11 Operations Environmental Impact Assessment, Mitigation and Monitoring

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11.1 Introduction

This Chapter of the Shah Deniz 2 (SD2) Project Environmental and Socio-Economic Impact Assessment (ESIA) presents the assessment of environmental impacts associated with the following SD2 Project phases:

- Offshore Operations;
- Onshore Operations; and
- Subsea Operations.

The impact assessment methodology followed and the structure of the SD2 Project impact assessment are described in full within Chapters 3 and 9 of this ESIA respectively.

11.2 Scoping Assessment

The SD2 Project Operations Activities and Events have been determined based on the SD2 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 discernable environmental impacts. Judgement is based on prior experience of similar Activities and Events, especially with respect to earlier ACG and 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 11.1 "Scoped Out" SD2 Project Offshore, Onshore and Subsea Operations Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Offshore Operations			
OPs-NR4	Fire System Tests	5.10.10.8	• Firewater pump testing will typically occur on a weekly basis for a short duration (approximately 1 hour) with seawater. • Discharge of seawater used for testing will be via the SDB-QU seawater discharge caisson. • There will be no planned discharge of fire fighting foam from the SDB platform complex except during annual system tests. • Foam system chemicals of the same specification and environmental performance as those used in existing SD and ACG platform foam systems will be stored on the platform for emergency use. The small volume of foam will disperse in minutes so there is little potential for acute toxicity in exposed organisms. • The fish most likely to be present for extended periods of time in the SD Contract Area and at the SDB-PR and SDB-QU locations are Kilka and Mullet, which may be present throughout the year. However, the SD Contract Area, including the SD2 Offshore location, is not exclusively used by these species and the Contract Area is not considered to be of primary importance. **Conclusion:** There is limited potential for discernable impact on the marine environment
Ops-R8	Supply Vessel Operations - Emissions to atmosphere	5.10.12	• On average it is assumed there will be support vessel trips every 7-14 days during the Operations phase to supply consumables (e.g. diesel, chemicals) to the SDB platform complex and ship solid and liquid waste to shore for treatment and disposal. • 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 discernable impact to human or ecological receptors.

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Ops-R9	Support Vessel Operations - Underwater Noise	**5.10.12**	• Support vessels used during the operations phase (every 7-14 days over the PSA period) will be similar to those used using the SD2 drilling activities (used almost continuously throughout the 14 year drilling programme). • Assessment of the underwater noise generated by support vessels during SD2 drilling demonstrated that the source noise levels for vessel operations are below the levels at which lethality and direct physical injury occur. At worst it was anticipated that there may be a strong behavioural reaction in seals within 13m of the noise source and mild behavioural reaction within 72m of the noise source (refer to Appendix 9C for further details). **Conclusion:** Support vessels will be transitory within the offshore environment. Modelling has shown there is a limited potential for impacts to fish and seals.
Ops-R10	Crew Change Operations	5.10.12	• Crew changes will be made on a regular basis using crew change vessels (up to two vessels per 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. • Underwater noise impacts will be similar to those for support vessels and are considered not significant. • Helicopters will be used only for non-routine or emergency crew transportation (no more than once a month). Flights will originate from Zabrat heliport. A portion of the flight path will be over residential receptors but at height (>500m). Noise disturbance will be temporary, of short duration and low intensity. • There will be no helicopter or vessel refuelling facilities on the SDB platform complex. **Conclusion:** Emissions and noise from crew change operations are expected to result in no discernable impact to human receptors. Underwater noise impact to fish and seals will be limited.
Ops-R11	Physical Presence of the SDB Platform Complex		• The SDB platform complex will be located approximately 45km from the Azerbaijani coastline. • The SDB platform complex will not be visible from onshore and therefore there will be no visual intrusion to onshore receptors. • The footprint of the SDB platform complex is negligible in the context of the South Caspian. • The fish most likely to be present for extended periods of time in the SD Contract Area and at the SDB-PR and SDB-QU locations are Kilka and Mullet, which may be present throughout the year. However, neither the SDB platform complex location nor the SD Contract Area are exclusively used by these species and the Contract Area is not considered to be of primary importance. • The Contract Area is not located within a bird migration flyover route. Birds found in the area will be transient and not resident. **Conclusion:** The SDB platform complex (including at night when lit/flaring) will not be visible from onshore and no discernable impact on ecological/biological receptors is expected.
Subsea Operations			
Sub-NR2	DEH Operation	5.11.2.2	• The Direct Electrical Heating (DEH) system will be used during low flow or upset conditions to maintain the internal temperature of the flowlines. • Operation will be intermittent; it is expected that the system will be used for approximately 8.5% of the year during the PSA period. • An electrical field will be generated around the flowlines during DEH operation. The field strength drops very rapidly away from the flowlines, halving within 10m of the flowlines. • Research has shown that elasmobranchs (marine species that are the most sensitive to electric fields) may be sensitive to levels as low as 1 nV/m (1 x 10-9 V/m)[1]. However, elasmobranchs are not expected to be present in the SD Contract Area. While other species may be slightly attracted to, or repelled by, the field, no significant impact is expected at the field strengths predicted for the SD2 Project. • Under both routine conditions and when the DEH system is operational, the outer surface of the production flowlines are not expected to be greater than 0.2°C above ambient seawater temperature. **Conclusion:** Impacts from DEH operation will be intermittent and limited to the immediate area surrounding the flowlines. No discernable impact to the marine environment is expected.

[1] Oregon Wave Energy Trust, Effects of electromagnetic fields on marine species: A literature review. September 2010.

ID	Activity / Event	Ch. 5 Project Description Reference	Justification for "Scoping Out"
Onshore Operations			
Ter-NR2	Fire System Tests	5.12.4.12	• It is anticipated that the firewater pumps will be tested on a weekly basis for 1 hour using freshwater from the firewater tank. Water will be routinely returned to the tank following testing. • Foam systems will be used for fire fighting in certain onshore process areas. • A foam system will be used to protect the SD2 condensate storage tank and any other areas where there is significant liquid hydrocarbon risk. SD2 will use foam system chemicals of the same specification and environmental performance as those currently used at the Terminal. No routine testing of the foam system is planned. **Conclusion:** No discernable impact to the marine environment is expected during fire system testing.
Ter-R2	Onshore Drainage: Discharge to Drainage Channel via the Open Drains Treatment Package	5.12.4.9	• Contaminated effluent will be routed to drainage sumps and holding tanks, which will be designed to allow hydrocarbons to be separated out and recovered to the closed drains system. From the open drains holding tank, the effluent will be routed to the open drains treatment package, designed to treat water to the applicable oil in water standards (i.e. less than 10 mg/l as a monthly average and less than 19 mg/l on a daily basis). Treated water will then be discharged to the drainage channel via the discharge basin. Hydrocarbons from the open drains treatment package will be routed to the oil containment chamber within the discharge basin, from where they will be pumped out and subsequently sent offsite for disposal in accordance with the existing AGT waste management plans and procedures. **Conclusion:** No discernable impact to the marine environment is expected.
Ter-NR3	Non Routine Pond Storage of Produced Water (potential soil, ground and surface contamination)	5.12.4.2	• In situations when the ACG produced water treatment facilities and offsite 3rd party treatment contractor are not available SD produced water will be sent to a new pond for storage. • Surface water and flood modelling will be completed to inform the design of the pond and pond integrity is protected • The pond design will include a composite liner and leak detection system. a sloped floor for drainage, composite liner of a type particularly suited to produced water, a gas-venting system to prevent gas build-up and ballooning of the liner, and an automatic leak detection system with a manual back-up. • The new pond design will adopt lessons learned from the existing ponds at the Terminal (refer to Chapter 6 Section 6.4.4). • Potential for contamination of soil, groundwater and surface water in the Terminal vicinity from produced water considered to be minimal; • When the ponds are being used, samples of water sent to the pond will be collected every week analysed for parameters listed in Appendix 11E and results provided to the MENR on a quarterly basis **Conclusion:** No discernible impact to the terrestrial environment is expected.
All Operations			
All-R1	Waste Management	5.10.13.3, 5.12.5.3 5.10.11.1 and 5.10.11.2 and 5.12.4.13	• Waste generated during SD2 Operations phase will be consistent with the types of waste that have been routinely generated by the existing operational ACG and SD onshore and offshore facilities. • Waste generated during Offshore and Onshore Operations will be segregated at source, stored and transported in fit for purpose containers. • There is no planned discharge of pigging waste to the marine environment. • It is expected that pigging waste quantities generated will not require additional handling resources and the waste will be managed in accordance with established practices. • All waste generated during SD2 Offshore Operations and Production Activities will be managed in accordance with the existing AGT management plans and procedures. Waste minimisation and management plans will be established for the Operations phase and all waste transfers controlled and documented. • 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 5.38 of Chapter 5: Project Description. **Conclusion**: Waste generated during the SD2 Project will be managed in accordance with the existing BP AGT Region management plans and procedures. No discernable impact to the terrestrial or marine environment expected.

Note: Support Vessels refers to both Offshore and Subsea supply/logistical support

The SD2 routine and non-routine Operations 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" SD2 Project Offshore, Onshore and Subsea Operations Activities

ID	Activity / Event	Ch. 5 Project Description Reference	Event	Receptor
Offshore Operations				
Ops-R1	Operation of offshore combustion sources under routine conditions	5.10.5, 5.10.7, 5.10.8, 5.10.10.1, and 5.10.13.1	Emissions to atmosphere (non GHG)	Atmosphere
Ops-NR1	Operation of offshore combustion sources under non routine emergency depressurisation conditions	5.10.7 & 5.10.13.1	Emissions to atmosphere (non GHG)	Atmosphere
Ops-NR2	Operation of offshore combustion sources under non routine DEH scenario conditions	5.10.8, 5.11.2.2	Emissions to atmosphere (non GHG)	Atmosphere
Ops-R2	Cooling water intake and discharge	5.10.10.2	Water intake/entrainment	Marine Environment
			Cooling water discharge to sea	
Ops-R3	Treated black water discharge	5.10.10.9	Other discharges to sea	Marine Environment
Ops-R4	Grey water discharges	5.10.10.9	Other discharges to sea	Marine Environment
Ops-R5	Galley waste discharges	5.10.10.10	Other discharges to sea	Marine Environment
Ops-R6	SDB platform complex drainage	5.10.10.5	Other discharges to sea	Marine Environment
Ops-R7	Saline effluent from Freshwater Maker	5.10.10.7	Other discharges to sea	Marine Environment
Subsea Operations				
Sub-R1	Control fluid discharge from Subsea Control System	5.11.3.5 and 5.11.3.6	Control fluid discharge to sea	Marine Environment
Sub-NR1	Discharge during Subsea Interventions	5.11.4	Other discharge to sea	Marine Environment
Onshore Operations				
Ter-R1	Operation of onshore combustion sources under routine conditions	5.12.4.4, 5.12.4.5, 5.12.4.6 and 5.12.4.7	Emissions to atmosphere (non GHG)	Atmosphere
			Noise	Terrestrial Noise Environment
Ter-NR1	Operation of onshore combustion sources under non routine emergency depressurisation conditions	5.12.4.5 and 5.12.4.6	Emissions to atmosphere (non GHG)	Atmosphere
			Noise	Terrestrial Environment
Ter-NR3	Non Routine Pond Storage of Produced Water (Odour)	5.12.4.2	Generation of odour	Terrestrial Environment

Notes: GHG Emissions are addressed in Chapter 13.

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 SD2 facilities and use of support vessels (offshore only). GHG emissions associated with the SD2 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

Mitigation measures associated with emissions from routine and non-routine emissions from Offshore and Onshore 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 PSA requirement to monitor emissions in accordance with generally accepted international Petroleum industry standards and practices;
- The diesel transported to and stored onboard the SDB platform complex and supplied to support vessels will typically contain a sulphur content of <0.05% weight.
- Onshore, flare gas recovery (FGR) will be used on both HP and LP flare systems to minimise hydrocarbon flows to the flare stacks during normal operations;
- Offshore and onshore flares will be designed to 98% combustion efficiency;
- Offshore and onshore flares 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 in terms of noise;
- There will be no continuous flaring or venting during routine onshore operations (with the exception of purge/pilot flaring and purging of off gas from the production vessels);
- Planned or unplanned onshore flaring or venting of hydrocarbons will be minimised where practical without compromising the safety of personnel or the integrity of plant;
- Fugitive VOC losses will be minimised through limiting valve connections and instrument intrusions as potential leak points wherever possible, taking into consideration construction, maintenance, isolation, process control and other operational requirements;
- If available and suitable for use, fuel gas will be routinely used for power generation during SDB platform complex operations. When not available e.g. during platform shutdown and restart, the preferred option is to use buy back gas from the SD2 32" gas pipeline, or if not available, diesel; and
- Fuel gas will be routinely used for onshore power generation with back up provided by the existing Terminal generation system or from the Azerbaijani grid.

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 generators under routine loading, pilot/purge flaring and fugitive emissions from fittings. Intermittent sources including crew change and supply vessels, diesel powered SDB platform complex cranes, emergency generators and fire water pumps (during testing) will also generate emissions.

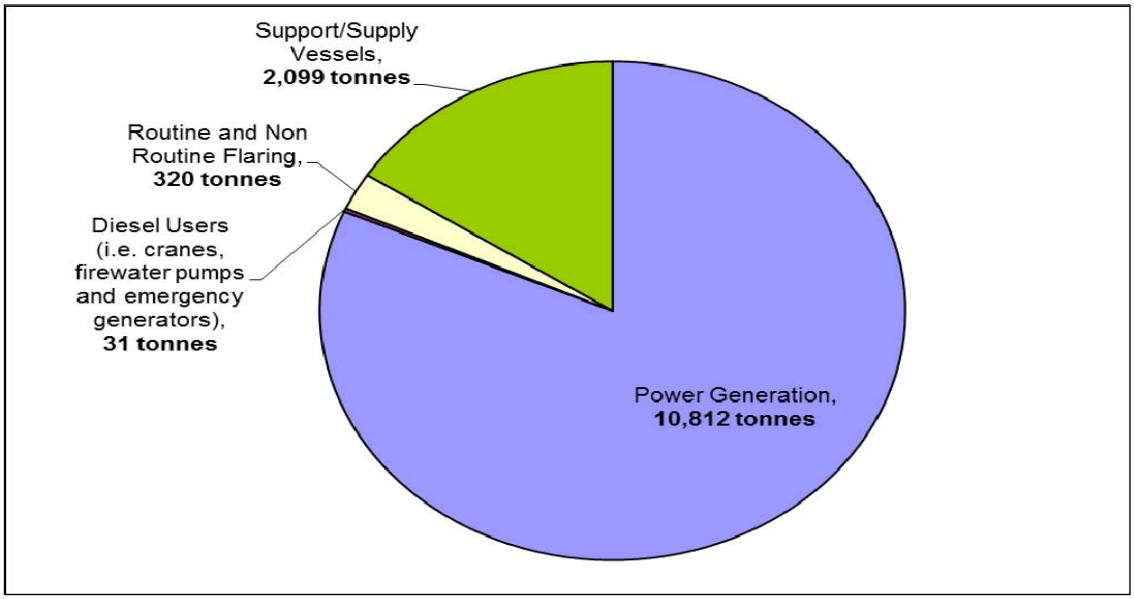
The main power generators on the SDB platform complex also provide power for the DEH, system which is required during low flow or upset conditions to maintain the internal temperature of the subsea flowlines.

During DEH system operation, the loading on the main power generators will increase, depending on the mode of operation (either keep warm or cold start up) and the number of flowlines. The anticipated load profile for the offshore main power generators is provided within Chapter 5 Section 5.10.8. DEH operation is expected for up to 8.5% of the year across the PSA with each event lasting for up to 72 hours.

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 5.10.7).

Figure 11.1 below shows the total expected volume of NO_2 emissions from Offshore Operations per source over the PSA period (refer to Appendix 5A for detailed emission estimates and key assumptions).

Figure 11.1 Total Volume of NO_X Emissions from Offshore Routine and Non Routine Operations during the PSA Period Per Source



Assessment

Air dispersion modelling undertaken for the Offshore Operations is presented in Appendix 11C. 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 SD2 Offshore Operations in the context of relevant standards 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:

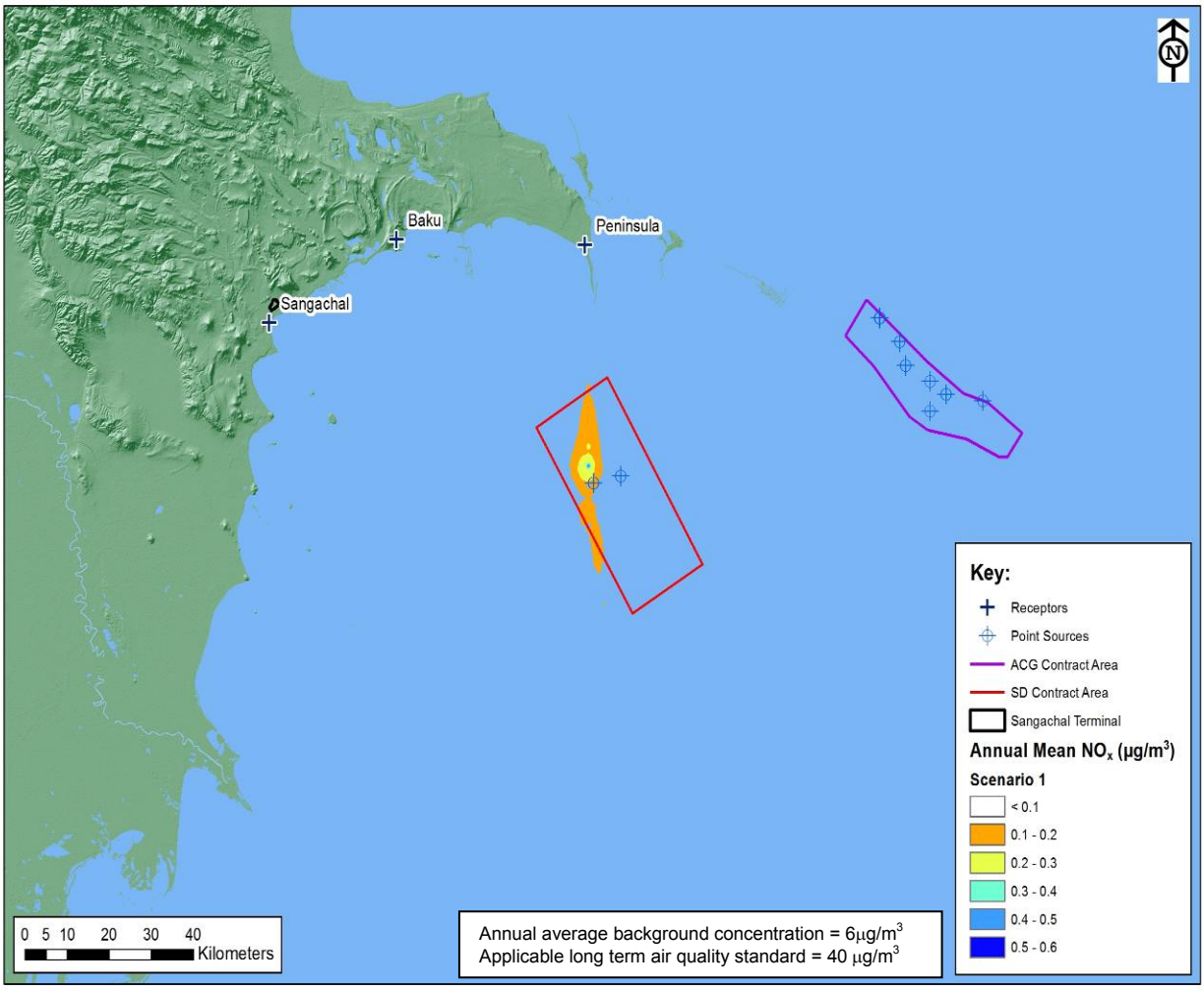
1. Routine operations – sources comprised two of the 11.9MW platform turbines operating at full load on fuel gas;
2. Non routine operations (DEH Operation) – sources comprised all the 11.9MW platform turbines operating at full load on fuel gas; and

3. Non routine operations (Emergency Flaring) - sources comprised two of the 11.9MW platform turbines operating at full load on fuel gas and emergency depressurisation flaring (estimated to occur over an hour).

For each scenario the assessment assumed full loading on the turbines to provide a worst case estimate. The modelling was undertaken based on slightly higher full turbine loads than those anticipated for the SD2 Project Base Case and assuming a total of five rather than four turbines in use for the DEH scenario. The modelling results are therefore considered to be conservative.

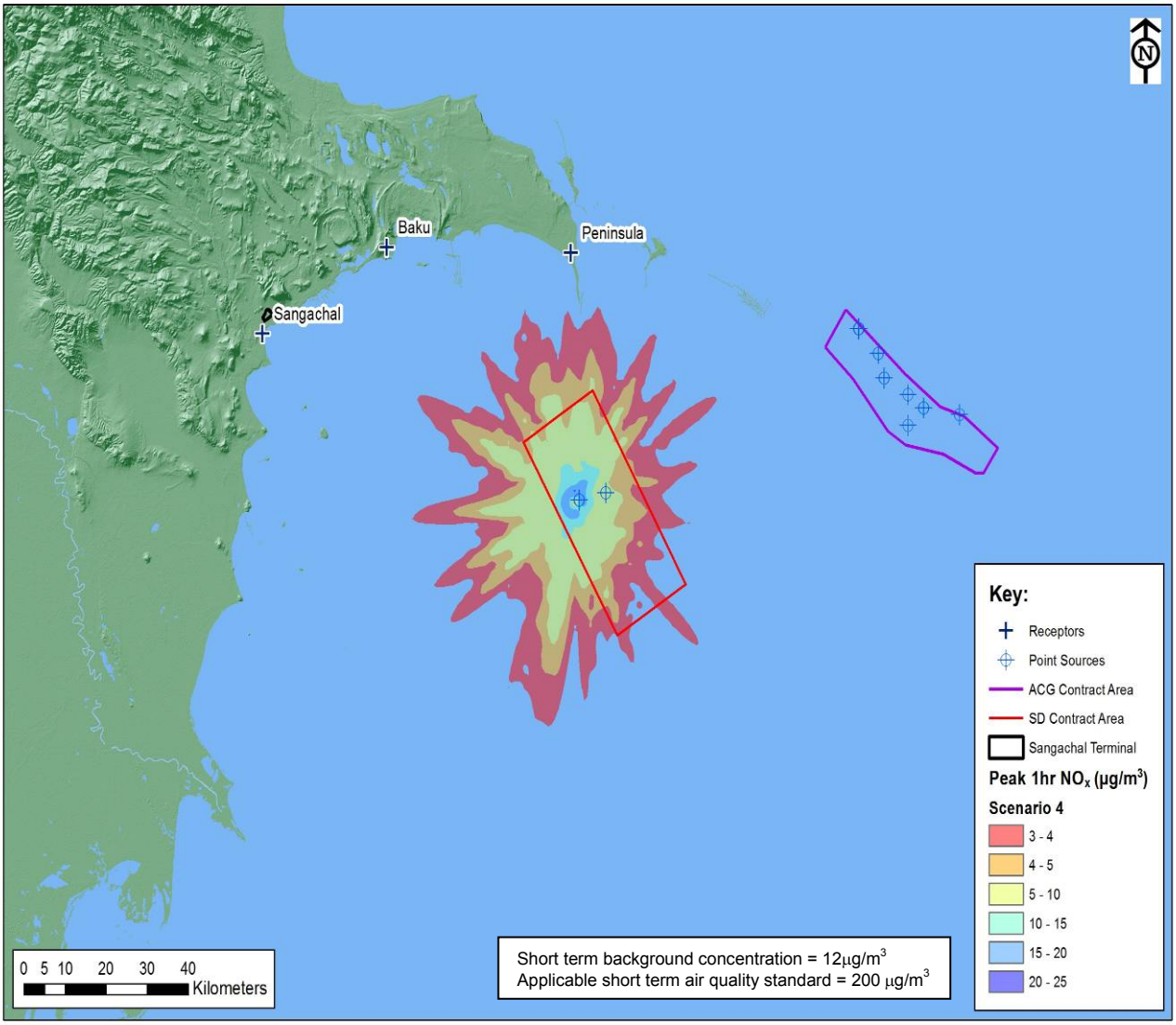
For all scenarios assessed the highest increase in concentrations of NO_2 concentrations were observed where the dispersion plume meets the Absheron Peninsula (at Shahdili Spit) due to prevailing northerly wind direction. Figures 11.2 and 11.3 show the increases in long and short term NO_X concentrations for the routine operation and non routine (Emergency Flaring) scenarios respectively.

Figure 11.2 Increase in Long Term NOx Concentration Onshore During Routine Offshore Operations



Note: As described in Appendix 11C, for the long term it is assumed that all NO_X converts to NO_2 in the atmosphere

Figure 11.3 Increase in Short Term NO_X Concentration Onshore During Non Routine Offshore Operations (Emergency Flaring for up to 1 hour duration)



Note: As described in Appendix 11C, for the short term it is assumed that 50% of NO_X converts to NO_2 in the atmosphere

The results at the Absheron Peninsula/Shahdili Spit receptor 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 6 and 12 respectively (refer to Appendix 11C for further details).

Table 11.3 Predicted Increase in Long Term and Short Term NO_2 Concentrations at the Absheron Peninsula/Shahdili Spit Receptor for Modelled Offshore Operating Scenarios

Scenario	Long Term Annual Average			Short Term Maximum		
	Increase in NO_2 concentration (long term) ($\mu g/m^3$)	% of air quality standard	% increase above background concentration	Increase in NO_2 concentration (short term) ($\mu g/m^3$)	% of air quality standard	% increase above background concentration
1. Routine operations	0.1	0.1%	0.8%	1.1	0.5%	9%
2. Non routine operations (DEH Operation)	n/a as event duration is approximately 72 hours			2.1	1.5%	17.5%
3. Non routine operations (Emergency Flaring)	n/a as event duration is approximately 1 hour			1.1	0.5%	9%

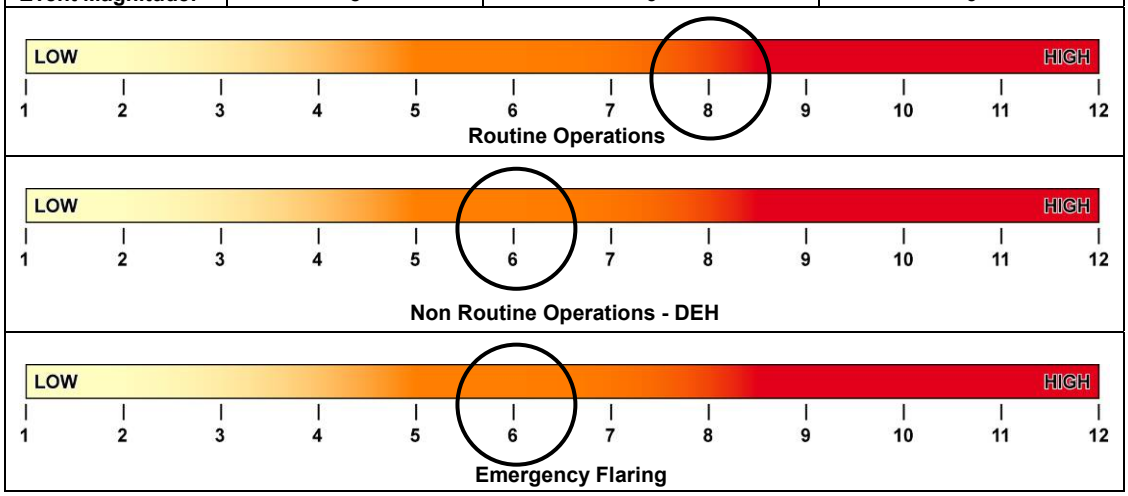
The results show that for all scenarios considered, no exceedances of the onshore short term or long term NO_2 air quality standards were predicted at onshore locations. Increases in NO_2 concentrations above background concentrations were also shown to be insignificant.

Based on efficient operation and regular maintenance, operation of the offshore generators and flaring will not result in plumes of visible particulates.

Table 11.4 presents the justification for assigning a score of 8 to emissions from routine Offshore Operations and 6 to non routine operations including DEH operation and Emergency Flaring, which represents Medium Event Magnitude.

Table 11.4 Event Magnitude

Event Parameter	Routine Operations	Non Routine Operations: DEH	Emergency Flaring
Extent/Scale	1	1	1
Frequency	3	3	3
Duration	3	1	1
Intensity	1	1	1
Event Magnitude:	**8**	**6**	**6**



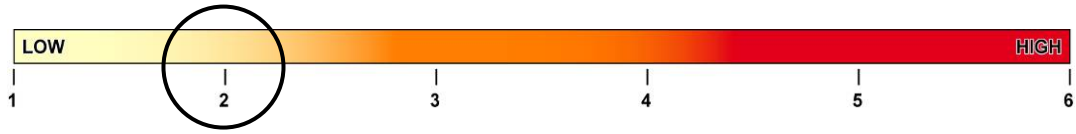
11.3.2.2 Receptor Sensitivity

Human Receptors

Table 11.5 presents the justification for assigning a score of 2, 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 80km of the SDB platform complex.	1
Resilience	Changes in air quality onshore will be indiscernible. Onshore receptors will be unaffected.	1
Total		**2**



Biological/Ecological Receptors

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 discernable to biological / ecological receptors[2].	1
Total		**2**

11.3.2.3 Impact Significance

Table 11.7 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	**Minor Negative**
		(Biological/Ecological) Low	**Minor Negative**
Non Routine Offshore Operations (DEH)	Medium	(Humans) Low	**Minor Negative**
		(Biological/Ecological) Low	**Minor Negative**
Non Routine Offshore Operations (Emergency Flaring)	Medium	(Humans) Low	**Minor Negative**
		(Biological/Ecological) Low	**Minor Negative**

[2] Note that ambient air quality standards are not relevant to biological/ecological receptors.

The following monitoring and reporting requirements related to emissions to atmosphere form part of the AGT Region Environmental Management System (EMS):

- Emissions testing of SDB platform complex 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;
- SDB platform complex exhaust emission test results will be submitted to the MENR; and
- Emission volumes for the SD2 facilities based on fuel usage and calculated flare volumes will be submitted to the MENR, SOCAR and the State Statistical Committee at an agreed frequency.

It is considered that impacts are minimised are far as practicable and necessary through the implementation of the existing mitigation measures and no additional controls are required.

11.3.3 Onshore Operations

11.3.3.1 Event Magnitude

Description

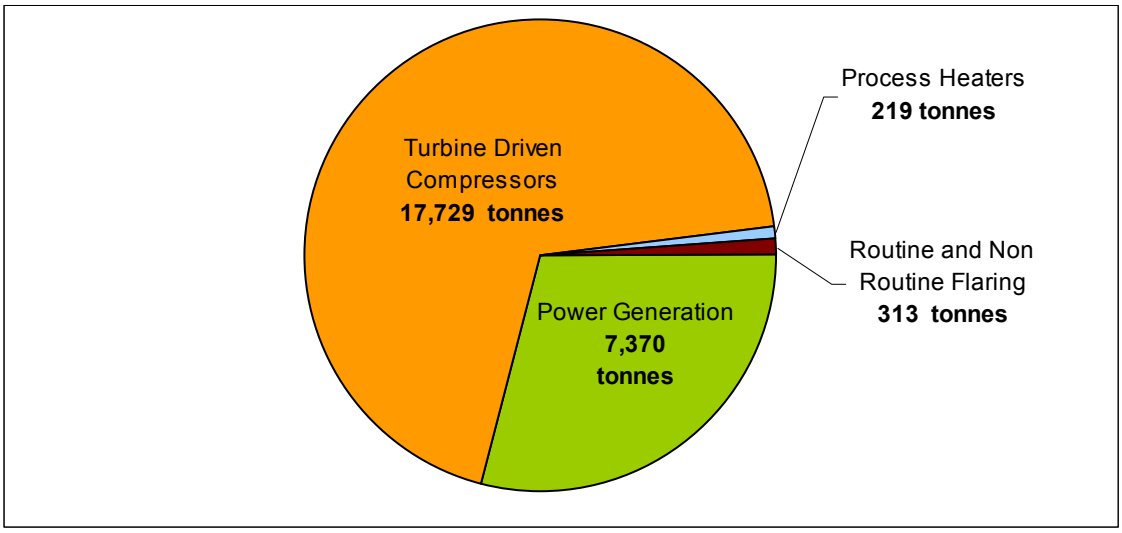
Under routine operating conditions, emissions will arise at the SD2 Sangachal Terminal from the main SD2 power generator, two direct drive export compressors fitted with waste heat recovery units (WHRU) and pilot flaring. During routine operation off gas from the majority of the production vessels and tanks will be sent to the FGR system. Fugitive emissions from fittings and the SD2 condensate tank, which cannot be sent to the FGR system for practical and safety reasons, will be released to the atmosphere.

Under non routine conditions when the WHRU are not available (e.g. during start up and maintenance), the heating requirement for the onshore facilities will be provided by a direct fired oil heater.

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 5.12.4.6).

Figure 11.4 below shows the total expected volume of NO_2 emissions from Onshore Operations per source over the PSA period (refer to Appendix 5A for detailed emission estimates and key assumptions).

Figure 11.4 Total Volume of NO_2 Emissions from Onshore Routine and Non Routine Operations during the PSA Period Per Source



Assessment

Air dispersion modelling undertaken for Onshore Operations is presented in Appendix 11B, and focused on NO_X 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 SD2 Onshore Operations in the context of relevant standards for NO_2 of 40µg/m^3 (annual average) and 200µg/m^3 (1 hour maximum). The long term and short term background concentrations of NO_2 were assumed to be 6 and 12 respectively (refer to Appendix 11C for further details).

The following scenarios were assessed:

1. Routine operations – sources comprised the power generation turbine and the direct drive compressors (with Waste Heat Recovery (WHR) operational);
2. Non routine operations (Fired Heater) – sources comprised the power generation turbine, the direct drive compressors (with WHR not operational) and the direct fired heater; and
3. Non routine operations (Emergency Flaring) - sources comprised the power generation turbine and the direct drive compressors (with WHR operational) and emergency depressurisation flaring (estimated to occur over an hour period).

For each scenario both loading at 100% and 70% were modelled, however the 70% loading is considered to be representative of operating conditions across the PSA period. The modelling was undertaken based on slightly higher turbine and fired heater loads than those anticipated for the SD2 Project Base Case. The modelling results are therefore considered to be conservative.

Increases in NO_2 concentrations for each scenario assessed were predicted for receptor locations in the Terminal vicinity. The increase in NO_2 concentrations at these receptors for onshore routine operations is presented in Figure 11.5. Figure 11.6 shows the predicted increase in long term NO_2 concentrations in the Terminal vicinity.

Figure 11.5 Increase in i) Long Term and ii) Short NO_2 Concentrations Due to Onshore Operations at Onshore Receptors (Routine Conditions)

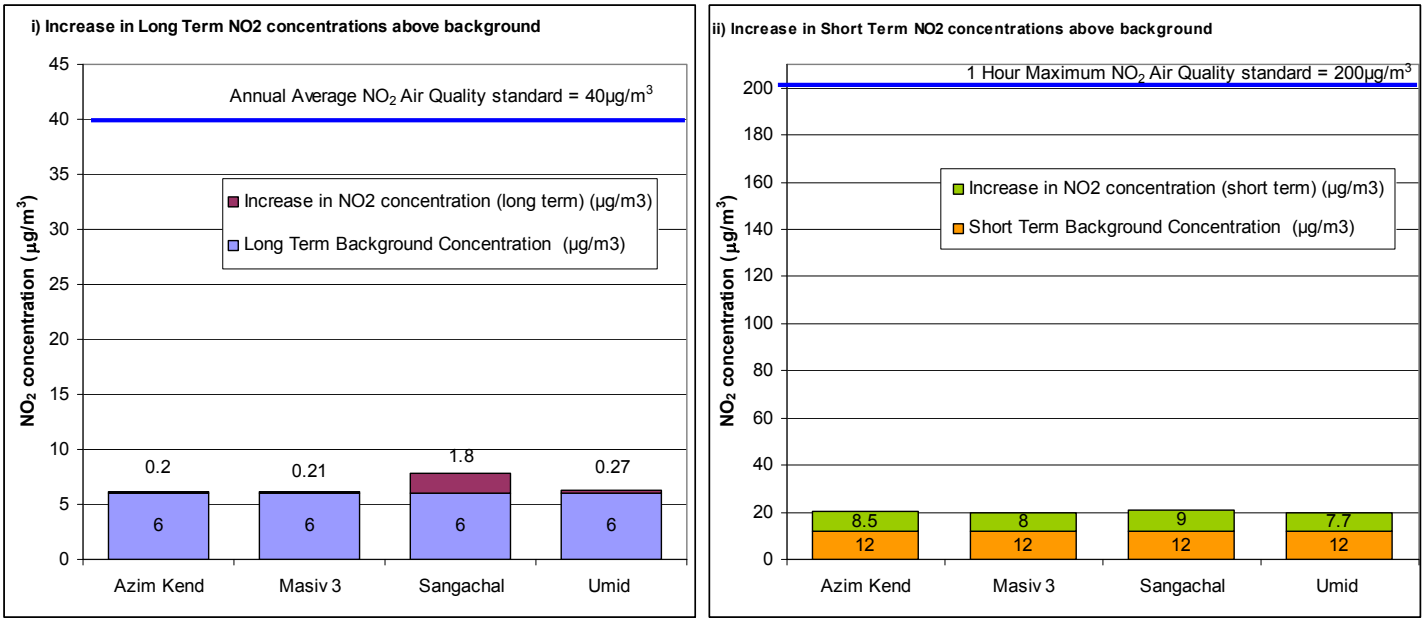


Figure 11.6 Increase in Long Term NO_X Concentrations in the Sangachal Terminal Vicnity During Routine Onshore Operations

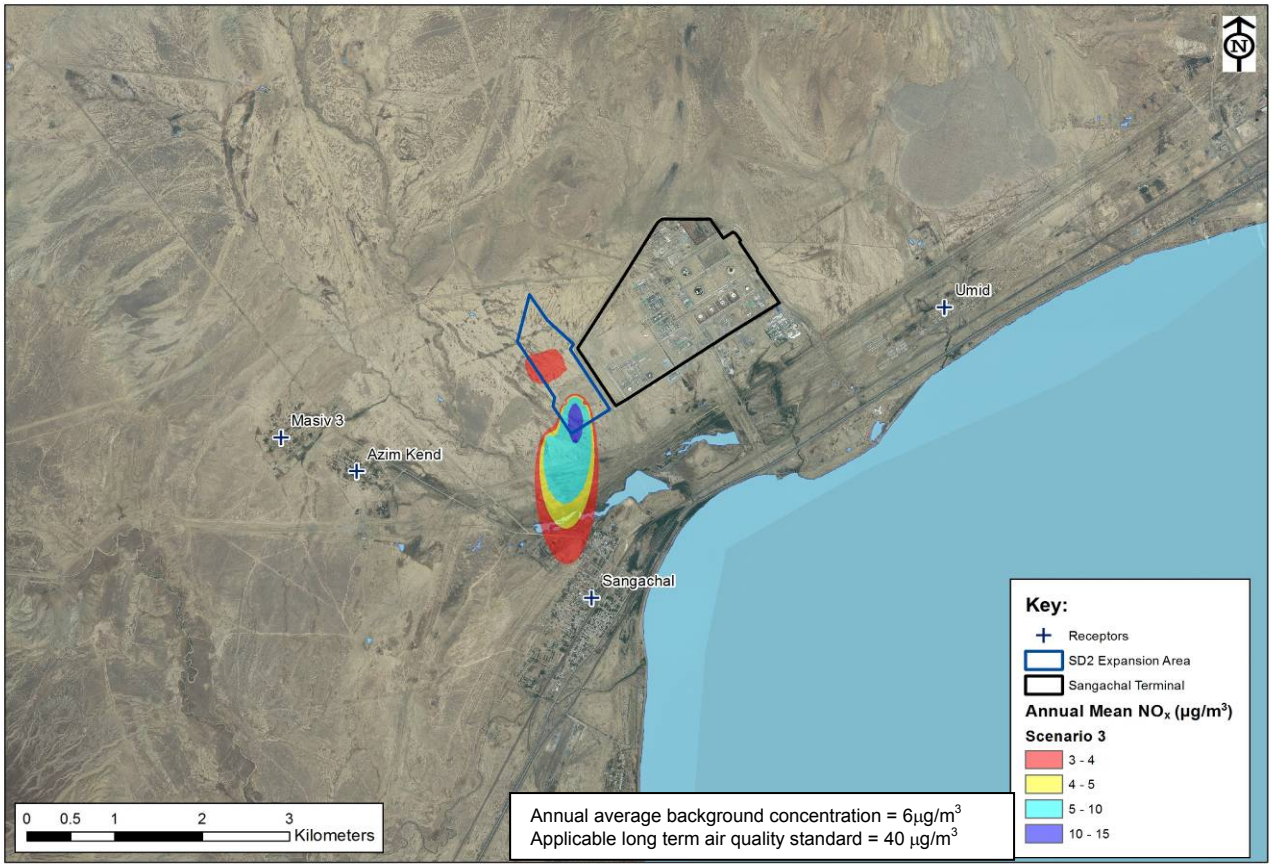


Figure 11.5 and 11.6 show that no exceedances of the onshore short term or long term NO_2 air quality standards were predicted at the onshore locations in the Terminal vicinity under routine operating conditions. The highest increase in NO_2 concentrations was predicted at the Sangachal receptor, which is directly downwind of the Terminal, where NO_2 long term concentrations are expected to increase by 1.8µg/m^3. This represents an increase of 30% above background concentrations however the predicted NO_2 concentration including background concentrations (7.8µg/m^3) remain well below the air quality standard of 40 µg/m^3.

Both non routine operating scenarios (fired heater operation and emergency flaring) are expected to occur intermittently and for short periods. The increase in NO_2 short term concentrations at receptors for onshore non routine operations is presented in Figure 11.7. Figure 11.8 shows the predicted increase in short term NO_2 concentrations in the Terminal vicinity under the emergency flaring scenario.

Figure 11.7 Increase in Short Term NO_2 Concentrations at Onshore Receptors For Non Routine i) Fired Heater and ii) Emergency Flaring Scenarios

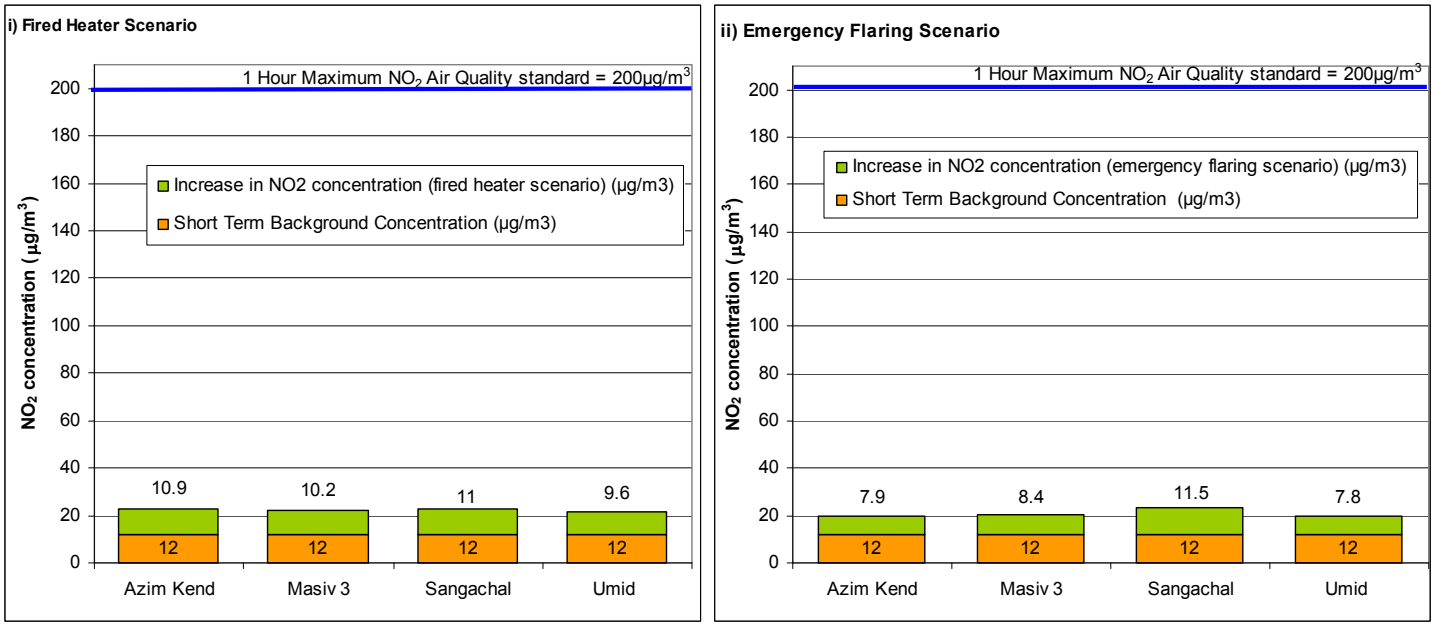
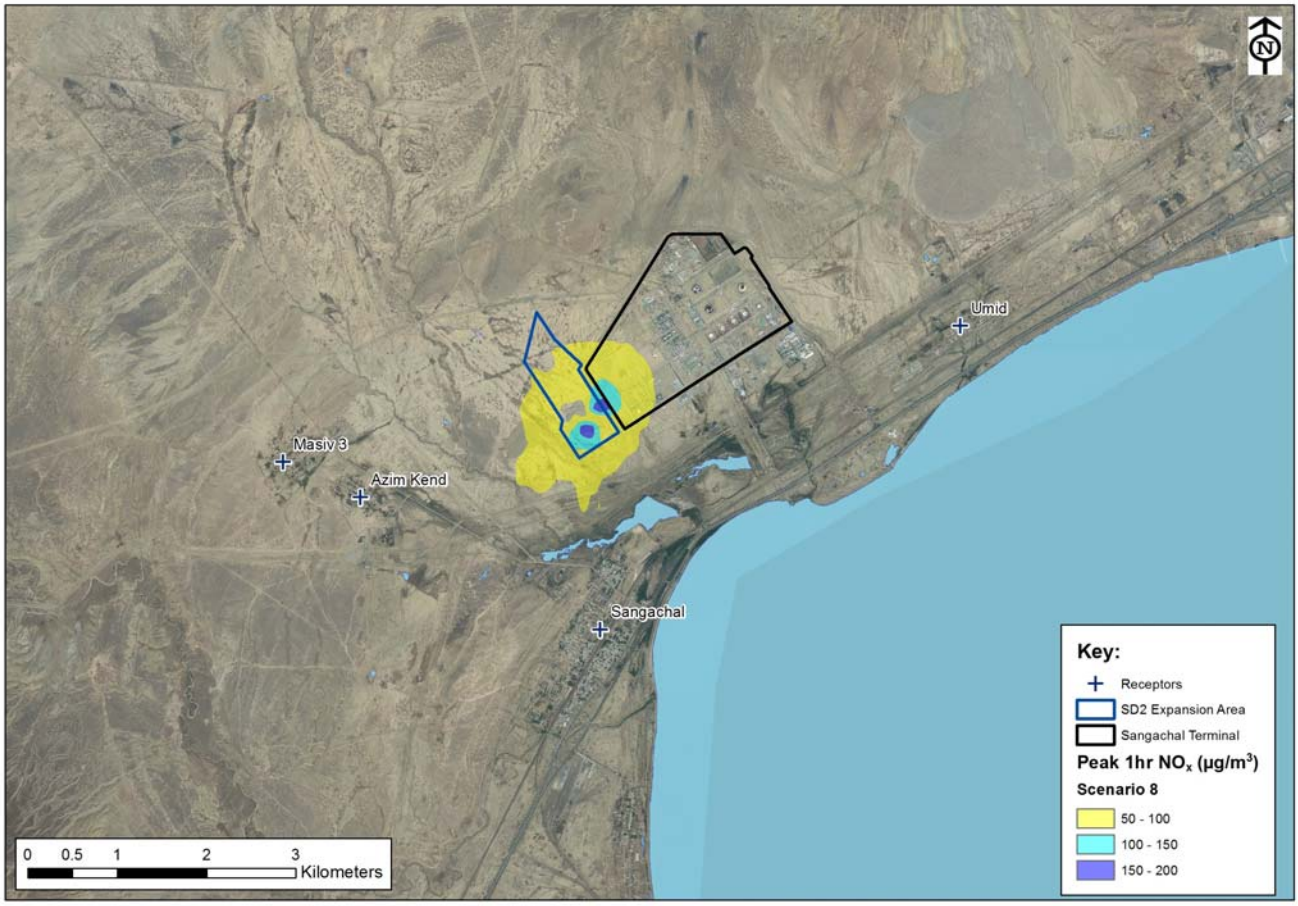


Figure 11.8 Increase in Short Term NOx Concentration in the Sangachal Terminal Vicnity During Non Routine Onshore Operation (Emergency Flaring)



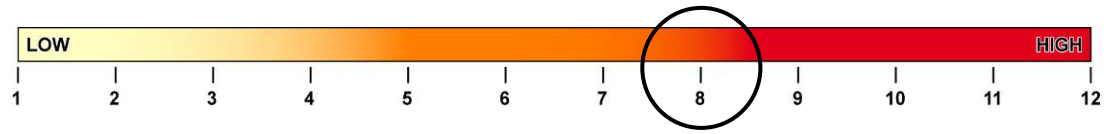
Figures 11.7 and 11.8 show that no exceedances of the onshore short term NO_2 air quality standards were predicted at the onshore locations in the Terminal vicinity under non routine operating conditions. The highest increase in NO_2 concentrations was again predicted at the Sangachal receptor, where NO_2 short term concentrations are expected to increase by 11µg/m^3 for the fired heater scenario. This represents an increase of 92% above background concentrations however the predicted NO_2 concentration including background concentrations (23µg/m^3) remain significantly below the air quality standard of 200µg/m^3.

Modelling focused on short term PM_{10} concentrations was also completed for the non routine emergency flaring scenario. As detailed in Chapter 6 Section 6.4.6.4 monitoring has shown that background concentrations of PM_{10} (estimated as 200 µg/m^3) exceed the relevant 24 hour air quality standard of 50µg/m^3. This is considered to be due to the semi arid environment where natural entrainment of dust in the atmosphere occurs. For the emergency flaring scenario the modelling predicted an increase in short term PM_{10} concentrations at the Sangachal North receptor of 24.1 µg/m^3 representing approximately 48% of the air quality standard. In the context of existing background PM_{10} concentrations this is not considered significant.

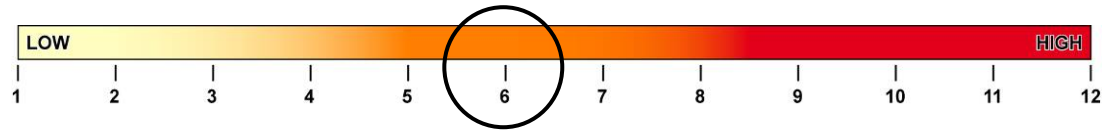
Table 11.8 presents the justification for assigning a score of 8 to emissions from routine Onshore Operations and 6 to non routine operations (both Fired Heater and Emergency Flaring Scenarios), which represents Medium Event Magnitude.

Table 11.8 Event Magnitude

Event Parameter	Routine Onshore Operations	Non Routine Onshore Operations (Fired Heater and Emergency Flaring)
Extent/Scale	1	1
Frequency	3	3
Duration	3	1
Intensity	1	1
Event Magnitude:	**8**	**6**



Routine Operations



Non Routine Operations – Fired Heater / Emergency Flaring

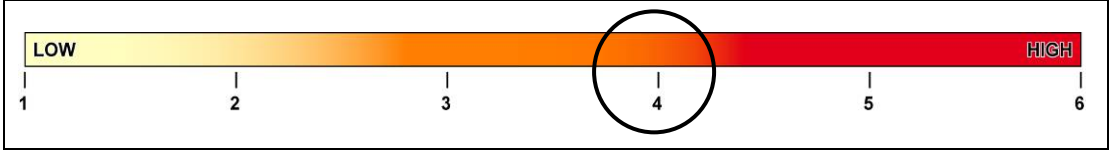
11.3.3.2 Receptor Sensitivity

Human Receptors

Table 11.9 presents the justification for assigning a score of 4, which represents Medium Receptor Sensitivity.

Table 11.9 Human Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Permanently present (i.e. resident) human receptors exist within 1km of the Terminal.	3
Resilience	Existing ambient NO_2 concentrations within residential areas in the Terminal vicinity are approximately 15% of the long term air quality standard and 6% of the short air quality.	1
Total		**4**

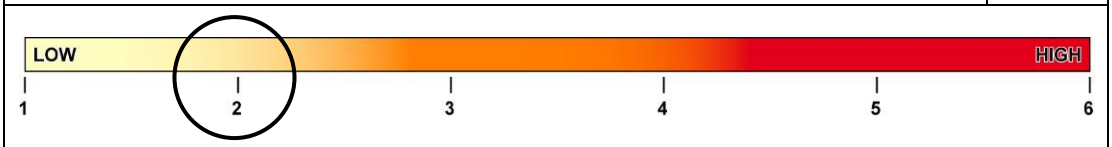


Biological/Ecological Receptors

Table 11.10 presents the justification for assigning a score of 2 to biological/ecological receptors, which represents Low Receptor Sensitivity.

Table 11.10 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Bird/terrestrial species are mobile and will not be present at one location for long periods of time. There is no evidence to indicate that the habitat within the area around the Terminal is of unique value to breeding birds in the vicinity of the Terminal[3].	1
Resilience	Volume of emissions released (including particulates) due to Onshore Operations will create a very small increase in pollutant concentrations in the atmosphere and in any washout from rainfall, which will not be discernable to biological/ecological receptors[4].	1
Total		**2**



11.3.3.3 Impact Significance

Table 11.11 summarises impacts on air quality from onshore combustion plant emissions and flaring.

Table 11.11 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Routine Operations	Medium	(Humans) Medium	**Moderate Negative**
		(Biological/Ecological) Low	**Minor Negative**
Non Routine Operations: (Fired Heater and Emergency Flaring)	Medium	(Humans) Medium	**Moderate Negative**
		(Biological/Ecological) Low	**Minor Negative**

The following monitoring and reporting requirements related to onshore emissions to atmosphere form part of the AGT Region EMS:

- Ambient air monitoring will be undertaken at and around the Sangachal Terminal as part of the EMP (quarterly monitoring for NO_X, SO_X and VOC);
- Annual stack emissions monitoring of emission sources will be completed for NO_X, SO_X and CO. Test results will be submitted to the MENR;
- Emission volumes for the SD2 facilities based on fuel usage and calculated flare volumes will be submitted to the MENR, SOCAR and the State Statistical Committee at an agreed frequency; and
- EMP monitoring results will be submitted to the MENR/MTAG.

It is considered that impacts are minimised are far as practicable and necessary through the implementation of the existing mitigation measures and no additional controls are required.

[3] Refer to Chapter 6.
[4] Note that ambient air quality standards are not relevant to biological/ecological receptors.

11.4 Impacts to the Terrestrial Environment – Odour

11.4.1 Onshore Operations Pond Storage of Produced Water

11.4.1.1 Mitigation

Planned mitigation measures associated with potential odour due to the use of produced water storage ponds include:

- Pond design will incorporate features to reduce formation of produced water aerosol during high wind events.

11.4.1.1 Event Magnitude

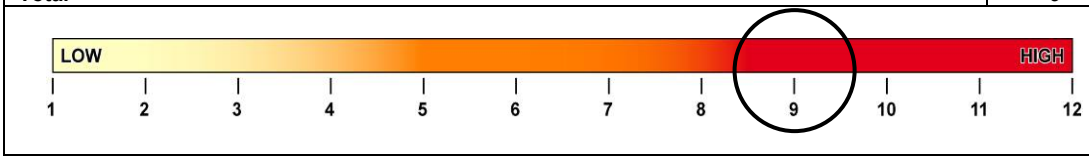
Description and Assessment

In situations when the ACG produced water treatment facilities and offsite 3rd party treatment contractor are not available SD produced water will be sent to a pond for storage. From previous experience during storage there is potential for odours to arise primarily due to the volatile organic compounds (VOCs) present in the produced water.

Table 11.12 presents the justification for assigning a score of 9 to odour generated by non routine pond storage of produced water, which represents a High Event Magnitude for routine operations.

Table 11.12 Event Magnitude

Parameter	Explanation	Rating
Extent / Scale	Based on experience from current operations, depending on meteorological conditions, there is potential for odour from the produced water pond to travel to communities surrounding the Terminal. Existing controls within the SD2 design include features to reduce formation of produced water aerosol during high wind events.	2
Frequency	The pond is not planned to be used on a continuous basis	2
Duration	Produced water maybe present in the pond for period of longer than one month	3
Intensity	Odour thresholds established in accordance with the UK Environment Agency Guidance for odour assessment may be exceeded during periods of pond operation although not on a continuous basis	2
Total		**9**



11.4.1.2 Receptor Sensitivity

The nearest receptors to the SD2 onshore facilities (refer to Chapter 6, Section 6.4.1) include residents of:

- Sangachal Town, approximately 2.5km southwest of the Terminal;
- Azim Kend, approximately 2.7km west of the Terminal; and
- Umid, approximately 1km southeast of the Terminal.

Table 11.13 presents the justification for assigning a score of 4 to human receptors, which represents High Sensitivity.

Table 11.13 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Nearest residential receptors based in Umid are located 1km southwest of the Terminal	3
Resilience	During monitoring odour levels in the communities surrounding the Terminal were generally classed as non offensive or least offensive (refer to Chapter 6 Section 6.4.6.3) however complaints have been received from residents within the communities around the Terminal regarding odours from historic and existing produced water storage in ponds.	2
Total		**5**

11.4.1.3 Impact Significance

Table 11.14 summarises impact of pond storage of produced water on odour levels at the the local communities

Table 11.14 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Odour from non routine pond storage of produced water	High	(Humans) High	**Major Negative**

The following monitoring and reporting requirements related to odour from the non routine storage of produced water in ponds will form part of the AGT Region EMS:

- An odour monitoring programme will be implemented and results provided to the MENR on a quarterly basis.
- When the ponds are being used, samples of water sent to the pond will be collected every week analysed for parameters listed in Appendix 11E associated with odour and results provided to the MENR on a quarterly basis.

11.4.1.4 Additional Mitigation Measures

The assessment above has demonstrated that odour generated from non routine pond storage of produced water may result in a Major Negative impact to receptors. Mitigation already adopted to minimise odour is detailed in Section 11.4.1.

To further minimise odour:

- A treatment package will be used to manage any potential exceedances of air quality thresholds from the produced water stored in the pond and odour control techniques will be evaluated and, if practicable, included in the design.

With this additional mitigation measure in place it is expected the impact associated with odour from non routine pond storage of produced water will reduce to Moderate Negative.

11.5 Impacts to the Terrestrial Noise Environment

This section presents the assessment of potential impacts to the terrestrial noise environment during Onshore Operations associated with routine operation of the SD2 facilities and non routine flaring. Existing mitigation measures relevant on routine and non routine noise from Onshore Operations are presented along with any additional controls that are required to further minimise the predicted impacts if required.

11.5.1 Mitigation

Existing mitigation measures associated with routine and non routine noise associated with the onshore operations include:

- The SD2 onshore facilities design incorporates basic pipework attenuation to achieve a 10 dB(A) reduction in pipework noise e.g. basic pipework cladding scheme of 50 mm mineral wool plus lightweight cladding;
- Cladding will be provided to onshore pipework associated with inlet and outlet compressors, recycle pipework, turbo expander pipework and pipework associated with major process control valves;
- Where cladding is not practical, inline silencers will be included in the onshore pipework where practical;
- Noise source levels for the onshore inlet and export compressors will be specified as no more than 85dB(A) at 1m from the skid;
- There will be no continuous flaring or venting during routine onshore operations (with the exception of purge/pilot flaring and purging of off gas from the production vessels); and
- Planned or unplanned onshore flaring or venting of hydrocarbons will be minimised where practical without compromising the safety of personnel or the integrity of plant.

11.5.2 Onshore Operations

11.5.2.1 Event Magnitude

Description

Under routine operating conditions, noise will result from operation of the SD2 onshore facilities, specifically:

- Large mechanically and electrically driven rotating equipment (i.e. main SD2 power generator, two export compressors, the turbo expander compressors and large pumps); and
- Main process pipe work and compressor pipework.

In addition to pilot/purge flaring during routine operations, non routine flaring will occur across the PSA period due to equipment malfunctions, repairs or maintenance (refer to Chapter 5: Section 5.12.4.6) or emergency depressurisation.

Assessment

Routine Plant Operation

An onshore plant noise modelling assessment was undertaken, taking into account the main noise sources including the main power generator turbine, the gas export compressors, pumps, pipework. The measures listed within Section 11.5.1 above were incorporated into the model. Noise levels were predicted at each receptor surrounding the Terminal (Sangachal Town, Umid and Azim Kend/Masiv 3) and compared against the relevant SD2 noise budgets. These were derived from the night-time noise limit of 45dB(A) (the most stringent noise limit) minus the noise levels currently being experienced at each receptor associated with the existing plant Terminal plant (refer to Appendix 11D for further details of the modelling assessment).

Table 11.15 presents the results obtained from the modelling.

Table 11.15 Summary of SD2 Noise Levels at Receptors During Routine Operations

Receptor	SD2 Noise Budget dB(A)	Predicted Noise Level dB(A)	Predicted Noise Level Relative to SD2 Noise Budget dB(A)
Sangachal	41.3	38.7	-2.6
Azim Kend/ Masiv 3	43.8	35.9	-7.9
Umid	40.1	28.1	-12.0

The modelling predicted noise levels at receptors between 2.6 and 12dB(A) below the SD2 noise budgets and hence the night time noise limit. It is therefore expected that noise limits would be met at all receptors under routine conditions.

Non Routine Flaring

Noise modelling was undertaken to estimate the noise levels at local community receptors due to SD2 non routine flaring in the vicinity of the Terminal and the potential duration of exceedance of the following operational noise limits (to be met for at least 95% of the time):

- Daytime (07:00 to 22:00) LAeq : 45 dB(A); and
- Night-time (22:00 to 07:00 LAeq : 55 dB(A).

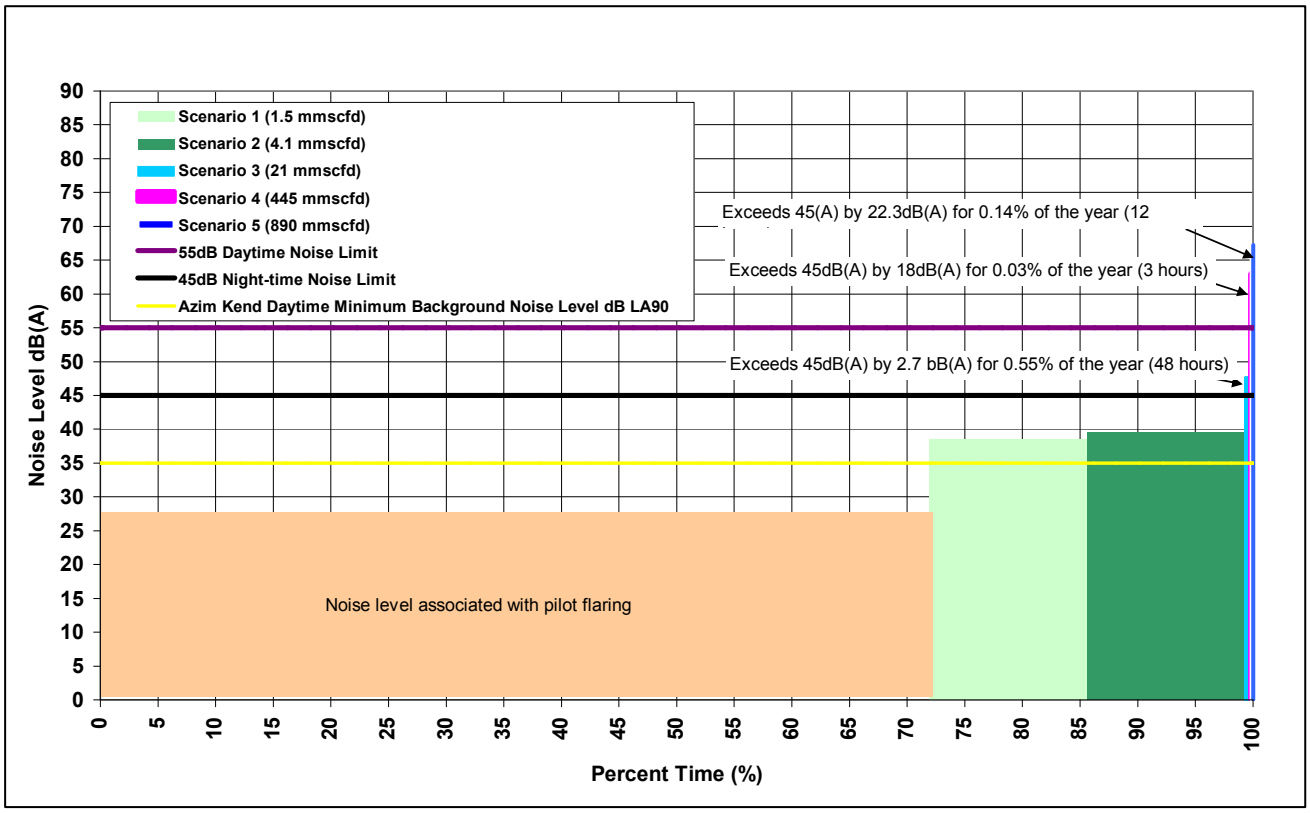
A number of anticipated flaring scenarios were identified for years 1, 2 and 3 onwards, including expected flowrates, frequency and duration of flaring per event. These are presented in Table 11.16.

Table 11.16 Anticipated Flaring Events (Routine and Non Routine Operations)

Event	Year	Flowrate (MMscfd)	Maximum Frequency per Year	Maximum Duration (hours)
Flare Gas Recovery Operation & Pilot Flaring (Routine Operations)	All Years	<1.5	n/a - continuous	
Normal operation with HP flare gas recovery offline	All Years	1.5	10	120
Normal operation with LP flare recovery offline	All Years	4.1	10	120
Loss of Flash Gas compression Operation with 2 x 50% flash gas compression	Years 1 &2	11	4	24
	Year 3 onwards	21	2	24
Small & Medium operational trips e.g. loss of compressor train, export compressor trips	Year 1	290	1	22
Small operational trips e.g. loss of 1 compressor train, 1 gas conditioning train	Year 2	445	1	6
Medium operational trips e.g. loss of 2 compressor trains, 2 export compressor trips	Year 2	750	1	9
Small & Medium operational trips e.g. loss of compressor train, export compressor trips	Year 3 onwards	890	1	12
Emergency Depressurisation	Year 2	1890	1	1

Noise levels were calculated at each receptor surrounding the Terminal (Sangachal, Azim Kend/Masiv 3 and Umid). The highest noise levels were found to occur at Azim Kend/Azim Kend. Figure 11.9 below show the noise levels at Azim Kend for the proportion of the year that the flaring scenario (and hence the noise level) is expected to occur for Year 3 (the worst case in terms of flaring frequency and duration).

Figure 11.9 Predicted Noise Levels Associated with Non Routine Flaring at Azim Kend/Masiv 3 (Year 3)



Based on the expected frequency and duration of the non routine flaring scenarios it was predicted that, as a worst case, the noise 45dB(A) limit would be met for at least 99.3% of the year at Azim Kend/Masiv 3 and Sangachal and at least 99.77% of the year at Umid for all years.

Table 11.17 presents the justification for assigning a score of 8 for routine onshore plant operations, which represents a Medium Event Magnitude for routine operations.

Table 11.17 Event Magnitude - Routine Plant Operations

Parameter	Explanation	Rating
Extent / Scale	Noise generated by Onshore Operations will be audible to residents of local communities that are located a distance greater than 1km from the Terminal. However noise will be low level that does not exceed noise standards.	1
Frequency	Noise emissions will occur continuously.	3
Duration	Emissions will continue for the SD2 Project lifetime.	3
Intensity	SD2 plant noise will not result in the exceedance of noise standards at the nearest residential receptors.	1
Total		**8**

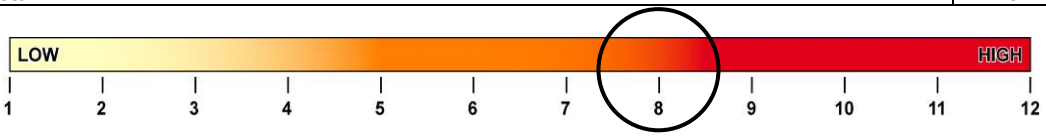
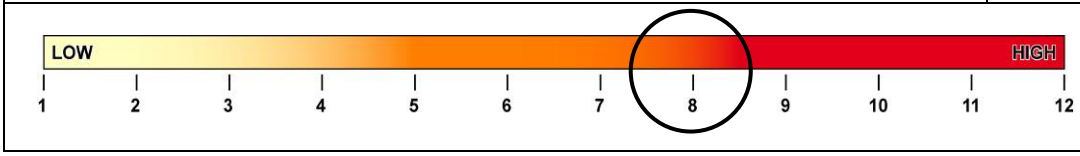


Table 11.18 presents the justification for assigning a score of 8 for non routine onshore flaring, which represents a Medium Event Magnitude.

Table 11.18 Event Magnitude – Non Routine Flaring

Parameter	Explanation	Rating
Extent / Scale	Noise generated by non-routine flaring conditions will be audible to residents of local communities that are located a distance greater than 1km from the SD2 elevated flare package	3
Frequency	Non routine flaring events are predicted to occur up to 27 times a year.	2
Duration	Non-routine flaring events are predicted to occur periodically for up to 120 hours per event	2
Intensity	Applicable noise limits are predicted to be met for 95% of the time per year.	1
Total		**8**



11.5.2.2 Receptor Sensitivity

Human Receptors

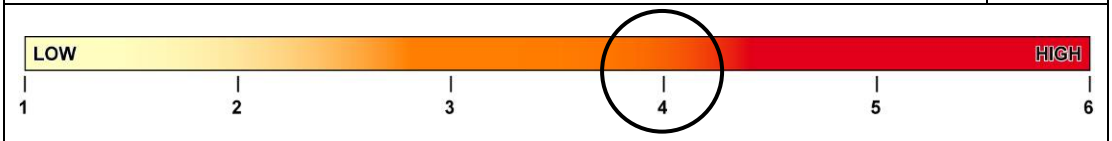
The nearest receptors to the SD2 onshore facilities (refer to Chapter 6, Section 6.4.1) include residents of:

- Sangachal Town, approximately 2.5km southwest of the Terminal;
- Azim Kend, approximately 2.7km west of the Terminal; and
- Umid, approximately 1km southeast of the Terminal.

Table 11.19 presents the justification for assigning a score of 4 to human receptors, which represents Medium Sensitivity.

Table 11.19 Receptor Sensitivity

Parameter	Explanation	Rating
Presence	Nearest residential receptors based in Umid are located 1km southwest of the Terminal	3
Resilience	Existing noise levels at receptors are dominated by road noise and noise from the Sangachal Power Station. The existing Sangachal Terminal plant is not routinely audible at receptors. Modelling results have confirmed that noise generated by plant will meet noise limits at receptors. Noise associated within non-routine flaring events will meet applicable noise limits at Umid, Azim Kend and Sangachal Town for at least 99.3% of the time (more than minimum 95%)	1
Total		**4**



11.5.2.3 Impact Significance

Table 11.20 summarises the significance of noise generated from routine operations and non-routine flaring events.

Table 11.20 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Routine Operations: Noise	Medium	Medium	**Moderate Negative**
Non Routine Operations (Flaring): Noise	Medium	Medium	**Moderate Negative**

The following monitoring and reporting requirements related to noise emissions form part of the AGT Region EMS:

- Ambient noise monitoring will be undertaken at and around the Sangachal Terminal as part of the EMP;
- EMP monitoring results will be submitted to the MENR/MTAG;
- Noise assessment will continue throughout the detailed design, procurement, mechanical completion and commissioning stages of the SD2 project focused on performance requirements in terms of noise (e.g. required sound power levels for plant items) such that noise limits can be achieved ; and
- An SD2 flaring policy will be developed and implemented. The policy will specify operational procedures aimed at reducing the frequency and duration of flaring associated with SD2 onshore non routine flaring events.

It is considered that impacts are minimised as far as practicable and necessary through the existing mitigation measures for the flare design and no further mitigation is required.

11.6 Impacts to the Marine Environment

Impacts to the marine environment from SD2 Offshore and Subsea Operations are assessed taking into account:

- Discharges to sea associated with SDB platform complex cooling water intake and discharge;
- Other SDB platform complex discharges (including treated black water, grey water, galley waste, drainage and saline effluent);
- Routine control fluid discharges from the subsea production system control system; and
- Non routine discharges associated with subsea production system interventions.

11.6.1 Offshore Operations - Cooling Water Intake and Discharge

11.6.1.1 Mitigation

Existing mitigation measures associated with the SDB platform complex cooling water intake and discharge include:

- The design and operation of the 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; and
- The seawater intake caissons design includes a mesh of 200mm diameter to prevent fish entrainment.

11.6.1.2 Event Magnitude

Description

An indirect seawater cooling system will be located on the SDB-QU platform. Seawater will be abstracted from a depth of -75m below sea level at a rate of approximately 2,173m^3/hr (refer to Chapter 5: Section 5.10.10.2).

Abstracted seawater will be electrochlorinated in an antifouling package and dosed with 50ppbv of chlorine and 5ppbv copper; and then filtered to remove any particles that are above 50 microns in diameter. After use, the majority of the seawater (up to 2,124m^3/hr) will be returned to the sea, via the seawater discharge caisson (at a depth of -54.5m below sea level).

Assessment

Seawater Intake

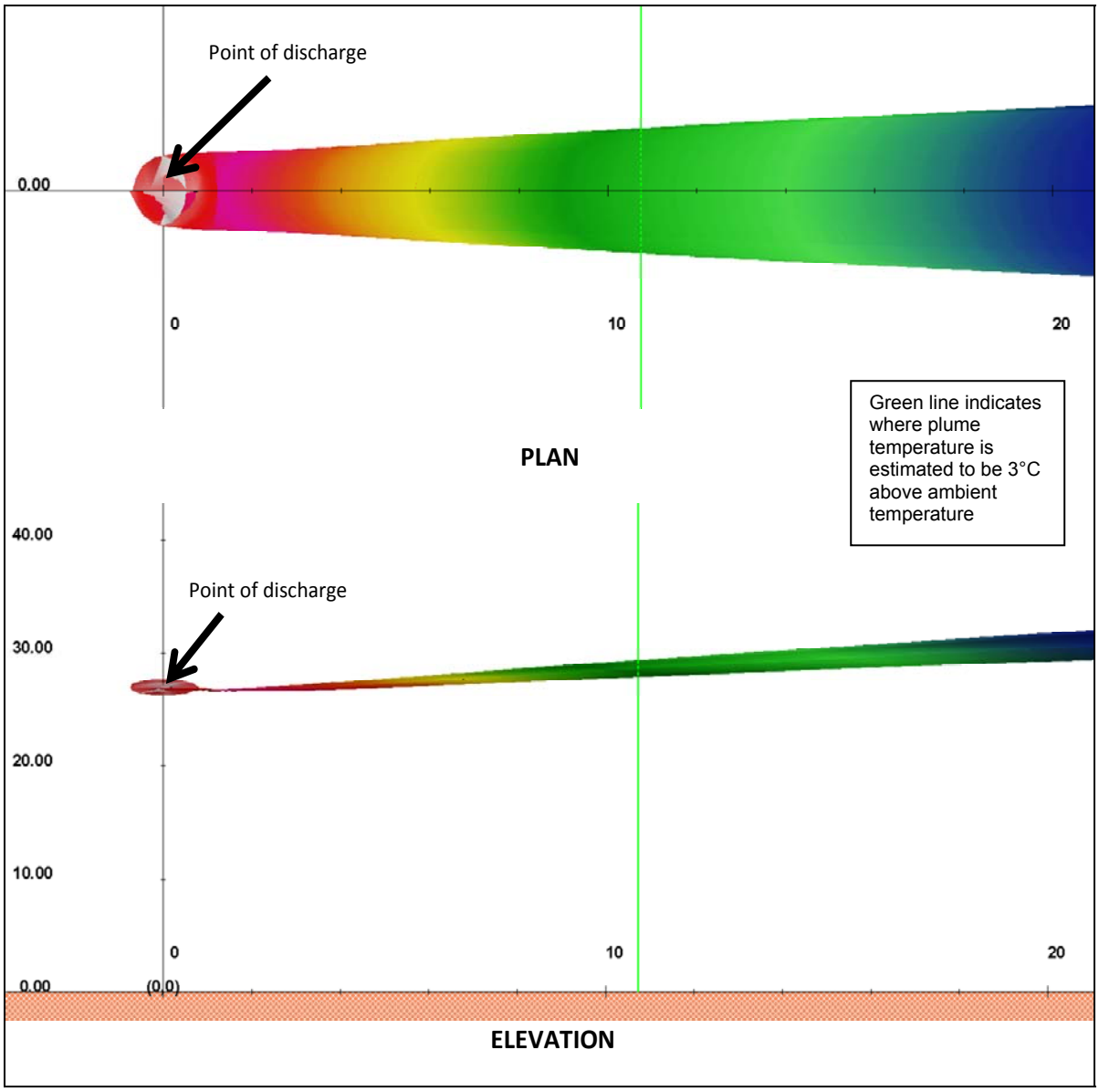
A modelling assessment was completed to assess the potential extent of the velocity field created in the vicinity of the intake location. The assessment was based on an intake rate of 3,360 m^3/hr (approximately 50% greater than the SD2 rate) and showed that water velocity would not exceed 13cm/s within a few centimetres of the intake and that the velocity gradient would extend less than 3m from the intake location, even under near-stagnant current conditions. Consequently, it is concluded that:

- There is a sufficient velocity gradient for fish to detect the intake; and
- The water velocity close to the intake is sufficiently low that even small fish would have no difficulty in avoiding the intake.

Seawater Discharge

The discharge of cooling water was assessed based on a typical discharge temperature of 25ºC. Full details of the modelling assumptions and methodology are provided within Appendix 10F. Figure 11.10 shows the predicted cooling water dispersion plume. The green line shown indicates the point at which the water temperature is estimated to be 3°C above ambient temperature. This occurs within 11m of the point of discharge. At a distance of 100m, the model predicted that the plume would be a maximum of 0.2ºC above ambient temperature. The plume experiences only a limited a degree of rise due to its thermal buoyancy and it is not predicted to reach the surface, or the depth of the thermocline transition. Results for summer and winter conditions were found to be very similar.

Figure 11.10 Plume Trajectory and Distance (m) to 3°C Change for Offshore Cooling Water Discharge at Discharge Temperature of 25°C

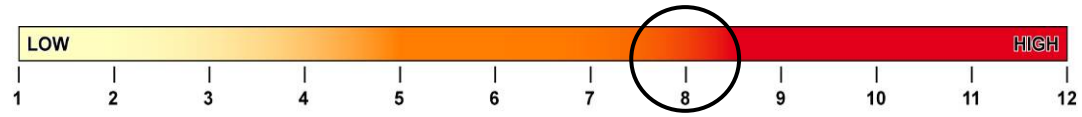


The cooling water system will include a 5ppbv copper/50ppbv chlorine biocide control system, but the concentration of both elements in the discharge will be below the international Environmental Quality Standards (EQS) and national Maximum Permissible Concentration (MPC) levels.

Table 11.21 presents the justification for assigning a score of 8 to offshore cooling water intake and discharge, which represents a Medium Event Magnitude.

Table 11.21 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 11m from the point of discharge	1
Frequency	Intake and discharge occur continuously throughout SD2 Offshore Operations.	3
Duration	The cooling water system will operate continuously throughout SD2 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		**8**



11.6.1.3 Receptor Sensitivity

Benthic invertebrates will not be exposed to either cooling water intake or discharge. The dimensions of the intake current field and the discharge plume are small and the residence time of any water column organism within the discharge plume will be too short to cause harm.

The 3°C temperature gradient limit is reached within 11m of the discharge, and therefore temperatures high enough to cause thermal stress to biological/ecological receptors are only likely to be present within a few tens of centimetres from the discharge location. It is unlikely that any receptors would be resident within such a small zone for long enough to be affected.

Seals are not considered to be at risk from the intake, and fish present at the intake depth are considered capable of detecting the low intake velocity gradient and avoiding it.

Zooplankton and phytoplankton would not be able to avoid entrainment, but the intake is at a depth of 75m and therefore well below the depth at which the main populations of both groups occur.

Table 11.22 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 11.22 Biological/Ecological Receptor Sensitivity

Parameter	Explanation	Rating
Resilience	Seals, fish and plankton are not expected to be present consistently or in significant numbers within the water volume affected by either intake or discharge. No significant exposure of benthos.	1
Presence	Although exposure is unlikely, seals and fish would not be adversely affected by short term exposure to the discharges. Plankton are unlikely to be exposed to discharge.	1
Total		**2**

11.6.1.4 Impact Significance

Table 11.23 summarises impacts to biological/ecological receptors from water intake and cooling water discharge.

Table 11.23 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Offshore Operations: Cooling water intake and discharge	Medium	Low	**Minor Negative**

The following monitoring and reporting requirement related to cooling water intake and discharge form part of the AGT EMS:

- SD2 platform complex cooling water biocide dosing levels will be checked automatically.

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.

11.6.2 Offshore Operations - Other Discharges

11.6.2.1 Mitigation

Existing mitigation measures associated with other SDB platform complex discharges from include:

- Black water will be treated on the SDB-QU platform to comply with USCG Type II standards i.e. total suspended solids of 150mg/l and fecal coliforms of 200MPN (most probable number) per 100ml)
- Grey water from the laundry will be discharged to sea (without treatment) as long as no floating matter or visible sheen is observable. Environmental factors are considered prior to selection of any chemical for use across the ACG and SD facilities, including cleaning fluids such as detergents. Under routine conditions grey water from the living quarters will be treated in the STP;
- The STP will be designed to ensure >90% of the biodegradable surfactants present degrade prior to discharge;
- Sewage sludge will be transported to shore from the SDB platform complex for disposal to an appropriately licensed facility;
- The SDB-QU and SDB-PR open drains caissons will be designed to ensure that there is no visible oil sheen and to discharge at a depth of 52m below sea level;
- Deluge from deck drain boxes will be routed directly overboard for safety reasons; and
- 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 SDB-QU sewage caisson.

11.6.2.2 Event Magnitude

Description and Assessment

Other SDB platform complex discharges comprise:

- **Treated Black Water** – SDB-QU platform sewage treatment package (STP) treats black water from living quarters and discharges it via the sewage discharge caisson (16.2m below sea level). Based on average 100 POB and an expected generation rate 0.1m^3/person/day, approximately 10m^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 discharged to sea without treatment via the SDB-QU sewage caisson. This will contain only dilute cleaning agents (soaps, detergents) and the impact of the discharge will be minimal. Other grey water from the living quarters will be treated in the STP.

- **Galley Waste** - SDB-QU platform galley waste system will be designed to treat food wastes to applicable MARPOL 73/78 Annex V and discharged via the SDB-QU sewage discharge caisson.

- **Drainage** – The SDB-PR and SDB-QU platforms will be provided with separate self-contained open drains systems. The SDB-PR platform will be provided with a hazardous area open drains system, which is routed to the SDB-PR open drains caisson. The SDB-QU platform will be provided with two separate systems; a hazardous area drains system and a non-hazardous area drains system, which will both be routed to the SDB-QU open drains caisson.

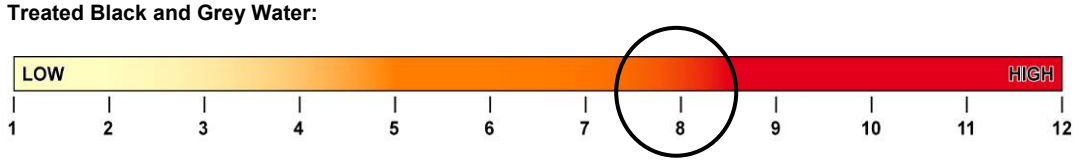
- **Saline Effluent –** The freshwater maker will be located on the SDB-QU platform. Saline effluent from the freshwater maker will be discharged via the SDB-QU seawater discharge caisson.

Event Magnitude is summarised in Table 11.24.

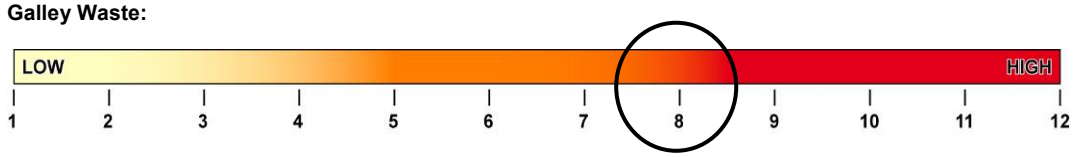
Table 11.24 Event Magnitude

Event Parameter / Discharge	Treated Black Water / Grey Water	Galley Waste	Drainage	Saline Effluent
Scale	1	1	1	1
Frequency	3	3	3	3
Duration	3	3	3	3
Intensity	1	1	1	1
Event Magnitude	**8**	**8**	**8**	**8**

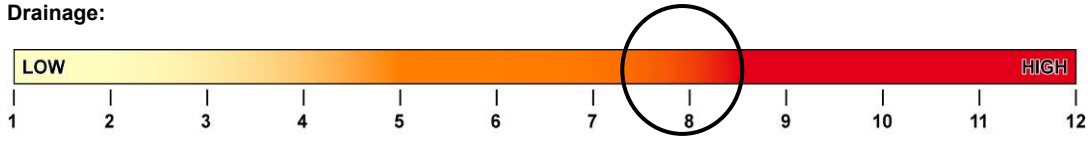
Treated Black and Grey Water:



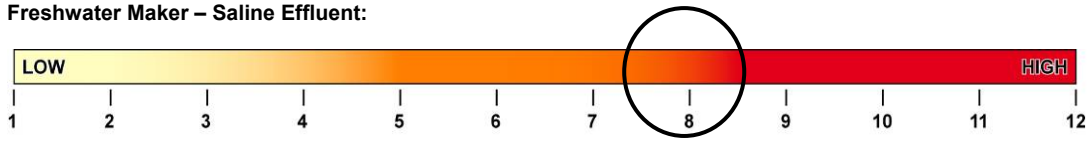
Galley Waste:



Drainage:



Freshwater Maker – Saline Effluent:



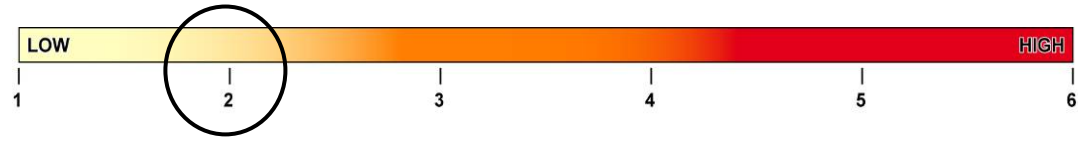
11.6.2.3 Receptor Sensitivity

All of the discharges are low in volume, do not contain toxic or persistent process chemicals and are considered to pose no significant threat to the environment or the identified biological/ecological receptors.

Table 11.25 presents the justification for assigning a score of 2, which represents Low Receptor Sensitivity.

Table 11.25 Receptor Sensitivity (All Receptors)

Parameter	Explanation	Rating
Resilience	The extremely low level of exposure is equivalent to high resilience.	1
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
Total		**2**



11.6.2.4 Impact Significance

Table 11.26 summarises impacts to receptors from other offshore discharges to sea.

Table 11.26 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Other Discharges to Sea **Treated Black and Grey Water**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Galley Waste**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Drainage**	Medium	(All Receptors) Low	**Minor Negative**
Other Discharges to Sea **Freshwater Maker – Saline Effluent**	Medium	(All Receptors) Low	**Minor Negative**

The following monitoring and reporting requirements related to other 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 fecal 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
- Recorded daily observations will be made. The estimated volumes of domestic wastes (grey water and galley waste) and drainage discharged daily will be submitted to the MENR.

It is considered that impacts are minimised as far as practicable and necessary through the implementation of the existing mitigation measures and no additional controls are required.

11.6.3 Subsea Operations: Control Fluid Discharge during Routine and Non Routine Operations

11.6.3.1 Mitigation

Existing mitigation measures associated with routine and non routine control fluid discharge from Subsea Operations include:

- Use of Castrol Transqua HC10 water based control fluid, which has been selected based on its suitability, environmental performance and low toxicity.

11.6.3.2 Event Magnitude

Description

As described with Chapter 5: Section 5.11.3, hydraulically actuated valves will be used to control and monitor the flow of production fluids within each manifold and production tree using a subsea control system.

Two types of discharges are anticipated to occur:

- Continuous discharge of approximately 0.03cm^3 per minute on average from each directional control valve (DCV) associated with each production tree and manifold; and
- Transient discharges from the actuated valves associated with each production tree and manifold when the valves are actuated.

The five scenarios which result in transient control fluid discharge include:

- Well testing – involves partial shutdown of each well on 3 occasions per year and a full shutdown once a year;
- Flowline pigging – expected to be required on a 3 yearly basis;
- Full field shutdown - expected to occur once every 4 years;
- Partial field shut shutdown - expected to occur once every 4 years; and
- High Integrity Pressure Production System (HIPPS) testing – testing of HIPPS associated with each manifold expected to occur annually.

The expected volumes of control fluid discharged per year are summarised within Chapter 5 Table 5.32.

Both continuous and transient discharges will take place from:

- Four vents on each manifolds; two at the side, 6m above seabed, and two on the top, 8m above seabed; and
- A single vent from the top of the each production tree, 4m above seabed.

Assessment

The dispersion of the control fluid discharge events was modelled to enable the dimensions and persistence of the dispersion plumes to be quantified and visualised. The modelling assumptions, methodology and results are provided in full within Appendix 10F.

Continuous Discharge

The Base Case design assumes 25 DCVs associated with a production tree and 25 DCVs associated with a manifold. The anticipated total flowrate of discharge from a single production tree and manifold was therefore calculated, and dispersion modelling was carried out on these release rates.

From the results of toxicity testing, a no-effect dilution of 40,000-fold was estimated for continuous release of Castrol HC10 (refer to Chapter 4 Section 4.9.3).

The modelling indicated that releases from both trees and manifolds would be diluted rapidly within 10m of the discharge location to more than 40,000-fold. The associated plumes were too small to represent graphically in the model output.

Transient Discharge

For the five anticipated valve operating scenarios, the valves to be actuated at the manifold and production tree per scenario were identified and the associated volume of discharge for a single manifold and production tree was calculated. From the results of toxicity testing, a no-effect dilution of 4000-fold was estimated for these intermittent releases. As a precaution, modelling was carried out for contingency discharge volumes which were larger than the volumes associated with the anticipated valve operating scenarios. Figure 11.11 indicates the maximum plume size 15 minutes after such a release from a production tree; at this point, the plume is less than 20m long, and only a small part of the plume (less than 10m long) remains

diluted to less than 4,000-fold. After one hour, the model output indicates that the discharge is completely diluted to >40,000-fold.

Figure 11.11 Dimensions of Tree Discharge Plume 15 Minutes After Discharge (Contingency Discharge Volume)

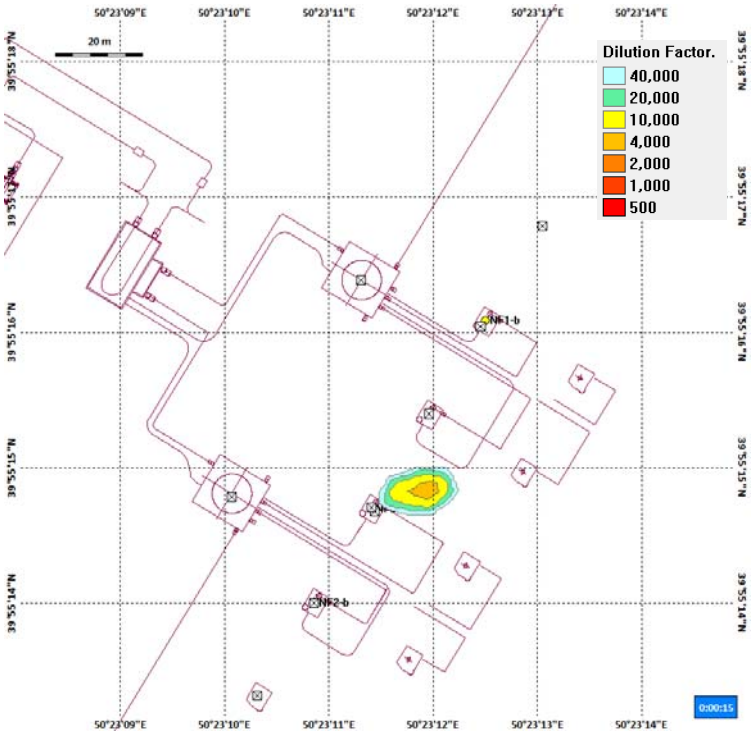
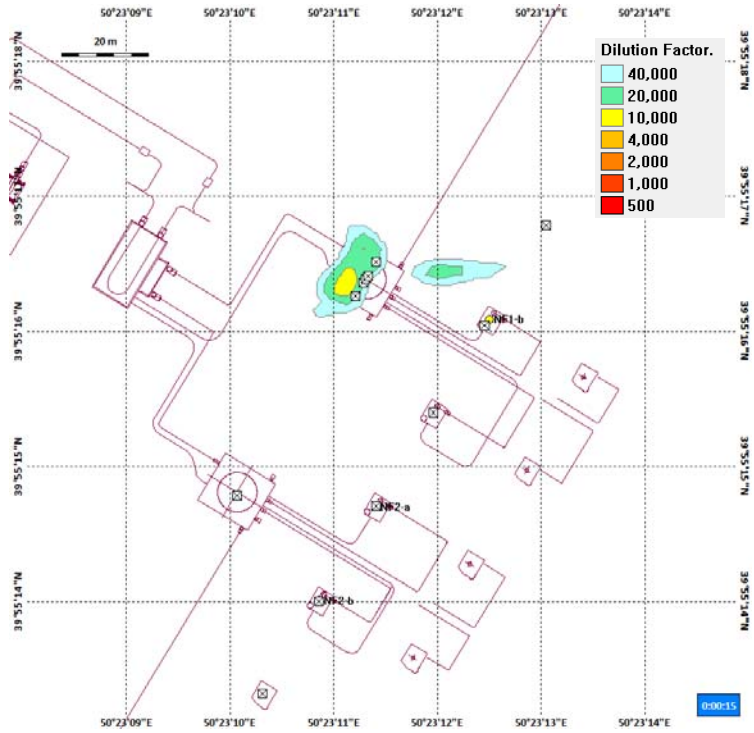


Figure 11.12 indicates the maximum plume size from a manifold discharge 15 minutes after the event. The plume is approximately 20m long, but is already diluted to >10,000-fold. After one hour, the plume is completely diluted to >40,000-fold.

Figure 11.12 Dimensions of Manifold Discharge Plume 15 minutes After Discharge (Contingency Discharge Volume)

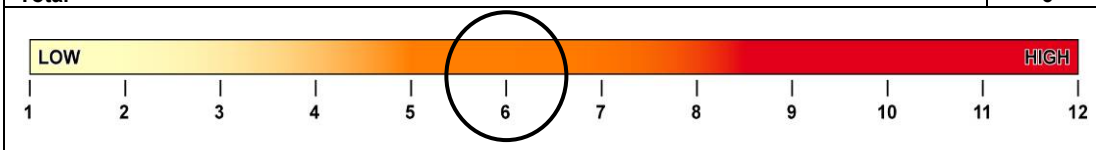


For both trees and manifolds, discharges are diluted to the no-effect concentration within 20m from the point of discharge, and within a very short period of time (less than an hour).
OSPAR tests have shown up to 90% degradation of glycol in 28 days. Rapid degradation may however commence after a lag period of 7 days[5]. Glycol, nevertheless, is highly biodegradable and will rapidly disperse to no effect concentrations in the marine environment following discharge and then completely degrade.

Table 11.27 presents the justification for assigning a score of 6, which represents a Medium Event Magnitude.

Table 11.27 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	Control fluid discharges are expected to affect a small area around the source up to a distance of approximately 20m from the discharge location.	1
Frequency	Routine and non routines discharges will take place continuously and on a regular basis (more than 50 times) throughout the PSA period.	3
Duration	Individual events will have a duration of between a few minutes and a few hours.	1
Intensity	Discharges will reach no effect concentration (established from Caspian specific toxicity testing) within short distance of discharge location. Discharge will contain no harmful persistent materials.	1
Total		**6**

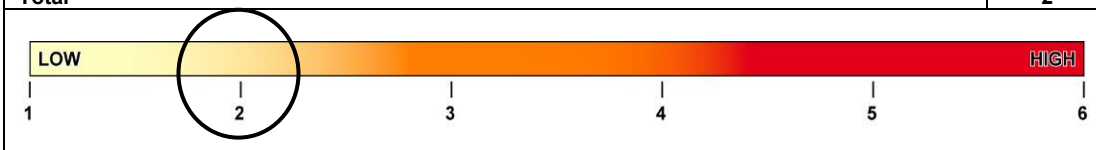


11.6.3.3 Receptor Sensitivity

Table 11.28 presents the justification for assigning a score of 2, which represents a Low Receptor Sensitivity.

Table 11.28 Receptor Sensitivity

Parameter	Explanation	Rating
Resilience	Although exposure is unlikely, seals and fish would not be adversely affected by short-term exposure to the discharges.	1
Presence	Seals and fish are not expected to be present consistently or in significant numbers near the seabed discharge sources. No significant exposure of benthos or plankton.	1
Total		**2**



11.6.3.4 Impact Significance

Table 11.29 summarises impacts to biological/ecological receptors from discharges associated with control fluid discharges.

[5] Concise International Chemical Assessment Document 22, Ethylene Glycol: Environmental Aspects, Geneva 2000

Table 11.29 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Subsea Operations: Routine and non routine control fluid discharge:	Medium	(Biological/Ecological) Low	**Minor Negative**

The following monitoring and reporting requirements related to control fluid discharge form part of the AGT Region EMS:

- Caspian specific ecotoxicity testing will be completed on samples of control fluid collected every 6 months and compared to the initial HC10 ecotoxicity testing to confirm the findings of the ecotoxicity risk assessment for control fluid discharges remain valid;
- Results of control fluid ecotoxicity testing will be reported to the MENR; and
- The quantity of control fluid discharged will be recorded and reported to the MENR annually.

The resulting Minor Negative impact from control fluid discharge is considered to be acceptable, since the volumes will be small and have a low toxicity.

11.6.4 Subsea Operations: Non Routine Discharges During Subsea System Interventions

11.6.4.1 Mitigation

Existing mitigation measures associated with discharge of fluids from interventions during Subsea Operations include:

- Prior to subsea interventions (not including control modules and production tree chokes) which may result in discharges to sea a risk assessment will be completed and the MENR informed as required.

11.6.4.2 Event Magnitude

Description and Assessment

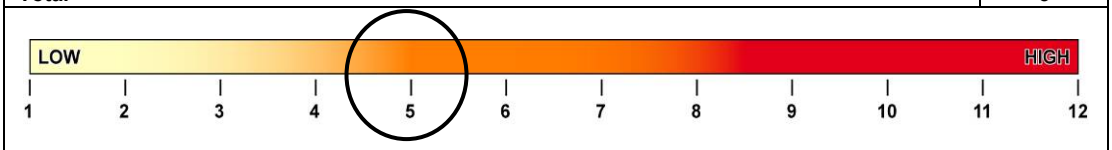
As described with Chapter 5 Section 5.11.4 during operations it will be necessary to replace components of the subsea production system. The most frequent replacements (known as interventions) are expected to be the control modules associated with the production trees and manifolds. During replacement activities, the relevant valves will be actuated to isolate the module being replaced, resulting in discharges of control fluids. These are expected to small and included within the control fluid volumes within Table 5.32. Discharges of approximately 1.3m^3 are also anticipated to result from replacement of each production tree choke (26 in total). This is expected to occur once for each production tree over the PSA period.

MEG discharges to the marine environment are discussed within Chapter 10 Section 10.8.3 where a discharge of up to 13.84m^3 of MEG during subsea production system installation is assessed. The modelling undertaken for this greater volume of MEG discharge indicated that the no-effect concentration would be met within 20m of the discharge location. For a discharge of 1.3m^3 it is therefore anticipated that the no-effect concentration would be met within a few metres from the point of discharge.

Table 11.30 presents the justification for assigning a score of 5**,** which represents a Medium Event Magnitude.

Table 11.30 Event Magnitude

Parameter	Explanation	Rating
Extent/Scale	No effect concentration would be met within a few metres of the discharge location (lass than 20m)	1
Frequency	Discharges will occur once per tree, 26 times in total	2
Duration	Individual discharges associated with subsea system interventions will last no more than 6 hours	1
Intensity	Discharges consist of a low toxicity, non-persistent substance	1
Total		**5**

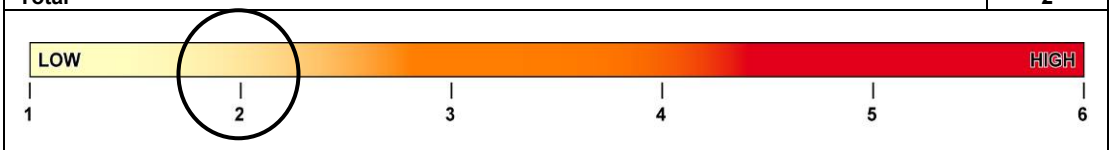


11.6.4.3 Receptor Sensitivity

Table 11.31 presents the justification for assigning a score of 2, which represents a Low Receptor Sensitivity.

Table 11.31 Receptor Sensitivity

Parameter	Explanation	Rating
Resilience	Although exposure is unlikely, seals and fish would not be adversely affected by short-term exposure to the discharges.	1
Presence	Seals and fish are not expected to be present consistently or in significant numbers near the seabed discharge sources. No significant exposure of benthos or plankton.	1
Total		**2**



11.6.4.4 Impact Significance

Table 11.32 summarises impacts to biological/ecological receptors associated with non routine discharge of fluids during subsea production system interventions.

Table 11.32 Impact Significance

Event	Event Magnitude	Receptor Sensitivity	Impact Significance
Subsea Operations: Non Routine Discharge of Fluids during Subsea Production System Interventions	Medium	(Biological/Ecological) Low	**Minor Negative**

The following monitoring and reporting requirements related to non routine discharge of fluids during subsea production system interventions form part of the AGT Region EMS:

- The composition and estimated quantity of fluids used and discharged during each intervention activity will be recorded and reported to the MENR periodically.

The resulting Minor Negative impact from discharges during interventions is considered to be acceptable, since the volumes will be small and have a low toxicity.

11.7 Summary of the SD2 Project Operations Residual Environmental Impacts

For the environmental impacts which the SD2 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 11.33 summarises the residual environmental impacts for the operations phase of the project.

Table 11.33 Summary of SD2 Project Operations Residual Environmental Impacts

	Event/ Activity	Magnitude				Sensitivity	Overall Score		
		Extent/ Scale	Frequency	Duration	Intensity		Event Magnitude	Receptor Sensitivity	Impact Significance
Atmosphere	Non-GHG Emissions from Routine Offshore Operations	1	3	3	1	1 1	Medium	Low	Minor Negative
	Non-GHG Emissions from Non Routine Offshore Operations (DEH)	1	3	1	1	1 1	Medium	Low	Minor Negative
	Non-GHG Emissions from Non Routine Offshore Operations (Emergency Flaring)	1	3	1	1	1 1	Medium	Low	Minor Negative
	Non-GHG Emissions from Routine Onshore Operations	1	3	3	1	3 1 1 1	Medium	Humans : Medium Biological / Ecological: Low	Moderate Negative Minor Negative
	Non-GHG Emissions from Non Routine Onshore Operations (Emergency Flaring)	1	3	1	1	3 1 1 1	Medium	Humans : Medium Biological / Ecological: Low	Moderate Negative Minor Negative
Terrestrial Environment	Noise associated with Routine Onshore Plant Operations	1	3	3	1	3 1	Medium	Medium	Moderate Negative
	Noise associated with Non Routine Onshore Flaring	3	2	2	1	3 1	Medium	Medium	Moderate Negative
	Odour from non routine pond storage of produced water	2	2	3	2	3 2	High	High	Major Negative - reduced to Moderate Negative following additional mitigation
Marine Environment	Offshore Operations: Cooling Water intake and discharge	1	3	3	1	1 1	Medium	Low	Minor Negative
	Offshore Operation: Other Discharges to Sea: **Treated Black and Grey Water**	1	3	3	1	1 1	Medium	Low	Minor Negative
	Offshore Operation: Other Discharges to Sea: **Galley Waste**	1	3	3	1	1 1	Medium	Low	Minor Negative
	Offshore Operation: Other Discharges to Sea: **Drainage**	1	3	3	1	1 1	Medium	Low	Minor Negative
	Offshore Operation: Other Discharges to Sea: **Freshwater Maker – Saline Effluent**	1	3	3	1	1 1	Medium	Low	Minor Negative
	Subsea Operations: Routine and Non Routine Control Fluid Discharge	1	3	1	1	1 1	Medium	Biological / Ecological: Low	Minor Negative
	Subsea Operations: Non Routine Discharge of Fluids during Subsea Production System Interventions	1	2	1	1	1 1	Medium	Biological / Ecological: Low	Minor Negative