ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) REPORT

PROPOSED COMBINED CYCLE POWER PLANT (CCPP)

OF LAYYAH POWER STATION

ELSEWEDY POWER

MHPS

for

Sharjah Water and Electricity Authority

Layyah Power Station, Sharjah

Environmental Solutions and Consultancy

Environmental Solutions and Consultancy

Sharjah, United Arab Emirates

OCTOBER, 2018

PROJECT PROPONENT	**PROJECT**
هيئة كهرباء ومياه الشارقة Sharjah Electricity & Water Authority	Proposed combined cycle power plant of Layyah Power Station

ENGINEERING CONSULTANT	**ENGINEERING, PROCUREMENT AND CONSTRUCTION CONTRACTOR - CONSORTIUM**
EDF	ELSEWEDY POWER MHPS

Environmental and Social Impact Assessment (ESIA) study for the proposed combined cycle power plant of Sharjah Electricity and Water Authority (SEWA) at Layyah Power Station, Sharjah - United Arab Emirates (UAE).

Document Title:
ESIA Study Report (Rev. 02) October, 2018

Notice:
This report was produced by **Environmental Solutions and Consultancy (ESC)** for the specific purpose of ESIA study for the proposed combined cycle power plant of Sharjah Electricity and Water Authority (SEWA). The details of the facility is provided by the consortium and reviewed to be factual at time of reporting.

Document History:

Project Ref. No.: *ESC/SHJ/SEWA-ESP/P695/ESIA*				**Document Ref. No.: *ESC/SHJ/SEWA-ESP/P695/ESIA/Rev.02***		
Type of Report	**Rev**	**Purpose Description**	**Prepared by**	**Reviewed by**	**Authorized by**	**Date**
Final	00	Submission to EPAA	MM BR KV	AJP RS	APM	25-08-2018
Final	01	Submission to EPAA	MM BR KV	AJP RS	APM	16-10-2018
Final	02	Submission to EPAA	MM BR KV	ABG	APM	31-10-2018

Environmental Solutions and Consultancy
Sharjah - UAE
+971 6 5688683/5262276
+971 6 5688684
www.esc-me.com
Dubai - UAE
+971 4 3215477
+971 4 3215474
info@esc-me.com

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXURES

ABBREVIATIONS

AAQ	Ambient Air Quality	LPS	Layyah Power Station
ABG	Abgina	LT	Long Term
AJP	Aparna Jaya Padman	m^3	Cubic Meter
ANQ	Ambient Noise Quality	ME	Marine Ecology
APM	Arunprasad Muthu	µg	microgram
BAT	Best Available Technology	MHPS	Mitsubishi Hitachi Power Systems Ltd.
BOD	Biological Oxygen Demand	MIGD	Million Imperial Gallons per Day
BS	British Standard	mm	millimeter
CCPP	Combined Cycle Power Plant	MM	Monalisha Murmu
CIP	Clean In Place	MoCCAE	Ministry of Climate Change and Environment
CITES	Convention on International Trade of Endangered Species of Wild Fauna and Flora	MS	Marine Sediment
cm	centimeter	MSDS	Material Safety Data Sheet
CO	Carbon monoxide	MSF	Multistage Flash
CO_2	Carbon dioxide	MW	Mega Watt
COD	Chemical Oxygen Demand	NCMS	National Center of Meteorology and Seismology
COMAH	Control of Major Accident Hazard	NE	North East
DAF	Dissolved air floatation	ng	nanogram
dBA	A weighted decibels	nm	nanometer
DG	Diesel Generator	Nm^3	Normal cubic meter
DM	Dubai Municipality	NO_2	Nitrogen Dioxide
DO	Dissolved Oxygen	NOAA	National Oceanic and Atmospheric Administration
EDI	Electro Deionization	NOx	Oxides of Nitrogen
EG	Elangovan Ganesan	OSHA	Occupational Safety and Health Administration
EMoP	Environmental Monitoring Plan	PM	Particulate Matters
EMP	Environmental Management Plan	POP	Persistent Organic Pollutants
EN	European Standard	PPE	Personal Protective Equipment
ENAS	Emirates National Accreditation System	PPM	Parts per million
EPAA	Environment and Protected Areas Authority	Rev	Revision
EPCC	Engineering, Procurement and Construction Contractor - Consortium	RO	Reverse Osmosis
EPDA	Environmental Protection and Development Authority	RPM	Respirable Particulate Matters
EPS	Environmental Protection Section	RS	Ramesh Suyambu
EPSS	Environmental Planning and Studies Section	SDS	Safety Data Sheet
ESC	Environmental Solutions and Consultancy	SE	Southeast
ESIA	Environmental and Social Impact Assessment	SEWA	Sharjah Electricity and Water Authority
ESM	Environmental Sound Management	SM	Sharjah Municipality
ESMP	Environmental and Social Management Plan	SO_2	Sulphur dioxide
ESP	Elsewedy Power S.A.E	SOP	Standard Operating Procedures
ETP	Effluent Treatment Plant	SOx	Oxides of Sulphur
EU	European Union	Sq.km	Square Kilometer
FEA	Federal Environment Agency	Sq.m	Square meter
g	gram	SSW	South of South West
GCC	Gulf Cooperation Council	ST	Short Term
GHG	Green House Gas	STEL	Short Term Exposure Level
HC	Hydrocarbon	STP	Sewage Treatment Plant
HCl	Hydro Chloric Acid	SW	Southwest
HF	Hydrogen Fluoride	SWQ	Sea Water Quality
HP	High Pressure	TDS	Total Dissolved Solids
hr	hour	TEQ	Total Equivalent Quantity
HRSG	Heat Recovery Steam Generators	TLV	Threshold Limit Value

HSE	Health, Safety and Environment	TOC	Total Organic Carbon
HVS	High Volume Sampler	ToR	Terms of Reference
IFC	International Financial Corporation	TSP	Total Suspended Particulates
ISO	International Standard Organization	TSS	Total Suspended Solids
kg	kilogram	TVOC	Total Volatile Organic Compounds
km	kilometer	TWA	Time Weighted Average
KV	Karthik Venkatesan	UAE	United Arab Emirates
KVA	Kilo Volt Amphere	UF	Ultrafiltration
KW	Kilo Watt	UN	United Nations
KWH	Kilo Watt Hour	US-EPA	United States - Environment Protection Agency
KWH	Kilowatt hour	VEC	Valuable Ecosystem Component
l	litres	VOC	Volatile Organic Compounds
Leq	Equivalent Continuous Noise Level		

GLOSSARY OF TERMS

Area of probable impact (Study area) — The extent of a physical area occupied by an environmental component that is likely to be impacted by at least one of the phases of the proposed project (i.e., construction, operation, and decommissioning activities and processes). The boundary of the area of probable impact is determined by measurements, previous studies, models, or best professional judgment and may vary by environmental component.

Assessment area — The physical area that the consultant and proponent have identified for assessment of potential environmental impacts.

Construction— The time period corresponding to any event, process, or activity that occurs during the construction phase (e.g., building of site, buildings, processing units) of the proposed project. This phase terminates when the project goes into full operation or use.

Consortium – Group of organizations for the development, design, engineering, procurement, manufacturing, financing, insurance, construction, permitting, completion, testing, commissioning, operation and maintenance of the proposed project

Environmental Component — Attribute or constituent of the environment (i.e., Air Quality, Marine Water, Waste Management, Geology, Seismicity, Soil, and Groundwater, Marine Ecology, Terrestrial Ecology, Noise, Traffic, Socio-economic) that may be impacted by the proposed project.

Environmental Impact — Positive or negative impact that occurs to an environmental component as a result of the proposed project. This impact can be directly or indirectly caused by the project's different phases (i.e., construction, operation, and decommissioning).

Hazardous Waste — Waste that poses potential harm to human health and the environment.

Maximum Absolute Temperature - The Highest maximum temperature observed in a specific month, measured by (°C)

Minimum Absolute Temperature - The lowest minimum temperature observed in a specific month, measured by (°C)

Mean Daily Maximum Temperature for a Month - Mean of daily maximum temperatures observed during a specific month, measured by (°C)

Mean Daily Minimum Temperature for a Month - Mean of daily minimum temperatures observed during a specific month measured by (°C)

Mean Daily Temperature - Mean of the temperatures observed at 24 equidistant times in the course of a continuous interval of 24 hours, measured by (°C)

Mean Monthly Maximum Temperature - Mean of the monthly maximum temperature observed during a specific month over a specific period of years, measured by (°C)

Mean monthly minimum Temperature - Mean of the monthly minimum temperature observed during a specific month over a specific period of years, measured by (°C)

Maximum Relative Humidity - The Highest daily maximum relative humidity observed in a specific month (%).

Average Maximum Relative Humidity - Mean of daily maximum relative humidity observed during a specific month (%).

Minimum Relative Humidity - The lowest daily minimum relative humidity observed in a specific month (%).

Operation—The time period corresponding to any event, process, or activity that occurs during the operation phase (fully functioning) of the proposed project (operation phase follows the construction phase, and then terminates when the project goes into the decommissioning phase).

Project Area — The physical area of the proposed project in which construction, operation and decommissioning phase take place referred as project area. It also includes processes and activities of the proposed project. The project area (boundary of project area is defined by titled property boundary) is equivalent to the project site.

Proponent— The owner, company or agency associated with the proposed project.

1. EXECUTIVE SUMMARY

1.1. INTRODUCTION

Executive Summary presents the brief statement of the findings of the environmental and social impacts assessment (ESIA) study for the development of 1,100 MW Combined Cycle Gas Turbine (CCGT) power plant as an extension of Layyah Power Station (SEWA) of Sharjah Electricity and Water Authority (SEWA) at Layyah, Sharjah – United Arab Emirates (UAE).

Sharjah Electricity and Water Authority (SEWA) is the responsible entity for the generation and distribution of electricity, water & gas to the Emirate of Sharjah – United Arab Emirates (UAE. Layyah power station is one of the key generation facilities for power and potable, located right in the city center area of Sharjah. It was started to build in 1977 and completed in several stages, which is currently producing approximately 896 MW of electric power capacity from steam turbine and gas fired combustion turbines and approximately 51 million gallons per day (MIGD) [231,800 m^3 per day] of water from desalination plant.

The proposed project is an expansion in the power generation capacity of Layyah Power Station with a natural gas fired combined cycle power plant of a total installed capacity of 1,100 MW. The project also includes the development of additional offshore intake and outfall pipelines. The proposed project will be developed by SEWA in association with Engineering, Procurement and Construction Contractor (EPCC) Consortium (**Elsewedy Power S.A.E [ESP]** and **Mitsubishi Hitachi Power Systems Ltd. [MHPS])**.

The proposed project is envisaged to be funded by **Japan Bank for International Cooperation (JBIC).** The projects which are funded by International finance institutions requires strict adherence to environmental and social principles. The Environmental and Social Impact Assessments (ESIA) has to be carried in line with The Equator Principles III (EPs), World Bank Group - International Finance Corporation (IFC) Policies and Standards, before start of the project.

Environmental Solutions and Consultancy (ESC) has been appointed to conduct the ESIA study. The ESIA study was carried out in accordance with the UAE federal legislation, regulations of Sharjah Emirate, World Bank Group - International Finance Corporation (IFC) Policies and Standards, The Equator Principles III and other relevant international environmental and social standards.

1.2. PROJECT SITE DESCRIPTION

The proposed project is planned within the existing Layyah Power Station (LPS) premises of SEWA located at Layyah, Sharjah – UAE. The total plot area of LPS is approximately 250,000 sq. m, in which 35,000 sq. m area will be utilized for the proposed project. There is no additonal land requirement for the proposed project. The land proposed for the project is already reclaimed during the time of LPS previous developments. The land is sandy and flat without any vegetation and currently left barren which is used for temporary storage. The ground level is in between +3 to +4 m MSL.

1.3. PROJECT DESCRIPTION

The proposed power plant will generate power by combined-cycle generation which is a configuration using both gas turbines and steam generator. The scheme of the power generation process comprises the following major components:

- Two Gas Turbine (GT) units.
- Two heat recovery steam generators (HRSGs).
- One condensing steam turbine (ST) unit.
- Two Gas Turbine Generator (GTGs)
- One Steam Turbine Generator (STG)

In the combined-cycle gas turbine (CCGT), the hot exhaust gases from the gas turbines will be the heat source for the steam boiler. The steam produced from the steam boiler will be used to run the steam turbine. The gas turbine drives an electric generator and the steam from the HRSG drives a steam turbine which also drives an electric generator. This combination increases the thermal efficiency. Salient features of the proposed project are hereby presented.

Table 1 – Salient features of the proposed project

S. No.	Description	Details
1	Proposed Activity	Power generation by Combined Cycle Power Plant (CCPP)
2	Capacity of plant	1,100 MW of electric power
3	Location of the project	Layyah Power Station (Extension), Sharjah - UAE
4	No. of man power to be deployed	45 - 55
5	Auxiliary power requirement	35 MW (Approx.)
6	Source of water	Portable water – Desalinated water from existing SWRO plant of LPS.

S. No.	Description	Details
		Industrial purposes – Sea
7	Water requirement	Desalinated water – 5,100 m^3/day Sea water – 1,873,225 m^3/day (78,050 m^3/hr)
8	Fuel requirement	Natural Gas (Primary fuel) - 189.4 Ton/hr Light Fuel Oil (Supplementary fuel) - 160 m^3/hr
9	Liquid waste generation and management	Domestic wastewater (sewage) will be collected in underground septic tank and discharge to existing Sharjah Municipality drainage system**.** The industrial wastewater to be generated from the proposed project will be neutralized and neutralized wastewater will be discharged to sea through outfall discharge system.

The Man power required for the operation of the power plant will be approximately 45-55 number. The auxiliary power requirement will be 35 MW and desalinated water of 5100 m^3/day, which will be met by existing Layyah power and desalination facility. Natural gas will be the primary fuel (189.4 Ton/hr) and fuel oil as supplementary fuel (160 m^3/hr). The waste generated during construction and operation phase will be managed and disposed as per regulatory requirement. The domestic solid waste will be disposed through municipal solid waste disposal means such as Bee'ah disposal mechanisms. The domestic liquid waste will be collected in septic tanks and disposed through Sharjah sewerage system and industrial liquid waste will be disposed through outfall after chemical neutralization.

1.4. BASELINE STUDIES AND SURVEY

The baseline environmental survey (terrestrial and marine environment) was conducted during the month of **July 2018 and August 2018**. The terrestrial sampling was carried out under supervision of ESC and analyses of environmental components were carried out by RAK Lab which is an accredited Laboratory by Emirates National Accreditation System (ENAS). The Marine Ecological Study and Sampling was done by the team of **Dr. Shahid Mustafa** and the lab analysis was carried out in M/s Lonestar technical services, Dubai. The secondary data for baseline environmental and social components are collected from authenticated web sources, published articles and books. Studies and surveys undertaken to determine the baseline conditions in the study area are hereunder presented.

Table 2 – Details of baseline studies and survey

Aspect	Study	Survey period	Primary Location	Carried out by
Air quality	Ambient air quality monitoring	July, 2018	4 locations in project site	RAK Lab LLC
Noise quality	Ambient noise quality monitoring	July, 2018	4 locations in project site	RAK Lab LLC
Land quality	Topographic survey	August, 2018	Project site	Middle East Survey Engineering
	Soil quality testing	July, 2018	6 locations in project site	RAK Lab LLC
	Soil investigation	August, 2018	Project site	Al Mawazeen soil testing
Water	Ground water quality testing	July, 2018	2 locations in project site	RAK Lab LLC
	Outfall effluent quality	July, 2018	2 samples from outfall channel	Lonestar Technical Services
Marine Environment	Marine water quality	July, 2018	12 locations in Arabian Gulf	
	Marine sediment quality	July, 2018	10 locations in Arabian Gulf	
	Marine Ecology	July, 2018 and October, 2018	10 locations in Arabian Gulf	Innovation Delta Environmental Consultants, Dubai
	Bathymetry survey	August, 2018	7 × 3 km area	Geomark Survey Services (FZE)
	Water current and tide data	August, 2018	1 location in Arabian Gulf	

Modeling studies carried out to assess the potential impacts during construction and operation phase of the project are hereunder presented.

Table 3 – Details of modeling studies

Aspect	Modeling	Modeler
Air quality	Air quality dispersion study using Lakes-AERMOD	ESC
Noise level	Sound propagation modeling - ISO 9613-2:1996	ESC
Marine environment	Hydro-dynamic modeling and plume dispersion study	KPB Consultants, Abu Dhabi - UAE

1.5. IMPACT ON AIR ENVIRONMENT

Baseline conditions – Ambient air quality survey was conducted at 4 locations in the project site continuously for 24 hours. The results of the ambient air quality survey in the project area indicate that levels of particulate matter (TSP and PM_{10}) and ozone are found to be significant in the ambient air. Levels of TSP in ambient air of project site ranged from 196 to 223 $\mu g/Nm^3$ which are in compliance with maximum allowable limit (230 $\mu g/Nm^3$) prescribed by Ministry of Climate Change and Environment (MoCCaE), UAE, while those values are in near borderline. Levels of PM_{10} ranged from 83 to 115 $\mu g/Nm^3$ which are in compliance with maximum allowable limit (150 $\mu g/Nm^3$). Higher levels of particulate matter in the ambient air may be contributed by wind-blown dust, fugitive dust emissions by vehicular movement in paved/unpaved roads in the project site/adjacent roads etc. Ozone levels in ambient air are insignificant which ranged from 58.9 to 78.5 mg/Nm^3 which are in compliance with maximum allowable limit (150 mg/Nm^3). Higher levels of O_3 may be associated with high sunny periods where the pollutants are indirectly formed by the action of sunlight on nitrogen dioxide. Other pollutants in the ambient air are well within maximum allowable limits prescribed by UAE-MoCCaE.

Perusal on last 5 years data, most prevalent wind flowing directions in Sharjah region is North-western directions, East, West & South-eastern and average wind speed is 7.5 miles per hour (breeze – constantly moving air).

Impact during construction phase – The various activities during construction phase include site preparation, approach roads, excavation, drilling, foundation, deployment of machinery, erection, transportation; dumping and nature of site condition may generate dust and gaseous emissions. During construction activities there is a potential to create dust, however not all construction activities have a high dust-raising potential and therefore it can be considered that potential dust episodes which may occur only over short periods. There are no sensitive receptors in the 250 m dust buffer zone and Golden beach hotel, which is attributed to be a sensitive receptor, is situated in the 500m dust buffer zone. As the construction activities lead to the generation of large particles that are unable to travel large distances and therefore usually deposit with 100-250m, impact to the nearby commercial destination will be moderate. CEMP (Construction Environmental Management Plan) will be developed and implemented which will detail about the dust management plan.

Impact during operation phase – The main environmental aspect affecting air environment during operation phase is stack emissions from gas turbines. The major air pollutants of concern for a fuel gas/fuel oil-fired combined cycle power plant are nitrogen dioxide (NO_2), sulphur dioxide (SO_2), particulate matters (PM) and Green House Gases (GHGs). The contributions of stack (combustion) emissions from the proposed

project have been quantitatively assessed using an air dispersion model, Lakes Environmental – AERMOD.

According to the modeled results, the maximum GLC is found occurring at a distance of about 0.49-km in the SE direction which is in project site boundary. The perusal of the modeled results, stack emissions from the proposed project contributes more SO_2 to ambient air than other pollutants. The contribution levels of pollutants to the ambient are in the order of SO_2>CO>NO_2>PM. It is also predicted that maximum increase of pollutant level within project boundary will be 30% as of SO_2 standard, and the resultant AAQ levels after implementation of the proposed project based on baseline air quality will remain within the permissible limits. The identified impact on air environment at project site will be assessed as minor effect.

The World Bank Group – IFC EHS guidelines suggests that emissions from a single project should not contribute more than 25% of the applicable ambient air quality standards to allow additional, future sustainable development in the same air shed. To confirm that the project meet the requirements of guidelines, project contributions to the sensitive receptors are also analyzed. It is estimated that impact due to the increase of pollutant level in the sensitive receptors will be negligible to minor (16.5% increase of SO_2 as of the standard in Layyah and Marijah residential area), which complies with the recommended norms of World Bank Group – IFC EHS guidelines. The identified impact on air environment at nearby sensitive receptors will be minor magnitude.

1.5.1. GREEN HOUSE GAS EMISSIONS

The Project is expected to have emissions of GHG, principally CO_2, during operation. These emissions mainly arise from the combustion of the fuel gas and fuel oil used as fuel to produce electricity. It is anticipated that the daily emission of GHG is estimated to be 12,252 tonnes of CO_2 by fuel gas combustion and 13,605 tonnes of CO_2 by fuel oil combustion. An annual emission of GHG is estimated to be 4,472,155 tonnes of CO_2 by fuel gas combustion and 4,965,781 tonnes of CO_2 by fuel oil combustion.

The Project's carbon intensity is estimated to be is 464 g CO_2/kWh, if combusting fuel gas and 512 g CO_2/kWh, if combusting light fuel oil. According to UAE state of green economy report 2017, the intensity of electricity generation recorded was 643 gCO_2/kWh in 2014 as reported by International Energy Agency (IEA).

The estimated GHG emissions from the proposed project during operation will exceed the threshold that defines significant emitters of GHGs and EP III (100,000 tonnes CO_2e per year) and IFC PS3 (25,000 tonnes CO_2e per year). Therefore, the project is required to implement measures for GHG reduction, and report annual GHG emissions as per the applicable reference framework.

1.6. IMPACT ON NOISE ENVIRONMENT

Baseline conditions – Noise quality survey was carried out at 4 locations in project site continuously for 24 hours. Noise levels (Leq) in project site during day time ranged from 64.3 to 80.9 dBA and night time noise levels (Leq) ranged from 61.6 to 76.4 dBA. The results of ambient noise level monitoring shows noise levels (Leq) during day and night times are significantly higher in the project areas and those levels are higher than maximum allowable limits prescribed by UAE-MoCCAE except day time noise level recorded at ANQ1 & ANQ 3 monitoring location. The higher noise levels during day and night times in the project area could be attributed to adjacent activities such as of ongoing industrial activity, and vehicular traffic. However, the measured noise levels in the project areas are less than maximum guideline value of WHO [Lmax – 110 dB(A)] for community noise specified for industrial environment.

Impact during construction phase – The identified sources of noise emissions during construction phase are mainly from the cranes, drilling equipment, compressors, generators, pneumatic tools and traffic & transportation. It was observed from the modeling results within project site boundary area that increase of the noise level (above baseline) will be in the range 0.0 to 1.1 dB (A) during day time and 0.0 to 2.5 dB (A) during night time and it is estimated that impact due to the increase of ambient noise level within project boundary will be minor which is less than 5% as of the noise standard (1.6% as of the standard during day time and 3.6% during night time). The identified impact on noise level at sensitive receptors will be minor effect.

The increase of resultant noise level in the nearest sensitive receptors (above baseline) will be 0.1 to 0.4 dB (A) during day time and 0.6 to 2.7 dB(A) during night time. It comply with the recommended norms of World Bank Group – IFC EHS noise guidelines, which says that maximum increase of resultant noise level at the nearest receptor location off-site shall be less than 3 dB (A). It is estimated that impact due to the increase of ambient noise level in the sensitive receptor will be negligible to minor (0.7% as of the standard during day time and 5.4% during night time).

1.7. IMPACT ON MARINE WATER ENVIRONMENT

Impact during construction phase – The construction of offshore intake and outfall structures and the laying of pipelines in the seabed may cause the following environmental impacts on marine water environment:

- Displacement or disturbance of sediments and sediment layering, or a compaction of sediments or wave refractions or changes to long shore currents may occur

- Accidental spills of chemicals, oils or fuels, or the leakage of these substances from underwater construction machinery may cause localized sediment contamination.
- The disturbance of sediments may lead to a re-suspension of material into the water column and a temporarily increased turbidity in the vicinity of the construction site.
- The construction of intake and outfall structures and the laying of pipelines in the seabed may lead to a destruction of benthic habitats. The mechanical impact is usually lethal for benthic organisms in the immediate construction site.
- Disturbance of sediments may have short term indirect effects on marine life.

Impact during operation phase – The key issue and potential impact associated with the operational phase of proposed project will be the effect of the discharged effluent potentially having a higher temperature and salinity than the receiving environment. Impact on seawater quality was assessed based on hydro-dynamic modeling and plume dispersion study. Modeled results indicate that extents of plume are almost similar with tidal currents but it is influenced by velocity of diffusion and wind speed and direction. When compared between the both outfall options, option 2 (Southern) is recommended, since the chances of recirculation is not existing during a normal tidal cycle and is sufficiently away from the intake location as outfall option-1 (close the intake) may affect near shore coastal water quality due to the proximity of the existing outfall point.

The perusal on thermal plume dispersion results that the temperature excess (above ambient) does not exceed 0.25 °C from ambient temperature level beyond initial zone of dilution (300 m radius). The recommended norm for excess temperature as per marine water quality objectives of DM-EPSS (Environmental Standards and Allowable Limits of Pollutants on Land, Water and Air Environment, 2003) is 2°C from background (ambient) level. The modeled results clearly indicates that the excess temperature outside the mixing zone complies with recommended norms, and the impact because of the increase in temperature in the sea water quality of Arabian Gulf will be negligible.

The perusal of the salinity plume dispersion results shows the increase of salinity concentration do not exceed 0.25 ppt from the ambient salinity with in the initial zone of dilution (300 m radius) and it is less than 0.25 ppt than the ambient salinity outside of the initial zone of dilution. The recommended norm for excess salinity as per article 22 of DM Local order 61 of 1991 is increased or decreased salinity of receiving water greater than 2ppt from ambient values. The modeled results clearly indicate that salinity change outside mixing zone comply with recommended norms, and impact due to the salinity increase in the sea water quality will be negligible.

1.8. IMPACT ON MARINE ECOLOGY

Baseline conditions – Marine Ecology survey was carried out in marine area of project vicinity by qualified divers and marine ecologist – Dr. Shahid Mustafa. Ten stations were selected to be representative within the study area. The epibenthic communities were dominated by oyster bed, corals, sandy and silty sand areas. Moderate diverse condition with potential importance of corals and oyster beds was found especially on stationME-05 and ME-08. Phytoplankton density in terms of cell counts varied from 22-83 $\times 10^3$ No./L with an overall average population density of 40.6×10^3 No./L. The dominant class of the phytoplankton was Dinophyceae (dinoflagellates) (45.8%) followed by Bacillariophyceae (Diatoms) (36%) and Cyanophyceae (Cyanobacteria) (18.2%). Harmful Algal blooms were absent in the phytoplankton samples. The zooplankton population had an average population of 172 individuals in no./m^3. A total of 12 taxa were recorded. Acartia fossae (22.3%), Copepods (19.7%), Oikupleura sp (14.8%), Sagitta (12.9%) and Lucifer sp. (10.12%) were the major group and species of the zooplankton. Fish eggs and fish larvae were not found in the samples collected. The perusal of the present levels of planktonic communities indicates that it was found in moderate population density along the project area. The macro-benthic infauna along the project area had population values ranging from 1200-3880 No./m^2 (average 2772 No./m^2). Moderately high diversity index of Margalef (d) and Shannon-Wiener (H') at stations ME-01, ME-02, ME-04, ME-05, ME-06, ME-07, ME-08 & ME-09 shows moderate healthy statues of macro-benthic in-fauna in this project area.

Impact during construction phase – The construction of offshore intake and outfall structures and the laying of pipelines in the seabed may cause impact that displacement or disturbance of sediments and sediment layering, or a compaction of sediments or wave refractions or changes to long shore currents may occur.

Impacts during operation phase – During operation phase of the facility, the following are the key issues and major potential impacts.

- Altered flows at the intake and discharge resulting in ecological impacts (e.g. entrainment and impingement of biota at the intake, flow distortion/changes at the discharge, and effects on natural sediment dynamics);
- Potential for habitat health impacts/losses resulting from elevated salinity in the vicinity of the outfall effluent discharge; and
- The effect of the discharged effluent potentially having a higher temperature than the receiving environment.

The perusal of the hydro-dynamic modeling and plume dispersion study results, there is no significant increase in temperature and salinity outside mixing zone (300m). According to the ecological survey, habitat in the mixing zone (ME-07) is dominated by sandy with

broken shells. Coral communities are not identified in the zone. Hence, impact on marine ecology will be minor a due to the discharge of outfall effluent.

1.9. PROJECT ALTERNATIVES

The management of SEWA planned for future power plant units and desalination units during initial development stage and areas are allocated accordingly. The land allocated for the proposed project is plain in topography and adjacent to the shoreline. Since the proposed project will be established in the existing Layyah Power Station, which was developed with good infrastructure, alternate sites are not considered. The chosen intake location is potential to provide a good and reliable water quality, with minimum danger of pollution or contamination, which helps to avoid performance problems of the plant.

In reference to the outfall discharge locations, two locations were considered. Hydrodynamic modeling and plume dispersion study was performed to select the suitable location for better dispersion of outfall effluent and lesser recirculation effect on intake sea water. The perusals of the modeled results shows that dispersion patterns of both outfall locations are observed to be more or less similar. Plume dissipates within 1 km of the outfall in both cases throughout the tidal cycle. However outfall option-1 (close the intake) may affect near shore coastal water quality due to the proximity of the existing outfall point. Outfall option 2 (Southern) is recommended as the chances of recirculation is not existing during a normal tidal cycle and is sufficiently away from the intake location.

Combined Cycle technology can provide high electrical efficiency that means electricity generation on the basis of more competitive prices in comparison with other technologies. Moreover, natural gas produces energy with the lowest rate emissions per produced kWh and the CCPP does not need additional expenditure for emissions control and fuel storage in comparison with coal. Combined cycle technology is chosen for the power generation, from the environmental point of view and its efficiency.

1.10. RESIDUAL EFFECTS

With effective implementation of CEMP (as per requirement of IFC EHS guideline), the dust emission impacts on onsite environment and adjacent commercial destination are likely to lead to minor residual effects. Although residual impacts are expected to be of minor significance, efficient monitoring shall be implemented.

Impacts from stack emissions from combustion process, operational traffic emissions and noise from operational equipment & vehicles are likely to lead to minor residual effects on human and ecological receptors which cannot be fully mitigated. Residual effects on air and noise quality associated with the operational phase will be minor adverse.

Impacts from discharge of outfall effluent are likely to have residual effects on marine biota health (Arabian Gulf). Although all residual impacts associated with the outfall effluent discharge are expected to be of minor significance

1.11. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The present ESIA study identified and assessed of various environmental and social impacts likely to be caused on the surrounding nature and society during the construction and operation phase of the project. The appropriate control/mitigation measures were also incorporated in the Environmental and Social Management Plan (ESMP) for implementation in order to minimize the adverse effects thereof. SEWA and EPCC have proposed to provide necessary preventive mitigation/control measures during implementation of the project. The details of potential impact and mitigation measures towards environment and social management system during operation phase are hereunder summarized.

Table 4 – Environmental and Social Management Plan during operation phase of the project

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
Discharge of outfall effluent into the Arabian Gulf will impact on marine biota.	• Use only anti-scalants with low toxicity to aquatic invertebrate and fish species; avoid the use of a polyphosphate anti-scalants. • Suitably neutralize residual chlorine with sodium bisulfite (SBS) in an emergency when intake water needs to be bypassed directly to the outfall, residual chlorine in the outfall discharge must be below 0.2 mg/l. • Monitor the outfall effluent characteristics to check the compliance with Sharjah Municipality sea discharge limits.	Minor effect - Residual impacts can be reduced to acceptable level	Outfall effluent quality shall be periodically checked	Operation of the project Plant Manager
Impingement and Entrainment adversely affect biotic productivity in the Arabian Gulf	• Keep reduced velocity in intake tower by velocity cap structure to ensure that fish and other organisms can escape the intake current.	Minor Effect - Residual impacts can be reduced to acceptable level	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
Dust deposition and air pollution at project site	• All the internal roads/working areas shall be paved by feasible materials (cement/asphalt/interlock) to avoid fugitive dust emissions. • The movement of heavy trucks over unpaved or dusty surfaces should be restricted. In case of unavoidable situation, unpaved or dusty surfaces should be controlled by good maintenance and wetting of the road surface by water sprinkling. • Speed Limit (20 km/hr) inforce on unpaved roads.	Minor effect - Residual impacts can be reduced to acceptable level	--	Operation of the project Plant Manager
Operational Combustion emissions in the study area	• Regular maintenance of vehicles for appropriate functioning of engine • Company vehicles should undergo emission test to ensure emissions are within permissible limits. • Commercially available Low sulphur diesel shall be used for vehicles/fuel fired equipment/machinery, in order to reduce excessive emissions of sulphur dioxides.	Minor effect - Residual impacts can be reduced to acceptable level	Undertake daily visual inspections and regular repairs, when appropriate, to ensure that equipment does not emit excessive fumes. If excessive fume, exhaust emission monitoring	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	• Specification of fuel supply to turbine combustion shall be strictly monitored and followed • Periodic monitoring of stack emissions to ensure that air emission characteristic is within the allowable limit for stationary sources		shall be conducted Stack emission main and bypass stack shall be regularly monitored	
Operational noise can cause nuisance to onsite workers	• Roadside tree plantation to be developed at a possible extent and maintained as a noise barrier • Keep internal haul routes well maintained. • Undertake regular maintenance by trained personnel to keep plant and equipment working as per manufacturer's specifications. • Undertake regular maintenance by trained personnel to keep plant and equipment working as per manufacturer's specifications. • All plant onsite should be low noise	Residual impacts can be reduced to acceptable level	Ambient noise levels shall be monitored regularly	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	versions, and where needed, acoustic enclosure shall be provided according to manufacturer's recommendations. • The use of damping material such as thin rubber/sheet for shielding the work places like DG sets, compressor etc., • Ear plugs/muffs for workers who are exposed to higher noise shall be provided and enforcement for its use by the workers.			
Improper dispersal of domestic wastewater may deteriorate the soil and groundwater quality at project site	• Toilets and septic tank facilities are to be appropriately designed and monitored. • Monitoring of internal sewerage system to ensure all pipelines and septic tanks are properly functioning. • Drainage systems from wash areas and other sources must be strictly monitored. • Regular vacuuming/ siphoning of septic tanks as needed by Sharjah Municipality authorized service providers for	Neutral – There is no residual impacts	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	transport to the designated municipal sewage treatment plant.			
Improper management of operation waste may deteriorate the soil and ground water quality at project site	• Storage of leachable operation materials and solid waste will be in an impervious area separately to avoid any soil contamination; • The generated solid wastes will be collected segregated as domestic wastes, recyclable solid wastes, non-hazardous solid waste and hazardous wastes and these wastes will be stored properly in the separate area in different coloured bins. • The domestic wastes and non-hazardous solid wastes will be properly disposed to Sharjah Municipality authorized service providers for further treatment and safe disposal. • Recyclable solid wastes will be sold to Sharjah Municipality authorized recyclers for recycling. • Hazardous wastes will be collected separately and properly disposed to	Neutral – There is no residual impacts	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	Sharjah Municipality authorized service providers after obtaining NOC from Sharjah Municipality.			
Spills and Leaks	• Spill prevention and management plan shall be developed and effectively implemented. • All hazardous/flammable material, including fuels, will be stored at designated sites in accordance with MSDS requirements best practice procedures. • MSDS to be available for hazardous materials stored on site. • Hazardous materials will need to be suitably stored to prevent leaks and spills. • Adequate bunding for fuel storage. • Drip trays will be required to be used to intercept leaks and spills from equipment and during refueling.	Neutral – There is no residual impacts	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
Health issues	• All hazardous chemicals and materials must be stored in a protected /secured place with limited access. • Chemicals handling, storage and instructions given in Material Safety Data Sheets & product manuals, supplied by the manufacturer or supplier, must be understood and observed strictly. • There shall be no open storage of any type of chemical in the premises. • Hazardous chemicals shall be stored appropriately based on the compatibility of the chemical to avoid any reaction. • Flammable and other highly flammable products storage should be stored in a controlled temperature and all the electrical fittings should be under classified category as per International standards. • Fire protection requirements shall be as per UAE Civil Defense Code, 2017 in the	Residual risk can be reduced as low as reasonably practicable	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	chemicals/hazardous materials storage areas • Appropriate training shall be provided to workers and Trained/competent persons shall be deployed for critical tasks such as handling of hazardous/flammable chemical, first aid, fire-fighting etc., • Appropriate Personal Protective Equipment shall be provided to workforce involved with hazardous/flammable chemical handling.			
Labour management	• Labour management (Project labour commitment, Workers Code of Conduct, Labour Grievance Mechanism) shall be strictly followed as per UAE Federal Labour Law • Labour accommodation strategies with welfare facilities shall be provided as UAE Federal Labour Law • Occupational Health and Safety Management shall be developed and	Neutral - There is no residual risk	--	Operation of the project Plant Manager

Significant Impacts	Recommended Mitigation Measures	Residual Effect	Monitoring Programme	Period of Implementation & Responsibility
	effectively implemented.			
Traffic	• Smooth entry and exit of vehicle shall be provided at the entry and ensure smooth transition for merging of vehicles. • Proper footpath provided for pedestrian movement along with interlocking and barricaded for safety. • Safety precautionary measures are ensured. • Adequate Lighting will be providing as per norms.	There is no residual risk	--	Operation of the project Plant Manager

2. INTRODUCTION

2.1. PREAMBLE

In the past, development endeavors have not considered environmental issues in the evaluation of development projects. Decision making on the implementation of development projects was merely focused on short-term technical feasibility and economic benefits. This negligence and unwise utilization of the natural resources resulted in the degradation of the environment and scarcity of the resources. The trend toward natural resource and environmental degradation stimulated the concept of sustainable development. According to the World Commission of the Environment and Development (1987), sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It encompasses three pillars namely: economy, environment and society. An assessment of potential impacts on the environment before the approval of investment proposals provides a means of harmonizing and integrating the three pillars of sustainable development *(Mekuriaw and Teffera, 2013*[1]*)*. Realizing the strong connection between development and the environment, and the need to keep up environmental protection efforts, United Arab Emirates formulated Federal Law No. (24) of 1999 for the protection and development of the environment. According to Articles 3 & 4 of Section 1 in Chapter I of Federal Law, impact on the environment should be assessed before the establishment of any new activity or expanding the existing activity.

The projects which are funded by International finance institutions require adherence to environmental and social principles and environmental impact assessments in line with The Equator Principles III (EPs), which in turn require adherence to the World Bank Group - International Finance Corporation (IFC) Policies and Standards to be carried out before a project can proceed.

Sharjah Electricity and Water Authority (SEWA) supply reliable and cost-effective electricity and water to the Emirate of Sharjah. It is still undergoing expansion as the demand for water and electricity increases in the Emirate of Sharjah. In this regard, SEWA proposed to develop combined cycle power plant as an extension of Layyah Power Station in the Emirate of Sharjah – United Arab Emirates (UAE). In accordance with requirements, **Environmental and Social Impact Assessment (ESIA) study** will be required for the proposed development.

[1] *Makuriaw, A. and Teffera, B., 2013. IAIA13 Conference Proceedings – Impact Assessment the Next Generation, 33rd Annual Meeting of the International Association for Impact Assessment (13-17 May 2013), Canada.*

[2] *Leopold, L.B., Clarke F.E., Hanshaw, B.B. and Balsley, J.R. 1973. A Procedure for evaluating*

In this regard, **Environmental Solutions and Consultancy (ESC)** has been appointed to conduct the **Environmental and Social Impact Assessment (ESIA) study** for the proposed project as per the pre-requisite requirement of Federal Environment Law, Environment and Protected Areas Authority (EPAA) and Sharjah City Municipality.

2.2. BACKGROUND OF PROJECT

Sharjah Electricity and Water Authority (SEWA) own and operate Layyah Power Station (LPS) located at Layyah, Emirate of Sharjah – United Arab Emirates (UAE). The Layyah power and desalination station were built in several stages at the beginning of the year, 1977. SEWA fulfills this obligation primarily through the integrated Layyah power and water station by producing approximately 896 MW of electric power capacity from steam turbine and gas-fired combustion turbines and a nominal 51 million gallons per day (MIGD) [231,800 m^3 per day] of water from the desalination plant.

Layyah power station uses steam and gas turbines to generate electricity with the total capacity of 900 MW. It has nine gas turbines with the total installed capacity of 464 MW and eight steam turbines with the total installed capacity of 432 MW. Layyah operates its gas & steam turbines on natural gas to comply with environmental standards, and fuel oil is used as a supplementary and back up fuel. Layyah power station also has seven Heat Recovery Steam Generators (HRSGs) that are connected to gas turbines to reduce the flue gas emission temperature and produce steam for the desalination plants. The Layyah desalination plant has 9 units consisting of 5 units of Multistage Flash (MSF) each of 5 MIGD capacity, 2 Multi Effect Distillation units of 5 MIGD capacity and 2 Multi Effect Distillation units of 8 MIGD capacities. As part of the expansion**,** SEWA intends to develop a 1,100 MW Combined Cycle Power Plant (CCPP) as an extension at Layyah Power Station (LPS). Basic information of the proposed project is given in **Table 5**.

Table 5 – Basic information of the proposed project

Description	Details
Name of the project	Combined Cycle Power Plant (CCPP)
Design capacity of the project	1,100 MW
Location of the project site	Layyah Power Station of SEWA, Layyah, Sharjah – UAE
Name of the owner	Sharjah Electricity and Water Authority (SEWA)
Name of the Engineering Consultant	EDF Energy
Name of the Engineering, Procurement and Construction (EPC) Contractor	Consortium [Elsewedy Power S.A.E (ESP) and Mitsubishi Hitachi Power Systems (MHPS)]

2.3. DETAILS OF PROJECT PROPONENT AND EPC CONTRACTOR

Sharjah Electricity and Water Authority (SEWA) is a financially and administratively independent entity to generate electricity, water and to distribute electricity, water & gas to the Sharjah Emirate. SEWA appointed a consortium consisting of Elsewedy Power S.A.E (ESP) and Mitsubishi Hitachi Power Systems Ltd. (MHPS) as an EPC contractor for the proposed project. The contact information for the project proponent and developer is presented in Table 2.

Table 6 - Contact information for project proponent and developer

Organization	Contact Information
Project Proponent	
Sharjah Electricity and Water Authority (SEWA) Government of Sharjah P O Box. 135 Sharjah - UAE	**Eng. Ali Sani** Manager of Projects Development Sharjah Electricity and Water Authority Tele: +971 6 5021935 Mobile: +971 50 429 3003 E-mail: ali.yousif@sewa.gov.ae
EPC Consortium Members	
Elsewedy Power S. A. E (ESP) Plot No. 246, Second Sector of City Center 5th Settlement, New Cairo Egypt	**Mr. Ramy Emam** Project Manager Tele: + 20 22 322 0240 Mobile: +971 556 711 617; +201066818188 Fax: +20 223 220 240 E-mail: ramy.emam@psp.com.eg
Mitsubishi Hitachi Power Systems Ltd. (MHPS) Dubai Airport Free Zone Phase 8WB, Office No. 229 P O Box. 54319, Dubai - UAE	**Mr. Elie Rizk** Business Development Director Tele: +971 506 684 121 Fax: +971 422 834 23 E-mail: Elie_rizk@mhps.com

2.4. DETAILS OF ENVIRONMENTAL CONSULTANT

Environmental Solutions and Consultancy (ESC) provides comprehensive solutions to industries in areas such as environment, sustainability, health and safety etc. ESC extends their services using our competent staff as well as through association with proficient companies worldwide. With an emphasis on sustainability and compliance with the relevant regulations, ESC delivers strategic services including environmental consulting, engineering design and knowledge management. ESC is a wholly-owned subsidiary of **Paradigm Pioneers Group** which focuses on offering high-quality and perfect services to clients as the name denotes, using its professional expertise and global talent pool.

Table 7 – Contact details of environmental consultant

Details	Contact Information
Environmental consultant Environmental Solutions and Consultancy PO Box: 68595, Sharjah-UAE	Mr. Arun Senior consultant & Business manager Mobile : + 971 55 9071 305 Tele : +971 6 5688683 E. mail : arun@esc-me.com projects@esc-me.com;

ESC has carried out 100+ Environmental Impact Assessment/Risk Assessment (EIA/RA) studies in the UAE and overseas for diversified fields such as infrastructure developmental projects and industries like Power Plant, Desalination Units, Oil & Gas, Chemicals, Petro Chemicals, Steel Manufacturing, Steel Fabrication, and Ship Building. ESC has technical resourcefulness in the Environment, Water and Energy sectors offering overall Design, Erection, commissioning of Wastewater Treatment Plants (STPs and ETPs) and water treatment plants. Along with ESC's multidisciplinary team and renowned partners, ESC conduct soil investigations, ecological studies, noise assessments, energy efficiency analyses, safety studies (including full Quantitative Risk Analysis, Hazard and Operability studies, COMAH), evaluations of Best Available Technologies (BAT), socio-economic assessments, Air Quality modeling studies, Bathymetry studies, Marine Ecological Studies and Pollutant transport in groundwater modeling. ESC is fully committed to quality and implements its quality policy through the application of quality management system, which is based on the primary operating process and fulfills Local, National and International legal compliance. ESC also carries out Third Party Inspection of Equipment and Machinery. ESC's experience on similar projects (Major Projects in the UAE region) is hereunder presented.

- Environmental and Social Impact Assessment (ESIA) Study for Sharjah Water and Electricity Authority for the proposed expansion of Sea Water Reverse Osmosis (SWRO) Plant – Hamriyah Independent Water Project, Hamriyah Sharjah UAE. – (Client - International Power SA (ENGIE), SUEZ & Mubadala)
- Environmental Impact Assessment Study for the proposed expansion of seawater Reverse osmosis plant at Hamriyah Free Zone Phase 1, Sharjah, UAE – (Client - Alpha Utilities FZE)
- Environmental and Impact Assessment and Risk Assessment (EIA/RA) Study for the proposed Ship Building Facility –at Hamriyah Free Zone Phase 1, Sharjah, UAE – (Client - Damen Shipyards Sharjah FZE)
- EIA/RA Study for the proposed Storage Terminal –at Hamriyah Free Zone Phase 1, Sharjah, UAE (Client- GP Global HMT Terminal FZE)
- ESIA Study for the proposed Sea Water Reverse Osmosis Plant – King Abdulla Economic City, Jeddah, KSA. – Client (Sogreah Gulf FZCO-EMAAR)

- EIA Study for the proposed Logistic Village Development at Hamriyah Free Zone Phase 2, Sharjah, UAE (Client - Hamriyah Free Zone Authority, Government of Sharjah)
- EIA Study for the Cement Manufacturing, Co-Generation Plant and Quarry (Client -Fujairah Cements Industries PJSC)
- EIA Study for the Cement Manufacturing and Quarry (Client –Sharjah Cement Factory)
- EIA for Sharjah Sustainable City for the Proposed Mixed Development, Sharjah UAE (Client- Atif & Bintoak)
- EIA Study for Proposed Shipbuilding Facility and Marine Services Facility, Ras Al Khaimah UAE (Client- Van Oord)

ESC has a technically proficient and experienced in-house team as well as the external professional expertise to carry out ESIA study. The details of the study team are presented in **Table 8**.

Table 8 – Details of the study team

Name & Designation	Qualification	Scope of Work
ENVIRONMENTAL SOLUTIONS AND CONSULTANCY		
Dr. Ramesh Suyambu (RS) Manager – Technical	M.Sc., Ph. D in Environmental Biotechnology	• Description of Project • Assessment of Environmental Impacts – Air, Noise, Water and Ecology • Mitigation Measures and Environmental Management Plan • Project Alternatives
Mrs. Aparna Jaya Padman (AJP) Project Manager	Master Degree in Environmental Technology	• Project Management • Marine Impact Assessment • Mitigation Measures and Environmental Management Plan
Mr. Arunprasad Muthu (APM) Sr. Consultant and Business Manager	Master of Technology in Environmental Science & Technology	• Assessment of Environmental and Social Impacts – Soil, Waste Management • Review and quality assurance
Mr. Elangovan Ganesan (EG) HSE Manager	Diploma in Mechanical Engineering	• Construction phase – Aspects, Impacts and mitigation measures • Occupation Health and Safety

Name & Designation	Qualification	Scope of Work
		• Socio-economic elements
Mr. Karthik Venkatesan (KV) Sr. Environmental Engineer	Master of Technology in Environmental Science & Technology	• Reference Laws, regulations and standards • Description of the environment
Mrs. Brindha Ram (BR) Sr. Environmental Engineer	Master of Technology in Environmental Science & Technology	• Description of Project • Description of the environment • Project Alternatives
Ms. Monalisha Murmu (MM) Sr. Environmental Engineer	Master of Science in Energy & Sustainability and Bachelor of Engineering in Civil	• Description of Project • Description of the environment • Project Alternatives

Curriculum vitae's of study team is presented in **ANNEXURE 10.**

3. ESIA STUDY PROCESS

3.1. NEED FOR AN ESIA STUDY

Construction and Infrastructure are vital for supporting economic growth and improving the quality of life. Around half of all non-renewable resources mankind consumes are used in construction, making it one of the least sustainable industries in the world.

However, these sectors have environmental impacts that the affect quality of life, including both biophysical and social aspects. The former affect geological and biological conditions such as land quality, water management, biodiversity, etc. the latter affect health and other social conditions due to air and water quality, resettlement, etc. Well-designed infrastructure projects can produce positive environmental impacts, e.g., by reducing water pollution or mitigate adverse environmental impacts, e.g., through emission control measures.

Environmental and Social Impact Assessment (ESIA) study is a planning tool generally accepted now as an integral component of sound decision-making. Early identification and characterization of critical environmental impact and risk allows stakeholders to form a view about the environmental acceptability of a proposed development project and what conditions should be applied to mitigate or reduce those risks and impact.

3.2. OBJECTIVES OF ESIA STUDY

The primary objective of the Environmental and Social Impact Assessment (ESIA) Study is that it supports the goals of health, safety and environmental protection and sustainable development; integrates environmental protection and economic decisions; predicts environmental, social, and economic consequences of an activity and assesses plans to mitigate any adverse impacts resulting from the proposed activity. Main objectives of the ESIA study are as follows:

- Assessment of baseline conditions before the development;
- Assessment of the projects critical environmental and social risks/impacts and mitigation & management measures and ensuring that potential impacts are avoided or minimized to the acceptable level through the recommendation of mitigation & management measures;
- Exploration of alternatives that can be used for the project leading to more significant social and environmental gains.
- The analysis of the physical, natural and social environment has considered the immediate site as well as a well-defined buffer surrounding the project site, relating to the likely extent of project impacts.

3.3. ESIA STUDY METHODOLOGY

The ESIA Study report has been prepared according to UAE Federal, Sharjah Government environmental laws, regulations & guidelines and International reputed regulations & guidelines, most notably:

- Federal Law No. (24) of 1999 for the Protection and Development of the Environment and associated Decrees/Executive Orders
- Guidelines for preparation & presentation of EIA reports – EIA Committee, Directorate of Environmental Services, Sharjah Municipality, Sharjah
- Technical Guidelines of DM - Environmental Planning and Studies Section (EPSS) - Environmental Impact Assessment, January 2017
- Equator Principles
- World Bank Group – International Finance Corporation (IFC) – Environmental, Health and Safety Guidelines.

The EIA study involves the following stages:

Stage I	Scoping
Stage II	Baseline Scenario
Stage III	Assessment of Environmental Impacts
Stage IV	Mitigation Measures
Stage V	Environmental Management and Monitoring Plan

3.4. SCOPING AND STAKEHOLDERS CONSULTATION

The key issues and concerns of stakeholders of the project have been identified in this phase. Consultations are an essential process in the overall ESIA study. ESC conducted consultations with the relevant organizations, departments and stakeholders in fulfilling the tasks related to the ESIA study. Formal and informal consultations have been carried out with EPAA and other relevant parties. The meetings are aimed at soliciting the comments and concerns of government agencies concerning technical, scientific and socio-economic understanding of the project. The scope of work for the consultation involves

- To provide a decision-making process by a systematic assessment of the environmental implications of the project

- To identify the negative and positive impacts of the development during its operational phase;
- To recommend mitigation and enhancement measures
- To plan and coordinate an EIA that satisfies the requirement of the Authority
- To provide an EMP consists of mitigation and enhancement measures and EMoP during the operational phase.

In perspective of the project, the stakeholders include the project proponent, consortium members, Environment & Protected Areas Authority and other agencies. The consultant has approached the owner to guide on the public engagement, considering the sensitivity of the project. In the initial stage of the project, the consultant had consulted with the proponent and other consultants involved in the project, and in consensus developed the scope of work/Terms of Reference for the ESIA Study Report, which was submitted to EPAA. EPAA issued a term of Reference for the ESIA study and it is enclosed as **ANNEXURE 2.**

3.4.1. SELECTION OF STUDY AREA

The study area is chosen as the project area and a primary impact area of at least 2 km within its radius. The impact areas have been delineated before the collection of baseline data. The factors considered includes but not limited to physical attributes of the project site, prevailing meteorological conditions, Valued Ecosystem Components (VECs), adjacent facilities and distance of the nearest community etc. The secondary impact areas cover a radius of about 5 km from the project site. The details of the project study area are discussed in **Section 6.2** of this report.

3.4.2. COLLECTION OF PRIMARY AND SECONDARY DATA COLLECTION

The baseline environmental survey (terrestrial and marine environment) was conducted during **July 2018 and August 2018**. The primary survey on terrestrial environmental components was carried out under the supervision of ESC and the sample analysis was done by RAK Lab, which is an accredited Laboratory by the Emirates National Accreditation System (ENAS). The marine ecology survey was done by the team lead by Dr. Shahid Mustafa and the lab analysis was carried out in **Lonestar Technical Services, Dubai.** The secondary data for baseline environmental and social components are collected from authenticated web sources, published articles and books. Secondary data on meteorology were collected from 2 National Center of Meteorology & Seismology (NCMS) monitoring stations (Sharjah International Airport station, and Dubai International Airport Station).

3.4.3. ASSESSMENT OF ENVIRONMENTAL IMPACTS

The impact of the proposed project is anticipated by using Environment and Social Impact Assessment Matrix in accordance with the procedure for evaluating environmental impacts by *Leopold et al., 1971*[2] and EIA guidelines of RAK- EPDA (Ras Al Khaimah – Environment Protection and Development Authority). An Environmental and Social Impact Assessment Matrix has been prepared to identify the potential impacts and to identify the impacts which are to be mitigated. An ESIA matrix ranks the significance of the environmental and social impacts before mitigation measures are implemented. This matrix has been divided according to the phases of the project (i.e., pre-construction, construction and operation, if relevant); and all of the impacts that require mitigation are included in this matrix and assessed according to the following criteria and associated scores. The environmental and social impact assessment matrix considers the three essential elements:

- Listing of the effects on the environment and society which would be caused by the proposed development, and an estimate of the *magnitude* of each.
- Evaluate the relative *importance* of the potential (sensitive) receptors.
- Effect – Significance of the impact - combining of *magnitude* and *importance* estimates concerning a summary evaluation.

For each aspect, the assessment identifies impacts and reports the likely significant environmental effects. In broad terms, it can be characterized as the interaction of the impact and the sensitivity or value of the receptor that is affected. For each aspect, the likely magnitude of the impact and the sensitivity of the receptor are defined, quantitatively to the extent possible. Generic criteria for the definition of magnitude and sensitivity are presented below.

3.4.3.1. Magnitude of Impact

It is categorized as beneficial or adverse, and it is assessed as major, moderate, minor or negligible based on consideration of parameters such as:

Spatial extent of the impact – for instance, within the site, boundary to regional, national and international;

Compliance – the margin by which an impact meets or fails to meet international, national and local standards, limits or guidance.

Duration of the impact – short/temporary to long-term/permanent;

[2] *Leopold, L.B., Clarke F.E., Hanshaw, B.B. and Balsley, J.R. 1973. A Procedure for evaluating environmental impact, Geological Survey Circular 645, US Geological Survey, Washington.PP.13.*

Reversibility – whether environmental conditions return to baseline or not;

Likelihood –regularly occurring under typical conditions to unlikely to occur; and

Nature of impact – the measure of whether the effect has a single direct effect or whether there is a cumulative effect over time or a synergic effect with other conditions

Generic criteria for determining impact magnitude (for both beneficial and adverse impacts), permanence, reversibility and nature of impact is hereunder described.

Table 9 – General criteria for determining the magnitude of the impact

Category	Description
Major	Environmental effects are noticeable and are sufficient to destabilize the resource. Change to the specific conditions assessed resulting in long term/permanent change, typically widespread and requiring significant intervention to return to baseline; exceeds national standards and limits.
Moderate	Detectable change to the specific conditions assessed resulting in non-fundamental temporary or permanent change.
Minor	Detectable but minor change to the specific condition assessed
Negligible	No perceptible change to the specific condition assessed.

Table 10 – General criteria for determining permanence

Category	Remarks
Permanent	Effect of Impact on permanent (Long-term) manner.
Temporary	The only effect of impact on temporary (Short-term) duration.
None	None

Table 11 – General criteria for determining reversibility

Category	Remarks
Irreversible	An irreversible impact is one from which recovery is not possible within a reasonable timescale or for which there is no reasonable chance of action being taken to reverse it.
Reversible	A reversible impact is one from which spontaneous recovery is possible or, for which effective mitigation is both possible and an enforceable commitment has been made.
None	None

Table 12 – General criteria for determining extent of the impact

Category	Remarks
Cumulative effect	Impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project or synergistic effect with other conditions
Single effect	Impact that result from single direct or indirect impact.
None	None

In addition to the general criteria, additional criteria for determining the magnitude of impact for specific environmental components are presented in **Section 7 of the report.**

3.4.3.2. Sensitive receptors

Sensitive receptors can be described as features that are notable in some way, whether due to their local or national importance or if they are especially sensitive to changes. Typically, sensitive receptors relate to ecological or human receptors (habitats, species, population centres) as well as geographical phenomenon or structures. The framework for assigning sensitivity to receptors is presented in **Table 13.**

Table 13 - Description and features of sensitive receptors area

Features of the Receptors area	Type of Area	Sensitivity
Protected areas for conservation of national or international importance	1	High
Water supply reserves	1	High
Hospitals, and school premises	1	High
Contagious high-density residential block, town center	1	High
Vital utilities such as electricity and energy sources, natural wealth reserves, and state-protected economic zones	2	Moderate
Light density residential blocks, public parks	2	Moderate
Natural bodies of water	2	Moderate
Place of cultural heritage	2	Moderate
Commercial buildings, offices, and other public areas	3	Light
Food products manufacturing premises	3	Light
Agricultural crops farmland	3	Light
Industrial	4	Marginal
Animal farmland but without food, milk or meat products processing	4	Marginal

Source: DM EPSS – TG02 (August 2018)

3.4.3.3. Determining the significance of the effect

Likely impacts are assessed taking into account the interaction between the magnitude and sensitivity criteria to determine the significance of any effect, which may be adverse

or beneficial, as presented in **Table 14.** Major or moderate effects are considered as significant.

Table 14 – Criteria for determining the significance

Magnitude of Impact	Sensitivity			
	Marginal	Light	Moderate	High
Negligible	Neutral	Neutral	Neutral	Neutral
Minor	Negligible	Negligible	Minor	Minor
Moderate	Negligible	Minor	Moderate	Moderate
Major	Negligible	Minor	Moderate	Major

3.5. STRUCTURE OF ESIA REPORT

The ESIA report is outlined as follows:

Chapter 1	Executive Summary
Chapter 2	Introduction – Basic project information, Project proponent, study team, project rationale
Chapter 3	Description of ESIA study methodology
Chapter 4	Reference Laws, Regulations, and Standards
Chapter 5	Project Description- - Location, process and resource requirements
Chapter 6	Description of Environment – Terrestrial and Marine Baseline Study – Air, Water, Noise, Solid waste, Biological, Socio-Economic environment
Chapter 7	Assessment of environmental impacts
Chapter 8	Project Alternatives
Chapter 8	Mitigating Measures and Enhancement Plan
Chapter 9	Environmental Management and Monitoring Program
Chapter 10	Conclusion
Chapter 11	Annexures