

# Initial Environmental Examination Report (Draft)

Project Number: 49067-001  
October 2017

## THA: Southern Thailand Waste-to-Energy Project (Part 4 of 5)

Prepared by Chana Green Company Ltd.

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## **CHAPTER 5**

### **ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATIONS**

#### **5.1 Introduction**

Environmental impact assessment of the Project was done for both construction and operation periods. The Consultant used the Project details and existing environmental condition as well as public participation in the environmental impact assessment. The assessment aimed to study changes which will cause by the operation of the Project. Physical resources, biological resource, human use value, and quality of life were covered in the assessment. The results were used in the manipulation of environmental impact mitigation measures and environmental quality monitoring program.

#### **5.2 Impacts on physical resources**

##### **5.2.1 Impacts on topography, geology, earthquakes, and soil resources**

###### **(1) Construction period**

Land clearing and leveling are needed for the Project area to make the area suitable for construction activities. The concept of soil balance will be applied. Excavated soil from reservoir excavation will be used to fill the land leveling. This will be the soil that has been excavated in the area with a total volume of 471,150 cubic meters. The volume of 471,150 cubic meters of excavated soil will be used to adjust the project area to about 1.0 m above the exiting ground level and dike flood protection around the project area from the ground level 2.0 meters. Such operation will not cause any change to the existing soil composition. Thus, the impact on soil resources during construction period is in low level.

The project area has 2 soil series, Ruso and Klaeng series. Properties of each soil series in the study area have following details.

###### **1) Ruso series**

This soil series occurs from the sedimentation of granite origin where water brought it to piled up on low level river base or alluvial fan. The condition of the area would be plain to quite plain with 0-2 % slope, poor water drainage, very slow of surface runoff, and fast water soak . For solid characteristic and properties, it is a deep soil with coarse brownish-gray to gray loamy sand as the top soil . The reaction of soil is strongly acid (pH 4.5-5.0). The low level soil is a coarse sand to coarse gray loamy sand with yellow or brown dots throughout the soil layer. The reaction of soil is moderately acid (pH 5.5-6.0). For natural plants

and land use, it is a brake with Samet as majority type of plants . This Ruso series is not suitable for agriculture due to its sandy soil with the very low water absorption capacity and low fertility.

## **2) Klaeng series**

This soil series occurs from the sedimentation on plain area (old river terrace). The condition of the area is plain or quite plain with the slope of 0-2%, bad water drainage, slow of surface run off, slow water soak and water immersion could be found during the rain season. For solid characteristic and properties, it is a very deep fine clay with loam, clay loam or silty clay loam as a top soil texture. It has yellowish brown , brownish gray or gray colors. The reaction of soil is moderately acid (pH 5.5-6.0). The low level soil has a soil texture of clay or silty clay with gray color. For the top soil, a yellowish brown or reddish yellow dot occurs in the soil texture. The reaction of soil is strongly acid (pH 4.5-5.5). For natural plants and land use, it is suitable to be paddy fields.

For the earthquake impacts, the Project is located in Chana Sub-district, Songkhla Province with the low and medium level of earthquake intensity. For the low level (below 3.0 Mercalli) or mind earthquake intensity in which human do not feel. The moderate earthquake level (4.0 Mercalli) is the level in which human can feel. Nevertheless, the Project area is classified as an earthquake surveillance area in according to Ministerial regulation (Ministry of Interior) on load resistance, the durability of buildings, and ground support for earthquake resistance B.E.2550.Details are as follows:

Article3This Ministerial Regulation shall apply to the following areas and buildings:

### **1) Surveillance Area and Area 1**

(a) Essential buildings for the well-being of the public such as hospital, fire station, disaster mitigation center, communication center, airport, power plant, and water treatment plant

(b) Hazardous materials storage buildings such as explosive, farmable, toxic, and radioactive

(c) Public building to serve 300 people or higher such as theater, auditorium, art gallery, museum, library, religious place, stadium, market, shopping mall, bus station, and hotel

(d) Academic institute that with 250 students or higher

(e) Nursery with 50 babies or higher

(f) Building that serves 5,000 people or higher

(g) Building with the height of 15 meters or higher

- (h) Bridges elevated path with the length between pillars of ten meters or higher
- (i) Dam or water reservoir with the height of ten meters or higher

Article 4 Designing of the buildings mentioned in Article 3, the designer shall consider the geometric shape of the buildings to withstand the earthquakes. For the structure details and joints between structures as well as overall structures arrangement must be limited ductility in according to the standard of building design to withstand earthquakes of Department of Public Works and Town and Country Planning and the standard of building design to withstand an earthquake that is approved by Engineer Council.

However, to mitigate the possible impacts, the Project must operate in according to the Ministerial Regulation (Ministry of Interior) on criteria for permitting the modification of buildings to strengthen the building's strength to withstand earthquakes B.E.2555. Furthermore, every step of building design of the Project must comply with the Building Control Act B.E.2522. Thus, the earthquake impacts low.

## **(2) Operation period**

During operation period, the Project has no activity that will cause any change to the topography, geology, and soil resources. Thus, the impact on topography, geology, and soil resources during operation period is in low level.

### **5.2.2 Air pollution impacts**

Air pollution impact assessment was done using mathematical model. It can be summarized as follows:

#### **(1) Model selection**

The Consultant considered AERMOD model version 1518.

#### **(2) Emission rate determination**

The Project is not located in the Rayong Province pollution control zone. The results of air pollution monitoring in the study area found that concentration of NO<sub>x</sub> and SO<sub>2</sub> are less than 80 percent of the ambient air standard.

#### **(3) Source information**

### 1) Construction period

Source of air pollution during construction period is area source which will generate air pollution during land leveling and foundation work. These activities will take place for approximately 12 months.

The Consultant used emission factors from U.S. Customs and Border Protection (Table 5.2.2-1) in the calculation of air pollution from the mentioned construction activities.

**Table 5.2.2-1**  
**Emission Factor**

Construction Equipment	Emission Factor (g/hp-hr)		
	NO <sub>x</sub>	PM-10	SO <sub>2</sub>
Water Truck	5.49	0.41	0.74
Diesel Dump Truck	5.49	0.41	0.74
Diesel Cement&Mortar Mixers	7.28	0.48	0.73
Diesel Cranes	5.72	0.34	0.73
Diesel Bull Dozers	4.76	0.33	0.74
Diesel Front End Loaders	5.00	0.35	0.74

Source:U.S. Customs and Border Protection

For the assessment of dispersion of total suspended particulate (TSP) and particulate with a diameter of fewer than 10 microns from the land clearing was done by using U.S.EPA. "Compilation of Air Pollution Emission Factors" Publication NO.AP-42 (1995). The quantity of TSP is approximately 1.2 ton/acre/month or 9.88 grams/square meter/day or counted for 0.000114 gram/square meter/second. The soil characteristic in the area is clay loam with particulate with a diameter of less than ten microns of 35-60 percent or about 0.42 ton/acre/month or counted for 0.0000399 gram/square meter/second (source: <http://www.garrison.hawaii.army.mil/sbctEIS/feis/Appendices/Appendix%20G2.pdf>). One of the Project activities is land clearing to prepare for the construction. This activity will be done gradually. The assumption is that the Project will clear the land of 200 square meters (according to the machine capacity) and the construction work hours is 8.00-17.00 o'clock, Monday to Saturday only (the air pollution impacts considered the concentration of particulate matter with diameter of less than ten micron from machinery use in the construction activity together with the land clearing).

Nevertheless, the Consultant selected the Variable Emission Rate by Hour / Day function of the AERMOD mathematical model to assess air pollution impacts that covered the Project's construction activities.

The assessment of the average concentration of nitrogen dioxide over the periods of one hour and one year by using the mathematical model was done in according to the U.S.EPA as follows:

- (a) The maximum average concentration over the period of one hour used default conversion of 0.8
- (b) The maximum average concentration over the period of one year used default conversion of 0.75

## **2) Operation period**

The source of air pollution in this study is a boiler stack (98 ton/hr.).

- (a) The air pollution source of the Project is a point source from the boiler (location of the boiler is showed in **Figure 5.2.2-1**). Emission rates of the boiler stack are showed in **Table 5.2.2-2**.

The Consultant computed the emission rate of particulate matter with diameter of less than ten microns based on assumption of  $PM_{10}$  is 0.58 (Mohd. Rashid Mohd. "Summary of PM-10 Monitoring at one site of Kuala Lumpur; two years survey" presented at Symposium on Advances in the Quality of the Malaysian Environment Date: 23 November 1988). This was used as there is no reference on converting from PM to  $PM_{10}$  in Thailand. The reference use in this report is accepted by Expert Committee Review.

- (b) The Consultant selected the function of Variable Emission Rate by Hour/ Day of the AERMOD mathematical model which can assess the impacts in both normal operation and soot blow of the boiler. The soot blow assumption is twice a day for approximately ten minutes/set. There are eight sets of soot blow which will serve as alternate to work in the case of air pollution treatment system failure. The Consultant did not use that function because the occurrence of the case cannot be predicted.

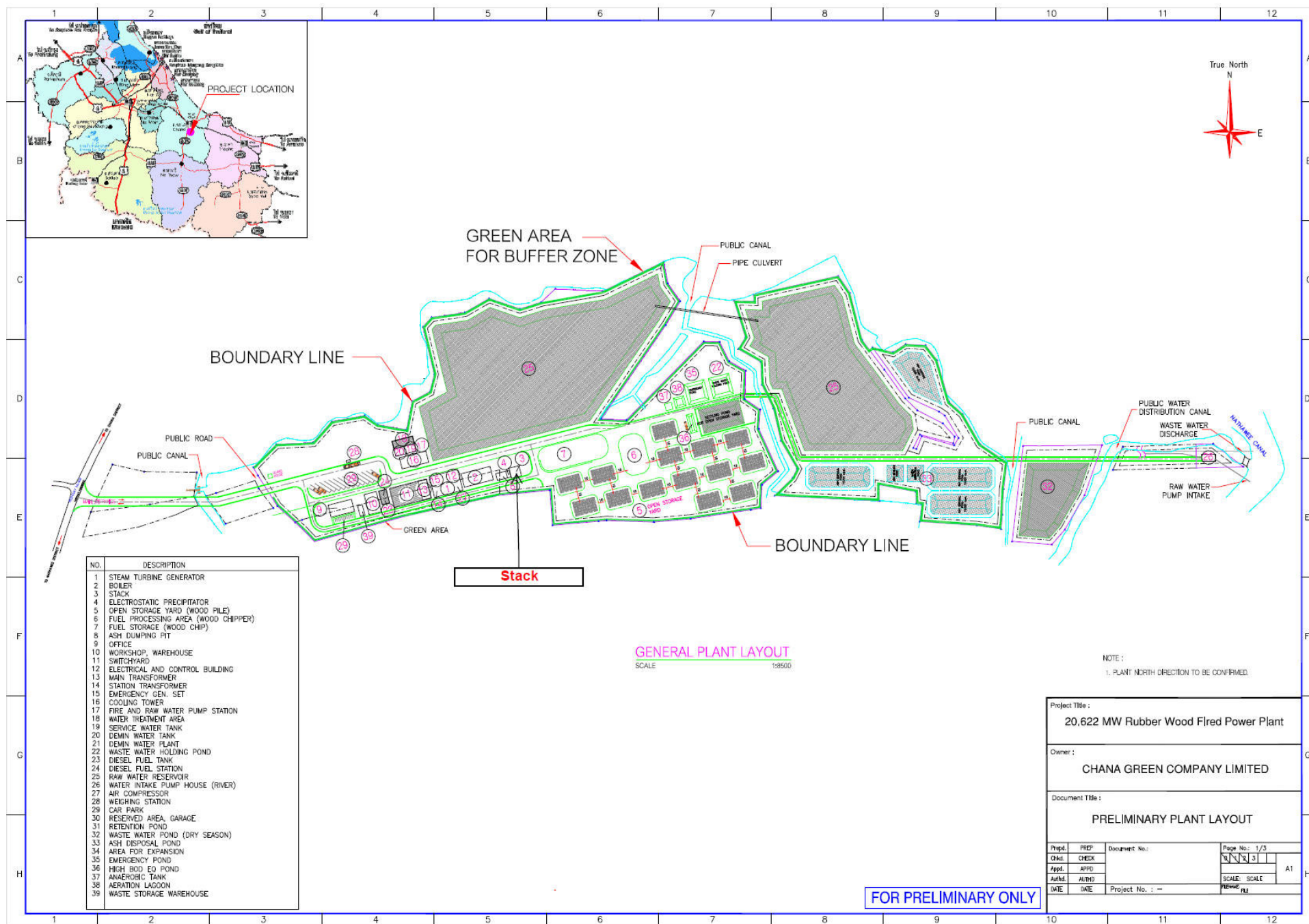


Figure 5.2.2-1 Stack Location

**Table 5.2.2-2**

### Emission Loading in Varies Operation modes

[illegible]



(c) The conversion factors in the assessment of the average maximum concentration of nitrogen oxide over the period of one hour and one year in the mathematical model were from the guideline of U.S.EPA. Details are as follows:

- a) Average maximum concentration over the period of one hour used the default conversion of 0.8
- b) Average maximum concentration over the period of one hour used the default conversion of 0.75

(d) The design of the stack height that did not comply with the Good Engineering Practice (GEP) in accordance with the Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised), U.S. Environmental Protection Agency, June 1985. Therefore, the Consultant carried out the assessment from the downwash as following:

$$H_g = H + 1.5L$$

Where :  $H_g$  = Good engineering practice stack height

$H$  = Height of nearby structure

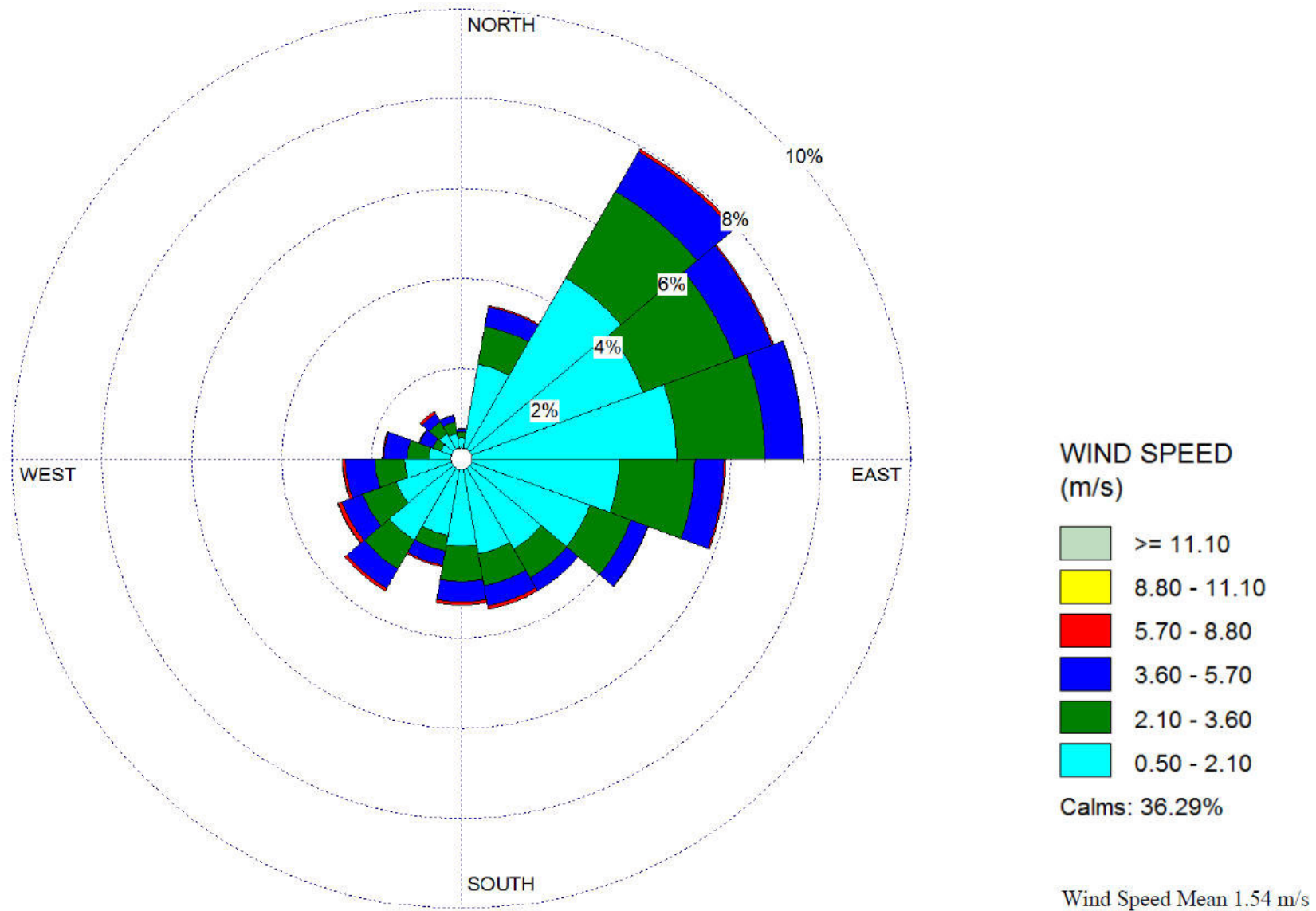
$L$  = Lesser dimension, height or projected width, of nearby structure

The structure surrounding of the boiler is the power generator building with the height of 27 meters and the width of 18 meters.

#### **(4) Meteorological data**

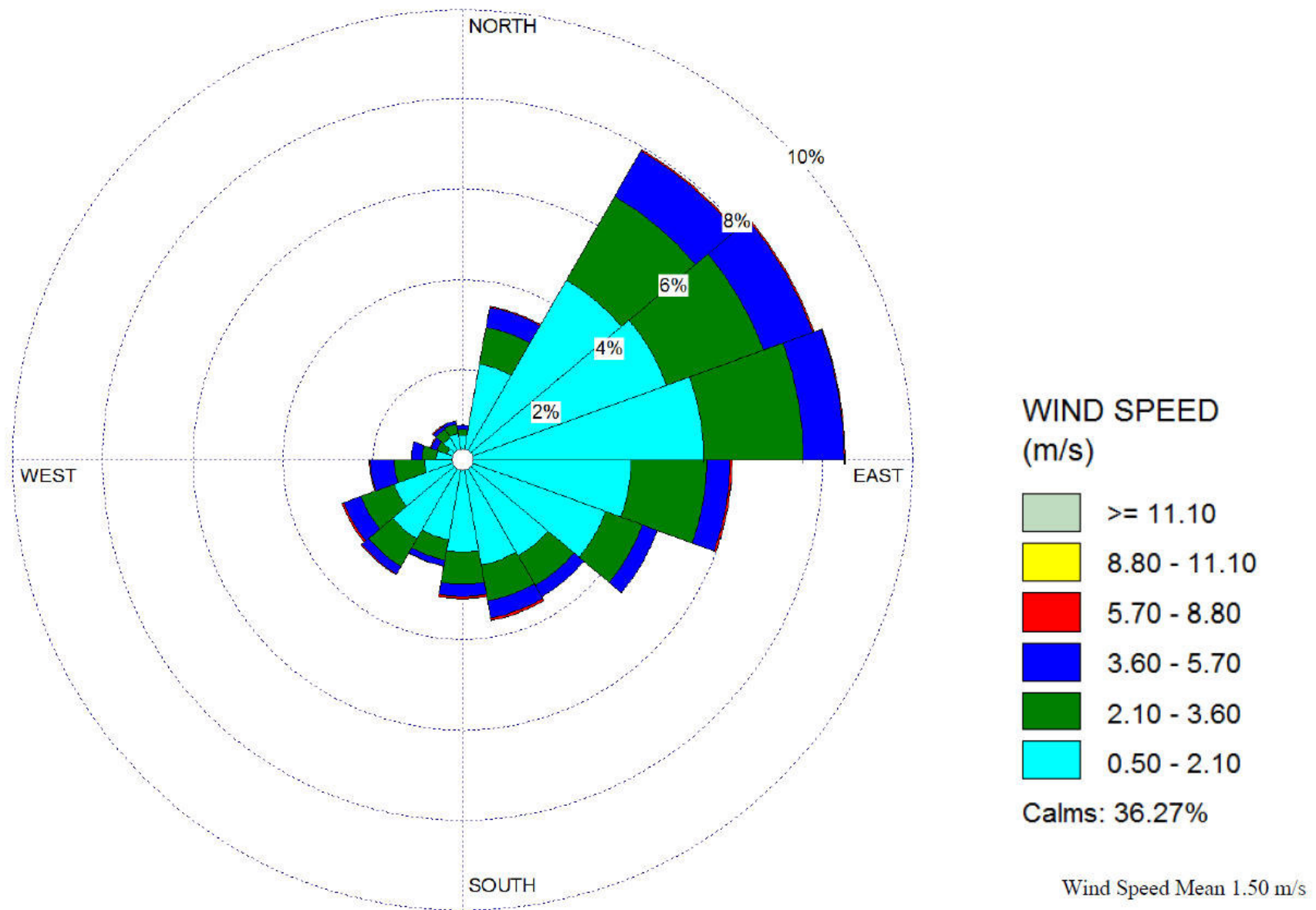
##### **1) Surface meteorological data**

Surface meteorological data used in the assessment were from the weather Station at Kor Hong rubber research center in Songkhla Province of Meteorological Department. The station number is 48571 and the location is Latitude  $7^{\circ} 0' 0.0''$  N and Longitude  $100^{\circ} 30' 0.0''$  E. The data were from 2013 – 2015. The prepared meteorological data in 2013 found that the majority of wind direction was northeast as showed in **Figure 5.2.2-2**, while the majority of the wind in 2014 was northeast as showed in **Figure 5.2.2-3**, and the majority of the wind in 2015 was northeast also as showed in **Figure 5.2.2-4**. The data were prepared in SCRAM format (short form of CD-144 format) to



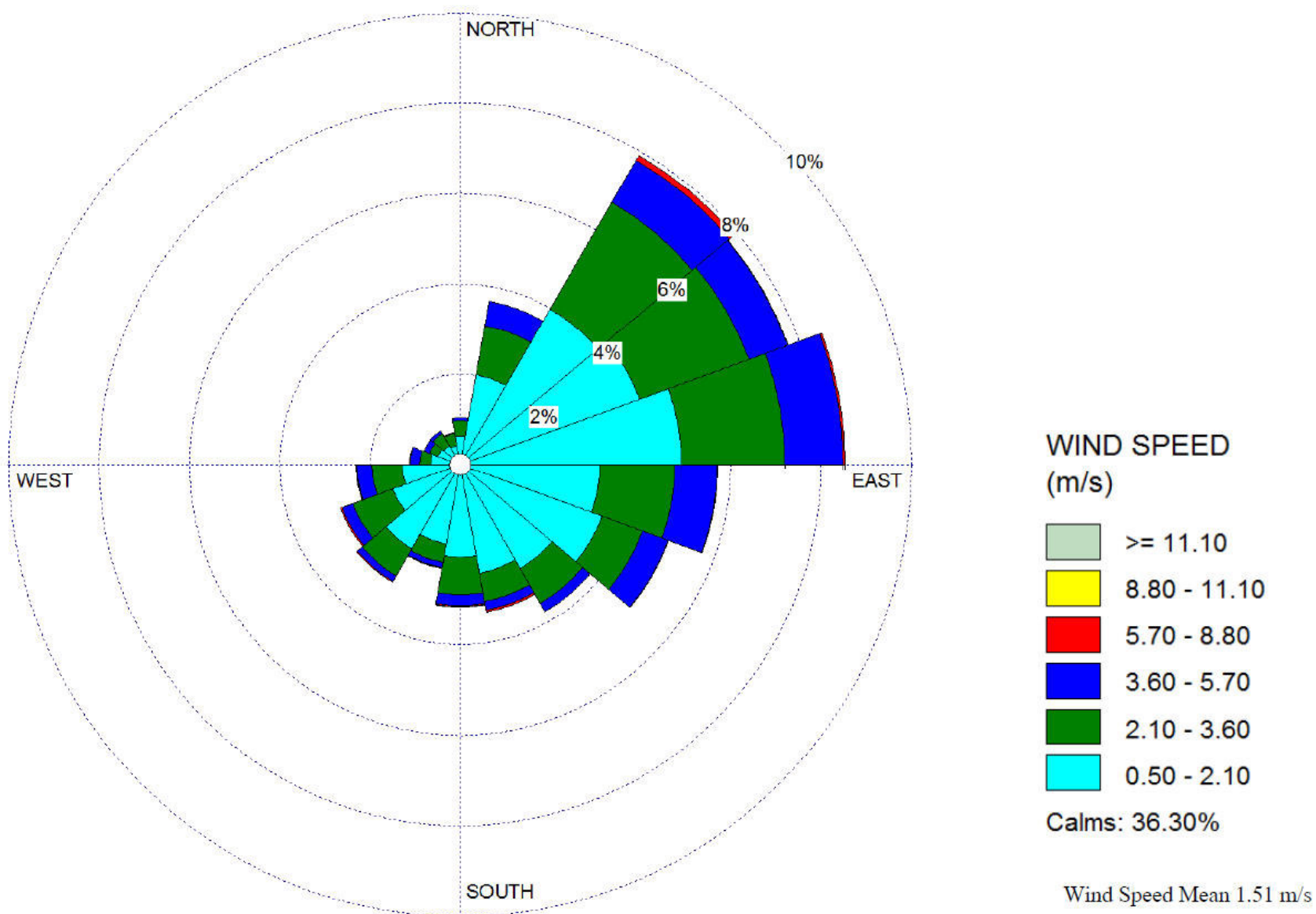
From : Consultants of Technology Co., Ltd., B.E. 2559

**Figure 5.2.2-2** Wind Speed and Wind Speed Direction from the weather Station at Kor Hong rubber research center in Songkhla Province of Meteorological Department B.E. 2556



From : Consultants of Technology Co., Ltd., B.E. 2559

**Figure 5.2.2-3** Wind Speed and Wind Speed Direction from the weather Station at Kor Hong rubber research center in Songkhla Province of Meteorological Department B.E. 2557



From : Consultants of Technology Co., Ltd., B.E. 2559

**Figure 5.2.2-4** Wind Speed and Wind Speed Direction from the weather Station at Kor Hong rubber research center in Songkhla Province of Meteorological Department B.E. 2558

input in AERMOD model. The prepared meteorological data were assessed by AERMET program prior applying to AERMOD mathematical model.

## **2) Upper meteorological data**

For the upper meteorological data, the Consultant used the data from Hat Yai weather station during 2013-2015 (the data in 2013-2015 were not completed, data from 2012 were used instead). The station is the nearest to the study area as there are only five weather stations; namely, Chiang Mai, Ubon Ratchathani, Bangna, Hat Yai, and Phuket Airport. The required data are wind direction and speed, temperature, atmospheric pressure, and meteorological data prepared by AERMET. These data were inputted in the AERMOD mathematical model.

## **3) Meteorological data by land use characteristic**

The meteorological data by land use characteristic are surface roughness length, Bowen ratio, and albedo. The Consultant considered the land use characteristic from the aerial map from Google Earth in 2015 together with land use data from Department of Land Development in 2012.

Due to the distance of the weather station at Kor Hong rubber research center in Songkhla Province and the Project is approximate 30 kilometers and the land use characteristic differs from the Project area, the Consultant decided to use land use characteristic of the Project area to calculate surface roughness length, Bowen ratio, and albedo. The roughness length, Bowen ratio, and albedo in accordance with the Air Dispersion Modeling Guideline for Ontario are showed in **Appendix 5-1**.

(a) Surface Roughness Length; weighted average with inverse distance in the radius of three kilometers in which divided into eight parts

(b) Bowen Ratio; weighted average within the area of ten kilometers x ten kilometers

(c) Albedo; weighted average within the area of ten kilometer x ten kilometers

The average of roughness length, Bowen ratio, and albedo by land use characteristic are as follows:

Frequency /Sector	Surface Roughness Length	Bowen Ratio	Albedo
0°-45°	0.20	Average dry = 1.45 Average wet= 0.31	0.19
45°-90°	0.17	Average dry = 1.45 Average wet= 0.31	0.19
90°-135°	0.18	Average dry = 1.45 Average wet= 0.31	0.19
135°-180°	0.15	Average dry = 1.45 Average wet= 0.31	0.19
180°-225°	0.73	Average dry = 1.45 Average wet= 0.31	0.19
225°-270°	0.21	Average dry = 1.45 Average wet= 0.31	0.19
270°-315°	0.21	Average dry = 1.45 Average wet= 0.31	0.19
315°-360°	0.23	Average dry = 1.45 Average wet= 0.31	0.19

Remark: Average dry of Bowen Ratio used for the assessment of the impacts during November –

April

Average wet of Bowen Ratio used for the assessment of the impacts during May - October

## (5) AERMAP input data

### 1) Terrain elevation information

The Consultant used the terrain data of the study area from SRTM (**Shuttle Radar Topography Mission**) with the resolution of 1-Arc Second (90 metersx90meters).

### 2) Specification of study area and receptor information

The Consultant specified the study area to cover the area of 13 kilometers x 13 kilometers by using two types of grids as follows:

(a) Uniform Cartesian; constant grid with resolution of 500 meters

(b) Multi-Tier; variable grid and specified the Project area as a center and the resolution is variable for the study of the following areas:

a) In the Project area to the distance of three kilometers from the fence line with resolution of 100 meters

b) Distance three – four kilometers with resolution of 250 meters

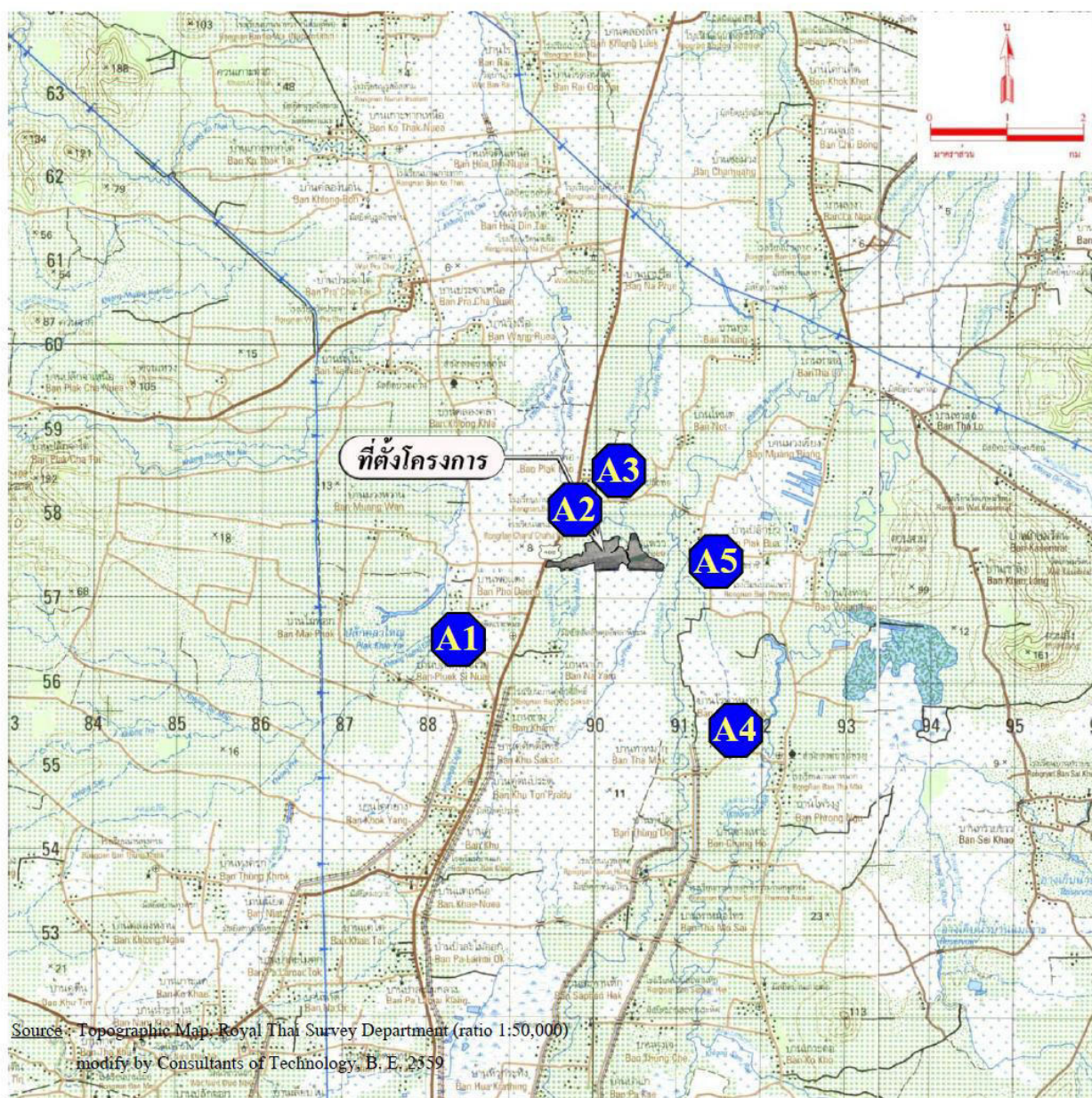
For the areas that sensitive to the air pollution impacts, the Consultant considered communities' locations along with the air pollution from the Project that may cause health impacts on the people who live in the surrounding area of 13 x 13 kilometers radius. There are five main sensitive areas in this assessment (**Figure 5.2.2-5**) as follows:

- 1) RohMah Mosque locates 1.5 kilometers from the Project
- 2) Chana Chanupathum School located 0.2 kilometers from the Project
- 3) Ban Plug Phor Mosque located 0.6 kilometers from the Project
- 4) Ban RaiThaMak located 2.5 kilometers from the Project
- 5) NuruchChamchee Mosque located 0.5 kilometers from the Project

Moreover, communities in the area were specified to be used as observing point for health impacts assessment as follows:

- 1) Khu Sub-district
  - Moo1 Ban KhuTonpradu
  - Moo2 Ban PhorDaeng
  - Moo3 Ban Na Yum
  - Moo4 Ban KhuSaksit
  - Moo5 Ban Khu
  - Moo6 Ban Tung
  - Moo7 Ban Node
  - Moo8 Ban Na Prue
  - Moo9 Ban Plug Phor
- 2) Paching Sub-district
  - Moo8 Ban Hua Din Nue
  - Moo9 Ban Hua Din Tai





**Figure 5.2.2-5** Receptor for air pollution impacts assessment

**Receptor**



= Roh Mah Mosque



= Chana Chanupathum School



= Ban Plug Phor Mosque



= Ban Rai Tha Mak



= Nuruch Chamchee Mosque



- 3) Sapan Mai Kaen Sub-district
  - Moo3 Ban ThaLor
  - Moo5 Ban SaiKhao
  - Moo6 Ban Kasemrat
  
- 4) Kae Sub-district
  - Moo1 Ban Khok Yang
  - Moo2 Ban KaeNue
  - Moo3 Ban Kae Tai
  - Moo4 Ban Nead
  
- 5) ThaMorSai Sub-district
  - Moo1 Ban ThaMorSai
  - Moo2 Ban RaiThaMak
  - Moo3 Ban Prong Ngu
  - Moo5 Ban Tung Che
  - Moo8 Ban Praew
  - Moo9 Ban SaphanHak
  - Moo10 Ban Wang Han
  
- 6) Na Wha Sub-district
  - Moo3 Ban KohTak Tai
  - Moo4 Ban Klong Bon
  - Moo5 Ban PrachaNue
  - Moo6 Ban Pracha Tai
  - Moo7 Ban Na Nai
  
- 7) Khud Tad Whai Sub-district
  - Moo2 Ban Pa LamaiKlang
  - Moo4 Ban Pa LamaiNok
  
- 8) Ban Na Sub-district
  - Moo7 Ban La Nga
  - Moo9 Ban Nam Khem

## **(6) Background concentration**

The Consultant collected air quality monitoring results during 24 February – 2 March 2016 and during 23-30 August 2016 from four monitoring stations (**Figure 5.2.2-5**); namely, Nuruch Chamchee Mosque, RohMah Mosque, Ban Plug Phor Mosque, and Ban Muang Whan. Results are expressed in **Table 5.2.2-3**. The monitoring station has not been set up at Chana Chanupathum School because school management did not allow it.

## **(7) Assumptions**

The assumptions used in the air quality impacts assessment are as follows:

- 1) Case 1: Forecasting air emission source from construction period of the project,
- 2) Case 2: Forecasting air emission source of the project (including downwash), and
- 3) Case 3: Forecasting air emission source of the project (including downwash) by which air quality control equipment of the boiler (capacity 98 tone/hr) is not working.

The Project activities during construction period may cause air pollution impacts. The construction will take place for approximately 24 months. Thus, the Consultant used meteorological data during 2013 – 2015 for the impacts assessment during construction and operation periods.

## **(8) Results of mathematical model**

### **1) Scenario1: Forecasting air emission source from construction period of the project**

Results of the study are showed in **Table 5.2.2-4** to **Table 5.2.2-7** and can be described as follows:

#### **(a) Total suspended particulate (TSP)**

The average concentration of total suspended particulate over the period of 24 hours is 9.65 micrograms/cubic meter or counted for 2.92 percent of the standard (occurs in December) at coordinates 690000E and 757500N, North of the Project area.

The average maximum concentration of total suspended particulate over the period of one year is 1.48 micrograms/cubic meter or counted for 1.48 percent of the standard at coordinates 690000E and 757500N, in the Project area.

**Table 5.2.2-3**  
**Result Air Quality Measurment**

Stations	Date	Results				
		TSP (ug/m <sup>3</sup> )	PM-10 (ug/m <sup>3</sup> )	SO <sub>2</sub> (ug/m <sup>3</sup> )		NO <sub>2</sub> (ug/m <sup>3</sup> )
		avg 24 hr	avg 24 hr	avg 1 hr	avg 24 hr	avg 1 hr
<b>Nuruch Chamchee Mosque (A1)</b>	24-25 Feb 2016	54	31	2.36 - 7.33	3.66	3.20 - 13.17
	25-26 Feb 2016	107	40	2.09 - 5.76	3.14	2.63 - 15.43
	26-27 Feb 2016	77	30	2.09 - 6.54	3.40	2.45 - 18.44
	27-28 Feb 2016	47	27	2.09 - 5.24	3.40	3.20 - 14.30
	28-29 Feb 2016	59	32	1.57 - 7.07	3.14	2.45 - 18.63
	29 Feb-1Mar 2016	60	31	2.09 - 4.71	2.62	0.75 - 16.74
	1-2 Mar 2016	62	33	2.09 - 6.02	3.93	2.63 - 17.12
<b>Min-Max from 1<sup>st</sup> monitoring</b>		<b>47-107</b>	<b>27-40</b>	<b>1.57 - 7.33</b>	<b>2.62-3.93</b>	<b>0.75 - 18.63</b>
	23-24 Aug 2016	35	20	1.05 - 3.40	2.09	0.75 - 11.10
	24-25 Aug 2016	19	9	1.05 - 3.14	1.83	2.07 - 9.78
	25-26 Aug 2016	21	11	1.05 - 3.40	1.57	0.94 - 9.41
	26-27 Aug 2016	28	15	1.05 - 4.19	2.09	0.75 - 15.24
	27-28 Aug 2016	37	23	1.05 - 3.66	1.83	2.26 - 16.18
	28-29 Aug 2016	34	18	1.05 - 3.14	1.57	2.26 - 11.66
	29-30 Aug 2016	36	22	1.05 - 3.93	1.83	0.94 - 17.12
<b>Min-Max from 2<sup>nd</sup> monitoring</b>		<b>19-37</b>	<b>9-23</b>	<b>1.05 - 4.19</b>	<b>1.57-2.09</b>	<b>0.75 - 17.12</b>
<b>Min - Max.</b>		<b>19-107</b>	<b>9-40</b>	<b>1.05 - 7.33</b>	<b>1.57-3.93</b>	<b>0.75 - 18.63</b>
<b>RohMah Mosque (A2)</b>	24-25 Feb 2016	74	27	2.88 - 5.24	3.66	4.14 - 15.24
	25-26 Feb 2016	115	30	1.83 - 7.85	3.66	3.76 - 15.43
	26-27 Feb 2016	73	22	1.83 - 4.71	3.40	2.07 - 8.65
	27-28 Feb 2016	49	18	2.62 - 5.24	3.40	2.26 - 12.23
	28-29 Feb 2016	48	21	2.88 - 4.19	3.40	2.07 - 17.12
	29 Feb-1Mar 2016	53	23	2.88 - 6.54	3.93	1.88 - 15.24
	1-2 Mar 2016	70	29	3.14 - 7.85	4.19	3.01 - 20.70
<b>Min-Max from 1<sup>st</sup> monitoring</b>		<b>48-115</b>	<b>18-30</b>	<b>1.83 - 7.85</b>	<b>3.40-4.19</b>	<b>1.88 - 20.70</b>
	23-24 Aug 2016	56	34	1.05 - 9.16	2.62	0.75 - 11.29
	24-25 Aug 2016	210	10	2.09 - 3.40	2.36	3.01 - 7.34
	25-26 Aug 2016	27	17	2.09 - 3.66	2.36	2.26 - 6.96
	26-27 Aug 2016	34	24	2.09 - 5.76	2.62	2.26 - 11.29
	27-28 Aug 2016	32	22	2.09 - 2.88	2.36	0.75 - 8.47
	28-29 Aug 2016	65	43	2.09 - 4.97	2.62	1.13 - 7.53
	29-30 Aug 2016	45	19	2.09 - 4.45	2.62	0.75 - 6.21
<b>Min-Max from 2<sup>nd</sup> monitoring</b>		<b>27-210</b>	<b>10-43</b>	<b>1.05 - 9.16</b>	<b>2.36-2.62</b>	<b>0.75 - 11.29</b>
<b>Min - Max.</b>		<b>27-210</b>	<b>10-43</b>	<b>1.05 - 9.16</b>	<b>2.36-4.19</b>	<b>0.75 - 20.70</b>
<b>Min - Max.</b>		<b>17-84</b>	<b>7-38</b>	<b>1.05 - 5.76</b>	<b>1.57-3.93</b>	<b>0.75 - 14.67</b>
<b>Min - Max. (Total)</b>		<b>16-210</b>	<b>6-43</b>	<b>1.05 - 9.42</b>	<b>1.31-4.19</b>	<b>0.75 - 20.70</b>
<b>Standard</b>		<b>330<sup>1/</sup></b>	<b>120<sup>1/</sup></b>	<b>780<sup>2/</sup></b>	<b>300<sup>1/</sup></b>	<b>320<sup>3/</sup></b>
<b>Standard<sup>4/</sup></b>		<b>-</b>	<b>150.00</b>	<b>-</b>	<b>125.00</b>	<b>-</b>

**Remark :** <sup>1/</sup> The Notification of National Environmental Board No.24 (B.E.2547)

<sup>2/</sup> The Notification of National Environmental Board No.21 (B.E.2544)

<sup>3/</sup> The Notification of National Environmental Board No.33 (B.E.2552)

<sup>4/</sup> IFC EHS General Guidelines for Ambient Air Quality

Table 5.2.2-3 (cont)

Stations	Date	Results				
		TSP (ug/m <sup>3</sup> )	PM-10 (ug/m <sup>3</sup> )	SO <sub>2</sub> (ug/m <sup>3</sup> )		NO <sub>2</sub> (ug/m <sup>3</sup> )
		avg 24 hr	avg 24 hr	avg 1 hr	avg 24 hr	avg 1 hr
<b>Plug Phor Mosque (A3)</b>	24-25 Feb 2016	35	21	2.62 - 5.76	3.66	2.26 - 12.04
	25-26 Feb 2016	42	22	1.83 - 4.97	3.40	2.82 - 15.62
	26-27 Feb 2016	32	18	1.83 - 4.45	3.14	0.75 - 15.62
	27-28 Feb 2016	31	20	1.83 - 5.76	3.40	3.20 - 16.37
	28-29 Feb 2016	29	19	2.36 - 6.02	3.66	2.82 - 18.06
	29 Feb-1Mar 2016	39	21	2.62 - 5.50	3.40	2.82 - 13.92
	1-2 Mar 2016	45	28	2.09 - 5.24	3.66	3.76 - 12.79
<b>Min-Max from 1<sup>st</sup> monitoring</b>		<b>29-45</b>	<b>18-28</b>	<b>1.83 - 6.02</b>	<b>3.14-3.66</b>	<b>0.75 - 18.06</b>
	23-24 Aug 2016	45	19	1.05 - 9.42	1.83	3.39 - 11.48
	24-25 Aug 2016	16	6	1.05 - 2.88	1.31	0.75 - 9.03
	25-26 Aug 2016	20	10	1.05 - 1.83	1.31	0.75 - 6.58
	26-27 Aug 2016	25	15	1.05 - 2.62	1.31	0.75 - 8.65
	27-28 Aug 2016	32	22	1.05 - 2.62	1.31	0.75 - 11.48
	28-29 Aug 2016	29	18	1.05 - 2.09	1.31	0.75 - 10.16
	29-30 Aug 2016	31	13	1.05 - 1.31	1.31	0.75 - 12.61
<b>Min-Max from 2<sup>nd</sup> monitoring</b>		<b>16-45</b>	<b>6-22</b>	<b>1.05 - 9.42</b>	<b>1.31-1.83</b>	<b>0.75 - 12.61</b>
<b>Min - Max.</b>		<b>16-45</b>	<b>6-28</b>	<b>1.05 - 9.42</b>	<b>1.31-3.66</b>	<b>0.75 - 18.06</b>
<b>Baan Muang Wan (A4)</b>	24-25 Feb 2016	62	27	2.88 - 5.76	3.93	2.63 - 14.11
	25-26 Feb 2016	84	36	2.09 - 4.97	3.14	2.45 - 14.67
	26-27 Feb 2016	62	27	2.62 - 4.97	3.40	3.20 - 14.30
	27-28 Feb 2016	31	21	2.09 - 4.71	3.40	3.76 - 13.92
	28-29 Feb 2016	39	19	2.09 - 5.24	3.14	3.95 - 10.91
	29 Feb-1Mar 2016	44	24	2.36 - 4.19	3.14	2.45 - 13.36
	1-2 Mar 2016	72	38	2.36 - 4.71	3.40	3.76 - 13.92
<b>Min-Max from 1<sup>st</sup> monitoring</b>		<b>31-84</b>	<b>19-38</b>	<b>2.09 - 5.76</b>	<b>3.14-3.93</b>	<b>2.45 - 14.67</b>
	23-24 Aug 2016	21	10	1.05 - 3.40	2.09	0.75 - 8.84
	24-25 Aug 2016	17	7	1.05 - 3.14	1.83	0.75 - 8.09
	25-26 Aug 2016	18	8	1.05 - 3.40	1.57	0.75 - 7.90
	26-27 Aug 2016	21	11	1.05 - 4.19	2.09	0.75 - 7.90
	27-28 Aug 2016	27	17	1.05 - 3.66	1.83	0.75 - 7.53
	28-29 Aug 2016	23	12	1.05 - 3.14	1.57	0.75 - 7.90
	29-30 Aug 2016	20	10	1.05 - 3.93	1.83	0.75 - 7.34
<b>Min-Max from 2<sup>nd</sup> monitoring</b>		<b>17-27</b>	<b>7-17</b>	<b>1.05 - 4.19</b>	<b>1.57-2.09</b>	<b>0.75 - 8.84</b>
<b>Min - Max.</b>		<b>17-84</b>	<b>7-38</b>	<b>1.05 - 5.76</b>	<b>1.57-3.93</b>	<b>0.75 - 14.67</b>
<b>Min - Max. (Total)</b>		<b>16-210</b>	<b>6-43</b>	<b>1.05 - 9.42</b>	<b>1.31-4.19</b>	<b>0.75 - 20.70</b>
<b>Standard</b>		<b>330<sup>1/</sup></b>	<b>120<sup>1/</sup></b>	<b>780<sup>2/</sup></b>	<b>300<sup>1/</sup></b>	<b>320<sup>3/</sup></b>
<b>Standard<sup>4/</sup></b>		<b>-</b>	<b>150.00</b>	<b>-</b>	<b>125.00</b>	<b>-</b>

Remark : <sup>1/</sup> The Notification of National Environmental Board No.24 (B.E.2547)

<sup>2/</sup> The Notification of National Environmental Board No.21 (B.E.2544)

<sup>3/</sup> The Notification of National Environmental Board No.33 (B.E.2552)

<sup>4/</sup> IFC EHS General Guidelines for Ambient Air Quality

**Table 5.2.2-4****The result of pollutant dispersion to ambient by mathematical model****Scenario 1 : Forecasting air emission source from construction period of the project**

		Concentration (ug/m3)		
		TSP		
		Average 24 hr		Average 1 year <sup>2/</sup>
		Mathematical model	Background <sup>1/</sup>	Mathematical model
Maximum		9.65	219.65	1.48
Maximum period		December	December	-
Coordinates		690000E, 757500N	690000E, 757500N	690000E, 757500N
Area		Project area	Project area	Project area
<b>Receptor</b>				
1.	Roh Mah Mosque	0.014	210.014	0.00103
2.	Chana Chanupathum School	0.115	210.115	0.01760
3.	Ban Plug Phor Mosque	0.041	210.041	0.00365
4.	Ban Rai Tha Mak	0.003	210.003	0.00010
5.	Nuruch Chamchee Mosque	0.015	210.015	0.00069
<b>Khu Sub-district</b>				
-	Moo 1 Ban Khu Tonpradu	0.005	210.005	0.00026
-	Moo 2 Ban Phor Daeng	0.014	210.014	0.00103
-	Moo 3 Ban Na Yum	0.115	210.115	0.01760
-	Moo 4 Ban Khu Saksit	0.013	210.013	0.00080
-	Moo 5 Ban Khu	0.007	210.007	0.00038
-	Moo 6 Ban Tung	0.006	210.006	0.00024
-	Moo 7 Ban Node	0.009	210.009	0.00066
-	Moo 8 Ban Na Prue	0.009	210.009	0.00028
-	Moo 9 Ban Plug Phor	0.041	210.041	0.00365
<b>Paching Sub-district</b>				
-	Moo 8 Ban Hua Din Nue	0.008	210.008	0.00026
-	Moo 9 Ban Hua Din Tai	0.007	210.007	0.00027
<b>Sapan Mai Kaen Sub-district</b>				
-	Moo 3 Ban Tha Lor	0.003	210.003	0.00019
-	Moo 5 Ban Sai Khao	0.003	210.003	0.00004
-	Moo 6 Ban Kasemrat	0.003	210.003	0.00011
<b>Kae Sub-district</b>				
-	Moo 1 Ban Khok Yang	0.005	210.005	0.00028
-	Moo 2 Ban Kae Nue	0.004	210.004	0.00019
-	Moo 3 Ban Kae Tai	0.004	210.004	0.00020
-	Moo 4 Ban Nead	0.008	210.008	0.00025

**Table 5.2.2-4 (cont'd)**

					Concentration (ug/m3)		
					TSP		
					Average 24 hr		Average 1 year <sup>2/</sup>
					Mathematical model	Background <sup>1/</sup>	Mathematical model
<b>Tha Mor Sai Sub-district</b>							
-	Moo 1 Ban Tha Mor Sai				0.003	210.003	0.00005
-	Moo 2 Ban Rai Tha Mak				0.003	210.003	0.00010
-	Moo 3 Ban Prong Ngu				0.003	210.003	0.00008
-	Moo 5 Ban Tung Che				0.003	210.003	0.00004
-	Moo 8 Ban Praew				0.015	210.015	0.00069
-	Moo 9 Ban Saphan Hak				0.001	210.001	0.00004
-	Moo 10 Ban Wang Han				0.004	210.004	0.00020
<b>Na Wha Sub-district</b>							
-	Moo 3 Ban Koh Tak Tai				0.007	210.007	0.00023
-	Moo 4 Ban Klong Bon				0.006	210.006	0.00023
-	Moo 5 Ban Pracha Nue				0.008	210.008	0.00032
-	Moo 6 Ban Pracha Tai				0.009	210.009	0.00036
-	Moo 7 Ban Na Nai				0.008	210.008	0.00044
<b>Khud Tad Whai Sub-district</b>							
-	Moo 2 Ban Pa Lamai Klang				0.004	210.004	0.00013
-	Moo 4 Ban Pa Lamai Nok				0.004	210.004	0.00013
<b>Ban Na Sub-district</b>							
-	Moo 7 Ban La Nga				0.004	210.004	0.00019
-	Moo 9 Ban Nam Khem				0.003	210.003	0.00013
<b>Standard<sup>3/</sup></b>					<b>330</b>		<b>100</b>
<b>Remark :</b>		<sup>1/</sup> Include Background and used maximum concentration during 24 Febuary - 2 March B.E. 2559 and 23-30 August B.E. 2559					
		<sup>2/</sup> Non include Background					
		<sup>3/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.24 (B.E. 2547)					
<b>Source :</b> Consultants of Technology Co., Ltd., B.E. 2559							

Table 5.2.2-5

**The result of pollutant dispersion to ambient by mathematical model****Scenario 1 : Forecasting air emission source from construction period of the project**

	Concentration (ug/m3)		
	PM10		
	Average 24 hr		Average 1 year <sup>2/</sup>
	Mathematical model	Background <sup>1/</sup>	Mathematical model
Maximum	6.20	49.20	0.95
Maximum period	December	December	-
Coordinates	690000E, 757500N	690000E, 757500N	690000E, 757500N
Area	Project area	Project area	Project area
<b>Receptor</b>			
1. Roh Mah Mosque	0.009	43.009	0.00066
2. Chana Chanupathum School	0.074	43.074	0.01130
3. Ban Plug Phor Mosque	0.027	43.027	0.00234
4. Ban Rai Tha Mak	0.002	43.002	0.00006
5. Nuruch Chamchee Mosque	0.010	43.010	0.00044
<b>Khu Sub-district</b>			
- Moo 1 Ban Khu Tonpradu	0.004	43.004	0.00017
- Moo 2 Ban Phor Daeng	0.009	43.009	0.00066
- Moo 3 Ban Na Yum	0.074	43.074	0.01130
- Moo 4 Ban Khu Saksit	0.008	43.008	0.00052
- Moo 5 Ban Khu	0.005	43.005	0.00024
- Moo 6 Ban Tung	0.004	43.004	0.00016
- Moo 7 Ban Node	0.006	43.006	0.00042
- Moo 8 Ban Na Prue	0.006	43.006	0.00018
- Moo 9 Ban Plug Phor	0.027	43.027	0.00234
<b>Paching Sub-district</b>			
- Moo 8 Ban Hua Din Nue	0.005	43.005	0.00017
- Moo 9 Ban Hua Din Tai	0.004	43.004	0.00017
<b>Sapan Mai Kaen Sub-district</b>			
- Moo 3 Ban Tha Lor	0.002	43.002	0.00012
- Moo 5 Ban Sai Khao	0.002	43.002	0.00003
- Moo 6 Ban Kasemrat	0.002	43.002	0.00007
<b>Kae Sub-district</b>			
- Moo 1 Ban Khok Yang	0.003	43.003	0.00018
- Moo 2 Ban Kae Nue	0.003	43.003	0.00012
- Moo 3 Ban Kae Tai	0.002	43.002	0.00013
- Moo 4 Ban Nead	0.005	43.005	0.00016
<b>Standard<sup>3/</sup></b>	<b>120</b>		<b>50</b>
<b>Standard<sup>4/</sup></b>	<b>150</b>		<b>70</b>

**Remark :** <sup>1/</sup> Include Background and used maximum concentration during 24 February - 2 March B.E. 2559 and 23-30 August B.E. 2559

<sup>2/</sup> Non include Background

<sup>3/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.24 (B.E. 2547)

<sup>4/</sup> IFC EHS General Guidelines for Ambient Air Quality

**Source :** Consultants of Technology Co., Ltd., B.E. 2559

Table 5.2.2-5 (cont'd)

	Concentration (ug/m3)		
	PM10		
	Average 24 hr		Average 1 year <sup>2/</sup>
	Mathematical model	Background <sup>1/</sup>	Mathematical model
<b>Tha Mor Sai Sub-district</b>			
- Moo 1 Ban Tha Mor Sai	0.002	43.002	0.00003
- Moo 2 Ban Rai Tha Mak	0.002	43.002	0.00006
- Moo 3 Ban Prong Ngu	0.002	43.002	0.00005
- Moo 5 Ban Tung Che	0.002	43.002	0.00003
- Moo 8 Ban Praew	0.010	43.010	0.00044
- Moo 9 Ban Saphan Hak	0.001	43.001	0.00003
- Moo 10 Ban Wang Han	0.003	43.003	0.00013
<b>Na Wha Sub-district</b>			
- Moo 3 Ban Koh Tak Tai	0.004	43.004	0.00015
- Moo 4 Ban Klong Bon	0.004	43.004	0.00015
- Moo 5 Ban Pracha Nue	0.005	43.005	0.00021
- Moo 6 Ban Pracha Tai	0.006	43.006	0.00023
- Moo 7 Ban Na Nai	0.005	43.005	0.00028
<b>Khud Tad Whai Sub-district</b>			
- Moo 2 Ban Pa Lamai Klang	0.003	43.003	0.00008
- Moo 4 Ban Pa Lamai Nok	0.003	43.003	0.00008
<b>Ban Na Sub-district</b>			
- Moo 7 Ban La Nga	0.002	43.002	0.00012
- Moo 9 Ban Nam Khem	0.002	43.002	0.00008
<b>Standard<sup>3/</sup></b>	<b>120</b>		<b>50</b>
<b>Standard<sup>4/</sup></b>	<b>150</b>		<b>70</b>

Remark : <sup>1/</sup> Include Background and used maximum concentration during 24 February - 2 March B.E. 2559 and 23-30 August B.E. 2559

<sup>2/</sup> Non include Background

<sup>3/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.24 (B.E. 2547)

<sup>4/</sup> IFC EHS General Guidelines for Ambient Air Quality

Source : Consultants of Technology Co., Ltd., B.E. 2559



Table 5.2.2-6

**The result of pollutant dispersion to ambient by mathematical model**  
**Scenario 1 : Forecasting air emission source from construction period of the project**

	Concentration (ug/m3)				
	SO <sub>2</sub>				
	Average 1 hr		Average 24 hr		Average 1 year <sup>2/</sup>
	Mathematical model	Background <sup>1/</sup>	Mathematical model	Background <sup>1/</sup>	Mathematical model
Maximum	32.50	41.92	5.34	9.53	0.82
Maximum period	July	July	December	December	-
Coordinates	690000E, 757500N	690000E, 757500N	690000E, 757500N	690000E, 757500N	690000E, 757500N
Area	Project area	Project area	Project area	Project area	Project area
<b>Receptor</b>					
1. Roh Mah Mosque	0.06	9.48	0.008	4.198	0.00057
2. Chana Chanupathum School	1.02	10.44	0.063	4.253	0.00972
3. Ban Plug Phor Mosque	0.20	9.62	0.023	4.213	0.00202
4. Ban Rai Tha Mak	0.03	9.45	0.002	4.192	0.00005
5. Nuruch Chamchee Mosque	0.07	9.49	0.008	4.198	0.00038
<b>Khu Sub-district</b>					
- Moo 1 Ban Khu Tonpradu	0.05	9.47	0.003	4.193	0.00015
- Moo 2 Ban Phor Daeng	0.06	9.48	0.008	4.198	0.00057
- Moo 3 Ban Na Yum	1.02	10.44	0.063	4.253	0.00972
- Moo 4 Ban Khu Saksit	0.13	9.55	0.007	4.197	0.00044
- Moo 5 Ban Khu	0.05	9.47	0.004	4.194	0.00021
- Moo 6 Ban Tung	0.05	9.47	0.003	4.193	0.00013
- Moo 7 Ban Node	0.06	9.48	0.005	4.195	0.00036
- Moo 8 Ban Na Prue	0.07	9.49	0.005	4.195	0.00016
- Moo 9 Ban Plug Phor	0.20	9.62	0.023	4.213	0.00202
<b>Paching Sub-district</b>					
- Moo 8 Ban Hua Din Nue	0.06	9.48	0.004	4.194	0.00015
- Moo 9 Ban Hua Din Tai	0.06	9.48	0.004	4.194	0.00015
<b>Standard<sup>3/</sup></b>	<b>780</b>		<b>300</b>		<b>100</b>
<b>Standard<sup>4/</sup></b>	<b>-</b>		<b>125</b>		<b>-</b>

**Remark :** <sup>1/</sup> Include Background and used maximum concentration during 24 February - 2 March B.E. 2559 and 23-30 August B.E. 2559

<sup>2/</sup> Non include Background

<sup>3/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.21 (B.E. 2544) and No.24 (B.E. 2547)

<sup>4/</sup> IFC EHS General Guidelines for Ambient Air Quality

**Source :** Consultants of Technology Co., Ltd., B.E. 2559

Table 5.2.2-6 (Cont)

	Concentration (ug/m3)				
	SO <sub>2</sub>				
	Average 1 hr		Average 24 hr		Average 1 year <sup>2/</sup>
	Mathematical model	Background <sup>1/</sup>	Mathematical model	Background <sup>1/</sup>	Mathematical model
Maximum	32.50	41.92	5.34	9.53	0.82
Maximum period	July	July	December	December	-
Coordinates	690000E, 757500N	690000E, 757500N	690000E, 757500N	690000E, 757500N	690000E, 757500N
Area	Project area	Project area	Project area	Project area	Project area
<b>Sapan Mai Kaen Sub-district</b>					
- Moo 3 Ban Tha Lor	0.03	9.45	0.002	4.192	0.00010
- Moo 5 Ban Sai Khao	0.03	9.45	0.002	4.192	0.00002
- Moo 6 Ban Kasemrat	0.03	9.45	0.001	4.191	0.00006
<b>Kae Sub-district</b>					
- Moo 1 Ban Khok Yang	0.05	9.47	0.003	4.193	0.00015
- Moo 2 Ban Kae Nue	0.04	9.46	0.002	4.192	0.00010
- Moo 3 Ban Kae Tai	0.03	9.45	0.002	4.192	0.00011
- Moo 4 Ban Nead	0.08	9.50	0.004	4.194	0.00014
<b>Tha Mor Sai Sub-district</b>					
- Moo 1 Ban Tha Mor Sai	0.03	9.45	0.002	4.192	0.00003
- Moo 2 Ban Rai Tha Mak	0.03	9.45	0.002	4.192	0.00005
- Moo 3 Ban Prong Ngu	0.02	9.44	0.002	4.192	0.00004
- Moo 5 Ban Tung Che	0.03	9.45	0.002	4.192	0.00002
- Moo 8 Ban Praew	0.07	9.49	0.008	4.198	0.00038
- Moo 9 Ban Saphan Hak	0.01	9.43	0.001	4.191	0.00002
- Moo 10 Ban Wang Han	0.04	9.46	0.002	4.192	0.00011
<b>Standard<sup>3/</sup></b>	<b>780</b>		<b>300</b>		<b>100</b>
<b>Standard<sup>4/</sup></b>	<b>-</b>		<b>125</b>		<b>-</b>

**Remark :** <sup>1/</sup> Include Background and used maximum concentration during 24 February - 2 March B.E. 2559 and 23-30 August B.E. 2559

<sup>2/</sup> Non include Background

<sup>3/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.21 (B.E. 2544) and No.24 (B.E. 2547)

<sup>4/</sup> IFC EHS General Guidelines for Ambient Air Quality

**Source :** Consultants of Technology Co., Ltd., B.E. 2559

Table 5.2.2-6 (Cont)

	Concentration (ug/m3)				
	SO <sub>2</sub>				
	Average 1 hr		Average 24 hr		Average 1 year <sup>2/</sup>
	Mathematical model	Background <sup>1/</sup>	Mathematical model	Background <sup>1/</sup>	Mathematical model
Maximum	32.50	41.92	5.34	9.53	0.82
Maximum period	July	July	December	December	-
Coordinates	690000E, 757500N	690000E, 757500N	690000E, 757500N	690000E, 757500N	690000E, 757500N
Area	Project area	Project area	Project area	Project area	Project area
<b>Na Wha Sub-district</b>					
- Moo 3 Ban Koh Tak Tai	0.05	9.47	0.004	4.194	0.00013
- Moo 4 Ban Klong Bon	0.04	9.46	0.003	4.193	0.00013
- Moo 5 Ban Pracha Nue	0.06	9.48	0.005	4.195	0.00018
- Moo 6 Ban Pracha Tai	0.06	9.48	0.005	4.195	0.00020
- Moo 7 Ban Na Nai	0.08	9.50	0.004	4.194	0.00024
<b>Khud Tad Whai Sub-district</b>					
- Moo 2 Ban Pa Lamai Klang	0.05	9.47	0.002	4.192	0.00007
- Moo 4 Ban Pa Lamai Nok	0.03	9.45	0.002	4.192	0.00007
<b>Ban Na Sub-district</b>					
- Moo 7 Ban La Nga	0.04	9.46	0.002	4.192	0.00011
- Moo 9 Ban Nam Khem	0.03	9.45	0.002	4.192	0.00007
<b>Standard<sup>3/</sup></b>	<b>780</b>		<b>300</b>		<b>100</b>
<b>Standard<sup>4/</sup></b>	<b>-</b>		<b>125</b>		<b>-</b>

Remark : <sup>1/</sup> Include Background and used maximum concentration during 24 February - 2 March B.E. 2559 and 23-30 August B.E. 2559

<sup>2/</sup> Non include Background

<sup>3/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.21 (B.E. 2544) and No.24 (B.E. 2547)

<sup>4/</sup> IFC EHS General Guidelines for Ambient Air Quality

Source : Consultants of Technology Co., Ltd., B.E. 2559

**Table 5.2.2-7**

**The result of pollutant dispersion to ambient by mathematical model**

**Scenario 1 : Forecasting air emission source from construction period of the project**

		Concentration (ug/m3)		
		NO <sub>2</sub>		
		Average 1 hr		Average 1 year <sup>2/</sup>
		Mathematical model	Background <sup>1/</sup>	Mathematical model
Maximum		198.07	218.77	4.67
Maximum period		July	July	-
Coordinates		690000E, 757500N	690000E, 757500N	690000E, 757500N
Area		Project area	Project area	Project area
<b><u>Receptor</u></b>				
1.	Roh Mah Mosque	0.39	21.09	0.0033
2.	Chana Chanupathum School	6.22	26.92	0.0556
3.	Ban Plug Phor Mosque	1.24	21.94	0.0115
4.	Ban Rai Tha Mak	0.15	20.85	0.0003
5.	Nuruch Chamchee Mosque	0.44	21.14	0.0022
<b>Khu Sub-district</b>				
-	Moo 1 Ban Khu Tonpradu	0.29	20.99	0.0008
-	Moo 2 Ban Phor Daeng	0.39	21.09	0.0033
-	Moo 3 Ban Na Yum	6.22	26.92	0.0556
-	Moo 4 Ban Khu Saksit	0.79	21.49	0.0025
-	Moo 5 Ban Khu	0.33	21.03	0.0012
-	Moo 6 Ban Tung	0.30	21.00	0.0008
-	Moo 7 Ban Node	0.38	21.08	0.0021
-	Moo 8 Ban Na Prue	0.44	21.14	0.0009
-	Moo 9 Ban Plug Phor	1.24	21.94	0.0115
<b>Paching Sub-district</b>				
-	Moo 8 Ban Hua Din Nue	0.38	21.08	0.0008
-	Moo 9 Ban Hua Din Tai	0.37	21.07	0.0008
<b>Sapan Mai Kaen Sub-district</b>				
-	Moo 3 Ban Tha Lor	0.17	20.87	0.0006
-	Moo 5 Ban Sai Khao	0.16	20.86	0.0001
-	Moo 6 Ban Kasemrat	0.16	20.86	0.0004
<b>Kae Sub-district</b>				
-	Moo 1 Ban Khok Yang	0.29	20.99	0.0009
-	Moo 2 Ban Kae Nue	0.22	20.92	0.0006
-	Moo 3 Ban Kae Tai	0.20	20.90	0.0006
-	Moo 4 Ban Nead	0.46	21.16	0.0008

**Table 5.2.2-7 (cont'd)**

		Concentration (ug/m3)		
		NO <sub>2</sub>		
		Average 1 hr		Average 1 year <sup>2/</sup>
		Mathematical model	Background <sup>1/</sup>	Mathematical model
Tha Mor Sai Sub-district				
-	Moo 1 Ban Tha Mor Sai	0.20	20.90	0.0002
-	Moo 2 Ban Rai Tha Mak	0.15	20.85	0.0003
-	Moo 3 Ban Prong Ngu	0.10	20.80	0.0002
-	Moo 5 Ban Tung Che	0.20	20.90	0.0001
-	Moo 8 Ban Praew	0.44	21.14	0.0022
-	Moo 9 Ban Saphan Hak	0.06	20.76	0.0001
-	Moo 10 Ban Wang Han	0.22	20.92	0.0006
Na Wha Sub-district				
-	Moo 3 Ban Koh Tak Tai	0.32	21.02	0.0007
-	Moo 4 Ban Klong Bon	0.27	20.97	0.0007
-	Moo 5 Ban Pracha Nue	0.37	21.07	0.0010
-	Moo 6 Ban Pracha Tai	0.36	21.06	0.0011
-	Moo 7 Ban Na Nai	0.49	21.19	0.0014
Khud Tad Whai Sub-district				
-	Moo 2 Ban Pa Lamai Klang	0.32	21.02	0.0004
-	Moo 4 Ban Pa Lamai Nok	0.20	20.90	0.0004
Ban Na Sub-district				
-	Moo 7 Ban La Nga	0.23	20.93	0.0006
-	Moo 9 Ban Nam Khem	0.16	20.86	0.0004
Standard <sup>3/</sup>		320		57
Remark :	<sup>1/</sup> Include Background and used maximum concentration during 24 Febuary - 2 March B.E. 2559 and 23-30 August B.E. 2559			
	<sup>2/</sup> Non include Background			
	<sup>3/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.33 (B.E. 2552)			
Source : Consultants of Technology Co., Ltd., B.E. 2559				

Average maximum concentrations of total suspended particulate over the period of 24 hours and one year are 0.115 and 0.018 micrograms/cubic meter, respectively at the area of Moo 3 Ban Na Yum and Chana Chanupathum School which is also located in Moo 3 Ban Na Yum, with 200 households totally.

From the concentrations at ground level which are the results from the mathematical model, when compared with the ambient standard in accordance with the Notification of National Environmental Board No.24 (B.E.2547), it was found that the concentrations are met with the standard including the case of background concentration as showed in **Table 5.2.2-4**.

However, the majority of particulate will fall onto the ground easily. Thus, the dispersion of the particulate will be limited in the construction area only. Construction workers are the main direct receptors. Therefore, the Project shall manipulate environmental impact mitigation measure by covering the soil pile and truck and spray water on the ground for at least twice a day. From data of AP-42, spraying of water on the ground surface for at least twice a day will help reduce dispersion of suspended particulate for approximately 50 percent. Thus, the impact from suspended particulate during construction period is in low level.

**(b) Particulate matter with diameter of less than 10 microns ( $PM_{10}$ )**

The average maximum concentration of particulate matter with a diameter of less than ten microns over the period of 24 hours is 6.20 micrograms/cubic meter or counted for 5.17 percent of the standard (will occur in December) at coordinates 690000E and 757500N, in the Project area.

The average maximum concentration of particulate matter with a diameter of less than ten microns over the period of one year is 0.95 micrograms/cubic meter or counted for 1.90 percent of the standard at coordinates 690000E and 757500N, in the Project area.

Average maximum concentrations at the monitoring stations over the period of 24 hours and one year are 0.074 and 0.01130 micrograms/cubic meter, respectively at the area of Moo 3 Ban Na Yum and Chana Chanupathum School which is also located in Moo 3 Ban Na Yum, with 200 households totally.

From the concentrations at ground level which are results from the mathematical model, when compared with the ambient standard in accordance with the Notification of

National Environmental Board No.24 (B.E.2547), it was found that the concentrations are met with the standard including the case of background concentration as showed in **Table 5.2.2-5**.

**(c) Sulfur dioxide (SO<sub>2</sub>)**

The average maximum concentration of sulfur dioxide over the period of one hour is 32.50 micrograms/cubic meter or counted for 4.17 percent of the standard (will occur in July) at coordinates 690000E and 757500N, in the Project area.

The average maximum concentration of sulfur dioxide over the period of 24 hours is 5.34 micrograms/cubic meter or counted for 1.78 percent of the standard (will occur in December) at coordinates 690000E and 757500N, in the Project area.

The average maximum concentration of sulfur dioxide over the period of one year is 0.82 micrograms/cubic meter or counted for 0.82 percent of the standard at coordinates 690000E and 757500N, in the Project area.

Average maximum concentrations at the monitoring stations over the period of one hour, 24 hours, and one year are 1.02, 0.063, and 0.00972 micrograms/cubic meter, respectively at the area of Moo 3 Ban Na Yum and Chana Chanupathum School which is also located in Moo 3 Ban Na Yum, with 200 households totally. For Chana Chanupathum School High School has a total of 700 students.

From the concentrations at ground level which are results from the mathematical model, when compared with the ambient standard in accordance with the Notification of National Environmental Board No.21 (B.E.2544) and No.24 (B.E.2547), it was found that the concentrations are met with the standard including the case of background concentration as showed in **Table 5.2.2-6**.

**(d) Nitrogen dioxide (NO<sub>2</sub>)**

The average maximum concentration of nitrogen dioxide over the period of one hour is 198.07 micrograms/cubic meter or counted for 61.90 percent of the standard (will occur in July) at coordinates 690000E and 757500N, in the Project area.

The average maximum concentration of nitrogen dioxide over the period of one year is 4.67 micrograms/cubic meter or counted for 8.19 percent of the standard at coordinates 690000E and 757500N, in the Project area.

Average maximum concentrations at the monitoring stations over the period of one hour one year are 6.22 and 0.0556 micrograms/cubic meter, respectively at the area of Moo 3 Ban Na Yum and Chana Chanupathum School which is also located in Moo 3 Ban Na Yum, with 200 households totally.

From the concentrations at ground level which are the results from the mathematical model, when compared with the ambient standard in accordance with the Notification of National Environmental Board No.33 (B.E.2552), it was found that the concentrations are met with the standard including the case of background concentration as showed in **Table 5.2.2-7**.

## **2) Scenario 2 : Forecasting air emission source of the project (including downwash)**

Results of the study are showed in **Table 5.2.2-8** to **Table 5.2.2-11** and can be described as follows:

### **(a) Total suspended particulate (TSP)**

The average maximum concentration of total suspended particulate over the period of 24 hours is 4.46 micrograms/cubic meter or counted for 1.35 percent of the standard (occurs in December) at coordinates 689700E and 757200N, agricultural area, 0.2-kilometer South of the Project.

The average maximum concentration of total suspended particulate over the period of one year is 1.40 micrograms/cubic meter or counted for 1.40 percent of the standard at coordinates 689700E and 757300N, agricultural area, 0.1-kilometer South of the Project.

Average maximum concentrations at the monitoring stations over the period of one hour one year are 3.08 and 0.70 micrograms/cubic meter, respectively at the area of Moo 3 Ban Na Yum and Chana Chanupathum School which is also located in Moo 3 Ban Na Yum, with 200 households totally.

From the concentrations at ground level which are the results from the mathematical model, when compared with the ambient standard in accordance with the Notification of National Environmental Board No.24 (B.E.2547), it was found that the concentrations are met with the standard including the case of background concentration as showed in **Table 5.2.2-8**.



**Table 5.2.2-8**

**The result of pollutant dispersion to ambient by mathematical model**

**Scenario 2 : Forecasting air emission source of the project (including downwash)**

Detail		Concentration (ug/m3)				
		TSP				
		Average 10 min <sup>1/2/</sup>	Average 1 hr <sup>1/</sup>	Average 24 hr		Average 1 year <sup>1/</sup>
		calculates from an average of 1 hr	Mathematical model	Mathematical model	Background <sup>3/</sup>	Mathematical model
Maximum		30.44	21.31	4.46	214.46	1.40
Maximum period		March	March	March	March	-
Coordinates		684000E, 763000N	684000E, 763000N	689700E, 757200N	689700E, 757200N	689700E, 757300N
Area		mountainous area	mountainous area	agricultural area	agricultural area	agricultural area
		8 kilometers Northwest of the Project	8 kilometers Northwest of the Project	0.2 kilometer South of the Project	0.2 kilometer South of the Project	0.1 kilometer South of the Project
<b><u>Receptor</u></b>						
1.	Roh Mah Mosque	6.94	4.86	0.77	210.77	0.19
2.	Chana Chanupathum School	21.07	14.75	3.08	213.08	0.70
3.	Ban Plug Phor Mosque	9.82	6.87	1.42	211.42	0.37
4.	Ban Rai Tha Mak	2.55	1.79	0.24	210.24	0.04
5.	Nuruch Chamchee Mosque	5.96	4.17	1.34	211.34	0.17
<b>Khu Sub-district</b>						
-	Moo 1 Ban Khu Tonpradu	4.97	3.48	0.42	210.42	0.07
-	Moo 2 Ban Phor Daeng	6.94	4.86	0.77	210.77	0.19
-	Moo 3 Ban Na Yum	21.07	14.75	3.08	213.08	0.70
-	Moo 4 Ban Khu Saksit	7.29	5.10	0.68	210.68	0.15
-	Moo 5 Ban Khu	5.44	3.81	0.46	210.46	0.08
-	Moo 6 Ban Tung	3.89	2.73	0.38	210.38	0.06
-	Moo 7 Ban Node	5.30	3.71	0.68	210.68	0.13
-	Moo 8 Ban Na Prue	5.68	3.97	0.41	210.41	0.06
-	Moo 9 Ban Plug Phor	9.82	6.87	1.42	211.42	0.37

Table 5.2.2-8 (cont'd)

Detail	Concentration (ug/m3)				
	TSP				
	Average 10 min <sup>1/2/</sup>	Average 1 hr <sup>1/</sup>	Average 24 hr		Average 1 year <sup>1/</sup>
	calculates from an average of 1 hr	Mathematical model	Mathematical model	Background <sup>3/</sup>	Mathematical model
<b>Paching Sub-district</b>					
- Moo 8 Ban Hua Din Nue	5.35	3.74	0.40	210.40	0.06
- Moo 9 Ban Hua Din Tai	5.23	3.66	0.40	210.40	0.05
<b>Sapan Mai Kaen Sub-district</b>					
- Moo 3 Ban Tha Lor	3.62	2.53	0.27	210.27	0.05
- Moo 5 Ban Sai Khao	3.07	2.15	0.16	210.16	0.02
- Moo 6 Ban Kasemrat	3.07	2.15	0.25	210.25	0.03
<b>Kae Sub-district</b>					
- Moo 1 Ban Khok Yang	5.92	4.15	0.37	210.37	0.06
- Moo 2 Ban Kae Nue	4.33	3.03	0.33	210.33	0.05
- Moo 3 Ban Kae Tai	4.63	3.24	0.34	210.34	0.05
- Moo 4 Ban Nead	5.37	3.76	0.32	210.32	0.05
<b>Tha Mor Sai Sub-district</b>					
- Moo 1 Ban Tha Mor Sai	3.63	2.54	0.19	210.19	0.03
- Moo 2 Ban Rai Tha Mak	2.55	1.79	0.24	210.24	0.04
- Moo 3 Ban Prong Ngu	2.75	1.93	0.18	210.18	0.03
- Moo 5 Ban Tung Che	3.28	2.30	0.16	210.16	0.02
- Moo 8 Ban Praew	5.96	4.17	1.34	211.34	0.17
- Moo 9 Ban Saphan Hak	2.13	1.49	0.16	210.16	0.02
- Moo 10 Ban Wang Han	3.98	2.79	0.43	210.43	0.06
<b>Na Wha Sub-district</b>					
- Moo 3 Ban Koh Tak Tai	5.06	3.54	0.32	210.32	0.04
- Moo 4 Ban Klong Bon	5.44	3.81	0.32	210.32	0.05
- Moo 5 Ban Pracha Nue	6.59	4.61	0.38	210.38	0.06
- Moo 6 Ban Pracha Tai	4.89	3.42	0.42	210.42	0.07
- Moo 7 Ban Na Nai	6.72	4.70	0.42	210.42	0.09

**Table 5.2.2-8 (cont'd)**

Detail		Concentration (ug/m3)				
		TSP				
		Average 10 min <sup>1/2/</sup>	Average 1 hr <sup>1/</sup>	Average 24 hr		Average 1 year <sup>1/</sup>
		calculates from an average of 1 hr	Mathematical model	Mathematical model	Background <sup>3/</sup>	Mathematical model
Khud Tad Whai Sub-district						
-	Moo 2 Ban Pa Lamai Klang	4.22	2.95	0.34	210.34	0.04
-	Moo 4 Ban Pa Lamai Nok	4.30	3.01	0.42	210.42	0.04
Ban Na Sub-district						
-	Moo 7 Ban La Nga	3.48	2.43	0.34	210.34	0.05
-	Moo 9 Ban Nam Khem	3.58	2.50	0.29	210.29	0.03
Standard <sup>4/</sup>		-	-	330		100
Remark :	<sup>1/</sup> Non include Background					
	<sup>2/</sup> Average 10 minutes = time period of soot blow (The soot blow assumption is twice a day for approximately ten minutes/set. There are 8 sets of soot blow which will be alternate work in the case of air pollution treatment system failure)					
	<sup>3/</sup> Include Background and used maximum concentration during 24 February - 2 March B.E. 2559 and 23-30 August B.E. 2559					
	<sup>4/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.24 (B.E. 2547)					
Source : Consultants of Technology Co., Ltd., B.E. 2559						

**Table 5.2.2-9**

**The result of pollutant dispersion to ambient by mathematical model**

**Scenario 2 : Prediction of air pollution sources of the Project (including of impacts from downwash phenomenon)**

Detail	Concentration (ug/m3)				
	PM-10				
	Averag 10 min <sup>1/2/</sup>	Averag 1 hr <sup>1/</sup>	Averag 24 hr		Averag 1 year <sup>1/</sup>
	calculates from an average of 1 hr	Mathematical model	Mathematical model	Background <sup>3/</sup>	Mathematical model
Maximum	17.65	12.36	2.59	45.59	0.81
Maximum period	March	March	March	March	-
Coordinates	684000E, 763000N	684000E, 763000N	689700E, 757200N	689700E, 757200N	689700E, 757300N
Area	mountainous area 8 kilometers Northwest of the Project	mountainous area 8 kilometers Northwest of the Project	agricultural area 0.2 kilometer South of the Project	agricultural area 0.2 kilometer South of the Project	agricultural area 0.1 kilometer South of the Project
<b><u>Receptor</u></b>					
1. Roh Mah Mosque	4.03	2.82	0.45	43.45	0.11
2. Chana Chanupathum School	12.22	8.55	1.78	44.78	0.41
3. Ban Plug Phor Mosque	5.70	3.99	0.83	43.83	0.21
4. Ban Rai Tha Mak	1.48	1.04	0.14	43.14	0.02
5. Nuruch Chamchee Mosque	3.45	2.42	0.78	43.78	0.10
<b><u>Khu Sub-district</u></b>					
- Moo 1 Ban Khu Tonpradu	2.88	2.02	0.24	43.24	0.04
- Moo 2 Ban Phor Daeng	4.03	2.82	0.45	43.45	0.11
- Moo 3 Ban Na Yum	12.22	8.55	1.78	44.78	0.41
- Moo 4 Ban Khu Saksit	4.23	2.96	0.40	43.40	0.09
- Moo 5 Ban Khu	3.15	2.21	0.27	43.27	0.05
- Moo 6 Ban Tung	2.26	1.58	0.22	43.22	0.03
- Moo 7 Ban Node	3.07	2.15	0.40	43.40	0.08
- Moo 8 Ban Na Prue	3.29	2.31	0.24	43.24	0.04
- Moo 9 Ban Plug Phor	5.70	3.99	0.83	43.83	0.21
<b>Standard<sup>4/</sup></b>	-	-	<b>120</b>		<b>50</b>
<b>Standard<sup>5/</sup></b>	-	-	<b>150</b>		<b>70</b>

Remark : The emission rate of PM-10 based on assumption of PM-10 is 0.58 (Mohd. Rashid Mohd, "Summary of PM-10 Monitoring at on site of Kaula Lumper; two years survey" Presented at Symposium on

Table 5.2.2-9 (cont'd)

Detail	Concentration (ug/m3)				
	PM-10				
	Averag 10 min <sup>1/2/</sup>	Averag 1 hr <sup>1/</sup>	Averag 24 hr		Averag 1 year <sup>1/</sup>
	calculates from an average of 1 hr	Mathematical model	Mathematical model	Background <sup>3/</sup>	Mathematical model
<b>Paching Sub-district</b>					
- Moo 8 Ban Hua Din Nue	3.10	2.17	0.23	43.23	0.03
- Moo 9 Ban Hua Din Tai	3.03	2.12	0.23	43.23	0.03
<b>Sapan Mai Kaen Sub-district</b>					
- Moo 3 Ban Tha Lor	2.10	1.47	0.16	43.16	0.03
- Moo 5 Ban Sai Khao	1.78	1.25	0.09	43.09	0.01
- Moo 6 Ban Kasemrat	1.78	1.25	0.15	43.15	0.02
<b>Kae Sub-district</b>					
- Moo 1 Ban Khok Yang	3.43	2.40	0.22	43.22	0.03
- Moo 2 Ban Kae Nue	2.51	1.76	0.19	43.19	0.03
- Moo 3 Ban Kae Tai	2.68	1.88	0.20	43.20	0.03
- Moo 4 Ban Nead	3.11	2.18	0.18	43.18	0.03
<b>Tha Mor Sai Sub-district</b>					
- Moo 1 Ban Tha Mor Sai	2.11	1.47	0.11	43.11	0.01
- Moo 2 Ban Rai Tha Mak	1.48	1.04	0.14	43.14	0.02
- Moo 3 Ban Prong Ngu	1.60	1.12	0.11	43.11	0.02
- Moo 5 Ban Tung Che	1.90	1.33	0.09	43.09	0.01
- Moo 8 Ban Praew	3.45	2.42	0.78	43.78	0.10
- Moo 9 Ban Saphan Hak	1.24	0.87	0.09	43.09	0.01
- Moo 10 Ban Wang Han	2.31	1.62	0.25	43.25	0.04
<b>Na Wha Sub-district</b>					
- Moo 3 Ban Koh Tak Tai	2.94	2.06	0.18	43.18	0.03
- Moo 4 Ban Klong Bon	3.16	2.21	0.18	43.18	0.03
- Moo 5 Ban Pracha Nue	3.82	2.68	0.22	43.22	0.04
- Moo 6 Ban Pracha Tai	2.84	1.99	0.24	43.24	0.04
- Moo 7 Ban Na Nai	3.90	2.73	0.24	43.24	0.05
<b>Standard<sup>4/</sup></b>	-	-	<b>120</b>		<b>50</b>
<b>Standard<sup>5/</sup></b>	-	-	<b>150</b>		<b>70</b>

**Remark :** The emission rate of PM-10 based on assumption of PM-10 is 0.58 (Mohd, Rashid Mohd, "Summary of PM-10 Monitoring at on site of Kaula Lumpur; two years survey" Presented at Symposiumon

**Table 5.2.2-9 (cont'd)**

Detail	Concentration (ug/m3)				
	PM-10				
	Averag 10 min <sup>1/2/</sup>	Averag 1 hr <sup>1/</sup>	Averag 24 hr		Averag 1 year <sup>1/</sup>
	calculates from an average of 1 hr	Mathematical model	Mathematical model	Background <sup>3/</sup>	Mathematical model
<b>Khud Tad Whai Sub-district</b>					
- Moo 2 Ban Pa Lamai Klang	2.45	1.71	0.20	43.20	0.02
- Moo 4 Ban Pa Lamai Nok	2.49	1.75	0.24	43.24	0.02
<b>Ban Na Sub-district</b>					
- Moo 7 Ban La Nga	2.02	1.41	0.20	43.20	0.03
- Moo 9 Ban Nam Khem	2.07	1.45	0.17	43.17	0.02
<b>Standard<sup>4/</sup></b>	-	-	<b>120</b>		<b>50</b>
<b>Standard<sup>5/</sup></b>	-	-	<b>150</b>		<b>70</b>

**Remark :** The emission rate of PM-10 based on assumption of PM-10 is 0.58 (Mohd. Rashid Mohd. "Summary of PM-10 Monitoring at on site of Kaula Lumpur; two years survey" Presented at Symposiumon

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<sup>1/</sup> Non include Background

<sup>2/</sup> Average 10 min = soot blow period (The soot blow assumption is twice a day for approximately ten minutes/set. There are 8 sets of soot blow which will be alternate work in the case of air pollution treatment system failure)

<sup>3/</sup> Include Background and used maximum concentration during 24 Febuary - 2 March B.E. 2559 and 23-30 August B.E. 2559

<sup>4/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.24 (B.E. 2547)

<sup>5/</sup> IFC EHS General Guidelines for Ambient Air Quality

**Source :** Consultants of Technology Co., Ltd., B.E. 2559

**Table 5.2.2-10**

**The result of pollutant dispersion to ambient by mathematical model**

**Scenario 2 : Forecasting air emission source of the project (including downwash)**

Detail	Concentration (ug/m3)				
	SO <sub>2</sub>				
	Average 1 hr		Average 24 hr		Average 1 year <sup>2/</sup>
	Mathematical model	Background <sup>1/</sup>	Mathematical model	Background <sup>1/</sup>	Mathematical model
Maximum	34.76	44.18	7.24	11.43	2.27
Maximum period	August	August	March	March	-
Coordinates	684000E, 763000N	684000E, 763000N	689700E, 757200N	689700E, 757200N	689700E, 757300N
Area	mountainous area 8 kilometers Northwest of the Project	mountainous area 8 kilometers Northwest of the Project	agricultural area 0.2 kilometer South of the Project	agricultural area 0.2 kilometer South of the Project	agricultural area 0.1 kilometer South of the Project
<b>Receptor</b>					
1. Roh Mah Mosque	7.93	17.35	1.25	5.44	0.31
2. Chana Chanupathum School	23.10	32.52	4.97	9.16	1.14
3. Ban Plug Phor Mosque	11.22	20.64	2.32	6.51	0.60
4. Ban Rai Tha Mak	2.92	12.34	0.39	4.58	0.06
5. Nuruch Chamchee Mosque	6.80	16.22	2.17	6.36	0.27
<b>Khu Sub-district</b>					
- Moo 1 Ban Khu Tonpradu	5.67	15.09	0.69	4.88	0.11
- Moo 2 Ban Phor Daeng	7.93	17.35	1.25	5.44	0.31
- Moo 3 Ban Na Yum	23.10	32.52	4.97	9.16	1.14
- Moo 4 Ban Khu Saksit	8.32	17.74	1.11	5.30	0.24
<b>Standard<sup>3/</sup></b>	<b>780</b>		<b>300</b>		<b>100</b>
<b>Standard<sup>3/</sup></b>	<b>-</b>		<b>125</b>		<b>-</b>

**Remark :** <sup>1/</sup> Include Background and used maximum concentration during 24 Febuary - 2 March B.E. 2559 and 23-30 August B.E. 2559

<sup>2/</sup> Non include Background

<sup>3/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.24 (B.E. 2547)

<sup>4/</sup> IFC EHS General Guidelines for Ambient Air Quality

**Source :** Consultants of Technology Co., Ltd., B.E. 2559

Table 5.2.2-10 (Cont'd)

Detail	Concentration (ug/m3)				
	SO <sub>2</sub>				
	Average 1 hr		Average 24 hr		Average 1 year <sup>2/</sup>
	Mathematical model	Background <sup>1/</sup>	Mathematical model	Background <sup>1/</sup>	Mathematical model
- Moo 5 Ban Khu	6.21	15.63	0.76	4.95	0.13
- Moo 6 Ban Tung	4.45	13.87	0.62	4.81	0.09
- Moo 7 Ban Node	6.05	15.47	1.11	5.30	0.21
- Moo 8 Ban Na Prue	6.48	15.90	0.68	4.87	0.10
- Moo 9 Ban Plug Phor	11.22	20.64	2.32	6.51	0.60
<b>Paching Sub-district</b>					
- Moo 8 Ban Hua Din Nue	6.11	15.53	0.65	4.84	0.09
- Moo 9 Ban Hua Din Tai	5.97	15.39	0.65	4.84	0.09
<b>Sapan Mai Kaen Sub-district</b>					
- Moo 3 Ban Tha Lor	4.13	13.55	0.44	4.63	0.08
- Moo 5 Ban Sai Khao	3.51	12.93	0.27	4.46	0.03
- Moo 6 Ban Kasemrat	3.51	12.93	0.41	4.60	0.06
<b>Kae Sub-district</b>					
- Moo 1 Ban Khok Yang	6.76	16.18	0.60	4.79	0.10
- Moo 2 Ban Kae Nue	4.95	14.37	0.54	4.73	0.08
- Moo 3 Ban Kae Tai	5.29	14.71	0.56	4.75	0.09
- Moo 4 Ban Nead	6.13	15.55	0.51	4.70	0.08
<b>Standard<sup>3/</sup></b>	<b>780</b>		<b>300</b>		<b>100</b>
<b>Standard<sup>3/</sup></b>	<b>-</b>		<b>125</b>		<b>-</b>

**Remark :** <sup>1/</sup> Include Background and used maximum concentration during 24 Febuary - 2 March B.E. 2559 and 23-30 August B.E. 2559

<sup>2/</sup> Non include Background

<sup>3/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.24 (B.E. 2547)

<sup>4/</sup> IFC EHS General Guidelines for Ambient Air Quality

**Source :** Consultants of Technology Co., Ltd., B.E. 2559



Table 5.2.2-10 (cont'd)

Detail	Concentration (ug/m3)				
	SO <sub>2</sub>				
	Average 1 hr		Average 24 hr		Average 1 year <sup>2/</sup>
	Mathematical model	Background <sup>1/</sup>	Mathematical model	Background <sup>1/</sup>	Mathematical model
<b>Tha Mor Sai Sub-district</b>					
- Moo 1 Ban Tha Mor Sai	4.15	13.57	0.30	4.49	0.04
- Moo 2 Ban Rai Tha Mak	2.92	12.34	0.39	4.58	0.06
- Moo 3 Ban Prong Ngu	3.14	12.56	0.30	4.49	0.05
- Moo 5 Ban Tung Che	3.75	13.17	0.26	4.45	0.03
- Moo 8 Ban Praew	6.80	16.22	2.17	6.36	0.27
- Moo 9 Ban Saphan Hak	2.44	11.86	0.26	4.45	0.03
- Moo 10 Ban Wang Han	4.55	13.97	0.69	4.88	0.10
<b>Na Wha Sub-district</b>					
- Moo 3 Ban Koh Tak Tai	5.78	15.20	0.52	4.71	0.07
- Moo 4 Ban Klong Bon	6.22	15.64	0.52	4.71	0.08
- Moo 5 Ban Pracha Nue	7.52	16.94	0.63	4.82	0.10
- Moo 6 Ban Pracha Tai	5.59	15.01	0.68	4.87	0.11
- Moo 7 Ban Na Nai	7.68	17.10	0.68	4.87	0.14
<b>Khud Tad Whai Sub-district</b>					
- Moo 2 Ban Pa Lamai Klang	4.82	14.24	0.56	4.75	0.06
- Moo 4 Ban Pa Lamai Nok	4.91	14.33	0.68	4.87	0.06
<b>Ban Na Sub-district</b>					
- Moo 7 Ban La Nga	3.97	13.39	0.56	4.75	0.07
- Moo 9 Ban Nam Khem	4.09	13.51	0.48	4.67	0.05
<b>Standard<sup>3/</sup></b>	<b>780</b>		<b>300</b>		<b>100</b>
<b>Standard<sup>3/</sup></b>	<b>-</b>		<b>125</b>		<b>-</b>

Remark : <sup>1/</sup> Include Background and used maximum concentration during 24 February - 2 March B.E. 2559 and 23-30 August B.E. 2559

<sup>2/</sup> Non include Background

<sup>3/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.24 (B.E. 2547)

<sup>4/</sup> IFC EHS General Guidelines for Ambient Air Quality

Source : Consultants of Technology Co., Ltd., B.E. 2559

Table 5.2.2-11

**The result of pollutant dispersion to ambient by mathematical model****Scenario 2 : Prediction of air pollution sources of the Project (including of impacts from downwash phenomenon)**

Detail		Concentration (ug/m3)		
		NO <sub>2</sub>		
		Average 1 hr		Average 1 year <sup>2/</sup>
		Mathematical model	Background <sup>1/</sup>	Mathematical model
Maximum		64.05	84.75	3.93
Maximum period		March	August	-
Coordinates		684000E, 763000N	684000E, 763000N	689700E, 757300N
Area		mountainous area	mountainous area	agricultural area
		8 kilometers Northwest of the Project	8 kilometers Northwest of the Project	0.1 kilometer South of the Project
<b>Receptor</b>				
1.	Roh Mah Mosque	14.61	35.31	0.54
2.	Chana Chanupathum School	42.56	63.26	1.97
3.	Ban Plug Phor Mosque	20.66	41.36	1.03
4.	Ban Rai Tha Mak	5.37	26.07	0.11
5.	Nuruch Chamchee Mosque	12.53	33.23	0.47
<b>Khu Sub-district</b>				
-	Moo 1 Ban Khu Tonpradu	10.45	31.15	0.20
-	Moo 2 Ban Phor Daeng	14.61	35.31	0.54
-	Moo 3 Ban Na Yum	42.56	63.26	1.97
-	Moo 4 Ban Khu Saksit	15.34	36.04	0.42
-	Moo 5 Ban Khu	11.44	32.14	0.22
-	Moo 6 Ban Tung	8.19	28.89	0.16
-	Moo 7 Ban Node	11.14	31.84	0.36
-	Moo 8 Ban Na Prue	11.95	32.65	0.17
-	Moo 9 Ban Plug Phor	20.66	41.36	1.03
<b>Paching Sub-district</b>				
-	Moo 8 Ban Hua Din Nue	11.25	31.95	0.16
-	Moo 9 Ban Hua Din Tai	11.00	31.70	0.15
<b>Sapan Mai Kaen Sub-district</b>				
-	Moo 3 Ban Tha Lor	7.61	28.31	0.13
-	Moo 5 Ban Sai Khao	6.47	27.17	0.05
-	Moo 6 Ban Kasemrat	6.47	27.17	0.10
<b>Kae Sub-district</b>				
-	Moo 1 Ban Khok Yang	12.46	33.16	0.17
-	Moo 2 Ban Kae Nue	9.11	29.81	0.15
-	Moo 3 Ban Kae Tai	9.74	30.44	0.15
-	Moo 4 Ban Nead	11.30	32.00	0.14
<b>Tha Mor Sai Sub-district</b>				
-	Moo 1 Ban Tha Mor Sai	7.64	28.34	0.07
-	Moo 2 Ban Rai Tha Mak	5.37	26.07	0.11
-	Moo 3 Ban Prong Ngu	5.79	26.49	0.08
-	Moo 5 Ban Tung Che	6.90	27.60	0.06
-	Moo 8 Ban Praew	12.53	33.23	0.47
-	Moo 9 Ban Saphan Hak	4.49	25.19	0.05
-	Moo 10 Ban Wang Han	8.38	29.08	0.17

Table 5.2.2-11 (cont'd)

Detail		Concentration (ug/m3)		
		NO <sub>2</sub>		
		Average 1 hr		Average 1 year <sup>2/</sup>
		Mathematical model	Background <sup>1/</sup>	Mathematical model
Na Wha Sub-district				
-	Moo 3 Ban Koh Tak Tai	10.65	31.35	0.12
-	Moo 4 Ban Klong Bon	11.46	32.16	0.13
-	Moo 5 Ban Pracha Nue	13.86	34.56	0.18
-	Moo 6 Ban Pracha Tai	10.29	30.99	0.19
-	Moo 7 Ban Na Nai	14.14	34.84	0.24
Khud Tad Whai Sub-district				
-	Moo 2 Ban Pa Lamai Klang	8.88	29.58	0.11
-	Moo 4 Ban Pa Lamai Nok	9.05	29.75	0.11
Ban Na Sub-district				
-	Moo 7 Ban La Nga	7.31	28.01	0.13
-	Moo 9 Ban Nam Khem	7.53	28.23	0.09
Standard <sup>3/</sup>		320		57
หมายเหตุ <sup>1/</sup>		Include Background and used maximum concentration during 24 Febuary - 2 March B.E. 2559 and 23-30 August B.E. 2559		
	<sup>2/</sup> Non include Background			
	<sup>3/</sup> The ambient standard in accordance with the Notification of National Environmental Board No.33 (B.E. 2552)			
Source: Consultants of Technology Co., Ltd., B.E. 2559				

Nevertheless, sootblow of the boiler will take approximately ten minutes/time/stack with the frequency of two times/stack/day. In the assessment of air pollution impact by including the sootblow into account, a limitation of AERMOD model is the limited duration of only one hour. Therefore, the Consultant assessed the impacts of total suspended particulate over the period of one hour and modified to ten minutes by using relation equation between the concentration of the pollutant and average time (Wark, K. and C. Warner, 1981. Air Pollution : Origin and Control, 2nd Edition, Harper Collins Publishers) as follows:

$$(C1/C2) = (t2/t1)^n$$

Where

C1 and C2 = Average concentration at time t1 and t2 (minute), respectively

n = Constant value of 0.17-0.20 (the Consultant used 0.20, due to the assessment for the worse case impacts

t1 and t2 = Period of time (minutes)

Results of the study are showed in **Table 5.2.2-8** and can be described as follows:

The average maximum concentration of total suspended particulate over the period of ten minutes is 30.44 micrograms/cubic meter (will occur in March) at coordinates 684000E and 763000N, mountainous area, eight kilometers Northwest of the Project.

The average maximum concentration of total suspended particulate over the period of one hour is 21.31 micrograms/cubic meter (will occur in March) at coordinates 684000E and 763000N, mountainous area, eight kilometers Northwest of the Project.

Average maximum concentrations at the monitoring stations over the period of ten minutes and one hour 21.01 and 14.75 micrograms/cubic meter, respectively at the area of Moo 3 Ban Na Yum and Chana Chanupathum School which is also located in Moo 3 Ban Na Yum, with 200 households totally.

**(b) Particulate matter with diameter of less than ten microns (PM<sub>10</sub>)**

The average maximum concentration of particulate matter with a diameter of less than ten microns over the period of 24 hours is 2.59 micrograms/cubic meter or counted for 2.16 percent of the standard (will occur in March) at coordinates 689700E and 757200N, agricultural area, 0.2 kilometer South of the Project.

The average maximum concentration of particulate matter with a diameter of less than ten microns over the period of one year is 1.40 micrograms/cubic meter or counted for 2.80 percent of the standard at coordinates 689700E and 757300N, agricultural area, 0.1 kilometer south of the Project.

Average maximum concentrations at the monitoring stations over the period of 24 hours are 1.78 and 0.41 micrograms/cubic meter, respectively at the area of Moo 3 Ban Na Yum and Chana Chanupathum School which is also located in Moo 3 Ban Na Yum, with 200 households totally.

From the concentrations at ground level which are results from the mathematical model, when compared with the ambient standard in accordance with the Notification of National Environmental Board No.24 (B.E.2547), it was found that the concentrations are met with the standard including the case of background concentration as showed in **Table 5.2.2-9**.

Nevertheless, sootblow of the boiler will take approximately ten minutes/time/stack with the frequency of two times/stack/day. In the assessment of air pollution impact by including the sootblow into account, a limitation of AERMOD model is the limited duration of only one hour. Therefore, the Consultant assessed the impacts of total suspended particulate over the period of one hour and modified to ten minutes by using the same concept with total suspended particulate, Results are presented in **Table 5.2.2-9** and can be described as follows:

The average maximum concentration of particulate matter with a diameter of less than ten microns over the period of 10 minutes is 17.65 micrograms/cubic meter (will occur in March) at coordinates 684000E and 763000N, mountainous area, eight kilometers northwest of the Project.

The average maximum concentration of particulate matter with a diameter of less than ten microns over the period of one hour is 12.36 micrograms/cubic meter (will occur in March) at coordinates 684000E and 763000N, mountainous area, eight kilometers northwest of the Project.

The average maximum concentration of particulate matter with a diameter of less than ten microns over the period of 10 minutes and one hour are 12.22 and 8.55 micrograms/cubic meter, respectively at the area of Moo 3 Ban Na Yum and Chana Chanupathum School which is also located in Moo 3 Ban Na Yum, with 200 households totally.

**(c) Sulfur dioxide (SO<sub>2</sub>)**

The average maximum concentration of sulfur dioxide over the period of one hour is 34.76 micrograms/cubic meter or counted for 4.46 percent of the standard (will occur in August) at coordinates 684000E and 763000N, mountainous area, eight kilometers Northwest of the Project.

The average maximum concentration of sulfur dioxide over the period of 24 hours is 7.24 micrograms/cubic meter or counted for 2.41 percent of the standard (will occur in March) at coordinates 689700E and 757200N, agricultural area, 0.2 kilometers South of the Project.

The average maximum concentration of sulfur dioxide over the period of one year is 2.27 micrograms/cubic meter or counted for 2.27 percent of the standard at coordinates 689700E and 757300N, agricultural area, 0.1 kilometers South of the Project.

Average maximum concentration of at the monitoring stations over the period of one hour, 24 hours, and one year are 23.10, 4.97, and 1.14 micrograms/cubic meter, respectively at the area of Moo 3 Ban Na Yum and Chana Chanupathum School which is also located in Moo 3 Ban Na Yum, with 200 households totally.

From the concentrations at ground level which are results from the mathematical model, when compared with the ambient standard in accordance with the Notification of National Environmental Board No.21 (B.E.2544) and No.24 (B.E.2547), it was found that, the concentrations are met with the standards including the case of background concentration as showed in **Table 5.2.2-10**.

**(d) Nitrogen oxide (NO<sub>2</sub>)**

The average maximum concentration of nitrogen dioxide over the period of one hour is 64.05 micrograms/cubic meter or counted for 20.02 percent of the standard (will occur in March) at coordinates 684000E and 763000N, mountainous area, eight kilometers Northwest of the Project.

The average maximum concentration of nitrogen dioxide over the period of one year is 3.93 micrograms/cubic meter or counted for 6.89 percent of the standard at coordinates 689700E and 757300N, agricultural area, 0.1 kilometer South of the Project.

The average maximum concentration of at the monitoring stations over the period of one hour and one year are 42.56 and 1.97 micrograms/cubic meter, respectively at the area of Moo 3 Ban Na Yum and Chana Chanupathum School which is also located in Moo 3 Ban Na Yum, with 200 households totally.

From the concentrations at ground level which are results from the mathematical model, when compared with the ambient standard in accordance with the Notification of National Environmental Board No.33 (B.E.2552), it was found that the concentrations are met with the standards including the case of background concentration as showed in **Table 5.2.2-11**.

**3) Scenario 3 : Forecasting air emission source of the project ( including downwash) by which air quality control equipment of the boiler (capacity 98 tone/hr) is not working**

The Consultant set the assumption that the air pollution treatment system of the 98 ton/hour boiler is failing which resulting in the concentration of particulate matter of 3,429 milligrams/ cubic meter. In case that the failure cannot be fixed, the Project will shutdown the boiler immediately to investigate and fix the problem. The Project will take five minutes to shutdown. However, the fuel will remain in the chamber for a certain period of time. The total time period until the combustion finish is approximately 30 minutes. Nevertheless, if the Project operation follows the measures, the situation will not occur.

For the assessment of air quality impacts from this scenario the Project modified the average concentrations of total suspended particulate (TSP) over the period of one hour to 30 minutes by using relationship equation between concentration of the pollutant and time which is same with the second scenario. The study results are showed in **Table 5.2.2-12** and can be described as follows:

**Table 5.2.2-12****The result of pollutant dispersion to ambient by mathematical model**

**Scenario 3 : Forecasting air emission source of the project (including downwash) by**  
**which air quality control equipment of the boiler (capacity 98 tone/hr) is not working**

Detail	Concentration (ug/m3)	
	TSP	
	Average 30 min	Average 1 hr
	calculates from an average of 1 hr	Mathematical model
Maximum	978.23	851.06
Maximum period	March	March
Coordinates	684000E, 763000N	684000E, 763000N
Area	mountainous area	mountainous area
	8 kilometers Northwest of the Project	8 kilometers Northwest of the Project
<b><u>Receptor</u></b>		
1. Roh Mah Mosque	223.16	194.15
2. Chana Chanupathum School	650.09	565.58
3. Ban Plug Phor Mosque	315.63	274.60
4. Ban Rai Tha Mak	82.07	71.40
5. Nuruch Chamchee Mosque	191.43	166.54
<b>Khu Sub-district</b>		
- Moo 1 Ban Khu Tonpradu	159.67	138.91
- Moo 2 Ban Phor Daeng	223.16	194.15
- Moo 3 Ban Na Yum	650.09	565.58
- Moo 4 Ban Khu Saksit	234.24	203.79
- Moo 5 Ban Khu	174.74	152.02
- Moo 6 Ban Tung	125.16	108.89
- Moo 7 Ban Node	170.18	148.06
- Moo 8 Ban Na Prue	182.48	158.76
- Moo 9 Ban Plug Phor	315.63	274.60
<b>Paching Sub-district</b>		
- Moo 8 Ban Hua Din Nue	171.81	149.48
- Moo 9 Ban Hua Din Tai	167.97	146.13
<b>Sapan Mai Kaen Sub-district</b>		
- Moo 3 Ban Tha Lor	116.21	101.10
- Moo 5 Ban Sai Khao	98.79	85.95
- Moo 6 Ban Kasemrat	98.78	85.94



**Table 5.2.2-12 (cont'd)**

Detail		Concentration (ug/m3)	
		TSP	
		Average 30 min	Average 1 hr
		calculates from an average of 1 hr	Mathematical model
Kae Sub-district			
-	Moo 1 Ban Khok Yang	190.32	165.58
-	Moo 2 Ban Kae Nue	139.16	121.07
-	Moo 3 Ban Kae Tai	148.75	129.42
-	Moo 4 Ban Nead	172.53	150.10
Tha Mor Sai Sub-district			
-	Moo 1 Ban Tha Mor Sai	116.75	101.57
-	Moo 2 Ban Rai Tha Mak	82.07	71.40
-	Moo 3 Ban Prong Ngu	88.50	76.99
-	Moo 5 Ban Tung Che	105.46	91.75
-	Moo 8 Ban Praew	191.43	166.54
-	Moo 9 Ban Saphan Hak	68.54	59.63
-	Moo 10 Ban Wang Han	127.99	111.35
Na Wha Sub-district			
-	Moo 3 Ban Koh Tak Tai	162.67	141.52
-	Moo 4 Ban Klong Bon	174.97	152.22
-	Moo 5 Ban Pracha Nue	211.75	184.22
-	Moo 6 Ban Pracha Tai	157.22	136.78
-	Moo 7 Ban Na Nai	215.99	187.91
Khud Tad Whai Sub-district			
-	Moo 2 Ban Pa Lamai Klang	135.64	118.01
-	Moo 4 Ban Pa Lamai Nok	138.17	120.21
Ban Na Sub-district			
-	Moo 7 Ban La Nga	111.68	97.16
-	Moo 9 Ban Nam Khem	114.96	100.02

Reamark : Average 30 minutes = time period of air pollution treatment system failure, the Project will shut down the boiler ,  
total time period until the combustion finish is approximately 30 minutes.

Source : Consultants of Technology Co., Ltd., B.E. 2559

The average maximum concentration of total suspended particulate over the period of 30 minutes is 978.23 micrograms/cubic meter at coordinates 684000 E and 763000N, mountainous area, eight kilometers northwest of the Project.

The average maximum concentration of total suspended particulate over the period of one hour is 851.06 micrograms/cubic meter (will occur in March) at coordinates 684000 E and 763000N, mountainous area, eight kilometers Northwest of the Project.

The average maximum concentration of at the monitoring stations over the period of 30 minutes and one hour are 650.09 and 565.58 micrograms/cubic meter, respectively at the area of Moo 3 Ban Na Yum and Chana Chanupathum School which is also located in Moo 3 Ban Na Yum, with 200 households totally.

Concentrations contour of all scenarios are showed in **Appendix 5-2**.

### **5.2.3 Impacts on water resources**

#### **(1) Construction period**

Wastewater discharged from construction period is mainly from water consumption of workers which is approximately 17 cu.m./day (calculated from 80% of consumption water) from 300 workers. The project will provide sufficient sanitary lavatories to those construction workers according to related laws with an installation of septic tank or instant wastewater treatment tank to treat wastewater discharged from worker consumption. The septic tank or instant wastewater treatment tank will be maintained to a proper condition for using over the construction period, and treating those wastewater according to the wastewater quality of building type Kor (Thai Alphabet) under the promulgation of the Ministry of Natural Resources and Environment about wastewater quality discharge from some building types, and sizes. Monitoring parameters for wastewater are pH, BOD, Suspended Solid (SS), Sulfide, Total Dissolved Solids (TDS), Settleable Solids, Oil and Grease, and TKN. Additional equipment for wastewater treatment system is an installation of water quality monitoring pond for wastewater to collect wastewater at least 1 day for quality monitoring before using the treated water as water spraying to construction site, and washing of truck wheels before entering and exiting the construction areas for dust dispersion reduction. Therefore, impact on public water sources is in low level.

#### **(2) Operation period**

### 1) Sources, quantity, and quality of wastewater

Wastewater management of the Project will be based on the characteristic of wastewater generated in operation period. In designing, the balance of water consumption and wastewater of the Project were considered. Wastewater consists of wastewater from consumption of workers, wastewater from production process and utility, contaminated rainwater/oil contaminated water, fuel yard runoff, and leachate from ash dumping pond (quantity of wastewater during operation period is the maximum quantity as showed in **Table 3.7.2-1**).

### 2) Wastewater treatment system for Wastewater from root washing, trucks cleaning, and fuel yard cleaning

Waste water from root and truck washing and wastewater from fuel yard washing. It will be collected in high BOD Equalization Pond (EQ pond) with a capacity of 260 cubic meters. Later, it will be treated in an upflow anaerobic filter tank follow by aeration tank.

Wastewater management diagram is shown in **Figure 3.7.2-4**. Location of the high-concentration wastewater treatment system is shown in **Figure 3.2.1-1** (No.23) and **Figure 3.4.2-5**.

Assumptions used in the design of the wastewater treatment system are as follows:

- Wastewater quantity	250	cubic meters/day
- Influent COD	300	milligrams/liter
- Effluent COD less than	120	milligrams/liter
- Influent BOD	80	milligrams/liter
- Effluent BOD less than	20	milligrams/liter

The wastewater will be collected to the EQ pond which able to retain for one day (260 cubic meters). Later, it will be sent to an upflow anaerobic filter tank. The dimension of the tank is six meters width, ten meters length, and three meters height. There is a media filter with a thickness of one meter and 2.6 meters height for water. The total water volume in the tank is 156 cubic meters. Microorganisms in the tank will digest organic materials resulting in reducing BOD concentration from 80 milligrams/liter to 32 milligrams/liter. After that, it will be sent to an aeration lagoon with a capacity of 217 cubic meters equip with an aerator with a capacity of 2.07 cubic meter/hour. After aerated, BOD concentration will be reduced to below 20 milligrams/liter. Then it will be sent to wastewater holding pond.

### **3) Wastewater Collection System**

Wastewater will be collected to wastewater holding pond with a capacity of 900 cubic meters. Later, it will be sent to an inspection tank where pH, temperature, and conductivity will be automatically measured. Treated wastewater will be discharged to the Nathawee Canal, unless water quality of those treated wastewater is not meeting the wastewater quality standard. Poor quality wastewater will be pumped to emergency pond (capacity of 900 cubic meters **Figure 3.7.2-7**) with a capacity to collect wastewater for 1 day to find a proper solution such as neutralized pH in the emergency pond, temperature adjustment, or resending those wastewater to fresh water reservoir for sedimentation and maintaining conductivity before reuse as recycling wastewater. In case of untreated wastewater over 1 day, the project will ask for wastewater treatment from authorized organizations.

During the dry season the water level in Nathawee Canal is shallow. The sewerage treatment may affect water resources. The project designed Waste Water Holding Pond paved with HDPE with a capacity of 58,820 cubic meters.

The effluent quality should meet the effluent standard in accordance with the Notification of Ministry of Industry No.2 (B.E.2539) issued under Factory Act B.E.2535 on the characteristic of effluent discharging out from factory. The Notification of Ministry of Natural Resources and Environment (B.E.2559) on standard of discharging of wastewater from factory, industrial estate, and industrial zone and the standard of discharging of wastewater in irrigation water body (an attachment of the Order the Royal Irrigation Department No.73/2554 on prevention of discharging wastewater into irrigation water body in irrigation area). The standard of Royal Irrigation Department limits the value of total dissolved solids (TDS) to be lower than the Notification of Ministry of Industry No.2 (B.E.2539). The discharging rate to Khlong Nathawee is 464.6 cubic meters/day.

The assessment of impacts on water resource was done by using a mathematical model, DO Sag Curve. In the assessment, mixing zone was considered in order to acquire complete mixing zone after discharging of wastewater to Nathawee Canal. The impact for BOD Mixing, DO Mixing, and DO Sag Curve of the Nathawee Canal is low and therefore can still be used for agricultural purpose.

### **4) Impacts on groundwater**

The Project's activities that possible to cause an impact on groundwater are wastewater treatment and reusing of wastewater for gardening.

(a) Impacts from wastewater treatment system: All of the wastewater generated from the Project's activities will be sent to the wastewater treatment system through wastewater collection system. The wastewater treatment system was designed to line with high-density polyethylene(HDPE). This is to prevent leakage of wastewater into groundwater and public water sources. Thus, the impact is in low level.

(b) Impacts on groundwater: From the study report and groundwater contour with a suggestion to install a groundwater monitoring well in the Project area by Associate Professor ChalongBuaphan (November 2016), it was found that the groundwater level in the study area is 30-104 meters depth. It is a confined aquifer within an aquitard that consists of rock, clay, and sand. The steady water level is between 3.00-7.31 meters with water quantity of 1.14-20.00 cubic meters/hour in which classified as an aquifer that provides less to very less water.

The survey of groundwater in the Project and surrounding area was done by selecting nine groundwater wells in the surrounding area as representatives. Groundwater contour and flow direction were prepared. The study found that the steady groundwater level is between 3.00-7.31 meters. The groundwater wells depths. are in the range of 27-104 meters. The flow direction is from the Project area to Noth as showed in **Figure 5.2.3-1** (enlarge image of the flow direction is showed in **Figure 5.2.3-2**). Groundwater quality is very good, it is fresh water with conductivity in the range of 80 – 160 micro cement/centimeter and pH in the range of 6.3-7.6. It can be used for household consumption and community water supply.

From the study results above which mentioned that the groundwater is a confined aquifer within rock, clay, and sand aquitard with the depth of 30 meters, considering that the Project will not dispose hazardous waste in the area and the wastewater treatment system is lined with HDPE or reinforced concrete, thus, impact on groundwater quality is in low level.

Moreover, the Project set groundwater impacts mitigation measures as follows:

a) Prevent the leaching of organic matter from water retention pond of the Project by lining with waterproof material;

b) Install five groundwater monitoring wells in the Project area and surrounding area comprise of a groundwater monitoring well in the Project area and four groundwater monitoring wells in the surrounding communities, two wells for upstream and two wells for downstream; and

c) Measure groundwater level and groundwater quality twice a year during rainy and dry seasons.

#### 5.2.4 Noise impact

The Consultant assessed noise impact from the Project. The two monitoring stations used in the assessment (sensitive area) are located near the Project; namely, Chana Chanupathum School located 318 meters from the noise generating source of the Project to the Northwest and the area of Moo 6 Ban Thung (first house) located 600 meters from the Project to the East. From the results of noise monitoring during 23 – 30 August 2016 that covered weekday and weekend as showed in **Table 5.2.4-1**. The results of noise impact assessment during construction and operation periods can be described as follows:

**Table 5.2.4-1**  
**Results of noise monitoring during 23-30 August 2016**

Monitoring station	Average sound level 24 hours (decibel (A))	Maximum sound level (decibel (A))
1. Chana Chanupathum School	49.9-53.9	52.2-87.4
2. The area of Moo 6 Ban Thung (first house)	51.1-54.3	52.8-101.4
Standard <sup>1/</sup>	70.0	115.0
Standard <sup>2/</sup>	55/45	-

**Remarks:**<sup>1/</sup> Notification of the National Environmental Board No.15 (B.E.2540) on ambient sound level

<sup>2/</sup> IFC EHS General EHS Guidelines: One Hour Laeq for Daytime (7:00-22:00) = 55 dB(A)  
and for Nighttime (22:00-7:00) = 45 dB(A)

**Source:** Measured by United Analyst and Engineering Consultant Company Limited, 2016

### (1) Construction period

Land clearing and leveling are needed in the construction of the Project. Thus, these activities will cause noise as follows:

Activity	Sound level (decibel (A))	Distance (meter)
Land preparation	84	15
Drilling and foundation work	88	15
Structural work	79	15
Decorative work	84	15

Source: US. EPA, 1972

Noise impact assessment during the construction period of the Project was done based on work hours of 08.00-17.00 o'clock. Normally, construction activities will not be done at the same time. Thus, the Consultant selected the activity that will cause the highest sound level which is drilling and foundation work at the distance of 15 meters of 88 decibel (A) to represent the worst case situation in noise impact assessment. By assessing the worst case scenario of foundation work, the sound equation (equation (1)), it was found that sound level at source is 88 decibel (A) at the distance of 15 meters.

$$L_{p_{Total}} = 10 \log (10^{L_{p1}/10} + \dots 10^{L_{pn}/10}) \dots\dots\dots (1)$$

Where  $L_{p1}$  = Sound level from source 1

$L_{pn}$  = Sound level from source n

### 1) Weighted equivalent sound level over 24 hours

The assessment of sound level from the Project that is reduced over distance at two receptors was done using the reducing equation (equation (2))

$$L_{p2} = L_{p1} - 20 \log R_2/R_1 \dots\dots\dots (2)$$

Where;  $L_{p1}$  = Sound level from the construction at distance of 15 meters

$L_{p2}$  = Sound level at a certain distance, decibel (A)

$R_1$  = Distance between sources, 15 meters

$R_2$  = Distance between source and receptor (meter)

The results of the calculation of sound level that is reduced over distance to the receptors; Chana Chanupathum School located 318 meters Northwest of the Project and the area of Moo 6 Ban Thung (the first house) located 600 meters East of the Project to the East, found that, sound levels at the receptors are 61.47 and 55.96 decibel (A), respectively.

The assessment of total sound at Chana Chanupathum School and the area of Moo 6 Ban Thung (the first house) considering the existing sound levels are 53.9 decibel (A) and 54.3 decibel (A), respectively. The sound levels from the Project at the receptors; Chana Chanupathum School and the area of Moo 6 Ban Thung (the first house), are 61.47 and 55.95 decibel (A), respectively. According to the total sound equation (equation (1)), it was found that during the construction period, ambient noise levels at Chana Chanupathum School and the area of Moo 6 Ban Thung (the first house) are 62.17 decibel (A) and 58.22 decibel (A), respectively. The sound levels remain the same and met the standard in accordance with the Notification of the National Environmental Board No. 15 (B.E.2540) on the standard of ambient sound level which states that ambient sound level must not higher than 70 decibel (A). Thus, the impact is in low level.

## **2) Disturbance sound level**

Calculation of disturbance sound level was done in accordance with the guideline of Pollution Control Department and was complied with two notifications; the Notification of the National Environmental Board No.29 (B.E.2550) on disturbance sound and the Notification of the Pollution Control Committee on measuring of background noise and disturbance noise and recording of disturbance noise issued under the Royal Thai Government Gazette Vol.124 Section 145 Ngor dated 28 September 2007. The assessment was done to comply with the Project's construction activities during daytime (08.00-17.00 o'clock). The Leq-1hr from the monitoring results during 23-30 August 2016 were used in the assessment. Details are as follows:

(a) Calculated sound levels from the construction activity of the Project at Chana Chanupathum School and the area of Moo 6 Ban Thung (the first house) is reduced by distance;

(b) Calculated total sound levels at Chana Chnupathum School and the area of Moo 6 Ban Thung (the first house) that received from the activity of the Project together with measured weighted equivalent sound level over one hour (Leq-1hr) at Chana Chnupathum School and the area of Moo 6 Ban Thung (the first house) (the sound levels measured are without disturbance).

(c) Deducted the calculated sound levels (b) by the measured weighted equivalent sound level over one hour (Leq-1hr)



(d) Used the difference calculated from (c) to acquire the factor in according the standard as following:

**Table 5.2.4-2**  
**Sound factor table**

Difference of sound levels (decibel (A))	Sound factor (decibel (A))
1.4 or lower	7.0
1.5 -2.4	4.5
2.5 -3.4	3.0
3.5 -4.4	2.0
4.5 -5.4	1.5
6.5 -7.4	1.0
7.5 -12.4	0.5
12.5 or higher	0

(e) Calculated disturbance sound by deducting the calculated result in (b) with the factor in (d)

(f) Calculated disturbance sound levels by deducting disturbance sound in (e) with background sound over one hour period ( $L_{90}$  1 hr)

Calculation of the noise level from the construction period of the Project during 08.00-17.00 o'clock at Chana Chanupathum School and the area of Moo 6 Ban Thung (the first house). Noise impact to Chana Chanupathum School will be evaluated based on the actual construction activity, which typically involves the installation of temporary moving sound barriers in the project area. It is a thick stainless steel fence of 1.27 mm (18 ga) steel, a height of 3 meters, leaving a distance or gap of about 10 meters to provide sufficient and convenient operation. The steel noise barrier will have a Transmission Loss (TL) of 25 decibels (A) (**Table 5.2.4-3**). This can reduce the attenuation capacity by 2 decibels (A) (**Table 5.2.4-4**). Therefore, the wall can attenuate the sound by 23 decibels (A)).

**Table 5.2.4-3****Noise Barrier**

Material	Thickness	Surface Density	Transmission Loss (TL)*
	(mm)	(kg/m <sup>2</sup> )	(dB)
Polycarbonate	8-12	10-14	30-33
Acrylic [Poly-Methyl-Meta- Acrylate (PMMA)]	15	18	32
Concrete Block 200x200x400 light weight	200	151	34
Dense concrete	100	244	40
Light concrete	150	244	39
Light concrete	100	161	36
Brick	150	288	40
Steel, 18 ga	1.27	9.8	25
Steel, 20 ga	0.95	7.3	22
Steel, 22 ga	0.79	6.1	20
Steel, 24 ga	0.64	4.9	18
Aluminium Sheet	1.59	4.4	23
Aluminium Sheet	3.18	8.8	25
Aluminium Sheet	6.35	17.1	27
Wood	25	18	21
Plywood	13	8.3	20
Plywood	25	16.1	23
Absorptive panels with polyester film backed by metal sheet	50-125	20-30	30-47
<u>Remark</u> : * Values assuming no openings or gaps in the barriers			
<u>Source</u> : Noise Barrier Design Handbook. Federal Highway Administration (FHWA), 2000			

**Table 5.2.4-4****Transmission Loss**

% area Occupied by leaks	<b>Transmission Loss without leaks at 500 Hz</b>			
	<b>10dB*</b>	<b>15dB*</b>	<b>20dB*</b>	<b>25dB*</b>
	↓ reduction in transmission loss, dB ↓			
50	10+	15+	20+	25+
25	10	15	20	25
13	8	12	17	22
6	5	10	14	19
3	4	7	11	16
1.5	2	5	9	13
0.78	1	3	6	10
0.39	1	2	4	8
0.2	0	1	3	5
0.1	0	1	1	4
0.05	0	0	1	2
<b>Remark :</b> * Required transmission loss for the proposed barriers				
<b>Source :</b> Guidelines on Design of Noise Barriers. Environmental Protection. Highway Department. Government of the Hong Kong SAR, 2003				

From the assessment of disturbance noise at Chana Chanupathum School and the area of Moo 6 Ban Thung (the first house) during construction period are 0.0-1.6 decibel (A) and 4.8-8.2 decibel (A), respectively. It was found that majority of sound levels met the standard in accordance with the Notification of the National Environmental Board No.29 (B.E.2550) on disturbance noise. Thus, the noise impact arises from the construction activities of the Project to the communities is in low level.

However, the Project set preventive measures for the construction period as follows:

- No construction activities that cause loud sound after 17.00 o'clock to 08.00 o'clock of the next day to reduce impacts on the communities during this period;
- Use construction tools and equipment that will not create loud sound and maintain good conditions all the times to reduce sound;
- Provide safety sign boards to wear personal protective equipment in loud sound area in accordance with risky zone specified by the safety officer; and
- The Project shall provide officers to participate with the adjacent communities in which affected from the noise from construction activity in order to find way to reduce the impact.

## **(2) Operation period**

### **1) Sound levels generated from the Project**

<b>Sources</b>	<b>Set</b>	<b>Sound level at distance of one meter (Decible (A))</b>
Boiler 98 ton/hr	1	85
power generator with a capacity of 25 MW	1	85
cooling tower	1	91
Grinder	2	85
Pre-Shredder	2	85
<b>Total</b>		<b>94.99</b>

### **3) Weighted equivalent sound level over 24 hours (Leq-24 hr)**

The assessment of noise impact at the receptors in the case of 24 hours' operation continuously was done as following steps:

Estimate sound levels from the Project that are reduced by distance to the receptors by using equation (2).

The assessment of sound levels that are reduced by berm for flood protection and distance found that the sound levels at Chana Chanupathum School and the area of Moo 6 Ban Thung (the first house) are 39.94 and 34.43 decibel (A), respectively.

The assessment of total sound levels at Chana Chanupathum School and the area of Moo 6 Ban Thung (the first house) which are representatives of sound levels wherein the communities will be exposed found that the maximum existing sound levels are 53.9 decibel (A) and 54.3 decibel (A), respectively. The inclusion of reduced sound levels by the distance from the Project during operation period at the receptors found that sound levels at Chana Chanupathum School and the area of Moo 6 Ban Thung (the first house) are 54.07 decibel (A) and 54.34 decibel (A), respectively. It can be seen that the sound levels are almost the same with the existing condition and met the standard in accordance with the Notification of the National Environmental Board No.15 B.E.2540 on ambient sound level states that sound level must not be higher than 70 decibel (A). To comply with WB IFC EHS Standard for Noise of LAeq 70 dbA at site boundary mitigation measures will be undertaken. Thus, the impact is in low level.

#### **4) Disturbance sound level**

The Consultant considered disturbance noise in accordance with the Notification of the National Environmental Board. The assessment was done in according to the guideline of Pollution Control Department on measuring of background noise B.E.2550 and complied with the Project's operation. It can be summarized as follows:

(a) Measured background sound levels at the monitoring stations for seven days continuously. The data required in this assessment consist of results of sound monitoring over one hour period in daytime (06.00 – 22.00 o'clock) and results of sound monitoring over five minutes period in night time (22.00 – 06.00 o'clock).

(b) Estimate total sound levels at receptors by the following steps:

- Calculate reduced sound levels by distance at the receptors by using equation (2)

- Calculate total sound levels by adding reduced sound levels generated from the Project to the monitored weighted equivalent sound level over 24 hours at the receptors by using equation (1)

(c) Calculate the difference of sound levels by subtracting measured sound levels from total sound levels and compare with the modification factors, after that, subtracting the modified factors from total sound levels during the Project activity to get disturbance sound levels

(d) Modify factors in the case of the following:

Plus three decibels (A) for an area that requires tranquility and for a nighttime

(e) Assess disturbance levels from the following equation

*Disturbance level = Sound level while disturbed – Background sound level*

$L_{90}$

From the assessment of disturbance noise at Chana Chanupathum School and the area of Moo 6 Ban Thung (the first house) during operation period, it was found that majority of sound levels met the standards in accordance with the Notification of the National Environmental Board No.29 (B.E.2550) on disturbance noise except if the case that the measured sound levels before development of the Project were already high. Thus, the impact on disturbance noise from construction activities of the Project on the communities is in low level.

However, the Project set measures to prevent the impacts during operation period as follows:

(a) Provide cover material for source of sound in accordance with engineering principle and maintain systemically to reduce sound level.

(b) Provide noise contour that covers the whole area of the factory within the period of one year and revises every three years as well as review it periodically especially when installing machinery or equipment that create noise. The noise contour will be utilized in controlling and solving problems of the noise source and to specify areas that have loud noise or exceed the standard. Due to the areas with loud noise have a high risk of hearing loss of the workers, warning sign board will be provided to warn the workers to wear personal protective equipment.

- (c) Provide a control room to operate the machinery and can prevent loud noise
- (d) Provide a suitable restroom that can prevent loud noise for the workers to rest.
- (e) Working continuously for eight hours must expose to noise below 85 decibels (A).
- (f) Provide signboard or warning sign for the area with higher than 85 decibels (A) noise and provide a hearing conservation project with annual evaluation, in case that the project is not success, review the operation to reduce impacts on the workers.
- (g) Provide personal protective equipment or ear muffs for the workers, in case that a worker do not wear them for three times, make an official notification.
- (h) Provide officers to participate with the adjacent communities that affected from the noise from the Project periodically to find impact reduction approach.
- (i) Notify the communities about time period before starting to operate after machinery repair.

Therefore, noise impacts during construction and operation periods of the Project to the communities are in low level.

### **5.3 Biological resources**

#### **5.3.1 Impacts on terrestrial biological resources**

Songkhla has 41 national forests. Within Amphoe Chana, there are 3 national forests, Kuan Cham Sil, Kuan Lang and Kuan Hin Phao Forests. The distance of Kuan Jumsin Forest from the project site is approximately 8 Km. The distance of Kuan Lung Forest from the project site is approximately 7.5 Km. The distance of Kuan Hinpao Forest from the project site is approximately 9 Km.

(1) Kuan Jumsin Forest was declared as the conserved national forest since B.E. 2505. The forest covers SapanMaikan subdistrict of Chana, Songkhla which is occupy an area of 2.30 sq.km. or 1,437.50 Rai,

(2) Kuan Lung Forest was declared as the conserved national forest since B.E. 2502. The forest covers SapanMaikan subdistrict of Chana, Songkhla which is occupy an area of 220.0 sq.km. or 137,500 Rai, and

(3) Kuan Hinpao Forest was declared as the conserved national forest since B.E. 2511. The forest covers SapanMaikan and Tamorsai subdistricts of Chana, Chang and Nathawi subdistricts of Nathawi, and Wangyai subdistrict of Thepa, Songkhla which is occupy an area of 35.75 sq.km. or 2,250 Rai.

The majority of the Project area and adjacent areas have been utilized for agricultural purposes. Forest areas are less. From the survey, it was found that there are small forests on mountains which are not suitable for rubber plant cultivation (the main economic plant) while the surrounding areas have been transformed to rubber plants field. As a result, rare wildlife was not found. Moreover, there is no forest area in accordance with the Notification of National Reserved Forests Area near the Project. The nearest forest area to the Project is a forest on a red mountain about two kilometers from the Project which is already deteriorated. Thus, the impact on terrestrial biological resources is in low level.

### **5.3.2 Impacts on aquatic biological resources**

#### **(1) Construction period**

In the construction, transport of heavy machinery to the construction are is required. Land preparation and drilling will generate dust and it will be leached into water sources and block sunlight in which will have an impact on photosynthesis of plankton. However, the Project will construct a dike surrounding the Project area to prevent and reduce leaching of sediment into water sources in the adjacent area. Thus, the impact on aquatic biological resources is in low level.

Most of the wastewater that will be generated during construction period is from toilets. It will be treated by a septic-anaerobic filtration system and aerated before reuse. Nevertheless, the Project will follow the Ministerial Regulation (Ministry of Labor) on welfare in the workplace B.E. 2548 and Ministerial Regulation (Ministry of Interior) No.63 (B.E.2551) issued under the Building Act B.E.2522. By considering the criteria that toilets must be located at least 30 meters from a water body, it was found that the toilets are located far from Khong Nathawee which is more than 300 meters, thus, no impact on Khlong Nathawee. For wastewater from two construction activities with the total quantity of 18 cubic meters/day, the Project will provide a settling pond with a capacity of 20 cubic meters to receive wastewater from construction activities. After that, it will be sent to a retention pond with a capacity of 20 cubic meters or can retain wastewater for one day for purpose of wastewater quality monitoring. The parameters are pH, temperature, BOD, COD, TDS, oil & grease, and TKN. The monitoring frequency is once a month. The treated wastewater will be reused to spray on construction



area and entrance-exit road to reduce dispersion of dust. The monitoring of wastewater will be done once a month. Therefore, impact on aquatic biological resources is in low level.

## **(2) Operation period**

The effluent quality should meet with the effluent standard in accordance with the Notification of Ministry of Industry No.2 (B.E.2539) issued under Factory Act B.E.2535 on characteristic of effluent discharging out from the factory. The Notification of Ministry of Natural Resources and Environment (B.E.2559) on standard of discharging of wastewater from factory, industrial estate, and industrial zone and the standard of discharging of wastewater in irrigation water body (an attachment of the Order the Royal Irrigation Department No.73/2554 on prevention of discharging wastewater into irrigation water body in irrigation area) The standard of Royal Irrigation Department limits the value of total dissolved solids (TDS) to be lower than the Notification of Ministry of Industry No.2 (B.E.2539). The discharging rate to Nathawee canal is 464.6 cubic meters/day.

The assessment of impacts on water resource was done by using a mathematical model, DO Sag Curve. In the assessment, mixing zone was considered in order to acquire complete mixing zone after discharging of wastewater to Nathawee canal. For DO Sag Curve, the worse case flow rate was used in the assessment, it was found that the discharging of wastewater into Khlong Nathawee of 749.40 cubic meter/day (or 0.009 cubic meter/second) will not lower DO concentration of Khlong Nathawee. The concentration of DO at the mixing zone is 4.66 milligrams/liter in which remains the same as before receiving wastewater from the Project. Thus, impact on water quality is in low level.

Thus, it can be concluded that the impact of the Project on biological resources in Khlong Nathawee is in low level.

### **5.3.3 Greenhouse gas (GHG) assessment**

Electrical Power Generation	25	MWe
Plant Availability	92	%
Annual Power Producer	201,480,000.00	kW.Hr per year
	725,328,000,000.00	kJ per year
Typical Biomass Plant Efficiency	0.25	
Biomass Moisture Content	40.00	%
LHV	9,900.00	kJ/kg
Required Biomass Fuel	293,061,818.18	kgs per year
	293,061.82	Tons per year
	802.91	Tons per day

C-Component	22.00	% by weight (as fire basis)
Tons of C per Year	64,473.60	Tons C per year
C to CO2 generation ratio (44/12)	3.667	weight/weight
CO2 generation from power plant	<b>236,403.20</b>	Tons CO2 per year
	1,173.33	g / kW.Hr per year
CO2 reduction from biomass production	890.00	g / kW.Hr per year
Total CO2 emission	283.33	g / kW.Hr per year

Reference: Coal versus biomass electricity generation-comparing environmental implications using life cycle assessment, National Renewable Energy Laboratory

## 5.4 Impacts on human use value

### 5.4.1 Impacts on land use

#### (1) Compliance with laws especially set back that affect the communities

According to Ministerial Regulation No.2 (B.E.2535) issued under the Factory Act B.E.2535, Chana Green Power Plan is categorized into a factory type 3 (a factory with total horsepower of higher than 50 HP and/or have more than 50 workers or a factory that generates pollution in which an approval is required prior establishing). Factories in this category cannot be constructed in the following areas:

1) *Residential housing, condominium, and townhouse*

2) *Within 100 meters from the border of public places i.e., school or academic institute, temple or religious place, hospital, archaeological site, and office of government agency as well as natural and environmental conservation area in which defined by the cabinet*

Upon checking the Project location and its surrounding area, it was found that the nearest public place is the Chana Chanupathum School. The distance between the school to the Project fence line is 136 meters (**Figure 5.4.1-1**). Thus, it complies with the Ministerial Regulation No.2 (B.E.2535) Section 1 in terms of location, environment, building characteristic, and interior.

#### (2) Compliance with town planning requirements

According to the Ministerial Regulation, Songkhla town planning B.E.2559 announced in the government gazette Vol.134 Section 4 Kor dated 13 January 2017, the Project area located in Khu Sub-district, Chana District, Songkhla Province is in rural and agricultural land area. However, the Project which is a power plant generating heat energy is not a type of factory that is prohibited in the area. Thus, the Project location complies with the Ministerial Regulation.

## **5.4.2 Impacts on transportation**

### **(1) Transport route**

#### **1) Fuel transport route**

Fuel used in the Project is rubber wood residue from wood processing such as branches and roots. The rubber wood will be transported by conveyor to the combustion chamber of the boiler. In case that the rubber wood is more than the requirement, it will be stored in the fuel yard in the Project.

#### **2) Ash transport route**

The Project will use Highway No.408 to transport ash out of the Project by covering the trucks to prevent dispersion of dust. Ash will be sent to be used as soil conditioning by mixing with other materials. It will be done with an approval from the Department of Industrial Works.

#### **3) Rubber wood transport route**

The Highway No.408 is the main route to transport fuel to the Project. The Project will arrange to prevent accumulating of trucks and will not transport during rush hours in

**Figure 5.4.1-1 The Distance of the Ministerial Notification no.2 (B.E.2535) Issue under the Factory Act B.E. 2535 \_**

both morning and evening. At the Project, trucks will be weighted before and after dumping of biofuel to the fuel yard immediately.

#### **4) Chemical transport route**

Types and quantities of chemicals to be used in the project are presented in **Table 3.3.3-1**. They consist of chemicals for water treatment and boiler system and cooling tower. Chemicals will be supplied by local suppliers. Transportation will be done by using Highway No.408 as the main transportation route.

### **(2) Density of traffic on the main route**

The assessment of traffic impact was done based on the following assumptions:

#### **1) Construction period**

##### **(a) Traffic volume of the Project**

- Medium bus for transportation of workers of 10 bus/day or 15 PCU/day
- Heavy truck for transportation of construction materials of 10trucks/day or 25 PCU/day

During construction period, the traffic volume of the Project is 40 PCU/day or 5 PCU/hour (based on 8 hours)

##### **(b) Other**

The traffic volume of Highway No. 43 km 29+617 (Na Mom – Chana) from Bureau of Highway Safety, Department of Highways was used.

#### **2) Operation period**

##### **(a) Traffic volume of the Project**

- Cars of the Project workers of 21 cars/day or 21 PCU/day and motorcycles of 44 motorcycles/day or 14.65 PCU/day
- 10 wheels trucks for rubberwood transport of 50 trucks/day or 125 PCU/day
- 6 wheels trucks for chemicals transport of 9 truck/2 months (0.15 truck/day) or 0.32 PCU/day

- 10 wheels trucks for waste transport of 1 truck/day or 2.5 PCU/day
- 10 wheels trucks for ash transport of 1 truck/day or 2.5 PCU/day

During operation period, the traffic volume of the Project is 165.97 PCU/day or 6.92 PCU/hour (based on 24 hours)

#### (b) Other

The traffic volume of Highway No. 43 km 29+617 (Na Mom – Chana) from Bureau of Highway Safety, Department of Highways was used together with data of traffic volume surveyed by the Consultant (surveyed at Highway No.43 and Highway No.408 as showed in **Figure 5.4.2-1**).

The Consultant assessed the traffic density by using Volume-to-Capacity Ratio (V/C) of the main route which is Highway No. 43 km 29+617 (Na Mom – Chana) that relates to the Project under the following conditions:

1) Modify traffic volume of each type of vehicle into the same unit, Passenger Car Unit (PCU). It was done by applying factors of Passenger Car Equivalents (PCEs) (Traffic Congestion Index and Density Analysis Report 2015, Bureau of Highway Safety, Department of Highways, April, 2016) as follows:

- Car $\leq 7$ person	=	1	PCU
- Car $> 7$ person	=	1	PCU
- Light bus	=	1.5	PCU
- Medium bus	=	1.5	PCU
- Heavy bus	=	2.1	PCU
- Light truck	=	1	PCU
- Medium truck	=	2.1	PCU
- Heavy truck	=	2.5	PCU
- Full trailer	=	2.5	PCU
- Semi trailer	=	2.5	PCU
- Motorcycle	=	0.333	PCU

2) The capacity of highway (C) from Traffic Congestion Index and Density Analysis Report 2015, Bureau of Highway Safety, Department of Highways, April 2016 was used. Details of the capacity calculation are as follows:

**Case of highway with 2 traffic lanes**

$$C = 2,500 \times RL \times RC \times RN \times RI \times RJ$$

**Case of highway with more than 2 traffic lanes**

$$C = 2,200 \times RL \times RC \times RN \times RI \times RJ \times N$$

Where

C = Highway capacity

N = Number of traffic lane

RL = Correction rate of highway capacity by lane width

= 1.00 when lane width (WL)  $\geq$  3.25 meters

=  $0.24 \times WL + 0.27$  when WL < 3.25 meters

RC = Correction rate of highway capacity by lateral clearance

= 1.00 when lateral clearance (WC)  $\geq$  0.75 meter

=  $0.18 \times WC + 0.86$  when WC < 0.75 meter

RN = Correction rate of highway capacity by mixed with two-wheel vehicle

=  $100 / (100 + 0.75 \times Mc)$  ; Mc = percentage of 2-wheel vehicle

RI = Correction rate of highway capacity by roadside situation

= 0.90 for outside city

= 0.70 For Bangkok and vicinity

RJ = Correction rate of highway capacity by percentage of heavy vehicle

=  $1 / ((1 - HV/100) \times 1 + (HV/100 \times 2))$  ; HV = Percentage of heavy vehicle

The assessment of highway capacity (C) of the Project was done for Highway No. 43 (Na Mom – Chana) with 4 lanes and Highway No. 408 with 2 lanes.

3) Calculate volume-to-capacity (V/C) ratio

4) The travel time on the route is 24 hours

5) Calculate PCU of Highway No.43 km 29+617 (Na Mom – Chana) as showed in **Table 5.4.2-1** and Highway No.43 (km 28+800) as showed in **Table 5.4.2-2** and **Table 5.4.2-3** and the entrance to the Project (Highway No.408) as showed in **Table 5.4.2-4** and **Table 5.4.2-5**.

6) The assessment of traffic volume in the future used the statistic of transport volume on highways in 2015 (Traffic Congestion Index and Density Analysis Report 2015, Bureau of Highway Safety, Department of Highways, April 2016). The Highway No. 43 (Na Mom – Chana) is a secondary highway with the annual increasing rate of 4.781 percent. The entrance to the Project (Highway No.408) is likened to provincial road with the annual increasing rate of 4.778 percent.

Compared Volume Capacity Ratio (V/C) with the Traffic Congestion Index and Density Analysis Report 2015, Bureau of Highway Safety, Department of Highways, April 2016 as follows:

Level of service	Description	V/C
<b>A</b>	Free-flow conditions with unimpeded maneuverability. Stopped delay at signalized intersection is minimal.	0.00-0.60
<b>B</b>	Reasonable unimpeded operations with slightly restricted maneuverability. Stopped delays are not bothersome.	0.61-0.70
<b>C</b>	Stable operations with somewhat more restrictions in making mid-block lane changes.	0.71-0.80
<b>D</b>	Approaching unstable operations where small increases in volume produce a substantial increase in delay and decreases in speed.	0.81-0.90
<b>E</b>	Operations with significant intersection approach delays and low average speeds.	0.91-1.00
<b>F</b>	Operations with extremely low speed.	> 1.00

Source: Transportation Research Board, Highway Capacity Manual, Special Report 209 (Washington, D.C. 1994).

**- Level of Service A**

The level of service A that is free flow. Traffic flows at or above the posted speed limit and motorists have complete mobility between lanes. The average spacing between



**Table 5.4.2-1**

**V/C ratio of Highway No.43 km 29+617 (Na Mom – Chana) during B.E. 2554-2558**

Type of vehicle		PCU	number of car (car/day)					PCU/day					PCU/hr				
		Factor	2554	2555	2556	2557	2558	2554	2555	2556	2557	2558	2554	2555	2556	2557	2558
1.	Bicycles and Tricycles	0.333	13	16	13	4	33	4	5	4	1	11	0.2	0.2	0.2	0.1	0.5
2.	Motorcycles and Motortricycles	0.333	2,650	1,398	2,318	679	2,376	882	466	772	226	791	36.8	19.4	32.2	9.4	33.0
3.	Car more than 7 person	1	7,318	3,891	9,226	7,378	7,929	7,318	3,891	9,226	7,378	7,929	304.9	162.1	384.4	307.4	330.4
4.	Car less than 7 person	1	8,365	3,044	10,665	963	6,996	8,365	3,044	10,665	963	6,996	348.5	126.8	444.4	40.1	291.5
5.	Light bus	1.5	257	355	347	263	644	386	533	521	395	966	16.1	22.2	21.7	16.4	40.3
6.	Medium bus	1.5	629	57	1,004	135	994	944	86	1,506	203	1,491	39.3	3.6	62.8	8.4	62.1
7.	Heavy bus	2.1	167	140	192	89	80	351	294	403	187	168	14.6	12.3	16.8	7.8	7.0
8.	Light truck (4 wheels)	1	1,951	4,880	2,027	5,289	4,528	1,951	4,880	2,027	5,289	4,528	81.3	203.3	84.5	220.4	188.7
9.	Medium truck (6 wheels)	2.1	701	560	872	485	636	1,472	1,176	1,831	1,019	1,336	61.3	49.0	76.3	42.4	55.7
10.	Heavy truck (10 wheels)	2.5	783	648	901	512	826	1,958	1,620	2,253	1,280	2,065	81.6	67.5	93.9	53.3	86.0
11.	Full trailer	2.5	514	365	690	237	462	1,285	913	1,725	593	1,155	53.5	38.0	71.9	24.7	48.1
12.	Semi trailer	2.5	125	172	372	226	221	313	430	930	565	553	13.0	17.9	38.8	23.5	23.0
<b>Total</b>			<b>23,473</b>	<b>15,526</b>	<b>28,627</b>	<b>16,260</b>	<b>25,725</b>	<b>25,228</b>	<b>17,336</b>	<b>31,863</b>	<b>18,097</b>	<b>27,988</b>	<b>1,051.1</b>	<b>722.3</b>	<b>1,327.6</b>	<b>754.1</b>	<b>1,166.2</b>
<b>V/C Ratio</b>													<b>0.150</b>	<b>0.103</b>	<b>0.190</b>	<b>0.108</b>	<b>0.167</b>

Source : Consultants of Technology Co., Ltd., B.E. 2559

**Table 5.4.2-2****Daily average traffic volume of highway No.43 (km 28+800)****Sunday, 1<sup>st</sup> May 2016 (weekend)**

Type of vehicle		PCU Factor	rush hour (morning)		out of rush hour		rush hour (evening)	
			number of car/day	PCU/hr	number of car/day	PCU/hr	number of car/day	PCU/hr
1	Bicycles and Tricycles/ Motorcycles and Motortricycles	0.333	211	70.26	204	67.93	359	119.55
2	Car more than 7 person	1	677	677.00	869	869.00	1,642	1642.00
3	Car less than 7 person	1	27	27.00	38	38.00	51	51.00
4	Light bus	1.5	64	96.00	84	126.00	94	141.00
5	Medium bus	1.5	5	7.50	3	4.50	7	10.50
6	Heavy bus	2.1	12	25.20	11	23.10	18	37.80
7	Light truck (4 wheels)	1	341	341.00	475	475.00	569	569.00
8	Medium truck (6 wheels)	2.1	19	39.90	13	27.30	9	18.90
9	Heavy truck (10 wheels)	2.5	13	32.50	15	37.50	20	50.00
10	Full trailer	2.5	3	7.50	0	0.00	8	20.00
11	Semi trailer	2.5	7	17.50	6	15.00	13	32.50
<b>Total</b>			<b>1,379</b>	<b>1,341.36</b>	<b>1,718</b>	<b>1,683.33</b>	<b>2,790</b>	<b>2,692.25</b>
<b>V/C Ratio</b>			<b>0.19</b>		<b>0.23</b>		<b>0.38</b>	
<u>Source</u> : Consultants of Technology Co., Ltd., B.E. 2559								

**Table 5.4.2-3****Traffic volume of highway No.43 (km 28+800)****Wednesday, 4<sup>th</sup> May 2016 (weekday)**

Type of vehicle		PCU Factor	rush hour (morning)		out of rush hour		rush hour (evening)	
			number of car/day	PCU/hr	number of car/day	PCU/hr	number of car/day	PCU/hr
1	Bicycles and Tricycles/ Motorcycles and Motortricycles	0.333	355	118.22	269	89.58	412	137.20
2	Car more than 7 person	1	1,075	1075.00	1,117	1117.00	1,322	1322.00
3	Car less than 7 person	1	51	51.00	45	45.00	43	43.00
4	Light bus	1.5	56	84.00	72	108.00	79	118.50
5	Medium bus	1.5	3	4.50	3	4.50	4	6.00
6	Heavy bus	2.1	7	14.70	8	16.80	11	23.10
7	Light truck (4 wheels)	1	509	509.00	896	896.00	830	830.00
8	Medium truck (6 wheels)	2.1	47	98.70	63	132.30	42	88.20
9	Heavy truck (10 wheels)	2.5	42	105.00	57	142.50	38	95.00
10	Full trailer	2.5	23	57.50	22	55.00	13	32.50
11	Semi trailer	2.5	24	60.00	29	72.50	19	47.50
<b>Total</b>			<b>2,192</b>	<b>2,177.62</b>	<b>2,581</b>	<b>2,679.18</b>	<b>2,813</b>	<b>2,743.00</b>
<b>V/C Ratio</b>			<b>0.31</b>		<b>0.37</b>		<b>0.39</b>	
<u>Source</u> : Consultants of Technology Co., Ltd., B.E. 2559								

**Table 5.4.2-4****Traffic volume at the entrance to the project (Highway No.408)****Sunday, 1<sup>st</sup> May 2016 (weekend)**

Type of vehicle		PCU Factor	rush hour (morning)		out of rush hour		rush hour (evening)	
			number (car/day)	PCU/hr	number (car/day)	PCU/hr	number (car/day)	PCU/hr
1	Bicycles and Tricycles/ Motorcycles and Motortricycles	0.333	212	70.60	236	78.59	242	80.59
2	Car more than 7 person	1	133	133.00	136	136.00	341	341.00
3	Car less than 7 person	1	16	16.00	10	10.00	13	13.00
4	Light bus	1.5	9	13.50	10	15.00	12	18.00
5	Medium bus	1.5	0	0.00	0	0.00	0	0.00
6	Heavy bus	2.1	0	0.00	2	4.20	2	4.20
7	Light truck (4 wheels)	1	239	239.00	290	290.00	395	395.00
8	Medium truck (6 wheels)	2.1	9	18.90	4	8.40	2	4.20
9	Heavy truck (10 wheels)	2.5	4	10.00	6	15.00	1	2.50
10	Full trailer	2.5	2	5.00	0	0.00	0	0.00
11	Semi trailer	2.5	0	0.00	0	0.00	0	0.00
<b>Total</b>			<b>624</b>	<b>506.00</b>	<b>694</b>	<b>557.19</b>	<b>1,008</b>	<b>858.49</b>
<b>V/C Ratio</b>			<b>0.28</b>		<b>0.31</b>		<b>0.45</b>	
<u>Source</u> : Consultants of Technology Co., Ltd., B.E. 2559								

**Table 5.4.2-5****Traffic volume at the entrance to the project (Highway No.408)****Wednesday, 4th May 2016 (weekday)**

Type of vehicle		PCU Factor	rush hour (morning)		out of rush hour		rush hour (evening)	
			number (car/day)	PCU/hr	number (car/day)	PCU/hr	number (car/day)	PCU/hr
1	Bicycles and Tricycles/ Motorcycles and Motortricycles	0.333	304	101.23	291	96.90	437	145.52
2	Car more than 7 person	1	285	285.00	230	230.00	349	349.00
3	Car less than 7 person	1	10	10.00	15	15.00	9	9.00
4	Light bus	1.5	23	34.50	17	25.50	18	27.00
5	Medium bus	1.5	0	0.00	0	0.00	0	0.00
6	Heavy bus	2.1	0	0.00	0	0.00	2	4.20
7	Light truck (4 wheels)	1	435	435.00	320	320.00	390	390.00
8	Medium truck (6 wheels)	2.1	13	27.30	17	35.70	14	29.40
9	Heavy truck (10 wheels)	2.5	4	10.00	9	22.50	7	17.50
10	Full trailer	2.5	4	10.00	5	12.50	5	12.50
11	Semi trailer	2.5	3	7.50	7	17.50	6	15.00
<b>Total</b>			<b>1,081</b>	<b>920.53</b>	<b>911</b>	<b>775.60</b>	<b>1,237</b>	<b>999.12</b>
<b>V/C Ratio</b>			<b>0.50</b>		<b>0.44</b>		<b>0.57</b>	

Source : Consultants of Technology Co., Ltd., B.E. 2559

vehicles is about 167 meters (550 ft) or 2.7 car lengths. Motorists have a high level of physical and psychological comfort. The effects of incidents or point breakdowns are easily absorbed. The level of service A generally occurs late at night in urban areas and frequently in rural areas.

**- Level of Service B**

The level of service B that is reasonably free flow. Speeds are maintained, maneuverability within the traffic stream is slightly restricted. The lowest average vehicle spacing is about 100 meters (330 ft) or 1.6 car lengths. Motorists still have a high level of physical and psychological comfort. The effects of incidents or point breakdowns are easily absorbed.

**- Level of Service C**

The level of service C that is stable flow, at or near free flow. Ability to maneuver through lanes is noticeably restricted and lane changes require more driver awareness. Minimum vehicle spacing is about 37 meters (220 ft) or 1.1 car lengths. Most experienced drivers are comfortable, roads remain safely below but efficiently close to capacity, and posted speed is maintained. Minor incidents may still have no effect but localized service will have noticeable effects and traffic delays will form behind the incident.

**- Level of Service D**

The level of service D that is approaching unstable flow. Speeds slightly decrease as traffic volume slightly increase. Freedom to maneuver within the traffic stream is much more limited and driver comfort levels decrease. Vehicles are spaced about 50 meters (160 ft) or 0.8 car lengths. Minor incidents are expected to create delays. It is a common goal for urban streets during peak hours, as attaining LOS C would require prohibitive cost and societal impact in bypass roads and lane additions.

**- Level of Service E**

The level of service E that is unstable flow, operating at capacity. Flow becomes irregular and speed varies rapidly because there are virtually no usable gaps to maneuver in the traffic stream and speeds rarely reach the posted limit. Vehicle spacing is about 0.6 car lengths, but speeds are still at or above 80 kilometers/hour (50 mi/hour). Any disruption to traffic flow, such as merging ramp traffic or lane changes, will create a shock wave affecting traffic upstream. Any incident will create serious delays. Drivers' level of comfort become poor. This is a common standard in larger urban areas, where some roadway congestion is inevitable.

**- Level of Service F**

The level of service F that is every vehicle moves in lockstep with the vehicle in front of it, with frequent slowing required. The main causes are as follows:

- \* Traffic incidents cause a temporary reduction in the capacity of a short segment so that the number of vehicles arriving at the point is greater than the number of vehicles that can traverse it.

- \* Recurring points of congestion exist, such as merge or weaving areas and lane drops, where the number of vehicles arriving is greater than the number of vehicles traversing the point.

- \* In forecasting situations, any location presents a problem when the projected peak-hour flow rate exceeds the estimated capacity of the location.

From the above, assessment results of traffic impacts during construction and operation periods are presented in **Table 5.4.2-6** and **Table 5.4.2-7** and can be summarized as follows:

**1) Highway No.43**

**(a) Average impact throughout a day**

**a) Construction period**

During construction period the traffic volume to the Project is approximately 40 PCU/day or 5 PCU/hour (based on 8 hours). From the assumption above, V/C ratio can be compared between with and without the Project development by using average PCU as presented in **Table 5.4.2-6**. The V/C ratios during the construction period are in the range of 0.184 – 0.193 in which falls in the level of service A (V/C ratio = 0.00 – 0.60). Thus, the impact in traffic is in low level.

**b) Operation period**

The Project will begin to operate in 2018 with the traffic volume to the Project of approximately 165.97 PCU/day or 6.92 PCU/hour. From the assumption above, V/C ratio can be compared between with and without the Project development by using average PCU as presented in **Table 5.4.2-7**. The V/C ratios during operation period are in the range of 0.202-0.243 in which falls in the level of service A (V/C ratio = 0.00 – 0.60). Thus, the impact in traffic is in low level.

**Table 5.4.2-6****Comparison V/C ratio in case with and without the Project development (Construction period)**

B.E.	Period	Highway No.43		Road at the entrance to the Project (Highway No.408)	
		without Project development	Project development	without Project development	Project development
2560	Average throughout a day	0.183	0.184	-	-
2561		0.192	0.193	-	-
2560	Weekday (rush hour in the morning)	0.330	0.331	0.524	0.527
2561		0.346	0.347	0.549	0.552
2560	Weekday (out of rush hour)	0.390	0.390	0.458	0.461
2561		0.408	0.409	0.480	0.483
2560	Weekday (rush hour in the evening)	0.407	0.408	0.597	0.600
2561		0.427	0.428	0.626	0.628
2560	Weekend (rush hour in the morning)	0.199	0.200	0.299	0.301
2561		0.209	0.209	0.313	0.316
2560	Weekend (out of rush hour)	0.243	0.244	0.328	0.331
2561		0.255	0.256	0.344	0.347
2560	Weekend (rush hour in the evening)	0.393	0.394	0.472	0.475
2561		0.412	0.413	0.495	0.497

Source : Consultants of Technology Co., Ltd., B.E. 2559



**Table 5.4.2-7****Comparison V/C ratio in case with and without the Project development (Operation period)**

B.E.	Period	Highway No.43		Road at the entrance to the Project (Highway No.408)	
		without Project development	Project development	without Project development	Project development
2562	Average throughout a day	0.201	0.202	-	-
2563		0.211	0.212	-	-
2564		0.221	0.222	-	-
2565		0.231	0.232	-	-
2566		0.242	0.243	-	-
2562	Weekday (rush hour in the morning)	0.362	0.363	0.576	0.579
2563		0.380	0.381	0.603	0.607
2564		0.398	0.399	0.632	0.636
2565		0.417	0.418	0.662	0.666
2566		0.437	0.438	0.694	0.698
2562	Weekday (out of rush hour)	0.428	0.429	0.503	0.507
2563		0.448	0.449	0.527	0.531
2564		0.470	0.471	0.552	0.556
2565		0.492	0.493	0.578	0.582
2566		0.516	0.517	0.606	0.610
2562	Weekday (rush hour in the evening)	0.447	0.448	0.656	0.659
2563		0.469	0.470	0.687	0.691
2564		0.491	0.492	0.720	0.724
2565		0.514	0.515	0.754	0.758
2566		0.539	0.540	0.790	0.794

**Table 5.4.2-7 (Cont'd)**

B.E.	Period	Highway No.43		Road at the entrance to the Project (Highway No.408)	
		without Project development	Project development	without Project development	Project development
2562	Weekend (rush hour in the morning)	0.219	0.220	0.328	0.332
2563		0.229	0.230	0.343	0.347
2564		0.240	0.241	0.360	0.364
2565		0.252	0.253	0.377	0.381
2566		0.264	0.265	0.395	0.399
2562	Weekend (out of rush hour)	0.267	0.268	0.361	0.364
2563		0.280	0.281	0.378	0.382
2564		0.293	0.294	0.396	0.400
2565		0.307	0.308	0.415	0.419
2566		0.322	0.323	0.435	0.439
2562	Weekend (rush hour in the evening)	0.432	0.433	0.518	0.522
2563		0.453	0.454	0.543	0.547
2564		0.474	0.475	0.569	0.573
2565		0.497	0.498	0.596	0.600
2566		0.521	0.522	0.625	0.628
Source : Consultants of Technology Co., Ltd., B.E. 2559					

**(b) Impacts on rush hour and out of rush hour**

**a) Construction period**

During construction period the traffic volume to the Project is approximately 40 PCU/day or 5 PCU/hour (based on 8 hours). From the assumption above, V/C ratio can be compared between with and without the Project development by using average PCU as presented in **Table 5.4.2-6**. The V/C ratios during the construction period are in the range of 0.200-0.428 in which falls in the level of service A (V/C ratio = 0.00 – 0.60). Thus, the impact in traffic is in low level.

**b) Operation period**

The Project will begin to operate in 2017 with the traffic volume to the Project of approximately 165.97 PCU/day or 6.92 PCU/hour. From the assumption above, V/C ratio can be compared between with and without the Project development by using average PCU as presented in **Table 5.4.2-7**. The V/C ratios during operation period are in the range of 0.220-0.540 in which falls in the level of service A (V/C ratio = 0.00 – 0.60). Thus, the impact in traffic is in low level.

**2) Road at the entrance to the Project (Highway No.408)**

The traffic volume statistic of Highway No. 408 has not been recorded. Therefore, an assessment of average impact throughout a day is not possible. Nevertheless, an assessment of impact in rush hour and out of rush hour can be summarized as follows:

**(a) Construction period**

During construction period the traffic volume to the Project is approximately 40 PCU/day or 5 PCU/hour (based on 8 hours). From the assumption above, V/C ratio can be compared between with and without the Project development by using average PCU as presented in **Table 5.4.2-6**. The V/C ratios during the construction period are in the range of 0.321-0.628 in which falls at the level of service B (V/C ratio = 0.61 – 0.70). Thus, the impact in traffic is in low level.

**(b) Operation period**

The Project will begin to operate in 2017 with the traffic volume to the Project of approximately 165.97 PCU/day or 6.92 PCU/hour. From the assumption above, V/C ratio can be compared between with and without the Project development by using average PCU as presented in **Table 5.4.2-7**. The V/C ratios during operation period are in the range of 0.332-0.794 in which falls at level of service B (V/C ratio = 0.61 – 0.70). Thus, the impact in traffic is in low level.

### **5.4.3 Impact on electricity consumption**

#### **(1) Construction period**

During the construction period, the Project will use electricity from Chana Provincial Electricity Authority of two MW totally together with a diesel power generator which will be provided by the contractor. At present, Chana Provincial Electricity Authority has one power station, Chana power station, with a 24 MVA transformer. It has a maximum capacity of 25 MW. The maximum power supply is 10 MW covers the responsible areas of Chana District and Thepha District (some parts).

From the volume of electricity supply together with the demand of power of the Project of approximate 2 MW, the electricity authority will have increased burden of 12 MW, capable of supplying. Thus, impact on electricity consumption during the construction period of the Project is in low level.

#### **(2) Operation period**

The Project has a designed capacity of 25 MW in according to the capacity of machines to be installed. The maximum operating capacity so 24 MW in which 20.622 MW will be supplied to Electricity Generating Authority of Thailand and the rest of 2.4 MW will be used in the Project.

For the worst case scenario that the boiler is not in function, the Project will need to restart the system, the Project will coordinate with provincial electricity authority to use electricity for the start up. However, this scenario will not occur commonly. Thus, the impact is in low level.

### **5.4.4 Impacts on water consumption**

#### **(1) Construction period**

Water usage during construction can be categorized into two types, consumption of the workers and construction activities.

1) Water usage for the worker's consumptions is forecasted of approximately 21 cubic meters/day (calculated from consumption rate of 70 liters/capita/day x 300 workers, workers that stay in the Project). The Project will assign the contractor company to provide a water container

that can store water to be used for three days. For drinking water, the Project will buy from the general market.

2) Water usage for construction activities will be used for cleaning of tools and equipment and concrete mixing with a ratio of 1 cubic meter concrete with 185 liters of water (Source: Council of Engineers, 2016). The quantity is small due to the use of ready mixed concrete. The water usage in construction activities is approximately 2 cubic meter/day. Source of water is same as the source of water for worker consumption.

Thus, the impact on the communities is in low level.

## **(2) Operation period**

There are two main water sources as follows:

1) Rainwater in the reservoir with the quantity of approximately 29,226.6 cubic meters/year. The Project has a water reservoir with a capacity of approximately 370,000 cubic meters.

2) Water from Nathawee canal, the water will be stored in the raw water reservoir (370,000 cubic meters).

From the study of water adequacy and security, the water balance of the Project was studied to estimate, analyze, proof, and report the adequacy and security of water throughout the Project period of 25 years. Water demand in other activities (excluded the Project) was considered, it consists of water demand for consumption, water supply, agriculture, industrial, and downstream ecosystem conservation.

The water demand in the area of Nathawee water basin over the period of the next 30 years are demands for water supply production of Nathawee Provincial Waterworks of 1.63 million cubic meters/year, water demand for consumption of the population in the area of Nathawee District of 3.35 million cubic meters/year, water demand for agricultural purposes of 98.89 million cubic meters/year, water demand for consumption of the population in the area of Chana District of 4.98 million cubic meters/year, and water demand for downstream ecosystem conservation for Nathawee water basin of 47.28 million cubic meters/year. From the retrospective data of runoff water that was analyzed according to the previous section, the monthly water demand over the period of the next 30 years or 2016 – 2045. It can be summarized as follows:

- (1) Maximum continuous period of lacking water is four months and will occur in 2016, 2020, 2035, and 2042
- (2) Minimum continuous period of lacking water is zero months and will occur in 2027 and 2031
- (3) Average continuous period of lacking water for three months will occur in 2017, 2033, 2034, and 2041

From the study, water reservoir that can retain water for longer than four months will be established to prevent impact on surface water during pumping. The water level that can be pumped after deducting the water demands and enough for the Project to pump (15,365 cubic meter/day) starts at +5.35 msl or 0.15 meter from the bottom of the canal. The design of the water reservoir complies with the study. Thus, the impact is in low level.

## **5.5 Impact on Quality of Life Values**

### **5.5.1 Impacts on Socio-economic**

An installation of the project makes an expansion of local construction business which is increasing provincial gross domestic product. Furthermore, the installation of the power plant can turn business cycle in the province such as material supply, and service business to related business sectors. Therefore, the power plant construction has positive impact to provincial fiscal structure. In addition, the biomass power plant project can increase agricultural product income to local farmers by which an increasing income is support the provincial gross domestic product according to an increasing of buying power in local community. Economic expansion due to buying cycle from product and service buying is considered a positive impact to socio-economic in Songkhla. However, a negative impact from power plant installation is a duration of construction period which is approximately 24 months using 300 construction workers. Those construction workers are provided by subcontractors which is normally employ local or regional workers for operation. Thus, construction workers for power plant installation during the construction period are local workers which will not affect population structure, and minimal impact on worker migration to the area. Therefore, socio-economic is considered low.

The biomass power plant project can increase provincial income, and make provincial buying cycle to provide sufficient money returns for making basic infrastructure to serve local peoples. Those money returns are posted tax, building and land tax, juristic person tax, and power plant development fund. Furthermore, additional positive impact is an employment of local workers

for project operation. Nevertheless, negative impact is about a relocation of occupational system from agricultural sector to industrial sector of adolescents according to higher income stable income from industrial sector for maintaining better living quality.

Local peoples are not interested in socio-economic news or academic report about the operation of the project which are difficult to understand. Since they can easily get news from T.V, communication with neighbors, and from community leaders however normally lack of details and distorting main information of about the project that lead to some uncertainties in the project operations. Therefore, correct information should be disseminated to communities to enhance awareness on the environmental quality management that will be implemented by the company to avoid or reduce pollutants during operations. Continuous public/community relation and engagement through series of meetings and consultations should be carried out as a means to provide correct and accurate information the community leaders and local residents.

## **5.6 Health Impact Assessment**

### **5.6.1 Health Impact Assessment Concept**

An additional vision about health impact assessment to environmental impact assessment is based on a concept of human health depends on environmental factor and development. Therefore, health impact assessment is a tool for expanding and covering health dimension to “public health and occupational safety” by representing correlation between health data and environmental alteration, natural resources, and other impacts. Those related impacts are human utilization for socio-economic which is used for identifying target groups and risk areas.

A conceptual idea for health impact assessment is determined by the following definitions.

**Health** according to the definition mentioned in the National Health Act B.E. 2550 is a complete human status for body, mind, intelligent, and social which is a balancing linkage to each other. The WHO had definition of health as a complete status of body, mind, and living with peaceful which is not specific to no illness condition (WHO, 2541).

**Health impact assessment** is a process of social perception for analyzing and forecasting both positive and negative impacts to public health which are affected by individual or multiple policy, project, or activity in a particular period and place. The assessment apply many tools and participations for making

optimized decision for maintain good condition of public health in both short time and long time (Promulgation of the National Health Committee: NHC, 2552).

From the above definition, it is used for making conceptual study for an additional assessment other than those 4 categories which are physical resource, biological resource, human utilization, and living quality. The assessment is studied by using target groups as a center of assessment, and analyzing impact to target groups. The conceptual study had conducted to consider all dimension of impacts to make linkage between factors and results from the activity. The consultant had analyzed human factor alteration for 3 issues which are environmental, socio-economic, and public and health service factors. Target groups are those local people affected by pollutants dispersion/transportation routes, and project staffs/construction workers. Conceptual study for health risk assessment is shown in **Figure 5.5.6-1**.

Nevertheless, health impacts caused by those 3 factors will be mitigated to reduce impact by making 3 level of measures which are (1) source control, (2) impact reduction and monitoring, and (3) operation of related health service organizations.

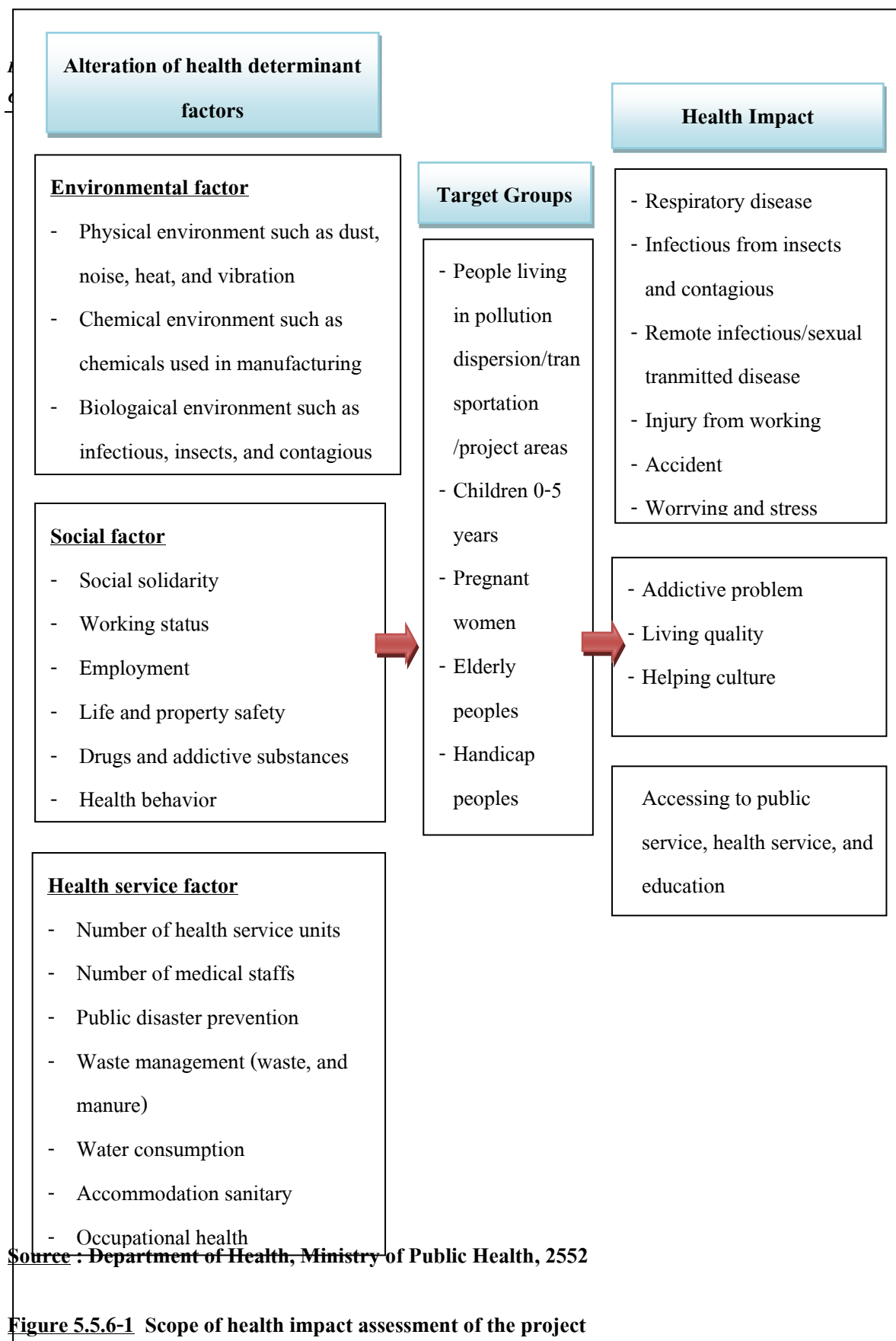
#### **5.6.2 Objective of health impact assessment**

To identify health determinant factors caused by project development, a forecasting of health impact and decision making are performed to determine sufficient and efficient of measure and mitigation for controlling health impact including health condition monitoring before affecting staffs and surrounding peoples.

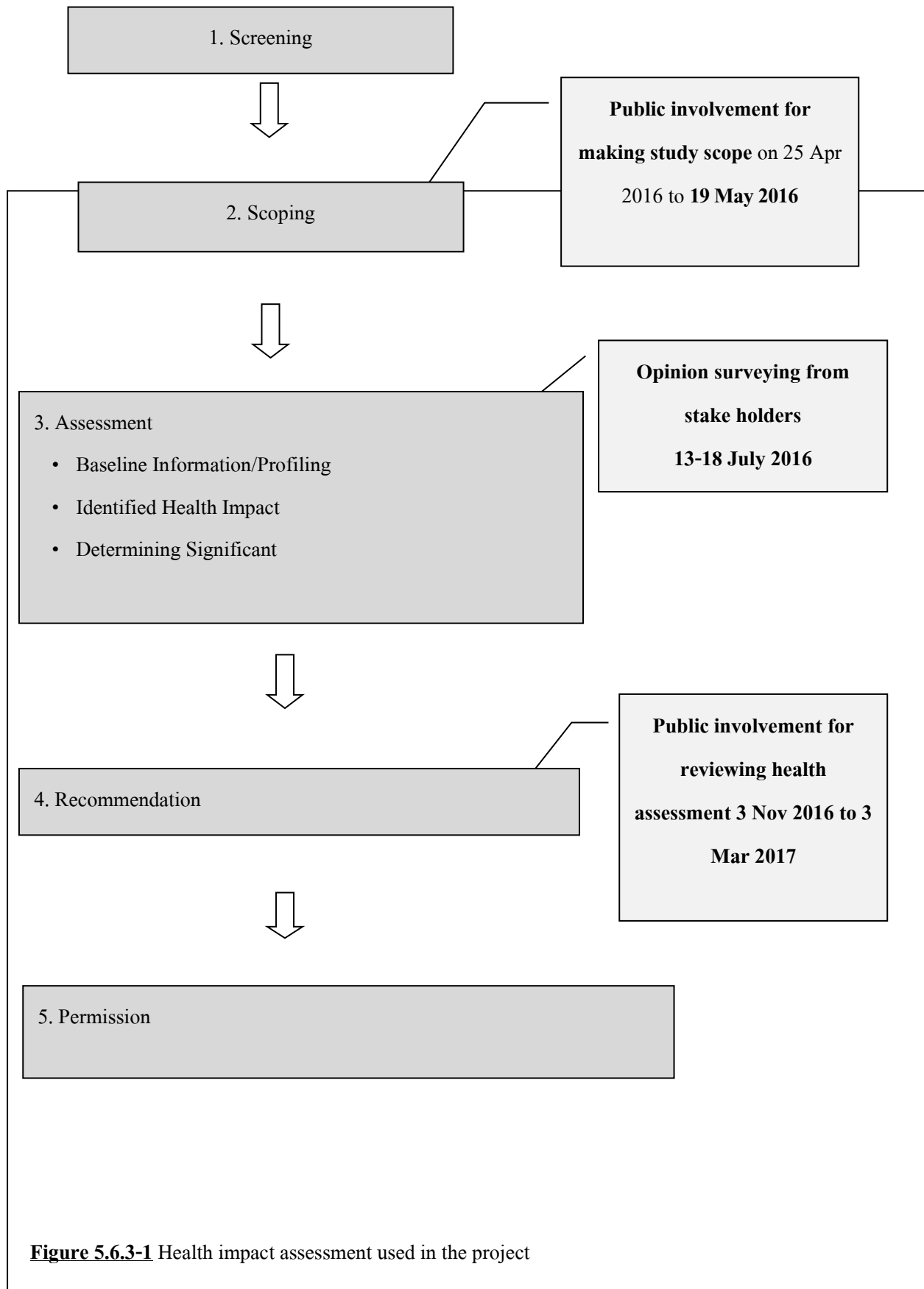
#### **5.6.3 Public involvements for health impact assessment**

The health impact assessment procedures consist of 5 steps as shown in the **Figure 5.6.3-1** by which public involvement is a significant process for making studying scope, and measures with mitigations to complete the assessment.





**Health impact assessment consists of 5 steps**



**Figure 5.6.3-1** Health impact assessment used in the project

#### **5.6.4 Screening**

The Chana Green Co.ltd. has planned to develop the Chana Green Power Plant Project at Khu sub district, Chana, Songkhla. The project is a biomass power plant project using piece of woods obtained from wood transformation industry. Those biomass are residue from agriculture which are rubber tree, and mangium. The power plant has capacity of 25 MW by which the Chana Green Power Plant Project is one of the renewable electricity project in the 3 provinces of the deep south of Thailand. The project has to acquire for EIA permission before operation according to the promulgation of the Ministry of Natural Resource and Environment about Category and type of project and activity which is acquire for EIA approval based on conditions, procedures and methods of EIA preparation declared by the Royal Gazette Edition 129<sup>th</sup> Special Section 97 Ngor-ngu (Thai Character) issued by 20<sup>th</sup> June B.E. 2555.

The biomass project is classified as the 18<sup>th</sup> activity of thermal power plant with capacity larger than 10 MW. Thus, the activity can affect health determinant factors. Thus, health impact assessment is combined in the EIA report which is adapt from related laws and conditions by;

(1) Promulgation of the NHC about criteria and methods for health impact assessment due to public policy B.E. 2552,

(2) Health impact assessment guideline of the EIA report of the ONEP, Ministry of Natural Resource and Environment, December B.E. 2552,

(3) Guideline for health impact assessment, Department of Health, Ministry of Public Health B.E. 2552

(4) Guide line for health impact assessment for power plant project of the Department of Health, Ministry of Public Health, September B.E. 2555

(5) Guideline for monitoring risk area according to biomass power plant of the Department of Health and the Department of Disease Control, Ministry of Public Health, March B.E. 2558

#### **5.6.5 Criteria and method for Assessment**

Health impact assessment from project operation is considered from related factors according to procedures and scopes of studying to identify characteristic of impact in term of chance and impact level to target groups for making significant priority of measures and mitigations including monitoring methods for health impact reduction.

#### 5.6.5.1 Collection of Baseline Information/ Profiling

The consultant had collected baseline information includes population, social and economic, environment, and public health condition in the study area (as explained in the Chapter 3) which is related to scoping issue for using in health impact assessment. Health condition alteration and monitoring measures after operation is explained in the Chapter 5 of EIA report while health impact due to risk factors is reviewed for health impact assessment by the following topics.

#### 5.6.5.2 Health Impact Identification

Health impact identification is classified into 2 groups by;

- (1) **health impact assessment of project staffs** which are
  - 1) Health impact to construction workers, and
  - 2) Health impact to operation staffs.

Health impact identification was assessed using occupational health and safety principal for determining and managing health risk of those staffs.

- (2) **health impact assessment of local peoples**

- 1) Health impact according to construction and operation periods.

Health impact assessment tools include public involvement, literature review, and environmental quality modeling for predicting exposure level with detail assessment.

Exposure level prediction of pollutants due to project emission is a comparison between predicted ambient air pollutants concentration and reference ambient air quality standard to calculate Hazard Quotient (HQ) by

$$\text{Hazard Quotient (HQ)} = \frac{\text{Forecasting pollutant concentration}}{\text{Reference concentration}}$$

The calculation of HQ is classified into 2 cases which are;

Case 1 HQ Lower than 1 ( $HQ < 1$ ) means exposure level less than reference concentration indicating low risk of health impact, and

Case 2 HQ equal to or higher than 1 ( $HQ \geq 1$ ) means exposure level higher than reference concentration indicating high risk of health impact.

### 5.6.5.3 Criteria for identifying significant level of impact

Significant level is mainly focused on relation between Likelihood and Severity of consequence by which impact opportunity is determined from historic evidences of exposure and related data obtained from researches and studying results as shown in the **Table 5.6.5.3-1** and **Table 5.6.5.3-2**. Then, the Health Risk Matrix is used for assessment as shown in the **Table 5.6.5.3-3**, and classified priority of impact as shown in the **Table 6.3.3-4**.

**Table 5.6.5.3-1**

**Likelihood of health risk**

<b>Opportunity to health impact</b>	<b>Definition</b>
Very low	No evidences
Low	Theoretical possible without report of the case in the area or international
Moderate	Once happening in Thailand or other countries on the same activity
High	More than 1 happening in Thailand or other countries on the same activity
Very high	Currently found evidence of happening during operation in Thailand or other countries on the same activity

Source : Guideline for health impact assessment, Department of Health, Ministry of Public Health, 2552

**Table 5.6.5.3-2**  
**Severity of Consequence**

Level of impact	Definition
Very low	<u>Health impact</u> • No injury or illness : Not affecting daily life or working ability • No serious illness
	<u>Mind impact</u> • No negative feeling which is not affecting daily life
Low	<u>Body impact</u> • Causing mild illness : Affecting quality or daily life's activities • Causing general illness : irritation or toxic from bacteria
	<u>Mind impact</u> • It causes negative feelings such as panic, anxiety, which affects the way of living happily.
Moderate	<u>Body impact</u> • Causing moderate illness : Affecting quality of life of target groups for a long time • Serious causes of illness : Noise and harmful of working operation
	<u>Mind impact</u> • It causes negative feelings, such as anxiety, irritability, negative feelings that occur at the level that affects the happy life but not to the level of mental illness.
High	<u>Body impact</u> • Serious illness : Causing death of staffs and local peoples

Level of impact	Definition
	<u>Mind impact</u> • Affecting negative response including stress or violent feeling to treating living quality or happiness which is not mental illness.
Very high	<u>Body impact</u> • Making multiple impact (widely affect to peoples) : illness causes increasing health impact
	<u>Mind impact</u> • Affecting negative response including stress or violent feeling to treating living quality or happiness which leads to mental illness (People have been widely affected) : illness causes increasing health impact

Source : Guideline for health impact assessment, Department of Health, Ministry of Public Health, 2552

**Table 5.6.5.3-3**

**Health Risk Matrix**

Severity of consequence		Likelihood				
Level of impact (Consequence Rating)	Health Harm	Very low 1	Low 2	Moderate 3	High 4	Very high 5
1	No injury/no illness	1	2	3	4	5
2	Injury/mild illness	2	4	6	8	10
3	Injury/illness	3	6	9	12	15
4	Losing property/violent injury	4	8	12	16	20
5	High level of losing property/life	5	10	15	20	25
		Risk significant level				

**Table 5.6.5.3-4**

**Health risk level and Definition**

Risk level	Score	Definition
Low	1-3	Acceptable
Moderate	4-9	Acceptable under control to limit risk level to unacceptable level
High	10-16	Unacceptable with risk management to control to acceptable level
Very high	17-25	Unacceptable that urgently require risk management to control to acceptable level

Source : Guideline for health impact assessment, Department of Health, Ministry of Public Health, 2552



#### **5.6.4 Scope of the study**

Study scoping was determined according to project details, EIA, natural resources and environmental and social quality alterations, and current environmental condition. These data were used for health impact assessment by which the consultant had studied and considered health factors according to the guideline for health impact assessment mentioned in the environmental impact assessment preparation of the ONEP, Ministry of Natural Resources and Environment B.E. 2552.

The health impact assessment was studied by the consultant from analyzing of project activities affecting health determinant factors which is potentially affect health condition. The activities of the project are divided to 2 phases which are construction and operation periods. A screening of health factors with worrying and suggestion from public involvement on 25<sup>th</sup> April 2016 to 19<sup>th</sup> May 2016 were brought to classify impact level 3 levels which are negative impact (-), neutral (non-significant) impact (0), and positive impact (+) for using in health impact scoping and assessment.

##### **(1) Study scope for construction period**

Construction activities are land preparation, machine installation, and material and workers transportation by which those activities have health nuisance from air pollution, noise, transportation accident, remote disease, health service, and worrying. Target groups are construction workers, and local/sensitive peoples as shown in the **Table 5.6.4-1**.

##### **(2) Study scope for operation period**

Operation activities are biomass transportation, biomass preparation (chopping), biomass conveying, and biomass combustion for boiler by which those activities have health nuisance from air pollution, noise, transportation accident, chemical used in manufacturing, working accident, health service, and worrying. Target groups are operation staffs, and local/sensitive peoples as shown in the **Table 5.6.4-2**.

Those negative health determinants are used as condition guideline for health impact assessment to make measures and mitigations for reducing health impact.

#### **5.6.5 Health impact assessment**

##### **5.6.5.1 Health impact to construction workers**

There will be around 300 construction workers which are affected by air pollutants, noise, vibration, transportation accident, and health service requirements according to health impact scoping by;

### **(1) Air pollutants**

#### **1) Air pollution sources**

Construction activities generating air pollutants are dust dispersion by construction material transportation, land preparation, civil and building works by which main air pollutants are TSP, PM-10, NO<sub>2</sub>, and SO<sub>2</sub>.

#### **2) Concentration of air pollutants**

Assessment of air pollutants concentration emitted by construction activity revealed that ambient air pollutants are not exceed ambient air quality standard according to the NEB promulgation issued 21<sup>st</sup> (B.E. 2544) 24<sup>th</sup> (B.E. 2547), and 33<sup>rd</sup> (B.E. 2552) as shown in the **Table 5.6.5.1-1**.

#### **3) Health impact according to air pollutants exposure**

Health impact from dust exposure depends on ability of pollutants to penetrate respiratory system by which large size dust can irritating upper respiratory system causing mucus to narrowing and inflaming bronchus. The long term inflaming bronchus is a chronic effect especially those immune disorder patients causing asthma. Micro size dust can penetrate lower respiratory system which is a gas exchanging tissue causing membrane penetrated between lung alveoli to reduce lung expansion during breath. Micro dust with size of 0.3-0.6 microns could penetrate to lung tissue while those size of 0.5-2.5 microns could deposit in lung alveoli. Furthermore, micro dust under 0.5 microns is freely passing lung tissue. Large size dust (>10 microns) is captured in nose causing cough and sneeze. For NO<sub>2</sub> exposure, health impact is a decreasing of lung efficiency by which affecting lower respiratory system especially those patients of emphysema, bronchitis, and heart disease. For SO<sub>2</sub> exposure, health impact are skin irritation, eyes tissue irritation, nose tissue inflammatory, and chronic bronchitis.

Health impact according to dust exposure from construction activity was assessed by air quality modeling with additional background concentration for representing actual exposure which is concluded by;

**(A) TSP**

Predicted ambient air concentration for TSP according to construction activity for maximum 24 hours averaging, and yearly averaging are 319.65, and 1.48 micrograms/cu.m., respectively. Risk ratio for acute and chronic exposure are 0.6656, and 0.0148, respectively. Thus, health risk from those TSP exposure is lower than 1.0 indicating low impact.

**(B) PM-10**

Predicted ambient air concentration for PM-10 according to construction activity for maximum 24 hours averaging, and yearly averaging are 49.20, and 0.95 micrograms/cu.m., respectively. Risk ratio for acute and chronic exposure are 0.4100, and 0.0190, respectively. Thus, health risk from those PM-10 exposure is lower than 1.0 indicating low impact.

**(C) NO<sub>2</sub>**

Predicted ambient air concentration for NO<sub>2</sub> according to construction activity for maximum 1 hours averaging, and yearly averaging are 218.77, and 4.67 micrograms/cu.m., respectively. Risk ratio for acute and chronic exposure are 0.6837, and 0.0819, respectively. Thus, health risk from those NO<sub>2</sub> exposure is lower than 1.0 indicating low impact.

**(D) SO<sub>2</sub>**

Predicted ambient air concentration for SO<sub>2</sub> according to construction activity for maximum 24 hours averaging, and yearly averaging are 9.53, and 0.82 micrograms/cu.m., respectively. Risk ratio for acute and chronic exposure are 0.0318, and 0.0082, respectively. Thus, health risk from those SO<sub>2</sub> exposure is lower than 1.0 indicating low impact.

**(2) Noise**

**1) Noise source**

Noise sources according to construction activity are land preparation, foundation installation, structural development, and decoration.

**2) Noise level in construction works**

Construction activities are not operated on the same time, therefore, only maximum noise activities affecting health condition are used for health impact assessment. The maximum noise is caused by foundation installation with noise level of 88 dB(A) at a distance of 15 m. Other activities give noise level around 79-84 dB(A) which are operated from 8.00-17.00 hrs.

### **1) Health impact from noise exposure according to construction activity**

Noise could affect construction workers if the level of noise is louder than 85 dB(A) over 8 hours. The workers can lose hearing ability or hearing efficiency under a chronic exposure (NIOSH, 1998) by which loud noise can damage soft tissues of hearing organs inside inner ears (Saowaros Assawavichienjinda, 2543 ; Sataloff, 2006). The WHO indicating that a chronic exposure over 6-12 months of loud noise at 85 dB(A) over 8 hours could show some hearing disorder. However, an operation under noise level around 79-88 dB(A) which is depending on activity types is less than maximum noise level of 90 dB(A) for operation over 8 hours according to Noise Level Standard of the Ministry of Labor. Furthermore, noise exposure comparing to noise level standard given percentile 98, therefore, construction workers have high level of noise exposure (TWA is the permission noise exposure to workers over 8 hours/day or 40 hours/week without significant adverse health effect according to exposure criteria shown in **Appendix 6-2**).

Controlling and preventing of noise exposure is a limiting working period not exceeding 8 hours/day (noise generated during 8.00-17.00 hrs). Otherwise, subcontractors have to provide sufficient PPE (ears muff, and ears plug) by which the PPE is working as insulation sheet to reduce noise energy to middle and inner ears which is reducing noise level from 8-30 dB(A) according to PPE type.

## **(3) Vibration**

### **1) Vibration source**

Vibration is emitted by construction machine such as pile rig, cement penetrating equipment, and grinding machine.

### **2) Vibration level**

Vibration happens by 2 types which are whole body vibration, and body part vibration especially hand and arm vibration by which whole body vibration is a transmitted wave from machine to all body parts with frequency of 2-100 Hertz (Hz) while body part vibration is a transmitted wave from machine to hand and arm with frequency of 8-1,500 Hz.

### **3) Health impact from vibration**

Vibration exposure affects both direct touching organs and all body parts which depend on frequency, magnitude, direction, and duration. Acute effect is abnormal symptom during operation under frequency of 6.5-10 Hz on up and down directions causing stress to spine lipid, while

body part impact is blood circulation blocking and nervous system interfering. Furthermore, vibration can cause chronic effect to bone and muscle especially spine and increasing risk of adverse health effect in central nervous system, and chest while vibration over 40 Hz can affect both central and peripheral nervous systems.

Controlling and preventing vibration exposure is a proper selecting tools according to ergonomics and using PPE especially gloves to reduce vibration with a strictly following operation instructions by which the ACGIH had limited vibration wave standard to 4 Hz for hands/arms operation on vibrating machine over 4-8 hours/day.

#### **(4) Working accident**

##### **1) Characteristic of construction work accident**

Construction work accident happen by many factors such as workers' carelessness, hazardous operation, and improper environment.

##### **2) Statistic of construction work accident**

The ANSI has classified working accidental type to crashing, slipping, injury from using high energy, repeated working, and vehicle accident. In Thailand, the Office of Social Insurance has classified accidental type according to significant level and injury result to death, losing organs, stop working more than 3 days, and stop working less than or equal to 3 days. It was found that construction work accident statistic from B.E. 2554-2558 was continuously decreasing by which the death and stop working less than or equal to 3 days tend to decrease while losing organs, and stop working more than 3 days tends to increase (**Appendix 6-1**).

##### **3) Health impact from construction working accident**

Construction workers have opportunity to get working accident and injury from working careless due to improper attire (wearing improper shirt and pants or using flip-flop which is easy get slipper, and do not wearing helmet), harmful operation (walking on danger platform). Working conditions which leads to cause accident are high elevation platform, material falling, and machine operation. Working environments causing accident are lighting, dust, smoke, odor, and noise.

Controlling and prevention for accident is conducted by choosing occupational health and safety standard subcontractors, and good health condition with experienced workers to reduce accidental risk. And, assigning clearly construction area for operation area, material/equipment

storage area, unwanted material storage area, and labelling warning signs for strictly control area with a training course for safety operation under related laws to subcontractors.

#### **5.6.5.2 Health impact to operation staffs**

Health impact assessment to operation staffs is considered from manufacturing process, and safety environment of working. The manufacturing process consists of 3 main processes which are biomass conveying to combustion chamber of boiler, combustion in boiler, and electricity generating of steam turbine which are required operation staffs to control those machine. Furthermore, health harassment also consists of dust, noise, heat, chemicals used in processing.

##### **(1) Dust**

###### **1) Dust emission source**

Dust emission source from the project emitted by biomass conveying to combustion, and ash from combustion process. There 2 types of dust which are TSP and micro dust.

###### **2) Dust in workplace**

Dust in work place is classified to 2 types which is Total Dust, and fine particle dust (Respirable Dust) by which all size dust can annoying staffs while high concentration dust can cause violent affect to staffs due to lower respiratory system penetration. The Ministry Regulation about Occupational Health and Safety Management and Standard , and Working Environment for Hazardous Chemicals ( B.E. 2 5 5 6 ), and the standard of the US OSHA have limited ambient concentration for Total Dust, and Respirable Dust at 15 and 5 mg/cu.m. , respectively. And, the US ACGIH has limited ambient concentration of TSP in workplace at 10 mg/cu.m.

###### **3) Health impact from dust exposure**

Manufacturing process of the project causes dust dispersion to workplace from biomass conveying to combustion and ash from combustion process, therefore, air pollution affecting staffs are those total dust and Respirable Dust. Health impact depends on ability to penetrate respiratory system by which large size dust can irritate upper respiratory system causing mucus to narrowing and inflaming bronchus. The long term inflaming bronchus is a chronic effect especially those immune disorder patients causing asthma. Respirable Dust can penetrate lower respiratory system which is a gas exchanging tissue causing membrane penetrated between lung alveoli to reduce lung expansion during breath. Respirable Dust with size of 0.3-0.6 microns could penetrate to lung tissue.

Occupational and Environment lung diseases statistic from chronic exposure of breathing of dust, smoke, fume, and organic dust obtained from the Bureau of Epidemiology, Thailand B.E. 2556-2557 revealed that there were 184, and 651 patients, respectively. The north-east, and central regions have the highest patients which were 0.69, and 2.53 patients per 100,000 capita, respectively. The maximum patient's province in B.E. 2556 was Srisaket, and in B.E. 2557 was Rayong. Total patients in B.E.2556 were mostly get recovery form sub district health promotion hospital (60.87%). However in B.E. 2557, it was found that patients were mostly get recovery from central/general hospitals (92.01%). Occupational and Environment lung diseases classification indicated that there are 29 patients of asthma (15.76%), TB 15 patients (8.16%), cotton fume disease 6 patients (3.26%), chronic bronchitis 4 patients (2.18%), silicosis 2 patients (1.09%), and unidentified 128 patients (95.57%). The most affected age is 65 years old, and 55-64 years old by which the most affected career is farmer and daily employee.

The project had developed measures and mitigations for dust control and management by using closed system of belt conveyor from storage areas to combustion chamber to avoid dust dispersion, requiring operation staffs in a risk area of dust exposure (fuel storage areas and fuel storage buildings) to wear proper attire which is long sleeves shirt and pants, safety boots, and mask to reduce risk of dust exposure, and cleaning fuel storage areas and fuel storage buildings routinely to avoid dust dispersion including yearly health condition monitoring to staffs according to risk factors.

## **(2) Noise**

### **1) Noise sources**

Noise sources in the manufacturing process of the project are those chopping machine, boilers, and electricity generator which are continuous operation.

### **2) Noise level in workplace**

Machine operation in manufacturing process of the project had designed to release noise level at 85 dB(A) which is exposure to staffs not more than 12 hours/day according to Tolerance Noise Level Exposure to Worker mentioned in the Ministry of Industry Promulgation about Safety Operation Standard for Factory Working and Environment B.E. 2546, and Ministry of Labor Regulation about Management Standard and Occupational Health and Safety and Working Environment B.E. 2559.

### **3) Health impact from noise exposure**

Loud noise exposure over limitation standard causes by working environment of surrounding environment affects hearing ability for both acute and chronic impact. Loud noise exposure leads to temporary or permanent hearing loss. Losing hearing ability is incurable disease due to hearing nervous disorder. The international classification disease (ICD-10) has assigned disease code for hearing loss due to loud noise as conductive hearing loss (CHL) by H83.3, and Sensorineural hearing loss (SNHL) by H90.3-H90.5.

Conductive hearing loss composes of Acoustic trauma, and Noise-induced hearing loss. Those hearing loss is caused by suddenly loud noise which has headache, ears pain, and ears tissue damage. The Occupational Health and Safety Administration (OSHA) has limited maximum suddenly loud noise to 140 dB(A) while hearing loss is depends on noise frequency according to continuous noise or interrupted noise. Loud noise over 85 dB(A) can cause Occupational noise-induce hearing loss due to manufacturing operation while Non-occupation noise-induce hearing loss are those noise as same as noise from dental equipment. Therefore, risk factor of hearing loss is from loud noise.

Hearing loss record obtained from Bureau of Policy and Strategy, Ministry of Public Health had indicated that the most affected province is Payao, followed by Lampoon, and Phare with number of patients of 244.65, 242.74, and 211.17 patients per 1,000 capita, respectively. Mostly patients are female (51.63%), followed by male (48.37%). The most affected age is 60 years old (54.97%), 55-59 years old (10.38%), and 50-54 years old (7.97%), respectively by which the most affected career is farmer (19.37%), followed by temporary employee (13.38%), and permanent employee (9.44%) , respectively. Consideration for ICD-10 (The international classification disease), it was found that most of the patients is H90.3 (hearing loss due to hearing nervous damaged for both sides by 53.21%), followed by H90.5 (unidentified cause of hearing loss by 31.67%), and H90.4 (hearing loss due to hearing nervous damaged only one side without any hearing condition for another side by 13.38%), respectively. For hearing loss in Songkhla, it was found that in B.E. 2556 there were patients of H83.3; Conductive hearing loss (CHL) by 2 male patients, and in B.E. 2557 there were totally 1,042 patients which were 489 male patients and 553 female patient. Data reported in B.E. 2557 was a total patients according to hearing loss (H83.3, H90.3, H90.4, and H 90.5).

The project will develop measures and mitigations for noise reduction by making Noise Contour over the entire area of the power plant within 1 year, and reviewing the noise contour map every 3 years especially a new equipment installation for using as guideline for controlling and resolving noise problem, and covering noise sources according to engineering principles including



labelling warning signs to use PPE over those loud noise areas for saving hearing ability of operation staffs, and set up preventive maintenance routinely for reducing noise level using lubricants to reduce vibration of machine and equipment.

### **(3) Heat**

#### **1) Heat sources**

Heat sources in the manufacturing process of the project is a combustion process to generate heat for using by boiler to generate electricity.

#### **2) Heat level in workplace**

Heat generated from fuel combustion for boiler and heat transfer from steam in boiler to move steam turbine for electricity generating. Temperature in boiler (Super heater) is around 520°C.

#### **3) Health impact from heat exposure**

Manufacturing process of the project is causing high temperature, and releasing heat to ambient environment. Thus, it is increasing working temperature around those manufacturing areas (boiler, electricity generator, and cooling tower). Therefore, working staffs in those areas have high risk for heat exposure by which those areas have high temperature with low humidity. Working procedures in those areas are adjusting parameter at controlling cabinets, material feeding, and data recording. The works are classified as light work which are limited working temperature at 34°C. The ACGIH has suggested working duration by 8 hrs/day under 5 days/week without any impact (Threshold Limit Value: TLV) by which working temperature is 31.0°C (ACGIH, 2007). Heat exposure from manufacturing process of the project indicated that direct heat exposure staffs are those who are working under high temperature area by which human body has mechanism to adjust body temperature to normal condition using heat exchanging between skin and environment. An exceeding heat can cause significant health impact to human. However, level of heat exposure from the project is low which is not causing uncomfortable feeling, and annoyance.

### **(4) Chemicals**

#### **1) Chemical Sources**

The project uses chemicals for water quality adjustment before using in boiler, and cooling tower.

## **2) Chemicals type used in the project**

Power plant operation requires steam for moving turbine for electricity generating, and preventing any reaction in boiler. Those required chemicals are substances to prevent microbiological growth in boiler and corrosion prevention by which the chemicals have reaction with oxygen to block other chemical reaction in boiler. Furthermore, some chemicals are used for boiler cleaning during shutdown.

## **3) Health impact from chemicals exposure**

Target group for chemical exposure are those staffs who work in electricity generating process (boiler and cooling tower sections). Toxicity of chemicals caused by digestion, inhalation, and skin and eyes contact. Chemical exposure pathways are from direct dispersion and leakage from careless operation. Health impacts are eyes irritant upper respiratory inflammation, and dermal irritant. Sensitive group is those that are allergic to chemicals or asthma patients. A chronic exposure is causing upper respiratory irritant, nose irritant, bronchitis, itchy to skin under dermal exposure, and eyes irritant. Acute effect is caused by long exposure to chemicals.

Measure for safety operation with chemicals is conducted by assigning occupational health and safety committee for safety planning and audition, providing sufficient PPE to staffs for chemical operation, and reviewing chemical data (type, amount, storage, and hazardous information) yearly for emergency operation. Furthermore, additional measures are required for leakage prevention during transportation, safety checking before transferring with safety equipment and proper standard linkage, and avoiding or keeping chemical with other substances.

## **(5) Working accident**

### **1) Characteristic of working accident**

Manufacturing process of the project has using large machine and equipment such as boiler, chemical conveyor, and biomass conveyor to combustion.

### **2) Health impact from working accident**

Many factories have assistant machine for helping manufacturing process to save time and cost of operation, however, those machine must be operated properly and suitable for particular job to avoid working accident. Unwanted accident leads to employee injury and losing that

person. Main cause of accident is unsafe operation such as inexperienced operation, sudden stoppage of machine, improper tools application, not wearing PPE, and illegal safety operation. Additional causes of accident that brought about unsafe condition are using broken-down equipment, dirty operation platform, and improper working area (improper chemical management) including unsafe working place (insufficient light, loud noise, and inefficiency ventilation). However, accidental cases of the project are injury which can be recovered without disability or death to cause long term impact.

The project has measures for controlling accident by setting up occupational health and safety committee for managing and controlling working procedures by which assigning a monthly meeting for assessing and reviewing problems to seek for proper solution and making safety guide for operation to use as safety procedure, training and providing knowledge about occupational health and safety according to working characteristic and safety procedure for new and current staffs routinely, informing operation staffs about safety procedures for maintaining safety operation and accidental prevention with responsibility according to emergency plan, and providing sufficient Personal Protective Equipment (PPE) to operation staffs.

#### **5.6.5.3 Health impact to local peoples**

Health impact assessment to local peoples was considered from project activities causing alteration of health determinant factors. According to scope of the study, health harassment consists of air pollution, noise, and public health service system.

##### **(1) Air pollutants**

###### **1) Air pollution sources**

Sources of air pollutants of the project from construction period are those land preparation, foundation installation, and civil and building works. While air pollutants sources from operation period are from combustion process by which criteria air pollutants are TSP, PM-10, NO<sub>2</sub>, and SO<sub>2</sub>.

###### **2) Concentration of air pollutants**

Air quality monitoring results during B.E. 2557-2559 were obtained from 4 stations which were Nuruchchamchee, Rohmah, Plugpor, and Mungwan Mosques. It was found that all 4 criteria pollutants have not exceeded the national ambient air quality standard according to the NEB promulgation issued 21<sup>st</sup> (B.E. 2544), 24<sup>th</sup> (B.E. 2547), and 33<sup>rd</sup> (B.E. 2552).

### **3) Health impact from air pollutants exposure**

Record of respiratory disease of local peoples was obtained from 9 hospitals in the study area which these are: (i) Chana Hospital, (ii) Khu Sub District Health Promotion Hospital, (iii) Khae Sub District Health Promotion Hospital, (iv) Nawah Sub District Health Promotion Hospital, (v) Khuntudwai Sub District Health Promotion Hospital, (vi) Tamorsai Sub District Health Promotion Hospital, (vii) Sapanmaikan Sub District Health Promotion Hospital, (viii) Paching Sub District Health Promotion Hospital, and (ix) Ban Langar Community Health Center. It was found that during B.E. 2554-2558, the highest number of respiratory patients was the Khae, and Sapanmaikan Sub District Health Promotion Hospitals while others had the same patient rate. According to those 4 air quality monitoring stations which were Nuruchchamchee, Rohmah, Plugpor, and Mungwan Mosques, it was found that air quality is highest TSP at Rohmoh mosque and lowest TSP at Plugpor mosque by which ambient air pollutant concentration were not related to illness rate which was the highest patient rate has the lowest ambient TSP concentration (Khae Sub District Health Promotion Hospital is located in air shed of Ban Mungwan station, and Sapanmaikan Sub District Health Promotion Hospital is located in air shed of Nuruchchamchee station. However, location of monitoring station at Rohmoh mosque is closed to roadside which was the main reason there is an increase dust concentration. A comparison of respiratory patient rate to dermal patient and tissue under skin patient rates was not correlated (Correlation graph between respiratory patient rate to dermal patient and tissue under skin patient rates).

Health risk impact according to air pollutants exposure from project activities were assessed by using air quality modeling with additional background concentration for representing actual exposure to local peoples by;

#### **A. Construction period**

Construction period has air pollution sources from land preparation, foundation installation, and civil and building work. Ambient air quality assessment revealed that maximum concentration is happen in the project area by which details of health risk from ambient air quality assessment is explained by;

##### **A) TSP**

Predicted ambient air concentration for TSP according to construction activity for maximum 24 hours averaging, and yearly averaging are 210.115, and 0.0176 micrograms/cu.m., respectively at Chana Chanupatham School, and Moo 3 (Ban Nayum). Risk ratio for acute and chronic exposure are 0.6367, and 0.000176, respectively. Thus, health risk from those TSP exposure is lower than 1.0 for all observing points indicating low impact.

#### **B) PM-10**

Predicted ambient air concentration for PM-10 according to construction activity for maximum 24 hours averaging, and yearly averaging are 43.074, and 0.0113 micrograms/cu.m., respectively at Chana Chanupatham School, and Moo 3 (Ban Nayum). Risk ratio for acute and chronic exposure are 0.3590, and 0.000226, respectively. Thus, health risk from those PM-10 exposure is lower than 1.0 for all observing points indicating low impact.

#### **C) NO<sub>2</sub>**

Predicted ambient air concentration for NO<sub>2</sub> according to construction activity for maximum 1 hour averaging, and yearly averaging are 26.92, and 0.0556 micrograms/cu.m., respectively at Chana Chanupatham School, and Moo 3 (Ban Nayum). Risk ratio for acute and chronic exposure are 0.0841, and 0.000975, respectively. Thus, health risk from those NO<sub>2</sub> exposure is lower than 1.0 for all observing points indicating low impact.

#### **D) SO<sub>2</sub>**

Predicted ambient air concentration for SO<sub>2</sub> according to construction activity for maximum 24 hours averaging, and yearly averaging are 4.253, and 0.00972 micrograms/cu.m., respectively at Chana Chanupatham School, and Moo 3 (Ban Nayum). Risk ratio for acute and chronic exposure are 0.0142, and 0.0001, respectively. Thus, health risk from those NO<sub>2</sub> exposure is lower than 1.0 for all observing points indicating low impact.

#### **(B) Operation period**

Operation period has air pollution sources from boiler, and electricity generator. Ambient air quality assessment revealed that maximum concentration happened in the project area and surrounding area which are agricultural area and hills by which details of health risk from ambient air quality assessment is explained by;

#### **A) TSP**

Predicted ambient air concentration for TSP according to operation activity for maximum 24 hours averaging, and yearly averaging are 213.08, and 0.70 micrograms/cu.m., respectively at Chana Chanupatham School, and Moo 3 (Ban Nayum). Risk ratio

for acute and chronic exposure are 0.6457, and 0.007, respectively. Thus, health risk from those TSP exposure is lower than 1.0 for all observing points indicating low impact.

#### **B) PM-10**

Predicted ambient air concentration for PM-10 according to operation activity for maximum 24 hours averaging, and yearly averaging are 44.78, and 0.41 micrograms/cu.m., respectively at Chana Chanupatham School, and Moo 3 (Ban Nayum). Risk ratio for acute and chronic exposure are 0.0305, and 0.0114, respectively. Thus, health risk from those PM-10 exposure is lower than 1.0 for all observing points indicating low impact.

#### **C) NO<sub>2</sub>**

Predicted ambient air concentration for NO<sub>2</sub> according to operation activity for maximum 1 hour averaging, and yearly averaging are 63.26, and 1.97 micrograms/cu.m., respectively at Chana Chanupatham School, and Moo 3 (Ban Nayum). Risk ratio for acute and chronic exposure are 0.1977, and 0.0345, respectively. Thus, health risk from those NO<sub>2</sub> exposure is lower than 1.0 for all observing points indicating low impact.

#### **D) SO<sub>2</sub>**

Predicted ambient air concentration for SO<sub>2</sub> according to operation activity for maximum 24 hours averaging, and yearly averaging are 9.16, and 1.14 micrograms/cu.m., respectively at Chana Chanupatham School, and Moo 3 (Ban Nayum). Risk ratio for acute and chronic exposure are 0.0305, and 0.0114, respectively. Thus, health risk from those SO<sub>2</sub> exposure is lower than 1.0 for all observing points indicating low impact.

It was found that predicted ambient air concentration for all pollutant given maximum concentration at Chana Chanupatham School, and Moo 3 (Ban Nayum) while other places did not show different impact. The most significant pollutant is TSP which had the highest concentration comparing with other pollutants. Health impact from dust exposure depends on ability of pollutants to penetrate the respiratory system by which large size dust can irritate upper respiratory system causing mucus to narrow and inflame bronchus. The long term inflaming bronchus is a chronic effect especially those immune disorder patients causing asthma. Improper management combustion can cause micro size dust (PM-10) which can penetrate lower respiratory system. An assessment found that PM-10 concentration was 44.78 micrograms/cu.m. which was slightly increasing only 1.78 micrograms/cu.m. (monitoring result for PM-10 was 43 micrograms/cu.m.) by which the PM-10 can affect sensitive target group causing irritation to respiratory system. Therefore, the project has made

measures for controlling air pollutants emitted from boiler according to ambient concentration and emission standards.

## **(2) Noise**

### **1) noise sources**

Noise sources of the project during construction period are foundation installation, structural development, and decoration while noise sources from operation are wood chopping, boiler operation, and electricity generation.

### **2) Noise level in communities**

Noise level parameters for noise level monitoring in communities are Leq 24 hr, and Lmax. There are 3 monitoring stations which are Chana Chanupatham School, Rohmoh mosk, and Moo6 Ban tung, Khu sub district. Noise level monitoring results were not exceed noise level standard according to the NEB promulgation issued 15<sup>th</sup> (B.E. 2540) about general noise level standard.

### **3) Health impact from noise exposure**

Construction activities causing loud noise are land preparation, foundation installation, structural development, and decoration. The most loud noise is pile rig operation for foundation installation causing noise level of 88 dB(A) at the distance of 15 m. Noise level assessment for Leq 24 hr during construction period was 53.9 dB(A) at the Chana Chanupatham School which had noise level less than 10 dB(A). However, noise level exposure risk to local people in communities was 85% for Leq 24 hr standard which is indicating low level for health impact.

Noise sources during operation period are wood chopping, boiler operation, and electricity generation by which noise level from those sources are 85 dB(A). Noise level assessment for maximum Leq 24 hr. was 56.2 dB(A) at the Chana Chanupatham School which had noise level less than 10 dB(A). However, noise level exposure risk to local people in communities was 80% for the Leq 24 hr standard which is indicating low level for health impact.

It was found that noise level from project operation has low risk to health impact by which communication noise level is around 40-50 dB(A) which is not affect hearing ability. Noise impact to living quality and daily life of peoples is considered equal to communication noise level.. The WHO has indicated that outdoor safety noise level not to exceed 50-55 dB(A). Furthermore, the

construction activity will not operate during 17.00-8.00 hrs of the next day to reduce noise impact in then nighttime. For operation period, covering sheet is applied to noise sources (noisy machine) which is easily open during repair while routine maintenance is planned for machine to reduce vibration causing noise such as using lubricants to moving parts. An additional measures for noise reduction are conducted by providing community relation staffs to acquire opinion about noise impact from project operation continuously and use opinion data to review noise reduction plan, and informing communities about noise impact according to timing of engine start for power plant test-run.

### **(3) Health service system**

#### **1) Health service requirement**

During construction period, workers require health service when getting injury and illness including working accident. Furthermore, remote workers could bring remote disease to local peoples. Therefore, public health service staffs will have more work load for managing and controlling diseases according to an increasing of workers and their families.

Results of people opinion about health service system revealed that in case of illness, they used governmental hospital as the first priority, followed by sub district health promotion hospital, and private clinic, respectively. Illnesses which were treated by sub district health promotion hospital are cough/mucus, itchy, muscle pain, headache, GI tract disease, allergic, respiratory disease, eyes irritant, cold, vomiting, asthma, pneumonia, weakness, and emphysema.

#### **2) Local health service under the national health service system**

Health service station in the study area are under national health service insurance system. The system consists of 2 levels which are Contracting Unit for Primary care, (CUP), and Contracting Unit for Secondary care (CUS). The CUP is those sub district health promotion hospital, and sub district health center. The CUS is only 1 community hospital which is the Chana Hospital. The CUP is easily for accessing to service under the Front-line care before transfer patients to CUS. The CUP has duty to provide health care for all ages according to health problems by which the service aims to provide knowledge for health promotion and health suggestion to peoples before and after illness. The CUS provide complicated health service particularly emergency case from the CUP.

#### **3) Health service impact**



Construction period has a maximum workers around 300 person, and operation period has staffs around 65 person. The project has policy to employ local peoples to work according to work type. Health service requirement for construction workers due to illness and injury is a first aid conducted by nursing unit of the project. In case of emergency, those workers can get health service from local hospital using social insurance system. Those mild illnesses (cold, allergic, and food toxic) will be treated using public health centers in the community with assistance from local health service staffs. Additional remote worker could bring remote disease to the area causing an increase number of patients. Air pollutants also cause increasing number of patients with respiratory disease, allergic, lung disease which are requiring additional health service staffs and budget.

#### **5.6.6 Priority of significant level of health impact**

Priority of significant level of health impact is a consideration for relation between exposure risk and level of impact for making measures and mitigations for health impact reduction as shown in the **Table 5.6.6-1**, and **Table 5.6.6-2**. Project will apply Thai Law and IFC guidelines on air emission and ambient air quality.

**Table 5.6.4-1**

**Analysis issues causing alteration for health factors to be used as study scopes during construction**

**Chana Green Power Plant Project of the Chana Green Co., Ltd.**

Project Activity	Health factors for health impact assessment							Significant level	Referencing data used for assessment
	Health Threaten	Natural Resource and Environment	Exposure Factor	Health Impact	Health Service Impact	Social and Living Impact	Worrying <sup>1/</sup>		
1. Land development for construction	- Total Suspended Particulate (TSP)	- Contamination and dispersion to environment	- Inhalation and dermal exposure - Construction workers - Children, elderly person, and inhalation patient - People living in dispersion zone	- Inhalation disorder, dermal disease, immune system disorders, and asthma	- Service requirement of construction workers, and local peoples who are affected by project activities	- Causing dirt to local buildings and important places	-	-1	- Air quality assessment - Current ambient TSP - Secondary data obtained from sub district health promotion hospital and related health organizations
	- Particulate Matter: 10 microns (PM-10)	- Contamination and dispersion to environment	- Inhalation and dermal exposure - Construction workers - Children, elderly person, and inhalation patient - People living in dispersion zone	- Inhalation disorder, dermal disease, immune system disorders, and asthma - Heart disease, angina pectoris, and pneumonia	- Service requirement of construction workers, and local peoples who are affected by project activities	-	-	-1	- Air quality assessment - Current ambient PM-10 - Secondary data obtained from sub district health promotion hospital and related health organizations

**Table 5.6.4-1 (Continued)**

Project Activity	Health factors for health impact assessment							Significant level	Referencing data used for assessment
	Health Threaten	Natural Resource and Environment	Exposure Factor	Health Impact	Health Service Impact	Social and Living Impact	Worrying <sup>1/</sup>		
(Continued)	- Nitrogen Dioxide (NO <sub>2</sub> )	- Contamination and dispersion to environment	-Inhalation and dermal exposure -Construction workers - Children, elderly person, and asthma and emphysema patient - People living in dispersion zone	- Inhalation disorder, bronchitis, and pneumonia	- Service requirement of construction workers, and local peoples who are affected by project activities	- Causing damage to buildings/places built by cement and iron	-	-1	- Air quality assessment - Current ambient NO <sub>2</sub> - Secondary data obtained from sub district health promotion hospital and related health organizations
	- Sulfur - Dioxide (SO <sub>2</sub> )	- Contamination and dispersion to environment	-Inhalation and dermal exposure -Construction workers -Children, elderly person, and asthma and emphysema patient -People living in dispersion zone	- Affect to eyes tissue and skin - Inhalation disorder, bronchitis, and pneumonia	- Service requirement of construction workers, and local peoples who are affected by project activities	- Causing damage to buildings/places built by cement and iron	-	-1	- Air quality assessment - Current ambient SO <sub>2</sub> - Secondary data obtained from sub district health promotion hospital and related health organizations

**Table 5.6.4-1 (Continued)**

Project Activity	Health factors for health impact assessment							Significant level	Referencing data used for assessment
	Health Threaten	Natural Resource and Environment	Exposure Factor	Health Impact	Health Service Impact	Social and Living Impact	Worrying <sup>1/</sup>		
2. Equipment installation	- Noise	-	- Noise from construction equipment - Construction workers - People living nearby construction site/noise sources	- Hearing efficiency of construction workers - Annoying to people living nearby the project and interfering sleeping time	- Service requirement of construction workers	- Interfering daily activities of local peoples - Interfering social activities of surrounding communities	- Worrying about noise from a using of pile-driver which is affecting educational activity, because the project is located nearby a school	-1	- Noise assessment - Current noise monitoring results - Complaints
3. Construction material transportation	- Traffic Volume - Accident	-	- People using material construction transportation roads	- Injury from accident - Increasing stress due to high traffic volume	- People requirement to use same transportation roads of the project	- Road surface destroying - Affecting personnel connection and social activities due to high volume of traffic	-	-1	- Current traffic volume in the study area - Number of transportation shifts - Accidental statistic and results - Emergency medical service system

**Table 5.6.4-1 (Continued)**

Project Activity	Health factors for health impact assessment							Significant level	Referencing data used for assessment
	Health Threaten	Natural Resource and Environment	Exposure Factor	Health Impact	Health Service Impact	Social and Living Impact	Worrying <sup>1/</sup>		
4. Construction worker	- Waste	- Source of contagion - Waste accumulation - Contamination from leachate to public reservoir	- Exposure to contagions causing illness due to infection - Distribution of contagions causing disease contamination to foods and water	- Gastrointestinal tract illness caused by bacteria and infectious	- Service requirement of construction workers, and local peoples - Disease control budget of government organizations to control contagions	- Increasing work load of local organizations to eliminate waste	-	-1	- Waste management plan of local organizations - Amount of waste generated from construction activity
	- Wastewater	- Contamination to public reservoir	- People using contaminated water	-Gastrointestinal tract illness caused by bacteria and infectious	-	-	-	-1	- Wastewater discharged from construction activity and worker consumption - Efficiency of wastewater treatment system
	- Contagious Disease	-	- Health behavior of construction workers - Accommodation sanitary	- Gastrointestinal tract illness, other contagious diseases, and sexually transmitted disease	- Health service requirement of local peoples and workers - Disease control budget of government organizations	-	-	-1	-Secondary data obtained from sub district health promotion hospital and related health organizations

**Table 5.6.4-1 (Continued)**

Project Activity	Health factors for health impact assessment							Significant level	Referencing data used for assessment
	Health Threaten	Natural Resource and Environment	Exposure Factor	Health Impact	Health Service Impact	Social and Living Impact	Worrying <sup>1/</sup>		
(Continued)	- Occupational Disease/ Working accident	-	- construction workers	- Injury from accident	- Service requirement of construction workers	-	-	-1	- Construction characteristic causing injury/illness from operation - Emergency medical service system - Safety plan of construction subcontractor
	- Life and property safety	-	- construction workers - Local peoples	- Injury from squabble - Worrying about isolation and life and property safety	-	- Alteration of living quality	-	-1	- Number of remote workers
	- Community employment	-	- Local peoples - Commercial entrepreneurs	-	-	- Increasing income from additional workers and staffs of the project	-	+1	-

Remark: <sup>1/</sup>Worrying obtained from public participation meetings (PP1 and PP2)

Source: Consultants of Technology Co.Ltd., 2560

**Table 5.6.4-2**

**Analysis issues causing alteration for health factors to be used as study scopes during operation**

**Chana Green Power Plant Project of the Chana Green Co.ltd.**

Project Activity	Health factors for health impact assessment							Significant level	Referencing data used for assessment
	Health Threaten	Natural Resource and Environment	Exposure Factor	Health Impact	Health Service Impact	Social and Living Impact	Worrying <sup>1/</sup>		
5. Fuel storage area	- Interfering Odor	-	- Odor exposure	- Annoying from odor and bad smell	-	-	- Does the fuel storage area is an open area or a closed building? The open area can emit sour odor when raining.		- Fuel storage management - Water drainage , and irrigation management systems of the project
6. Fuel preparation	- Total Suspended Particulate (TSP)	- Contamination and dispersion in working area	- Inhalation, dermal, and eyes tissue exposure - Project staffs	-Inhalation disorder, dermal disease, immune system disorders, and asthma due to TSP exposure	- Health service requirement of Project staffs	- Causing dirty to local buildings and important places	- Worrying about dust dispersion from an operation of the power plant. - Plant growing for using as buffer zone might not be tall enough when the power plant is operated. Thus, plant growing should be	-1	- Occupational health plan of the project - Fuel transportation management system

							done during construction.		
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**Table 5.6.4-2 (Continued)**

Project Activity	Health factors for health impact assessment							Significant level	Referencing data used for assessment
	Health Threaten	Natural Resource and Environment	Exposure Factor	Health Impact	Health Service Impact	Social and Living Impact	Worrying <sup>1/</sup>		
(Continued)	- Noise from wood chopping	-	- Noise exposure - Project staffs - People living nearby noise sources	- Affecting hearing ability of Project staffs -Annoying to people living nearby the project and interfering rest time	- Health service requirement of Project staffs	-Interfering social activities of surrounding communities	- Noise from wood chopping especially nighttime which is resting time, and a combination between roots and branches of wood pieces can make loud noise rather than branches or trunks.		- Noise impact assessment - Distance from communities and important places to noise sources.



7. Fuel combustion for electricity generation	- Particulate Matter: 10 microns (PM-10)	- Contamination and dispersion in working area	- Inhalation, dermal, and eyes tissue exposure - Children, elderly person, heart patient, and asthma and emphysema patient - People living in dispersion zone	- Inhalation disorder, bronchitis, and pneumonia	- Health service requirement of community peoples	- Causing dirty to local buildings and important places	- Worrying about dust dispersion from operation - Frequency and organizations for air quality monitoring, and participation by communities in monitoring process	-1	- Efficiency of pollution treatment system - Impact assessment using air quality modeling - PM-10 monitoring results - Secondary data obtained from related health organizations
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**Table 5.6.4-2 (Continued)**

Project Activity	Health factors for health impact assessment							Significant level	Referencing data used for assessment
	Health Threaten	Natural Resource and Environment	Exposure Factor	Health Impact	Health Service Impact	Social and Living Impact	Worrying <sup>1/</sup>		
(Continued)	- Nitrogen Dioxide (NO <sub>2</sub> )	- Contamination and dispersion to environment	- Inhalation, and dermal exposure - Children, elderly person, heart patient, and asthma and emphysema patient - People living in dispersion zone	- Inhalation disorder, bronchitis, and pneumonia	- Health service requirement of community peoples	- Causing damage to buildings/places built by cement and iron	-	-1	- Air quality assessment using air quality modeling - Efficiency of pollution treatment system - Personnel data obtained from sub district health promotion hospital - Secondary data obtained from related health organizations

	- Sulfur Dioxide (SO <sub>2</sub> )	-Contamination and dispersion to environment	- Inhalation, and dermal exposure - Children, elderly person, heart patient, and asthma and emphysema patient - People living in dispersion zone	-Affect to eyes tissue and skin  -Inhalation disorder, bronchitis, and pneumonia	- Health service requirement of community peoples	-Causing damage to buildings/places built by cement and iron	- Does an emission of SO <sub>2</sub> can cause acid rain?	-1	- Air quality assessment using air quality modeling - Efficiency of pollution treatment system - Personnel data obtained from sub district health promotion hospital - Secondary data obtained from related health organizations
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**Table 5.6.4-2**

Project Activity	Health factors for health impact assessment							Significant level	Referencing data used for assessment
	Health Threaten	Natural Resource and Environment	Exposure Factor	Health Impact	Health Service Impact	Social and Living Impact	Worrying <sup>1/</sup>		

(Continued)	- Heat	- Heat convection to atmosphere	- Crop products get damaged by heat	-	-	- Causing damage to crop products	<ul style="list-style-type: none"> <li>- Does the power plant increase ambient temperature?</li> <li>- The project can increase ambient temperature which is effecting crop productions such as decreasing latex</li> <li>- Does heat generated from operation affect small organisms such as insects?</li> </ul>	-1	<ul style="list-style-type: none"> <li>- Efficiency of pollution treatment system</li> <li>- Data of heat impact to crop production</li> </ul>
	- Ash	- Contamination and dispersion to environment	<ul style="list-style-type: none"> <li>- Inhalation and dermal exposure</li> <li>- Project staffs</li> </ul>	- Inhalation disorder, dermal disease, immune system disorders, and asthma due to ash exposure	- Health service requirement of Project staffs and community peoples	- Causing dirty to local buildings and important places	<ul style="list-style-type: none"> <li>- How to eliminate ash?</li> <li>- It should has a clear studying result for a feasibility study of applying ash to agriculture.</li> </ul>	-1	<ul style="list-style-type: none"> <li>- Heat management plan of the project</li> <li>- Occupational health plan of the project</li> </ul>

**Table 5.6.4-2 (Continued)**

	<b>Health factors for health impact assessment</b>		
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Project Activity	Health Threaten	Natural Resource and Environment	Exposure Factor	Health Impact	Health Service Impact	Social and Living Impact	Worrying <sup>1/</sup>	Significant level	Referencing data used for assessment
8. Electricity generation	- Noise from electricity generator	-	<ul style="list-style-type: none"> <li>- Noise exposure</li> <li>- Project staffs</li> <li>- Peoples living nearby noise sources</li> </ul>	<ul style="list-style-type: none"> <li>- Affecting hearing ability of Project staffs</li> <li>- Annoying to people living nearby the project and interfering rest time</li> </ul>	<ul style="list-style-type: none"> <li>- Health service requirement of Project staffs and community peoples</li> </ul>	<ul style="list-style-type: none"> <li>- Interfering social activities of surrounding communities</li> </ul>	<ul style="list-style-type: none"> <li>- Does the project operates all times? Noise from operation can disturb sleeping period.</li> <li>- Worrying about noise from the project, because there are a lot of noise sources from factories in the area.</li> </ul>	-1	<ul style="list-style-type: none"> <li>- Noise impact assessment</li> <li>- Distance from communities and important places to noise sources.</li> </ul>
	- Waste water	- Contamination to public reservoir	- Contamination to water quality	- Contamination of wastewater from processing to natural water reservoir	-	<ul style="list-style-type: none"> <li>- Reducing water quality of natural reservoir due to contamination</li> </ul>	<ul style="list-style-type: none"> <li>- How to manage wastewater treatment system before discharging to natural reservoir, and the wastewater affecting marine animals or not?</li> <li>- Worrying about wastewater.</li> </ul>	-1	<ul style="list-style-type: none"> <li>- Amount of wastewater discharge</li> <li>- Efficiency of wastewater treatment system</li> </ul>

**Table 5.6.4-2 (Continued)**

Project Activity	Health factors for health impact assessment							Significant level	Referencing data used for assessment
	Health Threaten	Natural Resource and Environment	Exposure Factor	Health Impact	Health Service Impact	Social and Living Impact	Worrying <sup>1/</sup>		
9. Fuel transportation	<ul style="list-style-type: none"> <li>- Additional traffic volume</li> <li>- Accident</li> </ul>	-	<ul style="list-style-type: none"> <li>- People using same roads with the project material transportation routes</li> </ul>	<ul style="list-style-type: none"> <li>- Material, equipment, and biofuel transportation on transportation routes increase traffic volume which is increasing accidental risk due to careless of drivers (local peoples and project staffs) causing violent accident</li> <li>- Increasing stress due to high traffic volume</li> </ul>	<ul style="list-style-type: none"> <li>- Health service requirement of transportation route users</li> </ul>	<ul style="list-style-type: none"> <li>- Affecting personnel connection and social activities due to high volume of traffic</li> </ul>	<ul style="list-style-type: none"> <li>- How much does the weight per trip, and how many trips/day of transportation?</li> <li>- Transportation impact should be conducted by comparing accidental cases before and after operation</li> </ul>	-1	<ul style="list-style-type: none"> <li>- Traffic volume in the area</li> <li>- Number of fuel and waste transportation trips</li> <li>- Accidental records and results statistic</li> <li>- Emergency medical service system</li> </ul>

**Table 5.6.4-2 (Continued)**

Project Activity	Health factors for health impact assessment							Significant level	Referencing data used for assessment
	Health Threaten	Natural Resource and Environment	Exposure Factor	Health Impact	Health Service Impact	Social and Living Impact	Worrying <sup>1/</sup>		
10. Working accident	- Chemical - Working accident	-	- Project staffs	- Injury caused by chemical exposure - Injury caused by accident from working	- Health service requirement of Project staffs	-	- Does the project has safety system plan for staffs after operation?	-1	- Working environment - Manufacturing process of the project - Emergency plan - Chemicals used by the project
11. Consumption water	- Water insufficient	- Decreasing of natural fresh water	- Water consumption of the project	- Worrying about water consumption of the project which is possibly make water tussle problem between the project and local peoples	-	-	- Worrying about water level in the Natawee Canal, because provincial tap water authority using this canal for making tap water. An operation of the project can affect water supply for tap water service.	-1	- Water consumption data of the project - Current water supply data in the study area
12. Project staff	- Waste	- Land filling area	-	-	-	- Increasing work load of local organizations to eliminate waste	-	-1	- Waste elimination service data - Amount of waste generated by staffs

Remark: 1/Worrying obtained from public participation meetings (PP1 and PP2)

Source: Consultants of Technology Co., Ltd. 2559

**Table 5.6.6-1**

**Measures and mitigations for health impact reduction of the Chana Green Power Plant, Chana Green Co.ltd. (Construction Period)**

Health Threaten	Target Group	Health Risk Assessment Matrix		Measure for health impact reduction	Measure for health promotion
		Risk Opportunity	Significant Level		
1. Air pollutants (TSP, PM-10, NO <sub>2</sub> and SO <sub>2</sub> )	- Construction workers	- Land filling for elevation adjustment causes dust dispersion while machine operation for construction release NO <sub>2</sub> and SO <sub>2</sub> , however, maximum emission assessment indicated that ambient air quality still not exceed ambient air quality standard according to the promulgation of the National Environmental Board (NEB) issued 21 <sup>st</sup> (B.E. 2544), 24 <sup>th</sup> (B.E. 2547), and 33 <sup>rd</sup> (B.E. 2552) by which the construction workers will operate for 8 hrs/day. Therefore, pollutant exposure is considered <b>moderate (3)</b>	- Concentration level of dust can cause irritation to eyes tissue and inhalation system. An exposure of NO <sub>2</sub> over 1 hr is affecting asthma patients. Health risk assessment of acute effects revealed that TSP= 0.67, PM-10 = 0.41, NO <sub>2</sub> = 0.68, and SO <sub>2</sub> = 0.03. While a chronic effects was found TSP= 0.01, PM-10 = 0.02, NO <sub>2</sub> = 0.82, and SO <sub>2</sub> = 0.008 by which risk ratio assessment is less than 1.0. Therefore, pollutant exposure causes mild illness which is recovery within 2-3 days. Thus, significant level is considered <b>low (2)</b>	- Spraying water over those construction areas and related activity areas such as roads, and land filling areas 2 times/day (morning and afternoon sessions). And, an additional spraying time will be considered according to meteorological condition.  - Limiting and controlling truck speed to reduce dust dispersion which is not exceed 30 km/hr.	-
		Significant level according to health risk is determined <b>moderate (3x2=6)</b>			
	- Peoples living in dispersion area	- Construction activity causes dust dispersion to environment affecting surrounding communities by which a maximum air pollutants dispersion assessment indicated that affecting areas was the Chana Chanupathum School and Moo3 (Ban Nayum).	- Concentration of all air pollutants were not exceed ambient air quality standard. The most significant air pollutant is TSP which is irritating upper respiratory tract to cause a cough, sneeze, or eyes irritant.	- Covering trucks with canvas while transporting construction material to avoid material falling on roads.	-

**Table 5.6.6-1 (Continued)**

Health Threaten	Target Group	Health Risk Assessment Matrix		Measure for health impact reduction	Measure for health promotion
		Risk Opportunity	Significant Level		
(Continued)		However, other areas do not have different air pollutant concentration. Furthermore, ambient air quality still not exceed ambient air quality standard according to the promulgation of the NEB issued 21 <sup>st</sup> (B.E. 2544), 24 <sup>th</sup> (B.E. 2547), and 33 <sup>rd</sup> (B.E. 2552) for all observation areas. Therefore, pollutant exposure to peoples is considered <b>moderate (3)</b> .	Health risk assessment of acute effects revealed that TSP = 0.64, PM-10 = 0.36, NO <sub>2</sub> = 0.08, and SO <sub>2</sub> = 0.01. While a chronic effects was found TSP = 0.0002, PM-10 = 0.0002, NO <sub>2</sub> = 0.001, and SO <sub>2</sub> = 0.0001 by which risk ratio assessment is less than 1.0. Therefore, pollutant exposure might not affect working or living quality which is not causing illness to local peoples. Thus, significant level is considered <b>low (2)</b>	- Cleaning wheels before leaving the construction areas all the times to reduce dust dispersion.	
		Significant level according to health risk is determined <b>Low (3x2=6)</b>			
	- Sensitive peoples	- Construction activity causes dust dispersion to environment affecting surrounding communities. Affecting target groups are those children, elderly peoples, and patients with respiratory conditions. However, maximum air pollutants concentration over the observation areas still not exceed ambient air quality standard according to the promulgation of the NEB issued 21st (B.E. 2544), 24th (B.E. 2547), and 33rd (B.E. 2552).	- TSP concentration is not affecting health condition according to US EPA criteria, while NO <sub>2</sub> and SO <sub>2</sub> concentrations are also not affecting health condition. Thus, air pollutants do not cause injury or illness to risk groups by which those air pollutants is not considered health impact. Thus, significant level is considered <b>low (2)</b> .	- Covering trucks with canvas while transporting construction material to avoid material falling on roads. - Cleaning wheels before leaving the construction areas all the times to reduce dust dispersion	-



**Table 5.6.6-1 (Continued)**

Health Threaten	Target Group	Health Risk Assessment Matrix		Measure for health impact reduction	Measure for health promotion
		Risk Opportunity	Significant Level		
		Therefore, pollutant exposure to peoples is considered <b>moderate (3)</b> .			
		Significant level according to health risk is determined <b>Low (3x2=6)</b>			
2. Noise	- Construction workers	- Maximum noise level from construction activity is caused by foundation installation by which the maximum noise level is 88 dB(A) at the distance of 15 m. An average noise level over construction period is around 79-88 dB(A). However, noise exposure at 88 dB(A) is not exceed 12 hrs/day according to the Promulgation of the Ministry of Labor B.E.2549 about standard and management for occupational health and safety, and working environment Section 3 (Noise). However, loud noise is a non-continuous activity according to shift of operation. There for risk opportunity of noise exposure to construction workers is considered <b>moderate (3)</b>	- Noise could affect construction workers if the level of noise is louder than 85 dB(A) over 8 hours. The workers can loss hearing ability or hearing efficiency under a chronic exposure by which loud noise can damage soft tissues of hearing organs inside inner ears. The WHO indicating that a chronic exposure over 6-12 months of loud noise at 85 dB(A) could show some hearing disorder. Therefore, noise exposure can cause moderate illness, but not violence. Thus, significant level is considered <b>moderate (3)</b> .	- Selecting low noise machine and equipment with a routinely maintenance for reducing loud noise such as those pile rig.  - Asking workers to use PPE for noise protection over a loud noise areas which has noise level louder tshan 85 dB(A).	- Labelling warning signs to use PPE in those noisy areas according to noise contour assessed by occupational health and safety staffs
		Significant level according to health risk is determined <b>moderate (3x3=9)</b>			

**Table 5.6.6-1 (Continued)**

Health Threaten	Target Group	Health Risk Assessment Matrix		Measure for health impact reduction	Measure for health promotion
		Risk Opportunity	Significant Level		
	- Community peoples	- Construction activity can cause loud noise to affect communities especially foundation installation, however, noise level assessment indicating that maximum noise level from the project still not exceed the Promulgation of the NEB about Noise Level Standard issued 15 <sup>th</sup> B.E. 2540. Therefore, noise exposure to peoples is considered <b>low (2)</b> .	- Noise impact to living quality and dialy life of peoples is considered equal to communication noise level. Thus, noise impact is not alter hearing ability of local peoples. The WHO has indicated that outdoor safety noise level is not exceed 50-55 dB(A). Therefore, noise impact can cause only mild illness which is not interfering living quality of local peoples. Therefore, significant level is considered <b>low (2)</b> .	- Limiting working operation period of loud noise equipment only daytime from 7.00-18.00 hrs. Nighttime operation must be strictly acquire for permission from responsible organization which is needed to inform communities before operation at least 2 weeks prior to working date.	-
		Significant level according to health risk is determined <b>moderate (2x2 = 4)</b>			
				- Loud noise is possibly caused by pile rig operation which is a non-continuous operation to cause frightening to	- Noise from construction activity is a non-continuous exposure by which loud noise is related to pile rig operation for

		elderly peoples including students in those nearby schools.	foundation installation. The operation is not allowed for nighttime from 17.00-8.00 hrs which is made frightening causing negative feeling to local peoples.	schools by which noise control is strictly required for reducing noise impact.	
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**Table 5.6.6-1 (Continued)**

Health Threaten	Target Group	Health Risk Assessment Matrix		Measure for health impact reduction	Measure for health promotion
		Risk Opportunity	Significant Level		
		Therefore, risk opportunity of loud noise to communities is <b>moderate (3)</b> .	Therefore, significant level is considered <b>moderate (3)</b> .	- In case of pile rig operation for foundation installation, public relation to inform the activity must be performed before operation at least 2 weeks prior to operation date.	
		Significant level according to health risk is determined <b>moderate (3x3=9)</b>			

3. Accidents from construction activities	- Constructi on workers	- Accidents caused by construction activities happen by many factors such as construction workers careless, harmful operation, and improper working environment. The carelessness of the workers such as improper attire, improper PPE, and unsafety operation. Harmful operation are those high elevation workplace and danger machine operation. Improper working environment are too much working light, dust, noise, smoke, and odor which cannot avoiding. Therefore, risk opportunity is considered <b>moderate (3)</b> .	- Injury caused by Accident to construction workers is violent health risk. Types of injury are bone fracture, bone transform, wound, and internal injury. Working environment impact can cause unconscious. Therefore, health risk according to accident low to high which is self-recovery to death. Thus, significant level is considered <b>moderate (3)</b> .	- Clearly issuing about occupational health and safety conditions with subcontractors by;  - Providing and asking to use Personal Protective Equipment (PPE) for workers such as Safety Helmets, Safety Shoes, and Safety Glasses.  - Installations of construction equipment must be conducted by trusty subcontractors under safety staffs for controlling safety operation and testing the performance by professional engineers.	-
		Significant level according to health risk is determined <b>moderate (3x3=9)</b>			

Table 5.6.6-1 (Continued)

Health Threaten	Target Group	Health Risk Assessment Matrix		Measure for health impact reduction	Measure for health promotion
		Risk Opportunity	Significant Level		

4. Waste	- Construction workers	- Waste generated from construction activity such as papers, plastics, bricks, pebbles and sand, and those household waste from workers (food residue, and water bottles) are separated and eliminated by responsible company, Thus, risk opportunity is considered <b>low (2)</b> .	- Infectious sources from contagious animals cause illness to gastrointestinal tract due to bacteria and other infections. The infection cause mild illness which can be recovery in short time and interfering living quality. The significant level is considered <b>low (2)</b> .	- Providing sufficient waste containers with lids to avoiding waste falling on ground and assigning cleaning staffs to collect and eliminate waste for sending to responsible organizations.	-
		Significant level according to health risk is determined <b>moderate (2x2=4)</b>			
	- Community peoples	- Improper waste elimination can cause infection from contagious animals which is causing illness to gastrointestinal tract due to bacteria and other infections. Therefore, the project assigns waste elimination subcontractor to eliminate waste daily. Thus, risk opportunity is considered <b>low (2)</b> .	- Infectious sources from contagious animals cause illness to gastrointestinal tract due to bacteria and other infections. The infection cause mild illness which can be recovery in short time and interfering living quality. The significant level is considered <b>low (2)</b> .	-	- Participating for health promotion staffs for preventing and destroying sources of diseases such as mosquitoes and contagions
		Significant level according to health risk is determined <b>moderate (2x2=4)</b>			

Source: Consultants of Technology Co., Ltd. 2560

**Table 5.6.6-2**

**Measures and mitigations for health impact reduction of the Chana Green Power Plant, Chana Green Co.ltd. (Operation Period)**

Health Threaten	Target Group	Health Risk Assessment Matrix		Measure for health impact reduction	Measure for health promotion
		Risk Opportunity	Significant Level		
5. Air pollutants (TSP, PM-10, NO <sub>2</sub> , SO <sub>2</sub> )	- Project staffs	- Manufacturing process emits dust that can make dust dispersion all over working places such as fuel and ash transportation for combustion. Project staffs will be exposed over 8 hours of working time. However, the ministry promulgation about standard for occupational health and safety, and working environment management for chemical operation (B.E. 2556), and the Ministry of Labor of the US (OSHA) has limited concentration of TSP, and PM-10 at 15 , and 5 mg/m <sup>3</sup> , respectively. Therefore, the project had set up monitoring plan after operation for assessing risk exposure to staffs. Thus, risk opportunity is considered <b>moderate (3)</b>	- Air pollutants exposure can affect respiratory tract and lungs. Exposure by TSP and SO <sub>2</sub> could irritate trachea while exposure by NO <sub>2</sub> that could affect both trachea and lung by which a chronic exposure of TSP can cause irritation to upper respiratory tract (cough and breath), eyes tissue. Therefore, significant level according to air pollutants exposure is considered <b>low (2)</b>	- Using closed system of belt conveyor from storage areas to combustion chamber to avoid dust dispersion  - Operation staffs in a risk area of dust exposure (fuel storage areas and fuel storage buildings) must use proper attire which is long sleeves shirt and pants, safety boots, and mask to reduce risk of dust exposure  - Cleaning fuel storage areas and fuel storage buildings routinely to avoid dust dispersion	-
		Significant level according to health risk is determined <b>moderate (3x2 = 6)</b>			
	- Peoples living in dispersion area	- Air pollutants is emitted from combustion in boiler composed of those pollutants such as: TSP, Oxide of Nitrogen, and SO <sub>2</sub> . The assessment of pollutant concentration in communities was found that the	- TSP concentration is not affecting health condition according to US EPA criteria, while NO <sub>2</sub> and SO <sub>2</sub> concentrations are also not affecting health condition.	- Growing 2 rows of small tree as a zigzag pattern around fuel storage areas to reduce wind speed over those areas	-

		maximum pollutant concentration areas are;			
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**Table 5.6.6-2 (Continued)**

Health Threaten	Target Group	Health Risk Assessment Matrix		Measure for health impact reduction	Measure for health promotion
		Risk Opportunity	Significant Level		
	-	the Chana Chanupatham School, and Moo3 (Ban Nayum). However, other areas do not have different air pollutant concentration. Furthermore, ambient air quality still does not exceed ambient air quality standard according to the promulgation of the NEB issued 21 <sup>st</sup> (B.E. 2544), 24 <sup>th</sup> (B.E. 2547), and 33 <sup>rd</sup> (B.E. 2552) for all observation areas. Therefore, pollutant exposure to peoples is considered moderate (3).	Health risk assessment of acute effects revealed that TSP = 0.36, NO <sub>2</sub> = 0.18, and SO <sub>2</sub> = 0.03. While a chronic effects was found TSP = 0.007, NO <sub>2</sub> = 0.04, and SO <sub>2</sub> = 0.01 by which risk ratio assessment is less than 1.0. Thus, air pollutants do not cause injury or illness to risk groups by which those air pollutants is not considered health impact. Thus, significant level is considered <b>low (2)</b> .	- Providing experienced staffs for pollution control according to the promulgation of the Ministry of Industry B.E. 2545 or the current promulgation  - In case of uncontrolled air pollution system, the project has to shut down the power plant operation to maintain air pollution system ready to use before rerunning the power plant	
	Significant level according to health risk is determined <b>Low (3x2=6)</b>				
	- Sensitive peoples	Biofuel combustion can cause pollutants dispersion to environment which is affecting surrounding communities. Affecting target groups are those children, elderly peoples, and patients with respiratory conditions. However, maximum air pollutants concentration over the observation areas still not exceed ambient air quality standard according to the promulgation of the NEB issued 21 <sup>st</sup> (B.E. 2544), 24 <sup>th</sup> (B.E. 2547), and 33 <sup>rd</sup> (B.E. 2552).	TSP concentration is not affecting health condition according to US EPA criteria, while NO <sub>2</sub> and SO <sub>2</sub> concentrations are also not affecting health condition. Thus, air pollutants do not cause injury or illness to risk groups by which those air pollutants is not considered health impact. Thus, significant level is considered low (2).	-	

**Table 5.6.6-2 (Continued)**

Health Threaten	Target Group	Health Risk Assessment Matrix		Measure for health impact reduction	Measure for health promotion
		Risk Opportunity	Significant Level		
		Therefore, pollutant exposure to peoples is considered <b>moderate (3)</b> .			
		Significant level according to health risk is determined <b>Low (3x2=6)</b>			



6. Noise	- Project staffs	<p>- Noise sources from processing is boiler and cooling tower which is designed to have noise level below 85 dB(A) without any operation staffs working in the areas. An accessing to the areas is only for short period of maintaining. Therefore, risk opportunity of loud noise is <b>low (2)</b></p>	<p>- Noise could affect operation staffs if the level of noise is louder than 85 dB(A) over 8 hours. The staffs are not allowed to work under noise level of 115 dB(A). Those staffs will loss hearing ability or hearing efficiency under a chronic exposure by which loud noise can damage soft tissues of hearing organs inside inner ears. Nevertheless, protection system will working at noise level of 90 dB(A) by middle ear muscle shrinkage. However, this mechanism is only work in a short period. Therefore, significant level of noise exposure is considered <b>moderate (3)</b>.</p>	<p>- Covering noise sources according to engineering principles, and set up preventive maintenance routinely for reducing noise level</p> <p>- Making Noise Contour over the entire area of the power plant within 1 year, and reviewing the noise contour map every 3 years especially a new equipment installation for using as guideline for controlling and resolving noise problem. An additional measure is to labelling warning signs to use PPE over those loud noise areas for saving hearing ability of operation staffs</p>	<p>- Making a training courses for a proper using of noise protection equipment to staffs for safety purposes in working area with loud noise.</p>
		Significant level according to health risk is determined <b>moderate (2x3= 6)</b>			

**Table 5.6.6-2 (Continued)**

Health Threaten	Target Group	Health Risk Assessment Matrix		Measure for health impact reduction	Measure for health promotion
		Risk Opportunity	Significant Level		
	- Community peoples	- Power plant operation can cause loud noise to affect communities, however, noise level assessment indicating that	- Noise impact to living quality and dialy life of peoples is considered equal to communication noise level. Thus, noise	- Providing community relation staffs to acquire opinion about noise impact from project	-

		<p>maximum noise level from the project is not exceed the Promulgation of the NEB about Noise Level Standard issued 15<sup>th</sup> B.E. 2540. Therefore, noise exposure to peoples is considered <b>low (2)</b>.</p>	<p>impact is not alter hearing ability of local peoples. The WHO has indicated that outdoor safety noise level is not exceed 50-55 dB(A). Therefore, noise impact can cause only mild illness which is not interfering living quality of local peoples. Therefore, significant level is considered <b>low (2)</b>.</p>	<p>operation continuously, and use opinion data to review noise reduction plan</p> <ul style="list-style-type: none"> <li>- Informing communities about noise impact according to timing of engine start for power plant test-run</li> </ul>	
		Significant level according to health risk is determined <b>moderate (2x2= 4)</b>			
7. Accidents from working operations	- Project staffs	<ul style="list-style-type: none"> <li>- There are many heavy machine and equipment in the factory for assisting staffs while operation. An improper usage of those machine and equipment can cause accident which is a reason of injury. Main cause of accident is from careless, harmful operation, and improper working environment. However, the project will train all staffs about safety operation before working, machine maintenance and checking, and installing warning signs for using PPE with a routine check for sufficient light for reducing accidents.</li> </ul>	<ul style="list-style-type: none"> <li>- Accidental types are those high elevation falling, slippery falling, crashing, material falling, injury caused by equipment, and electricity short circuit.</li> </ul>	<ul style="list-style-type: none"> <li>- Providing sufficient PPE for operation staffs such as ear-muff, ear plug, safety glasses, safety shoes, gloves, and mask</li> <li>- Recording accidental statistic with cause of accident and solution case by case</li> </ul>	<ul style="list-style-type: none"> <li>- Training/providing knowledge about occupational health and safety according to working characteristic.</li> <li>- Making safety promotion activities for operation such as using announcement board to represent safety information</li> </ul>

**Table 5.6.6-2 (Continued)**

Health Threaten	Target Group	Health Risk Assessment Matrix		Measure for health impact reduction	Measure for health promotion
		Risk Opportunity	Significant Level		
		Therefore, risk opportunity according to accident is considered <b>moderate (3)</b>	Those accidental cases leads to losing of staffs, and factory which are recovery cost to staffs and rehabilitation cost for factory. Therefore, significant level is considered <b>moderate (3)</b>		<ul style="list-style-type: none"><li>- Informing operation staffs about safety procedures for maintaining safety operation and accidental prevention with responsibility according to emergency plan</li><li>- Set up occupational health and safety committee for managing and controlling working procedures by which assigning a monthly meeting for assessing and reviewing problems to seek for proper solution</li></ul>
		Significant level according to health risk is determined <b>moderate (3x3= 9)</b>			
8. Health service system	- Project staffs	- Project staffs require health service when getting injury and illness including working accident. Therefore, emergency health service requirement is necessary. Thus, risk opportunity for health service system is considered <b>moderate (3)</b>	- Project staffs have to register as personnel insurance under a social insurance system which can have right to get service from the social insurance network hospitals. Furthermore, the project has policy to receive local peoples to work as staffs which is the first priority for employment according to knowledge and experience. Therefore, significant level is considered <b>low (2)</b>	<ul style="list-style-type: none"><li>- Set up a yearly emergency practicing for both power plant, and related organizations. And training staffs to have experiences for emergency protection yearly</li><li>- Following all occupational health and safety laws according to power plant operation, strictly</li></ul>	Cooperation with sub district health promotion hospitals and village public health volunteers to make health protection and promotion activities for staffs and local peoples
		Significant level according to health risk is determined <b>moderate (3x2= 6)</b>			



## **CHAPTER 6**

### **ALTERNATIVES**

The two main issues that were considered in the analysis of alternatives are: (i) project location and operation as described below:

#### **6.1 The Project location options**

The Project considers the source of fuel, transportation, distance between the power plant and the transmission system, water resource, and capacity to acquire an enough space of land for the Project development. After thorough evaluation, the location at Khu Sub-district, Chana District, Songkhla was selected to be the most feasible sites for the proposed biomass power plant.

##### **(1) Fuel source**

The Project is surrounded with vast rubber plantation areas that can be the potential fuel source from the rubber tree such as wooden slab, branch, and root. Thus, the fuel source supply is stable.

##### **(2) Transport**

The Project site will be located on Highway No.408 which is connected to main roads such as: Highway No.43 and Highway No.42. Thus, transport of fuels to the Project can be done conveniently.

##### **(3) Power transmission system**

The Project is located near the existing transmission system (about 8 km) of Electricity Generating Authority of Thailand along the Highway No.43.

##### **(4) Water sources**

The Project's location is adjacent Nathawee irrigation canal (about 15m) that is currently being used for irrigation purpose. The canal capacity is capable of supplying the required water to the Project.

#### **6.2 The Project operation options**

After the consideration of the Project location, the suitable of the Project operation options were considered. It can be summarized as follows:

(1) **Production capacity** – The capacity to supply fuel was considered to reduce long distance transport. In addition, the suitability of effective machine and the familiarity of the Project to operate were also considered. Therefore, the production capacity of 25 MW was selected.

(2) **Major power production technology** – The Project considered the combustion and turbine systems as follows:

1) **Combustion system** – The Project considered two options as summarized in the table below.

Option	Combustion system	Supporting data
1	Grate combustion	It can be designed for various types of solid fuel and suitable for relatively big piece of fuel
2	Fluidized bed combustion	It can be used for all kind of solid fuels because temperatures in the furnace are even. So, the fuel combustion rates are regularly. It can burn high moisture content fuel. Moreover, the temperature of the flame is stable makes it suitable for small size biomass fuel.

The Project considered the option one due to the suitability of the combustor and the size of biomass fuel or wooden chips. Moreover, the Company has experienced to operate the same kind of system in contrast with the fluidize bed combustion.

2) **Turbine system** – The Project considered two options that are currently commonly used as follow.

Option	Turbine system	Supporting data
1	Extraction Condensing Turbine	Boiled will turn to steam and go through a turbine to generate power. The steam from the turbine has low pressure must be converted back to water by a condenser and cooling tower. Later water will be recirculated back to the boiler.

2	Back Pressure Turbine	There is no condenser and cooling tower. The steam from turbine has high pressure. It can be used in the production process. Therefore, the turbine is a back pressure type. The steam's pressure can be controlled in regarding with requirement of the production process. However, the power production yield is lower.
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The Project selected option one as the operation method because the Project focuses on power production to sell to the Electricity Generating Authority of Thailand (EGAT).

**3) Air pollution treatment system** – The Project considered four available air pollution treatment systems: bag filter, electrostatic precipitator, and a wet scrubber. The Project selected the electrostatic precipitator due to capacity to control air emission to meet with air emission standard in which the parameters are dust, sulfur dioxide, and nitrogen dioxide. It can also help reducing the amount of water consumption and wastewater in compared with wet scrubber system. It can also build confidence among the communities that the Project uses a good air pollution treatment system. It also creates a good image of the Company on paying attention to the environment.

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## **CHAPTER 7**

### **INFORMATION DISCLOSURE, PUBLIC CONSULTATIONS AND PARTICIPATIONS**

#### **7.1 Preface**

The public participation process is an important process that stakeholders especially the people living in the study area would be informed about both potential positive and negative impacts of the project which may occur to the community. Moreover, it provided an opportunity for the community to express their comments, suggestions and concerns to the project.

Chana Green Co.,Ltd realizes the public participation process due to increasing public awareness on environment. When incorrect and incomplete information are continuously shared with the public, this could lead to the misunderstanding and concerns on the project. Therefore, the company set up the public relation activity to introduce the project and explain on the details, the operation plan, environmental impact prevention and measures and environmental impact monitoring during the project construction and operation with sincerity and transparency on information. The project uses the two-way communication, so that, information from the public participation in every step would be taken into account to improve the project measures. This could lead to an establishment of guidelines and measures to prevent any potential impacts on the community. Moreover, it could reduce concerns from surrounding communities, increase the interest on the project operation and create an acceptance from surrounding communities as the way toward the guideline for the sustainability on minimizing environmental and social impacts.

#### **7.2 Objectives of the public participation**

- (1) To clarify and distribute information and details of the project to target groups, particularly, target groups that might receive both positive and negative impacts, including related target groups that might receive indirect impacts.
- (2) To receive comments from the public on the project operation.
- (3) To take information from the process and questionnaires into account for the study on the development of environmental impact assessment of the project and establish prevention measures, in order to increase benefits from practical measures matching with the public demand.

#### **7.3 Scope of the operation**

For the scope of the project operation, the operation pattern done by Office of The Natural Resources and Environmental Policy and Planning, in accordance with the guideline of public



participation on the environmental impact analysis was applied as the study scope. The public participation process was organized 2 time at least.

First time, Public Participation round 1 (PP1) occurred during project design preparation and project scoping. There was a public hearing on the draft of the project and its study scope. The objective of this process at this time was to inform public and related agencies about the project and both positive and negative impacts, including the study scope (Public Scoping). Comments from the process was summarized as a part of this report. This meeting was held last 25 April – 19 May 2016. Details are shown in section 7.6.1.

Second time, Public Participation round 2 (PP2) occurred during the preparation of a draft environmental impact prevention and measures report. The objective of this process at this time was to inform the public of the environmental impact prevention and measures report (Public Review). Comments from the process was also summarized and included in this report.. This meeting was undertaken last 3 November 2016 – 3 March 2017. Details are shown in section 7.6.4.

## **I. Public Hearing/Consultation During Project Design Preparation and Project Scoping**

### **7.4 The operation on public relations and public hearing**

The operation on public relations and public hearing had the target areas covering the area that could receive both direct and indirect impacts due to the project operation

### **7.5 Stakeholder groups**

There are 7 groups of stakeholders which could potentially be impacted, the authority with the duty of considering the environmental impact assessment, agency providing the environmental impact assessment report, an authority for approval/permits, government organizations at various levels, academics /temples, mass media and general public. Details are provided in **Table7.5-1**.

**Table7.5-1****Stakeholder groups****Table7.5-1 (cont.)**

<b>Stakeholder groups</b>	<b>Subgroups</b>	<b>Details of subgroups</b>
1. Population receive impacts	- People living in the location of the project	<b>Chana District, Songkhla</b> <b>Tumbon Ku</b> - Moo3, Baan Na Yam
	- People living in nearby areas of the project location	<b>Chana District, Songkhla</b> <b>Tumbon Ku</b> - Moo1, BaanKhu Ton Pradu - Moo2, Baan Phodang - Moo4, Baan Khu Saksit - Moo5, Baan Khu - Moo6, BaanThung - Moo7, BaanNot - Moo8, BaanNaPrue - Moo9, BaanPlak Pho <b>Tumbon Pa Ching</b> - Moo8, BaanHuadinnuea - Moo9, BaanHuadintai <b>Tumbon Saphan Mai Kaen</b> - Moo3, BaanTha Lo - Moo5, BaanSai Khao - Moo6, BaanKasemrat <b>Tumbon Khae</b> - Moo1, BaanKhok Yang - Moo2, Baan Khae Nuea - Moo3, Baan Khae Tai - Moo4, BaanNiat

Table 7.5-1 (cont.)

Stakeholder groups	Subgroups	Details of subgroups
		<b>Tumbon Tha Mo Sai</b> <ul style="list-style-type: none"> <li>- Moo1, BaanTha Mo Sai</li> <li>- Moo2, Baan Rai Tha Mak</li> <li>- Moo3, BaanPhong Ngu</li> <li>- Moo5, BaanThung Che</li> <li>- Moo8, BaanPhraeo</li> <li>- Moo9, BaanSaphan Hak</li> <li>- Moo10, BaanWang Han</li> </ul> <b>Tumbon Na Wa</b> <ul style="list-style-type: none"> <li>- Moo3, BaanKothaktai</li> <li>- Moo4, BaanKhlom Bon</li> <li>- Moo5, BaanPrachanuea</li> <li>- Moo6, BaanPrachatai</li> <li>- Moo7, BaanNa Nai</li> </ul> <b>TumbonKhun Tat Wai</b> <ul style="list-style-type: none"> <li>- Moo2, BaanPa Lamai Klang</li> <li>- Moo4, BaanPa La Mai Ok</li> </ul> <b>Tumbon Baan Na</b> <ul style="list-style-type: none"> <li>- Moo7, BaanLa Nga</li> <li>- Moo9, Baan Nam Khem</li> </ul>
2. Responsible agency on providing the environmental impact assessment report	<ul style="list-style-type: none"> <li>- The project owner</li> <li>- Corporation with the right to prepare an environmental impact assessment report</li> </ul>	<ul style="list-style-type: none"> <li>-Chana Green Co.,Ltd.</li> <li>-Consultant of Technology Co.,Ltd.</li> </ul>
3. Authority with the duty of considering the environmental impact assessment/ authority for approval/permits	<ul style="list-style-type: none"> <li>- Central organization</li> <li>- Local organizations</li> </ul>	<ul style="list-style-type: none"> <li>- Office of The Natural Resources and Environmental Policy and Planning (ONEP)</li> <li>- Department of Industrial Works</li> <li>- Office of Energy Regulatory Commission</li> </ul> <p>Ku SAO</p>

**Table 7.5-1 (cont.)**

Stakeholder groups	Subgroups	Details of subgroups
4. Government organization at various levels	- Central organization	-Pollution Control Department -Department of Energy Business
	- Provincial organization	- Regional Environmental Office 16 - Office of Energy Regulatory Commission, 12 District - Office of Songkhla - Songkhla Provincial Natural Resource and Environmental Office - Songkhla Public Works and Town & Country Planning Office - Songkhla Provincial Public Health Office - Songkhla Provincial Industrial Office - Songkhla Provincial Office of Labor Protection and Welfare - Energy Provincial Office of Songkhla - Songkhla Agricultural Extension Office - Songkhla Irrigation Project - Chana District office - Chana District Public Health Office - Chana District Agricultural Extension Office - Chana Police Station - Provincial Electricity Authority in Chana - Chana Hospital
	- Local organizations	- Pa Ching SAO - Saphan Mai Kaen SAO - Khae SAO - Tha Mo Sai SAO - Na Wa SAO - Khun Tat Wai SAO - Baan Na SAO - Ku Health Promoting Hospital

Table 7.5-1 (cont.)

Stakeholder groups	Subgroups	Details of subgroups
		<ul style="list-style-type: none"> <li>- Pa Ching Health Promoting Hospital</li> <li>- Saphan Mai Kaen Health Promoting Hospital</li> <li>- Khae Health Promoting Hospital</li> <li>- Tha Mo Sai Health Promoting Hospital</li> <li>- Saphan Mai Kaen Health Promoting Hospital</li> <li>- Khun Tat Wai Health Promoting Hospital</li> </ul>
5. Academics and religions	<p>Academics located in the nearby areas of the project, including institutions of higher education in the province.</p> <p>Temples located near the project area.</p> <p>Mosques located near the project area.</p>	<ul style="list-style-type: none"> <li>- Ko Thank School</li> <li>- Wat Praja School</li> <li>- Baan Khae School</li> <li>- Wat Naphrue School</li> <li>- La Nga School</li> <li>- Kasemrat School</li> <li>- Baan Not School</li> <li>- Chana Chanupatham School</li> <li>- Baan Khu Saksit school</li> <li>- Kordiruddin School</li> <li>- Prince of Songkla University</li> <li>- Thaksin University</li> <li>- Songkhla Rajabhat University</li> <li>- Rajamangala University of Technology Srivijaya</li> <li>- Hatyai University</li> <li>- Wat Praja</li> <li>- Wat Matchimmakhet</li> <li>- Wat Kasemrat</li> <li>- Baan Thung Mosque</li> <li>- Nurut Chamchi Mosque</li> <li>- Nurun Komari Mosque</li> <li>- Asliyatun Isalaniya Mosque</li> <li>- Baan Khu Mosque (Khupradu)</li> <li>- Baan Plak Pho Mosque</li> </ul>

**Table 7.5-1 (cont.)**

Stakeholder groups	Subgroups	Details of subgroups
		<ul style="list-style-type: none"> <li>- Tha Mo Sai Mosque</li> <li>- Ro Ma Mosque</li> <li>- Baan Na Nai Mosque</li> <li>- Baan Hua Din Mosque</li> <li>- Nurulihsa Mosque</li> <li>- Mawai Mosque</li> </ul>
	Companies located around the project area.	<ul style="list-style-type: none"> <li>- Chana Power Plant</li> <li>- Songkhla Biomass co.,Ltd.</li> </ul>
7. Mass media	Community Radio Station Local Newspaper	
8. General public	General public who are interested in the project	<ul style="list-style-type: none"> <li>- General people who are interested.</li> </ul>

## **7.6 The Actual Conduct of Public Consultations**

### **7.6.1 Public relation and the dissemination of primary project documents**

(1) There was an advertising of the project and its primary detail before organizing the meeting and public hearing. The project held this meeting during 25<sup>th</sup> April to 19<sup>th</sup> May, 2016.

(2) Invitation letters, related documents and leaflet for the meeting on the scope and criteria for environmental impact assessment were sent during 7-8<sup>th</sup> April, 2016.

(3) Advertising board was installed at important points of the community that can be easily seen for 39 locations where it was distributed within study areas of 39 communities. These were done during 7-8<sup>th</sup> April 2014 including sending the invitation letter.

### **7.6.2 The meeting for the feedback on the scope and criteria for an environmental impact assessment (Public Scoping)**

The meeting was held by the project for the feedback on the scope and criteria for an environmental impact assessment during 25<sup>th</sup> April to 19<sup>th</sup> May, 2016. Details of the meeting as seen in **Table 7.6.2-1.**

**Table 7.6.2-1****Details of the meeting on the scope and criteria for an environmental impact assessment**

<b>Time</b>	<b>Date</b>	<b>District / Province</b>	<b>Location</b>	<b>Number of participants (persons)</b>
1	25/04/2016	Tumbon Ku	At the village meeting hall, Moo 6, Baan Thung, Tumbon Ku, Chana, SongKhla	329
2	27/04/2016	Tumbon Khae	At the village meeting hall, Moo 2, Baan Khae Nuea, Tumbon Khae, Chana, SongKhla	76
3	28/04/2016	Tumbon Baan Na	At the village meeting hall, Moo 7, Baan La Nga, Tumbon Baan Na, Chana, SongKhla	103
4	30/04/2016	Tambon Tha Mo Sai	At the meeting hall of Tumbon Tha Mo Sai, Chana, SongKhla	66
5	03/05/2016	Tumbon Saphan Mai Kaen	At the meeting hall of Tambon Saphan Mai Kaen, Chana, SongKhla	56
6	07/05/2016	Tumbon Khun Tat Wai	At the village meeting hall, Moo 2, Baan Pa Lamai Klang, Tumbon Khun Tat Wai, Chana, SongKhla	60
7	10/05/2016	Tumbon Na Wa	At the meeting room of Na Wa SAO, Tumbon Na Wa, Chana, SongKhla	65
8	17/05/2016	Tumbon Tha Mo Sai	At the headman office, Moo 9, Baan Saphan Hak, Tumbon Tha Mo Sai, Chana, SongKhla	15
9	18/05/2016	Tumbon Pa Ching	At the meeting hall of Pa Ching SAO, Tumbon Pa Ching, Chana, SongKhla	61
10	19/5/2016	SongKhla	At the meeting room of Department of Public Work and Town Planning Songkhla Office, Songkhla Government Center, SongKhla	17
<b>Total participants</b>			<b>848</b>	

**(1) The meeting for public hearing of the project at the village meeting hall, Moo 6 Baan Thung, Tumbon Ku, Chana, SongKhla**

The meeting on the scope and criteria for an environmental impact assessment of Chana Green Power Plant was held on 25<sup>th</sup> April 2016 during 13.30-15.30 hours at the village meeting hall, Moo 6, Baan Thung, Tumbon Ku, Chana, SongKhla. There were totally 329 participants. Summary of the meeting is shown in **Figure 7.6.2-1**.

**1) Comments and suggestions on the scope and criteria for an environmental impact assessment of Chana Green Power Plant of Chana Green, Co., Ltd.**

The meeting on 25<sup>th</sup> April 2016 had details on issues, clarification, and suggestion as seen in **Table 7.6.2-2**. Moreover, participants could provide additional comments on given papers during the meeting and it could be concluded as follows.

- There was a concern on no latex from rubber woods due to the increasing of temperature from the power plant.
- What was a reason why Chana District was selected as a power plant location?
- At the present, there is insufficient water for consumption. In case of the project establishment, will there be a scramble of water consumption or not?

**2) Comments from the evaluation form of the meeting**

An Evaluation Form was distributed after the meeting for the Chana Green Power Plant on 25<sup>th</sup> April 2016 at the village meeting hall, Moo 6, Baan Thung, Tumbon Ku, Chana, SongKhla. Out of 329 attendees, 306 responded and their comments/response are as follows.

**(A) Issues on environmental aspect for an additional study.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant would like the project to conduct an additional study on dust (16.3%) and raised other issues such as noise (15.7%), wastewater (15.1%) and odor (12.6%). Details can be seen in **Table 7.6.2-3**.





Registration



Participants in the meeting



Describe Project Information



Discussion & Suggestion with Participants

**Figure 7.6.2-1** The meeting atmosphere on 25<sup>th</sup> April 2016 during 13.30-15.30 hours, at the village meeting hall, Moo 6, Baan Thung, Tumbon Ku, Chana, Song khla

**Table 7.6.2-2**

**Comments and suggestions during the meeting for  
scope and criteria for environmental impact assessment  
The Chana Green power plant project of Chana Green Co.,Ltd.  
on 25 April, 2016 during 13.30-15.30 hrs.  
at Village meeting hall, Moo 6, Baan Thung, Tumbon Ku, Chana, Songkhla**

**Table 7.6.2-2 (Cont.)**

<b>1. Project details</b>	<b><u>Response from the CGCL and Consultant</u></b>
<p>- The reclamation may cause flooding to nearby communities, how would the project deal with the drainage problem? <b><u>(Headman of Moo 3, Baan Na Shyam)</u></b></p>	<p>- The project area had a ditch that link to Na Tawee canal locating at the back of the project. The project would build a waterway to prevent flooding in the community. Moreover, the consultant company conducted a study on flooding and the direction of the water flow, in order to design the drainage system.</p>
<p>- There was a concern on noise from the project started from the piling construction due to the project located near the school. Therefore, students could got an impact. <b>(Headman of Moo 3, Baan Na Shyam)</b></p>	<p>- The nearest boundary of the project area that is close to a school is approximately 100 meters. The power plant of the project would use machines and technology same as Yala Green Power Plant, where the community is also closely located. To prevent impacts, the power plant will be designed to be located far away from the school fence. Furthermore, the sound source must be located in the closed area or located in the remote area to prevent too much noise in the nearby school. For the area close to the school, it would be designed as a non impact area such as a green zone, a clarifier, etc. Moreover, how to pile and the duration of piling would be considered to prevent the impact on students. <b><u>Additional clarification</u></b> During the project construction, there will be a study on impact and mitigations to minimize impacts on</p>

**Table 7.6.2-2 (Cont.)**

	school and the nearest community. The study would be presented in the next meeting.
<p>- At the present, the area has a problem on water consumption. Therefore, there was a concern on a competition for water consumption between the project and community</p> <p><b>(Headman of Moo 3, Baan Na Shyam)</b></p>	<p>- Given the large volume of water required for the power plant, the project assessed whether there was sufficient water before the project started. The consultation with the representative of Provincial Irrigation Office was done to find out the statistic of water flow to Na Tawee canal and assessed months containing lowest water volume in the canal. This assessment would be used to as basis in calculating and designing a pond as a water storage to avoid competition of water consumption with the community.</p>
<b>2. Environment</b>	
<p>- There was a concern on dust occurring from the project operation.</p> <p><b>(Headman of Moo 3, Baan Na Shyam)</b></p>	<p>- Air released from the stack will go through an Electrostatic Precipitator (ESP), a system that efficiently trap pollutants. The principle of this system was to make an electric charge of dust different from an electric charge of the precipitator. Therefore, the precipitator could trap more dust which can lead to less emission of particles from the stack.</p>
<p>- How did the project treat wastewater before releasing into public water source?</p> <p><b>(Headman of Moo 3, Baan Na Shyam)</b></p>	<p>- Water discharged from the plant will undergo the process of condensation (the process of turning steam to water). Water will then be sent to a cooling tower and will be reused until the concentration of minerals will reach a level that could not be used for the production. Then it would be released at a state where where minerals are less concentrated.</p>
<p>- Rubberwood yard using for the fuel could cause the odor during the rain.</p> <p><b>(Headman of Moo 3, Baan Na Shyam)</b></p>	<p>From the design, there would be temporary piles of rubber wood. These woods would then be chopped into small pieces before storage in the closed building. Thus, wood piles would not get wet and</p>

**Table 7.6.2-2 (Cont.)**

	not cause odor. Moreover, the project designed the drainage system around the wood pile yard to prevent woods soaking in water and the principle of first come first use will be implemented for wood stocks.
<b>3. Socio-economic</b>	
<ul style="list-style-type: none"> <li>- The project establishment caused higher temperature that lead to the agricultural impact such as no latex coming out.</li> </ul> <b>(Headman of Moo 3, Baan Na Shyam)</b>	<ul style="list-style-type: none"> <li>- The project and consultant company took this issue for further study and would present the result in the 2nd meeting. (The meeting to review the draft of environmental impact assessment report)</li> </ul>
<ul style="list-style-type: none"> <li>- What kind of advantage and disadvantage that the community would gain from the project?</li> </ul> <b>(Headman of Moo 3, Baan Na Shyam)</b>	<ul style="list-style-type: none"> <li>- The law required the power plant to establish the community development fund for communities around the plant. This fund allowed communities to send a request for budget supporting from such fund.</li> </ul>
<ul style="list-style-type: none"> <li>- The project should made a written greement to supervise and manage ollutions that would be occurred.</li> </ul> <b>(Headman of Moo 3, Baan Na Shyam)</b>	<ul style="list-style-type: none"> <li>- The project take this issue to be considered.</li> </ul>
<ul style="list-style-type: none"> <li>- The project should supported activities of the community such as buidling a football field andan exercise yard.</li> </ul> <b>(Headman of Moo 3, Baan Na Shyam)</b>	<ul style="list-style-type: none"> <li>- The project was willing to support community activities. If the community or organization needed the support, please informed the project officer stationing in the area.</li> </ul>

**Table 7.6.2-3**

**Problems on environmental and health aspects and concerns for an additional study**

Details	Numbers	%
- Dust	193	16.3
- Noise	186	15.7
- Wastewater	179	15.1
- Odor	149	12.6
- Solid waste	108	9.1
- The adequacy of utility system such as tap water, electricity, road, etc.	97	8.2
- Accident and safety	88	7.4
- The adequacy of public health service facility	74	6.3
- Transportation / Traffic	68	5.7
- No comment	42	3.5

Note: can select more than 1 answer

**(B) Concerns and additional comments to the Chana Green Power Plant of Chana Green, Co.,Ltd.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant provided concerns and additional suggestions to the project as following issues.

**a) Environmental aspect**

- Smoke from the combustion increase the temperature.
- The project should provide the dust elimination system.
- The project should provide wastewater treatment system before releasing into public water source.
- There was an environmental concern that could be destroyed in the future.

**b) Social aspect**

- There was a request for the promotion/support activities of the community in every aspect.

- There was a request for a local employment as a priority.

- The project should visit the area to educate local people.

- There was a request for the project to take the community for a study tour at the Yala Green Power Plant.

### c) Health aspect

- In case of the health impact occurred in the community from the project operation, how will the project take care/solve this problem?

- There was a request for the project to provide the mobile medical unit for public.

- The project should promote/support health related activities such as sport activity.

## (2) The meeting for public hearing of the project at the village meeting hall, Moo 2, Baan Khae Nuea, Tumbon Khae Chana SongKhla

The meeting was held to identify the scope and criteria for an environmental impact assessment of Chana Power Plant Green on 27<sup>th</sup> April 2016 during 13.30-15.30 hours at the village meeting hall, Moo 2, Baan Khae Nuea, Tumbon Khae, Chana, SongKhla. There were totally 76 participants. The meeting atmosphere can be seen in **Figure 7.6.2-2**.

### 1) Comments and suggestions on the scope and criteria for an environmental impact assessment of Chana Green Power Plant of Chana Green, Co., Ltd.

The meeting on 27<sup>th</sup> April 2016 at the village meeting hall, Moo 2, Baan Khae Nuea, Tumbon Khae, Chana, SongKhla, had details on issues, clarification, and suggestion as seen in **Table 7.6.2-4**. Moreover, participants could provide additional comments on given papers which can be concluded as follows issues.

- There was a concern on solid waste/waste.

- There was a concern on noise from the project.

- There was a concern on the illness of the community when the power plant took place.

- What kind of benefits community will gain from the project?

- The power plant causes no rain in the rainy season.



- What was the reason to select Chana as a location for the project despite many power plants were already established here?
- There was a concern on health impact to the community.



Registration



Participants in the meeting



Describe Project Information

Discussion & Suggestion with Participants

**Figure 7.6.2-2** The meeting atmosphere on 27<sup>th</sup> April 2016 during 13.30-15.30 hours, at the village meeting hall, Moo 2, Baan khea Nuea, Tumbon Khae, Chana, Song khla

**Table 7.6.2-4**

**Comments and suggestions during the meeting for  
scope and criteria for environmental impact assessment**

**The Chana Green power plant project of Chana Green Co.,Ltd.**

**on 27 April, 2016 during 13.30-15.30 hrs.**

**at Village meeting hall, Moo 2, Baan Khae Nuea, Tumbon Khae, Chana, Songkhla**

**Table 7.6.2-4 (Cont.)**

<b>1. Environmental aspect</b>	<b><u>Response from the CGCL and Consultant</u></b>
<p>- There was a concern on pollutions occurring from the project (dust, ash from fuel combustion and wastewater).</p> <p><b>(Village Board, Moo 2, Baan Khae Nuea)</b></p>	<p>- The project and the consultant company took this concern for further study and defined prevention measures, in order to prevent such impacts occurring to the community.</p>
<p>- Did the establishment of the power plant cause the raising of the temperature or not?</p> <p><b>(Questionnaire)</b></p>	<p>- The project took this issue for the temperature study.</p>
<p>- There was a concern that aquatic animals would be dead due to the releasing of hotwater from the project to a public water source.</p> <p><b>(Questionnaire)</b></p>	<p>- The project will be using a cooling system through a cooling tower with cooling fan on top to reduce temperature of water going through the condenser. This water will not be directly released in public water source. It will be released into a clarifier for quality and temperature checking before releasing.</p>
<b>2. Socio-economic aspect</b>	
<p>- The project was unwated in the area, due to the concern on the heat generating from the project that could affect the flow of latex.</p> <p><b>(Khae SAO, Moo 1)</b></p>	<p>- Before the environmental impact assessment would be done, the consultant company had to collect basic data that recently existed in the community. Research output from the local institute was also included in the study of the impact on latex flow. The consultant company would consult related agencies for more information. These information would be presented in the next meeting.</p>



**Table 7.6.2-4 (Cont.)**

<p>- Na Tawee canal was a fish source of the community. If the project consumed water from this canal, the community could be unable to find fish. (Village Board,Moo 2, Baan Khae Nuea)</p>	<p>- The project and the consultant company took this concern for further study and defined the prevention measures, in order to prevent such impacts occurring to the community.</p>
<p>- Did the establishment of the project cause poaching of natural resources between the project and community or not? (Questionnaire)</p>	<p>- The project and consultant company took this issue for further study and would present the result in the 2nd meeting.</p>
<b>3. Other</b>	
<p>- Why did many projects that community disagree still establish and operate? (Khae SAO, Moo 1)</p>	<p>- The objective of this meeting was to hearing concerns/community feedback for further study on such concerns. The result of the study would be presented in the next meeting. Thus, the issue of unwated project would be recorded in the report and then sent to related agencies for their consideration.</p>
<p>- Could it be possible to let the community perform CHIA (Community Health Impact Assessment) together with EIA of the project? (Village Board,Moo 2, Baan Khae Nuea)</p>	<p>- The consultant company took this isse to be considered for the possibility to operate such thing.</p>
<p>- Due to Chana had many power plants in the area, the project should study impacts in cooperate with other power plants as well. (Village Board,Moo 2, Baan Khae Nuea)</p>	<p>- If there were other sources of pollution in the study area,the consultant company would normally took data from other sources to combine in the impact assessment. In some cases, the study of the project only may pass the standard but when taking other sources into account, it may not pass.</p>
<b>4. Suggestions</b>	
<p>- Requested for the consultant company to have the professional ethic on the study of impact assessment as real as possible. (Village Board,Moo 2, Baan Khae Nuea)</p>	
<p>- Did not trust the government auditing process, due to the concern that the government would favor the factory. (Village Board,Moo 2, Baan Khae Nuea)</p>	
<p>- Although there were many power plants in Chana area, people in Chana consumed less power than</p>	

**Table 7.6.2-4 (Cont.)**

the department store where majority of power consumption was there.

**(Village Board, Moo 2, Baan Khae Nuea)**

## **2) Comments from the evaluation form of the meeting**

From evaluation forms after the meeting of the Chana Green Power Plant on 27<sup>th</sup> April 2016 at the village meeting hall, Moo 2, Baan Khae Nuea, Tumbon Khae, Chana, SongKhla, there were 73 respondents in total which their comments can be concluded as follows.

### **(A) Issues on environmental aspect for an additional study.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant would like the project to conduct an additional study on dust (17.6%), then there were other problems such as noise (16.4%), wastewater (15.2%) and solid waste (11.3%). Details can be seen in **Table 7.6.2-5**.

**Table 7.6.2-5**

### **Problems on environmental and health aspects and concerns for an additional study**

<b>Details</b>	<b>Numbers</b>	<b>%</b>
- Dust	59	17.6
- Noise	55	16.4
- Wastewater	51	15.2
- Solid waste	38	11.3
- Odor	34	10.1
- The adequacy of utility system such as tap water, electricity, road, etc	27	8.1
- Accident and safety	23	6.9
- The adequacy of public health service facility	21	6.3
- Transportation / Traffic	18	5.4
- Others	1	0.3
Air from the combustion could cause the hot weather		
- No comment	7	2.1

Note: can select more than 1 answer

**(B) Concerns and additional comments to the Chana Green Power Plant of Chana Green, Co.,Ltd.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant provided concerns and additional suggestions to the project as following issues.

**a) Environmental aspect**

- There was a request for the efficient pollution management with no impact to the community.
- The project must have the noise prevention system.
- There was a concern on the project would cause impacts on agriculture in the community.
- The plantation should be done in the project area.

**b) Social aspect**

- The project should support the budget for community's activities.
- The local employment should be a priority.
- The meeting should be organized in each village so that people can reach to actual information.

**c) Health aspect**

There was a request for the mobile medical unit.

**(3) The meeting for public hearing of the project at the village meeting hall, Moo 7, Baan La Nga, Tumbon Baan Na, Chana, SongKhla**

The meeting was held to identify the scope and criteria for an environmental impact assessment of Chana Power Plant Green on 28<sup>th</sup> April 2016 during 13.30-15.30 hours at the village meeting hall, Moo 7, Baan La Nga, Tumbon Baan Na, Chana, SongKhla. There were totally 103 participants. The meeting atmosphere can be seen in **Figure 7.6.2-3**.

**1) Comments and suggestions on the scope and criteria for an environmental impact assessment of Chana Green Power Plant of Chana Green, Co.,Ltd.**

The meeting on 28<sup>th</sup> April 2016 during 13.30-15.00 at the village meeting hall, Moo 7, Baan La Nga, Tumbon Baan Na, Chana, SongKhla had details on issues, clarification, and suggestion as seen in **Table 7.6.2-6**. Moreover, participants could provide additional comments on given papers which can be concluded as follows issues.

- The project would cause noise impacts to the community.
- There was a concern on health impact to the community
- There was a concern on the safety of the community.



**Figure 7.6.2-3** The meeting atmosphere on 28<sup>th</sup> April 2016 during 13.30-15.30 hours, at the

**Table 7.6.2-6**

**Comments and suggestions during the meeting for  
scope and criteria for environmental impact assessment**

**The Chana Green power plant project of Chana Green Co.,Ltd.**

**on 28 April, 2016 during 13.30-15.30 hrs.**

**at Village meeting hall, Moo 7, Baan La Nga, Tumbon Baan Na, Chana, Songkhla**

**Table 7.6.2-6 (Cont.)**

<b>1. Environmental impact study</b>	<b><u>Response from the CGCL and Consultant</u></b>
Requesting for the consultant company to verify communities within the radius of 5 kilometers of Tumbon Baan Na as they could be more communities than what was presented in the invitation. (Chief Executive of Baan Na SAO)	The consultant company took this issue for further verification.
<b>2. Project details</b>	
- In case of unavailble of wood, the project would change to other fuels, such as coal, or not? (People of Moo 7, Tumbon Baan Na)	- The project had a contract with the Electricity Generating Authority of Thailand to produce 25 megawatts of electricity by using wood as fuel, for further distribution. Moreover, the klin was designed in compatible with the heating value from wood fuel only. Thus, the project could not use other fuels such as coal.
- Waste/ash occuring from the project, how did the project manage them? And when the corrected and clearly data would be informed? (People of Moo 7, Tumbon Baan Na)	- The project and consultant company took this issue for further study and would present the result in the 2nd meeting.
- Why did the project select Chana as a location of the power plant? (Questionnaires)	- Main points for the selection of power plant location include: sufficient fuel source, sufficient water source for the production and location which

**Table 7.6.2-6 (Cont.)**

	should be near the electrical transmission system. Four provinces of Southern Thailand and Chana had plenty sources of rubber wood, had water source from Na Tawee canal and located near the high voltage transmission lines.
<b>3. Socio-economic</b>	
- Requesting for the project to promote/support activities in the community. Was it true that the project would only support the community locating within the radius of 5 kilometers? <b>(People of Moo 7, Tumbon Baan Na)</b>	- The project is willing to support activities of the community locating within a radius of 5 kilometers around the power plant.
- For the community care, the project would took care of mosque, local agencies and community or not and how? In case of supporting as a budget, could it specify in term of numbers? <b>(People of Moo 7, Tumbon Baan Na)</b>	- The project is willing to support activities of the community. Those activities should set for the community at large. However, the project could not identified the budget number. It depended on activities of each community.

**2) Comments from the evaluation form of the meeting**

From evaluation forms after the meeting of the Chana Green Power Plant on 28<sup>th</sup> April 2016 during 13.30-15.00 hours at the village meeting hall, Moo 7, Baan La Nga, Tumbon Baan Na, Chana, SongKhla, there were 95 respondents in total which their comments can be concluded as follows.

**(A) Issues on environmental aspect for an additional study.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant would like the project to conduct an additional study on dust (20.8 %) and then there were other problems such as wastewater (18.7 %), odor (15.9 %) and solid waste (9.5%). Details can be seen in **Table 7.6.2-7.**

**Table 7.6.2-7**

**Problems on environmental and health aspects and concerns for an additional study**

Details	Numbers	%
- Dust	59	20.8
- Wastewater	53	18.7
- Odor	45	15.9
- Solid waste	27	9.5
- Noise	26	9.2
- The adequacy of utility system such as tap water, electricity, road, etc.	20	7.1
- Accident and safety	16	5.7
- Transportation / Traffic	12	4.2
- The adequacy of the public health service facility	12	4.2
- Others Impacts on the education of nearby schools	2	0.7
- No comment	11	3.9

Note: can select more than 1 answer

**(B) Concerns and additional comments to the Chana Green Power Plant of Chana Green, Co.,Ltd.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant provided concerns and additional suggestions to the project as following issues.

**a) Environmental aspect**

-There was a request for the efficient environmental management with no impact on the community.

- The plantation should be done around the power plant.

## **b) Social aspect**

The project supports activities of the community such as traditional events or community sport days.

### **(4) The meeting for public hearing of the project at the meeting room of village chief / headman, Tumbon Tha Mo Sai, Chana, SongKhla**

The meeting on the scope and criteria for an environmental impact assessment of Chana Green Power Plant was held on 30<sup>th</sup> April 2016 during 13.30-15.30 hours at the meeting room of village/headman of Tumbon Tha Mo Sai, Tumbon Tha Mo Sai, Chana, SongKhla. There were totally 66 participants. The meeting atmosphere can be seen in **Figure 7.6.2-4**.

### **1) Comments and suggestions on the scope and criteria for an environmental impact assessment of Chana Green Power Plant of Chana Green, Co.,Ltd**

The meeting on 30<sup>th</sup> April 2016 at the meeting room of village/headman of Tha Mo Sai, Tumbon Tha Mo Sai, Chana, SongKhla had details on issues, clarification, and suggestion as seen in **Table 7.6.2-8**. Moreover, participants could provide additional comments on given papers during the meeting and it could be concluded as follows.

- Actions to solve impacts occurring from the project must be immediately done.
- The weather will change or not with the power plant locating in the area.
- The area around the power plant will be more arid than its original or not.
- Where is the sufficient water source of the project? Will nearby communities be lack of water?
- There was a concern on dust/ash from the project operation.
- The project would cause the global warming.
- The project would cause noise.
- There would be chemical leakage.
- Would there be an opportunity of the explosion or not?
- Wastewater could contaminate the public water source or not
- The project establishment could cause the conflict in the community.
- There was a concern on health impacts on people in the community.





Registration



Participants in the meeting



Describe Project Information



Discussion & Suggestion with Participants

**Figure 7.6.2-4** The meeting atmosphere on 28<sup>th</sup> April 2016 during 13.30-15.30 hours, at the meeting room of village/headman of Tumbon Tha Mo Sai, Chana, Song khla

**Table 7.6.2-8**

**Comments and suggestions during the meeting for  
scope and criteria for environmental impact assessment  
The Chana Green power plant project of Chana Green Co.,Ltd.  
on 30 April, 2016 during 13.30-15.30 hrs.  
at the meeting for village chief/headman of Tambon Tha Mo Sai,  
Tambon Tha Mo Sai, Chana, Songkhla**

**Table 7.6.2-8 (Cont.)**

<b>1. Environmental aspect</b>	<b><u>Response from the CGCL and Consultant</u></b>
<p>- There was a concern on noise of the plant,due to the impact on noise from existing factories in the area.</p> <p><b>(People of Moo 3, Tambon Tha Mo Sai)</b></p>	<p>- The project and the consultant company took the concern for further study and the result would be presented in the 2nd meeting together with the preventive measures to prevent impacts on the community.</p>
<p><b>2. Environmental impact study</b></p> <p>- If there were many power plants in the area, does it affect to the community?</p> <p><b>(Questionnaires)</b></p>	<p>- The process of environmental study, all dimensions must be included in the study. Every operation of every project inevitably caused impacts. However, the project construction had to be controlled not to cause additional impacts. The study must be done in the combination of impacts from other existing factories in the area as well.</p>
<p><b>3. Project details</b></p> <p>- Which water source the project would use to fulfill the consumption of the project?</p> <p><b>(Questionnaires)</b></p>	<p>- The project would consume water from Na Tawee canal. For the sufficient water volume, the consultant company had to study water volumes whether which month containing the lowest volume so that the pumping was not done at that time.The result of the study was used to calculate how much water must be</p>

**Table 7.6.2-8 (Cont.)**

	stored for the sufficient consumption without the competition to the community.
- What was the reason to select Chana, where other power plants were exsited, as a location of the proejct? <b>(Questionnaires)</b>	- Main points for the selection of power plant location were to considered the sufficient of fuel, sufficient water source for the production and locating near the electrical transmission system.Four provinces of Southen Thailand and Chana had plenty sources of rubber wood, had water source from Na Tawee canal and located near the high voltage transmission lines.
<b>4. Suggestion</b>	
Requesting for the project to obtain correct and clear study so that the operation would went well. <b>(Questionnaires)</b>	

**2) Comments from the evaluation form of the meeting**

From evaluation forms after the meeting of the Chana Green Power Plant on30<sup>th</sup> April2016 atthe meeting room of village/headman of Tha Mo Sai, Tumbon Tha Mo Sai, Chana, SongKhla, there weretotally 59 respondents and their comments can be concluded as follows.

**(A) Issues on concerned environmental aspect for an additional study.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant would like the project to conduct an additional study on dust and noise (equally 20.5% ) and then there were other problems such aswastewater (16.5%), odor (14.6%) and solid waste, including accident and safety (5.9%). Details can be seen in **Table 7.6.2-9**.

**Table 7.6.2-9****Problems on environmental and health aspects and concerns for an additional study**

<b>Details</b>	<b>Numbers</b>	<b>%</b>
- Noise	52	20.5
- Dust	52	20.5
- Wastewater	42	16.5
- Odor	37	14.6

Details	Numbers	%
- Accident and safety	15	5.9
- Solid waste	15	5.9
- Transportation / Traffic	14	5.5
- The adequacy of utility system such as tap water, electricity, road, etc.	13	5.1
- The adequacy of public health service facility	5	2.0
- Others Impacts on the education of nearby schools	3	1.2
- No comment	6	2.4

Note: can select more than 1 answer

**(B) Concerns and additional comments to the Chana Green Power Plant of Chana Green, Co.,Ltd.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant provided concerns and additional suggestions to the project as following issues.

**a) Environmental aspect**

-There was a request for the efficient environmental management with no impact on the community.

- The plantation should be done around the power plant.

**b) Social aspect**

The project supports activities of the community such as traditional events or community sport days.

**(5) The meeting for public hearing of the project at the meeting hall of Tumbon Saphan Mai Kaen SAO, Tumbon Tha MaiKaen, Chana, SongKhla**

The meeting on the scope and criteria for an environmental impact assessment of Chana Green Power Plant was held on 3<sup>rd</sup> May 2016 during 13.30-15.30 hours at the meeting hall of Tumbon Saphan Mai Kaen SAO, Tumbon Saphan Mai Kaen, Chana, SongKhla. There weretotally56participants. The meeting atmosphere can be seen in **Figure 7.6.2-5**.

**1) Comments and suggesstions on the scope and criteria for an environmental impact assessmentof Chana Green Power Plant of Chana Green, Co.,Ltd.**

The meeting on 3<sup>rd</sup> May 2016 during 13.30-15.30 hours at the meeting hall of Tumbon Saphan Mai Kaen SAO, Tumbon Saphan Mai Kaen, Chana, SongKhla had details on issues, clarification, and suggestion as seen in **Table 7.6.2-10**. Moreover, participants could provided additional comments on given papers during the meeting and it could be concluded as follows.

- There was a concern on pollutions occurring from the project such as wastewater, ash from the combustion and heat.
- There was a request for a raw water retention pond in the project so that there would be no scramble for water consumption with the community.

## **2) Comments from the evaluation form of the meeting**

From evaluation forms after the meeting of the Chana Green Power Plant on 3<sup>rd</sup> May 2016 during 13.30-15.30 hours at the meeting hall of Tumbon Saphan Mai Kaen SAO, Tumbon Saphan Mai Kaen, Chana, there were totally 46 respondents and comments can be concluded as follows.

### **(A) Issues on concerned environmental aspect for an additional study.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant would like the project to conduct an additional study on dust (23.1%) and then there were other problems such as wastewater(15.7%),odor (11.1%) and solid waste (9.3%). Details can be seen in **Table 7.6.2-11**.



Registration



Participants in the meeting



Describe Project Information



Discussion & Suggestion with Participants

**Figure 7.6.2-5** The meeting atmosphere on 3<sup>th</sup> May 2016 during 13.30-15.30 hours, at the meeting hall of Saphan Mai Kean SAO, Chana, Song khla

**Table 7.6.2-10**

**Comments and suggesstions during the meeting for  
scope and criteria for environmental impact assessment  
The Chana Green power plant project of Chana Green Co,Ltd.  
on 3 May, 2016 during 13.30-15.30 hrs.  
at the meeting room of Tambon Saphan Mai Kaen SAO,  
Tumbon Saphan Mai Kaen, Chana, Songkhla**

**Table 7.6.2-10 (Cont.)**

<b>1. Project details</b>	<b><u>Response from the CGCL and Consultant</u></b>
<p>- There was a concern on water volumes in Na Tawee canal due to the Provincial Waterworks Authority also used water from this canal for tap water. If there will be a rising of water demand and water was not sufficient, how would the project fix this problem?</p> <p><b>(People of Moo 5,Tambon Saphan Mai Kaen)</b></p>	<p>- The consultant company collected the recent potentiality of Na Tawee canal to identify the utilization of water source. If the Provincial Waterworks Authority used water from this canal for tap water production, the project shall assess whether how much volumes of water can be onsumed to prevent an impact on tap water production. In case of rising of water demand in the future, the project, the Provincial Waterworks Authority and the Royal Irrigation Department should jointly discuss for further establishment of water allocation plan.</p>
<b>2. Environmental aspect</b>	
<p>- Since the project consumed water from Na Tawee canal that flew through Moo 3,Tambon Saphan Mai Kaen, Did it cause any impacts to the community?</p> <p><b>(Chief Administrator of Saphan Mai Kaen SAO)</b></p>	<p>- In principle, an environmental impact assessment of water consumption from natural canal must be done by studying the potentiality of water source utilization, consumption volumes and availability of water in each month. These information was used to calculate and build the sufficient size of raw water retention pond wihtout any competition of water consumption to the community.</p>
<p>- There was a concern on dust from the project that could affect the commuity.</p>	<p>- The consultant company installed the air quality monitoring point in association with the wind</p>

**Table 7.6.2-10 (Cont.)**

<b>(Chief Administrator of Saphan Mai Kaen SAO)</b>	direction for the update weather condition. This information would then be compared to the weather condition after the project establishment by using the mathematical modeling. Results of be presented in the 2nd meeting.
- Did the project casue infrared or not? There was a concern that infrared could affect the agricultural activities. <b>(People of Moo 3,Tambon Saphan Mai Kaen)</b>	- The project and consultant company took this issue for further study and the result would be presented in the 2nd meeting.
- Did treated water of the project affect aquatic animals when releasing into natural water source? <b>(People of Moo 5,Tambon Saphan Mai Kaen)</b>	- The consultant company took this concern for further study and defined the prevention measures, in order to prevent impacts occurring to the community. Continuous monitoring of water source quality would be done throughout the project.
- Did the heat generating from the project affect small creatures such as insects and poultry? <b>(People of Moo 5,Tambon Saphan Mai Kaen)</b>	- The consultant company took this concern for further study and defined the prevention measures, in order to prevent impacts occurring to the community.
- There was a concern on noise due to the community located at the back of the project. <b>(People of Moo 5,Tambon Saphan Mai Kaen)</b>	- The project installed the monitoring tool for the noise level at the nearest point to the project. According to the noise factor, the further from noise soure, the less impact occured. Therefore, if the first house close to the project had the noise level that met the standard, level of noise in next houses should not exceed the standard as well.
<b>3. Socio-economic aspect</b>	
- Could the project support activities of the community? <b>(Chief Administrator of Saphan Mai Kaen SAO)</b>	- The project is willing to support/help activities of Tumbon Saphan Mai Kaen. However, such activities should be set for majority of the community.
- For the electricity producing from the project, could it be used in the community? How did the project manage those electricity?	- The electricity producing from the project would be sold to Electricity Generating Authority of Thailand by sending it to the transmission line. Thus, the



**Table 7.6.2-10 (Cont.)**

Would it reduce the electrical cost of the community? <b>(People of Moo 5,Tambon Saphan Mai Kaen)</b>	project could not sell it directly to the community and the cost was set by EGAT.
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**Table 7.6.2-11****Problems on environmental and health aspects and concerns for an additional study**

<b>Details</b>	<b>Numbers</b>	<b>%</b>
- Dust	25	23.1
- Wastewater	17	15.7
- Noise	12	11.1
- Solid waste	10	9.3
- The adequacy of utility system such as tap water, electricity, road, etc.	10	9.3
- Odor	9	8.3
- The adequacy of public health service faci	7	6.5
- Transportation / Traffic	5	4.6
- Accident and safety	5	4.6
- No comment	8	7.4

Note: can select more than 1 answer

**(B) Concerns and additional comments to the Chana Green Power Plant of Chana Green, Co.,Ltd.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant provided concerns and additional suggestions to the project as following issues.

**a) Environmental aspect**

- Would it an opportunity that substance/gas from the production could cause a severe impact?
- Could the project cause more heat or not?
- There was a request to conduct a study of the air impact
- There was a concern on wastewater in the community.
- There was a request for the project to use an environmental friendly technology.

**b) Social aspect**

- There was a request for the plantation activity in the community.
- There was a request for the project to join community activities to build a good relationship between the project and the community.
- There was a concern on the problems of migrant workers moving in the area.
- There was a request for the project to provide an information board in the community to inform.
- There was a request for the project to organize the training/ knowledge distribution about the power plant to the youth.

**c) Health aspect**

There was a request for the project to take care of the community health.

**(6) The meeting for public hearing of the project at the village meeting hall, Moo 2, Baan Pa Lamai Klang, Tumbon Khun Tat Wai, Chana, SongKhla**

The meeting on the scope and criteria for an environmental impact assessment of Chana Green Power Plant was held on 7<sup>th</sup> May 2016 during 13.30-15.30 hours at the village meeting hall, Moo 2, Baan Pa Lamai Klang, Tumbon Khun Tat Wai, Chana, SongKhla. There were totally 60 participants. The meeting atmosphere can be seen in **Figure 7.6.2-6**.

**1) Comments and suggestions on the scope and criteria for an environmental impact assessment of Chana Green Power Plant of Chana Green, Co.,Ltd.**

The meeting on 7<sup>th</sup> May 2016 during 13.30-15.30 hours at the village meeting hall, Moo 2, Baan Pa Lamai Klang, Tumbon Khun Tat Wai, Chana, SongKhla had details on issues, clarification, and suggestion as seen in **Table 7.6.2-12**. Moreover, participants could provide additional comments on given papers during the meeting and it could be concluded as follows.

- At the present, areas of Tumbon Khun Tat Wai already receive impacts from existing power plants in the area. The establishment of Chana Green Power Plant would aggravate impacts to the community.

**2) Comments from the evaluation form of the meeting**

From evaluation forms after the meeting of the Chana Green Power Plant on 7<sup>th</sup> May 2016 during 13.30-15.30 hours at the village meeting hall, Moo 2, Baan Pa Lamai Klang, Tumbon Khun Tat Wai, Chana, SongKhla, there were totally 46 respondents and their comments can be concluded as follows.



Registration



Participants in the meeting



Describe Project Information



Discussion & Suggestion with Participants

**Figure 7.6.2-6** The meeting atmosphere on 7<sup>th</sup> May 2016 during 13.30-15.30 hours, at the village meeting hall, Moo 2, Baan Pa Lamai Klang, Chana, Song khla

**Table 7.6.2-12**

**Comments and suggestions during the meeting for  
scope and criteria for environmental impact assessment**

**The Chana Green power plant project of Chana Green Co.,Ltd.**

**on 7 May, 2016 during 13.30-15.30 hrs.**

**at the village meeting hall, Moo 2, Baan Pa Lamai Klang, Tumbon Khun Tat Wai,**

**Chana, Songkhla**

**Table 7.6.2-12 (Cont.)**

<b>1. Project details</b>	<b>Response from CGCL and Consultant</b>
<p>- In case of rubber wood was not available, other fuels would be used or not? There was a concern on using a coal.</p> <p><b>(Village Board, Moo 4 Tumbon Khun Tat Wai)</b></p>	<p>- The project had a contract with the Electricity Generating Authority of Thailand to produce 25 megawatts of electricity by using wood as fuel, for further distribution. Moreover, the klin was designed in compatible with the heating value from wood fuel only. Thus, the project could not use other fuels such as coal.</p>
<b>2. Environmental aspect</b>	
<p>There was a concern on wastewater occurring from the project operation.</p> <p><b>(Village Board, Moo 4 Tumbon Khun Tat Wai)</b></p>	<p>- Before releasing water from the project, there was an assessment of the potentiality of water source whether it could cope with water releasing from the project or not. The analysis would be done in association with other factories located in upstream and downstream areas. Moreover, the season would be considered such as draining during drought was not suitable.</p>
<p>- Building a check dam or a dam on Na Tawee canal for the project would affect the community locating in the downstream.</p> <p><b>(Village Board, Moo 4)</b></p>	<p>- The project had no policy to build a check dam or a dam. However, the establishment of sufficient retention pond would be considered for the water consumption within the project.</p>

**Table 7.6.2-12 (Cont.)**

<b>Tumbon Khun Tat Wai)</b>	
<b>3. Public participation aspect</b>	
<p>There was a need of public participation in various project monitoring such as wastewater and noise level, since the beginning of the project operation.</p> <p><b>(Village Board, Moo 4 Tumbon Khun Tat Wai)</b></p>	<p>The public participation of the project monitoring was the policy of Gulf group as the community, where the plant located, was a sacrifice. The company had a policy to repayment such as the supporting of community activities. For example, the power plant of The Gulf Group, locating in Kaeng Khoi, Saraburi, had a joint activity with the school called "Detective Water" to monitored an ecology of water source and to assessed the quality of such water source.</p>
<p>- Requesting the project to establish the Local Committee to monitor the project.</p> <p><b>(Village Board, Moo 4 Tumbon Khun Tat Wai)</b></p>	<p>- The power plant of the Gulf Group had a policy of local appointment as a committee for the environmental impact monitoring. If the project got approved for the operation, The project would organize the meeting to select members of the committee for the environmental impact monitoring as a representative to investigate the power plant. The investigation of power plant could be done throughout 24 hours. The report of environmental impact assessment or measure that the project must implement since the construction until the operation of the project.</p>
<b>4. Suggestions</b>	
<p>- Support and promote children in the community for the education that meet the project requirement.</p> <p><b>(Village Board, Moo 4, Tumbon Khun Tat Wai)</b></p>	
<p>- Support various activities of the community, such as temple and mosque, in appropriate ways.</p> <p><b>(Village Board, Moo 4, Tumbon Khun Tat Wai)</b></p>	
<p>- Requesting the project to had its own retention pond, due to the concern of the water use competition to the community over Na Tawee canal.</p> <p><b>(Village Board, Moo 4, Tumbon Khun Tat Wai)</b></p>	

**(A) Issues on concerned environmental aspect for an additional study.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant would like the project to conduct an additional study on noise (24.8 %) then there were other problems such as dust (22.3%), wastewater (14.4%) and odor (13.4%).Details can be seen in **Table 7.6.2-13**.

**Table 7.6.2-13****Problems on environmental and health aspects and concerns for an additional study**

Details	Numbers	%
- Noise	50	24.8
- Dust	45	22.3
- Wastewater	29	14.4
- Odor	27	13.4
- The adequacy of utility system such as tap water, electricity, road, etc.	14	6.9
- Solid waste	11	5.4
- Transportation / Traffic	11	5.4
- The adequacy of public health service facility	7	3.5
- Accident and safety	6	3.0
- Others	1	0.5
- The adequacy of water that the project requires		
- No comment	1	0.5

Note: can select more than 1 answer

**(B) Concerns and additional comments to the Chana Green Power Plant of Chana Green, Co.,Ltd.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant provided concerns and additional suggestions to the project as following issues.

**a) Environmental aspect**

- There was a request to continually track and monitor environmental impacts.
- There was a concern that the project will cause impact on local agriculture.

- There was a request to study amount of water for consumption to avoid the scramble for water use to the community.

**b) Social aspect**

- There was a request to support a scholarship for local students.
- There was a request for the budget for sports facilities.
- There was a request to support activities of the community.

**c) Health aspect**

- There was a request to establish the mobile medical unit.
- There was a request for the community health check up activity.

**(7) The meeting for public hearing of the project at the meeting room of Na Wa SAO, Tumbon Na Wa, Chana, SongKhla**

The meeting on the scope and criteria for an environmental impact assessment of Chana Green Power Plant was held on 10<sup>th</sup> May 2016 during 13.30-15.30 hours at the meeting room of Na Wa SAO, Tumbon Na Wa, Chana, SongKhla. There were totally 65 participants in the meeting. The meeting atmosphere can be seen in **Figure 7.6.2-7**.

**1) Comments and suggestions on the scope and criteria for an environmental impact assessment of Chana Green Power Plant of Chana Green, Co.,Ltd.**

The meeting on 10<sup>th</sup> May 2016 during 13.30-15.30 hours at the meeting room of Na Wa SAO, Tumbon Na Wa, Chana, SongKhla had details on issues, clarification, and suggestion as seen in **Table 7.6.2-14**. Moreover, participants could provide additional comments on given papers during the meeting and it could be concluded as follows.

- Could the monitoring process happen or not? And can the public sector have an opportunity to join this process?
- When impacts occurred, how could the project resolve problems?
- There was a concern on the impact to crops
- Air pollution occurred from the project establishment.
- The project caused no rain in the area and led to the drought condition and no latex from rubber woods.
- The temperature was highly increased during the day and night times
- There was no crops and agriculture outputs due to the change of the temperature.

- There was no certainty on the information received from the speaker.



Registration



Participants in the meeting



Describe Project Information



Discussion & Suggestion with Participants

**Figure 7.6.2-7** The meeting atmosphere on 10<sup>th</sup> May 2016 during 13.30-15.30 hours, at the meeting hall of Na Wa SAO, Chana, Song khla



**Table 7.6.2-14**

**Comments and suggestions during the meeting for  
scope and criteria for environmental impact assessment  
The Chana Green power plant project of Chana Green Co.,Ltd.  
on 10 May, 2016 during 13.30-15.30 hrs.  
at the meeting room of Na Wa SAO, Tambon Na Wa, Chana, Songkhla**

**Table 7.6.2-14 (Cont.)**

<b>1. Environmental aspect</b>	<b>Response from CGCL and Consultant</b>
<ul style="list-style-type: none"> <li>- Wastewater should be completely treated, before releasing into canal. <b>(People of Moo 5, Tambon Na Wa)</b></li> </ul>	<ul style="list-style-type: none"> <li>- Drainage of water into natural water source must comply with the regulation of Division of the Industrial Factory which it applied to general factory. It must comply with more stringent criteria of the Royal Irrigation Department. The project used the wastewater standard of the Royal Irrigation Department. The study of impacts occurring from the drainage must be done by the consultant company. Its result would be presented in the 2nd meeting.</li> </ul>
<ul style="list-style-type: none"> <li>- There was a concern about the impact on agricultural sector. <b>(People of Moo 5, Tambon Na Wa)</b></li> </ul>	<ul style="list-style-type: none"> <li>- The project and consultant company took this issue for further study and results would be presented in the 2nd meeting.</li> </ul>
<ul style="list-style-type: none"> <li>- There was a concern on water consumption due to dry areas of Tambon Na Wa. If the project located in this area, it could cause a scramble for water. Therefore, this problem had to be a priority to resolve. <b>(People of Moo 5, Tambon Na Wa)</b></li> </ul>	<ul style="list-style-type: none"> <li>- According to massive water consumption of the power plant, the assessment on the sufficiency of water must be done before the project start. The discussion with the representative of Provincial Irrigation Office should occur to find out the statistic of water flow to Na Tawee canal and assessed months containing lowest water volume in the canal. This would be used to calculate and build a pond as a water storage to avoid the water scramble with the community.</li> </ul>

## 2) Comments from the evaluation form of the meeting

From evaluation forms after the meeting of the Chana Green Power Plant on 10<sup>th</sup> May 2016 during 13.30-15.30 hours at the meeting room of Na Wa SAO, Tumbon Na Wa, Chana, SongKhla, there were totally 57 respondents and their comments can be concluded as follows.

### (A) Issues on concerned environmental aspect for an additional study

Respondents of the evaluation after the meeting of the Chana Green Power Plant would like the project to conduct an additional study on dust (24.2%) and then there were other problems such as wastewater (17.6%), odor (15.9%) and noise (15.4%).Details can be seen in **Table 7.6.2-15**.

**Table 7.6.2-15**

#### **Problems on environmental and health aspects and concerns for an additional study**

Details	Numbers	%
- Dust	55	24.2
- Wastewater	40	17.6
- Odor	36	15.9
- Noise	35	15.4
- The adequacy of public health service facility	14	6.2
- The adequacy of utility system such as tap water, electricity, road, etc.	14	6.2
- Solid waste	13	5.7
- Accident and safety	10	4.4
- Transportation / Traffic	9	4.0
- No comment	1	0.5

Note: can select more than 1 answer

### **(B) Concerns and additional comments to the Chana Green Power Plant of Chana Green, Co.,Ltd.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant provided concerns and additional suggestions to the project as following issues.

#### **a) Environmental aspect**

- The project located close to the school, thus, there should be an efficient pollution prevention.
- There was a concern on pollutions such as wastewaterpolluted air solid waste/waste.
- There was a concern on insufficient water for the consumption.
- The project should provide the wastewater treatment system before releasing into public water source.
- Will there be impacts on aquatic animals?

**b) Social aspect**

- There was a request for a local employment as a priority.
- There was a request to the project for supporting community activities.

**c) Health aspect**

- There was a request for the project to provide the mobile medical unit for public.
- There was a request for the community health check up activity.

**(8) The meeting for public hearing of the project at the headman office, Moo 9, Baan Saphan Hak, Tumbon Tha Mo Sai, Chana, SongKhla**

The meeting on the scope and criteria for an environmental impact assessment of Chana Green Power Plant was held on 17<sup>th</sup> May 2016 during 15.30-16.45 hours at the headman office, Moo 9, Baan Saphan Hak, Tumbon Tha Mo Sai, Chana, SongKhla. There were totally 15 participants. The meeting atmosphere can be seen in **Figure 7.6.2-8**.

**1) Comments and suggestions on the scope and criteria for an environmental impact assessment of Chana Green Power Plant of Chana Green, Co.,Ltd.**

The meeting on 17<sup>th</sup> May 2016 during 15.30-16.45 hours at the headman office, Moo 9, Baan Saphan Hak, Tumbon Tha Mo Sai, Chana, SongKhla had details on issues, clarification, and suggestion as seen in **Table 7.6.2-16**.

**2) Comments from the evaluation form of the meeting**

From evaluation forms after the meeting of the Chana Green Power Plant on 17<sup>th</sup> May 2016 during 15.30-16.45 hours at the headman office, Moo 9, Baan Saphan Hak, Tumbon Tha

Mo Sai, Chana, SongKhla, there were totally 15 respondents and their comments can be concluded as follows.



Registration



Participants in the meeting



Describe Project Information

**Figure 7.6.2-8** The meeting atmosphere on 17<sup>th</sup> May 2016 during 13.30-15.30 hours, at the headman office Moo 9, Baan Saphan Tha Mo Sai, Tumbon Ku, Chana, Song khla

**Table 7.6.2-16**

**Comments and suggesstions during the meeting for  
scope and criteria for environmental impact assessment  
The Chana Green power plant project of Chana Green Co.,Ltd.  
on 17 May, 2016 during 13.30-15.30 hrs.  
at the Headman office, Moo 9, Baan Saphan Hak, Tumbon Tha Mo Sai, Chana,Songkhla**

<b>1. Environmental aspect</b>	<b><u>Response from CGCL and Consultant</u></b>
- Why did local people go against the power plant? <b>(People of Moo 5, Tumbon Saphan Mai Kaen)</b>	- It was a news focusing on negative side of the power plant and the project did not reveal the true data that caused impacts to the community at the beginning. Thus, the community went against the power plant.
- There was a concern on dust in atmosphere. <b>(People of Moo 9, Tumbon Tha Mo Sai)</b>	- The consultant company took this issue for further study and the result would be presented in the 2nd meeting.
- The project could cause the hot weather which led to the unflow of latex. <b>(People of Moo 9, Tumbon Tha Mo Sai)</b>	- The consultant company took this issue for further study and the result would be presented in the 2nd meeting.
- Could project cause the noise impact? <b>(People of Moo 9, Tumbon Tha Mo Sai)</b>	- The consultant company took this issue for further study and the result would be presented in the 2nd meeting.
<b>2. Suggestions</b>	
- Requesting for project to establish the community fund. <b>(People of Moo 9, Tumbon Tha Mo Sai)</b>	
- The plant should support/help activities of the community. <b>(People of Moo 9, Tumbon Tha Mo Sai)</b>	
- Requesting for local employment as the priority of the project. <b>(People of Moo 9, Tumbon Tha Mo Sai)</b>	
- Requesting the project for a thoroughly PR on the project employment to the community. <b>(People of Moo 9, Tumbon Tha Mo Sai)</b>	
- Requesting the project to bring local people for the site visit of Yala Green power plant.	

**(People of Moo 9, Tumbon Tha Mo Sai)****(A) Issues on concerned environmental aspect for an additional study.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant would like the project to conduct an additional study on noise ( 16.3%) and then there were other problems such as dust and solid waste (equally 15.1%) and accident and safety (11.6%) Details can be seen in **Table 7.6.2-17**.

**Table 7.6.2-17****Problems on environmental and health aspects and concerns for an additional study**

Details	Numbers	%
- Noise	14	16.3
- Dust	13	15.1
- Solid waste	13	15.1
- Accident and safety	10	11.6
- The adequacy of utility system such as tap water, electricity, road, etc.	9	10.5
- Wastewater	8	9.3
- The adequacy of public health service facility	6	7.0
- Transportation / Traffic	6	7.0
- Odor	5	5.8
- No comment	1	1.2

Note: can select more than 1 answer

**(B) Concerns and additional comments to the Chana Green Power Plant of Chana Green, Co.,Ltd.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant provided concerns and additional suggestions to the project as following issues.

**a) Environmental aspect**

- Would it be noisy if the project located in the community?

- There was a concern on insufficient water due to the project used water from Na Tawee cannal.

**b) Social aspect**

- There was a request for a local employment as a priority.
- There was a request for the project to take the community for a study tour at the Yala Green Power Plant.
- There was a request for the project to support activities of the community.

**c) Health aspect**

There was a request for an annual health check up.

**(9) The meeting for public hearing of the project at the meeting hall of Pa ChingSAO,Tumbon Pa Ching, Chana, SongKhla**

The meeting on the scope and criteria for an environmental impact assessment of Chana Green Power Plant was held on 18<sup>th</sup> May 2016 during 13.30-16.00 hours at the meeting hall of Pa Ching SAO, Tumbon Pa Ching, Chana, SongKhla. There were totally 61 participants. The meeting atmosphere can be seen in **Figure 7.6.2-9**.

**1) Comments and suggestions on the scope and criteria for an environmental impact assessment of Chana Green Power Plant of Chana Green, Co.,Ltd.**

The meeting on 18<sup>th</sup> May 2016 during 13.30-16.00 hours at the meeting hall of Pa Ching SAO, Tumbon Pa Ching, Chana, SongKhla had details on issues, clarification, and suggestions as seen in **Table 7.6.2-18**.

**2) Comments from the evaluation form of the meeting**

From evaluation forms after the meeting of the Chana Green Power Plant on 18<sup>th</sup> May 2016 during 13.30-16.00 hours at the meeting hall of Pa Ching SAO, Tumbon Pa Ching, Chana, SongKhla, there were totally 58 respondents and their comments can be concluded as follows.

**(A) Issues on concerned environmental aspect for an additional study.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant would like the project to conduct an additional study on noise (21.5%) and then there were other

problems such as dust (19.6%), wastewater (17.8A%) and odor (13.7%). Details can be seen in **Table 7.6.2-19**.



**Figure 7.6.2-9** The meeting atmosphere on 18<sup>th</sup> May 2016 during 13.30-15.30 hours, at the meeting hall of Pa Ching SAO, Chana, Song khla



**Table 7.6.2-18**

**Comments and suggestions during the meeting for  
scope and criteria for environmental impact assessment  
The Chana Green power plant project of Chana Green Co.,Ltd.  
on 18 May, 2016 during 13.30-15.30 hrs.  
at Pa Ching SAO, Tumbon Pa Ching, Chana, Songkhla**

**Table 7.6.2-18 (Cont.)**

<b>1. Environmental aspect</b>	<b><u>Response from CGCL and Consultant</u></b>
<p>- What was the reason to select Chana as a location for the power plant?</p> <p><b>(Questionnair)</b></p>	<p>- Main points for the selection of power plant location were to considered the sufficient of fuel, sufficient water source for the production and locating near the electrical transmission system. Four provinces of Southen of Thailand and Chana had plenty sources of rubber wood, had water source from Na Tawee canal and located near the high voltage transmission lines.</p>
<p>- If there was no rubberwood in the future,what would the project use as a fuel?</p> <p><b>(Questionnairs)</b></p>	<p>- The project had a contract with the Electricity Generating Authority of Thailand to produce 25 megawatts of electricity by using wood as fuel, for further distribution. Moreover, the klin was designed in compatible with the heating value from wood fuel only. Thus, the project could not use other fuels such as coal.</p>
<b>2. Environmental aspect</b>	
<p>- Communities locating near the power plant in Tumbon Khun Tat Wai moved away due to the heat causing by the plant.Would Cha na Green powerplant be like this?</p> <p><b>(Questionnairs)</b></p>	<p>- Heat occuring from the thermal ventilation at the stack was approximately 100 oC and the ventilation stack would be in the high level for an effective heat ventilation. However, the project established the measure to capture an aerial photographs to monitor the heat during all seasons. This measure would be implemented since the construction period.</p>
<p>- Since the project and other power plants consumed water from Na Tawee canal, there was a concern on insufficient water for the agriculture of the community.</p>	<p>- The project and consultant company took this issue for further study and the result would be presented in the 2nd meeting.</p>

Table 7.6.2-18 (Cont.)

<b>(People of Moo 9,Tumbon Pa Ching)</b>	
<p>- Did the project cause noise? Did the machine run all the time? There was a concern on noise that cause a sleeplessness.</p> <p><b>(Questionnaires)</b></p>	<p>- Sounds of the machine was a still sound except the machine had a problem or noise occurring from testing of the system before startup. Therefore, if the project had activities causing noise, it had to inform the community in advance. Moreover, the project had to installed equipments to reduce noise at the source.</p>
<p>- Did the water circulation system affect underground water?</p> <p><b>(Questionnaires)</b></p>	<p>- According to the measure, the project had to draw the line of groundwater level, the treatment system must had a leakage prevention such as using concerte or high-density plastic to reduce the contamination. Moreover, the observation point for underground water sampling was identified to analyze the contamination in order to provide the prevention and measure.</p>
<b>3. Socio-economic aspect</b>	
<p>- What would the community gain from the project?</p> <p><b>(People of Moo 9,Tumbon Pa Ching)</b></p>	<p>-The project is willing to support activities of community.</p>
<p>- What would be advantage and disadvantage that the community gain from the project establishment?</p> <p><b>(Questionnaires)</b></p>	<p>- Operation of every project could cause impacts on air, water and noise. For these issues, the consultant company had to study their impacts to the community. For the overall picture, the advantage to the community was from the government supporting biomass power plants to reduce global warming as biomass came from plants and the final product was carbon dioxide gas generating from the combustion which can be reused by plants. The benefit that the community would got was the community development fund for communities around the plant, CSR, an income from selling woods to the project and the better trading condition.</p>

**Table 7.6.2-18 (Cont.)**

<b>4. Other</b>	
<p>- Why did Moo 3, Tumbon Ku area have a protest banner against the power plant? Was it because of impacts?</p> <p><b>(Questionnaires)</b></p>	<p>-The project was in the step of providing the environmental impact assessment with no construction activity. Thus, there was no impact occurred. However, the community also had different opinions for both agree and disagree. This meeting had the objective to receive concerns for further study on the prevention and the establishment of the operation plan for both project and community to live together.</p>
<p>- With the project establishment, the weather would be higher. Rubber trees gave less latex. Fruit tree had no fruits and there were incompleting trees.</p> <p><b>(Questionnaires)</b></p>	<p>-Global warming has been occurred in worldwide. Temperature had highly changed in each areas. Therefore, it affected the community in various conditions such as health, general environment, agricultural products. There were many researchs on how the temperature affected crops. Thus, the consultant company considered to add results from these researchs to this environmental impact assessment report.</p>
<b>5. Suggestions</b>	
<p>- Concerns on the conflict that might occurs among people who agree and disagree of the project.</p> <p><b>(People of Moo 9,Tumbon Pa Ching)</b></p>	
<p>- Requesting for the use of rubber wood as the only fuel source without other fuels</p> <p><b>(Questionnaires)</b></p>	
<p>- Requesting for the site visit of Yala Green Power Plant</p> <p><b>(Questionnaires)</b></p>	

**Table 7.6.2-19****Problems on environmental and health aspects and concerns for an additional study**

<b>Details</b>	<b>Numbers</b>	<b>%</b>
- Noise	47	21.5
- Dust	43	19.6
- Wastewater	39	17.8
- Odor	30	13.7
- Solid waste	16	7.3
- Accident and safety	11	5.0
- The adequacy of utility system such as tap water, electricity, road, etc.	10	4.6
- Transportation / Traffic	10	4.6
- The adequacy of public health service facility	11	5.0

Note: can select more than 1 answer

**(B) Concerns and additional comments to the Chana Green Power Plant of Chana Green, Co.,Ltd.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant provided concerns and additional suggestions to the project as following issues.

**a) Environmental aspect**

- Due to insufficiency of water from Na Tawee canal, will the project scramble for water to the community or not?
- How can the community trust the mathematical model done by the consultant company since the company was hired by the project?
- Does noise impact could reach to Tumbon Pa Ching or not?
- The project establishment causes the conflict among local people.

**b) Social aspect**

- There was a request for the project to support activities of the community.
- There was a request for a local employment as a priority.
- There was a request for the project to take the community for a study tour at the Yala Green Power Plant.

- What kind of benefit does the community gain from having Chana Green power Plant?
- The project caused more vehicles in the area and would increased an opportunity for the accident.

**c) Health aspect**

- Dust from the project could cause the impact on respiratory system or not?
- The project caused stress to people in the community and it led to poor mental health.
- There was a request for an annual health check up.
- With the power plant establishment, it caused skin disease or not?

**(10) The meeting for public hearing of the project at the meeting room of Department of Public Work and Town Planning Songkhla Office, Songkhla Government Center, SongKhla**

The meeting on the scope and criteria for an environmental impact assessment of Chana Green Power Plant was held on 19<sup>th</sup> May 2016 during 14.00-16.00 hours at the meeting room of Department of Public Work and Town Planning Songkhla Office, Songkhla Government Center, SongKhla. There were totally 17 participants. The meeting atmosphere can be seen in **Figure 7.6.2-10**.

**1) Comments and suggestions on the scope and criteria for an environmental impact assessment of Chana Green Power Plant of Chana Green, Co.,Ltd.**

The meeting on 19<sup>th</sup> May 2016 during 14.00-16.00 hours at the meeting room of Department of Public Work and Town Planning Songkhla Office, Songkhla Government Center, SongKhla had details on issues, clarification, and suggestion as seen in **Table 7.6.2-20**. Moreover, participants could provide additional comments on given papers during the meeting and it could be concluded as follows.

- The amount of water pumped from the public canal could affect the local people in agricultural sector. Therefore, it should be a well study.

**2) Comments from the evaluation form of the meeting**

From evaluation forms after the meeting of the Chana Green Power Plant on 19<sup>th</sup> May 2016 during 14.00-16.00 hours at the meeting room of Department of Public Work and Town Planning Songkhla Office, Songkhla Government Center, SongKhla, there were totally 5 respondents and their comments can be concluded as follows.



วิทยากรบรรยาย



Participants in the meeting



Discussion & Suggestion with Participants

**Figure 7.6.2-10** The meeting atmosphere on 19<sup>th</sup> May 2016 during 13.30-15.30 hours, at the meeting room Department of Public Work and Town Planning Song Khla Office, Song Khla Government Center

**Table 7.6.2-20**

**Comments and suggestions during the meeting for  
scope and criteria for environmental impact assessment**

**The Chana Green power plant project of Chana Green Co.,Ltd.**

**on 19 May, 2016 during 14.00-16.00 hrs.**

**at the meeting room of Department of Public Work and Town Planning Songkhla Office,**

**Songkhla Government Center**

**Table 7.6.2-20 (Cont.)**

<b>1. Project details</b>	<b><u>Response from CGCL and Consultant</u></b>
<p>- Where did woods as raw materials of the project come from? Was there any checking on the sufficiency? Due to there were other power plants in Chana areas, so that there was a concern on the scramble of raw materials among factories.</p> <p><b>(Songkhla Provincial Office of Natural Resources and Environment)</b></p>	<p>- Recently, there are plenty of rubber wood in 4 provinces of the south border and the project also plan to use roots rubber wood as a fuel which could generate the heat value in similar to rubber timber. Therefore, it could ensure the sufficient amounts of raw materials for power production throughout the project lifetime.</p>
<p>- The project will use raw materials for 800 tons/day. Is there any source? Are there any contracts had been done?</p> <p><b>( Provincial Energy Office)</b></p>	<p>- The project already had a preliminary agreement. Due to the study and the construction of the project would take another 2-3 years, so there is no written agreement at this time.</p>
<p>- Since the project located in Tumbon Ku, did the local agency participate in the public hearing? How did KU SAO contribute to this project construction?</p> <p><b>(Songkhla Local Office)</b></p>	<p>- Environmental impact information had been clarified to the public. However, because of different opinions, agree and disagree, upon the project construction, then there had a conflict among them. If Provincial Office of Natural Resources and Environment provided the clarification to the community at that time, people would have had less concerns.</p> <p><b>(Chief Executive of Ku SAO)</b></p> <p><b><u>Additional clarification by the local agency</u></b></p> <p>The agency was not able to clarify during the EIA study as it could dictate the community's response or attitude towards the project. Unless the project got an approval for the construction, the agency is then willing</p>

**Table 7.6.2-20 (Cont.)**

	to clarify and help the community. <b>(Songkhla Provincial Office of Natural Resources and Environment)</b>
From the past 4-5 years, there were many power plants. How did the province plan to control or manage the plant? <b>(Songkhla Local Office)</b>	- According to the Power Development Plan of Thailand (PDP), it promoted the biomass power plant. Energy Policy and Planning Office had studied the potentiality of the southern area for numbers of plants and its capacity in MW. The project was also in this plan and there will be an auction to increase power to 36 MW within 3 provinces at the south border on 4 districts in the future. Then it will move to other areas.
- Providinf a buffer zone, trees may not grew that fast. If it was possible, the plantation had to be done before the construction of the project. <b>(Regional Environment Office 16)</b>	- In EIA report, the plant was determined that the plantation must occur in 3 rows with zigzag line around the fence.The area where community was located, could have more than 3 rows of plantation. Trees that could prevent impacts, such as pine tree, would be used.
<b>2. Transportation aspect</b>	
- How many time did the trasportation occurper day? And how many ton to transport per trip? <b>(Songkhla Provincial Office of Natural Resources and Environment)</b>	- The project required fuel approximately 800 tons/day. In case of using a 10 wheel truck, it could carry approximately 15 tons/vehicle with the estimated transportation for 50 trips/day. Normally the project used a trailer which could reduce the transportation to 25-30 trips/day.
- The accident information prior the project should be collected in order to compare numbers of accidents whether it was increasind or decreasing after the project establishment. <b>(Regional Environment Office 16)</b>	- The traffic accident was one of issues in the EIA report.The consultant company took accident reports in the past to identidy the most types of accidents occuring near the plant, in order to further establish the preventive measure.
<b>3. Waste</b>	
- The study on reused ash for the agriculture should be clearly done wheter it can be used	The project hired the institute, conducting a research on ash for Yala Green power plant, to study reused



**Table 7.6.2-20 (Cont.)**

<p>or not?</p> <p><b>( Provincial Energy Office)</b></p>	<p>ash for agriculture and to analyze the contamination. This study is on going.</p> <p><b><u>Additional clarification</u></b></p> <p>Recently, the study on rubber wood ash is on going. In the past, Yala Green power plant (an operated biomass power plant of the Gulf Group locating in Yala) used such ash to improve soil for various agricultural project with a good result and no impact occurred.</p>
<p><b>4. Corporate Social Responsibility aspect</b></p>	
<p>- Focusing on CSR plan and making it clearly to reduce the complaint.</p> <p><b>(Regional Environment Office 16)</b></p>	<p>For the CSR, besides the payment to the community development fund, the project also had its own budget to fasten the support community activities. Moreover, the project prepared to take care/support various agencies in the area.</p>
<p>- The construction of industrial factory would raised the complaint from the the community. The reason people sent complaints to the government sector was due to unable to make an agreement. Thus, the project should listen and resolve problems that meet the public needs, so that, the government will not be the solely responsible part to resolve problems from the project operation.</p> <p><b>(Songkhla Provincial Office of Natural Resources and Environment)</b></p>	<p>- In the environmental impact assessment report, there was a committee to monitor environmental impacts. Responsibilities of the committee were to monitor the quality of an environment and to receive complaints from the community, then inform the plant for further discussion. The committee consisted of public representatives in a higher numbers than representatives from plants or government sectors together.</p>
<p><b>5. Environmental impact aspect</b></p>	
<p>- For the data collect in the area, update and realistic information should be collected as much as possible. Using old information, the comparison would be inappropriate and out of date.</p> <p><b>(Songkhla Provincial Office of Natural Resources and Environment)</b></p>	<p>- The consultant company collected both update and retrospective data to identify the change from the past such as health information. Therefore, this information would be a part of the study on the change of diseases in each year.</p>

**Table 7.6.2-20 (Cont.)**

<b>6. Environmental aspect</b>	
<p>- Noise from cutting wood disturbed the public in particularly at night which more quiet than day times. Noise disturbed the sleep. If its root had been cut, there would generated more noise than a trunk.</p> <p><b>(Songkhla Provincial Industrial Office)</b></p>	<p>- There were 2 related laws involve in chopping the wood which were laws of Department of Industrial Work and laws of Royal Forest Department that identify types of permit and forbidden woods. The duration of wood chopping was included to prevent problems occurring from such activity during the night.</p>
<b>7. Suggestion</b>	
<p>- Although the project had a good impact prevention plan, without the implementation or incorrect practises, problems would occur. Therefore, the project should strictly consider and emphasize the implementation of the mitigation.</p> <p><b>(Songkhla Provincial Office of Natural Resources and Environment)</b></p>	
<p>When an environmental impact assessment report (EIA) was completed, it must be sent to local authorities, in order to inform them so that they would perform on their duties. Moreover, the monitoring report must be sent to related agencies for their information so that whenever problems occurs, all related agencies would have all information.</p> <p><b>(Songkhla Provincial Office of Natural Resources and Environment)</b></p>	
<p>Problems and impacts would occur in similar to other industrial factories such as odor, noise and dust.</p> <p><b>(Songkhla Provincial Office of Natural Resources and Environment)</b></p>	
<p>The study should cover all 4 aspects but it should focus on the air quality.</p> <p><b>(Regional Environment Office 16)</b></p>	
<p>For the water consumption, there should be agreement between project and community due to the concern on the scramble for water. The project should reuse water as much as possible to reduce wastewater from the project.</p> <p><b>(Regional Environment Office 16)</b></p>	
<p>The project should emphasize the employee health problem after the operation. Since employee could have a health problem such as hearing loss.</p> <p><b>(Regional Environment Office 16)</b></p>	
<p>This was a first biomass power plant in the area providing an environmental impact assessment report (EIA). It was good as the prevention and monitoring could be prepared for impacts that might occur.</p> <p><b>(Songkhla Provincial Public Health Office)</b></p>	
<p>For health impacts occurring from air pollution, an environmental impact assessment report should</p>	

**Table 7.6.2-20 (Cont.)**

<p>collect basic data of 4 diseases which are cardiovascular disease, dermatitis, respiratory disease and eye disease. Therefore, after the project established, people could compare the disease trend and local authorities could also surveillance health impacts.</p> <p><b>(Songkhla Provincial Public Health Office)</b></p>
<p>The raw material yard without a suitable cover could flow into a canal during the rain.</p> <p><b>(Songkhla Provincial Industrial Office)</b></p>
<p>According to the use of roots as raw material, soil that attached to roots should be considered as a waste and must be conducted in accordance with related laws.</p> <p><b>(Songkhla Provincial Industrial Office)</b></p>
<p>Air quality problem occurs from total suspended particles (TSP). The project must have a concise management plan.</p> <p><b>(Songkhla Provincial Industrial Office)</b></p>
<p>Before using ash/sediment of the project for the soil quality improvement or other uses, the verification with the Division of the Industrial factory must be done to ensure whether it can be used or not.</p> <p><b>(Songkhla Provincial Industrial Office)</b></p>
<p>Was the sludge yard designed with a cover? The project should manage the spreading of dust from the sludge yard and the run off during the rain as well.</p> <p><b>(Songkhla Provincial Industrial Office)</b></p>
<p>For the fuel consumption of the project, it should be clearly identified that coal was not involved.</p> <p><b>(Songkhla Provincial Industrial Office)</b></p>
<p>If the project transportation causing the damage on the road, who would be responsible to repair the road.</p> <p><b>(Songkhla Provincial Industrial Office)</b></p>
<p>Did the project have raw water retention pond for the consumption? And what size was it?</p> <p><b>(Songkhla Provincial Industrial Office)</b></p>
<p>There should have a clear study on reusing ash for the agriculture whether it can be used or not.</p> <p><b>( Provincial Energy Office)</b></p>
<p>Every maintenance of equipments that could cause impacts on the community, SAO should be informed.</p> <p><b>(Songkhla Provincial Office of Natural Resources and Environment)</b></p>
<p>Mental health information of people in the community should be collected due to the concern on the problem of the competition for water use and the water consumption of Na Tawee canal which was issues that the conservation group concerns.</p>

**Table 7.6.2-20 (Cont.)**

<b>(Songkhla Provincial Office of Natural Resources and Environment)</b>
The participation should focus on the truly participation in the community, not just the donation because the community would have to wait for the budget from the project and as the only demand. Thus, in the process of participation, the project should help the community to improve the potentiality to be able to live and depend on their own.
<b>(Songkhla Provincial Industrial Office)</b>

**(A) Issues on concerned environmental aspect for an additional study.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant would like the project to conduct an additional study on noise, dust and wastewater (equally 18.5%). Then there were other problems such as transportation / traffic and odor (equally 11.1%) and solid waste and accident and safety (equally 7.4%). Details can be seen in **Table 7.6.2-21**.

**Table 7.6.2-21****Problems on environmental and health aspects and concerns for an additional study**

<b>Details</b>	<b>Numbers</b>	<b>%</b>
- Noise	5	18.5
- Dust	5	18.5
- Wastewater	5	18.5
- Transportation / Traffic	3	11.1
- Odor	3	11.1
- Solid waste	2	7.4
- Accident and safety	2	7.4
- The adequacy of public health service facility	1	3.7
- The adequacy of utility system such as tap water, electricity, road, etc.	1	3.7

Note: can select more than 1 answer

**(B) Concerns and additional comments to the Chana Green Power Plant of Chana Green, Co.,Ltd.**

Respondents of the evaluation after the meeting of the Chana Green Power Plant provided concerns and additional suggestions to the project as following issues.

**a) Environmental aspect**

- There was a request for the project to strictly implement mitigations reporting in the environmental impact assessment (EIA).
- Plantation should be done to prevent noise and dust. Local plants should be planted for the buffer zone area.
- The control of environmental quality must be operated in accordance with the standard and regulations.
- Electrostatic Precipitator system ( ESP) must be continually maintained and monitored.
- The suitable waste management from the combustion must be implemented.
- There should be a plan to prevent noise the impact from chopping wood.

**b) Social aspect**

- Focusing on activities that could build relationships with the community.
- The project should have a clear and practical CSR plan.
- The project should have sustainable solutions that met the demand of local complaints.
- Local people should be employed with an appropriate ratio.

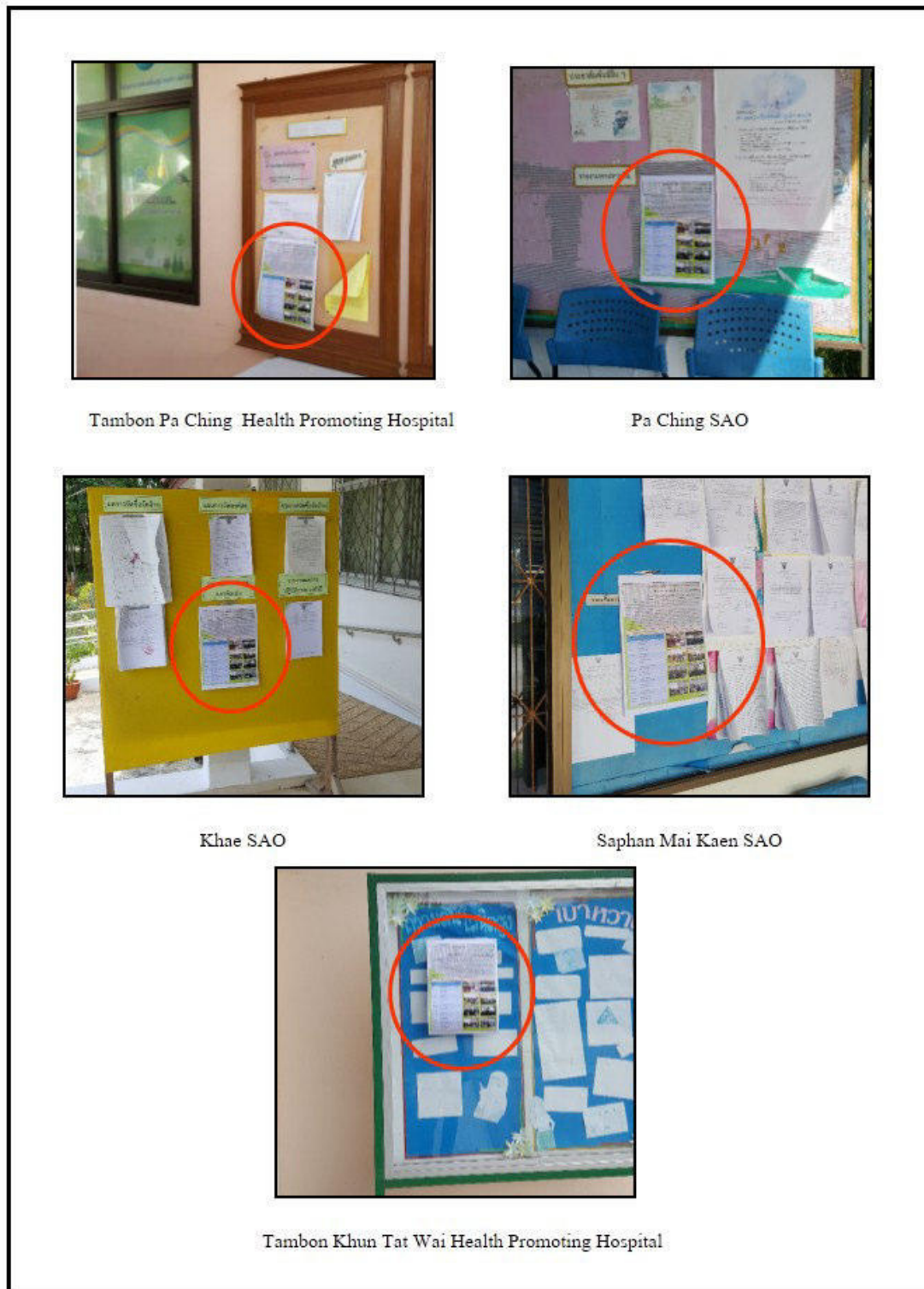
**c) Health aspect**

- There should be a mitigation for the health check up within the power plant and also the health of the community at least once a week (a mobile medical unit).
- Information on diseases occurring from the project operation and during the construction should be collected.

**7.6.3 The distribution of the minute of the public hearing meeting on the scope and criteria for an environmental impact assessment of the project**

The project sent the minute of the public hearing meeting on the scope and criteria for an environmental impact assessment of the project including the cover letter to government organizations and community leaders in the study area for further distribution. ( a copy of the cover letter for distribution of the minute of the public hearing meeting on the scope and criteria for an

environmental impact assessment of the project can be seen in **Annex 7-2**). Moreover, the project posted the minute of the public hearing meeting on the scope and criteria for an environmental impact assessment of the project within the community. This was done during 2-3 June 2016 (a copy of a meeting minute posting in the community can be seen in **Figure 7.6.3-1**).



**Figure 7.6.3-1** A copy of a meeting minute posting in the community

## II. Consultations and Meeting for Review of Draft EIA Report

### 7.6.4 The meeting for the review of the draft environmental impact assessment report (Public Review)

The Company has organized a site visit to the Yala Green power plant at Pron sub-district Muang district Yala province, together with the meeting for the review of the draft environmental impact assessment report (Public Review) during 3-26 November 2016. After receiving suggestions/concerns from stakeholders during the meeting. The project has revised project details following the concerns of communities which include the master plan to increase distance between the machine and sensitive areas. The company also increased the capacity of water storage ponds to reserve water for at least four months in order to reduce competition for water use in the community during the dry season. To inform the stakeholders about the details that has been revised, the project conducted additional meetings on February 28, 2017 which include focus group meetings during 1-3 March 2017 with representatives of agencies and people in the study area. Details of the meetings are presented in **Table 7.6.4-1**

(1) A field trip to visit the power plant and Public Review at the meeting room of the development center of Sukhothai Thammathirat Open University in Phron Sub-district, Mueang Yala District, Yala Province

The public participation meeting was conducted to listen to the opinion of the public to the draft of the environmental impact assessment report and the environmental impact prevention and mitigation measures and the environmental impact monitoring program (Public Review) as well as the approaches to assess the environmental impact of the Project. It was organized on 3 November 2016 at 09.30 – 12.30 o'clock at the meeting room of the development center of Sukhothai Thammathirat Open University in Phron Sub-district, Mueang Yala District, Yala Province. The participants were from Khu District and relevant agencies of 517 people (**Table 7.6.4-2**). The photographs of the meeting atmosphere are shown in **Figure 7.6.4-1**.

**Table 7.6.4-1**

**Details of the meeting for the review of the draft environmental impact assessment report**

**Table 7.6.4-1 (cont.)**

Time	Date	Location	Number of participants (persons)
1	3/11/2016	At the meeting room of Sukhothai Thammathirat Open University	517

**Table 7.6.4-1 (cont.)**

<b>Time</b>	<b>Date</b>	<b>Location</b>	<b>Number of participants (persons)</b>
		Pron sub-District Muang District Yala Province (Participants : People in Ku sub-district and government agencies)	
2	5/11/2016	At the meeting room of Sukhothai Thammathirat Open University Pron sub-District Muang District Yala Province (Participants : People in Khae, Na Wa, Pa Ching, Khun Tat Wai sub-District and government agencies)	177
3	7/11/2016	At the meeting room of Sukhothai Thammathirat Open University Pron sub-District Muang District Yala Province (Participants : People in Baan Na, Tha Mo Sai, Saphan Mai Kaen sub-District and government agencies)	223
4	26/11/2016	Nai Muang garden hotel Chana District, Songkhla Province	442
5	28/02/2017	At the meeting room of CEO, Songkhla city hall (Participants : government agencies)	23
6	1/03/2017	Participants : Representatives of Baan Khae School, Chana District Non-formal and informal education centers, Village Security Team	12
7	2/03/2017	Participants : Representatives of Naphrue Temple, Na Phrue Shcool, People of Moo8, Tha Mo Sai Health Promoting Hospital, Tha Mo Sai SAO, Ku Health Promoting Hospital, community leaders of Baan Prachanuea and Wat Praja School	15
8	3/03/2017	Participants : Representatives of religious leaders Moo 1, religious leaders Moo 8, People of Moo 5, Ko Thank School, Baan Not School and Chana Chanupatham School	7





Table 7.6.4-2 (cont.)

Attendant	Position	Number of participants (person)
3. Government organization at various levels		
- Local organizations		
- Ku Subdistrict Administrative Organization	- Subdistrict Administrative Organization Officer	13
	<b>Total</b>	<b>13</b>
<b>Grand Total</b>		<b>517</b>

Remark: <sup>1/</sup> Total number of participants excluding the Project owner and the Consultant

Source: Consultants of Technology Company Limited, 2017



Registration



Participants in the meeting



Describe Project Information



Discussion & Suggestion with Participants

**Figure 7.6.4-1** The meeting atmosphere On November 3, 2016

At the meeting room of Sukhothai Thammathirat Open University, Muang District Yala Province

**1) Suggestions and comments from the field trip and the Public Review meeting on the Project of Chana Green Power Plant of Chana Green Company Limited**

From the meeting that was organized on 3 November, 2016 at 09.30 – 12.30 o'clock at the meeting room of the development center of Sukhothai Thammathirat Open University in Phron Sub-district, Mueang Yala District, Yala Province, questions, declarations, suggestions, and comments were obtained from the participants. They can be summarized as shown in **Table 7.6.4-3**.

**2) Comments from the evaluation form after the Public Review meeting**

After the Public Review meeting of the Project of Chana Green Power Plant on 3 November 2016, 495 evaluation forms were collected from 517 participants. It can be summarized as follows:

**Table 7.6.4-3**

**Comments and suggestion from the power plant field trip and public participation meeting of**

**Chana Green Power Plant Project of Chana Green Company Limited**

**3 November 2016**

**at the meeting room of the development center, Sukhothai Thammathirat Open University, Phron**

**Sub-district, Mueang Yala District, Yala Province**

**Table 7.6.4-3 (cont.)**

<b>Question/concern</b>	<b>Clarification</b>
<b>1. Project description</b>	
- The project can change fuel from wood to coal or not? (question sheet)	- The project cannot change type of fuel from rubberwood and lumber to coal because it will not comply with the terms specified in the environmental impact assessment report (EIA) that is used to control the power plant operation. Moreover, the machines used in the Project can be used with wooden fuel only. In case of wooden shortage, the Project must stop the operation.
<b>2. Water drainage</b>	
- The Project will cause flood in the communities or not? (question sheet)	- In order to prevent such problem, the Project will build a dyke and will design a ditch at south of the Project area to maintain the direct water flow to Nathawee canal directly and

Table 7.6.4-3 (cont.)

Question/concern	Clarification
	rapidly. Thus, the communities will not face such problem more than usual. Also based on the study, it was found that relevant government agencies excavated Nathawee canal for it to be able to drain well.
<b>3. Socio-economic</b>	
- It the Project actually happens, is there possibility to move Chana Chanupatham School or not? (question sheet)	- The power plant will be strictly operated in accordance with the environmental impact prevention and mitigation measures proposed in the environmental impact assessment report as well as related laws and regulations. If there is an impact from the Project, it will be fixed with participation of the community. The community way of living will be the same as before development of the power plant. Chana Chanupatham School will not have to be moved.
- In the case of flood, how will the project support communities? (Vice President of Khu Sub-district Administration Organization)	- The Project is pleased to help communities in every way such as supporting of survival bags and budget for local organizations for flood problems. This is the power plant's policy that the Company always upholds.
- In the case that the Project operation has an impact on agriculture such as such as rubber latex, how will the Project help? (Resident in Moo 9 Ban Plak Por, Khu Sub-district)	- If the problem is caused by the Project, the Project will compensate according to the actual damages.
- In the case that the Project causes the death of people in communities with a proof, the Project should compensate 500,000 –	- If the impact is actually caused by the Project, the Project will compensate according to the damages.

Table 7.6.4-3 (cont.)

Question/concern	Clarification
1,000,000 Baht per case. (question sheet)	
- What are the benefits that communities will gain from the power plant? (question sheet)	- There will be a power plant development fund in which the power plant will pay into the fund according to the type of fuel and capacity of the power plant. For the Project that uses wood as a fuel with a capacity of 25 MW, the Project shall pay about 1.5 million Baht a year into the fund per which is similar to Yala Green Power Plant. There will be a fund committee from the communities with roles to manage the fund. Communities surrounding the power plant can prepare a project and submit the committee to get a fund with approval from the committee. Another benefit that the communities will gain from the power plant is that the Project will buy wood at the power plant. It will generate more income to the communities.
<b>4. Other</b>	
- Can community holds a share of the power plant? (question sheet)	- Gulf Group of Company have no policy to allocate share to community
<b>5. Comments/suggestions</b>	
<ul style="list-style-type: none"> <li>- Request the Project to drill groundwater pound or provide water for consumption of the communities in the case of water shortage during dry season</li> <li>- Request the Project to compensate in the case of an impact on communities and it can be proofed that it caused by the Project operation</li> <li>- Request the Project to help to provide water for community consumption in the case of water shortage</li> <li>- Request the Project to support electricity expenditures to government organizations in the area</li> </ul>	

**Table 7.6.4-3 (cont.)**

Question/concern	Clarification
<ul style="list-style-type: none"> <li>- Request the Project to support a football field in the community</li> <li>- Request the Project to allocate budget to support annual sports activities of the sub-district</li> <li>- Request the Project to allocate 1-2 shares to community leaders for further community development</li> <li>- Request the Project to employ local labors of at least 80 percent of the total employees</li> </ul>	

**(a) Measures that should be studied further**

From the evaluation of the meeting of the Project of Chana Green Power Plant, the majority of the participants (75.6 percent) specified that no need of additional measures. However, those who specified that more measures should be added (24.4 percent) emphasized that the additional measures are air quality (16.7 percent) follow by noise (14.1 percent), health (13.4 percent), and water usage (12.1 percent). Details are presented in **Table 7.6.4-4**.

**Table 7.6.4-4****Measures that should be studied further**

Detail	Number of participant	Percentage
- Air quality	77	16.7
- Noise	65	14.1
- Health	62	13.4
- Water usage	56	12.1
- Wastewater management	47	10.2
- Waste management	43	9.3
- Safety measures	43	9.3
- Socio-economic	41	8.9
- Transport	26	5.6
- Other (economic, social, and community way)	2	0.4

Remark: multiple answers allowed

**(b) Other suggestions/comments to the Project**

- Good environmental management that will not have impact on communities

- Concern about air pollution that would occur, the Project must be strictly supervised
- The Project should build a ditch for flood prevention and make a dam to prevent water shortage
- Concern about heat from the power plant
- The Project should clarify about issues that the public unsatisfied to make them not oppose the construction of the power plant
- In case of proved impacts on the communities, the Project should take care/compensate appropriately
- The project should have activities that build good relation with the communities
- The Project should support/promote community development activities
- Support community activities such as sub-district annual sports event and sports field in the village
- Request the Project to provide health insurance for children and elderly in the area
- The Project should have a community loan fund for individual benefits such as house loan, car loan, and business loan
- Provide at least ten scholarships a year for poor good students
- Request the Project to get local people to work as the first priority
- Request the Project to conduct public relations for every village in the area
- Request the Project to provide annual medical check-up for the people

**(3) The power plant field trip and the public participation meeting at the meeting room of the development center of Sukhothai Thammathirat Open University in Phron Sub-district, Mueang Yala District, Yala Province**

The public participation meeting to the reviewing of the draft of environmental impact assessment report, the environmental impact prevention and mitigation measures, the environmental impact monitoring program, and the approaches to assessing environmental impact of the Project was organized on 5 November 2016 at 09.30 – 12.30 o'clock at the meeting of the development center of Sukhothai Thammathirat Open University in Phron Sub-district, Mueang Yala District, Yala Province. The participants were from communities in Khae Sub-district, Wha Sub-district, Pa Ching Sub-district,



Khun Tut Wai Sub-district, and relevant agencies of 177 people (Table 7.6.4-5). The atmosphere of the meeting is shown in Figure 7.6.4-2.

Table 7.6.4-5

**Summarize of the Attendant for the Power Plant Field Trip and the Public Participation Meeting  
by group of stakeholders**

**The Project of Chana Green Power Plant of Chana Green Company Limited**

**5 November 2016 at 09.30 a.m. - 12.30 p.m.**

**at the meeting room of the development center of Sukhothai Thammathirat Open University**

Table 7.6.4-5 (Continued)

Attendant	Position	Number of participants (person)
<b>1. Population receive impacts</b>		
<b><u>Tumbon Khun Tat Wai, Chana District, Songkhla</u></b>		
- Moo 2 Baan Pa Lamai Klang	- Village health volunteers	2
	- Local residents	8
- Moo 4 Baan Pa La Mai Ok	- Local residents	19
<b><u>Tumbon Pa Ching, Chana District, Songkhla</u></b>		
- Moo 8 Baan Huadinnuea	- Local residents	15
- Moo 9 Baan Huadintai	- Assistant Village Headman	3
	- Local residents	28
<b><u>Tumbon Khae, Chana District, Songkhla</u></b>		
- Moo 1 Baan Khok Yang	- Village health volunteers	3
	- Local residents	2
- Moo 2 Baan Khae Nuea	- Assistant Village Headman	1
	- Village health volunteers	2
	- Local residents	2
- Moo 3 Baan Khae Tai	- Village Headman	1
	- Assistant Village Headman	1
	- Village health volunteers	1

Table 7.6.4-5 (Continued)

Attendant	Position	Number of participants (person)
- Moo 4 Baan Niat	- Local residents	6
	- Village Headman	1
	- Village health volunteers	2
<b><u>Tumbon Na Wa, Chana District, Songkhla</u></b>	- Imam	1
	- Local residents	28
- Moo 3 Baan Kothaktai	- Village Headman	1
	- Assistant Village Headman	1
	- Village health volunteers	2
	- Imam	1
	- Mosque committee	2
	- Chief of Women's groups	1
	- Local residents	5
- Moo 4 Baan Khlong Bon	- Local residents	5
- Moo 5 Baan Prachanuea	- Local residents	5
- Moo 6 , Baan Prachatai	- Local residents	5
- Moo 7 Baan Na Nai	- Local residents	5
	<b>Total</b>	<b>159</b>
<b>2. Responsible agency on providing the EIA report</b>		
- Chana Green Co.,Ltd.		15
- Consultants of Technology Co.,Ltd.		3
	<b>Total</b>	<b>18</b>
<b>3. General public</b>		
- General public	- General public who are interested in the project	18
	<b>Total</b>	<b>18</b>

**Table 7.6.4-5 (Continued)**

Attendant	Position	Number of participants (person)
Grand Total <sup>1/</sup>		177

Remark: <sup>1/</sup> Total number of participants excluding the Project owner and the Consultant

Source: Consultants of Technology



- **Figure 7.6.4-2** The meeting atmosphere On November 5, 2016

At the meeting room of Sukhothai Thammathirat Open University, Muang District Yala Province

.,Ltd.

**1) Suggestions and comments from the field trip and the public participation meeting on the Project of Chana Green Power Plant of Chana Green Company Limited**

From the meeting that was organized on 5 November 2016, questions, declarations, suggestions, and comments were obtained from the participants as shown in **Table 7.6.4-6**. Moreover, the participants gave more comments on the provided papers, they can be summarized as shown in **Table 7.6.4-6**.

**Table 7.6.4-6**

**Comments and suggestion from the power plant field trip and public participation meeting of**

**Chana Green Power Plant Project of Chana Green Company Limited**

**5 November 2016**

**at the meeting room of the development center, Sukhothai Thammathirat Open University, Phron**

**Sub-district, Mueang Yala District, Yala Province**

**Table 7.6.4-6 (cont.)**

<b>Question/concern</b>	<b>Clarification</b>
<b>1. Project description</b>	
- Is the fuel yard close or open system? If it is an open yard, it may cause malodor after rain. (Resident of Khun Tat Wai Sub-district)	- The Project's fuel yard is an open yard but the Project has set a measure not to keep fuel too long at the yard. It would help reduce malodor. For the case of rubber latex with rainwater runoff in which cause malodor, the Project shall collect such water to the wastewater treatment system. Chopped rubberwood shall be kept in the closed building.
- Will the project use any chemical in the combustion process to generate electricity or not? If yes, will it affect the health of the people? (Resident of Khun Tat Wai Sub-district)	- In the Project's power generation process, there is no chemical used in the combustion. The selected fuel is wood only. The Project will use chemicals in the water treatment system only. Raw water will be pumped from Nathawee canal. The treatment process is the same as tap water treatment to make raw water clean. Thus, the chemicals are same as such being used in community water treatment facility such as a coagulant, chlorine for disinfection, and

Table 7.6.4-6 (cont.)

Question/concern	Clarification
<p>- Request the Project to appoint potential consultant from the residents in the communities.</p>	<p>chemical to adjust pH of water.</p> <p>- The Project shall set up the environmental monitoring committee prior construction period. The committee will consist of representatives of the communities, representative or related government agencies, experts, and representative of the power plant. They will be working together to monitor the environmental operation of the Project as well as complaints response. However, the Project has a wish that if the operation causes an impact on the communities, the Project will be notified and the problem will be solved together. This will lead to sustainable coexistence between the Project and the communities.</p>
<p>- How does the Project treat wastewater? How many wastewater treatment ponds? Is it sufficient? (Resident of Khun Tat Wai Sub-district)</p>	<p>- High contaminated wastewater such as wastewater from root cleaning and fuel yard cleaning will be collected to a clarification pond. Later, it will be sent to an anaerobic wastewater treatment system to make the wastewater quality meet with the effluent standard (BOD below 20 milligrams per liter). Next, it will be pumped to the wastewater collection system together with low contaminated wastewater such as wastewater from the cooling tower and blowdown water from the boiler. This wastewater will be sent to the pond where continuous water quality measuring system is installed. In the case that the quality is not meet the effluent standard, it</p>

Table 7.6.4-6 (cont.)

Question/concern	Clarification
	will be retreated prior sending to the polishing pond. The quality of water in this pond is meet with the effluent standard of the Royal Irrigation Department and can be discharged into a public waterway.
<b>2. Environment</b>	
- Request the Project to manage the environment properly not to cause an impact on communities in Chana District. If there is an impact, the Project should fix the problem rapidly.  (Ban Khae Islamic Headman)	- The Project has practical environment impact preventive measures and listens to the comments and suggestions of the communities for sustainable coexistence.
- How often will air quality monitoring take place? What organization will be responsible is it? Can communities participate in the monitoring?  (Resident of Khun Tat Wai Sub-district)	- The Project shall monitor air quality twice a year since before construction throughout the operation period. The monitoring stations are located in the communities surrounding the Project at stationary sensitive areas according to the wind direction such as school and mosque. The monitoring will be done seven days continuously. Moreover, the Project welcomes the communities to participate via the environmental impact monitoring committee.
<b>3. Noise</b>	
- The Project's power plant will generate loud noise like the power plant in Khun Tat Wai Sub-district or not?  (Resident of Khun Tat Wai Sub-district)	- Noise will be caused from high-pressure steam releasing. In the operation, the Project shall control steam pressure properly and install silencers at steam releasing pipe. However, loud noise will be generated for 1-2 times a year (during start-up) and the Project shall inform the communities earlier.

## 2) Comments from the evaluation form after the public participation meeting

After the public participation meeting of the Project of Chana Green Power Plant on 5 November 2016, 175 evaluation forms were collected from 177 participants. It can be summarized as follows:

### (a) Measures that should be studied further

From the evaluation of the meeting of the Project of Chana Green Power Plant, the majority of the participants (65.7 percent) specified that no need of additional measures. However, those who specified that more measures should be added (34.4 percent) emphasized that the additional measures are air quality (20.6 percent) follow by noise (16.0 percent), wastewater management (15.5 percent), and health (14.4 percent). Details are presented in **Table 7.6.4-7**.

**Table 7.6.4-7**

### Measures that should be studied further

Detail	Number of participant	Percentage
- Air quality	40	20.6
- Noise	31	16.0
- Wastewater management	30	15.5
- Health	28	14.4
- Water usage	25	12.9
- Transport	12	6.2
- Waste management	11	5.7
- Socio-economic	9	4.6
- Safety measures	8	4.1

Remark: multiple answers allowed

### (b) Other suggestions/comments to the Project

- Request the project to manage dust and noise properly and not affect the communities
- Concern about the wastewater treatment system that probably inadequate
- The Project's staffs gave unclear information about the Project and lack of impact details
- Request the Project to organize a public participation after operational

- The Yala Green Power Plant field trip should be done thoroughly not only listening to a presentation
- The Project should meet the communities more often and give more information about the power plant
- Request the Project to take action immediately if there is a problem arises from the Project operation
- Request the Project to consider to relocate the power plant far from communities
- Request the Project to educate the people about the impacts that will occur
- The Project should have activities for community development around the power plant
- Support scholarships for poor good students
- Request the Project to get local people to work as first priority
- The Project should help to provide water for agriculture in adjacent areas
- Request to deduct half of electricity price in the community or 20 percent reduction per electricity unit in daily use

**(4) The power plant field trip and the public participation meeting at the meeting room of the development center of Sukhothai Thammathirat Open University in Phron Sub-district, Mueang Yala District, Yala Province**

The public participation meeting to the reviewing of the draft of environmental impact assessment report, the environmental impact prevention and mitigation measures, the environmental impact monitoring program, and the approaches to assessing environmental impact of the Project was organized on 7 November 2016 at 09.30 – 12.30 o'clock at the meeting of the development center of Sukhothai Thammathirat Open University in Phron Sub-district, Mueang Yala District, Yala Province. The participants were from communities in Ban Na Sub-district, Tha Mo Sai Sub-district, Mai Kaen Sub-district, and relevant agencies of 223 people (**Table 7.6.4-8**). The atmosphere of the meeting is shown in **Figure 7.6.4-3**.

**1) Suggestions and comments from the public participation meeting on the Project of Chana Green Power Plant of Chana Green Company Limited**

From the meeting that was organized on 7 November 2016, questions, declarations, suggestions, and comments were obtained from the participants. Moreover, the participants gave more comments on the provided papers, they can be summarized as shown in **Table 7.6.4-9**.



**Table 7.6.4-8**

**Summarize of the Attendant for the Power Plant Field Trip and the Public Participation Meeting  
by group of stakeholders**

**The Project of Chana Green Power Plant of Chana Green Company Limited**

**7 November 2016 at 9.30 a.m. - 12.30 p.m.**

**at the meeting room of the development center of Sukhothai Thammathirat Open University  
in Phron Sub-district, Mueang Yala District, Yala Province**

**Table 7.6.4-8 (cont.)**

Attendant	Position	Number of participants (person)
<b>1. Population receive impacts</b>		
<b><u>Tumbon Baan Na, Chana District, Songkhla</u></b>		
- Moo 7 Baan La Nga	- Member of Subdistrict Municipality	1
	- Village health volunteers	1
	- Local residents	21
- Moo 9 Baan Nam Khem	- Assistant Village Headman	1
	- Security Team of the village	1
	- Local residents	36
<b><u>Tumbon Saphan Mai Kaen, Chana District, Songkhla</u></b>		
- Moo 3 Baan Tha Lo	- Assistant Village Headman	2
	- Member of SAO	1
	- Village committee	3
	- Village health volunteers	7
	- Local residents	12
- Moo 5 Baan Sai Khao	- Local residents	18
- Moo 6 Baan Kasemrat	- Village Headman	1
	- Local residents	4
<b><u>Tumbon Tha Mo Sai, Chana District, Songkhla</u></b>		
- Moo 1 Baan Tha Mo Sai	- Village health volunteers	1
	- Local residents	17

Table 7.6.4-8 (cont.)

Attendant	Position	Number of participants (person)
- Moo 2 Baan Rai Tha Mak	- Assistant Village Headman	2
- Moo 3 Baan Phong Ngu	- Member of SAO	1
	- Village health volunteers	4
	- Security Team of the village	6
	- Local residents	4
	- Village committee	2
	- Village health volunteers	11
	- Local residents	2
	- Assistant Village Headman	2
	- Village health volunteers	4
	- Local residents	4
- Moo 5 Baan Thung Che	- Assistant Village Headman	2
- Moo 8 Baan Phraeo	- Village health volunteers	4
	- Local residents	4
	- Assistant Village Headman	1
	- Member of SAO	1
	- Village health volunteers	8
- Moo 9 Baan Saphan Hak	- Local residents	5
	- Village health volunteers	5
	- Imam	1
- Moo 10 Baan Wang Han	- Local residents	2
	- Local residents	20
	<b>Total</b>	<b>212</b>
<b>2. Responsible agency on providing the EIA report</b>		
- Chana Green Co.,Ltd.		15
- Consultants of Technology Co.,Ltd.		3
	<b>Total</b>	<b>18</b>
<b>3. Government organization at various levels</b>		
- <b>Local organizations</b>		
- Tha Mo Sai Subdistrict	- Chief Administrator of the SAO	1

**Table 7.6.4-8 (cont.)**

<b>Attendant</b>	<b>Position</b>	<b>Number of participants (person)</b>
Administrative Organization (SAO)	- Chief of the Office of the SAO	1
- Tha Mo Sai Health Promoting Hospital	- Division Director	1
	- Assistant General Service Officer	1
	- Community Development Officer	1
	- Assistant Community Development Officer	1
	- SAO Officer	1
	- Director of Health Promoting Hospital	1
	- Registered Nurse	1
	- Public Health Officer	1
	- Assistant Public Health Officer	1
	<b>Total</b>	<b>11</b>
<b>Grand Total <sup>1/</sup></b>		<b>223</b>

Remark: <sup>1/</sup> Total number of participants excluding the Project owner and the Consultant

Source: Consultants of Technology Company Limited, 2017



Registration



Participants in the meeting



Describe Project Information



Discussion & Suggestion with Participants

**Figure 7.6.4-3** The meeting atmosphere On November 7, 2016

At the meeting room of Sukhothai Thammathirat Open University, Muang District Yala Province

**Table 7.6.4-9****Comments and suggestion from the power plant field trip and public participation meeting of****Chana Green Power Plant Project of Chana Green Company Limited****7 November 2016****at the meeting room of the development center, Sukhothai Thammathirat Open University, Phron****Sub-district, Mueang Yala District, Yala Province****Table 7.6.4-9 (cont.)**

<b>Question/concern</b>	<b>Clarification</b>
<b>1. Project description</b>	
- In the case of malfunction of the air pollution treatment system (case of waiting for a spare part), will the Project stop its operation? (Question sheet)	- In the case of malfunction of the air pollution treatment system and no spare part, the Project shall stop the operation immediately.
- When the power plant turns its life span, what will the Project do? (Question sheet)	- The Project will develop a decommissioning plan prior to final closure to ensure proper disposal, site restoration and remediation, if required. The land acquired will be used for other purposes according to the Company policy at that time.
<b>2. Environment</b>	
- The discharging of the Project wastewater will affect the community water supply treatment or not? Are there any impacts on aquatic creatures? (Question sheet)	- The wastewater will be treated and the quality meets the effluent standard. The wastewater quality will be monitored continuously. Nathawee canal water quality will be monitored twice a year.
- What is the temperature of the wastewater to be discharged into the public water source? It will affect on dissolved oxygen (DO) and aquatic creatures. (Director of Tha Mo Sai Sub-district Health Promotion Hospital)	- Wastewater will be treated to meets the effluent standard. The wastewater quality will be monitored continuously. The temperature will not differ from the natural water source. Thus, there is no impact on aquatic creatures.
- Will the sulfur dioxide that emits to the	- The Project uses wooden fuel that contains a

Table 7.6.4-9 (cont.)

Question/concern	Clarification
atmosphere causes acid rain? (Director of Tha Mo Sai Sub-district Health Promotion Hospital)	low level of sulfur. Thus, the combustion will generate sulfur dioxide at a very low amount. From the mathematical model, the concentration of sulfur dioxide in the atmosphere is very low. It is not a cause of acid rain.
<b>3. Socio-economic</b>	
- What are the benefits from the Project to communities in Chana District? (Resident in Moo 5 Ban Sai Khao, Saphan Mai Kaen Sub-district)	- There will be a power plant development fund in which the power plant will pay into the fund according to the type of fuel and capacity of the power plant. For the Project that uses wood as a fuel with a capacity of 25 MW, the Project shall pay about 1.5 million Baht a year into the fund per which is similar to Yala Green Power Plant. There will be a fund committee from the communities with roles to manage the fund. Communities surrounding the power plant can prepare a project and submit the committee to get a fund with approval from the committee. Another benefit that the communities will gain from the power plant is that the Project will buy wood at the power plant. It will generate more income to the communities. The project will also generate employment during its construction and operation.
- Presently, rain does not fall seasonally makes rubber tree leaves dry and decreases rubber latex. Is it because of the power plant? (Resident in Moo 5 Ban Sai Khao, Saphan Mai Kaen Sub-district)	- The cause of leaves dry is probably climate change. However, the air emission temperature from the stack of the Project of 30-40 meters height is below 110 degrees Celcius. Normally, the heat at the end of the stack is transfer with

Table 7.6.4-9 (cont.)

Question/concern	Clarification
	the ambient air. With plenty of air, the discharged heat will not affect the atmospheric temperature around the Project.
<p>- The communities could use groundwater in the past but cannot do so now. Is it because of the existing power plant?</p> <p>(Resident in Moo 5 Ban Sai Khao, Saphan Mai Kaen Sub-district)</p>	<p>- The Project cannot answer instead of another power plant. For Chana Green Power Plant, the Project must conduct a study about conditions of the area in which the operation will not cause any changes to the area. The Project will use raw water from the Project reservoir lining with a rubber sheet to retain pumped water from Nathawee canal. The Project shall not use groundwater.</p>
<p>- Will the Project employ local labors?</p> <p>(Question sheet)</p>	<p>- During project construction, local labors will be required but less during project operation. The Project mainly uses machines in the process and control by electronic systems. Thus, there is a small number of employees. However, the Project requires gardeners and workers at the fuel yard of approximately ten workers. In machinery work, the Project requires mainly electrical and robotic engineering. If there are qualified candidates in the communities, the Project shall consider firstly.</p>
<b>4. Health</b>	
<p>- Chemicals that contaminated in the Project emissions have an impact on health or not?</p> <p>(Question sheet)</p>	<p>- The majority of chemicals used in the Project are same as chemicals used in tap water treatment. The Project will pump raw water from Nathawee canal and treat to make tap water like quality. The examples of chemicals are liquid polymer for sedimentation and</p>

Table 7.6.4-9 (cont.)

Question/concern	Clarification
	<p>chlorine for disinfection. They will be used at low amounts and will not cause health impact on the people in communities. Treated water will be used for two purposes:</p> <ol style="list-style-type: none"> <li>1. Water to be used in the boiler, the quality is similar to distilled water to prevent scale.</li> <li>2. Water to be used in the cooling tower to reduce the temperature of the condensate. Hot water will fall to the bottom of the cooling tower. There is a fan in the tower to reduce the water temperature rapidly. Some water will be converted to vapor and disperse into the atmosphere. It is not harmful because it is clean as same as tap water. The Project shall discharge this cooling water into the natural water source.</li> </ol>
<b>5. Other</b>	
<p>- Why is electricity charge increasing every year even in Chana District has many power plant installed in the area? Can the power plant sale electricity to community directly? (Question sheet)</p>	<p>- Electricity Generating Authority of Thailand (EGAT) is the organization that responsible to provide electricity and send to Provincial Electricity Authority to distribute nationwide. With increasing demand for electricity, EGAT requires to build more power plants by a loan from other countries. It caused of the debt of the people. In 1997, the government had the policy to support private power plants to generate electricity and sell to EGAT. As a result, EGAT did not invest but could have more power plants. The generated electricity cannot be sold directly to the people but EGAT. The electricity</p>



**Table 7.6.4-9 (cont.)**

Question/concern	Clarification
	fee is controlled by the central organization and depends on the average fuel prices to generate electricity of the whole country at that time.
<b>6. Comments/suggestions</b>	
<ul style="list-style-type: none"> <li>- Concern for community health especially small children and elderly.</li> <li>- There are impacts on water resources at present without solving. The development of the Project will increase the problems.</li> </ul>	

**(2) Comments from the evaluation form after the public participation meeting**

After the public participation meeting of the Project of Chana Green Power Plant on 7 November 2016, 222 evaluation forms were collected from 223 participants. It can be summarized as follows:

**(a) Measures that should be studied further**

From the evaluation of the meeting of the Project of Chana Green Power Plant, the majority of the participants (68.9 percent) specified that no need of additional measures. However, those who specified that more measures should be added (31.1 percent) emphasized that the additional measures are air quality (21.5 percent) follow by noise (16.6 percent), health (14.1 percent), and water usage (13.7 percent). Details are presented in **Table 7.6.4-10**.

**Table 7.6.4-10****Measures that should be studied further**

Detail	Number of participant	Percentage
- Air quality	44	21.5
- Noise	34	16.6
- Health	29	14.1
- Water usage	28	13.7
- Wastewater management	23	11.2
- Transport	15	7.3
- Socio-economic	13	6.3
- Safety measures	11	5.4

Detail	Number of participant	Percentage
- Waste management	8	3.9

Remark: multiple answers allowed

**(b) Other suggestions/comments to the Project**

- The project should notify the communities if there is a loud noise from the Project operation
- Wastewater should not be discharged into public canal or community waterway
- Need to have the project because there are more advantages than disadvantages
- The Project should employ local labors as first priority
- Request the Project to hire elderly to work in proper positions in the power plant
- Request the Project to provide activities to educate and build understanding of the communities
- Request the Project to explain about the Project to the communities because many people do not understand about the Project
- The Project should give information to students, parents, and teachers of Chana Chanupatham School because they are directly affected
- The presentation lacked potential impacts from the Project
- Benefits from the power plant are not matched with the community needs
- Request the Project to continuously and fully support the community development
- Concern about health of the people from the Project operation

**(5) The public participation meeting to the reviewing of the draft of environmental impact assessment of Chana Green Power Plant Project of Chana Green Company Limited at the meeting room of Ban Na Sub-district Municipality Office, Chana District, Songkhla Province**

The public participation meeting to the reviewing of the draft of environmental impact assessment report, the environmental impact prevention and mitigation measures, the environmental impact monitoring program, and the approaches to assessing environmental impact of the Project was

organized on 26 November 2016 at Nai Mueang Garden Hotel, Chana District, Songkhla Province. There were 223 participants (**Table 7.6.4-11**). The atmosphere of the meeting is shown in **Figure 7.6.4-4**.

**1) Suggestions and comments from the public participation meeting on the Project of Chana Green Power Plant of Chana Green Company Limited**

From the meeting that was organized on 26 November 2016, questions, declarations, suggestions, and comments were obtained from the participants as shown in **Table 7.6.4-12**. Moreover, the participants gave more comments on the provided papers, they can be summarized as follows:

- Request the Project to concern about safety of the communities in adjacent area of the power plant
- Concern about potential impacts that will occur
- Concern about impact of water consumption and agricultural water usage
- Concern about physical and mental health impact from the project on communities (stress from indirect impact such as damage of agricultural products)

**Table 7.6.4-11**

**Summarize the attendant for the Public Review on draft EIA report**

**by group of stakeholders**

**The Project of Chana Green Power Plant of Chana Green Company Limited**

**26 November 2016**

**at Nai Muang Garden Hotel, Chana District, Songkhla**

**Table 7.6.4-11 (Continued)**

Attendant	Position	Number of Participants (person)
<b>1. Population receive impacts</b>		
<b><u>Tumbon Ku, Chana District, Songkhla</u></b>		
- Moo 1 Baan Khu Ton Pradu	- Local residents	10
- Moo 2 Baan Phodang	- Local residents	6
- Moo 3 Baan Na Yam	- Assistant Village Headman	3
	- Local residents	59
- Moo 4 Baan Khu Saksit	- Local residents	9
- Moo 5 Baan Khu	- Assistant Village Headman	1
	- Local residents	21
- Moo 6 Baan Thung	- Assistant Village Headman	2

Table 7.6.4-11 (Continued)

Attendant	Position	Number of Participants (person)
- Moo 7 Baan Not	- Local residents	76
	- Assistant Village Headman	4
	- Local residents	17
- Moo 8 Baan Na Prue	- Local residents	1
- Moo 9 Baan Plak Pho	- Village Headman	1
	- Assistant Village Headman	1
	- Local residents	31
<b><u>Tumbon Khae, Chana District, Songkhla</u></b>		
- Moo 1 Baan Khok Yang		-
- Moo 2 Baan Khae Nuea	- Local residents	12
- Moo 3 Baan Khae Tai		-
- Moo 4 Baan Niat		-
<b><u>Tumbon Pa Ching, Chana District, Songkhla</u></b>		
- Moo 8 Baan Huadinnuea	- Local residents	13
- Moo 9 Baan Huadintai	- Village Headman	1
	- Assistant Village Headman	2
	- Local residents	10
<b><u>Tumbon Saphan Mai Kaen, Chana District, Songkhla</u></b>		
- Moo 3 Baan Tha Lo	- Local residents	5
- Moo 5 Baan Sai Khao	- Village Headman	1
	- Imam	1
	- Local residents	22
- Moo 6 Baan Kasemrat		-
<b><u>Tumbon Tha Mo Sai, Chana District, Songkhla</u></b>		
- Moo 1 Baan Tha Mo Sai		-
- Moo 2 Baan Rai Tha Mak		-

Table 7.6.4-11 (Continued)

Attendant	Position	Number of Participants (person)
<ul style="list-style-type: none"> <li>- Moo 3 Baan Phong Ngu</li> <li>- Moo 5 Baan Thung Che</li> <li>- Moo 8 Baan Phraeo</li> <li>- Moo 9 Baan Saphan Hak</li> <li>- Moo 10 Baan Wang Han</li> </ul>		<ul style="list-style-type: none"> <li>-</li> <li>-</li> <li>-</li> <li>-</li> <li>-</li> </ul>
<b><u>Tumbon Na Wa, Chana District, Songkhla</u></b>		
<ul style="list-style-type: none"> <li>- Moo 3 Baan Kothaktai</li> <li>- Moo 4 Baan Khlong Bon</li> <li>- Moo 5 <sup>๗</sup>Baan Prachanuea</li> <li>- Moo 6 , Baan Prachatai</li> <li>- Moo 7 Baan Na Nai</li> </ul>	<ul style="list-style-type: none"> <li>- Local residents</li> <li>- Local residents</li> </ul>	<ul style="list-style-type: none"> <li>14</li> <li>-</li> <li>9</li> <li>-</li> <li>-</li> </ul>
<b><u>Tumbon Khun Tat Wai, Chana District, Songkhla</u></b>		
<ul style="list-style-type: none"> <li>- Moo 2 Baan Pa Lamai Klang</li> </ul>	<ul style="list-style-type: none"> <li>- Local residents</li> </ul>	<ul style="list-style-type: none"> <li>15</li> </ul>
<ul style="list-style-type: none"> <li>- Moo 4 Baan Pa La Mai Ok</li> </ul>	<ul style="list-style-type: none"> <li>- Local residents</li> </ul>	<ul style="list-style-type: none"> <li>17</li> </ul>
<b><u>Tumbon Baan Na, Chana District, Songkhla</u></b>		
<ul style="list-style-type: none"> <li>- Moo 7 Baan La Nga</li> <li>- Moo 9 Baan Nam Khem</li> </ul>	<ul style="list-style-type: none"> <li>- Local residents</li> <li>- Local residents</li> </ul>	<ul style="list-style-type: none"> <li>5</li> <li>5</li> </ul>
	<b>Total</b>	<b>374</b>
<b>2. Responsible agency on providing the EIA report</b>		
<ul style="list-style-type: none"> <li>- Chana Green Co.,Ltd.</li> <li>- Consultants of Technology Co.,Ltd.</li> </ul>		<ul style="list-style-type: none"> <li>12</li> <li>7</li> </ul>
	<b>Total</b>	<b>19</b>
<b>3. General public</b>		
<ul style="list-style-type: none"> <li>- General public</li> </ul>	<ul style="list-style-type: none"> <li>- General public who are interested in the project</li> </ul>	<ul style="list-style-type: none"> <li>68</li> </ul>
<b>Grand Total <sup>1/</sup></b>		<b>442</b>

Remark: <sup>1/</sup> Total number of participants excluding the Project owner and the Consultant

**Table 7.6.4-11 (Continued)**

<b>Attendant</b>	<b>Position</b>	<b>Number of Participants (person)</b>
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Source: Consultants of Technology Company Limited, 2017



Participants in the meeting



Describe Project Information

**Figure 7.6.4-4** The meeting atmosphere On November 26, 2016

At Nai Muang garden hotel, Chana District, Songkhla Province

**Table 7.6.4-12**

**Comments and suggestions from the public participation meeting**  
**on the reviewing of the draft of the environmental impact assessment report of**  
**the Project of Chana Green Power Plant of Chana Green Company Limited**  
**26 November 2016**  
**at Nai Mueang Garden Hotel, Chana District, Songkhla Province**

**Table 7.6.4-12 (cont.)**

Question/concern	Clarification
<b>1. Drainage</b>	
- What is the Project's land level after landfilling? Concern on flooding (Resident in Moo 3 Ban Na yum, Khu District)	- The Project will level up about one meter from the existing level and will build a one-meter dyke wall. For the flooding problem in the communities from the Project land leveling, the Project conducted a study and design a water gate at the south of the Project area to receive water from the nearby area and discharge into Nathawee canal rapidly. From the design, the communities will not be affected to flood problems more than before.
<b>2. Public participation</b>	
- Can the communities actually investigate the Project's operation? What are the guidelines for the investigation? (Question sheet)	<p><b>Additional clarification</b></p> <p>- The communities can investigate the power plant operation via the environmental impact monitoring committee which consists of representatives of the communities, related government agencies, experts, and the power plant. The committee has a role to monitor the Project's environmental operation as well as receive complaints and solve together.</p>
<b>3. Environment</b>	
- Will the power plant affect people in the communities? Concern on dust and respiratory	<p><b>Additional clarification</b></p> <p>- From the study result, it was found that ambient</p>



**Table 7.6.4-12 (cont.)**

Question/concern	Clarification
<p>system.</p> <p>(Question sheet)</p>	<p>air quality in the area (includes dust) meets with the standard that will cause impact in a low level. However, air quality measures were set to prevent health impacts.</p>
<p>- In the case that the Project cannot solve the problems as proposed, what will be done?</p> <p>(Question sheet)</p>	<p><b>Additional clarification</b></p> <p>- In the case that the Project causes a serious impact on the communities and the environment and not capable to solve the problem, the licensing agency has right to revoke or terminate the license. Thus, the Project cannot continue to operate.</p>

## 2) Comments from the evaluation form after the public participation meeting

After the public participation meeting of the Project of Chana Green Power Plant on 26 November 2016, 380 evaluation forms were collected from 223 participants (as presented on the attendance registration form). It can be summarized as follows:

### (a) Measures that should be additionally set

From the evaluation of the meeting of the Project of Chana Green Power Plant, the majority of the participants (69.5 percent) specified that no need of additional measures. However, those who specified that more measures should be added (30.5 percent) emphasized that the additional measures are air quality (16.7 percent) follow by noise (16.3 percent), health (12.9 percent), and water usage (12.1 percent). Details are presented in **Table 7.6.4-10**.

**Table 7.6.4-10**  
**Measures that should be additionally set**

Detail	Number of participant	Percentage
- Air quality	83	16.7
- Noise	81	16.3
- Health	64	12.9
- Water usage	60	12.1
- Wastewater management	59	11.9
- Waste management	46	9.3
- Safety measures	38	7.6
- Socio-economic	36	7.2
- Transport	28	5.6
- Other * Mental health (stress)	2	0.4

Remark: multiple answers allowed

**(b) Other suggestions/comments to the Project**

- Agree with the Project because it will have benefit to the public and the whole country
- Concern about potential impacts such as dust, wastewater, and noise.  
Request the project to manage the environment properly
- Request the project to respond immediately if there is an impact on the community
- Request the Project to strictly implemented according to the proposed measures
- Request the Project to monitor environmental quality regularly and present the results to the communities
- Request the Project to support communities such as scholarship, part-time job, community annual events, and community sport field
- Request the Project to provide health insurance for the people around the Project area

- Request the Project to provide insurance for damages of agricultural products
- The project should build understanding among communities to reduce concerns
- The Project should employ local labors as the first priority
- Request the Project to examine mental health of the people before and after development of the power plant

#### **7.6.5 Dissemination of results of the meeting to review the draft of environmental impact assessment report**

The Project sent the summary of the results of the meeting to review the draft of environmental impact assessment report by sending letters to government agencies and community leaders for their information and further distributed. The letters were sent on 9 December 2016.

#### **7.6.6 Declaration of additional description of the Project**

Chana Green Company Limited took suggestions/concerns obtained from the public participation of all stakeholders into consideration to improve the Project layout design. The Project's machine was redesigned to located far from the sensitive area. Moreover, the capacity of water reservoir was increased to store raw water for longer than four months to reduce water usage competition with communities during the dry season. Thus, the information and the study results were presented to relevant agencies on 28 February 2017 at the CEO meeting room on the fifth floor of Songkhla Town Hall. There were representatives from government agencies of 23 people participated in the meeting. Name of agencies and positions of the participants are shown in **Table 7.6.6-1** and the meeting atmosphere is shown in **Figure 7.6.6-1**. In addition, the Project conducted subgroups meetings to talk with a representative of agencies and the public in the study area. It was done during 1-3 March 2017 ( an example of the subgroups meeting is shown in **Figure 7.6.6-2**).

**Table 7.6.6-1****Additional comments and suggestions by****group of stakeholders****The Project of Chana Green Power Plant of Chana Green Company Limited****28 February 2017****at the CEO meeting room, fifth floor, Songkhla Town Hall****Table 7.6.6-1 (cont.)**

Participant	Position	Number of participants (person)
<b>1. Organizations responsible to prepare the environmental impact assessment report</b>		
- Chana Green Company Limited		3
- Consultant of Technology Company Limited		12
<b>Total</b>		<b>15</b>
<b>2. Government organizations</b>		
- <b>Regional agencies</b>		
- Region Environmental Office 16	- Professional Level	2
- Office of the Energy Regulatory Commission 12	- Environmentalist	
	- Director of the Office of the Energy Regulatory Commission 12	1
	- Senior Professional Officer	1
	- Officer of the Office of the Energy Regulatory Commission	1
	- Academic officer	1
- Southern Institute for Health Research and Development	- Director of the Southern Institute for Health Research and Development	1
- Songkhla Provincial Education Office	- Vice president of the Songkhla Provincial Education Office	
- Songkhla Provincial Industry Office	- Engineer, Practitioner Level	1
	- Head of Industrial Division	
- Songkhla Public Works and Town Planning Office	- Civil Engineer, Senior Level	1
- Songkhla Provincial Agricultural Extension Office	- Agricultural Extensionist	1
- Songkhla Provincial Office of Natural Resources and Environment	- Director of the Songkhla Provincial Office of Natural Resources	1
	- Professional Level Environmentalist	1
- Songkhla Provincial Energy Office	- Songkhla Energy Director	1

**Table 7.6.6-1 (cont.)**

Participant	Position	Number of participants (person)
	- Energy Officer, Professional Level	1
- Songkhla Irrigation Project	- Field craftsman	1
- Songkhla Provincial Health Office	- Public Health Officer	1
- Songkhla Provincial Office of Labor Protection and Welfare	- Labour Specialist, Professional Level	1
- Chana District	- Senior deputy	1
	- Chana Bailiff	2
<b>Total</b>		<b>22</b>
<b>4. Government organizations</b>		
- Private environmental organization, private development organization Local academic institutes and independent academics		
- Thaksin University	- Head of environmental landscape and energy conservation	1
<b>Grand total <sup>1/</sup></b>		<b>23</b>

Remark: <sup>1/</sup> Total number of participants excluding the Project owner and the Consultant

Source: Consultant of Technology Company Limited, 2017

### (1) Questions, declaration, and suggestions from the meeting

There were questions, declarations, and suggestions obtained from the meeting on 28 February 2017 as shown in **Table 7.6.6-2**. Moreover, the project provided another channel that participants can give comments on provided papers after the meeting. The comments/suggestions/concerns from the subgroup meetings can be summarized as follows:

- Some of the ash from combustion can be used for soil conditioning and the rest that will be disposed of in a landfill will cause dispersion of dust
- The power plant stack height should be 40-60 meters
- Should take care of cultivated plants if it dies or broken
- Should have a planting area of 10-20 meter width
- Why set up the power plant in this area?
- Request the Project to build understanding among communities for coexistence and must disclose the Project information clearly
- What are the requirements for setting up an environmental impact monitoring committee? What are the responsibilities of the committee?



Registration



Participants in the meeting



Describe Project Information



Discussion & Suggestion with Participants

**Figure 7.6.6-1** The meeting atmosphere on February 28, 2017

At the meeting room of CEO, Songkhla City Hall



**Figure 7.6.6-2** The subgroups meeting during March 1-3, 2017

- Should educate the environmental impact monitoring committee to be capable to investigate the impact
- Request the Project to guarantee to take responsibility if there is an impact on communities
- Has a power plant in the group ever had a problem with the community? How is the problem solved?
- The power plant should manage the environment properly not to cause impact on communities such as air pollution, noise, wastewater, and malodor
- Concern about dust from the wood yard, if the Project has a wooden chips storage building, should manage it properly not to have dust impact on communities
- Concern about loud noise because the small power plant that has been operated generates loud noise (alarm) that affects people in the area
- Request the Project to support community activities for youth development in the area
- Environmental monitoring should be done continuously such as monitoring of air quality and noise, and report results to communities
- Will the project cause an impact on agriculture or not? Such as rubber latex
- Request the Project to employ local labors as the first priority
- Can the locals sell wood to the power plant directly or not?
- The Project is located pretty much near the school, there are concerns about impacts on the school such as dust, loud noise, malodor, and health impacts on students and communities
- Should manage traffic properly not to cause impact on transport in the area as well as prevent accident not to occur.
- Must check wastewater quality to meet with the effluent standard prior discharging to water source to prevent impact on water resources and aquatic creatures
- Should do reforestation and provide green area in the power plant area to reduce air pollution and noise impacts
- Should manage sludge and ash properly not to affect surrounding communities, ash should be maximize used such as fertilizer
- Concern of water usage competition with communities
- Concern of impact on Islamic graveyard such as flood from blocking the drainage
- The power plant will cause higher atmospheric temperature or not?
- The power plant should be located in industrial area not to locate near communities and school
- The power plant life span should be longer than 25 years
- Agree with the development but concerned about impacts that will occur
- Not confident with the government supervision as the government agencies cannot manage problems in the area



**Table 7.6.6-2****Additional comments and suggestions from the additional clarification****The Project of Chana Green Power Plant of Chana Company Limited****28 February 2017****at the CEO meeting room, fifth floor, Songkhla Town Hall****Table 7.6.6-2 (cont)**

<b>Questions/concerns</b>	<b>Clarification</b>
<b>1. Project description</b>	
<ul style="list-style-type: none"> <li>- How much is the Project green area? What kind of trees will be planted? (Songkhla Provincial Office of Natural Resources and Environment) (Region Environmental Office 16)</li> </ul>	<ul style="list-style-type: none"> <li>- According to the opinion of the public, the project expanded the green area to approximately seven percent of the Project area. At present, the area is larger than the requirement of the Office of Natural Resources and Environmental Policy and Planning of five percent of total project area. When the Project specifies this issue in the environmental impact assessment report, it shall not be changed throughout the Project life span. For the type of tree to be planted, the Project has not selected yet. However, local plant species will be selected.</li> </ul>
<ul style="list-style-type: none"> <li>- Some of the information presented in the document and in the presentation is different such as air quality monitoring measures during operation period has not specified air monitoring at the stack and the frequency. (Region Environmental Office 16)</li> </ul>	<ul style="list-style-type: none"> <li>- Pollution emissions of the Project were designed to be lower than emission standards as specify by laws. The emission values present in the environmental impact assessment report will be used as control values of the Project throughout it's life span. The Consultant used these emission values in the mathematical model. It was found that, after development of the Project the ambient air quality still meet with the standard. Thus, there will be no impact on the environment and health of the people in the surrounding communities. Continuous air</li> </ul>

**Table 7.6.6-2 (cont)**

Questions/concerns	Clarification
	<p>quality measurement equipment will be installed at the stack to measure and monitor air emissions not to higher than the standard. The monitoring data will be presented only at the board (online) in front of the Project. Therefore, people whose interested can check. Moreover, the Project shall monitor ambient air quality every six months in surrounding communities. The monitoring will be done prior development of the Project. The results will be used as baseline data to compare with monitoring results during construction and operation periods. The monitoring shall be done throughout the Project life span. Monitoring reports shall be prepared and submitted to related agencies.</p>
<p>- The Project has a plan to monitor ambient air quality during construction and operation periods or not? The Project should include the monitoring of particulate matter with a diameter of less than 2.5 micron (PM 2.5) as it is specified by law due to health impact. (Region Environmental Office 16)</p>	<p>- The Project shall monitor ambient air quality during before construction, construction, and operation periods. The parameter is particulate matter with diameter of less than ten micron (PM10). However, the Project shall consider the suggestion to monitor particulate matter with diameter of less than 2.5 micron (PM2.5).</p>
<p>- Request the Proct to consider a way to reduce loud noise at safety valves such as installing of silencers. (Region Environmental Office 16)</p>	<p>- The Project shall install silencers at the beginning where steam is charged and at safety valves. - Furthermore, the Project was designed to reduce noise impact. Steam that is needed to discharged will be sent to the condenser to convert to deionized water prior reuse. Normally loud noise will occur during startup</p>

**Table 7.6.6-2 (cont)**

Questions/concerns	Clarification
	for 2-3 times a year in which the Project shall make an announcement to the communities before startup.
<b>2. Environment</b>	
<p>- Can noise and malodor from the Project operation be prevented? It is to prevent impact on studying of the students and request the Project to make a guarantee that there will be no such impacts on the school. (Songkhla Provincial Education Office)</p>	<p>- The Project improved the layout regarding the comment received from the public participation (PP2) by putting the source of pollution away from the school as far as possible. At present, the Project's machine is located approximately 300 meters away from the school. Moreover, trees will be planted as a buffer zone to prevent dust and noise. From the environmental impact assessment, it was found that noise from the Project including with background noise meets with the standard. The Project shall monitor noise levels every six months in the school and communities during before construction, construction, and operation periods. For malodor, normally odors occur in a power plant are chemical odors which are mind and limited in chemical storage area. The Project has a separate chemical storage area and will not keep large quantity of chemicals in other area. Thus, there will be no odor problem.</p>
<b>3. Public participation</b>	
<p>- For the public participation that the Project organized a field to Yala Green Power Plant together with public participation 2, the participants recognized it as a field trip, not a public participation. There are complaints that</p>	<p>- In the preparation of the environmental impact assessment report, two public participation meetings are required. The first meeting (to listen to comments on the scope and assessing approaches to the environmental impact</p>

**Table 7.6.6-2 (cont)**

Questions/concerns	Clarification
<p>the Project selected only people who are agreed to the Project while those who disagree were not informed about the field trip.</p> <p>- The relocation of the meeting venue on 26 November 2016 from the meeting room Ban Na Sub-district Municipality Office to Nai Mueang Garden Hotel, in the view of those who disagree to the Project, it is a distortion about the meeting venue and they could not participate.</p> <p>(Songkhla Provincial Office of Natural Resources and Environment)</p>	<p>assessment (PP1)) was to tell about the Project details to the communities surrounding the Project. For Khu Sub-district, the Project organized the meeting at Moo 6 Ban Thung. There were 300 participants, all of them are residents in Khu Sub-district. The second public participation meeting (to listen to comments on the draft of environmental impact assessment report, environmental impact prevention and mitigation measures, and environmental impact monitoring program(PP 2)) was organized later on. This is the process after environmental impacts were studied and measures were set and presented to the communities. In the second public participation meeting organized on 5 October 2016, there were objectors participated and they requested to end the meeting. The government officials tried to clarify and make understanding but were not succeeded. Later on, the government official made an order to end the meeting because there is a chance of a serious conflict. With safety reasons and the area of Chana District is a special area of Southern border provinces, the administrative agency requested the Project to end the meeting. The Project also canceled other communities meetings. Later in November 2016, the Project organized field trips to Yala Green Power Plant for better understanding about a biomass power plant. It</p>

**Table 7.6.6-2 (cont)**

Questions/concerns	Clarification
	<p>was done in accordance with a suggestion of local administrative agency. The Project also presented the details of the power plant as well as environmental impact preventive measures according to the community concerns. In order to give chances to people who did not participate in the Yala Green power plant field trip to give their opinions, the Project organized the second public participation meeting at the Office of Ban Na Sub-district Municipality on 25 November 2016. Unfortunately, the objectors were designed the office during the meeting. The public could not participate in the meeting. The administrative agency announced the meeting is canceled and asked the Company to organize another meeting that suitable for the situation. The Project solved the problem by organizing another meeting in another area for the public who are interested to participate to know more about the Project.</p>
<b>4. Drainage</b>	
<p>- Concern about flooding because of the Project is higher than the school. Will the Project provide any preventive measures? Is there any organization can guarantee about this problem?</p> <p>(Songkhla Provincial Office of Natural Resources and Environment)</p> <p>(Songkhla Provincial Education Office)</p>	<p>- From the cross-sectional figure of the Project, the land level is only one meter above the adjacent area of Chana Chanupatham School. However, the Project was designed to have a drainage system in the south of the Project area to divert water into Nathawee canal rapidly. Furthermore, the Project was designed not to block waterway. From the present data of the Royal Irrigation Department, there is a project</p>

**Table 7.6.6-2 (cont)**

<b>Questions/concerns</b>	<b>Clarification</b>
	to excavate Nathawee canal for fast water flow to the sea to reduce flood problem in the area.
<b>5. Waste</b>	
<ul style="list-style-type: none"> <li>- What are the measures o waste management (fly ash, bottom ash, used oil, and spent chemicals)?  (Region Environmental Office 16)</li> </ul>	<ul style="list-style-type: none"> <li>- Used oil and spent chemicals will be sent to dispose of by approved waste processor. For fly ash and bottom ash, the Project has a plan to use as same as the Yala Green Power Plant. About 13 tons/day of ash from Yala Green Power plant is used as a soil conditioner in the area that has a problem with acid soil. In 2016, Yala Green Power Plant sent about 4,000 tons of ash to oil palm gardens, rubber tree garden, and paddy field. Moreover, the ash is also used to produce lightweight brick. The power plant also joined hand with the faculty of medicine, Prince of Songkhla University to extract base in the ash and use to make soap. If the project success, it will be disseminated to the people in Phron and Lam Mai District as another source of income. Thus, the Project is confident that ash will be fully managed.</li> </ul>
<b>6. Health</b>	
<ul style="list-style-type: none"> <li>- The concern of the impact of dust on respiratory diseases. Has the project set a preventive measure to sustainably prevent dust or not?  (Songkhla Provincial Education Office)</li> </ul>	<ul style="list-style-type: none"> <li>- The Project shall install a dust collecting system, electrostatic precipitator, to reduce particulate matter from the combustion. Moreover, the Project has set measures to reduce particulate mater in the Project area.</li> </ul>
<ul style="list-style-type: none"> <li>- From the health check of the people in the areas surround Chana Power Plant during 2009 – 2015 of 21 groups of diseases, it was</li> </ul>	<ul style="list-style-type: none"> <li>- From the experiences of the Consultant the health expert, the health status baseline data should be collected by government agencies. It</li> </ul>

**Table 7.6.6-2 (cont)**

<b>Questions/concerns</b>	<b>Clarification</b>
<p>found that the first three diseases are gastrointestinal diseases, blood circulation system diseases, and respiratory diseases. Request the Project to conduct a medical checkup of the communities to be used in the health impact assessment.</p> <p>(Southern Institute for Health Research and Development)</p>	<p>would be reliable and can be referenced. The Consultant collected health data from hospitals in the area. The data were used in the health impact assessment particularly respiratory diseases as the main health impact from the Project. From the experiences on health impact assessment nationwide, the number of respiratory disease patients is very high as colds are included in the respiratory diseases. The Consultant assessed the impact and compared with the standard of World Health Organization (WHO) by using hazard quotient. In the case that it meets the standard, the impacts are acceptable. In order to reduce health impact, measures to support health agencies in the area were set to provide convenience in their work.</p>
<b>7. Environmetnal impact assessment</b>	
<p>- In order the make the communities understand, the Project should present primary data in the area. In the case of environmental impact from the Project, measures should be set.</p> <p>(Office of the Energy Regulatory Commission 12)</p>	<p>- The primary data that the Consultant monitored in the area indicate the existing conditions of the environmental quality to be used in the forecasting whether the impacts are acceptable or not. If the impacts are unacceptable, measures must be set. The data are presented in the environmental impact assessment report. Moreover, the data were used in the designing of the power plant. The Project considered the suitability of the area and tried to solve problems for the coexistence of the Project and the communities.</p>
<b>8. Water usage</b>	

**Table 7.6.6-2 (cont)**

Questions/concerns	Clarification
<ul style="list-style-type: none"> <li>- The Project declared that wastewater will not be discharged during the dry season. Is it possible that the Project will reuse as much as possible and minimize the discharging into the natural water source?</li> <li>- Concern on water usage from Nathawee canal, even the Project is allowed from the Songkhla Irrigation Project, the Project should inform the communities prior pumping the water. (Region Environmental Office 16)</li> </ul>	<ul style="list-style-type: none"> <li>- The Project extensively collected data to be used in the impact assessment. The Project conducted a water quality monitoring (water quantity, water quality, and water level) about one year prior the environmental impact assessment. This was to make sure that there will be no impact when the Project discharge treated wastewater into the water source. Over the period of one year, the dry season took place for four months. Thus, the Project planned to excavate a water reservoir to retain water to be used for four months. However, the Project conducted an additional study to see if the reservoir capacity can be expanded. In-depth data were required in the study such as level of the soil. At present, the Project declares in the report that the raw water will be retained for four months. For the wastewater, due to the water use permission from the Royal Irrigation Department, the Project shall follow the effluent standard of the Royal Irrigation Department which is tougher than the standard of the Department of Industrial Works. However, the Project will not discharge wastewater during the dry season to prevent impact on the downstream water users. Thus, the Project will construct a water reservoir to retain water for four months. The period that the Project can discharge wastewater in the same period that the Project can pump water from the canal (due to self-</li> </ul>



**Table 7.6.6-2 (cont)**

Questions/concerns	Clarification
	<p>purification capacity of the water source). This is a preventive measure that Project has set. Furthermore, the Project will monitor wastewater quality continuously. Wastewater from every part of the Project shall be treated. The quality must be checked before discharging. Lastly, the Project will also monitor water quality of the natural water source.</p>
<b>9. Other</b>	
<ul style="list-style-type: none"> <li>- Request the Project to meet the Director of Chana Chanupatham School to build understanding and work together to find an acceptable way for coexistence. (Songkhla Provincial Office of Natural Resources and Environment)</li> </ul>	<ul style="list-style-type: none"> <li>- The Project sent a document telling about the Project description to the school but there was no response. Thus, the Project has not talked to the school officially. However, the Project shall meet for a dialogue.</li> </ul>
<ul style="list-style-type: none"> <li>- Concern about comments obtained from the public participation meetings if the Project shall consider to improve and inform the people or not? (Region Environmental Office 16)</li> </ul>	<ul style="list-style-type: none"> <li>- The Project organized the meeting to clarify the Project details to the central government agencies on 28 February 2017 and to local agencies and the school on 1 March 2017. Moreover, the Project provided details of the Project on the boards in communities.</li> </ul>
<b>10 Comments/suggestions</b>	
<ul style="list-style-type: none"> <li>- In the case of community water shortage, request the Project to drill groundwater pond that meets the needs of the community or provide drinking water for the community. (Songkhla Provincial Office of Natural Resources and Environment)</li> <li>- Request the Project to meet and build understanding with Chana Chanupatham School because of the school concerns about pollution. The school probably won't agree with the Project if there is no guarantee and clear understanding that the Project will not affect the school. (Songkhla Provincial Education Office)</li> </ul>	

**Table 7.6.6-2 (cont)**

Questions/concerns	Clarification
<ul style="list-style-type: none"> <li>- The school is a center of the communities because the children are the heart of the people. The people will listen to their children. If the Project can make the students understand, likewise the people will understand. (Songkhla Provincial Education Office)</li> <li>- What are the measures that the Project can build understanding among the people surround the Project area (Moo 3 Khu Sub-district) that leads to sustainable operational in the future? (Office of the Energy Regulatory Commission 12)</li> </ul>	

## (2) Comments obtained from the meeting evaluation form

From the evaluation forms of the additional meeting of the Project of Chana Green Power Plant, six evaluation forms were obtained from 23 participants and can be summarized as follows:

### 1) Measures that should be additionally set

From the evaluation of the meeting of the Project of Chana Green Power Plant, three responders specified that no need of additional measures. However, those who specified that more measures should be added of three agencies emphasized that the additional measures are noise and socio-economic impacts follow by health, water usage, and waste management impacts as well as the green area. Details are presented in **Table 7.6.6-3**.

**Table 7.6.6-3**

### Measures that should be additionally set

Detail	Number of organization
- Noise	2
- Socio-economic	2
- Health	1
- Water usage	1
- Waste management	1
- Other * Green area	1

Remark: multiple answers allowed

## **7.7 Conclusion**

From the environmental impact assessment in accordance with the academic guideline, the Project realizes and emphasizes on the public participation of the Project. The Project conducted public participation meetings at the publicity step to declare about the Project details. Opinions and information have been presented to the public as well as disputes and suggestions about the environmental impact assessment were obtained especially concerns of the communities that needed to be focus carefully. This leads to understanding and confident to the Project operation as results of the public participation that the Project conducted over a period of time. In addition, results of the public opinion survey were considered by the Project and the Consultant to improve the study in many parts of this report. Moreover, measures were improved to comply with practical suggestions and comments from the stakeholders as presented in **Chapter 9** of this report.

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III. Interview with landowners, land users and community leaders

**7.8 Summary of land owner interviewing and land user interviewing**

**(1) Land owner**

1) Mr. Donteh Kasama (citizen of Moo3, Ku Subdistrict)

- Occupation: rubber farmer,
- Receiving land from ancestors,
- Occupy total area of 20 Rai by which selling to the power plant around 5 Rai

(Title deed No. 2 and 12),

- Rubber plantation for selling latex, does not has employee or any structure in the area,

- Selling land to the Chana Co.ltd. staffs directly by understanding that the land will be used for power plant installation,

- Making decision to sell the land immediately, because he was satisfying for the selling price. And, he want to bring money for buying new land in other area and used for descendant education and family expenditure,

- Selling money was used for buying new land which is around 1 km far from previous land with a total area of 11 Rai for rubber plantation

- Getting all selling money on the land transferring date,

- Satisfying for the land selling, and

- Do not worry about the power plant, because he used to have experience from power plant visiting in Yala, and there are some power plants installed in the area without any threats to communities.

2) Mr. Donrochet Zadel (Village headman of a subdistrict in Nathawi)

- Occupation: Village headman, and oil palm owner (total area of 200 Rai) in Nathawi,

- Compiling land for oil palm plantation,

- Selling 164 Rai of land to the company (all land in that area),

- Some areas were used for oil palm plantation around 1 year, does not has employee or any structure in the area, and most of the area was abandoned land before plantation,

- Selling land to the Chana Co.ltd. staffs directly by understanding that the land will be used for power plant installation,
- Making decision to sell the land immediately, because he was satisfying for the selling price,
- He used selling money for family expenditure, and buying land in other areas,
- Getting all selling money on the land transferring date,
- Satisfying for the land selling, and
- Do not worry about the power plant, because he believe that community will be developed from power plant supporting.

## **(2) Land user**

### **1) Mr. Ma-ae Samae (Assistant village leader Moo3, Ku Subdistrict)**

- Occupation: Assistant village leader, and farmer,
- Doing agriculture in the land of Mr. Donrochet Zadeli (only for nonoil palm plantation area around 4-5 Rai) which is peanuts, cassava, and sticky rice,
- Farming for self-consumption and selling,
- Owns farm land estimated at 10 Rai for plantation of peanuts, rubber trees, and seasonal vegetation, and not affected when the land that he used to rent was sold because he owns 10 rai for agricultural production
- Currently, not has agricultural activity in the power plant area.

### **2) Interviewing community leaders about ancient community**

- Community in Ku Subdistrict was resettled around 200 years ago without ethnic minority community in the area,
- Majority of local people (80%) are native habitat, some are people who relocated (20%) which are from Malaysia to get married with local people,
- Majority are Muslim (85%), and minority are Buddhism (15%), and
- Local traditional is religion tradition.

