PECAN ENERGIES

ENVIRONMENTAL IMPACT STATEMENT

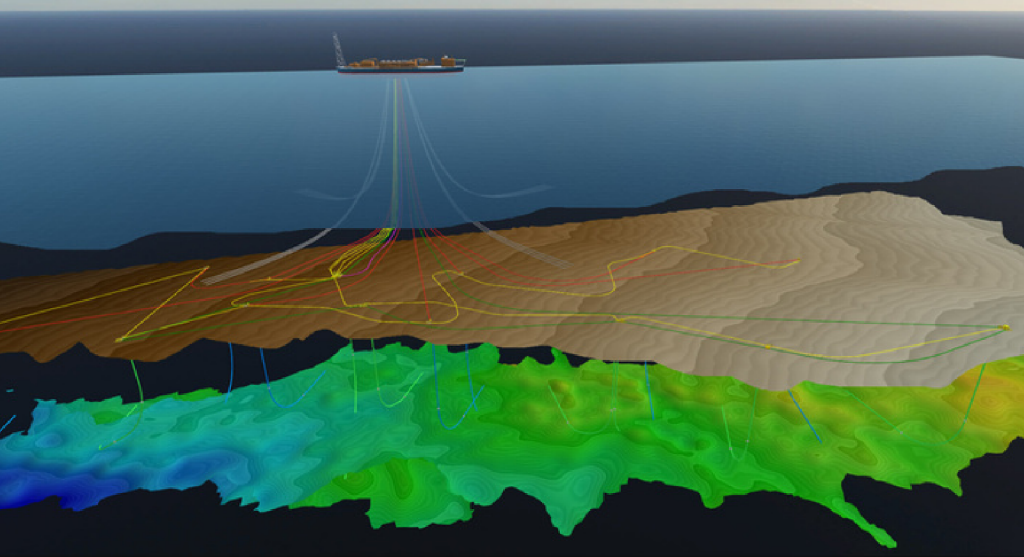
Non-Technical Summary

for

DEEP WATER TANO/CAPE THREE POINTS

PECAN FIELD DEVELOPMENT

December 2023



Pecan Phase 1

Development Project

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Revision Record Sheet

All changes after rev. 01 shall be listed in this revision record sheet and by horizontal margin markers within the document.

Revision	Section	Description of changed/updated sections
01	Entire document	Issue for Information

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1 The Pecan Project

1.1 Introduction

The Project Contractor Group, comprising Pecan Energies, Lukoil Overseas Ghana Tano Limited (LOGT), Ghana National Petroleum Corporation (GNPC) and Fueltrade Limited (Fueltrade), own participating interests in the Contract Area, with Pecan Energies holding 50%, Lukoil 38%, GNPC 10% and Fueltrade 2%. For the purposes of this report Pecan Energies is defined as the Operator within the overall Contractor Group.

The Contractor Group propose to develop the Pecan Field within the Contract Area with an initial development phase (Pecan Phase 1 Project).

For projects of this type, there is a legislative requirement to undertake an Environmental Impact Assessment (EIA). The Environmental Impact Statement (EIS) reports the findings of the EIA. This document is the Non-Technical Summary of the Draft EIS for the Pecan Project, and it presents an overview of the EIA process, baseline environment, and impact assessment and mitigation measures. Following a review of the draft EIS and the public hearing process then a final EIS will be submitted to the regulator.

The EIA was undertaken by Environmental Resources Management Ltd (ERM) and ESL Consulting Ltd (ESL), jointly referred to as the EIA team. It follows the EIA Scoping Report and Terms of Reference submitted to and endorsed by the Ghana Environmental Protection Agency (EPA) (endorsed in May 2022).

The Draft EIS has been submitted to the EPA for expert panel review and disclosure for public comments, under EPA's direction. A final EIS will be prepared and submitted to the EPA for approval once this process has been completed, taking onboard the regulators and public comments.

1.2 Project Overview

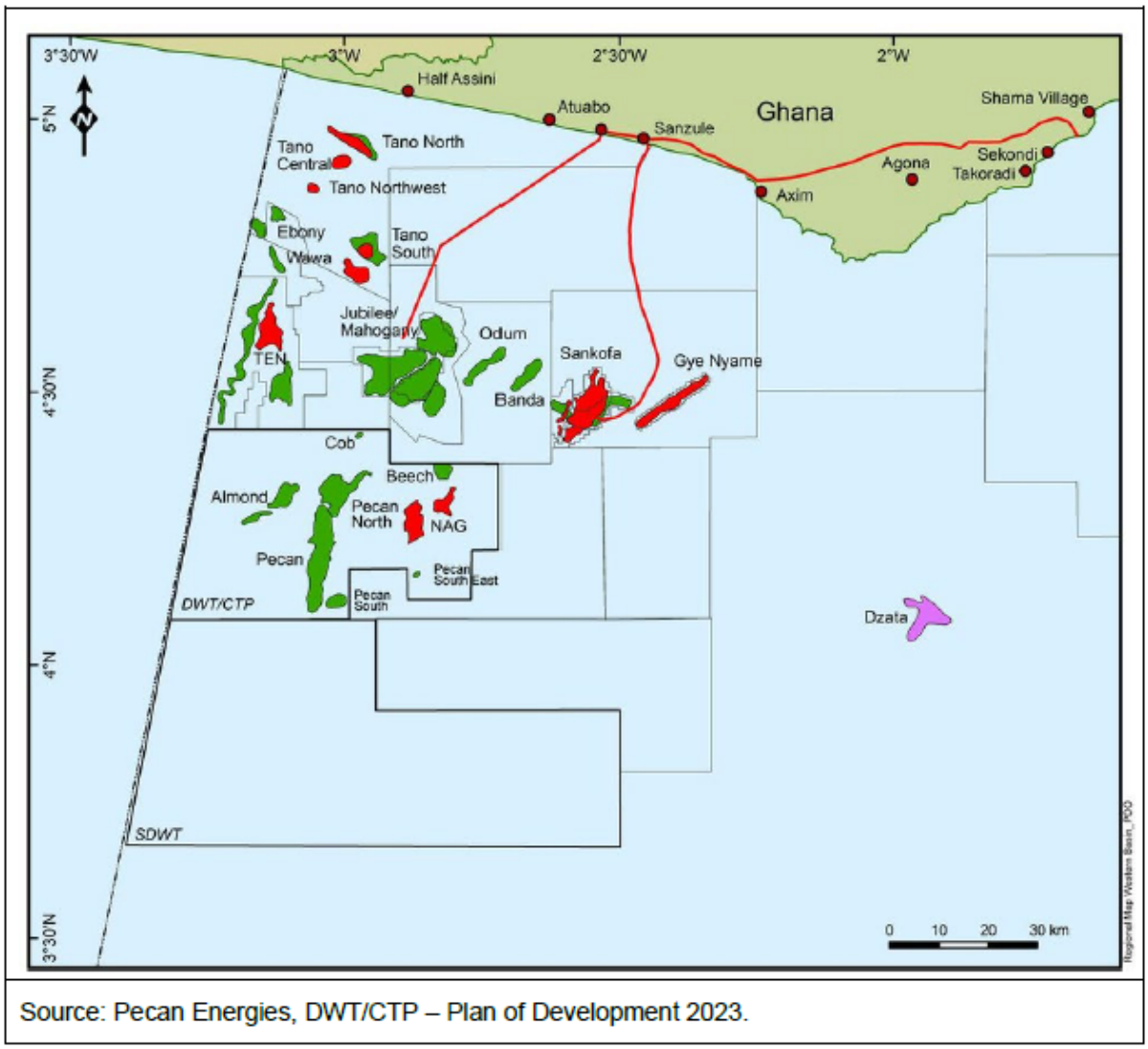
The Contract Area is located off the Western Region of Ghana, about 70 km from the coast at the nearest point, covers an area of approximately 200,000 ha (2,000 km^2) and is located in water depths of approximately 1,600 m to. 2,800m. An exploration and appraisal programme has been undertaken over the Contract Area involving seismic surveys and well drilling to define oil and gas resources.

There are four identified commercial oil discoveries within the Contract Area: named Pecan, Beech, Almond and Pecan North and two gas condensate discoveries: named Paradise and Hickory. These are illustrated in Figure 1, along with previous discoveries and developments to the north.

The Contractor Group proposes to develop the DWT/CTP discoveries in a series of phases with facilities comprising a subsea production system tied back to a spread moored leased Floating Production Storage and Offloading (FPSO) vessel. The initial phase (Phase 1) will be the development of the Pecan discovery, which will comprise the following.

1. Drilling of seven oil and gas producing wells and seven water and gas injection wells, with the wells tied back to a spread moored FPSO located to the west of the discovery.
2. Wells will be drilled using one mobile offshore drilling unit (MODU) over an approximate three-year period.
3. The FPSO will be capable of storing up to approximately 1.285 million barrels of oil and located approximately 113 km offshore in 2,620 m of water.
4. The FPSO would offload directly to conventional export tankers approximately every ten days.

5. Water and gas will be injected for increased oil recovery.



Source: Pecan Energies, DWT/CTP – Plan of Development 2023.

Figure 1 Location of DWT/CTP Contract Area and Neighbouring Fields and Existing Pipelines (Integrated Plan of Development)

1.3 Project Need and Benefits

The Ministry of Energy is responsible to promote the exploration and development of Ghana's petroleum resources and to ensure that Ghana obtains the greatest possible benefits from these developments. To this end, the Ministry of Energy grants oil exploration, appraisal, and production licences for the commercial development of these resources. The commercial development of the hydrocarbon resources complies with Ghana's national development strategy (Growth and Poverty Reduction Strategy) which includes infrastructure development and private sector development as priority areas. Reducing the costs of imported oil through facilitating private sector investment in the domestic oil and gas sector, and generating direct income through selling extracted hydrocarbons, are central to this strategy.

The proposed Pecan Project will support this goal by developing additional oil and gas prospects. This will provide direct benefit to the Government of Ghana as a shareholder as well as generating income through royalties and taxes and supply chain taxes that will benefit of the people of Ghana. The Project would also generate employment and training opportunities directly and indirectly through service, supply, and support industries.

1.4 Purpose of EIA

For the purposes of the EIA, the Project was defined as all activities necessary for the Pecan Project and included development drilling, well completions, installation of subsea infrastructure and the FPSO, commissioning, operation (including production, hydrocarbon processing, crude oil offloading, and support and maintenance activities) and decommissioning.

The purpose of an EIA is to provide information to regulators, the public and other stakeholders to aid the decision-making process. The objectives of an EIA are as follows.

- To define the scope of the Project and the potential interactions of Project activities with the natural and social (including socio-economics and health) environment that should be defined and assessed during the EIA.
- To review national and international legislation, standards and guidelines, to ensure that all stages of the proposed Project through its complete lifecycle take into consideration the requirement of Ghanaian legislation, internationally accepted environmental management practices and guidelines, and Project-related Environment Health and Safety (EHS) policies and standards.
- To provide a description of the proposed Project activities and the existing physical, chemical, biological, socio-economic and human environment that these activities may interact with.
- To assess the potential environmental and social impacts resulting from the Project activities and identify viable mitigation measures and management actions that are designed to avoid, reduce, remedy or compensate for any significant adverse environmental and social impacts and, where practicable, to maximise potential positive impacts and opportunities that may arise due to the Project.
- To describe how the mitigation measures will be implemented, and residual impacts managed, through the provision of an outline Environmental and Social Management Plan (ESMP). This will also require the development of monitoring plans for various environmental and social impacts and a mechanism for audit, review and corrective action.

2 Legal and Policy Framework

2.1 Environmental Assessment Regulations

The EIS has been compiled in compliance with the requirements of the Environmental Assessment Regulations (LI 652, 1999), the principal enactment within the Environmental Protection Act (Act 490 of 1994). Schedules 1 and 2 of the Regulations provide lists of activities for which an environmental permit is required, and EIA is mandatory, respectively. The EPA has issued formal guidance on regulatory requirements and the EIA process specific to oil and gas development, namely:

- Environmental Assessment in Ghana, a Guide to Environmental Impact Assessment Procedures (1996).
- EPA Guidelines for Environmental Assessment and Management in the Offshore Oil and Gas Development (2011).

2.2 Petroleum Legislation

Relevant Petroleum Legislation includes:

- The Petroleum Commission Act 2011 (Act 821) established the Petroleum Commission to regulate and manage the exploitation of petroleum resources.;
- the Ghana National Petroleum Corporation Law (Act 64 of 1983), established the GNPC to promote exploration and development of petroleum resources; and
- the Petroleum (Exploration and Production) Law (Act 84 of 1984) requires that adverse effects on the environment, people and resources are prevented, and that a Plan of Development and Emergency Response Plans are submitted and approved by the Government of Ghana.

2.3 Other Relevant Regulations

Other relevant Regulations include maritime, pollution control and protection of coastal and marine areas legislation. These include the following.

- Town and Country Planning Act (Cap 84 of 1945) (as amended by Act 30 of 1958 and Act 33 of 1960).
- Wild Animals Preservation Act 1961 (Act 43).
- Oil in Navigable Waters Act (Act 235 of 1964).
- The Maritime Zones (Delimitation) Law (PNDCL 159 of 1986).
- Radiation Protection Instrument 1993 (LI 1559).
- The Environmental Protection Act (Act No. 490 of 1994).
- Wetland Management (Ramsar Sites) Regulations 1999.
- Shipping Act (Act No. 645 of 2003) (as amended).
- Maritime Security Act (Act No. 675 of 2004) (as amended).
- The Fisheries Regulation (LI 1968 of 2010).
- Ghana Shipping (Protection of Offshore Operations and Assets) Regulations (LI 2010, 2012).

2.4 State and Classification Requirements

Ships or offshore facilities trading internationally have to comply with the safety regulations of the maritime authority from the country whose flag the unit is flying. The MODU and other Project vessels are likely to be flagged and will therefore be required to comply with safety regulations, such as those of the International Maritime Organisation, the requirements of the relevant classification society, as well as the relevant Ghanaian environmental and safety regulations.

2.5 Relevant International Agreements and Conventions

Various international agreements and conventions that Ghana has ratified are relevant to the project such as the United Nations Convention on the Laws of the Sea (1982) and a number of International Maritime Organisation Conventions relating to safety at sea and prevention of pollution of the marine environment.

The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) contains a number of the provisions relevant to the project. These include general requirements regarding the control of waste oil, engine oil discharges as well as grey and black wastewater discharges.

The *International Convention of Oil Preparedness, Response and Co-operation Convention* (1990) requires the Operator to establish an Oil Spill Contingency Plan to combat accidental pollution to be coordinated with the National Oil Spill Contingency Plan. It also requires approval by the EPA. Ghana joined the International Labour Organisation in 1957.

2.6 Good Practice Standards and Guidelines

The International Finance Corporation Performance Standards for Environmental and Social Sustainability (2012) and associated EHS Guidance address environmental and social requirements that may apply to projects and are considered to represent Good International Industry Practice. The following guidelines are relevant to the Project.

- EHS General Guidelines.
- EHS Guidelines for Offshore Oil and Gas Development.
- EHS Guidelines for Shipping; and

  EHS Guidelines for Crude Oil and Petroleum Product Terminals.

Guidance is also provided by:

- International Association of Oil & Gas Producers which has established industry guidelines and standards on environmental protection and personnel safety; and
- International Petroleum Industry Environmental Conservation Association on oil spill response and contingency planning for the marine environment.

2.7 Pecan Energies Policies and Standards

The Pecan Project will also be conducted in compliance with the environmental and social policies and standards of Pecan Energies (as Operator or as otherwise approved by the Contactor Group), and recognised industry practice standards, design codes and practices. These include the overarching Pecan Energies Code of Conduct. The Code of Conduct addresses:

- Human Rights;
- Labour Standards;
- Health, Safety and Environment;
- Corporate Social Responsibility; and
- Local Content and Long-Term Local Value Creation.

In addition, the Pecan Energies Health, Safety, Security, Environment and Quality Policy (HSSEQ) will apply to the Project activities.

3 Project Overview

3.1 Pecan Development and Schedule

A phased development of the resources in the Contract Area will start with the development of the Pecan Field, as Phase 1, based on a FPSO as a field processing and crude export centre.

Phase 1 will have a total of 14 subsea wells to be developed over two sub-phases: Phase 1a and Phase 1b. Phase 1a will have seven wells and Phase 1b will have seven wells. Figure 2 illustrates the seabed locations for the Phase 1a and Phase 1b wells.

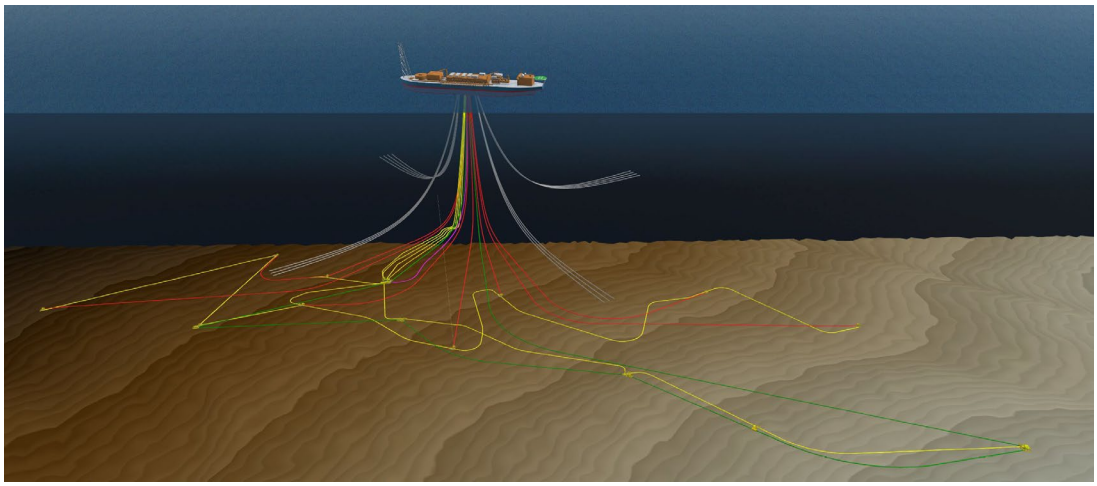


Figure 2 Pecan Phase 1a and 1b illustration

Figure 3 shows the indicative schedule for the Pecan Phase 1 Project up to the commissioning of Phase 1b. The schedule is based on the time required for FPSO conversion/fabrication, sub-sea installation and hook up, well drilling and completions, and commissioning following the project execution startup after final investment decision. The programme may change subject to detailed scheduling of fabrication times of various elements and the availability of drilling vessels and specialist construction vessels.

The Phase 1a oil producers give an initial production of approximately 70,000 to 80,000 barrels per day, which will be maintained when Phase 1b comes on stream three years after first oil. Offloading of the cargo crude will be approximately every ten to fourteen days to export tankers, when on plateau production.

3.2 Facilities Description

3.2.1 Floating Production Storage and Offloading Vessel

The FPSO will receive hydrocarbons from the production wells, process them and store the crude oil until it can be offloaded onto an export tanker. The Project will use an existing FPSO that will be modified to operate on the Pecan field (see Figure 4 for illustration). The FPSO has a cargo storage capacity of 1,285,000 barrels. It has a double bottom and the starboard side, where supply vessels can approach, will be modified with a Sandwich Plate System for added collision protection. Port side will have an arrangement of riser pipes from the seafloor to the vessel and will be a restricted area for all vessels. The original steel in the sides of the DB-1 FPSO is very thick and strong. The FPSO will be moored in position using a spread anchor mooring system in approximately 2,700 m water depth.

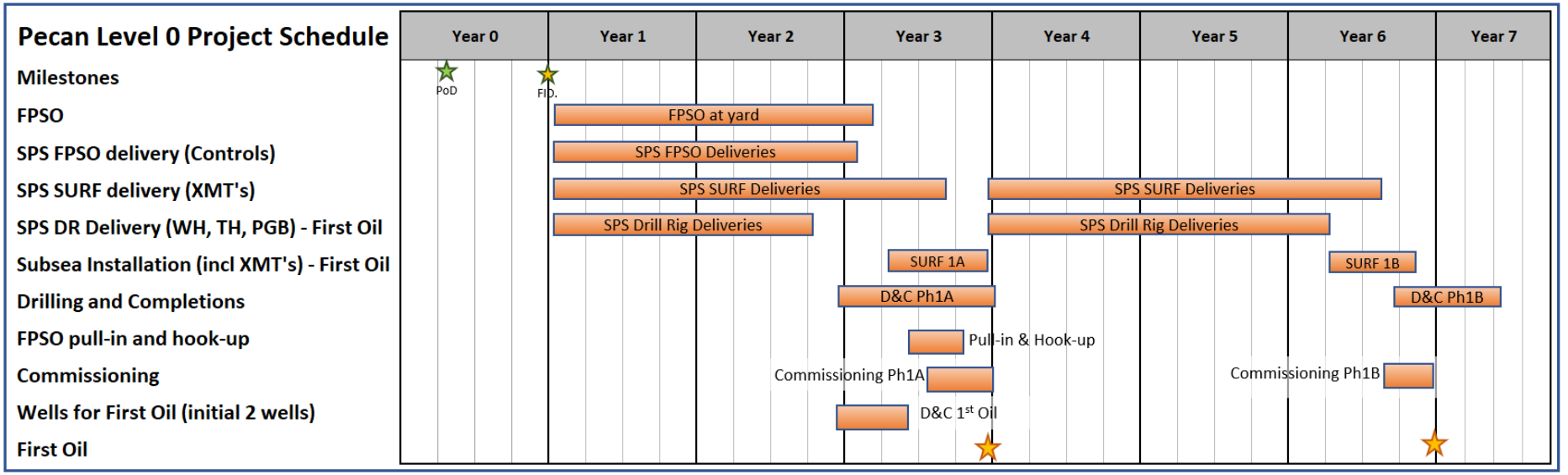


Figure 3 Pecan Phase 1 Drilling, Installation and Commissioning Schedule

Figure 4 Photograph of FPSO Dhirubhai-1 (Ghana FPSO Company)

3.2.2 Safety Zones and Advisory Areas

Safety zones are an international standard for oil industry zoning. They will be legally enforced with the assistance of the agencies of the Government of Ghana, for the safety of the facility and other users of the area (e.g. fishermen) when potentially close to the FPSO or MODU (when present). These areas will be mapped on international nautical charts and formally designated by the Ghana Maritime Authority and endorsed by the International Maritime Organisation. The enforcement will also be applied by project standby and guard vessels.

There will be a permanent safety zone of 500 m radius surrounding the FPSO facility and a temporary safety zone of 500 m radius applied at each of the drill centres when the dril ship is present. In addition there will be a 3 nautical mile (5.556 km) radius advisory area around the offloading tanker waiting area where tankers will be located prior to coupling for crude oil offloading.

3.2.3 Subsea Systems

Subsea infrastructure will be required to support production, water injection, gas injection and for system control. There will be one combined production loop for Phase 1a and 1b, where the Phase 1b wells will be connected to the production loop at the later stage.

On the seabed, the production wells will be linked to manifolds and fluids from the production wells will flow through a series of subsea pipelines (flowlines) and through risers up to the FPSO. Dedicated subsea gas and water injection systems (including wells, flowlines and risers) will also be provided. A combined water alternating gas injection system will be used for reservoir pressure support and increase oil recovery. All gas that are not used for gas turbine fuel or artificial gas lift, will be injected in the reservoirs through the injection wells. There will be no routine flaring of gas.

3.2.4 Shore Base

The Pecan Energies headquarters are in Accra, and it is likely that these facilities will be expanded as well as offices established in Takoradi to support supply chain and project management functions. Contractors providing services such as rental of drilling equipment and provision of drilling fluids will operate out of their own shore bases.

Marine vessels and helicopters will be required to support the drilling, installation, production and decommissioning operations. The onshore logistics support base will be at Takoradi.

Existing shore bases at Takoradi Port and the Takoradi Air Force base will be utilised. The support base will be used for dock space to serve as a loading/offloading point for equipment and machinery, provide facilities for dispatching equipment and allow for temporary storage of materials and equipment. Other than offices and access to port facilities, including some storage areas, Pecan Energies do not require to set up a separate shore base.

Once the FPSO has been installed and begins operations, a supply boat will visit the FPSO on a weekly basis. In addition, two helicopter trips to the FPSO will be required daily.

The FPSO will undergo conversion/fabrication in a yard outside Ghana, although some modules and systems may be fabricated in other locations. Fabrication of items such as suction piles, supporting engineering services, and installation activities may be undertaken within Ghana, subject to capacity and contractual agreements.

3.3 Project Activities

3.3.1 Drilling and Completions

A drill ship will be used for drilling and completing the development wells. There will be two types of wells: oil producing wells and injection wells (capable of alternating between using gas and seawater). Two types of drilling fluid are typically used: Water Based Muds for the upper well sections; Non-Aqueous Drilling Fluids (NADF) for the lower well sections.

Drilling the seven Phase 1a will take approximately one to two months per well, over a 12-month period with the Phase 1b wells taking a similar time per well, commencing three years later.

After wells have been drilled a process known as well completions and clean-up is undertaken to install safety valves in the well to provide pressure isolation and prevent pollution in the event of damage to the wellhead and seabed surface valves. In addition, sand filters and pressure and temperature gauges will be installed into producing wells to provide improved operational control and continuous data during the life of the wells. These valves close off the well in the event of loss of control of the reservoir fluids. Well completions and clean-up will take about a month per well.

3.3.2 Infrastructure Installation

The FPSO would sail under its own power or be towed from the conversion yard to the installation site. Installation of the FPSO mooring suction piles will be performed prior to FPSO arrival. Subsea Production Systems and flowlines, umbilicals and risers will be installed as a part of the subsea infrastructure.

3.3.3 FPSO and Subsea Systems Testing and Commissioning

Most of the commissioning and testing will be undertaken at the FPSO shipyard to minimise offshore risk and provide a timely start up. The flowlines and subsea equipment will be pressure tested (hydrotested) to verify system integrity and flushed with potable or treated seawater prior to commissioning. The specific chemicals and additives that would be used would be in line with the Harmonized Offshore Chemicals Notification Format to ensure the least hazardous available chemicals are used.

3.3.4 FPSO Operations and Export Tanker Operations

The FPSO will be operated by the FPSO Owner according to an Operation & Maintenance agreement with Pecan Energies. Following installation and commissioning, the FPSO will receive and process fluids from the reservoirs, separating the crude oil, gas and produced water.

- The crude oil stored on the FPSO will be transferred to an export tanker approximately every 10 to 12 days, with offloading volumes typically being approximately one million barrels. Offloading of crude will be undertaken a tandem offloading system where the export tanker bow connects to the FPSO stern using a hawser and the oil is transferred using a floating hose.
- Produced water will be treated and discharged overboard.
- Seawater and excess gas will be treated and injected into the reservoirs to maintain reservoir pressure.

Other contracts with external vendors will include the following.

- Shore base facilities and storage areas.
- Quayside /berth area.
- Helicopter transportation and booking services.
- Marine operations (construction and supply vessels, tanker offloading support vessels, guard vessels).
- Production and injection chemicals.
- Diesel and fresh water supply.
- Waste handling services.

3.4 Emissions, Discharges and Waste Generation

3.4.1 Emissions to Air

Emissions to air will result from the combustion of fuels, such as marine gas oil, gas and aviation fuel, consumed to support field development (Drill ship, field support vessels and construction support vessels and production operations (FPSO and vessel engines, FPSO topsides equipment and helicopters).

These will result in emissions of greenhouse gases and pollutants such as carbon dioxide (CO_2), methane, volatile organic compounds, carbon monoxide, oxides of nitrogen (NOx) and sulphur (SOx), and particulate matter.

The generators existing on the FPSO are being replaced by low NOx Dry Low Emission gas turbine generators resulting in approximately 65% reduction in NOx emissions from this source.

Associated gas will be used for fuel on the FPSO or for gas reinjection. There will only be gas flaring undertaken during the commissioning phase but there will be no routine flaring of associated gas, other than under specific situations to maintain safe conditions or during activities such as process start-up and maintenance shut-downs.

FPSO cargo tanks will be maintained in a pressurised state using a hydrocarbon ‘blanket’ gas to avoid the ingress of air and the potential for fire or explosion. As the cargo tanks are filled, the displaced gas and any vapours will be captured in a recovery unit and sent to the gas handling system for mixing with produced gas.

3.4.2 Light

Offshore activities will require 24 hr operations therefore light is required to maintain a safe working environment on the drill vessel, FPSO, construction and support vessels. Onshore operations will require some 24-hr working, for example at the port, and adequate lighting will be required for safety and security.

3.4.3 Discharges

The drill ship, FPSO, construction vessels and support vessels operations will result in routine discharges to sea (i.e. sewage, grey water, food waste, bilge water, ballast water and deck drainage. In addition, the drill ship will discharge cleaned drill cuttings from the drilling of the well, with small amounts of residual drilling fluid. FPSO operation discharges will include produced formation water that has been treated to remove oil droplets. The treated formation water will contain low concentration of oil droplets as well as production chemicals. Drilling, completion and production chemicals will be chosen to have minimum impacts on the aquatic environment. The Guidelines on Environmental Assessment and Management in the Offshore Oil and Gas Development in Ghana (EPA 2011) define four hazard categories of chemicals, with green chemicals as the most environmentally friendly. The Project will have procedures to substitute chemicals with more environmentally friendly substances whenever possible.

Discharges to water from the drilling, completion, installation and commissioning activities, are outlined in Table 1.

Table 1 Summary of Discharges and Treatment

Discharge and Source	Treatment
Black Water from vessels, MODU and FPSO	Treat with approved sanitation unit. Maceration and Chlorination
Grey Water from vessels, MODU and FPSO	Remove floating solids
Food Waste from vessels, MODU and FPSO	Macerate to acceptable levels
Deck Drainage from vessels and MODU	Oil-water separation
Bilge Water from vessels, MODU and FPSO	Bilge water separator
Ballast Water from vessels	Replace ballast water on acceptable distance from national waters when arriving from other regions.
Drill cuttings and fluid from drill ship	Water based mud drilled section: No treatment – discharge to seafloor. Unused fluid will be returned to supplier. NADF drilled section: Mud recycled using solid control equipment. Unused retuned to supplier
Cement returns from drill ship	None
Cement slurry and washdown water from drill ship	None
Completion fluids from drill ship	Oil-water separation. Any acids used will be neutralised to pH 5-7 by addition of soda ash or similar prior to discharge
Pre-commissioning - treated seawater from FCG, hydrotest and leak tests.	No treatment prior to discharge.
Pre-commissioning - gas system dewatering fluids – treated seawater and MEG.	No treatment prior to discharge.
Production system commissioning fluids from FPSO – treated seawater, diesel or crude.	Treated water processed on FPSO via oil in water treatment system.
Produced water from FPSO	Centrifugation and floculation filtering.

3.5 Accidental Releases

Accidental releases of chemicals and / or hydrocarbons may occur. Barriers to prevent spill to sea are the primary measures to reduce risk for accidental releases.

The main well control barriers during drilling operation will be from the following.

- Primary Well Control, a conditioned and monitored drilling fluid is the primary means of well control in all well construction operations.
- Secondary Well Control is the Blowout Preventer that will shut down the well flow in case of loss of primary well control.
- Tertiary Well Control will be needed in case both primary and secondary well control is compromised and will be deployment of a capping stack at the well head or drilling of a relief well.

The FPSO will be designed with a separate drainage system for areas with risk for spill of chemicals or hydrocarbons.

The secondary measure will be oil and chemical spill response. The FPSO and drill ship will have oil and chemical spill response equipment to contain and recover small spills onboard the installation. In the unlikely event of a large oil spill, there will be an oil spill response according to the Project oil spill contingency plan (OSCP). The OSCP, part of the Project's Emergency Response Plan, will be developed, based on input from an oil spill risk assessment and an oil spill contingency assessment, giving requirements for response capacity and capability.

3.6 Underwater Noise

The MODU and installation vessels and support vessels will introduce sound into the marine environment during their operation from propeller cavitation and propulsion. Underwater noise will also be produced from drilling activities and during operational equipment such as flowlines and valves.

3.7 Solid Waste Management

Non-hazardous and hazardous solid waste will be generated at onshore and offshore facilities during all project phases. Most of the solid wastes generated offshore will be transferred from the FPSO, drill ship and support vessels and appropriately managed onshore. Waste will be treated and disposed in accordance with procedures outlined in the Project Waste Management Plan (WMP) to be developed as part of the ESMP.

3.8 Local Content

The achievement of the local content strategic objectives will be facilitated through the implementation of the Local Content Management Plan. In addition, all subcontractors will be required to outline their proposed Local Content Management Plan in their bid documents with the expectation that, if selected, their plan will be incorporated in the corresponding Contract.

Pecan Energies has developed guidelines on recruiting and employment practices, training and succession practices, and reporting of training and employment activities, to ensure compliance with applicable requirements and to achieve Pecan Energies strategic local content objectives.

3.9 Decommissioning

At the end of economic life of the Pecan Field, the Field facilities and wells will be decommissioned and/or abandoned in accordance with the Petroleum Agreement, applicable Ghanaian Acts and Regulations and relevant international petroleum industry practices. A detailed Decommissioning and Abandonment Plan will be submitted to the EPA between two and five years prior to the planned cessation of production operations, as required by the Petroleum Agreement. The Decommissioning and Abandonment Plan will include decommissioning methods and procedures for individual components of the Pecan facilities and infrastructure. The plan will address potential environmental and social impacts, as well as health and safety issues identified by a risk assessment. It will also include details on a post-decommissioning survey and monitoring programme.

4 Baseline Environmental and Social Conditions

4.1 Baseline Data Collection

The baseline includes information on receptors and resources that were identified during the 2019 scoping phase and through stakeholder consultations undertaken as part of the EIA between November 2021 and March 2023 as having the potential to be significantly affected by the proposed Project. Stakeholders included national, regional and district authorities, traditional leadership, Non-Governmental Organisations and communities in the coastal districts of the Western Region.

A marine Environmental Baseline Survey (EBS) was undertaken in 2013/2014 within the Contract Area which included physio-chemical data on water and sediment quality and characterisation of benthic communities. Geotechnical and geophysical surveys as well as additional water and sediment samples were collected in 2021.

4.2 Physical Environmental Baseline

4.2.1 Climate and Meteorology

Regional climatic conditions are influenced by two air masses: one over the Sahara Desert (tropical continental) and the other over the Atlantic Ocean (maritime). These two air masses meet at the Intertropical Convergence Zone (ITCZ) and the characteristics of weather and climate in the region are influenced by the seasonal movement of the ITCZ.

In general, two seasons are characteristic of the climate in the region, namely the dry and wet seasons. The occurrence of these seasons corresponds with periods when the tropical continental and maritime air masses, and their associated winds, influence the region.

Climate variability is linked to changes in the movement and intensity of the ITCZ as well as variations in the timing and intensity of the West African Monsoon, which is influenced by the El Niño Southern Oscillation. El Niño is connected to below normal rainfall in West Africa.

4.2.2 Air Quality

The Project is located between 90 and 103 km from the coast of Ghana (locations of the closest and farthest away wells) and the FPSO location is approximately 98 km from the nearest coast. The Project is therefore, away from any industries, urban areas or other onshore sources of air pollution. The only offshore source of air pollution would be vessels travelling along shipping lanes in the proximity as well as vessels involved in oil and gas operations in the area including process emissions from the Jubilee Field FPSO and TEN Field FPSO to the north of the Contract Area, and combustion emissions from exploration

and appraisal well drilling in the vicinity. In general, the airshed in the Project Area offshore is considered un-degraded.

Onshore air quality in the Western Region of Ghana is expected to be good. Elevated concentrations of pollutants will, however, occur in more densely populated areas such as Axim, Bonyere, Esiama, Half Assini, and Sekondi-Takoradi Metropolitan Assembly (STMA), due to combustion sources used for cooking and space heating, road traffic, local and industry. The principal source of atmospheric pollution in urban areas in the region are from biomass burning, e.g., firewood for cooking and heating, and controlled burning for agriculture. Other sources of urban air pollution will be from transportation, industrial pollution, and non-combustion sources.

4.2.3 Climate Change

The Ghana Government ratified the United Nations Framework Convention on Climate Change in September 1995. The Environmental Protection Agency calculated the greenhouse gas GHG emissions for Ghana that have increased from 25.34 metric tonnes (Mt) CO_{2e} in 1990 to 42.15 Mt CO_{2e} in 2016. Countries with a dependence of the majority of the population on agriculture, particularly rain-fed agriculture as well as widespread poverty that reduces the population's ability to withstand climate stress are vulnerable to the effects of climate change. In Ghana 25% ***Error! Reference source not found.***of the population lives along the coast and 45 % of the workforce depends on rain-fed agriculture.

4.2.4 Hydrology and Oceanography

Tides, Currents, and Waves

The oceanography of the Gulf of Guinea comprises the principal water types of the South Atlantic but is largely influenced by the meteorological and oceanographic processes of the South and North Atlantic Oceans. Surface water temperatures are warm (24ºC to 31ºC) with the daily sea surface temperature cycle showing annual variability. The water temperature decreases with depth to below 5°C near the seabed.

The Equatorial Counter Current which flows in an eastward direction becomes known as the Guinea Current as it runs from Senegal to Nigeria.

During upwelling, cold nutrient-rich water from depths rises to the surface, resulting in increased biological productivity in the surface waters. The major upwelling season along the Ghana coast occurs from July through to September, while a minor upwelling occurs between December and March. The major and minor upwellings drive important pelagic (living in the water column) species into the upper layers of the water column, thereby increasing fish catches.

Bathymetry and Topography

The continental shelf at about 200 m water depth off the coast of the Western Region of Ghana is at its narrowest off Cape St Paul in the east (20 km wide) and at its widest between Takoradi and Cape Coast in the west (90 km). The continental slope is steep, and the depths increase sharply from approximately 100 m on the shelf and drop to approximately 1,600 m at the deepest part of the slope. The Project Area is located on the deeper portion of the continental slope in water depths ranging between 1,600 to 2,700 m.

Water Quality

Water samples collected during the 2013/2014 EBS showed the water quality to be good with low levels of nutrients, suspended solids and contaminants such as hydrocarbons and metals.

Sediments

Sediment samples analysed from the EBS and a later survey in 2021 showed that sediments across the Contract Area were found to be generally similar, mainly comprising fine or medium silt with low levels of organic carbon. Sediment quality is generally good with concentrations of metals, hydrocarbons typical of background levels.

Noise, Vibration, Light

Existing noise, vibration and light levels in the Project Area will be from natural sources (such as water movement, weather events and natural light cycles) as well as from marine traffic.

4.3 Biological Baseline

4.3.1 Plankton and Invertebrates

Plankton

Plankton community composition and abundance is variable and depends upon water circulation into and around the Gulf of Guinea, the time of year, nutrient availability, depth and temperature stratification. Plankton biomass is highest offshore Ghana during the main upwelling season which starts in June to October. During this upwelling, nutrient availability in surface waters in much higher leading to the increased concentrations of biomass.

Benthic Invertebrates

Benthic fauna (organisms on the sea floor) forms an important part of the marine ecosystem, providing a food source for other invertebrates and fish as well as cycling nutrients and materials between the water column and underlying sediments. The 2013/2014 EBS found that the macrofaunal community in the Contract Area has a low abundance but proportionally high diversity. Many of the sites exhibited a high level of bioturbation indicating burying fauna. Polychaetes, arthropod, crustaceans and molluscs dominated species composition and abundance, with relatively few echinoderms or other taxa present in the samples (see example in Figure 5). No potentially sensitive or threatened species were observed during the EBS. No corals were observed in the EBS or in the seabed mapping surveys undertaken in 2021.

Molluscs and Crustaceans

A variety of molluscs and crustaceans are known to be present within the DWT/CTP blocks. These mostly occupy the closer to shore, shallower waters and are not found in the water depths at the Pecan field. These include the common cuttlefish, pink cuttlefish, common squid, common octopus, the royal spiny lobster, deep-sea rose shrimp and other shrimps.

4.3.2 Fish

Pelagic Fish

The pelagic fish are those that live in the water column. The distribution and quantity of each population largely depend on hydrological conditions, with each species distributed according to the optimum temperature and salinity required for growth and reproduction. Most of the fish species have spawning grounds offshore Ghana and spawning of different species takes place throughout the year, typically with a peak from April to November.

Small pelagic fish in the coastal and offshore waters of Ghana include round sardinella, flat sardinella, European anchovy and chub mackerel. The large pelagic fish species include skipjack tuna, yellowfin tuna and bigeye tuna, swordfish, Atlantic blue marlin and Atlantic sailfish. Shark species include blue shark and hammerhead shark.

Demersal Fish

Demersal fish species are those that live on or near the seabed. They are usually found over the continental shelf and the continental slope. Their distribution and composition is influenced by oceanographic conditions and specifically by the upwelling that results in changes of the bathymetric extension suitable for different species. The density of demersal species is higher on shallower waters up to 50 m depth. Surveys have shown that demersal fish are widespread on the continental shelf along the entire length of the Ghanaian coastline. Species composition is a typical tropical assemblage including porgies or seabreams, grunts, croakers or drums, goatfish, snappers, groupers, threadfins, emperors and triggerfish.

Fix: 282 E: 495808 N: 462264 Depth: 2546

Fix282: Silt with occasional shell fragments, Echinodermata (Scotoplanes sp.)

Fix: 286 E: 495801 N: 462271 Depth: 2546

Fix286: Silt with occasional shell fragments Mollusca (Scaphopoda), Bioturbation

Fix: 343 E:494285 N:462266 Depth: 2575 m

Box Core: Fine silt with clay, no visible live fauna

Fix: 343 E:494285 N:462266 Retention: MFA

Sieve: Sand, shell fragments and small clay aggregates Fauna, no visible live fauna

Figure 5 Example Sampling and Seabed Photograph from Pecan-A (Gardline 2014)

Deep Sea Species

Deepwater sea species are those that inhabit areas beyond and below the depth of the continental shelf. These can be pelagic or demersal. Over 180 deepwater species have been reported off Ghana, including approximately 110 that are principally pelagic, 60 that are principally demersal and 10 that frequently migrate between the bottom and higher layer of the seabed.

Protected or Endangered Species

The main fish species of concern offshore Ghana according to the International Union for Conservation of Nature (IUCN) Red List are angle sharks as they are considered as Critically Endangered and shortfin mako, longfin mako and whale sharks as they are Endangered. The tuna species are subject to international regulations and monitoring.

4.3.3 Marine Mammals

The water of the Gulf of Guinea and offshore Ghana are considered favourable to the presence of marine mammals, especially due to the seasonal upwelling, which boosts productivity and therefore ensures food availability for these species. The results of surveys, including the EBS (which recorded sperm whale, Bryde's Whale, short-finned pilot whale, clymene Dolphin bottlenose dolphin, melon-headed whale, Fraser's dolphin, spinner dolphin and pantropical spotted dolphin) and historic beach standings data indicate that the whale and dolphin fauna of Ghana is moderately diverse with 18 sub-tropical pelagic species identified. The main marine mammals of concern are sei whale as they are considered as Endangered and sperm whale, as they are classed as Vulnerable.

4.3.4 Sea Turtles

The Gulf of Guinea serves as an important migration route, feeding ground, and nesting site for sea turtles. Five species of sea turtles have been confirmed for Ghana, namely loggerhead, olive ridley, hawksbill, green turtle and leatherback. Olive ridley, green and leatherback sea turtles are known to nest in Ghana regularly, and hawksbills are thought to have nested historically. Records of loggerhead turtles nesting on one beach have also been recorded. The beaches of Ghana from Keta to Half-Assini in the Western Region of Ghana are important nesting areas for sea turtle species.

The IUCN Red List classifies hawksbill turtles as Critically Endangered, green turtles and loggerhead turtles as Endangered and olive ridley and leatherback turtles as Vulnerable. All five species of sea turtles are listed by the Convention on International Trade in Endangered Species (CITES) and National Wildlife Conservation Regulations.

During a seismic survey of areas in the Contract Area carried out from November 2013 to April 2014 leatherback, olive ridley and hawksbill turtles were observed.

4.3.5 Seabirds

The west coast of Africa forms an important section of the East Atlantic Flyway, an internationally important migration route for a range of bird species, especially shore birds and seabirds.

A number of species that breed in higher northern latitudes winter along the West African coast and many fly along the coast on migration. Seabirds known to follow this migration route include a number of tern species, skuas and petrels. The highest concentrations of seabirds are experienced during the spring and autumn migrations, around March and April, and September and October.

Waders are present during the winter months between October and March. Species of waders known to migrate along the flyway include sanderling and knott.

The rarity of oceanic birds may be attributable to the absence of suitable breeding sites (eg remote islands and rocky cliffs) off the Ghana coast and in the Gulf of Guinea.

4.3.6 Protected and Sensitive Areas

The stretch of coastline west of Cape Three Points consists mainly of sandy beaches (Esiama Beach), rocky beaches (Axim and Cape Three Points), coastal lagoons (Domini Lagoon, Amansuri Lagoon, Ehnuli Lagoon) and estuarine wetlands (Ankobra estuary).

These coastal habitats are important for their biodiversity as well as for rare and endangered species.

Ghana has not established any marine protected areas, however five coastal areas are currently protected. These areas are all located onshore and are protected under the Ramsar Convention. None of these protected areas are located along the coast of the Western Region. There are six Important Bird Areas (IBAs) along the coastline of Ghana, with one, the Amansuri Wetland (which is the largest stand of intact swamp-forest in Ghana) is located along the western coastline.

4.4 Socio-Economic and Health Baseline

4.4.1 Introduction

The baseline draws on primary data collected through extensive consultations on national, regional and local level, as well as available secondary data (eg district development plans and census data) and. Secondary data included the 2021 Population and Housing Census.

4.4.2 Administrative Structure

There is a dual system of governance in Ghana made up of formal government structures and traditional leadership structures. The decentralised Local Government System comprises three levels of administrative authorities, namely national, regional and district in both systems.

The Local Government System is made up of the Regional Coordinating Council (RCC), four-tier Metropolitan and three-tier Municipal/District Assemblies. Under these fall the Sub-Metropolitan District Council, Zonal Council and Urban/Town/Area/ Councils, as well as Unit Committees. A District Assembly is established by the Minister of Local Government and serves as the highest political authority in each district.

The Western Region has Sekondi-Takoradi as its capital. Within the Western Region there are six coastal districts including, from west to east, Jomoro District, Ellembelle District, Nzema East District, Ahanta West District, Sekondi-Takoradi metropolis (STM) and Shama District.

4.4.3 Demographic Profile

Demographics

The population of Ghana is approximately 30.8 million (2021 data), an increase of over 6 million since the 2010 census. The 2021 Ghana Population and Housing Census indicated there was a big difference between the rate of growth of the urban and rural population in Ghana, reflecting a shift of the population from rural to urban localities. The new Western Region (formed after the 2018 administrative reorganisation) had a total population of 2,060,585 or 6.7% of the national population.

The birth rate per woman in 2020 was 3.8. The life expectancy at birth for Ghana was 64 years (both sexes combined), increasing from 46 years in 1960.

Age and Gender Distribution

In the Western Region, 44.8% of the population is below the age of 14, 51.9% between 15 and 64 and 3.3 % above 65. The high proportion of youth leads to a relatively high dependency level in the Region. This dependency places a demand on the economically active sector of the population and thus households have difficulties in maintaining and/or improving their standards of living.

Urbanisation

Approximately, 51.6 % of the Western Region is urbanised and the remaining 48.4% is rural (the rural/urban classification of localities is population based, with a population size of 5,000 or more being urban and less than 5,000 being rural).

Population Change

There is a high level of migration within the Region, primarily in search of employment opportunities. People migrate to areas with more employment opportunities such as Ahanta West and STM. The Region also attracts many male migrants from other Regions in Ghana due to the employment opportunities in the cocoa-growing and mining sectors within the Western Region. Seasonal migration is also a common practice, particularly amongst men who migrate to the coast during the fishing season and return to the inland areas during the farming season.

Ethnicity and Language

The official language of Ghana is English, and it is the main medium for teaching in schools from the fourth year of basic schooling. Other languages spoken in Ghana include Akan, Dagaare, Dagbani, Dangme, Ewe, Ga, Gonja, and Kasem. The dominant ethnic group in Ghana is Akan, which is made up of a number of smaller ethnic groups, each of which has its own language. The population in the Western Region consists predominantly of people from Akan decent and is dominated by two ethnolinguistic groups: the Nzema and the Ahantas.

Religion

The predominant religion in the coastal districts in the AoI in 2020 is Christianity (82.65%) followed by Islam (8.3%). The rest of the population are either Traditional believers, belong to other religious affiliations (i.e., Buddhists, Hindus, Rastafarianism, etc) or profess no religion.

4.4.4 Human Rights, Poverty and Conflict

The Ghana Commission on Human Rights and Administrative Justice has a mandate to protect universal human rights and freedoms, especially those vested in the 1992 Constitution. These include labour rights, fair treatment and equal pay, child labour and forced labour.

According to the 2015 Ghana Poverty Map, STM, Jomoro and Wassa Amenfi Central are the districts with the highest number of poor persons in the Western Region. Vulnerable groups that may be present in the coastal districts include:

- low-income households;
- female-headed households;
- households with a high number of dependents;
- households with limited or no access to land;
- households with limited or no alternative livelihood activities other than fishing;
- households with elderly and/or disabled individuals; and
- people with HIV/AIDS.

Conflict in communities may occur because of many factors. Indebtedness, ethnic/ tribal conflict, political differences, land disputes, chieftaincy, and religion, among others, are mostly the cause of conflict in communities. In the Western Region, chieftaincy was the

major cause of conflict in communities, followed by land disputes and conflict due to ethnic/tribal differences.

According to the Ghana Statistical Service (2019) the majority of communities in Ghana), had never experienced any force or violence by other groups of people or one group against the other, although approximately 20% of communities indicated that their communities occasionally experienced this in the three years prior to the 2019 survey. At the regional level, the Western Region ranked third out of the ten regions with the highest percentage of people indicating they feel very safe with only 0.5% of the people in the Western Region indicated to be feeling very unsafe.

4.4.5 Land Tenure and Use

Ghana maintains a dual land tenure system, comprised of customary and statutory land tenure. Customary owners own about 78% of the total land area in Ghana, the State owns about 20% percent while the remaining 2% percent is held in dual ownership. Most of the land in the Western Region is used for the commercial exploitation of natural resources. In the coastal districts, land is mostly used for community infrastructure and subsistence farming.

4.4.6 National and Regional Economy

The Gross Domestic Product (GDP) in Ghana was 68.53 billion US dollars in 2020, according to official data from the World Bank and projections from Trading Economics. Per capita GDP in 2020 was 2,205.5 USD. Ghana's service sector is the largest sector of the economy, followed by agriculture (including fishing) and industry.

The Western Region's economy currently revolves around agriculture (including fishing and forestry), mainly small landholders and artisanal fishers. Other major sources of employment include mining and quarrying and manufacturing. The Western Region has considerable natural resources (minerals: gold, manganese, bauxite, forest reserves, timber, cocoa, oil palm and coconut), which gives it a high level of economic importance within the context of the national economy. Other economic activities undertaken in the Western Region includes offshore oil & gas production, imports and exports, and, to a limited extent, tourism.

According to the 2020 Census Data for the Western Region, approximately 60.2% of the population were economically active, with 85.2% of these being gainfully employed. The dependency on agricultural activities has also caused a lot of seasonal unemployment whereby people who are involved in fishing and farming are unemployed during the off seasons.

Fisheries

Information on fisheries was derived from published sources and through primary research undertaken to obtain information on fisheries activities in the Pecan Project area.

There is a long tradition of both artisanal and commercial fishing in Ghana. Ghana's marine fisheries are spread along 550 km of coastline and concentrated on its approximately continental shelf. The fisheries sector contributes significantly to the local economy in the Western Region in terms of food security, employment and poverty alleviation.

These waters form part of the Gulf of Guinea Large Marine Ecosystem and are highly productive due to the Central West African Upwelling. Fishing occurs all year with periods of higher landings linked to the upwelling periods when biological activity is increased due to greater concentrations of nutrients in the water column that have been drawn up from deeper waters. Most fish spawn during this period and stocks are more readily available to the fishers. For the rest of the year, catches are lower and more sporadic.

The fish biomass is primarily composed of small pelagics: primarily round sardine, flat sardine, chub mackerel and anchovy. These species also support populations of large

pelagics such as tuna, marlin, swordfish and sharks. In addition, the upwellings support important demersal fisheries along the continental shelf.

The artisanal fishery accounts for about half of the total marine catch in Ghana. It involves the use of canoes or dug-out wooden boats with inboard or outboard engines. The fishing gears are diverse, including beach seine nets, purse seine nets, set nets, drift gillnets, and hook and line. Artisanal fishers are mobile following the small pelagic fish stocks that in turn are dependent on the location of the upwelling, which can vary along the coast during the fishing season. They operate anywhere in the Ghana Exclusive Economic Zone, although most fishermen operate in the inshore, shelf waters (typically within 15 km of the shore). However, artisanal fishermen have been observed in deeper waters near offshore oil drilling and production installations at distances of beyond 60 km from the shoreline. The latest statistical survey (from 2016) estimated 11,583 active fishing canoes in the artisanal fisheries in Ghana.

The inshore (or semi-industrial) fishing fleet consists of locally built wooden vessels fitted within inboard engines ranging between 8 and 37 m in length. The vessels are generally multipurpose and carry both purse-seine and bottom trawl gear, exploiting both small pelagic and demersal species. There are approximately 224 inshore vessels operating from seven landing centres.

The industrial fleet comprises large, steel-hulled, foreign-built trawlers, shrimpers, tuna pole-and-line and tuna purse-seiners. Trawlers are normally 35 m in length and mainly exploit the demersal fish, including sole and flounders, groupers and cuttlefish as well as shrimps and pelagic tunas. They also target other species including porgies or seabreams, jacks, snappers, croakers, goatfish. In 2020 there were 76 active vessels.

The main tuna species targeted by the tuna boats of the industrial fleet, are skipjack tuna (over 50%), yellowfin tuna and bigeye tuna. Of the 30 vessels registered in 2020, 16 were purse-seiners and 14 were pole-and-line vessels. Most tuna vessels operate outside the continental shelf.

Ghana is faced with several forms of Illegal Unregulated and Unreported fishing practices, including the use of illegal fishing gears, overexploitation, overcapacity, light fishing, fishing with explosives, and illegal transhipment at sea.

Figure 6 shows the Catch-Per-Unit-Effort (CPUE), in tonnes of fish caught per vessel per year, from 1990 to 2020 for the artisanal, semi-industrial and industrial trawler sectors. The figure shows a general decline in fish stocks over the past three decades (1990 - 2020), indicative of diminishing stock due to overfishing. Catch from artisanal fisheries make up about 55% of total marine capture fisheries.

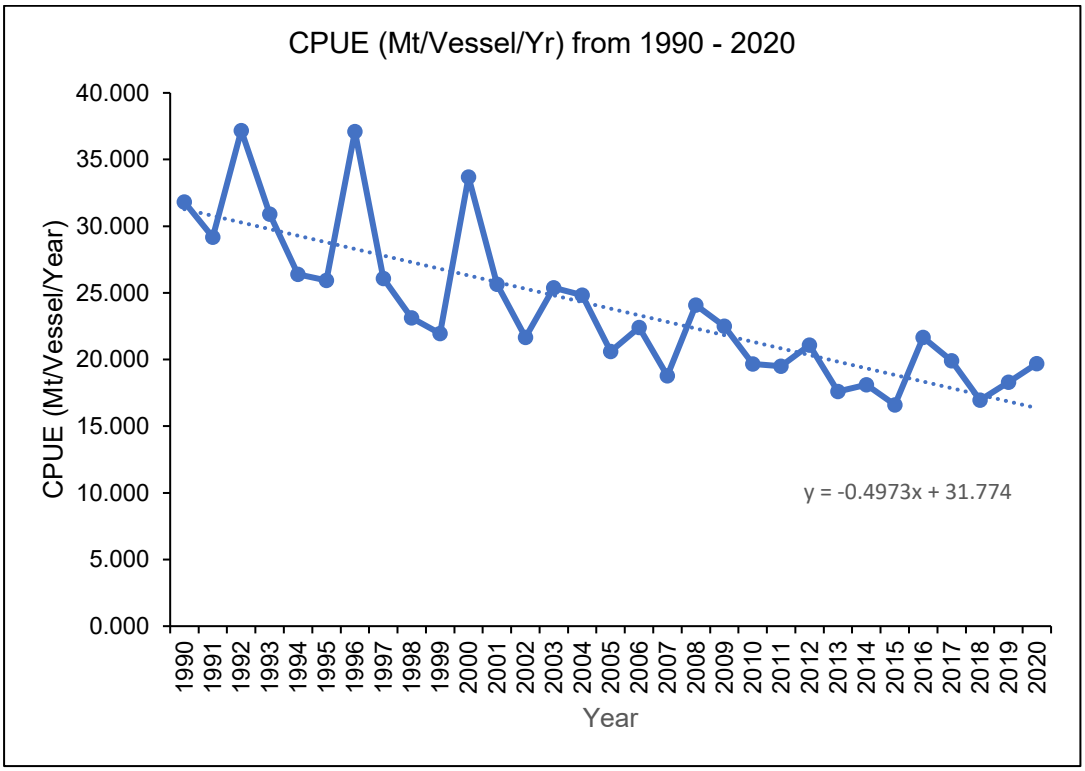


Figure 6 CPUE from 1990 to 2020 (Ghana Fisheries Commission 2022)

Oil and Gas Activities

Oil and gas was discovered off the coast of Ghana's Western Region in 2007 with the first production commencing in 2010. Ghana has three offshore and one onshore petroleum basins, which comprise the Tano-Cape Three Points Basin/ the Western basin; the Saltpond Basin / central basin; Accra–Keta Basin / eastern basin and the onshore Voltaian Basin. The Western Basin is currently the most active and includes the Deepwater Tano and Cape Three Point basin. The Jubilee Field straddles Tano and Cape Three Points, the TEN Fields are located in Tano, and the Sankofa Field is located in Cape Three Points. The Central Basin has Ghana's longstanding Saltpond field. The Eastern Basin includes both Accra and Keta Blocks, where exploration has been carried out without much commercial result to date. Lastly, the Voltaian Basin covers 40 per cent of Ghana's land mass and may have the potential for onshore petroleum extraction.

The country also has an active midstream and downstream oil and gas sector including a refinery at Tema and storage and distribution systems for refined products.

Tullow Ghana Ltd built a technical training centre at the Takoradi Polytechnic to provide skills to young people so they can be employed. In addition, there is the USAID Ghana Supply Chain Development Program that provides capacity support to small and medium enterprises and business service providers to participate in procurement tenders for contracts within the oil sector.

Mining

There are five major gold mines in the Western Region namely Teberebie and Iduapriem, Prestea/Bogoso, Tarkwa and Aboso-Damang gold fields. Tarkwa is one of the largest gold mines in Ghana and it is owned and operated by Gold Fields Limited. The mine is served by the main road connecting to the port of Takoradi some 60 km to the south on the Atlantic coast. The Damang concession lies to the north of and joins the Tarkwa concession, which is

located near the town of Tarkwa. The area is served by access roads with established infrastructure, and the main road connects the mine to the port of Takoradi, some 90 km to the southeast.

Informal Economy

According to data from the Ghana Statistical Service (2019) more than 71% of employed persons in Ghana were employed informally and about 29% were engaged in the formal sector, with woman and urban dwellers more likely to be engaged in formal employment.

The informal sector in Ghana consists of various small-scale businesses, for example, producers, wholesalers and retailers. Informal sector workers are largely self-employed persons such as farmers, traders, food processors, artisans and craft workers.

The rural informal economy centres on the following.

- Agricultural activities focused on family farming units or community-owned assets. Farming is generally on a low technology basis dependent on family labour.
- Artisanal fishing is predominantly undertaken by males. Women generally undertake processing activities, including the smoking and marketing of fish in coastal villages.
- Rural agro-based processing activities of local crops. These include processing cassava, palm kernel, groundnut and copra oils, brewing distilling, and traditional soap making. These activities are generally undertaken by women.

The urban informal economy centres on the following.

- The services sector, for example, urban food traders, domestic workers and repairmen and women.
- The construction sector, for example, masons, carpenters, and small-scale plumbers (mainly men).
- The manufacturing sector includes, food processing, textiles and garments, wood processing and metal works.

Gender-based livelihoods

According to the WRCF Community Perceptions and Socio-Economic Survey (CPSES) Baseline Report (2016) data, both male and female heads of household in the coastal districts of the Western Region are engaged in the fishing and farming sector (44% of men and 38% of women) with the women mainly engaged in fish processing. Female heads of household are much more likely to be engaged in trade and sales and accommodation and food services. None of the female-headed households was engaged in the transportation and storage, construction, or public administration sectors, all of which employed substantial numbers of men.

Tourism

Ghana has a wide range of natural, cultural and historical attractions, which provides the basis for a growing tourism industry. The primary tourist sites in the Western Region pertain to national parks or reserves, forts and cultural heritage and beaches. These are considered sites that can attract tourists but would still need associated infrastructure developed to boost tourism in the region.

4.4.7 Education

Ghana has a basic education system that is compulsory up to the age of 15 (to end of junior high school).

According to 2016 data provided by the Ghana Statistical Service, the ratio of students enrolled in basic education schools across the six districts is higher than 20%, reaching approximately 40% in Sekondi Takoradi Metropolis. Attendance at senior high school and tertiary education is optional. There are currently 753 primary schools, 563 junior secondary schools and only 32 senior high schools in in the six districts within the AoI i. Many children, particularly those from the rural areas, are unable to access education, especially senior high schools, due distance and affordability. Nearly half (48%) of female heads of households had received no formal schooling, compared to 13% of male heads of households.

Schools across the six districts face significant challenges in terms of access to electricity, access to sanitary facilities, adequate teaching resources and insufficiently trained teachers across all sectors. Literacy levels for the over 6 years olds was approximately 70% in 2021. This could also be attributed to high levels of employment in the agricultural and fishing sectors requiring no formal education.

4.4.8 Health Care

The Ghana Ministry of Health is responsible for the health system in Ghana. There are 1,811 government-owned healthcare facilities and 1,356 private healthcare facilities (2020 data). In addition, the Christian Health Association of Ghana has a network of 302 health facilities and health training institutions providing health care to vulnerable and underprivileged population groups, particularly in remote areas. The use of traditional healers is common in Ghana and is recognised by the Ghana Health Service.

In the 2017 annual health report, the 895 health facilities recorded in the Western Region were made up of 50 Hospitals, 80 Health Centres, 126 Clinics, 601 National Community Health Planning and Services compounds and 38 Maternity Homes.

The National Health Insurance Scheme (NHIS) is a social intervention program introduced by the government to provide financial access to quality health care for residents in Ghana. The NHIS is managed by National Health Insurance Authority. In 2017, there were 10.5 million people, active members, within the NHIS, resulting in a coverage of approximately 35% of the population.

Various illnesses are prevalent throughout the Western Region. In data recorded in hospitals in the region malaria, diarrhoeal diseases, and anaemia were the top three reasons for admission. Road accidents show an increasing trend over the last few years.

4.4.9 Utilities, Infrastructure and Services

There are a series of major sources of drinking water in Ghana: piped (inside the dwelling, outside the dwelling, tanker supply), well (covered, uncovered), borehole and natural (spring, river, stream, lakes and rainwater). A number of these are reported as being non-functional and many were below the basic acceptable levels. Approximately 54 to 90% of houses in the region have access to treated water. The highly urbanised districts have 90% viability of, or accessibility to, piped water. This is in contrast to rural districts where over half of households use rivers, streams, dugouts, spring or rainwater as their main source of water.

Based on 2017/2018 data, only 66.5% of the population in Western Region has access to improved sanitary facilities, similar to the 65.2% national average. The use of public toilet facilities or open defecation is common.

Electricity and kerosene lamps are used as the main sources of lighting in the Western Region, providing lighting needs in about 99% of the households. Electricity dominates in urban areas and kerosene lamps in rural areas. Charcoal and fuel wood are the main sources of cooking fuel in the region (including urban dwellers), however liquid petroleum gas and coconut husks are also used as a source of cooking fuel.

The predominant means of waste disposal is either by dumping, at specified sites, or indiscriminately burning or burying refuse. The majority of landfills for solid waste are open, unlined, and largely unmanaged, giving rise to scavenging activities on the dumping sites and associated risks of disease, infection and personal injury.

The most common means of transport is by road where there are privately owned or state-owned buses. The state-owned buses usually operate within the urban areas. In the villages, private taxis and small buses owned by private individuals are operational. The road network in the Western Region is limited and the conditions of the roads can be very poor, particularly in the rainy season.

Ports and Harbours

The Ghana Ports and Harbours Authority (GPHA) manages all ports and harbours in Ghana and provides facilities for bunkering, stevedoring and handling, electricity and water supplies. The main ports in Ghana are located at Tema in the east and in STM in the west. Approximately 85% of Ghana's trade is done through these ports.

The Port of Takoradi possesses the majority of the basic infrastructure required to support the current offshore oil and gas industry. It has embarked on a major expansion and investment program to transform the port's capacity, facilities and operations, including the extension of the breakwater; provision of a bulk terminal/jetty to handle bulk commodities and dredging of the access channels and berths. The Port of Takoradi also has a fishing harbour located at Sekondi, which has an ice plant that can accommodate vessels with up to 3 m draft.

In the Western Region, there are four other ports at Apam, Mumford, Elmina and Axim that provide landing facilities for inshore vessels.

Artisanal Fishing Landings Sites

Artisanal fishers use over 300 landing sites along the coastline of Ghana. In the Western Region there are several major artisanal landing towns including Dixcove, Axim, Sekondi-Takoradi's fishing harbour, Elmina and Mumford. The typical artisanal catch landings sites are the beaches adjacent to the fishing communities. For many of these areas there is generally very little physical infrastructure and canoes are launched from the beaches.

Information and Communication Technology

Ghana's Information and Communication Technology sector includes telecommunication service providers, internet service providers, software developers and training institutions. It plays an important role in Ghana's economic growth. The percentage of the population using the internet increased from 53% in 2019 to 58% in 2020. The percentage of households having a mobile phone is approximately 92 %.

4.5 Cultural Heritage

There is generally very little information on offshore marine heritage sites in Ghana, with the main sources being the site surveys undertaken by oil and gas operators. Marine surveys undertaken on behalf of Pecan Energies for geophysical and geotechnical purposes in 2021 and the EBS in 2013/14 did not identify any seabed wreckage or other sites of potential heritage value. During any future site surveys prior to drilling and laying anchors, additional information on any potential wreck sites will be identified, as these are areas to be avoided for drilling and field development purposes.

For the onshore areas, the Project will use facilities at Takoradi Harbour. The approved development of Takoradi Harbour was subject to its own EIA process in 2015. The issue of cultural heritage was scoped out of that EIA as the development was at an existing port. The Project will use contractors with existing shore bases in Takoradi and no new sites to be

developed with Takoradi are planned. Therefore, potential impacts on onshore cultural heritage have been scoped out of the EIA.

5 Impact Assessment

5.1 EIA Assessment Methodology

The EIA scoping process identified key issues for assessment in the EIA based on industry knowledge of sources of potential impact associated with offshore oil and gas development and production and the issues raised during the scoping consultation process.

A methodical impact assessment was then carried out to predict the magnitude of impacts following the key stages below.

- Identification of potential environmental and social receptors.
- Identification of the activities of the proposed drilling, installation, commissioning, production and decommissioning activities with the potential to contribute to or cause impacts to environmental and social resources and receptors.
- Assessment of the likely magnitude of the impact (depending on its intensity, its duration, its scale, etc.), and the sensitivity of the resource and receptors affected to determine its significance.
- Impact significances are assessed for the Project including the embedded controls (i.e., those that have been incorporated into the Project design), and residual impact significances are assessed based on a consideration of the embedded controls and additional mitigation and management measures that have been defined during the IA process. Impacts were assessed as either significant or not significant. Those that were assessed as significant were further rated as being of Minor, Moderate or Major significance.
- In addition to predicted impacts from planned activities, those impacts that could result from an accident or unplanned event within the Project (e.g. pollution event from a fuel or oil spill) are considered. In these cases, the likelihood (probability) of the event occurring is considered. The impact of non-routine events is therefore assessed in terms of the risk, i.e. considering both the consequence of the event and the probability of occurrence. A summary of the EIA process is presented in Figure 7.

5.2 Summary of Impacts and Mitigation Measures

The assessment of impacts considered the mitigation measures that have been built into the project design. Additional mitigation measures were developed to reduce the severity of identified impacts to as low as reasonably practicable levels. Where impacts could not be fully eliminated by mitigation measures, the residual impact was described. The assessment addressed the impacts associated with drilling, installation, commissioning and operational phases of the development. A summary of the source of potential impact from the planned activities, the committed mitigation measures to address these impacts and the assessment of the residual impacts is presented in Table 2.

Overview

The purpose of the impact assessment process is to identify any likely significant effects on receptors/resources as a result of impacts from a Project and develop appropriate mitigation measures to effectively manage these environmental and social effects. The process is iterative and can be summarised by the figure to the right.

The detailed impact assessment methodology used is in accordance with widely accepted international practice for impact assessment. The overarching principles of this methodology are illustrated here, but note that each topic area will have specific criteria for defining receptor sensitivity/vulnerability and impact magnitude.

Evaluation of Significance

The significance of the potential effect on receptors/resources is determined through the combined consideration of:

- **the importance of the affected environment and its sensitivity/vulnerability to the particular impact being assessed, and**
- **the magnitude of the potential impact.**

Note that the term '**magnitude**' is used as shorthand to encompass various possible dimensions of the predicted impact, such as:

- the nature of the change (what is affected and how);
- its size, scale or intensity;
- its geographical extent and distribution;
- its duration and frequency; -and
- where relevant, the probability of the impact occurring as a result of accidental or unplanned events.

		Sensitivity of Resources/Vulnerability of Receptors		
		Low	Medium	High
Magnitude of Impact	Negligible	Not Significant	Not Significant	Not Significant
	Small	Not Significant	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

There is no statutory definition of significance however, for the purposes of this assessment, the following practical definition is proposed:

An impact will be judged to be significant if, in isolation or in combination with other impacts, the effects will be a notable change from baseline conditions and may require mitigation to management environmental/social effects and risks.

Magnitude and vulnerability/sensitivity will be looked at in combination to evaluate whether an impact is significant and if so its degree of significance. The principle is illustrated here.

The impact assessment process evaluates both beneficial and adverse impacts, however the magnitude rating is only assigned for adverse impacts.

Residual Impacts/Effects

Is it still significant?

Once mitigation has been identified, a re-assessment of impacts to determine the magnitude and significance of any residual effects (after mitigation) will be undertaken.

The results are represented in the EIA Report, with an explanation of how the impacts have been reduced to as low as reasonably practicable (ALARP) levels.

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Figure 7 Environmental Impact Assessment Method

Table 2 Summary of Impacts and Mitigation Measures

Issue	Impact Summary	Key Mitigation Measures	Residual Impact
Seabed impacts on the benthic environment.	The Project will have a physical footprint on the seabed through placement of infrastructure during the construction and commissioning of subsea infrastructure and from the permanent presence of some of this infrastructure. This will result in habitat loss, sediment disturbance, disruption to defined areas of the seabed and impacts on seabed habitats and species that rely on these habitats.	The layout of the subsea infrastructure will be designed to avoid seabed features such as reef areas and areas of potential geo-hazard which will potentially have more diverse habitats and species. Most in-field subsea flowlines and the gas export pipeline will be laid directly on the seabed and flowline burial using methods such as dredging and jetting which creates sediment plumes will be avoided.	Not significant
Underwater sound.	The Project will be the source of underwater sound from a number of activities including drilling, facilities installation and operation. Noise impacts will occur mainly to marine mammals but also to a lesser extent to turtles and fish.	Vessels will not be allowed to intentionally approach marine mammals and, where practicable, will alter course or reduce speed to further limit the potential for disturbance. Marine mammal observation and monitoring programme at and in the vicinity of its operations to obtain additional information on marine mammal distributions in the area using vessels operating in the field.	Minor significance
Aerial noise impacts on natural populations.	Close to sensitive receptors the main potential impacts will be from general port activities involving Project vessels and helicopter flights to and from the offshore Project area.	Helicopter flight planning will make provisions to avoid sensitive areas of population and nature conservation. Pecan Energies will assure that the helicopter operator follows national and local regulations and restriction regarding flight routes.	Not significant
Lighting and flaring impacts mainly on birds, but also fish and turtles.	Lights (and flaring when used) on the MODU, FPSO and support vessels could potentially attract, disturb and disorientate seabirds and turtles feeding or passing through the area. Attraction or disorientation could increase the risk of collisions with the drill ship, FPSO and other vessels.	The requirements for lighting and use of flaring will be dictated by operational safety. Light will use the lowest intensity lighting appropriate for the task. Closed flare with no pilot flame. No operational flaring, except for during start-up, maintenance, gas injection downtime and when required for safety reasons.	Not significant
Risk of collision with marine mammals and turtles.	Large fauna swimming at or near the sea surface are most likely to be at risk from collision with the Project vessels. Turtles and species of larger, slow-moving whales are usually considered to be most at risk from vessel collision.	Measures for reducing vessel-animal collision risk will include direct observation, communication and navigational responses, particularly speed restrictions when the risks of collision are expected to be high. Support and supply vessels will adopt observation as part of regular navigation, communication and navigational responses, to reduce collision risks with marine mammals and turtles.	Not significant

Issue	Impact Summary	Key Mitigation Measures	Residual Impact
Emissions from vessel engines, impacts on air quality.	The Project will emit various pollutants to atmosphere as a result of combustion products (e.g. from power generation, vessels' engines) and from processes on board the FPSO. There is also the potential for fugitive emissions (e.g. volatile organic compounds during loading of oil to the shuttle tankers). However, it is a large distance from sensitive coastal receptors. Emissions from shore-based activities will be negligible compared with existing terrestrial emissions.	The FPSO, drill ship, construction vessels and supply vessels will comply with MARPOL standards with regards to emissions to air. The Project will use low NOx GTGs and use marine diesel fuel. Methods for controlling and reducing leaks and fugitive emissions, such as the use of fuel gas for crude oil storage tank blanketing together with a vapour recovery unit, will be implemented. Routine flaring will be avoided, and non-routine flaring will be kept to a minimum to maintain safe conditions or during short-duration activities such as commissioning, start-up, re-start and maintenance activities.	Not significant
Greenhouse gas emissions.	Project activities will emit varying amounts of Greenhouse Gases (GHGs) (e.g. carbon dioxide and methane, which contribute to global climate change). GHG emissions have been estimated for the Project and include well drilling and completions, subsea and FPSO installations, commissioning and operations.	The mitigation measures aimed at reducing GHG emissions to as low as reasonably practicable are built into the design of the FPSO and focus predominantly on: • efficiency of power generation; • optimisation of overall energy efficiency; • reduction in flaring; and • reduction in venting.	Moderate significance
Drilling discharges (fluids and cuttings).	Impacts on sediment and water quality and associated benthic and water column fauna. Modelling shows that small areas near the drill ship will be affected.	Solids control systems will be used, including dryers to reduce oil on cuttings to a target of 2 to 5% based on the Best Available Technology assessment undertaken by Pecan Energies. Measures will be taken to comply with Project effluent guidelines, including use of low toxicity (Group III) NADF, no free oil, and limits on mercury and cadmium concentrations.	Not significant
Well completion and workover discharge.	Potential effects on water quality and marine biota.	Chemical selection and use will be advised by the EPA (2011) Guidelines for Environmental Assessment and Management in the Offshore Oil and Gas Development. Completion fluids will be tested for total oil and grease content to ensure that it is below the specification for discharge to sea (i.e. 40 mgl^{-1} or the 30-day average of 29 mgl^{-1} as per EPA guidance. If the fluids exceed the specification, they will be retained on the vessel and shipped for onshore disposal.	Not significant

Issue	Impact Summary	Key Mitigation Measures	Residual Impact
Black and grey water discharge.	Discharges of black water (from toilets) and grey water (from washing, laundering, bathing and showering) and macerated food waste. Potential effects on water quality and marine biota.	Black water will be treated using a marine sanitation device that treats the waste and produces an effluent with a maximum residual chlorine concentration of 0.5 mg l^{-1} and no visible floating solids or oil and grease. Food wastes will be macerated to acceptable levels such that they will pass through a 25 mm mesh.	Minor significance
Hazardous deck drainage from drill ship and FPSO.	Residual hydrocarbon content after treatment. Impacts on water quality and marine biota.	Hydrocarbon contaminated fluids will be routed to a hazardous drain tank with oil/water separation. Process fluids sent to the hazardous drain tank will not be recycled into the process unless approved.	Minor significance
Non-hazardous deck drainage discharge from various Project vessels.	Occasional impacts on water quality and marine biota near the vessels.	Non-hazardous drains will be provided with removable covers to prevent debris from entering the drains systems. The system will have provision for biocide treatment.	Not significant
Bilge water discharge from various Project vessels.	Occasional impacts on water quality and marine biota near the vessels.	Treatment in the bilge water separator to achieve no free oil and maximum 15 parts per million instantaneous reading oil water threshold.	Not significant
Ballast water discharge from various Project vessels.	Occasional impacts on water quality and marine biota near the vessels.	Discharges will meet the requirements of the International Convention for the Control and Management of Ships' Ballast Water and Sediments. Project vessels will have onboard and implement a Ballast Water Management Plan.	Not significant
Discharges of pre-commissioning treated seawater from flooding, cleaning and gauging flowlines, hydrotest and leak tests and pre-commissioning gas system dewatering fluids.	Impacts on water quality and marine biota close to the seabed points of release. The larger volumes discharged during hydrotesting may lead at most to temporary, small, localised effects on benthic communities.	Chemicals will be chosen to be minimise impacts on the aquatic environment in accordance with the EPA (2011) Guidelines for Environmental Assessment and Management in the Offshore Oil and Gas Development.	Minor significance
Discharges of production system commissioning fluids from FPSO.	A small-volume one-off discharge with impacts on temporary, small, localised effects water quality and marine biota.	Treated water will be processed on the FPSO via the oil in water treatment system. Diesel / crude will be routed to the crude oil stock tanks.	Not significant
Releases of hydraulic fluid.	Occasional infrequent release of small quantities of low-toxicity fluids with temporary localised impacts on water quality and marine biota.	The subsea control system will use a water-based hydraulic fluid that is biodegradable with low toxicity and minimal impact to the marine ecosystem rated yellow according to the Ghana Guideline on Environmental Assessment and Management (EPA 2011).	Not significant

Issue	Impact Summary	Key Mitigation Measures	Residual Impact
Discharge of cooling water from FPSO.	The discharge will introduce a temperature differential and residual chlorine with impacts on water quality and marine biota. Modelling shows adequate dilution within 500 m.	Chlorine dosage will be kept to the minimum required to achieve disinfection and will be verified through monitoring.	Not significant
Discharge of produced water from FPSO.	Residual hydrocarbon content after treatment will have impacts on water quality and marine biota. Modelling shows the impacts will be over a small area. Mobile species will tend to avoid or be less exposed than plankton.	Produced water will be continually monitored and if oil in water exceeds the daily limit of 40 mgl^{-1} or the 30-day average of 29 mgl^{-1} as per EPA (2011), the water will be routed to the off-specification tank for further treatment prior to any discharge.	Minor significance for plankton
Potential impacts on the marine and onshore environment from waste segregation and storage.	The Project during its various stages will produce a variety of wastes that will require handling both offshore and onshore. Inappropriate or inadequate storage of wastes could lead to impacts on the marine and terrestrial environments.	There will be designated areas for the temporary storage and segregation of waste on the FPSO, drill ship and supply vessels. The onshore bases at Takoradi Port and the Air Force base will also have designated secure waste reception and temporary storage facilities. The key procedures for controlling wastes from offshore and onshore will be set out in the Project WMP.	Not significant
Potential impacts on the marine and onshore environment from transport of waste.	The Project during its various stages will require wastes to be transported to port and then from port to waste management facilities. Inappropriate or inadequate handling of wastes during transport could lead to impacts on the marine and terrestrial environments.	Mitigation of potential impacts during waste transport will be by the way of operational controls. These will be documented in the Project WMP.	Not significant
Potential impacts on the environment (onshore) from the treatment and disposal of waste.	Even with the application of reuse and recycling as part of Project waste management procedures there will be residual hazardous and non-hazardous wastes that require disposal.	Only EPA approved contractors providing waste treatment and disposal services will be selected. Periodic audits of third-party waste facilities and sites will be undertaken. Waste will be tracked, treated and disposed in accordance with procedures outlined in the Project WMP.	Minor significance
Impacts on fishing activity due to the presence of the Drill ship and FPSO.	The Project area is in an offshore area in water depths that precludes trawling or other bottom fishing activities. Pelagic fishing methods are used in these areas, mainly targeting large oceanic species, using passive gear (longlines) and active gear (pole and line, purse seines).	CLOs will liaise between fishermen and the Project to provide information to fishing communities and deal with any grievances. Mariners will be notified of the presence of the FPSO, MODU and other marine operations within the Project area and the safety and advisory areas will be marked on nautical charts as cautionary advice to all sea-usersThe safety zones will be monitored by Pecan	Not significant

Issue	Impact Summary	Key Mitigation Measures	Residual Impact
		Energies with the assistance of the agencies of the Government of Ghana.	
Impacts on fishing activity due to the movement of vessels between Pecan field and shore.	Vessels in transit could interfere with fishing activity over a wider area, including smaller fishing vessels nearer to shore.	A vessel transit route will be agreed with the Ghana Maritime Agency and communicated to fishermen and other marine users through the CLOs.	Minor significance
Benefits to Ghana nationally from increased Government revenue.	The primary economic impact of the operational phase of the Project will be the payment of taxes and royalties related to the income production by the Pecan Project.	Good governance and fiscal management are the key measures for Ghana's benefit from the economic gains by the royalties and taxes paid by the Project. The absolute value of oil will depend directly on market prices. Pecan Energies will work with the Government of Ghana to make payments of taxes and royalties in a transparent and accurate manner, utilising sound financial principles and accounting processes.	Moderate significance (positive)
Potential benefits from employment and skills development.	The Project is expected to contribute to the creation of direct and indirect employment opportunities in the Western Region. Given the nature of the Project's activities, the majority of the jobs will need to be filled with qualified and experienced personnel.	Pecan Energies will seek to enhance local employment and skills development from direct and indirect employment through the development of an Employment and Training Plan as part of the Local Content Management Plan.	Minor significance (positive)
Opportunities to provide benefits through the procurement of goods and services.	During the lifetime of the Project there will be procurement of goods and equipment (e.g. food, fuel, chemicals and other consumables), and services (e.g. onshore administrative support, accommodation staff, security, catering, cleaning) from national and, where possible, local businesses.	Additional measures will be included into the Local Content Plan in order to enhance procurement of goods and services from companies in Ghana.	Minor significance (positive)
Protection of workers' rights.	Workers' rights, including occupational health and safety, will be addressed to avoid accidents and injuries, loss of man-hours, labour abuses and to ensure fair treatment, remuneration and working and living conditions. These will apply to those who are directly employed by Pecan Energies and its contractors (including sub-contractors) and within the supply chain.	Pecan Energies has developed a People Policy, , company Code of Conduct, including contractor requirements for hiring, workers' rights, terms and conditions and monitoring of compliance with these requirements.	Minor significance

Issue	Impact Summary	Key Mitigation Measures	Residual Impact
Impacts on commercial shipping.	Additional vessel movements associated with the Project could arise as a potential source of impact on existing navigation and shipping traffic in the area. During the installation phase more vessels will be involved, and impacts would therefore be largest during this phase.	Pecan Energies will develop a Marine Traffic Management Plan which will also consider vessel movements associated with other Projects in the area as well as fishing and commercial shipping traffic. The plan will aim at reducing risk of vessel collision and minimising inconvenience to other sea users through a number of Project-specific measures.	Minor significance
Potential impacts on community health, safety, and security.	Onshore activities associated with the Project could affect the health, safety and security of the communities around the shore base facilities (e.g. worker-community, interactions, traffic movements, pressure on health care resources).	Pecan Energies has developed a Health Safety Security and Environment (HSSE) management approach outlining its responsibility for its personnel by means of systems. CLOs will inform local fishermen from the coastal communities of the offshore activities, locations, vessel movements, routes and timing, as well as the safety reasons for keeping away from operational areas.	Minor significance
Potential impacts from an influx of job seekers.	The expansion in communication, energy, transportation, water and sanitation, the social interactions of people and the development of the oil and gas industry over the past years, mainly based in STM, act as a pull factor to attract migrants into the city from different parts of the country. As the development of the oil and gas sector continues, additional influx of employment seekers can be expected into STM and surrounding areas.	Facilitated by its Stakeholder Engagement Plan, Pecan Energies will seek to develop strong partnerships with government agencies, traditional authorities, district assemblies, youth groups, non-governmental organisations, community-based organisations, civil society, fishing communities and other relevant stakeholders. In all its Corporate Social Responsibility projects, Pecan Energies will seek to actively engage affected stakeholders and local communities.	Minor significance
Risk of heightened and unmet expectations regarding potential benefits.	People in the Western Region are anticipating that oil and gas developments in the region will provide employment opportunities. More specifically, the communities are expecting that jobs will be made available for the youth who are unemployed or who are employed but seeking alternate employment.	Implementation of the Stakeholder Engagement Plan will be the key mitigation measure to redress public perceptions about potential Project benefits and to addressing public expectations related to development opportunities and investments.	Minor significance
Impacts on local communities from shore-based activities.	In addition to the expansion of the existing offices in Accra, the Project will establish a base within Takoradi port, comprising the use of a supply vessel berth, offices and material storage and laydown areas. These will all be within the existing established complex. In addition, accommodation in Takoradi for Pecan Energies staff will be required.	Pecan Energies will undertake periodic audits and reviews of its and its contractors' shore-based operations to review site EHS performance and take corrective actions as required. A Traffic Management Plan will be developed including a number of Project-specific measures.	Minor significance

Issue	Impact Summary	Key Mitigation Measures	Residual Impact
	Existing facilities will be adequate to support the Project and therefore no new-build infrastructure dedicated to the Project will be required.	Pecan Energies' CLOs will disseminate information about the Project to the community and process any suggestions, complaints or grievances received.	
Impact on Cultural Heritage.	Offshore, there are no historical records of wrecks sites in the Project area or evidence of wreckage from the site surveys undertaken. The location of shore-based offices will be within existing facilities at Takoradi port therefore there is minimal potential for impacts, therefore no mitigation is required.	For offshore operations a chance find procedure will put in place for any installation activities in areas not previously surveys.	Not significant
Offshore cumulative impacts.	The offshore impacts from the Project are generally localised to the Pecan field area, and specifically at the FPSO and subsea infrastructure locations. The Pecan field is some distance from other offshore oil and gas activity and the potential for impacts on the same receptors is limited.	The mitigations measures presented under the individual Project impacts in this table are also relevant to controlling cumulative impacts.	Not significant.
Onshore/nearshore cumulative impacts.	Closer to shore the support and supply vessels for the Project will add to the general maritime traffic moving between oil and gas fields and shore bases and cumulative impacts on other sea users (including fisheries). Onshore, the potential exists for both positive and negative impacts, particularly if Takoradi continues to develop as a base to serve a growing offshore oil and gas industry.	Strategic actions by government and industry will be required to manage nearshore/onshore impacts if the oil and gas industry develops further in Ghana.	Minor significance
Navigation Risk.	The drill ship and the FPSO present a hazard to passing third party shipping (as well as to supply, support and standby Project vessels and the visiting offloading tankers). Collision between vessels of sufficient energy could lead to injuries, fatalities, loss of assets and release of harmful materials (especially fuel oil or crude product oil) to sea.	The Project vessels will adhere to standard navigational procedures while on station, together with Project-specific operational procedures in accordance with the International Guidelines for Offshore Marine Operations. Details of the planned drilling programme and production operations will be notified to other sea users through the Notice to Mariners system, as well as through navigation communication systems.	Collision risks are assessed as being low.

Issue	Impact Summary	Key Mitigation Measures	Residual Impact
Oil spill and potential consequences to the marine and coastal environments (natural populations and humans uses).	The risk of an oil spill into the marine environment is inherent in all offshore oil developments. The likelihood (probability) of significant oil spills, i.e. those that can reach the shoreline or other sensitive areas from the Pecan Project area is very low with most oil spills associated with offshore installations being small and having only limited environmental effects. Oil spill scenarios for the Project have been modelled.	Mitigation of oil spill incidents will be addressed through the implementation of oil spill prevention and oil spill preparedness measures. Pecan Energies will be responsible for ensuring that oil spill risks have been fully considered and addressed to the extent that residual risks have been reduced to as low as reasonably practicable (ALARP). Pecan Energies will have in place the fundamental components of preparedness and response, including an OSCP which sets out the strategy and procedures that will be taken in the event of an oil spill. The OSCP will be based on the standard 3-tiered response approach.	All four spill scenarios examined (which included a worst case) are rated as risk level: 'tolerable if as low as reasonably practicable'.

6 Mitigation and Monitoring

A key objective of the EIA is to develop and describe practical, commensurate and cost-effective mitigation measures that avoid, reduce, control, remedy or compensate for potential negative impacts and to create or enhance potential positive impacts such as environmental and social benefits. For the purposes of this EIS the term mitigation measures has been used to include aspects of the design, engineering controls and procedures, and operational plans and procedures.

The objectives of mitigation have been established through legal requirements or industry good practice standards and where standards were not available, project-specific standards have been established.

The approach taken to defining mitigation and management measures is based on a hierarchy of decisions and measures. The majority of mitigation and management measures fall within the upper two tiers of the hierarchy and are effectively built into the design of the project. Table 2 summarises the key proposed mitigation measures together with the impact assessment.

The focus of mitigation is to avoid or reduce negative impacts through the Project design. Where that is not practicable then operational and management measures are taken to reduce the magnitude of potential impacts. The final approach in the mitigation hierarchy is to respond to significant impacts that may occur such as through Emergency Response Plans or repair or remedy actions. This can include compensation for loss or damage.

A series of monitoring programmes are proposed. The overall objectives of the Monitoring Plan will be to:

- verify predictions made in the EIA;
- verify that mitigation measures are effective and implemented in the manner described in the EIS; and
- inform future operations and contribute to continuous improvement in the management of environmental and social issues related to the Project.

Through the process of inspection, monitoring and auditing, Pecan Energies will seek to ensure that the requirements of the ESMP and its applicable standards, procedures and guidelines are complied with.

Specific monitoring requirements will apply to the various Project phases such as drilling, installation, commissioning, operations, and decommissioning. This will include a schedule for HSSE and quality audits / inspections of the principal contractors and primary supply chain facilities, who will also be required to establish a similar schedule for their activities and those of any subcontractors and suppliers. The frequencies of inspection, monitoring, audits and reporting will be based on Project risk management requirements and standard industry practices.

In addition to routine reporting, a bi-annual monitoring report, aggregating the data produced by the other reporting processes, will be submitted to the Ghana Government (Petroleum Commission and EPA), Project Partners and lenders.

7 Environmental and Social Management Plan

7.1 Introduction

The findings and outcomes of the EIA process will be implanted through a Pecan Project ESMP. The outline ESMP presented in the EIS will inform the Project ESMP to be developed by Pecan Energies to cover the implementation of the Project following its approval.

The overall objective of the Project ESMP will be to ensure that mitigation measures identified and committed to in this EIA and in any subsequent studies are translated into

practical management actions, which can be adequately implemented, resourced, monitored and reported against through all phases of the Project.

The ESMP will be applied to all phases of the Project including onshore logistics; drilling; offshore construction, installation and pre-commissioning; production; and decommissioning.

7.2 Roles and Responsibilities

Pecan Energies is accountable for ensuring that contractors and suppliers appointed to deliver the Project also deliver relevant commitments made in the ESMP. Using a team of Technical and HSSE professionals, Pecan Energies will tender and appoint companies to deliver the Project. The contractor selection processes will include the review of contract specific HSSE aspects.

The contractors will mobilise sufficient resources to deliver their activities for the Project in accordance with the commitments laid out in the Project ESMP. All contractors will identify and define roles, responsibility and authorities, and ensure that human, technical and financial resources are provided to enable compliance with the ESMP requirements.

7.3 Proposed Management Plans

The key management plans to be developed as part of the Project ESMP are listed below based on the mitigation measures and management actions required to address the potential impacts identified through the EIA process.

- Waste Management Plan.
- Chemical Management Plan.
- Greenhouse Gas and Energy Management Plan.
- Traffic Management Plan (including onshore and marine traffic).
- Stakeholder Engagement Plan (including Grievance Mechanism).
- Pecan Local Content Plan.
- Workers Management Plan.
- Recruitment, Employment and Training Plan.
- Community Health, Safety and Security Management Plan.
- Decommissioning Plan.
- Emergency Preparedness and Response Plan for Ghana operations (including Oil Spill Contingency Plan).

In addition, there will be a number of other plans to address standard operational requirements. These will include the following.

- Audit and Verification Plan.
- Project Monitoring Plan.
- Cultural Heritage Plan (including Chance Finds Procedure).
- Onshore Security Plan.
- Safety Zone Management Plan.
- Ballast Water Management Plan.
- Supply Chain Management Plan.

- Resource Efficiency and Conservation Management Plan.
- Retrenchment Plan as part of Pecan Energies Ghana Ltd. Employee Handbook.

8 Summary and Conclusion

8.1 EIA Process

This EIA for the proposed Pecan Project was undertaken in accordance with the Ghanaian Environmental Assessment Regulations. An EIA is mandatory for an oil and gas field development and the scope of this EIA includes drilling, installation, commissioning, operation and decommissioning project phases.

Potential impacts were assessed as being significant or not significant. Impacts that were assessed as significant were rated as being of Minor, Moderate or Major significance. The assessment considered the magnitude of impacts, and sensitivity, importance or value of the affected resource or receptor. The assessment of impacts considered mitigation measures that have been built into the Project design. Additional mitigation measures were identified to reduce the severity of identified impacts to the extent that was practicable.

8.2 Overall Conclusion

The conclusions of the EIA are that with the proposed mitigation and management measures in place during the design, installation, operation and decommissioning stages of the Pecan Project all impacts of Major significance can be avoided and impacts of Moderate and Minor significance reduced to as low as reasonably practicable levels, through design, use of control technology and operational management controls. Positive impacts include increased government revenue, employment and skills development and procurement of goods and services.