# Draft Environmental and Social Impact Assessment Report (ESIA) – Part 2

Project Number: 51112-001
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# INO: Jawa-1 LNG to Power Project

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# 8 ENVIRONMENTAL IMPACT ASSESSMENT

## 8.1 INTRODUCTION

The overall approach to the rating and evaluation of impacts follows the methodology presented in **Section 3**. This Section provides greater detail in the evaluation of the significance of environmental impacts identified during Scoping. Where resource/receptor specific magnitude or sensitivity/ vulnerability definitions apply, these are discussed in the relevant subsections.

The impact assessment has taken into account the scoping results regarding the assessment of environmental and social aspects for the ESIA in fulfilment of the international lender standards discussed in **Section 2** as per the findings presented in **Section 5**. The impacts and management of general non-routine Project activities during construction and operations are discussed in **Section 10** of this Report.

## 8.2 ENVIRONMENTAL RECEPTORS

ESIA Scoping identified the following activities and environmental receptors to be carried forward to be further assessed in the ESIA.

***Table 8.1 Summary of the Routine Project Activities and Key Environmental Receptors***

| Phase | Environmental Receptors |
|---|---|
| Planned activities during Pre-Construction and Construction | • Climate Change;<br>• Air Quality;<br>• Acoustics & Vibration;<br>• Soil and Groundwater;<br>• Surface Water Quality;<br>• Terrestrial Biodiversity;<br>• Waste Management;<br>• Marine Water Quality; and<br>• Marine Biodiversity. |
| Planned activities during Operations | • Climate Change;<br>• Air Quality;<br>• Greenhouse Gases Emission;<br>• Acoustics & Vibration;<br>• Soil and Groundwater;<br>• Surface Water Quality;<br>• Terrestrial Biodiversity;<br>• Waste Management;<br>• Landscape & Visual;<br>• Electric and Magnetic Fields (EMF);<br>• Marine Water Quality; and<br>• Marine Biodiversity. |

There are a number of intrusive activities that occur throughout the lifecycle of the Project which, if not managed effectively, may cause impacts to the sensitive receptors in the vicinity of the Project Area.

The temporal and spatial spread of activities will mean that actual impacts will be dependent on the specific activities. Accordingly, to enable clearer assessment of impacts and development of management and mitigation measures specific to each activity/receptor interaction and reduce repetition, the potential impacts are described on a receptor basis.

This Section also develops management, mitigation and monitoring measures needed to ensure that any identified impacts can be reduced to as low as reasonably practical. Such measures are presented and will form part of the overall environmental and social management plan for the Project.

## 8.3 *GENERAL CLIMATE CHANGE*

### 8.3.1 *Potential Source of Impact*

In recent decades, changes in climate change have caused impacts on natural and human systems on all continents and across the oceans. According to the IPCC, changes in many extreme weather and climate events have been observed since about 1950. Some of these changes have been linked to human influences, including a decrease in cold temperature extremes, an increase in warm temperature extremes, an increase in extreme high sea levels and an increase in the number of heavy precipitation events in a number of regions.

According to the IPCC, global warming trends and increasing temperature extremes have been observed across most of the Asian region over the past century. Water scarcity is expected to be a major challenge for many countries in the regions as a result of increased water demand across industry, agriculture and domestically but also the lack of good water management. Coastal systems are under increasing stress from climate drivers. Extreme climate event such as more frequent and intense heat waves and heavy rain, will have an increasing impact on human health with the type and magnitude of impact varying across Asia.

#### 8.3.1.1 *Observed Climate Change*

Across Southeast Asia, temperature has been increasing at a rate of $0.14^0C$ to $0.20^0C$ per decade since the 1960s, in conjunction with a rising number of days and warm nights, and a decline in cooler weather. For Indonesia, there is a strong evidence of pronounced and high spatially coherence of warming of surface air temperature during the past three decades. The frequency of cool days and cool nights had decreased whereas more frequency of warm days and nights were observed and a clear warming trend of $0.18^0$ - $0.30^0C$ per decade can be seen.

In Southeast Asia annual total wet-day rainfall has increased by 22 mm per decade while rainfall from extreme rain days has increased by 10 mm per decade; climate variability and trends differ vastly across the region and season. Annual precipitation overall has decreased by two or three percent across all of Indonesia over the last century, however there exist a substantial spatial variability of the rainfall extreme throughout the country, with the drying trend in Java being more pronounced.

There has also been a shift in the seasonality of precipitation. Precipitation in Indonesia (and in many parts of the world) is strongly influenced by El Nino and Southern Oscillation (ENSO) events; for instance 93% of droughts Indonesia between 1830 and 1953 occurred during El Niño years.

#### 8.3.1.2 *Projected Climate Change*

Under IPCC scenarios it is very likely for all land areas of Asia in the mid-and late 21st century to see an increase in temperature. Average changes in mean annual temperature are projected to exceed $2^{0}$C above the late 20th century baseline over most land areas in the mid-21st century. Projected temperature increases over Indonesia are generally consistent in the range of 2-2.$5^{0}$C.

Modelled precipitation changes are note as uniform; it is projected that annual rainfall will increase across the majority of the Indonesian island, with the possible exception of southern Indonesia including Java which is projected to decline.

However there is considerable variance in rainfall for different climate models. Changes in the timing and seasonality of rainfall is also projected to change.

### 8.3.2 *Assessment of Impacts*

Impacts of observed changes in climate are already evident in Indonesia and will likely worsen due to further human-induced climate change. Continued emission of greenhouse gases will cause further warming and long-lasting changes including the raise of surface and ocean temperatures, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems such as increase sea levels, more frequent fires to increased health risk.

Indonesia will likely experience sea-level rise, changes in the intensity of rainfall patterns which will increase the risk of floods and droughts, increase of surface and ocean temperatures, degradation of biodiversity, increased health risks, and more frequent and intense weather events.

The following section highlights some of these projected climate change impacts that are relevant in the context of this ESIA Report.

#### 8.3.2.1 *Changes in Water Availability*

Observed climate change impacts in Indonesia include changes in the intensity and patterns of precipitation, which are a result of the increase of surface temperatures. There are currently few studies on the impact of climate change on water stress and drought in Indonesia, especially at the national scale. Important uncertainties concern the role of the Asian monsoon affecting drought occurrences in Indonesia under climate change scenarios.

The IPCC AR4 previously reported potential increases in precipitation over Indonesia under global climate change scenarios. Large uncertainties remain, particularly regarding the response of the El Niño Southern Oscillation to climate change. A majority of the available models show a tendency for increasing flood risk; few studies have made projections of changes in flood hazard under climate change in Indonesia at national or local scale.

However, given that severe floods have affected Indonesia several times in recent history, a better quantification of the risk of flooding in Indonesia under climate change scenarios is needed. Events such as the Jakarta flood on 2nd February 2007 affected 80 districts in Jakarta. More than 70,000 houses were inundated with water levels ranging from 10cm to 5m and 69 people were killed and an estimated 420,440 people were displaced. The Indonesian government estimates that losses amount to Rp 4.1 trillion (US$ 450 million) (*WHO, 2007*). Since then, large areas of the country, including parts of West Sumatra, Central, East and West Java and Jakarta have been severely affected by heavy rains and subsequent landslides and flooding in recent years.

#### 8.3.2.2 *Tropical Cyclones*

The country report for Indonesia produced for the Department of Energy and Climate Change, suggested that the frequency of landfilling tropical cyclones in Indonesia could decrease with climate change, for both West Pacific, affecting the eastern part of the country; and South Indian Ocean cyclones, affecting the western and southern regions.

However, the intensity of cyclones could increase with climate change, particularly for the most severe storms. The combination of these two (2) effects, and the uncertainties in each of their magnitudes, leads to considerable uncertainty in the estimation of future cyclone damages in Indonesia under climate change.

#### 8.3.2.3 *Increase of Sea Surface Level*

Global mean sea level rise (SLR) will continue during the 21st century likely at a faster rate than observed from 1971 to 2010. SLR will not be uniform across regions; by the end of the 21st century, it is very likely that sea level will rise in more than about 95% of the ocean area. For the period 2081—2100 relative to 1986—2005, the rise will likely be in the ranges of 0.26 to 0.55 m and 0.45 to

0.82m for selected representative Concentration Pathways (RCP2.6 and RCP8.5 respectively) adopted by the IPCC for its fifth Assessment Report in 2014.

SLR could have major impacts on Indonesia's coastal regions as well as marine resources such as reefs and mangroves. A 10% intensification of the current 1 -in-100-year storm surge combined with a prescribed 1m SLR could affect 39% of Indonesia's coastal GDP and 14,400 $km^2$ of coastal land and increase the annual number of people in coastal populations being flooded.

*8.3.2.4 Human Health*

Climate change will have widespread and diverse health impacts. For example, more frequent and intense heat waves will increase mortality and morbidity in vulnerable groups. The transmission of infectious disease will be affected as a result of warmer air and water temperatures and altered rain patterns and water flows. Changes in the geographical distribution of vector-borne diseases are already being observed, as vector species that carry and transmit diseases migrate to more hospitable environments.

Climate change will have associated direct effects, such as higher temperatures, changes in precipitation and sea- level rise can cause more frequent and severe heat waves, floods, extreme weather events, and prolonged droughts and lead to increased injury, illness, and death; and Indirect effects, which are more difficult to attribute to climate change, may include more widespread vector-borne infections (e.g., malaria and dengue), an expansion of water-borne diseases, such as diarrhoea and increase in infectious diseases.

**Table 8.2** below outlines the key risks from climate change and the potential for risk reduction through mitigation and adaptation relevant to this Project and reference to how the impacts of climate change on the Project has been addressed in the design.

*Table 8.2 Key Risks from Climate Change and the Potential for Risk Reduction*

| Key risk | Adaptation issues & prospects | Climatic drivers | Addressed in section |
|---|---|---|---|
| Increased riverine, coastal and urban flooding leading to widespread damage to infrastructure, livelihoods and settlement | • Exposure reduction via structural and non-structural measures, effective land-use planning, and selective relocation;<br>• Reduction in the vulnerability of lifeline infrastructure and services (e.g., water, energy, waste management, food, biomass, mobility, local ecosystems, telecommunications);<br>• Construction of monitoring and early warning systems; and<br>• Measures to identify exposed areas, assist vulnerable areas and households, and diversify livelihoods. | • Extreme precipitation;<br>• Sea level; and<br>• Cyclone. | Flood & Sea Level Risk (refer to **Section 10.6**) |
| Increased risk of flood-related deaths, injuries, infectious disease and mental disorders | Disaster preparedness including early-warning systems and local coping strategies. | • Extreme precipitation; and<br>• Cyclone. | Flood & Sea Level Risk (refer to **Section 10.6**) |
| Increased risk of water and vector-borne diseases | Early-warning systems, vector control programs, water management and sanitation programs. | • Extreme precipitation;<br>• Drying trend;<br>• Warming trend; and<br>• Extreme temperatures | Social and Community Health (refer to **Section 9**) |

## 8.4 AIR QUALITY

### 8.4.1 *Potential Source of Impact*

The Project activities and associated emissions to air that may have an impact on ambient air quality during the construction and operation of the CCGT Power Plant and associate facilities including the Floating Storage Regasification Unit (FSRU), the Onshore Gas Receiving Facility (ORF), onshore pipelines, and Transmission Line (hereafter collectively referred to as "the Project") are presented below in **Table 8.3.**

*Table 8.3 Project Activities and Associated Emissions to Air*

| Project Phase | Project Activity | Source of Emission | Substances(1) |
|---|---|---|---|
| Construction | • Land clearance;<br>• Land excavation;<br>• Material transfer;<br>• Material stockpiling;<br>• Use of unpaved roads;<br>• Installation of onshore pipeline; and<br>• Construction of Project infrastructure including CCGT, FSRU, ORF and transmissions lines. | • Point source: Exhaust emissions from diesel engine driven mobile and non-mobile machinery, vehicles and vessels.<br>• Fugitive: dust generated from the mechanical disturbance of granular materials exposed to the air. | • $NO_2$, $SO_2$, TSP, $PM_{10}$ and $PM_{2.5}$ |
| Operation | • Power generation at the CCGT power plant;<br>• Power generation required for black start, station black out and/or emergency power;<br>• Gas processing at the ORF; and<br>• Power generation on the FSRU.<br>• Process Water Cooling. | • Point source: Stack emissions from diesel engine-generators, gas turbines, high pressure emergency vent and cooling towers | • $NO_2$, CO, $SO_2$, TSP, $PM_{10}$ and $PM_{2.5}$, hydrocarbon and NaCl. |

(1) Nitrogen Dioxide ($NO_2$); sulphur dioxide ($SO_2$); total suspended particulates (TSP); particulate matter with an aerodynamic diameter no greater than 10µg ($PM_{10}$); particulate matter with an aerodynamic diameter no greater than 2.5µg ($PM_{2.5}$); Carbon Monoxide (CO).

### 8.4.2 *Assessment Approach and Criteria*

#### 8.4.2.1 *Air Quality Standards and Guidelines*

The legal framework of relevance to the air quality impact assessment is listed below:

- *World Bank IFC General EHS Guidelines for Air Emissions and Ambient Air Quality, 2007;*
- *World Bank IFC EHS Guidelines for Construction and Decommissioning, 2007;*

- *World Bank IFC EHS Guidelines for Thermal Power Plants, 2007;*
- *World Bank IFC EHS Guidelines for Liquefied Natural Gas (LNG) Facilities, 2017;*
- *World Bank IFC EHS Guidelines for Shipping, 2007;* and
- *Regulation of the Republic of Indonesia Number 41 (1999) regarding Air Pollution Control (PP41/1999).*

In accordance with the IFC guidelines for Air Emissions and Ambient Air Quality, the air quality standards presented in the Indonesian Regulation of the Republic of Indonesia Number 41 (1999) regarding Air Pollution Control (PP41/1999) should be considered the appropriate standard and are therefore used for comparison of baseline data and predicted impacts in the air quality impact assessment. A summary of the Indonesian air quality standards are presented in **Table 8.4.**

***Table 8.4 Indonesia (PP41/1999) Ambient Air Quality Standards***

| Parameter | Averaging Period | Air Quality Standard (μg/m³) |
|---|---|---|
| Nitrogen Dioxide (NO2) | 1-hour | 400 |
| | 24-hour | 150 |
| | Annual | 100 |
| Sulphur dioxide ($SO_2$) | 1-hour | 900 |
| | 24-hour | 365 |
| | Annual | 60 |
| Carbon Monoxide (CO) | 1-hour | 30,000 |
| | 24-hour | 10,000 |
| Total Suspended Particulate (TSP) | 24-hour | 230 |
| | Annual | 90 |
| $PM_{10}$ | 24-hour | 150 |
| $PM_{2.5}$ | 24-hour | 65 |
| | Annual | 15 |
| Ozone ($O_3$) | 1-hour | 50 |
| | Annual | 235 |
| Lead (Pb) | 24-hour | 2 |
| | Annual | 1 |
| Hydrocarbons (HC) | 3-hours | 160 |
| Total Fluorides (F) | 24-hour | 3 |
| | 90 days | 0.5 |
| Chlorine and Chlorine dioxide | 24-hour | 150 |

In terms of potential impacts to ecology and agriculture, local assessment criteria do not exist and the IFC do not set standards or guidelines for protection of vegetation. Instead, critical levels and salt deposition thresholds provided by the WHO, the EU and the United States Nuclear Regulatory

Commission have been used to inform the impact assessment and are presented below in **Table 8.5** and **Table 8.6**.

*Table 8.5* *Air Quality Critical Levels used for the Assessment of Impacts on Sensitive Ecological and Agricultural Receptors*

| Pollutant | Averaging Period | Critical Levels (µg/m³)(1,2) |
|---|---|---|
| Nitrogen Oxides ($NO_x$) | Annual mean | 30 |
| Sulphur dioxide ($SO_2$) | Annual Mean | 20 |

(1) *Source: WHO, 2000*
(2) *Source: EU, 2008*

*Table 8.6* *Sodium Chloride (Salt) Deposition Threshold*

| Substance | Averaging Period | Threshold (kg/ha)(1) |
|---|---|---|
| Sodium Chloride (NaCl) | Month | 10 |

*(1) Source: United States Nuclear Regulatory Commission, 1999.*

### 8.4.2.2 *Emission Limits Applicable to the Project*

The relevant emission limits as per the IFC EHS Guidelines for Thermal Power Plants greater than 50 megawatt thermal input (MWth) are presented in **Table 8.7.**

*Table 8.7* *International Finance Corporation (IFC) Air Emissions Guidelines for Combustion Turbine (>50MWth)*

| Combustion Technology/Fuel | Particulate Matter (PM) | Sulphur Dioxide ($SO_2$) | Nitrogen Oxides ($NO_x$) | Dry Gas, Excess $O_2$ content (%) |
|---|---|---|---|---|
| | in mg/Nm³ or as indicated | | | |
| | NDA(1) / DA(2) | NDA(1) / DA(2) | NDA(1) / DA(2) | |
| Natural Gas (all turbine types of unit >50MWth(3)) | n/a | n/a | 51 (25ppm) | 15% |

(1) Non-degraded airshed
(2) Degraded airshed
(3) Megawatt thermal input

### 8.4.2.3 *Air Quality Assessment Significance Criteria*

The magnitude of the impact on air quality was ascertained by means of comparison to the air quality standards presented and is based upon whether or not the impacts result in air quality standards being exceeded or contribute a substantial proportion of airborne pollutants in the local airshed. The magnitude is based on both the 'Project Contribution (PC)'; this is the impact arising solely from Project related emissions, and the Predicted Environmental Concentration (PEC); this is the PC added to the existing baseline.

The significance of impacts is defined in terms of the magnitude of impacts (i.e. the PEC), the sensitivity of the receptors, and whether the baseline pollution concentrations are above or below the air quality standards. Using this approach, the significance criteria for air quality have been defined.

The magnitude and significance of impacts for non-degraded and degraded airsheds have been derived and presented in **Table 8.8** and **Table 8.9** respectively. The approach used in this assessment assumes that sensitivity within the general study area is 'Medium' for human health and ecological receptors, noting that no hospitals or internationally designated ecological sites have been identified. Under no circumstances is the sensitivity for human health described as 'Low'.

*Table 8.8 Magnitude Criteria for Assessment of Air Pollutants*

| Magnitude of impact | Non-degraded airshed (i.e. baseline < AQS) | Degraded airshed (i.e. baseline > AQS) |
|---|---|---|
| Negligible | PC <25% of AQS | PC <10% of AQS |
| Small | PC between 25% and 50% of AQS and PEC <100% of AQS | PC between 10% and 30% of AQS |
| Medium | PC between 50% and 100% of AQS, and PEC <100% AQS; or<br>PC between 25% and 50% of AQS, and PEC >100% of AQS | PC between 30% and 50% of AQS |
| Large | PC > 100% of AQS; or<br>PC > 50% of AQS, and PEC >100% of AQS | PC > 50% of AQS |

PC: Process Contribution
PEC: Predicted Environmental Concentration
AQS: Air Quality Standard/Guideline

*Table 8.9 Determination of Significance*

| Impact Magnitude | Receptor Sensitivity | | |
|---|---|---|---|
| | Low | Medium | High |
| **Negligible** | Negligible | Negligible | Negligible |
| **Small** | Negligible | Minor | Moderate |
| **Medium** | Minor | Moderate | Major |
| **Large** | Moderate | Major | Major |

### 8.4.3 *Scoping of Likely Impacts to Air Quality*

A detailed preliminary screening assessment was undertaken to better understand the Project activities, processes and emissions which are likely to have a significant impact on air quality and therefore require further more detailed consideration. The findings from the screening assessment concluded that the main activities which require further more detailed assessment are as follows:

- Construction activities: These activities are specifically associated with earthworks, the construction of the Project infrastructure, and track-out (carrying and contamination) of materials onto public roads leading to increased ambient concentrations of TSP and $PM_{10}$;

- Offsite construction traffic: The use of vehicle on the public road network during the construction phase resulting in elevated concentrations of $NO_2$ and $PM_{10}$;

- Operation of the CCGT Power Plant: The continuous operation of two Combined Cycle Gas Turbines (CCGT) used for power generation during the normal operation of the Project resulting in elevated ambient concentrations of $NO_2$ and CO;

- Operation of diesel-engine generators: The intermittent and infrequent use of diesel generators required for black start and emergency shut down procedures during the operation phase resulting in elevated ambient concentrations of $NO_2$, $SO_2$, $PM_{2.5}$ and $PM_{10}$; and

- Operation of cooling towers: The continuous operation of two seawater cooling tower systems can lead to increased sodium chloride (NaCl) deposition on the surrounding agriculture.

### *8.4.4 Assessment of Impacts – Construction Activities*

#### *8.4.4.1 Overview*

The activities associated with the construction phase of the Project have the potential to generate TSP and particulate matter ($PM_{10}$). These activities include ground excavation, material transfer and material stockpiling; construction of the main infrastructure including the power plant and transmission line tower; and track-out of dusty materials and dirt onto the public road network. Fugitive dust has the potential to cause impacts on sensitive receptors in the vicinity of the above named activities if not managed accordingly. Dust emissions can vary substantially from day to day and will depend on the level of activity, the specific operations being undertaken and the meteorological conditions.

#### *8.4.4.2 Assessment Approach and Criteria*

The Institute of Air Quality Management (IAQM) (1) provide guidance for defining the significance arising from construction sites based on the magnitude of the change and the sensitivity of the receptors identified.

(1) Institute of Air Quality Management (IAQM) (2014) Guidance on the Assessment of Dust from Demolition and Construction [Online] Available at: http://iaqm.co.uk/guidance/ {Accessed 07 August 2017}

The IAQM define the risk of dust emissions using a number of variables including, but not limited to the activities being undertaken, the duration of activities, the size of the site and the meteorological conditions. The criteria for estimating the magnitude of dust impacts as per the IAQM guidance note is presented in **Table 8.10.** The IAQM guidance further provides screening criteria of 350m and 50m from the construction site and access road respectively beyond which impacts are not considered likely. The premise of the guidance is that with the implementation of effective site specific mitigation measures, the environmental effect will not be significant in most cases.

As the IAQM guidance is primarily developed for use in the UK, consideration is given to its applicability in Indonesia due to the dissimilar climate and differing construction working practices. The potential impacts on air quality from activities including earthworks, construction and track-out have therefore been considered at a conservative distance of 500m from the Project components including the CCGT Power Plant area and onshore pipeline right of way (ROW) (see **Figure 8-1**).

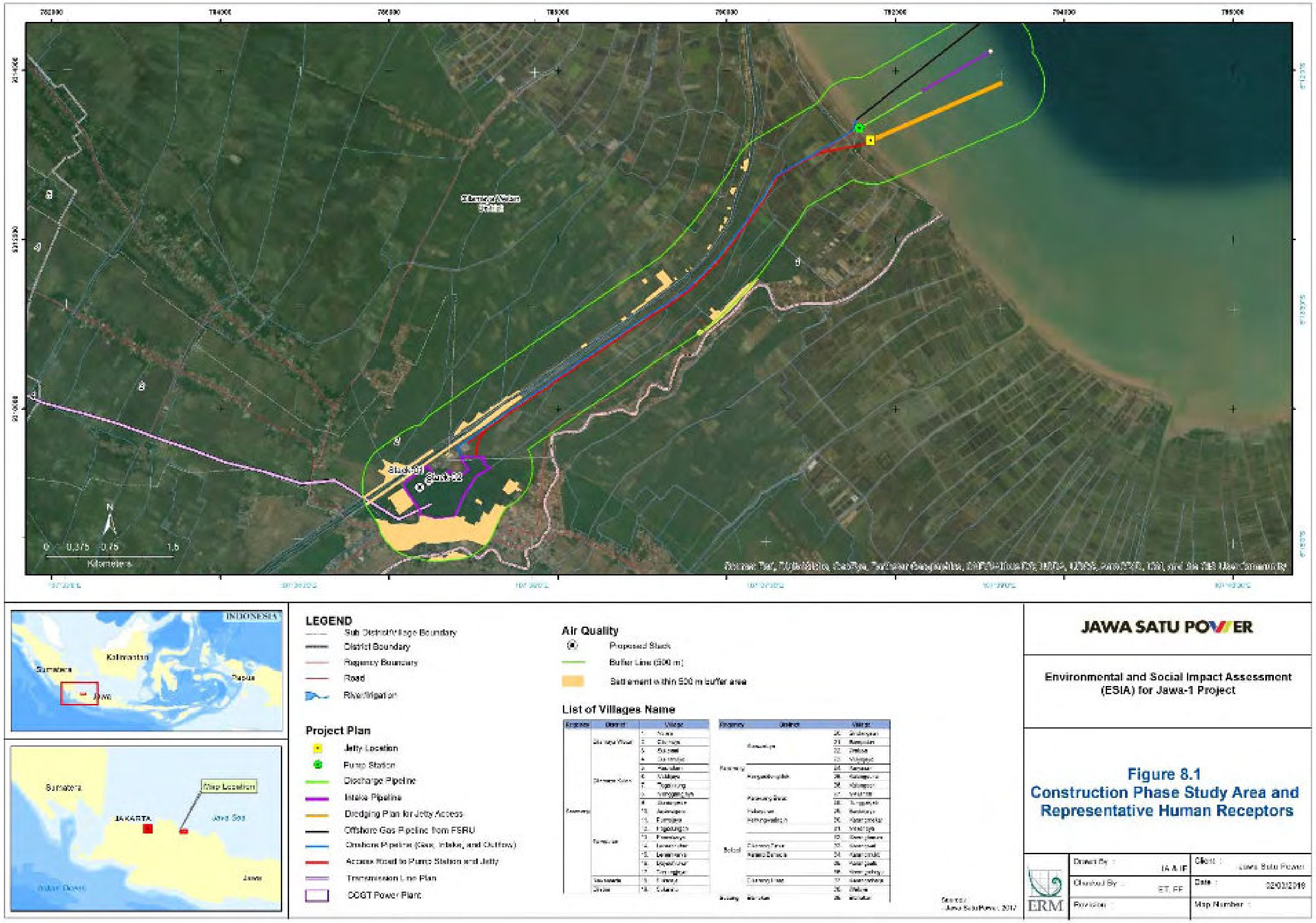
Air Sensitive receptors within 500m of the transmission line tower and substation construction sites are also considered and part of this impact assessment however given the spatial extent of the transmission lines these have not been presented in a figure. The potential impact significance from the different Project components and activities and the specific mitigation measures which are required have been considered. The construction of the FSRU and Jetty have been screened out on the basis that no dust will be generated in the marine environment and no sensitive receptors exist within 500m. Where necessary professional judgement has been used to estimate the impact magnitude from the different Project components and activities.

***Table 8.10 Dust Emission Magnitude***

| **Activity** | **Impact Magnitude** | | |
|---|---|---|---|
| | **Small** | **Medium** | **Large** |
| Earthworks | Total site area <2 ,500m$^2$, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <4m in height, total material moved <20,000 tonnes, earthworks during wetter months | Total site area 2,500 m$^2$ – 10,000 m$^2$, moderately dusty soil type (e.g. silt), 5-10 heavy earth moving vehicles active at any one time, formation of bunds 4 m - 8 m in height, total material moved 20,000 tonnes –100,000 tonnes | Total site area >10,000 m$^2$, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >8 m in height, total material moved >100,000 tonnes |

| Activity | Impact Magnitude | | |
|---|---|---|---|
| | **Small** | **Medium** | **Large** |
| General Construction | Total building volume <25,000m$^3$, construction material with low potential for dust release (e.g. metal cladding or timber). | Total building volume 25,000m$^3$ – 100,000m$^3$, potentially dusty construction material (e.g. concrete), on-site concrete batching; | Total building volume >100, 000m$^3$, on-site concrete batching, sandblasting |
| Trackout | <10 HDV (>3.5t) outward movements in any one day, surface material with low potential for dust release, unpaved road length <50 m. | 10-50 HDV (>3.5t) outward movements in any one day, moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m | >50 HDV (>3.5t) outward movements in any one day, potentially dusty surface material (e.g. high clay content), unpaved road length >100m |

*Figure 8-1 Construction Phase Study Area and Representative Human Receptors*



*8.4.4.3 Construction Phase Impacts: Earthworks*

Earthwork activities are primarily associated with excavating material, haulage, tipping, stockpiling, site levelling and landscaping. The assessment considers the construction of the power plant and the installation of the onshore pipeline to be the Project components with the greatest potential to generate dust emissions due to earthwork activities. Earthwork activities associated with the transmission line towers and the substation are also considered.

The CCGT Power Plant will be developed on 21 ha of land and earthworks will be carried out to raise the power plant platform to 4.0 m above mean sea level (msl). The site is currently at 2.5 m-msl, requiring the site to be raised by 1.5 m from the current level, with a predicted 310,000 $m^3$ of soil needed for backfilling purposes. The IAQM consider the dust impact magnitude to be **Large** for a site which requires >100,000$m^3$ of material to be handled. On the basis that all residential properties within 500m of the power plant area are considered **Medium** sensitivity, the impact significance from earthwork activities at the power plant can be considered **Major** prior to site specific mitigation being implemented.

The proposed onshore pipelines will include three (3) main pipelines i.e. the seawater supply pipe, the waste water discharge pipe and the 20-inch gas supply pipeline. The total length of pipeline will be approximately 7.6 km from the landfall point to the CCGT Power Plant. The right of way (ROW) for pipeline installation will be cleared and will be graded to same level using bulldozers and/or excavators. All roots and stumps shall be removed by grubbing, digging or such other means. All unwanted stumps, roots and other vegetation shall be disposed outside the boundaries of worksite.

Prior to excavating in work area, all topsoil shall be stripped, stored and topsoil which is deemed to be unsuitable shall be disposed of offsite. The exact amount of material moved or number of vehicles operating at once during the onshore pipeline installation is not known. As a conservative assumption the impact magnitude from the installation of the onshore pipeline is considered **Medium**. On the basis that all residential properties within 500m of the onshore pipeline ROW site are considered **Medium** sensitivity, the impact significance from earthwork activities at the power plant can be considered **Moderate** prior to site specific mitigation being implemented.

This impact assessment associated with the earthworks within the proposed Cibatu substation site assumes that the total volume of soil for site elevation will be 125,000 $m^3$ (or higher, subject to an ongoing flood study if this shows the requirement for a higher site elevation) with additional construction material with low potential for dust release (e.g. metal cladding or timber). Given the volume of soil handling the impact magnitude is considered **Large**.

On the basis that the majority of residential properties are located > 500m of the substation location are not considered, however due to the existence of rice paddy in these area the sensitivity is considered **Low**. The impact significance from the construction of the substations can therefore be considered **Moderate** prior to site specific mitigation being implemented.

The actual land area required for each transmission line tower will depend on the nature of the tower and will range from $784m^2$ to $1,7642m^2$. The IAQM consider the dust impact magnitude to be **Small** for a site less than $2,500m^2$ (**Table 8.12**). Given the location of the tower footing locations, the majority of residential properties are > 500 m and so are not considered, however due to the existence of rice paddy in these area the sensitivity is considered **Low**. The impact significance from earthwork activities for the installation of the transmission lines can be considered **Negligible** prior to site specific mitigation being implemented.

The impacts from earthworks for each Project component are presented in **Table 8.11** to **Table 8.14.**

*Table 8.11 Earthworks: CCGT Power Plant*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | **Large** | Moderate | **Major** | Major |

*Table 8.12 Earthworks: Onshore Pipeline*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | Large | **Moderate** | Major | Major |

*Table 8.13 Earthworks: Substation*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | **Low** | Medium | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | **Large** | **Moderate** | Major | Major |

*Table 8.14 Earthworks: Transmission Line Towers*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | **Low** | Medium | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | **Negligible** | Minor | Moderate |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

#### *8.4.4.4 Construction Phase Impacts: General Construction Activities*

The key considerations when determining the potential dust emission magnitude during the construction phase include the size of the building(s)/infrastructure, method of construction and construction materials.

The power plant complex will consist of five main buildings supported by other infrastructure. The main buildings include the Onshore Receiving Facilities (ORF), two (2) turbine buildings, two (2) Heat Recovery Steam Generator (HRSG), Control and Electrical building (CEB), two (2) Cooling Towers, administration building and a workshop/warehouse building. The Project estimates that 57,000 $m^3$ of construction materials will be required and as such is considered to have a **Medium** impact magnitude. On the basis that all residential properties within 500 m of the power plant area are considered **Medium** sensitivity the impact significance from construction activities at the power plant can be considered **Moderate** prior to site specific mitigation being implemented.

There are no construction activities *per se* associated with the installation of the onshore pipeline. Pipe sections from the laydown area will be transported using trailer trucks to pipeline ROW. Dust impacts from the construction of the pipeline are considered negligible and have not been considered further.

This impact assessment of the proposed Cibatu substation assumes that the total building volume will be <25,000 $m^3$ and construction material with low potential for dust release (e.g. metal cladding or timber). On this basis the impact magnitude is considered **Small** (**Table 8.17**). The residential properties are > 500m and so are not considered, however due to the existence of rice paddy in these area the sensitivity is considered **Low**. The impact significance from the construction of the substations can be considered **Negligible** prior to site specific mitigation being implemented.

The transmission line tower foundations will be made of iron framework casted with casted concrete consist of sand, coral and cement. The Project predicts that ± 30,000 cement sacks, ± 1,179 $m^3$ sand and ± 1,769 $m^3$ gravels will be required for the construction. Approximately 5,550 tonnes of steel material will be required to construct the towers.

Given the quantity and type of materials, the impact magnitude from the construction of the transmission lines is considered **Small**. Based on the proposed locations of the 118 towers, residential properties are > 500m and so are not considered, however due to the existence of rice paddy in these area the sensitivity is considered **Low**. The impact significance from earthwork activities for the installation of the transmission lines can therefore be considered **Negligible** prior to site specific mitigation being implemented.

*Table 8.15 General Construction: CCGT Power Plant*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| Magnitude of Impact | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | Large | Moderate | Major | Major |

*Table 8.16 General Construction: Substation*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | Medium | High |
| Magnitude of Impact | Negligible | Negligible | Negligible | Negligible |
| | **Small** | **Negligible** | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

*Table 8.17 General Construction: Transmission Line Towers*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | Medium | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | **Small** | **Negligible** | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

*8.4.4.5 Construction Phase Impacts: Trackout*

Factors which determine the dust emission magnitude are vehicle size, vehicle speed, vehicle numbers, geology and duration.

During the construction activities at the power plant area, approximately 40,000 vehicles are expected to be utilised for material transportation of the 315,000 $m^3$ of infill soil for levelling of the CCGT area. Based on an 8 $m^3$ (>3.5t) dump truck capacity this is estimated to be approximately 200 dump truck trips/day to the CCGT area. Transportation of the 57,000 $m^3$ construction materials for the CCGT requires an estimated 27,360 trips or 76 truck trips/day over the construction period.

On the basis that all residential properties within 50m of the power plant area access roads and up to 500m from the site entrance are considered **Medium** sensitivity and an impact magnitude of **Large** (>50 truck trips/day), the impact significance from trackout can be considered **Major adverse** for the CCGT and substation sites prior to site specific mitigation being implemented (**Table 8.18**).

For the Cibatu substation site, approximately 15,000 truck trips are required for the site levelling, equating to 120 truck trips/day. With a **Medium** sensitivity for residential properties within 50m of the site access road, **Large** impact magnitude for the numbers of truck trips/day (>50/day), the impact significance from trackout can be considered **Major adverse** for the Cibatu substation (**Table 8.19**).

For jetty construction, the transportation of infill material to site, small equipment and construction materials is estimated to require approximately 14 truck trips/day. An additional 400 trips per year will be required for mobilisation of ± 1650 joint pipes, pulleys and welding equipment required for the construction of the seawater supply and waste water discharge pipeline and gas pipeline. The access road for the onshore pipeline installation will use the same public road as that for CCGT access, before entering the purpose built access road from the CCGT area to the jetty and pipeline ROW.

Based on this information, the impact magnitude is **Medium** and sensitivity **Medium**, equating to a **Moderate** impact significance (**Table 8.20**).

Construction of the transmission towers will require a total of approximately 1,000 trips per year to transport materials such as steel piece, cement, sand and gravel. The movements will be coordinated from a deposition camp that is yet to be selected but will be local to the tower installation sites, relocating along the transmission line route as required.

The individual transportation activities will therefore be localised to each tower location with small numbers of trucks required to transport the materials to the nearest access road for hand carry to each installation site. The impact magnitude from this Project infrastructure is therefore considered **Small**. On the basis that any residential properties within 50m of the roads and up to 500m from the site entrance used to access the pipeline ROW and transmission line towers are considered **Medium** sensitivity the impact significance from trackout can be considered **Minor adverse** prior to site specific mitigation being implemented (**Table 8.22**).

*Table 8.18 Trackout: CCGT Power Plant*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

*Table 8.19 Trackout: Substation*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

*Table 8.20 Trackout: Onshore Pipeline*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| Magnitude of Impact | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | Large | Moderate | Major | Major |

*Table 8.21 Trackout: Transmission Line Towers*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| Magnitude of Impact | Negligible | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

### *8.4.4.6 Mitigation Measures, Management and Monitoring Measures*

At all construction sites a series of specific Project component mitigation measures for earthworks, construction and trackout are required and are presented in **Table 8.22**. Where the assessment predicts minor adverse impacts no site specific mitigation measures are proposed.

*Table 8.22 Mitigation Measures*

| Project Component | Activity | Mitigation |
|---|---|---|
| All construction sites | Construction | 1. Daily onsite and offsite inspections will be undertaken to visually assess the dust emissions from earthwork and construction activities, and from vehicles exiting the construction sites. Results from the inspection will be recorded and appropriate measures will be taken to reduce emissions where necessary.<br>2. All dust and air quality complaints will be recorded, the cause identified and the appropriate measures taken to reduce emissions in a timely manner.<br>3. Use of site watering to suppress wind and physical disturbance dust generation. |
| CCGT Power Plant/ Substation | Earthworks | 1. Use hessian, mulches or trackifiers, or cover with topsoil, as soon as practicable.<br>2. Only remove the top soil in small and specific areas during the construction phase and not all at once.<br>3. Stockpiles will be places as far as reasonably practicable from air sensitive receptor locations.<br>4. The design of stockpiles will be optimised to retain a low profile with no sharp changes in shape.<br>5. Real time PM10 monitoring will be undertaken at two fenceline locations. Monitoring will commence 3-months prior to the earthwork phase commencing. |
| | Construction | 1. The construction site will be planned so that machinery and dust causing activities are located away from air sensitive receptors as far as possible<br>2. Wind breaks will be erected around the construction site at least the height of any stockpile on site.<br>3. Use of site watering to suppress wind and physical disturbance dust generation.<br>4. All sand and aggregates will be stored in bunded areas and are not allowed to dry out unless specifically required.<br>5. Deliveries of ready made cement and other fine powders will be delivered in enclosed tankers and stored in silos with suitable emission controls to prevent escape of material and overfilling during delivery. |
| | Trackout | 1. Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport.<br>2. Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable.<br>3. Implement a wheel washing system.<br>4. Regular inspection and washing of site access and local roads to remove any materials tracked out of the site.<br>5. Access gates will be located at least 10m from air sensitive receptors where possible. |

| Project Component | Activity | Mitigation |
|---|---|---|
| Onshore Pipeline | Earthworks | 1. Re-vegetate earthworks and exposed areas including stockpiles to stabilise the surfaces as soon as is practicable.<br>2. Use hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.<br>3. Only remove the top soil in small and specific areas during the construction phase and not all at once.<br>4. Stockpiles will be places as far as reasonably practicable from air sensitive receptor locations.<br>5. The design of stockpiles will be optimised to retain a low profile with no sharp changes in shape. |
| | Trackout | 1. Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport.<br>2. Implement a wheel washing system.<br>3. Regular inspection and washing of site access and local roads to remove any materials tracked out of the site. |

*8.4.4.7 Significance of Residual Impacts*

When correctly applying and actively managing the mitigating controls outlined previously the impacts to receptors located within 500 m downwind of the Project components are likely to experience negligible impacts to air quality for the large majority of the time. However, due to the nature of construction activities and the scale and duration of the construction phase, no guarantee can be made that significant impacts will not arise under any circumstance. It can be concluded, therefore, that construction phase activities are likely to result in **Minor impact** post mitigation.

### *8.4.5 Assessment of Impacts – Offsite Construction Traffic*

*8.4.5.1 Overview*

Exhaust emissions from increased offsite traffic required during the construction phase could potentially lead to impacts on air quality at sensitive receptors in the study area. The potential impact to sensitive receptors has been assessed using a screening method based upon the formulae presented in the UK Highways Agency Design Manual for Roads and Bridges (DMRB).

*8.4.5.2 Assessment Approach and Criteria*

The DMRB methodology has been used to determine the PC of $NO_x/NO_2$ and $PM_{10}$ at 5m, 20m, 50m, 100m and 200m from the road side to determine the potential magnitude of the impact at air sensitive receptors located along access roads used by construction traffic during the construction phase. The detailed methodology is presented in **Annex D.**

Given that the exact number of vehicle movements on any given road during the construction period is currently unknown, a conservative value of 1,000 and 10,000 additional heavy good vehicle (HGV) movements per day has been used to understand the likely impacts on ambient air quality.

*8.4.5.3 Traffic Related Impacts*

The results indicate that the concentration of $NO_2$ and $PM_{10}$ is well below the relevant air quality standard at all distances from the road when considering the most conservative value of 10,000 HGV movements per day. The magnitude of the impact can be considered negligible. The resulting likely impact on air quality from vehicle exhausts associated with increased traffic on the public road network during the construction phase is presented in **Table 8.23.**

On the basis that the sensitivity within the general study area is **Medium**, the impact to air quality from vehicle exhausts associated with increased traffic on the public road network during the construction phase is said to have a **Negligible impact** on air quality.

*Table 8.23 Assessment of Impacts on Air Quality Due to Offsite Construction Traffic*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | **Negligible** | Negligible |
| | Small | Negligible | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

*8.4.5.4 Mitigation Measures, Management and Monitoring Measures*

Good practice procedures such as those outline in the IFC EHS Guidelines for Air Emissions and Ambient Air Quality will be implemented to ensure that the impact on ambient air quality from vehicle exhausts is kept as low as is reasonably achievable:

- Old vehicles will be replaced with new, more fuel efficient alternatives;
- Where feasible high use vehicles will be converted to cleaner fuels (it is assumed 0.5% sulphur content in the locally purchased diesel fuel); and
- All vehicles, equipment and machinery will undergo a pre-use inspection prior to use and periodic maintenance inspections.

*8.4.5.5 Significance of Residual Impact*

The residual impact on air quality from vehicle exhausts associated with increased traffic on the public road network during the construction phase is **Negligible.**

### *8.4.6 Assessment of Impacts – Operation of CCGT Power Plant*

*8.4.6.1 Overview*

The combustion of natural gas has the potential to impact air quality at sensitive receptors across a wide area depending on the operating conditions of the power plant and the meteorological conditions. Potential impacts to air quality from the CCGT Power Plant were quantified using detailed dispersion modelling.

*8.4.6.2 Assessment Approach and Criteria*

The dispersion model used in the assessment was the USEPA AERMOD dispersion model version 16216r. AERMOD is a state of the art detailed dispersion model that can be used to represent complex multiple emission sources and predict air quality at receptor locations taking into account meteorology. The model is widely recognised for use in this type of application, including by the IFC, US EPA, UK Environment Agency and state based EPA's throughout Australia.

Detailed dispersion modelling was used to predict concentrations of emitted substances at ground level locations outside the Project area boundary and at a number of specific air sensitive receptors. Five (5) years of hourly sequential meteorological data was used so that inter annual variability was incorporated into the model.

The modelling scenarios and methodology, including receptor grid spacing, meteorological data information, $NO_x$ to $NO_2$ conversion and the treatment of buildings, land use and terrain is presented in detail in **Annex D**. The emission inventory for the CCGT Power Plant is presented in **Table 8.24.**

***Table 8.24 Emission Inventory for CCGT Power Plant***

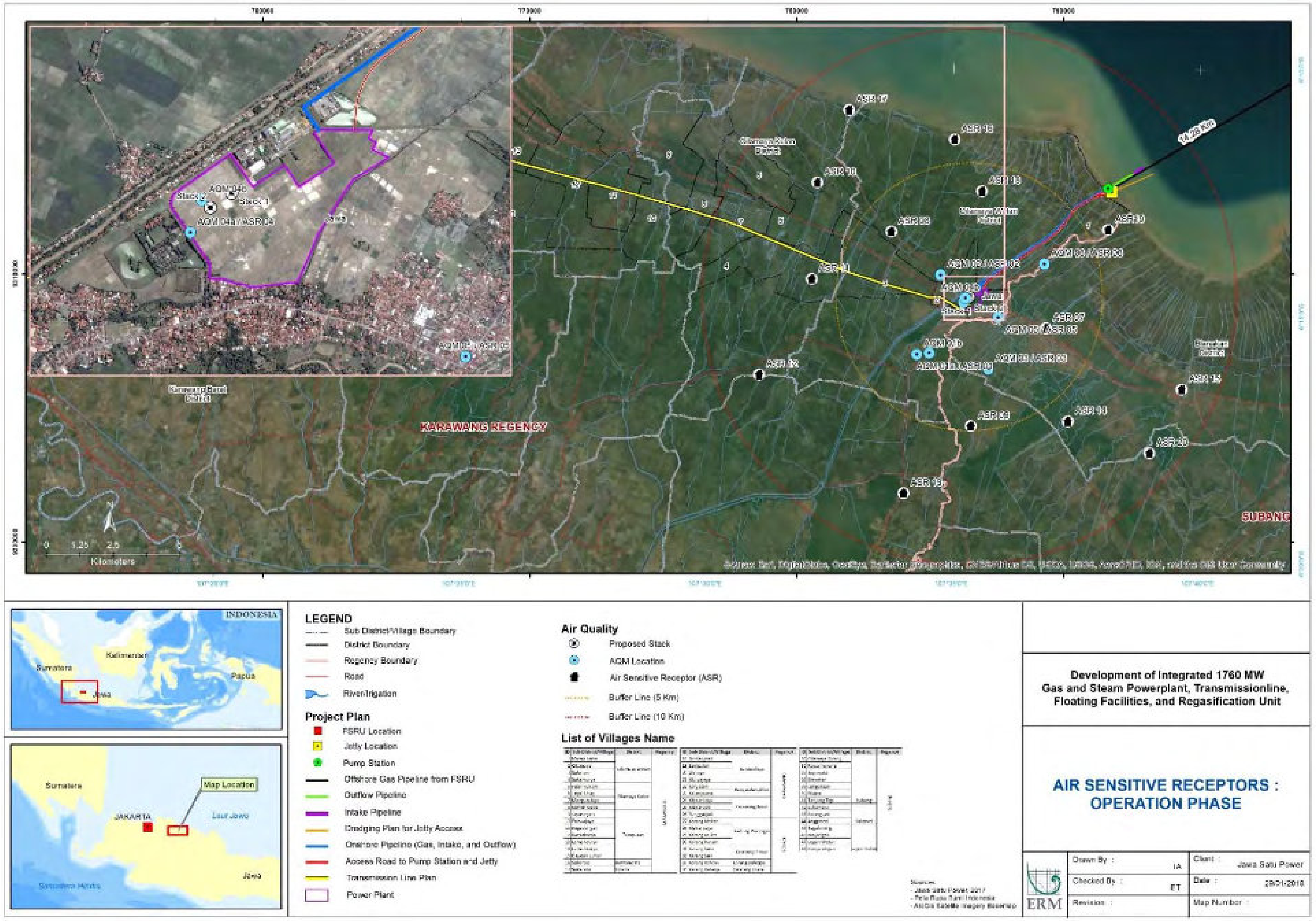
| | Unit | Stack A | Stack B |
|---|---|---|---|
| Stack Location | Lat/Long | 6°14'37.84"S 107°35'19.58"E | 6°14'40.04"S 107°35'16.25"E |
| ***Actual Stack Conditions* (1)** | | | |
| Stack height | m | 60 | 60 |
| Stack diameter | m | 9.44 | 9.44 |
| Exit Temperature | k | 340 | 340 |
| Emission Velocity | m/s | 15.2 | 15.2 |
| Actual oxygen ($O_2$) content (dry) | % | 10.7 | 10.7 |
| Actual moisture ($H_2O$) content (wet) | % | 13.2 | 13.2 |
| Actual volume flow rate | $Am^3/s$ | 1067 | 1067 |
| ***Reference Conditions* (2)** | | | |
| Temperature | K | 273.15 | 273.15 |
| Oxygen content (dry gas) | % | 15 | 15 |
| Moisture content (dry gas) | % | 0 | 0 |
| ***Normalised Volume Flow Rate* (3)** | | | |
| Normalised volume flow rate | $Nm^3/s$ | 1283 | 1283 |
| ***Emission Concentrations*** | | | |
| Oxides of Nitrogen ($NO_x$) (2) | $mg/Nm^3$ | 51 | 51 |
| Carbon Monoxide (CO) (1) | $mg/Nm^3$ | 50 | 50 |
| ***Emission Rates*** | | | |
| Oxides of Nitrogen ($NO_x$) | g/s | 65.4 | 65.4 |
| Carbon Monoxide (CO) | g/s | 64.2 | 64.2 |

(1) Data provided by Marubeni

(2) International Finance Corporation (IFC) (2008) Environmental, Health and Safety Guidelines for Thermal Power Plants [Online] Available at: http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/ehsguidelines [Accessed 05 February 2018].

(3) Calculated using the Environment Agency (2013) Pollution Inventory Reporting – Combustion Activities Guidance Note [online] Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/296994/LIT_7825_e97f48.pdf [Accessed 05 February 2018]

*Figure 8-2 Operation Phase Study Area and Representative Human Receptors*



### 8.4.6.3 *CCGT Power Plant Related Impacts to Air Quality*

The detailed modelling results are presented in **Annex D.** The likely impacts on air quality associated with the continuous operation of the CCGT Power Plant are summarised as follows for each substance of interest and relevant averaging period:

- Nitrogen Dioxide ($NO_2$) 1-hour Average: The modelling results indicate that **Minor impacts** to air quality from the Project are likely at offsite locations. A contour figure showing the area of predicted minor adverse impacts is presented in **Figure 8-3;**

- Nitrogen Dioxide ($NO_2$) 24-hour Average: The modelling results indicate that **Minor impacts** to air quality from the Project are likely at offsite locations. A contour figure showing the area of predicted minor adverse impacts is presented in **Figure 8-4**;

- Nitrogen Dioxide ($NO_2$) Annual Average: The modelling results indicate that the adverse impacts to air quality from the Project are expected to be **Negligible** throughout the entire study area;

- Carbon Monoxide (CO) 1-hour Average: The modelling results indicate that the adverse impacts to air quality from the Project are expected to be **Negligible** throughout the entire study area;

- Carbon Monoxide (CO) 24-hour Average: The modelling results indicate that the adverse impacts to air quality from the Project are expected to be **Negligible** throughout the entire study area; and

- Oxides of Nitrogen ($NO_x$) Annual Average: The modelling results indicate that the adverse impacts to air quality from the Project are expected to be **Minor** at worst in a small area approximately 500m south west of the site boundary. It is noted that in the coastal areas where protected mangrove have been identified the impacts to air quality are **Negligible** (**Table 8.26**).

*Figure 8-3 NO₂ One (1)-Hour Average – 99.9 Percentile (Human Health)*

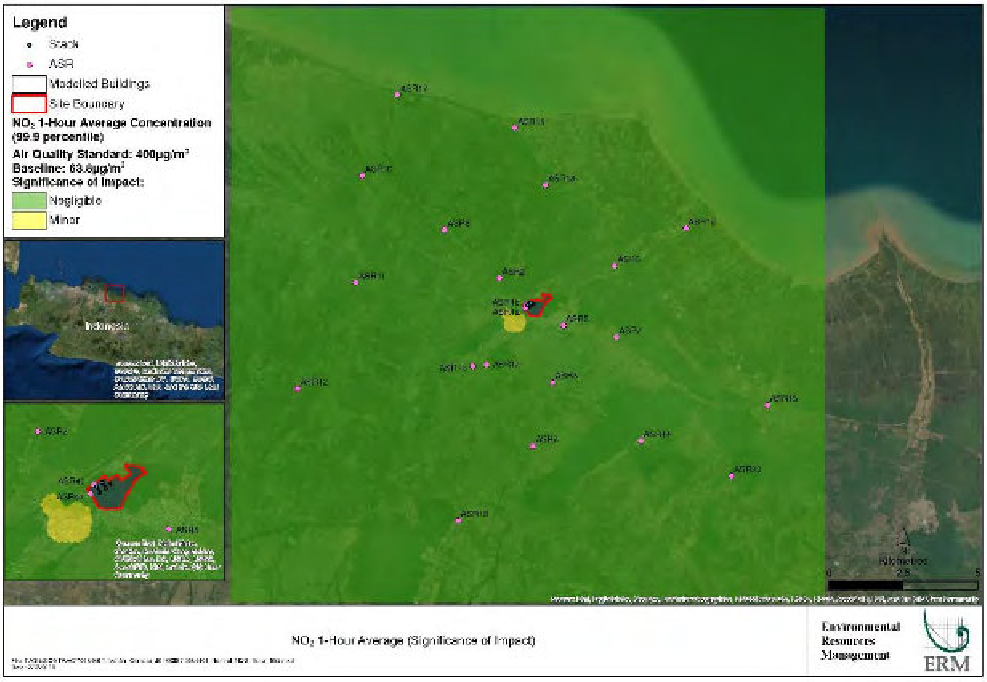



*Figure 8-4 NO₂ 24-Hour Average – 100th Percentile (Human Health)*

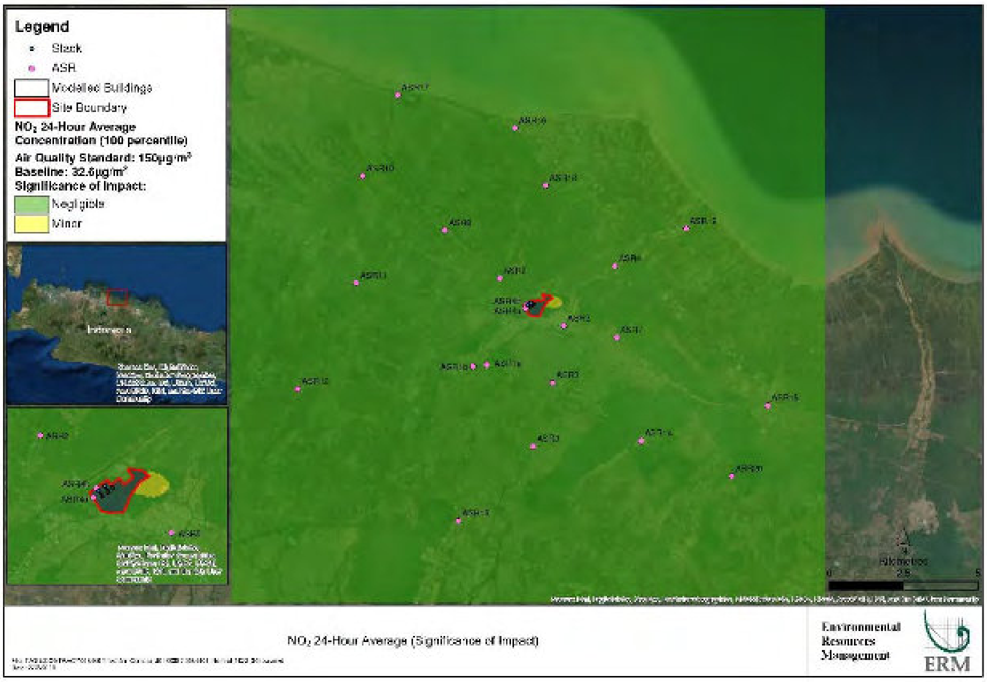
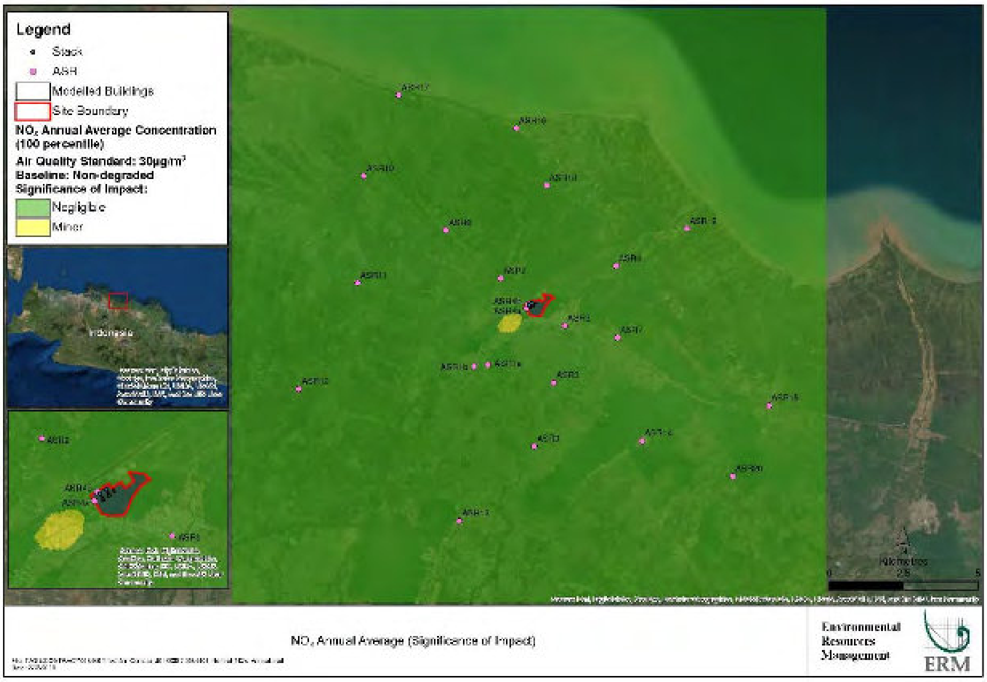


*Figure 8-5 Oxides of Nitrogen ($NO_x$) Annual Average – 100th Percentile (Ecology)*




The likely impacts on air quality associated with the continuous operation of the CCGT Power Plant are presented in **Table 8.25** and **Table 8.26** for human health and ecology respectively.

The approach used in this assessment assumes that the sensitivity within the general study area is **Medium** for both human health and ecological receptors.

The impact from power generation is predicted to have a **Minor impact** on ambient air quality at human air sensitive receptors in the study area; and a **Negligible impact** on ambient air quality at ecological sensitive receptors.

*Table 8.25 Assessment of Impacts on Air Quality Due to the Operation of the CCGT Power Plant (Human Health)*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

*Table 8.26 Assessment of Impacts on Air Quality Due to the Operation of the CCGT Power Plant (Ecology)*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | **Negligible** | Negligible |
| | Small | Negligible | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

*8.4.6.1 Mitigation Measures, Management and Monitoring Measures*

The assessment concludes that **Minor impacts** to air quality are expected at worst due to the continuous and normal operation of the CCGT Power Plant when operating at the maximum permissible $NO_x$ emission limit concentration of 51mg/Nm$^3$. Impacts to air quality from CO emissions are considered negligible. In practice the plant is not expected to operate at the emission limit on a continuous basis and the subsequent impacts to air quality when operating at decreased loads will be reduced further. On this basis no additional mitigation is suggested, however, continuous stack emission monitoring (CEM) will be installed and operated throughout the operational lifetime of the Project to ensure that the $NO_x$ emission concentration from the CCGT does not exceed the IFC emission limit guideline value of 51mg/Nm$^3$.

*8.4.6.2 Significance of Residual Impacts*

With a suitably designed and well managed stack emission monitoring program, the residual impacts from the operation of the CCGT Power Plant are likely to be **Minor** at worst throughout the study area during the normal and continuous operation of the Project.

### *8.4.7 Assessment of Impacts – Operation of Diesel Engine-Generators for Black Start*

*8.4.7.1 Overview*

The combustion of diesel in engine-generators used for black start (i.e less than 10) has the potential to adversely impact air quality at sensitive receptors across a wide area depending on specific operating conditions and meteorological conditions. Potential impacts to air quality from the operation of the diesel engine-generators were quantified using detailed dispersion modelling.

### 8.4.7.2 *Assessment Approach and Criteria*

The likely impacts on ambient air quality from twelve diesel engine-generator sets running continuously and at full power for 50 minutes was considered. Similar to the method discussed in **Section 8.4.6.2**, the dispersion model used in the assessment was the USEPA AERMOD dispersion model version 16216r.

Detailed dispersion modelling was used to predict concentrations of emitted substances at ground level locations outside the Project area boundary. Five (5) years of hourly sequential meteorological data was used so that inter annual variability was incorporated into the model. The modelled concentrations were compared to the one (1)-hour ambient air quality standards for $NO_2$ and $SO_2$ only on the basis that the black start process will take 50 minutes.

While the assessment scenario is considered good practice for air quality impact assessment, given the short term nature and infrequent requirement for all twelve engine-generators to be operating simultaneously (i.e. black start seldom required), the possibility that the emissions to air will occur at the same time as the worst case meteorological condition used to define the significance of the impact at each receptor point is considered extremely unlikely in practice.

The modelling scenarios and methodology, including receptor grid spacing, meteorological data information, $NO_x$ to $NO_2$ conversion and the treatment of buildings, land use and terrain is presented in detail in **Annex D**. The emission inventory for the diesel engine-generators is presented in **Table 8.27.**

***Table 8.27 Emission Inventory for Black Start and Emergency Generators***

| Parameter | Unit | Generator 1 – 12 (1) |
|---|---|---|
| Stack height | m | 9 |
| Stack Diameter | m | 0.478 |
| Exit Velocity | m/s | 40.1 |
| Volume Flow Rate | $m^3/s$ | 7.20 |
| Exit Temperature | k | 813 |
| Power Output (2) | kW | 2200 |
| $NO_x$ Emission Rate | g/kWh | 10.4 |
| | g/s | 6.4 |
| $SO_2$ Emission Rate | g/kWh | $2.00 \times 10^{-3}$ |
| | g/s | $1.2 \times 10^{-3}$ |
| PM Emission Rate | g/kWh | 0.0400 |
| | g/s | 0.0244 |

(1) Data provided by engine manufacturer MTU for engine model 20V4000G23 6ETC
(2) Single Engine-Generator

### 8.4.7.3 *Diesel Engine-Generator (Black-Start) Related Impacts to Air Quality*

The significance of the modelled impacts on ambient air quality are as follows:

- Nitrogen Dioxide ($NO_2$) one (1)-hour Average
  - The modelling results indicate that **Moderate** adverse impacts to ambient air quality are expected at worst when a black start is required. The significance of the impacts to air quality throughout the study area is presented in **Figure 8-6.**
- Sulphur Dioxide ($SO_2$) one (1)-hour Average
  - The modelling results indicate that **Negligible** impacts to ambient air quality are expected at worst when a black start is required.

The significance of the impacts to air quality throughout the study area is presented in **Table 8.28.**

***Figure 8-6 Scenario 1: Nitrogen Dioxide ($NO_2$) 1-Hour Average – 99.9 Percentile (All Engine-Generators at 100% Load for 50 minutes)***

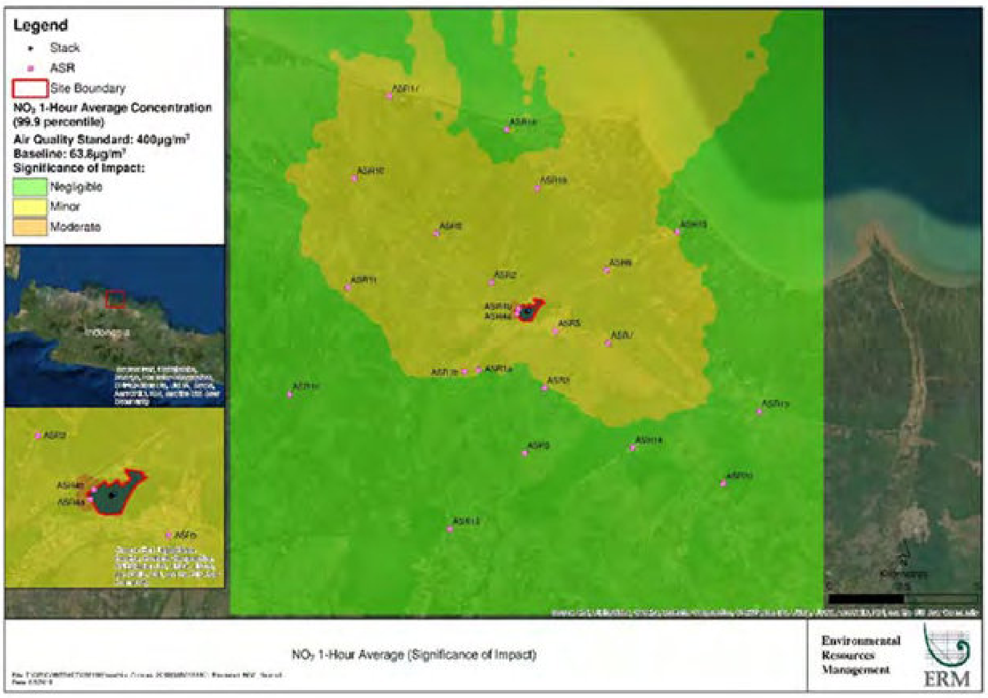


*Table 8.28 Assessment of Impacts on Air Quality Due to the Short Term Operation of Twelve Diesel Engine-Generator Sets Required for Black Start*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | Large | Moderate | Major | Major |

### 8.4.7.4 *Mitigation Measures, Management and Monitoring Measures*

The findings indicate that moderate adverse impacts to air quality from $NO_x$ emissions are expected at worst due to operation of twelve diesel engine generators at full load for 50 minutes. Impacts to air quality from $SO_2$ emissions are considered negligible. No assessment of PM has been undertaken as no one (1)-hour air quality standard exists in Indonesia.

Given that the impacts to air quality are moderate, it is suggested that the following mitigation and management measures are implemented to reduce the likelihood of unacceptable impacts on air quality during a black start:

- The simultaneous operation of all twelve diesel engine-generators will only occur when required and for the amount of time necessary to black start the power plant. The operator will endeavour to reduce this time period as much as is feasible to minimise the likelihood of unacceptable impacts on air quality;

- All engine-generators will be routinely checked and maintained in accordance with the manufactures specifications. This routine maintenance will ensure that the operational performance of the engine-generator is maintained at a high level throughout the operational lifetime of the Project; and

- Diesel fuel with a maximum sulphur content of 0.5% will be used at all times.

### 8.4.7.5 *Significance of Residual Impact*

With the implementation of the suggested mitigation and management measures discussed in **Section 8.3.7.4**, it is considered likely that the significance of the $NO_2$ process contribution aat ground level will be **Minor** adverse impact at worst at offsite locations within the study area.

### 8.4.8 *Assessment of Impacts – Operation of Diesel Engine-Generators for Emergency Shut Down*

#### 8.4.8.1 *Overview*

The combustion of diesel in engine-generators used for emergency shut-down has the potential to adversely impact air quality at sensitive receptors across a wide area depending on specific operating conditions and meteorological conditions. Potential impacts to air quality from the operation of the diesel engine-generators were quantified using detailed dispersion modelling.

#### 8.4.8.2 *Assessment Approach and Criteria*

The likely impact on air quality from one of the twelve diesel engine-generator sets (Generator No. 1) running at full power was considered.

The assessment assumes that the engine-generator may operate for two hours, six times a year as a worst case estimate. Similar to the method discussed in **Section 8.4.6.2**, the dispersion model used in the assessment was the USEPA AERMOD dispersion model version 16216r.

Detailed dispersion modelling was used to predict concentrations of emitted substances at ground level locations outside the Project area boundary. Five (5) years of hourly sequential meteorological data was used so that inter annual variability was incorporated into the model. The modelled concentrations were compared to the 1-hour ambient air quality standards for $NO_2$ and $SO_2$.

#### 8.4.8.3 *Diesel Engine-Generator (Emergency) Related Impacts to Air Quality*

The detailed modelling results are presented in **Annex D.** The likely impacts on air quality associated with the operation of one diesel engine generator are summarised as follows for each substance of interest and averaging period:

- Nitrogen Dioxide ($NO_2$) 1-hour Average: The modelling results indicate that **Minor impacts** are expected at worst during emergency conditions;
- Sulphur Dioxide ($SO_2$) 1-hour Average: The modelling results indicate that impacts to air quality will be **Negligible** throughout the study area during emergency conditions;

The likely impacts on air quality associated with the short term operation of one (1) 2 MWel diesel powered engine-generator set are presented in **Table 8.29.**

The approach used in this assessment assumes that the sensitivity within the general study area is **Medium**.

The impact from the short term operation of one 2MWel diesel powered engine-generator sets is predicted to have a **Minor impact** on ambient air quality at human air sensitive receptors in the study area. The minor adverse impacts are associated with $NO_x$ emissions. The predicted impacts on air quality from $SO_2$ are expected to be negligible.

*Table 8.29 Assessment of Impacts on Air Quality Due to the Short Term Operation of One Diesel Engine-Generator Set Required for Emergency Shut Down*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

*8.4.8.4 Mitigation Measures, Management and Monitoring Measures*

The findings from the air quality impact assessment indicate that minor adverse impacts to air quality are expected at worst due to the operation of one diesel fired engine-generator operating at full load during black outs and/or when emergency power is required for the safe shutdown of the power plant in the event of loss of main supply. On this basis no additional mitigation is required.

*8.4.8.5 Significance of Residual Impact*

The residual impacts are likely to be **Minor adverse** at worst throughout the study area during black outs and/or when emergency power is required for the safe shutdown of the power plant in the event of loss of main supply.

### *8.4.9 Assessment of Impacts – Operation of Cooling Towers*

*8.4.9.1 Overview*

The Project will be equipped with two (2) wet cooling tower systems necessary for the normal operation of the power station. The system will utilise sea water and will dissipate large heat loads to the atmosphere. Due to the direct contact between the cooling water and the air passing through it, small amounts of water are lost as liquid drift. The liquid drift evaporates to a solid salt crystal when the water in the drift evaporates. The deposition of salt (Sodium Chloride (NaCl)) on the surrounding agriculture can have an adverse impact on crop production.

The assessment of NaCl deposition and its effect on agriculture has been considered in detail in **Annex D** and summarised in the following section.

### 8.4.9.2 *Assessment Approach and Criteria*

The USEPA AERMOD dispersion model version 16216r was used to predict the maximum deposition rates of NaCl averaged over a one month period in the study area. Five (5) years of hourly sequential meteorological data was used so that inter annual variability was incorporated into the model and the highest one month average of any of the five meteorological years was used to define the impact significance as a worst case.

The amount of total particulate matter (TPM) released to the atmosphere was calculated using the following formula (2):

- TPM [g/h] = Total Dissolved Solids (TDS) [ppmw] x Drift Loss [%] / 100% x Circulating Water Rate [$m^3$/hr]

Each fan was treated as a point source and modelled using the information presented in **Table 8.30.**

***Table 8.30 Cooling Tower and Modelling Information***

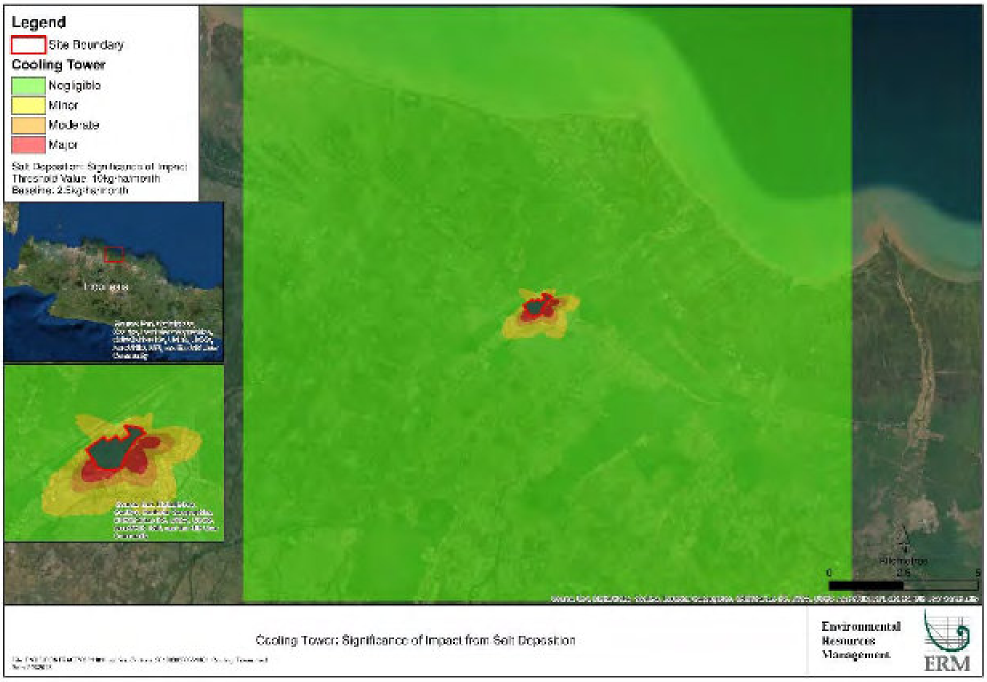
| Item | Data | Unit |
|---|---|---|
| Number of cooling towers | 2 | - |
| Cells/fans per cooling tower | 16 | - |
| Total cells/fans | 32 | - |
| Cooling tower structure height | 18.7 | m |
| Cell/fan diameter | 9.75 | m |
| Exit velocity | 8.73 | m/s |
| Exit temperature | 37.8 | C |
| Circulating rate | 54478 | $m^3$/hr |
| | 907603 (1) | lpm |
| Total dissolved solids (TDS) | 44,100 | mg/l |
| Design drift | 0.0005 | % |
| | 4.54 | lpm |
| | 200127 | mg/min |
| | 3.34 | g/s |
| | 0.208 | g/s/$PM_{10}$/cell |
| Operating hours | 8760 | hours |
| Sodium Chloride (NaCl) Particle Density | 2.165 | g/$cm^3$ |
| (1) 1 cubic meter / hour = 16.7lpm | | |

### 8.4.9.3 *Cooling Tower Related Impacts to Vegetation*

The likely impacts on air quality associated with the operation of the cooling towers are presented in **Figure 8-7** and **Table 8.31**.

(2) Government of Canada (2015) Wet cooling tower particulate matter emission: guide to reporting [Online] Available at: https://www.canada.ca/en/environment-climate-change/services/national-pollutant-release-inventory/report/sector-specific-tools-calculate-emissions/wet-cooling-tower-particulate-guide.html [Accessed 07 March 2018]

*Figure 8-7 Predicted Sodium Chloride (Salt) Deposition Rates from Cooling Towers - Significance of Impact on Crops*




The approach used in this assessment assumes that the sensitivity within the general study area is **Medium**.

*Table 8.31 Assessment of Impacts on Agriculture Due to the Operation of the Cooling Towers*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | **Large** | Moderate | **Major** | Major |

The impacted area as outlined indicates that salt deposition rates will exceed the threshold value of 10kg/ha/mo and have a **Major** adverse impact up to 380 metres outside of the Project boundary. This area contains the Project area, agricultural and urban developments.

Impacts may cause reductions in agricultural yield through leaf damage (leaf necrosis) and damage to infrastructure due to salt corrosion. This however depends on the frequency of rainfall that would wash salt deposits off foliage.

It is anticipated that daily rainfall during the wet season (November to March) will reduce salt deposition on foliage, reducing opportunities for leaf damage. Extended periods of dry weather however may see an accumulation of salts on foliage, particularly during the dry season (April to October).

Impacts from salt on urban development as well as machinery and equipment within the Project area may occur due to salt corrosion, mainly within the dry season. Given rice crops in north western Java are planted from the beginning of the wet season, it is considered that salt deposition is unlikely to affect agricultural production.

Crops grown outside of the wet season and other vegetation within the potentially affected zone may be impacted by leaf damage. Impacts may also occur to plant and equipment within the Project area from salt corrosion.

#### *8.4.9.4 Mitigation Measures, Management and Monitoring Measures*

Monitoring of salt deposition rates is recommended within 500m of the Project area. The monitoring should be designed to determine the level of salt deposition against appropriate standards. Monitoring of foliage on vegetation within the 500m boundary is also to occur to determine the extent of leaf damage (leaf necrosis).

Where impacts to vegetation is determined from the monitoring, engagement within affected parties is to occur to determine appropriate actions. These actions may include (but are not limited to): investigation and support of alternative cropping methods/species; adoption of spray irrigation methods; and/or compensation for lost agricultural production or impacts on households.

Regarding impacts on plant and equipment, it is recommended that all exposed surfaces be coated or painted to reduce corrosion from salt deposition. Regular maintenance of exposed surfaces is also required. Salt tolerant vegetation should also be planted within the Project area and within 500m of the Project.

#### *8.4.9.5 Significance of Residual Impact*

Residual impacts may consist of lost agricultural production within 500m of the Project area, damage to household structures from corrosion and damage to plant and equipment within the project area, predominately during the dry season. The adoption of the recommended mitigations are likely to reduce the residual impact to **Minor**.

## 8.5 *GREENHOUSE GAS EMISSIONS*

### 8.5.1 *Potential Sources of Impacts*

This assessment provides an estimate of the Greenhouse Gas (GHG) emissions that are likely to be emitted by the Project, as related to the issue of climate change. GHGs are assessed to provide an indication of what the Project's GHG emissions will be, and to evaluate ways to minimise / mitigate them early on in the development process.

### 8.5.2 *Assessment Approach and Criteria*

The estimate of the Project GHG footprint was done based on the Greenhouse Gas Protocol Corporate Accounting Standard (3).

GHGs included in the GHG assessment methodology are the gases under the UNFCCC/Kyoto Protocol. Of these, carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$) are considered the main GHG pollutants for the Project based on the planned activities.

The GHG Protocol defines three (3) emissions 'scopes' for GHG accounting and reporting purposes: Scope 1, Scope 2 and Scope 3. Scope 1 includes direct GHG emissions coming from the Project. Scope 2 includes indirect GHG emissions associated with consumption of energy produced off-site (i.e. electricity from the grid). Scope 3 includes all other indirect GHG sources.

Both the construction and operation phases have been quantified in terms of their GHG emissions.

Assuming a 20 year asset life from the start of operations, the Project as a whole is anticipated to comprise 77.7 Mt $CO_2$-e of (Scope 1 and 2) emissions during its total life cycle. Of these, 99.8% of emissions are anticipated to be related to (combustion and fugitive) emissions during the operational phase. On this basis, only the operational emission inventory is discussed in more detail below.

A summary of the Scope 1, Scope 2 and Scope 3 Emissions included in the operational phase of the Project is provided in **Figure 8-8**.

(3) The Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard, Revised, World Resources Institute.

*Figure 8-8 Scope 1, 2 and 3 Emissions related to the Project Operational Phase*

***Scope 1** emissions include combustion sources (i.e. gas turbine). For this GHG inventory, Combustion related Scope 1 emissions have been included for the 1,760 MW Combined Cycle Gas Turbine (CCGT) Power Plant and diesel generators located at a Liquefied Natural Gas (LNG) Floating Storage and Regasification Unit (FSRU). Scope 1 emissions associated with natural gas (i.e. methane) releases have been quantified associated with emergency / maintenance venting at an Onshore Receiving Facility (ORF) as well as gas transmission fugitive losses. Operation of the CCGT is anticipated to constitute almost 90% of the operational GHG emission inventory on an annual basis. The gas consumption by the CCGT is estimated to be around 64,000,000 mmBTU/year (~67,523 TJ/year) based on a 60% capacity factor.*

*Greenhouse gas emissions from this source reference the emission factor contained in IPCC Guidelines for National Greenhouse Gas Inventories (2006).*

***Scope 2** emissions include all emissions associated with electricity imports, heat imports, as well as with cold imports and compressed air imports. Power is anticipated to be imported only when the CCGT is completely shut down. It has been estimated that the FSRU will be shut down for an average of 10 days a year. Additionally, it is also assumed there will be four times a year when the CCGT is shutdown/tripped. It is estimated that during a normal shutdown the average CCGT load is 4 MW and during the FSRU dry dock outages, 3 MW. These Scope 1 emissions are anticipated to comprise less than 0.1% of the Scope 1 and 2 emissions during the operational phase.*

***Scope 3** emissions include all other indirect emissions, such as (but not limited to) contracted and other associated activities. As an example, this includes emissions associated with any machine or vehicle operated by a supplier. IFC Performance Standards require that facilities to quantify Scope 1 and Scope 2, but not Scope 3. However, there are material Scope 3 GHG emission sources associated with the Project, and these are discussed briefly below.*

*The production and transportation (shipping) of LNG to the FSRU is assumed to be under the operational control of a third party. These potentially significant emissions will be accounted for within the GHG emission inventories of the entities that complete these activities.*

### *8.5.3 Assessment of Impacts – Increased GHG Emissions*

The global nature of the impacts of climate change such as temperature increases, sea level rise, ecological impacts, changes in crop productivity, disease distribution etc. are well documented. Despite the potential severity of consequences at the national and global level, it is not meaningful to link emissions from single source to particular impacts at this scale.

It is more instructive, rather, to look at the impact of the Project on Indonesia's National GHG Inventory, as well as global anthropogenic emissions, and the implications of this rather than the physical impacts of climate change.

In 2014, global emissions of greenhouse gases from anthropogenic activities excluding land use change and deforestation came to 36.14 giga tonnes (Gt) CO2-e (*CDIAC, 2017*). For the same year, Indonesia ranked the 14th highest in terms of national GHG emissions, with an estimated 126.6 Mt CO2-e (*CDIAC, 2017).*

The annual operational (Scope 1 and 2) emissions estimated from the project are anticipated to be of the order of 3.9 Mt CO2-e. The Project is therefore anticipated to contribute to 3% of Indonesia's national GHG emissions annually, and 0.01% of global anthropogenic emissions over the same period.

However, the Project is responding to additional power demands for the region. Therefore, it needs to be queried as to whether there are alternative, lower GHG intensive power generation options available. Given the scale of the Project (1,760MW), and the requirement for baseload power generation, it is appropriate to compare the Project with other thermal (fossil fuel) power generation alternatives.

A comparison of conventional (thermal) baseload electricity generation operations is provided in **Table 8.32**.

*Table 8.32 Electricity Generation Greenhouse Gas Intensities ($tCO_2$-e/MWh)*

| Operation | Natural Gas | | Black Coal | | |
|---|---|---|---|---|---|
| | OCGT | CCGT | Sub-critical | Super critical | Ultra super critical |
| Assumed average efficiency (%) | 39 | 53 | 33 | 41 | 43 |
| Extraction and processing | 0.14 | 0.1 | 0.03 | 0.02 | 0.02 |
| Transport | 0.02 | 0.01 | 0.03 | 0.03 | 0.03 |
| Processing and Power Generation | 0.59 | 0.43 | 0.97 | 0.78 | 0.74 |
| **Total** | **0.75** | **0.55** | **1.03** | **0.83** | **0.79** |
| Min estimate | 0.64 | 0.49 | 0.75 | 0.61 | 0.58 |
| Max estimate | 0.84 | 0.64 | 1.56 | 1.26 | 1.2 |

*Source: Worley Parsons, 2011*

**Table 8.32** shows that, compared with other conventional fossil fuel baseload power generation, CCGT Power Plant is the least GHG-intensive option. Table 4 within the *IFC Thermal Power Plant Guidelines 2008 and 2017 (in Draft)* (*IFC, 2017a*) provides typical $CO_2$ emissions performance of new thermal power plants. IFC, 2008 further supports that CCGT is the least GHG-intensive of all fossil fuel baseload power generation options.

For new CCGT Power Plant facilities, the following $CO_2$ emissions performance is noted (Table 4 of *IFC, 2008*):

- 0.40 $tCO_2$/MWh (gross, LHV) – CCGT Power Plant, 51% efficiency.

The Project's GHG intensity can be estimated referencing a 1,760MW facility operating at a 60% capacity factor and producing 3.79 Mt CO2-e from the gas combustion. This calculation leads to an estimate of 0.41 tCO2/MWh, which is commensurate with both Worley Parsons (2011) and IFC (2008) estimates.

It is instructive to compare the estimated GHG intensity of the project (0.41 tCO2-e/MWh for generation alone) with the electricity grid emission factor corresponding to Java of 0.9 tCO2-e /MWh (*Institute for Global Environmental Strategies, 2017*). This thus indicates that electricity generated via the Project's CCGT has a GHG intensity of approximately 50% compared to the existing power generation mix for the region.

To conclude whether this impact is deemed significant or not, a risk classification approach is used. The approach is derived from classic risk assessment nomenclature which involves the expression of risk as the consequence of the event multiplied by the probability of that event. The environmental assessment equivalent is the magnitude of the impact multiplied by the sensitivity/vulnerability/importance of the resource or receptor.

The impact magnitude of the Project, in terms of its contribution to GHG emission inventories, is thus considered to be **Medium** at a National (Indonesian) level, and **Small** in a global context. The weight of evidence is that anthropogenic climate change will impact multiple resources, human activities and ecological systems on a global scale (i.e. multiple, geographically diverse receptors). The importance of the system subject to impacts is thus **High**.

Application of a conventional risk classification matrix to the Project thus indicates that at a national level, the significance is **Major**, while at a global level the significance is considered **Moderate**.

*Table 8.33 Assessment of Increased GHG Emissions*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| Magnitude of Impact | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | **Moderate (Global Level)** |
| | **Medium** | Minor | Moderate | **Major (National Level)** |
| | **Large** | Moderate | Major | Major |

### 8.5.4 *Mitigation Measures, Management and Monitoring*

The key mitigation measures proposed to minimise GHG emissions associated with the Project include:

- Cold venting of gas directly to atmosphere will be avoided where possible. If significant quantities are emitted, the Project should consider flaring, as this converts the $CH_4$ to $CO_2$ and thereby reduces the net GHG emissions in terms of CO2-e emissions; and

- Optimisation of construction schedule and placement of laydown areas/temporary camp sites to reduce overall traffic movements/distance travelled, thus reducing GHG emissions from transport.

Other opportunities exist to further reduce GHG emissions, and should be evaluated for feasibility as the Project progresses further along the Front End Engineering and Design (FEED) and Detailed Design (DD) stages:

- Actual land clearing/disturbance will be minimised to the greatest extent possible. Net GHG emissions could also be reduced by revegetation in many areas that will be cleared only for temporary activities such as laydown areas and temporary camps for construction.

Throughout the design process, assessment of GHG mitigation options should continue. The opportunity exists to continue to optimise energy consumption throughout the Project, where key project decisions relating to equipment selection have not been made. Technical studies relating to equipment selection (e.g. Best Available Technology studies) will take into account GHG emissions and energy efficiency as factors for consideration.

Consistent with IFC Performance Standards, for projects > 25,000 t CO2-e/year (current project anticipated to comprise 3.9 Mt CO2-e/year), quantification of direct GHG emissions is required to be conducted by the Sponsor annually.

### 8.5.5 *Significance of Residual Impact*

The combustion of natural gas within the CCGT Power Plant comprises approximately 90% of the annual operational GHG emission, and this contribution will not change significantly under the proposed mitigation measures for the Project.

On this basis, the impact significance is not anticipated to change post-mitigation, as summarised in the **Table 8.34** of residual impact below.

*Table 8.34 Summary of Residual Impact*

| Activities | Significance before Mitigation | Residual Impact Significance |
|---|---|---|
| Increase GHG Emissions and Climate Change (Indonesia Level) | **Major (National Level)** | **Major (National Level)** |
| Increase GHG Emissions and Climate Change (Global Level) | **Moderate (Global Level)** | **Moderate (Global Level)** |

## 8.6 *ACOUSTICS AND VIBRATION*

The Acoustics Assessment is provided in **Annex E** and included consideration of the following features:

- Construction (including road traffic) air-borne noise and ground-born vibration impacts to human receptors from significant emission generating works and activities, for the various onshore and nearshore components and phases associated with the development, that are proposed to occur within and near the Project area;
- Construction underwater noise impacts to wildlife receptors from significant emission generating works and activities, for the various nearshore and offshore components and phases associated with the development, that are proposed to occur within and near the Project area[4] and
- Operational air-borne noise and ground-born vibration impacts to human receptors from significant emission generating activities, for the various onshore components and phases associated with the development (i.e. significant fixed infrastructure assets such as the power station facility and the transmission line) that are proposed to occur within and near the Project area.

A qualitative assessment has been conducted for Project noise and vibration components that have limited or no potential to generate any impacts at nearby potentially sensitive receptors, whilst a quantitative assessment has been conducted for other components where a potential for impacts to occur has been identified. A preliminary evaluation of potential impacts identified that construction and operational airborne noise are considered the highest environmental risk. These potential impacts are therefore the focus of the **Annex E** preliminary acoustics assessment, as summarised in this section.

This section is structured as such that it considers both unmitigated and mitigated (residual) impacts for the key Project components or activities that may have a significant noise impact.

### 8.6.1 *Potential Source of Impact*

Key Project components or activities that may have a significant noise impact include the following:

- Construction at the CCGT Power Station;

[4] This acoustical feature is being assessed in more detail by other specialists but given its association with the potential project noise, has been evaluated in the Preliminary acoustics assessment with conceptual recommendations provided.

- Construction of the 500 kV transmission line;
- Construction of the ORF and nearshore area including site preparation, pile driving and foundation works and installation of equipment;
- Construction of the infrastructure;
- Operation of the CCGT Power Station; and
- Operation of the 500 kV transmission line.

### 8.6.2 *Assessment Approach and Criteria*

#### 8.6.2.1 *Vibration Standards*

The key international documents adopted for the terms of reference from which vibration criteria (human exposure/annoyance and structural damage) were established are:

- British Standards Institution (BSI, United Kingdom) – BS 6472 - *Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* (BS 6472), dated 1992.
- British Standards Institution (BSI, United Kingdom) – BS 5228 - *Code of Practice for Noise and Vibration Control on Construction and Open Sites*, Part 2: Vibration (BS 5228:2), dated 2009.
- Department of Environment and Conservation NSW (DECC, Australia) – *Assessing Vibration: a Technical Guideline* (DECC Guideline, 2006), dated February 2006.
- German Institute for Standardisation (GIS, Germany) – DIN 4150 Part 3: *Structural Vibration: Effects of Vibration on Structures* (DIN 4150:3), dated February 1999.

Unlike noise where impact significance ratings may be derived from incremental thresholds the combined impact magnitude with receptor sensitivity and/or exposure: vibration guidelines are typically adopted in a manner that recognises any levels that are predicted to exceed the criteria are likely to generate a significant impact that should be mitigated.

Values predicted to exceed the structural damage criteria would be considered a significant adverse impact and further detailed assessment, investigation or monitoring would likely be required. Further information on these values is provided in **Annex E**.

#### 8.6.2.2 *Noise Standards and Guidelines*

This assessment has been conducted with due regard to and in accordance with the following IFC guidelines:

- World Bank Group: International Finance Corporation (IFC) - *Environmental, Health, and Safety Guidelines for Thermal Power Plants* (IFC Thermal Power Plants Guideline, 2017), draft for second public consultation, dated May/June 2017;

- World Bank Group: International Finance Corporation (IFC) - *Environmental, Health and Safety (EHS) Guidelines - General EHS Guidelines: Environmental Noise Management*, Section 1.7 Noise (IFC 1.7 Noise), dated 30 April 2007; and

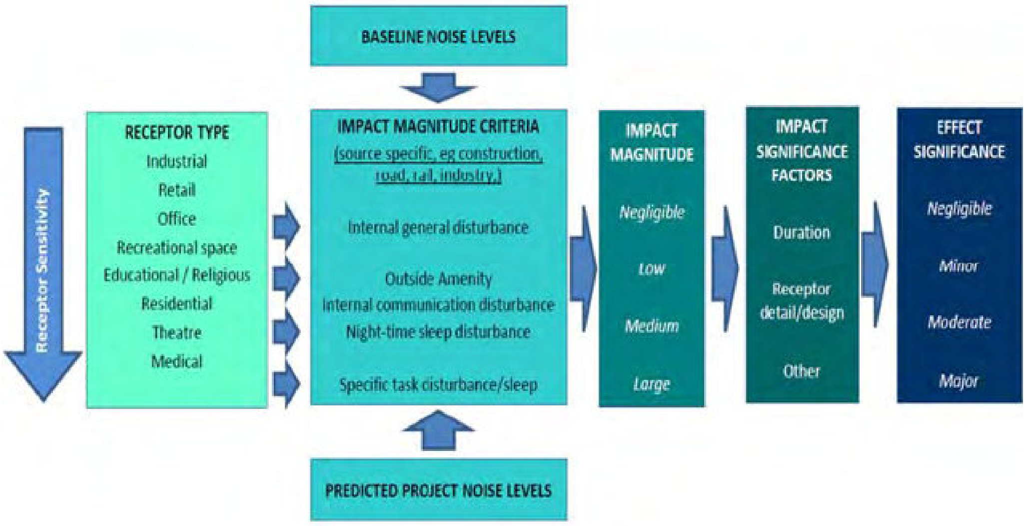
- World Bank Group: International Finance Corporation (IFC) - *Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution* (IFC Electrical Power Guideline, 2007), dated 30 April 2007.

For the noise assessment an approach that combines a) impact magnitude with b) receptor sensitivity to determine impact significance has been adopted. For most environmental impact topics/resources, this allows a significance matrix to be used that combines resource/receptor sensitivity with impact magnitude.

For noise, however, it is usually possible to predict noise levels quantitatively and compare them against standards that are resource/receptor-specific and inherently take into account resource/receptor sensitivity.

Furthermore, many numerical noise standards are noise source-specific (e.g., industrial noise is different to aircraft noise), some refer to baseline levels (i.e., allowable increases above baseline), and there can be a number of other factors that are relevant to determining Impact Significance. Thus, impact significance for noise is not determined using a simple two-dimensional matrix, but is instead determined using the following process as outlined in **Figure 8-9**.

*Figure 8-9 Noise Impact Significance Assessment Process*




Rather than applying a two-dimensional matrix for noise impact significance, the process for noise instead considers the type of receptor, draws on relevant standards or guidance to determine impact magnitude, and then considers other factors to determine significance.

*8.6.2.3 Potentially Sensitive Receptors*

The potentially sensitive receptors where potential noise impacts have been assessed are identified in **Figure 8-10** and tabulated in **Table 8.35**.

*Figure 8-10 Power Station Site Locality and Nearest Receptors*

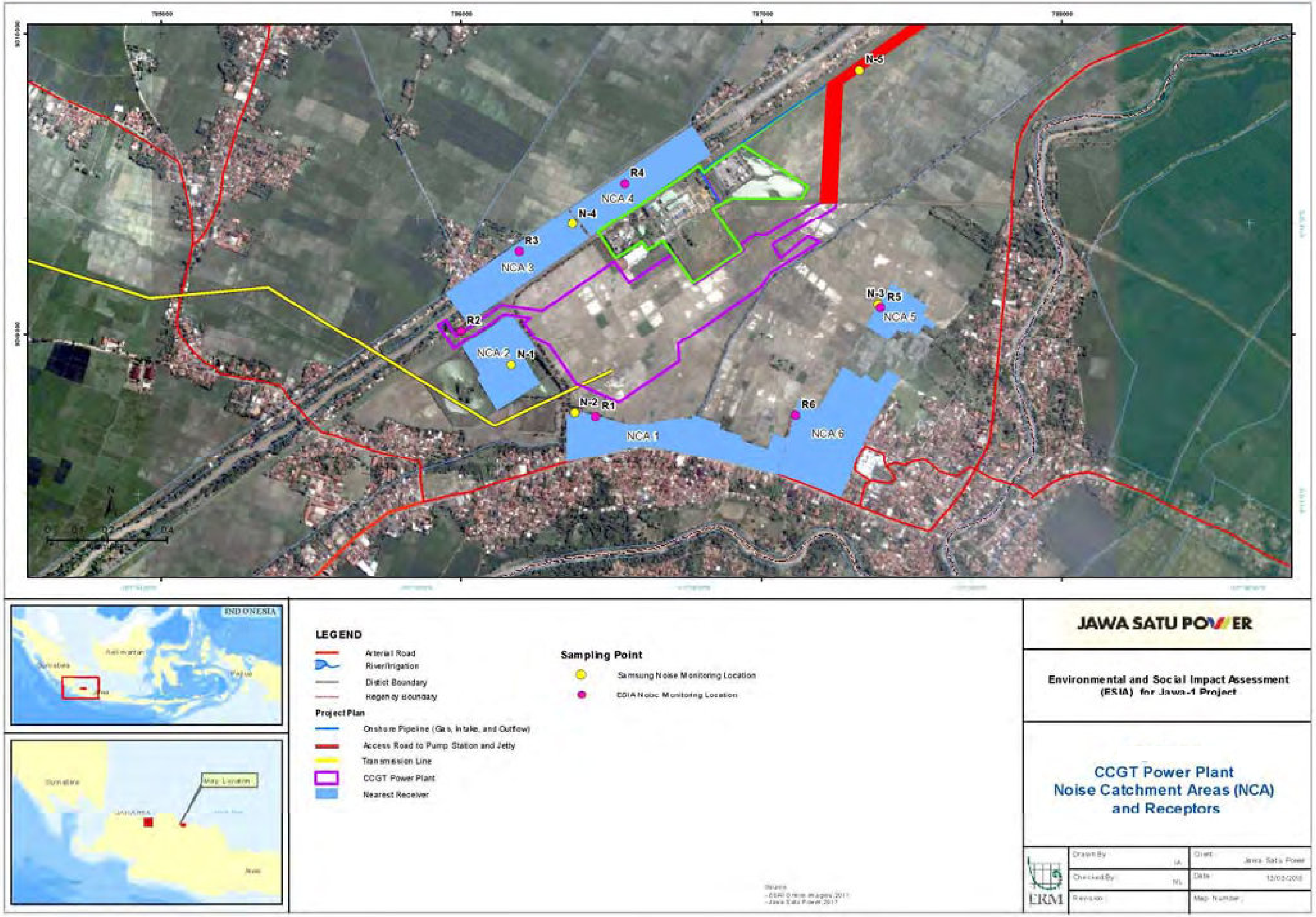


*Table 8.35 Potentially Sensitive Noise Receptor Locations*

| Noise ID | Description | UTM Co-ordinates (X and Y, Zone 48) | |
|---|---|---|---|
| N-1[1] | Residential (Dwelling) Receptor/s situated south-west of the CCGT Power Plant. | 786166 | 9308897 |
| N-2[1] | Residential (Dwelling) Receptor/s situated south of the CCGT Power Plant. | 786376 | 9308737 |
| N-3[1] | Residential (Dwelling) Receptor/s situated east of the CCGT Power Plant. | 787390 | 9309099 |
| N-4[1] | Residential (Dwelling) Receptor/s situated north of the CCGT Power Plant. | 786369 | 9309369 |
| N-5[1] | Paddy field in Cilamaya Village. Cilamaya Wetan District | 786997 | 9309091 |
| R1[2] | Residential (Dwelling) Receptor/s situated south of the CCGT Power Plant, within NCA 1 | 786447 | 9308724 |
| R2[2] | Workforce Accommodation Receptor situated west of the CCGT Power Plant, within NCA 2. | 785997 | 9309012 |
| R3[2] | Residential (Dwelling) Receptor/s situated north-west of the CCGT Power Plant, within NCA 3. | 786192 | 9309274 |
| R4[2] | Residential (Dwelling) Receptor/s situated north of the CCGT Power Plant, within NCA 4. | 786542 | 9309507 |
| R5[2] | Residential (Dwelling) Receptor/s situated east of the CCGT Power Plant, within NCA 5. | 787397 | 9309090 |
| R6[2] | Residential (Dwelling) Receptor/s situated south-east of the CCGT Power Plant, within NCA 6. | 787113 | 9308727 |

1. Source: Samsung, 2016 Noise Study Review.
2. Source: identified for this assessment.

These locations were identified via a rapid review of aerial photography and were adopted based on their proximity to key emission sources.

These locations do not represent all receptors located in the vicinity or area of influence of the Project but have been adopted for the purposes of the preliminary acoustics assessment. They are considered to be representative of locations that will experience the highest noise or vibration levels and most significant impacts associated with the construction and ongoing operation of the Project.

Furthermore, where additional receptors are identified (beyond those presented in **Table 8.35**) the predicted noise levels at the nearest assessed receptor (N-1 to N-5 and R1 to R6) provides an indication of potential Project emissions and impacts that could be experienced at these other locations not specifically identified in this assessment.

#### *8.6.2.4 Noise Criteria*

The project-specific noise criteria for the eleven receptors (previously described in **Table 8.35**) were adopted from the *Samsung C&T – Engineering and Construction Group (Samsung) – Indonesia Jawa-1 Noise Study Review – Ver.*

*07 - Cooling Tower Re-location to East-Side* report, dated 2016.7.9 and prepared by Samsung - Quality Technology Division, Technical Team (Samsung, 2016 Noise Study Review). Refer to *Annex E* of this report for the full Acoustic and Vibration Assessment Report.

These project-specific criteria values, as adopted from the Samsung, 2016 Noise Study Review, were derived with due regard to the existing night time $L_{eq}$ noise levels presented in **Table 8.36** and IFC 1.7 Noise. The basis of these project-specific criteria values as stated in the Samsung, 2016 Noise Study Review is: existing $L_{eq,\ 8\ hour\ night}$ + 3 dBA = $L_{eq,\ 1\ hour}$ project-specific criteria, for each receptor.

***Table 8.36 Noise Monitoring (Samsung, 2016 Noise Study Review)***

| ID | Description | Measured Noise Levels (Night time) |
|---|---|---|
| N-1 | In the PT Pertamina adjacent to school boundary | Leq (8 hour) 48.9 dBA |
| N-2 | Cilamaya IV State Primary School | Leq (8 hour) 52.1 dBA |
| N-3 | Bunut Ageung Hamlet. Cilamaya Village. Cilamaya Wetan District | Leq (8 hour) 45.6 dBA |
| N-4 | In the Pertamina (adjacent to wall (irrigation area) | Leq (8 hour) 52.0 dBA |
| N-5 | Paddy field in Cilamaya Village. Cilamaya Wetan District | Leq (8 hour) 51.5 dBA |

1. Source: Section 2, *Samsung C&T – Engineering and Construction Group (Samsung) – Indonesia Jawa-1 Noise Study Review – Ver. 07 - Cooling Tower Re-location to East-Side* report, dated 2016.7.9 and prepared by Samsung - Quality Technology Division, Technical Team (Samsung, 2016 Noise Study Review).
2. Refer *Annex B* of this report for further information.

For locations N-1 to N-5 identified in the Samsung, 2016 Noise Study Review the criteria values were adopted as reported. For each of the additional six receptors (R1 to R6) identified for this assessment the criteria value from the closest Samsung, 2016 Noise Study Review location (of N-1 to N-5) has been used.

The consolidated set of criteria values are presented in **Table 8.37**.

*Table 8.37 Project-Specific Noise Criteria*

| Noise ID | Desc. | Noise Criteria, dBA Leq, 1 hour in dBA |
|---|---|---|
| N-1[1] | Residential (Dwelling) Receptor/s situated south-west of the CCGT Power Plant. | 51.9 |
| N-2[1] | Residential (Dwelling) Receptor/s situated south of the CCGT Power Plant. | 55.1 |
| N-3[1] | Residential (Dwelling) Receptor/s situated east of the CCGT Power Plant. | 48.6 |
| N-4[1] | Residential (Dwelling) Receptor/s situated north of the CCGT Power Plant. | 55.0 |
| N-5[1] | Residential (Dwelling) Receptor/s situated north-east of the CCGT Power Plant. | 54.5 |
| R1[2] | Residential (Dwelling) Receptor/s situated south of the CCGT Power Plant, within NCA 1 | 55.1 |
| R2[2] | Workforce Accommodation Receptor situated west of the CCGT Power Plant, within NCA 2. | 51.9 |
| R3[2] | Residential (Dwelling) Receptor/s situated north-west of the CCGT Power Plant, within NCA 3. | 55.0 |
| R4[2] | Residential (Dwelling) Receptor/s situated north of the CCGT Power Plant, within NCA 4. | 55.0 |
| R5[2] | Residential (Dwelling) Receptor/s situated east of the CCGT Power Plant, within NCA 5. | 48.6 |
| R6[2] | Residential (Dwelling) Receptor/s situated south-east of the CCGT Power Plant, within NCA 6. | 48.6 |

1. Source: Samsung, 2016 Noise Study Review.
2. Source: identified for this assessment.

For the purpose of this assessment, predicted transmission line (Corona) noise levels have been compared to the most stringent criteria (48.6 dBA) shown for receptor N-3 in **Table 8.37** above.

This approach enables consistency between the general operational CCGT Power Plant noise assessment, where detailed noise modelling was conducted, and the transmission line noise assessment where modelling was completed to identify potential impacts at distance offsets from the transmission line centre alignment.

### *8.6.3 Assessment of Impacts*

An evaluation of likely construction (general works and activities, and road traffic) air-borne noise and ground-born vibration impacts to human receptors has been conducted.

An evaluation of likely operational air-borne noise and ground-born vibration impacts to human receptors has also been conducted.

#### 8.6.3.1 *General Construction (Onshore and Nearshore)*

The evaluation of likely construction (general works and activities) air-borne noise and ground-born vibration impacts to human receptors, and underwater noise impacts to wildlife receptors did however identify a potential for issues to occur.

Based on the type of construction works and activities that will be required for the onshore a) 1,760 MW CCGT Power Plant, b) Onshore Receiving Facility, c) 500 kV Transmission Line d) onshore gas delivery pipeline and e) Cibatu Baru II/Sukatani Substation identify it is likely that significant noise and vibration impacts would occur that may warrant consideration of mitigation and management measures. Consistent with the statement above for nearshore activities, recommendations to reduce levels and minimise onshore impacts can be established without the need for a quantitative (modelling) assessment to occur.

Similarly, the type of construction works and activities that will be required for the nearshore a) Seawater Water Intake, b) Cooling Water Outfall Discharge Pipeline and c) Jetty, it is likely that significant noise and vibration impacts would occur that may warrant consideration of mitigation and management measures.

This is however typical of projects of this scale and design and recommendations to reduce levels and minimise impacts can be established without the need for a quantitative (modelling) assessment to occur. These recommended noise and vibration mitigation and management measures are commonly incorporated into good construction management practices that are feasible, reasonable and practical to implement on-site.

**Further Discussion**: noise emissions from construction works can also vary significantly depending on the type of activity being conducted e.g. site preparation, bulk earthworks, building construction and the level of noise reducing mitigation being implemented. The distance offset to potentially sensitive receptors also influences the received noise level and magnitude of impacts. Construction fleet noise emissions values (combined emission from multiple sources) can vary but are commonly in the range of 110 dBA (e.g. site preparation) to 130 dBA (e.g. demolition), and good practice construction mitigation can readily achieve noise level reductions of approximately 10 dBA.

These parameters provided above are only conceptual but identify that noise levels may comply with the IFC 1.7 Noise "Disturbance" criteria at a worst-case (130 LW, dBA) distance of 2,250 m during the daytime and 7,000 m during the night time. With a lower noise fleet (110 LW, dBA) these distances reduce to 225 metres during the daytime and 700 metres during the night.

Based on the conceptual 10 dBA reduction due to mitigation being implemented noise levels may comply with the IFC 1.7 Noise "Disturbance" noise criteria (refer *Chapter 5*) at a worst-case (130 LW, dBA) distance of 700 metres during the daytime and 2,250 metres during the night time. This feature identifies the significant spatial reduction to potential impacts due to effective noise reducing mitigation being implemented. With a lower noise fleet (110 dBA) this distance reduces again to 70 metres during the daytime and 225 metres during the night.

Based on these general statements provided above it is possible to derive "safe work distance offsets" which require consideration of mitigation and/or management measures to be considered and implemented, but beyond which no further mitigation may be required.

For vibration, impacts are usually not experienced for the majority of normal construction works and activities that are commonly conducted for projects of this nature at distances beyond 100 m. Inside this distance good construction management practices should be implemented and vibration will likely be perceptible and may generate significant human exposure and annoyance issues, within 50 metres there is potential for structural damage impacts, depending on the works being undertaken. Beyond 100 metres vibration may be perceptible but is unlikely to generate significant human exposure and annoyance or structural damage impacts.

***Table 8.38 Assessment of Noise/Vibration Impacts to Human Receptors – General Construction Noise: Onshore and Nearshore***

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

### 8.6.3.2 *Construction Road Traffic (Onshore, Nearshore)*

This evaluation identified that significant construction road traffic (noise and vibration) impacts from the project i.e. from vehicles on the construction and access road are not anticipated given the short term nature of the activities. Although project noise levels will be sometimes audible at receptors, the construction road is temporary and will only be used for the mobilisation of pipelines as well as the mobile heavy vehicles i.e. backhoes, excavators and the access road (constructed between the equipment jetty and the power plant) will have a limited number of vehicles generating minimal noise emissions when compared to the overall site contribution from other site components. On this basis, significant construction road traffic (noise and vibration) impacts from the project are not anticipated and no further assessment is warranted or provided in this report.

#### 8.6.3.3 *General Construction (Offshore)*

The evaluation of likely construction (e.g. piling) underwater noise impacts to wildlife receptors also identified a potential for issues to occur. The evaluation of likely operational underwater noise impacts to wildlife receptors is provided in **Section 8.1** and not repeated here.

#### 8.6.3.4 *General Operation (Onshore Normal Operations)*

The evaluation of likely operational air-borne noise and ground-born vibration impacts to human receptors identified a potential for issues to occur for select components of the project.

A detailed assessment of operational vibration has not been conducted however based on a) the type of operational equipment that is required for the project and b) the distance offset to the closest and/or potentially most affected receptors, perceptible levels of vibration may be experienced. Specific recommendations for noise and vibration mitigation and management measures are provided in *Chapter 7* of this report.

Based on the type of operational activities proposed for the onshore a) 1,760 MW CCGT Power Plant, and b) 500 kV Transmission Line it is likely that significant noise and vibration impacts could occur that may warrant consideration of mitigation and management measures. Unlike the statements made above for construction works and activities recommendations to reduce levels and minimise onshore impacts are best established via a quantitative (modelling) assessment.

Section 1.1.61 of the IFC Thermal Power Plants Guideline, 2017 recognises the effectiveness of noise modelling and as such modelling was completed to quantify the potential impact of the project's operation on surrounding receptors.

Noise emission source values (LW, dBA) were established based on information provided for significant noise generating plant, equipment and machinery, or activities to be undertaken, as associated with the near and onshore items noted above.

Emission data for key power station sources was provided for noise modelling. The individual LW, dBA values are identified in **Table 8.39**. The sound power levels listed include source mitigation.

*Table 8.39 Significant Operational Noise Sources and Emissions Data*

| Type | Sound Power Level (Lw in dBA) |
|---|---|
| GT Inlet | 107 |
| CT Inlet duct | 108 |
| GT Package | 119 |
| Generator Package | 103 |
| ST Package | 114 |
| GT Fan Casing | 98 |
| GT Vent Fan outlet | 99 |
| Condensor Vent | 98 |
| HRSG Inlet Duct | 104 |
| HRSG Body | 99 |
| Stack Tip | 101 |
| Pre Heat Pumps | 103 |
| HP Water Feed Pump | 105 |
| Cooling Tower, (per unit) | 105 |
| CT Pump | 85 |
| Transformers | 93 |

**Building Components and Enclosures:** the modelling has incorporated the presence of several buildings and enclosures, as discussed in the broader environmental assessment. These include the following buildings:

- There will be two cooling tower blocks, one for each single shaft CCGT unit. The preliminary design foresees 16 cells per unit, with each cell having dimensions 16 x 16 x 18.7 metres (18.7 metres high from finished ground level).

- Two turbine buildings, one for each of the two single shaft CCGT units. Each building has an area of 2,500 square metres ($m^2$) squared and will be 25 meters in height. Constructed of sheet steel.

- There will be two (2) HRSGs, one (1) for each single shaft CCGT unit. Each HRSG will be approximately 40 m in height.

- Exhaust stacks for each CCGT unit with heights of 60m.

Ancillary buildings will provide noise shielding, including:

- Administration Building

- Workshop

- Electrical Control Buildings

The Project design includes the following noise barriers:

- 17m high 300m long barrier located 20m from the southern façade of the cooling tower block
- 7m high 40m long barrier located 50m south west of the turbine hall and HRSG.

The resultant general operational noise levels for the CCGT Power Plant, comparison to the project-specific noise criteria are presented in **Table 8.40**.

Any noise levels that exceed criteria by >0.5 dBA are highlighted in **bold** typeset. Differences in noise levels of less than approximately 2 dBA are generally imperceptible in practice hence an increase of 2 dBA is hardly perceivable; such that a level which exceeds criteria by less than 0.5 dBA is insignificant.

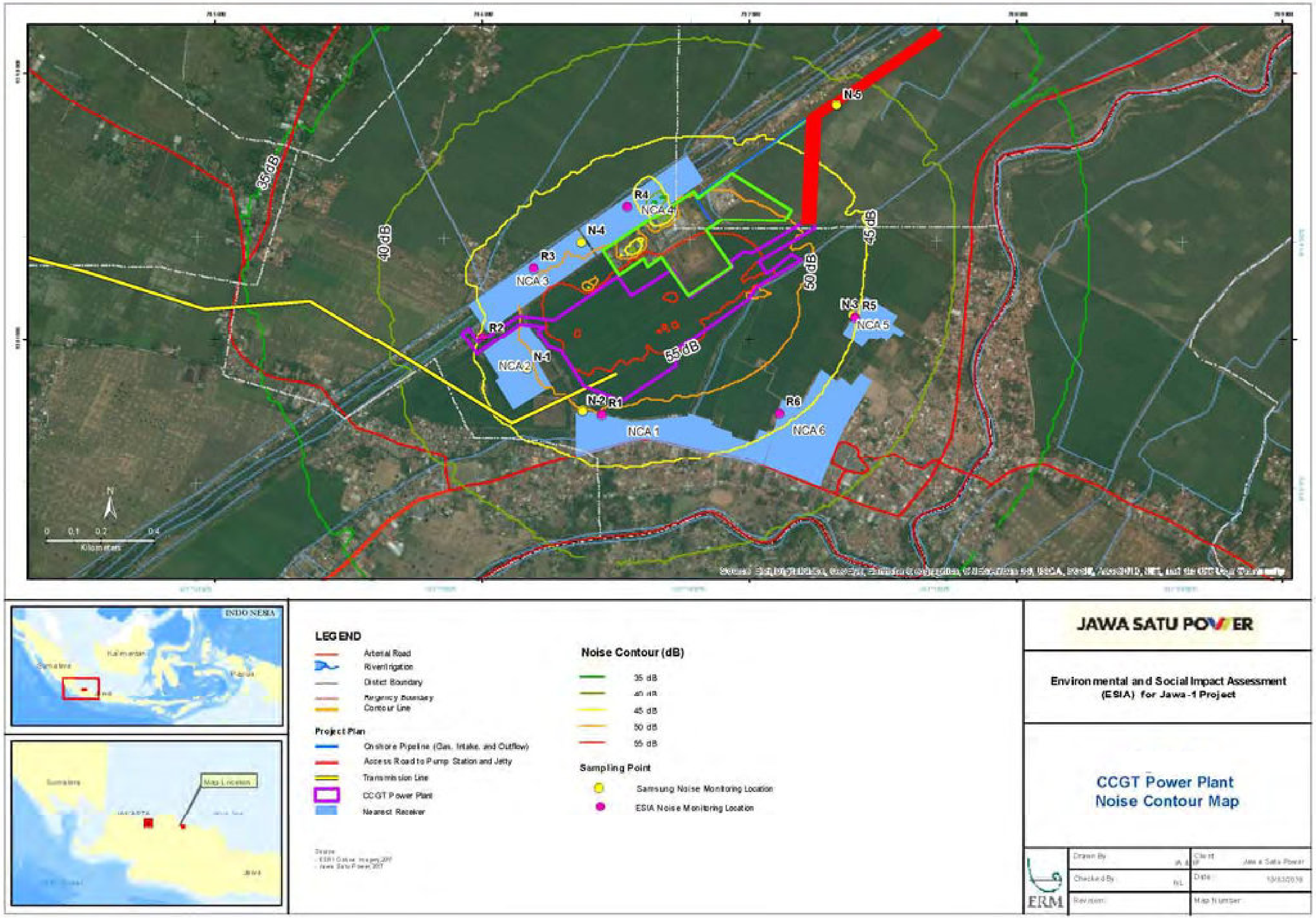
Noise contours, which illustrate the spatial extents of the predicted project CCGT Power Plant noise levels, are presented in **Figure 8-11**.

*Table 8.40 Predicted CCGT Power Plant Noise Levels*

| Noise ID | Project-specific Noise Criteria Leq, 1hour in dBA | Predicted Noise Levels Leq, 1hour in dBA | Comparison to Criteria Leq, 1hour in dBA |
|---|---|---|---|
| N-1[1] | 51.9 | 49.2 | -2.7 |
| N-2[1] | 55.1 | 50.2 | -4.9 |
| N-3[1] | 48.6 | 45.4 | -3.2 |
| N-4[1] | 55.0 | 48.4 | -6.6 |
| N-5[1] | 54.5 | 41.7 | -12.8 |
| R1[2] (NCA 1) | 55.1 | 50.0 | -5.1 |
| R2[2] (NCA 2) | 51.9 | 45.3 | -6.6 |
| R3[2] (NCA 3) | 55.0 | 49.2 | -5.8 |
| R4[2] (NCA 4) | 55.0 | 47.9 | -7.1 |
| R5[2] (NCA 5) | 48.6 | 45.2 | -3.4 |
| R6[2] (NCA 6) | 48.6 | 45.9 | -2.7 |

1. Source: Samsung, 2016 Noise Study Review.
2. Source: identified for this assessment.

*Figure 8-11 CCGT Power Plant Operations Noise Contour Map*



The results presented above identify that the predicted project noise levels ($L_{eq, 1hour}$) associated with the CCGT Power Plant are below project-specific noise criteria adopted for this assessment.

Evaluating the predicted noise levels with regard to the project-specific noise criteria described in **Section 8.6.2**, identifies that predicted noise levels are not expected to exceed the adopted criteria. On this basis an acceptable level of noise impact is expected.

***Table 8.41 Assessment of Noise/Vibration Impacts to Human Receptors - Operations of the CCGT Power Plant***

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

*8.6.3.5 Transmission Line (Corona Noise)*

A 52.16 kilometre 500kV Transmission Line is proposed to be established from the CCGT Power Plant in Cilamaya to Cibatu Baru II/Sukatani EHV Substation in Sukatani. As stated in the IFC Electrical Power Guideline, 2007 (Page 13) "*noise in the form of buzzing or humming can often be heard around transformers or high voltage power lines producing corona. Ozone, a colourless gas with a pungent odour, may also be produced. Neither the noise nor ozone produced by power distribution lines or transformers carries any known health risks*".

The IFC Electrical Power Guideline, 2007 goes on to state that "*the acoustic noise produced by transmission lines is greater with high voltage power lines (400-800 kilo volts, kV) and even greater with ultra-high voltage lines (1000 kV and higher). Noise from transmission lines reaches its maximum during periods of precipitation, including rain, sleet, snow or hail, or as the result of fog. The sound of rain typically masks the increase in noise produced by the transmission lines, but during other forms of precipitation (e.g. snow and sleet) and fog, the noise from overhead power lines can be troubling to nearby residents*".

These features are to be expected for the proposed development and as such modelling was completed to quantify the potential impact of transmission line operation on surrounding receptors based on an indicative line source emission value of 64 dBA per metre, at a nominal minimum height of 15 m above ground level, to identify distance offsets from the transmission line centre alignment.

Consistent with the approach described in the IFC Electrical Power Guideline, 2007 this enables measures to be identified that are designed to mitigate impacts, where necessary. These may be implemented "*during project planning stages to locate rights-of-way away from human receptors, to the extent possible*".

The resultant operational noise levels (corona noise) for the 500 kV transmission line and comparison to the project-specific noise criteria are presented in **Table 8.42**.

As per the impact assessment methodology these predictions are provided for a range of horizontal distance offsets from transmission line centre line, in metres. This approach does not predict levels at specific receptors but provides an understanding of the likely noise that will be experienced at different distances along the transmission line full alignment.

Any noise levels that exceed criteria by >0.5 dBA are highlighted in **bold** typeset. Differences in noise levels of less than approximately 2 dBA are generally imperceptible in practice hence an increase of 2 dBA is hardly perceivable; such that a level which exceeds criteria by less than 0.5 dBA is insignificant, as shown in **Table 8.43**.

*Table 8.42 Predicted Transmission Line (Corona) Noise Levels*

| Horizontal Distance Offset from Transmission Line Centre Line, metres | Project-specific Noise Criteria[1] Leq, 1hour in dBA | Predicted Noise Levels $L_{eq,\ 1hour}$ in dBA | Comparison to Criteria Leq, 1hour in dBA |
|---|---|---|---|
| 0 | 48.6 | **50.7** | **2.1** |
| 10 | 48.6 | **50.2** | **1.6** |
| 20 | 48.6 | 49.1 | **0.5** |
| 30 | 48.6 | 47.9 | -0.7 |
| 40 | 48.6 | 46.8 | -1.8 |
| 50 | 48.6 | 45.8 | -2.8 |
| 60 | 48.6 | 45.0 | -3.6 |
| 70 | 48.6 | 44.2 | -4.4 |

1. Source: N-3 limiting criteria value from the Samsung, 2016 Noise Study Review.

*Table 8.43 Assessment Noise/Vibration Impacts to Human Receptors - Operation of the 500 kV Transmission Line*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| Magnitude of Impact | **Negligible** | Negligible | **Negligible** | Negligible |
| | Small | Negligible | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

### 8.6.3.6 *General Operation (Nearshore)*

For the proposed operational activities associated with the nearshore a) Seawater Water Intake, b) Cooling Water Outfall Discharge Pipeline and c) Jetty, and onshore a) b) Onshore Receiving Facility and b) Cibatu Baru II/Sukatani Substation, it is unlikely that significant noise and vibration impacts occur that may warrant consideration of mitigation and management measures.

This is primarily due to significant influence of the key operational activities noted above, or typical design measures that are implemented during detailed design of the project to ensure impacts are minimal, if any at all. Accordingly, suitable recommendations for conceptual noise and vibration mitigation and management measures are provided in **Section 8.6.4** to assist minimise impacts.

### 8.6.3.7 *Operational Road Traffic (Onshore)*

An evaluation of likely operational road traffic air-borne noise and ground-born vibration impacts to human receptors identified that significant operational road traffic (noise and vibration) impacts from the project i.e. from vehicles on the access road are not anticipated. Although project noise levels will be sometimes audible at receptors, the operational access road (constructed between the equipment jetty and the power plant) will have a limited number of vehicles generating minimal noise emissions when compared to the overall site contribution from other site components.
On this basis, significant operational road traffic (noise and vibration) impacts from the project are not anticipated and no further assessment is warranted or provided in this report. Regardless, recommendations for conceptual road traffic noise and vibration mitigation and management measures are provided in **Section 8.6.4** of this report to assist minimise impacts if needed.

#### 8.6.3.8 *General Operation (Offshore)*

The evaluation of likely operational underwater noise impacts to wildlife receptors is provided in **Section 8.1** and not repeated here.

### 8.6.4 *Mitigation Measures, Management and Monitoring*

This chapter presents safeguards and provisions for construction and operational noise and vibration associated with the project. They are based on the impacts evaluated in **Section 8.6.3**. These safeguards and provisions are designed to minimise impacts at the most affected receptors and on the broader community.

The focus of these safeguards and provisions are associated with potential construction (including road traffic) air-borne noise and ground-borne vibration impacts to human receptors. Construction safeguards and provisions are presented in **Section 8.6.4.1** and target significant emission generating works and activities associated with the development, that are proposed to occur within and near the project site.

In addition, safeguards and provisions are provided in **Section 8.6.4.2** for potential operational air-borne noise and ground-born vibration impacts to human receptors. These operational safeguards and provisions target post commercial operation noise verification and compliance monitoring for significant emission generating activities, for the various nearshore and onshore components associated with the development (i.e. the CCGT Power Plant and the 500 kV transmission line) that are proposed to occur within and near the project site.

#### 8.6.4.1 *Construction Phase Mitigation*

To ensure noise emissions associated with construction works and activities are kept to acceptable levels, the following mitigation and management measures are recommended:

- Work and activities should be carried out during the IFC daytime hours (i.e. 7am to 10pm). Any work that is performed outside these hours (i.e. during the night time period, 10pm to 7am) should be suitably managed with a goal of achieving levels compliant with the IFC 1.7 Noise Disturbance criteria, at all potentially affected sensitive receptors. Where this is not possible it may be necessary to undertake the night works with agreement from nearby and potentially affected neighbours.

- Where unforeseen works will occur in close proximity to a receptor and these works are anticipated to generate high levels of noise (e.g. >75 dBA), potential respite periods (e.g. three hours of work, followed by one hour of respite) should be considered. Respite should be implemented if they are the preference of the affected receptors and if they are feasible and reasonable, and practicable, to implement during the works. In some circumstances respite may extend the duration of works and inadvertently increase noise impacts, hence due care should be taken when considering this management measure.

- During the construction design, choose appropriate machines for each task and adopt efficient work practices to minimise the total construction period and the number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit.

- During the works, avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient.

- During the works, instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night.

- During any night works, any activity that has the potential to generate impulsive noise should be avoided. These types of events are particularly annoying, especially at night and have the limited potential to generate sleep disturbance or awakening impacts.

- During the works, ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines should be repaired or removed from the Site.

- During the works, ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse.

No further recommendations for mitigation and management to the above are provided. JSP should however remain aware of the potential for nuisance, or an unacceptable level of amenity, to occur due to construction noise and vibration and continue to plan for and then manage construction works accordingly.

#### 8.6.4.2 *Operational Phase Mitigation*

Based on the generally compliant results presented, no additional noise mitigation of plant and equipment is expected. It is understood the EPC responsible for the design of the transmission line is building in a factor of 18m vertical height at the lowest point in the cable slag (as a minimum) and therefore it is not anticipated additional mitigation measures will be required as this meet the requirements set out by PLN.

JSP should however remain aware of the potential for nuisance, or an unacceptable level of amenity, to occur due to operational noise and vibration and continue to plan for and then manage the project design accordingly. Post commercial operation noise and vibration verification and compliance monitoring should be conducted to measure and compare the site noise level contributions ($L_{eq, 1hour}$ in dBA) to a) the predicted values, and b) the criteria presented in this report. The same should occur if any validated noise or vibration complaints are received. All site noise (or vibration) levels should be measured in the absence of any influential sources not associated with the project. If the measured project noise levels are below the predicted values and noise/vibration levels comply with the criteria presented in this report, no further mitigation or management measures may be required. If the measured project levels are above the predicted noise levels and/or criteria presented in this report, further mitigation and/or management measures should be considered.

## 8.7 *SOIL AND GROUNDWATER*

Understanding potential changes in soil quality and associated changes to the groundwater quality are essential in forming an overall understanding of Project impacts. In this regard, this Section presents an evaluation of the potential impacts on changes in soil and groundwater levels and quality and issues pertaining to quality of the *in-situ* soils. Secondary impacts relating to deterioration of surface water quality and soil erosion from surface water flows are discussed later in the section. This is primarily due to the fact that management of surface water is related to ensuring that topsoil does not become mobilised as suspended solids.

Potential soil and groundwater contamination due to improper construction waste storage and disposal would be the result of contaminated surface water run-off being discharged from waste storage and disposal areas is discussed in **Section 8.9**. The production and discharge of this contaminated surface water is assessed extensively within **Section 8.7**. It is considered that this impact has therefore already been covered and will not be re-assessed within the context of impacts to soil and groundwater.

This is also the case with the impacts due to improper discharge of wastewater and runoff which if direct to either a surface water, groundwater or soil receptor would all be subject to similar impacts and thus mitigation, management and monitoring measures.

The assessment of potential impacts related to groundwater and soils in this section is based on the environmental and social baseline data (presented in **Section 7**) and the information available from the Sponsor at the time of writing.

It is noted that no quantitative modelling has been undertaken concerning any elements of the ground water impact assessment. Should there be significant changes in factors such as assumed input data or assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may need to be amended to reflect these changes.

The environmental parameters sampled in the baseline survey, data from which have been used in the assessment, are commonly found contaminants and were selected based on extensive analysis suites provided by internationally recognised laboratories. Contaminants outside the analysis suite used under this ESIA were not assessed.

### *8.7.1 Potential Sources of Impacts*

#### *8.7.1.1 Construction Phase*

Based upon Scoping, during the construction phase the following routine impacts are identified as potentially occurring:

- Soil disturbance, loss of soil structure, quantity and quality from site preparation and excavation activities and development of access roads;
- Changes to groundwater levels during development due to site dewatering (if necessary);
- Soil and groundwater contamination liberated from naturally occurring "stored sources" (e.g. acid sulphate soils) arising from soil disturbance during excavation; and
- Soil and groundwater contamination due to the contaminated fill materials during all phases of Project construction.

#### *8.7.1.2 Operations Phase*

The operation phase is expected to continue for 25 years. The average number of permanent workers present during operation is expected to be up to 150 personnel. The assessment of operational phase impacts includes those arising from both routine operations and maintenance of the CCGT Power Plant, onshore pipelines, Transmission Line, the Substation, and the pump station

During the operation phase, potential soil and groundwater impacts may arise due to loss of soil due to increased erosion potential during operation phase.

It is noted that soil and groundwater contamination due to improper construction waste storage and disposal would be the result of contaminated surface water run-off being discharged from waste storage and disposal areas. The production and discharge of this contaminated surface water is assessed in **Section 8.5.2**. Additionally, impacts of soil and groundwater contamination due to potential accidental leaks, spills and leakages of hazardous chemicals and materials is discussed in **Section 10**.

It is considered that this impact has therefore already been covered and will not be re-assessed within the context of impacts to soil and groundwater. This is also the case with the impacts due to improper discharge of waste water and runoff which if direct to either a surface water, groundwater or soil receptor would all be subject to similar impacts and thus mitigation, management and monitoring measures.

### 8.7.2 *Assessment Approach and Criteria*

The legal framework of relevance to Soil and Groundwater is listed below:

- *World Bank IFC General EHS Guidelines, 2007.*

***Table 8.44 Sensitivity Criteria for Impacts to Soil Quality***

| Sensitivity | Definition |
|---|---|
| Low | • Low soil fertility not used for agriculture, contaminated made-ground soils at brownfield sites, soils not supporting any particularly sensitive or important habitats. |
| Medium | • Typical agricultural land, soils supporting specific habitats (e.g. forests), soils on residential sites |
| High | • Intensively farmed, highly fertile soils, wetland soils, soils which host shallow aquifers relied upon for abstraction or essential for river base flow, soils of specific characteristics (e.g. pH, carbon content, mineralogy) that support specific significant or high-value flora or faunal habitats. |

Source: *ERM, 2017b*

***Table 8.45 Magnitude Criteria for Impacts to Soil Quality***

| Magnitude | Definition |
|---|---|
| Negligible | • Change well within the bounds of normal natural variation. No effect detectable or recovery within a very short timescale (<1 year). Could occur over any size of area. |
| Small | • Change likely to adversely affect the quality/value of the soil but recovery is expected in the short term (i.e. 1 – 4 years). Changes are over a small to moderate area. Impacts beyond levels of natural variation that do not exceed assessment criteria (i.e. low intensity), for any duration or geographic extent. |
| Medium | • Change over a moderate (i.e. 1 – 100 ha) to large area, likely to adversely affect the quality/value of the soil but recovery is predicted in the medium term (i.e. 5 – 10 years) and there is predicted to be no permanent impact to its integrity. Conversely, change over a small area (i.e. <1 ha) with direct adverse permanent or long-term effects. |
| Large | • Change is likely to cause a direct adverse permanent or long-term (i.e. >10 years) effect on the quality/value of the soil over a large area (i.e. >100 ha). |

Source: *ERM, 2017b*

***Table 8.46 Sensitivity Criteria for Groundwater Quality***

| Sensitivity | Definition |
|---|---|
| Negligible | • The groundwater resource does not support diverse habitat or populations within groundwater dependent ecosystem. |
| Low | • The groundwater resource supports aquatic habitat or population, but the habitat/population is common/ non-diverse/ insignificant. |
| Medium | • The groundwater resource supports diverse or susceptible populations of flora and/or fauna. |

| Sensitivity | Definition |
|---|---|
| High | • The groundwater resource supports economically important or biologically unique species or provides essential habitat/ nutrients to sustain such species. |

Source: *ERM, 2015*

***Table 8.47 Magnitude Criteria for Impacts to Groundwater Quality***

| Magnitude | Definition |
|---|---|
| Negligible | • The Project is unlikely to have an impact on recharge/ discharge regimes at any time. |
| Small | • There is likely to be some alteration to existing recharge/ discharge regimes, although these changes are unlikely to result in any significant long term changes to groundwater levels, quality or flows.<br>• There are known/ expected groundwater users/ supply or physical (property, agricultural fields, infrastructure, etc.) or sensitive ecological receptors within the aquifer or upstream or downstream but these are not considered susceptible to such changes in groundwater flow and/or quality. |
| Medium | • The Project is likely to involve significant changes to existing recharge / discharge regimes which result in long term changes to groundwater flows (vertical and/or horizontal) and/or quality.<br>• There are known/ expected groundwater users/ supply or physical (property, agricultural fields, infrastructure, etc.) or sensitive ecological receptors within the aquifer or upstream or downstream which are susceptible to such changes in groundwater flow and/or quality. |
| Large | • The Project is likely to involve significant changes to groundwater flows (vertical and / or horizontal) and / or quality.<br>• There are known/ expected groundwater users/ supply or physical (property, agricultural fields, infrastructure, etc.) or sensitive ecological receptors within the aquifer or upstream or downstream which are susceptible to changes in groundwater flow and/or quality that are likely to be significantly affected by such changes. |

Source: *ERM, 2015*

### *8.7.3 Assessment of Impacts – Site Clearance Activities and Dewatering Activities*

#### *8.7.3.1 Soil Disturbance due to Site Clearance Activities*

Impacts during the construction phase are noted as being similar across all aspects of the Project (i.e. CCGT, onshore pipelines, Transmission Line & substation) and are thus assessed collectively.

The EPC contractors appointed by the Sponsor will carry out the construction of the onshore facilities. The entire construction phase is expected to continue for approximately 36 months. The approximate number of workers for the overall construction activities is approximately 3,500. The workers will be sourced both locally as well as externally.

Soil works, including vegetation clearance, potential grading and levelling, compaction, construction of various structures must be carried out at the CCGT Power Plant site, access roads, and for the laying of the right of way for the gas pipeline, transmission line and the substation.

Changes to soil structure may be caused by mechanical disturbance to the soil from these activities. Exposure of soil to rain and wind may in turn cause erosion and loss of top soil.

Earthworks will be carried out to raise the CCGT Power Plant platform to 4.0 m above mean sea level, a 1.5 m increase from the current height of the land. This requires approximately 315,000 $m^3$ of soil for backfilling purposes by the licensed land excavation company in Purwakarta or Subang region. Initial backfilling and consolidation activity will be conducted over three (3) months, with final height correction planned over a 5 month period from NTP +7 months.

Additionally, the ROW for pipeline installation will be cleared and will be graded to same level using a bulldozer or excavator. All roots and stumps shall be removed by grubbing, digging or such other means. All unwanted stumps, roots and other vegetation shall be disposed outside of the worksite boundaries. Prior to excavating in work area, all topsoil shall be stripped, stored and topsoil which is deemed to be unsuitable shall be disposed of to the dumping site approved by local Authorities. Soil Compactor will be utilised for compacting the opened ROW after land grading activity. Trenching will be conducted based on the approved engineering design procedures. The trenching activities will be conducted by the EPC Contractor.

The construction activities at the Transmission Line will require will land clearing and soil compaction activities. Following to this, tower foundations will be constructed involving land excavation, piling, setting, working floor making, stub shoes making, stub setting, crooked cut and supporting, formwork installation, cast preparation, earthing angle installation and grounding, cast foundation concrete, formwork disposal, filling and equipment demobilisation, and PLN boundary stacks installation.

An excavation of the land as deep as 3.5 m according to tower engineering design will be conducted for the tower that located within the paddy field. The excavated soil will be placed on the left and right side of holes, which will be utilised to close the holes after foundation making, is finished.

This phase of the Project is generally the most intensive in terms of loss of topsoil. Poor topsoil management can lead to a loss of topsoil through either the air (as dust) or as sediment entrained within surface water flows. Soil erosion can also result from poor management of stockpiled soils, excavated areas and general construction areas. Additionally, soil will be compacted at the CCGT Power Plant site and access roads, permanent operator housing and the lay down area to ensure soil stability.

Movement of heavy vehicles in the construction area will also result in soil compaction and damage to the soil structure. This compaction of the soil may potentially result in changed hydrological characteristics, such as reduced permeability and water infiltration to the soil, which could create additional surface run-off (and increase the flow velocity of this run-off), as well as reducing infiltration into subsurface aquifers. If compaction and erosion are not managed, associated potential impacts could include excessive sedimentation of local waterways, loss of topsoil and reduction in soil fertility, and detrimental changes to site hydrology.

Additionally, soil erosion is mostly a concern during periods of high rainfall. Loss of topsoil, if not controlled, can result in a waste of valuable topsoil resource which can be used in rehabilitation activities and or/agriculture. Presently there are no mitigation, management and monitoring measures directly associated with topsoil management.

This impact will occur throughout the construction phase, with the most intensive time being during the clearance of the proposed Transmission Line. However, the improper management during site clearance activities is expected to be limited to the project footprint only, and therefore the extent is considered local. Therefore, the magnitude scale of this impact is expected to be **Medium.**

The resource sensitivity (being the topsoil) is considered to be **Medium** as it a valuable asset which can be easily lost due to inappropriate management practices.

The significance of potential impacts to soil due to the improper management during site clearance activities at all Project area is assessed as **Moderate** as shown in **Table 8.48**.

*Table 8.48 Assessment of Impacts on Soil due to Site Clearance Activities*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| Magnitude of Impact | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | **Large** | Moderate | Major | Major |

#### 8.7.3.2 *Changes to Groundwater Levels during the Construction of CCGT Power Plant as a result of Dewatering Activities*

Groundwater dewatering activities at the proposed CCGT Power Plant area during the construction phase may lead to temporary lowering of the groundwater table, adversely impacting groundwater availability.

Potential impacts would be limited to the aquifer within the proposed CCGT Power Plant and neighbouring area, and hence would be considered to be local. Additionally, the quantities of groundwater that will be dewatered are comparatively low. Hence, the potential impacts to groundwater levels due to groundwater dewatering are expected to be of **Small** magnitude.

Given the high dependency of the local community on groundwater for domestic purposes, the resource sensitivity is determined to be **Medium**.

The significance of potential impacts to groundwater due to the dewatering activities during Project Construction of CCGT Power Plant is assessed in **Table 8.49**.

*Table 8.49 Assessment of Impacts due to Dewatering Activities*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

The combination of a Medium Sensitivity and Small Impact Magnitude will result in an overall **Minor** Impact.

### 8.7.3.3 *Acid Sulphate Soil*

Acid sulphate soils (ASS) are naturally occurring soils, sediments or organic substrates that are formed under waterlogged conditions. ASS may exist at the Project coastal locations, such as in mangroves, salt marsh vegetation or tidal areas, and at the bottom of coastal rivers and lakes where iron-rich sediments, sulphate sources (e.g. from seawater), sulphate-reducing bacteria, or supply of organic matter are present. When drained, excavated or exposed to air through a lowering of the water table, the sulphide reacts with oxygen to form sulphuric acid, which can release heavy metals within the soil as well as reduce oxygen levels.

During the construction phase of the coastal access road, jetty and pipelines, there is a concern that excavation of the coastal soils may expose ASS and result in negative impacts, such as toxic effects on vegetation, acidification of groundwater and surface water through leaching as well as mortality of fish and aquatic organisms.

A number of factors can be considered when assessing the potential for ASS. One is acidity or pH. A total of 13 soil bore locations were sampled from 2015 to 2017 to assess the geological conditions in areas where soil disturbance or excavation is proposed. Results are summarised in **Tables B.1** through **B.3** in **Annex B** of this Report.

Of these, sample S6 is at the landfall for the pipeline and costal jetty location of concern. The pH at S6 ranged from 7.73 at 0.5-1.5 m depth to 8.23 at between 2.0-3.0 m depth. This indicates slightly basic conditions, which is not conclusive as to whether the soil contains ASS as it is common in undisturbed soils and particularly marine influenced samples. Another factor is appearance, with the presence of waterlogged soils in the coastal area, characterised by dark grey to black subsurface sediments suggestive that ASS could potentially be present (e.g. sulfidic materials could be present but not yet oxidised).

Vegetation type can also help identify the potential for acid sulphate soils or can indicate that acidification may have already taken place. This includes vegetation that is salt-tolerant and occur in waterlogged areas, such as mangrove which thrive in anaerobic soils and saline waters and contribute organic matter that aids acid sulphate soil formation in coastal wetlands. The Project location for the coastal road, jetty and pipeline landfall is characterised by interspersed mangrove communities.

Water chemistry can also help in identifying potential for ASS presence. Surface water monitoring was conducted at river locations in the vicinity of the CCGT in 2016 and 2017 to assess the surface water conditions adjacent to the project location. Results are summarised in **Tables B.8, B.10, B.11** and **B.12** of **Annex B**. The chloride-to-sulphate ratio was calculated to assess the potential presence of ASS and is summarised in **Table 8.50**. A $Cl^{-}:SO_4^{2-}$ ratio of less than four, and certainly a ration less than two, is a strong indication of an extra source of sulate from previous sulphide oxidation (*Mulvey, 1993*).

*Table 8.50* *Assessment of Chloride-Sulfate ratio for Representative Surface Water Samples*

| Parameter | Units | RW2 | RW3 | RW6 | RW7 | RW8 |
|---|---|---|---|---|---|---|
| pH | - | 7 | 7.6 | 7.38 | 7.43 | 6.98 |
| Chloride | mg/L | 14.5 | 7 | 28.99 | 36.99 | 31.99 |
| Sulphate (SO4) | mg/L | 53.9 | 10 | 39.67 | 31.26 | 25.79 |
| **Ratio** | **-** | **0.27** | **0.70** | **0.73** | **1.18** | **1.24** |

Considering all the factors discussed above, the waterlogged coastal soils have the potential to contain ASS. Given the wetland nature of the soil, high fertility of surrounding area, chemical content, mangrove and bird areas, this is of high sensitivity. The proposed level of disturbance is greater than natural variation, is considered to be a small to moderate area and have a recover time of 1-4 years (small ranking). This results in an impact significance of **moderate** ranking, requiring mitigation. The potential impact of earthworks and soil clearance at this location is provided in **Table 8.51**.

*Table 8.51 Assessment of Impacts from Acid Sulphate Soils to Site Clearance Activities*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | Low | Medium | **High** |
| Magnitude of Impact | Negligible | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | **Moderate** |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

*8.7.3.4 Mitigation Measures, Management and Monitoring*

During soil disturbing activities, the mitigation measures developed with regards to surface water quality (**Section 8.7**) will serve to prevent soil loss through limiting TSS loading in surface water bodies.

Other mitigation measures to be implemented are:

- Delineation of clearance boundaries to limit the areas to be cleared;
- Scheduling clearance activities to avoid extreme weather events such as heavy rainfall, extreme dry and high winds;
- Revegetation areas with temporary land use, conducting progressive rehabilitation;
- Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers;
- Reuse topsoil within rehabilitation activities; and
- Control erosion through diversion drains, sediment fences, and sediment retention basins.

Where topsoil is to be stored for later use in rehabilitation activities, the following basic principles are to be applied:

- Stockpiles to be separated into topsoil and sub-soil and be located at least 10 m from any surface water source and groundwater well or 50 m from Cilamaya canal; and
- To the extent possible, stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion.

The following additional mitigation, management and monitoring measures will be implemented to reduce the impacts of dewatering activities:

- Monitor the quantity of groundwater abstracted and associated draw down; and

- Address and respond to any community complaints regarding Project impacts on groundwater availability.

For earthworks and excavations in the waterlogged coastal soils where there is the potential for ASS, mitigation is based on the approach of:

- Identification and characterisation of ASS presence;
- Minimisation of disturbance and exposure to air;
- Control of dispersion through soil/water;
- Removal/treatment; and
- Monitoring.

The following measures are required:

- Prior to proceeding with any soil disturbance activities, conduct onsite ASS tests at coastal excavation locations;

- Where ASS is confirmed to be present, implement control measures for area exposed and potential spread of acid effects in soil/water, such as:
  - Schedule excavation such that the potential effects on any area disturbed at any one time are limited and managed;
  - Stockpiling of ASS is only permitted as a short-term activity where removal from site is not possible (e.g. weather) and must be placed on impermeable area with runoff protection, 50 m away from surface water;
  - Minimise the time that excavations are left open and the presence of temporary spoil piles to reduce the amount of time that ASS is exposed to the air.
  - No dumping of exposed ASS is permitted onto the surrounding land or into surface waters;
  - Use of marine, estuarine, brackish or fresh waters is not permitted as a means of diluting and/or neutralising ASS or associated contaminated waters.
  - Given the fine sediment and waterlogged nature of the potential area of ASS, covering excavated spoil with clean material is not recommended as the material may liquidise, flow and contaminate the surrounding area.

- Evaluate treatment and disposal options based on volume of ASS material, considering:
  - Removal, treatment and disposal offsite (preferred);
  - Neutralisation of ASS materials (e.g. lime application); or
  - Strategic reburial in anoxic environment;

- Monitoring samples of soil and surface water following completion of earthworks/excavation in ASS affected area.

The above mitigation measures should be detailed in an ASS Management Plan that details the steps, measures and strategies that will be used to manage potential impacts of the excavation works that have the potential to disturb ASS materials at the site to reduce the magnitude of the potential impact.

*8.7.3.5 Significance of Residual Impact*

Based upon the implementation of the above management and mitigation measures, the residual impact level of each potential impact sources can be summarises as follows:

***Table 8.52 Summary of Residual Impact***

| Activities | Significance before Mitigation | Residual Impact Significance |
|---|---|---|
| Loss of soil structure, quantity and quality due to site clearance activities | **Moderate** | **Minor** |
| Changes to groundwater levels during development due to dewatering | **Minor** | **Minor** |
| Acid Sulphate Soil impacts to groundwater and aquatic biota from soil clearing at the access road and jetty coastal areas | **Moderate** | **Negligible** |

### *8.7.4 Assessment of Impacts - Loss of Soil due to increased Erosion during Operations*

The total area of the Project's footprint will be as follows:

- CCCT Power Plant: 21 ha or 210,000 $m^2$;
- Onshore Pipeline: 6.08 ha or 60,800 $m^2$;
- Transmission Line: approximately 13.47 ha or 134,700 $m^2$; and
- Substation: 1.1 ha or 11,000 $m^2$.

During the operation phase, the physical footprint of the proposed installations will increase the impermeable area of the Project, resulting in changed hydrological characteristics, such as reduced water infiltration to the soil, which could create additional surface run-off (and increase the flow velocity of this run-off), as well as reducing infiltration into subsurface aquifers.

The increased of impervious surfaces from the Project footprint are expected to cause rainfall runoff. This flow rate has the potential to cause soil erosion and sedimentation. However, if the drainage channel surrounding the Project is designed with enough capacity to accommodate this increased flow rate, potential impacts can be minimised.

Impacts to soil due to erosion from increased rainwater runoff would occur during rainfall events, and will be more frequent during the rainy season. Potential impacts to soil in the Project area due to increased rainfall run-off from the impervious surfaces are expected to be of **Medium** magnitude. The existing soil quality in the Project area is generally fair, but soil is susceptible to erosion. Hence, the overall sensitivity is rated as **Medium**.

The significance of potential impacts to soil due to erosion from increased run-off from impervious surfaces during the operation phase are assessed in the following table, and mitigation measures are presented in **Section 8.5.1.4**.

*Table 8.53 Assessment of Impacts due to Increased Erosion Potential during Operations*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | **Large** | Moderate | Major | Major |

The combination of a Medium Resource Sensitivity and Small Impact Magnitude will result in an overall **Minor** Impact.

### 8.7.4.1 *Mitigation Measures, Management and Monitoring*

It is recommended that the drainage channel and irrigation canal have enough capacity to accommodate the increased rainfall run-off from the Projects impervious surfaces.

### 8.7.4.2 *Significance of Residual Impact*

Based upon the implementation of the above management and mitigation measures, residual impact significance would remain **Moderate**.

## 8.8 SURFACE WATER QUALITY

This Section presents an evaluation of the potential impacts on surface water associated with the construction of the proposed Project based on the impacts identified during Scoping (outlined in **Section 5**). The assessment of potential impacts related to surface water in this section is based on the baseline data presented within **Section 7** and the information available from the Sponsor at the time of writing.

The assessment focuses purely on water bodies as the receptor. It is recognised that any changes to surface water may potentially impact sensitive receptors that utilise these surface water resources. In this regard, the mitigation measures have also been provided where necessary to be implemented alongside in-place controls to reduce the potential residual impacts to acceptable levels.

It is noted that no quantitative modelling has been undertaken with regards to any elements of the surface water impact assessment. Should there be significant changes in factors such as assumed input data, engineering design of wastewater management and treatment components of the Project, or agreed assessment criteria, then elements of this impact assessment and associated management, mitigation and monitoring measures may be needed to reflect these changes.

### 8.8.1 *Potential Sources of Impacts*

#### 8.8.1.1 *Construction Phase*

During the construction, different activities have the potential to generate wastewater, sedimentation, and increased water consumption, which could lead to impacts on the hydrology and quality of surrounding freshwater bodies. Based upon this, during the construction phase the following impacts are identified as potentially occurring:

- Wastewater discharges and run-off; and
- Construction waste storage and disposal.

#### 8.8.1.1 *Operations*

The operation phase is expected to continue for 25 years. The average number of permanent workers present during operation is expected to be up to 150 personnel. The assessment of operational phase impacts includes those arising both from routine operations and maintenance of the onshore associated facilities i.e. CCGT Power Plant, Transmission Line and Substation.

During the operation phase, potential surface water impacts may arise as follows:

- Wastewater discharges and run-off; and
- Waste storage and disposal.

The impacts due to potential accidental leaks, spills and leakages of hazardous chemicals and materials are discussed in **Section 8.10**.

### 8.8.2 *Assessment Approach and Criteria*

The legal framework of relevance to Surface Water is listed below:

- *World Bank IFC General EHS Guidelines, 2007;*
- *World Bank IFC EHS Guidelines for Thermal Power Plants, 2008, and 2017 (in Draft)*; and
- *World Bank IFC EHS Guidelines for Electric Power Transmission and Distribution, 2007.*

The significance of the impacts has been assessed using the approach and methodology as described in **Section 3.6**. The criteria for sensitivity o and magnitude of the impact to surface water quality are defined in **Table 8.54** and **Table 8.55**.

***Table 8.54 Sensitivity Criteria for Surface Water Quality***

| Sensitivity | Definition |
|---|---|
| Low | • The water resource does not support diverse aquatic habitat or populations, or supports aquatic habitat or population that is low quality. |
| Medium | • The water resource supports diverse populations of flora and/or fauna. |
| High | • The water resource supports economically important or biologically unique aquatic species or provides essential habitat for such species. |

*Source: ERM, 2012a*

***Table 8.55 Magnitude Criteria for Impacts to Surface Water Quality***

| Magnitude | Definition |
|---|---|
| Negligible | • Potential short-term localised effects on water quality but likely to be highly transitory (e.g. lasting a matter of hours) and well within natural fluctuations. |
| Small | • Potential short-term localised effects on water quality but which are likely to return to equilibrium conditions within a short timeframe (e.g. hours or days at most). |
| Medium | • Potential localised effects on water quality which are likely to be fairly long lasting (e.g. weeks or months) and/or give rise to indirect ecological and/or socio-economic impacts. |
| Large | • Potentially severe effects on water quality which are likely to be long-lasting (e.g. months or more) or permanent and/or give rice to indirect ecological and/or socio-economic impacts. |

*Source: ERM, 2012a*

### *8.8.3 Assessment of Impacts – Wastewater Discharges an Run-Off*

#### *8.8.3.1 Construction Phase*

Wastewater discharge and runoff during the construction phase may lead to contamination of freshwater sources if not managed appropriately. During the construction phase, there are a number of anticipated wastewater sources.

Amount of sewage will arise from the construction workforce and offices. The uncontrolled discharge of wastewater is generally characterised as having a high concentration of solids (both suspended and dissolved), Oil & Grease, Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), nutrients (Ammonia) and E. coli counts.

In addition, periods of high rainfall could lead to overflow, or rapid through-flow, of the effluent to surface water prior to its full digestion in the septic tanks. Raw sewage can impact surface water quality by delivering pathogens that may be harmful to human and ecological receptors. Sanitary wastewater is generally characterised as having a high concentration of solids (suspended and dissolved), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), nutrients (nitrogen, ammonia) and Faecal Coliform counts. The organic substances (e.g. hydrocarbon, protein) are decomposed in water, and the decomposition of organic matter will reduce the oxygen content dissolved in water.

The general construction activities also have the potential to generate wastewater from the concrete batching plant, wastewater from washing equipment operation etc. These wastewaters could potentially contain chemicals (e.g. spent paints and solvents), alkali water, oil and grease and high concentration of suspended solids and traces of hydrocarbon. The discharge of wastewater produced during concreting can also lead to changes in the pH of the receiving water body, if not first treated.

The construction activities of the CCGT Power Plant, Transmission Line and substations will require as site clearance, earthworks, disposal of backfill materials, installation of hard standing areas, erosion of exposed bare soil, slopes and earth, and release of cement materials could cause run-off of unconsolidated sediments during rainfall. The generation of sediment laden run-off could be transferred to the nearby freshwater bodies, which could increase total suspended solids and turbidity in receiving waters.

Impacts from surface run-off are of more concern near surface water bodies such as rivers, streams and lakes, particularly where the adjacent land is made up of areas which are susceptible to erosion such as grasslands, agricultural land, and secondary forests.

The surface water quality conducted in 2016 includes a significant number of exceedances with the water quality standards. These include levels of Total Suspended Solid (TSS), Biological Demand (BOD), Sulphide, Copper and Oil

& Grease. In addition to these parameters, Arsenic from the downstream location was recorded at 0.1793 mg/L, exceeded the maximum quality standard of 0.05 mg/L. These exceedances are likely to be associated with agricultural and urban land uses upstream of the canal (*ERM, 2017; IEE, 2016; Pöyry, 2016b)*.

In addition, sample of surface water taken in August and November 2016 and February and May 2017 showed that level of *Faecal Coliform* for all monitoring activities exceeded the applicable quality standards (*SGK Cilamaya, 2016*; *SGK Cilamaya, 2017*). The plankton and benthos monitoring was also conducted at two (2) locations i.e. upstream and downstream of Cilamaya River and indicated that the rivers water around the proposed Project site falls under medium - highly polluted categories (*Pöyry, 2016b*).

The severity of the potential impact would depend on the magnitude of the activity and the sensitivity of the surface water body affected. Impacts from surface run-off are dependent on surface water flow, which is higher during the rainy season and faster in areas with high surface gradient.

The Project is near some sensitive receptors with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as **Medium**.

The impacts are expected to be fairly long lasting (e.g. weeks or months) and/or give rise to indirect environmental and/or social impacts.

The significance of impacts associated with surface water during the construction is discussed and presented in **Table 8.56**. The impact significance has been assessed as **Moderate.**

***Table 8.56 Assessment of Impacts on Surface Water due to Wastewater Discharges and Run-Off during Construction***

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | **Large** | Moderate | Major | Major |

The combination of a Medium Sensitivity and Small Impact Magnitude will result in an overall **Moderate** Impact.

#### 8.8.3.2 *Operations Phase*

Sources and estimated quantities of wastewater generation from the Plant during the operation and maintenance phase are as follows:

***Table 8.57 Wastewater Discharge Volumes***

| Type | Discharges (ton/hour) |
|---|---|
| Cooling Water Blowdown | 3,681.4 |
| SWRO reject | 75 |
| Neutralisation Pond | 21.0 |
| Oil Separator | 15.0 |
| Miscellaneous Demineralisation Water | 6.0 |
| Laboratory | 0.01 |
| Sewage Treatment Plant | 1.0 |

Source: *PT Jawa Satu Power, 2017*

Surface water quality analysis from the baseline surveys are as discussed above for construction. It is reminded that the Project is near some sensitive receptors with regards to surface water quality, such as agricultural lands, which rely on surface water for irrigation. Overall sensitivity is rated as **High.** Potential impacts associated with mismanagement of wastewater could be water pollution, localised land contamination and impacts to health.

Treated waste water and sanitary waste water will be discharged to the Java sea. It is informed that the wastewater treatment plants are designed to be more stringent than standards and levels provided in General EHS Guidelines.

A number of controls to reduce the potential for impacts to water quality will be in place.

The wastewater treatment facility will be installed on-site to treat sewage wastewater, construction wastewater and contaminated run-off. Currently, the design of sewage wastewater is based on the *Quality of Waste Domestic Waste Water Individually, Appendix I, Minister of Environment No.68 of 2016* – which requires that the limit of Total Coliform Bacteria in the treated wastewater discharge is 3,000 MPN/100ml.

In addition, the oily waste water in the oily waste water surge pond is transferred to CPI oil/water separator constant flow rate and oil is removed to 10 mg/l in the separator. Collected oil/sludge in the CPI oil/water separator is drained to the Oil sludge tank and removed away by licensed local hauler when required.

Potential impacts to surface water quality in the Project area from wastewater discharges and run-off are expected to be localised effects on water quality which are likely to be fairly short-term to indirect impacts. Overall magnitude is rated as **Small.**

The significance of impacts associated with surface water quality during the operations is discussed and presented in **Table 8.58**.

*Table 8.58 Assessment of Impacts from the Wastewater Discharges and Run-Off during Operations*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | **Moderate** |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

The impact significance has been assessed as **Moderate**.

### *8.8.4 Mitigation Measures, Management, and Monitoring*

Mitigation measures for construction and operations are as follows:

*Construction Phase*

- Sponsor shall also inform the EPCs to develop Construction Environment Management Plan and Run-off and Sediment Control Plans prior to the commencement of construction activities to include the following:
  - Major earthworks activities during construction shall be scheduled during dry season as much as possible;
  - Topsoil removed during clearing shall be stored in specified areas. Stockpiled earthworks, during and after clearing will be placed as bunds at strategic locations in order to reduce sediment loadings to the storm run-off;
  - Stockpiles to be separated into topsoil and sub-soil and be located at least 10 m from any surface water source and groundwater well or 50 m from Cilamaya canal; and
  - Open stockpiles of construction materials (e.g. aggregates, sand and fill material) in places which are identified to have a possibility of significant run-off will have measures in place to prevent the washing away of construction materials, soil, silt or debris into any drainage system;
  - Earthworks to form the final surfaces will be followed up with surface protection and drainage works to prevent erosion caused by rainstorms. Soil erosion caused by wind and rainstorms shall also be reduced by minimising the land clearance area during construction activities, where possible, providing surface protection such as sheet cover; and

- Temporary traffic areas and access roads, if any, formed during construction will be protected by coarse stone ballast or equivalent.

These measures shall prevent soil erosion caused by rainstorms.

- All surface run-off from the construction areas potential sources of contamination will be minimised and reduced (e.g. by minimising the area of impermeable surfaces) and the peak discharge rate will be reduced (e.g. by using retention ponds and silt screen);

- Appropriate surface drainage surrounding the construction areas will be designed and provided where necessary. This includes diversion channels to intercept stormwater running-off the cleared areas and prior to large scale land clearance and removal of topsoil, where appropriate. These channels will be protected against erosion such as sandbag, rock armouring or lining as required;

- Stormwater management structures to collect the silt-laden surface runoff and allow the removal of silt by natural settlement, which in turn should reduce sediment loading prior to discharge into receiving environment;

- All drainage facilities and sediment control structures will be inspected on a regular basis and maintained to confirm proper and efficient operation at all times and particularly during rainstorms. Deposited silt and grit will be removed regularly. The stormwater drainage system will be periodically inspected for blockage sand cleaned at least once before the monsoon season each year;

- Measures will be taken to reduce the ingress of drainage into excavations. If trenches have to be excavated during the wet season or rainy conditions, they will be excavated and backfilled in short sections wherever practicable. Water will pumped out from trenches or foundation excavations will be discharged into storm drains via silt removal facilities;

- Personnel will be trained to visually inspect discharged water quality for oil and grease traces (that will be visible on the surface) periodically and take appropriate corrective actions;

- A dike wall shall also be constructed around high potential spillage area such as fuel tank. For spillage in other location is considered to be minor so that oil pan and containment devices are necessary to response. Additionally, containment devices are to be provided for storage areas of oil, fuel and chemicals to control contaminated surface runoff.

- Control and monitoring systems will be used to alert the crew to leaks or any other potential risks.

- Portable or permanent sanitation facilities serving all workers should be provided at all construction sites e.g. one (1) toilet for every 25 workers up to the first 100, and one for every 50 thereafter) will be provided for the construction workforce. Septic tanks shall be provided to treat the sanitary discharge.

- Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps. The sanitary sewer should then be treated prior to discharge or reuse as greywater.
- Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the stormwater system.
- For the selection of chemicals for hydrotest water, the Project will select biocides / chemical additives that present a low risk of contamination, in terms of dose concentration, toxicity, biodegradability, bioavailability, and bioaccumulation potential.

*Operations Phase*

- All drainage facilities and sediment control structures will be inspected on a regular basis and maintained to confirm proper and efficient operation at all times and particularly during rainstorms. Deposited silt and grit will be removed regularly. The stormwater drainage system will be periodically inspected for blockage sand cleaned at least once before the monsoon season each year;
- Measures will be taken to reduce the ingress of drainage into excavations. If trenches have to be excavated during the wet season or rainy conditions, they will be excavated and backfilled in short sections wherever practicable. Water will pumped out from trenches or foundation excavations will be discharged into storm drains via silt removal facilities;
- Personnel will be trained to visually inspect discharged water quality for oil and grease traces (that will be visible on the surface) periodically and take appropriate corrective actions.
- Control and monitoring systems will be used to alert the crew to leaks or any other potential risks.

### *8.8.5 Significance of Residual Impact*

Based upon the implementation of the above management and mitigation measures, the residual impact level of potential impact on water quality from wastewater discharges and run-off during both construction and operations is **Minor**.

## 8.9 TERRESTRIAL BIODIVERSITY

### 8.9.1 *Potential Sources of Impacts*

Project activities that may have an impact on terrestrial biodiversity during the construction and operation phases are:

- Permanent loss of habitat and degradation of habitat from clearance and preparation for the construction of the CCGT Power Plant and along the Transmission Line for the supporting pads;
- Permanent loss of habitat and degradation of habitat due to the construction activities of CCGT Power Plant and associate facilities including the access road, onshore pipelines, and Transmission Line;
- Permanent loss of habitat and degradation of habitat due to the dredging, trenching and lay down of the pipeline and jetty construction;
- Temporary disturbance and displacement of fauna and flora due to the use and movement of heavy machinery and vehicles during construction and operational activities within the Project area;
- Temporary fragmentation of habitats in natural terrestrial habitats from erection of barriers (fences), transmission line, roads, pipelines and habitat loss;
- Direct mortality to fauna and flora from hunting and poaching from the workforce and local residents;
- Degradation of habitat from air emissions and runoff during operation; and
- Direct mortality of avifauna along the transmission line due to strike during operation.

### 8.9.2 *Assessment Approach and Criteria*

The legal framework of relevance to Terrestrial Biodiversity is listed below:

- *ASEAN Agreement on the Conservation of Nature and Natural Resources, 1985*;
- *IFC PS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources, 2012;*
- *ADB Safeguard Policy Statement – Environment Safeguard;*
- *World Bank IFC General EHS Guidelines, 2007;*

- *World Bank IFC EHS Guidelines for Thermal Power Plants, 2008, and 2017* (in Draft); and

- *World Bank IFC EHS Guidelines for Electric Power Transmission and Distribution, 2007.*

The significance of the impacts has been assessed using the approach and methodology as described in **Section 3.6**. The criteria for sensitivity to and magnitude of the impact to Terrestrial Biodiversity (Habitat & Species) are defined in **Table 8.59** to **Table 8.62.**

***Table 8.59 Sensitivity Criteria for Biodiversity - Habitat***

| Sensitivity | Definition |
|---|---|
| Low | • Habitats with no, or only a local designation/ recognition, habitats of significance for species listed as Least Concern (LC) on IUCN Red List of Threatened Species, habitats which are common and widespread within the region, or with low conservation interest based on expert opinion. |
| Medium | • Habitats within nationally designated or recognised areas, habitats of significant importance to globally Vulnerable (VU), Near Threatened (NT), or Data Deficient (DD) species, habitats of significant importance for nationally restricted range species, habitats supporting nationally significant concentrations of migratory species and/ or congregatory species, and low value habitats used by species of medium value. |
| High | • Habitats within internationally designated or recognised areas, habitats of significant importance to globally Critically Endangered (CR) or Endangered (EN) species, habitats of significant importance to endemic and/ or globally restricted-range species, habitats supporting globally significant concentrations of migratory species and/ or congregatory species, highly threatened and/ or unique ecosystems, areas associated with key evolutionary species, and low or medium value habitats used by high value species. |

*Source: ERM, 2012a*

***Table 8.60 Magnitude Criteria for Impacts to Biodiversity - Habitat***

| Magnitude | Definition |
|---|---|
| Negligible | • No existing habitat is affected |
| Small | • Affects only a small area of habitat, such that there is no loss of viability/ function of the habitat. |
| Medium | • Affects part of the habitat, but does not threaten the long term viability/ function of the habitat. |
| Large | • Affects the entire habitat, or a significant proportion of it, and the long term viability/ function of the habitat is threatened. |

*Source: ERM, 2012a*

***Table 8.61 Sensitivity Criteria for Biodiversity - Species***

| Sensitivity | Definition |
|---|---|
| Low | • Species and sub-species of LC on the IUCN Red List, or not meeting criteria for medium or high value. |
| Medium | • Species on IUCN Red List as VU, NT, or DD, species protected under national legislation, nationally restricted range species, nationally important numbers |

| Sensitivity | Definition |
|---|---|
| | of migratory, or congregatory species, species not meeting criteria for high value, and species vital to the survival of a medium value species. |
| High | • Species on IUCN Red List as CR, or EN. Species having a globally restricted range (i.e. plants endemic to a site, or found globally at fewer than 10 sites, fauna having a distribution range (or globally breeding range for bird species) of less than 50,000 km$^2$), internationally important numbers of migratory, congregatory species, key evolutionary species, and species vital to the survival of a high value species. |

*Source: ERM, 2012a*

### *Table 8.62 Magnitude Criteria for Impacts to Biodiversity – Species*

| Magnitude | Definition |
|---|---|
| Negligible | • No species is affected |
| Small | • Effect does not cause a substantial change in the population of the species, or other species dependent on it. |
| Medium | • Effect causes a substantial change in abundance and/ or reduction in distribution of a population over one, or more generations, but does not threaten the long term viability/ function of that population, or any population dependent on it. |
| Large | • Affects entire population, or a significant part of it causing a substantial decline in abundance and/ or change in and recovery of the population (or another dependent on it) is not possible either at all, or within several generations due to natural recruitment (reproduction, immigration from unaffected areas). |

*Source: ERM, 2012a*

### *8.9.2.1 Scoping of Likely Impacts to Biodiversity Values*

**Table 8.63** broadly defines the types of threats to biodiversity values that have potential to occur as a result of this Project. These threats to biodiversity are derived from IFC PS6 and relate to the activities that are likely to occur during construction and post construction phases.

### *Table 8.63 Types of Threats to Biodiversity Values*

| Term | Description |
|---|---|
| Loss of habitat | Permanent loss of habitat or species due to permanent or temporary site activities. |
| Disturbance or displacement of individuals<br>• Light<br>• Noise<br>• vibration impacts | Temporary disturbance to, or displacement/exclusion of a species from foraging habitat due to construction activities, and operational and maintenance activities.<br>Permanent impacts from light, noise and vibration sources on surrounding habitats during operation causing disturbance and displacement and changes in behaviour |

| Term | Description |
|---|---|
| Barrier creation, fragmentation and edge effects | Permanent and temporary creation of barriers to the movements of animals, especially fish, but also mammals, reptiles and amphibians and invertebrates and plants with limited powers of dispersal.<br>Fragmentation of habitat, or permanent /temporary severance of wildlife corridors between isolated habitats of importance for biodiversity.<br>Impacts that occur when a habitat is exposed to a different adjacent habitat type or structure. These impacts can include increased risk of parasitism or disease, increased risk of predation, adverse microclimate conditions (including drying out and subsequent fire risk), and competition from invasive species |
| Degradation of habitat<br>• Dust<br>• Water pollution<br>• Invasive species | Disturbance or damage to adjacent habitat and species caused by changes in microclimate, vulnerability to predation and invasion and overall changes in conditions that can lead to a change in the community and its values for flora and fauna. This can include increased exposure to noise, light and dust.<br>Introduction or spreading of alien species during the construction works. |
| Mortality – vehicle strike, hunting and poaching | Mortality of individual fauna species as a result of vehicle or machinery strike or falling debris during clearing activities.<br>Mortality to individual fauna species as a result of worker influx and hunting/poaching of extant fauna |

#### 8.9.2.2 *Biodiversity Impact Typology*

The scoping and screening of potential Project impacts identified a number of Project aspects and activities that have potential to biodiversity values. Whilst the potential impacts relate to a combination of Project aspects/activities and biodiversity threats, they can be summarised into a number of key potential impacts according to the biodiversity threat type. These impacts can relate to habitat areas, specific species or both.

These impact assessment types are further explored in relation to the biodiversity values identified within the Project Area and outlined in the physical and biological baseline (**Section 7**) and the specific Project activities/aspects.

This section discusses on the nature of impacts to biodiversity values at it relates to the characteristics of the Project Area as determined by assessing the impacts of the Project Description (**Section 4**). The information has been used to inform the evaluation of the significance of the impact in the impact assessment summary tables following each impact assessment type. Impact assessments have been undertaken for both the Construction Phase and Operation Phase.

ERM has utilised the mitigation hierarchy to outline avoidance, mitigation and compensation (offset) requirements as required by the ADB SPS and IFC PS6.

**Table 8.64** scopes the impacts likely during the construction, operational and decommissioning phases of the Project. The impact assessment for these impact types are further assessed below.

*Table 8.64 Scoping of Potential Impacts during Construction and Operational Phases*

| Type of Impact | **Construction Phase** | **Operational Phase** |
|---|---|---|
| Permanent loss of habitat | Yes | No |
| Temporary disturbance or displacement of fauna | Yes | Continuing from construction phase |
| Temporary and permanent barrier creation, fragmentation and edge effects | Yes | Continuing from construction phase |
| Temporary degradation of habitat | Yes | Continuing from construction phase |
| Mortality – turbine strike, vehicle strike, hunting and poaching | Yes | Reassessed for operational phase |

Notes:

**Yes**: considered to be likely impacts during the phase

**No**: considered that there will be no impacts or negligible impacts during the phase

**Continuing from construction/operation phase**: the impact is likely to continue from the operation phase and the mitigations outlined are appropriate to manage impacts during construction and/or operational phase.

**Reassessed for operational phase**: the impact is likely to be different during the phase and hence is reassessed based on the likely impacts. Additional mitigations may be outlined to apply to this phase.

### *8.9.3 Assessment of Impacts - Loss of Terrestrial Habitat from Construction*

Habitat is important to support the lifecycles of fauna identified with the Project area. This includes habitat for breeding, foraging and roosting. Removal of the habitat reduces the habitat available to resident species and the ecological value of the area.

Habitat will be cleared for all Project components, including Natural Habitat, Modified Habitat and Critical Habitat. Clearing and habitat disturbance will be associated with the Transmission Line, CCGT Power Plant, jetty and onshore pipelines.

The area of habitat lost from clearing and construction in relation to these Project components is outlined in **Table 8.65** and **Table 8.66**. **Figure 8-12**, **Figure 8-13** and **Figure 8-14** shows the impacts of each facility and associated habitat impacts.

*Table 8.65 Area of Land Class within Project Area of Influence*

| S/N | Land Class | Natural/Modified | Area of Influence (ha) | Project Area (ha) |
|---|---|---|---|---|
| 1 | Fresh water | Natural | 38.29 | 3.69 |
| 2 | Secondary mangrove forest | Natural | 34.52 | 0.33 |
| 3 | Dryland agriculture | Modified | 137.05 | 0.21 |
| 4 | Settlement | Modified | 3,202.30 | 0.78 |
| 5 | Bare land | Modified | 70.84 | 2.81 |

| S/N | Land Class | Natural/Modified | Area of Influence (ha) | Project Area (ha) |
|---|---|---|---|---|
| 6 | Plantation | Modified | 383.25 | 0.84 |
| 7 | Paddy field | Modified | 18,754.56 | 214.61 |
| 8 | Shrub | Modified | 167.06 | 0.71 |
| 9 | Ponds | Modified | 966.37 | 9.8 |
| | **Totals** | | **23,754.24** | **233.78** |

*Table 8.66 Habitat Loss Associated with Terrestrial Project Components*

| Habitat Type | Natural Habitat (ha) | Modified Habitat (ha) | Critical Habitat (ha) |
|---|---|---|---|
| CCGT Power Plant | - | 24.04 | 24,04 |
| Transmission Line and substation | 3.65 | 182.96 | 11.44 |
| Other facilities | 0.37 | 22.80 | 16.36 |
| **Totals** | **4.02** | **229.80** | **51.84** |

Approximately 32.1 ha of the Project area is classified as Protection Forest under the Indonesian Forestry law.

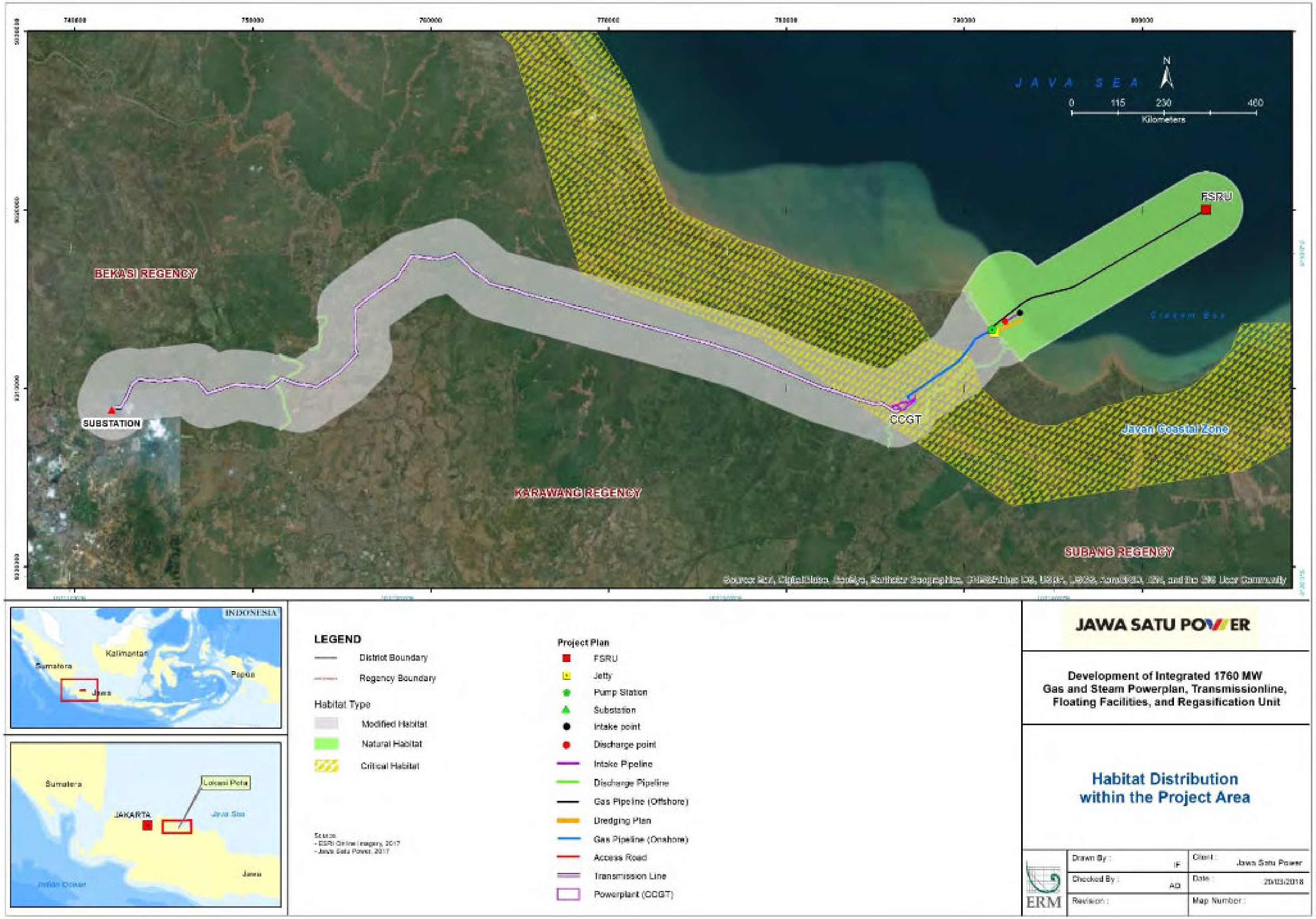
The Modified Habitat lost consists primarily of ponds, rice paddy field and urban development. The CCGT Power Plant, roads, infrastructure and Transmission Line (52.16 km in length) will be constructed within this habitat. The transmission line will be constructed upon concrete pads with wires strung between towers. The area of Modified habitat underneath the transmission line is estimated to be 182.96 ha. It should be noted that the habitat impact associated with the transmission line will be minimal and restricted to impacts from the construction of the footings. The total impact on Modified Habitat is therefore estimated at 55.14 ha.

The area of terrestrial Natural Habitat lost within the Project area is estimated to be 4.02ha which consists of 0.33ha of mangrove habitat at the shoreline. The transmission line will cross "freshwater" habitat which consists of mapped local streams and totals 3.65ha. It is not anticipated that the transmission line will have habitat impacts upon the freshwater habitat as the footings will be placed on Modified Habitat areas on land.

Critical Habitat consisting of both Natural Habitat and Modified Habitat will be cleared. The habitat includes potential habitat for endemic bird species associated with the Javan Coastal Zone EBA and habitat for the Javan White-eye (*Zosterops flavus*) VU). The project area that overlaps with the Critical Habitat area is approximately 51.84 ha in size.

All flora species identified during survey is listed as Least Concern, Data Deficient or Not Evaluated. Some species are listed as Endangered or Vulnerable but have been planted and introduced into the Project area and hence are not considered as threatened species in this assessment. Removal of these plant species is not considered to be a major impact during clearing activities.

*Figure 8-12 Habitat Classifications for the Entire Project*



## *Figure 8-13 Habitat Classifications for CCGT Power Plant*

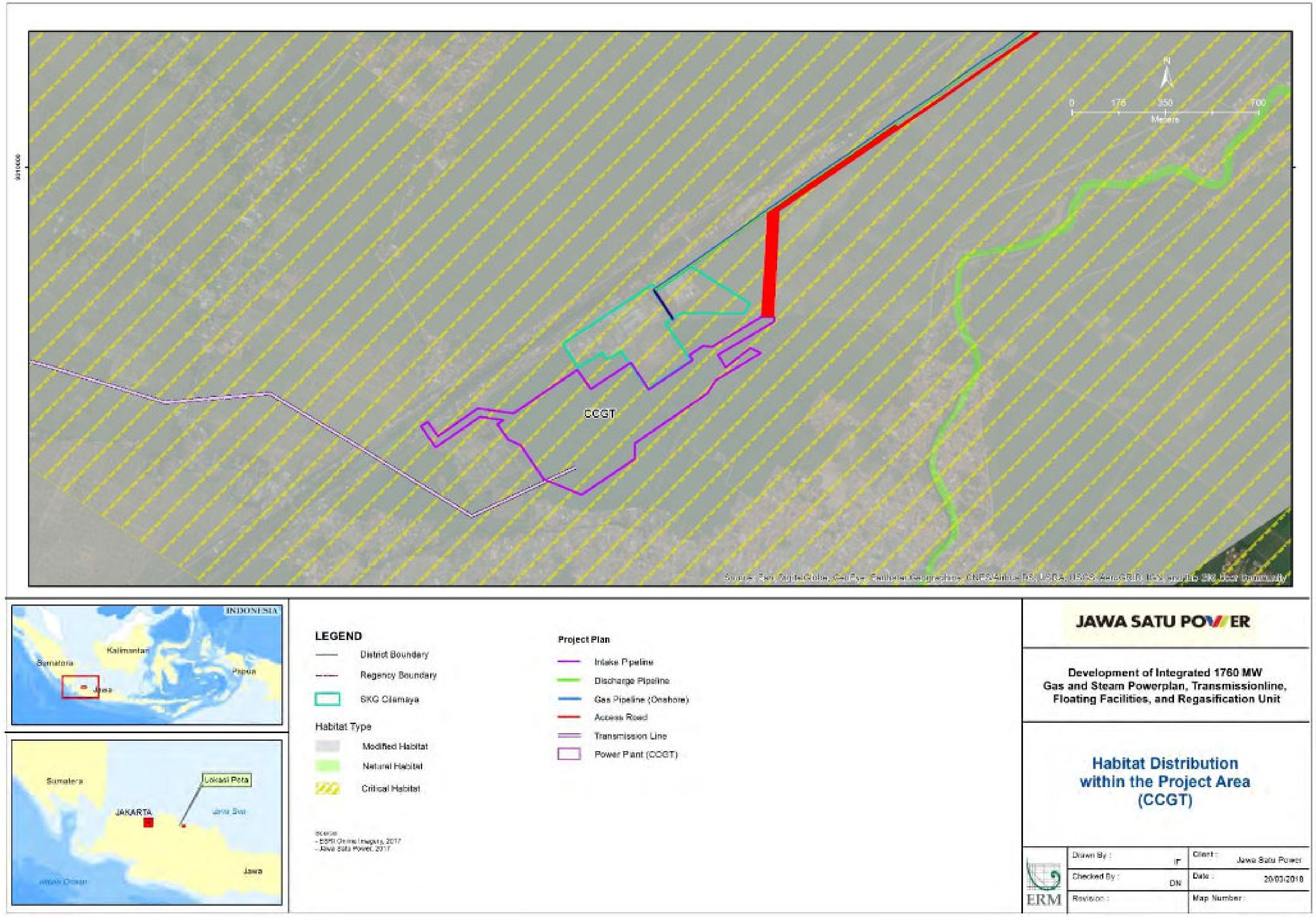
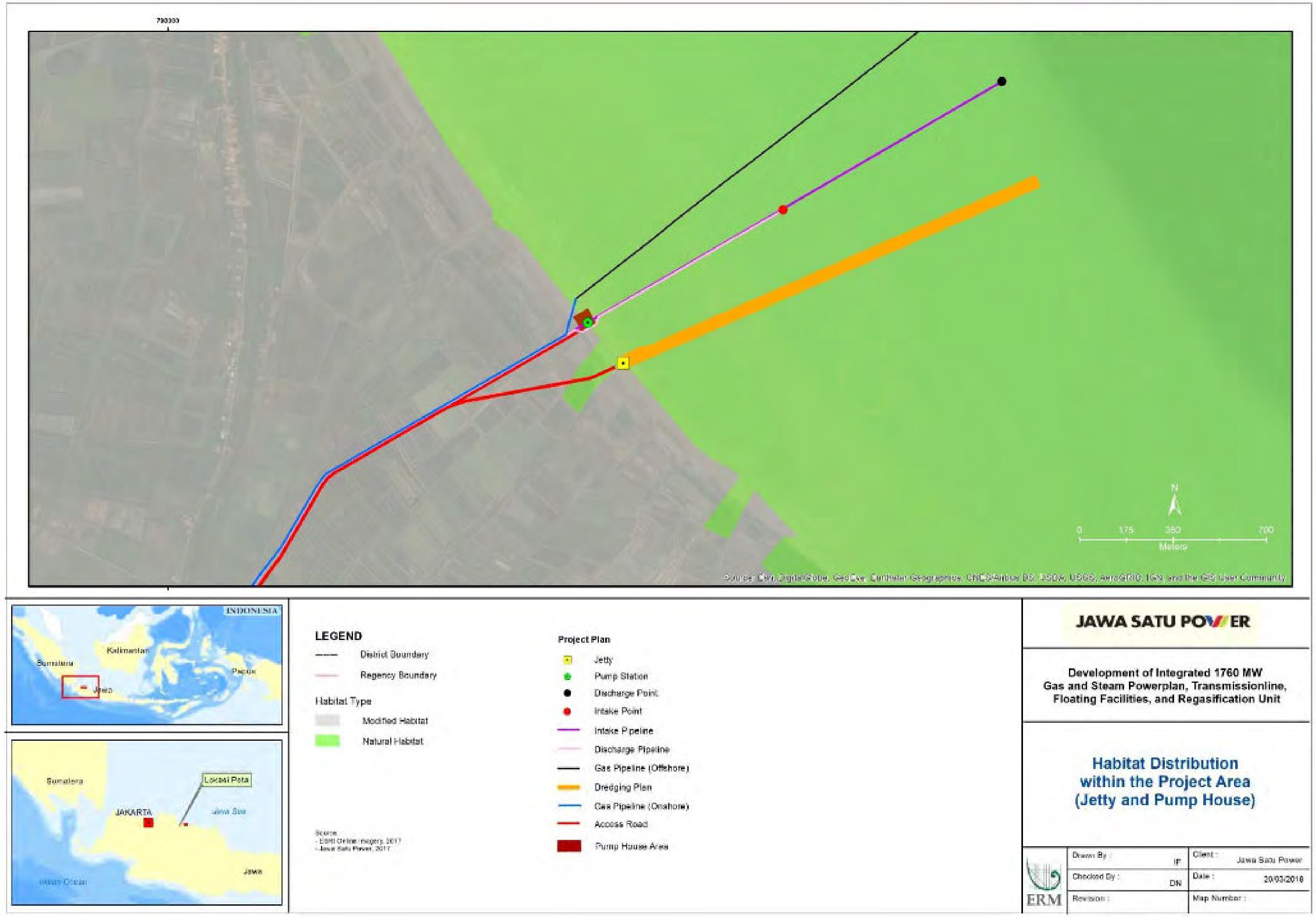


*Figure 8-14 Habitat Classifications for Jetty and Pump House*



The significance of impacts associated with terrestrial biodiversity using the assessment of significance during construction activities are presented in **Table 8.67**.

The sensitivity of the Critical Habitat (Javan Coastal Zone EBA) is considered to be **High**. The sensitivity of Natural Habitats is considered to be **Medium**. The sensitivity of Modified Habitats are considered to be **Low**.

The magnitude of effect is likely to be small as it will effect only a small area of habitat, but without the loss of viability/function of the habitat. The overall magnitude of this impact is therefore **Moderate** for Critical Habitats as only a small proportion of the Javan Coastal Zone will be impacted (compared to its large geographic extent along the coastal zone of Java); **Minor** for Natural Habitat and **Negligible** for Modified Habitat before Mitigation Measures.

*Table 8.67 Assessment of Impacts from Loss of Habitat*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Modified Habitat** | **Natural Habitat** | **Critical Habitat** |
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | **Negligible** | **Minor** | **Moderate** |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

### 8.9.3.1 *Mitigation Measures, Management and Monitoring*

It is recommend that the following mitigation measures be applied in relation to habitat impacts during construction:

- Clearing of habitat within Natural Habitat areas (mangrove forests) along the coastal zone will be avoided and minimised where possible. No clearing of mangroves is to occur outside of the Project area;
- Clearing vegetation outside of designated areas will be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation;
- The Project owner shall provide training to staff and workers on all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violates rules and regulations;

- The planned vegetation clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing;

- Use of the access road should be restricted to construction vehicles only. Checkpoints should be used to manage access and inspect vehicles for vegetation (including firewood) taken from the Project Area;

- All land rehabilitation will be undertaken using native indigenous species. The area of landscaping within the Project area shall re-establish habitat values including re-establishing mangrove habitats along the foreshore area and coastal vegetation along the access road, CCGT plant and facilities. Re-establishment of native vegetation will create habitat for Critical Habitat species and improve the habitat values of the Javan Coastal Zone EBA. The area anticipated to be replanted will be approximately 10ha adjacent to the project footprint. The replanting strategy shall be outlined within the Biodiversity Action Plan (BAP) ;

- A community program is to be established with adjacent landowners to replant mangrove forest along foreshore areas and re-establish coastal vegetation on non-utilised public land and private land (With consent of the land-owner) within the Javan Coastal Zone EBA between the Muara Gembang – Tanjung Sedary KBA and the Muara Gimanuk KBA. This program will re-establish habitat within the EBA suitable for Critical Habitat species. The area targeted for reestablishment of vegetation is to be 80 ha. The program is to be detailed within the BAP; and

- A BAP will be prepared for the management and monitoring of Critical Habitats within the Javan Coastal Zone EBA. The BAP will assess the requirements to achieve no-net-loss of biodiversity values for loss of habitats and impacts on Critical Habitat species.

#### *8.9.3.2 Significance of Residual Impact*

In view of the implementation of mitigation measures, the residual impact is to reduce to **Negligible** for Natural Habitat and Modified Habitat. Impacts to Critical Habitat will remain as **Moderate.**

The permanent loss of Natural Habitat is estimated to be 0.33ha of terrestrial habitat (mangrove forest). The mitigation measures outlines will reduce the extent of overall impact. Regeneration of habitats within the Project footprint will negate losses of Natural Habitats, including re-establishing mangroves and native coastal vegetation in an estimated 10 hectares within the project area. Additional vegetation re-establishment measures will be undertaken with a community program to re-establish vegetation within the Javan Coastal Zone EBA. At least 80ha of habitat will be targeted for replanting in conjunction with the community program. An estimated 90ha of land will therefore be re-established within the coastal zone.

A Biodiversity Action Plan will be required to outline the requirements to achieve a No-Net-Loss in biodiversity values for impacts to Critical Habitat as required by the ADB SPS.

### *8.9.4 Assessment of Impacts - Disturbance or Displacement of Fauna*

The disturbance and displacement of resident fauna species within the footprint will primarily be caused by light, noise and vibration impacts during construction.

Noise, light and vibration disturbances have the potential to influence breeding, roosting or foraging behaviour of fauna. During the exploration/construction phase temporary impacts from the Project are expected. Noise will be the primary disturbance of this nature due to vegetation clearing, excavation, movement of materials, drilling and general construction activities. These activities will introduce noise sources to areas not currently exposed to these disturbances. In addition there may be vibration associated with drilling activities and the movement of any heavy vehicles/machinery.

The consequences of these influences are dependent on the extent of disturbance but in extreme cases these factors can influence local populations. For example if breeding and communication is inhibited influencing lifecycle, or, if individuals are displaced from noisy areas and home ranges are reduced. Excessive noise can impede fauna communication and deter the use of habitats nearby. Similarly, introducing light sources has the potential to deter foraging and dispersal activities of nocturnal species.

The duration of construction activities it is expected to be short-term. Similarly, it should be noted that the noise, light and vibration disturbances will not be continuous for the construction period, or focused on any one specific location for the total time. Noise light and vibration disturbances will occur throughout the Project Area during construction for the Project components identified.

Although temporary, the construction schedule is expected to be relatively short and not to span multiple breeding seasons. Noise, light and vibration disturbance are unlikely to occur at all locations simultaneously and will be localised. Terrestrial fauna likely to be disturbed include all resident species, including birds, mammals and herpetofauna identified in the Project area. The majority of these species are listed as Least Concern or Not Evaluated on the IUCN Red List. These species are likely to be disturbed through the operation of machinery, clearing activities and erection of barriers. It is not considered that disturbance of these species is of concern as they are widely distributed and of stable or widespread populations.

Fourteen (14) bird species are listed as Protected under Indonesian legislation. These birds will be temporarily displaced from the Project area during construction and are likely to return to areas rehabilitated during operation.

Some minor disturbance impacts to these species may occur from construction activities, including along the Transmission Line during construction. Impacts are expected to reduce during operation. These birds are listed in **Table 8.68**.

*Table 8.68 Indonesian Listed Protected Bird Species in the Project Area*

| No | Scientific Name | Common Name | IUCN | Ind. Listing |
|---|---|---|---|---|
| 1. | *Alcedo atthis* | Common Kingfisher | LC | X |
| 2. | *Anthreptes malacensis* | Brown-throated Sunbird | LC | X |
| 3. | *Ardea alba* | Great Egret | LC | X |
| 4. | *Ardeola speciose* | Javan Pond Heron | LC | X |
| 5. | *Bubulcus ibis* | Cattle Egret | LC | X |
| 6. | *Egretta garzetta* | Little Egret | LC | X |
| 7. | *Egretta sacra* | Pacific Reef Egret | LC | X |
| 8. | *Halcyon chloris* | Collared Kingfisher | LC | X |
| 9. | *Himantopus leucocephalus* | White-headed Stilt | LC | X |
| 10. | *Nectarinia jugularis* | Olive-backed sunbird | LC | X |
| 11. | *Nycticorax caledonicus* | Rufous Night Heron | LC | X |
| 12. | *Plegadis falcinellus* | Glossy Ibis | LC | X |
| 13. | *Rhipidura javanica* | Pied Fantail | LC | X |
| 14. | *Todirhamphus chloris* | Collared kingfisher | LC | X |

Disturbance or displacement of endemic birds, including the Javan White-eye (*Zosterops flavus*) VU within the Javan Coastline EBA (Critical Habitat) may also occur. This will happen mainly during the construction phase within the EBA.

The significance of impacts associated with terrestrial biodiversity during construction activities are discussed and presented in **Table 8.69**.

The sensitivity of terrestrial species to disturbance and displacement is considered to be **Low** for all Least Concern species. The sensitivity of Critical Habitat species (Javan White-eye, *Zosterops flavus*) is rated as **High**.

The magnitude of effect due to disturbance and displacement of fauna in terrestrial habitats is likely to be **Small** as the effect will not cause a substantial change in the population of the species present, or other species dependent on them during construction.

The overall magnitude of this impact is therefore **Moderate** for Critical Habitat species; and **Negligible** for Least Concern Species.

*Table 8.69 Assessment of Impacts on Disturbance and Displacement of Fauna*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | |
|---|---|---|---|
| | | Least Concern | Critical Habitat |
| | | Low | High |
| Magnitude of Impact | Negligible | Negligible | Negligible |
| | Small | Negligible | Moderate |

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | |
|---|---|---|---|
| | | Least Concern | Critical Habitat |
| | | Low | High |
| | Medium | Minor | Major |
| | Large | Moderate | Major |

8.9.4.1 *Mitigation Measures, Management and Monitoring*

It is recommend that the following mitigation measures be applied in relation to habitat impacts during construction:

*Terrestrial Habitat Impact Mitigations*

- A *Fauna Shepherding Protocol* is be used in the Javan Coastal EBA to ensure that any endemic bird species have vacated the area prior to any clearance work; and
- Additional mitigation measures are outlined below in relation to the impacts from potential collision with the transmission line to the Indonesian Protected bird species.

8.9.4.2 *Significance of Residual Impact*

In view of the implementation of mitigation measures, the residual impact is to remain as **Negligible** for terrestrial species considered as Least Concern on the IUCN Red List.

Impacts to the Critical Habitat species (Javan White-eye, *Zosterops flavus*) will reduce to **Negligible**.

### 8.9.5 *Assessment of Impacts – Temporary and Permanent Barrier Creation, Edge Effects and Fragmentation*

Construction activities relating to linear infrastructure have potential to create a temporary barrier to fauna movement (for some fauna groups). This includes construction of the access roads, the transmission line and other infrastructure. Most other Project components are discrete areas that may be navigated around by fauna that may be moving through the area. The construction of access roads and transmission line will primarily be within Modified Habitat, however the Project area is located within the Javan Coastal Zone Endemic Bird Area. Temporary barriers within the EBA may disrupt the movement of endemic birds along the coastline, including the Javan White-eye *Zosterops flavus*. This is likely to be temporary during construction and reduce during operation.

Temporary and permanent barrier creation will occur during construction. This will include the erection of fences and hoardings around construction sites, and also construction of linear infrastructure (such as the access road and transmission line). This may impact the movement of fauna within the landscape, particularly bird species.

Edge effects are an indirect impact of land clearing during construction and throughout operation and can have temporary and permanent impacts. Where vegetation clearing occurs, adjacent vegetation and habitats can be exposed to changes in noise, light (natural or artificial), dust, humidity and temperature factors as well as increased competition from predators and invasive species. The impact of edge effects to habitat value and forest composition has been widely recognised as a contributor to habitat degradation and impacts to biodiversity. In extreme cases the effects have potential to alter the habitat characteristics of the ecotone and influence suitable habitat for native flora and fauna (including threatened species).

Both Natural and Modified Habitats surrounding the Project area may be temporarily impacted due to Project construction from dust and pollution. This will be most pronounced along the transmission line and road construction routes where vehicle movements along dirt roads will likely increase dust impacts. The primary impact will be dust deposition on flora within close proximity of construction sites.

Fragmentation of habitats can occur where currently linked habitats are disconnected through the construction of Project components. Fragmentation reduces the continuity of habitat and hence the ability for fauna to move within and between habitats patches. The resulting impact can cause reductions in foraging and breeding habitats. Species with limited home ranges may have a reduction in available area, leading to conflict over resources or negative interactions over territories.

Fragmentation of existing habitats within the project area is not considered to be a significant impact as the infrastructure design does not lead to isolation of habitat patches and is primarily within Modified Habitat. The area of mangroves along the immediate shoreline which is considered to be Natural Habitat will have a reduction in connectivity along the shoreline due to the construction of the access road and jetty. This is considered to be a minor impact as the area of habitat loss of mangroves is estimated to be 0.33 ha.

The significance of impacts associated with terrestrial biodiversity during construction activities are discussed and presented in **Table 8.70**.

The sensitivity of terrestrial species to disturbance and displacement is considered to be **Low** for all Least Concern species. The sensitivity of Critical Habitat species (Javan White-eye, *Zosterops flavus*) is rated as **High**.

The magnitude of effect due to disturbance and displacement of terrestrial habitats is likely to be **Small** as the effect will not cause a substantial change in the population of the species present, or other species dependent on them during both construction.

The overall magnitude of this impact is therefore **Moderate** for Critical Habitat species; and **Negligible** for Least Concern Species.

*Table 8.70* *Assessment of Impacts from Barrier Creation on Fauna*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | |
|---|---|---|---|
| | | Least Concern | Critical Habitat |
| | | Low | High |
| Magnitude of Impact | Negligible | Negligible | Negligible |
| | Small | Negligible | Moderate |
| | Medium | Minor | Major |
| | Large | Moderate | Major |

8.9.5.1 *Mitigation Measures, Management and Monitoring*

It is recommend that the following mitigation measures be applied in relation to habitat impacts during construction:

- The use of fencing and hoarding during construction in the Javan Coastal EBA is to be kept to a minimum around Project construction sites;
- Measures to control dust are to be utilised to limit generation of dust and hence deposition onto vegetation surrounding construction areas;
- Planting of native indigenous flora, including mangroves along the shoreline adjacent to the road and jetty construction sites is to occur to reduce impacts to connectivity along the shoreline; and
- Appropriate rehabilitation of disturbed areas using native vegetation is to occur to facilitate movement of fauna species, especially within the EBA. It is estimated that approximately 10ha of land adjacent to project components is available for site revegetation.

8.9.5.2 *Significance of Residual Impact*

In view of the implementation of mitigation measures, the residual impact is to remain as **Negligible** for terrestrial species considered as Least Concern on the IUCN Red List.

Impacts to potential Critical Habitat species (Javan White-eye, *Zosterops flavus*) will reduce to **Negligible**.

### 8.9.6 *Assessment of Impacts – Temporary Degradation of Habitat during Construction Phase*

A range of Project activities have the potential to lead to degradation of native flora and fauna habitats including excavation, construction, land clearing, spoil disposal, movement of vehicles, drilling, refuelling, hazardous materials storage and maintenance. In general the impacts will cause: dust; runoff; release of potential contaminants; and invasive species. Construction activities have been assessed for these impact types, including: construction of the access roads, erection of the power plant and construction of the transmission line and associated infrastructure.

*Dust*

During construction, land preparation has the potential to generate dust which may settle on vegetation adjacent to the construction area (including access roads). Excessive dust deposition on flora may act to suppress growth through limiting photosynthesis and the dusted foliage may also become unpalatable to foraging fauna. The construction activities will be temporary and dust generation is likely to be localised to active work areas. Rainfall will generally remove dust from foliage and this impact has been assessed for significance as part of the edge effects impact assessment.

*Run-off*

Land preparation will expose earth areas to be vulnerable to erosion (wind and/or runoff) until infrastructure construction or replanting is completed to stabilise the surface. The Project Area experience varied topography including steep slopes. Erosive processes transport sediment downstream depositing mobilised sediment downstream/downslope of habitats (both aquatic and terrestrial). This indirect impact has potential to degrade downstream habitat areas or change habitat characteristics, and as such influencing suitability for native flora and fauna communities. Runoff may flow into the local river systems which may provide habitat for conservation significant and commercially utilised fish species (if present).

*Release of Contaminants*

Accidental release or spill of these materials can be toxic to flora and fauna locally and downstream if substances are released into the aquatic environment. Runoff from construction sites has potential to carry contaminants substantial distance downstream. Construction activities such as refuelling, storage and other activities that require oil and hazardous substances to be used are undertaken at risk of accidental release.

*Invasive Species*

Invasive species (flora and fauna) have the potential to be introduced or spread throughout the Project Area through increased movement of people, vehicles, machinery, vegetation and soil. An increase in the prevalence of weeds or other pests has the potential to reduce the quality of habitat for some native flora and fauna, including conservation significant species. Invasive flora species can rapidly germinate in disturbed areas whereby affecting the ability of native vegetation communities to re-establish. Invasive animals also have the potential to be introduced or increased in abundance. These animals may adversely impact native fauna as a result of increased competition for resources, predation or habitat degradation.

Specific impacts to biodiversity values is expected to be minimal along the transmission line route as this section of the Project is in Modified Habitat. Some impacts to avifauna may occur due to strung wires.

The construction of the power plant and associated facilities will occur in Critical Habitat (Javan Coastal Zone EBA). This area is highly modified however and localised impacts are likely occur to habitats from: soil compaction by the use of vehicles; dust deposition on vegetation; and the temporary disturbance of fauna from around the construction site (from noise and light).

Contaminated runoff from construction sites may also enter waterways, including the Cilamya River and Java Sea. Contaminated water from sediments can impact aquatic ecosystems through changes in light penetration, smothering of vegetation and localised mortality of fauna.

The introduction of invasive species onto the site can contribute to changes in species composition and disturb the integrity of Natural Habitat and Critical Habitat areas. The following invasive species were identified at the Project area (**Table 8.71**).

***Table 8.71 Invasive Species Identified at the Project Area***

| No | Taxonomic group | Species | Habitat | Status | Location in Project Area |
|---|---|---|---|---|---|
| 1. | Animalia | *Cipangopaludina chinensis* | Freshwater | Native to Indonesia | BL/PL |
| 2. | Plantae | *Alternanthera philoxeroides* | Terrestrial | Introduced | 3,4,5, and BL/PL |
| 3. | Plantae | *Chromolaena odorata* | Terrestrial | Introduced | BL/PL |
| 4. | Plantae | *Leucaena leucocephala* | Terrestrial | Introduced | 1,2,5, and BL/PL |
| 5. | Plantae | *Mikania micrantha* | Terrestrial | Introduced | BL/PL |
| 6. | Plantae | *Mimosa pigra* | Terrestrial | Introduced | 2,4, and BL/PL |
| 7. | Plantae | *Psidium guajava* | Terrestrial | Introduced | 5 |
| 8. | Plantae | *Syzygium cumini* | Terrestrial | Native to Indonesia | 3 and BL/PL |

The significance of impacts associated with terrestrial biodiversity during construction activities are discussed and presented in **Table 8.72.**

The sensitivity of the Critical Habitat (Javan Coastal Zone EBA) is considered to be **High**. The sensitivity of Natural Habitats is considered to be **Medium**. The sensitivity of Modified Habitats are considered to be **Low**.

The magnitude of effect is likely to be small as the degradation of habitat will effect only a small area of habitat, but without the loss of viability/function of the habitat.

The overall magnitude of this impact is therefore **Moderate** for Critical Habitats; **Minor** for Natural Habitat and **Negligible** for Modified Habitat before Mitigation Measures.

***Table 8.72 Assessment of Impacts on Degradation of Habitat during Construction***

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Modified Habitat** | **Natural Habitat** | **Critical Habitat** |
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | **Negligible** | **Minor** | **Moderate** |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

### *8.9.6.1 Mitigation Measures, Management and Monitoring*

It is recommend that the following mitigation measures be applied in relation to habitat impacts during construction:

- All machinery to be used in areas of Natural Habitat and Critical Habitat are to exert a low pressure on the ground surface so as to minimise soil compaction;
- All machinery and hand held equipment used must comply with required air and noise emission standards;
- Sediment and erosion control measures are to be used in all areas of construction to minimise soil contaminated runoff entering waterways. These measures are to be outlined in a *Sediment and Erosion Control Plan*;
- All disturbed soil surfaces are to be rehabilitated and native flora species are to be planted within areas under the Projects control. These species are to be suitable habitat for bird species listed in the Javan Coastal Zone EBA;
- Existing populations and the introduction of new invasive species into Natural Habitats and Critical Habitats are to be managed. These measures

are to be outlined in an *Invasive Species Management Plan* and include measures such as:

- The provenance of any fill material brought onto the site is to be checked regarding invasive species contamination;
- Vehicle wash down procedures are to be used to reduce the transmission of invasive species into and from the Project area(s);
- Control measures are to be utilised in areas of Natural Habitat and Critical Habitat;

- Hours of operation of the construction site are to be limited to the hours of 6.00am to 10.00pm Monday to Sunday; and

- All light sources are to be directed away from areas of Natural Habitat and Critical Habitat, where feasible.

#### *8.9.6.2 Significance of Residual Impact*

In view of the implementation of mitigation measures, the residual impact is to reduce to **Negligible** for Natural Habitat and Modified Habitat.

The permanent loss of Natural Habitat is estimated to be 0.33 ha of mangrove habitat. The mitigation measures will reduce the extent of overall impact.

Impacts to Critical Habitat will remain as **Moderate**.

Regeneration of habitats with native species within the Project footprint will negate losses of Natural Habitats. It is considered that habitat biodiversity offsets are unnecessary to achieve a no-net-loss of biodiversity values. Specific measures however to manage Critical habitat species will be required to be outlined within a Biodiversity Action Plan.

### *8.9.7 Assessment of Impacts - Mortality: Vehicle Strike, Hunting and Poaching*

Mortality of individual fauna may occur during construction due to vehicle or machinery strike or falling debris during clearing activities; and worker influx and hunting/poaching of extant fauna.

During construction, vehicle and machinery use may strike fauna within the Project area, however this is likely to impact livestock rather than species of conservation concern. Clearance activities within the Java Coastal Zone EBA (Critical Habitat) however may impact upon species of conservation concern, although these are likely to be birds.

Hunting and poaching by local people and the workforce may impact on species of conservation concern, especially birds captured for the bird trade that may occasionally visit the Project area. These species include Tenggara Hill Myna (*Gracula venerate*) and the Javan Pied Starling (*Gracupica jalla*).

The potential impacts during construction will remain during operation.

The significance of impacts associated with terrestrial biodiversity during construction activities are discussed and presented in **Table 8.73**.

The sensitivity of terrestrial species to fauna mortality from vehicle strike, hunting and poaching is considered to be **Low** for all Least Concern species. The sensitivity of Critical Habitat species (Javan White-eye, *Zosterops flavus*) and vagrant species listed as Critically Endangered or Endangered is rated as **High**.

The magnitude of effect due fauna mortality from vehicle strike, hunting and poaching is likely to be **Small** as the effect will not cause a substantial change in the population of the species present, or other species dependent on them during construction.

The overall magnitude of this impact is therefore **Moderate** for Critical Habitat species; and **Negligible** for Least Concern Species.

*Table 8.73 Assessment of Impacts from Mortality: Vehicle Strike, Hunting and Poaching*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | |
|---|---|---|---|
| | | Least Concern | Critical Habitat |
| | | Low | High |
| Magnitude of Impact | Negligible | Negligible | Negligible |
| | Small | Negligible | Moderate |
| | Medium | Minor | Major |
| | Large | Moderate | Major |

### 8.9.7.1 *Mitigation Measures, Management and Monitoring*

It is recommend that the following mitigation measures be applied in relation to habitat impacts during construction:

- Hunting and poaching will be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation;

- The Project owner shall provide training to staff and workers on all rules, regulations and information concerning restrictions related to hunting and poaching, as well as the punishment that can expected if any staff or worker or other person associated with the Project violates rules and regulations;

- All vehicles are to maintain a speed of a maximum of 40km/hr within work sites to reduce the risk of fauna strike; and

- Measures to manage hunting and poaching in the DMU by the local community are to be outlined in a *Biodiversity Action Plan*.

*8.9.7.2 Significance of Residual Impact*

In view of the implementation of mitigation measures, the residual impact is to remain **Minor** significance.

### *8.9.8 Assessment of Impacts - Degradation of Habitat during Operations Phase*

Minor residual impacts for all construction phase impacts are likely remain during operation. Additional impacts due to degradation of habitat and mortality are likely to be different during operation and hence are reassessed for operational phase impacts.

Degradation of habitat during operation will occur due to air, noise and water discharges into the environment.

Impacts due to air, noise and water emissions during operation can cause impacts to biodiversity values such as: deposition of particulates on vegetation; leaf necrosis; disturbance of fauna from close proximity to noise sources (such as the CCGT plant) and increases in flows and pollution impacting aquatic values in the Java Sea and Cilamaya River.

Compliance with relevant standards will reduce the impacts on biodiversity values from air, noise and water pollution.

The significance of impacts associated with terrestrial biodiversity during operation activities are discussed and presented in **Table 8.74.**

The sensitivity of the Critical Habitat (Javan Coastal Zone EBA) is considered to be **High**. The sensitivity of Natural Habitats is considered to be **Medium**. The sensitivity of Modified Habitats are considered to be **Low**.

The magnitude of effect is likely to be small as the degradation of habitat will effect only a small area of habitat, but without the loss of viability/function of the habitat.

The overall magnitude of this impact is therefore **Moderate** for Critical Habitats; **Minor** for Natural Habitat and **Negligible** for Modified Habitat before Mitigation Measures.

*Table 8.74 Assessment of Impacts on Degradation of Habitat during Operations*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Modified Habitat** | **Natural Habitat** | **Critical Habitat** |
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | **Negligible** | **Minor** | **Moderate** |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

### 8.9.8.1 *Mitigation Measures, Management and Monitoring*

No additional measures are necessary than those outlined in the impacts to air, water and noise.

### 8.9.8.2 *Significance of Residual Impact*

In view of the implementation of mitigation measures, the residual impact is to remain **Minor** significance.

## 8.9.9 *Assessment of Impacts - Mortality: Avifauna Infrastructure Strike*

Impacts to fauna during operation may persist with potential impacts to infrastructure causing local mortality of individuals. This is most likely to occur with avifauna striking the transmission line during construction and operation.

Whilst no bat species were detected during surveys, it is likely that bats would forage over the rice paddies during dawn and dusk. Individuals may collide with the transmission line, causing mortality of individuals. Similarly, bird species may collide with the transmission line during flight.

The sensitivity of terrestrial species to fauna mortality from avifauna strike with infrastructure is considered to be **Low** for all Least Concern species. The sensitivity of Critical Habitat species (Javan White-eye, *Zosterops flavus*) and vagrant species listed as Critically Endangered or Endangered is rated as **High**.

The magnitude of effect due fauna mortality from avifauna infrastructure strike is likely to be **Small** as the effect will not cause a substantial change in the population of the species present, or other species dependent on them during construction.

The overall magnitude of this impact is therefore **Moderate** for Critical Habitat species; and **Negligible** for Least Concern Species.

*Table 8.75 Assessment of Impacts from Avifauna Infrastructure Strike*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | |
|---|---|---|---|
| | | Least Concern | Critical Habitat |
| | | Low | High |
| Magnitude of Impact | Negligible | Negligible | Negligible |
| | Small | Negligible | Moderate |
| | Medium | Minor | Major |
| | Large | Moderate | Major |

### 8.9.9.1 *Mitigation Measures, Management and Monitoring*

It is recommend that the following mitigation measures be applied in relation to habitat impacts during construction:

- Biodiversity Action Plan for the Project area to include:
  - Use of bird deflectors on the length of the power line. The deflectors will increase line visibility by thickening the appearance of the line for easier detection by avifauna;
  - Moveable markers of contrasting colours (e.g. black and white) that protrude above and below the line, and be placed 5-10 m apart;
  - Removing the thin neutral or earth (shield) wire above the high voltage transmission lines where feasible, and where this is not possible, marking the line to make it more visible;
  - Minimising the vertical spread of power lines. Having lines in a horizontal plane reduces collision risk;
  - Habitat manipulation to influence flight activity and bird behaviour, e.g. tree lines under the high voltage lines to increase visibility;
  - Insulating cables close to poles, at least 70 cm on both sides and around perching areas, and up to at least 140cm; and
  - Hanging insulators under cross arms and poles, provided the distance between a likely perch (mainly the transmission tower crossarm) and the energised parts (conductors) is at least 70 cm.

### 8.9.9.2 *Significance of Residual Impact*

In view of the implementation of mitigation measures, the residual impact remains of **Minor** significance.

### 8.9.10 *Assessment of No-Net-Loss of Biodiversity Values*

The ADB SPS requires that standards are met in relation to Natural, Modified and Critical Habitats. These standards are outlined in **Table 8.76** below.

*Table 8.76 Standards required to be met by the ADB SPS in relation to the Modified, Natural and Critical Habitats*

| Habitat Classification | Required Standard |
|---|---|
| Modified Habitat | The borrower/client will exercise care to minimize any further conversion or degradation of such habitat, and will, depending on the nature and scale of the project, identify opportunities to enhance habitat and protect and conserve biodiversity as part of project operations. |
| Natural Habitat | In areas of natural habitat, the project will not significantly convert or degrade such habitat, unless the following conditions are met:<br>• No alternatives are available.<br>• A comprehensive analysis demonstrates that the overall benefits from the project will substantially outweigh the project costs, including environmental costs.<br>• Any conversion or degradation is appropriately mitigated.<br><br>Mitigation measures will be designed to achieve at least no net loss of biodiversity. They may include a combination of actions, such as post-project restoration of habitats, offset of losses through the creation or effective conservation of ecologically comparable areas that are managed for biodiversity while respecting the ongoing use of such biodiversity by Indigenous Peoples or traditional communities, and compensation to direct users of biodiversity. |
| Critical Habitat | No project activity will be implemented in areas of critical habitat unless the following requirements are met:<br>• There are no measurable adverse impacts, or likelihood of such, on the critical habitat which could impair its high biodiversity value or the ability to function.<br>• The project is not anticipated to lead to a reduction in the population of any recognized endangered or critically endangered species or a loss in area of the habitat concerned such that the persistence of a viable and representative host ecosystem be compromised.<br><br>Any lesser impacts are mitigated |

In order to demonstrate the compliance with these requirements, a summary of the application of the impact assessment as outlined above is contained in **Table 8.77.**

*Table 8.77 Standards Required to be met by the ADB SPS in Relation to the Modified, Natural and Critical Habitats*

| Habitat Type | Avoidance Measures Applied | Mitigation Measures Applied | Residual Impacts | Assessment of No-Net-Loss |
|---|---|---|---|---|
| Modified Habitat<br>• 238.1ha, including 182.96ha underneath the transmission line.<br>• Total direct impacts to Modified Habitat is 55.15ha | Not required. | As required by the SPS, measures to enhance habitats surrounding project components will be undertaken. Progressive rehabilitation of land disturbed during construction will occur using native indigenous species. It is estimated that 10ha of Modified Habitat can be revegetated within the Project Area.<br><br>Additional measures will be applied in relation to Critical Habitat values (also classified as Modified Habitat). These measures are outlined below. | Approximately 55.15ha of Modified Habitat will be converted to project facilities within the Project area.<br><br>Rehabilitation of approximately 10ha of Modified Habitat will occur. | Not required. |
| Natural Habitat<br>• 0.33ha of Mangrove habitat<br>• 3.69ha of freshwater habitat (not impacted) | The area of Natural Habitat is located along the foreshore area and consists primarily of mangrove habitat. In order for the road to access the jetty, this area will be required to be cleared in order to enable access. Recommendations have been made to reduce the footprint of the road and jetty construction within the area of mangroves.<br>The area classified as freshwater habitat will be avoided and is outside of the Project footprint. | Mitigation measures will be applied in Natural Habitat and Critical Habitat as outlined in the impact assessment above. These measures will be outlined within the *Biodiversity Action Plan* to be prepared for the Project and are summarized below:<br>• *Fauna shepherding protocol* to reduce impacts to species during construction;<br>• Management of the use of fencing and hoarding | It is anticipated that the mitigation measures outlined will reduce the impact significance to Low/Negligible (as outlined in the impact assessment above).<br>Approximately 0.33ha of Natural Habitat will be permanently lost due to the construction of project facilities.<br>Revegetation of mangrove forest within the project footprint adjacent to the road and jetty will be undertaken. | In order to achieve no-net-loss for impacts to Natural Habitat and Critical Habitat, it is recommended that the following measures be applied in addition to the mitigation measures outlined to compensate for residual impacts to habitat values. Further details will be outlined within the BAP and will include:<br>• The project owner is to establish a community program in conjunction |

| Habitat Type | Avoidance Measures Applied | Mitigation Measures Applied | Residual Impacts | Assessment of No-Net-Loss |
|---|---|---|---|---|
| | | during construction and operation to reduce barriers to fauna movement (including avifauna);<br>• Manage access to the project construction site to reduce access by local people to reduce the potential for hunting, poaching and clearing impacts;<br>• Measures to control dust in order to limit dust deposition on adjacent vegetation during construction activities;<br>• Planting of native indigenous flora to rehabilitate construction sites following construction activities to enhance habitat values within the Project Area (estimated to be approximately 80ha);<br>• Use of machinery and hand held equipment to comply with relevant air and noise emission standards to reduce disturbance and displacement during construction;<br>• *Sediment and Erosion Control Plan* to outline measures to reduce | It is estimated that the area that will be replanted is 10ha. | with the local community and Forestry Department to undertake revegetation of land within the Javan Coastal Zone EBA between the Muara Gembang – Tanjung Sedary KBA and the Muara Gimanuk KBA<br>• The revegetation program is to plant native indigenous species suitable for endemic birds (such as the Javan White-Eye);<br>• A minimum goal of 80 hectares of revegetation within this area is to be undertaken;<br>• The program is to work collaboratively with local landowners. Planting should occur on community land and private land (with permission from the landowner);<br>• Where possible, planting should be contiguous within the landscape to improve the connectivity of vegetation along the coastal zone between the KBAs;<br>• The period of the community program is to extend for the life of the |
| Critical Habitat<br>• Javan Coastal Zone EBA (approximately 51.84ha)<br>• Habitat for the Javan White-eye, *Zosterops flavus* within the EBA<br>No CR or EN listed species were identified as having Critical Habitat within the DMU. | The Project is located within the Javan Coastal Zone EBA, which also contains habitat for the Javan White Eye. It is necessary for the project to be located close to the shoreline in order to access the FSRU facilities. It is not feasible to avoid construction within the EBA given the EBA covers the entire northern coastline of Java.<br>Avoidance measures however have been recommended, including reducing the footprint areas during construction within the EBA and minimising the use of fencing and hoarding. | | Approximately 51.84ha of Critical Habitat will be lost due to the construction of project facilities. This will consist of:<br>• 0.33ha of Mangrove habitat (as outlined above); and<br>• 51.51ha of habitat within the Javan Coastal Zone EBA<br>Given that the existing condition of the Javan Coastal Zone EBA is highly modified, it is not anticipated that the loss in area of the habitat concerned will result in the persistence of the ecosystem being compromised. The EBA is also very large in extent (being along the entire northern coastal zone of Java), with only a minor area of the development occurring within it.<br>Habitat for the Javan White-eye consists of mangroves, coastal scrub, relict coastal forest and scattered trees. Removal of these trees from the project footprint during construction will results in a temporary loss of habitat for the species. | |

| Habitat Type | Avoidance Measures Applied | Mitigation Measures Applied | Residual Impacts | Assessment of No-Net-Loss |
|---|---|---|---|---|
| | | sediment polluted water entering local waterways;<br>• Preparation of an *Invasive Species Management Plan* to control the transmission and proliferation of invasive species within the Project Area;<br>• Manage the hours of operation to reduce night time impacts to nocturnal fauna;<br>• Direct light sources away from natural and critical habitat areas to reduce impacts to nocturnal fauna;<br>• Manage threats, including hunting and poaching by workers and vehicle strike of fauna by company vehicles; and<br>• Utilize best practice measures along the transmission line to reduce impacts to avifauna. | Rehabilitation on site with native indigenous flora suitable for the Javan White-eye, including mangrove forests along the coastal zone will increase the habitat available for the species in the medium to longer term (within 5 years). It is estimated that an area of at least 10ha is available for rehabilitation within the Project footprint area. | Project concession agreement period; and<br>• Sufficient funding and in-kind support is to be allocated by the project owner.<br>It is expected that this program will contribute to a gain in habitat values within the EBA between the adjacent KBA areas. |

## 8.10 *WASTE MANAGEMENT*

Impacts to waste management infrastructure from the construction phase of the Project are anticipated from the construction and operation of the CCGT power station, transmission line and the substation, FSRU and pipeline outfall.

A holistic approach has been taken to assessing the impacts from waste arisings recognising that the infrastructure that will be used is likely to be common to all Project features (e.g. local landfill sites, recycling facilities, hauliers).

As the Project is in the early stages of planning comprehensive details of waste management plans from the waste source to its final disposal point are not fully confirmed. As such, the assessment of waste impacts has taken into account the information provided to date and the understanding of the waste industry in the Project area. It will be essential to ground truth this information in advance of the construction phase.

### 8.10.1 *Potential Sources of Impacts*

*Construction Phase:*

The construction activities will generate solid and liquid hazardous and non-hazardous wastes that will require off-site disposal. Anticipated wastes include:

- Solid construction waste (e.g. packaging waste; scrap metals, waste wood, redundant formwork; offcuts; fabrication waste; and pallets), storage & disposal;
- Excavated waste from site levelling works and construction of the pipeline route;
- Domestic waste generated by the construction workforce (including paper, plastics and putrescible wastes);
- Biomass from site clearance activities including waste from the transmission line and pipeline routes; and
- Hazardous waste including used paint, engine oils, hydraulic fluids and waste fuel, spent solvents from equipment cleaning activities, and spent batteries or spent acid/alkali from the maintenance of machinery on-site.

*Operations:*

The operational activities are expected to generate solid and liquid hazardous and non-hazardous wastes that require off-site disposal:

- Domestic waste generated by the operations workforce (including paper, plastics and putrescible wastes);

- Waste materials such as steel, excess cables etc. associated with routine and non-routine maintenance; and

- Hazardous waste including used paint, engine oils, hydraulic fluids and waste fuel, spent solvents from equipment cleaning activities, and spent batteries or spent acid/alkali from the maintenance of machinery on-site.

### *8.10.2 Assessment Approach and Criteria*

The legal framework in Indonesia under which waste from the Project needs to be managed is shown in **Figure 8-15.**

*Figure 8-15 Indonesian Waste Management Framework*


A full summary of the legislation governing waste management in Indonesia is provided in **Annex F**.

Waste impacts are also assessed, reviewed, discussed and presented with reference to the *IFC PS3: Resource Efficiency and Pollution Prevention* as well as the *ADB SPS* both of which are underpinned by the following WBG Environment Health and Safety Guidelines:

- *World Bank IFC General EHS Guidelines, 2007;*

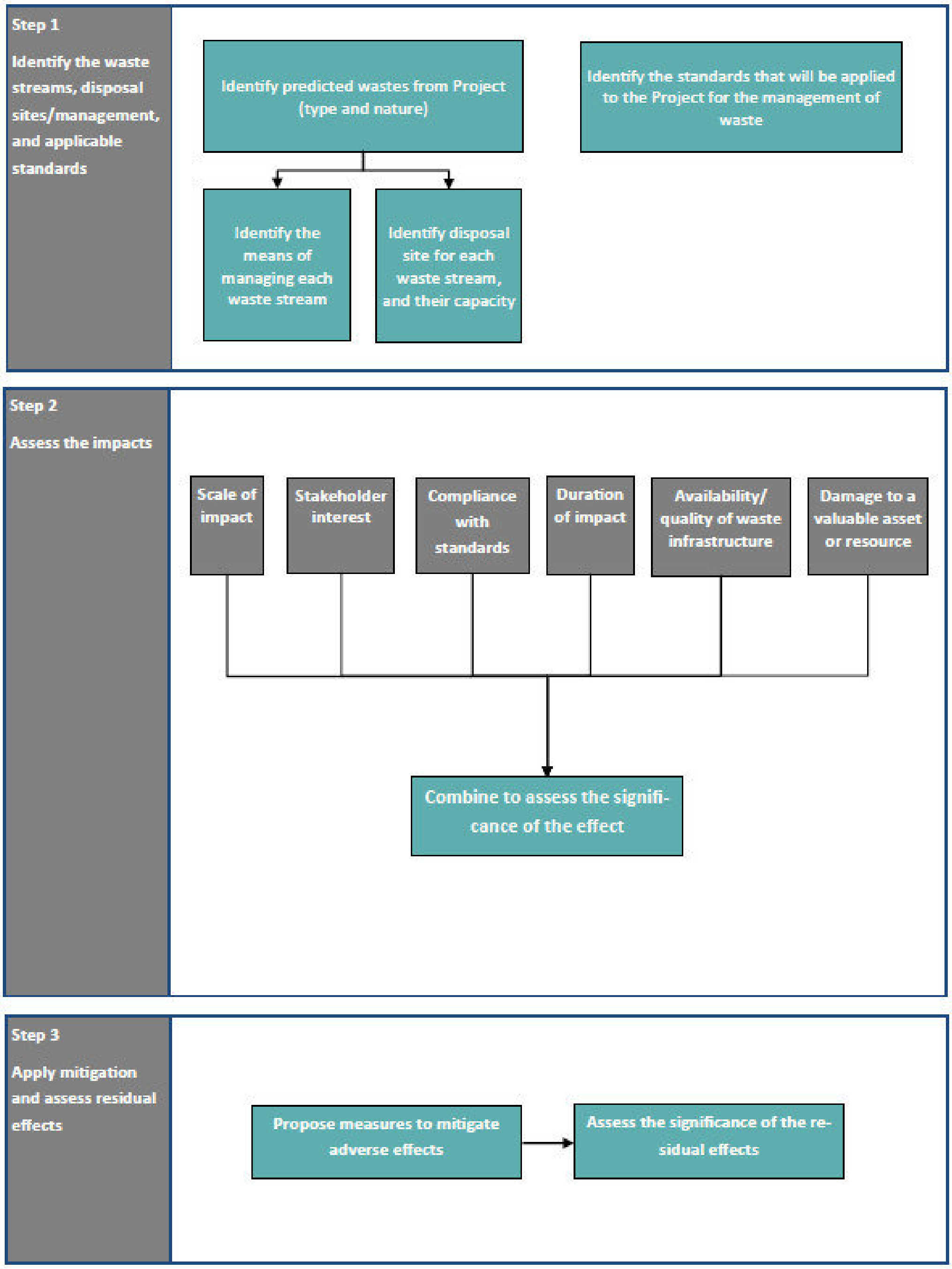
- *World Bank IFC EHS Guidelines for Thermal Power Plants, 2008, and 2017 (in Draft)*;
- *World Bank IFC EHS Guidelines for Electric Power Transmission and Distribution, 2007*.

The typical approach taken to the assessment of wastes from any Project is as follows:

- Identify the type and nature of waste being produced;
- Confirm the means of managing these waste with the Project Proponent;
- Identify any off-site waste management facilities that will be used and:
  - Try to demonstrate that capacity exists for the identified wastes;
  - Describe how the sites will be assessed for compliance with the relevant environmental standards relating to waste management.
- Propose measures to monitor waste management activities and ensure a duty of care is maintained for waste from its origin to its final disposal in line with the applicable legal framework.

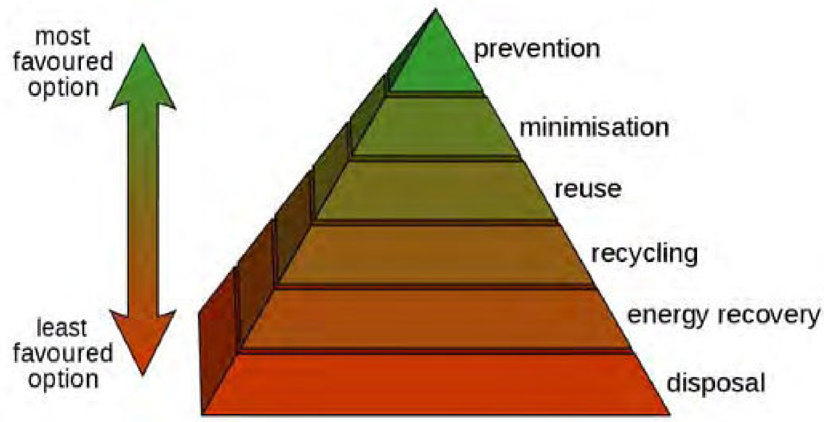
The approach to assessing waste impacts is shown in **Figure 8-16**.

*Figure 8-16 Assessing Waste Impacts*




The principles of the waste hierarchy should be applied to all wastes with emphasis placed on waste avoidance, waste reduction, reuse of waste, waste recovery and finally disposal.

*Figure 8-17 Waste Hierarchy*




The assessment of potential impacts related to waste in this section is based on the environmental baseline data, socio-economic baseline data and the information available from the Sponsor at the time of writing.

Judgements and assessments have been made based on professional knowledge and previous experience of ERM. Should there be significant changes in factors such as assumed input data, engineering design of waste management and treatment components of the Project, or agreed assessment criteria, the elements of this impact assessment and associated management, mitigation and monitoring measures may be needed to reflect these changes

This standard requires an assessment of the waste generated and avoidance and minimisation measures proposed to be utilised as part of the basic Project description.

This includes an assessment of the measures on how to best avoid or minimise all waste stream, put in place resource recovery, recycling and/or reuse measures where avoidance is not feasible, and as a final resort how remaining waste will be treated and disposed of in an environmentally sound manner.

### *8.10.3 Assessment of Impacts – Construction Phase*

The following quantities of wastes are anticipated by the Project in the construction phase.

*Table 8.78 Construction Phase Wastes*

| *Waste Type* | *FSRU* | *Jetty and Pipeline* | *CCGT* | *Transmission* | *Substation* |
|---|---|---|---|---|---|
| Construction Solid Wastes | Nil[1] | 600 kg/ per day[4] | | | |
| Excavation Waste | Nil[1] | Nil[2] | Nil[2] | N/A | N/A |
| Domestic Waste | Nil[1] | N/A[5] | 80 t/month[3] | N/A[5] | N/A[5] |

| | | | |
|---|---|---|---|
| Hazardous Waste | Nil[1] | | 135 kg / month[6] |
| Dredged Material | | 80,000 $m^3$[(7)] | |

[1] The FSRU is due to be constructed off-site and therefore there will be no waste created in Indonesia as part of its construction
[2] wastes excavated during the installation of the pipeline onshore will be used to backfill the pipeline trench during reinstatement. Similarly excavated soil at the CCGT site will be used in site levelling works.
[3] assumption that each worker generates a waste volume of 0.65 kg/day (Indonesian standard SNI – 19.3983.1995).
[4] Previous experience of this type of Projects suggests that a Project with a workforce of around 600 would produce about 600 kg of solid waste per day during construction
[5] domestic waste will arise from the workers accommodation which is planned to be located at the CCGT site.
[6] The Project anticipates around 135 kg of hazardous waste per month during construction across all sites.
[7] 80,000$m^3$ of dredged material is expected during dredging works for the jetty construction. Note that an on-going dredging will be required as the siltation back fills the dredged areas in the approach to the proposed Jetty.

*FSRU*

The FSRU construction is taking place outside of Indonesia and therefore there are no direct waste impacts anticipated.

*Jetty and Pipeline*

Wastes from the excavation of the pipeline route will be set aside for use in its reinstatement after the pipe has been installed. It is anticipated that most of the excavated soil will be reused in the pipeline route however, any surplus this will be directed to the CCGT Power Plant area and used in the site levelling activities if the Project programme allows.

Dredged sediment from the jetty construction and laying of the 1500 m pipeline is estimated at 80,000 $m^3$. An on-going dredging will be required as the siltation back fills the dredged areas in the approach to the proposed Jetty. The current proposed method is for side casting of the material.

*CCGT Power Plant*

Based on experience with similar projects, the total approximate quantities of non-hazardous and hazardous waste that could be a potential source of impact during this stage include:

- 600 kg/day of solid (non-hazardous) waste; and
- 135 kg/month hazardous waste.

The waste generated from construction workforces of approximately 3,500 will be approximately 2.27 t/day or 68 t/month, with an assumption that each worker generates a waste volume of 0.65 kg/day (Indonesian standard SNI – 19.3983.1995).

The site levelling works for the CCGT Power Plant area requires approximately 879,719 $m^3$ of soil for backfilling purposes therefore it is anticipated that any waste soils created during the works at other Project features will be used in the site levelling activities as a priority, before virgin soils are imported to the site.

*Transmission Line*

Biomass from the creation of the 1000 $m^2$ transmission line footprints is the most prominent waste from the transmission line construction. There will be a requirement to remove any biomass and the top layer of topsoil to install the transmission line towers.

It is anticipated that any useable soils will be routed to the CCGT Power Plant area for use in the site levelling works if the programme allows

*Substation*

It is anticipated that site levelling of the substation site will be required however there is no indication of any wastes associated with this construction.

The Project has specified the Jalupang Landfill, in Cikampek District as the disposal site for waste generated during construction. It is located about 24 km south of the CCGT Power Plant area. The Project will, with its contractors, carry out an audit of the landfill site to determine if it is suitable to receive wastes from the Project. This audit will be documented in a Waste Management Plan (WMP). If it transpires that the landfill site does not meet the relevant criteria for the wastes the Project intends to send to it, alternative arrangements will be sought by the Project through its contractors.

A framework for hazardous waste management has yet to be developed by the local authorities. Nevertheless, the Project will create a WMP for the construction phase that includes provisions for the appropriate management of hazardous wastes. All hazardous waste streams will be identified by the key contractors in their preparatory works, prior to the commencement of the construction phase. For all hazardous wastes, the WMP will identify appropriately licenced waste hauliers and disposal facilities in the Jawa region.

During construction, the EPC contractor is responsible for appropriate handling and waste disposal. Waste will be managed within the requirements of the applicable legal framework and lenders guidelines.

Impacts from waste management are likely to be confined to the Project areas and the waste infrastructure in the locale of the Project.

At this stage, as the disposal routes for all wastes have not been fully identified or assessed, it is not possible to categorise the sensitivity of the area as low. However, in the course of the planning stage for the Project, the EPC contractor will be able to establish if sufficient suitable waste disposal capacity exists and this impact could potentially be reduced. Presently, it is acknowledged that waste infrastructure of the type required by the Project does exist in and around the area.

Given the location of the Project and its proximity to the waste infrastructure, the overall sensitivity to waste management impacts is considered to be medium. The magnitude of the impacts is considered to be medium. The Project construction appears to have no significant waste stream that would place undue pressures on waste infrastructure in the region. The impact significances has been assessed as **Moderate** on account of the uncertainty of the waste disposal routes.

The significance of potential impacts to waste infrastructure during the construction phase are assessed in **Table 8.79.**

*Table 8.79 Assessment of Impacts on Waste Management Infrastructure*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | Large | Moderate | Major | Major |

### 8.10.3.1 *Mitigation Measures, Management and Monitoring*

In order to manage the wastes from the Project appropriately a few key steps should be followed by the Proponent and the EPC contractor and should be completed in advance of financial close.

*Waste Management Plan*

The Project and its EPC contactor should develop a full WMP. A waste inventory that details all wastes anticipated by the construction works, the frequency at which they will occur and the timing in the Project programme, is needed.

The waste inventory will be aligned with the waste disposal sites in the area that are licensed to accept the types of waste the construction phase will create, following the 3Rs ethos (i.e. reduce, reuse and recycle).

The inventory will also be used to determine the scale of service required to manage the waste from the Project including container types (bins, skip), frequency of collection, storage times, etc. This information should be mapped to the Project area to ensure that the correct containers and capacities are deployed at the correct locations.

A system for documenting waste movements should be created. A trip ticket or waste transfer note system will be used to document all waste types leaving the Project area, their haulier, source, proposed disposal site etc. These tickets should be produced as counterfoil to create a full audit trail.

A programme of waste facility audits should be proposed to assess the credentials of would be waste hauliers, treatment facilities and disposal sites. A site audit should be conducted by the Project Proponent or its EPC contractor in advance of using any site / haulier for waste disposal, to establish if the site / haulier is operating within the bounds of its licence, the law and to a standard acceptable to the Project.

The WMP should be in place well in advance of the start of construction to demonstrate that sustainable waste management has been incorporated into the Project construction phase. The WMP will evolve during the construction phase and should be a 'live' document, adapted for the operation phase.

Specific items to be included in the WMP or to be carried out under it guise include:

- Providing training to all workers on the waste management system of the Project;
- Implement proper storage of the construction materials and wastes to minimise the potential damage or contamination of the materials;
- Implement construction materials inventory management system to minimise over-supply of the construction materials, which may lead to disposal of the surplus materials at the end of the construction period;
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance);
- Store wastes in closed containers away from direct sunlight, wind and rain and systematically to allow inspection between containers to monitor leaks or spills;
- Ensure that liquid waste storage areas have impermeable floors and containment, of capacity to accommodate 110% of the volume of the largest waste container;

- All wastes will be disposed of by authorised third- party disposal contractors;

- Concrete waste of inert nature will be stored in a laydown area near the concrete batching plant and will be reused where possible; and

- Any bitumen waste will be stored separately in a lined area to be disposed of by licensed contractors.

*8.10.3.2 Significance of Residual Impact*

Formulation and execution of a satisfactory WMP will result in the impact from waste management reducing to **Minor** significance. Until such time as the WMP has been accepted, the impact significance should remain as **Moderate**.

### 8.10.4 Assessment of Impacts – Operations Phase

During the Operation of the Project there will be wastes generated from a range of Project activities noted in **Section 4**. The amounts of waste anticipated by the Project from the different aspects of its operation are set out in **Table 8.80.**

***Table 8.80 Operation Phase Wastes***

| *Waste Type* | *FSRU[1]* | *Pipeline* | *CCGT** | *Transmission* | *Substation* |
|---|---|---|---|---|---|
| Operation and Maintenance Solid Wastes | 382 $m^3$ (~100t) / annum[2] | Negligible | 1,250kg / day | Negligible | Negligible |
| Domestic Waste | 15 kg/ day | Nil | 60 kg / day | Nil | 50 kg / day |
| Hazardous Waste | 550 $m^3$ / annum | Negligible | Negligible | Negligible | Negligible |
| Sewage sludge[3] | | Nil | 700kg | Nil | 0.03 $m^3$/day for septic tank[4] |

Note:
[1] Information provided via email by Exmar March 2017.
[2] Compacted volumes based on information provided by the Project proponent. All compacted waste will be brought ashore for disposal.
[3] All other wastewater will be discharged to the Java Sea.
[4] Sewage sludge from substation will not be discharged into the Java Sea.
*Obtained from Samsung on March 12 2018

*FSRU*

Apart from any wastes that can be disposed overboard wastes generated aboard the FSRU will be stored on the ship until such time as a suitably sized load is available for transportation to the shore base. At this time an appropriate contractor for transporting and disposing of the waste will be secured and used to manage the waste on behalf of the Project. A workforce of 48 will be based at the FSRU. Domestic wastes will be compacted prior to being brought ashore. Putrescible (food) wastes will be macerated and released overboard in accordance with MARPOL Annex V[1]. Hazardous wastes (lubricant oils, chemicals, etc.) will be stored in appropriate containers aboard the FSRU. The storage area will have secondary containment to prevent spillage.

*Pipeline*

The pipeline may have a small amount of waste from its maintenance but it is anticipated that this will be returned to the maintenance base, most likely located at the CCGT Power Plant area. Cleaning of the pipeline will be undertaken by a programme of 'pigging'. Pigging involves the passing of a cleaning module through the pipeline under pressure to remove the build-up of contaminants. A small amount of wash-down waste will be generated during pigging but most likely captured and discharged via the pigging stations.

*CCGT Power Plant*

A total of 95 workers will be employed to operate the CCGT Power Plant. The generation of domestic waste is estimated at (about 60kg) with an assumption that each worker generates a waste volume of 0.65 kg/day (Indonesian standard SNI – 19.3983.1995). The domestic solid waste will be handed over to suitably licensed third parties and transported periodically (probably weekly) to the local landfill site.

The wastes from the Project during the operation phase will include hazardous waste (i.e. used paint, engine oils, hydraulic fluids and waste fuel, spent solvents from equipment cleaning activities, and spent batteries or spent acid/alkali from the maintenance of machinery on-site). These wastes will be generated in small quantities and it is expected that the waste processors in the Jawa region will have capacity to accept them for processing / disposal. This will have to be confirmed when the WMP is finalised with the EPC contractor and the Project Proponent.

The majority of process effluents will be treated and discharged to the Jawa Sea and therefore should not impact the local waste infrastructure. Sewage sludge from the sewage treatment plant will be chlorinated in an effluent tank and discharged to the Cilamaya irrigation canal. The sludge will be sent to sludge thickener and then removed by licensed local hauler.

A small amount of solid waste will be removed from the screens in the wastewater treatment plant. Treated effluent is passed through series of mesh

1 As the FSRU is located more than 3 nautical miles offshore the vessel is permitted to discharge food (putrescible) waste if treated through maceration to particle sizes of less than 25mm.

screens or equivalent to remove contamination prior to discharge. This waste will be periodically removed and sent to landfill.

An oil interceptor will also be used at the wastewater treatment plant to remove oil at times when the concentration exceeds 10 mg/l. The oil separator will be emptied periodically by vacuum tanker and sent for further processing at an appropriately equipped and licensed oil treatment facility.

*Transmission Line*

If maintenance of vegetation is required at the transmission line towers, CCGT site perimeter, within the CCGT site or along the pipeline route it is likely that these wastes will be left in situ to decompose naturally.

*Substation*

The substation will be operated by a total workforce of 76 persons. Domestic waste generated by the workers is estimated at about 50kg / day with an assumption that each worker generates a waste volume of 0.65 kg/day (Indonesian standard SNI – 19.3983.1995). This waste will be disposed periodically (weekly) at the local landfill site.

Any hazardous wastes generated at the substation will be stored on-site and collected periodically by licensed hauliers. It is not anticipated that hazardous wastes will arise in significant quantities at the substation during the operation phase.

During operation, the operating company is responsible for appropriate handling and waste disposal. The waste management shall be in accordance with the applicable guidelines and the WMP that will be developed by the Project.

The significance of potential impacts to waste infrastructure during the operation phase is assessed in **Table 8.81**.

Potential impacts would be limited to the locale of the Project area with the exception of some hazardous wastes that may require transportation to larger population centres to find appropriate disposal services, most likely to Jakarta.

Given the understanding of the available waste infrastructure in the Project area the sensitivity of the resource is considered to be medium. The magnitude of the impact is also considered to be medium based on the Project understanding of the wastes it will produce during its operation.

The impact significance has been assessed as **Moderate.**

*Table 8.81 Assessment of Impacts on Waste Management*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | Large | Moderate | Major | Major |

### 8.10.4.1 *Mitigation Measures, Management and Monitoring*

In order to reduce the impact significance to an acceptable level it is recommended that the Project builds upon the WMP created during the construction phase and extends it to apply to the operation phase.

The WMP will include:

- An inventory of the wastes anticipated by the Project;
- Identification of the disposal routes the Project plans to use for its waste in the operation phase;
- A programme of audit for the waste infrastructure and waste hauliers the Project intends to use;
- Site rules for waste management including segregation, storage and packaging requirements for each waste type;
- Mapping of waste facilities on site including distribution of waste receptacles at strategic locations aboard the FSRU, along the pipe line route, at the CCGT power station and the substation.

Further items to be included in the WMP are:

- An induction regime for Project staff highlighting the waste management system and how wastes are to be managed on-site;
- Provide bins for the segregation and proper storage wastes to minimise the potential releases to the environment or contamination of other materials;
- Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance);

- Hazardous waste store should be segregated to avoid the co-storage of incompatible waste types;
- Store wastes in closed containers away from direct sunlight, wind and rain and systematically to allow inspection between containers to monitor leaks or spills;
- Ensure that storage areas have impermeable floors and secondary containment, of a capacity to accommodate 110% of the volume of the largest waste container; and
- Hazardous wastes will be disposed of by authorised third- party disposal contractors.

*8.10.4.2 Significance of Residual Impact*

Formulation and execution of a satisfactory WMP will result in the impact from waste management reducing to **Minor** significance. Until such time as the WMP has been created and approved the impact significance will remain as **Moderate**.

## 8.11 LANDSCAPE AND VISUAL

### 8.11.1 *Potential Sources of Impacts*

Project activities that may have an impact on visual impact during the construction and operation phases include:

Construction Phase

Visual Impacts brought about by construction activities associated with the project will comprise:

- Clearing of vegetation associated with the establishment and construction of the pipeline corridor;
- Construction of the Jetty and access road;
- Preparation and construction works for the CCGT, Transmission Line supporting tower footings and Substation; and
- Construction lighting.

Access roads constructed by the project will be visual similar to those that already exist in close proximity to all Project areas.

*Operations Phase*

Visual impacts during the operational project phase will comprise:

- Jetty, above ground components of the pumping station;
- CCGT and associated lighting;
- New transmission lines; and
- Substation.

### 8.11.2 *Assessment and Approach*

There are no global standards or assessment requirements for visual assessment of infrastructure projects. This assessment does however respond to the requirements of *Performance Standard 3, Resource Efficiency and Pollution Prevention* of the IFC Guidelines. Performance Standard 3 seeks to avoid or minimise adverse impacts on human health and the environment by avoiding or minimising pollution from project activities, where pollution includes visual impacts.

In the absence of firm guidance on which to prepare visual assessment, this assessment has therefore been prepared under ERM's Global ESHIA framework. This methodology has been applied to many infrastructure projects through the Asia Pacific region.

The significance of the impacts has been assessed using the approach and methodology as described in **Annex G.** The assessment methodology adopted for assessing the visual impact of the project is outlined below.

*Define the Visual Components of the Project*

Describe the key components of the Project that may contribute to visual impact during the construction and operation phases of the Project.

*Establish study area /Viewshed*

Define the study area for visual assessment of the Project.

*Landscape Units and Sensitivity*

Determine areas of visual sensitivity within the view shed and the ability of those areas to accommodate the visual change of the Project.

*Seen Area Analysis*

The Project is located in agricultural plains of Karawang and Bekasi Regencies of West Java, Indonesia. The landscape surrounding the Project is flat with little topographical relief, which may afford screening of the Project. It is therefore assumed that the Project is potentially visible throughout the viewshed the identified zones of visual influence.

*Assessment of Publicly Accessible Viewpoints*

The visual assessment of the Project is determined by considered a selection of viewpoints, which provide for the range of view angles, distances and settings towards the Project. Visual Impact Assessment is based on four criteria; visibility, distance, and landscape character & viewer sensitivity and viewer number.

- **Visibility:** Project visibility can be affected by intervening topography, vegetation and buildings.

- **Distance:** Visibility and scale of project infrastructure decreases as distance increases. This is considered by Zones of Visual Influence (ZVI) where an indication of impact based solely on distance is provided for.

- **Landscape character and viewer sensitivity:** The character of the landscape around the site and adjacent to the viewing location will influence the ability of the project changes to be absorbed within existing change. That is, a landscape such as farmland is considered of low sensitivity, whereby a pristine landscape such as a national park is considered highly sensitive. Similarly, a greater sensitivity to visual change is afforded to a residential area or township than that of an industrial landscape.

- **Number of viewers:** The level of visual impact decreases where there are fewer people able to view the Project. Alternatively, the level of visual impact may increase where views are from a recognised vantage point. Viewer numbers from a recognised vantage point would be rated as high.

The ratings of each criterion are not numerically based and cannot be simply added together and averaged to arrive at an overall rating. These four criteria need to be considered in the assessment of each viewpoint.

The overall effect of the Project at each viewpoint will be assessed by evaluating the value of each of those criteria, ranking those as being either low, moderate, or high, and subsequently making an assessment as to the overall effect by balancing each of those criteria.

*Scale of Effects*

The overall visual impact of the Project when assessed from each viewpoints will use the following scale of effects:

- ***Negligible*** – minute level of effect that is barely discernible over ordinary day to day effects.

- ***Low adverse effect*** – adverse effects that are noticeable but that will not cause any significant adverse impacts.

- ***Moderate adverse effect*** – significant effects that may be able to be mitigated/remedied.

- ***High or unacceptable adverse effect*** – extensive adverse effects that cannot be avoided, remedied or mitigated.

A detailed description of the scale of effects is provided in **Annex G** of the technical report.

*Mitigation Measures for Publicly Accessible Viewpoints*

Landscape mitigation can positively contribute to visual impacts from sensitive viewing locations by screening or filtering views the Project, thereby reducing the visual impact.

### 8.11.3 *Assessment of Impacts – Construction Phase*

Major construction activities will include:

- Clearing of vegetation;
- Excavation and general earthworks (including topsoil stripping, excavation, filling, topsoil spreading and rehabilitation works);
- Building construction;
- Drainage installation (including, where required, measures to protect water quality and groundwater flows);
- Power connection;
- Equipment fabrication and installation; and
- Landscaping and rehabilitation of redundant construction areas.

The major areas that will be visible would be the earthworks and temporary structures such which may include material stockpiles, laydown areas and concrete batching plants.

There are no landscape techniques that can be employed to mitigate the visual impacts associated with the construction of the Project. However best practice construction management would be employed to maintain construction areas to the minimum required.

Construction Impacts, although highly visible, will be relatively short in duration and will cease following commissioning of the Project.

The overall magnitude of this impact is therefore **Small**, resulting in a **Negligible** impact significance.

***Table 8.82*** ***Assessment of Visual Impacts on Landscape during Construction***

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | **Low** | Medium | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | **Medium** | **Minor** | Moderate | Major |
| | Large | Moderate | Major | Major |

##### 8.11.3.1 *Mitigation Measures, Management and Monitoring*

Given the impact significance is low, no further mitigation is needed for visual impact of construction activities.

##### 8.11.3.2 *Significance of Residual Impact*

The overall visual impact of the Project, that is a balanced consideration of the visual criteria of distance, viewer number and landscape sensitivity are considered, would be **Minor**.

#### 8.11.4 *Assessment of Impacts – Operation Phase*

The Project will be located within an "Agricultural Plain" that is flat and with little topographical variation. This landscape type is one that has a low sensitivity to visual change and is one that can accommodate the visual change proposed by the Project.

The landscapes within the project viewshed are not rare or unique. There are no protected areas or landscapes that would attract a high level of visual sensitivity in the region, particularly the beaches running along the water's edge.

The landscape is bisected by many roads and tracks which provide access between villages and towns throughout the region. These roads area largely elevated above the surrounding agricultural plains and are punctuated by roadside vegetation. When travelling along many roads, this vegetation filters or screen views to the surrounding landscape and towards the proposed project. Views from these areas are over a highly modified landscape that, in many instances already includes infrastructure. For these reasons the overall visual impact from roads and tracks would be **Minor**.

There are approximately 35 villages within the area that, based on distance and the Zones of Visual Influence have the potential to have a high level of visual impact. The visual assessment determined that for the majority of views from within villages to the surrounding landscape and the Project are filtered or screened by buildings, structures and vegetation within the villages. Further, many views from these areas already include infrastructure such as power poles, lights or towers.

Due to the existing screening afforded from many areas within villages, views over a landscape that has a low sensitivity to visual change and the inclusion of infrastructure in these views the visual impact from many of these area would be **Minor**.

*Table 8.83 Assessment of Visual Impacts on Landscape during Operations*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | Medium | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | **Medium** | **Minor** | Moderate | Major |
| | Large | Moderate | Major | Major |

*8.11.4.1 Mitigation Measures, Management and Monitoring*

Landscape planting is a suitable mitigation option for sensitive viewing locations such as residential properties or fixed viewpoints.

Planting may be designed to either screen or significantly reduce the visual dominance through filtering. For viewing locations where a high or un-acceptable level of visual impact may occur that has not been identified by this assessment, this assessment has also determined that landscape mitigation and screening would assist to reduce these impacts.

*8.11.4.2 Significance of Residual Impact*

The overall visual impact of the Project, that is a balanced consideration of the visual criteria of distance, viewer number and landscape sensitivity are considered, would be **Minor**.

## 8.12 MARINE WATER QUALITY

### 8.12.1 *Potential Sources of Impacts*

Project activities that may have an impact on seawater quality include:

- Temporary decline in water quality as a result of earthworks, piling and backfilling activities and silt-laden surface runoff;
- Discharge of hydrotest during pre-commissioning of the offshore pipeline;
- Discharge of wastewater generated from the FSRU and other vessels;
- Operational Discharge of Process Cooling Water from FSRU and CCGT Power Plant to the sea; and
- Alteration of coastal processes and sedimentation from presence of the jetty.

### 8.12.2 *Assessment Approach and Criteria*

The legal framework and applicable guidelines of relevance to seawater quality is listed below:

- *World Bank IFC EHS Guidelines for Ports, Harbors and Terminals, 2017;*
- *World Bank IFC EHS Guidelines for Liquefied Natural Gas Facilities, 2017*; and
- *World Bank IFC EHS Guidelines for Offshore Oil and Gas Development, 2015*; and
- *International Convention for the Prevention of Pollution from Ships 1973 as modified by the Protocol of 1978 (MARPOL 73/78*).

The criteria for sensitivity and magnitude of the impact to seawater quality are defined in **Table 8.84** and **Table 8.85**.

***Table 8.84 Sensitivity Criteria for Seawater Quality***

| Sensitivity | Definition |
|---|---|
| Low | • Existing water quality is good and the ecological resources that it supports are not sensitive to a change in water quality |
| Medium | • Existing water quality show some signs of stress and/ or supports ecological resources that could be sensitive to change in water quality |
| High | • Existing water quality is already under stress and/ or the ecological resources it supports are very sensitive to change |

*Source: ERM, 2012a*

*Table 8.85 Magnitude Criteria for Impacts to Seawater Quality*

| Magnitude | Definition |
|---|---|
| Small | • Slight change in water quality expected over a limited area with water quality returning to background levels within a few metres; and/ or<br>• Discharges are well within benchmark effluent discharge limits. |
| Medium | • Temporary or localised change in water quality with water quality returning to background levels thereafter; and/ or<br>• Occasional exceedance of benchmark effluent discharge limits. |
| Large | • Change in water quality over a large area that lasts over the course of several months with quality likely to cause secondary impacts on marine ecology; and/ or<br>• Routine exceedance of benchmark effluent discharge limits. |

*Source: ERM, 2012a*

### 8.12.3 *Assessment of Impacts - Degradation of Marine Water Quality from Surface Water Run-Off to Seawater from Coastal Preparation and Construction Works*

Earthworks, piling and backfilling activities will be conducted at the jetty area. This has the potential to result in an increase of surface water run-off from exposed soil and stockpiles on land, particularly following heavy rains, which could have potential impacts to adjacent water bodies including the adjacent creek and seawaters.

Surface run-off from the Project area could contain high levels of suspended sediments (SS). It may also contain contaminants washed out during rainstorms such as from accidentally spilled fuels (e.g. petroleum, gasoline and waste oil) or leaks from machinery (e.g. lubricants).

#### 8.12.3.1 *Impact Evaluation and Significance*

Intertidal seawater quality monitoring was conducted at six (6) locations within the vicinity of seawater intake and outfall facilities (*ERM, 2017*; *IEE, 2016; Pöyry, 2016b*). Additionally, 11 seawater samples were analysed. This includes four (4) surrounding the FSRU location, two (2) along the pipelines and five (5) within the vicinity of Project area. Relatively high turbidity was recorded at the survey locations and an exceedance of the Indonesian Standard was recorded.

The chemical analysis results indicate a high influence of organic matter on nearshore water quality. This is likely to be attributed to discharges from nearby rivers and streams. Total Organic Matter (measured by$BOD_5$) exceeded the quality standard at all sampling sites with significant exceedances measured at most locations. Other exceedances for parameters such as Ammonia and Nitrates were also recorded (*ERM, 2017*; *IEE, 2016*; *Pöyry, 2016b*). Exceedances in many cases (such as for Oil & Grease, Zinc and Copper) were significant.

Seawater plankton monitoring was also conducted at six (6) locations. The index was based on diversity ranged from < 0.6 and indicated that the waters around the proposed Project site is heavily polluted (*Pöyry, 2016b*).

There will be periods when heavy rains occur during land clearing activities and may occur before erosion mitigation measures have been implemented. At such times, surges of highly turbid water may drain into the adjacent river and directly into the onshore and nearshore environment adjacent to the construction sites. As such, site clearance is expected to result in localised, short-term elevation of suspended solids and potential increased concentrations of contaminants in the receiving waters.

The sensitivity of degradation of marine water quality from surface water run-off to seawater from land clearing and preparation works is considered to be **Low.** The magnitude of effect due to surface water run-off to seawater from land clearing and preparation works is likely to be **Small** due to the exceedances of quality standards of the measured seawater quality (turbidity, organics, ammonia, phosphate and nitrates), and the impacts of surface run-off will contribute only a small amount to the existing water quality.

The overall significance of this impact is therefore **Minor** for seawater quality from surface water run-off to seawater from land clearing and preparation works.

*Table 8.86 Assessment of Impacts Seawater Quality from Surface Water Run-Off to Seawater from Land Clearing and Preparation Works*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | High |
| Magnitude of Impact | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | **Medium** | **Minor** | Moderate | Major |
| | Large | Moderate | Major | Major |

*8.12.3.2 Mitigation Measures, Management, and Monitoring*

It is recommended that the following mitigation measures be applied in relation to seawater quality from surface water run-off to seawater from land clearing and preparation works:

- Construction of drainage ditches and retention ponds to collect water run-off to reduce flows.
- Develop a Construction Sediment and Erosion Management Plan including erosion control measures such as sediment barriers and geotextile curtains.

- Implement measures to avoid the potential for accidental or unintended introductions including the transportation of substrates e.g. chemicals and hydrocarbon bunding.

*8.12.3.3 Significance of Residual Impact*

In view of the implementation of mitigation measures, the residual impact to seawater quality is expected to be **Minor.**

### *8.12.4 Assessment of Impacts - Degradation of Marine Water Quality from Pipeline Hydrotest Dewatering*

Discharge of hydrotest water will occur during the offshore pipeline pre-commissioning. Prior to commissioning, the structural integrity of the subsea pipeline will be determined using a hydrostatic pressure test (hydrotest), in which the pipelines are filled with seawater i.e. approximately 10,000 $m^3$, pressurised above the intended operating pressure and monitored for leaks or pressure loss over a specified time period. Additives such as oxygen scavengers and biocides will be added as a preventative measure to control the risk of potential corrosion and microorganism growth in the pipes.

After a test is completed, the pressure is released and the pipelines dewatered by pushing a 'pig' device through the line. During dewatering, the pig will push the water from the ORF to the offloading platform; water will be dispose of to the Java Sea at the FSRU.

*8.12.4.1 Impact Evaluation and Significance*

The discharge of hydrotest water may cause acute toxicity to marine biota in the immediate surrounds of the discharge, if exposed to toxic concentrations over time. Biocide is the predominant chemical of concern as it is identified as having the highest toxicity to marine receptors (INPEX 2010). Excluding biocide from hydrotest water is not feasible given the need to limit activity of corrosion inducing microbial and bacterial micro-organisms in the water to preserve long-term pipeline integrity.

The significance of impacts associated with hydrotest dewatering is discussed and presented in **Table 8.87**. Dispersion of hydrotest water, similar in density to seawater, is expected to be rapid, minimising the potential for longer-term exposure effects. The sensitivity of marine water quality from pipeline hydrotest dewatering is considered to be **Medium**.

Any toxicity effects from the discharged pollutants typically only impact on marine biota that happen to travel or remain entrained within the discharge plume for an extended period (INPEX 2010). The magnitude of effect due to pipeline hydrotest dewatering is likely to be **Small** as the effect will not cause any long-term change in water quality and any effects on marine biota would only occur if exposed to toxic concentrations over time.

The overall significance of the impact of pipeline hydrotest discharge on water quality is therefore **Minor**.

*Table 8.87* *Assessment of Impacts on Marine Water Quality from Pipeline Hydrotest Dewatering*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

*8.12.4.2* *Mitigation Measures, Management and Monitoring*

The following mitigation measures are required:

- Chemicals used in hydrotesting will be selected with consideration for their potential ecotoxicity and will use the lowest toxicity practicable for preserving pipeline integrity.

*8.12.4.3* *Significance of Residual Impact*

The residual impact to water quality from the discharge of pipeline hydrotest water is considered to remain **Minor,** given the above additional measures.

### *8.12.5* *Assessment of Impacts - Degradation of Marine Water Quality from Wastewater and Process Cooling Water Discharges from the CCGT Power Plant Outflow Pipeline during Operations*

Wastewater will be produced at the CCGT Power Plant and discharged to sea. The wastewater will be a combination of water from the Waste water treatment System (WWTS) (equipped with oil separator, neutralisation pond, normal waste holding pond) which receives waste from WTP and the main boiler process; the Sewage Treatment Plant (STP) and the cooling water from the cooling tower blowdown.

The discharge point will be located 1.5 km from shore, releasing the water 0.5 meters above the seabed. Discharges will be treated to ensure parameters (i.e. pH, temperature, turbidity, residual chlorine, and residual oil) will meet discharge standards.

A waste water dispersion model was undertaken using the predicted Project emissions (see **Annex N**). The main purpose was to verify that the intake/outfall positions were optimised with respect to the following criteria:

- Potential recirculation is minimised and quantified; and

- Proper mixing of the discharge in order to ensure compliance with relevant environmental standards. The Delft3D-FLOW model was used to characterise the nearfield mixing effects of the waste water discharge outfall for thermal and salinity dispersion.

The modelling assumed the power plant will be operating continuously at 100% load which is a conservative view given the expected load for the CCGT will be 60%.

### 8.12.5.1 *Impact Evaluation and Significance*

The Project will comply with IFC EHS Guidelines for wastewater discharge and Indonesian waste water quality, namely *The Decree of the Ministry of Environment No. 8 of 2009 (Waste Limits of Thermal Power Plant).*

The applicable limits for temperature when discharging waste water to the sea are set out in the table below. The IFC does not have any standards related to salinity limits from discharges to the marine environment, but *Ministerial Decree of State Minister of Environment No.51 of 2004 for Threshold Limit of Seawater Quality*, states a salinity marine biota thresholds of 33-34‰.

***Table 8.88 Indonesian Temperature and Salinity Limits***

| Parameter | Units | Limit |
|---|---|---|
| Temperature | Dec C | < 3°C at edge of scientifically established mixing zone (note 1 and 2) |
| Salinity | ‰ | Salinity marine biota threshold of 33-34‰ |

Note 1: 100 meters mixing zone is typically applied in Indonesia and is considered appropriate for this project given the limited sensitivity of ecological receptors within this range of the discharge location.
Note 2: This is also consistent with the IFC EHS Guidelines

In addition to temperature and salinity, other water quality parameters will be met, in accordance with *Minister of Environment and Forestry Regulation № 68 Year 2016* for STP outlet parameters, including pH, Free Chlorine, Zinc, Phosphate, BOD, COD, TSS, Oil and Grease, Ammonia, and Total Coliforms.

*Salinity*

Modelling was undertaken for the East Monsoon and West Monsoon, using a discharge of 42‰ (1.4 x Design purpose salinity, using a base salinity of 30‰). Salinity predictions were modelled at 30 m from the point of discharge, as shown in **Table 8.89**.

***Table 8.89 Salinity Modelling Predictions***

| | East Monsoon | | West Monsoon | |
|---|---|---|---|---|
| | At intake location (ppt) | At edge of mixing zone (ppt) | At intake location (ppt) | At edge of mixing zone (ppt) |
| **Max** | 30.2‰ | 32.57‰ | 30.33‰ | 32.8‰ |
| **Average** | 30.026‰ | 31.87‰ | 30.13‰ | 32.08‰ |

Modelling shows that salinity reduces from 42‰ to the values in Table 8.81 at a distance of 30 m. These values are below the salinity marine biota thresholds of 33-34‰ and within the range of baseline marine salinity values obtained from the 2018 surveys, which ranged from 30-32‰.

At the discharge location, there are no particularly sensitive benthic communities or assemblages, or habitats present that support significant fish assemblages. The benthic communities are comprised of soft sediment benthic invertebrates and pelagic species are expected to be transient.

Elevated seawater temperatures have the potential to cause alteration of the physiological processes (especially enzyme mediated processes) of exposed biota (*Wolanski, 1994*). These alterations may cause a variety of effects, ranging from behavioural response (including attraction and avoidance behaviour), minor stress and potential mortality for prolonged exposure. The potential for thermal impacts and associated reduction in oxygen is limited due to the rapid reduction in temperature in receiving water and localised affected area in addition to the fact that only marine biota that happen to travel or remain entrained within the discharge plume for an extended period of time could be impacted by the discharge.

Most marine species are able to tolerate short-term fluctuations in salinity of 20-30 % (*Walker and McComb 1990*). Therefore, it is expected that any pelagic species (including marine mammals, marine reptiles, fish, sharks and rays) passing through the plume would not experience any adverse effects.

Discernible impacts to benthic communities are also expected to be limited given the small predicted changes to baseline temperature and salinity, which is within the range of natural variation at this site where there are both marine and fresh water influences. Benthic invertebrates at the project site are typical of this region, where they may occur in waters with temperature and salinity ranges comparable to those predicted here. Worst-case impacts are, therefore, expected to be limited to potential minor alterations to benthic invertebrate species abundance and community structure (i.e. species richness, density) in the immediate vicinity of the point of discharge.

Based on the modelling results used to simulate the advection, dispersion and dissipation of the proposed discharge it was concluded that the Project is compliant with the Applicable Standards in terms of salinity and thermal plume. Further there is no significant (<1°C) recirculation between the intakes and outfall.

The sensitivity of marine water quality and biota to localised changes in temperature and salinity is considered **Medium.** However given the above modelling data the magnitude of the effects of waste water discharges from the CCGT Power Plant outflow pipeline are considered to be **Small**. Therefore the overall significance of the impact of waste water and cooling water discharge on water quality is therefore **Minor**.

**Figure 8-18** to **Figure 8-21** and **Annex N** provide the salinity and waste water thermal dispersion modelling parameters and results.

*Table 8.90 Assessment of Impacts of Wastewater and Cooling Water Discharges on Water Quality*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | Low | **Medium** | High |
| Magnitude of Impact | Negligible | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

### 8.12.5.2 *Mitigation Measures, Management, and Monitoring*

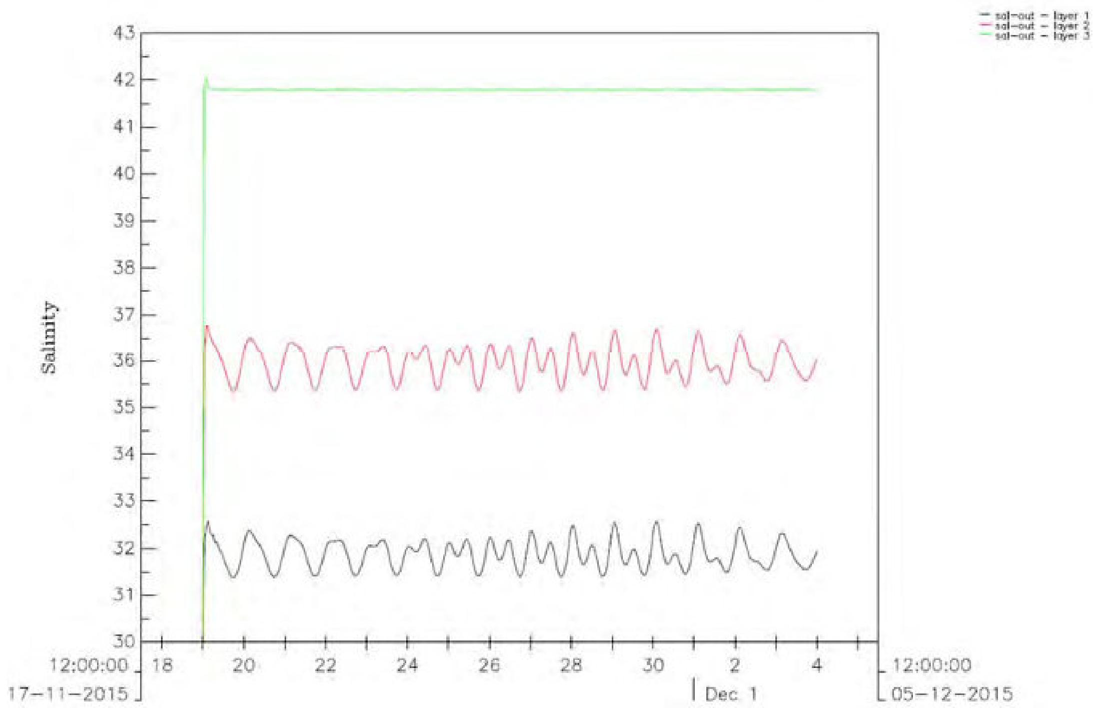
The following mitigation measures are required:

- Wastewater and cooling water discharge will be conducted below the water surface, to increase dispersion;
- Pipeline outlet structure to include a diffuser to comply with water quality standards and the 3°C rise in the seawater temperature; and
- Monitoring of receiving water quality will be undertaken at the discharge location within three (3) months of operations commencing, and annually thereafter.

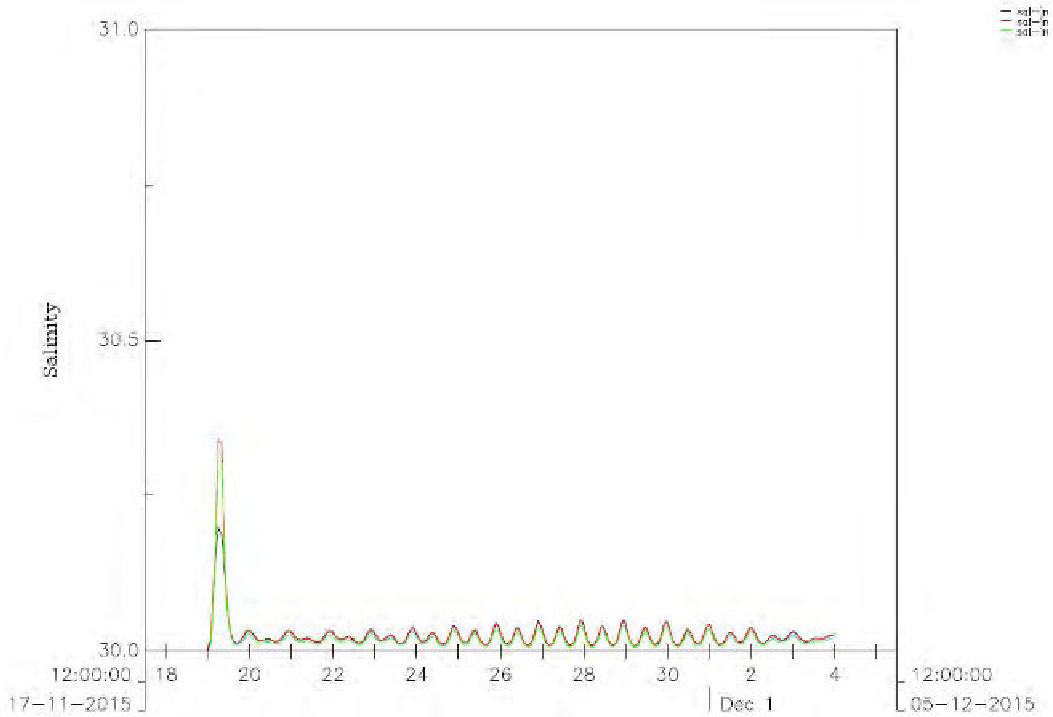
### 8.12.5.3 *Significance of Residual Impact*

The residual impact to water quality from the discharge of waste water and cooling water on water quality is considered to be **Negligible**, given the above additional measures.

*Figure 8-18 Salinity Concentration Values in Water Outlet and Intake during East Monsoon*

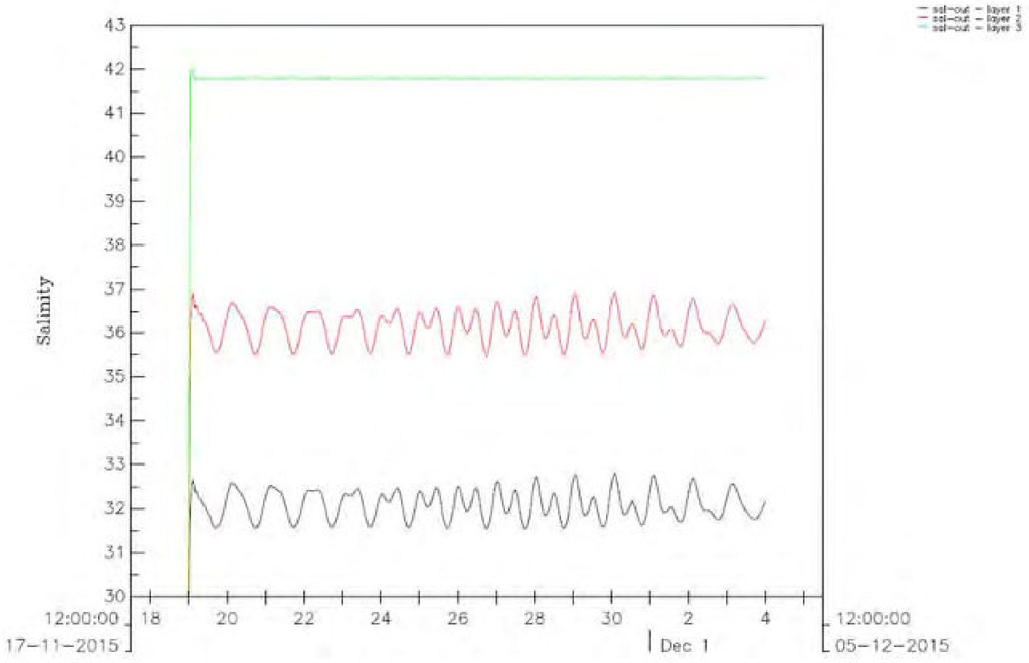



***Water Outlet***

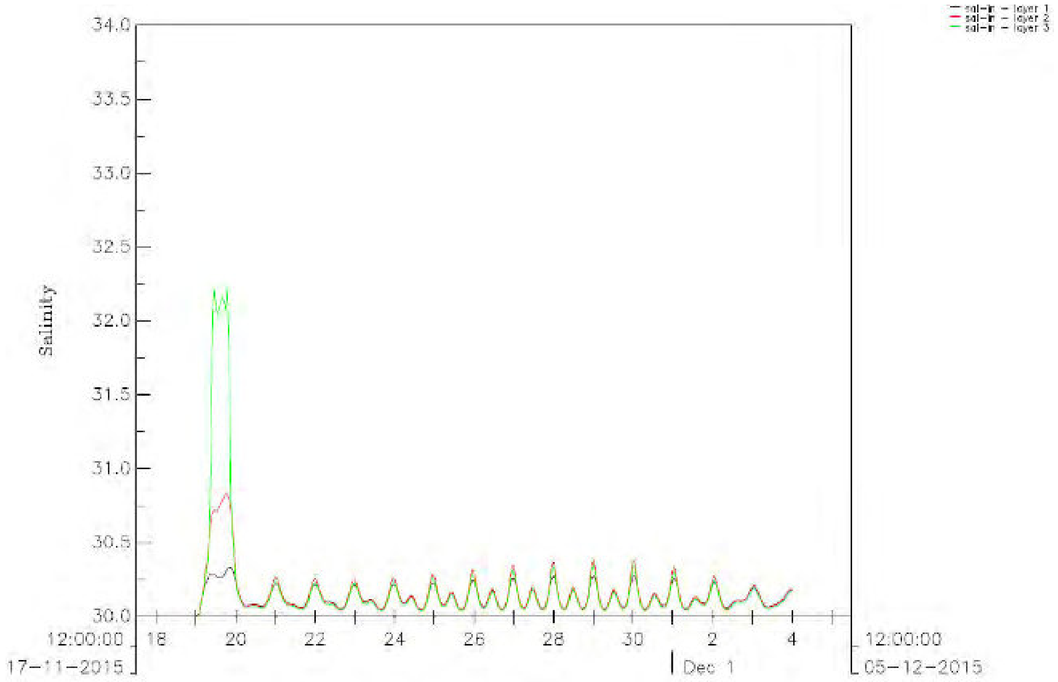



***Water Intake***

*Figure 8-19 Salinity Concentration Values in Water Outlet and Intake during West Monsoon*

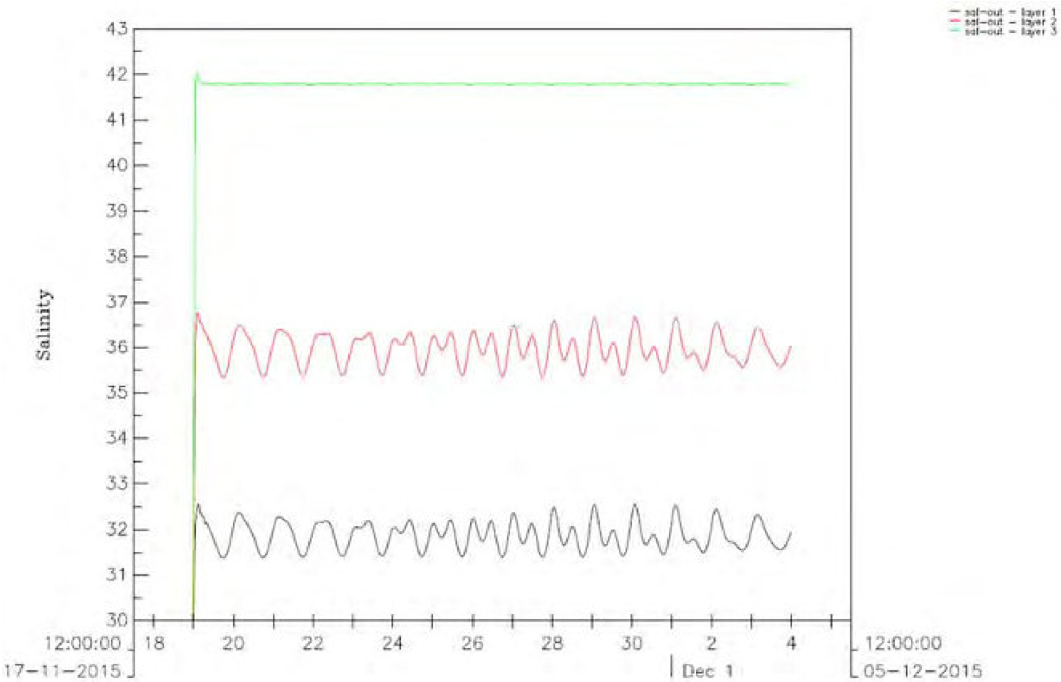



***Water Outlet***

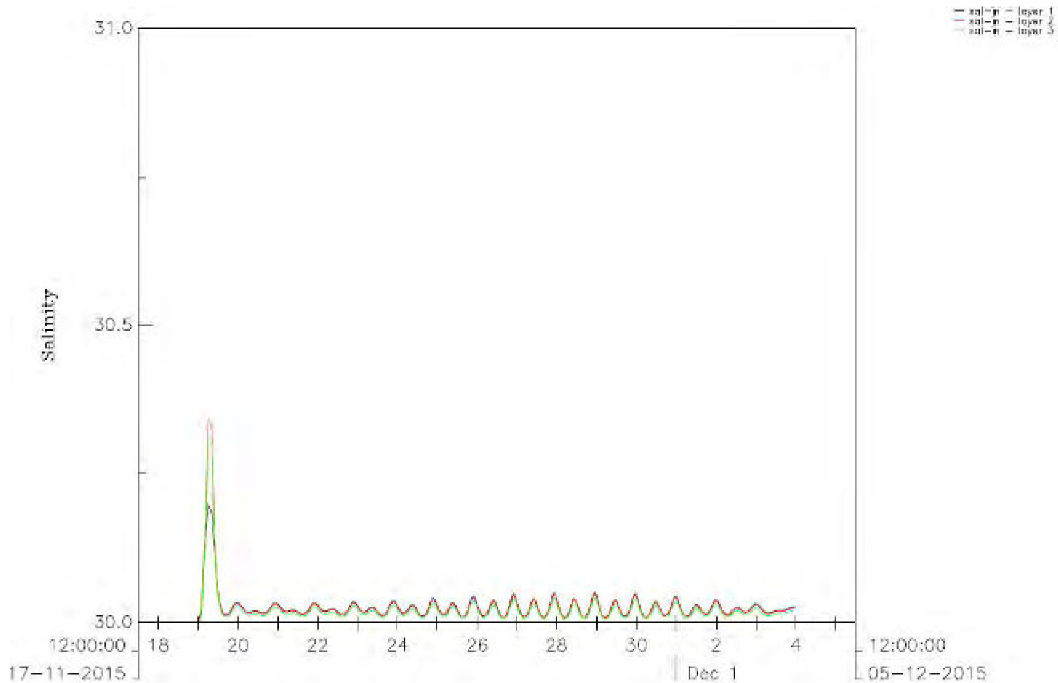



***Water Intake***

*Figure 8-20 Thermal Dispersion Values in Water Outlet and Intake during East Monsoon*

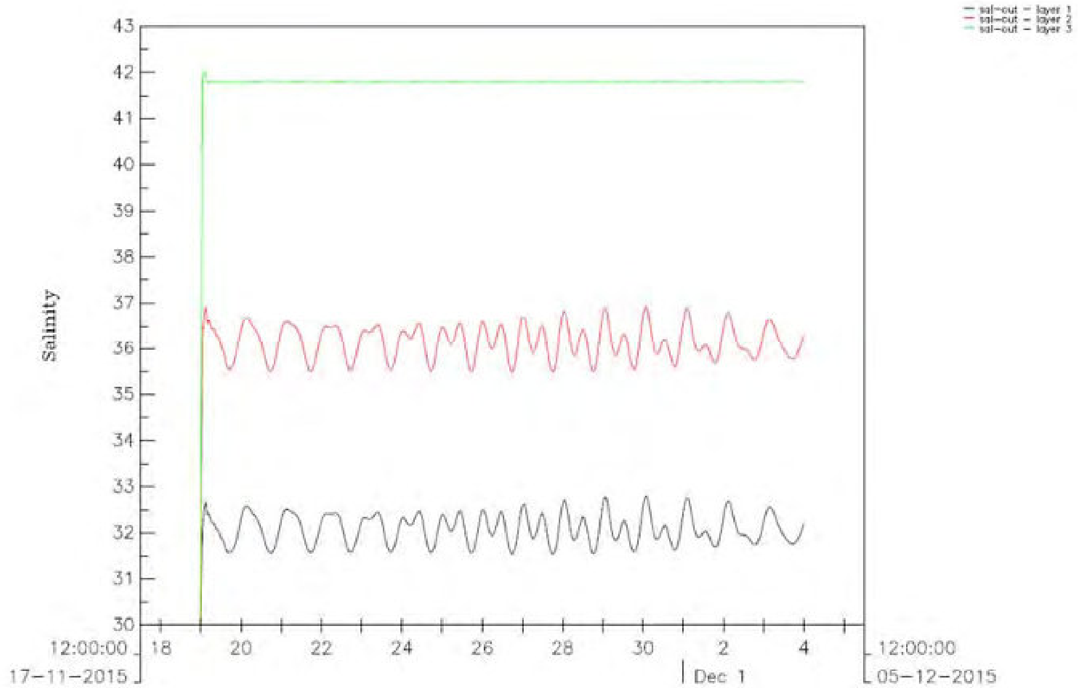



***Water Outlet***

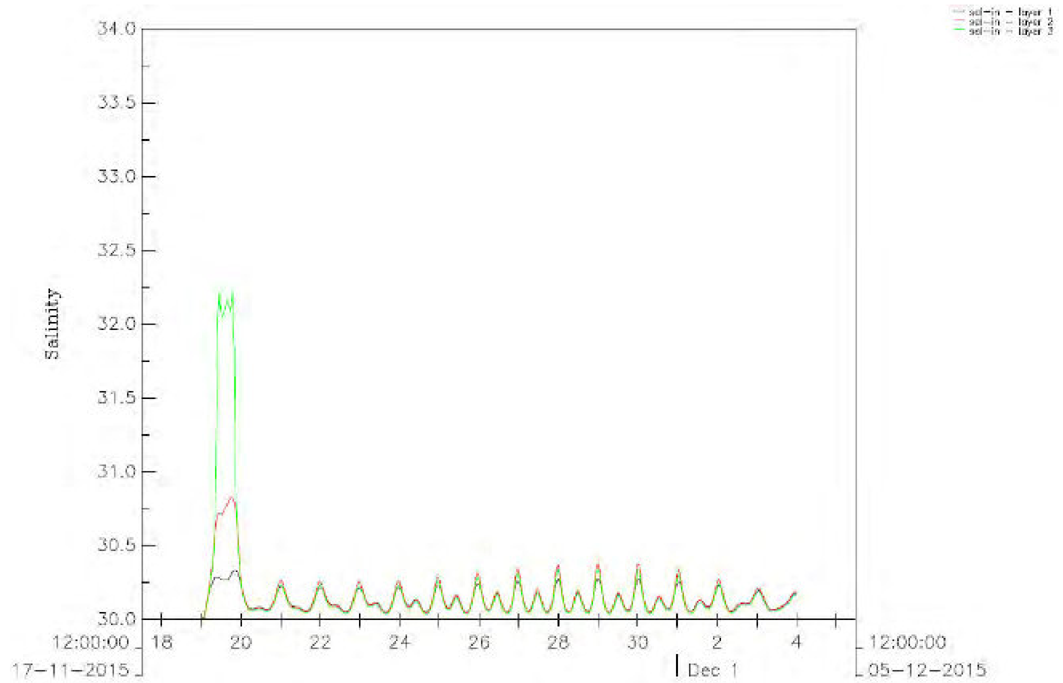



***Water Intake***

*Figure 8-21 Thermal Dispersion Values in Water Outlet and Intake during West Monsoon*




**Water Outlet**




**Water Intake**

### 8.12.6 *Assessment of Impacts - Degradation of Marine Water Quality from Wastewater and Process Water Discharges from the FSRU and Vessels during Operations*

The FSRU and other operating vessels will discharge wastewater from time to time over the course of the operational activities.

Heating of the LNG for the regasification process requires the use of seawater. The sweater used in the process will be discharged back to the sea with a temperature decrease of 7°C (cold water effluent). In the open loop method, the volume of seawater needed to evaporate LNG is estimated to be 2700 $m^3$/hr and the equivalent volume must be released below the sea surface.

The seawater intake and effluent release are integral part of the design and construction of the FSRU. The cold water effluent is released from the hull of the FSRU.

#### 8.12.6.1 *Impact Evaluation and Significance*

In accordance with MARPOL 73/78 requirements, all waste water discharges (i.e. sewage and oily water) will be treated prior to being discharged to sea, and assuming water treatment systems are in place and in good operational conditions, any impacts to seawater quality from these discharges is expected to be minimal and will be rapidly diluted.

Baseline conditions of seawater temperature are 30.3 °C at the surface and 28.56 °C at a depth of 1.5 - 2 m. The *Decree of the Ministry of Environment No. 8 of 2009 (Waste Limits of Thermal Power Plant) - Annex I part C* allows a temperature variance of ±2 °C.

Modelling was undertaken to show the difference in temperature at several locations between the baseline water temperatures and the expected temperatures during the FSRU Operation.

Out of eleven (11) sampling locations, only the FRSU Outlet (AL-9) showed a temperature of more than 2°C above or below baseline, with a temperature of 4.95°C below baseline. This is expected to rapidly increase through mixing within the water column and meet the IFC Guidelines of < 3°C at edge of the 100m scientifically established mixing zone.

As outlined in **Section 8.12.5**, changes in seawater temperatures have the potential to cause alteration of the physiological processes (especially enzymemediated processes) of exposed biota (Wolanski 1994). These alterations may cause a variety of effects, ranging from behavioural response (including attraction and avoidance behaviour), minor stress and potential mortality for prolonged exposure. The potential for thermal impacts and associated reduction in oxygen is limited due to the rapid reduction in temperature in receiving water and localised affected area in addition to the fact that only marine biota that happen to travel or remain entrained within the discharge plume for an extended period of time could be impacted by the discharge.

The sensitivity of marine water quality and biota to localised changes in temperature and salinity is considered to be **Medium**. The magnitude of the effects FSRU waste water and process water discharges on water quality are considered to be **Small**. The overall significance of the impact FSRU waste water and process water discharges on water quality is therefore **Minor**.

*Table 8.91 Assessment of Impacts of FSRU Wastewater and Process Water Discharges on Water Quality*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

### 8.12.6.2 *Mitigation Measures, Management, and Monitoring*

The following mitigation measures are required:

- In accordance with MARPOL 73/78 requirements, all water discharges from the FSRU and vessels will be treated prior to being discharged to sea.
- Waste water and process water discharge will be conducted below the water surface, to increase dispersion.
- Pipeline outlet structure to include a diffuser to comply with water quality standards and the 3°C rise in the seawater temperature.
- Monitoring of receiving water quality will be undertaken at the discharge location within three (3) months of operations commencing, and annually thereafter.
- Any potential exceedances in discharge standards will be addressed through corrective actions, which may include additional treatment or dilutions prior to discharge.

### 8.12.6.3 *Significance of Residual Impact*

The residual impact to water quality from the discharge of waste water and cooling water on water quality is considered to remain **Minor**, given the above additional measures.

### 8.12.7 *Alteration of Coastal Processes and Sedimentation from Presence of the Jetty.*

The construction jetty will be left in place after startup of the CCGT operations to provide an option for transportation of large equipment to/from the site in the event of repair/replacement during operational maintenance.

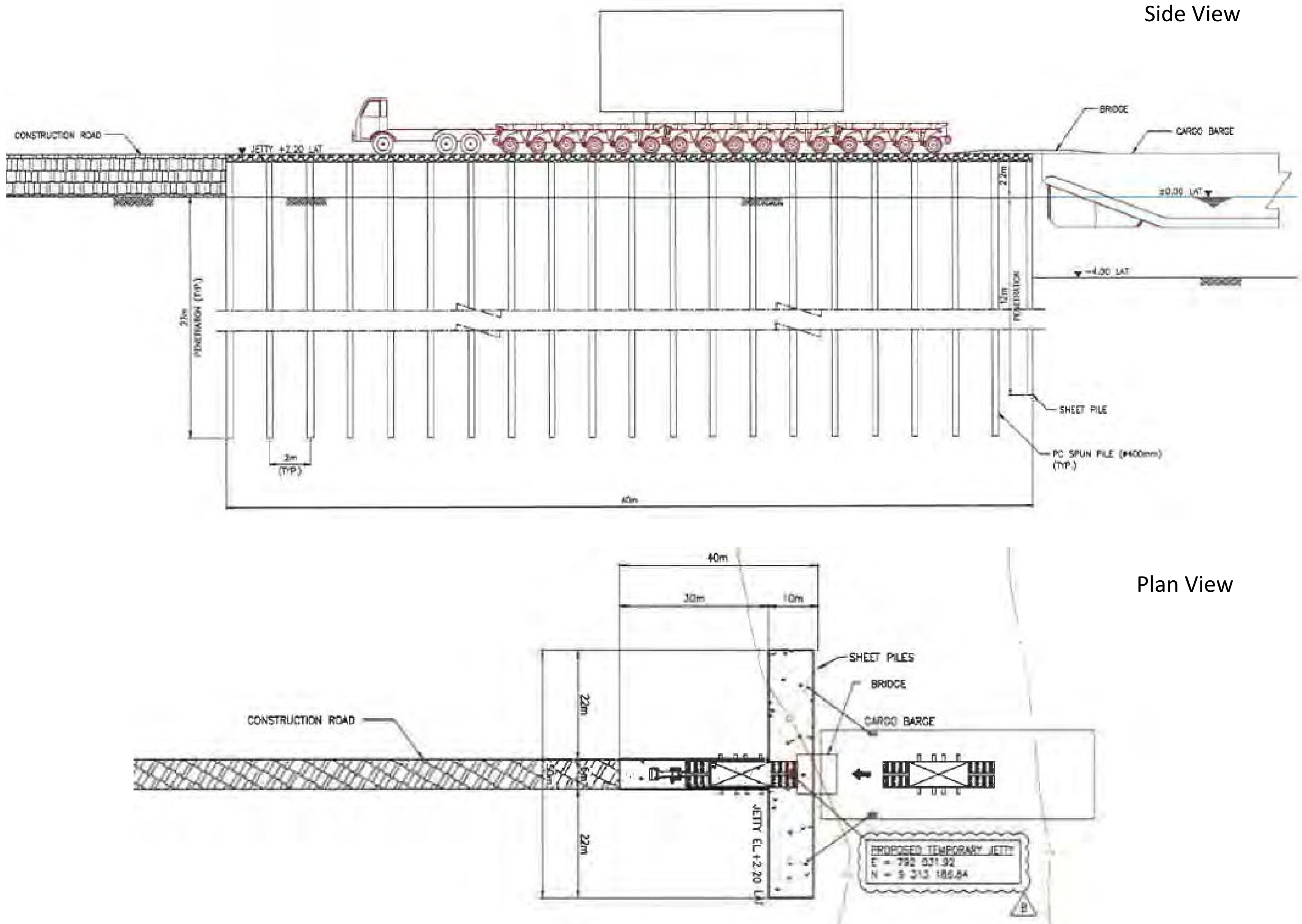
There is the potential for the physical presence of the jetty to affect coastal processes, such as the longshore transport of sediment, influence water flow and result in local sediment scouring around the structure, increased deposition or downdrift erosion. The potential impacts depend on the design of the jetty and main wave and sediment transport direction at the Project location.

#### *8.12.7.1 Impact Evaluation and Significance*

The jetty design consists of a concrete pile structure, fronted by a steel sheet pile retaining wall. The total length of the jetty is 40 m and 6 m width, with a perpendicular T-shaped front of 50 m length (**Figure 8-22**).

The concrete pile of 400mm outer diameter will have a total length of 24m embedded in the soil. The spacing of the piles will be 2m x 2m. On top of the piles at laid down area a concrete slab of about 30cm thickness will be poured.

*Figure 8-22 Construction Jetty Design*



The jetty structure is planned to be installed at an angle across a drainage channel, as shown in **Figure 8-23.**

*Figure 8-23 Construction Jetty Orientation*

The piled structure and orientation of the jetty is judged not to substantially impede water flow and sediment movement at the coastal location. In addition, the short length of the jetty extends over the intertidal area, therefore the jetty would only be exposed to currents and sediment transport during short periods of high tide. During this period maximum current velocities measured in the baseline surveys 2017 (Section 7) reach 40 cm/s.

The proposed location is a low energy environment, which displays net deposition of sediment carried in the water discharge from the terrestrial environment into the marine zone. From the satellite image in **Figure 8-23**, it can be seen that the build-up of sediment at the nearby drainage channels appears more or less equal on either side. The coastal features do not indicate that there is a dominant direction of net sediment transport in one direction or the other.

Seaward of the jetty facing, the dredge channel may result in some gradual settlement into the dredge channel, however noting that sediments here are predominantly fine and in suspension, the jetty is not considered a barrier to longshore sediment transport.

Based on the above, any impacts to coastal processes and water quality are assessed to be localised and erosion impacts are unlikely to occur, particularly in the context of affecting baseline accretion rates. Some localised scour and/or sediment build up may occur in the immediate vicinity of the jetty but is unlikely to significantly influence the area beyond this.

*Table 8.92* *Assessment of Impacts of Jetty Presence on Coastal Processes, Sedimentation and Water Quality*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | Medium | High |
| **Magnitude of Impact** | Negligible | Negligible | Negligible | Negligible |
| | **Small** | **Negligible** | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

*8.12.7.2* *Mitigation Measures, Management, and Monitoring*

Given the negligible significance ranking, no further mitigation is required. It is noted that the EPC Meindo is required to conduct a detailed engineering design following Notice to Proceed (NTP) on the Project, which will include a sedimentation study to measure the sedimentation rate and the required frequency for potential maintenance dredging. It is recommended that this is detailed in a maintenance plan which includes periodic monitoring for sediment accretion or erosion in the area of the jetty.

## *8.13* *MARINE BIODIVERSITY*

### *8.13.1* *Potential Sources of Impacts*

Routine project activities that may have an impact on marine biodiversity include:

*Construction Phase*

- Direct loss and degradation of marine habitats and water quality from jetty construction, dredging and pipeline trenching;
- Degradation of marine habitats and ecological communities from invasive marine species (IMS);
- Direct mortality or injury of marine fauna from vessel movements; and
- Disturbance and displacement of marine fauna by underwater noise generated by pile driving activities, dredging and vessel activities during construction.

*Operations Phase*

- Direct mortality or injury of marine fauna from vessel movements;

- Direct loss and degradation of marine habitats and water quality from maintenance dredging;

- Direct mortality to marine fauna from seawater intake;

- Disturbance of marine fauna by operational underwater noise generated by FSRU operations, LNG tanker unloading, and vessel and maintenance dredging activities at the jetty; and

- Disturbance to coastal morphology and sediment transport from the presence of the jetty and dredge access channel.

Potential impacts to marine habitats from non-routine events are discussed in **Section 10**.

*8.13.1.1 Assessment Approach and Criteria*

The standards of relevance to habitats, criteria for sensitivity and magnitude of the impact to marine biodiversity are as defined in **Section 8.9** of this Report.

### *8.13.2 Assessment of Impacts - Direct Loss and Degradation of Marine Habitats and Water Quality from Jetty Construction, Dredging and Pipeline Trenching*

The seabed sediments at the nearshore locations of the proposed jetty, jetty approach and intake and outlet pipelines are characterised by very soft clay to firm sandy silt (*Tigenco, 2016*). The sediments along the gas pipeline route and at the FSRU become progressively dominated by soft clay and silty clay with some coarser sediment and rock outcrops. At the greatest depths, sediments comprise stiff clay (CH) and sand (SP) (*Mahakarya, 2015a*). Benthic surveys completed nearshore and along the pipeline route indicate that there are no significant areas of corals and other benthic primary producer habitat, with the nearest corals located 5 km north-west from the pipeline route.

A range of infauna and epifauna were identified in the nearshore area, including species of *Polychaeta*, *Crustaceae*, *Pelecypoda*, *Nemertina*, *Oligochaeta*, *Sipuncula*, *Anthozoa* and *Echinodermata* (*ERM, 2018b*). Additionally, an abundance of *Nauplius sp*. was also recorded at several locations within the Project area namely at Cimalaya River estuary, nearshore and to the west of the proposed gas pipeline. Crustaceans were very well represented within the surveyed mangrove area and other species are expected to occur widely in sediment throughout the region. It is possible that endangered species of sea cucumber occur in this region, but the project area is not considered to be of significant importance for these species. The ecological quality status of benthic communities in the project area are classified as slightly disturbed.

Nearshore waters are turbid with relatively high concentrations of TSS and elevated levels of organics, oil and grease, zinc, copper, ammonia and nitrates above local water quality standards, likely to be a result of existing estuary discharges into the nearshore area. Waters along the offshore gas pipeline were also found to have elevated concentrations of phosphate and nitrate above local water quality standards.

The existing habitats at the proposed jetty and dredge channel location and the Area of Influence are considered to be Natural Habitat, but supports relatively depauperate soft-sediment benthic invertebrate communities and there are existing levels of pollution and disturbance. No Critical Habitat is present within the Area of Influence. The sensitivity of these Natural Habitats is considered to be Low.

#### *8.13.2.1 Impact Evaluation and Significance*

Direct loss of benthic habitat will occur as a result of jetty construction and dredging of the jetty access channel, although sediments will be side cast onto adjacent seabed. Seabed disturbance will also occur as a result of pipeline trenching activities and installation of the FSRU moorings. Dredging and trenching activities are expected to result in localised increases in suspended sediments, potential mobilisation of contaminated sediments and deposition of sediment on the seabed adjacent to the areas of direct removal. The area of direct benthic habitat loss as a result of construction phase activities is outlined in **Table 8.93**.

***Table 8.93 Direct Habitat Loss Associated with Project Components***

| Project Component | Natural Habitat (ha) | Modified Habitat (ha) | Critical Habitat (ha) |
|---|---|---|---|
| Pipelines (Offshore) | 120.13 | None | None |
| Jetty and Dredging Area | 7.25 | None | None |
| Total | 127.38 | None | None |

Dredging activity at the jetty location and approach will be conducted from the shoreline (jetty location) to a distance of approximately 1.5 km offshore. Dredged material with a total predicted volume of approximately 80,000 $m^3$ will be extracted using either swamp backhoes near the shoreline (from 0 m until one (1) m LAT depth) or using a flat barge equipped with a long arm excavator or crawler crane with clam shell. Dredged material will be deposited on each side of the access channel using side-casting methods. It is estimated that 300 $m^3$/hour of sediments will be deposited along the dredged access channel over 10 hours a day and 27 days duration (equivalent to 3,000 $m^3$/day).

A 2D Mud Dispersion model was conducted for both the wet season and the dry season to estimate the magnitude and extent of the dredge plume (elevated TSS above background concentrations) and the amount of sediment deposited. Throughout the dredging activity, there are two sediment phases i.e. elevating phase and precipitated sediment with ratio of 50:50.

Based on the modelling results, dredging is expected to increase TSS concentrations between 0.2 – 4.7 mg/L above baseline conditions, which already exceed local standards in the nearshore estuary area. Impact parameters are shown in **Table 8.94** and **Table 8.95**. Complete results of TSS increase are depicted in **Figure 8-24** to **Figure 8-26.**

Given the already turbid nearshore conditions and the relatively low tidal currents in the project area, the extent of the sediment plume remains relatively localised and within approximately 500 m of the activity.

*Table 8.94 TSS Parameter Impact Magnitude Prediction*

| No | Locations | TSS Concentration (mg/l) | | | Standards (mg/l) *) | |
|---|---|---|---|---|---|---|
| | | Baseline | Impact Magnitude (TSS Increase – Modelling Result) | Environmental Condition during the Activity | Mangrove | Coral |
| 1 | AL-1 0794256; 9320559 | <8 | 0.0 | <8 | 80 | 20 |
| 3 | AL-3 0792762; 9312641 | 647 | 4.7 | 651.7 | 80 | 20 |
| 4 | AL-4 0790867; 9315270 | 142 | 0.3 | 142.3 | 80 | 20 |
| 5 | AL-5 0791380; 9316755 | 11 | 0.7 | 11.7 | 80 | 20 |
| 6 | AL-6 0793222; 9315547 | 12 | 3.3 | 15.3 | 80 | 20 |
| 7 | AL-7 0796821; 9315687 | 50 | 4.0 | 54 | 80 | 20 |
| 11 | AL-11 0792749; 9316745 | 11 | 2.2 | 13.2 | 80 | 20 |

*) Minister of Environment Decree № 51 Year 2004 for marine biota.

*Table 8.95 Area and Trajectory of Elevated TSS*

| Time | West Season (km²) | East Season (km²) |
|---|---|---|
| Day 1 | 4.49 (around the shore of project site) | 4.49 (around the shore of project site) |
| Day 5 | 5.71 (around the shore of project site) | 5.26 (around the shore of project site) |
| Day 10 | 8.25 (Northeastern side) | 7.19 (Northeastern side) |
| Day 15 | 9.05 (arah timur laut) | 9.23 (Northeastern side) |
| Day 20 | 9.1 (Northeastern side) | 9.21 (Northeastern side) |

| Time | West Season ($km^2$) | East Season ($km^2$) |
|---|---|---|
| Day 25 | 9.25<br>(Northeastern side) | 9.34<br>(Northeastern side) |
| Day 30 (no input already) | 4.12<br>(around the shore of project site) | 5.26<br>(around the shore of project site) |

*Figure 8-24 Modelled TSS Increase at Jetty and Open Channel Dredging Activities in Wet Season*

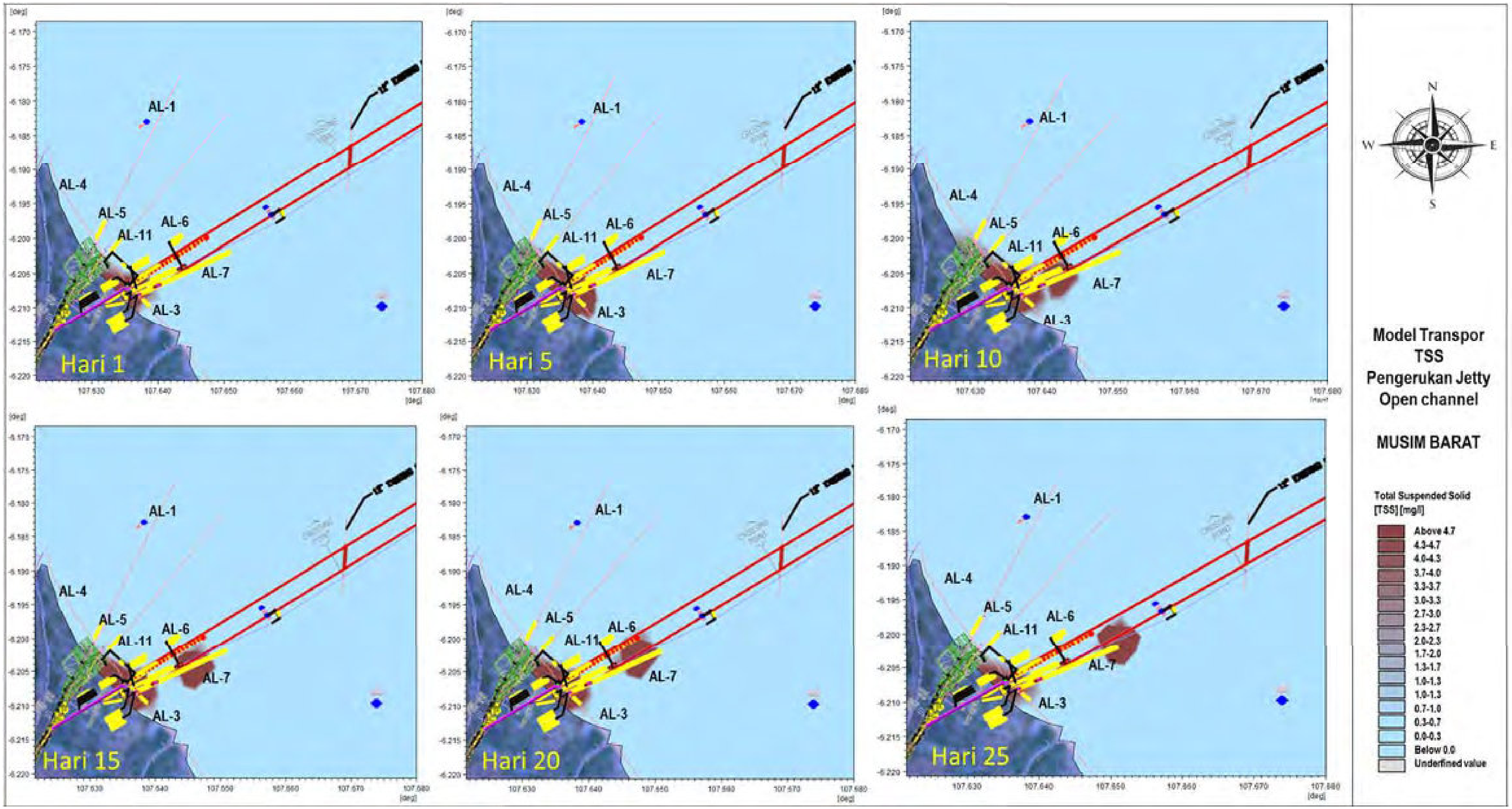


*Figure 8-25 Modelled TSS Increase at Jetty and Open Channel Dredging Activities in East Season*

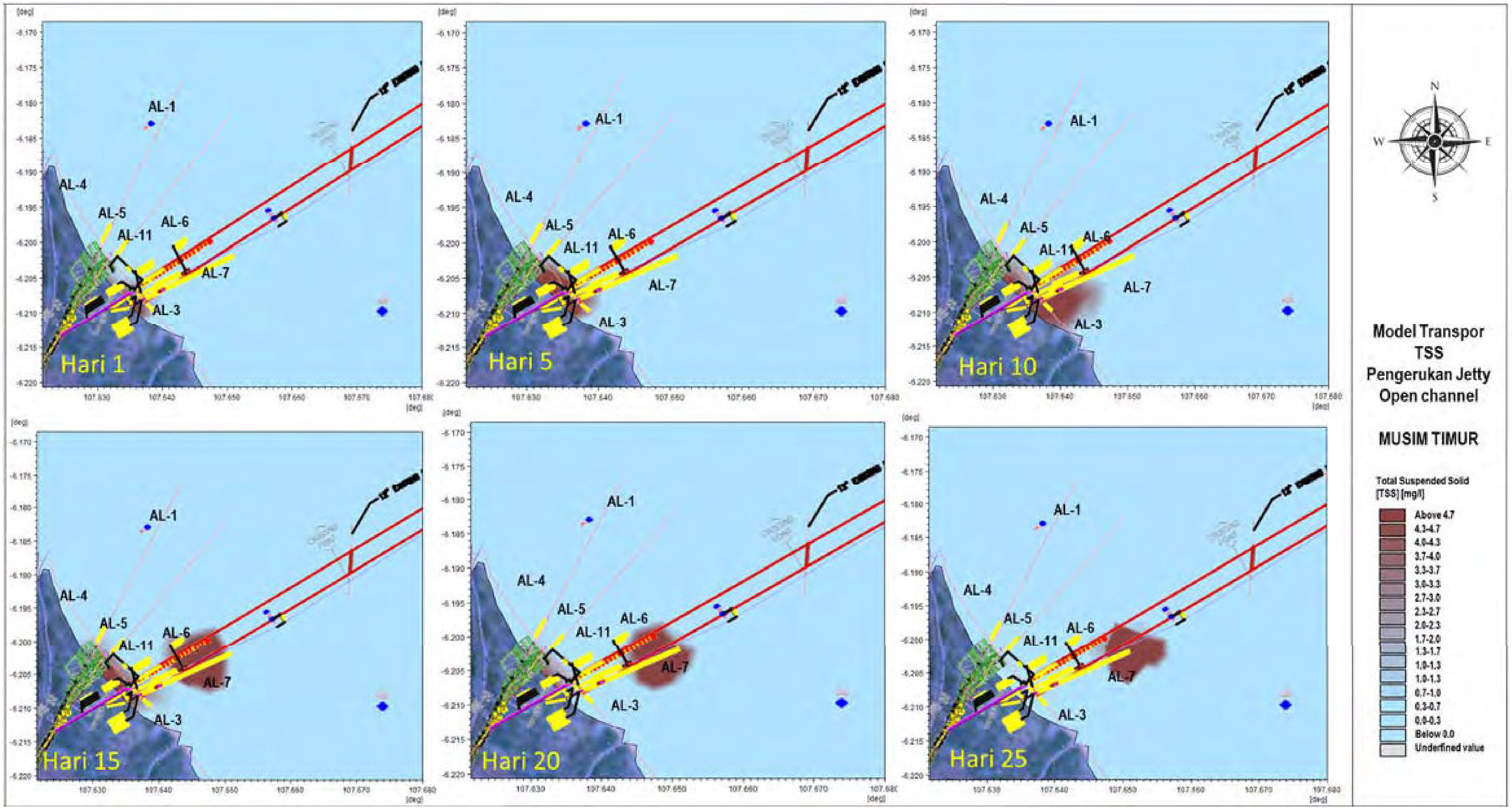


*Figure 8-26 TSS Spread Simulation after Dredging Activities Terminated*

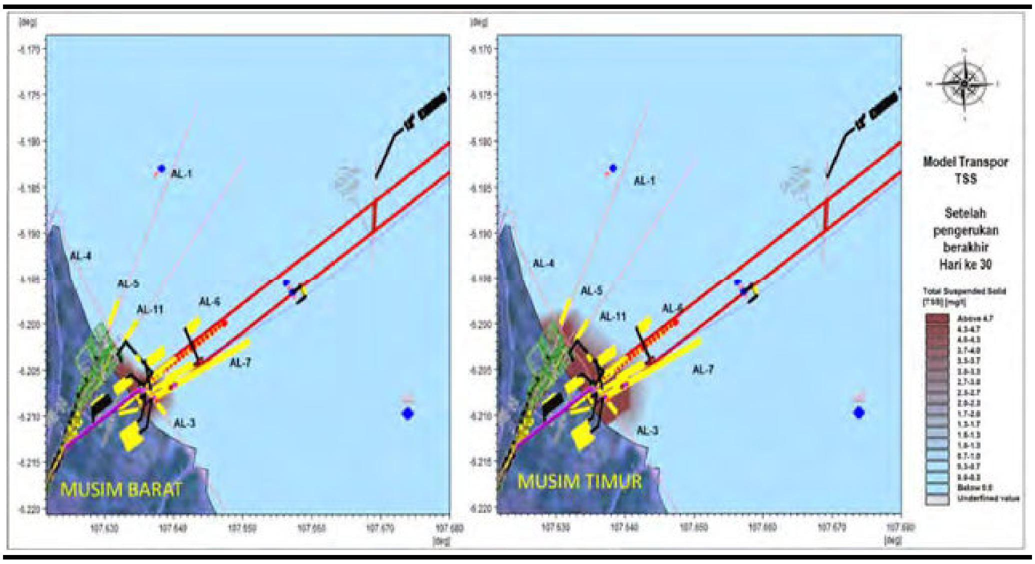
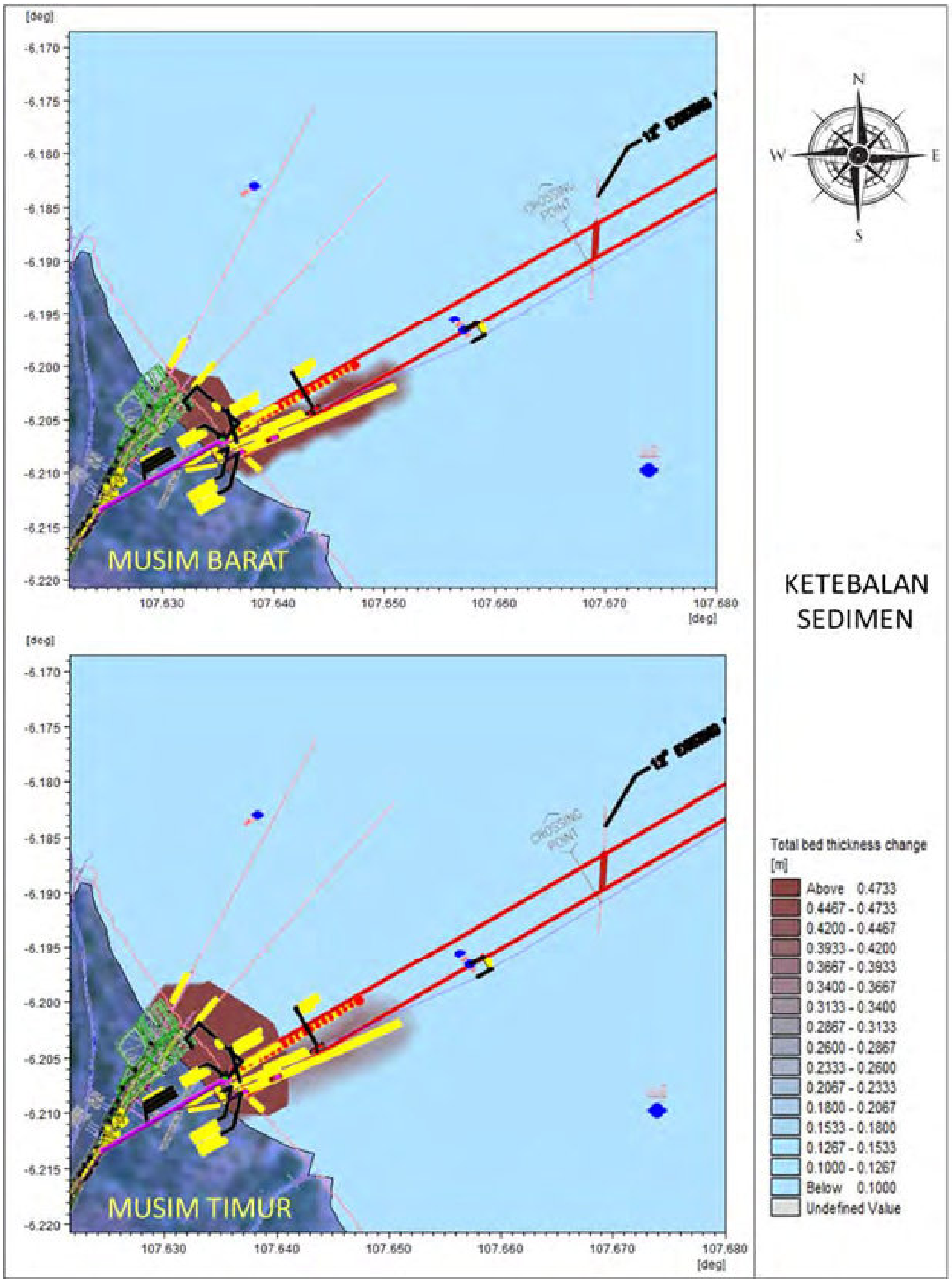



**Table 8.96** and **Table 8.97** presents sediment deposition estimates adjacent to the dredged channel both in west season and east season based on the modelling.

*Table 8.96 Impact Magnitude of Increasing Sedimentation in Construction Phase*

| Season | Thickness (m) | Sediment thickening area |
|---|---|---|
| West Season | 0.4467 m | 4.55 km$^2$ |
| East Season | 0.3933 m | 6.44 km$^2$ |

*Figure 8-27 Sediment Thickness Changes Following Dredging*




Based on heavy metals content analysis in the sediment, riverbed sediment is still under the *Probable Effect Level* (PEL) values and can be categorised as safe for water biota life. Regarding Copper (Cu) concentration in the river water and groundwater at the community wells at the study area that do not meet the river water standard and clean water requirement, it is being assumed that it was sourced from weathering metal from sediment or soil around the site.

Sediments are relatively uniform at all river/surface water measurement locations. Relative uniform contents of Cu and Pb metal explains the natural condition and that it is not from contamination. Specifically for Pb parameter, naturally the riverbed sediment at the study area has closely approached the PEL values.

Overall, the magnitude of loss and disturbance of low sensitivity soft sediment benthic infauna and epifauna communities as a result of jetty construction, dredging, trenching and the FSRU moorings will affect a relatively small proportion of the widely occurring habitats and communities along this coastline, but has the potential to significantly reduce environmental quality due to the proposed side-casting trenching method. The impact magnitude is considered to be **medium** and therefore of **Moderate** significance.

*Table 8.97 Assessment of Impacts from Loss and Degradation of Marine Habitats during Construction*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | **Large** | Moderate | Major | Major |

### 8.13.2.2 *Mitigation Measures, Management and Monitoring*

It is recommend that the following mitigation measures be applied in relation to marine habitat impacts during construction:

- Project shall develop a development of a dredging and disposal risk assessment and Dredging Management Plan in accordance with IMO and OSPAR guidelines.

Additionally, the dredging footprint of the Project should be reduced as far as practicable in order to reduce the direct disturbance to the seabed and indirect effects from turbidity plumes. This includes:

- Dredging vessels will be equipped with the appropriate Global Positioning System (GPS) equipment or other navigational aids to ensure dredging will occur at the specified dredge footprint and disposal at the designated soil disposal site;

- EPCs' dredgers will maintain adequate clearance between vessel hull and the seabed at all states of the tide and reduce vessel speed to ensure that excessive turbidity is not generated by turbulence from vessel movement or propeller wash.

### 8.13.2.3 *Significance of Residual Impact*

In view of the implementation of mitigation measures, the residual impact to seawater quality is expected to be **Minor**.

### 8.13.3 *Assessment of Impacts - Degradation of Marine Habitats and Ecological Communities from Invasive Marine Species (IMS)*

The FSRU will be mobilised to Indonesia from a fabrication yard in Korea. Additional support vessels may also be mobilised to the region from waters outside Indonesia. Invasive Marine Species could therefore be introduced through the discharge of ballast water or from vessel hull fouling.

Invasive species are any species that are non-native to a particular ecosystem and whose introduction and spread causes, or are likely to cause, socio-cultural, economic or environmental harm or harm to human health (*FAO, 2013*). Invasive species are naturalised species that reproduce often in large numbers and are spread over a large area, damaging native species (*FAO, 2005*).

The Global Invasive Species Database (GISD) (2017), returned no records for the marine area although there is potential for unreported invasive species to be present.

#### 8.13.3.1 *Impact Evaluation and Significance*

Ballast water can contain thousands of aquatic microbes, plants and animals, which can be spread across the globe as the vessel releases ballast water. Unmanaged ballast water released in foreign ports could potentially introduce a range of invasive marine species. Invasions have already taken place around the world, in some instances with significant consequences for the local ecosystem.

The introduction or spreading of non-indigenous species through hull fouling of (typically slow-moving) vessels such as dredgers or Project equipment can occur, when marine plants and animals that attach and grow on the submerged parts of a vessel like the hull, propellers, anchors, niche areas and fishing gear and are transported to a receiving port and become established. Vessel biofouling is a major pathway for the introduction of exotic species around the world.

The introduction and spread of marine species through biofouling, or in a ship's ballast water, can harm fisheries, threaten healthy fish habitats and have adverse economic and health effects.

In view of the globally recorded negative effects of invasive species transfers, the International Maritime Organisation (IMO) considers these introductions to new environments via ships' ballast water, hull or other vectors. To reduce these risks, the IMO has instituted ballast water management regulations (1), including requirements for open ocean ballast water exchanges and associated ballast water management record books.

The implementation of open ocean ballast water exchanges has been shown to reduce plankton concentrations within ballast water holding tanks on container vessels by 90 percent (*Ruiz & Smith, 2005*).

The sensitivity of the project area to Invasive Marine Species is considered to be **Low**. The magnitude of effect due to Invasive Marine Species is likely to be **Medium**. The overall magnitude of this impact is therefore **Minor**.

*Table 8.98 Assessment of Impacts from Invasive Marine Species*

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | **Minor** | Moderate | Major |
| | **Large** | Moderate | Major | Major |

### *8.13.3.2 Mitigation Measures, Management, and Monitoring*

It is recommended that the following mitigation measures be applied in relation to Invasive Marine Species during construction:

- The FSRU and any contracted vessels coming from outside of Java territorial waters will have vessel hull and niches confirmed to be free of IMS prior to mobilisation to the local waters of the Project area.
- All contracted vessels and the FSRU will maintain a current anti-fouling coating, as evidenced by a current Anti-fouling System Certificate under Annex 1 of the International Convention on the Control of Harmful Anti-Fouling Systems on Ships or other equivalent records.
- The FSRU and all contracted vessels will meet the requirements of the International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004, including:
    - Ballast water shall be managed in accordance with the provisions set out in the Convention; and
    - A Ballast Water Management Plan and a ballast water record book will be implemented and maintained on board. The FSRU and any vessels coming from outside of Jawa waters will have vessel hull and niches confirmed to be free of IMS prior to mobilisation to the local waters of the Project area.

### *8.13.3.3 Significance of Residual Impacts*

The residual impact remains **Minor**.

### *8.13.4 Assessment of Impacts - Direct Mortality or Injury of Marine Fauna from Vessel Movements (Construction Vessel Presence)*

A number of vessels will support the project during the construction phase, including those associated with the mobilisation and construction of the FSRU, construction and installation of the pipeline and general supply vessels. Specifically, vessels are likely to include a crane barge, support barge, tug and dive vessels. Vessels will also be temporarily present within the nearshore area during pipe laying, dredging and establishment of the FSRU mooring.

Project vessels could collide with marine fauna resulting in superficial injury, serious injury, affecting life functions (e.g. movement and reproduction) and in the most extreme cases, mortality.

#### *8.13.4.1 Impact Evaluation and Significance*

Marine fauna at most risk of vessel collision include marine turtle and marine mammal species of conservation significance. There are no confirmed records of marine turtles or mammals from surveys conducted within the Project site and there are no known important marine mammal or turtle habitats, such as turtle nesting beaches, associated with the coastline at the Project area. However, species of marine mammals are known to occur within Indonesia. Spinner dolphins (IUCN listed as Data Deficient) have been anecdotally recorded in the Project site, therefore individuals may occur within the Project site on occasion.

The sensitivity of marine mammal species to injury or mortality from vessel strike is considered to be **Medium** for the Data Deficient species.

Vessel speed has been demonstrated as a key factor in collisions with marine fauna such as marine mammals with faster vessels having a greater collision risk than slower vessels (*Laist et al. 2001*). Laist et al. (2001) suggest that the most severe and lethal injuries to cetaceans are caused by vessels travelling at 14 knots or faster.

Marine mammal collisions are uncommon and based on a NOAA database there are only two known instances of marine mammal collisions with vessels travelling at less than 6 knots (Jensen and Silber 2004).

Small cetaceans (dolphins) that may occur in the Project site are agile and highly mobile animals. Dolphins are commonly observed swimming around vessels and riding bow waves and are thus expected to have a greater awareness and ability to avoid the relatively slow moving Project vessels during construction activities. The lack of any recognised aggregation areas for marine mammals in the Project site reduces the likelihood of any vessel interactions with marine mammals.

The magnitude of effect due to marine fauna injury or mortality from vessel strike is likely to be **Small** as such an incident is either unlikely to occur or will be highly infrequent. Potential injury or mortality of an individual or small number of marine fauna during construction will not result in a substantial change in the population of the species present, or other species dependent on them. The overall magnitude of this impact is therefore **Minor**.

*Table 8.99 Assessment of Impacts on Marine Fauna from Vessel Collision*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

### *8.13.4.2 Mitigation Measures, Management and Monitoring*

It is recommend that the following mitigation measures be applied in relation to vessel collision during construction:

- Vessels will operate in accordance with standard maritime practices, whereby vessel speeds will be adjusted depending on environmental conditions (e.g., visibility, metocean condition) as required by the captain of the vessel and to avoid any encountered hazards;
- Support vessels will not travel greater than six (6) knots within 300 m of a whale or 100 m from a dolphin, if sighted, (i.e. will maintain a caution zone of those distances). In addition, vessels will approach no closer than 100m from a whale or 50 m from a dolphin, if sighted. (Note this standard does not apply to support vessels engaged in limited/constrained manoeuvrability activities where vessel speed will already be low);
- Vessels will not directly approach a marine mammal from in front or behind their path of travel;
- Vessels will not exceed a speed limit of 5 knots within designated boating channels around the jetty or the FSRU; and
- Vessel bridge crew to maintain visual watch of any hazards (including marine mammals).

### *8.13.4.3 Significance of Residual Impact*

In view of the implementation of mitigation measures, the residual impact is to remain **Minor** significance.

*8.13.4.4 Operations Vessel Presence*

Vessel collision impacts to marine fauna are described in the preceding Section under the construction phase and are not assessed further. Standard control measures for operational vessel movements will be the same.

### *8.13.5 Assessment of Impacts - Disturbance and Displacement of Marine Fauna by Underwater Noise during Construction*

Disturbance and displacement of marine fauna by underwater noise could occur from pile driving activities, dredging and vessel activities during construction. Pile driving is required for the jetty construction as well as the FSRU mooring. The jetty construction is expected to require nine (9) months, with the foundations piled into the seabed. FSRU mooring is expected to require 32 days to install a total of 32 circular steel piles related to breasting and mooring dolphins (i.e. one (1) pile installed per day). All piling works will be completed using a hydraulic hammer as a quieter alternative to a diesel powered impact hammer.

Dredging activities will be required for the jetty construction to allow access to barges and other supply vessels. Dredging will be undertaken by swamp backhoe in shallow intertidal areas (<1 m depth) and by flat working barge equipped with long arm excavators or crawler cranes with clam shells in deeper water. Dredging will occur over approximately 9 months. Trenching along the seawater intake and waste water outflow pipelines and the pipeline route will also be undertaken using backhoe or clamshell methods for open trenching in shallow water up to 2 m depth and potential jetting or ploughing for post-trench activities in deep waters. Other vessel activities during construction, such as supply vessels, will also create underwater noise.

Construction activities at the proposed jetty and FSRU are therefore expected to generate underwater noise. This can affect marine biodiversity in three (3) main ways (*Richardson et al., 1995; Simmonds et al., 2004*):

- Injury or hearing impairment. Hearing loss may be temporary i.e. Temporary Threshold Shift (TTS), or permanent (Permanent Threshold Shift (PTS);
- Masking or interfering with other biologically important sounds (including vocal communication, echolocation, signals and sounds produced by predators or prey); and
- Disturbance leading to behavioural changes.

*8.13.5.1 Impact Evaluation and Significance*

As described in **Section 7**, deep water marine mammal species that have been recorded in the region are very unlikely to occur within the Project area. Interviews with local fishermen have indicated that dolphins, however, may sometimes occur in the area. The species are unknown but are most likely to be bottlenose dolphins. There is a small possibility that Indo-Pacific humpback and Irrawaddy dolphins could be present in nearshore waters. They are coastal species found broadly in Indonesia, but in fragmented and patchily distributed subpopulations, and have not been recorded in the region.

The severity of potential underwater noise impacts depends on the context of the surrounding environment and the sensitivity that the animal has to the sound. Three functional hearing categories have been assigned to whales and dolphins, based on whether they hear and communicate at low, mid or high frequencies (*Southall et al. 2007, Finneran 2015; 2016 and NMFS 2016a*). Large baleen whales (e.g. humpback whales) use low frequency sounds. Large toothed whales (e.g. sperm whales and some offshore dolphins) use mid-frequency sounds. Coastal dolphins (e.g. Irrawaddy dolphins) use high-frequency sounds. Based on this, NMFS (2016) have proposed impact criteria for TTS and PTS impacts in cetaceans (**Table 8.100**).

The context of sound exposure plays a critical and complex role in behavioural responses (*Gomez et al. 2016*). For example, different species (and different individuals or groups within a species) may respond differently to varying levels of sound depending on their behaviours and motivation at the time (e.g. foraging, socialising, reproduction) and other factors such as the type of sound, duration of exposure, and the suddenness of the onset of the received sound (*Gomez et al. 2016*). Cetaceans have been observed to exhibit varying behavioural responses to underwater sounds (ranging from, for example, momentary pauses in vocalisations and changes in body orientation, to changes in travel direction and behavioural avoidance) between SPLs of 120 and >180 dB re 1 µPa (*Southall et al. 2007; Gomez et al. 2016).* Higher received levels are not always associated with stronger behavioural responses (*Southall et al. 2007; Gomez et al. 2016*), but it is reasonable to assume that more significant behavioural responses such as avoidance are more likely to occur in response to higher sound levels. It is important to differentiate minor, biologically insignificant reactions from sustained, and/or biologically meaningful responses that may influence survival (*Southall et al. 2007*).

Currently, there are no specific received level thresholds for reliably assessing or regulating masking or stress responses. Impact assessment is focussed on responses that may lead to significant life stage impacts or displacement from an area, so a threshold for behavioural disturbance based on cetacean avoidance reactions to sound is more commonly adopted as a proxy for such effects (*Gomez et al. 2016*).

*Table 8.100 Auditory Hearing Ranges and Underwater Noise Impact Criteria Proposed for Cetaceans*

| Receptor Group | Auditory Hearing Range | Impact Criteria | |
|---|---|---|---|
| | | **TTS * 3** | **PTS * 3** |
| Low-frequency cetaceans | 7 Hz – 35 kHz, most sensitive between 200 Hz and 19 kHz [1, 2, 3] | Impulsive: 213 dB (Pk), 168 dB ($SEL_{cum}$) Non-impulsive: 179 dB ($SEL_{cum}$) | Impulsive: 219 dB (Pk), 183 dB ($SEL_{cum}$) Non-impulsive: 199 dB ($SEL_{cum}$) |
| Mid-frequency cetaceans | 150 Hz – 160 kHz, most sensitive between 8.8 kHz and 110 kHz [1, 2, 3] | Impulsive: 224 dB (Pk), 170 dB ($SEL_{cum}$) Non-impulsive: 178 dB ($SEL_{cum}$) | Impulsive: 230 dB (Pk), 185 dB ($SEL_{cum}$) Non-impulsive: 198 dB ($SEL_{cum}$) |
| High-frequency cetaceans | 275 Hz – 160 kHz, most sensitive between 12 kHz and 140 kHz [1, 2, 3] | Impulsive: 196 dB (Pk), 140 dB ($SEL_{cum}$) Non-impulsive: 173 dB ($SEL_{cum}$) | Impulsive: 202 dB (Pk), 155 dB ($SEL_{cum}$) Non-impulsive: 173 dB ($SEL_{cum}$) |

References: [1] Finneran (2015); [2] Finneran (2016); [3] NMFS (2016); [4] Southall *et al.* (2007)

Notes:

* Cumulative SEL thresholds are frequency-weighted according to the low, mid and high frequency functional hearing categories for cetaceans.

Fish vary widely in their vocalisations and hearing abilities. Fish species with swim bladders connected to their inner-ear are considered to be most sensitive to sound pressure, while fish species without a swim bladder connection are less sensitive to sound pressure and may only be sensitive to the particle motion components of sound at very close ranges (*Popper & Fay 2011; Popper et al. 2014; Hawkins & Popper 2016; Carroll et al. 2017*).

Behavioural effects of noise on fish will vary depending on the particular circumstances of the fish, hearing sensitivity, the activities in which it is engaged, its motivation, and the context in which it is exposed to sounds (*Hawkins & Popper 2017*). Responses may include avoidance behaviours, startle reactions, increased swimming speed, change in orientation, change in position in the water column, changes to schooling behaviour (e.g. tightening of school structure), seeking refuge in reefs, and temporary avoidance of an area leading to temporary and localised changes in distribution (*Simmonds & MacLennan 2005; McCauley et al. 2003; Engås et al. 1996; Engås & Løkkeberg 2002; Slotte et al. 2004; Fewtrell & McCauley 2012; Popper et al. 2014; Carroll et al. 2017*).

*Piling Noise*

Literature indicates noise levels for a variety of pile and hammer types ranged from approximately 170 to 220 dB re 1 µPa (peak); 165 to 205 dB re 1 µPa (SPL); and 150 to 195 dB re 1 µPa2-s (SEL) (measured at 10 m from the source) (*Illinworth and Rodkin, 2007*). Hammering sounds from percussive pile driving have been reported with received levels to 135 dB re 1µPa at a range of one (1) km from the source, and an audible range extending to 10–15 km.

The highest sound intensity recorded for a pile driver (on record) is 257 dB re 1 µPa at 1 m (*Nedwell et al., 2009*). A 2002 study of pile-driving operations (to construct a new Australian Defence Force wharfing area in Twofold Bay, Eden, NSW) recorded an average level of 167 dB re 1 µPa (SPL) (at 300 m from the operation), falling to 145 dB and 136 dB re 1 µPa at 1.8 and 4.6 km respectively (*McCauley et al.,2002*). The average signal strength fell from 150 dB to 140 dB re 1 µPa between one (1) km and 3.1 km from the operation. Power spectra showed peaks mostly between 100 Hz and 1 kHz.

As well as the hammer types influence on noise levels, noise levels may also vary with rocky or soft substrate, where hammering through soft sediment may generate lower noise levels (*Luis et al., 2007*). Noise levels from percussive piling have their highest energy at lower frequencies from about 20 Hz to 1 kHz (*Greene, 1987*) but the range can extend much higher.

Based on the criteria recommended by NMFS (2016), pile driving may cause injury or hearing impairment (PTS/TTS) to dolphins from single hammer strike at close range (tens to hundreds of metres). Cumulative exposures may result in TTS to dolphins within a few kilometres if they remain within range for the duration of a pile driving activity, but they are likely to swim away and avoid the area before significant TTS occurs. Noise levels may remain above thresholds for behavioural disturbance for considerable distance (>five (5) km) (David, 2006), although significant avoidance responses can reasonably be expected to occur within one (1) or two (2) kilometres.

Popper *et al.* (2014) suggest that injury to fish may occur in response to pile driving sound levels greater than 207 dB re 1 µPa (peak), which would be limited to the immediate vicinity of the pile or may not be exceeded at all. TTS impacts may occur if fish remain in close proximity for an extended period of time, but again, it is likely that fish will swim away and avoid the area before significant TTS occurs. Fish that may normally be resident within adjacent mangrove habitat may abandon the mangroves immediately adjacent to the jetty during the pile driving period (approximately 64 days) but occupancy would be expected to return over days/weeks following construction activities and no long term population impacts are expected.

*Dredging Noise*

Literature is limited regarding noise levels generated from dredging activities and also depend on the type of dredger used. Most studies have been carried out on trailer suction hopper dredgers and indicate that the highest levels of sound are generated when the vessel is in transit. Jiménez Arranz et al. (2017) reviewed a number of dredging studies and indicate that backhoe dredging can produce noise levels of 164-179 dB re 1µPa@1m, reducing to 130-140 re 1µPa (rms) within approximately 100-200 m. Similarly, noise levels during a number of different grab dredging projects were found to fall to approximately 100-110 dB re 1µPa (rms) within approximately 150 m to 550 m.

To date, auditory injuries have not been observed or documented to occur in association with dredging. Lower levels of impact may take the form of recoverable damage to auditory tissues and hearing loss attributable to temporary threshold shifts (TTS) if animals are exposed for a long period of time and stay in the vicinity of the dredger. Behavioural responses from transient marine mammals and fish are more likely to occur, though such effects are likely to be limited mostly to within a few hundred metres from the dredging activity with underwater noise levels potential audible to over 1 km. Therefore, impacts from dredging are expected to be highly localised, temporary and of low magnitude.

*Vessel Noise*

Vessel movements during construction activities (i.e. construction, supply, etc.) will generate noise by cavitation caused by the rotation of propellers and by machinery operated on the decks and working areas. Marine operations conducted on the decks and working areas of the vessel introduce strong sounds of varying characteristics into the water column, largely at low frequencies.

Excessive continuous noise above a tolerable threshold for marine fauna may result in damage to the auditory system, behavioural change, avoidance, temporary shift in hearing thresholds and interference with acoustic signals (McCauley et al., 2003). The likely impacts associated with noise emissions from vessels are limited to localised disturbance of very low numbers of marine fauna that may be present in the vicinity of the works. Fish are known to quickly habituate to vessel noise (Smith *et al.,* 2004; Wysocki *et al*. 2006; Spiga *et al*., 2012; Nichols *et al*., 2015; Johansson *et al.,* 2016; Holmes *et al.,* 2017).

The overall significance of impacts associated with marine fauna during piling activities, dredging and vessel activities is discussed and presented in **Table 8.101.** The sensitivity of impacts associated with marine fauna during piling activities, dredging and vessel activities is considered to be **Medium**. The magnitude of effect associated with marine fauna during piling activities, dredging and vessel activities is likely to be **Medium** as without mitigation, injury/PTS/TTS impacts are possible adjacent to pile driving, in addition to behavioural impacts, although no long term population impacts expected.

The overall significance of this impact is therefore **Moderate** for this activity.

*Table 8.101 Assessment of Impacts on Marine Fauna during Piling Activities, Dredging and Vessel Activities*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | **Large** | Moderate | Major | Major |

### *8.13.5.2 Mitigation Measures, Management, and Monitoring*

Given impacts are assessed of **Moderate** significance, the following additional mitigation measures, which are considered standard good practice controls are recommended:

- Acoustic decoupling (i.e. repositioning or placement on rubber fittings) of loud equipment during piling should be implemented.

- Pile driving management measures consistent with JNCC (2010) standard pile driving protocol:
  - Trained and dedicated Marine Mammal Observers (MMOs) and Passive Acoustic Monitoring (PAM) operatives during pile driving;
  - Mitigation zone (JNCC recommend a minimum mitigation zone of 500 m, to be determined on a case-by-case basis. The zone may be determined using numerical modelling of the pile driving characteristics proposed for the project, but in the absence of modelling, a conservative one (1) km mitigation zone will be implemented);
  - 30-minute pre-start observations;
  - Delay-start procedure (if marine mammal sighted within the mitigation zone);
  - Soft-start procedure (minimum 20 minutes); and
  - Shut-down procedures if marine mammal sighted within the mitigation zone during pile driving.

- Delay-start and shut-down procedures will also be implemented if a marine turtle is sighted within 500 m of the pile driving activity;

- Vessel and Dredger maintenance to be performed as adequate maintenance, including lubrication and repair of winches, generators, propulsion components and other potential sources is an effective measure for noise reduction;

- Records shall be maintained of all marine species sightings in the area, including date and time, weather conditions, species identification, approximate distance from the pile, direction and heading in relation to the pile driving, and behavioural observations. When marine species are observed in the mitigation zone, additional information and corrective actions taken such as a shutdown of the pile driver, duration of the shutdown, behaviour of the animal, and time spent in the mitigation zone will be recorded; and

- Any incidents that occur during dredging that result in negative impacts on the marine species will be documented and reported to the authorities when required.

It is understood that marine piling work is based on 24 hour activity with a continuous operation until final penetration depth of the pile to avoid set-up, therefore night-time work will be required. In this case the following applies:

- Where piling/activity continues into a period of poor visibility/ night-time there is no need for additional mitigation.

- Where piling/activity is initiated during times of poor visibility (including night-time conditions, the activity will only be permitted if there have been no sightings of marine mammals within 2 hours prior to low visibility/darkness. Activities then to be kept continuous as much as is possible. Other standard mitigation is also required (with the exception of observation period).

#### *8.13.5.3 Significance of Residual Impact*

The residual impact to Marine Fauna during piling activities, dredging and vessel activities is considered to become **Minor**, given the above additional measures.

### *8.13.6 Assessment of Impacts - Direct loss and Degradation of Marine Habitats and Water Quality from Maintenance Dredging*

During operations, the jetty will be left unused and will only be needed if major plant equipment needs changing. Therefore, maintenance dredging and vessel activities at the jetty will be infrequent and so minor behavioural effects of vessel and dredging noise are not assessed further here.

### *8.13.7 Assessment of Impacts - Direct Mortality to Marine Fauna from Seawater Intake*

The operational water supply of CCGT Power Plant will be primarily sourced from seawater. A seawater intake structure and pump station will be established in a fenced compound at the shoreline of the Java sea, close to the jetty and intake and discharge pipelines.

The base of the pump station will be 9.6m below the mean sea level (MSL). The seawater will be abstracted using one (1) offshore intake pipe connected to a submerged intake head located in a dredged pit located at -4.5 meters MSL. The offshore intake pipe is preliminary sized at 1.3 meter diameter. The approximate length of the intake pipe is 2,000 m.

Seawater intake has the potential for impingement and subsequent entrainment of marine fauna, with can result in injury and mortality effects. Some of these organisms (or life stages of organisms), such as fish eggs, may be fully passive, lacking the ability to avoid intake flow regardless of velocity

#### 8.13.7.1 *Impact Evaluation and Significance*

The significance of impacts associated with the seawater intake during operation activities is discussed and presented in **Table 8.102**.

There are no confirmed records of marine turtles or mammals from surveys conducted within the Project site and there are no known important marine mammal or turtle habitats, such as nesting beaches, associated with the coastline at the Project area. Spinner dolphins (IUCN listed as Data Deficient) have been anecdotally recorded in the Project site, therefore individuals may occur within the Project site on occasion.

As previously discussed, a range of infauna and epifauna were identified in the nearshore area. Crustaceans were very well represented within the surveyed mangrove area and other species are expected to occur widely in sediment throughout the region. The ecological quality status of benthic communities in the project area is classified as undisturbed to slightly disturbed.

Given that marine turtles or mammals are not expected to frequent the area and that no Critical Habitat is present within the Area of Influence, seawater intake is not expected to have an effect on mobile marine fauna. Impacts are likely to be limited to occasional and incidental intake of benthic invertebrates, although this is expected to have a negligible impact in the context of the wider soft sediment benthic communities surrounding the Project area.

The sensitivity of marine fauna to impingement and entrainment from the seawater intake is considered to be **Low.** The magnitude of effect on marine fauna due to the seawater intake is therefore **Negligible** as the effect will not cause substantial change in the populations of marine fauna present in the area. The overall significance of this impact is therefore **Negligible**.

*Table 8.102 Assessment of Impacts from on Marine fauna from the Seawater Intake*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | **Negligible** | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | **Minor** | Moderate | Major |
| | **Large** | Moderate | Major | Major |

*8.13.7.2 Mitigation Measures, Management and Monitoring*

It is recommended that the following mitigation measures be applied in relation to the seawater intake:

- Installation of mesh screens or equivalent to limit ingress of marine organisms.

*8.13.7.3 Significance of Residual Impact*

In view of the implementation of mitigation measures, the residual impact remains **Negligible**.

### *8.13.8 Assessment of Impacts - Disturbance of Marine Fauna by Operational Underwater Noise Generated by FSRU Operations and LNG Tanker Offloading*

Disturbance and displacement of marine fauna may occur from underwater noise produced by the operational FSRU and LNG tanker offloading activities. The estimated number of LNG tankers expected to offload LNG per will be based on PLNs energy requirements; the duration of the offloading process ranges from one (1) to two (2) days. During offloading, tankers may engage thrusters and will be assisted by tugs.

*8.13.8.1 Impact Evaluation and Significance*

During operations, the FSRU will be stationary and, therefore, noise sources will be limited to structure-borne noise from the gas fired turbine engine and machinery noise passing through the hull, noting that gas-fired engine turbines are less noisy than diesel-fired engine turbines.

As the FSRU will be stationary during operations no propeller cavitation noise will be expected, which accounts for a significant proportion of noise produced by vessels. Underwater noise generated by the FSRU will primarily consist of continuous broadband noise. Increased noise levels are expected during LNG offloading activities when tankers and tugs will engage thrusters to position alongside the FSRU, and machinery and pump noise may increase.

Operational noise from floating facilities have been measured in other locations around the world. Operational FPSO noise, which is comparable to the FSRU, has been reported to be in the order of 180 dB re 1µPa@1 m (SPL) (*Erbe et al. 2013*) and large vessel and tankers, such as the condensate tankers that will be involved in offtake activities, also produce noise in the order of 175 to 185 dB re 1µPa@1 m (SPL) (*Jiménez-Arranz et al. 2017*).

Modelling of both operational and unloading noise from an FPSO in the Barossa field (*ConocoPhillips 2017*) predicted that noise levels would fall below 160 dB re 1µPa within less than 100 m from the FPSO, and would fall to 120 dB re 1µPa within 1.4 km and within 11.4 km during normal operations and offloading activities respectively. However, while noise levels may be audible over these ranges, the lower noise levels in the order of 120 dB re 1µPa are likely to be only marginally above ambient background noise levels given existing distant vessel noise in the area. Other vessels operating in the area will also generate noise in the order of 165-185 dB re 1µPa at 1 m.

Despite the Project area considered to support low numbers of marine mammals, dolphins have previously been sighted and it is reasonable to assume there is some potential for dolphin species to be present in the vicinity of the FSRU on occasion. No aggregation, migration or important habitat for feeding or breeding is known to occur in the vicinity of the FRSU, and therefore, animals that occur in the area are expected to be transitory.

The noise levels generated during operations are not high enough to result in injury or hearing impairment. TTS would only occur if animals choose to remain in the immediate vicinity of the FSRU and tankers for an extended period, although such effects would be recoverable and habituation to the noise is likely. Behavioural responses from transient marine mammals and fish are more likely to occur.

Whales and dolphins have been observed to exhibit varying behavioural responses to underwater sounds (ranging from, for example, momentary pauses in vocalisations and changes in body orientation, to changes in travel direction and behavioural avoidance) between SPLs of 120 and >180 dB re 1 µPa (*Southall et al. 2007; Gomez et al. 2016*). Higher received levels are not always associated with stronger behavioural responses (*Southall et al. 2007; Gomez et al. 2016*), but it is reasonable to assume that more significant behavioural responses such as avoidance are more likely to occur in response to higher sound levels.

Impacts to marine fauna during operations are therefore expected to be limited to behavioural avoidance impacts which may be localised within a few hundred metres from the FSRU during normal operations, or could potentially extend to a few kilometres during peak unloading activities. It should be noted that dolphins are regularly observed swimming voluntarily in close proximity to vessels that generate comparable noise levels without apparent disturbance or disruption, and so this range of potential impact is considered to be conservative. Masking effects to dolphins are not expected except at close range, as the operational noise will be dominant at low frequencies, which would not significantly acoustically interfere with small cetaceans, which typically communicate and echolocate using much high frequencies.

Behavioural impacts to fish are likely to occur over shorter distances than for whales and dolphins. Behavioural response effects in fish will depend on the hearing sensitivity of the fish species that are present, but behavioural effects in response to continuous noise are likely to be limited to within tens or hundreds of metres, but are known to quickly habituate to such noise (*Smith et al., 2004; Wysocki et al. 2006; Spiga et al., 2012; Nichols et al., 2015; Johansson et al., 2016; Holmes et al., 2017*).

As the FSRU does not occur in any biologically important feeding, breeding or aggregation areas, only transient individuals will be exposed for relatively short periods of time. Therefore, while noise from the FSRU and LNG tankers may trigger a range of behavioural reactions, these responses are not are expected to be biologically significant or result in population level effects.

The sensitivity of marine fauna to underwater noise from FSRU operations and LNG tanker offloading activities is considered to be **Medium**. The magnitude of effect associated with localised behavioural impacts to marine fauna and fish during operations is **Small**. The overall significance of this impact is therefore **Minor** for this activity.

***Table 8.103 Assessment of Impacts on Marine Fauna during FSRU Operations and LNG Tanker Offloading Activities***

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

### 8.13.8.2 *Mitigation Measures, Management, and Monitoring*

The following additional mitigation measure is recommended to minimise underwater noise during operations:

- The FSRU will be maintained in accordance with an inspection and maintenance schedule and procedure, which will reduce excessive noise levels that may otherwise be produced by defective machinery and equipment.

#### 8.13.8.3 *Significance of Residual Impact*

The residual impact to Marine Fauna during FSRU operations and LNG tanker offloading activities is considered to remain **Minor** with the above additional mitigation.

### 8.14 *SUMMARY OF ENVIRONMENTAL IMPACTS*

Summaries of the environmental impact assessment for construction and operations are provided in **Table 8.104** and **Table 8.105**.

*Table 8.104 Summary of Environmental Impacts during Construction*

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Transportation/operation of vehicles (construction, materials/supplies and workforce) | Air Quality | Deterioration of air quality from exhaust emissions from vehicles | **Negligible** | • Old vehicles will be replaced with new, more fuel efficient alternatives.<br>• Where feasible high use vehicles will be converted to cleaner fuels.<br>• All vehicles, equipment and machinery will undergo a pre-use inspection prior to use and periodic maintenance inspections. | **Negligible** |
| Transportation/operation of vehicles (construction, materials/supplies and workforce) | GHG | Increased GHG Emissions at National Level | **Major** | • Optimisation of construction schedule and placement of laydown areas/temporary camp sites to reduce overall traffic movements/distance travelled, thus reducing GHG emissions from transport. | **Major** |
| Transportation/operation of vehicles (construction, materials/supplies and workforce) | GHG | Increased GHG Emissions at Global Level | **Moderate** | | **Moderate** |
| Transportation/operation of vehicles (construction, materials/supplies and workforce) | Terrestrial Biodiversity | Disturbance and displacement of fauna and flora due to the use and movement of heavy machinery and vehicles | **Negligible** | • Use of the access road should be restricted to construction vehicles only. Checkpoints should be used to manage access and inspect vehicles for vegetation (including firewood) taken from the Project Area.<br>• All vehicles are to maintain a speed of a maximum of 40km/hr within work sites to reduce the risk of fauna strike.<br>• All land rehabilitation will be undertaken using native indigenous species.<br>• A community program is to be established with adjacent landowners to replant mangrove forest along foreshore areas and re-establish coastal vegetation on non-utilised public land and private land (With consent of the land-owner) within the Javan Coastal Zone EBA between the Muara Gembang – Tanjung Sedary KBA and the Muara Gimanuk KBA.<br>• A BAP will be prepared for the management and monitoring of Critical Habitats within the Javan Coastal Zone EBA | **Negligible** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Workforce presence | Terrestrial Biodiversity | Direct mortality to fauna and flora from hunting and poaching from the workforce and local residents | **Minor** | • Hunting and poaching will be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation.<br>• The Project owner shall provide training to staff and workers on all rules, regulations and information concerning restrictions related to hunting and poaching, as well as the punishment that can expected if any staff or worker or other person associated with the Project violates rules and regulations.<br>• Measures to manage hunting and poaching in the DMU by the local community are to be outlined in a Biodiversity Action Plan. | **Negligible** |
| General Land Clearance – all sites | GHG and Climate Change | Increased GHG emissions (National Level) | **Major** | • Actual land clearing/disturbance will be minimised to the greatest extent possible. Net GHG emissions could also be reduced by revegetation in many areas that will be cleared only for temporary activities such as laydown areas and temporary camps for construction. | **Major** |
| General Land Clearance – all sites | GHG and Climate Change | Increased GHG emissions (Global Level) | **Moderate** | | **Moderate** |
| Site dewatering | Groundwater | Deterioration of groundwater quality. | **Minor** | • Monitor the quantity of groundwater abstracted and associated draw down.<br>• Address and respond to any community complaints regarding Project impacts on groundwater availability. | **Minor** |
| General construction activities - all sites | Terrestrial Biodiversity | Disturbance and Displacement of Fauna | **Moderate** | • The planned vegetation clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing;<br>• Clearing of habitat within Natural Habitat areas (mangrove forests) along the coastal zone will be avoided and minimised where possible. No clearing of mangroves is to occur outside of the Project area. | **Negligible** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| | | | | • All land rehabilitation will be undertaken using native indigenous species.<br>• A community program is to be established with adjacent landowners to replant mangrove forest along foreshore areas and re-establish coastal vegetation on non-utilised public land and private land (With consent of the land-owner) within the Javan Coastal Zone EBA between the Muara Gembang – Tanjung Sedary KBA and the Muara Gimanuk KBA.<br>• A BAP will be prepared for the management and monitoring of Critical Habitats within the Javan Coastal Zone EBA<br>• A Fauna Shepherding Protocol is be used in the Javan Coastal EBA to ensure that any endemic bird species have vacated the area prior to any clearance work. | |
| General construction activities - all sites | Landscape & Visual | Visual impact of activities and sites | **Negligible** | No additional mitigation needed | **Negligible** |
| General construction activities - all sites | Air Quality | Dust generation - Deterioration of air quality | **Moderate** | • Daily onsite and offsite inspections will be undertaken to visually assess the dust emissions from earthwork and construction activities, and from vehicles exiting the construction sites. Results from the inspection will be recorded and appropriate measures will be taken to reduce emissions where necessary.<br>• All dust and air quality complaints will be recorded, the cause identified and the appropriate measures taken to reduce emissions in a timely manner.<br>• Use of site watering to suppress wind and physical disturbance dust generation. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| General construction activities – CCGT Power Plant | Air Quality | Dust generation - Deterioration of air quality | **Moderate** | • The construction site will be planned so that machinery and dust causing activities are located away from air sensitive receptors as far as possible.<br>• Wind breaks will be erected around the construction site at least the height of any stockpile on-site.<br>• Use of site watering to suppress wind and physical disturbance dust generation.<br>• All sand and aggregates will be stored in bunded areas and are not allowed to dry out unless specifically required.<br>• Deliveries of ready-made cement and other fine powders will be delivered in enclosed tankers and stored in silos with suitable emission controls to prevent escape of material and overfilling during delivery. | **Minor** |
| General construction activities – CCGT Power Plant | Air Quality | Dust generation - Deterioration of air quality | **Moderate** | • Re-vegetate earthworks and exposed areas including stockpiles to stabilise the surfaces as soon as is practicable.<br>• Use hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.<br>• Only remove the top soil in small and specific areas during the construction phase and not all at once.<br>• Stockpiles will be places as far as reasonably practicable from air sensitive receptor locations.<br>• The design of stockpiles will be optimised to retain a low profile with no sharp changes in shape. | **Minor** |
| General construction activities - Substation | Air Quality | Dust generation - Deterioration of air quality | **Negligible** | • The construction site will be planned so that machinery and dust causing activities are located away from air sensitive receptors as far as possible.<br>• Wind breaks will be erected around the construction site at least the height of any stockpile on site.<br>• Use of site watering to suppress wind and physical disturbance dust generation.<br>• All sand and aggregates will be stored in bunded areas and are not allowed to dry out unless specifically required.<br>• EPC plan to use ready mix concrete for substation foundation. | **Negligible** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| General construction activities - Substation | Air Quality | Dust generation - Deterioration of air quality | **Negligible** | • Use hessian, mulches or trackifiers or cover with topsoil, as soon as practicable.<br>• Stockpiles will be places as far as reasonably practicable from air sensitive receptor locations.<br>• The design of stockpiles will be optimised to retain a low profile with no sharp changes in shape. | **Negligible** |
| General construction activities - Transmission Line | Air Quality | Dust generation - Deterioration of air quality | **Negligible** | • EPC plan to use watering during earthworks to minimise dust effects | **Negligible** |
| CCGT Power Station, 500kV transmission line, ORF and nearshore area and infrastructure. | Acoustics & Vibration | Temporary and short-term noise disturbance impacts and amenity issues. | **Minor** | • Work and activities should be carried out during the IFC daytime hours (i.e. 7am to 10pm). Any work that is performed outside these hours (i.e. during the night time period, 10pm to 7am) should be suitably managed with a goal of achieving levels compliant with the IFC 1.7 Noise Disturbance criteria, at all potentially affected sensitive receptors. Where this is not possible it may be necessary to undertake the night works with agreement from nearby and potentially affected neighbours.<br>• Where unforeseen works will occur in close proximity to a receptor and these works are anticipated to generate high levels of noise (e.g. >75 dBA), potential respite periods (e.g. three hours of work, followed by one hour of respite) should be considered. Respite should be implemented if they are the preference of the affected receptors and if they are feasible and reasonable, and practicable, to implement during the works. In some circumstances respite may extend the duration of works and inadvertently increase noise impacts, hence due care should be taken when considering this management measure.<br>• During the construction design, choose appropriate machines for each task and adopt efficient work practices to minimise the total construction period and the number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit.<br>• During the works, avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| | | | | • During the works, instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night.<br>• During any night works, any activity that has the potential to generate impulsive noise should be avoided. These types of events are particularly annoying, especially at night and have the limited potential to generate sleep disturbance or awakening impacts.<br>• During the works, ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines should be repaired or removed from the Site.<br>• During the works, ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse. | |
| Earthworks, including vegetation clearance, excavation, grading and levelling | Soil | Exposure of soil causing erosion and loss of top soil. | **Moderate** | • Delineation of clearance boundaries to limit the areas to be cleared.<br>• Scheduling clearance activities to avoid extreme weather events such as heavy rainfall, extreme dry and high winds.<br>• Revegetation areas with temporary land use, conducting progressive rehabilitation.<br>• Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers.<br>• Reuse topsoil within rehabilitation activities.<br>• Control erosion through diversion drains, sediment fences, and sediment retention basins. | **Minor** |
| Earthworks, including vegetation clearance, excavation, grading and levelling | Soil | Exposure of soil causing erosion and loss of top soil. | **Moderate** | • Stockpiles to be separated into topsoil and sub-soil and be located at least 10 m from any surface water source and groundwater well or 50 m from Cilamaya canal; and<br>• Stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion. | **Minor** |

<table>
<tr><th>Activity/Aspect</th><th>Receptor</th><th>Potential Impacts</th><th>Impact Evaluation Significance (Pre-Mitigation)</th><th>Mitigation</th><th>Residual Impact</th></tr>
<tr><td>Earthworks, including vegetation clearance, excavation, grading and levelling</td><td>Groundwater</td><td>Acid Sulfate Soil impacts to groundwater, vegetation, surface water quality and aquatic biota from soil clearing at the Access Road and Jetty coastal areas</td><td>Moderate</td><td>For earthworks and excavations in the waterlogged coastal soils where there is the potential for ASS, the following measures are recommended:
<ul>
<li>Prior to proceeding with any soil disturbance activities, conduct onsite ASS tests at coastal excavation locations;</li>
<li>Where ASS is confirmed to be present implement control measures, such as:
<ul>
<li>Schedule excavation such that the potential effects on any area disturbed at any one time are limited and managed;</li>
<li>Stockpiling of ASS is only permitted as a short-term activity where removal from site is not possible (e.g. weather) and must be placed on impermeable area with runoff protection, 50 m away from surface water;</li>
<li>Minimise the time that excavations are left open and the presence of temporary spoil piles to reduce the amount of time that ASS is exposed to the air.</li>
<li>No dumping of exposed ASS is permitted onto the surrounding land or into surface waters;</li>
<li>Use of marine, estuarine, brackish or fresh waters is not permitted as a means of diluting and/or neutralising ASS or associated contaminated waters.</li>
<li>Given the fine sediment and waterlogged nature of the potential area of ASS, covering excavated spoil with clean material is not recommended as the material may liquidise, flow and contaminate the surrounding area.</li>
</ul></li>
<li>Evaluate treatment and disposal options based on volume of ASS material, considering:
<ul>
<li>Removal, treatment and disposal offsite;</li>
<li>Neutralisation of ASS materials (e.g. lime application); or</li>
<li>Strategic reburial in anoxic environment.</li>
</ul></li>
<li>Monitoring samples of soil and surface water following completion of earthworks/excavation in ASS affected area.</li>
</ul>
The above mitigation measures should be detailed in an ASS Management Plan that details the steps, measures and strategies that will be used to manage potential impacts of the excavation works that have the potential to disturb ASS materials at the site to reduce the magnitude of the potential impact.</td><td>Negligible</td></tr>
</table>

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Earthworks, including vegetation clearance, excavation, grading and levelling | Surface Water Quality | Deterioration of surface water quality. | **Moderate** | Sponsor shall also inform the EPCs to develop Construction Environment Management Plan and Run-off and Sediment Control Plans prior to the commencement of construction activities to include the following:<br>• Major earthworks activities during construction shall be scheduled during dry season as much as possible.<br>• Topsoil removed during clearing shall be stored in specified areas. Stockpiled earthworks, during and after clearing will be placed as bunds at strategic locations in order to reduce sediment loadings to the storm run-off.<br>• Stockpiles to be separated into topsoil and sub-soil and be located at least 10 m from any surface water source and groundwater well or 50 m from Cilamaya canal;<br>• Open stockpiles of construction materials (e.g. aggregates, sand and fill material) in places which are identified to have a possibility of significant run-off will have measures in place to prevent the washing away of construction materials, soil, silt or debris into any drainage system.<br>• Earthworks to form the final surfaces will be followed up with surface protection and drainage works to prevent erosion caused by rainstorms. Soil erosion caused by wind and rainstorms shall also be reduced by minimising the land clearance area during construction activities, where possible, providing surface protection such as sheet cover.<br>• Temporary traffic areas and access roads, if any, formed during construction will be protected by coarse stone ballast or equivalent.<br>These measures shall prevent soil erosion caused by rainstorms. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Earthworks, including vegetation clearance, excavation, grading and levelling | Terrestrial Biodiversity | Loss of habitat and degradation of habitat due to the construction activities | **Minor** | • Clearing vegetation outside of designated areas will be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation.<br>• The Project owner shall provide training to staff and workers on all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violates rules and regulations.<br>• The planned vegetation clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing.<br>• All land rehabilitation will be undertaken using native indigenous species. The area of landscaping should at least equal to the area of Natural Habitat loss.<br>• A community program is to be established with adjacent landowners to replant mangrove forest along foreshore areas and re-establish coastal vegetation on non-utilised public land and private land (With consent of the land-owner) within the Javan Coastal Zone EBA between the Muara Gembang – Tanjung Sedary KBA and the Muara Gimanuk KBA.<br>• A BAP will be prepared for the management and monitoring of Critical Habitats within the Javan Coastal Zone EBA.<br>• Planting of native indigenous flora, including mangroves along the shoreline adjacent to the road and jetty construction sites is to occur to reduce impacts to connectivity along the shoreline.<br>• Appropriate rehabilitation of disturbed areas using native vegetation is to occur to facilitate movement of fauna species, especially within the EBA. It is estimated that approximately 10ha of land adjacent to project components is available for site revegetation. | **Negligible** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Earthworks, including vegetation clearance, excavation, grading and levelling | Terrestrial Biodiversity | Emissions (dust, noise, vibration) and discharges (run-off, effluent) disturbance and degradation of habitats | **Minor** | • Measures to control dust are to be utilised to limit generation of dust and hence deposition onto vegetation surrounding construction areas.<br>• All machinery to be used in areas of Natural Habitat and Critical Habitat are to exert a low pressure on the ground surface so as to minimise soil compaction.<br>• All machinery and hand held equipment used must comply with required air and noise emission standards.<br>• Sediment and erosion control measures are to be used in all areas of construction to minimise soil contaminated runoff entering waterways. These measures are to be outlined in a Sediment and Erosion Control Plan.<br>• All disturbed soil surfaces are to be rehabilitated and native flora species are to be planted within areas under the projects control. These species are to be suitable habitat for bird species listed in the Javan Coastal Zone EBA. | **Negligible** |
| Earthworks, including vegetation clearance, excavation, grading and levelling | Surface Water Quality | Reduction of surface water quality | **Minor** | • Stockpiles to be separated into topsoil and sub-soil and be located at least 10 m from any surface water source and groundwater well or 50 m from Cilamaya canal;<br>• Construction of drainage ditches and retention ponds to collect water run-off to reduce flows.<br>• Develop a Construction Sediment and Erosion Management Plan including erosion control measures such as sediment barriers and geotextile curtains.<br>• Implement measures to avoid the potential for accidental or unintended introductions including the transportation of substrates e.g. chemicals and hydrocarbon bunding. | **Minor** |
| Earthworks, including vegetation clearance, excavation, grading and levelling - Critical and Natural habitat | Terrestrial Biodiversity | Emissions (dust, noise, vibration) and discharges (run-off, effluent) disturbance and degradation of habitats | **Moderate** | • Habitat biodiversity offsets are unnecessary to achieve a no-net-loss of biodiversity values. Specific measures however to manage Critical habitat species will be required to be outlined within a Biodiversity Action Plan. | **Moderate** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Earthworks, including vegetation clearance, excavation, grading and levelling - Critical and Natural habitat | Terrestrial Biodiversity | Emissions (dust, noise, vibration) and discharges (run-off, effluent) disturbance and degradation of habitats | **Moderate** | • All machinery to be used in areas of Natural Habitat and Critical Habitat are to exert a low pressure on the ground surface so as to minimise soil compaction.<br>• All machinery and hand held equipment used must comply with required air and noise emission standards.<br>• Sediment and erosion control measures are to be used in all areas of construction to minimise soil contaminated runoff entering waterways. These measures are to be outlined in a Sediment and Erosion Control Plan.<br>• Hours of operation of the construction site are to be limited to the hours of 7.00am to 10.00pm Monday to Sunday.<br>• All light sources are to be directed away from areas of Natural Habitat and Critical Habitat, where feasible. | **Minor** |
| Earthworks, including vegetation clearance, excavation, grading and levelling - Critical and Natural habitat | Terrestrial Biodiversity | Introduction of invasive species through increased movement of people, vehicles, machinery, vegetation and soil. | **Moderate** | • The use of fencing and hoarding during construction in the Javan Coastal EBA is to be kept to a minimum around Project construction sites;<br>•<br>Development of an Invasive Species Management Plan to include:<br>• The provenance of any fill material brought onto the site is to be checked regarding invasive species contamination.<br>• Vehicle wash down procedures are to be used to reduce the transmission of invasive species into and from the project site(s).<br>• Control measures are to be utilised in areas of Natural Habitat and Critical Habitat<br>• All disturbed soil surfaces are to be rehabilitated and native flora species are to be planted within areas under the projects control. These species are to be suitable habitat for bird species listed in the Javan Coastal Zone EBA. | **Minor** |
| Earthworks, including vegetation clearance, excavation, grading and levelling – CCGT Power Plant | Air Quality | Dust generation - Deterioration of air quality | **Major** | | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Earthworks, including vegetation clearance, excavation, grading and levelling - Substation | Air Quality | Dust generation - Deterioration of air quality | **Moderate** | • Re-vegetate earthworks and exposed areas including stockpiles to stabilise the surfaces as soon as is practicable.<br>• Use hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.<br>• Only remove the top soil in small and specific areas during the construction phase and not all at once.<br>• Stockpiles will be places as far as reasonably practicable from air sensitive receptor locations.<br>• The design of stockpiles will be optimised to retain a low profile with no sharp changes in shape.<br>• Real time PM10 monitoring will be undertaken at two fenceline locations. Monitoring will commence 3-months prior to the earthwork phase commencing. | **Minor** |
| Earthworks, including vegetation clearance, excavation, grading and levelling - Onshore pipeline | Air Quality | Dust generation - Deterioration of air quality | **Moderate** | • Re-vegetate earthworks and exposed areas including stockpiles to stabilise the surfaces as soon as is practicable.<br>• Use hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.<br>• Only remove the top soil in small and specific areas during the construction phase and not all at once.<br>• Stockpiles will be places as far as reasonably practicable from air sensitive receptor locations.<br>• The design of stockpiles will be optimised to retain a low profile with no sharp changes in shape. | **Minor** |
| Earthworks, including vegetation clearance, excavation, grading and levelling - Transmission Line | Air Quality | Dust generation - Deterioration of air quality | **Negligible** | No additional mitigation needed | **Negligible** |
| Fencing | Terrestrial Biodiversity | Fragmentation of habitat, or permanent /temporary severance of wildlife corridors between isolated habitats of importance for biodiversity. | **Moderate** | • The use of fencing and hoarding during construction in the Javan Coastal EBA is to be kept to a minimum around project construction sites.<br>• Appropriate rehabilitation of disturbed areas is to occur to facilitate movement of fauna species during operation, especially within the EBA. | **Negligible** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Vehicle use - trackout of soil material – CCGT Power Plant | Air Quality | Dust generation - Deterioration of air quality | **Major** | • Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport.<br>• Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable.<br>• Implement a wheel washing system.<br>• Regular inspection and washing of site access and local roads to remove any materials tracked out of the site.<br>• Access gates will be located at least 10m from air sensitive receptors where possible. | **Minor** |
| Vehicle use - trackout of soil material - Substation | Air Quality | Dust generation - Deterioration of air quality | **Major** | | **Minor** |
| Vehicle use - trackout of soil material - Onshore pipeline | Air Quality | Dust generation - Deterioration of air quality | **Moderate** | • Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport.<br>• Implement a wheel washing system.<br>• Regular inspection and washing of site access and local roads to remove any materials tracked out of the site. | **Minor** |
| Vehicle use - trackout of soil material - Transmission Line | Air Quality | Dust generation - Deterioration of air quality | **Negligible** | No additional mitigation needed | **Negligible** |
| Site preparation Jetty, onshore pipeline and access roads | Terrestrial Biodiversity | Loss of habitat and degradation of habitat due to the construction activities | **Moderate** | • A Biodiversity Action Plan (BAP) will be prepared for the management and monitoring of Critical Habitats within the Javan Coastal Zone EBA. The BAP will assess the requirements to achieve no-net-loss of biodiversity values for loss of habitats and impacts on Critical Habitat species. | **Minor** |
| Jetty Construction, Dredging and Pipeline Trenching | Marine Biodiversity | Direct loss and Degradation of Marine Habitats and Water Quality | **Moderate** | • Project shall develop a development of a dredging and disposal risk assessment and Dredging Management Plan in accordance with IMO and OSPAR guidelines. | **Minor** |
| Jetty Construction, Dredging and Pipeline Trenching | Marine Biodiversity | Direct loss and Degradation of Marine Habitats and Water Quality | **Moderate** | • Dredging vessels will be equipped with the appropriate Global Positioning System (GPS) equipment or other navigational aids to ensure dredging will occur at the specified dredge footprint and disposal at the designated soil disposal site.<br>• EPCs' dredgers will maintain adequate clearance between vessel hull and the seabed at all states of the tide and reduce vessel speed to ensure that excessive turbidity is not generated by turbulence from vessel movement or propeller wash. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Vessel presence and movements | Marine Biodiversity | Direct mortality or injury of marine fauna from vessel movements | **Minor** | • Vessels will operate in accordance with standard maritime practices, whereby vessel speeds will be adjusted depending on environmental conditions (e.g., visibility, metocean condition) as required by the captain of the vessel and to avoid any encountered hazards.<br>• Support vessels will not travel greater than 6 knots within 300m of a whale or 100m from a dolphin, if sighted, (i.e. will maintain a caution zone of those distances).<br>• Vessels will approach no closer than 100m from a whale or 50m from a dolphin, if sighted (Note this standard does not apply to support vessels engaged in limited/constrained manoeuvrability activities where vessel speed will already be low).<br>• Vessels will not directly approach a marine mammal from in front or behind their path of travel.<br>• Vessels will not exceed a speed limit of 5 knots within designated boating channels around the jetty or the FSRU.<br>• Vessel bridge crew to maintain visual watch of any hazards (including marine mammals). | **Minor** |
| Dredging, FSRU mooring/jetty pile driving, construction | Marine Biodiversity | Disturbance and displacement of marine fauna by underwater noise during construction | **Moderate** | • Acoustic decoupling (i.e. repositioning or placement on rubber fittings) of loud equipment during piling should be implemented.<br>• Pile driving management measures consistent with JNCC (2010) standard pile driving protocol:<br>– Trained and dedicated MMOs and PAM operatives during pile driving.<br>– Mitigation zone (JNCC recommend a minimum mitigation zone of 500 m, to be determined on a case-by-case basis. The zone may be determined using numerical modelling of the pile driving characteristics proposed for the project, but in the absence of modelling, a conservative 1 km mitigation zone will be implemented).<br>– 30-minute pre-start observations.<br>– Delay-start procedure (if marine mammal sighted within the mitigation zone).<br>– Soft-start procedure (minimum 20 minutes).<br>– Shut-down procedures if marine mammal sighted within the mitigation zone during pile driving. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| | | | | • Delay-start and shut-down procedures will also be implemented if a marine turtle is sighted within 500 m of the pile driving activity.<br>• Where piling/activity continues into a period of poor visibility/ night-time there is no need for additional mitigation.<br>• Where piling/activity is initiated during times of poor visibility (including night-time conditions, the activity will only be permitted if there have been no sightings of marine mammals within 2 hours prior to low visibility/darkness. Activities then to be kept continuous as much as is possible. Other standard mitigation is also required (with the exception of observation period).<br>• Vessel and Dredger maintenance to be performed as adequate maintenance, including lubrication and repair of winches, generators, propulsion components and other potential sources is an effective measure for noise reduction.<br>• Records shall be maintained of all marine species sightings in the area.<br>• When marine species are observed in the mitigation zone, additional information and corrective actions taken such as a shutdown of the pile driver, duration of the shutdown, behaviour of the animal, and time spent in the mitigation zone will be recorded.<br>• Any incidents that occur during dredging that result in negative impacts on the marine species will be documented and reported to the authorities when required.<br>• Only hydraulic hammer for pile driving is used, not diesel based for the FSRU piles. | |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| FSRU and vessel mobilisation | Marine Biodiversity | Introduction of invasive species from FSRU/vessels brought from outside Indonesian waters (ballast water/hull fouling) | **Minor** | • The FSRU and any contracted vessels coming from outside of Java territorial waters will have vessel hull and niches confirmed to be free of IMS prior to mobilisation to the local waters of the Project area.<br>• All contracted vessels and the FSRU will maintain a current anti-fouling coating, as evidenced by a current Anti-fouling System Certificate under *Annex 1 of the International Convention on the Control of Harmful Anti-Fouling Systems on Ships* or other equivalent records.<br>• The FSRU and all contracted vessels will meet the requirements of the International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004, including:<br>- Ballast water shall be managed in accordance with the provisions set out in the Convention; and<br>- A Ballast Water Management Plan and a ballast water record book will be implemented and maintained on board. | **Minor** |
| Hydrotest of offshore pipeline | Marine Water Quality | Reduction of marine water quality | **Minor** | • Chemicals used in hydrotesting will be selected with consideration for their potential ecotoxicity and will use the lowest toxicity practicable for preserving pipeline integrity. | **Minor** |
| Hydrotest of onshore equipment | Surface Water Quality | Deterioration of surface water quality. | **Moderate** | • For the selection of chemicals for hydrotest water, the Project will select biocides / chemical additives that present a low risk of contamination, in terms of dose concentration, toxicity, biodegradability, bioavailability, and bioaccumulation potential. | **Minor** |
| Waste management | Environmental Quality | Generation, handling, treatment and disposal of solid and liquid hazardous and non-hazardous wastes | **Moderate** | • Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance).<br>• Store wastes in closed containers away from direct sunlight, wind and rain and systematically to allow inspection between containers to monitor leaks or spills.<br>• Ensure that liquid waste storage areas have impermeable floors and containment, of capacity to accommodate 110% of the volume of the largest waste container.<br>• All wastes will be disposed of by authorised third- party disposal contractors. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| | | | | • Concrete waste of inert nature will be stored in a laydown area near the concrete batching plant and will be reused where possible.<br>• Any bitumen waste will be stored separately in a lined area to be disposed of by licensed contractors. | |
| Waste management | Infrastructure | Pressure on existing waste management infrastructure | **Moderate** | • WMP required detailing:<br>• Waste inventory that details all wastes anticipated by the construction works, the frequency at which they will occur and the timing in the Project programme, is needed.<br>• Waste disposal sites in the area that are licensed to accept the types of waste the construction phase will create, following the 3Rs ethos (i.e. reduce, reuse and recycle).<br>• Waste storage and segregation.<br>• Waste transfer and transport.<br>• Training to workers.<br>• Waste auditing. | **Minor** |
| Wastewater discharge and runoff | Surface Water Quality | Deterioration of surface water quality. | **Moderate** | • Portable or permanent sanitation facilities serving all workers should be provided at all construction sites e.g. one (1) toilet for every 25 workers up to the first 100, and one for every 50 thereafter) will be provided for the construction workforce. Septic tanks shall be provided to treat the sanitary discharge.<br>• Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps. The sanitary sewer should then be treated prior to discharge or reuse as greywater.<br>• Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the stormwater system. | **Minor** |
| Wastewater discharge and runoff | Surface Water Quality | Deterioration of surface water quality. | **Moderate** | • All surface run-off from the construction areas potential sources of contamination will be minimised and reduced (e.g. by minimising the area of impermeable surfaces) and the peak discharge rate will be reduced (e.g. by using retention ponds and silt screen).<br>• Appropriate surface drainage surrounding the construction areas will be designed and provided where necessary. This includes diversion channels to intercept storm water running-off the cleared areas and prior to large scale land | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| | | | | clearance and removal of topsoil, where appropriate. These channels will be protected against erosion such as sandbag, rock armouring or lining as required.<br>• Stormwater management structures such as stormwater ponds will be designed to collect the silt-laden surface runoff and allow the removal of silt by natural settlement, which in turn should reduce sediment loading prior to discharge into receiving environment.<br>• All drainage facilities and sediment control structures will be inspected on a regular basis and maintained to confirm proper and efficient operation at all times and particularly during rainstorms. Deposited silt and grit will be removed regularly. The stormwater drainage system will be periodically inspected for blockage sand cleaned at least once before the monsoon season each year.<br>• Measures will be taken to reduce the ingress of drainage into excavations. If trenches have to be excavated during the wet season or rainy conditions, they will be excavated and backfilled in short sections wherever practicable. Water will pumped out from trenches or foundation excavations will be discharged into storm drains via silt removal facilities.<br>• Personnel will be trained to visually inspect discharged water quality for oil and grease traces (that will be visible on the surface) periodically and take appropriate corrective actions.<br>• A dike wall shall also be constructed around high potential spillage area such as fuel tank. For spillage in other location is considered to be minor so that oil pan and containment devices are necessary to response. Additionally, containment devices are to be provided for storage areas of oil, fuel and chemicals to control contaminated surface runoff.<br>• Control and monitoring systems will be used to alert the crew to leaks or any other potential risks. | |
| Black start diesel generator operation | Air Quality | NOx emissions and deterioration of air quality | **Moderate** | • The simultaneous operation of all twelve diesel engine-generators will only occur when required and for the amount of time necessary to black start the power plant. The operator will endeavour to reduce this time period as | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| | | | | much as is feasible to minimise the likelihood of unacceptable impacts on air quality;<br>• All engine-generators will be routinely checked and maintained in accordance with the manufactures specifications. This routine maintenance will ensure that the operational performance of the engine-generator is maintained at a high level throughout the operational lifetime of the Project; and<br>• Diesel fuel with a maximum sulphur content of 0.5% will be used at all times. | |

*Table 8.105 Summary of Environmental Impacts during Operation*

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Workforce presence | Terrestrial Biodiversity | Direct mortality to fauna and flora from hunting and poaching from the workforce and local residents | **Moderate** | • Fauna Shepherding Protocol is be used in the Javan Coastal EBA to ensure that any endemic bird species have vacated the area prior to any clearance work. | **Negligible** |
| CCGT Power Plant | Air Quality | Combustion of natural gas and deterioration of air quality (on Ecology) | **Negligible** | • Continuous stack emission monitoring (CEM) will be installed and operated throughout the operational lifetime of the Project to ensure that the NOx emission concentration from the CCGT does not exceed the IFC emission limit guideline value of 51mg/Nm3. | **Negligible** |
| CCGT Power Plant | Air Quality | Combustion of natural gas and deterioration of air quality (on Human Health) | **Minor** | | **Minor** |
| CCGT Power Plant | Air Quality | Combustion of diesel in engine-generators used for black start | **Moderate** | • The simultaneous operation of all 12 diesel engine-generators will only occur when required and for the amount of time necessary to black start the power plant. The operator will endeavour to reduce this time period as much as is feasible to minimise the likelihood of unacceptable impacts on air quality.<br>• All engine-generators will be routinely checked and maintained in accordance with the manufactures specifications. This routine maintenance will ensure that the operational performance of the engine-generator is maintained at a high level throughout the operational lifetime of the Project.<br>• Diesel fuel with a maximum sulphur content of 0.5% will be used at all times. | **Moderate** |
| CCGT Power Plant | Air Quality | Combustion of diesel in engine-generators used for emergency shut-down | **Minor** | No additional mitigation is required. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| CCGT Power Plant | Air Quality | Deposition of salt (Sodium Chloride (NaCl)) on the surrounding agriculture from the operations of two (2) wet cooling tower systems | **Major** | • Monitoring of salt deposition rates is recommended within 500 m of the Project area. The monitoring should be designed to determine the level of salt deposition against appropriate standards. Monitoring of foliage on vegetation within the 500 m boundary is also to occur to determine the extent of leaf damage (leaf necrosis).<br>• Where impacts to vegetation is determined from the monitoring, engagement within affected parties is to occur to determine appropriate actions. These actions may include (but are not limited to): investigation and support of alternative cropping methods/species; adoption of spray irrigation methods; and/or compensation for lost agricultural production or impacts on households.<br>• Regarding impacts on plant and equipment, it is recommended that all exposed surfaces be coated or painted to reduce corrosion from salt deposition. Regular maintenance of exposed surfaces is also required.<br>• Salt tolerant vegetation should also be planted within the Project area and within 500m of the Project. | **Minor** |
| CCGT Power Plant | GHG and Climate Change | Increased GHG Emissions (National Level) | **Major** | • Cold venting of gas directly to atmosphere will be avoided where possible. If significant quantities are emitted, the project should consider flaring, as this converts the $CH_4$ to $CO_2$ and thereby reduces the net GHG emissions in terms of $CO_2$-e emissions | **Major** |
| CCGT Power Plant | GHG and Climate Change | Increased GHG Emissions (Global Level) | **Moderate** | | **Moderate** |
| CCGT Power Plant | Acoustics & Vibration | Noise disturbance impacts and amenity issues. | **Minor** | Based on the generally compliant results presented, no additional noise mitigation of plant and equipment is expected. | **Minor** |
| CCGT Power Plant | Vibration | Vibration annoyance impacts and amenity issues. Structural damage | **Minor** | No additional mitigation is required. | **Minor** |
| CCGT Power Plant | Terrestrial Biodiversity | Degradation of habitat from air emissions and runoff | **Minor** | • Mitigation measures are to be outlined within the Biodiversity Action Plan for the Project area. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Presence of CCGT, transmission lines, substation and roads | Landscape and Visual | Visual impact of activities and sites | **Minor** | • Planting may be designed to either screen or significantly reduce the visual dominance through filtering.<br>• For viewing locations where a high or un-acceptable level of visual impact may occur, landscape mitigation and screening would reduce these impacts. | **Minor** |
| 500 kV Transmission Line | Acoustics & Vibration | Noise disturbance impacts and amenity issues. | **Negligible** | • No additional mitigation needed | **Negligible** |
| FSRU Operations and LNG Tanker Offloading | Marine Biodiversity | Disturbance and displacement of marine fauna may occur from underwater noise | **Minor** | • The FSRU will be maintained in accordance with an inspection and maintenance schedule and procedure, which will reduce excessive noise levels that may otherwise be produced by defective machinery and equipment. | **Minor** |
| ORF and nearshore area and infrastructure. | Acoustics | Noise disturbance impacts and amenity issues. | **Minor** | No additional mitigation is required. | **Minor** |
| ORF and nearshore area and infrastructure. | Vibration | Vibration annoyance impacts and amenity issues. Structural damage | **Minor** | No additional mitigation is required. | **Minor** |
| Road traffic, light and heavy vehicles | Acoustics | Noise disturbance impacts and amenity issues. | **Minor** | No additional mitigation is required. | **Minor** |
| Road traffic, light and heavy vehicles | Vibration | Vibration annoyance impacts and amenity issues. Structural damage | **Minor** | No additional mitigation is required. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Seawater intake | Marine Biodiversity | Impingement and subsequent entrainment of marine fauna, with can result in injury and mortality effects. | **Negligible** | • Installation of mesh screens or equivalent to limit ingress of marine organisms. | **Negligible** |
| 500 kV Transmission Line | Terrestrial Biodiversity | Direct mortality of avifauna along the transmission line due to strike during operation | **Moderate** | Biodiversity Action Plan for the Project area to include:<br>• Bird deflectors on the length of the power line. The deflectors will increase line visibility by thickening the appearance of the line for easier detection by avifauna.<br>• Use moveable markers of contrasting colours (e.g. black and white) that protrude above and below the line, and be placed 5-10 m apart.<br>• Removing the thin neutral or earth (shield) wire above the high voltage transmission lines where feasible, and where this is not possible, marking the line to make it more visible.<br>• Minimising the vertical spread of power lines. Having lines in a horizontal plane reduces collision risk.<br>• Habitat manipulation to influence flight activity and bird behaviour, e.g. tree lines under the high voltage lines to increase visibility.<br>• Insulating cables close to poles, at least 70 cm on both sides and around perching areas, and up to at least 140cm.<br>• Hanging insulators under cross arms and poles, provided the distance between a likely perch (mainly the crossarm) and the energised parts (conductors) is at least 70 cm. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Vessel presence and movements | Marine Biodiversity | Direct mortality or injury of marine fauna from vessel movements | **Minor** | • Vessels will operate in accordance with standard maritime practices, whereby vessel speeds will be adjusted depending on environmental conditions (e.g., visibility, metocean condition) as required by the captain of the vessel and to avoid any encountered hazards.<br>• Support vessels will not travel greater than 6 knots within 300m of a whale or 100m from a dolphin, if sighted, (i.e. will maintain a caution zone of those distances).<br>• Vessels will approach no closer than 100m from a whale or 50m from a dolphin, if sighted. (Note this standard does not apply to support vessels engaged in limited/constrained manoeuvrability activities where vessel speed will already be low). Vessels will not directly approach a marine mammal from in front or behind their path of travel.<br>• Vessel bridge crew to maintain visual watch of any hazards (including marine mammals). | **Minor** |
| Waste management | Environmental Quality | Generation, handling, treatment and disposal of solid and liquid hazardous and non-hazardous wastes | **Moderate** | • An induction regime for Project staff highlighting the waste management system and how wastes are to be managed on site.<br>• Provide bins for the segregation and proper storage wastes to minimise the potential releases to the environment or contamination of other materials.<br>• Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance).<br>• Hazardous waste store should be segregated to avoid the co-storage of incompatible waste types.<br>• Store wastes in closed containers away from direct sunlight, wind and rain and systematically to allow inspection between containers to monitor leaks or spills.<br>• Ensure that storage areas have impermeable floors and secondary containment, of a capacity to accommodate 110% of the volume of the largest waste container.<br>• Hazardous wastes will be disposed of by authorised third-party disposal contractors. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Waste management | Infrastructure | Pressure on existing waste management infrastructure | **Moderate** | • WMP required detailing:<br>• An inventory of the wastes anticipated by the Project.<br>• Identification of the disposal routes the Project plans to use for its waste in the operation phase.<br>• A programme of audit for the waste infrastructure and waste hauliers the Project intends to use.<br>• Site rules for waste management including segregation, storage and packaging requirements for each waste type.<br>• Mapping of waste facilities on site including distribution of waste receptacles at strategic locations aboard the FSRU, along the pipe line route, at the CCGT power station and the substation. | **Minor** |
| Wastewater discharge and runoff | Surface Water Quality | Deterioration of surface water quality. | **Moderate** | • All drainage facilities and sediment control structures will be inspected on a regular basis and maintained to confirm proper and efficient operation at all times and particularly during rainstorms.<br>• Deposited silt and grit will be removed regularly. The stormwater drainage system will be periodically inspected for blockage sand cleaned at least once before the monsoon season each year.<br>• Measures will be taken to reduce the ingress of drainage into excavations. If trenches have to be excavated during the wet season or rainy conditions, they will be excavated and backfilled in short sections wherever practicable. Water will pumped out from trenches or foundation excavations will be discharged into storm drains via silt removal facilities.<br>• Personnel will be trained to visually inspect discharged water quality for oil and grease traces (that will be visible on the surface) periodically and take appropriate corrective actions.<br>• Control and monitoring systems will be used to alert the crew to leaks or any other potential risks. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Wastewater and process cooling water discharges from the CCGT pipeline | Marine Water Quality | Reduction of marine water quality | **Minor** | • Wastewater and cooling water discharge will be conducted below the water surface, to increase dispersion.<br>• Pipeline outlet structure to include a diffuser to comply with water quality standards and the 3°C rise in the seawater temperature.<br>• Monitoring of receiving water quality will be undertaken at the discharge location within three (3) months of operations commencing, and annually thereafter. | **Negligible** |
| Waste water and process cooling water discharges from the FSRU and Vessels | Marine Water Quality | Reduction of marine water quality | **Minor** | • In accordance with MARPOL 73/78 requirements, all water discharges from the FSRU and vessels will be treated prior to being discharged to sea.<br>• Waste water and process water discharge will be conducted below the water surface, to increase dispersion.<br>• Pipeline outlet structure to include a diffuser to comply with water quality standards and the 3°C rise in the seawater temperature.<br>• Monitoring of receiving water quality will be undertaken at the discharge location within 3 months of operations commencing, and annually thereafter.<br>• Any potential exceedances in discharge standards will be addressed through corrective actions, which may include additional treatment or dilutions prior to discharge. | **Minor** |
| Jetty Presence | Marine Water Quality | Disturbance to coastal processes, sedimentation and reduction of water quality | **Negligible** | • EPC required to conduct sedimentation study to measure the sedimentation rate and the required frequency for potential maintenance dredging.<br>• Maintenance plan which includes periodic monitoring for sediment accretion or erosion in the area of the jetty. | **Negligible** |

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# 9 SOCIAL AND COMMUNITY HEALTH IMPACT ASSESSMENT

The following sections identify and discuss the predicted positive and significant negative social and community health impacts associated with construction and operation of the Project. The Project receptors are defined as villagers located within the AoI that may be impacted or influenced by the Project as a result of their proximity to the Project site and/or associated facilities.

Based on the analysis of the Area of Influence (AoI), the Project will impact total of 39 villages in three (3) regencies, Karawang, Bekasi, and Subang in the West Java Province, Indonesia.

## 9.1 SOCIAL AND HEALTH IMPACT ASSESSMENT DEFINITIONS

The impacts are assessed based on the data in **Section 7** and the impact assessment methodology explained in **Section 3**. When undertaking assessments of this nature, several important criteria must be considered such as magnitude; vulnerability and stakeholder perceptions:

- Determining the magnitude of change in social and community health, assets and conditions as a result of the Project and the vulnerability of social receptors involves ascertaining their ability to adapt to socio-economic, cultural or bio-physical changes whilst maintaining their overall livelihood, health status and quality of life; and

- Determining the magnitude of change in social and community health, assets and conditions as a result of the Project.

### 9.1.1 Determining Magnitude

The magnitude of social and community health impacts is understood as a reflection of the 'size' or degree of change caused by social and community health impacts. As discussed in **Section 3**, magnitude is a function of one or more of the following characteristics:

- Extent;
- Duration;
- Scale;
- Frequency; and
- Likelihood (for unplanned events only).

**Table 9.1** provides the definitions for social and community health impact characteristics that culminate in a rating for magnitude.

*Table 9.1 Designation of Social Magnitude*

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

### *9.1.2 Determining Vulnerability*

In the social and community health context, vulnerability is the accepted term for describing the sensitivity of the social receptor that will experience the impact. A vulnerable individual (or group) is one that could experience adverse impacts more severely than others, based on his/her status (for example poverty status, access to basic goods and services). Vulnerability is a pre-existing status that is independent of the Project.

It is important to understand the vulnerability context as it will affect the ability of the social receptor to adapt to any changes brought about by the Project (directly or indirectly). A higher level of vulnerability can result in increased susceptibility to negative impacts or a limited ability to take advantage of positive impacts.

A Project may also exacerbate existing vulnerabilities if the status of individuals and communities and their coping mechanisms are not adequately understood or considered. In order to identify vulnerable receptors, it is necessary to identify receptors that may experience these circumstances (**Table 9.2**).

*Table 9.2 Levels of Vulnerability*

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

*Vulnerable and Sensitive Receptors*

In the case of this Project the ESIA team identified a number of potentially vulnerable and sensitive receptors. Vulnerable groups may include:

- Those residing below the poverty line such as sharecroppers and skewer makers;

- Female headed households with no additional income streams; and
- The elderly, young and ill.

Sensitivity groups may include:

- Land owners and users in close proximity to Project construction activities;
- Fishermen along the coastline in the vicinity of the FSRU and subsea pipeline locations;
- Those residing along the fence line of the power plant or utilising facilities along the fence line such as the school and mosque; and
- Other road users along the Project transportation routes.

### *9.1.3 Integrating Stakeholder Perceptions into the Assessment Process*

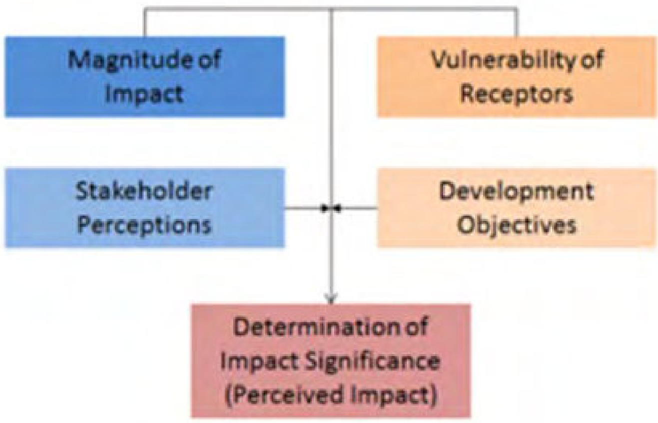
It is common that Project affected people have perceptions that Project impacts are more significant than will actually be the case. This is referred to as perceived impacts (as opposed to actual impacts). A common example of this is the perception that Project health and safety impacts are more significant than the reality; this is largely due to a limited understanding of the Project description and the Best Available Technology (BAT) that can be applied.

Regardless as to whether an impact is considered as negligible by the Project or ESIA team, if it has been identified as significant by a stakeholder and therefore must be factored into the evaluation process. This may result in the development of focused mitigation and management measures that specifically address these perceptions (such as technical health and safety briefings with the communities).

It should be noted that perceived impacts are no less important than actual impacts with respect to addressing community acceptance for a Project, and that failure to adequately assess such impacts and develop supporting mitigation may result in Project delays as in the case of actual impacts.

**Figure 9.1** illustrates how the assessment of impacts considers stakeholder perceptions and vulnerability as well as similar criteria to the environmental assessment (e.g. magnitude and development objectives).

*Figure 9.1 Building in Perceptions, Stakeholders and Planning*




### 9.1.4 *Evaluating Significance for Social and Health Impacts*

The significance of social and community health impacts is evaluated taking into account the magnitude of the impact and the vulnerability of affected receptors. In rating significance the matrix in **Table 9.3** is used to assign social and community health impact significance for both negative and positive impacts, and includes the definitions of magnitude and vulnerability designations.

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

*Table 9.3 Significance Rankings for Social and Community Health Impacts*

| | | VULNERABILITY | | |
|---|---|---|---|---|
| | | **Low**<br>Minimal areas of vulnerabilities; consequently with a high ability to adapt to changes brought by the Project | **Medium**<br>Some but few areas of vulnerability; but still retaining an ability to at least in part adapt to change brought by the Project | **High**<br>Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought by the Project |
| MAGNITUDE | **Negligible**<br>Change remains within the range commonly experienced within the household or community. | **Negligible** | **Negligible** | **Negligible** |
| | **Small**<br>Perceptible difference from baseline conditions. Tendency is that impact is local, rare and affects a small proportion of receptors and is of a short duration. | **Negligible** | **Minor** | **Moderate** |
| | **Medium**<br>Clearly evident difference from baseline conditions. Tendency is that impact affects a substantial area or number of people and/or is of medium duration. Frequency may be occasional and impact may potentially be regional in scale. | **Minor** | **Moderate** | **Major** |
| | **Large**<br>Change dominates over baseline conditions. Affects the majority of the area or population in the area of influence and/or persists over many years. The impact may be experienced over a regional or national area. | **Moderate** | **Major** | **Major** |

### 9.1.5 *Interpretation of Social Impact Significance*

**Table 9.4** shows how the different designations of significance may be interpreted. These are described to reflect the Project context and setting, specifically reflected in planning and stakeholder views as appropriate.

*Table 9.4 Description of Social and Health Impact Assessment Significance Rankings*

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

*Note: *Positive impacts are not ranked for significance, as discussed above.*

## 9.2 FINDINGS OF THE SOCIAL AND HEALTH IMPACT ASSESSMENT

Key socio-economic impacts were identified during the scoping phase and through engagement with relevant stakeholders i.e. local government authorities and potentially impacted villagers. Different potential impacts have been identified and assessed as a result of the proposed construction and operation activities i.e. the CCGT Power Plant and the transmission line and substation, as well as the FSRU and its associated facilities. The resulting potential community impacts also vary in significance at different phases of the Project i.e. construction and operation.

The key social impacts and/ or opportunities identified and assessed include:

- Local employment and business opportunities;
- Disturbance to/ loss of income from agricultural activities;
- Disturbance to/ loss of income from marine fishing activities;

- Disturbance to/loss of income from fresh water fish cultivation;
- Community health, safety, and security; and
- Disturbance to social structure.

The impact assessment results will be grouped into three main categories namely:

- Social impacts resulting from the land acquisition;
- Social impacts during the construction activities; and
- Social impacts during the operations.

It is noted that some impacts (or opportunities), such as local employment and business opportunities, community health, and community safety, are triggered across a number of the proposed Project activities and throughout each of the Project phases.

As such, discussion on these impacts may be repetitive however, deemed important to show the detailed analysis of the impact at each of the facilities and Project phase. A summary table is provided at the end of each section to condense the impacts evaluated.

## *9.3 SOCIAL IMPACT RESULTING FROM THE PROJECT'S LAND ACQUISITION*

The ADB considers resettlement impacts as significant if 200 or more persons lose 10% or more of their productive or income-generating assets. (No physical land displacement is planned). Given the land acquisition is still ongoing it is assumed the Involuntary ADB Resettlement Category is A/B presently. This will be updated following the completion of the land acquisition census.

Also important when considering lost income is vulnerability; in this case we consider those receiving less than the regional minimum wage. Based on the decree of the West Jawa Governor the monthly minimum wage in 2017 for the Bekasi Regency was IDR 3,530,438, Karawang Regency IDR 3,605,272 and Subang Regency IDR 2,327,072.

Based on the surveys undertaken in the impacted villages it was assessed overall that the average monthly wages were above these minimum values (IDR 3,900,000 in Karawang and Bekasi for farmers and IDR 4,000,000 for fisher folks in Blanakan and Muara). However some fishermen and farmers interviewed earnt less than the monthly income (approximately 30% of fishermen and 16% of farmers).

The following sections provide an overview of the land acquisition at each Project location.

### 9.3.1 *Loss of Income from Fresh Water Fisheries Activities*

*Discussion of Impacts*

The estimation of the total land to be acquired by the Project for access road, jetty, onshore pipeline and placement of dredging material is approximately 290,000 $m^2$. Approximately 125,000 $m^2$ (or 43.1%) is utilised by the community for fresh water fish cultivation. The land areas to be acquired in this area are illustrated in **Figure 9.2.**

The coastal area displays accumulation of sediment carried to the area in suspension by the river discharge. This is deposited in a low energy environment, resulting in the gradual accumulation of sediment layers, shallowing of the coastal waters and build up of land. It is estimated from historical maps that this pattern of deposition has resulted in a seaward shift of the coastline of approximately 300 m over 15 years.

This natural process was confirmed during the ESIA surveys with the fish pond cultivators who stated that the area originally underwater has emerged due to natural sea sedimentation. According to a statement letter from the MoEF due to this process the land is now categorised as protected forest belonging to the MoEF[1].

However, the local community has been utilising this land for many years (in the form of fish ponds) and as such the ownership of the land around the area varies i.e. a number of people have ownership certificates, deed of sale and purchase, or a land use permit from the village authorities. The Project is currently undertaking the land owner identification and inventory process (as of March 2017).

The fish pond cultivators in the area confirmed that it typically takes three years to cultivate the land into a fish pond requiring regular maintenance i.e. once every five or six (6) months. Typical fish cultivated in the area include milkfish and tilapia as well as wild shrimps from the sea that enter the ponds during the high tide. The actual size and location of the plots of land to be acquired by the Project are still to be confirmed (as of February 2017) in relation to the pipeline right of way and access road. Note a part of this area is also classified as Protected Forest however some households are claiming ownership. The Project is obtaining an IPPKH (the right to borrow and use Forest Area) and then will proceed with consultation over the land acquisition with these households.

However, given the presence of these fish pond areas, some form of impact to the land owners'/users' income is likely. This is resulting from a loss of shrimp or fish for daily consumption or income and lost income/incurred expenses during the establishment of a new fish pond. The Project is developing a Resettlement Plan (RP) that sets out how the Project will assess and compensate the land owners and users at full cost replacement.

The amount of compensation paid will consider the following aspects:

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[1] The Ciasem-Pamanukan Protected Forest Area is based on the Decree of the Minister of Environment and Forestry Number SK.3287 / MenLHK-PKTL / KUH / PLA.2 / 7/2016

- Size of the fish pond;
- Market value of assets on the land such as fish, shrimps and huts;
- Cost spent to establish a new fishpond; and
- Lost income whilst establishing a new fishpond with the same quality.

*Impact Evaluation and Significance*

The number of the land owners to be impacted by the land acquisition in this area is still to be determined however it is assumed based on the current survey findings that the magnitude is Medium.

For some of the fish pond owners and users, income from the fresh water fisheries is their sole income source. Based on the ESIA survey roughly 30% of fishermen interviewed earned less than the minimum wage (in Karawang this is IDR 3,605,272) however on average most earning around IDR 4,000,000 per month.

The Project is proposing to compensate the impacted people (both land owners and land users) at full replacement cost along with consideration of lost earnings; further the same quality of the land is abundantly available nearby the current location.

Nevertheless, it is predicted that the cultivators will need some time to re-establish their fish pond in a new location (or seek an alternative income stream) thus a temporary loss of income is anticipated. Considering these issues, the sensitivity is assessed as being **Medium** as the magnitude given the potential number of people impacted and their vulnerability.

Therefore, the Project land acquisition impact to loss of income from fresh water fisheries activities is assessed as **Moderate** and is presented in **Table 9.5**.

***Table 9.5 Loss of Income from Fresh Water Fisheries Activities***

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| Magnitude of Impact | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

To mitigate the negative impacts, the Project is expected to implement the following measures:

- Implement the RP in a timely manner to ensure that the livelihood of the affected people is not impacted (this includes addressing grievances effectively and implementing a livelihoods strategy);

- Undertaking consultation with the land owners and users about the Project schedule to allow them to preparing the necessary activities to sell their fish or shrimp and identify a new land area to re-establish their fish pond (or seek alternative employment opportunities);

- Support the fishpond owners/ cultivators to re-establish new fish ponds (e.g. provision of construction equipment) to shorten the period of transition from the current to the new location to reduce temporary loss of income;

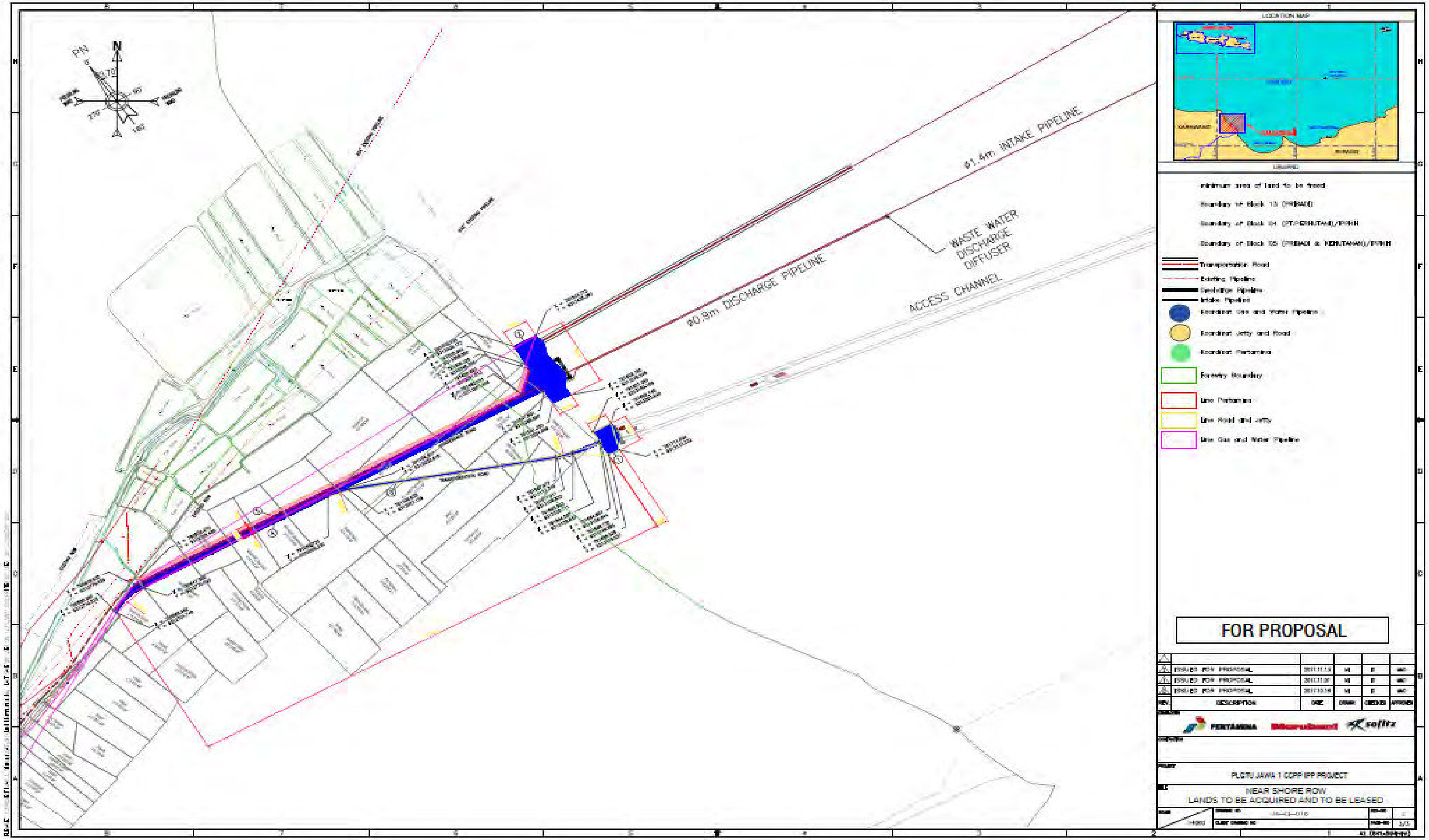
- Prioritisation for Project employment opportunities and/ or provision of goods and services;

- Prioritisation for participation in the Project's community development program.

*Residual Impact Significance*

As a result of implementation of the proposed additional measures, the residual negative impact to fresh water fishing activities will be **Minor**. This is assuming the RP, livelihoods strategy and additional mitigations above are implemented effectively.

*Figure 9.2* *Location of Coastal Areas to be Acquired*



### 9.3.2 *Loss of Income of the Land Owners from Agricultural Activities*

*Discussion of Impacts*

The Project is acquiring land approximately 373,712 $m^2$ in the Karawang and Bekasi Regencies for the pipeline right of way, access road, transmission line and sub station.

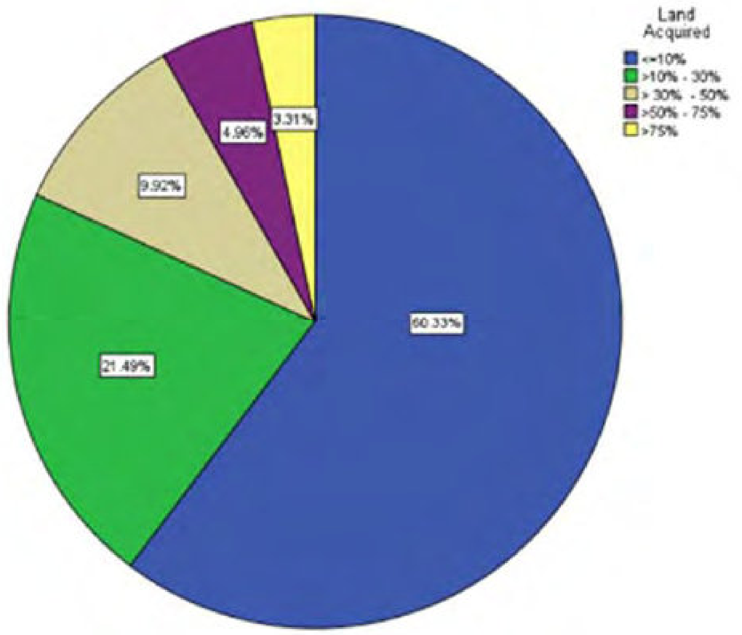
The land acquisition has been undertaken on a willing buyer willing seller principle through a negotiated settlement process; in cases where the owner does not agree to sell their land, the Project has adjusted the design. For example the transmission line has been rerouted at approximately 15 locations; this is to either address land owners refusing to sell or to avoid the right of way being in close proximity to sensitive receptors. The offered price is based on the market value provided by the Project's land appraiser and verified by the village leader.

The market price offered in the negotiated settlement process was confirmed to be above the tax object sale value (*Nilai Jual Objek Pajak*) of the land and typically two times of the current market price in the area. However in some instances the agreed price was nearly ten times the market value. A comprehensive overview of the land acquired, NJOP, market values and agreed final price are presented in the RP (**Annex I**).

One (1) Ha of land produces 6.1 ton of paddy in Karawang and 5.3 ton in Bekasi Regency per one harvest season (6 months). Farmers typically spend IDR 8,142,857 for production costs per 1 Ha. The crops (largely paddy) are sold at an average price of IDR 4,500/ kg.

The majority (60.33%) of the land owners associated with the transmission line and substation sold less than 10% of their total agricultural land to the Project and less than 10% of the land owners sold more than 50% of their agricultural land to the Project as presented in **Figure 9.3.** Hence, there is a potential for lost income of the land owners from agricultural activities due to the land acquisition.

*Figure 9.3 Percentage of Total Land Acquired (Transmission Line and Substation)*




*Impact Evaluation and Significance*

The total number of agricultural land owners impacted from the land acquisition is still unknown; this will be updated following the livelihoods survey. Given the majority of land owners still own a significant amount of remaining lands and that only a few land users were impacted (and confirmed they can easily find additional land to work on), the magnitude is assessed as **Small** however the sensitivity is considered **Medium** given their high reliance on agriculture as the primary income.

The Project's RP has a policy to compensate the land owners with the full replacement cost and also allowing the owners/users to harvest their crops prior to the construction. Notice is being communicated to the land owners as to when the Project will acquire their lands and as such a cut-off date for harvesting.

Furthermore, the Project's intent is to allow the land owners to continue paddy cultivation underneath the tower footing once construction has been completed. This is currently being discussed with PLN who will be the final approver of this approach.

The ESIA survey and consultations confirmed that the offered compensation value was higher than the current market price (and NJOP) and sufficient to buy bigger plots of paddy field in the area. Some of the land owners have already used the compensation money to buy or rent bigger plots and are expected to generate higher income from those plots. A detailed analysis of the impacted land owners is presented in the RP.

Given the above, the impact of the land acquisition as a result of lost income from agricultural activities is determined as **Minor** as presented in **Table 9.6.**

*Table 9.6 Loss of Income of the Land Owner from Agricultural Activities*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

### *9.3.3 Loss of Income of the Land Users from Agriculture Activities*

*Discussion of Impacts*

Although the majority of plots along the transmission line route are cultivated by the land owners a number of plots are utilised by sharecroppers or land users in particular at the sub station (more so along the pipeline right of way and access road). The land survey confirmed that 19 land users are cultivating plots of the land acquired in the transmission line area and five (5) in the substation area. They typically cultivate a minimum of 0.5 Ha of land in one plot.

Based on the ESIA socio-economic survey, the average income of the land users is IDR 1,800,000/ month (the monthly minimum wage is ~IDR 3,500,000). As such the land acquisition is potentially impacting the land users particularly those who rely solely on their income from cultivating the acquired land such as land users of the substation land in Bekasi Regency.

The Project does not intend to compensate land users however is planning to allow the users to harvest their crops prior to the construction period. Notice is being communicated to the land owners as to when the Project will acquire the land and as such a cut-off date for harvesting will be communicated. Furthermore, they will be supported with livelihood strategies; such as prioritisation related to Project employment and participation in the Project's community development program.

*Impact Evaluation and Significance*

The number of the agricultural land users to be impacted by the land acquisition process along the transmission line and substation is estimated at 24 people. Considering these facts, the magnitude of impact to land users' loss of income from agricultural activities is assessed as being Small. Furthermore 29% of the land users who work as a farmers have an alternative source of income other than cultivating the acquired land.

In addition, agricultural lands in the Karawang and Bekasi area are available abundantly if the land users seek to cultivate other plots. Even though the Project has communicated the cut-off date for harvesting, a temporary loss of income may occur during the transition period, when the user is identifying a new plot of land to cultivate (or alternative employment).

As such, the severity of the impact is assessed as being **Medium**. Therefore, the impact of land acquisition related to lost income of the land users from agricultural activities is determined as **Minor** as presented in **Table 9.7**.

*Table 9.7 Loss of Income of the Land User from Agricultural Activities*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

To mitigate the potential negative impacts, the Project is expected to implement the following measures:

- Implement the RP in a timely manner to ensure that the livelihood of the affected people is not impacted (this includes addressing grievances affectively and implementing a livelihoods strategy);
- Undertaking consultation with the land owners and users about the Project schedule to allow them to prepare the necessary activities to harvest their crops and identify a new land area to purchase and/ or cultivate (or seek alternative employment opportunities);
- Prioritisation for Project employment opportunities and/ or provision of goods and services;
- Prioritisation for participation in the Project's community development program; and
- Prioritise the severely affected land users in the livelihood restoration program and monitor the livelihood condition of the affected people to ensure their quality of life is the same of better than previously.

*Residual Impact Significance*

Given the sensitivities associated with land acquisition and the long term nature of its potential impacts the residual remains **Minor.** This is assuming the RP, livelihoods strategy and effective timely consultation is undertaken and the additional mitigations above are implemented effectively.

### 9.3.4 *Summary of Land Acquisition Impacts*

**Table 9.8** below provides a summary of the impact assessment for the land acquisition

*Table 9.8 Summary of Land Acquisition Impacts*

| Receptor | Potential Impact | Impact Evaluation | Mitigation | Residual Impact |
|---|---|---|---|---|
| Land Acquisition – land owners & cultivators along the access road, jetty, onshore pipeline | Lost income from fresh water fisheries activities (shrimp or fish) | **Moderate** | • Implement the RP to ensure livelihoods are not impacted;<br>• Undertaking consultation with the land owners and users;<br>• Support the fishpond owners/ cultivators to re-establish new fish; and<br>• Prioritisation for Project opportunities. | **Minor** |
| Land Acquisition – land owners & users along the access road, , onshore pipeline, transmission line right of way and substation | Lost income from paddy fields | **Minor** | | **Minor** |

## 9.4 SOCIAL IMPACTS DURING CONSTRUCTION

This section discusses the potential social and community health impacts predicted as a result of the three key Project activities during construction:

- FSRU and Offshore Pipelines;
- CCGT Power Plant, Onshore Pipelines and Coastal Infrastructure; and
- Transmission Line and Substation.

### 9.4.1 *Loss of Income of Marine Fishermen Communities*

*Discussion of Impacts*

The FSRU will be located in Ciasem-Pamanukan Bay within the Subang Regency; it will be permanently moored offshore at a distance of roughly 9 km perpendicular from the Regency coastline and will receive LNG deliveries. The construction of the FSRU will be outside of Indonesia in a shipyard; after which the vessel will be transported to the location where it will be installed with mooring poles and the offshore unloading platform decks. Mobilisation of the equipment and construction materials will be transported via a range of vessels to the FRSU, most likely from Tanjung Priok Port or the jetty.

The FSRU will be permanently moored with a 500 m exclusion zone in accordance with the Indonesian Government regulations that states ships/ vessels can only pass outside the prohibited/restricted zones. As such, a disturbance to local fishing activities further than 9 km offshore may occur due to the longer distances to travel increasing operational costs (mainly fuel and reducing time at sea resulting in a potentially decreased fish catch.

A subsea gas pipeline will be required to deliver gas to shore from the FSRU. As the FSRU location is within the fishing Zone II area (roughly seven (7) km to 22 km coastal area from the sea level at the lowest tide), the pipeline will traverse through both Zone II and Zone I (roughly four (4) km to seven (7) km of coastal area from the sea level at lowest tide).

In order to lay and bury the pipeline, there will be dredging of seabed materials which potentially may damage fish nets and other fishing equipment whilst causing a disturbance to the fishing ground especially shrimp ponds which are typically located up to 3.2 km from the shoreline.

However during the surveys from mid-2017 to early 2018 only a few permanent fishing devices were observed nearshore. These are likely to grow in numbers with Project activities being more visible due to the attraction of compensation.

Based on discussions with the fishing communities in Blanakan and Muara villages, many still use traditional methods to locate fish grounds (especially shrimp). Given the potential for noise and vibration activities during the construction period, albeit temporary, they expressed some concerns around how these activities may impact their fishing activities.

The mooring of the FSRU is estimated to take three to four (4) days after which the 500 m exclusion zone will be in place throughout the duration of the operations. The laying of the subsea pipeline is estimated to be completed within three (3) months (April to July 2020).

*Impact Evaluation and Significance*

The magnitude of the impact of an increase in marine traffic and the decrease in water quality for the local fishing activities are assessed as **Small** due to the impact duration being only three months in total to lay the offshore pipeline and the fact that restricted areas will be minimal during this time.

Meanwhile, the sensitivity of receptors is assessed as being High as fishing is the main source of income for the majority of people particularly in Blanakan Village (there were no alternative sources of income identified during the ESIA survey). It was noted in 2017 farming conditions were poor hence there was a high reliance on fishing for their daily income.

This is further compounded by the existing concerns/perceptions on the impacts to fishing by the fishermen (as captured in the AMDAL public consultations and ESIA community consultations).

The Project impact significance to fishing income is assessed as **Moderate** as presented in **Table 9.9**.

***Table 9.9 Disturbance to Marine Fishing Income***

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | Minor | Moderate | **Major** |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

To mitigate the impact, the Project is expected to implement the following measures:

- Conduct regular socialisation and consultation activities with the relevant stakeholders such as the head of Blankan and Muara villages, the district as well as the impacted fishermen in an open, timely and transparent manner;

- Map and monitor the fishing activities and patterns in the vicinity of the FSRU and subsea pipeline area to understand fishing behaviours of the community to allow the Project develop construction schedule with minimal impact to the fishing activities;

- Ensure the Project's grievance mechanism is well socialised and that any grievances submitted are addressed in a fair and timely manner;
- Ensure the RP set out the process for entitlements for damage or removal of or to fishing nets/equipment. Any compensation agreed will be on a case by case basis through discussion with all parties involved;
- Develop a relevant community development program for the impacted fishermen, coordinating with relevant authorities, and fishing communities. The program will be identified through further identification of the fishermen's needs;
- Prioritise employment for interested local fishermen; and
- As set out in **Chapter 8** (EIA) section all activities undertaken offshore will be undertaken using BAT[1] with the aim of reducing environmental impacts where possible.

*Residual Impacts*

As a result of implementation of the proposed additional measures, the residual negative impact of the Project construction to fishing activities will be **Minor**.

### 9.4.2 *Employment and Business Opportunities*

*Discussion of Impacts*

Based on the estimation of workforce requirements from the Sponsors and EPC estimation up to 500 workers are required for the mooring of the FSRU, offshore infrastructure, jetty and access road construction. Of this total around 150 will be unskilled and used to support the onshore construction activities.

The majority of the unskilled roles are assumed to be prioritised for the local directly impacted villages around the Project facilities (in this case Muara, Blanakan and Cilamaya) with jobs likely to include manual laborers, drivers, security, catering and cleaning positions. The Sponsors will instruct the EPC (Meindo) to optimise local employment where feasible as part of their local content policy.

Based on current estimates from Samsung, the Power Plant EPC, approximately 3,500 workers will be required during the peak construction activities; around 50-60% will be local. These numbers include the site manager, construction superintendent and supervisor, electrical and instrument installation, health and safety officer, heavy machine operator, welder, piping installation, crane operator, road construction, security and civil works.

Roughly 600 workers will be required during the construction of the sub station and transmission line; of that roughly 80% will be local. The Project has

[1] Best Available Technology refers to technology for limiting pollutant discharges with regard to an abatement strategy.

described the minimum requirement for the workers as secondary / junior high school graduates with a relevant certification. The construction of the CCGT Power Plant will take up to 36 months to complete and the transmission line roughly 22 months from the laying of the foundation, construction, tower erection and stringing.

Based on the baseline information (Karawang Regency Statistic in Figures, 2016), there are 82,118 people in Karawang Regency and 122,444 in Bekasi that are classified as unemployed and of a working age. At the village level of Cilamaya there are reportedly 2,528 people categorised as of working age but not employed and seeking job opportunities. This indicates a large segment of locals that are willing and potentially expect to have access to Project employment opportunities.

The baseline data presented in **Section 7** indicates not only a large pool of unemployed workers or casual/seasonal workers but also a high desire amongst the directly impacted communities to be employed by the Project. This was also reflected very strongly in the consultation activities undertaken as part of the AMDAL and ESIA processes.

In addition to employment opportunities, to support the construction activities (e.g. to provide materials, equipment, supplies as well as services such as cleaning and catering and other construction activities) a number of goods and services will be required. The Project will require accommodation for non-local (skilled) workers amongst the villages close by to the construction activities. This is likely to be within the community in rented houses. As such, in addition to rent, cleaning and catering needs will also need to be met locally.

This large demand for employment and goods and services over the construction period will create additional markets for existing small and medium local business e.g. kiosks supplying daily needs or restaurants near the Project location. It is assumed that the Project would optimise the procurement of local goods and services where feasible.

*Impact Evaluation and Significance*

Given the Project's commitment to optimise local employment and procurement, also the high community expectation to be employed and to provide good and services, it is therefore very likely that the Project will have a positive impact in terms of employment and business opportunities; albeit small in scale and temporary.

*Proposed Mitigation Measures*

Local people have a high expectation to be employed by the Project; hence it is likely that during the Project construction there will be competition among the locals as well as people from the neighbouring villages and districts.

To optimise the Project benefits to local community through employment and business opportunities, the Project will implement the following additional mitigation measures:

- To have clear stipulation of using local labour in the EPC contract to instruct the EPC to prioritise qualified local people in accordance with the needs of the Project;

- To ensure the EPC liaises closely with the local village leaders and local government authorities to agree on the appropriate procedures for recruitment and hiring (to avoid agents and set out a fair and transparent process);

- Provide and communicate clear and factual information about the Project's needs related to employment and business opportunities to ensure the community understand the opportunities and the scale and to prioritise locals where feasible; and

- To widely socialise the grievance mechanism (set out in the SEP) to track and monitor concerns associated with Project employment / workforce recruitment. Where complaints are submitted the Project will undertake an immediate investigation to close the matter out fairly.

### *9.4.3 Managing Community Expectations*

*Discussion of Impacts*

During the consultations undertaken for the AMDAL and ESIA the expectation of employment as raised on many occasions by males, females and youth in the impacted villages visited. This need is supported by the fact that many of the households' income in the Project area are below the monthly minimum wage.

This is also likely creating high community expectation for the Project local employment to improve their economic condition. Furthermore the lack of economic opportunities other than fishing and agriculture also hinder the ability for the villagers (especially in Karawang) to gain employment outside these sector.

To handle this issue, the EPCs will coordinate with the Sponsors on the approach taken to recruitment and local employment. The job opportunities will be communicated with village heads and an announcement placed on the village announcement boards. All candidates from the directly affected villages will be eligible for selection by the EPC based on their needs and skills.

*Impact Evaluation and Significance*

Given the existing skill sets within the community and the Project's requirements for workers some of these expectations will be met (especially around the power plant that requires a significant number of unskilled workers).

However the number of realistic job positions along the transmission line and substation will not be as significant and therefore individuals seeking employment indicates expectations require management.

Furthermore the requirements during operations even at the power plant will reduce significantly therefore the mature and duration of employment will need to be careful communicated. Should they not be managed the community may become discontent with the Project, social jealousies may arise between those who have been employed and those who have not which could lead to community protests, delays and escalating Project costs.

This likely impact may not only take place during the construction but also potentially occur during the operation stage. There will be a significant decrease in the number of job opportunities during this stage. In addition, at the end of construction worker contracts, due to the limited employment opportunities elsewhere, as is typical on Projects of this nature in Indonesia, the hope is that once employed by the Project the worker will be retained through the whole Project lifecycle.

As a result of the above, managing expectations early and clearly will be important when mitigating community impacts. The availability of local jobs for the CCGT is relatively high given the existing employment market and as such the magnitude is considered **Medium** and the sensitivity is clearly **High**.

The Project is committing to optimising local employment where feasible; however, there is still the potential for community dissatisfaction. For this reason, the impact is assessed as **Major**.

*Table 9.10 Community Expectations for Local Employment*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | Minor | Moderate | **Major** |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

It is assumed that a range of management measures will be in place. In addition, the Project is expected to implement the following additional mitigation measures:

Provide and communicate clear and factual information about the Project's needs related to employment and business opportunities to ensure the community understand the opportunities and the scale and to prioritise locals where feasible:

- To avoid over committing or promising employment and clearly setting out employment needs to address grievances or community complaints;

- To have clear stipulation of using local labour in the EPC (Samsung) contracts to instruct the EPC to prioritise qualified local people as construction workers in accordance with the needs of the Project;

- To ensure the EPC liaise closely with the local village leaders and local government authorities to agree on the appropriate procedures for recruitment and hiring (to avoid agents and set out a fair and transparent process);

- Work closely with the local government agencies to synchronise the Project's needs and the local's capacity to offer opportunities to females also;

- To widely socialise the grievance mechanism (set out in the SEP) to track and monitor concerns associated with Project employment / workforce recruitment. Where complaints are submitted the Project will undertake an immediate investigation to close the matter out fairly; and

- Implement a community development program to increase the skills of local workers and the capacity of local businesses to meet the needs and requirements of the Project for the longer term.

*Residual Impact Significance*

As a result of implementation of proposed additional measures, the residual Project impact related to managing community expectations associated with Project employment will be **Minor**.

This impact is variable and requires careful monitoring to test (and adapt) the level of engagement and provision of Project information is sufficient.

### 9.4.4 Disturbance to Fresh Water Fisheries Activities

*Discussion of Impacts*

A jetty will be built to support mobilisation of heavy equipment and materials during construction and also be used during emergencies during operations. The jetty will be constructed at Muara Village located 7.6 km miles from the north coast of Ciasem Bay, Subang Regency. The jetty will occupy an area of 500 $m^2$.

The onshore pipeline is approximately seven (7) km length will be installed underground. Backhoes will be used to trench the area where proposed pipeline is buried. The proposed onshore pipelines will include three main pipelines i.e. the seawater supply pipe, the waste water discharge pipe and the 20-inch gas supply pipeline.

The construction of the jetty, onshore pipeline, and access road to CCGT is estimated to complete within 12 months. These facilities are located adjacent of the fish pond areas in Muara and Cilamaya Villages. The construction activities will involve land clearing and earth works, trenching and dredging.

In additional to the land acquisition impacts discussed earlier it is predicted that during the construction activities the level of noise, dust, and vibration will increase significantly. Given the location is nearby active fish ponds the disturbance to fishing activities in the fish pond area is anticipated.

*Impact Evaluation and Significance*

The exact location of the nearby fish ponds is currently unknown as the access road and pipeline routes are still to be finalised. However given the location it is likely that active fish ponds will be in close proximity to the activities. As such the dust from the construction vehicles and activities may cause damage to the nearby ponds affecting the yield of fish or shrimp.

Given the fact that fresh water fish cultivation is one of the main sources of income in Muara Village the increased noise, dust, and vibration during the construction may also pose a perceived impact to the reduced productivity of the fish pond, therefore the magnitude and sensitivity of this issue is Medium. This may be further heightened by the desire for compensation given the land acquisition process will have previously acquired several ponds along the right of way and access road.

Therefore the significance of impact to fresh water fisheries activities is assessed as **Moderate (Table 9.11).**

***Table 9.11 Disturbance to Fresh Water Fisheries Activities during the Construction***

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

To mitigate the negative impacts, the Project is suggested to implement the following measures:

- Apply noise, dust, and vibration barriers to reduce the level of disturbance to fresh water fisheries activities;
- Establish a grievance mechanism which is accessible for all community groups to report concerns associated with disturbance to fresh water fisheries activities. Immediate action should be taken in a case that the livelihood of the fish pond owners/ cultivators is impacted by the Project;

- Conduct regular socialisation and consultation activities with the relevant stakeholders such as the head of Blanakan and Muara villages, in an open, timely and transparent manner;
- Ensure the RP set out the process for entitlements for damage of fish ponds. Any compensation agreed will be on a case by case basis through discussion with all parties involved; and
- Prioritise employment for interested local fish pond owners.

*Residual Impact Significance*

As a result of implementation of the proposed additional measures, the residual Project negative impact to fresh water fisheries activities during the construction will be **Minor** significance.

### 9.4.5 Disturbance to Agriculture Activities

*Discussion of Impacts*

Based on the spatial analysis and field observations the access road, pipeline, and maintenance road facilities in Cilamaya and Muara village will be built along agricultural areas. The access road will be constructed seven (7) km length and six (6) m in width with a one (1) m slope on both sides. As such there is a potential of higher water flow to the paddy field along the construction site especially during the rainy season hence potential disturbance to agricultural activities due to flood is also anticipated.

In additional to the land acquisition impacts discussed earlier it is predicted that during the construction activities the level of noise, dust, and vibration will increase significantly as well as the risk of flooding. Given the location is nearby paddy fields the potential to disturb farming activities exists.

The transmission line will be approximately 52 km in length routed from the proposed CCGT Power Plant to Cibatu Baru II/Sukatani EHV substation. The right of way has been routed as much as possible away from residential areas; passing largely over paddy fields. The route passes through the Bekasi and Karawang Regencies impacting land owners and users in 37 villages, temporarily. The line will comprise 118 transmission towers with a transmission corridor/ right of way of around 17 m each side of the transmission lines (total of 34 m).

All land required to construct the tower footings has been acquired by the Project based on a willing buyer and willing seller principle as discussed in the previous section (a remaining 20% payment will be made following the transfer of the land deeds by the land agency, expected to be complete by May 2018). Land owners underneath the right of way will also be compensated based on the government regulations for easement compensation (the identification of these land owners is still underway).

Similar to the pipeline right of way and access road, during the construction land owners and users of the fields just outside the right of way may be impacted due to the mobilisation of equipment and materials as well as the construction activities.

The EPC (Samsung) is still developing the detailed design and as such information on access to the right of way is unknown. Based on the site observations access will be through paddy fields. The EPC will plan to liaise with the local owner of the land required for access and laydown areas. Compensation will be agreed on a one to one basis depending on the size of land required, loss of potential income and the duration (noting the use of the land is only temporary).

Based on discussion with the EPC access to the right of way (to bring in equipment) is likely to be using manual labor (rather than constructing a road and using vehicles). This will reduce the level of impact on the existing paddy lands.

*Impact Evaluation and Significance*

The construction activities, to develop the access roads in particular, may cause damage to the nearby paddy fields may affecting the crop yield or be perceived to damage the paddy field or its irrigation. Given the reliance on paddy as one of the main sources of income the sensitivity to the fields being damaged is **High**, however the magnitude is considered **Low** as the impact is likely to only be those field directly adjacent to the construction activities.

Similar to the impacts to fish ponds the issue may be further heightened by the desire for compensation given the land acquisition process will have previously acquired several areas of paddy field ponds located along the right of way of access road.

Given the above the significance of impact to agriculture activities along the due to construction activities are assessed as **Moderate**.

***Table 9.12 Disturbance to Agriculture Activities***

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | **Moderate** |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

To mitigate the negative impacts, the Project is suggested to implement the following measures:

- Apply appropriate flood barriers, box culverts etc. to manage flooding as well as dust mitigations/suppression techniques;

- Socialise the grievance mechanism which is accessible for all community groups to report concerns associated with damage to paddy fields;
- Conduct regular socialisation and consultation activities with the relevant stakeholders along the road and right of way in an open, timely and transparent manner;
- Ensure the RP set out the process for entitlements for damage to paddy. Any compensation agreed will be on a case by case basis through discussion with all parties involved; and
- Prioritise employment for interested local farmers.

*Residual Impact Significance*

As a result of implementation of the proposed additional measures, the residual Project negative impact agricultural activities during the construction of the jetty, access road, and maintenance road will be **Minor** significance.

### *9.4.6 Reduced/Loss of Community Access*

*Discussion of Impacts*

Based on the spatial analysis and field observations the access road, pipeline, and maintenance road facilities in Cilamaya and Muara village will be built along agricultural areas. It is anticipated that the community, particularly farmers who cultivate land along the main facilities, may have to reroute, resulting in a longer journey time to and from their fields, village office, market, and other public facilities. At this stage it is unclear how the construction activities access will be managed however it is assumed that access will be restricted to workers only to manage health and safety risks.

Furthermore it is not the intention of the EPC to restrict road use of the private SKG Cilamaya road (around the Power plant perimeter) during construction, as such communities residing close to the power plant site will still be able to use this road. It should be noted that during specific construction periods there will large traffic volumes delivering materials to and from the site that may result in congestion.

*Impact Evaluation and Significance*

The EPC has confirmed that it will enable access for local communities during the construction activities across the access road construction via flagmen as such it is anticipated that although the sensitivity to this issue is Medium, the magnitude is small and therefore the impact is **Minor**.

*Table 9.13 Impact as a Result of Lost/Reduced Access*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| Magnitude of Impact | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

Proposed Mitigation Measures

To mitigate the negative impacts, the Project is suggested to implement the following measures:

- Socialise the grievance mechanism which is accessible for all community groups to report concerns associated with loss in access;
- Conduct regular socialisation and consultation activities with the relevant stakeholders along the road and right of way in an open, timely and transparent manner; and
- Discuss with EPC and village head options to allow safe access through the construction works e.g. pedestrian bridge, flag men and safe pathways etc.

*Residual Impact Significance*

As a result of implementation of the proposed additional measures, the residual Project negative impact on loss of access is predicted as **Negligible**.

### *9.4.7 Impacts due to a Non-local Workforce Presence*

*Discussion of Impacts*

Across the various Project activities non local workers who will be employed where skilled positions cannot be filled by locals; this will particularly be the case for the power plant where non locals will be housed in the community and surrounding areas in rental properties.

The workers will therefore inject cash into the local economy through rental payments and daily needs. However, the presence of non-locals in a community such as Cilamaya can result in a number of adverse issues including:

- Local community discontent due to non locals benefiting from employment opportunities;
- Community conflict between non locals due to ethnicities/religions;

- Increased pressure on existing community infrastructure and services (e.g. waste disposal, electricity, water, sanitation and health care);
- Increased demand for good leads to increased prices in goods and services;
- Increased anti-social behaviours (including excessive alcohol use and use of sex workers); and
- Introduction and / or increases prevalence of communicable diseases such as sexually transmitted infections (STIs).

Of particular concern is the potential for an increase in the commercial sex trade as is often associated with large scale developments, particularly when a large (often mainly male) workforce is required for short to medium period of time. If appropriate precautions are not taken, this can increase the rate of STIs (e.g. HIV / AIDS and Hepatitis A) in the Project area and unwanted pregnancies.

The ESIA field survey and secondary research confirmed that prostitution exists within the Project area. Based on the data from the HIV / AIDS Prevention Commission of Indonesia, there were 25 hotspot locations for prostitution in the Regency of Karawang in 2016 with the risk ratio of being infected with HIV/ AIDS through commercial sex trade at 59%[1]. It was also reported that there was generally a limited awareness and understanding in the community related to STIs. The village of Blanakan is also a well-known area for prostitution; 10 km from the Power Plant area.

Health facilities in the areas area available to address day to day health issues. However, their capacity (e.g. availability of diagnostic equipment, availability of medicine) to respond to an increase in STI transmission is limited.

*Impact Evaluation and Significance*

The impacts associated with the presence of a non local workforce such as community health, community conflict and increase in anti-social behaviours have been considered in this assessment. Given the large number of non-locals that will be present in the area for up to 36 months, the close proximity of their living arrangements and the presence of commercial sex workers in close proximity the impact is considered **High**.

[1] https://karawangplus.com/gila-karawang-punya-25-tempat-prostitusi/

*Table 9.14 Impacts as a Result of Non-Local Workers*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | **Major** | Major |

*Proposed Mitigation Measures*

The Project will implement the following additional mitigation measures to manage potential negative impacts associated with the presence of non-local workers:

- Compulsory medical examinations for Project workers, including contractors to ensure they are fit for working and to monitor the prevalence of communicable diseases detected through annual medical check-up;
- Training for all workers on the expected healthy workforce behaviours and cultural awareness;
- Conduct inductions and training refreshers on the Project's Code of Conduct regarding do's and don'ts in relation with interaction with locals;
- Implementation of a strict worker management plan;
- Provision of onsite health care, to ensure that medical attention can be sought should a worker present with the symptoms of a communicable disease; and
- Establish a grievance mechanism and accessible for all community groups to report concerns associated with non local workers.

*Residual Impact Significance*

As a result of implementation of proposed additional measures, the residual impact on the community associated with non-local presence to community health is considered **Minor.**

### *9.4.8 Community Impacts on due to Migration Influx*

*Discussion of Impacts*

The Project will employ a range of people during the construction phase; as stated previously over 4,000 workers will be employed during the construction and onshore facilities around the coastal area. Given the large number of workers and the potential for indirect employment or goods and services opportunities there is the potential for an influx of people seeking opportunities. These opportunity seekers may be local who have left and are now returning to seek employment, families of workers employed by the Project or business entrepreneurs. These scenarios may all be likely given the Project's location to Jakarta and its ease of access.

The influx of opportunity seekers to a Project area has with it associated benefits and also adverse impacts including:

- Local community discontent due to non locals benefiting from business opportunities;
- Community conflict between non locals due to ethnicities/religions;
- Increased pressure on existing community infrastructure and services (e.g. waste disposal, electricity, water, sanitation and health care);
- Increased demand for good leads to increased prices in goods and services;
- Increased anti-social behaviours (including excessive alcohol use, drug misuse, use of sex workers and crime);
- Introduction and / or increases prevalence of communicable diseases in the Project area or to the local community; and
- Increase demand for housing and daily goods benefiting local land lords and hospitality/retail owners.

*Impact Evaluation and Significance*

The impacts associated with influx such as community health, community conflict and increase in anti-social behaviours are currently have been considered in this assessment.

The local community has a high expectation for employment and as such would have a low tolerance to non locals being offered opportunities over locals therefore the sensitivity is **Medium** as they still have opportunities for other income streams in the area.

However the magnitude is **Small** due to small number of non-local opportunities associated with the Project and the close proximity of Jakarta that offers numerous job and business opportunities.

Considering the above the impact significance as a result of influx is assessed as being **Minor.**

*Table 9.15 Impacts as a Result of Influx*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | Low | Medium | High |
| Magnitude of Impact | Negligible | Negligible | Negligible | Negligible |
| | Small | Negligible | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

*Proposed Mitigation Measures*

The Project will implement the following additional mitigation measures to manage potential negative impacts associated with influx:

- Establish recruitment and employment plan that clearly sets out workforce requirements and local content. This plan will be consulted with local government and disseminated widely with the aim of discouraging influx. The plan will also include a demobilisation plan for non-locals after the construction period;

- Establish a grievance mechanism and accessible for all community groups to report concerns associated with potential influx. Where complaints are submitted the Project will undertake an immediate investigation; and

- The Project to liaise with the local police and healthcare providers to ensure no additional pressure has been placed on them due to Project influx.

*Residual Impact Significance*

As a result of implementation of proposed additional measures, the residual impact on the community is considered **Negligible**.

### *9.4.9 Disturbance to Public Marine Transportation and Fishermen Safety*

The Project will likely have an impact on community safety and security especially the fishermen due to its marine transportation. All the material for the construction will be transported via Tanjung Priok Port up to seven times during the construction phase; in addition there will be two pontoon logistic barges alternating every three days and one pontoon lay barge used for pipe welding.

The area will also be utilised to mobilise other material and heavy equipment through the jetty for the construction of the CCGT Power Plant over a three (3) year period. The location surrounding the FSRU is used by the fishermen traveling to their fishing grounds. The increased marine traffic may impact the safety of the fishermen from Blanakan Village and the surrounding villages, in particular those in smaller vessels. This concern was expressed during consultations with the Blanakan fishing group based on previous experience of other large vessels traversing the bay.

The bay also has some marine traffic from vessels leaving or arriving at Tanjung Priok (~ 96 km as the crow flies from the FSRU) and other vessels associated with Pertamina's offshore activities (the Uniform platform is more than 10 km northeast of the FSRU). However as both are located more than 10 km away from the FSRU, cumulative traffic congestion is not anticipated to be an issue given the exclusion zone is only 500 m.

*Impact Evaluation and Significance*

As Pamanukan Bay is the main fishing ground for fishermen from Blanakan village, there is a potential for negative impacts to their safety while fishing in the area around the FRSU or when the barges are laying the pipelines to shore. Thus the mag and duration of construction i.e. three (3) months. Considering the safety issues in the past (an incident was recorded near Pertamina's platform in 2008) and the fact that the fishing communities are adaptable the sensitivity is assessed as **Medium**.

Therefore the significance of impact to fishermen safety is assessed as **Minor**. Disturbance to other marine traffic is assumed Negligible.

***Table 9.16 Disturbance to Public Marine Transportation and Fishermen Safety***

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

To mitigate the impact, the Project is expected to implement the following measures:

- Coordinate with the relevant authorities i.e. *Kantor Kesyahbandaran Tanjung Priok* and Port Authority Class II in Tanjung Priok to communicate updates on Project shipping activities;
- Coordinate with *Kantor Kesyahbandaran Tanjung Priok* and Port Authority Class II in Tanjung Priok (and other key parties) regarding the pipe deployment plan and data of burial position and publish with the *Berita Pelaut Indonesia* (BPI) and Notice to Mariners (NTM);
- Conduct consultation activities with the fishing groups prior to and during the construction activities to raise their awareness of the routes, activities and safety distances and exclusion areas; and

- Socialise the grievance mechanism to ensure the community groups understand its functionality and where complaints on accidents or near misses are submitted work closely with the complainant and EPC to close the issues out in a fair and timely manner.

*Residual Impact Significance*

As a result of implementation of the proposed additional measures, the residual Project negative impact to public marine transportation and fishermen safety will be **Minor** significance.

However should an incident (in particular a fatality of serious injury) occur this rating will need to be reviewed.

### 9.4.10 Community Safety Risk as a Result of Increased Traffic

*Discussion of Impacts*

The Project will result in increased traffic during the construction period as discussed previously. This will be most noticeable in and around the CCGT that will be constructed over a three year period and to a lesser extent in the villages with access to the transmission line and sub station. The vehicle movements will be transporting goods, equipment and materials to and from the site along the main road in Cilamaya Wetan as well as smaller village roads. Where possible materials will be sourced locally or from sources nearby.

In addition to traffic into Cilamaya from Tanjung Priok and Jakarta there will be movements back and forth to the jetty on the newly developed access road. The main traffic movements will be during the top soil removal at the power plant and the foundation laying for the access road, power plant and substation in Bekasi. These activities will require significant volumes of material and as such between one to two truck movements are likely every five (5) minutes over a 12-hour period during the peak construction periods.

The main toll roads that are used frequently for transportation from Jakarta to Cilamaya are in relatively good condition with typical road safety practices as is common in Indonesia. However the majority of the roads along the substation and transmission line are of a poor quality and narrow, passing through paddy land and villages with communities residing along the roadside.

The main roads in Cilamaya and to some extent the local roads are frequently used with vehicles, motorbikes and pedestrians as well as many warungs and street stalls along the local roads but with a lower level of caution or safety awareness. Motorbike helmets were rarely observed and road conditions are quite poor. No data was available on traffic incidents however during the surveys several traffic incidents were observed.

*Impact Evaluation and Significance*

As presented in **Table 9.17,** the magnitude of impact is assessed as being **Major** mainly due to the additional traffic volume, duration of construction i.e. 36 months at the power plant site, low level of community safety awareness and the fact that other roads users will be using the roads. This also considers the impact as a result of refuelling requirements at public facilities as well as congestion; both of which will impact other road users.

The material mobilisation, using heavy and large vehicles, is predicted to disrupt the traffic smoothness of roads from Cilamaya Wetan Village, Cilamaya Kulon Village, Tempuran Village, Kutawaluya Village, Rengasdengklok Village, and Karawang Barat Village.

This will increase the volume of traffic and may impact the safety of the community who reside along the road and who are commonly using the village road as the main access to conduct their day to day activities (access to markets, shops, schools, medical facilities etc.). Further traffic accidents are likely given the poor road conditions, traffic volumes and narrow condition of the roads as well as the unsafe practices by locals (more the two (2) person per motorbike, no helmets used, workers in the back of pickup trucks, lack of seatbelt use.

***Table 9.17 Community Safety Risk Associated with Increase Project Traffic***

| **Evaluation of Significance** | | **Sensitivity/Vulnerability/ Importance of Resource/Receptor** | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

It is assumed that a range of management measures will be in place. In addition, the Project/EPCs are expected to implement the following additional mitigation measures:

- Developing and implementing effective logistics and transportation management plans;
- Consultation with the communities on key Project traffic routes, timing of peak movements, type of vehicles and heavy equipment and provision of road safety awareness to the surrounding community, through corporation with the local police;
- The Project will erect traffic safety signs along routes and hot spots where vehicles frequent regularly;

- Undertake traffic safety awareness activities in the local schools in Cilamaya;
- Undertake road improvements along routes where construction vehicles will frequent often to ensure the conditions are maintained (particularly those that are road side);
- Ensure all Project drivers are trained in defensive driving and safety awareness and that all vehicles log in and out through their journey management plan;
- Enforce speed limit regulations to all Project construction vehicles, along with an emergency response procedures should any incidents with other road users or pedestrians occur; and
- The proposed grievance mechanism (set out in the SEP- **Annex C**) should be accessible for all communities to report concerns associated with safety and security. Where complaints on accidents or near misses are submitted the Project will undertake an immediate investigation.

*Residual Impact Significance*

As a result of implementation of proposed additional measures, the residual Project negative impact to traffic accidents will be **Moderate**. However should an incident (in particular a fatality or serious injury) occur with a community member, this rating will need to be revised.

### 9.4.11 *Community Health and Safety Associated with Construction Activities*

*Discussion of Impacts*

The construction of the CCGT will take an estimated 30 to 36 months with a significant presence of workers, vehicles and movements as discussed in previous Sections. The site itself is located within a residential area with communities residing along the site boundary to the south west including a school and mosque. The main road that these facilities are located on is also used frequently by local stalls and warungs; in particular in the evening.

The EPC (Samsung) plans to install temporary fencing around site boundary with a height of three (3) m, wire-mesh and post type security fence. For the southern part of site boundary an Electrolytic Galvanised Steel Sheet type fence is being considered to block visuals from the residential areas close by. As such access to the site will be carefully managed to only allow authorised personnel to enter the site. The controlled access will also help to avoid community accidents related to construction activities.

*Impact Evaluation and Significance*

Community safety around the power plant will be managed carefully to ensure no unauthorised access; similar to the security procedures currently with the SKG Cilamaya compression plant. The main area of concern would be children accessing areas where construction is being undertaken.

Given the security measures in place the sensitivity is **Low** although the magnitude would be **Medium** given the scale of the site. As such the overall impact rating in relation to community health and safety around the power plant is **Minor** during planned events. Unplanned events are discussed in **Section 10.**

*Table 9.18 Community Health and Safety Risk Associated with Construction*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| Magnitude of Impact | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | **Minor** | Moderate | Major |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

It is assumed that a range of management measures will be in place. In addition, the Project is expected to implement the following additional mitigation measures:

- Consultation with the communities on upcoming Project activities within the CCGT to inform them of any specific activities that may have H&S risks;
- The Project will post safety signs around the entrances to the site to inform community members of the risks and authorised access; and
- The proposed grievance mechanism (set out in the SEP) should be accessible for the fence line households around the power plant to report concerns associated with safety and security. Where complaints on accidents or near misses are submitted the Project will undertake an immediate investigation.

*Residual Impact Significance*

The residual impact related to community health and safety impacts will likely remain **Minor** given the measures that are proposed. However should an incident (in particular a fatality or serious injury) occur with a community member, this rating will need to be revised.

### *9.4.12 Summary of Social Impacts during Construction*

A summary of the impact assessment for the construction period is provided below.

*Table 9.19* *Summary of Social Impacts during Construction*

| Receptor | Potential Impact | Impact Evaluation | Mitigation | Residual Impact |
|---|---|---|---|---|
| Fisher folk in Blanakan and Muara villages, | Loss of income due to restrictions and construction activities (perceived and actual) | **Moderate** | • Conduct regular socialisation and consultation activities;<br>• Map and monitor the fishing activities in the vicinity of the FSRU;<br>• Ensure the Project's grievance mechanism is well socialised;<br>• Compensation will be on a case by case basis and agreed by both parties involved;<br>• Implement a relevant community development of the fishermen's needs; and<br>• Prioritise employment for interested local fishermen. | **Minor** |
| Local communities residing near Project activities | Managing Community Expectations | **Major** | • Provide and communicate clear and factual information about the Project's needs;<br>• To avoid over committing or promising employment;<br>• To have clear stipulation of using local labour in the EPC contracts; and<br>• To ensure the EPC liaise closely with the local village leaders and local government authorities to agree on the appropriate procedures for recruitment and hiring. | **Minor** |
| Local fish pond cultivators in Cilamaya, Muara and Blanakan | Damage to fishponds due to dust, waste disposal and other construction activities | **Moderate** | • Apply noise, dust, and vibration barriers to reduce the level of disturbance;<br>• Establish a grievance mechanism;<br>• Conduct regular socialisation and consultation activities;<br>• Compensation will be on a case by case basis and agreed by both parties involved; and<br>• Prioritise employment for interested local fish pond owners. | **Minor** |
| Local paddy owners and users along transmission line, substation and Cilamaya | Damage to paddy fields due to dust, waste disposal, flooding and other construction activities | **Moderate** | • Apply appropriate flood barriers and dust suppression techniques;<br>• Socialise the grievance mechanism;<br>• Conduct regular socialisation and consultation activities;<br>• Compensation will be on a case by case basis and agreed by both parties involved; and<br>• Prioritise employment for interested local farmers. | **Minor** |
| Villagers in Cilamaya and Muara | Loss in access to fields due to access road construction activities | **Minor** | • Socialise the grievance mechanism;<br>• Conduct regular socialisation and consultation activities; and<br>• Discuss with EPC and village head options to allow safe access through the construction works. | **Negligible** |
| Local villages in close proximity to | Adverse interaction with non local workers | **Major** | • Compulsory medical examinations for Project workers;<br>• Training for all workers on the expected workforce behaviours;<br>• Conduct inductions and training refreshers on the Project's Code of Conduct; | **Minor** |

| Receptor | Potential Impact | Impact Evaluation | Mitigation | Residual Impact |
|---|---|---|---|---|
| construction activities | | | • Provision of onsite health care; and<br>• Implement a grievance mechanism. | |
| Cilamaya village surrounding the power plant area | Influx resulting in increased pressure on infrastructure and services and creating social discontent | **Minor** | • Establish recruitment and employment plan;<br>• Establish a grievance mechanism; and<br>• The Project to liaise with the local police and healthcare providers to ensure no additional pressure has been placed on them due to Project influx. | **Negligible** |
| Local fishing folk from Blanakan and Muara | Health and safety impacts offshore | **Minor** | • Coordinate with the relevant authorities i.e. to communicate Project shipping activities;<br>• Coordinate with *Kantor Kesyahbandaran Tanjung Priok* and Port Authority Class II in Tanjung Priok (and other key parties) regarding the pipe deployment plan;<br>• Conduct consultation activities with the fishing groups;<br>• Socialise the grievance mechanism;<br>• Establish an ERP and safety markers; and<br>• Undertake formal safety studies. | **Negligible** |
| Local villages in close proximity to construction activities and residing along transportation routes | Traffic congestion and incidents with community members and other road users | **Major** | • Consultation with the communities on key Project traffic routes;<br>• Traffic safety signs along routes and hot spots;<br>• Undertake road improvements;<br>• Ensure all Project drivers are trained in safety awareness; and<br>• Enforce speed limit regulations. | **Moderate** |
| Cilamaya communities residing around power plant | Community health and safety impacts due to construction activities | **Minor** | • Consultation with the communities on upcoming Project activities;<br>• Post safety signs around the entrances; and<br>• Grievance mechanism should be accessible to all. | **Minor** |

## 9.5 *SOCIAL IMPACT DURING THE OPERATIONS PHASE*

### 9.5.1 *Disturbance to Fishing Activities*

*Discussion of Impacts*

During the operations, the LNG will be transferred to the FSRU via an LNG Carrier with a total capacity of 125,000 $m^3$ to 155,000 $m^3$. The FSRU is designed to operate for more than 25 years. On-going maintenance will occur during the vessel life-cycle at the proposed mooring location.

As discussed previously, restriction zones around the FRSU will be applied in accordance with Indonesian *Government Regulation No. 5 Year 2010 regarding Navigation*. Furthermore, based on the regulations, the area above the pipeline if prohibited for fishing activities.

*Impact Evaluation and Significance*

Disturbance to fishing activities as a result of the FSRU operation is potentially less than compared to the construction. During the operation phase, marine traffic will only occur at particular time (such as LNG transfer and FSRU maintenance) located within the area of the Project facilities. Although fishing is prohibited above the pipeline; the area is not considered as a desired fishing location due to the high turbidity.

As such, the negative impact to fishing activities is assessed as being **Small** due to lower frequency and traffic volume. Considering that the impacted location will be limited to certain areas surrounding the facilities the fishermen can reroute their fishing lane quite easily to avoid the disturbance in the impacted area, hence the sensitivity is assessed as being **Medium**.

Therefore the significance of impact to disturbance to fishing activities during the operation of FSRU and associated facilities is **Minor**.

***Table 9.20 Disturbance to Fishing Activities Resulted from the FSRU and Associated Facilities***

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

To mitigate the impacts, the Project is expected to implement the following mitigation measures:

- Development and socialisation of a marine facilities management plan for operations to relevant stakeholders and the community;

- Coordinate with relevant authorities such as *Kantor Kesyahbandaran* Tanjung Priok and Port Authority Class II in Tanjung Priok regarding operation activities plan publish those in *Berita Pelaut Indonesia* (BPI) and Notice to Mariners (NTM);

- Submit relevant data and report to relevant institutions such as Directorate General of Oil and Gas, Directorate General of Sea Transportation, Indonesian Navy Hydrography and Oceanography Department, Kantor Kesyahbandaran Tanjung Priok, and Directorate of Navigation;

- Provide compensation to the directly impacted fishermen due to the operation activities such as damage to fishing equipment;

- Monitoring of sea water quality (based on national and international standards) to ensure the FSRU activities do not impact seawater quality; and

- Ensuring the Project grievance mechanism is accessible to the fishing communities in the Project area enabling them to report concerns/issues associated with the FSRU activities.

*Residual Impact Significance*

As a result of implementation of the proposed mitigation measures, the residual Project negative impact to disturbance to fishing activities will be **Negligible.**

### *9.5.2 Employment and Business Opportunities*

*Discussion of Impacts*

During the operations phase the total number of local workers that can be employed by the Project will be relatively limited as the majority of activities will require specific skills and competency (estimated across the Project at 200 depending on maintenance requirements). Around 95 workers will be based at the power plant site (housed within the SKG Cilamaya housing complex area). The majority of the skilled labourers will be likely recruited from outside the area, although priority will be given to the local community to fill the required unskilled positions.

The baseline study reveals most agricultural and fishing workers are keen to participate in the Project especially considering the large unemployment pool. There will also be a high expectation amongst the local construction workers anticipating operational employment.

*Impact Evaluation and Significance*

Viewed solely as the operations phase, the opportunities are considered as positive to the local area and economy. In particular given the power plant will be operating for 25 years and over; the opportunity to support its on-going activities (supported by a community development program) and considered as longer term, although limited in numbers compared to construction.

*Proposed Mitigation Measures*

To optimise the Project benefits to the local community the Project will implement the following additional mitigation measures:

- Carefully manage construction demobilisation; many local workers will have their contract end when pre commissioning commences, as such communications around operational employment levels should be widely disclosed to manage expectations;

- To plan for local workforce employment and provision of goods and services in advance (during construction) supporting training and capacity building so that locals can be considered for operational opportunities;

- To prioritise qualified local people in accordance with the needs of the Project;

- Provide and communicate clear information about the Project's requirements related to operational employment to ensure the community understand the opportunities and the scale and to prioritise locals where feasible; and

- Ensure the grievance mechanism is accessible for all communities to report concerns associated with Project employment / workforce recruitment. Where complaints are submitted the Project will undertake an immediate investigation.

### *9.5.3 Loss of Income due to Construction Demobilisation*

*Discussion of Impacts*

As mentioned previously, the demobilisation of construction workers; particularly related to the power plant that has the highest and longest local employment, requires careful management. Overall there will be over 4,000 workers employed during the peak construction activities; this will decrease to a maximum of 300 during operations that will mostly consist of semi-skilled and skilled workers.

The construction workforce demobilisation will be carried out in accordance regulations from the Department of Manpower and Transmigration of Karawang Regency.

However, the baseline study indicates a large unemployment pool and a high expectation for Project employment. As such it is likely, due to the limited employment opportunities in the AoI and Project few opportunities will lead to many locals returning to agriculture or fishing (and as such a lower salary). This, in turn may influence public perceptions of the Project and may lead to community discontent.

Conversely there is also a risk that with the influx of migrants to the area seeking Project opportunities, a number of local contracts and business opportunities will be provided by them if the service is not available within the local community. This impact (non local Project benefits) was raised during the ESIA survey in Cilamaya as a community concern.

*Impact Evaluation and Significance*

As presented in **Table 9.21**, the significance of community unrest / upset due to the loss in income associated with construction demobilisation is identified as being **Moderate** significance. The magnitude is assessed as **Medium** due to the tendency that the impact is at the village to the regencial level of scale. Meanwhile the sensitivity is assessed as **Medium** due to small number of local workforce likely to be absorbed during the operation phase, the risks of influx of migrants to the area but the communities' ability to adopt.

***Table 9.21 Construction Worker Demobilisation***

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

In order to mitigate potential impacts, particularly those resulting from the community expectation of employment opportunity during the transition period from the construction into the operation phase, the Project is expected to implement the following additional mitigation measures:

- The Project will inform the community about employment opportunities prior to operations to allow them to be in a position to respond for such opportunities;
- Where feasible the EPCs will provide local construction worker details to the Sponsors to optimise transfer of workers to the operations phase;
- The Project's grievance mechanism will be accessible for all communities to report concerns associated with Project employment / workforce recruitment; and
- The Project will develop relevant community development activities for the impacted communities; coordinating with relevant authorities particularly with the regional and local government to align programs to needs. The program will prioritise local directly impacted communities to participate.

*Residual Impact Significance*

As a result of implementation of the proposed additional measures, the residual Project impact on the community is considered to be **Minor** significance. This impact is discussed in the ESIA section.

### 9.5.4 Health and Safety of Local Fishermen

*Discussion of Impacts*

The exclusion zone will be applied around the FSRU location in accordance with the Indonesian *Government Regulation No. 5 Year 2010 regarding Navigation*. The regulation states that vessels or boats can operate outside the safety and security zones by keeping safe distance.

At the present, there are a number of operating Pertamina gas platform facilities in the area. These facilities also apply exclusion zones as stated by the *Government Regulation No 5 Year 2010 regarding Navigation*. The baseline study confirmed that the fishing communities in the area are aware of the exclusion zones however sometimes they violate the regulation by fishing within the restricted zones. The fishermen argued that those locations are abundant with fish as the result of the flaring system that attract fish during the night as well as the subsea platform structure that encourages marine life.

The fishing communities confirmed there was an accident in 2008 causing five casualties nearby one of the Pertamina platform's due to the fishermen entering the exclusion zone. Since then Pertamina has increased efforts to ensure the fishermen obey the exclusion zones by conducting regular patrols.

*Impact Evaluation and Significance*

The exclusion zones to be applied surround the FSRU is considered to be sufficient to manage the health and safety impacts from the FSRU, hence the magnitude is assessed as Small. However, considering the history of the safety issues in the past, the sensitivity is assessed as Medium.

Based on the QRA (**Annex H**) undertaken for the FRSU the societal risks to the fishermen are considered acceptable even based on very conservative assumptions. Therefore the significance of impact to public marine transportation and fishermen safety is assessed as **Minor**.

*Table 9.22 Disturbance to Public Marine Transportation and Fishermen Safety*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | **Minor** | Moderate |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

To mitigate the impacts, the Project is expected to implement the following mitigation measures:

- Development and socialisation of a marine facilities management plan for operation phase to relevant stakeholders include the community;
- Consultation with fishermen on marine safety, the Project shipping lanes, and exclusion areas;
- Regular patrol to ensure the exclusion zones are clear from any activities prohibited by the law;
- Establish an ERP and safety markers to identify the exclusion zone areas and undertake formal safety studies such as HAZOP; and
- Establish a grievance mechanism to be accessible for all community groups to report concerns associated with health and safety. Where complaints on accidents or near misses are submitted the Project will undertake an immediate investigation.

*Residual Impact Significance*

As a result of implementation of the proposed mitigation measures, the residual Project negative impact to disturbance to fishing activities will be **Negligible.**

### *9.5.5 Impact to Community Health and Safety*

*Discussion of Impacts*

The operation of the CCGT will be for +25 years with only a small presence of workers, vehicles and movements as discussed in previous Sections. The site itself is located within a residential area with communities residing along the site boundary to the south west. The main road that these facilities are located on is also used frequently by local stalls and warungs; in particular in the evening.

Fencing will be erected around site boundary to block visuals from the residential areas close by and manage access. Access will be carefully managed to only allow authorised personnel to enter the site.

The operation of the power plant will be in line with Indonesian and international safety standards with the appropriate safety considerations and zones in place. It is assumed the operator will undertake a HAZOP and other necessary safety studies

Once operational the transmission line will cross over six residential areas; near Towers 3, 5, 44, 81 and 94. The transmission lines has been designed to minimise noise impacts through insulation and the potential for electrocution through built in cutback. The potential for health impact due to EMF from the transmission line is addressed through the height of the cable above the receptor. Given PLN will be responsible for the operation of the transmission line its guidelines will be followed i.e. at least 15 m above the nearest receptor.

When considering the transmission line a number of community concerns have been raised during the consultations along the right of way from the AMDAL, land acquisition and ESIA processes. The main concerns has been related to radiation from the transmission line and also the potential for electrocution. Given the right of way passes close to around a number of villages and is of a high voltage (500 kv) these concerns need to be considered carefully. The right of way has been rerouted a number of times so as to avoid crossing over residential areas, schools or other sensitive receptors. Based on the current route the transmission line crosses over 6 sensitive receptors; this is likely to be the final fixed route. As such it will be important for the Project to consider how these crossing areas will be managed in terms of health and safety and consultation.

*Impact Evaluation and Significance*

Given the close proximity to the power plant and transmission line and the fact that health and safety is a major concern for the communities the sensitivity is rated **High**. However the Magnitude is considered small due to the limited likelihood of an incident.

Community perceptions and concerns related to the transmission line are high and as such this impact is considered **Moderate**.

*Table 9.23 Community Health & Safety Impacts*

| Evaluation of Significance | | Sensitivity/Vulnerability/ Importance of Resource/Receptor | | |
|---|---|---|---|---|
| | | **Low** | **Medium** | **High** |
| **Magnitude of Impact** | **Negligible** | Negligible | Negligible | Negligible |
| | **Small** | Negligible | Minor | **Moderate** |
| | **Medium** | Minor | Moderate | Major |
| | **Large** | Moderate | Major | Major |

*Proposed Mitigation Measures*

To mitigate the negative impacts, the Project is proposed to implement the following measures:

- Conduct regular clearance of the vertical height to ensure the area is safe as required by the regulation; at least 15 m (PLN);
- Conduct regular checking/ maintenance to ensure the safe condition of the tower and the cable (PLN);
- Develop a community emergency response plan and socialise it to the relevant communities to ensure that the communities are aware about the safety risk and understand what to do in a case of emergency; and
- Socialise the Project's grievance mechanism to the community to enable them submit grievances.

*Residual Impact Significance*

As a result of implementation of the proposed mitigation measures, the residual Project negative impact to disturbance to fishing activities will be **Minor.**

### 9.5.6 *Summary of Social Impacts during Operations*

A summary of the social impact assessment for the operations is provided below.

*Table 9.24 Summary of Social Impacts during Operations*

| Receptor | Potential Impact | Impact Evaluation | Mitigation | Residual Impact |
|---|---|---|---|---|
| Fisher folk in Blanakan and Muara villages, | Loss of income due to restrictions and exclusion zone and operations of FSRU | **Minor** | • Conduct regular socialisation and consultation activities;<br>• Ensure the Project's grievance mechanism is well socialised;<br>• Compensation will be on a case by case basis and agreed by both parties involved;<br>• Coordinate with relevant authorities regarding operation activities plan; and<br>• Submit relevant data and report to relevant institutions. | **Negligible** |
| Local communities residing near Project activities | Construction demobilisation and reduced local incomes | **Moderate** | • The Project will inform the community about employment opportunities prior to operations;<br>• Where feasible the EPCs will provide local construction worker details to the Sponsors to optimise transfer of workers to the operations phase;<br>• The Project's grievance mechanism will be accessible for all communities; and<br>• The Project will develop relevant community development activities for the impacted communities; coordinating with relevant authorities to prioritise local directly impacted communities to participate. | **Minor** |
| Fisherfolk in Blanakan and Muara villages, | Health and safety of local fishing groups | **Minor** | • Development and socialisation of a marine facilities management plan;<br>• Consultation with fishermen on marine safety;<br>• Regular patrol to ensure the exclusion zones are clear from any activities prohibited by the law;<br>• Establish an ERP and safety markers to identify the exclusion zone areas;<br>• Undertake formal safety studies such as HAZOPs; and<br>• Implement a grievance mechanism. | **Minor** |
| Local villages residing by CCGT and transmission line | Health and safety of unplanned events occurring at power plant or along the transmission line (EMF, noise and electrocution) | **Moderate** | • Conduct regular clearance of the clear zone to ensure the area is safe as required by the regulation (PLN);<br>• Conduct regular checking/ maintenance to ensure the safe condition of the tower and the cable (PLN); and<br>• Develop a community emergency response plan and socialise it to the relevant communities to ensure that the communities are aware about the safety risk and understand what to do in a case of emergency.<br>• Socialise the Project's grievance mechanism to the community to enable them submit grievances. | **Minor** |

# 10 UNPLANNED AND NON-ROUTINE EVENTS

## 10.1 INTRODUCTION

An unplanned event is defined as 'a reasonably foreseeable event that is not planned to occur as part of the Project, but which may conceivably occur as a result of Project activities (e.g. accidents), even with a low probability.

Unplanned events may occur during any phase of the Project. This Section describes the high-level assessment of potential unplanned events associated with the Project, based on discussions that took place during the Scoping exercise and provides an assessment of the potential impacts on the receiving environment.

## 10.2 POTENTIAL SOURCE OF IMPACTS

This chapter therefore discusses risks associated with the following unplanned and non-routine events:

- Soil and Groundwater Contamination due to Contaminated Fill Material during Project Construction;
- Spillage of hazardous materials onshore;
- Accidental release of vessel wastes offshore;
- Traffic accidents and vessel collision;
- Accidental release of hydrocarbons or chemicals offshore;
- Dropped objects;
- Natural hazard event (flooding); and
- Transmission line break.

The approach adopted in the assessment of impacts from unplanned events considers the likelihood of such an event occurring, and should it occur, its associated consequence on the environment and public health and safety.

## 10.3 ASSESSMENT APPROACH AND CRITERIA

The methodology used to assess the risks associated with unplanned events differs from the impact assessment methodology set out in **Section 3** of this Report. Impacts resulting from unplanned events are defined as being a combination of the likelihood (or frequency) of incident occurrence and the consequences of the incident should it occur. The assessment of likelihood takes a qualitative approach based on professional judgement, experience from similar projects and interaction with the Engineering Team.

Definitions used in the assessment for likelihood and consequence are set out in **Table 10.1** and **Table 10.2**.

*Table 10.1 Significance Criteria for Unplanned Events - Likelihood*

| **Likelihood describes the probability of an event or incident actually occurring or taking place. It is considered in terms of the following variables:** | |
|---|---|
| Low | The event or incident is reported in the industry, but rarely occurs. |
| Medium | The event or incident does occur but is not common. |
| High | The event or incident is likely to occur several times during the Project's lifetime. |

*Table 10.2 Significance Criteria for Unplanned Events - Consequence*

| **The potential consequence of an impact occurring is a culmination of those factors that determine the magnitude of the unplanned impact (in terms of the extent, duration and intensity of the impact).**<br><br>**Consequence in unplanned events is similar to magnitude of planned events and is classified as either:** | |
|---|---|
| Minor | Impacts of low intensity to receptors/resources across a local extent, that can readily recover in the short term with little or no recovery/remediation measures required. |
| Moderate | Impacts of Low to Medium intensity across a local to regional extent, to receptors/resources that can recover in the short term to medium term with the intervention of recovery/remediation measures. |
| Major | Exceeds acceptable limits and standards, is of Medium to High intensity affecting receptors/resources across a regional to international extent that will recover in the long term only with the implementation of significant/remediation measures. |

Once a rating is determined for likelihood and consequence, the risk matrix in **Table 10.3** is used to determine the impact risk significance for unplanned events.

The prediction takes into account the mitigation and/or risk control measures that are already an integral part of the Project design, and the management plans to be implemented by the Project.

*Table 10.3 Unplanned Events Risk Significance*

| Risk Significance Rating | | | | |
|---|---|---|---|---|
| Likelihood | | Low | Medium | High |
| Consequence | Small | Minor | Minor | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

***Table 3.2*** in ***Section 3*** of this Report outlines the definitions of impact significance for planned Project activities. The definitions of Minor, Moderate and Major significance are also applicable for unplanned events.

It is not possible to completely eliminate the risk of unplanned events occurring. However, the mitigation strategy to minimise the risk of the occurrence of unplanned events is outlined in **Table 10.4.**

*Table 10.4 Mitigation Strategy for Unplanned Events*

| Strategy | Description |
|---|---|
| Control | It aims to prevent an incident happening or reduce the risk of it happening to ALARP through:<br>• Reducing the likelihood of the event (e.g. preventative maintenance regimes, reducing chemical usage, traffic calming and speed limits, community road safety awareness training, implementation of state-of-the-art blowout preventative equipment, procedures and training); and<br>• Reducing the consequence (e.g. bunds to contain spilled fuels, fire protection); and a combination of both of these. |
| Recovery/ Remediation | Includes contingency plans and response including Emergency Response Pan and Oil Spill Contingency Plan. |

In general, a variety of safety management plans and mitigation measures will be developed to further reduce potential impacts to the onshore and offshore environment.

This includes the overall Emergency Response Plan (ERP) that defines an organisational structure and provides a framework for responding to a major accident event. These mitigation measures in terms of prevention, control, protection serve to reduce the likelihood, extent and duration of adverse impacts resulting from an unplanned event.

Therefore, the potential impact of unplanned and non-routine event during construction and operations phases at onshore and offshore environment are assessed together.

## 10.4 *SPILLAGE OF HAZARDOUS MATERIALS ONSHORE*

### 10.4.1 *Assessment of Impact*

Spillages of chemicals, hydrocarbons and other hazardous materials are considered unplanned events with the potential for significant environmental or social effects. Contaminated or polluted surface water or soil can directly affect human health through direct contact, or via the infiltration of contamination into groundwater aquifers known to occur under the site.

Surface water, soil and groundwater contamination may occur on all parts of the Project (power plant, electricity transmission line, river water supply pipeline and gas supply pipeline) during the construction phase due to accidental leaks or spills of chemicals or hazardous materials such as oils, lubricants or fuel from heavy equipment, and improper chemical/fuel storage. Spills and leaks may occur during vehicle/equipment operation, fuelling, and maintenance and from the temporary storage of fuels, oils, lubricants and other hazardous waste types.

Additionally, chemical cleaning during the pre-commissioning activities may impact surrounding sensitive receptors, should leakages of cleaning chemicals occur. Such spills can impact surface water quality either due to direct discharge or indirect discharge due to stormwater runoff. In addition, discharges of oily bilge or ballast water from barges could impact surface water quality during construction.

Temporary storage of fuels, oils, lubricants and other hazardous waste types is also a source of spills and leaks. Any such spills can impact groundwater quality due to leaching through soil during periods of rainfall. This is particularly the case during the initial phases of construction where machinery will be undertaken works on exposed soils.

Contaminated or polluted soil can directly affect human health through direct contact with soil, or via the infiltration of soil contamination into the aquifers known to occur under the site. Accidental release or spill of can be toxic to flora and fauna locally and downstream if substances are released into the aquatic environment.

Based on experience with similar projects, the total approximate quantities of hazardous materials that could be a potential source of impact during this stage include:

- 30,000 L/month diesel fuel;
- Small, infrequent quantities of lubricants, oil; and
- Hydrostatic testing chemicals.

Accidental releases from operational activities, including the natural gas supply pipeline, and insulant chemicals from operation of the transmission line, have the potential to impact surrounding surface water, soil and groundwater. There is the potential for deoxygenation of the soil and groundwater due to natural gas leaks from the gas supply pipeline.

A further risk during the operational phase is from a potential spill of back up fuel (should this be used to provide a backup fuel supply during breaks in the natural gas supply). These discharges may have a direct impact on the soil quality and surface water, which in turn may cause secondary impacts to groundwater. Leakage from chemical storage facilities may result in surface water, soil and groundwater contamination.

Further risks during the operational phase are from the handling of hazardous materials and potential spill from back-up fuel (should this be used to provide a back-up fuel supply during breaks in the natural gas supply). These discharges may have a direct impact on water or soil quality which in turn could have ecological implications.

### 10.4.2 *Impact Evaluation and Significance*

At any stage of construction or during the operational phase, there is the possibility that a major hydrocarbon and chemical spill could occur. Even with the application of the latest industry standards and consideration of the highest standards of safety, unplanned events may still occur due to human error, equipment failure and other procedural aspects.

In general, the impacts of such spills will be localised and of relatively short duration, whereas fuel oil may be more persistent. The likelihood of such an occurrence taking place would be **Low**, but the potential consequence could be **Large**, dependent on the sensitivity and importance of receptors affected.

Therefore, the risk significance from Hydrocarbon and Chemicals Spills and Releases is ranked as **Moderate.**

***Table 10.5 Unplanned Events Risk Significance***

| **Risk Significance Rating** | | | | |
|---|---|---|---|---|
| **Likelihood** | | Low | Medium | **High** |
| Consequence | **Small** | Minor | Minor | **Moderate** |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

### 10.4.3 *Mitigation Measures, Management and Monitoring*

During soil disturbing activities, the mitigation measures developed with regards to surface water quality (**Section 8.7.3.2**) will serve to prevent soil contamination through limiting TSS loading in surface water bodies.

The proposed measures to prevent and respond to chemical and hydrocarbon spills are:

- Hazardous materials storage areas will be sited on sealed areas and provided with locks to prevent unauthorized entry;
- Secondary containment to accommodate 110% of the largest volume of material, with appropriate drainage connection and/or provision for removal of spilled liquids, will be provided around places of fuel and hazardous materials storage such as oil filled transformers, oil pumps and tanks, generators, chemical storage houses etc. to contain any hazardous spills and to exclude surface water run-off from entering the contained area;
- All hazardous materials will be segregated and stored according to their material safety data sheet (MSDS), and will be disposed in an appropriate manner;
- All vehicles are to be equipped with spill control kits to contain and clean small spills and leaks;
- Vehicle servicing areas, vehicle wash bays and lubrication bays will, as far as practical, be located within roofed and cemented areas. The drainage in these covered areas will be connected to sewers via an oil/water interceptor.
- Any refuelling activities will only take place within a designated area of hard standing with spill kits present;
- All mobile equipment is to be equipped with spill or drip trays to contain spills and leaks of hazardous materials i.e. chemicals, hydrocarbon oils etc.;
- Equipment and vehicle maintenance scheduling is to be undertaken such that they are continually monitored for potential or actual leaks;
- A training program will be implemented to familiarise staff with measures to be taken to prevent spills and leaks, and for emergency procedures and practices related to contamination events;
- Mitigation measures/ monitoring programme with regard to accidental events/ spills shall be communicated to the EPC Contractor at the commencement of the Project implementation;

- For any spills or leaks, once the initial emergency response has been implemented, an appropriate clean up and monitoring plan is to be developed. This is to take into account the type of spill and its extent. It is also to include provisions for monitoring of soil and groundwater quality to track potential or actual migration of the contamination through the soil and groundwater profiles; and
- Develop a SEP that includes neighbouring countries and impacted communities to ensure that impacts arising from spills are managed effectively.

### *10.4.4 Significance of Residual Impact*

Based upon the implementation of the above management and mitigation measures, the residual impact level of the potential impact sources is reduced to **Minor**.

## *10.5 DEGRADATION OF HABITAT AND MORTALITY TO MARINE FAUNA FROM ACCIDENTAL RELEASE OF VESSEL WASTE*

The FSRU and support vessels will generate solid wastes, including non-hazardous wastes (e.g. paper, plastics, waste metal and glass, putrescible in the form of food waste) and/or hazardous wastes (e.g. used oil, batteries, oil filters).

There will be no planned discharge of these wastes to the marine environment. However, accidental discharge or loss of such wastes overboard may occur which may lead to impacts to marine fauna and habitats, which include pollution and contamination of the marine environment, and secondary toxicity and physical effects on marine fauna through ingestion or entanglement.

### *10.5.1 Impact Evaluation and Significance*

The existing Natural Habitat supports relatively depauperate (lacking in variety) benthic communities, there are existing sources of contamination, and there is no Critical Habitat is present within the Area of Influence.

Benthic surveys completed nearshore and along the pipeline route indicate that there are no significant areas of corals and other benthic primary producer habitat, with the nearest corals located 5 km from the pipeline route.

A range of infauna and epifauna were identified in the nearshore area, crustaceans were very well represented within the surveyed mangrove area and it is possible that endangered species of sea cucumber occur in this region, but the Project area is not considered to provide unique habitat for these species. Individual large marine fauna such as marine mammals may occur in the Project area on occasion, but it is not known to support them in significant numbers.

The likelihood of the accidental discharge of solid waste marine habitats and fauna species to be impacted is considered to be **Medium**.

Impacts resulting from the routine management of solid hazardous and non-hazardous wastes are expected to be negligible, as there will be no planned discharge of solid wastes to the marine environment. Discharge of solid wastes has the potential to create a localised change in water quality and temporary ecological impacts (e.g. changes in the availability of light, certain nutrients and/or dissolved oxygen).

Solid wastes may also be blown off the vessel, which could have the potential to result in fauna mortality or injury through ingestion or entanglement. Windblown waste would be rare as wastes will be stored in closed containers. Given the localised nature of impacts, the magnitude of effect from the accidental release of solid wastes is likely to be **small**, resulting in an impact significance of **Minor** (**Table 10.6***)*.

*Table 10.6 Assessment of Impacts on Marine Habitat and Fauna from the Accidental Release of Solid Wastes*

| Risk Significance Rating | | | | |
|---|---|---|---|---|
| **Likelihood** | | Low | **Medium** | **High** |
| Consequence | **Small** | Minor | **Minor** | Moderate |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

### 10.5.2 *Mitigation Measures, Management and Monitoring*

It is recommend that the following mitigation measures be applied in relation to solid waste management, in accordance with MARPOL 73/78 Annex V:

- Implementation of a Waste Management Plan.
- Bins available for the segregation of waste in accordance with the vessel Waste Management Plan, and bins are fitted with lids/cargo nets for waste with potential to be wind-blown (e.g. paper, cardboard).
- Solid hazardous and non-hazardous wastes generated will be either incinerated or appropriately disposed of at a licensed onshore facility in accordance with the Waste Management Plan.

### 10.5.3 *Significance of Residual Impact*

In view of the implementation of mitigation measures, the residual impact significance remains **Minor**.

## 10.6 *TRAFFIC ACCIDENTS AND VESSEL COLLISIONS*

### *10.6.1 Assessment of Impacts*

#### *10.6.1.1 Vehicle Movements*

The movement of materials between laydown/ storage areas, of structures to dismantling yards and of wastes to treatment and disposal facilities and workers from work camp(s) to Project areas, is likely to result in an increase in traffic on public road networks, thereby increasing the risk of accidents with other road users and pedestrians, and injuries/fatalities of wildlife.

#### *10.6.1.2 Vessel Activity*

Similarly, increased movements and presence of marine vessels throughout the duration of construction and operational phases will give rise to an increase in collision risks to shipping and fishing vessels.

It is unclear how many marine vessel movements will occur on a daily basis, however similarly to the terrestrial environment, it is expected that marine collisions will have the potential to be significant.

Collisions and capsizes could result in loss of inventory leading to hazardous material spills which would impact water quality and affect associated marine biodiversity and benthic communities (**Section 10.7**) and/or risk to community of worker safety.

### *10.6.2 Impact Evaluation and Significance*

Based on the current understanding of Project activities and the existing environment it is expected that during construction the likelihood of a collision occurring will be High for vehicle activities onshore given the predicted number of vehicle movements to and from the construction sites. Offshore the use of marker buoys and support vessels to monitor the presence of other sea users during construction will result in a Medium likelihood of vessel incident.

Land based collisions are likely to be localised. However, marine collisions may require a recovery of receptors/resources in the short term to medium term with the intervention of recovery/remediation measures.

From the above information, the overall impacts have been assessed to be of **Major** Significance for onshore (vehicle) incidents and **Moderate** for offshore (vessel) incidents.

*Table 10.7 Unplanned Events Risk Significance – Vehicle Incident*

| **Risk Significance Rating** | | | | |
|---|---|---|---|---|
| **Likelihood** | | **Low** | **Medium** | **High** |
| Consequence | Small | Minor | Minor | Moderate |
| | **Medium** | Minor | Moderate | **Major** |
| | Large | Moderate | Major | Major |

*Table 10.8 Unplanned Events Risk Significance – Vessel Incident*

| **Risk Significance Rating** | | | | |
|---|---|---|---|---|
| **Likelihood** | | **Low** | **Medium** | **High** |
| Consequence | Small | Minor | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | **Major** |
| | Large | Moderate | Major | Major |

### *10.6.3 Mitigation Measures, Management and Monitoring*

The proposed measures to prevent and respond to traffic accidents and marine vessel collisions are:

*Onshore*:

- Project ERP to incorporate Project vehicle activities;
- Develop and implement a traffic management plan. This should detail access routes, quality of existing roads, measures that will be implemented to minimize the risks associated with transporting materials and workers to and from site, including factors such as fatigue management and ensuring all employees observe recommended speed limits; Bus workers between the accommodation camp and the Project area. This will reduce the amount of traffic generated by the Project;
- Ensure all employees complete training prior to driving any Project vehicle. The content of the training should be tailored to the employee's role;
- Explore opportunities to work with local stakeholders to increase awareness within local villages about the hazards associated with traffic;
- Develop, communicate and implement Journey Management Plans for heavy equipment, construction and transport vehicles and worker buses; and
- Undertake stakeholder engagement with the local community for both traffic road user groups and stakeholders living at settlements adjacent to

traffic roads used during construction including updating and inform the community in the Traffic Management Plan.

*Offshore*:

In addition to the controls of notification to the relevant authorities, use of marker buoys to detail the marine safety exclusion zone and use of support vessels to intercept other sea users, the following mitigation is required:

- Undertake stakeholder engagement with marine environment users including the fishing community and other users. This include inform location of exclusion zones and better organisation of general vessel movements;
- Vessels to meet MARPOL[1] requirements including developing a Shipboard Oil Pollution Emergency Plan (SOPEP);
- Implement Adverse Weather Working Standard;
- Mark the presence of construction areas with appropriate lighting to reduce the risk of collision with other marine users;
- Prepare a Collision Risk Management Plan; and
- Use of Automatic Radar Plotting Aid (ARPA), Radar Early Warning System (REWS) and Vessel Traffic Surveillance System (VTS) where applicable to all contracted vessels.

#### *10.6.3.1 Significance of Residual Impact*

In view of the implementation of mitigation measures to manage the likelihood of such an event occurring, the residual impact significance is deemed to be **Moderate** for onshore vehicle incidents and **Minor** for vessel incidents.

## *10.7 ACCIDENTAL SPILLS OF HYDROCARBONS OR CHEMICALS OFFSHORE*

Accidental spills of hydrocarbons and chemicals could occur from various sources such as:

- A refuelling incident;
- Vessel collision leading to a rupture of vessel fuel tank;
- Equipment leaks; or
- Leaks from storage areas.

[1] The International Convention for the Prevention of Pollution from Ships.

Accidental spills of hydrocarbons and chemicals could result in impacts to marine fauna and avifauna through physical contact, ingestion, inhalation and absorption. Degradation of habitat can also occur as hydrocarbons have the potential to persist in the environment long after a spill event. Effects of hydrocarbons in these systems have the potential to have long-term impacts on fish and wildlife populations.

### *10.7.1 Impact Evaluation and Significance*

The significance of impacts associated with accidental release of hydrocarbons and chemicals is discussed and presented in **Table 10.9**.

Marine fauna most at risk include cetaceans such as dolphins and fish. Avifauna at risk include any bird species foraging at sea or on the shoreline.

Cetaceans such as dolphins are air breathing mammals and theoretically vulnerable to exposure to hydrocarbon spill impacts through the inhalation of evaporated volatiles once the crude has surfaced. They are smooth-skinned, hairless mammals. Given the nature of their skin, hydrocarbons do not tend to stick to their skin and they are not expected to be sensitive to the physical effects of oiling. Ingested hydrocarbons, particularly dissolved aromatics can be toxic to marine mammals as they can remain within the gastro-intestinal tract and be absorbed into the bloodstream and thus irritate and/or destroy epithelial cells in the stomach and intestine. Marine mammals may also be susceptible to indirect toxic effects through ingestion of contaminated prey.

Studies of bottlenose dolphins found that they were able to detect and actively avoid a surface slick after a few brief contacts and that there were no observed adverse effects with the surface slick (*Smith et al., 1983*). It is not known if other marine mammals potentially present in the area are able to similarly detect and avoid hydrocarbon slicks.

The potential for significant impacts to cetaceans as a result of ingestion of hydrocarbons is limited due to the low numbers of cetaceans expected to be present in the area that may be contacted by hydrocarbons from a spill.

Fish also have a natural avoidance instinct for many hydrocarbons (*Hoar et al., 1997)* and are therefore unlikely to be exposed to high concentration of dissolved aromatic or entrained hydrocarbons.

Birds foraging at sea have the potential to directly interact with oil on the sea surface some considerable distance from terrestrial habitats in the course of normal foraging activities. Surface plunging species that readily rest on the sea surface are most at risk.

Direct contact with surface hydrocarbons may result in dehydration, drowning and starvation and is likely to foul feathers, which may result in hypothermia (*AMSA 2015a*). Impacts may include damage to external tissues, including skin and eyes, and internal tissue irritation in lungs and stomachs (*Clark 1984*). Toxic effects may also result where hydrocarbons are ingested, as birds attempt to preen their feathers (*Jenssen, 1994*).

Although marine mammal species of conservation significance are known to occur within Indonesia; there are no confirmed records of their presences from the surveys conducted within the Project area. Important marine habitats such as nesting beaches are also not associated with the coastline at the Project area. This was confirmed by the fishing communities consulted during the AMDAL process.

Avifauna which may be present around the potentially impacted habitat are discussed in **Section 7.3.8**. A total of 53 bird species were recorded within the proposed Project area. According to IUCN Red List, 49 species are listed as Least Concern (LC) and one (1) species is listed as Near Threatened (NT), which is *Charadrius javanicus*.

The survey encountered seven (7) species of Ardeidae family. This family belongs to the Order Pelecaniformes, and includes herons, egrets, bitterns, night-herons and allies. These birds live in all kinds of wetlands, from open marshlands with shallow water to coastal areas, through tidal flats and mangroves (*Hoyo, Elliott, Sargatal, & Collar, 2002*). The presence of birds is highly dependent on the habitat quality, therefore a hydrocarbon spill reaching such habitats is likely to impact the number of species present.

Of particular concern are the potential impacts from an oil spill at sea reaching coastal areas, which have a concentration of sensitive receptors (e.g. corals, marine mammals nesting grounds, important bird migratory pathways, fishing grounds or the impacts from a spill on land in sensitive areas (e.g. protected habitats, areas of high conservation value), into water courses or in built up areas affecting the public.

The coastal area of the Project jetty and pipeline landfall locations exhibits mangroves in areas. The impacts of hydrocarbons on mangroves include damage as a result of smothering of lenticels (breathing pores) on pneumatophores or prop roots or by the loss of leaves (defoliation) due to chemical burning (*Duke, et al., 1999*). Thorhaug (1987) concluded that while defoliation of mangroves was a common occurrence when exposed to hydrocarbon slicks, massive mortality was not always the ultimate outcome. Mangrove death is predicted whenever more than 50% of the leaves are lost (*Evans, 1985*).

It is also known that mangroves take up hydrocarbons from contact with leaves, roots or sediments, and it is suspected that this uptake causes defoliation through leaf damage and tree death (*Wardrop et al., 1987*). The recovery of mangroves from shoreline oil accumulation can be a slow process, due to the long term persistence of oil trapped in anoxic sediments and subsequent release into the water column. (*Burns et al., 1993*).

The sensitivity of marine fauna and avifauna to hydrocarbon spills is considered to be **Medium**. The magnitude of effect due to Accidental Spills of Hydrocarbons and Chemicals, considering likelihood of the event occurring and volume of potential marine diesel release is ranked as **Medium**. The overall magnitude of this impact is therefore **Moderate**.

*Table 10.9 Assessment of Impacts from Accidental Hydrocarbon or Chemical Spills*

| **Risk Significance Rating** | | | | |
|---|---|---|---|---|
| **Likelihood** | | **Low** | **Medium** | High |
| Consequence | Small | Minor | Minor | Moderate |
| | **Medium** | Minor | **Moderate** | Major |
| | Large | Moderate | Major | Major |

### 10.7.2 *Mitigation Measures, Management, and Monitoring*

It is recommended that the following mitigation measures be applied in relation to Invasive Marine Species during construction:

- Vessels will have Shipboard Oil Pollution Emergency Plan (SOPEP) and spill kits on vessels;
- Chemicals and lubricants to be stored as per SDS and in bunded area;
- Vessel will be of suitable standard and build quality;
- Vessels will maintain visual, radio and radar watch at all times, and will implement lighting, shapes and practices in accordance with COLREGS; and
- A Marine Oil Spill Contingency Plan will be developed and personnel trained in its implementation.

### 10.7.3 *Significance of Residual Impacts*

In view of the implementation of mitigation measures as reducing the likelihood of such an event occurring, the significance of residual impacts is predicted to be **Minor.**

## 10.8 *Dropped Objects*

### 10.8.1 *Assessment of Impact*

Materials and supplies during operation will be transported by supply vessels in the offshore environment. Similar to the onshore environment, any construction activities and transfer operations there is the risk of objects being dropped.

In the marine environment similarly to the construction phase should materials lost at sea be inert, there will be little risk to the environment.

However, drums/containers of chemicals, fuel, oil or other environmentally hazardous materials pose a potential pollution hazard unless they can be recovered undamaged. This has the potential to impact the seabed, benthic communities, other marine life and users of the marine environment such as fishermen and other local recreational users.

In the case of large structures lost to sea such as during the deployment of pipelines, the risk to the marine environment would primarily be the potential of collision with vessels working within the area/ disrupting fishing activities. Equipment or structure impacting the seabed would have a direct impact to corals, where present.

### *10.8.2 Impact Evaluation and Significance*

Based on current understanding of the Project it is expected that the likelihood of objects being dropped during construction and operation will be **High**.

As outlined above the sensitivity of the environment will vary across the Project area. Considering the likelihood of an event occurring, the consequence for dropped objects is considered as **Minor** based on the likelihood outlined above and the fact that the extent and duration of any impacts will generally be small.

From the above information, the overall impacts have been assessed to be of **Moderate** Significance.

*Table 10.10 Dropped Objects Impact Significance*

| **Risk Significance Rating** | | | | |
|---|---|---|---|---|
| **Likelihood** | | **Low** | **Medium** | **High** |
| Consequence | **Small** | Minor | Minor | **Moderate** |
| | Medium | Minor | Moderate | Major |
| | Large | Moderate | Major | Major |

### *10.8.3 Mitigation Measures, Management and Monitoring*

The proposed measures to prevent and respond to dropped objects are:

- Develop Standard Operating Procedures and Permit to Work Systems;
- Restrict the lifting path to avoid critical/ sensitive equipment;
- Lift loads within the maximum lifting capacity of crane systems only; and

- Recover (wherever practicable) objects which are accidentally dropped into the sea.

### 10.8.4 *Significance of Residual Impact*

The residual impact significance of dropped objects is assessed to be **Minor**.

## 10.9 NATURAL HAZARDS

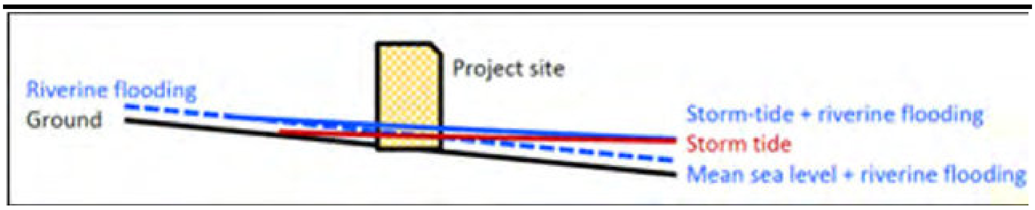
### 10.9.1 *Potential Impacts*

The Project site is situated between the Cilamaya Main River and Cilamaya Irrigation Canal. Due to location of the Project area, it is vulnerable to flooding due to:

- Riverine flooding – inland flooding;
- Extreme storm-tidal conditions along with sea level rise – coastal flooding; and
- Combination of both inland and coastal flooding.

The three (3) schematic flood scenarios are shown in **Figure 10.1**.

*Figure 10.1* *Schematic of Flood Scenarios*




The Project area was hit by some major floods in the last few years. The Project area and its vicinity were flooded on March 17, 2014. It was reported that this flooding event was not caused due to extreme basin-wide rainfall-runoff analysis but by the waterways being jammed by debris and so, inadequate drainage due to blockage. In addition, long time Cilamaya residents reported flooding inundation from Cilamaya River on January 18, 2013. This was caused due to extreme rainfall and associated runoff in the Cilamaya River basin.

### 10.9.2 *Assessment and Approach*

ERM referred to the flood risk assessment report titled 'Cilamaya Flood Report' completed by Pöyry Energy GmbH December 2017 for the proposed Cilamaya Combined Cycle Gas Power Plant in West Java, Indonesia. The objective of the study was to determine 100-year flood water levels for the design of the flood dike around the proposed Project area. The approach comprised of hydrological analyses that included flow regionalization approaches and rainfall-runoff modelling which were used to compute 100-year flood hydrographs for the Irrigation Canal (729 $m^3$/sec – peak flow) and the Cilamaya River (600 $m^3$/sec – peak flow).

Prior to the study, it was not clear if the main flood risk to the Project area originates from Cilamaya Irrigation Canal or from Cilamaya Main River. In addition, tidal storm surges may significantly influence the flood situation in combination with backwater effects.

In the study area, several other larger and smaller irrigation canals are operated. Their discharge capacities seem to be limited in terms of cross-sections and by structures as bridges and inverted syphons. Thus, these other canals were not considered as relevant factors of flood risk to the Project area and were not studied in detail. Hence, major focus of the study is to evaluate the riverine flood risk associated with Cilamaya Main River and Cilamaya Irrigation Canal at Projects area, and tidal flood risk associated with tides, storm surge and sea level rise impact at the Project area.

*Hydrologic Analysis*

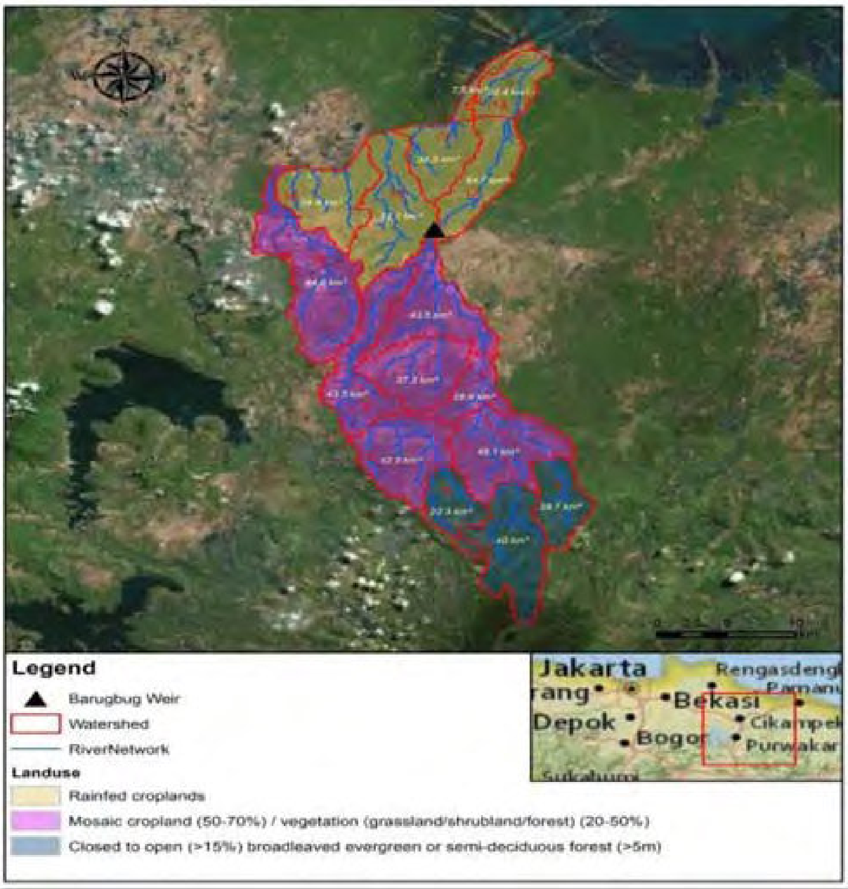
A 2D-hydraulic model was built from LiDAR-based Digital Terrain Model (DTM), cross-sectional surveys and sea bed elevations, after ground-truthing and modifying some of the input-data. In order to account for the uncertainties in the data input, a set of conservative model assumptions were made.

Model simulation was run for Project state (site area was excluded from active discharge domain), to understand the changes in flow direction due to the flood dike. The objective of the study was to determine 100-year flood water levels for the design of the flood dike around the proposed Cilamaya Combined Cycle Gas Power Plant. For that purpose, hydrological analyses were carried out using rainfall–runoff modelling in order to obtain the 100-year design flood hydrograph.

This hydrologic analysis was supported with flood regionalization approaches. Details of hydrologic analysis are summarized below in subsequent sections. Hydrologic analysis needs catchment delineation of the Cilamaya River and the Cilamaya Irrigation Canal, which contributes flow at Project area. Catchment and sub catchment/sub basins were delineated using a Digital Elevation Model (DEM) in GIS.

**Figure 10.2** presents the catchment of the Project area and gives an overview of the determined sub-basins. Major land uses and area values of each sub basin are highlighted.

*Figure 10.2 Project Catchment Area*




*Rainfall-Runoff Modelling*

Hydrologic Modelling System (HEC-HMS) software by USACE-HEC was used to obtain the design flood hydrograph at Project area. HEC-HMS is designed to simulate the complete hydrologic processes of event-based scenarios.

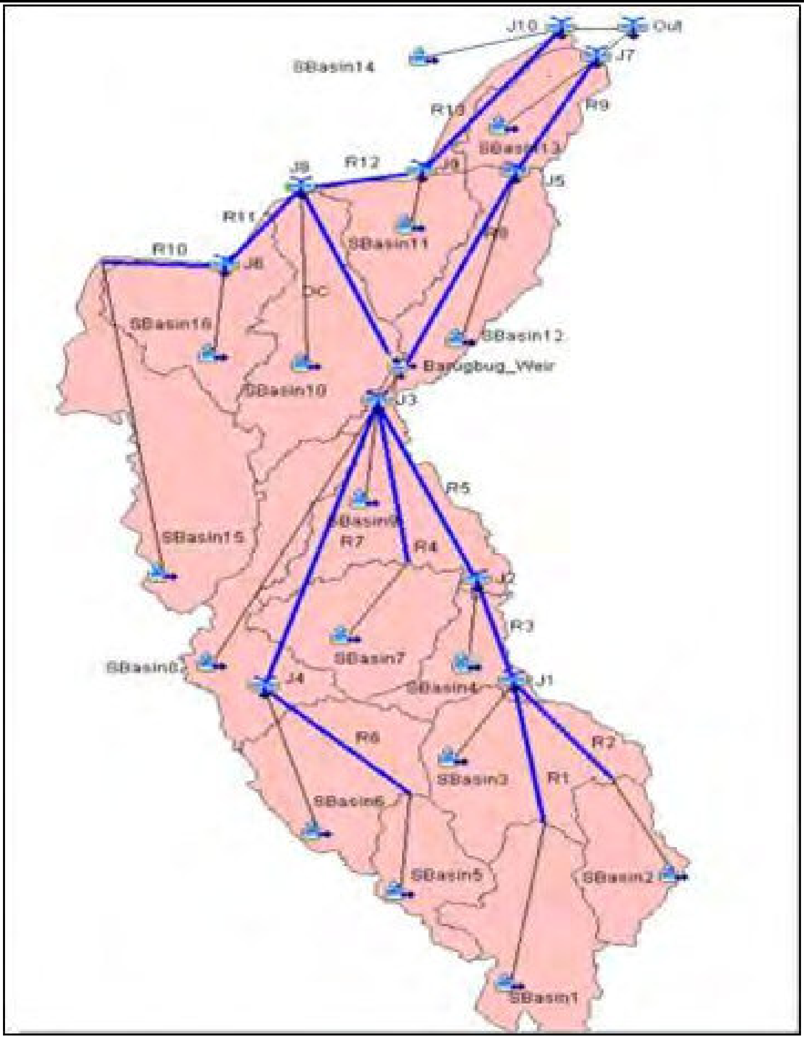
The software includes many traditional hydrologic analysis procedures such as event infiltration, unit hydrographs, and hydrologic routing. This study used Soil Conservation Service (SCS; presently known as USDA Natural Resources Conservation Service) based hydrologic analysis procedure.

**Figure 10.3** shows the setup of the HEC-HMS[1] model. It consists of a basin model (catchment) and a meteorological model (precipitation). The basin model converts atmospheric conditions (precipitation) into streamflow at the sub-basin outlets.

[1] The Hydrologic Modeling System (HEC-HMS) is designed to simulate the precipitation-runoff processes of dendritic drainage watershed basins. HEC-HMS is a product of the Hydrologic Engineering Center within the U.S. Army Corps of Engineers.

These outlets are connected by river reaches which account for flood routing. The basin model consists of sub-basins (SBasin), river reaches (R), junctions (J) and the diversion at Barugbug weir. Barugbug weir is located approximately 20 km upstream the Project area and it consists of two spillways for diverting floods into the Cilamaya main river (J7) and via the Ciherang River into the Cilamaya Irrigation Canal (J10).

*Figure 10.3 Overview of the HEC-HMS Model*

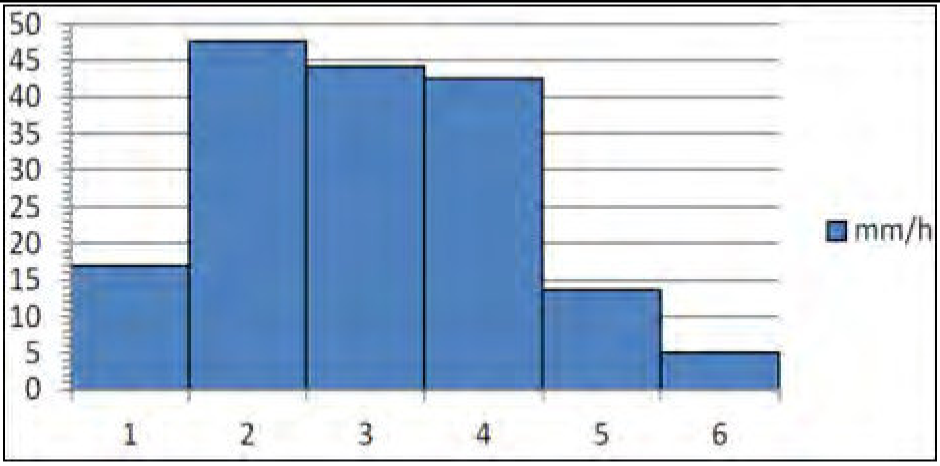



Design storm rainfall input for the HMS meteorological model was obtained by a combination of 100-year point precipitation estimate, areal reduction, and consideration of IDF curves, critical storm duration and temporal storm pattern.

Design storm hyetograph with a total accumulative precipitation of 170 mm was given as input to the HMS model and shown below in **Figure 10.4**.

The rainfall-runoff HMS model was roughly evaluated with flood data from January 18, 2013 before estimating the 100 year design flood in the Project area. Limited rainfall and spillway data documented in the Barugbug weir's operator notebook was used to evaluate the model.

*Figure 10.4 100 Year Design Storm Hyetograph Input*

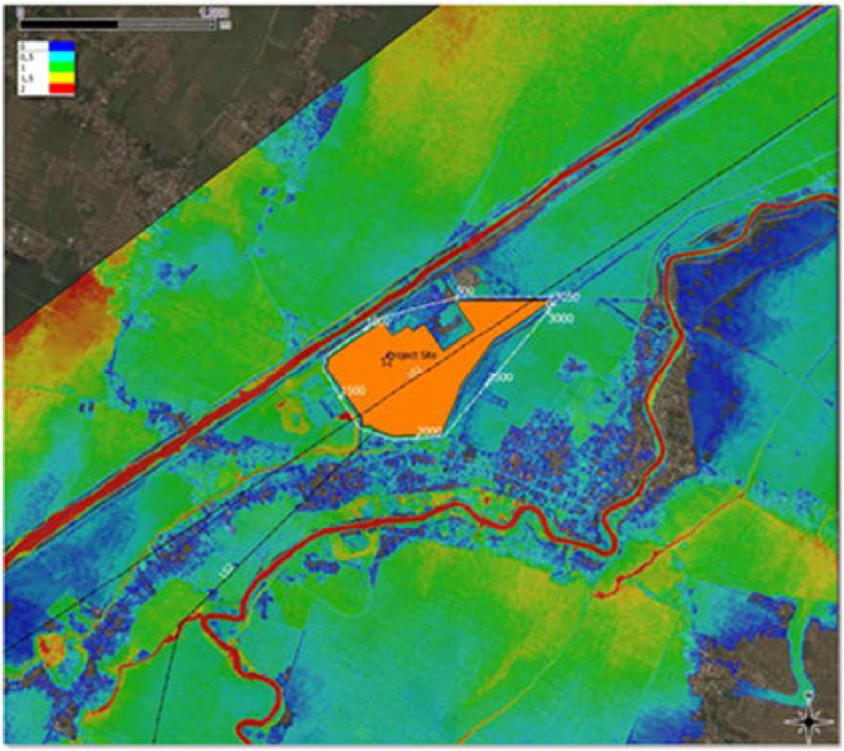



### *10.9.3 Assessment of Impacts*

The flood report (*Pöyry, 2016a*) focused on dike design around the periphery of site area based on 100-year return period water level. This 100-year return period water level risk was quantified by hydraulic model development with Project state scenario i.e. site area within the flood dike was excluded from the modelling domain.

**Figure 10.5** shows that the model predicted maximum inundation depth in most areas in the immediate vicinity of the Project area were in a range of up to one (1) m.

*Figure 10.5 Modelled Flood Inundation at CCGT Power Plant*



*Note: Detail with longitudinal sections (black dotted line) and perimeter section (with station in white). Site boundary is filled orange polygon.*

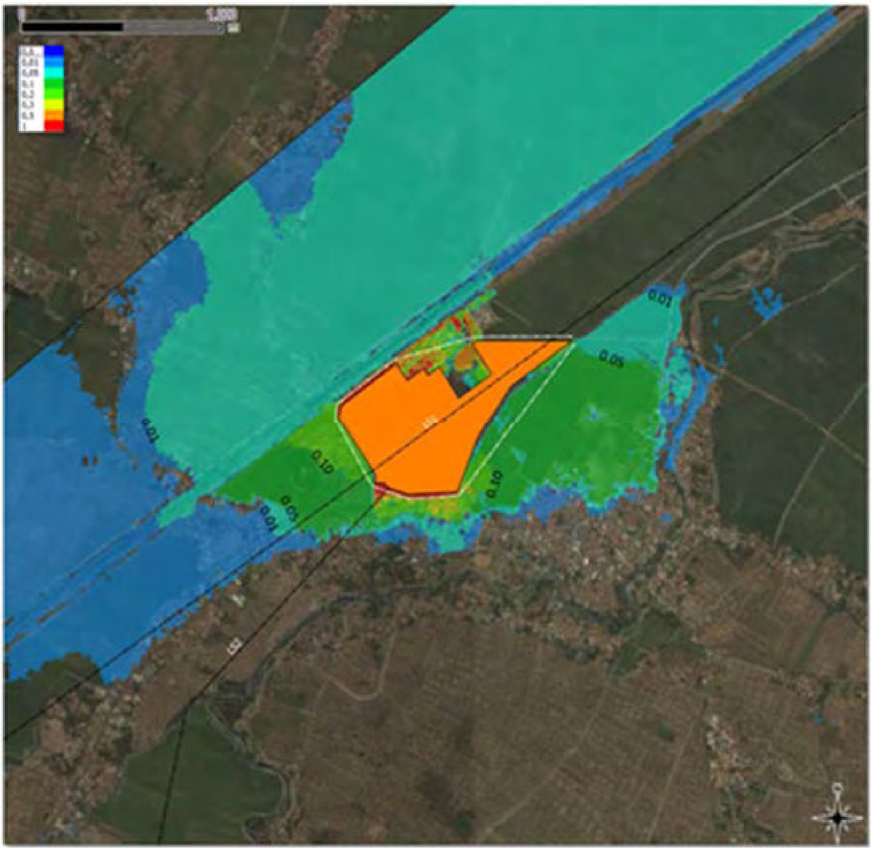
### 10.9.4 *Flood Impacts due to Project*

Impacts due to the Project-induced changes to the maximum water level flooding in the vicinity of the site area was quantified by another hydraulic model development with current state scenario i.e. site area was included in the modelling domain, and comparing it with Project state scenario.

**Figure 10.6** highlights areas with increased flood levels and areas which were dry in the current state and are flooded to a certain depth in the Project state.

This figure shows that the increased water level in most areas in the immediate vicinity of the Project site were in the range of 0.01 to 0.2 m. Also, there are few local spots in south and north-west direction of site area where the water level increase was up to one (1) m. The water level changes and in particular these maxima, result from blocking some discharge patterns by the flood dike.

***Figure 10.6 Increased 100-year water levels due to the Project (m)***




*Note: Areas without changes and decreased water levels are not coloured*

### 10.9.5 *Mitigation, Measures, Management and Monitoring*

In order to prevent inundation on Project area and to avoid the Project impact, the following mitigation recommendations were made:

- A flood dike with height varying from 5.5 to 4.2 m above MSL is proposed to avoid the site area getting inundated;

- A 25 m trapezoidal drainage canal/swale system around the flood dike was proposed to compensate for increased water level in the vicinity of the site due to Project. Such drainage system should compensate for blocked flow paths due to dike, and the effect of the proposed swale is to intercept floodwaters along the flood dike and convey them downstream; and

- Four (4) two (2) m x two (2) m concrete box culverts under the access road are recommended.

The design schematic of flood mitigation measures are shown in **Figure 10.7**.

*Figure 10.7* ***Proposed Flood Flow Path (Swale, Polygon colored by depth below current ground) along the revised Flood Dike (Green Line) – Dike Levels in msl***


In addition, following general measures are being suggested to avoid the flood impact during construction phase. Typically these measures are likely to be the same for operational phase:

- There is high probability of natural drainage system getting blocked by debris associated with construction activities. It is important to mention that there is an existing small drainage canal runs along the periphery of site boundary in the direction of SW to NE. It is recommended to avoid the canal clogging with debris/grasses otherwise this can lead to flooding the site and its vicinity area, associated with back flow;

- Proper storm water drainage plan is needed to drain the flow from site area to the nearby natural stream/canal;

- Planning construction activities in non-monsoon period;

- Emergency pump / generator set up is recommended to install at site area to discharge the flood water to nearby stream/canal in case of extreme flooding event;

- It is recommended to clean natural stream/canal for adequate drainage near to site area before arrival of normal monsoon; and

- It is recommended to keep critical equipment at high elevated area within the site premises to avoid any damage associated with water logging.

### *10.9.6 Significance of Residual Impact*

A final hydraulic model simulation was made by considering the above mentioned two design measures and compared with current state simulation.

**Figure 10.8** shows the Project impact in terms of increased water level with the implementation of the proposed mitigation measures. It also shows that areas where water levels are higher than in current state are reduced to a small region in the nearby agricultural area where water level increases may be accepted. In large areas such as residential, school etc., the water levels remain unchanged or decrease slightly.

***Figure 10.8 Modelled Increased Water Levels after Redesign of Flood***


*Note: Coloured areas indicate increased water levels, non-coloured areas indicate no change or slight decrease. Small local spots are considered as non-representative or artefacts.*

*Table 10.11 Summary of Unplanned / Non-Routine Impacts*

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Accidental spill of hazardous material onshore | Soil Groundwater | Deterioration of groundwater quality. | **Moderate** | • Hazardous materials storage areas will be sited on sealed areas and provided with locks to prevent unauthorized entry;<br>• Secondary containment to accommodate 110% of the largest volume of material, with appropriate drainage connection and/or provision for removal of spilled liquids, will be provided around places of fuel and hazardous materials storage such as oil filled transformers, oil pumps and tanks, generators, chemical storage houses etc. to contain any hazardous spills and to exclude surface water run-off from entering the contained area; and<br>• All hazardous materials will be segregated and stored according to their material safety data sheet (MSDS), and will be disposed in an appropriate manner. | **Minor** |
| Accidental spill of hazardous material onshore | Soil Groundwater | Deterioration of groundwater quality. | **Moderate** | • All vehicles are to be equipped with spill control kits to contain and clean small spills and leaks;<br>• Vehicle servicing areas, vehicle wash bays and lubrication bays will, as far as practical, be located within roofed and cemented areas. The drainage in these covered areas will be connected to sewers via an oil/water interceptor;<br>• Any refuelling activities will only take place within a designated area of hard standing with spill kits present;<br>• All mobile equipment is to be equipped with spill or drip trays to contain spills and leaks of hazardous materials i.e. chemicals, hydrocarbon oils; and<br>• Equipment and vehicle maintenance scheduling is to be undertaken such that they are continually monitored for potential or actual leaks. | **Minor** |
| Accidental spill of hazardous material onshore | Soil Groundwater | Deterioration of groundwater quality. | **Moderate** | • A training program will be implemented to familiarise staff with measures to be taken to prevent spills and leaks, and for emergency procedures and practices related to contamination events;<br>• Mitigation measures/ monitoring programme with regard to accidental events/ spills shall be communicated to the EPC Contractor at the commencement of the Project implementation; | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| | | | | • For any spills or leaks, once the initial emergency response has been implemented, an appropriate mean up and monitoring plan is to be developed. This is to take into account the type of spill and its extent. It is also to include provisions for monitoring of soil, surface water and groundwater quality to track potential or actual migration of the contamination through the soil and groundwater profiles; and<br>• Develop a SEP that includes neighbouring countries and impacted communities to ensure that impacts arising from spills are managed effectively. | |
| Accidental spill of hydrocarbon or chemicals offshore | Marine biodiversity | Pollution and contamination of the marine environment, and secondary toxicity and physical effects on marine fauna | **Moderate** | • Vessels will have Shipboard Oil Pollution Emergency Plan (SOPEP) and spill kits on vessels;<br>• Chemicals and lubricants to be stored as per SDS and in bunded area;<br>• Vessel will be of suitable standard and build quality;<br>• Vessels will maintain visual, radio and radar watch at all times, and will implement lighting, shapes and practices in accordance with COLREGS; and<br>• A Marine Oil Spill Contingency Plan will be developed and personnel trained in its implementation. | **Minor** |
| Accidental spill of vessel wastes offshore | Marine biodiversity | Pollution and contamination of the marine environment, and secondary toxicity and physical effects on marine fauna | **Minor** | • Implementation of a Waste Management Plan;<br>• Bins available for the segregation of waste in accordance with the vessel Waste Management Plan, and bins are fitted with lids/cargo nets for waste with potential to be wind-blown (e.g. paper, cardboard); and<br>• Solid hazardous and non-hazardous wastes generated will be either incinerated or appropriately disposed of at a licensed onshore facility in accordance with the Waste Management Plan. | **Minor** |
| Dropped object | Marine biodiversity | Physical impact, potential contamination if hazardous and not recovered | **Moderate** | • Develop Standard Operating Procedures and Permit to Work Systems;<br>• Restrict the lifting path to avoid critical/ sensitive equipment;<br>• Lift loads within the maximum lifting capacity of crane systems only; and<br>• Recover (wherever practicable) objects which are accidentally dropped into the sea. | **Minor** |

| Activity/Aspect | Receptor | Potential Impacts | Impact Evaluation Significance (Pre-Mitigation) | Mitigation | Residual Impact |
|---|---|---|---|---|---|
| Vehicle accident | Community Health & Safety | • Injury or mortality of community member(s); and<br>• Release of hazardous material | **Major** | • Project ERP to incorporate Project vehicle activities;<br>• Develop and implement a traffic management plan. This should detail access routes, quality of existing roads, measures that will be implemented to minimize the risks associated with transporting materials and workers to and from site, including factors such as fatigue management and ensuring all employees observe recommended speed limits;<br>• Bus workers between the accommodation camp and the Project area. This will reduce the amount of traffic generated by the Project;<br>• Ensure all employees complete training prior to driving any Project vehicle. The content of the training should be tailored to the employee's role;<br>• Explore opportunities to work with local stakeholders to increase awareness within local villages about the hazards associated with traffic;<br>• Develop, communicate and implement Journey Management Plans for heavy equipment, construction and transport vehicles and worker buses; and<br>• Undertake stakeholder engagement with the local community for both traffic road user groups and stakeholders living at settlements adjacent to traffic roads used during construction including updating and inform the community in the Traffic Management Plan. | **Moderate** |
| Vessel incident | Fishing/shipping | Injury or mortality of community member(s) | **Moderate** | • Undertake stakeholder engagement with marine environment users including the fishing community and other users. This include inform location of exclusion zones and better organisation of general vessel movements;<br>• Vessels to meet MARPOL requirements including developing a SOPEP;<br>• Implement Adverse Weather Working Standard;<br>• Mark the presence of construction areas with appropriate lighting to reduce the risk of collision with other marine users;<br>• Prepare a Collision Risk Management Plan; and<br>• Use of Automatic Radar Plotting Aid (ARPA), Radar Early Warning System (REWS) and Vessel Traffic Surveillance System (VTS) where applicable to all contracted vessels. | **Minor** |

# 11 CUMULATIVE IMPACT ASSESSMENT

## 11.1 OVERVIEW

The cumulative impact assessment (CIA) for the Project is undertaken in accordance with the IFC Performance Standards, the IFC's Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for Private Sector in Emerging Markets (the "IFC Handbook") and ADB's Safeguards Policy Statement 2009.

Cumulative impacts are generally considered as those, which are additive or interactive in nature that arises as a result of an impact from the Project interacting with an impact from another activity to create an intensified impact:

"*…result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted. Cumulative impacts are limited to those impacts generally recognised as important on the basis of scientific concerns and/or concerns from Affected Communities*" (*IFC, 2017*).

IFC PS 1 requires that an environmental assessment should also address cumulative impacts. The objective of the cumulative impact assessment is to identify those environmental, social or health aspects that may not be on their own constitute a significant impact but when combined with impacts from past, present or reasonably foreseeable future Project activities or other projects/activities may result in a larger and more significance impact.

In order to gain an understanding of the Project's overall contribution to impacts within the AoI a CIA is required. Whilst total cumulative impacts due to multiple projects within a given area should be identified within government led spatial planning efforts (generally as part of a Strategic Environmental Assessment), the Sponsor needs to determine the degree to which it is contributing to these overall cumulative impacts on Valued Environmental and Social Components (VEC). In this regards, the objectives of the CIA are:

- Use the outcomes of the preceding chapters of this ESIA to determine spatial and temporal boundaries, identify VEC's and all development and external natural and social stressors affecting them;

- Recognise and identify how the Project, along with other existing and future projects may contribute to cumulative impacts on the predicted future condition of the identified VEC's; and

- Develop measures to ensure these are avoided and/or minimised to the greatest extent possible.

To achieve these objectives and gain a better understanding of the cumulative impacts, this Chapter presents the cumulative assessment that has been undertaken largely in accordance with the *IFC's Good Practice Handbook: Cumulative Impact Assessment and Management Guidance for Private Sector in Emerging Markets* (the "IFC Handbook"). This has been supplemented by further guidance such as:

- The European Union's "Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interactions" (1999);
- The Canadian Environmental Assessment Agency's "*Assessing Cumulative Environmental Effects under the Canadian Environmental Assessment Act*" (2012);
- The USA NEPA Council on Environmental Quality's "*Considering Cumulative Effects under the National Environmental Policy Act*" (1997); and
- ADB's Environmental Assessment Guidelines (2003).

*It is important to recognise that the Project has limited capacity to influence the environmental and social performance of external facilities (other than the SKG Cilamaya Gas Compression plant) and also has limited access to the relevant environmental and community information required to undertaken a detailed CIA.*

## *11.2 ASSESSMENT APPROACH AND CRITERIA*

The CIA has been undertaken following the subsequent eight-step process outlined in **Figure 11.1**.

The CIA forms part of the overall ESIA, the general conditions and trends of the VEC's have previously been identified (established during the environmental and social baseline condition assessments in **Chapter 7**), as are the impacts from the Project (outlined in **Chapter 8** and **Chapter 9**) and the proposed mitigation, management and monitoring measures (set out in **Chapter 12**).

Given this, VEC's and impacts have been easily established, with an emphasis placed on the steps pertaining to the CIA and impacts management.

Emphasis in developing the methodology for this CIA been placed upon following a largely qualitative approach, allowing for identification of general trends and developing appropriate management, mitigation and monitoring measures.

This is primarily due to the lack of accurate and specific data on surrounding projects. Given this approach, the majority of the methodology relies upon the use of professional judgements, complimented by ERM's understanding of the Project, experience with similar projects in similar settings, and the elements of the ESIA.

The eight step process is based on the IFC CIA six stage approach as set out in **Figure 11.1**.

- **Steps 1, 2 and 3**: Key activities include identifying VECs, identifying the temporal and spatial boundaries of the CIA and identifying sources of cumulative impacts.

- **Steps 4 and 5**: Define the level of detailed assessment, VECs, their spatial and temporal extent, the potential impacts on them, existing condition, sensitivity to change, resilience/recovery time, existing stressors and trend in condition. This information is taken directly from the ESIA.

- **Steps 6 and 7**: Assessment of the contribution of the Project to the predicted cumulative impacts arising from interactions between the sources of cumulative impact and the VECs. Evaluation of the significance of predicted cumulative impacts to the viability/sustainability of the affected VECs.

- **Step 8**: Design and implementation of mitigation measures additional to those already identified in the ESMP (**Chapter 12**) required to manage the Project's contribution to the predicted cumulative impacts. This includes not only management of impacts where the Project has control but also consultation and liaison with third parties where impacts are outside of the Project's direct control.

### *11.2.1 Determine Spatial and Temporal Boundaries and VEC*

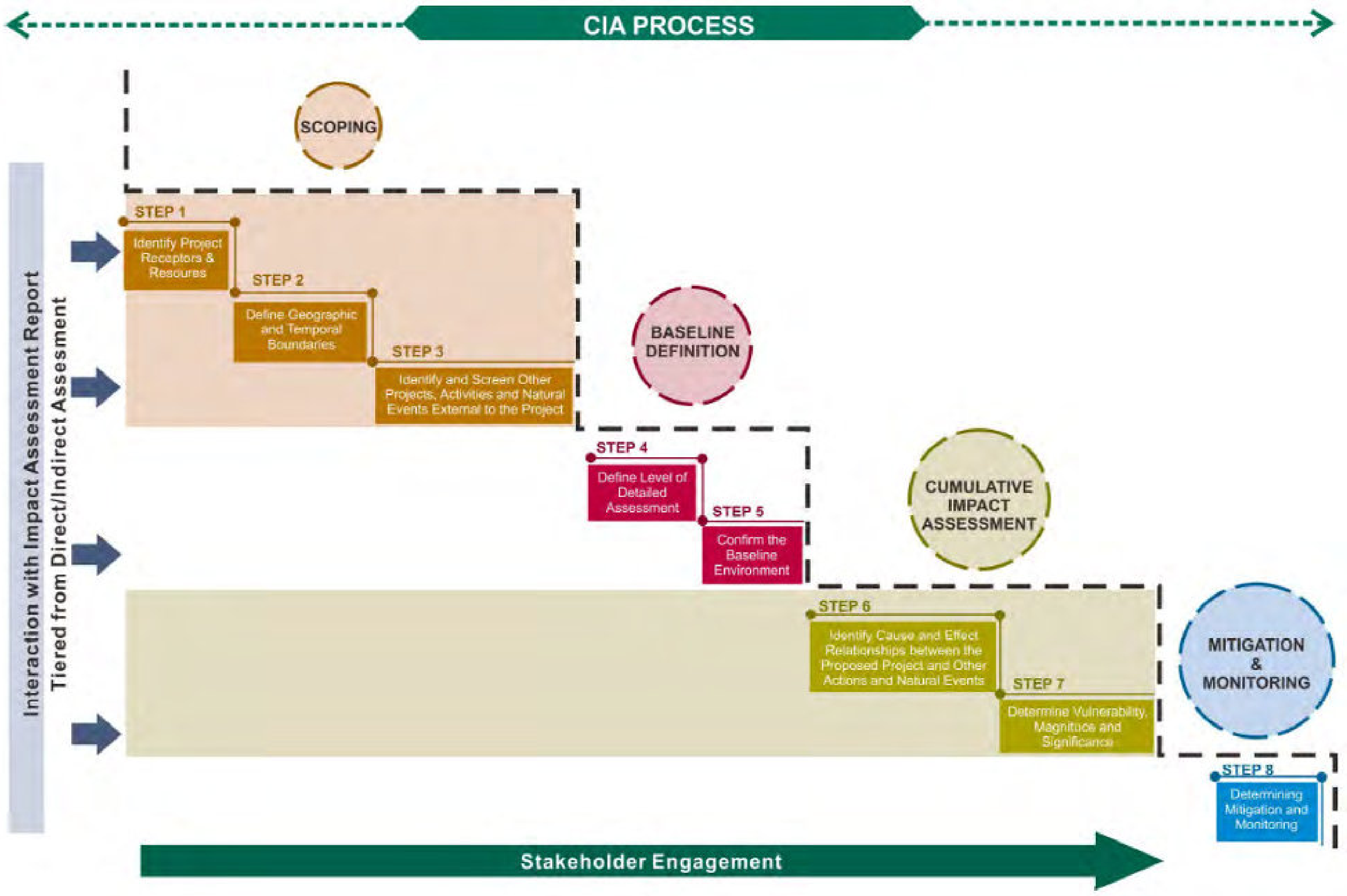
The methodology used in the setting of the spatial and temporal boundaries is largely qualitative and based upon the general "rules of thumb" suggested in the IFC's Handbook. The following factors have been set within the methodology:

- Temporal boundaries have been set based on a desktop review of available information pertaining to other proposed Projects within the area;

- ERM's understanding of the projects currently within and proposed to be developed within the local area; and

- Geographic boundaries are a composite of the location of the identified VEC assessed impacts of the Project and the degree to which they may overlap with other external projects and stressors to impact upon an identified VEC.

*Figure 11.1 General RCIA Methodology*



### 11.2.2 *Identify VECs and their Present Conditions*

The identification of VEC is largely drawn from work previously undertaken, supplemented by stakeholder engagement. VECs are defined as:

- Those defined as sensitive receptors within the ESIA such as the school located in close proximity to the power plant and main transportation route (a sensitive receptor for the purposes of air quality modelling);
- Any particular resource or ecosystem service identified as being utilised by sensitive receptors such as fishermen reliant on the rounds in the vicinity of the offshore pipelines and FSRU; and
- Those identified as part of stakeholder engagement, regardless of whether or not they meet either of the above definitions.

### 11.2.3 *Identify all Developments, External and Social Stressors Affecting the VECs*

External developments, also known as reasonably foreseeable future actions (RFFA), are identified utilising knowledge gained through the ESIA, stakeholder engagement and the interpretation of readily available external data.

The outcomes of these considerations will be a simple binomial decision, i.e. yes the Project is likely and therefore will be included within the CIA, or no, it is unlikely and therefore will not be included within the CIA.

The second step is to determine the extent of the various impacts of these projects. This allows for a decision to be made as to whether there is the potential for an overlap in Project impacts that could lead to a measurable cumulative impact. Key to this are the following elements:

- Identification of appropriate geographical/spatial boundaries, where potentially interacting projects are not located close enough, or sufficiently linked through various ecological and social processes, for relevant impacts to overlap, cumulative impacts are less likely;
- Identification of temporal boundaries, where the schedules of various components of projects do not overlap in time, particularly with regards to the construction phase of large projects, cumulative impacts are less likely. Additionally, where projects are short term, cumulative impacts will generally be of a limited duration;
- Consideration of impact type. Whilst there may be no direct geographical overlap in project boundaries, there is the possibility that their offsite impacts may directly overlap elsewhere and cause offsite cumulative impacts. Examples are discharges into the river and offshore air pollutant emissions, and social impacts associated with overall migration influx;

- Determination of any aggravating factors that may be evident within a particular project identified for inclusion within the CIA. This includes elements such as the size of the project, environmental management performance, and the regulatory regime under which it operates; and

- Identification of potential externalities, that is the Project's ability to influence (either positively or negatively) the behaviours of other operations in the area. (This may be possible with SKG Cilamaya gas compressor plant).

External natural and social stressors unrelated to a single project or source are not considered as this are assumed to be captured as part of the current Project baseline conditions (**Chapter 7**) and the impact assessment (**Chapter 8** and **Chapter 9**).

### 11.2.4 *Identification and Assessment of Impacts*

A largely qualitative approach was adopted to enable the focus on identification of trends across the various projects in the area, their temporal and spatial interactions and how these are likely to impact upon VEC.

Whilst impacts arising from the Project have been defined and assessed in isolation, it can be difficult to accurately quantify cumulative impacts as there can be a high degree of uncertainty in interactions with other projects and activities that may be occurring in the area as well as a lack of confirmed project information.

Therefore, the impacts are to be assessed qualitatively based on the identified trends and grouped according to impact type, rather than VEC, in accordance with the overall methodology adopted for the ESIA. The CIA is also based on the assumption that all assessed residual impact levels within the ESIA are achievable.

It is recognised at this stage that this approach may not be accurately able to define the cumulative impacts from a purely VEC-cantered perspective (i.e. proposed actions impact on VEC + other past, present and future impacts on VEC = Cumulative Impacts).

However given the clustered nature of the human VECs, the large scale extent of the environmental VEC (such as the groundwater system, which is also heavily relied upon by human VECs) it can be assumed that all impacts will accumulate to each VEC.

Therefore attempting to address impacts by nature is a suitable approach and is able to produce effective management, mitigation and monitoring measures.

### 11.2.5 *Development of Management, Mitigation and Monitoring Measures*

Based upon identification of broad impact trends, broad scale mitigation measures will need to be developed. Generally, these are based upon:

- Effective application of, and adherence to, the mitigation hierarchy in environmental and social management of the specific contributions by the project expected cumulative impacts. This is generally achieved through stringent implementation of the measures developed specifically for the Project; and

- Development of best efforts to engage in, enhance and/or contribute to a multi-stakeholder, collaborative approach to implementing management actions which are beyond the capacity of an individual project proponent.

Any measures developed to address concerns identified within this CIA will take into account these general concepts. There also needs to be scope to develop these measures further when detailed information regarding projects becomes available.

### 11.2.6 *Identification of VEC and their Present Conditions*

The ESIA identifies and describes the current condition of a range of Sensitive Receptors, defined as VEC for the purposes of this CIA. These are:

- Air quality and environmental and operational noise and vibration receptors in close proximity to the Project area;

- Surface water quality;

- Traffic on the main road into Cilamaya and access roads toe transmission lines;

- Terrestrial biodiversity and particularly the potential presence of conservation significant habitats and species. This includes the mangrove area at the north of Cilamaya Bay by the proposed jetty location;

- Marine biodiversity and benthic communities and particularly a decline in water quality and seabed conditions as a result of sedimentations increases during dredging and movement of vessels and anchoring activities;

- Nearby communities who will be exposed to potential benefits associated with job opportunities, but also potentially negative impacts associated with worker influx and potentially, increasing prices for goods and services (in particular in Cilamaya area); and

- Fishing communities that may be impacted by Project activities. There appear to be varying degrees of reliance on fishing as a source and it is likely that intermittent fishing activities currently occur within the area to be affected by the Project;

- Shipping and navigation across Ciasem Bay such as traffic to and from Tanjung Priok; and
- Those identified as part of stakeholder engagement, regardless of whether or not they meet either of the above definitions.

### *11.2.7 Identification of External Natural and Social Stressors*

The Project is situated largely within the vicinity of residential areas and a small cluster of industrial facilities within a broader semi-rural environment.

Based upon a desktop review of readily available online information and site investigations, there are two (2) key projects under construction/planned within the immediate Project area.

The listed projects represent those that are relatively large in scale/impact and are likely to generate significant environmental and social impacts as shown in **Table 11.1**.

*Table 11.1 Known nearby Development Projects and Activities*

| Project Name | Comments | Anticipated Impact Types |
|---|---|---|
| **Within five (5) km radius from project facilities** | | |
| Upgrade of Jalan Cilamaya – Cikalong | Public Works Office - Human Settlements and Spatial Planning (PUPR) Karawang Regency is planning to upgrade of Jalan Cilamaya – Cikalong in 2018. The local authority is also expecting that PT Pertamina in Cilamaya to co-operate during the construction phase and during road maintenance. The 10-km road is located within five (5) km from the proposed CCGT Power Plant. | • Traffic;<br>• Noise; and<br>• Unplanned and Non-Routine Event. |
| **Within 10 km radius from project facilities** | | |
| High Speed Train Jakarta-Bandung | The High-Speed Train Jakarta Bandung is developed by PT Kereta Cepat Indonesia China, a joint venture formed in October 2015 between a consortium of Indonesian state-owned companies, and China Railway International.<br><br>The proposed rail link will be 150 km long, with an approximate train speed estimated to be between 200km/hr and 250km/hr.<br><br>The construction phase of this USD$ $5.5bn project will last for three (3) years, with completion scheduled for 2019. This includes a station in Karawang nearby the Jakarta-Cikampek Toll Road i.e. approximately 10 km from the proposed Cibatu II/Sukatani Substation. | • Traffic; and<br>• Unplanned and Non-Routine Event. |
| **Within 20 km radius from project facilities** | | |
| Inland Waterways/Cikarang-Bekasi – Javan Sea by PT Pelabuhan Indonesia II | The development of 45 km Inland Waterways will link Tanjung Priok in Jakarta, with the hinterland area of Cibitung-Cikarang in Bekasi (i.e. within 10 km from Cibatu II/Sukatani Substation) and Cikampek in Karawang (i.e. within 20 km from the proposed CCGT Power Plant), where major industries are located, through a river-canal route.<br><br>The project, included in the list of strategic national projects, is estimated to cost IDR3.4trn (USD$255.6m) and is expected to bring down logistics costs by 20% to 25%. It is expected to be completed by 2019. | • Traffic;<br>• Surface Water; and<br>• Unplanned and Non-Routine Event |

### 11.2.8 *Scope Finalisation*

**Table 11.1** presents the outcomes of scoping, based upon identified VEC, assessed Project impacts, the identified external projects, and the summary of trends.

The core outcome of this table is that cumulative impacts will be assessed with regards to the following key impact types:

- Air Quality;
- Noise;
- Employment and Business Opportunities;
- Increased Pressure on Community Infrastructure and Services; and
- Community Health and Safety.

The remainder of impacts either have already been assessed in a cumulative manner within the ESIA, or the Project will only have negligible impacts and therefore will not contribute to any broader cumulative impacts to VEC.

*Table 11.2 Scoping of Impacts on Sensitive Receptors*

| Impact Type | VEC's Likely to be Impacted | Existing Assessment in ESIA | CIA Scope |
|---|---|---|---|
| Air Quality | In general, the VEC is likely to be impacted are those people residing in the various villages along the main transportation routes in Karawang and Cilamaya. | **Section 9** of this Report presents the outcomes of detailed air quality modelling during both construction and operation phases.<br><br>The assessment captures only the predicted future emissions from the Project plus the existing baseline. | A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative air quality impacts may occur and appropriate mitigation strategies to adopt. |
| Noise | In general, the VEC is likely to be impacted are those people residing in the various villages along the main transportation routes in Karawang and Cilamaya. | **Section 9** of this Report presents the outcomes of detailed noise assessment during both construction and operation phases.<br><br>The assessment captures only the predicted future noise levels from the Project plus the existing baseline. | A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative noise impacts may occur and appropriate mitigation strategies to adopt. |
| Employment and Business Opportunities | The VEC is likely to be impacted are those people residing in the residing along the main transportation routes of the Project. | Positive social impacts from the Project include impacts to employment and economy during both the construction and operation phases, were assessed as part of **Section 9** of this Report. | A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative impacts may occur to VEC and develop appropriate mitigation strategies. |
| Increased Pressure on Community Infrastructure and Services | The VEC is likely to be impacted are those people residing in the residing along the main transportation routes of the Project. | **Section 9** of this Report presents a detailed assessment of impacts relating to Community Health & Safety during construction and operations phase.<br><br>None of these were considered cumulatively. | A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative impacts may occur to VEC and develop appropriate mitigation strategies. |
| Community Health & Safety | The VEC is likely to be impacted are those people residing in the residing along the main transportation routes of the Project. | **Section 10** of this Report presents an assessment of impacts relating to Community Health & Safety during construction and operations phase.<br><br>None of these were considered cumulatively. | A qualitative assessment will be undertaken, focusing on identification of ways in which cumulative impacts may occur to VEC and develop appropriate mitigation strategies. |

## 11.3 *AIR QUALITY IMPACT ASSESSMENT*

### 11.3.1 *Project Impacts*

The Project was identified to have a number of potential impacts to air quality, particularly with regards to ambient air quality in the local community (also defined as VEC's). To mitigate these impacts, during both construction and operation, a range of mitigation measures have been developed to manage potential impacts.

### 11.3.2 *Relevant Cumulative Impacts with Other Projects*

During the Project construction phase, the upgrade of Jalan Cilamaya to Cikalong and the construction of the High Speed Train (Jakarta-Bandung) are ongoing. Both will involve intensive construction works in close proximity to some of the Project sites that may affect air quality conditions, particularly as a result of increased traffic and construction dust.

### 11.3.3 *Specific Mitigation Measures for Cumulative Impacts*

During the construction phase, the Sponsors and EPCs have committed to using BAT including construction vehicles of an acceptable quality with appropriate emission tests, which will reduce the overall contribution to cumulative emissions and air quality. It is recommended that the Project engage with local government agencies (MoEF in particular) to ensure regular monitoring of air emissions in these hotspots is conducted. Where required additional mitigation measures are put in place to ensure emission levels remain below the accepted standards.

## 11.4 *NOISE IMPACT ASSESSMENT*

### 11.4.1 *Project Impacts*

The Project was identified to have a number of potential noise/community health impacts, particularly in and around the power plant during construction. To mitigate these impacts, during both construction and operation, a range of mitigation measures have been developed such as the use of noise barriers.

### 11.4.2 *Relevant Cumulative Impacts with Other Projects*

During the Project construction phase, the upgrade of Jalan Cilamaya to Cikalong and the construction of the High Speed Train (Jakarta-Bandung) are ongoing. Both will involve intensive construction works in close proximity to some of the Project sites that may elevate noise levels, particularly as a result of increased construction traffic and construction noise.

### 11.4.3 *Specific Mitigation Measures for Cumulative Impacts*

During the construction phase, the Sponsors and EPCs have committed to using BAT including noise barriers, implementation of a community grievance mechanism and community consultation to provide advance notice of potentially noisy construction periods. These mitigations have been proposed with the aim of reducing the impacts of Project noise to as acceptable a level as possible.

As discussed in the previous section it is recommended that the Project engage with local government agencies (MoEF in particular) to ensure regular monitoring of noise levels in these construction areas is conducted. Where required additional noise mitigation measures are put in place to ensure levels remain below the accepted standards.

## *11.5 SOCIO-ECONOMIC CUMULATIVE IMPACT ASSESSMENT – EMPLOYMENT AND BUSINESS OPPORTUNITIES*

### *11.5.1 Project Impacts*

The communities surrounding the Project area are aware of the potential positive impacts on employment and business opportunities. This was confirmed through the public consultation activities undertaken for the AMDAL and ESIA (and discussed in **Chapter 9**).

The community in and around the Cibatu sub station and close to Cilamaya expect to be employed by the Project and be involved in the procurement of goods and services such as provision of materials for construction, food catering and non local workforce accommodation.

To enhance the benefits of this impact, the Project will implement measures including primarily engaging relevant stakeholders e.g. village leaders to provide as much information as possible regarding employment and business opportunities to the local communities.

### *11.5.2 Relevant Cumulative Impacts with Other Projects*

The Project, when considered along with the Jakarta-Cikampek Toll Road and the upgrade of Jalan Cilamaya, will contribute to the local economy within the area (and develop local construction skills), providing a significant boost to the local and regional economics. There will be substantial opportunities for skilled and unskilled labour associated with all of these projects.

### *11.5.3 Specific Mitigation Measures for Cumulative Impacts*

The Sponsor to give consideration to sharing information regarding its local content plan and skills training program with the village leaders and relevant government agencies i.e. local manpower agency (*Dinas Ketenagakerjaan*) so that proposed hiring plans are understood. A collaborative and integrated approach can lead to better outcomes and assist in seeing potential cumulative positive economic impacts realised and appropriately distributed throughout the local population.

## 11.6 INCREASED PRESSURE ON COMMUNITY INFRASTRUCTURE AND SERVICES

### 11.6.1 *Project Impacts*

The demands from the Project on the local services and infrastructure are anticipated to be high; in particular during the peak construction period. The Project will require accommodation for non-local workers in Cibatu, along the transmission lines villages and in Cilamaya and the surrounding villages. In some periods there are expected to be more than 1,500 workers residing in the community. In addition to this there will be a requirement for local health provision, waste disposal, provision of electricity and provision of clean water. Furthermore the workforce will be expected to adhere to a strict code of conduct.

The Project's EPCs are preparing worker management and logistics plans to ascertain how the above impacts will be managed in order to reduce potential community impacts. The Project also intends to coordinate with local stakeholders such as the police, local government and healthcare providers.

### 11.6.2 *Relevant Cumulative Impacts with Other Projects*

The Project, when added to the proposed projects within the area, may result in increased pressure on the local communities' infrastructure and services; in particular addressing waste management and social risks (excessive alcohol use has been reported as a concern within the Project area amongst youth and commercial sex workers are known to be present in the areas of Blanakan and Bekasi).

### 11.6.3 *Specific Mitigation Measures for Cumulative Impacts*

The Sponsors and EPCs are planning to implement a range of measures to comprehensively address Project impacts to community services/ wellbeing through effective consultation and socialisation of the Project's Code of Conduct. It is also recommended that coordination is undertaken with the relevant authorities to understand manpower schedules in particular hotspots and the requirements each Project may have from local services.

## 11.7 SOCIO-ECONOMIC CUMULATIVE IMPACT ASSESSMENT – COMMUNITY HEALTH AND SAFETY

### 11.7.1 *Project Impacts*

The impact assessment noted a number of impacts to community health and safety, which would be caused by the Project, particularly during the construction phase. Those of relevance for this CIA include:

- An increase in vehicles, particularly construction vehicles, leading to an increased potential for accidents to occur;

- An increase in STIs as the result of the introduction of a large non local construction workforce into the area; and

- Daily construction activities in close proximity to residential areas which could lead to an incident with a community member.

Measures to mitigate these impacts have been proposed within **Chapter 9** and **Chapter 10** and summarised in the ESMP (**Chapter 12**). They primarily involve the implementation of an effective SEP for the Project, preparation of a community emergency response plan (ERP), controlled access to construction areas and signage as well as safe driving practices by construction drivers.

### *11.7.2 Relevant Cumulative Impacts with Other Projects*

There is likely to be overlap with construction of the two above mentioned road projects occurring in close proximity to Cilamaya and Bekasi. This would primarily present risks associated with traffic movements and construction activities posing a risk to local communities residing close by and other road users.

### *11.7.3 Specific Mitigation Measures for Cumulative Impacts*

The Sponsors and EPCs are planning to implement a range of measures to comprehensively address Project impacts to community health and safety. It is unlikely that the Project will be able to influence the activities conducted for the construction of the Jakarta-Cikampek Toll Road however more so with the upgrade of Jalan Cilamaya to Cikalong given the proximity to the site and expectation of the local government for Project support.

As such it is recommended that coordination is undertaken with the relevant authorities to understand how overlapping construction movements will be managed.

# 12 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

## 12.1 OVERVIEW

The ESIA process has identified the key environmental, social and community health issues, impacts associated with the Project requiring the implementation of a wide range of mitigation measures. The necessary actions required to manage these issues, impacts and risks are presented in this Environmental and Social Management Plan (ESMP); these are the mitigation and monitoring measures that have been identified through the impact assessment, and other best practice measures designed to avoid, minimise or reduce negative impacts and enhance positive impacts.

The objectives of an Environmental and Social Management Plan (ESMP) are to:

- Identify the set of responses to potentially adverse impacts;
- Define the responsibilities for implementation and monitoring;
- Determine requirements for ensuring that mitigation and management measures are implemented effectively and in a timely manner; and
- Describe the means for meeting those requirements.

The purpose of this Chapter is to demonstrate how the mitigation commitments made through the IA Process will be put into practice, monitored and upheld. The content of this chapter is crucial to bridge the findings of the IA with the implementation of the mitigation measures and to provide an early framework of management systems/monitoring regimes that will help to deliver these IA commitments.

Specifically, this ESMP Chapter provides information and instructions on how commitments of the Project will be managed from pre-construction through the construction and operation phases.

## 12.2 OBJECTIVES

The ESMP is a living document which:

- Incorporates the Environment and Social mitigation measures identified as a result of the ESIA process into a comprehensive framework to facilitate and ensure appropriate management throughout the Project cycle;
- Provides a framework to incorporate commitments into the Project plans and procedures for activities that have risks, as identified in the IA;

- Presents responsibilities for meeting ESMP requirements including the provision of training;
- Identifies the detailed management plans which will need to be developed for implementation throughout the various phases of the Project by the EPCs and operators; and
- Defines the monitoring and reporting program.

## *12.3 RESPONSIBILITY FOR IMPLEMENTING THE ESMP*

The key parties and their primary roles in implementing the ESMP are as follows:

- **Sponsors**: Responsibility for the implementation of the Project to the required Applicable Standards of the Government of Indonesia and Lender consortium;
- **EPC Contractors** – responsible for complying with ESMP requirements under the contract; and
- **Sub-contractors** – responsible for complying with ESMP requirements as applicable under the EPC contracts.

## *12.4 POLICY & COMMITMENT TO ENVIRONMENTAL MANAGEMENT*

The ESMP detailed management plans will be developed to align to the Sponsors' and EPCs' HSE policies. These will be developed by the Sponsors' prior to NTP and operations.

#### *12.4.1.1 Sponsor*

The Sponsors (PT JSP and PT JSR) are a Consortium of Pertamina, Sojitz and Marubeni as discussed previously in this ESIA.

### 12.4.2 *EPC Contractors - Construction*

#### 12.4.2.1 *General Electric*

GE has an established management systems for quality (ISO 9001). In terms of HSE GE has established an "e-Framework" which has been mapped to ISO14001/OHSASN18001.

#### 12.4.2.2 *Samsung C&T Corporation*

Samsung C&T Corporation has an established management systems for Quality (ISO 9001), Safety (OHSAS 18001) and Environment (ISO 14001).

***Figure 12.1 Samsung EHS Policies***

Lloyd's Register LRQA

CERTIFICATE OF APPROVAL

This is to certify that the Environmental Management System of:

**SAMSUNG C&T CORPORATION**
**Engineering & Construction Group**
**14, Seocho-daero 74-gil, Seocho-gu**
**Seoul, Korea**

has been approved by Lloyd's Register Quality Assurance to the following Environmental Management System Standards:

**ISO 14001:2004 KS I ISO 14001:2009**

The Environmental Management System is applicable to:

**R&D, project management, engineering & design, procurement, construction, commissioning and operation, maintenance, consulting and after-servicing for civil, building, housing, plants(power, nuclear power, desalination, industrial, fire-fighting, offshore, oil and gas, chemical, petrochemical, environmental plants included), electrical, information and telecommunication, dredging, reclamation, health care, mining, landscaping and structural steel works. Design, development, manufacture and servicing of precast concrete products.**

Original Approval: 12 July 1997
Current Certificate: 12 May 2015
Certificate Expiry: 11 May 2018

Issued by: LRQA (Korea) Ltd. for and on behalf of Lloyd's Register Quality Assurance Limited

DNV·GL

**MANAGEMENT SYSTEM CERTIFICATE**

This is to certify that the management system of

**SAMSUNG C&T CORPORATION**
**Engineering & Construction Group**

14, Seocho-daero 74-gil, Seocho-gu, Seoul, Korea
and the sites as mentioned in the Appendix accompanying this Certificate

has been found to conform to occupational health and safety management system standard(s):
**OHSAS 18001:2007**

This certificate is valid for the following scope:
**R&D, Construction Management, Engineering & Design, Procurement, Construction Commissioning & Operation, Maintenance, Consulting and Servicing for Civil, Building & Housing, Industrial Plant, Electrical, Information & Telecommunication, Dredging, Reclamation, Landscaping and Structural Steel Works and Afer-Servicing for Civil, Residentioal Plant, Machine & Electrical Works**

#### 12.4.2.3 *PT Meindo Elang Indah*

PT Meindo Elang Indah (Meindo) has established a management system for Quality (ISO 9001), Safety (OHSAS 18001) and Environment (ISO 14001).

*Figure 12.2 Meindo EHS Policies*


BUREAU VERITAS Certification

PT. MEINDO ELANG INDAH

OHSAS 18001:2007

BUREAU VERITAS Certification

PT. MEINDO ELANG INDAH

ISO 14001:2004

*12.4.2.4 EPC Consortium*

It is also anticipated that the EPC consortium consists of GE and Meindo will develop an HSE policy applicable during the construction activities.

### *12.4.3 Roles and Responsibilities*

*12.4.3.1 Project Manager*

The Project Manager would normally be responsible for all construction activities and accountable for overall EHSS (Environmental, Health, Safety and Social performance) of the project. Expectations for the role in terms of implementing a Health, Safety, Social and Environmental management system would include:

- Actively promote and participate in the Project EHSS Programs;
- Ensure that the EHSS Management Plan and its derivative program, procedures and work practices are implemented on the Project;
- Ensure that the EHSS Program reflects the requirements of the Project in terms of resources;
- Ensure that all legislative and company requirements are complied with;
- Ensure that the work scope is conducted in accordance with the Project EHS rules and regulations, work practices and procedures, as detailed in this ESMP and other associated documentation;

- Ensure that all contractors are made aware of their roles and responsibilities with regard to EHSS management;
- Ensure that safety is an agenda item in every weekly contractor progress meeting;
- Ensure that all contractors are evaluated throughout the duration of the Project, as to their capabilities and performance; and
- Ensure implementation of EHSS audit by an appointed third-party auditor and recommendations for non-compliances.

### *12.4.4 HSE Department*

Health, Safety and Environmental (HSE) Department would be expected to undertake the following roles:

- Manage, review and develop the HSE program to ensure that it fulfils Project requirements, including measures observed in this ESMP, and monitor the implementation including e.g. patrol the job site daily to ensure construction works' compliance to Project HSE Procedures and working practices;
- Coordinate and evaluate the effectiveness of all program elements;
- Liaison with related government bodies as necessary;
- Manage the Project HSE team and supervise them to ensure that all areas of the project are given the required level of safety support and attention;
- Ensure proper housekeeping and waste disposal in accordance with company requirements and regulations;
- Ensure that the respective control areas are given in the required level of safety support and attention including e.g. only safety-approved material and equipment are allowed to be brought onto site;
- Ensure that all HSE reports/findings of any unsafe conditions/practices is brought to the attention of field management and those are immediately corrected, and coordinate accident/incident investigations and report to Project Manager; and
- Manage HSE Audits and report the results to the Project Manager.

### 12.4.5 *Administrative /Corporate Social Responsibility Department*

This Department would be expected to undertake the following roles:

- Manage, review and develop the Social Program to ensure that it fulfils Project requirements, including measures observed in this ESMP, and monitor the implementation;

- Coordinate and evaluate the effectiveness of all program elements;

- Manage the implementation of stakeholder relations and grievance management to ensure that all social-related requirements in this ESMP are implemented;

- Manage the implementation of community development program that are required in this ESMP;

- Manage the implementation of community health program, including coordination with HSE team on occupational health and safety measures associated with management of impact to community health;

- Coordinating with HSE team on implementation of the Project vehicle safety measures associated with management of impact to community safety;

- Coordinating with HR (Human Resources) person to ensure implementation of labour-related measures required in this ESMP;

- Consultation with community and liaise with relevant stakeholders in implementing the required stakeholder and grievance management measures, including liaison with related government bodies as necessary;

- Lead collaboration to establish and implement the Project grievance mechanism during construction phase, and supervise contractor's social performance as required in this ESMP; and

- Manage social monitoring and report the results to the Project Manager.

### 12.4.6 *Contractors' Site Representatives/ HSE Department*

Contractors, depending on their workscopes, would be expected to have an HSE team. Contractors' Site Representatives or HSE Department should be assigned clear responsibilities and expectations with respect to implementing the projects EHSS expectations and should be fully responsible for implementing any required expectations which fall under their workscopes. More specifically, they shall:

- Actively promote and implement all Project HSE Plans related with the work they are preforming. Contractor shall make sure that all activities under his/her responsibility shall follow all safety regulation/requirement, coordinating with Sponsor's Project Manager; and

Ensure that committed resources (personnel, material, and equipment) used are consistent with achieving the objectives and requirements of Project EHSS Plan and its entire associated document.

### 12.4.7 *Employees*

All employees involved in the Project shall be qualified through training, experience, or knowledge. Non-supervisory personnel employed on the Project shall:

- Familiarise themselves with the concept of the Project EHSS rules and regulations;

- Work in accordance with Project HSE Procedure, safe work practices, and method statements, risk assessments, permits to work and any other instructions that apply to their works;

- Use only tools/equipment and materials, which have been approved for use, and employ them only for the purpose for which they were designed;

- Take an active part in the protection of themselves, fellow workers, property and the environment from accidental losses;

- Immediately report to his respective supervisor or HSE officer/inspector if any potential hazards (relates to unsafe conditions and/or unsafe acts), which could lead to an accident, are found;

- Report promptly to immediate supervisor and HSE officer/inspector if any incidents/near misses as well as injuries, regardless how minor; and

- Shall attend Project safety training and drills programs as required.

## 12.5 *TRAINING, AWARENESS AND COMPETENCE*

It is expected that the Project would implement a training and awareness program covering environmental, health, safety and social expectations of the Project. As a minimum, this should be implemented as an induction for all employees and contractors engaged on the Project construction, with further training to be implemented depending on the level of responsibility for implementing HSE and social expectations and exposure to environmental and safety risks.

The Project should ensure that all personnel responsible for the implementation of this ESMP are competent on the basis of education, training and experience. All personnel shall be provided with environmental and social training appropriate to their scope of activity and level of responsibility.

## *12.6 ORGANISATIONAL CAPABILITY*

The overall Project organisational structure is presented below; outlining the structure of PT IPP (responsible for the construction of all Project facilities except the FRSU) and PT FRSU (the FSRU will be constructed by Samsung Heavy Industries in South Korea).

PT IPP (JSP) will own and operate the CCGT Power Plant, the gas pipeline and transfer the transmission line to PLN on COD and PT FSRU (JSR) will own and operate the FSRU asset.

PT IPP will be a self O&M structure with Marubeni taking role of O&M Leader whilst PT IPP and PT FSRU will enter into Time Charter Party (TCP), in which PT FSRU will time charter the FSRU to PT IPP and receive time charter payments from PT IPP in return. See **Figure 12.3** for the overall Project structure and **Figure 12.4** illustrates the organisational structure during construction activities.

During construction the EPC Owners Engineer (yet to be decided) and the FSRU construction supervisors will have the responsibilities for:

- Quality Control;
- HSE;
- Project Management;
- Programme, Controls and Reporting;
- Construction Supervision;
- Engineering and logistics;
- Contracts and administration.

The Sponsors will have suitable resources in place to oversee the ESMP implementation; ensuring construction activities are addressing commitments set out in the ESMP. This team will be led by the HSSE Manager.

The EPC consortium (led by GE) will be responsible for implementation of the ESMP with appropriate HSE and Community Relations resources in place to support the implementation. **Figure 12.5** illustrates the organisational structure of the EPCs led by GE.

During operations the Sponsors will be fully responsible for implementation of the ESMP (JSP for the power plant and JSR for the FRSU). The JSP EHS Manager at the power plant, supported by an environmental/CSR officer, will monitor the implementation of the operational mitigation measures. The chief officer and engineer will oversee the FSRU operational mitigation measures.

*Figure 12.3 Overall Project Organisational Structure*

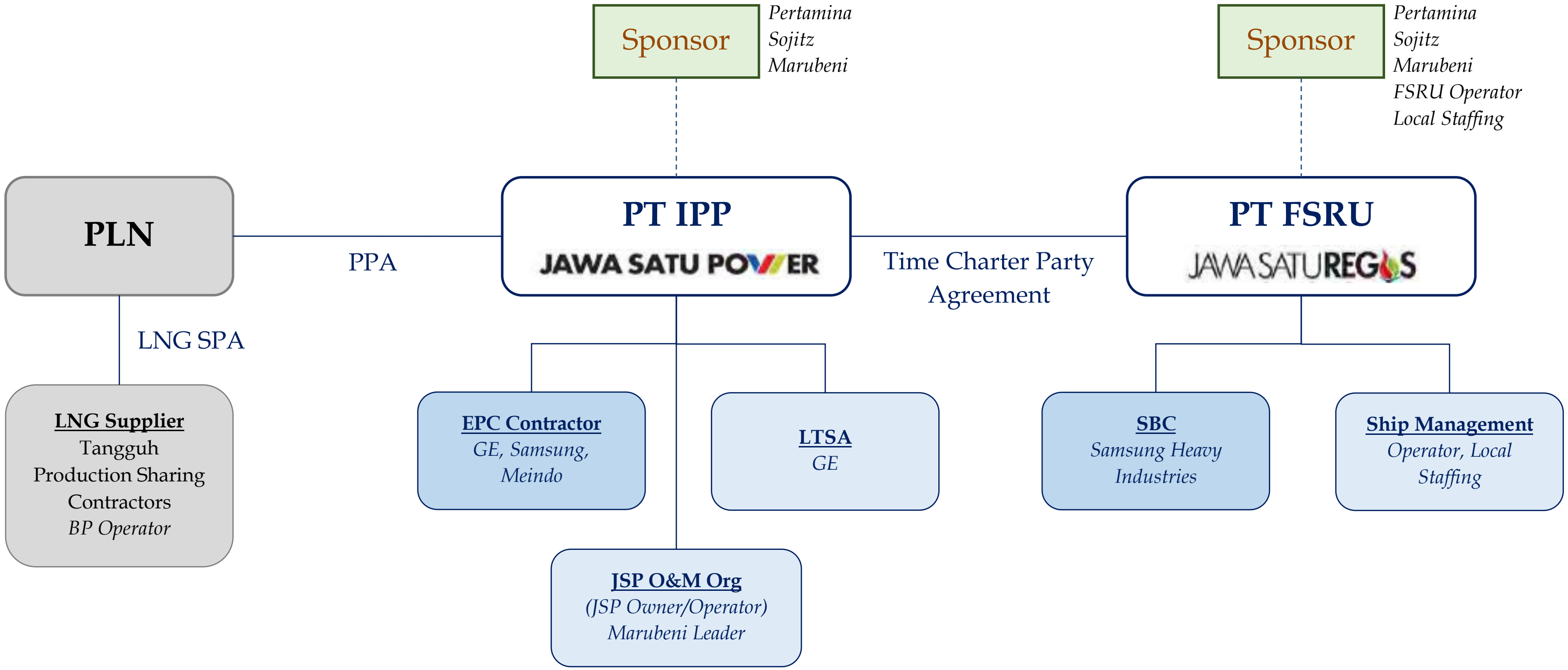


*Figure 12.4 Organisation Structure of Sponsors during Construction*

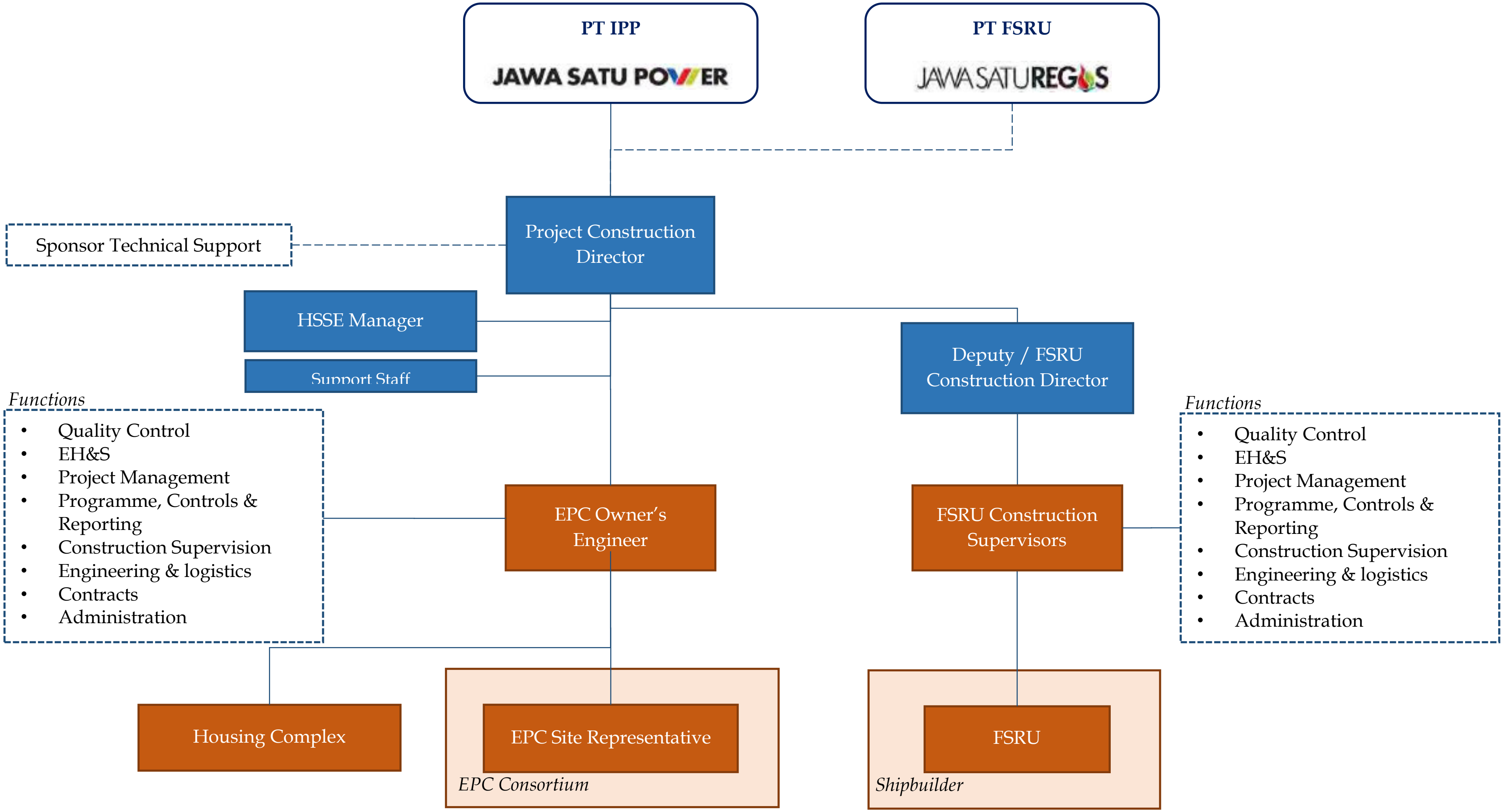
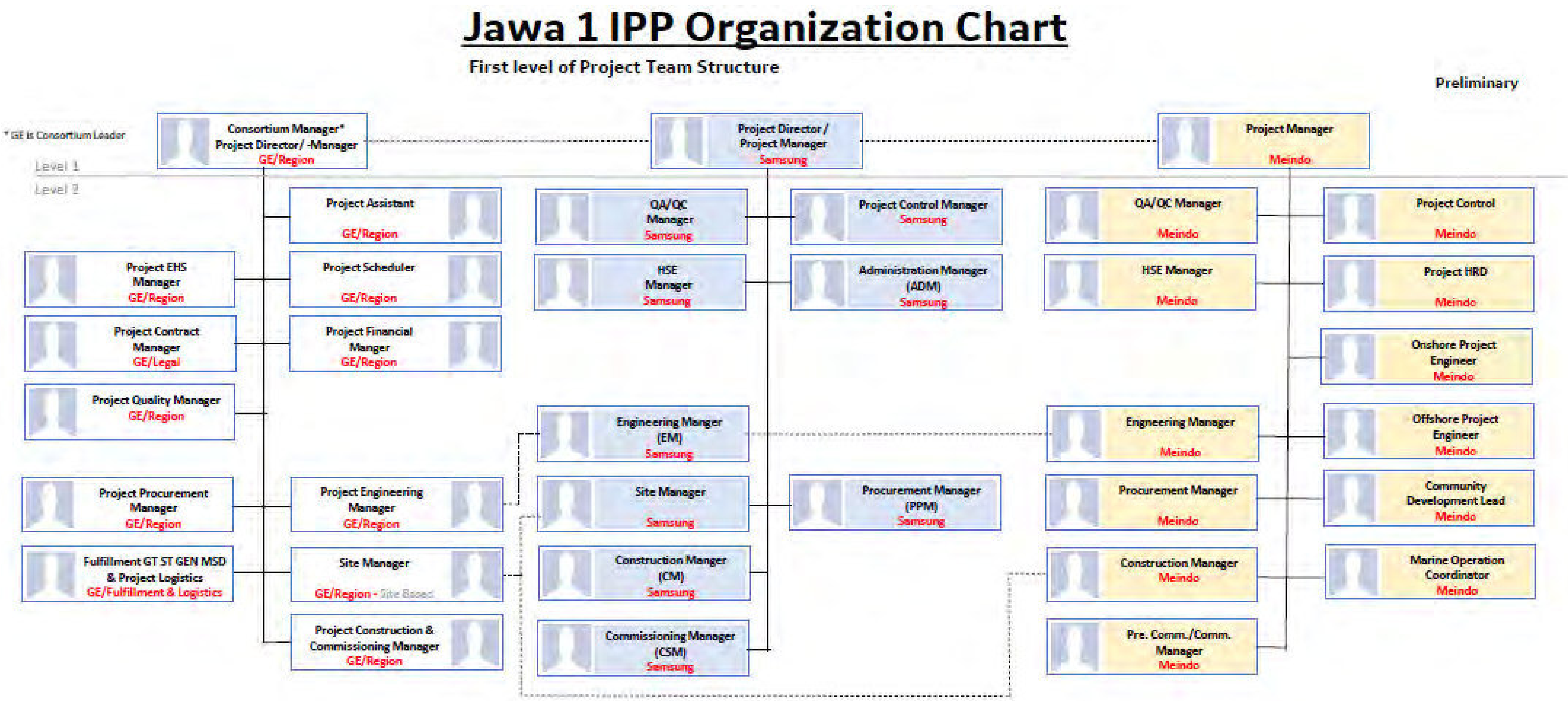


*Figure 12.5 EPC Consortium Organisation Structure*



## 12.7 OUTLINE OF ESMP

As identified with the summary of impacts, mitigation and management measures, the following detailed management plans are considered necessary to effectively implement the outcomes of the ESIA throughout the life of the Project:

- Air Quality Management Plan;
- Biodiversity Action Plan;
- Community Development Plan (CDP);
- Cultural Heritage Chance Find Procedure;
- Emergency Response Plan;
- Livelihood Restoration Plan;
- Local Recruitment and Procurement Plan;
- Noise and Vibration Management Plan;
- Oil and Chemical Spill Contingency Management Plan;
- Vehicle Management and Maintenance Plan;
- Security Plan;
- Soil and Groundwater Management Plan;
- Stakeholder Engagement Plan;
- Surface Water Management Plan;
- Traffic Management Plan;
- Waste Management Plan (Hazardous and Non Hazardous);
- Occupational Health and Safety Management Plan;
- Worker Training Plan; and
- Worker Management Plan.

These plans are set out further in the subsequent two sections covering construction and operational impacts. They will be the responsibility of the EPCs and Sponsors to develop, implement and monitor.

## 12.8 *ENVIRONMENTAL AND SOCIAL MANAGEMENT*

A management and monitoring plan has been prepared for all phases of the Project and is presented in **Table 12.1** to **Table 12.4**. This includes the tentative parameters to be measured, methods to be utilised, sampling locations, frequency of measurements, detection limits, cost and responsibilities for implementation and supervision.

However, it is to be noted that the detailed and specific monitoring measures will be developed and included within the relevant Project management plans. The monitoring components of the various management plans will be refined and finalised during plan development.

Impact monitoring will be required during the life of the Project to verify the predicted levels of residual impacts from the Project and the effectiveness of the various environmental and social management plans or construction and operations.

*Table 12.1 Environmental Management and Monitoring during Construction*

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 1 | Transportation/operation of vehicles (construction, materials/supplies and workforce) | Air Quality | Deterioration of air quality from exhaust emissions from vehicles | • Old vehicles will be replaced with new, more fuel efficient alternatives.<br>• Where feasible high use vehicles will be converted to cleaner fuels.<br>• All vehicles, equipment and machinery will undergo a pre-use inspection prior to use and periodic maintenance inspections. | Appointed EPC Contractor | • Vehicle checklists.<br>• Fuel usage record.<br>• Annual maintenance record. |
| 2 | Transportation/operation of vehicles (construction, materials/supplies and workforce) | Terrestrial Biodiversity | Disturbance and displacement of fauna and flora due to the use and movement of heavy machinery and vehicles | • Use of the access road should be restricted to construction vehicles only. Checkpoints should be used to manage access and inspect vehicles for vegetation (including firewood) taken from the Project Area.<br>• All vehicles are to maintain a speed of a maximum of 40km/hr within work sites to reduce the risk of fauna strike.<br>• All land rehabilitation will be undertaken using native indigenous species.<br>• A community program is to be established with adjacent landowners to replant mangrove forest along foreshore areas and re-establish coastal vegetation on non-utilised public land and private land (With consent of the land-owner) within the Javan Coastal Zone EBA between the Muara Gembang – Tanjung Sedary KBA and the Muara Gimanuk KBA.<br>• A BAP will be prepared for the management and monitoring of Critical Habitats within the Javan Coastal Zone EBA | Appointed EPC Contractor | • Checkpoints in place.<br>• Vehicle entry and inspection record.<br>• Driver training record. |
| 3 | Transportation/operation of vehicles (construction, materials/supplies and workforce) | GHG | Increased GHG Emissions at National and Global Levels | • Optimisation of construction schedule and placement of laydown areas/temporary camp sites to reduce overall traffic movements/distance travelled, thus reducing GHG emissions from transport. | Appointed EPC Contractor | • GHG emission inventory |
| 4 | Workforce presence | Terrestrial Biodiversity | Direct mortality to fauna and flora from hunting and poaching from the workforce and local residents | • Hunting and poaching will be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation.<br>• The Project owner shall provide training to staff and workers on all rules, regulations and information concerning restrictions related to hunting and poaching, as well as the punishment that can expected if any staff or worker or other person associated with the Project violates rules and regulations.<br>• Measures to manage hunting and poaching in the DMU by the local community are to be outlined in a Biodiversity Action Plan. | Appointed EPC Contractor | • Workforce induction program includes anti-poaching and code of conduct.<br>• Worker training record.<br>• Biodiversity Action Plan in place and socialised to workforce. |
| 5 | General Land Clearance – all sites | GHG and Climate Change | Increased GHG emissions (National and Global Level) | • Actual land clearing/disturbance will be minimised to the greatest extent possible. Net GHG emissions could also be reduced by revegetation in many areas that will be cleared only for temporary activities such as laydown areas and temporary camps for construction. | Appointed EPC Contractor | • GHG emission inventory |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 6 | Site dewatering | Groundwater | Deterioration of groundwater quality. | • Monitor the quantity of groundwater abstracted and associated draw down.<br>• Address and respond to any community complaints regarding Project impacts on groundwater availability. | Appointed EPC Contractor | • Groundwater abstraction record.<br>• Grievance records. |
| 7 | General construction activities - all sites | Terrestrial Biodiversity | Disturbance and Displacement of Fauna | • The planned vegetation clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing;<br>• Clearing of habitat within Natural Habitat areas (mangrove forests) along the coastal zone will be avoided and minimised where possible. No clearing of mangroves is to occur outside of the Project area.<br>• All land rehabilitation will be undertaken using native indigenous species.<br>• A community program is to be established with adjacent landowners to replant mangrove forest along foreshore areas and re-establish coastal vegetation on non-utilised public land and private land (With consent of the land-owner) within the Javan Coastal Zone EBA between the Muara Gembang – Tanjung Sedary KBA and the Muara Gimanuk KBA.<br>• A BAP will be prepared for the management and monitoring of Critical Habitats within the Javan Coastal Zone EBA<br>• A Fauna Shepherding Protocol is be used in the Javan Coastal EBA to ensure that any endemic bird species have vacated the area prior to any clearance work. | Appointed EPC Contractor | • Protocol in place and socialised to workers.<br>• Fences in place. |
| 8 | General construction activities - all sites | Air Quality | Dust generation - Deterioration of air quality | • Daily onsite and offsite inspections will be undertaken to visually assess the dust emissions from earthwork and construction activities, and from vehicles exiting the construction sites. Results from the inspection will be recorded and appropriate measures will be taken to reduce emissions where necessary.<br>• All dust and air quality complaints will be recorded, the cause identified and the appropriate measures taken to reduce emissions in a timely manner.<br>• Use of site watering to suppress wind and physical disturbance dust generation. | Appointed EPC Contractor | • Inspection records for daily activities.<br>• PM25, PM10 monitoring at sensitive receptors.<br>• Community grievance records |
| 9 | General construction activities - CCGT | Air Quality | Dust generation - Deterioration of air quality | • The construction site will be planned so that machinery and dust causing activities are located away from air sensitive receptors as far as possible.<br>• Wind breaks will be erected around the construction site at least the height of any stockpile on site.<br>• Use of site watering to suppress wind and physical disturbance dust generation.<br>• All sand and aggregates will be stored in bunded areas and are not allowed to dry out unless specifically required.<br>• Deliveries of ready made cement and other fine powders will be delivered in enclosed tankers and stored with suitable emission controls to prevent escape of material and overfilling during delivery. | Appointed EPC Contractor | • Site inspection records.<br>• Wind breaks in place.<br>• Sand and aggregates in bunded areas. |
| 10 | General construction activities - CCGT | Air Quality | Dust generation - Deterioration of air quality | • Re-vegetate earthworks and exposed areas including stockpiles to stabilise the surfaces as soon as is practicable.<br>• Use hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.<br>• Only remove the top cover in small and specific areas during the construction phase and not all at once.<br>• Stockpiles will be places as far as reasonably practicable from air sensitive receptor locations.<br>• The design of stockpiles will be optimised to retain a low profile with no sharp changes in shape. | Appointed EPC Contractor | • Site inspection records. |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 11 | General construction activities - Substation | Air Quality | Dust generation - Deterioration of air quality | • The construction site will be planned so that machinery and dust causing activities are located away from air sensitive receptors as far as possible.<br>• Wind breaks will be erected around the construction site at least the height of any stockpile on site.<br>• All sand and aggregates will be stored in bunded areas and are not allowed to dry out unless specifically required.<br>• Deliveries of ready made cement in enclosed tankers to prevent escape of material and overfilling during delivery.<br>• Plan to use watering during earthworks to minimise dust effects. | Appointed EPC Contractor | • Site inspection records. |
| 12 | General construction activities - Substation | Air Quality | Dust generation - Deterioration of air quality | • Use hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.<br>• Only remove the top cover in small and specific areas during the construction phase and not all at once.<br>• Stockpiles will be places as far as reasonably practicable from air sensitive receptor locations.<br>• The design of stockpiles will be optimised to retain a low profile with no sharp changes in shape. | Appointed EPC Contractor | • Site inspection records. |
| 13 | CCGT Power Station, 500 kV transmission line, ORF and nearshore area and infrastructure | Acoustics & Vibration | Temporary and short-term noise disturbance impacts and amenity issues. | • Work and activities should be carried out during the IFC daytime hours (i.e. 7am to 10pm). Any work that is performed outside these hours (i.e. during the night time period, 10pm to 7am) should be suitably managed with a goal of achieving levels compliant with the IFC 1.7 Noise Disturbance criteria, at all potentially affected sensitive receptors. Where this is not possible it may be necessary to undertake the night works with agreement from nearby and potentially affected neighbours.<br>• Where unforeseen works will occur in close proximity to a receptor and these works are anticipated to generate high levels of noise (e.g. >75 dBA), potential respite periods (e.g. three hours of work, followed by one hour of respite) should be considered. Respite should be implemented if they are the preference of the affected receptors and if they are feasible and reasonable, and practicable, to implement during the works. In some circumstances respite may extend the duration of works and inadvertently increase noise impacts, hence due care should be taken when considering this management measure.<br>• During the construction design, choose appropriate machines for each task and adopt efficient work practices to minimise the total construction period and the number of noise sources on the site. Select the quietest item of plant available where options that suit the design permit.<br>• During the works, avoid unnecessary noise due to idling diesel engines and fast engine speeds when lower speeds are sufficient.<br>• During the works, instruct drivers to travel directly to site and avoid any extended periods of engine idling at or near residential areas, especially at night.<br>• During any night works, any activity that has the potential to generate impulsive noise should be avoided. These types of events are particularly annoying, especially at night and have the limited potential to generate sleep disturbance or awakening impacts.<br>• During the works, ensure all machines used on the site are in good condition, with particular emphasis on exhaust silencers, covers on engines and transmissions and squeaking or rattling components. Excessively noisy machines should be repaired or removed from the Site. | Appointed EPC Contractor | • Noise monitoring |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| | | | | • During the works, ensure that all plant, equipment and vehicles movements are optimised in a forward direction to avoid triggering motion alarms that are typically required when these items are used in reverse. | | |
| 14 | Earthworks, including vegetation clearance, excavation, grading and levelling | Soil | Exposure of soil causing erosion and loss of top soil. | • Delineation of clearance boundaries to limit the areas to be cleared.<br>• Scheduling clearance activities to avoid extreme weather events such as heavy rainfall, extreme dry and high winds.<br>• Revegetation areas with temporary land use, conducting progressive rehabilitation.<br>• Demarcate routes for movement of heavy vehicles to minimise disturbance of exposed soils and compaction of sub-surface layers.<br>• Reuse topsoil within rehabilitation activities.<br>• Control erosion through diversion drains, sediment fences, and sediment retention basins. | Appointed EPC Contractor | • Site inspection records. |
| 15 | Earthworks, including vegetation clearance, excavation, grading and levelling | Soil | Exposure of soil causing erosion and loss of top soil. | • Stockpiles to be separated into topsoil and sub-soil and be located at least 10 m from any surface water source and groundwater well or 50 m from Cilamaya canal; and<br>• Stockpiles are to be located in areas surrounded by natural wind barriers to minimise the potential for wind erosion. | Appointed EPC Contractor | • Site inspection records. |
| 16 | Earthworks, including vegetation clearance, excavation, grading and levelling | Groundwater | Acid Sulfate Soil impacts to groundwater, vegetation, surface water quality and aquatic biota from soil clearing at the Access Road and Jetty coastal areas | For earthworks and excavations in the waterlogged coastal soils where there is the potential for ASS, the following measures are recommended:<br>• Prior to proceeding with any soil disturbance activities, conduct onsite ASS tests at coastal excavation locations;<br>• Where ASS is confirmed to be present implement control measures, such as:<br>– Schedule excavation such that the potential effects on any area disturbed at any one time are limited and managed;<br>– Stockpiling of ASS is only permitted as a short-term activity where removal from site is not possible (e.g. weather) and must be placed on impermeable area with runoff protection, 50 m away from surface water;<br>– Minimise the time that excavations are left open and the presence of temporary spoil piles to reduce the amount of time that ASS is exposed to the air.<br>– No dumping of exposed ASS is permitted onto the surrounding land or into surface waters;<br>– Use of marine, estuarine, brackish or fresh waters is not permitted as a means of diluting and/or neutralising ASS or associated contaminated waters.<br>– Given the fine sediment and waterlogged nature of the potential area of ASS, covering excavated spoil with clean material is not recommended as the material may liquidise, flow and contaminate the surrounding area.<br>• Evaluate treatment and disposal options based on volume of ASS material, considering:<br>– Removal, treatment and disposal offsite;<br>– Neutralisation of ASS materials (e.g. lime application); or<br>– Strategic reburial in anoxic environment.<br>• Monitoring samples of soil and surface water following completion of earthworks/excavation in ASS affected area.<br>• The above mitigation measures should be detailed in an ASS Management Plan that details the steps, measures and strategies that will be used to manage potential impacts of the excavation works that have the potential to disturb ASS materials at the site to reduce the magnitude of the potential impact. | Appointed EPC Contractor | • ASS Management Plan;<br>• ASS test results prior to excavation works in coastal areas;<br>• Soil and Surface Water Monitoring; and<br>• Site inspection records. |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 17 | Earthworks, including vegetation clearance, excavation, grading and levelling | Surface Water Quality | Deterioration of surface water quality. | Sponsor shall also inform the EPCs to develop Construction Environment Management Plan and Run-off and Sediment Control Plans prior to the commencement of construction activities to include the following:<br>• Major earthworks activities during construction shall be scheduled during dry season as much as possible.<br>• Topsoil removed during clearing shall be stored in specified areas. Stockpiled earthworks, during and after clearing will be placed as bunds at strategic locations in order to reduce sediment loadings to the storm run-off.<br>• Stockpiles to be separated into topsoil and sub-soil and be located at least 10 m from any surface water source and groundwater well or 50 m from Cilamaya canal;<br>• Open stockpiles of construction materials (e.g. aggregates, sand and fill material) in places which are identified to have a possibility of significant run-off will have measures in place to prevent the washing away of construction materials, soil, silt or debris into any drainage system.<br>• Earthworks to form the final surfaces will be followed up with surface protection and drainage works to prevent erosion caused by rainstorms. Soil erosion caused by wind and rainstorms shall also be reduced by minimising the land clearance area during construction activities, where possible, providing surface protection such as sheet cover.<br>• Temporary traffic areas and access roads, if any, formed during construction will be protected by coarse stone ballast or equivalent.<br>These measures shall prevent soil erosion caused by rainstorms. | Appointed EPC Contractor | • CEMP and SCP in place and socialised to workers. |
| 18 | Earthworks, including vegetation clearance, excavation, grading and levelling | Terrestrial Biodiversity | Loss of habitat and degradation of habitat due to the construction activities | • Clearing vegetation outside of designated areas will be prohibited for Project staff, workers, all contractors and personnel engaged in or associated with the Project, with penalties levied, including fines and dismissal, and prosecution under the relevant laws for clearing vegetation.<br>• The Project owner shall provide training to staff and workers on all rules, regulations and information concerning restrictions related to unauthorised clearing of vegetation, as well as the punishment that can expected if any staff or worker or other person associated with the Project violates rules and regulations.<br>• The planned vegetation clearance area for the construction works shall be clearly identified and marked to avoid accidental clearing.<br>• All land rehabilitation will be undertaken using native indigenous species. The area of landscaping should at least equal to the area of Natural Habitat loss.<br>• A community program is to be established with adjacent landowners to replant mangrove forest along foreshore areas and re-establish coastal vegetation on non-utilised public land and private land (With consent of the land-owner) within the Javan Coastal Zone EBA between the Muara Gembang – Tanjung Sedary KBA and the Muara Gimanuk KBA.<br>• A BAP will be prepared for the management and monitoring of Critical Habitats within the Javan Coastal Zone EBA.<br>• Planting of native indigenous flora, including mangroves along the shoreline adjacent to the road and jetty construction sites is to occur to reduce impacts to connectivity along the shoreline.<br>• Appropriate rehabilitation of disturbed areas using native vegetation is to occur to facilitate movement of fauna species, especially within the EBA. It is estimated that approximately 10ha | Appointed EPC Contractor | • Site inspection records. |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| | | | | of land adjacent to project components is available for site revegetation. | | |
| 19 | Earthworks, including vegetation clearance, excavation, grading and levelling | Terrestrial Biodiversity | Emissions (dust, noise, vibration) and discharges (run-off, effluent) disturbance and degradation of habitats | • Measures to control dust are to be utilised to limit generation of dust and hence deposition onto vegetation surrounding construction areas.<br>• All machinery to be used in areas of Natural Habitat and Critical Habitat are to exert a low pressure on the ground surface so as to minimise soil compaction.<br>• All machinery and hand held equipment used must comply with required air and noise emission standards.<br>• Sediment and erosion control measures are to be used in all areas of construction to minimise soil contaminated runoff entering waterways. These measures are to be outlined in a Sediment and Erosion Control Plan.<br>• All disturbed soil surfaces are to be rehabilitated and native flora species are to be planted within areas under the projects control. These species are to be suitable habitat for bird species listed in the Javan Coastal Zone EBA. | Appointed EPC Contractor | • Site inspection records. |
| 20 | Earthworks, including vegetation clearance, excavation, grading and levelling | Surface water | Reduction of surface water quality | • Stockpiles to be separated into topsoil and sub-soil and be located at least 10 m from any surface water source and groundwater well or 50 m from Cilamaya canal;<br>• Construction of drainage ditches and retention ponds to collect water run-off to reduce flows.<br>• Develop a Construction Sediment and Erosion Management Plan including erosion control measures such as sediment barriers.<br>• Implement measures to avoid the potential for accidental or unintended introductions including the transportation of substrates e.g. chemicals and hydrocarbon bunding. | Appointed EPC Contractor | • Site inspection records. |
| 21 | Earthworks, including vegetation clearance, excavation, grading and levelling - Critical and Natural habitat | Terrestrial Biodiversity | Emissions (dust, noise, vibration) and discharges (run-off, effluent) disturbance and degradation of habitats | • Habitat biodiversity offsets are unnecessary to achieve a no-net-loss of biodiversity values. Specific measures however to manage Critical habitat species will be required to be outlined within a Biodiversity Action Plan. | Appointed EPC Contractor | Biodiversity Action Plan review. |
| 22 | Earthworks, including vegetation clearance, excavation, grading and levelling - Critical and Natural habitat | Terrestrial Biodiversity | Emissions (dust, noise, vibration) and discharges (run-off, effluent) disturbance and degradation of habitats | • All machinery to be used in areas of Natural Habitat and Critical Habitat are to exert a low pressure on the ground surface so as to minimise soil compaction.<br>• All machinery and hand held equipment used must comply with required air and noise emission standards.<br>• Sediment and erosion control measures are to be used in all areas of construction to minimise soil contaminated runoff entering waterways. These measures are to be outlined in a Sediment and Erosion Control Plan.<br>• Hours of operation of the construction site are to be limited to the hours of 7.00am to 10.00pm Monday to Sunday.<br>• All light sources are to be directed away from areas of Natural Habitat and Critical Habitat. | Appointed EPC Contractor | • Site inspection records. |
| 23 | Earthworks, including vegetation clearance, excavation, grading and levelling - Critical and Natural habitat | Terrestrial Biodiversity | Introduction of invasive species through increased movement of people, vehicles, machinery, vegetation and soil. | • The use of fencing and hoarding during construction in the Javan Coastal EBA is to be kept to a minimum around Project construction sites<br><br>Development of an Invasive Species Management Plan to include:<br>• The provenance of any fill material brought onto the site is to be checked regarding invasive species contamination.<br>• Vehicle wash down procedures are to be used to reduce the transmission of invasive species into and from the Project site(s). | Appointed EPC Contractor | • Invasive Species Management Plan in place and socialised to workforce.<br>• Site inspection records.<br>• Planting proliferation and growth assessment. |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| | | | | • Control measures are to be utilised in areas of Natural Habitat and Critical Habitat<br>• All disturbed soil surfaces are to be rehabilitated and native flora species are to be planted within areas under the Projects control. These species are to be suitable habitat for bird species listed in the Javan Coastal Zone EBA. | | |
| 24 | Earthworks, including vegetation clearance, excavation, grading and levelling - CCGT | Air Quality | Dust generation - Deterioration of air quality | • Re-vegetate earthworks and exposed areas including stockpiles to stabilise the surfaces as soon as is practicable.<br>• Use hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.<br>• Stockpiles will be places as far as reasonably practicable from air sensitive receptor locations.<br>• The design of stockpiles will be optimised to retain a low profile with no sharp changes in shape.<br>• Real time PM10 monitoring will be undertaken at two (2) fenceline locations. Monitoring will commence three (3)-months prior to the earthwork phase commencing. | Appointed EPC Contractor | • Site inspection records.<br>• Real time PM10 monitoring will be undertaken at two fenceline locations. Monitoring will commence 3-months prior to the earthwork phase commencing. |
| 25 | Earthworks, including vegetation clearance, excavation, grading and levelling - Substation | Air Quality | Dust generation - Deterioration of air quality | | | |
| 26 | Earthworks, including vegetation clearance, excavation, grading and levelling - Onshore pipeline | Air Quality | Dust generation - Deterioration of air quality | • Re-vegetate earthworks and exposed areas including stockpiles to stabilise the surfaces as soon as is practicable.<br>• Use hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.<br>• Stockpiles will be places as far as reasonably practicable from air sensitive receptor locations.<br>• The design of stockpiles will be optimised to retain a low profile with no sharp changes in shape. | Appointed EPC Contractor | • Site inspection records.<br>• Real time PM10 monitoring will be undertaken at two (2) fenceline locations. Monitoring will commence 3-months prior to the earthwork phase commencing. |
| 27 | Fencing | Terrestrial Biodiversity | Fragmentation of habitat, or permanent /temporary severance of wildlife corridors between isolated habitats of importance for biodiversity. | • The use of fencing and hoarding during construction in the Javan Coastal EBA is to be kept to a minimum around Project construction sites.<br>• Appropriate rehabilitation of disturbed areas is to occur to facilitate movement of fauna species during operation, especially within the EBA | Appointed EPC Contractor | • Site inspection records. |
| 28 | Vehicle use - trackout of soil material - CCGT | Air Quality | Dust generation - Deterioration of air quality | • Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport.<br>• Inspect on-site haul roads for integrity and instigate the necessary repairs to the surfaces as soon as reasonable practicable.<br>• Implement a wheel washing system.<br>• Regular inspection and washing of site access and local roads to remove any materials tracked out of the site.<br>• Access gates will be located at least 10m from air sensitive receptors where possible. | Appointed EPC Contractor | • Site inspection records. |
| 29 | Vehicle use - trackout of soil material - Substation | Air Quality | Dust generation - Deterioration of air quality | | | |
| 30 | Vehicle use - trackout of soil material - Onshore pipeline | Air Quality | Dust generation - Deterioration of air quality | • Ensure that all vehicles entering and leaving the site are covered to avoid fugitive emissions during transport.<br>• Implement a wheel washing system.<br>• Regular inspection and washing of site access and local roads to remove any materials tracked out of the site. | Appointed EPC Contractor | • Site inspection records. |
| 31 | Site preparation Jetty, onshore pipeline and access roads | Terrestrial Biodiversity | Loss of habitat and degradation of habitat due to the construction activities | • A Biodiversity Action Plan (BAP) will be prepared for the management and monitoring of Critical Habitats within the Javan Coastal Zone EBA. The BAP will assess the requirements to achieve no-net-loss of biodiversity values for loss of habitats and impacts on Critical Habitat species. | Appointed EPC Contractor | • BAP in place and socialised to workforce. |
| 32 | Jetty Construction, Dredging and Pipeline Trenching | Marine Biodiversity | Direct loss and Degradation of Marine Habitats and Water Quality | • Project shall develop a development of a dredging and disposal risk assessment and Dredging Management Plan in accordance with IMO and OSPAR guidelines.<br>• Project shall implement the standard turbidity controls during the dredging activities. | Appointed EPC Contractor | • Site inspection records.<br>• TSS monitoring of TSS levels at dredging sites. |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 33 | Jetty Construction, Dredging and Pipeline Trenching | Marine Biodiversity | Direct loss and Degradation of Marine Habitats and Water Quality | • Dredging vessels will be equipped with the appropriate Global Positioning System (GPS) equipment or other navigational aids to ensure dredging will occur at the specified dredge footprint and disposal at the designated soil disposal site.<br>• EPCs' dredgers will maintain adequate clearance between vessel hull and the seabed at all states of the tide and reduce vessel speed to ensure that excessive turbidity is not generated by turbulence from vessel movement or propeller wash. | Appointed EPC Contractor | • Vessel inspection.<br>• Dredging management plan. |
| 34 | Vessel presence and movements | Marine Biodiversity | Direct mortality or injury of marine fauna from vessel movements | • Vessels will operate in accordance with standard maritime practices, whereby vessel speeds will be adjusted depending on environmental conditions (e.g., visibility, metocean condition) as required by the captain of the vessel and to avoid any encountered hazards.<br>• Support vessels will not travel greater than six (6) knots within 300 m of a whale or 100 m from a dolphin, if sighted, (i.e. will maintain a caution zone of those distances).<br>• Vessels will approach no closer than 100 m from a whale or 50 m from a dolphin, if sighted (Note this standard does not apply to support vessels engaged in limited/constrained manoeuvrability activities where vessel speed will already be low).<br>• Vessels will not directly approach a marine mammal from in front or behind their path of travel.<br>• Vessels will not exceed a speed limit of five (5) knots within designated boating channels around the jetty or the FSRU.<br>• Vessel bridge crew to maintain visual watch of any hazards (including marine mammals). | JSR | • Training records for vessel personnel.<br>• Marine mammal observation forms. |
| 35 | Dredging, FSRU mooring/jetty pile driving, construction | Marine Biodiversity | Disturbance and displacement of marine fauna by underwater noise during construction | • Acoustic decoupling (i.e. repositioning or placement on rubber fittings) of loud equipment during piling should be implemented.<br>• Pile driving management measures consistent with JNCC (2010) standard pile driving protocol:<br>– Trained and dedicated MMOs and PAM operatives during pile driving.<br>– Mitigation zone (JNCC recommend a minimum mitigation zone of 500 m, to be determined on a case-by-case basis. The zone may be determined using numerical modelling of the pile driving characteristics proposed for the Project, but in the absence of modelling, a conservative 1 km mitigation zone will be implemented).<br>– 30-minute pre-start observations.<br>– Delay-start procedure (if marine mammal sighted within the mitigation zone).<br>– Soft-start procedure (minimum 20 minutes).<br>– Shut-down procedures if marine mammal sighted within the mitigation zone during pile driving.<br>• Delay-start and shut-down procedures will also be implemented if a marine turtle is sighted within 500 m of the pile driving activity.<br>• Where piling/activity continues into a period of poor visibility/ night-time there is no need for additional mitigation.<br>• Where piling/activity is initiated during times of poor visibility (including night-time conditions, the activity will only be permitted if there have been no sightings of marine mammals within 2 hours prior to low visibility/darkness. Activities then to be kept continuous as much as is possible. Other standard mitigation is also required (with the exception of observation period). | Appointed EPC Contractor | • Documentation on pre-start procedure.<br>• MMOs and PAMs present.<br>• Marine mammal observation forms.<br>• Site inspection records. |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| | | | | • Vessel and Dredger maintenance to be performed as adequate maintenance, including lubrication and repair of winches, generators, propulsion components and other potential sources is an effective measure for noise reduction.<br>• Records shall be maintained of all marine species sightings in the area.<br>• When marine species are observed in the mitigation zone, additional information and corrective actions taken such as a shutdown of the pile driver, duration of the shutdown, behaviour of the animal, and time spent in the mitigation zone will be recorded.<br>• Any incidents that occur during dredging that result in negative impacts on the marine species will be documented and reported to the authorities when required.<br>• Only hydraulic hammer for pile driving is used, not diesel based for the FSRU piles. | | |
| 36 | FSRU and vessel mobilisation | Marine Biodiversity | Introduction of invasive species from FSRU/vessels brought from outside Indonesian waters (ballast water/hull fouling) | • The FSRU and any contracted vessels coming from outside of Java territorial waters will have vessel hull and niches confirmed to be free of IMS prior to mobilisation to the local waters of the Project area.<br>• All contracted vessels and the FSRU will maintain a current anti-fouling coating, as evidenced by a current Anti-fouling System Certificate under *Annex 1 of the International Convention on the Control of Harmful Anti-Fouling Systems on Ships* or other equivalent records.<br>• The FSRU and all contracted vessels will meet the requirements of the International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004, including:<br>- Ballast water shall be managed in accordance with the provisions set out in the Convention; and<br>- A Ballast Water Management Plan and a ballast water record book will be implemented and maintained on board. | JSR | • Vessel inspection record.<br>• Ballast water management plan in place.<br>• Ballast water discharge record. |
| 37 | Hydrotest of offshore pipeline | Marine Water Quality | Reduction of marine water quality | • Chemicals used in hydrotesting will be selected with consideration for their potential ecotoxicity and will use the lowest toxicity practicable for preserving pipeline integrity. | Appointed EPC Contractor | • Chemical inventory for hydrotest water. |
| 38 | Hydrotest of onshore equipment | Surface Water Quality | Deterioration of surface water quality. | • For the selection of chemicals for hydrotest water, the Project will select biocides / chemical additives that present a low risk of contamination, in terms of dose concentration, toxicity, biodegradability, bioavailability, and bioaccumulation potential. | Appointed EPC Contractor | • Chemical inventory for hydrotest water. |
| 39 | Waste management | Environmental Quality | Generation, handling, treatment and disposal of solid and liquid hazardous and non-hazardous wastes | • Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance).<br>• Store wastes in closed containers away from direct sunlight, wind and rain and systematically to allow inspection between containers to monitor leaks or spills.<br>• Ensure that liquid waste storage areas have impermeable floors and containment, of capacity to accommodate 110% of the volume of the largest waste container.<br>• All wastes will be disposed of by authorised third- party disposal contractors.<br>• Concrete waste of inert nature will be stored in a laydown area near the concrete batching plant and will be reused where possible.<br>• Any bitumen waste will be stored separately in a lined area to be disposed of by licensed contractors. | Appointed EPC Contractor | • WMP in place and socialised to workers.<br>• Site inspection records. |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 40 | Waste management | Infrastructure | Pressure on existing waste management infrastructure | WMP required detailing:<br>• Waste inventory that details all wastes anticipated by the construction works, the frequency at which they will occur and the timing in the Project programme, is needed.<br>• Waste disposal sites in the area that are licensed to accept the types of waste the construction phase will create, following the 3Rs ethos (i.e. reduce, reuse and recycle).<br>• Waste storage and segregation.<br>• Waste transfer and transport.<br>• Training to workers.<br>• Waste auditing. | Appointed EPC Contractor | • WMP in place and socialised to workforce.<br>• Site inspection records. |
| 41 | Wastewater discharge and runoff | Surface Water Quality | Deterioration of surface water quality. | • Portable or permanent sanitation facilities serving all workers should be provided at all construction sites e.g. one (1) toilet for every 25 workers up to the first 100, and one for every 50 thereafter) will be provided for the construction workforce. Septic tanks shall be provided to treat the sanitary discharge.<br>• Wastewater collected from canteen kitchens, including that from basins, sinks and floor drains, should be discharged into sanitary sewers via grease traps. The sanitary sewer should then be treated prior to discharge or reuse as greywater.<br>• Surface run-off from bunded areas should pass through oil/water separators prior to discharge to the stormwater system. | Appointed EPC Contractor | • Site inspection records. |
| 42 | Wastewater discharge and runoff | Surface Water | Deterioration of surface water quality. | • All surface run-off from the construction areas potential sources of contamination will be minimised and reduced (e.g. by minimising the area of impermeable surfaces) and the peak discharge rate will be reduced (e.g. by using retention ponds and silt screen).<br>• Appropriate surface drainage surrounding the construction areas will be designed and provided where necessary. This includes diversion channels to intercept storm water running-off the cleared areas and prior to large scale land clearance and removal of topsoil, where appropriate. These channels will be protected against erosion such as sandbag, rock armouring or lining as required.<br>• Stormwater management structures such as stormwater ponds will be designed to collect the silt-laden surface runoff and allow the removal of silt by natural settlement, which in turn should reduce sediment loading prior to discharge into receiving environment.<br>• All drainage facilities and sediment control structures will be inspected on a regular basis and maintained to confirm proper and efficient operation at all times and particularly during rainstorms. Deposited silt and grit will be removed regularly. The stormwater drainage system will be periodically inspected for blockage sand cleaned at least once before the monsoon season each year.<br>• Measures will be taken to reduce the ingress of drainage into excavations. If trenches have to be excavated during the wet season or rainy conditions, they will be excavated and backfilled in short sections wherever practicable. Water will pumped out from trenches or foundation excavations will be discharged into storm drains via silt removal facilities.<br>• Personnel will be trained to visually inspect discharged water quality for oil and grease traces (that will be visible on the surface) periodically and take appropriate corrective actions. | Appointed EPC Contractor | • Site inspection records. |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
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| | | | | • A dike wall shall also be constructed around high potential spillage area such as fuel tank. For spillage in other location is considered to be minor so that oil pan and containment devices are necessary to response. Additionally, containment devices are to be provided for storage areas of oil, fuel and chemicals to control contaminated surface runoff.<br>• Control and monitoring systems will be used to alert the crew to leaks or any other potential risks. | | |
| 43 | Black start diesel generator operation | Air Quality | NOx emissions and deterioration of air quality | • The simultaneous operation of all twelve diesel engine-generators will only occur when required and for the amount of time necessary to black start the power plant. The operator will endeavour to reduce this time period as much as is feasible to minimise the likelihood of unacceptable impacts on air quality;<br>• All engine-generators will be routinely checked and maintained in accordance with the manufactures specifications. This routine maintenance will ensure that the operational performance of the engine-generator is maintained at a high level throughout the operational lifetime of the Project; and<br>• Diesel fuel with a maximum sulphur content of 0.5% will be used at all times. | Appointed EPC Contractor | • Site inspection records.<br>• Timing records of start up<br>• Routine generators checks |

*Table 12.2 Social Management and Monitoring during Construction*

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 1 | Land acquisition for pipeline right of way, access road and jetty | Land owners and fish pond cultivators | Land acquisition impacts and lost income from fresh water fisheries activities (shrimp or fish) | • Implement the RP to ensure livelihoods are not impacted<br>• Undertaking consultation with the land owners and users<br>• Support the fishpond owners/ cultivators to re-establish new fish<br>• Prioritisation for Project opportunities | JSP | • Number of resettlement related grievances submitted<br>• Number of land owners and users employed by Project<br>• Number of land owners and users participating in the Project's CDP<br>• Evidence of consultation activities and records<br>• Consultation database<br>• Evidence of new fish ponds established<br>• Consultation records with fish pond cultivators |
| 2 | Land acquisition for sub station, transmission line, pipeline right of way and access road | Land owners, users and sharecroppers | Land acquisition impacts and lost income from paddy fields | • Implement the RP to ensure livelihoods are not impacted<br>• Undertaking consultation with the land owners and users<br>• Prioritisation for Project opportunities | JSP | • Number of resettlement related grievances submitted<br>• Number of land owners and users employed by Project<br>• Number of land owners and users participating in the Project's CDP<br>• Evidence of consultation records<br>• Consultation database |
| 3 | FSRU installation and laying of offshore pipelines | Fisher folk in Blanakan and Muara villages | Loss of income due to restrictions and construction activities (perceived and actual) | • Conduct regular socialisation and consultation activities<br>• Map and monitor the fishing activities in the vicinity of the FSRU<br>• Ensure the Project's grievance mechanism is well socialised<br>• Compensation will be on a case by case basis and agreed by both parties involved<br>• Implement a relevant community development of the fishermen's needs<br>• Prioritise employment for interested local fishermen | • Meindo<br>• JSP | • Evidence of consultation records Consultation database<br>• Map of fishing activities<br>• Number of grievances submitted<br>• Report on grievance close out<br>• Number of local fishermen participating in CDP activities<br>• Number of local fishermen employed by the Project |
| 4 | Project Employment and Procurement of Goods and Services | Local communities residing near Project activities | Managing Community Expectations | • Provide and communicate clear and factual information about the Project's needs<br>• To avoid over committing or promising employment<br>• To have clear stipulation of using local labour in the EPC contracts<br>• To ensure the EPC liaise closely with the local village leaders and local government authorities to agree on the appropriate procedures for recruitment and hiring | • JSP<br>• JSR<br>• Meindo<br>• Samsung<br>• GE | • Evidence of consultation activities and records<br>• Consultation database<br>• Evidence of consultation activities and records<br>• Number of related grievances submitted<br>• Evidence of EPC local content commitments<br>• EPC Local Recruitment Policy |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 5 | Access road and onshore pipeline construction activities | Local fish pond cultivators in Cilamaya, Muara and Blanakan | Damage to fishponds due to dust, waste disposal and other construction activities | • Apply noise, dust, and vibration barriers to reduce the level of disturbance<br>• Establish a grievance mechanism<br>• Conduct regular socialisation and consultation activities<br>• Compensation will be on a case by case basis and agreed by both parties involved<br>• Prioritise employment for interested local fish pond owners | Meindo | • Number of related grievances submitted<br>• Evidence of consultation activities and records<br>• Report on grievance close out<br>• Number of fish pond cultivators employed by Project |
| 6 | Construction of the transmission line and substation | Local paddy owners and users along transmission line, substation and Cilamaya | Damage to paddy fields due to dust, waste disposal, flooding and other construction activities | • Apply appropriate flood barriers and dust suppression techniques<br>• Socialise the grievance mechanism<br>• Conduct regular socialisation and consultation activities<br>• Compensation will be on a case by case basis and agreed by both parties involved<br>• Prioritise employment for interested local farmers. | • Samsung<br>• GE | • Number of related grievances submitted<br>• Number of grievance mechanism socialisation activities<br>• Evidence of consultation records<br>• Consultation database<br>• Report on grievance close out<br>• Number of local famers employed by Project |
| 7 | Access road construction | Villagers in Cilamaya and Muara | Loss/restricted in access to fields due to access road construction activities | • Socialise the grievance mechanism<br>• Conduct regular socialisation and consultation activities<br>• Discuss with EPC and village head options to allow safe access through the construction works | Meindo | • Number of grievance mechanism socialisation activities<br>• Evidence of consultation records<br>• Consultation database<br>• Evidence of consultation records |
| 8 | Presence of non-local workers | Local villages in close proximity to construction activities | Adverse interactions with non-local workers resulting in community resentment, increased use of alcohol, violence, sex workers, poor waste management etc. | • Compulsory medical examinations for Project workers<br>• Training for all workers on the expected workforce behaviours<br>• Conduct inductions and training refreshers on the Project's Code of Conduct<br>• Provision of onsite health care<br>• Implement a grievance mechanism | • JSP<br>• Meindo,<br>• Samsung<br>• GE | • Evidence of medical records<br>• Training materials<br>• Workforce training logs<br>• Induction training materials<br>• Workforce induction logs<br>• Evidence of worker acknowledgement of code of conduct<br>• Onsite health clinic<br>• Number of related grievances submitted |
| 9 | Project employment | Cilamaya village surrounding the power plant area | Influx resulting in increased pressure on infrastructure and services and creating social discontent | • Establish recruitment and employment plan<br>• Establish a grievance mechanism<br>• The Project to liaise with the local police and healthcare providers to ensure no additional pressure has been placed on them due to Project influx. | Samsung | • Recruitment and Employment Policy and Procedure<br>• Number of local workforce employees<br>• Number of related grievances submitted<br>• Records of police and healthcare providers consultations |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 10 | FSRU installation and laying of offshore pipelines | Local fishing folk from Blanakan and Muara | Health and safety impacts offshore associated with local fishing vessel incidents | • Coordinate with the relevant authorities i.e. to communicate Project shipping activities<br>• Coordinate with Kantor Kesyahbandaran Tanjung Priok and Port Authority Class II in Tanjung Priok (and other key parties) regarding the pipe deployment plan<br>• Conduct consultation activities with the fishing groups<br>• Socialise the grievance mechanism<br>• Establish an ERP and safety markers<br>• Undertake formal safety studies | • JSR<br>• Meindo | • Records of consultations<br>• Number of grievance mechanism socialisation activities<br>• Evidence of ERP<br>• Evidence of ERP socialisation<br>• Evidence of safety buoys/markers<br>• EPC risk assessment studies |
| 11 | Project construction traffic | Local villages in close proximity to construction activities and residing along transportation routes | Traffic congestion and incidents with community members and other road users | • Consultation with the communities on key Project traffic routes<br>• Traffic safety signs along routes and hot spots<br>• Undertake road improvements<br>• Ensure all Project drivers are trained in safety awareness<br>• Enforce speed limit regulations | • Meindo<br>• Samsung<br>• GE | • Records of consultations<br>• Evidence of traffic safety signage<br>• Evidence of road safety improvements<br>• Safety awareness training materials Records of driver training sessions<br>• Journey plan records |
| 12 | Construction of CCGT Power Plant | Cilamaya communities residing around power plant | Community health and safety impacts due to construction activities | • Consultation with the communities on upcoming Project activities<br>• Post safety signs around the entrances<br>• Grievance mechanism should be accessible to all | • Samsung<br>• GE | • Records of consultations<br>• Evidence of safety signage<br>• Number of grievance mechanism socialisation activities<br>• Number of related grievances submitted |
| 13 | Construction workforce demobilisation | Local communities residing near Project activities | Construction demobilisation and reduced local incomes | • The Project will inform the community about employment opportunities prior to operations<br>• Where feasible the EPCs will provide local construction worker details to the Sponsors to optimise transfer of workers to the operations phase<br>• The Project's grievance mechanism will be accessible for all communities<br>• The Project will develop relevant community development activities for the impacted communities; coordinating with relevant authorities to prioritise local directly impacted communities to participate | • JSP<br>• Meindo<br>• Samsung<br>• GE | • Construction demobilisation plan and socialisation<br>• Socialisation records for operation employment opportunities<br>• Number of grievance mechanism socialisation activities<br>• Number of related grievances submitted<br>• Community development plan<br>• Consultation records associated with the CDP<br>• Number of locals participating in the CDP |

*Table 12.3 Environmental Management and Monitoring during Operation*

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 1 | Workforce presence | Terrestrial biodiversity | Direct mortality to fauna and flora from hunting and poaching from the workforce and local residents | • Fauna Shepherding Protocol is be used in the Javan Coastal EBA to ensure that any endemic bird species have vacated the area prior to any clearance work. | JSP | • Fencing in place |
| 2 | CCGT Power Plant | Air | Combustion of natural gas and deterioration of air quality.(on Ecology and Human Health) | • Continuous stack emission monitoring (CEM) will be installed and operated throughout the operational lifetime of the Project to ensure that the NOx emission concentration from the CCGT does not exceed the IFC emission limit guideline value of 51mg/Nm3. | JSP | • Stack emission monitoring records |
| 3 | CCGT Power Plant | Air | Combustion of diesel in engine-generators used for black start | • The simultaneous operation of all 12 diesel engine-generators will only occur when required and for the amount of time necessary to black start the power plant. The operator will endeavour to reduce this time period as much as is feasible to minimise the likelihood of unacceptable impacts on air quality.<br>• All engine-generators will be routinely checked and maintained in accordance with the manufactures specifications. This routine maintenance will ensure that the operational performance of the engine-generator is maintained at a high level throughout the operational lifetime of the Project.<br>• Diesel fuel with a maximum sulphur content of 0.5% will be used at all times. | JSP | • Black Start Frequency and duration<br>• Air monitoring data |
| 4 | CCGT Power Plant | Air | Deposition of salt (Sodium Chloride (NaCl)) on the surrounding agriculture from the operations of two (2) wet cooling tower systems | • 500m of the Project area. The monitoring should be designed to determine the level of salt deposition against appropriate standards. Monitoring of foliage on vegetation within the 500m boundary is also to occur to determine the extent of leaf damage (leaf necrosis).<br>• Where impacts to vegetation is determined from the monitoring, engagement within affected parties is to occur to determine appropriate actions. These actions may include (but are not limited to): investigation and support of alternative cropping methods/species; adoption of spray irrigation methods; and/or compensation for lost agricultural production or impacts on households.<br>• Regarding impacts on plant and equipment, it is recommended that all exposed surfaces be coated or painted to reduce corrosion from salt deposition. Regular maintenance of exposed surfaces is also required.<br>• Salt tolerant vegetation should also be planted within the Project area and within 500m of the Project. | JSP | • Air monitoring data |
| 5 | CCGT Power Plant | GHG | Increased GHG Emissions (National and Global Level) | • Cold venting of gas directly to atmosphere will be avoided where possible. If significant quantities are emitted, the Project should consider flaring, as this converts the $CH_4$ to $CO_2$ and thereby reduces the net GHG emissions in terms of $CO_2$-e emissions. | JSP | • GHG Emissions inventory |
| 6 | CCGT Power Plant | Noise/ Vibration | Noise disturbance impacts and amenity issues. | Based on the generally compliant results presented, no additional noise/ vibration mitigation of plant and equipment is expected. | JSP | • Noise monitoring |
| 7 | CCGT Power Plant | Terrestrial biodiversity | Degradation of habitat from air emissions and runoff | • Mitigation measures are to be outlined within the Biodiversity Action Plan for the Project site. | JSP | • BAP in place and socialised to workforce. |
| 8 | CCGT Power Plant | Air | Combustion of natural gas and deterioration of air quality. | • Continuous stack emission monitoring (CEM) will be installed and operated throughout the operational lifetime of the Project to ensure that the NOx emission concentration from the CCGT does not exceed the IFC emission limit guideline value of 51 mg/Nm3. | JSP | • Stack emissions monitoring records. |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 9 | Presence of CCGT, transmission lines, substation and roads | Landscape | Visual impact of activities and sites | • Planting may be designed to either screen or significantly reduce the visual dominance through filtering.<br>• For viewing locations where a high or un-acceptable level of visual impact may occur, landscape mitigation and screening would reduce these impacts. | • JSP<br>• PLN | • Site inspection records. |
| 10 | 500 kV Transmission Line | Noise/ Vibration | Noise disturbance impacts and amenity issues. | • No additional mitigation needed | PLN | • Site inspection records. |
| 11 | FSRU Operations and LNG Tanker Offloading | Marine biodiversity | Disturbance and displacement of marine fauna may occur from underwater noise | • The FSRU will be maintained in accordance with an inspection and maintenance schedule and procedure, which will reduce excessive noise levels that may otherwise be produced by defective machinery and equipment. | FSRU Operator | • Site inspection records. |
| 12 | Seawater intake | Marine biodiversity | Impingement and subsequent entrainment of marine fauna, with can result in injury and mortality effects. | • Installation of mesh screens or equivalent to limit ingress of marine organisms. | JSP | • Site inspection records. |
| 13 | 500 kV Transmission Line | Terrestrial biodiversity | Direct mortality of avifauna along the transmission line due to strike during operation | Biodiversity Action Plan for the Project site to include:<br>• Bird deflectors on the length of the power line. The deflectors will increase line visibility by thickening the appearance of the line for easier detection by avifauna.<br>• Use moveable markers of contrasting colours (e.g. black and white) that protrude above and below the line, and be placed five (5)-10 m apart.<br>• Removing the thin neutral or earth (shield) wire above the high voltage transmission lines where feasible, and where this is not possible, marking the line to make it more visible.<br>• Minimising the vertical spread of power lines. Having lines in a horizontal plane reduces collision risk.<br>• Habitat manipulation to influence flight activity and bird behaviour, e.g. tree lines under the high voltage lines to increase visibility.<br>• Insulating cables close to poles, at least 70 cm on both sides and around perching areas, and up to at least 140 cm.<br>• Hanging insulators under cross arms and poles, provided the distance between a likely perch (mainly the crossarm) and the energised parts (conductors) is at least 70 cm.<br>• Providing safe nesting and perching platforms above the pole at a minimum of 70 cm above energised components, or higher depending on the species present. | PLN | • BAP in place and socialised to workforce.<br>• Site inspection records. |
| 14 | Vessel presence and movements | Marine biodiversity | Direct mortality or injury of marine fauna from vessel movements | • Vessels will operate in accordance with standard maritime practices, whereby vessel speeds will be adjusted depending on environmental conditions (e.g., visibility, metocean condition) as required by the captain of the vessel and to avoid any encountered hazards.<br>• Support vessels will not travel greater than 6 knots within 300m of a whale or 100m from a dolphin, if sighted, (i.e. will maintain a caution zone of those distances).<br>• Vessels will approach no closer than 100m from a whale or 50m from a dolphin, if sighted. (Note this standard does not apply to support vessels engaged in limited/constrained manoeuvrability activities where vessel speed will already be low). Vessels will not directly approach a marine mammal from in front or behind their path of travel. | • JSP<br>• JSR | • Site inspection records. |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| | | | | • Vessel bridge crew to maintain visual watch of any hazards (including marine mammals). | | |
| 15 | Waste management | Environmental Quality | Generation, handling, treatment and disposal of solid and liquid hazardous and non-hazardous wastes | • An induction regime for Project staff highlighting the waste management system and how wastes are to be managed on site. • Provide bins for the segregation and proper storage wastes to minimise the potential releases to the environment or contamination of other materials.<br>• Segregate hazardous and non-hazardous waste and provide appropriate containers for the type of waste type (e.g. enclosed bins for putrescible materials to avoid attracting pests and vermin and to minimise odour nuisance).<br>• Hazardous waste store should be segregated to avoid the co-storage of incompatible waste types.<br>• Store wastes in closed containers away from direct sunlight, wind and rain and systematically to allow inspection between containers to monitor leaks or spills.<br>• Ensure that storage areas have impermeable floors and secondary containment, of a capacity to accommodate 110% of the volume of the largest waste container.<br>• Hazardous wastes will be disposed of by authorised third- party disposal contractors. | JSP | • Workforce induction records.<br>• Site inspection records. |
| 16 | Waste management | Infrastructure | Pressure on existing waste management infrastructure | • WMP required detailing:<br>• An inventory of the wastes anticipated by the Project.<br>• Identification of the disposal routes the Project plans to use for its waste in the operation phase.<br>• A programme of audit for the waste infrastructure and waste hauliers the Project intends to use.<br>• Site rules for waste management including segregation, storage and packaging requirements for each waste type.<br>• Mapping of waste facilities on site including distribution of waste receptacles at strategic locations aboard the FSRU, along the pipe line route, at the CCGT power station and the substation. | JSP | • WMP in place and socialised to workforce.<br>• Site inspection records. |
| 17 | Wastewater discharge and runoff | Surface water | Deterioration of surface water quality. | • All drainage facilities and sediment control structures will be inspected on a regular basis and maintained to confirm proper and efficient operation at all times and particularly during rainstorms.<br>• Deposited silt and grit will be removed regularly. The stormwater drainage system will be periodically inspected for blockage sand cleaned at least once before the monsoon season each year.<br>• Measures will be taken to reduce the ingress of drainage into excavations. If trenches have to be excavated during the wet season or rainy conditions, they will be excavated and backfilled in short sections wherever practicable. Water will pumped out from trenches or foundation excavations will be discharged into storm drains via silt removal facilities.<br>• Personnel will be trained to visually inspect discharged water quality for oil and grease traces (that will be visible on the surface) periodically and take appropriate corrective actions.<br>• Control and monitoring systems will be used to alert the crew to leaks or any other potential risks. | JSP | • Site inspection records. |

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation & Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 18 | Wastewater and process cooling water discharges from the CCGT pipeline | Marine water | Reduction of marine water quality | • Wastewater and cooling water discharge will be conducted below the water surface, to increase dispersion.<br>• Pipeline outlet structure to include a diffuser to comply with water quality standards and the 3°C rise in the seawater temperature.<br>• Monitoring of receiving water quality will be undertaken at the discharge location within three (3) months of operations commencing, and annually thereafter. | JSP | • Water monitoring data. |
| 19 | Waste water and process cooling water discharges from the FSRU and Vessels | Marine water | Reduction of marine water quality | • In accordance with MARPOL 73/78 requirements, all water discharges from the FSRU and vessels will be treated prior to being discharged to sea.<br>• Waste water and process water discharge will be conducted below the water surface, to increase dispersion.<br>• Pipeline outlet structure to include a diffuser to comply with water quality standards and the 3°C rise in the seawater temperature.<br>• Monitoring of receiving water quality will be undertaken at the discharge location within 3 months of operations commencing, and annually thereafter.<br>• Any potential exceedances in discharge standards will be addressed through corrective actions, which may include additional treatment or dilutions prior to discharge. | JSR | • Water monitoring data. |
| 20 | Jetty Presence | Marine Water Quality | Disturbance to coastal processes, sedimentation and reduction of water quality | • EPC required to conduct sedimentation study to measure the sedimentation rate and the required frequency for potential maintenance dredging.<br>• Maintenance plan which includes periodic monitoring for sediment accretion or erosion in the area of the jetty. | JSP | • Site inspection records. |

*Table 12.4 Social Management and Monitoring during Operation*

| # | Activity/Aspect | Receptor | Potential Impacts | Mitigation | Mitigation &Implementation Responsibility | Monitoring |
|---|---|---|---|---|---|---|
| 1 | FSRU operation | Fisher folk in Blanakan and Muara villages | Health and safety of local fishing groups | • Development and socialisation of a marine facilities management plan<br>• Consultation with fishermen on marine safety<br>• Regular patrol to ensure the exclusion zones are clear from any activities prohibited by the law<br>• Establish an ERP and safety markers to identify the exclusion zone areas<br>• Undertake formal safety studies such as HAZOPs<br>• Implement a grievance mechanism | JSR | • Records of consultations<br>• Patrol logs<br>• Evidence of ERP<br>• Evidence of ERP socialisation<br>• Evidence of safety buoys/markers<br>• Operator safety studies<br>• Number of grievance mechanism socialisation activities<br>• Number of related grievances submitted |
| | | Fisher folk in Blanakan and Muara villages | Loss of income due to restrictions and exclusion zone and operations of FSRU | • Conduct regular socialisation and consultation activities<br>• Ensure the Project's grievance mechanism is well socialised<br>• Compensation will be on a case by case basis and agreed by both parties involved | JSR | • Records of consultations<br>• Number of grievance mechanism socialisation activities<br>• Number of related grievances submitted<br>• Evidence of appropriate close out of grievance |
| 2 | CCGT Power Plant operation | Cilamaya village surrounding the power plant | Community health and safety in the event of an incident | • Conduct necessary safety studies to e.g. HAZOP<br>• Erect appropriate health and safety signage and limit access to authorised persons only<br>• Conduct suitable training and inspections amongst all workers<br>• Develop a community emergency response plan and socialise it to the relevant communities to ensure that the communities are aware about the safety risk and understand what to do in a case of emergency<br>• Socialise the Project's grievance mechanism to the community to enable them submit grievances. | JSP | • Operator safety studies<br>• Evidence of safety signage<br>• Appropriate access gates in place<br>• Provision of workforce access cards<br>• Induction training materials<br>• Workforce induction logs<br>• Evidence of ERP<br>• Evidence of ERP socialisation<br>• Number of grievance mechanism socialisation activities<br>• Number of related grievances submitted |
| 3 | Transmission Line operation | Local villages residing by CCGT and transmission line | Community health and safety resulting from EMF, noise and electrocution | • Conduct regular clearance of the clear zone to ensure the area is safe as required by the regulation<br>• Conduct regular checking/ maintenance to ensure the safe condition of the tower and the cable<br>• Develop a community emergency response plan and socialise it to the relevant communities to ensure that the communities are aware about the safety risk and understand what to do in a case of emergency<br>• Socialise the Project's grievance mechanism to the community to enable them submit grievances. | PLN | • Inspection records of transmission cable<br>• Evidence of ERP<br>• Evidence of ERP socialisation<br>• Number of grievance mechanism socialisation activities<br>• Number of related grievances submitted |

## 12.9 *MONITORING AND VERIFICATION*

A monitoring, review and auditing program is required to be implemented during construction to monitor implementation of the Projects HSE requirements and environment and social commitments. Ultimately the Sponsor is responsible for ensuring that all EPC contractors are complying with the applicable HSE and social requirements.

Monitoring is a means to verifying the overall effectiveness of the management and mitigation measures contained within the management plans set out in the previous tables. The key objectives to monitoring are to:

- Confirm effectiveness of management and mitigation measures;
- Ensure compliance with Applicable Standards (i.e. national, ADB SPS, IFC Performance Standards, EHS Guidelines, JBIC and NEXI Guidelines and the EP III);
- To inform the Sponsors of ineffective mitigations allowing an opportunity for adjustment;
- Determine whether environmental and social changes are attributable to Project activities, or as a result of external Project activities; and
- Provide a basis for continual review and improvements to Project design and execution.

Detailed and specific monitoring KPIs will be developed and included within the relevant management plans. Impact monitoring will also be undertaken during the life of the Project to verify the predicted levels of residual impacts from the Project and the effectiveness of the various management plans.

A robust reporting system will provide the Project with the necessary feedback mechanisms to ensure quality and timely implementation of the ESMP.

Reporting will be required for AMDAL compliance (quarterly RKL RPL reporting) and also for Lenders' compliance (typically quarterly during construction and bi annually during operations). This will typically be associated with Lender audits and the implementation not only of the ESMPs but the follow on Environmental and Social Action Plan (ESAP) developed by the Lenders' environmental and social advisors following the first monitoring audit prior to financial close.

Reporting will provide a mechanism to ensure that the measures proposed in the RKL RPL and the ESMP are well implemented.

Prior to the commencement of the construction activities, the Sponsors will finalise the format and frequency for reporting on the status and progress of environmental and social monitoring. The EPCs will be required to provide relevant EHS and community data to the Sponsors in a timely manner to enable the Sponsors to conduct the necessary reporting.

## *12.10 BUDGET*

The implementation responsibility and estimated budgets for each required management plan (where available) are provided in **Table 12.5**. The management plans to be implemented during construction by the EPCs will be established before implementation of each management plan; whereby commitments have been made in to adhere to the Applicable Standards and mitigations set out in this ESIA. As such **Table 12.5** only sets out additional costs to be incurred by JSP.

The below estimates include budgets for resources and equipment to implement the ESMP as well as conduct training, environmental and social monitoring, analysis and reporting.

*Table 12.5 ESMP Implementation Responsibilities and Estimated Costs*

| # | Management Plan | Responsible Party | Estimated Budget (USD) |
|---|---|---|---|
| **Environment** | | | |
| 1 | Air Quality Management Plan | EPCs | Under EPCs' Contract |
| 2 | Biodiversity Action Plan | EPCs | Under EPCs' Contract |
| 3 | Cultural Heritage Plan | EPCs | Under EPCs' Contract |
| 4 | Acoustics and Vibration Plan | EPCs | Under EPCs' Contract |
| 5 | Oil & Chemical Spill Contingency Plan | EPCs | Under EPCs' Contract |
| 6 | Vehicle Management & Maintenance Plan | EPCs | Under EPCs' Contract |
| 7 | Soil & Groundwater Management Plan | EPCs | Under EPCs' Contract |
| 8 | Surface Water Management Plan | EPCs | Under EPCs' Contract |
| 9 | Traffic Management Plan | EPCs | Under EPCs' Contract |
| 10 | Waste Management Plan | EPCs | Under EPCs' Contract |
| **Social** | | | |
| 11 | Local Recruitment & Hiring Plan | EPCs & JSP (Operations) | Under EPCs' Contract |
| 12 | Stakeholder Engagement Plan | JSP | ~500,000 |
| 13 | Land Acquisition and Resettlement Plan | JSP | ~25,000,000 |
| 14 | Grievance Management and Compensation | EPCs | Under EPCs' Contract |

| # | Management Plan | Responsible Party | Estimated Budget (USD) |
|---|---|---|---|
| 15 | Livelihood Restoration/Community Development Plan | JSP | ~625,000 |
| **Health and Safety** | | | |
| 16 | Emergency Response Plan | EPCs & JSP (operations) | Under EPCs' Contract |
| 17 | Occupational H&S Management Plan | EPCs & JSP (operations) | Under EPCs' Contract |
| 18 | Security Plan | EPCs & JSP (operations) | Under EPCs' Contract |
| 19 | Worker Training Plan | EPCs & JSP (operations) | Under EPCs' Contract |
| 20 | Worker Management Plan | EPCs & JSP (operations) | Under EPCs' Contract |
| **Data Management and Reporting** | | | |
| 21 | Environmental and Social Management System | JSP | ~250,000 |
| 22 | Environmental and Social Monitoring Plan | JSP | ~2,000,000 |
| | **TOTAL (JSP)** | **JSP** | **~283,750,000** |

- Estimates for JSP for 25 years
- JSP operational costs will be confirmed prior to FC

## 12.11 UPDATING OF ESMP

This ESMP will be updated, revised and reviewed internally on regular basis to ensure the management plans remain relevant and are effectively mitigating the risks set out in this ESIA. The ESMP will be monitored and reviewed on a bi annual basis. Furthermore, in the event of an unforeseen impact and design change with respect to the Project Standards (including the Indonesian Government, ADB and IFC requirements), the ESMP would be updated as necessary.

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