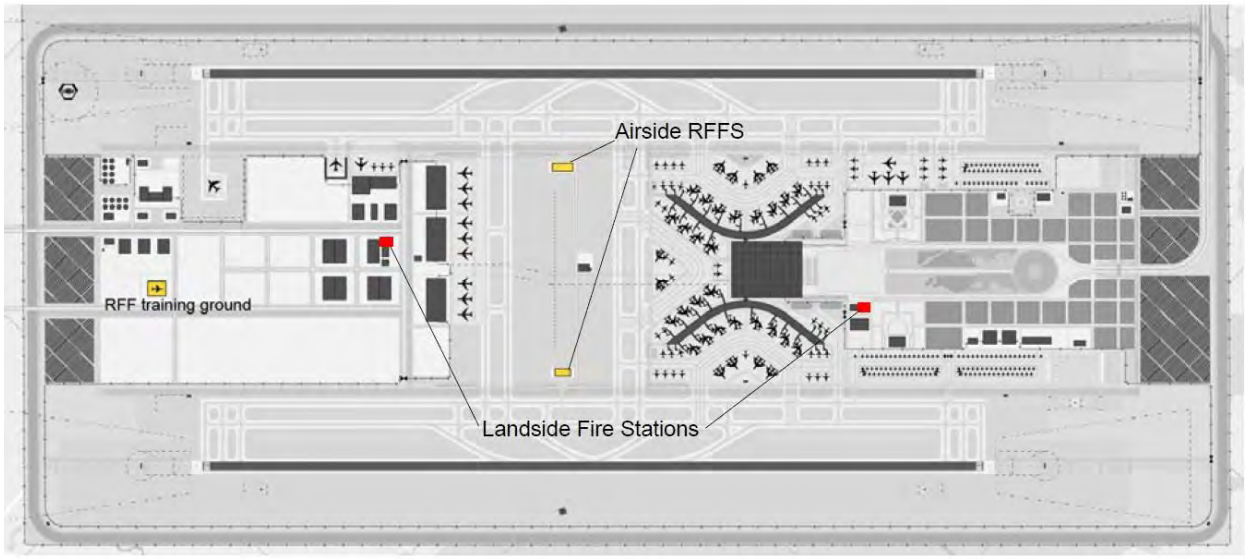
There are a number of potential sources of accidental fire or explosion at the project site. The most likely threat for causing accidental fires and explosions is from jet fuel (see figure 35). Jet fuel is a type of aviation fuel that is used for aircraft with gas-turbine engines. Although there are a variety of jet fuel types, the most common types of fuel for commercial use are Jet A and Jet A-1. Other potential sources of fire include the burning of garbage, discarded cigarettes, presence of diesel fuel on site, flammable material storage, and vapor from flammable material. The frequency/likelihood of a fire/explosion occurring is considered unlikely. However, the potential consequence of an accidental fire or explosion depends on the severity of the event and could range anywhere from minor damage in the case of a small fire, to major infrastructure damage, injury, or loss of life in the case of a large explosion.

The risk of fire or explosion at the airport is substantially reduced through standard operating procedures implemented by the project owner (CAIC). Burning of garbage will be prohibited and smoking will be restricted to safe areas. All aircraft fuel oil will be stored and handled according to appropriate international safety standards to minimize the risk of any leaks, spills, or accidental ignition. Therefore, the accidental fire and explosion (not due to aircraft accidents) is considered "low".

Mitigation Measures:

- All fuel oil storage units are appropriate, sealed and covered from any sunlight based on international safety standards, to reduce the risk of leaking or explosion.
- The airport will ultimately have two airside fire-fighting stations and two landside firefighting stations that are capable to prevent and control accidental fire or explosion.
- The airport has an Emergency Response Plan in case of any accidental fire or explosion.
- The airport will prohibit the burning of garbage and other wastes in the airport vicinity.
- The airport will collaborate with the local authorities, the provincial firefighting unit, and the provincial authorities to timely respond to any fire risk or explosion.
- Guard posts are located near the fuel storage.

Photo 107: Airport's Fire station



Source: CAIC (2019)

7.4.3 Closing Phase

During the closing phase, there are not any main activities that may potentially affect natural and social environment resources. CAIC will transfer the operation rights of the New Phnom Penh International Airport to the Royal Government of Cambodia.

7.5 Summary of Impacts and Mitigation Measures

The table below illustrates potential negative impacts that may occur due to the activities of New Phnom Penh International Airport project, and appropriate mitigation measures for each impact.

Table 108: Summary of Potential Negative Impacts and Mitigation Measures

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
1. Pre-Construction Phase						
1.1. Physical Resources						
A. Topography	– Affect waterways, soil erosion and loss of water storage		✓		– The company reserve a landplot to the south-west of the project area in order to divert water flow from Tonle Bati River. – Before the start of clearance activities, the company shall build dyke and drainage system to avoid runoff. – The company will avoid any unnecessary clearance in the project area. – Soil waste and other debris created by clearance activities will be properly kept by avoiding any mess pile in an area where easily block water way or/and cause any erosion to pollute the surface water around the project. – Clearance activities and soil backfilling will follow the clearance plan of the proposed project. The company shall prevent runoff from entering nearby water bodies.	
B. Air Quality and Greenhouse Gases	– Machinery mobilization – Site preparation activities; – Transportation of workers and staff – Transportation of earth materials, backfilling, and compacting soil; and – Construction activities for airport runway, passenger		✓		– Spray water for dust suppression in cases where dust is observed to be dispersing from construction works onto main roads. – Switch off engines when not needed – Maintain vehicle and equipment according to manufacturers' specifications. – During transportation of fill material by trucks, loads should be dampened or covered before transportation to prevent dust emissions when driving on public roads.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
	terminals, and other supporting infrastructure.					
C. Noise and Vibration	– Site preparation activities, infrastructure construction activities – Project's transportation activities – Generator, and construction activities of passenger terminal and runway.	✓			– Change engine oil in accordance with manufacturer's specifications. – The construction activities that produce high noise and vibration emission level shall be conducted during daytime (from 7 am-6 pm) only. In case of nighttime work, project will inform the local authority and local people before commencing work. – Fence the construction site to reduce noise and vibration disturbances. Arrange a grievance mechanism when villagers complain about noise and vibration disturbance. – Where possible, schedule operation of noisy construction equipment so that it is staggered and does not all occur at the same time. – Equipment used shall be in good condition and use mufflers. Generators shall sit inside a sound-proof room. – Provide personal protective equipment. No worker is exposed to the noise over 85 dB for over eight hours per day without any protective headset.	
D. Surface Water Quality	– Land clearing and preparation activities; – Solid, and hazardous waste management; – Wastewater and other runoff management.		✓		– The project will construct a dike to prevent accidental leakage of wastewater into water bodies. – The project will construct a sedimentation pond. – The project will have a secondary container to prevent accidental leakage of engine oil into water bodies. – The project will provide on-site mitigation measures. – The project will maintain sanitation and construct a septic tank. – The project will manage the potential water runoff caused by soil backfilling and concreting. – The project will conduct regular inspections of waste and sanitation areas to ensure there are no leakages, especially forbidding the construction of waste disposal sites, hazardous substances or latrines	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					located adjacent to the existing waterway near the project site without adequate containment measures. – The project will segregate and store waste in appropriate, secure, and properly labelled containers. Organic waste will be composted. Other solid waste will be dumped in the project's landfill. – For hazardous waste and other hazardous material, the project will properly manage hazardous waste storage and handling, and ensure that it is properly labelled. – The project will minimise the need to leave construction materials upon completion of construction. – The project will maintain spill kits/equipment, and post spill procedures on site, especially spill or leak response plans. – The project will keep a register of all hazardous substances on site and ensure that relevant Material Safety Data Sheets (MSDS) are readily accessible for reference. – Refueling and machinery maintenance is to be undertaken in a designated, sealed, bunded area with appropriate closed drainage and oil traps. – The project will maintain the vegetation presence around the project site where feasible, particularly the vegetation around the backfilling area to prevent erosion. – The project will prepare a wash area at the entrance point.	
E. Hydrology	– Affect waterways, soil erosion and loss of water storage			✓	– Project was organizing the master plan and including flood management plan (see Map 20) inside and outside the project site. Project design to divert water from Tonle Bati by allowing the like between Tonle Bati and Boueng Cheung Loung to keep the same flow – Clearance activities and soil backfilling will be conducted technically by construction of drainage system to prevent flooding or discharge into the project site.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– Project will ensure that the drainage system has adequate capacity to accepte heavy rainfall that flows on the surface Feasibility study of Boueng Cheung Loung and Boueng Rean restoration to take soil for backfilling at the airport site, then both lakes will have greater storage of water.	
F. Soil quality and Groundwater quality	– Discharge of wastewater – Storage and hazardous waste management – Soil nutrient loss	✓			– The project will regularly check weather, especially in the rainy season. Any earthwork activities will be temporary stopped during heavy rain. – The project will be watering regularly at the important sites such as runway, passenger terminal and other main road in order to reduce dust rising. – The project will regularly monitor waste management measures to prevent unnecessary flooding and prohibit the construction of waste disposal sites or rubbish and hazardous substances near existing waterways near the project site. – Hazardous storage sites will be constructed (possibly by concreting) to prevent any leakage into soil and groundwater sources, and the project will advise its workers about waste disposal at a designated location. – Spills or leaks (i.e. of fuel or lubricants) shall be cleaned up immediately, and contaminated rags or other material shall be disposed of properly. – For any storage of construction materials in the construction site which are not in a warehouse or under a roof are to be covered and regularly monitored during rainfall periods to prevent any runoff into groundwater sources. – The project's construction machinery will be monitored regularly, with regularly change of engine oil in accordance with the manufacturer's recommendations. Any machinery deemed by the project to bein a bad condition will stop operating and be appropriately repaired before proceeding. Refueling and machinery maintenance is to be undertaken in a designated, sealed, bunded area with appropriate closed drainage and oil traps.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					–	
1.2. Biological Resources						
A. Forest	– Land preparation activities; – Backfilling activities; – Construction activities		✓		– Project will avoid forest clearance at unnecessary sites – Project will educate workers to not undertake tree clearance present around the project area, particularly in Boueng Cheung Loung to maintain the vegetation and green space. – Collaborate with Kraing Yov fishing community and Kandal Fishery Administration to launch an off-set program to restore flooded forest in Boueng Cheung Loung. –	
B. Wildlife	– Land preparation activities; – Backfilling activities; – Construction activities for airport infrastructure; and – Waste and wastewater management.		✓		– The project, in collaboration with MOE, will launch an off-set program. – Project will check the soil backfilling site to identify vulnerable biodiversity before clearance vegetation. Wildlife habitat site will be checked. – In cases of discovery of a wildlife habitat, the vegetation clearance will immediately stop and the project will cooperate with the appropriate authority (Ministry/Department of Environment) to find solution. – Project will conduct standard clearance to ensure that wildlife will leave before land clearing and soil backfilling. – The project will collaborate with local authorities to prevent wildlife poaching and hunting. The project will also advise workers not to destroy vegetation and not to hunt wildlife in the project's vicinity.	
C. Bird	– Land preparation activities; – Backfilling activities; – Construction activities for airport infrastructure; and – Waste and wastewater management.	✓			– Soil backfilling and clearance will be conducted within airport construction period – The sign of No Hunting will be installed in the project area. Bird hunting is prohibited and illegal. – All lights used within the project area are to focus away from areas of natural habitat, particularly in Boueng Cheung Loung. – Wastewater or hazardous waste discharge into nearby public water bodies is prohibited.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
D. Fisheries	– Land preparation activities; – Backfilling activities; – Construction activities for airport infrastructure; and – Waste and wastewater management.	✓			– Clearing and backfilling activities will occur only in the proposed runway construction and passenger terminal spots – no backfilling of streams or vegetation clearing in the project's vicinity. – Regularly inspections of machinery and vehicles to prevent any engine oil leakage during operations, which would potentially affect water quality due to runoff. – Develop management plans for all types of wastes to ensure the project's waste will not affect fish in the study area. – Wastewater or hazardous waste discharge into nearby public water bodies is prohibited	
1.3. Socio-Economic Resources						
A. Land Use	– Land conversion from agricultural land to airport – Backfilling activity	✓			– The remaining land ownership issue, project will continue to work with local authority for future resolution. – Project will not prohibit any farming activities outside the project. – Land clearance will be conduct inside the project site only	
B. Fishing Activity	– Clearing, backfilling and site preparation activities in the project site – Construction activities for airport infrastructure; and – Waste, wastewater, and hazardous substance management.	✓			– The project will construct a dike to prevent accidental leakage of wastewater into water bodies. – The project will construct a sedimentation pond. – The project will have a secondary container to prevent accidental leakage of engine oil into water bodies. – The project will maintain sanitation and construct a septic tank. – The project will conduct regular inspections of waste and sanitation areas to ensure there are no leakages, especially forbidding the construction of waste disposal sites, hazardous substances or latrines located adjacent to the existing waterway near the project site without adequate containment measures. – The project will segregate and store waste in appropriate, secure, and properly labelled containers. Organic waste will be composted. Other solid waste will be dumped in the project's landfill.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– For hazardous waste and other hazardous material, the project will properly manage hazardous waste storage and handling, and ensure that it is properly labelled. – The project will maintain spill kits/equipment, and post spill procedures on site, especially spill or leak response plans. – The project will keep a register of all hazardous substances on site and ensure that relevant Material Safety Data Sheets (MSDS) are readily accessible for reference. – Refueling and machinery maintenance is to be undertaken in a designated, sealed, bunded area with appropriate closed drainage and oil traps.	
C. Traffic	– Construction materials transportation, worker transportation, and machinery mobilization	✓			– Project will provide the schedule to the local community regarding land transport to project site. – A detour road will be constructed to avoid traffic passing along National Road No. 2 and other laterite roads. – Project will avoid transporting materials during rush hour and those times material transport could create any dust dispersion when driving on public roads. – All transport vehicles of the project will be in good condition with the project's safety standards, especially driving in compliance with the Road Traffic Law. – The project will display traffic signs on key spots such as entrance gates, road curves, and install road marking. – The project will notify the project's drivers to slow down when arriving sensitive spots such as schools, temples, health centres and hospitals. – The following risk mitigation measures in relation to material and worker transportation will be adopted: – Limit vehicle speed to below 30 km/hour – Drivers shall have a valid driving license and driving experiences – Prohibit overweight trucks – Prohibit the use of drugs and alcohol during driving	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					–	
D. Public Infrastructure	– Transportation of workers and construction materials. – Waste management and labor influx	✓			– Provision of onsite health care to ensure that basic medical attention and first aid treatment can be sought by workers. Cooperate with Kandal referral hospital (Ta Khmao city) to immediately respond to any accident. – Do not overload trucks, which may damage road. – Maintain and repair public and private roads that the project damages. – Implement waste management plan considering waste reduction, reuse, and recycling. Segregate hazardous and non-hazardous waste.	
E. Public Health and Safety	– Clearing, transportation and site preparation activities in the project site – Construction activities for airport infrastructure; – Worker and material transportation; – Waste and wastewater management; – Hazardous substance management; – Labor influx		✓		***With regard to air quality management in the construction phase, the measures are as follows:*** – The project will limit the driving speed of its vehicles in residential areas – All transport vehicles of the project will be in good condition with the project's safety standards, especially driving in compliance with the Road Traffic Law. – During transportation of construction material by trucks, construction material which could pose any dust dispersion (i.e. sand and stone transportation, etc.), should be covered and regularly monitored before transportation to ensure that the project's transportation activities do not pose any dust dispersion issues to the public road user. – The project will regularly spray water in the project site in those areas where dust dispersion may occur. ***With regard to traffic management in the construction phase, the measures are as follows:*** – A detour road will be constructed to avoid traffic passing along National Road No. 2 and other laterite roads. – Project will provide the schedule to the local community regarding land transport to project site. – Project will avoid transporting materials during rush hour and those times material transport could create any dust dispersion when driving on public roads.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– The project will display traffic signs on key spots such as entrance gates, road curves, and install road marking. – The project will notify the project's drivers to slow down when arriving sensitive spots such as schools, temples, health centres and hospitals. – The following risk mitigation measures in relation to material and worker transportation will be adopted: – Limit vehicle speed to below 30 km/hour – Drivers shall have a valid driving license and driving experiences – Prohibit overweight trucks – Prohibit the use of drugs and alcohol during driving – Prohibit the use of mobile phone while driving – Prohibit reckless driving – The project site is to be partially fenced and manned at all times to prohibit unauthorised entry. ***With regard to waste management in the construction phase, the measures are as follows:*** – The project will construct a dike to prevent accidental leakage of wastewater into water bodies. – The project will construct a sedimentation pond. – The project will have a secondary container to prevent accidental leakage of engine oil into water bodies. – The project will maintain sanitation and construct a septic tank. – The project will maintain spill kits/equipment, and post spill procedures on site, especially spill or leak response plans. – The project or contractor will educate its workers about communicable diseases and their symptoms. – The project will provide regular health check-ups to all workers. – The project will organize awareness campaigns on sanitation.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
2. Operational Phase						
2.1. Physical Resources						
Air Quality and Greenhouse Gases (GHG)	– Dust dispersion, air pollutants, and increased greenhouse gas emissions from fuel combustion of project activities such as flights take-off and landing, and passenger commuting		✓		– The project has a plan to utilise solar power as a supplementary power source (75 MW). – Switch off unnecessary machinery. – Both GHG and non-GHG emissions shall not exceed the international standards. – The project will maintain vegetation, wherever possible, within the site. – Aircraft emissions from combustion are unavoidable, but the project will ensure that fuel suppliers provide the best quality fuel possible. – Airport access road will be built in accordance with international standards to reduce potential traffic congestion.	
Noise and Vibration	– Increased flights – Tourist traffic		✓		– Collaborate with the local authorities and relevant instiutions to identify area vulnerable to noise disturbance and specific mitigation measures agreed by both the project owners and the affected villagers, particularly those in Pot Sor commune. – Control all activities in the airport to avoid loud noise. – Collaborate with the Traffic Police to facilitate the traffic at the airport access road. – Switch off unnecessary machinery. – Schedule aircraft movements further away from each other can help reduce the amount of continuous noise exposure to nearby receptors.	
Surface Water Quality	– soil erosion, fuel runoff, and wastewater runoff from the airport	✓			– The airport will have separate wastewater and rainwater management systems. – The airport will regularly monitor all waste, particularly treated wastewater, which is required to meet the MOE's wastewater standards before being released into public water bodies or the sewage system.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– The airport will segregate and store waste in an appropriate, secure, and properly labeled containers. Organic waste will be composted. Other solid waste will be placed in an appropriate approved landfill. – For hazardous waste storage site, the project will be appropriately managed and sign posted. – Fuel and hazardous substance tank will be stored in a bunded wall. – The airport will maintain spill kits/equipment, and post spill procedure notices, on site. – The drainage system will be built to accommodate rainwater runoff from the runway and passenger terminal before being released into the airport's retention ponds.	
2.2. Biological Resources						
Bird	– Noise disturbance, and aircraft collision with bird	✓			– The airport will prohibit the clearance of vegetation, which is the source of food and habitat for birds and mammals. – The airport will train its air traffic control tower staff to identify risks related to a swarm of birds and be aware of those birds that like to cruise high in the aircraft route (eg. Hawkeye) and warn pilots to delay landing or take-off. – The airport will chase birds away from hangars and surrounding sites through emitting noise, light, and the use of ground radar or other effective approved method. – Regularly review the presence of birds (every six months) in the airport and flight tracks. – Launch an off-set program to rehabilitate affected natural resources.	
Fishery	– Inappropriate management of waste, wastewater, and hazardous waste	✓			– The project will construct ae drainage system where there is potential runoff to reduce soil erosion. – The project will regularly monitor the management of all types of wastes, including the wastewater which discharges from the wastewater treatment plant. This treated water will be required to meet the MoE's standard, which allows the release of wastewater from polluted sources	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					into protected public waters, or the public water areas and drainage system of the sub-decree on the water pollution control in 1999 of the MoE. – The airport will carefully separate and store solid waste, with clear markings on trash bins according to each type of trash and manage solid waste through composting, reuse, recyclng or burning in the incinerator or placement in a landfill. – For hazardous wastes and other hazardous substances handling, the airport will be properly managed and undertake regular monitoring.	
2.3. Socio-Economic Resources						
Traffic and public infrastructure	– Increased traffic of tourist – Increased number of taxi – Increased traffic on National Road 2			✓	– The project will conduct a study to build a dedicated access road for the execution phase. – The airport will display traffic signs at key spots such as weight limit, speed limit, and road marking. – The airport will clearly mark the airport entrance and exit to reduce traffic congestion. – All airport's vehicles will need to be in good condition and comply with the airport's safety standards, especially driving in compliance with the Road Traffic Law of the Kingdom of Cambodia. All airport's drivers shall have a valid driving licence and respect the traffic laws – A driving safety code for airport's staff and workers and other airport equipment transportation will be implemented to ensure road safety while driving, especially to ensure that airport activities do not cause any potential traffic accidents or affect to other public road users. This code will include: driving behavior, driving speed limits (≤40 km/h) in residential areas, horn use, speed limits applicable to sensitive areas such as schools, temples, health centres and hospitals, etc.	
Public Health and Safety	– increased noise/vibration levels associated with aircraft's flight frequency (219-511 flights/day);	✓			– Collaborate with the local authorities and relevant instiutions to identify area vulnerable to noise disturbance and specific mitigation measures agreed by both the project owners and the affected villagers, particularly those in Pot Sor commune.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
	– Increased traffic on National Road 2, and dust dispersion				– Control all activities in the airport to avoid loud noise. – Collaborate with the Traffic Police to facilitate the traffic at the airport access road. – Switch off unnecessary machinery. – Schedule aircraft movements further away from each other can help reduce the amount of continuous noise exposure to nearby receptors. – Develop waste management plans including waste and hazardous substance management procedures, waste collection schedules, and reuse/recycling programmes. – The airport company will need to provide training on driving safety standards to its staff to ensure that traffic incidents or accidents while using local roads are reduced or limited and don't have an adverse impact on the local community – During transportation of all materials (including waste by trucks and loads which potentially pose any dust), the material will be properly covered before transportation to prevent dust emissions when driving on public roads. – Collaborate with Kandal Provincial Department of Public Work and Transport to install pedestrian crossing signs on the National Road No. 2, particularly at the airport entrance.	
Aircraft accident risk	– Weather, aircraft collision with bird, miscalculation before take-off, engine, New or old aircraft, and runway condition.	✓			– The airport's firefighting station will be built with international standards, with enough fire suppression vehicles to cope with any risks that may happen. – Notify aircraft bound for the airport about bad weather. – Ensure appropriate training and validation of all air traffic control staff – Ensure appropriate level of navigation aids, regularly checked and serviced – Carry out regular training emergency exercises, desk top and real-time – Monitor the runway's humidity and dryness in accordance with specification by airport's inspector.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– Collaborate with Cambodian authorities of all levels in case there is any aircraft accident to ensure timely rescue. – Comply with Cambodia Civil Aviation Authority's guidelines and the standards and recommended practices (SARPs) of the International Civil Aviation Organization (ICAO) – Collaborate with the local authorities and the Civil Aviation State Secretariat to set below height restrictions: o Approach path/take-off climb zone: the height of building and tree, existing between the edge of runway to 15,000 meters away, shall be below 150 meters. o Transitional zone: the height of building and tree, existing between 150 meters from the runway axis and 465 meters from the runway axis, shall be below 45 meters. o Inner Horizontal/Conical/Outer Horizontal zone: ▪ For 4,000 meter perimeter from the runway axis: the height of building and tree shall be below 45 meters. ▪ For 4,000 meter to 6,000 meter perimeter from the runway axis: the height of building and tree shall be below 45 meters-145 meters. ▪ For 6,000 meter to 15,000 meter perimeter from the runway axis: the height of building and tree shall be below 150 meters.	
Accidental Fire and Explosion	– Burning of waste, cigarette butt disposal, fuel or flammable substance leakage	✓			– All fuel oil storage units are appropriate, sealed and covered from any sunlight based on international safety standards, to reduce the risk of leaking or explosion. – The airport will ultimately have two airside fire-fighting stations and two landside firefighting stations that are capable to prevent and control accidental fire or explosion. – The airport has an Emergency Response Plan in case of any accidental fire or explosion. – The airport will prohibit the burning of garbage and other wastes in the airport vicinity.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– The airport will collaborate with the local authorities, the provincial firefighting unit, and the provincial authorities to timely respond to any fire risk or explosion.	
3. Closing phase						
There is no major activity that will affect natural and social environmental resources. The project owner will transfer the airport management to the Royal Government of Cambodia.						

7.6 Cumulative Impact Assessment

Cumulative impact refers to the impacts that result from the incremental impact on an areas or resources used or directly/indirectly impacted by the project, from other existing, planned activities. The International Finance Corporation (IFC) (2012) defines cumulative impacts as "those that result from successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned and/or reasonably anticipated future ones" [8].

7.6.1 Scope of Cumulative Impact Assessment

Cumulative impacts assessment refer to the additional impacts that may be caused by other developments or activities in the vicinity of the Project Area (5 km radius from the New Phnom Penh International Airport).

7.6.2 Identification of Other Developments

According to direct observation and interview with the local authorities, there are 13 projects that could potentially contribute to cumulative impacts including garment and footwear factories, food production, rock grinding, and soil mining. These projects' activities consist of machinery operation, goods/material transportation activities, soil and construction material transporation, and other services. Figure 7-10 illustrates the locations of these projects with below details:

1. Rock grinding: this project is located in Roka Kpous commune, Sa'ang district about 1.5 km to the north-east of the New Phnom Penh International Airport. It started operation in 2018. Rock explosion, grinding, and transportation as well as machinery operation/maintenance may pose risks to water quality, air quality, and noise/vibration disturbance.
2. Fortune Garment Factory: this factory is located on the National Road No. 21 in Roka Kpous commune, Sa'ang district about 3 km to the north-east of the New Phnom Penh International Airport. It started operation in 2003. Waste/wastewater management and worker/raw material/finished product transportation may potentially affect air quality, water quality, and traffic on the National Road No. 21.
3. Sunthing Factory: this factory is located in Prek Koy commune, Sa'ang district about 5 km from the New Phnom Penh International Airport. Waste/wastewater management and worker/raw material/finished product transportation may potentially affect air quality, water quality, and traffic on the National Road No. 21.
4. Li Thing Cambodia Factory: this factory is located in Prek Koy commune, Sa'ang district about 5 km from the New Phnom Penh International Airport. Waste/wastewater management and worker/raw material/finished product transportation may potentially affect air quality, water quality, and traffic on the National Road No. 21.
5. JD and Toyosima Factory: this garment factory is located in Pot Sor commune, Bati district about 3 km to the west of the New Phnom Penh International Airport. It started operation in 2010. Waste/wastewater management may potentially affect water quality.
6. Solamoda garment factory: this factory is located in Pot Sor commune, Bati district about 3 km to the west of the New Phnom Penh International Airport. It started operation in 2013. Waste/wastewater management may potentially affect water quality.
7. SC Food Processing Factory: located on the National Road No. 2 in Boeung Khyang commune, Kandal Stoeng district, this factory produces candy and snack cracker. It started operation in 2019. Waste/wastewater management may potentially affect water and air quality.
8. Golden garment factory: located in Boeung Khyang commune, Kandal Stoeng district about 4 km to the west of the New Phnom Penh International Airport. It started operation in 2013. Waste/wastewater management may potentially affect water quality.

([8]) IFC Performance Standards on Environmental and Social Sustainability, January 2012, International Finance Corporation, World Bank Group

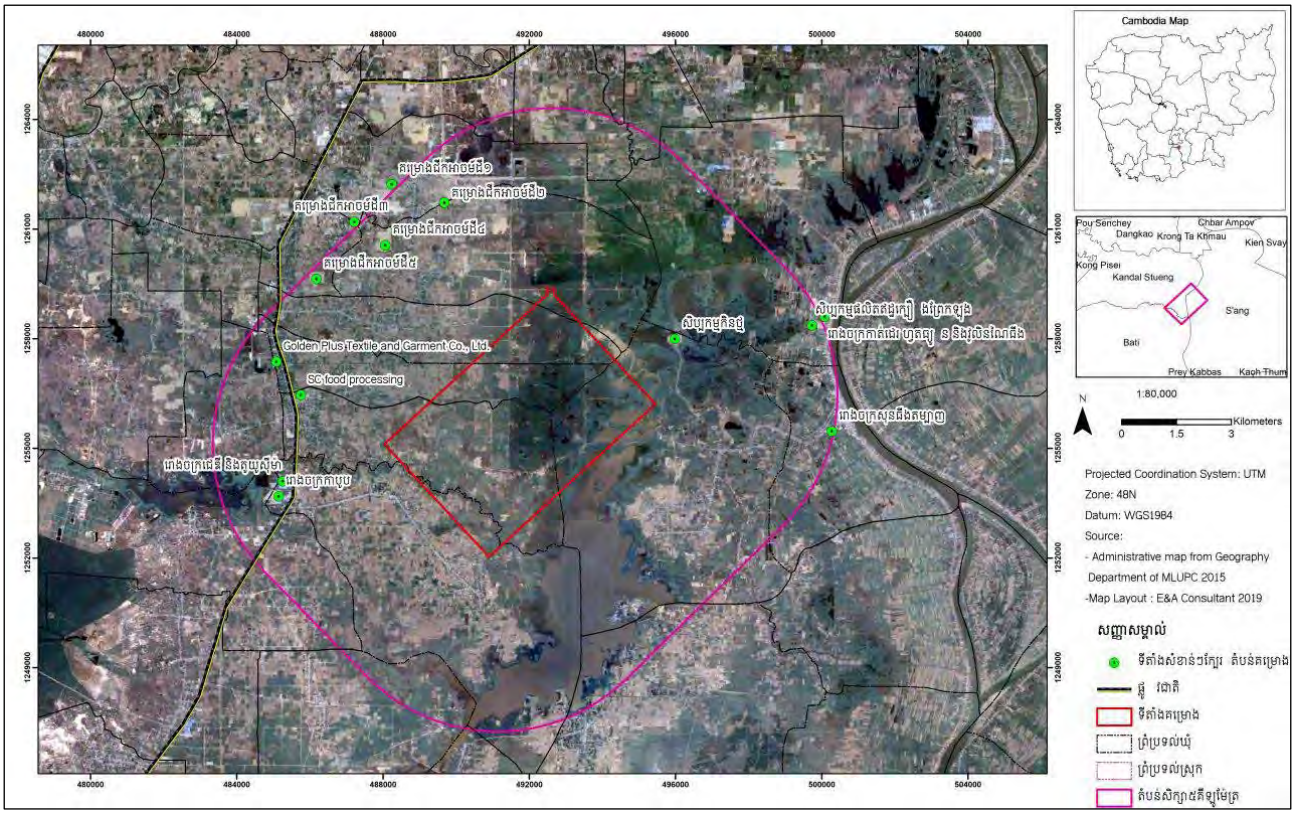
9. Soil mining project No. 1: located in Choung Kerb commune, Kandal Stoeng district about 4.5 km to the north-west of the New Phnom Penh International Airport. It started operation in 2013. Soil excavation and tranportation may potentially affect air quality, traffic, noise, and vibration.
10. Soil mining project No. 2: located in Kondoak commune, Kandal Stoeng district about 4 km from the New Phnom Penh International Airport. It started operation in 2017. Soil excavation and tranportation may potentially affect air quality, traffic, noise, and vibration.
11. Soil mining project No. 3: located in Kondoak commune, Kandal Stoeng district about 5 km to the north-west of the New Phnom Penh International Airport. It started operation in 2010. Soil excavation and tranportation may potentially affect air quality, traffic, noise, and vibration.
12. Soil mining project No. 4: located in Kondoak commune, Kandal Stoeng district about 4 km to the north-west of the New Phnom Penh International Airport. It started operation in 2015. Soil excavation and tranportation may potentially affect air quality, traffic, noise, and vibration.
13. Soil mining project No. 5: located in Siem Reap commune, Kandal Stoeng district about 4.5 km to the north-west of the New Phnom Penh International Airport. Soil excavation and tranportation may potentially affect air quality, traffic, noise, and vibration.

Table 109: Existing projects within 5 km radius from the New Phnom Penh International Airport project site

No.	Project	Operational project	Under construction project	Future project	UTM WGS1984 4N	Location and Distance from the project site	Potential cumulative impacts
1	Rock grinding		√		X: 495984 Y: 1257993	1.5 km to the north-east of the New Phnom Penh International Airport site	Rock explosion, grinding, and transportation as well as machinery operation/maintenance
2	Fortune Garment Factory	√			X: 500018 Y: 1258508	3 km to the east of the New Phnom Penh International Airport site	Waste/wastewater management and worker/raw material/finished product transportation
3	Sunthing Factory	√			X: 500278 Y: 1255467	5 km from the New Phnom Penh International Airport site	Waste/wastewater management and worker/raw material/finished product transportation
4	Li Thing Cambodia Factory	√			X: 485143 Y: 1253688	3 km to the west of the New Phnom Penh International Airport site	Waste/wastewater management
5	JD and Toyosima Factory	√			X: 485255 Y: 1254103	3 km from the New Phnom Penh International Airport site	Waste/wastewater management
6	Solamoda garment factory	√			X: 485663 Y: 1254185	3 km to the west of the New Phnom Penh	Waste/wastewater management

No.	Project	Operational project	Under construction project	Future project	UTM WGS1984 4N	Location and Distance from the project site	Potential cumulative impacts
						International Airport site	
7	SC food processing	√			X: 485747 Y: 1256460	3.5 km to the west of the New Phnom Penh International Airport site	Waste/wastewater management, air pollution
8	Golden Plus Textile and Garment	√			X: 485086 Y: 1257370	4 km to the west of the New Phnom Penh International Airport site	Waste/wastewater management
9	Soil mining project No. 1	√			X: 488178 Y: 1261670	4.5 km to the north-west of the New Phnom Penh International Airport site	Soil excavation and tranportation
10	Soil mining project No. 2	√			X: 489676 Y: 1261725	4 km from the New Phnom Penh International Airport site	Soil excavation and tranportation
11	Soil mining project No. 3	√			X: 487211 Y: 1261194	5 km to the north-west of the New Phnom Penh International Airport site	Soil excavation and tranportation
12	Soil mining project No. 4	√			X: 488062 Y: 1260558	4 km to the north-west of the New Phnom Penh International Airport site	Soil excavation and transportation
13	Soil mining project No. 5	√			X: 486176 Y: 1259634	4.5 km to the north-west of the New Phnom Penh International Airport site	Soil excavation and tranportation

Photo 108: Locations of existing projects within 5 km radius from the New Phnom Penh International Airport project site



Source: E&A Consultant (2019)

7.6.3 Summary of Cumulative Impacts

The cumulative impacts of the New Phnom Penh International Airport consider 32 parameters as described below by considering the potential impacts caused by the other 13 existing projects within 5-km radius of the New Phnom Penh International Airport.

Table 110: Summary of Cumulative Impacts

No.	Environmental Resources	Project Phases*			Projects potentially causing cumulative impacts**													Level of Cumulative impacts
		Pre-Operation	Operation	Closing	1	2	3	4	5	6	7	8	9	10	11	12	13	
A. Physical Resources																		
1	Geology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	Topography	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	Soil quality	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	Mineral resources	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	Climate	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Air quality	M	M	-	☑	-	-	-	-	-	☑	-	☑	☑	☑	☑	☑	H
7	Noise and vibration	L	L	-	☑	-	-	-	-	-	-	-	☑	☑	☑	☑	☑	M
8	Hydrology	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Surface water quality	M	L	-	☑	☑	☑	☑	☑	-	☑	☑	-	-	-	-	-	H
10	Groundwater quality	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
B. Biological Resources																		
11	Forest	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	Wildlife	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Bird	L	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	Fisheries	L	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

15	Protected area	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C. Socio-Economic Resources																		
16	Demography	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	Settlement	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	Land use	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	Occupation	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	Infrastructure	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	Electricity use	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22	Water use	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	Public health and safety	L	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	Education	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	Tourist site	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26	Landscape	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
27	Heritage and sacred sites	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28	Land traffic	L	M	-	-	☑	☑	-	-	-	-	-	☑	☑	☑	☑	☑	H
29	Unexploded ordnance	H	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30	Occupational accident	M	L	-			-	-	-									
31	Other risks (flood, fire, etc)	L	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: * Level of Impact of the New Phnom Penh International Airport
L: Low; M: Moderate; H: High
** Cumulative Impact (☑) potentially happen; (-) not happen
Source: E&A Consultant (2019)

7.6.4 Cumulative Impacts

7.6.2.1 Air Quality

The air quality in the study area may potentially be affected by the cumulative impact of other existing project activities as well as the proposed airport project. The potential cumulative impact to air quality include the emissions of air pollutants, particularly GHG, dust dispersion, traffic on the National Road No. 2, and soil transportation. In addition, raw material and staff transportation of garment/footwear/food processing factories contribute to the air quality impact. Therefore, the cumulative impact on air quality in the study area is considered “high”.

7.6.2.2 Noise and Vibration

There are potential noise and vibration disturbance to the local communities, particularly in Village 1. The level of impact in the construction and the operation phases are low. However, other existing projects such as the soil mining projects and the traffic on the National Road No. 2 may potentially cause cumulative impact on noise and vibration. Therefore, the cumulative impact on noise and vibration in the study area is considered “moderate”.

7.6.2.3 Surface water quality

The projects that potentially affect surface water quality include the rock grinding, Fortune garment, Sunthing, Li Thing, JD and Toyosima, SC food processing, and Golden Plus Textile and Garment because these projects dispose of wastewater into water bodies. The wastewater from factory/handicraft may be untreated prior to disposal, and it consists of coliform, e-coli, soap, and other substances. The cumulative impact on surface water quality is considered “high”.

7.6.2.4 Land Traffic

In the operation phase of the airport project, the potential impact on land transportation/traffic is moderate.

Land traffic will be further impacted by the cumulative impact of other existing projects such as the rock grinding, Fortune garment, Sunthing, Li Thing, JD and Toyosima, SC food processing, Golden Plus Textile and Garment, and all five soil mining projects. The activities that potentially cause cumulative impacts on the National Road No. 2 are soil transportation and construction material transportation. They contribute to traffic accident, traffic congestion, and dust dispersion. Therefore, the cumulative impact on land traffic is considered "high".

7.6.2.5 Mitigation Measures

Cumulative impact mitigation is not the sole responsibility of the airport project owner or the owners of other relevant projects. All stakeholders and the authorities shall work together. The mitigation measures are divided into two: for the airport project, and for the study area.

A. Mitigation Measures for the Airport Project:

- The airport will implement the mitigation measures for air quality, noise/vibration, surface water quality, and land traffic, as outlined in the section 7.4. The project should ensure that wastewater discharge follows the relevant standard.
- Collaborate with other projects and the local authorities to jointly address the pollution issues and disturbances.

***B.* Mitigation Measures for the Study Area**

- The Ministry of Environment, the Provincial Department of Environment, and other related institutions shall regularly monitor the project activities.
- The Ministry of Environment encourage all projects to conduct environmental and social impact assessment. The Ministry will monitor all project activities.
- The local authorities in collaboration with all project owners and local villagers will monitor all activities and identify suitable measures.

7.7 Positive Impacts

A summary of the positive impacts expected from the Project include increased tourist arrivals, increased use of local employment, and increased investment and national economy growth. The details of positive impacts are as follows:

7.7.1 National Revenue

The project will provide significant national income through various taxes such as a tax on tourists who travel via the airport, a tax on profit, and a tax on staff salary, based on the laws and contracts between the project owner and Royal Government of Cambodia.

7.7.2 Promoting National Economy

The construction and operation of the new Phnom Penh International Airport will require expenditure on site preparation, machinery, material, equipment and services rendered/supplied by international and local companies. Such expenditure will feed into Cambodian economy.

7.7.3 Employment

In the design and planning phase, the project provide employment for engineers, designers, financial consultants, administrative staff, legal consultants, and communication consultants.

In the operation phase, the project will provide employment for many Cambodians including team leaders, technicians, engineers, administration, finance, security guards, laborers, and vendors.

The arrival of passengers will create indirect jobs around the airport such as restaurants, hotels, and transpotation.

7.7.4 Increased Tourists

The airport expects to receive at least 13 million passengers and 30 million passengers in 2030 and 2050, respectively. They will contribute to the national economy through airport tax payment and other expenditures during their travel and stay in Cambodia.

7.7.5 Technical Skill Development

The project will provide technical skill training to its staff and workers such as pre-placement training, and on-the-job training with regard to their positions. The project will encourage knowledge exchange with local and international experts.

Chapter 8 Environmental Management Plan

8.1 Introduction

This chapter indicates the Environmental Management Plan (EMP) which is an environmental management framework which reflects the requirement conditions, responsibilities and implementation objectives, as well as providing practical recommendations to mitigate the potential negative impacts, possibly caused by project activities.

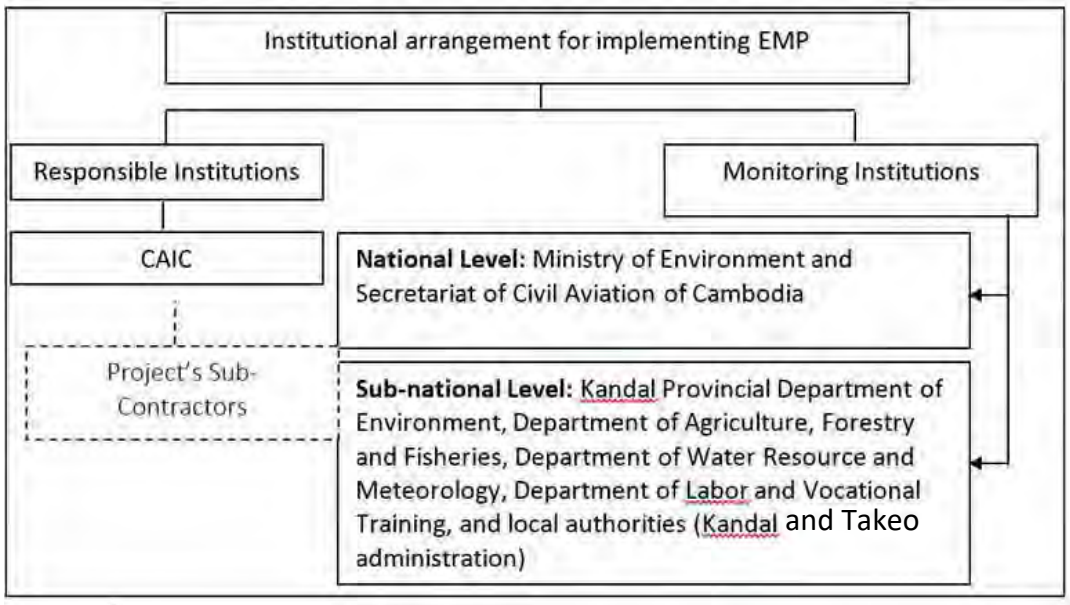
The EMP will identify the project's relevant stakeholders, monitoring methods, indicators and essential parameters that need to be monitored, frequency, and monitoring activities plan, as well as all estimating expenses which required for implementing this EMP. The objective of this chapter is to improve the implementation of the EMP basically on existing project's information. Moreover, the plan will be reviewed and adjusted according to the real situation of the implementation of each impact management plan. The main section of this chapter includes:

- Summary of impacts and mitigation measures
- Monitoring and the responsible institution;
- Training programmes preparation;
- Monitoring programmes;
- Budget plan for monitoring programmes;
- Reporting; and
- Environmental and social funds.

8.2 Monitoring and Responsible Institutions

To successfully implement EMPs, the monitoring and responsible institutions at national and sub-national level must be required to participate in implementing this plan. A project owner (The Cambodia Airport Investment Co., Ltd) is a responsible institution, whereas the Ministry of Environment, line ministry and other relevant institutions, is a monitoring institution, which monitors and controls the project owner's EMP implementation. The monitoring institution is divided into two levels: national and sub-national institutions, as shown in the following diagram.

Figure 30: Institutional arrangement for implementation of EMP



8.2.1. Responsible institutions

The project implementation company (Cambodia Airport Investment Co Ltd) must ensure that all activities that may affect the environmental and social resources must comply with technical national and international standards by monitoring on a daily or weekly or monthly basis both in and around the project site at each stage, especially during project execution.

The company is responsible for all costs related to mitigation and monitoring measures at each stage of the project. In addition, the company must liaise well with local people, authorities and relevant institutions to ensure that every stage of the project implementation is smooth and successful. Monthly and annual monitoring or any emergency monitoring is required if needed. The main roles of the company are as follows:

- Implement the project's environmental and social management plan at all stages
- Ensure that all project activities are carried out in accordance with relevant national laws and regulations
- Ensure that all staff and labor are trained on environmental protection to promote their daily practices in compliance with environmental regulations.
- Reflect on the results of the implementation of the Environmental and Social Management Plan and revise the mitigation measures outlined in Chapter 7 to strengthen environmental protection.
- Solemnly monitor the environmental and social management plan implementation on all project activities to ensure that environmental conditions in and around the project area are protected.
- Maintain regular communication with local stakeholders and authorities and respond to any questions and complaints that may arise.

8.2.2. Monitoring institutions

Monitoring teams of the environmental and social management plan are divided into two levels: national level monitoring institution which consists of the Department of Environmental Impact Assessment of the Ministry of Environment, and the State Secretariat of Civil Aviation. The sub-national institutions include the Department of Environment of Kandal and Takeo province, and Kandal and Takeo Provincial Administration. These two institutions have the following functions:

- Monitors of the implementation activities of the environmental and social management plan at each stage on a regular basis
- Receive reports on results of the implementation of the environmental and social management plan
- Inform and recommend any shortcomings or gaps associated with the implementation of the environmental and social management plan at each stage

8.3 Summary of Negative Impacts and Mitigation Measures

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
1. Pre-Construction Phase						
1.1 Physical Resources						
Topography	– Affect waterways, soil erosion and loss of water storage		✓		– The company reserve a landplot to the south-west of the project area in order to divert water flow from Tonle Bati River. – Before the start of clearance activities, the company shall build dyke and drainage system to avoid runoff. – The company will avoid any unnecessary clearance in the project area. – Soil waste and other debris created by clearance activities will be properly kept by avoiding any mess pile in an area where easily block water way or/and cause any erosion to pollute the surface water around the project. – Clearance activities and soil backfilling will follow the clearance plan of the proposed project. The company shall prevent runoff from entering nearby water bodies.	
Air Quality and Greenhouse Gases	– Machinery mobilization – Site preparation activities; – Transportation of workers and staff – Transportation of earth materials, backfilling, and compacting soil; and – Construction activities for airport runway, passenger terminals, and other supporting infrastructure.		✓		– Spray water for dust suppression in cases where dust is observed to be dispersing from construction works onto main roads. – Switch off engines when not needed – Maintain vehicle and equipment according to manufacturers' specifications. – During transportation of fill material by trucks, loads should be dampened or covered before transportation to prevent dust emissions when driving on public roads.	
Noise and Vibration	– Site preparation activities, infrastructure construction activities – Project's transportation activities	✓			– Change engine oil in accordance with manufacturer's specifications. – The construction activities that produce high noise and vibration emission level shall be conducted during daytime (from 7 am-6 pm) only. In case of nighttime work, project will inform the local authority and local people before commencing work. – Fence the construction site to reduce noise and vibration disturbances. Arrange a grievance mechanism when villagers complain about noise and vibration disturbance.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
	– Generator, and construction activities of passenger terminal and runway.				– Where possible, schedule operation of noisy construction equipment so that it is staggered and does not all occur at the same time. – Equipment used shall be in good condition and use mufflers. Generators shall sit inside a sound-proof room. – Provide personal protective equipment. No worker is exposed to the noise over 85 dB for over eight hours per day without any protective headset.	
Surface Water Quality	– Land clearing and preparation activities; – Solid, and hazardous waste management; – Wastewater and other runoff management.		✓		– The project will construct a dike to prevent accidental leakage of wastewater into water bodies. – The project will construct a sedimentation pond. – The project will have a secondary container to prevent accidental leakage of engine oil into water bodies. – The project will provide on-site mitigation measures. – The project will maintain sanitation and construct a septic tank. – The project will manage the potential water runoff caused by soil backfilling and concreting. – The project will conduct regular inspections of waste and sanitation areas to ensure there are no leakages, especially forbidding the construction of waste disposal sites, hazardous substances or latrines located adjacent to the existing waterway near the project site without adequate containment measures. – The project will segregate and store waste in appropriate, secure, and properly labelled containers. Organic waste will be composted. Other solid waste will be dumped in the project's landfill. – For hazardous waste and other hazardous material, the project will properly manage hazardous waste storage and handling, and ensure that it is properly labelled. – The project will minimise the need to leave construction materials upon completion of construction. – The project will maintain spill kits/equipment, and post spill procedures on site, especially spill or leak response plans.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– The project will keep a register of all hazardous substances on site and ensure that relevant Material Safety Data Sheets (MSDS) are readily accessible for reference. – Refueling and machinery maintenance is to be undertaken in a designated, sealed, bunded area with appropriate closed drainage and oil traps. – The project will maintain the vegetation presence around the project site where feasible, particularly the vegetation around the backfilling area to prevent erosion. – The project will prepare a wash area at the entrance point.	
Hydrology	– Affect waterways, soil erosion and loss of water storage			✓	– Project was organizing the master plan and including flood management plan (see Map 20) inside and outside the project site. Project design to divert water from Tonle Bati by allowing the like between Tonle Bati and Boueng Cheung Loung to keep the same flow – Clearance activities and soil backfilling will be conducted technically by construction of drainage system to prevent flooding or discharge into the project site. – Project will ensure that the drainage system has adequate capacity to accepte heavy rainfall that flows on the surface Feasibility study of Boueng Cheung Loung and Boueng Rean restoration to take soil for backfilling at the airport site, then both lakes will have greater storage of water.	
Soil quality and Groundwater quality	– Discharge of wastewater – Storage and hazardous waste management – Soil nutrient loss	✓			– The project will regularly check weather, especially in the rainy season. Any earthwork activities will be temporary stopped during heavy rain. – The project will be watering regularly at the important sites such as runway, passenger terminal and other main road in order to reduce dust rising. – The project will regularly monitor waste management measures to prevent unnecessary flooding and prohibit the construction of waste disposal sites or rubbish and hazardous substances near existing waterways near the project site. – Hazardous storage sites will be constructed (possibly by concreting) to prevent any leakage into soil and groundwater sources, and the project will advise its workers about waste disposal at a designated location.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– Spills or leaks (i.e. of fuel or lubricants) shall be cleaned up immediately, and contaminated rags or other material shall be disposed of properly. – For any storage of construction materials in the construction site which are not in a warehouse or under a roof are to be covered and regularly monitored during rainfall periods to prevent any runoff into groundwater sources. – The project's construction machinery will be monitored regularly, with regularly change of engine oil in accordance with the manufacturer's recommendations. Any machinery deemed by the project to bein a bad condition will stop operating and be appropriately repaired before proceeding. Refueling and machinery maintenance is to be undertaken in a designated, sealed, bunded area with appropriate closed drainage and oil traps.	
1.2 Biological Resources						
Forest	– Land preparation activities; – Backfilling activities; – Construction activities		✓		– Project will avoid forest clearance at unnecessary sites – Project will educate workers to not undertake tree clearance present around the project area, particularly in Boueng Cheung Loung to maintain the vegetation and green space. – Collaborate with Kraing Yov fishing community and Kandal Fishery Administration to launch an off-set program to restore flooded forest in Boueng Cheung Loung. –	
Wildlife	– Land preparation activities; – Backfilling activities; – Construction activities for airport infrastructure; and – Waste and wastewater management.		✓		– The project, in collaboration with MOE, will launch an off-set program. – Project will check the soil backfilling site to identify vulnerable biodiversity before clearance vegetation. Wildlife habitat site will be checked. – In cases of discovery of a wildlife habitat, the vegetation clearance will immediately stop and the project will cooperate with the appropriate authority (Ministry/Department of Environment) to find solution. – Project will conduct standard clearance to ensure that wildlife will leave before land clearing and soil backfilling.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– The project will collaborate with local authorities to prevent wildlife poaching and hunting. The project will also advise workers not to destroy vegetation and not to hunt wildlife in the project's vicinity.	
Bird	– Land preparation activities; – Backfilling activities; – Construction activities for airport infrastructure; and – Waste and wastewater management.	✓			– Soil backfilling and clearance will be conducted within airport construction period – The sign of No Hunting will be installed in the project area. Bird hunting is prohibited and illegal. – All lights used within the project area are to focus away from areas of natural habitat, particularly in Boueng Cheung Loung. – Wastewater or hazardous waste discharge into nearby public water bodies is prohibited.	
Fisheries	– Land preparation activities; – Backfilling activities; – Construction activities for airport infrastructure; and – Waste and wastewater management.	✓			– Clearing and backfilling activities will occur only in the proposed runway construction and passenger terminal spots – no backfilling of streams or vegetation clearing in the project's vicinity. – Regularly inspections of machinery and vehicles to prevent any engine oil leakage during operations, which would potentially affect water quality due to runoff. – Develop management plans for all types of wastes to ensure the project's waste will not affect fish in the study area. – Wastewater or hazardous waste discharge into nearby public water bodies is prohibited	
1.3 Socio-Economic Resources						
Land Use	– Land conversion from agricultural land to airport – Backfilling activity	✓			– The remaining land ownership issue, project will continue to work with local authority for future resolution. – Project will not prohibit any farming activities outside the project. – Land clearance will be conduct inside the project site only	
Fishing Activity	– Clearing, backfilling and site preparation activities in the project site – Construction activities for airport infrastructure; and	✓			– The project will construct a dike to prevent accidental leakage of wastewater into water bodies. – The project will construct a sedimentation pond. – The project will have a secondary container to prevent accidental leakage of engine oil into water bodies. – The project will maintain sanitation and construct a septic tank.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
	– Waste, wastewater, and hazardous substance management.				– The project will conduct regular inspections of waste and sanitation areas to ensure there are no leakages, especially forbidding the construction of waste disposal sites, hazardous substances or latrines located adjacent to the existing waterway near the project site without adequate containment measures. – The project will segregate and store waste in appropriate, secure, and properly labelled containers. Organic waste will be composted. Other solid waste will be dumped in the project's landfill. – For hazardous waste and other hazardous material, the project will properly manage hazardous waste storage and handling, and ensure that it is properly labelled. – The project will maintain spill kits/equipment, and post spill procedures on site, especially spill or leak response plans. – The project will keep a register of all hazardous substances on site and ensure that relevant Material Safety Data Sheets (MSDS) are readily accessible for reference. – Refueling and machinery maintenance is to be undertaken in a designated, sealed, bunded area with appropriate closed drainage and oil traps.	
Traffic	– Construction materials transportation, worker transportation, and machinery mobilization	✓			– Project will provide the schedule to the local community regarding land transport to project site. – A detour road will be constructed to avoid traffic passing along National Road No. 2 and other laterite roads. – Project will avoid transporting materials during rush hour and those times material transport could create any dust dispersion when driving on public roads. – All transport vehicles of the project will be in good condition with the project's safety standards, especially driving in compliance with the Road Traffic Law. – The project will display traffic signs on key spots such as entrance gates, road curves, and install road marking. – The project will notify the project's drivers to slow down when arriving sensitive spots such as schools, temples, health centres and hospitals. – The following risk mitigation measures in relation to material and worker transportation will be adopted: – Limit vehicle speed to below 30 km/hour – Drivers shall have a valid driving license and driving experiences	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– Prohibit overweight trucks – Prohibit the use of drugs and alcohol during driving –	
Public Infrastructure	– Transportation of workers and construction materials. – Waste management and labor influx	✓			– Provision of onsite health care to ensure that basic medical attention and first aid treatment can be sought by workers. Cooperate with Kandal referral hospital (Ta Khmao city) to immediately respond to any accident. – Do not overload trucks, which may damage road. – Maintain and repair public and private roads that the project damages. – Implement waste management plan considering waste reduction, reuse, and recycling. Segregate hazardous and non-hazardous waste.	
Public Health and Safety	– Clearing, transportation and site preparation activities in the project site – Construction activities for airport infrastructure; – Worker and material transportation; – Waste and wastewater management; – Hazardous substance management; – Labor influx		✓		***With regard to air quality management in the construction phase, the measures are as follows:*** – The project will limit the driving speed of its vehicles in residential areas – All transport vehicles of the project will be in good condition with the project's safety standards, especially driving in compliance with the Road Traffic Law. – During transportation of construction material by trucks, construction material which could pose any dust dispersion (i.e. sand and stone transportation, etc.), should be covered and regularly monitored before transportation to ensure that the project's transportation activities do not pose any dust dispersion issues to the public road user. – The project will regularly spray water in the project site in those areas where dust dispersion may occur. ***With regard to traffic management in the construction phase, the measures are as follows:*** – A detour road will be constructed to avoid traffic passing along National Road No. 2 and other laterite roads. – Project will provide the schedule to the local community regarding land transport to project site. – Project will avoid transporting materials during rush hour and those times material transport could create any dust dispersion when driving on public roads.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– The project will display traffic signs on key spots such as entrance gates, road curves, and install road marking. – The project will notify the project's drivers to slow down when arriving sensitive spots such as schools, temples, health centres and hospitals. – The following risk mitigation measures in relation to material and worker transportation will be adopted: – Limit vehicle speed to below 30 km/hour – Drivers shall have a valid driving license and driving experiences – Prohibit overweight trucks – Prohibit the use of drugs and alcohol during driving – Prohibit the use of mobile phone while driving – Prohibit reckless driving – The project site is to be partially fenced and manned at all times to prohibit unauthorised entry. ***With regard to waste management in the construction phase, the measures are as follows:*** – The project will construct a dike to prevent accidental leakage of wastewater into water bodies. – The project will construct a sedimentation pond. – The project will have a secondary container to prevent accidental leakage of engine oil into water bodies. – The project will maintain sanitation and construct a septic tank. – The project will maintain spill kits/equipment, and post spill procedures on site, especially spill or leak response plans. – The project or contractor will educate its workers about communicable diseases and their symptoms. – The project will provide regular health check-ups to all workers. – The project will organize awareness campaigns on sanitation.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
2. Operational Phase						
2.1 Physical Resources						
Air Quality and Greenhouse Gases (GHG)	– Dust dispersion, air pollutants, and increased greenhouse gas emissions from fuel combustion of project activities such as flights take-off and landing, and passenger commuting		✓		– The project has a plan to utilise solar power as a supplementary power source (75 MW). – Switch off unnecessary machinery. – Both GHG and non-GHG emissions shall not exceed the international standards. – The project will maintain vegetation, wherever possible, within the site. – Aircraft emissions from combustion are unavoidable, but the project will ensure that fuel suppliers provide the best quality fuel possible. – Airport access road will be built in accordance with international standards to reduce potential traffic congestion.	
Noise and Vibration	– Increased flights – Tourist traffic		✓		– Collaborate with the local authorities and relevant instiutions to identify area vulnerable to noise disturbance and specific mitigation measures agreed by both the project owners and the affected villagers, particularly those in Pot Sor commune. – Control all activities in the airport to avoid loud noise. – Collaborate with the Traffic Police to facilitate the traffic at the airport access road. – Switch off unnecessary machinery. – Schedule aircraft movements further away from each other can help reduce the amount of continuous noise exposure to nearby receptors.	
Surface Water Quality	– soil erosion, fuel runoff, and wastewater runoff from the airport	✓			– The airport will have separate wastewater and rainwater management systems. – The airport will regularly monitor all waste, particularly treated wastewater, which is required to meet the MOE's wastewater standards before being released into public water bodies or the sewage system. – The airport will segregate and store waste in an appropriate, secure, and properly labeled containers. Organic waste will be composted. Other solid waste will be placed in an appropriate approved landfill.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– For hazardous waste storage site, the project will be appropriately managed and sign posted. - Fuel and hazardous substance tank will be stored in a bunded wall. - The airport will maintain spill kits/equipment, and post spill procedure notices, on site. - The drainage system will be built to accommodate rainwater runoff from the runway and passenger terminal before being released into the airport's retention ponds.	
2.2 Biological Resources						
Bird	– Noise disturbance, and aircraft collision with bird	✓			– The airport will prohibit the clearance of vegetation, which is the source of food and habitat for birds and mammals. – The airport will train its air traffic control tower staff to identify risks related to a swarm of birds and be aware of those birds that like to cruise high in the aircraft route (eg. Hawkeye) and warn pilots to delay landing or take-off. – The airport will chase birds away from hangars and surrounding sites through emitting noise, light, and the use of ground radar or other effective approved method. – Regularly review the presence of birds (every six months) in the airport and flight tracks. – Launch an off-set program to rehabilitate affected natural resources.	
Fishery	– Inappropriate management of waste, wastewater, and hazardous waste	✓			– The project will construct ae drainage system where there is potential runoff to reduce soil erosion. – The project will regularly monitor the management of all types of wastes, including the wastewater which discharges from the wastewater treatment plant. This treated water will be required to meet the MoE's standard, which allows the release of wastewater from polluted sources into protected public waters, or the public water areas and drainage system of the sub-decree on the water pollution control in 1999 of the MoE. – The airport will carefully separate and store solid waste, with clear markings on trash bins according to each type of trash and manage solid waste through composting, reuse, recyclng or burning in the incinerator or placement in a landfill.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– For hazardous wastes and other hazardous substances handling, the airport will be properly managed and undertake regular monitoring.	
2.3 Socio-Economic Resources						
Traffic and public infrastructure	– Increased traffic of tourist – Increased number of taxi – Increased traffic on National Road 2			✓	– The project will conduct a study to build a dedicated access road for the execution phase. – The airport will display traffic signs at key spots such as weight limit, speed limit, and road marking. – The airport will clearly mark the airport entrance and exit to reduce traffic congestion. – All airport's vehicles will need to be in good condition and comply with the airport's safety standards, especially driving in compliance with the Road Traffic Law of the Kingdom of Cambodia. All airport's drivers shall have a valid driving licence and respect the traffic laws – A driving safety code for airport's staff and workers and other airport equipment transportation will be implemented to ensure road safety while driving, especially to ensure that airport activities do not cause any potential traffic accidents or affect to other public road users. This code will include: driving behavior, driving speed limits (≤40 km/h) in residential areas, horn use, speed limits applicable to sensitive areas such as schools, temples, health centres and hospitals, etc.	
Public Health and Safety	– increased noise/vibration levels associated with aircraft's flight frequency (219-511 flights/day); – Increased traffic on National Road 2, and dust dispersion	✓			– Collaborate with the local authorities and relevant instiutions to identify area vulnerable to noise disturbance and specific mitigation measures agreed by both the project owners and the affected villagers, particularly those in Pot Sor commune. – Control all activities in the airport to avoid loud noise. – Collaborate with the Traffic Police to facilitate the traffic at the airport access road. – Switch off unnecessary machinery. – Schedule aircraft movements further away from each other can help reduce the amount of continuous noise exposure to nearby receptors.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					– Develop waste management plans including waste and hazardous substance management procedures, waste collection schedules, and reuse/recycling programmes. – The airport company will need to provide training on driving safety standards to its staff to ensure that traffic incidents or accidents while using local roads are reduced or limited and don't have an adverse impact on the local community – During transportation of all materials (including waste by trucks and loads which potentially pose any dust), the material will be properly covered before transportation to prevent dust emissions when driving on public roads. – Collaborate with Kandal Provincial Department of Public Work and Transport to install pedestrian crossing signs on the National Road No. 2, particularly at the airport entrance.	
Aircraft accident risk	– Weather, aircraft collision with bird, miscalculation before take-off, engine, New or old aircraft, and runway condition.	✓			– The airport's firefighting station will be built with international standards, with enough fire suppression vehicles to cope with any risks that may happen. – Notify aircraft bound for the airport about bad weather. – Ensure appropriate training and validation of all air traffic control staff – Ensure appropriate level of navigation aids, regularly checked and serviced – Carry out regular training emergency exercises, desk top and real-time – Monitor the runway's humidity and dryness in accordance with specification by airport's inspector. – Collaborate with Cambodian authorities of all levels in case there is any aircraft accident to ensure timely rescue. – Comply with Cambodia Civil Aviation Authority's guidelines and the standards and recommended practices (SARPs) of the International Civil Aviation Organization (ICAO) – Collaborate with the local authorities and the Civil Aviation State Secretariat to set below height restrictions: o Approach path/take-off climb zone: the height of building and tree, existing between the edge of runway to 15,000 meters away, shall be below 150 meters.	

Environmental and Social Resources	Key Activities	Significance of Impact			Mitigation Measures	Others
		Low	Mod.	High		
					o Transitional zone: the height of building and tree, existing between 150 meters from the runway axis and 465 meters from the runway axis, shall be below 45 meters. o Inner Horizontal/Conical/Outer Horizontal zone: ▪ For 4,000 meter perimeter from the runway axis: the height of building and tree shall be below 45 meters. ▪ For 4,000 meter to 6,000 meter perimeter from the runway axis: the height of building and tree shall be below 45 meters-145 meters. ▪ For 6,000 meter to 15,000 meter perimeter from the runway axis: the height of building and tree shall be below 150 meters.	
Accidental Fire and Explosion	– Burning of waste, cigarette butt disposal, fuel or flammable substance leakage	✓			– All fuel oil storage units are appropriate, sealed and covered from any sunlight based on international safety standards, to reduce the risk of leaking or explosion. – The airport will ultimately have two airside fire-fighting stations and two landside firefighting stations that are capable to prevent and control accidental fire or explosion. – The airport has an Emergency Response Plan in case of any accidental fire or explosion. – The airport will prohibit the burning of garbage and other wastes in the airport vicinity. – The airport will collaborate with the local authorities, the provincial firefighting unit, and the provincial authorities to timely respond to any fire risk or explosion.	
3. Closing phase						
There is no major activity that will affect natural and social environmental resources. The project owner will transfer the airport management to the Royal Government of Cambodia.						

8.4 Training Programmes

To ensure the smooth and effective implementation of the EMP, it requires full participation from project's personnel. Skills training on environmental protection for project personnel will be conducted to equip them with environmental issue-related concepts and knowledge that would benefit in implementing the project's activities.

The purpose of the training programmes is to keep the project's business sustainable. In other words, it is to produce human resources with the full capacity to fulfil both technical and environmental tasks. This training programme will focus on:

- The Law on Environmental Protection and other legal documents related to environmental and social protection.
- Training on the results of environmental and social impact assessment reports
- Training on the strengthening of management and monitoring
- The training on Occupational safety and health (OSH) including: physical risk, chemical risk, biological risk, lifting injuries risk, electrocution risk, fire and explosion risk, risk of working in confined area, risk of night work, safety and security, Covid-19 prevention and other risks.

8.4.1. Training on the results of the environmental and social impact assessment report

Cambodia Airport Investment Co Ltd (CAIC) plans to educate human resources on environmental and social impact assessment reports, noise and vibration, health and work safety, public health and safety, etc to contribute to helping prevent environmental harms when the project begins. In addition, the training program helps to increase the awareness of the staff-labor to be effective in reducing the impacts. The knowledge and skills gained from this training will enhance the capacity of staff-labor and other project stakeholders in implementing the master plan of the project in order to achieve environmental and socially sustainable development. To achieve this goal the project plans to provide the following training sessions for staff-labor and other stakeholders:

- Training on environmental and social issues that may be affected by the implementation of the project activities at each stage of the project.
- Strengthen the dissemination of a number of laws and legal principles related to the project
- Establish short training courses on works safety and public health and safety.

8.4.2. Training session on strengthening management and monitoring

The training program on strengthening the management and monitoring of the implementation of the environmental and social management plan will be conducted through technical training for staff and labor in order to implement the master plan effectively. This training program will ensure that all staff and labor understand their duties and responsibilities in relation to their environment and social issues. The purpose of this training is to contribute to the effective implementation of the environmental and social management plan as follows:

- Enhance technical knowledge of the soil excavation and machinery/machine inspection at each stage to ensure that the work practice complies with technical standards and has effectiveness and avoid adverse impacts on health, occupational safety, public health and safety, noise and vibration, and air quality.
- Work safety at each stage of the project involves risk responding procedures, healthcare, and the use of protective equipment.
- Training course on response procedures when having accidents or risks

- Enhance knowledge of the staff and labor in monitoring and implementing the environmental management plan set out in Chapter 8 of the full EIA Report.
- Management of solid-liquid waste both in the construction phase, the execution phase and the completion phase of the project.

8.5 Monitoring Programmes

The monitoring programmes are carried out to manage and mitigate the significant negative impacts caused by project activities in each stage (pre-construction and operational phases) through monitoring processes as shown in details in the table below:

Table 111: Environmental and social monitoring programs

Environmental Resources	Activities, Parameters to be monitored, and method	Location	Frequency	Responsible Institution	Monitoring Institution	Budget (US$)
1. Pre-Operational phase (Construction phase)						
1.1 Physical Resources						
Topography	Monitoring on: - Clearance and soil backfilling on the project site, and project site levelling - Soil stockpile or debris after site clearance	• In the project area	• Regularly	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE	Include in construction budget
Air quality and GHG	Monitoring on: - Transportation activity, clearance, soil compaction in the project site - Runway and other supporting infrastructure construction activities - Soil stockpile - Air quality monitoring plan	• In the project area	• Regularly	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	6,000
	Monitoring on: - Air parameters analysis focus on: CO, NO_2, O_3, SO_2, Pb, TSP, PM10 and PM2.5 - Comparing with MoE's air quality standard.	<u>Location 1:</u> X: 491617 Y: 1254210 <u>Location 2:</u> X: 488937 Y: 1253580 <u>Location 3:</u> X: 496685 Y: 1254320 <u>Location 4:</u> X: 488901 Y:1257380	• Every 6 months			
Noise and Vibration	Monitoring on:	• In the project area	• Regularly	• CAIC	- **National level:**	6,000

Environmental Resources	Activities, Parameters to be monitored, and method	Location	Frequency	Responsible Institution	Monitoring Institution	Budget (US$)
	- Implementation of mitigation measures on Noise and vibration disturbance - Construction machineries operation mode and project's material transportation mode - Construction machineries maintenance plans			• Contractors • SSCA	- MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	
	Monitoring on: - Sampling on noise and vibration disturbance based on the noise and vibration allowable standard of MoE	<u>Location 1:</u> X: 491617 Y: 1254210 <u>Location 2:</u> X: 488937 Y: 1253580 <u>Location 3:</u> X: 496685 Y: 1254320 <u>Location 4:</u> X: 488901 Y:1257380	• Every 6 months			
Surface water quality	Monitoring on: - Solid waste management: • Temporary waste storage with roof and concrete seal • Transfer waste from the project site - Wastewater management: • Efficient wastewater treatment • Waastewater discharge to water bodies - Implementation of mitigation measures on surface water quality impact - Surface water quality management and monitoring plan.	• In the project site	• Regularly • When leakage occurs	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	5,000

Environmental Resources	Activities, Parameters to be monitored, and method	Location	Frequency	Responsible Institution	Monitoring Institution	Budget (US$)
	Monitoring on: - Surface water quality analysis focus on the following parameters such as pH, Temperature, TDS, TSS, DO, BOD5, COD, Oil and Grease, Detergent, SO4, TN, TP, As, Fe, Hg, Pb, Cd, and Total Coliform\ - Compare with surface water quality standard of MoE (The standard for lake, reservoirs and seawater).	Location 1: X: 493299 Y: 1252180 Location 2: X: 491536 Y: 1252354 Location 3: X: 493513 Y: 1259352 Location 4: X: 489848 Y:1257382	Every 6 months			
Hydrology system	Monitoring on: - Site clearance activities and soil backfilling plan at the project site - Erosion prevention plan.	• In the project area	• 1 time/year	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in construction budget
Soil and Ground water quality	Monitoring on: - Fuel waste management - Construction machineries maintenance, repaired and fuel oil replacement plan - Soil erosion management and prevention	• In the project area	• Regularly	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	5,000
	Monitoring on: - Analysis on parameters such as pH, TN, TP, K, As, Cd, Cu, Fe, Hg, Pb and Cr - Comparing with the permit standard on chemical substance or hazardous	Location 1: X: 495823 Y: 1255478 Location 2: X: 303613	• Every 6 months • When leakage occurs			

Environmental Resources	Activities, Parameters to be monitored, and method	Location	Frequency	Responsible Institution	Monitoring Institution	Budget (US$)
	substance which allow to be in soil of MoE	Y: 1204565				
1.2 Biological resources						
Forest	Monitoring on: - Clearance and construction techniques, and machineries operation - Forest management plan and vegetation clearance plan	• In the project area	• 1 time/year	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in construction budget
Wildlife and Birds	Monitoring on: - Clearance and soil backfilling activity plan - Forest management plan - Noise and vibration levels caused by the project activities	• In the project area	• 1 time/year	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in construction budget
Fisheries	- Consult with fishing communities	• Surrounding fishing communities	• 1 time/year • When any leak or spill of oil/liquids waste	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in construction budget
	Monitoring on: - Surface water quality analysis focus on the following parameters such as pH,	<u>Location 1:</u> X: 493299 Y: 1252180	• Every six month	• CAIC • Contractors • SSCA	-	

Environmental Resources	Activities, Parameters to be monitored, and method	Location	Frequency	Responsible Institution	Monitoring Institution	Budget (US$)
	Temperature, TDS, TSS, DO, BOD5, COD, Oil and Grease, Detergent, SO4, TN, TP, As, Fe, Hg, Pb, Cd, and Total Coliform\	Location 2: X: 491536 Y: 1252354 Location 3: X: 493513 Y: 1259352 Location 4: X: 489848 Y:1257382				
1.3 Socio-Economic Resources						
Land use	Monitoring on: - Solid waste, liquid waste and hazardous waste management plan - Site clearance and soil backfilling activity plan - Mechanisms of Land conflict resolution	• In the project area	• 1 time/year	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in construction budget
Fishing	- Consult with fishing communities	• Surrounding fishing communities	• 1 time/year • When any leak or spill of oil/liquids waste	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in construction budget
	Monitoring on: - Surface water quality analysis focus on the following parameters such as pH, Temperature, TDS, TSS, DO, BOD5, COD, Oil and Grease, Detergent, SO4,	Location 1: X: 493299 Y: 1252180 Location 2: X: 491536	Every six month	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national**	Include in construction budget

Environmental Resources	Activities, Parameters to be monitored, and method	Location	Frequency	Responsible Institution	Monitoring Institution	Budget (US$)
	TN, TP, As, Fe, Hg, Pb, Cd, and Total Coliform	Y: 1252354 <u>Location 3:</u> X: 493513 Y: 1259352 <u>Location 4:</u> X: 489848 Y:1257382			- KDPDoE - Takeo Provincial DoE - Local authorities	
Traffic and Public Infrastructure	Monitoring on: - Driving on the National Road No. 2 - Safety and public health management plan - Traffic signs at the project entrance - Public infrastructure in the project area - Consult with the local authorities and relevant institutions - Construction waste handling	• In the project area • National Road No. 2	Regularly 1 time/year	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in construction budget
Public health and safety	Monitoring on: - Implementation of mitigation measures on impact of public health and safety - Construction material transportation Plan and management procedure - Public health and safety management plan - Public infrastructure which used by the project - Dust, noise and vibration management plan - Grievances mechanism resolution of local communities	• In the project area	• 1 times/year • Regularly	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - MoLVT - **Sub-national** - Kandal PDoE - Takeo Provincial DoE - Kandal PDoLVT - Takeo PDoLVT - Local authorities	Include in construction budget
	Monitoring on: - Surface water quality analysis focus on the following parameters such as pH,	<u>Location 1:</u> X: 493299 Y: 1252180	• Every six month	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT	Include in construc

Environmental Resources	Activities, Parameters to be monitored, and method	Location	Frequency	Responsible Institution	Monitoring Institution	Budget (US$)
	Temperature, TDS, TSS, DO, BOD5, COD, Oil and Grease, Detergent, SO4, TN, TP, As, Fe, Hg, Pb, Cd, and Total Coliform	Location 2: X: 491536 Y: 1252354 Location 3: X: 493513 Y: 1259352 Location 4: X: 489848 Y:1257382			- **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	tion budget
	Monitoring on: - Analysis on parameters such as pH, TN, TP, K, As, Cd, Cu, Fe, Hg, Pb, Cr, Mn, Al, Total coliform, and E-coli - Comparing with the permit standard on chemical substance or hazardous substance which allow to be in soil of MoE	Location 1: X: 495823 Y: 1255478 Location 2: X: 303613 Y: 1204565	• Every 6 months • When leakage occurs	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in construction budget
2. Operational phase						
2.1 Physical Resources						
Air quality and GHG	Monitoring on: - Control traffic of vehicles in and out airport; - Aircraft's landing and take-off - Implement air quality control plan	• In the airport area • On national road 2	• Regularly	• CAIC • SSCA	- **National level:** - MoE - MPWT - SCAC - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in operation budget
	Monitoring on: - Air quality analysis focus on following parameters: CO, NO_2, O_3, SO_2, Pb, TSP, PM10 and PM2.5 - Compare to the MoE's air quality standard	Location 1: X: 491617 Y: 1254210 Location 2: X: 488937 Y: 1253580 Location 3:	• Every 6 months			6,000

Environmental Resources	Activities, Parameters to be monitored, and method	Location	Frequency	Responsible Institution	Monitoring Institution	Budget (US$)
		X: 496685 Y: 1254320 <u>Location 4:</u> X: 488901 Y:1257380				
Noise and Vibration	Monitoring on: - Increased land traffic on the National Road No. 2 - Aircraft noise Management	• In the project area	• Regularly	• CAIC • SSCA	- **National level:** - MoE - MPWT - SCAC - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in operation budget
	Monitoring on: - Sampling on noise and vibration disturbance based on the noise and vibration allowable standard of MoE	<u>Location 1:</u> X: 491617 Y: 1254210 <u>Location 2:</u> X: 488937 Y: 1253580 <u>Location 3:</u> X: 496685 Y: 1254320 <u>Location 4:</u> X: 488901 Y:1257380	Every six months			6,000
Surface water quality	Monitoring on: - Solid waste, liquid waste and hazardous waste management plan in the airport - Wastewater treatment method, and wastewater quality at the discharge point - Hazardous waste storage - Surface water quality management and monitoring plan	• In the airport area	• Regularly • When leakage occurs	• CAIC • SSCA	- **National level:** - MoE - MPWT - SCAC - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	5,000
	Monitoring on:	<u>Location 1:</u> X: 493299	Every six months			

Environmental Resources	Activities, Parameters to be monitored, and method	Location	Frequency	Responsible Institution	Monitoring Institution	Budget (US$)
	- Surface water quality analysis focus on the parameter such as pH, Temperature, TDS, TSS, DO, BOD_5, COD, Oil and Grease, Detergent, SO_4, TN, TP, As, Fe, Hg, Pb, Cd, and Total Coliform - Compare with surface water quality standard of MoE (The standard for lake, reservoirs and seawater)	Y: 1252180 Location 2: X: 491536 Y: 1252354 Location 3: X: 493513 Y: 1259352 Location 4: X: 489848 Y:1257382				
Soil and Ground water quality	Monitoring on: - Fuel waste management - Construction machineries maintenance, repaired and fuel oil replacement plan - Soil erosion management and prevention	• In the project area	• Regularly	• CAIC • Contractors • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	5,000
	Monitoring on: - Analysis on parameters such as pH, TN, TP, K, As, Cd, Cu, Fe, Hg, Pb, Cr, Mn, Al, Total Coliform, and E-Coli. - Comparing with the permit standard on chemical substance or hazardous substance which allow to be in soil of MoE	Location 1: X: 495823 Y: 1255478 Location 2: X: 303613 Y: 1204565	• Every 6 months • When leakage occurs			
2.2 Biological Resources						
Wildlife and Birds	Monitoring on: - Noise and vibration levels caused by aircraft when landing or taking-off and collision with birds - Leakage of hazardous substance into water bodies	• In the airport area	• Regularly	• CAIC • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE	Include in operation budget

Environmental Resources	Activities, Parameters to be monitored, and method	Location	Frequency	Responsible Institution	Monitoring Institution	Budget (US$)
					- Takeo Provincial DoE - Local authorities	
2.3 Socio-Economic Resources						
Traffic and Public Infrastructure	Monitoring on: - The number of tourists' vehicles on the road 2 - Driving on the National Road No. 2 - Public health and safety management plan - Traffic signs installation at the project entrance - Transportation activities of the project	• In the airport area • National road 2	• Regularly • 1 time/year	• CAIC • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in operation budget
Public health and safety	Monitoring on: - Control noise emitted by airplane - Air quality, noise, and vibration levels. - Increased number of vehicles on the National Road No. 2.	• In the airport area • In residential areas	• 1 time/year	• CAIC • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in operation budget
Risk of aircraft crash	Monitoring on: - Take-off and landing direction and other obstacle on the flight rout - Building height below the flight tracks - Passenger injury due to aircraft crash - Firefighting station and emergency response procedures - Fire extinguisher and standard operational procedure	• In the airport area • Flight track	• Regularly • 1 time/year	• CAIC • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in operation budget

Environmental Resources	Activities, Parameters to be monitored, and method	Location	Frequency	Responsible Institution	Monitoring Institution	Budget (US$)
d. Risk of fire and other explosions	Monitoring on: - Aviation fuel storage procedures and safety standard of fuel companies - Surrounding residential situation nearby the Airport - Firefighting station and emergency response procedures - Fire extinguisher and standard operational procedure	• In the airport area	• Regularly	• CAIC • SSCA	- **National level:** - MoE - MPWT - **Sub-national** - KDPDoE - Takeo Provincial DoE - Local authorities	Include in operation budget

8.6 Budget Plan for Monitoring Programme

A budget plan for the monitoring programme of this project is estimated to be approximately US $22,000 per year. This budget plan would be varied based on each activity's implementation.

Table 112: Budget plan for monitoring program of each phase

No.	Environmental Resource	cost/time	frequency	total cost/year (US$)
a. Pre-construction phase (Design and Construction phase)				
1	Topography	-	Regularly	-
2	Air quality and GHG	3,000	Twice/year	6,000
3	Noise and Vibration	3,000	Twice/year	6,000
4	Surface water quality	2,500	Twice/year	5,000
5	Hydrology	-	Regularly	-
6	Soil and Groundwater quality	2,500	Twice/year	5,000
7	Forest	-	Regularly	-
8	Wildlife	-	Regularly	-
9	Fisheries	-	Regularly	-
10	Land use	-	Regularly	-
11	Fishing	-	Regularly	-
12	Traffic	-	Regularly	-
13	Occupational health and safety	-	Regularly	-
14	Public health and safety	-	Regularly	-
Total Cost (US$)				**22,000**
b. Operational Phase				
1	Air quality and GHG	3,000	Twice/year	6,000
2	Noise and Vibration	3,000	Twice/year	6,000
3	Surface water quality	2,500	Twice/year	5,000
4	Soil and ground water	2,500	Twice/year	5,000
5	Wildlife	-	Regularly	-
6	Traffic and public infrastructure	-	Regularly	-
7	Public health and safety	-	Regularly	-
8	Risk of aircraft accident	-	Regularly	-
9	Risk of fire and other explosions	-	Regularly	-
Total Cost (US$)				**22,000**

8.7 Monitoring Report Preparation

This section outlines the reporting frequencies and types of reports to be prepared for the Project with regards to environmental management, monitoring, and compliance. A concrete reporting system will provide the project's necessary feedback mechanism to ensure the quality and timely implementation of work.

8.7.1 Monitoring Report Preparation for the Authority

To ensure that relevant institutions, especially the Department of Environmental Impact Assessment of the MoE receives adequate information regarding to the results of the implementation of the EMP, the project owner will prepare a monitoring report every 6-months basis (two times/year) for submission to the regulatory authorities (the Department of Environmental Impact Assessment of the MoE. The monitoring report will be prepared by the CAIC or its independent responsible person or institution who they have authorised to monitor the implementation of the EMP.

The MoE (Department of Environmental Impact Assessments, and the Department of Environment of Kandal province) is a receiver of reports of the results of the implementation of the EMP. If the report has any shortcomings associated with the implementation of the EMP, the MoE or inter-ministerial team must report deficiencies to CAIC to do a number of necessary adjustments and update the EMP to fulfill the gaps and follow the given recommendations.

8.7.2 CAIC's Internal Reporting

CAIC will develop a reporting system with regard to accident, occupational health and safety, security, operation, or environment. This system will facilitate any investigation and the development of action plan to prevent any issue if necessary. In the operational phase, CAIC will develop an information system to timely respond to any risk.

8.8 The Establishment of an Environmental and Social Fund

In 2016, the Royal Government of Cambodia issued a sub-decree on the Establishment of Environmental and Social Funds that requires development projects to establish an environment and social fund for the purpose of environmental restoring, preventing, conserving biodiversity, natural resources consumption appropriately and sustainably, as well as living sustainably for long-term benefits of every new generation in the Kingdom of Cambodia.

For this project, environmental and social funds will be used for the following activities:

- Sustainable environmental protection, forest conservation, biodiversity conservation, ecosystems, and sustainable livelihoods;
- Environmental restoration, biodiversity and ecosystem rehabilitation throughout the Kingdom of Cambodia;
- Infrastructure development will improve the daily livelihood conditions of the people, who live in and around development project area or other areas;
- Technical research, scientific biodiversity, ecology system;
- Scientific research on environment field;
- Promoting environmental management
- Support any programmes on Establishment of Natural Resource Protection Community and other communities which are serving the r environmental;
- Human resources training for natural resource and environmental field, and
- Awareness raising activities about natural protected areas.

In order to contribute to the Royal Government of Cambodia in restoring and protecting environment, conserving biodiversity, and use the natural resources appropriately and sustainablity, the project owner will establish an environment and social fund to the MoE for a total of US$ 700,000 per over 10 years: US$ 450,000 for the environmental fund and another US$ 250,000 for the social fund.

- Year 1 – 3 (2021 – 2023): US$ 40,000 per year (US$ 30,000 for the environmental fund and another US$ 10,000 for the social fund)
- Year 4 – 6 (2024 – 2026): US$ 60,000 per year (US$ 40,000 for the environmental fund and another US$ 20,000 for the social fund)
- Year 7 – 10 (2027 – 2030): US$ 100,000 per year (US$ 60,000 for the environmental fund and another US$ 40,000 for the social fund)

Chapter 9 Environmental Analysis and Environmental Costs

9.1 Introduction

9.1.1 Objective

Economic and environmental value analysis is very important to present the economic benefits and losses of environmental resources caused by the project, to the public, especially the decision makers of this airport project. The main objective of the economic and environmental value analysis is to determine the cost-benefits of environmental and socio-economic resources caused by the project.

In this study, economic and environmental value analysis focused on positive economic, environment and social impact, and negative natural environment and socio-economic resources impact as shown in the following sections. The analysis is based on Cambodia Airport Investment Company's master plan and the data from socio-economic and environmental resources within 3 km from the project area. Environmental resources refer to key ecosystem services such as provisioning services (e.g. fish and plant), regulating services (e.g. air quality, noise), and supporting services (e.g. habitat for bird, reptile, and fish). The period of economic analysis is 32 years (2019-December 2050) using 9% discount rate of the Asian Development Bank[9]

9.2 Economic and Social Benefits

9.2.1 Promoting National Economic Growth

The total investment of this project is 1,500 million USD, which will be spend on airport construction and other infrastructure.The New Phnom Penh International Aairport will spend on site preparation, machinery, equipment, materials, and other services provided by Cambodian and foreign companies. Such expenses will nurture new business opportunities and improve Cambodia's economic status. The cash circulation will promote national economic growth, increase GDP, and improve livelihoods.

9.2.2. National income through tax payment

The project will provide significant national income through various taxes such as a tax on tourists who travel via the airport, a tax on profits, and a tax on staff salaries, based on the laws and contracts between the project owner and Royal Government of Cambodia.

9.2.3 New Jobs Generated by the Project

The project involves key activities such as planning, airport construction, and airport operation. In the planning phase, the project creates a lot of job opportunities for engineers, architects, financial consultants, administrative staff, legal experts, and coordination and communication experts. According to the master plan, the project will create 2,200 direct jobs. In the construction phase, the project will create a lot of jobs for team leaders, technicians, engineers, administrative and finance staff, security staff, and workers.

In the operational phase, the project creates a lot of job opportunities for Cambodians including team leaders, technicians, engineers, air traffic controllers, refuelling and maintenance staff, administrative officers, financial officers, vendors and security guards.

[9] https://www.adb.org/sites/default/files/institutional-document/32256/economic-analysis-projects.pdf

9.2.4 Indirect Job Creation

Upon completion, the airport will serve domestic and international flights. Based on the project's masterplan, the forecast passenger would be 13 million by 2030 and 30 million by 2050. The presence of these passengers will create indirect jobs opportunities for the local people who live around the project site through various services such as the sale of food and groceries, hotel provision and transportation.

9.2.5 Increase of Tourist Arrivals

Based on CAIC's plan, 13 million passengers are expected to arrive in the first phase and 30 million passengers in the second phase. The increasing capacity of Cambodian aviation sector, particularly the construction of international airport, will promote the aviation sector in general and will accommodate large aircrafts. This will, in turn, increase domestic and foreign tourist arrivals.

9.2.6. Contribution to social development and environmental protection

The project has planned to assist the Royal Government in developing communities and protecting natural resources. The project comply with existing legal instruments by contributing to the environmental and social funds through annual disbursement of 10,000 when the operational phase kicks off. The disbursement amount is assumed to be constant until 2050, and the project will start making disbursement to the Ministry of Environment in 2020.

9.3. Economic, Social and Environmental Losses

9.3.1 Fishing area loss

The value of fishing area loss is determined by the amount of fish catch (lake's provisioning service) generated by local villagers in the past. As described in Chapter 5 of this report, the airport construction will backfill an area of 306 hectares of Beoung Choung Loeung lake. This will affect the fishing area of 100 fishing families in Sala Taprom village. The subsistence fishing is conducted near the lake's bank and use small fishing gears. The number of times that villagers go fishing vary from month to month, and the average is 15 times per month. It is also found that the average fish catch is 3 kg/day/family, while the value is 17,400 Riel/kg. Therefore, upon backfilling, the loss would be approximately USD 238,100 per year. This value is assumed to be constant until 2050 because the fishery resources in this area are expected to decline due to illegal fishing activities, lake encroachment, and other development projects surrounding the lake despite the absence of the airport project.

9.3.2 Agricultural area loss

The land use survey shows that the proposed location for airport sits on an area of 2,015 hectares of paddy fields for dry season rice production, which will be converted to other uses apart from rice production. The average rice yield for dry season in this area is 1.5 ton, equivalent to USD 320. Therefore, the total loss would be USD 644,800 per year. In the economic analysis, the future value of agricultural area loss is assumed to be constant every year until year 32.

9.3.3 Noise impact during the operational phase

The noise impact assessment is largely based on Philip J. Wolfe et al (2014) study on the near-airport distribution of the environmental costs of aviation in the United States. It adopts the aviation environmental portfolio management tool model to determine the noise emitted by aircraft and potential receptors. The Willing-to-pay method is used to estimate the value of noise impact. According to the study, the average costs per person who may be affected by noise within 5km around the airport, are approximately US$41/year. By using purchasing power parity (PPP), US$41/year of the average costs per person who may be affected by noise in the United States, and is approximately USD 14.35 (2018) in Cambodia. According to the scope of the study within the 3 km radius of the airport, there are approximately 40,160 people. Therefore, the average expenditure due to noise in the construction phase would be USD 576,296 per year. This value is assumed to be constant till 2050.

9.3.4 Greenhouse Gas Emissions in the Operational Phase

According to the calculation, the annual greenhouse gas emissions from aircraft will be 3,385.67 kt CO_2 eq. According to Carbon Footprint, Verified Carbon Standard (VCS) is priced at USD 7.68 per ton of CO_2 eq. Therefore, the estimated price of carbon emissions during the operational phase is USD 25,996, which is assumed to be constant till 2050.

9.4 Cost and Benefit Analysis

Based on the above analysis, the project's present value (Price in 2019) over a period of 32 years is as follows:

Table 113: Net Present Value (2019)

Year	Environmental and Social Funds	Fishing Area Loss	Agricultural Land Loss	Noise Impact	GHG Emissions	Long-tailed Macaque Habitat Loss
2019				$ 591,560		
2020			$ 200,404	$ 542,715	$ 485,057	$ 21,880
2021		$ 11,583	$ 183,857	$ 497,904	$ 445,006	$ 20,074
2022		$ 10,626	$ 168,676	$ 456,793	$ 408,263	$ 18,416
2023	$ 4,289,547	$ 9,749	$ 154,749	$ 419,076	$ 374,553	$ 16,896
2024	$ 4,029,420	$ 8,944	$ 141,971	$ 384,473	$ 343,626	$ 15,501
2025	$ 3,785,067	$ 8,206	$ 130,249	$ 352,728	$ 315,254	$ 14,221
2026	$ 3,555,532	$ 7,528	$ 119,494	$ 323,603	$ 289,224	$ 13,047
2027	$ 3,339,917	$ 6,906	$ 109,628	$ 296,884	$ 265,343	$ 11,969
2028	$ 3,137,377	$ 6,336	$ 100,576	$ 272,370	$ 243,434	$ 10,981
2029	$ 2,947,119	$ 5,813	$ 92,272	$ 249,881	$ 223,334	$ 10,074
2030	$ 2,768,399	$ 5,333	$ 84,653	$ 229,249	$ 204,893	$ 9,242
2031	$ 2,600,518	$ 4,893	$ 77,663	$ 210,320	$ 187,975	$ 8,479
2032	$ 2,442,817	$ 4,489	$ 71,251	$ 192,954	$ 172,455	$ 7,779
2033	$ 2,294,679	$ 4,118	$ 65,368	$ 177,022	$ 158,215	$ 7,137
2034	$ 2,155,524	$ 3,778	$ 59,970	$ 162,406	$ 145,152	$ 6,548
2035	$ 2,024,809	$ 3,466	$ 55,019	$ 148,996	$ 133,167	$ 6,007
2036	$ 1,902,020	$ 3,180	$ 50,476	$ 136,694	$ 122,171	$ 5,511
2037	$ 1,786,677	$ 2,917	$ 46,308	$ 125,407	$ 112,084	$ 5,056
2038	$ 1,678,329	$ 2,676	$ 42,484	$ 115,052	$ 102,829	$ 4,638
2039	$ 1,576,552	$ 2,455	$ 38,977	$ 105,553	$ 94,339	$ 4,255
2040	$ 1,480,946	$ 2,253	$ 35,758	$ 96,837	$ 86,549	$ 3,904
2041	$ 1,391,138	$ 2,067	$ 32,806	$ 88,841	$ 79,403	$ 3,582
2042	$ 1,306,776	$ 1,896	$ 30,097	$ 81,506	$ 72,847	$ 3,286
2043	$ 1,227,531	$ 1,740	$ 27,612	$ 74,776	$ 66,832	$ 3,015
2044	$ 1,153,090	$ 1,596	$ 25,332	$ 68,602	$ 61,314	$ 2,766
2045	$ 1,083,165	$ 1,464	$ 23,240	$ 62,938	$ 56,251	$ 2,537
2046	$ 1,017,479	$ 1,343	$ 21,321	$ 57,741	$ 51,606	$ 2,328
2047	$ 955,777	$ 1,232	$ 19,561	$ 52,973	$ 47,345	$ 2,136
2048	$ 897,816	$ 1,131	$ 17,946	$ 48,599	$ 43,436	$ 1,959
2049	$ 843,371	$ 1,037	$ 16,464	$ 44,587	$ 39,850	$ 1,798
2050	$ 792,227	$ 952	$ 15,105	$ 40,905	$ 36,559	$ 1,649
Total	$ 58,463,618	$ 129,707	$ 2,259,285	$ 6,709,944	$ 5,468,363	$ 192,244

Year	Environmental and Social Funds	Fishing Area Loss	Agricultural Land Loss	Noise Impact	GHG Emissions	Long-tailed Macaque Habitat Loss
	$58,593,325 (Present value of total profits)		$14,629,836 (Present value of total losses)			

Source: E&A Consultant (2019)

9.5 Conclusion

As shown above, although the project would incur some costs on environmental, social and economic resources, the project would bring substantial benefits to the Cambodian economy. According to the calculations above, the economic losses caused by the project's existence during the 32-year period totaled US $ 14.6 million, while the potential return was 58.5 million. USD (value in 2019). These benefits will be distributed to the economic system through marketing mechanisms to the Cambodian people involved in the project.

Chapter 10 Conclusion and Recommendations

10.1 Conclusion

The New Phnom Penh International Airport Development Plan has been approved by the Royal Government of Cambodia for the purpose of facilitating and meeting the growing demand for air transportation, while the present Phnom Penh Airport is currently unable to expand. Cambodia Airport Investment Co LTD (CAIC), under a Public-Private Partnership signed with the Royal Government of Cambodia in 2017, received the investment concession to develop and manage the New Phnom Penh International Airport in Kandal which is a province that surrounds Phnom Penh capital. CAIC is the investment of two companies: OCIC (90%) and State Secretariat of Civil Aviation, which represents the Royal Government of Cambodia (10%).

The project site is about 23 km from Phnom Penh. The total land area is 2,600 hectares, located in Kandal's province Kandal Stung district and Sa'ang district, and Takeo province's Bati district. The new Phnom Penh International Airport is a Category 4F airport capable of operating and receiving all current aircraft types, and is divided into two main phases covering a combined area of 1,638 hectares, with a reserved area of 962 hectares.

The construction period of Operational Phase 1 is three years (2020-2023), while the second runway expects to complete in 2025. Key activities in the construction include machinery mobilization, site preparation, runway and other infrastructure construction, and construction site cleaning. The airport construction consists of two runways, passenger terminal, apron, supporting infrastructure and ground service.

In the operational phase, the airport will allow a number of aircraft types to operate such as B777-300ER B78-8 B787-9 A330-243 B747-8 and A380-841. International flight destinations include China (Beijing, Shanghai, Guangzhou, and Shenzhen), South Korea (Seoul), Vietnam (Ho Chi Minh City), Thailand (Bangkok), Singapore, Hong Kong, and Taiwan, etc. According to the forecast, the airport expect to receive 13 million and 30 million passengers per year in 2030 and 2050, respectively.

To comply with the Laws for the Protection of Natural Resources, and Sub-decree 72 of the Environmental Impact Assessment Report, the New Phnom Penh International Airport project has prepared the Environmental Impact Assessment Report for submission to the Ministry of Environment for reviews and recommendation.

A comprehensive environmental and social impact assessment study of the New Phnom Penh International Airport project was conducted in response to the Term of Reference (ToR) approved on January 17, 2019. In addition, the project owner has completed all requirements set in TOR to prepare an Environmental Impact Assessment Report and Prokas on the General Guideline of Environmental Impact Assessment of the Ministry of Environment in 2009.

Physical resources: The study on physical resources include geology, topography, soil type, hydrology, and climate. Geotechnical investigation assesses soil compaction, which is suitable for foundation. In addition, the air quality, noise, and vibration test results are within the MOE's standards.

The surface water quality test in the dry season (February 2019) and wet season (May 2019) show that almost all parameters in the four locations are within the MOE's standards. For the first location (SW-01, Boeung Cheung Loung lake), five parameters (TSS, Oil & Grease, COD, TN, and TP) exceed the standards because it is a natural lake where there is daily fishing activity. Leakage of oil from fishing boat may have increased the amount of TSS and Oil & Grease.

For the other three locations (SW-02, SW-03, and SW-04), five parameters (DO, Oil & Grease, Coliform, TN, and TP) exceed the standards. This may have caused by the decay of leaf or aquatic vegetation as well as sewage or kitchen waste disposal from residences along the river or stream. However, they slightly exceed the standards, which is not a concern.

The surface water quality test results suggest that most parameters except As and Fe-total are within the national drinking water standards of the Ministry of Industry and Handicraft of the Kingdom of Cambodia (2004). This may be due to Kandal province as a whole has relatively higher As and Fe-total contents than other provinces of Cambodia. The increase of Fe content may have been a natural process within the soil subsurface or the leakage of contents from well construction materials.

Biological resources: The study area is a flooded area, consisting of rivers, lakes, creeks, and canals and is covered by flooded forest, rice fields and other natural resources. The study found that there are 44 species of vegetation and trees, which do not have any significant economic value or classified as endangered, in the study area. The study also found 46 fish species, of which 20 among the least concern category. Hypsibarbus lagleri and Cirrhinus microlepis are in the IUCN Red List's endangered category.

The study identified 62 bird species in the study area. 43 species identified in the area falls in the "least concern" classification, eight species as "threatened", four species as "vulnerable", and one specie as "critically endangered". There are 22 bird species that have always been present in the study area (Beoung Cheung Loung Lake and Beoung Rean Lake).

The study identified 18 reptile species, five of which (Monocled cobra, Black copper rat snake, Common wolf snake, Black-yellow banded krai, and Yellow spotted water snake,) classified as "least concern", three classified (Burmese python, King cobra, and Indochina spitting cobra) as "vulnerable", and nine as data-deficient.

The study identified 9 mammal species in the study area. Seven mammal species (Berdmore's squirrel, Burmese hare, Long-tailed macaque, Small Asian Mongoose, Crab-eating Mongoose, Grey bellied squirrel, and Common Palm Civet) are classified as "least concern", and the other two (rat and fishing cat) are not in the IUCN Red List. Two mammals (Long-tailed Macaque and Fishing Cat) are classified as "vulnerable" and three species (Small Asian Mongoose, Crab-eating Mongoose, and Common Palm Civet) are classified as "nearly threatened" as defined by CITES. These mammals' habitats will be disturbed by the flooded forest encroachment, villager's trap, and development activities in the area.

Socio-economic resources: the results are as follows:

- The completion rate of primary school (38.9%), junior high school (16.7%), and high school (2.8%). The illiteracy rate is 25%. The rate of people with limited literacy is 16.7%.
- Primary occupations are plantation (21.9%) and construction worker (10.7%). The secondary occupation is livestock rearing such as chicken, duck, and water buffalo (30.7%).
- The residential land area is around 0.5 hectare/family, and the agricultural land area ranges between two and three hectares per family.
- Almost all families have land ownership certificates or also known as hard title (92.7%), while the remaining hold ownership title certified by local authorities only because they just moved in.
- 81.8% of all families own one to three hectares of agricultural land, 9.1% below one hectare, and 9.1% above one hectare.
- 72.2% of all families are connected the national grid (EDC), 2.8% use solar panel, and 16.7% use battery.
- 40.6% of all families use rainwater, 29.7% use water from open wells, 9.4% use water from tube wells, 7.5% use water from pond, and 12.8% use bottled water.

- In the past one year, 47% of villagers had flu, and 22.7% had typhoid. With regard to treatment, most villagers went to health center(47.2%), referral hospital (4.5%), pharmacy (20%), and private health clinic (25.5%).

  According to the Land Settelment Committee, the data is as follows:
  - Agricultural land: 2015 ha (77.5%)
  - Residential land: 7.8 ha (0.3%)
  - Public land (commune land, road, lake, canal …): 577.2 ha (22.20%)
  - Land swap: this mechanism is used by the villagers living illegally on Canal No. 54, Canal No. 92, and Canal No. 94 (a total number of 143 households; please see Photo 5-25). Based on the villager's request and the project owner's consent, each household receives a plot of land (5m x 20m) to build a new house in Boeung Khyang commune (please see photo 5-26). Water pipe and electricity facilities will be constructed. The photo below illustrates the house layout.
  - Cash payment: this mechanism is used by the villagers that have land ownership. The committee is negotiating the price.

The results of the environmental and social impact assessment on the project indicated that the implementation of the project (design, construction and operational phases) could lead to 17 adverse impacts with the degree of severity from low to high. However, these adverse effects will be prevented or minimised through the implementation of standard operating procedures and the proposed action plan. In addition, the project will follow the mitigation measures and environmental management plans proposed in Chapters 7 and 8 of this report.

The project has developed a specific Environmental Management Plan (EMP) which is a tool to manage the adverse impacts associated with the project activities and to ensure compliance with standards and standards of best practice in the project implementation.

Moreover, consultation with the public has shown that all institutions and people applaud the presence of the project because the project can provide a number of benefits such as: 1) economic growth in the local community as well as the national economy; 2) improving the air transportation sector; 3) Increase in appearance and aesthetics both in and outside the airport location; 4) Provide jobs for the people of the adjacent villages and earn money directly and indirectly; 5) land price increase. The relevant local authorities, including Pot Sor commune and Takeo Province's Bati District, support the project because it provides a lot of benefits to their villagers such as indirect employment (e.g. retailing, houses rental, and other services, etc), direct employment (e.g. working in the airport), and rising land price. Both local authorities and the public have below suggestions:

- The company should offer jobs to local people based on their qualifications and experiences;
- The company should solve land conflicts before implementing the project; and
- Suggest developing the villages and communes near the project area.

In conclusion, the study found that no serious impacts were expected to occur on natural and socio-economic resources, and that the impact would be consistently reduced to a minimum level. The Company requests the Ministry of the Environment to support and issue a permit to the company for implementation of its construction plan.

10.2 Recommendations

In addition to the mitigation measures and environmental management plans described in Chapters 7 and 8, the study recommended that:

- Due to the high volume of water demand and release of waste from the project, the company must prepare a wastewater treatment tank capable of cleaning the waste in accordance with

the Ministry of Environment's permit so that it does not affect the quality of surface water, soil quality and population protests around the area;

- The design of fire-fighting system in the project area shall be detailed and submitted to Ministry of Interior for review and approval;
- The company must build road around the lakes where soil is mined, and plant trees in order to covert them into tourist attractions and to maintain the state-owned lakes.
- The company must provide on-the-job training for each staff member before the airport staff start to ensure that the staff can undertake the technical requirements and high standards required, for example cleaning staff;
- Before the project starts its implementation phase, the project owner must arrange a public forum to inform and update the public about the project;
- The company must fully resolve the land-related issues to ensure that the project is not subject to complaints or delayed due to these issues;
- For its water supply, the project must have detailed discussions with technical teams and professional ministries / departments (Ministry of Industry and Handicrafts) to obtain the water supply;
- The company must have strict internal regulations, especially for dump trucks used in the project;
- The company shall have funds for the conservation and restoration of natural resources around the project area, such as fish, and participation in the preservation of some flooded forests in Boueng Cheung Loung and Boueng Rean.
- The company should regularly monitor and control the management of solid and wastewater and noise in accordance with environmental technical standards, not to discharge into low-lying areas or water sources that could affect the health and livelihood of the community. Basics and affect the quality of water and biodiversity in the construction and operational stages.
- The company helps to develop community infrastructure and provides annual scholarships to the children of workers and/or communities at the technical level and/or university level.
- Promote control mechanisms to properly address the impacts of Boueng Cheung Loung.
- Please follow the standards set by the company in the report, both at the beginning and end of the project.
- The company shall make sure the balance of water constribution with Tonle Bati with local people.
- The company must instruct the staff to understand the environmental impact and the use of all kinds of plastic bags and waste separation
- Give priority to employ the local people as much as possible with a decent salary to boost the family economy to avoid migration
- Provide safety facilities and first aid training and how to escape in case of any emergencies.
- Reserve the room for staff to rest during an accident and have a doctor regularly
- The company shall cooperate and participate in humanitarian work and planting trees in schools, health centers, and pagodas.

In general, CAIC must implement the proposed mitigation measures and Environmental Management Plan (EMP) proposed and developed in the environmental and social impact assessment report of the project at all stages in order to respond the Cambodia laws and international standards. At the same time, the company will use a public settlement plan that will allow people or local communities to raise

any concerns regarding the potential impact to them on the implementation of road expansion projects and to ensure that all concerns are identified and addressed appropriately.

Finally, the Company guarantee to comply with the Environmental Impact Assessment Report and to take responsibility for the implementation of mitigation measures and environmental management plans proposed in this Full Environmental and Social Impact Assessment Report.

Phnom Penh, Date…	Phnom Penh, Date…
Cambodia Airport Investment Co Ltd. Director	E&A Consultant Company Managing Director

Reference

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3. The Law on Land Management, Urban Planning, and Construction was adopted by Royal Kram No. 04/94 dated August 10, 1994.
4. Law on Land was adopted Royal Kram No 0810/14 dated on August 30, 2001.
5. Law on Fisheries was adopted Royal Kram No 0506/011, dated on May 21, 2006
6. Law on Water Resource Management in the Kingdom of Cambodia was promulgated by Royal Kram No 0607/016 dated June 29, 2007.
7. Labor Law and the Law on Amendment of Article 139 and Article 144 of Labor Law was adopted by Royal Kram No 0707/020 dated on July 20, 2007
8. The Law on Road adopted by the National Assembly on December 5, 2014.
9. Law on Fire Prevention and Fire Fighting was approved by National AssemblyBon May 07, 2013
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Appendix

Appendix 1: Authorization Letter to E&A Consultant

CAMBODIA AIRPORT INVESTMENT CO., LTD

(Private limited company incorporated under the laws of the Kingdom of Cambodia)

(Company Registration Number: Co.0001M/2018)

Canadia Tower, 28th Floor, Preah Monivong Blvd, Sangkat Wat Phnom,

Khan Daun Penh, Phnom Penh, Cambodia

លិខិតផ្ទេរសិទ្ធិ

ក្រុមហ៊ុន Cambodia Airport Investment co., LTD សូមជម្រាបជូន**ឯកឧត្តម លោកជំទាវ លោក លោកស្រី** មេត្តាជ្រាបថា ក្រុមហ៊ុន បានផ្ទេរសិទ្ធិជូន **ក្រុមហ៊ុន អ៊ីអេ ខនសាល់ធេន** ដើម្បីសិក្សាវាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន និងសង្គមពេញលេញ រៀបចំលក្ខខណ្ឌការងារ និងឯកសារផ្សេងៗ សម្រាប់គម្រោងបង្កើតព្រលានយន្តហោះ ដែលស្ថិតនៅស្រុកកណ្តាលស្ទឹង ខេត្តកណ្តាល។

ក្រុមហ៊ុន អ៊ីអេ ខនសាល់ធេន នឹងធ្វើការសម្របសម្រួលជាមួយក្រសួងបរិស្ថាននិងស្ថាប័នផ្សេងៗដែលពាក់ព័ន្ធនឹងគម្រោងខាងលើនេះក្នុងនាមក្រុមហ៊ុន Cambodia Airport Investment Co., Ltd រហូតដល់គម្រោងនេះត្រូវបានបញ្ចប់។

សេចក្តីដូចដែលបានជម្រាបជូនខាងលើ សូម **ឯកឧត្តម លោកជំទាវ លោក លោកស្រី** មេត្តាសហការជាមួយក្រុមហ៊ុន **អ៊ីអេ ខនសាល់ធេន** ដោយក្តីអនុគ្រោះ។

សូម **ឯកឧត្តម លោកជំទាវ លោក លោកស្រី** ទទួលនូវការគោរពដ៏ខ្ពង់ខ្ពស់អំពីខ្ញុំ។

ភ្នំពេញថ្ងៃទី ១៥ រោច ខែកក្តិក ឆ្នាំច សំរឹទ្ធិស័ក ព.ស ២៥៦២

ត្រូវនឹងថ្ងៃទី ០៧ ខែធ្នូ ឆ្នាំ២០១៨

នាយកក្រុមហ៊ុន

V/E Lon Long

CAMBODIA AIRPORT INVESTMENT CO., LTD

(Private limited company incorporated under the laws of the Kingdom of Cambodia)

(Company Registration Number: Co.0001M/2018)

Canadia Tower, 28th Floor, Preah Monivong Blvd, Sangkat Wat Phnom,

Khan Daun Penh, Phnom Penh, Cambodia

Date: 07th December 2018

Subject: Authorization Letter

To Whom It May Concern

Dear Sir/Madam,

This letter is to certify that E&A Consultants Co., Ltd registered address: #69, Street 111, Sangkat Beoung Prolet, Khan 7 Makara, Phnom Penh is authorized to prepare a Full Environmental Impact Assessment (Full EIA), Terms of References (ToR) and other relevant documents for the Cambodia Airport Investment Co., LTD is project; located at Kandal Stung District, Kandal Province.

The E&A Consultants Co., Ltd will be facilitating the above mentioned project with the Ministry of Environment and other relevant government agency on behalf of Cambodia Airport Investment Co., Ltd until the final Full EIA project is completed.

Thank for your kind co-operation and assistance.

Kind regards,

Name: Yee Con Long

Position: Director

Appendix 2: Letter of EIA Permit from Ministry of Environment

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
លេខ: ០៦០/ប.ស

ថ្ងៃសុក្រ ទី២៤ ខែ ឧសភា ឆ្នាំច សំរឹទ្ធិស័ក ព.ស.២៥៦២
រាជធានីភ្នំពេញ ថ្ងៃទី១០ ខែ មិថុនា ឆ្នាំ២០១៩

ជម្រាបជូន
លោកនាយកក្រុមហ៊ុនទីប្រឹក្សា E & A CONSULTANT CO., LTD.

កម្មវត្ថុ ៖ ការណើសំណើសុំការអនុញ្ញាតចុះសិក្សា និងពិគ្រោះយោបល់ជាសាធារណៈជាមួយស្ថាប័នពាក់ព័ន្ធ ដើម្បីរៀបចំរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន និងសង្គមពេញលេញ សម្រាប់គម្រោងអភិវឌ្ឍន៍សាងសង់អាកាសយានដ្ឋានអន្តរជាតិលំដាប់ថ្នាក់ 4F នៅខេត្តកណ្តាល

យោង ៖ - ព្រះរាជក្រមលេខ នស/រកម/១២៩៦/៣៦ ចុះថ្ងៃទី២៤ ខែធ្នូ ឆ្នាំ១៩៩៦ ដែលប្រកាសឱ្យប្រើច្បាប់ស្តីពីកិច្ចការពារបរិស្ថាន និងការគ្រប់គ្រងធនធានធម្មជាតិ
- អនុក្រឹត្យលេខ ៧២ អនក្រ.បក ចុះថ្ងៃទី១១ ខែសីហា ឆ្នាំ១៩៩៩ ស្តីពីកិច្ចដំណើរការវាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន
- ប្រកាសលេខ ២១៥ ប្រកប.ស្ថ ចុះថ្ងៃទី១៩ ខែឧសភា ឆ្នាំ២០១៤ ស្តីពីការចុះបញ្ជីក្រុមហ៊ុនទីប្រឹក្សាសម្រាប់ការសិក្សា និងរៀបចំរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន និងសង្គម
- លិខិតលេខ ០៧៨/១៨ ចុះថ្ងៃទី១២ ខែធ្នូ ឆ្នាំ២០១៨ របស់ក្រុមហ៊ុនទីប្រឹក្សា E & A Consultant Co., Ltd.

សេចក្តីដូចមានចែងក្នុងកម្មវត្ថុ និងយោងខាងលើ ខ្ញុំសូមជម្រាបជូន **លោកនាយក** ជ្រាបថា ក្រសួងបរិស្ថានឯកភាពលើសំណើសុំការអនុញ្ញាតចុះសិក្សា និងពិគ្រោះយោបល់ជាសាធារណៈជាមួយស្ថាប័នពាក់ព័ន្ធ ដើម្បីរៀបចំរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន និងសង្គមពេញលេញ សម្រាប់គម្រោងអភិវឌ្ឍន៍សាងសង់អាកាសយានដ្ឋានអន្តរជាតិលំដាប់ថ្នាក់ 4F នៅលើផ្ទៃដីទំហំ ២.៦០០ហិកតា ដែលមានទីតាំងភូមិសាស្ត្រស្ថិតនៅក្រុងតាខ្មៅ និងស្រុកកណ្តាលស្ទឹង ខេត្តកណ្តាល របស់ក្រុមហ៊ុន **ខេមបូឌា អ៊ែរផត អ៊ិនវេសមិន ឯ.ក** ដោយគិតចាប់ពីថ្ងៃចុះហត្ថលេខានេះរហូតដល់ថ្ងៃទី១៩ ខែកក្កដា ឆ្នាំ២០១៩ ដោយក្នុងនោះក្រុមហ៊ុនត្រូវ៖

- ធ្វើការសិក្សាដោយផ្អែកលើលក្ខខណ្ឌការងារដែលបានផ្តល់យោបល់ដោយនាយកដ្ឋានវាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន
- ធ្វើការទំនាក់ទំនងជាមួយក្រសួង-ស្ថាប័នជំនាញពាក់ព័ន្ធ និងអាជ្ញាធរមូលដ្ឋាននៅក្នុងតំបន់គម្រោង
- មានការចូលរួមអង្កេតការណ៍លើការសិក្សារបស់ក្រុមហ៊ុនពីសំណាក់មន្ទីរបរិស្ថាន
- សិក្សាឱ្យបានចប់តាមពេលវេលាកំណត់ដើម្បីកុំឱ្យរាំងស្ទះដល់ដំណើរការវិនិយោគ។

អាស្រ័យដូចបានជម្រាបជូនខាងលើ សូម **លោកនាយក** អនុវត្ត និងចាត់ចែងតាមការគួរ។
សូម **លោកនាយក** ទទួលនូវសេចក្តីរាប់អានដ៏ស្មោះពីខ្ញុំ។

ជ.រដ្ឋមន្ត្រី
ប្លែលេខាធិការ

សៅ_សុភាព

ចម្លងជូន៖
- រដ្ឋបាលខេត្តកណ្តាល
- មន្ទីរបរិស្ថានខេត្តកណ្តាល
- ក្រុមហ៊ុន ខេមបូឌា អ៊ែរផត អ៊ិនវេសមិន ឯ.ក
- ឯកសារ កាលប្បវត្តិ

អាគារមរតកតេជោ ដីឡូលេខ503 ផ្លូវកៅស៊ូអមមាត់ទន្លេបាសាក់ សង្កាត់ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ ទូរស័ព្ទ: 023 235 004 / 023 235 006

Appendix 3 :Data on existing environment

Appendix 3.1: Results of air quality analysis

1. Location 1 (ANV1)

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានគាំពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY

លេខ/N°: ០៥៥ _ ៣៤ _ ព.ស

ព្រឹត្តិប័ត្រវិភាគ

ប្រទេសសំណាក/Sample Source : **ក្រុមហ៊ុន** E & A Consultant Co.,Ltd
កន្លែងយកសំណាក/Survey Pint: ក្នុងតំបន់គម្រោងបង្កើតបង្កើនអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ(ថ្មី) របស់**ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC)
ស្ថិតនៅក្នុងភូមិពាមសាលា ឃុំស្អាងភ្នំ ស្រុកស្អាង ខេត្តកណ្តាល, UTM 48P 0496685 / 1254320
ថ្ងៃយកសំណាក/Sampling Date: February 04, 2019
រយៈពេល/Sampling Period: 15:50 PM to 15:50 PM next day

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	បទដ្ឋាន Standard	និធីសង្កេតវិភាគ Reference Method
1	Carbon Monoxide(CO)	mg /m^3	0.62	<20(8 Hour)	Method Carbon Monoxide Passive Dositube
2	Nitrogen Dioxide (NO2)	mg /m^3	0.015	<0.1(24 Hour)	Method Saltzman
3	Sulfur Dioxide (SO2)	mg /m^3	0.013	<0.3(24 Hour)	Method Pararosaniline
4	Ozone (O3)	mg /m^3	0.04	<0.2(1 Hour)	Method Professional Gas Detector GT-901 03
5	Total Suspended Particles(TSP)	mg /m^3	0.146	<0.33(24 Hour)	Method Weight Concentration Measuring
6	PM10	mg /m^3	0.068	<0.05(24 Hour)	Method Weight Concentration Measuring
7	PM2.5	mg /m^3	0.028	<0.025(24 ម៉ោង)	Method Weight Concentration Measuring
8	Lead (Pb)	mg /m^3	ND	<0.005(24Hour)	Method 3500-Pb C(HNO3,HCl Digestion)

សំគាល់ៈ ១- បំរែបំរួល និងស្តង់ដាសម្រាប់ពិនិត្យគុណភាពខ្យល់សម្រាប់គម្រោងអភិវឌ្ឍន៍វិស័យឧស្សាហកម្ម និងទេសចរណ៍(ដែលផ្តល់ជូនក្រោមសេចក្តីសម្រេច ១២០ ប្រ.ក.ប.ស្ត ចុះថ្ងៃទី ១១ ខែ មេសា ឆ្នាំ២០១៨)
២- ខ្យល់មានល្បឿន 0.4 m/s ដល់ 1.2 m/s*!

ចេញអោយនៅ ថ្ងៃទី ១៣ ខែ កុម្ភៈ ឆ្នាំ២០១៩
ប្រធានមន្ទីរពិសោធន៍
Date of Issue:
Director
ឆ្នុំ ប៉ាត់

ចេញអោយនៅ ថ្ងៃទី ១៣ ខែ កុម្ភៈ ឆ្នាំ២០១៩
អ្នកវិភាគ
Analyzer

បានឃើញដៅថ្ងៃទី ១៣ ខែ កុម្ភៈ ឆ្នាំ២០១៩
ជ.អគ្គនាយក:
Was seen on date:
Director General

2. Location 2 (ANV2)

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានគាំពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY

លេខ/N°: ០៤៩-I ប.ស

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample/Source: **ក្រុមហ៊ុន** E&A Consultant Co.,Ltd

កន្លែងយកសំណាក/Survey Point: ក្នុងតំបន់គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ (ថ្មី) របស់**ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC) ស្ថិតនៅក្នុងភូមិពត់សរ ឃុំពត់សរ ស្រុកបាទី ខេត្តតាកែវ, UTM 48 P 0488937 / 1253580

ថ្ងៃយកសំណាក/Sampling date: February 03, 2019

រយៈពេល/Sampling Period: 13:40 PM to 13:40 PM next day

លេខ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	បទដ្ឋាន Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	Carbon Monoxide(CO)	mg /m^3	0.26	<20(8 Hour)	Method Carbon Monoxide Passive Dositube
2	Nitrogen Dioxide (NO2)	mg /m^3	0.011	<0.1(24 Hour)	Method Saltzman
3	Sulfur Dioxide (SO2)	mg /m^3	0.008	<0.3(24 Hour)	Method Pararosaniline
4	Ozone (O3)	mg /m^3	0.06	<0.2(1 Hour)	Method Professional Gas Detector GT-901 03
5	Total Suspended Particles(TSP)	mg /m^3	0.081	<0.33(24 Hour)	Method Weight Concentration Measuring
6	PM10	mg /m^3	0.041	<0.05(24 Hour)	Method Weight Concentration Measuring
7	PM2.5	mg /m^3	0.016	<0.025(24 ម៉ោង)	Method Weight Concentration Measuring
8	Lead (Pb)	mg /m^3	ND	<0.005(24Hour)	Method 3500-Pb C(HNO3,HCl Digestion)

សំគាល់ៈ 1- ប៉ារ៉ាម៉ែត្រ និងស្តង់ដាសម្រាប់ពិនិត្យគុណភាពខ្យល់សម្រាប់គម្រោងអភិវឌ្ឍន៍សែីយហគ្គារចនាសម្ព័ន្ធ និងទេសចរណ៍(ឧបសម្ព័ន្ធនៃប្រកាសលេខ ១២០ ប្រ.ភ.ប.ស្ដ ចុះថ្ងៃទី ១១ ខែ មេសា ឆ្នាំ២០១៨)
2- ខ្យល់មានល្បឿន 0.4 m/s ដល់ 1.3 m/s

ចេញអោយនៅ ថ្ងៃទី ១៣ ខែ កុម្ភៈ ឆ្នាំ២០១៩

បានឃើញនៅថ្ងៃទី ១៣ ខែ កុម្ភៈ ឆ្នាំ២០១៩
ជំ. អគ្គនាយក:
Was seen on date:
Director General

ប្រធានមន្ទីរពិសោធន៍
Date of Issue:
Director

ភ្នំ ប៊ុនធឺ

ចេញអោយនៅ ថ្ងៃទី ១៣ ខែ កុម្ភៈ ឆ្នាំ២០១៩
អ្នកវិភាគ
Analyzer

3. Location 3 (ANV3)

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានគាំពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY
លេខ/N°: ០៤៧៤-ប ព.ស

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample/Source: **ក្រុមហ៊ុន** E&A Consultant Co.,Ltd
កន្លែងយកសំណាក/Survey Point: ក្នុងតំបន់គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ (ថ្មី) របស់**ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC) ស្ថិតនៅក្នុងភូមិតាព្រហ្ម ឃុំបឹងខ្យាង ស្រុកកណ្តាលស្ទឹង ខេត្តកណ្តាល, UTM 48 P 0491617 / 1254210
ថ្ងៃយកសំណាក/Sampling date: February 02, 2019
ម៉ោង:ពេល/Sampling Period: 11:20 AM to 11:20 AM next day

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	បទដ្ឋាន Standard	មីធីសង្គ្រួចវិភាគ Reference Method
1	Carbon Monoxide(CO)	mg /m^3	0.52	<20(8 Hour)	Method Carbon Monoxide Passive Dositube
2	Nitrogen Dioxide (NO2)	mg /m^3	0.014	<0.1(24 Hour)	Method Saltzman
3	Sulfur Dioxide (SO2)	mg /m^3	0.011	<0.3(24 Hour)	Method Pararosaniline
4	Ozone (O3)	mg /m^3	0.23	<0.2(1 Hour)	Method Professional Gas Detector GT-901 03
5	Total Suspended Particles(TSP)	mg /m^3	0.094	<0.33(24 Hour)	Method Weight Concentration Measuring
6	PM10	mg /m^3	0.035	<0.05(24 Hour)	Method Weight Concentration Measuring
7	PM2.5	mg /m^3	0.019	<0.025(24 ម៉ោង)	Method Weight Concentration Measuring
8	Lead (Pb)	mg /m^3	ND	<0.005(24Hour)	Method 3500-Pb C(HNO3,HCl Digestion)

សំគាល់ៈ 1- ប៉ារ៉ាម៉ែត្រ និងស្តង់ដាសម្រាប់ពិនិត្យគុណភាពខ្យល់សម្រាប់តម្រូវអភិវឌ្ឍន៍វិស័យហង្ហាចនាសម្ព័ន្ធ និងទេសចរណ៍(ឧបសម្ព័ន្ធនៃប្រកាសលេខ ១២០ ប្រ.ក.ប.ស្ដ ចុះថ្ងៃទី ១១ ខែ មេសា ឆ្នាំ២០១៨)
2- ខ្យល់មានល្បឿន 0.4 m/s ដល់ 1.3 m/s

ចេញអោយនៅ ថ្ងៃទី ១៣ ខែ កុម្ភៈ ឆ្នាំ២០១៩

បានឃើញនៅថ្ងៃទី ១៣ ខែ កុម្ភៈ ឆ្នាំ២០១៩
ស.អគ្គនាយក:
Was seen on date:
Director General

ប្រធានមន្ទីរពិសោធន៍ ភ្លុម
Date of Issue:
Director

ភ្នំ ប៊ុនធឿន

ចេញអោយនៅ ថ្ងៃទី ១៣ ខែ កុម្ភៈ ឆ្នាំ២០១៩
អ្នកវិភាគ
Analyzer

3. Location 4 (ANV4)

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានគាំពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY

លេខ/N°: ០៩៥-IV .ប.ស

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample/Source: **ក្រុមហ៊ុន** E&A Consultant Co.,Ltd

កន្លែងយកសំណាក/Survey Point: ក្នុងតំបន់គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ (ថ្មី) របស់**ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC) ស្ថិតនៅក្នុងភូមិដើងព្រៃ ឃុំអំពៅព្រៃ ស្រុកកណ្តាលស្ទឹង ខេត្តកណ្តាល, UTM 48 P 0488901 / 1257380

ថ្ងៃយកសំណាក/Sampling date: February 06, 2019

ម៉ោង/Sampling Period: 09:00 AM to 09:00 AM next day

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	បទដ្ឋាន Standard	និមិត្តសញ្ញាវិភាគ Reference Method
1	Carbon Monoxide(CO)	mg /m^3	0.78	<20(8 Hour)	Method Carbon Monoxide Passive Dositube
2	Nitrogen Dioxide (NO2)	mg /m^3	0.017	<0.1(24 Hour)	Method Saltzman
3	Sulfur Dioxide (SO2)	mg /m^3	0.013	<0.3(24 Hour)	Method Pararosaniline
4	Ozone (O3)	mg /m^3	0.02	<0.2(1 Hour)	Method Professional Gas Detector GT-901 03
5	Total Suspended Particles(TSP)	mg /m^3	0.205	<0.33(24 Hour)	Method Weight Concentration Measuring
6	PM10	mg /m^3	0.094	<0.05(24 Hour)	Method Weight Concentration Measuring
7	PM2.5	mg /m^3	0.037	<0.025(24 ម៉ោង)	Method Weight Concentration Measuring
8	Lead (Pb)	mg /m^3	ND	<0.005(24Hour)	Method 3500-Pb C(HNO3,HCl Digestion)

សំគាល់ៈ ១- ប៉ារ៉ាម៉ែត្រ និងស្តង់ដារសម្រាប់តំនិតិ្យគុណភាពខ្យល់សម្រាប់តម្រូវអភិរក្សនិស័យហេដ្ឋារចនាសម្ព័ន្ធ និងទេសចរណ៍(ឧបសម្ព័ន្ធនៃប្រកាសលេខ ១២០ ប្រ.ក.ប.ស្ដ ចុះថ្ងៃទី ១១ ខែ មេសា ឆ្នាំ២០១៨)
២- ខ្យល់មានល្បឿន 0.4 m/s ដល់ 1.3 m/s។

ចេញអោយនៅ ថ្ងៃទី ១៣ ខែ កុម្ភៈ ឆ្នាំ២០១៩

បានឃើញនៅថ្ងៃទី ១៣ ខែ កុម្ភៈ ឆ្នាំ២០១៩
ស.អគ្គនាយក:
Was seen on date:
Director General

ប្រធានមន្ទីរពិសោធន៍
Date of Issue:
Director

ស៊ឹ ប៊ុនឆ័ត

ចេញអោយនៅ ថ្ងៃទី ១៣ ខែ កុម្ភៈ ឆ្នាំ២០១៩

អ្នកវិភាគ
Analyzer

Appendix 3.2: Quality test of Surface water results

1. Dry Season

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានគាំពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY

លេខ/N° ០៥៤/១៩-I ព.ស

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample Source : **ក្រុមហ៊ុន** E & A Consultant Co.,Ltd
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: January 31, 2019
ប្រភេទសំណាក/Type of Sample: SW-01, ទឹកបឹងជើងលោង គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ (ថ្មី) របស់ **ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC), ស្ថិតនៅក្នុងភូមិជើងលោង ឃុំចំប៉ី ស្រុកបាទី ខេត្តតាកែវ, UTM 48 P 0493299 / 1252180

លរ No	តារាង៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	បទដ្ឋាន Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	pH	-	6.92	6.5-8.5	Method pH Meter
2	Dissolved Oxygen(DO)	mg/L	6.40	7.5-2.0	Method DO Meter
3	Total Dissolved Solid(TDS)	mg/L	46.00	<1000	Method ino-Lab Meter
4	Total Suspended Solid (TSS)	mg/L	38.00	1.0-15	Method 2540 D
5	Biochemical Oxygen Demand(BOD)5	mg/L	2.80	<30	Method 5210 B
6	Chemical Oxygen Demand (COD)Mn	mg/L	5.48	1.0-8.0	Method JIS K 0102
7	Oil and Grease	mg/L	29.00	<5.0	Method 5520 D
8	Ammonia(NH3)	mg/L	0.02	NV	Method Photometer
9	Detergent(MBAS)	mg/L	ND	<5.0	Method 5540 C
10	Sulphate(SO4)	mg/L	0.86	<300	Method 4500-SO_4^{2-} B
11	Total Nitrogen(TN)	mg/L	0.64	0.1-0.6	Method JIS K 0102 45
12	Total Phosphorus(TP)	mg/L	0.03	0.005-0.05	Method JIS K 0102 46
13	Arsenic(As)	mg/L	0.006	<0.01	Method 3500-As D
14	Cadmium(Cd)	mg/L	ND	<0.001	Method 3500-Cd C
15	Iron(Fe-total)	mg/L	0.09	<1.0	Method 3500-Fe C
16	Lead(Pb)	mg/L	ND	<0.01	Method 3500-Pb C
17	Mercury(Total)	mg/L	0.0001	<0.0005	Method ICP-MS
18	Total Coli form	MPN/100ml	$9.2x10^2$	<1000	Method NF T90-413

សំគាល់ៈ 1- ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកមកមន្ទីពិសោធន៍ក្រុមហ៊ុន(គំហាង)អនុវត្តដោយខ្លួនឯង។
2- Standards ប៉ារ៉ាម៉ែត្រ និងស្តង់ដារគុណភាពទឹកលើដីសម្រាប់គម្រោងអភិវឌ្ឍន៍វិស័យហេដ្ឋារចនាសម្ព័ន្ធ និងទេសចរណ៍(ប្រកាសលេខ១២០ ប្រ.ក ប.ស្ដ ១១ មេសា ឆ្នាំ២០១៨)
3- ND Mean Not Detected (Lower than LDL), NV Mean No Value.

ចេញអោយនៅ ថ្ងៃទី ២៨ ខែ កុម្ភៈ ឆ្នាំ២០១៩ ចេញអោយនៅ ថ្ងៃទី ២៨ ខែ កុម្ភៈ ឆ្នាំ២០១៩

បានឃើញនៅថ្ងៃទី ០៤ ខែ មីនា ឆ្នាំ២០១៩
អគ្គនាយក
Was seen on date:
Director General

ប្រធានមន្ទីពិសោធន៍
Date of Issue:
Director

អ្នវិភាគ
Analyzer

មាស ច័ន្ទធីតា

អគារបេតេកូ ឡូតិ៍លេខ៥០៣ ផ្លូវអមមាត់ទន្លេបាសាក់ សង្កាត់ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ The Heritae Techo Building, Lot 503, Tonle Bassac, Chamkarmorn, Phnom Penh, ទូរស័ព្ទ ០២៣-២១៣៤០៨

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានការពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY
លេខ/N°: ...

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample Source : **ក្រុមហ៊ុន** E & A Consultant Co.,Ltd
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: January 31, 2019
ប្រភេទសំណាក/Type of Sample: SW-02, ទឹកព្រែកនាឃុន គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ(ថ្មី)របស់**ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC), ស្ថិតនៅក្នុងភូមិក្រូច ឃុំពុទ្ធស ស្រុកបាទី ខេត្តតាកែវ, UTM 48 P 0491536 / 1252354

លេខ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	បទដ្ឋាន Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	pH	-	6.61	6.5-8.5	Method pH Meter
2	Dissolved Oxygen(DO)	mg/L	1.60	7.5-2.0	Method DO Meter
3	Total Dissolved Solid(TDS)	mg/L	48.00	<1000	Method ino-Lab Meter
4	Total Suspended Solid (TSS)	mg/L	42.00	25-100	Method 2540 D
5	Biochemical Oxygen Demand(BOD)5	mg/L	3.15	1.0-10	Method 5210 B
6	Chemical Oxygen Demand (COD)Mn	mg/L	8.23	<50	Method JIS K 0102
7	Oil and Grease	mg/L	12.80	<5.0	Method 5520 D
8	Ammonia(NH3)	mg/L	0.06	NV	Method Photometer
9	Detergent(MBAS)	mg/L	0.02	<5.0	Method 5540 C
10	Sulphate(SO4)	mg/L	1.06	<300	Method 4500-SO_4^{2-} B
11	Total Nitrogen(TN)	mg/L	0.68	0.1-0.6	Method JIS K 0102 45
12	Total Phosphorus(TP)	mg/L	0.05	0.005-0.05	Method JIS K 0102 46
13	Arsenic(As)	mg/L	0.007	<0.01	Method 3500-As D
14	Cadmium(Cd)	mg/L	ND	<0.001	Method 3500-Cd C
15	Iron(Fe-total)	mg/L	0.14	<1.0	Method 3500-Fe C
16	Lead(Pb)	mg/L	ND	<0.01	Method 3500-Pb C
17	Mercury(Total)	mg/L	0.0003	<0.0005	Method ICP-MS
18	Total Coli form	MPN/100ml	$2.3x10^3$	<5000	Method NF T90-413

សំគាល់៖ 1- ការយកសំណាក ការរក្សាទុក និងការដើរដឹកជញ្ជូនសំណាកមកមន្ទីរពិសោធន៍ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។
2- Standards ប៉ារ៉ាម៉ែត្រ និងស្តង់ដារគុណភាពទឹកលើដីសម្រាប់គម្រោងអភិវឌ្ឍន៍វិស័យហេដ្ឋារចនាសម្ព័ន្ធ និងទេសចរណ៍(ប្រកាសលេខ១១២០ ប្រ.ក ប.ស្ដ ១១ មេសា ឆ្នាំ២០១៨)
3- ND Mean Not Detected (Lower than LDL), NV Mean No Value.

ចេញអោយនៅ ថ្ងៃទី២៤ ខែតុលា ឆ្នាំ២០១៩ ចេញអោយនៅ ថ្ងៃទី២៤ ខែតុលា ឆ្នាំ២០១៩

បានឃើញនៅថ្ងៃទី២៤ ខែតុលា ឆ្នាំ២០១៩
អគ្គនាយក:
Was seen on date:
Director General

ប្រធានមន្ទីរពិសោធន៍
Date of Issue:
Director

អក្ខរិនាគ
Analyzer

មាស ច័ន្ទធីតា

អគារអតសតេចក៏ ឡូតលេខ៥៣ ផ្លូវមហាត់មន្ត្រីបាសាក់ សង្កាត់មន្ត្រីបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ The Heritae Techo Building, Lot 503, Tonle Bassac, Chamkarmorn, Phnom Penh, ទូរស័ព្ទ ០២៣-២១៣៤០៨

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានការពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY

លេខ/N°: ...

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample Source : **ក្រុមហ៊ុន** E & A Consultant Co.,Ltd
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: January 31, 2019
ប្រភេទសំណាក./Type of Sample: SW-03, ទឹកប្រឡាយ៩៨ គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ(ថ្មី)របស់**ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC), ស្ថិតនៅក្នុងឃុំកណ្តោក ស្រុកកណ្តាលស្ទឹង ខេត្តកណ្តាល, UTM 48 P 0493513 / 1259352

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	ចន្ទដ្ឋាន Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	pH	-	7.04	6.5-8.5	Method pH Meter
2	Dissolved Oxygen(DO)	mg/L	3.80	7.5-2.0	Method DO Meter
3	Total Dissolved Solid(TDS)	mg/L	109.00	<1000	Method ino-Lab Meter
4	Total Suspended Solid (TSS)	mg/L	52.00	25-100	Method 2540 D
5	Biochemical Oxygen Demand(BOD)5	mg/L	2.98	1.0-10	Method 5210 B
6	Chemical Oxygen Demand (COD)Mn	mg/L	6.66	<50	Method JIS K 0102
7	Oil and Grease	mg/L	19.70	<5.0	Method 5520 D
8	Ammonia(NH3)	mg/L	0.08	NV	Method Photometer
9	Detergent(MBAS)	mg/L	0.03	<5.0	Method 5540 C
10	Sulphate(SO4)	mg/L	1.26	<300	Method 4500-SO_4^{2-} B
11	Total Nitrogen(TN)	mg/L	0.65	0.1-0.6	Method JIS K 0102 45
12	Total Phosphorus(TP)	mg/L	0.05	0.005-0.05	Method JIS K 0102 46
13	Arsenic(As)	mg/L	0.005	<0.01	Method 3500-As D
14	Cadmium(Cd)	mg/L	0.0003	<0.001	Method 3500-Cd C
15	Iron(Fe-total)	mg/L	0.34	<1.0	Method 3500-Fe C
16	Lead(Pb)	mg/L	ND	<0.01	Method 3500-Pb C
17	Mercury(Total)	mg/L	0.0002	<0.0005	Method ICP-MS
18	Total Coli form	MPN/100ml	$4.3x10^3$	<5000	Method NF T90-413

សំគាល់៖ 1- ការយកសំណាក ការរក្សារអនុក និងការដឹកជញ្ជូនសំណាកមកមន្ទីពិសោធន៍ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។
2- Standards ប៉ារ៉ាម៉ែត្រ និងស្តង់ដារគុណភាពទឹកលើដីសម្រាប់គម្រោងអភិវឌ្ឍន៍វិស័យហេដ្ឋារចនាសម្ព័ន្ធ និងទេសចរណ៍(ប្រកាសលេខ១២០ ប្រ.ក ប.ស្ព ១១ មេសា ឆ្នាំ២០១៨)
3- ND Mean Not Detected (Lower than LDL), NV Mean No Value.

ចេញអោយនៅ ថ្ងៃទី ... ខែ ... ឆ្នាំ២០១៩

បានឃើញនៅថ្ងៃទី ... ខែ ... ឆ្នាំ២០១៩
អគ្គនាយក:
Was seen on date:
Director General

ប្រធានមន្ទីពិសោធន៍
Date of Issue:
Director

មាស ច័ន្ទធីតា

ចេញអោយនៅ ថ្ងៃទី ... ខែ ... ឆ្នាំ២០១៩
អ្នវិភាគ
Analyzer

អគារមេតតេជោ ម្យ៉ាត់លេខ៥០៣ ផ្លូវរមាសត់ទន្លេបាសាក់ សង្កាត់ទន្លេបាសាក់ ខណ្ឌចំការមន ភ្នំពេញ The Heritae Techo Building, Lot 503, Tonle Bassac, Chamkarmom, Phnom Penh, ទូរស័ព្ទ ០២៣-២១៣៤០៨

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានការពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY

លេខ/N°: ០៤៦-W ព.ស

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample Source : **ក្រុមហ៊ុន** E & A Consultant Co.,Ltd
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: January 31, 2019
ប្រភេទសំណាក./Type of Sample: SW-04, ទឹកប្រឡាយ៩២ គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ(ថ្មី)របស់**ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC), ស្ថិតនៅក្នុងភូមិជើងព្រៃ៣ ឃុំអំពៅព្រៃ ស្រុកកណ្តាលស្ទឹង ខេត្តកណ្តាល, UTM 48 P 0489848 / 1257382

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	បទដ្ឋាន Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	pH	-	7.08	6.5-8.5	Method pH Meter
2	Dissolved Oxygen(DO)	mg/L	2.40	7.5-2.0	Method DO Meter
3	Total Dissolved Solid(TDS)	mg/L	36.00	<1000	Method ino-Lab Meter
4	Total Suspended Solid (TSS)	mg/L	37.00	25-100	Method 2540 D
5	Biochemical Oxygen Demand(BOD)5	mg/L	3.18	1.0-10	Method 5210 B
6	Chemical Oxygen Demand (COD)Mn	mg/L	7.84	<50	Method JIS K 0102
7	Oil and Grease	mg/L	17.60	<5.0	Method 5520 D
8	Ammonia(NH3)	mg/L	0.06	NV	Method Photometer
9	Detergent(MBAS)	mg/L	0.04	<5.0	Method 5540 C
10	Sulphate(SO4)	mg/L	1.83	<300	Method 4500-SO_4^{2-} B
11	Total Nitrogen(TN)	mg/L	0.72	0.1-0.6	Method JIS K 0102 45
12	Total Phosphorus(TP)	mg/L	0.06	0.005-0.05	Method JIS K 0102 46
13	Arsenic(As)	mg/L	0.007	<0.01	Method 3500-As D
14	Cadmium(Cd)	mg/L	0.0004	<0.001	Method 3500-Cd C
15	Iron(Fe-total)	mg/L	0.10	<1.0	Method 3500-Fe C
16	Lead(Pb)	mg/L	ND	<0.01	Method 3500-Pb C
17	Mercury(Total)	mg/L	0.0001	<0.0005	Method ICP-MS
18	Total Coli form	MPN/100ml	$2.3x10^3$	<5000	Method NF T90-413

សំគាល់៖ 1- ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកមកមន្ទីរពិសោធន៍ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។
2- Standards ប៉ារ៉ាម៉ែត្រ និងស្តង់ដារគុណភាពទឹកលើដីសម្រាប់គម្រោងអភិវឌ្ឍន៍វិស័យហេដ្ឋារចនាសម្ព័ន្ធ និងទេសចរណ៍(ប្រកាសលេខ១២០ ប្រ.ក ប.ស្ព ១១ មេសា ឆ្នាំ២០១៨)
3- ND Mean Not Detected (Lower than LDL), NV Mean No Value.

ចេញអោយនៅ ថ្ងៃទី ២៤ ខែ ក្រុម ឆ្នាំ២០១៩

បានឃើញនៅថ្ងៃទី ២៤ ខែ ក្រុម ឆ្នាំ២០១៩
អគ្គនាយក:
Was seen on date:
Director General

ប្រធានមន្ទីរពិសោធន៍
Date of Issue:
Director
មាស ច័ន្ទធីតា

ចេញអោយនៅ ថ្ងៃទី ២៤ ខែ ក្រុម ឆ្នាំ២០១៩
អ្នវិភាគ
Analyzer

អគារលេខ ភ្នំពេញ-ព្រែកលៀប ភូមិ ឃុំ ស្រុក ខេត្ត ក្រុង ភ្នំពេញ
The Heritae Techo Building, Lot 503, Tonle Bassac, Chamkarmorn, Phnom Penh, ទូរស័ព្ទ ០២៣-២១៣៩០៨

2. Rainy Season

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានការពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY

លេខ/N°: ១៤៧-៦ ប.ស

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample Source : **ក្រុមហ៊ុន** E & A Consultant Co.,Ltd
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 28 May, 2019
ប្រភេទសំណាក/Type of Sample: SW-01, ទឹកបឹងជើងលោង គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ (ថ្មី) របស់ **ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC), ស្ថិតនៅក្នុងភូមិជើងលោង ឃុំចំប៉ី ស្រុកបាទី ខេត្តតាកែវ, UTM 48 P 0493299 / 1252180

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	បទដ្ឋាន Standard	និមិត្តសាស្ត្រវិភាគ Reference Method
1	pH	-	7.54	6.5-8.5	Method pH Meter
2	Dissolved Oxygen(DO)	mg/L	6.80	7.5-2.0	Method DO Meter
3	Total Dissolved Solid(TDS)	mg/L	81.00	<1000	Method ino-Lab Meter
4	Total Suspended Solid (TSS)	mg/L	99.00	1.0-15	Method 2540 D
5	Biochemical Oxygen Demand(BOD)5	mg/L	5.40	<30	Method 5210 B
6	Chemical Oxygen Demand (COD)Mn	mg/L	14.47	1.0-8.0	Method JIS K 0102
7	Oil and Grease	mg/L	17.00	<5.0	Method 5520 D
8	Ammonia(NH3)	mg/L	1.34	NV	Method Photometer
9	Detergent(MBAS)	mg/L	ND	<5.0	Method 5540 C
10	Sulphate(SO4)	mg/L	28.00	<300	Method 4500-SO_4^{2-} B
11	Total Nitrogen(TN)	mg/L	3.09	0.1-0.6	Method JIS K 0102 45
12	Total Phosphorus(TP)	mg/L	0.44	0.005-0.05	Method JIS K 0102 46
13	Arsenic(As)	mg/L	0.004	<0.01	Method 3500-As D
14	Cadmium(Cd)	mg/L	ND	<0.001	Method 3500-Cd C
15	Iron(Fe-total)	mg/L	0.11	<1.0	Method 3500-Fe C
16	Lead(Pb)	mg/L	ND	<0.01	Method 3500-Pb C
17	Mercury(Total)	mg/L	ND	<0.0005	Method ICP-MS
18	Total Coli form	MPN/100ml	$3.6x10^2$	<1000	Method NF T90-413

សំគាល់៖ 1- ការយកសំណាក ការរក្សារទុក និងការដឹកជញ្ជូនសំណាកមកមន្ទីរពិសោធន៍ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។
2- Standards ប៉ារ៉ាម៉ែត្រ និងស្តង់ដារគុណភាពទឹកលើដីសម្រាប់គម្រោងអភិវឌ្ឍន៍វិស័យអាជ្ញាធរអាសន្ន និងទេសចរណ៍(ប្រកាសលេខ១២០ ប្រ.ក ប.ស្ដ ១១ មេសា ឆ្នាំ២០១៨)
3- ND Mean Not Detected (Lower than LDL), NV Mean No Value.

ចេញអោយនៅ ថ្ងៃទី ១៨ ខែ ឆ្នូ ឆ្នាំ២០១៩

ចេញអោយនៅ ថ្ងៃទី ១៨ ខែ ឆ្នូ ឆ្នាំ២០១៩

បានឃើញនៅថ្ងៃទី ១៨ ខែ ឆ្នូ ឆ្នាំ២០១៩
អគ្គនាយក:
Was seen on date:
Director General

ហេង-ណារ៉ង់តែ

ប្រធានមន្ទីរពិសោធន៍
Date of Issue:
Director

មាស ច័ន្ទធីតា

អ្នវិភាគ
Analyzer

The Heritae Techo Building, Lot 503, Tonle Bassac, Chamkarmorn, Phnom Penh, ទូរស័ព្ទ ០១២៣-២១៣៩០៨

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានគាំពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY

លេខ/N°: ...

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample Source : **ក្រុមហ៊ុន** E & A Consultant Co.,Ltd
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 28 May, 2019
ប្រភេទសំណាក./Type of Sample: SW-02, ទឹកព្រែកនាឃុន គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ(ថ្មី)របស់**ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC), ស្ថិតនៅក្នុងភូមិក្រូច ឃុំពុទ្ធស្រុកបាទី ខេត្តតាកែវ, UTM 48 P 0491536 / 1252354

លរ No	**ប៉ារ៉ាម៉ែត្រ** Parameter	**ខ្នាត** Unit	**លទ្ធផល** Result	**បទដ្ឋាន** Standard	**វិធីសាស្ត្រវិភាគ** Reference Method
1	pH	-	6.21	6.5-8.5	Method pH Meter
2	Dissolved Oxygen(DO)	mg/L	3.20	7.5-2.0	Method DO Meter
3	Total Dissolved Solid(TDS)	mg/L	158.00	<1000	Method ino-Lab Meter
4	Total Suspended Solid (TSS)	mg/L	53.00	25-100	Method 2540 D
5	Biochemical Oxygen Demand(BOD)5	mg/L	3.60	1.0-10	Method 5210 B
6	Chemical Oxygen Demand (COD)Mn	mg/L	10.15	<50	Method JIS K 0102
7	Oil and Grease	mg/L	3.87	<5.0	Method 5520 D
8	Ammonia(NH3)	mg/L	1.46	NV	Method Photometer
9	Detergent(MBAS)	mg/L	ND	<5.0	Method 5540 C
10	Sulphate(SO4)	mg/L	52.00	<300	Method 4500-$SO4^{2-}$ B
11	Total Nitrogen(TN)	mg/L	1.56	0.1-0.6	Method JIS K 0102 45
12	Total Phosphorus(TP)	mg/L	0.08	0.005-0.05	Method JIS K 0102 46
13	Arsenic(As)	mg/L	0.005	<0.01	Method 3500-As D
14	Cadmium(Cd)	mg/L	ND	<0.001	Method 3500-Cd C
15	Iron(Fe-total)	mg/L	0.06	<1.0	Method 3500-Fe C
16	Lead(Pb)	mg/L	ND	<0.01	Method 3500-Pb C
17	Mercury(Total)	mg/L	ND	<0.0005	Method ICP-MS
18	Total Coli form	MPN/100ml	$7.4x10^2$	<5000	Method NF T90-413

សំគាល់៖ 1- ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកមកមន្ទីពិសោធន៍ក្រុមហ៊ុន(តំរាង)អនុវត្តដោយខ្លួនឯង។
2- Standards ប៉ារ៉ាម៉ែត្រ និងស្តង់ដារគុណភាពទឹកលើដីសម្រាប់គម្រោងអភិវឌ្ឍន៍វិស័យហេដ្ឋារចនាសម្ព័ន្ធ និងទេសចរណ៍(ប្រកាសលេខ១២០ ប្រ.ក ប.ស្ដ ១១ មេសា ឆ្នាំ២០១៨)
3- ND Mean Not Detected (Lower than LDL), NV Mean No Value.

ចេញអោយនៅ ថ្ងៃទី ... ខែ ... ឆ្នាំ២០១៩

ចេញអោយនៅ ថ្ងៃទី ... ខែ ... ឆ្នាំ២០១៩

បានឃើញនៅថ្ងៃទី ... ខែ ... ឆ្នាំ២០១៩
អគ្គនាយក
Was seen on date:
Director General

ប្រធានមន្ទីរពិសោធន៍
Date of Issue:
Director

អ្នវិភាគ
Analyzer

ហេង - ណារ៉ាវុត្ថ

មាស ប័ន្ធធីតា

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានគាំពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY
លេខ/N°...១៤២-៣...ព.ស

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample Source : **ក្រុមហ៊ុន** E & A Consultant Co.,Ltd
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: 28 May, 2019
ប្រភេទសំណាក./Type of Sample: SW-03, ទឹកប្រឡាយ៩៨ គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ(ថ្មី)របស់**ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC), ស្ថិតនៅក្នុងឃុំកណ្តោក ស្រុកកណ្តាលស្ទឹង ខេត្តកណ្តាល, UTM 48 P 0493513 / 1259352

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	បទដ្ឋាន Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	pH	-	6.88	6.5-8.5	Method pH Meter
2	Dissolved Oxygen(DO)	mg/L	3.94	7.5-2.0	Method DO Meter
3	Total Dissolved Solid(TDS)	mg/L	122.00	<1000	Method ino-Lab Meter
4	Total Suspended Solid (TSS)	mg/L	71.00	25-100	Method 2540 D
5	Biochemical Oxygen Demand(BOD)5	mg/L	3.40	1.0-10	Method 5210 B
6	Chemical Oxygen Demand (COD)Mn	mg/L	10.07	<50	Method JIS K 0102
7	Oil and Grease	mg/L	32.00	<5.0	Method 5520 D
8	Ammonia(NH3)	mg/L	1.34	NV	Method Photometer
9	Detergent(MBAS)	mg/L	ND	<5.0	Method 5540 C
10	Sulphate(SO4)	mg/L	42.00	<300	Method 4500-SO_4^{2-} B
11	Total Nitrogen(TN)	mg/L	1.89	0.1-0.6	Method JIS K 0102 45
12	Total Phosphorus(TP)	mg/L	0.27	0.005-0.05	Method JIS K 0102 46
13	Arsenic(As)	mg/L	0.002	<0.01	Method 3500-As D
14	Cadmium(Cd)	mg/L	ND	<0.001	Method 3500-Cd C
15	Iron(Fe-total)	mg/L	0.08	<1.0	Method 3500-Fe C
16	Lead(Pb)	mg/L	ND	<0.01	Method 3500-Pb C
17	Mercury(Total)	mg/L	ND	<0.0005	Method ICP-MS
18	Total Coli form	MPN/100ml	$2.1x10^4$	<5000	Method NF T90-413

សំគាល់៖ 1- ការយកសំណាក ការរក្សាទុក និងការដឹកជញ្ជូនសំណាកមកមន្ទីពិសោធន៍ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។
2- Standards ប៉ារ៉ាម៉ែត្រ និងស្តង់ដារគុណភាពទឹកលើដីសម្រាប់គម្រោងអភិវឌ្ឍន៍វិស័យហេដ្ឋារចនាសម្ព័ន្ធ និងទេសចរណ៍(ប្រកាសលេខ១២០ ប្រ.ក ប.ស្ដ ១១ មេសា ឆ្នាំ២០១៨)
3- ND Mean Not Detected (Lower than LDL), NV Mean No Value.

ចេញអោយនៅ ថ្ងៃទី២៩ ខែឧសភា ឆ្នាំ២០១៩ ចេញអោយនៅ ថ្ងៃទី២៩ ខែឧសភា ឆ្នាំ២០១៩

បានឃើញនៅថ្ងៃទី២៩ ខែឧសភា ឆ្នាំ២០១៩	ប្រធានមន្ទីពិសោធន៍	អ្នវិនាគ
អគ្គនាយក:	Date of Issue:	Analyzer
Was seen on date:	Director	
Director General		
	មាស ច័ន្ទធីតា	

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានការពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY

លេខ/N°: ១៤៦-ហ ព.ស

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample Source : **ក្រុមហ៊ុន** E & A Consultant Co.,Ltd
ថ្ងៃខែ ឆ្នាំទទួលសំណាក/Date: 28 May, 2019
ប្រភេទសំណាក./Type of Sample: SW-04, ទឹកប្រឡាយ៩២ គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ(ថ្មី)របស់**ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC), ស្ថិតនៅក្នុងភូមិជើងព្រៃ៣ ឃុំអំពៅព្រៃ ស្រុកកណ្តាលស្ទឹង ខេត្តកណ្តាល, UTM 48 P 0489848 / 1257382

ល.រ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	បទដ្ឋាន Standard	វិធីសាស្ត្រវិភាគ Reference Method
1	pH	-	6.82	6.5-8.5	Method pH Meter
2	Dissolved Oxygen(DO)	mg/L	3.10	7.5-2.0	Method DO Meter
3	Total Dissolved Solid(TDS)	mg/L	178.00	<1000	Method ino-Lab Meter
4	Total Suspended Solid (TSS)	mg/L	102.00	25-100	Method 2540 D
5	Biochemical Oxygen Demand(BOD)5	mg/L	4.20	1.0-10	Method 5210 B
6	Chemical Oxygen Demand (COD)Mn	mg/L	8.72	<50	Method JIS K 0102
7	Oil and Grease	mg/L	16.40	<5.0	Method 5520 D
8	Ammonia(NH3)	mg/L	1.46	NV	Method Photometer
9	Detergent(MBAS)	mg/L	ND	<5.0	Method 5540 C
10	Sulphate(SO4)	mg/L	24.00	<300	Method 4500-$SO4^{2-}$ B
11	Total Nitrogen(TN)	mg/L	3.66	0.1-0.6	Method JIS K 0102 45
12	Total Phosphorus(TP)	mg/L	0.43	0.005-0.05	Method JIS K 0102 46
13	Arsenic(As)	mg/L	0.001	<0.01	Method 3500-As D
14	Cadmium(Cd)	mg/L	ND	<0.001	Method 3500-Cd C
15	Iron(Fe-total)	mg/L	0.05	<1.0	Method 3500-Fe C
16	Lead(Pb)	mg/L	ND	<0.01	Method 3500-Pb C
17	Mercury(Total)	mg/L	ND	<0.0005	Method ICP-MS
18	Total Coli form	MPN/100ml	$9.3x10^3$	<5000	Method NF T90-413

សំគាល់៖ 1- ការយកសំណាក ការរក្សារទុក និងការដឹកជញ្ជូនសំណាកមកមន្ទីពិសោធន៍ក្រុមហ៊ុន(គំពោង)អនុវត្តដោយខ្លួនឯង។
2- Standards ប៉ារ៉ាម៉ែត្រ និងស្តង់ដារគុណភាពទឹកលើដីសម្រាប់គម្រោងអភិវឌ្ឍនិងសំណង់ហេដ្ឋារចនាសម្ព័ន្ធ និងទេសចរណ៍(ប្រកាសលេខ១២០ ប្រ.ក ប.ស្ដ ១១ មេសា ឆ្នាំ២០១៨)
3- ND Mean Not Detected (Lower than LDL), NV Mean No Value.

ចេញអោយនៅ ថ្ងៃទី ១៤ ខែ ឆ្នាំ ២០១៩

ប្រធានមន្ទីពិសោធន៍
Date of Issue:
Director

មាស ច័ន្ទធីតា

ចេញអោយនៅ ថ្ងៃទី ១៤ ខែ ឆ្នាំ ២០១៩

អ្នវិនាទ
Analyzer

បានឃើញនៅថ្ងៃទី ១៤ ខែ ឆ្នាំ ២០១៩
អគ្គនាយក:
Was seen on date:
Director General

ហោន ណារ៉ុង

Appendix 3.3: Quality test of Groundwater results

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានគាំពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY

លេខ/N°: ០៥៦-V ព.ស

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample Source : **ក្រុមហ៊ុន** E & A Consultant Co.,Ltd.
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: January 31, 2019
ប្រភេទសំណាក./Type of Sample: GW-01, ទឹកអណ្តូងស្នប់ គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ(ថ្មី)របស់**ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC), ស្ថិតនៅក្នុងភូមិតាណូ ឃុំស្អាងភ្នំ ស្រុកស្អាង ខេត្តកណ្តាល, UTM 48 P 0495914 / 1253461

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	បទដ្ឋាន Standards	វិធីសាស្ត្រវិភាគ Reference Method
1	pH	-	6.71	6.5-8.5	Method pH Meter
2	Electrical Conductivity(EC)	µs/cm	116.00	500-1500	Method Digital Turbidimeter
3	Total Dissolved Solid(TDS)	mg/L	78.00	<800	Method ino-Lab Meter
4	Turbidity	NTU	0.00	<5.0	Method Digitalturbidi Meter
5	Total Hardness(as CaCO3)	mg/L	38.90	<300	Method 2340 C
6	Total Chlorine (Cl2)	mg/L	0.02	NV	Method Photometer
7	Fluoride(F--)	mg/L	0.15	<1.5	Method 4500-F⁻ F
8	Nitrate(NO3)	mg/L	0.39	<50	Method 4500-NO3 C
9	Sulphate(SO4)	mg/L	2.35	<250	Method 4500-SO_4^{2-} B
10	Aluminum(Al)	mg/L	ND	<0.2	Method 3500-Al C
11	Arsenic(As)	mg/L	0.12	<0.05	Method 3500-As D
12	Cadmium(Cd)	mg/L	ND	<0.003	Method 3500-Cd C
13	Chromium (Cr-total)	mg/L	ND	<0.05	Method 3500-Cr C
14	Iron(Fe-total)	mg/L	0.04	<0.3	Method 3500-Fe C
15	Manganese (Mn)	mg/L	0.001	<0.1	Method 3500-Mn C
16	Mercury(Hg-total)	mg/L	ND	<0.001	Method ICP-MS
17	Thermo tolerant Coli form(E-Coli)	MPN/100ml	0	0	Method NF T90-413
18	Total Coli form	MPN/100ml	0	0	Method NF T90-413

សំគាល់ៈ 1- ការយកសំណាក ការវេចខ្ចប់ និងការដឹកជញ្ជូនសំណាកមកមន្ទីពិសោធន៍ក្រុមហ៊ុន(គំរោង)អនុវត្តដោយខ្លួនឯង។
2- Standards ប៉ារ៉ាម៉ែត្រ និងស្តង់ដារគុណភាពទឹកក្រោមវិសាស្ត្រគ្រប់គ្រងអភិវឌ្ឍន៍សំណង់ហេដ្ឋារចនាសម្ព័ន្ធ និងទេសចរណ៍(ប្រកាសលេខ១២០ ប្រ.ក ប.ស្ព ១១ មេសា ឆ្នាំ២០១៨)
3- ND Mean Not Detected (Lower than LDL), NV Mean No Value.

ចេញអោយនៅថ្ងៃទី ខែ ឆ្នាំ២០១៩ ចេញអោយនៅថ្ងៃទី ខែ ឆ្នាំ២០១៩

បានឃើញនៅថ្ងៃទី ខែ ឆ្នាំ២០១៩
អគ្គនាយក
Was seen on date:
Director General

ប្រធានមន្ទីពិសោធន៍
Date of Issue:
Director

អ្នកវិភាគ
Analyzer

មាស ច័ន្ទធីតា

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងបរិស្ថាន
អគ្គនាយកដ្ឋានការពារបរិស្ថាន
មន្ទីរពិសោធន៍
LABORATORY
លេខ/N°: ០៥៤-VI ព.ស

ព្រឹត្តិប័ត្រវិភាគ
ANALYSIS REPORT

ប្រភពសំណាក/Sample Source : **ក្រុមហ៊ុន** E & A Consultant Co.,Ltd.
ថ្ងៃ ខែ ឆ្នាំទទួលសំណាក/Date: January 31, 2019
ប្រភេទសំណាក./Type of Sample: GW-02, ទឹកអណ្តូងស្នប់ គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ(ថ្មី)របស់**ក្រុមហ៊ុន** Cambodia Airport Investment Co.,Ltd (CAIC), ស្ថិតនៅក្នុងភូមិតាណូ ឃុំស្អាងភ្នំ ស្រុកស្អាង ខេត្តកណ្តាល, UTM 48 P 0495914 / 1253461

លរ No	ប៉ារ៉ាម៉ែត្រ Parameter	ខ្នាត Unit	លទ្ធផល Result	បទដ្ឋាន Standards	មិធីសាស្ត្រវិភាគ Reference Method
1	pH	-	7.40	6.5-8.5	Method pH Meter
2	Electrical Conductivity(EC)	µs/cm	123.00	500-1500	Method Digital Turbidimeter
3	Total Dissolved Solid(TDS)	mg/L	98.00	<800	Method ino-Lab Meter
4	Turbidity	NTU	0.00	<5.0	Method Digitalturbidi Meter
5	Total Hardness(as CaCO3)	mg/L	46.40	<300	Method 2340 C
6	Total Chlorine (Cl2)	mg/L	0.01	NV	Method Photometer
7	Fluoride(F--)	mg/L	0.18	<1.5	Method 4500-F⁻ F
8	Nitrate(NO3)	mg/L	0.48	<50	Method 4500-NO3 C
9	Sulphate(SO4)	mg/L	2.65	<250	Method 4500-SO_4^{2-} B
10	Aluminum(Al)	mg/L	ND	<0.2	Method 3500-Al C
11	Arsenic(As)	mg/L	0.14	<0.05	Method 3500-As D
12	Cadmium(Cd)	mg/L	ND	<0.003	Method 3500-Cd C
13	Chromium (Cr-total)	mg/L	0.003	<0.05	Method 3500-Cr C
14	Iron(Fe-total)	mg/L	0.006	<0.3	Method 3500-Fe C
15	Manganese (Mn)	mg/L	0.003	<0.1	Method 3500-Mn C
16	Mercury(Hg-total)	mg/L	ND	<0.001	Method ICP-MS
17	Thermo tolerant Coli form(E-Coli)	MPN/100ml	0	0	Method NF T90-413
18	Total Coli form	MPN/100ml	0	0	Method NF T90-413

សំគាល់៖ 1- ការយកសំណាក ការរក្សារទុក និងការដឹកជញ្ជូនសំណាកមកមន្ទីពិសោធន៍ក្រុមហ៊ុន(គំហាង)អនុវត្តដោយខ្លួនឯង។
2- Standards ប៉ារ៉ាម៉ែត្រ និងស្តង់ដារគុណភាពទឹកត្រូវបានជ្រើសរើសសម្រាប់គម្រោងអភិវឌ្ឍន៍វិស័យហេដ្ឋារចនាសម្ព័ន្ធ និងទេសចរណ៍(ប្រកាសលេខ១២០ ប្រ.ក ប.ស្ដ ១១ មេសា ឆ្នាំ២០១៨)
3- ND Mean Not Detected (Lower than LDL), NV Mean No Value.

ចេញអោយនៅថ្ងៃទី ២៨ ខែ កុម្ភៈ ឆ្នាំ២០១៩ ចេញអោយនៅថ្ងៃទី ២៨ ខែ កុម្ភៈ ឆ្នាំ២០១៩

បានឃើញនៅថ្ងៃទី ២៨ ខែ កុម្ភៈ ឆ្នាំ២០១៩
អគ្គនាយក
Was seen on date:
Director General

ប្រធានមន្ទីរពិសោធន៍
Date of Issue:
Director

អ្នកវិភាគ
Analyzer

មាស ច័ន្ទធីតា

Appendix 4.4: Quality test of Soil results

ព្រះរាជាណាចក្រកម្ពុជា
ជាតិ សាសនា ព្រះមហាក្សត្រ

ក្រសួងកសិកម្ម រុក្ខាប្រមាញ់ និងនេសាទ
អគ្គនាយកដ្ឋានកសិកម្ម

លេខ.....អ.ន.ក

ថ្ងៃ.....ខែ.....ឆ្នាំ.....ស័ក ពស.២៥៦២
រាជធានីភ្នំពេញ, ថ្ងៃទី.....ខែ.....ឆ្នាំ ២០១៨

លទ្ធផលវិភាគដី

Soil Analysis Results

ឈ្មោះក្រុមហ៊ុន(Company Name): **E & A Consultant**

អាសយដ្ឋានAddress:

ថ្ងៃខែទទួលសំណាក: 11/02/19 , NAL : 063_045 / S09_19

Lab. ID: 09 /19	**LabNo. :**	**1**
Description Parameter Field ID: ភូមិប្រាសាទ ឃុំព្រែកស្លែង ស្រុកកណ្តាលស្ទឹង		SS01(0.3m) , X= 490795 , Y= 1252162
Particle Size (Pipette Method)	(< 0.002mm)ឥដ្ឋ, Clay %	12.75
	(0.002-0.02 mm)ល្បាប់ ម៉ត់, Fine Silt , %	24.65
	(0.02- 0.05mm)ល្បាប់ គ្រើម, Coase Silt , %	25.83
	(0.05- 0.2mm) ខ្សាច់ម៉ត់, Fine Sand,%	30.09
	(0.02 - 2mm) ខ្សាច់គ្រើម, Coase Sand,%	5.45
សំណើម Moisture % , (Oven dry at 105 °C and 24 hours)		1.02
កំហាប់ចរន្តអ.នី Electrode Conductivity µS/cm , (1:5 Soil: water)		77.60
កាបូន Total Carbon (Black & Walkey Method) , C %		1.63
អាសូត Total Nitrogen (Kjeldal Sulfuric Method) ,N %		0.14
អនុបាត C/N Ratio (Unit)		12
សារធាតុសរីរាង្គ Organic Matter (OM) %		2.80
ផូស្វ័រសរុប Total Phosphorus (Nitric Digestion) P %		0.049
ផូស្វ័រឈាយ Available Phosphorus (Pray II) , P ppm		132
សមត្ថភាពដោះដូរកាចុង Cation Exchange Capacity C.E.C m.e/100g Soil (Method ,1M Ammonium Acetate at pH = 7 & Leach with 10 % NaCl)		16.80
កាចុងដោះដូរ ,Exchangeable Cation (m.e/100g Soil), (Method, 1M Ammonium Acetateat pH =7)	កាល់ស្យូម, Calcium Ca	8.40
	ម៉ាញ៉េស្យូម,Magnesium Mg	2.80
	សូដ្យូម,Sodium Na	0.43
	ប៉ូតាស្យូម,Potasium K	0.46
កាចុងដោះដូរសរុប , Total Exchangeable Bases (m.e/100g soil)		12.09
អត្រាចំរែតនៃកាចុង, Bass Saturation %		72
អាស៊ីតដោះដូរ Exchange Acidity m.e/100g Soil , (1 M KCl Method)		5.40
អាលុយមីញ៉ូមដោះដូរ Exchange Al m.e/100g Soil , (1 M KCl Method)		0.15
ប៉េហាស់ទឹក pH H2O , (1:5 Soil: water)		7.12
ប៉េហាស់អំបិល pH KCL , (1:5 (Soil : 1N KCL)		6.16

ចំណាំ: លទ្ធផលទទួលខុសត្រូវតែចំពោះសំណាកដែលបានវិភាគ(Note: This report only valid for sample examined)

1

អាសយដ្ឋានលេខ: ៥៤ប/៤៩អេហ្វ ផ្លូវលេខ ៣៩៥-៦៥៦ សង្កាត់ទឹកល្អក់៣ ខ័ណ្ឌទួលគោក រាជធានីភ្នំពេញ ទូរស័ព្ទលេខ: (៨៦៣) ៨៨៣ ៤២៧, ទូរសារលេខ:(៨៦៣) ៨៨៣ ៤២៧
Address # 54B/49F, Street 395-656, Sangkat Toeuk Laak 3, Khan Tuol Kok, Phnom Penh, Cambodia, Phone: (023) 883 427, Fax: (023) 883 427

Lab. ID: 09/19		LabNo. :	2
Description Parameter Field ID:			SS02(0.3m) , X= 487690 , Y= 1251710
Particle Size (Pipette Method)	(< 0.002mm)ឥដ្ឋ, Clay %		19.36
	(0.002-0.02 mm)ល្បាប់ ម៉ត់, Fine Silt , %		22.15
	(0.02- 0.05mm)ល្បាប់ គ្រើម, Coase Silt , %		15.12
	(0.05- 0.2mm) ខ្សាច់ម៉ត់, Fine Sand,%		19.21
	(0.02 - 2mm) ខ្សាច់គ្រើម, Coase Sand,%		23.57
សំណើម Moisture % , (Oven dry at 105 °C and 24 hours)			1.37
កំហាប់ចរន្តអ.នី Electrode Conductivity µS/cm , (1:5 Soil: water)			18.40
កាបូន Total Carbon (Black & Walkey Method) , C %			1.80
អាសូត Total Nitrogen (Kjeldal Sulfuric Method) ,N %			0.16
អនុបាត C/N Ratio (Unit)			11
សារធាតុសរីរាង្គ Organic Matter (OM) %			3.09
ផូស្វ័រសរុប Total Phosphorus (Nitric Digestion) P %			0.025
ផូស្វ័រឈាយ Available Phosphorus (Pray II) , P ppm			32
សមត្ថភាពដោះដូរកាចុង Cation Exchange Capacity C.E.C m.e/100g Soil			15.50
(Method ,1M Ammonium Acetate at pH = 7 & Leach with 10 % NaCl)			
កាចុងដោះដូរ ,Exchangeable Cation (m.e/100g Soil), (Method, 1M Ammonium Acetateat pH =7)		កាល់ស្យូម, Calcium Ca	6.40
		ម៉ាញ៉េស្យូម,Magnesium Mg	2.01
		សូដ្យូម,Sodium Na	0.22
		ប៉ូតាស្យូម,Potasium K	0.35
កាចុងដោះដូរសរុប , Total Exchangeable Bases (m.e/100g soil)			8.98
អត្រាចំអែតនៃកាចុង, Bass Saturation %			58
អាស៊ីតដោះដូរ Exchange Acidity m.e/100g Soil , (1 M KCl Method)			9.27
អាលុយមីញ៉ូមដោះដូរ Exchange Al m.e/100g Soil , (1 M KCl Method)			0.24
ប៉េហាស់ទឹក pH H2O , (1:5 Soil: water)			5.12
ប៉េហាស់អំបិល pH KCL , (1:5 (Soil : 1N KCL)			4.11

ចំណាំ: លទ្ធផលទទួលខុសត្រូវតែចំពោះសំណាកដែលបានវិភាគ(Note: This report only valid for sample examined)

ប្រធានមន្ទីរពិសោធន៍ជាតិកសិកម្ម

បានឃើញ និងឯកភាព
ប្រតិភូរាជរដ្ឋាភិបាលទទួលបន្ទុកជាអគ្គនាយក
នៃអគ្គនាយកដ្ឋានកសិកម្ម

ប៊ុត សុភណ្ឌ

2

Appendix 3.4: Results of traffic around the project area

តារាងនិទ្ទេសចំនួនយានយន្ត

ទីតាំងរាប់៖ ស្រុកតាខ្មៅ ខេត្ត (ចតុមុខ)
ឈ្មោះអ្នករាប់៖.....
ថ្ងៃខែឆ្នាំរាប់ចុងក្រោយ៖ ០៩. ធ្នូ. ២០១៩
☑ ថ្ងៃធ្វើការ ☐ ថ្ងៃឈប់សំរាក

ទិសដៅទី១៖ ភ្នំពេញ ទៅ ខ្សាច់ក្រហម
ទិសដៅទី២៖ ខ្សាច់ក្រហម ទៅ ភ្នំពេញ
ម៉ោងចាប់ផ្តើម៖ 7:00 AM ដល់ 6:00 PM

ម៉ោង	ទោចក្រយានយន្ត		ម៉ូតូ		ឡាន		ឡានក្រុង១២កៅអី		ឡានក្រុង១៦-៨៨ កៅអី		ឡានដឹកទំនិញស្រាល		ឡានដឹកទំនិញធ្ងន់		ឡានកង់ទាំ	
ទិសដៅ	១	២	១	២	១	២	១	២	១	២	១	២	១	២	១	២
៧-៨	478	484	54	49	183	171	19	25	2	1	26	24	25	21	2	1
៨-៩	297	386	29	35	153	149	25	31	0	1	11	12	9	13	2	1
៩-១០	429	351	56	61	159	323	82	33	2	1	25	24	16	22	7	5
១០-១១	427	438	41	76	178	337	45	41	1	1	23	25	18	31	6	5
១១-១២	408	567	43	84	166	275	50	49	1	1	12	13	17	25	10	13
១២-១៣	370	450	37	60	162	230	46	30	2	0	13	15	19	30	8	1
១៣-១៨	345	470	50	62	231	200	43	63	4	2	14	16	23	20	11	5
១៨-១៥	461	463	54	55	302	210	44	61	0	0	22	20	24	18	5	13
១៥-១៦	807	525	48	40	381	214	47	56	3	0	26	14	21	22	7	11
១៦-១៧	1134	724	52	62	368	200	34	43	1	1	24	18	7	21	12	9
១៧-១៨	1129	620	50	40	350	150	32	40	5	2	15	10	9	17	6	8
សរុប	11.763		1.138		5.087		944		31		402		428		146	

តារាងចំនួនយានយន្តរាប់ចរាចរណ៍

ទីតាំងរាប់ៈ ផ្លូវជាតិលេខ ២ (ចំណុចប្រសព្វ)
ឈ្មោះអ្នករាប់ៈ.....
ថ្ងៃកាលបរិច្ឆេទៈ 05 ឧសភា 2019
☐ ថ្ងៃឈប់សំរាក ☑ ថ្ងៃធ្វើការ

ទិសដៅទី១ៈ ភ្នំពេញ ទៅ ជើងព្រៃ
ទិសដៅទី២ៈ ជើងព្រៃ ទៅ ភ្នំពេញ
ម៉ោងចាប់ផ្តើមៈ 7:00 AM ដល់ 6:00 PM

ម៉ោង	ទោចក្រយានយន្ត		ម៉ូតូ		ឡានតូច		ឡានក្រុង១២កៅអី		ឡានក្រុង១៦-៤៤ កៅអី		ឡានដឹកធន់ស្រាល		ឡានដឹកធន់ធ្ងន់		ឡានកុងតានឺរ	
ទិសដៅ	១	២	១	២	១	២	១	២	១	២	១	២	១	២	១	២
៧-៨	730	729	92	89	162	189	48	52	6	5	34	38	22	34	4	3
៨-៩	585	427	73	48	141	165	85	50	1	7	29	42	19	28	8	6
៩-១០	424	400	59	55	157	171	92	65	3	0	28	32	35	40	5	15
១០-១១	363	417	58	70	165	159	61	55	1	0	21	36	21	37	11	8
១១-១២	400	434	43	59	127	136	36	38	0	1	15	25	24	32	12	18
១២-១៣	147	390	28	56	63	130	17	35	0	0	7	35	17	30	6	9
១៣-១៤	250	330	32	70	160	152	49	64	0	1	20	46	36	20	18	6
១៤-១៥	244	320	148	55	148	146	34	72	0	1	32	22	19	22	10	6
១៥-១៦	398	371	32	62	162	132	37	68	1	1	25	35	33	18	8	3
១៦-១៧	674	370	48	48	213	205	27	50	1	5	34	41	29	23	7	9
១៧-១៨	546	578	38	36	167	154	28	34	2	1	28	35	25	21	4	7
សរុប	9.527		1.299		3.404		1.097		37		660		585		183	

តារាងនិទ្ទេសរាប់ចរាចរណ៍

ទីតាំងរាប់៖ ចំណុចសង្កាត់ចំការដូង ខេត្តកណ្តាល ដឹកជញ្ជូនដីឥដ្ឋ

ឈ្មោះអ្នករាប់៖.....

ថ្ងៃខែឆ្នាំរាប់ចូល៖ 06 ឧសភា 2019

✓ ថ្ងៃធ្វើសំណាក ☐ ថ្ងៃធ្វើការ

ទិសដៅទី១៖ ភ្នំពេញ ទៅ .....

ទិសដៅទី២៖ .....ទៅ .....

ម៉ោងចាប់ផ្តើម៖ 7:00 AM ដល់ 6:00 PM

ម៉ោង	រថយន្តធុនធ្ងន់		រ៉ឺម៉ក		ឡានក្រុង		ឡានរាងបួនកៅអី		ឡានដឹកទំនិញស្រាល		ឡានដឹកទំនិញធ្ងន់		ឡានកង់តាន់	
ទិសដៅ	១	២	១	២	១	២	១	២	១	២	១	២	១	២
៧-៨	๕๘๑	๗๒๔	๙๕	๙๘	๒๒๓	๒๑๕	๘	๑๐	๒	๐	๓๐	๓๒	๗๘	๘๑	๑	๐
๘-๙	๕๕๒	๗๕๑	๙๓	๑๓๒	๒๑๑	๒๐๖	๑๖	๑๙	๐	๐	๓๑	๔๐	๕๘	๕๑	๐	๑
๙-๑๐	๕๕๑	๔๘๓	๙๕	๑๗	๒๒๕	๑๗๒	๖	๑๙	๒	๑	๔๘	๒๖	๕๗	๓๕	๐	๒
๑๐-๑๑	๕๔๑	๔๑๑	๙๖	๑๘	๒๑๑	๒๑๖	๖	๑๔	๐	๐	๔๓	๓๔	๖๘	๖๑	๐	๑
๑๑-๑๒	๕๗๓	๓๗๖	๑๐๐	๕๓	๑๙๓	๑๙๓	๑๙	๑๘	๐	๐	๕๖	๒๗	๖๐	๘๗	๒	๕
๑๒-๑๓	๓๘๑	๓๕๗	๗๓	๗๘	๑๕๑	๑๔๘	๑๒	๑๙	๐	๐	๒๘	๑๗	๑๘	๒๑	๐	๑
๑๓-๑๔	๔๘๘	๓๘๔	๘๑	๗๑	๑๗๘	๑๖๑	๘	๗	๐	๐	๒๑	๓๔	๕๐	๖๗	๐	๓
๑๔-๑๕	๔๐๓	๔๙๘	๖๕	๕๘	๑๘๑	๒๓๕	๑	๒	๐	๐	๓๑	๒๕	๕๘	๘๕	๑	๓
๑๕-๑๖	๔๖๑	๓๗๑	๗๑	๕๖	๑๖๑	๒๕๐	๘	๑๓	๐	๖	๔๙	๔๕	๕๖	๖๑	๒	๑
๑๖-๑๗	๖๙๑	๖๑๔	๙๗	๘๑	๑๙๑	๒๗๘	๖	๓	๐	๓	๒๓	๒๑	๕๐	๘๓	๙	๘
๑๗-๑๘	๖๙๒	๖๙๘	๖๐	๖๓	๑๔๔	๓๐๔	๗	๑๒	๒	๐	๒๒	๒๘	๒๑	๕๔	๖	๖
សរុប	๑๑.๕๔๗		๑.๗๕๗		๔.๖๑๘		๒๒๙		๑๖		๗๓๑		๑.๓๓๒		๕๒	

តារាងនិទ្ទេសយានយន្ត

ទីតាំងរាប់៖ ..... ទិសដៅទី១៖ ..... ថ្ងៃ .....

ឈ្មោះអ្នករាប់៖ ..... ទិសដៅទី២៖ ..... ថ្ងៃ .....

ថ្ងៃកាលបរិច្ឆេទ៖ ..... ម៉ោងចាប់ផ្តើម៖ 7:00 AM ដល់ 6:00 PM

☐ថ្ងៃធ្វើការ ☑ថ្ងៃសប្តាហ៍ចុងក្រោយ

ម៉ោង	ទោចក្រយានយន្ត		ម៉ូតូ		ឡានតូច		ឡានក្រុង២ជាន់		ឡានក្រុង២ជាន់-៨៨ កៅអី		ឡានដឹកទំនិញស្រាល		ឡានដឹកទំនិញធ្ងន់		ឡានកង់តាន់	
ទិសដៅ	១	២	១	២	១	២	១	២	១	២	១	២	១	២	១	២
៧-៨	370	1115	53	134	124	162	5	15	11	1	21	24	24	46	1	4
៨-៩	384	586	64	97	155	133	3	14	30	0	17	32	11	48	0	6
៩-១០	415	425	84	81	191	115	0	10	0	1	6	31	36	35	0	11
១០-១១	330	401	40	78	145	110	0	11	0	0	10	29	27	30	0	9
១១-១២	360	361	35	55	150	105	0	10	0	1	7	17	17	64	0	11
១២-១៣	283	513	88	74	121	119	4	13	4	13	5	23	32	52	0	3
១៣-១៨	290	421	66	61	130	149	11	12	11	12	85	24	35	58	0	5
១៨-១៥	280	405	60	67	135	157	2	14	2	14	16	21	27	37	0	15
១៥-១៦	300	395	71	62	140	151	7	13	7	13	20	27	24	31	0	14
១៦-១៧	686	540	73	63	153	140	15	20	15	20	25	30	19	30	1	13
១៧-១៨	705	684	67	79	145	150	17	18	17	18	20	28	17	52	0	6
សរុប	10.189		1.552		3080		214		60		518		992		99	

Appendix 3.5: Question for household interview

Question for household interviews

For an evaluate environmental and social impact assessment

លេខកូដសំណួរ៖.....!	ឈ្មោះអ្នកសម្ភាសន៍.....!	កាលបរិច្ឆេទ៖.....!
ភូមិ៖.....!	ឃុំ៖.....!	ស្រុក៖ .....!

1. ព័ត៌មានទូទៅអំពីប្រជាសាស្ត្រនិងសាសនា!

1.1. ឈ្មោះអ្នកផ្តល់សម្ភាសន៍.....អាយុ៖..!.....ភេទ៖□ ១ប្រុស .! □ ២ស្រី!

1.2. តើអ្នកជាមេគ្រួសារ? □ 1. បាទ! ចាស/! □ 2. ទេ! បើទេភេទនៃមេគ្រួសារ)□ ១ប្រុស .! □ ២(ស្រី .!

1.3. កម្រិតអប់រំ៖ □ 1.មិនចេះអក្សរ!□ 2. ចេះអក្សរ! □ 3.បឋមសិក្សា! □ 4.អនុវិទ្យាល័យ!□ 5.វិទ្យាល័យ! □ 6. បរិញ្ញាបត្រ!□ 7. បណ្តុះបណ្តាលវិជ្ជាជីវៈ!□ 8.ផ្សេងៗ!.....!

1.4. នជាតិរបស់មេគ្រួសារ៖ □ .1ខ្មែរ!□ .2ខ្មែអ៊ីស្លាម! □ .3វៀតណាម! □ 4ផ្សេងៗ.!..(បញ្ជាក់)).....!

1.5. សាសនារបស់មេគ្រួសារ!□ .1ព្រះពុទ្ធសាសនា!□ .2សាសនាគ្រឹះ!□ .3សាសនាមូស្លីម!□ .4ផ្សេងៗ!.....!

1.6. តើអ្នករស់នៅទីនេះរយៈពេលប៉ុន្មានឆ្នាំ ឬ ីឃ? □ .1ជាស្រុកកំណើត! □ .2<1ឆ្នាំ! □ .3ពី 1-5ឆ្នាំ! □ .4ពី៥! ១0ឆ្នាំ□ .5>១0ឆ្នាំ!

1.7. ប្រសិនបើជាអ្នកចំណូលថ្មី!តើមូលហេតុអ្វីបានជាអ្នកចាកចេញពីស្រុកកំណើត?
□ .1មកតាមគ្រួសារ! □ .2គ្មានមុខរបរ! □ .3! ផ្សេងៗ បញ្ជាក់) .....(!

2. ស្ថានភាពសេដ្ឋកិច្ច!

2.1. តើក្នុងគ្រួសាររបស់អ្នកមានសមាជិកប៉ុន្មាននាក់? សរុប៖ .....នាក់! នាក់.....ស្រី៖

2.2. តើនៅក្នុងគ្រួសាររបស់អ្នកមានមុខរបរអ្វីខ្លះ?!

ប្រភេទមុខរបរ	ចម្បង	បន្ទាប់បន្សំ	ចំណូលប្រចាំថ្ងៃ (៛)	ចំណូលប្រចាំខែ(៛)	ចំណូលប្រចាំឆ្នាំ (៛)
១ធ្វើស្រែ!.!	□	□			
២ប្រភេទដំណាំ៖) ធ្វើចម្ការ!.! (.....!	□	□			
៣នេសាទ .!	□	□			
៤ចិញ្ចឹមសត្វ!.!	□	□			
៥.!លក់ដូរនិងាំ នួញ!	□	□			
៦.!ជាង!ួស!ុល!	□	□			
៧.!ដឹក! ញ្ជូន	□	□			
៨.!ស៊ីឈ្នួលក្នុងវិស័យកសិកម្ម	□	□			
៩.!កម្មករសំណង់!	□	□			
១0.!កម្មកររោងចក្រ!	□	□			
១១.!បុគ្គលិកអង្គការ!	□	□			
១២.!បុគ្គលិកក្រុម ុនឯក! ន!	□	□			
១៣.!មន្ត្រីរ! ការ!	□	□			

ប្រភេទមុខរបរ	ចម្រុង	បន្ទាប់បន្សំ	ចំណូលប្រចាំថ្ងៃ (រ)	ចំណូលប្រចាំខែ(រ)	ចំណូលប្រចាំឆ្នាំ (រ)
១៤បំរើការងារក្នុងវិស័យសិប្បកម្ម៖! ប្រភេទសិប្បកម្ម៖) (.....!	□	□			
		សរុបចំណូល			

2.3. ចំណាយប្រចាំគ្រួសារ

អត្ថាធិប្បាយ	ការចំណាយប្រចាំថ្ងៃ (រ)	ការចំណាយប្រចាំខែ (រ)	ការចំណាយប្រចាំឆ្នាំ (រ)
□ 1. ម្ហូបអាហារ(អង្ករ!និងម្ហូប)			
□ 2. ការធ្វើដំណើរ!/ឈ្នួលឡាន)សាំង(...!			
□ 3. លើចរន្តអគ្គិសនី!			
□ 4. ថ្លៃហ្គាស!			
□ 5. ថ្លៃអុសធ្យូង/!			
□ 6. ការប្រើប្រាស់ទឹក!			
□ 7. ការសិក្សា!			
□ 8. ព្យាបាល!ំងឺ!(ថ្នាំពេទ្យ!ជាដើម)!			
□ 9. កម្មវិធីក្នុងសង្គមបុណ្យ) អាពារ!ៃ ពិព!ៃ!កម្មវិធី!ួប!ុំផ្សេងៗ(!			
□ 10. សំលៀកបំពាក់!			
□ 11. បំណុល!			
□ 12. ផ្សេងៗ!.....(បញ្ជាក់)			
សរុបចំណាយ			

2.4. តើអ្នកមាន ំពាក់បំណុលដៃរឺទេ? (មិនចាំបាច់សួរអ្នកផ្តល់សម្ភាសទេ!អាចគូសដោយស្វ័យប្រវត្តិប្រសិនបើអ្នកផ្តល់សម្ភាសឆ្លើយនៅចំណុចទី!១១!ក្នុងសំណួរទី!២ (៣.! □ 1. មាន! □ 2. មិនមាន!

<u>ក!ព័ត៌មានលម្អិតអំពីការធ្វើស្រែ!</u>

2.5. ពីការធ្វើរ៉ែស្រែ! □ .1ធ្វើ! □ .2មិនធ្វើ (2.11!សូមរំលងទៅសំណួរទី)

2.6. តើរ៉ែផ្ទៃដីស្រែទាំងអស់សរុបមានទំហំប៉ុន្មាន!ិកតា?.....!

2.7. ជាធម្មតាតើអ្នកធ្វើរ៉ែស្រែប៉ុន្មានដងក្នុងមួយឆ្នាំ!?.....ដង □ .1ស្រូវរដូវស្រា!□ .2ស្រូវប្រាំង!□ .3ទាំងពីររដូវ

2.8. <u>ការធ្វើរ៉ែស្រែវស្សា</u>! □ 1.ធ្វើ! □ 2.មិនធ្វើ! សូមរំលងទៅសំណួរទី)2.8)

2.7.1. តើអ្នកទទួលបានផលជាមធ្យមប៉ុន្មាន?.....គោន!ិកតា/!

2.7.2. ប្រភេទស្រែ៖1.ស្រែស្រាល(.....)□ 2.ស្រែធ្ងន់ (.....)!□3.ស្រែកណ្តាល!(.....)!

2.7.3. ប្រភពទឹកសម្រាប់ធ្វើរ៉ែស្រែវស្សា៖!(ចម្លើយអាចលើសពី១)

1.ទឹកប្រឡាយ(.....)!អូរ/! 2.ទឹកភ្លៀង! 3.ស្រះ! ត្រពាំង/4.អណ្តូង!

5.ទឹកស្ទឹង (.....)6.ទឹកទន្លេ 7. ផ្សេងៗ .....!

2.7.4. តម្លៃចំណាយសរុបពីស្រូវវស្សា!ក្នុរ)ស្មង!ច្រូត!ថ្នាំឆ្នាំ/រៀល.....ឆ្នាំរ/(...!

2.7.5. តើអ្នកប្រើប្រាស់ជីប្រភេទអ្វីសម្រាប់ការធ្វើរ៉ែស្រែវស្សា? (អាចប្រើសរើសបានច្រើន(!

□1. ីគីមី! □2. ីធម្មជាតិ!(...!អាចម៍គោ ប្រូក)! □3. ីតំប៉ុស្ដិ៍

2.7.6. បរិមាណ!ីប្រើប្រាស់ក្នុងមួយ!ិតតា? □1. <1ប៉ាវ! □2. 2-5ប៉ាវ! □3. 5-10ប៉ាវ

□4. >10ប៉ាវ!

2.9. <u>ការធ្វើរ៉ែស្រែប្រាំង</u>! □1.ធ្វើ! □2.មិនធ្វើ!សូមរំលងទៅសំណួរទី)2.9)

2.8.1. តើអ្នកទទួលបានផលជាមធ្យមប៉ុន្មាន? .....តោន១!ិតតា/

2.8.2. ប្រភេទស្រូវ៖ 1.ស្រូវស្រាល (.....)2.ស្រូវធ្ងន់ (.....)3.ស្រូវកណ្ដាល!(.....)!

2.8.3. ប្រភពទឹកសម្រាប់ធ្វើរ៉ែស្រែប្រាំង៖!(អាចប្រើសរើសបានច្រើន)

□1.ទឹកប្រឡាយអូរ/!(.....)!□2.ទឹកភ្លៀង! □3.ស្រះ! ត្រពាំង/□4. អណ្ដូង!

□5.ទឹកស្ទឹង (.....)□6.ទឹកទន្លេ □7. ផ្សេងៗ .....!

2.8.4. តម្លៃចំណាយសរុបពីស្រូវប្រាំង ក្នុរ)ស្មង ច្រូត!ថ្នាំឆ្នាំ/រ.....ឆ្នាំរ/(...!

2.8.5.តើអ្នកប្រើប្រាស់ជីប្រភេទអ្វីសម្រាប់ការធ្វើរ៉ែស្រែវស្សា? (អាចប្រើសរើសបានច្រើន(! □1. ីគីមី!

□2. ីធម្មជាតិ!(...!អាចម៍គោ ប្រូក)!□3. ីតំប៉ុស្ដិ៍

សូមបញ្ជាក់ប្រភេទ!ីគីមី!និងទីតាំងទិញ!ី!..... ថ្នាំគីមី៖/!

2.8.5. បរិមាណ!ីប្រើប្រាស់ក្នុងមួយ!ិតតា?

□1. <1ប៉ាវ! □2. 2-5ប៉ាវ! □3. 5-10ប៉ាវ! □4. >10ប៉ាវ!

2.8.6. ព័ត៌មានស្ដីអំពីការប្រើប្រាស់!ី.....ថ្នាំគីមី៖/!

.....!

2.8.7. ព័ត៌មានស្ដីអំពីតារទុកដាក់!និងបោះចោលសំបកថ្នាំ!.....!ថ្នាំគីមី៖/ចង់!ី/

.....!

2.10. <u>តើអ្នក!ួបប្រទះនូវបញ្ហាអ្វីខ្លះក្នុងការធ្វើរ៉ែស្រែ? (ប្រើសរើសចម្លើយបានច្រើន(</u>

□1. ខ្វះបច្ចេតទេស! □2. ខ្វះដើមទុន! □3. ខ្វះពូ! □4. ខ្វះ!ី

□5.ខ្វះកម្លាំងពលកម្ម! □6. ទិន្នផលទាប! □7. ខ្វះទឹក! □8. សត្វល្អិតបំផ្លាញ!

□9. គ្រោះរាំងស្ងួត!ឬទឹក ំនន់! □10. ដីគ្មាន!ីជាតិ! □11. ផ្សេងៗ .....!

2.11. តើអ្នកចង់បន្តមុខរបរធ្វើស្រែទៀតដែរឬទេ?!

1. ចង់!ពីព្រោះ!.....

2. មិនចង់!ពីព្រោះ!.....

<u>ខ!ព័ត៌មានលម្អិតអំពីតារធ្វើចម្ការ!</u>

2.12. ការធ្វើចម្ការ៖!□1.ធ្វើ! 2.មិនធ្វើ!សូមរំលងទៅសំណួរទី)2.16)

2.13. តើរ៉ែដីចម្ការទាំងអស់សរុបមានប៉ុន្មាន ិតតា?.....!

2.14. តើប្រភេទដំណាំអ្វីខ្លះដែលអ្នកបានដាំដុះ!?

ប្រភេទដំណាំ	ទិន្នផល(ដង/កឬតោន.គ)	ចំណាយ(ដង/រ)
□ 1. ស្វាយ!		

ប្រភេទដំណាំ	ទិន្នផល(ដង/កឬគោន.គ)	ចំណាយ(ដង/ឆ)
☐ 2. មៀន!		
☐ 3. សណ្តែក!		
☐ 4. ពោត!		
☐ 5. ចេក!		
☐ 6. ស្មៅ!		
☐ 7. បន្លែ៖ .....!		
☐ 8. ផ្សេងៗ!(បញ្ជាក់.....(!		
តម្លៃចំណាយសរុបពីការធ្វើចម្ការក្នុងមួយឆ្នាំ		

2.15. តើអ្នកប្រើប្រាស់ដីប្រភេទអ្វីសម្រាប់ការធ្វើចម្ការ? (អាចប្រើ សរើសបានច្រើន(
☐1. ីតីមី! ☐2. ីធម្មជាតិ!(...អាចម៍គោ ប្រូក)! ☐3. ីតំប៉ុស្តិ!

2.16. បរិមាណ!ប្រើប្រាស់ក្នុងមួយ ិកតា? ☐1. <1ប៉ាវ! ☐2. 2-5ប៉ាវ! ☐3. 5-10ប៉ាវ! ☐4. >10ប៉ាវ!
គប្រសិនបើការចិញ្ចឹមសត្វជាប្រភពចំណូល)!ព័ត៌មានលម្អិតអំពីការចិញ្ចឹមសត្វ .ចម្បងរបស់អ្នកផ្តល់សម្ភាស(!

2.17. តើគ្រួសាររបស់អ្នកមានចិញ្ចឹមសត្វសម្រាប់លក់ដូរដែរឬទេ? ☐1. មាន! ☐2.គ្មាន! បើគ្មានសូមរំលងទៅ)!
សំណួរទី៣)

ប្រភេទសត្វ	ចំនួន (ក្បាល)	ចំនួនលក់ (រ(ឆ្នាំ/	តម្លៃ(ដង/ឆ) ដង/	ចំណាយឆ្នាំ/(រ(ឆ្នាំ/
☐1. គោ!				
☐2. ប្រូក!				
☐3. មាន់!				
☐4. ទា!				
☐5. ពពែ!				
☐6. ត្រី!				
☐7. ផ្សេងៗ.....!				
		តម្លៃសរុប	***ឆ***	***ឆ***

3. លំនៅដ្ឋាន!ការកាន់កាប់ដីធ្លី!និងទ្រព្យសម្បត្តិ!

<u>កលំនៅដ្ឋាន!និងការកាន់កាប់ដីធ្លី .</u>!

3.1. តើគ្រួសាររបស់អ្នកមានដីធ្លីកាន់កាប់ដែរឬទេ? ☐.1!មិនមាន ☐.2!មាន!

3.1.1. តើគ្រួសាររបស់អ្នកមានឯកសារកម្មសិទ្ធិដីធ្លីដែរ ឬទេ? ☐.1មិនមាន ☐.2!មាន!

3.1.2. បើមាន!តើឯកសារកម្មសិទ្ធិប្រភេទអ្វី? ☐1.ប្លង់ឆ្វែ ☐2.ប័ណ្ណកម្មសិទ្ធិ! ☐3.ផ្សេង!
.....!

3.2. ប្រភេទផ្ទះ (សូមធ្វើការអង្កេត)☐1.ផ្ទះដំបូលប្រក់ស្លឹកស្វាយ! ☐2.ផ្ទះដំបូលប្រក់សង្កសីស៊ីប្រូស៊ីម៉ង់!
☐.3!ផ្ទះដំបូលប្រក់ក្បឿង! ☐.4!ផ្ទះឋមិនមែនបេតុង!☐.5!ផ្ទះឋល្វែង! ☐.6!ផ្ទះកូមិក្រឹរ(វីឡា)!
☐.7!ផ្សេងៗ.....(បញ្ជាក់)

ខ!ទ្រព្យសម្បត្តិក្នុងគ្រួសារ!

3.3. តើគ្រួសារអ្នកមានទ្រព្យសម្បត្តិអ្វីខ្លះ?!

ប្រភេទ	ចំនួន	ប្រភេទ	ចំនួន
□1. ឡាន!		□8. ទូរទស្សន៍!	
□2. ម៉ូតូ!		□9. ទូរស័ព្ទដៃ!	
□3. កង់!		□10. កុំព្យូទ័រ!	
□4. ម៉ាស៊ីនភ្លើង!		□11. គោយន្ត!	
□5. ម៉ាស៊ីញ៉ូ!/ម៉ាស៊ីនចាក់ស៊ីឌី!/VCD		□12. ត្រាក់ទ័រ!	
□6. ម៉ាស៊ីនម៉ូទ័របូមទឹក/!		□13. ទូក (.....!ទំហំ)	
□7. រទេះគោ!		□14. ផ្សេងៗ .....(បញ្ជាក់)	

4. ! ដ្ឋានសេដ្ឋកិច្ច និងសេវាកម្មក្នុងតំបន់!

ក!បញ្ហាសុខភាព!

4.1. តើគ្រួសាររបស់អ្នកធ្លាប់មាន!ជំងឺដែរឬទេ!ក្នុងរយៈពេល!១ឆ្នាំចុងក្រោយនេះ?

□1.ធ្លាប់! □2.មិនធ្លាប់ បើមិនធ្លាប់ សូមរំលងទៅសំណួរទី)4.3)

4.2. តើគ្រួសាររបស់អ្នកធ្លាប់មាន!ជំងឺអ្វីខ្លះក្នុងរយៈពេល!១ឆ្នាំចុងក្រោយនេះ?

*លេខកូដ៖! 1. ធ្ងន់ធ្ងរជាងមុន! 2.នៅដដែល 3.ប្រសើរជាងមុនឬជាសះស្បើយ! 4.ផ្សេង..... (បញ្ជាក់)!

**លេខកូដ៖!1. មណ្ឌលសុខភាព!(.....ឈ្មោះ)! 2.មន្ទីរពេទ្យបង្អែក (.....ឈ្មោះ)!.3ពេទ្យឯកទេស!ន/!

.4ទិញថ្នាំញ៉ាំខ្លួនឯង! គ្រូខ្មែរ.5! .6ផ្សេង.....(បញ្ជាក់)!

ប្រភេទ មី	ស្ថានភាព មីនៅ ពេលបច្ចុប្បន្ន*	កន្លែងព្យាបាល**
□1. ំងឺរាគមួលរាគគ្មានខ្សោះជាតិទឹក/!		
□2. ំងឺអាសន្នរោគ!		
□3. ំងឺកាមរោគ!		
□4. ំងឺគ្រុនឈាម!		
□5. ំងឺពងបែកនៅដៃមាត់ៈើង!		
□6. ំងឺរលាកថ្លើមប្រភេទ!A		
□7. ំងឺរលាកថ្លើមប្រភេទ!B		
□8. ំងឺរលាកថ្លើមប្រភេទ!C		
□9. ំងឺអេដស៍!		
□10. ំងឺគ្រុនចាញ់!		
□11. ំងឺផ្តាសេសាយ!		
□12. ំងឺគ្រុនពោះវៀន!		
□13. ំងឺរបេង!		
□14. ំងឺទឹកនោមផ្អែម!		
□15. ំងឺកង្វះអាហាររូបត្ថម្ភ!		

ប្រភេទ ម្ចី	ស្ថានភាព ម្ចីនៅ ពេល បច្ចុប្បន្ន*	កន្លែងព្យាបាល**
□16. ំងឺលើសសម្ពាធឈាម!		
□17. របួសដោយគ្រោះថ្នាក់ចរាចរណ៍មានប៉ះ! ទង្គិចក្បាល!		
□18. ំងឺវិតលចរិត!		
□19. ំងឺនានាផ្នែករោគស្ត្រី!		
□20. ំងឺរលាកផ្លូវដង្ហើមខាងលើ(រលាកសួត!ឬ) (រលាកទងសួត!		
□21. ំងឺរលាកផ្លូវដង្ហើមខាងក្រោម! ម្ចី!ត) (ទឹកស្រោមសួត!		
□22. ំងឺនានាទាក់ទងនឹងស្បែក.....!		
□23. ំងឺផ្នែកភ្នែក!.....!		
□24. ំងឺសន្លាក់ដៃើង!		
□25. គ្រុនស្វិតដៃើង!		
□26. ផ្សេងៗ.....!		

<u>ខ!ការប្រើប្រាស់ទឹកនិងអនាម័យ</u>!

4.3. តើប្រភពទឹកណាខ្លះដែលអ្នកអាចយកមកប្រើប្រាស់ជាប្រចាំថ្ងៃបាន?

*លេខកូដ៖!1. សម្រាប់ផឹក 2. សម្រាប់ងូត!3.សម្រាប់លាងសម្ពាត!4.សម្រាប់ការងារកសិកម្ម!5.សម្រាប់ការងារ! សិប្បកម្ម! 6.ផ្សេង!.....!

**លេខកូដ៖!1. ល្អ!(...!គ្មានក្លិន ថ្លា!)!2.មិនល្អ!(ទឹកក្រ ម!! តុអ្វី)

ប្រភពទឹក	គោលបំណងនៃការប្រើប្រាស់ទឹក*	លក្ខណៈគុណភាពទឹក**
□1.ពីរដ្ឋករទឹកក្នុងតំបន់(ទឹកស្អាត)		
□2. ប្រឡាយអូរ!		
□3.ស្រះ(.....ទីតាំង)បឹង!ត្រពាំង!		
□4.អណ្តូងស្នប់(.....! ម្រៅ)		
□5.អណ្តូងលូ(.....! ម្រៅ)		
□6.ទឹកភ្លៀង!		
□7.ទឹកទន្លេ!		
□8.ផ្សេងៗ.....!		

4.4. តើការប្រើប្រាស់ទឹកប្រចាំថ្ងៃក្នុងគ្រួសាររបស់លោកអ្នកគ្រប់គ្រាន់ដែរឬទេ?

□1!. គ្រប់គ្រាន់!	បរិមាណទឹកដែលបានប្រើក្នុងមួយថ្ងៃម)^{3}..... (ថ្ងៃ/
□2!.មិនគ្រប់គ្រាន់!	នៅខែណា? .....!! តុអ្វី? .....

4.5. តើរលោកអ្នកបរិភោគទឹកអ្វី? □1. ទឹកឆ្អិន □2. ទឹកដៅ!□3. ទឹកចម្រោះ! □4. ផ្សេងៗ.....!

4.6. បើបរិភោគទឹកមិនទាន់ដាំ!! តុអ្វី? □1. ទម្លាប់ □2. គ្មានពេលដាំ! □3. ស្អាតស្រាប់!ើយ!

□4. គ្មានចរិកា □5. ផ្សេងៗ .....!

4.7. តើគ្រួសាររលោកអ្នកមានបង្គន់អនាម័យដែរឬទេ ? □1. មាន! □2. គ្មាន

4.7.1. បើមាន!តើបង្គន់របស់គ្រួសារអ្នក!ជាបង្គន់ប្រភេទអ្វី? □1. បង្គន់ចាក់ទឹក!□2. បង្គន់ចាក់ផេះ!
□3. ផ្សេងៗ.....!

4.7.2. បើគ្មាន!តើរលោកអ្នកបន្ទោរបង់នៅឯណា ? □1.បង្គន់អ្នក!តខាង!□2. គម្ពោតព្រៃ!□3.វាលស្រែ!
□4. ផ្សេងៗ.....!

<u>គ!.ការប្រើប្រាស់ថាមពល!</u>

4.8. តើគ្រួសារអ្នកប្រើប្រាស់អគ្គិសនីមានប្រភពមកពីណា ? □1.អគ្គិសនីតម្លៃ(រដ្ឋ) □2.ឯកជន
□3.អាគុយ! □4.ម៉ាស៊ីនភ្លើងខ្លួនឯង!□5. ថាមពលបន្ទរសូឡា!□6.ឡ ីវឌស្ន័ន!□7.ផ្សេងៗ..

4.9. តម្លៃថាមពលអគ្គិសនី!.....!រៀលក្នុងមួយគីឡូវ៉ាត់ម៉ោង!

4.10. ផលវិបាកនៃការប្រើប្រាស់ថាមពលអគ្គិសនី.....!

4.11. តើស! គមន៍របស់អ្នកមានសេវាកម្មប្រមូលសំរាមដែរឬទេ ? □.1!មិនមាន! □.2 មាន!

4.12. តើអ្នកត្រូវចំណាយយ៉ាងដូចម្តេចចំពោះសេវាកម្មនេះ ?.....!

4.13. បើគ្មាន!តើអ្នក!និងស! គមន៍របស់អ្នកទុតជាក់សំណល់រឹងដោយរបៀបណា ?
□1.ដុតចោល! □2.កប់ចោល! □3.បោះចោលពាសវាលពាសកាល!
□4.ផ្សេងៗ.....!

5. ព័ត៌មានបរិស្ថានរូបសាស្ត្រ

<u>ក!.ការរំខានដោយសារសំឡេង!</u>

.6.1! រំញ័រដែរឬទេ/!តើគ្រួសាររបស់អ្នកមានការរំខានដោយសារសំឡេង!? □ .1មាន! □ .2មិនមាន!

កម្រិតរំខាន	ព្រឹក ម៉ោង	រសៀល ម៉ោង	ល្ងាច ម៉ោង	យប់ ម៉ោង	ប្រភពសំឡេង ឬរំញ័រ
□ 1 .រំខានតិច! .....!					
□ 2 .រំខានមធ្យម! .....!					
□ 3 .រំខានខ្លាំង! .....!					
សំណូមពរ					

<u>ខ(ក្លិន)!គុណភាពខ្យល់ .!</u>

.6.2! ុំរិញផ្ទះ!ឬនៅក្នុងភូមិរបស់អ្នកមានលក្ខណៈដូចម្តេច!( )តើគុណភាពខ្យល់!?
□1.មិនល្អ! □2.ធម្មតា! □3.ល្អ!

5.1.1. បើមិនល្អ!មូលេ! តុអ្វី!?
□1. ុយពីការធ្វើចរាចរណ៍! □2.ការចិញ្ចឹមសត្វ! □3.ផ្សេងៗ.....!

5.1.2. បើការបំពុលនោះមានកម្រិតណា ? □1.តិច□2.មធ្យម! □3.ខ្លាំង

5.1.3. បរិយាយអំពីការបំពុល!យ៉ាងដូចម្តេច ?.....!

5.1.4. តើនៅក្នុងអំឡុងពេលណាដែលមានការបំពុលខ្លាំងជាងគេ ?

□1.ពេលព្រឹក □2.ពេលថ្ងៃ! □3.ពេលរសៀល! □4.ពេលល្ងាច! □5.ពេលយប់!
□6.ពេលមានខ្យល់! □7. ជាប្រចាំរាល់តែម្តង! □8.ផ្សេងៗ .....!

6. ទស្សនៈនិងការយល់ឃើញរបស់ប្រជាជន!

6.1. តើក្នុងតំបន់ដែលអ្នករស់នៅមានបញ្ហាបរិស្ថានអ្វីខ្លះ? □1. ការបំពុលទឹក! □2.ការបំពុលខ្យល់
□3. ការបំពុលដី! □4. បញ្ហាស្ថិនស្មុយ! □5. បញ្ហាសំណល់រឹង! □6. ផ្សេងៗ.....!

6.2. តើអ្នកបានដឹងអំពីព័ត៌មានដំណើរការរបស់គម្រោងដែរឬទេ!? □1.ដឹង! □2.មិនដឹង!

6.3. តើអ្នកមានដីនៅក្បែរគម្រោងនេះដែរឬទេ? □1. មាន!□2. មិនមាន (6.4រំលងទៅសំណួរទី)

.7.4! តើអ្នកមានការព្រួយបារម្ភអ្វីខ្លះទាក់ទងទៅនឹងដំណើរការរបស់គម្រោងនេះ? □.1មាន! □.2មិនមាន!
បើមាន!តើបញ្ហាអ្វីខ្លះដែលអ្នកព្រួយបារម្ភ?
□.1!ប៉ះពាល់ដីធ្លី! □ .2រំខានដោយសំឡេង ឬរំញ័រ! □3. ការបំពុលខ្យល់

□4. ការទុកដាក់សំណល់រឹង □5. ការស្នះសណ្តាប់ធ្នាប់ចរាចរណ៍! □6.ផ្សេងៗ .....!

6.4. តើអ្នកគិតថាគម្រោងនេះនឹងផ្តល់អត្ថប្រយោ! ន៍ដល់គ្រួសារអ្នក!ឬសហគមន៍ដែរឬទេ?
□1.មានប្រយោ! ន៍ □2. គ្មានប្រយោ! ន៍! □3. មិនដឹង
បើមាន!តើគម្រោងនេះបានផ្តល់នូវអត្ថប្រយោ! ន៍អ្វីខ្លះ?
□1.បង្កើតការងារដល់ស! គមន៍! □2.ការសាងសង់ផ្លូវធ្វើដំណើរ□3. បង្កើនតម្លៃអចលនទ្រព្យ!
□4. ួយស្តារប្រព័ន្ធលូ! □5.បង្កើនភ្ញៀវទេសចរណ៍! □6. ួយអភិវឌ្ឍន៍!
សេដ្ឋកិច្ចជាតិ!
□7.ផ្សេងៗ.....!

សូមអរគុណចំពោះការចូលរួមរបស់អ្នក !!!!

Appendix 3.6: Questions for key informant interviews

1. **Bati District Officer**

- សក្តានពុល!សម្រាប់ការអភិវឌ្ឍ
- យោបល់របស់រដ្ឋបាលអំពីផលប៉ះពាល់អវិ!មាន!និងវិ!មាន!នៃគម្រោង!
- តួនាទីរបស់រដ្ឋបាលស្រុកក្នុងការគ្រប់គ្រងសកម្មភាពរបស់គម្រោង!និងកិច្ចការងារការពារបរិស្ថាន!ពាក់ព័ន្ធនឹង! គម្រោងនេះ!
- ផែនការអភិវឌ្ឍន៍សំខាន់ៗនៅក្នុងស្រុក!(ទាំងក្នុងពេលបច្ចុប្បន្ន និងនៅពេលអនាគត)!
- វិស័យអទិភាពសម្រាប់អភិវឌ្ឍន៍
- អនុសាសន៍ និងសំណូមពរចំពោះរោងចក្រ!និងការវាយតម្លៃ! តុប៉ះពាល់បរិស្ថានរបស់តម្រោងនេះ!

ឯកសារស្នើសុំ

- ✧ ទិន្នន័យស្ថិតិស្រុក!
- ✧ ផែនការវិនិយោគស្រុក

2. Sa'ang District Officer

- សក្តានពុល!សម្រាប់ការអភិវឌ្ឍ!

- យោបល់របស់រដ្ឋបាលអំពីផែលប៉ះពាល់អវិជ្ជមាន និងវិជ្ជមាននៃគម្រោងរោង!
- តួនាទីរបស់រដ្ឋបាលស្រុកក្នុងការគ្រប់គ្រងសកម្មភាពរបស់គម្រោង និងកិច្ចការងារការពារបរិស្ថាន ពាក់ព័ន្ធនឹង! គម្រោងនេះ!
- ផែនការអភិវឌ្ឍន៍សំខាន់ៗនៅក្នុងស្រុក ទាំងក្នុងពេលបច្ចុប្ប)បន្ទ និងនៅពេលអនាគត(!
- វិស័យអទិភាពសម្រាប់អភិវឌ្ឍន៍
- អនុសាសន៍ និងសំណូមពរចំពោះរោងចក្រ និងការវាយតម្លៃ! គុប៉ះពាល់បរិស្ថានរបស់គម្រោងនេះ!

ឯកសារស្នើសុំ

- ✧ ទិន្នន័យស្ថិតិស្រុក!
- ✧ ផែនការវិនិយោគស្រុក!

3. Kandal Province Officer

- ការអភិវឌ្ឍលើគ្រប់វិស័យទាំងអស់នៅក្នុងខេត្តតណ្តាល
- យោបល់របស់សាលាក្រុងអំពីផែលប៉ះពាល់អវិជ្ជមាន និងវិជ្ជមាននៃគម្រោងនេះ!
- តួនាទីរបស់សាលាក្រុងក្នុងការគ្រប់គ្រងសកម្មភាពរបស់គម្រោងនេះ! និងកិច្ចការងារការពារបរិស្ថាន ពាក់ព័ន្ធ នឹងគម្រោងនេះ
- ផែនការឬទិសដៅអភិវឌ្ឍន៍សំខាន់ៗ(ទាំងក្នុងពេលបច្ចុប្បន្ន និងនៅពេលអនាគត)
- អនុសាសន៍ និងសំណូមពរចំពោះរោងចក្រស្រាបៀរ និងកេស : និងការវាយតម្លៃ! គុប៉ះពាល់បរិស្ថានរបស់ គម្រោង!
- សំណួរពាក់ព័ន្ធផ្សេងៗទៀត!

ឯកសារស្នើសុំ

ទិន្នន័យ និងរបាយការណ៍អំពីប្រជាសាស្ត្រ ការចិញ្ចឹម ពីរ និងសេដ្ឋកិច្ចរបស់ប្រជា! ន!

4. Kandal Stoeng District Officer

- សក្តានពុល សម្រាប់ការអភិវឌ្ឍ!
- យោបល់របស់រដ្ឋបាលអំពីផែលប៉ះពាល់អវិជ្ជមាន និងវិជ្ជមាន នៃគម្រោង!
- តួនាទីរបស់រដ្ឋបាលស្រុកក្នុងការគ្រប់គ្រងសកម្មភាពរបស់គម្រោង និងកិច្ចការងារការពារបរិស្ថាន ពាក់ព័ន្ធនឹង! គម្រោង!
- ផែនការអភិវឌ្ឍន៍សំខាន់ៗនៅក្នុងស្រុក(ទាំងក្នុងពេលបច្ចុប្បន្ន និងនៅពេលអនាគត)
- វិស័យអទិភាពសម្រាប់អភិវឌ្ឍន៍
- អនុសាសន៍ និងសំណូមពរចំពោះរោងចក្រ និងការវាយតម្លៃ! គុប៉ះពាល់បរិស្ថានរបស់គម្រោងនេះ!

ឯកសារស្នើសុំ

- ✧ ទិន្នន័យស្ថិតិស្រុក
- ✧ ផែនការវិនិយោគស្រុក

5. Department of Industry and Handicrafts of Kandal Province

- ព័ត៌មានទូទៅទាក់ទងវិស័យឧស្សា! កម្ម និងសិប្បកម្មសំខាន់ៗ!

- សក្តានុពលក្នុងការអភិវឌ្ឍវិស័យឧស្សាកម្ម និងសិប្បកម្មស្រុកកណ្តាលស្ទឹង
- ចំនួនគម្រោងវិនិយោគដែលបាន និងមិនទាន់បានអាជ្ញាប័ណ្ណវិនិយោគ
- យោបល់របស់មន្ទីរទៅលើផលប៉ះពាល់ និងផលប្រយោន៍លើវិ (ស គមន៍មូលដ្ឋាន និងប្រទេសជាតិ)
  ស័យឧស្សាកម្ម និងសិប្បកម្មដែលអាចប៉ះពាល់ដោយសារគម្រោងអភិវឌ្ឍន៍នេះ
- អនុសាសន៍លើស្ថេរភាពបុគ្គលិកកម្មករក្នុងរោងចក្រ និងការរៀបចំរោងចក្រ
- អនុសាសន៍លើស្ថេរភាពចំណីអាហារ និងកេស្ត
- សំណូមពរ

ឯកសារស្នើសុំ

- ✧ របាយការណ៍ស្តីពីតារអភិវឌ្ឍវិស័យឧស្សា កម្ម និងសិប្បកម្ម
- ✧ លិខិតបទដ្ឋានគតិយុត្តដែលពាក់ព័ន្ធនឹងស្ថេរភាពចំណីអាហារ និងកេស្ត និងស្ថេរភាពបុគ្គលិកកម្មករ ក្នុងរោងចក្រ និងការរៀបចំរោងចក្រ

6. Department of Tourism Kandal of Province

- ស្ថានភាពទូទៅលើវិស័យទេសចរណ៍នៅក្នុងរា ជានីភ្នំពេញ និងសារៈសំខាន់វិស័យទេសចរណ៍
- សក្តានុពលទេសចរណ៍
- ទិស្ដៅនៃការអភិវឌ្ឍវិស័យទេសចរណ៍
- យោបល់របស់មន្ទីរពាក់ព័ន្ធនឹង តុប៉ះពាល់ ដែលអាចប៉ះពាល់គម្រោងវិនិ (វិជ្ជមាន និងអវិជ្ជមាន) យោគនេះ
- អនុសាសន៍ និងសំណូមពរ

ឯកសារស្នើសុំ

- ✧ របាយការណ៍ស្តីពីតារអភិវឌ្ឍវិស័យទេសចរណ៍

7. Department of Water Resource & Meteorology of Kandal Province

- ព័ត៌មានទូទៅលើការអភិវឌ្ឍក្នុងការគ្រប់គ្រងធនធានទឹក និងសមិទ្ធិផលសំខាន់ៗ
- បញ្ហា និងឧបសគ្គ ក្នុងការអភិវឌ្ឍ និងការគ្រប់គ្រងលើវិស័យធនធានទឹក
- ស្ថានភាពទឹក ំនន់នៅក្នុងស្រុកកណ្តាលស្ទឹង
- យោបល់របស់មន្ទីរទៅលើផលប៉ះពាល់ និងផលប្រយោន៍លើវិ (ស គមន៍មូលដ្ឋាន និងប្រទេសជាតិ) ស័យធនធានទឹកដែលអាចប៉ះពាល់ដោយសារគម្រោងអភិវឌ្ឍន៍នេះ
- អនុសាសន៍ និងសំណូមពរ

ឯកសារស្នើសុំ

- ✧ របាយការណ៍ស្តីពីស្ថានភាពទឹក ំនន់
- ✧ ផែនទីស្តីពីរយៈកម្ពស់ និងស្ថានភាពទឹក

8. Department of Land Management Urban Planning and Construction of Kandal Province

- បញ្ហាទូទៅដែលកើតមានឡើង និងវិធានការដោះស្រាយ
- ស្តង់ដារគុណភាពសំណង់រោងចក្រ

- តួនាទីរបស់មន្ទីរក្នុងការគ្រប់គ្រង និងត្រួតពិនិត្យសកម្មភាពសាងសង់របស់គម្រោងរោងចក្រផលិតកម្មផ) លិតស្រាបៀរ(និងភេស្ជៈរបស់ក្រុម ុន ខ្មែរប្រូវើរីលើមីតធីត!
- មតិរយោបល់របស់មន្ទីរ ពាក់ព័ន្ធនឹងៈ តុប៉ះពាល់ ដែលអាចប៉ះពាល់ដោយ! (វិជ្ជមាន! និងអវិជ្ជមាន)! គម្រោងរោងត!
- អនុសាសន៍ និងសំណូមពរ!

ឯកសារស្នើសុំ

✧ លិខិតបទដ្ឋានគតិយុត្ត ពាក់ព័ន្ធការគ្រប់គ្រងវិស័យសំណង់ នៅក្នុងប្រទេសកម្ពុជា!

9. Department of Rural Development of Kandal Province

- ព័ត៌មានទូទៅនៃការអភិវឌ្ឍន៍ៈ ដ្ឋានេចនាសម្ព័ន្ធជនបទដែលទើបអភិវឌ្ឍន៍និងផែនការអភិវឌ្ឍនៅក្នុងខេត្ត! កណ្តាល!
- ស្ថានភាពការអភិវឌ្ឍន៍ហេដ្ឋារចនាសម្ព័ន្ធ និងសមិទ្ធិផលសំខាន់ៗ និងបញ្ហាប្រឈម!
- ផែនការអភិវឌ្ឍន៍ៈ ដ្ឋារចនាសម្ព័ន្ធជនបទនៅក្នុងតំបន់ក្បែរទើតាំងគម្រោង!
- យោបល់របស់មន្ទីរពាក់ព័ន្ធនឹងៈ តុប៉ះពាល់ដែលអាចបង្កឡើងដោយគម្រោង (វិជ្ជមាន និងអវិជ្ជមាន)។!
- អនុសាសន៍ និងសំណូមពរចំពោះក្រុម ុន!
- ការវាយតម្លៃៈ តុប៉ះពាល់បរិស្ថានរបស់គម្រោងនេះ!
- សំណូរពាក់ព័ន្ធផ្សេងៗទៀត!

ឯកសារស្នើសុំ

✧ របាយការណ៍ប្រចាំឆ្នាំចុងក្រោយ ស្តីពីស្ថានភាពនៃការអភិវឌ្ឍៈ ដ្ឋារចនាសម្ព័ន្ធ និងសមិទ្ធិផលនានា នៅ! ក្នុងខេត្ត!

10. Department of Planning of Kandal Province

- តួនាទីរបស់មន្ទីរផែនការ!
- ប្រឈមនានារបស់មន្ទីរពាក់ព័ន្ធការងាររៀបចំចងក្រងទិន្នន័យស្ថិតិ!
- ព័ត៌មានពាក់ព័ន្ធសកម្មភាពវិនិរយោគសាធារណៈ និងឯក ន
- ផែនការអភិវឌ្ឍន៍សំខាន់ៗដែលជាយុទ្ធសាស្ត្ររបស់មន្ទីរនាពេលអនាគត!
- យោបល់របស់មន្ទីរពាក់ព័ន្ធនឹងៈ តុប៉ះពាល់ ដែលអាចបង្កឡើងដោយគម្រោង!(វិជ្ជមាន និងអវិជ្ជមាន)
- អនុសាសន៍ និងសំណូមពរលើគម្រោងនេះ
- សំណូរពាក់ព័ន្ធផ្សេងៗទៀត!

ឯកសារស្នើសុំ

- ទិន្នន័យស្ថិតិប្រជាសាស្ត្រ និងសេដ្ឋកិច្ច!
- របាយការណ៍ផែនការយុទ្ធសាស្ត្រក្នុងការអភិវឌ្ឍន៍មូលដ្ឋាន

11. Department of Environment of Kandal Province

- ស្ថានភាពទូទៅនៃការគ្រប់គ្រងបរិស្ថានរបស់មន្ទីរបរិស្ថាន នៅទីក្រុងភ្នំពេញ!
- តួនាទីរបស់មន្ទីរបរិស្ថាន ពាក់ព័ន្ធនឹងការងារវាយតម្លៃៈ តុប៉ះពាល់បរិស្ថាន និងការត្រួតពិនិត្យបញ្ហាបរិស្ថានរបស់គម្រោងអភិវឌ្ឍន៍នៅក្នុងទីក្រុង!

- បញ្ហាប្រឈមសំខាន់ៗ នៅក្នុងការអនុវត្តការងារគ្រប់គ្រងបរិស្ថាន ក៏ដូចជាការចូលរួមក្នុងការងារវាយតម្លៃ លទ្ធផល តុប៉ះពាល់បរិស្ថានទូទៅ
- យោបល់របស់មន្ទីរទៅលើផលប៉ះពាល់ និងផលប្រយោជន៍ទៅ (ស្ថានមូលដ្ឋាន និងប្រទេសជាតិ) លើគម្រោងអភិវឌ្ឍន៍នេះ
- អនុសាសន៍ និងសំណូមពរ

ឯកសារស្នើសុំ

✧ របាយការណ៍ស្ថានភាពបរិស្ថានលើការងារវាយតម្លៃ តុប៉ះពាល់បរិស្ថាន និងការត្រួតពិនិត្យបញ្ហាបរិស្ថានប្រចាំឆ្នាំ២០១៥-២០១៨ឬឆ្នាំ ?

12. Department of Agriculture, Forestry and Fisheries of Kandal Province

- ព័ត៌មានទូទៅវិស័យកសិកម្ម និងសមិទ្ធិផលសំខាន់ៗនៅក្នុងខេត្តកណ្តាល
- សក្តានុពល និង ស្ថានភាពកសិកម្ម ក្នុងការអភិវឌ្ឍវិស័យកសិកម្មនៅក្នុង ស្រុកកណ្តាលស្ទឹង
- បញ្ហា និងឧបសគ្គ ក្នុងការអភិវឌ្ឍវិស័យកសិកម្ម
- យោបល់របស់មន្ទីរទៅលើផលប៉ះពាល់ និងផលប្រយោជន៍ (ស្ថានមូលដ្ឋាន និងប្រទេសជាតិ) លើវិស័យកសិកម្ម ដែលអាចប៉ះពាល់ដោយសារគម្រោងអភិវឌ្ឍន៍នេះ
- ការប្រើប្រាស់ទឹកសម្រាប់វិស័យកសិកម្ម ស្រុក និង តំបន់គម្រោង
- អនុសាសន៍ និងសំណូមពរ

ឯកសារស្នើសុំ

✧ របាយការណ៍ស្តីពីអភិវឌ្ឍន៍វិស័យកសិកម្ម នៅក្នុងក្រុងភ្នំពេញ ឆ្នាំ២០១៥ ឬ២០១៨

✧ ផែនទីបម្រែបម្រួលដីកសិកម្ម

13. Water Authority of Kandal Province

- ស្ថានភាពទូទៅនៃការផ្គត់ផ្គង់ទឹកខេត្តកណ្តាលក្នុងមួយថ្ងៃ ?
- សមត្ថភាពក្នុងការផ្គត់ផ្គង់ទឹកក្នុងមួយថ្ងៃ ?
- បរិមាណតម្រូវការទឹកស្អាត ?
- តើអ្នកយល់យ៉ាងដូចម្តេចចំពោះគម្រោងនេះ (វិជ្ជមាន និងអវិជ្ជមាន) ?
- តើអ្នកមានមតិយោបល់ ឬសំណូមពរបន្ថែមអ្វីខ្លះចំពោះការអនុវត្តគម្រោង ?

ឯកសារស្នើសុំ

✧ របាយការណ៍ប្រចាំឆ្នាំ ២០១៥ ដល់ឆ្នាំ២០១៨ ស្តីពីស្ថានភាពផ្គត់ផ្គង់ទឹកស្អាត

14.Department of Labor and Vocational Training of Phnom Penh

- ស្ថានភាពវិស័យការងារ និងបណ្តុះបណ្តាលវិជ្ជាជីវៈ
- បញ្ហាប្រឈមទូទៅ ដែលកើតមានឡើងនៅតាមបណ្តារោងចក្រ នៅក្នុងរាជធានីភ្នំពេញ និងវិធានការណ៍ ក្នុងការដោះស្រាយ
- សុវត្ថិភាពការងារទូទៅទាក់ទងវិស័យរោងចក្រ
- តួនាទីរបស់មន្ទីរក្នុងការគ្រប់គ្រង និងត្រួតពិនិត្យសកម្មភាពរបស់គម្រោង
- យោបល់របស់មន្ទីរពាក់ព័ន្ធនឹង តុប៉ះពាល់ ដែលអាចប៉ះពាល់ដោយ (វិជ្ជមាន និងអវិជ្ជមាន) គម្រោង

- អនុសាសន៍ និងសំណូមពរ!

ឯកសារស្នើសុំ

✧ របាយការណ៍!ស្តីពីការស្ថានភាពវិស័យការងារ!និងបណ្តុះបណ្តាលវិជ្ជា!ីវៈ

15. Department of Public Works and Transport of Kandal Province

- ព័ត៌មានទូទៅលើ!ៈ ដ្ឋារចនាសម្ព័ន្ធ និងសមិទ្ធិផលសំខាន់ៗ!
- តួនាទី!និងបញ្ហាប្រឈម!ក្នុងការអនុវត្តសកម្មភាពការងារ!របស់មន្ទីរ!សាធារណៈការ!និងដឹក!ញ្ជូន!
- ផែនការអភិវឌ្ឍន៍លើវិស័យ!ៈ ដ្ឋារចនាសម្ព័ន្ធសំខាន់ៗ!
- យោបល់របស់មន្ទីរ!ពាក់ព័ន្ធនឹង!ៈ តុប៉ារពាល់ ដែលអាច (វិ!!មាន!និង!អវិ!មាន)ប៉ារពាល់ដោយគម្រោង
- អនុសាសន៍ និងសំណូមពរ!

ឯកសារស្នើសុំ

✧ លិខិតបទដ្ឋានគតិយុត្ត ពាក់ព័ន្ធនឹងវិស័យសាធារណការ!និងដឹក ញ្ជូន!ជាពិសេស!ការប្រើប្រាស់យានយន្ត! បើកបរ

✧ ឯកសារទាក់ទងនឹង!ប្រព័ន្ធលូសាធារណៈ!ុវិញតំបន់គម្រោង!

16. **Department of Culture and Fine Arts**

- ព័ត៌មានទូទៅស្តីពី(រចនាសម្ព័ន្ធគ្រប់គ្រង!ចំនួនការិយាល័យ!និង!គម្រោងសិក្សាស្រាវជ្រាវ។ល។)!មន្ទីរ!ប្ប! ធម៌ និង!វិចិត្រសិល្ប:
- នៅក្នុងខណ្ឌដង្កោ! មានតំបន់រ!ប្បធម៌ និង!ប្រវត្តិសាស្ត្រប៉ុន្មាន!?អ្វីខ្លះ ?!
- មន្ទីរ!មានផែនការកំណាយប្រវត្តិសាស្ត្រនៅទីតាំងណាខ្លះ?!
- តំបន់សាងសង់រោងចក្រស្ថិតក្នុង!តំបន់សិក្សាស្រាវជ្រាវទាក់ទងតំបន់ប្រវត្តិសាស្ត្រ!
- គម្រោងពង្រីក! និង!សាងសង់រោង! មានផលប៉ារពាល់! ឬការរំខាន!អ្វីដល់សិក្សាស្រាវជ្រាវទាក់ទងតំបន់ ប្រវត្តិសាស្ត្រ របស់មន្ទីរ!ដែលរឺទេ?!
- យោបល់របស់មន្ទីរ!ពាក់ព័ន្ធនឹង!ៈ តុប៉ារពាល់ ដែលអាច (វិ!!មាន!និង!អវិ!មាន)ប៉ារពាល់ដោយគម្រោង!
- អនុសាសន៍ និង!សំណូមពរ!

ឯកសារស្នើសុំ

✧ ផែនទី!ធ្វើកំណាយ !ុវិញតំបន់គម្រោង!

17. **Civil Aviation of Kandal Province**

- ស្ថានភាពទូទៅនៃការផ្គត់ផ្គង់!អគ្គិសនីក្នុង!រ! ធានីភ្នំពេញអគ្គិសនីក្នុងមួយថ្ងៃសម្រាប់ខេត្តតណ្តាល? ចំនួន! អនុស្ថា!នីយ៍!?
- បរិមាណតម្រូវការថាមពលអគ្គិសនីក្នុង!រ! ធានីភ្នំពេញ? តើការផ្គត់ផ្គង់!អគ្គសនីក្នុង!រ! ធានីភ្នំពេញបែង! ចែកជា!ប៉ុន្មានតំបន់!?
- តើអ្វីជាបញ្ហាប្រឈមដែលបាន! និង!កំពុងកើតឡើង!សម្រាប់ការផលិត! និង!ផ្គត់ផ្គង់!អគ្គិសនីក្នុង!ខេត្តតណ្តា! ល?
- តើការអភិវឌ្ឍគម្រោងខាងលើ!អាចបង្កផលប៉ារពាល់ ឬជា!បន្ទុកបន្ថែមដល់សមត្ថភាពនៃការផ្គត់ផ្គង់!អគ្គិស! នីដែរឬទេ?!

- តើអ្នកយល់យ៉ាងដូចម្តេចចំពោះគម្រោងនេះ!(វិជ្ជមាន និងអវិជ្ជមាន)?
- តើអ្នកមានមតិយោបល់ឬសំណូមពរបន្ថែមអ្វីខ្លះចំពោះការអនុវត្តគម្រោង?!

ឯកសារស្នើសុំ

✧ របាយការណ៍ប្រចាំឆ្នាំ ២០១៥!២០១៨!ស្តីពីស្ថានភាពផ្គត់ផ្គង់អគ្គិសនីក្នុងខេត្ត!

18. Department of Women's Affairs Kandal Province

- ព័ត៌មានទូទៅស្តីពីមន្ទីរកិច្ចការនារី!
- តួនាទី!និងបញ្ហាប្រឈម!ក្នុងការអនុវត្តសកម្មភាពការងារ!របស់មន្ទីរកិច្ចការនារី!
- ផែនការអភិវឌ្ឍន៍លើវិស័យ!ដ្ឋារចនាសម្ព័នសំខាន់ៗ!
- យោបល់របស់មន្ទីរ!ពាក់ព័ន្ធនឹង!តុប៉ះពាល់ ដែលអាច(វិជ្ជមាន!និងអវិជ្ជមាន)ប៉ះពាល់ដោយគម្រោង
- អនុសាសន៍ និងសំណូមពរ!

ឯកសារស្នើសុំ

✧ របាយការណ៍ប្រចាំឆ្នាំរបស់មន្ទីរ!

✧ លិខិតបទដ្ឋានគតិយុត្ត ពាក់ព័ន្ធនឹងគម្រោង!

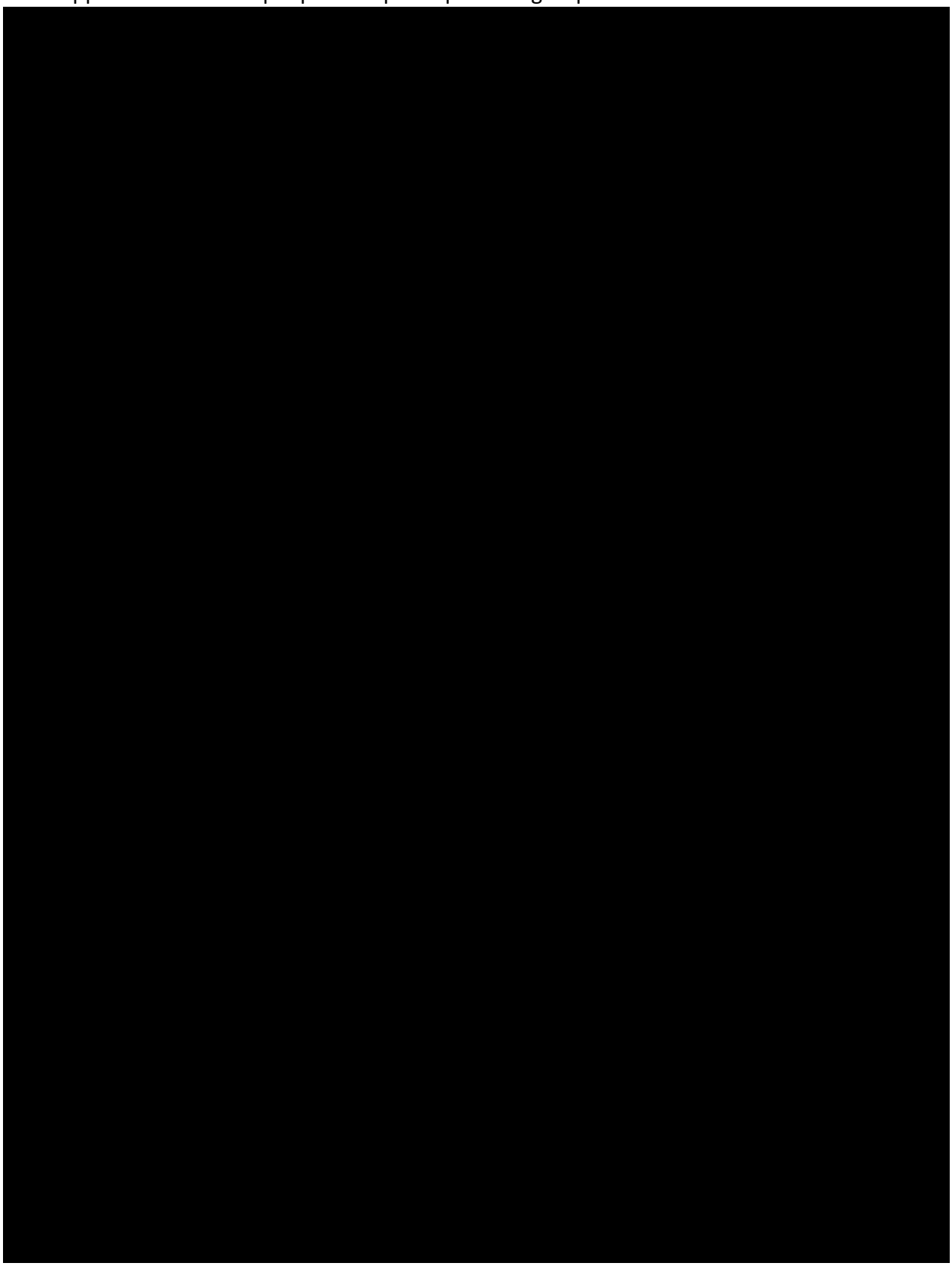
19. General Commisariat of Province Police of Kandal Province

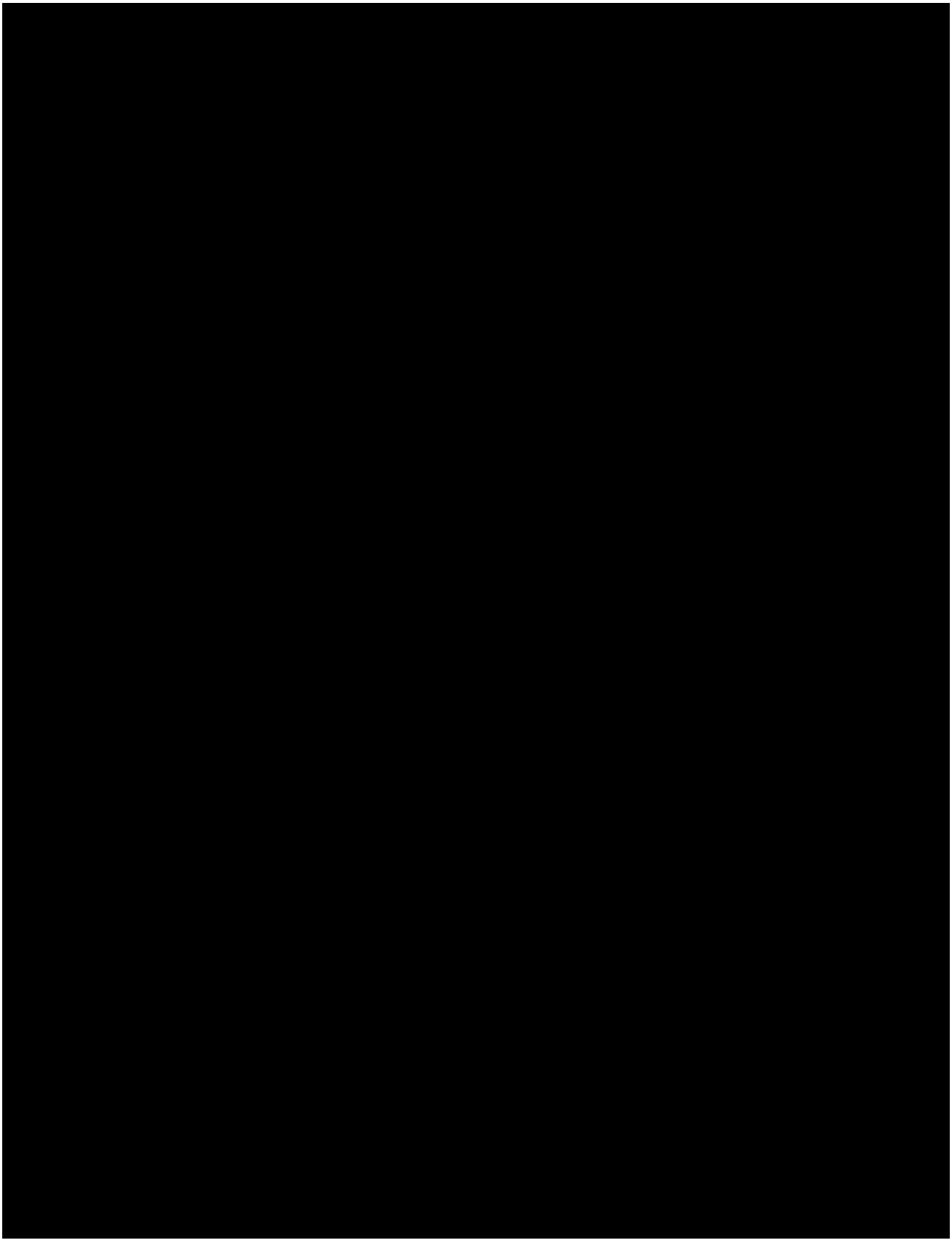
- បញ្ហាប្រឈមក្នុងខេត្តកណ្តាល
- យោបល់របស់រដ្ឋបាលអំពីផលប៉ះពាល់អវិជ្ជមាន!និងវិជ្ជមាន!នៃគម្រោង!
- តួនាទីរបស់រដ្ឋបាលស្រុកក្នុងការគ្រប់គ្រងសកម្មភាពរបស់គម្រោង!និងកិច្ចការងារការពារបរិស្ថាន!ពាក់ព័ន្ធ!នឹងគម្រោងនេះ
- ផែនការអភិវឌ្ឍន៍សំខាន់ៗនៅក្នុងស្រុក!(ទាំងក្នុងពេលបច្ចុប្បន្ន!និងនៅពេលអនាគត)
- វិស័យអទិភាពសម្រាប់អភិវឌ្ឍន៍!
- អនុសាសន៍!និងសំណូមពរចំពោះរោងចក្រ!និងការវាយតម្លៃ!តុប៉ះពាល់បរិស្ថានរបស់គម្រោងនេះ!

ឯកសារស្នើសុំ

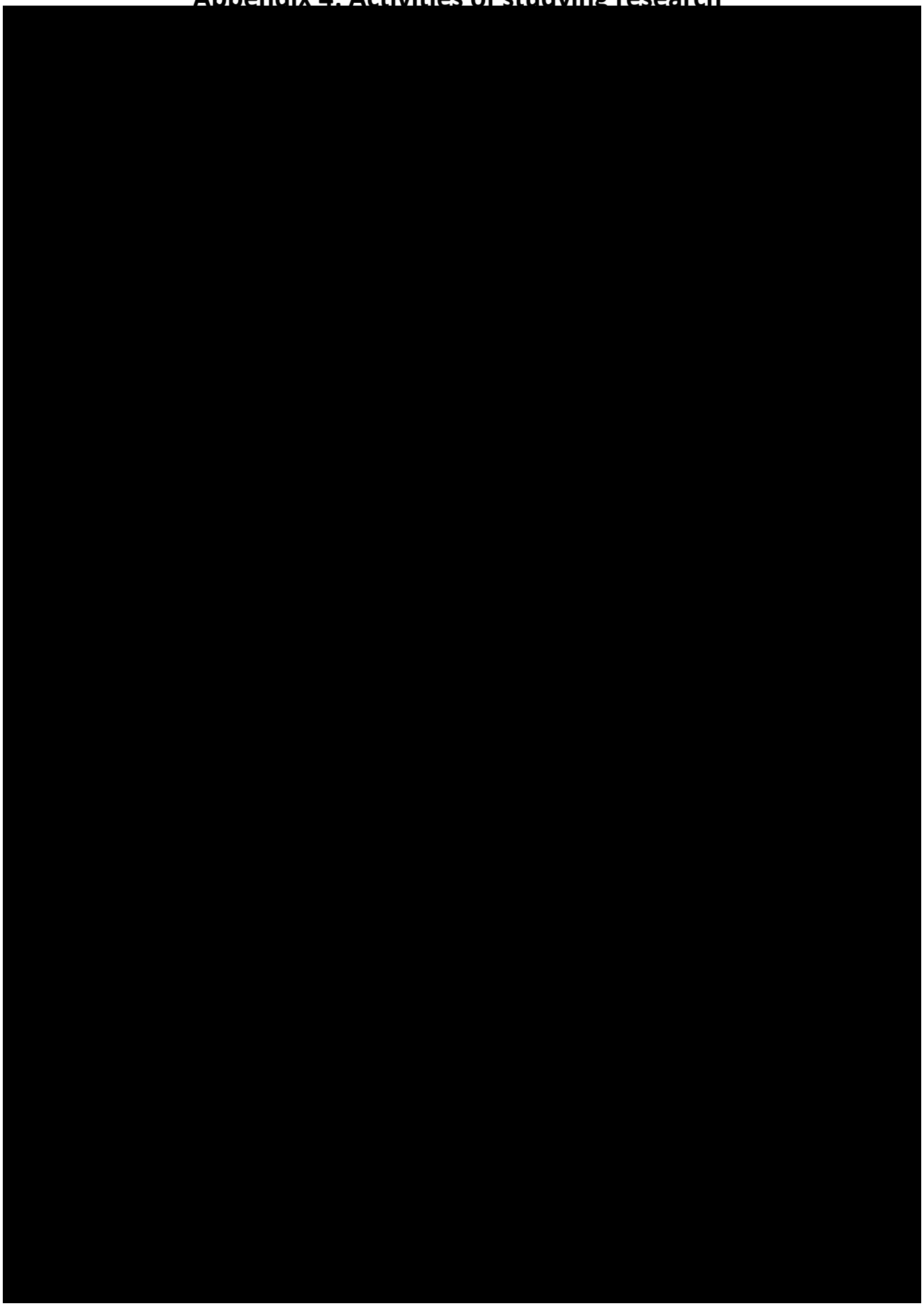
✧ របាយការណ៍ប្រចាំឆ្នាំ ២០១៥!២០១៨!ស្តីពីស្ថានភាពផ្គត់ផ្គង់អគ្គិសនីក្នុងខេត្ត

Appendix 3.7: List of people who participated in group discussions and consultations





Appendix 4: Activities of studying research



Appendix 5: Project Summarization (Material for Public Consultation)

ព័ត៌មានសង្ខេប
ស្តីពី
គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ (ថ្មី) ប្រទេសកម្ពុជា
(New Phnom Penh International Airport in Cambodia)
របស់ ក្រុមហ៊ុន ខេមបូឌា អ៊ែរផេត អ៊ិនវេសមិន ឯ.ក

១. ព័ត៌មានអំពីគម្រោង

១.១. ប្រវត្តិគម្រោង

ដោយពិនិត្យឃើញ ពីសក្តានុពលនៃកំណើនសេដ្ឋកិច្ច ក្រុមហ៊ុនម្ចាស់គម្រោង បានស្នើសុំរាជរដ្ឋាភិបាលកម្ពុជា ក្នុងការវិនិយោគលើការសាងសង់អាកាសយានដ្ឋានអន្តរជាតិមួយ ក្រោមនាមកណ្តាល «អាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ (ថ្មី)» លើផ្ទៃដីទំហំសរុប ២ ៦០០ ហិកតា នៅក្នុងស្រុកកណ្តាលស្ទឹង ខេត្តកណ្តាល ដើម្បីបង្កភាពងាយស្រួលដល់វិនិយោគិន និងភ្ញៀវទេសចរទាំងជាតិ និងអន្តរជាតិ ដែលមកវិនិយោគ និងទេសចរណ៍នៅក្នុងតំបន់អភិវឌ្ឍន៍របស់ក្រុមហ៊ុន។ ក្រុមហ៊ុន បានជ្រើសរើសទីតាំង ការរចនា និងការចាក់បំពេញដីនៅទីតាំងគម្រោងអាកាសយានដ្ឋាននេះ និងជាពិសេសបានសហការជាមួយក្រុមហ៊ុនទីប្រឹក្សា ក្នុងការវាយតម្លៃហេតុប៉ះពាល់នានាដែលអាចកើតមានពីការអនុវត្តសកម្មភាពគម្រោងគ្រប់ដំណាក់កាល ដើម្បីធានាថា រាល់ហេតុប៉ះពាល់អវិជ្ជមានទាំងអស់ ដែលអាចបង្ករឡើងដោយសកម្មភាពរបស់គម្រោង ត្រូវបានកំណត់ វាយតម្លៃច្បាស់លាស់ និងមានវិធានការកាត់បន្ថយសមស្រប។

១.២. ព័ត៌មានអំពីម្ចាស់គម្រោង និងទំនាក់ទំនង

ក្រុមហ៊ុន CAIC ជាក្រុមហ៊ុនទទួលខុសត្រូវលើការអនុវត្តគម្រោង។ ក្រុមហ៊ុននេះ គឺជាក្រុមហ៊ុនឯកជនទទួលខុសត្រូវមានកម្រិត ដែលមានដើមទុនចុះបញ្ជីចំនួន ៤៨០.០០០.០០០.០០០ រៀល (ឬស្មើនឹង ១២០ ០០០ ០០០ ដុល្លារអាមេរិក[1])។

ក្រុមហ៊ុននេះមានអាសយដ្ឋានស្ថិតនៅអគារលេខ ៣១៥ វិមានកាណាឌីយ៉ា ជាន់ទី២៨ មហាវិថីព្រះមន្នីវង្ស សង្កាត់វត្តភ្នំ ខណ្ឌដូនពេញ រាជធានីភ្នំពេញ ព្រះរាជាណាចក្រកម្ពុជា។ បរិវេលសកម្មភាពរបស់ក្រុមហ៊ុនមានចំនួន ៩៩ឆ្នាំ ដែលត្រូវចាប់ផ្តើមគិតចាប់តាំងពីថ្ងៃចុះបញ្ជីពាណិជ្ជកម្មនិងដោយមានការអនុម័តយល់ព្រមពីអាជ្ញាធរអាណាចក្រព្យាបាលពាក់ព័ន្ធ (ក្រុមហ៊ុន CAIC . អ., ២០១៨)។

១.៣. ទុនវិនិយោគរបស់គម្រោង

ទុនវិនិយោគរបស់ក្រុមហ៊ុន CAIC មានចំនួនសរុប **១ ៥០០ លានដុល្លារអាមេរិក** ដែលក្នុងនោះតម្លៃទុនវិនិយោគចំនួន ១០ភាគរយ ពីរាជរដ្ឋាភិបាលកម្ពុជា ដែលមានរដ្ឋលេខាធិការអាកាសចរស៊ីវិលជាតំណាង និង៩០ភាគរយ ទៀតជារបស់ក្រុមហ៊ុន ខេមបូឌា អ៊ែរផេត អ៊ិនវេសមេន ឯ.ក។

១.៤. លិខិតបទដ្ឋានគតិយុត្តពាក់ព័ន្ធនឹងគម្រោង

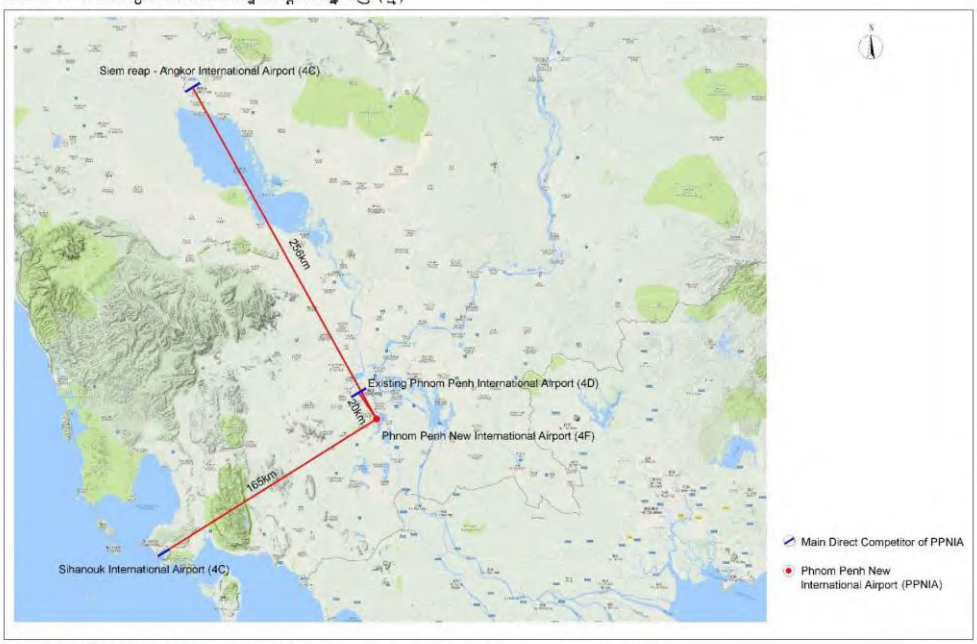
ឯកសារបទដ្ឋានគតិយុត្តរបស់គម្រោងនឹងមានលម្អិតនៅក្នុងរបាយការណ៍វាយតម្លៃហេតុប៉ះពាល់បរិស្ថាន និងសង្គមពេញលេញរបស់គម្រោង។

១.៥. ទីតាំងភូមិសាស្ត្រគម្រោង

គម្រោងបង្កើតអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ (ថ្មី) មានចម្ងាយប្រមាណ ២០គីឡូម៉ែត្រ ពីរាជធានីភ្នំពេញ (សូមមើលផែនទីទី ២ ខាងក្រោម)។ គម្រោងនេះ នឹងអនុវត្តលើទីតាំងដីកម្មសិទ្ធិឯកជនដែលម្ចាស់គម្រោងបានទិញពីប្រជាពលរដ្ឋ ហើយផ្ទៃដីគម្រោងសរុបទំហំ ២៦០០ ហិកតា ស្ថិតនៅក្នុងភូមិសាស្ត្រស្រុកកណ្តាលស្ទឹង ខេត្តកណ្តាល ដែលជាតំបន់កំពុងអភិវឌ្ឍន៍ទាំងវិស័យសេដ្ឋកិច្ច និងហេដ្ឋារចនាសម្ព័ន្ធ។

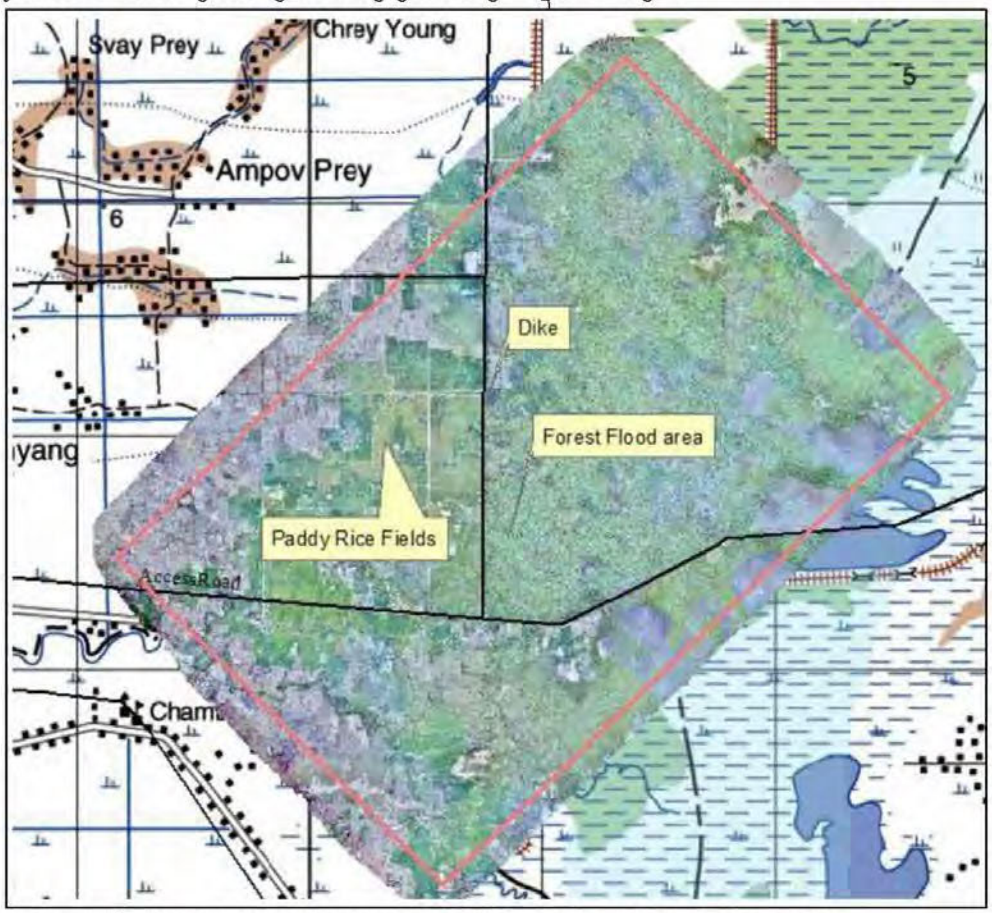
[1] អត្រាប្តូរប្រាក់ ៤០០០រៀល/ដុល្លារអាមេរិក ក្នុងខែមិថុនា ឆ្នាំ២០១៨

ផែនទីទី 1៖ ទីតាំងគម្រោងអាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ (ថ្មី)



ប្រភព៖ (ក្រុមហ៊ុន CAIC C. A., Master Plan of Phnom Penh New International Airport in Cambodia, 2018)

រូបភាពទី 1៖ ទីតាំងគម្រោងនិងប្រភេទការប្រើប្រាស់មានស្រាប់ក្នុងតំបន់គម្រោង



ប្រភព៖ (ក្រុមហ៊ុន CAIC C. A., Master Plan of Phnom Penh New International Airport in Cambodia, 2018)

១.៦. ការប្រើប្រាស់ដីរបស់គម្រោង

អាកាសយានដ្ឋានអន្តរជាតិភ្នំពេញ (ថ្មី) ជាប្រភេទអាកាសយានដ្ឋាន 4F។

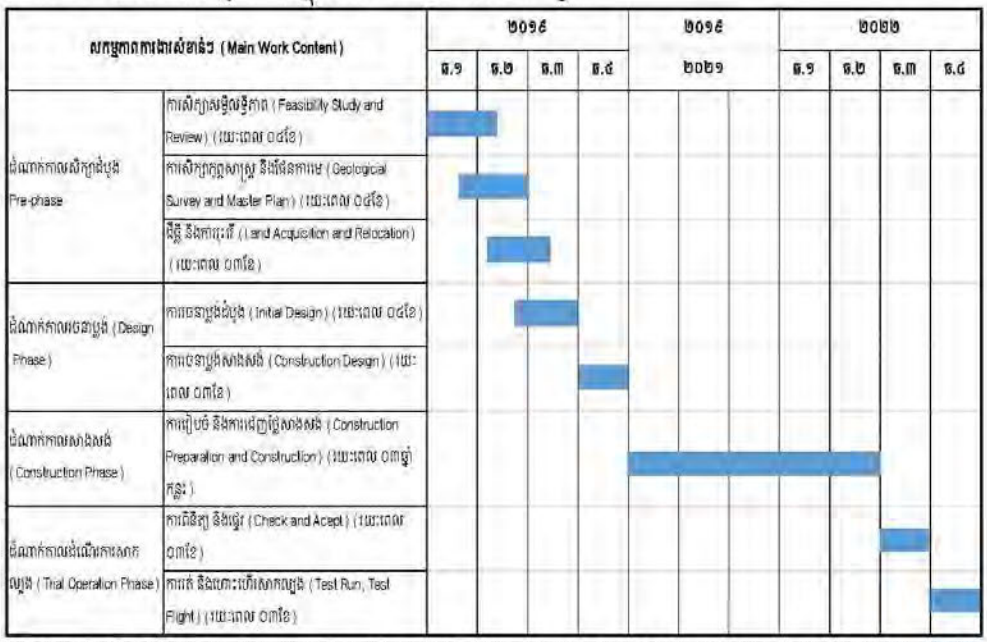
១.៧. សកម្មភាពគម្រោង

១.៧.១. សកម្មភាពនៅក្នុងដំណាក់កាលសាងសង់

តាមផែនការរបស់គម្រោង ផែនការអនុវត្តគម្រោង មានរយៈពេល ០៥ឆ្នាំ ដោយគិតពីឆ្នាំ២០១៨ រហូតដល់ចុងឆ្នាំ២០២២។ នៅក្នុងដំណាក់កាលនេះ សកម្មភាពសំខាន់ៗរបស់គម្រោងមានដូចខាងក្រោម៖

- ការរចនាទីតាំងគម្រោង
- ការរៀបចំឈូសឆាយ និងការចាក់ដីបំពេញទីតាំងគម្រោង
- សកម្មភាពសាងសង់ផ្លូវរត់ និងហេដ្ឋារចនាសម្ព័ន្ធផ្សេងៗ
- ការសម្អាតការដ្ឋានសាងសង់ និងហេដ្ឋារចនាសម្ព័ន្ធផ្សេង។

តារាងទី 1៖ ផែនការសកម្មភាពនៅក្នុងដំណាក់កាលសាងសង់គម្រោង



ប្រភព៖ (ក្រុមហ៊ុន CAIC C. A., Feasibility Study Report of The New Phnom Penh International Airport in Cambodia, 2018)

១.៧.១.១. ការឈូសឆាយ និងការចាក់ដីបំពេញទីតាំងគម្រោង

ការឈូសឆាយ និងការចាក់ដីបំពេញ នឹងត្រូវបានធ្វើឡើងនៅក្នុងតំបន់ដែលត្រូវសាងសង់ផ្លូវរត់ និងបណ្តាហេដ្ឋារចនាសម្ព័ន្ធផ្សេងៗរបស់គម្រោង ដែលមានទំហំប្រមាណ ២៦០០ ហិកតា។ ដោយសារតំបន់គម្រោងជាតំបន់ទំនាបលិចទឹកជាប្រចាំ ដូច្នេះ ការឈូសឆាយ និងការចាក់ដីបំពេញ ត្រូវបានធ្វើឡើងដោយការដើកជញ្ជូនដីពីកន្លែងផ្សេងដែលនៅក្បែរតំបន់គម្រោង (ដោយមានការពិភាក្សា និងឯកភាពរវាងម្ចាស់គម្រោង និងម្ចាស់ការដ្ឋានយកដី) ពោលគឺត្រូវការការដើកជញ្ជូនដីពីទីតាំងយកដី ទៅចាក់បំពេញនៅទីតាំងគម្រោងសាងសង។ គួរបញ្ជាក់ផងដែរថា គម្រោងនឹងកិនបង្ហាប់ដី និងធ្វើការបាញ់ទឹកជាប្រចាំ ជាពិសេសលើផ្លូវដើកជញ្ជូនដែលក្រុមហ៊ុនប្រើប្រាស់សម្រាប់ការដើកជញ្ជូន ដី និងសម្ភារៈសាងសង់ផ្សេងៗ ដើម្បីការពារការហុយធូលី ដែលអាចបង្កផលប៉ះពាល់ដល់សុខភាព របស់បុគ្គលិក និងកម្មករនៅក្នុងការដ្ឋាន។

១.៧.២. ឧបករណ៍ និងគ្រឿងចក្រសំខាន់ៗសម្រាប់គាំទ្រដល់សកម្មភាពសាងសង់គម្រោង

នៅក្នុងដំណាក់កាលសាងសង់ ឧបករណ៍ និងគ្រឿងចក្រសំខាន់ៗ សម្រាប់គាំទ្រដល់សកម្មភាពសាងសង់របស់គម្រោងត្រូវបានព្យាករ ដូចមានបង្ហាញក្នុងតារាងខាងក្រោម៖

តារាងទី 2៖ ការព្យាករ ពីបរិមាណឧបករណ៍ និងគ្រឿងចក្រសំខាន់ៗសម្រាប់គាំទ្រដល់ការសាងសង់គម្រោង

ល.រ	ឧបករណ៍ និងគ្រឿងចក្រ	ចំនួន
១	ម៉ាស៊ីនភ្លើង (Generator)	៣
២	អេស្កាវ៉ាទ័រ (Excavator)	៦
៣	រថយន្តគ្រៀរ (Grader)	៣
៤	ប៊ុនដូហ្ស៊ី (Bulldozer)	៦

ល.រ	ឧបករណ៍ និងគ្រឿងចក្រ	ចំនួន
៥	រ៉ូឡូកិនដី (Roller)	៦
៦	រ៉ូឡូកិនដីកង់កៅស៊ូ	២
៧	រថយន្តដឹក ៦ម៉ែត្រត្រីគុណ	៥
៨	រថយន្តដឹក ១៤ម៉ែត្រត្រីគុណ	១០
៩	រថយន្តដឹក ១៨ម៉ែត្រត្រីគុណ	១៥
១០	រថយន្តដឹកជញ្ជូនកិកអាប់ (Pickup)	២
១១	ម៉ាស៊ីនបូមទឹក (Water Pump)	៦
១២	រថយន្តលាយស៊ីម៉ងត៍ (Concrete Truck)	៥
១៣	រថយន្តបូមបេតុង (Concrete pump truck)	២
១៤	រថយន្តចាក់ និងអ៊ិតកៅស៊ូ (Asphalt Truck)	១
១៥	រថយន្តដឹកទឹក	២

ប្រភព៖ ក្រុមហ៊ុន CAIC, ឆ្នាំ២០១៨

១.៧.៣. តម្រូវការធនធានមនុស្ស

តាមផែនការរបស់គម្រោង ធនធានមនុស្សសរុបសម្រាប់អនុវត្តសកម្មភាពការងារក្នុងគម្រោងប្រចាំថ្ងៃមានប្រមាណ ៣០០នាក់ ដែលក្នុងនោះ ដំណាក់កាលឈូសឆាយ និងចាក់ដីបំពេញទីតាំងគម្រោងមានប្រមាណ ១០០ នាក់ និងប្រមាណ ២០០នាក់ នៅក្នុងដំណាក់កាលសាងសង់អាកាសយានដ្ឋាន។

ដោយឡែក ការស្នាក់នៅរបស់បុគ្គលិក/កម្មកទាំងអស់ នឹងត្រូវធ្វើឡើងនៅក្នុងការដ្ឋានផ្ទាល់តែម្តង ដោយគម្រោងនឹងសាងសង់អគារស្នាក់នៅបណ្តោះអាសន្ន ដែលមានទំហំសមស្របនិងចំនួនបុគ្គលិក និងកម្មកតាមបទដ្ឋានរបស់ច្បាប់ការងារនៃព្រះរាជាណាចក្រកម្ពុជា។

១.៧.៤. ការប្រើប្រាស់ទឹក

តាមផែនការមេរបស់គម្រោង តម្រូវការទឹកសម្រាប់ប្រើប្រាស់ប្រចាំថ្ងៃសម្រាប់បុគ្គលិក/កម្មករ និងអ្នកដំណើរ ក្នុងដំណាក់កាលប្រតិបត្តិអាចមានបរិមាណ ១៨០០ m^3/ថ្ងៃ នៅដំណាក់កាលទី I និង ៣៥០០ m^3/ថ្ងៃ នៅដំណាក់កាលទី II[2]។

១.៧.៤. ការប្រើប្រាស់អគ្គិសនី

តម្រូវការថាមពលក្នុងដំណាក់កាលប្រតិបត្តិចំនួនជាង ២៨៤៨៤ kW ក្នុងឆ្នាំ២០៣០ និងចំនួនជាង ៣៨ ៤៦១ kW ក្នុងឆ្នាំ២០៥០។

១.៨. ដំណាក់កាលប្រតិបត្តិ

បន្ទាប់ពីបញ្ចប់ការសាងសង់ គម្រោងនឹងដាក់ឱ្យដំណើការអាកាសយានដ្ឋាននេះ ដែលអាចអនុញ្ញាតឱ្យយន្តហោះប្រភេទផ្សេងៗដូចជា A380 ជាដើម ដើម្បីទទួលជើងហោះហើរក្នុងស្រុក និងក្រៅស្រុក។ គោលដៅនៃជើងហោះហើរក្រៅស្រុកមានគោលដៅមកពីប្រទេសចិន (ទីក្រុងប៉េកាំង សៀងហៃ ខ្វាងចូវ សេនហ្សិន) ប្រទេសកូរ៉េខាងត្បូង (ទីក្រុងសេអ៊ូល) ប្រទេសវៀតណាម (ទីក្រុងហូជីមិញ) ប្រទេសថៃ (ទីក្រុងបាងកក) ប្រទេសសិង្ហបុរី ហុងកុង និងតៃវ៉ាន់ ជាដើម។

[2] NPPIA_Stage 5_ task_A_Phasing_strategy_CAPEX_v01 (Table 5-4 Portable Water Demand Estimations), page 54

តាមផែនការរបស់គម្រោង (**តារាងទី** 1) គម្រោងបញ្ចប់ការដោសាងសង់ និងដំណើរការសាកល្បងនៅចុងឆ្នាំ២០២២។ ផ្អែកតាមព័ត៌មានប្លង់មេរបស់គម្រោង នៅដំណាក់កាលទី I ដែលគិតចាប់ពីឆ្នាំក្រុមហ៊ុនដាក់ដំណើរអាកាសយានដ្ឋានសាកល្បង គឺ ពីឆ្នាំ២០៣០ ដល់ ឆ្នាំ២០៣០ អាកាសយានដ្ឋាននេះ នឹងអាចទទួលភ្ញៀវធ្វើដំណើរចំនួន ១៥ លាននាក់/ឆ្នាំ ដែលនេះដំណាក់កាលទីI។ ចំណែកឯនៅដំណាក់កាលទី II គឺចាប់ពីឆ្នាំ២០៣០ - ឆ្នាំ ២០៥០ គម្រោងនឹងទទួលភ្ញៀវធ្វើដំណើរចំនួន ២៩ លាននាក់/ឆ្នាំ[3]។

១.៩. ការគ្រប់គ្រងសំណល់

១.៩.១. ការគ្រប់គ្រងសំណល់រឹង

ការគ្រប់គ្រងសំណល់រឹងចែកចេញជា ២ដំណាក់កាល គឺដំណាក់កាលសាងសង់ និងដំណាក់កាលប្រតិបត្តិ។ នៅដំណាក់កាលសាងសង់ ការគ្រប់គ្រងសំណល់រឹងផ្តោតលើប្រភពសំណល់ពីការដ្ឋានសាងសង់ និងសកម្មភាពរបស់បុគ្គលិក និងកម្មករ។ សំណល់រឹង ដែលបង្កើតពីសកម្មភពសាងសង់ភាគច្រើនជា ជ័រ ប្លាស្ទិក កំណាត់ឈើ សំបកបាវ ធុងថ្នាំពណ៌ សំណល់ផ្ទះបាយ និងសម្ភារប្រើប្រាស់ចាស់ៗពីការប្រើប្រាស់ប្រចាំថ្ងៃរបស់បុគ្គលិក និងកម្មករ។ គម្រោង នឹងតម្រូវឱ្យគ្រប់បុគ្គលិក និងកម្មករញែកសំរាមដាច់ដោយឡែកចំពោះសំណល់ប្រភេទគ្រោះថ្នាក់ និងធម្មតា ទៅតាមធុងសំរាមដែលបានកំណត់។ គម្រោង នឹងហាមបុគ្គលិក កម្មករ មិនឱ្យប្រមូលគរជុតនៅតាមកន្លែងផ្សេងៗដោយគ្មានការពិនិត្យ និងការអនុញ្ញាតទេ។

ដោយឡែក នៅក្នុងដំណាក់កាលប្រតិបត្តិ សំណល់រឹងមានប្រភពចេញពីស្ថានីយចេញដំណើរបស់អាកាសយានដ្ឋានផ្ទាល់តែម្តង។ គម្រោងបានបំពាក់ធុងសំរាមតាមទីតាំងនីមួយៗ នៅក្នុងស្ថានីយ៍រង់ចាំ និងចេញដំណើរ និងទីតាំងសំខាន់ៗមួយចំនួនទៀតក្នុងអាកាសយានដ្ឋាន។ សំរាមដែលបង្កើតដោយសកម្មភាពគម្រោងនឹងត្រូវប្រមូលទៅដាក់ក្នុងធុងសំរាម និងដឹកចេញជាប្រចាំថ្ងៃ ដើម្បីបង្ការហេតុប៉ះពាល់ណាមួយដល់ភ្ញៀវទេសចរណ៍។ តាមការប៉ាន់ស្មាន បរិមាណសំណល់រឹងក្នុងដំណាក់កាលប្រតិបត្តិ ដំណាក់កាលទី I (ឆ្នាំ២០៣០) ប្រមាណជាង ១៨តោន/ថ្ងៃ និងនៅដំណាក់កាលទី II (ឆ្នាំ២០៥០) ប្រមាណជាង ២៧ តោន/ថ្ងៃ[4]។

១.៩.២. ការគ្រប់គ្រងសំណល់រាវ

សំណល់រាវដែលបង្កើតឡើងដោយគម្រោង ជាប្រភេទសំណល់រាវធម្មតា (Domestic Wastewater) ដែលតាមការប៉ាន់ស្មាន បរិមាណសំណល់រាវក្នុងដំណាក់កាលប្រតិបត្តិដំណាក់កាលទី I (ឆ្នាំ២០៣០) ប្រមាណជា ១៣ ម៣/ថ្ងៃ និងនៅដំណាក់កាលទី II (ឆ្នាំ២០៥០) ប្រមាណជាង ២៥ ម៣/ថ្ងៃ[5]។

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[3] New Phnom Penh International Airport Master Plan «*Phase 1: Opening year – 2030 (15 Million Annual Passengers); Phase 2: 2030 – 2050 (29 Million Annual Passengers)*» ទំព័រទី ២

[4] New Phnom Penh International Airport Master Plan «*Table 5-8 Solid waste production and disposal*» ទំព័រទី ៥៩

[5] New Phnom Penh International Airport Master Plan «*Table 5-7 Sewage treatment demand estimations*» ទំព័រទី ៥៨