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Non-Technical Summary

This Non-Technical Summary presents a concise overview of the Environmental and Social Impact Assessment (ESIA) prepared for the proposed Azeri Central East (ACE) Project located in the Azeri Chirag Gunashli (ACG) Contract Area. It is intended to provide a summary of the project design and activities, the issues considered in the ESIA and of the main conclusions with respect to the potential environmental and social impacts and their mitigation. Detailed technical descriptions of modelling studies, proposed mitigation and monitoring activities are presented in the main sections of the ESIA.

A.1 Introduction

The ACG Contract Area, which covers an area of approximately 432 square kilometres (km^2), is located approximately 120 kilometres (km) east of Baku (refer to Figure N.1). The development of the Contract Area has been pursued in phases which, to date, has included:

- Early Oil Project (EOP);
- ACG Phase 1;
- ACG Phase 2;
- ACG Phase 3; and
- Chirag Oil Project (COP).

Operations at the ACG field started in November 1997 with the start-up of production from the Chirag-1 platform (EOP). The Central, West and East Azeri facilities (including the EA, WA and CA compression and water injection (CA-CWP) and production, drilling and quarters (CA-PDQ) platforms) were developed under Phases 1 and 2 and Deepwater Gunashli (DWG) portion was developed under Phase 3. The Chirag Oil Project (COP) was developed in 2014, with the installation of West Chirag PDQ platform (denoted WC-PDQ).

The ACE Project represents the next stage of development in the ACG Contract Area. Figure N.1 shows the location of the existing ACG and Shah Deniz (SD) facilities and the proposed ACE Project offshore facilities within the ACG Contract Area in addition to the subsea pipeline network, connecting the facilities to the onshore processing facilities at Sangachal Terminal.

A.2 Project Overview

The ACE Project represents the next stage of development in the ACG Contract Area. The ACE-PDQ platform will be located mid-way between the CA and EA platforms in a water depth of approximately 137 metres (m). Infield pipelines will be installed for the transfer of produced oil and gas from the ACE-PDQ platform to the existing ACG Phase 2 oil and gas export pipeline. In addition, there will be a water injection pipeline installed between the EA-PDQ and ACE-PDQ platforms to supply injection water from the CA-CWP platform to the ACE-PDQ. A combined power (to supply back up power) and telecommunications subsea cable will also be installed on the seabed from EA-PDQ to ACE-PDQ.

Figure N.1 shows the location of the proposed offshore ACE facilities and the routing of the infield pipelines between the ACE-PDQ and CA and EA platforms. The locations of the potential onshore construction yards where the platform topside and jacket will be constructed are also shown. The candidates include the Baku Deep Water Jacket Factory (BDJF) and Bayil (formerly known as the Amec-Tekfen-Azfen (ATA) yard) yards which were used for previous ACG development phases.

The key subsea and offshore elements of the ACE Project Base Case are shown in Figure N.2, which indicates the production fluids from the wells are received on the ACE-PDQ platform where they are separated into two primary streams: oil (comingled with produced water) and gas. The separated oil is transferred from the ACE-PDQ platform via a new 30" infield pipeline to a tie-in with the existing ACG Phase 2 30" oil export pipeline near the CA platform. The ACE produced oil is then sent to the Sangachal Terminal with other ACG produced oil where it is processed to meet export specifications. A portion of the separated gas will be used as fuel gas on the ACE-PDQ platform. Gas will also be used as lift gas to maximise well productivity and sent to dedicated ACE gas injection wells to improve resource recovery. Excess gas not required for gas lift, gas injection or fuel gas on ACE will be exported to CA via the new ACE 18" infield gas pipeline to the existing ACG Phase 2 22" gas export pipeline.

Figure N.1 Location of ACG Contract Area, Existing ACG and SD Offshore Facilities and Planned ACE Project Facilities

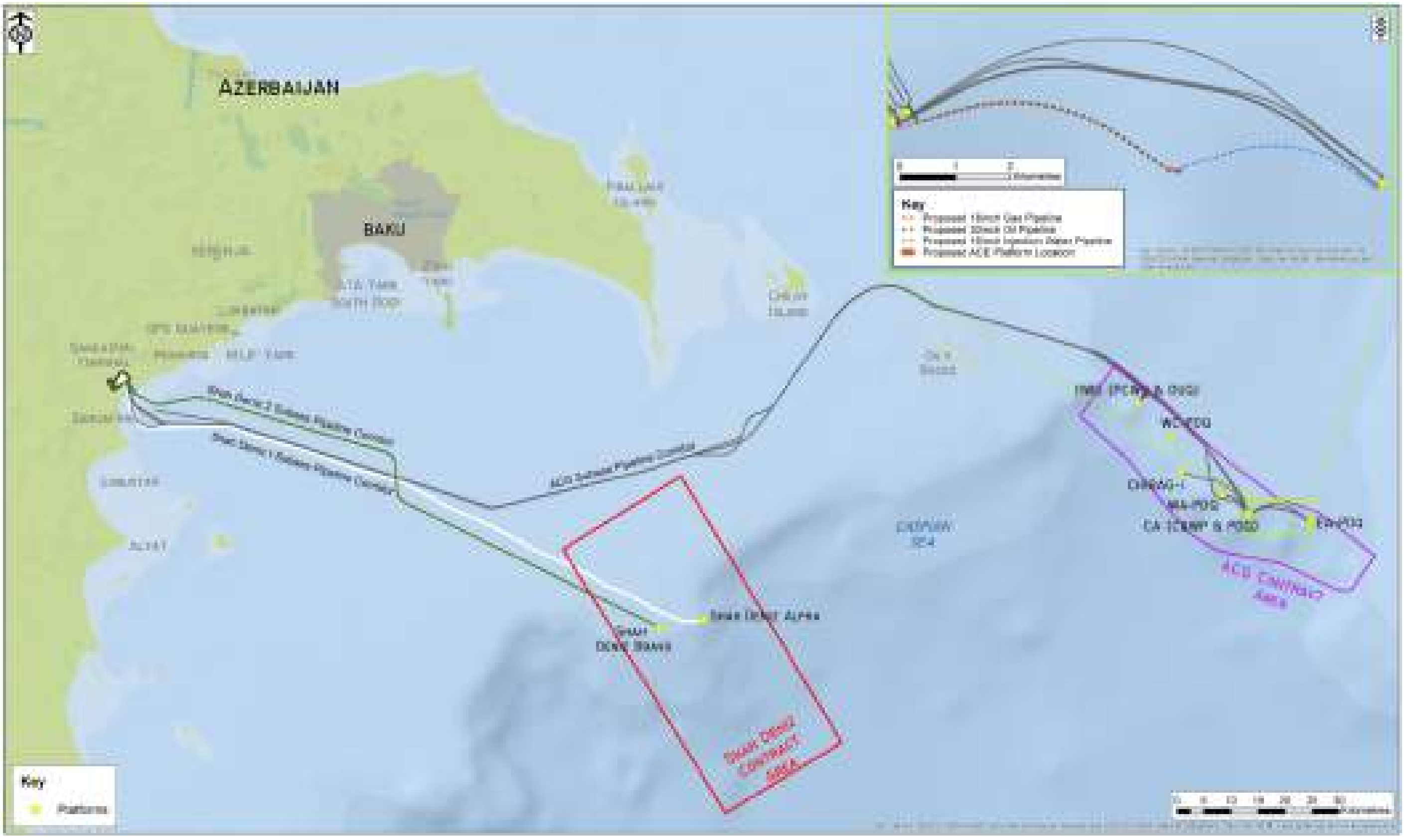
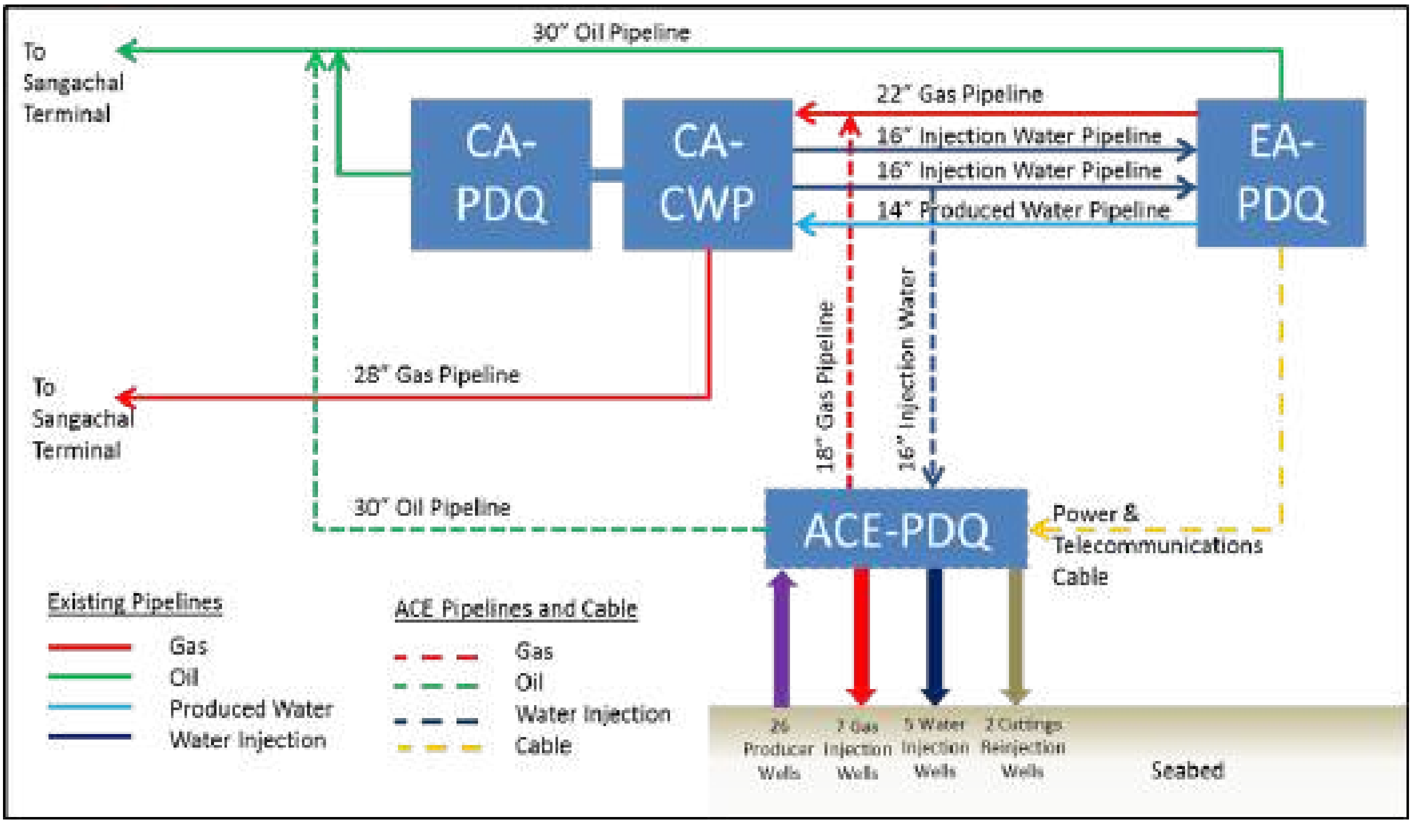


Figure N.2 Overview of Azeri Central East Project

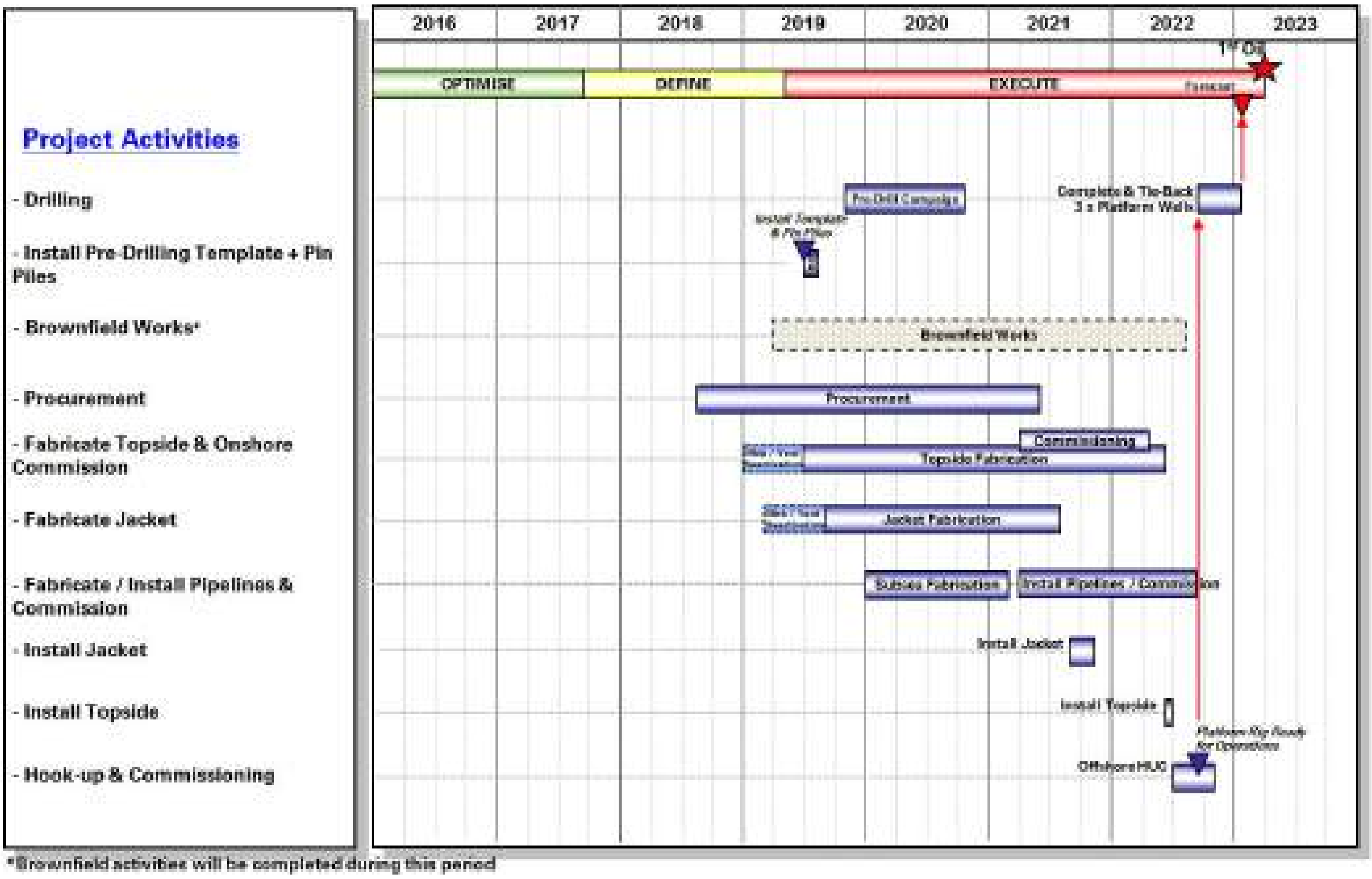


The ACE Project offshore facilities have been designed to process:

- Up to 100 thousand barrels per day (Mbpd) oil (commingled with produced water); and
- Up to 350 million standard cubic feet per day (MMscfd) gas.

Figure N.3 shows the anticipated schedule for the predrilling, construction, installation and commissioning and operations phase activities. As the figure indicates, the majority of the onshore construction and commissioning activities at the construction yards are expected to occur between mid 2019 and mid 2022 based on the current schedule. It is anticipated that first oil will be achieved in 2023 following completion of installation, tie-back of the predrill wells and start up activities.

Figure N.3 Estimated ACE Project Schedule to First Oil



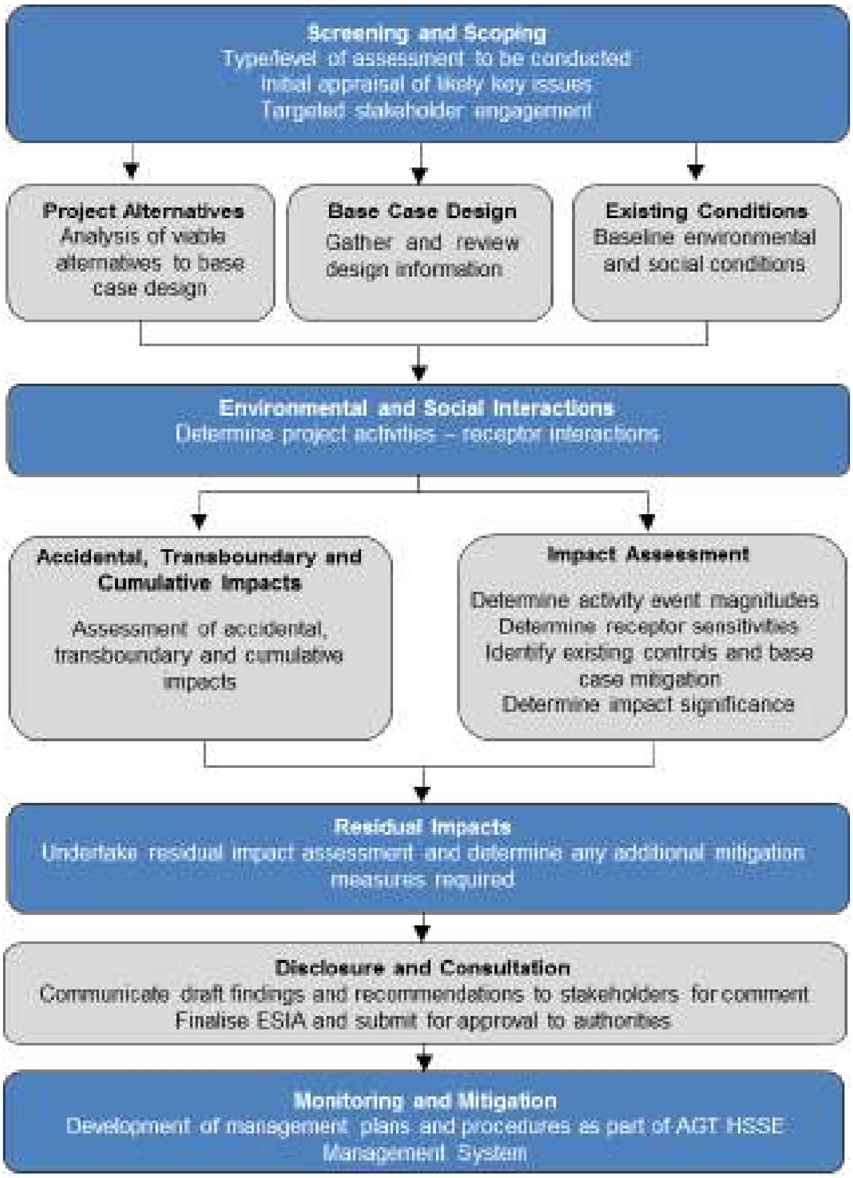
*Brownfield activities will be completed during this period

The environmental and social impacts associated with each project phase were assessed in accordance with the ESIA methodology presented below. The volumes of emissions, discharges and waste associated with each phase were also estimated.

A.3 Assessment Methodology

The ESIA has been conducted in accordance with the legal requirements of Azerbaijan as well as BP Azerbaijan's Health, Safety, Security and Environment (HSSE) Policy. The ESIA process (illustrated in Figure N.4) constitutes a systematic approach to the evaluation of a project and its associated activities throughout the project lifecycle. The overall aim of the ESIA process is to identify, reduce and effectively manage potential negative environmental and social impacts arising from the ACE Project activities.

Figure N.4 The ESIA Process



Assessment of ACE Project environmental impacts have been undertaken based on identified ACE Project activities and events for each phase that have the potential to interact with the environment. The expected significance of the impact has been assessed taking into account:

- **Event Magnitude**: Determined based on the following parameters:
  - ***Extent*** – the size of the area that is affected by the activity being undertaken;
  - ***Duration*** – the length of time that the activity occurs;
  - ***Frequency*** – how often the activity occurs; and
  - ***Intensity of the impact*** - concentration of an emission or discharge with respect to standards of acceptability that include applicable legislation and international guidance, its toxicity or potential for bioaccumulation, and its likely persistence in the environment.
- **Receptor Sensitivity**: Determined based on:
  - ***Presence*** – whether species/people are regularly present/transient, and whether species present are unique, threatened or protected; and
  - ***Resilience*** – how vulnerable people/species are to the change or disturbance associated with the environmental interaction with reference to existing baseline conditions and trends (e.g. trends in ecological abundance/diversity/status, ambient air quality etc.).

The ACE Project impact assessment process has benefited from the fact that offshore ACG and SD Contract Area discharges and emissions have been comprehensively studied and characterised during the operational phase of the existing ACG and SD facilities. As a result, impacts have been evaluated and understood to a far greater extent than is typically possible.

The evaluation of impacts has been based on three principal sources of information:

- Previous environmental risk assessments, including results of toxicity tests and modelling studies which are applicable to the ACE Project;
- Modelling studies, including discharge and spill modelling, onshore and offshore air dispersion modelling, underwater sound modelling and onshore noise assessments, undertaken specifically for the ACE Project; and
- Results from the BP Azerbaijan Georgia and Turkey (AGT) Region Environmental Monitoring Programme (EMP), which included systematic and regular offshore monitoring at all new and operational platforms and which regularly carried out ‘regional’ monitoring to identify and quantify natural environmental trends, and with onshore surveys including ecological and air quality monitoring in and around Sangachal Terminal.

The EMP has provided a clearer picture of the composition and sensitivity of benthic biological communities in both the ACG and SD Contract Areas and of the effect of platform and pipeline installation, drilling activities and platform operations on these receptors. With ACG Phases 1, 2 and 3, COP and SD1 now in operation, the EMP demonstrates that the control measures (design and operation) included in previous ESIAs have adequately mitigated impacts on the marine environment.

A.4 Policy, Regulatory and Administrative Framework

The assessment has also included examination of how agreements, legislation, standards and guidelines apply to the project.

The detailed legal regime for the joint development and production sharing of the ACG field is set out within the Production Sharing Agreement (PSA) signed by BP and the Contractor Parties and the State Oil Company of the Azerbaijan Republic (SOCAR) in June 1994, and passed into Azerbaijan law in December 1994. An amended and restated PSA effective until the end of 2049 was enacted into Azerbaijan law in 2017.

The PSA states that the *“Contractor shall conduct the Petroleum Operations in a diligent, safe and efficient manner in accordance with Good International Petroleum Industry Practice...”* and requires the Contractor to *“comply with present and future Azerbaijani laws or regulations of general applicability with respect to public health, safety and protection and restoration of the environment to the extent that such laws and regulations are no more stringent than the then current Good International Petroleum Industry Practice…”.*

The ACE Project also takes account of a wide range of international and regional environmental conventions and commits to comply with the intent of current national legal requirements where those requirements are consistent with the provisions of the PSA, and do not contradict, or are otherwise incompatible with, international petroleum industry standards and practice. The ACE Project will also adhere to the framework of environmental and social standards within the ESIA approved by the Ministry of Ecology and Natural Resources (MENR). The PSA also makes reference to international petroleum industry standards and practices with which the Project will comply.

A.5 Options Assessed

The key options assessed during the ACE Project design development have focused on:

- Concept selection and definition;
- The selection of a suitable location within the ACG Contract Area to site the offshore facilities;
- Platform design and the extent of integration with existing ACG offshore facilities; and
- Efficiency and performance improvements offered by technology alternatives.

The environmental evaluation of project options was undertaken alongside technical and economic evaluation and consultation with stakeholders including SOCAR and PSA Contractor Parties. The concept selection was primarily informed by drilling conditions, seabed depths and reservoir characteristics.

The option of not developing the ACE Project has also been considered. The decision to not proceed would result in a reduction of potential revenues to the Azerbaijan government with a resultant inability to deliver the associated benefits to the Azerbaijan economy. Pursuing the ACE Project will result in employment creation for national citizens during the design, construction and operational phases of the development, as well as increased use of local facilities, infrastructure and suppliers. The option of not proceeding was therefore disregarded when considered against these socio-economic benefits.

A.6 Environmental Impact Assessment

The environmental assessment draws on a wide range of surveys principally from 1995-2004, and the survey data collected from the EMP from 2004 to date, in which survey work was overseen by stakeholder representatives including SOCAR, ministerial bodies and the Azerbaijan National Academy of Sciences. An Environmental Baseline Survey of the proposed ACE platform location was carried out in 2017.

Environmental impact was assessed for each of the three main phases of the ACE Project.

- **Predrill:** The Project has adopted the established ACG practice of using a Mobile Offshore Drilling Unit (MODU) to predrill a number of producer and water injection wells and a cuttings reinjection well prior to ACE-PDQ platform installation to accelerate early production once the platform is in place;
- **Construction, installation, hook up and commissioning:** Includes all onshore construction and commissioning activities at the construction yards, offshore pipelay and pipeline commissioning and connection to the platform and existing ACG export pipeline network; and
- **Operations:** Platform production drilling and onshore hydrocarbon processing using the existing Sangachal Terminal facilities.

A.6.1 Predrill Activities

Table N.1 presents the residual impacts of the environmental assessment for the predrill phase of the ACE Project. As the table shows, the impacts of all aspects of the predrill phase were predicted to be of minor negative significance, with adequate control, monitoring and mitigation measures in place.

Table N.1 Summary of Residual Environmental Impacts for ACE Predrill Activities

	Event/ Activity	Magnitude				Sensitivity		Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity	Human	Ecological	Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	MODU Power Generation	1	3	3	1	2	2	Medium	Low	Minor Negative
	Support Vessel Engines	1	3	3	1	2	2	Medium	Low	Minor Negative
Marine Environment	Underwater Sound (MODU Drilling)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Underwater Sound (Support Vessels)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Drilling Discharges to Sea	1	2	2	1	-	2	Medium	Low	Minor Negative
	Cement Discharges to Seabed	1	3	1	2	-	2	Medium	Low	Minor Negative
	Cement Unit Wash Out Discharges	1	2	1	2	-	2	Medium	Low	Minor Negative
	BOP Testing	1	3	1	1	-	2	Medium	Low	Minor Negative
	MODU Cooling Water Discharges to Sea	1	1	3	1	-	2	Medium	Low	Minor Negative
	MODU and Vessels Ballast Water Discharge	1	2	1	1	-	2	Medium	Low	Minor Negative
	MODU and Vessels Treated Black Water Discharge	1	1	3	1	-	2	Medium	Low	Minor Negative
	MODU and Vessels Grey Water Discharge	1	1	3	1	-	2	Medium	Low	Minor Negative
	MODU and Vessels Drainage Discharges	1	1	3	1	-	2	Medium	Low	Minor Negative

Emissions associated with MODU power generation, and support vessel activity will all occur offshore and disperse into the atmosphere. Modelling has been undertaken to determine the increase in the concentrations of key pollutants due to the MODU activities at receptor locations (i.e. onshore). Based on existing onshore air quality which meets the applicable EU air quality limit values (with the exception of particulate matter[1]), receptor sensitivity was considered to be low. The modelling indicated that the activities would be unlikely to result in a discernible increase in emissions onshore. As such the impact of atmospheric emissions due to MODU and support vessel activities to onshore communities was considered to be of minor negative significance.

Underwater sound associated with the drilling and support vessel activities was assessed and modelling was undertaken to estimate the distances at which various impacts on the marine species known to be present in Caspian Sea may occur. The results showed that for drilling activities, seals and fish would only suffer potential hearing injury from underwater sound at very short distances (<2m) from the drilling location. Vessel noise is expected to cause potential hearing injury to seals within 505m of the vessel and recoverable injury up to 10.9km from the vessel. However, these distances do not account for movement of either the vessels or the seals. It is considered that when exposed to vessel noise there is a low risk of mortality for fish of all hearing abilities and a moderate risk of recoverable injury in hearing generalist fish at short distances. The local underwater sound environment is known to be dominated by existing commercial and oil industry shipping noise and there would be a minimal relative increase to existing levels of disturbance on seals and fish species from vessel movements. Although there may be some behavioural disturbance, it has been shown that Caspian seals utilise a wide area of the Caspian Sea year round, and would be largely habituated to vessel noise and can easily move if necessary. Based on the predicted event magnitude, receptor

[1] The semi-arid environment gives rise to dust which naturally increases the concentration of particulate matter in the atmosphere, leading to concentrations that are naturally higher than EU limit values.

characteristics and observed sensitivities the impact was assessed as being of minor negative significance.

During predrilling, the largest discharges to the marine environment by volume are drilling discharges; specifically the discharge of drill cuttings and water based drilling mud, and the discharge of cooling water from the mobile drilling rig cooling water system. Modelling has shown that such discharges, which are required to meet applicable standards prior to discharge, have a very limited ecological impact to marine receptors. Based on the predicted event magnitude, receptor characteristics and observed sensitivities the impact significance was assessed as minor negative. Cooling water modelling similarly indicated impacts would be very limited in scale (a few metres) and an impact upon biological receptors in the water column (i.e. zooplankton, phytoplankton, seals and fish) would be of no more than minor negative significance.

Small quantities of cement may be discharged to the seabed whilst cementing well casings into place. These will remain close to the wellhead in the same area as drill cuttings are deposited. The impact to benthic invertebrates, which were evaluated as having a low sensitivity to cement discharges, was therefore assessed as being of minor negative significance. The discharge of residual diluted cement at the end of well casing cementing activities was also assessed and found to be of minor adverse significance.

Modelling discharges from hydraulic fluids associated with the routine testing of the blowout preventer (BOP) to be used on the wells during predrilling showed a maximum extent of the dilution plume during summer is approximately 28m long, 6m wide and the plume will completely disperse in the water column to the no effect concentration within 15 minutes. The impact to benthic invertebrates and seals, fish and plankton, which were evaluated as having a low sensitivity to BOP fluid discharges, was therefore assessed as being of minor negative significance.

The remaining discharges to sea (ballast water, black water, grey water and deck drainage) are all small in volume (relative to drilling and cooling water discharges) and do not contain components of high environmental concern. These discharges, which are monitored in accordance with existing procedures to ensure applicable project standards are met, will be rapidly diluted and are all assessed as having a minor impact upon biological receptors in the water column.

For all predrill phase environmental impacts assessed it has been concluded that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

A.6.2 Construction, Installation and Hook-Up and Commissioning Activities

Table N.2 presents the residual impacts of the environmental assessment for the Construction, Installation and Hook-Up and Commissioning (HUC) phase of the ACE Project, which includes:

- Onshore Construction and Commissioning of Offshore Facilities;
- Infield Pipeline Installation, Tie-in and Commissioning; and
- Platform Installation, HUC.

Table N.2 Summary of Residual Environmental Impacts for ACE Construction, Installation and HUC Activities

	Event/ Activity	Magnitude				Sensitivity		Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity	Human	Ecological	Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Construction Yard Plant and Vehicles	1	1	3	1	2	-	Medium	Low	Minor Negative
	Onshore Commissioning of Main Platform Generator and Topside Utilities	1	3	2	1	2	-	Medium	Low	Minor Negative
	Vessel Engines	1	1	3	1	2	-	Medium	Low	Minor Negative
Terrestrial Environment (Noise)	Construction Yard Plant and Vehicles	1	1	3	1	2	-	Medium	Low	Minor Negative
	Onshore Commissioning of Main Platform Generators and Topside Utilities	3	2	1	1	2	-	Medium	Low	Minor Negative
Marine Environment	Construction Yard Cooling Water Discharge	1	1	3	1	-	2	Medium	Low	Minor Negative
	Pipeline Cleaning and Pre-commissioning Discharges (Treated seawater)	3	2	1	1	-	2	Medium	Low	Minor Negative
	Pipeline cleaning and Pre-commissioning Discharges (MEG)	1	1	1	1	-	2	Low	Low	Negligible
	Subsea Infrastructure and Spool Tie-in Discharges (Treated seawater)	1	2	1	1	-	2	Medium	Low	Minor Negative
	Other Discharges to Sea: **Ballast Water (Vessels)**	1	2	1	1	-	2	Medium	Low	Minor Negative
	Other Discharges to Sea: **Treated Black Water (Vessels)**	1	1	3	1	-	2	Medium	Low	Minor Negative
	Other Discharges to Sea: **Grey Water (Vessels)**	1	1	3	1	-	2	Medium	Low	Minor Negative
	Other Discharges to Sea: **Drainage (Vessels)**	1	1	3	1	-	2	Medium	Low	Minor Negative
	Jacket pin and skirt piling (underwater sound)	3	3	1	2	-	2	High	Low	Moderate Negative
	Vessel movements (underwater sound)	1	1	3	1	-	2	Medium	Low	Minor Negative

Emissions and noise associated with onshore construction and commissioning activities at the construction yards were assessed. Air quality dispersion modelling and noise modelling screening assessments demonstrated that potential impacts to nearby onshore receptors were considered to be minor and additional mitigation was not required.

During onshore commissioning of the platform generators and topside utilities at the construction yard, a temporary cooling water system will abstract and discharge water at the quayside. The thermal impact of the discharge was modelled, and indicated that the discharged water (at a worst-case temperature of 50ºC) would not exceed ambient temperature by more than 3ºC at a distance beyond 4m from the point of discharge. Thermal impact is therefore considered minimal, with no need for further mitigation. The cooling water will be treated to inhibit marine fouling and will be neutralised prior to discharge. The discharge will contain no harmful persistent materials.

Following installation of the pipelines, they will be filled with seawater containing preservation chemicals (to prevent corrosion and biological growth). The pipelines will be tied-in and additional testing will be undertaken also using treated seawater. Discharges to sea of treated seawater associated with these activities are anticipated to vary in volume between 2 and 2545 cubic metres (m^3). Aquatic toxicity tests have been carried out on the preservation chemicals, and no-effect concentrations have been estimated for the treated seawater. Dispersion modelling has been conducted for a representative range of discharges, in order to estimate the point at which the discharges will be diluted to the no-effect concentration. Many of the smaller (hydrotest and leak test) discharges are predicted to be diluted almost immediately to a no-effect concentration. Modelling of the largest discharges (associated with the cleaning and gauging and dewatering of the existing 22" gas export pipeline between the EA and CA platforms) predicted a narrow plume of 4.3 to 10.1km long. In no instance did the modelling predict a plume that reached the seabed or the sea surface. The volumes of water occupied by the discharge plumes are small relative to the receiving environment, and the discharge durations are short.

Mono ethylene glycol (MEG) is planned to be used to dehydrate and condition the new infield gas pipeline. While the base case is to recover all the MEG used, it is possible that up to three discharges of up to 10 m^3 of MEG may be discharged to sea. Modelling has indicated the impact would be limited to a very small area within the immediate vicinity of the release. Additionally, approximately 40 discharges of treated seawater associated with the tie-in of spools and subsea structures, varying between 1 to 16m^3, are anticipated. Modelling of these discharge events has confirmed the discharge plumes will rapidly disperse in the water column in the vicinity of the discharge location. The preservation chemicals are non-persistent, and it is considered that there will be no cumulative effects from successive events.

Aqueous discharges from installation vessels (ballast water, grey water, treated black water and drainage) will also be similar in magnitude and impact to those for the predrill programme and were assessed as having a minor impact upon biological receptors.

Propagation of underwater sound from installation of the jacket pin and skirt piles was calculated to estimate distances at which various impacts on marine species may occur. For piling, the modelling results show that seals may experience permanent hearing damage 2.3km from the piling while temporary hearing damage may arise up to 23.5km if exposed to the noise for an hour or more. For fish exposed to piling sound, mortality could occur up to 80m from the piling location whilst the recoverable injury zone extends to 148m from the centre of piling if exposed to the sound for an hour or more. For the pipelay barge, the modelling predicts permanent hearing injury may arise in seals at distances up to 2km from the vessel over an exposure duration of 1 hour while temporary injury could occur at distances up to 43km for the same exposure period. However, these distances do not account for the movement of either vessel or seal. The Caspian seal is a highly intelligent and mobile animal. The seals are habituated to vessel noise associated with routine commercial traffic and vessels associated with the oil and gas industry, and will take action to avoid the associated sound from this activity. Similarly, the use of an Acoustic Deterrent Device (ADD) (specifically set for the hearing range of pinniped seals) during piling activities will alert any seals present to the activity, allowing them to leave the area as soon as they detect the sound source. Risk of injury to individuals and detectable effects on the seal population as a whole is therefore considered very unlikely. Further, it is expected any individual fish in the vicinity will move away as soon as they detect the sound source and there is very low injury risk to individual fish and to fish populations.

Overall, the majority of the residual impacts were assessed as minor or negligible. The only moderate impact was underwater sound generated from piling activities. It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures.

A.6.3 Operational Activities

Table N.3 presents the residual impacts of the environmental impact assessment for the Operations phase associated with the ACE Project.

Table N.3 Summary of Residual Environmental Impacts for ACE Operations Phase

<table>
<tr><th rowspan="2"></th><th rowspan="2">Event/ Activity</th><th colspan="4">Magnitude</th><th colspan="2">Sensitivity</th><th colspan="3">Overall Score</th></tr>
<tr><th>Extent/ Scale</th><th>Frequency</th><th>Duration</th><th>Intensity</th><th>Human</th><th>Ecological</th><th>Event Magnitude</th><th>Receptor Sensitivity</th><th>Impact Significance</th></tr>
<tr><td rowspan="3">Atmosphere</td><td>Operation of offshore combustion sources under routine operations</td><td>1</td><td>1</td><td>3</td><td>1</td><td rowspan="3">2</td><td rowspan="3">2</td><td rowspan="2">Medium</td><td rowspan="2">Low</td><td rowspan="2">Minor Negative</td></tr>
<tr><td>Operation of offshore combustion sources under non routine operations (maintenance)</td><td>1</td><td>2</td><td>1</td><td>1</td></tr>
<tr><td>Operation of offshore combustion sources under emergency depressurisation conditions</td><td>1</td><td>1</td><td>1</td><td>1</td><td>Low</td><td>Low</td><td>Negligible</td></tr>
<tr><td rowspan="12">Marine Environment</td><td>Underwater Sound (Hydraulic Hammering)</td><td>3</td><td>2</td><td>1</td><td>2</td><td rowspan="3">-</td><td rowspan="3">2</td><td rowspan="3">Medium</td><td rowspan="3">Low</td><td rowspan="3">Minor Negative</td></tr>
<tr><td>Underwater Sound (Platform Drilling)</td><td>1</td><td>1</td><td>3</td><td>1</td></tr>
<tr><td>Underwater Sound (Vessels)</td><td>1</td><td>1</td><td>3</td><td>1</td></tr>
<tr><td>Drilling Discharges to Sea</td><td>1</td><td>2</td><td>2</td><td>1</td><td>-</td><td>2</td><td>Medium</td><td>Low</td><td>Minor Negative</td></tr>
<tr><td>Cement Wash Out Discharges</td><td>1</td><td>2</td><td>1</td><td>1</td><td>-</td><td>2</td><td>Medium</td><td>Low</td><td>Minor Negative</td></tr>
<tr><td>Cooling Water System Intake and Discharge</td><td>1</td><td>1</td><td>3</td><td>1</td><td>-</td><td>2</td><td>Medium</td><td>Low</td><td>Minor Negative</td></tr>
<tr><td>Offshore Operation: Other Discharges to Sea: Treated Black Water</td><td>1</td><td>1</td><td>3</td><td>1</td><td>-</td><td>2</td><td rowspan="5">Medium</td><td rowspan="5">Low</td><td rowspan="5">Minor Negative</td></tr>
<tr><td>Offshore Operation: Other Discharges to Sea: Grey Water</td><td>1</td><td>1</td><td>3</td><td>1</td><td>-</td><td>2</td></tr>
<tr><td>Offshore Operation: Other Discharges to Sea: Drainage</td><td>1</td><td>1</td><td>3</td><td>1</td><td>-</td><td>2</td></tr>
<tr><td>Offshore Operation: Other Discharges to Sea: Galley Waste</td><td>1</td><td>1</td><td>3</td><td>1</td><td>-</td><td>2</td></tr>
<tr><td>Offshore Operation: Other Discharges to Sea: Freshwater Maker Saline Effluent</td><td>1</td><td>1</td><td>3</td><td>1</td><td>-</td><td>2</td></tr>
<tr><td>Injection Water Pipeline Pigging Discharges</td><td>2</td><td>2</td><td>1</td><td>2</td><td>-</td><td>2</td><td>Medium</td><td>Low</td><td>Minor Negative</td></tr>
</table>

The impact of emissions to atmosphere from routine and non routine offshore operations was assessed using dispersion modelling. Sources included the offshore platform generators during routine operations and the flare during non routine events or emergency depressurisation. For all scenarios assessed, a minor impact to onshore receptors was predicted.

Propagation modelling of underwater sound generated during driving of the 30” conductor into the seabed using a hydraulic hammer was undertaken to estimate distances at which various impacts on marine species may occur. The sound generated during installation of the 30” conductor section using a hydraulic hammer will be similar in nature to the piling noise generated during the installation of the jacket pin and skirt piles activities described in Section N.6.2 above. However, in the case of the conductor installation the hydraulic hammer will be located on the platform topside meaning the sound will be mainly emitted above water, with low transmission into the water from air, however some sound will be emitted directly into the water. For the purposes of this ESIA, it is conservatively assumed the sound level within the water column from conductor hammering is similar to the levels associated with the installation of the jacket pin and skirt piles described in Section N.6.2 above. Similarly, the sound levels generated and the potential impacts from platform drilling and vessel movements during offshore operations will be similar to the results presented for predrilling in Section N.6.1 above. Overall, the risk of injury to individuals and detectable effects on the seal population and fish as a whole is considered very unlikely and impacts are assessed as being of no more than minor negative significance.

Modelling of the platform drilling discharges was undertaken to confirm the extent and scale of water based mud and cuttings predicted to be deposited on the seabed during ACE platform drilling. The modelling has shown that such discharges have a very limited ecological impact on marine receptors. Based on the predicted event magnitude, receptor characteristics and observed sensitivities and monitoring of impacts on benthic communities at existing ACG and SD drill sites, the impact was assessed as being of minor negative significance.

Cementing discharges will occur from wash out activities where cement remaining in the platform cement system will be slurrified with seawater, and will be discharged from the platform via the cuttings caisson. Modelling of the cement washout discharges predict that the discharge plume will dilute rapidly and a very small amount of the cement solids would be deposited on the seabed under worst case conditions. Therefore, the impact to benthic invertebrates and seals, fish and plankton, which were evaluated as having a low sensitivity to cement discharges, was assessed as being of minor negative significance.

The effects of the cooling water intake and discharge on the water column associated with the ACE-PDQ platform were assessed. Based on earlier modelling work for a similar intake it was determined that effects on water velocities in the vicinity of the intake will be such that fish are able to detect and avoid the intake. The ACE platform cooling water discharge was modelled to determine the extent of the thermal plume. The distance from the discharge point to where the water temperature is estimated to be 3°C above ambient temperature is predicted to be within 12m during summer conditions and 3m in winter conditions. Thus it is concluded that the discharge will have a very small zone of influence (i.e., where the temperature of the discharge is greater than the ambient water temperature). Impacts upon biological receptors in the water column (i.e. zooplankton, phytoplankton, seals and fish) were assessed as being of minor negative significance.

The remaining discharges to sea from offshore operations (treated black water, grey water, galley waste, drainage and saline effluent) are all small in volume (relative to cooling water discharges) and do not contain components of high environmental concern. These discharges, which are monitored in accordance with existing procedures to ensure applicable project standards are met, will be rapidly diluted and are all assessed as having an impact of minor adverse significance upon biological receptors in the water column.

Pigging of the 16” infield injection water pipeline will be carried out from the CA-PDQ platform to the ACE-PDQ platform as required to maintain pipeline integrity. The water injection pipeline will be flushed with seawater prior to pigging. It is estimated up to 950m^3 of water (primarily seawater with some injection water from CA) will be discharged every three months during operations comingled with the ACE seawater returns (up to 3,410m^3/hr). Recent modelling for a similar discharge at the CA platform comprising 100% injection water, and hence not taking into account the dilution afforded by the seawater returns, estimated that the relevant no effect concentration (derived from the most conservative ecotoxicity test sample results obtained for produced and injection water across the ACG offshore facilities) would be reached within 9.5km of the discharge with the plume dispersing within an area of approximately 0.77km^2. The discharge of pigging water is predicted to have a minor impact to the marine environment since the discharges will be infrequent; the volumes will be small and have a low toxicity and do not require additional mitigation beyond the existing controls.

Overall, the majority of residual impacts from operations are assessed as being of minor adverse or negligible significance. All activities will be managed in accordance with previously established practice and BP Azerbaijan Georgia Turkey (AGT) Region procedures, and impacts are considered to be controlled and mitigated to an acceptable level.

A.7 Social Impact Assessment

The majority of ACE Project related activities occur offshore with the exception of the onshore construction and commissioning activities. It is currently planned to use a number of existing onshore construction yards for the ACE Project with candidate yards including the BDJF and Bayil Yard. With reference to the experience gained from previous ACG Phases 1-3, COP and SD projects, the following key social issues were assessed:

- Employment creation and subsequent demanning of the construction workforce, after peak employment has been reached;
- Training and skills development opportunities provided to the workforce;
- Procurement of goods and services by the main construction and installation contractors through internal supply chains; and
- Potential social conflict from (perceived or actual) competition between individuals seeking jobs.

The assessment concluded that the national workforce to be employed during the ACE Project construction phase is likely to peak at approximately 3,700 in 2021. Additional and new employment during the operations phase will be less in terms of new positions. Employment impacts are likely to be distributed within the local area with the majority of employees expected to be recruited from the Baku City economic region (which includes the Sabayil and Garadagh Districts). It is anticipated that employment will not require establishment of workforce accommodation or significant migration of populations to the construction areas.

Every effort will be made to re-hire workers who have demonstrated competence whilst working on previous oil and gas construction projects. Upon hiring workers, a gap analysis will be undertaken by the main construction and installation contractors between relevant competence criteria and the contractor's Training and Development Plan. Where gaps are identified training will be provided to bring each worker up to at least the minimum standards for the role expressed in the Training and Development Plan. It is expected that the employment generated by the ACE Project will result in positive impacts to individuals and their households.

As the construction phase will generate temporary employment opportunities, planning for the conclusion of construction workforce contracts will be carefully considered from the start of the ACE Project. Measures to mitigate this will include adequate staff communications between the main construction and installation contractors and their workforce which will inform the workforce of project progress and expected completion dates.

The overall social impacts of the ACE Project, particularly from employment creation throughout the construction, installation and HUC phases were assessed as positive.

A.8 Cumulative, Transboundary and Accidental Events

Potential cumulative and transboundary impacts were assessed taking into account potential for inter project impacts as well as other potentially significant projects where the associated impacts may overlap geographically or temporally with ACE Project impacts. The most significant project where this potential exists is the Shah Deniz Stage 2 (SD2) Project, which achieved first gas during 4Q 2018[2].

With regard to discharges, the majority of the ACE Project discharges are small, and are comparable to discharges associated with previous projects and existing operations. The largest discharges will either be confined to a small area of seabed (drilling discharges) or will be short in duration and have transient impact (discharge of treated seawater during pipeline cleaning and pre-commissioning). All of the discharges associated with construction, installation, HUC and operation, have been assessed, and it is concluded that there will be no cumulative or additive interactions between the impacts.

With regard to emissions to atmosphere, the most significant air quality pollutant in terms of health impacts is nitrogen oxide (NO_2). It has been demonstrated that emissions associated with the ACE Project activities alone and emissions from worst-case cumulative SD2 Project offshore activities are not expected to result in any discernible changes in NO_2 concentrations at onshore receptors.

For both onshore construction and commissioning and offshore activities, the volumes of atmospheric emissions released (including visible particulates) due to the ACE Project are expected to result in

[2] While the SD2 Project achieved first gas in Q4 2018 the effects of the SD2 Project are not captured within the existing baseline conditions against which the ACE Project impacts have been assessed. Therefore, for the purposes of the ESIA, the SD2 Project activities and impacts have been considered within the ACE ESIA cumulative assessment.

very small increases in pollutant concentrations in the atmosphere and in any washout from rainfall, which will not be discernible to biological/ecological receptors.

Based on the limited geographic scope of pollutant species, which will disperse rapidly in the atmosphere, no transboundary impacts associated with air quality and human health are predicted from the ACE Project.

Greenhouse gases (GHG) have the potential to give rise to transboundary impacts. The majority (86%) of greenhouse gases (GHG) estimated to be generated by the ACE Project are predicted to result from offshore activities during the ACE Project operations phase while onshore emissions from ACE Project operational activities will contribute approximately 5%. Activities associated with predrilling are predicted to contribute 0.6%, while onshore construction and commissioning and installation and HUC activities are estimated to contribute approximately 8.6% of the total volume of GHG emissions produced by the ACE Project. The annual contribution of ACE GHG emissions in the year 2030 to the predicted national Azerbaijan forecast GHG emissions was estimated to be approximately 0.5%.

To support the assessment of accidental events, modelling of potential hydrocarbon spill scenarios was undertaken to predict the behaviour of the spilled hydrocarbon in the water column and on the sea surface and to estimate where and how much spilled hydrocarbon may come ashore. It must be noted that modelling has not taken into account any response mitigation measures such as dispersant application, containment or recovery, meaning that the results should only be interpreted as indication of theoretical spill consequences without implementation of the oil pollution prevention strategy. The key accidental event scenarios modelled and assessed included

- Scenario 1: A loss of 92 cubic metres (m^3) of diesel from the platform;
- Scenario 2: A blowout of crude oil (3,195,000 barrels (bbls)) over 90 days duration; and
- Scenario 3: A rupture of the ACE 30” oil export pipeline resulting in the release of 962 tonnes of crude oil.

The 92m^3 of diesel released from the ACE platform is predicted to rapidly spread out to form a thin sheen on the sea surface. The modelling indicates that the maximum extent of sea surface covered by a diesel sheen of 0.04 micrometres (µm) or thicker from this spill would be approximately 20.1km in summer and 52.3km in winter. The majority of the volume of the released diesel is rapidly lost to the air by evaporation or naturally dispersed into the water column and then biodegraded with no diesel predicted to reach the shore. No significant ecological damage would be anticipated from a spill of this magnitude.

Based on worst case estimates, a blowout of crude oil from an ACE well could continue for an estimated 90 days, which is the time that would be required to mobilise a drilling rig and to drill a relief well. During this time, approximately 35,500 bbls of crude oil would be released per day. The majority of the oil would initially be present on the sea surface following the release, while 15% evaporates almost immediately and 5% is dispersed into the water column. The amount of evaporation stabilises at just over 30% while the amount biodegraded rises steadily to 38% by the end of the simulation. Ultimately, 32% evaporates, 38% is biodegraded, 13% remains in the water column, 15% is deposited in sediments and approximately 2% is deposited on the shoreline, with less than 1% remaining on the surface. The crude oil on the sea surface is predicted to travel around 400-500km before it drops below the lowest recognised visible thickness under ideal viewing conditions. Although the precise movement of the surface oil is dependent on the exact metocean conditions at the time, the analysis of over 100 different sets of metocean data suggest that the most likely locations to receive oil on shore are southern Azerbaijan, northern Iran and the tip of the Absheron Peninsula. The extent of oil in the water column above the 58 parts per billion (ppb) threshold tracks the path of the surface release and can extend over 200km from the source. The modelling predicts that a blowout under summer conditions could result is a worst case of 18,295 tonnes of oil reaching the coastline and that this would mainly impact three areas: southern Azerbaijan, northern Iran and the Absheron Peninsula. The eastern coastline of the Caspian Sea is unaffected. A mixture of areas of very light, light (0.1-1mm), moderate (1-10mm) and heavy (>10mm) oil deposition are predicted in these areas.

In the event of a rupture of the ACE 30” oil export pipeline midway between the ACE and CA platforms it is anticipated that approximately 962 tonnes of oil and 12 tonnes of associated gas would be released into the marine environment. Following the release, the majority of the oil would initially be present on the sea surface, while 10% evaporates almost immediately and 15% is dispersed into the water column. Oil travels through the water column and takes just under two minutes to reach the surface. After around 6 days, oil has moved into shallower waters and begins to deposit in sediments. Ultimately, 36% evaporates, 29% is biodegraded, 7.5% remains in the water column, 24% is deposited in sediments, approximately 2.5% is on the shoreline and less than 1% remains on the sea surface. Crude oil on the sea surface is predicted to travel up to 340km before it drops below the lowest recognised visible thickness under ideal viewing conditions. The thickest areas of oil (> 0.2 mm) are present within around 10-20 km of the release but are short term (lasting up to 2 days) and occupying an area of up to 2km^2. The area of water column affected is relatively small, partly because of the size of the release, the low gas content and the low energy conditions towards the end of the release. The extent of oil in the water column above the 58ppb threshold tracks the path of the surface release and can extend around 30-40km from the source. Oil deposition on the shoreline is spread out given the distance and time separating the source from the shore, and the mass of oil involved is relatively small. The summer case release results in oil mainly reaching three areas: southern Azerbaijan, northern Iran and Turkmenistan. A mixture of areas of very light and light (0.1-1mm) oil deposition is predicted in these areas.

For both the blowout and pipeline rupture scenarios species in the immediate vicinity of the spill that cannot actively avoid the oil such as plankton, benthic invertebrates, birds and seals are likely to suffer the greatest impacts. Highly mobile species such as fish are anticipated to avoid the spilled oil areas. The modelling of the blowout scenario shows that a number of Important Bird and Biodiversity (IBAs) and Key Biodiversity Areas (KBAs), and associated bird species, may be exposed to elevated hydrocarbon concentrations as a result of surface or dispersed / dissolved oil beaching on the shoreline following a blowout. Given the persistence and volume of oil predicted to beach in some IBAs and KBAs, the potential impact on these areas (and the birds present there) could have a potentially significant impact, especially if the release occurs during the bird nesting period (April to July). In the event of a blowout or pipeline rupture, the potential impacts are assumed to be significant for the areas impacted by the spill and it is anticipated that recovery would take a period of time in the medium to long term. The impact on fisheries would be reflected by the impact on fish and the presence of juvenile stages at the time of a spill as they are more susceptible to relatively low levels of oil within the water column and are less likely to be able to move away. Fish can become tainted and contaminated with hydrocarbons. If there are signs of fish oil tainting or contamination as a consequence of a hydrocarbon spill event, any resultant imposed authority restrictions on fishing activities could result in a detrimental financial impact upon local fisheries. Equally, a lack of timely restrictions, or illegal fishing, can create a risk to human health from contaminated product consumption. Therefore, the impact to the commercial fishing industry in the unlikely event of a blowout or pipeline rupture is considered to be potentially significant.

An Offshore Facilities Oil Spill Contingency Plan (OSCP) has been developed, which provides guidance and actions to be taken during a hydrocarbon spill incident associated with all ACG and SD offshore operations including MODUs, platforms, subsea pipelines and marine vessels. It is authoritative for spills that may occur during commissioning, operation, and decommissioning of the systems.

A.9 Environmental and Social Management

Each phase of the ACE Project will be subject to formal environmental and social management planning. During predrilling, construction, installation and HUC, the main contractor companies will be contractually required to develop and implement environmental and social management systems (ESMS). An Environmental and Social Management and Monitoring Plan (ESMMP) will also be prepared to manage the specific environmental and social requirements associated with the construction, HUC and start up phase activities. To support the ESMMP, environmental and social management plans will be developed to present the ACE Project environmental and social requirements by subject matter. BP will operate the ACE facilities using an Operations Phase Environmental Management System (EMS) that is aligned with the requirements of the ISO 14001 EMS and will be based on the ‘plan-do-check-act’ cycle. Prior to commencement of ACE operations, a transition plan will be developed to support the movement of ACE from the Construction Phase ESMS to the Operations Phase EMS.

BP's has implemented an Environmental Monitoring Programme (EMP) in Azerbaijan, designed to provide a consistent, long-term set of data, with the objective of developing an accurate picture of potential impacts on the surrounding environment, so that they can be managed and mitigated as effectively as possible. The EMP will be expanded for the ACE Project, to integrate operational monitoring of key discharges and emissions. The aim of regular monitoring is to establish an understanding of trends over time, taking account of the results from concurrent regional surveys and initial baseline data. Combined with operational discharge and emissions monitoring, this approach provides a robust method for assessing the impact of ACE Project operations based on actual monitoring data.

A.10 ESIA Consultation and Disclosure

Stakeholder consultation is an important element of the ESIA process, ensuring that the opinions of potentially affected people and interested parties are solicited, collated and documented. The stakeholder engagement and consultation process has:

- Made use of the consultation framework and methods established for other BP projects in Azerbaijan;
- Been developed with reference to accepted guidance on expectations of ESIA consultation and disclosure;
- Considered the extent of consultation and disclosure processes undertaken in recent years; and
- Acknowledged the requirement to engage with state bodies and academic institutions.

The scope of the ESIA was agreed with the MENR and the Monitoring and Technical Advisory Group (MTAG) at a scoping meeting held in Baku in February 2018.

The Draft Final ESIA Report and Non-Technical Summary, in English and Azerbaijani, were made available (along with feedback forms) for a period of 60 days at the following locations and via the Internet:

- BP website;
- BP Xazar Centre Office Reception, 153, Neftchilar Avenue, Baku;
- Umid Settlement, Secondary School No. 294;
- Umid Settlement, Secondary School No. 7;
- Public Library at Sangachal settlement, Qaradag District, M. A. Sabir Street 1, Centralized Library No. 5;
- Public Library at Sahil Settlement, E. Guliyev Street, Centralized Library No. 2;
- M.F. Akhundov Public Library, 29 Khagani Street, Baku;
- Central Library of the Azerbaijan National Academy of Sciences, 31 Huseyn Javid Street, Baku;
- Library of the Azerbaijan State University of Oil and Industry, 20 Azadlig Avenue, Baku; and
- Aarhus Environmental Information Centre, MENR, 100a B. Agayev Street, Baku.

As part of the Draft Final ESIA consultation process the following meetings were held:

- MENR, Baku, 30th October 2018;
- MTAG, Baku 30th October 2018; and
- Public meeting, Baku 31st October 2018.

Comments received on the Draft ESIA were collated, analysed with responses issued where relevant. The ESIA was subsequently revised and finalised for MENR approval.

The Final Non-Technical Summary and ESIA are available at:

www.bp.com/caspian

Units and Abbreviations

Units

%	Percent
% wt.	percentage by weight
% vol.	percentage by volume
µg/g	Micrograms per gram
µg/l	Micrograms per litre
µg/m^3	Micrograms per cubic meter
µm	Micrometer
µPa	Micro Pascal
˚C	Degrees Celsius
˚	Degrees
“	Inches
+/-	Plus/minus
<	Less than
>	Greater than
barg	1 bar (gauge) = 14.5 psi
bbl	Barrel (6.2898 barrels = 1 m3)
bcm	Billion standard cubic metres
bcma	Billion cubic metres per annum
Bstb	Billion standard barrels
cm	Centimetre
cm/year	Centimetres per year
cSt	centistokes
dB	Decibel
dB(A)	A weighted unit of sound intensity weighted in favour of frequencies audible to the human ear
dB L_{AEQ}	Sound pressure level
g/l	Grams per litre
ha	Hectare
HP	Horsepower
hr	Hour
in	Inches
kg	Kilograms
km	Kilometre
km/ma	Kilometres per million years
km^2	Square kilometre
Knots	Measurement of wind speed (1 Knot = 0.514 m/s)
ktonne	Thousand tonnes
kV	Kilovolt
kVA	Kilovolt- ampere
kW	Kilowatt
lb/MMscf	Pounds per million standard cubic feet
LC_{50}	Lethal Concentration 50. The concentration of a chemical which kills 50% of a sample population.
l/h	Litres per hour
l/MMscfd	Litres per million standard cubic feet per day
l/m^2	Litres/square meter
m	Metres
m^2	Square metres
m^3	Cubic metres
m^3/day	Cubic metres per day
m^3/hr	Cubic metres per hour
m^3/person/day	Cubic metres per person per day
m/s	Metres per second
mbd	Thousand barrels per day

mg/kg	Milligrams per kilogram
mg/l	Milligrams per litre
mg/Nm3	Milligrams per cubic meter (at normal conditions)
ml	Millilitres
mm	Millimetres
mm/year	Millimetres per year
MMscf	Million standard cubic feet
MMscfd	Million standard cubic feet per day
MPN	Most Probable Number
MPN/100ml	Most Probable Number per 100 millilitres
mPa.s	millipascal-second
MW	Megawatt
MWth	Megawatts thermal
Mbpd	Thousand barrels per day
Mbwpd	Thousand barrels of water per day
n/m^2	Number per square metre
pH	-log 10 [H+] (Measure of acidity or alkalinity)
PM_{10}	Particulate matter measuring 10µm or less in diameter
ppb	Parts per billion
ppbv	Parts per billion by volume
ppm	Parts per million
ppm/m^3	Parts per million per cubic metre
ppmv	Parts per million by volume
ppmw	Parts per million by weight
PSU	Practical saline unit
V	Volt
dB_{PEAK} re. 1 µPa	Peak decibels relative to one micropascal
dB re. 1 µPa	Decibels relative to one micropascal
2D	Two dimensional
3D	Three dimensional
1Q	Quarter one (of year)
2Q	Quarter two (of year)
3Q	Quarter three (of year)
4Q	Quarter four (of year)

Chemical Elements and Compounds

As	Arsenic
Ba	Barium
BTEX	Benzene, toluene, ethylbenzene, xylene
Cd	Cadmium
CH_4	Methane
Co	Cobalt
CO	Carbon Monoxide
CO_2	Carbon Dioxide
Cr	Chromium
Cu	Copper
Fe	Iron
HEC	Hydroxyethylcellulose
H_2S	Hydrogen Sulphide
HDPE	High Density Polyethylene
Hg	Mercury
HNO_3	Nitric Acid
KCl	Potassium Chloride
MEG	Mono Ethylene Glycol
Mn	Manganese
Ni	Nickle
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide

NO_x	Nitrogen Oxides
NMVOC	Non-methane volatile organic compounds
NPD	Naphthalenes, phenanthrenes and dibenzothiophenes
PAH	Polycyclic aromatic hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyls
PHB	Pre Hydrated Bentonite
SO_2	Sulphur Dioxide
SO_x	Sulphur Oxides
TEG	Tri-Ethylene Glycol
Zn	Zinc

Abbreviations

AC	Alternating Current
ACE	Azeri Central East
ACE-PDQ	Azeri Central East Production Drilling & Quarters Platform
ACG	Azeri Chirag Gunashli
ADD	Acoustic Deterrent Device
AFFF	Aqueous Film Forming Foam
AGT	Azerbaijan Georgia Turkey
AIS	Automatic Identification System
ANAS	Azerbaijan National Academy of Sciences
ATA	Amec-Tekfen-Azfen
AZE	Alliance for Zero Extinction
AZN	Azeri Currency (manats)
AzRDB	Azerbaijan Red Data Book
BAT	Best Available Technique
BDJF	Baku Deep Water Jacket Factory
BLP	Bridge-Linked Platform
BAOAC	Bonn Agreement Oil Appearance Code
BOD	Biological Oxygen Demand
BOP	Blow Out Preventer
BPEO	Best Practicable Environmental Option
Bpd	barrels per day
BRT	Below rotary table
BS	British Standard
BSL	Below Sea Level
BTC	Baku Tbilisi Ceyhan
BU	Business Unit
C&WP	Compression and Water Injection Platform
CA	Central Azeri
CA-CWP	Central Azeri Compression and Water Injection Platform
CA-EA	Central Azeri - East Azeri
CA-PDQ	Central Azeri Production Drilling & Quarters Platform
CAPEX	Capital Expenditure
CASMOS	Caspian Sea Meteorological and Oceanographic Study
CDV	Canine Distemper Virus
CEFAS	Centre for Environment, Fisheries and Aquaculture Science
CHARM	Chemical Hazard Assessment and Risk Management
CICAD	Concise International Chemical Assessment Document (World Health Organization)
CIS	Commonwealth of Independent States
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CTD	Conductivity Temperature Depth
COD	Chemical Oxygen Demand
CoM	Cabinet of Minsters
COP	Chirag Oil Project
CRI	Cuttings Reinjection

CSC	Caspian Shipyard Company
CWAA	Central Waste Accumulation Area
CWP	Compression and Water Injection Platform
DBA	Derrick Barge Azerbaijan
DDT	Dichlorodiphenyltrichloroethane
DES	Drilling Equipment Set
DO	Dissolved Oxygen
DPCU	Dew Point Control Units
DPRAB	Department on the Protection and Reproduction of Aquatic Bioresources
DREAM	Dose-related Risk Effects Assessment Model
DSM	Drilling Support Module
DSV	Dive Support Vessel
DWG	Deep Water Gunashli
DWG-DUQ	Deep Water Gunashli Drilling, Utilities and Quarters Platform
DWG-PCWU	Deep Water Gunashli Production, Compression, Water Injection & Utilities Platform
E&P Forum	Exploration and Production Forum
EA	East Azeri
EA-CA	East Azeri - Central Azeri
EA-PDQ	East Azeri Production Drilling & Quarters Platform
EA-WA	East Azeri - West Azeri
EBRD	European Bank for Reconstruction and Development
EBS	Environmental Baseline Survey
EBSAs	Ecologically & Biologically Significant Areas
EC	European Commission
EC_{50}	The statistical estimate of the toxicant concentration that has an adverse effect on 50% of the test organisms after a specific exposure time.
EFL	Electrical Flying Lead
EDTP	Enterprise Development and Training Programme
EIA	Environmental Impact Assessment
EMS	Environmental Management System
EMP	Environment Management Plan
EN	East North
EN	Endangered (IUCN Red List)
ENP	European Neighbourhood Policy
EOP	Early Oil Project
ERD	Extended Reach Drilling
ERMP	Employee Relations Management Plan
ERP	Emergency Response Plan
ES	East South
ESC	Environmental Sub-Committee
ESD	Emergency Shut Down
ESIA	Environmental and Social Impact Assessment
ESMMP	Environmental and Social Management and Monitoring Plan
ESMS	Environmental and Social Management System
ESS	Expandable Sand Screen
ETN	Environmental Technical Note
EU	European Union
FCG	Flooding, Cleaning and Gauging
FD	Future Development
FFD	Full Field Development
FGR	Flare Gas Recovery
GDP	Gross Domestic Product
GE	Gas Export
GEBCO	General Bathymetric Chart of the Oceans
GHG	Greenhouse Gas
GI	Gas Injection
GIWA	Global International Waters Assessment
GL	Gas Lift
GNI	Gross National Income

GTG	Gas Turbine Generator
HDI	Human Development Index
HDPE	High Density Polyethylene
HMCS	Harmonised Mandatory Control System
HOCNF	Harmonised Offshore Chemical Notification Format
HOCNS	Harmonised Offshore Chemical Notification Scheme
HP	High Pressure
HPU	Hydraulic Pumping Unit
HS	Hearing experts with wide hearing frequency rate
HSE	Health, Safety & Environment
HSE MS	Health, Safety & Environmental Management System
HSSE	Health Safety Security and Environment
HUC	Hook-Up and Commissioning
HV	High Voltage
HV AC	High Voltage Alternating Current
HV DC	High Voltage Direct Current
HVAC	Heating, Ventilation and Air-Conditioning
HFL	Hydraulic Flying Lead
IADC	International Association of Drilling Contractors
IAGC	International Association of Geophysical Contractors
IBAs	Important Bird Areas
IC	Internal Combustion
ID	Intervention Deck
ID	Internal Diameter
IDPs	Internally Displaced Persons
IOGP	International Association of Oil and Gas Producers
IPA	Important Plant Areas
ISO	International Organization for Standardization
IUCN	International Union for the Conservation of Nature
JNCC	Joint Nature Conservation Committee
JOA	Joint Operating Agreement
KBAs	Key Biodiversity Areas
LC	Least concern (IUCN Red List)
LC_{50}	Lethal Concentration 50%. The concentration of a chemical which kills 50% of a sample population
LCM	Loss Control Materials
LIC	Lower Inner Choke
LIK	Lower Inner Kill
LMF	Labour Management Forum
LTFV	Lifting Transportation Freezer Vessel
LTMOBM	Low Toxic Mineral Oil Based Mud
LTV	Lifting Transportation Vessel
LV	Low Vulnerability (IUCN Red List)
LV	Low Voltage
MBES	Bathymetric Multibeam Echo Sounder
MAC	Maximum Allowable Concentration
MEG	Mono Ethylene Glycol
MARPOL	International Convention for the Pollution of Prevention by Ships, 1973, as modified by the Protocol of 1978
MD	Measured Depth
MDG	Millennium Development Goals
MDSM	Modular Drilling Support Module
MENR	Ministry of Ecology and Natural Resources
MEP	Mast Equipment Package
MEPC	Marine Environment Protection Committee
MES	Ministry of Emergency Situations
MIA	Ministry of Internal Affairs
MMO	Marine Mammal Observer
MODU	Mobile Offshore Drilling Unit
MPcp	Major Projects common process

MPN	Most Probable Number
MRS	Mud Recovery System
MSD	Marine Sanitation Device
MSDS	Material Safety Data Sheet
MTAG	Monitoring Technical Advisory Group
MW	Megawatt
N	North
ND	Not Detected
NDT	Non-Destructive Testing
NEC	No-Effect Concentration
NGO	Non-Governmental Organisation
Non GHG	Non Greenhouse Gas
NP	National Park
NPV	Net Present Value
NR	Nature Reserve
NR	Non Routine
NRV	Non-Return Valve
NS	Not Significant
NWBM	Non-Water Based Mud
OAO	Open Joint-Stock Company
OCNS	Offshore Chemical Notification Scheme
OE	Oil Export
OHGP	Open Hole Gravel Pack
OMS	Operating Management System
ONGC	Oil and Natural Gas Corporation
OSCP	Oil Spill Contingency Plan
OSPAR	Oslo and Paris Convention for the Protection of the Marine Environment of the North East Atlantic
OSRL	Oil Spill Response (Ltd)
OSRP	Oil Spill Response Plan
PCA	EU-Azerbaijan Partnership and Cooperation Agreement
PCDP	Public Consultation and Disclosure Plan
PDF	Potential Dangerous Facilities
PDQ	Production Drilling & Quarters
PDQU	Production, Drilling, Utilities & Quarters
PEC	Predicted Environmental Concentration
PFOC	Combined Power and Fibre Optic Cable
PHB	Pre Hydrated Bentonite
PI	Performance Improvements
PIMS	Pipeline Integrity Management System
PLONOR	Presenting Little Or No Risk to the Environment
PLR	Pig Launcher Receiver
PNEC	Predicted No-Effect Concentration
POB	Persons On Board
POSVCM	Pipeline Oil Spill Volume Estimation Model
PRIS	Plug Retrieval Isolation Structure
PR	Production and Riser
PSA	Production Sharing Agreement
PT	Power and Telecommunication
PTS	Permanent Threshold Shift
PW	Produced Water
PWD	Produced Water Disposal
R	Routine
QU	Quarters and Utilities
RAMSAR	Convention on the, Protection of wetlands of international importance
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RMS	Root Mean Square
RO	Reverse Osmosis
ROV	Remotely Operated Vehicle
SB	Seine Boat

SB	Swim Bladder (fish)
SBM	Synthetic Based Mud
SBS	State Border Service
SCP	South Caucasus Pipeline
SCPx	South Caucasus Pipeline Expansion
SCS	Solids Circulation System
SD	Shah Deniz
SD1	Shah Deniz Stage 1
SD2	Shah Deniz Phase 2
SDA	Shah Deniz Alpha
SDB	Shah Deniz Bravo
SDB-PR	Shah Deniz Bravo Production and Risers Platform
SDB-QU	Shah Deniz Bravo Quarters and Utilities Platform
SEE	State Ecological Expertise
SEL	Sound Exposure Level
SIMOPS	Simultaneous Operations
SINTEF	Stiftelsen for Industriell og Teknisk Forskning
SMA	State Marine Administration
SME	Small and Medium Enterprises
SOBM	Synthetic Oil Based Mud
SOCAR	State Oil Company of Azerbaijan Republic
SOFAZ	State Oil Fund of Azerbaijan
SPL	Sound Pressure Level
SPS	Shelfprojectsroi
SSES	Stakeholder and Socio-Economic Survey
SSIV	Subsea Safety Isolation Valve
ST	Sangachal Terminal
STB-01	Name of a transportation and installation barge
STP	Sewage Treatment Plant/Package
SWRP	Subsea Well Response Project
SWAP	Shallow Water Absheron Peninsula
TAC	Total Allowable Catch
TB	Tuberculosis
TEG	Tri-Ethylene Glycol
THC	Total Hydrocarbon Content
TPAO	Turkish Petroleum Corporation
TPH	Total Petroleum Hydrocarbon
TSS	Total Suspended Solids
TTS	Temporary Threshold Shift
TVD	True Vertical Depth
UCM	Unresolved Complex Mixture
UK	United Kingdom
UIC	Upper Inner Choke
UIK	Upper Inner Kill
UN	United Nations
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNHCR	United Nations Refugee Agency
UOC	Upper Outer Choke
UOK	Upper Outer Kill
US$	United States Dollars
US$M	United States Dollars (Millions)
USCG	United States Coast Guard
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
V	Vulnerable (IUCN Red List)
VOC	Volatile Organic Compounds
W	Winter

WA	West Azeri
WA-PDQ	West Azeri, Production Drilling & Quarters Platform
WAT	Wax Appearance Temperature
WBM	Water Based Mud
WC	West Chirag
WC-PDQ	West Chirag, Production Drilling & Quarters Platform
WDPA	World Protected Areas Database
WF	Western Flank
WI	Water Injection
WREP	Western Route Export Pipeline
WS	West South
WTNs	Waste Transfer Notes
ZAP	Closed Joint-Stock Company

Glossary

Aarhus Convention
An international legal agreement which promotes access to information, public participation in decision making and access to justice in environmental matters.

Abandonment
Final plugging of wells and/or permanent dismantling of a production platform or other installation.

Accidental Events
Incidents or non-routine events that have the potential to trigger impacts that would otherwise not be anticipated.

Amphipod
A small crustacean of the order Amphipoda having a laterally compressed body with no carapace.

Annelid
Any of various worms or wormlike animals of the phylum Annelida, characterised by an elongated, cylindrical and segmented body.

Annulus
The space between two concentric objects, such as between the wellbore and casing or between casing and tubing.

Anode
A positively charged electrode (associated with a battery, electronic device or electrical equipment).

Anticline
An arch-shaped fold in rock in which the rock layers are upwardly convex.

Anthropogenic
Relating to humans.

Associated Gas
Natural gas found as part of or in conjunction with other constituents of crude oil. This may be dissolved in the crude oil or found as a cap of free gas above the oil.

Azerbaijan Manat (AZN)
Currency of Azerbaijan.

Background Level
The concentration of a substance or energy intensity level (such as noise or light) that is characteristic of the surrounding environment.

Ballast
Water taken aboard a vessel to maintain stability and to distribute load.

Barite
A very heavy substance used as a main component of drilling mud to increase its density (mud weight). Chemical name is barium sulphate.

Barrels
The traditional unit of measure of oil volume, equivalent to 159 liters (0.159 m^3) or approximately 35 imperial gallons (42 US gallons).

Base Case Design
Project design as described and assessed within the ESIA.

Basel Convention
An international legal agreement that primarily deals with transboundary hazardous waste movement and other hazardous waste management.

Bathymetry
The measurement of the depth of bodies of water.

Benthos
The collection of organisms attached to or resting on the bottom (benthic) sediments and those which bore or burrow into the sediments.

Best Practicable Environmental Option (BPEO)
Procedure which results in identification of the option that causes least damage to the environment at acceptable cost.

Biocide
A chemical agent that can be added to fluids for the purpose of selectively preventing or limiting the growth of bacteria and other organisms.

Biodegradable
Susceptible to breakdown into simpler compounds by microorganisms in the soil, water and atmosphere. Biodegradation often converts toxic organic compounds into non- or less toxic substances.

Biodiversity
The number of plant and animal species in a given area.

Biological Oxygen Demand (BOD)
The amount of oxygen required by aerobic microorganisms to decompose the organic matter in a sample of water, such as that polluted by sewage. It is used as a measure of the degree of water pollution.

Biomass
The total mass of living matter within a given quantity.

Bivalve
A marine or freshwater mollusc having a laterally compressed body and a shell consisting of two hinged valves.

Black Water
Human generated wastewater containing fecal matter and urine.

Blowout
Uncontrolled or uncontrollable release of downhole pressure upward through the wellbore or casing.

Blow Out Preventer (BOP)
Hydraulically operated device used to prevent uncontrolled releases of oil or gas from a well.

Borehole
A hole in the ground made by drilling; the uncased drill hole from the surface to the bottom of the well.

Bund
Containment around a storage tank to contain the contents in case of rupture or spillage.

Buy Back
A system to allow the use of gas from a gas export line, when fuel gas is unavailable on the platform.

Caisson
A steel cylindrical chamber extending from a drilling rig or platform that may be used for uptake or discharge.

Casing
The steel piping used to line a well for protection against collapse of the well borehole and unwanted leakage into or from the surrounding formation.

Cathodic Protection
A method of neutralising the corrosive static electric charges in a submerged steel structure.

Cement
A powdery substance that acts as a binder that hardens (sets) after mixing with water. Cement is often used to bind aggregate materials (such as sand and gravel) together, to form concrete.

Chemical Oxygen Demand (COD)
The amount of oxygen consumed by organic compounds in a sample of water. It is used to indirectly measure the amount of organic compounds in water.

Chronostratigraphy
The branch of geology concerned with establishing the absolute ages of strata.

Circulation
The passage of fluids, primarily drilling mud, down the interior of the drill stem and back to the surface via the annulus.

Coalescer
A device used to change material from a liquid to a thickened curd-like state by chemical reaction.

Coliform
Of or relating to the bacteria that commonly inhabit the intestines/colons of humans and other vertebrates.

Commissioning
Preparatory work comprising system testing of the process systems, prior to full production.

Communities
A social group whose members reside in a specific locality, share government and often have a common cultural and historical heritage / an ecological unit composed of the various populations of micro-organisms, plants, animals that inhabit a particular area.

Completion
The work of preparing a newly drilled well for production.

Compression
The raising of pressure within a substance.

Condensate (Gas Condensate)
Light hydrocarbon fractions produced with natural gas which condense into liquid at normal temperatures and pressures associated with surface production equipment.

Conductivity
A measure of the ability of a substance to transmit heat, electrical charge or sound through a medium without noticeable motion of the medium itself.

Conductor Section
Casing string that is usually hammered into the well at the seabed, to prevent the sides of the hole from caving into the wellbore.

Consequence
The resultant effect (positive or negative) of an activity's interaction with the legal, natural and/or socio-economic environments.

Consultation
A formal process which aims to obtain the views and opinions from stakeholders about a project.

Continental Plate
A tectonic plate that forms part of one of the Earth's continents.

Continental Slope
Connects the continental shelf and the oceanic crust and is part of the continental margin.

Contract Area
Area of the sea that has been sub-divided and licensed/leased to a company or group of companies for exploration and production of hydrocarbons.

Control Fluid
A type of hydraulic fluid and the medium by which power is transferred in hydraulically operated systems.

Convergent Plate Boundary
An actively deforming region where two (or more) tectonic plates or fragments of lithosphere move toward one another and collide.

Copepod
Any member of a large family of the phylum Arthropoda, including many crustaceans, living in freshwater and marine water. Some copepods are parasitic and others are free living.

Corrosion
The eating away of metal by chemical or electrochemical action. The rusting and pitting of pipelines, steel tanks, and other metal structures is caused by a complex electrochemical action.

Crude Oil
An unrefined mixture of naturally-occurring hydrocarbons with varying densities and properties.

Crest
Highest point of a geological structure.

Ctenophore
Any of various marine animals of the phylum Ctenophora, having transparent, gelatinous bodies bearing eight rows of comblike cilia used for swimming. Also known as comb jelly.

Cumulative Impact
Environmental and/or socio-economic aspects that may not on their own constitute a significant impact but when combined with impacts from past, present or reasonably foreseeable future activities, result in a larger /more significance impact(s).

Cumacea
Small crustaceans, typically 1 to 10 mm in size.

Cuttings
See drill cuttings.

Dada Gorgud
A semi-submersible mobile drilling rig used to drill predrill wells.

Daphnia
Small planktonic invertebrate, cladoceran, varying in length from 0.2 to 5 mm.

Decibel (dB)
A unit used (one tenth of a bel) used in the comparison of two power levels relating to sound intensities.

Decommissioning
Shutdown and dismantling of any facilities.

Degasser
A separator which removes entrained gas from the returned mud flow. Also any process which removes gases of various kinds from an oil flow.

Dehydration
Removal of water.

Derrick
A crane. Also the frame structure used to support drilling equipment.

Dewpoint
The temperature to which a given parcel of air must be cooled, at constant pressure, for water vapour to condense into water.

Disclosure
Release of ESIA information into the public domain.

Dispersant
Specially designed oil spill products that are composed of detergent-like surfactants in low toxicity solvents. Dispersants do not remove oil from the water but break the oil slick into small particles, which then disperse into the water where they are further broken down by natural processes.

Domestic waste
Solid waste, composed of garbage and rubbish, which normally originates from a residence/living quarters.

Downhole
Area within the drilled bore of an oil or gas well.

Drill Bit
A drilling tool used to cut through rock.

Drill Cuttings
Small fragments of rock produced as the result of drilling that are brought to the surface by the flow of the drilling mud as it is circulated.

Drilling Mud
A special clay mixed with water or oil and chemical additives, pumped downhole through the drill pipe (string) and drill bit. The mud cools the rapidly rotating bit, lubricates the drillpipe as it turns in the well bore, carries rock cuttings to the surface and serves as a plaster to prevent the wall of the borehole from collapsing. Also known as drilling fluid.

Drill String
Lengths of steel tubing screwed together to form a pipe connecting the drill bit to the drilling rig. It is rotated to drill the hole and delivers the drilling fluids to the cutting edge of the bit.

Early Oil Project
The first large-scale oil project in the Caspian Sea. It commenced in 1994 and involved a consortium of companies who invested to extract oil from the Azeri, Chirag and Guneshli wells.

Ecosystem
The interrelationships between all living organisms in a given area, and their relationships to non-living materials.

Effluent
Waste emitted as a liquid by an operation or process.

Emergency
An unplanned activity e.g. due to equipment failure, loss of containment, operator error, unexpected well conditions or design error.

Endemic
Present within a localised area or peculiar to organisms in such an area.

Emulsion
A mixture of two or more immiscible liquids, with one being dispersed in another.

Environment for Europe
A partnership of member states, including Azerbaijan, and other organisations within the UNECE region.

Environmental and Social Impact Assessment (ESIA)
Systematic review of the environmental or social effects that a proposed project may have on its surrounding environment.

Environmental Aspect
An element of an organisation's activities, products or services that can interact with the environment.

Environmental Impact
Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's activities, products or services.

Environmental Management System
A system established to plan, manage and document an organisation's activities and processes and resultant environmental impacts.

Environmental Receptors
Any of various organisms that are directly or indirectly affected by environmental impact.

Espoo Convention
A regional legal agreement to promote environmentally sound and sustainable economic development through the application of ESIA.

Eurasian
The extended landmass of Europe and Asia and specifically the large indeterminate region where the two continents join.

Exploration Well
A well drilled in search of an undiscovered reservoir or to greatly extend the limits of a known reservoir.

Filter Feeder
A variety of organisms living mostly on detritus or on plankton, whose feeding mechanism comprises a filter and a means of creating a current carrying particles through the filter.

Flaring
Controlled disposal of surplus combustible hydrocarbons by igniting their vapours.

Flash
The sudden release of gases and/or vapours due to an instantaneous reduction in temperature and/or pressure.

Float Over
The launch or loading out of jackets or other structures for installation offshore on a flotation barge or other vessel.

Flora/fauna
Plants/wildlife that occur within a defined geographical area.

Flowline
The pipe through which oil/gas travels from the well to the offshore platform processing facilities.

Fluvial
Of or relating to rivers or streams or produced by the action of a river or stream.

Footprint
The spatial impact/impression on the land from a facility, building or disturbed area.

Formation
A rock deposit or structure of homogenous origin and appearance.

Fugitive Emissions
Release of small volumes of gas due to filling, emptying and "breathing losses" from tanks and small losses from fittings that cannot be practically recovered in capture systems

Galley Waste
Organic food waste originating from a vessel's galley (or kitchen).

Gastropod
Any of the various molluscs of the class Gastropoda such as the snail.

Greenhouse Gas (GHG)
Atmospheric gases considered to contribute to the greenhouse effect by absorbing and emitting radiation within the thermal and infrared range. GHG primarily include carbon dioxide and methane.

Grey Water
Wastewater from wash basins, showers and laundry use.

Grout
A material that is used for filling voids and sealing joints.

Habitat
An area where particular animal or plant species and assemblages are found, defined by environmental parameters.

Hazard
The potential to cause harm, including ill health or injury; damage to property, plant, products or the environment; production losses or increased liabilities.

Heavy Metals
A subset of elements that exhibit metallic properties with high atomic weights, and which include the transition metals and a number of metalloids, lanthanoids, and actinides. Examples include mercury, chromuim, cadmuim, arsenic and lead.

Heritage
Valued objects and qualities such as cultural traditions, unspoiled countryside, and historic building that have been passed down previous generations.

Hook Up
The activity following plant installation during which all connections and services are made operable for commissioning and 'start-up'.

Hydrate
These are molecules of natural gas, typically methane, which are trapped in ice molecules. Hydrates can form in pipelines and in gas processing facilities at reduced temperatures and high pressures. Hydrates can plug the pipelines and significantly affect production operations.

Hydrocarbon
Organic chemical compounds of hydrogen and carbon atoms. There are a vast number of these compounds and they form the basis of all petroleum products. They may exist as gases, liquids or solids, examples being methane, hexane and paraffin.

Hydrotesting
The checking of the integrity of a container (e.g. tank or pipe) by filling it with water under pressure and testing for any loss of pressure.

Inert Gas
Chemically unreactive gases used to flood compartments in a vessel or platform when there is fire or imminent danger of fire.

International Finance Corporation
Organisation that is a member of the World Bank, and promotes sustainable private sector investment in developing countries.

Internally Displaced Persons
People who are forced to flee their homes, but unlike refugees, remain within their country's borders.

Invertebrates
Any animal lacking a backbone, including all species not classified as vertebrates.

ISO 14001
An evolving series of generic environmental management system standards developed by the International Standards Organisation that provides business management with a structure for managing environmental impacts.

Isopod
A type of peracarid crustacean.

Istiglal
A semi-submersible mobile drilling rig used to drill predrill wells.

Jacket
The structure of an offshore steel platform, which supports the topside facilities.

J-Tube
Open-ended J section of pipe attached to a jacket structure providing a means of installation and protection for flexible flow lines, cables and umbilicals

Landfill
Disposal of waste materials by burial.

Larvae
An immature free-living form of animal that develops into a different form through metamorphosis.

Law on Normative-Legal Acts
Azerbaijani legislation that stipulates that acts in force prior to independence, not subsequently cancelled or contradictory to the Constitution, remain in force.

Law on the Protection of the Environment
Azerbaijani legislation that addresses use of natural resources, the rights and responsibilities of the State and its citizens, ecological requirements for economic activities, ecological emergencies and disaster zones, etc.

Lay down area
Temporary storage area for supplies and materials.

Likelihood
The possibility that an activity or effect will occur.

Liner
Similar to casing except the steel tubing that forms the liner does not run the complete length of the well. It is hung within the well inside the previous casing and cemented into place.

Macrobenthos or Macrofauna
Organisms that live on/in sediment at the bottom of a water column. Relatively larger than other benthos with a size range of approximately 20 cm to 0.5 mm.

Manifold
Assembly of pipes, valves and fittings which allows fluids from more than one source to be collected together.

Mammal
A class of air-breathing warm-blooded vertebrates, Mammalia, having mammary glands in the female.

Maersk Explorer
A semi-submersible mobile drilling rig used to drill predrill wells.

Material Safety Data Sheet (MSDS)
An information sheet used by chemical suppliers to summarise properties of products, including health, safety and environmental aspects.

Microplate
Any small lithospheric (Earth's crust and upper mantle) plate.

Migration
Movement of people to a new area or country in order to find work or better living conditions / any regular animal journeys along well-defined routes, particularly those involving a return to breeding grounds.

Milli Mejlis
Azerbaijan Parliament.

Mitigation
The measures put forward to prevent, reduce and where possible, offset any adverse environmental or socio-economic effects.

Module
A separate section or box-like compartment of the topside of a platform, as far as possible self-contained, designed to be connected to other modules offshore.

Neutralised Seawater
A process to chemically alter seawater to make its pH level nearer neutral, to enhance its effectiveness for drilling mud.

Non Destructive Testing (NDT)
Methods of inspecting and testing the quality or integrity of vessels or equipment which do not involve the removal or testing to destruction of representative sections.

Oceanography
The study of the ocean, including marine ecosystems, ocean currents, waves, and physical and chemical changes.

Oligochaete
Any of various annelid worms of the class Oligochaeta, including the earthworms and a few small freshwater forms.

Operator
The company responsible for conducting operations on a concession on behalf of itself and any other concession-holders.

Overpressure
Subsurface pressure that is abnormally high, exceeding hydrostatic pressure at a given depth.

Packer
Device that can be installed into a drilled well that expands to seal the wellbore.

Particulates
Tiny particles of solid or liquid suspended in a gas or liquid.

pH
A scale of alkalinity or acidity, running from 0 to 14 with 7 representing neutrality, 0 maximum acidity and 14 maximum alkalinity.

Phytoplankton
Microscopic photosynthetic organisms which float or drift in the surface waters of seas and lakes, e.g. diatoms, dinoflagellates.

Pig (train)
A bullet shaped, cylindrical or spherical capsule which is inserted into a pipeline flow and travels along with the fluid in the pipeline. Its primary purpose is to scrape the pipeline clean from rust, wax or other deposits. More sophisticated pigs, called intelligent pigs, carry instrumentation used in pipeline inspection.

Pigging
The process of cleaning or measuring internally the pipeline whereby a “pig” is sent though the line to clean/ measure the inside of the pipeline.

Piling
A heavy beam of timber, concrete, or steel, driven into the earth as a foundation or support for a structure.

Pipe Dope
Lubricating grease which seals pipe joints to prevent damage to threads.

Pipelay Barge
A vessel designed for welding together pipelines and laying them on the seabed.

Pipe Rack
Where stands of drill pipe are stacked vertically in a derrick ready for use.

Plankton
Tiny plants (phytoplankton) and animals (zooplankton) that drift in the surface waters of seas and lakes. They are of high ecological importance as they provide a source of food to larger marine organisms such as fish.

Platform
A large structure offshore which has facilities to drill, extract, process and temporarily store hydrocarbons.

Plug
To seal a well or part of a well.

Pollution
The introduction by man, directly or indirectly, of substances or energy to the environment resulting in deleterious effects such as harm to living resources; hazards to human health; hindrance of marine activities including fishing and impairment of the quality for use of seawater and reduction of amenities.

Polychaete
Any of various annelid worms of the class Polychaeta, including mostly marine worms such as the lugworm, and characterised by fleshy paired appendages tipped with bristles on each body segment.

Polycyclic Aromatic Hydrocarbons (PAH)
Hydrocarbons whose carbon atoms form a ring or rings.

Polymer
Two or more molecules of the same kind, combined to form a compound with different physical properties.

Potable Water
Water that is suitable for human consumption.

Pour Point
The lowest temperature at which a liquid will pour or flow under prescribed conditions.

Precipitation
The product of atmospheric water vapour condensation that falls to the Earth’s surface under gravity. The main types of precipitation are: drizzle, rain, sleet, snow and hail.

Predrill
Drilling activities taking place to accelerate early production once offshore facilities are in place.

Preservation Chemicals
Chemicals used to prevent corrosion and inhibit bacteria growth in seawater used for hydrotesting.

Pressure Maintenance
The process of keeping reservoir pressure at the optimum level during production, usually by water or gas injection to replace the extracted fluids.

Produced Water
Water that naturally accompanies produced oil/condensate. Also known as produced formation water.

Producer Well
A drilled hole through which oil and gas is extracted.

Production
Extraction of hydrocarbon from the reservoir.

Production Tree
Device fitted to a wellhead to control the flow of formation fluids from the well.

Production Sharing Agreement (PSA)
Type of contract signed between a government and a resource extraction company (or group of companies).

Productive Zone
Most populated zone of the ocean (usually the top layer).

Public Participation
Process where the affected public are informed about the planned activities.

RAMSAR Convention
An intergovernmental treaty that provides designations to sites that are considered internationally important wetlands.

Receptor
The aspect of the environment (air, water, ecosystem, human, fauna, etc.) that is affected by/interacts with an environmental or socio-economic impact.

Recycling/Recovery
The conversion of wastes into usable materials and/or extraction of energy or materials from wastes.

Red List / Red Book
A list comprised of rare or endangered species of plants and animals / the book containing Red List species.

Reedbed
Tall plants that grow in large groups in shallow water or on ground that is always wet and soft.

Reservoir
A porous, fractured or cavitied rock formation with a geological seal forming a trap for producible hydrocarbons.

Reservoir Pressure
The pressure at reservoir depth in a shut-in well.

Residual Impacts
Residual impacts are impacts that remain after mitigation measures, including those incorporated into the project's Base Case design and those developed in addition to the base design, have been applied.

Resilience
A measure of how a biological, ecological or human receptor is affected by an identified stressor.

Reuse
The use of materials or products that are reusable in their original form.

Rig
A collective term to describe the equipment needed for drilling a well.

Riser
A pipe through which fluids flow upwards.

Risk
The product of the chance that a specified undesired event will occur and the severity of the consequences of the event.

Sail-away
The process of transporting equipment from onshore to its offshore location by vessel.

Salinity
Total amount of salt dissolved in an aqueous solution usually expressed as parts per thousand.

Scale Inhibitor
Substances added to minimise deposition of solids such as calcium carbonates and sulphates in equipment, pipework or casings.

Scoping
Early stage in the ESIA process which appraises the likely key issues requiring detailed assessment.

Screening
The process by which it is decided if an ESIA is required to be carried out for a project.

Sediment
Solid fragments of inorganic or organic material that come from the weathering and erosion of rock and are carried and deposited by wind, water, or ice.

Seismic
The characteristics (e.g. frequency and intensity) of earthquake activity in a given region.

Semi-submersible Rig
A type of floating offshore drilling rig which has pontoons or buoyancy chambers located on short legs below the drilling platform.

Separator
A process vessel used to separate gases and liquids in a hydrocarbon stream.

Shale Shaker
Screen for extracting rock cuttings from circulating drilling mud.

Shrub
A woody plant of relatively low height, having several stems from the base.

Significant Wave Height
The average wave height (trough to crest) of the 1/3 largest waves.

Slurry
A mix of cement and waste.

Solids Circulation System
A device that separates SBM/LTMOBM from cuttings via a series of shale shakers, a vacuum degasser and centrifuges.

Stakeholder
A person, group and/or organisation with an interest in a project.

Stinger
A support boom that extends outwards from the stern of a lay-barge and used to lay pipes.

Stockholm Convention
An international legal agreement requiring Governments to reduce the release of persistent organic pollutants.

Storm Surge
An offshore rise in water level associated with a low pressure weather system. Usually caused by strong winds pushing the surface of the water body.

Stratigraphy
The study and classification of rock layers.

Strata
Distinct, usually parallel beds of rock.

Subsea Isolation Valve (SSIV)
A subsea valve fitted to provide isolation in the event of an emergency. Typically SSIVs are fitted to protect a platform and its personnel from unintended release of hydrocarbons.

Surfactant
An additive that reduces surface tension e.g. a detergent or emulsifier.

Suspension Fluids
Fluids used in the well during well suspension to maintain the integrity of the well.

Sweeps
Viscous fluids typically used to convey debris or residual fluids during drilling. Typically used during conductor or top hole drilling of wells.

Swim Bladder
Buoyancy organ possessed by most bony fish.

Taxon
Plural -Taxa. A taxonomic category or group, used to classify organisms.

Thermal desorption
A non-oxidising process using heat to desorp oil from oily wastes.

Thermocline
Temperature differential in the water.

Topside
Part of a rig which includes the upper deck, mezzanine deck, cellar deck and underdeck.

Toxicity
Inherent potential or capacity of a substance to cause adverse effects on living organisms.

Toxicity Test
Procedure that measures the toxicity produced by exposure to a series of concentrations of a test substance. In an aquatic toxicity test, the effect is usually measured as either the proportion of organisms affected or the degree of effect shown by the organism.

Transboundary impact
An impact which crosses any boundaries between two geopolitical boundaries (i.e. a border).

Treated Seawater
Seawater which is treated with preservation chemicals to reduce potential corrosion and biofouling.

Turbidity
The cloudiness or haziness of a fluid caused by individual particles. It is used as a test of water quality.

Umbilical
Tube or line that connects the subsurface to the surface of the sea.

Venting
The release of uncombusted gases to the atmosphere.

Vienna Convention
An international legal agreement regarding the protection of the Ozone Layer.

Viscosity
The resistance of a fluid to flow due to the mutual adherence to its molecules.

Wadi
A river valley which may be ephemeral and flow only after heavy rain, or during certain periods of the year.

Wastewater
Water contaminated with domestic and production wastes.

Water Based Muds (WBM)
Drilling fluid based on suspension of solids in water.

Water Injection
The injection of water into a reservoir or well.

Wax
Wax is a constituent of crude oil that often requires special treatment to allow the oil to flow freely at surface conditions.

Weathering
Processes related to the chemical action of air, water and organisms. Weathering results in evaporative loss of light hydrocarbons and it is commonly accompanied by biodegradation and water washing.

Well Clean Up
Ridding the borehole of spent fluid. This returns the well to an original state and drains back into the borehole where it is pumped or circulated out, leaving the hole clean.

Wellhead
Top of a casing and the attached control and flow valves. The well head is where the control valves, testing equipment and take-off piping are located.

Wetland
An area of land whose soil is saturated with moisture either permanently or seasonally.

Well Workover
Operations on a producing well to restore or increase production. A workover may be performed to stimulate the well, remove sand or wax from the wellbore, to mechanically repair the well, or for other reasons

Zooplankton
Plankton that consists of animals such as corals and jellyfish, usually small and often microscopic.

1 Introduction

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1.1 Introduction

This Environmental and Social Impact Assessment (ESIA) has been prepared for the Azeri Central East (ACE) Project. The ACE Project represents the next stage of development in the Azeri Chirag Gunashli (ACG) Contract Area in the Azerbaijani sector of the Caspian Sea (see Figure 1.1). The ACE Project aims to achieve peak production rates of up to 100,000 barrels per day (bpd) oil and 350 million standard cubic feet per day (MMscfd) gas through the drilling of additional wells and installation of an additional offshore facility within the ACG Contract Area.

Figure 1.1 Location of ACG Contract Area, Existing ACG and Shah Deniz (SD) Offshore Facilities and SD2 Project Facilities

The ESIA has been conducted in accordance with the legal requirements of Azerbaijan including ACG Production Sharing Agreement (PSA) requirements as described in Chapter 2: Policy, Regulatory and Administrative Framework. The scope and assessment methodologies used in this ESIA have been informed through a consultation process, as described in Chapter 8: Consultation and Disclosure. Stakeholders consulted have included, among others, the Azerbaijan Ministry of Ecology and Natural Resources (MENR), the State Oil Company of Azerbaijan Republic (SOCAR) and National Academy of Sciences of Azerbaijan (ANAS).

1.2 ACG and SD Development to Date

1.2.1 ACG Production Sharing Agreement

The PSA was signed in September 1994 between the State Oil Company of the Azerbaijan Republic (SOCAR) and certain international oil companies (“Contractor Parties” or “Contractor” if referred to all of the Contractor Parties collectively). The PSA passed into Azerbaijan law in December 1994 and granted the Contractor the rights to develop and produce hydrocarbons within the “Contract Area” of the ACG Field over a period of 30 years. In July 1999, BP was appointed Operator of the PSA on behalf of the Contractor Parties. An amended and restated PSA effective until the end of 2049 was enacted into Azerbaijan law in October 2017.

1.2.2 ACG Contract Area and Field Development

The ACG Contract Area, which covers an area of approximately 432 square kilometres (km^2), is located approximately 120 kilometres (km) east of Baku. The development of the Contract Area has been pursued in phases which, to date, has included:

- Early Oil Project (EOP);
- ACG Phase 1;
- ACG Phase 2;
- ACG Phase 3; and
- Chirag Oil Project (COP).

Table 1.1 presents a summary of each development phase and the current status. The location of the Sangachal Terminal (ST), the ACG offshore facilities associated with each development phase and the ACG subsea export pipeline corridor from the Contract Area to ST are shown within Figure 1.1 above.

Table 1.1 Summary of ACG Development Phases to Date and Current Status

ACG Phase	Scope and Current Status
EOP	• Construction and installation of: - Chirag-1 Offshore Production Drilling & Quarters (PDQ) platform; - 24" subsea oil pipeline from the Chirag-1 platform to ST; - 16" subsea gas pipeline from the Chirag-1 platform to the SOCAR Oily Rocks facility; - 18" subsea gas pipeline from the Chirag-1 platform to the Central Azeri (CA) platform[1]; and - EOP oil receiving and stabilisation facilities at ST. ***Current Status:*** Commenced operations in 1997 and is currently producing approximately 49000bpd oil.
Phase 1	• Construction and installation of: - CA Production Drilling & Quarters (PDQ) platform bridge-linked to CA Compression and Water Injection (CWP) platform; - 30" subsea oil pipeline and 28" subsea gas pipeline from CA to ST; and - Additional oil receiving and stabilisation facilities at ST. ***Current Status:*** Commenced operation in February 2005 and is currently producing approximately 158000bpd oil.
Phase 2	• Construction and installation of: - West Azeri (WA) and East Azeri (EA) Production, Drilling, Utilities and Quarters (PDUQ) platforms; - Expansion of the CA CWP facilities to provide both the WA and EA platforms with gas transfer facilities to ST; - Infield subsea pipelines between WA, EA and CA platforms to provide the Phase 2 platforms with water reinjection and gas reinjection facilities; - Subsea tie-ins to the Phase 1 30" subsea oil pipeline for oil transfer to ST; and - Additional oil receiving and stabilisation facilities at ST. ***Current Status:*** WA platform commenced operations in January 2006. EA platform commenced operations in October 2006.
Phase 3	• Construction and installation of: - Deep Water Gunashli (DWG) Drilling, Utilities and Quarters (DUQ) platform, bridge-linked to a Production, Compression, Water Injection (WI) and Utilities (PCWU) platform; - Subsea tie-ins connecting the platforms to the 30" subsea oil pipeline for transfer of oil to ST; - Subsea tie-in connecting the Phase 3 facilities to the 28" subsea gas pipeline for gas transfer to ST; - Subsea WI wells at three manifolds (north, south and east) tied back to the DWG PCWU platform via flowlines[2]; and - Additional oil receiving and stabilisation facilities at ST. ***Current Status:*** DWG platforms commenced operations in May 2008 and are currently producing approximately 107000bpd oil.

ACG Phase	Scope and Current Status
COP[3]	• Construction and installation of: - West Chirag PDQ platform (WC-PDQ); - Infield subsea pipelines between WC-PDQ and DWG-PCWU for transfer of produced water and reinjection water between the platforms; and - Subsea tie-ins to the existing Phase 2 30" oil pipeline and the Phase 1 28" gas pipeline for transfer of gas and oil to ST. ***Current Status:*** Commenced operations in January 2014 and is currently producing approximately 59000bpd.oil.
Notes: 1. Installed following the installation of the ACG Phase 1 facilities. 2. The project scope originally included three subsea WI wells. Additional WI wells and associated subsea infrastructure have been installed subsequently with the purpose of increasing and maintaining production rates. 3. There are no onshore facilities at Sangachal Terminal associated with COP as project makes use of the existing capacity within the ACG Phase 1, 2 and 3 onshore processing facilities.	

Oil produced from the ACG Contract Area contains a percentage of water, referred to as "produced water". The CA, EA, WA, DWG and WC offshore facilities are designed such that initially produced water arising from the reservoir is sent to the ST co-mingled with oil for treatment. When the water cut on each platform reaches more than 5% by volume water-in-oil, the offshore facilities are designed to enable offshore produced water separation, treatment and reinjection. At the ST the oil-water stream is separated to meet the water-in-oil specification required for delivery of oil to the oil export pipelines.

A separate project, known as the ACG Full Field Development (FFD) Produced Water Disposal (PWD) Project, included the construction and installation of onshore facilities at the ST to treat the separated water to a standard suitable for transfer back offshore and the installation of a dedicated marine pipeline to the CA CWP platform for reinjection into the ACG reservoir for reservoir pressure maintenance. The onshore treatment and offshore reinjection of ACG produced water from ST commenced in the fourth quarter of 2008.

Offshore ACG produced water separation and treatment has commenced on the EA, WA, DWG and WC platforms with start up and commissioning of the CA platform facilities planned to be complete by 2025[1].

1.2.3 SD Contract Area and Field Development

1.2.3.1 Shah Deniz Stage 1 Gas Export Project

The SD Contract Area lies approximately 100km south east of Baku (refer to Figure 1.1). Development of the SD Contract Area is being pursued in stages with the Shah Deniz Stage 1 (SD1) development commencing production in 2006. SD1 comprises:

- A fixed platform (denoted SD Alpha) with drilling and processing facilities limited to primary separation of gas and liquids; and
- Two marine export pipelines to transport gas and condensate to onshore reception, gas-processing and condensate facilities located at ST.

In 2017 SD1 produced 10.2 billion standard cubic metres (bcm) of gas and 2.4 million tonnes (about 19 million barrels) of condensate.

1.2.3.2 Shah Deniz Stage 2 Project

The Shah Deniz Stage 2 (SD2) Project represents the second stage of SD field development and is designed to produce up to 16 billion cubic meters per year (bcma) of gas and 85mbd condensate. The scope of the SD2 Project includes:

[1] Start up, commissioning and operation of CA-CWP 3 phase separation is a separate project and is therefore outside of the ACE ESIA scope.

- SD Bravo (SDB) platform complex including a Production and Risers (SDB-PR) and a Quarters and Utilities (SDB-QU) platform, bridge linked to the SDB-PR;
- 10 subsea manifolds and 5 associated well clusters, tied back to the fixed SDB platform complex by twin 14” flowlines to each cluster;
- Subsea pipelines from the SDB-PR platform to ST comprising:
    - Two 32” gas pipelines (for export to ST);
    - One 16” condensate pipeline (for export to ST); and
    - One 6” mono ethylene glycol (MEG) pipeline (for supply to the SDB platform complex).
- Onshore SD2 Project facilities at ST to receive the hydrocarbon streams via the SD2 gas and condensate subsea export pipelines and process the fluids to obtain gas and condensate at a quality suitable for export.

The SD2 Project commenced operations during 4Q 2018 with wells to date drilled and completed at two of the 5 well clusters. Ongoing SD2 activities include the drilling and completion of further SD2 wells and installation of remaining subsea infrastructure within the SD Contract Area (including manifolds and flowlines).

1.2.4 Oil and Gas Export Pipelines

Oil and gas produced from the ACG and SD Contract Areas is exported from ST following stabilisation and dehydration respectively via the following:

- The Baku-Tblisi-Ceyhan (BTC) Pipeline transports oil from ST through Azerbaijan, Georgia and Turkey to the Ceyhan Terminal located on the Turkish coast of the Mediterranean Sea. From Ceyhan the oil is distributed to international markets. The pipeline covers a distance of 1,768km and has eight pump stations along the route with the head pump station installed at ST. During 2017 BTC exported approximately 256 million barrels of crude oil.

- Western Route Export Pipeline (WREP) is 829km in length and transports oil from ST to the Supsa Terminal located on Georgia’s Black Sea coast. During 2017, the ST exported approximately 28 million barrels oil via the WREP. A number of upgrades comprising sectional replacements of the pipeline are currently in progress, aimed at ensuring the integrity of the pipeline through Azerbaijan and Georgia.

- South Caucasus Pipeline (SCP), which commenced operation in 2006, transports gas from the ST in Azerbaijan, through Georgia to Turkey. The pipeline is 691km in length and runs parallel to the BTC Pipeline to the Turkish border where it is linked with the Turkish gas distribution network. During 2017 the pipeline delivered approximately 20.5 million cubic metres of gas per day (m^3/day).

  To export the increased gas flows associated with SD2 Project, a project is currently underway to expand the capacity of the SCP. This project, known as SCPx, involves the laying of new pipeline sections across Azerbaijan and Georgia and the construction of two new compressor stations in Georgia. At the time of writing, construction activities are complete and commissioning and start up activities are in progress.

1.2.5 ACE Project

The ACE Project represents the next stage of development in the ACG Contract Area and is planned to comprise:

- A PDQ platform, to be located mid-way between the CA and EA platforms in a water depth of approximately 137 metres(m);
- Three new infield subsea gas, oil and WI pipeline tie-ins and associated subsea infrastructure; and
- A combined power (back-up) and telecommunications subsea cable from EA to ACE.

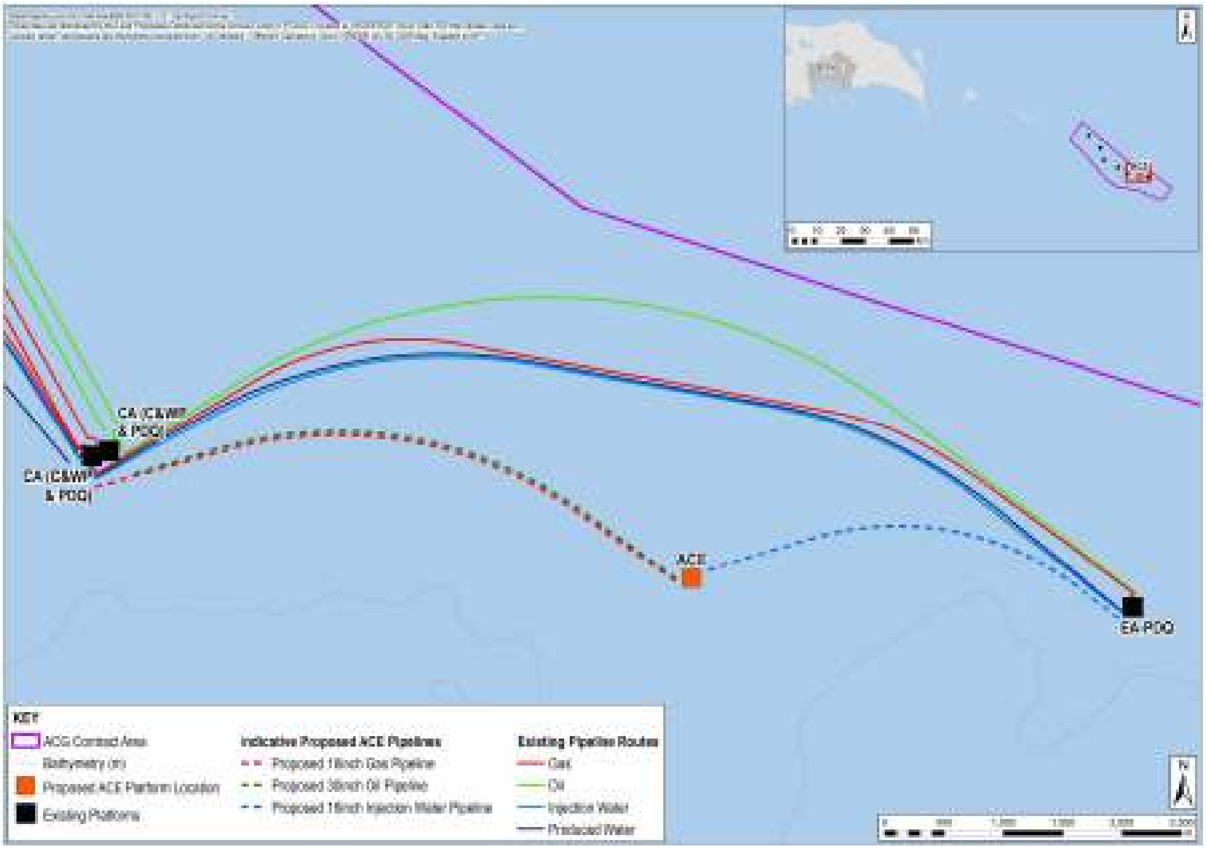
The Project is designed such that:

- Partially stabilised reservoir fluids comprising comingled oil and produced water are sent to ST via a new 30” infield oil pipeline tie-in to the existing 30” oil export pipeline adjacent to the CA-CWP platform;
- Gas arising on the platform is used for fuel and, following compression, as lift gas and for gas reinjection. A new 18” infield gas pipeline tie-in to the existing gas export pipeline upstream of the CA-CWP platform will allow gas not required on the ACE platform to be exported to ST; and
- High pressure water for reinjection into the reservoir is supplied to the ACE platform via a new 16” water injection infield pipeline to the existing CA-EA water injection pipeline.

Brownfield modifications on the CA-CWP and EA-PDQ platforms will be undertaken respectively to enable all gas from ACE to be exported to shore in the event gas injection is shut down or unavailable on ACE and to install and operate the power and telecommunications cable between EA-PDQ and ACE. The ACE Project does not require any additional facilities at ST (other than minor telecommunication modifications) as there is existing capacity within the ACG Phase 1, 2 and 3 onshore processing facilities to meet the requirements for ACE based on forecast production rates.

Figure 1.2 shows the scope of the ACE Project offshore facilities including the platform location and the new infield pipelines.

Figure 1.2 Scope of the ACE Project



An Environmental Technical Note (ETN) was submitted to, and approved by, the Ministry of Ecology and Natural Resources (MENR) to undertake a geotechnical survey in the vicinity of the ACE platform. The geotechnical survey was undertaken in March 2018.

The purpose of this ESIA is to assess the environmental and social impacts associated with the ACE Project construction, installation, drilling and operational activities.

1.3 ACE Project Environmental and Social Impact Assessment

The overall objective of the ACE Project ESIA process is to ensure that any adverse environmental and socio-economic impacts arising from the proposed works are identified and, where possible, eliminated or minimised through early recognition of and response to the issues.

The purpose of this ESIA is to:

- Ensure that environmental and social considerations are integrated into Project design, construction and operation;
- Ensure that previous experience is acknowledged and where appropriate, integrated into the project design, construction and operation;
- Ensure that environmental and social impacts are identified, quantified and assessed and appropriate mitigation measures proposed;
- Ensure that a high standard of environmental performance is planned and achieved for the Project;
- Consult with relevant stakeholders throughout the Project and address their concerns; and
- Demonstrate that the Project will be implemented with due regard to environmental and socio-economic considerations.

Within the impact assessment, activities and potential receptor interactions are evaluated against existing environmental and social conditions and sensitivities, and the potential impacts are ranked. The assessment of potential impacts takes account of existing and planned controls and monitoring and mitigation measures developed as part of earlier ACG and SD projects.

1.4 ESIA Team and Structure

The details of the ACE Project ESIA Team are provided in Table 1.2.

Table 1.2 ACE Project ESIA Team

Team Member	Role
AECOM	ESIA Project Manager and Lead Authors
Tariel Eybatov	Local Caspian Seal Specialist
Ilyas Babayev	Local Bird Specialist
Mehman Akhundov	Local Fish and Fisheries Specialist
More Energy Limited	Offshore Discharges and Oil Spill Modelling
Award Environmental Consultants Limited	Underwater Sound Specialist
Bren Sheehy Consulting Ltd	Social Specialist
KBR	Project Design Engineers
BP	ACG Contract Area PSA Operator on behalf of Contractor Parties

Table 1.3 provides a summary of the ACE Project ESIA structure and content.

Table 1.3 Structure and Content of the ESIA

Chapter Title	Description
Executive Summary	A concise summary of the ESIA findings
Units & Abbreviations	A list of the units and abbreviations used in the ESIA Report
Glossary	A description of the technical terms used in the ESIA Report
1. Introduction	An overview of the ACE Project, ESIA objectives, details of ESIA team members and ESIA Report structure
2. Policy, Regulatory and Administrative Framework	A summary of applicable requirements from the PSA, ratified international conventions, International Petroleum Industry Standards and Practices, applicable national legislation and guidance
3. Impact Assessment Methodology	A description of the methodology used for the impact assessment
4. Options Assessed	A description of the alternative concept options assessed for the ACE Project. A summary of the initiatives and options assessed which aimed to avoid or reduce negative environmental and social impacts

Chapter Title	Description
5. Project Description	A detailed description of the ACE Project
6. Environmental Description	A description of onshore and offshore environmental conditions
7. Social Description	A description of onshore and offshore social conditions
8. Consultation and Disclosure	An overview of consultation activities undertaken during the ESIA programme and the issues and concerns raised
9. Predrill Environmental Impact Assessment, Monitoring and Mitigation	An assessment of potential environmental impacts associated with ACE Project predrilling activities, including any necessary mitigation and monitoring
10. Construction, Installation and Hook Up and Commissioning (HUC) Environmental Impact Assessment, Monitoring and Mitigation	An assessment of potential environmental impacts associated with onshore, subsea and offshore construction, installation and HUC ACE Project activities, including any necessary mitigation and monitoring
11. Operations Environmental Impact Assessment, Monitoring and Mitigation	An assessment of potential environmental impacts associated with the operations phase of the ACE Project, including any necessary mitigation and monitoring
12. Social Impact Assessment, Monitoring and Mitigation	An assessment of potential social impacts associated with each phase of the ACE Project activities
13. Cumulative and Transboundary Impacts and Accidental Events	An assessment of potential cumulative and transboundary impacts and accidental events associated with the ACE Project activities
14. Environmental and Social Management.	A summary of the environmental and social management system associated with the ACE Project activities
15. Residual Impacts and Conclusion	A summary of the residual impacts and conclusions arising from the ESIA process
Appendices	Supporting studies and information.

2 Policy, Regulatory and Administrative Framework

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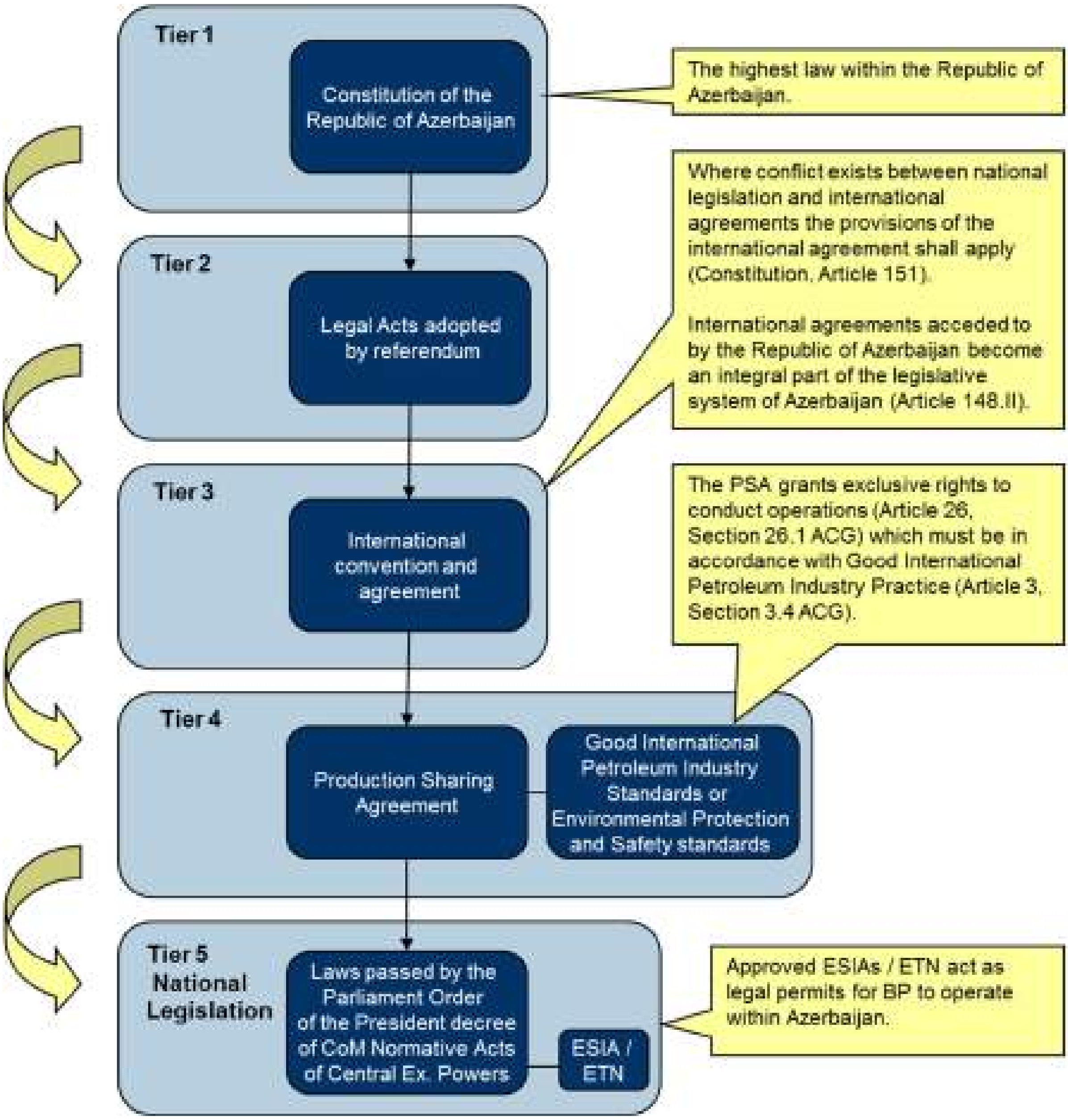
2.1 Introduction

This Chapter provides an overview of the agreements, legislation, standards and guidelines which are applicable to the Azeri Central East (ACE) Project including the following:

- Azeri Chirag Gunashli (ACG) Production Sharing Agreement (referred herein as the "PSA");
- Applicable national legislation and guidance;
- Applicable requirements of international and regional conventions ratified by the Azerbaijan government;
- Regional processes; and
- International petroleum industry standards and practices.

The legal hierarchy applicable to the ACE Project is illustrated in Figure 2.1.

Figure 2.1 Azerbaijan Legal Hierarchy



In addition to the applicable legal requirements, the ACE Project will be undertaken in accordance with BP Group, Segment and Regional standards.

2.2 Regulatory Agencies

The Ministry of Ecology and Natural Resources (MENR) has primary responsibility for environmental regulation. The MENR's statutes were adopted by presidential decree in 2001, making this body responsible for:

- Development of draft environmental legislation for submission to the Azerbaijan Parliament (Milli Mejlis[1]);
- Implementation of environmental policy;
- Enforcement of standards and requirements for environmental protection;
- Suspension or termination of activities not meeting set standards;
- Advising on environmental issues;
- Expert review and approval of environmental documentation, including Environmental Impact Assessment (EIA) and Environmental and Social Impact Assessment (ESIA); and
- Implementation of the requirements set out in international conventions ratified by the Azerbaijan Republic (within its competence).

Other ministries and committees also have functions that relate to environmental regulation including:

- **Ministry of Emergency Situations (MES)** - responsible for the management of natural disasters and industrial accidents and the implementation of safety rules in construction, mining and industry. MES (along with the SOCAR, MENR and other appropriate Ministries) require prompt notification in the event of an emergency, or accident;
- **Ministry of Health** - state institution controlling the sanitary-epidemiological situation in the country and regulation of health protection in the work place; and
- **Ministry of Energy** - responsible for oil and gas activities, the sale of oil and gas products, and the efficient utilisation of Azerbaijan's energy resources.

2.3 The Constitution

The Constitution is the highest law in the Republic of Azerbaijan and prevails over national legislation and international agreements. The following articles help determine the applicability of national and international requirements to the ACE Project:

- **Article 148.II - I**nternational agreements acceded to by the Republic of Azerbaijan become an integral part of the legislative system of Azerbaijan; and
- **Article 151** - If any conflicts arise between the normative-legal acts which constitute the legislative system of Azerbaijan (except for the Constitution and the acts adopted via referendum) and the international agreements acceded to by the Republic of Azerbaijan, the provisions of the international agreements shall apply.

The Constitution (Article 39) also stipulates the basic rights of people to live in a healthy environment, to have access to information on the state of the environment and to obtain compensation for damage suffered as the result of a violation of environmental legislation.

2.4 Production Sharing Agreement

The PSA is the legally binding agreement for the joint development and production sharing of the Azeri and Chirag fields and the deep-water portion of the Gunashli field in the Azerbaijan sector of the Caspian Sea. This agreement, between State Oil Company of the Azerbaijan Republic (SOCAR) and certain international oil companies ("Contractor Parties" or "Contractor" if referred to all of the Contractor Parties collectively) was enacted into Azerbaijan law in October 2017 and applies to all phases of the ACE Project.

[1] Milli Mejlis is the name of the National Parliament of the Azerbaijan Republic.

Under the terms of the PSA and the relevant Joint Operating Agreement (JOA), BP Exploration (Caspian Sea) Limited acting as the Operating Company on behalf of the Contractor Parties, has the right, for the entire term of the PSA, to develop and produce hydrocarbons from the ACG offshore fields. The PSA states that the conduct of operations should be undertaken with respect to the general environment, other natural resources and property, with the order of priority being the protection of life, environment and property.

Article 26.1 of the PSA states:

"Contractor shall conduct the Petroleum Operations in a diligent, safe and efficient manner in accordance with Good International Petroleum Industry Practice..."

Article 26.3 of the PSA requires the Contractor to:

"comply with present and future Azerbaijani laws or regulations of general applicability with respect to public health, safety and protection and restoration of the environment to the extent that such laws and regulations are no more stringent than the then current Good International Petroleum Industry Practice…".

The requirement to prepare environmental documentation, including an Environmental Impact Assessment of any new facilities and gain approval from the MENR is also a condition of Appendix IX of the PSA. The specific environmental standards that must be met throughout the life of the PSA are also stipulated in Appendix IX of the PSA (refer to ESIA Appendix 2A).

2.5 International and Regional Environmental Conventions

Azerbaijan is signatory to numerous international and regional conventions that oblige the government to prevent pollution and protect specified habitats, flora and fauna. Those of relevance to the ACE Project are listed in Tables 2.1 and 2.2.

Table 2.1 Summary of International Conventions

Convention	Purpose	Status
Bern Convention	Conservation of wild flora and fauna and their natural habitats.	In force in Azerbaijan since 2002.
UNESCO Convention on Wetlands of International Importance especially as Waterfowl Habitat / RAMSAR Convention	Promotes conservation of wetlands and waterfowl. In addition, certain wetlands are designated as Wetlands of International Importance and receive additional protection.	Azerbaijan signed the Ramsar Convention in 2001.
International Convention for the Prevention of Pollution from Ships / Vessels (MARPOL), 1973 as amended by the protocol, 1978	The legislation giving effect to MARPOL 73/78 in Azerbaijan is the Protection of the Sea (Prevention of Pollution from Ships) Act 1983. Preventing and minimising pollution of the marine environment from ships - both accidental pollution and that from routine operations.	Azerbaijan acceded in 2004.
UN Convention on the Protection of the Ozone Layer (Vienna Convention)	Framework for directing international effort to protect the ozone layer, including legally binding requirements limiting the production and use of ozone depleting substances as defined in the Montreal Protocol to the Convention. Supported by the Montreal Protocol and amendments (see below).	Azerbaijan acceded in 1996.
Montreal Protocol on Substances that Deplete the Ozone Layer, 1987	Specific requirements for reductions in emissions of gases that deplete the ozone layer. Amended four times: London 1990, Copenhagen 1992, Montreal 1997 and Beijing 1999.	Azerbaijan acceded in 1996.
United Nations Framework Convention on Climate Change, 1992	Seeks to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, within a sufficient time frame to allow the ecosystem to adapt naturally, protect food production and enable sustainable economic development.	Azerbaijan acceded in 1992 and not formally required to meet specific targets.
Kyoto Protocol, 1997	Follow on from the Framework Convention on Climate Change.	Azerbaijan acceded in 2000.
UN Convention on Biological Diversity, 1992	Conservation of biological diversity including the sustainable use of its components, and the fair and equitable sharing of benefits.	Azerbaijan became party to the Convention in 2000.
International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990	Seeks to develop further measures to prevent pollution from ships.	Azerbaijan acceded in 2004.
Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)	Controls trade in selected species of plants and animals.	Entered into force in Azerbaijan in 1999.
Convention for the Protection of the Archaeological Heritage of Europe	Requires each state party to support archaeological research financially and promote archaeology, using public or private funding.	Azerbaijan ratified in 2000.
Basel Convention on Control of Transboundary Movements of Hazardous Wastes and their Disposals	Seeks to control and reduce transboundary movements of hazardous wastes, minimise the hazardous wastes generated, ensure environmentally sound waste management and recovery practices and assist developing countries in improving waste management systems.	Azerbaijan ratified in 2001.
UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions	Promotes participants' right to formulate and implement their cultural policies and to adopt measures to protect and promote the diversity of cultural expressions and to strengthen international cooperation.	Azerbaijan acceded in 2010.
Stockholm Convention on Persistent Organic Pollutants	Reduction in releases of dioxins, furans, hexachlorobenzene and PCBs with the aim of minimisation or elimination.	Azerbaijan acceded in 2004.

Table 2.2 Summary of Regional Conventions

Convention	Purpose	Status
Aarhus Convention*	To guarantee the rights of access to information, public participation in decision-making and access to justice in environmental matters.	Azerbaijan acceded in 2000.
Espoo Convention*	To promote environmentally sound and sustainable development through the application of ESIA, especially as a preventive measure against transboundary environmental degradation.	Azerbaijan acceded in 1999 and at the time of writing, Azerbaijan had not signed a related protocol on Strategic Environmental Assessment.
Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Helsinki Convention)*	To prevent, control or reduce transboundary impact resulting from the pollution of transboundary waters by human activity.	Azerbaijan acceded in 2002.
UN Convention on Control of Transboundary Movements of Hazardous Wastes and their Disposals	Regulates the transboundary movements of hazardous wastes and provides obligations to its Parties to ensure that such wastes are managed and disposed of in an environmentally sound manner.	Azerbaijan ratified in 2001.
Protocol on Water and Health*	To protect human health and well-being by better water management and by preventing, controlling and reducing water-related diseases.	Azerbaijan acceded in 2003.
UNECE Geneva Convention on Long-range Transboundary Air Pollution*	Provides a framework for controlling and reducing transboundary air pollution.	Entered into force in Azerbaijan in 2002. Has been extended by 8 protocols, none of which at the time of writing have been ratified by Azerbaijan.
International Carriage of Dangerous Goods by Road*	Provides requirements for the packaging and labelling of dangerous goods and the construction, equipment and operations of transportation vehicles. Annexes provide detailed technical requirements.	Entered into force in Azerbaijan in 2000.
Convention on the Transboundary Effects of Industrial Accidents*	To prevent industrial accidents that may have transboundary effects, and to prepare for and respond to such events.	Azerbaijan acceded in 2004.
Tehran-Caspian Framework Convention	Ratified by all five littoral states and entered into force in 2006. Requires member states to take a number of generic measures to control pollution of the Caspian Sea. Three protocols have been adopted and therefore form the basis for national legislation and regulations. One protocol, namely Environment Impact Assessment in a Transboundary Context, has been drafted and was not adopted at the time of writing.	Convention is ratified, and the following protocols have been adopted: • The Protocol Concerning Regional Preparedness, Response and Co-operation in Combating Oil Pollution Incidents ("Aktau Protocol") (August 2011); • The Protocol for the Protection of the Caspian Sea against Pollution from Land-based Sources and Activities ("Moscow Protocol") (December 2012); and • The Protocol for the Conservation of Biological Diversity ("Ashgabat Protocol") (May 2014).
* A UNECE agreement; Azerbaijan became a member of the UNECE in 1993. The major aim of the UNECE is to promote pan-European integration through the establishment of norms, standards and conventions.		

2.6 National Environmental Legislation

The Government of Azerbaijan has committed to a process to align national environmental legislation with the principles of internationally recognised legislation, based on EU environmental legislation. As this process is on-going, the ACE Project will comply with the intent of current national legal requirements of general applicability with respect to public health, safety and the protection and restoration of the environment, to the extent that such laws and regulations are no more stringent than the international petroleum industry standards and practice.

The framework for national environmental legislation in Azerbaijan is provided by the Law on the Protection of the Environment (1999), which addresses the following issues:

- The rights and responsibilities of the State, the citizens, public associations and local authorities;
- The use of natural resources;
- Monitoring, standardisation and certification;
- Economic regulation of environmental protection;
- State Ecological Expertise (SEE);
- Ecological requirements for economic activities;
- Education, scientific research, statistics and information;
- Ecological emergencies and ecological disaster zones;
- Control of environmental protection;
- Ecological auditing;
- Responsibility for the violation of environmental legislation; and
- International cooperation.

According to Article 54.2 of the Law on Protection of the Environment, EIAs are subject to SEE, which means that the environmental authority (MENR) is responsible for the review and approval of EIA reports submitted by developers. The Law establishes the basis for the SEE procedure, which can be seen as a “stand-alone” check of compliance of the proposed project with the relevant environmental standards (e.g. for pollution levels, discharges and noise). In addition the law determines that projects cannot be implemented without a positive SEE resolution.

The SEE approach requires state authorities to formally verify all submitted developments for their potential environmental impacts. Current internationally recognised practice emphasises a proportionate, consultative and publicly accountable approach to assessing impacts.

As of 12th June 2018, Azerbaijan introduced a law on Environmental Impact Assessment which establishes a legal, economic and organisational framework for assessment of impacts on natural environment and human health associated with economic activities proposed by public and private developers. Further information on this this law is provided in Section 2.6.1.

Table 2.3 provides a summary of the key national environmental and social laws.

Table 2.3 Key National Environmental and Social Laws[2]

Subject	Title	Description / Relevance to ACE Project ESIA
General	Law of Azerbaijan Republic on Environmental Impact Assessment (EIA) No. 1175-VQ.	Determines the legal framework for the Environmental Impact Assessment process in Azerbaijan and outlines the objectives and principles of EIA. It also introduces a list of mandatory activities that require an EIA and identifies the rights and responsibilities of all parties involved in its' preparation, approval and communication.
	Law of Azerbaijan Republic on the Protection of the Environment No. 678-IQ.	Establishes the main environmental protection principles and the rights and obligations of the State, public associations and citizens regarding environmental protection (described above).
	Law of Azerbaijan Republic on Ecological Safety No. 677-IQ.	One of two keystone laws of the country's environmental legislation (along with the *Law on the Protection of the Environment*). Its purpose is to establish a legal basis for the protection of life and health, society, the environment, including atmospheric air, space, water bodies, mineral resources, natural landscapes, plants and animals from natural and anthropogenic dangers. The Law assigns the rights and responsibilities of the State, citizens and public associations in ecological safety, including information and liability. The Law also deals with the regulation of economic activity, territorial zoning and the alleviation of the consequences of environmental disasters.
Ecosystems	Law of the Azerbaijan Republic on Specially Protected Natural Territories and Objects No. 840-IQ.	Determines the legal basis for protected natural areas and objects in Azerbaijan.
	Law of Azerbaijan Republic on Fauna No. 675-IQ.	Defines the animal world, property rights over fauna and legal relationships between parties. It also describes issues of State inventory and monitoring, and economic and punitive regulations.
Water	Water Code of Azerbaijan Republic (approved by Law No. 418-IQ).	Regulates the use of water bodies, sets property rights and covers issues of inventory and monitoring. The Code regulates the use of water bodies for drinking and service water and for medical treatment, spas, recreation and sports, agricultural needs, industrial needs and hydro energy, transport, fishing and hunting, discharge of waste water, fire protection and specially protected water bodies. It provides for zoning, maximum allowable concentrations of harmful substances and basic rules of industry conduct.
	Rules of Referral of Specially Protected Water Objects to Individual Categories, Cabinet of Ministers Decree No. 77.	The Caspian Sea is a specially protected water body. This resolution requires special permits for disposal if there are no other options for wastewater discharge. The resolution allows for restrictions to be placed on the use of specially protected water bodies, and for further development of regulations related to these water bodies. It requires consent from MENR for activities that modify the natural conditions of specially protected water bodies, and includes provisions for permitting of any discharges to water that cannot be avoided. There are also special requirements for the protection of water bodies designated for recreational or sports use (which includes the Caspian).

[2] This table is compiled from a variety of sources including: United Nations 2010, Environmental Performance Reviews Series No. 31. Second Review – Azerbaijan (Ref.1); Currie & Brown, 2008, Integrated Solid Waste Management System for the Absheron Peninsula Project (Ref. 2); and Popov 2005, Azerbaijan Urban Environmental Profile (Ref. 3).

Subject	Title	Description / Relevance to ACE Project ESIA
	Rules for Protection of Surface Waters from Waste Water Pollution, State Committee of Ecology Decree No. 1.	Under this legislation the *Permitted Norms of Harmful Impact Upon Water Bodies of Importance to Fisheries* require discharges to meet several specified standards for designated water bodies in terms of suspended solids; floating matter; colour, smell and taste; temperature; dissolved oxygen; pH; Biological Oxygen Demand (BOD); and poisonous substances. Limits are based on Soviet era standards and are to be achieved at the boundary of the facility (specific “sanitary protection zone limits”) rather than “end-of-pipe” limits. End of pipe limits are defined in facility-specific “eco-passports” and are established with the intent to ensure compliance with applicable ambient standards.
Air	Law of Azerbaijan Republic on Air Protection No. 109-IIQ.	Establishes the legal basis for the protection of air, thus implementing the constitutional right of the population to live in a healthy environment. It stipulates the rights and obligations of the authorities, legal and physical persons and non-governmental organisations (NGOs) in this respect, sets general requirements for air protection during economic activities, establishes norms for mitigating physical and chemical impacts to the atmosphere, establishes rules for the State inventory of harmful emissions and their sources and introduces general categories of breaches of the Law that will trigger punitive measures.
	Methodology to Define Facilities’ Hazards Categories Subject to Hazardous Substance Emissions Levels and Need to Develop Projects’ Maximum Permissible Emissions.	Under this methodology the maximum permissible concentrations of harmful substances and their hazard classes are provided. Limits are based on Soviet era standards.
Waste	Law of Azerbaijan Republic on Industrial and Domestic Waste No. 514-IQ.	Describes State policy in environmental protection from industrial and household waste including harmful gases, waste water and radioactive waste. It defines the rights and responsibilities of the State and other entities, sets requirements for the design and construction of waste-treatment installations, licensing of waste generating activities, and for the storage and transport of waste (including transboundary transportation). The Law also encourages the introduction of technologies for the minimisation of waste generation by industrial enterprises. There is a general description of responses to infringements. This law is specified by Resolutions of the Cabinet of Ministers on the rules of certification of hazardous wastes, state strategy on management of hazardous wastes in Azerbaijan and by Instructions on the Inventorisation Rules and Classification System of the Wastes generated by Industrial Processes and In the Field of Services approved by the MENR.
Subsurface	Law of the Azerbaijan Republic on Subsurface Resources No. 439-IQ.	Regulates the exploitation, rational use, safety and protection of subsurface resources and the Azerbaijani sector of the Caspian Sea. The Law lays down the principal property rights and responsibilities of users. It puts certain restrictions on the use of mineral resources, based on environmental protection considerations, public health and economic interests.
Information	Law of the Azerbaijan Republic on Access to Environmental Information No. 270-IIQ.	Establishes the classification of environmental information. If information is not explicitly classified “for restricted use” then it is available to the public. Procedures for the application of restrictions are described. Law aims to incorporate the provisions of the Aarhus Convention into Azerbaijani Law.
Health & Safety	Law on Sanitary-Epidemiological Services (authorised by Presidential Decree No. 371).	Establishes sanitary and epidemiological requirements for industrial entities to be met at design, construction and operational stages, and for other economic activities. Aims to protect the health of the population. It addresses the rights of citizens to live in a safe environment and to receive full and free information on sanitary-epidemic conditions, the environment and public health.

Subject	Title	Description / Relevance to ACE Project ESIA
	Law of the Azerbaijan Republic on Protection of Public Health No. 360-IQ.	Sets out the basic principles of public health protection and the health care system. The Law assigns liability for harmful impact on public health, stipulating that damage to health that results from a polluted environment shall be compensated by the entity or person that caused the damage.
	Law of the Azerbaijan Republic on Public Radiation Safety No. 423-IQ.	Includes requirements for ensuring radiation safety in industrial entities. The Law establishes the main principles of government policy on radiation safety, as well as environmental norms protecting the safety of employees and populations in areas potentially affected by the use of radioactive sources. The Law provides for compensation for damage to health, property and life due to accidents.
	Law of Azerbaijan on Technical Safety - 733-IQ	The current law sets legislative, economic and social basis of PDF (Potential Dangerous Facilities) exploitation.
Permitting	A System of Standards for the Environment Protection and Improvement of Natural Resources Utilisation. Industrial Enterprise Ecological Certificate Fundamental Regulations, GOST 17.0.0.04-90.	The MENR issues ecological documents on the impact on the environment of potentially polluting enterprises. The documents include maximum allowable emissions, maximum allowable discharges, and an “ecological passport.” The last item is specific to countries of the Former Soviet Union and contains a broad profile of an enterprise’s environmental impacts, including resource consumption, waste management, recycling, and the effectiveness of pollution treatment. Enterprises develop the draft passport themselves and submit it to MENR for approval.

2.6.1 National EIA Guidance

As described in Section 2.6 above, Azerbaijan introduced a Law on Environmental Impact Assessment on 12th June 2018, which sets out the mandatory EIA requirements within Azerbaijan. The purpose of this legislation is to give effect to Article 54.2 of the Law on the Protection of the Environment in Azerbaijan, establishing the legal, economic and organisational framework for assessment of impacts on natural environment and human health associated with economic activities proposed by public and private developers.

The Handbook for the Environmental Impact Assessment Process in Azerbaijan (Ref. 4) provides a guidance on the EIA process in Azerbaijan and contains the following main principles:

- The EIA process, i.e. the sequence of events and the roles and responsibilities of applicants and Government institutions;
- The purpose and scope of the EIA document;
- Public participation in the process;
- Environmental review decision (following its submission to the MENR, the EIA document is reviewed for up to three months by an expert panel); and
- The appeal process.

A summary of the guidance provided in the Handbook is given in Table 2.4.

Table 2.4 Summary of Guidance on the EIA Process in Azerbaijan[3]

Screening	The developer is required to submit an Application (containing basic information on the proposal) to MENR to determine whether an EIA is required.
Scoping	Requirement for a Scoping Meeting to be attended by the developer, experts and concerned members of the public, and aimed at reaching a consensus on the scope of the EIA.
Project Description	Full description of technological process and analysis of what is being proposed in terms of planning, pre-feasibility, construction and operation.
Environmental Studies	Requirement to describe fully the baseline environment at the site and elsewhere, if likely to be affected by the proposal. The environment must be described in terms of its various components – physical, ecological and social.
Consideration of Alternatives	No requirement to discuss project alternatives and their potential impacts (including the so-called "do-nothing" alternative), except for the description of alternative technologies.
Impact Assessment and Mitigation	Requirement to identify all impacts (direct and indirect, onsite and offsite, acute and chronic, one-off and cumulative, transient and irreversible). Each impact must be evaluated according to its significance and severity and mitigation measures provided to avoid, reduce, or compensate for these impacts.
Public Participation	Requirement to inform the affected public about the planned activities twice: when the application is submitted to the MENR for the preliminary assessment and during the EIA process. The developer is expected to involve the affected public in discussions on the proposal.
Monitoring	The developer is responsible for continuous compliance with the conditions of the EIA approval through a monitoring programme. The MENR undertakes inspections of the implementation of activities in order to verify the accuracy and reliability of the developer's monitoring data. The developer is responsible for notifying the MENR and taking necessary measures in case the monitoring reveals inconsistencies with the conditions of the EIA approval.

The Handbook is aligned with the Law of Azerbaijan Republic on Environmental Impact Assessment and provides additional guidance on the EIA process and ongoing management and monitoring.

The approval of an EIA by the MENR establishes the compliance framework, including the environmental and social standards that an organisation should adhere to.

[3] Based on a review of the Azerbaijan State Committee for Ecology/United Nations Development Programme, 1996. Handbook for the Environmental Impact Assessment Process in Azerbaijan (Ref. 4).

2.7 Regional Processes

2.7.1 European Union

European Union (EU) relations with Azerbaijan are governed primarily by the EU-Azerbaijan Partnership and Cooperation Agreement (PCA) and the European Neighbourhood Policy (ENP).

The PCA entered into force in 1999. Under Article 43:

"The Republic of Azerbaijan should endeavour to ensure that its legislation will be gradually made compatible with that of the Community".

As part of the PCA an EU assessment of Azerbaijan's environmental legislation against EU Directives identified a number of recommendations for the approximation of national legislation with EU Directives (Ref. 5). Based on this, a draft national programme was developed that emphasises a flexible approach to amending national legislation to take account of institutional capacity and cost (Ref. 6.

Following the enlargement of the European Union, the EU launched the ENP and Azerbaijan became part of this policy in 2004. The current National Indicative Programme for implementing the ENP (Ref. 7) includes a commitment to support legislative reform in the environmental sector, including:

- Approximation of Azerbaijan's environmental legislation and standards with the EU's;
- Strengthening management capacity through integrated environmental authorisation;
- Improved procedures and structures for environmental impact assessment; and
- Development of sectoral environmental plans (waste and water management, air pollution, etc.).

2.7.2 Environment for Europe

Environment for Europe (Ref. 8) is a partnership of member states, including Azerbaijan, and other organisations within the UNECE region. Under the auspices of the Environment for Europe a series of ministerial conferences on the environment have been held that have resulted in the establishment of the UNECE conventions described in Section 2.5.

2.8 International Petroleum Industry Standards and Practices

ACG related activities are required to comply with national legislation where it is no more stringent than *"the then current Good International Petroleum Industry Practice"* (PSA, Art. 26.3). Industry standards including those of the Oil Industry International Exploration and Production Forum (E&P Forum), the International Association of Geophysical Contractors (IAGC) and the International Association of Drilling Contractors (IADC) are specifically mentioned in the PSA.

The Convention for the Protection of the Marine Environment of the North-East Atlantic[4] (the "OSPAR Convention) is of relevance to ACE offshore activities and in particular to the regulation of chemicals.

2.8.1 OSPAR Guidelines

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was developed from the 1972 Oslo Convention on dumping waste at sea and the 1974 Paris Convention on land-based sources of marine pollution. It was signed on 22 September 1992 by all of the Contracting Parties to the original Oslo or Paris Conventions and by Luxembourg and Switzerland. After ratification it entered into force on 25 March 1998 at the Ministerial Meeting of the parent Conventions.

[4] Formed by 5 regions – Arctic Waters, Greater North Sea, Celtic Seas, Bay of Biscay and Iberian Coast, and the Wider Atlantic.

2.8.2 Harmonised Mandatory Control System and REACH

The OSPAR Decision 2000/2 on the Harmonised Mandatory Control System (HMCS) for the Use and Reduction of the Discharge of Offshore Chemicals is the basis for regulating the use of chemicals by the North Sea offshore oil and gas industry.

The common framework outlined in OSPAR Decision 2000/2 has been incorporated into the national legislation of the contracting parties to OSPAR and each country has its own regulatory scheme to implement OSPAR Decisions and Recommendations.

In addition to the OSPAR Decisions and Recommendations, in 2006 the Registration, Evaluation, Authorisation and restriction of Chemicals (REACH) (EC 1907/2006) Regulation came into force. The OSPAR and REACH systems will initially run in parallel, with the HMCS gradually being harmonised with the obligations of the REACH Regulation (Ref. 9).

2.8.3 Harmonised Offshore Chemical Notification Format

The HMCS requires the completion of a standard form known as the Harmonised Offshore Chemical Notification Format or HOCNF, which is described in Recommendation 2010/4.

The HOCNF requires details of the chemical composition, the environmental properties of the products including toxicity to aquatic organisms and the fate and effects of component substances, together with how the chemical will be applied with information on the quantities to be used and discharged.

Only substances which appear on the PLONOR List (Pose Little Or NO Risk to the environment and their environmental effects are considered to be well known) are not required to be tested as described above.

Once the HOCNF is submitted, the data are evaluated against the Pre-Screening Scheme, which is designed to eliminate, or require the substitution of chemicals which are highly persistent, highly toxic, or which have high bioaccumulation potential.

The Chemical Hazard and Risk Management (CHARM) model provides a standardised methodology for assessing the environmental hazard of a product. A hazard quotient is calculated, which is based on the ratio of:

- the predicted environmental concentration of a product or substance at a distance of 500m from a discharge (PEC) to:
- the predicted no-effect concentration (PNEC) for that product or substance, derived by applying a safety factor of 10 (for short duration discharges) or 100 (for continuous releases) to the ‘most sensitive’ results of toxicity testing.

2.8.4 Ecotoxicological Hazard Assessment

BP has adopted the OSPAR principles as the basis for chemical selection and discharge evaluation in its Caspian operations. The principles have been embedded in:

- Routine assessment of chemicals and discharges associated with the ACG and Shah Deniz Projects; and
- BP Azerbaijan Georgia Turkey (AGT) Region procedures for chemical selection and environmental risk assessment.

The selection of chemicals is restricted to those which have passed the OSPAR screening process (i.e., those which are already on a national approved list, or which have been separately and independently subjected to the screening process).

The process implemented by BP is more location-specific and application-specific than the OSPAR/CHARM approach:

- Toxicity tests are conducted, preferably using Caspian species, and Caspian seawater;
- To complement the HOCNF data available for the components of candidate products, these tests are conducted on the whole, formulated product rather than on the component substances;
- Each release or discharge scenario is subject to site-specific dispersion modelling, and on detailed release scenarios;
- The limit of the mixing zone is determined by the point at which the hazard quotient equals 1 i.e., the 'point of protection' (in contrast, the OSPAR/CHARM process accepts hazard quotients of >1); and
- The significance and acceptability of the estimated mixing zone is assessed using detailed information on the characteristics and sensitivity of the receiving environment in the vicinity of the release.

The results of hazard assessments form the basis on which the national regulatory authorities are informed and consulted, and the basis on which many discharge approvals have been granted.

2.9 References

Ref. No.	Title
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3 Impact Assessment Methodology

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3.1 Introduction

This Chapter presents a description of the Environmental and Social Impact Assessment (ESIA) process adopted for the Azeri Central East (ACE) Project and the methodology used to assess impact significance.

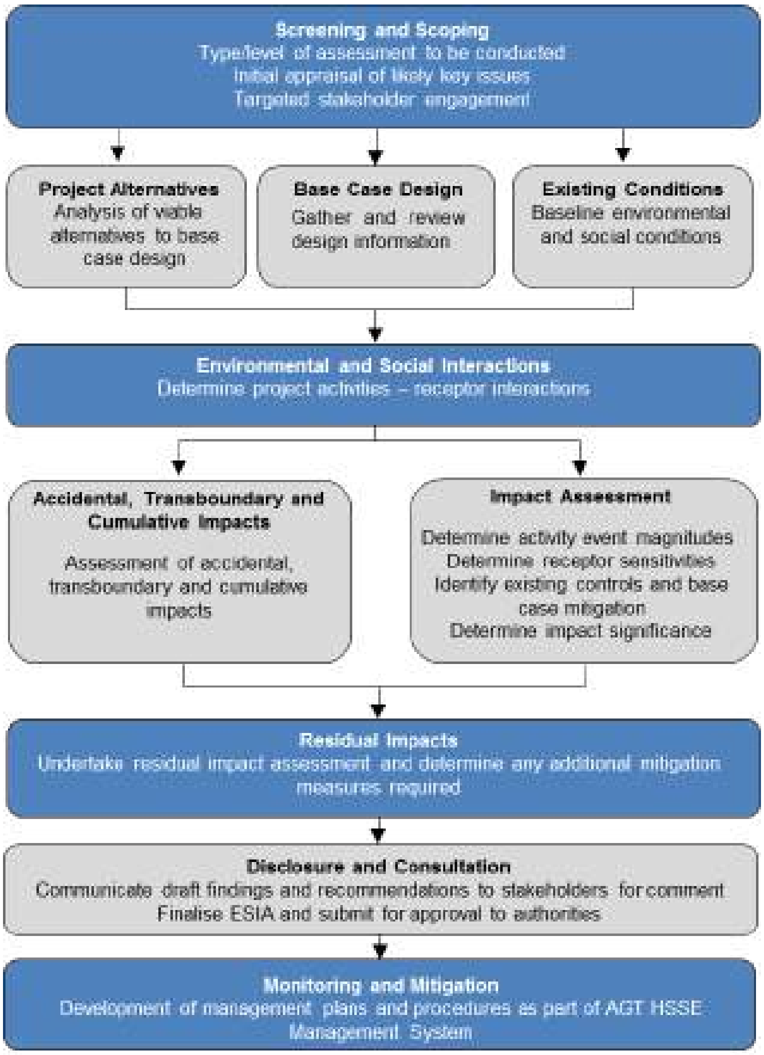
3.2 ESIA Process

The ESIA process constitutes a systematic approach to the evaluation of a project and its associated activities throughout the project lifecycle. The process (refer to Figure 3.1) includes:

- Screening and Scoping;
- Project Alternatives and Base Case Design;
- Existing Environmental and Social Conditions;
- Impact Assessment;
- Residual Impact Identification;
- Disclosure and Stakeholder Consultation; and
- Monitoring and Mitigation.

The purpose of stakeholder consultation is to obtain the views and opinions of potentially affected people and other interested parties. Stakeholder feedback was used to focus the impact assessment and, where appropriate, influence project design and execution (refer to Chapter 8 of this ESIA for further detail regarding the consultation and disclosure process).

Figure 3.1 The ESIA Process



3.2.1 Screening and Scoping

Screening is the first step in the assessment process. It confirms the need (or otherwise) for an ESIA by appraising the type of project and its associated activities throughout the project lifecycle in the context of its biophysical, social, policy and regulatory environments.

Given the location, scale and planned activities associated with the ACE Project, it was agreed with the Ministry of Ecology and Natural Resources (MENR) that the project should be subject to an ESIA, and the ESIA should take account of applicable national and international legislation and the Production Sharing Agreement (PSA) as detailed in Chapter 2: Policy, Regulatory and Administrative Framework.

Scoping is a high level assessment of anticipated **interactions** between **project activities** and **environmental and social receptors**. Its purpose is to focus the assessment on key issues and eliminate certain activities from the full impact assessment process based on their limited potential to result in discernible impacts. To arrive at a conclusion to 'scope out' an activity/event, a mixture of expert scientific judgement based on prior experience of similar activities and events and, in some instances, scoping level quantification/numerical analysis (e.g. emission and discharge modelling) is used.

The ACE Scoping process has included:

- Review of available environmental and social data and reports relevant to the area potentially affected by the ACE Project activities; and
- Liaison with the ACE Project Team to gather data and to formulate an understanding of project activities.

Based on the findings and results of these reviews, investigations and consultations, the following were identified:

- Potential project related environmental and social impacts based on likely interactions between ACE Project activities and environmental/social receptors; and
- Gaps where the extent, depth and/or quality of environmental, social and/or technical data are insufficient for the ACE Project ESIA process, thus identifying the additional work required to complete the ESIA.

3.2.2 Project Alternatives and Base Case Design

3.2.3.1 Project Alternatives

The initial step in defining a project is to identify, at a conceptual level, viable alternatives to the project so that an ACE Base Case Design may be realised. Consideration of project alternatives occurs at two levels:

- To the development as a whole, including the "no development" option; and
- Engineering alternatives within the selected project's concept design definition.

Project alternatives were defined during the early conceptual design of the ACE Project and were compared on financial, technical design, safety, environmental and social criteria. The alternative that represented the best balance with regard to criteria was taken forward to the subsequent detailed design stage.

Chapter 4: Options Assessed presents a summary of the alternative designs considered and options evaluated for the ACE Project.

3.2.3.2 Project Design

The ACE ESIA Team worked with the ACE Design Team to gather and interpret relevant information for the ESIA. This dialogue between the teams identified where additional project design definition, in terms of existing controls and additional mitigation measures, was required in the ACE Base Case Design to minimise impacts. Opportunities identified for environmental and social enhancements were considered by the teams and incorporated into the ACE Base Case Design where appropriate and practicable.

The ACE Base Case Design, on which the ACE Project ESIA is based, is presented in Chapter 5: Project Description.

3.2.3 Existing Conditions

In order to identify potential impacts to receptors, an understanding of the existing conditions is required to be established prior to execution of project activities. The ACE Project ESIA Scoping exercise determined that the project will likely result in impacts on the following receptor groups:

- Biological/Ecological; and
- Social/Human.

A number of environmental surveys have been undertaken within the Azeri Chirag Gunashli (ACG) Contract Area and along the existing ACG pipeline corridor to support the preparation of the previous ACG ESIAs and, since 2004, as part of the Environmental Monitoring Programme (EMP). In addition a baseline survey was completed for the offshore ACE location in 2017.

The following reviews were completed in liaison with Azerbaijani academics from the Azerbaijan National Academy of Sciences to provide additional data:

- Migratory, overwintering and nesting birds along the Absheron-Pirallahi coastline;
- Fish and fishing activities within the Azerbaijan sector of the Caspian Sea; and
- Activity and distribution of Caspian Seal across the Caspian Sea.

Data on national and regional socio-economic conditions was obtained from a review of secondary data including data from the Azerbaijan State Statistical Committee. The results of the environmental and social surveys and reviews were used to prepare Chapter 6: Environmental Description and Chapter 7: Social Description presented in this ESIA.

3.2.4 Impact Significance Assessment

An **impact**, as defined by the international standard ISO14001:2015 is:

"*Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects*"

Where environmental aspect is defined as:

"*Element of an organisation's activities or products or services that can interact with the environment*".

An impact is defined where an interaction occurs between a project activity and an environmental receptor. The ESIA process ranks impacts according to their **significance** determined by considering project activity **event magnitude** and **receptor sensitivity**. Determining event magnitude requires the identification and quantification (as far as practical) of the sources of potential environmental and social effects from routine and non-routine project activities. Determining receptor environmental sensitivity requires an understanding of the biophysical environment.

The sections below set out the methodology for both environmental and social impact assessment.

3.2.5 Environmental Impacts

3.2.3.1 Method for Determining Event Magnitude

Event magnitude is determined based on the following parameters, which are equally weighted and are each assigned a rating of 1, 2, or 3:

- **Extent / Scale**: Events range from those affecting an area:

  1 - Up to 500m from the source or an area less than 50 hectares; to
  2 - Greater than 500m and up to 1km from the source or an area between 50-100 hectares; to
  3 - Greater than 1km from the source or an area greater than 100 hectares.

- **Frequency**: Events range from those occurring:

  1 - Once or continuously; to
  2 - Up to 50 times; to
  3 - More than 50 times

- **Duration**: Events range from those occurring for:

  1 - Up to one week; to
  2 - More than one week and up to one month; to
  3 - Periods longer than one month to permanent.

- **Intensity**: Concentration of an emission or discharge with respect to standards of acceptability that include applicable legislation and international guidance, its toxicity or potential for bioaccumulation, and its likely persistence in the environment. Degree/permanence of disturbance or physical impact (e.g. disturbance to species or loss of habitat). Ranges from:

  1 - A low intensity event; to
  2 - A moderate intensity event; to
  3 - A high intensity event.

Overall, event magnitude is scored from low (1) to high (12) by adding the individual parameter scores:

Resulting individual ratings are summed to give the overall event magnitude ranking. Table 3.1 presents the score ranges for magnitude rankings of Low, Medium and High.

Table 3.1 Event Magnitude Ranking

Event Magnitude	Score (Summed Parameter Rankings)
Low	4
Medium	5-8
High	9-12

3.2.3.2 Method for Determining Receptor Sensitivity

Receptor sensitivity is determined based on the following parameters, which are equally weighted and are each assigned a rating of ”1”, ”2”, or ”3”:

- **Biological/Ecological Receptors:**

  – ***Presence:*** Ranges from:

    3 - Routine, regular or reliably predictable presence of any species which is, in reverse order, a unique, threatened or protected species; to
    2 - Regionally rare or largely confined to the ACE Project area or sensitive to industry emissions /disturbances; to
    1 - A species which is none of the above and is therefore assessed at the community level only.

  – ***Resilience (to the identified stressor):*** Ranges from:

    1 - Species or community unaffected or marginally affected; to
    2 - Species undergoing moderate but sustainable change which stabilises under constant presence of impact source, with ecological functionality maintained; to
    3 - Substantial loss of ecological functionality (e.g. loss of species in key groups, substantially lower abundance and diversity).

- **Human Receptor:**

  – ***Presence:*** Ranges from:

    3 - People being permanently present (e.g. residential property) in the geographical area of anticipated impact; to
    2 - People being present some of the time (e.g. commercial property); to
    1 - People being uncommon in the geographical area of anticipated impact.

  – ***Resilience (to the identified stressor):*** Ranges from:

    1 - People being least vulnerable to change or disturbance (i.e. ambient conditions (air quality, noise) are well below applicable legislation and international guidance); to
    2 - People being vulnerable to change or disturbance (i.e. ambient conditions (air quality, noise) are below adopted standards); to
    3 - Most vulnerable groups (i.e. ambient conditions (air quality, noise) are at or above adopted standards).

Overall, receptor sensitivity is then scored on a spectrum from low (1) to high (6) by adding the individual parameter scores:

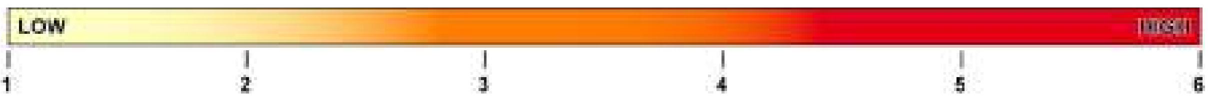


Table 3.2 presents the score ranges for sensitivity rankings of Low, Medium and High.

Table 3.2 Receptor Sensitivity Rankings

Receptor Sensitivity	Score (Summed Parameter Rankings)
Low	2
Medium	3-4
High	5-6

3.2.3.3 Method for Determining Environmental Impact Significance

Impact significance, as a function of event magnitude and receptor sensitivity is subsequently ranked as “Negligible”, “Minor”, “Moderate” or “Major” as presented in Table 3.3 below. Impacts can be “positive” or “negative”.

Table 3.3 Impact Significance

		Receptor Sensitivity		
		Low	**Medium**	**High**
Event Magnitude	**Low**	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	High	Moderate	Major	Major

Any impact classified as "Major" is considered to be significant and where the impact is negative, requires additional mitigation. Impacts of negligible, minor or moderate significance are considered as being mitigated as far as practicable and necessary, and therefore, do not require further mitigation.

3.2.6 Social Impacts

The social impact assessment will use a semi-qualitative assessment approach to describe and evaluate impacts. Factors taken into account to establish impact significance will include probability, spatial extent, duration and magnitude of the impacts in addition to the sensitivity of receptors (e.g. the groups of people or populations most likely to be affected and, in particular, whether impacts are likely to be disproportionately experienced by vulnerable groups). Indirect social impacts (i.e. induced effects) will also be assessed using the same approach.

3.3 Transboundary and Cumulative Impacts and Accidental Events

Transboundary impacts are impacts that occur outside the jurisdictional borders of a project's host country. The potential transboundary impacts associated with the ACE Project activities are anticipated to include:

- Social issues surrounding the sourcing of labour, goods and services from the international market; and
- Greenhouse gas (GHG) emissions to air.

Cumulative impacts arise from:

- Interactions between separate project-related residual impacts; and
- Interactions between project-related residual impacts in combination with impacts from other BP projects and their associated activities.

These can be either additive or synergistic effects, which result in a larger (in terms of extent or duration) or different (dependent on impact interaction) impacts when compared to project-related residual impacts alone.

The cumulative assessment presented in Chapter 13: Cumulative and Transboundary Impacts and Accidental Events, initially considers the potential for impact interaction and accumulation in terms of the following:

- Temporal Overlap – the impacts are so close in time that the effect of one is not dissipated before the next one occurs; and
- Spatial Overlap – the impacts are so close in space that their effects overlap.

At the time of writing the following projects within the offshore environment that have the potential for cumulative impacts include:

- Shah Deniz 2 (SD2) Project – represents the second stage of SD field development and comprises onshore, offshore and subsea works. The offshore development consists of a series of subsea manifolds and associated well clusters which have been tied back to a twin-platform complex by flow lines. Subsea export pipelines have been installed between the platform complex and the existing Sangachal Terminal, which has been expanded to accommodate the SD2 onshore facilities. First gas from the platform commenced in Q4 2018[1] with wells to date drilled and completed at two well clusters. Ongoing SD2 activities include the drilling and completion of further SD2 wells and installation of remaining subsea infrastructure within the SD Contract Area (including manifolds and flowlines). The platform complex is located approximately 115km to the south west of the planned ACE platform location; and
- Shallow Water Absheron Peninsula (SWAP) Exploration Drilling Project – drilling of up to three exploration wells within the SWAP Contract Area during 2019 and 2020. The wells are anticipated to be drilled in shallow water locations close to the Azerbaijan coastline, approximately 90km to 120km west of the ACE platform location.

No significant changes to the existing offshore operational ACG facilities or the existing Shah Deniz Alpha (SDA) operational offshore facilities that could result in cumulative impacts with the ACE offshore facility are foreseen, and the ACE Project is not aware of any significant third party developments that could result in significant cumulative impacts in combination with the ACE Project.

Where there is potential for impact interaction, and the project is sufficiently defined and sufficient data is available, a quantitative assessment of cumulative and transboundary impacts will be undertaken. Where insufficient data is available, a qualitative assessment is presented (refer to Chapter 13).

Accidental events are those that occur as a result of a technical failure, human error or as a result of natural phenomena such as a seismic event. Those identified for assessment include events that, while unlikely, have the potential to result in significant impacts e.g. such as a well blowout. The significance of accidental impacts is assessed using a semi-quantitative analysis, and taking into account existing controls.

3.4 Mitigation and Monitoring

The iterative and integrated nature of the ESIA and project planning processes means that the majority of proposed additional mitigation measures and strategies have been incorporated into the project Base Case (as provided within Chapter 5: Project Description) and integrated into the design of the Project. These measures and strategies have included mitigation measures and ongoing commitments as previously adopted by other projects in the AGT Region.

The ESIA will be submitted for review and comment to the MENR who will have an opportunity to make comments on the findings, including suggestions for additional mitigation measures to those already committed to in this ESIA associated with project activities. If deemed appropriate, such mitigation measures will be added to the ACE Project design and/or management programme.

[1] While SD2 Project operations and first gas commenced in Q4 2018 the effects of the SD2 Project are not captured within the existing baseline conditions against which the ACE Project impacts have been assessed. Therefore, for the purposes of the ESIA, the SD2 Project activities and impacts have been considered within the ACE ESIA cumulative assessment.

4 Options Assessed

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4.1 Introduction

This Chapter of the Environmental and Social Impact Assessment (ESIA) presents the options assessed for the Azeri Central East (ACE) Project. The design options assessment process followed is summarised within Figure 4.1, which illustrates the stages for the project and the various aspects associated with each stage.

Figure 4.1 Project Development Process

Concept Development:	→	**Optimise:**	→	**Define:**	→	**Execute:**	→	**Operate:**
• Confirms the viability of the Project • Identifies a shortlist of technically and commercially viable development options which are robust to technical and commercial risks • Evaluates the shortlisted development options to select a concept that optimises value and is robust to technical and commercial risks		• Optimise the design and value of the concept option • Perform technical definition and mature the scope of the selected option • Develop initial cost and schedule estimates		• Develop and complete the detailed technical definition and project execution planning • Confirm cost, schedule and production estimates and complete the business case • Set performance targets and confirm readiness for Execute		• Completion of detailed engineering • Implementing contracts and procurement • Equipment manufacture, construction, installation and delivery and preservation of packages to site on schedule and budget • Site support • Final hook-up, mechanical completion, execution and completion of commissioning activities and handover to Operations		• Support the safe execution of the startup and production ramp up plans • Verify the completion of performance testing and lessons learned • Complete the Project close out and handover

As Figure 4.1 demonstrates, conceptual options are shortlisted and analysed in terms of their technical and commercial feasibility during the Concept Development stage. The recommended design concept then passes into the Optimise stage during which the design is further defined and matured. During the Define stage, the detailed technical definition of the project is completed and final design decisions are made.

The earlier Azeri Chirag Gunashli (ACG) Phases 1-3 projects were developed based on a standardised design principle, utilising in-country construction facilities wherever possible. Lessons learned during the design and development of ACG Phases 1-3 were subsequently incorporated into the design of the Chirag Oil Project (COP) and Shah Deniz Stage 2 (SD2) facilities to minimise environmental impacts and improve environmental performance.

The ACE Project adopts existing good practice from the existing ACG and SD facilities while incorporating key learnings to improve the design, where appropriate.

The key options assessed during the ACE Project design development have focused on:

- Concept selection and definition;
- The selection of a suitable location within the ACG Contract Area to site the offshore facilities;
- Platform design and the extent of integration with existing ACG offshore facilities; and
- Efficiency and performance improvements offered by technology alternatives.

Design options previously considered throughout the development of the ACG Phases 1-3 and COP Projects and relevant to the ACE Project have been re-evaluated and revalidated, as appropriate.

Throughout the design development to date, environmental evaluation of the Project options has been undertaken alongside technical and economic evaluation and consultation with stakeholders including the State Oil Company of the Azerbaijan Republic (SOCAR) and the Production Sharing Agreement (PSA) Contractor Parties[1].

This Chapter presents a summary of the options that have been assessed to support the current design Base Case (presented in Chapter 5 of this ESIA) comprising:

- A production, drilling and quarters (PDQ) platform located mid-way between the Central Azeri (CA) and East Azeri (EA) platforms;
- Three new infield subsea pipelines for gas, oil[2] and water injection (WI) water;
- A combined power (back-up) and telecommunications subsea cable from EA to ACE and minor telecommunication modifications at ST; and
- Brownfield modifications on the CA–CWP (Compression, Water and Power CA-CWP) and EA-PDQ platforms.

The option of not developing the ACE Project has also been considered. The decision to not proceed would result in a reduction of potential revenues to the Azerbaijan government with a resultant inability to deliver the associated benefits to the Azerbaijan economy. Pursuing the ACE Project will result in employment creation for national citizens during the design, construction and operational phases of the development, as well as increased use of local facilities, infrastructure and suppliers. The option of not proceeding was therefore disregarded when considered against these socio-economic benefits.

4.2 Preliminary Concept Development and Selection

As part of the ACG Future Development (FD) Programme which commenced in 2013 a number of studies were undertaken to identify feasible options to further develop the oil reservoirs in the ACG. The ACG field is a complex environment consisting of 9 stacked reservoirs (Pereriv A-E, Balakhany VII-X) of different geological complexities with a wide range of geotechnical and drilling hazards. Taking into account these aspects as well as risks and opportunities across the ACG field, the decision was made under the ACG FD Programme to target the Balakhany reservoir in the south east quadrant of the ACG field. The feasibility of accessing the location from either existing operational platforms or from new offshore facilities was further studied. Figure 4.2 below shows the general location within the field which was selected to be targeted by the ACE Project, the location of the EA and CA platforms and the drilling reach radii around each platform. As the figure shows the ACE location is outside of the drilling reach radii of the EA and CA platforms.

Figure 4.2 Proposed ACE Location Relative to Existing ACG Platforms and Drilling Reach Radii

[1] Chapter 8: Consultation and Disclosure provides details of the consultation undertaken and proposed specifically with regard to the ACE Project ESIA.
[2] Oil will be exported comingled with produced water.

Figure 4.2 also shows the water and gas injection activities currently undertaken across the ACG field to enhance recovery as well as revealing the opportunities to expand this for the ACE Project. Based on the concept studies, the decision was therefore made to target the Balakhany reservoir in the south east quadrant of the ACG field with development options including:

- Expansion of subsea WI to enhance recovery;
- Use of surface platform production trees as opposed to subsea trees to increase production; and
- Installation of fixed production facilities or floating facilities in deeper waters of the ACG field to target the ACG reservoir.

Work undertaken during 2014 and 2015 confirmed that the next investment in the ACG Contract Area should be a new fixed facility located approximately mid-way between the CA and EA platforms. The project should include a new drilling centre to simplify drilling, maximise potential synergy with existing facilities and maximise economic recovery with the aim of accelerating production from this portion of the ACG field. As set out within Section 4.3.1 below the location of the facility was a key driver in terms of accessing drilling targets not otherwise accessible and minimising risks around potentially drilling extended reach wells from the existing CA and EA platforms, which would have resulted in a significant time delay as well as reduced economic profitability.

The decision to install a new facility at the ACE location was based on the physical reach constraints associated with the existing platforms. The opportunity to accelerate production and incrementally increase recovery from the Azeri portion of the ACG field made the facility the most technically and economically attractive option. A new facility at this location provides both new drilling opportunities and processing options to accelerate production as well as enabling management of reservoir uncertainty and adding flexibility to access future development opportunities.

4.3 ACE Platform Location Options

4.3.1 Concept Development

The location of the proposed ACE offshore fixed facilities, as outlined above, was selected for a number of reasons associated with the technical challenges around drilling from the existing ACG platforms and optimising production. Specifically the location was selected to:

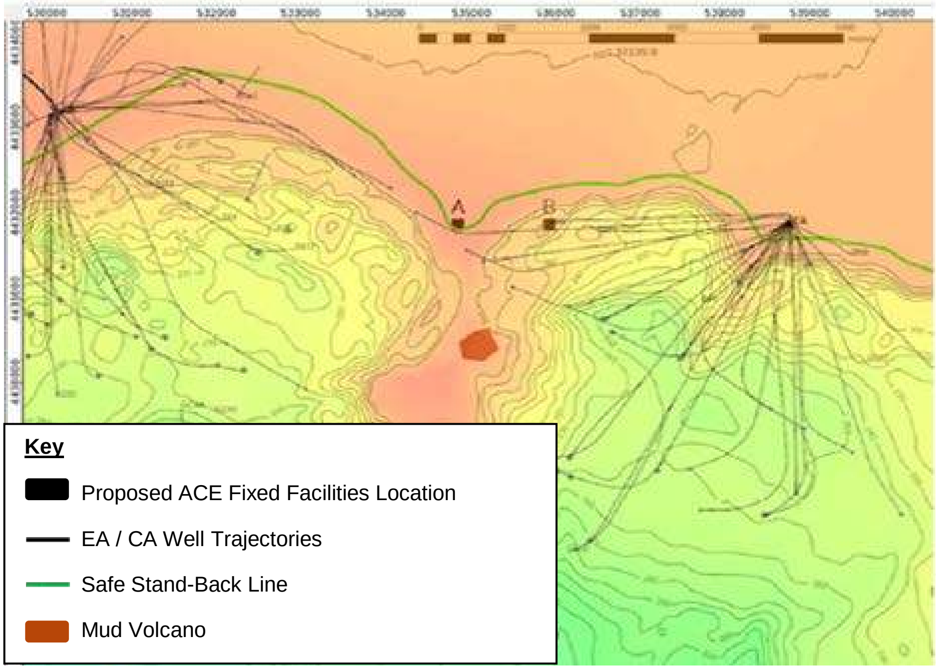
- Increase pace of well delivery and accelerating drilling of targets in both major and minor reservoirs;
- Reduce the challenges associated with extended reach drilling (ERD)[3] from the existing platforms;
- Enable access to additional minor reservoir targets that cannot be reached by existing platforms; and
- Enable gas injection to be implemented in the EA target reservoir (which cannot be reached from the CA platform).

During the Concept Development phase two potential locations (A and B – refer to Figure 4.3) for the proposed ACE fixed facilities were evaluated:

- A – Located on a shelf in 130m water depth; and
- B – Located on an escarpment in 160m water depth.

[3] Extended reach drilling is a directional drilling of very long horizontal wells. Extended reach wells can be described by their ratio of the measured depth (MD) vs. the true vertical depth (TVD) which shall be at least equal to 2.

Figure 4.3 Preliminary Proposed ACE Fixed Facilities Locations



As shown in Figure 4.3, Location A is situated on a peninsula where the shelf in this location and safe stand-back line[4] extend to the south closer to the majority of the reservoir targets. Initial studies of Location A indicated that drilling some of the target areas would be challenging due to the existence of one active mud volcano (shown in red in Figure 4.3). Therefore, a deeper water location (Location B), situated on the escarpment approximately 1km east from Location A was assessed. A review of the two locations concluded the following:

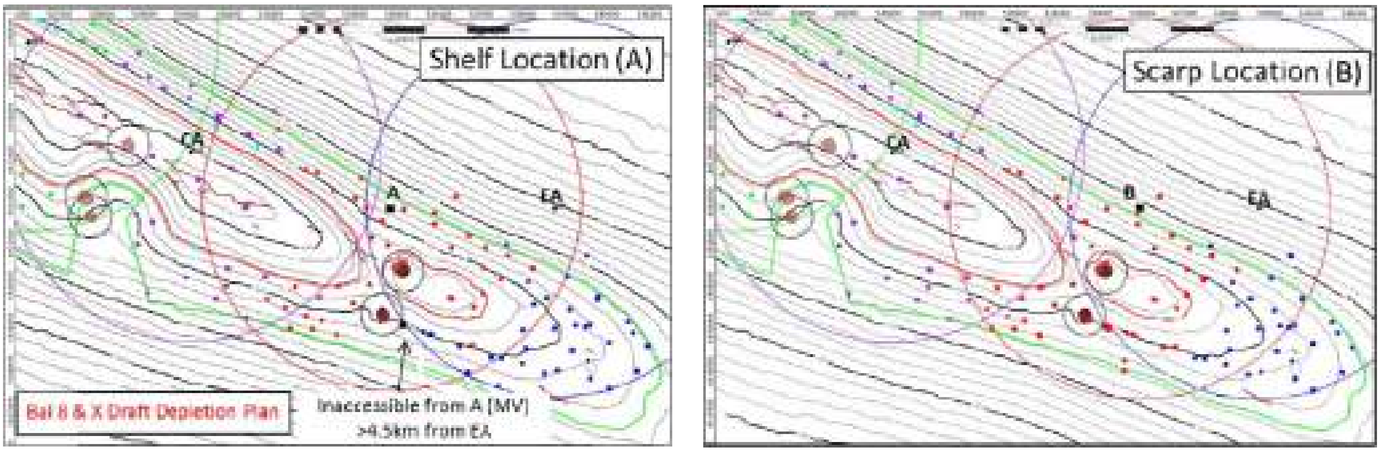
- **Offshore Facilities Considerations:** Costs associated with jacket construction and subsea equipment installation and commissioning would be significantly higher at Location B due to the deeper water at this location. The larger jacket required for the deeper water at Location B would require more materials and create significantly more waste, emissions and discharges during construction and installation. Location A is therefore deemed the preferred location from the perspective of platform facilities installation.
- **Geotechnical Considerations:** Although it was considered feasible to install the ACE facilities at Location B this option has two significant disadvantages compared to Location A, which are the higher ground accelerations (shaking) during an earthquake and the very limited opportunity to move the platform footprint in the event there is an issue with the drilling template or predrill wells. Location A therefore was deemed the preferred location from a geotechnical perspective.
- **New Well Delivery Feasibility:** A detailed review was undertaken to assess how the two platform location options compared in terms of being able to drill the targeted reservoir locations, including examining the various subsurface features such as mud volcanoes, faulting and reservoir structure. The study compared 10 targets from each platform location and assumed a 500m radius exclusion zone around mud volcanoes and a maximum 4.5km radius step out for ERD wells (as illustrated in Figure 4.4). The assessment found that, in terms of flexibility, Location A was considered advantageous due to the ability to reach more reservoir targets currently assigned to the CA platform. In terms of well complexity (e.g. well length, distance to mud volcano, drilling and mechanical difficulty) and well cost, Location B was considered preferable due to reduced well complexity and lower well delivery costs. The

[4] The stand-back line ensures facilities are not located in areas with potential slope instability issues associated with the steeper seabed slopes. The safe stand-back line was identified following a review of geotechnical information in the 1990s. Recent data acquisition and modern analytical techniques have provided an opportunity for revisiting the safe stand-back line and to potentially locate facilities in areas not previously deemed possible.

potential well cost savings at Location B would be achieved later in field life. Facilities costs would be incurred during construction and installation (i.e. pre-production).

Following analysis as per above of both options the decision was made to locate the ACE platform on the shelf at Location A.

Figure 4.4 Proposed ACE Project Targeted Reservoir Locations From Locations A and B



Key

- 4.5km drilling radius from Location A and Location B
- 4.5km drilling radius from EA Platfrom
- 4.5km drilling radius from CA Platfrom
- 500m radius mud volcano exclusion zone
- ACE Target Sets
- EA Target Sets
- CA Target Sets

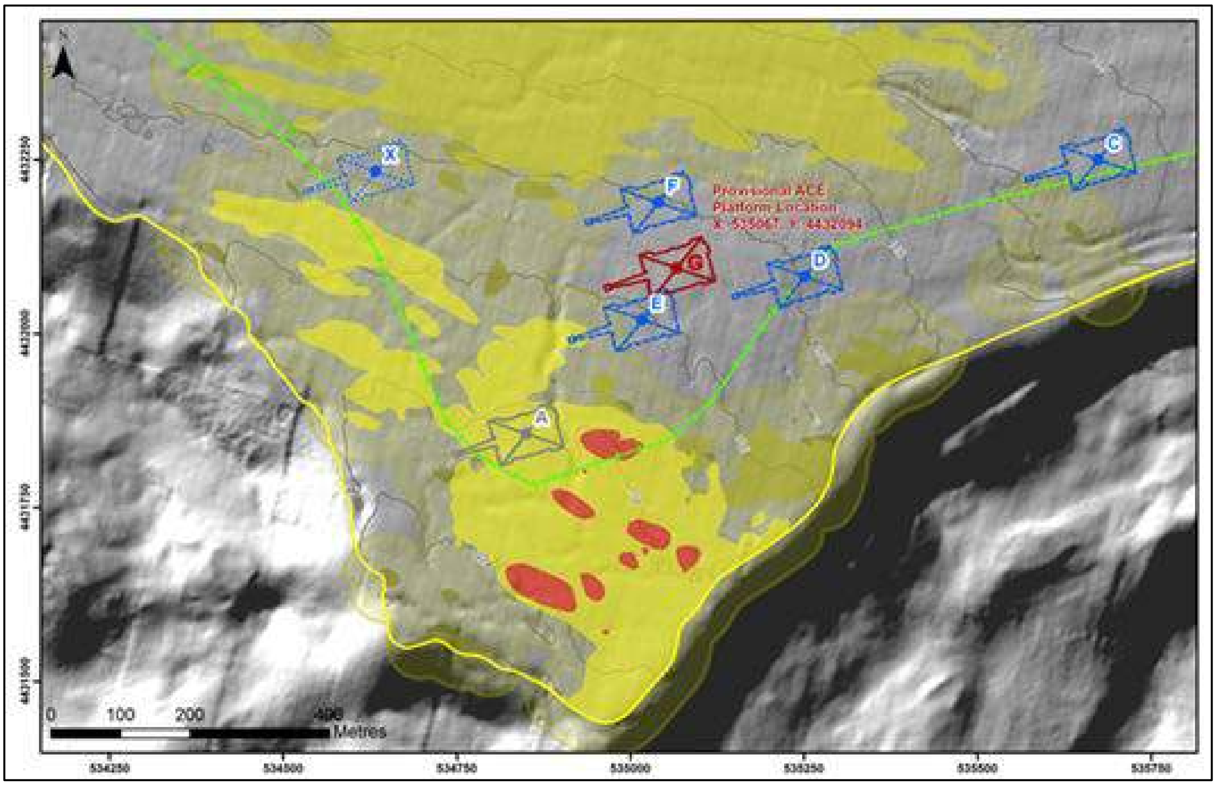
4.3.2 Platform Location Optimisation Studies

Following the decision to locate the ACE fixed facilities at Location A, further work was undertaken to optimise the platform location. Seven potential options were considered as part of a multi-disciplined study (Figure 4.5). The criteria used to assess and compare each option are shown in Table 4.1.

Table 4.1 ACE Fixed Facilities Location Options Assessment Criteria

Subject	Criteria
Geotechnical	• Ground Stability During Earthquake and Platform Vulnerability to Permanent Ground Displacements • Complexity Due to Proximity of Promontory • Relative Shallow Drilling Hazard Risk • Relocation Potential
Top-hole Drilling Hazards	• Shallow Gas • Shallow Water Flow • Geological Drilling Constraints
Subsurface	• Delivery of EA Target Reservoir Gas Injection • Target Access (considering reservoir access to CA and EA targets round mud volcano) • Shallow Overburden Faulting
Wells	• Well Trajectory Feasibility • Well Time and Cost Analysis
Facilities	• Pipeline Routing • Water Depth (jacket length and associated CAPEX)

Figure 4.5 Potential On-Shelf ACE Fixed Facilities Locations Considered During The Optimise Stage



The selection of the provisional ACE fixed facilities location from the seven options identified was based on the judgement of the multi-disciplined project team and supported using a semi-quantified assessment which highlighted the relative importance placed on each of the criteria shown in Table 4.1. As part of the assessment of options a ranking matrix was generated. For each of the criteria a weighting (1=lowest, 3=highest) was allocated. For each criteria the seven potential locations were given a relative ranking (1=worst, 3=best). A total score was applied to each location by summing the scoring for each criteria multiplied by the weighting. A summary of the overall scoring for each option is provided in Table 4.2.

Table 4.2 ACE Platform Location Options Scoring Summary

	Platform Location Options						
Subject	**A**	**C**	**D**	**E**	**F**	**G**	**X**
Geotechnical and Tophole Drilling Hazards	4	11	10	8	11	9	9
Subsurface and Wells	23	19	19	29	23	29	22
Facilities	10	6	6	10	10	10	10
Total Score	**37**	**36**	**35**	**47**	**44**	**48**	**41**

As shown in Table 4.2, Location G scored marginally better than Location E based on numerical scoring and was also selected as the preferred option by the multi-disciplined review team. The key criteria that led to the selection of Location G as the proposed location for the ACE fixed facilities were:

- Minimisation of overall total well step out distance;
- Access to CA reservoir targets that may not be deliverable due to primary slot availability or inability to access as a side track on CA;
- Access to targets southeast of the mud volcano (shown in Figure 4.4); and
- Avoidance of shallow gas hazards.

4.4 Platform Design Options

4.4.1 Concept Development

During the Concept Development Stage, a process of design refinements was initiated to identify options to optimise gas management, utilise spare processing capacity on existing ACG facilities and maximise economic value. The process included the identification and assessment of three platform concept options to meet the Project objectives:

- **1 Platform:** Single drilling rig platform equipped with a single gas injection (GI) compressor, capability to export gas to CA via an infield pipeline and importing power from the existing offshore Azeri power grid to minimise power generation requirements on the ACE facilities.
- **1½ Platform:** Single drilling rig platform for ACE and a "½" platform referring to a small bridge-linked platform (BLP) at EA. The single platform would be equipped with a 48 slot well bay, water injection capability and minimum processing facilities to produce fluids to be transferred to the ½ BLP connected to EA. The ½ BLP and EA would provide gas compression, dehydration and separation and processing facilities.
- **2 Platforms:** Stand-alone twin BLP with a drilling configuration choice of:
  - Single drilling rig with no intervention deck (ID) (similar to existing Caspian rigs such as the West Chirag (WC) platform and to the single platform concept);
  - Single rig with an ID located below the drilling derrick which provides the ability to perform well surveillance and interventions in parallel with drilling new wells; and
  - Two drilling rigs (one on each platform) both equipped with a 24 slot well bay and drilling packages with utilities and processing functionality distributed across each platform.

The 1½ platform option was rejected early in the assessment process as it would have a reduced production profile compared to the other options and would not maximise economic recovery. In addition, this option would require extensive brownfield work and prolonged shutdowns of EA as well as having to rely on new technology for the Caspian (i.e. installation of the ½ platform topsides) and introduce flow assurance challenges associated with the tie-back of multi-phase fluids (comprising more than one phase, such as water- or oil-based liquids).

The assessment of the two platform option, which was considered to be technically feasible, focused on establishing which of the three drilling configurations was preferable. It was found that the single rig with ID option provided the greatest value due to the increased production which can be achieved compared to the other options through simultaneous drilling and well intervention as well as the ID providing mitigation against well / reservoir uncertainty. However, this option was found to have a substantially higher cost for approximately the same recovery as the single platform option due to the increased costs of the design, construction and increased delivery schedule compared to the single platform option.

The single platform option was found to be capable of producing approximately the same amount of barrels of oil compared to the two platform option, but at a significantly lower CAPEX. As the single platform option incorporates GI it was estimated to be heavier than previous ACG projects. Therefore, to mitigate the weight increase associated with the GI equipment and remain within the offshore installation capabilities of the existing transportation barge, a number of design decisions were made to reduce the weight of the platform. These included the adoption of a single, two phase separation train philosophy, importing power from the existing offshore Azeri power grid and exporting gas to CA. The construction and installation of a single platform will also use significantly fewer raw materials and generate less waste, emissions and discharges than a 1½ or two platform concept due to the reduction in materials required. Therefore, the decision was made to proceed with the single platform case to the Optimise Stage.

4.4.2 Optimise Stage

During the Optimise Stage the design of the ACE-PDQ progressed with a focus on initiatives to reduce the weight of the topsides, to lower project costs and to maximise the use of existing ACG facilities infrastructure, while still meeting the Project objectives.

Key design decisions taken included:

- Reducing the weight of the platform by utilising the existing produced water treatment facilities at ST and therefore minimising the equipment required offshore from the design. The decision was made to design the platform such that two phase fluids (i.e. oil and produced water) are transported to ST for treatment via a new infield pipeline that ties-in to the existing ACG Phase 2 oil export pipeline near CA.
- Replacing the drilling rig facility, that consisted of a Drilling Equipment Set (DES) and Drilling Support Module (DSM) similar to the rig facility used on COP, with a lightweight derrick and modular DSM. The lightweight option was selected as it has a comparable specification to the DES typically used on previous projects but is significantly lighter.
- Selection of two 50% flash gas compressors and three 50% oil / produced water export pumps to improve operational efficiency (compared to two 100% equipment) and reduce the potential for emissions due to flaring during unplanned outages.
- Incorporate one Gas Turbine Generator (GTG) into the platform design with spare provision provided by a subsea cable from EA. This option was recommended as it had the highest production availability and optimised utilisation of existing infrastructure. The other options considered comprised:
    - Two GTGs (no power import) - evaluated to result in unacceptable CAPEX and environmental impacts;
    - One EA submarine cable with no new GTGs on ACE - not considered to be operationally or technically viable; and
    - Two submarine cables - One EA submarine cable and one West Azeri (WA) submarine cable, with no new GTGs on ACE - evaluated as being unable to provide the required power system sparing capacity as well as increasing existing Azeri field emissions from inefficient running of existing power generators and flaring events due to “load shedding” of the flash gas compressors due to GTG trips.

4.5 Well Drilling Options

The number of wells drilled per year is a critical project driver from a schedule and economic feasibility perspective. The principle of predrilling a number of wells, as adopted for the previous ACG Phases and COP, was incorporated in the ACE Project Base Case during the Optimise Stage. If predrilling were not to be performed the duration required for production ramp-up would be increased, resulting in a reduction in the economics for the ACE Project. This is however offset by the increased upfront CAPEX required to deliver the pre-drills. The number of predrill wells to ensure economic feasibility was determined with reference to the optimal project drilling and completion rate. The drilling of a cuttings and reinjection (CRI) well is included as part of the planned predrill programme. This will have environmental benefits as it will result in a reduction in waste volumes being sent to shore (e.g. non-water based mud and cuttings) for disposal compared to if the CRI well was not available early following platform drilling commencing.

4.6 Pipeline Route Selection

As stated in Section 4.1 the ACE Project design includes three infield pipelines to transfer comingled oil (including unseparated produced water) to ST for separation and processing, gas not compressed and injected on ACE-PDQ to CA or onto ST and transfer injection water to ACE-PDQ from CA-CWP.

The initial ACE pipeline routes were developed based on minimising the overall length of the subsea pipelines, the length of pipe within exclusion zones around the platforms and the number of extended pipeline free span distances (where a pipe segment is not supported by the seabed). In addition, a number of constraints to the pipeline routes were considered including existing facility locations, dropped object exclusion zones, seabed topography and geohazards and construction and installation requirements.

4.6.1 Oil Pipeline

Several options for the location of the tie-in for the new 30" oil infield pipeline between ACE and the existing ACG Phase 2 EA to ST 30" oil export pipeline were considered, the main ones being as follows:

- Subsea tie-in north of the EA platform;
- Subsea mid-line tie-in approximately mid-way between the CA and EA platforms; and
- Subsea tie-in east of the CA-PDQ platform.

The tie-in location at CA was originally discounted for a number of reasons including concerns over issues with bringing construction vessels close to the CA platform and the potential limits that may have to be put on production at CA, EA and WA during the installation works at CA. Therefore, routing studies concentrated on the EA tie-in and mid-line tie-in locations.

The subsea tie-in north of the EA platform considered routing the 30" pipeline to EA (a route passing around the south of the platform). This option was discounted as it would require a long shutdown of the EA platform during the final subsea tie-in work along with considerable subsea work close to EA and a large number of spools to be installed which would result in increased costs as a result of the additional materials, time and complexity of installation. In addition there would be an increased geohazard risk as the pipeline and spools would have to be laid in close proximity to the edge of the escarpment (refer to Figure 4.32).

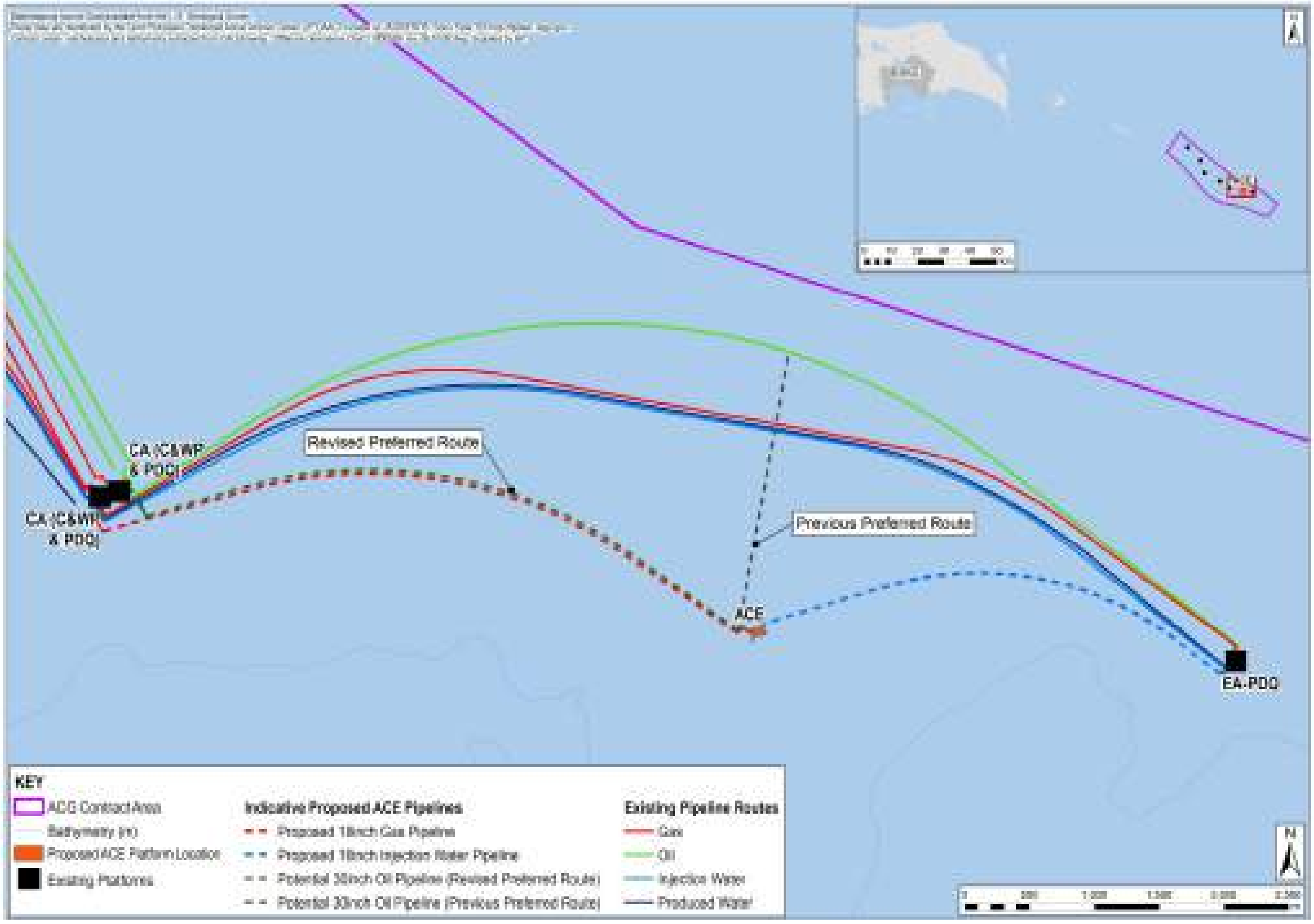
The subsea mid-line tie-in option would require a 16" pipeline to be installed using a hot tap tee[5]. Typically operational pigging of pipelines is undertaken for integrity and wax management however this is would not be possible through the hot tap. The approach for this option therefore would rely on careful management of wax in the pipeline throughout its operation (due to the operating temperature being very close to the Wax Appearance Temperature (WAT)), which places restrictions on operations to ensure that the fluid blend leaving ACE remains above the WAT throughout the pipeline. It also imposes restrictions on which wells can be started up post shutdown and the sequence on which wells are drilled to remain above the WAT of the pipeline which could lead to a pipeline blockage.

Subsequently, further studies of the proposed pipeline routes were undertaken and the decision made to route the 30" oil pipeline parallel to the new 18" infield gas pipeline and tie-in to the existing ACG Phase 2 oil export pipeline near the CA platform (refer to Figure 4.6). The key drivers for the change in the pipeline route include:

- Further analysis of the midline tie-in option between EA and CA confirmed that production on the EA platform would require to be shutdown for a long duration while the tie-in is performed leading to a significant loss of production time. Furthermore, a risk of pipeline movement was identified on this route which could result in the requirement for suction and/or piled anchors to secure the pipeline; and
- The CA tie-in option was found to result in a reduced operational impact through minimising flaring and production impact on EA, and reduced risk to the pipeline (i.e. potential pipeline movement and associated anchoring requirements are unlikely).

[5] Hot tapping refers to the installation of connections to pipelines while they remain in service.

Figure 4.6 ACE Oil Pipeline Route Options



4.6.2 Gas Pipeline

Three potential options for the location of the tie-in to the new gas infield pipeline between ACE and the existing ACG Phase 2 EA to ST gas export pipeline were considered:

- Subsea mid-line tie-in approximately mid-way between the CA and EA platforms;
- Subsea tie-in near the EA platform using a wye and spool connection; and
- Subsea tie-in south of the CA platform using a wye and spool connection.

The mid-line tie-in option was not considered feasible due to flow assurance studies indicating increased back pressure severely limiting production from EA. The option to tie-in the gas export pipeline at EA was discounted as the predicted increase in back pressure at EA would be more than the midline tie-in option and this option would also require a pipeline crossing at 25 degrees. Therefore, the tie-in option at CA was selected as the base case because of the flow assurance analysis and the pipeline route has been optimised to avoid seabed depressions between CA and ACE.

4.6.3 Water Injection Pipeline and Power and Telecommunications Cable

The proposed WI pipeline route between ACE and EA runs approximately parallel with the edge of the escarpment. The route has been optimised to ensure a safe distance back from the escarpment. It is planned that the WI pipeline is installed parallel to the combined power and telecommunication subsea cable which runs from ACE to EA (with a separation distance of approximately 15m).

4.7 Revalidation of Previous ACG Facilities Options

Throughout previous phases of ACG field development a significant amount of work has been undertaken to assess the viability of options that would reduce emissions to air, discharges to sea and improve the energy efficiency and overall environmental performance of the facilities. These were reviewed and re-evaluated for the ACE Project. Some options were discounted based on space, weight, technological challenges or adverse economics. Similarly, some options were shown to improve environmental performance while fulfilling the weight and space restrictions of the offshore environment. The advantages and disadvantages of each option were examined and a summary of these options detailing previous considerations and why they were found to not be viable was included in the COP ESIA (Ref. 1). A summary of the options considered that are relevant to the ACE Project are provided below.

The options that were previously evaluated and discounted and are of relevance to the ACE Project include:

- **CO_2 Recovery & Sequestration:** The principle would be to capture the CO_2 emissions from combustion sources (gas turbines primarily) and dispose to sub-surface. This has not been adopted previously and will not be for the ACE Project due to the weight of the equipment required to capture and dispose of the CO_2, safety aspects, technological novelty and adverse economics.
- **Solar Thermal and Solar Photovoltaic Power Generation:** This option is technically impractical and would not be able to make a significant contribution to the energy requirement of the topsides without the presence of impractically large solar collection areas. Additionally, this option was has not found to be economically viable.
- **Wind Power Generation:** This option was found to have limited application offshore, represent a safety risk (due to rotating blades) as well as prohibitive costs.
- **Wave Power:** The Caspian Sea is a low wave energy environment and therefore this option was not considered practical.
- **Combined Heat & Power Offshore and Combined Cycled Power Generation Offshore:** There is no significant requirement for process heat on the offshore platform, as such, this option was not considered further in previous phases. The same limitation applies to the ACE-PDQ topside and therefore was not considered a viable option.
- **Non-Continuously Lit Pilot Ignition Systems:** A non-continuously lit pilot would eliminate the requirement for continuously lit flare tips, thereby reducing emissions. The systems evaluated previously were not considered viable due to reliability and safety issues associated with electronic ignition of the flare, or due to adverse economics.
- **Low Nitrogen Oxide (NO_x) Gas Turbine Offshore:** Such technology can achieve around a 90% reduction of NO_x emissions. The technology was rejected in previous ACG development phases due to the requirement for dual fuel machines offshore (i.e. can run on either gas or diesel if required) for which low NO_x technology was not available at the time. As per the findings of the review undertaken for COP and summarised in the COP ESIA (Ref. 1) the decision has been taken not to use low NO_x turbine technology for the ACE-PDQ topside for the following reasons:
    - There is a need for a dual fuel (gas and diesel) capability for the ACE-PDQ GTG and there are currently very few low NO_x burners available on the market for dual fuel turbines and evidence suggests there is poor reliability due to mechanical issues with these versions (Ref. 2);
    - Low NO_x burners respond poorly to changes in fuel gas composition and sudden changes in load (e.g. due to a trip) which can occur more frequently offshore; and
    - Low NO_x burner turbines are known to consume more fuel than non low NO_x turbines when under low loads (i.e. below 70%). During the early years of ACE production this will be the case and hence the benefits of this technology are low.

The options previously evaluated and adopted in earlier ACG projects and taken forward for the ACE Project include:

- **Electric Flash Gas Compression:** The project adopted a two flash gas compression train (2 x 50%) configuration. This configuration provides higher availability than a single train to process the full gas inventory and consequently results in a reduced amount of gas routed to flare should a compressor suffer downtime.

- **Fugitive Emissions:** Reduction in fugitive emissions will be achieved by incorporating the following aspects into the design:
  - Closed drains for drainage of the hydrocarbon system; and
  - All process vents piped to flare.
- **Copper-Chlorine Seawater Anti-fouling System:** A copper-chlorine system which uses the application of direct current electrolysis to produce copper and chlorine at low concentrations has been adopted for the Project. This system results in significantly lower concentrations of chlorine discharged into the Caspian Sea over the lifetime of the project from the seawater system, when compared to systems utilising a hypochlorite generator to dose incoming seawater for anti-fouling control.
- **Fire Fighting Systems:** No halon fire suppressants will be used in fire fighting systems. Deluge/water mist and Niagara 3-3 Foam will be the primary methods of fire fighting. Niagara foam is based on natural protein foaming agent and contains no harmful synthetic detergents, glycol ethers, alkyl phenol ethoxylates, totyltriazoles or complexing agents. It is biodegradable and virtually non-toxic to aquatic organisms.
- **Refrigerants:** Refrigeration or heating, ventilation, and air conditioning systems will not utilise hydrochlorofluorocarbons and chlorofluorocarbons.
- **Drilling Mud and Cuttings Disposal:** During the ACG Phase 1 Project a Best Practicable Environmental Option (BPEO) assessment was undertaken considering the handling and disposal of water based mud (WBM) and non-water based mud (NWBM) and cuttings from drilling operations. The assessment concluded that the BPEO was that NWBM and cuttings should be re-injected offshore or shipped to shore for disposal and WBM and cuttings, which meet the relevant project standards, would be discharged to the marine environment based on the expected low levels of environmental toxicity of the chemicals in the WBM and the localised impact of solids deposition, which will occur near to the discharge point. This approach has been consistently utilised across ACG Phases 1-3, COP and SD projects and will be adopted for the ACE Project.
- **Sewage Treatment System:** A rigorous approach was adopted for the selection of the Sewage Treatment Plant (STP) for the COP WC platform, which involved a comprehensive review of sewage treatment systems and technology. The review considered the problems with the existing ACG platform treatment plants to ensure that any technology selected for the WC-PDQ would not have the same compliance, operability and reliability issues. The review included an assessment of the ability to comply with applicable discharge standards, the operability and reliability of the plant, sludge generation and handling and maintenance requirements. Based on the selection criteria developed for this exercise the DVZ Membrane Bioreactor Package Plant fitted with jet aeration was selected as the best technical option for sewage treatment. Following the installation and start-up of the WC-PDQ STP a review was undertaken to identify lessons learned and make recommendations for improvements in the package design that can be investigated on future projects. As well as design improvements, a review of training and operational procedures was also undertaken to ensure the STP was operated as efficiently as possible. The SD2 Project topsides used the same STP design and ACE will also adopt the same STP design and will build on experience and lessons learned from both COP and SD2.

4.7.1 ACE Facilities Options Appraisal

In addition to revalidation of earlier ACG options, a number of ACE Project specific studies have been undertaken to identify means of optimising the overall environmental performance of the facilities. A summary of these studies is presented below.

4.7.1.1 Options for Reducing or Eliminating Emissions from Combustion

Power from Shore

A power supply options study was undertaken to examine the option of using a centralised power generation scheme onshore and subsequent power transmission via a subsea cable to the ACE platform. Oil Rocks, Chilov and Sangachal were reviewed as suitable locations for new onshore power generation. Both High Voltage Direct Current (HV DC) and Alternating Current (HV AC) options were considered. The options were compared in terms of capital cost, operating cost and environmental impact. The power from shore option would not eliminate the production of combustion emissions but would help to reduce such emissions through increased efficiency of power generation. However, calculations for previous phases demonstrated the CO_2 saving to be only marginal. The ACE feasibility study showed the option to provide the power from shore did not offer significant operating cost benefits to offset the significantly increased CAPEX costs and minor environmental/energy efficiency benefits compared to the offshore power generation option. The requirement to install high voltage DC/AC converter modules on the ACE topside would also compromise the weight and space restrictions on the ACE-PDQ topside. Thus, the option of using power from shore for the ACE Project was discounted.

Power Configuration and Gas Turbine Generator Selection

As described in Section 4.4.2 the base case power supply option selected for the ACE Project is a single GTG on the ACE-PDQ with spare provision provided by importing power via a cable from EA.

To determine the optimal generator size and configuration for offshore power generation to meet the ACE power demand, a total of eight generator types were selected for assessment. The assessment criteria included:

- Technology suitability and lessons learned;
- Import power scenarios;
- Weight and layout considerations; and
- Target machine loading (i.e. percentage capacity GTG will normally operate at).

The assessment concluded that a single SGT-A35 (G62) 27.5MW ISO GTG with imported power from EA offers the best flexibility in terms of a high efficiency engine that is not oversized for duty, yet during periods where imported power may not be available, is still large enough to support the power demand of the platform throughout the Life of Field (LoF).

A further assessment using production and power profiles over the LoF and performance curves for the generator options was completed to compare the predicted greenhouse gas (GHG) (as carbon dioxide (CO_2)) and NO_X emissions for the preferred option and alternatives. The results showed that, while the difference between the CO_2 emissions for the options considered was marginal, G62 27.5MW ISO turbine resulted in lower NO_X emissions compared to the other options assessed.

Based on technical and environmental assessments, the SGT-A35 (G62) 27.5MW ISO option was subsequently adopted as the ACE Project Base Case for power generation. For gas compression duty, the Base Case design includes a single SGT-A35 (G62) gas driven compression turbine, capable of providing 29.1MW of electrical power (based on ISO rating).

Flaring

Flare Purge

Flare systems require continuous purging to prevent air ingress and potentially creating a hazard in the flare. The purge gas can be fuel gas or an inert gas alternative such as nitrogen. To date fuel gas has been used as the flare purge method for the flares across the ACG offshore facilities. Due to the lower carbon emissions option which nitrogen presents as a purging fluid, this option was compared to the use of fuel gas for purging (base case across other ACG facilities). The analysis found that although it would be environmentally favourable to operate a nitrogen based purging fluid due to lower CO_2 emissions, the safety implications (e.g. increased likelihood of extinguishing the flare pilot lights and potential for reduced combustibility), operational risk (e.g. relying fully on instrumentation to detect a nitrogen purge failure rather than a visual flame) and cost implications outweigh its environmental benefit (which was found to be marginal across the LoF). Thus, it was concluded during the early stages of the design process that ACE should continue with the implementation of the fuel gas based purging system.

BP is, however, committed to exploring options to reduce its GHG emissions. Detailed engineering studies are ongoing to re-evaluate whether a nitrogen flare purge system option could be incorporated into the platform design while ensuring the related risks and challenges are suitably minimised and managed.

Offshore Flare Gas Recovery

Flare gas recovery (FGR) systems enable hydrocarbon vapours sent to the flare system to be returned to the processing facilities during normal purging and low flow conditions. The flare requires a purge flowrate and in the absence of fuel gas, purge gas would need to be inert gas (nitrogen). This would increase the size and weight of equipment on the topside, both for generating inert gas and for the FGR package required for compressing recovered hydrocarbon vapours back into the process. For the ACE-PDQ the FGR package would require to be installed on the processing side of the platform which would negatively impact the topside weight distribution (centre of gravity). The size, weight and associated cost issues offset the potential environmental benefits in the use of FGR technology on the ACE-PDQ.

Flaring Minimisation

The ACE platform has been designed to minimise flaring through effectively eliminating as far as possible the need to flare under normal routine operations. In order to meet this objective an overall integrated design of the flare systems, atmospheric vents and depressurisation facilities has been designed by considering various options to reduce flaring. Unlike other ACG offshore facilities, the ACE facilities have been designed to avoid flaring during planned maintenance of certain equipment such as the GI gas turbines. This is achieved by designing in the ability to send ACE gas to the CA platform via the new infield gas pipeline where it is either used for GI at CA or exported to ST if not required on CA.

4.7.1.2 Process Chemicals

Chemicals perform a variety of roles in offshore hydrocarbon production and export (e.g. hydrate and corrosion control and scale inhibition) and in some cases can be eliminated by design or materials selected. Although the chemical functions required on the ACE platform are common to other ACG offshore platforms, a study was undertaken to identify and evaluate the options, including the use of chemicals, for production on ACE using the Best Available Technique (BAT) methodology. The study considered material selection, heating and other design measures which may reduce or eliminate the need for chemicals. Where chemicals were deemed necessary, low-toxicity alternatives were evaluated. The primary focus of the BAT evaluation was on technical solutions to meet process demands while minimising material consumption, wastes, energy, emissions, discharges and other relevant environmental parameters. The BAT study also considered the potential risks and impacts, safety, practicality, schedule and cost implications of each option.

The evaluations conducted for the BAT study confirmed that the ACE base case design, including the use of production chemicals, represented BAT at this time. No new options were identified which offered significant advantages to the base case. The production chemicals proposed for use on ACE are described in Chapter 5: Section 5.8.6.15 of this ESIA.

4.7.1.3 Cooling System

As for the previous ACG projects the initial base case considered for the ACE Project was the use of lifted seawater to provide platform cooling.

In order to revalidate this decision a Cooling Water BAT Study was undertaken for ACE to assess options for providing the cooling demand on the ACE platform. The BAT Study assessed three methods of cooling: cooling water using seawater lift (base case); air coolers; and the use of injection water obtained via a new pipeline from CA as coolant. The three options were evaluated based on cost, safety, technical and environmental factors.

The air coolers option was rejected (as when previously considered) due to the increase in topside weight to accommodate the air coolers and this was deemed not feasible given the project weight constraints. The injection water option was rejected due to high CAPEX, reliability concerns and the need for a seawater lift system as back-up. Therefore, a conventional seawater lift system was selected for the ACE Project as it provides a reliable and compact system for ACE. A preliminary dispersion modelling study of the cooling water discharge based on preliminary design characteristics was undertaken which confirmed that the Project environmental requirements would be met for the current design i.e. the temperature at the edge of the mixing zone (assumed to be 100m from the discharge point) will be less than 3°C above the ambient water temperature. The seawater lift system to provide cooling was retained as the Project base case.

4.8 Base Case Optimisation

The design of the ACE Project facilities will be further optimised during the Define stage of the Project. It is not anticipated, however, that there will be any significant changes to the current design Base Case presented in Chapter 5.

Should the optimisation result in a change to the ACE Project Base Case design as assessed within this ESIA, the ACE Project Management of Change Process will be followed as described within Chapter 5: Section 5.13.

4.9 References

Ref. No.	Title
1	URS, 2010. Chirag Oil Project Environmental and Socio-Economic Impact Assessment (ESIA)
2	Oil & Gas UK, 2015. Offshore Gas Turbines and Dry Low NOx Burners. An analysis of the Performance Improvements (PI) Limited Database. Technical Note – [ENV002] – Rev01. Available from: https://oilandgasuk.co.uk/wp-content/uploads/2015/05/producys-cayrgory.pdf

5 Project Description

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5.1 Introduction

This Chapter of the Environmental and Social Impact Assessment (ESIA) describes the construction and operational activities associated with the Azeri Central East (ACE) Project. This Chapter describes the design basis for the project facilities, as well as planned activities for the following project phases:

- Offshore predrilling;
- Onshore construction and commissioning of offshore facilities;
- Infield pipeline installation, tie-in and commissioning;
- Platform installation, hook up and commissioning;
- Platform drilling;
- Offshore operations; and
- Decommissioning of offshore facilities.

Estimated emissions, discharges and wastes from the ACE Project are presented for each project phase; emission estimate assumptions are provided in full within Appendix 5A.

This Chapter provides the basis for the assessment of environmental and social impacts as presented in Chapters 9 to 13 and was prepared during the 'Define' stage of the project. During subsequent stages of the ACE Project, there may be a need to change a design element. The ACE Project ESIA Management of Change Process that will be followed should this be necessary, is presented in Section 5.13 of this Chapter.

The Base Case ACE Project design includes:

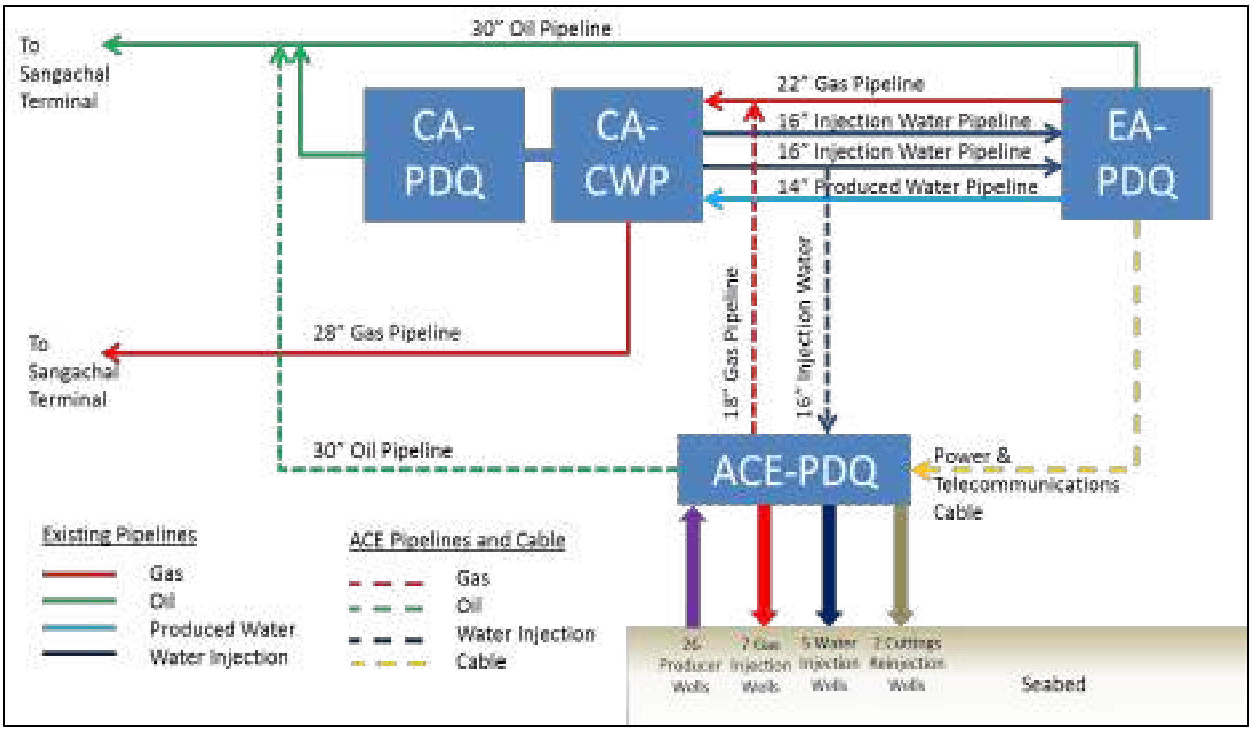
- ACE Production, Drilling and Quarters (ACE-PDQ) platform;
- Infield subsea oil pipeline to tie the ACE-PDQ platform into the existing Azeri Chirag Gunashli (ACG) oil export pipeline adjacent to the Central Azeri compression, and water injection platform (CA-CWP) to transport liquids produced from the ACE platform to the Sangachal Terminal (ST) for separation and processing;
- Infield water injection pipeline for provision of injection water to the ACE platform from the existing Central Azeri – East Azeri (CA-EA) water injection pipeline at a tie-in location adjacent to the EA platform;
- Infield gas pipeline tie-in to the existing gas export pipeline upstream of the CA-CWP platform to allow gas produced from the ACE platform that is not required for injection, lift and fuel gas to be exported to ST; and
- A combined power and fibre optic cable (PFOC) from the EA platform to ACE-PDQ platform.

Up to 26 producer wells, 5 water injection wells, 7 gas injection wells and 2 cutting reinjection (CRI) wells are planned for the ACE Project.

The ACE Project will make use of existing capacity/ullage within the ST processing facilities and no new infrastructure or ST expansion will be required (other than minor telecommunication modifications). A number of brownfield modifications at the CA-CWP and EA platforms are also included within the project scope.

Figure 5.1 presents an overview of the ACE Project and the associated tie-ins to the existing ACG facilities and infrastructure.

Figure 5.1 Overview of Azeri Central East Project

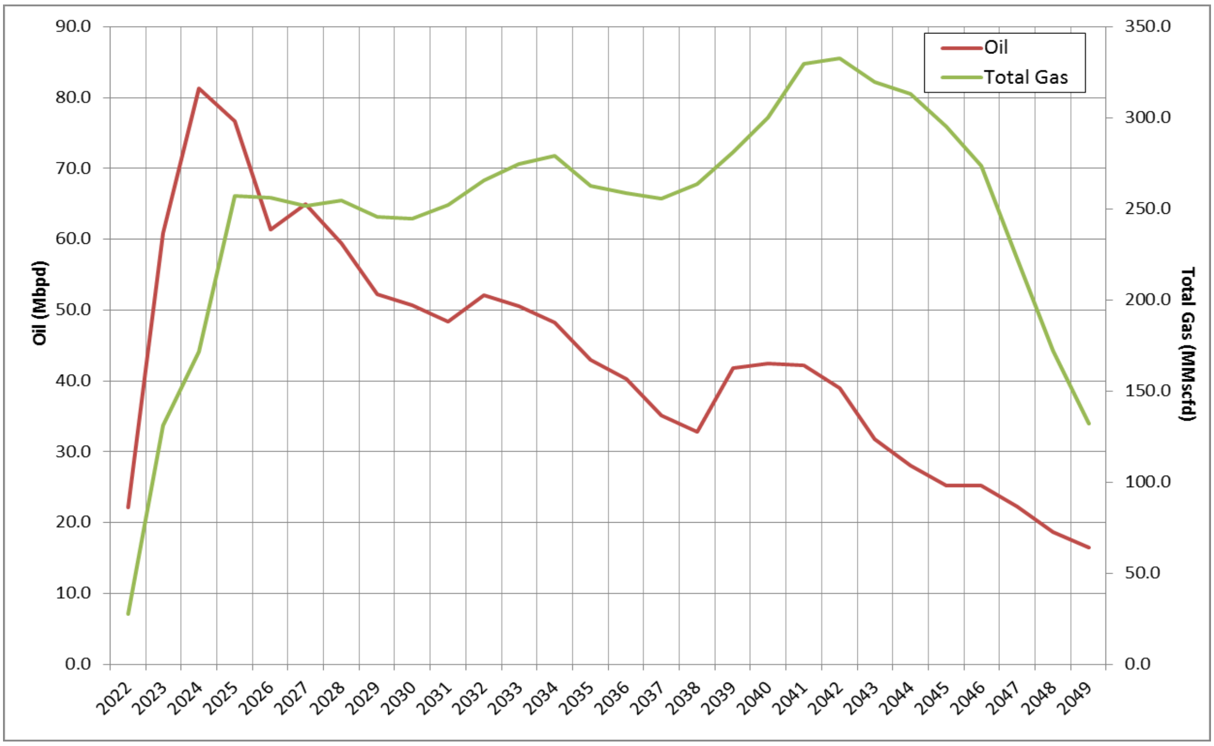


Planned first oil for the ACE Project is 2023 with peak production anticipated in 2024. The ACG field, comprising 5 Pereriv (A, B, C, D, E) and 4 Balakhany (VII/VIII/IX/X) reservoirs, contains "total-original-oil-in-place" of approximately 16 billion standard barrels (Bstb). The ACE Project aims to further develop the oil reservoirs, maximising recovery. The ACE Project offshore facilities have been designed to process:

- Up to 100 thousand barrels per day (Mbpd)) oil (commingled with produced water); and
- Up to 350 million standard cubic feet per day (MMscfd) gas.

Figure 5.2 illustrates the estimated ACE Project oil (excluding produced water) and total gas production profile over the Production Sharing Agreement (PSA) period.

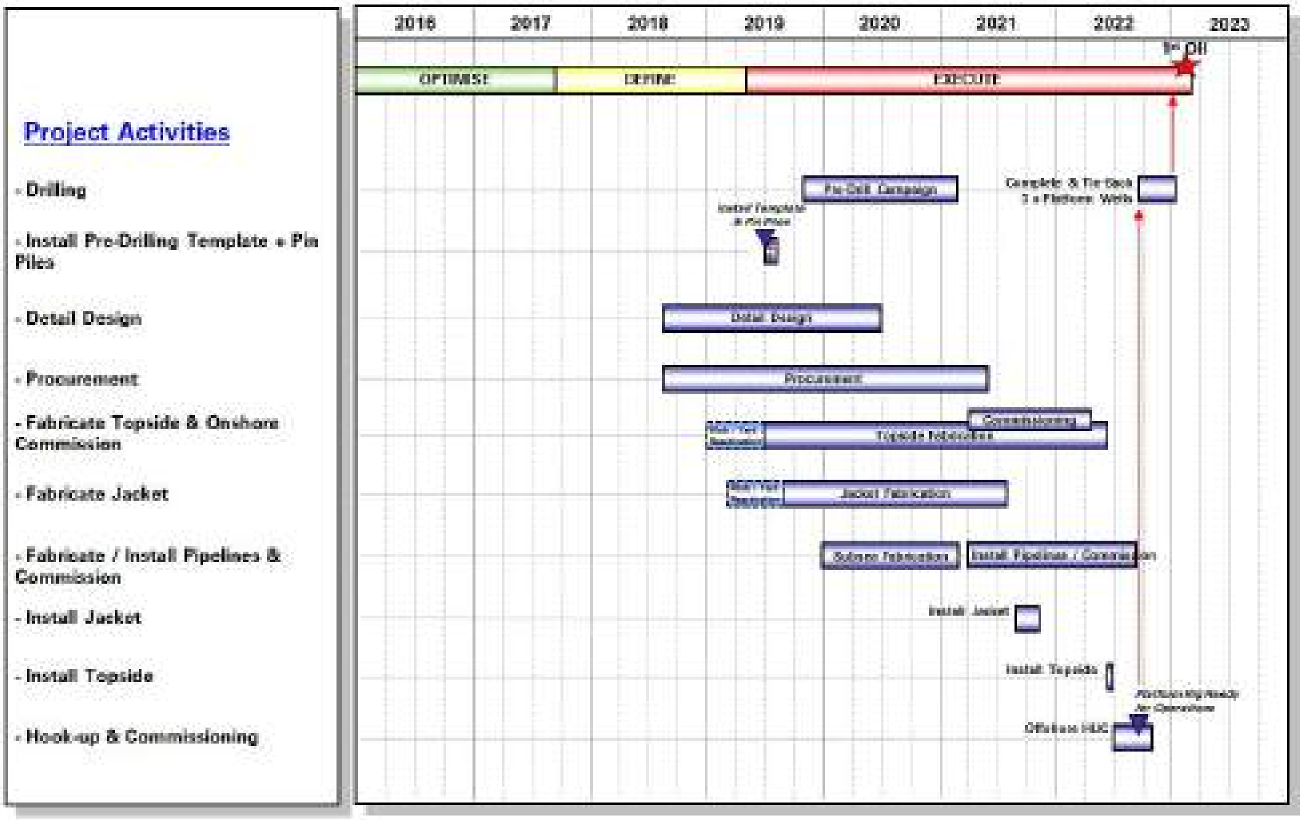
Figure 5.2 Estimated ACE Production Profiles Across the PSA Period



5.2 ACE Project Schedule

Key ACE Project milestones are shown in Figure 5.3. The milestones are based on the best available knowledge at the time of writing.

Figure 5.3 Estimated ACE Project Schedule to First Oil



5.3 MODU Predrilling Activities

The purpose of predrilling is to accelerate early production once the platform is in place. It is planned that up to six wells (including one CRI well) will be predrilled, using a Mobile Offshore Drilling Unit (MODU), prior to the installation of the ACE-PDQ platform. It is anticipated that the wells will be drilled using one of the semi-submersible rigs located within the Caspian Sea. For the purpose of this ESIA it is assumed that the Dada Gorgud or Istiglal rig may be used, with the final rig selection dependent on the rig availability.

To control the horizontal positioning of the predrill wells, prior to predrilling commencing, a drilling template comprising 12 “slots” (i.e. wellhead receptacles) will be lifted into position by the Derrick Barge Azerbaijan (DBA), lowered onto the seabed and levelled using a hydraulic system. Following installation of the drilling template, four 96” (2.43m) diameter 118m length pin piles will be driven into the seabed using an underwater hydraulic hammer. These pin piles will form the temporary foundation support for the ACE-PDQ jacket when it is installed (see Section 5.5.2). The construction and installation activities associated with the jacket pin piles are described in Sections 5.4.4 and 5.5.2.

As shown with Figure 5.3, it is anticipated that predrilling activities will take place over approximately 12 months, commencing in Q4 2019. It is anticipated the first well will take approximately 100 days to drill with the subsequent five wells taking approximately 50 days to drill each (including casing, displacing and suspending). The wells are anticipated to be approximately 2m apart on the seabed.

5.3.1 MODU Predrilling Activities

5.3.1.1 MODU Positioning

Support vessels will tow the MODU to the drilling location and move it into position prior to anchoring, using 8 anchors. The mobilisation, positioning and set up of the MODU is expected to take up to 5 days and a further 5 days to demobilise the rig at the end of the drilling programme. A mandatory 500 metre (m) exclusion zone will be established around the rig while drilling is in progress.

5.3.1.2 MODU Logistics and Utilities

In addition to the MODU, vessels will be required throughout the drilling programme to supply consumables such as drilling mud to the MODU and ship solid and liquid waste to shore for treatment and disposal. Table 5.1 summarises the estimated number and function of the vessels. Table 5.2 summarises the MODU and support vessel utilities.

Estimated volumes of waste and greenhouse gas (GHG) and non GHG gas atmospheric emissions generated during the drilling programme are summarised within Section 5.3.6 below.

Consumables such as drilling mud and diesel will be provided to the MODU by vessels from the existing onshore facilities previously used during ACG and SD predrilling programmes and which also supply the operational ACG and SD platforms.

Table 5.1 Estimated Number and Function of ACE Predrilling Vessels

Vessel	Basis of Use	Function	POB
MODU	Continuous through predrilling	Predrill wells	145 Istiglal 120 Dada Gorgud
Anchor Handling Tugs	Three tugs used for each operation	Tow out and position MODU (5 days) and demobilise MODU (5 days)	18
Support Vessels	Up to three trips per week	- Supply drilling mud, diesel and other consumables to the MODU - Ship solid and liquid wastes to shore	15
Standby Vessel	Continuous through predrilling	Back up support for MODU/support vessels	15
Crew Change Vessel	Up to three trips per week	Personnel transfer	14 (crew)

Table 5.2 Summary of the MODU and Vessel Utilities

<table>
<tr><th>Utility/Support Activity</th><th>Dada Gorgud Description</th><th>Istiglal Description</th></tr>
<tr><td>MODU Power Generation</td><td>• Main Power provided by 4 Wartsila W8L26F diesel generators rated 2720 kW.
• Emergency diesel generator rated at 635kW.</td><td>• Main Power provided by 4 Wärtsilä W6L32E diesel engines rated at 3480 kW.
• Emergency diesel generator rated at 1562 kW.</td></tr>
<tr><td>MODU and Support Vessels Grey Water and Sanitary Waste[1]</td><td colspan="2">• Grey water will be discharged to sea (without treatment) as long as no floating matter or visible sheen is observable.
• Under routine conditions black water will be treated within the sewage treatment system to:
- MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards[1.] No chlorination of the effluent will be required under routine conditions, however when chlorine is used for disinfectant purposes, it is planned to maintain the concentration of residual chlorine in the effluent below 0.5mg/l and discharge to sea. In the event it is not practicable to achieve this concentration, the effluent will be contained and shipped to shore.
• When MODU sewage treatment system is not available black water will be managed in accordance with the existing AGT plans and procedures.
• MODU sewage sludge will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.</td></tr>
<tr><td>MODU and Support Vessels Galley Waste[2]</td><td>• Depending on the availability of the system, food waste will either be: sent to vessel maceration units designed to treat food wastes to applicable MARPOL 73/78 Annex V[2]; or disposed in accordance with the existing AGT waste management plans and procedures (Dada Gorgud).</td><td>• Food waste will be contained and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures (Istiglal).</td></tr>
<tr><td rowspan="2">MODU Seawater/ Cooling Water Systems</td><td>• Seawater used onboard within the engine and compressor systems (for cooling), desalinisation unit and sanitary system.
• 2 seawater service pumps (one operating at a time) designed to lift approximately 575m^3/hr from a depth below sea level of 9m.
• Cooling system discharge up to 575m^3/hr via caisson 1m above sea level.</td><td>• Seawater used onboard within the engine and compressor systems (for cooling).
• Design incorporates anodic biofouling and corrosion control system.
• 4 main seawater cooling pumps (two operating at a time) designed to lift up to 400m^3/hr each from a depth below sea level of approximately 11.5m.
• 4 seawater service pumps designed to lift up to 100 m^3/h each.
• Cooling system discharge up to 1600m^3/hr at a depth below sea level of approximately 11.5m.</td></tr>
<tr><td colspan="2">• Design and operation of MODU cooling water system reviewed and confirmed that temperature at the edge of the cooling mixing zone (assumed to be 100m from discharge) will be no greater than 3 degrees more than ambient water temperature.</td></tr>
<tr><td>MODU/ Vessel Fresh Water</td><td>• Unit produces freshwater from seawater by reverse osmosis for sanitary and galley use.</td><td>• Fresh water supplied from shore by supply vessels and stored onboard for use.</td></tr>
<tr><td>MODU Desalination Unit</td><td>• Discharge of 2,000m^3/day saline water at approximately 5°C above ambient temperature and twice the salinity of the receiving waters.</td><td>• NA</td></tr>
<tr><td rowspan="2">MODU Drainage</td><td colspan="2">• MODU deck drainage and wash water will be discharged to sea as long as no visible sheen is observable.
• In the event of a spill, main MODU deck drainage will be diverted to hazardous drainage tank for spills including SOBM/LTMOBM, oil/diesel/cement and oily water. Contents of the tank will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.</td></tr>
<tr><td colspan="2">• Rig floor runoff, including WBM spills, collected via rig floor drains will be recycled to mud system or if not possible for technical reasons, diluted and discharged to sea (>60cm from sea surface) in accordance with applicable PSA requirements[3].</td></tr>
<tr><td>MODU Ballast System</td><td colspan="2">• Ballasting, using untreated seawater, undertaken daily to maintain stability of the MODU for effective drilling.</td></tr>
<tr><td>Support Vessel Drainage</td><td colspan="2">• Oily and non-oily drainage and wash water will be segregated.
• Non-oily drainage (deck drainage and wash water) may be discharged as long as no visible sheen is observable.
• Oily water will either be treated to 15ppm or less oil in water content and discharged to sea or contained and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.</td></tr>
<tr><td colspan="3">Notes:
1. MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards: Five day Biological Oxygen Demand (BOD) of less than or equal to (≤)50mg/l, total suspended solids ≤50mg/l (in lab) or 100mg/l (on board) and thermotolerant coliforms ≤250MPN (most probable number) per 100ml.
2. Macerated to particle size less than 25mm.
3. There shall be no discharge of drill cuttings or drilling fluids if the maximum chloride concentration of the drilling fluid system is greater than four times the ambient concentration of the receiving water.</td></tr>
</table>

5.3.2 Predrilling Operations and Activities

Mobile drilling rig activities during the ACE Project predrilling programme include:

- Preparation of drilling equipment;
- Drilling of conductor, surface and lower well hole sections of the predrill wells;
- Installing and cementing casings; and
- Well displacement and suspension.

The predrill wells will be subsequently re-entered and completed when the platform has been installed and commissioned as described within Section 5.7.3 below.

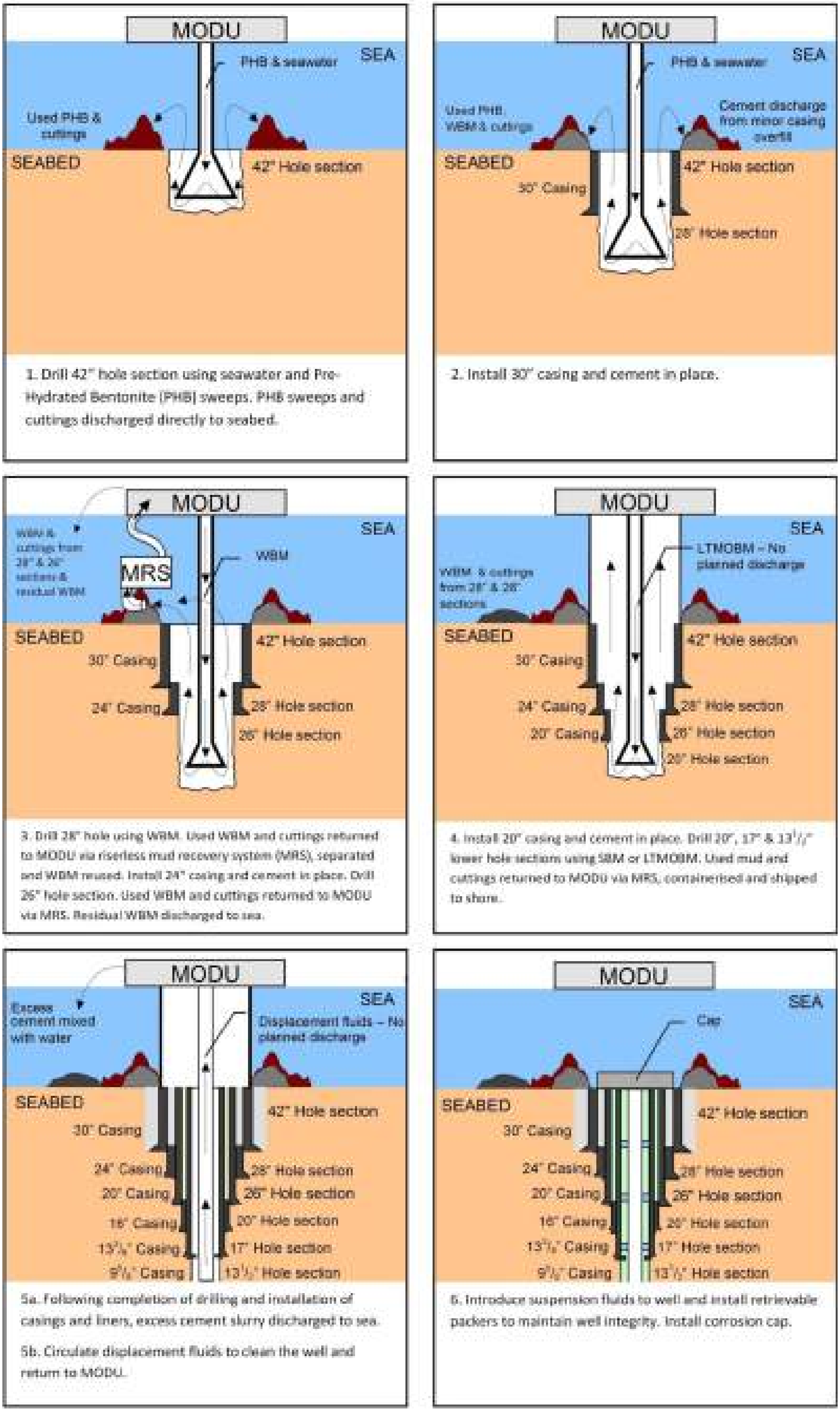
A summary of discharge types and the associated discharge scenarios associated with predrilling activities is provided in Table 5.3. The activities associated with the ACE predrill wells are illustrated in Figure 5.4 below.

Table 5.3 Summary of Drilling Discharge Types and Scenarios

Step (as per Figure 5.4)	Activity	Composition	Discharge Scenario
-	Application of pipe dope to drilling equipment joints	Pipe dope	Discharge very small amount of pipe dope with seawater/PHB sweeps/WBM prior to riser installation (42", 28" and 26" hole sections).
1 and 2	Drilling of conductor sections (42")	Cuttings and seawater with pre-hydrated bentonite (PHB) sweeps	Discharge seawater/PHB sweeps and cuttings directly to seabed.
3	Drilling of 28" and 26" upper hole sections (riserless)	Cuttings with WBM	Return WBM and cuttings to MODU using riserless Mud Recovery System (MRS), separate mud from the cuttings. Recovered WBM will be reused whenever possible. Discharge WBM cuttings to the sea via the MODU cuttings chute or a discharge hose in accordance with PSA requirements[1,2]. If, as a result of shale hydration, the MRS hoses become plugged, then mud may be discharged at the seabed while the well is made safe and the hoses are unblocked.
	End of drilling 26" hole section	WBM	Residual WBM remaining in the rig mud system after completion of 26" hole section drilling that cannot be recovered will be discharged to sea via the MODU cuttings chute or a discharge hose in accordance with PSA requirements[1,2].
4 and 5	Drilling of lower hole sections (20", 17" & 13.5") (with riser)	No planned discharge	
2 and 3	Casing cementing	Cement	Discharge small amount of cement, due to slight overfill (required to ensure the casing is fully cemented to the seabed), directly to seabed following cementing of surface casing and drilling liner.
5a	End of cementing	Cement	Residual cement remaining in cement system on completion of cementing activities cannot feasibly be recovered and will be mixed with water and discharged to sea via the MODU cuttings chute.
5b and 6	Well displacement and suspension	No planned discharge	

Notes:
[1] There shall be no discharge of drill cuttings or drilling fluids if the maximum chloride concentration of the drilling fluid system is greater than 4 times the ambient concentration of the receiving water.
[2] MODU cuttings chute is located at a depth of 11m below sea level. A hose of 6 inches diameter positioned 25 m from the seabed may be used to avoid discharge of mud and cuttings in locations where it is planned to install ACE subsea equipment.

Figure 5.4 Summary of Drilling Activities and Discharges



5.3.2.1 Well Design and Drilling Fluid Types

All well-bore sections will be drilled using drilling fluids/drilling muds, the primary role of which is to:

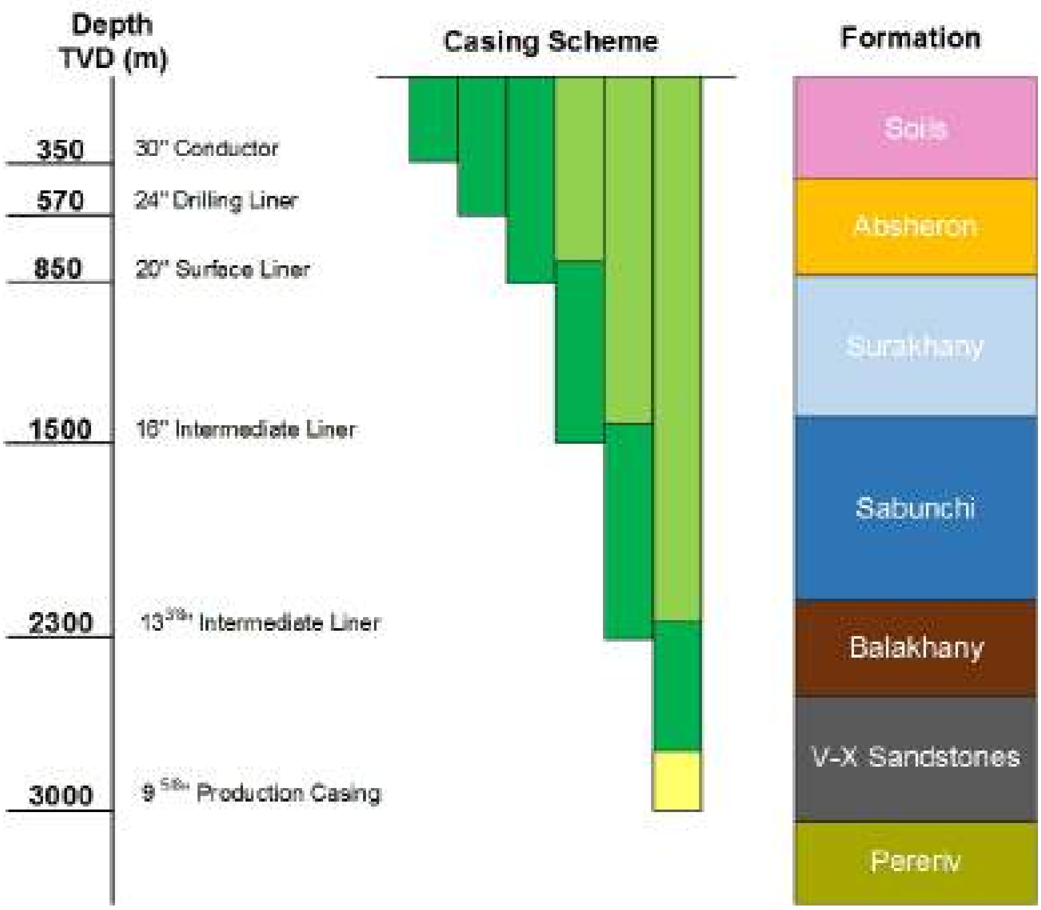
- Maintain down-hole pressure to prevent formation fluids entering the well bore;
- Remove drill cuttings generated by the drill bit as it bores through the rock strata and transport these to the surface;
- Lubricate and provide cooling to the drill bit and the drill string; and
- Seal the wall of the well-bore in order to provide stabilisation.

The generic design for the predrill wells is presented in Table 5.4 and illustrated in Figure 5.5. The casing design for the wells will be similar to the existing ACG predrill well designs. It should be noted that the section lengths shown in Figure 5.5 are generic and will be relevant to all predrill wells although there will be small fluctuations in length between well locations.

Table 5.4 ACE Project Generic Predrill Well Design

Hole Size (in)	Casing Size (in)	Description	Approximate Setting Depth (TVD BRT) (m)	Drilling Mud System	Disposal Route of Drilling Muds/Cuttings
42	30	Conductor	+/-350	Seawater and gel sweeps	Discharge to sea at seabed
28	24	Drilling Liner	+/-570	WBM	Discharge to sea via rig cuttings chute or via hose
26	20	Surface	+/-850		
20	16	Intermediate Liner	1,300 - 1,500	SOBM or LTMOBM	Ship to shore
17	$13^3/_8$	Intermediate	2,000 - 2,300		
$13^1/_2$	$9^5/_8$	Production	Top Reservoir (2,500 - 3,000)		

Figure 5.5 Generic ACE Predrill Well Casing Design



5.3.2.2 Drill String Lubrication

Prior to the start of any drilling activities, the rig crew will apply pipe dope to the internal surfaces of the drilling string joints to prevent thread damage. Pipe dope is a lubricating grease which prevents the joints from becoming stuck together under high torque conditions. It is anticipated that a heavy metal free dope will be primarily used for this purpose with a small volume of heavy metal dope used for certain operations, including tubing connections and associated completions for reliability and safety reasons. Pipe dope of the same or equivalent environmental performance to those currently used and approved within the region will be used for the project. It is expected that trace amounts of pipe dope will be discharged to sea during the drilling of conductor and top hole sections with seawater, PHB sweeps (42" hole sections) and WBM (28" and 26" hole sections).

5.3.2.3 Drilling Fluids and Cuttings Generation

Upper 42", 28" and 26" Hole Sections

The 42" hole section of each well will be drilled using a seawater system with drill cuttings discharged directly to the seabed. While drilling, the borehole will be cleaned out using high viscosity sweeps of PHB. The 30" diameter casing will be installed following drilling of the 42" hole section, following which, the 28" and 26" hole sections will be drilled using a different weighted, WBM system, designed to stabilise the borehole and allow an increase in the pressure on the borehole wall. The 24" and 20" casings will be installed after the 28" and 26" hole sections are drilled respectively.

For the upper sections of the wells, it is proposed to use PHB sweeps and a WBM of the same specification and environmental performance as used for previous ACG wells (refer to Chapter 9 for environmental performance/toxicity details). If there is a requirement to change the sweeps/WBM drilling mud composition or to select different drilling fluids for commercial or technical reasons, the ESIA Management of Change Process (see Section 5.13) will be followed.

Table 5.5 presents a summary of the total expected chemical composition of the 42", 28" and 26" hole section drilling fluids to be used per hole section.

Table 5.5 Estimated Use of WBM Drilling Chemicals Per Hole – 42", 28" and 26" Sections

Chemical	Composition	Function	Estimated Use per Hole (tonnes)[1]			Hazard Category[2]
			42"	28"	26"	
Bentonite	Clay ore	Viscosifier and removal of cuttings	20	10	10	E
Sodium Bicarbonate	Sodium bicarbonate	pH treatment and calcium ion separation	1	1		E
Fluorescein	Fluorescent dye	Cement tracer	0.1			GOLD
Barite	Barium sulphate ore	Weighting agent		150	50	E
KCL	Potassium chloride	Borehole stabiliser		10	5	E
Ultrahib	Polyether amine	Stabiliser / shale iInhibitor		2	1	GOLD
Polypac	Polyanionic cellulose	Encapsulater		0.2	0.1	E
Flo-Trol	Cellulose polymer/ Modified starch	Fluid loss control and reduces the risk of drill string sticking		0.2	0.1	E
Duo-Vis	Bio-polymer	Viscosifier		0.3	0.2	GOLD
UltraFree	Synthetic alyphatic hydrocarbon	Lubricant, prevents bit balling		2	1	GOLD
Ultracap	Polymer	Encapsulator		2	1	GOLD
Citric acid	Citric acid	pH treatment and calcium ion separation		0.5	0.2	E

Notes:
1. Volumes will depend on the actual subsurface conditions encountered; as such these volumes are best estimates based on previous experience.
2. Two methods of hazard assessment are used in accordance with internationally recognised practice - CHARM and Non CHARM. The CHARM Model is used to calculate the ratio of predicted exposure concentration against no effect concentration (PEC:NEC) and is expressed as a Hazard Quotient. Hazard Quotients are assigned to 1 of 6 categories and "GOLD" is the least hazardous category. Those chemicals that cannot be modelled by CHARM are assigned to a category (A to E) based on toxicity assessment, biodegradation and bioaccumulation potential. Category E is the least harmful category. Source: CEFAS, Offshore Chemical Notification Scheme - Ranked Lists of Notified Chemicals, Updated 17th April 2018. Full details of the determination of hazard categories can be found in Appendix 5B.

The WBM and cuttings from the 28” and 26” hole sections will be returned to the MODU using a riserless Mud Recovery System (MRS). The riserless MRS consists of a subsea pump located on the seabed with a wellhead adapter which allows the attachment of hoses to the wellhead outlet valves. The seabed pump sucks WBM from the wellhead and returns it, along with cuttings, to the MODU via a series of hoses. The mud and cuttings will then be treated in a solids control unit, separating mud from the cuttings onboard the MODU.

However, if as a result of shale hydration, the MRS hoses become blocked then excess mud will be pumped out of the top of the wellhead and discharged at the seabed, similar to the 42” hole section. Discharge at the seabed may also occur if there is a sudden flow of sands or fluids from the well onto the seafloor, known as shallow flow. This would be controlled by pumping mud at a high rate down the well causing the discharge of excess mud at the seabed. This would be undertaken for safety reasons as the MRS system does not have a well control capability[1].

The intention is not to routinely discharge WBM at the seabed, but if a blockage of the MRS hoses occurs during drilling of the 28” or 26” hole sections, then WBM will be discharged while the hoses are cleared. It is not possible to shut down the MRS while the blockage is cleared as it is necessary for any rock cuttings in the hole to be removed to avoid the drillstring becoming stuck.

It is anticipated that it will take approximately 10-15 minutes to restore the MRS and depending on the stage of drilling, the discharge volume would vary between 13-62m^3.

WBM cuttings will be discharged below the sea surface from the MODU cuttings chute or a discharge hose in accordance with applicable PSA requirements[2]. It is anticipated a hose of 6” diameter and at 25m above sea bed may be used.

It is not possible to preserve the separated WBM to allow for shipping to shore or other drilling rigs/platforms upon completion of drilling the 28” and 26” hole sections. When drilling of the 28” and 26” hole sections is completed residual mud will be discharged to sea in accordance with PSA requirements[2]; the total quantities for the ACE Project are summarised in Table 5.7 below.

Lower 20”, 17” and 13 ½” Hole Sections

To improve well bore stability, ensure appropriate lubrication, inhibit potential reactions with the shale sequence present in the Contract Area and minimise the risk of stuck pipe, it will be necessary to change to a Synthetic Oil Based Mud (SOBM) or Low Toxic Mineral Oil Based Mud (LTMOBM) for the 20”, 17” and 13 ½” lower hole sections. The density of the drilling mud system will be monitored and adjusted by the addition of chemicals according to the down-hole conditions. The density and chemical composition of the SOBM/LTMOBM will be dependent on the actual well conditions encountered during drilling operations.

Table 5.6 presents the typical composition and estimated volumes of SOBM/LTMOBM expected to be used per hole.

[1] Well control equipment is not installed at this stage to mitigate against weak formation.
[2] There shall be no discharge of drill cuttings or drilling fluids from the MODU if the maximum chloride concentration of the drilling fluid system is greater than 4 times the ambient concentration of the receiving water.

Table 5.6 Estimated Use of SOBM/LTMOBM Drilling Chemicals Per Hole – 20", 17" and 13 ½" Lower Hole Sections

Chemical	Composition	Function	Estimated Use per Well (tonnes)[1]	Hazard Category[2]
			All lower hole sections	
Barite	Barium sulphate ore	Weighting agent	500	E
Calcium Chloride	Calcium chloride	Borehole stabiliser	80	E
Ecotrol	Polymer	Fluid loss control and reduces the risk of drill string sticking	5	*
Lime	Calcium hydroxide	Alkalinity, calcium ion treatment	3	E
Suremul EH	Emulsifier	Emulsifier	30	C
Surewet	Surfactant	Wetting agent for drill solids and barite	5	D
Rheflat	Alkenes/Fatty Acid	Rheology modifier	0.2	*
Rhethik	Oxybisethanol/ Diethylenetriamine	Viscosifier	4	*
Rhebuild	Propylene Carbonate	Viscosifier	0.1	C
Escaid 110	Aliphatic Hydrocarbon mixture	Base fluid	534	C
Versatrol	Gilsonite/Lignite	Fluid Loss Additive	20	D
G Seal	Graphite	Lost Circulation Material	16	E
VG Plus/VG Supreme	Treated Bentonite	Viscosifier	18	E

Notes as per Table 5.5
* Not currently listed into UK Offshore Chemical Notification Scheme (OCNS) Ranked Lists of Notified Products

Used SOBM/LTMOBM and associated cuttings will be returned to the MODU via the marine riser, installed after the 20" diameter casing has been cemented in place. Onboard the MODU, mud and cuttings will pass through the MODU Solids Circulation System (SCS) that separates SOBM/LTMOBM from cuttings via a series of shale shakers, a vacuum degasser and centrifuges, which in turn, separate increasingly smaller cutting particles from the mud. Separated SOBM/LTMOBM will be reused where practicable, and the remainder returned to shore for disposal. SOBM/LTMOBM associated drill cuttings will be contained in dedicated cuttings skips on the rig deck for subsequent transfer to shore for treatment and final disposal. It is not planned to release any SOBM/LTMOBM or associated cuttings into the marine environment.

5.3.2.4 Summary of Mud and Cuttings

Table 5.7 presents the estimated quantities of waste drilling fluids and cuttings for each well hole section (based on the experience of the project engineers and the diameter and length of each well section) and the planned disposal route.

Table 5.7 Estimated Well Cuttings and Mud Volumes Per Hole

Hole Size (Drill Bit Diameter)	Description	Estimated Fluids Discharged (Tonnes)[1,2]	Estimated Cuttings Discharged (Tonnes)	Estimated Cuttings Shipped to Shore (Tonnes)	Estimated Fluids Shipped to Shore (Tonnes)	Drilling Fluid/ Mud System	Cuttings and Mud Disposal	Duration of Discharge (hours)
42"	Conductor Holes	42	730	-	-	Seawater & PHB sweeps	At seabed	8
28" & 26"	Surface Holes	550	306	-	-	WBM	To sea via cuttings chute / hose. Plan to use MRS to recover mud	35
	Residual Mud at end of WBM drilling	239	N/A	-	-		To sea via cuttings chute / hose	12
20",17" and 13 $^1/_2$"	Lower Holes	No planned discharge		600	1400	SOBM/ LTMOBM[3]	Ship to shore	-

Notes:
[1]The WBM chemical usage includes water. Currently WBM is not stored for reuse. Untreated WBM is not stable over extended periods without additions of viscosifier and biocide.
[2] Note that estimates of WBM discharged is not equivalent to the estimated volumes of chemical used as per Table 5.4. This is because allowance is made for mud volumes left behind in casings.
[3] Estimated volume of SOBM/LTMOBM shipped to shore is conservative as it excludes mud volumes left behind in the well following casing, attached to the cuttings shipped to shore and the SOBM/LTMOBM returned to shore for reuse on subsequent wells.

5.3.2.5 Casing and Cementing

Once each hole section is drilled, a steel casing string will be installed and cemented into place. The casing provides structural strength for the well and is cemented into place by pumping cement slurry into the well bore. The cement passes around the open lower end of the casing and into the annulus between the casing outer wall and the host rock formation in the case of the top-hole conductor. For subsequent casings, the cement passes between the casing outer wall and inner wall of the previous casing. For the surface casing string and drilling liner, some loss of cement to the seafloor usually occurs when completing the casing cementing as a result of needing to ensure the casing is fully cemented to the seabed to prevent the well and specifically the conductor section from becoming unstable and potentially failing. Cement losses per well are estimated to occur over approximately 1 hour per hole**.**

The volume of cement used to cement each casing is calculated prior to the start of the activity. Sufficient cement is used to ensure that the casing is cemented securely and necessary formations isolated so that this safety and production critical activity is completed effectively while minimising excess cement discharges to the sea. However, at the end of cementing each casing string excess cement will remain in the MODU cement system. It is not technically practicable or safe to recover this. Excess cement remaining in the cement system will be mixed with seawater and discharged to the marine environment following the cementing of each casing. The discharge of dilute cement slurry is estimated to take approximately an hour at a rate of 78m^3 per hour. Excess cement from well cementing will be discharged to sea via the cement unit hoses. Dry cement will not be discharged to the marine environment under routine conditions.

Table 5.8 below presents the estimates of the worst-case volume discharged to the seafloor during casing cementing and from the drilling rig to sea during wash out of the cement unit. The estimated discharges of each cement chemical, and the associated hazard categories, are presented in Appendix 5C.

Table 5.8 Estimated Discharge of Well Cement Chemicals per Hole During Cementing and Cement Unit Wash Out

Activity	Discharge Route	30” Casing	24” Liner	20” Casing	16” Liner	13 $^{3}/_{8}$” Casing	9 $^{5}/_{8}$” Liner
		Estimated Discharge per Casing/Liner (tonnes)[1]					
During casing/ liner cementing	To seafloor	33.9	4.3	-	-	-	-
During cement unit wash out[1]	To sea (via cement unit hoses)	1.4	2.1	2.3	1.8	1.6	1.6
Note 1. Discharge comprises cement and water at a ratio of approximately 1:10.							

5.3.2.6 Drilling Hazards and Contingency Chemicals

A number of contingency chemicals will be retained for use in the event that hazards are encountered during drilling, predominantly associated with downhole mud losses which may pose a risk due to the relationship between the pore pressure and the rock strength. Well paths are deliberately chosen to avoid zones of excessive pore pressure, where the pore pressure approaches the fracture pressure of the rock. The mud weight required to stabilise the borehole effectively fractures the rock and results in downhole losses. To prevent this, Loss Control Materials (LCM) can be added to the mud system.

Table 5.9 lists the anticipated chemicals intended to be stored on the rigs, used in the event of contingencies when drilling. By definition the extent of the use of contingency chemicals cannot be predicted with accuracy, although their use will be minimised to the extent practicable in accordance with operational needs and safety considerations.

Table 5.9 Estimated Usage of Drilling Contingency Chemicals per Hole

Chemical Trade Name	Function	Estimated use per Hole (tonnes)[1]	Hazard Category[2]
G-Seal	Stress cage application	13	E
Durcal 130	Stress cage application	13	*
Safecarb Z3	Stress cage application	7	E
Safecarb Z4	Stress cage application	7	E
Starcarb	Calcium carbonate – LCM	5	E
Nutplug	LCM /Cement scouring pill	1	E
M-I-X II	LCM	4	E
Guar Gum	Gel sweeps	4	E
Notes as per Table 5.5. * Not currently listed into UK OCNS Ranked Lists of Notified Products.			

Contingency chemicals are planned to be used during lower hole drilling and will be recovered with the SOBM/LTMOBM and shipped to shore for disposal.

5.3.3 Well Displacement

Displacement of the ACE Project wells will be achieved by circulating a number of fluid slugs or “pills”. The function of the displacement pills (lighter synthetic mud sweeps) is to displace any SOBM/LTMOBM from the well. Table 5.10 details the chemicals and fluids planned to be stored on the rig and used for well displacement[3].

[3] The ACE Management of Change Process (Section 5.13) will be followed should alternative chemicals be required.

Table 5.10 Estimated Well Displacement Chemicals

Chemical/Fluid	Function	Estimated Use (tonnes)[1]	Hazard Category[2]
1.46 SG Brine	Weighted circulation fluid	12.5	N/A
SAFE-VIS OGS (@7ppb)	Viscosifier	0.2	*
Sodium Bromide	Brine additive	0.75	E
Hydroxyethylcellulose (HEC) Pill**			
1.35 SG Brine	Weighted circulation fluid	35	N/A
Drill water	Circulation fluid	6	N/A
SAFE-VIS OGS(@7ppb)	Viscosifier	0.8	*
CCT®3000D Hi-Vis Pill			
1.46 SG Brine	Weighted circulation fluid	13	N/A
Drill water	Circulation fluid	3.5	N/A
RX03X	Detergent	2.5	D
SAFE-VIS OGS	Viscosifier	0.1	*
CCT®3000D Wash Pill			
1.46 SG Brine	Weighted circulation fluid	22	N/A
Drill water	Circulation fluid	8	N/A
RX03X	Detergent	4	D
Casing Tail Spacer			
1.46 SG Brine	Weighted circulation fluid	7	N/A
Drill water	Circulation fluid	4	N/A
SAFE-VIS OGS	Viscosifier	0.05	*
Notes as per Table 5.5. * Not currently listed into UK OCNS Ranked Lists of Notified Products. ** Hydroxyethyl Cellulose (HEC) rated as E under UK OCNS Ranked Lists of Notified Products.			

It is planned that displacement chemicals will be circulated back to the MODU with the SOBM/LTMOBM and either be reused/recycled or will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures. It is not planned to discharge displacement chemicals or fluids to the marine environment under routine conditions. Solids collected within the MODU separator during well displacement will be collected and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

5.3.4 Blowout Preventer

5.3.4.1 BOP Operation

A blowout preventer (BOP) will be installed on all predrill wells to control pressure in the well prior to suspension and subsequent tie-in to the platform. The BOP control system uses hydraulic fluids to actuate the BOP valves. The response time between activation and complete function is based on the BOP valve closure and seal off time. For subsea installations, the BOP control system should be capable of closing each ram BOP in 45 seconds or less. Closing times should not exceed 60 seconds for annular BOPs. In order to comply with these response times, it is necessary to discharge small volumes of hydraulic fluid to sea; this design and practice is used in all BOP installations worldwide.

The BOP fluid comprises a proprietary control fluid (Stack Magic ECO Fv2), ethylene glycol and water. The active components of Stack Magic ECO Fv2 and the typical proportions of this product, ethylene glycol and water in the BOP fluid as a whole are summarised in Table 5.11.

Table 5.11 Percentage Composition of Control Fluid and BOP Fluid

Control Fluid	Percentage (%)	BOP Fluid	Percentage (%)
Ethylene glycol	10-25	Control Fluid	3-5
Ethanolamine	2.5-10	Ethylene glycol	5-25
Triazine	2.5-10	Water	70-97
Neutralised Ethanolamine	2.5-10		
Trimethylhexanoic Acid	1-2.5		
Triethanolamine	1-2.5		
Water	35-80.5		

It is anticipated that BOP testing will take place weekly for each well from when the BOP is installed to the end of well suspension activities (approximately 100 days for the first well and 50 days for the subsequent wells). On alternate weeks, either function testing (one pod) or full function/pressure testing (two pods) will be carried out. Table 5.12 summarises individual discharge events and the estimated volume discharged per event for two pod full function/pressure testing. Discharges from single-pod flushing will be 50% of the volumes and durations indicated in Table 5.12.

Table 5.12 Summary of BOP Fluid Discharge Events Per Well – Two Pods

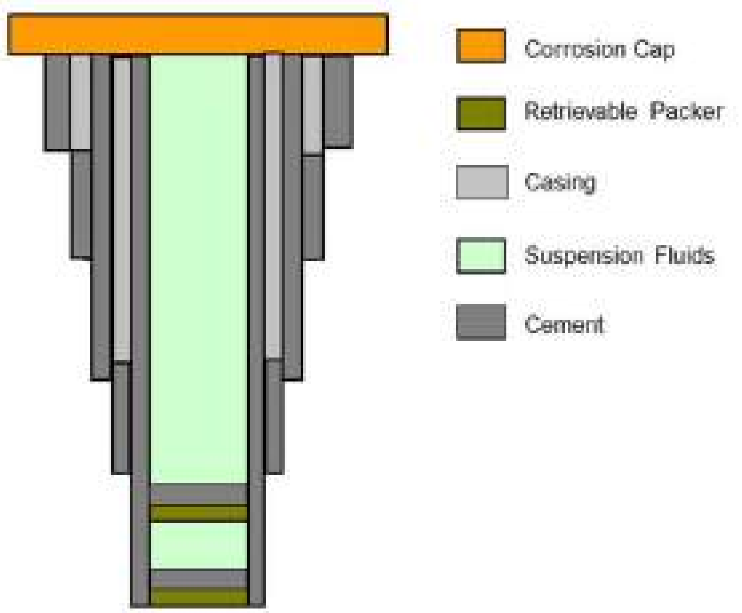
BOP Function	Volume (litres)	Duration (min)	Depth	Frequency
Upper Annular	654	3.00	Approximately 8m above seabed	Fortnightly – 2 pod test
Lower Annular	644	3.00		
Upper Pipe Ram	260	1.16		
Middle Pipe Ram	264	1.16		
Lower Pipe Ram	70	1.16		
Upper Outer Choke (U.O.C) line	20	0.57		
Upper Inner Choke (U.I.C) line	20	0.57		
Lower Outer Choke (L.O.C) line	20	0.57		
Lower Inner Choke (L.I.C) line	20	0.57		
Upper Outer Choke (U.O.K) line	20	0.57		
Upper Inner Kill (U.I.K) line	20	0.5		
Lower Outer Kill (L.O.K) line	20	0.5		
Lower Inner Kill (L.I.K) line	20	0.5		
Total	**2,052**	**13.8**		

5.3.5 Well Suspension

Following drilling, casing, cementing and displacement, the well is temporarily suspended by introducing treated brine, which will protect it from any pressurised formations. It is anticipated that calcium bromide, calcium chloride or sodium chloride brine will be used, depending on the downhole conditions of each well in addition to LTMOBM. It is not planned to discharge well suspension fluids to sea except in the case of emergency (e.g. presence of elevated levels of hydrogen sulphide (H_2S)).

The well will be isolated using mechanical packers, which isolate the zones within the well, and a corrosion cap is installed on the subsea wellhead. The purpose of the cap is to seal the well until the ACE platform is in place and the wells can be re-entered for completion. It is not planned to re-enter any wells from the MODU unless there is an emergency event (such as elevated H_2S presence in the well). Figure 5.6 shows the suspended well.

Figure 5.6 Suspended Well



5.3.6 MODU Drilling Emissions, Discharges and Waste

5.3.6.1 Summary of Emissions to Atmosphere

Table 5.13 summarises the GHG (i.e. CO_2 and CH_4[4]) and non GHG emissions predicted for the ACE MODU predrilling activities. Key sources include:

- MODU engines and generators; and
- MODU support / supply vessel engines.

Table 5.13 Estimated GHG and Non GHG Emissions Associated with Routine and Non Routine Predrilling Activities

	MODU	Support Vessels	TOTAL
CO_2 (ktonnes)	15	38	**53**
CO (tonnes)	73	94	**168**
NO_x (tonnes)	278	694	**972**
SO_x (tonnes)	0	1	**2**
CH_4 (tonnes)	1	3	**4**
NMVOC (tonnes)	9	28	**38**
GHG (ktonnes)	15	38	**53**
See Appendix 5A for detailed emission estimate assumptions.			

5.3.6.2 Summary of Discharges to Sea

Table 5.14 provides a summary of the total estimated routine and non routine drilling fluid, cuttings and cement discharges to sea across the ACE Project predrill programme associated with planned activities.

Table 5.14 Estimated Drilling Fluids and Cement Discharges to Sea

Discharge	Frequency	Location	Estimated Volume (tonnes)	Discharge Composition
Seawater, PHB sweeps and cuttings	During 42" hole section drilling	Seabed	4380 cuttings and 252 drilling fluids	Refer to Table 5.5
WBM and cuttings[1]	During 28" and 26" hole section drilling	To sea (via cuttings chute or hose)	1836 cuttings and 3300 drilling fluids	Refer to Table 5.5
Cement and cement chemicals	During surface casing and drilling liner casing cementing	Seabed	229	Refer to Appendix 5C
Residual WBM	At end of 26" hole drilling	To sea (via cuttings chute or hose)	1434 drilling fluids	Refer to Table 5.5
Residual cement	At the end of each casing section	To sea (via cement unit hoses)	64	Refer to Appendix 5C
Note 1. Should the MRS fail or it becomes technically impractical or unsafe to use it, WBM and cuttings from the 28" and/or 26" hole sections will be discharged directly to the seabed.				

Discharges of hydraulic fluids to sea due to testing of the BOP are detailed in Section 5.3.4 above.

5.3.6.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non hazardous and hazardous waste generated during the ACE Project predrilling programme are provided in Table 5.15. Waste quantities have been estimated based on operational data from the other ACG predrilling programmes including for the Chirag Oil Project (COP) predrill wells.

All waste generated during MODU predrilling activities will be managed in accordance with the existing AGT waste management plans and procedures. The planned destination of each waste stream is provided within Section 5.11.2 below.

[4] To convert to CO_2 equivalent the predicted volume of CH_4 is multiplied by a global warming potential of 25.

Table 5.15 Estimated Hazardous and Non Hazardous Waste Associated with Predrilling Activities

Classification	Physical form	Waste stream name	Estimated quantity (tonnes)
Non hazardous	Solid wastes	Domestic/office waste	121
		Metals - scrap	80
		Paper and cardboard	0.3
		Plastic- recyclable (HDPE)	3
		Wood	19
		Total (Non hazardous)	**223**
Hazardous	Solid wastes	Cement	54
		Batteries - dry cell	0.03
		Batteries - wet cell	4
		Filter bodies	2
		Lamps/tubes – mercury vapour	0.2
		Oily rags	38
		Toner or printer cartridges	0.2
	Liquid wastes	Drilling muds SOBM/LTMOBM	8400
		Drilling cuttings SOBM/LTMOBM	3600
		Drilling chemicals	7
		Drilling cuttings WBM - contaminated	18
		Drilling muds WBM - contaminated	
		Oils - fuel	78
		Paints and coatings	1
		Sewage - untreated	29
		Water - oily	1079
		Total (Hazardous)	**13306**

5.4 Onshore Construction and Commissioning of Offshore Facilities

5.4.1 Introduction

It is currently planned to undertake fabrication of the ACE jacket and topside as well as elements of the subsea infrastructure in Azerbaijan. The tender process for the selection of the construction contractors is planned for completion by the end of first quarter of 2019. It has been assumed for the purposes of this ESIA, that a combination of the following construction yards may be used:

- Baku Deep Water Jacket Factory (BDJF) yard[5]: Used extensively during the ACG Projects. It is planned that the jackets and elements of the subsea equipment will be constructed at the BDJF yard;
- Construction yards located on the western fringe of the Bibiheybat oil field: Either in the South Dock[6] or Bayil yard previously used to construct the ACG DWG-PCWU, Central Azeri Compression and Water Injection (CA-CWP), West Chirag (WC) and Shah Deniz Stage 2 (SD2) offshore facilities[7]; and
- Pipe coating and storage yard.

No major upgrades or modifications at the potential construction yards to be used for the ACE Project have been identified to date.

5.4.2 Materials Transportation

Preference will be given to source equipment and materials which meet the required project specifications from Azerbaijan wherever possible, including utilising suitable in-country surplus material. Where international procurement is required, materials and equipment (including prefabricated components/modules) will arrive by road, rail, sea and air using the transportation routes established for the previous ACG and SD construction programmes.

Goods arriving via sea can travel by two main routes. From the Mediterranean and Black Sea, vessels must pass through the Don-Volga canal system. Cargoes following the Baltic Sea route,

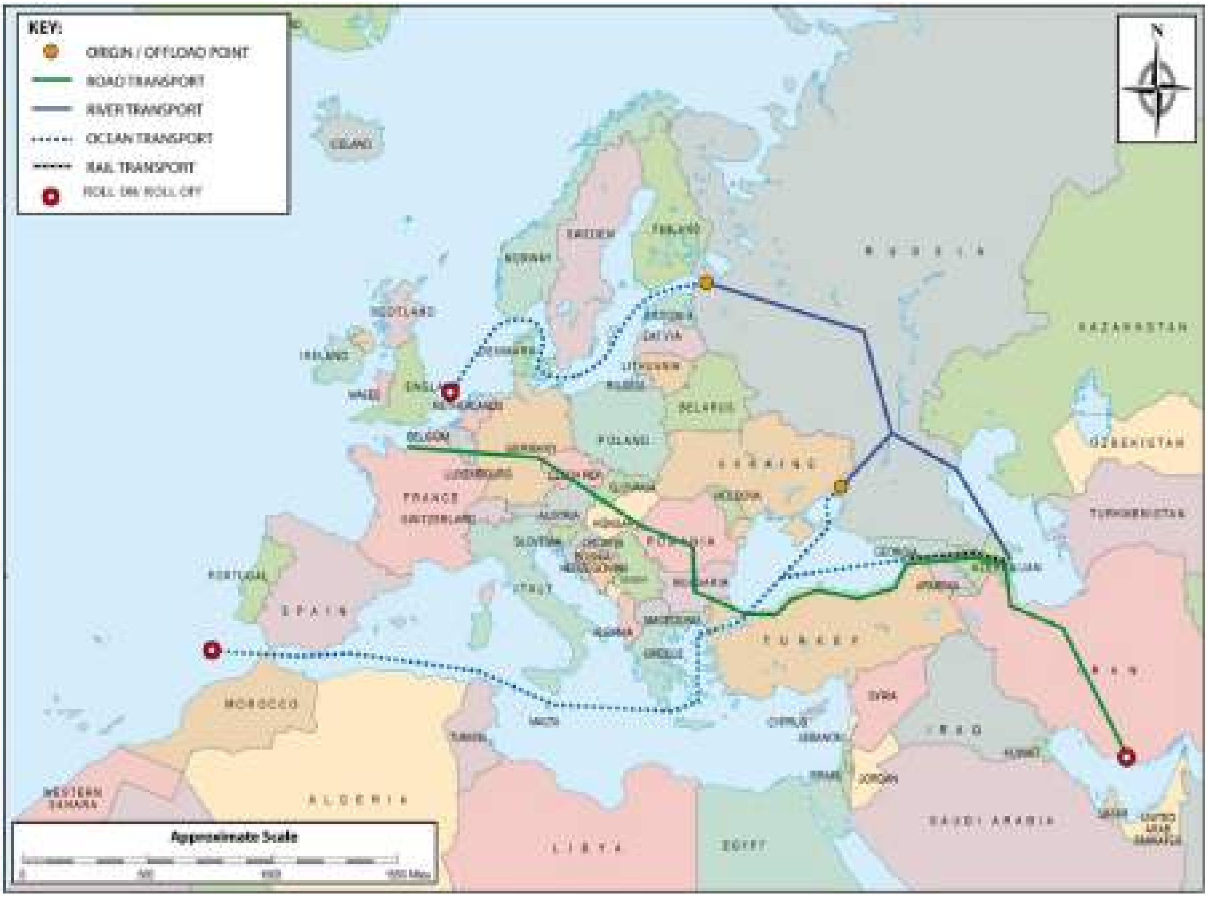
[5] Referred to in previous ACG Project ESIAs as Shelfprojectsroi (SPS).
[6] Operated by the Caspian Shipyard Company (CSC).
[7] Formally known as the Amec-Tekfen-Azfen (ATA) yard

would be transhipped at St. Petersburg and travel along the Baltic-Volga system. These routes are not available during the ice season (November - April).

Rail links are available from Poti in Georgia and Riga in Latvia. Deliveries by road from Europe would be through Turkey and Georgia and via Iran. Figure 5.7 illustrates potential transport routes.

While available transport routes can be identified, the likely use of each and what will be transported cannot be determined with any certainty until the procurement strategy and award of construction contracts has been made.

Figure 5.7 Import Routes to Azerbaijan



5.4.3 Subsea Infrastructure and Pipelines

Materials to fabricate the elements of the subsea infrastructure to be constructed in country (which are planned to include a number of the tie-in spools, the oil Non Return Valve (NRV) and gas Subsea Isolation Valve (SSIV), the oil and gas wye structures and the Plug Retrieval Isolation Structure (PRIS)) associated with the oil pipeline will be received at the selected onshore subsea component fabrication facility. Fabrication activities will include cutting, welding, applying a corrosion coating and non-destructive testing (NDT).

The current base case is to import line pipe, spool pipe and bends to Azerbaijan and undertaking coating and NDT at the applicable selected construction yard. Hydrotesting of ACE subsea spools and structures within the yard will be undertaken using freshwater supplied from a tank, with the water returned to the tank following use. Following hydrotesting, it is planned to prefill all subsea structures and spools with seawater dosed with preservation chemicals in the yard prior to installation offshore. The preservation chemicals to be used, together with the associated dosage, is provided within Section 5.6.2.2 below.

5.4.4 Jacket and Piles

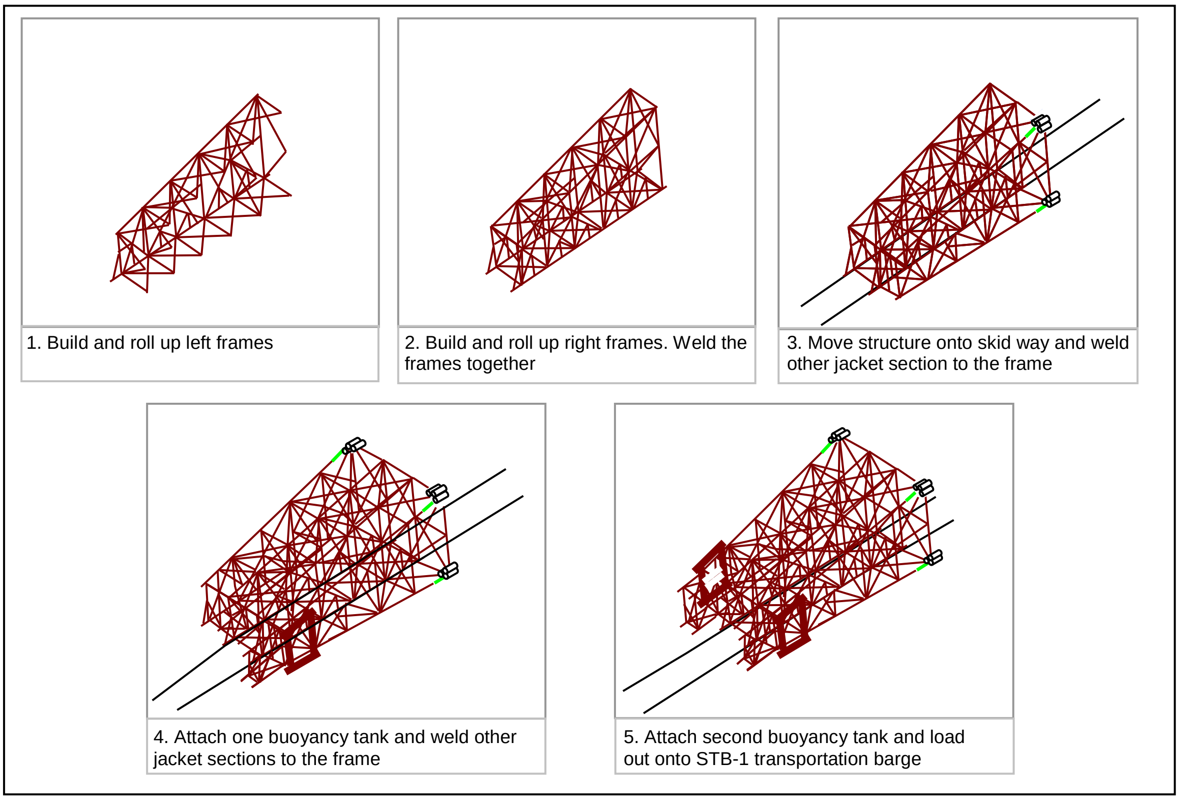
The ACE jacket, an 8 legged, braced, steel structure will support the topside and will be designed for installation over the pre-installed drilling template and the four pre-installed jacket pin piles. The jacket structure will be approximately 155m tall, extending approximately 18m above the sea surface. The top of the jacket will be a “twin tower” configuration to enable “float over” installation of the topside deck. The design of the base will incorporate 3 pile sleeves at each of the 4 corners into which 12 skirt piles will be driven.

To construct the jacket, steel plate received at the fabrication yard will be cut and shaped as required and then welded together with any prefabricated elements that are not constructed in country, to form the various sectional pieces. Section and weld joints will be integrity tested using NDT prior to grit blasting in preparation for painting.

The majority of grit blasting and anti-corrosion painting of jacket and pile components will be undertaken in a paint shop with a fume extraction and grit recovery system in place. Grit blasting and anti-corrosion painting of sections which are too large to be accommodated within a paint shop will be undertaken within a temporary enclosure. Waste grit and paint will be collected and disposed of in accordance with existing AGT waste management plans and procedures (see Chapter 14). Cathodic protection will be provided with the active anode material comprising an aluminium-zinc-indium type alloy. Onshore hydrotesting of the risers will be undertaken using freshwater supplied from a tank, with the water returned to the tank following use. The jacket sections will then be transferred to the assembly skidway, where they will be crane lifted into position and welded to other jacket sections to form the complete structure.

Two buoyancy tanks will be placed on either side of the jacket (see Section 5.5.2 below). The current plan is to reuse the ACG Phase 2 tanks, which will be cleaned and integrity checked using ultrasonic inspection. Figure 5.8 shows the various stages of jacket fabrication.

Figure 5.8 Jacket Fabrication Process



During jacket installation, a number of the buoyancy tank compartments will be flooded to ensure stability of the jacket during installation, using approximately 2,500m^3 of seawater for each tank.

Following installation of the jacket the buoyancy tanks will be emptied and then towed back to the shore for re-use or disposal.

The 4 jacket pin piles (each 96" diameter and approximately 118m in length) and 12 jacket skirt piles (each 96" diameter and approximately 143m to 165m in length) will be assembled, inspected and tested at the construction yard in a similar manner to the jacket.

5.4.5 Drilling Modules

The ACE drilling module elements will be constructed in country. The Modular Drilling Support Module (MDSM), Drilling Derrick and Drilling Equipment Set (DES will be constructed up to mechanical completion over approximately 20 months at the selected drilling module construction yard (anticipated to be the Bayil Yard). Activities within the yard will predominantly include cutting, shaping, erecting and welding of steel, pipefitting, grit blasting and painting of steel and pipework in dedicated paint shops. Once mechanical completion has been achieved, the MDSM and DES will be installed into a predetermined location on the topside.

Following installation onto the topside, onshore testing, pre-commissioning and operator training of the drilling module is expected to take approximately 8 months.

5.4.6 Topside

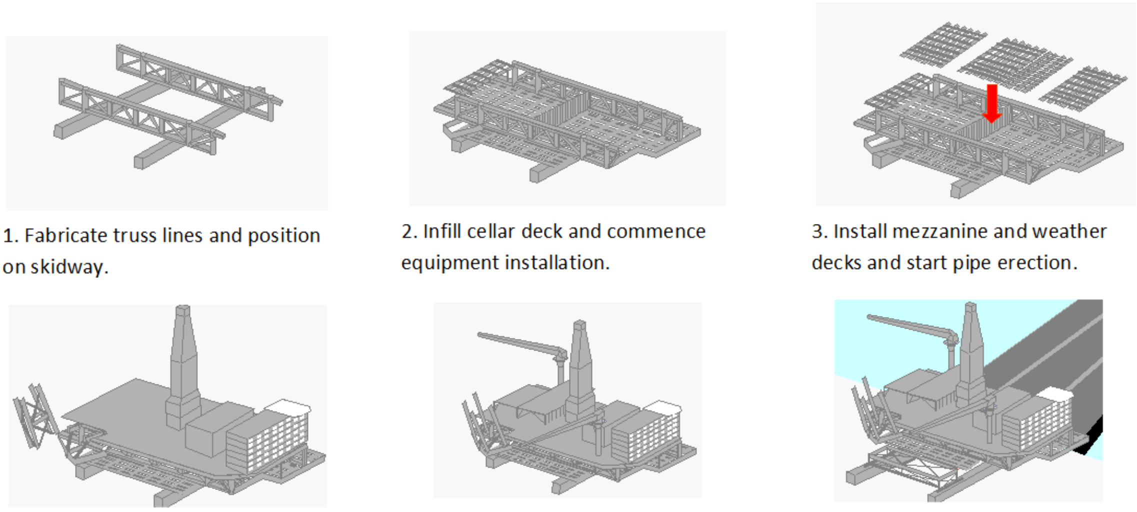
The ACE topside will be a steel structure erected from steel girders, steel stanchions, trusses and cross beams, which form and enclose decks and modules. Equipment, both electrical and mechanical, will be installed into the topside modules. The ACE topside will comprise a series of major equipment packages assembled into an integrated deck, comprising a sub-cellar deck, cellar deck, mezzanine deck, upper and weather deck. This will support the following:

- Living Quarters;
- Power Generation Skid;
- Modular Drilling Support Module;
- Mast Equipment Package including the Drilling Derrick;
- HP/LP Cooling and Separation System;
- Gas Compressor System;
- Pig Launchers;
- Chemical Injection Package
- Gas Lift and Injection Manifold;
- Flare;
- Oil Export Pumps;
- Drilling Bulk Storage;
- Wellbay Module;
- Equipment Room;
- Emergency Shutdown and Evacuation Systems;
- Switchroom Module; and
- Utility Systems.

The main topside structure and decks will be fabricated at the selected topside construction yard. Prefabricated and imported components and modules will either be transported from international fabrication yards or fabricated in other Baku construction yards.

Steel plate will be cut, shaped and welded to form the topside structural elements. The sections will then be grit blasted and painted with anti-corrosion paint. Prefabricated utility and process equipment will be lifted into place using cranes, installed into the structural frame, secured and then fitted with power and piping connections as required. A single flare boom structure for the offshore platform, comprising a steel lattice frame structure, will be attached to the integrated deck in the construction yard. All deck frame and component weld joints will be tested using NDT methods. Figure 5.9 shows the general topside construction approach.

Figure 5.9 Topside Fabrication Process



1. Fabricate truss lines and position on skidway.
2. Infill cellar deck and commence equipment installation.
3. Install mezzanine and weather decks and start pipe erection.
4. Install drilling modules, derrick, living quarters and power generation.
5. Install separation module, complete equipment, piping and cable installation.
6. Jack up and install loadout and installation frame ready for loadout onto barge.

5.4.7 Testing and Pre-Commissioning

The topside module elements including processing equipment and utilities will be tested onshore and where practicable, pre-commissioned. Testing will include hydrotesting of pipework and/or pressurised gas tests (using nitrogen with a 1% helium trace for detection). Onshore hydrotesting of the topside will be performed using freshwater which will be reused where possible. If the water cannot be reused onsite, it will be discharged to the site sewer network (if relevant discharge standards are met), used for dust suppression onsite (if required and if relevant standards are met) or disposed of offsite by a licensed AGT Region approved contractor. If chemical dosing of the water is identified as being required e.g. for corrosion protection, a risk assessment will be undertaken to confirm the appropriate discharge route. Preference will be given to selection of chemicals already approved for this purpose.

5.4.8 Topside Commissioning

All topside utilities will be fully commissioned, where practicable, at the construction yard over an approximate 12 month period including a number of systems associated with the living quarters e.g. the sewage treatment plant (STP). The living quarters will be provided with power from the temporary generators in the yard for a period of 3 months (refer to section 5.4.8.3 below). Effluent and waste generated from commissioning activities (including sewage) will be contained and managed in accordance with the existing AGT management plans and procedures.

Partial commissioning (comprising system testing) of the platform process systems will also be undertaken where possible, including:

- The fuel gas system;
- The oil export pumps;
- The flare system;
- The flash gas compression system;
- The gas injection compression system;
- Chemical systems; and
- Sand separation units.

These systems will be fully commissioned once in place offshore.

5.4.8.1 Seawater System

During onshore commissioning, seawater will be supplied to the topside via a temporary seawater lift system from the quayside. The seawater system will be designed to operate at a flow rate of approximately $575m^3$/hr for a period of up to 6 - 9 months and will be of a similar design to that approved for previous ACG projects. Seawater will be abstracted from the construction yard quayside and discharged back to the sea after use. The design and operation of the seawater/cooling water system has been reviewed and confirmed that the temperature at the edge of the cooling water mixing zone (assumed to be 100m from the discharge point) will be no greater than 3 degrees more than the ambient water temperature[8].

The seawater system will be designed to incorporate continuous dosing of sodium hypochlorite (a sterilising agent) at a concentration of 2mg/l. The dose rate will be controlled and checked. Prior to discharging the cooling water, a neutralising agent will be added to reduce the chlorine concentration to a safe level (i.e. to <1mg/l residual chlorine). In the event different or additional chemicals are identified to be added to the lifted seawater e.g. for corrosion control the ESIA Management of Change Process (Section 5.13) will be followed.

5.4.8.2 Freshwater System

The freshwater supply system, with a total volume of approximately $120m^3$, is planned to be filled with freshwater dosed with sodium hypochlorite. To ensure that the entire system is adequately sterilised, approximately 2 - $3m^3$ will be expelled via taps and drains, collected and analysed. The system will be sealed once it is confirmed that the target concentration of hypochlorite has been achieved throughout the system.

After sterilisation, the contents of the system will be neutralised and discharged with the cooling water to the Caspian Sea.

5.4.8.3 Diesel Users

The main platform power is a SGT-A35 (G62) dual fuel generator. Onshore commissioning of the generator using diesel is planned to include the generator run intermittently for a week, for up to 8 hours a day at a maximum load of approximately 26%. During commissioning of the compression system and topside utilities, the intention is to run the platform generator intermittently for approximately 6 months. It is also planned to run the compression generator intermittently over an approximate 2-3 week period for up to an hour in the yard. The diesel powered emergency generator, firewater pump engines and platform pedestal cranes are also planned to be commissioned onshore. The cranes, once commissioned, will be available for use for the period that the topside remains onshore.

It is expected that up to two air compressors with air drier packages, two 400V15Kva temporary generators and up to eight 1MW temporary generators will be used at the selected topside construction yard(s) for the duration of the commissioning activities.

5.4.9 Load Out and Sail-away

Once completed, the jacket and topside will each be loaded onto the STB-1 barge at the respective fabrication yards for transportation to the ACE platform location, with sponsons fitted to the barge to increase the vessel's stability prior to loadout.

The jacket will be manoeuvred onto the STB-1 barge and sea fastened by welding members from the jacket to the barge deck. The barge will be ballasted and trimmed to sea-tow condition. Figure 5.10 shows the Deep Water Gunashli drilling, utilities, and quarters (DWG-DUQ) jacket on the transportation barge ready for sail-away. The jacket pin and skirt piles will be transported to site by "wet float", that is, towed in the water behind a tow vessel.

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[8] The ACE ESIA Management of Change Process (Section 5.13) will be followed should any change to the design or operation of the cooling water system be required.

Figure 5.10 DWG-DUQ Jacket During Loadout

The topside will be positioned on a 13m high loadout frame, which will then be moved onto the STB-1 barge. During both jacket and topside sail-away, the barge will be assisted by a number of support vessels. Figure 5.11 shows the EA platform topside on the transportation barge.

Figure 5.11 EA Platform Topside Onboard STB-1 Barge

5.4.10 Onshore Construction and Commissioning – Emissions, Discharges and Waste

5.4.10.1 Summary of Emissions to Atmosphere

Table 5.16 summarises the GHG (i.e. CO_2 and CH_4) and non GHG emissions predicted to be generated during onshore construction and commissioning from key sources which include:

- Construction yard engines and generators (including plant, cranes and onsite vehicles);
- Volatile materials used during construction (e.g. paint and solvents);
- Temporary generators (during commissioning);
- Platform firewater pump engines (during commissioning);
- Platform crane and emergency generators (during commissioning); and
- Platform main generator (during commissioning).

Table 5.16 Estimated GHG and Non GHG Emissions Associated with Routine and Non Routine ACE Onshore Construction and Commissioning Activities

	Jacket and Subsea Construction	Topside Construction and Commissioning	TOTAL
CO_2 (k tonnes)	8	49	57
CO (tonnes)	26	194	220
NO_x (tonnes)	106	777	883
SO_2 (tonnes)	0.2	1.3	1.5
CH_4 (tonnes)	0.3	2.4	2.7
NMVOC (tonnes)	3	32	35
GHG (k tonnes)	8	49	57
See Appendix 5A for detailed emission estimate assumptions.			

5.4.10.2 Summary of Discharges to Sea

Planned routine discharges to the sea during ACE onshore construction and commissioning will be associated with the cooling water system. In total, approximately 575m^3/hr of neutralised seawater is estimated to be discharged to sea over a 6 to 9 month period (See Section 5.4.8.1).

At the construction yards there will be three categories of drainage water:

- **Black and grey water** – black and grey water generated at the construction yard(s) will be collected in onsite sewer pipes and sumps and then either transferred by road tanker or by sewer pipes to a MENR approved sewage treatment plant for treatment and disposal. If the construction yard has an operational sewage treatment plant that discharges treated effluent to the environment, the yard operator will be responsible for agreeing the discharge standard with the MENR and maintaining the discharge permit conditions stipulated by the MENR;
- **Hazardous area drainage** – Drainage water from areas in the construction yard(s) in which hazardous materials are stored and routinely used will be contained and will be collected by road tanker, handled as liquid waste and removed from site. If the yard operator has an agreement with the MENR for discharge of drainage from areas where hazardous materials are storage or used, they will be responsible for maintaining the discharge permit conditions stipulated by the MENR[9], and
- **Storm/rain water drainage** - uncontaminated rainwater will be discharged directly to the onshore or marine environment to prevent flooding and ponding of water onsite.

5.4.10.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non hazardous and hazardous waste that will be generated during onshore construction and commissioning are provided in Table 5.17. These have been estimated based on the waste records for construction of the previous ACG platforms, taking into account the scope of onshore construction associated with the ACE Project.

[9] For discussion regarding spills refer to Chapter 14.

All waste generated during onshore platform and subsea infrastructure construction and commissioning activities will be managed in accordance with the existing AGT management plans and procedures.

Table 5.17 Estimated Hazardous and Non Hazardous Waste Associated with Onshore Construction and Commissioning Activities

Classification	Physical form	Waste stream name	Estimated quantity (tonnes)
Non hazardous	Solid wastes	Domestic/office wastes	4889
		Grit blast	683
		Wood	470
		Metals - scrap	3038
		Paper and cardboard	45
		Plastic- recyclable (HDPE)	31
		Construction rubble	120
		Tyres	3
	Liquid wastes	Oils - cooking oil	30
		Total (Non hazardous)	**9307**
Hazardous	Solid wastes	Adhesives, resins and sealants	1
		Cement	123
		Batteries - dry cell	0.3
		Batteries - wet cell	3
		Clinical waste	2
		Contaminated materials	35
		Contaminated soil and sand	31
		Filter bodies	0.4
		Oily rags	11
		Filter media	16
		Explosives	0.001
		Lamps/tubes - mercury vapour	6
		Pressurised containers	3
		Toner or printer cartridges	3
		Tank bottom sludge	16
	Liquid wastes	Acids	1
		Alkalis and bases	101
		Antifreezes	1
		Oils - fuel	23
		Oils - lubricating oil	115
		Paints and coatings	63
		Sewage - untreated	7165
		Sewage sludge	2498
		Solvents, degreasers and thinners	71
		Biocides and pesticides	0.1
		Drilling additives	0.2
		Fire fighting foam	1
		Water treatment chemicals	3
		Well suspension fluids	76
		Water - hydrotest water	22
		Water - oily	2766
		Total (Hazardous)	**13155**

5.5 Offshore Platform Installation, Hook Up and Commissioning

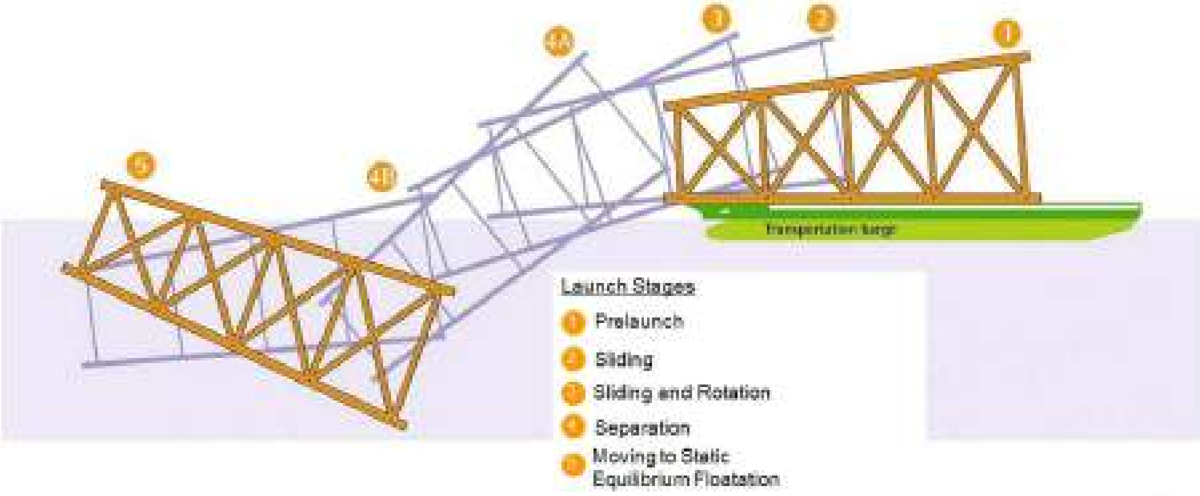
5.5.1 Pre-Installation Surveys

Prior to any installation works, a pre-installation survey will be undertaken along the proposed ACE pipeline routes to identify any potential obstructions which may cause a hazard to the pipelaying operations. A pre-installation survey for the associated subsea infrastructure will either be undertaken as part of the pipeline survey or as an additional survey prior to deployment of the subsea elements and spools to the seabed. The survey of the platform location will be undertaken prior to installing the drilling template and jacket. Where obstacles are identified that may result in a hazard to ACE subsea installation activities, it is planned to move or remove them. In the event that the obstacles identified cannot be cleared from the pipeline routes, the pipelines may be slightly re-routed to ensure safe pipeline installation.

5.5.2 Jacket

Installation of the ACE jacket, scheduled to take approximately 75 days, will follow similar methods as employed for the previous ACG projects with the jacket launched from the STB-1 barge and the anchored DBA crane[10] or Khankendi Subsea Construction Vessel (SCV) used to position and lower the jacket and install the skirt piles. The process followed to unload and position the jacket is shown in Figure 5.12. This involves lifting, positioning, ballasting (using the jacket leg and buoyancy tanks) and setting down the jacket over the pre-installed drilling template and the four pre-installed jacket pin piles.

Figure 5.12 Jacket Installation



The function of the pin piles is to provide temporary foundations for the jacket, until the jacket skirt piles are installed and grouted. Each pin pile will be approximately 118m in length and will be transported to site by “wet float” and installed using the DBA or the SCV. To position the piles for installation, a support vessel will be used to assist the DBA/SCV. The pin piles will be driven into the sediment until they are 4m above the seabed using an underwater hydraulic hammer. It is anticipated that it will take approximately 2.5 days to install each jacket pin pile. Markers on the seabed and a subsea acoustic system will ensure that the pin piles are accurately positioned.

Following set-down of the jacket onto the pin piles, the buoyancy tanks will be removed and hydraulic grippers activated to provide additional stability. The buoyancy tanks will be removed by a combination of seawater ballasting and lifting with the DBA/SCV crane, then drained and towed back to the onshore fabrication site for reuse.

The jacket will be secured into position using the 12 skirt piles. Each jacket skirt pile will be lifted vertically by the DBA/SCV crane and positioned, penetrating into the seabed through its own weight. Once sufficient penetration is achieved, the DBA/SCV crane will detach itself from the pile and a hydraulic hammer will then be used to drive it to its target penetration.

The skirt piles will be grouted. Grout will be supplied via flexible hoses to the grout manifold panel located on the side of the jacket; and pumped down into the annulus between the pile and pile sleeve. A passive mechanical seal will ensure that the grout material is retained inside the pile sleeve annulus. A high strength cement will be used for the grout operation.

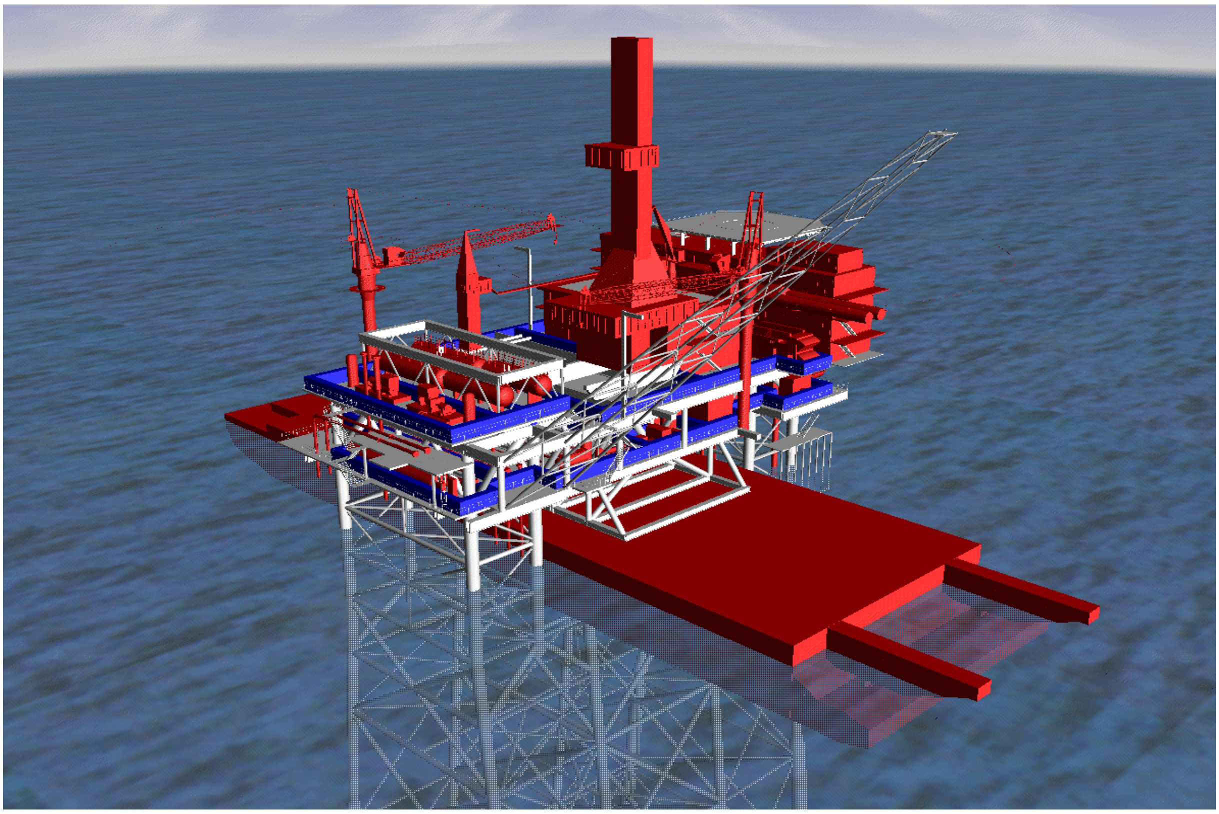
5.5.3 Topside Installation

The topside is designed for the “float-over” method of installation, as employed for the previous ACG Phases. The STB-1 transportation barge is positioned between the two jacket towers and then ballasting is undertaken until the weight of the topside is transferred to the jacket as illustrated in Figure 5.13. The mating operation (i.e. the process of connecting the topside to the jacket) is

[10] The DBA anchoring system comprises 8 anchors each attached to electrically driven hydraulic mooring winches.

executed by ballasting the barge such that the topside engages with shock absorbers in the jacket legs and the load is transferred. Sand jacks are then used to lower the topside until steel faces mate, and are ready for welding. It is estimated that approximately 35m^3 of sand will be released from the 8 sand jacks during this process and discharged to the sea**.** Topside installation is scheduled to take approximately 36 days.

Figure 5.13 Topside "Float-Over" Installation Method



5.5.4 Topside Hook Up and Commissioning

Once the topside is installed, a number of offshore hook up activities will need to be completed on the topside prior to start up. These will include:

- Installation of firewater, seawater lift and hazardous open drains caisson pumps to relevant platform caissons;
- Installation of spool connections between the deck and the platform caissons and risers; and
- Connection of the PFOC and SSIV umbilical.

Commissioning will commence with living quarters and utility systems. The systems will then be started up utilising power from four 1MW temporary diesel generators allowing workers to inhabit the platform during commissioning and start-up of the process facilities.

The current base case assumes that power during early commissioning will be provided by the four 1MW temporary diesel generators. Power will then be subsequently provided from the 33kV subsea power cable from EA and the main platform generator which will run initially on diesel and then using fuel gas received from the "buy back system" from the CA/ACE export gas pipeline. It is the intention to keep the temporary diesel generators onboard ACE until the 33kV subsea power supply and the main platform generator running on gas are fully commissioned. Diesel required during the commissioning phase will be stored within the two platform crane pedestals with additional temporary capacity provided within the platform separator vessels located on the topside.

Commissioning of the deluge and foam systems is predicted to result in approximately 200 litres of seawater and approximately 20 litres of aqueous film forming foam (AFFF) (mixed with 140m^3 of seawater) discharged via the ACE open drains caisson to the sea at 48m below sea level.

Hook up and commissioning of the ACE topside is scheduled to take place over an approximate 4 month period.

5.5.5 Brownfield Works

Brownfield works will be undertaken on the CA and EA platforms for the purpose of the ACE Project. Works on the CA-CWP platform will comprise "debottlenecking" of the existing EA and WA Gas Slug-catcher Vessel to handle the flow from ACE when gas is exported from the new platform to CA. The modifications, which will comprise removal and replacement of the slugcatcher internals and associated instrumentation, are planned to be completed during a scheduled shutdown of the CA-CWP platform in Q2 2019. Minor valve repair/modification works may also be undertaken during this period associated with tie-in requirements.

On the EA-PDQ platform topside modifications will be required to provide a complementary power source and telecommunications link along the subsea PFOC from ACE to EA. This will include the installation of a new 33 kV switchgear module, associated equipment and High Voltage (HV) and Instrument cable racks / routing. Additional structural strengthening to the workshop structure and weather deck will also be required along with control, safety and electrical system modifications and minor valve repair / modification works.

Tie-in to the EA-PDQ platform will require use of currently unused and sealed pipe (termed a J-tube) that extends from the topside into the sea. The J-tube currently contains treated seawater[11] (approximately 17m^3 in volume) that was introduced when the platform was constructed to provide corrosion protection. Prior to unsealing both ends of the j-tube, a sample will be taken and analysed to confirm composition and ecotoxicity, and a risk assessment completed to confirm potential impacts to the marine environment associated with discharge to sea. Depending on the outcome of the risk assessment the contents of the J-tube will either be discharged to sea or recovered to the topside, contained and shipped to shore for disposal. Once emptied it is then planned to flush the pipe casing twice using seawater treated with Hydrosure HD5000 at a dose of 1000ppm (i.e. the same product and dosage planned to be used during cleaning and hydrotesting of the new infield pipelines - refer to Section 5.6.2.2). Up to two J-tubes may be emptied and flushed for contingency, with each discharge totalling 17m^3.

Shutdowns will be required on both the EA and CA platforms for the purpose of the brownfield works and tie-in of the subsea pipelines. Flaring at the EA and WA platforms during the gas pipeline tie-in period is anticipated at a rate of up to 120MMscfd for up to 52 days on the EA platform and up to 8 days on the WA platform. The periods of shutdowns and flaring on the platforms will be minimised as far as practicable while allowing the modifications and tie-in activities associated with the ACE Project to be undertaken safely.

It is currently planned to undertake the EA brownfield works between Q4 2020 and Q1 2021 with the connection, tie-in and commissioning of the subsea cable scheduled for 3Q 2022, following ACE topside installation.

5.5.6 Installation, Hook Up and Commissioning Vessels

A number of vessels will be used to support the ACE platform installation, hook up and commissioning (HUC) activities and the brownfield modifications including the DBA/SCV, anchoring handling vessels, the STB-1 installation barge and fast boats for crew transfer (refer to Table 5.18). The utility specifications associated with these vessels are provided within Table 5.23.

[11] Original dosing of 500ppm biocide and 100ppm oxygen scavenger.

Table 5.18 Estimated Number and Function of ACE Platform Installation, Hook up and Commissioning Vessels

Vessel	Number	Function	POB
DBA / SCV	1	Installation of pin piles, jacket and skirt piles, support to STB-1 during topside installation and to provide accommodation during HUC period	200 / 175
Anchor handling / support vessels	6	Tow out ACE jacket pin and skirt piles to ACE platform location, positioning of piles, tow STB-1 during jacket / topside transportation, assist with DBA anchor handling	23
STB-1	1	Transportation and installation of the jacket and topside	8
Fast Boats	2	Personnel transfer	8 (crew)
Survey Vessel	1	Platform offshore pre-installation surveys and preparatory works prior to offshore installation.	51

It is planned that crew changes will be by vessel and helicopter through the ACE platform installation and HUC with helicopters typically making up to 4 trips per day, twice per week.

5.5.7 Offshore Facilities Installation, Hook Up and Commissioning – Emissions, Discharges and Waste

5.5.7.1 Summary of Emissions to Atmosphere

Table 5.19 summarises the GHG (i.e. CO_2 and CH_4) and non GHG routine emissions predicted to be generated during platform installation and HUC from key sources, which include:

- Jacket installation vessel engines and generators;
- Topside installation vessel engines and generators;
- Helicopters used for crew change;
- Power during platform commissioning; and
- Flaring associated with brownfield tie-ins.

Table 5.19 Estimated GHG and Non GHG Emissions Associated with ACE Project Platform Installation, Hook Up and Commissioning

	Jacket and Pin Pile Installation	Topside Installation	Platform Commissioning	Brownfield Tie-in Flaring	TOTAL
CO_2 (k tonnes)	20	9	53	440	522
CO (tonnes)	51	22	24	1052	1149
NO_x (tonnes)	374	164	277	188	1004
SO_2 (tonnes)	0.6	0.3	0.3	2	3
CH_4 (tonnes)	2	0.8	0.8	7064	7068
NMVOC (tonnes)	15	7	7	785	814
GHG (k tonnes)	20	9	53	616	698
See Appendix 5A for detailed emission estimate assumptions.					

5.5.7.2 Summary of Discharges to Sea

Routine discharges to sea during platform installation, hook up and commissioning comprise:

- Ballast water during jacket installation (refer to Section 5.5.2);
- Sand from topside jacking activities (refer to Section 5.5.3);
- Seawater and AFFF from deluge and foam system testing (refer to Section 5.5.4);
- Installation and support vessel discharges (refer to Tables 5.18 and 5.23); and
- Potential discharges associated with the EA platform J-tube (refer to Section 5.5.5).

5.5.7.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non hazardous and hazardous waste that will be generated during ACE Project installation and HUC are provided in Table 5.20. These have been calculated using data gained during the previous ACG Phases.

All waste generated during platform installation and HUC will be managed in accordance with the existing AGT management plans and procedures.

Table 5.20 Estimated Hazardous and Non Hazardous Waste Associated with Offshore Installation, Hook-up and Commissioning Activities

Classification	Physical form	Waste stream name	Estimated quantity (tonnes)
Non hazardous	Solid wastes	Metals - scrap	989
		Paper and cardboard	4
		Plastics - recyclable (HDPE)	3
		Cement	5
		Construction rubble	145
		Container - metal	10
		Container - plastic	0.8
		Domestic/office wastes	1003
		Tyres	5
		Wood	87
	Liquid wastes	Oils - cooking oil	0.02
		Total (Non hazardous)	**2253**
Hazardous	Solid wastes	Adhesives, resins and sealants	0.1
		Batteries - dry cell	0.4
		Batteries - wet cell	3
		Clinical waste	0.2
		Contaminated materials	2
		Contaminated soil and sand	2
		Explosives	0.001
		Filter bodies	3
		Filter media	17
		Lamps/tubes - mercury vapour	0.6
		Oil delivery hose	3
		Oily rags	23
		Pressurized containers	0.9
		Tank bottom sludge	19
		Toner or printer cartridges	0.7
	Liquid wastes	Acids	0.8
		Alkalis and bases	2
		Biocides and pesticides	0.1
		Drilling chemicals	0.3
		Fire fighting foam	1
		Oils - fuel	14
		Oils - lubricating oil	120
		Paints and coatings	0.4
		Pipe dope	0.2
		Sewage - untreated	23452
		Sewage sludge	406
		Solvents, degreasers and thinners	0.2
		Water - oily	1563
		Water treatment chemicals	4
		Total (Hazardous)	**25640**

5.6 Infield Pipeline Installation, Tie-in and Commissioning

To enable oil to be exported from the ACE-PDQ platform, a 30” diameter infield pipeline will be installed to connect the platform to the existing 30” oil export pipeline adjacent to the CA-PDQ platform. This pipeline connects into the existing Phase 2 main export pipeline from EA which runs from the CA facilities to Sangachal Terminal. As there is no planned separation of produced water on the ACE platform, the ACE oil pipeline will introduce oil commingled with produced water from the reservoir into the main oil export pipeline with the produced water to be separated and treated at the Terminal.

An 18” diameter infield gas pipeline will be installed to connect the ACE-PDQ platform to the 22” gas export pipeline at the CA-CWP platform. This pipeline enables gas that is not used for gas injection, fuel or gas lift on the ACE platform to be sent to the CA platform or exported via the main 28” Phase 1 gas export pipeline to Sangachal Terminal. An infield water injection pipeline will be installed connecting to the existing EA-CA water injection pipeline adjacent to the EA platform. The ACE infield pipeline dimensions as currently planned are presented in Table 5.21.

Table 5.21 ACE Infield Pipelines

Infield Pipeline	Inside Diameter (mm)	Length (km)
ACE 18" Gas Export Pipeline	428	4.9
ACE 30" Oil Pipeline	721	5.2
ACE 16" Water Injection Pipeline	336	3.7

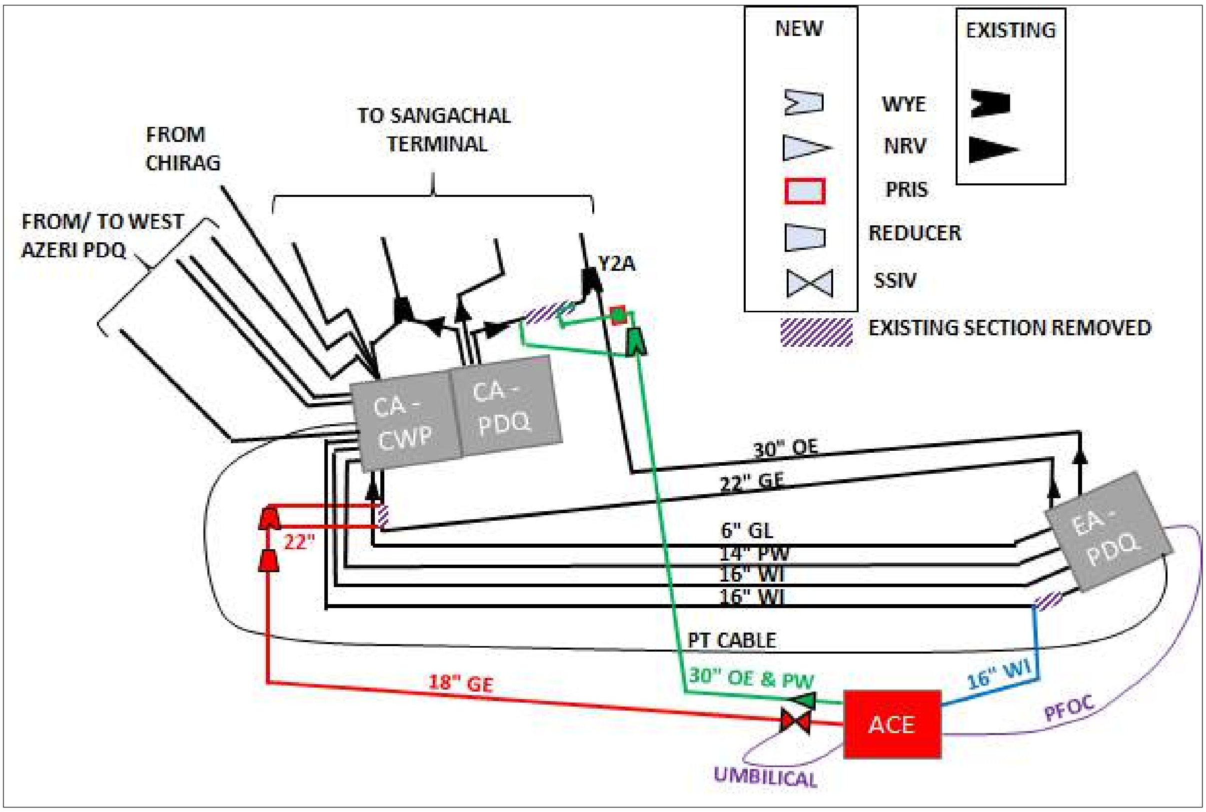
Spools will be used to connect in the new pipelines and associated subsea structures which include:

- A combined structure consisting of a NRV associated with the new ACE 30” oil infield pipeline and a SSIV associated with the new ACE 18" gas pipeline, adjacent to the ACE-PDQ platform. The SSIV is controlled via an umbilical from the ACE-PDQ platform;
- A combined structure consisting of a wye and a PRIS, designed to enable connection to a temporary pig trap for plug retrieval, within the new 30" ACE infield oil pipeline adjacent to the CA-PDQ platform; and
- 22” wye structure within the infield gas pipeline adjacent to the CA-CWP platform.

A PFOC will also be installed between the EA-PDQ and ACE-PDQ platforms.

Figure 5.14 illustrates the scope of the infield pipelines and associated infrastructure associated with the project. The approximate routing of the pipelines is shown in Figure 1.2. The design and exact routing of ACE infield pipelines and associated subsea infrastructure is ongoing through the ‘Define’ stage**.**

Figure 5.14 Illustration Showing ACE Infield Pipelines and Associated Subsea Infrastructure



5.6.1 ACE Pipeline Integrity and Design

The ACE infield pipeline design and materials will be consistent with that used for the previous ACG Projects. The pipelines will be constructed of carbon steel and will be designed to ensure that they are suitable for the environmental conditions, including seawater properties and geo-hazards. The pipelines will be designed for a 25 year operational design life.

The design of subsea structures and infrastructure is largely based on existing similar structures (where applicable) within the ACG Contract Area, and comprises steel tubular sections with perforated mudmat foundations and skirts, fitted with removable roof panels for dropped object protection and valve access.

The pipelines will be protected by a high integrity coating together with a sacrificial anode cathodic protection system. In addition, corrosion-inhibiting chemicals will be added to the hydrocarbon product before it passes through the pipeline to minimise internal corrosion. The anti-corrosion coating applied will comprise a three layer system except where not practical to do so e.g. on spool bends, where a liquid coating system shall be used such as glass flake vinyl ester.

The pipelines will be provided with a reinforced concrete weight coating with a thickness of 40mm along the majority of the length to provide the required level of negative buoyancy. The concrete weight coating where applied also affords protection from the mechanical impact of a dropped object. Use of concrete mattresses in the vicinity of the platforms to protect the pipelines from potential dropped objects has also been included with the base case design.

In addition to the passive protection measures integrated into the subsea pipelines design described above, pipeline integrity systems will also include the following measures:

- Monitoring (pressure, flow and fluid contaminant concentrations);
- Corrosion protection;
- Inspection;
- Emergency response;
- Management of change (e.g. pipeline system modifications); and
- Assurance.

These measures form part of the existing Offshore Operations Pipeline Integrity Management System (PIMS).

5.6.2 ACE Pipeline and Subsea Infrastructure Installation

The activities to install, tie-in and commission the ACE pipelines and associated subsea infrastructure are expected to begin in Q2 2021, commencing with the pipeline sections being prepared onshore at the relevant storage yard and being transported offshore for installation. The activities will involve the use of a number of vessels from the Azerbaijani fleet that have been used for similar activities previously (refer to Table 5.22).

Table 5.22 Estimated Number and Function of Subsea Installation Support Vessels

Vessel	Number	Function	POB
Pipelay barge (Israfil Huseynov)	1	Pipelay	285
Anchor handling vessels	6	Positioning and anchor handling for pipelay barge and DBA	23
Pipe supply vessels	4	Supplies pipe to the pipelay barge from the onshore pipe storage yard	7
Barge support vessels	4	Tow pipeline barge and barges used to support subsea infrastructure and spools installation. Provide support through subsea installation	16
Survey vessel	1	Inspection during subsea structures and pipelay activities	51
DBA / SCV	1	Installation of subsea structures and spools	200 / 175
Diving Support Vessel (DSV) / SCV	1	Performs subsea tie-ins and other project diving work.	113 / 175
Supply / support vessel	1	Installation of PFOC and SSIV umbilical and other support activities, including pipeline flooding, cleaning, gauging and hydrotesting	18
Fast Boats	2	Personnel transfer	8 (crew)

Table 5.23 summarises the subsea, platform and brownfield installation, hook up and commissioning utilities associated with vessels anticipated to be used.

Table 5.23 Subsea, Platform and Brownfield Installation, Hook Up and Commissioning Vessel Utilities

Utility	Description
Power Generation (DBA)	Main power provided by 3 diesel engines rated at 2700 kW.
Power Generation (SCV)	Main power provided by 8 diesel generators; 6 rated at 4400kW each and 2 at 3200kW
Power Generation (Israfil Huseynov)	Main power provided by 5 diesel generators rated at 1600kW each.

Sanitary Waste (All Vessels)	• Grey water will either be sent to the vessel sewage treatment system or discharged to sea (without treatment) as long as no floating matter or visible sheen is observable.
	• Under routine conditions black water will be treated within the vessel sewage treatment system to either:
	  ◦ MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards: Five day BOD ≤50mg/l, total suspended solids ≤50mg/l (in lab) or ≤100mg/l (on board) and thermotolerant coliforms ≤250MPN per 100 ml. Residual chlorine as low as practicable where chlorine is added (for vessel STP plants installed prior to January 2010); or
	  ◦ MARPOL 73/78 Annex IV MEPC. 159 (55) standards: Five day BOD ≤25mg/l, Chemical Oxygen Demand (COD) ≤125 mg/l, total suspended solids ≤35mg/l, pH between 6 and 8.5 and thermotolerant coliform 100MPN per 100ml. Where chlorine is added, residual chlorine in the effluent to achieve below 0.5 mg/l (for vessels STP plants installed after January 2010).
	• Under non routine conditions when the sewage treatment system is not available black water will be managed in accordance with the existing AGT plans and procedures and reported to the MENR as required.
	• Sewage sludge will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

Galley Waste (All Vessels)	Depending on the availability of the vessel system, galley food waste will either be: • Sent to vessel maceration units designed to treat food wastes to applicable MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships particle size standards prior to discharge; or • Contained and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.
Drainage / Wash Water (All Vessels)	• Oily and non-oily drainage and wash water will be segregated. • Non oily drainage (deck drainage and wash water) may be discharged as long as no visible sheen is observable. • Oily water will either be treated to 15ppm or less oil in water content and discharged to sea or contained and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

Offshore pipeline and subsea infrastructure installation, tie-in and activities are to take place over approximately 18 months.

5.6.2.1 ACE Pipeline Installation

To install the three new infield pipelines, it is planned to use the pipelay barge “Israfil Huseynov”. The installation methodology will be consistent with the previous ACG projects.

On the pipelay barge, each pipe section will be welded to the preceding one and the welded joints will be visually inspected and integrity tested using NDT techniques. The weld area will then be coated for protection with anti-corrosion material. The pipeline will be progressively deployed from the stern of the pipelay barge via the “stinger” (a support boom that extends outwards from the stern of the barge).

The tensioning system on the pipelay barge maintains a controlled and constant deployment rate, while reducing bending stresses that could threaten the pipeline structure.

The pipe-laying operation will be continuous with the barge moving progressively forward as sections of the pipe are welded, inspected, coated on board and then deployed to the seabed. The barge will be held in position by anchors. As pipe-laying proceeds, the anchors will be periodically moved by 3 anchor handling support vessels to pull the barge forward. The distance of this will vary, but will typically be every 500m to 600m of pipeline length. During installation activities, an exclusion zone will be enforced around the pipelay barge.

The pipelines will be laid directly on the seabed and will not be trenched.

5.6.2.2 Pipeline Cleaning and Hydrotesting

Following installation, each new ACE pipeline will be cleaned, gauged and hydro-tested. Treated seawater, pumped from a support vessel, will push a pig train from a temporary subsea pig launcher/receiver (PLR) to a pig receiver to clean and gauge the pipeline. The pig train will be removed and test flanges installed at either end of the pipeline. Hydrotesting will then be undertaken by pumping treated seawater from a support vessel to raise the pressure in the pipeline and confirm that there are no leaks. The PLRs used during cleaning and hydrotesting of the pipelines will be removed along with any test flanges not required. The volumes of treated seawater from cleaning, gauging and hydrotesting each infield pipeline discharged to the sea are presented in Table 5.25.

To prevent corrosion and inhibit bacteria growth, seawater used for cleaning and hydrotesting will be chemically treated. A dye will also be added to the water to provide a method of identifying leakage during hydrotesting.

The following Base Case chemicals at the indicated dosage rates, which have been approved by the MENR, are currently planned to be used:

- 1000ppm Hydrosure HD5000 (combined biocide, corrosion inhibitor and oxygen scavenger); and
- 100ppm Tros Seadye (dye).

If there is a requirement to select different hydrotest water treatment chemicals for commercial or technical reasons, the ESIA Management of Change Process (see Section 5.13) will be followed. The intent is to use chemicals no more toxic or persistent than the Base Case chemicals.

5.6.2.3 ACE Subsea Infrastructure Installation

The subsea structures and spools will be transported from the relevant onshore construction yard prefilled with treated seawater (dosed as described within Section 5.6.2.2). Prior to tie-in, chemical sticks (refer to Section 5.4.3 above) will be introduced to ensure that the seawater entering into the open end of the spool or structure is treated to minimise corrosion risk. The ‘sticks’ are to be covered with a membrane that dissolves slowly in water after a period of approximately 24 hours. As the infrastructure is being placed on the seabed, seawater will flood each spool and structure, which will then be sealed using endplates. After sealing, the sticks will dissolve to provide the required corrosion protection. The chemicals and dye to be used are presented in Table 5.24.

Table 5.24 Proposed Chemical Package for ACE Subsea Structure and Spools

Chemical	Function	Dosage Per stick (ppm/m^3)	Maximum Dosage (ppm/m^3)
HydrosureTM Biocide Stick	Biocide	50	200
HydrosureTM Corrosion Inhibitor Stick	Corrosion Inhibitor	30	120
HydrosureTM Oxygen Scavenger E2 Stick	Oxygen Scavenger	40	80
Fluorodye UC	Dye	12.5	37.5

During connection of the spool pieces and subsea structures described in Section 5.6.2.4 below, the treated seawater within the spools and subsea elements will be released to sea when the endplates are removed. Based on experience it is assumed that five meters of pipeline volume will be released to sea at the maximum dosage concentration for the five year preservation period from each spool and subsea element. The anticipated number and volume of these discharges is provided within Section 5.6.3 below.

The SSIV umbilical will be installed between the ACE platform and the combined SSIV and NRV structure installed in the vicinity of the ACE platform. The PFOC will be installed between the ACE and EA platforms.

Both the umbilical and cable will be laid from either a reel or carousel on a vessel. The base case assumes the PFOC will first be pulled in at EA, then the cable is laid towards ACE and its second end will be pulled in there.

The SSIV umbilical will be pulled in at ACE and then laid towards the combined SSIV and NRV structure and connected. The Electrical Flying Lead (EFL) and Hydraulic Flying Lead (HFL) will be connected to the SSIV and the umbilical.

5.6.2.4 Pipeline Tie-in, Testing and Dewatering

The activities to tie-in each of the new ACE pipelines and associated infrastructure are described below (refer to Table 5.25 for further details including anticipated volume and location of pipeline discharges):

- **18" infield gas pipeline**: following hydrotesting of the new 18" gas pipeline, spools will be used to tie-in the pipeline to the SSIV and the riser at the ACE-PDQ platform and to the new wye adjacent to the CA-CWP platform. Treated seawater (see Section 5.6.2.2 above for proposed chemicals and dosage rates) will be used to leak test the 18" gas pipeline section between the new wye and the ACE-PDQ platform. The existing 22" gas pipeline between the CA-CWP and EA platforms, which contains treated seawater, will then be prepared for tie-in. The water within the pipeline will first be displaced and sent for reinjection. Operational pigging from EA to CA-CWP will then be undertaken using deoxygenated seawater from CA before flood, clean and gauging (FCG) activities of the existing pipeline are undertaken using treated seawater also from EA to CA-CWP. Discharges will occur at CA-CWP. It is proposed that a slug of mono ethylene glycol (MEG) will be used to provide an interface between the gas in the pipeline and the treated water. The drop out spool will be then removed at the new wye location at CA-CWP and the new 18" gas pipeline tied in. Spools will also be used to tie-in the existing 22" gas export pipeline at CA-CWP to the new wye. A leak test will be undertaken of the existing 22" gas export pipeline using treated seawater from the EA to CA-CWP platforms via the new wye followed by cleaning and gauging, a baseline survey, dewatering and conditioning of the pipeline using MEG prior to reintroduction of gas. The final activity will be to undertake leak tests associated with the SSIV then dewater and condition the new 18" gas pipeline.

  The base case is to recover all the MEG used following the initial FCG of the 22" pipeline and during final conditioning of the 18" and 22" pipelines, however it is possible up to $10m^3$ of MEG per activity may not be recovered and is discharged to sea with the treated seawater via the CA-CWP seawater caisson at a depth of -44m.

- **30" infield oil pipeline**: following hydrotesting, spools will be used to tie-in the pipeline to the NRV and the riser at the ACE-PDQ platform and to the new wye adjacent to the CA-PDQ platform. Treated seawater (see Section 5.6.2.2 above for proposed chemicals and dosage rates) will be used to leak test the new 30" oil pipeline section from the new wye to the ACE-PDQ platform. The existing 30" oil export pipeline will be operationally pigged from CA-PDQ to Sangachal Terminal followed by the introduction of cleaning fluids (including wax solvents and diesel) to displace the oil and minimise the amount of oil remaining on the internal surfaces of the pipeline. The cleaning fluids, together with the cleaning pig train, will be propelled through the pipeline using the treated seawater with the pig train recovered at the Terminal and the fluids sent to the processing facilities.

  On completion of cleaning operations, a section of existing pipeline will be removed to enable tie-in of the PRIS, wye and new ACE oil pipeline. Secure isolation will be established using a high integrity piggable pipeline isolation tool. Once isolation has been verified, a section of cleaned pipeline will be removed and the new PRIS and spools connected. The section of new infrastructure will then be leak tested to the isolation tool using treated seawater. A temporary subsea pig launcher will be installed, the isolation tool removed and the new PRIS and wye to be tied in. The new section between the PRIS to the CA-PDQ platform will then undergo leak testing using treated seawater prior to dewatering of the complete 30" oil pipeline to the ACE-PDQ platform and re-commissioning the 30" oil export pipeline system with hydrocarbons.

- **16" infield water injection pipeline:** prior to any tie-in activities, the existing water injection pipeline between EA and CA-CWP will be initially operationally pigged using filtered seawater. Depending on the condition of the pipeline, additional pigging may be undertaken using seawater containing scale inhibitor. If required, it is planned that an approved scale inhibitor chemical of the same dosage and environmental performance as used previously for similar activities within the ACG Contract Area is used. If there is a requirement to select different scale inhibitor chemicals for commercial or technical reasons, the ESIA Management of Change Process (see Section 5.13) will be followed.

  Following hydrotesting, the new water injection pipeline will be tied into the ACE-PDQ platform riser using spools. The drop out spool adjacent to the EA platform will be then removed, the pipeline tied in at the EA platform and the EA riser flushed with treated seawater. The new pipeline will then be leak tested from CA-CWP to ACE using treated seawater, cleaned and gauged and a baseline survey completed. The treated seawater used will be displaced and discharged to sea via the ACE seawater discharge caisson as injection water is re-introduced to the pipeline.

5.6.3 Summary of Pipeline Installation Discharges

Table 5.25 presents the expected volume and location of treated seawater and filtered seawater discharges associated with gauging, hydrotesting, tie-in, testing and dewatering of the infield ACE pipelines.

Table 5.25 Treated Seawater Discharges from Pipeline Gauging, Hydrotesting, Tie-in, Leak Tests and Dewatering Discharges

Pipeline***	Activity	Discharge Location	Discharge depth below sea level (m)	Volume per discharge event (m^3)	Discharge duration (hours)	Total estimated discharge volume (m^3)
New 18" ACE Gas Export Pipeline	Flood, Clean & Gauge*	Subsea PLR	1m (above seabed)	77 -970	0.3 to 3	17,820 treated seawater 5,548 contingency 77 filtered seawater
	Hydrotest			6	3.3	
	Leak Test* (new Wye to ACE)	ACE SSIV or DSV discharge hose	5m (above seabed)	5	3.3	
Existing 22" Gas Export Pipeline - EA to CA-CWP	Flood, Clean & Gauge (EA to CA-CWP) - 4 events**	CA-CWP Seawater Discharge Caisson	44m	2,281	2.7 to 5.4	
	Leak test* (EA to CA-CWP via new Wye)	EA Seawater Discharge Caisson	50m	11	2.7	
	Clean & Gauge Baseline Survey (EA to CA-CWP)	CA-CWP Seawater Discharge Caisson	44m	2,545	2.7 to 5.4	
	Baseline Survey (EA to CA-CWP)			2,545		
	Dewatering (EA to CA-CWP)			2,545		
New 18" ACE Gas Export Pipeline	Leak Test (ACE to SSIV)	ACE Seawater Discharge Caisson	46m	2	1.3	
	Leak Test (SSIV test at ACE)			7	4.6	
	Dewatering (new Wye to ACE)			830	2 to 3.2	
New 30" ACE Oil Pipeline	Flood, Clean & Gauge*	Subsea PLR	1m (above seabed)	204-2,244	0.3 to 5.6	584 treated seawater 2,278 contingency 204 filtered seawater
	Hydrotest			20	5.9	
	Leak Test* (ACE to new Wye)	ACE Seawater Discharge Caisson or DSV	46m	44	5.2	
	Leak Test* (CA-PDQ pipeline to isolation tool)	CA-PDQ Open Drains Caisson	48m	4	5.2	
	Leak Test* (PRIS to isolation tool)	Seabed	1m (above seabed)	2	5.2	

Pipeline***	Activity	Discharge Location	Discharge depth below sea level (m)	Volume per discharge event (m^3)	Discharge duration (hours)	Total estimated discharge volume (m^3)
	Leak Test* (CA-PDQ to PRIS)			2	5.2	
	Leak Test* (ACE to NRV)	ACE Seawater Discharge Caisson	46m	4	5.2	
16" ACE Water Injection Pipeline	Flood, Clean & Gauge - 3 events	Subsea PLR	1m (above seabed)	32 to 350	0.1 to 2.6	5,040 treated seawater 424 contingency
	Hydrotest			10	22	
Existing 16" Water Injection Pipeline	Clean & Gauge - 4 events (CA CWP to EA)**	EA Seawater Discharge Caisson	50m	937	2.6 to 5.2	
	EA WI Riser flush	EA Riser base	1m (above seabed)	20	0.1	
16" Water Injection Pipeline (Existing and New)	Leak test* (CA-CWP to ACE)	CA-CWP Seawater Discharge Caisson	44m	29	9.7 to 19.2	2,843 filtered seawater
	Clean & Gauge (CA-CWP to ACE)	ACE Seawater Discharge Caisson	46m	1,322	3.7 to 7.4	
	Baseline Survey (CA-CWP to ACE)			1,322		
	Water Replacement (CA-CWP to ACE)			1,322		

Notes:
* Includes contingency for test to be repeated.
** Comprises 3 events using filtered seawater and 1 event using treated seawater.
*** Volumes presented are associated with the pipeline activities and do not include the discharges associated with subsea structures and spools installation.

As stated in Section 5.6.2.4 above up to up to 10m^3 of MEG may be discharged per event (30m^3 in total) via the CA-CWP seawater caisson during flood, clean and gauging of the 22" gas export pipeline and dewatering and final conditioning of the 18" infield gas pipeline and 22" gas export pipeline in the event it cannot be recovered.

Discharges associated with the subsea structures and spools pre-loaded with sticks of chemicals and dye are anticipated to range in volume from approximately 1 to 16m^3 per event. Based on the anticipated number of spools in total it is estimated approximately 40 discharges are anticipated, each in the immediate vicinity of the spool or structure. In addition, the tubing on the EA and ACE jackets (comprising "J-tubes" and risers) that the subsea infrastructure will tie-into will also filled with treated seawater, which will be discharged, resulting in up to 10 discharges of between 17m^3 and 66m^3 just above the seabed at the EA and ACE platform locations. An additional discharge of 50m^3 of treated seawater at the NRV at the ACE-PDQ platform is also anticipated associated with the installation of the new PRIS and spool connections adjacent to the CA-PDQ platform.

5.6.4 Pipeline Installation, Tie-in and Commissioning – Emissions, Discharges and Waste

5.6.4.1 Summary of Emissions to Atmosphere

Table 5.26 summarises the GHG (i.e. CO_2 and CH_4) and non GHG emissions predicted to be generated during pipeline installation, tie-in and commissioning from key sources which include pipelay barge and support vessel engines and generators.

Table 5.26 Estimated GHG and non GHG Emissions Associated with Routine and Non Routine Pipeline Installation, Tie-in and Commissioning Activities

	Pipeline and Subsea Installation	TOTAL
CO_2 (k tonnes)	40	40
CO (tonnes)	99	99
NO_x (tonnes)	732	732
SO_2 (tonnes)	1	1
CH_4 (tonnes)	3	3
NMVOC (tonnes)	30	30
GHG (k tonnes)	40	40

See Appendix 5A for detailed emission estimate assumptions.

5.6.4.2 Summary of Discharges to Sea

Routine and non routine discharges to the sea during pipeline installation, tie-in and commissioning comprise:

- Pipeline and subsea infrastructure cleaning and hydrotest fluids (refer to Section 5.6.3 above); and
- Pipelay and support vessel discharges as described within Table 5.23.

5.6.4.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non hazardous and hazardous waste that will be generated during the pipeline and platform installation, tie-in and commissioning programme are provided in Section 5.5.7.3 Table 5.20.

5.7 Platform Drilling

5.7.1 Introduction

The ACE Base Case assumes the following well requirements:

- 26 production wells;
- 5 WI wells;
- 7 gas injection wells; and
- 2 CRI wells.

Up to six of these wells are planned to be predrilled using a MODU as described in Section 5.3 above. Platform drilling operations will commence with the tie-back of the predrill wells to the production facilities and re-entry and completion of these wells from the platform. The Base Case design incorporates 48 well slots in total; four of which are unassigned (i.e. spare) and four are assumed to be unavailable for technical reasons. Additional reservoir penetration will be achieved in the future through sidetracking.

Following the tie-back of the predrilled wells, it is anticipated that platform drilling will commence in Q2 2023. It is estimated that an average annual drill rate of 4.5 wells/year can be achieved, with each well taking approximately 65 days to drill and approximately 25 days to complete (total of 90 days).

Sidetrack drilling operations, well maintenance and remedial works (known as ‘workovers’ or ‘interventions’) will be undertaken throughout operations to optimise production and reservoir management. The majority of these activities will be completed once the initial drilling programme is finalised, however it is possible that some well intervention activities will be required during the period when the platform wells are being drilled, in which case the drilling program would be interrupted to allow the well intervention to take place. In addition, it may be necessary to undertake some limited types of rigless interventions (SIMOPS) at the same time as drilling. These are currently anticipated to be simple measurement (known as wireline) and pumping operations (e.g. acid stimulation of wells). There are no anticipated planned discharges to sea associated with these activities.

5.7.2 Platform Drilling Facilities

Drilling facilities will comprise the DES and MDSM. The DES will be a moveable rig, which can be positioned, by means of hydraulic rams, over the required drilling slots. It will comprise the following principal equipment items:

- Drilling equipment and pipe handling systems;
- Mast/Derrick;
- Draw works;
- Well control system;
- Solids control system;
- Drilling cuttings handling, slurrification and reinjection system;

- Ship-to-shore system;
- Drilling cuttings storage and transportation system;
- Rig skidding system; and
- Washdown system.

The MDSM is used for the storage and mixing of mud, cement and other chemicals necessary to support drilling. The module comprises the following principal equipment items:

- Pipe rack and lay-down area;
- Low and high pressure mud mixing and storage systems;
- Mud chemical stores;
- Fluid and dry bulk stores;
- Mud mixing;
- Cementer unit;
- Cuttings slurry holding tank and re-injection pump;
- 3 x cement powder and 3 x barite storage tanks;
- Hazardous stores; and
- Forklift.

Power and other utilities will be routinely supplied to the drilling facilities from the platform power generator system comprising the main platform gas turbine generator and cable supply.

5.7.3 Predrill Well Tie-in and Re-entry

Tie-back operations will involve the installation of the conductor and casings between the seabed and the platform well head. Drillpipe interventions will be undertaken to remove the mechanical barriers installed during the predrilling campaign allowing for cleaning of the well with viscous sweeps (comprising freshwater, bentonite, guar gum and glutaraldehyde).

Following well completion operations, a production tree will be installed onto each well head allowing tie-in to the production manifolds.

As is the case for existing ACG projects, suspension fluids associated with predrill well re-entry will be sent to the CRI well, when available. Prior to the CRI well being tied-back and when it is not available, suspension fluids will be recovered and shipped to shore. It is not planned to discharge suspension fluids, except in the case of emergency (e.g. presence of elevated levels of H_2S).

5.7.4 Platform Well Design

Table 5.27 below summarises the platform well design, the drilling mud system for each hole section and the respective disposal or discharge route.

Table 5.27 Generic ACE Platform Well Design

Hole Size (Drill Bit Diameter)	Casing Outer Dimension	Description	Setting Depth (m TVD BRT[1])	Drilling Mud System	Disposal Route of Drilling Muds/Cuttings
30”	30”	Conductor	+/-350	-	-
30”	24”	Drilling Liner	+/-570	WBM	Discharge to sea via cuttings caisson at 104m below sea level
26”	20”	Surface	+/-850	WBM	Discharge to sea via cuttings caisson at 104m below sea level
20”	16”	Intermediate Liner	1,300 - 1,500	SOBM or LTMOBM	CRI or shipped to shore
$17^1/_2$”	$13^3/_8$”	Intermediate	2,000 - 2,300	SOBM or LTMOBM	CRI or shipped to shore
$13^1/_2$”	$9^5/_8$”	Production	Top Reservoir	SOBM or LTMOBM	CRI or shipped to shore
$9^1/_4$”	NA	-	-	SOBM or LTMOBM	CRI or shipped to shore

Unlike the predrill wells, the platform well **30” conductor** will initially self penetrate and then be driven by hydraulic hammer into the seabed. No drilling will be required.

30" and 26" Upper Hole Sections - will be drilled with WBM as per the predrill wells (see Section 5.3.2.3)[12].

The resulting cuttings will be discharged from the platform cuttings caisson at a depth of 104m below the sea surface with the seawater used for drill equipment cooling. As with the predrill programme, WBM will be reused wherever possible. Residual WBM that cannot be reused will be shipped to shore or sent to the CRI well. WBM that cannot be recovered will be diluted to ensure a chloride concentration in accordance with PSA requirements[13], and discharged to sea.

20", 17½", 13½" and 9$^1/_4$" Lower-Hole Sections - will be drilled from the platform with LTMOBM or SOBM as described for the predrill wells (see Section 5.3.2.3). Mud and cuttings from these hole sections will be returned to the platform topside, separated and the mud reused wherever possible. Cuttings will be re-injected into the CRI wells with mud that it is not practicable to separate and/or reuse. When the CRI wells are not available, cuttings and mud for disposal will be contained and either transported to another operational platform for reinjection or shipped to shore for treatment.

Table 5.28 below summarises the expected volumes of mud and cuttings generated per well and the preferred disposal route.

Table 5.28 Estimated Platform Well Cuttings and Mud Volumes per Well

Hole Size (Drill Bit Diameter)	Description	Quantity of Cuttings (tonnes)[1,2]	Quantity of Drilling Fluids Associated with Cuttings (tonnes)[2]	Drilling Fluid / Mud System	Cuttings and Mud Disposal	Duration of Discharge per Well (hours)
30" & 26"	Drilling Liner and Surface Holes	630	250	WBM	To sea via cuttings caisson at -104m. Mud recovery system utilised to recover muds from cuttings. CRI preferred option for residual mud.	Between 12 and 48 hours.
20", 17½"", 13½" and 9$^1/_4$"	Intermediate and Production Holes	3,,334	1,093	SOBM/ LTMOBM	SOBM/LTMOBM	N/A - Mud recovery system utilised to recover muds from cuttings. CRI preferred option for excess /residual mud.

Notes:
1. Total estimated fluid volumes including chemicals and seawater / drill water.
2. It should be noted that these estimates are based on a reference platform well design that provides the most conservative estimates in terms of cuttings and drilling fluids generated.

A total of approximately 7.4 tonnes of residual WBM per well, diluted to achieve the PSA chloride standard (i.e. no discharge of drill cuttings or drilling fluids if the maximum chloride concentration of the drilling fluid system is greater than four times the ambient concentration of the receiving water), may be discharged should recovery/reuse or reinjection not be possible.

5.7.5 Cuttings Treatment and Disposal

Mud and cuttings from both the surface and lower holes will be returned to the platform. Each will pass through a shale shaker screen system to separate and recover the muds from the cuttings. The WBM cuttings will be discharged to the platform cuttings caisson and the mud stored for reuse. The SOBM/LTMOBM cuttings will be routinely treated for reinjection as described below.

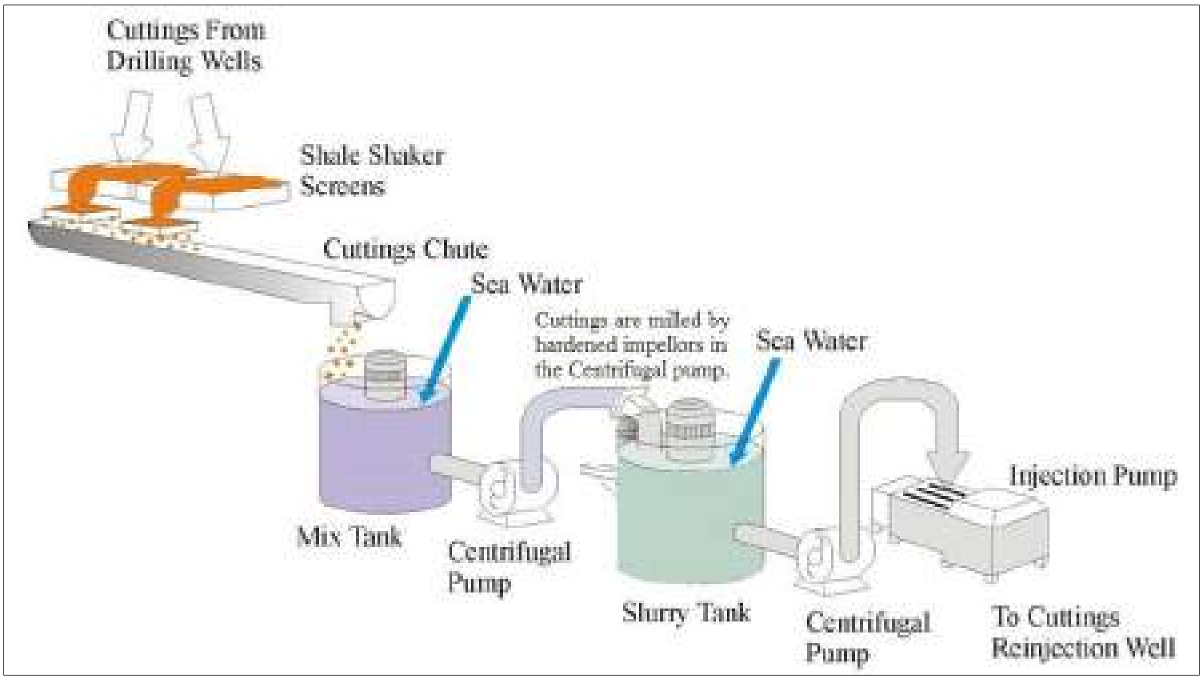
5.7.5.1 Cuttings Reinjection

In addition to used SOBM and/or LTMOBM and cuttings, contaminated WBMs, used contingency and well clean up chemicals, predrill and batch suspension fluids, produced sand from the processing facilities, and those waste streams previously approved by the MENR for offshore reinjection, may also be sent to the CRI well for disposal.

[12] Chemicals used will be of the equivalent specification and environmental performance as used for previous ACG wells.
[13] There shall be no discharge of drill cuttings or drilling fluids if the maximum chloride concentration of the drilling fluid system is greater than 4 times the ambient concentration of the receiving water.

Figure 5.15 below illustrates the cuttings reinjection process.

Figure 5.15 Cuttings Reinjection Process



After separation by the shale shaker screens, the cuttings will be mixed with seawater and the resulting slurry milled. The slurry, injected with a viscosifier, oxygen scavenger and biocide, will then be pumped downhole into the CRI well either continuously or in batches. The slurry enters sub-surface fractures created by injecting high pressure water into the well. The fracture characteristics are controlled by the flowrate, pressure and properties of the slurry. Injection rates and batch sizes will vary across the PSA period[14].

In addition to used SOBM and/or LTMOBM mud and cuttings, contaminated WBMs, used contingency and well clean up chemicals, predrill and batch suspension fluids, and waste streams previously approved by the MENR for offshore reinjection, are approved to be disposed of via the CRI well.

5.7.6 Cuttings Reinjection Well Design

The ACE CRI well location, design and operation have been based on the findings of two major studies[15,16], which include detailed analysis and consideration of the following:

- Estimating the total volume of drilling and completion wastes expected from the proposed development;
- Assessing the technical and environmental suitability of overburden formations for burial of waste. This includes an understanding of stress and permeability barriers in the target formation that provide containment to ensure the waste domain does not grow upward to surface, into shallow faulted zones or over-pressured zones. Similarly, this assessment ensures that the waste domain does not grow downwards into reservoirs or deeper over-pressured zones;
- Numerical simulation of the injection process to define the geometry of the waste domain and the limit for the volume of waste that can be buried safely in the targeted formation. This includes numerical simulation of fracture development and containment over time which requires understanding of the overall subsurface stress state;

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[14] See ACG Phase 1 and 3 ESIAs for a full description of the cuttings reinjection process.
[15] Subsurface Burial of Well Construction Wastes from the DWG field Development, Gidatec Ltd., March 2005.
[16] Disposal of Drill Cuttings from the Azeri Field Development: A Re-Injection Feasibility Study, BP Sunbury report UTG/245/01, May 2001.

- Estimation of surface injection pressures and slurry re-injection rates required to sustain the burial operation, plus possible constraints in achieving these parameters;
- Examination of any constraints on subsurface re-injection posed by nearby wells and stratigraphic features, such as faults, abnormally pressured formations, mud volcanoes or offset wells, which have potential to cause communication paths to surface;
- Identification of any operational and environmental issues affecting the overall success of the re-injection operation; and
- Departure of the CRI well design required from normal ACG well design to prevent pressure-up of drill-through intervals.

Compliance with these findings and BP's internal CRI well policy has formed the basis of design for the ACE CRI wells. In addition to initial well design, the two studies consider well-life through operations, surveillance, well workover and well abandonment.

Cuttings/slurry capacity determination is based on specific well conditions as drilled, which is a function of formation porosity and thickness characteristics. Should the ACE CRI wells fail to provide the required performance or capacity or otherwise fail during service there is sufficient appropriately located volume within the Surakhany formation within the drilling radius of the ACE platform for an additional CRI well to be located. This is not part of the current Base Case design.

All ACG CRI wells are designed with the casing shoes located to provide redundant isolation between the injection interval and the overlying formations. Cement bond logs are run in CRI wells to ensure annular integrity. During well operation, injection pressure trends are monitored to detect any significant deviation from the fracture growth behaviour predicted by the fracture modelling work. This would provide early indication of any fracture containment barrier being breached. Annulus pressures are continuously monitored to ensure that the mechanical integrity of the wellbore is being maintained. All CRI wells are fitted with downhole pressure and temperature gauges which provide data from just above the depth of formation injection. These gauges are used for Pressure Fall-Off testing which provide additional information regarding fracture growth and containment which can be used to calibrate the fracture models.

5.7.7 Conductor Suspension

During drilling operations, it is expected that a number of the platform wells will be suspended with suspension fluids (as used for existing ACG projects) after the 30" conductor has been installed and then re-entered at a later date in the drilling programme. The preferred option for disposing of conductor suspension fluids when the wells are re-entered will be to recover and inject via the CRI well or, if this is unavailable, to ship to shore. It is not planned to discharge conductor suspension fluids to sea unless there is an emergency event (such as H_2S presence in the well).

5.7.8 Well Completion Activities

5.7.8.1 Casing and Cementing

As for the predrill wells, different hole sections will be cased and cemented into place. The cement slurry will be provided from the cementing unit with the MDSM. It is expected that the cement formulation used for predrilling will also be used for platform well casing. Unlike the predrill wells, overspill of cement at the seabed during cementing of casings is not anticipated due to the design of the platform cement system. Where it is not technically practicable or safe to recover residual cement remaining in the cement system following casing operations, the remaining inventory (estimated to be approximately 1.2 tonnes per hole section) will be mixed with seawater and discharged via the platform cuttings caisson. While it is not planned to routinely discharge any dry cement to the marine environment, there may be a loss of up to 10 kilograms (kg) of dry cement in the event of an overpressure event. This is expected to occur, as a worst case, no more than once every 10 years.

5.7.8.2 Well Displacement

During well completion activities, a number of displacement chemicals will be circulated to the wells. Estimated chemicals and usage is provided in Table 5.10. Displacement fluids will be recovered and injected via the CRI well or, if this is unavailable, shipped to shore.

5.7.9 Sand Control

Without a form of sand control, the wells would accumulate considerable quantities of sand thereby adversely affecting production. It is expected that both Open Hole Gravel Pack (OHGP) and Expandable Sand Screen (ESS) sand control will be used depending on the well characteristics. In both cases, a well screen is installed in the open-hole-producing zone of the well. OHGP involves gravel packing the annular space between the screens and wellbore. This has the disadvantage of reducing the wellbore inside diameter due to the packing. The expandable sand screen option maintains the wellbore diameter and allows zonal isolation between oil arising from different formations.

5.7.10 Contingency Chemicals

Potential hazards during platform drilling include shallow gas, reactive formation and overpressure as discussed in Section 5.3.2.6. By definition, the use of contingency chemicals cannot be predicted with accuracy. Indicative information on the use of contingency chemicals for predrilling, provided previously in Table 5.9, is also applicable for platform drilling[26]. Contingency chemicals, if required, will be minimised, recovered and disposed of with the SOBM/LTMOBM and cuttings, either to the CRI well (preferred option) or, if this is unavailable, shipped to shore.

5.7.11 Platform Drilling – Emissions, Discharges and Waste

Emissions, discharges and waste associated with all platform operations including drilling are provided in Section 5.8.9.

5.8 Offshore Operations and Production

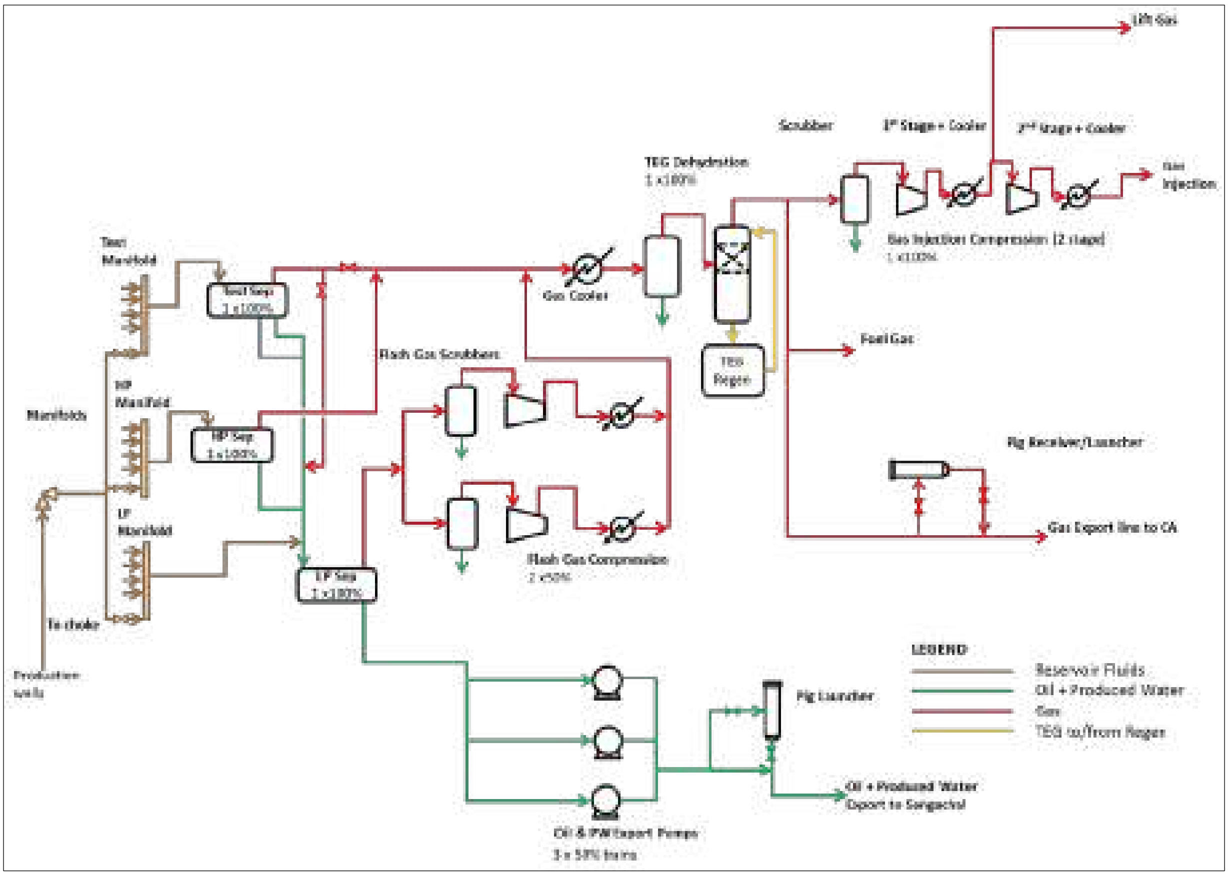
5.8.1 Overview

Key production activities that will be undertaken on the ACE-PDQ platform will include:

- Produced hydrocarbon separation;
- Oil export (commingled with produced water);
- Gas processing and compression;
- Gas lift and injection;
- Water injection (supplied from CA-CWP); and
- Utilities to support these processes.

Figure 5.16 shows a simplified flow diagram of the platform processes.

Figure 5.16 ACE Process Schematic



The principal processes and support utilities for the ACE Project are described below.

5.8.2 Separation System

Well fluids will be transferred from producing wells to the platform via flow-lines, which tie into either the high pressure (HP) or low pressure (LP) production manifold of the platform. From the manifolds, the fluids will be sent to a separation train where two phase separation (i.e. gas and liquid) will be carried out.

The separation train will comprise an HP separator, which will receive well fluids from the HP production manifold and a downstream LP separator, which will receive fluids from the HP separator and from the LP production manifold. The HP separator is designed to permit two phase separation of gas from liquids at a pressure of 55 bar gauge (barg). The LP separator is designed to permit further separation of the gas, at a pressure of 20barg and to achieve a partially stabilised liquid stream (oil and produced water), exported to the Sangachal Terminal from the platform via three 50% electrically driven oil and PW export pumps.

When testing wells, reservoir fluids will be sent to an additional test manifold and separator. The test separator will be sized to accommodate the maximum expected operational flows from any single well and will be capable of operating as a production separator in the event that the HP separator is unavailable (e.g. due to maintenance).

5.8.3 Gas Processing and Compression

Flash gas from the LP separator will be compressed by two electric motor driven flash gas compressors to the HP separator operating pressure, cooled and combined with the gas from the HP separator. The combined gas stream will then be cooled and passed to the gas dehydration package.

The gas dehydration package will comprise an inlet scrubber, glycol contactor and glycol regeneration package. The system is designed to reduce the water content of the combined separator flash gas stream to 4 lb/MMscf. The purpose of the dehydration process is to prevent hydrate formation and corrosion within the gas pipeline system.

The combined gas stream passes through the glycol contactor, where it is scrubbed by a recirculating solution of lean tri-ethylene glycol (TEG). The TEG absorbs the water within the gas stream and some heavy gaseous hydrocarbons. The rich TEG (i.e. water and hydrocarbon saturated) is then sent to the glycol regeneration package where it is heated to release the absorbed compounds. The regenerator off-gas (i.e. gas released during heating) is cooled to condense the water present. The residual gaseous hydrocarbon and the condensed water streams are sent to the LP flare header. The regenerated glycol is recirculated back to the contactor.

Under routine conditions the majority of the dehydrated gas stream will be sent to a single two stage gas injection compression train powered by a single SGT-A35(G62) gas driven compression turbine, capable of providing 29.1MW of power (based on ISO rating). Gas from the first stage of compression at a pressure of 140-160 barg will be taken off for use as lift gas with gas from the second stage at 320 barg used for gas injection.

The portion of the dehydrated gas stream not sent for compression will be used as fuel gas with any excess gas not required for gas lift, gas injection or fuel gas on ACE exported to CA via the new ACE 18” gas infield pipeline to the 22” EA-CA gas pipeline. The facilities are designed such that during maintenance of the gas turbine for the gas injection compression system, gas from ACE may be exported to CA via the new ACE gas infield pipeline rather than sent to flare. In the event that the dehydration system is not available, produced gas will be either flared or sent to the gas export pipeline without being dehydrated (i.e. wet) via a bypass around the TEG contactor. This is a non-routine activity, which is expected to occur infrequently and would require methanol injection plus corrosion inhibitor into the gas export pipeline to mitigate for hydrate formation and corrosion in the pipeline.

5.8.4 Lift and Injection Gas

The purpose of lift gas is to maximise well productivity. Gas will be sourced from the outlet of the gas injection compression train first stage and sent to the lift gas manifold before being delivered to the wellhead. The lift gas system will be sized to provide 50MMscfd of gas, with a maximum lift gas flowrate per well of 6MMscfd. Injection gas sourced from the second stage of the gas injection compression train will be routinely sent to the dedicated ACE gas injection wells, each designed to handle up to 30MMscfd of gas.

5.8.5 Water Injection

Injection water at injection specifications will be provided to the ACE-PDQ from the CA-CWP platform via the new ACE water injection pipeline, which ties into the EA-CA water injection pipeline adjacent to the EA platform. Injection water received at the ACE-PDQ platform will be supplied to the ACE-PDQ injection water manifold and routed to the ACE water injection wells (each designed to send up to 25Mbwpd into the reservoir). Under routine conditions, it is not planned that injection water will be discharged to sea from the ACE-PDQ platform.

5.8.6 Platform Utilities

5.8.6.1 Fuel Gas

As described above, a portion of the gas abstracted from the reservoir will be used as fuel gas, which will be used for the following:

- G62 main gas turbine generator;
- G62 gas compression turbine; and
- Purge and pilot within the HP and LP flare systems.

The gas, taken from downstream of the dehydration package, will be sent to a knock out drum, filtered and superheated using two fuel gas heaters, before being distributed to the platform users. Any entrained liquids collected within the fuel gas system knock out drum will be sent to the LP Separator.

The ACE design also incorporates a fuel gas “buy back” system to allow the import of fuel gas to the platform from the main gas export line under the following non routine conditions:

- To enable the platform separators to be pressurised prior to platform start-up; and
- In the event both ACE process gas and power via the subsea power import cable are unavailable.

The platform is equipped with a heater to heat the imported buy back gas.

5.8.6.2 Power Generation and Supply

Power for the ACE-PDQ platform will be provided by a single SGT-A35(G62) dual fuelled (fuel gas with diesel back up supply) gas turbine driven power generator, capable of providing 27.5MW of electrical power (based on ISO rating) with a complementary power supply provided via a cable from the EA platform. Under routine conditions power to the platform users will be provided from these sources. Under non routine conditions in the event the required power demand cannot be provided by the cable and fuel gas is not available, the main power generator will switch to diesel.

Emergency power will be provided for essential service by a 1250 kW diesel generator.

5.8.6.3 Diesel System

The main platform diesel users comprise:

- Cranes;
- Emergency power generator;
- Main power generator (only when fuel gas is unavailable);
- Standby air compressor;
- Firewater pumps; and
- Lifeboats.

Diesel will be transferred from supply boats and offloaded onto the platform by hose, where it will be filtered and stored in the two crane pedestals (providing 92m^3 of storage in each). When required, it will be pumped to the diesel users, via the diesel treatment package, which will remove small amounts of water and particulates that have contaminated the diesel during vessel transfer from the onshore diesel treatment facilities. All by-products generated from the diesel treatment system will be transferred to the hazardous or non hazardous open drains system (see Section 5.8.6.10 below).

5.8.6.4 Flare System

The platform will be fitted with an LP and HP flare system. Each of the systems is designed to collect gaseous releases from various sources around the platforms and convey them, via a header and flare drum, to a flare tip where the gas is burned and the products of combustion discharged to atmosphere. The liquids collected within both the HP and LP flare drums will be recirculated to the process, however the LP flare drum is designed and sized to provide dual function as the platform closed drains drum (refer to Section 5.8.6.10 below for further detail).

Under routine operational conditions, flaring emissions will only be associated with the following:

- The glycol regeneration package, which will vent continuously into the LP flare header;
- The flare system, which will be continuously purged with fuel gas[17] to prevent ingress of oxygen and the build-up of an explosive atmosphere; and
- The flare tip, which will be provided with a fuel gas-fired pilot light to ensure ignition of any gaseous releases.

[17] As described in Chapter 4 (Section 4.7.1.1) detailed engineering studies are ongoing to re-evaluate whether a nitrogen flare purge system option could be incorporated into the platform design. The ACE ESIA Management of Change Process (Section 5.13) will be followed should there be a change to the design of the flare purge system.

The HP flare system will be designed to collect hydrocarbon discharges from pressure relief, control and depressurisation valves from equipment with a design pressure above 20 barg with the LP system designed to collect hydrocarbon discharges from pressure relief, control valves and tank/drum vents from equipment with a design pressure at or below 20 barg.

The LP flare will share the 1x100% HP/LP flare tip package. The flare boom will be located on the south west corner of the ACE-PDQ at 180° to platform north and orientated at 60° to the horizontal. The flare, up to approximately 75m in height, will be designed to achieve a combustion efficiency of 98% and will be of a ‘smokeless design’ (Ringelmann<1) for all purge and pilot flaring events and as far as practicable for non routine flaring events without comprising safety, combustion efficiency or flare performance.

The ACE Base Case assumes approximately 0.5 to 1% of the total gas produced will be flared per annum over the PSA period at a maximum rate of 333MMscfd (in the event of emergency depressurisation).

5.8.6.5 Sand Separation System

The well completions will be designed to minimise sand production. Nevertheless, sand will be transported into the topside production facilities. As such, online sand removal will be required and will comprise sand jetting equipment. This will be internally fitted to the LP and test separators to remove accumulated sand. Deoxygenated seawater will be injected into the equipment to generate a sand-water slurry. This slurry will then exit the vessel via dedicated nozzles and be routed to the sand treatment package. A temporary connection will be provided to the LP flare/closed drains drum to enable connection to the sand jetting system if required for this vessel in the future.

The ACE sand separation package will be designed to separate sand and fluids within the slurry. The fluids from the sand treatment package will be routed to the LP flare/closed drains drum (see Section 5.8.6.10 below). The separated sand will be sent to a sand bin package where the sand will be dewatered and sent to shore in sand bins for treatment and disposal. The water separated from the sand in the sand bins will sent to the oily drains tank from where it will be sent to the CRI well. Should this prove technically unfeasible then other options being considered include routing the water to the closed drains drum where the liquids will be pumped to the LP separator or alternatively back into the sand separation package to be used for sand jetting or sending the water to shore with the sand in the sand bins. There will be no planned overboard discharge of sand from the platform.

Based on anticipated sand production volumes, vessel jetting and sand removal is expected to be required on a weekly basis, potentially more frequently for the Test Separator during well clean-up activities when higher sand volumes are anticipated.

5.8.6.6 Hydraulic Valve Control System

The subsea isolation valve (SSIV) on the new 18” infield gas pipeline at the ACE-PDQ platform will be controlled from the platform by a direct hydraulic closed loop control system. The control system will provide low pressure hydraulics from a dedicated hydraulic pumping unit (HPU) to the subsea valve via an umbilical. The umbilical contains hydraulic control lines and electrical cabling for instrumentation providing valve position status. During normal valve operations, the hydraulic fluid will be returned to the HPU via this closed loop system. It is not planned to discharge hydraulic fluid to the marine environment.

5.8.6.7 Seawater System

Seawater will be required onboard the platform for a number of purposes including:

- Heating, Ventilation and Air Conditioning (HVAC);
- Living quarters ablutions;
- Drilling facilities;
- Freshwater maker;
- Fire water ring main pressurisation facility;
- Sewage treatment system;

- Sand jetting system;
- Course filter backwash;
- Cooling for the cooling medium system; and
- Washdown facilities.

Approximately 75% of the lifted seawater used for continuous supply will be used to cool the cooling medium system (which is then distributed to the main process equipment cooling users), approximately 20% will be used by the drilling module for cooling purposes and approximately 5% will be distributed to the HVAC systems (plant and living quarters). Intermittent supply of seawater will be provided to a number of users, with the greatest demand associated with the drilling system where seawater is required to mix drilling mud and slurrify cuttings during drilling operations.

Seawater will be extracted from 1 of the 3 vertical seawater lift pump caissons at a depth of -106m below sea level. The maximum seawater extraction design flow rate per pump will be approximately 2,187m^3/hr with 2 pumps operating at one time and one on stand-by (3 x 50% configuration). The design of the seawater intake caissons on the platform will incorporate a mesh of 200mm diameter.

Lifted seawater is dosed within the seawater lift caisson to achieve concentrations of 50 parts per billion by volume (ppbv) of chlorine and 5ppbv copper. This is accomplished by sending a small stream of the lifted water to a treatment package and returning the treated water to the seawater lift caisson at the pump suction. The seawater is filtered to remove any particles that are above 150 microns in diameter. After use, part of the seawater (up to 3410m^3/hr) will be returned to the Caspian, via the seawater discharge caisson (at a depth of 46m below sea level). Seawater forwarded to the drilling system will be used to mix drilling mud, slurrify cuttings (see Section 5.7) and for cooling of the drilling equipment. The portion of the lifted seawater used to cool the drilling equipment will be sent to the cuttings caisson following use and discharged to sea.

The design and operation of the seawater/cooling water system has been reviewed and confirmed that the temperature at the edge of the cooling water mixing zone (assumed to be 100m from the discharge point) will be no greater than 3 degrees more than the ambient water temperature. The design assumes a seawater supply temperature of 11ºC in summer and 7ºC in winter with maximum discharge temperatures estimated to be approximately 29ºC in summer and 21.5ºC in winter.

5.8.6.8 Fire Systems

The platform will be equipped with a firewater distribution system, which will be supplied by two diesel powered firewater pumps. The firewater pumps will be tested on a weekly basis with seawater circulated through the firewater system and discharged via the seawater discharge caisson. In addition there will be discharges of lifted seawater to the seawater discharge caisson associated with the operation of the fire water ringmain and fire hydrants during the winter months.

A foam concentrate system will be provided in the separator module (where there is potential for hydrocarbon pool fires), which will enhance the effectiveness of the fire system's deluge water spray. A foam system will also be provided for the helideck. Following commissioning (see Section 5.5.4), firefighting foam system tests will be undertaken monthly for approximately five minutes resulting in a release of approximately 3.5m^3/hr of foam. Foam system chemicals of the same specification and environmental performance as those used in existing ACG platform foam systems will be stored on the platform for emergency use.[18]

5.8.6.9 Cooling Medium System

The platform will be equipped with an indirect cooling medium system. The cooling medium (20% by weight MEG) will be cooled against seawater and will be circulated to users within a closed loop. In the event that the cooling medium becomes degraded and requires replacement, the used cooling medium will be drained from the system, contained and will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures. The system will then be recharged with fresh cooling medium.

[18] The ACE ESIA Management of Change Process (Section 5.13) will be followed should alternative chemicals be required.

5.8.6.10 Drainage System

Open Drains

The open drains system on the ACE-PDQ platform will comprise two separate gathering systems: a hazardous area drains system and a non hazardous area drains system (see Figure 5.17). These will be segregated.

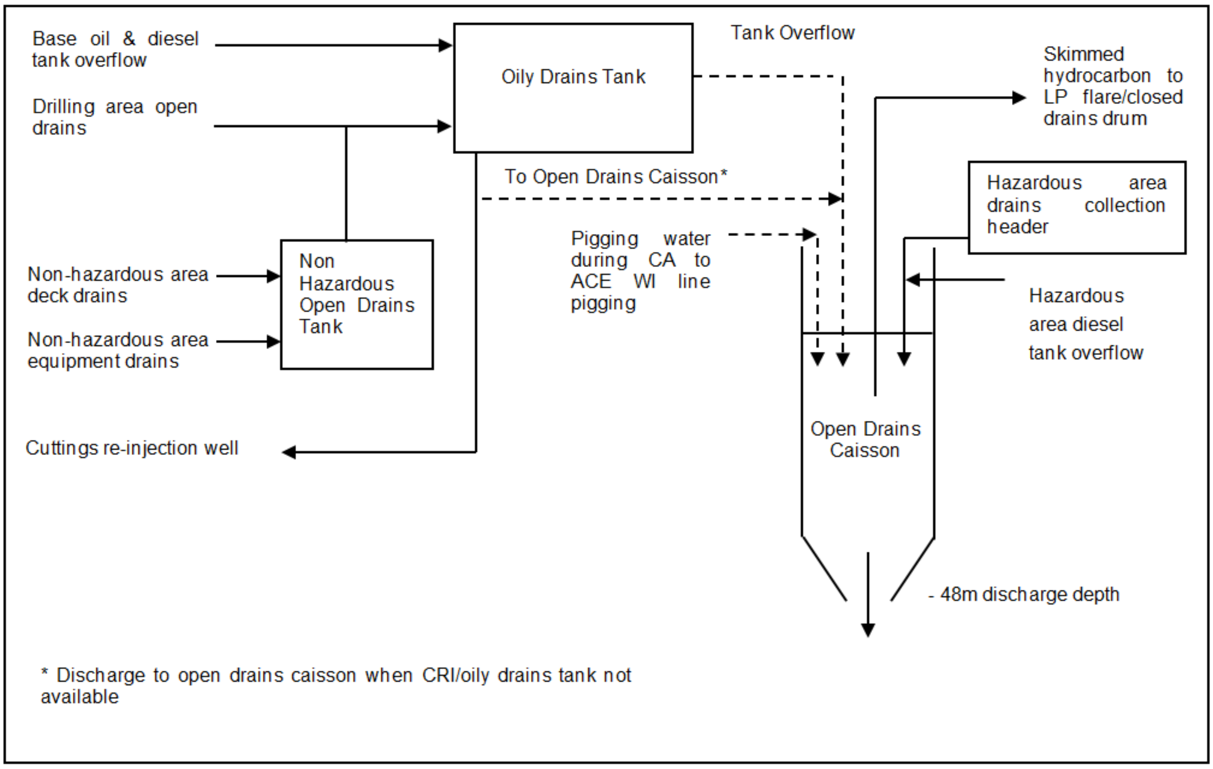
The purpose of the non hazardous open drains system is to provide drainage for rainwater, wash down water, spillages and equipment drains / leakages from all the deck levels in the non hazardous area of the platform. The non hazardous area open drains will be routed to the non hazardous open drains tank and then to the drilling oily drains tank. Liquids from the oily drains tank will then be pumped to the CRI system. Non hazardous area liquids will be discharged to sea via the open drains caisson, provided that no visible sheen is observable[19] if:

- The oily drains tank is unavailable;
- The oily drains tank overflows; or
- The CRI well is unavailable.

Under routine conditions it is not planned to route minor spills of production chemicals to the open drains caisson. However, in the event of a production chemical tank overfilling or a significant spill or leakage, production chemicals will be sent to the non hazardous drains for safety reasons.

The purpose of the hazardous open drains system is to provide drainage for rainwater, wash down water, firewater deluge, spillages and equipment drains/leakages from all the deck levels in the hazardous area of the platform. The hazardous area open drains will be routed to the open drains caisson, which is designed to ensure that there is no visible sheen on the sea surface, and discharged at a depth of 48m below sea level. The open drains caisson design will include a facility to manually sample the effluent in the open drains caisson. The sampling system shall be a pipe within a pipe. Any oil in the open drains caisson will be routed to the LP flare/closed drains drum. Helideck drains, deck wash and deluge from deck drain boxes and from the DES drain gullies shall be routed directly overboard.

Figure 5.17 Open Drains System



[19] The non hazardous area and hazardous area drains design is based on previous ACG platform designs and is determined by space and weight requirements as well as safety considerations.

Closed Drains

The function of the closed drains system is to collect residual fluids from all equipment. Separate headers will collect drainage from each of the different pressure rated systems on the ACE-PDQ platform and route these to the LP flare drum/closed drains drum. Liquid collected in the drum will be sent to the LP separator. Additionally, the test separator has the functionality to provide additional closed drainage storage capacity during a turnaround scenario.

5.8.6.11 Instrument Air and Inert Gas System

The instrument air system will provide plant and instrument air for use in drilling, process and maintenance. The system will include a 275kW diesel driven standby air compressor for emergency use in the event the main electrically driven air compressors are shut down providing up to 12 hours supply to drilling and 2 hours of supply to the main power generation package.

Inert gas (nitrogen) will be generated on demand by a membrane package using dry compressed air and a backup supply facility will be provided which includes a back up 8kW electric heater**.** Inert gas users include compressor seals, cooling medium expansion drum, methanol storage vessel blanketing and utility systems.

5.8.6.12 Freshwater

Freshwater will be produced on the ACE-PDQ platform from seawater (taken from the seawater system) in the freshwater maker. There will also be a backup system whereby freshwater from supply boats is transferred to the freshwater tanks (via a filtration unit). The freshwater maker system will utilise a reverse osmosis (RO) process to desalinate seawater. Saline effluent from the freshwater maker will be discharged to sea via the seawater discharge caisson or directly to the sea surface during periods when freshwater generation exceeds demand. The freshwater maker equipment and floor drains will also be directed to the seawater discharge caisson.

5.8.6.13 Black and Grey Water

Black water and grey water from living quarters will be collected via the sewer system and routinely treated in a sewage treatment package on the ACE-PDQ platform, sized to accommodate up to 260 Persons On Board (POB) (anticipated during commissioning). The grey water from living quarters will include small concentrations of household products used for cleaning such as detergents and soap.

It is intended that the STP will be a membrane bioreactor fitted with jet aeration. Treated effluent will be discharged to sea via the ACE-PDQ platform sewage caisson (-18m below sea level).

The platform STP will be designed to:

- USCG Type II discharge standards of total suspended solids of 150mg/l and faecal coliforms of 200MPN (most probable number) per 100ml;
- Ensure that a high proportion of the biodegradable surfactants present (greater than 90%) degrade prior to discharge of the treated effluent; and
- Allow mechanical removal of sludge, which will be contained in dedicated tote tanks and shipped to shore from the ACE-PDQ for disposal in accordance with the existing AGT waste management plans and procedures.

Under routine conditions laundry grey water will be discharged to sea (without treatment) in accordance with applicable PSA requirements via the ACE-PDQ platform sewage caisson (-18m below sea level) i.e. domestic wastes and grey water may be discharged as long as no floating solids are observable.

The sewage treatment package buffer tank will be sized to accommodate an additional day’s black water above the normal operating capacity. In the event that the sewage treatment package is unavailable, all grey water (from living quarters and laundry) will be routed directly to the sewage caisson to maximise the storage volume available for black water.

5.8.6.14 Galley Waste

Organic food waste originating from the platform galley will be macerated to less than 25mm in accordance with MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships requirements and discharged to the ACE-PDQ platform sewage caisson.

5.8.6.15 Chemical Injection System

The production process requires the addition of certain chemicals to facilitate production, aid the separation process, protect process equipment from corrosion and protect equipment and pipelines from hydrate formation. There will be two separate chemical systems located on the platform:

- Main chemical injection system; and
- Methanol injection system.

The Main Chemical Injection Package will provide chemicals primarily for the production and export systems. The purpose of the methanol system is to prevent ice/hydrate formation in the gas export pipeline and production flowlines in the event of start-up, shutdown and process upsets when the pipeline may become cold and moisture may be present. Chemicals will be supplied to the platform in transportable tote tanks located on a dedicated chemical lay down area above the storage tanks. These tote tanks will be decanted into the 1 x 100% storage tanks for each of the injection systems. Storage tanks shall be sized to provide 14 days of chemicals at the maximum dosage rate.

The pumps associated with the main chemical injection package will be provided with integral drip trays or pans. Minor spills contained with the drip pans or trays will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

The methanol system will be located within a dedicated kerbed area and methanol pumps equipped with drip trays. For safety reasons, methanol spillage from the kerbed area will be routed overboard, while methanol pump drip trays (which may contain lube oil) will be routed to the platform hazardous area open drains system. Under routine conditions it is not planned to discharge any production chemicals to sea.

Table 5.29 presents a list of anticipated production chemical requirements to be stored on the platform along with the dosage range and injection points. The chemical systems will be continually evaluated and modified as necessary depending on specific operating conditions. It is planned to use production chemicals with comparable performance to those previously approved for use on existing ACG platforms[20].

Table 5.29 Anticipated ACE Production Chemicals and Requirements

Chemical	Dosage Unit	Design Rates	Dosage Basis[1]	Injection Mode[2]	Injection Location
Antifoam	ppmv	15	Total production liquids	Continuous	HP Separator
	ppmv	15	Total production liquids	Continuous	LP Separator
	ppmv	15	Total production liquids	Continuous	Test Separator
Demulsifier	ppmv	30	Total production liquids	Continuous	Test Separator
Scale Inhibitor	ppmv	20	Produced water rate	Continuous	Wellhead
Corrosion Inhibitor (Liquids)	ppmv	15	Total production liquids	Continuous	LP Separator Outlet
Biocide	ppmv	500	Total production liquids	Batch[3]	Liquid Export; Sand Separation Package Surge Drum; HP Flare KO Drum; LP Flare/Closed Drain Drum; Main Oil Line (MOL) Pumps Suction; and Non Hazardous Open Drains Tank.
Oxygen Scavenger	ppmw	150	Equipment Volume	Batch	Cooling Medium and Seawater to Sand Separation Package
Methanol (Gas Export)	l/MMscfd	60	Export Gas Rate	Intermittent	Gas Export Line[4]; and Suction Scrubber Buy-Back Piping Spill-Off Piping
Methanol (Gas Injection Well)	l/MMscfd	60	Absolute Rate	Intermittent	Wellhead[5]

[20] The ACE ESIA Management of Change Process (Section 5.13) will be followed should alternative chemicals be required.

Chemical	Dosage Unit	Design Rates	Dosage Basis[1]	Injection Mode[2]	Injection Location
Methanol (Production Well)	l/h	100	Absolute Rate	Intermittent	Wellhead[5]

Notes:
[1] The rate or volume on which the dosage is based.
[2] Temporary = continuous injection for a short period; batch = single finite dose.
[3] Shock dosing for 4 hours once a week.
[4] Temporary injection only (during wet gas export operation). Dosing facility to be available for start up.
[5] Methanol may be injected into a well particularly during start up to inhibit the formation of hydrates and prevent blockages of process equipment and pipe work that could create emergency situations associated with over pressure events.

5.8.7 Pipeline Operations and Maintenance

Maintenance of the ACE pipelines will include periodic pigging to inspect and remove any wax or debris from the oil and gas pipelines and to remove scale and biological growth (thereby controlling internal corrosion) from the water injection pipeline. The oil pipeline will be pigged from the ACE-PDQ platform towards Sangachal Terminal with any waste collected at the Terminal and sent for disposal in accordance with the existing AGT waste management plans and procedures. The gas pipeline will be pigged from ACE to CA.

The water injection pipeline will be pigged as required to maintain pipeline integrity. The pigging will be carried out from the CA-CWP platform to the ACE-PDQ platform (i.e. the normal direction of flow) with pigging water discharged at the ACE-PDQ open drains caisson. The water injection pipeline is flushed with seawater prior to pigging. Approximately 950m^3 of water will be discharged per pigging event over the duration of the PSA with pigging planned every 3 months. Solids from pigging collected in the ACE-PDQ pig receiver will be contained and shipped to shore for disposal.

5.8.8 Supply and Logistics

Consumables such as mud, diesel, chemicals, water and supplies will be transported to the platform by vessels. During drilling operations, supplies will normally be delivered by up to 3 vessels per week. When there is no drilling, supply vessels will visit less frequently, as a minimum every 14 days, depending on requirements. Personnel will be transferred to the platform by vessel (up to three vessels per week during normal operations). Helicopter transfer may be used for emergencies. There will be no helicopter or vessel refuelling facilities on the platform.

5.8.9 Offshore Operations and Production – Emissions, Discharges and Waste

5.8.9.1 Summary of Emissions to Atmosphere

Table 5.30 shows the GHG (i.e. CO_2 and CH_4) and non GHG emissions predicted to be generated during ACE offshore production from key sources across the PSA period. These sources include:

- Main power generator;
- Gas compression generator;
- Emergency diesel generators;
- Firewater pumps;
- Platform cranes;
- Crew change vessels and supply vessels; and
- Offshore flaring.

Table 5.30 Predicted GHG and non GHG Emissions Associated with Routine and Non Routine ACE Offshore Operations and Production Activities

	CO_2	CO	NOx	SO_2	CH_4	NMVOC	GHG
	(ktonne)	(tonne)	(tonne)	(tonne)	(tonne)	(tonne)	(ktonne)
TOTAL	7,551	4,743	32,055	122	11,696	1,196	7,843

See Appendix 5A for detailed emission estimate assumptions.

5.8.9.2 Summary of Discharges to Sea

Table 5.31 provides a summary of planned discharges to sea associated with ACE-PDQ platform drilling.

Table 5.31 Estimated Planned Discharges to Sea Associated with Routine and Non Routine Platform Drilling Activities

Discharge	R/NR*	Frequency	Location	Estimated Volume (tonnes)	Discharge Composition
WBM and cuttings	R	During surface hole drilling	To sea (via ACE-PDQ cuttings caisson)	17,784 cuttings and 15,200 drilling fluids[1]	Refer to Tables 5.5 and 5.28
Residual WBM	NR	At end of surface hole drilling (if WBM cannot be recovered/ recycled and CRI is not available)		685	Refer to Section 5.7.4
Excess cement and cement chemicals	NR	At the end of each casing section (if excess cement cannot be recovered)		245	Refer to Section 5.7.8.1

Notes:
* R – Routine, NR – Non Routine
[1] Calculated based on an average of the reference case generic predrill (shortest) and plaform (longest) well to provide a realistic estimate for volumes generated from the drilling of all platform wells.

Other planned discharges to sea from ACE offshore operations comprise:

- Platform cooling water (refer to Section 5.8.6.7);
- Platform drainage (refer to Section 5.8.6.10);
- Platform freshwater maker returns (refer to Section 5.8.6.12);
- Platform black and grey water (refer to Section 5.8.6.13);
- Platform galley waste (refer to Section 5.8.6.14);
- Infield water injection pipeline pigging fluids (refer to Section 5.8.7); and
- Firefighting foam from system tests and seawater discharges associated with the fire water system (Section 5.8.6.8).

5.8.9.3 Summary of Hazardous and Non Hazardous Waste

The estimated quantities of non hazardous and hazardous waste that will be generated by the ACE-PDQ operations during the PSA period are provided in Table 5.32. These have been estimated based on the waste records for the operational ACG platforms.

Solid and liquid waste generated will be shipped to shore and managed in accordance with the Waste Management principles detailed in Chapter 14.

Table 5.32 Estimated Hazardous and Non Hazardous Waste Associated with Offshore Drilling and Processing Activities

Classification	Physical form	Waste stream name	Estimated quantity (tonnes)
Non hazardous	Solid wastes	Domestic/office wastes	2916
		Metals - scrap	3159
		Paper and cardboard	189
		Plastic – recyclable (HDPE)	135
		Container Plastic	459
		Wood	1107
		Total (Non hazardous)	**7965**
Hazardous	Solid wastes	Batteries - wet cell	27
		Contaminated materials	27
		Contaminated soils	243
		Oily rags	702
		Tank bottom sludges	81
		Produced Sand	2997
		Toner or printer cartridges	27
		Drilling Chemicals	1323
		oil lubricating oil	216
		Sewage sludges	81
		sewage untreated	1809
		water oily	5427
		waste brine	4455
		Drilling muds SOBM	1782
		Drilling Cuttings SOBM	10935
		Drilling muds LTOBM	89289
		Drilling cuttings LTOBM	12879
		Drilling Cuttings WBM	1026
		Drilling muds WBM contaminated	8316
		Cement	5481
		Total (Hazardous)	**147123**

5.9 Terminal

The partially stabilised oil and produced water from the ACE platform and any excess exported gas will be transported via the existing 30” oil and 18/22” gas subsea export pipelines to Sangachal Terminal for processing. Final processing to export specifications will be carried out in the existing ACG facilities onshore at Sangachal Terminal. There is sufficient capacity at Sangachal Terminal therefore no additional facilities, upgrades or improvements are required for onshore processing of the ACE produced fluids. The existing ACG facilities at the Terminal comprise:

- Oil and gas reception facilities;
- 6 separation and stabilisation trains;
- 3 crude oil storage tanks;
- 2 dew point control units;
- 3 off spec crude oil tanks;
- Produced water storage tanks and treatment facilities;
- Open drains water tank;
- PSA1 Pump Head Station operated by BTC under the Export Business Unit (BU); and
- Standalone and back-up support and utility systems.

5.9.1 Oil Processing

Partially stabilised oil from the two 30” marine oil pipelines is fed to the six onshore processing trains. The oil is fed to the fired heater of each train where it is heated, before being degassed in a separator. The oil then flows into a low pressure separator where the pressure is reduced further to achieve the vapour pressure specification. Stabilised oil flows to an electrostatic coalescer where the water content is reduced to export specifications. Flash gas is compressed and co-mingled with the gas stream arriving from the 28” marine pipeline.

5.9.2 Gas Processing

Gas from the 22" marine pipeline (with water removed but containing residual hydrocarbons) will be co-mingled with flash gas from the oil stabilisation train and fed to the Dew Point Control Units (DPCUs). Here the gas is chilled using a propane refrigerant circuit to recover condensate and water from the gas. MEG is injected to prevent the formation of hydrates in the DPCU process. The residual gas is exported to the SOCAR pipeline. Recovered liquids are fed back into the process.

5.9.3 Produced Water

The produced water separated from the oil is pumped to produced water storage tanks. The treatment facilities enable the produced water from the storage tanks to be filtered and treated to remove oil and solids, cooled and chemically treated prior to sending offshore to the CA facilities via the ACG produced water disposal pipeline for reinjection.

5.9.4 Terminal Operations – Emissions, Discharges and Waste

Additional emissions, discharges and waste arising at the Terminal due to ACE Activities will be associated with the incremental increase in ACG production over the PSA period associated with the Project.

The additional demand on the ACG facilities over the duration of the PSA as a result of the ACE Project is expected to give rise to additional emissions to atmosphere, primarily comprising CO_2 and NO_X from combustion processes. It is estimated that the ACE Project will give rise to approximately 440ktonnes of CO_2 emissions over the period of the PSA with an incremental increase in NO_X emissions from ACG Terminal operations of 10%. Increases in other pollutants such as CO and SO_X are expected to be insignificant (refer to Appendix 5A for further details).

The incremental change in waste is expected to be limited to a very small increase in waste generated from routine activities such as oil pipeline pigging, and will be managed in accordance with existing AGT waste management plans and procedures.

5.10 Decommissioning

In view of the operational lifetime of the ACE development, it is not currently possible to provide a detailed methodology for the potential decommissioning of the offshore facility. According to the amended and restated ACG PSA, an abandonment plan shall be prepared not later than 1 January 2026 (if not required earlier by reason of reduced production in accordance with Article 14.2 (c) of the amended and restated ACG PSA).

5.11 Summary of Emissions and Waste

5.11.1 ACE Emissions

Table 5.33 presents an estimate of the total GHG and non GHG emissions associated with ACE, assuming operations continue until 2049 (i.e. the end of the PSA).

Table 5.33 Estimated GHG and non GHG Emissions Associated with the ACE Project

Emissions to Atmosphere							
		Predrill	Onshore Construction & Commissioning	Pipeline and Subsea Installation	Platform Installation & Commissioning*	Offshore Operations**	Total
CO_2	ktonnes	53	57	40	522	7,551	**8,222**
CO	tonnes	168	220	99	1149	4,743	**6,378**
NO_x	tonnes	972	883	732	1004	32,055	**35,646**
SO_x	tonnes	2	2	1	3	122	**130**
CH_4	tonnes	4	3	3	7068	11,696	**18,773**
NMVOC	tonnes	38	35	30	814	1,196	**2,113**
GHG	ktonnes	53	57	40	698	7,843	**8,691**

See Appendix 5A for detailed emission estimate assumptions.
* Including brownfield works and tie-in activities.
** Estimated for period of PSA from planned ACE first oil in 2023.

In addition to the emissions presented in Table 5.33, Section 5.9.4 above sets out the estimated CO_2 and NO_X emissions expected to be generated at the Terminal as a result of the additional demand on the ACG facilities over the duration of the PSA as a result of the ACE Project.

5.11.2 ACE Hazardous and Non Hazardous Waste

Table 5.34 presents a summary of the expected hazardous and non hazardous waste generated by the ACE Project. The planned destination of each ACE waste stream is provided within Table 5.35. Waste management plans and procedures are detailed within Chapter 14.

Table 5.34 Estimated Hazardous and Non Hazardous Waste Associated with the ACE Project

Type	Waste Category	Estimated Volume(tonnes)					
		Sub Category	Predrill	Onshore Construction & Commissioning	Installation and HUC	Offshore Operations (LoF - 27 years)	Total
Non hazardous waste	Non hazardous non recyclable waste	Domestic/office wastes	121	4,889	1,003	2,916	**8,929**
	Recyclable waste	Grit blast Wood Oils - cooking oil Metals - scrap Paper and cardboard Plastics - recyclable (HDPE) Construction rubble Plastic- non- recyclable Tyres Cement Container Plastic	102	4,418	1,250	5,049	**10,819**
	Total (Non hazardous)		**223**	**9,307**	**2,253**	**7,965**	**19,748**
Hazardous waste	Solid hazardous waste	Adhesives, resins and sealants Cement Batteries - dry cell Batteries - wet cell Clinical waste Contaminated materials Contaminated soil and sand Filter bodies Oily rags Filter media Explosives Lamps/tubes - mercury vapour Pressurized containers Toner or printer cartridges Tank bottom sludge Greases	95	250	74	4,104	**4,523**

Type	Waste Category	Estimated Volume(tonnes)					
		Sub Category	**Predrill**	**Onshore Construction & Commissioning**	**Installation and HUC**	**Offshore Operations (LoF - 27 years)**	**Total**
	Non-water based associated drill cuttings[3]	-	3,600	0	0	23,814	**27,414**
	Hazardous liquid waste	Drilling muds LTOBM Drilling muds SOBM Drilling Cuttings WBM contaminated Drilling muds WBM contaminated Drilling adhesive Biocides and pesticides Acids Alkalis and bases Antifreezes Oils - fuel Oils - lubricating oil Paints and coatings Sewage – untreated Sewage sludge Solvents, degreasers and thinners Drilling chemicals Fire fighting foam Water treatment chemicals Waste brine Water - hydrotest water Water - oily	9,611	13,154	25,637	119,205	**167,607**
		Total (Hazardous)	**13,306**	**22,461**	**27,890**	**147,123**	**210780**

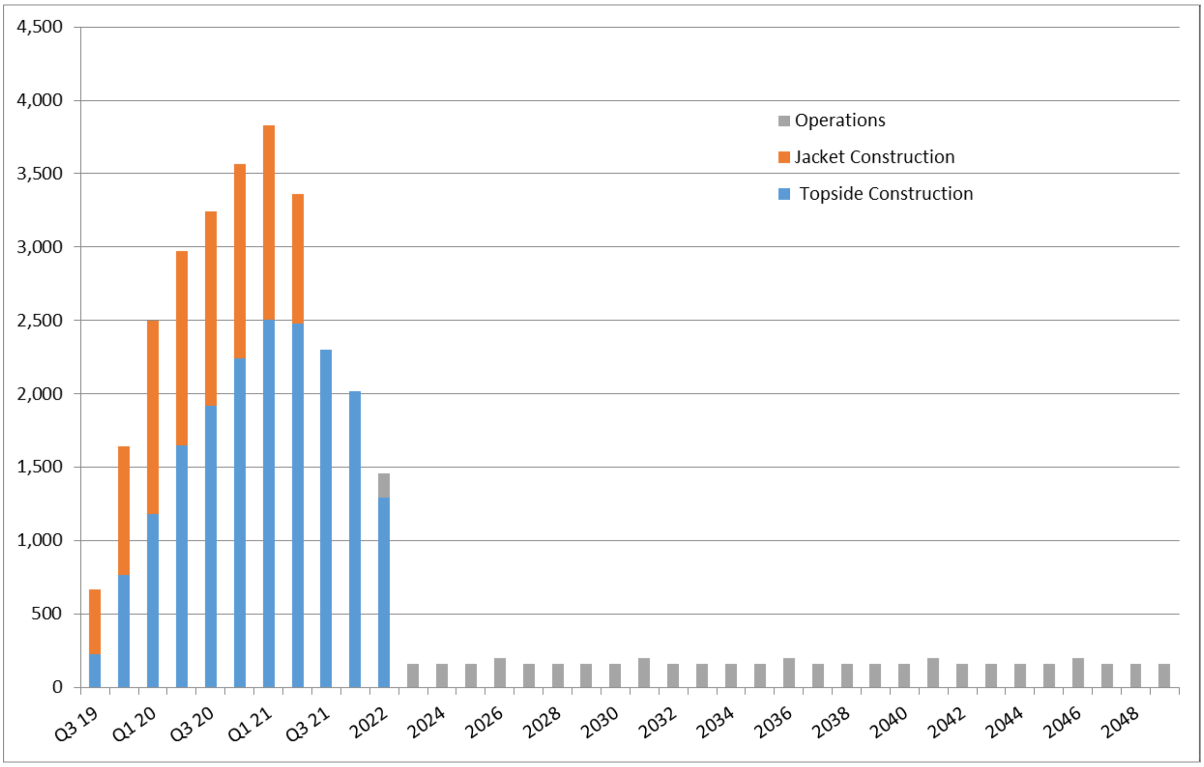
Table 5.35 Planned Destination of ACE Waste Streams

Category	Sub Category	Destination
Non hazardous non-recyclable waste	Domestic/office wastes	Non hazardous landfill – current facility has been designed and constructed to EU standards.
Recyclable waste	Waste electrical and electronic cables	Treatment/disposal by licensed AGT Region approved contractor or storage pending availability of appropriate techniques/contractor.
	Paper and cardboard	
	Plastics - recyclable (HDPE)	
	Wood	
	Container Plastic	
	Construction debris	
	Tyre	
	Grit blast	
	Metals - scrap	Sent to SOCAR.
Solid hazardous waste	Batteries - dry cell	Treatment/disposal by licensed AGT Region approved contractor or storage pending availability of appropriate techniques/contractor.
	Batteries - wet cell	
	Cement	
	Clinical waste	
	Contaminated materials	
	Contaminated soil and sand	
	Filter bodies	
	Lamps/tubes – mercury vapour	
	Oily rags	
	Produced Sand	
	Tank bottom sludge	
	Toner or printer cartridges	
	Batteries - dry cell	Sent to SOCAR.
	Batteries - wet cell	
Non-water based drill cuttings	Drilling cuttings LTOBM	Cuttings will be treated by the indirect thermal desorption unit at Serenja or by alternative disposal options. Recovered base oil from thermal desorption unit may be reused if it meets the reuse specification or it will be either disposed as a liquid waste. Solid process residuals from the thermal desorption unit will either be disposed or used as cover material at a hazardous or non hazardous landfill depending on its characterisation. One of current alternative disposal options for non-water based cuttings is bioremediation, however BP will continue working on alternative long term reuse options, that may add additional disposal routes non-water based drill cuttings and associated treatment process residuals.
	Drilling cuttings SOBM	
	Drilling muds LTOBM	
	Drilling muds SOBM	
Liquid hazardous waste	Drilling chemicals	Treatment and disposal/recovery by licensed AGT Region approved contractor or storage pending availability of appropriate techniques/contractor.
	Cement	
	Drilling Chemicals	
	Drilling cuttings WBM - contaminated	
	Drilling muds WBM - contaminated	
	Oils - fuel	
	Oils - lubricating oil	
	Paints and coatings	
	Sewage - sludge	
	Sewage - untreated	
	Solvents, degreasers and thinners	
	Tank bottom sludge	
	Waste brine	
	Water - hydrotest water	
	Water - oily	
	Water treatment chemicals	

5.12 ACE Employment

The estimated employment associated with the ACE Project during the topside and jacket construction project phase and during operations is presented in Figure 5.17. Employment during topside and jacket construction is estimated to peak at approximately 3,700 persons in Q1 2021. It is anticipated that routinely up to 160 persons will be employed during operations.

Figure 5.18 Estimated Manpower Associated with ACE Onshore Jacket/Topsides Construction and Operation Phases



5.13 Management of Change Process

During the 'Define', 'Execute' and 'Operate' stages of the ACE Project**,** there may occasionally be a need to change a design element or a process. The ACE Project intends to implement a formal process to manage and track any such changes, and to:

- Assess their potential consequences with respect to environmental and social impact; and
- In cases where a new or significantly increased impact is anticipated, to inform and consult with the MENR to ensure that any essential changes are implemented with the minimum practicable impact.

All proposed changes where there is potential for new or altered environmental and social interactions, whether to design or process, will be notified to the Project HSE team, who will review the proposals and assess their potential for creating potentially significant environmental or social interactions.

Changes which do not alter existing interactions or impacts, or which give rise to no interactions or impacts, will be summarised and periodically notified to the MENR, but will not be considered to require additional approval. This category will include items such as minor modification of chemical and drilling fluid systems, where the modification involves substitution of a chemical with equal or less environmental impact than the original.

If internal review and assessment indicates that a new or significantly increased impact may occur, the following process will be applied:

- Categorisation of the impact using ESIA methodology;
- Assessment of the practicable mitigation measures;
- Selection and incorporation of mitigation measures; and
- Re-assessment of the impact with mitigation measures in place.

In practical terms, the changes that will require prior engagement and approval by the MENR are those that:

- Result in a discharge to the Caspian that is not described in the ACE Project ESIA;
- Increase the quantity discharged as detailed in the ACE Project ESIA by more than 20%[21,22];
- Result in the discharge of a chemical not referenced in the ESIA and not currently approved by the MENR for use in the same application by existing AGT Region operations; or
- Create or increase noise, light or other disturbance above applicable thresholds to human populations living in the vicinity of the ACE Project activities.

Once the changes (and any appropriate mitigation) have been assessed as described above, a technical note will be submitted to the MENR describing the proposal and reporting the results of the revised impact evaluation. Where appropriate, this may include the results of environmental testing and modelling (e.g. chemical toxicity testing and dispersion modelling). Following submission of the technical note, the Project team will engage in meetings and communication with the MENR in order to secure formal approval. Once approved, each item will be added to a register of change. The register will include all changes, including those non-significant changes notified in periodic summaries, and will note any specific commitments or regulatory requirements associated with those changes.

[21] For the discharges detailed in the ESIA, an increase of 20% in volume would result in a 3-4% increase in the linear dimension of the mixing zone. For instance, a mixing plume 100m by 20m by 20m would increase by less than 2m in each dimension. Taking into account the actual size of the predicted mixing zones, this magnitude of increase is considered to make no material difference to the physical extent of the impacts. In practical terms, this would apply to increases of more than 20% (the value was selected to be conservative).

[22] Unless increase is deemed to have no material effect on the associated impact(s).

6 Environmental Description

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6.1 Introduction

This Chapter describes the environmental baseline conditions relevant to the Azeri Central East (ACE) Project. The purpose of the Chapter is to provide sufficient information to allow the potential impacts of the Project activities to be assessed in accordance with the assessment methodology as set out in Chapter 3 of this Environmental and Social Impact Assessment (ESIA). The scope and content of this Chapter has therefore been determined based on the anticipated environmental interactions identified during the ACE Project scoping process with the geographic scope focused on:

- Onshore: The Azerbaijan coastline and the vicinity of the potential construction yards to be used for ACE construction activities (refer to Chapter 5: Section 5.4.1); and
- Offshore: The Azeri-Chirag-Gunashli Contract Area including the East Azeri (EA), Central Azeri (CA) and proposed ACE platform locations and along the proposed ACE infield pipeline routes.

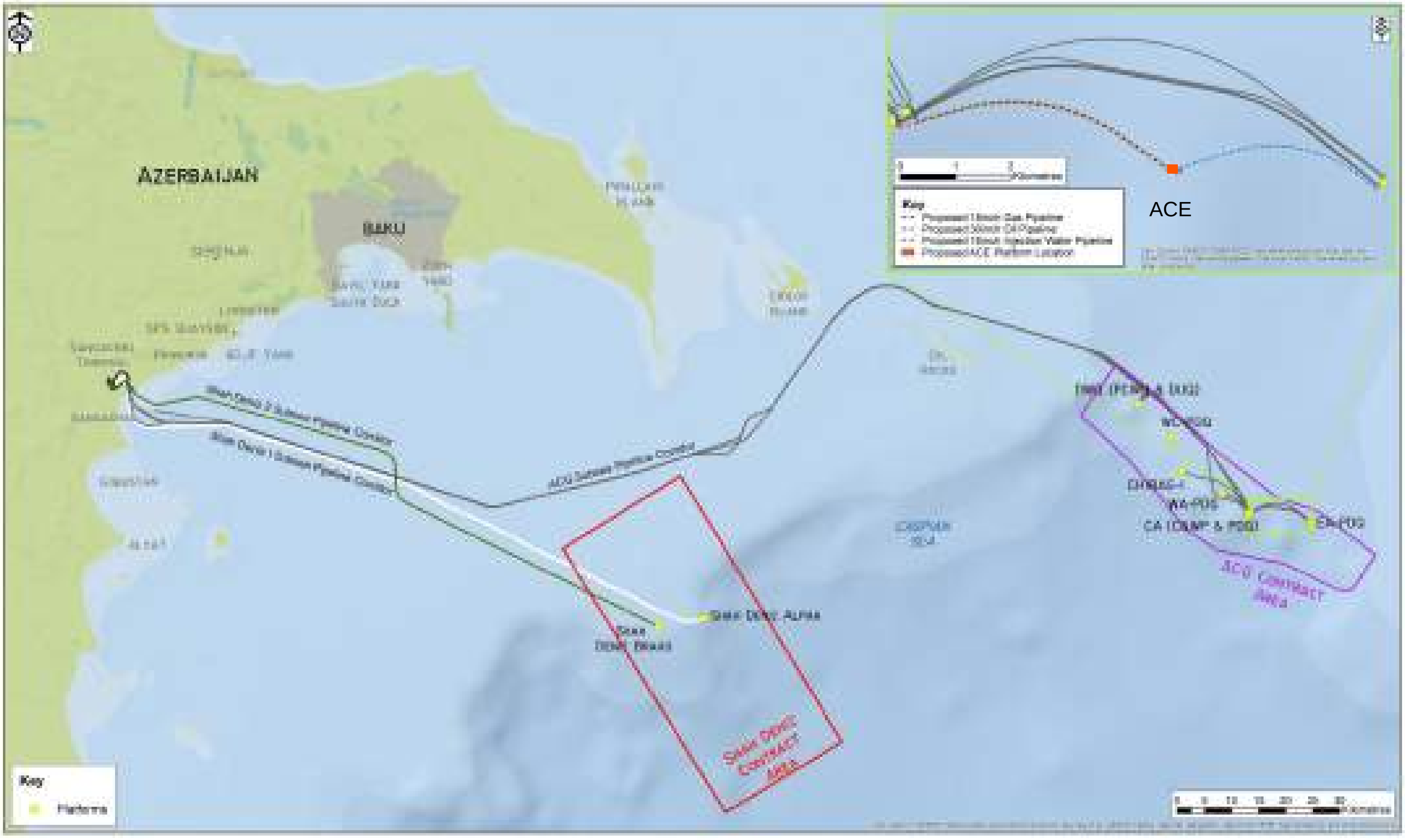
This Chapter provides relevant information on the following relating to environmental baseline conditions:

- Physical setting including a summary of seismicity, geology, meteorology and climatic conditions relevant to the Caspian region as a whole (i.e. the entire geographic area in which the Caspian Sea is located) and to the ACG Contract Area;
- An overview of the setting and relevant environmental conditions in the vicinity of the potential construction yards to be used for the ACE Project and Sangachal Terminal (ST);
- An overview of the coastal environment of the Absheron region (from the Absheron Peninsula to Gobustan in the south) including the main habitat types present, the location and characteristics of protected areas and a summary setting out the importance of the coastline for birds;
- A description of the marine environment relevant to the Southern basin of the Caspian Sea and to ACG Contract Area including an overview of bathymetry and oceanography, general seabed and water column physical, chemical and biological/ecological conditions across the ACG Contract Area as a whole;
- A summary of the known presence, behaviour and seasonal sensitivity of fish and Caspian seals within the ACG Contract Area; and
- Specific data relating to the seabed and water column physical, chemical and biological/ecological conditions at the proposed ACE platform location and the nearby CA and EA platforms.

Figure 6.1 presents the key terrestrial, coastal and offshore locations associated with the ACE Project.

The social baseline conditions relevant to the ACE Project activities are presented within Chapter 7 of this ESIA.

Figure 6.1 Key Onshore and Offshore Locations Associated with the ACE Project



6.2 Data Sources

Environmental monitoring data has been collected by BP across the ACG field for over 25 years. Since 2004 data has been collected under the Environmental Monitoring Programme (EMP). EMP data collected relevant to the ACE Project includes:

- Marine benthic flora and fauna; and
- Water quality and plankton surveys.

The primary aim of the EMP is to develop reliable and consistent time series data for each monitoring location within a clearly defined survey area to enable long-term trends to be identified.

Under the Production Sharing Agreement (PSA), responsibility for the preparation and approval of the overall EMP rests with the Environmental Sub-Committee (ESC), which carries out an annual review of planned activities. The ESC comprises representatives of key stakeholders such as the State Oil Company of the Azerbaijan Republic (SOCAR), the Council of Ministers, the Ministry of Ecology and Natural Resources (MENR) and the Azerbaijan National Academy of Sciences (ANAS). Practical supervision and review of ongoing activities is delegated to the ACG and SD Environmental Monitoring Technical Advisory Group (MTAG), which comprises environmental specialists representing these organisations.

Offshore baseline benthic and water column surveys have been undertaken across the Azeri-Chirag-Gunashli (ACG) Contract Area since 1992. An Environmental Baseline Survey (EBS) which involved water column and sediment sampling was undertaken at the proposed ACE platform location in June 2017. In total 4 water column and 22 sediment samples were taken and physical, chemical and biological analysis undertaken.

Table 6.1 lists the baseline and EMP surveys carried out that are relevant to the ACE Project.

Table 6.1 Baseline and EMP Surveys Relevant to the ACE Project Completed to Date

Date	Title of Survey
Offshore Surveys	
2017	ACE Environmental Baseline Survey
2016	East Azeri Benthic Survey
2016	Central Azeri Benthic Survey
2015	ACG Regional Benthic Survey
2014	ACG Regional and Pipeline Route Water Column and Plankton Communities Survey
2014	East Azeri Benthic Survey
2014	Central Azeri Benthic Survey
2012	ACG Regional and Pipeline Route Water and Plankton Survey
2012	ACG Regional Benthic Survey
2012	East Azeri Benthic Survey
2012	Central Azeri Benthic Survey
2010	ACG Regional Water Quality Survey
2010	ACG Regional Benthic Survey
2010	East Azeri Benthic Survey
2010	Central Azeri Benthic Survey
2008	ACG Regional Plankton Survey
2008	ACG Regional Water Quality Survey
2008	East Azeri Benthic Survey
2008	ACG Regional Benthic Survey
2008	Central Azeri Benthic Survey
2006	East Azeri Post-installation Benthic Survey
2006	ACG Regional Survey (Benthic, Plankton, Water Quality)
2006	Central Azeri Benthic Survey
2005	ACG Regional Plankton Survey
2005	ACG Regional Benthic Survey
2005	Central Azeri Post well Survey
2004	ACG Regional Benthic and Plankton Survey
2004	Central Azeri Benthic Survey
2002	ACG Phase 2 Environmental Baseline Survey (East Azeri and West Azeri)
2001	ACG Phase 1 ESIA Baseline Survey (Central Azeri)
2000	Chirag - Sangachal Sub-sea Pipeline Survey
2000	GCA 5 and 6 Post Well Survey
2000	Chirag 1 Post Saraline Survey
1999-2001	Gunashli Field Fisheries Surveys
1998	Phase 1 Platform 1a and 1b Environmental Baseline Surveys
1998	AIOC Chirag 1 Mid Drilling Environmental Survey
1997	AIOC Appraisal Well GCA No. 3 GCA No. 4, Post Appraisal Drilling Surveys
1997	AIOC Appraisal Well 1 Pre and Post Appraisal Drilling Seabed Environmental Survey
1996	AIOC Appraisal Well 1 Pre and Post Appraisal Drilling Seabed Environmental Survey
1996	AIOC Contract Area Long Term Monitoring Stations
1995	AIOC Offshore Environmental Baseline Survey 1995, September and December
1992	Pilot Environmental Survey, Chirag oilfield
Relevant Terrestrial / Coastal Surveys	
2006	Winter Waterfowl Monitoring Study, Absheron to Kura
2005	Winter Waterfowl Monitoring Study, Absheron to Kura
2004	Overwintering Bird Survey, Absheron to Kura
2004	Winter Waterfowl Monitoring Study, Absheron to Kura
2003	Overwintering Bird Survey, Absheron to Kura
2002	Winter Waterfowl Monitoring Study, Absheron to Kura
1996	Sangachal Coastal Environmental Survey

This Chapter has also been prepared based on a review of other BP ESIAs and Environmental Technical Notes (ETNs) completed for projects in the ACG Contract Area and Azerbaijan sector of the Caspian Sea, specifically those in close proximity to the proposed ACE Project location, including:

- ACE Geotechnical Survey ETN, 2017 (Ref. 2);
- Shallow Water Absheron Peninsula (SWAP) 2D Seismic Survey ESIA, 2015 (Ref. 3);
- SWAP 3D Seismic Survey ESIA, 2015 (Ref. 4);

- Shah Deniz Stage 2 (SD2) Project ESIA, 2012 (Ref. 5);
- Chirag Oil Project (COP) ESIA, 2010 (Ref. 6);
- ACG Full Field Development Produced Water Disposal Project ESIA, 2007 (Ref. 7);
- ACG Phase 3 ESIA (2004) (Ref. 8);
- ACG Phase 2 ESIA (2003) (Ref. 9); and
- ACG Phase 1 ESIA (2002) (Ref. 10).

Secondary data sources used to inform the ESIA include:

- Data collected through consultation with local specialists including:
  - o Review of available bird data relevant to the ACG Contract Area and along the Absheron-Gobustan Coastline of the Caspian Sea completed by Ilyas Babayev of the Institute of Zoology;
  - o Review of the most recent available data relating to Caspian Sea fishes relevant to the ACG Contract Area completed by Professor Mehman Akhundov of the Azerbaijan Fisheries Research Institute; and
  - o Review of the most recent available data relating to Caspian seals completed by Tariel Eybatov of the Natural History Museum.
- Data and literature publically available on the internet including reports published by International Union for Conservation of Nature (IUCN); United Nations Environment Programme Global International Waters Assessment (UNEP / GIWA), BirdLife International; World Protected Areas Database (WDPA) and Casp Info.

6.3 Physical and Geophysical Environment

6.3.1 Geology

The Caspian Basin represents one of the largest continental lake systems in the world and has been an area of major sedimentary deposition since its formation in the late Jurassic to early Cretaceous times (approximately 145 million years before present) (Ref. 51). The recent geological sequence is characterised by Fluvial Deltaic sandstones and Lacustrine shales. The ACG Contract Area lies on the northern margin of the South Caspian Basin, approximately 60 kilometres (km) east from the coast of Azerbaijan, and the proposed ACE platform will be located in the southeast corner of the Contract Area, on the relatively flat shelf or plateau area.

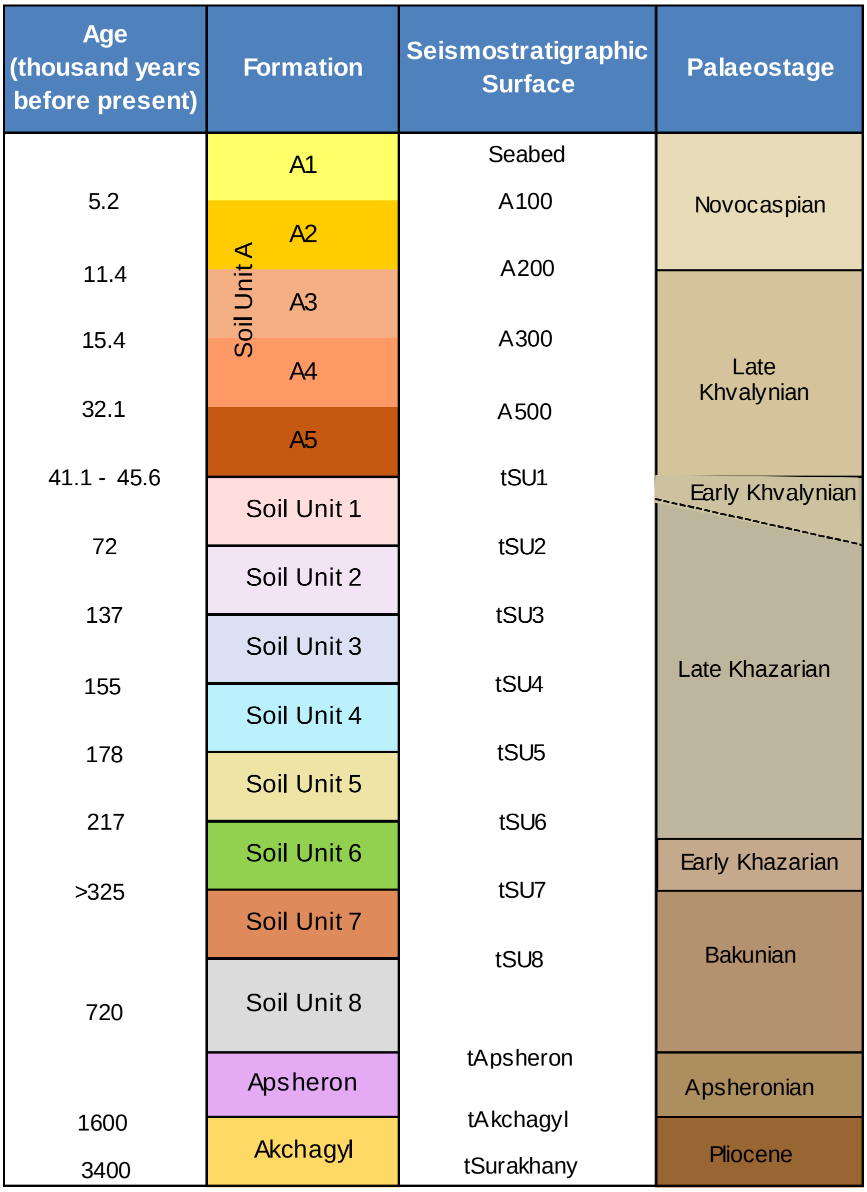
The Caspian region is characterised by the tectonic collision within the Arabia-Eurasia zone which has produced a series of anticlinal (arch-like) upward thrusting folds and exhibits horizontal motion rates of several centimetres per year (Ref. 11). The ACG field lies within a north-west to south-east asymmetric anticline along the Absheron Ridge, where the palaeo-Volga deposited sediment at exceptionally high rates (up to 4.5 kilometres/million years (km/ma)) reaching thicknesses of up to 20km. The primary reservoirs in the region are fluvio-deltaic sediments deposited during the Pliocene as the Volga palaeo-delta prograded south (Ref. 12). The present day seabed is a function of past and ongoing geological processes. The stratigraphy (i.e. the composition, relative age and distribution of strata) of the seabed within the ACG Contract Area from the Cretaceous time to the present, derived from data collected by BP from over 25 years of exploration in the area, is summarised within Figure 6.2a (Ref. 52). Further detail relating to the stratigraphic column relevant to the South Caspian, including an overview of the events that led to its formation is provided within Appendix 6E.

Available soils data shows significant variation in the governing soil parameters across the ACG Contract Area. Historically, at least 22 soil units have been identified in the shallow ACG stratigraphy from data acquired during numerous geotechnical campaigns dating back to 1995.

A typical stratigraphic column in the ACG Contract Area comprises sedimentary strata, which are mainly rich in claystones. The claystones are interlayered with siltstone and sandstone beds, and contain high proportions of quartz. Lower in the sequence, units are encountered with potential as oil reservoirs, and in areas the claystones become progressively siltier and sandier with increasing depth before the sandstone develops (refer to Appendix 6E for further detail).

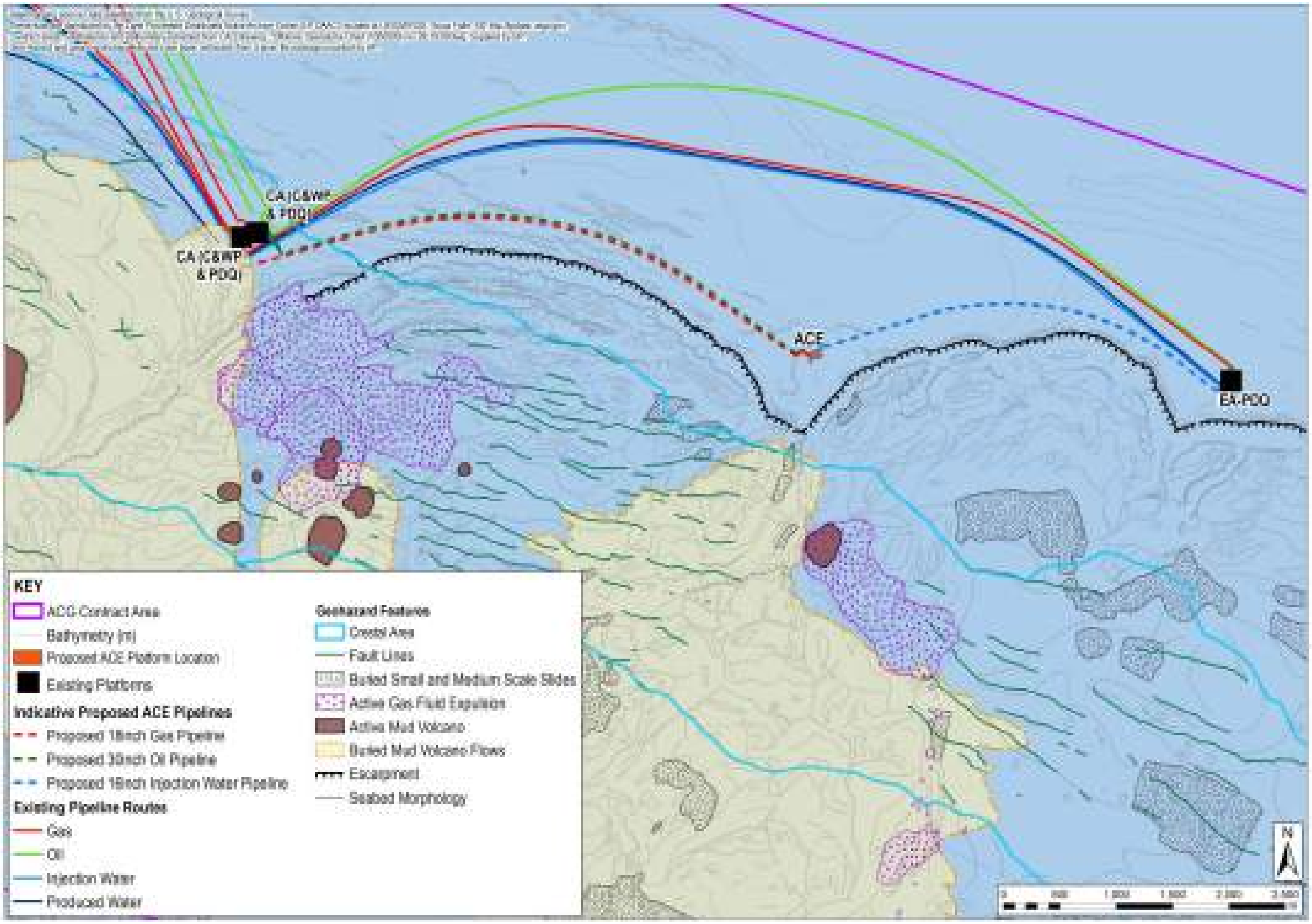
The surface soils are typically silty clay, with layers and pockets of silt and sand present in some units deposited at a time when the sea level was at its lowest. Based on the results of core samples taken during geotechnical surveys undertaken by BP 12 main soil units are present within the top 150m of soils below the seabed surface within the Azeri area (Ref. 52). A description of the surface soil units within the seabed is provided in Figure 6.2a. Further detail, including an overview of the composition of each soil unit, is provided within Appendix 6E. The proposed ACE platform will be located in an area with soils described as a relatively low plasticity calcareous clay with inclusion and laminations of organic clay, and with pockets and laminations of silt and fine sand (Ref. 13).

Figure 6.2a Shallow Chronostratigraphic Sequence Within the ACG Contract Area (Ref. 13)



Over the last 217,000 years, the Azeri portion of the ACG Contract Area has been subject to periodic landslide and mud volcano activity, which has occurred against a backdrop of sea level and climatic change during a continuous phase of tectonic uplift and sediment deposition. Larger scale landslide activity tends to occur once enough sediment has been deposited on top of previous landslides and seabed topography has been smoothed. Small scale landslide activity is prevalent in the aftermath of a large event following sediment accumulation on locally steep slopes and continues periodically once further sediment is deposited (Ref. 13). The mud volcano deposits in the Azeri Area comprises slightly sandy-gravelly-silty clay where the sand and gravel-sized fraction typically comprises fragments (known as clasts) of stronger clay (Ref. 52). The locations of known landslide events in the vicinity of the proposed ACE platform location are presented in Figure 6.2b.

Figure 6.2b Overview of Geohazards within ACG Contract Area Relevant to the ACE Project



6.3.1.1 Mud Volcanoes

Approximately half of the world's known mud volcanoes are found within Azerbaijan with over 250 known mud volcanoes located both onshore and offshore (Ref. 53). The greatest number and largest offshore mud volcanoes are concentrated at the northwestern margin of the South Caspian abyss (Ref. 12). Periodic fluid upwelling from deeper overpressured shales has led to the formation of numerous mud volcanoes and seepage features. This formation occurs through the rapid sedimentation of low permeability clay layers which leads to a thick blanket (>20km thick) of low density shale containing high excess pore-pressures. These overpressures in the sediments, combined with the vertical and lateral stresses induced by the regional compressive tectonics, are key traits which explain the upward migration of fluids in the near-seabed sediments which result in the numerous mud volcanoes at the seafloor.

A number of islands in the Baku Archipelago[1] and many underwater banks were formed as a result of mud volcano activity and underwater releases of volcanic rock comprising consolidated and unconsolidated volcanic fragments and particles (known as breccia) cover large areas of the seabed (Ref. 12). Offshore mud volcanoes within the Azerbaijan sector of the Caspian Sea occur at depths ranging from 2 to 900m water depth. The heights of the mud volcanoes vary with some known to be as great as 500m in height from the seabed (Ref. 12). In addition, there are also a number of known buried mud volcanoes. Due to their underwater location, information on offshore mud volcanoes is primarily obtained from the analysis of seismic data gathered as part of oil and gas exploration surveys. Therefore, new offshore mud volcanoes in Azerbaijan are still being discovered as oil and

[1] Comprising the islands closest to Baku and including Boyuk Zira, Dash Zira and Tava islands.

gas exploration activities in the Azerbaijan sector of the Caspian Sea investigate new areas not previously surveyed (Ref. 12).

The ACG Contract Area contains a number of hazardous active and inactive mud volcanoes and fluid upwelling features which result in a number of seabed and subsurface features visible from geophysical and geotechnical data (Ref. 13). The three largest mud volcanoes in the ACG Contract Area are Gunashli, Chirag-Azeri and Azeri-1. In addition, there is a buried volcano structure (Azeri-2) and three small volcanoes (Azeri-3, Azeri-4 and Azeri-5).

The location of known geohazards such as active mud volcanoes and buried mud volcano flows within the vicinity of the proposed ACE platform location are shown in Figure 6.2b. These features have been mapped using the latest available geophysical (2D and 3D seismic survey data, Bathymetric Multibeam Echo Sounder (MBES), side scan sonar) and geotechnical (combination of borehole and seabed) data gathered by BP from 1995 – 2015. The locations of known mud volcanos across Azerbaijan, both onshore and offshore, based on data from the Republican Seismic Survey Centre of ANAS are provided in in Appendix 6E.

6.3.1.2 Seismicity

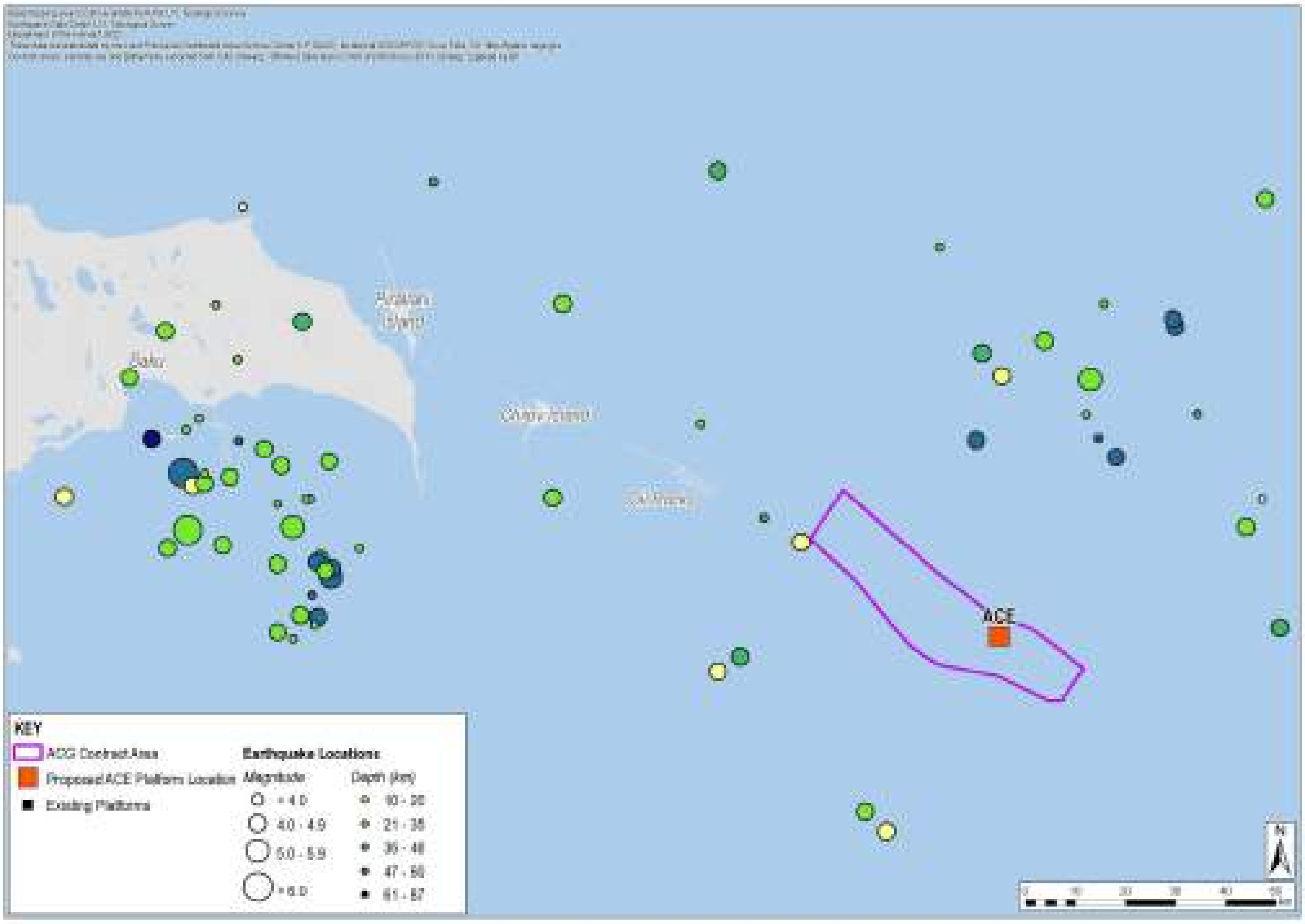
The main source of seismic activity within Azerbaijan results from the Caucasian segment of the Alpine-Himalayan (Mediterranean) folded belt, which was generated through the collision between the Eurasian and Afro-Arabian lithospheric plates, which continues to occur. The rate of northward motion of Arabia relative to Eurasia has remained more or less constant at about 2 centimetres per year (cm/year) since the collision began.

The Southern Caspian is defined by the Scythian microplate (regional tectonic block), as part of the Russian plate, the Turanian, Iranian and small Caucasian plates, as well as the South Caspian microplate. Current neotectonic (more recent) processes are leading to convergent movements of these plates. These convergent plate movements are generally associated with relatively high levels of seismic activity. The ACG Contract Area sits in the Deep Absheron Sill seismic source zone, which is where the plates meet (in the subduction zone), and the primary contributor to seismic activity in the region.

A seismic assessment (Ref. 15) undertaken for the region in 1996 detected 565 earthquakes which occurred from 650 AD to 1996 and included a subset of nine significant (magnitude[2] 6-7.7) historic earthquakes since 1668. Since the 1996 study, there have been a further four earthquakes with magnitude greater than 5 within the Baku region, including a magnitude 6.8 event in 2000. The location, magnitude and depth of earthquakes in the vicinity of the ACG Contract Area recorded by the U.S. Geological Survey (USGS) from 2000 to 2018 are shown in Figure 6.2c. The location, depth and magnitude of earthquakes across Azerbaijan with a magnitude greater than 5 recorded by the USGS in Azerbaijan during this period are summarised in Appendix 6E (Ref. 54). In addition mapping is also presented in Appendix 6E showing the spatial distribution of seismicity in Azerbaijan and surrounding regions recorded from 2003 to 2016 based on data from the seismic catalog administered by the Republican Seismic Survey Centre of ANAS (Ref. 53). It is understood this data is obtained from seismic monitoring within Azerbaijan and the surrounding regions that has been ongoing since early 2000 using modern telemetric seismic stations with satellite communication systems which provide direct observations of surface motions (Ref. 55).

[2] The magnitude is a number that characterises the relative size of an earthquake. Magnitude is based on measurement of the maximum motion recorded by a seismograph.

Figure 6.2c Earthquakes Recorded by the USGS from 2000 to 2018 (Ref. 54)



6.3.2 Meteorology and Climate

6.3.2.1 Temperature and Precipitation

The Caspian Sea region is climatically diverse and encompasses the basins of the vast semi-arid and hot arid plains of northern Kazakhstan and Turkmenistan in the east, and the humid Caucasus and Elburz Mountains in the south-west. The Caspian plays an important role in atmospheric processes, regional water balance and microclimate. Climate conditions in the Caspian region are linked to the Northern Atlantic Oscillation (fluctuations in atmospheric air pressure) which affects variations in temperatures, humidity and rainfall.

Over the Caspian area, July to August average temperatures vary between 24 and 26°C, with a maximum of 44°C on the sun-baked eastern shore. Monthly average temperatures during winter range from −10°C in the north to 10°C in the south (Ref. 16). In the western part of the Southern Caspian where Azerbaijan is located, annual variations in the temperature regime are considerable, but in general air temperatures below freezing are uncommon. Extreme air temperatures offshore have been derived by using a combined data set that comprises measurements taken from the EA and WA platforms over a total duration of approximately nine years. Estimates of extreme return period values for hundred year values are 40.8°C and -7.3°C for the maxima and minima, respectively (Ref. 37).

Precipitation is highly variable throughout the Caspian region. The highest levels of precipitation occur between September and April where the monthly average can be up to 35mm. The driest months, July to August, have monthly average precipitation ranging from 7 to 8mm (Ref. 17). Annual average precipitation in the offshore environment of Azerbaijan is approximately 300 to 400mm.

6.3.2.2 Wind

The wind conditions found on the Caspian Sea are formed largely as a result of its north to south orientation, the mountain ranges which surround it and the different weather systems converging on this area (Ref. 18). The average annual wind speed across the Caspian Sea is around 5 to 6 metres per second (m/s). The greatest average speeds of 6 to 7m/s are observed in the Central Caspian Sea (Ref. 19). Highest annual average wind speeds of 8 to 9m/s are observed around the Absheron Peninsula which also experiences the largest number of stormy days (wind speed exceeding 15m/s) at 60 to 80 days/year. Strong winds and storms can arise at any time of the year but are more common during the winter months.

Wind measurements recorded at the proposed ACE platform location, recorded an omnidirectional annual extreme wind speed of 21.2m/s hourly at 10m elevation during December and January (Ref. 20). The predominant offshore winds in the ACG Contract Area are from the north.

6.3.2.3 Visibility

Moisture saturated air converges in the south-west Caspian giving rise to foggy conditions during the winter months. Such conditions are expected to occur for around 10% of the year, mainly between October and May (Ref. 21).

6.4 Terrestrial and Coastal Environment

6.4.1 Terrestrial Setting

6.4.1.1 Construction Yards

As described in Chapter 5: Section 5.4.1 the construction yards to be utilised for the Project are yet to be confirmed. It has been assumed for the purposes of this ESIA, that a combination of the yards used for the previous ACG and SD projects will be used for the ACE Project. The setting of these yards is described below and their location is shown in Figure 6.1.

Bayil Yard

The Bayil yard (formerly known as the Amec-Tekfen-Azfen (ATA) yard) is an operational yard used extensively for oil and gas industry related construction. It is located approximately 8km south of Baku and is bound to the east and south by the Caspian Sea. Land to the west of the yard is mostly a mix of industrial sheds and storage yards with the settlement of Bibiheybat located approximately 1km away. To the north is the Bibiheybat oil field. The yard extends over an area of approximately $1km^2$. The Phase 1 Compression and Water Injection Platform (CWP), Phase 3 Production Compression Water Injection and Utilities (PCWU), West Chirag and Shah Deniz Bravo (SDB) Quarters and Utilities (QU) and Production and Riser (PR) topsides were fabricated at this yard.

With the exception of the Bibiheybat settlement approximately 1km to the west of the yard boundary, the area in which the yard is located is generally commercial / industrial in nature. Baseline ambient noise surveys undertaken in the yard vicinity in 2015 (Ref. 4) recorded average daytime noise levels of 63-65 dB (L_{Aeq}), which are considered to be typical of industrial environment and were considered to be due to industrial activities and road traffic noise primarily from the Baku-Salyan Highway, which was identified as the dominant noise source.

South Dock

South Dock is located approximately 8km to the south of Baku, in close proximity to the Bayil Yard. It has been used for various construction and upgrade projects, including barge and vessel upgrades and construction associated with ACG developments. The western boundary of South Dock is adjacent to the Baku-Salyan Highway. To the southwest there is a steep escarpment on which is located the settlement of Bibiheybat and the Bibiheybat Mosque. To the south there is a concrete jetty at the entrance to the dock and the Caspian Sea beyond. To the north is a small area of land that was previously part of the Bibiheybat oil field, which has been remediated, while to the east there is a mix of sheds and open vessel service areas with the Bayil yard located beyond.

Background noise levels were also recorded in this location in 2015 and found to be typical of an industrial / commercial area, again dominated by local road traffic noise with daytime noise levels of 43-68 dB (L_{Aeq}) (Ref. 4).

BDJF Yard

The Baku Deepwater Jacket Factory (BDJF) yard lies approximately 20km southwest of Baku on the western coastline of the Caspian Sea. The site is approximately 1.5km^2 in size and bound to the north by vacant land, to the southeast by the Caspian Sea and to the west by the Baku-Salyan Highway. The site is located on a coastal plain backed by steep hills that form a ridgeline running approximately parallel to the coast. The coastal area in the vicinity of the yard also includes a number of shallow lagoons, particularly to the west of the yard. Several derelict structures including buildings, storage tanks and wellheads are present in the surrounding area. There are no residential receptors located within close proximity to the yard.

The BDJF yard includes two areas: the area to the north that was previously used for construction of the ACG Phases 1, 2 and 3, West Chirag and SDB-QU and SDB-PR jackets and the area to the south where the corresponding topsides were constructed (except for the Phase 1 CWP, Phase 3 PCWU topsides, West Chirag and SDB topsides). The BDJF yard was also used to construct some of the subsea infrastructure for the SD2 Project.

6.4.1.2 Sangachal Terminal

The Terminal was first developed as part of the Early Oil Project (EOP) in 1996 and 1997 to process and export to market the oil produced on the Chirag platform. There have been a number of upgrades and expansions of the ST over the years to support the development of the ACG and SD fields. The most recent expansion works at the Terminal for the SD2 Project commenced in 2011 and are now complete. The existing Terminal is sited on a plain sloping gently towards the south east and to the Caspian Sea.

There are four main settlements in the vicinity of the Terminal (Figure 6.1), the largest being Sangachal Town, located approximately 2.5km southwest. Umid lies less than 1km to the southeast of the Terminal, and Azim Kend and Masiv 3 are located approximately 2.7km to the west.

Umid and Sangachal Town are adjacent to the Baku-Salyan Highway, a four lane hard-surfaced road that runs parallel to the Caspian Sea coastline. A raised railway line (2m to 4m above ground level) runs parallel to the highway, between the highway and the Terminal. Multiple underground and aboveground pipelines (oil, water and gas pipelines) also run parallel to the highway between the railway and Terminal within a third-party pipeline corridor.

Other nearby industrial development includes the state-owned power station located between the Terminal and Sangachal Town which started operation at the end of 2008. The Sangachal Power Station has been designed to produce electricity using generators powered by gas combustion with the option of using heavy fuel oil.

6.4.2 Air Quality

At a national level, air quality varies across Azerbaijan with higher pollutant concentrations recorded in cities (such as Baku) due to increased industry and transport emissions than in rural areas. Monitoring of ambient air quality in Azerbaijan is undertaken by the Department of National Environmental Monitoring and reported on an annual basis since 2005 at 26 stations in cities across the country, including nine locations within Baku city including two locations in the vicinity of Bibiheybat (Ref. 22). Outside of Baku it is understood that air quality in coastal areas of the Absheron region is not routinely monitored except in the vicinity of ST located approximately 40km south west of Baku.

From the survey data available, air quality along the coastline of the Absheron region is known to be variable with the background NO_2 concentrations in the vicinity of ST remaining relatively consistent from 2012 to 2016 based on 18 monitoring locations around the Terminal (varying between average NO_2 concentrations of 10.4µg/m^3 and 11.8µg/m^3, well below the annual average EU limit value for NO_2 of 40µg/m^3). In the vicinity of Bibiheybat, concentrations of NO_2 recorded between 2005 and 2013 have varied between approximately 25µg/m^3 and 50µg/m^3 with a concentration of approximately 38µg/m^3 recorded in 2013. Significantly higher NO_2 concentrations (up to 120µg/m^3) have been recorded within Baku itself. The lower concentrations recorded around Sangachal are due to the relatively rural setting of the Terminal.

The potential construction yards (BDJF yard, Bayil yard and South Dock) are located within an industrial setting and air quality in these locations is expected to be consistent with areas of an industrial nature as reflected by the NO_2 concentrations recorded in the vicinity of Bibiheybat.

Air quality within the Absheron Peninsula is not expected to be affected by the poor air quality within the Baku area as the predominant wind direction is north and the rural coastal areas in this region are expected to have relatively good air quality.

Monitoring of dust and particulate levels around the ST and within Baku indicate average particulate concentrations (as PM_{10}[3]) of 24.3 and 240µg/m^3 which is 6 times more than the annual average EU limit value of 40µg/m^3. Wind blown dust is a known nuisance issue across the region and within Baku, and considered typical of such an environment.

6.4.3 Coastal Environment

6.4.3.1 Coastal Habitat

A variety of coastal habitats comprising a mixture of natural and man-made are found along the Azerbaijan coastline (Ref. 1). The typical habitats present along the coast from the Absheron Peninsula to Neftchala in the south (approximately 150km length of coastline) include:

- Exposed rocky shores;
- Exposed solid man-made structures;
- Shelving bedrock shores;
- Eroding scarps;
- Sand and mixed gravel beaches;
- Mixture of exposed and sheltered riprap;
- Mixture of exposed and sheltered sand and mud flats;
- Backshore sand and mud flats; and
- Marsh, reed beds and bog.

The distribution of these habitats varies along this stretch of coastline. The coastline of the Absheron Peninsula comprises mainly marsh vegetation including dense stands of water reed and soft rush (*Juncus effusus*) interspersed with areas of sand beach and rocky shores. Much of the coastline from Turkan, around Baku Bay and towards Sahil has either been developed or is in the early stages of development with only sporadic patches of natural habitat or semi-natural habitat such as Puta Bay near the BDJF yard which consists of coastal lagoons, wet sandy areas and areas of gravelly beach. The coastline around Sangachal Bay comprises several habitats including a rocky coastline with sparse vegetation cover, littoral reedbeds, shallow lagoons, and a salt marsh interspersed with areas of existing or previous urban and industrial development. The coastline from Sangachal Bay to Neftchala in the south is mainly rural in character and is dominated by sandy beaches with some sand and mud flats which are used by birds. Vegetation density varies from sparse to extensive with swamp/marsh areas, together with areas of mudflat, frequently colonised by glasswort grasses, shrubs and some reed beds (depending on the extent of standing water).

[3] Atmospheric air containing dust having particulates with <10 um diameter aerodynamic size distribution.

6.4.4 Birds

The Caspian region has a high diversity of bird species, with a large number of endemic species present. Migrating and overwintering birds tend to move widely along the Caspian coast. Consequently, at a regional level, the coastal zone of the Caspian Sea has been identified as an area of ornithological importance as it supports both internationally and nationally significant numbers of migrating and overwintering birds. Given Azerbaijan's location within the bird migrating circuit of Europe, Asia and the Middle East a large number of bird species have been recorded, with onshore and offshore areas providing habitats for 347 avifauna species, including 31 species of seabirds (Ref. 23).

The Azerbaijan coastline of the Caspian Sea from the Absheron region moving south is an area of international and regional importance providing habitat for breeding, nesting, migratory and overwintering birds. An estimated 85 species of waterfowl and coastal birds have been recorded in this region over the past 17 years (Refs. 24, 25, 26 & 27). Many species of conservation importance, including globally threatened species, species included in Annex I of the EU Birds Directive (2009/147/EC) and birds listed in the Azerbaijan Red Data Book (AzRDB) can be found in this coastal area at some point. Fifteen of these species are included in the AzRDB and the IUCN Red List of Threatened Species (refer to Appendix 6A for full list).

A literature review was undertaken in March 2018 to obtain the latest information on migratory, wintering and nesting bird species present along the Azerbaijan coastline of the Caspian Sea between Absheron and Neftchala (located within Shirvan National Park) to the south and information specific to birds and the ACG Contract Area. The review was prepared using the latest available literature on bird data and the evaluation of coastal survey data from 2002-2017 in order to identify the likely species present, estimated number of birds, identify important and sensitive bird areas and confirm key bird migration routes and seasonal variations in their presence. A summary is provided below with the full review report presented within Appendix 6A.

6.4.4.1 Migratory Birds

The distribution and abundance of birds in the coastal region is subject to significant seasonal changes particularly during the spring and autumn migration periods as birds move between feeding, breeding and overwintering grounds.

The coastlines of Azerbaijan are a major flyway for migrating waterfowl and coastal birds, who nest in the parts of Russia, western Siberia, and north-western Kazakstan and migrate to the southern coast of the Caspian Sea, the Kur-Araz lowland, Turkmenistan, southwest Asia and Africa for the winter. The autumn migration begins in the second half of August and continues until mid-December although this may extend into January during years of severe winter in Russia. The most active autumn migration period is November. The spring migration starts in the second half of February and ends in April, with the most active period during March. Table 6.2 below outlines the key migratory periods in the region and the migration routes are illustrated in Figure 6.3.

Table 6.2 Key Migration and Active Periods Along the Southwest Caspian Coastline (Absheron to Neftchala)

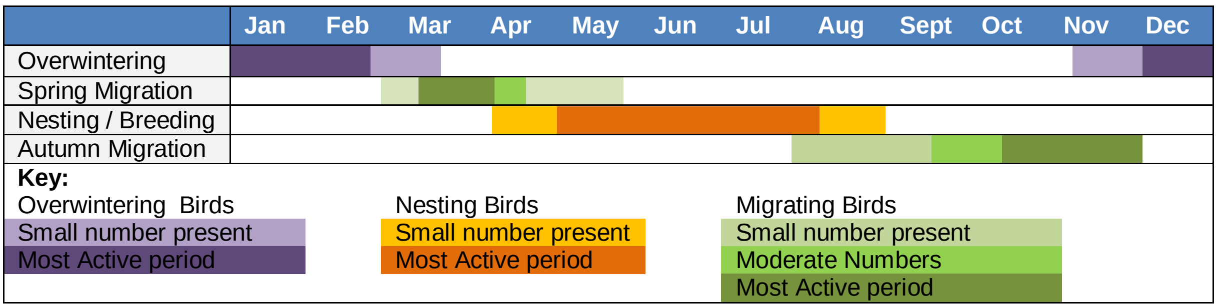
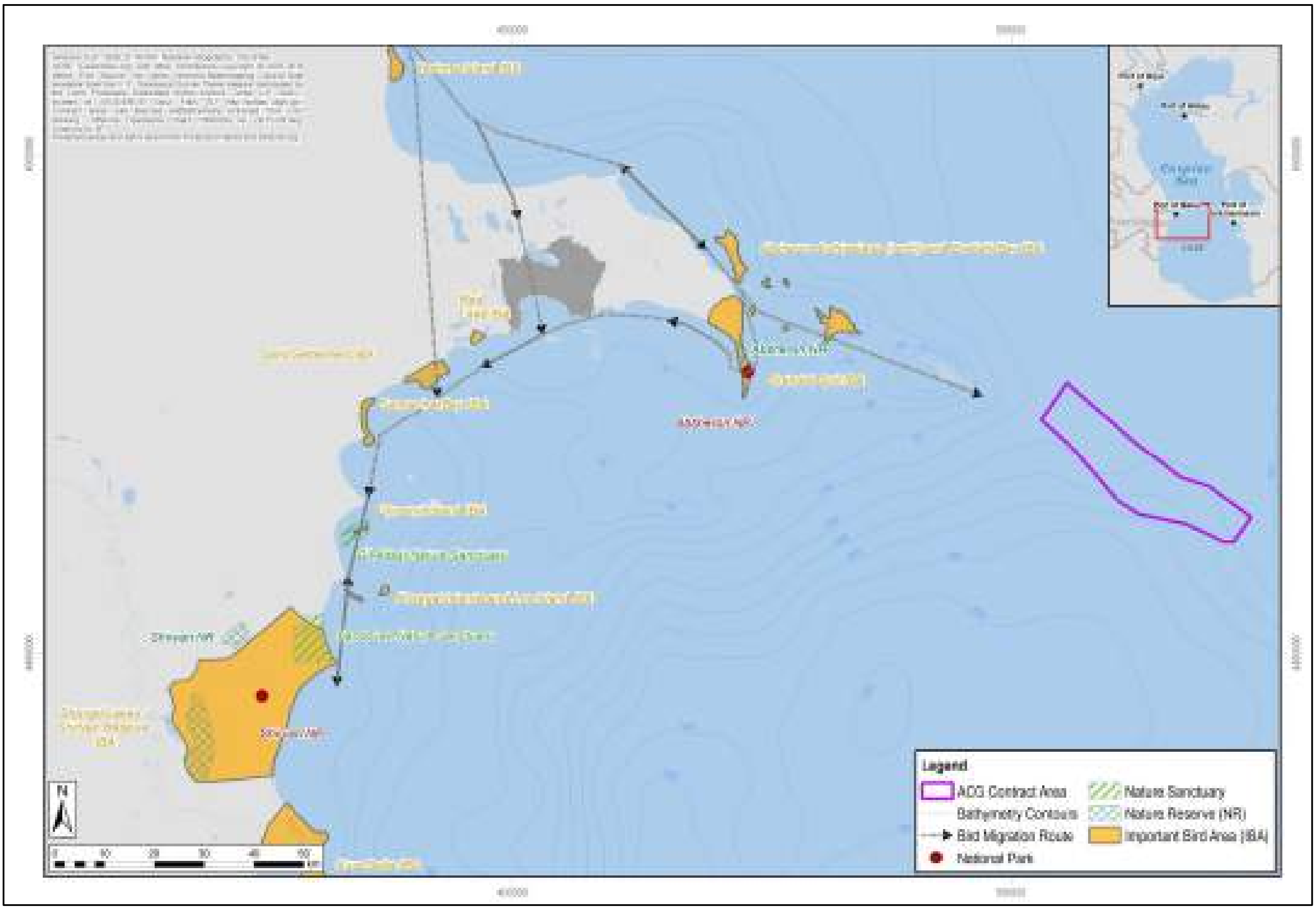


Figure 6.3 Important Ornithological Sites Located on the Southwest Caspian Coastline (Absheron to Neftchala) and Migration Routes



During the autumn migration, research has indicated that 51% of birds fly along the Caspian Sea coast to the south, 37% fly to the south west, while 12% of the birds fly from the Pirallahi-Shahdili coastline to the south east (Ref. 31). The migration routes broadly understood to be followed are illustrated in Figure 6.3.

84 species of waterfowl and coastal birds recorded along the Absheron-Neftchala coastline area between 2002-2017 are known to have migrant populations. The species composition changes sharply during migration periods, leading to the coastal area being highly sensitive during periods of overwintering and migration (although Shahdili Spit is considered to be sensitive all year around). Birds use these routes primarily for migrating to the southern coast of the Caspian Sea, the Kur-Araz lowland, Turkmenistan, south west Asia and Africa for the winter and then fly north along the same route during spring (see Figure 6.3).

6.4.4.2 Overwintering Birds

Approximately 36 species of waterfowl and 16 species of coastal migratory birds are reported to overwinter along the coastline from Absheron to the north to Neftchala to the south (refer to Appendix 6A for list of recorded species). The most vulnerable areas for overwintering are coastal waters near Pirallahi, Shahdili, Turkan, Gobustan and Alat coastlines (refer to Appendix 6A).

The majority of birds to overwinter are ducks (of the genera *Anas, Netta* and *Aythya*) and coot (*Fulica atra*) but migrating herring, common, black-headed and great black-headed gulls (all of the genus *Larus*) also overwinter along the coastline. These particular species will dive in shallow waters to feed on small fish and benthic invertebrates on or near the seabed. Wading birds also feed in coastal waters but, with the exception of the beak, remain above the water during feeding.

6.4.4.3 Nesting Birds

The breeding and nesting season along the Azerbaijan coastline begins at the end of April/beginning May and continues until mid-July. At the end of July and beginning of August, the birds leave their nesting places and disperse. The coastline is host to a number of important nesting migratory seabirds, in particular the Mediterranean gull (*Larus melanocephalus*) (listed in the AzRDB) and the slender-billed gull (*Larus genei*), and a number of tern species (of the genera *Sterna*, *Chlidonius* and *Hydroprogne*). The most recent surveys undertaken in June 2017 indicated three areas of particular importance to nesting birds (refer to Appendix 6A):

- **Shahdili Spit** – The Shahdili Spit and associated islands is a designated IBA, comprising of a mixture of habitats for nesting birds including areas of open dry land, wet sandy areas, rocky areas, reeds and marshes. A wide variety of nesting species are known to use the area (primarily terns and gulls but also wading birds including plover and avocet, herons, grebes and coots). One nesting species of conservation importance (pied avocet) has been recorded in this area.
- **Dash Zira** – Island located to the immediate south of Baku and comprising open dry lands, rocky, gravelly places, piled shells and wet sandy areas. Also includes an area of long reeds approximately 1 to 2m wide and between 60 to 70m long. A rich diversity of birds is found here, which is attributed to the favourable ecological conditions.
- **Gil Island** – This State Nature Reserve consists of open dry rocky shore with shell and sandy areas throughout and some long reed bush. The most recent surveys carried out recorded five species including Caspian gull, common terns, sandwich tern, black winged stilt and pied avocet.

6.4.4.4 Species of Conservation Importance

Table 6.3 lists the 15 species of bird of conservation importance (included on the IUCN Red List or listed in the AzRDB) known to be present along the Absheron to Neftchala coastline (predominantly migratory and overwintering birds).

Table 6.3 Bird Species of Conservation Concern Observed on the Southwest Caspian Coastline (Absheron to Neftchala)

Common Name	Scientific Name	Protection Status
Great white pelican	*Pelecanus onocrotalus*	AzRDB
Dalmatian pelican	*Pelecanus crispus*	AzRDB, IUCN Red List
Greater flamingo	*Phoenicopterus ruber*	AzRDB
Whooping swan	*Cygnus Cygnus*	AzRDB
Tundra swan	*Cygnus columbianus*	AzRDB
Marbled duck	*Marmaronetta angustirostris*	AzRDB, IUCN Red List
White-eyed pochard	*Aythya nyroca*	AzRDB, IUCN Red List
Common pochard	*Aythya farina*	IUCN Red List
White-headed duck	*Oxyura leucocephala*	AzRDB, IUCN Red List
Western swamphen	*Porphyrio porphyrio*	AzRDB
Black-tailed godwit	*Limosa limosa*	IUCN Red List
Eurasian curlew	*Numenius arquata*	IUCN Red List
Curlew sandpiper	*Calidris ferruginea*	IUCN Red List
Northern lapwing	*Vanellus vanellus*	IUCN Red List
Mediterranean gull	*Larus melanocephalu*	AzRDB

6.4.4.5 Bird Sensitivity

The major flyway for migrating waterfowl and coastal birds, which is most active during March and November, passes between the ACG Contract Area and the Azerbaijani coastline. Birds are primarily migrating to the southern coast of the Caspian Sea, the Kur-Araz lowland, Turkmenistan, southwest Asia and Africa for the winter and then fly north along the same route during spring. It is also considered likely that some birds may migrate from the key ornithological sites through the ACG Contract Area during the spring (February – April) and autumn (August – December) migration periods (Table 6.2).

A number of overwintering species, particularly ducks, will dive in shallow waters to feed on small fish and benthic invertebrates on or near the seabed. Wading birds will be common only in shallow coastal waters. Whilst some species, such as the gulls, will feed offshore at times it is likely their presence in the ACG Contract Area will be limited to occasional individuals.

Bird species at the key ornithological sites along the Azerbaijan coastline, particularly species that spend most of their time in the water (e.g. genera *Aythya, Anas, Cygnus, Bucephala, Mergus, Podiceps, Phalacrocorax, Pelecanus* and *Fulica atra*) will be most vulnerable to potential major spills. To date, no major spills have occurred due to activities associated with the ACG Contract Area.

6.4.4.6 Protected Areas and Sites of Ornithological Importance

In total there are eight National Parks, 11 State Nature Reserves and 24 Sanctuaries designated within Azerbaijan primarily for the protection of wildlife. Table 6.4 lists the protected sites and Important Bird and Biodiversity Areas (IBAs) which are located along the coastline from the Absheron Peninsula to the Kura Delta (refer to Figure 6.3 for locations). In a number of cases, some areas are designated as both protected areas and Sites of Ornithological Importance, although the area under each designation may slightly differ.

Table 6.4 Sites of Ornithological Importance

Sites of Ornithological Importance		Designation	Reasons for Designation
1	Absheron National Park (including Shahdili spit and Pirallahi Island)	KBA[1]/IBA[2] IUCN II[3]	KBA/IBA – The area is important for overwintering and migrating bird species. IUCN II – In 1969 the area was established as a Nature Reserve to protect, amongst others, the endangered Caspian seals (during haul out) and water birds of international importance. It was later designated as a National Park in 2005. Approximately 46 RDB species occur within and in the surroundings of the national park.
2	Red Lake	KBA/IBA	Significant populations of globally threatened bird species are known to occur here. The area is important for breeding bird species.
3	Sahil Settlement – 'Shelf Factory	KBA/IBA	Significant populations of globally threatened bird species are known to occur here. The area is important for overwintering and migrating bird species.
4	Sangachal Bay	KBA/IBA	The area is important for overwintering and migrating bird species.
5	Gobustan Area	KBA/IBA IUCN not reported[4]	KBA/IBA – Populations of globally threatened bird species are known to occur here. The area is important for breeding bird species. IUCN not reported – Gobustan State Nature Reserve.
6	Glinyani Island	KBA/IBA IUCN IV[5]	KBA/IBA – The area is important for breeding bird species. IUCN IV – Designated in 1964 due to its importance for migratory and wintering waterfowl birds, sea-gull colonies and Caspian seals. Two RDB species occur in the area. KBA/IBA - The area is important for breeding bird species.
7	Pirsagat Islands and Los Island	KBA/IBA	Populations of globally threatened bird species are known to occur here. The area is important for breeding bird species.
8	Bandovan	IUCN IV	49 RDB species known to occur here.
9	Shirvan National Park	KBA/IBA IUCN II	KBA/IBA – Significant populations of globally threatened bird species are known to occur here. The area is important for overwintering and breeding bird species. IUCN II – In 1969 the area was established as Shirvan State Reserve, focused to protect one of the world's largest population of Persian gazelle (*Gazella sulgutturosa*) and its rich water-wading ecosystem. The wetlands are considered as an important site for many valuable bird species, used for nesting, migration routes and wintering area. It was later designated as a National Park in 2003. Approximately 56 threatened species occur in this area.
10	Kura Delta	KBA/IBA	Significant populations of globally threatened bird species are known to occur here. The area is important for overwintering and migrating bird species.
11	Gizil Agach	KBA/IBA IUCN Ia Ramsar Site[6]	KBA/IBA – Important breeding and overwintering area for birds. A large number of globally threatened species occur here. IUCN Ia – Gizilagach State Reserve is located within this area. Fifty nine threatened species occur in this area. Ramsar – A wetland of international importance for migrating and breeding birds.

Notes:
[1] Nationally identified sites of global significance that address biodiversity conservation at a local scale (individual protected areas, concessions and land management units). Key Biodiversity Areas (KBAs) comprise an 'umbrella' which includes globally important sites (e.g. Important Bird Areas (IBAs), Important Plant Areas (IPA), Important Sites for Freshwater

Sites of Ornithological Importance	Designation	Reasons for Designation
Biodiversity, Ecologically & Biologically Significant Areas (EBSAs) in the High Seas, Alliance for Zero Extinction (AZE) sites). [2] Key sites for the conservation of bird species, identified by BirdLife International. These sites are small enough to be conserved in their entirety, and are different in character or habitat or ornithological importance from the surrounding area. [3] The main objective of a national park (IUCN Category II) is to protect functioning ecosystems, rather than focussing on protecting a particular species or habitats through management of the reserves thus prioritising these species or habitats which would come under IUCN category IV. [4] A nationally protected area as listed by the World database on protected areas, but with an unknown IUCN category, e.g. Gobustan State Nature Reserve. [4] Protecting a particular species or habitats and management of the reserves prioritises these species or habitats. [5] Category IV refer to Habitat/Species Management Area. It aims protecting a particular species or habitats and its management prioritise these species or habitats. [6] Convention on Wetlands of International Importance – ensuring the conservation and wise use of wetlands in national environmental planning; and consulting with other parties in regard to trans-boundary wetlands, shared water systems, and shared species.		

6.5 Regional Offshore Environment

6.5.1 Bathymetry and Physical Oceanography

The Caspian Sea is the largest landlocked water body on Earth with a surface area of approximately 371,000km^2. It is fed by numerous rivers, the largest of which is the Volga to the north. The Caspian Sea is made up of three basins: the Northern, Central and Southern Basins. The Northern Basin is the smallest (about 25% of the total surface area), but is very shallow. The Central and Southern Basins have similar surface areas, but the Southern is deeper and contains almost twice the volume of water as the Central Basin. The deepest recorded depth is in the Southern Caspian Basin and is just over 1,000m.

The bathymetry of the ACG Contract Area is particularly complex. It lies on the southern flank of the Absheron sill: the sill that separates the Central and Southern Caspian Basins. Depths vary little longitudinally, but change rapidly transversely. The deepest waters (about 600m) are along the southern border of the Contract Area. The continental slope is very steep (up to 1:8), with the shallowest waters found at the crest of the slope where a few isolated regions are less than 100m. Further north, the bathymetry plateaus at a depth of about 150m. The water depth at the proposed location of the ACE platform is approximately 137m.

6.5.1.1 Sea Level

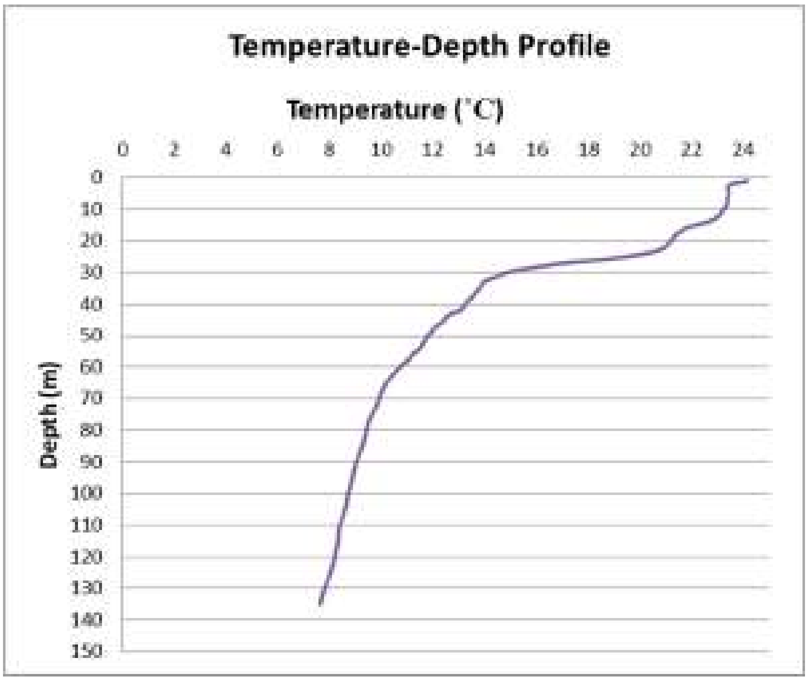
The Caspian Sea has experienced significant water level fluctuations over the past several hundred years, including changes of several metres within the past few decades. The Caspian Sea and is one of the few water bodies in the world where the water level is lower than the global mean sea level of the world’s oceans. The variation in sea level is a result of changes in water inflow from rivers (mainly the Volga which represents 70% of total inflow), precipitation, loss from evaporation and discharge to the Kara-Bogaz-Gol in Turkmenistan. A recent study (Ref. 28) found that water levels in the Caspian Sea increased by approximately 12.74cm/year during the period 1979–1995 and dropped approximately 6.72cm/year during the period 1996–2015. The study found that increased evaporation rates over the Caspian have significantly contributed to the recent drop in sea level and predicts accumulating evaporation rates over the Caspian Sea for the foreseeable future will lead to further sea level decline. The current Caspian Sea level is approximately 28m below sea level.

6.5.1.2 Water Temperature

As a result of the differential climatic conditions between the Caspian basins, the seabed bathymetry, the current regime and the northern fluvial inputs, sea surface temperatures change significantly across the seasons in the Central Caspian while the temperature at depth remains constant. In the vicinity of the ACG Contract Area, the top 10m of the water column typically experiences temperature variations from approximately 7°C in February to about 27°C during August, while at a 100m depth little seasonal variation occurs (temperature ranges between 5.7°C and 6.3°C) (Ref. 29 & 30). These marked differences between surface and deeper water temperature result in the formation of a seasonal thermocline (a stable zone within the water column exhibiting a rapid rate of temperature change), which restricts mixing of the upper and lower water layers, thereby stratifying the water column while it persists.

The ACE EBS conducted in June 2017 measured the water temperature-depth profile using a submersible CTD (Conductivity, Temperature, Depth) sensor. The survey recorded a major temperature decline of ~10 °C between 21 and 34m water depth (refer to Figure 6.4).

Figure 6.4 Temperature-Depth Profile Measured at the ACE Location in 2017



6.5.1.3 Salinity

The salinity in the Caspian Sea is almost three times lower than that of the world oceans (Ref. 32). The surface salinity levels vary with water temperature (i.e. evaporation rates), distance to fresh water sources and the riverine input. The salinity of the surface water in the ACG Contract Area increases in summer months and can reach up to 11-13 practical saline unit (PSU). The most recent samples taken from the ACG Contract Area in July/August 2014 recorded salinity values of 10.35 to 11.32 PSU. Sampling conducted as part of the 2017 ACE EBS found little variation in salinity at the stations sampled, ranging from 10.75-10.82 PSU at 5m water depth and 10.52-10.74 PSU at 50m water depth.

6.5.1.4 Oxygen Regime

Oxygen levels in seawater are dependent on photosynthesis, respiration of marine fauna and physical mixing, and can be affected through temperature change with warmer water generally holding less oxygen. The biological effects of warmer water temperatures can be to increase oxygen demand from marine organisms (Ref. 50). Increased nutrient inputs (e.g. from sewage discharges or agricultural run-off) can also lead to oxygen depletion.

The deep water areas of the Southern Caspian Basin are characterised by lower dissolved oxygen levels compared to the Northern and Central Caspian Basins. This is caused among other factors, by poor penetration of sunlight and reduced photosynthesis activity, the deficiency of large river inflows and the stratification of the water column during the thermocline. Dissolved Oxygen (DO) levels in the Southern Caspian Basin decrease with depth and saturation can reach levels as low as 10% at 600m depth (Ref. 33).

Throughout the year the surface waters of the Southern Caspian Basin are characterised by high oxygenation with high saturation levels occurring in the spring due to phytoplankton activity. During summer, the water column becomes stratified, resulting in decreased oxygen levels below the thermocline.

Sampling conducted as part of the 2017 ACE EBS recorded DO levels of between 6.88 milligrams per litre (mg/l) and 7.51mg/l at 5m water depth and between 6.74mg/l and 6.86mg/l at 50m water depth. This compares to levels of between 6.85 and 8.01 mg/l (surface) and 7.56 and 7.84mg/l (50m water depth) recorded across the ACG Contract Area in 2014. Water quality standards in Azerbaijan for fisheries require DO level in excess of 6 mg/l; all samples taken during the ACE EBS were above the recommended level.

6.5.1.5 Wave and Current Regime

The main distinguishing features of the Caspian Sea are its isolation from the world's oceans and its intracontinental location. The Caspian is non-tidal, with the currents primarily influenced by wind, bathymetry, water density and temperature variations leading to some isolation between the Northern, Central and Southern Caspian areas (Ref. 34). The resulting large scale circulation pattern consists of two anti-clockwise currents in the Northern and Central Caspian, and the western anticyclonic and the eastern cyclonic gyres in the Southern Caspian. According to Kosarev and Yablonskaya (Ref. 35), in-flowing rivers influence the current regime, creating a southwards flow down the west coast of the Central Caspian and a counter current up the east coast as well as small residual currents in the southwest of the Caspian Sea.

The predominant wave heights in the Caspian Sea are relatively low with a minor build-up of swells, given the sea's land-locked nature and absence of tides. The greatest wave development occurs from the western section of the Central Caspian basin down and across the central section of the Absheron Ridge. The strong north-western winds under the influence of costal and nearshore morphology of the Absheron Peninsula create waves directed to the east nearshore and to the northwest offshore. During normal conditions, waves in the Absheron region are generally less than 2m in height (Ref. 36).

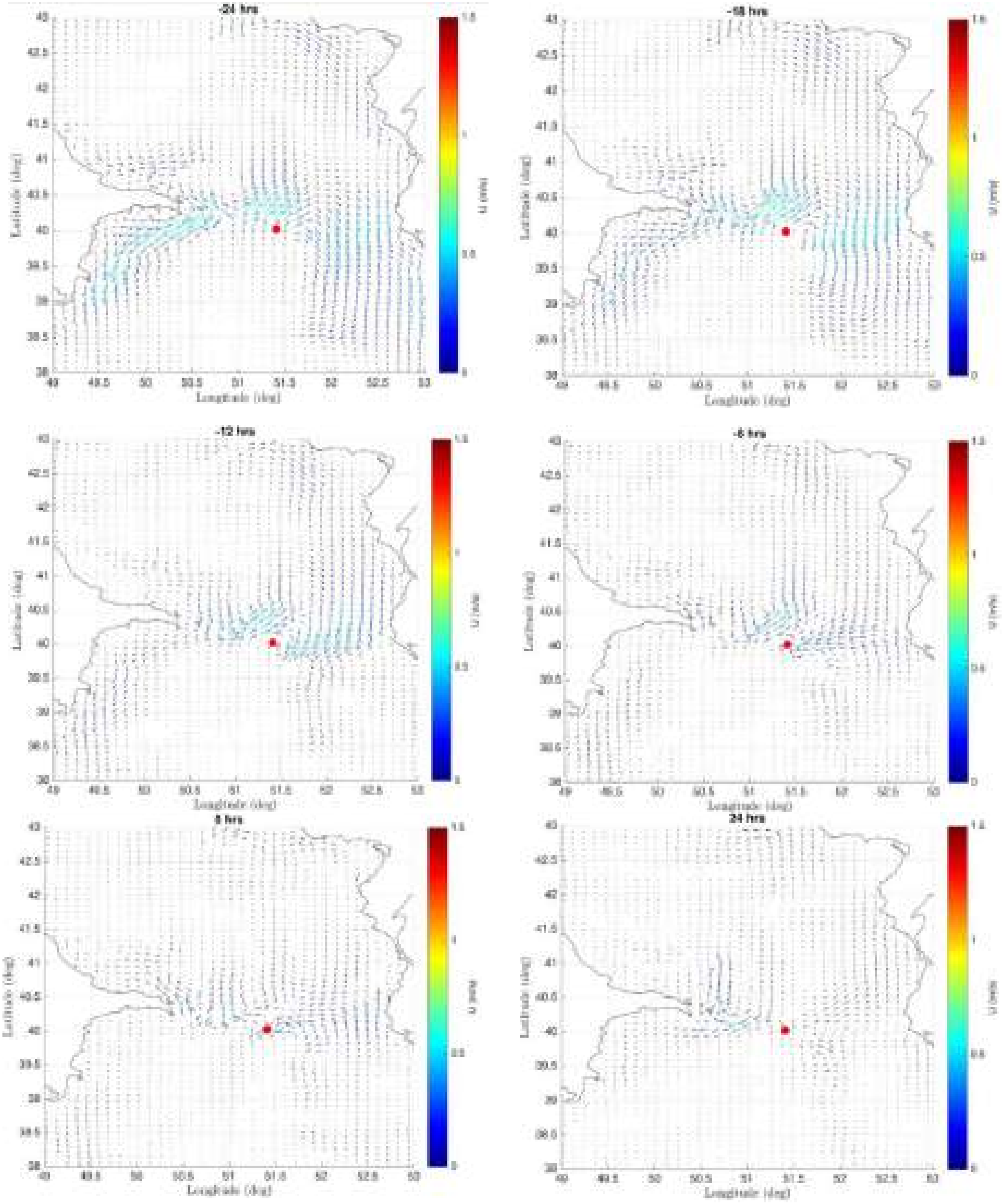
The mechanism that drives the currents can be traced back to the Northern Caspian Basin. Here, very cold winter air temperatures, shallow waters and large fluvial inputs from rivers, lead to rapid ice development and the formation of a reservoir of cold, dense water on the boundary with the Central Caspian Basin. The cold water is transported along the western Central Caspian Basin under the influence of cyclonic winds associated with the winter low pressure trough. A component sinks and flushes the bottom waters of the Central Caspian Basin, but in normal years a large volume finds its way over the western section of the Absheron sill and into the Southern Caspian Basin where it appears to mix and sink. A counter flow of relatively warm Southern Caspian Basin water along the eastern section of the Absheron sill balances the cold water inflow.

The irregular depth of the Absheron shelf complicates the winter seasonal flow further. The shelf is deeper on the western side (with a maximum depth of over 200m) than on the eastern side (where depths are usually less than 150m). Therefore, the cold water inflow penetrates beneath the level of the warm water outflow. This is thought to cause currents along the continental slope of the eastern shelf to flow towards the west. Currents in the region are complex and may be strong, especially during winter. The main component of strong currents is a winter wind driven circulation modulated, and sometimes reversed, by the action of passing storms. Tidal currents in the Caspian are negligible.

Storm Driven Flows

The passage of storms with strong winds from the northwest may cause large current surges. As the storms build the southerly flow into the Southern Basin is enhanced. Later, however, as the storms dissipate, the currents in the western region of the ACG Contract Area reverse and flow strongly back into the Central Caspian. The most severe storms are associated with extra-tropical cyclones and are from the north or northwest with approximately ten storms each year, usually occurring in winter months. Figure 6.5 shows an extreme current event modelled using the Caspian Sea Meteorological and Oceanographic Study (CASMOS) hindcast data from January 1975 during a period of backflow following a north-westerly storm. The extreme current event occurred 24 hours after a large wave event which at the proposed ACE platform location had a significant wave height of almost 9m and peak wind speeds of 25m/s (Ref. 20).

Figure 6.5 Vectors of Average Depth Current Speed (U) During An Extreme Current Event (Ref. 37)



*Approximate location of ACE Platform is shown in red.

The high persistent winds resulted in strong currents (through the entire water column) that flowed southwards around the Absheron Peninsula, but also southwards along the eastern edge of the Caspian Sea. However, along the central part of the sill a return flow developed with strong currents from the Southern basin entering the Central basin. At the time of the peak of the current event there was a convergence between a southerly flow along the eastern edge of the central basin and a northerly flow along the eastern edge of the southern basin. This led to a westerly flow along the sill that was constrained by an eddy to the northwest of the ACG Contract Area that appears to have resulted in an intensification of the currents.

Figure 6.5 shows the current dynamic in relation to the location of the proposed ACE Project platform. Current regime follows characteristic circulation on the east and western coasts of the Caspian with an upwelling which flows through the Central basin past the proposed ACE platform location.

6.5.1.6 Storm Surges

Storm surges are a common event in the Caspian causing temporary rises or falls in sea level. Significant sea level changes occur in the Southern Caspian including at the proposed ACE Project location. These events are associated with persistent strong winds, particularly the strong prevailing regional winds that blow along the axis of the Caspian, from north and northwest or from south and southeast (Ref. 35). Waves in the Caspian Sea, including in the ACG Contract Area, are wind driven and subsequently the windiest months also exhibit the greatest wave action (Ref. 20). The largest waves can be expected when the wind direction is northerly or southerly, as waves have longer time to build up at these wind directions.

Wave height data recorded at Nyeftyanye Kamni/Oil Rocks indicates that the months of July, August and September have the strongest winds and storms, with a higher frequency of wave heights in excess of 2m recorded. The period of October to February however shows the greatest number of wave heights between 1 and 2m, reflecting the steady occurrence of strong winds during this period.

South of the Absheron Peninsula northerly winds will create a fall in sea level while southerly winds result in a rise. In Baku Bay this change can be ±70-80cm. The typical time period for a storm surge is estimated at between 6-24 hours (Ref. 37).

The area of greatest wave development extends from the western portion of the Central Caspian basin, down and across the central section of the Absheron Ridge.

Storm surges occur in the Caspian Sea causing temporary rises or falls in sea level. Significant sea level changes occur in the Southern and Central Caspian Basin. These events are associated with persistent strong winds, particularly the strong prevailing regional winds that blow along the axis of the Caspian Sea, from north and north-west or from the south and south-east. Strong winds from the north are more frequent and more severe than strong winds from the south. Waves in the Caspian Sea are wind driven and subsequently the windiest months also exhibit the greatest wave action. The largest waves can be expected when the wind direction is northerly or southerly, as waves have longer time to build up at these wind directions.

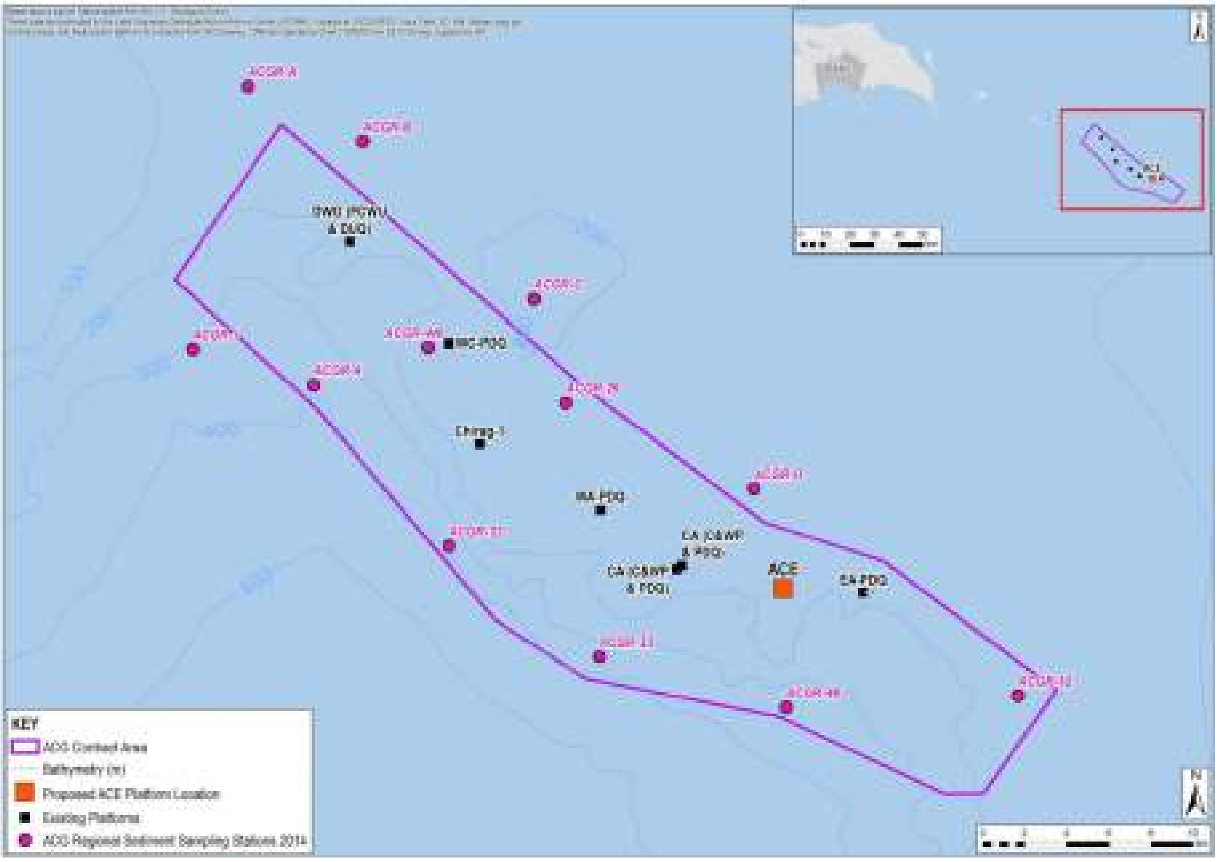
Predicted metocean conditions at the proposed ACE platform location were modelled using a variety of metocean data sources to inform the design of the ACE Project (Ref. 37). The modelled metocean conditions suggest that extreme maximum wave heights would range from 9.4-9.6m at the proposed ACE platform location and would occur from November to February. Actual measured wave height data from 2015-2018 recorded at the WA platform supports the modelled predictions with significant wave heights of over 8.5m recorded within the same months (Ref. 37).

6.5.2 Physical and Chemical Characteristics of Seabed Sediments

The physical and chemical composition of seabed sediments within the ACG Contract Area have been established through monitoring and baseline surveys undertaken in 1995, 1996, 2004, 2006, 2008, 2010, 2012 and 2014. Since 2004 these surveys have been regularly undertaken as part of the EMP using standardised methods and reported to the MENR within annual EMP reporting. The most recent regional benthic survey was undertaken in 2014 at the sampling stations shown in Figure 6.6 below.

The seabed sediment characteristics specific to the proposed ACE platform location are described in Sections 6.6.1 and 6.6.2.

Figure 6.6 Location of ACG Regional Benthic Survey Sediment Sampling Stations (2014)



6.5.2.1 Physical Properties

Physical characteristics of the sediments sampled that have been routinely recorded across the regional surveys between 2004 and 2014 include mean diameter, % carbonate, % organic matter and % silt-clay. The results (refer to Table 6.5) indicate that there have been some fluctuations in sediment characteristics at a number of the stations over the period of surveys (stations 1, A, B, and C), but there was no evidence of long-term, significant changes in the sediment characteristics of the Contract Area. The surveys have indicated that physical conditions at the majority of stations have been stable over the past ten years, with the physical character of the sediments at some stations changing from one survey to the next, but then returning to the previous conditions in a subsequent survey. This indicates potentially a short term localised fluctuation occurring after which the sediments recover and return to their previous status.

The organic matter content of the sediments has been consistently highest at stations 22 and 33, which are located close to known mud volcanoes. Carbonate content of the sediment has been consistently highest at station 62. This suggests that the seabed contains a high proportion of shell fragments in this area.

Table 6.5 Physical Properties of Sediments, ACG Regional Surveys, 2004 to 2014

Year	Mean Diameter (µm)						Carbonate %					
Station	2004	2006	2008	2010	2012	2014	2004	2006	2008	2010	2012	2014
01	104	63	15	14	10	16	33	33	20	18	12	24
A	14	13	21	11	218	12	22	22	24	20	42	20
04	12	9	7	8	9	9	23	25	20	20	15	23
B	136	434	552	7	6	319	26	31	28	24	29	41
W6	502	759	389	378	255	280	41	58	41	44	42	35
22	5	5	6	6	5	6	31	31	27	26	17	23
C	177	209	10	295	153	108	30	46	22	49	47	44
26	12	16	10	9	8	9	28	30	24	22	16	23
33	6	6	6	6	6	7	31	31	34	30	19	25
D	9	7	8	9	8	7	11	24	26	29	17	24
46	9	10	9	10	8	8	26	30	30	27	25	25
62	182	200	154	273	183	155	65	66	63	65	63	62
Minimum	5	5	6	6	5	6	11	22	20	18	12	20
Maximum	502	759	552	378	255	319	65	66	63	65	63	62
Mean	97	144	99	86	72	78	31	36	30	31	29	31
	Organic %						Silt-Clay %					
	2004	2006	2008	2010	2012	2014	2004	2006	2008	2010	2012	2014
01	4.5	5.5	3.5	4.1	5.0	3.3	71	69	86	86	87	81
A	4.2	4.1	3.4	4.3	4.2	3.7	88	87	80	90	37	87
04	6.4	4.9	3.9	6.6	9.3	5.1	92	93	97	96	91	92
B	4.1	3.3	3.9	7.7	9.2	3.8	69	49	41	98	100	46
W6	4.1	3.4	2.8	2.9	3.2	3.4	55	24	41	43	38	68
22	8.8	8.6	8.2	9.7	11.3	8.7	98	99	99	98	98	98
C	3.5	2.7	4.7	2.2	2.8	2.5	32	34	93	23	33	42
26	4.9	3.2	4.1	4.4	4.9	4.3	85	78	90	92	94	92
33	7.9	7.9	7.1	7.9	10.0	8.4	98	98	98	98	98	98
D	6.3	7.5	5.6	4.9	6.1	6.1	88	92	91	90	87	94
46	5.3	3.9	3.8	3.7	5.0	3.6	95	92	94	92	96	97
62	3.0	3.2	2.3	2.7	3.5	4.1	40	40	41	35	40	45
Minimum	3.0	2.7	2.3	2.2	2.8	2.5	32.0	24	41	23	33	42
Maximum	8.8	8.6	8.2	9.7	11.3	8.7	98.0	99	99	98	100	98
Mean	5.3	4.9	4.4	5.1	6.2	4.7	75.9	71	79	78	75	78

6.5.2.2 Hydrocarbon Concentrations

Hydrocarbon concentrations have also been routinely monitored within the ACG regional surveys. A summary of results obtained is provided within Table 6.6, showing that for the latest survey in 2014, the range of hydrocarbon content of sediments recorded across the sampling stations was large with concentrations of Total Hydrocarbon Content (THC) ranging from 7 to 601 micrograms per gram (µg/g). The highest concentrations were recorded at stations 22 and 33 which lie in deep water at the foot of a very steep slope, on the central southern flank of the Contract Area. The lowest hydrocarbon concentrations were recorded in the shallower north-western (e.g. stations A, B, 1 4 and W6) and south-eastern (e.g. stations 46 and 62) stations. Spatial patterns of THC and aromatic hydrocarbon concentrations recorded were very similar.

The concentrations of hydrocarbons recorded in the samples from the 2014 survey were the highest that have been recorded at the regional sampling stations for the period 2004 to 2014. However, there was no evidence of recent hydrocarbon inputs at any station and this result is most likely due to a combination of natural sample variation and analytical variation, and the input of weathered hydrocarbon material originating in the Chirag-Azeri and Azeri-1 mud volcanoes which are thought to influence the stations with the highest hydrocarbon concentrations (stations 22 and 33). In summary, there was no evidence that operations in the Contract Area have affected the hydrocarbon concentrations at any of the regional stations and no hydrocarbons characteristic of operational discharges were detected in the 2014 survey.

Table 6.6 Statistical Summary of Trends in Sediment Hydrocarbon Content in ACG Regional Benthic Surveys 2004 – 2014, Mean, Minimum and Maximum Concentrations

	THC (µg/g)			UCM (µg/g)			%UCM			Phenol (µg/g)		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2004	6	94	633	3	75	549	18	59	83	<0.3	1.9	8.1
2006	5	44	223	3	31	218	19	54	76	<0.03	0.08	0.24
2008	4	47	221	ND	42	190	66	71	77	<0.03	0.87	3.68
2010	3	77	454	3	80	440	52	69	79	-	-	-
2012	4	75	369	1.9	62	303	45	68	78	-	-	-
2014	7	124	601	2.7	105	698	73	81	90	-	-	-
	2-6 Ring PAH (ng/g)			NPD (ng/g)			%NPD			USEPA 16 PAH (ng/g)		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2004	45	371	1440	23	159	601	36	48	57	5	48	202
2006	106	320	1216	42	156	686	43	49	55	20	59	285
2008	54	235	982	7	49	512	42	49	56	<0.5	44	208
2010	50	287	1284	22	147	672	45	52	59	5	43	165
2012	86	321	873	25	182	488	49	59	64	8	73	252
2014	54	382	1361	31	210	887	49	61	74	6	81	362

6.5.2.3 Heavy Metal Concentrations

With regard to heavy metal concentrations, the latest regional survey results show that concentrations were generally consistent across the majority of the stations sampled (refer to Table 6.7). The exceptions were stations W6, C, and 62 where concentrations of most metals were lower than the average recorded across all stations although concentrations of barium recorded at these stations were substantially higher. In this area the seabed is patchier than in other locations and comprises relatively coarse sediment and relatively low, variable silt-clay content. The concentration of barium over time shows no clear trend, either at stations C and W6 or over the survey area as a whole, and thus there is no clear reason for the higher concentrations recorded.

At station B higher iron, arsenic and manganese concentrations were recorded than elsewhere, which is considered to be most likely the consequence of the presence of an arsenoferrous-manganese mineral in this part of the Contract Area. This was been reported in previous surveys, though not in all surveys, which suggests the distribution of this mineral is patchy. The mean and maximum concentrations of arsenic in 2014 were the highest recorded in the regional surveys since 2004 but were similar to the levels reported in 2008 and 2006. The distribution of arsenic was closely correlated with iron.

Lead concentrations have been homogeneous over most of the sampling stations for the period 2004 to 2014 with the regional average ranging between 11µg/g in 2006 and 17µg/g in 2008. The exceptions are stations A and B, where lead concentrations have varied between surveys, sometimes above the average for the survey area, sometimes close to the average.

Overall, there was no evidence of any significant trends in metal concentrations in the survey area between 2004 and 2014.

Table 6.7 Statistical Summary of Trends in Sediment Heavy Metal Concentrations, ACG Regional Benthic Surveys 2004 – 2014 (µg/g)

	Arsenic (As)			Barium (Ba) Nitric Acid (HNO_3)			Barium (Ba) Fusion		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2004	4	11	19	-	-	-	190	1560	19120
2006	4	18	278	198	2138	14200	316	2521	16100
2008	3	24	218	297	1180	7220	398	1394	7530
2010	3	12	45	315	2434	16698	458	2807	17620
2012	6	16	83	247	1454	6375	373	2277	14820
2014	8	25	228	205	1085	5694	536	1061	12680
	Cadmium (Cd)			**Chromium (Cr)**			**Copper (Cu)**		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2004	0.06	0.14	0.26	24	86	101	9	23	45
2006	0.11	0.24	0.51	20	44	64	10	28	56
2008	0.05	0.19	0.49	30	58	79	18	33	59
2010	0.13	0.26	0.64	19	28	80	11	28	53
2012	0.080	0.169	0.301	25	58	78	15	33	56
2014	0.105	0.169	0.267	31	56	74	17	31	74
	Iron (Fe)			**Mercury (Hg)**			**Manganese (Mn)**		
	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max
2004	11466	27735	141295	0.013	0.049	0.147	-	-	-
2006	15700	33233	120000	0.014	0.040	0.090	303	600	1890
2008	18300	35207	96000	0.021	0.044	0.085	266	562	991
2010	10318	28088	44009	0.02	0.04	0.090	263	454	678
2012	13393	30890	56820	0.016	0.041	0.082	317	499	821
2014	18758	32990	81990	0.022	0.043	0.103	341	587	2366
	Lead (Pb)			**Zinc (Zn)**					
	Min	Mean	Max	Min	Mean	Max			
2004	10	14	22	26	67	79			
2006	8	11	19	22	48	64			
2008	9	17	46	41	69	101			
2010	9	14	26	19	56	83			
2012	8	16	42	37	70	90			
2014	10	14	25	45	68	88			

6.5.3 Biological Characteristics of Seabed Sediments

6.5.3.1 Benthic Communities

As shown in Table 6.8, which summarises the number of taxa present at each station sampled during the 2014 ACG Regional Benthic Survey, 46 taxa[4] in total were recorded, with amphipods as the dominant group throughout the ACG Contract Area. Amphipods were numerically dominant or co-dominant at most stations with the exception of station 4 where polychaetes dominated a very sparse community and stations 26 and D where oligochaete worms were numerically dominant. Amphipods of the genera Corophium and Gammarus were the most abundant at most stations, while the amphipod *Pontoporeia affinis microphthalma* was the only taxon found at every station. Station 22 was almost abiotic (i.e. exhibiting absence of life), similar to findings in previous EMP surveys. Stations at the north-western and south-eastern extremities of the ACG Contract Area supported a community relatively rich in species and individuals, while at stations in the centre of the ACG Contract Area, a notably sparse community was recorded. This pattern was also reported from the regional benthic surveys conducted between 2004 and 2014 surveys.

[4] A total of 63 taxa were recorded from the macrofaunal samples, however this was edited in order to ensure consistency between surveys and between different years. This process, known as 'rationalisation' involved removal of juvenile taxa and indeterminate taxa (since both may be duplications of adult specific taxa). *Gammarus spp* and *Corophium spp* were retained because of the large proportion of adults of these genera which could not be identified to species level. Additionally, the records of colonial animals (Hydrozoans and Bryozoans), epifaunal barnacles (Cirripedia), and meiofaunal nematodes and ostracods were removed during rationalisation of the data. All these animals were excluded from numerical analyses, because grab sampling does not sample them quantitatively.

Table 6.8 Number of Taxa Present at Each Station, ACG Regional Benthic Survey 2014

Taxonomic Group	ACG Regional Stations, 2014											
	1	A	4	B	W6	22	C	26	33	D	46	62
Class Nematodes	0	0	0	0	0	0	0	0	0	0	0	0
Class Polychaeta	1	1	1	1	1	0	0	0	1	0	0	1
Class Oligochaeta	3	0	0	3	3	0	2	3	2	3	1	3
Order Cirripedia	0	0	0	0	0	0	0	0	0	0	0	0
Order Cumacea	3	4	1	2	3	0	2	1	0	3	2	4
Order Amphipoda	3	15	2	18	19	1	7	2	1	1	3	12
Order Isopoda	0	1	0	1	1	0	1	1	0	0	0	1
Class Insecta	0	0	0	0	1	0	0	0	0	0	0	0
Class Bivalvia	0	0	0	1	1	0	0	0	0	0	0	0
Class Gastropoda	0	0	0	0	7	0	0	0	0	0	0	0
Total	**10**	**21**	**4**	**26**	**36**	**1**	**12**	**7**	**4**	**7**	**6**	**21**

Note: Highlighted cells represent deepwater locations

Table 6.9 presents a summary of the regional survey results obtained between 1995 and 2014 and indicates that the most substantial changes in the communities occurred from 2004 to 2008. Total macrofaunal abundance was highest in 2004 but reduced sharply in 2006 and remained low in 2008. There was recovery in abundance in 2010 although there have been further falls in 2012 and 2014; the ‘average’ community has been fairly stable, while the variability of the community over the survey area has remained high and consistent over these surveys. The most notable changes observed in recent years have been within the polychaete and amphipod taxonomic groups. Polychaete species *Hypania invalida* and *Hypaniola kowalewskii* were absent or present in very low numbers in 2012 and 2014 while *Manayunkia caspica* has become abundant in recent surveys and was the only polychaete species recorded in 2014. Abundance of the amphipod genus Corophium has increased between 2012 and 2014. The abundance in 2014 is three times the level recorded in 2012 and is the highest recorded across the regional surveys to date. Although not as abundant as Corophium or Gammarus, the occurrence of *Pontoporeia affinis microphthalma* has increased on each consecutive survey from 2006, and is present at all stations in 2014.

Table 6.9 Temporal Variation in the Number of Species per Taxonomic Group within the ACG Contract Area

Taxonomic Group	1995	1996	2004	2006	2008	2012	2014
Class Polychaeta	5	7	5	5	7	2	1
Class Oligochaeta	2	4	5	4	4	4	3
Order Cumacea	6	8	9	7	5	5	7
Order Amphipoda	15	16	20	12	28	22	25
Order Isopoda	1	2	2	2	2	1	1
Class Insecta	1	1	1	1	1	1	1
Class Gastropoda	6	8	13	1	5	8	7
Class Bivalvia	4	3	2	2	1	2	1

In comparison with the regional survey conducted in 2004, the results of the latest regional survey indicate the macrofaunal community was comparable in the overall taxonomic richness and average abundance of individuals between the two years. However, the 2014 results indicate that the community was more strongly dominated by amphipods, with notably fewer oligochaete and mollusc taxa and individuals. None of the changes observed in macrofaunal community between 2004 and 2014 have been found to be correlated to any observed physical and chemical changes in the ACG Contract Area. The biological changes are therefore thought to be the result of natural variability.

6.5.3.2 Benthic Sensitivity

The benthic environment within the area defined by the ACG regional survey is dominated by amphipods, cumaceans and oligochaetes, the majority of which are native or endemic species. These animals are either deposit or suspension feeders and as a result are potentially sensitive to the following:

- Chemical contamination of the sediment;

- Smothering of the habitat by solids deposition (such as from deep deposits of drill cuttings); and
- Physical disturbance of the habitat (such as from shallow deposits of drill cuttings).

In the past, water based mud (WBM) and associated cuttings (which do not contain toxic chemical additives) have been discharged to the seabed as part of project activities within the ACG and SD Contract Areas. Extensive monitoring[5] undertaken over a number of years in the vicinity of the ACG and SD offshore facilities has demonstrated that such discharges do not lead to the contamination of the sediment with harmful, or potentially harmful, chemicals.

Where cuttings deposits are deep (tens of centimetres to metres), the benthic habitat is effectively eradicated. With shallower deposits (less than 10cm, for example), burrowing organisms are capable of re-establishing themselves near the surface quite rapidly. Monitoring has shown that substantial populations can be found in areas of sediment with high barium concentrations (which are the most distinct indication of the presence of shallow drill cuttings deposits).

Alteration of the structure of the habitat by physical events such as cuttings deposition has the potential to interfere with the construction of burrows and with feeding. Monitoring has shown that, even when high barium concentrations indicate the presence of cuttings, there is little evidence that the structure of the habitat has been substantially altered. This is likely to be because only cuttings from the top hole sections are discharged to sea, and these consist of poorly-consolidated sediments which are similar in composition to the surficial seabed sediments in which the benthic organisms live.

During periods of discharge, very short-term disruption might occur within a small area, but adaptation will take place rapidly. These organisms have relatively short generation times, thus meaning populations of these animals have the potential to replace losses within months rather than years. The period of greatest sensitivity to short-term disruption is likely to be from the end of the breeding season until the beginning of the next breeding season – that is, between autumn and spring. During this period, losses cannot be replenished. Persistent impact is only likely in instances where there is sustained or persistent chemical contamination. Amphipods, for instance, are sensitive to hydrocarbons in sediment, and populations may be reduced for as long as significant contamination is present.

Caspian gastropods are a diverse group, all of which are very small and are surface deposit feeders. Although represented by seven species, gastropods were only present at station W6 in the 2014 survey. Gastropods are primarily vulnerable to surface sediment contamination, and relatively vulnerable to physical smothering.

Bivalves, which were only recorded at two stations (W6 and B) during 2014, are either deposit feeders or filter feeders that reproduce and grow relatively slowly. These organisms are not highly vulnerable to short-term high water turbidity arising from cuttings discharge, as they can close their valves and isolate themselves for several days if necessary. They are, however, effectively immobile and attached to their substrate, and are consequently more vulnerable to smothering from deposits of more than 1-2cm. Bivalves are also relatively vulnerable to water contamination because they filter large volumes of water. Consequently, damage to bivalve populations would take longer to recover from.

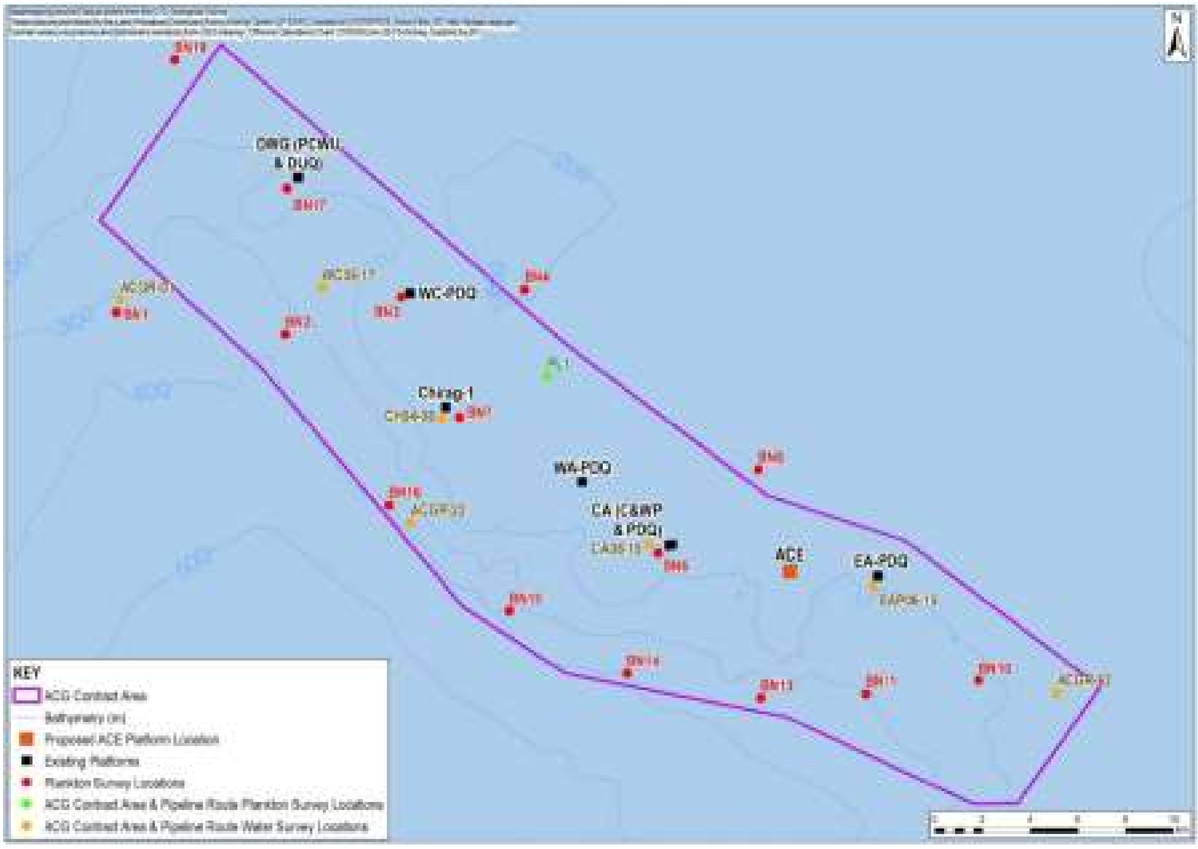
6.5.4 Chemical Characteristics of the Water Column

Water column surveys within the ACG Contract Area have been undertaken in 1995, 1996, 2004, 2005, 2006, 2008, 2010, 2012 and 2014. Since 2004 these surveys have been regularly undertaken as part of the EMP using standardised methods and reported to the MENR within annual EMP reporting. Figure 6.7 shows the location of the most recent 2014 regional and ACG pipeline survey plankton and water quality stations.

The water column characteristics specific to the proposed ACE platform location are described in Section 6.6.3 and 6.6.4.

[5] The monitoring surveys form part of the EMP and reported to the MENR within annual EMP reporting.

Figure 6.7 ACG Regional and Pipeline Route Plankton and Water Quality Sampling Locations (2014)



6.5.4.1 Water Quality

As Figure 6.7 shows, water samples were collected at seven stations along the pipeline route and seven stations in the ACG Contract Area during the 2014 ACG Regional and Pipeline Route Water Column and Plankton Communities Survey.

Biological oxygen demand (BOD), chemical oxygen demand (COD) and total suspended solids (TSS) levels measured during the same 2014 survey were below the detection limit in all samples.

While total hydrocarbon concentrations (THC) and USEPA polynuclear aromatic hydrocarbon (PAH) levels were higher across all the samples taken within the Contract Area in 2014 than in previous years (refer to Table 6.10), the composition of the hydrocarbon material detected during the 2014 survey did not indicate recent contamination of the environment, and it is considered likely that the measurable quantities of THC and possibly also PAH were the result of contamination of the samples during retrieval or transfer to containers during the field survey. Phenols were only detectable in two samples, at very low concentrations (less than twice the lower detection limit).

Table 6.10 Hydrocarbon and Phenol Concentrations in Water Samples, ACG Regional Survey, 2014

Station	Sample Depth	THC (µg/l)	16 US EPA PAH (µg/l)	Phenols (µg/l)
ACGR01	Surface	<20	0.026	<1
	100m	20	0.011	<1
ACGR22	Surface	<20	<0.01	<1
	50m	20	0.034	<1
	100m	30	0.024	<1
	200m	30	0.013	<1
	350m	40	<0.01	<1
ACGR62	Surface	20	<0.01	<1

Station	Sample Depth	THC (µg/l)	16 US EPA PAH (µg/l)	Phenols (µg/l)
CA08-10	Surface	<20	<0.01	<1
	100m	20	<0.01	<1
ACGR63	Surface	40	0.021	<1
ACGR64	Surface	40	0.01	<1
ACGR67	Surface	<20	0.011	<1
ACGR70	Surface	20	0.012	<1
	50m	30	0.013	<1
	100m	80	0.023	<1
	200m	50	0.012	<1
	350m	40	0.013	<1
ACGR73	Surface	<20	0.023	<1
EAP06-15	Surface	<20	0.012	<1
	100m	<20	0.011	<1
Ch0408	Surface	30	0.013	<1
	50m	<20	0.011	<1
	100m	<20	0.011	1.4
WC06-17	Surface	40	0.03	<1
	100m	<20	<0.01	<1
PL1401	Surface	<20	0.010	<1
	100m	<20	<0.01	<1
PL1403	Surface	50	0.015	<1
	100m	30	<0.01	<1
PL1406	Surface	40	0.011	<1
PL1409	Surface	40	0.010	<1
PL1410	Surface	40	0.011	<1
PL1411	Surface	20	<0.01	1.7
PL1412	Surface	<20	<0.01	<1

Concentrations of seven metals in each sample analysed for the 2014 survey are listed in Table 6.11. Concentrations of cadmium, cobalt, copper, nickel and lead were low and below the Maximum Allowable Concentration (MAC) for fisheries waters in Azerbaijan. The concentration of zinc exceeded the MAC for Azerbaijan fisheries waters in two samples with the highest concentration recorded from ACGR62 to the south of the ACG Contract Area. A relatively high variation was observed in the concentration of iron with the highest concentrations recorded in samples from stations close to the coast, such as ACGR63 and ACGR64 in Baku Bay and along the pipeline route west of Chilov Island, while the lowest iron concentrations were recorded at stations in the offshore waters of the ACG Contract Area. In general the water quality within the ACG Contract Area is considered good.

Table 6.11 Heavy Metal Concentrations in Water Samples, ACG Regional Survey, 2014 (µg/l)

Station	Sample Depth	Cd	Co	Cu	Fe	Ni	Pb	Zn
ACGR01	Surface	0.025	0.034	0.774	1.2	0.883	0.138	<0.3
	100m	0.023	0.036	0.69	1.45	0.933	0.078	0.548
ACGR22	Surface	0.013	0.057	1.18	10.3	0.96	0.21	11.0
	50m	<0.01	0.048	0.87	2.18	0.90	0.09	2.34
	100m	0.019	0.035	0.89	1.53	0.91	0.15	0.73
	200m	0.019	0.027	0.66	2.31	1.04	0.06	0.57
	350m	0.019	0.045	0.68	4.93	0.90	0.12	2.80
ACGR62	Surface	0.014	0.038	0.90	7.12	0.89	0.10	23.8
CA08-10	Surface	0.016	0.038	0.93	3.25	0.94	1.32	2.27
	100m	0.013	0.035	0.86	2.20	0.874	0.12	1.43
ACGR63	Surface	0.014	0.083	1.21	57.8	1.14	0.17	5.56
ACGR64	Surface	0.024	0.065	1.18	14.4	1.02	0.09	1.07
ACGR67	Surface	<0.01	0.042	0.92	3.37	0.97	0.06	0.76
ACGR70	Surface	0.016	0.037	0.99	3.08	1.01	0.06	1.5
	50m	0.024	0.031	1.32	5.60	0.84	0.08	2.22
	100m	<0.01	0.034	0.84	4.26	0.94	0.07	0.72
	200m	0.023	0.044	0.79	4.93	0.95	0.11	0.24
	350m	0.022	0.034	0.90	7.95	1.00	0.11	5.77
ACGR73	Surface	0.021	0.051	1.24	5.37	1.04	0.11	0.35
EAP06-15	Surface	0.030	0.049	0.92	2.05	0.87	0.59	0.59

Station	Sample Depth	Cd	Co	Cu	Fe	Ni	Pb	Zn
	100m	0.086	0.042	0.85	2.40	0.95	0.51	0.42
Ch0408	Surface	0.019	0.046	0.91	2.35	0.92	0.36	0.15
	50m	0.024	0.042	1.10	4.63	0.90	0.27	1.85
	100m	0.019	0.033	0.83	2.13	0.96	0.35	<0.3
WC06-17	Surface	0.017	0.064	0.92	2.59	0.83	0.19	0.84
	100m	0.023	0.033	0.95	2.29	0.93	0.15	0.87
PL1401	Surface	0.013	0.037	0.89	2.13	0.930	0.139	0.415
	100m	0.026	0.046	0.912	2.42	0.896	0.146	0.488
PL1403	Surface	<0.01	0.039	0.954	1.96	0.850	0.168	0.243
	100m	0.016	0.055	0.969	20.1	0.970	0.211	0.58
PL1406	Surface	0.027	0.049	1.11	10.0	0.944	0.163	0.142
PL1409	Surface	0.030	0.047	1.74	13.4	1.713	0.256	0.633
PL1410	Surface	0.016	0.048	1.08	11.4	1.022	0.199	0.561
PL1411	Surface	0.022	0.042	1.02	17.0	0.973	0.201	0.643
PL1412	Surface	0.014	0.059	1.10	14.2	0.925	0.179	0.482

6.5.5 Biological Characteristics of the Water Column

6.5.5.1 Plankton

As in previous years, a total of 20 plankton samples (15 at the ACG Contract Area and 5 along the ACG export pipeline route) were collected in 2014 at the sample locations shown in Figure 6.7.

Phytoplankton

The overall composition of the phytoplankton communities has remained broadly similar between surveys, although the number of phytoplankton taxa in 2014 is the highest recorded over the survey period, although this is mainly due to the high number of bacillariophyta (diatom) species (Table 6.12). However, the increased number of taxa recorded in the Contract Area may be due, in part, to a change of analytical laboratory, and should not be confidently understood as a change in the phytoplankton ecology of the region.

The community has been found to be dominated by diatom and dinophyte species in all surveys, although there has been some fluctuation in both groups, likely to be due to seasonal successional changes where the proportion of different groups of phytoplankton changes through the season. There are no systematic trends indicated by the survey results. The non-native diatom *Pseudosolenia calcar-avis* was numerically dominant in all samples in the 2014 survey.

Table 6.12 Taxonomic Composition of Phytoplankton Communities, ACG Regional Plankton Surveys, 2004 to 2014

Group / Year	ACG Regional Surveys						
	2004	2005	2006	2008	2010	2012	2014
Cyanophyta	5	6	7	7	9	3	6
Bacillariophyta	16	12	18	10	11	12	23
Dinophyta	9	6	11	13	12	8	13
Chlorophyta	1	0	0	1	1	1	5
Euglenophyta	0	0	0	1	0	0	0
Total	**31**	**24**	**36**	**32**	**33**	**24**	**47**

Zooplankton

A total of seven species of zooplankton were recorded (refer to Table 6.13) during the 2014 ACG regional survey, with a number of other taxonomic groups such as larvae of molluscs and polychaetes that cannot be identified to a species level. All plankton surveys from 2004 to 2014 have indicated that the zooplankton community in the ACG Contract Area is numerically dominated by the invasive copepod *Acartia tonsa*. In 2014, *A. tonsa* accounted for 92% of all zooplankton individuals sampled during the survey in the ACG Contract Area. This is very similar to the proportions observed in 2012 (88%) and 2006 (95%), but significantly higher than 2008 (57%). This difference in 2008 is most likely to reflect the large seasonal changes that are observed in the composition of zooplankton samples and so proportions of taxa can change significantly from month to month. The invasive ctenophore *Mnemiopsis sp*. was consistently present and appears to have become firmly established in the zooplankton.

Throughout most of the period since 2004, the only copepod species present was the invasive species *A. tonsa*. However, the endemic copepod *Eurytemora minor*, which was widespread prior to 2003, re-appeared in 2008 samples and was 2% of the total zooplankton community in 2014. This suggests some recovery of this species may have taken place.

Overall, there is no clear evidence of spatial variation of plankton communities over the regional survey locations, which is consistent with most of the water quality parameters, suggesting that the area defined by the location may be considered as a single ecosystem, or more probably part of a single ecosystem.

Table 6.13 Taxonomic Richness of Zooplankton Groups, ACG Regional Surveys, 2006-2014

Group / Year	200µm Net					53µm Net				
	2006	2008	2010	2012	2014	2006	2008	2010	2012	2014
Cladocera	4	4	4	4	4	3	4	4	2	1
Copepoda	1	2	2	2	2	1	2	2	2	2
Ostracoda		1	1	1	1	1	1	1	1	1
Rotatoria	1									
Mysidea Nauplii	1									
Cumacaea larvae						1				
Polychaete larvae	1				1	1	1		1	
Cirripedia Nauplii		1	1	1	1	1	1	1	1	1
Mollusc larvae		1	1	1	1		1	1	1	1
Scyphozoa		1								
Ctenophora	1	1	1	1	1					

Plankton Sensitivity

Phytoplankton and zooplankton are sensitive to chemical contamination at an individual level. However, plankton are not highly sensitive at the population level as populations can grow rapidly from a few individuals (phytoplankton populations can double in 12 hours, copepod zooplankton populations in 2-3 days). Populations can therefore re-establish quickly; and in some instances, rapid growth can offset the effects of chemical contamination.

Being dependent on light to photosynthesise, phytoplankton are confined to the upper layers of the water column. Periods of high turbidity, such as those associated with drill cuttings discharge, can interfere with this process.

Both phytoplankton and zooplankton can be sensitive to aqueous discharges in the water column, such as cooling water which has been treated with corrosion control systems.

There are no widely recognised underwater sound thresholds for plankton and they are generally considered to be unaffected by underwater sound except in the very immediate vicinity (metres) of the sound source (Ref. 38).

6.5.5.2 Fish

The Caspian Sea's unique geography, climate and hydrological characteristics create a range of different habitats that support a large diversity of fish species. The existence of shallow areas, deep depressions, and a wide range of salinities provide different environmental conditions and habitats favourable for species diversity. According to the latest literature, approximately 151 species and subspecies of fish can be found in the Caspian and associated river deltas (Ref. 39). Due to the Caspian Sea's isolation from other water bodies, the sea is characterised by the presence of many endemic species and the presence of 54 endemic fish species (Ref. 40).

Fish commonly found in the Central Caspian Sea can be categorised into the three following categories:

- **Migratory species**: this includes sturgeon and shad species whose key spawning grounds are the river Kura in the Southern Caspian and rivers Terek and Samar, which flow into the Central Caspian. These species migrate in water depths of between 50 to 100m. Some species of sturgeon (i.e. Beluga) spend the spring and summer mostly in the Northern and Central Caspian and in autumn migrate southwards for wintering.
- **Other species (semi migratory)**: this includes kilka (herring family), the most abundant fish in the Caspian. Kilka are widely distributed in the Caspian and are important prey for other species such as sturgeon, salmon and the Caspian seal. Mullet were introduced from the Black Sea in the 1930s and normally overwinter in the Southern Caspian. They migrate in the spring to feeding grounds in the Central and Northern Caspian. The key spawning period takes place between late August and early September in water depths typically between 300 to 600m.
- **Resident species**: several non-commercial species such as gobies are found in all regions of the Caspian Sea, predominantly in shallower areas (up to 30 to 70m in spring and summer, migrating to greater depths in winter). Gobies are second only to herring in the number of species in the Caspian Sea.

The most common species of fish in the Caspian Sea are kilka. However, in recent years the abundance and distribution of kilka has altered in response to a number of factors including overfishing and the presence of the invasive ctenophore (*Mnemiopsis leidyi*) which feeds on the zooplankton prey of many fish species. In addition, in April and May 2001, a mass mortality of 166,000 tonnes of kilka (mainly anchovy kilka) was recorded in the Central and Southern Caspian Sea. Earthquake data reveals that, in the first quarter of 2001, the local Absheron seismic plate was active, the water and gas systems in the soil were unstable suggesting a series of natural hydro-volcanic events occurred, resulting in the release of significant gas and poisonous substances into the water column. It is thought that this event was a significant contributor to the mass kill (Ref. 41).

Data from Department on Protection and Reproduction of Aquatic Bioresources (DPRAB) indicates that the total quantity of kilka (traditionally the most important species for the fishing industry) landed in the Azerbaijan Sector of the Caspian Sea has reduced by 99% from 1999 (271,000 tonnes) to 2016 (316 tonnes). The reduction in kilka species caught by the commercial fishing fleet over the past 10-15 years is generally attributed to the impact of the increased presence of *M. leidyi*, which is particularly evident since 2001. Recently there is evidence to suggest that kilka have started feeding on zooplankton *Acartia*. The prevalence of *Acartia* (*clause and tonsa*) within the structure of current zooplankton communities instead of *Eurythemora, Limnocalanus* and *Calanipeda*, is leading to a change in composition of the diet of the kilka (mainly the anchovy kilka).

As well as a reduction in catch size, the proportional share of species in catches has changed from being dominated by anchovy kilka (*Clupeonella engrauliformis*) to ordinary Caspian kilka (*Clupeonella cultriventris*). In addition, major aggregations of kilka have been observed in nearshore locations in less than 50m of water, such as at Oil Rocks rather than in deeper waters at the traditional fishing banks. The most common species of fish in the Caspian Sea after kilka is mullet.

Throughout their lifecycle, fish use spawning, feeding and wintering habitats. For fish species with limited migratory range these three habitats often coincide. Some fish species spend a certain amount of time at sea, but during the wintering and spawning seasons move to rivers. Some marine fish can undertake considerable migrations across the sea, while others inhabit relatively limited areas of the sea. The migration routes and spawning areas of the main fish species passing through the Southern Caspian are shown in Figures 6.8 and 6.9. Table 6.14 presents the fish species known to be present in the Southern Caspian, their protection status, hearing sensitivity, the estimated water depth they are present per season and location where spawning takes place (Ref. 42). Further information regarding fish migration and spawning is provided in Appendix 6B.

In general, the main distribution of fish species in the Caspian Sea is within the shallow water shelf areas. Maximum concentrations of fish are typically found at depths of up to 75m for the majority of the year but it is common for Caspian fish species to migrate to warmer waters for overwintering and to migrate to nutrient rich shallow areas of the north or river deltas in the spring / summer for spawning and feeding (Ref. 43). The coastal region is important for non-migratory species as it provides breeding and nursery habitat for a number of species during spring, summer and autumn. The area south of the Absheron Peninsula is a known nursery area for the main commercial fish species (Refer to Appendix 6B for further information on commercial fishing).

Pelagic species such as kilka are likely to be found in the waters of the Southern Caspian year round, although in smaller numbers in winter, outside the main spawning and migration periods. Anchovy (*Clupeonella engrauliformis*) and big-eyed kilka (*Clupeonella grimmi*) are found generally in shallower waters during spring and summer but in water depths from 60-100m in autumn, increasing to up to 450m in winter.

Anchovy and big-eyed kilka stay in the Southern Caspian, mainly during winter, with a correlated distribution between herring and kilka (food source for herring) and the distribution of zooplankton (food source for kilka). Herring generally spend winter in the Southern Caspian, from Chilov Island offshore of the Absheron Peninsula to Astara on the Iranian border and mainly near the western shores and southern slopes of the Absheron sill. Herring and kilka in the ACG Contract Area are generally found mainly in winter, at depths up to 50-100m.

Mullet spawn within the deep waters of the Central and Southern Caspian between the end of August to early September, and migrate south in the autumn to dwell in the very south of the Caspian Sea in the winter, typically in deeper water depths, including waters ranging up to 600m.

Goby species are very common and widespread in the Caspian Sea. Many goby species usually stay in shallow waters (up to 20 to 200m) and some migrate through and into deeper waters during autumn and into winter. There are occasions when they are found at greater depths (between 200-300m to 500m depths) but not typically. They are mainly distributed in the Central and Southern Caspian and avoid the coastal areas freshened by river flows.

Figure 6.8 Kilka Migration Routes

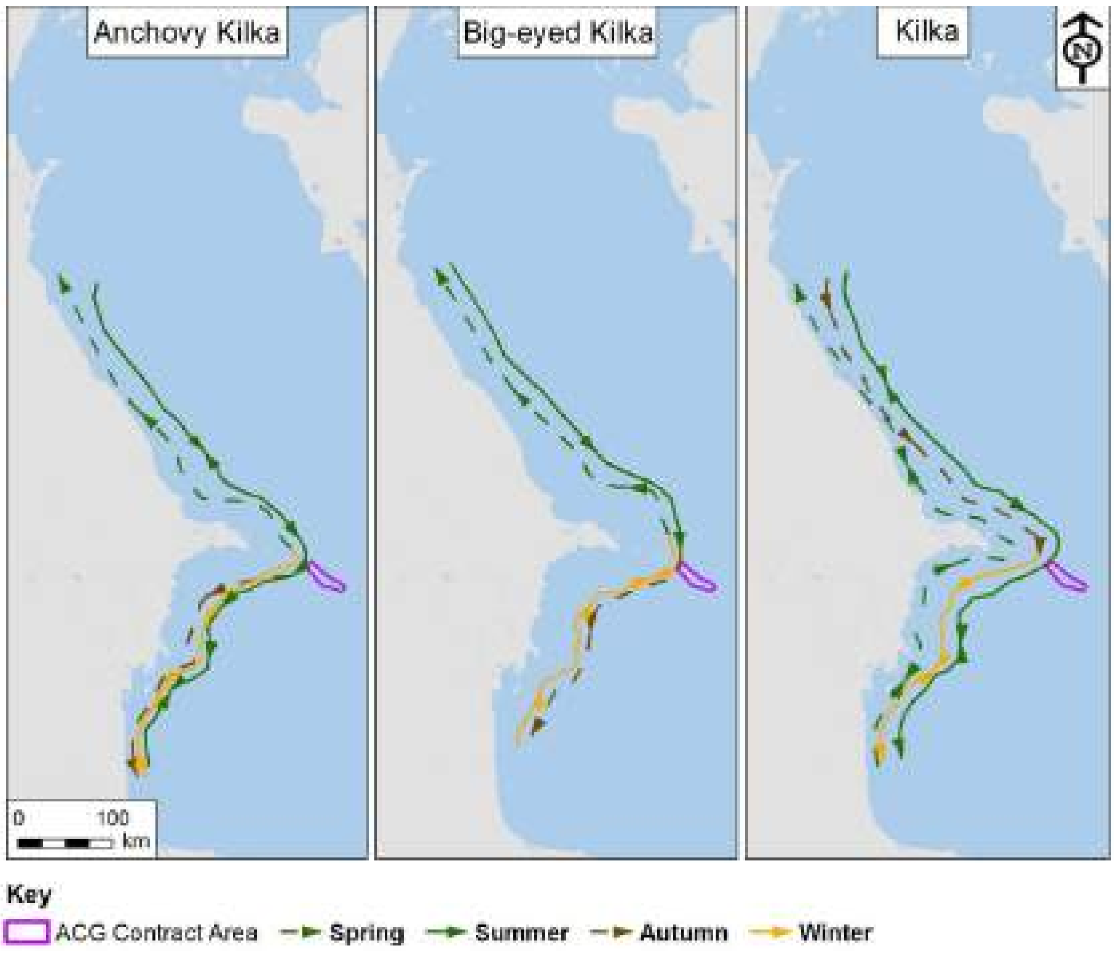


Figure 6.9 Shad, Sturgeon and Mullet Migration Routes

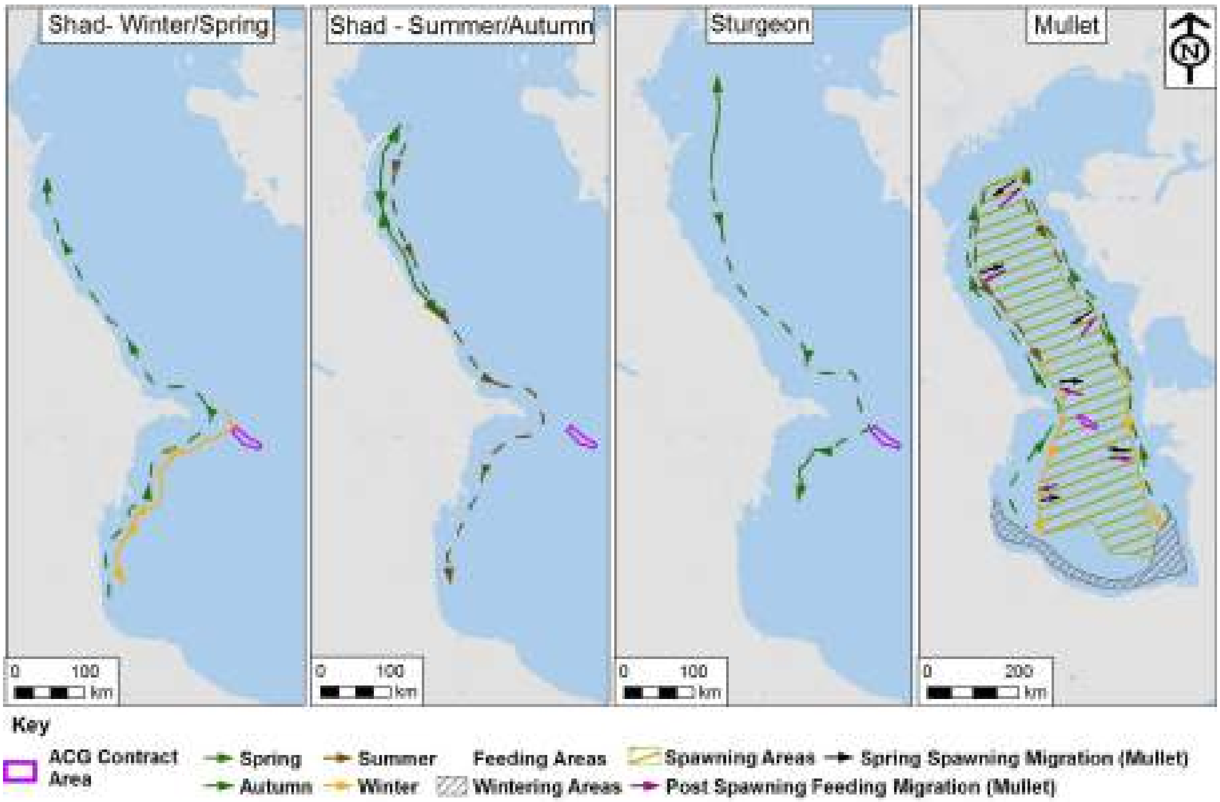


Table 6.14 Summary of the Fish Species Expected to Present in the Southern Caspian Sea

Name of Species	Common Name	Hearing Group	IUCN Red List Status	Spawning Location	Reason for Presence in Southern Caspian (south of Absheron Ridge)
STURGEON (Family Acipenseridae)					
Huso huso	Beluga	SB	EN#	River Volga, Ural, Kura, Sefīd-Rūd and sometimes Terek.	Spring migration to spawning areas located in Volga, Ural and Sefīd-Rūd Rivers. Typically found at water depths between 50-70m in spring/summer and 70-100m in autumn/winter. Feeding and breeding in sea feeding sites in spring/summer/ autumn months. Wintering areas in winter.
Acipenser güldenstädtii	Russian sturgeon	SB	EN#	River Volga, Ural, sometimes Terek and Kura.	
Acipenser güldenstädtii persicus natio cyrensis	Kura (Persian) sturgeon	SB	EN#	River Volga, Ural, Kura, Sefīd-Rūd and sometimes Terek.	
Acipenser nudiventris	Kura barbel sturgeon	SB	EN#		
Acipenser stellatus	Kura (South-Caspian) stellate sturgeon	SB	EN#		
KILKA (genus Clupeonella, family Clupeidae – herring)					
Clupeonella engrauliformis	Anchovy kilka	SB/HS	LV	The eastern part of the Central and South Caspian in the area of circular flows at depths of 50 to 200m in the upper layers of water not less than 15 to 20m from the surface.	Spring migration to spawning areas. Feeding and breeding in sea feeding sites in 50-130m depth in spring/summer/autumn months. Autumn migration to the wintering areas in the south. Wintering areas in winter.
Clupeonella grimmi	Big-eyed kilka	SB/HS	LV	The eastern part of the Central and South Caspian in the area of circular flows at depths of 350 to 450m in the upper layers of water not less than 15 to 20m from the surface.	Spring migration to spawning areas. Feeding and breeding in sea feeding sites in 80-450m depth in spring/summer/autumn months. Autumn migration to the wintering areas in the south. Wintering areas in winter.
Clupeonella delicatula caspia	Caspian common kilka	SB/HS	LV	North Caspian in 1-3 m depth, down part of deltas of Volga, on the opposite side of the mouth of the Ural River, Buzachi peninsula, up to 10m depth in shallow waters of the Middle and South Caspian.	Spring migration to spawning areas. Feeding and breeding in sea feeding sites in 20-40m depth in summer/autumn months. Wintering areas in winter.
SHAD (genus Alosa Cuvier, family Clupeidae – herring)					
Alosa caspia caspia	Caspian shad	SB/HS	LC	At a depth of 1 to 3m in Northern Caspian, opposite of Volga and Ural River mouth.	Spring migration to spawning areas. Feeding and breeding in sea feeding sites in 40-100m depth in summer/autumn months. Autumn migration to the wintering areas. Wintering areas in winter.
Alosa brashnikovi autumnalis	Big-eyed shad	SB/HS	LC	At a depth of 2-6m in western and eastern coastal area of the South Caspian.	
Alosa kessleri volgensis	Volga shad	SB/HS	LC	Volga River and in rare cases in Ural and Terek Rivers.	
Alosa kessleri kessleri	Black-backed shad	SB/HS	LC	Volga River and in rare cases in Ural river.	
Alosa braschnikowii braschnikowii	Dolgin shad	SB/HS	LC	At a depth of 1 to 4 m in the Northern Caspian, in the opposite side of Ural River mouth, Buzaji peninsula and around Saridash.	
Alosa saposchnikowii	Big-eyed shad	SB/HS	LC	At a depth of 1 to 6 m in the Northern Caspian, in the opposite side of Volga and Ural River mouth.	

Name of Species	Common Name	Hearing Group	IUCN Red List Status	Spawning Location	Reason for Presence in Southern Caspian (south of Absheron Ridge)
CARP (family Cyprinidae)					
Rutilus frisii kutum	Kutum/Black Sea Roach	SB	LC	Kura and Terek Rivers, rivers of the western coast of the Southern Caspian, Small Gizilagaj Bay.	Spring migration to spawning areas. Spring/Autumn feeding route. Wintering areas in winter. Typically found at depths of up to 10-25m throughout the year.
Rutilus rutilus caspicus	Roach	SB	LC	Small Gizilagaj Bay, Kura River, the rivers of the western coast of the Southern Caspian, extremely rarely in the Terek River.	Spring migration to spawning areas. Spring/Autumn feeding route. Wintering areas in winter. Typically found at depths of up to 10-25m throughout the year.
Aspius aspius taeniatus	Asp	SB	LC	Kura River, as well as in the rivers along the western shores of the South Caspian and Small Gizilagaj Bay, very rarely in Terek River.	Autumn/winter/spring migration to spawning areas. Migration for feeding during the whole year. Wintering areas in winter. Typically found at depths of up to 10-25m throughout the year.
Lusibarbus brachycephalus caspius	Caspian barbel	SB	LC	Kura River, as well as in the rivers along the western shores of the South Caspian and Small Gizilagaj Bay, very rarely in Terek River.	Spring/summer migration to spawning areas. Feeding and breeding in spring/summer/autumn months. Wintering areas in winter. Typically found at depths of up to 20-25m throughout the year.
Abramis sapa bergi	White-eye bream	SB	LC	Kura River, as well as in the rivers along the western shores of the South Caspian and Small Gizilagaj Bay, very rarely in Terek River.	Migration to spawning areas in winter and early spring. Southwest migration for feeding along the shore during the whole year. Wintering areas in winter. Typically found at depths of up to 10-25m throughout the year.
Pelecus cultratus	Sabrefish	SB	LC	Rivers Volga, Ural, Kura and Terek as well as in the rivers of the Lankaran coast.	Autumn/winter migration to spawning areas. North-south migration for feeding along the shore during the whole year. Wintering areas in winter. Typically found at depths of up to 10-25m throughout the year.
Abramis brama orientalis	East bream	SB	LC	Rivers Volga, Ural, Kura and Terek, rivers of the Lankaran coast.	Migration to spawning areas in winter and early spring. Southwest migration for feeding along the shore during the whole year. Wintering areas in winter. Typically found at depths of up to 10-25m throughout the year.
Chalcalburnus chalcoides	Danube bleak	SB	LC	Rivers Kura, Terek and other rivers of the western coast of the Central and Southern Caspian, extremely rarely in the Volga and Ural rivers.	Migration to spawning areas throughout the year and mainly end of autumn and winter months. Southwest migration for feeding along the shore during the whole year. Wintering areas in winter. Typically found at depths of up to 20-30m throughout the year.
Vimba vimba persa	Caspian bream	SB	LC	Kura and Terek Rivers, extremely rarely in the Volga River.	Spring migration to spawning areas. North-south migration for feeding along the shore during the whole year. Wintering areas in winter. Typically found at depths of up to 20-25m throughout the year.

Name of Species	Common Name	Hearing Group	IUCN Red List Status	Spawning Location	Reason for Presence in Southern Caspian (south of Absheron Ridge)
Cyprinus carpio Linnaeus	Carp	SB	LC	Volga, Ural and Terek rivers as well as the Small Gizilagaj Bay, the Kura River and rivers of the southern coast.	Spring migration to spawning areas. North-south migration for feeding along the shore during the whole year. Wintering areas in winter. Typically found at depths of up to 8-20m throughout the year.
MULLET (family Mugilidae)					
Liza aurata	Golden mullet	SB	LC	Central Caspian (300 to 600m depth).	Spring/summer migration to the Central Caspian for feeding. Autumn/winter migration to wintering areas. Feeding and breeding in the sea feeding areas throughout the year. Typically found at depths of up to 400-500m throughout the year.
Liza saliens	Leaping mullet	SB	LC	South and Central Caspian (5 to 700m depth).	Spring migration for feeding. Spring/summer migration to the spawning places located in deep-water areas of the sea. Autumn/winter migration to wintering areas. Feeding and breeding in the sea feeding areas throughout the year. Typically found at depths of up to 200-300m throughout the year.
GOBY (family Gobiidae)					
Neogobius bathybius	Deepwater goby	No SB	LC	Central and Southern Caspian, west coast, up to 10-20 m, sometimes up to 3-5 m.	Resident species dominate in shallow waters (30-200m in spring/ summer months), but can be also found in deeper areas of the sea in winter months (up to 300m).
Mesogobius nonultimus	Nonultimus goby	SB	LC		
Benthophilus grimmi	Grimms' pugolovka	No SB	LC		
Benthophilus ctenolepidus	Persian goby	No SB	LC		
Benthophilus svetovidovi	Pugolovka svetovidovi	No SB	LC		
Knipowitschia Iljini	Ilyin goby	SB	LC	Central and Southern Caspian, west coast, up to 70-80m, sometimes up to 40-50m.	Resident species dominate in shallow waters (100-300m in spring/ summer), but can be also found in deeper areas of the sea in winter months (300-500m).
Benthophilus leptocephalus	Slender-snouted pugolovka	No SB	LC		
Benthophilus leptorhynchus	Slender-snouted pugolovka	No SB	LC		
Anatrirostrum profundurum	Pugolovka-platypus	SB	LC		
Benthophilus stellatus leobergius Iljin	Caspian tadpole goby	No SB	LC	North, Central and Southern Caspian, west coast, up to 1-10m, included deltas of Volga, Kura, Terek, rivers.	Resident species dominate in shallow waters (1-10m), but can be also found in deeper areas of the sea in winter months (20-50m).
Neogobius fluviatilis	Monkey goby	No SB	LC		
Knipowitschia longicaudata	Knipovich long-tailed goby	SB	LC		
Neogobius kessleri gorlap	Caspian big-headed pugolovka	No SB	LC		
Neogobius ratan goebeli	Ratan Goby	No SB	LC		
Benthophilus macrocephalus Pallas	Big-headed pugolovka	No SB	LC		
Neogobius caspius	Caspian goby	No SB	LC	North, Central and Southern Caspian, west coast, up to 1-10m, included deltas of Volga, Kura, Terek, rivers.	Resident species dominate in shallow waters (1-10m), but can be found in deeper areas of the sea in winter months (60-150m).
Benthophilus granulosus	Granular pugolovka	No SB	LC		
Benthophilus Baeri	Baer pugolovka	No SB	LC		

Name of Species	Common Name	Hearing Group	IUCN Red List Status	Spawning Location	Reason for Presence in Southern Caspian (south of Absheron Ridge)
Neogobius melanostomus affinis	Round goby	No SB	LC		
Neogobius syrman eurystomus	Caspian syrman goby	No SB	LC		
Others					
Salmo trutta caspius	Caspian brown trout	SB	EN#	Kura, Terek, Samur, Keyranchay rivers, small rivers of the western coast of the Central and South Caspian Sea, in rare occasions Volga and Ural rivers.	Autumn/winter migration to the spawning places. Feeding and breeding in the sea feeding areas throughout the year. Typically found at depths of up to 40-50m throughout the year.
*Atherina mochon pontica nation caspia**	Big-scale sandsmelt	SB	V	In all areas of the sea, at the depth of 1.5-2.0m, mainly in the sandy seabed areas, mainly in the Gizilagaj Bay.	Present throughout the year for spawning, feeding and wintering in shallow coastal waters. Typically found at depths of up to 50m.
Gasterosteus aculeatus	Three-spined stickleback	SB	LC	Shallow parts of the rivers flowing into the Caspian Sea (estuaries) Volga, Ural, Kura, Terek rivers and others.	Present throughout the year for spawning, feeding and wintering in shallow coastal waters. Typically found at depths of up to 20m throughout the year.
Syngnathus nigrolineatus caspius	Caspian Pipefish	SB	LC	In all parts of the sea located close to the coast (depth of 1-4m), also in the areas where the Zostera plants grow such as the shallow parts of the rivers flowing into the Caspian.	Present throughout the year for spawning, feeding and wintering in shallow coastal waters. Typically found at depths of up to 10m.
Sander marinus	Sea pikeperch	SB/HS	EN#	Chilov and Pirallahi islands, Baku archipelago, Kurdashi aquatorium of the Central and Southern Caspian at a depth up to 10m in the coastal waters with rocky seabed.	Migration to spawning, feeding and wintering areas throughout the year. Typically found at depths of up to 50-100m.

Key:
Hearing group: SB – fish with swim bladder; V – sometimes does not have swim bladder depending on species; HS – hearing experts with wide hearing frequency rate.
IUCN Red List: EN – Endangered; LV – Low Vulnerability; LC – Least Concern, # also included in CITES Appendix II.
*Also, known as *Atherina boyeri caspia*.

Fish Sensitivity

The common threats to fish populations are over fishing, high levels of pollution (from both man-made and natural events) and habitat loss. Impacts relating to the oil industry are direct (e.g. accidental spills, noise) and indirect (e.g. fish consuming prey that ingested or had been affected by accidental spills). Fish species are vulnerable to oil and chemical spills, specifically during spawning, and are sensitive to increased turbidity and to underwater sound impacts, which may discourage them from approaching operational sites. Those species with swim bladders are most susceptible. Their response to underwater sound is determined by the duration, sound pressure level and frequency; and ranges from changes in behaviour, recoverable injury to, in extreme instances, mortal injury.

Table 6.15 outlines the key periods the main fish species are likely to be potentially present in the Southern Caspian and near and within the ACG Contract Area.

Table 6.15 Potential Seasonal Fish Presence in the Vicinity of the Southern Caspian and ACG Contract Area

Species	Activity	Month											
		J	F	M	A	M	J	J	A	S	O	N	D
Resident Fish (e.g. Goby)	Feeding	■	■	■	■	■	■	■	■	■	■	■	■
	Breeding				■	■	■	■					
Carp/Herring	Feeding				■	■	■	■	■	■	■	■	
Sturgeon	Migrating			■	■					■	■	■	
Shad	Migrating								■	■	■	■	
Kilka	Feeding			■	■	■	■	■	■	■	■	■	
	Breeding				■	■	■	■	■				
Mullet	Feeding	■	■	■	■	■	■	■	■	■	■	■	■
	Breeding						■	■	■	■			
Key: ■ Present													

In general fish species are not known to migrate through the ACG Contract Area, preferring to remain within the shallower waters between the shore and the Contract Area.

6.5.5.3 Caspian Seals

The Caspian seal (*Phoca caspica*) is the only marine mammal present in the Caspian Sea. The species is endemic to the Caspian Sea and has been listed on the IUCN Red List of Threatened Species as Endangered since October 2008 and has been included in the AzRDB since 1993 (Ref. 44).

The population of Caspian seals has decreased by more than 90% since the start of the 20th century, considered to be due to a combination of commercial hunting, habitat degradation (through introduction of invasive species), disease, industrial development, pollution and fishing operations using nets (Ref. 45). The population of seals has been estimated using a number of different methods. A 2012 paper (Ref. 46), using an age-structured projection model and the annually recorded seal harvest, between 1867 and 2005 estimated the 2005 population to be 104,000. In comparison, data collected from aerial surveys in Kazakhstan and sea ice surveys resulted in estimates of between 100,000 and 170,000 (Ref. 47) (Refer to Appendix 6C).

There have been a number of survey/research programmes undertaken to improve understanding of the distribution and population numbers of Caspian seals. Data collection has included the following:

- **1980 – present**: Opportunistic monitoring of dead seals and confirmation of seal sightings by fishermen and helicopter pilots;
- **2005 - 2012**: Annual aerial surveys of the breeding population on the winter ice-field in the Northern Caspian from 18 to 27 February to estimate the overall breeding distribution; and
- **2009 - 2012**: Telemetry tagging survey, where 75 seals were tagged and their movements across the Caspian Sea tracked. Data collection included dive depths.

In addition, seal observations have been undertaken by BP and their contractors during surveys. Most recently these have included the following:

- **2016**: October, November and December: seal observations from vessels during the SWAP seismic surveys; and
- **2018**: Mid-March to late April: seal observations made from vessels at the location of the proposed ACE platform during geotechnical investigation works.

Caspian seals are observed in many regions of the Caspian Sea depending on the season. Until recently it was thought that the Caspian seal population as a whole undertakes annual migrations between breeding locations in the north (where pupping and mating occurs on the ice) to feeding locations in the Central and Southern Caspian during the spring months (Ref. 48). The spring southwards migration was understood to take place between April to May and the autumn northwards migration between October to December, although some were thought to migrate north as early as August.

Recent satellite tagging research, conducted between 2009 and 2012 (Ref. 49) has shown that this pattern of migration is not as regular or direct as had been previously reported. Data obtained from 75 tagged adult seals, of both sexes, showed that whilst seals migrated to the ice field in the Northern Caspian during autumn-winter months for breeding (the timing depending on changeable metocean conditions), they did not all migrate south in the spring. For example, in 2011 40% of the tagged seals remained in the Northern Caspian and were considered to be ‘non-migratory’. The remaining 60% of the seals migrated to the Central and Southern Caspian in the spring for foraging and the migration routes taken were not restricted to proximity to haul-out sites as had been believed. Both the primary routes followed by the seals during migration and the secondary spring routes as suggested by previous research programmes, the satellite tagging study and also through direct observations (see below) are shown in Figure 6.10.

Assuming the findings of the research are representative of the wider population, there is the potential for migrating seals to pass through the Central Caspian, including the proposed ACE platform location. In addition to seal presence during the migration period, there is also the potential for seals that have not migrated to the Southern Caspian to be present for foraging from May to September with peak numbers coinciding with the peak kilka numbers in July. The lowest numbers of seals is expected to be present in the Southern Caspian (including the Contract Area) between January and March when seals will be in the Northern Caspian pupping and mating, although this can vary by up to a month depending on weather.

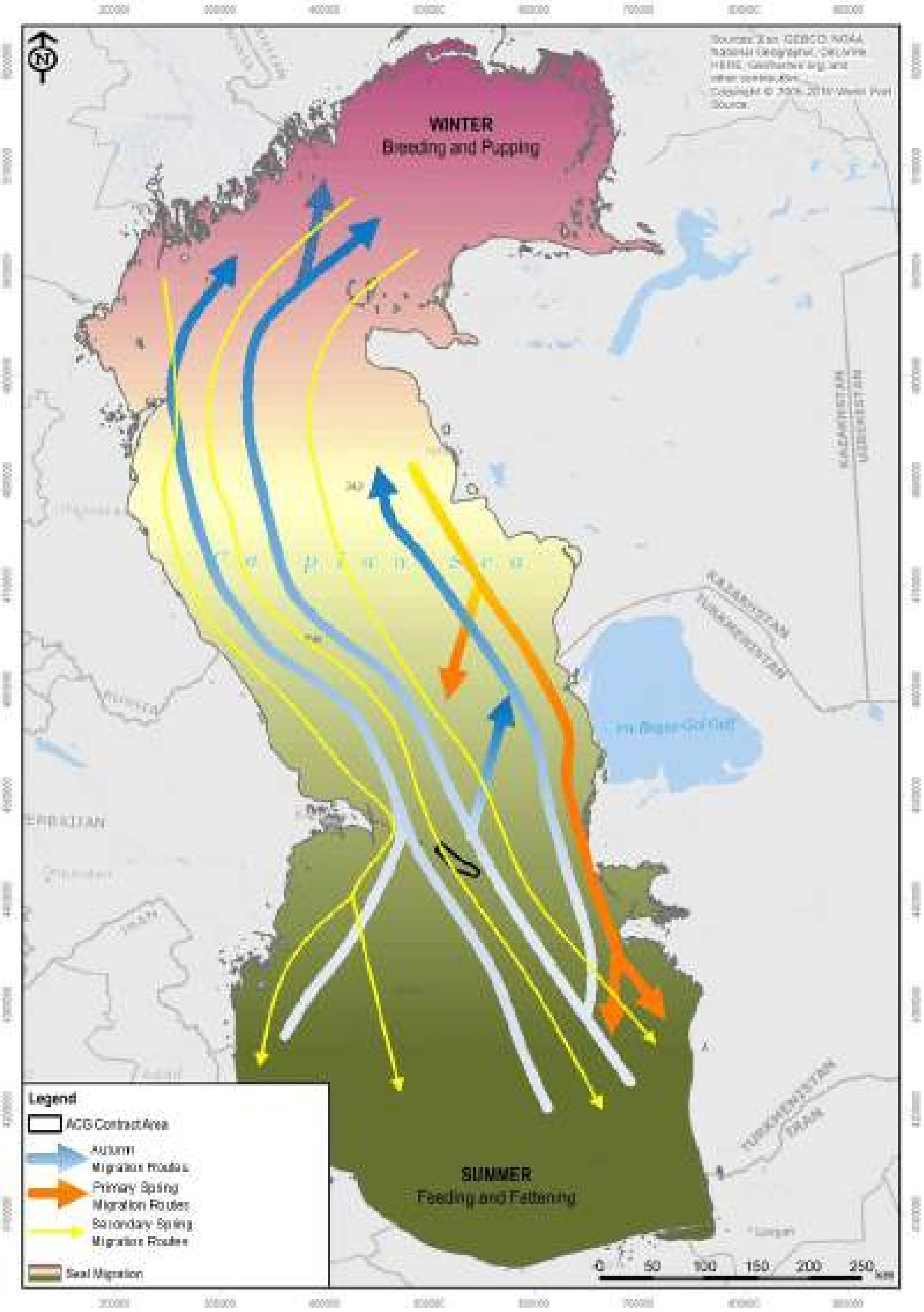
The scientific opinion is that seals are showing signs of adaptation to anthropogenic disturbances (Ref. 14). It is understood that, following increased disturbances within the Dagestan coastal area of Russia (including reported mass poaching), seals tended to avoid coastal areas during the autumn and spring migrations and use routes located away from the coast. Thus, the latest research has shown it is not possible to assume the seals will always follow the previously defined migratory paths close to the east and west coastline and may travel through the centre of the Caspian (including through the ACG Contract Area). Observations completed during the recent ACE geotechnical survey at the proposed ACE platform location during March and April 2018 recorded five seal sightings between the 18th and 23rd April 2018. All seals were observed when the survey vessel was stationary and not conducting survey activities. In general seals were observed during calm sea conditions with one seal sighting on the sea surface observed by eye at a distance of approximately 20m from the vessel and the remainder near the seabed (via the remote video camera being used to monitor the survey activities) in the immediate vicinity of the vessel.

Typically seals migrating during spring have been observed in the Southern Caspian, particularly offshore of the Absheron Peninsula, in April and May. When observed earlier than April this has been correlated to the sea ice melting in the Northern Caspian.

While this section presents an overview of expected seasonal distribution of the seals throughout the Caspian Sea, it does not represent a comprehensive understanding. There are a number of limitations in relation to the available data used to determine migration patterns:

- The tagging research programme was based on a 3 year period (2009 to 2012); there is no ongoing survey programme in place to monitor long-term trends of distribution across the Caspian Sea. Prior to 2009, historic distribution data had been based on live seals sightings provided by vessels and helicopter pilots observation, opportunistic recordings which has not been collected as part of an ongoing scientific programme; and
- The research programme tagged 75 seals. This is not considered to be a representative number to enable an accurate conclusion of the distribution of seals across the Caspian Sea (Ref. 14).

Figure 6.10 Spring and Autumn Migration Routes of the Caspian Seal[6]



[6] Compiled by Dr Tariel Eybatov

Seal Sensitivity

The reasons for the significant decline in the Caspian seal's population in the past century are complex but are thought to be associated with hunting, fishing activities, outbreaks of Canine Distemper Virus (CDV), invasive species and pollution (mainly organochlorides such as DDT).

Seals are directly and indirectly sensitive to pollution spills (such as oils or chemicals) and ongoing discharges which contribute to contamination over time. Seals are dependent on eyesight to hunt and are therefore sensitive to any increases in turbidity which may result from oil and gas activities such as vessel movements, platform operations and installation activities involving disturbance of the seabed sediment.

Seals are sensitive to underwater sound while diving or swimming so may be susceptible to high levels of underwater sound generated by vessel movements and construction activities, particularly impact piling.

As discussed above, Caspian seals may be present in the ACG Contract Area at any time of year but with an increased likelihood during the spring migration, during the summer months and, to a lesser extent, during autumn migration. Table 6.16 below sets out the most sensitive times of the year for the Caspian seals in the Southern Caspian with particular reference to the ACG Contract Area. As the table shows spring is typically the period when the seals potentially present are most sensitive. This is because their fat reserves are depleted after the months spent on sea-ice in the north during winter.

Table 6.16 Seasonal Sensitivity of Caspian Seal Relative to ACG Contract Area

Sensitivity Relative to ACG Contract Area	Month											
	J	F	M	A	M	J	J	A	S	O	N	D
Least Sensitive Period/Not Present - Winter												
Least Sensitive Period - Autumn												
Most Sensitive Period - Spring												
Distribution Influenced by Food Source												

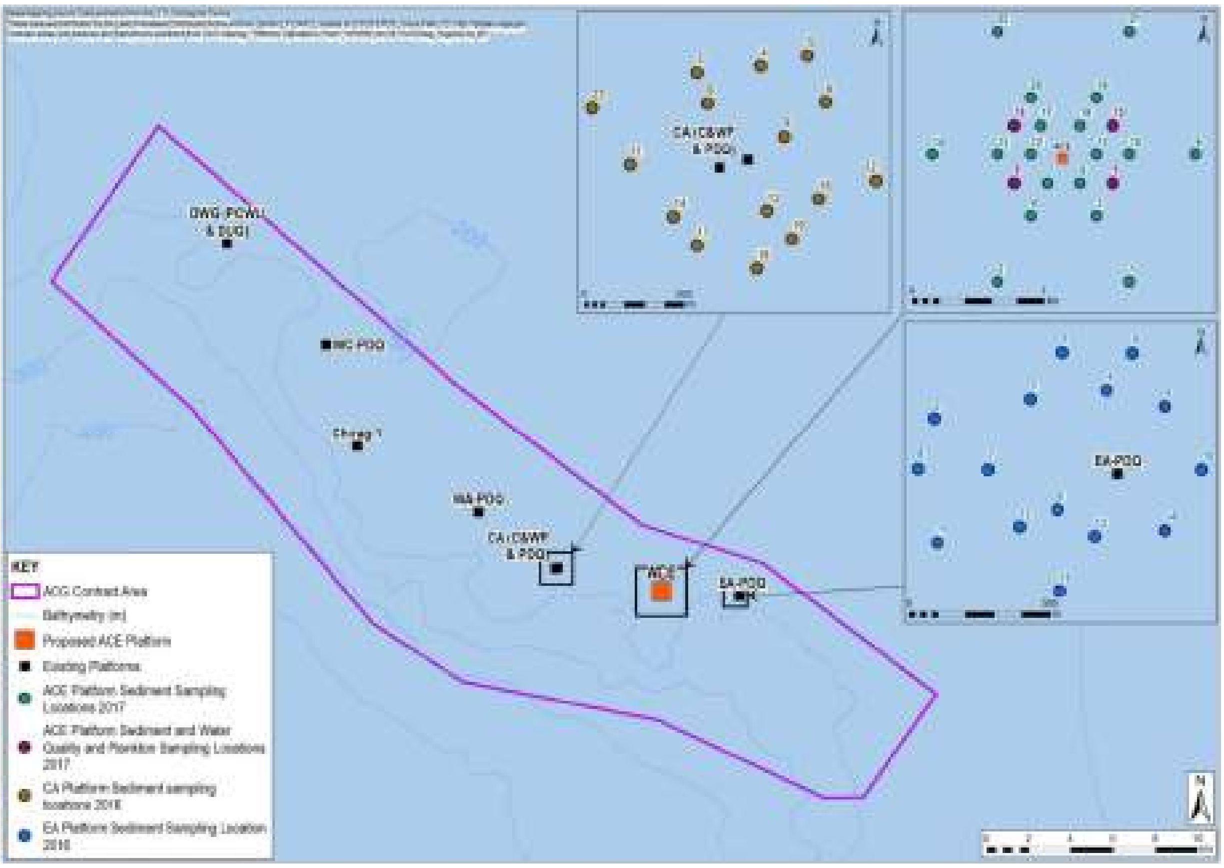
Key:

Fewer numbers of seals/absent as they move to Northern Caspian for winter.	Individuals distributed as groups according to migration flows of food components.	Individuals present during the spring and autumn migrations.

6.6 Offshore Environment Specific to ACE

An EBS at the proposed ACE platform location, which included both sediment and water column sampling, was undertaken in 2017. The water depth at the sampling stations ranged between 134-169m. Figure 6.11 shows the ACE EBS sampling stations in addition to the sediment monitoring locations at the CA and EA platforms. The section below presents a summary of the ACE EBS results and a comparison between these and the results from the latest CA and EA platform surveys carried out in 2016. Appendix 6D presents the full results of the EA and CA 2016 surveys for reference.

Figure 6.11 Sediment and Water Sampling Locations at the ACE Platform (2017) and Sediment Sampling Locations at CA and EA Platforms (2016)



6.6.1 Physical and Chemical Characteristics of Seabed Sediments

6.6.1.1 Physical Properties of Sediments

Table 6.17 presents a summary of the physical properties of the sediments at the proposed ACE platform location. The results indicated that sediments across the area surveyed were generally heterogeneous with a wide range of particle sizes present in most samples. The greatest variation in mean particle size was observed at stations 8, 12 and 13 where sediments generally contained a higher proportion of coarser grained size fractions.

Table 6.17 Summary of Physical Sediment Properties Recorded at ACE Platform Location (2017)

	Mean Diameter (µm)	Carbonate %	Organics %	Gravel >2mm	Silt/Clay %	Silt %	Clay %	Wentworth Scale	Sorting Index
Min	9	30	1.18	0	9	3	4	Fine silt	Moderate
Max	1742	84	3.78	76	92	53	66	Very coarse sand	Extremely poor
Median	151	65	1.92	25	34	17	15		
Mean	363	60	2.15	29	43	23	21		

Results from the baseline survey indicated coarser grained sediments with high carbonate content were present at stations in the south-western quadrant of the survey area (stations 2, 4, 8 12 and 13), and on the centre of the eastern flank. The finest grained sediments were present in a north to south strip through the centre of the eastern half of the survey area (stations 3, 5, 10, 11, 15, 16 and 19-22), from the northern flank to the southern flank. The characteristics across the ACE survey area were found to be similar to those recorded during the EA and CA surveys. Mean diameter and carbonate content was similar to the results from CA, silt/clay content exhibited a greater similarity to the results from EA.

6.6.1.2 Hydrocarbon Concentrations

Table 6.18 summarises the sediment hydrocarbon concentrations recorded in the ACE EBS samples. Hydrocarbon concentrations were generally low across all the sample locations. Aromatic and aliphatic compounds were strongly correlated and the general composition was indicative of heavily weathered material being present throughout the area surveyed. The highest average THC and PAH concentrations were present at stations in the centre of the survey area, directly to the west, northwest and south of the planned ACE platform location. Concentrations in the eastern half of the survey area were relatively uneven, with the lowest THC levels recorded at stations 15 and 5.

Overall, the hydrocarbon concentrations within the ACE baseline survey area were, on average, within the levels recorded during the 2016 CA and EA platform surveys (refer to Appendix 6D for full list of results).

Table 6.18 Statistical Summary of Sediment Hydrocarbon Concentrations – ACE Platform Location (2017)

	THC (µg/g)	UCM (µg/g)	% UCM	Total 2-6 ring PAH (ng/g)	NPD (ng/g)	% NPD	Total EPA 16 (ng/g)
Min	8	6	74	40	23	44	5
Max	66	57	92	203	111	58	41
Median	30	25	83	108	55	52	20
Mean	33	27	83	111	57	52	22

6.6.1.3 Heavy Metal Concentrations

Table 6.19 provides a statistical summary of the concentration of heavy metals recorded in the ACE EBS sediment samples. The highest concentrations of barium were present at stations 14 and 2 located approximately 1,000m to the west and southwest of the proposed ACE platform location, respectively. A general southwest-northeast gradient of reducing concentrations was found to be present within the survey area, with the lowest concentrations recorded at stations 5 and 15. The concentrations of copper, chromium, iron and zinc in sediments were identified as being inter-correlated with higher concentrations generally present within a north-south transect through the eastern half of the survey area while the highest concentrations were centred on stations 15 and 5. Concentrations of arsenic and lead were found to be low throughout the survey area and are considered to be representative of the regional background. The highest concentrations of mercury were present in an area centred on station 12 while the lowest concentrations were recorded at station 15.

Overall the 2017 ACE baseline sediment metal concentrations were comparable to the results observed at EA and CA and were typical of the regional background.

Table 6.19 Statistical Summary of Heavy Metal Concentrations (mg/kg) – ACE Platform Location (2017)

	As	Ba HNO_3	Ba Fusion	Cd	Cr	Cu	Hg	Fe	Mn	Pb	Zn
Min	4.2	285	694	0.088	24.8	10.1	0.022	11533	268	4.3	25.8
Max	14.5	6524	15627	0.301	57.4	20.3	0.043	23374	626	10.5	47.8
Median	6.4	1464	3120	0.119	36.7	15.4	0.030	15266	369	5.8	33.8
Mean	7.1	1825	3863	0.132	38.6	15.7	0.030	16705	392	6.1	35.5

6.6.2 Biological Characteristics of Seabed Sediments

Table 6.20 presents the abundance and species richness for each benthic taxonomic group at each station. The survey recorded a total of 64 taxa across the 22 stations sampled which comprised 31 amphipoda, 17 gastropods and cumacea and annelid worms were represented by 6 taxa each. Bivalve mollusc, isopods and insects were represented by three, two and one species respectively.

The macrofaunal community was numerically dominated by amphipod crustaceans which represented 76% of the total abundance. Individuals from the amphipod genera Gammarus and Corophium were particularly abundant, accounting for 54% and 19% of the total abundance respectively. Of the three polychaete species present, *Manayunkia caspica* was the numerically dominant species, representing 99% of the total polychaete abundance.

Figure 6.12 presents contour plots showing the abundance distributions of the main taxonomic groups. Abundance and species richness were highest at stations within the south-western quadrant of the survey area and station 9, located on the centre of the eastern flank. The lowest abundance and taxonomic richness was present at stations in the north-eastern quadrant, extending from station 21 in the north to stations 11 and 10 in the centre of the eastern half of the survey area.

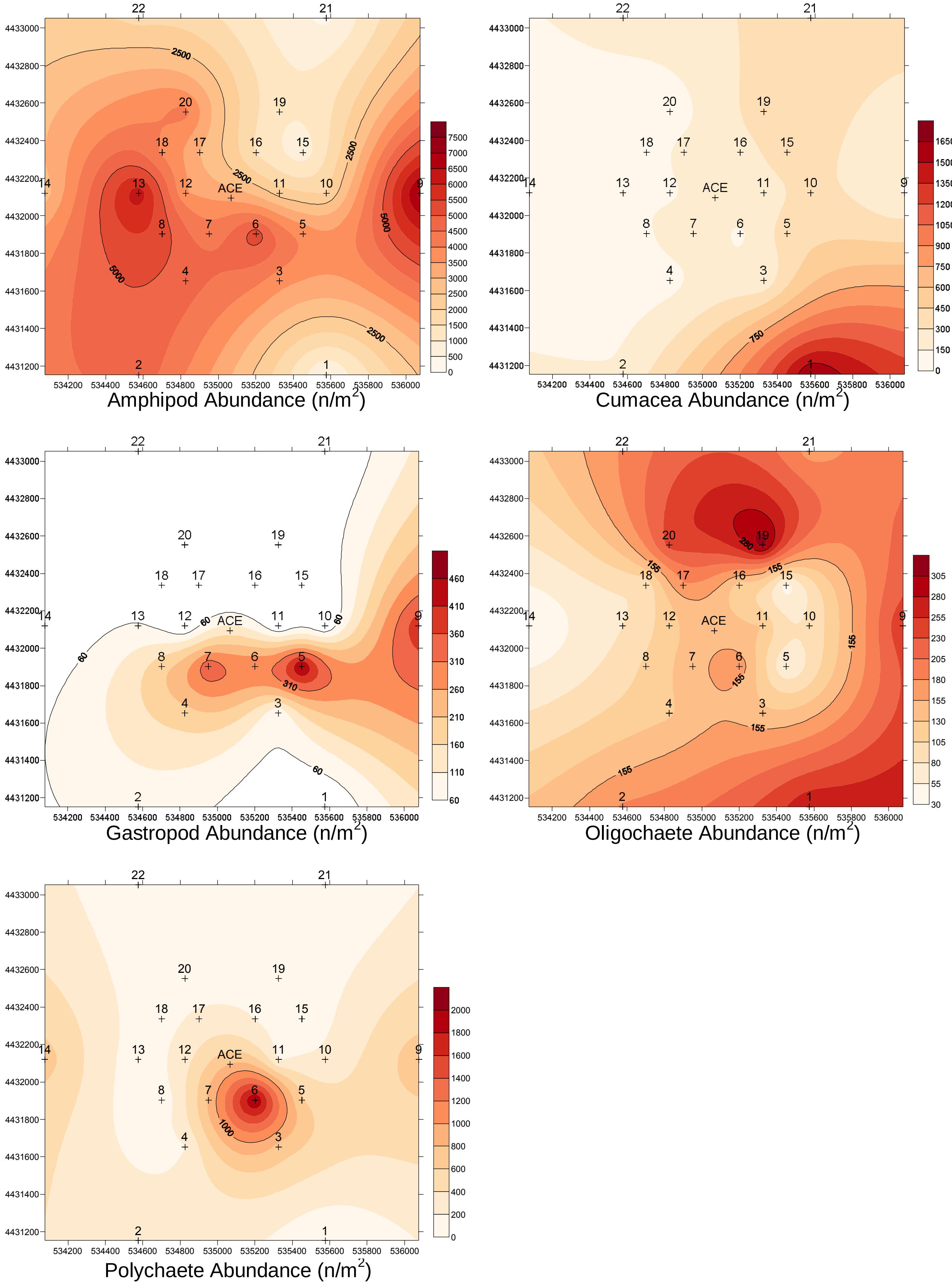
Different spatial distributions were observed for each individual taxonomic group. As the numerically dominant taxonomic group, amphipod distribution heavily influenced the distribution of total abundance across the survey area. Gastropods were absent from stations in the northern half of the survey area with abundance highest within the centre of the survey area while oligochaetes were most abundant at stations on the northern, southern and eastern peripheries of the survey area. A general west to east gradient of increasing cumacean abundance was observed. The highest polychaete abundance was found at station 6 while the lowest abundance was recorded at stations within the northern third of the survey area.

Overall, the macrofaunal community structure within the survey area exhibited typical species richness and abundance recorded during the ACG regional surveys, and was numerically dominated by amphipod crustaceans. The community varied in abundance and taxonomic richness across the survey area and the benthic community was correlated to the sediment physical properties as expected based on previous surveys in the ACG Contract Area with more abundant and species rich communities present in areas with a higher proportion of coarse grained particle size fractions.

Table 6.20 Number of Benthic Taxa and Abundance (number per square metre (n/m^2)) of Main Taxonomic Groups – ACE Platform Location (2017)

Station	Polychaete		Oligochaete		Cumacea		Amphipod		Isopod		Insect	Bivalve		Gastropod	
	Taxa	n/m^2	Taxa	n/m^2	Taxa	n/m^2	Taxa	n/m^2	Taxa	n/m^2	n/m^2	Taxa	n/m^2	Taxa	n/m^2
1	0	0	3	277	3	1650	10	433	1	3	30	0	0	0	0
2	3	337	2	183	4	180	18	4810	1	1220	117	2	207	5	83
3	2	730	3	137	4	183	19	3700	0	0	37	3	177	5	63
4	3	193	3	127	4	107	18	4700	1	250	53	2	137	8	190
5	1	623	3	53	5	390	17	3863	0	0	10	2	57	12	477
6	2	2060	3	170	4	133	18	5287	1	3	73	3	143	8	307
7	1	827	3	147	4	260	24	4190	1	13	20	3	107	9	350
8	1	63	3	110	3	140	20	5250	1	143	17	3	163	8	193
9	1	723	3	253	4	137	19	7213	1	3	13	0	0	6	397
10	1	260	3	87	3	327	12	2003	1	7	0	0	0	0	0
11	1	180	3	130	4	227	15	2280	0	0	0	0	0	0	0
12	1	330	3	120	3	130	23	3553	0	0	3	2	7	0	0
13	2	110	3	80	4	153	23	6350	1	7	13	3	187	4	67
14	1	693	2	33	3	100	18	2777	0	0	0	2	130	1	3
15	1	107	2	43	3	383	11	737	0	0	3	0	0	0	0
16	1	197	2	117	4	230	16	1467	1	3	3	0	0	0	0
17	1	263	2	177	4	203	21	3003	0	0	3	0	0	0	0
18	1	120	3	87	4	73	17	3923	0	0	3	0	0	0	0
19	1	120	3	320	4	380	12	1157	0	0	0	0	0	0	0
20	1	63	2	240	4	60	17	4173	0	0	7	0	0	0	0
21	1	3	3	170	3	377	10	397	0	0	3	0	0	0	0
22	1	70	3	183	4	210	14	1850	0	0	3	0	0	0	0

Figure 6.12 Abundance of Main Benthic Taxonomic Groups – ACE Platform Location (2017)



6.6.3 Biological Characteristics of Water Column

Plankton samples were collected at four stations in the vicinity of the proposed ACE platform location during the 2017 ACE EBS (refer to Figure 6.11).

6.6.3.1 Phytoplankton

A total of 37 species of phytoplankton were recorded in the samples taken during the 2017 ACE EBS. The most abundant species recorded were dinophyta (dinoflagellates) followed by bacillariophyta (diatoms) and cholorophyta (green and blue-green algae) (refer to Table 6.21). The phytoplankton community within the samples was similar in composition to the communities observed on previous surveys carried out within the ACG Contract Area (refer to Table 6.12). The only notable difference is the higher number of dinoflagellate species present in ACE 2017 samples (19 compared to 6 to13 in recorded in previous regional survey samples).

Table 6.21 Taxonomic Composition of Phytoplankton Communities – ACE Platform Location (2017)

Group	No. of Species
Cyanophyta	3
Bacillariophyta	12
Dinophyta	19
Chlorophyta	3
Euglenophyta	0
Total	37

6.6.3.2 Zooplankton

A total of eight zooplankton species were recorded (refer to Table 6.22) during the 2017 ACE EBS. The community was numerically dominated by copepod crustaceans at all stations, with cladoceran crustaceans and planktonic stages of ostracod species also present at a lower density. The most abundant species was the alien copepod *Acartia tonsa*, which accounted for 84% of the individuals present. Zooplankton taxonomic richness within the samples analysed was lower than in previous surveys carried out within the ACG Contract Area. This was particularly evident in 200µm net samples (6 taxa in the 2017 ACE samples, compared to 10-18 taxa in the regional survey samples). However, the lower number of species observed in ACE samples is likely to be a consequence of the fewer samples collected on the ACE EBS compared to ACG regional surveys. Despite the lower number of species present, the general community structure was comparable to ACG regional survey samples.

Table 6.22 Taxonomic Richness of Zooplankton Groups – ACE Platform Location (2017)

Group	No. of Species	
	200µm Net	53µm Net
Cladocera	1	1
Copepoda	2	2
Ostracoda	1	1
Rotatoria		1
Polychaete larvae		1
Cirripedia Nauplii		1
Mollusc larvae		1
Ctenophora	2	
Total	**6**	**8**

6.6.4 Chemical Characteristics of Water Column

Water samples were collected at four stations in the vicinity of the proposed ACE platform location during the ACE 2017 EBS (refer to Figure 6.11). Two samples were taken at each station, one from surface waters (0-2m) and the second from 50m; below the major thermocline.

Overall the COD levels recorded at the ACE location were slightly higher than those recorded in previous surveys within the ACG Contract Area. There was no difference in the BOD levels (1mg/l) in any of the collected samples from the ACE stations and concentrations of TSS, nitrates, nitrites and ammonium were below the detection limit in all samples, a common trait of water samples previously collected in the region. Overall the levels of nutrients in the 2017 ACE samples were within the ranges observed on previous surveys conducted within the ACG Contract Area.

Concentrations of THC, PAH and phenols were also all below the respective limits of detection of 20µg/l, 0.01µg/l and 0.001mg/l in all samples.

The concentrations of all metals in all samples were within the MAC for Azerbaijan fisheries waters (refer to Table 6.23) and the concentrations of most metals were within the ranges observed on previous surveys carried out within the ACG Contract Area with the exception of iron which was slightly higher.

Table 6.23 Heavy Metal Concentrations in Water Samples – ACE Platform Location (2017) (µg/l)

Station	Sample Depth	Cd	Co	Cu	Fe	Ni	Pb	Zn
05	5m	<0.01	0.036	0.687	3.89	1.22	0.073	0.808
	50m	0.01	0.041	2.08	15.7	0.981	0.483	1.19
08	5m	<0.01	0.032	2.02	13.7	0.885	0.638	1.43
	50m	<0.01	0.053	1.81	15.2	1.22	0.486	1.05
15	5m	<0.01	0.049	1.84	11.4	1.05	0.497	1.27
	50m	<0.01	0.049	1.79	13.2	0.882	0.513	3.17
18	5m	<0.01	0.039	1.77	12.7	0.981	0.503	1.99
	50m	<0.01	0.031	2.27	14.4	1.21	0.598	2.20
MAC		5	10	10	N/A	10	100	10

6.6.5 Comparison Between ACE, CA and EA Survey Results

Tables 6.24, 6.25 and 6.26 summarise the physical and chemical characteristics of the sediments from the most recent surveys carried out at the proposed ACE location and the CA and EA platform locations.

As shown in Table 6.24 the ACE 2017 sediment mean diameter and carbonate content results were similar to those recorded at CA, whereas the silt-clay content exhibited a greater similarity to the results from EA. The only parameter to be identified as being different across the three surveys was organic content, which was lowest in the ACE 2017 samples.

Table 6.24 Comparison of Sediment Physical Properties at EA and CA Platforms (2016) and ACE Platform (2017)

	Mean Diameter (µm)			Silt/Clay %		
	EA (2016)	CA (2016)	ACE (2017)	EA (2016)	CA (2016)	ACE (2017)
Min	9	15	9	7	14	9
Max	390	721	1742	96	80	92
Mean	125	372	363	52	26	43
	Carbonate %			**Organic %**		
	EA (2016)	**CA (2016)**	**ACE (2017)**	**EA (2016)**	**CA (2016)**	**ACE (2017)**
Min	27	34	30	1.2	1.2	1.2
Max	75	70	84	3.7	3.6	3.8
Mean	53	63	60	2.8	1.7	2.1

The ACE 2017 TPH and PAH concentrations were, on average, between the values recorded within the CA and EA surveys in 2016, as shown in Table 6.25, although the ACE results show a greater similarity to the characteristics observed at CA.

Table 6.25 Comparison of Sediment Hydrocarbon Characteristics at EA and CA Platforms (2016) and ACE Platform (2017)

	TPH (µg/g)			Total 2-6 ring PAH (ng/g)			Total EPA 16 PAH (ng/g)		
	EA (2016)	CA (2016)	ACE (2017)	EA (2016)	CA (2016)	ACE (2017)	EA (2016)	CA (2016)	ACE (2017)
Min	4	16	8	16	74	40	1	11	5
Max	51	61	66	152	252	203	25	45	41
Mean	25	38	33	79	139	111	15	26	22

	% UCM of TPH			% NPD		
	EA (2016)	CA (2016)	ACE (2017)	EA (2016)	CA (2016)	ACE (2017)
Min	65	79	74	49	49	44
Max	83	89	92	75	69	58
Mean	78	86	83	61	59	52

As shown in Table 6.26 the mean concentration of arsenic, barium (fusion) and iron within the ACE 2017 survey samples was most comparable to the results from the EA survey and lower than the mean concentrations recorded at CA, while the opposite was observed for copper. The mean concentrations of cadmium, lead and zinc recorded were lower for the ACE survey than for both the CA and EA surveys. No notable differences were observed between the ACE, EA and CA surveys with regard to concentrations of chromium and manganese.

Overall the absolute differences between concentrations recorded at the ACE, EA and CA locations are not significant and in general the metal composition of sediments across all three surveys were relatively similar and typical of the regional background. The only exception was the higher barium fusion level at a localised area near the CA platform, which is understood to be due to the presence of WBM drilled cuttings at that location.

Table 6.26 Comparison of Sediment Metals (mg/kg) at EA and CA Platforms (2016) and ACE Platform (2017)

	As			Ba HNO_3			Ba Fusion		
	EA (2016)	CA (2016)	ACE (2017)	EA (2016)	CA (2016)	ACE (2017)	EA (2016)	CA (2016)	ACE (2017)
Min	4.3	6.2	4.2	626	2101	285	1080	3675	694
Max	15.6	16.7	14.5	8606	11754	6524	13370	35093	15627
Mean	7.1	9.7	7.1	3352	6613	1825	4993	10797	3863
	Cd			**Cr**			**Cu**		
	EA (2016)	CA (2016)	ACE (2017)	EA (2016)	CA (2016)	ACE (2017)	EA (2016)	CA (2016)	ACE (2017)
Min	0.12	0.12	0.09	12.8	23.0	24.8	6.3	10.9	10.1
Max	0.21	0.21	0.30	55.8	63.8	57.4	25.7	24.3	20.3
Mean	0.16	0.17	0.13	36.5	41.3	38.6	18.8	16.9	15.7
	Fe			**Mn**			**Pb**		
	EA (2016)	CA (2016)	ACE (2017)	EA (2016)	CA (2016)	ACE (2017)	EA (2016)	CA (2016)	ACE (2017)
Min	10993	16644	11533	221	281	268	8.3	8.2	4.3
Max	26728	25969	23374	624	554	626	12.8	13.4	10.5
Mean	17090	20505	16705	359	374	392	10.8	10.8	6.1
	Zn								
	EA (2016)	CA (2016)	ACE (2017)						
Min	21.8	38.3	25.8						
Max	60.8	61.3	47.8						
Mean	41.7	49.6	35.5						

Table 6.27 presents a summary of the benthic survey results from 2017 ACE EBS and the 2016 CA and EA platform surveys.

Table 6.27 Summary of Major Taxonomic Groups Species and Average Abundance at EA and CA Platforms (2016) and ACE Platform (2017)

Taxonomic Group		EA (2016)	CA (2016)	ACE (2017)
Polychaete	No. of Species	3	3	3
	Abundance (n/m^2)	105	506	367
Oligochaete	No. of Species	3	3	3
	Abundance (n/m^2)	131	361	147
Cumacea	No. of Species	4	6	6
	Abundance (n/m^2)	153	53	274
Amphipod	No. of Species	26	30	31
	Abundance (n/m^2)	1307	4804	3323
Isopod	No. of Species	1	1	2
	Abundance (n/m^2)	4	4	75
Bivalve	No. of Species	1	4	3
	Abundance (n/m^2)	0	94	60
Gastropod	No. of Species	7	15	15
	Abundance (n/m^2)	6	68	97

The results show that for all three surveys amphipods were the numerically dominant taxonomic group. When compared to the community data from the surveys carried out at CA and EA in 2016 (refer to Appendix 6D) the community structure across the area surveyed for the 2017 ACE survey area exhibited a high degree of similarity (~80%) to the CA survey area. Polychaetes were numerically dominant over oligochaetes and similar numbers of bivalves and gastropods were present on both surveys.

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7 Social Description

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7.1 Introduction

This Chapter of the Environmental and Social Impact Assessment (ESIA) describes the existing social and socio-economic conditions relevant to the Azeri Central East (ACE) Project.

With the exception of onshore construction and commissioning, the planned ACE Project activities will be predominantly located offshore. The focus of this Chapter is to provide a general overview of the social environment and establish the national, regional and local employment and community and economic conditions against which construction, commissioning and operational activities can be assessed. The social impact assessment is presented in Chapter 12 of this ESIA. Taking into account the scope, scale and location of the project activities (including potential accidental events as assessed within Chapter 13 of this ESIA), the main interactions likely to arise from ACE Project activities, as identified through Scoping (refer to Chapter 3 of this ESIA), are positive impacts on the local economy and employment and therefore, this description of existing socio-economic conditions focuses on these.

This Chapter provides the following information relevant to the ACE Project:

- An overview of Azerbaijan national and regional socio-economic conditions, including population demographics, regional and local economic status and income and poverty conditions;
- An overview of the educational structure within Azerbaijan;
- A summary of offshore commercial fishing and small scale fishing currently undertaken within areas potentially impacted by ACE Project activities;
- An overview of national tourism and regional coastal recreational activities;
- A description of regional and international shipping routes known to cross the Azeri Chirag Gunashli (ACG) Contract Area and ACE Project location and the associated port infrastructure; and
- An overview of BP’s social investment and local development programmes and initiatives.

7.2 Data Sources

Socio-economic data presented in this Chapter has been taken from the following sources:

- Review of other available BP and third party ESIAs/Environmental Technical Notes (ETNs) completed for projects in the Azerbaijan sector of the Caspian Sea, specifically within or in close proximity to the ACE Project, including:
    - ACE Geotechnical Survey ETN, 2017 (Ref. 1);
    - Shallow Water Absheron Peninsula (SWAP) 2D Seismic Survey ESIA, 2015 (Ref. 2);
    - SWAP 3D Seismic Survey ESIA, 2015 (Ref. 3);
    - Shah Deniz Stage 2 (SD2) Project ESIA, 2012 (Ref. 4); and
    - Chirag Oil Project (COP) ESIA, 2010 (Ref. 5).
- Primary data collected during an earlier coastal sensitivity mapping exercise completed in 2014 (Ref. 6).
- Secondary data collected through consultation with local governmental and other organisations including:
    - Ministry of Ecology and Natural Resources (MENR); and
    - Azerbaijan Fisheries Research Institute.
- Secondary data and literature publically available on the internet including data and reports published by The State Statistical Committee of the Republic of Azerbaijan, The Republic of Azerbaijan Ministry of Economy, US Energy Information Administration, United Nations Development Programme and the World Bank.

7.3 Geographic Context

As set out within Chapter 5 of this ESIA the ACE Project comprises the construction and commissioning of the ACE platform topside, jacket and subsea equipment within a number of construction yards located on the Azerbaijan coastline. The yards anticipated to be used for the Project and their setting is described in Section 6.4.1.1 of this ESIA.

Land use in the vicinity of Bayil yard[1] and South Dock is dominated by commercial and industrial use with the nearest residential settlement of Bibiheybat (population approximately 1,000-1,200 people) located approximately 1 kilometre (km) to the west of the yards. The Bayil and South Dock yards are located within the Sabayil District. The Baku Deep Water Jacket Factory (BDJF) yard is located in Garadagh District within a mostly industrial and commercial area. The nearest residential settlement of Sahil is located approximately 5km to the west. Sangachal Terminal (ST) is located approximately 55km southwest of Baku within Garadagh District. There are four main settlements in the vicinity of ST, the largest being Sangachal Town located approximately 2.5km southwest and the closest being Umid, located less than 1km to the southeast. The ACE Project does not require any additional expansion or upgrades to ST (other than minor telecommunication modifications) as there is existing capacity at ST to meet the requirements for ACE.

7.4 Overview of Onshore Socio-Economic Conditions

7.4.1 Population, Demographic Structure and Ethnicity

Azerbaijan is an independent, secular state comprising of 77 administrative districts including 11 city districts, which are independently administered. The city district of Baku which extends from the Absheron Peninsula along the coastline to approximately 50km to the south of Baku, is subdivided into 12 administrative districts: Binagadi, Khazar, Khatai, Garadagh, Narimanov, Nasimi, Nizami, Sabunchu, Sabail, Surakhani, Yasamal, and Pirallahi.

Most of Azerbaijan's major settlements are coastal, with 22% of the population registered as resident in the Azerbaijani capital, Baku (Ref. 7). In 2017, the population of Azerbaijan was estimated at 9,867,250, with a gender distribution of 49.8% male and 50.2% female. Population growth between 2006 and 2013 averaged at 1.3% per annum (Ref. 7).

The proportion of the population resident in urban areas has remained relatively constant at around 50% over the past 20 years and between 2004 and 2014 the share of the urban population has only increased by 1%. The average population density in Azerbaijan is 109 persons per square kilometre (km^2) and Baku has the highest population density at around 1,000 people per km^2 (Ref. 8).

In 2015, life expectancy in Azerbaijan was 73.6 years (69.6 years for men and 75.8 years for women) which reflected a significant, positive change since 1990 when average life expectancy was 71.1 years (67.0 for men and 74.8 years for women) (Ref. 8).

Based on the 2009 census (latest data available), there are over 80 different ethnic groups in Azerbaijan. The majority of the national population (91.6%) was ethnically 'Azerbaijani', with the remaining 8% comprising a range of ethnic groups including Lezgis (2%), Armenians (1%), Russians (1%) and Talyshs (1%). Additionally, according to the 2009 census, there were 38,000 Turks, 26,000 Tatars, 25,000 Tats, 21,000 Ukrainians and 12,000 Tzakhurs living in Azerbaijan (Ref. 9).

The official language is Azerbaijani spoken by 98.6% of the population (Ref. 8). After Azerbaijani, Russian is the most commonly used language (8%). Other ethnic languages include Tat, Georgian, Ukrainian, Talysh, Kurdish and other.

The religious distribution in Azerbaijan is relatively homogenous, with the majority of the population defined as Muslim. Other religions include Orthodox Christianity, Judaism, Catholicism and Protestantism (Ref. 8).

[1] Formerly known as the Amec-Tekfen-Azfen (ATA) yard

Azerbaijan has one of the highest per capita concentrations of internally displaced persons (IDPs) in the world. IDPs are perceived as vulnerable and often marginalised members of the community, and tend to be excluded from the formal economy and civil, social and political life, living in poor housing and lacking access to basic services such as water and sanitation. Nationally, approximately 393,000 people are classed as IDPs, which represented approximately 4% of the total population in 2017 (Ref. 9). As well as the IDPs, there are approximately 10,000 people registered as refugees according to the United Nations Refugee Agency (UNHCR) (Ref. 9). IDPs are concentrated in Baku, Sumgayit and around Mingechevir. There are also a number of IDPs from the Zangilan region who live in Bibiheybat, which is located south of Baku near the Bayil and South Dock yards.

7.4.2 Economy

Azerbaijan's economy is heavily dependent on its energy exports, with more than 90% of total exports accounted for by oil and gas, and the country is one of the Caspian Sea region's most important export routes to the West. The State Oil Company of the Azerbaijan Republic (SOCAR) is involved in all segments of the oil sector. SOCAR produces about 20% of Azerbaijan's total oil output, with the remainder produced by international oil companies (Ref. 10). The State Oil Fund of the Republic of Azerbaijan (SOFAZ), established in 1999 to manage currency and assets from oil and natural gas activities, had $33.5 billion in managed assets at the beginning of 2017, down 1.27% from the beginning of 2016. The most recent quarterly report states that the assets of SOFAZ as of October 1, 2017 have increased by 8.67% compared to the beginning of 2017 (Ref. 11).

Following the economic downturn in 2015–16 going forward, growth is expected to strengthen, driven mainly by a fiscal stimulus, a rise in hydrocarbon prices, and an increase in gas exports (Ref. 12). There were signs of recovery in Azerbaijan's financial sector in 2017, supported by the stabilization of the Manat (AZN) exchange rate and growth across non-oil sectors.

In recent years the Azerbaijani Government has been implementing policies to help diversify the economy away from oil and towards non-oil sectors such as agriculture, fishing and livestock production. In 2017, public financing, improved confidence and a favourable external environment all supported non-oil economic growth, but this was offset by a decline in oil production (Ref. 12).

Other important economic sectors include manufacturing and services such as tourism, finance and telecommunications. The overall contribution of fisheries to national food security and poverty reduction is generally low, but there are areas where fisheries are important for the rural economy and the livelihoods of coastal communities (Ref. 13). The fisheries industry is discussed in further detail in Section 7.6.

Agriculture also plays an important role in providing employment and livelihood for a large portion of the population in Azerbaijan, providing employment for approximately 40% of the population. Although in 2016 it made up only 6% of Gross Domestic Product (GDP), decreasing significantly since 2000 when it accounted for approximately 17% of GDP (Ref. 14).

Key agricultural products produced in Azerbaijan include; grains (wheat, barley, corn), legumes (peas, beans, etc.), vegetables, nuts, fruits, berries, tea leaves, tobacco, cattle, sheep and goats, poultry and animal products such as milk, eggs and wool (Ref. 15). These crops, livestock and livestock products are mostly produced to be sold in the domestic consumer market, with some produced for household use. Within the Baku City economic region (which includes the Sabayil and Garadagh Districts), the economy is dominated by the industrial sector, primarily oil and gas. Economic activity by sector in terms of small enterprises is presented in Table 7.1 for Baku and for Azerbaijan as a whole in 2015 (Ref. 36).

Table 7.1 Proportion of Small Enterprises by Economic Sector and Region (2015)

Number of Small Enterprises	Azerbaijan		Baku City	
	Total	%	Total	%
Agriculture, forestry and fishing	1915	11	69	1
Industry	1241	7	544	6
Construction	1282	7	616	6
Trade and transport repair services	6781	37	4108	42
Transportation and storage	447	2	229	2
Real estate activities	505	3	422	4
Other fields	5993	33	3832	39
Total	**18164**	**100**	**9820**	**100**

Economic activity associated with small enterprises was dominated by enterprises involved in trade and transport repair services and, to a lesser extent, industry; agriculture, forestry and fishing; and construction (Ref. 14).

7.4.2.1 National Employment Trends

Azerbaijan has relatively high employment and labour force participation rates and a correspondingly low unemployment rate. According to the national data recorded in 2016, 5,012,700 people were recorded as economically active in Azerbaijan. Unemployment was recorded at ~5%, with 252,800 people unemployed, of which 33,000 were officially registered as unemployed (Ref. 20).

Female unemployment stood at 5.9% (as a percentage of female employment), decreasing from 2000 when it was 13.9% (Ref. 15). Similarly, male unemployment in 2017 was 4.4%, decreasing from 2000 when it stood at 10% (of total male employment).

Youth unemployment (15 – 24 years old) was recorded as relatively high, at 14.8% in 2017. However, it has also significantly decreased from 2000, when youth unemployment was around 28% (Ref. 15).

Non-oil sector employment is concentrated in low productivity jobs predominantly in agriculture (36.3% of total employment) with the majority engaged in subsistence farming (refer to Table 7.2 (Ref. 20)). The informal sector dominates and jobs are often seasonal and/or temporary in nature. Jobs requiring technical skills and computer proficiency are frequently unfilled. Young people entering the labour market often have only general education or skills for which there is little demand while many adult job seekers have skills for jobs that are no longer available (Ref. 15).

Table 7.2 National Employment by Sector in 2016

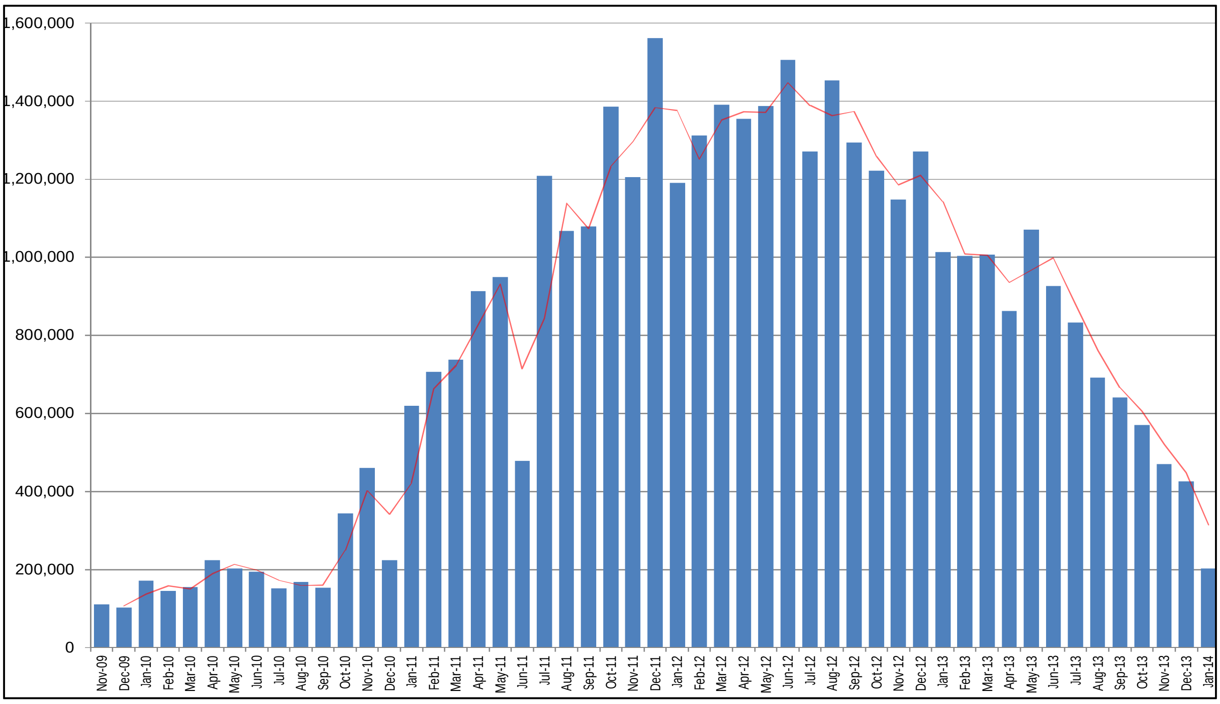
Sector	'000 People	Percent (%)
Agriculture, Forestry and Fishing	1,729.60	36.3
Mining	38.1	0.8
Manufacturing	242.2	5.1
Energy Production	27.3	0.6
Water Supply and Waste Treatment and Disposal	30.6	0.6
Construction	343.8	7.2
Transport and Storage	898.0	18.9
Accommodation and Food Service	68.4	1.4
Information and Communication	61.2	1.3
Financial Services	27.1	0.6
Real Estate	88.0	1.8
Professional, Scientific and Technical	68.4	1.4
Administrative and Support Services	57.1	1.2
Public Administration and Defence	285.4	6.0
Education	374.8	7.9
Health and Social Services	185.6	3.9
Art, Entertainment and Recreation	77.4	1.6
Other Services	156.9	3.3
Total	**4,759.9**	**100.0**

7.4.2.2 Previous BP Projects Employment

Historically, BP projects (construction and operations) have had a significant impact on local and regional employment levels. Data collected during construction of the ACG Phases 1 and 2 projects between 2002 and 2005 indicated employment for these projects peaked at approximately 5,500 workers in mid-2004 (Ref. 16). Total employment for the ACG Phase 3 project peaked during 2006 with 2,500 jobs (onshore and offshore construction). At the peak of construction for COP during 2011/2012 employment peaked at more than 8,000 workers (Ref. 17) of which approximately 90% were Azerbaijani nationals. Figure 7.1 presents a histogram of the man-hours worked on COP from the start of construction in 4Q 2009 until handover to operations in 1Q 2014.

The SD2 Project achieved first gas in 2018. During 2016 at the peak of project activities, over 24,000 people were involved in construction works across all main contracts in Azerbaijan, of which over 80% consisted of Azerbaijani nationals (Ref. 18).

Figure 7.1 Chirag Oil Project Workforce Man-Hours (2009-2014)



To maximise positive impacts from employment, the previous ACG Phases and SD1 and SD2 construction projects adopted the following measures:

- **Targets:** BP committed to specific national content targets through each of the projects;
- **Preference in Recruitment:** Priority was given to recruit local residents in the Garadagh District and in particular the settlements in close proximity to the construction yards and Sangachal Terminal;
- **Information Centres:** Local community information centres were established in Sangachal Town, Umid and Sahil to enable local people to register for employment and the centres developed a database for future potential projects; and
- **Training:** Extensive training programmes were implemented both prior to and during employment of the construction workforce. Training focused on Health, Safely and Environment (HSE), language and computer skills, driving and certified courses including painting, lifting, scaffolding and welding. For the SD2 Project, in one yard alone more than 412,000 training hours of HSE training and more than 292,000 hours of craft training were provided.

7.4.3 Income and Poverty

In 1995, it was estimated that 68.1% of the population in Azerbaijan was living under the absolute poverty line[2] (Ref. 7). However, following significant economic and political reforms from the early 2000s, poverty has decreased substantially, and in 2013 it was estimated that only 5% of the population was living below the national poverty line[3]. This was coupled with a rise of 91% in gross national income (GNI) per capita between 2001 and 2013 (Ref. 19). This rapid growth is due to the expansion of the oil and gas sector, high levels of public expenditure and substantial reforms supporting a market-based economy.

However, in 2014, growth slowed down primarily due to falling oil prices and a decline in total oil and gas production (Ref. 19). The average national monthly nominal income in 2006 was 499.8 AZN. Significant economic disparities existed between rural and urban areas. For example, in 2016 the average monthly income in a predominantly rural region such as Salyan (located 50km south of Baku) was 302.5 AZN compared to 742.2 AZN in Baku (Ref. 20). There were also discrepancies between urban and rural areas in terms of poverty reduction, with poverty reducing at a faster rate in more urban environments.

Although significant improvements have been made to reduce poverty levels, there are still a number of issues relating to poverty in Azerbaijan. There remains a lack of appropriate job opportunities in the labour market, with many Azerbaijanis working in low-paying or informal[4] jobs (Ref. 21). Only 1% of the workforce holds higher wage jobs in the petroleum sector, which generates about half of GDP, while 44% of the population works in the informal economy (Ref. 21).

Income within coastal areas around Baku and in the vicinity of the proposed construction yards to be used for the Project is primarily derived from the oil and gas industry. However, the studies undertaken for the SD2 and SWAP ESIAs (Refs. 2, 3, 4) have confirmed a small number of fishermen along the coastline who hold permits to undertake small scale coastal fishing within 2-3 nautical miles from the coastline. The fishing industry, and its value to the economy, is further discussed in Section 7.6.

7.5 Human Development

Azerbaijan ranks 78th out of 188 countries in the United Nations Development Programme (UNDP) 2016 Human Development Index (HDI)[5] and is classified as a 'high human development' country (Ref. 22). By 2013, Azerbaijan had attained or was on track to achieve 15 of the 21 Millennium Development Goals (MDGs). However, one of Azerbaijan's significant development challenges is the development of human capital of the population, in order to enable more people to participate actively in future growth, and thereby increase national productivity (Ref. 22).

A European Bank for Reconstruction and Development (EBRD) gender gap analysis highlights significant levels of gender inequality, particularly in relation to women's participation in the labour force and access to finance. Relative to men, women still have fewer opportunities for participation in social, economic and political life (Ref. 23).

Social conditions remain a major source of concern, as real wages and spending on social protection programs declined in 2017.

[2] Absolute poverty line is characterised by severe deprivation of basic human needs, including food, safe drinking water, sanitation facilities, health, shelter, education and information. It depends not only on income but also on access to services. In 2015, the international poverty line stood at $1.90 a day (World Bank).
[3] Poverty decreased from 49.0% in 2001 to 29.3% in 2005, 10.9% in 2009, to 5.0% in 2013 (ADB, 2013).
[4] The informal economy is the diversified set of economic activities, enterprises, jobs, and workers that are not regulated or protected by the state.
[5] The HDI is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions. The health dimension is assessed by life expectancy at birth, the education dimension is measured by mean of years of schooling for adults aged 25 years and more and expected years of schooling for children of school entering age. The standard of living dimension is measured by gross national income per capita. The scores for the three HDI dimension indices are then aggregated into a composite index using geometric mean.

7.5.1 Education

The Azerbaijan education law guarantees the right to education for all its citizens irrespective of race, nationality or sex. In 2016, approximately two million people were registered as students at various institutions throughout the country. Table 7.3 presents a summary of the key education indicators reported nationally for 2000 to 2016 (Ref. 24).

As Table 7.3 shows the period 2000 to 2016 saw a decrease of approximately 12% in the number of pupils in general day schools, although there was an increase of 8% in 2016 compared to 2015 (Ref. 24). During the same period there was a fall of approximately 3% in the number of teachers in general schools. The most significant changes over the period to 2016 were in the growth in the number of students in higher educational institutions, which increased by 37%. These numbers suggest a high level of gender equity within the education system with 48.3% of students in higher education in 2016 registered as female. However, the percentage of female students enrolled in vocational schools is lower compared to other educational categories and has fallen from 36.7% in 2000 to 25.1% in 2016 (Ref. 24).

Educational quality continues to be an important challenge. Since the adoption of a National Education Development Strategy in 2013, the government has initiated a number of reforms to address the issues of content, relevance, quality, management, and equity at all levels of the education system. The Action Plan for the National Education Development Strategy, approved in 2015, includes, among other measures, actions to improve the content of education based on competent, student-oriented, and innovative approaches at all levels, and aims to transform higher educational institutions into research and innovation centres.

Table 7.3 Key Education Indicators, 2000 to 2016

Indicator	2000	2005	2010	2014	2015	2016
Number of children in preschool institutions	111,020	110,017	112,892	116,049	117,239	118,685
Percent (%) female	48.3	47.3	45.8	46.4	46.3	46.2
Number of pupils in general schools	1,653,703	1,578,579	1,318,123	1,315,674	1,344,961	1,452,987
Percent (%) female	-	19.9	16.9	17.1	17.4	13.2
Number of teachers in general schools	161,492	171,788	172,579	160,894	158,275	157,018
Percent (%) female	68.6	71.2	73.9	76.6	78.6	78.0
Number of pupils in vocational schools	22,944	22,189	27,330	25,414	24,482	23,814
Percent (%) female	36.7	29.4	28.9	27.2	26.4	25.1
Number of students admitted to secondary education	14,823	17,330	15,884	14,337	13,845	15,139
Number of students in specialised secondary educational institutions	42,612	57,896	53,451	60,478	56,427	51,702
Percent (%) female	69.8	69.8	66.2	67.4	66.7	66.4
Number of students of specialised secondary educational institutions per 10,000 people	53	69	59	64	59	53
Number of graduates of specialised secondary educational institutions per 10,000 people	14	19	16	16	17	18
Number of students in higher educational institutions	119,683	129,948	140,241	158,212	161,234	163,779
Percent (%) female	41.7	47.7	46.4	48.5	48.8	48.3
Number of students in higher educational institutions per 10,000 people	150	154	156	167	168	169
Number of graduates of higher educational institutions	26,403	28,747	29,904	35,801	33,645	36,126
Number of graduates of higher education per 10,000 people	31	39	35	35	35	38

7.5.2 Health

Despite significant increases in public health expenditure, Azerbaijan is still characterised by significantly lower levels of public health expenditure compared to other Commonwealth of Independent States (CIS) countries (Ref. 35). Analysis of the 2011 Stakeholder and Socio-Economic Survey conducted to inform the SD2 Project ESIA (Ref. 4) estimates that an additional 10% of Azeri households were poor as a result of out-of-pocket spending on health.

In terms of disease statistics, there are increases in non-communicable diseases (NCDs) and obesity, in addition to infectious diseases such as HIV/AIDS, avian influenza, tuberculosis (TB) and malaria.

Infrastructure quality varies across the country. For example, water supply has become more reliable in Baku in the last few years. However, regions outside Baku suffer poor access to water supply. Less well-off households also tend to have limited access to other infrastructure services such as hot water, electricity and sewerage.

7.5.3 National Development Policy Goals

Azerbaijan’s overarching national development policy framework is set out in four key instruments: ‘Development Concept Azerbaijan 2020: Outlook for the Future’ (Ref. 25), ‘Presidential Decree on Socio-Economic Development of Regions 2008-2015’ (Ref. 26), ‘State Program on Poverty Reduction and Sustainable Development in the Republic of Azerbaijan 2008-2015’ (Ref. 27) and ‘State Programme on Socio-Economic Development of Regions of the Republic of Azerbaijan 2014-2018’ (Ref. 28). These describe the main objectives of Azerbaijan’s development policy in the development of the non-oil sectors, diversification of the economy, rapid development of regions, and in particular, improvements to infrastructure and social services related to rural development:

- Economic policy includes measures to stimulate agricultural producers, increase wheat production and strengthen competitiveness, as well as stimulate export-oriented activities. Food security is a key priority area for economic policy;
- Social investments will prioritise both human capital and infrastructure development. Business development policy will focus on financial provisions for entrepreneurs in regions. Production, market and social infrastructure for entrepreneurs will be improved, including accelerating the development of modern market infrastructure mechanisms (finance, banking and insurance system, stock market, audit, leasing, and franchising services);
- Industrialisation policy aims to develop the traditional processing sectors of the non-oil industry such as chemical industry, metallurgy, machine building, electrical technology, electronics, light industry and the food industry. The state will support the development of mechanisms for the recruitment of qualified staff;
- Agriculture policy focuses on the coordinated development of raw material production and processing. The state aims to increase financial support to the agrarian sector and continue incentive measures for development of traditional agricultural sectors including large wheat or seeding, seedling, grape growing, and gardening enterprises. The state will continue to support logistics centres for agricultural production, procurement, storage and sale. The state will support efforts to strengthen the material and technical base of the agrarian sector, and promote specialisation based on the natural and climatic conditions of each district;
- Health policies aim to emphasise public health protection, improvements to service quality as well as skills and knowledge development for specialists. Implementation will include constructing new facilities as well as repairing existing ones. Health resort facilities will also receive state support;
- State policy in the education sector includes construction of, and major repairs to, education facilities in the regions, regular labour market surveys to ensure a match between the labour pool and work spaces, distance learning, education for gifted children as well as special needs children, and adult education, including vocational studies. Education policy also aims to empower women and youth and enable their employment. The state will specifically channel oil income into developing human capital. Internal migration levels will be reduced through further development of social and communal infrastructure in rural area;

- The state will support activities aiming to improve gas supply in the regions, the installation of modern heating systems, as well as the rehabilitation, modernization and reconstruction of existing heating systems in the regions; and
- Youth policy will focus on information and counselling for young people living in remote districts and rural areas, as well as physical culture and sport for health and well-being, as well as productive use of leisure time. Youth employment and entrepreneurship development will also be a priority. The state will support the strengthening and development of the material and technical base of sport facilities in regions.

7.6 Commercial Fishing

7.6.1 Fisheries Regulations

7.6.1.1 Legislation Regulating Fishing Activity in the Republic Of Azerbaijan

Fishing activity is regulated through legislation, and respective rules and regulations. The legal basis for the organisation, management, development, usage and protection of fish resources in the Azerbaijan Republic is regulated by the Azerbaijan Republic Law "On Fishing" adopted in 1998 (No 457-IQ, 27.03.1998). In 2017, the "Regulations for fishing and hunting of other water bioresources" No 243, was adopted to outline the hunting means, including seasonal restrictions and equipment to be used in the Caspian Sea.

Coastal fishing is regulated by the "*Rules for state registration of small tonnage vessels, approved pursuant to Resolution 97 (dated 23 April 2008) of the Cabinet of Ministers of the Republic of Azerbaijan*". The *"Classification of small tonnage vessels sailing under the state flag of the Republic of Azerbaijan", Order 073 issued by the Ministry of Emergency Situations on 16 June 2007* and *Ministry of Justice Certificate 3350 on 26 June 2007* stipulate that the region in which small-tonnage vessels can fish is limited to 2-3 miles (5km) from the coastline.

A summary of the fishing regulatory authorities and their functions are provided in Table 7.4.

Table 7.4 Fishing Regulatory Authorities and Their Functions

Regulatory State Authority	Function
State Maritime Administration (SMA)	Issue documents identifying the vessel owner, crew members of the vessel and the country where the vessel is formally registered.
Ministry of Emergency Situations (MES)	Inspects the technical condition of the vessel and issues a certificate of seaworthiness. Technical certificates for large vessels are issued by the Baku representative office of the Russian Maritime Register of Shipping.
Department for the Increase and Protection of Aquatic Biological Resources (DPABR) – MENR	For vessels in possession of SMA and MES-issued relevant documents DPABR – MENR shall: - Issue formal permission to specific vessels and determine the catch quotas for biological marine products; and - Conduct inspections to approve that the volume and species of the biological marine products caught by the vessels are in accordance with license conditions.
Water Transport Police (WTP) at the Ministry of Internal Affairs (MIA)	For vessels holding respective documents issued by SMA, MES and DPRAB, WTP-MIA shall: - Inspect the vessel appropriate documents; - Confirm whether the vessel is designed for fishing or other purposes such as transporting dry cargo; and - Verify and confirm that the vessel is in possession of DPABR MENR-issued formal documentation and shall not allow the vessel to head for sea without the correct documents.
State Border Service (SBS)	For vessels holding the respective documents issued by SMA, MES and DPRAB-MENR, SBS shall: - Inspect to check the purpose of a vessel's journey out to sea; and - Not allow a vessel to head to the sea for catching fishery products within the economic zone on 10-nautical mile territory, unless it has the correct documentation.

7.6.1.2 Fishing Licensing

DPRAB-MENR is responsible for issuing fishing licences for both commercial and small scale coastal fishing. Coastal fishing areas for which licences have been granted are generally named after the adjacent coastal town or settlement, and it is understood that DPRAB-MENR authorises fishing activities within these coastal areas adjacent to these towns or settlements, extending up to 3 nautical miles from the shoreline.

Unlicensed fishing activity relates to both fish catch exceeding the quota and species authorised by the regulatory authorities, as well as fishing without any license, i.e. unlicensed vessels or unlicensed fishermen. There is evidence of violations of fishery protection legislation every year as well as instances of fishing gear and catch being confiscated. In 2017, there were 272 recorded cases of violations and 122 individuals subjected to administrative and criminal charges. The total amount of claims for damages caused to biological resources was 51,229 AZN (Ref. 29).

7.6.2 Overview of Commercial Fishing within Azerbaijan Sector of Caspian Sea

7.6.2.1 Commercial Fisheries

The latest review of fishing activity (completed in 2018 for this ESIA; refer to Appendix 6B) indicated that commercial fishing is primarily undertaken in shallower coastal waters of the Caspian (up to 50m depth) where the largest concentrations of kilka (the primary catch) are found. In 2016, only 10 commercial fishing vessels equipped with gear necessary for fishing of commercial species were sailing under the Azerbaijan flag. Nine of these vessels were ported in Lankaran city, while the remaining vessel previously ported in Pirallahi island, was moved to the Bibiheybat port of Baku city.

7.6.2.2 Offshore Commercial Fishing

Heavy tonnage fishing vessels made of steel and approximately 30m length and 5m width are used to undertake offshore commercial fishing. Due to decline of the anchovy kilka population which used to be caught at 80-120m depth, fishing vessels have adjusted their methods to catch kilka at shallower depths of 20-40m.

Fishing methods and equipment typically used in offshore commercial fishing are described below:

- Underwater electric lighting method: Electric lighting is the most common method used in the Caspian Sea to attract kilka, which are then caught using cone-shaped bag nets, centrifugal fish pumps, or air hoist (most common method for kilka fishing);
    - Where fish are attracted using lighting and are then sucked in by pump, the method is implemented without fishermen's participation. This method is particularly efficient when the fish population concentration is high; and
- The use of cone-shaped fishing nets involves launching the nets from the boat and encircling the fish. The net is left under water for approximately 5-10 minutes before being lifted out the water. Cone-shaped nets are used at a maximum water depth of 20-90m.

Vessels used for offshore fishing are typically fishing trawlers and seine trawlers. Overall characteristics of these vessels are:

- Fishing trawlers are mainly designed for catching fish in the open sea using trawl nets. The use of a trawl net is not permitted to catch fishery-important kilka in the territorial waters of Azerbaijan; and
- Seine-trawlers are designed for catching fish with bag nets (bottom net) and are the type of vessels used in Azerbaijan. Vessels are normally equipped with different gear including fish pumps, cone-shaped bag nets, and electric lighting. In Azerbaijan and for kilka fishing only, the use of cone-shaped fishing nets is permitted.

Commercial fishing effort varies throughout the year due to fish presence and weather conditions. Low season is generally May to June when the kilka species migrate to the Northern and Central Caspian for spawning. High season is typically March to April with fishing also taking place in

December to February and July to August although fishing effort is reduced during these months due to unfavourable winter (cold and windy) and summer (hot and clear skies) conditions. Favourable conditions are typically dull, cloudy weather conditions when electric lighting used to attract fish is particularly effective.

7.6.2.3 Fishing within ACG Contract Area

The latest review of fishing activity in the Southern Caspian (Appendix 6B) indicated that commercial fishing is not routinely undertaken within the ACG Contract Area. However, the following legal entities and individuals carry out commercial fishing in the Southern Caspian, including the ACG Contract Area:

- Closed joint-stock company (ZAP) “Khazarbalig” (“Khazarbalig” MMM); and
- Closed joint-stock company “Caspian Fish Co Azerbaijan”.

The location of the main fishing grounds in relation to the ACG Contract Area are shown in Figure 7.2.

7.6.3 Small Scale Fishing

Small scale and coastal fishing is predominantly undertaken using medium sized small tonnage vessels, with fishing taking place within to 2-3 nautical miles from the coastline. Typically, March-April and September-November are the peak seasons for fishing with many of the fish caught being sold to local markets. Areas along the coastline between the Absheron Peninsula and Gobustan where the majority of licences have been issued for small-scale fishing include Zira, Hovsan, Shikh, Bayil, Zygh and Sangachal-Gobustan.

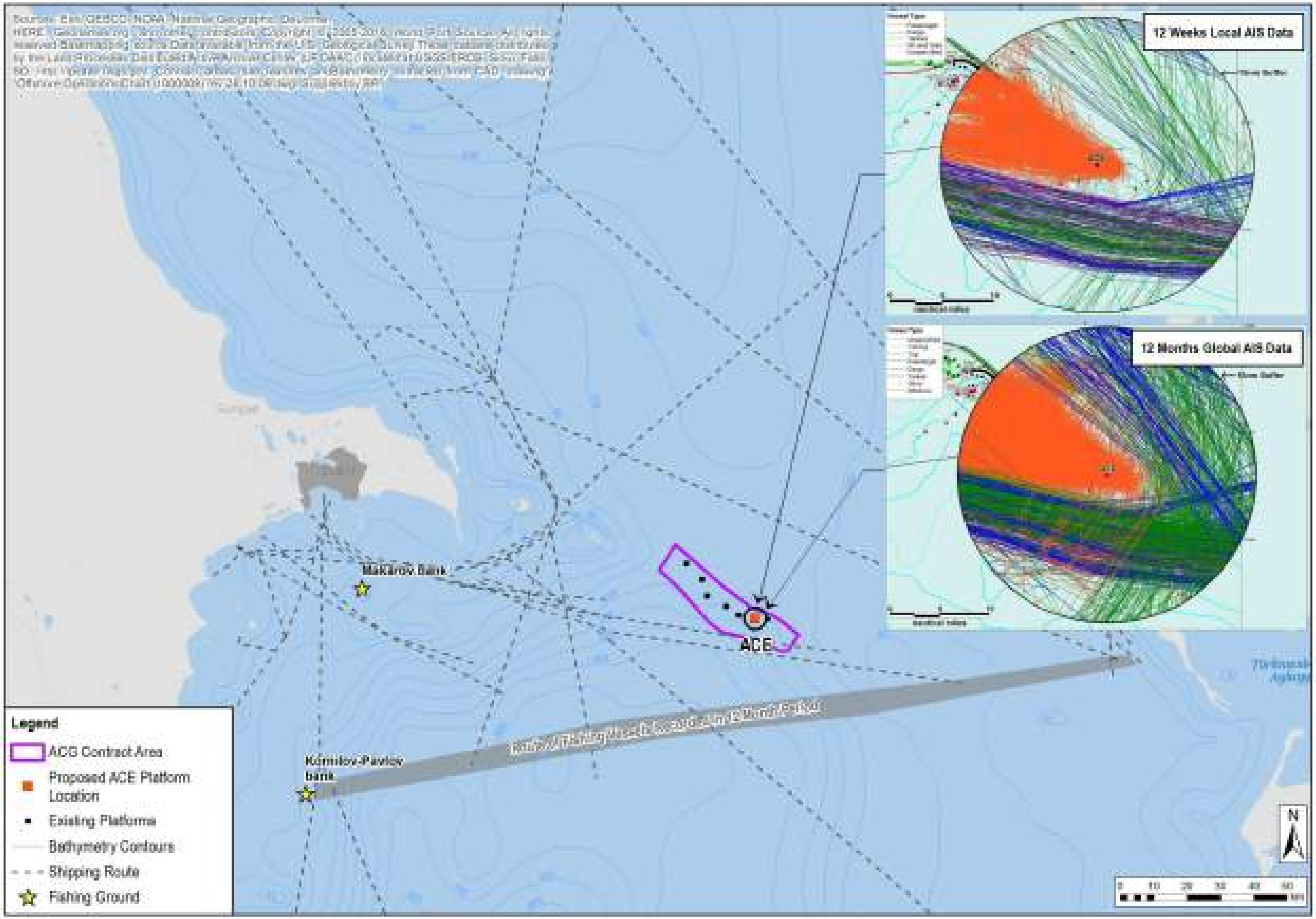
7.6.3.1 Fishing Trends

Historically, kilka has been the main commercial species caught in Azerbaijan. Kilka was the single authorised commercial fishing species until 2012. Commercial catch of anchovy kilka has gradually decreased during the last 12-15 years due to the reduction of kilka reserves since 2001. Due to the reduced reserves of anchovy kilka, there has been a recent change (between 2012-2016) in the commercial fishing licences issued by MENR where both the number of licences issued and the number of larger kilka fishing vessels has decreased. In parallel, the number of licences issued for other fish species and for small boats has increased.

Azerbaijan has also experienced a reduction in the number of recorded violations of fish protection legislation. The likely reason for this change is decreased activity of the Department of Protection and Reproduction of Bioresources in Water Basins of MENR during the last 5-7 years in the prosecution of violations coupled with the reduction in natural reserves of sturgeon (including beluga, sturgeon, sturgeon stellate, ship sturgeon) and the corresponding reduction of illegal fishing of these prohibited species.

In recent years (2011-2016) the number of licences issued for fishing has increased compared to earlier years (2005-2010). This increase is associated with the additional number of licences issued for catching small fish (herring, roach, carp, small fry, bream, grey mullet, shemaya) and increased number of licences for small-capacity fleet (boats). The reduced weight of the landed commercial species of fish, which is a common trend for the entire Caspian Sea in recent years, is due to the reduced amount of kilka. The decreasing catch volume of kilka is becoming more significant, while the amount of small fish caught is increasing. Thus, as compared to 2005-2010, the trend in recent years (2011-2016) indicates a change in commercial fishing from targeting kilka to other small fish species. Due to the decreased amount of kilka landed, the number of fishing licences issued to large-capacity kilka vessels has reduced, while the number of licences issued for small fish harvesting and for small-capacity vessels (boats) has increased.

Figure 7.2 Offshore Fishing Areas and Shipping Routes



7.7 Shipping, Navigation and Offshore Infrastructure

The primary commercial ports of Azerbaijan are situated on the Absheron Peninsula and in the vicinity of Baku. Shipping activities in the waters of the Central Caspian Sea include cargo shipping, passenger vessels, scientific surveys and other vessel movements supporting the oil and gas industry with the key shipping chart routes shown in Figure 7.2.

There is a dense network of navigation routes across the Central Caspian Sea, which are supported by a number of commercial ports, including the Port of Baku, Turkmanbashi (Turkmenistan), Aktau (Kazakhstan) and Olya (Russia). Cargo and passenger ferries operate between Baku/Alat and Aktau and between Baku/Alat and Turkmenbashi; and between Olya and Turkmenbashi. They do not operate under a timetable; operations are dictated by passenger and cargo demand, as well as by the weather (Ref. 30).

During 2017, a vessel tracking study was undertaken using a combination of global satellite and local Automatic Identification System (AIS) data to track the movements of vessels relevant to the proposed ACE platform location over a period of 12 months (global satellite AIS data) and 12 weeks (local AIS data), respectively. As shown in Figure 7.2 the AIS tracking data found the highest density of shipping is to the south of the proposed ACE platform location and that the main shipping activity was associated with supply vessels supporting the oil and gas facilities in the area (Ref. 31).

The 2017 vessel tracking study conducted over 12 weeks from the end of May to the end of August showed that no fishing vessels fitted with AIS passed within 10 nautical miles of the proposed ACE platform location during the period of the study (refer to Figure 7.2). However, it should be noted that this study was conducted outside the fishing high season (which is typically March to April) and it is also possible that fishing vessels without AIS fitted could have operated in this area.

7.8 Tourism and Recreation

In 2017, the direct contribution of tourism activities to the Azerbaijani economy was US$1.6 million or 4.2% of GDP (Ref. 32). It is forecast to rise to $US3.1 million (or 5.6% of GDP) by 2027. The tourism sector directly supported around 173,000 jobs in 2017 (~3.8% of total employment), and indirectly around 611,000 jobs (or 13.2% of total employment). By 2028, travel and tourism is forecast to support 834,000 jobs (18.1% of total employment), an increase of 2.7% per annum over the period (Ref. 32).

In 2017, Azerbaijan generated US$3.2 million in visitor exports; in 2018, this is expected to grow by 9%, and the country is expected to attract 2,125,000 international tourist arrivals; and by 2028, international tourist arrivals are forecast to total 3,235,000 (Ref. 32).

There are a number of locations along the coast of the Absheron Region and south of Baku city that are used for recreational activities and water sports (including diving, sailing and kite surfing) and are available for beach users, particularly in the beach clubs and hotels. A number of these beach clubs and hotels rely on seasonal income, and offer employment opportunities to the region, particularly during high season (Ref. 3).

7.9 BP Azerbaijan’s Social Investment Programmes

BP’s previous projects have played an important role in social development within Azerbaijan. In addition to the direct economic benefit and training gained through local employment and the use of regional (Baku City economic region) and other national businesses by BP, these previous projects were implemented, within a framework of substantial community investment programmes.

BP reported a gross social spend in Azerbaijan, by BP and its co-venturers, of approximately US$M 75 between 2002 and 2017 (refer to Table 7.5) (Ref. 33 and Ref. 34).

Table 7.5 BP and Co-Venturers Social Spend 2002 to 2017 (US$M)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Spend (US$M)	0.6	2.7	8.6	6.3	6.8	7.4	6.4	3.4	4.8	3.1	4.5	2.7	5.9	4.5	1.5	5.7

BP and its co-ventures currently support a variety of community and sustainable development initiatives, including projects designed to improve local education, build community-based skills and capabilities, and provide training that local enterprises need in order to grow. An overview of a selection of these initiatives is provided below:

- **Building Early Intervention Services:** An initiative designed to provide services to identify children's disabilities and developmental delays as early as possible, so appropriate assistance can be given. The work includes establishing early intervention centres, training early intervention specialists, empowering parents to be active participants in their children's development and building public awareness of the importance of early intervention.
- **Build Your Future Project**: This project aims to help students from disadvantaged backgrounds prepare for university. The programme targets students who have a strong desire to study but who cannot afford tutorial services. BP on behalf of its co-venturers provides support to students from the Garadagh, Agdash, Ujar, Kurdamir and Yevlakh regions.
- **Enhancing Employability Skills for People with Disabilities:** Aimed at creating employment opportunities for people with disabilities as skilled or semi-skilled workers, so that they are provided with opportunity for income generation. This project develops skills and capabilities of selected people through trainings and other specialised activities.
- **Supporting Improvement of Computer Science Education in High Schools:** This project aims to improve computer science education at secondary education level in 25 schools in Baku by preparing a computer science curriculum and improving teaching and learning materials for 10th and 11th grades.
- **Agricultural Vocational Education**: 19 modules for four new agricultural occupations (crop production, agriculture machinery, fruit growing, vegetable specialist) and trades have been developed thus contributing to the country's plans to raise the efficiency of the agricultural sector. The project also includes the development of textbooks and teaching materials in all of the newly-created occupations.
- **English for Communities:** This project is designed to enhance the quality of English language teaching in the communities from 11 regions – Garadag, Hajigabul, Kurdamir, Ujar, Agdash, Yevlakh, Goranboy, Samukh, Shamkir, Tovuz, Agstafa. The scope includes two aspects – English language training for teachers and English language sessions for community members. It is aimed at supporting community members to develop skills and build capacities that would help them expand their employment opportunities.
- **Sweet Gold**: An initiative aimed at increasing the income of the pipeline affected communities in Azerbaijan. The project will support up to 600 beekeepers in six districts along the BTC and SCP pipelines – Yevlakh, Samukh, Goranboy, Shamkir, Tovuz, and Agstafa. The project is also expected to result in planting of up to 60,000 trees, which are to serve as the nectar source for bee production.
- **Vocational Training on Detection, Prevention and Treatment of tuberculosis (TB):** The focus of this project is to increase community awareness on tuberculosis (TB) and to support primary health care doctors and nurses in prevention, detection, monitoring and treatment of TB. The project covers 11 regions (Hajigabul, Kurdamir, Ujar, Agdash, Yevlakh, Gobustan, Goranboy, Samukh, Shamkir, Tovuz, Agstafa), as well as the cities of Baku, Sumgait and Ganja.
- **Firavan Project:** An initiative aimed at increasing income for the farmers of a number of small and medium size farms in Samukh, Yevlak and Ujar regions through provision of training in greenhouse management, beekeeping, strawberry growing and animal husbandry, and through provision of equipment support.
- **Social Infrastructure Upgrade in the Communities**: Annually funding is provided for repairs at a number of kindergartens located in the community. The projects implemented in 2017

included renovation and major repair of five kindergarten buildings in Agstafa, Shamkir and Tovuz districts and purchase and installation of furniture for eight kindergartens in Yevlakh, Ujar, Agstafa, Shamkir, Tovuz.

7.10 Local Content Development Initiatives

Through the enterprise development and training programme, launched by BP and its co-venturers in 2007, local companies with strong business potential have been identified and supported to enable them to meet international standards and enhance their competitiveness. The long-term aim of the programme is to increase the number of local companies that can provide products and services to the industry in the region, thus contributing to the development of the local economy. In 2017, 19 companies completed the programme, and a further 51 companies went through the initial appraisal. Over 2,000 companies have been appraised since the programme started. The programme has helped local companies to secure international contracts with BP in Azerbaijan worth $93 million in 2017.

BP and its partners' operations and projects expenditure in Azerbaijan in 2017 is shown in Table 7.6 (Ref. 34). As shown in the table direct expenditure with local small and medium enterprises (SMEs) has exceeded $1 billion in three of the last four years. Spend with state-owned companies was $58 million in 2017 down from a peak spend of $284 million in 2014, and spend with joint venturers reached its highest level of $1,442 million in 2016.

Table 7.6 Local Content Spend 2006 to 2017 (US$M)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
SMEs	77	111	128	132	147	255	481	835	1,233	1,075	1,178	701
State-Owned Enterprises	60	43	37	29	28	36	51	175	284	180	108	58
Joint Venturers	520	450	408	320	366	285	490	533	759	1,174	1,442	1,017
Total	**657**	**604**	**573**	**481**	**541**	**576**	**1,122**	**1,543**	**2,276**	**2,429**	**2,728**	**1,776**

Building a strong national workforce in Azerbaijan remains one of BP's key priorities. BP Azerbaijan has a five-year nationalisation plan for increasing the share of national staff with an ultimate target of reaching 90% by the end of 2018. In 2017, 90% of BP Azerbaijan's permanent professional workforce was national citizens, compared to 89% in 2016 (Ref. 34). As part of the workforce nationalisation strategy, BP is also working to improve the national representation of its contractors' workforce. The strategy is designed to make sure BP contractors are accountable for the planning and delivery of the workforce nationalisation agenda at the early sourcing stage and sets out the target for 90% of the professional workforce to be nationals, as set out in production sharing agreements that BP operate on behalf of government of Azerbaijan and co-venturers.

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8 Consultation & Disclosure

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8.1 Introduction

Stakeholder consultation is an important element of the Environmental and Social Impact Assessment (ESIA) process. Soliciting, collating and documenting the input of potentially affected people and interested parties ensures that project design and the ESIA reflects the collective views of key stakeholders.

This Chapter presents an overview of the consultation and stakeholder engagement relevant to the Azeri Central East (ACE) Project and the process for ESIA disclosure.

8.2 Overview of Consultation and Disclosure Process

ACE Project ESIA stakeholder consultation has:

- Made use of the consultation framework and methods established for the earlier Azeri Chirag Gunashli (ACG) and other BP projects in Azerbaijan;
- Been developed with reference to accepted guidance on expectations of ESIA consultation and disclosure; and
- Considered the extent of consultation and disclosure already undertaken in recent years.

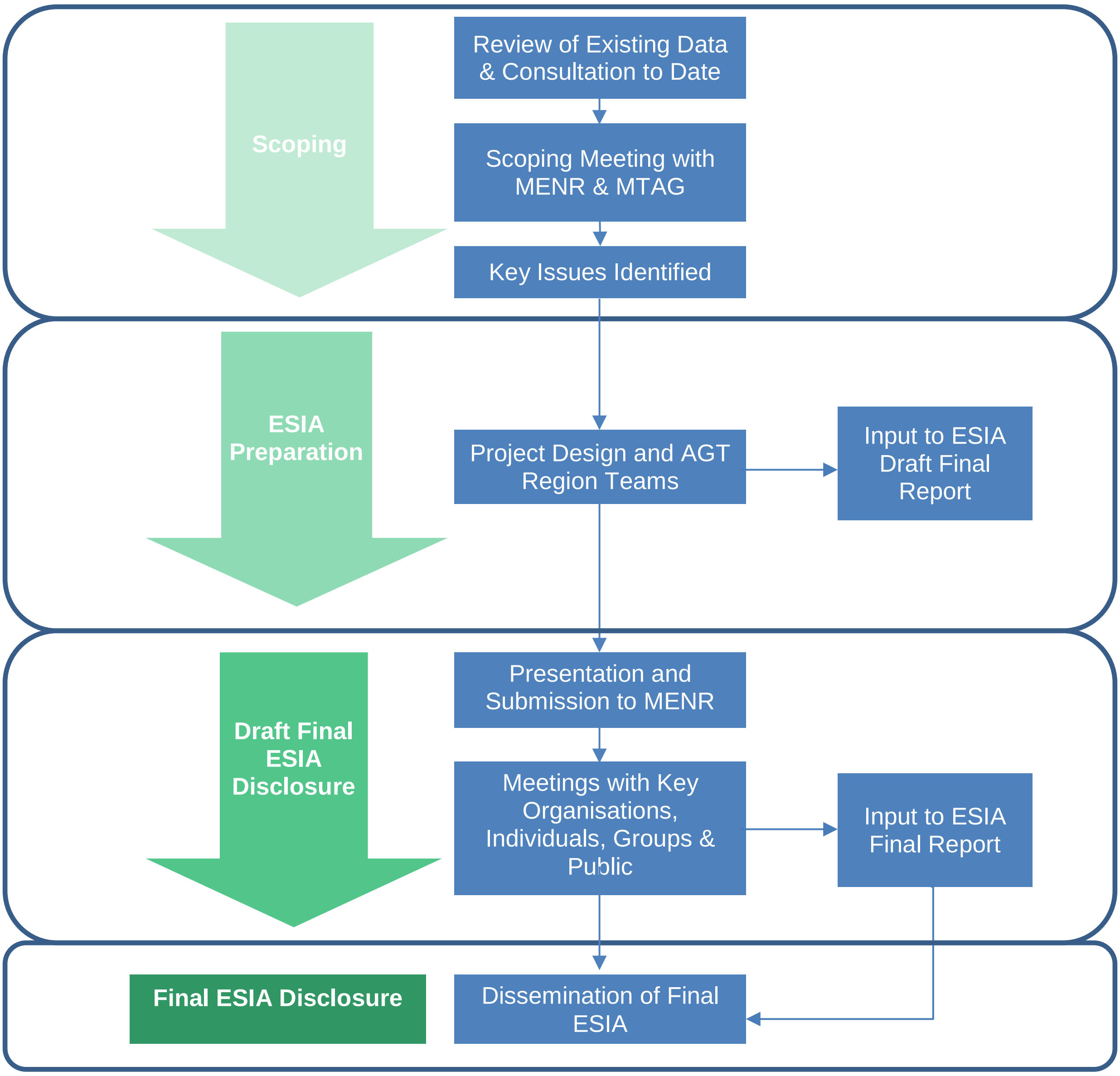
BP has been operating in Azerbaijan since the mid-1990s and built relationships with key local, regional and national stakeholders. For the earlier ACG and Shah Deniz (SD) ESIAs, extensive consultation with stakeholders including government, academic and scientific bodies, non-governmental organisations (NGOs) and communities potentially affected by the project activities was undertaken. This consultation continued throughout the construction of each project and is ongoing during operations, led by BP’s Community and External Affairs Team. The lessons learnt from the previous and ongoing consultation have helped to inform the ACE Project ESIA and the consultation approach.

Figure 8.1 below illustrates the ACE Project consultation and disclosure process. A Public Consultation and Disclosure Plan (PCDP) has been prepared to support the ACE Project ESIA. The PCDP outlines the consultation and disclosure objectives and the national and international regulatory regime that project consultation and disclosure will follow to ensure best practice approaches are adopted.

The PCDP also sets out the:

- Process by which stakeholders are identified and consulted;
- The consultation completed and planned over the duration of the ESIA; and
- Process for lodging and responding to complaints.

Figure 8.1 ESIA Consultation and Disclosure Process



8.3 Summary of Previous ACG and SD ESIA Consultation

Consultation with key stakeholders during project scoping and as part of ESIA disclosure activities has been undertaken for all previous ACG and SD ESIAs, with the most recent consultation concluded for the Chirag Oil Project (COP) and Shah Deniz Stage 2 (SD2) ESIAs completed in 2010 and 2013 respectively. The activities undertaken included:

- **Ministry of Ecology and Natural Resources (MENR) and Monitoring and Technical Advisory Group (MTAG) Consultation:** Preliminary scoping meetings during August 2008 were undertaken to provide an overview of the COP and SD2 projects, schedule and proposed scope of the ESIAs. Regular update meetings were held with the MENR throughout the development of the projects.
- **Consultation Workshops:** Two workshops held in September 2008 in Baku covering both the COP and SD2 Projects. Invitees to the first workshop included representatives from governmental, scientific, academic and NGOs. The second workshop took for the form of an open public meeting, advertised in the local press and attended by the general public. These

workshops, attended by 26 stakeholder representatives in total, provided a general presentation along with a following question and answer session.

- **Stakeholder and Socio-Economic Survey (SSES):** Undertaken in 2011 to inform the SD2 Infrastructure and SD2 Project ESIAs. The survey included 200 household surveys across the communities within the immediate vicinity of Sangachal Terminal i.e. Umid, Sangachal, Azim Kend and Masiv 3, collecting socio-economic data from project affected households; 12 Community Focus Groups covering community, women's and youth issues; and 66 stakeholder interviews including national and local governments, business and NGOs. The information gathered from the SSES was disclosed publicly through posters, briefings and leaflets across the survey communities.
- **ESIA Disclosure:** Each of the COP and SD2 ESIAs were disclosed in line with the process as described within Section 8.5 below with the feedback received from stakeholders incorporated into the final documents where relevant.

Key issues raised through the COP and SD2 consultation relevant to ACE and addressed within this ESIA included requirements to:

- Confirm the disposal route for produced water from operations;
- Assess discharges of cuttings and drilling mud and water used for hydrotesting in the marine environment;
- Ensure selection of an offshore Sewage Treatment Plant (STP) that meets relevant performance standards; and
- Quantify and assess volumes of greenhouse gas emissions generated during production.

The focus of the feedback from the community consultation undertaken as part of the SSES was around the creation of local employment and the provision of local jobs during the SD2 construction phase in particular. The small number of grievances recorded by BP and their main contractors throughout the SD2 Project has predominantly been associated with employment issues.

8.4 ACE Scoping Consultation

Scoping consultation for the ACE Project commenced with an initial meeting with the MENR in December 2017 followed by scoping meetings held with the MENR and the MTAG[1] on 19th and 20th February 2018. The purpose of the scoping meetings was to provide the attendees with an overview of the proposed ACE Project and scope of the ACE Project ESIA including planned baseline studies and surveys, and to provide the opportunity for feedback from the stakeholders.

Key concerns relevant to the scope of the ACE Project that were raised are summarised below. The sections within the ESIA where these have been addressed are provided within Table 8.1:

- All offshore discharges to the Caspian Sea, specifically:

  – Pipeline hydrotest discharges – All potential discharge events relating to pipeline pre-commissioning tests using seawater treated with chemicals (e.g. biocide, oxygen scavenger and dye) should be identified and assessed. The ESIA should confirm that the use of chemicals and volume of discharges are minimised as far as possible.
  – Pipeline tie-in discharges – any potential discharge of hydrocarbons or chemicals associated with the tie-in of the infield pipelines (including installing the oil pipeline wye spool) should be avoided and, where this is not possible, the reason for the discharge should be justified and the discharge(s) assessed within the ESIA.
  – Drilling discharges – discharge of water based mud and cuttings in accordance with the PSA requirements is permitted but should be minimised as far as possible. Discharge of clean up and suspension fluids to sea is not permitted.
  – Sewage Treatment Plant (STP) – Lessons learned from STP performance issues on previous projects should be captured and reviewed. The ESIA should include a description

[1] MTAG included representatives from the MENR, SOCAR and Azerbaijan National Academy of Sciences (ANAS).

of the STP package, how it has been selected, the relevant performance standards and the monitoring to be undertaken to confirm compliance with the performance standards.

- Flaring – the ESIA should confirm flaring is minimised as far as possible, taking into account safety and operational considerations and ensure the impacts from flaring (as well as routine operation of combustion sources) on air quality at onshore communities is assessed.
- Caspian Seals – the importance of the Caspian Seals, listed as Endangered under the International Union for the Conservation of Nature (IUCN) Red List, is recognised and the latest research over the last few years, indicating the seals' behaviour and movements per season within the Caspian Sea are less defined than previously thought, is acknowledged. The potential impacts of the Project to Caspian seals should be assessed, taking into account the most recent baseline information and based on realistic technical assessments.
- Geology and seismic conditions – it was requested that up to date context information relating to seismicity, geology and geomorphology relevant to the ACG Contract Area and specifically to the ACE location is included within the ESIA.

Table 8.1 Key Issues Raised During the ACE Project ESIA Scoping Consultation Process

Issue Raised	Chapter Reference where Addressed
Discharge of: - Hydrotest water from offshore pipeline pre-commissioning tests - Hydrocarbons or chemicals associated with the tie-in of the infield pipelines	Chapter 5: Section 5.6 Chapter 10: Section 10.5
Discharge of water based drilling mud and cuttings	Chapter 5: Sections 5.3 5.7 and 5.8 Chapter 9: Section 9.4 Chapter 11: Section 11.4
Discharge of domestic waste and sewage as generated from the offshore platform	Chapter 5: Section 5.8 Chapter 11: Section 11.4
Effect of operational flaring and other combustion sources on air quality at onshore communities	Chapter 5: Sections 5.3, 5.4, 5.5, 5.6, 5.8 and 5.11 Chapter 9: Section 9.3 Chapter 10: Section 10.3 Chapter 11: Section 11.3 Chapter 13: Section 13.5 and 13.6
Potential impact of the project activities on the Caspian Seal population when present in Azerbaijani waters	Chapter 9: Section 9.4 Chapter 10: Section 10.5 Chapter 11: Section 11.4
Inclusion of up to date geological and seismic information for the ACG Contract Area and specifically to the ACE platform location	Chapter 6: Section 6.3

The scoping presentations and meeting notes are included within Appendix 8A of this ESIA.

8.5 Draft Final ESIA Report Public Consultation and Disclosure

As per the United Nations Development Programme (UNDP) Handbook for the Environmental Impact Assessment Process in Azerbaijan, the Draft Final ESIA report was submitted to the MENR and simultaneously released to public and stakeholder groups for comment. The Draft Final ESIA Report and Non-Technical Summary, in English and Azerbaijani, were disseminated and made available (along with Feedback Forms) for a three-month consultation period at the following locations and via the internet:

- BP website;
- Public libraries in Sangachal (Sangachal Settlement, Qaradag District, M. A. Sabir Street 1) and Sahil (Sahil Settlement, E. Guliyev Street);
- Secondary Schools No. 294 and No. 7, Umid Settlement;
- Library of the Azerbaijan State University of Oil and Industry (20 Azadlig Avenue, Baku);
- Aarhus Environmental Information Centre (MENR, 100a B. Agayev Street, Baku);
- Baku Education Information Centre;
- BP Xazar Centre Office reception, Baku;

- M. F. Akhundov Public Library (29 Khagani Street, Baku); and
- Central Library of the Academy of Sciences of Azerbaijan (31 Huseyn Javid Street, Baku).

As part of the Draft Final ESIA consultation process the following meetings were held:

- MENR, Baku, 30th October 2018;
- MTAG, Baku 30th October 2018; and
- Public meeting, Baku 31st October 2018.

Minutes of these meetings and the associated presentation slides are included within Appendix 8B.

Comments received on the Draft Final ESIA Report were collated, analysed and responses issued where relevant. The ESIA was subsequently revised and finalised for MENR approval.

8.6 Consultation under the Espoo Convention

As a signatory to the Convention on Environmental Impact Assessment in a Transboundary context (i.e. the Espoo Convention), the Azerbaijan Government is obliged to provide early notification to countries that may be subject to transboundary impacts as a result of a development within Azerbaijan.

Potential transboundary impacts, including potential impacts associated with greenhouse emissions are presented in Chapter 13 of this ESIA.

9 Predrill Environmental Impact Assessment, Monitoring and Mitigation

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9.1 Introduction

For all phases of the Azeri Central East (ACE) Project, Activities and Events have been determined based on the ACE Project Base Case as detailed within Chapter 5: Project Description; and the potential for Interactions with the environment identified.

In accordance with the impact assessment methodology (see Chapter 3), Environmental and Social Impact Assessment (ESIA) Scoping has been undertaken to identify selected Activities that may be "scoped out" from the full environmental impact assessment process based on Event Magnitude and the likely receptor Interaction. In addition, existing controls and mitigation have been identified. These include:

- Existing Azerbaijan Georgia Turkey (AGT) Region procedures that will be used to ensure that activities are consistent with environmental expectations; and
- Feedback from existing operational and ambient monitoring of environmental performance and/or impacts.

Those Activities that have not been scoped out have been assessed on the basis of Event Magnitude and Receptor Sensitivity, taking into account the existing controls and mitigation, and impact significance. Monitoring and reporting activities undertaken to confirm that these controls are implemented and effective, as well as additional mitigation and monitoring to further minimise impacts, are provided.

Assessments of social, cumulative and transboundary impacts and accidental events have also been undertaken and are provided in Chapters 12 and 13 respectively.

The structure of the impact assessment within this ESIA is provided within Table 9.1 below.

Table 9.1 Structure of ACE Project Impact Assessment

<table>
<tr><th>Chapter No.</th><th>ACE Project Phase</th><th>Content</th></tr>
<tr><td>9</td><td>Predrill Activities</td><td rowspan="3">Common contents adopted for Chapters 9,10 and 11:
• Scoping Assessment of ACE Project Activities, Events and Interactions.
• Identification of existing controls, mitigation, monitoring and reporting.
• Environmental impact assessment of ACE Project activities based on:
– Event Magnitude
– Receptor Sensitivity
• Identification of any additional mitigation measures.</td></tr>
<tr><td>10</td><td>• Onshore Construction and Commissioning of Offshore Facilities;
• Infield Pipeline Installation, Tie-in and Commissioning; and
• Platform Installation, Hook Up and Commissioning (HUC)[1.]</td></tr>
<tr><td>11</td><td>• Offshore Operations
• Subsea Operations
• Terminal Activities</td></tr>
<tr><td>12</td><td>All Phases</td><td>Assessment of social impacts.</td></tr>
<tr><td>13</td><td>All Phases</td><td>Assessment of cumulative and transboundary impacts (including impacts associated with greenhouse gas emissions) and impacts arising from accidental events (including oil spills and spill management).</td></tr>
<tr><td>14</td><td>All Phases</td><td>Description of the ACE Project Environmental and Social Management System including waste management and procedures.</td></tr>
<tr><td colspan="3">Notes:
1. Includes brownfield works to be undertaken on the Central Azeri compression and water injection platform (CA-CWP) and East Azeri Production, Drilling and Quarters (EA-PDQ) platforms for the purpose of the ACE Project.</td></tr>
</table>

9.2 Scoping Assessment

The ACE Project Predrill Activities and associated Events that have been scoped out due to their limited potential to result in discernible environmental impacts are presented in Table 9.2 (see Appendix 9A for all ACE Project Predrill Activities, Events and Interactions). The scoping process has used judgement based on prior experience of similar Activities and Events, especially with respect to earlier Azeri Chirag Gunashli (ACG) or Shah Deniz (SD) developments. In some instances, scoping level quantification/numerical analysis has been used to justify the decision. Reference is made to relevant quantification, analysis, survey and/or monitoring reports in these instances.

Table 9.2 "Scoped Out" ACE Project Predrill Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Pre-R2	Seabed disturbance associated with MODU anchoring	5.3.1.1	• Mobile Offshore Drilling Unit (MODU) anchoring will result in disturbance due to positioning of anchors and anchor chains of approximately 13,000 square metres (m^2). • The displacement of sediment will not cause significant levels of mortality in benthic organisms. A small proportion of animals may be buried too deeply to recover to a position near the sediment surface, but the majority of organisms will be able to re-establish themselves once the anchors and chains have been removed. **Conclusion:** It is considered that impacts are minimised as far as practicable and no discernable impact to the marine environment due to seabed disturbance.
Pre-R4	Emissions and noise associated with crew change operations	Table 5.1	• Crew changes will be made on a regular basis using crew change vessels (approximately 3 trips per week are estimated). • The low volume of emissions released will be dispersed across the entire vessel route and the wider area. Increases in pollutant concentrations will be very small and indistinguishable from existing background concentrations. **Conclusion:** Emissions and noise from crew change operations is expected to result in no discernable impact to human receptors.
Pre-R15	Waste Generation	5.3.6.3	• Waste generated during predrilling will be consistent with the type and quantity that have been routinely generated during previous MODU drilling work. • Waste on the MODU will be segregated at source, stored and transported in fit for purpose containers. • The existing Central Waste Accumulation Areas (CWAAs) currently used and controlled by BP will be used as the main reception and consolidation points for solid waste from predrilling. • Waste generated during ACE Project predrilling will be managed in accordance with the existing BP Azerbaijan Georgia Turkey (AGT) Region management plans and procedures. BP has gained significant operational experience of managing similar waste from over 15 years of MODU drilling operations. • Waste management plans have been established for the MODU aligned to the existing BP AGT Region management plans and all waste transfers will be controlled and documented. **Conclusion:** Waste will be managed in accordance with the existing BP AGT Region management plans and procedures and the ACE Project Waste Management and Minimisation Plans as described within Chapter 14.
Pre-R16	Fugitive emissions from dry bulk transfer	N/A	• During the transfer dry bulk (primarily cement and barite) from vessels to the MODU silos over a period of approximately 3-4 hours some losses to the atmosphere of dry bulk may occur through vent lines (the vent lines must be open as part of operational requirements). • Fugitive emissions resulting from dry bulk transfer are expected to be minimal. **Conclusion:** No discernable impact to the marine environment anticipated due to fugitive emissions resulting from dry bulk transfer.

Table 9.3 presents the Activities related to predrilling that have been assessed within this Chapter.

Table 9.3 "Assessed" ACE Project Predrill Activities

ID	Activity	Ch. 5 Project Description Reference	Event	Receptor
Pre-R1	Tow out and positioning of MODU	5.3.1.1	Other discharges to sea Underwater sound	Marine Environment
			Emissions to atmosphere (non GHG)	Atmosphere
Pre-R3	Vessel support including supply to MODU and backload to shore	5.3.1.2 Table 5.1	Other discharges to sea Underwater sound	Marine Environment
			Emissions to atmosphere (non GHG)	Atmosphere
Pre-R5	MODU power generation	5.3.1.2 Table 5.2	Emissions to atmosphere (non GHG)	Atmosphere
Pre-R6	MODU treated black water/ grey water/ drainage discharges	5.3.1.2 Table 5.2	Other discharges to sea	Marine Environment
Pre-R7	MODU seawater/cooling water systems	5.3.1.2 Table 5.2	Water intake/entrainment Cooling water discharge to sea	Marine Environment
Pre-R8	Drilling with seawater/PHB sweeps or water based mud (WBM) (upper 42", 28" and 26" hole sections)	5.3.2.3	Underwater sound Drilling discharges to sea	Marine Environment
Pre-R9	Discharge of residual WBM (after 26" hole section drilling)	5.3.2.3	Drilling discharges to sea	Marine Environment
Pre-R10	Discharge from 28" or 26" hole sections due to Mud Recovery pumping System (MRS) failure	5.3.2.3	Drilling discharges to sea	Marine Environment
Pre-R11	Drilling with non-WBM (lower 20", 17" and 13 ½" hole sections)	5.3.2.3	Underwater sound	Marine Environment

ID	Activity	Ch. 5 Project Description Reference	Event	Receptor
Pre-R12	Cementing discharges to seabed (from cementing casings)	5.3.2.5	Cement discharges to sea	Marine Environment
Pre-R13	Discharge of cement system washout to sea via cement unit hose	5.3.2.5	Cement discharges to sea	Marine Environment
Pre-R14	Blowout Preventer (BOP) testing	5.3.4.1	Discharge of BOP control fluid to sea	Marine Environment

9.3 Impacts to the Atmosphere

9.3.1 Mitigation

Existing controls associated with emissions to atmosphere from MODU power generation and support vessel operations include:

- MODU diesel generators and engines will be maintained in accordance with written procedures based on the manufacturers' guidelines or applicable industry code or engineering standards to ensure efficient and reliable operation; and
- Planned use of good quality, low sulphur fuel.

9.3.2 MODU Power Generation and Support Vessel Engine Emissions

Non greenhouse gas (GHG) emissions to the atmosphere from predrill activities will be associated with MODU power generation and use of support vessels. GHG emissions associated with the ACE Project are discussed within Chapter 13 of this ESIA. This section focuses on the assessment of potential air quality impacts.

9.3.2.1 Event Magnitude

Description

As stated within Chapter 5: Section 5.3, it is anticipated that the wells will be drilled using one of the MODUs located within the Caspian Sea over a duration of approximately 12 months, commencing in 4Q 2019. Emissions will be generated through the use of the onboard MODU engines and generators. For the purpose of this ESIA it is assumed that the Dada Gorgud or Istiglal rig may be used, with the final rig selection dependent on the rig availability.

In addition, as discussed in Chapter 5: Section 5.3.1.2, emissions will result from the operation of support vessels required throughout the predrilling programme.

Assessment

Air quality dispersion modelling undertaken for MODU power generation is presented in Appendix 9B. The modelling focuses on NO_X (which comprises nitrogen oxide (NO) and nitrogen dioxide (NO_2)) as the main atmospheric pollutant of concern, based on the larger predicted emission volumes as compared to other pollutants (sulphur oxides (SO_X), carbon monoxide (CO) and non-methane hydrocarbons) and its potential to impact upon human health and the environment.

MODU Power Generation

For MODU power generation, long term (annual average) NO_2 concentrations were modelled to assess the contribution in the context of the annual EU limit value for NO_2 of 40 micrograms per cubic metre (µg/m^3). This standard is relevant to locations where humans are normally resident (i.e. onshore settlements) and do not apply to commercial locations and workers, which are subject to standards under separate occupational health requirements. The modelling conservatively assumed that, for the long term, all NO_X is converted to NO_2.

As described above, the drilling rig to be used for the ACE Project is yet to be selected. Therefore, the dispersion modelling assessment was carried out assuming the Istiglal MODU (which has larger engines as compared to the Dada Gorgud rig) will be used for the predrilling programme.

As shown in Figure 9.1 the results demonstrated that, during routine operation, the maximum increase in long term concentrations of NO_2 is 2µg/m^3 and occurs within a few kilometres of the MODU drilling activities. The modelling also shows that the modelled increase in long term NO_2 contributions at each of the onshore receptors is less than 0.1µg/m^3. Taking into account background concentrations (refer to Chapter 6: Section 6.4.2), the predicted concentrations at each onshore receptor are expected to meet the long term limit value for NO_2 of 40µg/m^3.

Figure 9.1 Predicted Increase in Long Term NO_2 Concentrations Due to MODU Power Generation

No discernible change in pollutant concentrations or exceedances of the long term air quality standards that could impact human health are predicted at any distance from the MODU due to the predrilling activities[1].

Based on efficient operation, regular maintenance, planned use of good quality, low sulphur fuel and previous experience, routine operation of the MODU engines and generators will not result in plumes of visible particulates from the generator exhausts.

Support Vessel Engines

As stated within Chapter 5: Section 5.3.1.2, vessels will be required throughout the drilling programme to supply consumables (e.g. drilling mud, diesel, chemicals, etc.) to the MODU and ship solid and

[1] Historically in Azerbaijan ambient concentrations of NO_2, SO_2, CO and PM_{10} have also been assessed against specific 24 hour and 1 hour limit values. These limit values were not derived using the same health based criteria as the IFC, WHO and EU guideline values and the limit values derived are not widely recognised. However, Appendix 9B includes an assessment of expected air quality concentrations against these limit values for completeness. The modelling demonstrated that none of these limit values would be exceeded during predrilling activities.

liquid waste to shore for treatment and disposal. The number and type of vessels anticipated to be used are presented in Chapter 5: Table 5.1.

The total volume of emissions of the key pollutant species relevant to human health, NO_2, for all sources over the entire predrilling programme (12 months), is presented in Chapter 5: Table 5.13. For the period of drilling activities it is predicted that NO_2 emissions from support vessels will total approximately 694 tonnes. This is approximately twice the NO_2 emissions associated with MODU power generation during predrill activities, however emissions from vessel movements will occur across a relatively large geographic area and over the entire predrilling programme. They are therefore expected to disperse rapidly and are not expected to result in noticeable increases in NO_2 concentrations at onshore locations.

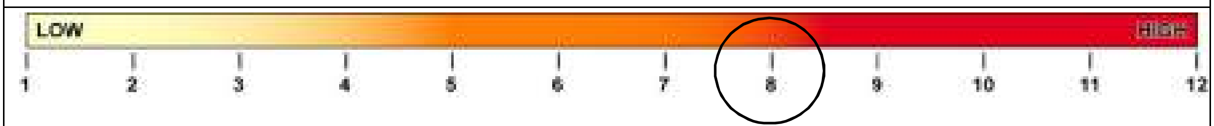
Based on efficient operation, regular maintenance, planned use of good quality, low sulphur fuel and previous experience, routine operation of the support vessels should not result in plumes of visible particulates from the vessel engine exhausts.

Table 9.4 presents the justification for assigning a score of 8 for MODU power generation and support vessels emissions, which represents a Medium Event Magnitude.

Table 9.4 Event Magnitude

Event Parameter	MODU Power Generation	Support Vessel Engines
Extent/Scale	1	1
Frequency	3	3
Duration	3	3
Intensity	1	1
Event Magnitude:	**8**	**8**

MODU Power Generation



Support Vessel Engines

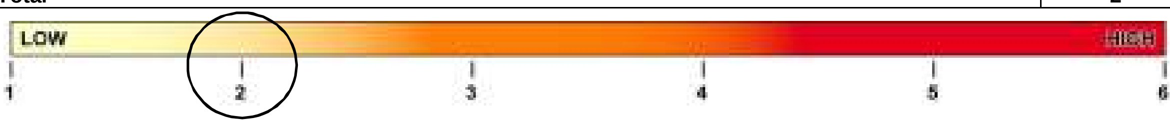
9.3.2.2 Receptor Sensitivity

Human Receptors

Table 9.5 presents the justification for assigning a score of 2 to human receptors, which represents Low Receptor Sensitivity.

Table 9.5 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	There are no permanently present (i.e. resident) human receptors within 95km of the ACE Project offshore location.	1
Resilience	Changes in air quality onshore will be indiscernible. Onshore receptors will be unaffected.	1
Total		**2**



Biological/Ecological Receptor Sensitivity

Table 9.6 presents the justification for assigning a score of 2 to biological/ecological receptors, which represents Low Receptor Sensitivity.

Table 9.6 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Marine/bird species are mobile and will not be present at one location for long periods of time. Birds found in the area will be transient and not resident.	1
Resilience	Volume of emissions released (including visible particulates) will create a very small increase in pollutant concentrations in the atmosphere and in any washout from rainfall, which will not be discernible to biological / ecological receptors[2].	1
Total		**2**

9.3.2.3 Impact Significance

Table 9.7 summarises impacts on air quality associated with ACE Project predrilling activities.

Table 9.7 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
MODU Power Generation	Medium	(Humans) Low	**Minor Negative**
		(Biological/Ecological) Low	**Minor Negative**
Support Vessel Engines	Medium	(Humans) Low	**Minor Negative**
		(Biological/Ecological) Low	**Minor Negative**

Monitoring and reporting requirements associated with emissions to atmosphere during MODU predrilling activities include:

- MODU diesel usage will be recorded on a daily basis;
- Environmental management system audits of drilling operations including MODU drilling will be undertaken periodically; and
- The following will be provided to the MENR either within the MODU Annual Emissions Report or the Environmental Report:
    - Volume of fuel used by the MODU (recorded daily in tonnes and reported monthly); and
    - Estimated volumes of emissions generated as a result of fuel used (calculated using emission factors).

These requirements are incorporated into the MODU Health, Safety & Environmental Management System (HSE MS), which is aligned to the AGT Region EMS as described within Chapter 14: Section 14.5 of this ESIA.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

9.4 Impacts to the Marine Environment

9.4.1 Mitigation

Existing control measures associated with underwater sound from MODU drilling and vessels include:

[2] Note that ambient air quality standards are not relevant to biological/ecological receptors.

- No project vessels will intentionally approach seals for the purposes of casual (recreational) marine mammal viewing which may result in disturbance; and
- Support vessels are subject to periodical performance review which includes environmental performance. Corrective actions will be undertaken to address any performance gaps.

Existing controls associated with MODU drilling discharges include the following:

- WBM and associated cuttings will be discharged below the sea surface from the MODU cuttings chute or a discharge hose in accordance with PSA requirements[3];
- Synthetic Oil Based Mud (SOBM) or Low Toxic Mineral Oil Based Mud (LTMOBM) and associated cuttings used for lower hole drilling will be returned to the MODU and separated. Separated SOBM/LTMOBM will be reused where practicable, and the remainder returned to shore for disposal. SOBM/LTMOBM associated drill cuttings will be contained in dedicated cuttings skips on the rig deck for subsequent transfer to shore for treatment and final disposal. It is not planned to release any SOBM/LTMOBM or associated cuttings into the marine environment;
- During MODU drilling activities, WBM will be separated from cuttings as far as practicable and reused;
- WBM additives used during MODU drilling activities will be of low toxicity (UK Offshore Chemical Notification Scheme (OCNS) “Gold” and “E” category or equivalent toxicity);
- Batches of barite supplied for use in WBM formulations will meet applicable heavy metals concentration standards i.e. Mercury <1 mg/kg and cadmium <3 mg/kg dry weight (total); and
- For the upper sections of the wells, it is proposed to use pre-hydrated bentonite (PHB) sweeps and a WBM of the same specification and environmental performance as used for previous ACG wells. If there is a requirement to change the sweeps/WBM composition or to select different drilling fluids for commercial or technical reasons, the ESIA Management of Change Process (see Chapter 5: Section 5.13) will be followed.

Existing controls associated with cement during MODU predrilling activities include:

- Cementing chemicals used during MODU drilling activities will be of low toxicity (UK HOCNS “Gold” and “E” category or equivalent toxicity);
- Cement is designed to set in a marine environment preventing widespread dispersion;
- The volume of cement used to cement each casing will be calculated prior to the start of the activity. Sufficient cement will be used to ensure that the casing is cemented securely and necessary formations isolated so that this safety and production critical activity is completed effectively while minimising excess cement discharges to the sea; and
- Periodic ROV surveys will be undertaken during predrilling activities including cementing; and
- Excess cement at the seabed will be observed and corrective action will be taken, if required, to ensure cement discharges are minimised.

Existing controls related to MODU cooling water intake and discharge include:

- The design and operation of the cooling water system has been reviewed. The temperature at the edge of the cooling water mixing zone (assumed to be 100m from the discharge point) will be no greater than 3 degrees Celsius (°C) above ambient water temperature; and
- The MODU seawater intake design will include the use of a screen mesh to prevent fish entrainment.

Existing controls related to other MODU discharges include:

- **Ballast Water:**
    - Ballast Water: The MODU water intake point will be screened to prevent fish entrainment;

[3] There shall be no discharge of drill cuttings or drilling fluids if the maximum chloride concentration of the drilling fluid system is greater than 4 times the ambient concentration of the receiving water.

- The MODU ballast system will be operated so that ballasting, which uses untreated seawater, will be undertaken daily to maintain stability of the MODU for effective drilling; and
- There will be no planned discharges to sea of treated oily water with an oil content more than 15 parts per million (ppm).

- **Treated Black Water:**
  - Under routine conditions, black water will be treated within the MODU sewage treatment system to MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards: Five day BOD of less than 50mg/l, suspended solids of less than 50mg/l (in lab) or 100mg/l (on board) and thermotolerant coliform 250MPN (most probable number) per 100ml. No chlorination of the effluent will be required under routine conditions, however when chlorine is used for disinfectant purposes, it is planned to maintain the concentration of residual chlorine in the effluent below 0.5 mg/l and discharge to sea. In the event it is not practicable to achieve this concentration, the effluent will be contained and shipped to shore;
  - MODU sewage sludge will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures; and
  - Under non routine conditions when the MODU sewage treatment system is not available black water will be managed in accordance with the existing AGT plans and procedures.

- **Grey Water:**
  - Grey water will be discharged to sea (without treatment) as long as no floating matter or visible sheen is observable.

- **Drainage:**
  - Deck drainage and wash water will be discharged to sea as long as no visible sheen is observable; and
  - Rig floor runoff, including WBM spills, collected via rig floor drains will be recycled to mud system or if not possible for technical reasons, diluted and discharged to sea (>60cm from sea surface) in accordance with applicable PSA requirements i.e. there shall be no discharge of drill cuttings or drilling fluids if the maximum chloride concentration of the drilling fluid system is greater than 4 times the ambient concentration of the receiving water.

- **Galley Waste**
  - Depending on the availability of the system, food waste generated onboard the Dada Gorgud will either be: sent to vessel maceration units (to particle size less than 25mm.) designed to treat food wastes to applicable MARPOL 73/78 Annex V; or disposed in accordance with the existing AGT waste management plans and procedures; and
  - Food waste generated onboard the Istiglal will be contained and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

9.4.2 Underwater Sound

9.4.2.1 Event Magnitude

Description

Underwater sound, resulting from the drilling of up to six predrill wells and vessel movements during predrilling activities as described within Section 5.3 of Chapter 5, has the potential to impact biological/ecological receptors (specifically seals and fish) in the marine environment.

The propagation of sound from these activities has been calculated using a simplified geometric spreading model (Ref. 1) to understand the magnitude of potential impacts of underwater sound to the biological receptors in the marine environment (seals and fish). The calculation (shown below) accounts for source sound levels and propagation of sound over distance:

SPL = SL - N log10(R)

where SL is the acoustic source level of the sound under consideration, SPL is the sound pressure level at range R and N is a constant: 20 for spherical spreading and 10 for cylindrical spreading. When sound propagates uniformly in all directions, spherical spreading applies. When the propagation of sound is constrained by the water surface and the seabed, then cylindrical spreading is most applicable (Ref. 1). If neither condition is most applicable then the use of an intermediate value such as 15 is considered acceptable and that is the approach adopted in the assessment presented in this ESIA.

Sound Sources

Drilling

Sound will be generated from the MODU at the drilling location when the drilling programme is in progress. The sound source levels emitted during the drilling programme will consist of drill pipe operation and on board machinery. The sound will be mainly emitted above water, with low transmission into the water from the air, however some sound will be emitted directly into the water.

While a literature review revealed there is limited data on which estimates of source levels for drilling may be established, two references of relevance are available. These reports discuss drilling using, in the first case, a 20cm diameter drill (Ref. 2) and in the second case, a much larger 4.2m diameter drill (Ref. 3). Source noise levels of 135.8 dB re 1 µPa at 1m and 153.4 dB re 1µPa at 1m, respectively were given. It is assumed that noise levels vary linearly with drill diameter (although there is insufficient data against which to test this hypothesis) hence the source levels associated with each of the ACE Project predrill hole size diameters were estimated. The source levels estimated varied between 137.2 dB re 1µPa at 1m ($13^1/_2$" hole size) and 140.2 dB re 1µPa at 1m (42" hole size). As there is little variation in source levels the use of a single source level may be used to represent all drilling activities. Therefore, for the purposes of this ESIA, a source level of 140 dB has been used as a worst case for all drilling activities.

Vessel Movements

The vessels required throughout the drilling programme to supply consumables (e.g. drilling mud, diesel, chemicals, etc.) to the MODU and ship solid and liquid waste to shore for treatment and disposal are presented in Chapter 5: Table 5.1. These will include support vessels and tugs in addition to the MODU.

Vessel noise is a combination of broadband sound superimposed with tonal sound at specific frequencies corresponding to propeller blade rate, engine cylinder firing and crankshaft rotation. A limited set of acoustic data for vessels (Ref. 4, 5, 6 & 7) are available. These have been used to provide proxy data for the vessels proposed to be deployed on the ACE Project based on vessel power and overall vessel size[4]. Table 9.8 presents the derived source levels for the support vessels proposed to be used during the ACE Project predrilling programme.

Table 9.8 Derived Acoustic Source Levels for Support Vessels Anticipated to be Used for the ACE Project Predrilling Programme

Vessel	Source Level dB re 1µPa @1m
MODU	-
Anchor Handling Tugs	196.4
Support Vessels	206
Standby Vessel	197.3
Crew Change Vessel	197.3

[4] Insufficient vessels of the same or similar class have been noise ranged hence any detailed relationship between noise and size is not known.

Sound Threshold Criteria Associated with Potential Impacts to Seals and Fish

Responses of marine mammals and fish to underwater sound have been studied and reported within scientific literature over many years with threshold criteria developed and revised for a number of species and groups of species. Thresholds are usually proposed in terms of one or more different sound level metrics and for different levels of potential impact ranging from mortality, physical injury and hearing damage through to behavioural reactions denoted by changes in feeding, breeding, respiration or movement patterns.

Sound can be described using various acoustic metrics, including sound pressure levels (SPL) and sound exposure levels (SEL). The former is the instantaneous pressure which can be defined as a peak, peak-to-peak, zero-to-peak or RMS (root-mean-square) value while the latter is a measure of received sound energy over some defined period of time.

Acoustic impacts are often but not always given in terms of both SPL and SEL. Where such dual criteria thresholds are available, the latest advice recommends that the criterion which is exceeded first (i.e. the more precautionary of the two measures) is subsequently used as the operative injury criterion. In the case of drilling sound (classified as non-pulse sound (Ref. 8)), acoustic thresholds for permanent threshold shift (PTS) and temporary threshold shift (TTS) are given in terms of SEL only while thresholds for behavioural reactions are given in terms of SPL_{RMS}.

Thresholds for physiological damage consider potential permanent and temporary effects on hearing where animals exposed to sufficiently intense sound exhibit an increased hearing threshold (i.e. poorer sensitivity) for some period of time following exposure. This is called a sound-induced threshold shift and the amount of shift is determined by the distance between a sound and the individual at the time of hearing the sound in combination with the amplitude, duration, frequency content, temporal pattern, and energy distribution of the sound exposure relative to the hearing sensitivity of the species and the background sound levels. Hearing threshold shifts may be permanent (PTS) or temporary (TTS) and thus physiological impacts are generally considered at these two levels:

- **Permanent threshold shift (PTS)** is a permanent, irreversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level. This is considered to be auditory injury.

  Due to the absence of data on permanent injury in marine taxa, PTS thresholds have been extrapolated from observed TTS responses and therefore, there are high levels of uncertainty in the currently available threshold criteria for PTS in marine receptors.

- **Temporary threshold shift (TTS)** is a temporary, reversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level.

Behavioural thresholds are based on observations of individuals or groups of individuals when exposed to sound at a given level. The sound levels involved are lower than those that would give rise to PTS or TTS. The nature of the sound, in terms of its frequency content as well as its duty cycle, whether continuous (e.g. drilling noise) or intermittent (e.g. piling noise), governs how the receptor may respond. The response of the animal is also often context-dependent (i.e. feeding, breeding, migrating etc.) and may relate to its motivation and previous experience to the perturbing sound.

Thresholds for Seals

Thresholds have been developed for both the onset of PTS and TTS in seals (based on data for the northern elephant seal and harbour seal) (Ref. 9). A recent study (Ref. 10) based on the underwater hearing ability of two captive spotted seals suggested that their hearing ability was similar to harbour seals, and lower than other Arctic species tested (i.e., harp and ringed seals). Taking a precautionary approach, this suggests that harbour seals are an appropriate proxy for other ice seals, such as the Caspian seal for which no specific thresholds exist.

Southall *et al*. (Ref. 9) reviewed published data concerning measurements of SPL and SEL together with data on hearing damage or behavioural characteristics. Subsequently, a set of acoustic impact criteria for marine mammals was produced and the injury and behavioural disturbance thresholds for pinnipeds such as the Caspian seal were established. The criteria for PTS and TTS were later revised (Ref. 1) and it is this later set on which the acoustic impact thresholds for PTS and TTS shown in Table 9.9 below are based.

Thresholds relating to behavioural reactions have also been established. Southall *et al*. (Ref. 9) states that the effects of non-pulse exposures on pinnipeds are poorly understood. Studies for which data are available involve harbour seals and northern elephant seals and indicate that noise levels between 90 and 140 dB re 1μPa were unlikely to elicit strong behavioural reactions. Further it was noted that the behavioural reactions in the seals were very context-driven varying from no change in behaviour through to moderate changes indicated by changes in speed, direction and/or dive profile; minor changes in group distribution; and moderate changes in vocal behaviour.

Thresholds for Fish

Popper *et al*. (Ref. 11) undertook a review and defined a set of acoustic impact criteria for fish having varying levels of sensitivity to underwater sound (refer to Table 9.9). The PTS thresholds for fish have been developed based on the following fish hearing categories (Ref. 12):

- High hearing sensitivity fish, particularly herring and related species (Clupeidae), which involve the use of the swim bladder in hearing;
- Medium sensitivity hearing generalist fish such as sturgeon which have a swim bladder but it is not used in hearing; and
- Low sensitivity hearing generalist[5] fish, particularly flatfish, sharks and rays, which do not have any gas filled organs.

TTS has been demonstrated in some fish but there are high levels of variability in the duration and magnitude of the shift depending on many factors, including the intensity and duration of sound exposure, the species and the life stage of fish. There are no reliable thresholds for fish behavioural changes but TTS can be used as an estimate of the point at which a significant behavioural response would be expected to occur.

With regards to continuous noise, there are no data on exposure or received levels that enable guideline thresholds to be set.

Assessment

Drilling

Using the geometric spreading model the SPL and SEL at distances from the source were calculated and compared to the applicable threshold criteria to confirm at what distance the threshold is met. The results of the calculations are presented in Table 9.9.

[5] Strictly Popper *et al*. (Ref. 11) classify fish as being hearing-specialist or hearing-generalist. In the latter case, physiological differences account for the fact that some species of hearing-generalist fish are more audiologically sensitive than other species. In order to differentiate between these two groups, the terms "low sensitivity" and "medium sensitivity" are used. It is acknowledged that the use of this specific terminology is informal and not used widely outside this ESIA. It is nevertheless considered helpful to use these terms from an environmental impact assessment perspective as a range of fish species of varying hearing sensitivity are present in the project area.

Table 9.9 Threshold Criteria for Seals and Fish and Predicted Distance at which the Criteria is Met (Drilling)

Receptor	Effect	Threshold Level	Distance at which Threshold is Met
Seals	Onset of Permanent Threshold Shift (PTS)	201 dB re. $1\mu Pa^2 s$ SEL M-Weighted	1 sec exposure: <1m 60 min exposure:<1m 8 hour exposure: <1m
	Onset of Temporary Threshold Shift (TTS) also indicating significant behavioural disturbance	181 dB re. $1\mu Pa^2 s$ SEL M-Weighted	1 sec exposure: <1m 60 min exposure: <1m 8 hour exposure: 2m
	Moderate behavioural reactions in pinnipeds exposed to non-pulse sounds	130 - 140 dB_{rms} re $1\mu Pa$	1m (upper range of criterion) 5m (lower range of criterion)
	No observable reactions expected in pinnipeds exposed to non-pulse sounds	120-130 dB_{rms} re $1\mu Pa$	5m (upper range of criterion) 25m (lower range of criterion)
Fish	Potential mortal injury in hearing-generalist ("low sensitivity") fish exposed to drilling sound	n/a – data not available. TTS used as an estimate	Low risk at all distances
	Potential mortal injury in hearing-generalist ("medium sensitivity") fish exposed to drilling sound		Low risk at all distances
	Potential mortal injury in hearing-specialist fish exposed to drilling sound		Low risk at all distances
	Potential mortal injury in eggs and larvae exposed to drilling sound		Low risk at all distances
Fish	Recoverable injury in hearing-generalist ("low sensitivity") fish exposed to drilling sound		Low risk at all distances
	Recoverable injury in hearing-generalist ("medium sensitivity") fish exposed to drilling sound		Low risk at all distances
	Recoverable injury in hearing-specialist fish exposed to drilling sound		<1m
	Recoverable injury in eggs and larvae exposed to drilling sound		Low risk at all distances
Fish	TTS in hearing-generalist ("low sensitivity") fish exposed to drilling sound		Moderate risk at short distances Low risk at all other distances
	TTS in hearing-generalist ("medium sensitivity") fish exposed to drilling sound		Moderate risk at short distances Low risk at all distances
	TTS in hearing-specialist fish exposed to drilling sound		Low risk at all distances
	TTS in eggs and larvae exposed to drilling sound		Low risk at all distances

With reference to seals, PTS is unlikely to arise even when the seals are adjacent to the drilling location. TTS may occur if the animals remain within 2m of the drilling operations for an extended period of 8 hours. There may be some moderate behavioural reactions in seals such as changes in swimming direction and speed at distances up to 5m from the drilling site. At distances beyond this the likelihood of any observable reactions quickly falls to insignificant.

Popper *et al*. (Ref. 11) states that fish of varying hearing sensitivities will respond to sounds but that there are no data on exposure or received levels that enable guideline threshold levels to be set. As such distances at which certain thresholds are met are expressed qualitatively rather than quantitatively. For fish exposed to continuous sounds, there is no data to support the establishment of thresholds for mortality, recoverable injury or TTS. It is considered that there is a low risk of mortality and recoverable injury for fish of all hearing abilities and a moderate risk of TTS in hearing generalist fish at short distances from the drilling location.

Taking into account drilling activities are located adjacent to existing commercial shipping lanes and in an area routinely and regularly crossed by supply vessels travelling to and from the offshore oil and gas facilities within the ACG Contract Area (refer to Chapter 7: Section 7.7) background underwater sound levels would be typical for this type of environment. Measurements made in the coastal North Sea where oil-field related activities predominate recorded background noise levels as high as 130 dB re $1\mu Pa$ (Ref. 13). It is assumed therefore that marine life will have become largely habituated to such noise levels and there would be a minimal relative increase to existing levels of disturbance on pinnipeds and fish species.

Support Vessels

Using the geometric spreading model the SPL and SEL at distances from the source were calculated and compared to the applicable threshold criteria to confirm at what distance the threshold is met. The results of the modelling are presented in Table 9.10.

Table 9.10 Threshold Criteria for Seals and Fish and Predicted Distance at which the Criteria is Met (Support Vessels)

<table>
<tr><th rowspan="2">Receptor</th><th rowspan="2">Effect</th><th rowspan="2">Threshold Level</th><th colspan="2">Distance at which Threshold is Met</th></tr>
<tr><th>Anchor Handling Tug</th><th>Support /Standby / Crew Change Vessels</th></tr>
<tr><td rowspan="10">Seals</td><td rowspan="3">Onset of Permanent Threshold Shift (PTS)</td><td rowspan="3">201 dB re. 1μPa^{2}s SEL M-Weighted</td><td>1 sec exposure: <1m</td><td>1 sec exposure: 2m</td></tr>
<tr><td>60 min exposure: 6m</td><td>60 min exposure: 505m</td></tr>
<tr><td>8 hour exposure: 22m</td><td>8 hour exposure: 2.1km</td></tr>
<tr><td rowspan="3">Onset of Temporary Threshold Shift (TTS) also indicating significant behavioural disturbance.</td><td rowspan="3">181 dB re. 1μPa^{2}s SEL M-Weighted</td><td>1 sec exposure: <1m</td><td>1 sec exposure: 47m</td></tr>
<tr><td>60 min exposure: 114m</td><td>60 min exposure: 10.9km</td></tr>
<tr><td>8 hour exposure: 460m</td><td>8 hour exposure: 44km</td></tr>
<tr><td rowspan="2">Moderate behavioural reactions in pinnipeds exposed to non-pulse sounds</td><td rowspan="2">130 - 140 dB_{rms} re 1μPa</td><td rowspan="2">265m (upper range of criterion)
1.2km (lower range of criterion)</td><td rowspan="2">25km (upper range of criterion)
116km (lower range of criterion)</td></tr>
<tr></tr>
<tr><td rowspan="2">No observable reactions expected in pinnipeds exposed to non-pulse sounds</td><td rowspan="2">120-130 dB_{rms} re 1μPa</td><td rowspan="2">1.2km (upper range of criterion)
5.7km (lower range of criterion)</td><td rowspan="2">116km (upper range of criterion)
500km[1] (lower range of criterion)</td></tr>
<tr></tr>
<tr><td rowspan="4">Fish</td><td>Potential mortal injury in hearing-generalist ("low sensitivity") fish exposed to drilling sound</td><td rowspan="12">n/a – data not available. TTS used as an estimate</td><td colspan="2">Low risk at all distances</td></tr>
<tr><td>Potential mortal injury in hearing-generalist ("medium sensitivity") fish exposed to drilling sound</td><td colspan="2">Low risk at all distances</td></tr>
<tr><td>Potential mortal injury in hearing-specialist fish exposed to drilling sound</td><td colspan="2">Low risk at all distances</td></tr>
<tr><td>Potential mortal injury in eggs and larvae exposed to drilling sound</td><td colspan="2">Low risk at all distances</td></tr>
<tr><td rowspan="4">Fish</td><td>Recoverable injury in hearing-generalist ("low sensitivity") fish exposed to drilling sound</td><td colspan="2">Low risk at all distances</td></tr>
<tr><td>Recoverable injury in hearing-generalist ("medium sensitivity") fish exposed to drilling sound</td><td colspan="2">Low risk at all distances</td></tr>
<tr><td>Recoverable injury in hearing-specialist fish exposed to drilling sound</td><td colspan="2"><1m</td></tr>
<tr><td>Recoverable injury in eggs and larvae exposed to drilling sound</td><td colspan="2">Low risk at all distances</td></tr>
<tr><td rowspan="4">Fish</td><td>TTS in hearing-generalist ("low sensitivity") fish exposed to drilling sound</td><td colspan="2">Moderate risk at short distances
Low risk at all other distances</td></tr>
<tr><td>TTS in hearing-generalist ("medium sensitivity") fish exposed to drilling sound</td><td colspan="2">Moderate risk at short distances
Low risk at all distances</td></tr>
<tr><td>TTS in hearing-specialist fish exposed to drilling sound</td><td colspan="2">Low risk at all distances</td></tr>
<tr><td>TTS in eggs and larvae exposed to drilling sound</td><td colspan="2">Low risk at all distances</td></tr>
<tr><td colspan="5">Notes: 1. At such approach distances, the vessel noise is likely to have fallen below the background underwater sound levels and will thus be inaudible to the receptor.</td></tr>
</table>

During the predrilling programme, PTS may occur in seals if they remain within a distance of 6m from the anchor handling tugs for a period of 1 hour. TTS may occur if the seals remain within 114m of the tug operations for a similar period. Moderate behavioural reactions in seals such as changes in swimming direction and speed may occur at distances up to 1.2km from the tugs. At distances beyond this the likelihood of any observable reactions quickly falls to insignificance although it is noted that the lower threshold at which no observable reactions are expected *viz*. 120 dB re 1μPa rms is likely to be close to the background underwater noise levels and hence vessel noise will become inaudible.

For support vessels, PTS may arise in seals if they remain within 505m of the vessels for an extended period of 1 hour. To avoid TTS, the seals would have to be no nearer than 10.9km to the vessels. Moderate behavioural reactions are likely to be evident from 265m to 116km. However, these distances do not account for the movement of either the vessels or the seal. The Caspian seal is an intelligent animal and known to move away from disturbance or sound. Seals dive to feed on fish and may be vulnerable during feeding. Recent telemetry research shows that although Caspian seals can dive to depths greater than 200m, with a maximum observed duration over 20 minutes, most dives (80%) were shallower than 15m and shorter than 5 minutes (Ref. 14). Thus, most seals undertaking foraging dives in the vicinity of a support vessel will be able to rapidly return to the surface or move away from the vessel. Seals are likely to be foraging where high abundance of fish will be found and fish are also expected to likely move away from the sound source, thus reducing the potential for seals to be present in the close vicinity of the vessel to feed.

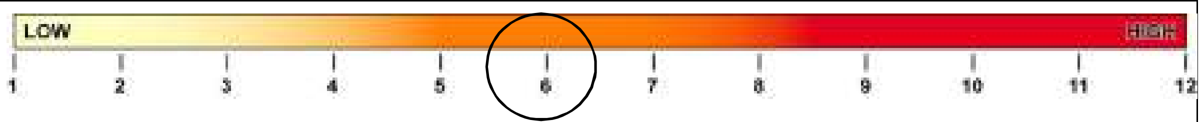
As described above, there is no data to support the establishment of thresholds for mortality, recoverable injury or TTS for fish exposed to continuous sounds. It is considered that when exposed to vessel noise there is a low risk of mortality and recoverable injury for fish of all hearing abilities and a moderate risk of TTS in hearing generalist fish at short distances.

As described above, it is considered that the local underwater sound environment would be dominated by existing commercial and oil industry shipping noise and there would be a minimal relative increase to existing levels of disturbance on pinnipeds and fish species from support vessel movements.

Table 9.11 presents the justification for assigning a score of 6 for MODU drilling and support vessels underwater sound, which represents a Medium Event Magnitude.

Table 9.11 Event Magnitude

Event Parameter	MODU Drilling	Support Vessels
Extent/Scale	1	1
Frequency	1	1
Duration	3	3
Intensity	1	1
Event Magnitude:	**6**	**6**



MODU Drilling

Support Vessels

9.4.2.2 Receptor Sensitivity

Seals

As stated within Chapter 6: Section 6.5.5.3 the Caspian seal population has significantly declined over the 20th Century (by more than 90% since the start of the century) and has continued to decline due to a combination of factors including commercial hunting, habitat degradation (through introduction of invasive species), disease, industrial development, pollution and fishing operations. The seal population is therefore highly vulnerable as reflected by its International Union for Conservation of Nature (IUCN) Red List “Endangered” and Azerbaijan Red Data Book (AzRDB) listed status.

Current information available on seal migration timing and routes are described within Chapter 6: Section 6.5.5.3. This shows that it is not possible to assume that seals will always follow the previously defined migratory paths close to the east and west coastline and may travel through the centre of the Caspian (including through the ACG Contract Area). Caspian seals may be present in the ACG Contract Area, including in the vicinity of the proposed ACE platform location, at any time of year but with an increased likelihood during the migration periods (April to May and November to December). There is also the potential for seals that have not migrated to the Southern Caspian to be present for foraging from May to September with peak numbers coinciding with the peak kilka numbers in July. During the ACE Geotechnical Survey conducted at the proposed ACE platform location in March and April 2018 the first seal sighting was recorded on April 18th, followed by four subsequent sightings up to 23rd April when the survey finished.

The MODU, anchor handling tugs and standby vessel will generally be stationary for the period of the predrill programme and as such are not expected to interfere with the presence of the seals. The support vessels will move between the shore and the ACE drill location, but the seals will detect the underwater sound from this source long before the vessel is sufficiently close for the associated sound to result in injury and will temporarily move. Any behavioural disturbance will be very short term, reversible and temporary.

Fish

In general, the main distribution of fish species in the Caspian Sea is within the shallow water shelf areas. Maximum concentrations of fish are typically found at depths of up to 75m for the majority of the year. It is common for Caspian fish species to migrate to warmer southern waters for overwintering and migrate to nutrient rich shallow areas of the north or river deltas in the spring / summer for spawning and feeding.

Fish known to be present within the vicinity of the proposed ACE location include species with moderate or high sensitivity to underwater sound. The species present (including seasonal activity, hearing sensitivity, depth of occurrence and protection status) are summarised within Chapter 6: Table 6.14.

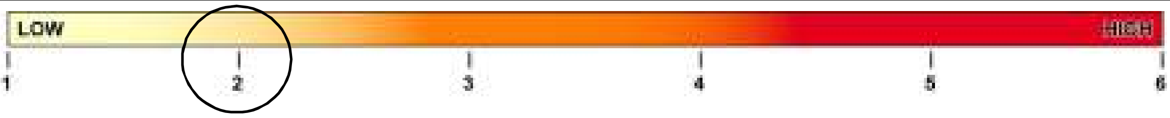
Sturgeon (classified as IUCN Critically Endangered) are known to migrate through the ACG Contract Area in March to April and September to November but are not common and are unlikely to be found in water depths exceeding 100m such as where the ACE predrilling activities are planned. Kilka (of genus Clupeonella) and shad (of genus Alosa) are highly sensitive to underwater sound. These species have structures that mechanically couple the inner ear to the swim bladder increasing the hearing ability compared to other fish. Kilka are semi migratory following migratory routes parallel to the coast of Azerbaijan to the north of the ACG Contract Area. However kilka species may be present in the ACG Contract Area, including the proposed ACE predrill site, throughout the year but particularly during the autumn migration period and winter months. Other species that may be present during the predrill programme include the mullet (during their autumn migration or juveniles) and goby species that are present throughout the year in the Central and Southern Caspian including the Contract Area. Although mullet and some species of gobies have swim bladders (the majority of goby species do not) they are not as sensitive to underwater sound as kilka and shad species.

No fish species is present exclusively within the ACG Contract Area. Migrating fish are also highly mobile, utilising a broad depth range for migration. In the event of a sound disturbance in the water column they will move away as soon as the disturbance is detected.

Table 9.12 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.12 Receptor Sensitivity (Seals and Fish)

Parameter	Explanation	Rating
Presence	**Fish:** Hearing specialist fish are likely to be present for limited periods of time in the vicinity of the proposed ACE location. However, these species are widely distributed and do not use this area exclusively. Fish species are able to easily move away from underwater sound before permanent or temporary injury impacts are likely to occur. There may be a change in behaviour but this is expected to be limited to a change in swimming direction and is expected to be short-term. **Seals:** There is potential for low numbers of individual seals to be present at the proposed ACE location throughout the year but with an increased likelihood during spring migration during April/May. However, the Caspian seal is a highly intelligent animal and will rapidly move away as soon as any disturbance or sound is detected.	1
Resilience	**Fish:** Individual fish are at very low risk of injury or significant behavioural disturbance and therefore the risk to populations is considered to be even lower and ecological functionality will be maintained. **Seals:** Internationally protected Caspian seals may be present in the vicinity of the ACE predrill activities year round including during spring migration. However the main migration route is typically between the Absheron Peninsula and the western edge of the ACG Contract Area. Caspian seals that may be present in the vicinity of the ACE predrill activities will sense the sound from these activities and alter their course away accordingly.	1
Total		**2**



9.4.2.3 Impact Significance

Table 9.13 summarises underwater sound impacts to marine biological receptors (seals and fish) associated with MODU drilling and vessel movements.

Table 9.13 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
MODU Drilling	Medium	(Biological/Ecological) Low	**Minor Negative**
Support Vessels	Medium	(Biological/Ecological) Low	**Minor Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures (refer to Section 9.4.1.1) and no additional mitigation is required.

9.4.3 Drilling Discharges

As described in Chapter 5, Section 5.3 it is planned that up to six wells will be predrilled, using a MODU, prior to the installation of the ACE platform. Discharges of water based mud (WBM) and cuttings are planned to be consistent with existing ACG drilling practices.

9.4.3.1 Event Magnitude

Description

The anticipated drilling activities resulting in discharges to sea are described within Chapter 5: Sections 5.3.2, 5.3.2.3 and 5.3.2.4. The estimated quantities of seawater and PHB sweeps, WBM and cuttings discharged per hole in tonnes are provided in Table 9.14. Two types of discharge events are anticipated to occur:

- Seabed discharges during routine drilling of the 42” holes, and in the event of a failure of the Mud Recovery System (MRS) when drilling the 28” and 26” holes; and
- Discharges from the MODU cuttings chute or via a discharge hose during routine drilling of the 28” and 26” holes and during discharge of residual WBM.

Table 9.14 Summary of Drilling Discharges per Hole

Discharge location	Hole Size	Description	Drilling Fluid/ Mud System	Estimated Fluids Discharged (Tonnes)	Estimated Cuttings Discharged (Tonnes)
Seabed	42”	Conductor Hole	Seawater & PHB sweeps	42	730
To sea via cuttings chute/ hose	28”	Surface Hole	WBM[1]	550	306
	26”				
	Residual Mud	At end of Drilling 26” Hole section	WBM[1]	239	NA
Notes: 1.The volume of WBM discharged includes water.					

The anticipated composition and function of the fluids discharged are provided within Table 9.16 below.

Assessment

The deposition of cuttings discharged directly to the seabed during drilling of the 42” hole section using seawater/PHB sweeps and the WBM and cuttings discharged to sea from the MODU during drilling of the 28” and 26” holes sections has been modelled using SINTEF’s DREAM (Dose-related Risk Effects Assessment Model), incorporating the ParTrack model for modelling solids in the water column and sediment. The results of the modelling are summarised below and presented in detail in Appendix 11C.

To assess the area over which cuttings and mud would be deposited, the deposition from the drilling of all six proposed ACE predrill wells was modelled. The wells will be located within approximately 2m of each other at a water depth of approximately 137m.

During drilling of the 42” hole section using seawater and high viscosity sweeps of PHB approximately 42 tonnes of drilling fluids and 730 tonnes of cuttings is expected to be discharged directly to the seabed. As described in Chapter 5: Section 5.3.2.3, the WBM cuttings generated by drilling the 28” and 26” hole sections will be discharged either from the MODU cuttings chute or using a hose of 6” diameter located at 25m above the seabed to avoid the accumulation of a cuttings pile in a location where subsequent infrastructure will be located. In terms of seabed deposition, it is considered that deposition of discharges from the hose give the most conservative results and as such the modelling was completed on this basis including the mud, cuttings and residual mud volumes from the 26” and 28” hole section drilling as presented in Table 9.14. The modelling assumed the discharges from the hose would occur approximately 50m from the well location.

In the event that there is a failure of the MRS, based on the typical chloride concentration within the WBM the resultant mud discharges at the seabed will require a dilution of 2-fold to meet the PSA salinity requirement and a dilution of 8-fold to reach ambient chloride concentrations.

The results of the modelling are presented in Figures 9.2 to 9.5 for winter and summer conditions and summarised within Table 9.15.

Table 9.15 Approximate Extent of WBM Cuttings Deposition to 1mm Depth and Maximum Depth of Deposition for ACE MODU Drilling Discharges (6 Wells)

Season	Water Depth	Approximate Extent of Cuttings Deposition to 1mm Depth	Maximum Depth of Deposition
Winter	137m	$8650m^2$	6.4m
Summer		$10450m^2$	6.4m

Winter Conditions

As shown in Figure 9.2, under winter conditions it is estimated that the cuttings pile generated by drilling the 42” hole sections of the six predrill wells will reach a maximum height of 5625mm while the cuttings pile generated from drilling of the 28” and 26” holes (including the discharge of residual mud) will reach a maximum height of approximately 6375mm. The height of two cuttings piles on the seabed drops away rapidly with distance from the wells with a height of 1mm reached within a radius of approximately 50m to 100m of the wells. As shown in Figures 9.2 and 9.3 the modelling predicts an overlap between the two cuttings piles i.e. from the 42" section and from the 28" and 26" hole section drilling. It is estimated that the cuttings depth where the cuttings piles overlap will be approximately 950mm. The modelling shows that the maximum estimated area affected by the cuttings deposition to a 1mm depth from the drilling of all six wells during winter conditions is approximately 8650m^2.

Figure 9.2 Cross Section Showing Depth of Deposition from WBM Cuttings Discharged to the Seabed during Drilling of Upper 42", 28" and 26" Hole Sections (6 Wells - Winter)

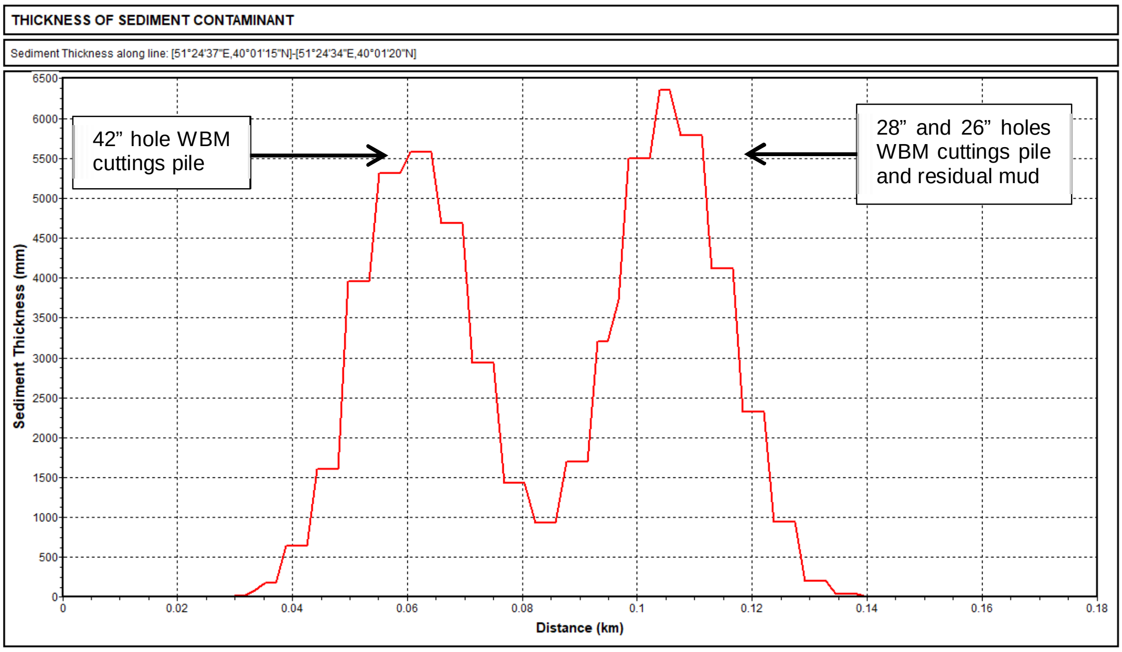
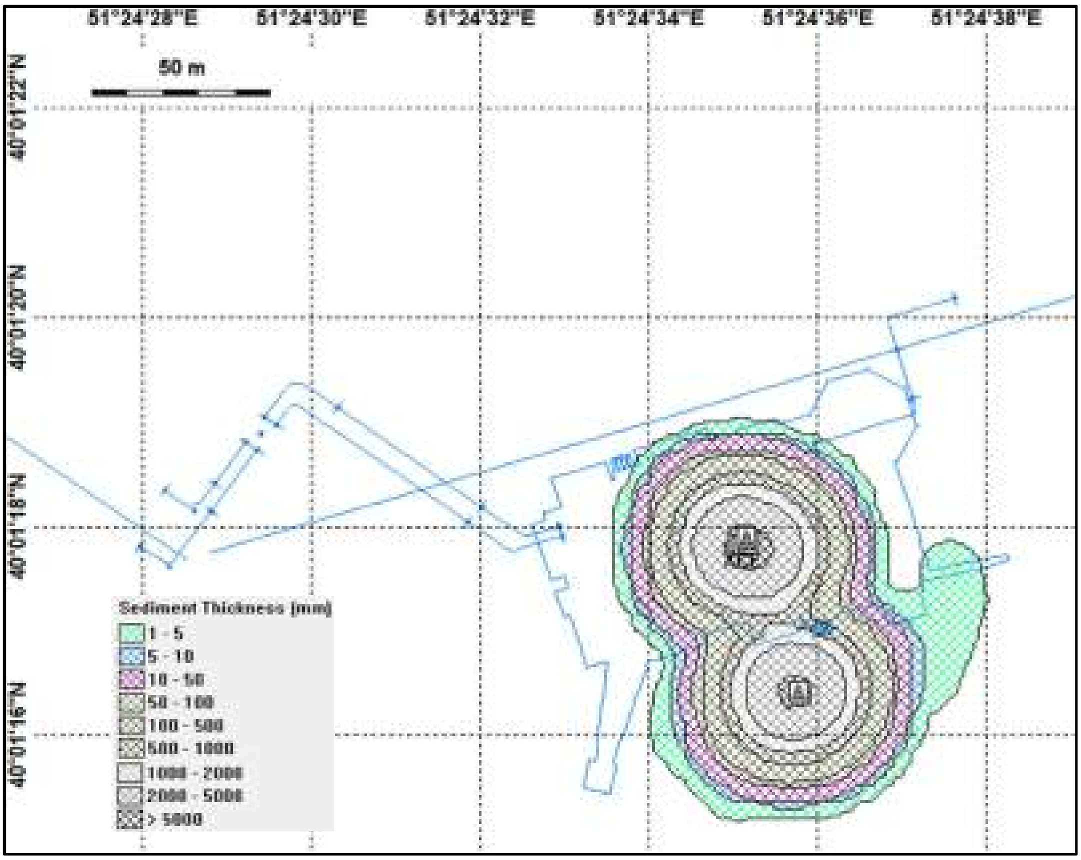


Figure 9.3 Deposition Thickness from MODU Drilling Discharge (6 Wells - Winter)



Summer Conditions

As shown in Figure 9.4 under summer conditions it is estimated that the cuttings pile generated by drilling the 42" hole sections of the six predrill wells will reach a maximum height of 5875mm while the cuttings pile generated from the drilling of the 28" and 26" holes (including the discharge of residual mud) will reach a maximum height of approximately 6300mm. As per the winter conditions modelling results, the height of the two cuttings piles on the seabed drops away rapidly with distance from the wells with a height of 1mm reached within a radius of approximately 50m to 100m of the wells. As shown in Figures 9.4 and 9.5 the modelling predicts an overlap between the two cuttings piles i.e. from the 42" section and from the 28" and 26" hole section drilling with a minimum deposition depth of approximately 900mm anticipated where they overlap. The modelling shows that the maximum estimated area affected by cuttings deposition to a 1mm depth from the drilling of all six wells during summer conditions is approximately 10450m^2.

Figure 9.4 Cross Section Showing Depth of Deposition from WBM Cuttings Discharged to the Seabed during Drilling of Upper 42", 28" and 26" Hole Sections (6 Wells - Summer)

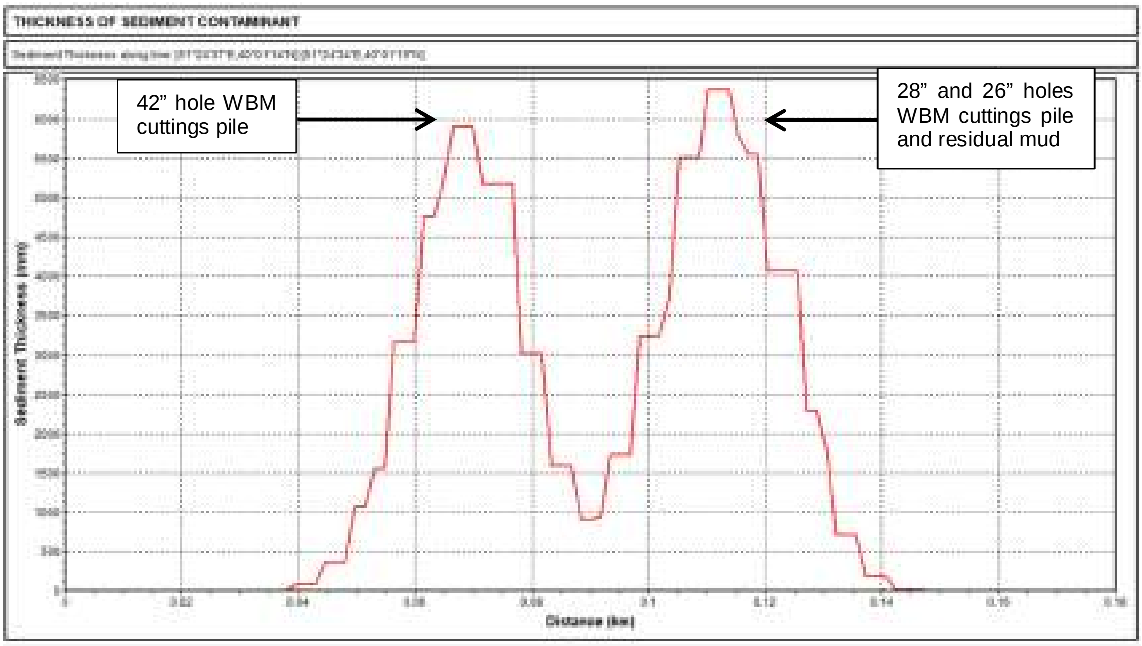
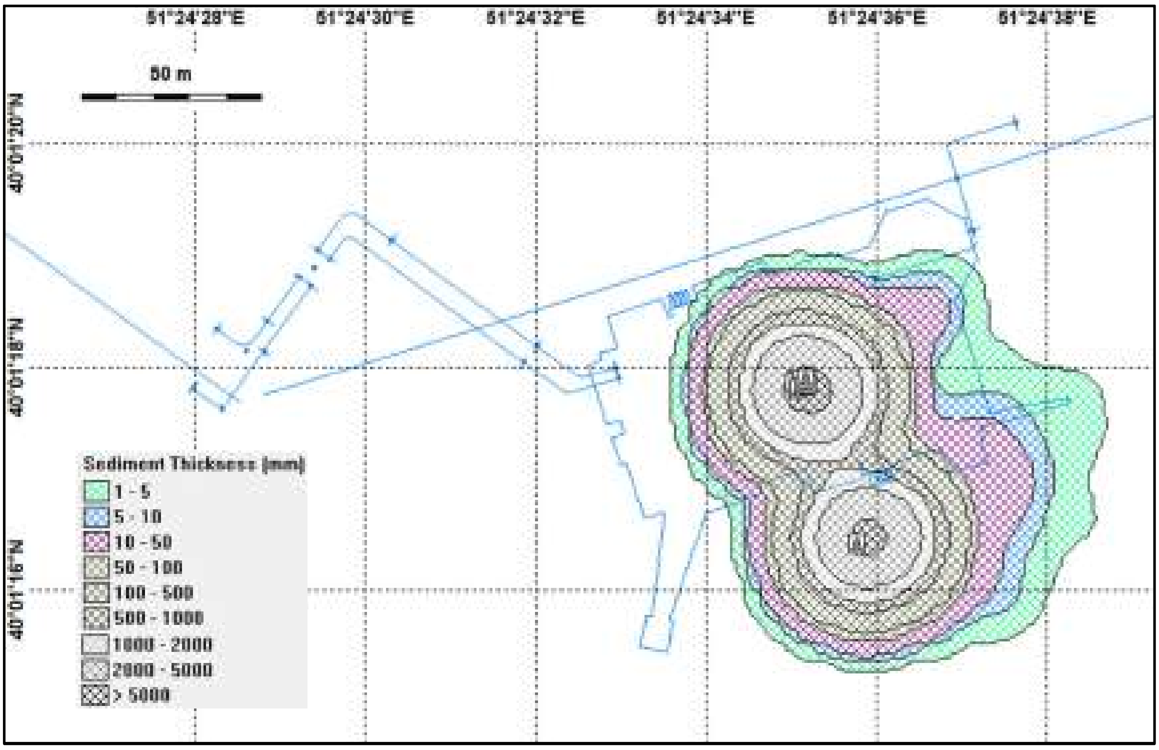


Figure 9.5 Deposition Thickness from MODU Drilling Discharge (6 Wells - Summer)



Direct Observation and Measurement

BP have accumulated a substantial amount of direct observational data derived from post-drilling environmental surveys conducted around existing operational facilities in both the ACG and SD Contract Areas. These studies provide direct evidence of the environmental effects of discharges arising from the drilling of multiple wells (over 20 in the case of some ACG platforms) at a single location.

In each case, chemical analysis of sediments has shown a detectable barium footprint extending out to approximately 500m from the platforms. This observation is consistent with the modelling predictions taking into account that the barite is predicted to be transported further than other mud and cuttings components. However, there is no evidence of any ecological effects associated with the barite footprint, and the monitoring evidence available to date indicates that the discharge of WBM cuttings is not creating any adverse effects on the benthic invertebrate communities at distances of more than 250m from the platforms (for safety reasons, it is not possible to conduct routine environmental surveys within a 250m exclusion radius). The monitoring has shown that substantial populations can be found in areas of sediment with high barium concentrations and there is little evidence that the structure of the habitat has been substantially altered.

Drilling discharges are assigned an intensity score of 1 for the following reasons:

- A large proportion (at least 55%) of the discharges consists of inert geological material (the cuttings);
- The drilling fluid components are inert or of very low toxicity;
- Only the solid, inert components of the drilling mud will settle to the seabed. Low toxicity soluble components, such as potassium chloride and minor additives, will dilute and disperse in the water column and will have neither acute or persistent effects;
- Evidence from monitoring in the vicinity of drilling operations where WBM cuttings have been discharged shows that there is no accumulation of drilling additives and only a very small effect on the benthos within the 'footprint' of the discharge (up to 500m from the drilling location); and
- The drilling fluids have been the subject of comprehensive testing and assessment and have been approved for use by the MENR for existing operations.

Mud Composition and Toxicity

The approximate composition of the proposed WBM to be used for drilling the ACE wells together with a brief summary of the environmental fate and effects of each component, is summarised in Table 9.16.

Table 9.16 Approximate Composition and Environmental Fate of WBM

Chemical	Function	Hazard Category[1]	Environmental Fate and Effect
Bentonite	Viscosifier and removal of cuttings	E	Inert clay. Not considered environmentally hazardous
Sodium Bicarbonate	pH treatment and calcium ion separation	E	The product itself and its products of degradation are not toxic
Fluorescein	Cement tracer	GOLD	UK HOCNS classification of GOLD – low toxicity and low persistence
Barite	Weighting agent	E	Dense, fine powder. Will settle to seabed. Not considered environmentally hazardous
KCL	Borehole stabiliser	E	Natural inorganic substance. Not considered environmentally harmful, will disperse rapidly in water column
Ultrahib	Stabiliser / Shale Inhibitor	GOLD	UK HOCNS classification of GOLD – low toxicity and low persistence
Polypac	Encapsulater	E	Not classified as environmentally hazardous, is water soluble, biodegradable and does not bioaccumulate
Flo-Trol	Fluid loss control and reduces the risk of drill string sticking	E	Not classified as environmentally hazardous, is water soluble, biodegradable and does not bioaccumulate
Duo-Vis	Viscosifier	GOLD	UK HOCNS classification of GOLD – low toxicity and low persistence
UltraFree	Lubricant, prevents bit balling	GOLD	UK HOCNS classification of GOLD – low toxicity and low persistence
Ultracap	Encapsulator	GOLD	UK HOCNS classification of GOLD – low toxicity and low persistence
Citric acid	pH treatment and calcium ion separation	E	Dilutes rapidly into the water column, typically of low toxicity, readily degradable, non-persistent, non-bioacccumulative and does not bind to sediments

Notes: 1. Two methods of hazard assessment are used in accordance with internationally recognised practice - CHARM and Non CHARM. The CHARM Model is used to calculate the ratio of predicted exposure concentration against no effect concentration (PEC:NEC) and is expressed as a Hazard Quotient. Hazard Quotients are assigned to 1 of 6 categories and "GOLD" is the least hazardous category. Those chemicals that cannot be modelled by CHARM are assigned to a category (A to E) based on toxicity assessment, biodegradation and bioaccumulation potential. Category E is the least harmful category. Source: CEFAS, Offshore Chemical Notification Scheme - Ranked Lists of Notified Chemicals, Updated 17th April 2018. Full details of the determination of hazard categories can be found in Appendix 5B.

Toxicity tests are regularly conducted on the proposed WBM formulations using Caspian zooplankton, phytoplankton and sediment-dwelling species. Toxicity was assessed in the water column and sediment[6]. The results from the WBM toxicity testing conducted since 1999 have been reviewed and are summarised in Table 9.17. The estimated acute toxicity levels would require dilution of WBM, discharged from the MODU in accordance with PSA chloride concentration requirements, by a factor of between 31- and 100-fold (depending on the mud composition). The relevant dilution factor would be reached very rapidly following the WBM discharge and the plume of the discharge would be very small, quickly dispersing. The concentrations within Table 9.17 would likely persist only for the duration of each discharge.

Table 9.17 Seawater Sweeps and Water Based Mud Toxicity Test Results

Mud Type	Water Column		Sediment
	Zooplankton 48 hour LC_{50}[1] (mg/l)	Phytoplankton 72 hour EC_{50}[2] (mg/l)	Amphipod 96 hour LC_{50}[1] (mg/kg)
Seawater sweeps (42" section)	>32000	>32000	>32000
KCl mud (28"& 26" sections)	>10000	>32000	>32000
Ultradril WBM (28" & 26" sections)	16568	9868	26270

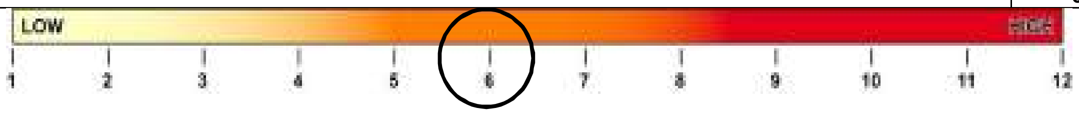
Notes: 1. LC_{50} - Lethal Concentration 50 is the estimated concentration of a substance required to cause death in 50% of the test organisms in a specified time period.
2. EC_{50} - Effective Concentration 50 is the concentration of a substance that has a specified non-lethal effect on half of the test organisms within a specified period of time. Effects measured are often number of young produced, time to reproduction, etc. In the case of phytoplankton, it is the concentration at which growth rate is reduced by 50%.

[6] The species tested were: Zooplankton: *Calanipeda aquae dulcis*; Phytoplankton: *Chaetoceros tenuissimus* and Sediment: *Pontogammarus maeoticus*.

Table 9.18 presents the justification for assigning a score of 6, which represents a Medium Event Magnitude.

Table 9.18 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Modelling indicates potential for cuttings deposition (from 6 wells) over an area of 10450m^2. Monitoring has shown evidence of barite at distances of up to 500m from drilling of other ACG/SD wells.	1
Frequency	Discharges of WBM and associated cuttings will occur once for each hole section.	2
Duration	Total duration of discharge is approximately 330 hours (6 wells) which will take place intermittently over a period of 12 months.	2
Intensity	Drilling discharges are considered to be of low intensity due to the composition and evidence from post well surveys of no accumulation of drilling additives and previous toxicity tests.	1
Total		**6**



9.4.3.2 Receptor Sensitivity

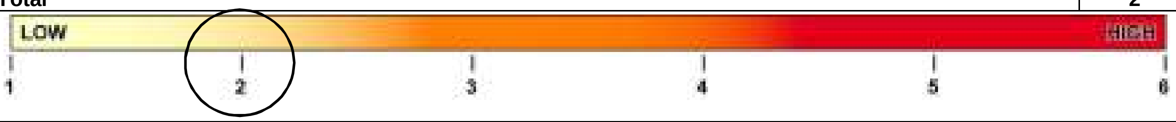
Seals and Fish

Drilling discharges will generate turbid plumes of limited duration and dimension. Based on EMP survey findings, observation and studies relating to similar discharges, these plumes however, are not expected generate chemical contamination of the water column and will not occupy a significant proportion of the local water column. It is anticipated that both fish and seals will avoid the plumes and will not be directly affected by the cuttings deposited at the seabed.

Table 9.19 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.19 Receptor Sensitivity (Seals and Fish)

Parameter	Explanation	Rating
Presence	**Fish:** Fish species including kilka and mullet will be present in the Contract Area throughout most of the year with other species present during migratory periods. However, the Contract Area is not exclusively used by these species and is not considered to be of primary importance for these species. Fish are highly mobile and sensitive and as soon as they detect the cuttings plume will rapidly move away, and so the risk of any impact to fish is low. **Seals:** There is potential for low numbers of individual seals to be present at the proposed ACE location throughout the year but with an increased likelihood during spring and autumn migration and during April/May and November/December. However, the Caspian seal is a highly intelligent animal and will sense and rapidly move away from any disturbance or from any localised particle plumes associated with drilling discharges, typically following their prey (fish) who will also rapidly move.	1
Resilience	Marine mammals are occasionally observed in turbid waters offshore, so some tolerance to localised increases due to drilling discharges is likely while most fish species are found in a range of turbidity conditions, such as coastal and riverine locations with much higher sediment loadings. Possibility that species may be temporarily affected by drilling discharges but effect would be short term and limited and ecological functionality will be maintained.	1
Total		**2**



Plankton

Zooplankton

As for fish and seals, the principal potential interaction of drilling discharges with zooplankton is via the intermittent presence of short-duration turbidity plumes. Discharges from the MODU will normally take place via the cuttings chute (at a depth of approximately 11m below sea level), which is within the zooplankton productive zone present during spring, summer and early autumn. WBM cuttings may also be discharged directly to the seabed using a hose of 6" diameter at 25m above the seabed to avoid the accumulation of a cuttings pile in a location where subsequent infrastructure will be located. However, this discharge will be below the main productive zone.

Much of the particulate matter in the cuttings discharged from the cuttings chute will sink rapidly to the seabed, although smaller particles will remain in the water column creating areas of elevated turbidity. The discharges will be intermittent and of short duration so will not impact a large volume of the productive zone. Unlike fish and seals, zooplankton cannot avoid turbidity plumes, but the dimension of the plume is anticipated to be sufficiently small that the "residence time" of individual organisms within the plume will be too short to cause significant harm.

As described in Chapter 6: Section 6.5.5.1 plankton surveys conducted in the ACG Contract Area have indicated that the zooplankton community is dominated by two invasive species; the copepod *Acartia tonsa* and the ctenophore *Mnemiopsis sp*. However, the endemic copepod *Eurytemora minor*, which was widespread prior to 2003, re-appeared in 2008 samples and was 2% of the total zooplankton community in 2014. This suggests some recovery of this species may have taken place. The plankton surveys conducted at the proposed ACE platform location in 2017 found zooplankton taxonomic richness was lower than in previous surveys carried out within the ACG Contract Area with *Acartia tonsa* found to be the most dominant species while the endemic copepod *Eurytemora minor* was not recorded. Despite the lower number of species present, the general community structure was comparable to ACG regional survey samples.

Zooplankton has high reproductive rates during spring, summer and autumn and localised populations tend to develop in patches in response to food availability. These patches then decline as local food resources are depleted. Consequently, zooplankton will be highly resilient to the effects of drilling discharges as populations can re-establish quickly.

Phytoplankton

The overall composition of the phytoplankton communities across the ACG Contract Area has remained broadly similar since 2004 and has been found to be dominated by diatom and dinophyte species in all surveys. There are no systematic trends indicated by the survey results and the non-native diatom *Pseudosolenia calcar-avis* was numerically dominant in all samples in the 2014 survey. The phytoplankton community within the samples taken during the plankton surveys undertaken at the proposed ACE platform location was similar in composition to the communities observed on previous surveys carried out within the ACG Contract Area. The only notable difference is the higher number of dinoflagellate species present in ACE 2017 samples (19 compared to 6 to13 in recorded in previous regional survey samples).

Being dependent on light to photosynthesise, phytoplankton are confined to the upper layers of the water column. As with zooplankton, phytoplankton populations tend to be patchy. In areas where nutrient levels are temporarily high, growth will be rapid and dense patches can develop. The development of patches is limited both by local nutrient availability and by zooplankton grazing.

Phytoplankton are fast growing, short-lived and respond quickly to changing conditions such as increases in nutrients or changes in light conditions and are therefore well adapted to rapidly changing conditions.

Table 9.20 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.20 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Species not rare or unique on a regional basis. Species are assessed at the community level only. Phytoplankton and zooplankton will be exposed to drilling discharges from the MODU cuttings chute. Discharges to seabed from drilling of 42" hole section and from hose 25m above seabed will be below the main productive zone.	1
Resilience	Community dominated by widespread and abundant invasive species. Plankton are fast growing, short-lived and respond rapidly to changing conditions.	1
Total		**2**

Benthic Invertebrates

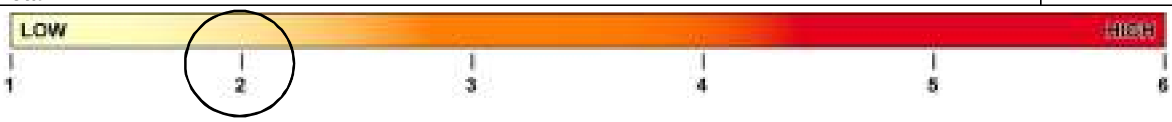
The benthic invertebrate communities within and in the vicinity of the proposed ACE platform location are similar in species richness and abundance to those across the rest of the ACG Contract Area and the Azerbaijani sector of the South Caspian. The benthic community is numerically dominated by native amphipod crustaceans followed by polychaete, oligochaete and cumacea species, most of which have the potential to reproduce several times a year. There are no rare, unique or endangered species present.

With the exception of some bivalves, the dominant taxa are deposit feeders which routinely construct burrows to a depth of 10cm or more (this is why field surveys take samples to a depth of 10-15cm). These species are physiologically equipped to construct new burrows through cuttings material deposited in layers of at least similar depth to that which they routinely penetrate during normal burrowing activity. Routine platform monitoring studies undertaken as part of the EMP provide support for the conclusion that burrowing species can penetrate deposited cuttings, by demonstrating the presence of such organisms in samples taken at locations where barite concentrations indicate the presence of cuttings. In addition the cuttings will be of a similar particle size to their natural sediment, and unlike filter feeders, deposit feeders will not suffer from the clogging of feeding appendages.

Table 9.21 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.21 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	No rare, unique or endangered species present. Species are assessed at the community level only.	1
Resilience	Species or community unaffected or marginally affected.	1
Total		**2**



9.4.3.3 Impact Significance

Table 9.22 summarises impacts to biological/ecological receptors associated with drilling discharges to sea.

Table 9.22 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Drilling Discharges to Sea	Medium	(Seals and Fish) Low	**Minor Negative**
		(Plankton) Low	**Minor Negative**
		(Benthic Invertebrates) Low	**Minor Negative**

Based on the findings from the surveys, as reported in detail within Chapter 6 of this ESIA, very limited impact on benthic communities has been observed from existing drilling discharges associated with drilling activities within the ACG Contract Area.

Monitoring and reporting requirements associated with drilling discharges to the sea during MODU drilling activities include following:

- Should the composition of the mud system be altered during the drilling programme to meet the drilling requirements the Management of Change Process will be followed (Chapter 5: Section 5.13). As a minimum, tests in accordance with Caspian Specific Ecotoxicity Procedures will be undertaken if the WBM system is changed and the results submitted to the MENR;
- Each batch of barite supplied for use in WBM will be tested by the supplier to confirm cadmium and mercury content;
- When WBM and cuttings are discharged from the MODU the chloride concentrations will be analysed twice a day;
- Volumes and composition of WBM and cuttings discharged at the end of each well section and chloride concentrations will be recorded daily during discharge events;
- Monitoring of potential effects on seabed and benthic communities will be carried out in accordance with the EMP. EMP monitoring results will be submitted to the MENR on an annual basis; and
- The Environmental Report submitted to the MENR following the completion of the predrilling activities will include the following relevant to drilling discharges:
    - Volumes of drill cuttings and drilling fluids discharged;
    - Volume of drilling chemicals used;
    - Chloride concentrations of discharged drilling fluids; and
    - Mud type and mud system associated with discharged drilling fluids and associated chemical names and OCNS categories as appropriate.

These requirements are incorporated into the MODU HSE MS, which is aligned to the AGT Region EMS as described within Chapter 14: Section 14.5 of this ESIA.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

9.4.4 Cement Discharges

As discussed within Chapter 5: Sections 5.3.2.5 and 5.3.6.2 it is expected that cement will be discharged to the marine environment during the cementing of the hole sections. In addition it is expected that excess cement will be discharged from the MODU following the completion of these activities.

9.4.4.1 Event Magnitude

Description

Cementing discharges will occur during drilling from two types of activity:

- During the cementing of successive well casings. A riserless MRS will be used following the cementing of the 30” casing (42” hole section) which will enable the majority of excess cement to be returned to the MODU. Cement discharged from the 42” hole section will be discharged directly to the seabed. The event duration will be approximately one hour per casing; and

- Cement discharges will also occur from wash out activities where cement remaining in the cement unit and associated hoses will be slurrified with seawater (approximately 10:1 dilution), and will be discharged from the MODU via a hose located below the sea surface. The discharge of dilute cement slurry is estimated to take approximately an hour at a rate of 1.3m^3 per minute. This rate of discharge is equivalent to approximately 250kg of cement per minute.

Assessment

Cement Discharges to Seabed

Cement discharged at the seabed is not expected to disperse (being designed to set in a marine environment) and will therefore set *in-situ*. The composition of the cement is described in detail in Table 1 of Appendix 5C. For all wells and hole sections, the principal component (representing between 58 and 99% of the cement by weight) is Class G cement, which is an environmentally inert solid. The total quantities of excess cement discharged for each well and hole section are summarised in Chapter 5: Table 5.8.

It is not anticipated that there will be any chemical releases from the cement, which will be effectively chemically inert. The impact of cement discharge will therefore be limited to a small area immediately around the well.

For each well, a total of approximately 38.2 tonnes of cement will be discharged directly to the seabed. Although this will occur in two separate events, the largest potential area of impact can be estimated by assuming that this volume forms a uniform shallow layer. If this layer is assumed to be 30cm deep, then the maximum radius to which the cement would extend would be about 3.55m, and the impact of seabed discharge would therefore be minimal, as this area would lie within the area previously impacted by cuttings discharge from the 42" hole sections.

Cement Discharges from Wash Out

The composition of the cement washout discharged is described in detail in Appendix 5C. As per the cement discharges to seabed described above, the principal component (representing between 50 and 89% of the cement chemicals washout by weight) is Class G cement, which is an environmentally inert solid.

Discharge of slurry at a rate of 1.3m^3 per minute will generate a downward plume, initially at a velocity of 30-40cm/s. The discharge will consist class G cement and Lightcrete, mixed with water. Other cementing additives included in the cement mixture are assumed to be dissolved or finely mixed into the mix water.

The discharges will occur after the cementing of each liner and casing including 24", 16'' and $9^5/_8$" liners as well as 30", 20" and $13^3/_8$" casings. They will last no more than one hour each, and the discharge and dispersion plumes will therefore be completely separated in time.

The cement washout discharges were modelled during summer and winter conditions in order to establish the extent of any turbidity plume. Figures 9.6 and 9.7 illustrate the plan and cross-section views of the plume two hours after the start of a discharge during summer conditions. At this point, particulate concentrations within the plume are in the 5-50mg/l range, and therefore too low to have an adverse turbidity effect. The horizontal and vertical extents of the plume are approximately 150m and 13m respectively at this time. The modelling indicates that the plume will have completely dispersed to particulate concentrations of less than 5mg/l within 3 hours 30 minutes during both summer and winter conditions and within a distance of 0.97km (summer) and 0.60km (winter). Full results of the modelling for discharges under both summer and winter conditions are presented in Appendix 11C.

Figure 9.6 Plan View of Cement Wash Out Dispersion Plume Two Hours after Start of Discharge (Summer)

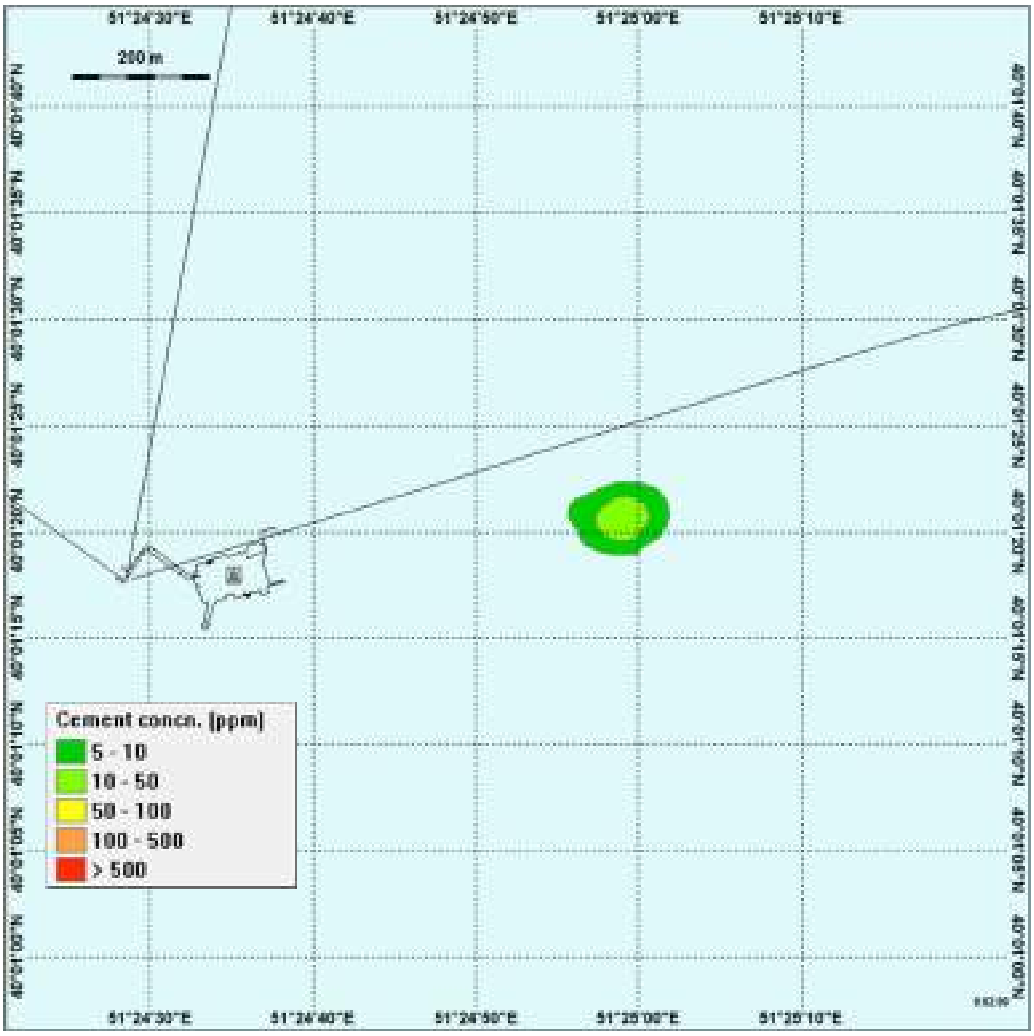
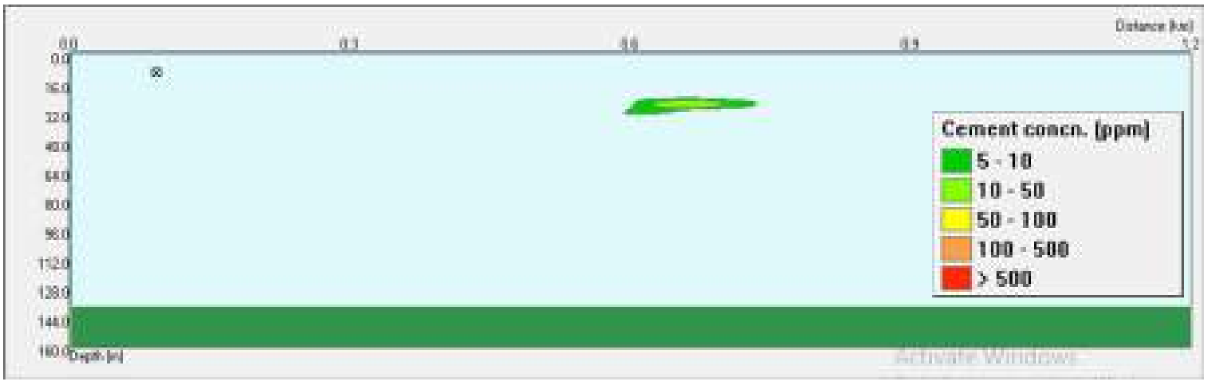


Figure 9.7 Cross-Section of Cement Wash Out Dispersion Plume Two Hours after Start of Discharge (Summer)

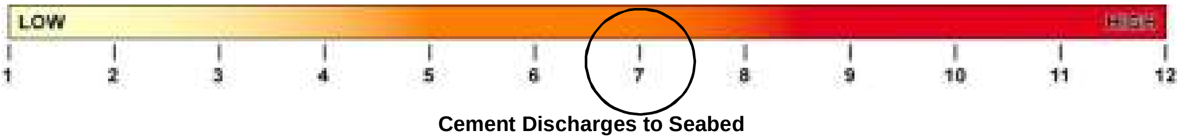


The modelling also indicated that less than 0.1% of the cement solids would be deposited on the seabed 2.5km of the point of discharge, and that no significant seabed deposition would occur at any location.

Table 9.23 presents the justification for assigning a score of 7 to cement discharges to seabed and 6 to cement discharges from wash out, which represents Medium Event Magnitude.

Table 9.23 Event Magnitude

Event Parameter	Cement Discharges to Seabed	Cement Discharges from Wash Out
Extent/Scale	1	1
Frequency	3	2
Duration	1	1
Intensity	2	2
Event Magnitude:	**7**	**6**



Cement Discharges to Seabed

Cement Discharges from Wash Out

9.4.4.2 Receptor Sensitivity

With regard to cement discharges to the seabed, these will be confined to a small area of seabed immediately around each well and no chemical releases are anticipated. Consequently, the only biological receptor is the benthic community. The cement deposits will not extend beyond the area occupied by the primary cuttings piles, and will therefore not give rise to any additional impact. The Receptor Sensitivity of all marine organisms to cement discharges is considered to be low and a score of 2 has been assigned in Table 9.24.

Table 9.24 Receptor Sensitivity (Benthic Invertebrates)

Parameter	Explanation	Rating
Presence	Toxicity and persistence of cement components is low, and cement will set rapidly. Effects will be limited to physical covering of small area of benthos.	1
Resilience	No rare, unique or endangered species at significant risk of exposure, receptor confined to benthic community close to well.	1
Total		**2**

With regard to cement discharges associated with wash out, the discharge will form a limited plume extending no more than 200m, comprising settling solids and soluble, low-toxicity chemicals. The quantity of solids is low compared to a WBM discharge, and will not cause significant turbidity or significant deposits on the seabed. The soluble chemical constituents are of low toxicity and low persistence, and will dilute rapidly, with minimal impact on fish and plankton.

Table 9.25 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.25 Receptor Sensitivity (Seals and Fish/ Zooplankton/ Phytoplankton)

Parameter	Explanation	Rating
Presence	Toxicity and persistence of cement components is low, and cement will settle (solids) or disperse (soluble components) rapidly. Receptors present only within limited plume which is of limited persistence.	1
Resilience	No rare, unique or endangered species at significant risk of exposure.	1
Total		**2**

9.4.4.3 Impact Significance

Table 9.26 summarises impacts to benthic invertebrates, seals and fish, zooplankton and phytoplankton associated with cement discharges to seabed and associated with washing of the cement unit.

Table 9.26 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Cement Discharges to Seabed	Medium	(Benthic Invertebrates) Low	**Minor Negative**
Cement Unit Wash Out Discharges	Medium	(Seals & Fish/ Zooplankton/ Phytoplankton) Low	**Minor Negative**

The assessment has demonstrated that a Minor Negative impact to benthic invertebrates is predicted from cement discharges to seabed and cement unit washing discharges. Cement chemicals are designed to be of low toxicity, chemically inert and to set in a marine environment. Only the seabed in the immediate vicinity of the well will be affected by cement discharges to seabed.

With regard to cement unit washing discharges, the solids within the discharge will settle over a large area, but the quantities are small compared to drilling mud discharges, and will make no observable difference to existing seabed impacts. Effects in the water column will be minor, and will be restricted to within a short distance (less than 200m) from the point of discharge. Both solids and chemical dispersion plumes will disperse rapidly following cessation of discharge and prior to the commencement of the next washout discharge associated with the subsequent well section, and therefore:

- No single discharge event will have a marked impact; and
- The successive discharge events at any well will not overlap and will not have cumulative impact.

Monitoring and reporting requirements associated with cement discharges to the sea during MODU drilling activities include:

- Monitoring of potential effects on seabed and benthic communities will be carried out in accordance with the EMP. EMP monitoring results are submitted to the MENR on an annual basis; and
- The volume of cementing chemicals used and discharged will be recorded daily and included within the Environmental Report submitted to the MENR following well drilling and cementing activities.

These requirements are incorporated into the MODU HSE MS, which is aligned to the AGT Region EMS as described within Chapter 14: Section 14.5 of this ESIA.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

9.4.5 BOP Testing

9.4.5.1 Event Magnitude

Description

As described with Chapter 5: Section 5.3.4 a blowout preventer (BOP) will be installed on all wells to control pressure in the well prior to well suspension. The BOP will be tested weekly for safety reasons, resulting in discharge of control fluids to sea. The anticipated discharges and duration of each event is detailed within Table 5.12. In total a discharge of 2052 litres of BOP fluid over a period of 13.8 minutes is estimated for each 2 pod test. Single pod testing results in discharges of 1026 litres. Single and 2 pod tests are undertaken on alternate weeks through the drilling programme.

The BOP fluid comprises a proprietary control fluid (Stack Magic ECO-F v2), ethylene glycol and water. The active components of Stack Magic ECO-F v2 and the typical proportions of this product, ethylene glycol and water in the BOP fluid as a whole are summarised in Table 5.11. Since the proportions of components can vary, the impact assessment is based on the highest proportions of each.

Assessment

Toxicity tests were conducted on the proposed BOP fluid in 2014 using Caspian zooplankton, phytoplankton and sediment-dwelling species. Toxicity was assessed in the water column[6]. The results are summarised in Table 9.27.

Table 9.27 BOP Fluid Toxicity Test (2014)

Chemical	Water Column	
	Zooplankton 48 hour LC_{50} [1] (mg/l)	Phytoplankton 72 hour EC_{50} [2] (mg/l)
BOP Fluid (Water, Ethylene Glycol and Stack Magic ECO-F v2)	27060	2170

Notes:

1. LC_{50} - Lethal Concentration 50 is the estimated concentration of a substance required to cause death in 50% of the test organisms in a specified time period.

2. EC_{50} - Effective Concentration 50 is the concentration of a substance that has a specified non-lethal effect on half of the test organisms within a specified period of time. Effects measured are often number of young produced, time to reproduction, etc. In the case of phytoplankton, it is the concentration at which growth rate is reduced by 50%.

In order to estimate BOP fluid toxicity, it has been assumed that the product LC_{50} is ten times the chronic no-effect value. This is based on the risk assessment convention of applying a safety factor of 10 to acute toxicity data (for short-duration discharges). Consequently, the BOP fluid no-effect concentration is estimated to be 2706mg/l. To reach these concentrations, a discharge would require dilution of 380-fold.

The dispersion of the discharges in Chapter 5: Table 5.11 (assumed to be discharged consecutively) was modelled for summer and winter conditions, to enable the dimensions and persistence of the dispersion plumes to be quantified and visualised. The modelling conservatively assumed that the discharge would require a dilution of 500-fold to reach the no-effect concentration. Figures 9.8 and 9.9 illustrate the plan and cross-section views of the total (cumulative) area affected by the discharge to a dilution of 500-fold during summer conditions.

Figure 9.8 Plan View of Cumulative BOP Fluid Discharge to 500-Fold Dilution (Summer)

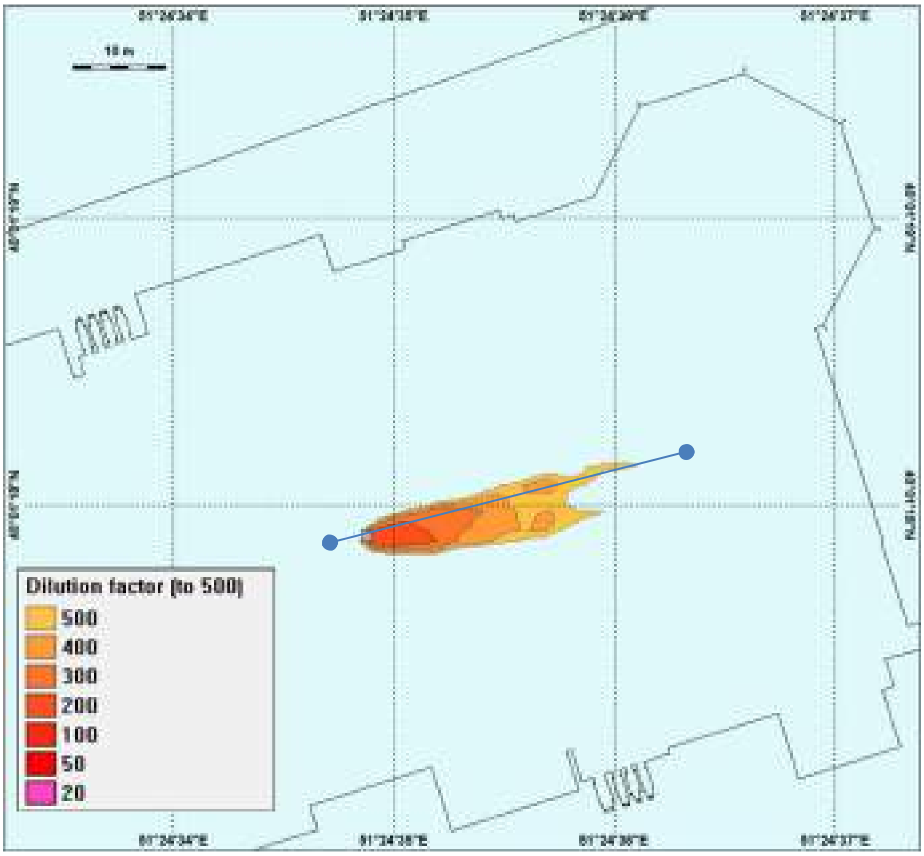
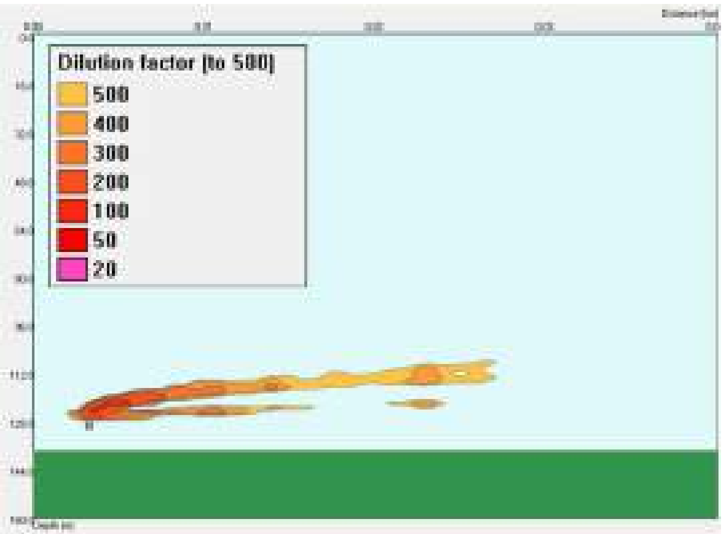


Figure 9.9 Cross-Section of Cumulative BOP Fluid Discharge to 500-Fold Dilution (Summer)



The modelling shows that the maximum extent of the 500-fold dilution plume area is approximately 28m long and 6m wide in summer while the discharge is anticipated to extend up to 20m in vertical height from the point of discharge. During winter conditions the modelling indicates that the plume will reach the 500-fold dilution requirement at approximately 21m from the discharge location with the width of the plume expected to be slightly larger (approximately 8m) than for summer conditions.

The plume generated by the release of BOP fluids is assumed to be upwards and at slightly above ambient temperature, causing the plume to rise a short way in the water column. The modelling undertaken represents the cumulative plume generated from the individual consecutive BOP fluid discharges. Under the stronger initial discharges the plume rises and extends further than for the weaker, subsequent discharges resulting in two distinct plume shapes appearing in the cross section. The plume extends approximately 25-30m in summer and winter before dispersing to below a factor of 500 with a slightly higher rise in winter due to the different ambient temperature profile. The exact orientation and geometry of discharges will depend on the design of the BOP, but the results are believed to be representative in terms of the area and volumes affected under the relatively poor dispersion conditions selected from the metocean data. The plume is completely dispersed to below a factor of 500 within two minutes after the end of the discharge, and there is a total period of 15 minutes during which the water column contain BOP fluids diluted by less than a factor of 500.

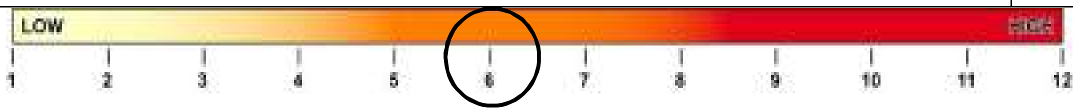
Full results of the modelling for BOP fluid discharges under both summer and winter conditions are presented in Appendix 11C.

The components of the BOP control fluid and ethylene glycol are all readily degradable, and the products have been assigned a HOCNS category D and E (rated A-E where E is the least environmental harmful). Taking into account both the limited area of potential impact and the very short duration, BOP fluid discharges is considered to be a low intensity activity.

Table 9.28 presents the justification for assigning a score of 6, which represents a Medium Event Magnitude.

Table 9.28 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Affects an area less than 28m from source (summer).	1
Frequency	Discharge will occur weekly for duration of the drilling programme.	3
Duration	Discharge from each weekly test will last for approximately 13.8 minutes.	1
Intensity	Low intensity.	1
Total		**6**



9.4.5.2 Receptor Sensitivity

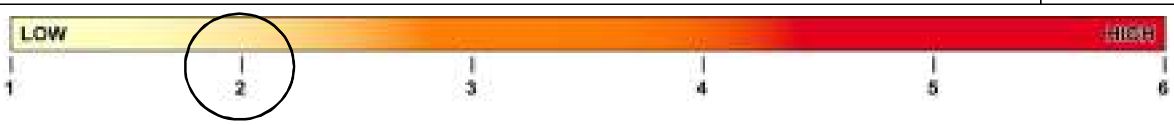
The discharges will take place approximately 8m above the seabed. Seals are not considered at risk of exposure due to the small size of the area of potential impact and the fact that dermal contact at the dilutions modelled would be very limited. Fish and zooplankton are most likely to be exposed, but neither category of organism is likely to be present in abundance at the discharge location during the very short period of discharge and plume persistence. There are no viable phytoplankton communities or macroalgae present at the discharge location.

For horizontal discharges (depending on the rig used, discharges will either be horizontal or vertical), it is possible that one or more plumes might transiently contact the seabed. However, the contact period and area would be insufficient to promote permeation of the sediment by the fluid components, and the exposure of benthic organisms would, overall, be less than the exposure of fish or zooplankton.

Table 9.29 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.29 Receptor Sensitivity (All Receptors)

Parameter	Explanation	Rating
Presence	Exposure is low and of short duration, so resilience is, in effect, high.	1
Resilience	No significant presence of rare, unique or endangered species.	1
Total		**2**



9.4.5.3 Impact Significance

Table 9.30 summarises the impact of BOP fluid discharge to sea on seals, fish, zooplankton, phytoplankton and benthos.

Table 9.30 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
BOP Discharges to Sea	Medium	(Seals) Low	**Minor Negative**
		(Fish/ Zooplankton) Low	**Minor Negative**
		(Phytoplankton/Benthos) Low	**Minor Negative**

The assessment has demonstrated that Minor Negative impacts to seals, fish, zooplankton, phytoplankton and benthos are predicted from BOP fluid discharge during the drilling programme.

Monitoring and reporting requirements associated with BOP discharges include:

- BOP fluid sampling will be undertaken at least once during the drilling programme and ecotoxicity testing, involving phytoplankton and zooplankton, will be implemented.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

9.4.6 Cooling Water Intake and Discharge

Cooling water will be continuously uplifted and discharged from the MODU during the predrilling activities.

9.4.6.1 Event Magnitude

Description

As described in Chapter 5: Section 5.3 the MODU to be used for the ACE Project is yet to be confirmed. To assess the potential impacts of the MODU cooling water system intake and discharge use of the Istiglal rig has been assumed for the purposes of the ESIA.

The Istiglal rig is designed to lift seawater at a rate of up to 400m^3 per pump (2 operating at a time) per hour with water lifted from a depth of approximately 11.5m depending on the draft of the MODU. Cooling water will be discharged at a rate of up to 1,600m^3 via a caisson 11.5m below sea level and at a maximum temperature of 30°C (during summer). The Istiglal secondary cooling system is protected by a standard anodic biofouling and corrosion control system[7].

Assessment

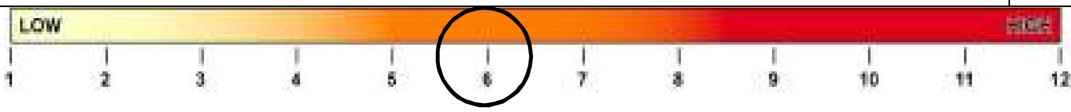
For the Istiglal rig as the intake depth is relatively shallow it is anticipated that the lifted water will be at the same ambient temperature as the receiving water at all times of the year. Modelling of the cooling water discharges show (refer to Appendix 11C) the discharge temperature will be no more than 4.5°C and 14°C above ambient temperature nearest to the discharge location during summer and winter conditions, respectively. It was concluded that the requirement that the temperature at the edge of a 100m mixing zone does not exceed ambient temperatures by more than 3°C would be achieved within 0.4m during summer conditions and 4m during winter conditions of the point of discharge.

[7] These systems typically result in very small concentrations of metal ions (e.g. copper, iron, aluminium) being introduced into the seawater at levels significantly below predicted no effect concentrations.

Table 9.31 presents the justification for assigning a score of 6, which represents a Medium Event Magnitude.

Table 9.31 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Affects an area less than 4m from source.	1
Frequency	Once.	1
Duration	Discharge will occur continuously through drilling and completion activities.	3
Intensity	Low intensity.	1
Total		**6**



9.4.6.2 Receptor Sensitivity

The MODU cooling water intake velocity will be low and screens installed on the cooling water intake will prevent fish entering the cooling water system. Plankton will, however, be entrained due to their small size. The volume flowrate is however, small compared to the water volume in the immediate surroundings of the MODU.

As noted above in Section 9.4.5.2, for the Istiglal MODU, the area and volume of water within which any potentially harmful exposure might occur, is limited to within 4m from the point of discharge, meaning the discharge plume would be very small in size. The temperature gradient at the edge of the plume is likely to be reasonably abrupt, provoking an avoidance reaction in fish and seals (although the probability of encounter with the plume for either group is very low based on their expected presence and the plume dimensions).

For all plankton, interaction with the plume depends on entrainment from the surrounding water and the process will ensure that individual plankton organisms do not remain in the discharge plume for more than a few tens of seconds.

The cooling water discharge takes place 11.5m below the sea surface and therefore does not have the potential to interact with benthic invertebrates.

Table 9.32 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.32 Receptor Sensitivity (All Receptors)

Parameter	Explanation	Rating
Presence	Exposure is negligible, so resilience is, in effect, high.	1
Resilience	No significant presence of rare, unique or endangered species.	1
Total		**2**

9.4.6.3 Impact Significance

Table 9.33 summarises the impact of cooling water discharges to sea on seals and fish, zooplankton and phytoplankton.

Table 9.33 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
MODU Cooling Water Discharges to Sea	Medium	(Seals/Fish) Low	**Minor Negative**
		(Zooplankton) Low	**Minor Negative**
		(Phytoplankton) Low	**Minor Negative**

The assessment has demonstrated that Minor Negative impacts to seals, fish, zooplankton and phytoplankton are predicted from cooling water intake and discharge. Therefore, no additional mitigation beyond existing control measures is deemed to be necessary.

9.4.7 Other Discharges

Other discharges to sea will result from the operation of the MODU throughout the predrilling programme. These discharges comprise ballast water, treated black water, grey water and drainage (refer to Chapter 5: Section 5.3.1.2).

9.4.7.1 Event Magnitude

Description and Assessment

Other discharges to sea comprise:

- **Ballast Water** – MODU ballasting activities will consist primarily of:
    - Ballasting the drilling rig for transit to the drilling location – minimum draft configuration for towing, so it may involve near shore discharge of some ballast water if the rig has been anchored close to shore prior to mobilisation;
    - Taking on ballast water to increase the draft to the drilling configuration once on site;
    - Occasional uptake and discharge of ballast water during drilling operations; and
    - De-ballasting prior to demobilisation once drilling is completed.

  Taking into account the existing mitigation uptake and discharge are therefore anticipated to have negligible environmental impact.

- **Treated Black Water** – Based on 145 Persons On Board (POB) for the Istiglal and a forecasted generation rate of $0.1m^3$/person/day, it is expected that approximately $14.4m^3$/day of black water will be generated by the MODU during the ACE Project predrilling programme. The flow rate is low, so the effluent will be rapidly diluted close to the point of discharge. The discharge of biologically treated black water offshore, including total suspended solids at the proposed treatment level, does not pose any risk of environmental impact.

- **Grey Water** – Based on the Istiglal POB and a forecasted generation rate of $0.22m^3$/person/day, it is expected that approximately $31.9m^3$/day of grey water will be generated by the MODU during the ACE Project predrilling programme. Grey water will be discharged directly to sea. Grey water (from showers, laundry etc.) will contain primarily dilute cleaning agents (soaps and detergents). Daily visual checks will be undertaken during the discharging process in order to confirm that no floating solids or visible sheen is observable.

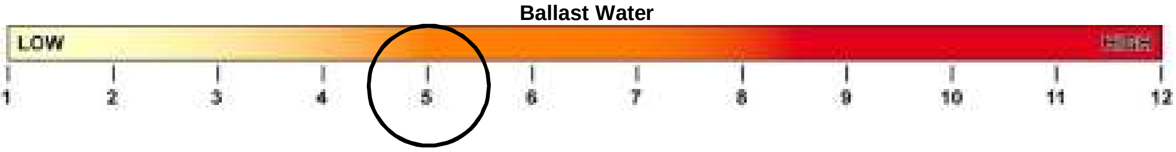
- **Drainage** – Comprises:
    - Deck drainage, washwater and diluted rig floor runoff containing WBM which cannot be returned to the mud system (see Section 9.4.1 above) will be routed to sea; and
    - In the event of a spill, main deck drainage will be diverted to hazardous drainage tank for spills including SOBM/LTMOBM, oil/diesel/cement and oily water. Contents of the tank will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

Event Magnitude is summarised in Table 9.34.

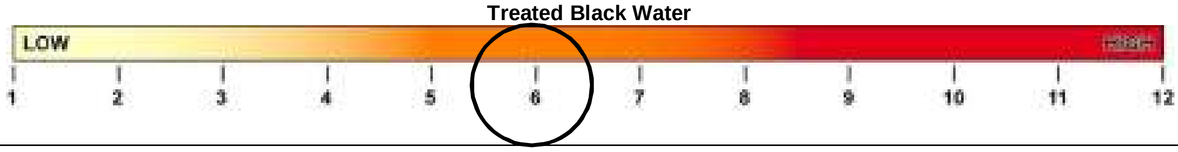
Table 9.34 Event Magnitude

Event Parameter / Discharge	Ballast Water	Treated Black Water	Grey Water	Drainage
Scale	1	1	1	1
Frequency	2	1	1	1
Duration	1	3	3	3
Intensity	1	1	1	1
Event Magnitude	**5**	**6**	**6**	**6**

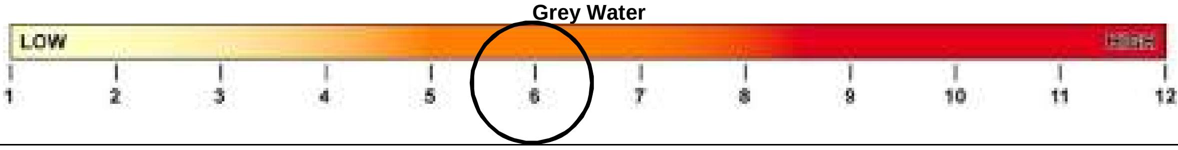
Ballast Water



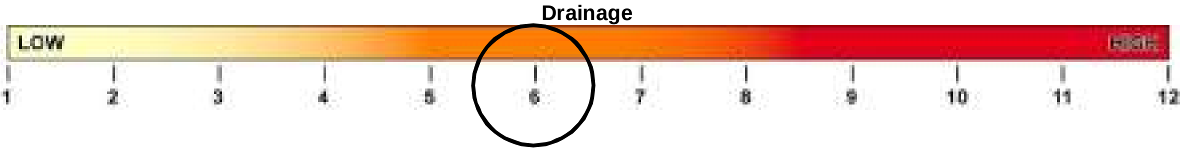
Treated Black Water



Grey Water



Drainage



9.4.7.2 Receptor Sensitivity

All of the discharges are low in volume, do not contain toxic or persistent process chemicals and are considered to pose no threat to the environment or the identified biological/ecological receptors.

Table 9.35 present the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 9.35 Receptor Sensitivity (All Receptors)

Parameter	Explanation	Rating
Presence	The extremely low level of exposure is equivalent to high resilience.	1
Resilience	There is no significant presence of rare, unique or endangered species (i.e. the risk of exposure for any such species is close to zero).	1
Total		**2**

9.4.7.3 Impact Significance

Table 9.36 summarises the impact of other discharges to sensitive marine receptors including seals, fish, zooplankton, phytoplankton and benthic invertebrates.

Table 9.36 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Other Discharges to Sea: **Ballast Water**	Medium	Low	**Minor Negative**
Other Discharges to Sea: **Treated Black Water**	Medium	Low	**Minor Negative**
Other Discharges to Sea: **Grey Water**	Medium	Low	**Minor Negative**
Other Discharges to Sea: **Drainage**	Medium	Low	**Minor Negative**

Monitoring and reporting requirements associated with discharges of black, grey and drainage water and galley waste during MODU drilling activities include:

- **Black Water:**
  - Sewage samples will be taken from the MODU sewage discharge outlet and analysed monthly for total suspended solids, thermotolerant coliforms and BOD to confirm compliance with applicable standards;
  - Daily visual checks will be undertaken when discharging to confirm no floating solids are observable; and
  - Summary of MODU sewage sampling analysis results, recorded floating solids observations and estimated volumes of treated black water discharged daily (based on a generation rate of 0.1m^3 per person per day) will be reported to the MENR on an annual basis.

- **Grey Water:**
  - Daily visual checks undertaken when discharging to confirm no visible sheen is observable; and
  - Daily estimated volumes of grey water discharged from the MODU will be recorded monthly and reported by MODU to the MENR on an annual basis. Estimates will be based on generation rates of 0.22m^3 per person per day (grey water).

- **Galley Waste:**
  - Depending on the availability of the system, food waste generated onboard the Dada Gorgud will either be: sent to vessel maceration units (to particle size less than 25mm) designed to treat food wastes to applicable MARPOL 73/78 Annex V; or disposed in accordance with the existing AGT waste management plans and procedures; or
  - Food waste generated onboard the Istiglal will be contained and shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

These requirements are incorporated into the MODU HSE MS, which is aligned to the AGT Region EMS as described within Chapter 14: Section 14.5 of this ESIA.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

9.5 Summary of the ACE Project Predrilling Activities Residual Environmental Impacts

With regard to the ACE Project predrill activities, it has been concluded that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures. No additional mitigation measures are required.

Table 9.37 summaries the residual environmental impacts for associated with the ACE Project predrill activities.

Table 9.37 Summary of ACE Project Predrill Activities Residual Environmental Impacts

	Event/ Activity	Magnitude				Sensitivity		Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity	Human	Ecological	Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	MODU Power Generation	1	3	3	1	2	2	Medium	Low	Minor Negative
	Support Vessel Engines	1	3	3	1	2	2	Medium	Low	Minor Negative
Marine Environment	Underwater Sound (MODU Drilling)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Underwater Sound (Support Vessels)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Drilling Discharges to Sea	1	2	2	1	-	2	Medium	Low	Minor Negative
	Cement Discharges to Seabed	1	3	1	2	-	2	Medium	Low	Minor Negative
	Cement Unit Wash Out Discharges	1	2	1	2	-	2	Medium	Low	Minor Negative
	BOP Testing	1	3	1	1	-	2	Medium	Low	Minor Negative
	MODU Cooling Water Discharges to Sea	1	1	3	1	-	2	Medium	Low	Minor Negative
	MODU and Vessels Ballast Water Discharge	1	2	1	1	-	2	Medium	Low	Minor Negative
	MODU and Vessels Treated Black Water Discharge	1	1	3	1	-	2	Medium	Low	Minor Negative
	MODU and Vessels Grey Water Discharge	1	1	3	1	-	2	Medium	Low	Minor Negative
	MODU and Vessels Drainage Discharges	1	1	3	1	-	2	Medium	Low	Minor Negative

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10 Construction, Installation and HUC Impact Assessment, Monitoring and Mitigation

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10.1 Introduction

This Chapter of the Azeri Central East (ACE) Project Environmental and Social Impact Assessment (ESIA) presents the assessment of environmental impacts associated with the following ACE phases:

- Onshore Construction and Commissioning of Offshore Facilities;
- Infield Pipeline Installation, Tie-in and Commissioning; and
- Platform Installation, Hook Up and Commissioning (HUC).

The impact assessment methodology followed and the structure of the ACE impact assessment are described in full within Chapters 3 and 9 of this ESIA respectively.

10.2 Scoping Assessment

The ACE Project Construction, Installation and HUC Activities and Events have been determined based on the ACE Project Base Case, as detailed within Chapter 5: Project Description (see Appendix 10A).

Table 10.1 presents the Activities and associated Events that have been scoped out of the full impact assessment process due to their limited potential to result in discernible environmental impacts. Judgement is based on prior experience of similar Activities and Events during earlier Azeri Chirag Gunashli (ACG) developments. In some instances, scoping level quantification/numerical analysis has been used to justify the decision. Reference is made to relevant quantification, analysis, survey and/or monitoring reports in these instances.

Table 10.1 "Scoped Out" ACE Project Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Onshore Construction and Commissioning of Offshore Facilities			
C-R2	Grit blasting / welding and painting of jacket components, piles and pipework	5.4.4	• Grit blasting, welding and painting of jacket components, piles and pipework are required. • The majority of grit blasting and anti-corrosion painting of jacket and pile components will be undertaken in a paint shop with a fume extraction and grit recovery system in place. Grit blasting and anti-corrosion painting of sections which are too large to be accommodated within a paint shop will be undertaken within a temporary enclosure. • Preference to use garnet for grit blasting which is inert, non-hazardous and suitable for disposal under European Union (EU) legislation in a non-hazardous landfill. **Conclusion:** No discernible impact on ecological/biological receptors is expected.
C-R3	Use of treated freshwater to sterilise topside freshwater system	5.4.8.2	• 120 cubic metres (m^3) of freshwater dosed with sodium hypochlorite will be used. Once sterilisation of the topside freshwater system is complete, the water within the system will be neutralised prior to being discharged with the yard cooling water. • No persistent or bio-accumulative chemicals present in the water discharged. **Conclusion:** Limited potential for discernible impact on the marine environment.
C-R6	Construction yard utilities (drainage / sewage)	5.4.10.2	• Sewage will either be treated by a sewage treatment plant at the construction yard(s) or collected onsite and transferred by road tanker or by sewer pipes to a Ministry of Ecology and Natural Resources (MENR) approved sewage treatment plant for treatment and disposal If sewage is treated and discharged from a construction yard, the construction yard contractor will be responsible for agreeing and maintaining the discharge permit for sewage with the MENR.[1] • Contaminated drainage water will be collected and delivered to an appropriate licensed waste management contractor in accordance with existing Azerbaijan Georgia Turkey (AGT) management plans and procedures.[2] • Uncontaminated rainwater will be discharged directly to the onshore/marine environment. **Conclusion:** Discharge of treated sewage from the construction yards will be in accordance with MENR requirements.

[1] Including agreeing discharge standards and maintaining the discharge permit conditions stipulated by the MENR.
[2] Waste management plans and procedures are discussed within Chapter 14.

<table>
<tr><th>ID</th><th>Activity / Event</th><th>Ch. 5 Project Description Reference</th><th>Justification for “Scoping Out”</th></tr>
<tr><td colspan="4">Platform Installation and HUC</td></tr>
<tr><td>C-R9</td><td>Jacket buoyancy tank dewatering</td><td>5.5.2</td><td>• A number of the buoyancy tank compartments fitted to the jacket will be flooded with seawater during jacket installation.
• When jacket installation is completed, the seawater will be released and compartments emptied.
• It is not planned to treat the seawater used to ballast the buoyancy tanks with chemicals.
• No change in composition or temperature of the seawater used is anticipated.
Conclusion: No discernible impact on the marine environment is expected.</td></tr>
<tr><td>C-R10</td><td>Offshore commissioning of the platform foam system</td><td>5.5.4</td><td>• Discharge of approximately 20 litres of aqueous film forming (AFFF) with 140m^3 of seawater via the ACE Production, Drilling and Quarters (PDQ) platform open drains caisson at 48m below sea level.
• The current foam used by the AGT Region is of very low toxicity (LC_{50}* 2.8 grams per litre (g/l) for fish, 34.8g/l for Daphnia)
• Readily degradable (28-day degradation 92%) and no bioaccumulation potential.
• Small volume will disperse in minutes so little potential for acute toxicity in exposed organisms.
• 20 litres of AFFF would require only about 1500m^3 of seawater to dilute to 96h no-effect level (a volume with an approximate radius of 7m).
• The fish most likely to be present for extended periods of time in the ACG Contract Area and at the proposed ACE platform location are kilka and mullet that may be present throughout the year. However, the ACG Contract Area is not exclusively used by these species and the Contract Area is not considered to be of primary importance.
Conclusion: Limited potential for discernible impact on the marine environment.</td></tr>
<tr><td>C-R11</td><td>Offshore commissioning of the platform deluge system</td><td>5.5.4</td><td>• Discharge of 200 litres of seawater from deluge system commissioning to sea.
• Seawater used sourced from the platform seawater system.
• No change in composition or temperature of seawater as a result of commissioning activities.
Conclusion: Limited potential for discernible impact on the marine environment.</td></tr>
<tr><td>C-R12</td><td>Use of temporary generators during offshore commissioning and start up</td><td>5.5.4</td><td>• It is planned to use four 1 megawatt (MW) temporary diesel generators for up to four months during commissioning and start up.
• This is estimated to result in the generation of approximately 20.6 tonnes of nitrogen oxide (NO_X), 1.4 tonnes of carbon monoxide (CO) and 6.1 tonnes of sulphur dioxide (SO_2). These volumes represent approximately 7% of the volumes of emissions released from the Mobile Offshore Drilling Unit (MODU) during the predrilling activities assessed in Chapter 9.
• Chapter 9: Section 9.3.1 demonstrates the emissions from MODU will disperse rapidly in the atmosphere and there will be no discernible impact to onshore receptors. As such, it is anticipated that emissions associated with use of temporary generators during platform commissioning which will be of a smaller volume and released over a shorter duration will also disperse rapidly and have no significant effect.
Conclusion: Limited potential for discernible impact to onshore receptors and to the atmosphere.</td></tr>
<tr><td>C-R13</td><td>Use of installation and HUC vessels and platform installation (seabed disturbance)</td><td rowspan="2">5.6.2.1, 5.6.2.3</td><td rowspan="2">• The presence of the ACE infield pipelines and associated subsea infrastructure have the potential to result in permanent seabed disturbance.
• In total the ACE pipelines and infrastructure will occupy an area of 0.0154 square kilometres (km^2), 0.000004% of the Caspian Sea.
• In practice, it is likely that the majority of the organisms within these areas would be sufficiently mobile to re-establish themselves on either side of the pipelines and subsea infrastructure since this would involve movement of only 30cm to 40cm at most.
• The concrete coating of the pipelines is chemically inert by design and will have no-effect on either the adjacent sediments or water column.
• Temporary seabed disturbance activities include anchoring and chain drag associated with the installation vessels.
• The primary impact associated with anchor setting and chain drag will be the disturbance and displacement of the sediment. The organisms living in the sediment are too small to be crushed by anchors and chain drag, although a small amount of mortality might occur at the point where the anchor initially impacts the seabed.
• The displacement of sediment will not cause significant levels of mortality in benthic organisms. A small proportion of animals may be buried too deeply to recover to a position near the sediment surface, but the majority of organisms will be able to re-establish themselves once the anchor and chain have been moved to their next position.
Conclusion: It is considered that impacts are minimised as far as practicable and no discernible impact to the marine environment due to seabed disturbance.</td></tr>
<tr><td>C-R16</td><td>Permanent presence of the new infield pipelines and the subsea infrastructure</td></tr>
</table>

<table>
<tr><th>ID</th><th>Activity / Event</th><th>Ch. 5 Project Description Reference</th><th>Justification for "Scoping Out"</th></tr>
<tr><td>C-R17</td><td>Topside flaring on East Azeri (EA) and West Azeri (WA) platforms during pipeline installation and tie-in</td><td>5.6.4</td><td>Flaring during brownfield works and tie-in is anticipated for up to 52 days on the East Azeri (EA) platform and up to 8 days on the West Azeri (WA) platform at a rate of up to 120 million standard cubic feet per day (MMscfd).
This is estimated to result in the generation of approximately 188 tonnes of nitrogen oxide (NO_X), 1052 tonnes of carbon monoxide (CO), 2 tonnes of sulphur dioxide (SO_2). These volumes represent approximately 15% of the estimated volumes of emissions released from the ACE platform per year during operational activities as assessed in Chapter 11.
Chapter 11: Section 11.3.2 demonstrates the predicted emissions from ACE operations (including non routine flaring) will disperse rapidly in the atmosphere and there will be no discernible impact to onshore receptors. As such, it is anticipated that emissions associated with flaring from the EA and WA platforms will also disperse rapidly and have no significant effect.
Additionally flaring associated with the EA and WA platforms was included within the assessments presented within the ACG Phase 2 ESIA, which confirmed no exceedances of the relevant air quality standards at onshore receptors.
The periods of flaring on the EA and WA platforms will be minimised as far as practicable while allowing the modifications and tie-in activities associated with the ACE Project to be undertaken safely.
Conclusion: Limited potential for discernible impact to onshore receptors and to the atmosphere.</td></tr>
<tr><td>C-R19</td><td>Emptying and flushing EA J-tube</td><td>5.5.5</td><td>Tie-in activities will require the use of a currently unused and sealed pipe (termed a J-tube) on the EA platform.
The J-tube currently contains treated seawater (approximately 17m^3) introduced when the platform was constructed to provide corrosion protection.
Prior to unsealing both ends of the J-tube, a sample will be taken and analysed to confirm composition and ecotoxicity, and a risk assessment completed to confirm potential impacts to the marine environment associated with discharge to sea. Depending on the outcome of the risk assessment the contents of the J-tube will either be discharged to sea or recovered to the topside, contained and shipped to shore for disposal.
Once emptied it is then planned to flush the pipe casing twice using seawater treated with Hydrosure HD5000 at a dose of 1000 parts per million (ppm) (i.e. the same product and dosage planned to be used during cleaning and hydrotesting of the new infield pipelines - refer to Chapter 5: Section 5.6.2.2).
Conclusion: Through the implementation of the existing control measures above no discernible impact on the marine environment is expected.</td></tr>
<tr><td>C-R20</td><td>Cleaning of existing water injection pipeline between EA and Central Azeri (CA) platforms</td><td>5.6.2.4</td><td>Depending on the condition of the water injection pipeline between EA and CA, pigging may be undertaken prior to tie-in activities using seawater containing scale inhibitor. It is planned that a scale inhibitor chemical of the same dosage and environmental performance as used previously for similar activities within the ACG Contract Area will be used.
The ecotoxicity results for seawater containing the currently selected scale inhibitor chemical at the selected dosage (Scale Inhibitor SA960 @20ppm) gave 48h EC_{50}** and 72h EC_{50} Phytoplankton and Zooplankton results of greater than greater than 100%, which is equivalent to seawater containing no chemical additives.
The discharge of seawater containing scale inhibitor is therefore anticipated to have no impact to the water column.
If there is a requirement to select different scale inhibitor chemicals for commercial or technical reasons, the ESIA Management of Change Process (see Chapter 5: Section 5.13) will be followed.
Conclusion: No impact to the marine environment anticipated.</td></tr>
<tr><td colspan="4">All Construction, Installation and HUC Activities</td></tr>
<tr><td>ALL-C-R1</td><td>Waste Generation</td><td>5.11.2</td><td>Waste generated during ACE Project construction, installation and HUC activities will be consistent with the type and quantity that have been routinely generated during previous construction works.
Waste at the construction yards and onboard the installation and HUC vessels will be segregated at source, stored and transported in fit for purpose containers.
All waste generated during onshore platform and subsea infrastructure construction and commissioning activities will be managed in accordance with the existing AGT management plans and procedures.
Waste minimisation and management plans will be established for the construction, installation and HUC phase and all waste transfers controlled and documented.
Conclusion: Waste generated during the ACE Project will be managed as described within Chapter 14. No discernible impacts expected.</td></tr>
<tr><td colspan="4">Notes: *LC_{50}: Lethal Concentration 50: estimated concentration of a substance required to cause death in 50% of the test organisms in a specified time period. **EC_{50}: Statistical estimate of the toxicant concentration that has an adverse effect on 50% of the test organisms after a specific exposure time.</td></tr>
</table>

The ACE Project routine and non routine Activities and their associated Events that have been assessed with the full impact assessment process are presented in Table 10.2.

Table 10.2 "Assessed" ACE Project Construction, Installation and HUC Activities

ID	Activity	Ch. 5 Project Description Reference	Event	Receptor
C-R1	Use of yard plant (generators and engines) during jacket, topside and subsea equipment fabrication and commissioning	5.4.10.1	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (noise)
C-R4	Use of temporary yard cooling water system during platform commissioning	5.4.8.1	Cooling water discharges to sea	Marine Environment (water column and seabed)
C-R5	Commissioning of main platform generators and topside utilities onshore	5.4.8.3	Emissions to atmosphere (non GHG)	Atmosphere
			Onshore noise	Terrestrial Environment (noise)
C-R7	Use of vessels for jacket and topside installation e.g. DBA, STB-1 Barge	5.4.9	Emissions to atmosphere (non GHG)	Atmosphere
			Underwater noise and vibration	Marine Environment (water column and seabed)
			Ballast water	
			Treated black water	
			Grey water	
			Drainage	
C-R8	Installation of jacket pin and skirt piles and grouting	5.5.2	Underwater noise and vibration	Marine Environment (water column and seabed)
			Seabed disturbance	
C-R13	Use of vessels during offshore pipelay of infield pipelines, ACE-EA cable and subsea infrastructure installation	5.5.6	Emissions to atmosphere (non GHG)	Atmosphere
			Underwater noise and vibration	Marine Environment (water column and seabed)
			Ballast water	
			Treated black water	
			Grey water	
			Drainage	
C-R14	Installation and tie-in of spools and subsea infrastructure	5.6.2	Discharge of chemically treated seawater to sea	Marine Environment (water column and seabed)
C-R15	Cleaning and pre-commissioning associated with new infield pipelines	5.6.2.4	Discharge of chemically treated seawater to sea (dosed)	
			Discharges of MEG	
C-R18	Use of vessels during brownfield modifications	5.5.6	Emissions to atmosphere (non GHG)	Atmosphere
			Underwater noise and vibration	Marine Environment (water column and seabed)
			Ballast water	
			Treated black water	
			Grey water	
			Drainage	

10.3 Impacts to the Atmosphere

Non greenhouse gas (GHG) emissions to the atmosphere from construction, installation and HUC activities will be associated with construction plant and vehicles, emissions from commissioning of the ACE offshore facilities at the construction yards and use of vessels. GHG emissions associated with the ACE Project are discussed within Chapter 13 of this ESIA. This section focuses on the assessment of potential air quality impacts.

10.3.1 Mitigation

Existing controls associated with emissions from construction, installation and HUC activities include:

- Construction plant and vehicles will be well maintained in accordance with the written procedures based on manufacturer's guidelines, applicable industry code, or engineering standard to ensure efficient and reliable operation;
- Where practicable, mains electricity will be used instead of mobile generators as a power source;
- Diesel supplied to the construction plant and vehicles will be low in sulphur; and
- Community disturbance management and engagement plans (refer to Chapter 14: Section 14.3) will be implemented and maintained as a mechanism of communicating with the community and responding to community grievances at the selected yard(s) except Baku Deep Water Jacket Factory (BDJF) (where there are no nearby residential receptors).

10.3.2 Construction Yard Emissions

10.3.2.1 Event Magnitude

Description

Construction Yard Plant and Vehicles

As stated within Chapter 5: Section 5.4, the ACE-PDQ jacket pin piles, topside, jacket and drilling module will be constructed at a combination of established construction yards. At present, the options that are being considered for the construction and commissioning of the ACE-PDQ topside (including the drilling support module), jacket and infield pipelines include the BDJF yard, construction yards located on the western fringe of the Bibiheybat oil field and the pipe coating and storage yard.

At each yard, the majority of power required for construction activities such as steel cutting, rolling and shaping will be provided from the Azerbaijan national grid. Onsite plant and equipment used including cranes, generators and vehicles, will consume diesel and gasoline, resulting in emissions to atmosphere (refer to Appendix 5A).

Onshore Commissioning of Main Platform Generators and Topside Utilities

As stated within Chapter 5: Section 5.4.8.3, all topside utilities will be commissioned at the topside construction yard over a 12 month period. Onshore commissioning using diesel is planned to include:

- The main platform dual fuel generator, run intermittently for a week, for up to 8 hours a day at a maximum load of approximately 26%, intermittently for approximately 6 months;
- Running the compression generator intermittently over an approximate 2-3 week period for up to an hour; and
- Commissioning the diesel powered emergency generator, firewater pump engines and platform pedestal cranes.

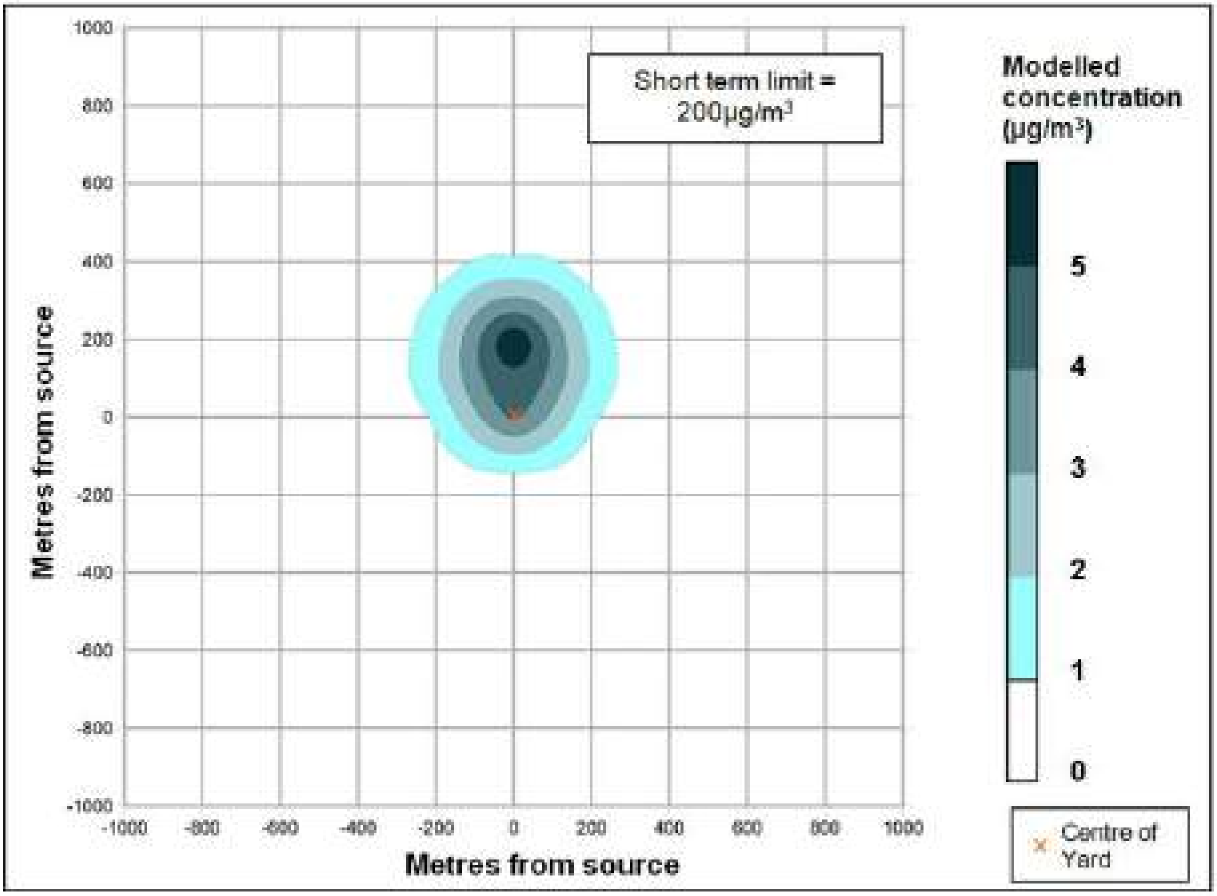
Assessment

A dispersion modelling screening assessment was undertaken to assess the potential magnitude of impacts from the construction yard emissions to any nearby receptors (see Appendix 10B). The assessment considered nitrogen dioxide (NO_2) emissions, comparing the short term and long term average modelled concentrations at ground level to the long term and short term standards for NO_2 (40 and 200 micrograms per cubic metre ($\mu g/m^3$)). Short and long term background concentrations of NO_2 were assumed to be $12\mu g/m^3$ and $24\mu g/m^3$ respectively.

Construction Yard Plant and Vehicles

The worst case modelling results demonstrated that construction plant emissions are predicted to result in a maximum increase in short term ground level NO_2 concentration of $3\mu g/m^3$ at the centre of the yard. This reduces to $1.5\mu g/m^3$ at 250m distance and returns to background concentrations at distances over 400m under high wind speeds (15 metres per second (m/s)) (Figure 10.1 below).

Figure 10.1 Maximum Short Term Ground Level NO_2 Concentration (µg/m^3) At Distance from Centre of Yard (High Wind Speed Conditions)



For typical wind speeds conditions (5m/s) the increase in NO_2 concentration is predicted to be approximately 6µg/m^3 up to 30m from the centre of the yard, reducing to background concentrations at a distance over 200m from the yard boundary. The modelling indicates that, at 1km from the construction yards, where the nearest residential receptors are located there will be no measurable increases in NO_2 concentrations as a result of the ACE Project construction yard activities and thus for all wind conditions assessed, no exceedances of ambient air quality standards at residential receptors are anticipated.

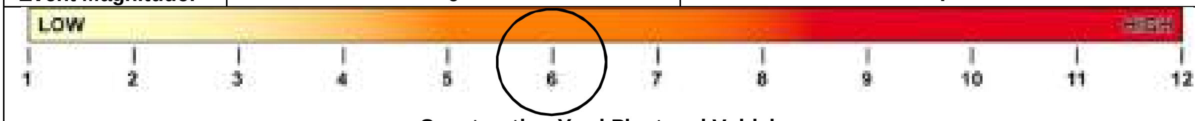
Onshore Commissioning of Main Platform Generators and Topside Utilities

The maximum increase in NO_X concentrations during onshore commissioning were predicted to be between 15-20µg/m^3, at a distance of approximately 500m to 1.5km from the emission source. It is assumed that 50% of short term NO_X is converted into NO_2, thus emissions from the main generator at full load are predicted to lead to a maximum increase in 1 hour ground level NO_2 concentration of 7.5 to 10µg/m^3 which represents approximately 5% of the short term ambient NO_2 limit of 200µg/m^3. Short term background concentrations in the vicinity of the yards are estimated to be between 22 and 76µg/m^3 (refer to Appendix 10B). The worst case estimated NO_2 concentration at 500m to 1.5km from the emission source is therefore predicted to be up to 96µg/m^3. Under all conditions modelled, concentrations of NO_2 are not expected to exceed the applicable short term standard for NO_2 of 200µg/m^3.

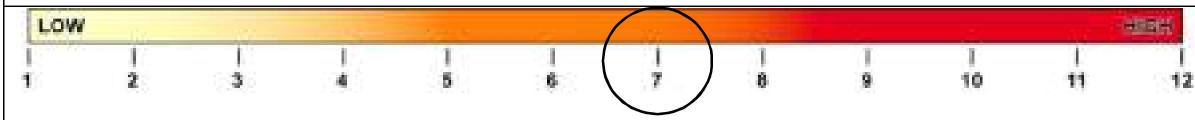
Table 10.3 presents the justification for assigning a score of 6 for construction yard emissions and 7 for yard commissioning emissions, which represents a Medium Event Magnitude.

Table 10.3 Event Magnitude

Event Parameter	Construction Yard Plant and Vehicles	Onshore Commissioning of Main Platform Generator and Topside Utilities
Extent/Scale	1	1
Frequency	1	3
Duration	3	2
Intensity	1	1
Event Magnitude:	**6**	**7**



Construction Yard Plant and Vehicles



Onshore Commissioning of Main Platform Generator and Topside Utilities

10.3.2.2 Receptor Sensitivity

All candidate construction yards are currently operational, are located within an industrial setting and have been used previously for ACG/SD construction works. Residential properties are not located within close proximity (no residents within 1km) to the construction yard site boundaries.

Table 10.4 presents the justification for assigning a score of 2 to human receptors, which represents Low Receptor Sensitivity.

Table 10.4 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	All construction yards are located in established industrial areas and there are no residential areas within close proximity of the construction yard site boundaries.	1
Resilience	Modelling results have confirmed that emissions from construction yard sources will not exceed air quality limit values and local receptors are not considered to be vulnerable.	1
Total		**2**

10.3.2.3 Impact Significance

Table 10.5 summarises impacts on air quality associated with yard plant emissions during the construction, installation and HUC phase.

Table 10.5 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Construction Yard Plant and Vehicles	Medium	Low	**Minor Negative**
Onshore Commissioning of Main Platform Generator and Topside Utilities	Medium	Low	**Minor Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

10.3.3 Vessel Emissions

10.3.3.1 Event Magnitude

Description

As stated within Chapter 5: Section 5.5.6 and 5.6.2, a number of vessels will be used during the construction, installation and HUC phase to support the installation of the jacket pin and skirt piles, jacket, topside, infield pipelines and associated subsea infrastructure within the Contract Area.

Assessment

The primary atmospheric pollutant of concern is NO_X, which comprises nitrous oxide (NO) and NO_2. This is based on the larger predicted emission volumes as compared to other pollutants (sulphur oxides or SOx, CO and non-methane hydrocarbons) and the potential to impact human health and the environment. NO_X emissions from vessels used during construction, installation and HUC activities are anticipated to total approximately 1341 tonnes. These will occur throughout the installation and HUC activities which take place across a large geographic area. They are expected to disperse rapidly and will result in increases in NO_2 concentrations that will be indiscernible from background levels at onshore receptors.

Based on efficient operation, regular maintenance, planned use of good quality, low sulphur fuel and previous experience, routine operation of the vessels will not result in plumes of visible particulates from vessel engine exhausts. Table 10.6 presents the justification for assigning a score of 6 to vessel activities during installation and HUC, which represents a Medium Event Magnitude.

Table 10.6 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Increases in concentrations of pollutant species will be indiscernible from background concentrations at onshore receptors.	1
Frequency	Emissions will occur continuously throughout the installation and HUC period.	1
Duration	Emissions will continue for a period of approximately 20 months.	3
Intensity	Long and short term concentrations of key pollutant, NO_2, are predicted to be significantly below relevant ambient air quality standards.	1
Total		**6**

10.3.3.2 Receptor Sensitivity

Table 10.7 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 10.7 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	There are no permanently present (i.e. resident) human receptors within 50km of the installation activities.	1
Resilience	Changes in air quality onshore associated with vessel emissions will be indiscernible. Onshore receptors will be unaffected.	1
Total		**2**

10.3.3.3 Impact Significance

Table 10.8 summarises impacts on air quality associated with support vessels during the installation and HUC phase.

Table 10.8 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Vessel Engines	Medium	Low	**Minor Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

10.4 Impacts to the Terrestrial Environment (Noise)

10.4.1 Mitigation

Existing controls associated with noise due to the operation of onsite construction plant and vehicles and construction activities within the construction yards include:

- Onshore construction plant and vehicles will be operated and maintained in accordance with written procedures based on the manufacturer's guidelines, applicable industry code, or engineering standards to ensure efficient and reliable operation;
- The main platform generator incorporates appropriate noise reduction measures[3] and is housed in a generator room/sound reduction enclosure to safeguard the health and safety of personnel on the platform;
- The platform main generator and compression generator are operated for a minimum duration to complete commissioning and will have lagging fitted for health and safety purposes;
- Where practicable, mains electricity will be used instead of mobile generators as a power source;
- Steel works are planned to be undertaken in fabrication sheds, where practicable and feasible;
- Grit blasting is planned to be undertaken in sheds or within enclosures where practical; and
- Community disturbance management and engagement plans (refer to Chapter 14: Section 14.3) will be implemented and maintained as a mechanism of communicating with the community and responding to community grievances at the selected yard(s) except BDJF (where there are no nearby residential receptors).

10.4.2 Construction Yard Noise

10.4.2.1 Event Magnitude

Description

Noise at the selected construction yard(s) during the construction and commissioning phase will arise from the use of plant and machinery to undertake steel rolling, cutting and shaping, welding, grit blasting and the movement of materials around the site(s) by vehicles/cranes. The anticipated use of mobile plant is calculated based on historic records from yards used during ACG and SD jacket and topside construction.

Onshore commissioning of the main platform generators and topside utilities will also be undertaken at the topside yard as described within Section 10.3.2.1 above.

[3] Measures include fitting of a suitable splitter silencer to the gas turbine combustion air intake vent and exhaust systems.

Assessment

Construction Yard Plant and Vehicles

A noise modelling assessment was undertaken to determine the potential magnitude of impacts from onshore construction noise to any nearby receptors (see Appendix 10C).

Using reasonable worst case assumptions regarding plant and operating times across the construction period, predictions of potential noise impact from the construction activities at increasing distances from the source were undertaken and compared to the daytime and night time limit values of 65dB L_{Aeq} and 45dB L_{Aeq} respectively.

The noise screening afforded by the buildings and perimeter fencing around each of the yards was assumed conservatively to provide 5dBA of attenuation. No account was taken for current operations at the construction yards.

The modelling demonstrated that 40m from the noise source, the daytime limit of 65dB will be met and at 400m, the night time limit of 45dB L_{Aeq} will be met. These limits are applicable to residential dwellings, where people are normally present. The modelling predicted no exceedances of the relevant noise limits at a distance of 400m or more from noise sources at the construction yard.

Onshore Commissioning of Main Platform Generators and Topside Utilities

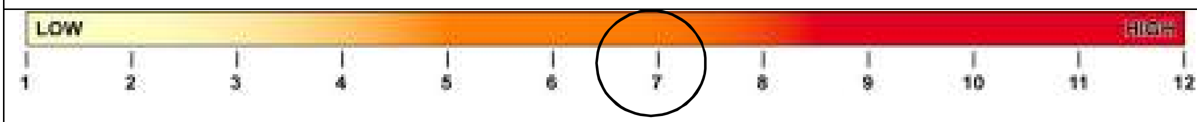
Noise modelling was undertaken to determine the likely magnitude of noise impacts from the operation of the main platform generator at the selected topside yard to any nearby receptors (see Appendix 10C). Worst case impacts were considered based on the operation of the main dual fuel generator running for 8 hours. The results demonstrated that predicted noise levels will meet the most stringent limit (night time limit of 45dB L_{Aeq}) at distances greater than 500m.

Event Magnitude is summarised in Table 10.9.

Table 10.9 Event Magnitude

Event Parameter	Construction Yard Plant and Vehicles	Onshore Commissioning of Main Platform Generator and Topside Utilities
Extent/Scale	1	3
Frequency	1	2
Duration	3	1
Intensity	1	1
Event Magnitude:	**6**	**7**

Construction Yard Plant and Vehicles



Onshore Commissioning of Main Platform Generator and Topside Utilities

10.4.2.2 Receptor Sensitivity

All of the candidate construction yards are currently operational, located within an industrial setting and have been used previously for ACG/SD construction works.

Table 10.10 presents the justification for assigning a score of 2 to human receptors, which represents Low Receptor Sensitivity.

Table 10.10 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	All construction yards are located in established industrial areas and there are no residential areas within close proximity of the construction yards site boundaries.	1
Resilience	Local receptors are not considered to be vulnerable to construction yard plant and machinery noise associated with the ACE Project, given the existing operations at the yard and in the immediate yard vicinity.	1
Total		**2**

10.4.2.3 Impact Significance

Table 10.11 summarises impacts to human receptors from noise due to construction yard plant operations and platform generator commissioning.

Table 10.11 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Construction yard plant	Medium	Low	**Minor Negative**
Platform commissioning and topside utilities	Medium	Low	**Minor Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is necessary.

10.5 Impacts to the Marine Environment

10.5.1 Mitigation

Existing controls related to impacts in the nearshore/coastal environment include:

- The cooling water system will be designed to meet a temperature specification for the discharge at the edge of the mixing zone, or 100m if a mixing zone is not defined, no greater than 3 degrees Celsius (ºC) more than the ambient water temperature; and
- Neutralising agent dosing will be controlled and checked to ensure neutralisation is effective and residual chlorine content is maintained at less than 1mg/l in the construction yard cooling water discharge.

Existing controls associated with ACE Project pipelines and subsea infrastructure HUC pre-commissioning discharges include:

- Water used during pipeline cleaning and pre-commissioning and subsea infrastructure installation will be dosed with chemicals which are not persistent in the marine environment and have been approved for use by the MENR.

Existing controls associated with cement discharges include:

- Cementing chemicals are of low toxicity (UK OCNS “Gold” and “E” categories or equivalent toxicity to those chemicals previously approved for use);
- Cement is designed to set in a marine environment preventing widespread dispersion; and
- The volume of cement used to cement the jacket skirt piles into position is calculated prior to the start of the activity. Sufficient cement is used to ensure that the piles are cemented securely while minimising excess cement discharges to the sea.

Existing controls associated with other vessel discharges include the following:

- Depending on the availability of the system, black water will either be:

- Treated within the vessel sewage treatment system to either:
  - MARPOL 73/78 Annex IV: Prevention of Pollution by Sewage from Ships standards: Five day Biological Oxygen Demand (BOD) ≤50mg/l, total suspended solids ≤50mg/l (in lab) or ≤100mg/l (on board) and thermotolerant coliform ≤250MPN (most probable number) per 100 ml. Residual chlorine as low as practicable where chlorine is added (for vessel STP plants installed prior to January 2010); or
  - MARPOL 73/78 Annex IV MEPC. 159 (55) standards: Five day BOD ≤25mg/l, Chemical Oxygen Demand (COD) ≤125 mg/l, total suspended solids ≤35mg/l, pH between 6 and 8.5 and thermotolerant coliform 100MPN per 100ml. Where chlorine is added, residual chlorine in the effluent to achieve below 0.5mg/l (for vessels STP plants installed after January 2010).
- Under non routine conditions when the sewage treatment system is not available black water will be managed in accordance with the existing AGT plans and procedures and reported to the MENR as required.
- Sewage sludge will be shipped to shore for disposal in accordance with the existing AGT waste management plans and procedures.

* Depending on the availability of the system, galley food waste will either be:
  - Contained and shipped to shore for disposal; or
  - Sent to vessel maceration units designed to treat food wastes to applicable MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships particle size standards prior to discharge.
* Vessel ballast tanks are designed to ensure that oil and chemicals do not come into contact with ballast water;
* Deck drainage and wash water will be discharged to sea as long as no visible sheen is observable; and
* Support vessels will be subject to periodic performance reviews, the scope of which includes environmental performance indicators[4].

Existing control measures associated with underwater noise and vibration from piling and vessels include:

* For the vessels undertaking piling activities, the relevant nominated vessel crew will be trained in marine mammal observations (MMOs);
* The Project will establish a Mitigation Buffer Zone of 500m from the centre of the piling sound sources for visual observations of Caspian seals during daylight hours;
* When the piling vessel is on site, the MMO observer will begin seal observations during the period when the pile is being prepared. An Acoustic Deterrent Device (ADD) (specifically set for the hearing range of pinniped seals) will be activated, gradually increasing to full intensity to allow any nearby seals to exit the Mitigation Buffer Zone, 30 minutes prior to the start of the impact piling. When piling starts the ADD should be turned off. The MMO should continue observations for the entire piling period to ensure accurate records are maintained;
* If piling activity stops for less than 30 minutes for any reason the ADD should be immediately activated. For planned pauses of greater than 30 minutes the device shall be switched on 30 minutes prior to re-commencement of piling as outlined above to allow any nearby seals to exit the Mitigation Buffer Zone. The ADD is to be stopped once piling re-commences;
* When piling during daylight hours, trained vessel crew will conduct ongoing visual observations of Caspian seal in the vicinity of the vessel undertaking piling activities. All observations will be logged including location of sighting and number of individuals seen. Daily and final summary reports will be prepared;
* No project vessels will intentionally approach seals for the purposes of casual (recreational) marine mammal viewing which may result in disturbance; and
* Support vessels are subject to periodical performance review, which includes environmental performance[4]. Corrective actions will be undertaken to address any performance gaps.

[4] The scope of environmental performance reviews are expected to include, but may not be limited to, the following: energy efficiency and diesel usage, sulphur content of diesel used, ballast water management, waste management, sewage treatment plant operation and management of bilge water.

10.5.2 Construction Yard Cooling Water Discharge

10.5.2.1 Event Magnitude

Description

As outlined in Section 5.4.8.1, the seawater system will be designed to operate at a flow rate of approximately 575m^3/hr for a period of up to 6 to 9 months and will be of a similar design to that approved for previous ACG projects. A cooling water system will ensure that the cooling water mixing zone will be not be greater than 3ºC more than the ambient water temperature.

The base case treatment package used for the temporary cooling water system to inhibit biological growth and corrosion within the seawater system will comprise a continuous dosing system, which involves injection of sodium hypochlorite into the abstracted seawater at a concentration of 2mg/l. Prior to discharging the cooling water, a neutralising agent (sodium thiosulphate) will be added. Neutralisation agent dosing will be controlled and checked to ensure neutralisation is effective and residual chlorine content is maintained at less than 1mg/l.

Assessment

Dispersion modelling was carried out to assess the distance within which the cooling water plume would exceed a temperature of more than 3ºC above ambient. Modelling was undertaken assuming a temperature difference between the intake and discharge flows of 50ºC (worst case) and 10ºC (typical case). The modelling showed that for worst case 50ºC temperature difference the cooling water plume would reach 3ºC above ambient within 4m from the point of discharge. For the typical 10ºC scenario modelling showed the cooling water plume reach 3ºC above ambient within 0.5m of the discharge.

Figure 10.2 illustrates the extent of the cooling plume for the worst case 50ºC temperature difference scenario.

Figure 10.2 Predicted Cooling Water Plume Temperature Above Ambient at Distance from Discharge (50ºC Temperature Difference Scenario)

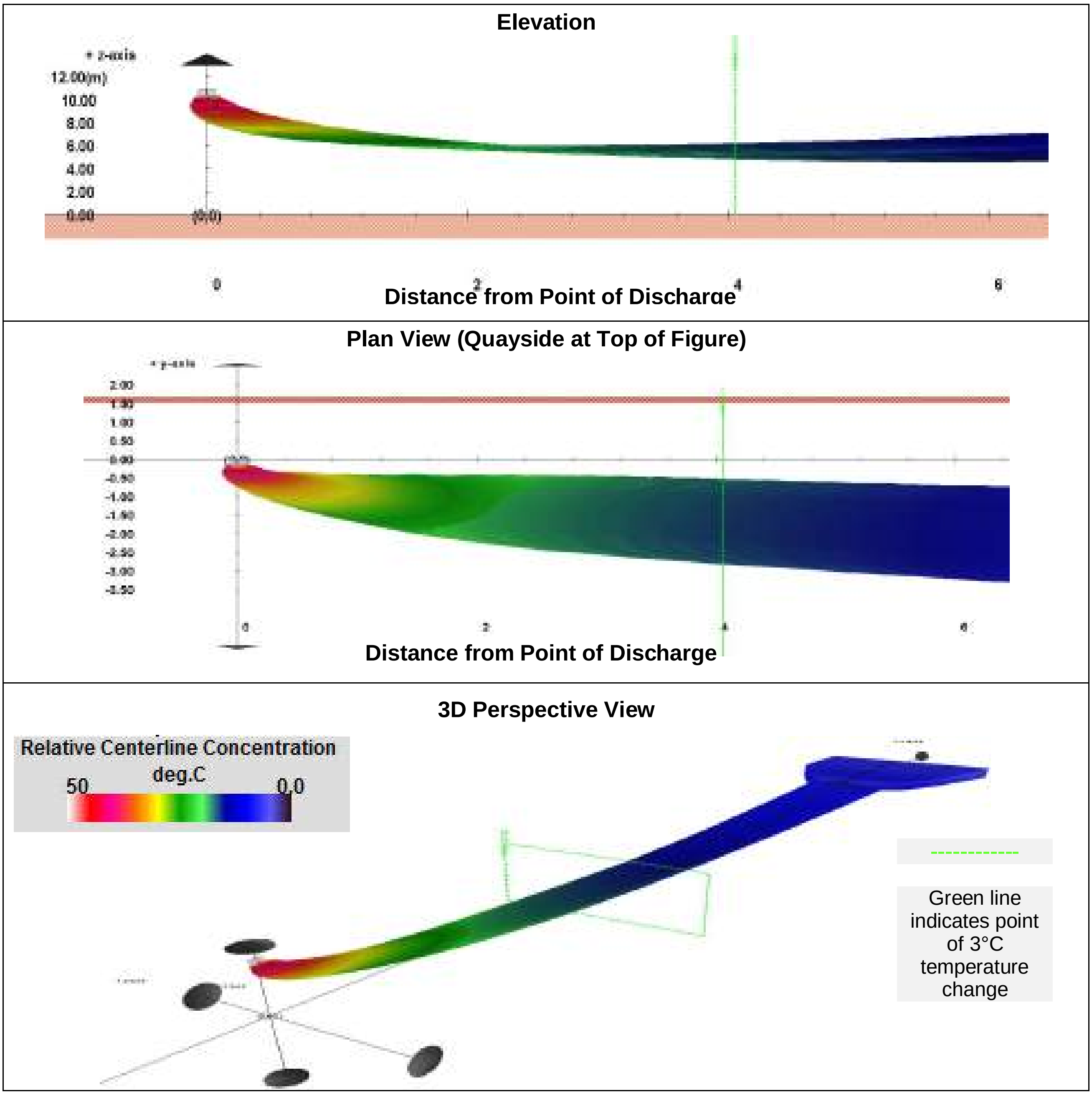
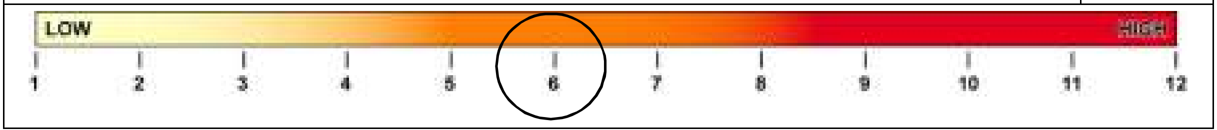


Table 10.12 presents the Event Magnitude for construction yard cooling water discharge. A Medium level Event Magnitude is assigned.

Table 10.12 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Cooling water discharges will be diluted to an acceptable level within 4m of the point of discharge.	1
Frequency	Discharge of cooling water will take place continuously.	1
Duration	The discharge will be continuous for approximately 6-9 months during topside commissioning.	3
Intensity	Discharges will be consistent with project standards and with previously approved practices and will contain no harmful persistent materials.	1
Total		**6**



10.5.2.2 Receptor Sensitivity

The discharge will take place close to the quayside adjacent to a construction yard in an industrial setting.

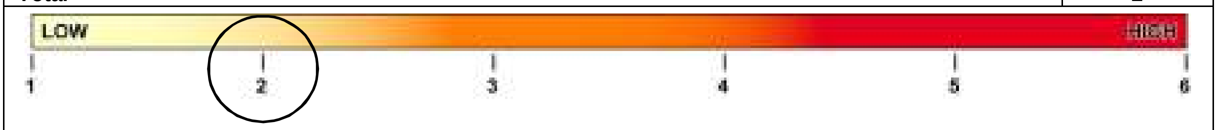
Due to the location of the construction yards within heavily industrialised areas, the presence of seals or threatened species of fish is extremely unlikely. The benthos of the coastal zone is largely dominated by pollution-tolerant invasive species, with few native species present. No plankton studies have been carried out near the construction yards, but it is probable that species diversity is lower than in open waters; and that communities will tend to be dominated by organisms which are tolerant of, or can competitively exploit water, which will often be of poorer quality than open coastal water.

In summary, no sensitive, rare or threatened species are anticipated to be present in the vicinity of construction yards, and the species most likely to be present and dominant will be those most tolerant of the discharges and emissions historically associated with shipping and industrial activity.

Table 10.13 presents the biological/ecological Receptor Sensitivity.

Table 10.13 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Seals and fish are not expected to be present consistently or in significant numbers near the discharge source. No significant exposure of benthos or plankton.	1
Resilience	The species likely to dominate in the area of the construction yards are expected to be predominantly invasive species with a high tolerance to anthropogenic impacts.	1
Total		**2**



10.5.2.3 Impact Significance

Table 10.14 summarises impacts to biological/ecological receptors from construction yard onshore topside commissioning cooling water discharge.

Table 10.14 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Cooling water discharge from onshore construction yard	Medium	Low	Minor Negative

The following monitoring and reporting requirements related to construction yard cooling water discharge will form part of the BP ACE Project Construction Phase Environmental and Social Management System (ESMS) described in Chapter 14:

- Neutralising agent flow and dose pump records will be maintained during construction yard cooling water discharge;
- Weekly sampling and analysis of the residual chlorine content of the construction yard cooling water discharge will be undertaken; and
- Flow and dose pump records and weekly chlorine content sampling results will be managed by the construction contractor during construction yard cooling water discharge.

It is considered that the impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

10.5.3 ACE Pipeline and Subsea Infrastructure HUC Discharges

10.5.3.1 Event Magnitude

ACE Pipeline Cleaning and Pre-Commissioning Discharges (Treated Seawater)

Description

As described within Chapter 5: Sections 5.6.2.2 and 5.6.2.4, following installation, a series of activities will be undertaken to clean, gauge and hydrotest the new ACE Project infield gas, oil and water injection pipelines prior to dewatering, in addition to a number of cleaning activities associated with existing pipelines prior to tie-in. These activities will involve the use of treated seawater. It is intended to use chemicals for this purpose that are of the same or equivalent environmental performance to those currently used and approved within the region. The following Base Case chemicals, at the indicated dosage rates, are currently planned to be used for these activities:

- 1000 parts per million (ppm) Hydrosure HD5000 (combined biocide, corrosion inhibitor and oxygen scavenger); and
- 100ppm Tros Seadye (dye).

A summary of the expected volume and location of treated seawater discharges associated with the ACE Project infield pipeline pre-commissioning activities is presented in Chapter 5: Table 5.25.

Discharges during pre-commissioning will be from either a temporary pig trap on the seabed adjacent to the ACE platform; via the ACE, CA or EA seawater caissons at a depths of 48m, 44m and 50m below sea level (BSL) respectively, from the CA-PDQ open drains caisson at a depth of 48m BSL, from the new subsea isolation valve (SSIV), at the EA riser base (1m above seabed) or via a hose from the Diving Support Vessel (DSV).

Up to approximately 42 separate discharge events (including up to 6 contingency events) ranging from 2m^3 (discharge from leak testing of small sections during oil pipeline tie-in) to 2545m^3 (discharge from existing 22” gas export pipeline during cleaning and gauging, baseline surveys and dewatering) are expected to take place over a year. In addition, the tubing on the EA and ACE jackets (comprising “J-tubes” and risers) that the subsea infrastructure will tie-into will also filled with treated seawater dosed as described above, which will be discharged, resulting in up to 10 discharges of between 17m^3 and 66m^3 just above the seabed at the EA and ACE platform locations.

Assessment

The potential environmental impact of the treated seawater (including preservation chemicals) discharges was assessed by:

- Conducting toxicity tests (OSPAR methodology) on seawater dosed with the Tros and Hydrosure products at the levels specified above; and
- Conducting dispersion modelling (DREAM (Dose-related Risk Effects Assessment Model)) on a range of scenarios representing the range and type of discharges.

Ecotoxicity values were expressed as a percentage of preservation chemicals in seawater. Tests were conducted with both phytoplankton (*Skeletonema costatum*) and zooplankton (*Acartia tonsa*), and the lowest LC/EC_{50} (representing greatest sensitivity) from these tests was selected as the basis for assessing environmental impact. The concentration corresponding to a 'no-effect' level was estimated by applying a safety factor of 10 (appropriate for short-duration discharges) to the selected value; for the purposes of modelling, the 'no-effect' concentrations were then expressed as a minimum dilution factor (refer to Table 10.15 – lowest value and minimum dilution are highlighted).

Table 10.15 EC/LC_{50} Values and No-Effect Dilution Factors for the ACE Pipeline Preservation Product

Hydrosure HD5000	Replicate	LC/EC_{50} (% treated water in seawater)	
		Acartia	Skeletonema
	1	0.14	0.12
	2	0.12	0.15
	Ave.	**0.13**	**0.135**
No-Effect Dilution Factor		**7,692**	**7,407**

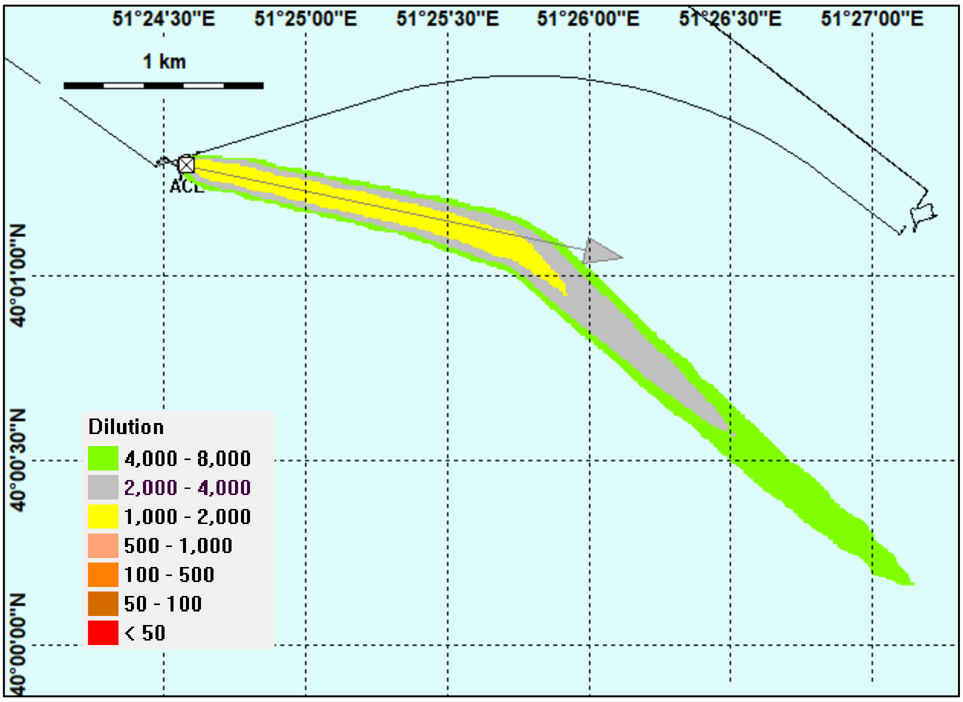
A total of 9 discharge scenarios were modelled, each covering dilution factors up to 8,000-fold (refer to Appendix 11C). The results of three scenarios, representing small, medium-sized and large discharges, are presented in Figures 10.3 to 10.6. Table 10.16 summarises these scenarios.

Table 10.16 Summary of Small, Medium and Large Discharge Scenarios

Operation	Scenario	Pipeline	Discharge Volume (m^3)	Discharge Duration per Discharge (hr)	Port Diameter (m)	Depth BSL (m)	Location
Dewatering EA to CA-CWP	2	Existing 22" Gas Pipeline	2545	5.4	1.5	44m	CA-CWP seawater discharge caisson
Dewatering New Wye to ACE	3	New 18" Gas Pipeline	830	3.2	1.1	48m	ACE seawater caisson
Flood, Clean and Gauge	4	New 30" Oil Pipeline	530	0.72 -1.4	0.1	136m	Temporary pig receiver at ACE location

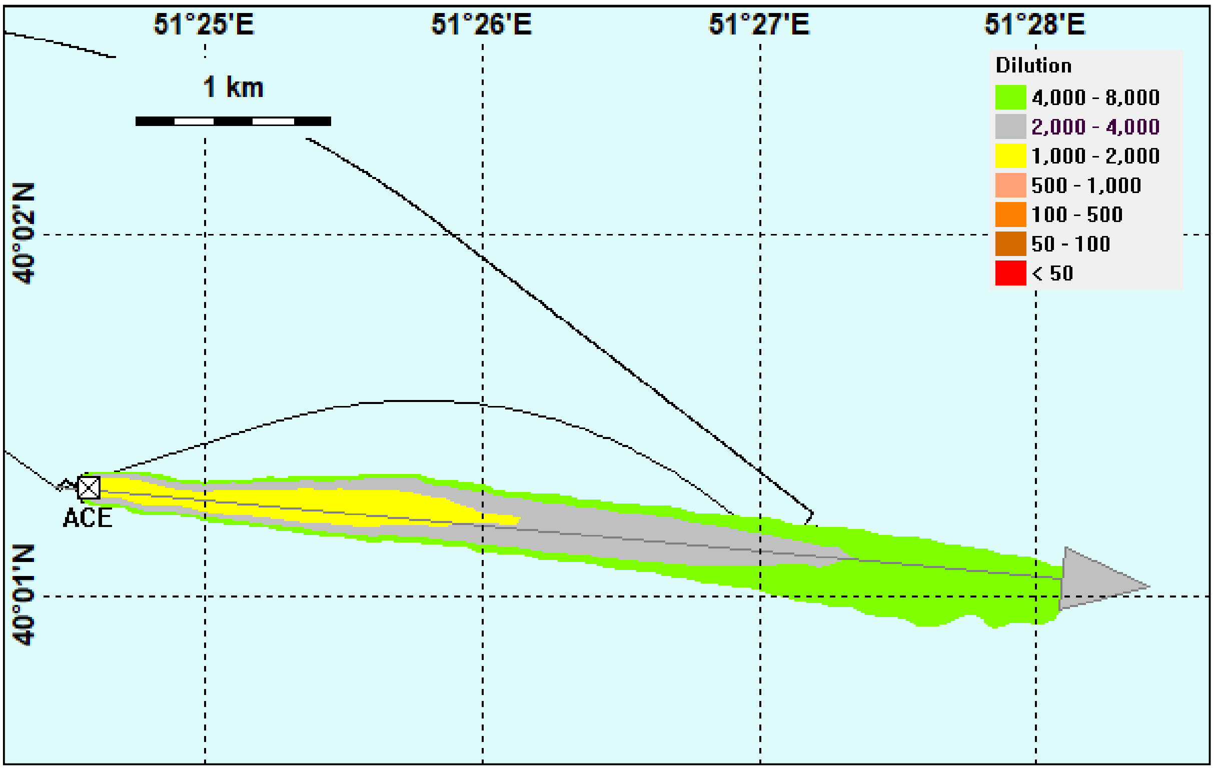
The plume arising from Scenario 4, a discharge at 1m from the seabed at the ACE location of $530m^3$ over a period of 0.72 to 1.4 hours was estimated to be approximately 500m wide and approximately 4.3km long (refer to Figure 10.3 which shows extent of the plume at the end of the discharge event for the worst case summer scenario).

Figure 10.3 Snapshot of Plume at End of Discharge Period, Scenario 4 (Summer)



The plume arising from Scenario 3, a discharge of 830m^3 from the ACE platform caisson over 2 to 3.2 hours extends approximately 5.2km from the ACE platform caisson at the end of the discharge (refer to Figure 10.4). Dilution to 8,000-fold is rapid and complete by the end of the discharge period.

Figure 10.4 Snapshot of Plume at End of Discharge Period, Scenario 3 (Summer)



The plume arising from Scenario 2, a discharge of 2545m^3 from the CA-CWP platform caisson over a period of 2.7 to 5.4 hours, extends over a distance of approximately 10.1km at the 8,000-fold dilution at the end of the discharge period in summer and approximately 4.3km in winter (refer to Figures 10.5 and 10.6 respectively).

Figure 10.5 Snapshot of Plume at End of Discharge Period, Scenario 2 (Summer)

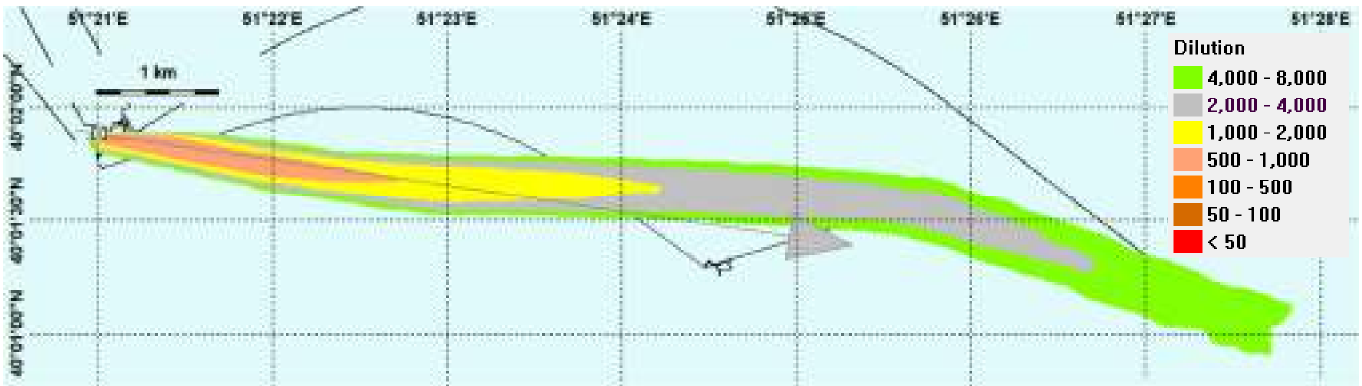
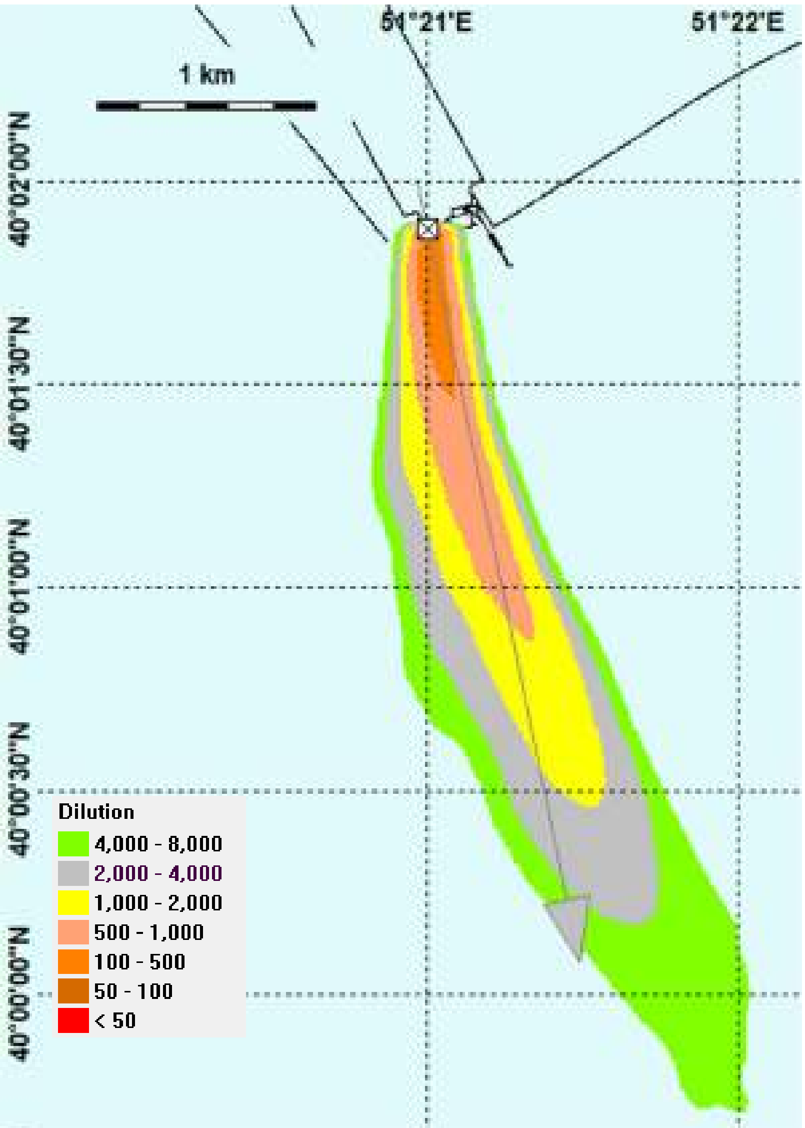


Figure 10.6 Snapshot of Plume at End of Discharge Period, Scenario 2 (Winter)



The range of plume sizes and orientation, the relatively short duration of individual events, and the fact that the plumes do not reach the seabed or sea surface, indicate that impact of individual discharges will be transient, and small relative to the scale of the receiving environment. The product is degradable and non-bioaccumulative, and will not give rise to persistent or cumulative impacts.

Table 10.17 presents the justification for assigning score of 7, which represents a Medium Event Magnitude.

Table 10.17 Event Magnitude (Pipeline Cleaning and Pre-commissioning Discharges)

Parameter	Explanation	Rating
Extent/Scale	Some discharge plumes will extend up to 10.1km.	3
Frequency	Discharges will occur up to 42 times.	2
Duration	Discharge durations will be short, and less than 24 hours in duration.	1
Intensity	Discharges will be consistent with project standards and with previously approved practices and will contain no persistently harmful materials.	1
Total		**7**

ACE Pipeline Cleaning and Pre-Commissioning Discharges (MEG)

Description

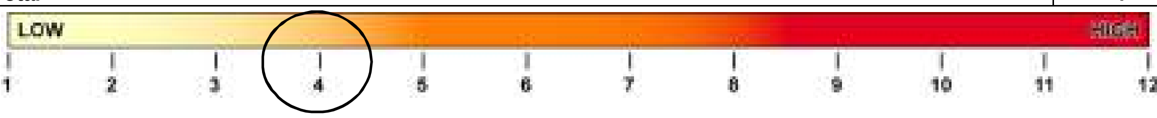
As stated in Chapter 5: Section 5.6.2.4 mono ethylene glycol (MEG) will be used for three activities: during flood, clean and gauging of the existing 22" gas export pipeline between CA-CWP and EA platforms, and dewatering and final conditioning of the new 18" infield gas pipeline between ACE and CA and existing 22" gas export pipeline. The base case is to recover all the MEG used however up to 10m^3 of MEG may be discharged per event (30m^3 in total) via the CA-CWP seawater caisson in the event it cannot be recovered.

Assessment

MEG is of very low toxicity to aquatic organisms, and the World Health Organization's Concise International Chemical Assessment Document (CICAD) (Ref. 1) estimates a no-effect concentration of approximately 890mg/l. The discharges have been modelled, and the plume dimensions at the required dilution have been estimated (refer to Appendix 11C). The modelling has shown that the no-effect concentration is reached instantaneously and in the immediate vicinity of the discharge under both summer and winter conditions. Table 10.18 presents the justification for assigned a score of 4, which represents a Low Event Magnitude

Table 10.18 Event Magnitude (MEG Discharges)

Parameter	Explanation	Rating
Extent/Scale	Discharges will impact only a very small area within the immediate vicinity of the release.	1
Frequency	Discharges may occur up to three times.	1
Duration	Discharges duration is less than one hour.	1
Intensity	Discharges will be consistent with project standards and with previously approved practices and will contain no persistently harmful materials.	1
Total		**4**



ACE Subsea Infrastructure and Spool Tie-in Discharges (Treated Seawater)

Description

As set out in Chapter 5: Section 5.6.2.3, the subsea structures and spools will contain 'sticks' of chemicals and dye. As they are lowered to the seabed they will fill with seawater and be sealed. After a 24 hour period, the sticks will slowly dissolve, allowing the minimum dosage rate for each chemical (as set out in Chapter 5: Table 5.24) to be achieved. When the spools and subsea structures are unsealed to enable tie-in activities, the contents will be released to sea. In total up to 40 releases are anticipated: ranging from 1m^3 to 16m^3 in volume.

Assessment

The dye (Fluorodye UC) and oxygen scavenger (Hydrosure^{TM} Oxygen Scavenger E2 stick) are similar in terms of toxicity to the chemicals used within the treated seawater to be used for pipeline pre-commissioning (refer to Chapter 5: Section 5.6.2.2). Both the proposed Fluorodye UC and the Hydrosure^{TM} Oxygen Scavenger E2 stick are of very low toxicity and will not bioaccumulate.

A comparison of North Sea regulatory test data[5] indicates that the biocide (Hydrosure^{TM} Biocide Stick) and the corrosion inhibitor (Hydrosure^{TM} Corrosion Inhibitor Stick) are of slightly lower toxicity than the combined biocide, corrosion inhibitor and oxygen scavenger (Hydrosure HD5000). Both products are readily biodegradable and would be expected to degrade completely under natural environmental conditions. Neither product has the potential to bioaccumulate. Modelling of the largest anticipated

[5] Based on Harmonised Offshore Chemical Notification Format (HOCNF) data provided by the vendor.

discharge from a spool release (16m[3]) adjacent to the CA platform was undertaken assuming the same dilution factor as for the pipeline treated seawater product (which is conservative). The modelling showed that the discharge plume will disperse instantaneously during summer and winter conditions assuming a dilution of 8000-fold.

Table 10.19 presents the justification for assigned a score of 5, which represents a Medium Event Magnitude.

Table 10.19 Event Magnitude (Tie-in Discharges)

Parameter	Explanation	Rating
Extent/Scale	Discharges will impact only a very small area within 100m of the release.	1
Frequency	Discharges may occur up to 40 times.	2
Duration	Discharge duration is less than one hour.	1
Intensity	Discharges will be consistent with project standards and with previously approved practices and will contain no persistently harmful materials.	1
Total		**5**

10.5.3.2 Receptor Sensitivity

Dispersion modelling has indicated that the treated seawater used during pre-commissioning, the treated seawater released from the spools and subsea structures and discharges of MEG will not impact the seabed or the photic (productive) zone. Discharges associated with MEG, and from the spools and subsea structures are expected to disperse in the immediate vicinity of the discharge location.

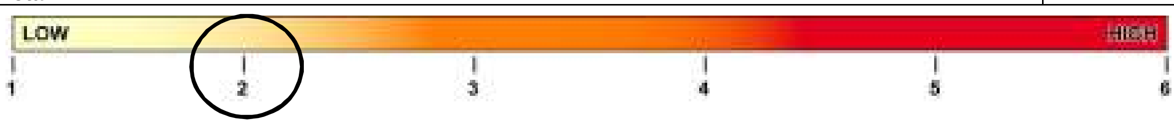
The anticipated plumes generated by the treated seawater used during pre-commissioning are predominantly long and narrow, and residence time within a plume for fish would be too short to result in either acutely or chronically toxic exposure. Productive phytoplankton populations will not be present in the volumes of water occupied by the plumes. Seals, as air-breathers, are unlikely to be affected by exposure.

Zooplankton are most likely to be exposed and affected, if vertically migrating populations are present at the times at which discharges take place. Water column surveys in the ACG Contract Area have indicated a substantial decline in native and endemic species over time, to the extent that the zooplankton community is dominated by two invasive species: the copepod *Acartia tonsa* and the ctenophore *Menmiopsis sp.* albeit it the endemic copepod *Eurytemora minor* has shown some recovery in more recent surveys. These species are widespread and comparatively abundant and are therefore not considered vulnerable at a population level to the proposed discharges.

Table 10.20 presents the biological/ecological Receptor Sensitivity.

Table 10.20 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Fish, seals and phytoplankton unlikely to be exposed. Effects on are zooplankton possible.	1
Resilience	Community dominated by widespread and abundant invasive species.	1
Total		**2**



10.5.3.3 Impact Significance

Table 10.21 summarises impacts to biological/ecological receptors from the ACE pipeline cleaning and pre-commissioning, spool and subsea structure tie-in and MEG discharges.

Table 10.21 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
ACE Pipeline Cleaning and Pre-Commissioning Discharges (Treated Seawater)	Medium	(Biological/Ecological) Low	**Minor Negative**
ACE Pipeline Cleaning and Pre-Commissioning Discharges (MEG)	Low	(Biological/Ecological) Low	**Negligible**
ACE Subsea Infrastructure and Spool Tie-in Discharges (Treated Seawater)	Medium	(Biological/Ecological) Low	**Minor Negative**

10.5.3.4 Additional Mitigation, Monitoring and Reporting

The assessment above has demonstrated, with reference to numerical modelling, that pipeline cleaning and pre-commissioning discharges will result in a Minor Negative impact to biological/ecological receptors.

Prior to the commencement of these activities, a Pipeline Cleaning and Pre-commissioning Discharge Management Plan will be prepared and subsequently maintained. This plan will establish, and regularly update, a schedule of discharge events together with a detailed set of cleaning and pre-commissioning procedures. The MENR will be informed of the hydrotest schedule and will be notified of any changes to the schedule.

Experience gained during the commissioning of the ACG Phase 3 pipelines demonstrated that, in most instances, it is not technically practicable to undertake a programme of field sampling and analysis during cleaning and pre-commissioning activities; this constraint applies particularly to events which involve the discharge of degraded chemicals after the fluid has been in a pipeline for a period of several months. Accordingly, the following measures, which were also adopted for the SD2 Project, will be undertaken for the ACE Project to provide the most effective and practicable monitoring and assurance:

- The amounts of chemicals used, together with the dosage rates and water flow rates during all pipeline filling, top-up and pressure testing activities will be rigorously recorded;
- The actual volumes of treated seawater released during each pipeline discharge event will be rigorously recorded; and
- Laboratory samples (seawater dosed with chemicals at the rate recorded during offshore pipeline fill activities) will be prepared and stored onshore under simulated pipeline conditions. These samples will be periodically subject to toxicity testing.

The information collected as a result of these monitoring and assurance measures will be collated, interpreted, and issued in the form of a final close-out report to the MENR once all pipeline cleaning and pre-commissioning activities have been completed.

It is considered that the impacts are minimised as far as practicable and no additional mitigation is required.

10.5.4 Other Discharges

10.5.4.1 Event Magnitude

Description

Other discharges to sea will result from the operation of vessels associated with the installation of the jacket and topside, the offshore pipelay of the infield pipelines and subsea cable, vessel support to the brownfield modifications on CA and EA platforms and subsea infrastructure installation (refer to Chapter 5: Sections 5.5.6 and 5.6.2).

Assessment

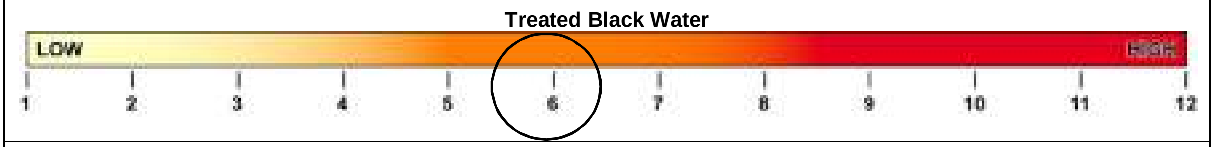
Discharges will comprise:

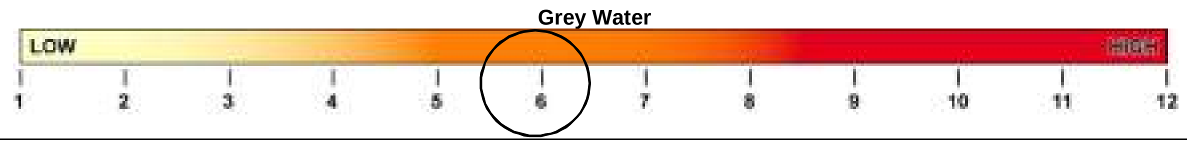
- **Ballast Water** – Support vessels will occasionally take up and discharge ballast water during installation support activities. Vessel ballast tanks are designed to ensure that ballast water does not come into contact with oil or chemicals. Uptake and discharge are not considered to present a significant environmental hazard;
- **Treated Black Water** – Treated black water will be rapidly diluted close to the point of discharge. Total suspended solids, BOD and coliforms at the proposed treatment level do not pose any risk of environmental impact;
- **Grey Water** – Grey water will either be sent to the vessel STP with the black water or discharged directly to sea. Grey water (from showers, laundry etc.) will contain only dilute cleaning agents (soaps, detergents) and the impact of discharge will be minimal; and
- **Drainage** – Drainage (including deck drainage and wash-down water) will be discharged directly to sea, provided no visible sheen is observable. No contaminated water will be discharged and therefore no environmental impact is anticipated.

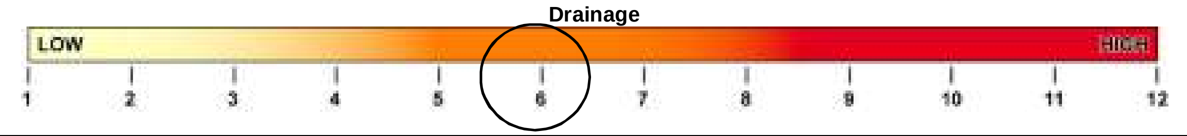
The event magnitude for other discharges is summarised in Table 10.22.

Table 10.22 Event Magnitude

Event Parameter / Discharge	Ballast Water	Treated Black Water	Grey Water	Drainage
Scale	1	1	1	1
Frequency	2	1	1	1
Duration	1	3	3	3
Intensity	1	1	1	1
Event Magnitude	5	6	6	6







10.5.4.2 Receptor Sensitivity

All of the discharges are low in volume and do not contain toxic or persistent process chemicals (with the exception of chlorination of treated black water). Receptors are not considered to be sensitive to these small discharges.

Table 10.23 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 10.23 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	There is no significant presence of rare, unique or endangered species (i.e. the risk of exposure for any such species is close to zero).	1
Resilience	The extremely low level of exposure is equivalent to high resilience.	1
Total		**2**

10.5.4.3 Impact Significance

Table 10.24 summarises the impact of other discharges to sensitive marine receptors including seals, fish, zooplankton, phytoplankton and benthic invertebrates.

Table 10.24 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Other Discharges to Sea: Ballast Water	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea: Treated Black Water	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea: Grey Water	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea: Drainage	Medium	(All Receptors) Low	**Minor Negative**

The following monitoring and reporting requirements related to treated black water, grey water and drainage discharges will form part of the ACE Project Construction Phase ESMS:

- Black Water:
  - Onboard vessels samples will be taken from the sewage discharge outlet and analysed monthly for total suspended solids, thermotolerant coliforms and BOD. Water samples should meet the applicable MARPOL 73/78 Annex IV[6] or MARPOL 73/78 Annex IV MEPC. 159 (55) standards[7];
  - Daily visual checks will be undertaken when discharging from vessels to confirm no floating solids are observable; and
  - Vessel sewage sampling results, recorded daily observations and estimated volumes of treated black water discharged daily (based on POB).
- Grey Water and Drainage:
  - Daily visual checks undertaken when discharging grey water and drainage from vessels to confirm no visible sheen; and
  - Daily observations and estimated volumes of grey water and drainage discharged daily from vessels will be recorded.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

[6] Five day BOD ≤50mg/l, total suspended solids ≤50mg/l (in lab) or ≤100mg/l (on board) and thermotolerant coliform ≤250MPN per 100ml. Residual chlorine as low as practicable where chlorine is added (for vessel STP plants installed prior to January 2010)

[7] Five day BOD ≤25mg/l, COD ≤125mg/l, total suspended solids ≤35mg/l, pH between 6 and 8.5 and thermotolerant coliform 100MPN per 100ml. Where chlorine is added, residual chlorine in the effluent to achieve below 0.5mg/l (for vessels STP plants installed after January 2010)

10.5.5 Underwater Sound

10.5.5.1 Event Magnitude

Description

Underwater sound will result from driving the jacket pin and skirt piles and vessel movements during infield pipeline pipelay, during installation of the subsea infrastructure and during jacket and topside installation as described in Chapter 5: Sections 5.4.3, 5.4.4, 5.5.6 and 5.6.2.

Assessment

Using the same approach as discussed in Chapter 9: Section 9.4.2.1 an analysis of the propagation of underwater noise was undertaken in order to estimate distances at which various acoustic impacts on marine species may occur. A simplified geometric spreading model has been used to understand the magnitude of potential impacts of underwater sound to the biological receptors in the marine environment (seals and fish). The modelling accounts for source sound levels and the propagation of sound over distance.

As described within Chapter 9: Section 9.4.2.1 threshold criteria have been established for a number of species taking into account various sound level metrics and for different levels of potential impact ranging from mortality, physical injury, hearing damage through to behavioural reactions denoted by changes in feeding, breeding, respiration or movement patterns.

Thresholds for physiological damage consider potential permanent and temporary effects on hearing with these defined as permanent threshold shift (PTS) and temporary threshold shift (TTS). These are expressed using sound pressure levels (SPL) and sound exposure levels (SEL). The former is the instantaneous pressure which can be defined as a peak, peak-to-peak, zero-to-peak or RMS (root-mean-square) value while the latter is a measure of received sound energy over some defined period of time. Where criteria thresholds are expressed in both SPL and SEL, the latest advice recommends that the criterion which is exceeded first (i.e. the more precautionary of the two measures) is subsequently used as the operative injury criterion.

Behavioural thresholds are based on observations of individuals or groups of individuals when exposed to sound at a given level. The sound levels involved are lower than those that would give rise to PTS or TTS. The nature of the sound, in terms of its frequency content as well as whether it is continuous or intermittent, governs how the receptor may respond.

Piling

Piling noise is generated through the impacting of a hydraulically powered hammer onto the end surface of a foundation pile. The noise levels are dependent on the force applied and the dimensions of the impacting hammer which themselves are related to the engineering properties of the sediment in which piling is taking place. Using published data for similar activities it is possible to establish an approximate relationship between pile diameter and the resulting noise levels associated with piling. As a result, it is estimated that the peak source level associated with the 96" (2.43m) diameter pile used in the Project is likely to be 213 dB_{peak} re 1 μPa at 1 m. Using the geometric spreading model the SPL and SEL at distances from the source were calculated and compared to the applicable threshold criteria to confirm at what distance the threshold is met. The threshold levels and the results of the modelling are presented in Table 10.25.

Table 10.25 Threshold Criteria for Seals and Fish and Predicted Distance at which the Criteria is Met (Piling)

Receptor	Effect	Threshold Level	Distance at which Threshold is met[2]
Seals	Onset of Permanent Threshold Shift (PTS)	218 dB re. 1μPa peak	<1m
		185 dB re. $1\mu Pa^2s$ SEL M-Weighted	1 sec exposure: 10m
			60 min exposure: 2.3km
			8 hour exposure: 9.4km
	Onset of Temporary Threshold Shift (TTS) also indicating significant behavioural disturbance.	212 dB re. 1μPa peak	2m
		170 dB re. $1\mu Pa^2s$ SEL M-Weighted	1 sec exposure: 100m
			60 min exposure: 23.5km
			8 hour exposure: 94km
	Avoidance behaviour in pinnipeds exposed to impulsive sounds	190 dB_{rms} re 1μPa	2m
	Limited disturbance expected in pinnipeds exposed to impulsive sounds	150-180 dB_{rms} re 1μPa	20m (upper range of criteria) 2.3km (lower range of criteria)
Fish	Potential mortal injury in hearing-generalist ("low sensitivity") fish exposed to piling sound	213 dB re. 1μPa peak	1 m
		219 dB re. $1\mu Pa^2s$	1 sec exposure: <1m
			60 min exposure: 13m
			8 hour exposure: 51m
	Potential mortal injury in hearing-generalist ("medium sensitivity") fish exposed to piling sound And Potential mortal injury in eggs and larvae exposed to piling sound	207 dB re. 1μPa peak	4m
		210 dB re. $1\mu Pa^2s$	1 sec exposure: <1m
			60 min exposure: 50m
			8 hour exposure: 202m
	Potential mortal injury in hearing-specialist fish exposed to piling sound	207 dB re. 1μPa peak	4m
		207 dB re. $1\mu Pa^2s$	1 sec exposure: <1m
			60 min exposure: 80m
			8 hour exposure: 320m
	Recoverable injury in hearing-generalist ("low sensitivity") fish exposed to piling sound	213 dB re. 1μPa peak	1m
		216 dB re. $1\mu Pa^2s$	1 sec exposure: <1m
			60 min exposure: 20m
			8 hour exposure: 80m
	Recoverable injury in hearing-generalist ("medium sensitivity") fish exposed to piling sound And Recoverable injury in hearing-specialist fish exposed to piling sound	207 dB re. 1μPa peak	4m
		203 dB re. $1\mu Pa^2s$	1 sec exposure: <1m
			60 min exposure: 148m
			8 hour exposure: 590m
	Recoverable injury in eggs and larvae	Data not available	Moderate risk at short distances Low risk at all other distances
	TTS in all fish[1], exposed to piling sound	186 dB re. $1\mu Pa^2s$	1 sec exposure: 9m
			60 min exposure: 2km
			8 hour exposure: 8km
	TTS in eggs and larvae	Data not available	Moderate risk at short distances Low risk at all other distances

Notes: 1. i.e. hearing-generalist ("low sensitivity") hearing-generalist ("medium sensitivity") and hearing-specialist
2. A number of the distances for avoidance behaviour and disturbance are shorter than those for PTS and TTS. This is due to units of the thresholds, which are expressed in energy units (SEL dB re 1μPa2s) and amplitude units (SPL dB re 1μPa peak, SPL dB re 1μPa rms), which are not directly comparable.

With reference to pinnipeds, when quantified in terms of peak units the results of the modelling indicated that PTS is unlikely to arise even when the animals are adjacent to the piling while TTS is unlikely to arise beyond a range of 2m. When quantified in terms of SEL units, PTS could occur at distances up to 2.3km from the piling while TTS may arise up to 23.5km both for a 1 hour exposure.

Avoidance behavioural reactions may be classed as a short range impact occurring at distances up to 2m from the piling. By contrast, limited disturbance reactions such as brief changes in swimming direction and speed may be seen up to 2.3km from piling activities.

For fish exposed to piling sound, when defined in terms of peak units, mortality and recoverable injury are both short-range impacts likely to occur no more than 4m from the piling location. For a 1 hour cumulative exposure (SEL units), mortality could occur up to 80m from the piling location whilst the recoverable injury zone extends to 148m from the centre of piling. TTS, which is also defined in terms of SEL units, might arise at distances up to 2km from the piling site for fish of all hearing sensitivities. There is a moderate risk of both recoverable injury and TTS in eggs and larvae over short ranges.

There are no data to support the establishment of thresholds for recoverable injury or TTS in eggs and larvae. It is considered that there is a moderate risk of either impact over short distances. Neither the terms "moderate" nor "short" are defined in this case.

Vessels

The vessels to be used to support the infield pipeline pipelay, during installation of the subsea infrastructure and during jacket and topside installation are detailed within Chapter 5: Sections 5.5.6 and 5.6.2. These will include smaller support vessels and tugs, larger supply vessels, the Derrick Barge Azerbaijan (DBA) or Khankendi Subsea Construction Vessel (SCV) and DSV, in addition to the pipelay barge. The approach taken to the modelling of the vessels and the results of the modelling completed for the smaller vessels and the supply vessels are presented in Chapter 9: Section 9.4.2.1.

With regard to fish, as stated in Chapter 9, there is no data to support the establishment of thresholds for mortality, recoverable injury or TTS for fish exposed to continuous sound. It is considered that when exposed to vessel noise for all sizes of vessel there is a low risk of mortality and recoverable injury for fish of all hearing abilities and a moderate risk of TTS in hearing generalist fish at short distances.

As stated in Chapter 9 for the smaller vessels (e.g. anchor handling tugs), PTS may occur in pinnipeds if they remain within a distance of 6m for a period of 1 hour. TTS may occur if the animals remain within 114m of the vessel operations for a similar period. Moderate behavioural reactions in seals such as changes in swimming direction and speed may occur at distances up to 1.2km. At distances beyond this the likelihood of any observable reactions quickly falls to insignificance although it is noted that the lower threshold at which no observable reactions are expected *viz*. 120 dB re 1 μPa rms is likely to be close to the ambient underwater noise floor and hence vessel noise will become inaudible.

For the larger support and supply vessels, PTS may arise in pinnipeds if the animal remains within 505m of the vessels for an extended period of 1 hour. To avoid TTS, the animals would have to be no nearer than 10.9km to the vessels. Moderate behavioural reactions are likely to be evident from 265m to 116km.

For the pipelay barge, which gives the most conservative results with regard to the generation of underwater sound from vessels (source level of 214.9 dB re 1µPa at 1m), the results of the modelling are presented in Table 10.26.

Table 10.26 Threshold Criteria for Seals and Predicted Distance at which the Criteria is Met (Pipelay Barge)

Effect	Threshold Level	Distance at which Threshold is Met
Onset of Permanent Threshold Shift (PTS)	201 dB re. 1µPa^{2}s SEL M-Weighted	1 sec exposure: 9m
		60 min exposure: 2km
		8 hour exposure: 7.9km
Onset of Temporary Threshold Shift (TTS) also indicating significant behavioural disturbance.	181 dB re. 1µPa^{2}s SEL M-Weighted	1 sec exposure: 182m
		60 min exposure: 43km
		8 hour exposure: 170km
Moderate behavioural reactions in pinnipeds exposed to vessel noise	130 - 140 dB$_{rms}$ re 1µPa	98km (upper range of criterion) 500km† (lower range of criterion)
No observable reactions expected in pinnipeds exposed to vessel noise	120-130 dB$_{rms}$ re 1µPa	500km† (upper range of criterion) 500+km† (lower range of criterion)
Note: † - At such approach distances, the vessel noise is likely to have fallen below the ambient underwater noise levels and will thus be inaudible to the receptor.		

As Table 10.26 shows for the pipelay barge, PTS may arise in pinnipeds at distances up to 2km from the vessel over an exposure duration of 1 hour. Similarly, TTS could occur at distances up to 43km for the same exposure period. Moderate behavioural impacts may be seen over significant distances - in excess of 98km.

Construction and installation activities are expected to take a period of approximately 18 months with the pipelay barge in operation for two periods of 3 months and 2 months respectively. It is expected that the barge will be operated continuously during these periods.

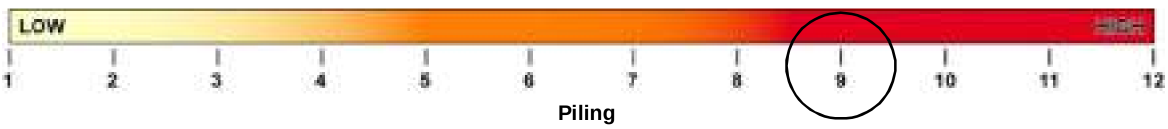
Southall *et al*. (Ref. 2) stated that the effects of non-pulse exposures such as vessel noise on pinnipeds are poorly understood. Studies for which data are available involve harbour seals and northern elephant seals and indicate that noise levels between 90 and 140 dB re 1 μPa were unlikely to elicit strong behavioural reactions. Further it was noted that the behavioural reactions in the seals were very context-driven varying from no change in behaviour through to moderate changes indicated by changes in speed, direction and/or dive profile; minor changes in group distribution; and moderate changes in vocal behaviour.

Apart from the activities associated with the Project, there will be commercial and other vessel movements in the area. It is assumed that the background noise levels will be relatively high. Although there are no acoustic data to support this assumption, similar measurements made in the coastal North Sea where oil-field related activities predominated, background noise levels were as high as 130 dB re 1 μPa (Ref. 3). It is assumed therefore that marine life will have become largely habituated to such noise levels.

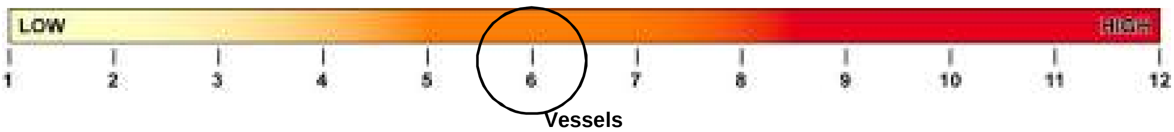
Table 10.27 outlines the event magnitude for both piling and vessel movements for the duration of the construction, installation and HUC activities.

Table 10.27 Event Magnitude

Event Parameter	Piling	Vessels
Extent/Scale	3	1
Frequency	3	1
Duration	1	3
Intensity	2	1
Event Magnitude:	**9**	**6**



Piling



Vessels

10.5.5.2 Receptor Sensitivity

The only relevant biological receptors to underwater noise are seals and fish. Plankton cannot sense the low frequency sound generated because the wavelength is longer than the organism and there is a lack of scientific data to suggest benthic invertebrates have sophisticated sound-sensing apparatus.

Fish

As set out within Chapter 6: Section 6.5.5.2 there are a number of species, including those with moderate and high sensitivity to underwater sound, expected to be present within the vicinity of the proposed ACE platform location and across the ACG Contract Area. As discussed within Chapter 9: Section 9.4.2.2 these species comprise fish that are resident, semi-migratory and migratory with kilka and shad, which are most sensitive to underwater sound, present during the autumn migration period (kilka and shad) and winter (kilka). Sturgeon, (critically endangered), are also known to migrate through the ACG Contract Area in March/April and September to November. No fish species is present exclusively within the Contract Area and their migration routes (as shown in Chapter 6 Figures 6.8 and 6.9) are typically concentrated in the shallower waters between the Absheron Peninsula and the western edge of the ACG Contract Area, over 50km from the proposed ACE platform location. Given the vessels will be moving and in constant operation it is expected any individual fish will move away as soon as the sound source is detected and there is very low injury risk to individual fish and to fish populations.

Seals

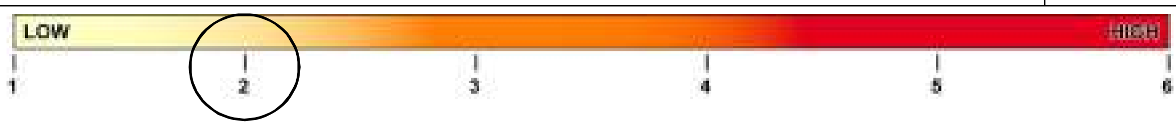
As stated within Chapter 6: Section 6.5.5.3 the Caspian seal population has significantly declined over the 20th Century (by more than 90% since the start of the century) and continues to decline due to a combination of factors including commercial hunting, habitat degradation (through introduction of invasive species), disease, industrial development, pollution and fishing operations. The seal population is therefore highly vulnerable as reflected by its IUCN Red List "Endangered" and Azerbaijan Red Data Book (AzRDB) listed status.

Caspian seals typically migrate north in the winter and south in the spring, with their migration route typically passing between the Absheron Peninsula and the western edge of the ACG Contract Area. The latest research has shown, however, that it is not possible to assume that seals will always follow the previously defined migratory paths (Chapter 6: Figure 6.10) and therefore it is possible a number of seals may be present in the ACG Contract Area at any time of year (refer to Chapter 6: Section 6.5.5.3). The Caspian seal is a highly intelligent and mobile animal. The seals are habituated to vessel noise associated with routine commercial traffic and vessels associated with the oil and gas industry, and will take action to avoid the associated sound from this activity. Similarly the use of the ADD during piling activities will alert any seals present to the activity, allowing them to leave the area as soon as they detect the sound source. Risk of injury to individuals and detectable effects on the seal population as a whole is therefore considered very unlikely.

Table 10.28 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 10.28 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	**Fish**: Hearing specialist fish are likely to be present for limited periods of time in the vicinity of the ACE offshore installation activities. However, these species are widely distributed and do not use this area exclusively. Fish species will move away from underwater sound as soon as it is detected and thus before permanent or temporary injury impacts are likely to occur. There may be a change in behaviour but this is expected to be limited to a change in swimming direction and short term. **Seals**: There is potential for low numbers of individual seals to be present in the vicinity of the ACE offshore installation activities. However, the Caspian seal is a highly intelligent animal and will rapidly move away from any disturbance or sound.	1
Resilience	**Fish**: Individual fish are at very low risk of injury or significant behavioural disturbance and therefore the risk to populations is considered to be even lower and ecological functionality will be maintained. **Seals**: Internationally protected Caspian seals may be present in the vicinity of the ACE offshore installation activities year round including during spring migration. However the main migration route is typically between the Absheron Peninsula and the western edge of the ACG Contract Area. Caspian seals that may be present in the vicinity of the ACE offshore installation activities will sense the sound from these activities and alter their course away accordingly.	1
Total		**2**



10.5.5.3 Impact Significance

Table 10.29 summarises noise and vibration impacts to marine biological receptors associated with jacket pin and skirt piling and vessel movements.

Table 10.29 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Jacket pin and skirt piling (underwater sound)	High	Low	**Moderate Negative**
Vessel movements (underwater sound)	Medium	Low	**Minor Negative**

The following monitoring and reporting activities will be undertaken related to seals:

- Daily logs of Caspian seal sightings will be completed by the trained vessel crew undertaking the piling activities using the relevant Joint Nature Conservation Committee (JNCC) marine mammal forms (Ref. 4); and
- A final report summarising the Caspian seal observations over the duration of the piling activities and including all the daily log forms will be completed by the trained vessel crew and submitted to BP within eight weeks of completion of the piling activities.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

10.6 Summary of ACE Construction, Installation and HUC Residual Environmental Impacts

For all construction, installation and HUC phase environmental impacts assessed it has been concluded that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures. No additional mitigation measures are required.

Table 10.30 summaries the residual environmental impacts for the construction, installation and HUC phase of the Project.

Table 10.30 Summary of ACE Project Construction, Installation and HUC Residual Environmental Impacts

	Event/ Activity	Magnitude				Sensitivity		Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity	Human	Ecological	Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Construction Yard Plant and Vehicles	1	1	3	1	2	-	Medium	Low	Minor Negative
	Onshore Commissioning of Main Platform Generator and Topside Utilities	1	3	2	1	2	-	Medium	Low	Minor Negative
	Vessel Engines	1	1	3	1	2	-	Medium	Low	Minor Negative
Terrestrial Environment (Noise)	Construction Yard Plant and Vehicles	1	1	3	1	2	-	Medium	Low	Minor Negative
	Onshore Commissioning of Main Platform Generators and Topside Utilities	3	2	1	1	2	-	Medium	Low	Minor Negative
Marine Environment	Construction Yard Cooling Water Discharge	1	1	3	1	-	2	Medium	Low	Minor Negative
	Pipeline Cleaning and Pre-commissioning Discharges (Treated seawater)	3	2	1	1	-	2	Medium	Low	Minor Negative
	Pipeline cleaning and Pre-commissioning Discharges (MEG)	1	1	1	1	-	2	Low	Low	Negligible
	Subsea Infrastructure and Spool Tie-in Discharges (Treated seawater)	1	2	1	1	-	2	Medium	Low	Minor Negative
	Ballast Water (Vessels)	1	2	1	1	-	2	Medium	Low	Minor Negative
	Treated Black Water (Vessels)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Grey Water (Vessels)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Drainage (Vessels)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Jacket pin and skirt piling (underwater sound)	3	3	1	2	-	2	High	Low	Moderate Negative
	Vessel movements (underwater sound)	1	1	3	1	-	2	Medium	Low	Minor Negative

10.7 References

Ref. No.	Title
1	World Health Organization (WHO), 2000. Ethylene Glycol: Environmental Aspects, Concise International Chemical Assessment Document 22, Geneva.
2	Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr., C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A., and Tyack, P.L. (2007). "Marine mammal noise exposure criteria: initial scientific recommendations," Aquatic Mammal. 33, 411-521.
3	Nedwell J R, Langworthy J and Howell D. Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; initial measurements of underwater noise during construction of offshore wind farms, and comparison with background noise. Subacoustech Report ref: 544R0423, published by COWRIE, May 2003
4	Joint Nature Conservation Committee (JNCC), 2010. Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise

11 Operations Impact Assessment, Mitigation and Monitoring

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11.1 Introduction

This Chapter of the Azeri Central East (ACE) Environmental and Social Impact Assessment (ESIA) presents the assessment of environmental impacts associated with the following ACE Project phases:

- Platform Drilling; and
- Offshore Operations and Production.

In addition, the incremental changes at Sangachal Terminal resulting from ACE production have also been considered.

The impact assessment methodology followed and the structure of the ACE Project impact assessment are described in full within Chapters 3 and 9 of this ESIA respectively.

11.2 Scoping Assessment

The ACE Project Operations Activities and Events have been determined based on the ACE Project Base Case, as detailed within Chapter 5: Project Description (see Appendix 11A).

Table 11.1 presents the Activities and associated Events that have been scoped out of the full assessment process due to their limited potential to result in discernible environmental impacts. Judgement is based on prior experience of similar Activities and Events, especially with respect to earlier Azeri Chirag Gunashli (ACG) developments. In some instances, scoping level quantification/numerical analysis has been used to justify the decision. Reference is made to relevant quantification, analysis, survey and/or monitoring reports in these instances.

Table 11.1 "Scoped Out" ACE Project Operation Phase Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Platform Drilling			
O-R2	Suspension fluids from predrill well tie-in and re-entry	5.7.3	• Prior to the cuttings reinjection (CRI) well being tied-back and when it is not available, suspension fluids and sweeps will be recovered and shipped to shore. • Suspension fluids associated with predrill well re-entry will be sent to the CRI well, when available. • It is not planned to discharge suspension fluids to sea except in the case of emergency (e.g. presence of elevated levels of hydrogen sulphide (H_2S)). **Conclusion**: No discernible impact to the marine environment is expected.
O-R4	30" and 26" hole upper hole section drilling - residual water based mud (WBM) recover to shore or sent to CRI (base case)	5.7.5	• Base case is to recover residual WBM associated with top hole drilling that cannot be reused and ship to shore or send the CRI well for reinjection. **Conclusion**: No discernible impact to the marine environment is expected.
O-R5	20", 17" and 13 ½" lower hole section drilling - Synthetic Oil Based Mud (SOBM) or Low Toxic Mineral Oil Based Mud (LTMOBM) sent to CRI (base case) or, if not available, sent to shore.	5.7.5	• SOBM/LTMOBM mud and cuttings from the lower hole sections will be returned to the platform, separated and the mud reused wherever possible. • Under routine conditions cuttings with the SOBM/LTMOBM mud that it is not practicable to separate and/or reuse will be sent to the CRI well for reinjection. • In the event CRI is not available, the cuttings and associated SOBM/LTMOBM mud will be contained and shipped to shore for treatment. **Conclusion:** It is considered that impacts are minimised as far as practicable and no discernible impact to the marine environment is predicted**.**
O-NR6	Fugitive emission of dry cement	5.7.8.1	• In the event of an overpressure event there may be a loss of up to 10 kilograms (kg) of dry cement. • This is expected to occur, as a worst case, no more than once every 10 years. • Fugitive emissions resulting from an overpressure event are expected to be minimal and are not expected to result in a discernible impact to the marine environment.

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
			Conclusion: No discernible impact to the marine environment is expected.
Offshore Operations and Production			
O-NR2	Fire system operation and tests	5.8.6.8 & 5.5.4	• The firewater pumps are planned to be tested on a weekly basis for an hour with seawater circulated through the firewater system and discharged via the seawater discharge caisson. • The operation of the fire water ringmain and fire hydrants during the winter months will also result in discharges of seawater to the seawater discharge caisson. • Firefighting foam system tests will be undertaken monthly for approximately five minutes resulting in a release of approximately 3.5 cubic metres per hour (m^3/hr) of foam. • Foam system chemicals of the same specification and environmental performance as those used in existing ACG platform foam systems will be stored on the platform for emergency use. • The fish most likely to be present for extended periods of time in the ACG Contract Area include kilka and mullet that may be present throughout the year. However, the ACG Contract Area, including the proposed ACE platform location, is not exclusively used by these species and the Contract Area is not considered to be of primary importance. • The small volume of foam released during system tests would be expected to disperse rapidly (refer to Chapter 10: Table 10.1) with very limited potential for impact. **Conclusion**: Limited potential for discernible impact on the marine environment.
O-R15	Pipeline operations and maintenance – pigging of ACE oil and gas infield pipelines	5.8.7	• Pigging of the ACG oil pipeline system (including the ACE oil infield pipeline) will be undertaken from the ACE production, drilling and quarters (PDQ) platform towards Sangachal Terminal. • Waste generated from the pigging of the ACG oil pipeline system is routinely collected at the Terminal and sent for disposal in accordance with the existing Azerbaijan Georgia Turkey (AGT) waste management plans and procedures. • Pigging of the ACG gas pipeline will be undertaken from the ACE-PDQ platform towards the Central Azeri compression and water injection platform (CA-CWP). • Solids from pigging the gas pipeline will be collected in the CA-CWP pig receiver, contained and shipped to shore for disposal. • The increase in waste volumes generated as a result of the ACE oil and gas infield pipelines is not expected to be significant. **Conclusion**: No significant change in waste type or quantities generated as a result of the ACE Project from pigging activities. Waste will be managed in accordance with existing AGT waste management plans and procedures.
O-R16	Pipeline operations and maintenance – pigging of water injection pipeline (generation of waste)	5.8.7	• Pigging of the ACE infield water injection pipeline will be undertaken from the EA-PDQ platform to the ACE-PDQ platform (i.e. the normal direction of flow), with pigging planned to be undertaken every 3 months during operations. • Solids from pigging the ACE infield injection water will be collected in the ACE-PDQ pig receiver, contained and shipped to shore for disposal. **Conclusion:** Waste generated during the ACE Project will be managed in accordance with the existing AGT Region management plans and procedures as described within Chapter 14. No discernible impact to the terrestrial or marine environment expected**.**
O-R17	Supply vessel operations (non GHG emissions to atmosphere)	5.8.8	• During drilling operations, supplies will normally be delivered by up to 3 vessels per week. When there is no drilling, supply vessels are expected to visit less frequently, normally every 14 days (minimum), depending on requirements. • The low volume of emissions released will be dispersed across the entire vessel route and the wider area. Increases in pollutant concentrations will be very small and indistinguishable from existing background concentrations. • Vessels will be well maintained and use good quality, and low sulphur fuel (typically <0.05% weight). **Conclusion:** Based on efficient operation, regular maintenance and planned use of low sulphur fuel there is deemed to be no discernible

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
			impact to human or ecological receptors.
O-R18	Crew change operations (non GHG emissions to atmosphere)	5.8.8	• Up to 3 crew change vessel trips are anticipated a week. • The low volume of emissions released will be dispersed across the entire vessel route and the wider area. Increases in pollutant concentrations will be very small and indistinguishable from existing background concentrations. • Helicopter transfer may be used for emergencies. • There will be no helicopter or vessel refuelling facilities on the platform. **Conclusion:** Emissions from crew change operations are expected to result in no discernible impact to human receptors.
Sangachal Terminal Activities			
Ter-R1	Use of existing processing and storage facilities (non GHG emissions to atmosphere)	5.9	• The ACE Project will use existing capacity within the onshore ACG facilities located at the Sangachal Terminal. • The overall ACG production from the Terminal including ACE will not exceed the design capacity of the onshore ACG facilities. • Air quality modelling was undertaken for the ACG Phase 3 ESIA (Ref. 1) for routine and non routine (flaring scenarios) including all onshore ACG and Shah Deniz Stage 1 (SD1) sources operating at design capacity. • The modelling predicted an increase in annual average NO_2 concentrations at Sangachal Town of less than 1 micrograms per cubic metre ($\mu g/m^3$) and an increase in 1 hour short term NO_2 concentrations at Sangachal Town of up to $63.7\mu g/m^3$ at Sangachal Town (due to worst case emergency depresiration flaring). • Monitoring in the vicinity of Sangachal Terminal between 2012 and 2016 has recorded annual average concentrations of NO_2 $10.4\mu g/m^3$ and $11.8\mu g/m^3$, well below the annual average EU limit value for NO_2 of $40\mu g/m^3$ (refer to Appendix 11B). Short term concentrations are estimated to be approximately $20.8\mu g/m^3$ to $23.6\mu g/m^3$, well below 1 hour EU limit value for NO_2 of $200\mu g/m^3$ (refer to Appendix 11B). • On the basis of the modelling undertaken assuming the ACG facilities operating at design capacity and results of the recent air quality monitoring it is anticipated that there will be no exceedances of relevant air quality limits and no discernible changes in air quality at onshore receptors. **Conclusion:** Contribution of ACE Project to onshore ACG production expected to result in no discernible impact to air quality at onshore receptors.
All Operations			
All-R1	Waste Management	5.11	• Waste generated during the operational phase will be consistent with the types and quantity of waste generated by the existing ACG and SD offshore facilities. • Waste types generated at the Terminal are not expected to change as a result of the ACE Project. • Waste generated during ACE operations will be segregated at source, stored and transported in fit for purpose containers. • Waste will be managed in line with the principles described in Chapter 14 and will benefit from the operational experience that has been gained from continuing BP operations. • BP will manage the collection, transportation, treatment, disposal and storage of waste generated during the operational phase via specialised approved waste management contractors- the destinations of the waste types is provided in Table 5.35 of Chapter 5. **Conclusion:** Waste generated during the ACE Project will be managed in accordance with the existing AGT Region management plans and procedures as described within Chapter 14. No discernible impact to the terrestrial or marine environment expected.

The ACE Project routine and non routine Activities and their associated Events that have been assessed with the full impact assessment process are presented in Table 11.2.

Table 11.2 "Assessed" ACE Project Operation Phase Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Event	Receptor
Platform Drilling				
O-R1	Installation of conductor section using hydraulic hammer	5.7.4	Underwater sound	Marine Environment
O-R3	30" and 26" upper hole section drilling	5.7.4	Drilling discharges to sea Underwater sound	Marine Environment
O-R4	30" and 26" hole section drilling - residual WBM that cannot be recovered discharged to sea	5.7.4	Drilling discharges to sea	Marine Environment
O-R5	20", 17" and 13 ½" lower hole section drilling	5.7.4	Underwater sound	Marine Environment
O-R7	Discharge of cement system washout to sea via the platform cuttings caisson	5.7.8.1	Cement discharges to sea	Marine Environment
Offshore Operations and Production				
O-R8	Operation of offshore combustion sources under routine conditions	5.8.6.4	Atmospheric emissions due to power generation	Atmosphere (flaring emissions)
O-NR1	Operation of offshore combustion sources under non routine or emergency depressurisation conditions	5.8.6.4	Emissions to atmosphere (non GHG)	Atmosphere (emissions)
O-R9	Cooling water system intake and discharge	5.8.6.7	Water intake/entrainment Cooling water discharge to sea	Marine Environment
O-R10	Platform drainage systems	5.8.6	Other Discharges	Marine Environment
O-R11	Saline effluent from freshwater maker			
O-R12	Treated black water discharge			
O-R13	Grey water discharges			
O-R14	Galley waste discharges			
O-R16	Pipeline operations and maintenance – pigging of water injection pipeline	5.8.7	Pigging discharges to sea	Marine Environment

11.3 Impacts to the Atmosphere

Non greenhouse gas (GHG) emissions to the atmosphere during offshore and onshore operations will be associated with routine and non routine operation of the ACE Project facilities (offshore), use of support vessels (offshore only) and emissions at the Sangachal Terminal (onshore). GHG emissions associated with the ACE Project are discussed within Chapter 13 of this ESIA. This section focuses on the assessment of potential air quality impacts during operations.

11.3.1 Mitigation

Existing controls associated with emissions from routine and non routine emissions from offshore operations include:

- Generators, cranes, flares and pumps will be subject to planned maintenance in accordance with written procedures based on the manufacturer's guidelines, or applicable industry code or engineering standard to ensure efficient and reliable operation;
- Exhaust emissions testing will be undertaken at least annually in accordance with the Production Sharing Agreement (PSA) requirement[1];
- Diesel supplied to the ACE platform and to vessels will typically contain a sulphur content of <0.05% weight;
- The flare will be designed to achieve 98% combustion efficiency;
- The flare will be designed to have a "smokeless design" (Ringelmann<1) for all purge and pilot flaring events and as far as practicable for non routine flaring events without comprising safety, combustion efficiency or flare performance;
- There will be no continuous flaring or venting during routine operations (with the exception of purge/pilot flaring);

[1] IC engines/turbines larger than 500 HP should be monitored on an annual basis to assure that the NO_X and CO emissions are at the specified levels.

- Planned and unplanned flaring or venting of hydrocarbons shall be minimised where practical without compromising the safety of personnel or the integrity of plant. Any unplanned flaring events will be categorised as routine or non routine based on frequency and root cause with the aim of minimising the event occurring;
- Unplanned equipment outages and/or plant upsets shall be corrected in a timely manner in order to eliminate flaring as soon as practical; and
- Fugitive volatile organic compound (VOC) losses shall be minimised through limiting flange connections and instrument intrusions and the installation of low loss valves, where practicable, on the platform.

11.3.2 Offshore Operations

11.3.2.1 Event Magnitude

Description

Under routine operating conditions, emissions will arise from use of the main power generator, the compression generator, pilot/purge flaring and fugitive emissions from fittings. Intermittent sources including crew change and supply vessels, diesel powered platform cranes, emergency generators, temporary brine filtration unit pump and fire water pumps (during testing) will also generate emissions.

In addition to pilot and purge flaring, it is intended to route hydrocarbon gases from the processing facilities to the flare under emergency or non routine conditions (i.e. due to equipment malfunctions, repairs or maintenance (refer to Chapter 5: Section 5.8.6.4)).

Assessment

Air dispersion modelling undertaken for the offshore operations is presented in Appendix 11B. The modelling focuses on NO_X (which comprises nitrous oxide (NO) and nitrogen dioxide (NO_2)) as the main atmospheric pollutant of concern. Short term (1 hour maximum) and long term (annual average) NO_2 concentrations were modelled to assess the contribution of emissions from ACE Project offshore operations in the context of the relevant limit values for NO_2 of 40µg/m^3 (annual average) and 200µg/m^3 (1 hour maximum). These standards are relevant to locations where humans are normally resident (i.e. onshore settlements). The following scenarios were assessed:

1. Routine operations – ACE facilities operating with power generation and gas compression turbines operating at 100% load on fuel gas and flare system operating in pilot/purge mode;
2. Non routine operations – ACE facilities operating with power generation turbine operating at 100% load on fuel gas, gas compression turbine under maintenance (0% load) and non routine flaring at 80 million standard cubic feet per day (MMscfd); and
3. Emergency Shutdown (ESD) – ACE facilities operating under power generation turbine running at 100% load on diesel, gas compression turbine at 0% load and emergency depressurisation flaring at 333MMscfd.

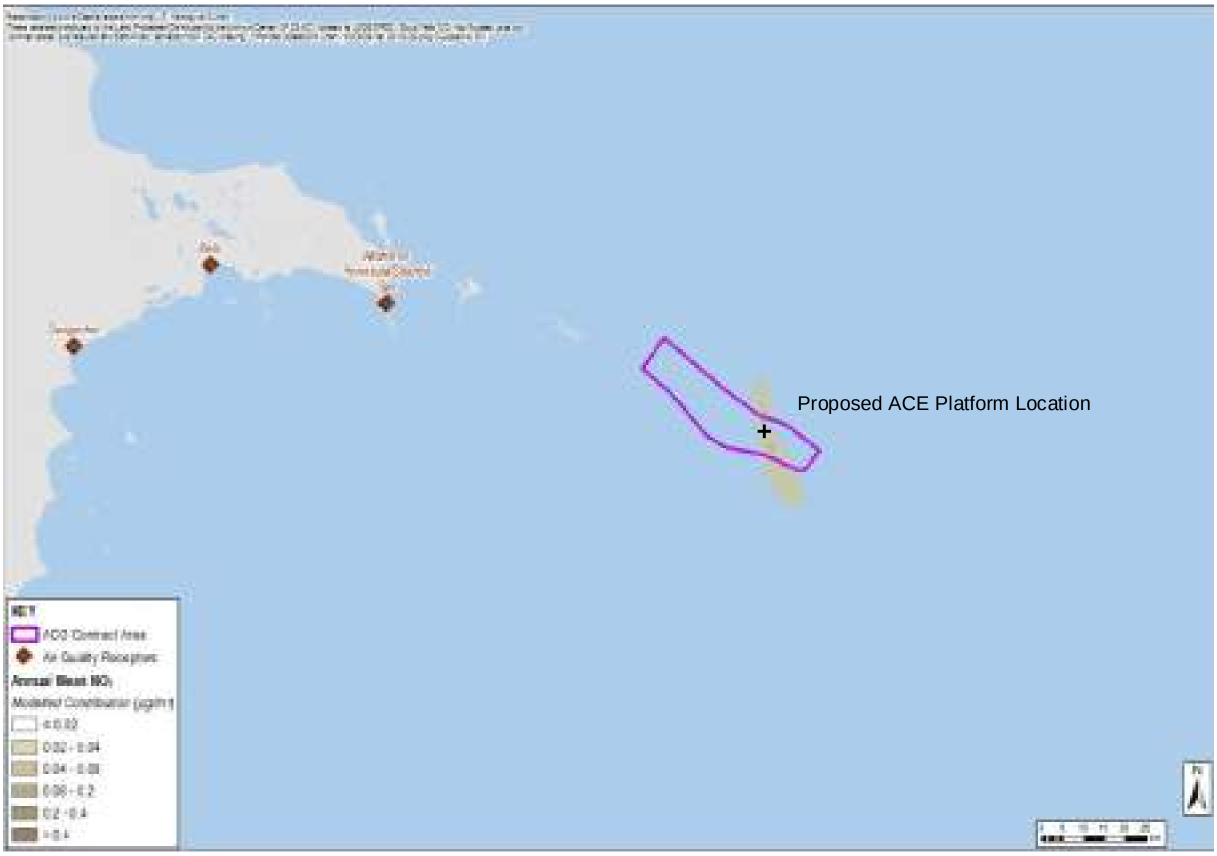
For each scenario the assessment assumed full loading on the turbines to provide a worst case estimate. The modelling results are therefore considered to be conservative.

For all scenarios the modelling predicted an increase in long term (annual average) NO_2 concentrations at onshore receptors of less than 0.1µg/m^3. The highest increase in short term NO_2 concentrations were predicted where the dispersion plume meets the Absheron Peninsula due to prevailing northerly wind direction. The results at the Absheron Peninsula location for the three scenarios assessed are summarised within Table 11.3. The long term and short term background concentrations of NO_2 were assumed to be 12µg/m^3 and 24µg/m^3 respectively (refer to Appendix 11B for further details). Figures 11.1 and 11.2 show the increases in long and short term NO_X concentrations for the routine operations and ESD scenarios respectively.

Table 11.3 Predicted Increase in Long Term and Short Term NO_2 Concentrations at the Absheron Peninsula Location for Modelled Offshore Operating Scenarios

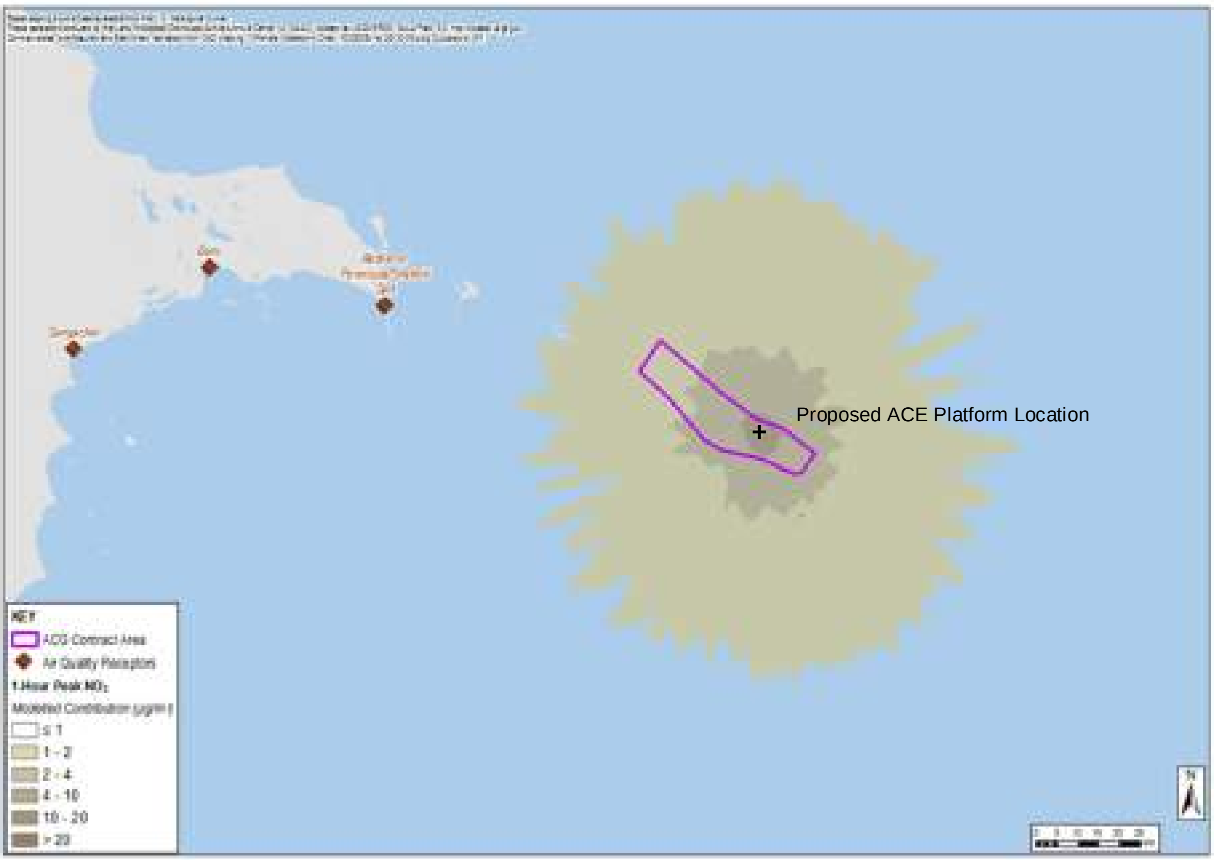
Scenario	NO_2 Annual Average (µg/m^3)				NO_2 1 Hour Peak (µg/m^3)			
	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value	Limit Value	Modelled Contribution	Predicted Concentration	Predicted Concentration as % Limit Value
1. Routine Operations	40	< 0.1	12.0	30.0%	200	0.1	24.1	12.1%
2. Non Routine Operations		< 0.1	12.0	30.0%		0.2	24.2	12.1%
3. ESD		< 0.1	12.0	30.0%		0.6	24.6	12.3%
Note: Assumed conversion of NO_x to NO_2, 100% for annual average (long term) and 50% for 1 hour peak (short term).								

Figure 11.1 Modelled Mean Annual NO_2 Contributions (Scenario 1 Routine Operations)



Note: As described in Appendix 11B, for the long term it is assumed that all NO_X converts to NO_2 in the atmosphere.

Figure 11.2 Increase in Short Term NO_X Concentrations (Scenario 3 ESD Flaring)



Note: As described in Appendix 11B, for the short term it is assumed that 50% of NO_X converts to NO_2 in the atmosphere.

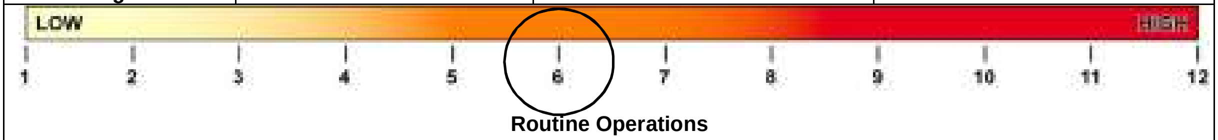
The results show that for all scenarios considered, no exceedances of the onshore short term or long term NO_2 air quality limits are predicted at onshore locations. Increases in NO_2 concentrations above background concentrations were also shown to be insignificant.

Based on efficient operation and regular maintenance, operation of the offshore turbines and flare will not result in plumes of visible particulates.

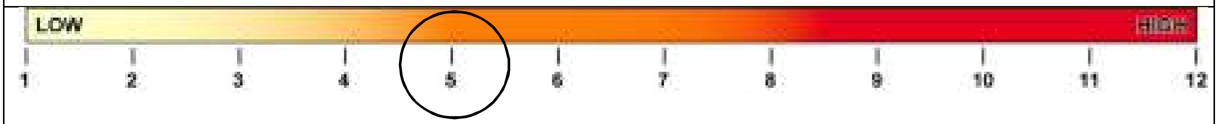
Table 11.4 presents the justification for assigning a score of 6 to emissions from routine offshore operations and 5 to non routine operations, which represents Medium Event Magnitude and a score of 4 to ESD flaring, which represents Low Event Magnitude.

Table 11.4 Event Magnitude

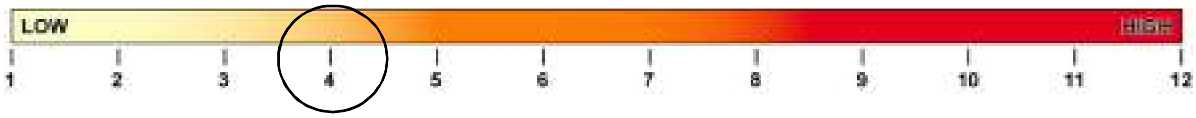
Event Parameter	Routine Operations	Non Routine Operations	ESD
Extent/Scale	1	1	1
Frequency	1	2	1
Duration	3	1	1
Intensity	1	1	1
Event Magnitude:	**6**	**5**	**4**



Routine Operations



Non Routine Operations



Emergency Depressurisation Flaring

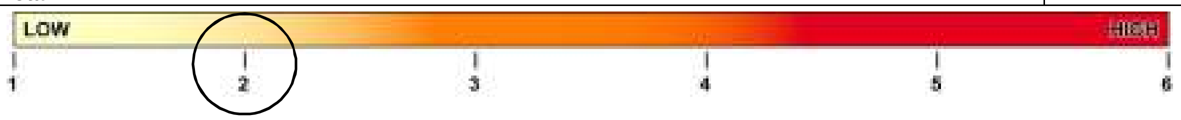
11.3.2.2 Receptor Sensitivity

Human Receptor Sensitivity

Table 11.5 presents the justification for assigning a score of 2 to human receptors, which represents Low Receptor Sensitivity.

Table 11.5 Human Receptor Sensitivity

Parameter	Explanation	Rating
Presence	There are no permanently present (i.e. resident) human receptors within 95km of the proposed ACE platform location.	1
Resilience	Changes in air quality onshore associated with emissions from ACE offshore operations will be indiscernible. Onshore receptors will be unaffected.	1
Total		**2**

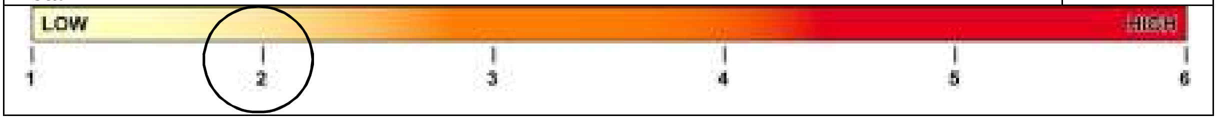


Biological/Ecological Receptor Sensitivity

Table 11.6 presents the justification for assigning a score of 2 to biological/ecological receptors, which represents Low Receptor Sensitivity.

Table 11.6 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Marine/bird species are mobile and will not be present at one location for long periods of time. Birds found in the area will be transient and not resident.	1
Resilience	Volume of emissions released (including visible particulates) will create a very small increase in pollutant concentrations in the atmosphere and in any washout from rainfall, which will not be discernible to biological/ecological receptors[2].	1
Total		**2**



11.3.2.3 Impact Significance

Table11.7 summarises impacts on air quality associated with offshore operations.

Table 11.7 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Routine Offshore Operations	Medium	(Humans) Low (Biological/Ecological) Low	**Minor Negative**
Non Routine Offshore Operations (Compression Turbine Maintenance)	Medium		**Minor Negative**
Emergency Depressurisation Flaring	Low		**Negligible**

The following monitoring and reporting requirements related to emissions to atmosphere form part of the AGT Region Environmental Management System (EMS):

- Emissions testing of ACE platform exhausts to confirm that the NO_X, SO_X and CO emissions are at the specified levels (i.e. the levels and tolerances determined by the equipment manufacturer which confirm efficient operation). Monitoring will be undertaken in accordance with the existing AGT Region methodologies and procedures aligned with US EPA and ISO stack emissions measurement and calibration requirements; and
- Emission volumes for the ACE platform based on fuel usage and calculated flare volumes will be submitted to the MENR, State Oil Company of the Azerbaijan Republic (SOCAR) and the State Statistical Committee at an agreed frequency.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

11.4 Impacts to the Marine Environment

11.4.1 Mitigation

Existing control measures associated with underwater sound from installation of well conductor sections, drilling of wells and vessel operations include:

- Support vessels are subject to periodical performance review, which includes environmental performance. Corrective actions will be undertaken to address any performance gaps.

Existing control measures associated with the platform drilling discharges include:

- During drilling, WBM will be separated from cuttings as far as practicable and re-used. The cuttings will be discharged to sea via the platform cuttings caisson with the seawater used for drill equipment cooling;

[2] Note that ambient air quality standards are not relevant to biological/ecological receptors.

- Residual WBM that cannot be reused will be shipped to shore or sent to the CRI wells. WBM that cannot be recovered will be discharged to sea via the platform cuttings caisson in accordance with PSA requirements[3];
- The platform cuttings caisson will be designed to discharge at a depth of 104m below sea level;
- WBM additives used during platform drilling activities will be of low toxicity (UK Offshore Chemical Notification Scheme (OCNS) "Gold" and "E" category or equivalent toxicity); and
- Batches of barite supplied for use in WBM formulations will meet applicable heavy metals concentration standards i.e. Mercury <1 mg/kg and cadmium <3 mg/kg dry weight (total).

Existing controls associated with cement during platform drilling activities include:

- Cement chemicals used during platform drilling activities will be of low toxicity (UK HOCNS "Gold" and "E" categories or equivalent toxicity);
- Cement is designed to set in a marine environment preventing widespread dispersion; and
- The volume of cement used to cement each casing is calculated prior to the start of the activity. Sufficient cement is used to ensure that the casing is cemented securely and necessary formations isolated so that this safety and production critical activity is completed effectively.

Existing control measures related to the platform seawater system intake and discharge include:

- The seawater intake caisson design includes a mesh of 200mm diameter to prevent fish entrainment;
- The seawater discharge caisson will be designed to discharge at a depth of 46m below sea level; and
- The design and operation of the seawater/cooling water system has been reviewed and confirmed that the temperature at the edge of the cooling water mixing zone (assumed to be 100m from the discharge point) will be no greater than 3 degrees more than the ambient water temperature.

Existing controls related to other platform discharges include:

- The open drains caisson will be designed to ensure that there is no visible oil sheen and to discharge at a depth of 48m below sea level;
- The open drains caisson design will include a facility to manually sample the effluent in the open drains caisson. The sampling system shall be a pipe within a pipe;
- Helideck drains, deck wash and deluge from deck drain boxes and from the Drilling Equipment Set (DES) drain gullies shall be routed directly overboard;
- Under routine conditions grey water from the living quarters and black water will be treated in the platform sewage treatment package (STP);
- The platform STP will be designed to:
    - USCG Type II discharge standards of total suspended solids of 150mg/l and faecal coliforms of 200MPN (most probable number) per 100ml;
    - Ensure that a high proportion of the biodegradable surfactants present (greater than 90%) degrade prior to discharge of the treated effluent; and
    - Allow mechanical removal of sludge, which will be contained in dedicated tote tanks and shipped to shore from the ACE platform for disposal in accordance with the existing AGT waste management plans and procedures.
- Under routine conditions laundry grey water will be discharged to sea (without treatment) as long as no floating matter or visible sheen is observable. In the event that the STP is unavailable, all grey water (from living quarters and laundry) will be routed directly to the sewage discharge caisson to maximise the storage volume available for black water;

[3] There shall be no discharge of drill cuttings or drilling fluids if the maximum chloride concentration of the drilling fluid system is greater than 4 times the ambient concentration of the receiving water.

- Organic food waste originating from the platform galley will be macerated to less than 25mm in accordance with MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships requirements and discharged to the sewage discharge caisson;
- Treated black water and grey water will be discharged to sea via the sewage discharge caisson; and
- The sewage discharge caisson will be designed to discharge at a depth of 18m below sea level.

11.4.2 Underwater Sound

11.4.2.1 Event Magnitude

Description

Underwater sound, resulting from the hammering of the platform well conductor sections, drilling of platform wells and vessel movements during operations is described within Sections 5.7.4 and 5.8.8 of Chapter 5.

Assessment

Using the same approach as discussed in Chapter 9: Section 9.4.2.1 an analysis of the propagation of underwater noise was undertaken in order to estimate distances at which various acoustic impacts on marine species may occur. A simplified geometric spreading model was used to understand the magnitude of potential impacts of underwater sound to the biological receptors in the marine environment (seals and fish). The modelling accounts for source sound levels and the propagation of sound over distance.

As described within Chapter 9: Section 9.4.2.1, threshold criteria have been established for a number of species taking into account various sound level metrics and for different levels of potential impact ranging from mortality, physical injury, hearing damage through to behavioural reactions denoted by changes in feeding, breeding, respiration or movement patterns.

Thresholds for physiological damage consider potential permanent and temporary effects on hearing with these defined as permanent threshold shift (PTS) and temporary threshold shift (TTS). These are expressed using sound pressure levels (SPL) and sound exposure levels (SEL). The former is the instantaneous pressure which can be defined as a peak, peak-to-peak, zero-to-peak or RMS (root-mean-square) value while the latter is a measure of received sound energy over some defined period of time. Where criteria thresholds are expressed in both SPL and SEL, the latest advice recommends that the criterion which is exceeded first (i.e. the more precautionary of the two measures) is subsequently used as the operative injury criterion.

Behavioural thresholds are based on observations of individuals or groups of individuals when exposed to sound at a given level. The sound levels involved are lower than those that would give rise to PTS or TTS. The nature of the sound, in terms of its frequency content as well as whether it is continuous or intermittent, governs how the receptor may respond.

Hydraulic Hammering

As described in Chapter 5: Section 5.7.4 the platform well 30” conductors are designed to initially self penetrate and then be driven by hydraulic hammer into the seabed. The underwater sound generated during installation of the conductor section will be similar in nature to the piling noise generated through the impacting of a hydraulically powered hammer onto the end surface of a foundation pile as described in Chapter 10: Section 10.5.5.1. However, in the case of the conductor installation the hydraulic hammer will be located on the platform topside meaning the sound will be mainly emitted above water, with low transmission into the water from air, however some sound will be emitted directly into the water. For the purposes of this ESIA it is conservatively assumed the sound level within the water column from conductor hammering are similar to the levels associated with the installation of the platform foundation piles. The approach taken to the modelling of the use of the hydraulic hammer and the results of the modelling are presented in Chapter 10: Section 10.5.5 which estimated that the underwater sound generated through piling activities would produce a peak source level of 213 dB_{peak} re 1μPa at 1m. Using the geometric spreading model the SPL and SEL at distances from the source were calculated and compared to the applicable threshold criteria to confirm at what distance the threshold is met. The results of the modelling are presented in Chapter 10: Table 10.25.

With reference to seals, as stated in Chapter 10, when quantified in terms of peak units the results of the modelling indicated that PTS is unlikely to arise even when the animals are adjacent to the conductor while TTS is unlikely to arise beyond a range of 2m. When quantified in terms of SEL units, PTS could occur at distances up to 2.3km from the sound source while TTS may arise up to 23.5km both for a 1 hour exposure.

Avoidance behavioural reactions may be classed as a short range impact occurring at distances up to 2m from the conductor. By contrast, limited disturbance reactions such as brief changes in swimming direction and speed may be seen up to 2.3km from the sound source.

For fish exposed to hammering sound, when defined in terms of peak units, mortality and recoverable injury are both short-range impacts likely to occur no more than 4m from the conductor location. For a 1 hour cumulative exposure (SEL units), mortality could occur up to 80m from the hammering location whilst recoverable injury zone extends to 148m from the centre of hammering. TTS, which is also defined in terms of SEL units, might arise at distances up to 2km from the sound source for fish of all hearing sensitivities. There is a moderate risk of both recoverable injury and TTS in eggs and larvae over short ranges.

There are no data to support the establishment of thresholds for recoverable injury or TTS in eggs and larvae. It is considered that there is a moderate risk of either impact over short distances. Neither the terms "moderate" nor "short" are defined in this case.

Taking into account the proposed ACE location is located adjacent to existing commercial shipping lanes and in an area routinely and regularly crossed by supply vessels travelling to and from the offshore oil and gas facilities within the ACG Contract Area (refer to Chapter 7: Section 7.7), background underwater sound levels would be typical for this type of environment. It is assumed therefore that marine life will have become largely habituated to such noise levels and there would be a minimal relative increase to existing levels of disturbance on seals and fish species.

Drilling

Sound will be generated from the platform when drilling is in progress and when not in progress. The sound source levels emitted will consist of drill pipe operation and onboard machinery. The sound will be mainly emitted above water, with low transmission into the water from air, however some sound will be emitted directly into the water. The approach taken to the modelling of drilling noise and the results of the modelling completed are presented in Chapter 9: Section 9.4.2.1.

The findings of the assessment showed that with reference to pinnipeds, PTS is unlikely to arise even when the animals are adjacent to the drilling location. TTS may occur if the animals remain within 2m of the drilling operations for an extended period of 8 hours. There may be some moderate behavioural reactions in seals such as changes in swimming direction and speed at distances up to 5m from the drilling site. At distances beyond this, the likelihood of any observable reactions quickly falls to insignificance.

With regard to fish exposed to continuous sound, as stated in Chapter 9, there is no data to support the establishment of thresholds for mortality, recoverable injury or TTS for fish exposed to continuous sound. It is considered that when exposed to vessel noise for all sizes of vessel there is a low risk of mortality and recoverable injury for fish of all hearing abilities and a moderate risk of TTS in hearing generalist fish at short distances.

As described above, it is considered that the local underwater sound environment would be dominated by existing commercial and oil industry shipping noise and there would be a minimal relative increase to existing levels of disturbance on seals and fish species from drilling activities.

Vessels

The vessels to be used for the supply of consumables to the platform and crew changes during the operations phase are detailed within Chapter 5: Section 5.8.8. The approach taken to the modelling of the vessels and the results of the modelling completed for the smaller vessels and the supply vessels are presented in Chapter 9: Section 9.4.2.1.

As stated in Chapter 9 for the larger support and supply vessels, PTS may arise in seals if the animal remains within 505m of the vessels for an extended period of 1 hour. To avoid TTS, the animals would have to be no nearer than 10.9km to the vessels. Moderate behavioural reactions are likely to be evident from 26m to 116km.

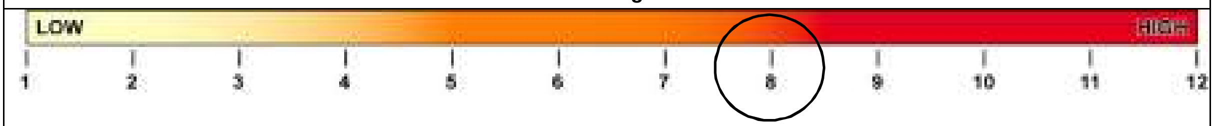
As described above, there is no data to support the establishment of thresholds for mortality, recoverable injury or TTS for fish exposed to continuous sounds. It is considered that when exposed to vessel noise there is a low risk of mortality and recoverable injury for fish of all hearing abilities and a moderate risk of TTS in hearing generalist fish at short distances.

Table 11.8 below presents the justification for assigning a score of 6 to drilling and vessel movements and 8 to hydraulic hammering, which represents Medium Event Magnitude.

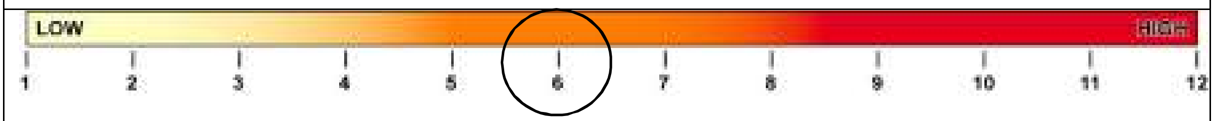
Table 11.8 Event Magnitude

Event Parameter	Drilling	Hydraulic Hammering	Vessels
Extent/Scale	1	3	1
Frequency	1	2	1
Duration	3	1	3
Intensity	1	2	1
Event Magnitude:	**6**	**8**	**6**

Drilling



Hydraulic Hammering



Vessels

11.4.2.2 Receptor Sensitivity

The only relevant biological receptors to underwater sound are seals and fish. Plankton cannot sense the low frequency sound generated because the wavelength is longer than the organism and there is a lack of scientific data to suggest benthic invertebrates do not have sophisticated sound-sensing apparatus.

The sensitivity to seals and fish from underwater sound generated by drilling, vessel movements and hydraulic hammering are described in Chapter 9: Section 9.4.2.2 and Chapter 10: Section 10.5.5.2.

Table 11.9 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 11.9 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	**Fish**: Hearing specialist fish are likely to be present for limited periods of time in the vicinity of the ACE platform. However, these species are widely distributed and do not use this area exclusively. Fish species are able to easily move away from underwater sound before permanent or temporary injury impacts are likely to occur. There may be a change in behaviour but this is expected to be limited to a change in swimming direction and is expected to be short-term. **Seals**: There is potential for low numbers of individual seals to be present in the vicinity of the ACE platform. However, the Caspian seal is a highly intelligent animal and will rapidly move away from any disturbance or sound.	1
Resilience	**Fish**: Individual fish are at very low risk of injury or significant behavioural disturbance and therefore the risk to populations is considered to be even lower and ecological functionality will be maintained. **Seals**: Internationally protected Caspian seals may be present in the vicinity of the ACE platform year round including during spring migration. However the main migration route is typically between the Absheron Peninsula and the western edge of the ACG Contract Area. Caspian seals that may be present in the vicinity of the ACE platform will sense the sound from platform operations and drilling and alter their course away accordingly.	1
Total		**2**

11.4.2.3 Impact Significance

Table 11.10 summarises noise and vibration impacts to marine biological receptors associated with jacket foundation piling and vessel movements.

Table 11.10 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Drilling of platform wells	Medium	(Biological/Ecological) Low	**Minor Negative**
Hydraulic hammering of well conductor sections	Medium		**Minor Negative**
Supply and crew change vessels	Medium		**Minor Negative**

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

11.4.3 Drilling Discharges

As described in Chapter 5: Section 5.7 it is planned that up to 38 wells will be drilled from the ACE platform (assuming six wells are predrilled prior to the platform being installed). Discharges of WBM and cuttings are planned to be consistent with existing ACG drilling practices.

11.4.3.1 Event Magnitude

Description

The anticipated platform drilling activities resulting in discharges to sea are described within Chapter 5: Sections 5.7.1 and 5.7.4. WBM and cuttings will be discharged from the platform cuttings caisson during routine drilling of the 30" and 26" holes and during discharge of residual WBM that cannot be recovered. The worst case estimated quantities of WBM and cuttings discharged per well in tonnes are provided in Chapter 5: Table 5.28.

Assessment

The deposition of the WBM and cuttings discharged to sea from the ACE platform cuttings caisson during drilling of the 30" and 26" hole sections has been modelled using SINTEF's DREAM (Dose-related Risk Effects Assessment Model), incorporating the ParTrack model for modelling solids in the water column and sediment. The full results of the modelling are presented in Appendix 11C.

To assess the area over which cuttings and mud would be deposited the deposition from the drilling of a single well and the cumulative deposition from 38 wells was modelled. It should be noted, however, that it is not planned to drill all wells sequentially. Some wells will be completed, tied in and producing before subsequent wells are drilled. The wells will be located within approximately 2m of each other at a water depth of approximately 137m.

Modelling was based on the expected discharges from the cuttings caisson during 30” and 26” hole drilling. The results of the modelling for 1 well and 38 well discharges during both winter and summer conditions are presented in Figures 11.3 to 11.8 and summarised within Table 11.11.

Table 11.11 Approximate Extent of WBM Cuttings Deposition to 1mm Depth and Maximum Depth of Deposition for ACE Platform Drilling Discharges (1 Well and 38 Wells)

Season	Water Depth	Approximate Extent of Cuttings Deposition to 1mm Depth		Maximum Depth of Deposition (m)	
		1 Well	38 Wells	1 Well	38 Wells
Winter	137m	$7350m^2$	Up to $22400m^2$	1.4	Up to 10.1
Summer		$4350m^2$			

Winter Conditions – 1 Well

As shown in Figures 11.3 and 11.4 under winter conditions it is estimated that the cuttings pile generated through discharge of the mud and cuttings from the 30” and 26” hole sections for a single well will reach a maximum depth of 1325mm. The modelling shows that the maximum worst case area of impact (to the 1mm depth) from the drilling of a single well under winter conditions is approximately $7350m^2$.

Figure 11.3 Cross Section Showing Depth of Deposition from WBM Cuttings Discharged to the Seabed during Drilling of 30” and 26” Hole Sections (1 Well in Winter)

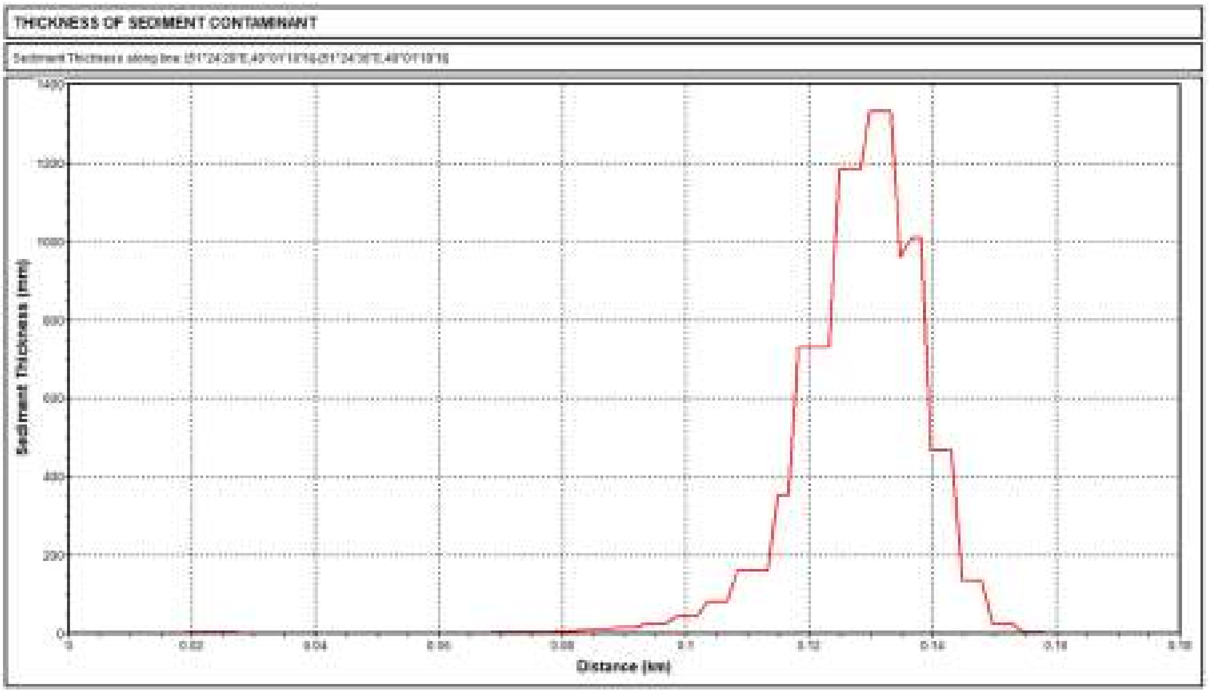
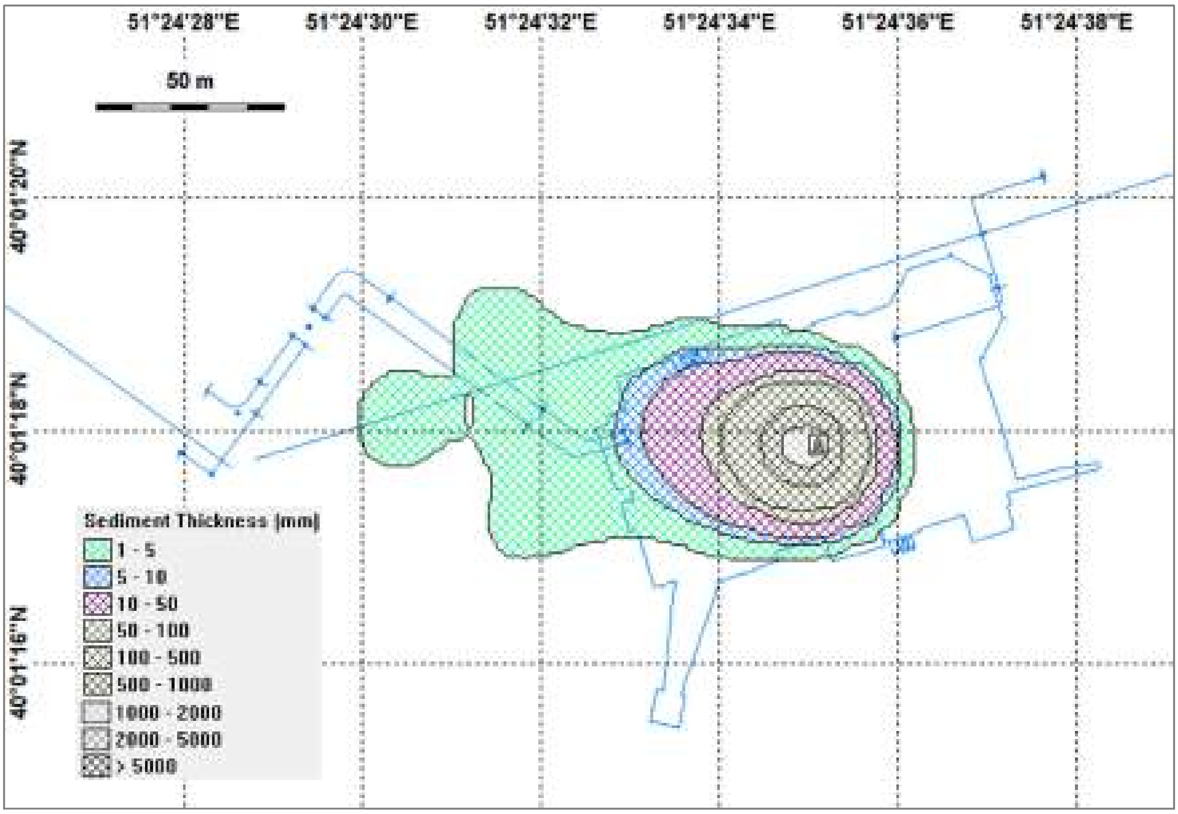


Figure 11.4 Deposition Thickness from Platform Drilling Discharge (1 Well in Winter)



Summer Conditions – 1 Well

As shown in Figures 11.5 and 11.6 under summer conditions it is estimated that the cuttings pile generated through discharge of the mud and cuttings from the 30" and 26" hole sections for a single well will reach a maximum of 1400mm. The modelling shows that the maximum worst case area of impact (to the 1mm depth) from the drilling of a single well under winter conditions is approximately 4350m^2.

Figure 11.5 Cross Section Showing Depth of Deposition from WBM Cuttings Discharged to the Seabed During Drilling of 30" and 26" Hole Sections (1 Well in Summer)

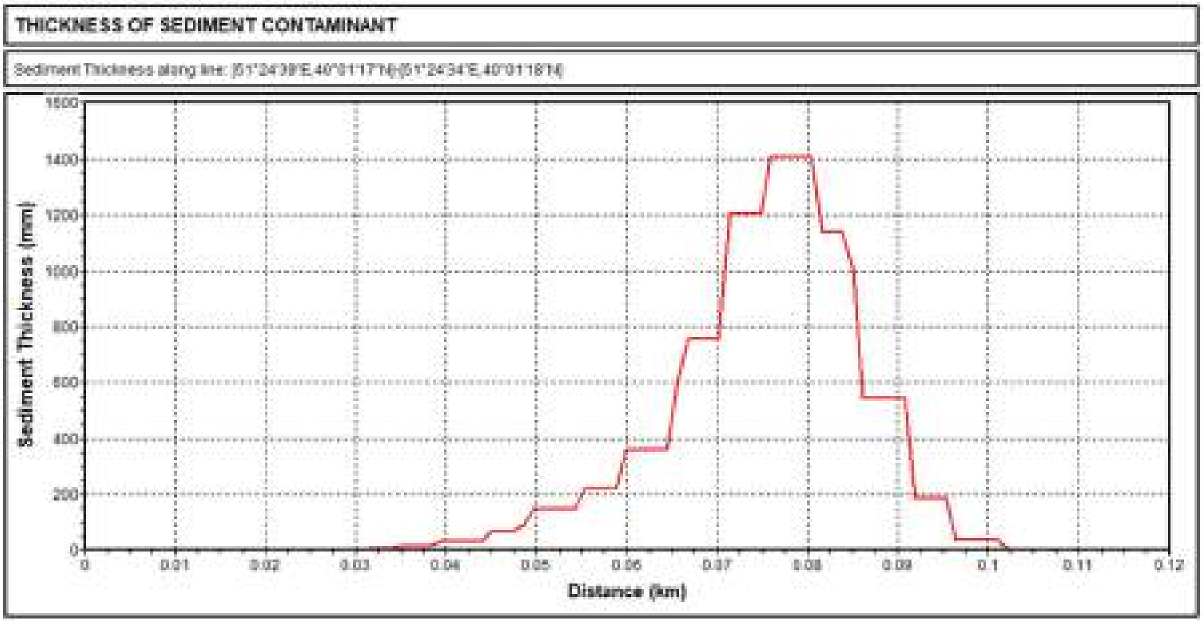
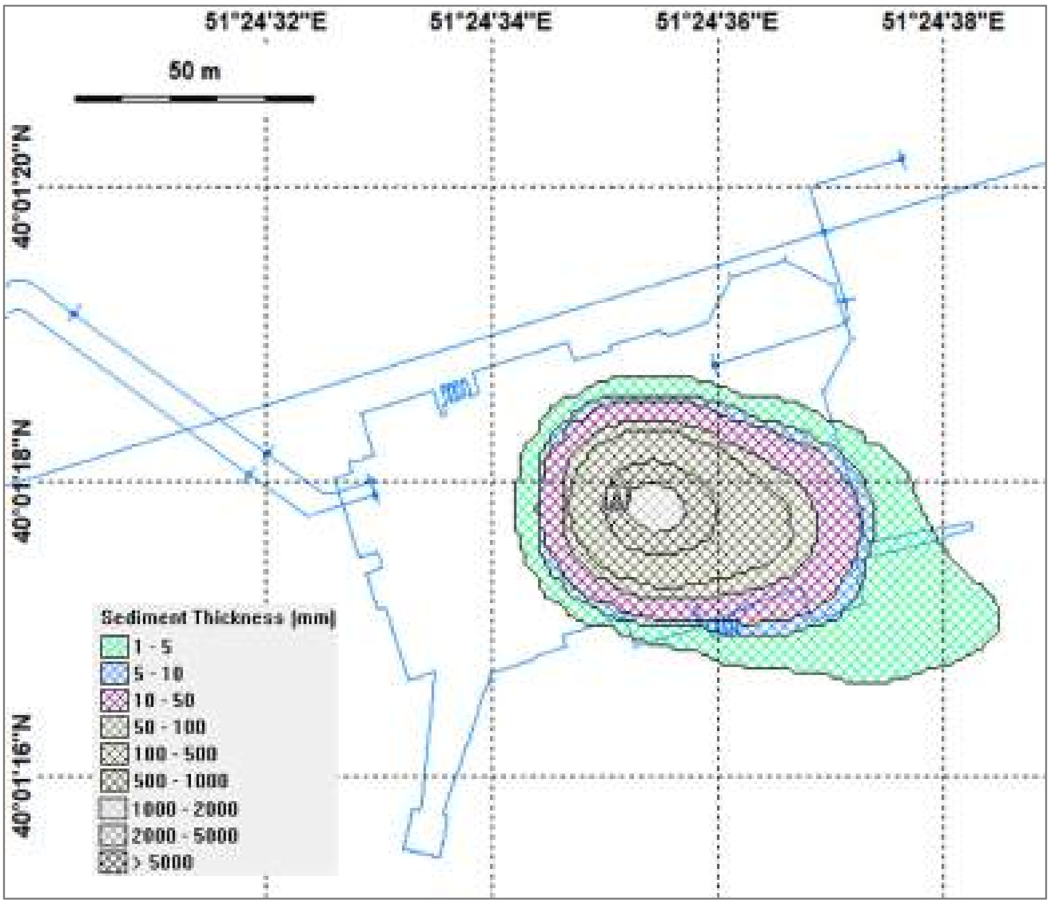


Figure 11.6 Deposition Thickness from Platform Drilling Discharge (1 Well in Summer)



As shown in Figures 11.7 and 11.8 it is estimated that for the drilling of all 38 platform wells, the cuttings pile generated through discharge of the mud and cuttings from the 30" and 26" hole sections over the period of the drilling programme will reach a maximum height of approximately 11000mm. The modelling shows that the maximum worst case area of impact (to the 1mm depth) from the drilling of all 38 platform wells is approximately 22400m^2.

Figure 11.7 Cross Section Showing Depth of Deposition from WBM Cuttings Discharged to the Seabed to the Seabed during Drilling of 30" and 26" Hole Sections (38 Wells)

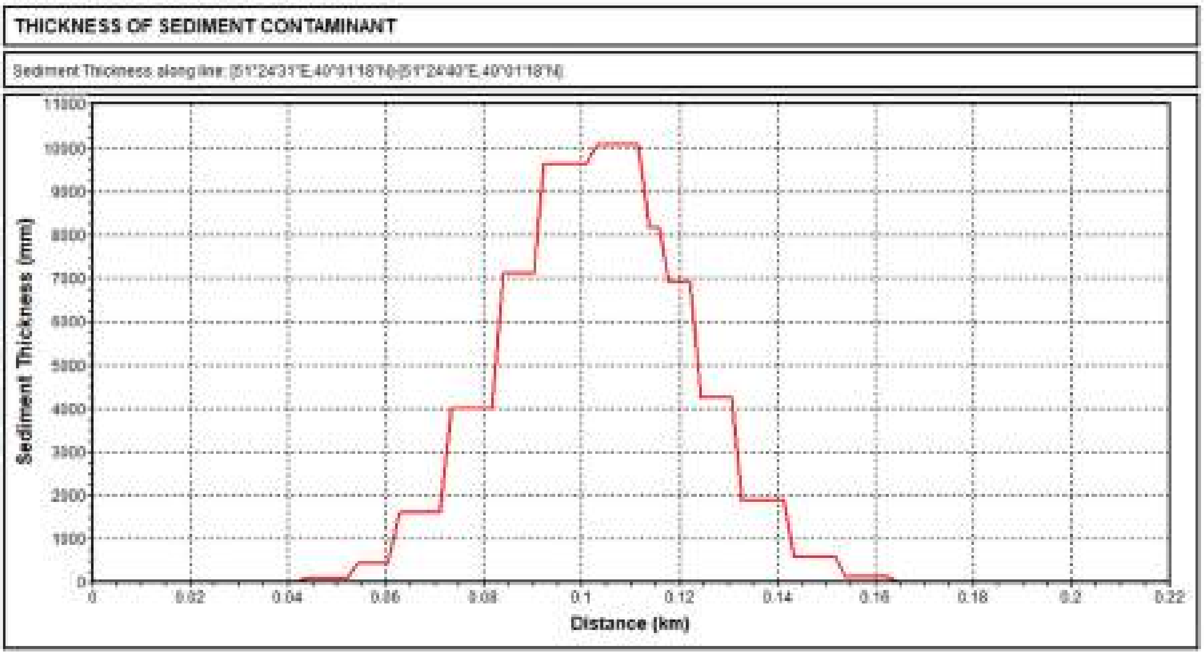
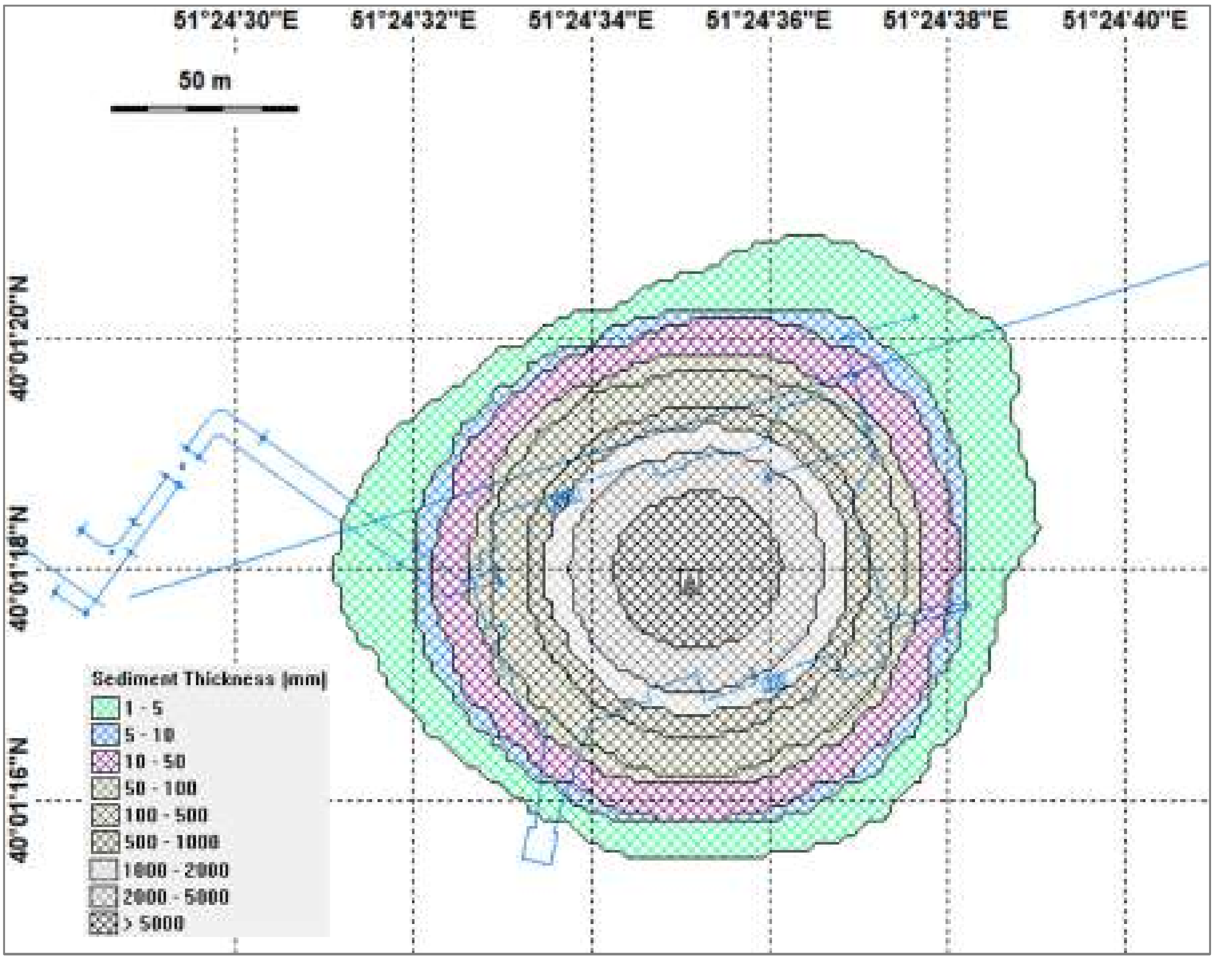


Figure 11.8 Deposition Thickness from Platform Drilling Discharge (38 Wells)



Direct Observation and Measurement

As described in Chapter 9: Section 9.4.3.1, BP have accumulated a substantial amount of direct observational data derived from post-drilling environmental surveys conducted around existing operational facilities in both the ACG and SD Contract Areas. These studies provide direct evidence of the environmental effects of discharges arising from the drilling of multiple wells (over 20 in the case of some ACG platforms) at a single location. The monitoring evidence available to date indicates that the discharge of WBM cuttings is not creating any adverse effects on the benthic invertebrate communities at distances of more than 250m from the platforms. Furthermore, the monitoring has shown that substantial populations can be found in areas of sediment with high barium concentrations and there is little evidence that the structure of the habitat has been substantially altered.

Drilling discharges are assigned an intensity score of 1 for the following reasons:

- A large proportion (at least 70%) of the discharges consists of inert geological material (the cuttings);
- The drilling fluid components are inert or of very low toxicity;
- Only the solid, inert components of the drilling mud will settle to the seabed. Low toxicity soluble components, such as potassium chloride and minor additives, will dilute and disperse in the water column and will have neither acute or persistent effects;
- Evidence from monitoring in the vicinity of drilling operations where WBM cuttings have been discharged shows that there is no accumulation of drilling additives and only a very small effect on the benthos within the 'footprint' of the discharge (up to 500m from the drilling location); and
- The drilling fluids have been the subject of comprehensive testing and assessment and have been approved for use by the MENR for existing operations.

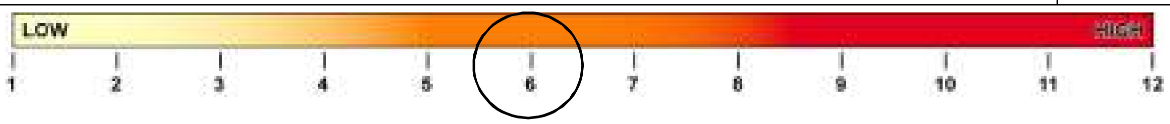
Mud Composition and Toxicity

The anticipated composition and function of the proposed WBM to be used for drilling the 30” and 26” hole sections together with a brief summary of the environmental fate and effects of each component is summarised in Chapter 9: Table 9.16 while the results of toxicity tests on the WBM components proposed to be used for the drilling of the wells are presented in Table 9.17. In summary, the estimated acute toxicity levels would require dilution of WBM, discharged from the platform in accordance with PSA chloride concentration requirements, by a factor of between 31- and 100-fold (depending on the mud composition). The relevant dilution factor would be reached very rapidly following the WBM discharge and the plume of the discharge would be very small, quickly dispersing.

Table 11.12 presents the justification of assigning an event magnitude score of 6, which represents a Medium Event Magnitude.

Table 11.12 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Modelling indicates potential for cuttings deposition (from 38 wells) over an area of 22400m^2. Monitoring has shown evidence of barite at distances of up to 500m from drilling of other ACG/SD wells.	1
Frequency	Discharges of WBM cuttings will occur once for each hole section.	2
Duration	Total duration of discharge is up to 48 hours (per well) which will take place intermittently over the operational life of the ACE platform.	2
Intensity	Drilling discharges are considered to be of low intensity due to the composition and evidence from post well surveys of no accumulation of drilling additives and previous toxicity tests.	1
Total		**6**



11.4.3.2 Receptor Sensitivity

Seals and Fish

Drilling discharges will generate turbid plumes of limited duration and dimension. These plumes will not however, generate chemical contamination of the water column and will not occupy a significant proportion of the local water column. It is anticipated that both fish and seals will avoid the plumes and as such will not be directly affected by the cuttings deposited at the seabed. Table 11.13 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 11.13 Seals and Fish Receptor Sensitivity

Parameter	Explanation	Rating
Presence	**Fish:** Fish species including kilka and mullet will be present in the Contract Area throughout most of the year with other species present during migratory periods. However, the Contract Area is not exclusively used by these species and is not considered to be of primary importance for these species. Fish are highly mobile and sensitive and as soon as they detect the cuttings plume will rapidly move away before any injury occurs and so the risk of any impact to fish is low. **Seals:** There is potential for low numbers of individual seals to be present at the proposed ACE location throughout the year but with an increased likelihood during the spring migration during April/May and during the summer months. However, the Caspian seal is a highly intelligent animal and will rapidly move away from any disturbance and follow its prey, typically kilka.	1
Resilience	Marine mammals are occasionally observed in turbid waters, so some tolerance to localised increases due to drilling discharges is likely while most fish species are found in a range of turbidity conditions, such as coastal and riverine locations with much higher sediment loadings. Possibility that species may be temporarily affected by drilling discharges but effect would be short term and limited and ecological functionality will be maintained.	1
Total		**2**

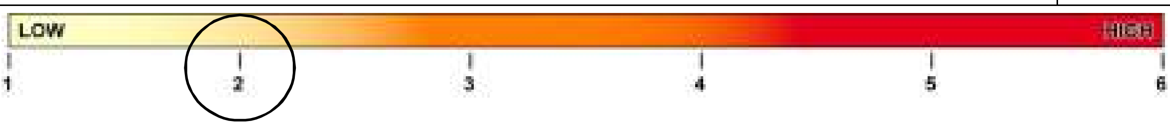
Plankton

Sensitivity of zooplankton and phytoplankton to drilling discharges is discussed in detail in Chapter 9: Section 9.4.3.2. In summary, plankton species are highly resilient to the effects of drilling discharges.

Table 11.14 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 11.14 Receptor Sensitivity (Plankton)

Parameter	Explanation	Rating
Presence	Species not rare or unique on a regional basis. Species are assessed at the community level only. Phytoplankton and zooplankton will be exposed to drilling discharges from the platform cuttings chute.	1
Resilience	Community dominated by widespread and abundant invasive species. Plankton are fast growing, short-lived and respond rapidly to changing conditions.	1
Total		**2**



Benthic Invertebrates

As described in Chapter 6: Section 6.6.2, the benthic invertebrate communities within and in the vicinity of the proposed ACE platform location are similar in species richness and abundance to those across the rest of the ACG Contract Area and the Azerbaijani sector of the South Caspian. The benthic community is numerically dominated by native amphipod crustaceans followed by polychaete, oligochaete and cumacea species, most of which have the potential to reproduce several times a year. There are no rare, unique or endangered species present. With the exception of some bivalves, the dominant taxa are deposit feeders which routinely construct burrows to a depth of 10cm or more (this is why field surveys take samples to a depth of 10-15cm).

As described in Chapter 9: Section 9.4.3.2 routine platform monitoring studies undertaken as part of the EMP provide support for the conclusion that burrowing species can penetrate deposited cuttings, by demonstrating the presence of such organisms in samples taken at locations where barite concentrations indicate the presence of significant amounts of cuttings. In addition the cuttings will be of a similar particle size to their natural sediment, and unlike filter feeders, deposit feeders will not suffer from the clogging of feeding appendages.

Table 11.15 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 11.15 Receptor Sensitivity (Benthic Invertebrates)

Parameter	Explanation	Rating
Presence	No rare, unique or endangered species present. Species are assessed at the community level only.	1
Resilience	Species or community unaffected or marginally affected.	1
Total		**2**

11.4.3.3 Impact Significance

Table 11.16 summarises impacts to biological/ecological receptors associated with platform drilling discharges to sea.

Table 11.16 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Drilling Discharges to Sea	Medium	(Seals and Fish) Low	**Minor Negative**
		(Plankton) Low	**Minor Negative**
		(Benthic Invertebrates) Low	**Minor Negative**

Based on the findings from the surveys, as reported in detail within Chapter 6 of this ESIA, very limited impact on benthic communities has been observed from existing drilling discharges associated with drilling activities within the ACG Contract Area.

The following monitoring and reporting requirements related to drilling discharges form part of the AGT Region EMS:

- Should the composition of the mud system be altered during the drilling programme to meet the drilling requirements, the Management of Change Process will be followed (Chapter 5: Section 5.13). As a minimum, tests in accordance with Caspian Specific Ecotoxicity Procedures will be undertaken if the WBM system is changed and the results submitted to the MENR;
- Each batch of barite supplied for use in WBM will be tested by the supplier to confirm cadmium and mercury content;
- When WBM and cuttings are discharged from the platform the chloride concentrations will be analysed twice a day;
- Volumes and composition of WBM and cuttings discharged at the end of each well section and chloride concentrations will be recorded daily during discharge events;
- Monitoring of potential effects on seabed and benthic communities will be carried out in accordance with the EMP. EMP monitoring results will be submitted to the MENR on an annual basis; and
- The platform well Environmental Report submitted to the MENR following the completion of the drilling activities will include the following relevant to drilling discharges:
    - o Volumes of drill cuttings and drilling fluids discharged;
    - o Volume of drilling chemicals used;
    - o Chloride concentrations of discharged drilling fluids; and
    - o Mud type and mud system associated with discharged drilling fluids and associated chemical names and OCNS categories as appropriate.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

11.4.4 Cement Washout Discharges

As discussed within Chapter 5: Section 5.7.8.1 it is expected that residual cement in the platform cement system will be discharged from the platform following the completion of cementing the well casings.

11.4.4.1 Event Magnitude

Description

Cementing discharges will occur from wash out activities where cement remaining in the platform cement system will be slurrified with seawater (approximately 10:1 dilution), and will be discharged from the platform via the cuttings caisson. The discharge of dilute cement slurry is estimated to take approximately an hour at a rate of 1.3m^3 per minute. This rate of discharge is equivalent to approximately 250kg of cement per minute. The discharges will occur at the end cementing the 24" and 16'' liners as well as 20", 13$^3/_8$" and 9$^5/_8$" casings and will last no more than one hour each.

Assessment

It is expected that the composition of the cement washout discharged from the platform will be the same as the cement washout during predrilling described in detail in Table 2 of Appendix 5C. As per the cement used during predrilling the principal component is Class G cement, which is an environmentally inert solid.

The cement washout discharges were modelled during summer and winter conditions in order to establish the extent of any turbidity plume. Figures 11.9 and 11.10 illustrate the plan and cross-section views of the plume two hours after the start of a discharge during summer conditions. At this point, particulate concentrations within the plume are in the 5-50mg/l range, and therefore too low to have an adverse turbidity effect. The horizontal and vertical extents of the plume are approximately 200m and 8m (at seabed) respectively at this time. The modelling indicates that the plume will have completely dispersed to particulate concentrations of less than 5mg/l within 5 hours 30 minutes during both summer and winter conditions and within a distance of 1.4km (summer) and 0.78km (winter). The modelling also indicates that approximately 2% of the cement solids would be deposited on the seabed within 2.5km of the point of discharge (summer) and approximately 3.3% in winter, and that no significant seabed deposition would occur at any location. Full results of the modelling for discharges under both summer and winter conditions are presented in Appendix 11C.

Effects in the water column will be minor, and will be restricted to within a short distance from the point of discharge. Both solids and chemical dispersion plumes will disperse rapidly following cessation of discharge, and therefore:

- No single discharge event will have a marked impact; and
- The successive discharge events at any well will not overlap and will not have cumulative impact.

Figure 11.9 Plan View of Cement Wash Out Dispersion Plume Two Hours after Start of Discharge (Summer)

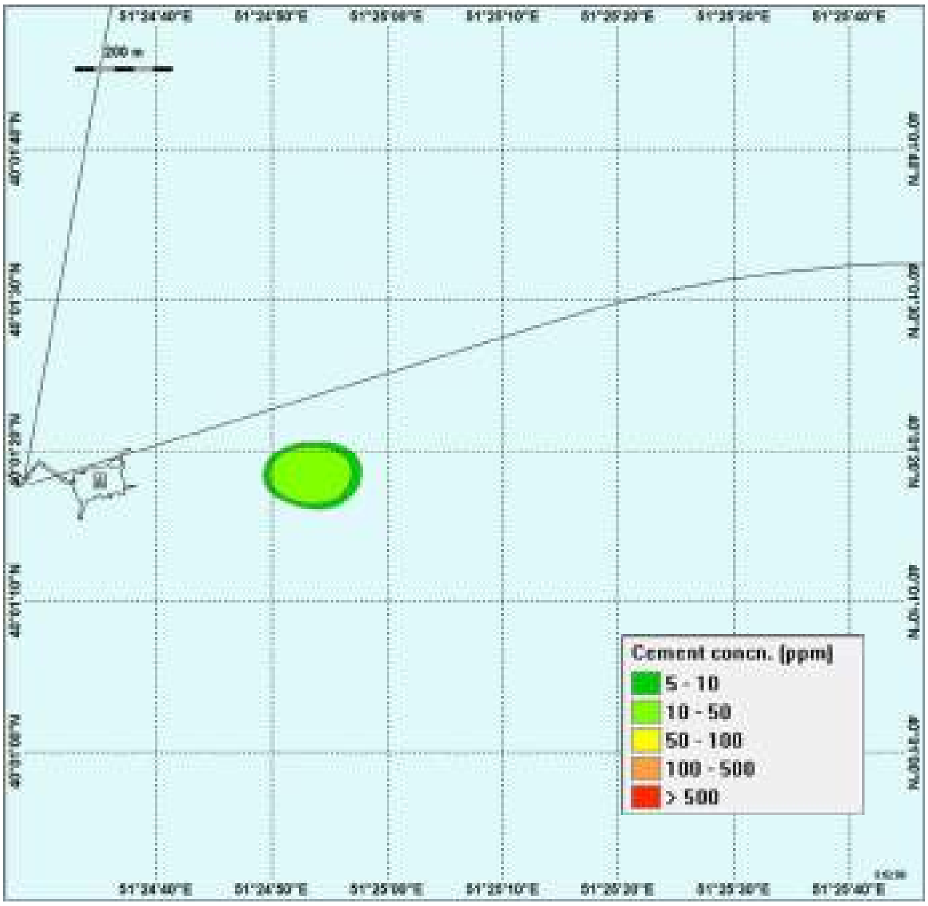


Figure 11.10 Cross-Section of Cement Wash Out Dispersion Plume Two Hours after Start of Discharge (Summer)

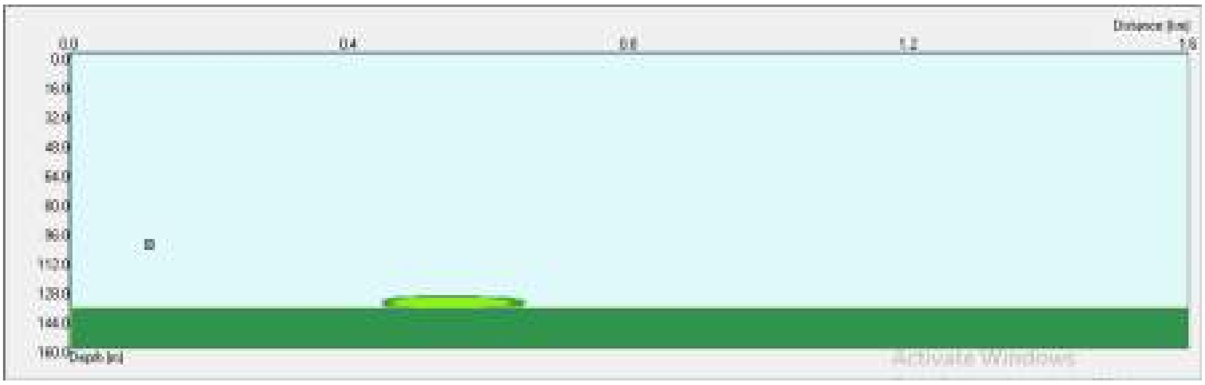
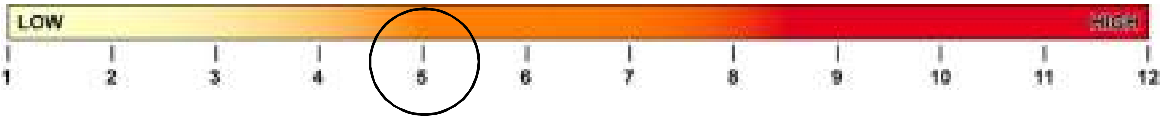


Table 11.17 presents the justification for assigning a score of 5 to cement discharges from wash out, which represents Medium Event Magnitude.

Table 11.17 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Modelling indicates the majority of cement from washout will not extend more than 500m from the platform	1
Frequency	Discharges of cement washout will occur following liner and casing cementing for each well.	2
Duration	Total duration of discharge is up to 1 hour (per well)	1
Intensity	Cement washout comprises water and primarily inert materials	1
Total		**5**



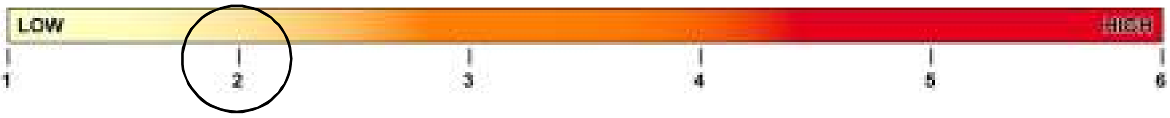
11.4.4.2 Receptor Sensitivity

The discharge of cement wash out will form a limited plume extending no more than 200m, comprising settling solids and soluble, low-toxicity chemicals. The quantity of solids is low compared to a WBM discharge, and will not cause significant turbidity or significant deposits on the seabed. The soluble chemical constituents are of low toxicity and low persistence, and will dilute rapidly, with minimal impact on fish and plankton.

Table 11.18 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 11.18 Receptor Sensitivity (Seals and Fish/ Zooplankton/ Phytoplankton)

Parameter	Explanation	Rating
Presence	Toxicity and persistence of cement components is low, and cement will settle (solids) or disperse (soluble components) rapidly. Receptors present only within limited plume which is of limited persistence.	1
Resilience	No rare, unique or endangered species at significant risk of exposure.	1
Total		**2**



11.4.4.3 Impact Significance

Table 11.19 summarises impacts to seals and fish, zooplankton and phytoplankton from cement washout discharges.

Table 11.19 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Cement Unit Wash Out Discharges	Medium	(Seals & Fish/ Zooplankton/ Phytoplankton) Low	**Minor Negative**

The assessment has demonstrated that a Minor Negative impact is predicted from cement washout discharges.

The following monitoring and reporting requirements related to cement discharges form part of the AGT Region EMS:

- Monitoring of potential effects on seabed and benthic communities will be carried out in accordance with the EMP. EMP monitoring results are submitted to the MENR on an annual basis; and
- The volume of cementing chemicals used and discharged will be recorded daily and included within the platform well Environmental Report submitted to the MENR following drilling and cementing activities.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

11.4.5 Seawater System Intake and Cooling Water Discharge

Seawater will be continuously uplifted to the ACE platform during the operational phase and the portion used for cooling continuously discharged (refer to Chapter 5: Section 5.8.6.7).

11.4.5.1 Event Magnitude

Description

An indirect seawater cooling system will be located on the ACE platform. Seawater will be abstracted from a depth of 106m below sea level via two of three seawater pumps located on the platform, each designed to lift up to 2,187 m^3/hr, and sent to the platform users.

The lifted seawater will be dosed within the seawater lift caisson to achieve concentrations of 50 parts per billion by volume (ppbv) of chlorine and 5 ppbv copper. This is accomplished by sending a small stream of the lifted water to a treatment package and returning the treated water to the seawater lift caisson at the pump suction. The seawater is then filtered to remove any particles that are above 150 microns in diameter. After use, part of the lifted seawater (up to 3410m^3/hr) will be returned to the Caspian, via the seawater discharge caisson (at a depth of 46m below sea level).

Assessment

Modelling of the platform cooling water discharge was undertaken (refer to Appendix 11C) considering low and high current conditions and summer and winter conditions. The results predict the distance from discharge at which the temperature at the edge of the discharge plume will be no more than 3°C above ambient would be limited to 12m under summer conditions and 3m in winter conditions.

Modelling undertaken for the West Chirag platform (Ref. 2) for a similar intake rate confirmed that the effect of the velocity gradient would not extend more than 3m from the intake in all directions.

Table 11.20 presents the justification for assigning a score of 8, which represents a Medium Event Magnitude.

Table 11.20 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	**Intake:** The velocity gradient would extend to less than 3m in any direction. **Discharge:** The area within which cooling water discharge effects might occur is limited to within 10m from the point of discharge	1
Frequency	Occurs once.	1
Duration	The cooling water system will operate continuously throughout ACE offshore operations.	3
Intensity	**Intake:** Deemed to be a low intensity activity. **Discharge:** Will met requirement for edge of the cooling water mixing zone (assumed to be 100m from the discharge point) to be no greater than 3°C more than the ambient water temperature. Discharge will contain no harmful persistent materials.	1
Total		**6**

11.4.5.2 Receptor Sensitivity

Biological/Ecological Receptor Sensitivity

The platform cooling water intake velocity will be low and the 200mm diameter mesh installed on the cooling water intake will prevent fish entering the cooling water system. Due to the depth of the intake it is expected that impacts to plankton populations will be negligible as the intake is located considerably below the productive zone. The volume flowrate is also small compared to the water volume in the immediate surroundings of the platform.

As noted above in Section 11.4.5.1, the area and volume of water within which any potentially harmful exposure might occur, is limited to within 12m from the point of discharge, meaning the discharge plume would be very small in size. The temperature gradient at the edge of the plume is likely to be reasonably abrupt, provoking an avoidance reaction in fish and seals (although the probability of an encounter with the plume for either group is very low based on their expected presence and the plume dimensions).

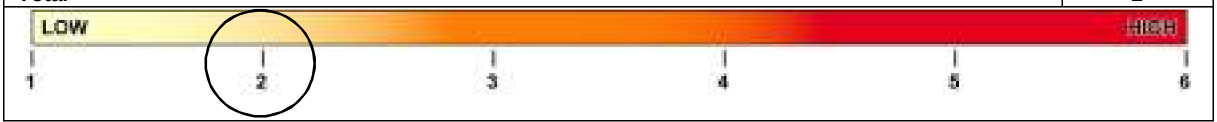
For all plankton, interaction with the discharge plume depends on entrainment from the surrounding water and the process will ensure that individual plankton organisms do not remain in the discharge plume for more than a few tens of seconds.

The cooling water discharge takes place 46m below the sea surface and therefore does not have the potential to interact with benthic invertebrates.

Table 11.21 presents the justification for assigning a score of 2, which represents a Low Receptor Sensitivity.

Table 11.21 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	No significant presence of rare, unique or endangered species	1
Resilience	Exposure is negligible therefore resilience is considered high and a low rating of sensitivity is applied.	1
Total		**2**



11.4.5.3 Impact Significance

Table 11.22 summarises the impact of cooling water intake / discharges to sea on seals and fish, zooplankton and phytoplankton.

Table 11.22 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Cooling Water System Intake / Discharge	Medium	(Seals/Fish) Low	**Minor Negative**
		(Zooplankton) Low	**Minor Negative**
		(Phytoplankton) Low	**Minor Negative**

The design of the intake and discharge process, and in particular the depth at which these occur, will minimise the exposure of marine organisms, which are considered to have low sensitivity. The resulting Minor Negative impact is considered to be acceptable and does not require additional mitigation beyond existing controls.

11.4.6 Offshore Operations – Other Discharges

Other discharges to sea will result from the operation of the ACE platform. These discharges comprise treated black water, grey water, drainage, saline effluent and galley waste.

11.4.6.1 Event Magnitude

Description and Assessment

Other ACE platform discharges comprise:

- **Treated Black Water** – The ACE platform sewage treatment package (STP) treats black water and grey water from living quarters and discharges it via the sewage discharge caisson. Based on average persons on board (POB) of 164 and an expected generation rate 0.1m^3/person/day, approximately 16.4m^3 of treated effluent will be discharged per day. The flow rate is low, so the effluent will be rapidly diluted close to the point of discharge. Total suspended solids at the proposed treatment level do not pose any risk of significant environmental impact.
- **Grey Water** - Laundry grey water will be routinely discharged directly to sea without treatment via the sewage discharge caisson. This will contain only dilute cleaning agents (soaps, detergents) and the impact of the discharge will be minimal. Grey water from the living quarters will be treated in the STP.
- **Galley Waste** – ACE platform galley waste system will be designed to treat food waste to applicable MARPOL 73/78 Annex V: Prevention of Pollution by Garbage from Ships and discharged via the sewage discharge caisson.
- **Platform Drainage** – The ACE platform will be provided with two separate gathering systems: a hazardous area drains system and a non hazardous area drains system. The hazardous area open drains will be routed to the open drains caisson, which is designed to ensure that there is no visible sheen on the sea surface. The non hazardous area open drains will be routed to the non hazardous open drains tank and then to the drilling oily drains tank. Liquids from the oily drains tank will then be pumped to the CRI system. Non hazardous area liquids will be discharged to sea via the open drains caisson, provided that no visible sheen is observable.
- **Saline Effluent from Fresh Water Maker** – Saline effluent from the freshwater maker will be discharged via the platform seawater caisson or directly to the sea surface during periods when freshwater generation exceeds demand. The freshwater maker equipment and floor drains will also be directed to the seawater discharge caisson.

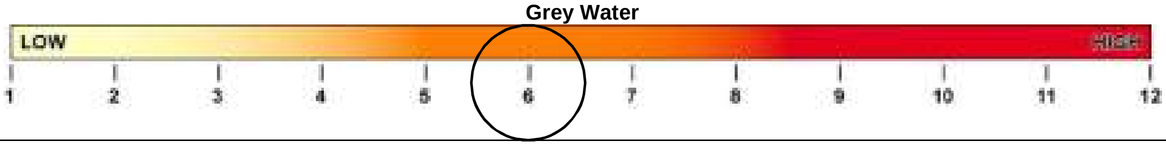
Event magnitude is summarised in Table 11.23.

Table 11.23 Event Magnitude

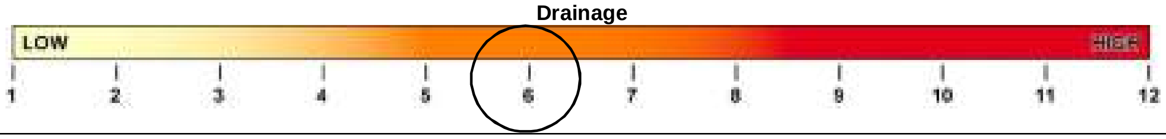
Event Parameter / Discharge	Treated Black Water	Grey Water	Drainage	Galley Waste	Saline Effluent
Scale	1	1	1	1	1
Frequency	1	1	1	1	1
Duration	3	3	3	3	3
Intensity	1	1	1	1	1
Event Magnitude	**6**	**6**	**6**	**6**	**6**

Treated Black Water

Grey Water

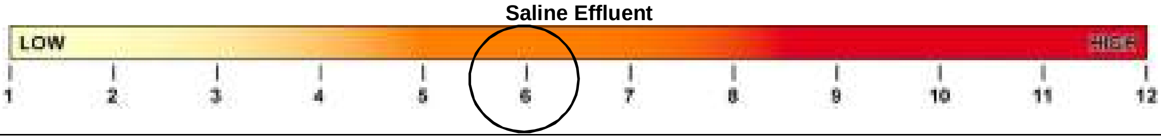


Drainage



Galley Waste

Saline Effluent



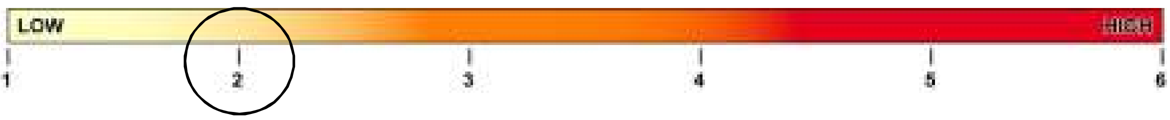
11.4.6.2 Receptor Sensitivity

All of the discharges are low in volume and do not contain toxic or persistent process chemicals and are considered to pose no threat to the environment or the identified biological/ecological receptors i.e. plankton, fish and seals in the water column.

Table 11.24 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 11.24 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	There is no significant presence of rare, unique or endangered species (i.e. the risk of exposure for any such species is close to zero).	1
Resilience	The extremely low level of exposure is equivalent to high resilience.	1
Total		**2**



11.4.6.3 Impact Significance

Table 11.25 summarises the impact to receptors from other offshore discharges to sea.

Table 11.25 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Other Discharges to Sea: **Treated Black Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea: **Grey Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea: **Drainage**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea: **Galley Waste**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea: **Saline Effluent**	Medium	(All Receptors) Low	**Minor Negative**

The following monitoring and reporting requirements related to offshore discharges form part of the AGT Region EMS:

- Samples will be taken from the sewage discharge outlet and analysed monthly for total suspended solids and faecal coliforms;
- Daily visual checks will be undertaken when treated sewage is discharging to confirm no floating solids are observable;
- Sewage sampling results will be recorded as daily observations and estimated volumes of daily treated black water discharges will be submitted to the MENR on a monthly basis;
- For discharge of galley waste, grey water and drainage visual checks will be undertaken when discharging to confirm no floating solids are observable and there is no visual sheen; and
- The estimated volumes of domestic wastes (grey water and galley waste) and drainage discharged will be recorded daily and submitted to the MENR.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

11.4.7 Water Injection Pipeline Pigging Discharges

11.4.7.1 Event Magnitude

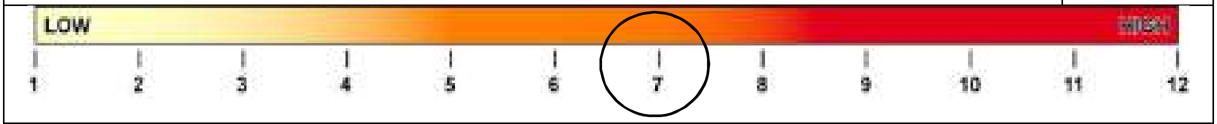
Description and Assessment

As described within Chapter 5: Section 5.8.7 the new infield water injection pipeline between the ACE and CA platforms will be pigged as required to maintain pipeline integrity. Pigging will be carried out from the CA-PDQ platform to the ACE-PDQ platform (i.e. the normal direction of flow). The water injection pipeline will be flushed with seawater prior to pigging. It is estimated up to 950m^3 of water (primarily seawater with some injection water from CA) will be discharged every 3 months during operations comingled with the ACE seawater returns (up to 3,410m^3/hr). Recent modelling for a similar discharge at the CA platform comprising 100% injection water, and hence not taking into account the dilution afforded by the seawater, estimated that the relevant no effect concentration (derived from the most conservative ecotoxicity test sample results obtained for produced and injection water across the ACG offshore facilities) would be reached within 9.5km of the discharge with the plume dispersing within an area of approximately 0.77km^2.

Table 11.26 presents the justification for assigning a score of 7, which represents a Medium Event Magnitude.

Table 11.26 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Discharges associated with pigging of the water injection pipeline are conservatively estimated to affect an area up to 0.77km^2 from the discharge.	2
Frequency	Occurring every 3 months during operations.	2
Duration	Each discharge event is expected to last less than 24 hours.	1
Intensity	Chemicals present in the discharge are approved for use, will be at low concentrations and are readily biodegradable, non bioaccumulative and non-persistent.	2
Total		**7**

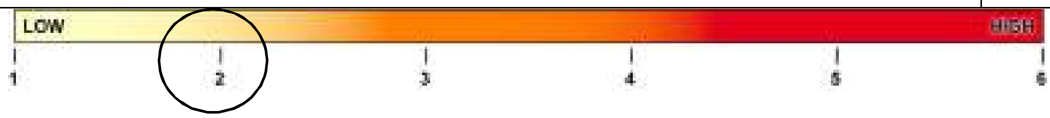


11.4.7.2 Receptor Sensitivity

Table 11.27 presents the justification for assigning a score of 2, which represents a Low Biological/Ecological Receptor Sensitivity.

Table 11.27 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	No rare, unique or endangered species at significant risk of exposure. Plankton most likely to be exposed for brief periods.	1
Resilience	Toxicity and persistence of discharge water is expected to be low. Any limited effects on individual planktonic organisms will not adversely affect local populations.	1
Total		**2**



11.4.7.3 Impact Significance

Table 11.28 summarises impacts to biological/ecological receptors from discharges associated with pigging discharges.

Table 11.28 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Injection Water Pipeline : pigging discharge	Medium	Low	**Minor Negative**

The resulting Minor Negative impact from pigging water discharges is considered to be acceptable, since the volumes will be small and have a low toxicity and does not require additional mitigation beyond the existing controls.

11.5 Summary of the ACE Project Operations Residual Environmental Impacts

For the environmental impacts which the ACE Project has been assessed, it has been concluded that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

Table 11.29 summaries the residual environmental impacts for the operations phase of the ACE Project.

Table 11.29 Summary of ACE Project Operational Phase Residual Environmental Impacts

	Event / Activity	Magnitude				Sensitivity		Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity	Human	Ecological	Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Operation of offshore combustion sources under routine operations	1	1	3	1	2	2	Medium	Low	Minor Negative
	Operation of offshore combustion sources under non routine operations (maintenance)	1	2	1	1					
	Operation of offshore combustion sources under emergency depressurisation conditions	1	1	1	1			Low	Low	Negligible
Marine Environment	Underwater Sound (Hydraulic Hammering)	3	2	1	2	-	2	Medium	Low	Minor Negative
	Underwater Sound (Platform Drilling)	1	1	3	1					
	Underwater Sound (Vessels)	1	1	3	1					
	Drilling Discharges to Sea	1	2	2	1	-	2	Medium	Low	Minor Negative
	Cement Wash Out Discharges	1	2	1	1	-	2	Medium	Low	Minor Negative
	Cooling Water System Intake and Discharge	1	1	3	1	-	2	Medium	Low	Minor Negative
	Offshore Operation: Other Discharges to Sea: **Treated Black Water**	1	1	3	1	-	2	Medium	Low	Minor Negative
	Offshore Operation: Other Discharges to Sea: **Grey Water**	1	1	3	1	-	2			
	Offshore Operation: Other Discharges to Sea: **Drainage**	1	1	3	1	-	2			
	Offshore Operation: Other Discharges to Sea: **Galley Waste**	1	1	3	1	-	2			
	Offshore Operation: Other Discharges to Sea: **Freshwater Maker Saline Effluent**	1	1	3	1	-	2			
	Injection Water Pipeline Pigging Discharges	2	2	1	2	-	2	Medium	Low	Minor Negative

11.6 References

Ref. No.	Title
1	URS, 2004, Azeri, Chirag and Gunashli Full Field Development Phase 3 ESIA
2	URS, 2010, Chirag Oil Project (COP) Environmental & Socio-Economic Impact Assessment.

12 Social Impact Assessment, Monitoring and Mitigation

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12.1 Introduction

This Chapter of the Environmental and Social Impact Assessment (ESIA) describes the social impacts, and planned mitigation and monitoring measures associated with the Azeri Central East (ACE) Project. The potential social impacts and planned mitigation and monitoring measures associated with the ACE Project have been determined based on the activities described within Chapter 5: Project Description; and the potential for interactions with social receptors identified in Chapter 7: Social Description.

In accordance with the impact assessment methodology (Chapter 3 of this ESIA), Scoping of the ESIA has been undertaken to identify Project activities that may be “scoped out” from the full impact assessment process based on Event Magnitude and likely receptor interaction (refer to Appendix 12A). Those activities that have not been scoped out are described, assessed and quantified, where possible, in accordance with the impact assessment methodology defined in Chapter 3.

The assessment of social impacts for the ACE Project takes into consideration experience gained from the Azeri Chirag Gunashli (ACG) Phases 1-3, Chirag Oil Project (COP), and Shah Deniz Stage 1 (SD1) and Shah Deniz Stage 2 (SD2) projects. The ACE Project is predominantly an offshore development with the majority of ACE Project related activities taking place within the ACG Contract Area offshore. Onshore activities will be limited to yard construction. It is anticipated that the same existing onshore construction yards that have been used previously for ACG and SD construction activities will be used for ACE Project activities. The social impacts associated with the ACE Project are similar to those previously assessed for COP and to those associated with the SD2 Project construction yard and offshore Contract Area activities (e.g. the creation of local employment, training and skills development of the workforce and the procurement of goods and services from local businesses).

The scale of impacts assessed in this Chapter includes changes that are predicted to occur at a local, regional and national level as a result of the Project.

12.2 Assessment of Scoped-Out Activities and Events

The scoping process has used professional judgement based on prior experience of similar Activities and Events for similar projects in Azerbaijan and across the world. The process has resulted in the scoping out of a number of ACE Project Activities and associated Events based on their limited potential to result in discernible social impacts, or if they have been already assessed in other Chapters of the ESIA. Justification for the scoping out of specific Activities and Events is presented below for the following:

- Community disturbance from construction yards;
- Community health and safety;
- Disruption to road users from construction related traffic; and
- Disruption to small-scale fishing, commercial fishing and commercial shipping operations from the enforcement of marine exclusion zones.

12.2.1 Community Disturbance from Construction Yards

As described in Chapter 5: Section 5.4.1.5 the construction yards to be used for the fabrication of the ACE jacket and topside, as well as elements of the subsea infrastructure, are yet to be confirmed. For the purposes of the ESIA it has been assumed that a combination of yards used for previous ACG and SD projects will be utilised. No major upgrades or modifications at the potential construction yards to be used for the ACE Project have been identified. All the potential yards are existing industrial sites with few residential premises in near proximity to their site boundaries.

An assessment of potential noise and air quality impacts from ACE Project activities at the construction yards, including description of existing control and mitigation measures, is provided in Chapter 10: Construction, Installation and HUC Impact Assessment. The assessment concludes that the potential for disturbance to occur from construction yard activities to residential receptors is minor.

The yards are well established and have been in operation for more than 10 years undertaking construction activities for the oil and gas industry. Information on the construction yards contractors' environmental management systems and plans that will be implemented for the ACE Project are described in Chapter 14: Section 14.2.2. The potential for significant community disturbance to occur from ACE Project related construction works is limited.

12.2.2 Community Health and Safety

As described in Section 12.2.1 above the ACE onshore construction activities will be undertaken within existing construction yards. Each of the potential construction yards have existing controls and plans in place to manage health and safety risks and interaction with the local community (refer to Chapter 14: Section 14.2.2). As these yards have been used for previous BP projects their plans have been developed over the years to meet BP's health, safety, security and environment project requirements. Taking this into account, impacts to community health and safety are expected to be negligible.

12.2.3 Construction Traffic

Each of the potential construction yards is located in close proximity to the Baku-Salyan Highway which will be the primary route used for the transport of construction materials and workforce on a daily basis. Road users may experience temporary disruption (in the order of hours) through potential delays associated with the transport of oversized and heavy loads and additional traffic associated with deliveries. To minimise the number of vehicle movements associated with the ACE Project, the use of buses to transport the construction workforce to site will be maximised.

BP and its main construction contractors have implemented successful driving and vehicle management plans during the previous ACG projects and most recently for the SD2 Project. In order to ensure that any disruption to road users is minimised from increases in traffic and the transport of oversized and heavy loads during the ACE Project, a Transportation and Traffic Management Plan will be developed and implemented by each of the yard's main construction contractors. Each Plan will require a risk assessment to be undertaken prior to the transportation of oversized and heavy loads which will include an inspection of the transport route for obstructions and hazards, the requirement for traffic diversions and the use of lifting, loading and rigging equipment. The Azerbaijan Ministry of Transport and the State Police will be notified in writing before the scheduled movement of oversized and heavy loads, and the exact time and date of the movement will be agreed. Once approved, oversized and heavy loads will be accompanied by front and back escort vehicles equipped with appropriate warning signage and/or lights as required. All received grievances associated with vehicle movements will be logged and appropriate corrective action determined in accordance with the Transportation and Traffic Management Plan.

Overall the impact to road users from the use of the road network for the Project is considered to be negligible.

12.2.4 Commercial Shipping and Fishing Operations

Vessels will be used throughout the ACE predrilling, offshore construction and installation activities with supply vessels required during operations as described within Chapter 5. There is potential that these activities could interfere with commercial shipping and fishing and potentially result in economic displacement due to an increase in travel time and the quantity of fuel consumed by vessels or by restricting access to fishing grounds.

For safety reasons marine exclusion zones will be enforced around key offshore activities as follows:

- Predrilling: 50m radius exclusion zone around the drilling rig for the duration of the predrilling activities;
- Infield pipelay: 500m exclusion zone either side of the route of the ACE subsea infield pipelines for the duration of the pipelay activities;
- Jacket and topside installation: 500m radius around the barge transporting the jacket and topside offshore to the ACE location; and

- ACE platform: 500m radius around the platform following installation.

These activities will all be located within the offshore ACG Contract Area (approximately 120km east from Baku) with the exception of the jacket and topside installation activities, which will involve transporting the jacket and topside from the yard quayside to the proposed ACE platform location over a period of approximately 40 days.

As described in Section 7.7 and illustrated in Figure 7.2 of Chapter 7 there are two main shipping routes that pass through the southern end of the ACG Contract Area. A vessel tracking study undertaken in 2017 to monitor vessel movements in the vicinity of the proposed ACE platform location showed the highest density of shipping is to the south of the proposed ACE platform location and hence the exclusion zones enforced during the installation and operation of the ACE facilities are unlikely to cause disruption to commercial shipping activities in this area.

There are however a number of commercial shipping routes located between the Azerbaijan coastline and the ACG Contract Area. It is possible that there will be minor disruption to commercial vessels using these routes during transport of the ACE topside, jacket and associated equipment from the construction yards to the proposed ACE platform location. However, these vessels will be continuously moving and will not be present in an area for any significant period of time.

As the majority of commercial shipping operations that occur are directly related to the oil and gas industry mariners working in the area of the Southern Caspian Sea are used to avoiding marine exclusion zones and any economic displacement or disruption to services is anticipated to be negligible.

Similarly, Chapter 7: Section 7.6.2.3 indicates that commercial fishing is not routinely undertaken within the ACG Contract Area and only two legal entities and individuals are currently undertaking commercial fishing in the Southern Caspian, including the ACG Contract Area. The proposed ACE platform location is not located near any important commercial fishing grounds such as the Makarov Bank (refer to Figure 7.2). The 2017 vessel tracking study conducted over 12 weeks from the end of May to the end of August showed that no fishing vessels fitted with AIS passed within 10 nautical miles of the proposed ACE platform location during the period of the study (refer to Figure 7.2). However, it should be noted that this study was conducted just outside the fishing high season (which is typically March to April) and it is also possible that fishing vessels without AIS fitted could have operated in this area. Nevertheless, given the lack of fishing effort known to occur within the ACG Contract Area and the distance between the proposed ACE platform and the important commercial fishing grounds the potential for interference to fishing activities and associated economic displacement is anticipated to be negligible.

As small-scale fishing is undertaken within 2-3 nautical miles of the shore, and locations where small scale fishing is known to occur are remote from the anticipated construction yards and supply bases where the ACE activities are expected to occur, the potential impact to small-scale fishermen is anticipated to be negligible.

Control measures included in the Project design to minimise potential impacts from interference with other commercial shipping and fishing include the following:

- A Notice to Mariners will be issued in advance of the offshore Project activities to warn mariners of the presence of nearshore and offshore activities and the position/duration of marine exclusion zones;
- The location of the ACE platform will be clearly marked on marine navigation charts provided to the appropriate relevant authorities;
- All vessels will operate in compliance with national and international maritime regulations for avoiding collisions at sea, including the use of signals and lights; and
- Any grievances raised by affected commercial shipping companies or fishermen will be managed through a grievance procedure which sets out the processes through which complaints are logged and recorded; and the approach to managing the complaint in an appropriate and timely manner. Where corrective actions are required, they will be implemented effectively and in a timely manner.

12.3 Impact Assessment

12.3.1 Employment

As set out in Chapter 5: Section 5.12, it is anticipated that the ACE Project will generate a number of employment opportunities over the Project duration with the greatest number of jobs generated during the construction phase.

The main construction and installation contractors (including their sub-contractors) used by BP during the ACE Project are required to develop and implement their own Employee Relations Management Plan (ERMP) which will include, as a minimum, the following:

- Project labour arrangements including the need to recruit new labour and potential sources of new workers;
- How the contractor will comply with the national requirements of Azerbaijan labour law;
- Details of a grievance mechanism that is available for use by the workforce;
- Training and development activities in the form of a Training and Development Plan;
- Demobilisation and demanning (see Section 12.3.2);
- A nationalisation programme;
- Cultural awareness and language familiarisation; and
- Statistical reporting and monitoring associated with employment and training.

Site specific Labour Management Forums (LMF) will be established by BP and regular meetings will occur between the BP project site management team and the main construction and installation contractors to discuss workforce welfare and related matters. The role of the LMFs are to undertake:

- A regular review of labour management performance and identify any trends;
- A review of work plans within the site for the next three to six months, discussing labour requirements and potential risks for labour management;
- Review the actions taken to mitigate the identified risks; and
- Discuss the results of statistical monitoring and the content of reports which have been submitted to BP.

Main construction and installation contractors and their sub-contractors will actively design and implement training and skills development programmes for their national staff. Main construction and installation contractors will prepare and submit a Training and Development Plan to BP on an annual basis which will include details of the training initiatives being undertaken in the next 12 months, and a summary of training activities completed in the past 12 months. BP will conduct periodic reviews of contractors' ERMP and Training and Development Plan implementation.

12.3.1.1 Event Magnitude

Based on experience from the previous ACG projects the ACE Project is anticipated to generate employment opportunities similar to those arising from the construction of COP due to the similar scope and scale of COP to the ACE Project. It is anticipated that the main construction yard contractors for the ACE Project will employ between approximately 650 and 3,700 people over the duration of the construction and commissioning works with employment numbers anticipated to peak at 3,700 people during 2021. During the operational phase, approximately 160 permanent jobs will be created offshore by the ACE Project.

Every effort will be made to re-hire workers who have demonstrated competence whilst working on previous oil and gas construction projects. Upon hiring workers, a gap analysis will be undertaken by the main construction and installation contractors between relevant competence criteria and the contractor’s Training and Development Plan. Where gaps are identified training will be provided to bring each worker up to the minimum standards for the role expressed in the Training and Development Plan The training will commence before the start of construction activities and will continue throughout the ACE Project.

12.3.1.2 Receptor Sensitivity

As discussed in Chapter 7: Section 7.4.2.2 BP projects (construction and operations) have historically had a significant impact on local and regional employment levels. Among job seekers based in the local communities, there are high expectations associated with the provision of employment, training and skills development activities. This is partly a result of the previous employment and training provided by BP during the ACG Phases 1-3, COP and SD1 and SD2 projects. Receptor sensitivity is considered to be 'high'.

12.3.1.3 Assessment

The benefits of employment to successful job seekers are expected to include, at a household and individual level, an increase in socio-economic status, improvement to their quality of life and living conditions, and the benefits from greater household expenditure on education and healthcare resources. Employment will benefit a greater number of individuals than the total workforce number, as positive changes at a household level will benefit partners (including women), relatives and young people. Increased household expenditure also increases local economic activity, thereby creating further economic benefits to the local communities.

It is expected that almost all (temporary or permanent) employed workers will benefit from the provision of training and skill development activities during the ACE Project. Such activities will commence before the start of construction activities as workers will be required to undergo competency-based training to undertake their role to the standard required. Similar to the previous ACG Phases 1-3, COP and SD1 and SD2 projects, the training and skills development activities will include the enhancement of technical skills in parallel with health and safety, information technology and communication/administrative skills. Training and skills development activities will continue throughout the ACE Project, and will provide workers with transferable skills that can be used to obtain future employment positions after their involvement in the ACE Project is complete.

The following workforce monitoring information will be submitted by the main construction and installation contractors to BP on a monthly basis:

- The total percentage of local and non-local employment, broken down for each job category;
- The number of grievances that have been received from the workforce, the actions taken to resolve the grievance and whether the grievance was resolved within 30 days;
- The number of hours lost due to sickness or other reasons of absence (the reason of absence should be recorded); and
- The number of hours of training and skill development activities delivered, broken down into each job category and a percentage of the workforce.

In addition the main construction and installation contractors will be required to maintain records of the workforce demographics e.g. gender, age, the geographical origin of the applicant (the community name) and whether the applicant has any special needs due to a disability or other reason.

BP and their main contractors will implement measures to achieve, or improve if practical, the local content percentages achieved for the previous ACG Phases 1-3, COP, and SD1 and SD2 projects with an ultimate nationalisation target of 90%. Particular objectives for the ACE Project with regard to employment will include preferential hiring of local residents where the relevant skills are available and advertising employment opportunities within the local labour market. It is not anticipated that employment for the ACE Project will require establishment of workforce accommodation or significant migration of populations to the construction areas.

12.3.2 Demanning

As the construction works at the construction yards pass the point of peak activity, the construction contractor's workforce will need to be reduced. This process will be undertaken in accordance with relevant Azerbaijan legislative and regulatory requirements. The existing controls associated with a reduction in employment numbers (referred to as demobilisation) are:

- Development and implementation of the ERMP which specifically includes a requirement to plan for demanning activities;
- Regular communication between BP and the main construction and installation contractors associated with the demanning activities during LMF meetings; and
- Adequate staff communications between the main construction and installation contractors and their workforce which will inform the workforce of project progress and expected completion dates, so they can start to seek alternative employment positions in advance of their position being made redundant. Workforce contracts will set out the terms of the employment including the expected duration of the contract.

12.3.2.1 Event Magnitude

The process of demanning will occur after peak employment is reached in 2021. Employment levels will gradually reduce until the start of Q3 2021 before reducing more rapidly in Q3 2021 and Q1 2022 with ACE Project construction yard activities expected to be completed in Q2 2022. Individuals, who are able to obtain alternative employment, or return to their previous role prior to their involvement in the ACE Project, may experience a temporary change in household income during the transition between employment roles. Workers unable to obtain an alternative source of employment may experience more serious impacts across a longer timescale.

12.3.2.2 Receptor Sensitivity

Receptor sensitivity is considered to be ‘high’ in relation to demanning as the individuals made redundant will be forced to find alternative sources of employment after their involvement in the ACE Project is complete.

12.3.2.3 Assessment

Individuals who are demanned from the ACE Project may experience increased psychological stress associated with the uncertainty of securing future household income and reduction in their household income, general well-being, quality of life and access to private healthcare and educational resources. Changes in the employment status of heads of households may also disrupt family life, personal relationships and the welfare of children.

Despite a period of slow economic growth in 2014-2016 (primarily due to falling oil prices and a decline in total oil and gas production) Azerbaijan has relatively high employment and labour force participation rates and a correspondingly low unemployment rate. There is a variety of regional industrial developments that are either planned or under construction across the Baku City economic region (which includes the Sabayil and Garadagh Districts), which is creating numerous professional and non-professional employment opportunities. However, within the local communities, there are unlikely to be sufficient vacancies available that can immediately absorb the number of workers coming off the ACE Project, many of whom will have similar non-professional skill sets to offer the employment market.

However, the training and skills development activities undertaken during implementation of the main contractor’s Training Plans will include providing practical support to individuals to find alternative sources of employment, which aims to minimise the time workers spend between employment positions.

It is expected that a large proportion of the construction workforce will be able to seek out alternative job opportunities after their involvement in the ACE Project is complete. The provision of training and skills development to the workforce, certificates to provide competence for certain types of professional positions and adequate warning in advance of their position being made redundant, will reduce the impact of demanning to the extent possible. No additional mitigation is required.

12.4 Indirect Socio-Economic Impacts

12.4.1 Increased Economic Flows

The increase in local employment levels within the nearby communities that will occur during the construction phase may result in a rapid, temporary increase in local economic capital flows. While affected individuals and business owners will typically consider this to be a positive change, there is a potential for local inflation to occur through an increase in the demand for the same types of goods and services. Business owners may also seek to maximise the local rise in household income by increasing prices to take full advantage of increased capital that becomes locally available.

A variety of contractors based in Azerbaijan will be used during the ACE Project which will result in an increase to their business revenue. Any increase in business revenue has the potential to benefit business owners through increased profits, the workforce through extended employment contracts, individuals who gain new employment with contractors, and government revenues through the collection of additional tax revenues.

The use of local, regional and national businesses to provide supply chain goods and services to BP's major contractors will be maximised where possible to do so. The use of in-country businesses for the construction of the ACE jacket and topside will support the strong expectation amongst local, regional and national business owners that a significant proportion of the total procurement will be allocated to in-country suppliers. In addition, the procurement of additional goods and services through the supply chain used by the construction yards will further contribute towards socio-economic development at a local, regional and national level.

The ACE Project requirement for professional staff to be preferentially sourced from the local communities may divert individuals from existing professional roles to the ACE Project, with the aim of securing higher paid employment. This may have negative consequences to the local community should professionals leave their current role, particularly if they are currently a professional public worker (e.g. in a governmental or social service role).

The negative impacts associated with increased economic flows cannot be mitigated to any reasonable extent, as BP does not have control over the way in which third-parties will use their additional income, or have any control on which individuals will apply for a professional job in the local workforce. However, lessons learned during the development of earlier ACG and SD developments over the last 20 years will be utilised to maximise economic flows and minimise the potential negative impacts. All job advertisements associated with the ACE Project will emphasise the temporary nature of the employment offered, to try and reduce existing professionals from leaving their current positions. In addition, the salaries of professional roles will be similar to those offered nationally and benchmarked using the most recent data available. The use of benchmarked salaries will avoid large discrepancies occurring between public sector roles and the temporary employment offered by BP's major contractors.

On balance, increased economic flows will result in a positive impact.

12.4.2 Social Conflict

There is the potential for conflict to occur from (perceived or actual) competition between individuals seeking jobs. Such conflicts could occur between members of the same settlement, between individuals from the local communities, or between 'local' and 'non-locals'. Such conflicts may be exacerbated by pre-existing tensions between groups of people and in particular, between non-locals and vulnerable groups (such as internally displaced persons).

Local targets (for professionals and non-professionals) will be used to maximise employment as far as practical for the existing residents of towns in proximity to the construction yards, which will be verified by the prospective employee's identification card and supporting information, in accordance with the ERMP. This will act to minimise the potential for in-migration by job seekers located outside of these communities.

13 Cumulative and Transboundary Impacts and Accidental Events

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13.1 Introduction

This Chapter of the Azeri Central East (ACE) Project Environmental and Social Impact Assessment (ESIA) discusses:

- Cumulative and Transboundary Impacts; and
- Accidental Events that could potentially occur during ACE Project activities and the control, mitigation and response measures designed to minimise event likelihood and impact.

13.2 Cumulative and Transboundary Impacts

As discussed within Chapter 3, cumulative impacts can arise from:

- Interactions between separate project-related residual impacts; and
- Interactions between project-related residual impacts in combination with impacts from other planned projects and their associated activities.

Transboundary impacts are impacts that occur outside the jurisdictional borders of a project's host country.

As outlined in Chapter 1 of this ESIA, the ACE Project comprises the next stage of development of the Azeri Chirag Gunashli (ACG) Contract Area. The earlier Early Oil Project (EOP), ACG Phase 1, 2, 3 and Chirag Oil Project (COP) development phases included the construction of the Chirag-1, Central Azeri (CA), East and West Azeri (EA and WA), Deep Water Gunashli (DWG) and West Chirag (WC) offshore platforms, which are currently operational.

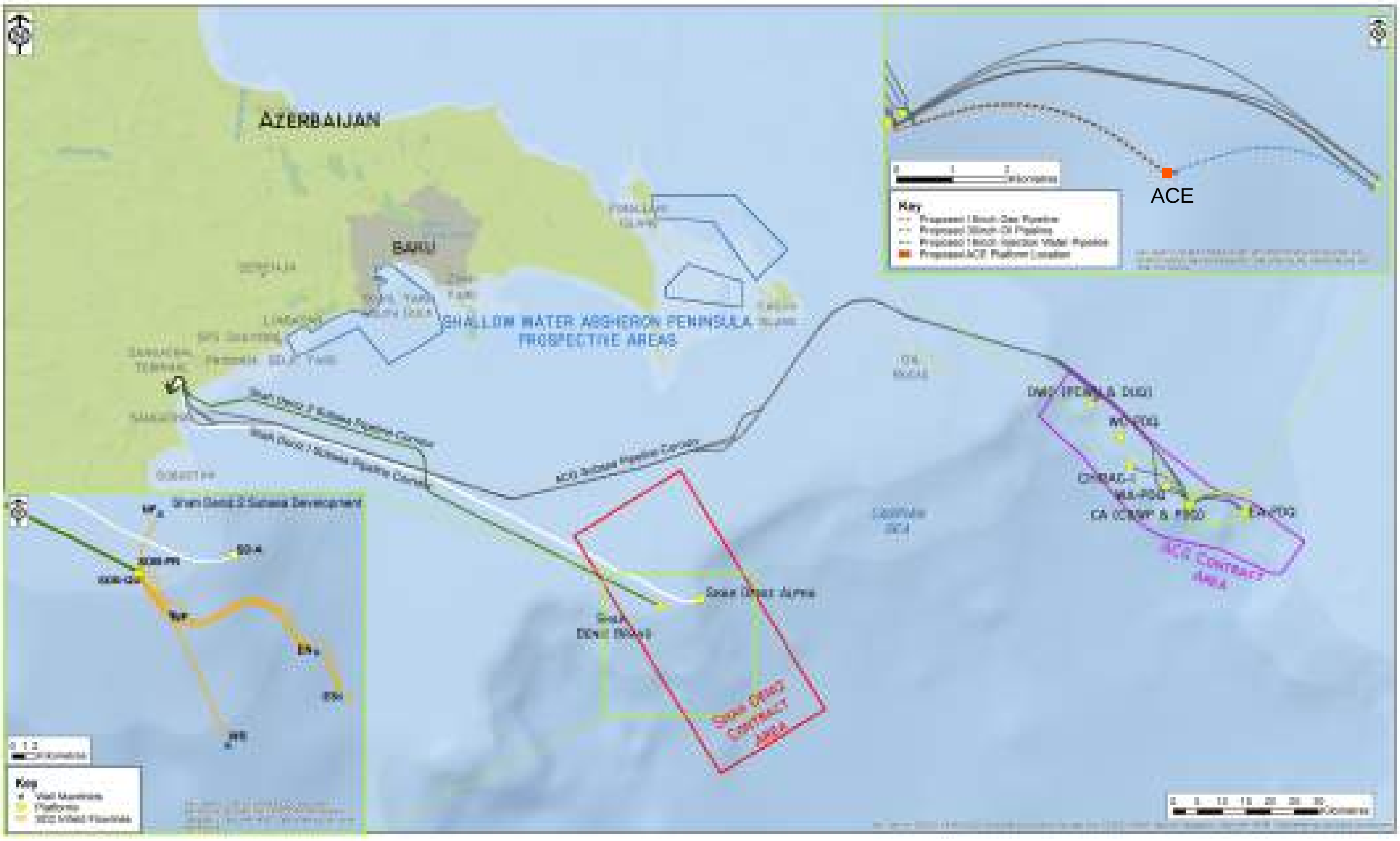
The original EOP development phase included the construction of the oil receiving facilities at Sangachal Terminal (ST), which were subsequently expanded for ACG Phases 1, 2 and 3. The ACE Project does not require any additional facilities at ST (other than minor telecommunication modifications) as there is existing capacity within the ACG Phase 1, 2 and 3 onshore processing facilities to meet the requirements for ACE based on forecast production rates.

Within the adjacent Shah Deniz (SD) Contract Area to the south west of the ACG Contract Area, the Shah Deniz Alpha offshore platform commenced production in 2006 under the SD Stage 1 (SD1) Project with the hydrocarbons sent to operational SD production facilities at ST. Current development within the SD Contract Area comprises activities associated with the SD Stage 2 (SD2) Project. The SD2 Project achieved first gas during 4Q 2018.

A further Contract Area, known as the Shallow Water Absheron Peninsula (SWAP) Contract Area, is located to the west of the ACG Contract Area. BP signed a new Production Sharing Agreement (PSA) with the State Oil Company of the Azerbaijan Republic (SOCAR) in December 2014 to jointly explore for and develop potential prospects within this Contract Area.

The location of the ACG and SD facilities and the SWAP Prospective Areas are shown in Figure 13.1.

Figure 13.1 Location of ACG and SD Offshore Developments and SWAP Prospective Areas



13.2.1 Approach to the Cumulative Assessment

The approach taken to assessing cumulative impacts between individual ACE Project impacts focuses on assessing the potential temporal and geographic overlap between environmental impacts based on the current schedule (refer to Chapter 5: Section 5.2) and the results of modelling assessments demonstrating the expected geographic extent of the impacts (refer to Chapters 9, 10 and 11). A detailed assessment of environmental and social project impacts, based on expected activities and events, is presented in Chapters 9, 10, 11 and 12 of this ESIA. The assessment takes into account each activity and the existing controls and additional mitigation measures identified to minimise and manage impacts. An analysis of the potential for these impacts to overlap and result in additive or synergistic effects within the marine environment and social environment is presented in Sections 13.3 and 13.4 below with potential cumulative and transboundary impacts associated with emissions to atmosphere discussed in Sections 13.5 to 13.7.

The potential for cumulative impacts with other planned projects[1] has been determined based on a review of available information and taking into account geographic and temporal scope of the individual project impacts and hence the potential to result in cumulative impacts in combination with the ACE Project impacts.

The two projects which have been identified as being potentially significant in terms of giving rise to cumulative impacts are the SD2 Project and the exploration activities within the SWAP Contract Area. While SD2 Project operations and first gas commenced in Q4 2018 the effects of the SD2 Project are not captured within the existing baseline conditions against which the ACE Project impacts have been assessed. Therefore, for the purposes of the ESIA, the SD2 Project activities and impacts have been considered within the ACE ESIA cumulative assessment.

[1] The cumulative assessment does not take into account projects or facilities that are operational where their effects are captured within the existing baseline against which the ACE Project impacts have been assessed. The assessment is focused on other proposed BP projects within the vicinity of the proposed ACE Project or those not operational when the baseline was established.

Potential activities within the SWAP Contract Area include the drilling of exploration wells in three prospective areas. At the time of writing the timing of these activities are not confirmed however it may be that drilling of the exploration wells will be in progress when ACE Project activities are underway. Given the distance of the SWAP Prospective Areas from the proposed ACE platform location (over 100km) and the anticipated localised impacts associated with the drilling of each of the three planned exploration wells the potential for cumulative impacts is considered insignificant.

The SD2 Project comprises the fixed Shah Deniz Bravo (SDB) platform complex, drilling and completion of 26 wells, subsea infrastructure tied back to the SDB platform and subsea export pipelines to the Sangachal Terminal. The wells associated with the SD2 Project are located in five clusters around the SD Contract Area and will all be drilled using a Mobile Offshore Drilling Unit (MODU). The wells are tied into a manifold which are tied into the SDB platform complex using flowlines. The SDB platforms are located approximately 115km southwest of the proposed ACE platform.

The SD2 Project construction and installation activities are complete and first gas from the platform commenced in Q4 2018 with wells to date drilled and completed at two well clusters. Ongoing SD2 activities include the drilling and completion of a number of wells at further SD2 wells and installation of remaining subsea infrastructure within the SD Contract Area (including manifolds and flowlines).

13.3 Marine Environment: Cumulative Impacts

13.3.1 Cumulative Impact Between Separate ACE Project Impacts

Environmental interactions will arise from the following ACE Project activities and operations:

- Pipeline installation (physical disturbance);
- Pipeline commissioning (treated seawater discharges);
- Drilling (drill cuttings and drilling fluid discharges during predrill and platform drilling activities);
- Platform installation (physical disturbance); and
- Platform operations.

Physical disturbance associated with pipelaying and platform installation will be primarily restricted to the footprint of the infrastructure and the immediate surroundings. While the platform and infrastructure permanently occupy areas of the seabed, the area affected is small in the context of the ACG Contract Area (less than 0.1%) and the Caspian Sea as a whole. Disturbance in the vicinity of the installation activities will be transient and localised and cumulative impacts are considered insignificant.

Discharges of treated seawater associated with the cleaning and hydrotesting of the infield pipelines will result in a number of discrete and intermittent discharge events occurring over a period of months and varying in volume between 2 and 2545 cubic metres (m^3) (refer to Chapter 5 Section 5.6.3). Additionally, up to 40 discharges of treated seawater associated with the tie-in of spools and subsea structures varying between 1 to 16m^3 are anticipated in addition to the potential discharge of mono ethylene glycol (MEG) (up to 10m^3 per event) in the event it cannot be recovered and handled as waste. Modelling of these discharge events has confirmed the discharge plumes will rapidly disperse in the water column in the vicinity of the discharge location (refer to Chapter 10: Section 10.5.3). The larger discharge events (i.e. dewatering of infield pipelines) are distributed in space and time, and the impacts will not overlap. It is considered that there will be no cumulative interaction between these discharges, and no cumulative interaction with other impacts.

The deposition of drill cuttings discharged during the predrill programme has been modelled for single well and cumulatively taking into account all six planned predrill wells (refer to Chapter 9: Section 9.4.3). Deposition of cuttings has also been modelled for the 38 wells proposed to be drilled from the ACE platform (Chapter 11: Section 11.4.32). The predrill and platforms wells will all be drilled through a drilling template and will be approximately 2m apart on the seabed with the predrill wells anticipated to be drilled within the centre of the drilling template. The modelling of the predrill wells indicated a maximum depth of accumulation (during winter conditions) of 6.375m for the six predrill wells with the area affected by the cuttings deposition to a 1 millimetre (mm) depth of 10450 square metres (m^2).

For the 38 platform wells the modelling predicted a maximum depth of accumulation of 10.1m with the area affected by the cuttings deposition to a 1mm depth of 22400m^2. For both predrill and platform wells the cuttings deposits (assuming deposition to 1mm thickness) was predicted to be confined to within a radius of 50-100m of the drill centre. It is anticipated that the overall cumulative effect of cuttings deposition will remain within a similar distance. While there will be areas where the cuttings deposited from the predrill and platform wells overlap the overall depth of accumulation is expected to be in the same order of magnitude as the maximum 10.1m depth predicted for 38 platform wells. No significant cumulative impacts are anticipated.

During routine platform operations, the principal discharges will be cooling water, treated black water, grey water, and open drains water. Cooling water discharge has been modelled to assess the potential for thermal impact (refer to Chapter 11: Section 11.4.5). The modelling indicated that the discharge would meet the required 3ºC temperature gradient between the discharge plume and ambient sea temperature within 3 to 12m from the point of discharge depending on the ambient water temperature at the time of discharge. Other routine discharges are small in volume and have no persistent or cumulative effect.

Overall, with the exception of the overlap in deposition of cuttings from the predrill and platform wells, it is considered very unlikely there will be cumulative impacts resulting from individual ACE project activities and interactions. The cumulative impact associated with the overlap in cuttings deposition is anticipated to be insignificant.

13.3.2 Cumulative Impact With Other Projects

Based on the findings of the SD2 Project ESIA (Ref. 1), SD2 offshore activities resulting in potential impacts to water column and seabed, such as the discharge of water based muds (WBM) and cuttings, underwater sound and discharge of cooling water, were predicted to result in minor and localised impacts. Given the scale of the impacts anticipated and the distance between the project activities, it is considered very unlikely there will be cumulative impacts between the ACE and SD2 project activities and interactions within the marine environment.

13.4 Social Environment: Cumulative Impacts

13.4.1 Cumulative Impact Between Separate ACE Project Impacts

A detailed assessment of individual ACE Project social impacts, based on expected activities and events, is presented in Chapter 12 of this ESIA. The assessment takes into account each activity and the existing controls in place to manage the impact. No requirement for additional mitigation was identified and all impacts were considered to be minimised as far as practicable.

The expected activities and events that may result in a cumulative social impact from different components of the ACE Project are:

- A rise in employment opportunities during the construction phase;
- A rise in economic flows from the use of major construction and installation contractors and their associated supply chain network of companies; and
- An increase in road traffic on the Baku-Salyan Highway associated with the onshore construction yards.

Employment

The estimated employment anticipated during the ACE Project construction phase is outlined in Chapter 5: Section 5.12. In summary it is estimated the Project will generate a workforce demand of:

- Approximately 2500 workers at the topside onshore construction yard which is expected to peak during 1Q 2021; and
- Approximately 1300 workers at the onshore construction yards used to fabricate the jacket and subsea equipment which is estimated to operate at peak numbers from 1Q 2020 to 1Q 2021.

Up to 160 permanent workers are expected to be required during the ACE operations phase.

While almost all of the jobs associated with the ACE Project will be temporary, workers will be provided with an opportunity to develop their skills and experience during their employment. This will be achieved through implementation of the Employee Relations Management Plan (ERMP) and formal training activities.

It is considered that the appropriate measures are in place to appropriately maximise the positive cumulative impacts associated with employment.

Economic Flows

The ACE Project is expected to increase economic flows at a regional (Baku City economic region) and national level through increased employment and the procurement of goods and services. This is expected to occur from the use of different construction and installation contractors at the same time during the construction phase. The increase in economic flows is expected to contribute at a regional level, to social development and improvement in social infrastructure.

Increased Traffic on the Baku-Salyan Highway - Congestion

The Baku-Salyan Highway is the main traffic route in the local area and is expected to be used by traffic associated with the main construction and installation contractors working at the main construction contractor yards. There is the potential for increased traffic on the Baku-Salyan Highway to cause disruption to other road users from increased congestion.

BP and its main construction contractors have implemented successful driving and vehicle management plans during the previous ACG projects and most recently for the SD2 Project. All of the main construction and installation contractors will implement a Traffic and Transportation Management Plan, one of the aims of which will be to minimise impacts to road users and ensure that adherence to BP’s strict procedures associated with vehicles and safe driving are enforced. The Traffic and Transportation Management Plan will be subject to regular review and update and will take into account any changes in traffic flows or routing issues during the ACE Project duration. Further details on construction traffic are provided in Chapter 12: Section 12.2.3.

Considering the use of the Traffic and Transportation Management Plan, the contribution of the ACE Project to potential traffic impacts are minimised as far as possible.

13.4.2 Cumulative Impact With Other Projects

It is considered that the social cumulative impacts that may arise as a result of the ACE Project in combination with the SD2 Project (where construction and installation activities are largely complete) and SWAP exploration drilling will be very limited and insignificant.

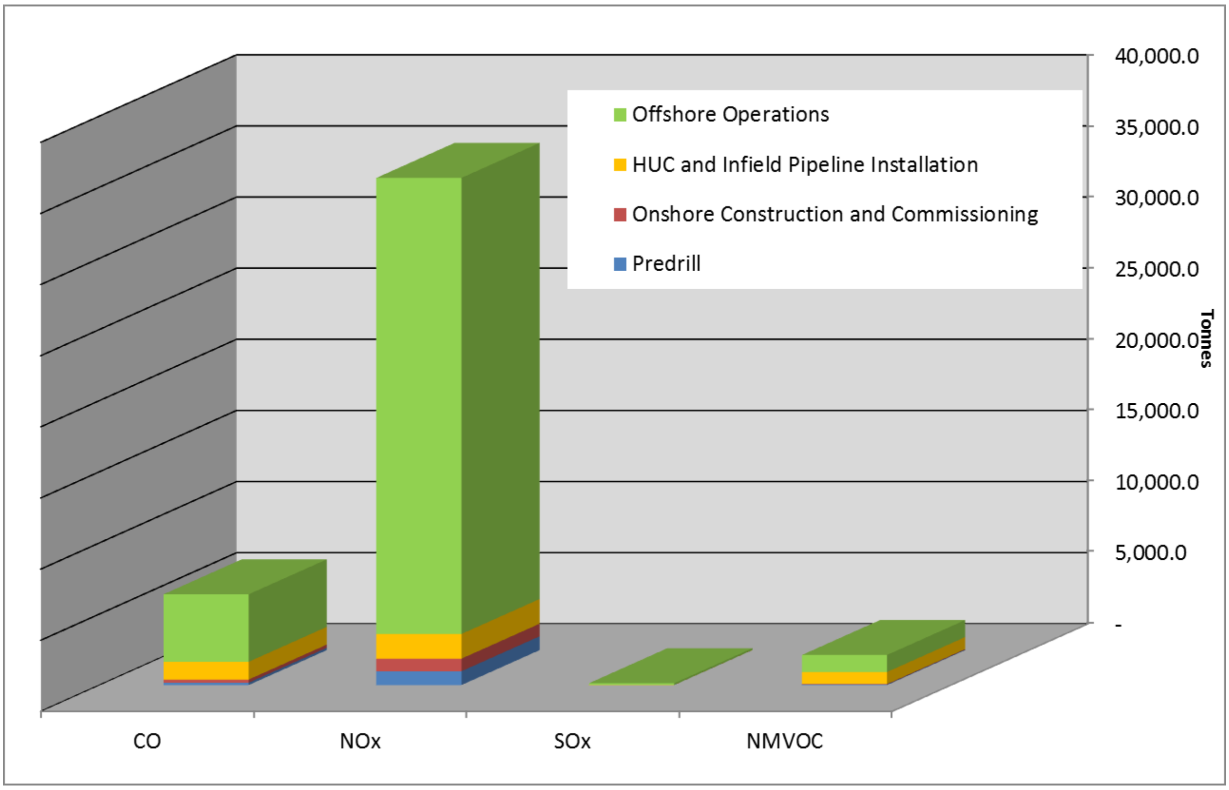
13.5 Atmosphere: Cumulative Impacts Associated with Non-Greenhouse Gas Atmospheric Emissions

Atmospheric emissions will be generated from the each ACE Project phase due to:

- Operation of combustion plant (during construction and operations);
- Operation of vessels (including a mobile drilling rig);
- Flaring (during brownfield tie-in activities and during operations); and
- Fugitive emissions.

Figure 13.2 presents the volumes of the non-greenhouse gas (non GHG) emissions comprising nitrous oxides, sulphur oxides, carbon monoxide and non-methane hydrocarbons for each phase of the ACE Project.

Figure 13.2 ACE Project Non GHG Emissions Per Project Phase



13.5.1 Cumulative Impact Between Separate ACE Project Impacts

Air dispersion modelling (focused on nitrogen dioxide (NO_2)) has been completed for emissions to atmosphere during ACE pre-drilling, onshore construction and commissioning activities at the construction yards and during offshore operations. Based on a review of the ACE Project schedule and the results of the modelling as presented in Chapters 9, 10 and 11 it is not expected there will be a cumulative impact associated with ACE Project non GHG emissions to atmosphere as the activities will be temporally discrete and the emissions associated with each project phase will rapidly disperse prior to the next phase commencing. Therefore, air quality impacts to receptors (i.e. onshore community) associated with each phase individually are not expected to be significant. Emissions associated with vessels that will be used throughout all ACE Project phases will also rapidly disperse and no cumulative impacts are anticipated.

13.5.2 Cumulative Impact With Other Projects

Modelling has been completed to estimate the cumulative effect from non GHG emissions due to the operation of the SD2[2] and ACE Project offshore facilities on NO_2 concentrations on onshore receptors (refer to Appendix 11B).

NO_2 emissions from both the SD2 platform complex and the proposed ACE platform were modelled to determine the future contribution of emissions to air quality at selected onshore receptors. Concentrations, taking into account existing background levels, were compared against relevant long term (annual average) and short term (1 hour peak) limit values for the protection of human health[3].

Two scenarios were modelled to represent typical and worst case operating conditions:

[2] Offshore non-GHG emissions generated by operations from EOP, ACG Phases 1, 2 and 3, COP, SD1 were not modelled as the emissions are captured in the background ambient concentrations (refer to Appendix 11B for further details).
[3] Applicable 1 hour average (short term) and annual average (long term) EU limit values for NO_2 are 200µg/m^3 and 40µg/m^3 respectively.

- ACE routine platform operations involving power generation turbine, gas compression turbine and flare system operating in pilot/purge mode and routine operation of the SD2 platform complex; and
- ACE Platform Emergency Shutdown (ESD) involving power generation turbine operating at 100% load on diesel, gas compression turbine not in operation (0% load) and flare system operating at 333 million standard cubic feet per day (MMscfd) and non-routine operation of SD2 platform complex with compressor trip flaring.

For both cumulative operations scenarios the modelling predicted an increase in long term (annual average) NO_2 concentrations at onshore receptors of less than 0.1µg/m^3. The highest increase in short term NO_2 concentrations were predicted at the Absheron Peninsula receptor due to the prevailing northerly wind direction. The results at the Absheron Peninsula location for the two scenarios assessed are summarised within Table 13.1. The long term and short term background concentrations of NO_2 were assumed to be 12µg/m^3 and 24µg/m^3 respectively (refer to Appendix 11B for further details). Figures 13.3 and 13.4 show the increases in long and short term NO_X[4] concentrations for the routine operations cumulative scenario. Figures showing the results for the non routine scenarios are presented in Appendix 11B.

Table 13.1 Predicted Increase in Long Term and Short Term NO_2 Concentrations at the Absheron Peninsula Location for Modelled Cumulative Scenarios

<table>
<tr><th rowspan="2">Scenario</th><th colspan="4">NO_2 Annual Average (µg/m^3)</th><th colspan="4">NO_2 1 Hour Peak (µg/m^3)</th></tr>
<tr><th>Limit Value</th><th>Modelled Contribution</th><th>Predicted Concentration</th><th>Predicted Concentration as % Limit Value</th><th>Limit Value</th><th>Modelled Contribution</th><th>Predicted Concentration</th><th>Predicted Concentration as % Limit Value</th></tr>
<tr><td>Routine Operations on ACE and SD2</td><td rowspan="2">40</td><td>< 0.1</td><td>12.0</td><td>30.0%</td><td rowspan="2">200</td><td>1.5</td><td>25.5</td><td>12.8%</td></tr>
<tr><td>ESD on ACE and Compressor Trip Flaring on SD2</td><td>< 0.1</td><td>12.0</td><td>30.0%</td><td>1.5</td><td>25.5</td><td>12.8%</td></tr>
<tr><td colspan="9">*Note Assumed conversion of NO_x to NO_2, 100% for annual average (long term) and 50% for 1 hour peak (short term).</td></tr>
</table>

[4] As described in Appendix 11B, for the short term it is assumed that 50% of NO_X converts to NO_2 in the atmosphere and for the long term it is assumed that all NO_X converts to NO_2 in the atmosphere.

Figure 13.3 Modelled Mean Annual NO_2 Contributions (Cumulative Routine Operations)

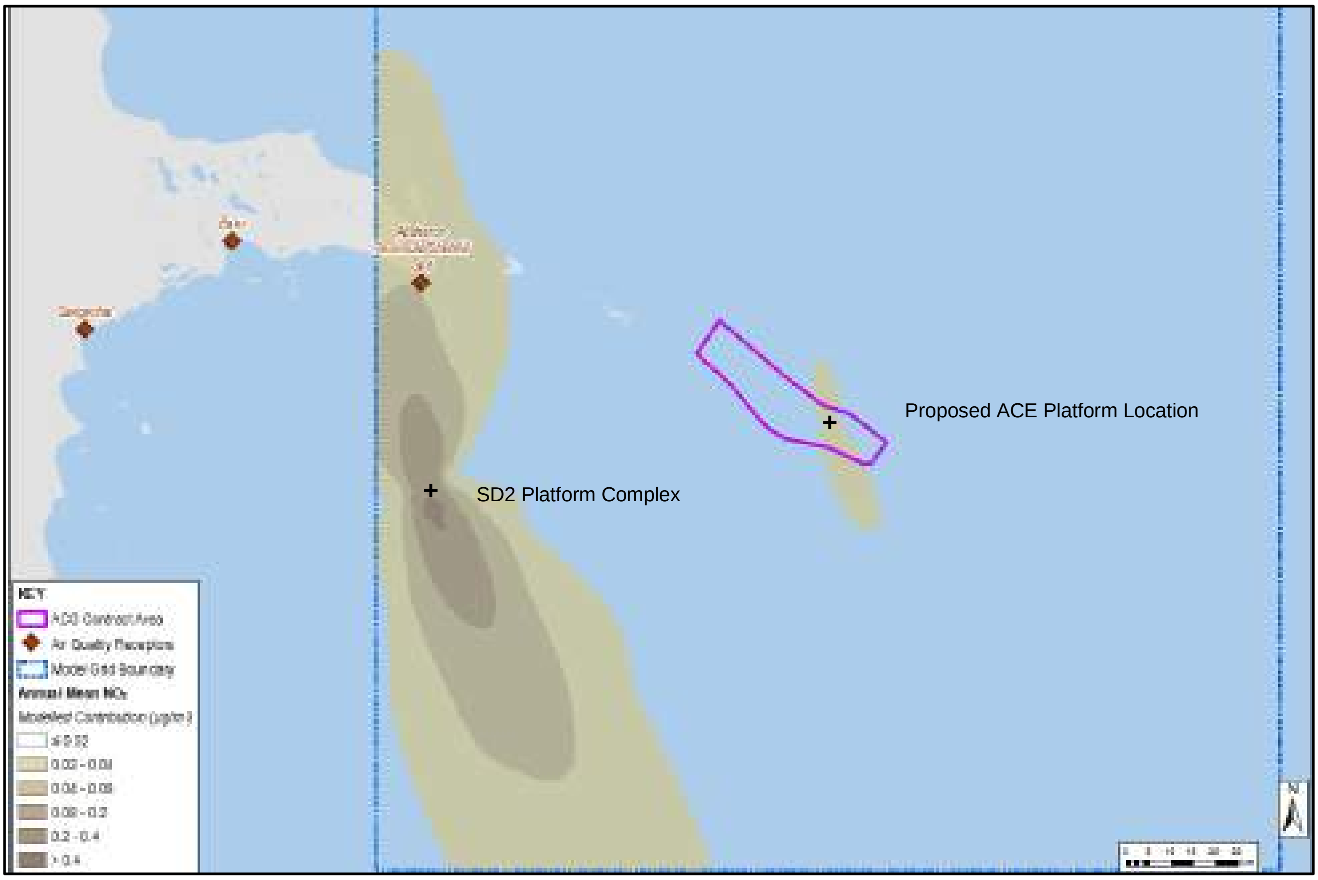
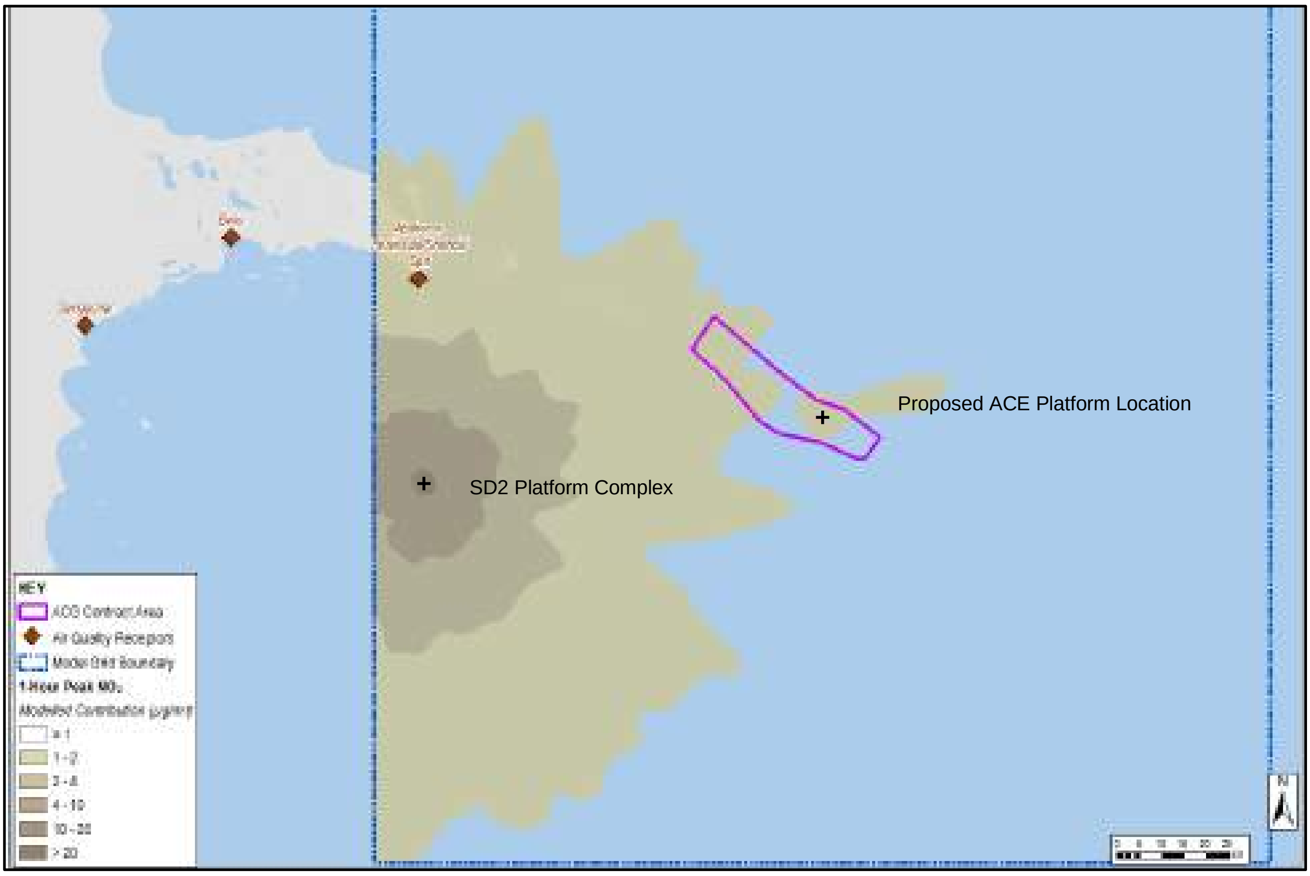


Figure 13.4 Increase in Short Term NO_2 Concentrations (Cumulative Routine Operations)



The modelling demonstrated that, during routine operations, NO_2 emissions are predicted to disperse rapidly and the increase in long term and short term NO_2 concentrations due to ACE and SD2 offshore operations are likely to be indiscernible from background levels at all onshore receptors. Comparing the results to those obtained for the ACE Project alone (routine operations) the SD2 Project offshore facilities are anticipated to increase the long term (annual average) NO_2 concentrations at onshore receptors by less than 0.1µg/m^3. Cumulative impacts to air quality are not considered significant and no additional mitigation measures are required.

13.6 Atmosphere: Transboundary Impacts Associated with Non-Greenhouse Gas Atmospheric Emissions

The potential for transboundary impacts associated with non GHG emissions are dependent on the environmental / health effects associated with the pollutant, residence time (i.e. atmospheric lifetime) and the expected dispersion characteristics of the pollutant in the atmosphere in addition to the location of potential receptors.

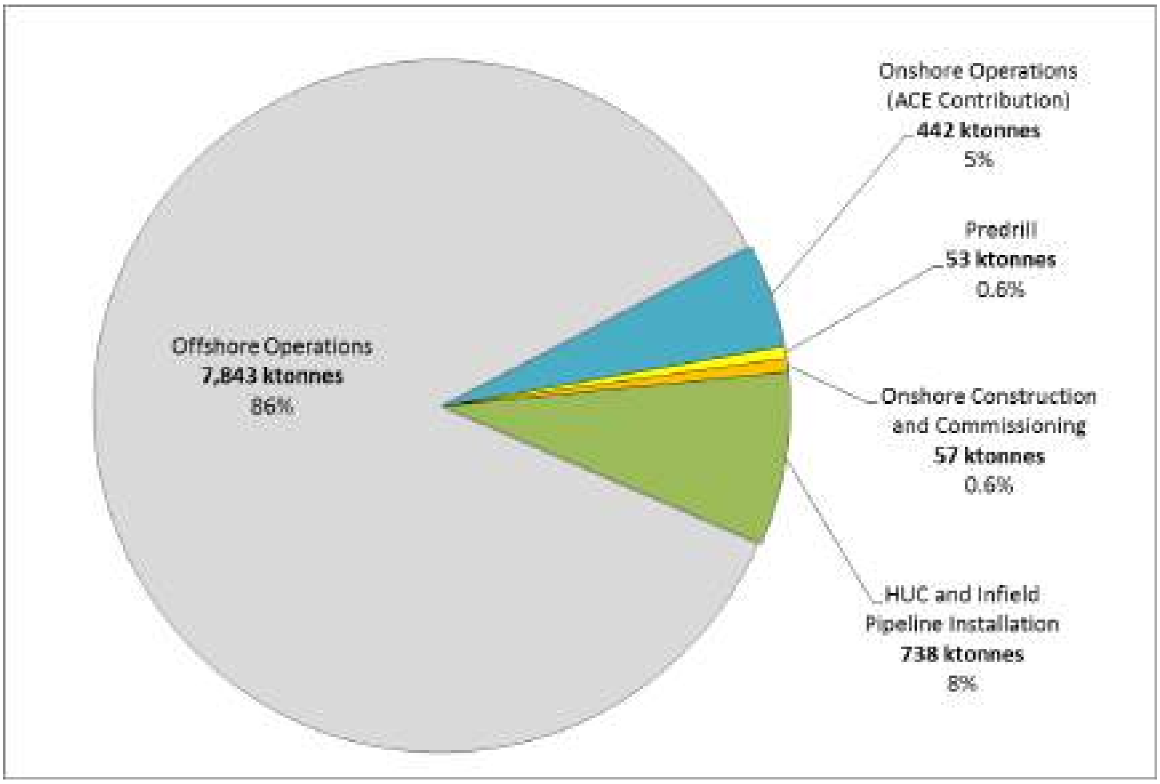
The most significant pollutant in terms of health impacts is NO_2. It has been demonstrated that emissions associated with ACE Project activities alone and emissions from worst-case cumulative ACE and SD2 offshore activities are not expected to result any discernible changes in onshore NO_2 concentrations at the nearest onshore receptors in Azerbaijan. Based on the limited geographic scope of pollutant species, which will disperse rapidly in the atmosphere, no transboundary impacts associated with air quality and human health are predicted.

The volumes of emissions released (including visible particulates) due to the ACE Project are expected to result in very small increases in pollutant concentrations in the atmosphere and in any washout from rainfall, which will not be discernible to biological/ecological receptors. Sulphur dioxide (SO_2) emissions will be minimised through the planned use of low sulphur diesel and the low hydrogen sulphide (H_2S) content in the fuel gas used on the platform under routine conditions and are expected to disperse rapidly due to appropriate equipment design. The contribution of the ACE Project SO_2 emissions to acid rain generation is therefore expected to be insignificant.

13.7 Atmosphere: Cumulative and Transboundary Impacts Associated with Greenhouse Gas Atmospheric Emissions

Expected GHG emissions from ACE Project activities (including carbon dioxide and methane) are presented in Chapter 5 of this ESIA for all phases of the Project. Figure 13.5 shows the predicted contribution per phase.

Figure 13.5 ACE Project Greenhouse Gas Emissions Generated for Each ACE Project Phase



The majority (86%) of GHG is predicted to result from offshore activities during the ACE Project operations phase. Activities associated with predrilling are predicted to contribute 0.6% of the total volume of GHG emissions produced by the ACE Project.

Figure 13.6 presents the volume of ACE Project average annual GHG emissions during the operations phase, compared with the annual BP Azerbaijan Operations GHG emission volumes reported for 2017 (Ref. 16).

Figure 13.6 BP Azerbaijan Operations GHG Emissions (2017) and Average Annual Forecast ACE Project GHG Emissions

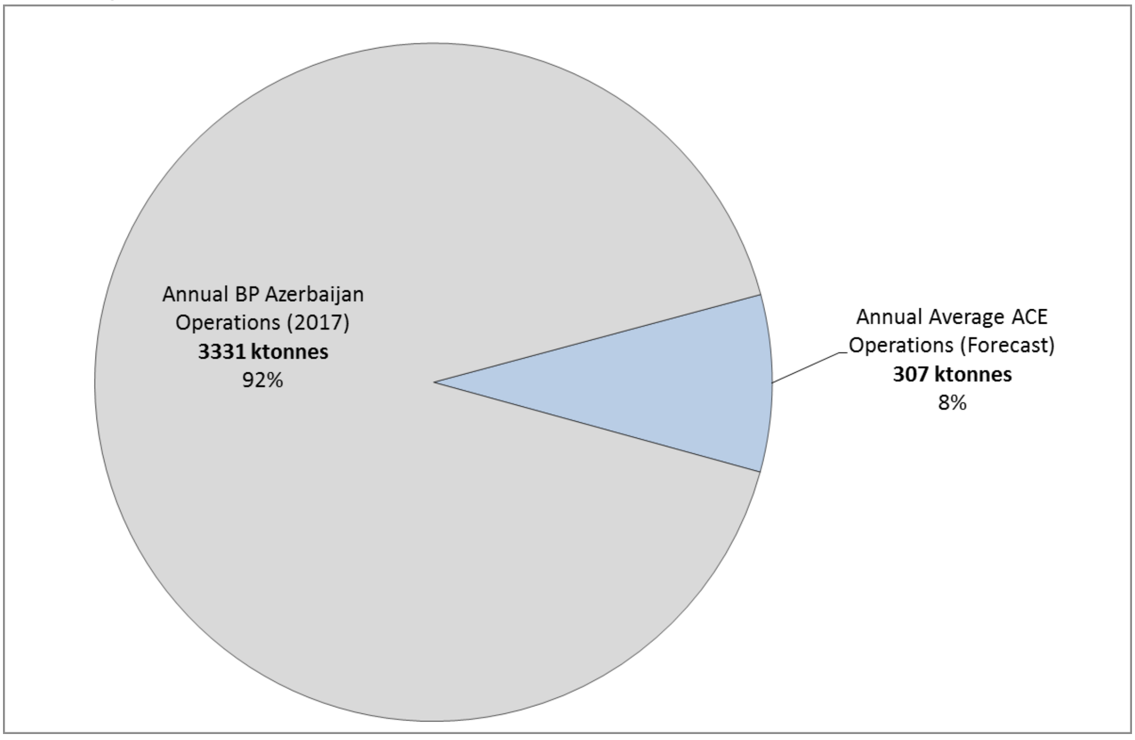


Figure 13.6 demonstrates that the ACE Project will contribute approximately 8% of the annual operational GHG emissions from BP's activities in Azerbaijan based on GHG emissions data from 2017.

The most recently published GHG emissions data for Azerbaijan estimated a total of 51851 kilotonnes (kt) were emitted in 2012 (Ref. 2), 76% of which was estimated to be generated by the energy sector. Total GHG emissions for 2030 were forecast to be approximately 67000 kt assuming a business as usual case (Ref. 2). As a proportion, the estimated GHG emissions for the ACE Project for 2030 are expected to contribute approximately 0.5% to the national total.

13.7.1 Conclusion

The principal sources of GHG emissions from the ACE Project are associated with power generation, gas compression and non-routine flaring of gas which is required to maintain the safety of the facilities and operational workforce. BP is committed to assessing and, where practical, reducing the GHG emissions. The following principles have been followed for the ACE Project:

- Evaluate options to reduce flaring - develop and implement an operational flare policy;
- Maximise energy efficiency;
- Minimise combustion and fugitive emissions; and
- Avoid venting.

In addition, design measures across the ACG and SD developments that contribute to GHG savings include:

- Onshore flare gas recovery;
- Onshore inert purge gas;
- Partial centralised power supply offshore for the Azeri Field;
- No continuous flaring for production;
- Use of aero-derivative turbines; and
- Electric motor driven export compression on ACG Phase 3 and COP.

Further to these measures, the ACG Projects participates in a gas management strategy whereby the majority of associated gas produced by the ACG developments is routinely re-injected (as opposed to flared) into the subsurface reservoir, and the remaining gas used for offshore platform power generation in the main gas turbines or exported to Sangachal Terminal.

As described within Chapter 4: Options Assessed, energy efficiency and GHG reduction was a key aspect taken into account during the development of the ACE Project design, contributing to the selection of a number of design options that will reduce the volume of GHG emissions over the life of field.

For both non GHG emissions and GHG emissions, monitoring and reporting procedures and documentation requirements for each ACG and SD project are included within BP Azerbaijan's Health, Safety, Security and Environment (HSSE) Policy. Once operational, the ACE Project will implement a set of specific monitoring, management and reporting procedures based on and consistent with the procedures already in use on existing ACG platforms.

13.8 Accidental Events

Accidental Events are considered separately from routine and non-routine activities as they only arise as a result of a technical failure, human error or as a result of natural phenomena such as a seismic event. High operational performance and compliance with good industry practices will be maintained at all times by BP and their contractors. However, as with most projects of this nature, a low probability of an accidental event does exist.

Potential accidental events that may result in potentially significant environmental impacts during the ACE Project have been identified and include:

- Vessel collision with other marine users and Caspian seals;
- Release of chemicals/ waste from the Project vessels and ACE platform; and
- Hydrocarbon spills (e.g. small spills resulting from refuelling, large spill of marine diesel resulting from a vessel collision, well blowout of crude oil or release of hydrocarbons from a rupture of the ACE gas or oil export infield pipelines).

13.8.1 Vessel Collision

As described in Chapter 7: Section 7.7 the ACG Contract Area is located within a busy shipping area, through which international and regional shipping vessels pass regularly in addition to numerous smaller vessels that provide offshore support to the oil and gas industry, and commercial fishing vessels travelling between the offshore fishing grounds to shore. The highest density of shipping passes to the south of the proposed ACE platform location. Nevertheless, there is potential of a collision between ACE Project vessels and other non-Project related vessels during the construction and operational phases of the ACE Project. A range of maritime and navigation safety measures outlined in Chapter 12: Section 12.2.4 are expected to minimise the risk of collision. The likelihood of a collision between vessels is considered to be very low given the preventative measures in place. However, in the event of a collision there is the potential for significant impacts on other marine users and infrastructure depending on the scale and nature of the collision.

Although unlikely, the potential for collision of Caspian seals with vessels used during the construction and operational phases of the Project cannot be excluded, and may cause injury or a lethal outcome for individual seals. However, the Caspian seal is a highly intelligent and mobile animal and will rapidly move away from any disturbance or sound and consequently the collision risk is likely to be extremely low. No project vessels will intentionally approach seals for the purposes of casual (recreational) marine mammal viewing which may result in disturbance.

13.8.2 Release of Chemicals / Waste

A number of chemicals to support the drilling operation (e.g. drilling mud chemicals) will be stored on board the MODU and ACE platform and transported by the support vessels. In addition, chemicals for cleaning and maintenance purposes, e.g. cleaning fluids, will be used on board the MODU / ACE platform and support vessels throughout the drilling programme, during installation activities and during operations. All chemicals on the MODU and vessels will be labelled and stored appropriately in areas with secondary containment. Waste generated during the ACE Project will be managed in accordance with the existing BP AGT Region management plans and procedures.

As per the other existing BP operated drilling platforms within the ACG Contract Area, the proposed ACE-PDQ platform drilling system includes a mud gas separator bypass line. The bypass line may be used in the unlikely event that the flow of oil or gas into the mud gas separator, during a well control event, is in excess of the processing capacity of the mud gas separator.

The likelihood of an accidental release of chemicals or waste to the marine environment is considered to be very low given the control mitigation measures are implemented as set out in Chapters 9, 10 and 11. In the unlikely event of loss of containment and release of hazardous substances overboard, the AGT Region spill reporting procedures described within Section 13.8.4.3 will be followed.

13.8.3 Hydrocarbon Spills and Releases

Potential accidental discharges of hydrocarbons that may lead to pollution of the marine environment during the proposed Project include:

- Spills during vessel collision, fuel tank failure, fire or explosion;
- Well blowout of crude oil following loss of well control; and
- Pipeline rupture of the ACE infield oil or gas export pipelines.

The resulting potential discharges can be broadly categorised as follows:

- Spill of diesel from the MODU / ACE platform or support vessels; and

- Major spill of crude oil from a well blowout or pipeline rupture.

13.8.3.1 Spill of Marine Diesel

As described in Section 13.8.1 the likelihood of a vessel collision occurring during the construction and operational phases of the ACE Project is considered to be very low. Analysis of water transport accident statistics by the International Association of Oil & Gas Producers (IOGP) (Ref. 3) shows that ship to ship collisions represent 12% of total ship losses and that the likelihood of this occurring is extremely low. The likelihood that such an incident would result in a loss of the vessel's fuel inventory is even lower, as a high-energy collision would be required to damage a vessel to such an extent that fuel tank integrity is compromised releasing its content into the sea.

Fuel on vessels is typically stored in a series of small tanks which are double bottomed and connected by valves and it is unlikely that contents of all the tanks would be lost simultaneously in the event of a collision. The MODU and ACE platforms will both be equipped with diesel tanks to provide fuel for on board use. The largest volume of diesel is stored within the two crane pedestals (providing 92m^3 of storage in each) on the ACE platform. The diesel tanks on the platform will be located within a bunded area and any minor spillages will be routed to the hazardous open drains system. However, in the unlikely event of a release of the full diesel tank inventory the diesel will spill overboard. A description of the ACE platform crane pedestal diesel tank spill scenario and the modelling undertaken to predict the potential impact of the spill is presented in Section 13.8.3.6.

13.8.3.2 Well Blowout Scenario

A well blowout, as a consequence of loss of well control, is an uncontrolled influx of liquids or gas from the formation into the wellbore which may result in an uncontrolled release into the environment. This influx can either be oil, gas, water or a combination of liquids and gas. Well blowout is considered to be the worst case scenario for oil spills.

Well blowouts are very low probability but high consequence events, which occur where all primary and secondary control failures occur together. A review of wells drilled in the period 2000-2015 in regulated countries across the world found that the probability of a well blowout that would result in a spill of 500 barrels or more of oil is 1 blowout per 3985 wells drilled (0.025% per well drilled) for exploration wells and 1 blowout per 14444 wells drilled (0.007% per well drilled) for development wells, respectively (Ref. 4). Similarly, a review conducted by the International Association of Oil and Gas Producers (IOGP) found a blowout occurs in approximately 1 out of every 4000 exploration wells operated at North Sea standards and 1 out of every 588 exploration wells operated at non-North Sea standards (Ref. 5). A description of a potential blowout scenario of an ACE Project well and the modelling undertaken to predict the potential impacts of the blowout is presented in Section 13.8.3.6.

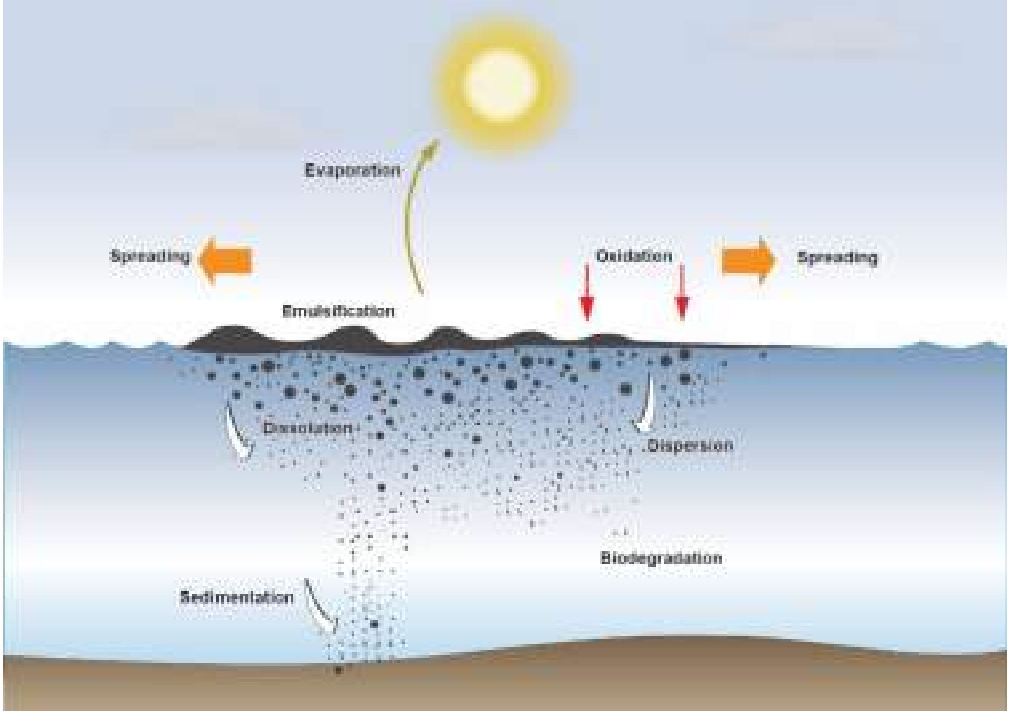
13.8.3.3 Pipeline Rupture

Offshore pipeline spills may occur due to corrosion, equipment failure, severe weather, damage to the pipeline by external objects (e.g., anchors or dropped objects) or human error. Like blowouts, the probability of a pipeline rupture is considered low but a high consequence event. Analysis of offshore pipeline spills in the U.S. Outer Continental Shelf found that the number of large pipeline spills has decreased from 1971 to 2015. Vessel-induced damages, such as an anchor striking a pipeline, tended to be the main causal factor for these spills. For spills including minor spills, equipment failures caused the majority of spills from 1971 to 2015 (Ref. 6). The ACE infield pipelines will have a concrete weight coating to provide impact protection and on-bottom stability. A description of the ACE Project 30" oil subsea export pipeline and the modelling undertaken to predict the potential impacts of the rupture is presented in Section 13.8.3.6.

13.8.3.4 Fate of Hydrocarbons in the Marine Environment

The key processes that govern the fate of hydrocarbons at sea are shown in Figure 13.7. When oil is released into the marine environment it undergoes a number of physical and chemical changes as a result of evaporation, dissolution, dispersion, emulsification, sedimentation, photo-oxidation and biodegradation processes, collectively known as weathering. These changes are dependent upon the type and volume of oil spilt and the prevailing weather and sea conditions.

Figure 13.7 Weathering Processes Acting on Spilled Oil



Marine Diesel

Diesel fuel is a light, refined petroleum product, and what is commonly referred to as "marine diesel" is a blend of gasoil and heavy fuel oil with a low viscosity (up to 12 centistokes (cSt)/400°C). When spilled on water, diesel fuel spreads very quickly to a thin film of rainbow and silver sheens, whereas marine diesel may form a thicker film of dull or dark colours and persist on the surface for longer.

Evaporation and dispersion are the two main mechanisms that act to remove diesel type fuels from the sea surface, whilst oxidation and biodegradation break down hydrocarbons into basic elements over a longer time period. Marine diesel is readily dispersed into the water column when wind speeds reach 5 to 7 knots, or the sea state is approximately Force 2 Beaufort scale or higher. It is much lighter than water, therefore it is not possible for the diesel to sink and accumulate on the seabed as pooled or free oil. However, diesel may be physically mixed into the water column by wave action, forming small droplets that are carried and kept in suspension by the currents. Diesel dispersed in the water column can adhere to suspended sediments, which then settle out and are deposited on the seabed. This process is more likely to occur in near shore areas or river estuaries rather than in the open marine environment.

Compared to unrefined crude oils, marine diesel is not sticky or viscous. When stranded on the shoreline, diesel tends to penetrate porous sediments quickly whereas if it is deposited on hard surfaces, it will be quickly washed off by wave action.

In terms of toxicity to marine organisms, diesel is considered to be one of the most acutely toxic oil types (Ref. 7).

Crude Oil

Crude oil is an unrefined mixture of naturally occurring hydrocarbons that exists as a liquid in underground geologic formations and remains a liquid when brought to the surface. Crude oils of different origin vary widely in their physical and chemical properties. The main physical characteristics that affect the behaviour and persistence of an oil spill at sea includes specific gravity, vapour pressure, distillation characteristics, viscosity and pour point. The chemical composition of the oil, such as the proportion of volatile components and the content of asphaltenes, resins and waxes, will also affect the behaviour of the oil.

The major processes contributing to crude oil weathering are:

- **Loss of more volatile oil components by evaporation:** Spilled crude oil rapidly spreads out to form a thin oil slick on the sea surface. The more volatile components then evaporate at a rate proportional to their individual volatilities (associated to boiling points) and the prevailing water temperature. The loss of these hydrocarbon fractions decreases the volume of oil that remains at sea. Crude oils with a higher proportion of volatile components will decrease in volume more than crude oils that contain less volatile components. Evaporation slows and eventually stops as the volatile components are progressively lost. The oil that remains at sea will have a higher viscosity than the original oil because the volatile components that are lost by evaporation are of low viscosity.
- **Incorporation of water into the oil to form water-in-oil emulsions:** Most crude oils will form water-in-oil emulsions when spilled at sea. Water-in-oil emulsification is caused by the prevailing wave action; spilled oils will emulsify faster in rougher seas than in calm conditions as water droplets become incorporated into the oil by the action of breaking waves. Water-in-oil emulsions are inherently unstable and will rapidly revert to oil and water unless they are stabilised by asphaltenes precipitated from the crude oil. The precipitated asphaltenes form an elastic skin around the water droplets in the oil and prevent them from coalescing and separating from the oil. Crude oils with a high asphaltene content form more stable emulsions than crude oils with low asphaltene content. The formation of water-in-oil emulsions greatly increases the volume of the emulsified oil on the sea surface. Emulsified oils typically contain a maximum of 60% to 75% volume of water and this causes a 3- to 4-fold increase in volume, compared to that of the volume of oil from which the emulsion is formed. Emulsification ceases when the maximum water content has been achieved. Formations of water-in-oil emulsions reduce the rate of other weathering process and are the main reason for the persistence of light and medium crude oils on the sea surface and shorelines (Ref. 8).
- **Natural dispersion:** Natural dispersion is driven by breaking waves. As a breaking wave crest passes through the oil slick, the oil is broken into oil droplets of various sizes and pushed into the water column. The larger oil droplets rapidly float back to the surface, but the very smallest oil droplets are retained in the water column by the prevailing turbulence. The rate of natural dispersion is driven by the prevailing sea state and limited by the viscosity of the emulsified oil; rough seas cause a high rate of natural dispersion, but high emulsified oil viscosity resists this process.

The relative rates of evaporation, water-in-oil emulsification and natural dispersion depend on the prevailing oceanographic conditions (temperature, wind speed and sea state) and the properties of the spilled oil (as described by the boiling point curve, density, viscosity and asphaltene content).

13.8.3.5 ACE Crude Oil Properties

Since oil has yet to be produced from the ACE target reservoir locations, no crude oil has been available for characterisation. However, a weathering study[5] undertaken on seven AGT Region crude oils found that the Central Azeri (CA) crude oil could be considered as the most representative oil for the AGT Region based on a comparison of the main physical-chemical properties (including asphaltenes and wax contents, maximum evaporation rates, maximum pour point, viscosity corresponding to the 10% dispersibility, etc.) (Ref. 9). Figure 13.8 illustrates the results obtained in this comparison. Therefore, for the purposes of this ESIA and the modelling results presented in Section 13.8.3.7 below the CA crude oil characteristics have been used as an analogue oil for ACE. The key characteristics of CA crude based on the results of the weathering study are presented in Table 13.2.

[5] The methodology adopted in this study was to prepare the oil residues from distillation to 200°C and 250°C (vapour temperature). These stimulate the oil residues that would result from evaporative loss after approximately 6 hours and 36 hours at sea. Emulsions are then produced from each of these residues by mixing them with seawater using the modified Mackay-Zagorsky method using rotary funnels (Ref. 10).

Figure 13.8 Comparison of the BP AGT Region Crude Oils Properties Relatively to the Average (Ref. 9)

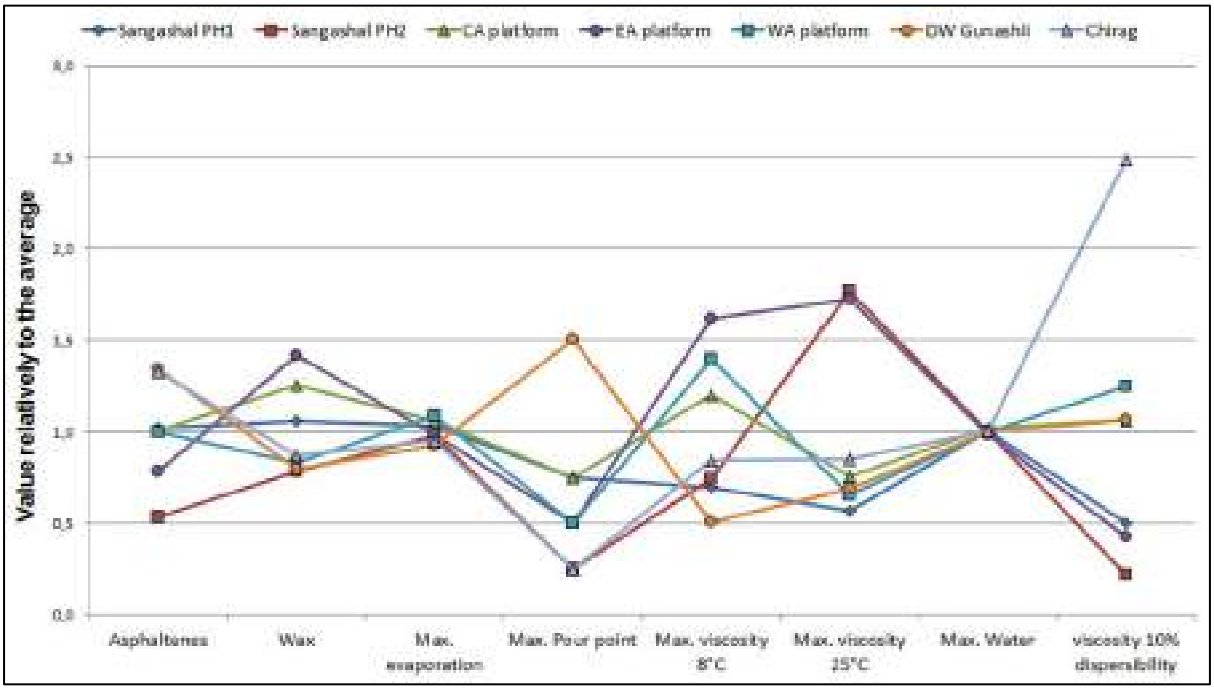


Table 13.2 Physical Characterisation of the Central Azeri Platform Oil

Characterisations	Fresh Oil	Residues of Distillation (vapours temperature)		
		150°C	200°C	250°C
Evaporation rate (% wt.)	-	7.5	22.8	33.0
Evaporation rate (% vol.)	-	8.3	24.9	35.7
Specific gravity (g/L)	0.849	0.856	0.872	0.884
Pour Point (°C)	6	9	9	21
Flash Point (°C)	9	45	94.5	>100
Asphaltenes (% wt.)	0.3	0.3	0.3	0.4
Wax (% wt.)	10.2	11.1	13.3	15.3
Viscosity and characterisations of emulsions at 25°C				
Non-emulsified oil [1]	10	14	29	112
50% water content emulsion [2]	-	56	153	760
75% water content emulsion [2]	-	24	1978	1594
Water content emulsion (%)	-	75	75	75
Viscosity max. water emulsion [2]	-	NS	NS	1416
Maximum water content (%)	-	NS	NS	86.0
Halftime for water uptake (min)	-	<1	44	5
Viscosity and characterisations of emulsions at 8°C				
Non-emulsified oil [1]	32	56	174	393
50% water content emulsion [2]	-	922	1735	3817
75% water content emulsion [2]	-	2048	6686	10605
Water content emulsion (%)	-	75	75	75
Viscosity max. water emulsion [2]	-	3377	25179	24043
Maximum water content (%)	-	91.6	78.8	76.5
Halftime for water uptake (min)	-	7	7	3

Notes:
[1] viscosity (mPa.s) measured at 100 s^{-1} on non-emulsified oils
[2] viscosity (mPa.s) measured at 10 s^{-1} on water-in-oil emulsions
NS: not significant, emulsion very unstable

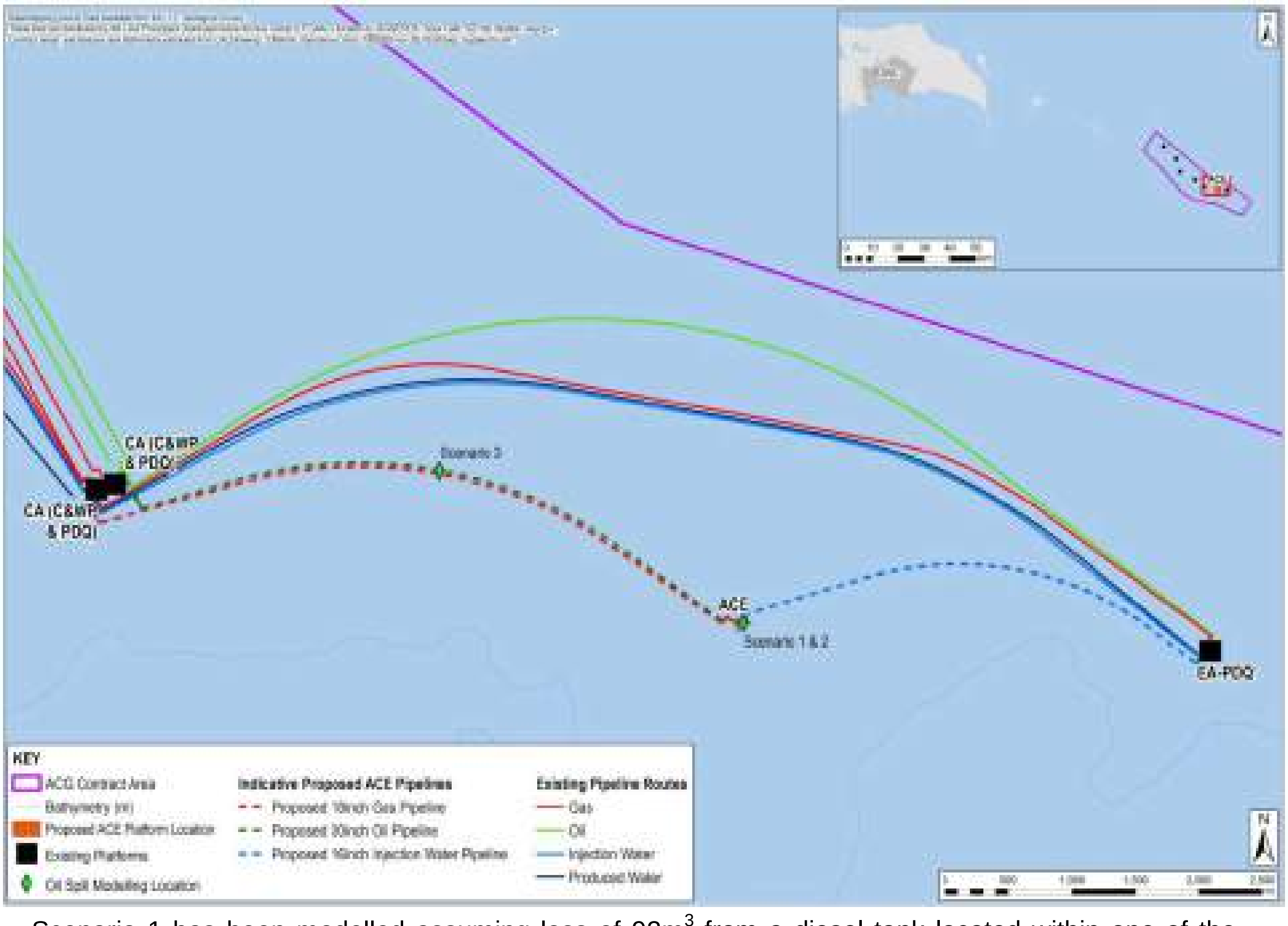
13.8.3.6 Oil Spill Modelling

To assess the potential impact of a hydrocarbon release during the ACE Project (i.e. a platform diesel inventory loss, well blowout or export pipeline rupture), modelling was undertaken using Stiftelsen for Industriell og Teknisk Forskning (SINTEF)'s Oil Spill Contingency and Response (OSCAR) modelling software (version 9.0.1). The locations of the spill events considered in the modelling assessment are shown in Figure 13.9.

The following scenarios were modelled (refer to Appendix 13A for full details):

- Scenario 1: A single platform inventory loss of $92m^3$ of diesel;
- Scenario 2: A blowout of crude oil (3,195,000 barrels (bbls)) over 90 days duration; and
- Scenario 3: A rupture of the ACE 30" oil export pipeline resulting in the release of 962 tonnes of crude oil.

Figure 13.9 Locations of Accidental Events Resulting in a Diesel Spill or Release of Crude Oil Considered Within the Spill Modelling Assessment



Scenario 1 has been modelled assuming loss of $92m^3$ from a diesel tank located within one of the ACE-PDQ crane pedestals. It has been assumed that the diesel would be spilled directly onto the sea surface over a period of one hour at a rate of $92m^3$/hour.

Scenario 2 is the "worst case" estimate for a blowout from an ACE well and assumes the blowout would flow for 90 days, based on the anticipated time it would take to drill a relief well and therefore cease the blowout release. Scenario 2 has assumed a flowrate of 35500 bbls/day, which is estimated to result in a total spill volume of 3,195,000 bbls (equivalent to $507681m^3$) of oil. The blowout scenario modelled has assumed, as a worst case, that the volume of oil spilled each day will continue at the maximum anticipated flow rate for the duration of the blowout. In reality there would be a declining flow rate over the duration of the blowout and the actual total volume of oil to be spilled is likely to be reduced significantly.

Scenario 3 assumes a full bore rupture of the ACE 30" infield oil pipeline approximately midway between the ACE and CA platforms. As the ACE 30" oil pipeline will be tied-in to the existing ACG Phase 2 30" oil export pipeline, a rupture of the ACE to CA oil pipeline section will result in oil from the entire ACG Phase 2 oil export pipeline network[6] being released from the rupture location. Following detection of a rupture to the ACE to CA section of pipeline it is estimated that it would take approximately four minutes to stop the oil export pumps on ACE and all the other platforms delivering oil into the ACG Phase 2 oil export pipeline network. Rupture of the oil export pipeline would result in an initial release of oil and associated gas before the flow was stopped, followed by a slower release during depressurisation due to the pressure drop in the pipeline. It is estimated that the pipeline depressurisation would take approximately 27 minutes. A slower release of oil would then occur as the ruptured pipeline partly fills with seawater, to the extent that the geometry of the pipeline would allow. It is estimated that the water ingress to the pipeline would last approximately 23 minutes. As a result it is estimated that approximately 962 tonnes of oil and 12 tonnes of associated gas would be released into the marine environment. These processes were modelled using the pipeline spill quantification software POSVCM (Pipeline Oil Spill Volume Estimation Model), developed by SINTEF for the US Minerals Management Service.

Spill scenarios were probabilistically analysed with time series weather and current data, demonstrating how the behaviour of the hydrocarbons change in variable metocean conditions. Stochastic outputs were generated as composites of all results obtained from 100 runs; and represent much larger areas than would be affected as a result of a single release scenario. Deterministic modelling (single scenario) was undertaken for the worst case scenario identified by stochastic modelling in both summer and winter conditions to predict the behaviour and fate of the plume over time in terms of surface accumulation, oil reaching the shore and water column concentrations.

Both stochastic and deterministic scenarios were run for the spill scenarios described above. From stochastic simulations the worse-case scenarios in terms of shoreline impact (greatest volume of hydrocarbon reaching shoreline) were identified and re-run as single deterministic simulations so that the fate of the release can be analysed in greater detail.

Section 13.8.3.7 provides a summary of the modelling undertaken. Appendix 13A provides a detailed overview of the fate of diesel and crude oil in the marine environment as a function of time, probabilities of surface and shoreline oiling and extent of the affected areas. It must be noted that modelling has not taken into account any response mitigation measures such as dispersant application, containment or recovery, meaning that the results should be only interpreted as indication of theoretical spill consequences without an implementation of the oil pollution prevention strategy. Section 13.8.4.1 below provides an overview of the spill planning to be adopted for the ACE Project which will outline all necessary preventative and mitigation measures for minimising the consequences of any spills.

13.8.3.7 Spill Modelling Results

Scenario 1 – Platform Inventory Loss of Diesel

This section presents the modelling results for Scenario 1, which are summarised in Table 13.3.

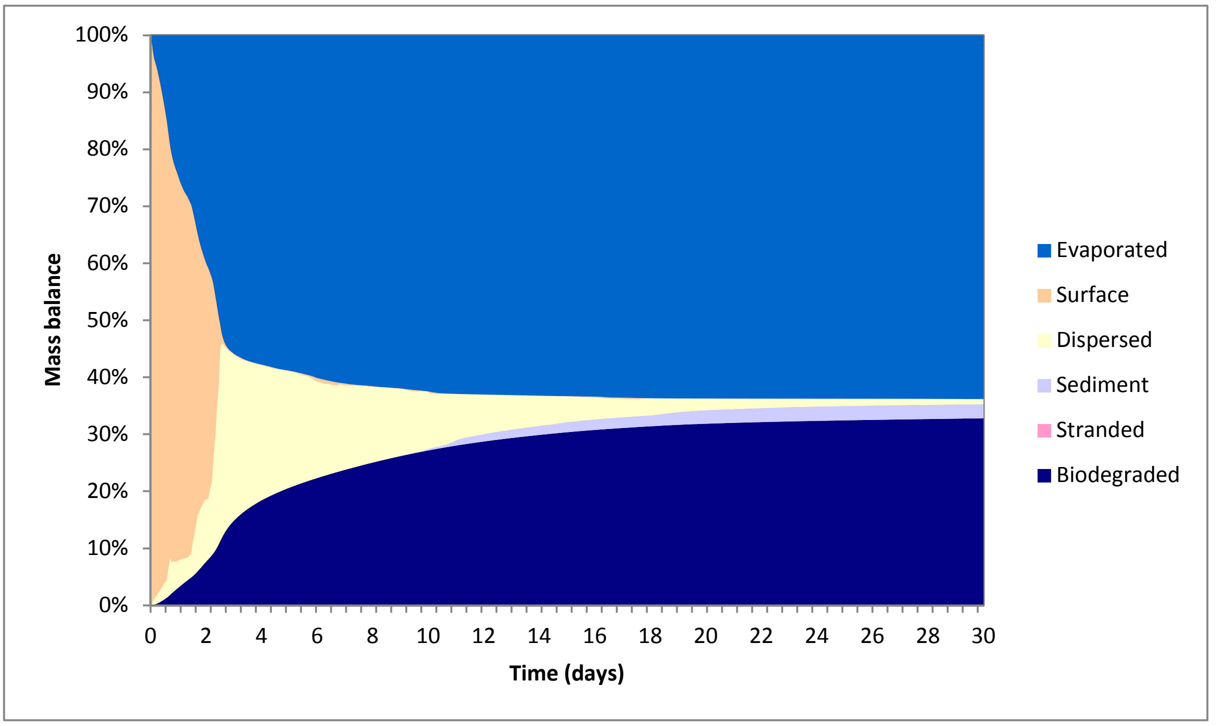
Table 13.3 Summary of Platform Diesel Inventory Loss Spill Modelling Results

Release Location	Maximum Surface Extent of Sheen Above 0.04µm (km)		Minimum Time to Beaching (days)		Time Until Water Column Dissolved concentration <58 ppb (days)[1]		Maximum Mass Onshore (tonnes)	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
ACE-PDQ	20.1	52.3	-	-	1.4	0.9	0	0
Note: 1. Time from start of release								

[6] The ACG Phase 2 30" oil export pipeline currently exports oil produced from the East Azeri (EA), Deepwater Gunashli (DWG), West Chirag (WC) and Central Azeri (CA) platforms.

As shown in Figure 13.10 the majority of the volume of the released diesel is rapidly lost to the air by evaporation or naturally dispersed into the water column and then biodegraded with no diesel predicted to reach the shore. Dispersion and dissolution into the upper water column takes place very close to the release point to a depth of 15m. Biodegradation also progresses relatively quickly such that only a very small fraction of diesel in the water column is left after 30 days.

Figure 13.10 Modelled Fate of Diesel Release (Summer)



The 92m³ of diesel released from the ACE platform is predicted to rapidly spread out to form a thin sheen on the sea surface. The modelling indicates that the maximum extent of sea surface covered by a diesel sheen of 0.04µm or thicker from this spill would be approximately 20.1km in summer and 52.3km in winter. Figures 13.11 and 13.12 present the modelling results for summer and winter, suggesting that the sheen on the sea surface would be visible up to 24km and 56km from the ACE platform, respectively.

Figures 13.13 and 13.14 shows the maximum area of the water column where the diesel in water concentration is above the 58 parts per billion (ppb) threshold. The area is affected for approximately 1.4 days after the release before the diesel disperses below the 58ppb threshold levels. In each figure, the output is a 'snapshot' at the time where the largest area is affected, which is at approximately 15 hours after the start of the release, where the diesel has moved away from the release location.

Figure 13.11 Modelled Cumulative Area Thickness of Diesel on the Sea Surface (Summer)

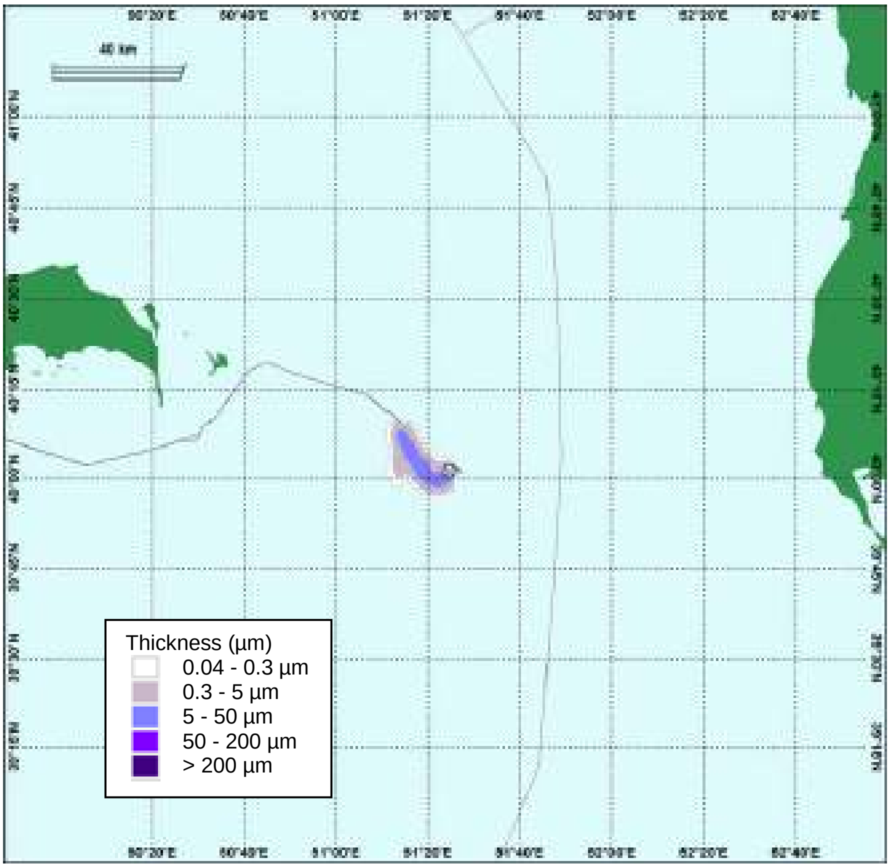


Figure 13.12 Modelled Cumulative Area Thickness of Diesel on the Sea Surface (Winter)

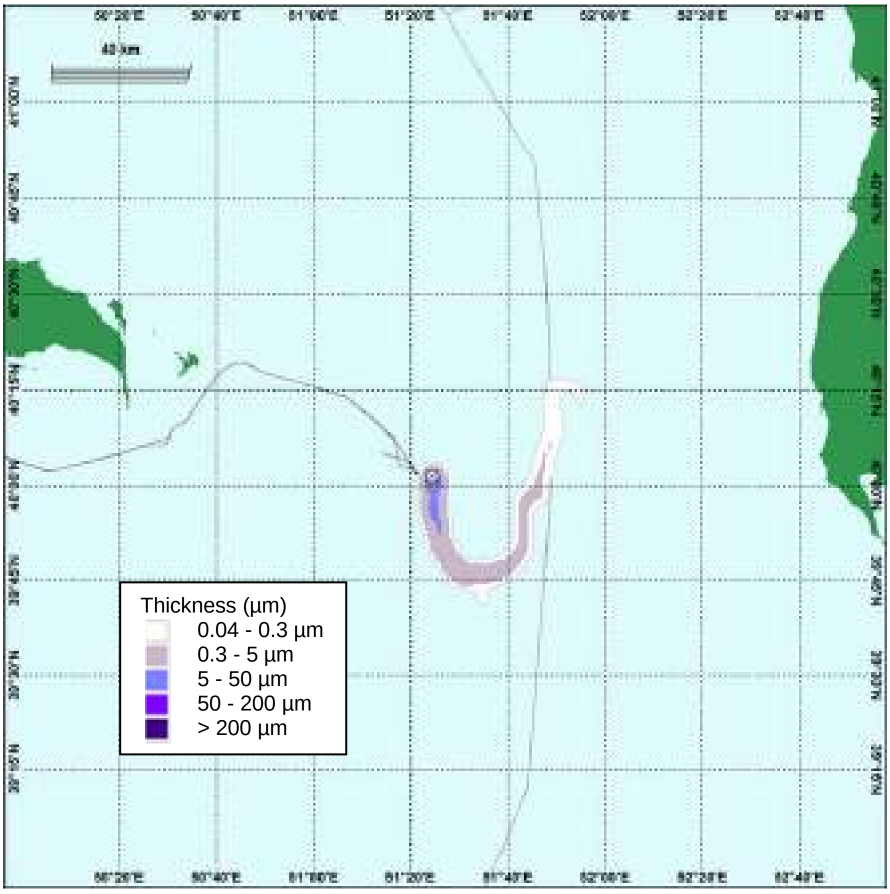


Figure 13.13 Modelled Concentration of Diesel Within the Water Column (Summer)

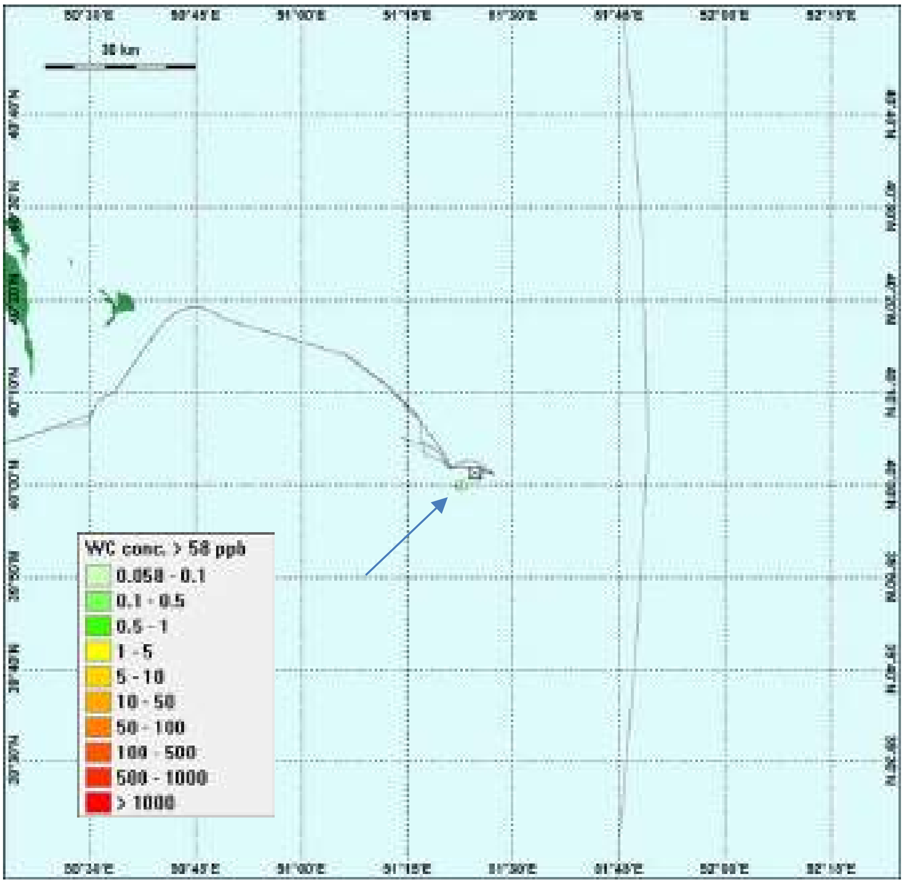
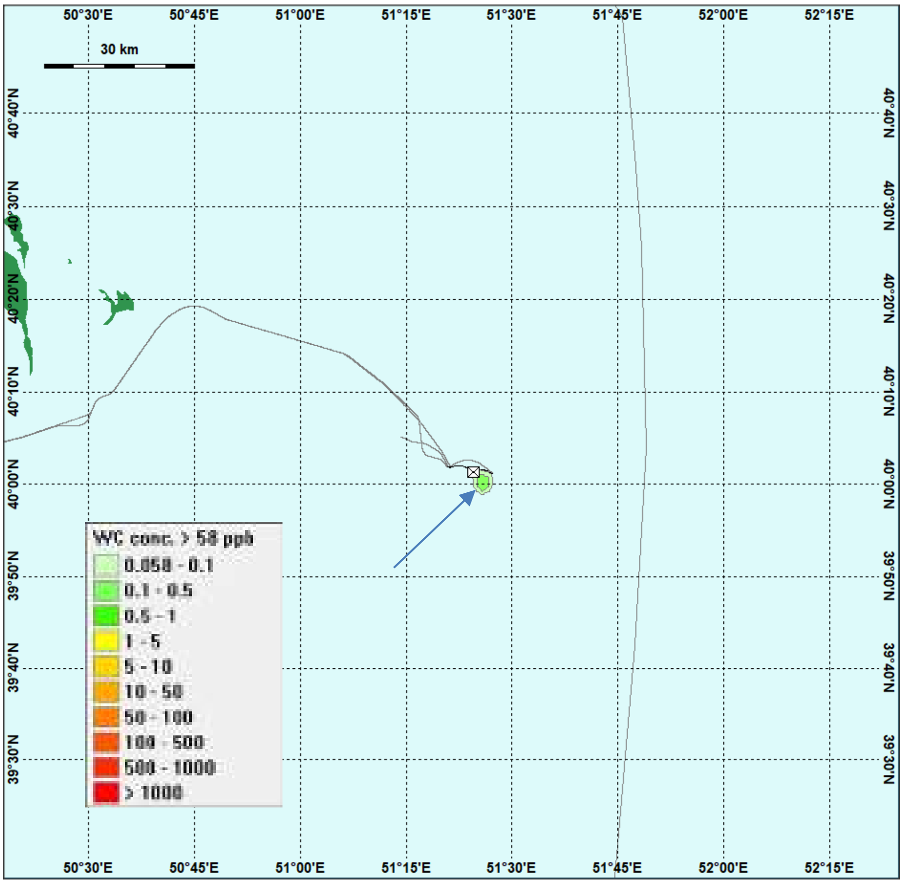


Figure 13.14 Modelled Concentration of Diesel Within the Water Column (Winter)



Scenario 2 – Blowout of Crude Oil

This section presents the modelling results for a worst case blowout, which are summarised in Table 13.4.

Table 13.4 Summary of Blowout of Crude Oil Spill Modelling Results

Release Location	Maximum Surface Extent of Sheen Above 0.04μm (km)		Minimum Time to Beaching (days)		Time Until Water Column Dissolved concentration <58 ppb (days)[1]		Maximum Mass Onshore (tonnes)	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
ACE-PDQ Wells	509	406	6.5	8.1	>120[2]	>120[2]	18,295	9,823

Notes:
1. Time from start of release
2. The modelling period is 120 days (30 days following the end of the 90 day blowout duration)

As shown in Figure 13.15 the majority of the oil is initially present on the sea surface following the release, while 15% evaporates almost immediately and 5% is dispersed into the water column. During the blowout period of 90 days, oil is continually supplied to the sea surface, and oil on the surface remains significant until after the end of the 90-day period. After around 18 days, oil has moved into shallower waters and begins to deposit in sediments, eventually accounting for around 15% of the oil at the end of the simulation. For this scenario, which represents the case with the maximum amount of oil on shore, oil reaches the shore at day 23 in southern Azerbaijan and Iran, although the fraction on shore does not exceed 1% of the total until day 32. The amount of evaporation stabilises at just over 30% while the amount biodegraded rises steadily to 38% by the end of the simulation. Ultimately 32% evaporates, 38% is biodegraded, 13% remains in the water column and 15% is deposited in sediments and approximately 2% is on the shoreline, with less than 1% remaining on the surface.

Oil can reach shore in as little as 6.5 days, although it can take around 30 days for substantial amounts of oil to reach shore.

The probability of surface oiling above 0.04μm threshold is shown in Figure 13.16. The crude oil on the sea surface is predicted to travel around 400-500km before it drops below the lowest recognised visible thickness under ideal viewing conditions. There is a distinct difference in oil movement between summer and winter with the oil more likely to travel southwest and follow the coast south in summer, while in the winter it is more likely to travel north or south and much less likely to approach the coast. The thickest areas of oil (>0.2mm) are present within 100km of the well and sometimes further.

Although the precise movement of the surface oil is dependent on the exact metocean conditions at the time, the analysis of over 100 different sets of metocean data suggest that the most likely locations to receive oil on shore are southern Azerbaijan, northern Iran and the tip of the Absheron Peninsula. The extent of oil in the water column above the 58ppb threshold tracks the path of the surface release and can extend over 200km from the source. Some areas continue to be affected 30 days after the end of the release. The upper 30m of the water column is most affected, although some oil above the 58ppb threshold is also predicted temporarily at depths of up to 80m, and in the plume directly above the blowout. The typical development of the subsea plume is shown in Figure 13.17, which illustrates the oil in the water column. This shows the rise of the oil and gas plume two hours after the start of the blowout, when the plume to the surface has reached stable conditions and oil has travelled around 2km from the source. Although summer conditions are shown, this initial development of the plume is similar in summer and winter. The sea currents at this time are relatively calm, so the plume appears vertical, although at other times it will be deflected off-vertical. Oil is predicted to appear on the surface approximately 100 seconds after the start of the release.

The probability of oil reaching the shoreline is presented in Figure 13.18 and the accumulation of oil predicted on shore following the blowout under summer conditions is shown in Figure 13.19. The summer case release results in oil mainly reaching three areas: southern Azerbaijan, northern Iran and the Absheron Peninsula. The eastern coastline of the Caspian Sea is unaffected. A mixture of areas of very light, light (0.1-1mm), moderate (1-10mm) and heavy (>10mm) oil deposition are predicted as can be seen in Figure 13.19.

Figure 13.15 Modelled Fate of Oil From Blowout Scenario (Summer)

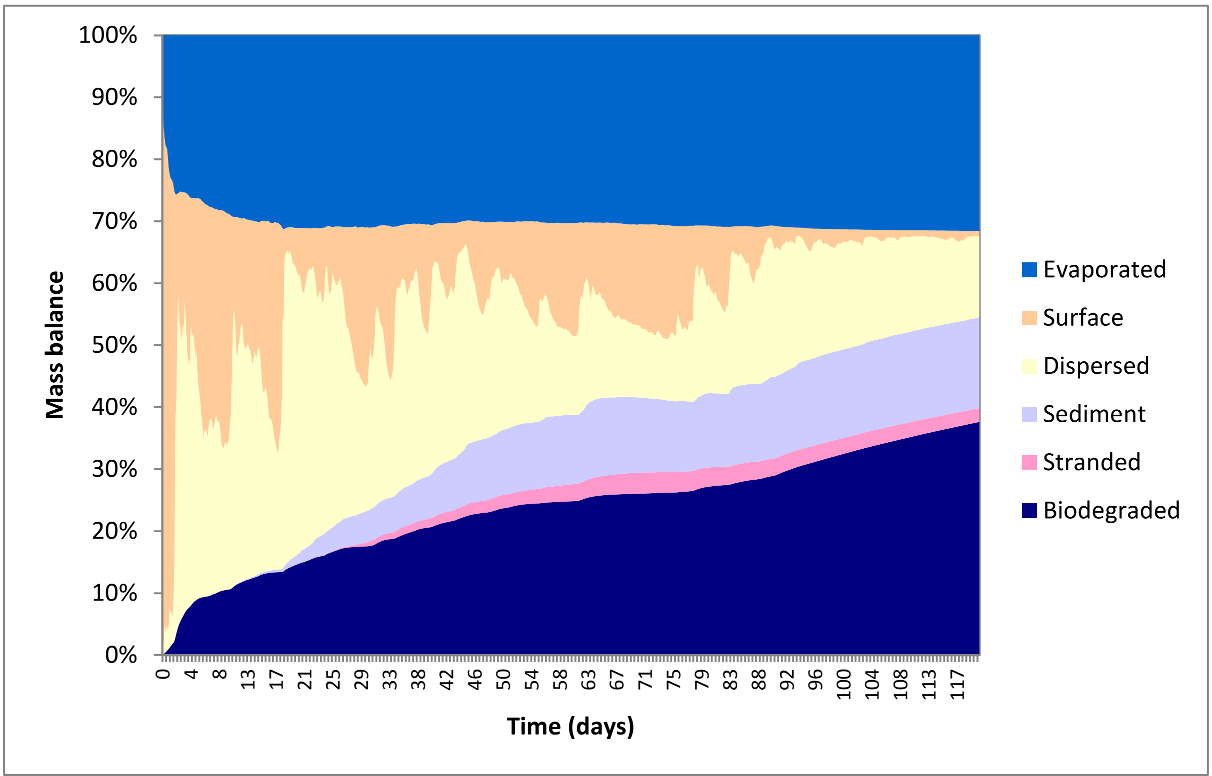


Figure 13.16 Modelled Probability of Surface Oil Thickness Above 0.04µm Threshold for Well Blowout Scenario

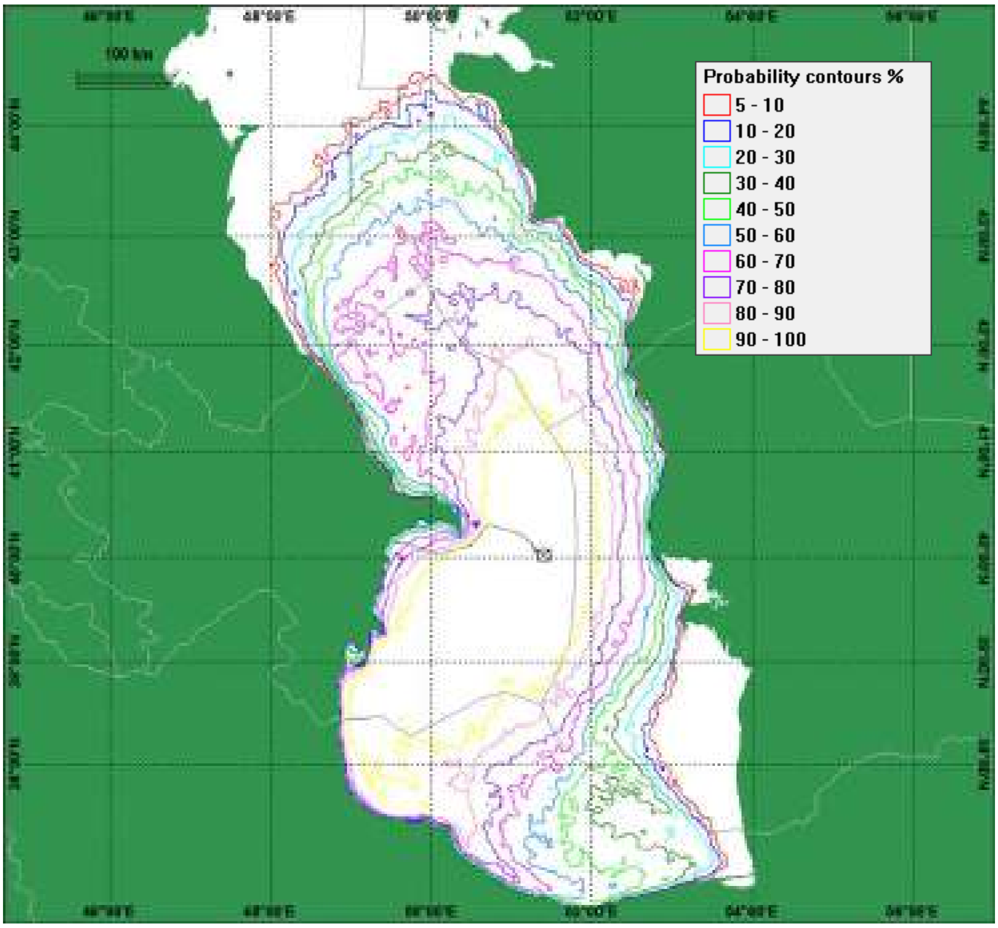


Figure 13.17 Modelled Typical Development of Blowout Plume Two Hours After Release in Summer

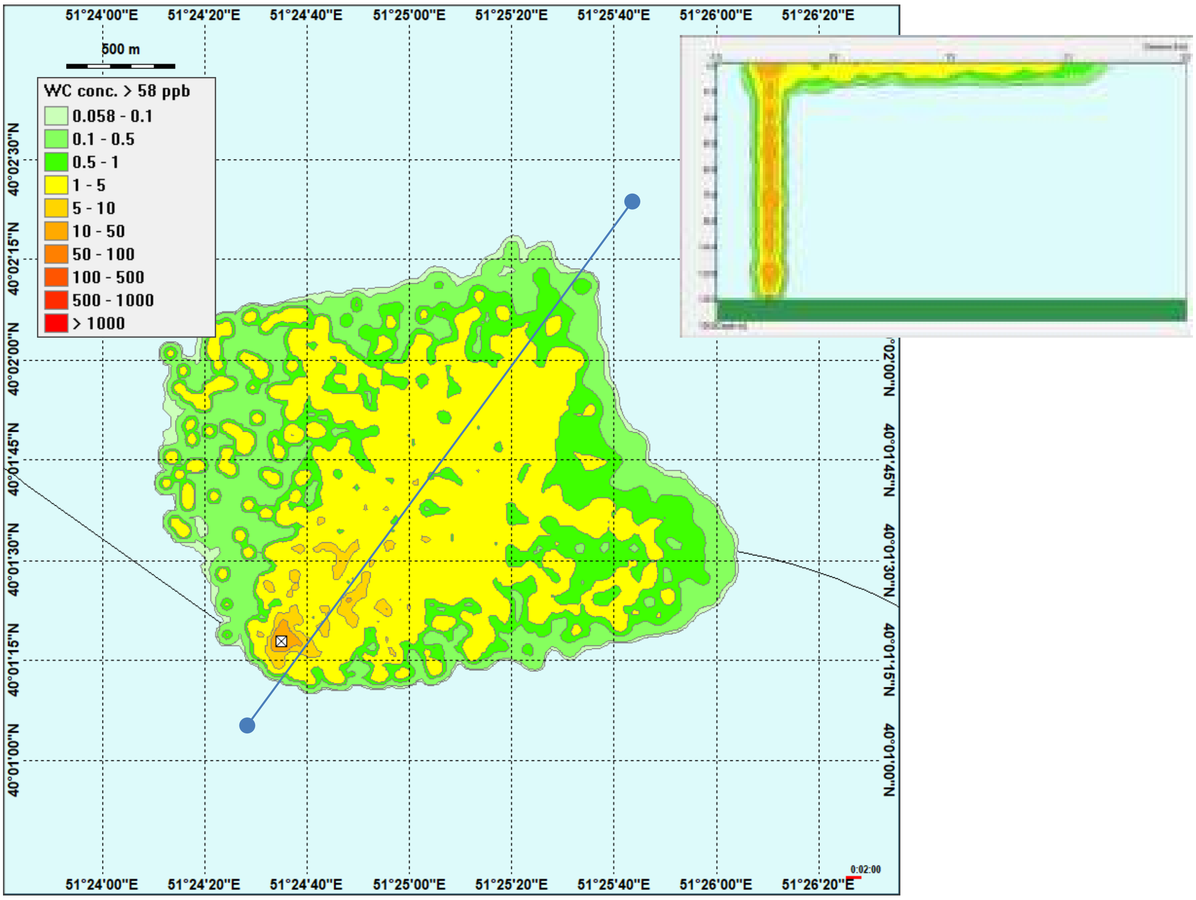


Figure 13.18 Modelled Probability of Shoreline Oiling Above 0.1 litres/m^2 for Blowout Scenario

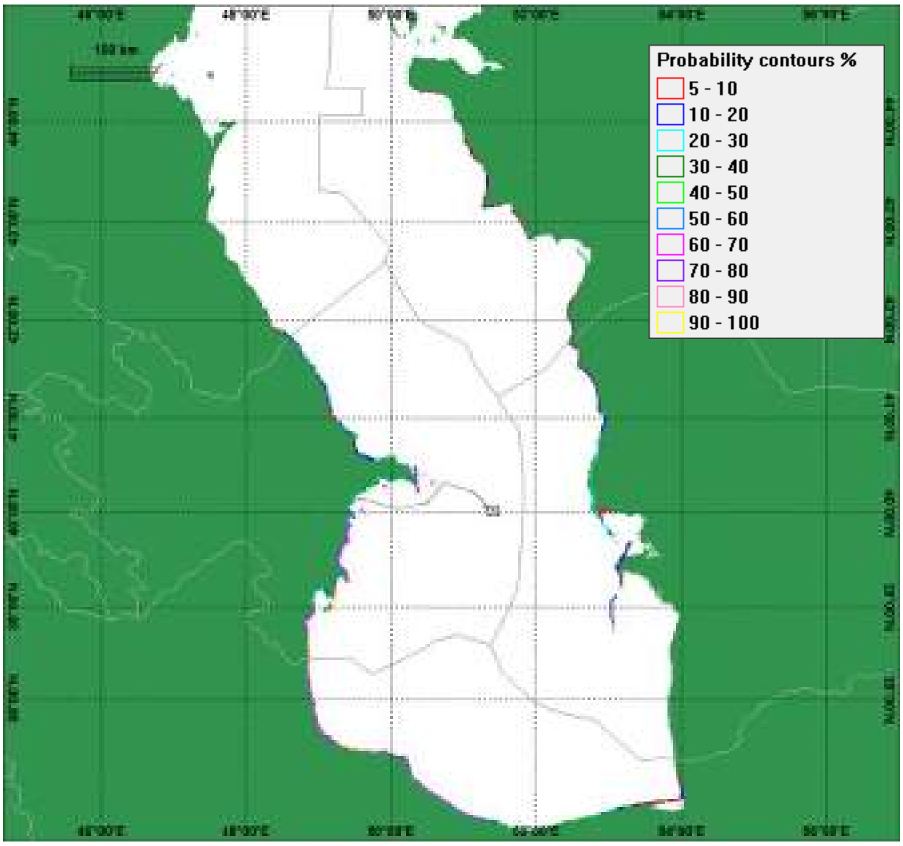
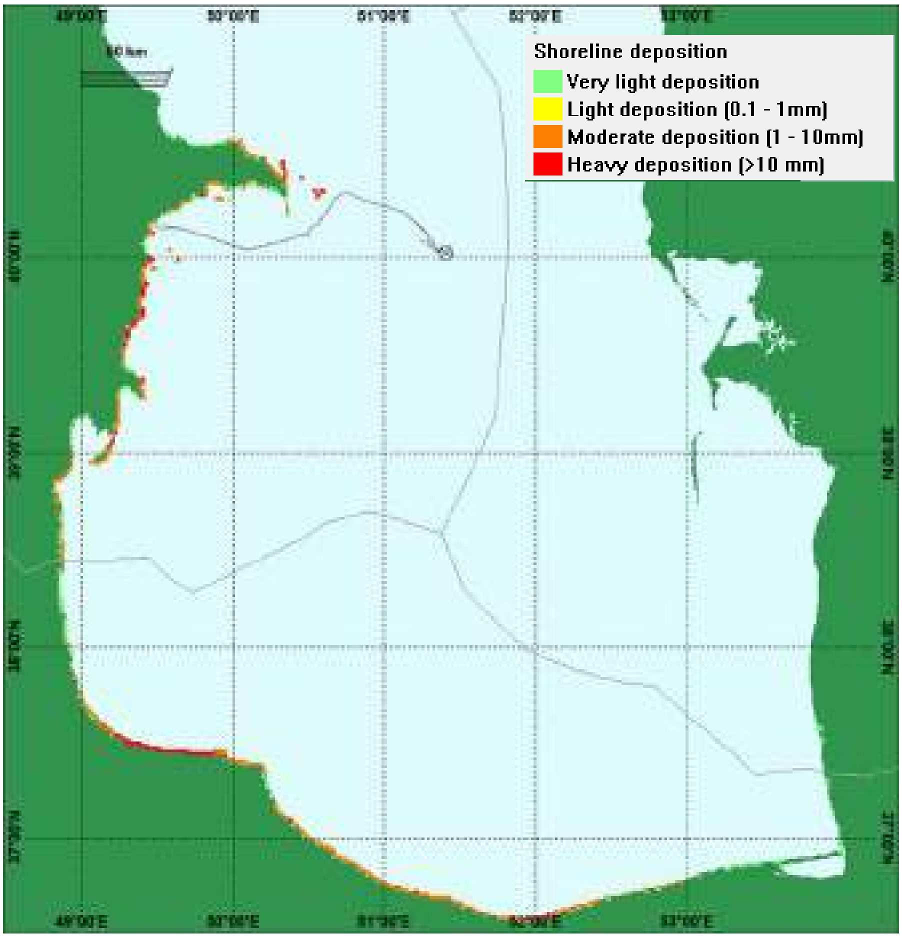


Figure 13.19 Modelled Shoreline Deposition Resulting from Blowout Scenario in Summer



Scenario 3 – ACE Oil Export Pipeline Rupture

This section presents the modelling results for the oil export pipeline rupture scenario, which are summarised in Table 13.5.

Table 13.5 Summary of Oil Export Pipeline Rupture Spill Modelling Results

Release Location	Maximum Surface Extent of Sheen Above 0.04µm (km)		Minimum Time to Beaching (days)		Time Until Water Column Dissolved concentration <58 ppb (days)[1]		Maximum Mass Onshore (tonnes)	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
30" Oil Export Pipeline Midway between ACE & CA Platforms	312	339	8.3	6	9	6	28	3
Note: 1. Time from start of release								

As shown in Figure 13.20 the majority of the oil is initially present on the sea surface, while 10% evaporates almost immediately and 15% is dispersed into the water column. Oil travels through the water column and takes just under two minutes to reach the surface. In the initial 48 hours oil is predominantly within the upper 15m of the water column, although in the first few hours, a secondary plume is also observed near the seabed resulting from initial high turbulence conditions that create neutrally buoyant oil droplets and promote dissolution. Oil on the surface diminishes rapidly after two days by mixing into the water column, although some oil can subsequently re-surface during calmer periods. After around 6 days, oil has moved into shallower waters and begins to deposit in sediments, eventually accounting for around 24% of the oil at the end of the simulation. For this scenario, which represents the case with the maximum amount of oil on shore, oil reaches the shore at day 10 in southern Azerbaijan, and the fraction on shore does not exceed 2.6% of the total at the end of 40 days. However, oil can reach shore in as little as 6 days and it can often take around 30 days for oil ashore to reach a number of tonnes. The amount of evaporation stabilises at around 30-35% while the amount biodegraded rises steadily to 29% by the end of the simulation. Ultimately 36% evaporates, 29% is biodegraded, 7.5% remains in the water column, 24% is deposited in sediments, approximately 2.5% is on the shoreline and less than 1% remains on the sea surface.

The majority of oil under this scenario moves southwest towards southern Azerbaijan and then circulates south along the coast towards northern Iran and the southern Caspian Sea shoreline. In the winter, oil transport is more likely to be to the north, tending to avoid the coastline. Although the precise movement of the surface oil is dependent on the exact metocean conditions at the time, the analysis of over 100 different sets of metocean data suggest that these two directions are dominant, and that the most likely locations to receive oil on shore are southern Azerbaijan, northern Iran and the tip of the Absheron Peninsula.

The probability of surface oiling above 0.04µm threshold is shown in Figure 13.21. Crude oil on the sea surface is predicted to travel up to 340km before it drops below the lowest recognised visible thickness under ideal viewing conditions. The oil droplets initially produced are larger than in the blowout scenario as there is little associated gas and the release conditions are lower energy, which means that although the release is far smaller, the surface sheen can still be somewhat persistent. There is a distinct difference in oil movement between summer and winter with the oil more likely to travel southwest and follow the coast south in summer, while in the winter it is more likely to travel north or south and is much less likely to approach the coast. The thickest areas of oil (> 0.2 mm) are present within around 10-20 km of the release but are short term (lasting up to 2 days) and occupying an area of up to 2km^2.

The area of water column affected is relatively small, partly because of the size of the release, the low gas content and the low energy conditions towards the end of the release which mean that the oil droplets formed are relatively large and do not spend long in the water column. The extent of oil in the water column above the threshold tracks the path of the surface release and can extend around 30-40km from the source. Some affected areas continue to be present up to four days after the end of the release. The upper 20m of the water column is most affected, although some oil above the 58ppb threshold is also predicted in the plume directly above the release point. The development of the subsea plume is shown in Figure 13.22, which illustrates the oil in the water column. Although summer conditions are shown, this initial development of the plume is similar in summer and winter. The release period is relatively short (up to 50 minutes) and the developed plume in Figure 13.22 is shown at 60 minutes after the start of the release (i.e. 10 minutes after it has ended, when oil is still ascending through the water column). At this time, oil has travelled around 1km from the source. The sea currents at this time are relatively calm, so the plume appears close to vertical, although at other times it will be more deflected. Some oil is also present near the seabed resulting from the very initial stage of the release when the highest energy is present, resulting from high energy turbulence creating small, neutrally buoyant droplets. Oil is predicted to reach the sea surface less than 90 seconds after the start of the release.

The probability of oil reaching the shoreline is presented in Figure 13.23 and the accumulation of oil predicted on shore following the pipeline rupture under summer conditions is shown in Figure 13.24. Oil deposition on the shoreline is spread out given the distance and time separating the source from the shore, and the mass of oil involved are relatively small. The summer case release results in oil mainly reaching three areas: southern Azerbaijan, northern Iran and Turkmenistan. A mixture of areas of very light and light (0.1-1mm) oil deposition is predicted as can be seen in Figure 13.24.

Figure 13.20 Modelled Fate of Oil From Pipeline Rupture Scenario (Summer)

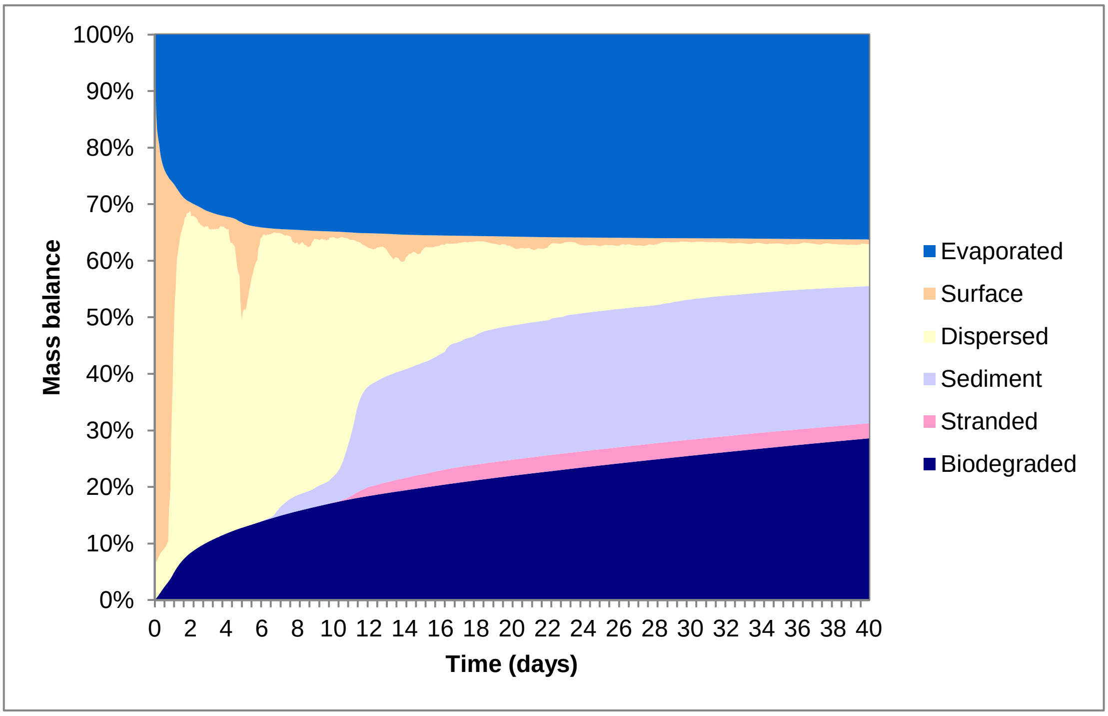


Figure 13.21 Modelled Probability of Surface Oil Thickness Above 0.04µm Threshold for Pipeline Rupture Scenario

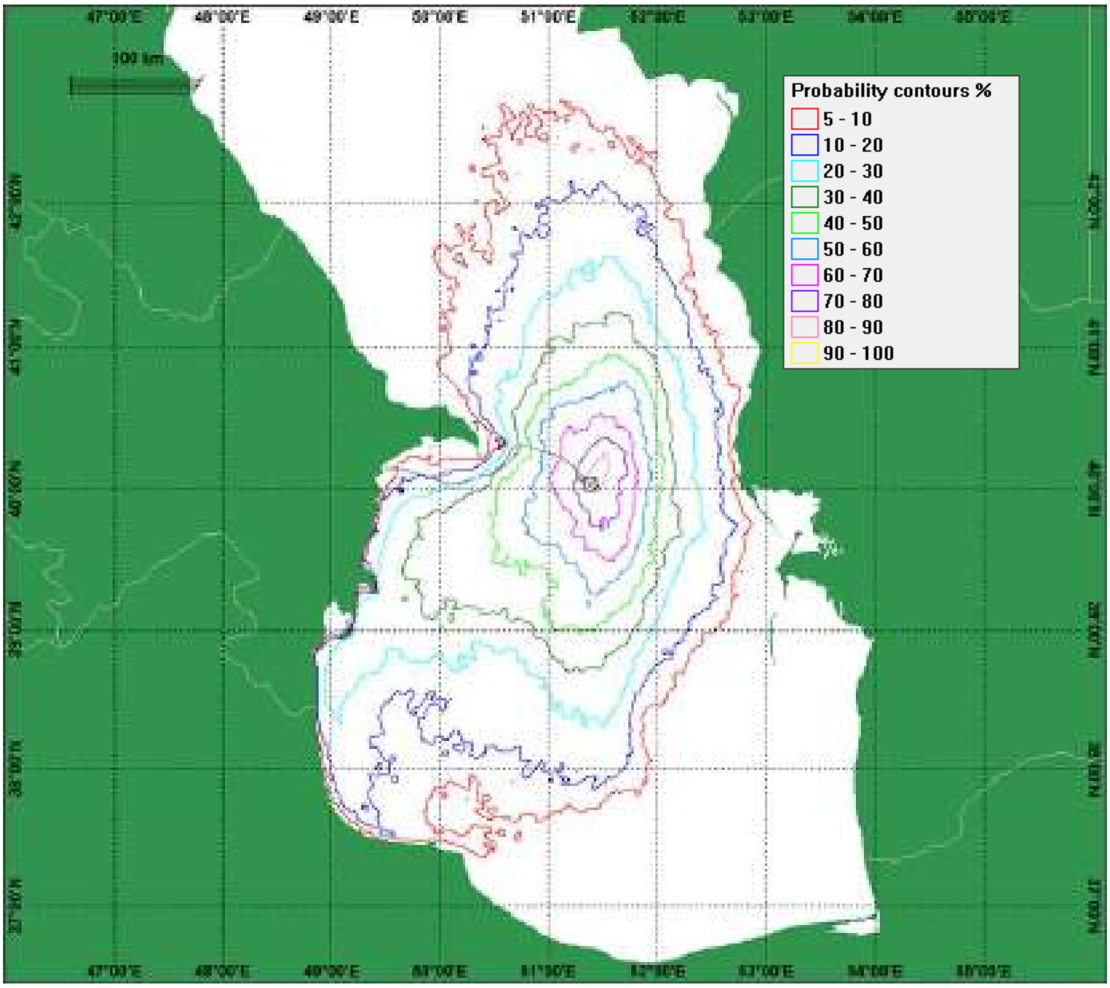


Figure 13.22 Modelled Typical Development of Pipeline Rupture Plume One Hour After Release In Summer

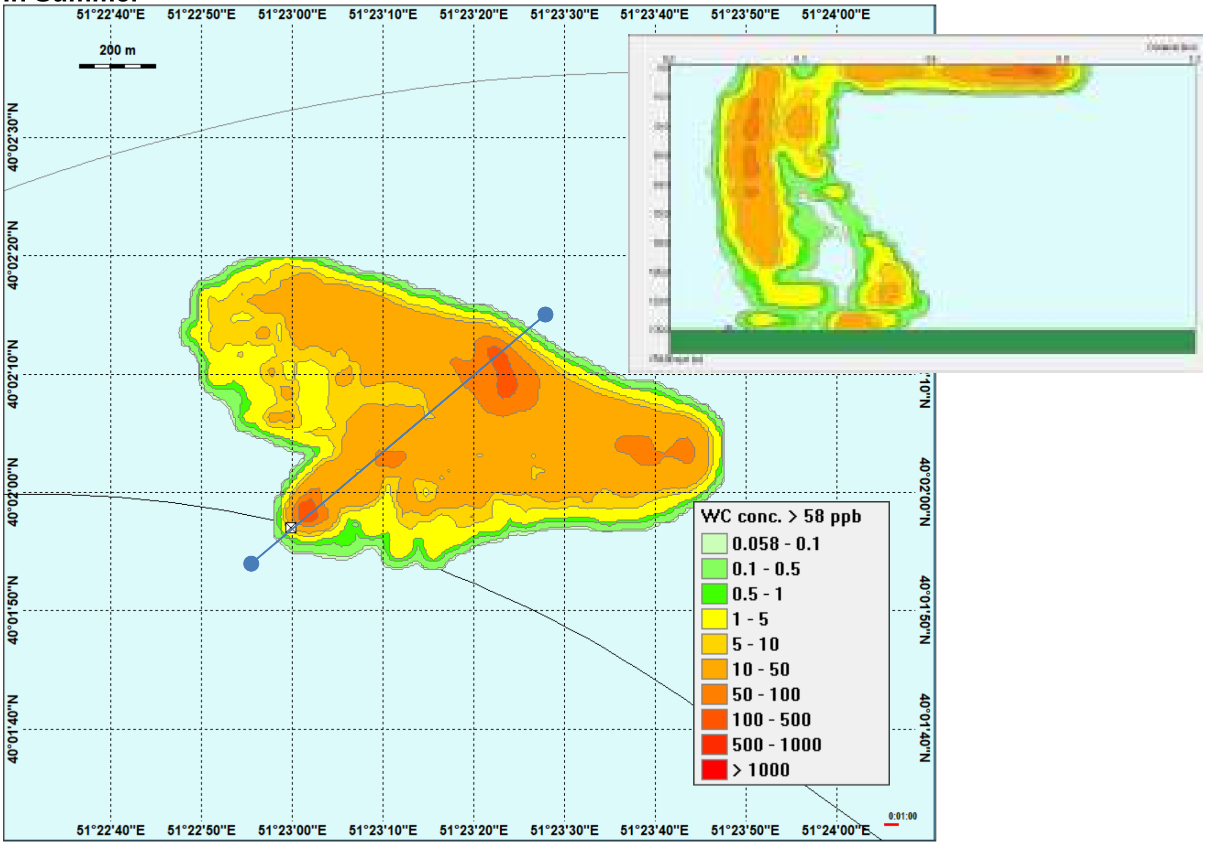


Figure 13.23 Modelled Probability of Shoreline Oiling Above 0.1 litres/m^2 for Pipeline Rupture Scenario

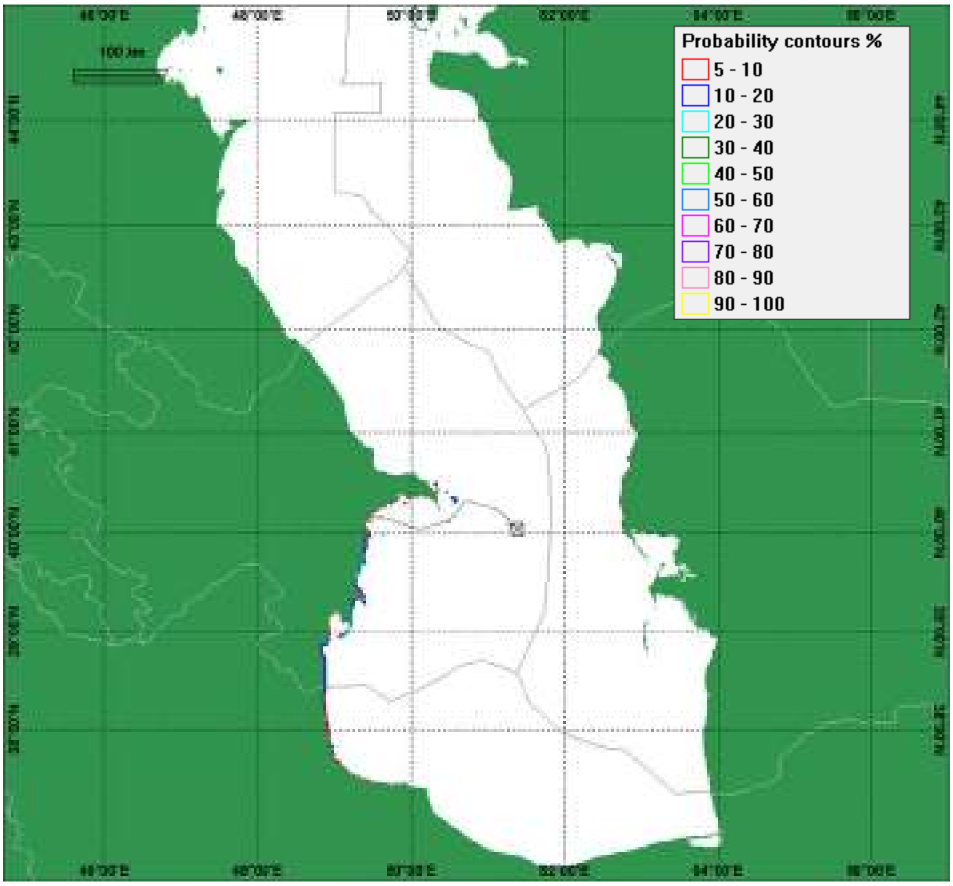
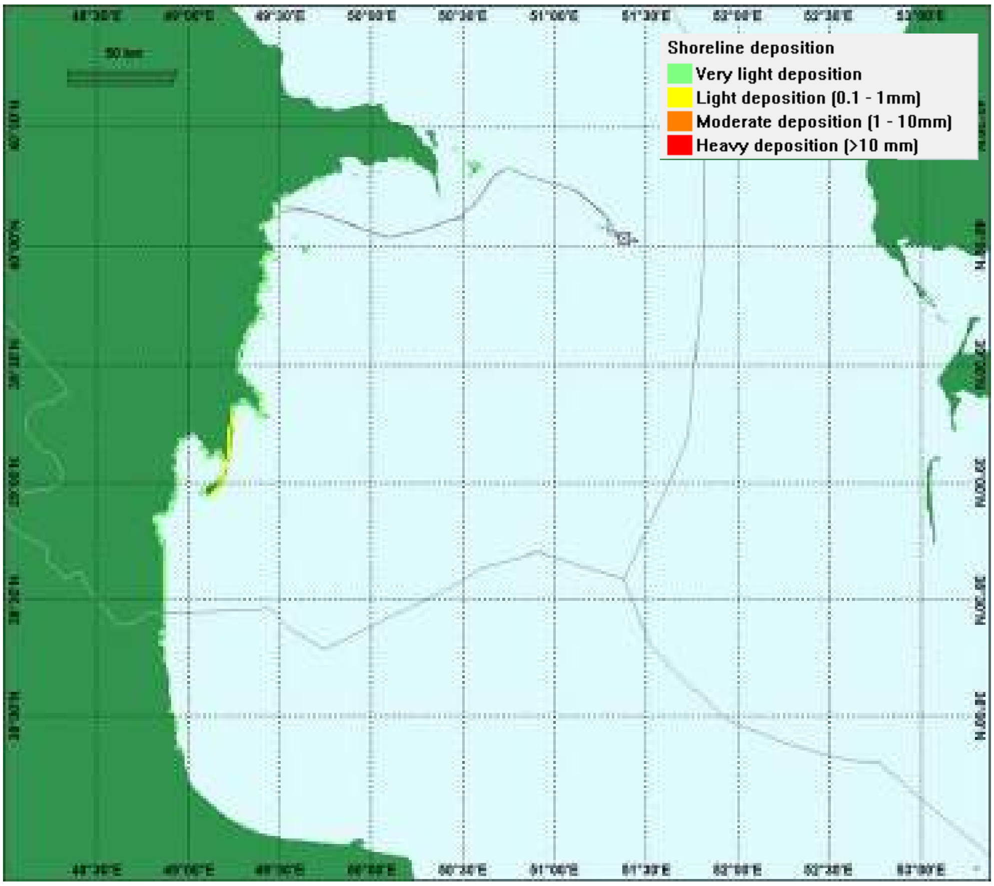


Figure 13.24 Modelled Shoreline Deposition Resulting from Pipeline Rupture Scenario in Summer



13.8.3.8 Potential Impact of Hydrocarbon Release

Hydrocarbons have the potential to cause detrimental effects to water and sediment quality, marine and coastal flora and fauna, including plankton, benthic invertebrates, fish, birds and marine mammals that may come into contact with a spill. An impact on fisheries and an indirect impact on human health via the food chain is also possible, depending on the scale of the spill and its proximity to fishing grounds. The vulnerability of marine and coastal receptors to hydrocarbon spills is summarised in Table 13.6 below.

Spilled hydrocarbons undergo a weathering process once they are released into the marine environment. The fate of diesel and crude oil in the marine environment is described in Section 13.8.3.5 and Appendix 13A and is dependent on the type and volume of oil spilled and the prevailing weather and sea conditions. The spill modelling described in Section 13.8.3.7 above has estimated the trajectory of hydrocarbons in the marine environment for a range of scenarios including a loss of diesel inventory from the ACE platform, a well blowout and a rupture of the oil export pipeline. A brief description of the potential impacts of the spills, taking into account the modelling results on marine and coastal receptors is presented below. Further details on the environmental and social receptors potentially impacted by a spill are provided in Chapters 6 and 7 of this ESIA.

Table 13.6 Vulnerability of Marine and Coastal Receptors to Hydrocarbon Spills

Receptor	Vulnerability to Hydrocarbon Spills
Plankton	• Abundance of phytoplankton may increase after a hydrocarbon spill due to increased nutrient availability, while zooplankton, fish larvae and eggs may suffer increased mortality due to toxicity in the water column, and therefore can affect the food chain of other fish species. • Although localised mortality is likely, the overall effect on plankton communities is not statistically significant and generally short-term. Following a spill, plankton biomass may fall, however, after a few weeks, population often returns to baseline levels as a as a result of high reproductive rates and redistribution of species from outside the affected area.
Benthic Invertebrates	• Effects on the benthos include acute toxicity and organic enrichment. Offshore impacts are typically minimal, and influenced by water depth and local hydrography. Sub-tidal regions generally have lower hydrocarbon concentrations after a spill than inter-tidal regions as often the hydrocarbon is carried and spread at the sea surface. Recovery times are variable, and for light hydrocarbons are generally in the region of a few months to a few years. • Impacts can include rapid mortality of sensitive species such as crustaceans and amphipods; a period of reduced species population and abundance; a period of altered community structure with increased abundance of opportunistic species.
Fish	• Evidence suggests that fish are able to detect and avoid hydrocarbon-contaminated waters. This avoidance may cause disruption to migration or spawning patterns. • Hydrocarbon exposure in fish can lead to mortality or sub-lethal impacts on growth, physiology, behaviour and lowered disease resistance. • Fish populations are more sensitive to hydrocarbon pollution in shallow waters than in deep waters, with hydrocarbon concentrations being typically higher in the upper column. • Fish may ingest large amounts of hydrocarbons through their gills. Fish that have been exposed to hydrocarbons may suffer from changes in heart and respiratory rate, enlarged livers, reduced growth, fin erosion and a variety of effects at biochemical and cellular levels. Hydrocarbons toxicity can also affect reproductive capacity negatively and/or result in deformed fry. • Fish eggs and larvae are more vulnerable to hydrocarbon pollution than adults. In many fish species, these stages float to the surface where contact with spilt hydrocarbons is more likely. However, as most fish species have extensive spawning grounds and produce large numbers of eggs, there is unlikely to be any effect on numbers in the adult populations. Stocks may be at risk from a spill if it is large and coincides with spawning periods. • Longer term impacts of a hydrocarbon spill have shown genetic damage, physical deformities, reduced abundance and growth, and compromised survival of some life stages.
Seals	• Seals are very vulnerable to hydrocarbon pollution because they spend much of their time on or near the surface of the water. They need to surface to breathe, and regularly haul out onto beaches. During the course of a hydrocarbon pollution incident, they are at risk both when surfacing and when hauling out. • Seals may be damaged through the ingestion of food contaminated by hydrocarbons or the inhalation of hydrocarbon droplets and vapours. Oil, especially light oils and hydrocarbon vapours, will attack exposed sensitive tissues. These include mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, anal and urogenital orifices. This can cause corneal abrasions, conjunctivitis and ulcers. Consumption of contaminated prey can lead to the accumulation of hydrocarbons in tissues and organs.
Birds	• The spilled hydrocarbon can penetrate into the plumage of sea birds, reducing its insulating ability, and making them more vulnerable to temperature fluctuations and much less buoyant in the water. This can lead to death from hypothermia or drowning. • In their efforts to clean themselves from hydrocarbon, the birds may inhale or ingest the hydrocarbon. As hydrocarbons are toxic, this may result in serious injuries/health effects such as pneumonia, congested lungs, intestinal or lung haemorrhage, liver and kidney damage. • Hydrocarbons may also affect the reproductive success of the birds as hydrocarbons from feathers of a bird that is laying on eggs may pass through the pores in the eggshells and either kill the embryos or lead to malformations.
Fisheries	• Fish exposed to hydrocarbons may become tainted, defined as giving the product a petroleum taste or smell. Commercial fish species rarely become tainted in open deep waters, as they are able to avoid the affected area. However, major spills can result in loss of fishing days and exclusion zones and bans on certain species lasting for a whole season may be enforced.
Sources: Ref. 7, Ref. 12, Ref. 13, Ref, 14 & Ref. 15	

Plankton

The spill modelling indicates that for a diesel release (Scenario 1) and pipeline rupture (Scenario 2) the concentrations of diesel or oil in the water column above the 58ppb threshold are limited in extent from the point of release and are not expected to persist for longer than 2 days and 9 days, respectively. The exposure of plankton (excluding fish larvae) to toxic levels of hydrocarbons from these scenarios is therefore expected to be short term and localised. However, the modelling of the well blowout scenario (Scenario 2) estimates the maximum area of water column with a concentration of oil in the water column above the 58ppb threshold would be extensive and the concentration would remain above the 58ppb threshold for greater than 120 days following the release.

Plankton (particularly zooplankton, fish larvae and eggs) are likely to suffer high levels of mortality through exposure to hydrocarbons. However, plankton already experience very high levels of natural mortality, predominantly the result of predation. Plankton are generally short-lived, rapidly reproducing often releasing very high numbers of eggs and/or larvae and are also widely distributed, so that recovery, even from significantly detrimental impacts, can be relatively short (weeks or months) (Ref. 11).

During the peak period of phytoplankton production (spring and autumn) the biomass exposed to a hydrocarbon spill would increase resulting in reduced growth levels and mortality. However, this is not expected to be significant in comparison to the total production level over the long term. Zooplankton may also suffer mortality as a result of a hydrocarbon spill, but the large number of early life stages produced and short reproductive cycles, will act as a buffer for recruitment from areas outside the spill affected region. Thus, plankton concentrations are expected to return to baseline levels after a relatively short period of time. As a result, the overall impact on the plankton communities is not considered to be significant.

Benthic Invertebrates

As detailed in Chapter 6: Sections 6.5.3.1 and 6.6.2, the benthic community throughout the ACG Contract Area and at the proposed ACE platform location is not expected to support any species of conservation significance. Nevertheless, benthic communities do play an important role in supporting critical functions of the local ecosystem, particularly as prey items for other species, including fish such as sturgeon. There are a number of taxa that are important prey e.g. amphipod crustaceans, which are known to be sensitive to hydrocarbons.

As shown in Figure 13.10 a release of diesel from the ACE platform is predicted approximately 2% of the spilled diesel ending up in sediments and thus benthic environments are less likely to suffer the impacts of a surface hydrocarbon spill. The spilled hydrocarbons become mixed into the water column, subsequently combining with suspended sediments. This then sinks to the seabed where its toxic components can be lethal to benthic organisms (Ref. 11). As shown in Figures 13.15 and 13.20, the spill modelling predicts that approximately 15% and 24% of the spilled oil from the blowout and pipeline rupture scenarios respectively will sink to the seabed. Furthermore, the predicted maximum amount of oil beached ashore is predicted to be 18295 tonnes for the worst case summer blowout scenario.

Potential impacts to the benthic invertebrates can include: (i) rapid mortality of sensitive species such as crustaceans, amphipods, and bivalves; (ii) a period of reduced species population and abundance and (iii) a period of altered community structure with increased abundance of opportunistic species.

Given the water depths in the vicinity of the well location (approximately 137m), it is unlikely to be a spill would give rise to highly significant effects to benthic invertebrates from a surface spill of diesel, particularly as the diesel will rapidly evaporate and disperse in the water column.

In the case of a pipeline rupture and well blowout, where the hydrocarbon initially disperses rapidly, the impact to the benthic environment in the vicinity of the release will be dependent upon weather conditions and levels of suspended sediment within the water column at the time. With regard to the blowout scenario a significant volume of oil is anticipated to reach the coastline and the probability of the concentration of oil in the water column being above the threshold rate of 58ppb is between 50 and 80% for significant lengths of coastline meaning there is potential to impact benthic species present within the shallow water coastal areas where oil is predicted to beach. As such, the potential impacts to benthic species in the coastal areas affected by the spilled oil from a blowout is likely to be significant in the short term. The recovery times for benthos would vary depending on the environmental conditions and species affected. Over time the oil will biodegrade and the effects of wave action and currents will naturally disperse the oil particularly along rocky and sandy shores, although benthic species present in areas of fine sand or mud may suffer longer term effects as the oil that penetrates fine sediments can persist for many years and can often be released back into the water column if disturbed.

In terms of a release of diesel from the platform or a pipeline rupture of crude oil, considering the low probability of oil beaching or reaching the seabed, the limited area of the coastal zone being affected by stranded oil and medium term recovery rates, the overall impact to low sensitivity benthic invertebrates is expected to be low. However in terms of the worst case blowout scenario, the potential for a large amount of oil to reach the seabed and beach along a significant length of coastline is expected to lead to a potentially significant impact on benthic species present in areas impacted by the oil. There is potential for recovery to take a number of years and for changes to the community structure due to the increased abundance of opportunistic species.

Fish

As discussed in Chapter 6: Section 6.5.5.2, the key locations for fish species in the southern Caspian are within the shallow water shelf areas. Maximum concentrations of fish are typically found at depths of up to 75m for the majority of the year but it is common for Caspian fish species to migrate to warmer waters for overwintering and migrate to nutrient rich shallow areas of the north or river deltas in the spring / summer for spawning and feeding. The coastal region is important for non-migratory species as it provides breeding and nursery habitat for a number of species during spring, summer and autumn. The area south of the Absheron Peninsula is a known nursery area for the main commercial fish species. Pelagic species such as kilka are likely to be found in the waters of the Southern Caspian year round, although in smaller numbers in winter, outside the main spawning and migration periods while migration of sturgeon and grey mullet takes place along the coast in water depths up to 100m.

The potential impacts of an oil spill on fish may include physical damage (e.g. through oiling of gills) and toxic effects (e.g. due to uptake of volatile toxic components of the crude). Fish have the ability to detect hydrocarbons in water through olfactory (smell) or gustatory (taste) systems and tend to avoid contaminated areas). Depending on the time of year that a spill was to occur, different groups of fish species may be affected. It can be assumed therefore that the majority of adult fish would avoid the area of a spill, although in very shallow waters fish may be more restricted between the seabed and the hydrocarbons on the sea surface. Spill avoidance behaviour can disrupt migration routes for some fish species. This has the potential to impact the migration of species of sturgeon and shad and semi-migratory species such kilka and mullet. Where mortalities have been recorded they have generally been associated with high levels of surface oiling in storm conditions when mixing increases the presence of oil compounds in the water column. Juveniles and larvae are more vulnerable to oil spills as they have limited ability to move away from the contaminated zone, which may have implications for the reproduction of these species. It should be noted that protected sturgeon species do not spawn within Azerbaijani waters but will be migrating in spring and summer and may be feeding during summer in coastal waters up to 100m water depth.

Oil spill modelling indicates that diesel concentrations in the water column that have the potential to cause toxic effects on fish are non-persistent, with a large proportion of the diesel evaporating within two days of the release. In the event of a blowout or pipeline rupture, a large proportion of the oil will evaporate, with the remaining oil expected to persist over a longer period compared to diesel (weeks and months compared to days for diesel). With the blowout scenario, the probability of the dispersed oil in water concentration exceeding the 58ppb threshold is 90-100% over an extensive area of the Southern and Central Caspian and the modelling predicts it will take greater than 120 days for the dissolved concentration to fall below 58ppb in impacted areas. Although adult fish have the ability to move away from affected areas, juveniles and larvae have limited ability. Coupled with the extensive area impacted by the oil spill and the duration of contamination there will likely be significant impacts to fish populations in the short to long-term.

Seals

If Caspian seals are within the area of a spill, or if the spill affects any resting or haul out sites, there could be irreversible impacts from a hydrocarbon spill through coating, inhalation and ingestion.

As discussed within Chapter 6: Section 6.5.5.3 seals may be present in the ACG Contract Area at any time of year but with an increased likelihood during both the spring (April-May) migration. In addition to seal presence during the migration period, there is also the potential for seals that have not migrated to the Southern Caspian to be present for foraging from May to September with peak numbers coinciding with the peak kilka numbers in July. The scientific opinion is that seals are showing signs of adaptation to anthropogenic disturbances. It is understood that, following increased disturbances within the Dagestan coastal area of Russia (including reported mass poaching), seals tended to avoid coastal areas during the autumn and spring migrations and use routes located away from the coast. Thus, the latest research has shown it is not possible to assume the seals will always follow the previously defined migratory paths close to the east and west coastline and may travel through the centre of the Caspian (including through the ACG Contract Area). Recent research indicates that a significant proportion of seals remain to feed in the Central Caspian (to the north and south of the Absheron Peninsula) throughout summer and autumn.

With regard to a release of diesel from the ACE platform (Scenario 1) the oil spill modelling confirmed that surface diesel thicknesses will be greatest near the spill location, dispersing and thinning out with distance and time. The duration of diesel remaining on the sea surface in most areas is not predicted to exceed two days and it is not predicted that any of the spilled diesel will reach the shoreline. Therefore, any exposure of seals to spilled diesel is likely to be limited.

In the event of a blowout (Scenario 2) there will be a significant volume of oil released to the sea surface. Over time, the volume of oil on the surface will reduce through evaporation, dispersion in the water column and biodegradation. However, under worst case conditions up to 18295 tonnes of oil may reach the shoreline with the first oil reaching shore within approximately six days following the blowout. The stochastic modelling indicates that different times of year can make a significant difference to the amount of oil that reaches the shore with a blowout during the summer months predicted to result in the most oil beaching. The probability of oil reaching the Azerbaijan coastline varies from 5-100% with oil most likely to come ashore around the Absheron Peninsula, Pirallahi Island, Chilov Island and from the Kura Delta to the border with Iran.

A rupture of the oil pipeline (Scenario 3) would result in about 70% of the spilled oil reaching the sea surface, however this diminishes rapidly to less than 10% of the volume within two days due to evaporation, dispersion in the water column and biodegradation. The modelling also predicts, as a worst case, that a small amount of oil would reach the coastline (28 tonnes), however the probability of this occurring ranges from 5% for the majority of the Azerbaijan coastline to 30% around Chilov Island and further down the coast towards Neftchala. As per the blowout scenario it is considered that a spill in the summer months would result in the greatest geographic spread of oil on the surface and coastline (refer to Figures 13.21 and 13.23).

Caspian seals are an IUCN endangered species and are under pressure from various natural and anthropogenic stressors. Seals are known to be highly sensitive to oiling and are most vulnerable during the breeding season (December to February) and feeding periods (May to November). Therefore, even small-medium scale exposure to toxic effects of diesel, within sensitive areas for seals, could result in a potentially significant impact. The anticipated larger volume of a major spill (i.e. blowout) and relative larger size of slick would increase the potential for contact with seals in the offshore waters and along the coastline meaning a significant impact to seals is highly likely in the event of a blowout.

Protected Areas of Sites of Ornithological Importance

As discussed in Chapter 6: Section 6.4.4.6 there are a number of Protected Areas (IUCN Categories II and IV), Important Bird and Biodiversity Areas (IBAs), and Key Biodiversity Areas (KBAs) located along the coastline of Azerbaijan.

In the event of a blowout (Scenario 2) or oil pipeline rupture (Scenario 3), these areas can be potentially exposed to shoreline oiling. The shoreline oiling probabilities predicted by modelling for these scenarios for each of the areas of ornithological importance are summarised in Table 13.7. The modelling predicts a range of probabilities of shoreline oiling for some of the important ornithological areas due to the extensive length of coastline they occupy, therefore the highest probability predicted for any part of the important ornithological area is presented as a worst case. Each of the important ornithological sites listed in Table 13.7 have at least a 50% probability of being impacted be shoreline oiling while for a number of sites including the Absheron National Park (including Shahdili spit and Pirallahi Island), Kura Delta and Gizil Agach the probability is 70-100%. The recovery of different habitats from an oil spill varies but for hydrocarbons such as crude oil the recovery typically takes place within a few seasonal cycles for most habitats within one to three years although the recovery in more sheltered areas may take up to five years (Ref. 14). Based on this medium to long term recovery and considering international conservation status and ecological importance of these areas, the potential impacts are assumed to be significant.

Table 13.7 Shoreline Oiling Probabilities for Designated Areas along the Azerbaijan Coastline

Sites of Ornithological Importance	Designation	Probability of Shoreline Oiling Under Worst Case Conditions	
		Blowout (Scenario 2)	Pipeline Rupture (Scenario 3)
Absheron National Park (including Shahdili Spit and Pirallahi Island)	National Park KBA/IBA IUCN II	70 - 80%	5-10%
Red Lake	KBA/IBA	50 - 60%	5 -10%
Sahil Settlement – 'Shelf Factory'	KBA/IBA	60 - 70%	5 -10%
Sangachal Bay	KBA/IBA	50 - 60%	5 -10%
Glinyani Island	KBA/IBA IUCN IV	70 - 80%	20 - 30%
Pirsagat Islands and Los Island	KBA/IBA	70 - 80%	20 - 30%
Bandovan	State Nature Sanctuary IUCN IV	70 - 80%	0%
Shirvan National Park	National Park KBA/IBA IUCN II	50 - 70%	20 - 30%
Shorgel Lakes / Shirvan Reserve	KBA/IBA IUCN not reported	50 - 70%	20 - 30%
Kura Delta	KBA/IBA	90 - 100%	20 - 30%
Gizil Agach	KBA/IBA IUCN Ia Ramsar Site	90 - 100%	20 - 30%
Gizil Agach State Nature Sanctuary	State Nature Sanctuary	60 - 70%	10 - 20%

Birds and Important Bird and Biodiversity Areas

The Caspian region supports a high diversity of bird species, with a large number of endemic and protected species present. The Azerbaijan coastline of the Caspian Sea from the Absheron region moving south is an area of international and regional importance providing habitat for breeding, nesting, migratory and overwintering birds, which is reflected in the designation of a number of IBAs (see Chapter 6: Section 6.4.4).

The distribution and abundance of birds in the coastal region changes significantly during the migration and overwintering periods. A large number of overwintering and migrating birds will be present offshore and along the Central and Southern Caspian coastline within a number of IBAs identified as areas of potential impact from an oil spill (Table 13.7).

There are, however, some key periods and areas of higher sensitivity. Ducks and coots are overwintering from December to February and the presence of migrating species peaks in March and November. The IBAs are the key habitats for these groups of birds, particularly for nesting and breeding. The bird nesting season begins at the end of April/beginning May and continues until mid-July. Limited information is available regarding the offshore distribution and abundance of birds in the

Southern Caspian; however it is anticipated that there may be small numbers of gulls and birds such as terns that plunge dive to feed and species. It is also considered likely that some birds may migrate through the ACG Contract Area during the spring (February – April) and autumn (August – December) migration periods.

An accidental release of hydrocarbons, particularly crude oil, can impact birds offshore and in the nearshore / coastal areas. The oiling of their plumage is the most obvious impact. When this occurs, the important layer of insulation is disrupted, which results in the skin coming into direct contact with the seawater. In this condition birds lose buoyancy and the ability to take off in search of food and/or escape predation. Smothered plumage also leads to loss of body heat putting the birds at risk of hypothermia as fat reserves beneath the skin are depleted during attempts to keep warm. Ultimately, birds that suffer from cold, exhaustion and loss of buoyancy, may drown (Ref. 11).

Should the birds return to a nest, this can transfer the oil to live young or hatching eggs, which can then suffer eggshell thinning, failure of the egg to hatch and developmental abnormalities. Ingestion of oil can lead to congested lungs, intestinal or lung haemorrhages, pneumonia and liver and kidney damage. Birds are likely to ingest oil whilst attempting to clean their plumage.

A small spill during breeding seasons could prove more catastrophic for birds than a larger spill at a different time of the year. The modelling of a blowout during summer conditions shows that a significant volume of oil will reach the coastline, including areas with IBA status. In some locations the oil is likely to persist for a number of months exposing birds and their habitats to the impacts of oil for an extended period.

It is considered that the impacts to birds and IBAs from a release of diesel from the platform (Scenario 1) will be minor as the diesel is not expected to reach the shore and has a low probability of reaching the shallower coastal areas important to birds. However, in the event of a blowout (Scenario 2), and to a lesser extent a pipeline rupture (Scenario 3), it is considered that the impact of a crude oil spill on birds at sea and the IBAs and KBAs could be a significant impact for the reasons mentioned above and due to the spill potentially occurring during the most sensitive time of year for nesting birds in the region.

Fisheries and Other Marine Users

Social receptors such as fisheries and coastal tourism could be exposed to the risk from an accidental spill. As described above, for Scenario 1, the modelled maximum exposure of the water surface to diesel is limited to approximately two days, and water column exposure to diesel concentrations exceeding 58 ppb is not expected to exceed 1.4 days. Furthermore, the diesel is not predicted to reach the shoreline. The probability of oil from a blowout (Scenario 2) reaching coastal areas or commercial fishing grounds within Azerbaijan varies with some areas around Baku Bay ranging from 30 to 60% while further south near Neftchala and Lenkeran the probability is in the range of 40 to 100% (refer to Figures 13.16 and 13.18). Although a large percentage of the oil will evaporate, biodegrade or disperse within the water column it is anticipated that up to 18295 tonnes of oil could reach the shoreline from a blowout during summer conditions. Areas of the Azerbaijan coastline that are predicted to receive moderate (1-10mm) or heavy (>10mm) depositions of oil include Chilov Island, Pirallahi Island, Absheron Peninsula, Baku Bay and along the coast between Alat and Neftchala (refer to Figure 13.19). A blowout of oil and a rupture of the oil pipeline will also result in a significant amount of oil on the sea surface which would slowly reduce over a period of several weeks (pipeline rupture) and several months (blowout). The concentration of oil in the water column is expected to remain above the 58ppb threshold for approximately nine days for the pipeline rupture and greater than 120 days for a blowout in some areas impacted by the spill.

In the unlikely event of a large spill such as a blowout, in addition to the significant effect on the marine and coastal receptors the negative public perception and media attention can have reputational implications. There is potential for tourist businesses located within the spill area to be affected, particularly during the summer period when the geographic extent of a spill is predicted to be greatest and tourist activities peak. While offshore oil will largely evaporate, disperse and biodegrade, any oil reaching the coastline may remain stranded for months on the affected recreational beaches, hence potentially having impacts on the recreational businesses within the affected area.

Chapter 7: Section 7.6.2.3 describes how commercial fishing is not routinely undertaken within the ACG Contract Area with only two legal entities and individuals known to fish occasionally in this area. However, there is the potential that a worst case spill from a blowout could have much wider impacts on fishing including to important commercial fishing grounds such as Oil Rocks and the Makarov Bank and smaller scale fishing areas (with fishing taking place within 2-3 nautical miles from the coastline) and landing sites located along the Azerbaijan coastline. Areas along the coastline between the Absheron Peninsula and Gobustan where the majority of licences have been issued for small-scale fishing include Zira, Hovsan, Shikh, Bayil, Zygh and Sangachal-Gobustan. It is understood that the high season for commercial fishing is during March to April whereas the peak fishing period for small scale fishing occurs in March-April and September-November, although fishing takes place throughout the year.

The impact on fisheries would reflect the impact on fish and the presence of juvenile stages at the time of a spill as they are more susceptible to relatively low levels of oil within the water column and are less likely to be able to move away. Any impact on juvenile stages could impact short to medium term recruitment to future stocks. Despite the susceptibility of fish larvae and juveniles to relatively low concentrations of hydrocarbons in the water column, adult free swimming fish and wild stocks of commercially important species are likely to detect and avoid hydrocarbon contaminated areas. Following a spillage, the reproductive success of unaffected fish, as well as the influx of larvae from unaffected areas should lead to the recovery of stock numbers. Given that many marine species produce vast numbers of eggs that are widely distributed by sea currents this means that species can recover from small mortality events relatively quickly.

However, fish can become tainted and contaminated with hydrocarbons. If there are signs of fish oil tainting or contamination, in the event of a hydrocarbon spill, any resultant imposed authority restrictions on fishing activities could result in detrimental financial impact upon local fisheries. Equally, a lack of timely restrictions, or illegal fishing, can create a risk to human health from contaminated product consumption. A release of diesel (Scenario 1) is unlikely to have an impact on small scale fishing whereas a pipeline rupture (Scenario 3) may affect some small scale fishing grounds along the coast. However, in the event of a blowout (Scenario 2) the impact from oil reaching the shoreline in areas of small scale fishing is likely to be significant as fishing represents the primary source of household income for the majority of fishermen. Commercial fishing can also be impacted in the event of a spill but in the case of a diesel release or pipeline rupture it is highly unlikely that the spill will impact important commercial fishing grounds. However, in the case of a blowout (Scenario 2) there is high probability that the spilled oil will result in the concentration of oil in the water column exceeding the 58ppb threshold at important commercial fishing grounds such as Oil Rocks, Makarov Bank and Kornilov-Pavlov Bank leading to the potential for toxic effects to fish and indirectly on human health that could trigger a temporary fishing ban. Therefore, the impact to the commercial fishing industry in the unlikely event of a blowout or pipeline rupture is considered to be potentially significant.

In the longer term, fishery products that consumers associate with areas affected by a large spill would become less marketable. This is only likely to occur for more substantial spills that endure over a long period and that receive broad media attention. In an extreme case where there are enduring concerns about food safety there could be restrictions placed by national regulators on all commercial fishing across an affected area.

Summary of Hydrocarbon Spill Impacts

Considering the spill scenarios assessed, the following conclusions can be drawn with regard to the impact of oil spills on the marine and coastal environment:

- A spill of diesel from the ACE platform will have a limited impact to the marine environment as the diesel will not reach the shore and will only persist in the environment for a short period.
- A major spill (i.e. well blowout or pipeline rupture) has the greatest potential for impact in terms of volume of hydrocarbons discharged into the marine environment. For both the blowout and pipeline rupture scenarios, species in the immediate vicinity of the spill that cannot actively avoid the oil such as plankton, benthic invertebrates, birds and seals are likely to suffer the greatest impacts. Highly mobile species such as fish are anticipated to avoid the spilled oil areas. The modelling of the blowout shows that a number of IBAs and KBAs, and

associated bird species may be exposed to elevated hydrocarbon concentrations as a result of surface or dispersed / dissolved oil beaching on the shoreline following a blowout. Given the persistence and volume of oil predicted to beach in some IBAs and KBAs the potential impact on IBAs and KBAs (and the birds present there) could have a potentially significant impact, especially if the release occurs during the bird nesting period (April to July). The blowout scenario may also affect small scale fishing grounds along the coast, and commercial fishing.

13.8.4 Spill Prevention and Response Planning

13.8.4.1 Oil Spill Contingency Planning - Azerbaijan Offshore

The AGT Region Offshore Facilities Oil Spill Contingency Plan (OSCP) provides guidance and actions to be taken during a hydrocarbon spill incident associated with all ACG and SD offshore operations, which include mobile offshore drilling units, platforms, subsea pipelines and marine vessels. It is valid for spills that may occur during the commissioning, operation, and decommissioning of the systems.

The OSCP is designed to:

- Establish procedures to control a release or the threat of a release, that may arise during offshore operations and associated facilities;
- Establish procedures to facilitate transition of response operations from a Tier 1 incident to a Tier 2/3 release or threat of release;
- Minimise the movement of the hydrocarbon spill from the source by timely containment;
- Minimise the environmental impact of the oil spill by timely response;
- Maximise the effectiveness of the recovery response through the selection of both the appropriate equipment and techniques to be employed; and
- Maximise the effectiveness of the response through trained and competent operational teams.

BP's response strategy is based on: an in-depth risk assessment of drilling and platform operations and subsea pipelines; analysis of potential spill movement; environmental sensitivities and; the optimum type and location of response resources. BP supplements its dedicated resources with specialist spill response contractors.

Under the AGT Region spill procedures, spill incidents are categorised according to the level of resource required to mitigate them. BP has adopted the internationally recognised tiered response concept to oil spill response as shown in Table 13.8.

Table 13.8 Oil Spill Response Tiers

Tier 1	Tier 1 spills are defined as small operational spills that can be can be handled immediately by on-site personnel. In most cases, the response would be to clean up using on site resources.
Tier 2	Tier 2 spills are defined as spills that require additional local (in-country) resources and manpower that are not available on the site that the spill occurs. The site response team would carry out cleanup, aided by the dedicated Tier 2 oil spill contractor.
Tier 3	Tier 3 spills are very large, possibly ongoing spills, which will require additional resources from outside the country of spill origin and is likely to impact the community for an extended period and may arouse national or international media interest. Such spills are very rare and would only occur through events such as a well blowout or full diameter pipe rupture. All available spill contractors (from within and outside Azerbaijan) would carry out the physical response, with extensive support from the BP Incident Management Team and the Business Support Team.

BP has contracted an independent oil spill response contractor in Azerbaijan to provide a response to a Tier 2 oil spill incident originating from BP's offshore operations. BP also have Tier 2 oil spill response capability in Georgia and Turkey and these resources may be accessed for larger spills in Azerbaijan. Oil Spill Response (Ltd) (OSRL) is a Tier 3 responder who has bases in both the UK and Singapore and will provide Tier 3 services to BP in the event of a major release and/or highly sensitive Tier 2 incident. In addition to the supply of equipment, they can also provide response technicians and supervisors.

BP will also coordinate with local emergency services and government agencies in Azerbaijan, both prior to, and during oil spill incidents, and additional resources are available from the Ministry of Emergency Situations (MES). The OSCP describes how BP will utilise these resources to protect the environment in which it resides.

13.8.4.2 BP Capping Resources - Azerbaijan Offshore

In addition to oil spill response capability, BP also has dispersant, riser adapters, debris removal equipment and a Remotely Operated Vehicle (ROV) tooling system designed to be transported by air to any location around the world where BP operates. BP is also a subscriber to the Subsea Well Response Project (SWRP) through which it will have access (subject to availability) to four capping stacks and subsea dispersant systems. OSRL manages and maintains the four capping stacks which are stored at bases in Norway, Brazil, Singapore and South Africa. In the event of a capping stack being required in the AGT Region the capping stacks in Norway and Brazil are the primary and back-up options. Both stacking caps are mobilised in the case of an incident. Both the BP and the SWRP capping stack systems are capable of being transported to Azerbaijan but are subject to deployment limitations in the Caspian as described below. OSRL's bases also have stocks of dispersant and dispersant equipment available to BP in the event of an incident.

The Caspian region is limited in the number of response vessels and vessels with suitable ROV and subsea crane capabilities to deploy a capping stack system. There is also a concern that the high flow-rate wells and the potential for gas plumes in the Caspian in combination with shallow water will limit vertical access to a failed BOP. This is due to high VOCs (Volatile Organic Compound) at surface and challenging vessel surface operating conditions.

There are significant challenges to an operator's ability to deploy a capping stack on Caspian wells. BP have carried out clash checks between the OSRL capping stack model proposed for use on the BOPs used on the MODUs contracted by BP for drilling in the Caspian Sea and potential clash risks have been identified on some MODUs. Therefore, work is ongoing to confirm capping stack landing requirements to avoid potential clash risk as well as understand capping stack landing limitations on a failed BOP (in the event it is damaged) to assess deployment requirements and develop vertical offset installation methods to respond to an incident in the Caspian.

13.8.4.3 Reporting

Under the AGT Region spill reporting procedures, all accidental and non-authorised releases (liquids, gases or solids), including releases exceeding approved limits or specified conditions during all phases of the ACE Project, will be internally reported and investigated. Existing external notification requirements agreed with the Ministry of Ecology and Natural Resources (MENR) will be adopted during the operation phase of the ACE Project are:

- For liquid releases to the environment exceeding a volume of 50 litres, notification will be made to the MENR within 24 hours after the incident verbally and within 72 hours in the written form; and
- If the release to the environment is less than 50 litres, then information about the release will be included into the BP AGT Region Report on Unplanned Releases and sent to the MENR on a monthly basis.

It will be the responsibility of the main construction and installation contractors to report any spills that occur at the sites where they are undertaking ACE Project related activities or from vessels used for ACE Project related activities to the MENR.

A Protocol "On Agreeing the Main Principles of Cooperation for Regulation of Unplanned Material Releases" signed between BP and MENR in December 2012 defines an approved release as "a release that is permitted by applicable PSA, MENR permitted and/or approved documents including ESIA, EIA, Technical Note, Technical Letter, individual discharge request letters to MENR or any other written agreement with the MENR". Unapproved releases are those that do not fall into this definition.

13.9 References

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14 Environmental and Social Management

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14.1 Introduction

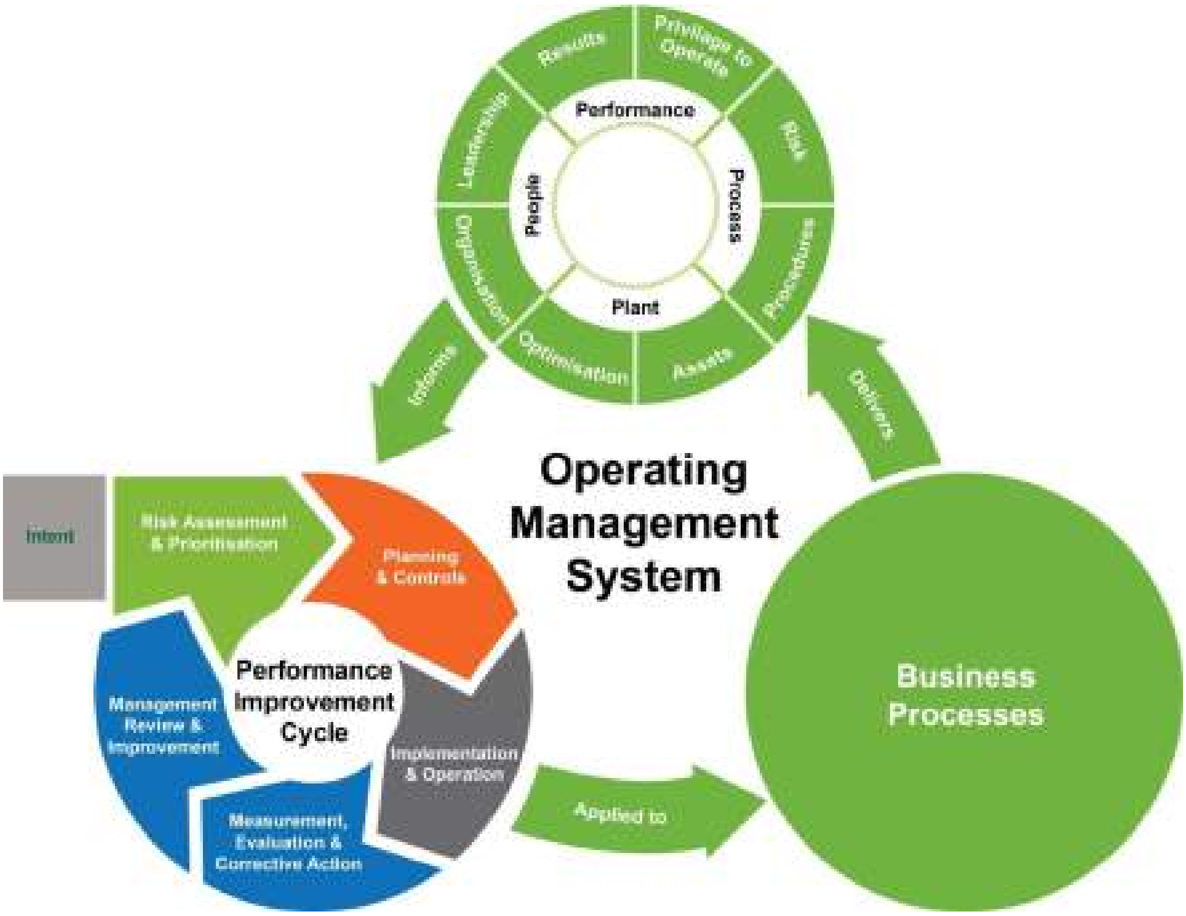
Under the Azeri Chirag Gunashli (ACG) Contract Area Production Sharing Agreement (PSA), BP as Operator, is responsible for the environmental and social management of all ACG activities, to ensure that project commitments are implemented, and conform to applicable environmental and social legal, regulatory and corporate requirements. This Chapter provides an overview of the system that will be used to manage the environmental and social issues associated with the ACE Project.

14.1.1 Overview of AGT Region Operating Management System

The BP Azerbaijan Georgia Turkey (AGT) Region manages BP's operations in Azerbaijan and has an established Operating Management System (OMS). The OMS is a structured set of processes designed to keep operations safe, compliant and reliable. This system forms the structured framework to the Health, Safety, Security and Environment (HSSE) performance of the organisation for which there are six key stages as set out in Figure 14.1:

- Intent;
- Risk Assessment & Prioritisation;
- Planning & Controls;
- Implementation & Operation;
- Measurement, Evaluation & Corrective Action; and
- Management Review & Improvement.

Figure 14.1 AGT Region Operating Management System Framework



The environmental portion of the AGT Region OMS for operations is aligned with ISO 14001 Environmental Management Systems (EMS), the leading international standard on environmental management.

In line with the six stages within the OMS, BP apply the following principles of environmental and social protection:

- **Plan** – prior assessment of potential environmental and social impact;
- **Do** – implementing design and mitigation measures that seek to avoid, reduce or minimise potential impact;
- **Check** – monitoring performance and the efficacy of the mitigation measures that are implemented; and
- **Act** – auditing and tracking the implementation of corrective actions.

Section 14.3 below highlights how these principles shall be applied to the ACE Project.

14.2 Project Construction Phase Roles and Responsibilities

14.2.1 BP

BP is responsible for the detailed design, procurement, construction and operation of the ACE Project and have appointed design contractors to undertake the detailed design of the ACE Project. In due course, BP will contract construction contractors to manage the various elements of the construction work scope and drilling contractor to drill the predrill wells using a Mobile Offshore Drilling Unit (MODU).

BP will monitor and audit the technical, environmental and social performance of its contractors throughout the predrilling and construction phase. The contractors will be responsible for the management of their staff (to the extent that reflects staffing at the site).

An ACE Project Construction Phase Environmental and Social Management System (ESMS) will be developed and implemented by BP and will include the following:

- Commitments aligned to those made within this Environmental and Social Impact Assessment (ESIA) that are to be implemented during the construction phase;
- A legal register of legislation applicable to the ACE Project;
- An Environmental and Social Management and Monitoring Plan (ESMMP) which will be prepared, reviewed and updated as needed as part of a process of continuous improvement;
- A schedule of monitoring, inspection and audit of environmental performance that includes checking that the main construction and installation contractors are meeting the expectations set out in the ESMMP; and
- Implementation of an action tracking system to monitor the findings of inspections and audits that do not conform to the ESMMP and the implementation of corrective actions.

14.2.2 Main Construction and Installation Contractors

The main construction and installation contractors for the jacket, topside and subsea facilities construction will be expected to conform fully to the relevant aspects of the BP ACE Project Construction Phase ESMS for which they are responsible.

The main construction and installation contractors will be required to develop and implement their own Construction Phase ESMS, specified for the ACE Project that is consistent with the BP ACE Project Construction Phase ESMS. The main construction and installation contractors' ESMS will include compiling a set of environmental and social management plans and procedures that will address contract requirements which include those aligned to ESIA committments. The drilling contractor will also implement their own management system. This is detailed below in Section 14.5.

14.3 Construction, HUC and Start-Up Phase ESMS

14.3.1 Introduction

The BP ACE Project Construction Phase ESMS will form the framework for managing social and environmental issues throughout construction, hook up and commissioning (HUC) and start up (i.e. all activities prior to the operations phase) of the ACE Project facilities and will be aligned with the requirements of ISO 14001. Once operational, the AGT Region management systems will apply to ACE.

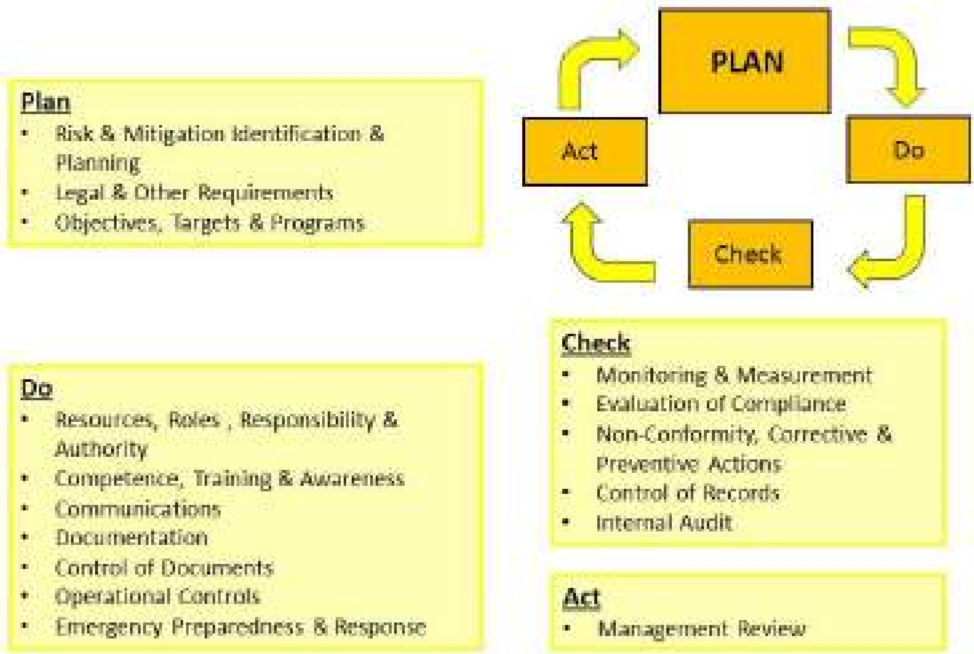
The BP ACE Project Construction Phase ESMS will demonstrate how the Project will deliver the ACE Project ESIA commitments and review the environmental and social performance of the ACE Project at the construction phase. Special consideration will be given to the following:

- Practical training and raising the environmental and social awareness of personnel;
- Supervision and monitoring of environmental and social issues in the field; and
- Continuous improvement of environmental and social performance throughout the ACE Project.

14.3.2 BP's ACE Project Construction Phase ESMS Framework

Figure 14.2 presents an overview of the elements of the BP Construction Phase ESMS 'plan–do–check–act' cycle. This process will establish a common understanding between the key staff involved in delivering effective environmental and social management of the ACE Project.

Figure 14.2 BP's Construction Phase ESMS Elements



14.3.3 Plan

The 'plan' stage of the cycle seeks to identify impacts and risks to the ACE Project, including through the ACE Project ESIA process. Planning also involves the identification of legal and other requirements, such as the development of goals and target setting.

14.3.4 Do

The 'do' stage of the cycle reflects the implementation of the BP ACE Construction Phase ESMS and its key components:

- Strategy and framework documents;
- ESMMP;
- Management plans; and
- Contractor procedures.

The ACE Project ESIA Management of Change Process (see Chapter 5: Section 5.13) will be followed if there is a need to change the Base Case design of the ACE Project.

14.3.4.1 Environmental and Social Management Plans

ESMMP

The BP Construction Phase ESMS will include the ESMMP that describes:

- Conformance requirements;
- Roles and responsibilities of BP and the main construction and installation contractors;
- The main activities that will be undertaken;
- The actions needed to avoid and/or mitigate environmental and social impacts and to put the commitments in the ESIA into effect; and
- The assurance process that will be adopted to monitor and report environmental and social performance will include inspection, audit and monitoring programs such as chemical inventory and storage.

BP Environmental and Social Management Plans

To support the ESMMP, environmental and social management plans will be developed by BP to present the ACE Project environmental and social requirements by subject matter. Table 14.1 lists those management plans that have been identified as being applicable to the ACE Project. The ACE Project environmental and social management plans will be finalised during mobilisation of the main construction and installation contractors, and regularly reviewed as the Project proceeds.

Table 14.1 BP Environmental and Social Management Plans

Title of Plan	Issues Covered
Pollution Prevention Management Plan	• Energy efficiency (vehicle and equipment selection, maintenance); • Emissions management (i.e. vehicle, equipment and generator emissions); • Wastewater management; • Sewage treatment and disposal, including sewage plant monitoring; • Chemical selection and management, and hazardous materials management; • Spill response and notification procedure; and • Monitoring and reporting.
Waste Management and Minimisation Plan	• Waste hierarchy (i.e. reduction at source, reuse, recycling, energy recovery, responsible disposal) and green procurement; • Identification and classification of waste; • Waste register; • Waste handling (i.e. collection, segregation and containers, storage, treatment, transport and documentation, disposal); and • Monitoring and reporting.
Pipeline Cleaning and Pre-commissioning Discharge Management Plan	• Schedule of discharge events; • Chemical selection and dosage process; • Cleaning and pre-commissioning procedures; and • Monitoring, assurance and reporting.

Title of Plan	Issues Covered
Community Engagement and Nuisance Management and Monitoring Plan	• Grievance mechanism; • Nuisance management and monitoring; • Community interaction (i.e. prior notification of activities that affect the community e.g. noisy activities, traffic restrictions etc.); and • Monitoring and reporting.
Stakeholder Engagement Plan	• Stakeholder identification; • Stakeholder engagement programme; • Social and environmental investment programme; and • Monitoring and reporting.
Employee Relations Management Plan	• Training and skill development activities; • Grievance mechanism; • Demanning; and • Monitoring and reporting.

Environmental and Social Management Plans are live documents which will be reviewed and revised throughout the ACE Project construction phase based on outputs and activities.

Main Construction and Installation Contractors Environmental and Social Management Plans

The main construction and installation contractors, as part of their ESMS, will be required to develop their own environmental and social management plans and procedures that are in line with the requirements of BP's ESMMP and submit them to BP for approval before construction begins.

14.3.4.2 Training

At the 'do' stage of the BP ACE Construction Phase ESMS, training is fundamental to the successful delivery of environmental and social aspects of the ACE Project. The ACE Project construction activity will be of relatively short duration, so establishing key environmental and social requirements at the outset is important to the provision of effective training. The main training elements required are:

- Management briefings;
- Induction training for BP, the main construction and installation contractors and their sub-contractor staff; and
- Toolbox talks and awareness programmes during construction.

Management Briefings

An environmental and social training session will provide the BP Project Management Team with an overview of the BP ACE Project Construction Phase ESMS and a common understanding of roles, responsibilities and applicable standards prior to the construction contracts being awarded.

Following award of contract, a second environmental and social training session will seek to ensure that the BP Project Management Team and the main construction and installation construction contractors' senior personnel adopt a coordinated approach to implementing BP requirements, and to affirm BP's commitment to good environmental performance and to establishing good community relations. Further briefings and awareness sessions will then be provided to the teams as required.

Induction Training

All ACE Project construction staff will receive an environmental and social induction which will explain the key requirements to everyone on site.

Toolbox Talks

In addition to toolbox talks delivered by the main construction and installation contractors as part of skills training, sessions to raise awareness will be held for the following environmental and social issues:

- Waste management, minimisation and handling (further detailed in Section 14.7.1 below);
- Refuelling;
- Hazardous materials management/handling; and
- Spill Prevention.

14.3.5 Check

14.3.5.1 Monitoring, Inspections Reporting and Audits

The BP ACE Project Construction Phase ESMS will identify key indicators that will be used to measure environmental and social performance.

BP's and the main construction and installation contractors procedures and plans will be used to collect and regularly report monitoring data to BP, including the following:

- Data (e.g. waste volumes, types and disposal, complaints received and resolved);
- Activities carried out (e.g. surveys, meetings with communities, site inspections and findings);
- Status of non-conformances identified during inspections;
- Environmental and social issues arising in the course of the works; and
- Site observations and reports, from inspections and incidents such as spill events.

BP and the main construction and installation contractors will conduct audits to track progress and performance in implementing the Construction Phase ESMS, and the effectiveness of the mitigation measures implemented in avoiding environmental and social impacts. The schedule of these audits will be determined after the contract has been awarded, but the aim will be to audit all elements of the Construction Phase ESMS. The frequency of auditing for individual commitments will be reviewed regularly and adjusted as necessary to take account of audit findings. BP will also carry out spot check audits of any issues that are of environmental and social concern.

14.3.6 Act

14.3.6.1 Corrective Action

The inspection and audit processes described in Section 14.3.5 will be documented and feedback will be formally submitted to contractors. Contractors will be notified about any actions arising from the inspections and audits. Both BP and the main construction and installation contractors will develop and maintain action-tracking systems to monitor close-out actions and the effectiveness of actions taken in response to findings.

BP will track the implementation of corrective actions and will update the relevant teams including the Project Manager on non-conformances that require follow-up actions.

14.4 Operations Phase EMS

BP will operate the ACE Project facilities using an Operations Phase EMS that is aligned with the requirements of the ISO 14001 EMS and will be based on the 'plan-do-check-act' cycle. Prior to commencement of ACE operations, a transition plan will be developed to support the movement of ACE from the Construction to the Operations Phase EMS, capturing start up activities. This will include integration of ACE into the scope of AGT Region wide EMS and its existing processes.

Similar to the BP Construction Phase ESMS, the primary functions of the BP Operations Phase EMS will be to operate the ACE facilities in accordance with the ESIA commitments and applicable legal and regulatory standards and BP policy.

The ACE Operations Phase EMS will:

- Regularly assess the environmental and social aspects and impacts of its activities;
- Develop objectives and indicators to address any significant aspects and ensure consistency with BP's environmental policy;
- Appropriately resource and train staff; and
- Monitor and audit the success of its actions in addressing the significant environmental aspects, compliance obligations and operational controls.

This system will be implemented with the aim of ensuring continual improvement in performance. The operations commitments included within this ESIA will be implemented through the Operations Phase EMS with existing environmental and social management and monitoring plans and procedures relevant to ACG Offshore Operations updated to incorporate the ACE Project. In addition, the existing AGT Region Emergency Response Plan (ERP) and Offshore Facilities Oil Spill Contingency Plan will be reviewed and amended to incorporate the new offshore ACE Project facilities.

14.5 MODU HSE Management System

14.5.1 Approach

The MODU used to drill the ACE Project predrill wells will be operated by a rig operator who has their own independent HSE MS (Health, Safety & Environmental Management System) already in place. Alignment of the plans, procedures and reporting requirements of the rig and AGT Region HSE MS has been achieved through the development of an HSE Bridging Document.

The aim of the HSE Bridging Document is to ensure that both the AGT Region and the rig operator's HSE MS do not result in any of the following, which is reflected in the AGT Region Local Operating Management System Policy:

- No accidents;
- No harm to people; and
- No harm to the environment.

The HSE Bridging Document is a live document and is reviewed on a regular basis. Both the BP HSE MS and the Rig Operator HSE MS monitor the same targets and objectives which are separately audited as part of their internal review process. Communications lines are in place to ensure the effective sharing of the findings and action lists.

14.5.2 Monitoring and Reporting

Monitoring and reporting is undertaken in accordance with the AGT Region policy and procedures and is set out within the MODU Environmental Operating Procedure which details the method and frequency of reporting for the following categories:

- Deck drainage and wash water, garbage disposal unit effluent and grey water treatment effluent, oily water, fuel usage records;
- Volume of drilling fluids and cuttings discharged;
- Wastes shipped to shore;
- Drilling/cementing/testing chemicals;
- Mud sampling;
- Rig chemical inventory;
- Seabed Remotely Operated Underwater Vehicle (ROV) monitoring;
- Material release reporting and external notification to MENR; and
- Environmental drilling report per well.

14.5.3 Audit and Review

Auditing and checking is a key element of the rig HSE MS. Both the AGT Region and the rig operator have systems in place to audit their respective HSE MS. Individuals from each company are tasked with the responsibility of sharing the audit findings. Where necessary, additional audits and reviews may be undertaken to address identified areas of concern. Joint audits are undertaken to ensure that procedures are being followed appropriately. Both the AGT Region and the rig operator have systems in place to control communication, tracking and follow up of audit and review recommendations.

14.6 Environmental Monitoring Programme (EMP)

BP's AGT Region has implemented an Environmental Monitoring Programme (EMP) designed to provide a consistent, long-term set of data, with the objective of ensuring an accurate picture of potential impacts on the surrounding environment, so that they can be managed and mitigated as effectively as possible.

The EMP follows a 10 year schedule and detailed monitoring plans are prepared for the next 3 years, with outline planning for the following 7 years. This approach allows a progressive and systematic modification of the programme to take into account the results and conclusions of the programme to date.

Offshore marine monitoring can be separated into the following categories:

- Baseline surveys – to provide a general understanding of the physical, chemical and ecological parameters at a particular location before development commences. Any unusual or sensitive ecological features, which might affect the design of a development, can also be identified;
- Post-drill surveys – completed following drilling operations in order to assess the impact of drilling discharges on the surrounding environment;
- Routine environmental monitoring surveys – to provide an assessment of the impact of AGT Region operations, aiding responsible environmental management; and
- Regional surveys – completed to enable the identification and type of environmental changes and trends that occurs over time. Sampling is undertaken at locations remote from AGT Region activities, providing information on changes in the terrestrial and marine environment that have resulted from natural processes, or other third party activities. This helps to distinguish potential impacts resulting from AGT Region activities from natural background environmental changes and other anthropogenic sources.

Offshore marine monitoring has been conducted as part of the ACG Contract Area development, with the primary focus being the benthic environment as sediments and their associated biological communities are widely considered to be the source of the most reliable indicators of ecological status and impact. Periodic water quality sampling is also undertaken.

The EMP will be expanded for the ACE Project. To date a baseline survey has been undertaken at the proposed ACE platform location in June 2017 (refer to Chapter 6: Section 6.6). Operational monitoring at the ACE location along with routine surveys across the Contract Area will also occur to allow for a more complete understanding of the potential impacts of AGT Region operations including ACE and trends over time. Combined with operational discharge monitoring, this approach provides a robust monitoring basis for assessing the impact of ACE Project operations, and for comparing the observed impact with the baseline and the impacts predicted in the ESIA.

Specifically with reference to the ACE Project's offshore operations, the EMP will:

- Undertake post-drilling seabed survey on completion of the predrilling programme;
- Undertake a post-installation seabed survey at the proposed ACE platform location; and
- Develop an offshore operational monitoring programme in consultation with the Environmental Sub-Committee.

The surveys will follow the standardised EMP approach to maximise the usefulness of comparisons over time and between locations.

14.7 Waste Management

Waste generated during the ACE Project will be managed in accordance with the existing BP AGT Region management plans and procedures. All wastes generated as part of the ACE Project will be identified and managed in accordance with the following requirements:

- Site specific Waste Management Plans will be prepared by the main construction and installation contractors for the jacket, topside and subsea facilities and reviewed by BP;
- Workforce awareness and training;
- AGT Region Approved Waste Contractors List;
- AGT Region Waste Streams Register; and
- AGT Region Waste Management Manual.

Waste disposal / treatment options will be assessed and adopted based upon the following guiding principles:

- Internationally recognised best practice;
- The waste hierarchy; and
- AGT Region Best Practicable Environmental Option (BPEO) assessments.

This approach is intended to ensure that wastes are managed in the most sustainable way and in compliance with all applicable AGT Region standards and national legislation.

14.7.1 Waste Management Processes and Procedures

Waste Management and Minimisation Plans will be developed and maintained for the duration of the ACE Project's activities and include the anticipated waste streams, likely quantities and any special handling requirements.

A schedule of internal audits will be developed to monitor the performance of the waste management systems during the ACE Project's activities and to ensure that all corrective actions and improvements are identified and implemented.

To support the Waste Management and Minimisation Plan, the main construction and installation contractors will receive waste management training covering:

- Identification of waste types and potential associated hazards;
- Waste segregation; and
- Waste transfer documentation (if involved in waste movement).

All new waste disposal routes are routinely assessed prior to use and must be compliant with applicable local laws and regulations. Waste will only be routed to those waste disposal facilities that have been approved for use by the AGT Region.

14.7.2 Waste Segregation and Transfer

Waste streams will be segregated at source to support reuse and recycling, and to avoid contact between incompatible materials. The segregation requirements will be clearly indicated by the use of containers with clear signage denoting the waste types that are suitable for the containers provided.

All waste generated offshore will be tracked and controlled. For waste generated on the MODU and ACE platform, an electronic Backload Manifest document will be completed for every waste shipment to shore while waste generated onboard vessels for disposal onshore will be accompanied by individual Waste Transfer Notes (WTNs). The electronic Backload Manifest and WTNs will detail the waste type, quantity, waste generator, consignee, consignor (if different from the generator) and, in the case of hazardous wastes, both Waste Passports and, where required, Material Safety Data Sheet (MSDS) documentation. A final visual inspection of all waste consignments will be made prior to sign-off and uplift. Completed electronic copies of Backload Manifest documentation and coloured copies of the WTNs together with other relevant information (e.g. MSDS, Waste Passports), will be retained by the waste generator. All parties involved in transporting wastes will retain a copy of the waste transfer documentation.

Depending upon the nature of the waste and the approved method of recycling or disposal, wastes may be routed via a Central Waste Accumulation Area (CWAA), waste transfer station or similar facility, or alternatively may be routed directly to their final approved destination.

15 Residual Impacts and Conclusions

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15.1 Introduction

This Chapter of the Environmental and Social Impact Assessment (ESIA) summarises the residual impacts and conclusions of the Azeri Central East (ACE) Project ESIA.

15.2 Residual Environmental Impacts

Environmental impacts have been assessed separately for the following:

- Predrill Activities (Chapter 9 of this ESIA);
- Onshore Construction and Commissioning Activities of Offshore Facilities and Infield Pipeline and Platform Installation, Hook Up and Commissioning (HUC) (Chapter 10 of this ESIA); and
- Platform Drilling and Offshore Operations and Production (Chapter 11 of this ESIA).

15.2.1 Predrill

Table 15.1 summarises the outcome of impact assessment for the predrill phase of the ACE Project.

Table 15.1 Summary of Residual Environmental Impacts for ACE Predrill Activities

	Event/ Activity	Magnitude				Sensitivity		Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity	Human	Ecological	Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	MODU Power Generation	1	3	3	1	2	2	Medium	Low	Minor Negative
	Support Vessel Engines	1	3	3	1	2	2	Medium	Low	Minor Negative
Marine Environment	Underwater Sound (MODU Drilling)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Underwater Sound (Support Vessels)	1	1	3	1	-	2	Medium	Low	Minor Negative
	Drilling Discharges to Sea	1	2	2	1	-	2	Medium	Low	Minor Negative
	Cement Discharges to Seabed	1	3	1	2	-	2	Medium	Low	Minor Negative
	Cement Unit Wash Out Discharges	1	2	1	2	-	2	Medium	Low	Minor Negative
	BOP Testing	1	3	1	1	-	2	Medium	Low	Minor Negative
	MODU Cooling Water Discharges to Sea	1	1	3	1	-	2	Medium	Low	Minor Negative
	MODU and Vessels Ballast Water Discharge	1	2	1	1	-	2	Medium	Low	Minor Negative
	MODU and Vessels Ballast Water Discharge	1	1	3	1	-	2	Medium	Low	Minor Negative
	MODU and Vessels Grey Water Discharge	1	1	3	1	-	2	Medium	Low	Minor Negative
	MODU and Vessels Drainage Discharges	1	1	3	1	-	2	Medium	Low	Minor Negative

Emissions associated with Mobile Offshore Drilling Unit (MODU) power generation and support vessel activities will all occur offshore and disperse into the atmosphere. Modelling was undertaken to determine the increase in the concentrations of key pollutants due to the MODU activities at receptor locations (i.e. onshore). Based on existing onshore air quality which meets the applicable EU air quality limit values (with the exception of particulate matter[1]), receptor sensitivity was considered to be low. The modelling indicated that the activities would be unlikely to result in a discernible increase in emissions onshore. As such the impact of atmospheric emissions due to MODU and support vessel activities to onshore communities was considered to be of minor negative significance.

[1] The semi-arid environment gives rise to dust which naturally increases the concentration of particulate matter in the atmosphere, leading to concentrations that are naturally higher than EU limit values.

Underwater sound associated with drilling activities was also assessed. Propagation of underwater sound from drilling was calculated using a simplified geometric spreading model to estimate distances at which various impacts on the marine species known to be present in Caspian Sea may occur. For drilling, the modelling results show that, for seals, permanent threshold shift (PTS) is unlikely to arise even when the seals are adjacent to the drilling location while temporary threshold shift (TTS) may occur if the animals remain within 2m of the drilling operations for an extended period of 8 hours. For fish species the calculations indicated there is a low risk of mortality and recoverable injury for fish of all hearing abilities and a moderate risk of TTS in hearing generalist fish at short distances from the drilling location. In terms of sound from vessels, the modelling concluded that PTS may arise in seals if they remain within 505m of the vessels for an extended period of 1 hour. To avoid TTS, the seals would have to be no nearer than 10.9km from the vessel. However, these distances do not account for movement of either the vessels or the seals. It is considered that when exposed to vessel noise there is a low risk of mortality for fish of all hearing abilities and a moderate risk of recoverable injury in hearing generalist fish at short distances. These estimates are derived without taking into account the existing sound environment, which is known to be dominated by existing commercial and oil industry shipping noise and it is likely there would be a minimal relative increase to existing levels of disturbance on seals and fish species from vessel movements. Although there may be some behavioural disturbance, it has been shown that Caspian seals utilise a wide area of the Caspian Sea year round, and would be largely habituated to vessel noise and can easily move if necessary. Based on the predicted event magnitude, receptor characteristics and observed sensitivities the impact was assessed as being of minor negative significance.

During predrilling, the largest discharges to the marine environment by volume are drilling discharges, specifically the discharge of drill cuttings and water based drilling mud, and the discharge of cooling water from the MODU cooling water system. Modelling of the drilling discharges was undertaken to confirm the extent and scale of mud and cuttings predicted to be deposited on the seabed during ACE predrilling. The modelling has shown that such discharges, which are required to meet applicable standards prior to discharge, have a very limited ecological impact to marine receptors. Based on the predicted event magnitude, receptor characteristics and observed sensitivities the impact significance was assessed as minor negative. Cooling water modelling similarly indicated impacts would be very limited in scale (a few metres) and an impact upon biological receptors in the water column (i.e. zooplankton, phytoplankton, seals and fish) would be of no more than minor negative significance.

Small quantities of cement may be discharged to the seabed whilst cementing well casings into place. These will remain close to the wellhead in the same area as drill cuttings are deposited. At the end of well casing cementing activities there will also be small discharges of washout cement from the MODU cement system, which will be diluted with seawater prior to being discharged. Modelling of the cement washout discharges predict that the discharge plume will dilute rapidly and only 0.1% of the cement solids would be deposited on the seabed. The impact to benthic invertebrates and seals, fish and plankton, which were evaluated as having a low sensitivity to cement discharges, was therefore assessed as minor.

During predrilling a blowout preventer (BOP) will be installed on each well to control pressure in the well. The BOP control system uses hydraulic fluids to actuate the BOP valves. Fortnightly testing of the valves will result in a small discharge to sea. The modelling conservatively assumed that the discharge would require a dilution of 500-fold to reach the no-effect concentration. The modelling results show that the maximum extent of the 500-fold dilution plume area during summer is approximately 28m long, 6m wide and that the plume will completely disperse in the water column to the no-effect concentration within 15 minutes. The impact to benthic invertebrates and seals, fish and plankton, which were evaluated as having a low sensitivity to BOP fluid discharges, was therefore assessed as being of minor negative significance.

The remaining discharges to sea (ballast water, treated black water, grey water and deck drainage) are all small in volume (relative to drilling and cooling water discharges) and do not contain components of high environmental concern. These discharges, which are monitored in accordance with existing procedures to ensure applicable project standards are met, will be rapidly diluted and are all assessed as having a minor impact upon biological receptors in the water column.

For all predrill phase environmental impacts assessed it has been concluded that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures and no additional mitigation is required.

15.2.2 Construction, Installation and Hook-Up and Commissioning

Table 15.2 summarises the outcome of impact assessment for the Construction, Installation and HUC Activities associated with the ACE Project.

Table 15.2 Summary of Residual Environmental Impacts for ACE Construction, Installation and HUC Activities

	Event/ Activity	Magnitude				Sensitivity		Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity	Human	Ecological	Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Construction Yard Plant and Vehicles	1	1	3	1	2	-	Medium	Low	Minor Negative
	Onshore Commissioning of Main Platform Generator and Topside Utilities	1	3	2	1	2	-	Medium	Low	Minor Negative
	Vessel Engines	1	1	3	1	2	-	Medium	Low	Minor Negative
Terrestrial Environment (Noise)	Construction Yard Plant and Vehicles	1	1	3	1	2	-	Medium	Low	Minor Negative
	Onshore Commissioning of Main Platform Generators and Topside Utilities	3	2	1	1	2	-	Medium	Low	Minor Negative
Marine Environment	Construction Yard Cooling Water Discharge	1	1	3	1	-	2	Medium	Low	Minor Negative
	Pipeline Cleaning and Pre-commissioning Discharges (Treated seawater)	3	2	1	1	-	2	Medium	Low	Minor Negative
	Pipeline cleaning and Pre-commissioning Discharges (MEG)	1	1	1	1	-	2	Low	Low	Negligible
	Subsea Infrastructure and Spool Tie-in Discharges (Treated seawater)	1	2	1	1	-	2	Medium	Low	Minor Negative
	Other Discharges to Sea: **Ballast Water (Vessels)**	1	2	1	1	-	2	Medium	Low	Minor Negative
	Other Discharges to Sea: **Treated Black Water**	1	1	3	1	-	2	Medium	Low	Minor Negative
	Other Discharges to Sea: **Grey Water**	1	1	3	1	-	2	Medium	Low	Minor Negative
	Other Discharges to Sea: **Drainage**	1	1	3	1	-	2	Medium	Low	Minor Negative
	Jacket pin and skirt piling (underwater sound)	3	3	1	2	-	2	High	Low	Moderate Negative
	Vessel movements (underwater sound)	1	1	3	1	-	2	Medium	Low	Minor Negative

Emissions and noise associated with onshore construction and commissioning activities at the construction yards were assessed. Air quality dispersion modelling and noise modelling screening assessments demonstrated that potential impacts to nearby onshore receptors were considered to be minor and additional mitigation was not required.

During onshore commissioning of the platform generators and topside utilities at the construction yard, a temporary cooling water system will abstract and discharge water at the quayside. The thermal impact of the discharge was modelled and indicated that the discharged water (at a worst-case temperature of 50ºC) would not exceed ambient temperature by more than 3ºC at a distance beyond 4m from the point of discharge. Thermal impact is therefore considered minimal, with no need for further mitigation. The cooling water will be treated to inhibit marine fouling and will be neutralised prior to discharge. The discharge will contain no harmful persistent materials.

Following installation of the pipelines, they will be filled with seawater containing preservation chemicals (to prevent corrosion and biological growth). Following initial filling, hydrotesting, leak testing and integrity testing will be undertaken. The pipelines will be tied-in and additional testing will be undertaken also using treated seawater. Discharges to sea of treated seawater associated with these activities are anticipated to vary in volume between 2 and 2545 cubic metres (m^3). Aquatic toxicity tests have been carried out on the preservation chemicals, and no-effect concentrations have been estimated for the treated seawater. Dispersion modelling has been conducted for a representative range of discharges, in order to estimate the point at which the discharges will be diluted to the no-effect concentration. Many of the smaller (hydrotest and leak test) discharges are predicted to be diluted almost immediately to a no-effect concentration. Modelling of the largest discharge (associated with the cleaning and gauging and dewatering of the existing 22" gas export pipeline between the East Azeri (EA) and Central Azeri (CA) platforms) predicted a narrow plume of 4.3 to 10.1km long, depending on the time of year of the discharge. In no instance did the modelling predict a plume that reached the seabed or the sea surface. The volumes of water occupied by the discharge plumes are small relative to the receiving environment, and the discharge durations are short.

Mono ethylene glycol (MEG) is planned to be used to dehydrate and condition the new infield gas pipeline. While the base case is to recover all the MEG used, it is possible that up to three discharges of up to 10m^3 of MEG may be discharged to sea. Modelling has indicated the impact would be limited to a very small area within the immediate vicinity of the release. Additionally, approximately 40 discharges of treated seawater associated with the tie-in of spools and subsea structures varying between 1 to 16m^3, are anticipated. Modelling of these discharge events has confirmed the discharge plumes will rapidly disperse in the water column in the vicinity of the discharge location. The preservation chemicals are non-persistent, and it is considered that there will be no cumulative effects from successive events.

Prior to the commencement of these activities, a Pipeline Cleaning and Pre-commissioning Discharge Management Plan will be prepared and subsequently maintained. This plan will establish, and regularly update, a schedule of discharge events together with a detailed set of cleaning and pre-commissioning procedures. The MENR will be informed of the pipeline cleaning and pre-commissioning schedule and will be notified of any changes to the schedule. The following measures will be undertaken for the ACE Project to provide the most effective and practicable monitoring and assurance:

- The amounts of chemicals used, together with the dosage rates and water flow rates during all pipeline filling, top-up and pressure testing activities will be rigorously recorded;
- The actual volumes of treated seawater released during each pipeline discharge event will be rigorously recorded; and
- Laboratory samples (seawater dosed with chemicals at the rate recorded during offshore pipeline fill activities) will be prepared and stored onshore under simulated pipeline conditions. These samples will be periodically subject to toxicity testing.

Aqueous discharges from installation vessels (ballast water, grey water, treated black water and drainage) will also be similar in magnitude and impact to those for the predrill programme and were assessed as having a minor impact upon biological receptors.

Propagation of underwater sound from installation of the jacket pin and skirt piles was calculated using the same model used to estimate drilling and vessel noise described above to estimate distances at which various impacts on marine species may occur. For piling, the modelling results show that for seals when quantified in terms of peak units the results of the modelling indicated that PTS is unlikely to arise even when the animals are adjacent to the piling while TTS is unlikely to arise beyond a range of 2m. When quantified in terms of sound exposure levels (SEL) units, PTS could occur at distances up to 2.3km from the piling while TTS may arise up to 23.5km both for a 1 hour exposure. For fish exposed to piling sound, when defined in terms of peak units, mortality and recoverable injury are both short-range impacts likely to occur no more than 4m from the piling location. For a 1 hour cumulative exposure (SEL units), mortality could occur up to 80m from the piling location whilst the recoverable injury zone extends to 148m from the centre of piling. TTS, which is also defined in terms of SEL units, might arise at distances up to 2km from the piling site for fish of all hearing sensitivities. Vessels used to support the infield pipeline pipelay, installation of the subsea infrastructure and during jacket and topside installation will include smaller support vessels and tugs, larger supply vessels in addition to the pipelay barge. The potential impacts to seals and fish from underwater sound from the support and supply vessels will be equivalent to the impacts described for the predrill support vessels described in Section 15.2.1 above. For the pipelay barge the modelling predicts PTS may arise in seals at distances up to 2km from the vessel over an exposure duration of 1 hour while TTS could occur at distances up to 43km for the same exposure period. However, these distances do not account for the movement of either vessel or seal. The Caspian seal is a highly intelligent and mobile animal. The seals are habituated to vessel noise associated with routine commercial traffic and vessels associated with the oil and gas industry, and will take action to avoid the associated sound from this activity. Similarly the use of an Acoustic Deterrent Device (ADD) (specifically set for the hearing range of pinniped seals) during piling activities will alert any seals present to the activity, allowing them to leave the area as soon as they detect the sound source. Risk of injury to individuals and detectable effects on the seal population as a whole is therefore considered very unlikely.

Overall, the majority of the residual impacts were assessed as minor or negligible. The only moderate impact was underwater sound generated from piling activities. It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing control measures.

15.2.3 Operations

Table 15.3 summarises the outcome of impact assessment for the Platform Drilling and Offshore Operations phase of the ACE Project.

Table 15.3 Summary of Residual Environmental Impacts for the ACE Offshore, Onshore and Subsea Operations Activities

	Event/ Activity	Magnitude				Sensitivity		Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity	Human	Ecological	Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Operation of offshore combustion sources under routine operations	1	1	3	1	2	2	Medium	Low	Minor Negative
	Operation of offshore combustion sources under non routine operations (maintenance)	1	2	1	1					
	Operation of offshore combustion sources under emergency depressurisation conditions	1	1	1	1			Low	Low	Negligible
Marine Environment	Underwater Sound (Hydraulic Hammering)	3	2	1	2	-	2	Medium	Low	Minor Negative
	Underwater Sound (Platform Drilling)	1	1	3	1					
	Underwater Sound (Vessels)	1	1	3	1					
	Drilling Discharges to Sea	1	2	2	1	-	2	Medium	Low	Minor Negative
	Cement Wash Out Discharges	1	2	1	1	-	2	Medium	Low	Minor Negative
	Cooling Water System Intake and Discharge	1	1	3	1	-	2	Medium	Low	Minor Negative
	Offshore Operation: Other Discharges to Sea: **Treated Black Water**	1	1	3	1	-	2	Medium	Low	Minor Negative
	Offshore Operation: Other Discharges to Sea: **Grey Water**	1	1	3	1	-	2			
	Offshore Operation: Other Discharges to Sea: **Drainage**	1	1	3	1	-	2			
	Offshore Operation: Other Discharges to Sea: **Galley Waste**	1	1	3	1	-	2			
	Offshore Operation: Other Discharges to Sea: **Freshwater Maker Saline Effluent**	1	1	3	1	-	2			
	Injection Water Pipeline Pigging Discharges	2	2	1	2	-	2	Medium	Low	Minor Negative

Offshore events assessed during the operations phase include emissions to atmosphere from the ACE-PDQ platform during routine and non routine events, underwater sound from drilling activities and vessels, drilling discharges (water based mud and cuttings discharge), cement discharges, cooling water discharge, aqueous discharges (i.e. treated black water, grey water, drainage, galley waste and saline effluent) and injection pipeline pigging water discharges.

The impact of emissions to atmosphere from routine and non routine offshore operations was assessed using dispersion modelling. Sources included the offshore platform generators during routine operations and the flare during non routine events or emergency depressurisation. For all scenarios assessed an impact of minor significance to onshore receptors was predicted.

Propagation of underwater sound generated during driving of the 30” conductor into the seabed using a hydraulic hammer was calculated using the same model used to estimate drilling, piling and vessel noise described in Sections 15.2.1 and 15.2.2 above to estimate distances at which various impacts on marine species may occur.

The sound generated during installation of the 30” conductor section using a hydraulic hammer will be similar in nature to the piling noise generated through the installation of the jacket pin and skirt piles (described in Section 15.2.2 above). However, in the case of the conductor installation the hydraulic hammer will be located on the platform topside meaning the sound will be mainly emitted above water, with low transmission into the water from air, however some sound will be emitted directly into the water. For the purposes of this ESIA it has been conservatively assumed the sound level within the water column from conductor hammering is similar to the levels associated with the installation of the jacket pin and skirt piles described in Section 15.2.2 above. Similarly, the sound levels generated and the potential impacts from platform drilling and vessel movements during offshore operations will be similar to the results presented for predrilling in Section 15.3.1 above. Overall the risk of injury to individuals and detectable effects on the seal population and fish as a whole is considered very unlikely and impacts are assessed as being of no more than minor negative significance.

Modelling of the platform drilling discharges was undertaken to confirm the extent and scale of water based mud and cuttings predicted to be deposited on the seabed during ACE platform drilling. The modelling has shown that such discharges have a very limited ecological impact on marine receptors. Based on the predicted event magnitude, receptor characteristics and observed sensitivities and monitoring of impacts on benthic communities at existing Azeri Chirag Gunashli (ACG) and Shah Deniz (SD) drill sites, the impact was assessed as being of minor negative significance.

Cementing discharges will occur from wash out activities where cement remaining in the platform cement system will be slurrified with seawater, and will be discharged from the platform via the cuttings caisson. Modelling of the cement washout discharges predict that the discharge plume will dilute rapidly and approximately 3% of the cement solids would be deposited on the seabed under worst case conditions. Therefore, the impact to benthic invertebrates and seals, fish and plankton, which were evaluated as having a low sensitivity to cement discharges was assessed as being of minor negative significance.

The effects of the cooling water intake and discharge on the water column associated with the ACE-PDQ platform were assessed. Based on earlier modelling work for a similar intake it was determined that effects on water velocities in the vicinity of the intake will be such that fish are able to detect and avoid the intake. The ACE platform cooling water discharge was modelled to determine the extent of the thermal plume. The distance from the discharge point to where the water temperature is estimated to be 3°C above ambient temperature is predicted to be within 12m during summer conditions and 3m in winter conditions. Thus it is concluded that the discharge will have a very small zone of influence (i.e. where the temperature of the discharge is greater than the ambient water temperature). Impacts upon biological receptors in the water column (i.e. zooplankton, phytoplankton, seals and fish) were assessed as being of minor negative significance.

The remaining discharges to sea from offshore operations (treated black water, grey water, galley waste, drainage and saline effluent) are all small in volume (relative to cooling water discharges) and do not contain components of high environmental concern. These discharges, which are monitored in accordance with existing procedures to ensure applicable project standards are met, will be rapidly diluted and are all assessed as having an impact of minor adverse significance on biological receptors in the water column.

Pigging of the 16” infield injection water pipeline will be carried out from the CA-PDQ platform to the ACE-PDQ platform as required to maintain pipeline integrity. The water injection pipeline will be flushed with seawater prior to pigging. It is estimated up to $950m^3$ of water (primarily seawater with some injection water from CA) will be discharged every three months during operations comingled with the ACE seawater returns (up to $3{,}410m^3/hr$). Recent modelling for a similar discharge at the CA platform comprising 100% injection water, and hence not taking into account the dilution afforded by the seawater returns, estimated that the relevant no effect concentration (derived from the most conservative ecotoxicity test sample results obtained for produced and injection water across the ACG offshore facilities) would be reached within 9.5km of the discharge with the plume dispersing within an area of approximately $0.77km^2$**.** The discharge of pigging water is predicted to have a minor impact to the marine environment since the discharges will be infrequent; the volumes will be small and have a low toxicity and do not require additional mitigation beyond the existing controls.

Overall, the majority of residual impacts from operations are assessed as being of minor adverse or negligible significance. All activities will be managed in accordance with previously established practice and BP Azerbaijan Georgia Turkey (AGT) Region procedures, and impacts are considered to be controlled and mitigated to an acceptable level.

15.3 Residual Social Impacts

The majority of ACE Project related Activities occur offshore with the exception of the onshore construction and commissioning activities. It is currently planned to use a number of existing onshore construction yards for the ACE Project with candidate yards including the Baku Deep Water Jacket Factory (BDJF) and Bayil Yard[2]. With reference to the experience gained from previous ACG Phases 1-3, Chirag Oil Project (COP) and SD projects, the following key social issues were assessed:

- Employment creation and subsequent demanning of the construction workforce, after peak employment has been reached;
- Training and skills development opportunities provided to the workforce;
- Procurement of goods and services by the main construction and installation contractors through internal supply chains; and
- Potential social conflict from (perceived or actual) competition between individuals seeking jobs.

The assessment concluded that the national workforce to be employed during the ACE Project construction phase is likely to peak at approximately 3,700 in 2021. Additional and new employment during the operations phase will be less in terms of new positions. Employment impacts are likely to be distributed within the local area with the majority of employees expected to be recruited from the Baku City economic region (which includes the Sabayil and Garadagh Districts). It is anticipated that employment will not require establishment of workforce accommodation or significant migration of populations to the construction areas.

Every effort will be made to re-hire workers who have demonstrated competence whilst working on previous oil and gas construction projects. Upon hiring workers, a gap analysis will be undertaken by the main construction and installation contractors between relevant competence criteria and the contractor's Training and Development Plan. Where gaps are identified training will be provided to bring each worker up to at least the minimum standards for the role expressed in the Training and Development Plan. It is expected that the employment generated by the ACE Project will result in positive impacts to individuals and their households.

As the construction phase will generate temporary employment opportunities, planning for the conclusion of construction workforce contracts will be carefully considered from the start of the ACE Project. Measures to mitigate this will include adequate staff communications between the main construction and installation contractors and their workforce which will inform the workforce of project progress and expected completion dates.

The overall social impacts of the ACE Project, particularly from employment creation throughout the construction, installation and HUC phases, were assessed as positive.

[2] Formerly known as the Amec-Tekfen-Azfen (ATA) yard

15.4 Cumulative, Transboundary and Accidental Events

Potential cumulative and transboundary impacts were assessed taking into account potential for inter project impacts as well as other potentially significant projects where the associated impacts may overlap geographically or temporally with ACE impacts. The most significant project where this potential exists is the Shah Deniz Stage 2 (SD2) Project, which achieved first gas during 4Q 2018[3].

With regard to discharges, the majority of the ACE Project discharges are small, and are comparable to discharges associated with previous projects and existing operations. The largest discharges will either be confined to a small area of seabed (drilling discharges) or will be short in duration and have transient impact (discharge of treated seawater during pipeline cleaning and pre-commissioning). All of the discharges associated with construction, installation, HUC and operation, have been assessed, and it is concluded that there will be no cumulative or additive interactions between the impacts.

With regard to emissions to atmosphere, the most significant air quality pollutant in terms of health impacts is nitrogen oxide (NO_2). It has been demonstrated that emissions associated with the ACE Project activities alone and emissions from worst-case cumulative SD2 Project offshore activities are not expected to result in any discernible changes in NO_2 concentrations at onshore receptors. For both onshore construction and commissioning and offshore activities, the volumes of atmospheric emissions released (including visible particulates) due to the ACE Project are expected to result in very small increases in pollutant concentrations in the atmosphere and in any washout from rainfall, which will not be discernible to biological/ecological receptors. Based on the limited geographic scope of pollutant species, which will disperse rapidly in the atmosphere, no transboundary impacts associated with air quality and human health are predicted from the ACE Project.

Greenhouse gases (GHG) have the potential to give rise to transboundary impacts. The majority (86%) of greenhouse gases (GHG) estimated to be generated by the ACE Project are predicted to result from offshore activities during the ACE Project operations phase while onshore emissions from ACE Project operational activities will contribute approximately 5%. Activities associated with predrilling are predicted to contribute 0.6%, while onshore construction and commissioning and installation and HUC activities are estimated to contribute approximately 8.6% of the total volume of GHG emissions produced by the ACE Project. The annual contribution of ACE GHG emissions in the year 2030 to the predicted national Azerbaijan GHG emissions forecast (Ref. 1) was estimated to be approximately 0.5%.

To support the assessment of accidental events, modelling of potential hydrocarbon spill scenarios using Stiftelsen for Industriell og Teknisk Forskning (SINTEF)'s Oil Spill Contingency and Response (OSCAR) modelling software (version 9.0.1) was undertaken to predict the behaviour of the spilled hydrocarbon in the water column and on the sea surface and to estimate where and how much spilled hydrocarbon may come ashore. It must be noted that modelling has not taken into account any response mitigation measures such as dispersant application, containment or recovery, meaning that the results should only be interpreted as indication of theoretical spill consequences without implementation of the oil pollution prevention strategy. The key accidental event scenarios modelled and assessed included

- Scenario 1: A loss of 92 cubic metres (m^3) of diesel from the platform;
- Scenario 2: A blowout of crude oil (3,195,000 barrels (bbls)) over 90 days duration; and
- Scenario 3: A rupture of the ACE 30" oil export pipeline resulting in the release of 962 tonnes of crude oil.

The 92m^3 of diesel released from the ACE platform is predicted to rapidly spread out to form a thin sheen on the sea surface. The modelling indicates that the maximum extent of sea surface covered by a diesel sheen of 0.04 micrometres (µm) or thicker from this spill would be approximately 20.1km in summer and 52.3km in winter. The majority of the volume of the released diesel is rapidly lost to the air by evaporation or naturally dispersed into the water column and then biodegraded with no

[3] While the SD2 Project achieved first gas in Q4 2018 the effects of the SD2 Project are not captured within the existing baseline conditions against which the ACE Project impacts have been assessed. Therefore, for the purposes of the ESIA, the SD2 Project activities and impacts have been considered within the ACE ESIA cumulative assessment.

diesel predicted to reach the shore. No significant ecological damage would be anticipated from a spill of this magnitude.

Based on worst case estimates, a blowout of crude oil from an ACE well could continue for an estimated 90 days, which is the time that would be required to mobilise a drilling rig and to drill a relief well. During this time, approximately 35,500 bbls of crude oil would be released per day. The majority of the oil would initially be present on the sea surface following the release, while 15% evaporates almost immediately and 5% is dispersed into the water column. The amount of evaporation stabilises at just over 30% while the amount biodegraded rises steadily to 38% by the end of the simulation. Ultimately 32% evaporates, 38% is biodegraded, 13% remains in the water column, 15% is deposited in sediments and approximately 2% is deposited on the shoreline, with less than 1% remaining on the surface. The crude oil on the sea surface is predicted to travel around 400-500km before it drops below the lowest recognised visible thickness under ideal viewing conditions. Although the precise movement of the surface oil is dependent on the exact metocean conditions at the time, the analysis of over 100 different sets of metocean data suggest that the most likely locations to receive oil on shore are southern Azerbaijan, northern Iran and the tip of the Absheron Peninsula. The extent of oil in the water column above the 58 parts per billion (ppb) threshold tracks the path of the surface release and can extend over 200km from the source. The modelling predicts that a blowout under summer conditions could result is a worst case of 18,295 tonnes of oil reaching the coastline and that this would mainly impact three areas: southern Azerbaijan, northern Iran and the Absheron Peninsula. The eastern coastline of the Caspian Sea is unaffected. A mixture of areas of very light, light (0.1-1mm), moderate (1-10mm) and heavy (>10mm) oil deposition are predicted in these areas.

In the event of a rupture of the ACE 30" oil export pipeline midway between the ACE and CA platforms it is anticipated that approximately 962 tonnes of oil and 12 tonnes of associated gas would be released into the marine environment. Following the release the majority of the oil would initially be present on the sea surface, while 10% evaporates almost immediately and 15% is dispersed into the water column. Oil travels through the water column and takes just under two minutes to reach the surface. After around 6 days, oil has moved into shallower waters and begins to deposit in sediments. Ultimately 36% evaporates, 29% is biodegraded, 7.5% remains in the water column, 24% is deposited in sediments, approximately 2.5% is on the shoreline and less than 1% remains on the sea surface. Crude oil on the sea surface is predicted to travel up to 340km before it drops below the lowest recognised visible thickness under ideal viewing conditions. The thickest areas of oil (> 0.2 mm) are present within around 10-20 km of the release but are short term (lasting up to 2 days) and occupying an area of up to 2km^2. The area of water column affected is relatively small, partly because of the size of the release, the low gas content and the low energy conditions towards the end of the release. The extent of oil in the water column above the 58ppb threshold tracks the path of the surface release and can extend around 30-40km from the source. Oil deposition on the shoreline is spread out given the distance and time separating the source from the shore, and the mass of oil involved is relatively small. The summer case release results in oil mainly reaching three areas: southern Azerbaijan, northern Iran and Turkmenistan. A mixture of areas of very light and light (0.1-1mm) oil deposition is predicted in these areas.

For both the blowout and pipeline rupture scenarios, species in the immediate vicinity of the spill that cannot actively avoid the oil such as plankton, benthic invertebrates, birds and seals are likely to suffer the greatest impacts. Highly mobile species such as fish are anticipated to avoid the spilled oil areas. The modelling of the blowout scenario shows that a number of Important Bird and Biodiversity (IBAs) and Key Biodiversity Areas (KBAs), and associated bird species, may be exposed to elevated hydrocarbon concentrations as a result of surface or dispersed / dissolved oil beaching on the shoreline following a blowout. Given the persistence and volume of oil predicted to beach in some IBAs and KBAs, the potential impact on these areas (and the birds present there) could have a potentially significant impact, especially if the release occurs during the bird nesting period (April to July). In the event of a blowout or pipeline rupture the potential impacts are assumed to be significant for the areas impacted by the spill and it is anticipated that recovery would take a period of time in the medium to long term. The impact on fisheries would be reflected by the impact on fish and the presence of juvenile stages at the time of a spill as they are more susceptible to relatively low levels of oil within the water column and are less likely to be able to move away. Fish can become tainted and contaminated with hydrocarbons. If there are signs of fish oil tainting or contamination as a consequence of a hydrocarbon spill event, any resultant imposed authority restrictions on fishing activities could result in a detrimental financial impact upon local fisheries. Equally, a lack of timely restrictions, or illegal fishing, can create a risk to human health from contaminated product consumption. Therefore, the impact to the commercial fishing industry in the unlikely event of a blowout or pipeline rupture is considered to be potentially significant.

An Offshore Facilities Oil Spill Contingency Plan (OSCP) has been developed, which provides guidance and actions to be taken during a hydrocarbon spill incident associated with all ACG and SD offshore operations including MODUs, platforms, subsea pipelines and marine vessels. It is authoritative for spills that may occur during commissioning, operation, and decommissioning of the systems.

15.5 Environmental and Social Management

Each phase of the ACE Project will be subject to formal environmental and social (E&S) management planning.

The BP Construction, HUC and Start-Up Phase Environmental and Social Management System (ESMS) will include the Environmental and Social Management and Monitoring Plan (ESMMP) that describes:

- Conformance requirements;
- Roles and responsibilities of BP and the main construction and installation contractors;
- The main activities that will be undertaken;
- The actions needed to avoid and/or mitigate environmental and social impacts and to put the commitments in the ESIA into effect; and
- The assurance process that will be adopted to monitor and report environmental and social performance will include inspection, audit and monitoring programs such as chemical inventory and storage.

To support the ESMMP, environmental and social management plans will be developed to present the ACE Project environmental and social requirements by subject matter. The ACE Project environmental and social management plans will be finalised during mobilisation of the main construction and installation contractors, and regularly reviewed as the Project proceeds.

The MODU used to drill the ACE Project predrill wells will be operated by a rig operator who has their own independent HSE MS (Health, Safety and Environmental Management System already in place. Alignment of the plans, procedures and reporting requirements of the rig and AGT Region HSE MS has been achieved through the development of a HSE Bridging Document.

BP will operate the ACE facilities using an Operations Phase Environmental Management System (EMS) that is aligned with the requirements of the ISO 14001 EMS and will be based on the ‘plan-do-check-act’ cycle. Prior to commencement of ACE operations, a transition plan will be developed to support the movement of ACE from the Construction Phase ESMS to the Operations Phase EMS, capturing start up activities. This will include integration of ACE into the scope of AGT Region wide EMS and its existing processes.

The environmental and social management process during all phases of the ACE Project will benefit from accumulated experience and ‘lessons learned’ from executing the previous ACG and SD projects. Major benefits of previous project experience include the development of:

- Effective and reliable procedures for on-site segregation and management of waste;
- A non-hazardous landfill site designed and constructed to EU standards; and
- An effective process for identifying and utilising opportunities for waste recovery and recycling.

15.6 Conclusions

Activities associated with the ACE Project have been assessed for all project phases. Residual environmental and social impacts identified have been of negligible, minor or moderate adverse significance with positive impacts arising from employment, training and skills development and through procurement of goods and services.

The monitoring and mitigation plans and procedures associated with each impact have been presented and discussed, and it is concluded that these are sufficient to ensure the sound management of impacts throughout the duration of the ACE Project. This conclusion is underpinned by the project philosophy of using only tried and tested technology, and by the substantial experience acquired by BP, its partners, and its contractors in successfully executing previous projects in the ACG and SD Contract Areas.

15.7 References

Ref. No.	Title
1	Ministry of Ecology and Natural Resources (MENR). (2015). Third National Communication to the United Nations Framework Convention on Climate Change. Available at: https://unfccc.int/resource/docs/natc/azenc3.pdf [Accessed 14.06.2018]