AGR Well Management
Annual Environmental Report 2018

AUTHORISATION			
	Name/Position	**Position**	**Date**
Prepared by	Gavin Kerr	HSEQ Manager	27/05/2019
Reviewed by	Ian Burdis	VP North Sea & WA	27/05/2019
Reviewed & Approved by	Svein Sollund	CEO	31/05/2019

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Contents

1 Introduction

This document presents the AGR Well Management Ltd (AGR) annual public statement for offshore operations during 2018. The annual statement is provided in line with the objectives of OSPAR Recommendation 2003/5 to Promote the Use and Implementation of Environmental Management Systems by the Offshore Industry, as implemented by the UK Department of Business, Energy and Industrial Strategy (BEIS). In accordance with BEIS guidance on Environmental Management Systems (EMS), well operators on the UK continental shelf (UKCS) must maintain a certified EMS, including the requirement to produce an annual public statement covering all offshore operations undertaken in the previous calendar year.

2 Scope and Model of Operations

AGR is an independent well management services company, which provides all aspects of well operations, including well design and planning, execution and close-out. The scope of operations includes exploration, appraisal and development drilling design and implementation, rig procurement and well abandonment.

With the introduction of the Offshore Installations (Offshore Safety Directive) (Safety Case etc) Regulations, licence operators for offshore oil and gas activities must formally appoint a competent well operator to undertake exploration and appraisal well operations, including drilling, well suspension and abandonment operations. As well operator, in addition to general project management duties, AGR is responsible for managing the environmental requirements of well operations, including the preparation and submission of all environmental permit applications.

In 2018 AGR acted as the well operator for two wells, one located to the west of Shetland and one in the northern North Sea. These operations were executed under the auspices of the AGR HSEQ Management System. This document discusses the environmental performance during these operations, including summaries of key emissions and discharges.

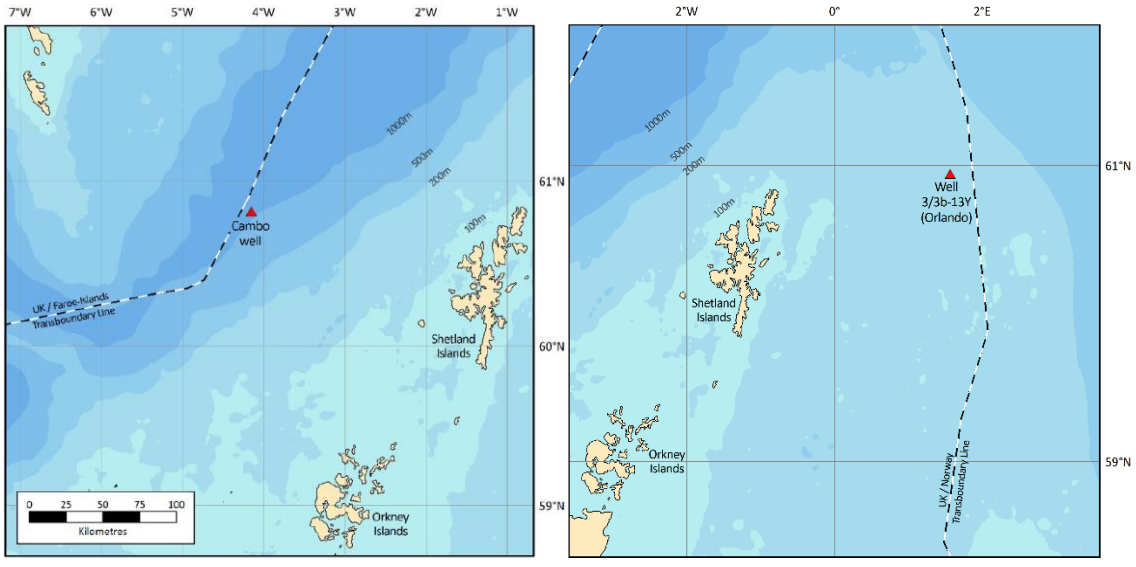

Figure 1 - Well Locations

3 EMS Overview

AGR is aware of the potential environmental implications of its business operations and is fully invested in safeguarding the environment as an underlying principle of our operations. This is demonstrated by the commitments outlined in the HSEQ policy underpinning our HSEQ Management System and all our activities. Following the principles of ISO14001, the HSEQ policy commits AGR to enhance our environmental performance, meet all identified compliance obligations and protect the environment wherever possible.

HSEQ policy

AGR is a learning organisation that builds on ethical principles where business results are directly connected to a responsible health, safety, environmental and social performance.

WE work in a knowledge based company, delivering Services to our Clients in the oil and gas industry.

WE strive to identify and manage any risk in all our activities and constantly work to avoid:

- Personal injuries
- Work-related illness
- Negative environmental impact
- Reputational and Economical loss

WE resolutely believe that no deadline is so important that a task cannot be carried out safely. Where there is doubt regarding safety, the task will be halted immediately. If we see a hazardous situation, we shall intervene.

WE are committed to identifying significant environmental aspects and reducing any environmental impact AGR may create.

WE are continually working to improve and, as such, realise that AGR's health, safety, environmental and social performance are essential for the continued success of our organisation, the wellbeing of our employees and further good relations with the communities in which we are based.

WE meet our Clients expectations, and use their feedback for continuous improvement.

WE shall continuously measure the performance of our business by use of HSEQ objectives and targets. The subsequent results will be communicated to all employees.

WE shall perform regular internal control activities to ensure compliance with the AGR Management System and relevant legislative requirements within the areas and countries in which we operate.

WE shall regularly review our Management System to ensure continuous improvement and that an adequate and effective system is in place.

WE are responsible for our own and each others' health and safety, as well as for the environment. Overall accountability, however, lies with management.

Svein Sollund
CEO

AGR-HSEQ-SD0 r2 28th May 2018

Figure 2 - HSEQ Policy

The HSEQ policy is part of the AGR integrated HSEQ Management System, which includes Environmental Management System (EMS) requirements. The Management System has been certified to the ISO14001 2015 International Standard in accordance with the requirements of OSPAR Recommendation 2003/5 and associated BEIS guidelines. The Management System is subject to regular external review and certification against the requirements of ISO14001. It was last fully certified on 27 December 2016. As part of the EMS, AGR has identified the significant environmental aspects of offshore operations and developed processes necessary to manage these aspects. The environmental elements of the Management System are applied to all well activities, including those covered in this annual statement.

4 Environmental Objectives

AGR collaborated with the Installation Operators to achieve a positive HSE culture onboard the drilling rigs involved in the 2018 operations, in accordance with respective HSE management systems and policies. This ensured that environmental protection was prioritised and all personnel were aware of their environmental responsibilities and associated risks. To help measure performance, the following key performance indicators (KPI) relevant to environmental issues were agreed for 2018 operations:

- Zero dropped objects
- Zero reportable spills

Further key environmental focus areas were identified as requiring close supervision during operations, based on the elevated environmental risk determined through the AGR risk assessment process.

Environmental Focus Area	Cambo Well	Orlando Well
Fuel bunkering	✓	✓
Chemical use and discharge	✓	✓
Well testing	✓	
Transfer and use of oil base mud (OBM) and pit cleaning operations		✓
Processing and discharge of OBM cuttings at sea		✓
Well clean up and flaring		✓

Figure 3 - Environmental Focus Areas

These operations were monitored to ensure compliance with AGR and rig contractor procedures, compliance with consent conditions and to help minimise environmental impacts. The KPIs and focus areas are reflected in the following discussion of environmental performance.

As stated above, AGR was well operator for two wells in 2018, the environmental performance of which is discussed in turn below.

4.1 Environmental Performance – Cambo Well

From April to September 2018, AGR acted as well operator for drilling operations in the Cambo prospect in deepwater to the west of Shetland. Operations involved a deviated appraisal pilot well (Well 204/10a-5) and associated horizontal sidetrack (Well 204/10a-5Z). Drilling operations were undertaken from the *West Hercules* dynamically positioned semi-submersible drilling rig, owned and operated by North Atlantic Drilling Ltd (NADL). An extended well test (EWT) was undertaken in the horizontal sidetrack in order to gather further information about the commercial viability of the reservoir.

4.1.1 Drill Cuttings

Drill cuttings, the fragments of broken rock generated by the action of the drill bit, vary in nature depending on the characteristics of the rock layers present, but generally range in size between very fine clay like particles to coarse gravels.

Typically, drill cuttings generated from the tophole sections of a well, before a blowout preventer and marine riser are installed, are deposited directly on the seabed surrounding the wellbore. However, in this case the uppermost section was replaced with a Conductor Anchor Node ('CAN-ductor'), a pre-rig stage well construction technology used in place of a conventional tophole section and associated conductor. This removes the need for tophole drilling, conductor installation and subsequent cementing operations. As a result, only cuttings from the second tophole section were discharged to the seabed, reducing related physical impacts upon seabed communities.

Drill cuttings from deeper sections of the pilot well and all sections of the sidetrack well were circulated up the marine riser to the drilling rig, where the drilling mud was recovered and the cuttings discharged to sea. Due to issues with the angle of the initial sidetrack reservoir section, it had to be re-drilled, resulting in additional cuttings being generated and discharged from the rig.

The table below presents the total quantities of drill cuttings discharged at the seabed and sea surface during drilling activities at Cambo.

Section	Discharge point	Section length (m)	Section volume (m^3)	Cuttings discharged (tonnes)
Well 204/10a-5 (pilot well)				
17½"	Seabed	738	114.5	266.9
12¼"	Surface	591	44.9	104.8
Total	**-**	**-**	**-**	**371.7**
Well 204/10a-5Z (sidetrack)				
12¼"	Surface	789	60	139.8
8½"	Surface	324	11.9	27.7
8½" (redrill)	Surface	477	17.5	40.7
Total	**-**	**-**	**-**	**208.2**

Figure 4 - Summary of Cambo well drill cuttings discharges

4.1.2 Chemical Use and Discharge

Chemical use and discharge during offshore operations is controlled by the Offshore Chemicals Regulations 2002, as amended (OCR regulations). These regulations introduced the OSPAR Harmonised Mandatory Control Scheme for the use of chemicals offshore. Within this scheme, all chemicals are ranked according to a hazard quotient (HQ) calculated using the Chemical Hazard and Risk Management model (CHARM). The HQ ranking is divided into six colour bands from least to most hazardous (gold, silver, white, blue, orange and purple).

There are some chemicals to which the CHARM model cannot be applied, eg inorganic substances. In such cases, chemicals are assigned a grouping under the Offshore Chemical Notification Scheme (OCNS) based on their toxicity characteristics (A to E, E being the least hazardous). Chemicals which are environmentally benign in seawater are termed as 'Poses Little or NO Risk' (PLONOR). All PLONOR products are given an 'E' rating (least hazardous).

A summary of chemicals regulated under the OCR Regulations used and discharged during offshore operations at the Cambo well is presented in the table below. Not all chemicals approved for use in the operations were ultimately required, some were identified as contingencies in case downhole conditions required them.

As introduced above, chemicals are categorised according to either their HQ colour band or OCNS ranking. The majority of chemicals used and discharged were classified as PLONOR and/or were ranked in the least environmentally hazardous categories.

Category	Number of chemicals	Used (kg)	Discharged (kg)
Gold	27	122,273.9	114,629.5
Silver	1	82.5	82.5
OCNS C	1	950.0	950.0
OCNS D	1	5,901.5	5,901.5
OCNS E	31	4,435,000.8	4,260,997.1
Total	**61**	**4,564,208.7**	**4,382,560.6**

Figure 5 - Chemical use and discharge quantities from Cambo well operations

Note: The HQ colour band and OCNS rankings are those in place at the time of operations, chemicals may have been re-categorised since that time.

Certain chemical components are marked with a 'substitution warning' (SUB) as they are listed on the OSPAR list of chemicals for priority action or due to characteristics such as high toxicity or poor biodegradation potential. The UK National Plan has set interim targets for these chemicals to be replaced with more environmentally friendly products, with priority given to those with the highest toxicity. Where technically possible, AGR actively seeks to minimise the number of chemicals with substitution warnings to be used when planning each offshore operation.

In total, 61 chemical products were ultimately used during the Cambo operations, of which only six had substitution warnings. Four of these chemicals were small solid tracers, Tracerco 165h, Tracerco 740, Tracerco 720 and Tracerco 701, used during the extended well test to determine the origin of the reservoir oil and connectivity in the

reservoir. As these tracers were oil soluble, any portion brought to surface would have been entrained with the produced oil and captured during sampling, with the remainder burnt in the flare. DMO86941 is a demuslifier used during the well test operations to help separate the oil, gas and water produced to the rig. As this well test chemical is also oil soluble, it would also have been entrained within the oil stream and sent to the flare during testing. Therefore, there was no discharge of these chemicals to sea.

The remaining SUB chemical, MCS-J is a surfactant. This was added to the cement spacer system to help remove drilling mud, clean the hole, and wet the casing and surrounding formation surfaces immediately prior to the arrival of the cement slurry. As a spacer chemical used to support cementing of the deeper well casings, most of this product remained in the well trapped behind the casings. Only minimal discharge was required in association with the washing out of tanks and lines once the cementing operation was complete. As described in the chemical permit application, not more than 20% of the quantity used was ultimately discharged to sea in this case.

AGR's UK offshore operations are focused on the management of exploration and appraisal drilling. As a different selection of chemicals may be required from one well to the next, it is very difficult to manage the ongoing use of specific chemicals or schedule the replacement of less environmentally favourable chemicals. However, AGR will continue to identify, and encourage sub-contractors to look for, suitable alternatives in future drilling operations.

4.1.3 Reservoir Oil Bearing Discharges - Payzone Cuttings

Whilst drilling through the target formation, drill cuttings and drilling muds returned to the rig were contaminated with crude oil from the reservoir. Oil contaminated cuttings and mud were encountered whilst drilling the 12¼" section of the pilot well and both sections of the horizontal sidetrack. As normal, the cuttings involved were circulated up to the rig and passed over the shakers to recover the drilling fluids. The cuttings and any remaining mud residues, along with associated crude oil, were then discharged to sea.

As required by relevant legislation, the discharge of oil contaminated drill cuttings was undertaken under conditions of an oil discharge permit, which imposes limits for the total quantity of crude oil discharged to sea. The permit requires samples of the returned cuttings to be gathered and analysed in order to determine the quantities of oil discharged were within approved limits. Based on the analysis undertaken, a total of 111.4 tonnes of oil contaminated cuttings containing 130 kg of crude oil were discharged to sea in relation to the Cambo well operations. The average proportion of oil on the cuttings discharged was 0.12%. The quantities of oil discharged were well within the permitted thresholds, as demonstrated in the table below.

Cambo well	Source of oil (tonnes)	
	Oil contaminated drill cuttings	Oil contaminated water during well testing
Permitted discharge	11.5	0.12
Actual discharge	0.13	0.0007

Figure 6 - Oil discharges during Cambo well operations

4.1.4 Reservoir Oil Bearing Discharges - Well Test Fluids

During a well test, produced fluids from the reservoir are returned to the surface. These fluids are a combination of completion fluids, oil, gas and produced water. Once returned to the drilling rig, oil and gas and water are separated into separate streams, with the hydrocarbons flared off (burnt). The separated water will contain some residual crude oil. This water is treated to reduce the oil content, then discharged to sea under an oil discharge permit. Samples of the fluids are taken and analysed to ensure the oil content is below the permitted threshold before discharge. Additional samples are gathered and sent onshore for further analysis to verify the oil content. A total of 63.75 m^3 of oil contaminated fluids were discharged in association with the Cambo extended well test. These fluids contained 0.7 kg of crude oil with an average dispersed oil concentration of approximately 11 mg/l. The quantities of oil discharged were also well within the permitted thresholds.

4.1.5 Atmospheric Emissions

The main atmospheric emissions generated during the Cambo well operations were derived from fuel combustion on the *West Hercules* drilling rig and the flaring of hydrocarbons during the extended well test, undertaken to further evaluate the Cambo reservoir. Over the course of operations, the rig burnt a total of 4,206 tonnes of diesel for power generation. This generated a total of 10,009.2 tonnes of CO_2 equivalents. Sulphur content of the fuel was 0.1%.

		Fuel use	Flaring - well testing	
		Diesel	Oil	Gas
Consumption (tonnes)		4,206	6,727	296
Emissions (tonnes)	CO_2	13,459.2	21,526.4	828.8
	CO	66.0	121.1	2.0
	NO_x	249.8	24.9	0.4
	N_2O	0.9	0.5	0.02
	SO_2	16.8	0.1	0.0
	CH_4	0.8	168.2	13.3
	VOC	8.4	168.2	1.5
	Total CO_2 equivalents[1]	**10,009.2**	**26,640.4**	**1,174.9**

Figure 7 - Atmospheric emissions from the Cambo well operations

[1]Total CO_2 is not a sum of all emission values given, it represents the contribution to climate change of all gaseous emissions by converting them into tonnes of CO_2 before giving a final total.

The Cambo extended well test lasted 337 hours or just over 14 days. As a result of the test, a total of 6,727 tonnes of crude oil and 296 tonnes of associated gas were flared off. This resulted in the emission of a total of 27,815.25 tonnes of CO_2 equivalents.

4.1.6 Waste Management

Under the relevant waste legislation designed to encourage waste reduction, appropriate storage and proper disposal, waste generated during rig based offshore activities must

be segregated and stored appropriately for disposal onshore. Waste is typically segregated and recorded according to the following categories:

- Group I is special waste such as oils, paints, used containers, sludges etc.
- Group II is general waste including domestic waste. Segregated materials, such as scrap metal, plastics, wood, paper and cardboard, are recycled.
- Group III is other waste including asbestos, clinical and explosive materials and radioactive materials.

It should be noted that, as water base mud (WBM) used throughout drilling of the Cambo well, all cuttings and used muds were discharged to sea. Therefore, no backloading of cuttings to shore for disposal as waste (Group IV – Backloaded Cuttings) was required. The types, quantities and disposal methods for waste generated during these operations are shown in the table below.

Waste category	Reuse (t)	Recycling (t)	Waste to energy (t)	Incinerate (t)	Landfill (t)	Other (t)	Total (t)
Group I	2.15	31.94	56.00	0	0	76.32	166.4
Group II	0	60.79	17.51	0	14.23	0	92.53
Group III	0	0	0	0.005	0	0	0.005
Total	**2.15**	**92.73**	**73.51**	**0.005**	**14.23**	**76.32**	**258.94**

Figure 8 - Waste generated during Cambo operations

A total of approximately 259 tonnes of waste was generated during the Cambo operations. The majority of waste was designated as Group I special waste, 166.4 tonnes. Within this category, waste was mostly comprised of sludges, liquids and tank washings (124.74 tonnes) and oils (31.06 tonnes). Miscellaneous special waste (7.6 tonnes), drums/containers (2.39 tonnes) and chemical/paint wastes (0.61 tonnes) made up the remaining quantity of special waste. The majority of the sludges, tank washings and other liquids consisted of water which was ultimately discharged to a sewer after being treated appropriately onshore. None of the waste was sent to landfill with the remainder mostly recycled or converted to energy.

The vast majority of the remaining waste, 92.53 tonnes, was classified as general waste (Group II), much of which was suitable for recycling. The remaining general waste was either converted to energy or had to be disposed of in landfill, as it was not suitable for other methods of disposal. A very small proportion of waste, 0.005 tonnes or 5 kg, was clinical waste (Group III) that had to be incinerated.

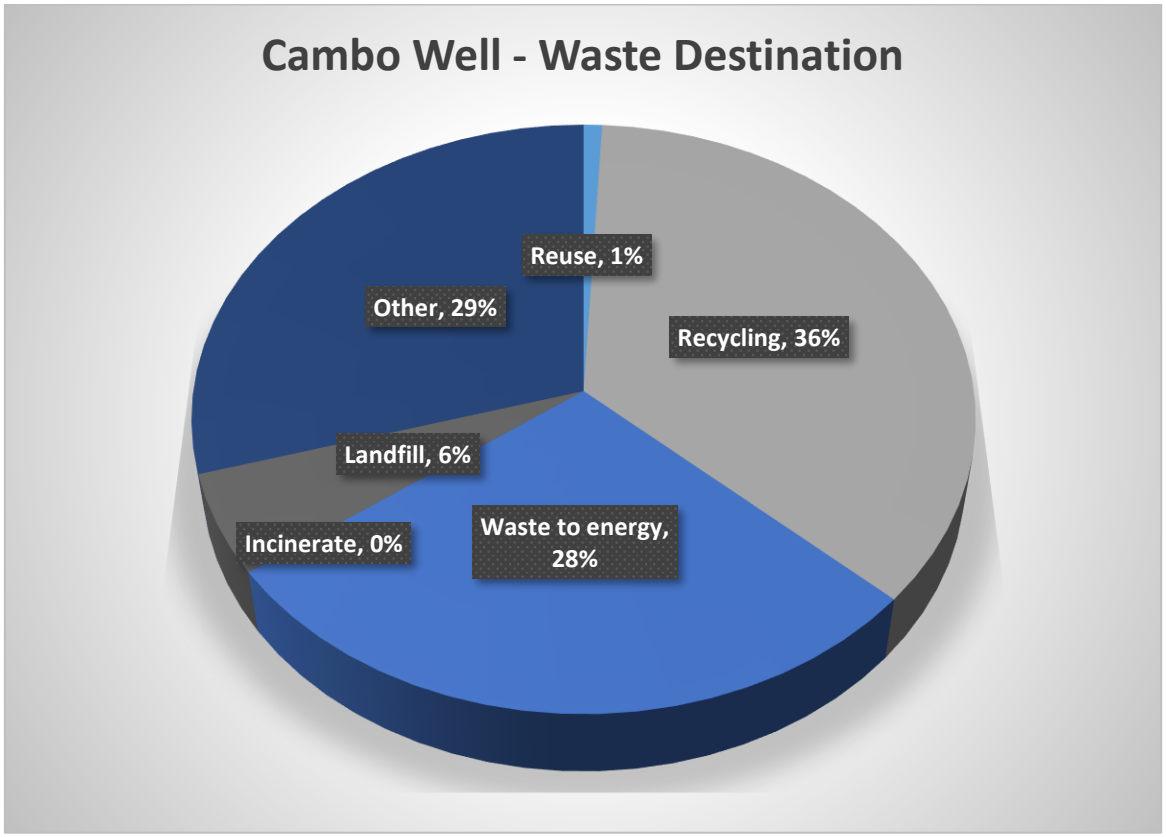

Figure 9 - Cambo Well - Waste Destination

Overall, the majority of waste was suitable for recycling (36%) or was converted to energy (28.4%). In accordance with waste management hierarchy requirements (reduce, reuse, recycle), less than 15% of waste was disposed of in landfill.

4.1.7 Oil and Chemical Spills to Sea

The Offshore Petroleum Activities (Oil Pollution Prevention and Control) Regulations 2005 (OPPC Regulations) stipulate that any oil or chemical spill within 500 m of a drilling rig or fixed platform must be reported. In the event of such a spill, an electronic Petroleum Operations Notice 1 (PON1) form must be submitted to BEIS and other relevant authorities informing them of the incident.

Only one small spill of crude oil to sea occurred during the Cambo operations. This was reported via the ePON1 form to BEIS and other relevant authorities. During the extended well test, oil drop out from the flare was observed to have caused a sheen on the sea surface. This was due to an excessive amount of water mixing with the oil stream, which disrupted combustion. Adjustments were made to the three way separator in the well test package in order to reduce the water content of the stream. Subsequently, no further issues with drop out were encountered. No other oil or chemical spills to sea within 500 m of the *West Hercules* drilling rig were encountered during the Cambo well operations.

4.1.8 Non-compliances

Under the OCR regime, failure to comply with the conditions of the chemical permit such as use of an unpermitted chemical or exceeding the permitted quantities must be

notified to BEIS via an OCR non-compliance notification form. All chemical use and discharge were monitored throughout the Cambo operations to ensure they remained within approved limits. Variations were made to the permit application in order to make necessary increases to chemical use and discharge, or to add new chemicals in a timely fashion as required.

There was a single isolated instance where gravel used in completing the well was allowed to return to the surface and be discharged to sea. This was quickly identified and no further instances of this discharge occurred. Although the gravel was not a chemical product permitted under the OCR regime, its discharge was reported to BEIS via the OCR NCN. As it involved a product outside its intended destination, this was deemed the most appropriate route for reporting the incident. No further non-compliance incidents were encountered.

Similarly, under the OPPC Regulations, failure to comply with the arrangements described within the permit application, the permit approval and the Standard Industry Conditions must be notified to BEIS via an OPPC non-compliance notification form (NCN). However, the reservoir oil discharges made at the Cambo well were all made within the conditions of the Oil Discharge permit.

Any failure to comply with the conditions of the Consent to Locate process under the Energy Act 2008, Part 4A, including failure of navigational aids, must be notified to BEIS via a PON10 form. As the *West Hercules* drilling rig had been out of use for several years and was entering UK waters for the first time, it was not fitted with appropriate ID panels and obstruction lights as stipulated under the Consent to Locate process. This was noted upon the rig's arrival at the Cambo location. The consequences of non-compliance with respect to navigation and potential collisions were deemed to be of low risk. However, appropriate ID panels and obstruction lights were procured and installed as soon as possible to address the non-compliance.

4.2 Environmental Performance – Orlando Well

The Orlando well operations were undertaken in Block 3/3b in the northern North Sea from March to June 2018. Operations involved re-entry of an existing suspended appraisal well (Well 3/3b-13Z) in order to drill and complete a new sidetrack (Well 3/3b-13Y) as part of a wider field development. Drilling operations were undertaken from the *Ocean Guardian* moored semi-submersible drilling rig, owned and operated by Diamond Offshore Drilling Inc. (Diamond). Once the well was drilled, fluids were produced to the surface and flared off in order to clean up the well and make it ready for development. Base oil discharges were made at a number of stages during the operations, which are detailed further at the relevant points below.

4.2.1 Drill Cuttings

A synthetic oil based mud (SBM) system was used throughout drilling the Orlando well. The discharge of whole oil based mud to sea is prohibited, and any base oil contamination on drill cuttings must not exceed 1% by weight of cuttings. Any discharge of base oil, including in association with drilling cuttings, is covered by the Offshore Chemical Regulations and therefore must be permitted via a Chemical Permit application.

During the Orlando drilling operations, all cuttings were returned to the rig with the SBM recovered for re-use as far as possible. The drill cuttings and associated drilling mud residues from the 17½" and 12¼" sections were then heat treated to evaporate the liquid drilling mud and separate it into base oil and water streams. The dry, inert powder cuttings remaining after this process were collected separately and tested to confirm the residual base oil content represented no more than 1% of the total weight. Once confirmed, the cuttings were discharged to sea from the rig. The total quantities of dry cuttings discharged, and base oil therein, are presented in the table below. Drill cuttings from the deepest section of the well (8½") were all contained and shipped back to shore for treatment and disposal, hence related discharge of base oil to sea was zero. A total of 0.68 tonnes of base oil was discharged to sea in association with the treated cuttings.

Section	Discharge point	Section length (m)	Section volume (m^3)	Cuttings discharged (t)	Cuttings to shore (t)	Base oil discharged (t)
17½"	Surface	1,475	226.1	533.52	0	0.343
12¼"	Surface	2,053	156.1	363.87	0	0.338
8½"	Surface	1,426	52.2	0	121.687	0
Total	**-**	**-**	**-**	**897.40**	**121.687**	**0.68**

Figure 10 - Summary of Orlando well drill cuttings and base oil discharges

The total quantities of contaminated drill cuttings and associated base oil discharged to sea were well within the permitted thresholds; 1,204 tonnes and 12.04 tonnes, respectively.

4.2.2 Other Base Oil Discharges

In addition to base oil contaminated drill cuttings, several additional sources of base oil discharge to sea were required during the Orlando well operations, as discussed below.

As stated above, a synthetic oil based mud system was used to drill the Orlando well, with all drill cuttings and used SBM returned to the drilling rig. Heat treatment was used to evaporate and separate the liquid components of the drilling mud into respective water and oil streams. These were then re-condensed separately and the base oil re-incorporated into the drilling mud. Once separated from the cuttings and re-condensed, the water stream contained some residual base oil. Therefore, the fluids involved were filtered to reduce this base oil content to no more than 30 mg/l and then discharged to sea. Through this process, a total of 0.47 kg of base oil was discharged to sea, dispersed within 223.37 m^3 of separated water. The total quantity of base oil discharged was well within the permitted threshold.

Base oil stream	Volume of fluid discharged (m^3)		Base oil concentration in fluid (mg/l)		Quantity of base oil discharged (kg)	
	Permitted	Actual	Permitted	Actual	Permitted	Actual
Separated water	436	223.37	30	7	13.1	0.47
Brine	800	83.48	30	9.85	24	0.8

Figure 11 - Summary of permitted and actual base oil discharges from Orlando well

Brine used during the completion operations was contaminated with base oil in SBM displaced from the well, and by pure base oil used to help flow the well during clean up flaring. When circulated out of the well and up to the rig, this brine was filtered to reduce any base oil contamination to a maximum of 30 mg/l on average. The treated brine was then discharged to sea. Through this process, a total of 0.8 kg of base oil was discharged to sea, dispersed within approximately 83.5 m^3 of brine. The total quantity of base oil discharged was well within the permitted threshold, as shown in the table above.

4.2.3 Chemical Use and Discharge

A summary of chemicals used and discharged under the OCR Regulations during offshore operations at the Orlando well is presented in the table below. Not all chemicals approved for use in the operations were actually required, as some were identified for contingency in case downhole conditions required them. The majority of chemicals used and discharged were classified as PLONOR and/or were ranked in the least environmentally hazardous categories introduced above.

Category	Number of chemicals	Used (kg)	Discharged (kg)
Gold	11	28,259.1	7,129.0
Silver	2	18,612.6	0
OCNS C	1	11,280.0	0
OCNS D	2	3,535.5	3,423.0
OCNS E	27	2,923,618.6	486,465.7
Total	**43**	**2,985,305.7**	**497,017.6**

Figure 12 - Chemical use and discharge quantities from Orlando well operations

Note: The HQ colour band and OCNS rankings are those in place at the time of operations, chemicals may have been re-categorised since that time.

In total, 43 chemicals were used during the Orlando operations, of which only two had substitution (SUB) warnings. Additional chemicals potentially proposed for use had SUB warnings, but were ultimately not used during operations. The two SUB chemicals used were VERSACLEAN CBE, an emulsifier, and VERSATROL M, a fluid loss control chemical. As both of these chemicals were both used as part of the oil base mud system, neither were discharged to the marine environment.

4.2.4 Atmospheric Emissions

The main atmospheric emissions generated during the Orlando well comprised of combustion emissions from the Ocean Guardian drilling rig and clean up flaring to prepare the well for production. The total atmospheric emissions generated from these are shown in the table below. The total diesel fuel consumption of the drilling rig was 1,210 tonnes, producing approximately 2,880 tonnes of CO2 equivalents. Sulphur content of the fuel was 0.1%.

		Fuel use	Flaring – well clean up	
		Diesel	Oil	Gas
	Consumption (tonnes)	1,210.0	1,501.5	0.1
Emissions (tonnes)	CO_2	3,872	6,992.0	0.3
	CO	19.0	39.3	0.0
	NO_x	71.9	8.1	0.0
	N_2O	0.3	0.2	0.0
	SO_2	4.8	13.1	0.0
	CH_4	0.2	54.6	0.005
	VOC	2.4	54.6	0.001
	Total CO_2 equivalents[1]	**2,879.5**	**5,946.3**	**0.4**

Figure 13 - Atmospheric emissions from the Orlando well operations

[1]Total CO_2 is not a sum of all emission values given, it represents the contribution to climate change of all gaseous emissions by converting them into tonnes of CO_2 before giving a final total.

During clean up flaring, 1,501.51 tonnes of oil were flared off along with 0.1 tonnes of gas. This resulted in total emissions equivalent to approximately 5,946 tonnes of CO_2.

4.2.5 Waste Management

A total of approximately 202 tonnes of waste was generated during the Orlando operations. The types, quantities and disposal methods for waste generated during these operations are shown in the table below. Group I special wastes were mostly drums or containers suitable for reuse, or oils sent for recycling. Most of the remaining special waste, 7.9 tonnes, was converted to energy. A total of less than 0.5 tonnes had to be incinerated or disposed of in landfill. Given the composition as drums or containers, scrap metal and segregated recyclables, most of the general waste (Group II) was also suitable for recycling. A smaller proportion, around 10 tonnes, was converted to energy once on shore. No waste falling under this category was incinerated or sent to landfill. A very small proportion of waste, 0.005 tonnes or 5 kg, was clinical waste (Group III) that had to be incinerated.

Waste category	Reuse (t)	Recycling (t)	Waste to energy (t)	Incinerate (t)	Landfill (t)	Other (t)	Total (t)
Group I	1.74	9.37	7.91	0.05	0.42	0	19.49
Group II	0	47.82	10.34	0	0	0	58.16
Group III	0	0	0	0.005	0	0	0.005
Group IV	0	8.05	0	0	79.78	36.26	124.09
Total	**1.74**	**65.24**	**18.25**	**0.06**	**80.2**	**36.26**	**201.75**

Figure 14 - Waste generated during Orlando operations

In addition to the three categories of waste described above in relation to the Cambo operations, the Orlando well operations also involved the backloading of used oil base mud and contaminated cuttings as waste (Group IV). Under this waste group, cuttings returned to shore were sub-divided into solids, water and oil components. In this case,

the solid cuttings material had to be disposed of in landfill once separated, approximately 80 tonnes. Base oil separated from the cuttings, just over 8 tonnes, was reconditioned (recycled) and will be re-used as drilling mud in future operations. The water separated from cuttings was appropriately treated and discharged to water streams/sea under permit. In total, 124.09 tonnes of Group IV cuttings waste were generated.

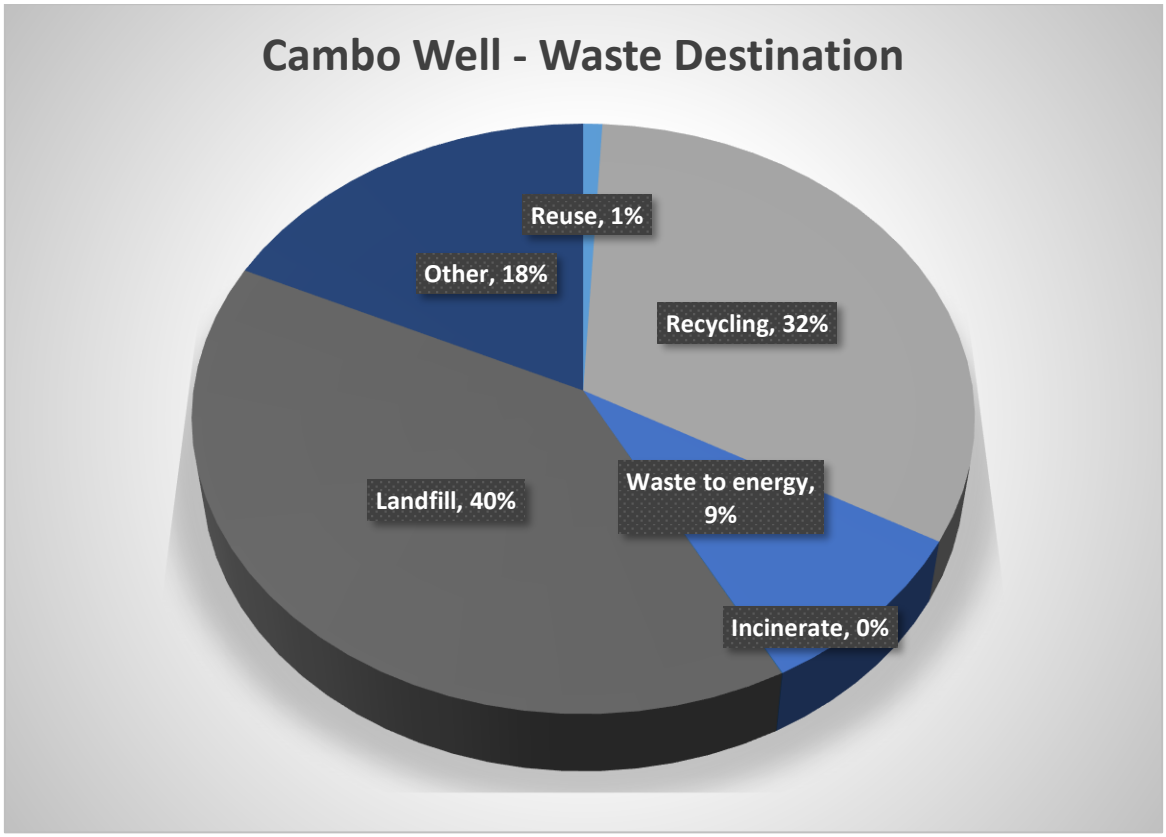

Figure 15 - Cambo Well - Waste Destinations

For this well, the largest overall component of waste generated, over half, was the Group IV backloaded cuttings. Within that category, the largest sub-component was the dry cuttings that were not suitable for reuse or recycling and had to be sent to landfill. Consequently, the overall proportion of waste sent to landfill from Orlando (40%) was higher than for Cambo, where water based drilling fluid was used and all cuttings were suitable for discharge to sea. A significant proportion also falls under the "other" category, 18%, largely due to the discharge of treated water to drainage. Other than the cuttings wastes, wastes were mostly recycled or converted to energy, avoiding the need to dispose of them in landfill.

4.2.6 Oil and Chemical Spills to Sea

Two incidents were encountered over the course of the Orlando operations that required reporting via the ePON1 form. The first of these was a sheen observed at the sea surface, caused by an unknown third party unrelated to the Orlando operations. It was estimated from the sheen that up to 46 tonnes of oil may have been released. All regulatory agencies were notified of the sighting (HM Coastguard, BEIS, JNCC and Marine Scotland).

The second incident occurred during the clean up flaring period. A change in wind direction brought the protective water curtain into contact with the flare. This dissolved some of the smoke from the flare, causing a visible sheen on the surface for a short period of time. The sheen was determined to be carbon dropout from the flare and no physical drop out of unburnt hydrocarbons was observed. An inspection around the rig confirmed no other sources of pollution to sea were present. As the incident duration was very short, no steps could be taken such as to shut in the well or reposition flaring operations. However, no further incidents of this nature were encountered.

No other oil or chemical spills to sea within 500 m of the *Ocean Guardian* drilling rig were encountered during the Orlando well operations.