



## Environmental Impact Assessment Report

**Project Name : Muang Rayong Combined Heat and Power Generation Plant**

**Project Location : IRPC Industrial Park  
Choengneon Subdistrict, Amphor Muang,  
Rayong Provice**

**Project Owner's Name : IRPC Public Company Limited**

**Project Owner's Address : 555/2 Energy Complex Tower B, Floor 7,  
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**Authorization :**

- ( / ) The Project Owner has given Power of Attorney to Thai Environmental Technic Limited to submitted the report.
- ( ) The Project Owner has not granted Power of Attorney

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**Environmental Impact Assessment (Executive Report)**  
**Muang Rayong Combined Heat and Power Project**  
**Located at IRPC Industrial Park**  
**Cheongneon, Muang, Rayong Province**

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**1. Introduction**

**1.1 Businesses of IRPC Public Co., Ltd.**

IRPC Public Company Limited which will be further called “Company” is the entrepreneur for integrated refinery and petrochemistry. The company started by producing and selling of plastic pellets in B.E. 2525 and continue expanded the production line for various plastic pellets, including the expansion of plants and basic infrastructures for the integrated petrochemical industry. Nowadays, IRPC Group is the first integrated petrochemical industrial entrepreneur in the Southeast Asia. The IRPC plant is located at Tambol Cheongneon, Muang District, Rayong Province which is the Industrial Park under the control and management of IRPC with fully infrastructure support for the integrated petrochemical industry such as deep-water port, fuel oil depot and power plant etc.

**1.2 Objectives of project**

IRPC Public Company Limited has planned to develop the project entitled “*Muang Rayong Combined Heat and Power Project*” which will be further called “Project”. The capacity of the power producing is 240 MW.

**1.3 Necessity for project development**

From the expansion of population and economy of Thailand, it is resulted in the increasing demand for energy consumption of households, businesses and industries. The company has operated the business related to petrochemical industry, oil refinery and energy industry as the public company in order to develop land utilization for industrial development, and provide facilities and infrastructures for the operation of industries. Per surveying data, it is found that the demand of steam and power for industries inside the IRPC Industrial Park is now continuously increasing as a result of expansion of industrial capacity and plants

Ministry of Energy together with Electricity Generating Authority of Thailand (EGAT) have provided the power development plan (PDP) to supply the energy for the country, to buy power from neighboring countries, to buy power from the Small Power Producer (SPP) and Very Small Power Producer (VSPP) and to distribute the power consumption for electricity production as indicated in PDP 2010 (B.E.2553-B.E.2573). In addition, they are concerned also on the power security, greenhouse gases reduction, increasing power efficiency and promoting of efficient process for electricity production. The cogeneration processes came as the efficient technology and utilized the highest efficiency for natural gas consumption, particularly the Small Power Producer (SPP) cogeneration.

From the mentioned Power Development Plan of Thailand, the company has planned to develop the SPP cogeneration with power and thermal productions under the capacity of 240 MW using the natural gases as fuel. The project is entitled "Muang Rayong Combined Heat and Power Project" in order to build up the power security for Eastern region of Thailand and reduce the burden of Thai's government for power investment, including build up the security related to electricity for the industries in the IRPC Industrial Park.

#### **1.4 Governmental policies related to project**

Ministry of Energy together with Electricity Generating Authority of Thailand (EGAT) have provided the power development plan (PDP) by the cabinet on March 23, B.E. 2553 and approved following the resolution of Energy Regulatory Commission (ERC) on March 12, B.E.2553 for the power development plan of Thailand B.E.2553-B.E.2573 (PDP2010). The plan is to provide security for power consumption in the near future, stimulate the investment for power, enhance reliability for power producers and respond to the policies of GHGs reduction from the power generation sector. In addition, the security for power generation is aimed to achieve together with environmental quality conservation by promoting the renewable power generation which is harmonized with the renewable power plan (within 15 years) and increasing the efficiency of power consumption and promoting the efficient electricity generation using the cogeneration system.

The cabinet on November 30, B.E. 2553 has approved the resolution of Energy Regulatory Commission (ERC) for the short-term plan (B.E.2554-2562) to handle the increasing demand of electricity as projected following the PDP 2010 as well as the slowing down of development of independent power producers (IPP). Thus, the revised plan was proposed for the power development plan of Thailand B.E.2553-2573 (PDP2010-Revision No.1).

The cabinet on May 3, B.E.2554 has approved the resolution of Energy Regulatory Commission (ERC) on April 27, B.E.2554 for the delay of the development of nuclear power plant for 3 years to revise for the security and safety issues after the accidents of nuclear power plant in Fukushima that resulted in unrecognition of people in many countries. With these reasons, the second revised plan was proposed for the power development plan of Thailand B.E.2553-2573 (PDP2010-Revision No.2).

The cabinet on December 27, B.E.2 5 5 4 has approved the resolution of Energy Regulatory Commission (ERC) on November 30, B.E.2554 for the renewable and alternative power development plan of 25% within 10 years (B.E.2555-2564) and the power conservation plan for 20 years (B.E.2554-2573). Thus, the third revised plan was proposed for the power development plan of Thailand B.E.2553-2573 (PDP2010-Revision No.3) to be harmonized with the increasing demand of power consumption following the Governmental New Action Plan in which there are a number of infrastructure development plans such as development of railway transportation (i.e. 10 lines of electricity trains in Bangkok and high speed trains etc.). In addition, to enhance the power security and mitigation of global warming impacts, appropriate distribution of power, import of electricity and backup of electricity should be conducted. However, the portion of CO<sub>2</sub> should be remained the same as specification in the PDP2010-Revision No.2.

For the clean power development and increasing efficiency of power consumption, it was addition proposed from the PDP2010-Revision No.2 to enhance the efficiency of power consumption by promoting the cogeneration system for electricity generation. The electricity produced by SPP and VSPP with the concentration system will be purchased more during the final stage of the plan without the specified period and quantity (excluding the Firm type).

## **1.5 Options for project development**

Development of Muang Rayong combined heat and power project using natural gas as fuel is harmonized with the PDP in which power will be purchased from the small power producer (SPP) as stated in PDP2010 (B.E.2553-B.E.2573). This plan is to focus on efficiency of power consumption and of power production via combined heat and power system (Cogeneration). The Electricity Generating Authority of Thailand (EGAT) selected IRPC Public Company Limited for the small power producer as firm type of contract with cogeneration system B.E.2553. The project is under the demand framework of 1,500 MW. The distribution of power to the system is indicated in the Schedule Commercial operation Date (SCOD) approved by the Energy Regulatory Commission (ERC) on February 11, B.E.2554.



## **1.6 Benefits of the project development**

Muang Rayong combined heat and power project will bring out the benefits for the country both at national and local levels as follows.

### **1) National level**

- (1) Building up the power security in Eastern Region of Thailand.
- (2) Reduction of investment burdens for Thai's Government for electricity generation and mega project that is mainly from taxes by handing over to the private sector.
- (3) Reduction of power import from other countries and hence reducing the total trade balance.
- (4) Promotion of efficient power generation of combined heat and power system with clean and advance technology.

### **2) Local level**

- (1) Project will co-fund for "power development fund of IRPC Public Company Limited" for the community to be used to enhance their living quality and environmental sustainability. Representatives of communities surrounded the project will be joined as committee for fund management under supervision of the Energy Regulatory Commission (ERC).
- (2) People will be able to participate for the management of power development fund. This is recognized as the promotion of people participation.
- (3) IRPC Public Company Limited will be fully and appropriately support various types of community development project to enhance the local development.
- (4) Taxes generated by the project will be directly paid to the Local Administration Organization that will be help enhancing the project development of the community.

## 1.7 Necessity for EIA report preparation

Muang Rayong Combined Heat and Power Project using natural gas with the capacity of 240 MW is accounted as the thermal power plant having higher than 10 MW in capacity. Thus, the project included in the types of thermal power plant specified in the attachment of the Notification of Ministry of Natural Resources and Environment entitled “specified type and capacity of project or business that must prepare the environmental impact assessment report (EIA report) and criteria, methodology, procedure and guideline for the preparation of EIA report (April 24, B.E.2555)”. Thus, the project must submit the EIA report to the Office of Natural Resources and Environment Policy and Planning (ONEP).

Therefore, IRPC Public Company Limited has appointed Thai Environmental Technic Limited (which will be further called “Consultant”) to study and prepare the EIA report for the Muang Rayong Combined Heat and Power Project to be submitted to ONEP for further consideration in accordance with the Enhancement and Conservation of National Environmental Quality Act B.E. 2535 for further approval.

## 1.8 Objectives

The EIA report for Muang Rayong Combined Heat and Power Project has the following objectives:

1) To study the project description such as location, project components, processes, infrastructure system, pollution and control, emergency prevention and control and risks of project development, and other details related the construction and operation of project.

2) To study the existing environment, natural resources and use values of the study area in which there are physical resources, biological resources, human use values and quality of life values.

3) To assess the expected impacts of construction and operation of project to the environment, natural resources and use values in 4 categories: physical resources, biological resources, human use values and quality of life values as well as health impact assessment, respectively.

4) To specify the prevention and mitigation measures for the possible impacts on environment, natural resources and various use values from construction and operation of project in order to minimize the severity of impacts.

5) To specify the monitoring programs for the possible impacts on environment, natural resources and various use values from construction and operation of project and to inspect the efficiency of the environmental prevention and mitigation measures.

## **1.9 Scopes and methodology**

### **1.9.1 Area scope**

For the assessment of environmental impacts of project, consultant has studied the existing environmental situation covering the project and surrounding area in the distance of 5 km radius. This area is classified as the potential area for environmental impacts. The area will be further called “study area” that covers some parts of Tambol Cheongneon, Tambol Tapong, Tambol Banlaeng and Rayong City Municipality, Muang Rayong District, Tambol Natakwan, Muang Rayong District and Tambol Takhan, Bankai District, Rayong Province. The covering area is shown in **Figure 1.9.1-1**.

### **1.9.2 Technical scope**

For the technical scope of the study and the components of EIA report, consultant has specified it in according to the guidelines and criteria for preparation and consideration of EIA report, particularly for the power project of the Office of Natural Resources and Environmental Policy and Planning (ONEP) including guidelines for people participation and social environmental impact assessment in the EIA of the Office of Natural Resources and Environmental Policy and Planning (ONEP), Ministry of Natural Resources and Environment, August B.E.2549.

## **1.10 Operation plan of project**

Operation plan for Muang Rayong Combined Heat and Power Project will spend around 48 months starting from design, construction, starting up and distribution of electricity to the system following the plan shown in **Table 1.10-1**. Project will start the construction in B.E.2556 and start up the electricity operation in B.E.2560. Nowadays, project is in the stage of engineering design.

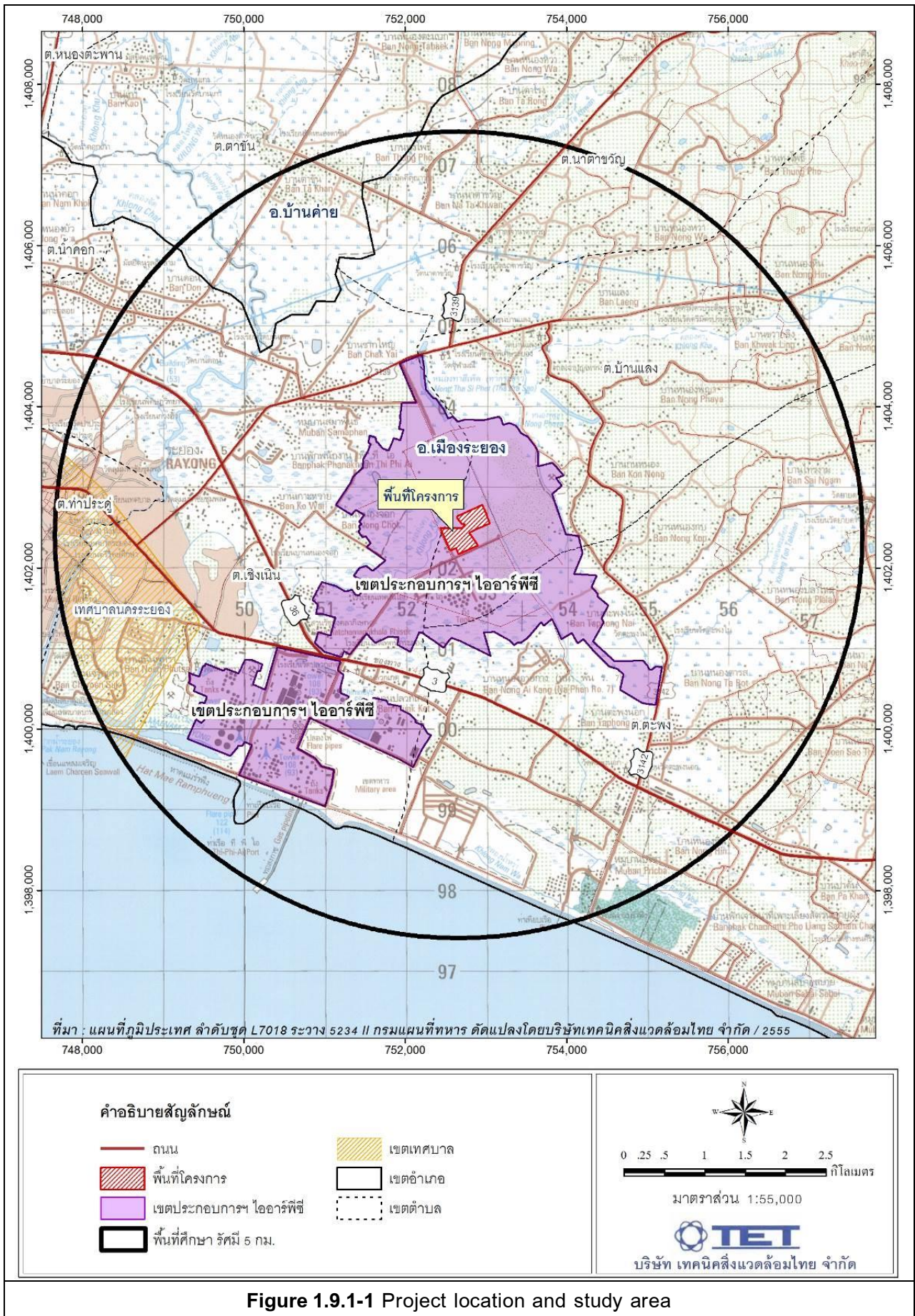


Figure 1.9.1-1 Project location and study area

**Table 3-1 Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1. Physical resources</b></p> <p><b>1.1 Geography</b></p> <p>Rayong province is located on the east coast of Thail Gulf with an area size of 3,552 km<sup>2</sup>, or 2,220,000 Rai, approximately, estimated to be 10.33% of total area of the east region of Thailand. It is 179 km. away from Bangkok. In the south of Rayong, the landscape is mainly sandy shore with long sandbank across from east-west of the coast. The area next to the coast is floodplains during the whole year. The main area of Rayong can be described as undulating and rolling, while many mountains are found in the north, east and the center of the province across the north-south.</p> <p>The study area is located in Amphur Maung Rayong, locating in the south of the province with a tidal flat geography at the coastal area from the sandbank to the north, including Rayong estuary. General characteristic of such area are floodplains during the whole year while the nearby zone can be described as alluvial plain and flood plain.</p>	<p><b>Construction phase</b></p> <p>The project is located in IRPC industrial estate land which has been allocated since B.E. 2525. Currently, the area is awaiting for land use within the industrial estate zone such that area grading for further development is unlikely to affect the change of topographical features. In addition, no construction activities conducted in the zone, therefore, presumably, there is no significant impacts towards geology and rock layers in the project area.</p> <p><b>Operation phase</b></p> <p>The project is located in IRPC industrial estate land which has been allocated since B.E. 2525. The project operation during the operation phase is unlikely to cause the impacts on geography, soil resource, and geology.</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.2 Geology and Earthquake</b></p> <p><b>1) Geology</b></p> <p>Geology in Amphur Maung Rayong and Amphur Ban Khai can be described as: floodplain deposits which comprises sandy sediments, silt; colluvial deposits which are gravels, sand, soil, and laterite; beach-sand deposits influenced by sea waves as beach sand, sandbar, and sandbank; and coastal deposits influenced by tides with a topography of mud, mire, fine sand, mangroves, swamp forest and wetland.</p> <p><b>2) Earthquake</b></p> <p>According to earthquake history, Thailand is located on partiality of Eurasian plate which is surrounded by 2 tectonic as Indian plate and Pacific plate. Probability of earthquake in Thailand is estimated as low level. According to the map demonstrating earthquake risk area in Thailand, the study area, located in Amphur Maung Rayong and Amphur Ban Khai, is categorised in the region no. 1, which is identified as a low risk zone for earthquake incident.</p>	<p>The project zone is located in region no.1, is considered as low risk zone in probability of earthquake, according to Thailand earthquake risk area map (revised version no. 2 B.E. 2548) categorised by Department of Mineral Resources, Ministry of Natural Resources and Environment, Division of Geological techniques, January B.E. 2548. This area is defined as a low risk zone while the vibration from earthquake may be felt by the residents living in high-rise building with the scale size of 3 -4 Mercalli. However, in the construction process, the project has designed the structure with appropriate foundation which is strong enough against the impact which may occur. Therefore, the negative impact (-) is estimated to be at low level (1).</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.3 Soil resources</b></p> <p>Soil series no. 6 is found in the project area. It is originated from the deposits accumulation on the river terrace (older terrace deposits). The drainage property of the soil in this area is low while clay is found at a huge depth of the ground, with low level of nutrients. The soil is acidic is some area. Meanwhile, water shortage problem is found whereas, in rainy season, flooding case damages towards hydrophobic plants.</p>	<p><b>Construction phase and Operation phase</b></p> <p>It is appeared that during the construction phase and operation phase, none of the project activities could affect the soil quality as there is no chemical transfer in the project zone. The activities operated would include area grading and compacting, therefore, the impact towards soil erosion is estimated to be at low level. Meanwhile, when the operation phase starts, the area surface will be changed to concrete and green area which could prevent the soil erosion occurrence. The ground level in the project zone does not cause the slope in such area such that the negative impact towards the soil erosion occurrence (-) is estimated to be mild (1).</p>		



**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.4 Climate and Meteorology</b></p> <p><b>1) Climate</b></p> <p>The weather condition in Rayong can be described as tropical monsoon with the whole year sea breeze. The weather is slightly hot but not too hot as well as cool across the coastal area. The weather in this area is unique that the temperature is unlikely to change over times while humidity is high. This characteristic is influenced by south-west and north-east monsoon which cause three different seasons in Thailand as rainy season, cool season and hot summer.</p> <p><b>2) Meteorology</b></p> <p>According to the climate data of 30 year cycle (B.E. 2514-2543) recorded by Rayong meteorology station, located at latitude 12 degree 38 lipda north and longitude 101 degree 21 lipda East, at 3 m above mean sea level, it can be summarised as follows</p>			



**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.4 Climate and Meteorology (continued)</b></p> <p>(1) Mean annual temperature is 28.2 °C, mean annual maximum temperature is 34.1°C, mean annual minimum temperature is 20.8 °C.</p> <p>(2) Mean annual relative humidity is 77 % with the range of 69-83%.</p> <p>(3) Mean annual evaporation rate was 1,732.5 mm, the highest evaporation rate was detected as 170.8 mm whereas the lowest evaporation rate was detected as 115.2 mm.</p> <p>(4) Average wind speed was in the range of 2.3-2.8 knot, the maximum wind speed was 50 knot.</p> <p>(5) Average annual rainfall was 1,401.3 mm.</p>			

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.5 Air quality</b></p> <p>The consultant has collected secondary data on atmospheric air quality monitoring in the study area and its neighbouring zone from Rayong industrial project performance report on environmental management regarding impact mitigation and monitoring measures B.E. 2552-2555 by IRPC Public Co., Ltd. There are 5 air quality monitoring stations air quality monitoring station located in the study area which includes IRPC industrial estate zone (A1), Rayong city park village (A2), Nong Chok health service centre (A3), Wat Ban Lang school (A4), and IRPC Technology school (A5). The recorded air quality parameters are Sulfur dioxide (24-hr), Nitrogen dioxide (1-hr), and Total Suspended Particulate (24-hr). The air quality measured according to such parameters were below the standard limits which can be summarised as follows;</p>	<p><b>Construction phase</b></p> <p>Significant air pollutant during the construction phase is predicted to be dust which is generated from the foundation works, area preparation, area grading, and transportation during the construction. Factors which may influence the dust quantity are characteristics and scales of the tasks, soil moisture, wind speed, and the length of the construction period, etc. The generated dust is considered as suspended particulate which may disperse in limited zone of the project area. This may affect workers in such area.</p> <p>The consultant has assessed the air quality impact during the construction phase by AERMOD mathematical model based on the activities which may cause impacts from total suspended particulate (TSP). The predicted calculation of maximum average 24-hr TSP was 22.66 µg/m<sup>3</sup> over the project zone, which is at acceptable level according to the standard criteria.</p>	<p><b>Construction phase</b></p> <p><b>(a) Transportation for workers and construction materials</b></p> <ul style="list-style-type: none"> <li>- Covering materials/ must be provided for material transporting trucks to avoid material dropping or dust dispersion.</li> <li>- Prevent soil debris contamination with the vehicle wheels when leaving the construction area.</li> <li>- Limit the vehicle speed in the project area at 40 km/hr</li> </ul> <p><b>(b) The construction area</b></p> <ul style="list-style-type: none"> <li>- Perform water spraying in the construction zone to prevent dust dispersion 2 times a day (morning-afternoon)</li> <li>- Conduct routine inspection for device/ machines operated in the project area.</li> <li>- Provide the instruction for cleaning and improving the construction area.</li> <li>- Solid waste/ material burning is not allowed in the construction area.</li> </ul>	<p><b>Construction phase</b></p> <p><b>Air Quality</b></p> <p><u>Parameters</u> : To measure Total Suspended Particulates (TSP) and average 24-hr 10 micron Particulate Matter (PM-10), wind speed and wind direction.</p> <p><u>Monitoring station</u> : To measure the parameters at 2 stations (according to <b>Figure 3</b>)</p> <ul style="list-style-type: none"> <li>• A1 IRPC Technology college</li> <li>• A2 Ban Gonnong, Moo 2, Tambon Banlang</li> </ul> <p><u>Frequency</u> : To monitor air quality 3 day continuously for 1 time during area grading until the completion of machine installation.</p>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.5 Air quality (continued)</b></p> <p><b>1) Sulferdioxide (SO<sub>2</sub>)</b></p> <p>According to the monitoring results, 24-hr average SO<sub>2</sub> was in the range of 0.00-0.045 ppm, while the maximum level was detected in B.E. 2553 at IRPC industrial estate zone. However, the SO<sub>2</sub> level tends to improve according to the detected levels in November B.E. 2552 and in February B.E. 2553. Meanwhile, the measuring results detected at all monitoring stations during B.E. 2552-2555 were not at stable levels.</p>	<p><b>Operation phase</b></p> <p>The consultant company has conducted air quality impact study by using mathematical model based on key factors relevant to 2 types of sources: point source (the project area) and other sources (other area located surrounding the project zone).</p> <p>The study results suggested the air quality impacts as follows;</p> <p>1) Impact prediction according to the project source: In case of Partial Load and Full Load operation, it suggested that maximum ground level concentrations of NO<sub>2</sub> SO<sub>2</sub> and TSP at 14 observation points were in the range of the standard levels.</p>	<p><b>Operation phase</b></p> <p><b>1) Stack emission control</b></p> <p>- To control stack emissions as follows: maintaining NO<sub>x</sub> at 60 ppm (5.13 g/ s/ stack), SO<sub>2</sub> at 5 ppm (0.59 g/ s/ stack), TSP at 5 ppm (0.23 g/ s/ stack).</p> <p>- To control based on standard atmosphere at temperature 25<sup>o</sup>C, pressure 1 ATM under dry condition that % excess air is at 50%, or % excess oxygen is at 7%.</p>	<p><b>Operation phase</b></p> <p><b>1) Ambient air quality</b></p> <p><u>Parameters</u> : NO<sub>2</sub>, SO<sub>2</sub>, TSP, Wind speed and wind direction (at 1 monitoring station)</p> <p><u>Monitoring stations</u> : measure at 4 monitoring station (according to <b>Figure 5</b>)</p> <ul style="list-style-type: none"> <li>• Wat Pluagket (A3)</li> <li>• Bangonnong health promoting hospital (A4)</li> <li>• Wat Na Ta Kwuan (A5)</li> <li>• Rayong Punyanukul school (A6)</li> </ul> <p><u>Frequency</u> : To measure 2 times annually based on 7-day continuously monitoring each time between March-April and between November – December.</p>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.5 Air quality (continued)</b></p> <p><b>2) Nitrogen dioxide (NO<sub>2</sub>)</b></p> <p>According to the monitoring results, 1-hr average NO<sub>2</sub> was in the range of 0.00004-0.037 ppm, while the maximum level was detected in October B.E. 2553 at Nong Chok health service centre station. However, the NO<sub>2</sub> level tends to improve according to the detected levels in October B.E. 2552. Meanwhile, the measuring results detected at all monitoring stations during B.E. 2552-2555 were not at stable levels.</p>	<p>2) Impact prediction according to other sources in IRPC industrial estate land: It was found that most of ground level concentrations of NO<sub>2</sub>, SO<sub>2</sub> and TSP at 14 observation points were in the range of the standard levels, except ground-level 1-hr average NO<sub>2</sub> and 1-hr average SO<sub>2</sub> concentrations were exceeded the standard levels in Pra Baht and Khao Ta Chud area, approximately 10 km away from the project zone where one of artificial land use found.</p> <p>3) Impact prediction according to the project operation in case of Partial Load and Full Load operation along with boiler sized 120 tonnes/ hr, combined with other sources in IRPC industrial estate zone; the results suggested that most of ground-level concentrations of NO<sub>2</sub>, SO<sub>2</sub> and TSP at 14 observation points in the sensitive area were in the range of the standard criteria, except ground-level concentrations of 1-hr average NO<sub>2</sub> and 1-hr average SO<sub>2</sub> measured in Pra Baht and Khao Ta Chud area ,</p>	<ul style="list-style-type: none"> <li>- To control emission rates of Total NOx Loading at the level 23.247 g/s.</li> <li>- Install Dry Low NOx Burner to control the generation of NOx automatically.</li> <li>- Install Continuous Emission Monitoring System (CEMs) according to US. EPA for measuring NOx and O<sub>2</sub> that the monitoring results are reported as 1-hr average level at dry condition, temperature 25°C, pressure 1 ATM with 7% of excess air.</li> </ul>	<p><b>2) Air quality at sources</b></p> <p>(1) To monitor the levels of ambient air pollutants by CEMs  <u>Parameters</u> : Nitrogen dioxide (NO<sub>2</sub>), O<sub>2</sub>  <u>Monitoring station</u> : HRSG, 4 stacks  <b>(Figure 4)</b>  <u>Frequency</u> : continual monitoring by CEMs</p> <p>(2) To monitor by Stack Sampling  <u>Parameters</u> : NO<sub>2</sub>, SO<sub>2</sub>, TSP  <u>Monitoring station</u> : at 4 stacks of HRSG (according to <b>Figure 4</b>)  <u>Frequency</u>: To measure 2 times annually during the same period as ambient air quality monitoring.</p>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.5 Air quality (continued)</b></p> <p><b>3) Total Suspended Particulates (TSP)</b></p> <p>According to the monitoring results, 24-hr average TSP was in the range of 0.0-166.61 µg/m<sup>3</sup>, while the maximum level was detected in January, B.E. 2553 at IRPC technology college. The trend of TSP level monitored at all monitoring stations during B.E. 2552-2555 was not stable.</p>	<p>approximately 10 km away from the project zone where one of artificial land use found.</p> <p>According to the study results above, it was found that air quality impact prediction according to other sources in IRPC industrial estate land, and air quality prediction according to Partial Load and Full Load combined with 120-tonnes/hr boiler operation along with other sources in IRPC industrial estate, maximum ground-level 1-hr average NO<sub>2</sub> and 1-hr average SO<sub>2</sub> concentrations were exceeding the standard levels. This is because AERMOD model used in this study was operated based on Gaussian Plume theory in both vertical and horizontal direction as Straight Line movement which could be considered 'over estimate' if the pollutant Plume moves towards against area with mountain geography.</p>	<p><b>2) Fuels quality control</b></p> <ul style="list-style-type: none"> <li>- Only natural gas is specified to be used as a fuel in the project operation.</li> </ul> <p><b>3) Air pollution management</b></p> <ul style="list-style-type: none"> <li>- To provide measures to conduct in case the pollutant concentrations (NO<sub>x</sub>, SO<sub>2</sub>, TSP) are higher than the limit controlled by CEMs as follows                             <ul style="list-style-type: none"> <li>● Inspect the related manufacturing process in terms of TSP, NO<sub>x</sub>, So2 recorded by CEMs.</li> <li>● Inspect CEMs of Dry Low NO<sub>x</sub> Buner and maintain it for good working condition.</li> </ul> </li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.5 Air quality (continued)</b></p> <p><b>2. Station no. 2 at Rayong city park community (A2)</b></p> <p><b>1) Sulferdioxide (SO<sub>2</sub>)</b></p> <p>According to the monitoring results of 24-hr average SO<sub>2</sub> , the results showed that it was less than 0.008 ppm in B.E. 2552, it was in the range of 0.001-0.019 ppm in B.E. 2553, it was in the range of 0.002-0.006 ppm in B.E. 2554, and it was in the range of 0.0044- 0.0047 ppm in B.E. 2555. According to National Environment Board Notification No. 24 (B.E. 2547) Re: Ambient air quality standards, which suggested that 24-hr average SO<sub>2</sub> level must not exceed 0.12 ppm, the SO<sub>2</sub> levels measured in this zone is acceptable.</p>		<ul style="list-style-type: none"> <li>● If any problem may cause from gas quality, contact PTT Public co., ltd.</li> <li>● Inspect related devices or system, for example, CEMs, if unusual condition occurs according to CEMs Fails/Error, investigate causes and the way to solve such problem. If the problem could no be figured out, call CEMs Service Provider to take action.</li> <li>- In case emission rate is at the high level after the whole process inspection, it si advised that coordinates of gas turbine operation should be adjusted as follows,             <ul style="list-style-type: none"> <li>● Test the system by decreasing coordinate of gas turbine operation and observe the levels of pollutant concentration.</li> <li>● If low coordinate is operated while the pollutant levels are still high, try increasing the coordinate of gas turbine operation.</li> <li>● If the problems could not be solved in any case, inform production manager and the plant manager stop the process so that the combustion system can be fixed.</li> </ul> </li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.5 Air quality (continued)</b></p> <p><b>2) Nitrogendioxide (NO<sub>2</sub>)</b></p> <p>According to the monitoring results of 1-hr average NO<sub>2</sub> , the results showed that it was in the range of 0.00001-0.00160 ppm in B.E. 2552, it was between 0.001-0.012 ppm in B.E. 2553, it was in the range of 0.002-0.015 ppm in B.E. 2554, and it was in the range of 0.0047- 0.0115 ppm in B.E. 2555. According to National Environment Board Notification No. 33 (B.E. 2552) Re: Nitrogen dioxide standard in ambient air, which suggested that 1-hr average NO<sub>2</sub> level must not exceed 0.17 ppm, the NO<sub>2</sub> levels measured in this zone is acceptable.</p>		<ul style="list-style-type: none"> <li>- Provide air pollutant treatment system controller who is qualified and experienced in taking care the system and related devices.</li> <li>- Provided reserved devices and spare parts sufficiently for the maintenance works of emission control system.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.6 Noise</b></p> <p>Sound level monitoring data in the study area were collected from the performance report of ABS, SAN plastic pellets production expansion project on environmental management regarding impact mitigation and monitoring measures B.E. 2552-2555 by Thai ABS Co., Ltd. The sound levels recorded in this report were measured at 2 monitoring stations at station no. 1 Wat Pluag Ket school and station no.2 Polytechnique school. Meanwhile, sound levels were measured in terms of average 24-hr Leq in the zone of IRPC technology college during 28 February until 5 March B.E. 2555, as follows.</p> <p>1) Wat Pluag Ket school: average 24-hr Leq was in the range of 58.8-60.2 dB(A)</p>	<p><b>Construction phase</b></p> <p>Noise impact from the machine and equipment operation across the sensitive area was assessed based on measured sound levels at IRPC Technology college which locates in the nearby zone of the project site, where sound level as average 24-hr Leq was between 53.8-56.0 dB(A), which is considered acceptable according to the ambient noise standard level ( specified as 70 dB(A) of average 24-hr Leq). Therefore, during the construction phase, noise imopact is considered as mild level.</p> <p>Noise impact towards community was assessed at the nearest location at IRPC technology college. Level of noise disturbance was calculated and was in the range which is acceptable by the standard according to National Environment Board Notification No. 29 ( B.E. 2550) Re: Disturbance noise which suggests that the difference between the noise generated during the time and its background noise must not exceed 10 dB(A). Therefore, the activities conducted in the construction phase tend to bring about no impact on disturbing noise.</p>	<p><b>Construction phase</b></p> <ul style="list-style-type: none"> <li>- Conduct loud noise activities, for example, foundation work, only between 08.00-17.00 hr.</li> <li>- Provide personal protective equipment, for example, ear plugs, and ear muff for construction workers when conducting tasks in working area with sound level higher than 85 dB(A)</li> <li>- Inspect and maintain the working condition of machines and equipment used in the construction activities regularly.</li> <li>- Build temporary fence surrounding the project construction area.</li> <li>- Conduct public relations to inform community surrounding the project zone about the project construction before starting the activities.</li> </ul>	<p><b>Construction phase</b></p> <p><u>Parameters</u> : average 24-hr Leq and L<sub>90</sub></p> <p><u>Monitoring station</u> : To measure sound levels at 2 locations ( according to <b>Figure 3</b>)</p> <ul style="list-style-type: none"> <li>● N1 IRPC Technology College</li> <li>● N2 Ban Gonnong Moo 2, Tambon Banlang</li> </ul> <p><u>Frequency</u> : To measure every 2 months, 5 days continuously each time during the period of area grading until machine installation.</p>



**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.6 Noise (continued)</b></p> <p>2) Polytechnique school: average 24-hr Leq was in the range of 50.8-63.1 dB(A) The results suggested that it was acceptable based on the ambient noise standard which is specified as average 24-hr Leq must not exceed 70 dB(A).</p>	<p><b>Operation phase</b></p> <p>The project will provide measures to control sound level at 70 dB(A) over its boundary zone according to Industry Ministerial Notification Re: Disturbing noise and industrial noise B.E. 2548 which specified 24-hr equivalent sound level generated from the factory/ project operation should not exceed 70 dB(A). The significant sources could be boilers, steam turbine generators, and cooling tower. The project will control noise at source not to exceed 85 dB(A) within 1 m distance, and not exceeding 70 dB(A) at the project's fence zone. However, according to sound level calculation by Decay Formula, at IRPC technology college, the noise was estimated to be 51.8 dB(A), which then calculated with other sources of the project operation, the sound level would be in the range of 51.5-52.2 dB(A), which is acceptable based on National Environment Board Notification No. 15 (B.E. 2540) on both ambient noise standard specified as Leq<sub>24hr</sub> (not exceed 70 dB(A) and maximum noise standard specified as 115 dB(A), therefore, noise impact from the project operation is estimated to be acceptable.</p>	<p><b>Operation phase</b></p> <ul style="list-style-type: none"> <li>- Provide warning signs in the area where sound level higher than 85 dB(A) may be generated.</li> <li>- Provide warning signs in the area where workers are requested to use PPE for loud noise protection.</li> <li>- Provide personal protective equipment, i.e. ear plugs and ear muffs for the workers in the working area where sound level higher than 85 dB(A) may be generated.</li> <li>- Arrange hearing test for the workers conducting tasks in loud noise area annually.</li> <li>- Inspect and maintain the machine and equipment following preventive maintenance plan regularly.</li> </ul>	<p><b>Operation phase</b></p> <p><u>Parameters</u> : average 24-hr Leq and L<sub>90</sub></p> <p><u>Monitoring station</u> :To measure sound levels at 2 locations ( according to <b>Figure 3</b>)</p> <ul style="list-style-type: none"> <li>● N1 IRPC Technology College</li> <li>● N2 Ban Gonnong Moo 2 , Tambon Banlang</li> </ul> <p><u>Frequency</u> : To measure every 2 months, 5 days continuously each time during the period of area grading until machine installation.</p> <p><u>Parameters</u> : average 24-hr Leq</p> <p><u>Monitoring station</u> : To measure sound levels at 4 locations ( according to <b>Figure 4</b>)</p> <ul style="list-style-type: none"> <li>● N3-N6 at 4 sides of the factory fence</li> </ul> <p><u>Frequency</u> : To measure the sound level 2 times per year during the same period of ambient air quality monitoring (5 days continuously including weekdays and weekend)</p>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>1.6 Noise (continued)</b></p>	<p>In terms of noise impact towards communities, assessed at the nearest zone at IRPC Technology colleges, it was found that no disturbing noise detected according to National Environment Board Notification No. 29 (B.E.2550) Re: Noise disturbing level which is specified to be not exceeding 10 dB(A), therefore, it tends to be no noise impact during the operation phase.</p>	<ul style="list-style-type: none"> <li>- Provide control room for working operation to prevent noise exposure.</li> <li>- Provide Noise Contour map in the project area when the project operation is started, and when noise sources, i.e. machine/ equipment installation, are changed or modified.</li> <li>- Plant perennial tress along the project fence to mitigate noise impact which may affect the community or nearby zone.</li> <li>- Install silencer at valves which may generate loud noise ex. steam valves, etc.</li> <li>- Always inspect the machines, apply lubricants or grease, if required, to the machine or equipment to mitigate loud noise.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>2. Hydrology and surface water quality</b></p> <p><b>1) Surface water hydrology</b></p> <p>The study area is located in lower coastal basin of rayong province. Surface water sources in the study area and the nearby zone can be described as small canals, which then flow through Thai Gulf. There 6 main canals in this area: Klong Kar, Klong Bangkacher, Klong Tubma, Klong Kuekrit, Klong Tagad Yai, and Klong Yai Da. Partiality of Klong Kar flows through IRPC industrial zone from the northeast to join Klong Bankacher prior to flowing towards the sea. Klong Tubma flows through the study area from the northwest of IRPC zone to join with Rayong River at Ban Chern Noen prior to flowing towards the sea. Klong Kuekrit was artificially built as water draining ditch for water flow from Tagrasao irrigation dam, parting from the upstream of Klong Kar flowing across Tambon Tapong towards the sea. Klong Tagard Yai flows through the study area from the north of IRPC zone prior to joining Rayong River and flowing towards the sea.</p>	<p><b>Construction phase</b></p> <p><b>(1) Impacts on surface water hydrology</b></p> <p>Existing environment of the project area can be described as industrial zone, therefore, it could be said that the project construction is unlikely to block the waterway or change the hydrology in such area.</p> <p><b>(2) Impacts on water quality</b></p> <p>Wastewater generated during the construction phase is from construction and worker activities. Workers may generate wastewater approximately 50 m<sup>3</sup>/day, which will be treated by on-site wastewater treatment system or as portabe toilet system. Wastewater from the construction activities, during area grading and foundation works generated in case of rain, will be drained towards the temporary ditch provided on the line of permanent drainage system, water sumps to collect suspended solids are provided along the drainage system so that the sediments is not drained towards IRPC drainage system. Runoff in IRPC drainage system will be collected in detention pond in IRPC industrial zone prior to discharging towards Klong Kar. This could possibly mitigate adverse impact which may occur. Therefore, it impact is estimated to be low and acceptable.</p>	<p><b>Construction phase</b></p> <p><b>Water quality</b></p> <ul style="list-style-type: none"> <li>- Provide mobile toilets with sufficient excreta storage for construction workers prior to contacting local organisation or private company to collect for further treatment and disposal.</li> <li>- Supervise the contractor to clean the construction area and collect material scraps, i.e. soil debris and plastics to prevent clogging of drainage system by such materials.</li> <li>- If any soil debris or construction materials such as cement scraps is contaminated in runoff drainage system, dredgeing will have to be conducted as soon as possible.</li> <li>- Provide effluent sump for wastewater generated from the construction activities to collect all sediments prior to discharging the effluent or spraying it over the project area to decrease dust dispersion.</li> </ul>	<p><b>Construction phase</b></p> <p><b>Effluent</b></p> <p><u>Parameters</u> : pH, BOD and suspended solids (SS)</p> <p><u>Monitoring location</u>: at Effluent sump discharge point</p> <p><u>Frequency</u> : Every 2 months during the construction phase</p>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>2. Hydrology and surface water quality (continued)</b></p> <p>Klong Yaida flows through the study area from the northeast of IRPC zone, prior to joining with Kong Kar at Ban Nong Trat. Klong Bankacher flows through the study area from the southeast of IRPC zone, joining with Klong Kar prior to flowing towards the sea at Ban Tapong nok of Tambon Tapong. Irrigation canal no. 2 was built for runoff draining to protect flooding in amphur Maung Rayong and amphur Ban Khai. The dam flows towards the sea at Ban Pak Nan community in Nakhon Rayong municipality zone.</p>	<p><b>(3) Impacts on ground water quality</b></p> <p>Groundwater is not used during the construction phase, therefore, it is unlikely that there is adverse impact towards the quality of groundwater.</p> <p><b>Operation phase</b></p> <p><b>(1) Impacts on ground water quality</b></p> <p>During the operation phase, wastewater could be generated as follow</p> <ul style="list-style-type: none"> <li>- Wastewater from daily routine activities of workers which is approximately 1.28 m<sup>3</sup>/day. The wastewater will be treated by onsite wastewater treatment system prior to discharging to effluent detention pond and discharged through IRPC drainage system.</li> </ul>	<p><b>Operation phase</b></p> <p><b>1) Water quality</b></p> <ul style="list-style-type: none"> <li>- Provide drainage system for the runoff and oil contaminated rainwater in the project zone. The contaminated rainwater will be primarily treated at the sump prior to draining from the project area towards effluent collection system and treated in central wastewater treatment system of IRPC industrial estate.</li> </ul>	<p><b>Operation phase</b></p> <p><b>Effluent</b></p> <p><u>Parameters</u> : pH, BOD, COD, SS, TDS, Oil&amp;Grease</p> <p><u>Monitoring location</u>: At effluent discharge point prior to draining towards the IRPC central wastewater treatment system no.3 (WWT3).</p> <p><u>Frequency</u> : Monthly</p>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>2. Hydrology and surface water quality (continued)</b></p> <p><b>2) Surface water quality</b></p> <p>According to environmental data monitored in the study area by IRPC Public co., Ltd. based on Rayong industrial centre project performance report on environmental management regarding impact mitigation and monitoring measures between B.E. 2552-2555, the surface water quality was measured at 4 monitoring stations at 1) Klong Kar at the upper part of IRPC zone (SW1) 2) Klong Kar in IRPC zone (SW2) 3) Klong Kar at the lower part of IRPC zone (SW3) and 4) Rayong River (SW4). In addition, the performance report of ABS, SAN plastic pellets production expansion project on environmental management regarding impact mitigation and monitoring measures B.E. 2551-2554 by Thai ABS Co., Ltd. reported surface water quality at 1 station at Klong Gon Pueg (SW5).</p>	<p>- Processed wastewater can be generated from maintenance works, machine washing and cleaning, contaminated rainwater, water quality improvement, discharge effluent and cooling water. Partiality of processed wastewater and contaminated rainwater in the effluent pond will be improved for better quality at Water Recovery Unit prior to reused again. Discharged effluent will be treated at central wastewater treatment system no. 3. According to the treated effluent quality analysis, all parameters are considered acceptable based on the standard criteria.</p>	<p>- Provide onsite wastewater treatment system which is efficient in treating generated wastewater in the project zone to meet required standards prior to discharging from the project zone.</p> <p>- Provide water recovery unit for treating effluent from demineralised water unit.</p> <p>- Provide effluent sumps for quality measurement prior to reutilisation.</p> <p>- Control water quality treated by IRPC central wastewater treatment system no.3 (WWT3) based on the standards suggested by the Notification no. 3 of Ministry of Science, Technology and Environment (B.E. 2539) as follows</p> <p style="padding-left: 40px;">BOD should be less than 20 mg/l</p> <p style="padding-left: 40px;">COD should be less than 120 mg/l</p> <p style="padding-left: 40px;">SS should be less than 50 mg/l.</p> <p style="padding-left: 40px;">TDS should be less than 3,000 mg/l</p> <p style="padding-left: 40px;">Oil&amp;Grease should be less than 5 mg/l</p> <p style="padding-left: 40px;">pH should be less than 5.5-9.0</p>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>2. Hydrology and surface water quality (continued)</b></p> <p>Parameters measured were pH, suspended solids (SS), dissolved oxygen (DO), BOD, COD, Total dissolved Solids (TDS), oil and grease, ammonia (NH<sub>3</sub>), nitrate (NO<sub>3</sub>), coliform bacteria, Chromium (Cr), Mercury (Hg), Nickel (Ni), Lead (Pb), Cadmium (Cd), Copper (Cu), Zinc (Zn), Manganese (Mn), and temperature. )</p> <p>The results of surface water quality measured at 5 stations (SW1-5), categorised as surface water source Type 3; suggested that at 4 stations at Klong Kar canal in IRPC zone, most parameters are acceptable based on the standards except DO, BOD, ammonia, nitrate and total coliform bacteria which occasionally found over the standards according to National Environment Board Notification No. 8 ( B.E. 2537) Re: Surface water quality standards. However, other sources such as household located by the river affect water quality in Sukhumvit road zone such that the pollutants in the water were found higher than limit levels.</p>	<p><b>(2) Impacts on ground water quality</b></p> <p>During the construction and operation phase, none of ground water is pumped for usage while partiality of wastewater is reused and treated in central wastewater treatment system no. 3 without discharging the effluent towards ground water sources, therefore, it is estimated that the project operation is unlikely to affect the ground water quality.</p>	<ul style="list-style-type: none"> <li>- In case water quality in effluent pond does not meet the standards, the effluent will be pumped for the treatment until its quality reached the standards prior to draining to IRPC drainage system.</li> <li>- Install automatic effluent measuring system i.e. thermometer, pressure gauge, pH meter etc.</li> <li>- Reuse effluent from detention pond as much as possible such as watering the plant in the project area, floor cleaning etc.</li> <li>- Provide qualified person (s) to take care of wastewater management in the project area.</li> <li>- Provide preventive maintenance for the wastewater treatment system regularly.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>2. Hydrology and surface water quality (continued)</b></p> <p>According to surface water quality in the source Type 5 ( for transportation purpose) at Klong Gon Puek, no standard levels has been provided yet.</p> <p><b>3) Seawater quality</b></p> <p>According to seawater quality data monitored in the study area by IRPC Public co., ltd. based on Rayong industrial centre project performance report on environmental management regarding impact mitigation and monitoring measures between B.E. 2552-2555, the seawater quality was measured at 3 monitoring stations at the end of the port 1,200 m away from the coast, coastal seawater, and seawater at Rayong estuary. According to National Environment Board Notification no. 27 (B.E. 2549) Re: Seawater standard (Type 5 for industrial and port activities),</p>			

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>2. Hydrology and surface water quality (continued)</b></p> <p>most parameters of seawater measured at the 3 stations were in the range of standards except dissolved oxygen ( DO) , coliform bacteria, Manganese (Mn) and Cadmium (Cd) that exceeded the standard levels occasionally during the monitoring period. This may cause from the contamination of municipal and industrial effluent. However, the indicative water quality was suggested to be at acceptable level.</p>			



**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>2. Hydrology and surface water quality (continued)</b></p> <p><b>4) Hydrogeology and groundwater quality</b></p> <p><b>(1) Geohydrology</b></p> <p>According to the study of groundwater hydrology, geohydrology in the study area can be described as Chao Phraya Aquifers (Qcp) where thickness of the gravel layer is not huge, 5-20 m averagely, due to its small stream size. Accumulated deposits comprises of fine sand and clay except granite area where gravels, coarse sand and clay can be found in watercourse. Rayong river basin encompasses amphur Ban Khai across amphur Maung Rayong and Huay Yai ( in amphur Banglamung) where the deposits comprise gravels, sand and clay, originated from granite, with 10-15 m layer. The water flow is approx 2-7 m<sup>3</sup> / hr, while the average width of Rayong river basin is 1-2 km, averagely.</p>			

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>2. Hydrology and surface water quality (continued)</b></p> <p><b>(2) Ground water quality</b></p> <p>The consultant has collected secondary data of groundwater quality in the study area and its neighbouring zone from the seaport project performance report on environmental management regarding impact mitigation and monitoring measures in B.E. 2551-2554 by IRPC Public Co., Ltd. The groundwater quality was measured at <b>12 station</b> as shallow well at IRPC fence (UW1), shallow well at Soi Prachapattana (UW2), shallow well at Wat Chulamanee (UW3), shallow well at Ban Lang (UW4), IRPC raw water well (UW5), shallow well at Map namyen (UW6), shallow well at Ban Tapong Nai (UW7), shallow well at soi Mai Hue Mai Aue (UW8), shallow well at Soi Tapong school (UW9), shallow well at Ban Tapong Nok (UW10), shallow well at Soi Tagard Sai 2 (UW11), and shallow well at Soi Tagard Sai 3 (UW12).</p>			

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>2. Hydrology and surface water quality (continued)</b></p> <p>Measured indicative parameters were Chloride, Turbidity, and Conductivity. The result of water quality collected from 12 stations during B.E. 2551-2554 suggested that Chloride levels at all stations were in the range that is complied with the standards specified in Natural Resources and Environment Ministerial Notification Re: Identification of academic criteria and standards for public health protection on toxic environment B.E. 2551, however, conductivity levels exceeded both the standard levels and maximum allowable concentration.</p>			

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>3. Biological resources</b></p> <p><b>1) Terrestrial biological resources</b></p> <p><b>(1) Forest resources</b></p> <p>The whole figure of forest ecology in Rayong is in a perfect condition. Most of the area is called Dry Evergreen Forest shedding the leaves upon tropical climate which is influenced by the sea, which cause raining the whole year in such area. Sizes of plants, growing densely, could vary from small size to Seedling and Sapling size. However, medium sizes plants can be rarely found according to previous cropping and gardening in such area. Vital economical plants in this area are i.e. <i>Hopea ferrea</i>. Pierre, <i>Hydnocarpus ilicifolia</i> King, <i>Afzela xylocarpa</i> (Kurz) Craib, <i>Anisoptera Costata</i> Korth, <i>Lagerstroemia colyculata</i> wall, and <i>Dipferocarpus alatus</i> Roxb, etc.</p> <p>Forest area in Amphur Maung Rayong can be categorised as 3 types as national park (1 location), arboretum (2 locations), and national forest (1 location).</p>	<p><b>1) Terrestrial biological resources</b></p> <p><b>Construction phase</b></p> <p>The project is located in IRPC industrial estate land which has been allocated for industrial development since B.E. 2525. Existing environment of such area can be described as vacant zone awaiting for industrial land use in future such that none of forest resource or wildlife is found in such area. Therefore, it can be estimated that the project operation would not affect terrestrial ecology in the study zone.</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>3. Biological resources (continued)</b></p> <p>The project area is located in the zone of eastern coast which is planned to be industrial development zone. At present, this zone has been developed for the IRPC industrial estate expansion, therefore, wild plants and conserved plants could not be found in this area. General trees are found across green area in the zone of factories and IRPC industrial estate boundary.</p>	<p><b>Operation phase</b></p> <p>Air pollutants and wastewater may affect terrestrial ecology; plants and animals, in the project zone to some extent. The project will provide air pollution control measures by limiting emissions based on the standards suggested by National Environment Board. In terms of wastewater management, partiality of the volume will be reused while the rest of it will be transferred to the central wastewater treatment system no. 3 of IRPC industrial estate land. Therefore, based on the protection measures provided, it could be estimated that negative impact (-) of air pollutants and wastewater towards terrestrial ecology would be at low level (1).</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>3. Biological resources (continued)</b></p> <p><b>(2) Wild life resources</b></p> <p>The consultant has classified details of wildlife diversity based on the forest area system, namely, Khao Laem Yha-Samed island national park, Ban Pae national floral park, Pa Kached-Pae-Glang forest national park, and Nong Sanom national floral park. It can be said that the condition of terrestrial ecological resources in this area, particularly, in national forest conservation area and national floral parks are diverse with wildlife. This is because such zones are protected and enforced by national forest management laws along with public participation on forest protection and recovery. However, when comparing with existing environment in the study area, it has been converted from forest area to residential, agricultural, and industrial area such that original ecology has been changed to the environment that wild life could not be found in this area anymore. Therefore, no conserving wild life can be found in the study area.</p>			

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>3. Biological resources (continued)</b></p> <p><b>2) Aquatic ecology</b></p> <p><b>(1) Freshwater ecological system</b></p> <p>There are small canals flowing across the study area as 6 main canals i.e. Klong Kar, Klong Tubma, Klong Tagard Yai, Klong Yaida, Klong Bangkracher and irrigation canal no.2, where the consultant surveyed aquatic ecology on planktons, fauna and fish in Klong Kuekrit and Klong Kar in the nearby zone. According to ecological sampling, it was found that 3 divisions 5 classes of 37 phytoplanktons (58.73% of total phytoplanktons found), 4 phylums 4 classes and 2 subclasses of 26 zooplanktons (41.27% of zooplanktons found). In terms of fauna sampling in the zone of Klong Kuekrit and Klong Kar, 10 species were found. Meanwhile, aquatic weeds were found on both canal banks covering approx 30% of the area. In addition, 6 species, 4 families of fish are found in Klong Kuekrit.</p>	<p><b>Construction phase</b></p> <p>During the construction phase, wastewater is generated by construction workers as well as the construction activities, however, the volume of the construction wastewater is considered low while toilet wastewater will be treated onsite wastewater treatment system prior to discharge to IRPC water drainage system. It is predicted that no significant impact may affect surface water quality. Therefore, negative impact (-) towards aquatic ecology is considered as low level (1).</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>3. Biological resources (continued)</b></p> <p><b>(2) Coastal ecology</b></p> <p>- Coastal zone of the study area encompasses the zone of Khao Laem Ya-Koh Samed including the nearby zone as Gudi islands and Talu islands. According to coastal and undersea resources survey, highly abundant condition of coral reefs was found in the zone of Kunna rock, Aow Pai rock, Aoe Jeck, Aow Giw Na in Koh Chan, Koh Plai teen, Koh Gudi and Koh Talu. Diversity of marine animals found are Table coral, Cauliflower coral, australiensis, Long Valley Coral, Mushroom Coral, Soft Coral, Sea Urchins, sea Cucumber, Green Turtle, Sea Anemone, Snail eater pangasius, Sand goby, Anchovy, Sand whiting, Cone snail, Hard shell, Thorny oyster, Horned ghost crab, and Hairy rock crab, etc.</p>	<p><b>Operation phase</b></p> <p>Processed wastewater and contaminated rainwater may affect aquatic ecology. Effluent detention pond with a size of 8,000 m<sup>3</sup> is provided as well as Water Recovery Unit so that the effluent can be reused as much as possible. The remaining effluent is discharged to central wastewater treatment system no. 3 which has the maximum capacity of wastewater treatment as 3,000 m<sup>3</sup>/day. At present, the system is running for 900 m<sup>3</sup>/day of wastewater volume, or 30% of total capacity of the system. This means the wastewater treatment plant has sufficient capacity for generated wastewater volume in the industrial estate zone. According to previous analysis of treated effluent by WWT3, it was found that all parameters were in the range of acceptable standard level. Therefore, it can be estimated that the impacts towards aquatic ecology is at low level.</p>		



**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>3. Biological resources (continued)</b></p> <p>- Rayong estuary in Amphur Maung is considered as the nearest coastal ecology to the project zone. The area can be described as mangrove forest area influenced by seawater from Thai Gulf and freshwater from Rayong River. The topography is muddy low-plain area with the size of 300 Rai. The mangrove trees include Olive mangrove, mainly found with an age of 100 years, and Red Mangrove. In addition, a few of other plants were found as Sea Hibiscus, Coast cotton tree, Pomerac, Cork tree, Black Mangrove, Littorea, and Mangrove palm. Marine animals are found, although not as many as in the old days, the villagers still suggested that they are abundant, for example, White perch, Milkfish, Mullet, Three spotted tilapia, Giant Malaysian prawn, Tiger prawn, Geloina, Leahed Telline, Mangrove crab, Flower crab, and Black crab.</p>			

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values</b></p> <p><b>1) Land use across the study area</b></p> <p>The project is located in the zone no. 2.14, identified as violet colour, allocated for industrial activities and cargo location. Public utilities are provided in this area, meanwhile, the area is limited approx. 15% as the maximum for such facilities.</p> <p>According to the land use survey of the area located within 5 km distance of the project location, there 12 typical landuses as follows,</p> <p><b>(1) Agricultural zone</b> encompasses an area of 20.69 km<sup>2</sup> or 28.08% of the study area.</p> <p><b>(2) Residential area</b> encompasses an area of 30.67 km<sup>2</sup> or 41.63 % of the study area.</p> <p><b>(3) Commercial zone</b> encompasses an area of 0.80 km<sup>2</sup> or 1.09 % of the study area.</p>	<p><b>1) Land use</b></p> <p>The construction of Rayong combined heat and power plant project, which uses natural gas as a fuel, will be conducted in the zone of IRPC industrial estate land, which is allocated for industrial purposes. This is related to the specification of land use according to Ministerial regulation on Rayong land use B.E.2549, identified as a violet zone for cargo location and industrial activities, mainly. This suggests that the project location would not affect towards the land use in the study area.</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p> <p><b>(4) Industrial zone</b> encompasses an area of 8.76 km<sup>2</sup> or 11.89 % of the study area.</p> <p><b>( 5) Governmental institutional zone</b> encompasses an area of 0.41 km<sup>2</sup> or 0.56 % of the study area.</p> <p><b>(6) Road surface</b> encompasses an area of 0.82 km<sup>2</sup> or 1.11 % of the study area.</p> <p><b>(7) Grass land and shrubbery</b> encompasses an area of 6.18 km<sup>2</sup> or 8.39 % of the study area.</p> <p><b>(8) Animal cultivation area</b> encompasses an area of 2.05 km<sup>2</sup> or 2.78 % of the study area.</p> <p><b>(9) Basin</b> encompasses an area of 1.25 km<sup>2</sup> or 1.70 % of the study area.</p> <p><b>(10) Watercourse</b> encompasses an area of 2.00 km<sup>2</sup> or 2.71 % of the study area.</p> <p><b>(11) Sea area</b> encompasses an area of 4.86 km<sup>2</sup> or 6.06 % of the study area.</p> <p><b>( 12) Other areas</b> surrounding the project location are used for various purposes which encompass an area of approx. 0.05 km<sup>2</sup> or 0.07 % of the study area.</p>			

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p> <p><b>2) Transportation</b></p> <p><b>Land transport networks</b></p> <p>Main transportation in the study area near IRPC zone comprise of 2 main routes as Highway no. 3 and Highway no. 36 where goods and raw materials are transported via these routes to Maung Rayong.</p>	<p><b>2) Transportation</b></p> <p>Traffic volume data on Highway no. 3 and Highway no. 36 were surveyed based on daily average traffic volume during B.E. 2552-2554.</p> <p><b>Construction phase</b></p> <p>According to traffic volume data and traffic flow assessment on public roads in the nearby zone, it is predicted that negative impact (-) of the construction activities on transportation tend to be at low level (1).</p>	<p><b>2) Transportation</b></p> <p><b>Construction phase</b></p> <ul style="list-style-type: none"> <li>- Conduct training for material truck drivers and employee bus drivers to follow the traffic rules strictly.</li> <li>- Limit the vehicle speed at 40 km/hr in the construction area.</li> <li>- Check/ inspect vehicle engine/ machines used in the construction activities according to suggested protective maintenance guideline regularly ( as indicated in the machine manuals)</li> <li>- Avoid transporting the construction materials during rush hours ( between 07.00-09.00 hr and 16.00-19.00 hr)</li> <li>- Control weights carried by vehicles according to legal regulations to prevent damages of road surface.</li> <li>- Organise traffic system in the construction area along with providing a person to get in charge with vehicles transporting in and out the construction zone.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p>	<p><b>Operation phase</b></p> <p>According to traffic flow assessment on Highway no. 3 at milestone no. 246+000 and milestone no. 246+753, and on Highway no. 3 6 at milestone no. 38+200 and milestone no. 37+087, it can be summarised that, during the operation phase, the traffic volume and traffic flow is likely to be affected by negative impact (-) at low level (1).</p>	<p><b>Operation phase</b></p> <ul style="list-style-type: none"> <li>- Collaborate with IRPC industrial estate land in supervising vehicle drivers to follow the traffic rules strictly, so that accident can be prevented.</li> <li>- Avoid the transportation during rush hours (between 07.00-09.00 hr and 16.00-19.00 hr)</li> <li>- Control weights carried by vehicles according to legal regulations to prevent damages of road surface.</li> <li>- Limit the vehicle speed at 40 km/hr in the project area.</li> <li>- Check/ inspect vehicle engine/ machines used in the project operation activities according to suggested protective maintenance guideline regularly ( as indicated in the machine manuals)</li> <li>- Provide the signs in the project area i.e. speed limit sign, direction signs, etc.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p> <p><b>3) Water use</b></p> <p>Industrial water demand is likely to depend on economic growths, mainly, while IRPC industrial estate land has provided water resource for its industrial operation. Meanwhile, most of the study area of this project is in the IRPC zone. There are 2 main sources of raw water supplying the IRPC industrial estate operation, which are the water supplied by Department of Irrigation as 70,000 m<sup>3</sup>/day, for current operation, and 69,000m<sup>3</sup>/ day supplied by East Water, for developing zone (including this project). Raw water from irrigation department is transferred via installed pump to a water supply plant no. 1 located in Amphur Ban Khai. Also, the irrigation department has increased the raw water volume to IRPC zone 40,000 m<sup>3</sup>/day, additionally, such that total volume of raw water supplying to IRPC zone at present is 179,000 m<sup>3</sup>/day.</p>	<p><b>3) Water use</b></p> <p><b>Construction phase</b></p> <p>Water demand during the construction phase can be divided into 2 parts as water demand for worker consumption and water use in the construction activities. Water demand for consumption could varied depending on number of workers. The contractor will be allowed to use water supplied in IRPC zone whereas the contractor is requested to provide 40m<sup>3</sup> reserved tank for water storage. The contractor is requested to provide portable drinking water for workers during the construction phase. It can be seen that water use volume in the construction phase tends to be low whereas water sources supplied are not from the nearby community. Therefore, negative impact (-) of the project construction towards water use in nearby community tend to be at low level (1)</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p>	<p><b>Operation phase</b></p> <p>Water use during the operation phase is mainly for the production process and consumption in office buildings as approximate volume of 9,289 m<sup>3</sup> / day. Water is supplied by the system provided in IRPC zone, supplied by Dok Grai reservoir of the irrigation department and EAST WATER with total volume of allocated raw water of 179,000 m<sup>3</sup>/day</p> <p>Total water volume allocated to IRPC industrial estate zone can be calculated as 15.8% of total water volume in Dok Grai reservoir, Nong Pla Lhai reservoir, and Klong Yai reservoir. This means there is 99.8% or 135.7 million m<sup>3</sup> /day of water distribution capacity to be able to supply by the three reservoirs. <u>When considering water use in the IRPC after this project development and project expansion, combined with raw water availability, it could be said that the impact tends to be low.</u></p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p>	<p>However, the 5 raw water reservoirs with total volume of 6 million m<sup>3</sup> will be provided in IRPC zone, therefore, water conflict with community can be avoided in case water scarcity may occur in Rayong. Meanwhile, IRPC can supply the water to the community in case water scarcity in the nearby zone.</p> <p>In addition, water management in the IRPC zone is connected with the concept of water management in eastern region which collaborates as Eastern region War room working group, to monitor water situation, climate as well as establishing relevant measure to use water resource efficiently among all sectors. This is implemented, particularly, when drought disaster occurs, that protection and mitigation measured for taking action are provided. For example, water allocation proportion will be decreased among relevant organisations according to the measures.</p>		



**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p>	<p>IRPC zone will not be affected Between month 1-6 according to its raw water allocation quota supplied by Department of Irrigations and East Water. In addition, reserved reservoirs in the IRPC zone can hold the water volume of 4.7 million m<sup>3</sup>, approximately. Raw water is also reserved for water supply production, fire control, and for community. Referring to Rayong precipitation records, it never experience 6 month lack of rain period. Therefore, it is assumed that the project would have sufficient water volume for its operation without building any water conflict with surrounding neighbours.</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p> <p><b>4) Electricity use</b></p> <p>Electricity use in industrial factories in the IRPC zone is supplied by an electric supply substation located in the industrial estate land which has electric supplying capacity of 100 MW. High voltage electric wire with 115 kV is connected from Rayong Provincial Electricity Authority to the substation. Meanwhile, the electricity is also supplied directly by Rayong electricity station no. 1.</p>	<p><b>4) Electricity use</b></p> <p><b>Construction phase</b></p> <p>It is estimated that electricity use in the project activities could be approximately 10 MW, supplied by IRPC substation. This is considered as low demand of electricity during the construction phase while the construction is temporary activity, therefore, it is likely to bring about negative impacts (-) on electricity use in nearby community as low level (1).</p> <p><b>Operation phase</b></p> <p>The project will generate 10 MW of electricity for usage in the project operation without involvement with electricity consumption in nearby community in the study area. Therefore, the project operation is not relied on other electricity supplier, instead, its operation can supply electricity to industrial factories in IRPC zone.</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p> <p><b>5) Water drainage and flood control</b></p> <p>According to the map of Royal Thai Survey Department, it was found that the location of study area is 3 -4 m above medium sea level (MSL), which the slightly sloping down to the sea. The drainage is naturally flow through the sea.</p>	<p><b>5) Water drainage and flood control</b></p> <p><b>Construction phase</b></p> <p>Temporary drainage system will be provided to prevent flooding problem during the construction phase such that flood problem in the project area can be protected. In addition, sumps will be provided for collecting the sediments from drainage system, to maintain the good condition for draining ditch, prior to discharging the effluent to IRPC drainage system. Therefore, water drainage and flood control during the construction phase is likely to cause negative impact (-) as low level (1).</p> <p><b>Operation phase</b></p> <p>Drainage system of the project is divided into 2 parts as drainage system for rainwater and wastewater. Rainwater drainage can be divided for draining uncontaminated and potentially contaminated rainwater as follows</p>	<p><b>5) Water drainage and flood control</b></p> <p><b>Construction phase</b></p> <ul style="list-style-type: none"> <li>- Provide temporary runoff drainage system in the project area.</li> <li>- Request the contractor to conduct drainage dredging regularly.</li> <li>- Provide sumps for collecting sediments from the drainage ditches.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p>	<p>1) Uncontaminated rainwater: There will be the installation of U-shape drainage ditch, covered with steel racks, surrounding the project area. The drainage channel will be laid in parallel with the roads inside the project area to drain all rainwater through the drainage to rainwater Holding Pond, 5,000 m<sup>3</sup> size. Then, rainwater will be pumped out and drained towards the IRPC rainwater collection system.</p> <p>2) Potentially contaminated rainwater: Rainwater may be contaminated by lubricant or oil in the project area. Estimated contaminated rainwater is approximately 37 m<sup>3</sup>. It is specified that the contaminated rainwater will be treated at Oil Separator prior to discharging to effluent holding pond with a volume of 1,000 m<sup>3</sup> prior to transferring to 8,000 m<sup>3</sup> holding pond while it is not discharged through public drainage system. Therefore, negative impact (-) during the operation phase tends to be low (1).</p>	<p><b>Operation phase</b></p> <ul style="list-style-type: none"> <li>- Construct rainwater collection system in the project area combined with that of provided by IRPC industrial estate.</li> <li>- Collect potentially contaminated rainwater in oil separator unit prior to transferring to effluent holding pond.</li> <li>- Provide drainage dredging plan for routine operation, particularly, during the time of pre-rainy season.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p> <p><b>6) Solid waste management</b></p> <p>Solid waste management in the study area can be classified based on governance zones of governmental organisations as Nakhon Rayong Municipality, Tambon Choeng Noen Administrative Organisation, Tambon Ban Lang Administrative Organisation, Tambon Tapong Administrative Organisation, and Tambon Nakwaun Administrative Organisation. Meanwhile, Pollution Control Department collaborated with Department of Industrial Works have visited and inspected 25 industrial factories operated in IRPC industrial estate zone and 50 factories operated outside IRPC zone, it was found that most factories have provided good system for hazardous waste storage and management, the waste collected and disposed by certified companies approved by Department of Industrial Works. However, some factories still stored hazardous waste outdoor, which were supervised to manage the waste properly.</p>	<p><b>6) Solid waste management</b></p> <p><b>Construction phase</b></p> <p>There are 2 types of solid waste generated during the construction phase; municipal waste and construction waste. Municipal waste is generated by workers which is estimated to be 800 kg/ day or 240 l/ day, calculated based on 1,000 workers. The contractor will provide 200-litre bins with lids for the waste storage prior to the collection for further disposal conducted by Tambon Choengnoen Administrative Organisation. Meanwhile, the construction waste will be disposed or reused or sold by the contractor. Therefore, solid waste generated from the construction activities are unlikely to affect phase the surrounding communities.</p>	<p><b>6) Solid waste management</b></p> <p><b>Construction phase</b></p> <ul style="list-style-type: none"> <li>- Provide solid waste storage containers sized 200 litres along with lids sufficiently as well as contact relevant organisation to collect the waste for further disposal by sanitary methods such as sanitary landfill.</li> <li>- Consider reuse materials or sell to approved party for recycling as much as possible.</li> <li>- Discardin waste into drainage system is prohibited.</li> <li>- Separate the solid waste for selling or reuse to avoid residual waste problem.</li> <li>- Provide stirage area for unused construction materials orderly.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p>	<p><b>Operation phase</b></p> <p>Unused materials, solid wastes and industrial wastes generated from the project operation can be classified into 2 types as follows</p> <p>(1) Unused materials which are exempted from the transportation permit. The waste will be collected in bags daily, to be transported and disposed by aothorised organisation.</p> <p>(2) Unused materials that transportation permit is required. Waste from manufactruing process identified as Non Hazardous Wastes and Hazardous Wastes that are subjected to follow Ministry of Industry Notification Re: Waste management B.E. 2548. The process of handling this waste can be started from requesting for a permission from Department of Industrial Works to transport the waste to disposal unit.</p>	<p><b>Operation phase</b></p> <ul style="list-style-type: none"> <li>- Provide 3 type storage containers as generl waste, recycling waste and hazardous waste from office building.</li> <li>- Collect general waste in provided portable containers, covered with lids, and contact authorised organisation to collect for disposal.</li> <li>- Recyclable/ reusable waste should be considered for efficient utilisation as muc as possible.</li> <li>- Provide waste storage area with roof so that the area is appropriate for storing the waste awaiting for further disposal by authorised organisation.</li> <li>- Promote 3 R schemes in solid waste management based on the concept of waste reduction at source ( reduce) waste reutilization ( reuse) and waste recycling (recycle)</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p>	<p>Waste storage area is provided under water quality improvement building with an area of 100 m<sup>2</sup>, which can store the waste volume of 200 m<sup>3</sup>. Waste storage area is categorised into the zones according to types of the waste labelled with information related to such waste. It is considered that the waste storage space is sufficient for the waste volume to be stored during awaiting for further collection by authorised organisation, contacted in advance by the project to collect the waste monthly.</p> <p>In addition, during Major Overhaul period, waste volume may be huge, particularly, used oil could be 36.3 m<sup>3</sup>/time as the maximum. The project will contact authorised organisations, which become more options on them available, to collect the waste for further disposal as soon as the waste is generated according to the process. Therefore, it is unlikely that the waste would remain storage in the project area.</p>	<ul style="list-style-type: none"> <li>- Collect hazardous waste generated in office building in appropriate containers prior to disposal conducted by authorised organisation approved by the Department of Industrial Works.</li> <li>- Assign authorised company/ organisation approved by the Department of Industrial Works to collect and dispose hazardous waste or contaminated waste such as resin from demineralised water production unit, lubricants, unused battery, used RO membrane, and heat insulating materials.</li> <li>- Record the waste type and quantity as well as authorised organisation that is responsible in transporting and disposing the waste prior to transferring the waste from the project area.</li> <li>- Submit for permission from Department of Industrial Works on legally transporting the hazardous waste from the project area.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>4. Human use values (continued)</b></p> <p><b>7) Disaster protection and mitigation</b></p> <p>Description of local disaster protection and mitigation offices in the study area within 5 km distance surrounding the project area include Nakhon Rayong Municipality, Choeng Noen TAO, Ban Lang TAO, Tapong TAO, Natakwaun TAO, and IRPC industrial estate land. Support help can be requested from the nearest fire station which is at Choeng Noen TAO that the team can access the project area within 10 minutes. Meanwhile, support helps also can be requested from Map Ta Phut Municipality, Maung Ban Chang Municipality, Ban Khai Municipality, Tambon Ban Pae Municipality, and Tambon Glang Municipality</p>	<p>However, reserved area for waste storage is provided near water quality improvement unit in case the waste transportation may be delayed.</p> <p>Therefore, the waste management impact during the operation phase could be stated as negative impact (-) at low leve (1)</p>		



**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life</b></p> <p><b>5.1 Socio-economic condition</b></p> <p>In addition to build energy security in eastern region as well as to mitigate government investment tension by having this project development in IRPC industrial estate land, it could also lead to socioeconomic change both positively and negatively in the relevant communities. Therefore, it is essential to consider well in studying the community socioeconomic condition as well as public opinions towards the change which may cause from the project development along with delivering the project information to the community members.</p>	<p><b>Construction phase</b></p> <p><b>a) Economic impacts</b></p> <p>It is estimated that the project construction may consume time approximately 48 months with maximum employment of 1,000 workers. The workers are required differently during the construction period according to the tasks during the time. It is predicted that the workers are supplied locally or from the nearby area such that financial flow is assumed to be increased during the employment time for the construction. It is specified that the contractor is requested to give priority in recruiting local workers regarding compatibility of their skills and abilities and job requirement criteria. In addition, it can be considered that sideline job opportunity could be increased in the community among local business according to more employability in the area.</p>	<p><b>Construction phase</b></p> <ul style="list-style-type: none"> <li>- Follow the provided environmental policy strictly to maintain the public benefits of the surrounding communities.</li> <li>- Consider hiring local workers who are qualified for the job as many as possible.</li> <li>- Build good relationship with surrounding communities i.e. visiting the communities, delivering the project information.</li> <li>- Conduct public relations activity to deliver information to the public via media, meeting, visiting the community, and inviting the community members to visit the project location.</li> <li>- Provide opportunity that community members can take part in sloving problem or environmental impacts which may cause from the project operation as well as provide public relations team and communication space for hearing comments or complaints from the public.</li> </ul>	<p><b>Construction phase</b></p> <p><u>Indicators</u> : Conduct survey on socioeconomic condition in the study area along with public opinions from community leaders, local administrative leaders, and representatives from relevant organisations and the changing condition annually.</p> <p><u>Survey location</u>: Communities located surrounding the project area and communities where other relevant environmental indicators are collected (<b>Figure 6-3</b>)</p> <p><u>Frequency</u> : During the construction phase</p>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p> <p><b>1) Study Methods</b></p> <p>Socioeconomics data and public opinion were collected from 2 sources as follows</p> <p><b><u>Secondary data ( Secondary Source)</u></b> was collected from related documents and media which represent the existing environment of the study area.</p> <p><b><u>Primary data (Primary Source)</u></b> was collected from the field by conducting in-depth interviews with representatives from relevant government organisations, local administrative leaders, community members, and household leaders based on provided questionnaires. The interviews focused on socioeconomic condition in the study area, existing environmental impacts, opinion and attitudes towards the project development.</p>	<p>In addition, the project has provided financial funds for community located surrounding the project site as required by law. During the construction phase, the fund will be provided approximately 9 million baht/ year, and this can be considered as positive impact towards the community at moderate level.</p> <p><b>b) Social impacts</b></p> <p><b><u>Positive impacts:</u></b> The project development could be counted as increasing employability for society, and this could improve the quality of life of the workers, particularly, local workers, that IRPC standard specified that local workers should be given the priority in job recruitment for any project development in IRPC zone.</p>	<ul style="list-style-type: none"> <li>- Conduct public participation activities as well as establish multilateral committee taken part by representatives from government organisations, citizens, and other relevant organisation to monitor the project operation performance.</li> <li>- Summarise environmental management performance according to provided impact protection and mitigation measures, and deliver the information to local organisations and communities every 6 months.</li> <li>- Deliver the project information and construction progress to communities and relevant local organisations via public relations media every 3 months during the construction period.</li> <li>- Provide procedures for the public to submit the complaints, if any, as presented in <b>Figure 2</b></li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p> <p>The consultant collected field data by interviewing household leaders or representatives living in the area within a distance of 5 km surrounding the project location. The area scoping for the respondent interviews was divided into 2 groups as community located in the area with a distance of 0-3 km and the community located in the area with a distance of 3-5 km away from the project location.</p> <p><b>2) Study area and selected community</b></p> <p>Communities locating within 5 km distance surrounding the project location was assumed to be affected by the project operation. These communities include 37 communities governed by 6 local administrative organisations namely, Nakhon Rayong Municipality, Tambon Banlang Administrative Organisation, Tambon Choeng Noen Administrative Organisation, Tambon Tapong Administrative Organisation, and Tambon Tanakhan Administrative Organisation of Amphur Ban Khai.</p>	<p><b>Negative impacts:</b> Construction workers mainly are from local area whereas technical workers may be recruited from other area, not locally, according to therequired expertise for the project operation. However, the immigrating workers are considered responsible on works and respect the rules, therefore, it is considerd that such group would unlikely to create the problem. Meanwhile, during the construction phase, conflicts between construction workers or them with the community member could happen, however, majority of the communities are located farther away from the project location, therefore, it it estimated that social impact from the construction phase could be negative impact (-) during the construction period as low level (1).</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p> <p><b>3) Data collection and survey results</b></p> <p>The consultant has collected secondart data from Nakhon Rayong Municipality, Tambon Banlang Administrative Organisation, Tambon Choeng Noen Administrative Organisation, Tambon Tapong Administrative Organisation, and Tambon Tanakhan Administrative Organisation of Amphur Ban Khai.</p>	<p>Meanwile, the project has provided impact mitibation measures such as assigning the contractor to be strict enough with construction workers as well as delivering the information to the public during the construction phase regarding the project activities so that negative social impact (-) may generate as low level (1).</p> <p><b>Operation phase</b></p> <p><b>1) Economic impacts</b></p> <p>There will be approximately 32 employees during the project operation, of this number, partiality of them will be transferred from other factories of the company group. In case more staff may be required, local people will be considered for the job as the priority, however, the personal qualification will have to be compatible with the job description and the company criteria.</p>	<p><b>Operation phase</b></p> <ul style="list-style-type: none"> <li>- Deliver information on employment opportunity on job vacancy to the surrounding communities.</li> <li>- Consider recruiting employees based on required qualifications and abilities, however, local people will be prioritised for the consideration.</li> <li>- Build good relationship with nearby community by taking part with local activities.</li> </ul>	<p><b>Operation phase</b></p> <p><u>Indicators</u> : Conduct survey on socioeconomic condition in the study area along with public opinions from community leaders, local administrative leaders, and representatives from relevant organisations and the changing condition annually.</p> <p><u>Survey location</u>: Communities located surrounding the project area and communities where other relevant environmental indicators are collected.</p> <p><u>Frequency</u> : During the operation phase</p>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p>	<p>This could also provide job opportunity in the local community which could help mitigate unemployment and poverty problem to some extent. The employment also could increase local financial flows which could bring about positive impact, eventhough it is considered as low level. If the employees are required to register their census record in Amphur Maung Rayong, their income will be delivered as tax payment to changwat Rayong which is good for the province. In terms of national economics, the project development could support public utilities for domestic and international clients, which could bring about high impact of economic performance to the country in terms of the taxes gained. In addition, the project will have to provide community development fund, according to the law, approximately 13 million baht/ year. Therefore, it is likely that the project operation could bring about positive impact (+) towards local and national on economic condition as moderate level.</p>	<ul style="list-style-type: none"> <li>- Deliver information on the project operation in terms of disaster protection system, safety measures, and the project emergency response plan.</li> <li>- Deliver information on the project operation in terms of environmental measures that the project has provided and implemented it strictly.</li> <li>- Provide procedures for the public to submit the complaints, if the case may cause from the project operation (<b>Figure 2</b>).</li> <li>- Provide opportunity that community members can take part in sloving problem or environmental impacts which may cause from the project operation as well as provide public relations team and communication space for hearing comments or complaints from the public.</li> <li>- Conduct public relations activity to deliver information to the public via media, meeting, visiting the community, and inviting the community members to visit the project location.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p>	<p><b>2) Social impacts</b></p> <p>There will be approximately 32 employee recruitment during the project operation, of this number, some positions may consider employ local people with qualification compatible with the job description and the company criteria. It could be estimated that very few number of people immigrating to the district. Therefore, social problem may not significantly increase from existing status. It could be implied that the social impacts tend to be at low level or unlikely to affect any change of the problem scale in such area.</p>	<ul style="list-style-type: none"> <li>- Survey public opinions/ anxiety/ comments and suggestions via community leaders, government officers/ relevant organisations, surrounding communities and communities where environmental quality is monitored at least once a year.</li> <li>- Conduct public participation activities as well as establish multilateral committee taken part by representatives from government organisations, citizens, and other relevant organisation to monitor the project operation performance. The concept of establishing environmental impact monitoring committee can be conducted as follows</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p>5. Values and quality of life (continued)</p>		<p><b>1) EIA Monitoring Committee Structure</b></p> <p>* EIA Monitoring Committee comprises representative from 3 parties as public representatives, government organisation representatives/ local scholars and the project developer representatives, with a proportion that number of public representatives must not less than 50% of total committee members as following details</p> <ul style="list-style-type: none"> <li>● Number of public representatives is not less than 20 persons, selected from nomination or recruitment from the communities located within 5 km radius of the project location. The number of the members can be decreased or increased later on, based on the committee agreement.</li> <li>● Number of government organisation representatives/ local scholars 8 persons as follows                     <ul style="list-style-type: none"> <li>▪ Government organisation representative</li> <li>▪ Local scholar can be recruited from local academic institutions or selected from local environmental and natural resource expertises.</li> </ul> </li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p>		<ul style="list-style-type: none"> <li>● Project developer representatives can be selected from each division of the company, but not exceed 5 persons.</li> </ul> <p>The EIA Monitoring Committee will have the first meeting to select the chair, the vice-chair, and the secretary prior to appointing notification based on the committee consensus.</p> <p><b>2) Authorities of the EIA Monitoring Committee</b></p> <ul style="list-style-type: none"> <li>* Seek for public needs, build understanding among the public and the project developer, and coordinate for cooperation between relevant parties.</li> <li>* Recognise environmental quality measuring process and the results according to impact mitigation and monitoring measures provided by the project, as well as to deliver the information to relevant organisation to maintain transparency on environmental management.</li> <li>* Provide information, advice, suggestions for the project operation to ensure effective operation as well as collaborate in providing problem prevention and solution measures.</li> </ul>	



**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p>		<ul style="list-style-type: none"> <li>* Collaborate in environmental mediation between project developer and community members.</li> <li>* To be community representative on visiting the project and monitoring the project operation based on relevant regulations and laws.</li> <li>* To be a centre of collaboration between relevant parties.</li> <li>* Provide space for idea exchange among relevant parties based on good understanding and community real benefits.</li> <li>* To hear public complaints, concerns related to the impacts which may cause from the project operation, answer questions and summarise preventive and mitigation measures.</li> <li>* Collaborate in environmental mediation between project developer and community members to establish the solution.</li> <li>* Collaborate in considering compensation payment in case it can be proved that the impacts from the project development affect community, as well as to follow up the compensation payment process.</li> <li>* Provide environmental education activities for community.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p>		<p><b>3) Term of the committee</b> is stated as follows</p> <ul style="list-style-type: none"> <li>* Term of the committee is 4 years since the date having been appointed. Meanwhile, the person can be nominated or recruited again later on.</li> <li>* When the term is finished according to section 1, whereas new committee has not been appointed, current committee may conduct its duties during the time, however, it must not exceed 90 days since the final date of such term.</li> <li>* In case any person of the committee may terminate his/her position before the term completed, it is suggested that new person should be recruited or nominated to substitute the position within 45 days, since the date of the vacant seat. The appointed person will be in the position for the remaining time of the term.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p>5. Values and quality of life (continued)</p>		<p>* If any person of the committee may terminate his/ her duties before the term finished, whereas the remaining time of the term is less than 90 days, new recruitment or nomination is not required for the seat substitution. The remaining persons in the committee will proceed their duties until the term is completed.</p> <p>* Apart from committee status termination according to its term, the position will be terminated when</p> <ul style="list-style-type: none"> <li>• died</li> <li>• resigned</li> <li>• Withdrawn according to two-thirds voted by the committee because of unwanted behaviour conducted by such person.</li> </ul> <p>* The meeting should be arranged at least 2 times annually provided that the number of the committee must not less than half of them so that the meeting can be commenced. However, if it is an urgent matter, the meeting can be arranged regarding the agreement of at least half of the committee members.</p>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p> <p><b>5.1 Public health</b></p> <p><b>1) Public health service office</b></p> <p>There are 9 government and private hospitals in changwat Rayong: 1 regional hospital, 1 community hospital, 2 of 120- bed hospitals, 6 of 30-bed hospitals, 4 private hospitals, 98 Tambon health promoting hospitals, and 11 municipality public health centres.</p>	<p><b>Public health</b></p> <p><b>Construction phase</b></p> <p>Environmental pollutants generated from the construction activities such as dust, solid waste and wastewater may affect workers' health and people living in the nearby area. However, the construction activities which include machine installation (gas turbine generator, steam turbine generator, transformer, etc.), pillar planting, area grading will be conducted in the limited zone where perennial trees are planted along the fence to prevent impacts which may cause by the project construction. Meanwhile, the project has provided measures to prevent and mitigate public health impacts and other relevant impacts for the contractor to implement in the construction operation.</p>	<p><b>Construction phase</b></p> <p>- Follow the procedure on physical examination for employee/ construction workers before starting their duties at work. The contractor will have to deliver the results of worker physical examination to the company.</p> <p>- Check employment standard provided by the contractor.</p> <p>- Specify that the contractor will have to register foreign migrant workers at responsible official.</p> <p>- Follow dust control measures during the construction work operation, for example, water spraying, covering the construction zone with canvas, and cleaning soil debris.</p> <p>- Follow measures according to air quality, water quality, noise, solid waste management, and occupational health and safety strictly.</p> <p>- Provide first aid unit, sufficient medication, and ambulance in case of emergency or accident.</p>	<p><b>Construction phase</b></p> <p><u>Indicators</u> :</p> <ul style="list-style-type: none"> <li>● Performance record according to work regulations</li> <li>● Community complaint records (if any)</li> <li>● Project informing records on construction activities, safety measures for community i.e. transporting time</li> <li>● Community complaint records (if any) (repeated)</li> </ul> <p><u>Observation point</u>: The project zone</p> <p><u>Frequency</u> : during the construction phase</p>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p> <p><b>2) Medical and public health personnel</b></p> <p><b>Public health</b></p> <p>According to Ministry of Public Health, 775,899 persons are required for medical and public health service. However, when considering the number of population combined with the standard suggested, it was found that doctor shortage rate. Meanwhile, if number of unregistered population is considered, it is clearly suggested that shortage of medical human resource is indicated as high level</p>	<p>In case any workers may be ill or injured from the accident, they can access medical service at nearby health/medical centre. Therefore, public health impact during the which considered negative (-) tend to be low (1).</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p> <p><b>3) Vital statistics data</b></p> <p>Birth rate in Rayon during B.E.2551 - 2553 was approximately 16 births per 100,000 population, which suggested decreasing trend.</p> <p><b>4) Significant causes of diseases and illness</b></p> <p>According to Rayong provincial public health office, top 10 causes of illness in Rayong during B.E.2550-2554, mainly out-patients, are blood circulation system, musculoskeleton system, dermal disease, while the trend is increasing on these causes. In addition the cause of disease with decreasing trends is digestive system whereas other causes with stable trend include respiratory system disease, endocrine disease &amp; nutrition and metabolism disease, infectious disease and parasite, reproductive and urinary system disease, eye disease, and disease consequences from accidents.</p>	<p><b>Operation phase</b></p> <p><b>(1) Public health</b></p> <p>Public health impact caused from the project operation can be considered on worker health and illness aspect. To prevent their illnesses which may cause from occupation, personal protective equipment is provided appropriately, regarding the tasks. In addition, first aid room is provided such that it can be considered that public health negative impact (-) from the project operation is likely to be low (1).</p>	<p><b>Operation phase</b></p> <ul style="list-style-type: none"> <li>- Perform tasks following air quality protection measures strictly</li> <li>- Present information on the project environmental performance, according to provided health and environmental impact protection and mitigation measures, to local public health office.</li> <li>- Disclose project information, especially environmental monitoring data, to the public via community media i.e. display board, community radio, community wire broadcasting, local administrative organisation, local public health service, etc.</li> <li>- Promote local public health service officer to take part in project activities related to environmental impact protection measures.</li> <li>- Support public health activities in the community such as primary care service, mobile health care service, etc.</li> </ul>	<p><b>Operation phase</b></p> <p><u>Indicators</u> :</p> <ul style="list-style-type: none"> <li>• Community complaint records</li> <li>• Conduct public survey on health in the study area</li> </ul> <p><u>Observation location</u>: the study area</p> <p><u>Frequency</u> : Operation phase</p>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p> <p><b>5) Significant cause of mortality</b></p> <p>Significant causes of mortality according to Rayong Provincial Public Health Office during B.E. 2553, top 10 causes of mortality in Rayong are cysts (including tumor), sepsis, and other external causes; accidents, stroke, pneumonia, myocardial infarction, kidney disease, liver disease, respiratory system disease, etc.</p> <p><b>6) Out-patient records</b></p> <p>According to outpatient records (Report Ro Ngo. 504) reported by government hospitals, health service office, and public health service centres under the hospital networks, it was found that the number of outpatients seeking for health services during B.E.2550-2553 was increasing and then slightly decreased in B.E. 2554. Top cause of the illness was respiratory system disease followed by blood circulation system disease, endocrine disease &amp; nutrition and metabolism, respectively.</p>	<p><b>(2) Human health condition</b></p> <p>According to the study of health records in communities located within 5km distance surrounding the project location, reported by local public health offices, the illness most frequently found is caused from respiratory system diseases. Meanwhile, available data has not specified causes of such diseases. This leads to difficulty in defining the specific casuses of the illness. Meanwhile, it has been recognised that the incidents of respiratory system diseases can be found all across regions in Thailand according to the climate condition, for example, cold fever. In order to mitigate the impacts which may cause from the project operation, the project will conduct the activities during the operation phase based on provided environmental impact protection and mitigation measures. This will include monitoring measures that will be conducted,</p>	<ul style="list-style-type: none"> <li>- Provide nurse (s) for the employees during the project operation phase.</li> <li>- Cooperate with IRPC industrial estate land on activities related to health promotion project provided for surrounding communities. For example, supporting mobile health care service, local public health service, and other relevant activities.</li> <li>- If any impacts affecting surrounding communities may cause from Rayong CHP operation, according to the study in EIA report, the project will be responsible for such affected case(s), as the best it can be.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p> <p><b>7) In-patient condition</b></p> <p>According to the inpatient records (Report (๖๓. In Thai) 505) reported by government hospitals in Rayong, it was found that top causes of diseases was pregnancy complications, which has been found at a higher rate, on perinatal mortality and accidents, when comparing with national records (excluding Bangkok).</p> <p><b>8) Existing health records in the study area</b></p> <p><b>(1) Tambon Nong Chok Health Promoting Hospital</b></p> <p>According to the illness recorded following significant causes, top 5 causes are respiratory system diseases, endocrine disease &amp; nutrition and metabolism, nervous sytem diseases, digestive system diseases including oral disease, and musculoskeleto diseases while the tendency of the incidents are not stable.</p>	<p>for example, measuring ambient air quality in the sensitive area every 6 months, measuring stack emissions every 6 months, providing physical examination for employees including in case there are public complaints, collecting heath data records from relevant public health service centres in the study area, interviewing community public health volunteers (๑๙๓. In Thai) and local health officers to gather for related health problems in connection with the power plant operation. Therefore, it can be estimated that negative health impact (-) which may cause from the project operation tends to be low (1)</p>		



**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p> <p><b>(2) Tambon Bandon Health Promoting Hospital</b></p> <p>According to the illness recorded following significant causes during B.E. 2551-2555, the top 5 causes are respiratory system diseases, musculoskeleto diseases, digestive system diseases including oral disease, dermal disease, eye diseases, while the tendency of the incidents are not stable.</p> <p><b>(3) Tambon Tapong Health Promoting Hospital</b></p> <p>According to the illness recorded following significant causes during B.E. 2551-2555, the top 5 causes are respiratory system diseases, blood circulation system diseases, endocrine disease &amp; nutrition and metabolism, digestive system diseases including oral disease, and musculoskeleto diseases while the tendency of the incidents are not stable.</p>			

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p> <p><b>(4) Tambon Yaida Health Promoting Hospital</b></p> <p>According to the illness recorded following significant causes during B.E. 2551-2555, the top 5 causes are respiratory system diseases, musculoskeleto diseases, digestive system diseases including oral disease, dermal diseases, and eye diseases, while the tendency of the incidents are not stable.</p> <p><b>(5) Tambon Banlang Health Promoting Hospital</b></p> <p>According to the illness recorded following significant causes during B.E. 2551-2555, the top 5 causes are respiratory system diseases, digestive system diseases including oral disease, musculoskeleto diseases, dermal diseases, eye diseases, and infectious disease and parasites, while the tendency of the incidents are not stable.</p>			

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>5. Values and quality of life (continued)</b></p> <p><b>(6) Tambon Na Kwuan Health Promoting Hospital</b></p> <p>According to the illness recorded following significant causes during B.E. 2551-2555, the top 5 causes are digestive system diseases including oral disease, respiratory system diseases, dermal diseases, musculoskeletal diseases, endocrine disease &amp; nutrition and metabolism, while the tendency of the incidents are not stable.</p>			

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>6. Aesthetics and tourism</b></p> <p>None of tourist attraction found in the study area, within 5 km distance surrounding the project location. However, interesting places to visit in Rayong are</p> <ul style="list-style-type: none"> <li>- King Thak Sin's shrine, Wat Bpa Pradoo, Pra Chedi Glang Nam (Middle water pagoda), city shrine, and Laem Charoen beach, etc</li> </ul>	<p>The project location is in IRPC industrial estate land, having been allocated for industrial purposes since B.E. 2525, where industrial factories are appeared as existing environment. The construction activities could cause Visual Pollution, however, this impact can be mitigated by fencing the construction zone. Referring to conserving area notification documents, the study area is not identified as conserving zone while none of tourist attraction and historic places are found. Therefore, it can be considered that the negative impact (-) tend to be low (1).</p>	<p><b>Operation phase</b></p> <ul style="list-style-type: none"> <li>- Provide green area in the project zone approximately 7.2 Rai or 6.74% of the project area (<b>Figure 5</b>).</li> <li>- Green area surrounding the project zone, particularly in the north and the east where the factory is close to, will have a space of 6 m width as suggested for Protection Strip categorised based on types of industries Re: "Distance problem management for industries and Map Ta Phut communities and information delivery on the approval result of Urban Planning Committee" proposed by the committee according to section 67 of the Kingdom of Thailand Constitutions (B.E. 2553)</li> <li>- Select plants for green area landscape which can help mitigating the pollutants according to the recommendation provided by ONEP in B.E. 2555 for Rayong and its neighbouring area.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others</b></p> <p>- Occupational health and safety</p> <p>(1) Noise</p> <p>(2) Accidents</p>	<p><b>Construction phase</b></p> <p>The workers may be affected from loud noise generated from machine operation. Meanwhile, protection measures have been provided such that the impact from noise could be considered as acceptable level.</p> <p>Accidents may occur from unsafe working environment such as material falling, sharp material handling, etc. However, protection and mitigation measures are provided for the contractor to implement during the working operation strictly, therefore, it is estimated that negative impacts (-) from accidents during the construction phase tend to be low (1)</p>	<p><b>Construction phase</b></p> <ul style="list-style-type: none"> <li>- Consider selecting the contractor who provides occupational health and safety measures based on good standards.</li> <li>- Provide sufficient personal protective equipment for workers appropriately according to assigned tasks.</li> <li>- Record the incident of accident along with causes identification and solution options.</li> <li>- Provide first aid kit, basic medication, and ambulance in case of emergency or accident.</li> <li>- Provide fire control equipment at appropriate location sufficiently.</li> <li>- Follow code of practice for construction works according to occupational health and safety law.</li> <li>- Define the zone clearly based on good housekeeping concept when equipment or machines are installed.</li> </ul>	<p><b>Construction phase</b></p> <p><u>Observation point</u> The project area</p> <p><u>Indicators</u> Accident records, types of incidents, place where the incident occurs, scale of the impact, cause of the incident, and solution during the construction period.</p> <p><u>Frequency of the inspection</u> the whole period of construction phase</p>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p> <p><b>(3) Fire</b></p>	<p>During the construction work operation, activity which may cause fire is welding work and electric short circuit from electric equipment. If the project and the contractor agree to provide safety protection measures for construction tasks, coupled with regularly conducting effective inspection regarding the provided plan, probability of this risk is considered low. In terms of support help, the project can request for support help from external organisations in case of emergency very quickly, therefore, the negative impact (-) of fire during the construction phase is considered to be low (1).</p>	<ul style="list-style-type: none"> <li>- Provide a controller or job supervisor to inspect the practice according to work regulations and safety measures.</li> <li>- Provide labels or warning texts/ signs in the risk zone such “No entry the construction zone” “No smoking” etc.</li> <li>- Provide 24-hr security guard in the construction area for general safety and directing the traffic in the project zone.</li> <li>- Provide safety training for workers on handling with machines or equipment prior to start working in the project zone.</li> <li>- Provide PPE and request workers to use them appropriately according to the assigned tasks.</li> <li>- Emphasise with the workers to follow the rules and working regulations specified by IRPC Public co., ltd. strictly.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
7. Others (continued)		<p>- Provide house rules and regulations for workers/ employees that will work during the construction phase as follow</p> <ol style="list-style-type: none"> <li>1) Provide 24-hr security guard at the entrance and residential zone as well as record daily report.</li> <li>2) Provide fencing surrounding the residential zone</li> <li>3) Provide security guard to check vehicles &amp; persons accessin the area</li> <li>4) People with following behaviours are not allowed to access the employee residential area                             <ul style="list-style-type: none"> <li>* Occupy any kinds of alcohols or drugs</li> <li>* Drunk</li> <li>* Disobey safety rules</li> <li>* Fight or frighten any person</li> <li>* Occupy weapons (i.e. gun), camera</li> <li>* Steal or try to steal the company's properties.</li> </ul> </li> </ol>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
7. Others (continued)		<p>5) Employee residents must present their cards to the security anytime when accessing or exiting the area.</p> <p>6) Vehicle permission to access the area will be approved by the security while the driver will be requested to fill the form.</p> <p>7) Provide camp boss for the residential zone</p> <p>8) Waste burning is not allowed in the residential zone.</p> <p>9) Install fire extinguishers at appropriate locations and be convenient in use in case of emergency.</p> <p>10) Inspect the fire extinguishers regularly, monthly, and record the inspection result on them everytime.</p> <p>11) Environment and occupational health and safety committee have been established</p> <p>12) Arrange the meeting for environment and occupational health and safety committee every month.</p>	



**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p>7. Others (continued)</p>		<p><b>Residential regulation during the project construction phase</b></p> <ol style="list-style-type: none"> <li>1) The resedents will have to present their employee card to the security anytime accessing or exiting the residential zone.</li> <li>2) Visitors will have to exchange the card at the security before accessing the residential zone.</li> <li>3) Unauthorised persons are not allowed in the residential zone.</li> <li>4) Gambling is prohibited in the residential zone.</li> <li>5) Alcohols is prohibited on sale in the company area.</li> <li>6) Weapons, explosive and illegal materials are not allowed in the construction zone.</li> <li>7) Fighting is prohibited.</li> <li>8) The building adaptation or demolition is not allowed.</li> <li>9) Improper discarding garbage and food waste is not allowed in the company zone.</li> <li>10) The company area must keep clean.</li> </ol>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p><b>Operation phase</b></p> <p>According to the project construction and operation, there are 2 main points should be additional considered: employee physical examination and health impact assessment.</p> <p><b>(1) Health impact assessment</b></p> <p>Health impact assessment can be conducted based on 2 main approaches: quantitatively and qualitatively. The quantitative approach involves using questionnaire survey on chemical exposure risk assessment. The qualitative approach considers existing environment and health in such area as well as public anxiety on the project development. Public hearing was conducted for stakeholders to express their opinions during the construction phase and the operation phase. The results of the study can be summarised below,</p>	<p><b>Operation phase</b></p> <p><b>Safety management policy and plan</b></p> <ul style="list-style-type: none"> <li>- Provide safety policy so that clear work instruction can be provided for the employees to follow.</li> <li>- Establish occupational health and safety committee as well as provide relevant training on working procedures.</li> <li>- Provide safety operation plan which provides accident protection measures that can eliminate any conditions causing the incident i.e. human error, machine, and working environment.</li> <li>- Conduct safety management process based on applying safety activities in practice so that the plan could achieve its aim on decreasing and protecting accidents in workplace.</li> <li>- Organise safety promotion activities in the project zone i.e. notification, poster, exhibition, etc.</li> </ul>	<p><b>Operation phase</b></p> <p><b>- General physical examination</b></p> <p><u>Indicators</u> : To provide physical examination by Occupational Physician</p> <p><u>Examined group</u>: All employees</p> <p><u>Frequency</u> : Before commencing the job for the first time, and annually</p> <p><b>- Specific physical examination</b></p> <p><u>Parameters</u> :</p> <ul style="list-style-type: none"> <li>● Vision check</li> <li>● Lung X-Ray and Lung capacity test</li> </ul> <p><u>Examined group</u>: All employees</p> <p><u>Frequency</u> : annually</p> <p><u>Parameters</u> : Hearing Test by Occupational Physician</p> <p><u>Examined group</u>: employees working in loud noise zone</p> <p><u>Frequency</u> : annually</p>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p><b><u>Factor category 1</u> The change of natural and environmental resource utilisation:</b> Data to be considered includes water resource data in connection with water utilisation in the project construction and operation. As having been mentioned, water is supplied by IRPC water supply unit which is estimated to be sufficient for the project operation. Interview results also ensured that water consumption in the study area is sufficient in terms of drinking water, as portable or bottled water, and water supply (as tap water). Therefore, the water use volume in the project operation is unlikely affect the community, which is considered as low level impact. This is because the impact which may occur tends not to be significant enough towards any changes of water consumption in the study area.</p>	<ul style="list-style-type: none"> <li>- Conduct safety training for the employees before commencing the job for the first time, along with emphasising safety concerns at work prior to regular training according to planned schedule.</li> <li>- Provide safety manuals for the employees to provide clear understanding for them to follow the work regulations.</li> <li>- Provide physical examination programme for new employees, as well as annual physical examination (1 time yearly).</li> <li>- Provide first aid room in the project zone as well as referral system.</li> <li>- Provide machine/ equipment operator as required by law.</li> <li>- Conduct risk assessment collaborated between the project team and the contractor during project detail design in order to analyse, study, and review for hazard identification in any case which may cause any hazards, coupled with providing protection measures.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Working environment inspection</b> <u>Sound leve; Parameters :</u> <ul style="list-style-type: none"> <li>● 8-hr Leq</li> <li>● Noise Dose</li> </ul> <u>Monitoring points:</u> Measure sound level at work stations <u>Frequency :</u> 4 times per year <u>Heat: Parameters :</u> Measure Wet Bulb Globe Thermometer (WBGT) <u>Monitoring points::</u> measure heat stress index as WBGT at HRSG area <u>Frequency :</u> 2 times annually                 </li> <li>- <b>Accident records</b> <u>Parameters :</u> <ul style="list-style-type: none"> <li>● Record the incidents of accidents along with causesm and problem solution &amp; protection</li> <li>● Report safety activities according to specification suggested by government organisations</li> </ul> <u>Observation points:</u> in the project area <u>Frequency :</u> during the operation phase                 </li> </ul>

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p><b>Factor category 2 Population Health threat</b>  <b>exposure:</b> According to the project operation, the health threats can be divided into 2 main parts as physical threats (noise, light, heat) and chemical threats. In terms of the physical threat, noise may affect community and sensitive receptors whereas light and heat could affect workers/ employees in workplace. According to measuring results, high intensity and heat were considered acceptable based on the standard levels. Therefore, in terms of physical health threats, noise will be considered as impact assessment.                      Concerning chemical health threats, Acute Toxicity, Chronic Toxicity, Carcinogenicity and Exposure are considered. Based on monitoring results at IRPC Technology college which is located at the nearest place to the project location and used as Reference Value of sound level as 60 dB(A), considered as the main concern on health impact, it was found that the measured sound level was lower than the reference value.</p>	<p>- The machines used in the project operation must be certified by international standards i.e. ASME (The American Society of Mechanical Engineering), BS (British Standard), DIN (Deutsches Institute Fur Normung), JIS (Japanese Industrial Standard), etc.</p> <p><b>Work environment management</b></p> <p>- Provide work environment according to Ministerial regulation Re: Safety, Occupational and environment management standards on heat, light, and noise B.E. 2549 as follows</p> <p><b>* Noise</b></p> <ul style="list-style-type: none"> <li>• Provide noise contour map as a guideline for PPE use in the zone with sound level higher than 85 dB(A)</li> <li>• Provide a control room for the staff to avoid direct exposure to loud noise.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p>This means the sound level at such location is likely to be at safe level towards the human health. Therefore, it could be considered that noise impact tend to be at low level. In terms of chemical threats, it was considered based on the levels of dust, NO<sub>2</sub> and SO<sub>2</sub>, it was found that none of the area may be affected by such impacts either chronically or acutely.</p>	<ul style="list-style-type: none"> <li>* <b>Light</b> <ul style="list-style-type: none"> <li>• Provide sufficient light for working space and transporting routes.</li> </ul> </li> <li>* <b>Heat</b> <ul style="list-style-type: none"> <li>• Allocate the staff to work under appropriate temperature level at work station.</li> <li>• Request the staff to use appropriate PPE when working under high temperature environment.</li> </ul> </li> <li>* <b>Hazard prevention system/ equipment</b> <ul style="list-style-type: none"> <li>• Provide sufficient PPE i.e. helmets, safety shoes, earplugs, ear muffs, etc.</li> <li>• Provide eye wash and shower stations in the manufacturing zone at appropriate locations sufficiently.</li> <li>• Provide sufficient fire control equipment according to the standard of National Fire Protection Association (NFPA) i.e. sprinkler system, gas detector, CO<sub>2</sub> system, fire hydrants, fire extinguishers, fire detector, etc.</li> </ul> </li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p>According to secondary data on public health in Chapter 3, in the top 10 significant causes of mortality rate in Rayong province during B.E. 2553, it was highlighted that cysts (including cancer from tumours) tend to be the major cause. Cancer cases in Rayong tend to increase among the population. Therefore, chemicals used in this project operation was investigated in terms of carcinogenicity. It can be underlined that none of the chemicals used in this project is categorised in group A or 2 A (Carcinogens). Meanwhile, emissions from the project (particulates, SO<sub>2</sub>, NO<sub>2</sub>) are unlikely to cause cancer or may affect as low level.</p>	<ul style="list-style-type: none"> <li>• Install measuring meters to monitor the machine/ equipment operation status on i.e. pressure, temperature, flow, water level, etc. The measuring devices can transfer the data to control system automatically.</li> <li>• Safety equipment or hazard prevention devices are suggested to install i.e. install 2 sets of safety valves to emerge the steam when the pressure becomes higher than set value.</li> </ul> <p>* <b>Chemicals handling</b></p> <ul style="list-style-type: none"> <li>• Provide chemical data sheets at relevant locations in working area.</li> <li>• Deliver relevant knowledge on chemical hazards in case of leakages and how to take action on the incident.</li> </ul> <p>* <b>Emergency response plan/ Inspection, protective and maintenance plan</b></p> <ul style="list-style-type: none"> <li>• Provide emergency response plan</li> <li>• Conduct emergency response practice with IRPC industrial estate team at least once a year.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p><b>Factor category 3 Social changes and quality of life</b> : This is considered based on the data of economic condition, industries, and agriculture. The result of safety and security assessment in the study area suggested that it was considered as moderate level according to its urbanised characteristics as well as the incident of unregistered population immigratio. However, these matter does not seem to connect with the project operation. This is because the employment of the project is not considered high while the project mainly focuses to employ local employees, however, based on required qualification. Therefore, it can be said that the employees are unlikely to cause social probles significantly such that the negative impact is considered as low level.</p>	<ul style="list-style-type: none"> <li>• Inspect safety condition by safety officer(s) daily along with fixing unsafe condition, if any, immediately.</li> <li>• Inspect and maintain machines and equipment for efficient operation regularly.</li> <li>• Provide fire control equipment inspection plan</li> <li>• Conduct fire response and control practice cooperated with the company team according to annual practice plan 1 time annually.</li> <li>• Provide protective and maintenance plan for boilers and relevan equipment.</li> <li>• Provide boiler safety test at least 1 time per year or as required by relevant notifications specified by the Ministry of Industry.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p><b><u>Factor category 4</u> Public health readiness:</b>                      This is considered based on the data of health service centres, public health human resources, health records, and public health questionnaires. The assessment suggests that sufficiency of health service centres and public health human resources can be identified as moderate risk (2), however, the project has provided measures cooperated with IRPC on providing mobile medical health service to visit the surrounding communities, as well as to provide financial support for Tambon health promoting hospitals based on the need analysis. In addition, the project team plans to join health promotion activities with the communities. Meanwhile, in the project zone, doctors and nurses are provided for the employees so that the workload of local health service centres can be mitigated. However, in order to maintain good relationship with surrounding communities, policy to support health promotion collaborated with related local government organisations in the study area is essential to consider.</p>		



**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p> <p><b>- Hazard and risk assessment</b></p>	<p>Hazard assessment according to the project operation can be conducted based on 2 main approaches on hazard identification and analysis and providing safety measures ( World Bank Technica, 1990).</p> <p>In terms of assessing incident probability which may lead to hazards, high risk activity of the project operation is considered as boiler explosion which is assessed based on the criteria suggested in Department of Industrial Works Regulation on hazard identification criteria, risk assessment and risk management planning B.E.2543.</p> <p>Major Hazard Study and risk assessment of the project was considered based on main activities conducted in power plant operation which provide hazard risk inventory, hazard identification and risk assessment as follows,</p>	<p><b>Construction phase</b></p> <ul style="list-style-type: none"> <li>- The contractor is required to follow the regulation according to manual guideline provided by IRPC Public Co., Ltd., strictly, i.e. regulations for contractor, etc.</li> <li>- Unauthorised persons are not allowed in the construction area.</li> <li>- Contact with emergency control centre (ECC) to prepare protection measures and coordinate with other organisations according to emergency response manual in case of fire or explosion (<b>Figure 1</b>)</li> </ul> <p><b>Operation phase</b></p> <ul style="list-style-type: none"> <li>- Provide Metering and regulation station (MRS) with control equipment in ventilated area.</li> <li>- Install safety equipment for natural gas pipeline system such as flow meter, vent valve, control valve, shut off valve, etc. Meanwhile, such equipment can automatically cut off the natural gas transferring system through the central control system ( in case leakages are detected)</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p>1) Steam generation process may generate potential risks on boilers, steam turbine, steam headers, and steam pipeline explosion, and heat from generated steam. Fault Tree Analysis is a technique used for hazard impact identification.</p> <p>The results of risk assessment on boiler explosion, steam turbine explosion, steam header explosion, and steam pipeline explosion can be identified as level 2 which is considered acceptable level while control measures must ne reviewed.</p> <p>2) Power generation process has potential risk on generator explosion. Fault Tree Analysis is a technique used for hazard impact identification.</p> <p>The results of risk assessment on generator explosion can be identified as level 2 which is considered acceptable level while control measures must ne reviewed.</p> <p>3) Chemical storage has potential risk on chemical leakage. Fault Tree Analysis is a technique used for hazard impact identification.</p>	<ul style="list-style-type: none"> <li>- Provide qualified engineer to design and contro the construction of natural gas transfer system.</li> <li>- Pipeline related materials for natural gas transfer must be certified by international standards such as American Society of Mechanical Engineering (ASME) or American Petroleum Institute (API), etc.</li> <li>- Before the project operation or transferring the system between contractor and the project, the natural gas transfer system check must be performed, particularly, control valves in case of emergency.</li> <li>- Provide protective and maintenance plan for safety device installed with natural gas transfer system.</li> <li>- Inspect the natural gas transfer system regularly.</li> <li>- Practice emergency response plan level 2 cooperated with IRPC team at least once a year, and cooperate in practicing emergency response plan level</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p>Chemical leakages could happen during the operation process and during the storage. The chemicals are stored separately according to the utilisation purposes on water quality improvement, water demineralisation process, boilers, and cooling towers. Most chemicals are neutral while some of them are corrosive. Fault analysis was conducted on chemical transfer via pipeline, therefore, the leaks probability is considered. The results of risk assessment on chemical leakage can be identified as level 1 which is considered acceptable level and control measures has been provided.</p> <p>4) Using natural gas as fuel could have potential risks on pipe leakages or damages. Event Tree Analysis and BREEZE HAZ mathematical model are techniques used for hazard impact identification.</p>	<ul style="list-style-type: none"> <li>- Summarise the performance after emergency response practice, particularly, problems found so that the improvement can be applied.</li> <li>- Cooperate with local disaster protection and mitigation organisations and police station so that the support help can be provided in case of emergency.</li> <li>- Provide public relations activities to deliver the project information and emergency response plan to nearby enterprises and communities.</li> <li>- Provide trained staff to take action in case of gas leakage.</li> <li>- Specify the area in metering and regulation station as restricted area that any incident which may cause fire is prohibited. Strict inspection must be conducted on the area access with Work Permit procedure.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p>Potential leakage points in the project area are at the connection point between external transmission pipeline and MRS, and between the MRS and steam turbine power generator. The hazard analysis was conducted in case 1 inch leakage size, as frequent incident, and in case the pipeline is broken, as worst case at heat energy level 12.5 KW/m<sup>2</sup> (heat radiation could cause fire on wood structure and able to melt the plastic, with may cause death as 1% in 1 minute, while dermal burning could occur in 10 seconds) as following details</p> <p>a) at the connection point between external transmission pipeline and MRS</p> <p>Scale of the impact, calculated from the connection point between external transmission pipeline and MRS , based on 1 inch leakage size with Jet fire flame as the most frequent incident which could occur, and in case of the pipe is broken as worst case with a diameter of leakage as 24 inches with leakage rate as 5.00 and 28.80 kg/sec. However, only the first case will be summarized in detail.</p>	<ul style="list-style-type: none"> <li>- Test natural gas cut-off control valves during the system test to ensure that it can work within 1 minute in connection with SCADA system at PTT pipe system operation centre.</li> <li>- Provide leaks detector i.e. Gas Detector at MRS station.</li> <li>- Provide protective and maintenance plan for safety control equipment and gas transfer system in case of emergency, including the pipe inspection regularly.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p>According to the first case when 1 inch leakage incident occurred as gas state, if there is any source of sparks, immediate ignition as Jet Fire will occur which will cause heat radiation which could bring about the impact at level 4 12.5 and 37.5 KW/m<sup>2</sup> at the range of hazard distance as 31.20 18.15 and 10.07 m, respectively. Affected area is predicted to be the project zone and the road in front of the project area.</p> <p>In case the leaks occur as a consequence of pipe breaking or damages, while the leakage happens as gas state, if there is any source of sparks, immediate ignition as Jet Fire will occur which will cause heat radiation which could bring about the impact at level 4 and 12.5 KW/m<sup>2</sup> at the range of hazard distance as 412.16 and 180.15 m , respectively. Affected area is predicted to be the project zone.</p>	<ul style="list-style-type: none"> <li>- Conduct practice on emergency response plan level 1 before the project operation prior to 4 time per year practice during the project operation. It is also specified that the practice will have to be conducted without advance notice. Meanwhile, the practice will focus on 30 seconds gas cut-off system by Line Break Protection Control, an automatic device installed at the control valves.</li> <li>- Summarise the performance after emergency response practice, particularly, problems found so that the improvement can be applied.</li> <li>- Cooperate with local disaster protection and mitigation organisations and police station so that the support help can be provided in case of emergency.</li> </ul>	

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p>In case of fire and explosion according to pressure, or Vapor Cloud Explosion, the hazard study on gas leaks found the natural gas dispersion is unlikely to affect living organisms, however, it is likely to affect on ignition. If ignition and explosion occur at pressure of 0.069 atm (g), the explosive boundary is at 1,236 m, at pressure of 0.138 atm (g), the explosive boundary is at 399 m, at pressure of 0.345 atm (g), the explosive boundary is at 267 m. The affected areas are likely to be the project zone at MRS and area located surrounding the project location, including area outsider IRPC zone.</p> <p>b) Between the MRS and steam turbine power generator</p> <p>Scale of the impact, calculated from the connection point between the MRS and steam turbine power generator, based on 1 inch leakage size with Jet fire flame as the most frequent incident which could occur, and in case of the pipe is broken as worst case with a diameter of leakage as 24 inches with leakage rate as 5.00 and 28.80 kg/sec. However, only the first case will be summarized in detail.</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p>According to the first case when 1 inch leakage incident occurred as gas state, if there is any source of sparks, immediate ignition as Jet Fire will occur which will cause heat radiation which could bring about the impact at level 4 12.5 and 37.5 KW/m<sup>2</sup> at the range of hazard distance as 31.20 18.15 and 10.07 m, respectively. Affected area is predicted to be the project zone and the road in front of the project area.</p> <p>In case the leaks occur as a consequence of pipe breaking or damages, while the leakage happens as gas state, if there is any source of sparks, immediate ignition as Jet Fire will occur which will cause heat radiation which could bring about the impact at level 4 and 12.5 KW/m<sup>2</sup> at the range of hazard distance as 412.16 and 180.15 m , respectively. Affected area is predicted to be the project zone</p>		

**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p>In case of fire and explosion according to pressure, or Vapor Cloud Explosion, the hazard study on gas leaks found the natural gas dispersion is unlikely to affect living organisms, however, it is likely to affect on ignition. If ignition and explosion occur at pressure of 0.069 atm (g), the explosive boundary is at 1,236 m, at pressure of 0.138 atm (g), the explosive boundary is at 399 m, at pressure of 0.345 atm (g), the explosive boundary is at 267 m. The affected areas are likely to be the project zone at MRS and area located surrounding the project location, including area outsider IRPC zone.</p> <p>Probability of continuouse hazard incident is likely to be low or very rare probability to occur.This is because the pipe transmission system was constructed based on maximum safety concern as well as the project has implemented engineering standard higher than ASME B 31.8 to the operation. In addition, SCADA system is installed for real time monitoring to ensure safe operation of the pipeline system coupled with good maintenance practice applied to the pipeline system regularly. Meanwhile, emergency response plan has been provided for effective practice.</p>		



**Table 3-1 (Con't) Summary of existing environment, environmental impact assessment, environmental impact protection, mitigation and monitoring measure**

Environmental components and values	Significant environmental impacts	Protection and mitigation measures	Monitoring measures
<p><b>7. Others (continued)</b></p>	<p>Therefore, probability of continuous hazard incident tend to be at low level. However, concerning the natural gas properties, distance between the pipes, and surrounding environment, PTT Public co., Ltd. has provided protective and maintenance measures for the pipeline networks along with emergency response plan which can be applied immediately in case of emergency. It is also stated that,any operation to be conducted near the pipeline network zone, permission must be approved by PTT. Therefore, it can be concluded that probability of continuous hazard incident tend to be at low level. If all protective measures are implemented strictly, it is estimated that negative impact (-) could be low (1).</p>		

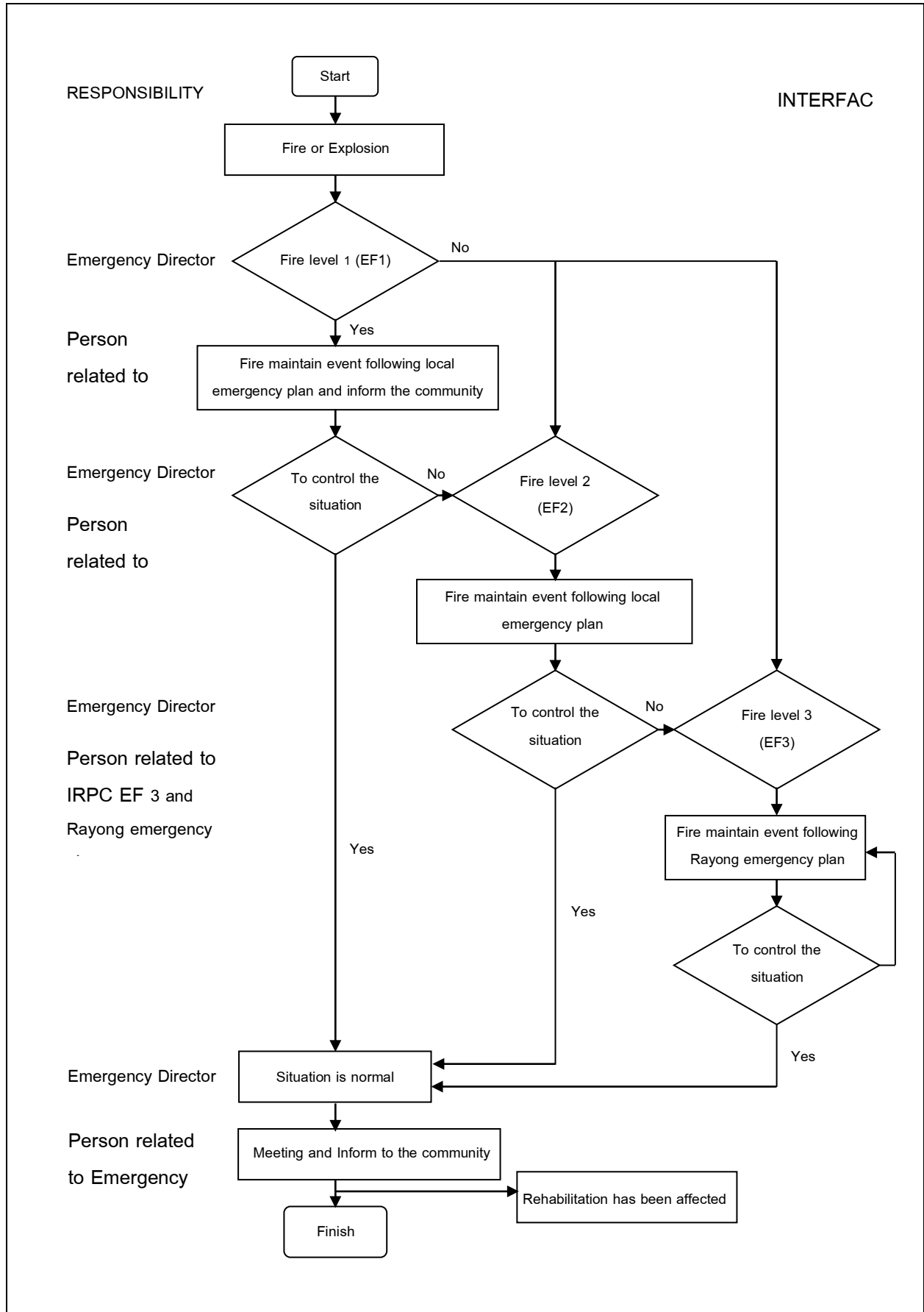
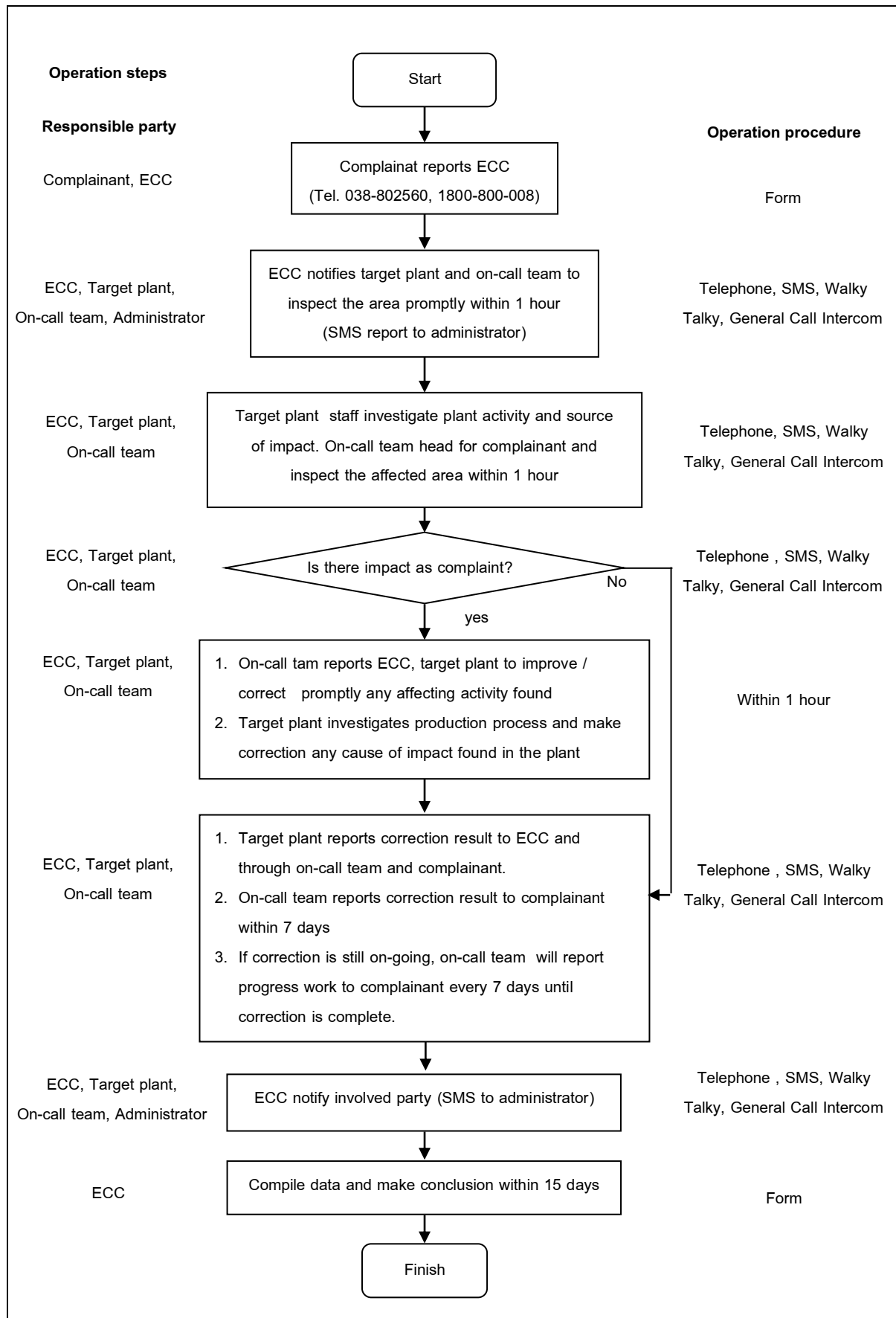
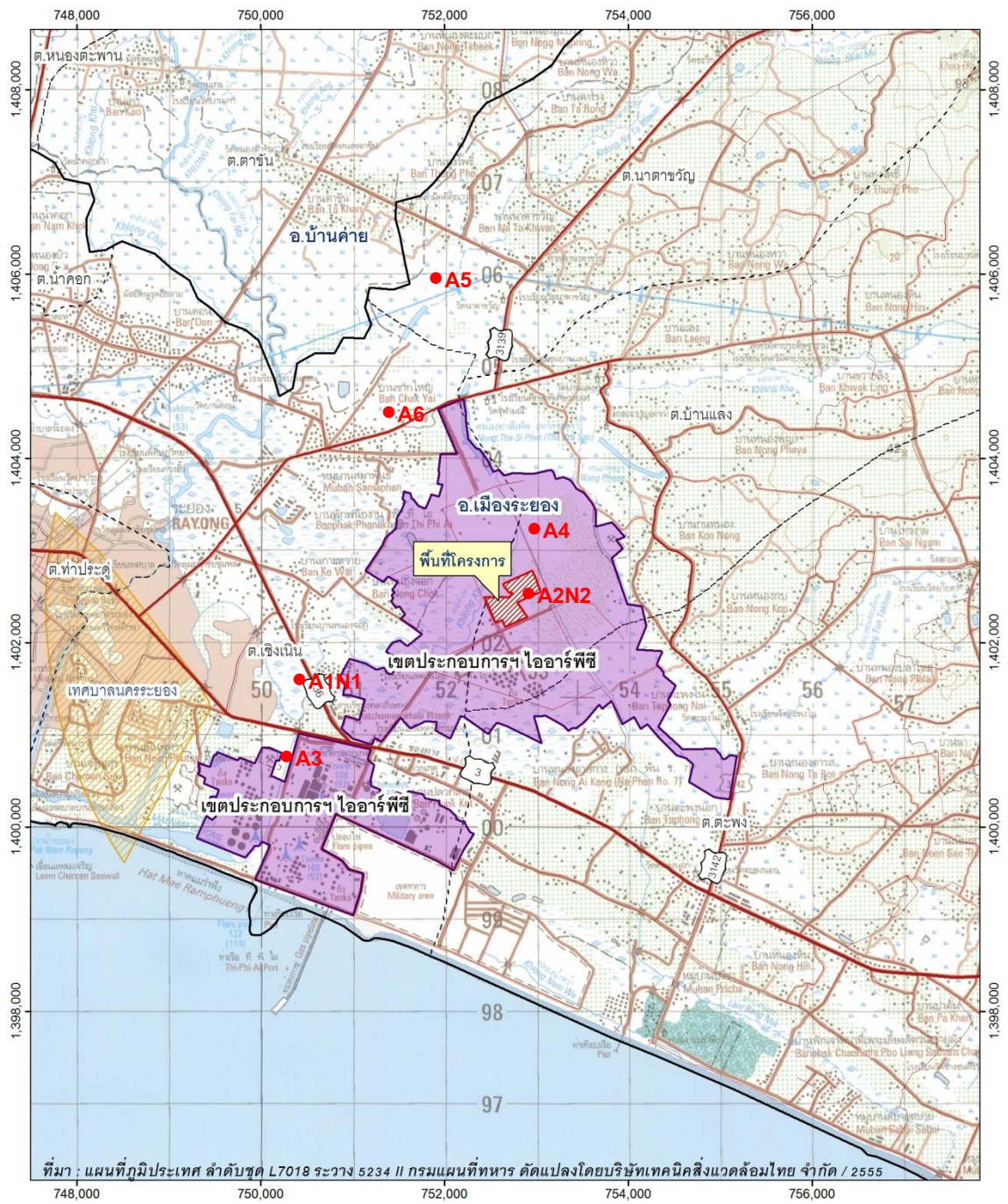


Figure 1 Fire and Explosion emergency plan



**Figure 2** Operation Steps of Complaint Filing and Response Action Plan



**Legends**

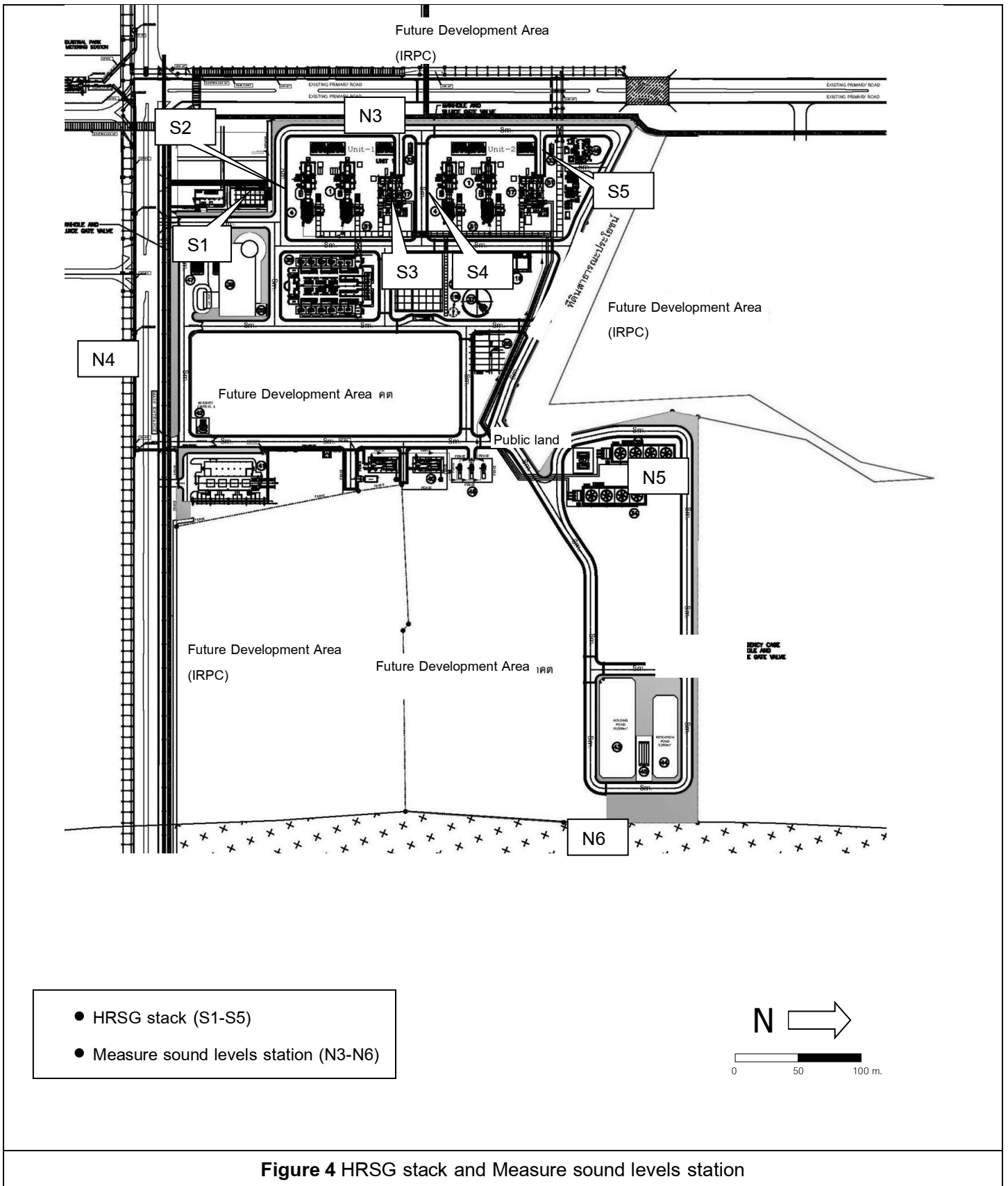
Ambient air level monitoring station

- A1 IRPC Technology college
- A2 Ban Gonnong, Moo 2 , Tambon Banlang
- A3 Wat Pluagket
- A4 Bangonnong health promoting hospital
- A5 Wat Na Ta Kwuan
- A6 Rayong Punyanukul school

Sound level monitoring station

- N1 IRPC Technology college
- N2 Ban Gonnong, Moo 2 , Tambon Banlang

**Figure 3** Ambient air and Sound level monitoring station



**Figure 4** HRSG stack and Measure sound levels station



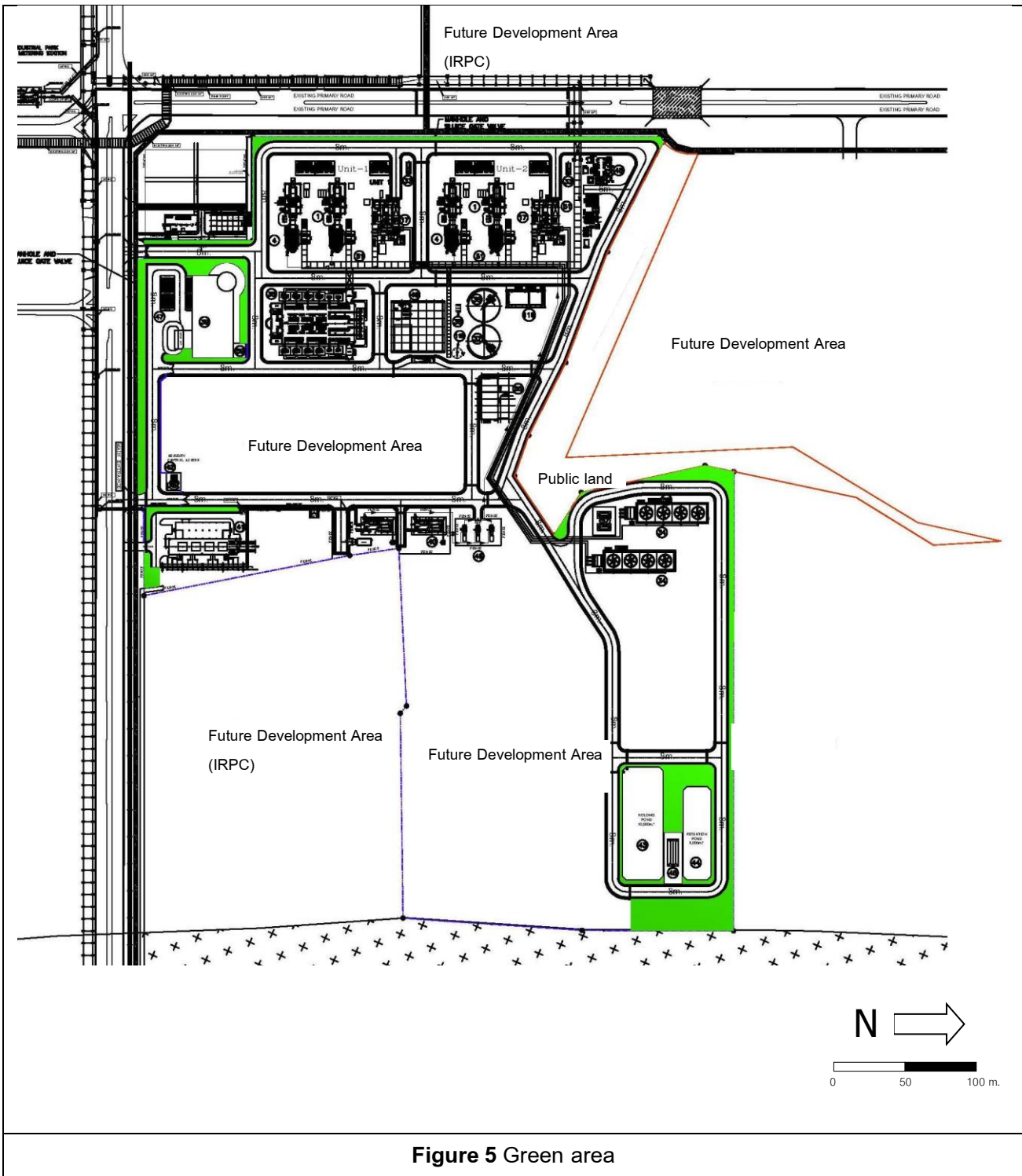


Figure 5 Green area