

Initial Environmental Examination Report (Draft)

Project Number: 49067-001
October 2017

THA: Southern Thailand Waste-to-Energy Project (Part 3 of 5)

Prepared by Chana Green Company Ltd.

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CHAPTER 4

EXISTING ENVIRONMENT

4.1 Introduction

According to the guidelines for the preparation of environmental impact assessment reports for the thermal power plant project. The study of recent environment condition has been conducted within the radius of 5 kilometers around the project area (will be called “the study area”) as the priority as per ONEP Guideline <http://www.onep.go.th/eia/images/6interest/eneegyupdate.pdf>. The sensitive areas for environmental impacts were also included in the study. This study covered resources and 4 following aspects of natural values.

- (1) Physical Resources
- (2) Biological Resources
- (3) Human Use Values
- (4) Quality of Life Values

For the result of the study on resource and 4 aspects of natural values, details are as follow;

4.2 Physical Resources

4.2.1 Topography

(1) Geography of Songkhla

Songkhla is located in the east coast of the southern of Thailand which is geographically located at around 6.17-7.56°N (lat), 100.01-100.06°E (lon), adjacent to the Gulf of Thailand. An average height of terrain in the province is around 4 metres above mean sea level (MASL). Songkhla occupy an entire area of 7,893.89 sq.km. or around 4,621,180 Rai (Thai area unit; 1 Rai is 1,600 sq.m.). This province is the 27th, and the 3rd place of the largest province in Thailand and southern region, respectively. The province is 947 km far from Bangkok (the capital city of Thailand) by railway route, and 950 km far from Bangkok by highway. Neighboring areas are;

- | | |
|-------|--|
| North | is adjacent to Nakhonsi-thammarat, and Pattalung provinces, |
| South | is adjacent to Yala and Pattani provinces, and Perlis state of Malaysia, |

East is adjacent to the Gulf of Thailand, and
West is adjacent to Pattalung, and Satun provinces.

Geography of Songkhla is a peninsula from north to south directions which is called Satingpura Peninsula, and flat terrain in southern area joined to the peninsula by the Tinnasulanondh Bridge. In this province, the north area is a flat terrain, east area is a coastal area, while south and west areas is wavy hills and plateau.

(2) Geography of Chana

Chana district is located in the east area of Songkhla. The district occupy an area of 502.98 sq.km. or 314,362.5 Rai. General geography is flat terrain which is suitable for agriculture. Some areas in the district are wavy hill in south and east directions. Most of forestry area in the district is tropical forest by which covering coastal area in the east direction. Neighboring areas are;

North is adjacent to Mueang district of Songkhla, and the Gulf of Thailand,

South is adjacent to Nathawi district of Songkhla,

East is adjacent to Thepa district of Songkhla, and the Gulf of Thailand, and

West is adjacent to Namom, Sadao, and Hatyai districts of Songkhla.

(3) Geography of Project location

The project locates in Tumbon Ku, Amphoe Chana, Songkhla. Majority of the study area (including the project area) are a basin with many rivers and canals, therefore, water flow through the area all year. For the study areas, they are located in Tumbon Khae, Tumbon Paching, Tumbon Nawa, Tumbon Sapan Mai Kaen, Tumbon Tha Mo Sai and Tumbon Ban Na. Majority of study areas are plains and plain areas with hills.

4.2.2 Geological and morphological characteristics

(1) Geological characteristic

Geological characteristics of Songkhla Province consist of various types of rock with both sedimentary rocks and igneous rocks causing a different topography. From geological evidence found in Songkhla, rocks from Cambrian period to the current sediment rock can be found.

The study area has geological characteristics as a sediment, gravel, sand, silt and clay accumulate along river channel, ridge and puddle.

(2) Soil resources

The study of soil classification around the study area within the radius of 5 kilometers around the project was done by the consultant company. There were data collection from Geography Information System (GIS) from Department of military maps (2002) and information on soil series from Department of Land Development (2004). For soil series, the study area consists of 18 soil series in total with the community areas as seen in **Figure 4.2.2-1**.

The project area has 2 soil series, Ruso and Klaeng series. Ruso series has the area of 0.0304 sq.km., as of 19.1% of the entire project area. For Klaeng series, it has the area of 0.144 sq.km., as of 80.9 % of the entire project area. 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 soil 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. The area of Ruso series is 27.45 sq.km., as of 28.04% of the entire project area.

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 runoff, slow water soak and water immersion could be found during the rain season. For soil 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, yellowish brown or reddish yellow dots occurs in the soil texture. Laterite, more than 50% by volumes, can be found. Moreover, it can be found continuously within a depth of 150 centimeters from the soil surface. 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. The area of Klaeng series is 16.29 sq.km., as of 17.17% of the entire project area.

(3) Earthquake

Department of Mineral Resources and other organizations identified 5 levels of earthquake intensity with 10% opportunity during 50 years as following details.

1) Less than 3.0 Mercalli, this is a minor intensity of earthquake. Public cannot feel the earthquake but the machine can detect it. It covers the lower Northeast, partial East and some lower Southern areas of the country.

2) 4.0 Mercalli, this is a moderated intensity of earthquake. Public can feel the different. It covers some parts of the upper Northeast, some of Central, some of East and some lower Southern areas of the country.

3) 5.0 Mercalli, this is a high intensity of earthquake and can awake of the public. . It covers some parts of North, upper Northeast, Central and Southern of the country.

4) 6.0 Mercalli, this is severe intensity of earthquake which could vibrate trees and houses and could destroy some types of buildings. It covers some parts of Northern, upper Northeast, Central and Southern of the country.

5) 7.0 Mercalli, this is strongly severe intensity of earthquake which could crack and break walls, fallen ceiling. It covers some parts of Northern, Central and upper Southern of the country.

For the project area, it is located in the minor intensity earthquake (less than 3.0 Mercalli) to a moderate intensity of earthquake (4.0 Mercalli) as details mentioned in above session.

4.2.3 Climate condition, Meteorology and Air quality

(1) General climate condition

Songkhla locates in the influence of 2 seasonal monsoons. The first one is the Northeast monsoon or winter season which cool and dry wind blows from the North of China that could lower the temperature of Central to upward zone of Thailand have cool and dry weather. However, the Southern of Thailand from Prachuap Khiri Khan to Songkhla would have heavy rain due to this monsoon flow through Gulf of Thailand and generally carry steam into rain, therefore, the weather will be different from other parts of the country with occasional cold weather. The second one is the Southwest monsoon that flow over the Indian Ocean, so that, it carries steam and moisture to Thailand. However, due to Tanaosri Mountain located in the West, therefore, rain occurs to be less in Songkhla and the east side of Southern part of Thailand than the west side where wind blows.

(2) Climate condition of the study areas

For the climate study within the project area, the consultant company collected statistical climate data for the past 10 years (2006-2015) from the weather measurement station at KHOR HONG Rubber Research Center in Songkhla as a representative in the study as it was the closest to the project area. This station is located at 7 degrees, 0 minute of arc, 0 second of arc and the longitude of 100 degrees, 30 minute of arc, 0 second of arc, in the East (**Table4.2.3-1**). Moreover, the company collect data from the Wind Rose during the past 10 years (2006-2015) as seen in **Figure4.2.3-1** with following explanation.

1) Wind

The major wind directions, that flow through the study area, are the East, Northeast and Southwest directions. The average wind speed for each month range approximately 1.3-3.0 knots. The maximum wind speed was 35 knots as it was measured and recorded in May.

2) Rain

The average rainfall per month throughout the year was 2,090.2 mm. The highest average rainfall was in November for 315.7 mm. The lowest average rainfall was in May for 89.4 mm. Moreover, the number of rainy days was equal to 166.2 days per year.

3) Temperature

The average temperature throughout the year was 27.6 °C with the range between 26.7-28.5 °C. The highest average temperature throughout the year was 32.7 °C and the lowest average temperature throughout the year was 24.2 °C. The highest temperature was 38.0 °C in May and the lowest temperature can be found in February with 16.9 °C.

4) Air pressure

The average pressure throughout the year was 1,009.5 hPa with the range between 1,008.2-1,011.3 hPa. The highest air pressure was 1,038.6 hPa which can be measured in September. The lowest air pressure was 1,002.1 hPa which can be measured in March. The difference value of air pressure for each day was 4.0 hPa on the average.

5) Relative humidity

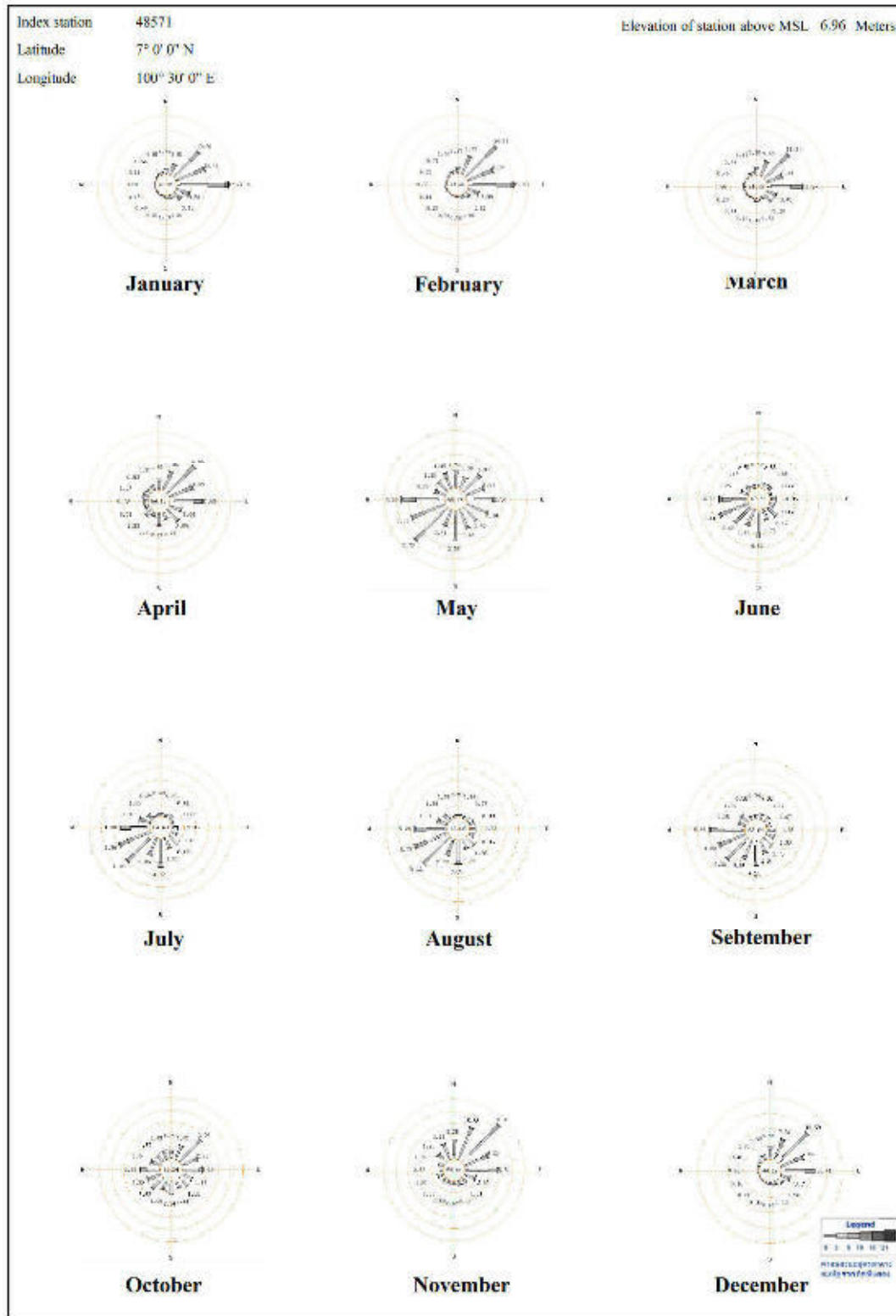
The average of relative humidity throughout the year was 79.1%. The highest average of relative humidity was 93.4% and the lowest average of relative humidity was 58.6 %. For the lowest relative humidity, it was 23.0% in March.

Table 4.2.3-1

Statistical climate data for the past 10 years (2006-2015) from the weather measurement station at KHOR HONG Rubber Research Center in Songkhla

Station	KHO HONG AGROMET.										Elevation of station above MSL		6.96 Meters	
Index station	48571										Height of barometer above MSL		9.73 Meters	
Latitude	7° 0' 0" N										Height of thermometer above ground		1.25 Meters	
Longitude	100° 30' 0" E										Height of wind vane above ground		10.8 Meters	
											Height of raingauge		1 Meters	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	
Pressure (Hectopascal)														
Mean	1,011.3	1,010.6	1,009.9	1,009.0	1,008.4	1,008.2	1,008.6	1,008.9	1,009.5	1,009.9	1,009.5	1,010.3	1,009.5	
Ext. Max.	1,017.6	1,016.6	1,016.3	1,014.8	1,013.5	1,014.8	1,013.6	1,013.4	1,038.6	1,015.8	1,014.5	1,017.0	1,038.6	
Ext. Min.	1,003.9	1,003.5	1,002.1	1,003.3	1,002.4	1,002.6	1,003.4	1,003.8	1,004.2	1,003.0	1,003.0	1,003.9	1,002.1	
Mean daily range	3.7	4.0	4.4	4.4	4.0	3.6	3.6	3.8	4.2	4.3	4.2	3.8	4.0	
Temperature (Celsius)														
Mean	26.7	27.3	28.0	28.5	28.3	28.2	27.9	27.8	27.5	27.1	26.7	26.7	27.6	
Mean Max.	30.5	31.9	33.3	34.2	34.3	33.9	33.6	33.8	33.1	32.4	30.9	30.2	32.7	
Mean Min.	23.9	24.0	24.3	24.8	24.8	24.6	24.2	24.1	24.1	23.9	23.9	24.0	24.2	
Ext. Max.	34.0	35.4	37.2	37.5	38.0	36.8	36.1	37.4	35.7	35.2	34.0	33.4	38.0	
Ext. Min.	19.8	16.9	20.8	22.9	22.5	22.2	21.3	21.3	22.2	21.2	21.9	21.7	16.9	
Relative Humidity (%)														
Mean	77.0	75.0	76.0	77.0	80.0	79.0	78.0	78.0	80.0	83.0	85.0	82.0	79.1	
Mean Max.	90.0	90.0	92.0	93.0	95.0	94.0	94.0	94.0	95.0	95.0	96.0	93.0	93.4	
Mean Min.	62.0	56.0	54.0	54.0	56.0	56.0	55.0	55.0	58.0	62.0	69.0	68.0	58.6	
Ext. Min.	38.0	34.0	23.0	29.0	30.0	37.0	38.0	36.0	41.0	41.0	50.0	46.0	23.0	
Dew Point (Celsius)														
Mean	22.2	22.2	23	23.7	24	23.8	23.4	23.2	23.4	23.6	23.8	23.1	23.3	
Pan Evaporation(mm.)														
Total	125.2	140.4	158.9	143.1	139	124.4	133.2	135.4	123.4	114.9	99.7	102.8	1,540.4	
Cloudiness (1-10)														
Mean	6.2	5.1	5.4	5.6	6.6	6.5	6.8	7.0	7.3	7.3	7.3	7.3	6.5	
Visibility (km.)														
0700 L.S.T.	9.5	9.7	9.6	9.8	9.8	9.7	9.7	9.6	9.7	9.3	8.7	9.1	9.5	
Mean	10.4	10.7	10.6	10.5	10.4	10.3	10.4	10.3	10.3	9.9	9.7	9.9	10.3	
Wind (Knots)														
Mean wind speed	3.0	2.9	2.3	1.6	1.3	1.4	1.6	1.5	1.6	1.5	1.7	2.6	1.9	
Prevailing wind	E	NE	NE	NE	SW	SW	SW	SW	SW	NE	NE	NE	-	
Max. wind speed	27.0	29.0	27.0	25.0	35.0	34.0	32.0	31.0	34.0	30.0	28.0	29.0	35.0	
Rainfall (mm.)														
Total	89.9	35.4	77.6	98.7	169.3	119.4	117.7	151.1	163.8	262.2	442.7	362.4	2,090.2	
Daily maximum	144.1	110.4	106.8	91.4	89.4	152.6	121.8	104.4	109.6	174.0	315.7	218.3	315.7	
Number of days	10.2	4.1	7.1	9.4	14.7	13.0	13.4	15.2	17.1	20.6	22.1	19.3	166.2	
Phenomena (Days)														
Haze	0.1	0.0	0.4	0.2	0.0	0.1	0.2	0.5	0.3	1.3	0.4	0.2	3.7	
Fog	5.6	2.5	1.3	0.5	0.6	0.7	1.8	3.4	3.3	5.3	6.1	5.4	36.5	
Hail	0.1	0.0	0.0	0.2	0.1	0.2	0.1	0.2	0.1	0.3	0.2	0.1	1.6	
Thunderstorm	1.1	0.8	2.8	4.9	10.3	5.9	3.6	4.8	4.4	6.1	5.5	2.6	52.8	
Squall	0.3	0.0	0.0	0.1	0.2	0.1	0.2	0.1	0.2	0.5	0.1	0.2	2.0	

Source : Thai Meteorological Department, 2017



6) Cloud volume

Cloud volume had an average values in the range of 5.1 - 7.3 parts from 10 parts of the sky. The highest cloud volume was in rainy and winter seasons. In September to December, there would be the highest cloud volume of 7.3 parts from 10 parts of the sky. In February, there would be the lowest cloud volume of 5.1 parts from 10 parts of the sky.

7) Thunderstorm

Numbers of days with thunderstorm throughout the year was equal to 166.2 days. The highest numbers of understorms occurs in October for 20.6 days. The lowest numbers of understorms occurs in February.

(3) Air quality

The consultant company defined points of measurement by considering of wind direction and conditions of communities locating along the wind direction as a representative. Data would be used as a baseline data for assessing an environmental impacts on air quality. Index to be measured at the station are total suspended particles (TSP) on an average for 24 hours, particulates not exceed to 10 microns (PM-10) on an average for 24 hours, Sulfur dioxide (SO₂) on average for one hour. Sulfur dioxide (SO₂) on an average for 24 hours and Nitrogen dioxide (NO₂) on average for one hour. There were 2 measurements which were during 24 February-2 March, 2016 and during 23-30 August, 2016 from 4 stations (**Figure 4.2.3-2**) as follows.

A1	=	around Nuruch Chamchee Mosque
A2	=	around Roh Mah Mosque
A3	=	around Plug Phor Mosque
A4	=	around Baan Muang Wan

Results from air quality measurement of 4 stations as seen in **Table 4.2.3-2** is within the allowable limits for Ambient Air Quality of WB IFS EHS General Guidelines.

1) Nuruchchamchee Mosque

Monitoring results from the 1st monitoring operation (24 Feb.-2 Mar. 2016) revealed that 24 hrs averaging for TSP was around 47-107 microgram/cu.m., 24 hrs averaging for PM-10 was around 27-40 microgram/cu.m., 1 hr averaging for SO₂ was around 1.57-7.33

microgram/cu.m., 24 hrs averaging for SO₂ was around 2.62-3.93 microgram/cu.m., and 1 hr averaging for NO₂ was around 0.75-18.63 microgram/cu.m.

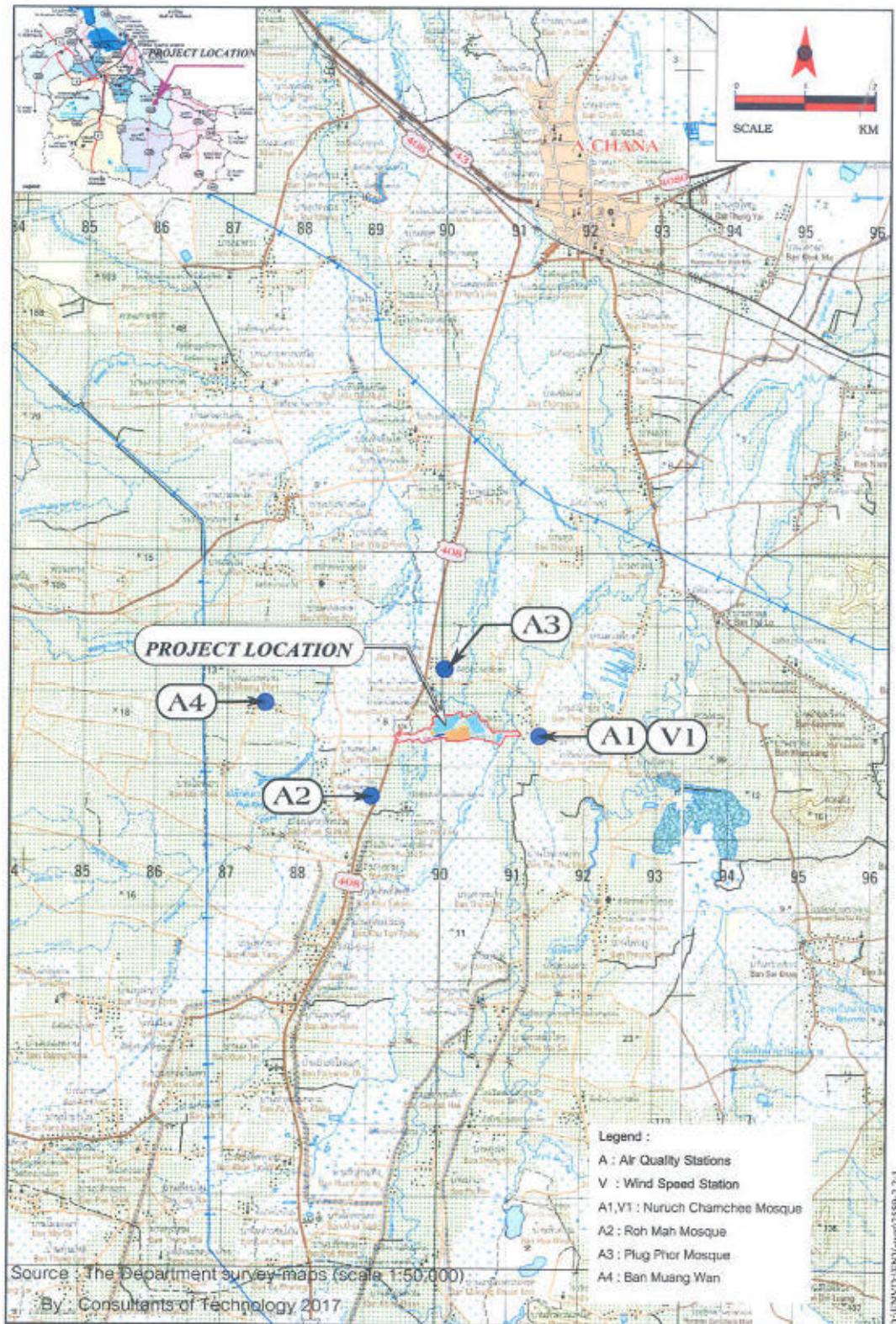


Figure 4.2.3-2 Air Quality and Wind Speed Stations

Table 4.2.3-2

Results from air quality measurement

Location	Date	Result				
		TSP (ug/m ³)	PM-10 (ug/m ³)	SO ₂ (ug/m ³)		NO ₂ (ug/m ³)
		Avg 24 hr	Avg 24 hr	Avg 1 hr	Avg 24 hr	Avg 1 hr
Nuruchamchee Mosk (A1)	24-25 Feb 16	54	31	2.36 - 7.33	3.66	3.20 - 13.17
	25-26 Feb 16	107	40	2.09 - 5.76	3.14	2.63 - 15.43
	26-27 Feb 16	77	30	2.09 - 6.54	3.40	2.45 - 18.44
	27-28 Feb 16	47	27	2.09 - 5.24	3.40	3.20 - 14.30
	28-29 Feb 16	59	32	1.57 - 7.07	3.14	2.45 - 18.63
	29 Feb-1 Mar 16	60	31	2.09 - 4.71	2.62	0.75 - 16.74
	1-2 Mar 16	62	33	2.09 - 6.02	3.93	2.63 - 17.12
Min-Max from 1 st monitoring		47-107	27-40	1.57 - 7.33	2.62-3.93	0.75 - 18.63
	23-24 Aug 16	35	20	1.05 - 3.40	2.09	0.75 - 11.10
	24-25 Aug 16	19	9	1.05 - 3.14	1.83	2.07 - 9.78
	25-26 Aug 16	21	11	1.05 - 3.40	1.57	0.94 - 9.41
	26-27 Aug 16	28	15	1.05 - 4.19	2.09	0.75 - 15.24
	27-28 Aug 16	37	23	1.05 - 3.66	1.83	2.26 - 16.18
	28-29 Aug 16	34	18	1.05 - 3.14	1.57	2.26 - 11.66
	29-30 Aug 16	36	22	1.05 - 3.93	1.83	0.94 - 17.12
Min-Max from 2 nd monitoring		19-37	9-23	1.05 - 4.19	1.57-2.09	0.75 - 17.12
Min - Max		19-107	9-40	1.05 - 7.33	1.57-3.93	0.75 - 18.63
Rohmah Mosk (A2)	24-25 Feb 16	74	27	2.88 - 5.24	3.66	4.14 - 15.24
	25-26 Feb 16	115	30	1.83 - 7.85	3.66	3.76 - 15.43
	26-27 Feb 16	73	22	1.83 - 4.71	3.40	2.07 - 8.65
	27-28 Feb 16	49	18	2.62 - 5.24	3.40	2.26 - 12.23
	28-29 Feb 16	48	21	2.88 - 4.19	3.40	2.07 - 17.12
	29 Feb-1 Mar 16	53	23	2.88 - 6.54	3.93	1.88 - 15.24
	1-2 Mar 16	70	29	3.14 - 7.85	4.19	3.01 - 20.70
Min-Max from 1 st monitoring		48-115	18-30	1.83 - 7.85	3.40-4.19	1.88 - 20.70
	23-24 Aug 16	56	34	1.05 - 9.16	2.62	0.75 - 11.29
	24-25 Aug 16	210	10	2.09 - 3.40	2.36	3.01 - 7.34
	25-26 Aug 16	27	17	2.09 - 3.66	2.36	2.26 - 6.96
	26-27 Aug 16	34	24	2.09 - 5.76	2.62	2.26 - 11.29
	27-28 Aug 16	32	22	2.09 - 2.88	2.36	0.75 - 8.47
	28-29 Aug 16	65	43	2.09 - 4.97	2.62	1.13 - 7.53
	29-30 Aug 16	45	19	2.09 - 4.45	2.62	0.75 - 6.21
Min-Max from 2 nd monitoring		27-210	10-43	1.05 - 9.16	2.36-2.62	0.75 - 11.29
Min - Max		27-210	10-43	1.05 - 9.16	2.36-4.19	0.75 - 20.70

Table 4.2.3-2 (Cont')

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

Remark: ^{1/} Announcement of National Environment Board No.24 (2004)

^{2/} Announcement of National Environment Board No.21 (2001)

^{3/} Announcement of National Environment Board No.33 (2009)

Source: Analysis by United Analyst and Engineering Consultant Co., Ltd. and data collection by Consultant of Technology Co., Ltd.

Monitoring results from the 2nd monitoring operation (23-30 Aug. 2016) revealed that 24 hrs averaging for TSP was around 19-37 microgram/cu.m., 24 hrs averaging for PM-10 was around 9-23 microgram/cu.m., 1 hr averaging for SO₂ was around 1.05-4.19 microgram/cu.m., 24 hrs averaging for SO₂ was around 1.57-2.09 microgram/cu.m., and 1 hr averaging for NO₂ was around 0.75-17.12 microgram/cu.m.

In conclusion, monitoring results from both 2 periods were found that 24 hrs averaging for TSP was around 19-107 microgram/cu.m., 24 hrs averaging for PM-10 was around 9-40 microgram/cu.m., 1 hr averaging for SO₂ was around 1.05-7.33 microgram/cu.m., 24 hrs averaging for SO₂ was around 1.57-3.93 microgram/cu.m., and 1 hr averaging for NO₂ was around 0.75-18.63 microgram/cu.m. which were indicated that both of those 2 monitoring results were follow the national ambient air quality standard according to the promulgation of the National Environmental Board.

2) Rohmah Mosque

Monitoring results from the 1st monitoring operation (24 Feb.-2 Mar. 2016) revealed that 24 hrs averaging for TSP was around 48-115 microgram/cu.m., 24 hrs averaging for PM-10 was around 18-30 microgram/cu.m., 1 hr averaging for SO₂ was around 1.83-7.85 microgram/cu.m., 24 hrs averaging for SO₂ was around 3.40-4.19 microgram/cu.m., and 1 hr averaging for NO₂ was around 1.88-20.70 microgram/cu.m.

Monitoring results from the 2nd monitoring operation (23-30 Aug. 2016) revealed that 24 hrs averaging for TSP was around 27-210 microgram/cu.m., 24 hrs averaging for PM-10 was around 10-43 microgram/cu.m., 1 hr averaging for SO₂ was around 1.05-9.16 microgram/cu.m., 24 hrs averaging for SO₂ was around 2.36-2.62 microgram/cu.m., and 1 hr averaging for NO₂ was around 0.75-11.29 microgram/cu.m.

In conclusion, monitoring results from both 2 periods were found that 24 hrs averaging for TSP was around 27-210 microgram/cu.m., 24 hrs averaging for PM-10 was around 10-43 microgram/cu.m., 1 hr averaging for SO₂ was around 1.05-9.16 microgram/cu.m., 24 hrs averaging for SO₂ was around 2.36-4.19 microgram/cu.m., and 1 hr averaging for NO₂ was around 0.75-20.70 microgram/cu.m. which were indicated that both of those 2 monitoring results were follow the national ambient air quality standard according to the promulgation of the National Environmental Board.

3) Plugpor Mosque

Monitoring results from the 1st monitoring operation (24 Feb.-2 Mar. 2016) revealed that 24 hrs averaging for TSP was around 29-45 microgram/cu.m., 24 hrs averaging for PM-10 was around 18-28 microgram/cu.m., 1 hr averaging for SO₂ was around 1.83-6.02 microgram/cu.m., 24 hrs averaging for SO₂ was around 3.14-3.66 microgram/cu.m., and 1 hr averaging for NO₂ was around 0.75-18.06 microgram/cu.m.

Monitoring results from the 2nd monitoring operation (23-30 Aug. 2016) revealed that 24 hrs averaging for TSP was around 16-45 microgram/cu.m., 24 hrs averaging for PM-10 was around 6-22 microgram/cu.m., 1 hr averaging for SO₂ was around 1.05-9.42 microgram/cu.m., 24 hrs averaging for SO₂ was around 1.31-1.83 microgram/cu.m., and 1 hr averaging for NO₂ was around 0.75-12.61 microgram/cu.m.

In conclusion, monitoring results from both 2 periods were found that 24 hrs averaging for TSP was around 16-45 microgram/cu.m., 24 hrs averaging for PM-10 was around 6-28 microgram/cu.m., 1 hr averaging for SO₂ was around 1.05-9.42 microgram/cu.m., 24 hrs averaging for SO₂ was around 1.31-3.66 microgram/cu.m., and 1 hr averaging for NO₂ was around 0.75-18.06 microgram/cu.m. which were indicated that both of those 2 monitoring results were follow the national ambient air quality standard according to the promulgation of the National Environmental Board.

4) Mungwan Village

Monitoring results from the 1st monitoring operation (24 Feb.-2 Mar. 2016) revealed that 24 hrs averaging for TSP was around 31-84 microgram/cu.m., 24 hrs averaging for PM-10 was around 19-38 microgram/cu.m., 1 hr averaging for SO₂ was around 2.09-5.76 microgram/cu.m., 24 hrs averaging for SO₂ was around 3.14-3.93 microgram/cu.m., and 1 hr averaging for NO₂ was around 2.45-14.67 microgram/cu.m.

Monitoring results from the 2nd monitoring operation (23-30 Aug. 2016) revealed that 24 hrs averaging for TSP was around 17-27 microgram/cu.m., 24 hrs averaging for PM-10 was around 7-17 microgram/cu.m., 1 hr averaging for SO₂ was around 1.05-4.19 microgram/cu.m., 24 hrs averaging for SO₂ was around 1.57-2.09 microgram/cu.m., and 1 hr averaging for NO₂ was around 0.75-8.84 microgram/cu.m.

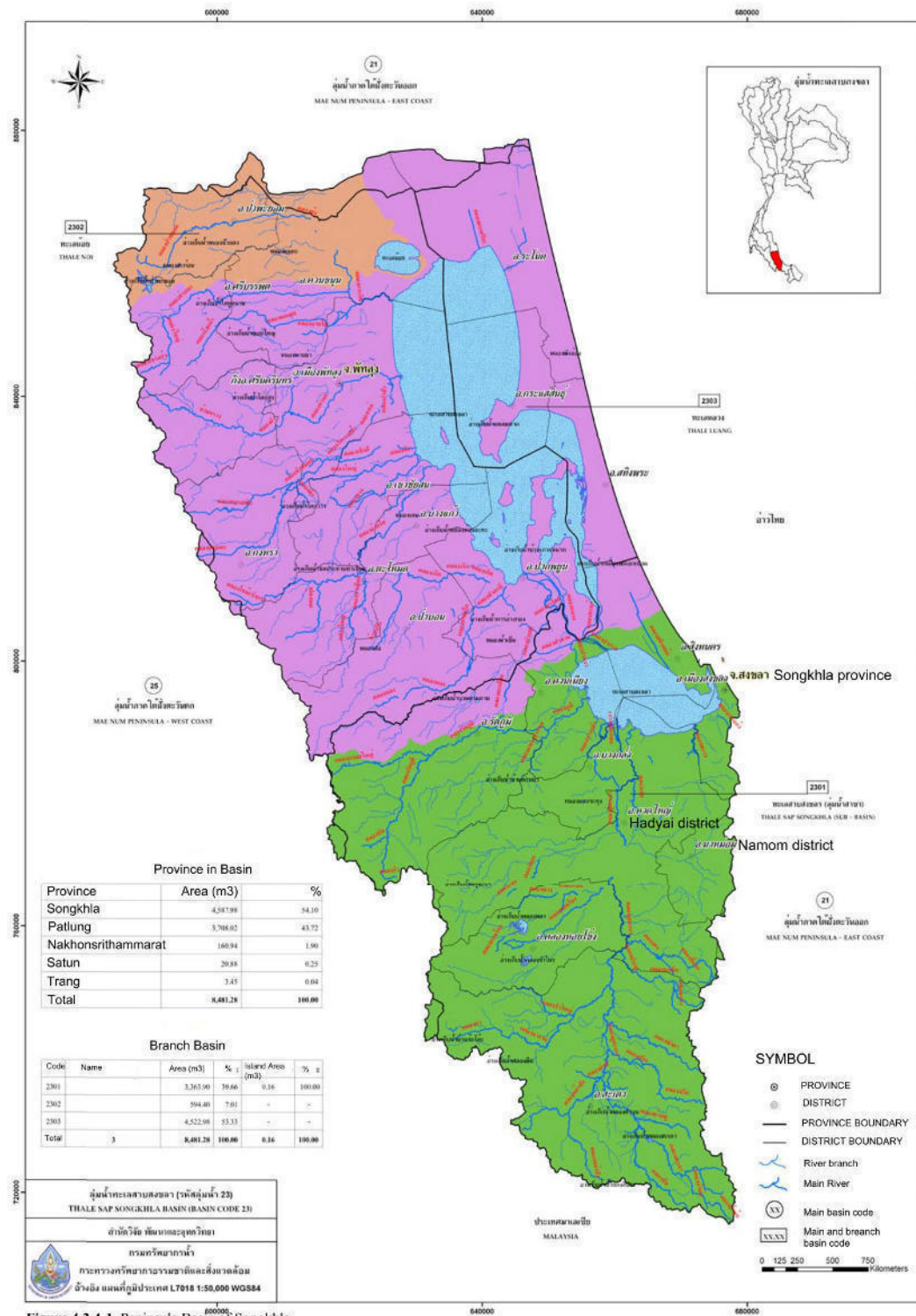
In conclusion, monitoring results from both 2 periods were found that 24 hrs averaging for TSP was around 17-84 microgram/cu.m., 24 hrs averaging for PM-10 was around 7-38 microgram/cu.m., 1 hr averaging for SO₂ was around 1.05-5.76 microgram/cu.m., 24 hrs averaging for SO₂ was around 1.57-3.93 microgram/cu.m., and 1 hr averaging for NO₂ was around 0.75-14.67 microgram/cu.m. which were indicated that both of those 2 monitoring results were follow the national ambient air quality standard according to the promulgation of the National Environmental Board.

Results from air quality measurement of 4 stations as seen in **Table 4.2.3-2**. From general air quality measurement, in comparison with the standard of air quality in the atmosphere, results showed that total suspended particles (TSP) on an average for 24 hours, particulates not exceeding 10 microns (PM-10) on an average for 24 hours and Sulfur dioxide (SO₂) on an average for 24 hours were in the standard according to the Announcement of National Environment Board No.24 (2004). Result of Sulfur dioxide (SO₂) on average for one hour was in the standard according to the Announcement of National Environment Board No.21 (2001). Result of Nitrogen dioxide (NO₂) on average for one hour was in the standard according to the Announcement of National Environment Board No.33 (2009).

4.2.4 Hydrology and water quality

(1) Hydrology

Songkhla has 2 main rivers which are Thale sap Songkhla and Peninsula-East coast. Thale sap Songkhla has sub basins, which are, Klong U-Tapao, Klong Rataphum basin, Sathing Phra Peninsula Basin and the lake area. Thale sap Songkhla also has branch rivers consisting of Klong U-Tapao, Klong Sadao, Klong Rum, Klong Lar, Klong Cham Rai, Klong Tam, Klong Wad, Klong Wa, Klong Rattaphum, coastal area and the lower lake. These branch rivers cover areas of Amphoe Bang Klam, Amphoe Hat Yai, Amphoe Sadao Amphoe Na Mom, Amphoe Khlong Hoi Khong, Amphoe Rattaphum, Amphoe Khuan Niang, Amphoe Hua Sai, Amphoe Ranot, Amphoe Krasae Sin, Amphoe Sathing Phra, Amphoe Singhanakhon, and Amphoe Mueang Songkhla. For Peninsula-East coast, its sub basins consists of Thepha-Na Thawi basin which has canals such as Klong Thepha and Klong Na Thawi. These canals cover areas of Amphoe Chana, Amphoe Thepha, Amphoe Na Thawi and Amphoe Saba Yoi (**Figure 4.2.4-1**).



The project located in the area of Klong Na Thawi basin where originated from Titiwangsa Mountains and then run through Amphoe Chana to the Gulf of Thailand at Pak Bang Sakom. The length is approximately 70 kilometers with the area of basin for 1,586 sq.km. An average of water volume throughout the year is 617 millions m³.

(2) Surface water quality

The consultant company measured surface water quality around Klong Na Thawi that flow through the study area. Index for measurement were temperature, pH value (pH), dissolved oxygen (DO), BOD, Total Dissolve Solid (TDS), nitrate-nitrogen (NO₃-N), ammonia-nitrogen (NH₃-N), Chloride (Cl), Sodium (Na), arsenic (As), cadmium (Cd), mercury (Hg), manganese (Mn), lead (Pb), Fecal Coliform Bacteria and Total Coliform Bacteria. The measurements from 3 stations were done on 24 May, 2016 (during the dry season) and on 27 August, 2016 (during the rain season) (**Figure 4.2.4-2**) as follows.

- SW1 = Upstream of Klong Na Thawi
- SW2 = Klong Na Thawi at the diversion point
- SW3 = Downstream of Klong Na Thawi

From the comparison of surface water quality during dry and rain seasons, the result showed no significant difference of water quality for some index such as temperature, pH value (pH), dissolved oxygen (DO), nitrate-nitrogen (NO₃-N), Chloride, Sodium, arsenic and Fecal Coliform Bacteria. For index which showed a different water quality between dry and rain seasons were dissolved oxygen and Total Dissolve Solid. The concentration of both index were higher during the rainy season than the dry season due to increase of oxygen from rainwater. Moreover, run off during the rain would increase substances in the water source. There were some undetectable index that could not be detected by the laboratory were cadmium, mercury and lead. For Total Coliform Bacteria, the Downstream of Klong Na Thawi station had higher value than other station when measuring in dry season. This Coliform Bacteria mostly located and found in human or animal intestine. Sometimes it could be found in plants, soil, grains, etc. At the downstream, Coliform Bacteria could be found higher than other area due to less volume of water when compared to the upstream. The result of the comparison on fecal coliform bacteria, indicating the source of wastewater effluent to the water source, showed that, at the point where high fecal coliform bacteria was found has no different value from other stations. This indicate that volumes of fecal coliform bacteria did not come from the releasing of household wastewater.

However, other factors such as soil and plant contamination could be the reason. The measurement result of water quality can be seen in **Table 4.2.4-1**.

Table 4.2.4-1														
Result of Surface water quality														
Parameter			Unit		Surface water quality (Klong Na Thawi)							Min-Max	STD ^{1/}	
					1st			2nd			3rd			
					(24 May 2016)			(29 August 2016)			(9 November 2016)			
					SW1	SW2	SW3	SW1	SW2	SW3	SW1			SW3
Temperature			-C	32	32	32	34	34	33	Not examined	Not examined	32-34	N'	
pH			-	7.1	7.1	7.1	7.4	7.1	7.2	Not examined	Not examined	7.1-7.4	5.0-9.0	
DO			mg/L	5.2	5.2	5.2	8.4	8.7	11.2	Not examined	Not examined	5.2-11.2	≥4.0	
BOD			mg/L	1.1	ND	ND	ND	ND	ND	Not examined	Not examined	ND-1.1	≤2.0	
Nitrate-nitrogen (NO ₃ -N)			mg/L	0.09	0.07	0.06	0.09	0.07	0.05	Not examined	Not examined	0.05-0.09	≤ 5.0	
Ammonia-nitrogen (NH ₃ -N)			mg/L	ND	ND	ND	ND	ND	ND	Not examined	Not examined	ND	≤ 0.5	
Total Dissolve Solid (TDS)			mg/L	67	68	70	147	124	153	Not examined	Not examined	67-153	-	
Chloride (Cl)			mg/L	7.3	8.8	6.4	7.3	7.3	6.8	Not examined	Not examined	6.4-8.8	-	
Sodium (Na)			mg/L	5.33	6.88	5.46	4.88	4.96	4.82	Not examined	Not examined	4.82-6.88	-	
Arsenic (As)			mg/L	0.0018	0.0021	0.0024	0.0031	0.0034	0.0031	Not examined	Not examined	0.0018-0.003	≤ 0.01	
Cadmium (Cd)			mg/L	ND	ND	ND	ND	ND	ND	Not examined	Not examined	ND	≤ 0.005	
Mercury (Hg)			mg/L	ND	ND	ND	ND	ND	ND	Not examined	Not examined	ND	≤ 0.002	
Manganese (Mn)			mg/L	0.198	0.2	0.176	0.189	0.208	0.234	Not examined	Not examined	0.176-0.234	≤ 1.0	
Lead (Pb)			mg/L	ND	<LOQ	ND	ND	ND	ND	Not examined	Not examined	ND	≤ 0.05	
Fecal Coliform Bacteria			MPN/ 100 mL	170	330	490	630	330	330	Not examined	Not examined	170-630	-	
Total Coliform Bacteria			MPN/ 100 mL	1,100	1,100	16,000	1,700	1,300	790	Not examined	Not examined	790-16,000	-	
Trihalomethanes														
- Chloroform			ug/L	Not examined	Not examined	Not examined	Not examined	Not examined	Not examined	ND	ND	ND	<0.3 ^{3/}	
- Bromodichloromethane			ug/L	Not examined	Not examined	Not examined	Not examined	Not examined	Not examined	ND	ND	ND	<0.06 ^{3/}	
- Dibromodichloromethane			ug/L	Not examined	Not examined	Not examined	Not examined	Not examined	Not examined	ND	ND	ND	<0.1 ^{3/}	
- Bromoform			ug/L	Not examined	Not examined	Not examined	Not examined	Not examined	Not examined	ND	ND	ND	<0.1 ^{3/}	
Remark:														
SW1			= Upstream of Klong Na Thawi											
SW2			= Klong Na Thawi at the diversion point											
SW3			= Downstream of Klong Na Thawi											
1/ Standard of water quality from the Announcement of National Environment Board No.8 (1994)														
2/ Rainy season = 24 May, 9 November 2015 and Drought season = 29 August 2015														
3/ WHO's Guidelines for Drinking Water Quality, 2011														
N'			Temperature of water can not exceed 3 degrees Celsius											
ND			Not Determind											
LOQ Level of Quantitation (Pb ≥ 0.010 and < 0.100 mg/L)														
Source : Data collection by Consultant of Technology Co., Ltd.														

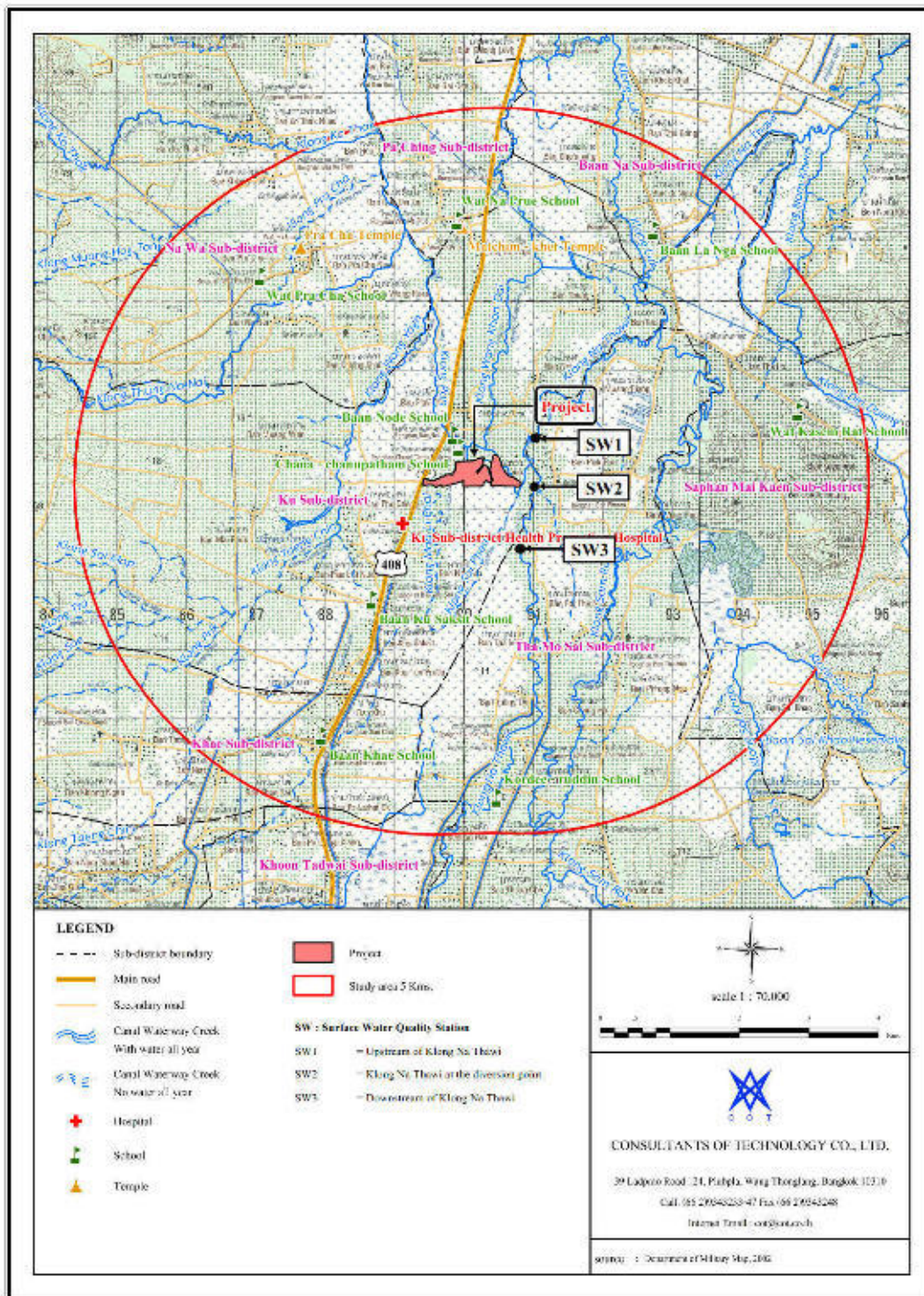


Figure 4.2.4-2 Surface Water Quality Station

Result of water quality in Klong Na Thawi showed that, it was a type 3 water source which receiving wastewater from some activities and can be used as water for the consumption after a routine treatment. Moreover, it could be a water source of agriculture according to the standard of water quality from the Announcement of National Environment Board No.8 (1994) on the establishment of surface water quality.

Moreover, there were measurements of Trihalomethan (THMs) on 2 stations around Klong Na Thawi on 9 November, 2016 . Locations of measurement station in Klong Na Thawi are the upstream of Klong Na Thawi (SW1) and the downstream of Klong Na Thawi (SW3). Trichloromethane was produced by the reaction between halogens and organic matter in water. Majority of substances were Humic acid and Fulvic acid compounds. Four parameters were taken into account of Trihalomethan analysis which were Chloroform, Bromodichloro-methanes, Dibromochloromethanes and Bromoform. The result showed that values are not above the parameters. Therefore when halogen compounds were not found to react with organic matter in water, the water quality in Klong Na Thawi was then not contaminated with trihalomethane.

(3) Ground water quality

Majority of ground water sources came from rainwater or surface water that penetrate into land and stored in gaps or cracks of soil or rocks. For the recent study on ground water study, the consultant company studied the characteristics of hydrologic and ground water quality with following details.

1) Hydrogeological characteristics

For Hydrogeological characteristics of the study area, the consultant company collected data from Geographic information system (GIS), geography map from Department of military maps (2002) and data from Department of Groundwater Resources (2006). The study showed that the majority of the study area covered by basin sedimentation, gravel, sand and silt (Qt) (with the area was approximately for 61.59 sq.km., or as of 64.92%). Gravel, sand, silt and alluvium (Qa) (with the area was approximately 30.58 sq.km., or as of 32.23%). Some areas on the east and west were supported by Lampang unit (TR1) which consists of pebble with red base color, mixed cement, gray shale insert with silt and sandstone (with the area was approximately 2.70 sq.km., or as of 2.85%) (**Figure 4.2.4-3**).

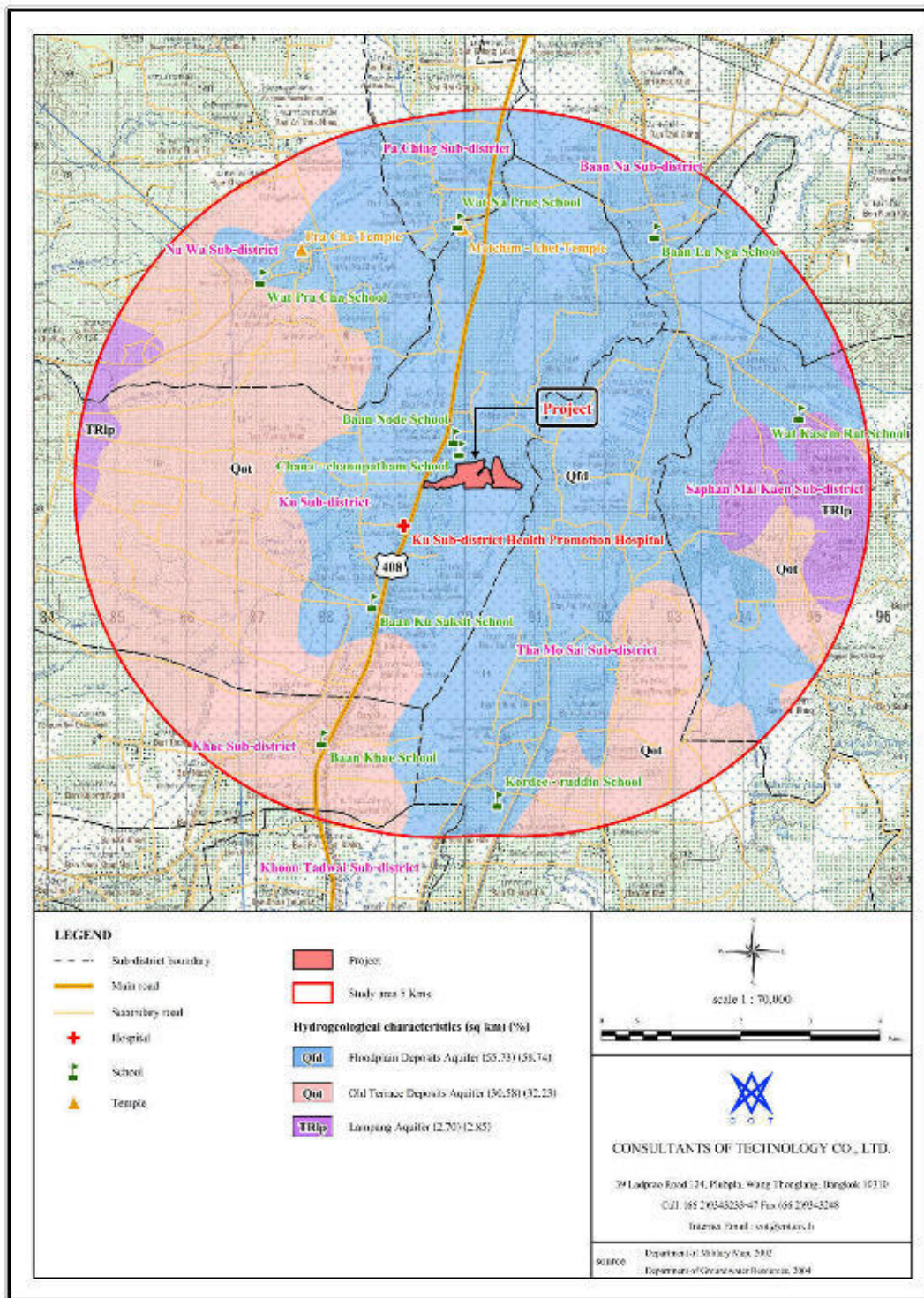


Figure 4.2.4-3 Hydrogeological characteristics of the study area

2) Ground water quality

The result from the ground water quality study around the project area showed that, general groundwater was ground water wells for village water supply with the depth of 36-104 meters. It was a water layer with pressure occurs in the gap between sandy gravel layer, claystone and the crack of sandstone. General water level was in between 1.44-5.70 meters with the volume of 1.14-20 m³ per hour. Index for measuring the ground water quality around the study area were Electric Conductivity, pH value (pH), Turbidity, Total Dissolve Solid (TDS), Total hardness, Iron (Fe), manganese (Mn), Copper (Cu), zinc (Zn), lead (Pb), Cadmium (Cd), Selenium (Se), Chloride(Cl), Sulfate (SO₄), Fluoride (F), nitrate-nitrogen (NO₃-N), arsenic(As), Mercury (Hg), Cyanide (CN), Total Coliform Bacteria and Fecal Coliform Bacteria. The result of ground water quality analysis as seen in **Table 4.2.4-2**.

The study of groundwater quality was done by sampling water from 6 wells around communities where the study area was located, which were, Baan Na Yam (UW1), Baan Phodang (UW2), Baan Not School (UW3), Baan Plak Pho (UW4), Wat Baan Na Prue (UW5), and Baan Tha Lo Mosque (UW6). Result of the ground water quality analysis showed that, there were no difference in some parameters except an Electric Conductivity. Some wells had higher electric conductivity than other wells, such as Baan Not School (UW3) and Baan Tha Lo Mosque (UW6). Nitrate-nitrogen and Cyanide were undetectable parameters.

When the result of these index value were compared with the Maximum Allowable Concentration of ground water; standard for the consumption in accordance with the Announcement of Ministry of Resources and Environment on the establishment of technical criteria and measures for public health and environmental toxins protection in 2008, showed that iron, zinc and arsenic had a higher concentration than the standard. However, this high value could be found in some places.

The area around the project site is the source of tin. In addition to these minerals, other minerals such as lead, copper, and zinc are found. When the sulfide is exposed to air and reacts with oxygen will form iron oxide and sulfuric acid, the soil is acidic, causing heavy metal to leach out. This can lead to high levels of lead and mercury in groundwater. Moreover, the sand pits near project site may cause the acid to dissolve the heavy metals in the soil and contaminate the groundwater. So, heavy metals in ground water are exceed standard.

4.2.5 Noise

The consultant company measured noise level in the atmosphere for communities nearby the project as a representative of the study. Parameters for this study were an equivalent continuous sound level for 24 hours ($L_{eq-24\text{ hr}}$) and maximum sound pressure level (L_{max}). The measurement was done at 3 stations during 23-30 July, 2015 as seen in **Figure 4.2.5-1** as follows.

- N1 = around Chana Chanupathum School
- N2 = around Roh Mah Mosque
- N3 = around the area of Moo 6, Ban Thung (first house)

Table 4.2.4-2
Result of Ground water quality

Parameter	Unit	Ground water quality							Min- Max	STD ²⁾
		UW1	UW2	UW3	UW4	UW5	UW6	UW6		
Electric Conductivity	µs/cm	90	80	150	80	80	160	160	80-160	N ^a
pH	-	4.46	4.31	4.52	4.60	4.18	-	4.05	4.05-4.60	7.0-8.5
Turbidity	NTU	<0.5	<0.5	<0.5	<0.5	<0.5	-	<0.5	<0.5	5
Total Dissolve Solid (TDS)	mg/L	19	19	72	25	21	-	34	19-72	<600
Total hardness	mg/L	2.4	5.2	4.2	7.2	1.6	-	13.6	2.4-13.6	<300
Iron (Fe)	mg/L	<0.03	0.13	0.05	0.22	1.29	-	6.18	<0.03-6.18	<0.5
Manganese (Mn)	mg/L	0.070	0.050	0.040	0.07	0.05	-	0.27	0.04-0.27	<0.3
Copper (Cu)	mg/L	<0.03	0.11	<0.03	<0.03	<0.03	-	<0.03	<0.03-0.11	<1.0
Zinc (Zn)	mg/L	<0.02	5.52	<0.02	<0.02	<0.02	-	<0.02	<0.02-5.52	<5.0
Lead (Pb)	mg/L	<0.08	<0.08	<0.08	<0.08	<0.08	-	<0.08	<0.08	<0.05
Cadmium (Cd)	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	-	<0.02	<0.02	<0.01
Selenium (Se)	mg/L	<0.33	<0.33	<0.33	<0.33	<0.33	-	<0.33	<0.33	<0.01
Chloride (Cl)	mg/L	4.41	4.21	3.2	5.17	5.18	-	8.6	3.2-5.18	<250
Sulfate (SO ₄)	mg/L	<5.0	<5.0	<5.0	<5.0	<5.0	-	<5.0	<5.0	<200
Fluoride (F)	mg/L	ND	ND	<0.02	ND	ND	-	<0.02	ND-<0.02	<0.7
Nitrate-nitrogen (NO ₃ -N)	mg/L	ND	ND	ND	ND	ND	-	ND	ND	<45
Arsenic (As)	mg/L	ND	ND	0.001	0.001	ND	-	0.009	ND-0.009	<0.05
Mercury (Hg)	mg/L	0.005	ND	0.001	0.002	ND	-	0.004	ND-0.005	<0.001
Cyanide (CN)	mg/L	ND	ND	ND	ND	ND	-	ND	ND	<0.1
Fecal Coliform Bacteria	MPN/ 100 ml	<1.8	<1.8	<1.8	<1.8	<1.8	-	<1.8	<1.8	<500
Total Coliform Bacteria	MPN/ 100 ml	<1.8	<1.8	<1.8	<1.8	<1.8	-	<1.8	<1.8	-

Remark : UW1 - Baan Na Yam

UW3 - Baan Not School

UW5 - Wat Baan Na Prue

UW2 - Baan Phodang

UW4 - Baan Plak Pho

UW6 - Baan Tha Lo Mosque

Announcement of Ministry of Resources and Environment on the establishment of technical criteria and measures for public health and environmental toxins protection in 2008

Source : Data collection by Consultant of Technology Co., Ltd., 2017

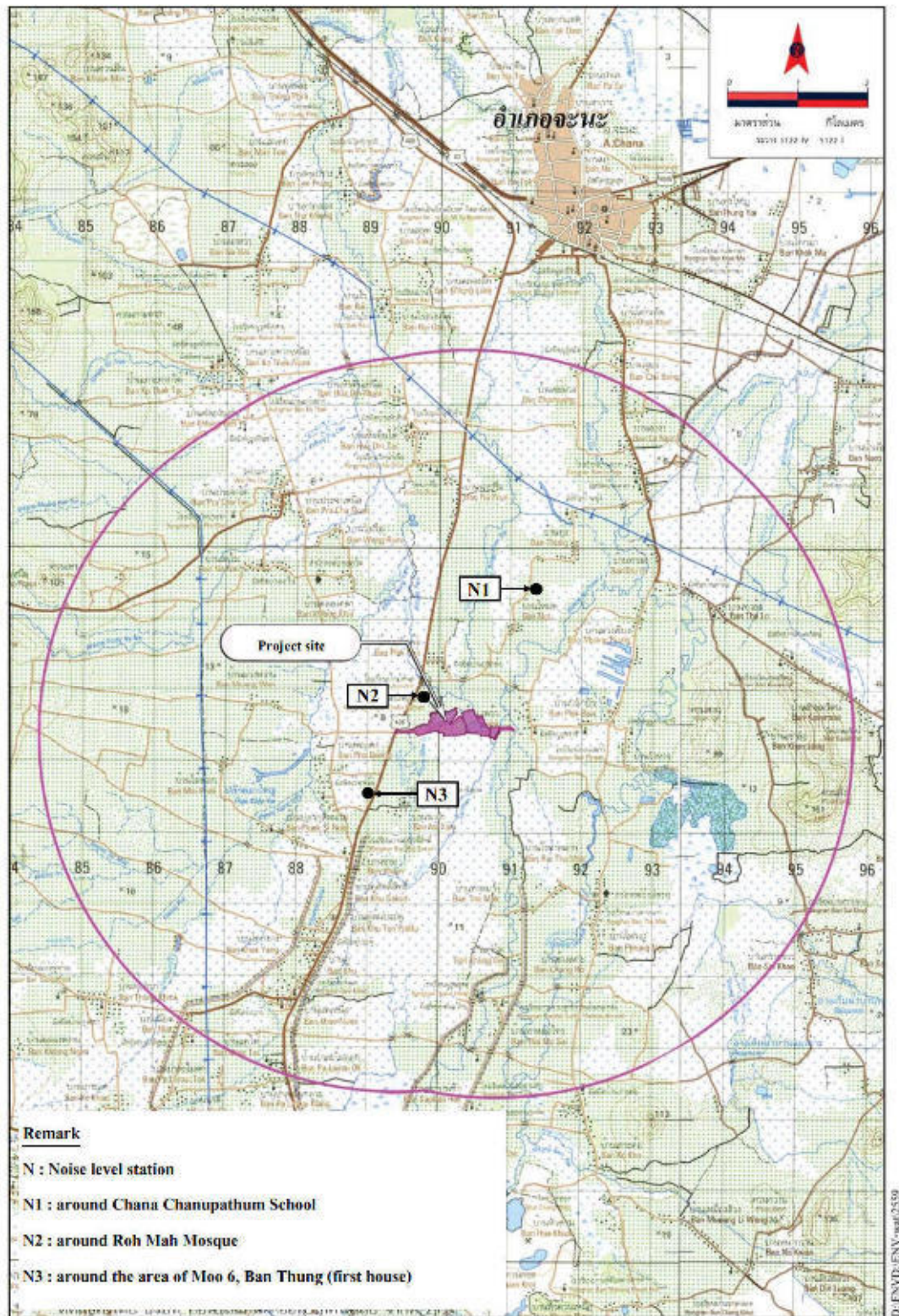


Figure 4.2.5-1 Noise level station

The result of measurement can be seen in **Table 4.2.5-1** . In comparison between the measured noise levels with the standard as required by Announcement of National Environment Board, No.15 (1997) on the establishment of the general standard noise level, results were within the standard level.

4.3 Biological Resources

4.3.1 Biological resources on land

Songkhla has 41 national forests. Within Amphoe Chana, there are 3 national forests, Kuan Cham Sil, Kuan Lang and Kuan Hin Phao Forests.

(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, Distance of Kuan Jumsin Forest from the project site is approximately 8 Km.

(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, Distance of Kuan Lung Forest from the project site is approximately 7.5 Km.

(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. Distance of Kuan Hinpao Forest from the project site is approximately 9 Km.

However, the project area is not located in the national forest nor any national park (**Figure 4.3.1-1**)

4.3.2 Biological resources in water

The study and exploration of an ecology in Klong Na Thawi, as the water resource nearby the project area, was done and 3 points were sampled on 24 May, 2016 and 27 August, 2016 as a representative samples of dry and rainy seasons. Parameters for this study were benthos, fish, plankton and aquatic plant. An exploration result in each season were shown in **Table 4.3.2-1** to **Table 4.3.2-5**. For the point where the measurement of biological resources was referred to **Figure 4.2.4-2** (SW1 :Upstream of Klong Na Thawi, SW2 : Klong Na Thawi at the diversion point and SW3 : Downstream of Klong Na Thawee).

Table 4.2.5-1
Result of Noise Level

Station	Date	Noise Level (dB (A))	
		Leq 24 hr	Max Level
1. Chana Chanupathum School (N1)	23-24/07/15	37.6-59.5	55.4-83.0
	24-25/07/15	38.4-59.7	52.2-78.4
	25-26/07/15	37.7-57.7	52.3-80.1
	26-27/07/15	35.9-57.7	53.3-80.8
	27-28/07/15	42.5-53.8	52.8-79.4
	28-29/07/15	44.6-57.0	55.1-87.4
	29-30/07/15	45.0-58.0	54.6-81.6
Min-Max		35.9-59.7	52.2-87.4
2. Roh Mah Mosque (N2)	23-24/07/15	44.2-65.0	51.0-86.2
	24-25/07/15	43.6-68.2	52.2-90.2
	25-26/07/15	44.4-68.4	54.3-88.3
	26-27/07/15	48.8-68.9	53.6-88.5
	27-28/07/15	43.3-65.5	52.9-87.2
	28-29/07/15	43.8-55.4	54.2-78.6
	29-30/07/15	45.7-69.6	52.2-89.3
Min-Max		43.3-69.6	51.0-90.2
3. area of Moo 6, Ban Thung (first house) (N3)	23-24/07/15	43.1-59.6	61.3-86.3
	24-25/07/15	47.2-62.2	60.7-83.8
	25-26/07/15	44.5-59.1	63.6-81.7
	26-27/07/15	42.4-55.7	66.3-87.6
	27-28/07/15	41.6-53.7	57.3-84.3
	28-29/07/15	43.8-59.6	53.7-101.4
	29-30/07/15	40.3-56.5	52.8-89.6
Min-Max		40.3-62.2	52.8-101.4
STD^{1/}		70	115
STD^{2/}		55/45	-

Remark : ^{1/}Announcement of National Environment Board, No.15 (1997) on the establishment of the general standard noise level

^{2/}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 : Data collection by Consultant of Technology Co., Ltd., 2017

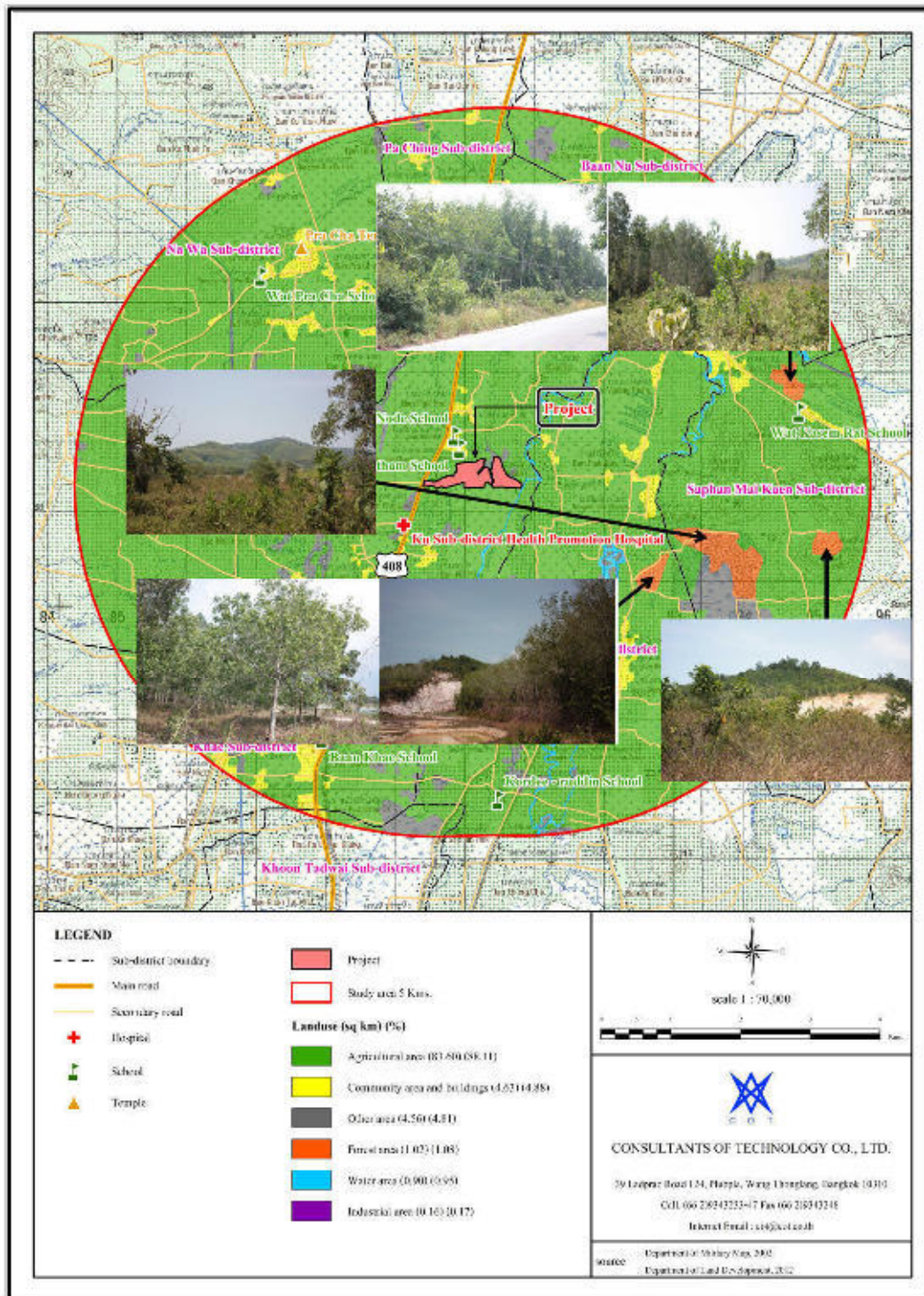


Figure 4.3.1-1 National forests in project area

Table 4.3.2-1
Result of Phytoplankton

Phytoplankton	Result (cell/m ³)					
	24-May-15			27-Aug-15		
	W1	W2	W3	W1	W2	W3
Division Cyanophyta						
Class Cyanophyceae						
Family Chroococcaceae						
<i>Chroococcus</i> sp.	15,000	0	9,000	6,000	6,000	1,000
<i>Merismopedia</i> sp.	0	2,000	0	0	2,000	0
<i>Microcystis aeruginosa</i>	5,000	0	9,000	0	0	0
Family Oscillatoriaceae						
<i>Oscillatoria</i> sp.	5,000	0	9,000	37,000	28,000	20,000
Family Nostocaceae						
<i>Anabaena</i> sp.	0	0	0	0	5,000	6,000
Division Chlorophyta						
Class Chlorophyceae						
Family Chlamydomonadaceae						
<i>Chlamydomonas</i> sp.	32,000	23,000	44,000	0	0	0
<i>Eudorina elegans</i>	32,000	0	9,000	3,000	0	0
<i>pandorina morum</i>	43,000	40,000	9,000	0	0	0
Family hydrodictyaceae						
<i>Pediastrum duplex</i>	64,000	39,000	20,000	12,000	18,000	26,000
Family Coelastraceae						
<i>Coelastrum</i> sp.	0	0	0	0	0	3,000
Family Oocystaceae						
<i>Tetradion</i> sp.	113,000	38,000	158,000	11,000	5,000	0
Family Scenedesmusaceae						
<i>Scenedesmus</i> sp.	765,000	1,092,000	913,000	288,000	257,000	223,000
Family Zygnemataceae						
<i>Monogelium</i> sp.	14,000	0	0	0	0	0
<i>Zygnema</i> sp.	2,236,000	2,927,000	1,221,000	0	0	0
Family Desmidiaceae						
<i>Cosmarium</i> sp.	1,073,000	1,078,000	986,000	152,000	311,000	358,000
<i>Closterium</i> sp.	1,073,000	1,195,000	793,000	18,000	57,000	26,000
<i>Enastrum</i> sp.	82,000	150,000	48,000	19,000	50,000	46,000
<i>Microsterias</i> sp.	48,000	0	8,000	0	0	0
<i>Pleurotaenium</i> sp.	16,000	29,000	0	0	10,000	0
<i>Staurastrum</i> sp.	202,000	0	259,000	11,000	12,000	43,000
<i>Xanthidium</i> sp.	65,000	40,000	21,000	0	0	0

Table 4.3.2-1 (Cont')

Phytoplankton	Result (cell/m ³)					
	24-May-15			27-Aug-15		
	W1	W2	W3	W1	W2	W3
Class Euglenophyceae						
Family Euglenaceae						
<i>Euglena</i> sp.	136,000	147,000	52,000	8,000	7,000	10,000
<i>Phacus</i> sp.	65,000	93,000	52,000	3,000	6,000	0
<i>Strombomonas</i> sp.	5,000	189,000	54,000	0	2,000	0
<i>Trachelomonas</i> sp.	52,000	72,000	32,000	25,000	4,000	8,000
Division Chromophyta						
Class Bacillariophyceae						
Family Aulacoseiraceae						
<i>Aulacoseira granulata</i>	0	8,000	0	0	0	0
Family Thalassiosiraceae						
<i>Cyclotella</i> sp.	0	0	0	5,000	0	0
Family Fragilariaceae						
<i>Synedra rampens</i>	48,000	18,000	45,000	329,000	822,000	606,000
<i>S. ulna</i>	132,000	183,000	69,000	111,000	118,000	105,000
Family Rhabdoniaceae						
<i>Rhabdonis</i> sp.	0	8,000	0	3,000	9,000	3,000
Family Eunotiaceae						
<i>Eunotia</i> sp.	95,000	103,000	204,000	25,000	93,000	20,000
Family Cymbellaceae						
<i>Gomphonema</i> sp.	66,000	78,000	37,000	39,000	63,000	44,000
Family Naviculaceae						
<i>Gyrosigma</i> sp.	87,000	130,000	24,000	7,000	19,000	10,000
<i>Navicula</i> sp.	1,818,000	3,181,000	2,185,000	95,000	355,000	113,000
<i>Pinnularia</i> sp.	83,000	120,120	76,000	0	0	0
Family Surirellaceae						
<i>Surirella</i> sp.	251,000	180,000	446,000	191,000	285,000	272,000
Class Dinophyceae						
Family Peridiniaceae						
<i>Peridinium</i> sp.	7,000	14,000	7,000	0	0	0
Total Abundance	8,758,000	11,233,120	7,810,000	1,398,000	2,544,000	1,943,000
No. of species	31	28	30	22	24	20
Sample condition						
Colour/Characteristics of water	No/Clear	No/Clear	No/Clear	No/Turbid	No/Turbid	No/Clear
Colour of sediment	Brown	Brown	Brown	Brown	Brown	Brown

Remark : W1 Nathawi canal at the distance of 1 km before the water irrigation point of the project

W2 Nathawi canal at the water irrigation point of the project

W3 Nathawi canal at the distance of 1 km after the water irrigation point of the project

Source : Data collection by Consultant of Technology Co., Ltd., 2017

Table 4.3.2-2
Result of Zooplankton

Zooplankton	Result (cell/m ³)					
	24-May-15			27-Aug-15		
	W1	W2	W3	W1	W2	W3
Phylum Protozoa						
Class Sarcodina						
Family Arcellidae						
<i>Arcella</i> sp.	4,000	2,000	2,000	0	1,000	0
Family Euglyphidae						
<i>Euglypha</i> sp.	0	0	1,000	0	0	0
Family Diffugiidae						
<i>Diffugia</i> sp.	0	0	2,000	0	0	1,000
<i>Centropxis</i> sp.	1,000	0	0	2,000	1,000	1,000
Phylum nematoda						
Unknow Nematode	1,000	2,000	0	0	0	1,000
Phylum Gastrotricha						
<i>Chaetonotus</i> sp.	1,000	2,000	0	1,000	2,000	0
Phylum Rotifera						
Class Monogononta						
Family Brachionidae						
<i>Anuraecopsis</i> sp.	4,000	5,000	5,000	0	0	0
<i>Brachionus</i> sp.	0	0	0	1,000	0	0
<i>Keratella</i> sp.	0	0	0	1,000	0	0
Family Trichocercidae						
<i>Trichocerca</i> sp.	0	2,000	0	0	0	0
Family Lecanidae						
<i>Lecane</i> sp.	4,000	6,000	9,000	2,000	3,000	6,000
Class Digononta						
Family Rhilodindae						
<i>Rotaria</i> sp.	6,000	0	0	1,000	1,000	0
Phylum Arthropoda						
Class Crustacea						
Nauplius of Copepod	0	2,000	1,000	0	0	0
Harpacticoid Copepod	0	0	0	0	0	1,000
Phylum Mollusca						
Class Bivalvia						
Bivalvis Larva	0	0	0	2,000	0	0
Total Abundance	21,000	21,000	20,000	10,000	8,000	10,000
No. of species	7	7	6	7	5	5

Remark : W1 Nathawi canal at the distance of 1 km before the water irrigation point of the project

W2 Nathawi canal at the water irrigation point of the project

W3 Nathawi canal at the distance of 1 km after the water irrigation point of the project

Source : Data collection by Consultant of Technology Co., Ltd., 2017

Table 4.3.2-3

Result of Benthos

Benthos	Result (unit/m ²)					
	24-May-15			27-Aug-15		
	W1	W2	W3	W1	W2	W3
Phylum Annelida						
Class Oligochaeta						
Family Lumbricidae	7	0	0	0	0	7
Phylum Arthropoda						
Class Malacostraca						
Family Palaemonidae	7	7	15	7	7	15
Class Insecta						
Family Bactidae	0	0	7	0	0	0
Family Chironomidae	7	15	0	7	7	0
Phylum Mollusca						
Class Gastropoda						
Family Lymnaeidae	0	7	15	0	7	7
Class Bivalvia						
Family Corbiculidae	15	15	7	0	30	0
Total	36	44	44	14	51	29
No. of Species	4	4	4	2	4	3

Remark : W1 Nathawi canal at the distance of 1 km before the water irrigation point of the project

W2 Nathawi canal at the water irrigation point of the project

W3 Nathawi canal at the distance of 1 km after the water irrigation point of the project

Source : Data collection by Consultant of Technology Co., Ltd., 2017

Table 4.3.2-4
Result of Aquatic plant

Aquatic plant	Result					
	24-May-15			27-Aug-15		
	W1	W2	W3	W1	W2	W3
Family Capparaceae						
<i>Crateva magna</i> (กะล่อน)	-	+	+	-	+	+
Family Cyperaceae						
<i>Cyperus pulcherrimus</i> (กกสี)	+	-	+	+	+	+
<i>Cyperus pilosus</i> (กกสีใบยาว)	+	+	+	+	+	++
Family Mimosaceae						
<i>Mimosa pigra</i> (ไม้มอธ)	+	-	-	+	+	+
<i>Mimosa pudica</i> (ไม้มอธ)	-	+	+	-	+	+
Family Poaceae						
<i>Leersia hexandra</i> (หญ้า)	+	+	+	+	+	+
<i>Brachiaria mutica</i> (หญ้า)	-	+	-	-	+	+
Family Asteraceae						
<i>Eclipta prostrata</i> (กุ่ม)	+	+	+	+	+	+
Family Amaranthaceae						
<i>Alternanthera sessilis</i> (หางนกยูง)	-	+	+	-	-	-
Family Lythraceae						
<i>Rotala indica</i> (หางนกยูง)	+	-	+	+	+	-
Family Convolvulaceae						
<i>Ipomoea aquatica</i> (ผัก)	-	-	-	+	++	-
No. of species	6	7	8	6	10	8

Remark : W1 Nathawi canal at the distance of 1 km before the water irrigation point of the project

W2 Nathawi canal at the water irrigation point of the project

W3 Nathawi canal at the distance of 1 km after the water irrigation point of the project

- - Not found

+ - Found

++ - Found in large quantities

Source : Data collection by Consultant of Technology Co., Ltd., 2017

Table 4.3.2-5
Surveying and sampling results for fish

Fish	Thai name	Result (Unit/Bai)					
		24-May-15			27-Aug-15		
		W1	W2	W3	W1	W2	W3
Family Cyprinidae							
<i>Barbonymus schwanefeldii</i>	ปลานิล	6	5	0	5	13	3
<i>Barbonymus gonionotus</i>	ปลานิล	3	3	8	0	0	0
<i>Mystus marginatus</i>	ปลานิล	32	58	96	13	11	45
<i>Puntius typus</i>	ปลานิล	2	0	0	2	0	0
<i>Cyclocheilichthys repasson</i>	ปลานิล	2	0	0	0	0	0
<i>Puntius brevis</i>	ปลานิล	2	0	0	0	0	0
<i>Hampala macrolepota</i>	ปลานิล	0	3	0	0	6	0
<i>Rasbora aurata</i>	ปลานิล	0	2	0	0	3	0
<i>Labeobarbus siamensis</i>	ปลานิล	0	0	0	0	14	0
<i>Osteochilus fasciatus</i>	ปลานิล	0	0	0	0	3	0
<i>Puntius orphoides</i>	ปลานิล	0	0	0	0	3	0
Family Mastomelidae							
<i>Mastomelus armatus</i>	ปลานิล	2	11	0	5	0	0
Family Bagridae							
<i>Hemibagrus nemurus</i>	ปลานิล	0	2	0	0	0	0
Family Pristigasteridae							
<i>Pristigaster fasciatus</i>	ปลานิล	0	2	0	0	5	0
Family Channidae							
<i>Channa striata</i>	ปลานิล	0	2	0	0	0	0
Total 5 Classes 12 species		2 Classes 7 species	3 Classes 9 species	1 Class 2 species	2 Classes 4 species	2 Classes 9 species	1 Class 2 species

Remark : W1 North canal at the distance of 1 km before the water irrigation point of the project

W2 North canal at the water irrigation point of the project

W3 North canal at the distance of 1 km after the water irrigation point of the project

Source : Data collection by Consultant of Technology Co., Ltd., 2017

(1) The 24th May 2016 (Rainy season)

General condition of Nathawi canal during a surveying operation was high water level due to a beginning of rainy season. It rained before survey works causing heavy flow and red color water due to turbidity as shown in the **Table 4.3.2-1** to **Table 4.3.2-5**. Surveying results was summarized below;

1) Plankton

Surveying results for phytoplankton from 3 divisions of 28-31 types was revealed that the majority was Division Chlorophyta, followed by Division Chromophyta, and Division Cyanophyta which were 20, 11, and 4 types, respectively. Population density was around 7,810,000-11,233,120 cells/cu.m. or an averaging density of 9,267,040 cells/cu.m. For zooplankton, there were 5 phylum by which the majority was Phylum Rotifera, and Phylum Protozoa which was 4 types equally. Population density was around 20,000-21,000 cells/cu.m. or an averaging density of 20,667 cells/cu.m.

A distribution of phytoplankton in the monitoring stations was shown in the **Table 4.3.2-1**, and the **Table 4.3.2-2** which is concluded by;

(A) Nathawi canal at the distance of 1 km before the water irrigation point of the project

Analysis results revealed that there were 31 types of phytoplankton with total population density of 8,758,000 cells/cu.m. by which the majority was *Zygnema* sp., *Cosmarium* sp., *Closterium* sp., and *Navicula* sp. For zooplankton, there were 7 types with total population density of 21,000 cells/cu.m. by which the majority was *Rotaria* sp., *Anuraeopsis* sp., and *Lecane* sp.,

(B) Nathawi canal at the water irrigation point of the project

Analysis results revealed that there were 28 types of phytoplankton with total population density of 11,233,120 cells/cu.m. by which the majority was *Navicula* sp., *Zygnema* sp., *Closterium* sp., and *Cosmarium* sp. For zooplankton, there were 7 types with total population density of 21,000 cells/cu.m. by which the majority was *Lecane* sp., and *Anuraeopsis* sp., and

(C) Nathawi canal at the distance of 1 km after the water irrigation point of the project

Analysis results revealed that there were 30 types of phytoplankton with total population density of 7,810,000 cells/cu.m. by which the majority was *Navicula* sp., *Zygnema* sp.,

Cosmarium sp., and *Scenedsmus* sp. For zooplankton, there were 6 types with total population density of 20,000 cells/cu.m. by which the majority was *Rotaria* sp., and *Anuraeopsis* sp.

2) Benthos

Surveying results for benthos revealed that there was 4 types of benthos with population density of 44-36 units/sq.m. by which those benthos was consists of 3 phylum which were Phylum Annelida, Phylum Arthropoda, and Phylum Mollusca. Majority type (found from all sampling stations) is prawn which is classified to Palaemonidae family, and other majority type is shell which is classified to Corbiculidae family. Population density of those majority type was 7-15 units/sq.m. by which a diversity index of benthos was distributed around 0.88-1.00 or averaged by 0.94 which was indicating a low distribution of benthos as shown in the **Table 4.3.2-3**.

3) Aquatic plant

It was found out that there are 10 types of aquatic plant which was distributed to 7 classes. For each sampling point, there was around 6-8 types of aquatic plant located adjacent to canal bank. Those types of aquatic plant were *Crateva magna*, *Cyperus pulcherrimus*, *Cyperus pilosus*, *Minosa pigra*, *Mimosa pudica*, *Leersia hexandra*, *Brachiaria mutica*, *Eclipta mutica*, and *Rotala indica*. For floated aquatic plant, there was *Alternanthera*. Details of surveying results for aquatic plant is shown in the **Table 4.3.2-4**.

4) Fish

Surveying and sampling results for fish in the area revealed that there were 12 types of fish distributed to 5 classes by which each sampling point was found 2-9 types of fish with weight unit per area was 0.593-3.519 kg/Rai. Fish size was around 6.0-37.0 cm. Majority type of fish was *Mystacoleucus marginatus*, *Barbonymus schwanenfeldii*, *Mastacembelus armatus*, and *Barbonymus gonionotus*. Those sampling species was small fish which was caught closed to canal bank due to difficulty from aquatic plant covering, high elevation of canal bank, and high flow rate of stream from rainy season. Sampling species was ordinary types which was found widely in fresh water without risk of extinction. General types of fish found in those 3 sampling points were *Mystacoleucus marginatus*, and *Barbonymus gonionotus*. Diversity index of fish was around 0.22-1.31 which is shown in the **Table 4.3.2-5**.

(2) The 27th August 2016 (Drought season)

General condition of the Nathawi canal from those sampling area was low water level due to drought season with mild precipitation before sampling. Stream flow in the canal was low to

steady flow causing reddish color and turbidity. Sampling results were concluded by following paragraph.

1) Plankton

Surveying results for phytoplankton from 3 divisions of 20-24 types was revealed that the majority was Division Chromophyta, followed by Division Chlorophyta, and Division Cyanophyta which were 14, 10, and 4 types, respectively. Population density was around 1,398,000-2,544,000 cells/cu.m. or an averaging density of 1,961,667 cells/cu.m. For zooplankton, there were 6 phylum by which the majority was Phylum Rotifera, and Phylum Protozoa which was 4 and 3 types, respectively. Population density was around 8,000-10,000 cells/cu.m. or an averaging density of 9,333 cells/cu.m.

A distribution of phytoplankton in the monitoring stations was shown in the **Table 4.3.2-1**, and the **Table 4.3.2-2** which is concluded by;

(A) Nathawi canal at the distance of 1 km before the water irrigation point of the project

Analysis results revealed that there were 22 types of phytoplankton with total population density of 1,398,000 cells/cu.m. by which the majority was *Synedra rumpens*, *Scenedesmus* sp., and *Surirella* sp. For zooplankton, there were 7 types with total population density of 10,000 cells/cu.m. by which the majority was *Centropyxis* sp., *Lecane* sp., and *Bivalvia* Larva,

(B) Nathawi canal at the water irrigation point of the project

Analysis results revealed that there were 24 types of phytoplankton with total population density of 2,544,000 cells/cu.m. by which the majority was *Synedra rumpens*, *Navicula* sp., and *Cosmarium* sp. For zooplankton, there were 5 types with total population density of 8,000 cells/cu.m. by which the majority was *Lecane* sp., and

(C) Nathawi canal at the distance of 1 km after the water irrigation point of the project

Analysis results revealed that there were 20 types of phytoplankton with total population density of 1,943,000 cells/cu.m. by which the majority was *Synedra rumpens*, *Scenedesmus* sp., and *Surirella* sp. For zooplankton, there were 5 types with total population density of 10,000 cells/cu.m. by which the majority was *Lecane* sp., and *Chaetonotus* sp.

2) Benthos

Surveying results for benthos revealed that there was 3 types of benthos with population density of 14-51 units/sq.m. by which those benthos consist of 3 phylum which were Phylum Annelida, Phylum Arthropoda, and Phylum Mollusca. Majority type (found from all sampling stations) is prawn which is classified to Palaemonidae and Malacostraca families. Population density of the majority type was 7-15 units/sq.m. as shown in the **Table 4.3.2-3**.

3) Aquatic plant

There was found 7 types of aquatic plant which was distributed to 10 classes. For each sampling point, there was around 6-10 types of aquatic plant located adjacent to canal bank. Those types of aquatic plant were *Crateva magna*, *Cyperus pulcherrimus*, *Cyperus pilosus*, *Mimosa pigra*, *Mimosa pudica*, *Leersia hexandra*, *Brachiaria mutica*, *Eclipta mutica*, and *Rotala indica*. For floated aquatic plant, there was *Ipomoea aquatica*. Details of surveying results for aquatic plant is shown in the **Table 4.3.2-4**.

4) Fish

Surveying and sampling results for fish in the area revealed that there were 11 types of fish distributed to 3 classes by which each sampling point was found 2-9 types of fish with weight unit per area was 0.003-0.231 kg/Rai. Fish size was around 7.7-27.7 cm. Majority type of fish was *Mystacoleucus marginatus*, *Barbonymus schwanenfeldii*, *Mastacembelus armatus*, and *Barbonymus gonionotus*. Those sampling species was small fish which was caught closed to canal bank due to difficulty from aquatic plant covering, high elevation of canal bank, and high flow rate of stream from rainy season. Sampling species was ordinary types which was found widely in fresh water without risk of extinction. General types of fish found in those 3 sampling points were *Mystacoleucus marginatus*, and *Barbonymus gonionotus*. No endangered fish has been found or identified in the area during the survey. Diversity index of fish was around 0.22-1.31 which is shown in the **Table 4.3.2-5**. No endangered fish has been found/surveyed/sampled in the project area.

4.4 Human Use Values

4.4.1 Land use

(1) Land use

The study of land uses within the study area covered areas with the radius of 5 kilometers around the project. The consultant company collected data from Geography Information System (GIS), the

geography map from Department of military maps (2002) and Department of Land Development (2012), including an additional field survey. The result showed that, majority of land use within the project area are agricultural areas. There are 6 types of land use in the study areas as seen in **Figure 4.4.1-1**.

1) Agricultural area

Agricultural area is the majority type for land use which is distributed widely in the study area. Those agricultural area is paddy field, farming, and flowers farm. Agricultural activity occupy total area of 83.60 sq.km. or 88.11% of the entire study area.

2) Community and construction area

Majority type of land use is agricultural area with good connection to nearby communities. Community and construction area is around 4.63 sq.km. or 4.88 % of the entire study area.

3) Forestry area

The study area with in a radius of 5 km from the project, there is totally 1.02 sq.m. of forestry area or 1.08% of of the entire study area.

4) Water area

The study area with in a radius of 5 km from the project, there is totally 0.92 sq.m. of water area or 0.95% of of the entire study area.

5) Industrial area

The study area with in a radius of 5 km from the project, there is totally 0.16 sq.m. of industrial area or 0.17% of of the entire study area by which the industrial area is belong to the project.

6) Other area

Other area which is abandoned land is 4.56 sq.km. or 4.81% of the entire study area.

(2) Land use by the city plan

According to the ministerial regulations on the enforcement of city plan of Songkhla, 2016 announcing in the Government Gazette No.134, Section 4 on 13th January, 2016, the project location is in Tumbon Ku, Amphoe Chana, Songkhla with the land use type of rural and agricultural areas. The project as a thermal power plant is not in the category or type of plant that prohibit the operation in such area. Thus, the project location complies with the the ministerial regulations on the enforcement of city

plan of Songkhla, 2016.

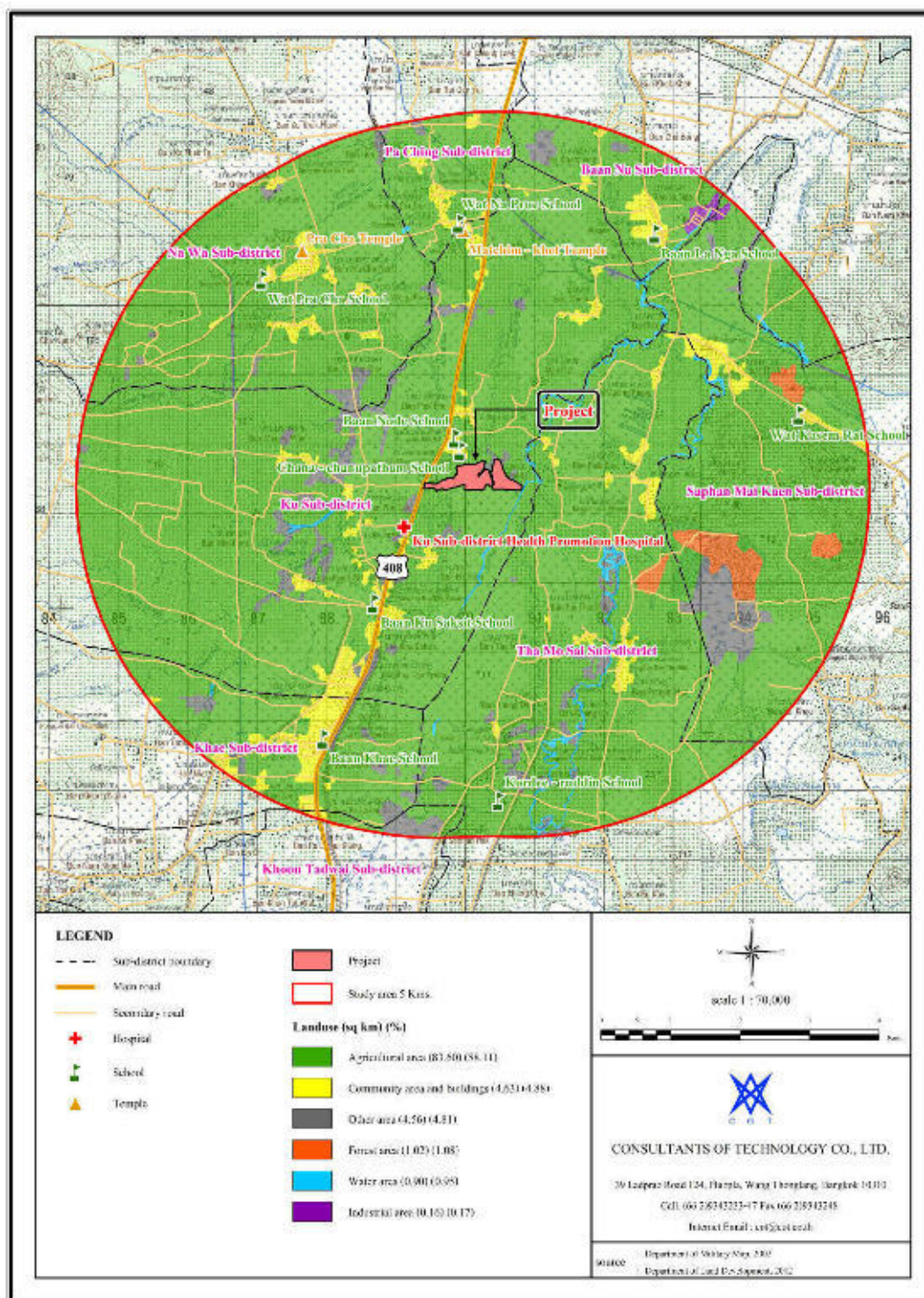


Figure 4.4.1-1 Land use

4.4.2 Transportation

(1) Transportation route

1) Southern Railway

The Southern Railway starts at the Thonburi Railway Station, Bangkok and then run through Nakhon Pathom, Ratchaburi, Phetchaburi, Prachuap Khiri Khan, Chumphon, Surat Thani, Nakhon Si Thammarat, Phatthalung, Songkhla, Yala and the final destination at Su-ngai Kolok station in Narathiwat. This railway converge with the Malaysia railway at Rantau Panjang Railway Station. The length of Southern Railway from Thonburi Railway Station until Thai-Malaysia border station at Su-ngai Kolok, Narathiwat is totally 1,144.29 kilometer. It is considered as the longest railway in Thailand.

2) Highway

From Bangkok, it must use the Highway No. 4 (Petchkasem Road) by starting at Naowa Chamnian Bridge (bridge crossing over Klong Bangkok Yai) and go through Bangkok Yai, Phasicharoen, Bangkae and Nongkhae of Bangkok. Then go through provinces locating in West and South by driving through Samut Sakhon, Nakhon Pathom, Ratchaburi, Phetchaburi, Prachuap Khiri Khan, Chumphon, and then cut through Ranong, Phang Nga, Trang, Phatthalung. The final destination will be Sadao Permanent border, Amphoe Sadao, Songkhla. This border is link to Bukit Kayu Hitam City, Kedah in Malaysia. Highway No. 4 has the length of 1,277.512 kilometers in total.

3) Airway

Hatyai International Airport or Hatyai Airport is located in Tunbon Khlong Lha, Amphoe Khlong Hoi Khong, Songkhla. It is 13.7 kilometers away from Amphoe Hatyai and 61.8 kilometers away from Amphoe Chana. Hatyai Airport is important as it is an exit gate for Muslims who would like to go on pilgrimage at Makkah, Saudi Arabia. Hatyai International Airport are the 6th largest flight of the country. This airport can accommodate the increasing of air traffic volume and passengers until 2025. Currently, there are totally 6 airlines operating on the domestic route Bangkok-Hatyai.

(2) Traffic density

The consultant company collected the statistical data on Average Annual Daily Traffic, (AADT) from the Bureau of Highway Safety, Department of Highways during 2012-2016 on the Highway No.43 (Na Mom-Chana) and Highway No.408 (Na Thawi- Dan Prakop). There are 12 categories of vehicles. Volumes of each vehicle category were then calculated into PCU unit (Passenger Car Unit) by using Passenger Car Equivalents (PCE) of each vehicle category. The conclusion are as follows.

1) Bi+Tri cycle	=	0.25	PCU
2) Motorcycle	=	0.33	PCU
3) Passenger car < 7 person	=	1.0	PCU
4) Passenger car > 7 person	=	1.0	PCU
5) Light bus	=	1.5	PCU
6) Medium bus	=	1.5	PCU
7) Heavy bus	=	2.1	PCU
8) Light truck or pick up	=	1.0	PCU
9) Medium truck	=	2.1	PCU
10) Heavy truck	=	2.5	PCU
11) Full trailer	=	2.5	PCU
12) Semi trailer	=	2.5	PCU

Then the calculation of traffic density can be done by using following formular.

$$D = \frac{AADT}{24 \times N \times L}$$

When AADT = Average Annual Daily Traffic, throughout the year
(Passenger Car Equivalents)

N = Numbers of traffic channels

L = Distance (kilometer)

There were 2 types of the traffic volume survey were done, an average traffic volume survey per day and the traffic volume survey during in and out of rush hour. This can be seen in **Table4.4.2-1** to **Table4.4.2-2**.

Table 4.4.2-1**V/C on Highways NO. 408 (in front of project area)****Sunday 1 May 2015 (Vacation)**

Type of vehicles	PCU Factor	Peak hour (Morning)		Daily traffic		Peak hour (Afternoon)	
		car/hr	PCU/hr	car/hr	PCU/hr	car/hr	PCU/hr
1 Bicycle 2 wheel and 3 wheel/ Motorcycle	0.333	212	70.60	236	78.59	242	80.59
2 Car < 7 P	1	133	133.00	136	136.00	341	341.00
3 Car > 7 P	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
Total		624	506.00	694	557.19	1,008	858.49
V/C Ratio		0.28		0.31		0.45	

Source : Consultant of Technology Co., Ltd., 2016

Table 4.4.2-2

V/C on Highways NO. 408 (in front of project area)

Wednesday 4 May 2015

Type of vehicles	PCU Factor	Peak hour (Morning)		Daily traffic		Peak hour (Afternoon)	
		car/hr	PCU/hr	car/hr	PCU/hr	car/hr	PCU/hr
1 Bicycle 2 wheel and 3 wheel/ Motorcycle	0.333	304	101.23	291	96.90	437	145.52
2 Car < 7 P	1	285	285.00	230	230.00	349	349.00
3 Car > 7 P	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
Total		1,081	920.53	911	775.60	1,237	999.12
V/C Ratio		0.50		0.44		0.57	

Source : Consultant of Technology Co., Ltd., 2016

4.4.4 Water consumption

From the study of water consumption in the study area, it can be separated into 3 categories; household water consumption, agricultural water consumption and finally industrial water consumption, with following details.

(1) Utilization of water for household consumption

In the study area, tap water is mainly used for household utilization. It is under the responsibility of the Provincial Waterworks Authority of Na Thawi within 16 sq.km. Raw water comes from Klong Na Thawi, Klong U-Tapao (Tha pho) and groundwater well. Currently, there are totally 4,286 customers of tap water. The production capacity of tap water is 6,000 m³/days which producing 115,033 m³ of tap water. It is then distributed for 68,450 m³. For water for utilization, consumers mostly use bottled/ tank drinking water. Some of them use rainwater or tap water.

For the potential service of NA Thawi Provincial Waterworks Authority, there are 4 water distribution points and service units which consist of following units; Na Thawi Municipality Service, Phang La Municipality Service, Chana Municipality Service and Phatong Municipality Service. These services cover areas of Na Thawi, Sadao, Chana and Hat Yai, Songkhla.

(2) Water consumption for agriculture

The study area mainly uses water from Klong Na Thawi. Klong Na Thawi has been developed for the maximum benefit of agriculture due to it has high quantity of water. Moreover, the characteristic of Na Thawi basin is a hill plain with the slope within the area from South to North. There are many river branches flow to Klong Na Thawi and continually flow through Amphoe Na Thawi and Amphoe Chana. After that, it splits into 2 canals at Tumbon Ban Na and then flow to The Gulf of Thailand at Bak Bang Na Thap (Klong Na Thap), Tumbon Na Thap and Baan Pak Bang Chana (Klong Nam Kem) Tumbon Sa Kom, Tumbon Na Thap, Chana, Songkhla. The total length of Klong Na Thawi is approximately 80 kilometers. From the geography, this basin area has high volumes of rainwater during the rain season. (Reference: Water Management Plan of Songkhla Irrigation Project, 2017).

4.4.5 Electrical consumption

Amphoe Chana is in the responsibility of Provincial Electricity Authority, Chana District. The Provincial Electricity Authority, Chana District is responsible for an electricital distribution in Amphoe Chana, Amphoe Na Thawi, Amphoe Thepha and Amphoe Saba Yoi. There is one sub station, Saba Yoi Power Station. Provincial Electricity Authority, Chana District has the maximum capacity of 100 MW, distributing to 2 transformers. The maximum output of each transformer is 50 MW. Saba Yoi Power Station has the maximum capacity of 100 MW for the electrical distribution.

Saba Yoi Power Station also distribute electricity through 2 transformers with the maximum output of 50 MW of each transformer as well.

4.4.6 Solid waste management

The study area is in the responsibility of 8 SAOs within Amphoe Chana. They are Ku SAO, Tha Mo Sai SAO, Sapan Mai Kaen SAO, Nawa SAO, Khae SAO, Paching SAO, Khoon Tadwai SAO and Baan Na SAO.

There are 2 local authorities with potential for waste management, Ban Na Municipal district and Sapan Mai Kaen SAO. For other local authorities in the study area such as Ku SAO, Tha Mo Sai SAO, Nawa SAO, Khae SAO, Paching SAO, Khoon Tadwai SAO, they are insufficient potentiality for solid waste management. Therefore, the solid waste disposal is in the responsibility of people living in that area. Most of them manage solid waste by outdoor combustion and landfill within their areas.

4.4.7 Drainage and flood prevention

The study area locates in Tumbon Ku, which has the topography as a basin with many rivers and canals, water flow throughout the year. The soil condition in the study area is in Ruso and Klaeng series. Ruso series has bad water drainage with slowly flow of surface runoff. The characteristic of the soil is a deep soil with coarse loamy sand as the top soil. For Klaeng series, there is bad water drainage, slowly flow of surface runoff and slow water soak through soil. The characteristic of the soil is a deep fine clay with loam, clay loam or silty clay loam as a top soil texture. In case of flooding, the main reason could come from continually rainfall with the difficulty of water drainage from community and water storage areas. Moreover, villages in the area do not have an efficient drainage system, therefore, flooding could occurs.

To investigate the flood problem in the surrounding area of the project, the consultant company then established the project area map that overlapping with the repeated flooding area for the past 10 years (2005-2015) and the map of flooding areas for each year, in 2011 and 2015 as seen in **Figure 4.4.7-1** to **Figure 4.4.7-3**. The result showed that the project area is not located in any repeated flooding areas due to there was no problem on an internal flooding. However, with the radius of 5 kilometers around the project area, the result showed that, some areas of Tumbon Sapan Mai Kaen and Tumbon Ku were in the repeated flooding areas. With the consideration of the worst and severe flooding in 2011, flooding occurred around plain areas and some of the study area were included.

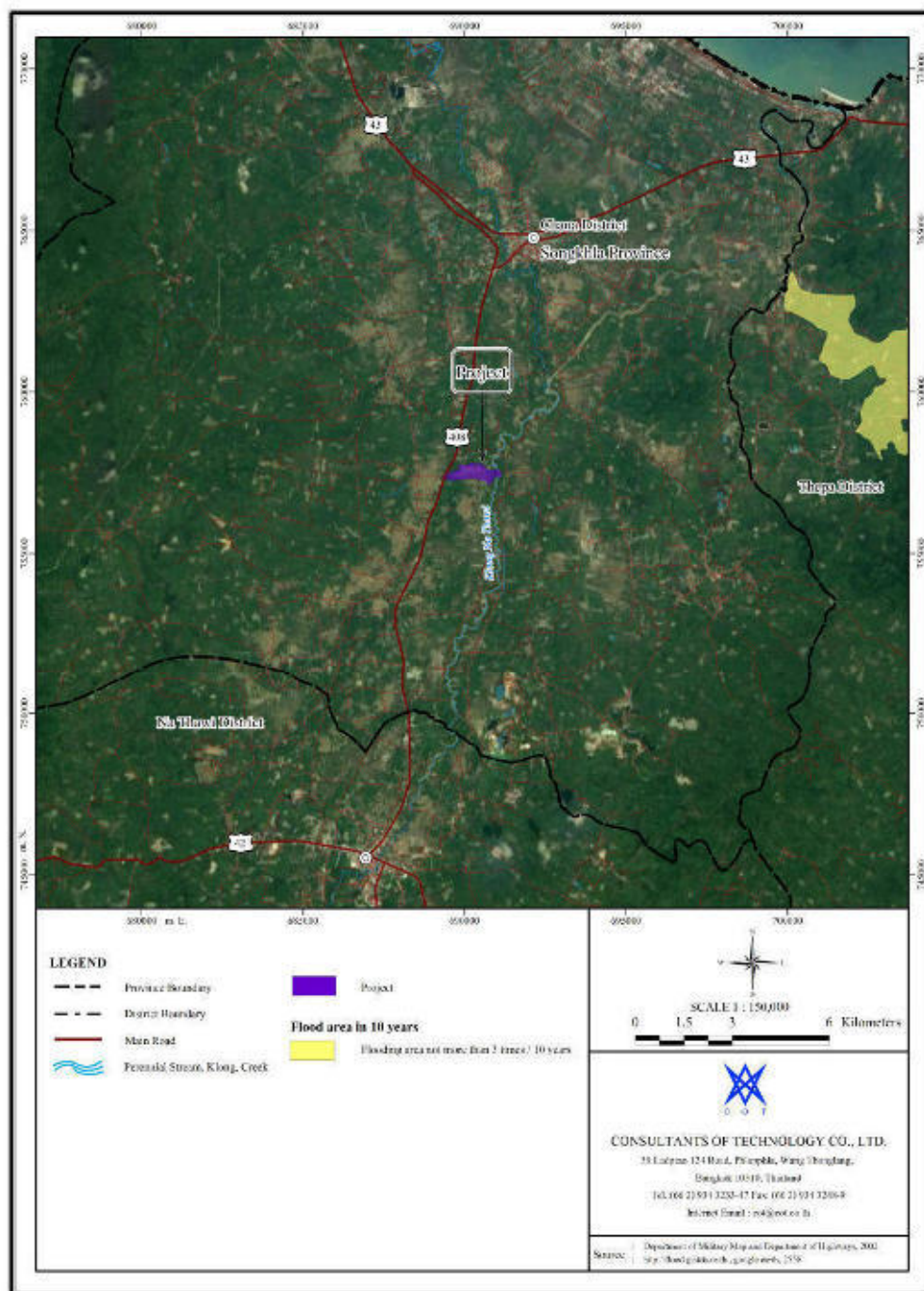


Figure 4.4.7-1 Flooding area for the past 10 years (2005-2015)

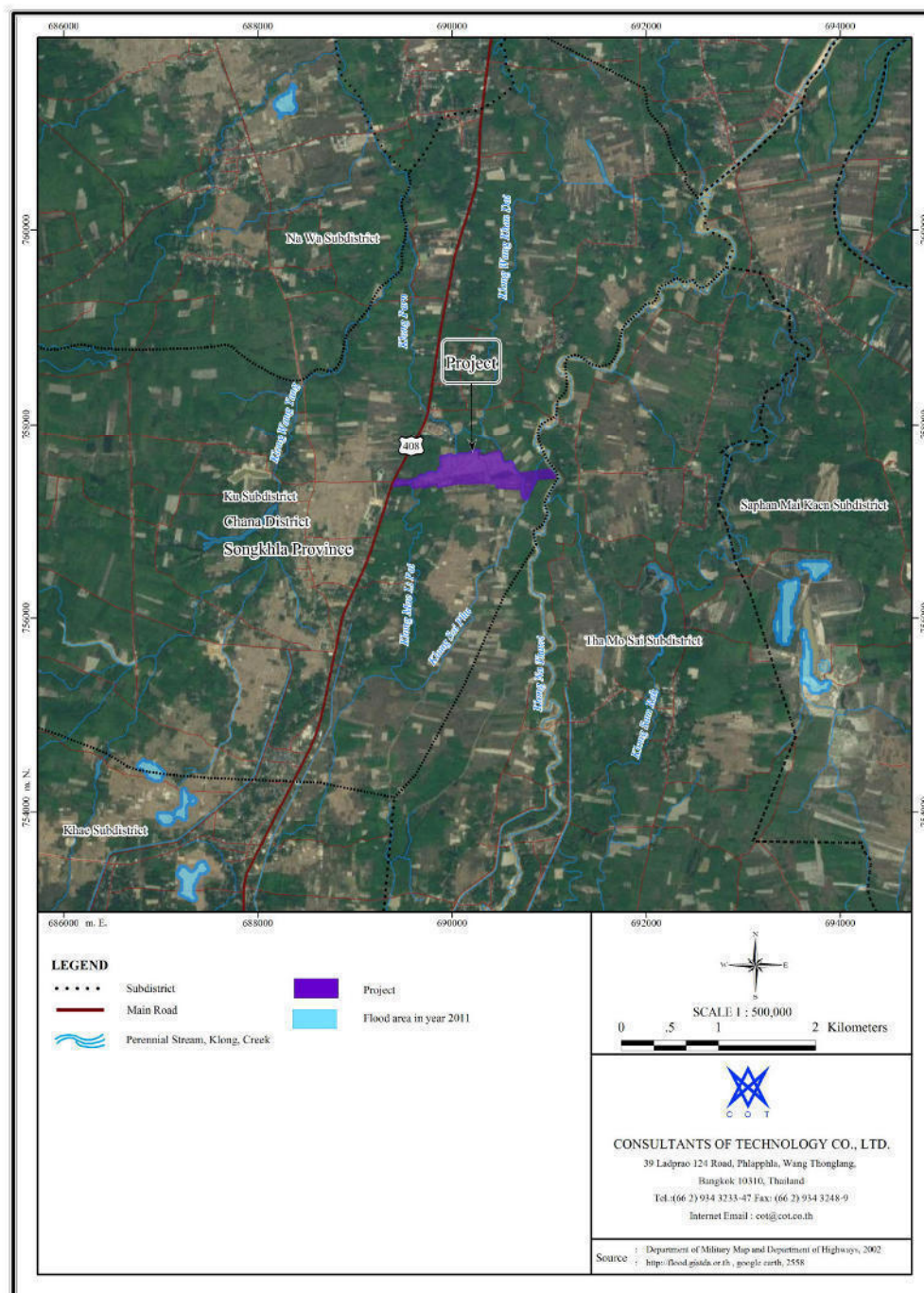


Figure 4.4.7-2 Flooding area in year 2001

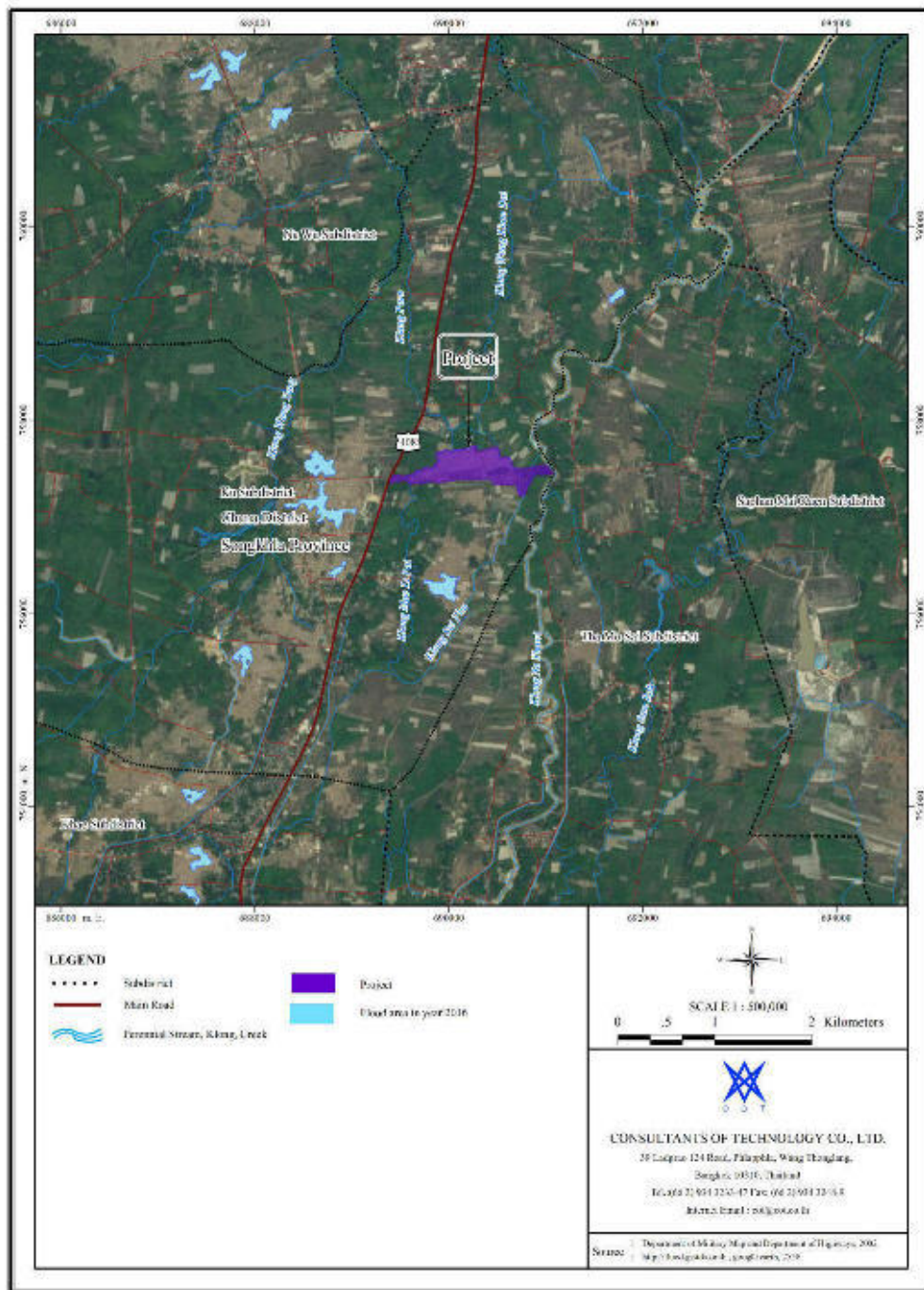


Figure 4.4.7-3 Flooding area in year 2016

4.5 Quality of Life Values

4.5.1 Socio-economic condition

The consulting company had studied socio-economic condition for evaluation of quality of life values for provincial, district, and subdistrict levels of the study area. The studying was conducted by collecting secondary data from related governmental organizations especially local administrative organizations in the study area, and field surveying from villagers using questionnaire including opinion surveying about the project from local governmental organizations. The surveying was combined together for analyzing related condition to project operation with multi perception from those stakeholders.

With the radius of 5 kilometers from the study area locates in Amphoe Chana, Songkhla and its consists of Ban Na Municipal district, Ku SAO, Paching SAO, Sapan Mai Kaen SAO, Khae SAO, Tha Mo Sai SAO, Nawa SAO and Khoon Tadvai SAO as seen in **Figure 4.5.1 -1**. In conclusion, the area consists of one Municipal district, 7 SAOs, 34 villages and the study area has 310.55 sq.km., with details shown in **Table 4.5.1-1**.

Table 4.5.1-1

People living in the location of the project

Table 4.5.1-1 (Cont')

Province	District	Administrative Region	The Study Aea		Village
			Square kilometre	Percent	Radius 3-5 Km.
Songkhla	Chana	Baan Na Municipality	41.41	13.33	Moo7, Baan La Nga Moo9, Baan Nam Khem
		Ku Subdistrict Administrative Organization (SAO)	23.27	7.49	Moo 1, Baan Khu Ton Pradu Moo 2, Baan Phodang Moo 3, Baan Na Yam (location of the project) Moo 4, Baan Khu Saksit Moo 5, Baan Khu Moo 6, Baan Thung Moo7, Baan Moo8, Baan Na Prue Moo9, Baan Plak Pho

Table 4.5.1-1 (Cont')

Province	District	Administrative Region	The Study Aea		Village
			Square kilometre	Percent	Radius 3-5 Km.
		Pa Ching SAO	25.00	8.05	Moo8, Baan Huadinnuea Moo9, Baan Huadintai
		Saphan Mai Kaen SAO	42.00	13.52	Moo3, Baan Tha Lo Moo5, Baan Sai Khao Moo6, Baan Kasemrat
		Khae SAO	40.12	12.92	Moo1, Baan Khok Yang Moo2, Baan Khae Nuea Moo3, Baan Khae Tai Moo4, Baan Niat
		Tha Mo Sai SAO	55.48	17.87	Moo1, Baan Tha Mo Sai Moo2, Baan Rai Tha Mak Moo3, Baan Phong Ngu Moo5, Baan Thung Che Moo8, Baan Phraeo Moo9, Baan Saphan Hak Moo10, Baan Wang Han
		Na Wa SAO	63.19	20.35	Moo3, Baan Kothaktai Moo4, Baan Khlong Bon Moo5, Baan Prachanuea Moo6, Baan Prachatai Moo7, Baan Na Nai
		Khun Tat Wai SAO	20.08	6.47	Moo2, Baan Pa Lamai Klang Moo4, Baan Pa La Mai Ok
Sum	1 District	1 Municipality 7 SAO	310.55	100.00	34 Villages

Source : Consultant of Technology Co., Ltd., 2017

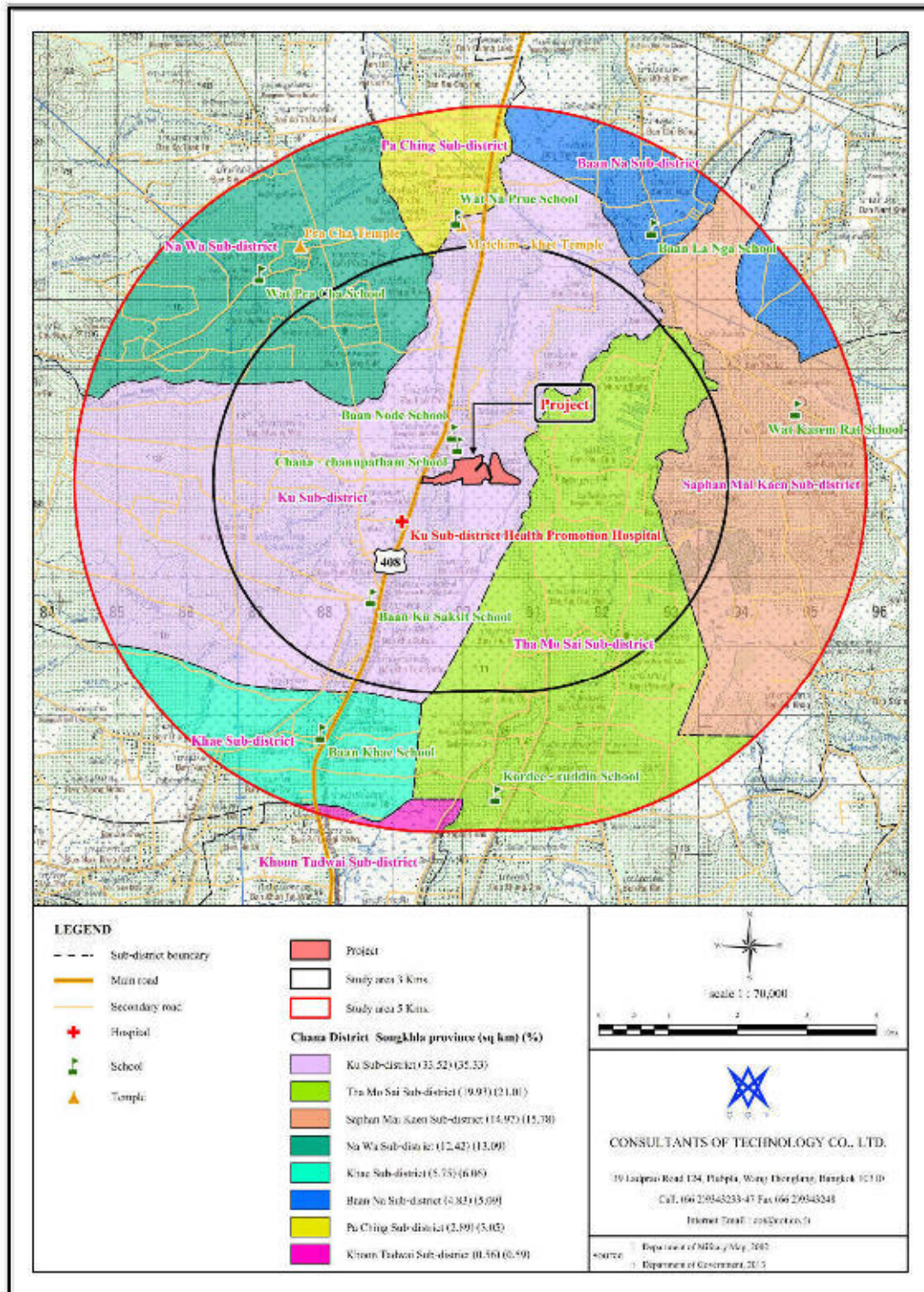


Figure 4.5.1-1 Study area for socio-economic (5 kilometers radius from project site)

4.5.1.2 Socio-economic condition for district level

The study area is covering some part of Chana district in Songkhla by which socio-economic was described by;

(1) Location and boundary of Chana

Chana is a which is assigned as danger area of the deep south of Thailand. The district is located in the south of Songkhla which is occupy an area of 502.98 sq.km. Those neighboring areas (**Figure 4.5.1.2-1**) are;

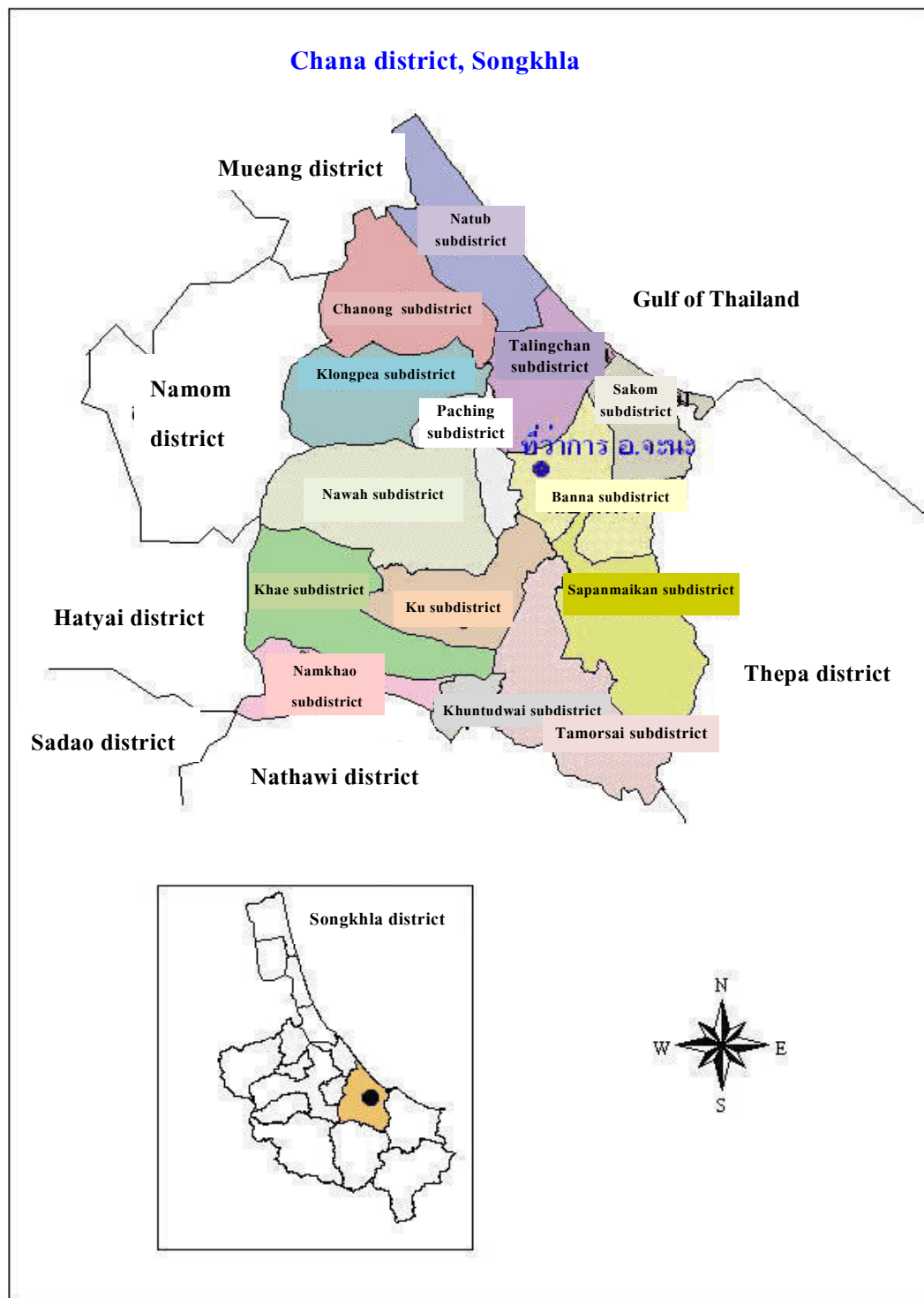
North adjacent to Mueang district and the Gulf of Thailand,
 East adjacent to the Gulf of Thailand, and Thepa district,
 South adjacent to Nathawi and Sadao districts, and
 West adjacent to Hatyai and Namom districts.

(2) Administration of Chana

Local administration for Chana is classified to 14 subdistrict administration organizations, 194 villages by which Banna subdistrict administration organization contains 10 villages, Paching subdistrict administration organization contains 9 villages, Sapanmaikan subdistrict administration organization contains 8 villages, Sakom subdistrict administration organization contains 9 villages, Nawah subdistrict administration organization contains 12 villages, Natub subdistrict administration organization contains 14 villages, Numkhao subdistrict administration organization contains 11 villages, Khuntudwai subdistrict administration organization contains 9 villages, Tamorsai subdistrict administration organization contains 11 villages, Chanong subdistrict administration organization contains 11 villages, Ku subdistrict administration organization contains 9 villages, Khae subdistrict administration organization contains 7 villages, Klongpea subdistrict administration organization contains 10 villages, Talingchan subdistrict administration organization contains 8 villages, and local administration includes 3 municipalities (Chana, Banna, and Natub).

The study area covering some part of Chana by;

- (a) Banna municipality (covering some area)
- (b) Ku subdistrict administration organization (covering entire area)
- (c) Paching subdistrict administration organization (covering some area)
- (d) Sapanmaikan subdistrict administration organization (covering some area)
- (e) Khae subdistrict administration organization (covering some area)



Source: Copy from <https://sites.google.com/site/tangintravel/tips-trick>

Figure 4.5.1.2-1 Map of Chana

- (f) Tamorsai subdistrict administration organization (covering some area)
- (g) Nawah subdistrict administration organization (covering some area)
- (h) Khuntudwai subdistrict administration organization (covering some area)

(3) Population of Chana

Data obtained from the Department of Provincial Administration, the Ministry of Interior in B.E. 2558 was found that total population of Chana was 98,090 capita which was male population of 48,617 capita, and female population of 49,473 capita. Population density was 13.27 capita/sq.km. Population statistic during B.E. 2548-2558 obtained from the Department of Provincial Administration, the Ministry of Interior was showing increasing trend for a decade which was indicating population expansion. While population changing rate was decreasing during B.E. 2549-2550, and increasing again during B.E. 2550-2551. An interested data in B.E. 2555 was the highest population changing rate in a decade which was 1.63%, nevertheless; in B.E. 2558 was the lowest population changing rate which was 0.86%. Therefore, population was changing continuously over a decade in Chana district.

(5) Economic condition of Chana

Economic structure of Chana is mostly depend on agricultural sector by which importance agricultural activities are rubber plantation (main income for the area), fishery (micro scale), fruit farming (durian, longkong, rambutan, and orange), livestock such as cow, zebra dove (large farming which is making a large income from zebra dove competition), and many of industrial activities to provide occupational alternative for local people.

(a) Industrial sector: There are 165 factories in Chana by which Chanong subdistrict has 35 factories which is the highest factory number in Chana, Banna subdistrict has 33 factories, and Khuntudwai has the lowest factory number which is 3 factories. Majority of factories are gravel and sand mining, rice mill, and rubber transformation factory, respectively.

(b) Tourism: Chana has potential to be natural and ecological, and cultural tourism destination. Those attractive places are Lanhoiseab, Bortao waterfall, Kuantong Pagoda, Khaoreng animal conservation forest, Keak-keao Buddha footprint, Old Taklong Mosk, and Chanong ferry tour.

(6) Facilities of Chana

1) Transportation

Land transportation could be made by car and train. For car, there is highway no.43 (Asia Route) which is the main route to the area made for 4 lanes to connect to deep south area of Thailand. For train, there are 2 railway stations which are Chana railway station (located at Banna subdistrict), and Kuanmeed (located at kuanmeed subdistrict)

2) Facilities

Chana has fire fighter stations in a high population density area, and Chana also has subdistrict health promotion hospital distributed to all subdistricts. However, police stations are not served to all subdistricts while public parks are still inadequate to support community activity (sources; Chana city planning project, Civil Office of Songkhla, B.E. 2559).

(7) Religion, culture, and tradition of Chana

Chana has 22 Buddhism Temples, and 2 monk shelters while most of population (90%) is muslim, and minority (10%) is Buddhism.

Religion tradition, culture, and local tradition of the district is similar to Songkhla which are;

- Islamic lent period (1 month),
- Sunat tradition for a completely receive of Islam,
- Hudji for preparing to be muslim,
- Maolid for celebration to birthday of Nabimuhummud,
- Bunor-zukor tradition,
- Buddihsn tradition for the 10th Month,
- Buddihsn celebration for the ending of Buddihsn lent period (11th Month),

and

- Loykratong festival, newyear festival, Chinese newyear festival, and Songkran festival.

4.5.1.3 Socio-economic of the local area in the study area

For socio-economic condition of Ku SAO as the project location can be concluded as follows.

(1) Location and boundary

Ku subdistrict administration organization is located 10 km far from Chana district which is covering an area of 23.27 sq.km. or 14,543 Rai. Surrounding area are;

North adjacent to Banna and Paching subdistrict,
 South adjacent to Khae subdistrict,
 East adjacent to Tamorsai subdistrict, and
 West adjacent to Nawah subdistrict.

(2) Administration

Ku subdistrict administration organization has divided administration to 9 villages which are;

Moo 1	Ban ku-pladoo	Moo 6	Ban Tung
Moo 2	Ban Pordang	Moo 7	Ban Node
Moo 3	Ban Nayum	Moo 8	Ban Naprue
Moo 4	Ban Ku-prasit	Moo 9	Ban Plugpor
Moo 5	Ban Ku		

All of those 9 villages are located inside the study area.

(3) History of Ku subdistrict administration organization

Ku subdistrict or Ku-kai is a small village since Ayuthaya period which is called “Ban Saksit (Holy village)”. The village was served as a camping place for Ancient Chana Leader (Wangto) when travelling to Songkhla. Once upon a time, Chana city was menaced by Malayu thief army, and Ancient Chana Leader could not strike back. So, he decided to move to Ban Saksit. The leader considered that Ban Saksit was a good place to make a barrack for fighting to the enemy. Then, he build an army barrack (called Ban Kai) to fight with the Malayu thief army which is currently appear as a rubber farm behind Ku subdistrict administration organization. Finally, Songkhla governmental army had helped Chana army to fight to those thief army and received victory over the war which was turn the area to historical place.

After the ending of the war, there was an evidence of war canal from that time till now (the war canal is located behind Ku subdistrict administration organization in the west direction which is around 200 m far from the office). There is an urban legend about golden containers secured by Tohyong who was asked to take care the property of the Malayu thief. Local peoples believe that during rainy season, a pair of golden containers are float over the canal, but nobody can touch them.

“Tohyong” is believed as a sanctified person who can transfer to white dragon to warn traveler for respecting the place. Therefore, shadow play, and traditional showing groups must give their respect to the place for 1 night before going anywhere nearby the holy place which is later called a name of a village “Ban Ku-prasit” (one of a village in Ku subdistrict).

Currently, peoples are not respect to “Tohyong”, but elderly peoples still give their respect to the place. It was told that in a full moon night, a holy fire ball is rising to the place and fade away. Thus, those gamblers have to ask for luck from “Tohyong”. (Source: general information of Ku subdistrict administration organization, searched by August 2559)

(4) Population size

Referring to the Department of Provincial Administration Ministry of the Interior, 2015 (searching on August 2016), the population of Ku SAO in 2015 was 6,479 persons in total. There were 3,214 males and 3,265 females with 1,561 households. The density of the population was 0.88 person/sq.km. The population change rate was 1.06%. During the past 10 years (2005-2015), there was a continually increasing of population, therefore, the population trends will increase.

(5) Economy and occupation

Majority of Ku population have occupations in agriculture such as rubber plantation, peddy fields, animal husbandry for both private and group. Moreover, some population are employee in the industry. Product of this Tumbom is Muslim hair scarf.

Based on economic crops and animal husbandry of Chana istrict Agriculture Office, the result showed that, Tumbon Ku has an agricultural areas of 12,395 rais. Majority of them are rubber areas for 8,750 rais, then peddy fields for 3,375 rais, fruit areas for 173 rais and standing timber areas for 97 rais. For the animal husbandary, the result showed that there are 848 cows, 380 goats, 5,980 chicken, 320 ducks and 55 wells of fishery.

(6) Basic infrastructure

1) Transportation

Routes to Ku subdistrict are mostly soil pavement which consists of 74 roads, and some are concrete roads (53 routes), and asphaltic roads (20 routes). There are 11 concrete bridges (Sources: Data information system of subdistrict organization center, the Department of Local Administration, B.E. 2559).

2) Electricity

Ku subdistrict is located under electricity serviced by the Chana Electricity Office, the Provincial Electricity Authority by which electricity is supplied to all families in the area (Source: Data information system of subdistrict organization center, the Department of Local Administration, B.E. 2559)

3) Tap water

Tap water is provided to all 1,574 families. (Source: Data information system of subdistrict organization center, the Department of Local Administration, B.E. 2559)

4) Fresh water

Natural fresh water of the Ku subdistrict such as canal/pond/reservoir are 15 units by which some water irrigation system are served for the area (7 units), and 152 ground water wells (Source: Data information system of subdistrict organization center, the Department of Local Administration, B.E. 2559)

5) Natural resources and environment

Majority of the area is flat terrain with canals which is not water inadequate over a year by which the area is consists of eluvial and flat terrains (Source: Analyzed by consultant from GIS database of villages, water shading area, and forestry area, B.E. 2560).

(7) Education

Ku subdistrict administration organization has 7 primary school as shown in the **Table 4.5.1.3-10**.

Table 4.5.1.3-10**Primary school in Ku subdistrict administration organization**

<i>No.</i>	<i>Name</i>	<i>Level</i>	<i>Location</i>
1	Child training center of the Mosk Ban ku-pladoo	Kindergarten	Moo 1 Ban ku-pladoo
2	Child training center of Rohmah Mosk	Kindergarten	Moo 2 Ban Pordang
3	Child training center of Ban Tung Mosk	Kindergarten	Moo 6 Ban Tung
4	Ban Ku-prasit School	Primary school	Moo 4 Ban Ku-prasit
5	Wat Naprue School	Primary school	Moo 8 Ban Naprue
6	Ban Node School	Primary school	Moo 9 Ban Plugpor
7	Chana-chanupatham School	Secondary school	Moo 3 Ban Nayum

Source : General information of Ku subdistrict administration organization, searched by August B.E.

2559

(8) Religion

Ku Population are 90 % Islam and then Buddhist. Ku SAO has one temple, 6 Mosques and 13 Balishans.

(9) Culture and tradition

Religious ceremony, culture and traditional activity of Tumbon Ku are as follows.

- Fasting Traditions in Ramadan for one month;
- Male Circumcision for the complete of Islamic religion;
- Hajj, this will be done when it is capable and ready;
- The Prophet's birthday as The Prophet Muhammad's birthday;
- Bunosuko;
- Buddhist Ghost Festival on the tenth month of each year;
- Robes Offering Ceremony in October;
- Loy Krathong Day, New Year's Day, Chinese New Year's Day, Songkran Festival.

4.5.1.4 Socio-economic and opinion surveying from the study area

(1) Surveying method

1) Scoping area for the study

Socio-economic and opinion surveying from the study area was conducted by the consultant over a radius of 5 km from the project which is called “study area” for covering some area of those 8 subdistricts which were Banna Subdistrict Minicipal, Ku subdistrict administration organization, Paching subdistrict administration organization, Sapanmaikan subdistrict administration organization, Khae subdistrict administration organization, Tamorsai subdistrict administration organization, Nawah subdistrict administration organization, and Khuntudwai subdistrict administration organization as shown in the **Table 4.5.1-1**.

The study was classified to 2 sub areas according to risk of impact from project operation which was a radius of 0-3 km around the project area, and a radius of 3-5 km around the project area as shown in the **Figure 4.5.1.4-1**. However, those villages in a radius of 5 km were 34 villages categorized by distance as follows.

(A) Surrounding area in a radius of 0-3 km from the project area

Surrounding area in a radius of 0-3 km from the project area is a high risk area due to project operation. Those high risk area covers 17 villages which are 9 villages located inside Ku subdistrict administration organization, 1 village located inside Sapanmaikan subdistrict administration organization, 5 villages located inside Tamorsai subdistrict administration organization, and 2 villages located inside Nawah subdistrict administration organization as shown in the **Table 4.5.1.4-1**.

(B) Surrounding area in a radius of 3-5 km from the project area

Surrounding area in a radius of 3-5 km from the project area is a lower risk area than the first high risk area. The low risk area covers 17 villages from which 2 villages are located inside Banna subdistrict municipal, 2 villages located inside Paching subdistrict administration organization, 2 village located inside Sapanmaikan subdistrict administration organization, 4 village located inside Khae subdistrict administration organization, 2 villages located inside Tamorsai subdistrict administration organization, 3 villages located inside Nawah subdistrict administration organization, and 2 villages located inside Khuntudwai subdistrict administration organization as shown in the **Table 4.5.1.4-1**.

Table 4.5.1.4-1**Villages in the study area classified by distance from the project area**

Study area	Province	District	Administration	Village	
1. Radius 0-3 km	Songkhla	Chana	Ku SAO.	Moo 1 Ban Ku-Tonpladoo	
				Moo 2 Ban Pordang	
				Moo 3 Ban Nayum	
				Moo 4 Ban Ku-prasit	
				Moo 5 Ban Ku	
				Moo 6 Ban Tung	
				Moo 7 Ban Node	
1. Radius 0-3 km	Songkhla	Chana	Ku SAO.	Moo 8 Ban Naprue	
				Moo 9 Ban Plugpor	
				Sapanmaikan SAO.	Moo 5 Ban saikhao
				Tamorsai SAO.	Moo 1 Ban Tamorsai
					Moo 2 Ban Rai-tamak
					Moo 3 Ban Prong-ngoo
					Moo 8 Ban Praw
1. Radius 0-3 km	Songkhla	Chana	Ku SAO.	Moo 10 Ban Wanghan	
				Nawah SAO.	Moo 3 Ban kohtaktai
					Moo 4 Ban Klongbon
				Total villages in a Radius of 0-3 km	
2. Radius 3-5 km	Songkhla	Chana	Banna SM.	Moo 7 Ban Langa	
				Moo 9 Ban Numkhem	
			Paching SAO.	Moo 8 Ban Huadinnuea	
				Moo 9 Ban Huadintai	
			Sapanmaikan SAO.	Moo 3 Ban Talor	
				Moo 6 Ban Kasemrat	
			Khae SAO.	Moo 1 Ban kokyang	
				Moo 2 Ban Khaenuea	
				Moo 3 Ban Khaetai	
Moo 4 Ban Nead					
2. Radius 3-5 km	Songkhla	Chana	SAO.Tamorsai	Moo 5 Ban Tung-jae	
				Moo 9 Ban Sapanhug	

Study area	Province	District	Administration	Village	
			Nawah SAO.	Moo 5 Ban Prajanuea Moo 6 Ban Prajatai Moo 7 Ban Nanai	
			Khuntudwai SAO.	Moo 2 Ban Palamaiklang Moo 4 Ban Palamai-oak	
			Total villages in a Radius of 3-5 km		17 villages
			Total villages in the study area		34 villages

Source: Consultant of Technology Co.ltd., 2559

2) Population and sampling of the study

(A) Governmental and religion leader group

Further than those community leaders and families, the study had surveyed other stakeholder groups which include (1) Environmental and inspection section (2) Health service section (3) Facility and social service section (4) Administration section (5) Agricultural section (6) Educational section and (7) Religion and faith section. The surveying was conducted by sending questionnaires to those target groups to get opinion about the project from 38 organizations (38 sampling groups) as shown in the **Table 4.5.2-2**.

Table 4.5.2-2

Position and operation period for those target organizations

Government Organization	Position	Operation period (year)
(1) Environmental and inspection section		
1) Energy Regulatory Commission Office Region 12	Academic officer	4
2) Environment Office Region 16	Environmental specialist	16
3) Songkhla Natural Resources and Environment Office	Environmental specialist	14
4) Songkhla Energy Office	Professional energy officer	4
(2) Health service section		

Government Organization	Position	Operation period (year)
1) Songkhla Public Health Office	Professional health officer	16
2) Chana Public Health Office	Chana Public health officer	2
3) Subdistrict Health Promotion Hospital Khae	Professional health officer	14
4) Subdistrict Health Promotion Hospital Tamorsai	Director of Subdistrict Health Promotion Hospital	3
5) Subdistrict Health Promotion Hospital Sapanmaikan	Practical health officer	1
6) Subdistrict Health Promotion Hospital Khuntudwai	Health station leader	19
7) Subdistrict Health Promotion Hospital Nawah	Professional health officer	4
(3) Facility and social service section		
1) Songkhla Civil and City Plan Office	Drafting officer Chor.3	19
(4) Administration section		
1) Songkhla Administration Office	Policy and planning officer	8
2) Songkhla labor welfare and protection office	Labor professional officer	3
3) Chana Police Station	Crime prevention officer	2
4) Ku subdistrict administration organization	Administrator SAO.	2
5) Sapanmaikan subdistrict administration organization	Policy and planning officer	13
6) subdistrict administration organization Khae	Administrator SAO.	4
7) Tamorsai subdistrict administration organization	Lawyer	2
8) Nawah subdistrict administration organization	Professional Lawyer	12
9) Khuntudwai subdistrict administration organization	Leader of secretary office	12
(5) Agricultural section		
1) Songkhla Agricultural Office	General administration	1

Government Organization	Position	Operation period (year)
2) Water irrigation project Songkhla	Leader of maintenance region 4	6
3) Chana Agricultural Office	Agricultural promotion specialist	21
(6) Educational section		
1) Koh Tak School	Director	7
2) Ban Khae School	Director	27
3) Naprue School	Teacher	35
4) Langa School	Director	5
5) Ban Node School	Director	4
6) Ban Ku-prasit School	Director	4
7) Prince of Songkhla University	Deputy Dean	6
(7) Religion and faith section		
1) Tamorsai Mosque	Toh E-mam	1
2) Ban Nanai Mosque	Toh E-mam	22
3) Mawai Mosque	Toh E-mam	20
4) Ban Saimak Mosque	Toh E-mam	10
5) Sa-nga Mosque	Toh E-mam	10
6) Kamaleeyah Mosque	Toh E-mam	10
7) Ban Nayum Mosque	Toh E-mam	34
Total 38 Organizationofs	38 Samples	

(B) Community leaders

Community leaders as representatives of local peoples by were chosen the 5 km radius of 5 km from the project area. The sampling was conducted by using Purposive Sampling Method (direct interviewing). Those community leaders are village headmen, village leaders, member of the subdistrict administration organization, and village public health volunteers. There were 84 answers from the surveying while some community leaders cannot gave answers due to personal reason. Detail of position and duration of working are shown in the **Table 4.5.1.4-2.**

Table 4.5.1.4-2

Position and working duration of community leaders

Administration	Community	Position	Working duration (year)
Risk area (community in a radius of 0-3 km around the project)			
Ku SAO.	Moo 2 Ban Pordang	Village headman	
		Assistant village leader	4
		Village public health	4
		volunteer	13
	Moo 3 Ban Nayum	Assistant village leader	
		Village public health	4
		volunteer	20
		Not mentioned	4
	Moo 5 Ban Ku	Assistant village leader	23
		Village public health	30
		volunteer	23
		Not mentioned	
	Moo 6 Ban Tung	Assistant village leader	3
		Village public health	13
		volunteer	3
		Not mentioned	
	Moo 7 Ban Node	Village leader	12
		Assistant village leader	12
		Village public health	11
		volunteer	
	Moo 8 Ban Naprue	Village leader	12
		Assistant village leader	12
		Village public health	7
		volunteer	
	Moo 9 Ban Plugpor	Village leader	20
		Assistant village leader	20
		Assistant village leader	20
SAO. Tamorsai	Moo 1 Ban Tamorsai	Village leader	11
		Assistant village leader	11
		Village public health	15

Administration	Community	Position	Woring duration (year)
		volunteer	
	Moo 2 Ban Raitamak	Village leader	6
		Village public health	5
		volunteer	7
		Village public health	
	Moo 3 Ban Prong-ngu	volunteer	
		Village leader	20
		Assistant village leader	20
	Moo 8 Ban Praw	Assistant village leader	20
		Village leader	16
		Assistant village leader	16
	Moo 10 Ban wanghan	Village public health	26
		volunteer	
		Village leader	1 Month
		Assistant village leader	1 Month
	SAO. Nawah	Village public health	20
		volunteer	
		Village public health	1
		volunteer	
Moo 3 Ban kohtaktai	Village leader	2	
	Assistant village leader	2	
	Assistant village leader	2	
Low risk area (community in a radius of 3-5 km around the project)			
Banna SM.	Moo 7 Ban la-nga	Village headman inspector	3
		Assistant village leader	3
		Assistant village leader	3
	Moo 9 Ban Numkhem	Village leader	6
		Assistant village leader	6
		Village public health	12
Paching SAO.	volunteer		
	Moo 8 Ban Huadinnuea	Village public health	23
		volunteer	5

Administration	Community	Position	Working duration (year)
	Moo 9 Ban Huadintai	Not mentioned	
		Assistant village leader	10 Months
		Village public health volunteer	16 10 Months
		Not mentioned	
Khae SAO.	Moo 1 Ban kokyang	Assistant village leader	4
		Village public health volunteer	15
	Moo 2 Ban Khaenua	Village headman	24
		Village headman inspector	24
		Village public health volunteer	23
	Moo 3 Ban Khaetai	Village leader	3
		Assistant village leader	3
		Assistant village leader	3
	Moo 4 Ban Nead	Village leader	3
		Assistant village leader	3
		Assistant village leader	3
Tamorsai SAO.	Moo 5 Ban Tung-jae	Village leader	11
		Assistant village leader	11
		Village public health volunteer	15
	Moo 9 Ban Sapanhug	Village leader	6
		Village public health volunteer	5 7
		Village public health volunteer	
Nawah SAO.	Moo 5 Ban Prajanuea	Village leader	1.5
		Assistant village leader	2
		Assistant village leader	2
	Moo 6 Ban Prajatai	Village leader	13
		Assistant village leader	13
		Village public health	13

Administration	Community	Position	Working duration (year)
		volunteer	
	Moo 7 Ban Nanai	Assistant village leader	3
		Village public health	30
		volunteer	3
		Not mentioned	
Khuntudwai SAO.	Moo 2 Ban	Village leader	15
	Palamaiklang	Assistant village leader	15
		Village public health	20
		volunteer	
Khuntudwai SAO.	Moo 4 Ban Palamai-oak	Village leader	5
		Assistant village leader	5
		Assistant village leader	5
Total		84 person	

Source: Consultant of Technology Co.ltd., 2560

(C) Family group

Those local peoples living in the study area within a radius 5 km from the project area will be affected by project operation. Thus, those people were very importance for assessing opinion about the project. The group was classified to 2 types according to location of accommodations to the project area. Those 2 types were risk area (community in a radius of 0-3 km around the project), and low risk area (community in a radius of 3-5 km around the project). Sampling method was conducted by;

a) Sampling size

Sampling size was calculated using formula of Taro Yamane (Yamane Taro, 1973: 725, Statistics: An Introductory Analysis, 3rd ed. Tokyo: Harper International Edition) which is containing bias of 0.05,

The main respondent for the survey is the head of the family or spouse who understand the family condition. The respondent should have a residency for at least 1 year and at 18 years of age, and

b) Sampling method

The sampling method was conducted using Probability sampling for randomly selection of population as shown in table below used to solicit local people's opinion and requirements,

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Table 4.5.1.4-3

List of community inside the subdistrict administration organization used for family sampling

No.	Name/villages	Number of family (unit)	Sampling size from calculation	Number of required sample	Number of actual sample
Risk area (community in a radius of 0-3 km around the project)					
KU SAO.					
1	Moo 1 Ban KuTonpladoo	278	19.64	20	20
2	Moo 2 Ban Pordang	248	17.52	18	18
3	Moo 3 Ban Nayum	200	14.13	15	15
4	Moo 4 Ban Ku-prasit	169	11.94	12	12
5	Moo 5 Ban Ku	188	13.28	14	14
6	Moo 6 Ban Tung	158	11.16	12	12
7	Moo 7 Ban Node	54	3.81	4	4
8	Moo 8 Ban Naprue	161	11.37	12	12
9	Moo 9 Ban Plugpor	188	13.28	14	15
Sapanmaikan SAO.					
10	Moo 5 Ban saikhao	208	14.69	15	15
Tamorsai SAO.					
11	Moo 1 Ban Tamorsai	275	19.43	20	20
12	Moo 2 Ban Raitamak	119	8.41	9	9
13	Moo 3 Ban prong-ngu	144	10.17	11	11
14	Moo 8 Ban Praw	65	4.59	5	5
15	Moo 10 Ban Wanghan	166	11.73	12	12
SAO. Nawah					
16	Moo 3 Ban Kohtaktai	175	12.36	13	13
17	Moo 4 Ban Klongbon	69	4.87	5	5
Total families in subdistrict administration organization (Radius 0-3 km)		2,865	202	211	212
Low risk area (community in a radius of 3-5 km around the project)					
PACHING SAO.					
18	Moo 8 Ban Huadinnuea	102	7.21	8	8
19	Moo 9 Ban Huadintai	241	17.03	18	18

No.	Name/villages	Number of family (unit)	Sampling size from calculation	Number of required sample	Number of actual sample
Sapanmaikan SAO.					
20	Moo 3 Ban Talor	203	14.34	15	15
21	Moo 6 Ban Kasemrat	142	10.03	11	11
SAO. Khae					
22	Moo 1 Ban Kokyang	106	7.49	8	8
23	Moo 2 Ban Khaenuea	96	6.78	7	7
24	Moo 3 Ban Khaetai	213	15.05	16	16
25	Moo 4 Ban Nead	117	8.27	9	9
Tamorsai SAO.					
26	Moo 5 Ban Tung-jae	86	6.08	7	7
27	Moo 9 Ban Sapanhug	229	16.18	17	17
Nawah SAO.					
28	Moo 5 Ban Prajanuea	145	10.24	11	11
29	Moo 6 Ban Prajatai	367	25.93	26	26
30	Moo 7 Ban Nanai	175	12.36	13	13
Khuntudwai SAO.					
31	Moo 2 Ban Palamaiklang	102	7.21	8	8
32	Moo 4 Ban Palamai-oak	73	5.16	6	6
Banna SM.					
33	Moo 7 Ban La-nga	155	68.28	69	69
34	Moo 9 Ban Numkhem	353	155.51	156	155
Total families in subdistrict administration organization (Radius 3-5 km)		2,397	169	180	180
Total families in subdistrict administration organization		5,262	372	391	392
Total families in subdistrict municipal (Radius 3-5 km)		508	224	225	224
Total samples		392 samples			

Source : Consultant of Technology Co.ltd., 2560

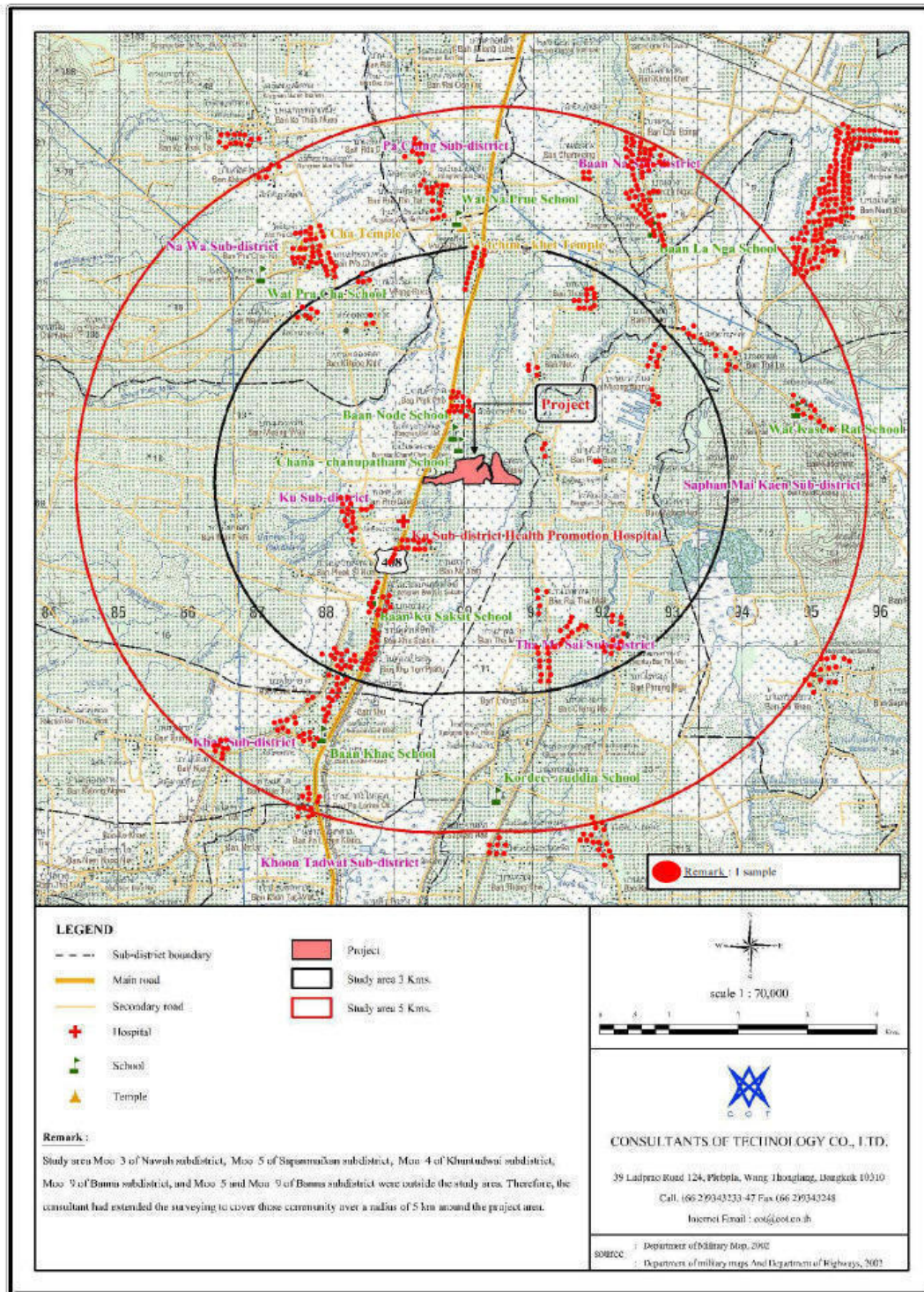


Figure 4.5.1.4-2 Location of sampling points

3) Tools for surveying

The surveying in this study was adapted from statistical surveying method by which the consultant had collected data without making situation. Thus, the study aims to find the facts from population using questionnaire (questionnaire used in this study were shown in **Appendix 3-1**) which has main issue for each target group as following;

(a) Environmental and inspection sectors were asking for general information, previous operation, policy of the organization, environmental impact, and opinioin with suggestion to the project,

(b) Health service sector was asking for general information, previous operation, policy of the organization, environmental impact, and opinioin with suggestion to the project,

(c) Facility and health service sector was asking for general information, previous operation, policy of the organization, environmental impact, and opinioin with suggestion to the project,

(d) Administration sector was asking for general information, previous operation, policy of the organization, environmental impact, and opinioin with suggestion to the project,

(e) Agricultural sector was asking for general information, previous operation, policy of the organization, environmental impact, and opinioin with suggestion to the project,

(f) Educational sector was asking for general information, previous operation, policy of the organization, environmental impact, and opinioin with suggestion to the project,

(g) Religion and faith leader sector was asking for general information, previous operation, policy of the organization, environmental impact, and opinioin with suggestion to the project,

(h) Community leader sector was asking for general information of interviewer, population data, employment data, communication data, satisfying of public health service, sufficiency of facility, environmental impact, and opinioin with suggestion to the project, and

(i) Family sector was asking for general socio-economic data, family hyGINE, environmental impact, and opinioin with suggestion to the project.

4) Data analysis

After receiving answers, those questionnaire were assessed for completeness of data, and used for analyzing by statistical software to examine percentage, mean, and descriptive statistical informationsuch as mean and standard deviation. For those text answers, the similar answers were grouped together for analyzing and translation of the results. Data analyzing was performed by;

(A) Statistical metrix

a) Mean or (\bar{x})

$$\bar{x} = \frac{\sum x}{n} \quad \text{----- (5)}$$

When \bar{x} = Mean,
 X = Raw data,
 $\sum x$ = Summation of raw data obtained from
 each group, and
 n = Total sampling groups.

b) Standard Diviation : SD

$$SD = \sqrt{\frac{n \sum fx^2 - (\sum fx)^2}{n(n-1)}} \text{ ----- (6)}$$

When SD = Standard Diviation of Sample,
 f = Frequency of each interval,
 X = Score of each level
 (low =1 , medium =2 , high =3), and
 N = Number of sample.

c) Percentage

$$\text{Percentage} = \frac{n}{N} \text{ ----- (7)}$$

When Percentage= Percent of interested data,
 n = interested data, and
 N = Total sampling data.

5) Results translation using percentage

The method was finding frequency (number) of each answer and transforming those frequency to percentage by which the answer was a closed choices which were;

(a) General information such as gender, age, educational level, and religion,

(b) Quality of life information which was consists of social dimension (family structure, and resettlement), economic dimension (occupation, income, saving and debt), basic infrastructure and environmental hygiene dimension (water supply, electricity consumption, waste management, and urban wastewater treatment), Social and public health service dimension, and communication with perception about the project information dimension (advantage and impact from project operation with confidence to inspection organizations).

6) Data translation using scaling and estimation

For those opinion surveying questions which were mostly scaling format, the analyzing was using estimation technic of Likert Scale, and using data measurement by classification. The method allocates weighting score to each data class, and calculates mean score to compare with translation criteria. The mean score comparison was using group criteria (Vichean Ketsingha, B.E. 2538)¹ and decimal rounding method for weighting score (Assoc.Prof. Boonchom Srisa-add)². Therefore, the scoring criteria was applied by;

Making 3 levels of opinion such as environmental impact which contains Criterion Reference as

- High gives 3 marks
- Medium gives 2 marks
- Low gives 1 marks

Marking translation using the following criteria;

- Average mark 1.00 – 1.50 means low level
- Average mark 1.51 - 2.50 means medium level
- Average mark 2.51 – 3.00 means high level

Making 5 levels of opinion such as confidence which contains Criterion Reference as

- High confidence gives 5 marks
- Confidence gives 4 marks
- Neutral gives 3 marks
- Unconfident gives 2 marks
- Very unconfident gives 1 marks

Marking translation using the following criteria;

- Average mark 1.00 – 1.50 means Very unconfident
- Average mark 1.51 - 2.50 means Unconfident
- Average mark 2.51 – 3.50 means Neutral
- Average mark 3.51 – 4.50 means Confidence

- Average mark 4.51 – 5.00 means High confidence

(2) Results of socio-economic opinion surveying in the study area

The surveying for socio-economic opinion in the study area was obtained from 3 target groups using questionnaire. Those target groups were related organizations, community leaders, and families (34 villages). The results was described using literature method for the high risk area (radius of 0-3 km from the project area), and the low risk area (radius of 0-3 km from the project area). Opinion results is described as follows.

1) Results obtained from related organizations

Results obtained from related organizations are;

(a) Environmental and inspection organizations

Results obtained from environmental and inspection organizations were summarized by;

Policy and opinion about industrial development which were supported by related organizations to maintain sufficiency electricity without environmental loading, industrial control which is conducted under good governance by entrepreneurs, and renewable energy in Songkhla which is supported by responsible organizations under actual potential and policy of the provincial industry office,

Opinion about project operation obtained from organization representatives which were mostly agreed that the project is good for local communities by which using unused material as raw material without any threat for elimination (percentage of 23.5), reducing green house gases causing global warming by using wood as fuel and maintaining economic growth in the local area to gain more tax and support electricity sustainability in the area (percentage of 17.6, equally), however; the sampling populations still worry about air pollution/dust (percentage of 30.8), accident from the project transportation, noise, argument of local peoples, and health impact (percentage of 15.4, equally), and traffic jam (percentage of 7.7). Those worrying were caused by an operation of neighboring industries (percentage of 60.0), and self prediction (percentage of 40.0), respectively,

Confidence about environmental management and inspection measures for environmental system with potential to protect public health due to the project operation

which were mostly (percentage of 50.0) confidence to the project, followed by neutral not mentioned (percentage of 25.0). For confidence about governmental inspection organization to control environmental and health impact was revealed that mostly (percentage of 50.0) were confidence, followed by high confidence and neutral (percentage of 25.0, equally), and

There were additional issues for special study to the project operation by;

Environmental issue
<ul style="list-style-type: none"> - Forest plantation around the power plant - Strictly following measures for environmental issue - Using best practice as proposed in the submission report - Strictly following good governance principle
Social issue
<ul style="list-style-type: none"> - Satisfaction of the project operation area - Following operation results and problem solving - Making people network from activities - Providing knowledge and operation facts - Providing career opportunity and promotion for increaasing income
Health issue
<ul style="list-style-type: none"> - Studying health impact from manufacturing - Studying water mass balance between consumption water and wastewater - Providing free health monitoring course to local people (yearly) - Providing health service for surrounding people sufficiently

(b) Public health service organizations

Results obtained from public health service organizations were summarized by;

Public health condition in the study area was found that majority illness were headache, itchy, cough with mucus, and eyes irritant (percentage of 13.8, equally), followed by vomiting and allergic (percentage of 10.3, equally), then vomiting, allergic, and

giddy (percentage of 6.9), weakness, asthma, respiratory disease and flu (percentage of 3.4, equally), respectively. Number of patient was the same as previous year (percentage of 40.0), increasing from the previous year (percentage of 40.0), and decreasing from the previous year (percentage of 20.0), respectively. Historical data obtained from 3 years indicated that illness trend was not change (percentage of 71.4), while percentage of 28.6 mentioned about an increasing of respiratory disease and dermal disease. The public health organizations had planned for supporting and increasing patient using various methods (percentage of 18.2), preparing sufficient medical equipment with providing health promotion and illness protection to local people, and analyzing illness statistic in the area (percentage of 9.1, equally),

Opinion about project operation obtained from organization representatives which were mostly agreed that the project is making high land price (percentage of 24.0), local administration will gain more tax (percentage of 16.0), maintaining economic growth in the local area and support electricity sustainability in the area (percentage of 12.0, equally), reducing green house gases causing global warming by using wood as fuel (percentage of 8.0, equally), good for local communities by which using unused material as raw material without any threat for elimination (percentage of 4.0, equally), respectively. However, the sampling populations still worry about air pollution/dust (percentage of 26.1), argument of local peoples (percentage of 17.4), wastewater and crime (percentage of 13.0, equally), accident from the project transportation and health impact (percentage of 8.7, equally, respectively. Those worrying were caused by an operation of neighboring industries (percentage of 36.4), and self prediction (percentage of 27.3), respectively. Information receiving from public relation media (percentage of 18.2), and verbal or communication from various media about bad practice of some industries (percentage of 9.1, equally), respectively.

For the level of confidence, the representatives were mostly feel unconfident to environmental management and measures of environmental inspection of the project (mean 2.25, S.D. 1.258) by which unconfident, and neutral were similar (percentage of 28.6, equally), followed by high unconfident and not mentioned (percentage of 14.3).

Furthermore, representatives of public health service organizations gave additional suggestion to the project by;

Environmental issue
<ul style="list-style-type: none"> - Asking the project owner to strictly follow measures for reducing environmental impact according to environmental issue, and health monitoring measures - Providing knowledge to community leaders and villagers - Recording chemical data which are affecting human health regularly - Making site visiting for villagers to the project area - Making public meeting for villagers at least 3 months/time - Controlling dust/particle size

Social issue
<ul style="list-style-type: none"> - Making CSR activity - Worrying about problems of robbery, fighting, drugs, and crime - Maintaining good relationship or culture

Health issue
<ul style="list-style-type: none"> - Assessing health condition with illness statistic regularly - Making health protection fund - Offering budget for health issue to the public health service organizations directly - Studying impact about health issue continuously - Worrying about unreadiness pregnant

(c) Facility and health service sector

Results obtained from facility and health service organizations were summarized by;

Opinion surveying in the study area was found that majority of facility and health service organizations believed that the project could maintain electricity sustainability to the area, but those representatives wer worrying about wastewater which were concerned by self prediction.

For the level of confidence about environmental inspection issue, the representatives were mostly feel neutral to environmental management and measures of environmental inspection of the project. Furthermore, representatives suggested that a good

method for making public relation was a meeting with villagers, while those representative were not have any additional suggestion.

(d) Administration sector

Results obtained from administration organizations were summarized by;

Consistent of organization policies about industrial development in the area to the project development were summarized by industrial operation should be performed with environmental awareness, an operation should not affect living quality of local people, environmental measures for pollution control should be assigned to the project, maintaining safety production and environmental protection under an industrial development concept, and routinely making public relation about project operation. Those representatives also gave suggestions for reducing environmental problems by talking with entrepreneurs to maintain proper environmental condition in the operation area for controlling noise and odor, making continuous public relation for environmental management with environmental conservation, making conscious mind for environmental protection to governmental officers with a promotion of environmental awareness to local people to maintain proper environment, inspecting environmental condition with related organizations, reporting environmental problems to responsible organizations to strictly operation for environmental protection, and providing knowledge to local people about environmental deteriorate due to industrial operation without environmental awareness.

Opinion about project operation obtained from organization representatives which were mostly agreed that the project is maintaining employment in the local area (percentage of 26.7), local administration will gain more tax (percentage of 23.3), good for local communities by which using unused material as raw material without any threat for elimination (percentage of 20.0) , supporting economic expansion (percentage of 16.7), reducing green house gases causing global warming by using wood as fuel and maintaining electricity sustainable with increasing high land price (percentage of 3.3 , equally), respectively. However, the sampling populations still worry about air pollution/dust (percentage of 24.3), wastewater (percentage of 18.9), noise odor and argument of local peoples (percentage of 16.2 , equally), health impact (percentage of 8.1) and accident from the project transportation (percentage of 2.7), respectively. Those worrying were caused by an operation of neighboring

industries (percentage of 58.3), self prediction (percentage of 25.0), and information receiving from public relation media (percentage of 16.7), respectively.

For the level of confidence, the representatives were mostly feel unconfident to environmental management and measures of environmental inspection of the project (mean 2.75 SD 0.957) by which unconfident had percentage of 22.2, confidence and neutral has the same percentage of 11.1 , respectively.

In addition, representatives of administration organizations gave additional suggestion to the project by;

Environmental issue
<ul style="list-style-type: none"> - Providing air pollution and dust controlling system which is affecting public health - Controlling noise which is affecting living quality - Monitoring impact about environmental issue continuously - Worrying about noise impact - Providing management system or complaint system to public - Worrying about dust problem - Responsible for environmental impact to communities

Social issue
<ul style="list-style-type: none"> - Providing clear answers about advantage to communities due to the project operation - Making career opportunity for local people - Making good relation activities for reducing argument of local people continuously - Participating and supporting for local activities and culture

Health issue
<ul style="list-style-type: none"> - Worrying about respirable dust which can affect human health - Installing dust controlling system - Maintaining health monitoring program for local people - Controlling health threats which could affect local people

(e) Agricultural sector

Results obtained from agricultural organizations were summarized by;

Consistent of organization policies about industrial development in the area to the project development were summarized by industrial operation should not affect agricultural activities according to micro scale agricultural production, an operation should reduce environmental problems in the responsible area by which reducing chemical in the irrigation area.

Opinion about project operation obtained from organization representatives which were mostly agreed that the project is maintaining employment in the local area (percentage of 50.0), and local administration will gain more tax and using agricultural residue for utilization (percentage of 25.0 , equally), respectively. However, the sampling populations still worry about air pollution/dust (percentage of 25.0) , noise and wastewater (percentage of 16.7 , equally), traffic jam and accident from the project transportation and argument of local peoples (percentage of 8.3 , equally), respectively. Those worrying were caused by self prediction (percentage of 66.7) , an operation of neighboring industries (percentage of 33.3), respectively.

For the level of confidence, the representatives were mostly feel confidence to environmental management and measures of environmental inspection of the project with the percentage of 33.3.

In addition, representatives of agricultural organizations gave additional suggestion to the project by;

Environmental issue
<ul style="list-style-type: none">- Making a proper system for wastewater management- Providing air and water quality monitoring equipment

Social issue
<ul style="list-style-type: none">- Participating with communities and governmental organizations for all procedures- Providing employment for local people

Health issue
<ul style="list-style-type: none"> - Providing health insurance for local people - Maintaining health monitoring program for local people

(f) Educational sector

Results obtained from educational organizations were summarized by;

Opinion about project operation obtained from organization representatives which were mostly agreed that the project is not has advantage to communities, using agricultural residue for utilization, and local administration will gain more tax (percentage of 16.7), maintaining employment in the local area and maintaining electricity sustainable (percentage of 16.7, equally), respectively. However, the sampling populations still worry about environmental impact caused by the operation of the project (percentage of 71.4). Most of the representatives were worry about air pollution/dust and wastewater (percentage of 25.0, equally), noise odor and argument of local peoples and health impact (percentage of 10.0, equally), and accident from the project transportation and robbery/crime (percentage of 5, equally), respectively. Those worrying were caused by an operation of neighboring industries (percentage of 57.1), information receiving from public relation media (percentage of 28.6), and self prediction (percentage of 14.3), respectively.

For the level of confidence, the representatives were mostly feel unconfident and high unconfident to environmental management and measures of environmental inspection of the project (percentage of 28.6, equally). However, high confidence and confidence had percentage of 14.3, equally (mean 2.33, S.D. 1.528).

In addition, representatives of educational organizations gave additional suggestion to the project by;

Environmental issue
<ul style="list-style-type: none"> - Worrying about noise impact from operation - Worrying about environmental impact - Worrying about dust impact - Worrying about wastewater impact - Worrying about air pollution impact

Social issue
<ul style="list-style-type: none">- Worrying about argument of local people and conflict of interest from the project- Providing career promotion to the project operation- Advantage of local communities from the operation of the project- Worrying about traffic condition due to material transportation to the project area which should has a proper mitigation- Making a participation for local people to inspect an operation

Health issue
<ul style="list-style-type: none">- An operation should not affect public health- Worrying about public health affected by the project operation

(g) Religion and faith leader

Results obtained from religion and faith leaders were summarized by;

Majority of religion and faith leaders did not gave any opinion (percentage of 45.5), followed by maintaining employment in the local area (percentage of 18.2), using agricultural residue for utilization, maintaining electricity sustainability, promoting for public health (percentage of 9.1 , equally), respectively. However, the sampling populations still worry about an operation of the Chana Green Power Plant for air pollution/dust (percentage of 33.3), nois and wastewater (percentage of 23.8 , equally) , accident from the project transportation and odor and remote workers (percentage of 4.8 , equally), respectively. Those worrying were caused by self prediction (percentage of 60.0) , an operation of neighboring industries (percentage of 20.0), information receiving from neighbors and public relation media (percentage of 10.0 , equally), and respectively.

For the level of confidence, the representatives were mostly feel confidence to environmental management and measures of environmental inspection of the project (mean 2.20 , S.D. 0.837). However, neutral and unconfident had percentage of 28.6, equally, and high unconfident had percentage of 14.3, respectively.

In addition, representatives gave additional suggestion to the power plant of the Chana Green Co.ltd. by;

Environmental issue
<ul style="list-style-type: none"> - Maintaining proper environment - Warming atmosphere could reduce rubber production - Maintaining proper management for the power plant

Social issue
<ul style="list-style-type: none"> - Providing information to communities - Supporting career groups in local communities

Health issue
<ul style="list-style-type: none"> - Providing compensation and visiting patient due to health impact from the operation of the project - Supporting career groups in local communities - Providing health monitoring program for elderly person, and making health care activities

2) Community leader sector in the study area

Position of community leaders is shown in the **Table 4.5.1.4-2** by which opinion surveying results which could be described by;

(A) Community leader in the municipality area

a) Community leaders in the low risk area (3-5 km)

Majority of representatives (percentage of 83.3) were male which were between 41-50 years old (percentage of 66.7), followed by 31-40 years old, and 51-60 years old (percentage of 16.7, equally). Most of community leaders were assistant village leader (percentage of 50.0), followed by village headman, village public health volunteer, and village leader (percentage of 16.7, equally). Education level of community leaders were secondary school or equivalence (percentage of 83.3), followed by bachelor degree (percentage of 16.7). Duration of operation were mostly 1-5 years (percentage of 50.0), 6-10 years (percentage of 33.3), and 11-15 years (percentage of 16.7), respectively.

Native habitat of those community leaders were local people (percentage of 100.0). Occupation of community leaders were mostly farmer (percentage of 83.3), followed by commercial career/private business (percentage of 16.7). Minor occupation of the leaders were non minor career (percentage of 66.7), followed by commercial career/private business and farmer (percentage of 16.7, equally), respectively.

*** Impact about environmental issue and opinion to factories in the study area**

Opinion about impacts/threats according to environmental issue in the study area were mostly not affected (percentage of 100.0) which were mostly never had complaint about environmental issue from local people (percentage of 100.0),

*** Impact about environmental issue and opinion to the project**

Those community leaders were mostly received information about the Chana Green Power Plant of the Chana Green Co.ltd. (percentage of 100.0) by which those community leaders were know about public involvement meeting and scoping of the study (percentage of 60.0), and know about public relation from the project (percentage of 40.0),

Opinion about project operation obtained from community leaders which were mostly agreed that the project is maintaining employment in the local area (percentage of 28.6), local administration will gain more tax and maintaining electricity sustainable (percentage of 21.4, equally), supporting economic expansion and disadvantage to local communities (percentage of 14.3, equally), respectively. However, the sampling populations is still worried about air pollution/dust (percentage of 23.8), wastewater (percentage of 19.0), odor (percentage of 14.3), traffic jam (percentage of 9.5), argument of local peoples (percentage of 5.1), robbery and crime (percentage of 4.8, equally), respectively. Those worrying were caused by self prediction (percentage of 100.0).

For public relation of the project/information distribution to community, mostly opinion indicating that the public relation should be passed to Village headman/ Village leader/Community leaders/Information tower of villages which was the highest effective method for providing information to local people (percentage of 85.7), followed by meeting (percentage of 14.3).

In addition, representatives of community leaders gave additional suggestion to the project by;

Environmental issue
- Protect environmental quality according to measure proposed for acquiring permission
Social issue
- Supporting/funding education
- Supporting or promoting community activities

(B) Community leader in the subdistrict administration organization area

a) Community leaders in the high risk area (0-3 km)

*** General information of sampling population**

Majority of representatives (percentage of 65.0) were male which were between 41-50 years old (percentage of 57.5), followed by 51-60 years old (percentage of 32.4), and 31-40 years old (percentage of 10.0), respectively. Most of community leaders were assistant village leader (percentage of 66.7), followed by Village public health volunteer (percentage of 30.0), and Village leader (percentage of 25.0), respectively. Education level of community leaders were high school or equivalence (percentage of 50.0), followed by junior high school or equivalence (percentage of 32.5), and primary school (percentage of 12.5), respectively. Duration of operation were mostly 1-5 years (percentage of 27.5), 11-20 years (percentage of 25.0), more than 20 years (percentage of 10.0), 6-10 years (percentage of 7.5), and less than 1 year (percentage of 5.0), respectively,

*** Impact about environmental issue and opinion to the project**

Those community leaders received information about the Chana Green Power Plant of the Chana Green Co.ltd. (percentage of 97.5) by which those community leaders know about public involvement meeting and scoping of the study (percentage of 50.0),

know about public relation from the project (percentage of 41.1), know from various medias (percentage of 5.4), and know from friends/neighbors/relatives (percentage of 1.8), respectively.

Opinion about project operation obtained from community leaders which were mostly agreed that the project is maintaining employment in the local area (percentage of 34.0), local economic expansion (percentage of 26.6), local administration will gain more tax (percentage of 24.5), disadvantage to local communities (percentage of 5.3), maintaining electricity sustainable and local communities have benefit from power plant fund (percentage of 4.3 , equally), and turn agricultural residue to be utilized (percentage of 1.1), respectively. However, the sampling populations still worry about noise problem (percentage of 23.4), air pollution/dust (percentage of 21.5) , wastewater (percentage of 20.9), odor (percentage of 17.1), argument of local peoples (percentage of 5.1), traffic jam (percentage of 3.2), robbery, crime, accident, and health impact (percentage of 2.5 , equally), and others such as reducing agricultural production/water shortage and flooding (percentage of 1.3), respectively. Those worrying were caused by self prediction (percentage of 94.9), followed by operation of neighboring industries (percentage of 5.1).

For the level of confidence, the representatives were mostly not mentioned (percentage of 52.5), followed by neutral (percentage of 17.5), confidence/unconfident/high unconfident to environmental management and measures of environmental inspection of the project (percentage of 10.0 , equally). Confidential surveying for measures and inspection from government organizations were mostly not mentioned (percentage of 50), followed by neutral (percentage of 27.5), confidence ((percentage of 10.0), and high unconfident (percentage of 5.0), respectively.

For public relation of the project/information distribution to community, mostly opinion indicating that the public relation should be pass to Village headman/ Village leader/Community leaders/Information tower of villages which was the highest effective method for providing information to local people (percentage of 47.8), followed by posting on the village public relation board (percentage of 4.3).

In addition, representatives of community leaders gave additional suggestion to the project by;

Environmental issue
<ul style="list-style-type: none"> - How to reduce environmental impact - Reducing noise from manufacturing - Reducing heat released from manufacturing - Avoiding impact to neighboring schools - Suggesting to install water spraying system to reduce heat from manufacturing - Protect environmental quality according to measure proposed for acquiring permission - Do not require power plant

Social issue
<ul style="list-style-type: none"> - Providing central fund for communities in the study area - Providing budget for communities - Supporting/funding education - Supporting or promoting community activities

Health issue
<ul style="list-style-type: none"> - Making health monitoring program for communities - Providing hospitality unit of the project to support communities

b) Community leaders in the low risk area (3-5 km)

Majority of representatives (percentage of 68.4) were male which were between 41-50 years old (percentage of 55.3), followed by 51-60 and 31-40 years old (percentage of 21.1, equally), and 21-30 years old (percentage of 2.6), respectively. Most of community leaders were assistant village leader (percentage of 39.5), followed by Village public health volunteer and Village leader (percentage of 23.7, equally), and Village headman (percentage of 5.3), respectively. Education level of community leaders were high school or equivalence (percentage of 47.4), followed by junior high school or equivalence (percentage of 23.7), bachelor degree (percentage of 7.9), and technical college/master degree (percentage of 2.6, equally), respectively. Duration of operation were mostly 1-5 years (percentage of 47.4), 11-20 years (percentage of 23.7), more than 20 years (percentage of 13.2), 6-10 years (percentage of 10.5), and less than 1 year (percentage of 5.3), respectively,

*** Impact about environmental issue and opinion to the project**

Those community leaders were mostly received information about the Chana Green Power Plant of the Chana Green Co.ltd. (percentage of 97.4) by which those community leaders were know about public involvement meeting and scoping of the study (percentage of 52.1), know about public relation from the project (percentage of 31.3), know from various medias (percentage of 10.4), and know from friends/neighbors/relatives (percentage of 6.3), respectively.

Opinion about project operation obtained from community leaders which were mostly agreed that the project is maintaining employment in the local area (percentage of 31.1), local economic expansion (percentage of 27.8), local administration will gain more tax (percentage of 23.3), disadvantage to local communities (percentage of 10.0), turn agricultural residue to be utilized (percentage of 3.3), reducing green house gases by using wood as fuel (percentage of 2.2), maintaining electricity sustainable and local communities have benefit from power plant fund (percentage of 1.1), respectively. However, the sampling populations still worry about noise problem (percentage of 25.0), air pollution/dust (percentage of 24.3), wastewater (percentage of 23.5), odor (percentage of 16.2), traffic jam (percentage of 5.1), argument of local peoples (percentage of 2.9), robbery, crime, accident, and health impact and others such as reducing agricultural production/water shortage and flooding (percentage of 0.7 , equally), respectively. Those worrying were caused by self prediction (percentage of 82.1), followed by operation of neighboring industries (percentage of 17.9).

For the level of confidence, the representatives were mostly not mentioned (percentage of 50.0), followed by confidence (percentage of 18.4), neutral (percentage of 15.8), unconfident (percentage of 10.5), and high confidence/high unconfident (percentage of 2.6 , equally). Confidential surveying for measures and inspection from government organizations were mostly not mentioned (percentage of 42.1), followed by neutral (percentage of 23.7), confidence (percentage of 15.8), unconfident (percentage of 13.2), and high confidence/high unconfident (percentage of 2.6 , equally), respectively.

For public relation of the project/information distribution to community, mostly opinion indicating that the public relation should be pass to Village headman/ Village leader/ Community leaders/ Information tower of villages which was the highest effective method for providing information to local people (percentage of 76.7), followed by

community meeting (percentage of 18.6), and posting on the village public relation board and providing information by the project staffs (percentage of 2.3 , equally).

In addition, representatives of community leaders gave additional suggestion to the project by;

Environmental issue
<ul style="list-style-type: none"> - Protect environmental quality according to measure proposed for acquiring permission - Do not require power plant

Social issue
<ul style="list-style-type: none"> - Providing knowledge and information directly to communities - Using local employees - Making argument to local people - Supporting or promoting community activities - Supporting health activities - Repairing facilities of community

Health issue
<ul style="list-style-type: none"> - Providing health monitoring program to communities

3) Family sector in the study area

Results obtained from family representatives were summarized by;

(A) Family living in subdistrict municipal

a) Community in the low risk area (3-5 km)

* General information of family representatives

Majority of representatives (percentage of 60.9) were female which were married (percentage of 53.8). Age of representatives were between 41-50 years old (percentage of 28.0), followed by 31-40 years old (percentage of 21.8), and 51-60 years old (percentage of 18.7), respectively. Education level of representatives were primary school school (percentage of 44.9), followed by junior high school (percentage of 19.1), and high school or equivalence (percentage of 14.7), respectively.

*** Opinion to the project**

Those representatives were mostly did not receive information about the project (percentage of 55.6) while minority representative were received information about the Chana Green Power Plant of the Chana Green Co.ltd. (percentage of 44.4) by which those representatives were know from friends/neighbors (percentage of 33.3), followed by relatives (percentage of 25.0), know from various medias (percentage of 12.9), respectively. Opinion about project operation obtained from representatives which were mostly did not mentioned (percentage of 27.2), turn agricultural residue to be utilized (percentage of 17.3), agreed that the project is maintaining employment in the local area (percentage of 16.6), and maintaining electricity sustainable (percentage of 15.9), respectively. However, the sampling populations still worry about air pollution/dust (percentage of 38.4), wastewater (percentage of 20.4), odor (percentage of 19.1), noise problem (percentage of 10.9), respectively. Those worrying were caused by self prediction (percentage of 71.0), followed by operation of neighboring industries (percentage of 17.2), participation with neighbors (percentage of 8.9), and various medias (percentage of 3.0).

For the level of confidence, the representatives were mostly neutral (percentage of 40.0), followed by unconfident (percentage of 27.6), and confidence (percentage of 19.6), respectively. Confidential average was 2.86 with S.D. was 0.781. Confidential surveying for measures and inspection from government organizations were mostly neutral (percentage of 45.3), followed by unconfident (percentage of 21.3), and confidence (percentage of 17.8), respectively by which confidential average was 2.88 with S.D. was 0.771.

For public relation of the project/information distribution to community, mostly opinion indicating that the public relation should be pass to Village headman/ Village leader/ Community leaders/ Information tower of villages which was the highest effective method for providing information to local people (percentage of 50.9), followed by community meeting (percentage of 36.4), and providing information by the project staffs (percentage of 5.8), respectively.

b) Summary of opinion surveying results for local people living in subdistrict municipal

Data obtained from opinion surveying for those representatives living in the low risk area were found that majority representative were female with age between 41-50 years old. Educational level were mostly primary school and working as farmer. Those

representatives were native habitat. Economic condition of local families were fair by which those representatives have saving money. Those representatives received information from television by which community relation was depend on relative connection. Religion activities were performed in temples/mosk/church especially for religion importance days without any mind principle. Local problem was addictive drugs.

For family hygiene data obtained from surveying results of family living in municipal areas, it was found that majority representatives were not get illness in the past year. For any illness case, those representative were used health service from governmental hospitals. For drinking water, most of representatives use underground water and tap water for drinking. Water sources have good quality and sufficiency for consumption. Agricultural water was supplied from precipitation. For waste management, those waste was burnt while waste water was discharged to abandoned area or grained on ground.

Opinion about environmental issue obtained from family representatives was found that most of representative did not get affected from the environmental impact while those who had got environmental impact were never sent any complaint to responsible organizations. Majority of accident cases in the area were car and motorcycles accident. Information receiving about the Chana Green Power Plant of the Chana Green Co.ltd. were mostly distributed to representatives by the meeting for scoping and guideline for environmental impact assessment by which those representative did not mention about advantage of the project to communities. However, those representatives worried about air pollution/dust, wastewater, and odor which were mostly concerned by self prediction.

Those representative had neutral opinion to environmental issue which are environmental measures and inspection for the project operation. Furthermore, those representatives were confidence to inspection tasks of responsible governmental organizations according to environmental issue, social, and public health.

For public relation pattern or information distribution about the project operation, those representatives suggested that public relation should be pass to Village headman/Village leader/Community leaders/Information tower of villages which was the highest effective method for providing information to local people.

In addition, representatives gave additional suggestion to the power plant of the Chana Green Co.ltd. for protecting environmental quality and living quality of local people living in the municipality areas by;

Environmental issue

- Filtering dust/smoke,
- Controlling noise,
- Controlling odor properly with high quality,
- Monitoring water quality/wastewater system
- Making forest plantation to increase green space
- Avoiding spillway/canal areas
- The project should not be installed according to environmental problems,
- Making management standard for solving problem about environmental issue

Social issue

- Transportation,
- Poor information distribution to local people about the project operation,
- Providing direct meeting with local people,
- Receiving local people opinion about project installation,
- helping for living quality to local people,
- Providing additional income promotion or offering occupational opportunity to local people,
- Inequity rubber wood price,
- Supporting and promotion for community activities and community development,

Health issue

- Controlling bad smelling from manufacturing,
- Providing health monitoring program to local people in the neighboring communities at least 1-2 times/month,
- Maintaining environmental condition around the project area to avoid impact about health issue to local people in the

neighboring communities, and

- Providing health welfare to local people in the neighboring communities.

(B) Family group living in subdistrict administration organization

a) Community in high risk area (0-3 km)

*** General information of family representatives**

Majority of representatives (percentage of 54.7) were female which were married (percentage of 46.7) and being family leader (percentage of 41.0) while being relatives (percentage of 12.3), respectively. Age of representatives were between 31 -40 years old (percentage of 25.0), followed by 41-50 years old (percentage of 24.1), and over 60 years old (percentage of 18.9), respectively. Education level of representatives were primary school school (percentage of 50.0), followed by junior high school (percentage of 17.5), and high school or equivalence (percentage of 17.0), respectively.

*** Opinion to the project**

Those representatives were mostly received information about the Chana Green Power Plant of the Chana Green Co.ltd. (percentage of 83.5) by which those representatives were know from friends/neighbors (percentage of 38.7), followed by know from various medias (percentage of 22.9), and relatives (percentage of 14.6), respectively. Opinion about project operation obtained from representatives which were mostly did not mentioned (percentage of 40.3), economic expansion (percentage of 13.1), agreed that the project is maintaining employment in the local area (percentage of 12.5), and local administration organizations earn more tax (percentage of 9.7), respectively. However, the sampling populations still worry about air pollution/dust (percentage of 97.3), noise problem (percentage of 22.6), wastewater (percentage of 14.2), and odor (percentage of 13.8), respectively. Those worrying were caused by self prediction (percentage of 42.7), followed by operation of neighboring industries (percentage of 25.1), participation with neighbors (percentage of 22.5), and various medias (percentage of 9.7).

For the level of confidence, the representatives were mostly unconfident (percentage of 38.7), followed by neutral (percentage of 23.1), and high unconfident (percentage of 19.8), respectively. Confidential average was 2.24 with S.D. was 0.918.

Confidential surveying for measures and inspection from government organizations were mostly unconfident (percentage of 33.0), followed by neutral (percentage of 28.8), and high unconfident (percentage of 16.5), respectively by which confidential average was 2.24 with S.D. was 0.960.

For public relation of the project/information distribution to community, mostly opinion indicating that the public relation should be pass to Village headman/ Village leader/ Community leaders/ Information tower of villages which was the highest effective method for providing information to local people (percentage of 55.5), followed by community meeting (percentage of 29.2), and posting on village public relation board (percentage of 11.7), respectively.

b) Community in low risk area (3-5 km)

*** General information of family representatives**

Majority of representatives (percentage of 67.2) were female which were married (percentage of 59.4) and being family leader (percentage of 32.2) while being relatives (percentage of 8.3), respectively. Age of representatives were between 31 -40 years old (percentage of 30.0), followed by 51-60 years old (percentage of 23.3), and 41-50 years old (percentage of 22.8), respectively. Education level of representatives were primary school school (percentage of 42.2), followed by junior high school (percentage of 23.3), and high school or equivalence (percentage of 14.4), respectively.

*** Opinion to the project**

Those representatives were mostly received information about the Chana Green Power Plant of the Chana Green Co.ltd. (percentage of 73.9) by which those representatives were know from friends/neighbors (percentage of 39.7), followed by know from various medias (percentage of 20.1), and public relation by the project (percentage of 16.3), respectively. Opinion about project operation obtained from representatives which were mostly did not mentioned (percentage of 28.), agreed that the project is maintaining employment in the local area (percentage of 12.1), maintaining electricity sustainable to local area (percentage of 10.2), economic expansion (percentage of 9.5), and local administration organizations earn more tax (percentage of 9.2), respectively. However, the sampling populations still worry about air pollution/dust (percentage of 92.2), noise problem (percentage of 19.7), wastewater (percentage of 16.5), and odor (percentage of 14.4), respectively. Those worrying were caused by self prediction (percentage of 45.1), followed by operation of neighboring industries (percentage of

24.6), participation with neighbors (percentage of 19.5), and various medias (percentage of 10.8).

For the level of confidence, the representatives were mostly unconfident (percentage of 39.4), followed by neutral (percentage of 36.1), and high unconfident (percentage of 8.9), respectively. Confidential average was 2.46 with S.D. was 0.783. Confidential surveying for measures and inspection from government organizations were mostly neutral (percentage of 38.3), followed by unconfident (percentage of 32.2), and confidence (percentage of 11.7), respectively by which confidential average was 2.69 with S.D. was 0.895.

For public relation of the project/information distribution to community, mostly opinion indicating that the public relation should be pass to Village headman/ Village leader/ Community leaders/ Information tower of villages which was the highest effective method for providing information to local people (percentage of 53.6), followed by community meeting (percentage of 31.4), and posting on village public relation board (percentage of 9.6), respectively.

4.5.2 Public Health

The consulting company had studied public health service issue in the study area from secondary data of readiness of service, preparation of staffs, illness statistic, and emergency medical service by which the study area is under public health service network of Cahna district.

(1) General information of public health service

Secondary data obtained from GIS searching system of the Ministry of Public Health was found that public health staffs in the study area were summarized by following paragraphs.

1) Chana Public Health Office

Number of medical staff of the Chana Public Health Office was;

- | | | |
|--|-----------|-----------|
| - District public health officer | Number 1 | Positions |
| - Public health administration officer | Number 10 | Positions |
| - Public health officer | Number 13 | Positions |
| - Public health staff | Number 6 | Positions |
| - Professional nurse | Number 17 | Positions |
| - General officer | Number 1 | Positions |

2) Ku Subdistrict Health Promotion Hospital

Ku Subdistrict Health Promotion Hospital is located at Moo 3 Ban Nayum, Ku subdistrict, Chana, Songkhla. Responsibility service covers 9 villages which are Moo 1 Ban Ku-Tonpladoo, Moo 2 Ban Pordang, Moo 3 Ban Nayum, Moo 4 Ban Ku-prasit, Moo 5 Ban Ku, Moo 6 Ban Tung, Moo 7 Ban Node, Moo 8 Ban Naprue, and Moo 9 Ban Plugpor by which operation staffs consist of

- Professional nurse	Number 1	Positions
- Public health staff	Number 3	Positions
- Patient assistance	Number 1	Positions
- Dental staff	Number 1	Positions
- Village public health volunteer	Number 53	Positions

3) Khae Subdistrict Health Promotion Hospital

Khae Subdistrict Health Promotion Hospital is located at Moo 5 Ban Tungkrok, Khae subdistrict, Chana, Songkhla. Responsibility service covers 5 villages which are Moo 1 Ban Kokyang, Moo 2 Ban Khaenua, Moo 3 Ban Khaetai, Moo 4 Ban Nead, and Moo 5 Ban Tungkrok by which operation staffs consist of

- Professional nurse	Number 1	Positions
- Public health officer	Number 1	Positions
- Public health staff	Number 1	Positions
- Village public health volunteer	Number 53	Positions

4) Nawah Subdistrict Health Promotion Hospital

Nawah Subdistrict Health Promotion Hospital is located at Moo 1 Ban Nawah, Nawah subdistrict, Chana, Songkhla. Responsibility service covers 8 villages which are Moo 1 Ban Nawah, Moo 2 Ban Kohtaknuea, Moo 3 Ban Kohtaktai, Moo 4 Ban Klongbon, Moo 5 Ban Prajanuea, Moo 6 Ban Prajatai, Moo 7 Ban Nanai, and Moo 12 Ban Maetoei by which operation staffs consist of

- Professional nurse	Number 2	Positions
- Public health officer	Number 2	Positions
- Public health staff	Number 2	Positions
- Public health officer assistance	Number 2	Positions
- Village public health volunteer	Number 60	Positions

5) Khuntudwai Subdistrict Health Promotion Hospital

Khuntudwai Subdistrict Health Promotion Hospital is located at Moo 3 Ban Khuntudwai, Khuntudwai subdistrict, Chana, Songkhla. Responsibility service covers 9 villages which are Moo 1 Ban Palamaitok, Moo 2 Ban Palamaiklang, Moo 3 Khuntudwai, Moo 4 Ban Palamai-oak, Moo 5 Ban Luangchaoon, Moo 6 Ban Leabnai, Moo 7 Ban Huakrating, Moo 8 Ban Pawah, and Moo 9 Ban Prong-charakhae by which operation staffs consist of

- Professional nurse	Number 1	Positions
- Public health officer	Number 1	Positions
- Public health staff	Number 1	Positions
- Patient assistant officer	Number 1	Positions
- Village public health volunteer	Number 126	Positions

6) Tamorsai Subdistrict Health Promotion Hospital

Tamorsai Subdistrict Health Promotion Hospital is located at Moo 9 Ban Sapanhug, Tamorsai subdistrict, Chana, Songkhla. Responsibility service covers 11 villages which are Moo 1 Ban Tamorsai, Moo 2 Ban Raitamak, Moo 3 Ban prong-ngu, Moo 4 Ban Changklod, Moo 5 Ban Tung-jae, Moo 6 Ban mueang-liwong, Moo 7 Ban Kienduai, Moo 8 Ban Praw, Moo 9 Ban Sapanhug, Moo 10 Ban Wanghan, and Moo 11 Ban Huakuan by which operation staffs consist of

- Professional nurse	Number 2	Positions
- Public health officer	Number 2	Positions
- Public health staff	Number 1	Positions
- Patient assistant officer	Number 2	Positions
- Dental staff	Number 1	Positions
- Village public health volunteer	Number 100	Positions

7) Sapanmaikan Subdistrict Health Promotion Hospital

Sapanmaikan Subdistrict Health Promotion Hospital is located at Moo 1 Ban Sapanmaikan-tok, Sapanmaikan subdistrict, Chana, Songkhla. Responsibility service covers 8 villages which are Moo 1 Ban Sapanmaikan-tok, Moo 2 Ban Tum-aok, Moo 3 Ban Talor, Moo 4 Ban Sapanmaikan-oak, Moo 5 Ban saikhao, Moo 6 Ban Kasemrat, Moo 7 Ban Sapanmaikan-klang, and Moo 8 Ban Rai by which operation staffs consist of

- Professional nurse	Number 2	Positions
- Public health officer	Number 1	Positions
- Public health staff	Number 4	Positions
- Patient assistant officer	Number 1	Positions

- Village public health volunteer Number 162 Positions

8) Paching Subdistrict Health Promotion Hospital

Paching Subdistrict Health Promotion Hospital is located at Moo 2 Ban Tungpra, Paching subdistrict, Chana, Songkhla. Responsibility service covers 9 villages which are Moo 1 Ban Paching, Moo 2 Ban Tungra, Moo 3 Ban Tonprang, Moo 4 Ban Taklong, Moo 5 Ban Rai, Moo 6 Ban Rai-donfai, Moo 7 Ban Salood, Moo 8 Ban Huadinnuea, and Moo 9 Ban Huadintai by which operation staffs consist of

- Professional nurse Number 3 Positions
- Public health officer Number 2 Positions
- Patient assistant officer Number 1 Positions
- Village public health volunteer Number 162 Positions

9) Health Center of Community Ban La-nga

Health Center of Community Ban La-nga is located at Moo 7 Ban La-nga Banna subdistrict, Chana, Songkhla. Responsibility service covers 4 villages which are Moo 4 Ban kokked, Moo 6 Ban Tachamuang, Moo 7 Ban La-nga, and Moo 9 Ban Numkhem by which operation staffs consist of

- Professional nurse Number 4 Positions
- Public health officer Number 1 Positions
- Village public health volunteer Number 156 Positions

The public health positions of those Subdistrict Health Promotion Hospital are classified by governmental structure of the Ministry of Public Health by which the number of staffs are categorized according to the size of Subdistrict Health Promotion Hospital (3 sizes) which are Small Subdistrict Health Promotion Hospital for responsible of population less than 3,000 capita, Medium Subdistrict Health Promotion Hospital for responsible of population between 3,001-8,000 capita, and Large Subdistrict Health Promotion Hospital for responsible of population more than 8,001 capita.

Considering for the size of Subdistrict Health Promotion Hospitals in the study area, it was found that there are 2 Small Subdistrict Health Promotion Hospitals, and 6 Medium Subdistrict Health Promotion Hospitals without any Large Subdistrict Health Promotion Hospital. Those Subdistrict Health Promotion Hospitals have high work load for nurses, while public health staffs have slightly high work load as shown in the Table 4.5.2-3.

Table 4.5.2-3

Staff management for Subdistrict Health Promotion Hospital in the Study area

Subdistrict Health Promotion Hospital	Size	Function (person)	
		Nurse	Public health staff
Ku Subdistrict Health Promotion Hospital	Medium	1 : 3,743	1 : 2,495
Nawah Subdistrict Health Promotion Hospital	Medium	1 : 3,157	1 : 1,579
Tamorsai Subdistrict Health Promotion Hospital	Medium	1 : 3,380	1 : 2,254
Sapanmaikan Subdistrict Health Promotion Hospital	Medium	1 : 3,111	1 : 1,245
Paching Subdistrict Health Promotion Hospital	Medium	1 : 1,482	1 : 2,223
Health Center of Community Ban La-nga	Medium	1 : 1,099	1 : 4,393
Khae Subdistrict Health Promotion Hospital	Small	1 : 2,911	1 : 2,911
Khuntudwai Subdistrict Health Promotion Hospital	Small	1 : 2,979	1 : 1,490
Criteria of the Ministry of Public Health		1:2,500	1:1,250

Remark : Small Size Subdistrict Health Promotion Hospital has responsibility for population less than 3,000 capita

Medium Size Subdistrict Health Promotion Hospital has responsibility for population between 3,001-8,000 capita

Source : Subdistrict Health Promotion Hospital , 2559

(3) Illness statistic of population classified by 21 causes of disease (Ror Ngor 504)

Illness statistic of population classified by 21 causes of disease was used to represent illness condition of local people which is described as follows.

1) Chana Hospital

Illness statistic of population who used health service from the Chana Hospital (data collected from the Chana Hospital) was classified by 21 causes of disease during B.E. 2554-2558. Illness statistic revealed that;

In B.E. 2554, top 5 disease of out-patient were circulatory system, followed by gastrointestinal tract diseases, respiratory diseases, endocrine system disease, and nutrition and metabolism and mental and behavioral disorders by which the patient ratio to a thousand population were 243.5, 197.6, 194.1, 160.7, and 133.1, respectively,

In B.E. 2555, top 5 disease of out-patient were circulatory system, followed by gastrointestinal tract diseases, respiratory diseases, mental and behavioral disorders, and endocrine system disease, nutrition and metabolism by which the patient ratio to a thousand population were 249.0, 198.9, 197.6, 171.3, and 138.8, respectively,

In B.E. 2556, top 5 disease of out-patient were mental and behavioral disorders, followed by circulatory system, respiratory diseases, gastrointestinal tract diseases, and muscle and structure with supporting tissue disease by which the patient ratio to a thousand population were 381.4, 248.6, 203.3, 199.7, and 143.1, respectively,

In B.E. 2557, top 5 disease of out-patient were circulatory system, followed by gastrointestinal tract diseases, respiratory diseases, endocrine system disease, nutrition and metabolism and mental and behavioral disorders by which the patient ratio to a thousand population were 252.5, 198.8, 184.1, 179.3, and 143.1, respectively, and

In B.E. 2558, top 5 disease of out-patient were circulatory system, followed by endocrine system disease, nutrition and metabolism, respiratory diseases, gastrointestinal tract diseases, and other diseases which are diagnosed by laboratory by which the patient ratio to a thousand population were 244.2, 191.5, 176.7, 183.4, and 117.4, respectively.

2) Ku Subdistrict Health Promotion Hospital

Illness statistic of population who used health service from the Ku Subdistrict Health Promotion Hospital (data collected from the Ku Subdistrict Health Promotion Hospital) was classified by 21 causes of disease during B.E. 2554-2558. Illness statistic revealed that;

In B.E. 2554, top 5 disease of out-patient were respiratory diseases, followed by gastrointestinal tract diseases, other diseases which are diagnosed by laboratory, circulatory system, and muscle and structure with supporting tissue disease by which the patient ratio to a thousand population were 258.8, 184.3, 147.5, 125.9, and 42.9, respectively,

In B.E. 2555, top 5 disease of out-patient were respiratory diseases, followed by other diseases which are diagnosed by laboratory, gastrointestinal tract diseases, circulatory system, and muscle and structure with supporting tissue disease by which the patient ratio to a thousand population were 233.2, 184.5, 139.9, 103.6, and 28.9, respectively,

In B.E. 2556, top 5 disease of out-patient were respiratory diseases, followed by other diseases which are diagnosed by laboratory, circulatory system, gastrointestinal tract diseases, and muscle and structure with supporting tissue disease by which the patient ratio to a thousand population were 265.3, 194.9, 177.9, 149.3, and 41.5, respectively,

In B.E. 2557, top 5 disease of out-patient were respiratory diseases, followed by other diseases which are diagnosed by laboratory, gastrointestinal tract diseases, circulatory system, and muscle and structure with supporting tissue disease by which the patient ratio to a thousand population were 283.6, 196.0, 170.4, 155.1, and 57.3, respectively, and

In B.E. 2558, top 5 disease of out-patient were respiratory diseases, followed by gastrointestinal tract diseases, circulatory system, other diseases which are diagnosed by laboratory, and muscle and structure with supporting tissue disease by which the patient ratio to a thousand population were 225.8, 128.0, 126.0, 117.2, and 42.5, respectively.