

EXECUTIVE SUMMARY

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Environmental Impact Assessment (EIA) for the Proposed Sapih, Tiram and Wangsa Development, Block SK311, Offshore Sarawak



Project Proponent



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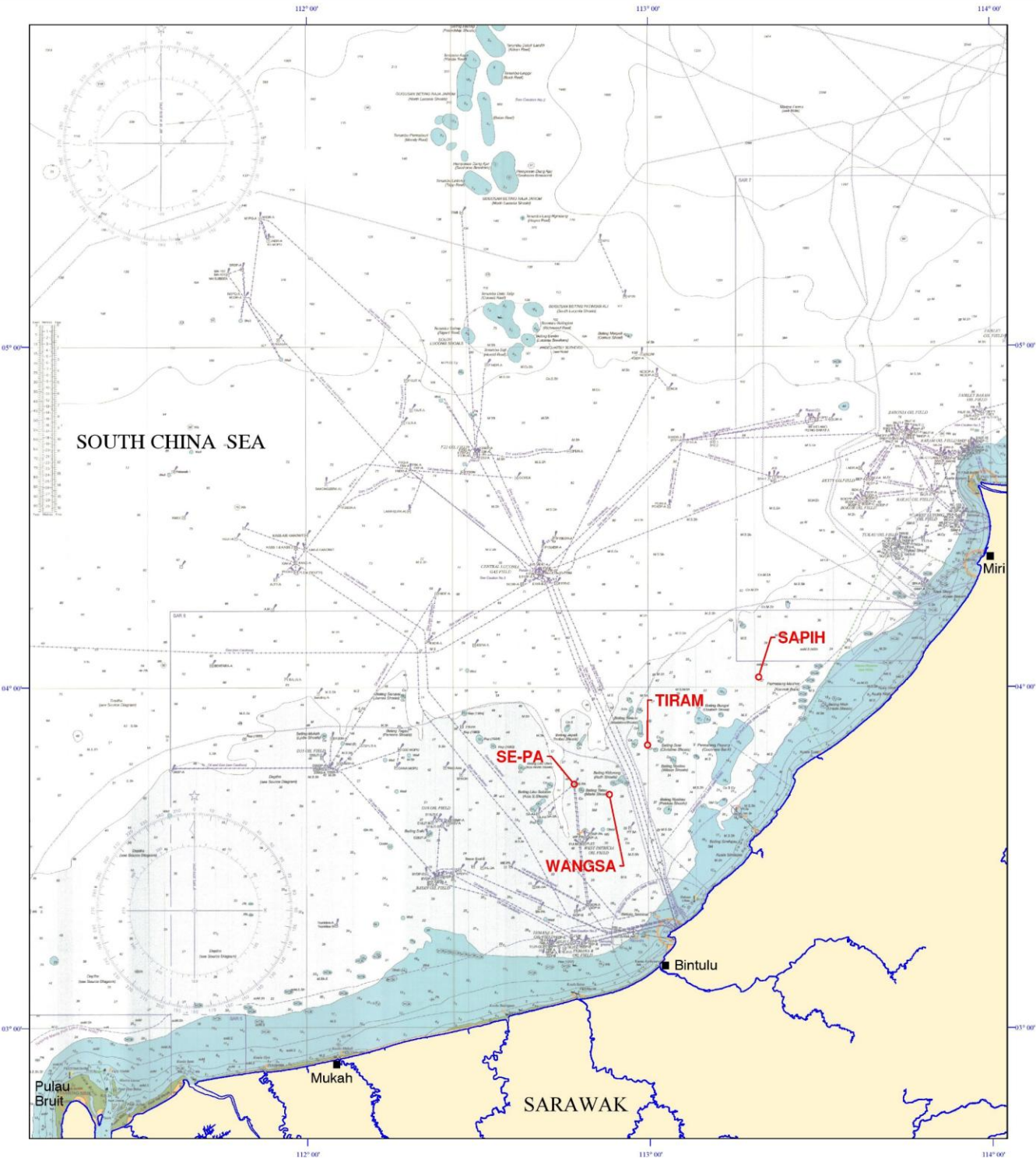
Introduction

- PTTEP Sarawak Oil Limited operates the SK309 and SK311 shallow-water gas fields (20–50 m) off Sarawak, with the STW Fields Development Projects driving production under the PSC with PETRONAS, including GSA Phase IV
- STW fields are located approximately 98 km northeast, 71 km north and 58 km northwest of Bintulu
- The EIA scope covers (i) Three 3 Wellhead Platforms (WHPs) which are SP-SA, TR-SA and WG-SA respectively, (ii) Export pipelines for each gas field, and (iii) Modifications for the host tie-in to the existing Serampang Production A (SE-PA) platform.

Coordinates of Sapih, Tiram and Wangsa (STW) Platforms

No.	Platform	Datum: WGS84		Water Depth (m)
		Latitude	Longitude	
1.	Sapih (SP-SA) WHP	4°01'41.95"	113°19'19.69"	33.5
2.	Tiram (TR-SA) WHP	3°49'45.96"	112°59'49.55"	36.1
3.	Wangsa (WG-SA) WHP	3°41'05.12"	112°53'07.44"	46.9

Project Location



LEGEND:
 WHP
 RIVERS / COAST

Legislative Requirement



Environmental Quality (Prescribed Activities) (Environmental Impact Assessment) Order 2015

Item 9 Petroleum

(a) Development of –
(ii) Gas field

(b) Construction of 30 kilometres or more in length of –
(i) Offshore pipeline

Statement of Need



Demand for sustained gas supply; benefiting :

(i) Proponent

Fulfilling PSC & GSA commitments, monetising undeveloped reserves, and supplying gas to MLNG, Bintulu

(ii) Economy

Supporting national energy security, creating jobs, and aligning with Sarawak's strategic and sustainability goals

Project Description

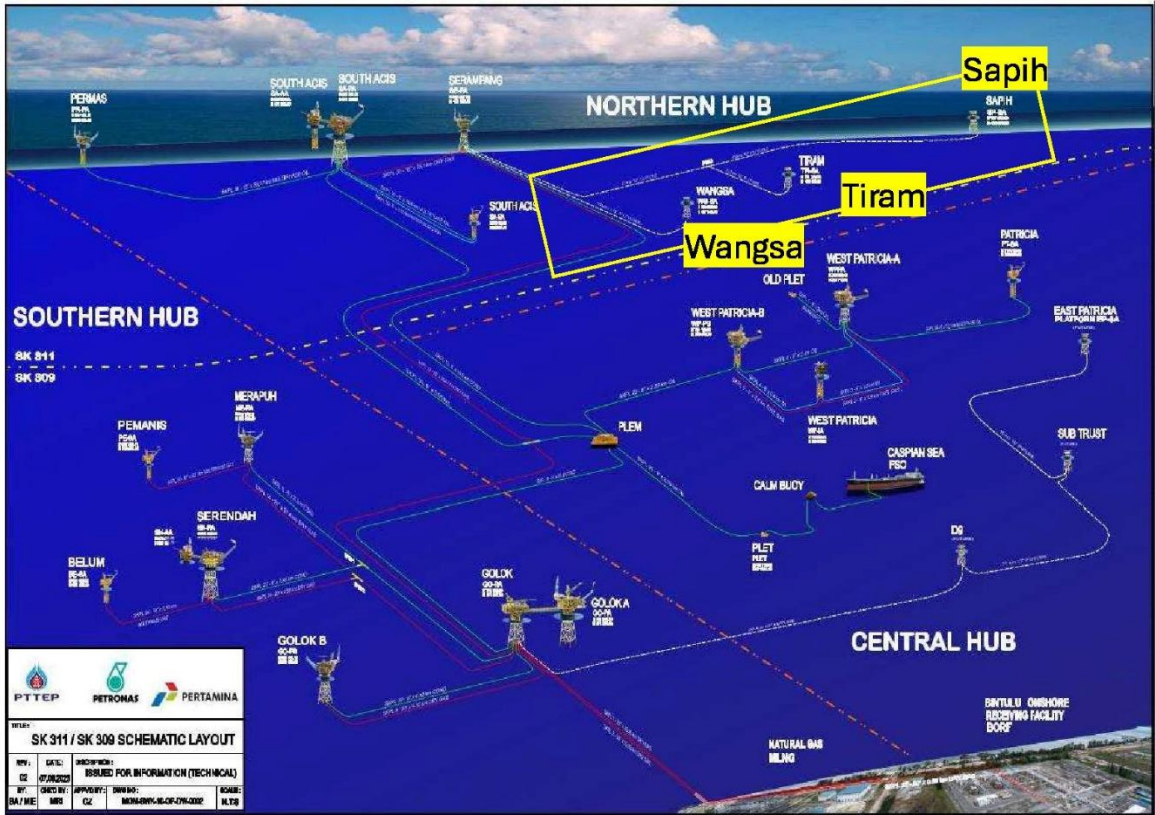
- **Wellhead Platform (WHP):** Three (3) unmanned WHPs at each gas field for Sapih (SP-SA), Tiram (TR-SA) and Wangsa (WG-SA)
- **Pipelines:** (i) Approx. 70 km (12") pipeline from SP-SA to SE-PA; (ii) Approx. 1 km (12") pipeline connecting TR-SA to the main SP-SA/SE-PA pipeline; and (iii) Approx. 12 km (10") dedicated pipeline from WG-SA to SE-PA
- **Modifications:** Modifications at host tie-in, SE-PA

* Future production of approximately **101.0 MMscf/d** (peak production in 2030) from STW fields

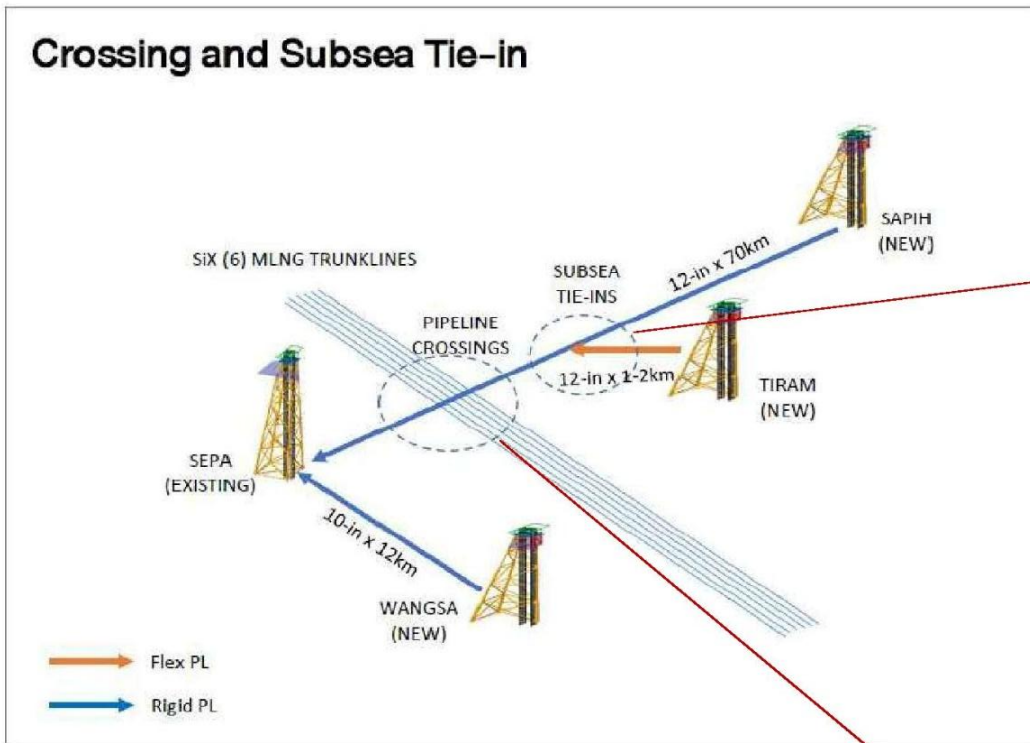
** Gas from STW fields will be transported to the SE-PA platform for initial gas processing before being routed to GO-RA platform, then through the existing 40 km, 20" trunk-line to BORF for final treatment and delivery to MLNG, Bintulu

*** This EIA shall only cover the development of STW fields and the exporting of gas from STW fields to SE-PA.

Project Overview



Overview of STW Fields' Development



Pipeline Crossing and Subsea Tie-In

Gas Evacuation Strategy



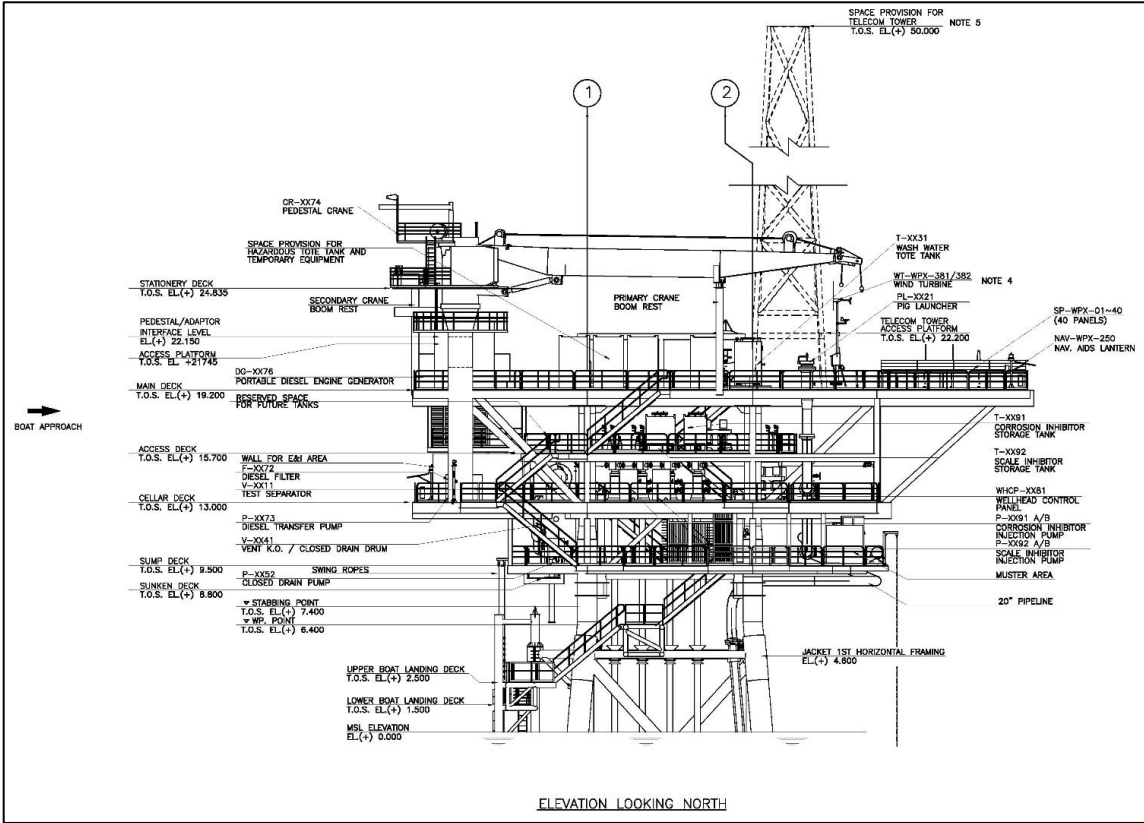
- **Integration with Existing Infrastructure:** Gas evacuation for SP-SA, TR-SA, and WG-SA fields will utilise the SE-PA platform as the central hub.
- Sapih Field: 70 km, 12” subsea pipeline directly to SE-PA.
- Tiram Field: 1 km, 12” tie-in line connecting to SP-SA pipeline, enabling commingled flow to SE-PA.
- Wangsa Field: Dedicated 12 km, 10” subsea pipeline to SE-PA.
- **Processing & Export:** SE-PA to handle initial gas processing; processed gas commingles with other SK309/311 field gas at GO-RA platform.
- **Trunk-line Transmission:** 40 km, 20” trunk-line from GO-RA to BORF for further treatment before delivery to MLNG plant for sale.
- **Benefits:** Efficient, cost-effective, and reliable integration of new developments into the existing gas export network.

Wellhead Platforms (WHPs)

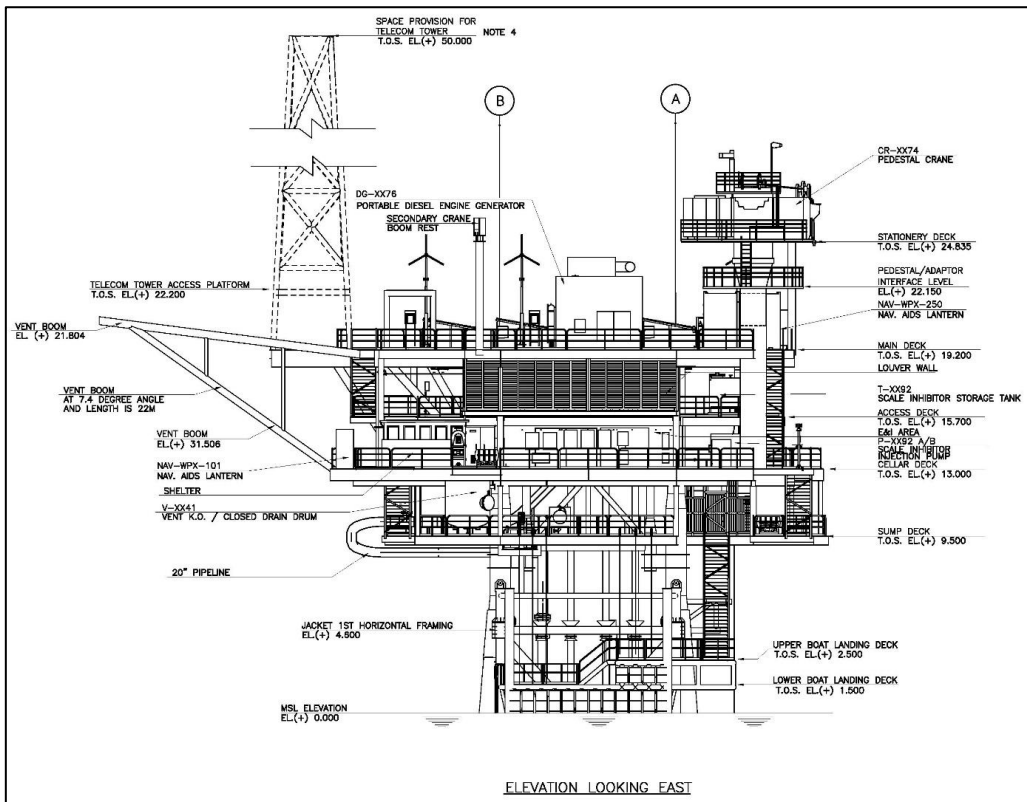


- **Structure & Design:** Four-legged, minimum facilities WHPs designed for not normally manned operations with a 15-year design life
- **Operational Presence:** Personnel visits only for replenishing consumables, planned maintenance, emergency shutdown reset, reconfiguration, and well service activities.
- **Equipment:** Well testing facility, manifold, wellhead control panel, PLC/SCADA on cellar deck.
- **Visit Frequency:** 1-2 times per month depending on operational needs.
- **Control & Monitoring:** All systems *remotely controlled and monitored*; monitoring from WP-FA, SE-PA Local Equipment Room, BORF Central Control Room; control from SE-PA Local Equipment Room and BORF Central Control Room.
- **Special Facilities:** Pig launcher/receiver and test separator for well testing.
- **Capacity & Dimensions:** Topside area 1,500 m²; topside payload 715 MT; crane capacity 15 MT.

Generic Wellhead Platform Equipment Layout



Elevation Looking North



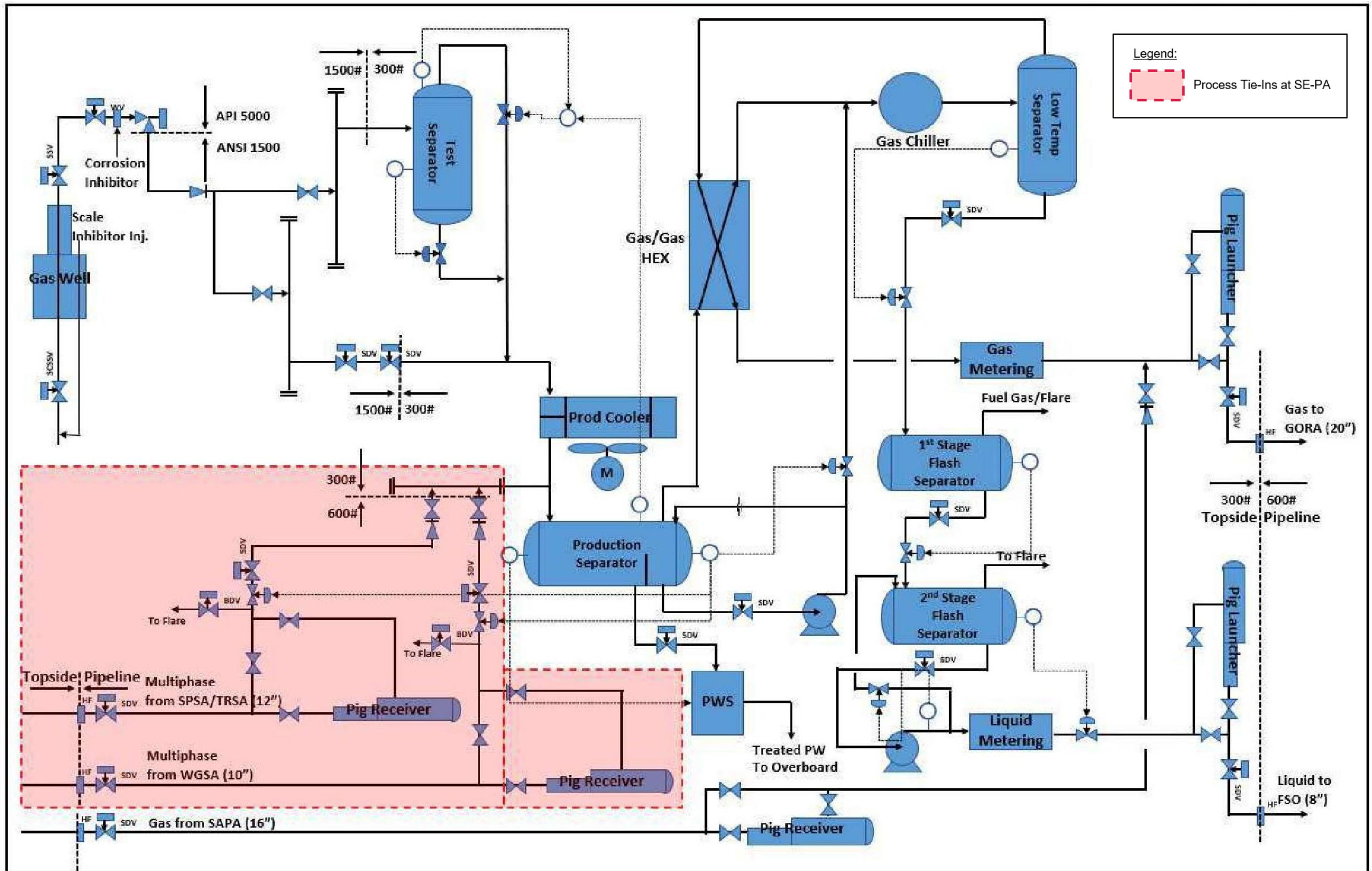
Elevation Looking East

Process Tie-Ins at SE-PA

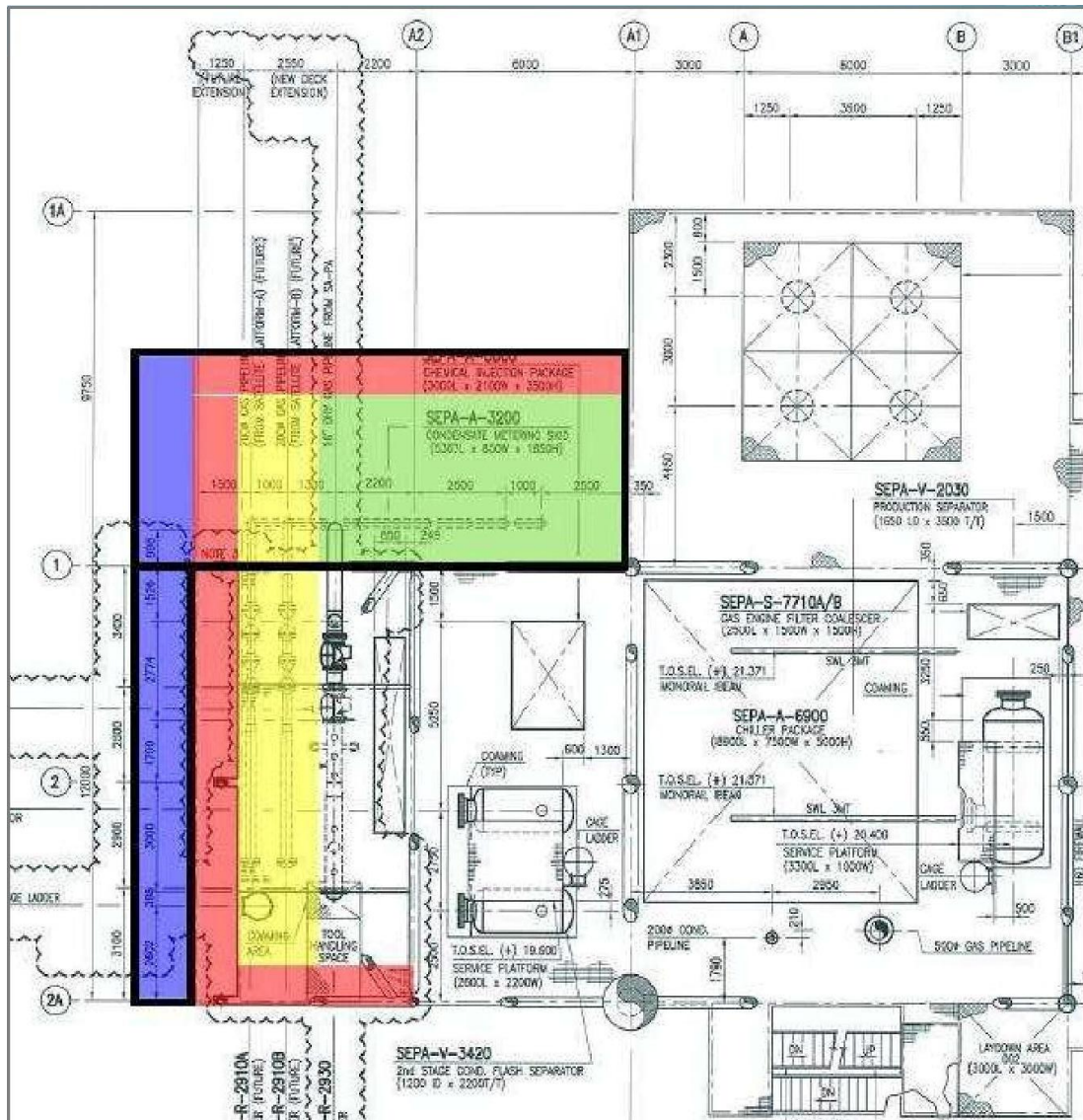


- **Tie-In Scope:** Integration of 12” multiphase pipeline from SP-SA and 10” multiphase pipeline from WG-SA into SE-PA platform via new risers, each with dedicated pig receivers.
- **Upstream Connection:** Incoming pipelines tied in upstream of the production separator to allow full processing through existing SE-PA facilities.
- **Utility Tie-Ins:** Connections provided for closed drain, open drain, vent/flare systems, and instrument air to support safe and reliable operations.
- **Slug Control:** Slug control valves installed to manage flow transients during start-up, shutdown, or operational fluctuations, preventing process upsets.
- **Production Separation:** Commingled multiphase fluids processed in the Production Separator for primary three-phase separation (gas, condensate/oil, produced water).
- **Gas Processing:** Gas routed through Gas Heat Exchanger, Gas Chiller, Low-Temperature Separator, and Gas Metering Skid before export via 20” gas pipeline to GO-RA.
- **Condensate Handling:** Liquids from Low-Temperature Separator processed in 1st and 2nd Stage Flash Separators, metered, and exported via 8” pipeline to FSO.
- **Produced Water Treatment:** Water from Production Separator treated in Produced Water System (PWS) and discharged overboard in compliance with environmental standards.
- **Pigging Facilities:** Pig receivers for SP-SA/TR-SA and WG-SA pipelines provided to maintain cleanliness and integrity of pipelines.
- **Operational Integration:** Design enables seamless incorporation of new STW field production into SE-PA processing systems with enhanced operational flexibility.

Process Schematic at SE-PA



Project Description



Mezzanine Deck Layout at SE-PA

- **Purpose:** The Mezzanine Deck at SE-PA is designed to house pig receiving facilities for incoming multiphase pipelines from SP-SA/TR-SA (12") and WG-SA (10") to enable safe and efficient pipeline cleaning and inspection.
- **Deck Extensions:** Two (2) proposed extensions to accommodate receivers and related systems: 12 m x 2 m (east side) and 14 m x 6 m (northeast side).
- **Piping & Equipment Zones:**
 - Blue-shaded area: pig receiver for SP-SA/TR-SA and WG-SA.
 - Green-shaded area: downstream piping, control valves, and associated components.
 - Red-marked route: designated primary escape route to meet safety and emergency egress requirements.

Project Activities



Transportation and Offshore Installation

Jackets, piles, boat landings, topsides and associated components will be fabricated onshore in Malaysia and transported by barge to site. Offshore installation of WHPs will be carried out by a Heavy Lift Vessel (HLV), followed by pile driving, boat landing installation, and topside placement. Subsea pipelines, risers and spools for SP-SA/TR-SA and WG-SA will be installed using a suitable pipelay barge.

Drilling and Well Clean-up (WCU)

Jack-Up drilling rig will be mobilised to drill 4 development wells each at SP-SA and TR-SA, and 3 wells at WG-SA.

Well clean-up and completion prepare the well for safe production and confirm its performance.

Commissioning and Start-up

Non-hydrocarbon systems will be commissioned first, followed by hydrocarbon systems to confirm readiness.

After start-up checks and testing, hydrocarbons will be introduced in a controlled manner, and production will begin once operations are stable.

Operation and Maintenance

Remote monitoring and control of the STW WHPs will be from SE-PA and BORF control rooms.

Maintenance will be carried out monthly.

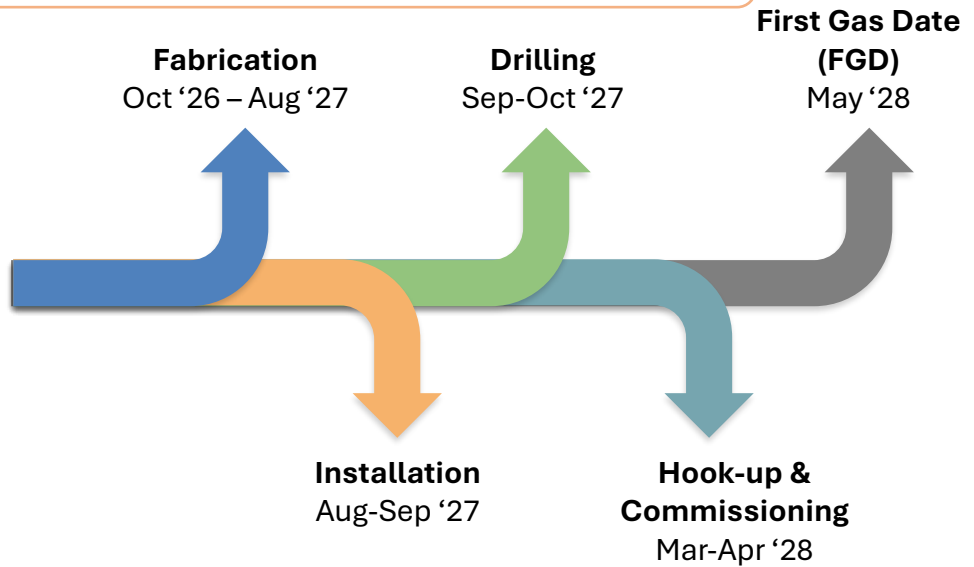
Decommissioning and Abandonment

Decommissioning and abandonment shall be carried out at the end of economic field life of the facility with PETRONAS approval in accordance to the Governing Standard for SFA-PSC-Abandonment and DOE Guideline on Decommissioning of Oil and Gas Facilities in Malaysia.

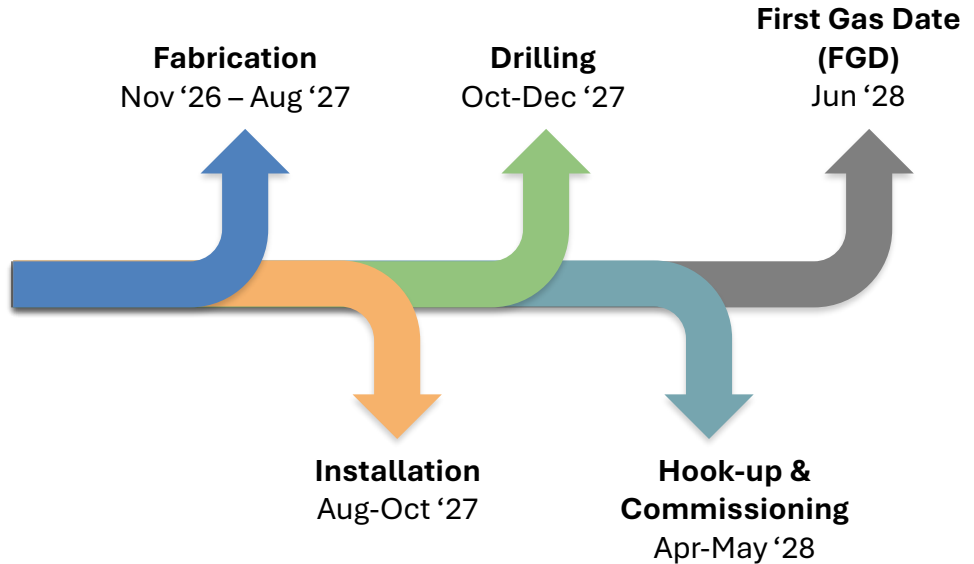
Project Implementation Schedule



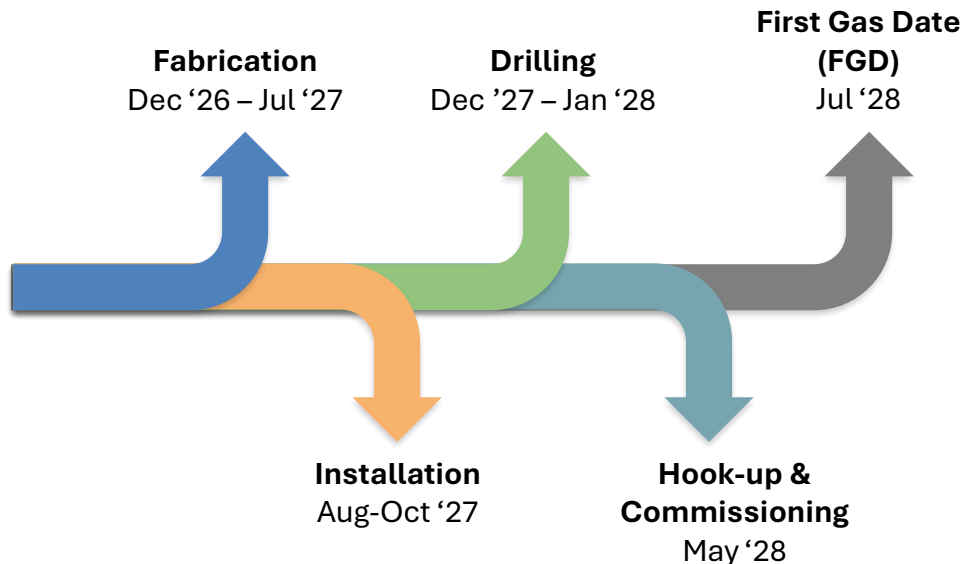
Sapuh
(SP-SA)



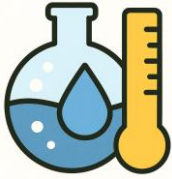
Tiram
(TR-SA)



Wangsa
(WG-SA)



Bathymetry and Seabed Features:



- **Sapih–Tiram Route (42.3 km):** Depths between 30.2 m and 46.9 m MSL; gentle seabed slope with minor undulations, jack-up rig footprints, platform footprints, anchor scars, pockmarks, and small debris; fine-grained sediments; no major hazards.
- **Tiram–SE-PA Route (27.0 km):** Depths between 27.0 m and 38.6 m MSL; smooth seabed, mild undulations, slope $<1^\circ$; features include trawl marks, pockmarks, anchor scars, pipelines and one platform near SE-PA; fine seabed texture; no major obstructions.
- **Wangsa–SE-PA Route (11.8 km):** Depths between 28.3 m and 48.5 m MSL; slopes between 0.24° and 0.35° ; smooth seabed in early section, more irregular later; depressions near KP 2-3 and KP 7-8 may cause free spans; features include jack-up rig footprints, disturbed seabed, coral outcrops, pockmarks, and high-reflectivity zones; alignment planned to mitigate span risks.

Oceanography:



- **Winds:** Offshore Sarawak wind regime is dominated by NE Monsoon (Sept–Apr, stronger winds) and SW Monsoon (Apr–Sept, lighter winds), with transitional periods sometimes producing intense squalls. Tropical cyclones occur mainly July–Sept, with maximum wind speeds >25 m/s.
- **Waves:** Dominant wave direction from north in winter and west in summer; extreme 100-year significant wave heights range between 3.7 m and 5.4 m.
- **Currents:** Monsoon-driven surface currents, cyclonic in NE Monsoon, anticyclonic in SW Monsoon, affected by eddies, upwelling, and occasional tropical cyclones; extreme 100-year near-surface current speeds range between 0.49 m/s and 1.02 m/s.
- **Tides:** Offshore Sarawak experiences diurnal tides, influenced by Pacific Ocean tidal waves entering the South China Sea.

Environmental Baseline Sampling:



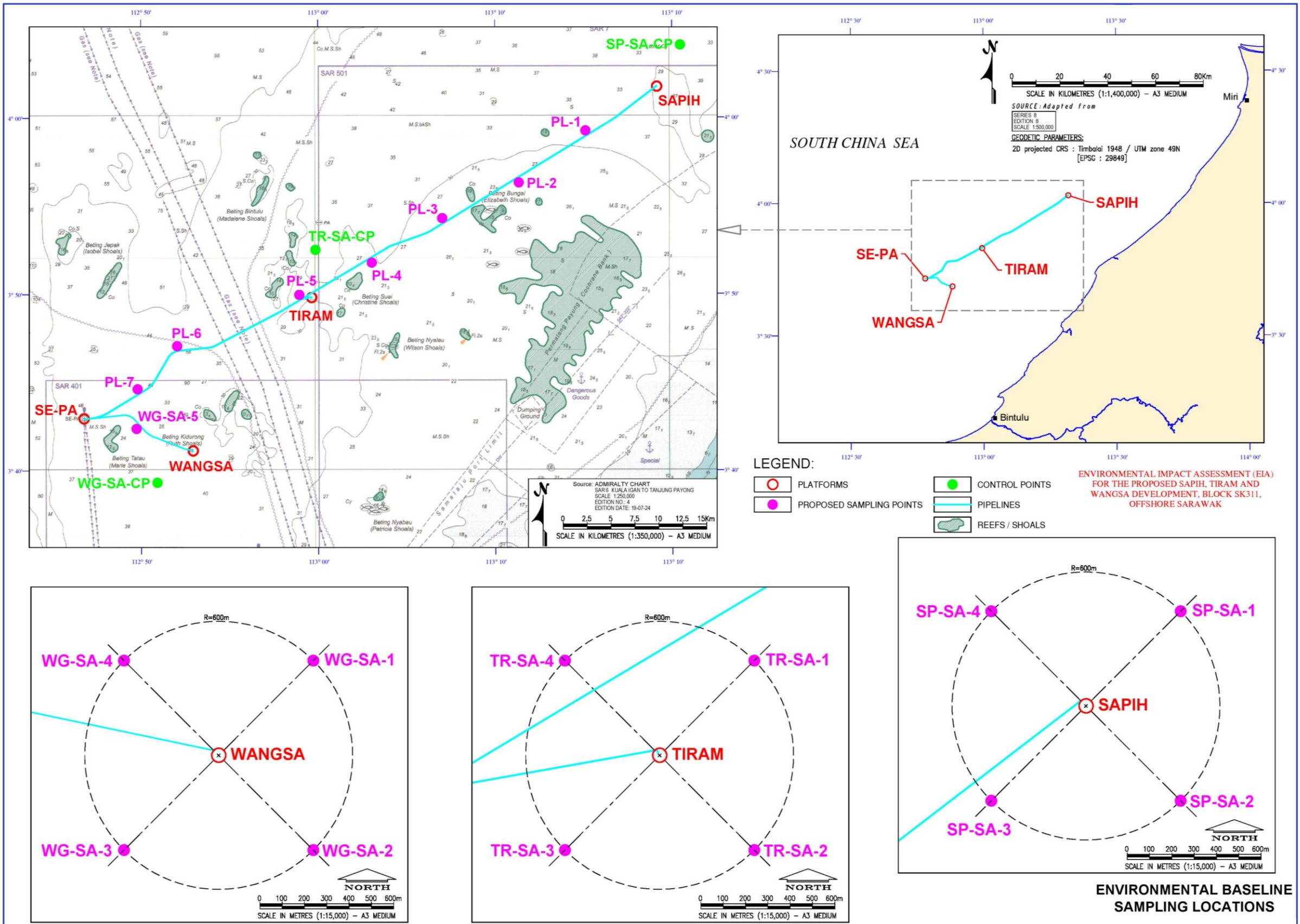
- **Sampling Date:** 31st March to 6th April 2025.
- **Sampling Activities:** Marine Water, Seabed Sediment, Planktons, and Macrobenthos.
- **Sampling Points:**
 - ✓ **SP-SA:** 4 stations at 600 m radius of SP-SA WHP, 1 CP at 5 km NE.
 - ✓ **TR-SA:** 4 stations at 600 m radius of TR-SA WHP, 1 CP at 5 km NE.
 - ✓ **WG-SA:** 4 stations at 600 m radius of WG-SA WHP, 1 CP at 5 km SW, 1 station at WG-SA/SE-PA pipeline corridor.
 - ✓ **Pipeline:** 4 stations along pipeline route between SP-SA and TR-SA; 1 station at 500 m from the tie-in point of the TR-SA pipeline and the main pipeline (SP-SA/SE-PA); 2 stations along pipeline route between TR-SA and SE-PA.
- **Sampling Results:**
 - ✓ **Marine Water:** All tested parameters complied with the Class 3 limits of the MMWQS.
 - ✓ **Seabed Sediment:** All samples were within the NOAA guidelines for most metals, with nickel slightly exceeding the ERL in some samples, hydrocarbons and PAHs undetected.
 - ✓ **Macrobenthos:** considerably diverse and well distributed, with moderate to high species richness dominated by Polychaeta.
 - ✓ **Phytoplankton:** low to moderately diverse, unevenly distributed, with low to moderate species richness dominated by centric and pennate diatoms.
 - ✓ **Zooplankton:** moderately diverse, unevenly distributed, with low to moderate species richness dominated by Arthropoda.

Environmental Sensitive Area:




- **Shorelines:** STW fields are located about 32-46 km from the nearest shorelines and are near existing oil and gas facilities.
- **Key sensitive areas:** Patricia Shoals (35-91 km), Batu Likau Reef (44-76 km), Sarawak Reef Ball (19-38 km), Similajau National Park (41-58 km), and Miri-Sibuti Coral Reefs National Park (16-52 km).



Environmental Baseline Sampling Locations





Potential Impacts and Recommended Mitigation Measures

Significant Potential Impacts		Magnitude of Significant Potential Impacts	Mitigation Measures	Reference Page to EIA Report
	<p>Marine Water Quality during All Phases</p> <ul style="list-style-type: none"> ▪ Sewage from toilets. ▪ Food waste from galley operations. ▪ Ballast water from vessels. ▪ Bilge water from machinery spaces. ▪ Deck drainage from vessel decks. ▪ Improper discharge of wastewater from vessels and rig operations. ▪ Discharge or loss of drilling fluids and cuttings. ▪ Resuspension of seabed sediments during installation activities. ▪ Uncontrolled disposal of solid and scheduled wastes. 	Low	<ul style="list-style-type: none"> ▪ Develop and implement Waste Management Plan for all offshore and onshore activities. ▪ All vessels, rigs, and barges shall comply to all MARPOL requirements for discharges into sea. ▪ Spent Synthetic-Based Mud (SBM) shall not be discharged overboard. ▪ Solids control system on the rig shall be designed and operated to ensure synthetic base oil retention on cuttings is less than 6.9% wet weight, in compliance with PETRONAS Guidelines on MES Rev. 5. ▪ Use only water-based mud (WBM) for riserless drilling sections to minimise hydrocarbon introduction to the marine environment. ▪ All hazardous/scheduled wastes shall be collected and retained onboard for disposal at licensed onshore reception facilities in accordance with the Environmental Quality (Scheduled Wastes) Regulations 2005. ▪ Macerate food waste to not bigger than 25 mm mesh size before discharge into the sea in compliance with MARPOL Annex V; discharges shall only occur when more than 12 nm from shore. ▪ Minimise chemical use during hydrotesting by reducing water holding time in systems. ▪ Select chemical additives based on low toxicity, high biodegradability, and minimal bioaccumulation potential. ▪ Implement spill prevention kits on all vessels, rigs, and platforms, with trained crew ready for immediate deployment. 	<p>Section 7.3.1.1, page C7-10</p> <p>Section 7.3.2.1, page C7-12</p> <p>Section 7.3.3.1, pages C7-18 to C7-20</p> <p>Section 7.3.4.1, Page C7-23</p> <p>Section 8.2.1.2, pages C8-3 to C8-5</p>




Potential Impacts and Recommended Mitigation Measures

Significant Potential Impacts		Magnitude of Significant Potential Impacts	Mitigation Measures	Reference Page to EIA Report
 <p>Waste Impact during Installation, Drilling, Operation and Maintenance Phase</p> <ul style="list-style-type: none"> Improper handling, storage and disposal of non-hazardous wastes. Poor management of hazardous or scheduled wastes. 	Low	<ul style="list-style-type: none"> Implement a comprehensive Waste Management Plan. Manage all scheduled waste as per EQ (Scheduled Wastes) Regulations, 2005. Comply with MARPOL Annex V for garbage management. Segregate, contain, and offload waste to licensed onshore facilities. Prohibit overboard disposal of plastics, hazardous waste, or untreated food waste. Equip all vessels, rigs, and barges with IMO-certified sewage treatment systems per MARPOL 73/78. Discharge sewage only per MARPOL rules, with no visible solids or discoloration. 	<p>Section 7.3.2.2, pages C7-13 to C7-14</p> <p>Section 7.3.3.2, page C7-20</p> <p>Section 8.2.1.2, pages C8-3 to C8-5</p> <p>Section 8.2.2.2, page C8-8</p>	
 <p>Ambient Air Quality during All Phase</p> <ul style="list-style-type: none"> Exhaust gases emitted from diesel-powered engines, drilling rigs, and support equipment. Flaring may occur during unloading as a routine safety measure or emergency response to gas releases. 	Low	<p><u>Installation and Drilling Phase</u></p> <ul style="list-style-type: none"> Optimise installation and drilling schedules to reduce vessel and equipment time. Flare only when necessary, ensuring controlled, complete combustion. All third-party vessels must be serviced regularly and use MARPOL Annex VI-compliant low-sulphur fuel to reduce emissions. <p><u>Operation and Maintenance Phase</u></p> <ul style="list-style-type: none"> No flaring during normal operations. Regularly inspect, tune, and maintain combustion and mechanical equipment to optimise efficiency and reduce emissions. All third-party vessels must be serviced regularly and use MARPOL Annex VI-compliant low-sulphur fuel to reduce emissions. 	<p>Section 7.3.1.4, page C7-11</p> <p>Section 7.3.2.10, page C7-17</p> <p>Section 7.3.3.6, page C7-21</p> <p>Section 7.3.4.4, page C7-24</p> <p>Section 8.2.5.2, pages C8-13 to C8-14</p> <p>Section 8.2.5.3, pages C8-14 to C8-15</p>	


Potential Impacts and Recommended Mitigation Measures

Significant Potential Impacts		Magnitude of Significant Potential Impacts	Mitigation Measures	Reference Page to EIA Report
 <p>Noise Impact during Installation and Drilling Phase</p> <ul style="list-style-type: none"> Underwater noise can cause behavioural changes, mask acoustic communication, and, at high intensities, inflict physiological damage on marine fauna. 	Low	<ul style="list-style-type: none"> Use low-noise equipment and dampening technologies, such as vibration-reduced piling and acoustic attenuation devices. Maintain vessel engines, thrusters, and machinery per manufacturer specs to reduce mechanical noise. Maintain safe distances from ecologically sensitive areas like marine protected zones. 	<p>Section 7.3.2.7, page C7-16</p> <p>Section 7.3.3.4, pages C7-20 to C7-21</p> <p>Section 8.2.4.2, page C8-12</p>	
 <p>Impact to the Seabed during Installation and Drilling Phase</p> <ul style="list-style-type: none"> Subsea pipeline and well installation may disturb the seabed, causing sediment resuspension and surface scarring during laying and anchoring. Jack-up rig drilling may cause localised seabed disturbance from leg placement, anchoring, and discharge of drilling fluids and cuttings, leading to sediment resuspension, seabed changes, and possible residual contamination. 	Low	<p><u>Installation and Commissioning Phase</u></p> <ul style="list-style-type: none"> Plan and execute installation efficiently to minimise seabed disturbance and allow faster natural recovery. Deploy anchors only at pre-determined, surveyed locations to avoid unnecessary seabed damage. Use low-toxicity, biodegradable, and low-bioaccumulation chemicals for pipeline cleaning, conditioning, and hydrotesting. Treat hydrotest water to remove contaminants and ensure discharge meets DOE effluent standards. <p><u>Drilling Phase</u></p> <ul style="list-style-type: none"> Use WBM where feasible, especially for top-hole and riserless sections, and if SBM is needed, choose low-toxicity, biodegradable, low-bioaccumulation base fluids and additives. Choose drilling fluid additives with minimal marine toxicity, high biodegradability, and low bioaccumulation. Discharge drill cuttings 3-5 m below the sea surface to aid dispersion, and operate solids control equipment to maximise drilling fluid recovery and minimise the volume of contaminated solids discharged. 	<p>Section 7.3.2.4, page C7-15</p> <p>Section 7.3.3.3, page C7-20</p> <p>Section 8.2.3.2, pages C8-9 to C8-10</p> <p>Section 8.2.3.3, page C8-11</p>	


Potential Impacts and Recommended Mitigation Measures

	Significant Potential Impacts	Magnitude of Significant Potential Impacts	Mitigation Measures	Reference Page to EIA Report
	<p>Impacts on Marine Ecology during all Phases</p> <ul style="list-style-type: none"> Drilling, piling, substructure placement, and pipeline installation may cause localised disturbance to seabed habitats and marine fauna through sediment resuspension, habitat loss, and pollutant release. The operation and maintenance phase will have minimal, short-term, and localised marine ecological impacts, with activities limited to periodic vessel support and maintenance and no significant disturbance or discharges. 	<p>Low</p>	<p>Besides those mitigation measures addressed for Marine Water Quality, others include:</p> <ul style="list-style-type: none"> Optimise pipeline routing to reduce seabed disturbance and habitat fragmentation. Restrict seabed-disturbing activities (e.g., anchoring, trenching, pipeline installation) to the smallest practicable area. 	<p>Section 7.3.2.3, page C7-14</p> <p>Section 7.3.3.5, page C7-21</p> <p>Section 7.3.4.3, page C7-24</p> <p>Section 8.2.8.1, page C8-23</p>
 	<p>Impacts on Marine Navigation and Fishing Community during all Phases</p> <ul style="list-style-type: none"> Increase of vessel traffic will create short-term navigational risks and potential disruption to other marine users. Vessel activity in the STW fields may temporarily disrupt local fishing by increasing collision risk and degrading water quality, reducing fish abundance and catch near transit routes. 	<p>Low</p>	<ul style="list-style-type: none"> Engage with the Marine Department and MMEA to confirm and communicate drilling rig, platform, and subsea pipeline locations. Coordinate with the DOF to issue notices to local fishermen on restricted areas and activity schedules. Implement a 500 m safety exclusion zone around platforms, drilling rigs, and pipelaying vessels during operations. Communicate offshore work details, including timelines and exclusion zones, via Notices to Mariners, marine radio, and other standard maritime channels. Regularly inspect, test, and maintain all navigational and communication equipment on rigs, platforms, and support vessels. 	<p>Section 7.3.1.2 and Section 7.3.1.3, pages C7-11</p> <p>Section 7.3.2.8, page C7-16</p> <p>Section 7.3.2.11, page C7-17</p> <p>Section 7.3.3.8 and Section 7.3.9, page C7-22</p> <p>Section 7.3.4.6 and Section 7.3.4.7, page C7-25</p> <p>Section 8.2.6.2, pages C8-17 to C8-19</p>


Potential Impacts and Recommended Mitigation Measures

Significant Potential Impacts		Magnitude of Significant Potential Impacts	Mitigation Measures	Reference Page to EIA Report
 <p>Impacts on Health and Safety during all Phases</p> <ul style="list-style-type: none"> Personnel involved in offshore activities face health and safety risks from environmental conditions and operational hazards. 	Low	<ul style="list-style-type: none"> Incorporate safety into the design of all offshore facilities, wells, and systems to minimise hazards. Ensure all offshore personnel pass a PETRONAS AME medical exam before deployment and complete TBOSIET plus any role-specific training to maintain competency. Implement and enforce JSA and PTW systems for all activities to identify hazards and control risks. Maintain and periodically review an offshore-specific ERP covering fire, explosion, medical emergencies, oil spills, and extreme weather. Conduct regular emergency drills (e.g., man-overboard, abandon-ship, fire-fighting) followed by debriefing and lessons learned. Employ only fully trained, certified, and competent personnel for all operational roles. Conduct regular inspection, testing, and maintenance of process equipment per manufacturer and statutory requirements. Perform routine inspections and tests of all fire safety equipment, including extinguishers, blankets, detectors, sprinklers, emergency lighting, and fire-rated doors. Implement a Safety Observation and Intervention Programme to encourage reporting and correction of unsafe acts or conditions. 	<p>Section 7.3.1.5, page C7-12</p> <p>Section 7.3.2.6, page C7-15</p> <p>Section 7.3.3.7, pages C7-21 to C7-22</p> <p>Section 7.3.4.5, page C7-25</p> <p>Section 8.2.7.2, page C8-10 to C8-11</p>	

Potential Impacts and Recommended Mitigation Measures

Significant Potential Impacts	Magnitude of Significant Potential Impacts	Mitigation Measures	Reference Page to EIA Report
 <p>Accidental/Emergency Events</p> <p>Hydrocarbon Spill (Vessel Collision)</p> <ul style="list-style-type: none"> ▪ Hydrocarbon or diesel spills from vessel collisions, adverse weather, or improper fuel transfer near the STW WHPs could release significant volumes into the marine environment. 	<p style="text-align: center;">Medium</p>	<ul style="list-style-type: none"> ▪ Ensure all contracted vessels meet PETRONAS and PTTEP minimum HSE standards and hold valid statutory certification. ▪ Ensure all operational equipment meets international industry standards, PETRONAS Technical Standards, and PTTEP engineering specifications. ▪ Conduct pre-mobilisation audits on all vessels, covering equipment, spill prevention systems, and crew readiness, and verify procedures meeting Project and regulatory requirements. ▪ Develop and implement a site-specific Oil Spill Contingency Plan (OSCP) for STW operations aligned with the National Oil Spill Contingency Plan (NOSCP). ▪ Ensure every vessel carries a Shipboard Oil Pollution Emergency Plan (SOPEP) in line with IMO requirements. ▪ Equip all vessels with spill response materials (e.g., pads, booms, bags) for immediate minor spill containment and clean-up. 	<p>Section 7.3.6.1, page C7-28</p> <p>Section 8.2.9.2, pages C8-25 to C8-31</p>
<p>Drilling Fluids / Chemical Spill</p> <ul style="list-style-type: none"> ▪ Accidental releases of drilling fluids or chemicals during drilling may cause short-term, localised impacts on marine water quality and nearby marine life. 	<p style="text-align: center;">Medium</p>	<ul style="list-style-type: none"> ▪ Place chemical spill kits, absorbents, neutralisers, and booms at strategic points such as storage areas, injection points, and transfer stations. ▪ Ensure spill kits are clearly labelled, accessible, and routinely inspected for readiness. ▪ Provide training to all installation and supply vessel personnel on chemical spill prevention, safe handling, and emergency response. ▪ Designate a centralised chemical injection area for injection skids to reduce spill-prone points on site. ▪ Equip injection areas with secondary containment and leak detection where practicable. 	<p>Section 7.3.6.2, pages C7-28</p> <p>Section 8.2.9.2, pages C8-32 to C8-33</p>

Potential Impacts and Recommended Mitigation Measures

Significant Potential Impacts	Magnitude of Significant Potential Impacts	Mitigation Measures	Reference Page to EIA Report
 <p>Pipeline Rupture and Leakage</p> <ul style="list-style-type: none"> Hydrocarbon leaks from pipeline ruptures caused by corrosion or impact damage may result in environmental impacts. 	Medium	<ul style="list-style-type: none"> Apply corrosion inhibitors in pipelines to reduce internal corrosion risk. Implement external corrosion protection, such as coatings and cathodic systems, and monitor performance regularly. Conduct routine integrity checks at high-risk pipeline areas such as connections, flanges, and valves. Continuously monitor pressure profiles along the pipeline. Implement a regular inspection schedule. Maintain a preventive maintenance programme to ensure pipeline safety and reliability. 	<p>Section 7.3.6.3, pages C7-28 to C7-29</p> <p>Section 8.2.9.2, pages C8-29 to C8-30</p>
<p>Well Blowout</p> <ul style="list-style-type: none"> A well blowout would involve the uncontrolled release of gas from simultaneous failure of primary and secondary barriers, posing significant safety and environmental risks. 	Medium	<ul style="list-style-type: none"> Deploy a suitably rated blowout preventer (BOP) for all drilling activities with well control risks. Verify the BOP control system, components, and pressure barriers through pre-operational and regular function tests. If a surface blowout occurs and all control methods fail, PTTEP may authorise drilling a relief well to contain and kill it. Ensure the drilling rig complies with IMO oil pollution prevention codes and maintains a SOPEP, and develop an OSCP for the drilling phase aligned with Petroleum Industry of Malaysia Mutual Aid Group (PIMMAG) and NOSCP requirements. Conduct regular well control and spill response drills to keep emergency teams prepared for blowouts and hydrocarbon releases. Maintain oil spill kits with absorbents, booms, and neutralisers on rigs and support vessels for immediate minor spill response. Rig crew shall monitor mud return flow sensors to detect hydrocarbon influx during drilling. 	<p>Section 7.3.6.4, pages C7-30 to C7-31</p> <p>Section 8.2.9.2, pages C8-27 to C8-29</p>

Performance Monitoring:



Oil or Oil Mixture Discharge from Vessels

- **Plan:** Maintain records of oily discharges per MARPOL Annex I; ensure oil content in drainage from machinery spaces ≤ 15 ppm; monitor validity of International Oil Pollution Certificate (IOPC).
- **Frequency:** Ongoing throughout Project life.



Drilling Fluids & Drill Cuttings

- **Plan:** Record drill cuttings volume for each well; monitor oil-on-cuttings (OOC) $< 6.9\%$ (wet weight) in accordance with PETRONAS MES Rev. 5 (2023); include results in end-of-well reports.
- **Frequency:** End of each well operation.



Segregation, Storage and Transport of Wastes

- **Plan:** Maintain inventory of hazardous and non-hazardous waste; track recycling, reuse, recovery, or disposal; monitor waste consignment notes.
- **Frequency:** Ongoing throughout Project life.



Spills

- **Plan:** Report and investigate all leaks and spills, including type and quantity of substances.
- **Frequency:** Ongoing throughout Project life.

Proposed Monitoring Programme

Compliance Monitoring:



Segregation, Storage and Transport of Wastes

- **Plan:** Monitor handling, storage, and disposal of scheduled wastes in compliance with the Environmental Quality (Scheduled Wastes) Regulations 2005; maintain updated records of waste categories and quantities; monitor garbage and food waste disposal in accordance with MARPOL 73/78 Annex V.
- **Frequency:** Ongoing throughout Project life.



Spills

- **Plan:** Report and investigate all leaks and spills, recording the type and quantity of substances released.
- **Frequency:** Ongoing throughout Project life.

Impact Monitoring:



Impact on Marine Water, Seabed Sediment and Biological Components

- **Plan:** Monitor the quality of marine water, seabed sediment, and biological components to assess potential impacts at STW fields.
- **Frequency:** Once every six (6) months during installation, and throughout the operation and maintenance stages.

Study Findings

The EIA concludes that the STW Development Project can be implemented in an environmentally responsible manner, with no significant residual impacts anticipated, provided the proposed environmental controls are applied throughout all phases of the project.