IOG UK LTD

D/4257/2020 Southwark Pipeline Installation Project Environmental Statement (ES)

IOG UK Ltd Response to Notice Pursuant to Regulation 12 (1) and 12 (3)

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INTERTEK

Intertek Energy & Water Consultancy Services is the trading name of Metoc Ltd, a member of the Intertek group of companies

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EXECUTIVE SUMMARY

The 24" Southwark pipeline is part of the wider Blythe Hub Development in the southern North Sea. The Blythe Hub Development Environmental Statement (ES) (reference D/4208/2018) was approved in April 2020 and work commenced in July 2020.

In May 2020, following developments within the project planning process, it became evident that the initial Blythe Hub ES did not sufficiently cover the activities associated with the Southwark pipeline installation. Therefore, a new ES for the Southwark pipeline installation was submitted on the 19th of April 2021 to describe and assess the impacts of the activities associated specifically with pipeline installation and commissioning. Hereafter this is referred to as the Southwark pipeline ES. The Southwark pipeline ES was issued for statutory and public consultation from the 1st – 31st May 2021 which led to extensive dialogue with OPRED. Key to this present document are Comments 2, 3 and 4 in the OPRED Notice Pursuant to Regulation 12 (1) issued on the 10th December 2021.

Following discussions with OPRED, and alongside refinement of the Southwark pipeline project design and receipt of actual data from the Blythe Hub development activities carried out thus far, a number of changes to the Southwark Pipeline operation have been identified. Specifically, these changes are:

1. Use of additional permanent and temporary deposits to the seabed to ensure the safe installation of the pipeline and its protection thereafter which will add to the overall footprint of the Southwark development, and
2. The need to displace the inert nitrogen used for Southwark pipeline dewatering with hydrocarbon gas prior to bringing the pipeline into service. This process involves the venting of the nitrogen and a limited volume of hydrocarbon displacement gas which will contribute to the overall project emissions.

The additional outputs of the two changes above with regard to the physical presence of objects, the footprint of seabed deposits/disturbance and changes to overall emissions was quantified. The potential for localised and cumulative impact was assessed in terms of:

- Physical presence and seabed disturbance, and
- Atmospheric emissions.

The assessment concludes that the effects from the above are considered to be **Tolerable** and do not present any additional significant impact. As such, the conclusions of the original Southwark Pipeline ES remain unchanged.

Comparison of the original Southwark pipeline ES outcome with the current assessment

Impact	Description	Worst Case ES Assessment (April 2021)	Incremental Change	Current Assessment (March 2022)
Seabed Deposits				
Physical Presence	Use of vessels and additional infrastructure on seabed and over existing pipelines at Sites A, B and C	**Acceptable**	No significant change to vessel numbers or movement and negligible increase in infrastructure in areas which already have infrastructure *in situ*	**Acceptable**
Seabed Disturbance	Increased footprint of permanent deposits and disturbance at Site C and increased footprint of temporary deposits at Sites A, B and C	**Tolerable**	Current changes amount to: ▪ 3% increase in temporary deposits, and ▪ 9% increase to permanent deposits	**Tolerable**
Emissions				
Emissions to air	▪ Increase in emissions of methane as a result of venting, and ▪ Decrease in emissions from vessel use	**Tolerable**	75% reduction in overall emissions	**Tolerable***

* Note that the total emissions from the Southwark pipeline installation and commissioning amount to only 0.0006% of the UK's 3rd carbon budget allocation (see Section 3.5). However, owing to the sensitivity of the global atmosphere as a receptor and IOG's Climate Change and Sustainability Policy, it is not considered appropriate to assess the impact of emissions as 'Acceptable' – hence set here as Tolerable.

CONTENTS

LIST OF TABLES AND FIGURES

Tables

Figures

1. INTRODUCTION

1.1 Background

The 24" Southwark pipeline is part of the wider Blythe Hub Development. The latter describes the installation of platforms at the Blythe and Southwark fields, the drilling of wells at Elgood, Blythe and Southwark and the installation of the Elgood subsea tree and the Blythe import and export pipelines. The Blythe Hub Development Environmental Statement (ES) (reference D/4208/2018[1]) was approved in April 2020 and work commenced in July 2020.

In May 2020, following developments within the project planning process, it became evident that the initial Blythe Hub ES did not sufficiently cover the activities associated with the Southwark pipeline installation and commissioning. Therefore, a new ES for the Southwark pipeline installation (D/4257/2020) was submitted on the 19th of April 2021 to describe and assess the impacts of the activities associated specifically with the Southwark pipeline installation. Hereafter this is referred to as the Southwark pipeline ES. The Southwark pipeline ES was issued for statutory and public consultation from the 1st – 31st May 2021.

Since the initial consultation process, two significant changes to the proposed activities have been identified as necessary for the successful installation and commissioning of the Southwark pipeline. These changes were identified as a result of:

- Internal appraisal and refinement of the project design and activities in the face of emerging data and lessons learned during the Blythe development, and
- Dialogue which commenced with OPRED during the formal consultation process[2] (see Appendix I).

The additional/changed activities constitute a potentially significant change to the proposed Southwark pipeline project and, as such, it is necessary for certain elements of the project to be reassessed in terms of the potential for environmental impact. Further, the revised Environmental Impact Assessment (EIA) must be presented for a secondary round of statutory and public consultation as per the OPRED Notice Pursuant to Regulation 12 (3) issued on the 4th February 2022 (Appendix I).

1.2 Objectives

This document is supplementary to the Southwark pipeline ES (D/4257/2020) and aims to itemise, quantify and impact assess the changes in the context of the Southwark pipeline project as a whole. The key objective is to determine whether the changes are likely to have a significant effect on the environment and/or alter the outcome of the original Southwark pipeline ES. For context, this document should be read in line with the Southwark pipeline ES. To access the ES please see the public consultation notice (Notice Regulation 12 (5)).

1.3 Itemisation of the Changes

The additional activities identified as necessary for the successful installation and commissioning of the Southwark pipeline that were *not* itemised in the original Southwark pipeline ES, are as follows:

[1] Note: The installation of the Southwark platform and drilling of the wells was covered in an Addendum to the Blyth Hub ES. .
[2] OPRED Notices Pursuant to Regulation 12 (1) dated 3rd November and 10th December 2021 .

1. Use of additional permanent and temporary deposits to the seabed to ensure the safe installation of the pipeline and its protection thereafter which will add to the overall footprint of the Southwark development, and
2. The need to displace the inert nitrogen used for Southwark pipeline dewatering with hydrocarbon gas prior to bringing the pipeline into service. This process involves the venting of the nitrogen and a limited volume of hydrocarbon displacement gas which will contribute to the overall project emissions.

Details on the relevant comments provided in the OPRED Notices Pursuant to Regulation 12 (1) are provided in Appendix I.

It is necessary to assess the above in terms of the local and cumulative impacts of:

- Physical presence and seabed disturbance, and
- Atmospheric emissions.

Details are provided below to characterise and quantify the nature of the above activities. The outputs of the changes (i.e., any increases or decreases in emissions or areal seabed disturbance) will be added to the outputs identified in the original Southwark pipeline ES to enable a conclusion on whether or not these changes significantly change the impact assessment provided in the original ES.

2. SEABED DISTURBANCE - UPDATE

2.1 Introduction

The following introduction is intended to provide sufficient context to enable understanding of the need for the additional deposits that were not itemised in the original Southwark pipeline ES. Please refer to Figure 2-1 (Drawing No: P2371S6-LOC-001) and Figure 2-2 below for reference as necessary.

The Blythe platform is intended to produce gas from the Elgood and Blythe wells with gas delivered to the Bacton Terminal via the existing Thames pipeline (previously known as PL370). The export line from Blythe is tied into the Thames pipeline at the Blythe hub and the pipeline is, therefore, currently active from KP0[3] (Bacton) to KP29 (i.e., the location of the Blythe Hub tie-in).

In order to enable safe production from Blythe prior to the Southwark platform coming on line, it was necessary to fully isolate the Southwark infrastructure from the Blythe Hub. This was achieved by installing a 24" valve skid at KP29 (i.e. at the Blythe tie-in). This effectively isolated the inactive remainder of the Thames pipeline which runs beyond the Blythe Hub tie-in point (at KP29) to the location where the Southwark pipeline will ultimately be tied-in (i.e. KP60). The installation of the 24" valve skid did not require an ES as it was part of existing infrastructure[4].

The Southwark gas export pipeline will be tied into the Thames pipeline at KP60. Once installed, the new section of pipeline (from Southwark to KP60) and the re-used section of the Thames pipeline (from KP60 to the 24" valve skid at KP29) will form a single pipeline approximately 37.4 km in length. This 37.4 km section of pipeline will be classed by the OGA as a whole and named PL5152.

For the purposes of this assessment, and to enable understanding of Figures 2-1 and 2-2, the different locations are labelled as follows:

- Site A: Southwark platform,
- Site B: The location on the existing (and currently isolated) Thames Pipeline at which the new Southwark pipeline will be tied-in (KP60), and
- Site C – the Blythe Hub tie-in location and the 24" valve skid (KP29).

The installation of the Southwark pipeline, and the associated deposits (at Sites A and B), were covered in the Southwark pipeline ES. However, since submission of the Southwark Pipeline ES , engineering design has progressed and the requirement for several temporary deposits have been identified which were not outlined in the Southwark Pipeline ES. In addition, permanent and temporary deposits associated with the tie-in to the 24" valve skid (Site C) have been included for completeness. These were not covered in the original Southwark pipeline ES as these deposits are associated with the tie-in of two existing pieces of infrastructure (24" valve skid and the re-used section of the former Thames pipeline).

For the sake of clarity, deposits already itemised in the Southwark pipeline ES are:

- The sand wave clearance process,
- The pipeline lay and trenching,
- The use of pipelay vessel anchors (if used),
- Dredging activities,

[3] Kilometre Point
[4] Note: This work was covered under PA/3514

- Pipeline connectors, and
- Permanent pipeline protection at Sites A and B.

Additional disturbances, which are the subject of this report and were not included in the Southwark pipeline ES, are:

- Permanent deposits
  - The installation of the spool pieces at Site C, and
  - Deposition of concrete mattresses and grout bags to provide protection of the spools at the Site C tie-in point[5].
- Temporary deposits required at Sites A, B and C[6], and
- Localised dredging at Site C.

The footprint of the additional materials is calculated in Section 2.3 below where it is added to the footprint of materials already included in the Southwark pipeline ES to enable assessment of whether or not there is a significant change to the impact assessment provided in the original ES.

2.2 Deposit Locations

Table 2-1 provides the co-ordinates for Sites A-C as shown in Figure 2-1 and Figure 2-2 below. Sites A and B are located within two protected sites: North Norfolk Sandbanks and Saturn Reef Special Area of Conservation (SAC) and the Southern North Sea SAC.

Table 2-1 Project co-ordinates

Site/tie in location	Location	
	Latitude	Longitude
Site A	53° 10' 59.77" N	02° 05' 48.19" E
Site B	53° 08' 10.99" N	02° 07' 12.03" E
Site C	53° 04' 31.69" N	01° 41' 18.43" E

Note: The co-ordinates provided are for the centre point of the tie-in locations and therefore do not match the Deposit Consent PA/3707[3], which shows the start and end points of the deposits.

[5] Note: for reference only, in 2021 a work program nearly identical to this operation was carried out on the west side of the Blythe Hub tie-in point (i.e., between Bacton (KP0) and the tie-in point at KP29). This was carried out under Deposit Consent - PA/3514 (PA/3476 was the associated PWA).

[6] Note: These temporary deposits were included on the Deposit Consent (PA/3707) and it was this which highlighted their absence from the initial ES. However, since submission of the Deposit Consent (PA/3707), the need for more temporary deposits have been identified and are included here.

Figure 2-1 Location Overview (Drawing No: P2371S6-LOC-001)

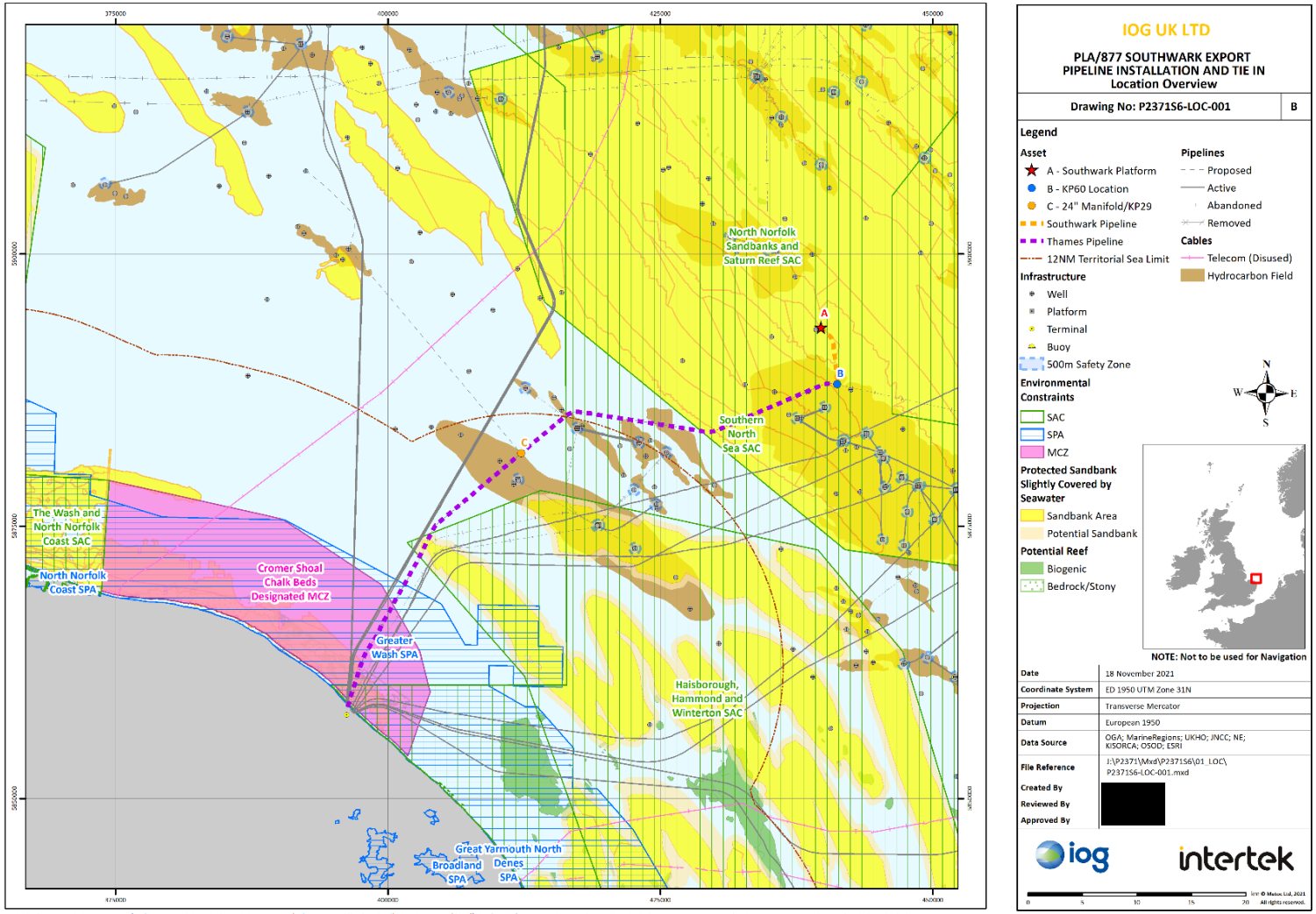
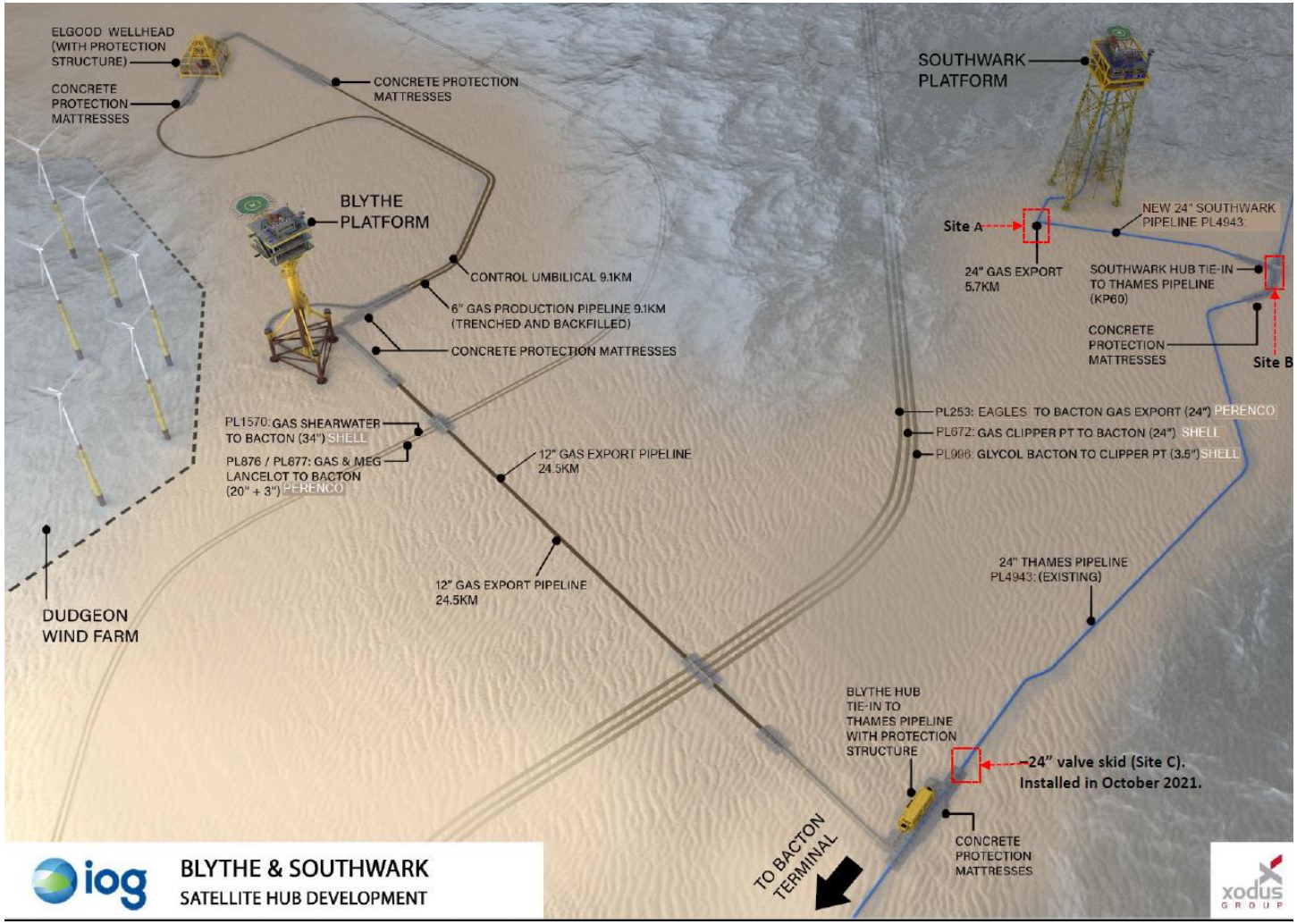


Figure 2-2 Schematic of the development showing the locations of Site A, Site B (KP60) and Site C (KP29)



2.3 Quantification of Additional Deposits

2.3.1 Additional Permanent Deposits and Dredging

The installation of the spool pieces required to tie the currently redundant Thames line into the 24" valve skid (at Site C), along with the subsequent deposition of protective mattresses and grout bags at Site C, were not assessed in the Southwark pipeline ES. Information has therefore been provided below.

The pipeline will be tied in at Site C using spool pieces. The number of spools required is currently under review, although it is estimated that as a worst case up to four spools will be used. However, irrespective of the quantity required to optimise the pipeline, it is estimated that the total length of the spool pieces at Site C will be approximately 62m, which enables estimation of the protective material quantities. These spool pieces will be protected using concrete mattresses and grout/sandbags. Given that the spools themselves will be covered by mattresses and grout bags, the footprint of the spools has not been included in the total footprint taken forward for assessment.

The spool pieces will be placed on the seabed using a support vessel crane, with the connections to the valve skid made by divers.

To aid the tie-in of the pipeline, localised dredging may be undertaken at the tie-in location to enable placement of the spools, and pipeline dredging may also be required to enable cutting of the pipe and attachment of the mechanical connector. This dredging is likely to be conducted using a control flow excavator (CFE), a diver or a remotely operated vehicle (ROV) operated suction dredger. The material dredged will be deposited within 100m of the dredged area. The estimated footprint of the spool site dredging at Site C is 863m^2 and the footprint of the pipeline dredging is estimated at 84m^2.

Table 2-2 summarises the additional permanent deposits to be placed at Site C during the reconnection of the existing Thames pipeline via the 24" valve skid (noting that the re-used section of the Thames pipeline and the new Southwark pipeline will ultimately be considered to be a single pipeline (namely PL/5152, as described above).

Table 2-2 Additional permanent deposits associated with the Southwark pipeline (PL5212) tie in at Site C[7]

Location	Material type	Quantity	Dimensions (m) L x W	Total footprint (m^2)
Site C – KP29 – Blythe Hub Thames Tie-in Approach	Spool pieces	62m (total length)	n/a*	n/a*
	Concrete mattresses	30	6 x 3	540
	36x 1Te** Biodegradable Grout/ Sand Bags (made of 40 x 25kg)	1440	0.45 x 0.25	162
Sub-total of permanent deposits footprint (m^2)				**702**

* Footprint not included as these will be under the mattresses

**Te = Tonne

[7] Note: As mentioned above, some of these temporary deposits were included on the Deposit Consent (PA/3707) and it was this which highlighted their absence from the initial ES. However, since submission of the Deposit Consent (PA/3707), the need for more temporary deposits have been identified and are included here.

2.3.2 New Temporary Deposits

During subsea operations associated with preparing the seabed and installing infrastructure, it is common practice to temporarily place installation equipment, protection material and infrastructure on the seabed prior to use and/or final deployment. The purpose of this temporary placement is to:

- Enable the utilisation of good weather windows to ensure safe deck handling, and
- To reflect the need to disconnect items from the crane at the earliest opportunity to avoid lengthy operations requiring suspension of equipment from vessel cranes in proximity to infrastructure on the seabed which is a high risk activity owing to the vessel movement.

It is anticipated that this approach will be required for the Southwark Pipeline installation with relocation of the items for use or permanent siting by divers/ROV using airbags. As such, items will be placed on the seabed at an appropriate location near the worksites for a short period of time prior to their final placement (in the case of permanent deposits), or their use followed by recovery to vessel (in the case of preparation, installation and testing equipment).

All temporary equipment required for the operation will be recovered at end of the vessel campaign and an as-left survey will be completed to confirm that no temporary equipment is left subsea.

Table 2-3 itemises the objects that will be placed on the seabed and the associated disturbance footprints. An additional 20% contingency has been included in the assessment to ensure that the worst-case is assessed.

Table 2-3 New Temporary deposits associated with the Southwark pipeline (PL5212) tie in at Sites A, B and C

Description	Quantity	Dimensions (m) L x W x H	Total footprint (m^2)
KP29 Blythe Hub Thames Tie-In Approach (Site C)			
CLUMPWEIGHTS C/W RIGGING	4	5 x 3 x 1.5	60
GROUT BAGS (1Te (40 x 25kg))*	36	1 x 1 x 1	36
TRANSPONDERS / BEACONS / SURVEY INSTRUMENTS	20	1.5 x 2 x 2	60
CONCRETE MATTRESS*	30	6 x 3 x 0.15	540
WORKBASKETS C/W RIGGING	3	3 x 3 x 2.5	27
DREDGE SKID C/W RIGGING	2	2 x 1.5 x 1.5	6
DEBRIS PIPE BASKET C/W RIGGING	2	8 x 3 x 2	48
MATTRESS HANDLING FRAME C/W RIGGING	1	6 x 3 x 1	18
24" MECHANICAL CONNECTOR C/W RIGGING	1	3.5 x 1.5	5.25
24" COATING REMOVAL TOOL C/W RIGGING	1	3 x 2 x 1	6
24” DIAMOND WIRE SAW C/W RIGGING	1	3 x 2 x 1	6
PIPE GRABBER C/W RIGGING	1	3 x 2 x 1.5	6
CUTTING SHEARS C/W RIGGING	1	3 x 2 x 1.5	6
CUT PIPE SECTIONS C/W RIGGING	5	5 x 1	25
24" PIPELINE ENVIRONMENTAL BUNG C/W RIGGING	1	1 x 1	1
24" MANIFOLD ROOF PANELS C/W RIGGING	1	1.2 x 5 x 0.5	6
24" MANIFOLD SIDE PANELS C/W RIGGING	3	4 x 3 x 0.5	36

Description	Quantity	Dimensions (m) L x W x H	Total footprint (m^2)
24" SPOOLS C/W RIGGING	2	28 x 20 x 2	1120
24" PLR C/W RIGGING	1	6 x 3 x 1	18
Total			**2030.25**
KP60 – Southwark Hub Thames Tie-in Approach (Site B)			
CLUMPWEIGHTS C/W RIGGING	4	5 x 3 x 1.5	60
GROUT BAGS (1Te (40 x 25kg)*	36	1 x 1 x 1	36
TRANSPONDERS / BEACONS / SURVEY INSTRUMENTS	20	1.5 x 2 x 2	60
CONCRETE MATTRESS*	30	6 x 3 x 0.15	540
WORKBASKETS C/W RIGGING	3	3 x 3 x 2.5	27
DREDGE SKID C/W RIGGING	2	2 x 1.5 x 1.5	6
DEBRIS PIPE BASKET C/W RIGGING	2	8 x 3 x 2	48
MATTRESS HANDLING FRAME C/W RIGGING	1	6 x 3 x 1	18
24" MECHANICAL CONNECTOR C/W RIGGING	1	3.5 x 1.5	5.25
24" COATING REMOVAL TOOL C/W RIGGING	1	3 x 2 x 1	6
24” DIAMOND WIRE SAW C/W RIGGING	1	3 x 2 x 1	6
PIPE GRABBER C/W RIGGING	1	3 x 2 x 1.5	6
CUTTING SHEARS C/W RIGGING	1	3 x 2 x 1.5	6
CUT PIPE SECTIONS C/W RIGGING	5	5 x 1	25
24" PIPELINE ENVIRONMENTAL BUNG C/W RIGGING	1	1 x 1	1
24" SPOOLS C/W RIGGING	2	28 x 20 x 2	1120
24" PIPELINE PLR C/W RIGGING	1	6 x 3 x 1	18
24" PIPELINE ABANDONEMENT & RECOVERY RIGGING	1	11 x 1	11
Total			**1,999.25**
Southwark Platform Approach (Site A)			
CLUMPWEIGHTS C/W RIGGING	4	5 x 3 x 1.5	60
GROUT BAGS (1Te (40 x 25kg)*	36	1 x 1 x 1	36
TRANSPONDERS / BEACONS / SURVEY INSTRUMENTS	20	1.5 x 2 x 2	60
CONCRETE MATTRESS*	61	6 x 3 x 0.15	1098
WORKBASKETS C/W RIGGING	3	3 x 3 x 2.5	27
DREDGE SKID C/W RIGGING	2	2 x 1.5 x 1.5	6
MATTRESS HANDLING FRAME C/W RIGGING	1	6 x 3 x 1	18
24" SPOOLS C/W RIGGING	6	28 x 20 x 2	3360
24" PIPELINE PLR C/W RIGGING	1	6 x 3 x 1	18
DRAG ANCHOR	1	7 x 8 x 5	56
24" PIPELINE INITIATION WIRE	1	500 x 0.1	50
24" PIPELINE ABANDONEMENT & RECOVERY RIGGING	1	11 x 1	11

Description	Quantity	Dimensions (m) L x W x H	Total footprint (m^2)
Total			**4,800**
Total All Sites (A, B, C)			**8,830**
Additional 20% contingency			**1,766**
TOTAL TEMPORARY FOOTPRINT			**10,596**

* As discussed in the narrative above, grout bags and mattresses will be temporarily placed on seabed prior to their final and permanent placement on the spools (covered in Table 2-2). They have been included here to ensure inclusion of this temporary footprint.

2.3.3 Deposits Summary

Table 2-4 provides the total footprint of the additional/new deposits that were not covered by the Southwark Pipeline ES alongside the original footprint to enable quantification of the increased overall footprint. The overall temporary footprint has been increased by 3% and the total permanent footprint has been increased by 9%.

Table 2-4 Footprint summary

Type	Total Footprint (m^2)
Additional/new deposits	
Seabed Disturbance from spool site dredging at Site C (Section 2.3.1)	863
Seabed Disturbance from pipeline dredging at Site C (Section 2.3.1)	84
Permanent footprint – Placement of mattresses and grout bags at the 24" skid valve tie-in at Site C * (Section 2.3.1)	702
Temporary footprint – from placement of equipment and materials on seabed prior to use for safety purposes (Section 2.3.2)	10,596
Total additional temporary footprint (Sites A, B and C)	**11,543**
Total additional permanent footprint (Site C)	**702**
TOTAL additional footprint	**12,245**
Deposits already itemised in the Southwark pipeline ES	
Temporary footprint	376,960
Permanent footprint	6,928
TOTAL footprint in original ES	**383,888**
Combined footprint for whole Southwark Pipeline installation	
Temporary (including dredging/trenching/sand wave clearance)	**388,503**
Permanent	**7,630**
% increase Temporary footprint	**3%**
% increase Permanent footprint	**9%**
TOTAL combined footprint	**396,049**

*Note – Permanent infrastructure (spools) will be covered by permanent deposits (mattresses and grout/sand bags).

2.4 Baseline Environment

2.4.1.1 Introduction

This section describes the existing baseline environment at Site C. It should be read in conjunction with Section 4 of the Southwark Pipeline ES which presents the existing baseline environment for Site A (Southwark Platform) and Site B Thames pipeline tie-in point. Site C lies in UKCS Block 48/29 and International Council for the Exploration of the Sea (ICES) rectangle 35F1.

2.4.1.2 Bathymetry

Bathymetry data obtained from the Blythe to Bacton pipeline route survey indicate water depths around Site C range from 23.5 m LAT to 36.2 m LAT with a maximum gradient of 21° (Fugro, 2018a[8]). This bathymetry is consistent with the presence of Annex I sandbanks.

2.4.1.3 Sediments and seabed features

Seabed sediments within the Site C survey area were interpreted to comprise fine to coarse locally gravelly sand with fine to medium gravel sized shell fragments and are classified as the EUNIS biotope complex A5.14 "Circalittoral Coarse Sediment" (Fugro, 2018a[8]). Megaripples and sand waves were interpreted as originating from tidal process, suggesting the presence of mobile sediments (Fugro, 2018a[8]). The station closest to Site C (station BLYBTP_ST04) comprised 98.3% sand and 1.67% gravel (Fugro, 2018a[8]).

Site C is located in an area where Annex I sandbanks are known to occur (MMO, 2021[9]). However, Site C is located 11km from the North Norfolk Sandbanks and Saturn Reef SAC. The remains of *Sabellaria spinulosa* tubes were collected in grab samples; however, no Sabellaria tubes, and thus no 'reef', was observed in stills or video photography.

2.4.1.4 Sediment contamination

Survey data (Fugro 2018a[8]) reported low Total Organic Matter (TOM) values for the station closest to Site C (BLYBTP_ST04), ranging from 0.45% to 0.61%, with a mean of 0.54%. These values are lower than background mean values reported for the SNS (UKOOA, 2001[10]). The Total Organic Content (TOC) was also low, ranging from 0.05% to 0.10%, with a mean of 0.08% (Fugro, 2018a[8]).

The Total Hydrocarbon Content (THC) values for the survey area ranged from 1.0 µg/g to 3.8 µg/g, with a mean concentration of 2.8 µg/g. The mean concentration is lower than the SNS background mean values (UKOOA, 2001[10]) (Fugro, 2018a[8]).

2.4.1.5 Benthic communities

Epifauna (the animals living on the surface of the seabed) encountered along the Blythe to Bacton corridor (which covers Site C) was generally sparse and included Hydrozoa/Bryozoa (*Flustra foliacea, Vesicularia spinosa and Nemertesia* sp.) and brittlestars (Ophiuroidea). Epifaunal diversity increased with a greater proportion of coarse material (ODE 2021[11]). The infaunal community contained 106 separate benthic taxa and 1,006 individual animals. Annelids accounted for 58.5% of the taxa and 66.3% of individuals observed. Arthropods (17.9% of taxa and 16.1% of individuals), molluscs (15.1% of taxa and 8.8% of individuals), echinoderms (1.9% of taxa and 0.7% of individuals) and other phyla (6.6% of taxa and 8.1% of individuals) were also identified. The most abundant and dominant taxon was the annelid *Polycirrus* sp (Fugro, 2018a[8]).

[8] Fugro (2018a). Blythe and Vulcan Satellites Hub development Blythe Habitat Assessment Report Unpublished.
[9] MMO (2021). Marine Activity data, Interactive tool. Available at https://explore-marineplans.marineservices.org.uk/ (Accessed November 2021)
[10] UKOOA (United Kingdom Offshore Operators Association) (2001). An analysis of UK Offshore oil & gas environmental surveys 1975-95. A study carried out by Heriot-University at the request of The United Kingdom Offshore Operators Association
[11] ODE (2021) PLA838 Thames pipeline EA Justification Document number:A-303297-S00-PERM-001 . ODE Ltd

2.4.1.6 Fish sensitivity

The fish species of commercial importance identified as spawning or nursing at Site C are largely the same as for Sites A and B, and as outlined in the Southwark Pipeline ES. The exception is Atlantic herring, which is identified as spawning within Block 48/29 between November and January.

2.4.1.7 Seabirds

Seabird sensitivity for site C (Block 48/29) and the surrounding eight blocks has been assessed using the Seabird Oil Sensitivity Index (SOSI). The index identifies areas at sea where seabirds are likely to be most sensitive to oil pollution by looking at offshore densities (based on seabird survey data from 1995 to 2015) and species sensitivity. Species sensitivity takes into consideration factors such as habitat flexibility (a species ability to locate to alternative feeding sites), adult survival rate, potential annual productivity, and the proportion of the biogeographical population in the UK. The combined seabird data and species sensitivity index values are subsequently summed at each location to create a single measure of seabird sensitivity to oil pollution.

Table 2-5 presents the seabird sensitivity within and surrounding Site C. While data is not available for each block-month, where possible sensitivity values have been interpolated from adjacent months.

The SOSI in Block 48/29 is potentially extremely high from January to February, very high in December, high in March, April, October and November, moderate in May and August and low in June, July and September.

Table 2-5 Seabird sensitivities Block 48/29 and surrounds

Block	J	F	M	A	M	J	J	A	S	O	N	D
48/23	2	2	3	3*	5	5	5	3	4	2*	2	2
48/24	1	2	2	2*	4	5	5	3	3	2*	2	2
48/25	1*	1	1	1*	3**	5**	4*	4	4*	2*	2	2
48/28	2	2	3	3*	5	5	5	3	4	2*	2	2
48/29	**1**	**1**	**3**	**3***	**4**	**5**	**5**	**4**	**5**	**3***	**3**	**2**
48/30	1*	1	3	3*	4**	5*	5	4	5	3*	3	2
52/3	2	2	3	3*	5	5	5	4	5	3*	3	2
52/4	2	1	2	2*	5	4	5	4	5	3*	3	2
52/5	1	1	3	3*	5	5	5	4	5	3*	3	2

Key	1 - Extremely High	2 – Very High	3 - High	4 - Moderate	5 - Low	No Data

Note: * Interpolated from surrounding months ** interpolated from surrounding blocks; Blocks of interest are in bold

Source: Webb et al (2016[12])

2.4.1.8 Shipping

Block 48/29 has been identified by the OGA (OGA, 2016[13]) as being within an area of very high shipping density.

A VTS for Blythe, including Site C (Xodus, 2020[14]), identified high levels of vessel activity in the area; however, a significant portion of vessel activity appeared to be attributed to the Dudgeon Offshore

[12] Webb, A., Elgie, M., Irwin, C., Pollock, C. and Barton, C. (2016). Sensitivity of offshore seabird concentrations to oil pollution around the United Kingdom: Report to Oil & Gas UK. Document No HP00061701

[13] OGA (2016). Information on levels of shipping activity. Oil & Gas Authority. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/540506/29R_Shipping_Density_Table.pdf

[14] Xodus (2020). Blythe & Vulcan Phase I: VTS/CRA/CRMP (2020 update).

windfarm which routes vessel traffic around its southwestern edge. High levels of shipping vessel activity were also identified to the north and northwest of the Southwark site. The Southwark area registered relatively low levels of in-field traffic, compared to the Blythe and Elgood sites. In-field traffic at Southwark is mainly associated with the Leman Alpha gas production platform complex, 7.4 km south of Site C. Fishing activity has also been identified in the areas surrounding Blythe and Southwark but the major traffic is associated with general shipping and passing vessels (Xodus 2020[14]).

2.4.1.9 Commercial fishing

Site C is located in ICES rectangle 35F1. According to fishing data from the MMO (2021[9]), fisheries in ICES rectangle 35F1 have predominantly targeted shellfish species. In 2016 – 2020, shellfish accounted for approximately 99% of all the catch by live weight and >97% of value in ICES rectangle 35F1 (see Table 2-6). The average annual value of all landings from within 35F1 between 2016 and 2020, which is the most recent five-year period for which data is currently available, was £662,449 with an average quantity of 445 tonnes landed (MMO 2021[9]).

Table 2-6 Fishing effort for quantity and landed values for ICES 35F1

Year	Quantity (tonnes)			Price (£)			Effort (months)
	Demersal	Pelagic	Shellfish	Demersal	Pelagic	Shellfish	
2016	1.56	N/A	1,116.22	8,065.73	N/A	1,454,308.21	12
2017	0.03	0.92	1,176.28	267.48	627.50	1,579,053.35	12
2018	0.53	0.63	1,249.65	1,430.92	304	1,966,017.35	12
2019	0.15	0.32	1,315.56	745	128	1,997,194.84	12
2020	N/A	N/A	1,820.04	N/A	N/A	2,395,201.20	12

Source: UK Government (2020)

2.4.1.10 Other marine users

The following are the closest instances of each type of seabed user occurring within 40km of Site C (Table 2-7).

Table 2-7 Closest marine users within 40km of Site C

Installation	Name	Distance (km)	Bearing (° True)
Pipeline	48/29B TO 48/29FTP GAS EXPORT	2.4	187
Well	Well 48/29- 1, decommissioned	2.0	251
Platform	48/29B, SATELLITE PLATFORM	2.4	187
Cables	HU144 -LEMAN BANK (Closed)	17.6	80
Windfarms	Orsted Hornsea Project Three (UK) Limited	10.1	314
Disposal site	HU202 -BBL PIPELINE TEMPORARY PRE-SWEEP (Disused)	17.6	80
Sailing route	RYA Route	6.6	248

No sites of marine archaeological interests or aquaculture sites have been identified within 40km of the Site C.

2.4.1.11 Seasonal sensitivities

There are periods during the year when one or more organisations have indicated to the OGA concerns about possible environmental effects of oil and gas activities in certain areas of the UKCS. Marine Scotland and the JNCC have indicated that there are the following periods of concern for Block 48/29:

- January to May and November to December – seismic survey
- January to February – drilling

Drilling and seismic survey are not included in the proposed operation.

2.5 Impact Assessment

The permanent deposits and seabed disturbance associated with operations at, and between, Sites A and B are within the limits of the Southwark Pipeline ES, and therefore the assessment still stands.

The following assesses the impact of the permanent and temporary deposits at Site C, and the temporary deposits at Sites A, B and C which were not included in the Southwark pipeline ES.

Aspects associated with the operation, which have the potential to impact the environment, and have been considered in this assessment are:

- Physical presence: The vessels and the additional subsea infrastructure and deposits can represent an obstruction to other marine activities e.g., commercial fishing and shipping, and
- Seabed footprint: The footprint from permanent deposits and dredging (Site C) and the temporary deposits (All Sites) will contribute to the established subsea footprint from oil and gas developments in the Southern North Sea.

Other potential impacts e.g., generation of underwater sound are within the limits assessed within the Southwark Pipeline ES and therefore have not been further assessed here.

2.5.1 Risk assessment outcomes summary

Table 2-8 summarises the conclusions of the risk assessment. For each activity, the assessment has considered the possibility that a receptor group may be exposed to a number of different potential impacts and that there may be different combinations of severity and likelihood e.g., low severity and high likelihood or high severity but low likelihood. The conclusions presented are for impacts which represent the greatest risk to the environment.

The risk assessment, along with proposed mitigation for each activity is discussed further in the sections below.

Table 2-8 Risk assessment

Activity	Environmental Receptor											
Physical presence	**Climate**	**Water quality**	**Seabed sediments**	**Plankton**	**Benthic communities**	**Fish**	**Seabirds**	**Marine mammals**	**Protected sites**	**Shipping**	**Commercial fishing**	**Other marine users**
Physical presence										2-C	2-C	2-C
Seabed footprint			3-C		3-C	1-A			3-C		2-C	

Key		Acceptable		Tolerable		Unacceptable

2.5.2 Physical presence

This ES concluded that the risk posed to the environment by the physical presence of the operation is ***Acceptable.*** *The use and movement of vessels, and the location of the permanent seabed structures*

are sufficiently similar to that described in the original ES that the conclusion remains the same for operations covered by this assessment.

2.5.2.1 Commercial fisheries

The assessment of fisheries statistics indicated that demersal fisheries are the most important fishery in the vicinity of Sites A and B (within ICES rectangle 35F2) and shellfish are the most important around Site C (within ICES rectangle 35F1).

The areas affected by the installation vessels are small and are of limited duration (up to 100 days) and therefore, will not significantly impact commercial fishing activity in the area.

2.5.2.2 Shipping and navigation

The operations have the potential to disrupt shipping routes as vessels move between Sites A, B and C. Sixteen shipping lanes/established patterns of vessel movement were identified in the Southwark study area (10NM around the Southwark platform), by a desktop Vessel Traffic Survey (Xodus, 2020). The survey by Xodus (2020) also showed high levels of shipping activity in the area around the Blythe Hub tie-in at Site C. However, a significant portion of vessel activity appeared to be attributed to the Dudgeon Offshore windfarm which routes vessel traffic around its southwestern edge.

Most of the shipping lanes are located either to the northeast or to the southwest of the operational area. These routes are predominantly used by vessels servicing the nearby Leman platforms and none of the shipping lanes cross the pipeline route. Safety vessels operating in the vicinity of the operation appear to be servicing the oil and gas infrastructure, particularly to the south of Southwark, whilst supply vessels service both offshore wind farms and oil and gas infrastructure. Such vessels will typically pass a minimum distance of 1NM from ongoing offshore operations involving vessels restricted in their manoeuvrability. There is sufficient sea room for vessels to change passage without causing a significant nuisance to their routes.

2.5.2.3 Mitigation measures

Project vessels will follow the international maritime organisation (IMO) standards to reduce the likelihood of collision, i.e., they will comply with Standard Marking Schedule which includes requirements for navigation, lighting, obstruction lighting and beacons.

Users of the sea will be notified of the presence and intended movements of the project vessels via the Kingfisher Fortnightly Bulletins, Notices to Mariners and very high frequency (VHF) radio broadcasts

Guard vessels will be utilised to prevent other none-project vessels entering the operation area during works, and to protect the pipeline prior to burial.

2.5.3 Seabed footprint

2.5.3.1 Protected sites

*This ES concluded that the risk posed to protected sites from the seabed footprint is **Tolerable**. The increases in the temporary and permanent footprints that result from the additional deposits described here are incremental such that the conclusion remains the same for operations covered by this assessment.*

North Norfolk Sandbanks and Saturn Reef (NNSSR) SAC

This section only applies to Sites A and B as Site C is not located within the NNSSR SAC. The SAC covers an area of 3,603.41km^2.

This ES concluded that that there will be no significant effect from sand wave clearance, trenching, dredging and permanent deposits to the NNSSR SAC.

The footprint of temporary deposits (Sites A and B) is 0.007km^2 (see Table 2-3 above) which amounts to <0.0002% of the SAC area. All temporary deposits required for the operation will be recovered at the end of the vessel campaigns and an as-left survey will be completed to confirm no temporary equipment is left subsea. There will therefore be no short or long-term impacts on site integrity.

Southern North Sea SAC

The operation is located partially within the Southern North Sea SAC, with Sites A and B being entirely within the SAC and Site C located 3.4km from the SAC. The SAC covers an area of 36,951km^2.

The conservation objectives for the Southern North Sea SAC are detailed in full in the Southwark Pipeline Installation ES. JNCC's view on the qualifying features of harbour porpoise is that the population is in a favourable condition.

For harbour porpoise the conservation objectives include the following attribute relevant to seabed disturbance:

- The condition of supporting habitats and processes, and the availability of prey is maintained.

The footprint of temporary deposits is 0.007km^2, effecting <0.000001 % of the SAC. All temporary deposits required for the operation will be recovered at the end of vessel campaign and an as-left survey will be completed to confirm no temporary equipment is left subsea. There will therefore be no short or long-term impacts on site integrity.

2.5.3.2 Fish and shellfish

*This ES concluded that the risk posed to fish and shellfish from seabed disturbance is **Acceptable**. The increases in the temporary and permanent footprints that result from the additional deposits described here are incremental such that the conclusion remains the same for operations covered by this assessment.*

Immobile eggs, juveniles and shellfish present on the seabed around the operation area will be subject to direct seabed disturbance and indirect disturbance from smothering. The loss or disturbance of habitat during operations will be localised, representing only a very small footprint of the wider region. Atlantic herring spawns within ICES rectangle 35F1 (Site C) and sandeel are found to spawn at all sites, however given the large area of both Atlantic herring and sandeel spawning grounds in the Southern North Sea, localised disturbance from the operation is unlikely to affect these species at a population level.

The fish spawning or nursery grounds of other species known to overlap the operation area also cover large areas, therefore the impacts from seabed disturbance is unlikely to affect any species on a population level.

The potential impacts to fish and shellfish from seabed disturbance caused by operation is localised and will not be significant.

2.5.3.3 Benthic fauna

*This ES concluded that the risk posed to benthic fauna from seabed disturbance is **Tolerable**. The increases in the temporary and permanent footprints that result from the additional deposits described here are incremental such that the conclusion remains the same for operations covered by this assessment.*

While the operation will impact individuals, the benthic community within the vicinity of the operation area is not expected to be impacted long term by the operations. The primary impact to the benthic community from the operation is direct disturbance to the seabed resulting in smothering and mortality of the benthic fauna. The most vulnerable species are epifaunal species which are incapable of moving away from the disturbance. Infaunal species that live within the sediment are adapted to

smothering and to some extent will be protected by overlying sediment. As detailed in Section 2.4.1.5 the epifaunal community within the operation area is sparse and lacks diversity.

Localised dredging will result in the redeposition of suspended sediments and could lead to the burial and smothering of benthic fauna. The disturbance incurred will be limited to the operational area. Once dredging is complete, sediment deposition, followed by re-colonisation, will start to restore the disturbed areas. As discussed in the Southwark pipeline ES, recovery is expected within a year given the high resilience of species found in the operation area.

Mattresses and grout and sandbags will be put in place at the tie in location at Site C altering the seabed substrate and habitat, leading to the loss of the current habitat and potential mortality of benthic fauna. Any seabed disturbance and alteration impacts due to the placement of mattresses will be confined to the immediate vicinity of the tie-in locations, in an area previously dredged. In addition, it is expected that, over time, some of the mattresses and grout/sandbags will be buried by sand deposition owing to the hydrodynamic regime in the area.

The addition of mattresses may create habitats for benthic organisms that live on hard substrates e.g., sponges, soft corals and hermit crabs. However, it is possible that over time, the natural movement of sediments across the seabed may gradually bury the concrete mattresses and fill the spaces between structures.

The placement of artificial structures creates the potential for scour pits to form around the base of structures. However, a study at the North Hoyle offshore windfarm found that the addition of rock placement for infrastructure protection failed to identify any environmental implications to the regional sediment transport regime within the operation site, with no distinct scour pits identified within the site (OSPAR, 2008). Given recent evidence of scour observed at the location of the Southwark platform, the formation of scour pits around the artificial structures is likely. However, the OSPAR (2008) report describes offshore windfarm foundations as having a relatively small area of impact in terms of direct impact on the seabed from the foundation pieces, scour pits and scour protection.

In consideration of the above factors, disturbance of seabed communities in the local area is seen as negligible and is not expected to cause a significant effect as per the conclusions of the Southwark Pipeline ES.

2.5.3.4 Seabed sediments

*This ES concluded that the risk posed to seabed sediments from seabed disturbance is **Tolerable**. The increases in the temporary and permanent footprints that result from the additional deposits described here are incremental such that the conclusion remains the same for operations covered by this assessment.*

Seabed sediments in the vicinity of the of the operation area comprise of sand, gravelly sand and sandy gravel with shell fragments.

Seabed sediments under the permanent deposits will be permanently impacted, but generally recovery is expected on a timescale of months to years, as a result of natural sediment movement and recolonisation by benthic species (Hiddink *et al.* 2017). Deposits and the localised dredging at Site C have the potential to alter hydrodynamic patterns which in turn could affect the sediment supply/transport to an area due to associated seabed elevation changes (DECC 2016). Alterations to soft bottom sediments can affect current patterns causing scour and changes in sand ripple patterns and sediment grain size (IOG 2020). However as discussed in the Southwark pipeline ES the effects of scour will be very localised and will not change the sedimentary habitat in the area.

2.5.3.5 Mitigation measures

Concrete mattresses, grout/sand bags will only be employed to protect the tie-in spools. Cover will be kept at the minimum required to ensure pipeline protection is adequate. Good industry practice will be used when deploying any pipeline protection.

2.5.4 Cumulative and transboundary impacts

*This ES concluded that the in-combination, cumulative and transboundary impacts from the operation are **Acceptable**. The increases in the temporary and permanent footprints that result from the additional deposits described here are incremental such that the conclusion remains the same for operations covered by this assessment.*

The Southwark pipeline ES considered the potential for in-combination and cumulative impacts from the proposed deposits and:

- Past, present and future oil and gas projects, and
- Other seabed users e.g., commercial fishing, wind farms, marine aggregate extraction.

2.5.4.1 Permanent disturbance

The permanent deposits to be placed at Sites A and B are within the limits of the Southwark pipeline ES.

The permanent deposits (concrete mattresses and grout/sand bags) at Site C generate an additional footprint of 702m^2 (see Section 2.3.3 above) which increases the original footprint by 9%. Given that this area is small and will have a localised impact, the potential for cumulative effect is limited, and the conclusions of the Southwark pipeline ES that the risk is **Acceptable** remains the same for the proposed additional activities.

2.5.4.2 Temporary disturbance

The temporary seabed disturbance at and between Sites A and B is within the limits of the Southwark pipeline ES. The temporary disturbance from dredging at Site C, and temporary deposits at Sites A, B and C generate an additional footprint of 11,459m^2 (0.011km^2). Overall the temporary footprint increases by 3% (see Section 2.3.3 above). The area affected is localised and this minor increase in seabed footprint will not cause a significant cumulative impact. Therefore, the conclusion of an **Acceptable** risk in the Southwark pipeline ES remains the same for operations covered by this assessment.

2.5.4.3 North Norfolk Sandbanks and Saturn Reef SAC (Sites A and B)

*This ES concluded that the potential overall cumulative impact on the sediment, benthos and conservation objectives of the NNSSR SAC is **Acceptable**.*

There has been no change to the project description which affects this conclusion. Therefore, this conclusion is still valid.

2.5.5 Assessment Conclusion

- The risk posed by the physical presence of the deposits is **Acceptable**.
- The risk posed to the benthic community and protected sites from the seabed footprint of the operation is deemed **Tolerable.**
- The risk associated from the seabed footprint of the operation to the fish species identified as spawning or using the area as a nursery ground has been assessed as **Acceptable**.
- The risk posed to seabed sediments is **Tolerable**. Permanent deposits will result in a localised change in sediment type but will not impact sediment transport pathways. North Norfolk

Sandbanks and Saturn Reef SAC - the risk posed to the NNSSR SAC from seabed disturbance has been assessed as tolerable. The Southwark pipeline ES concluded that the operation will not hinder the achievement of the conservation objectives and therefore will not adversely affect the integrity of the European site. Additional operations at Site C are outside the SAC and will not affect the integrity of the site.

- The risk posed by the potential for cumulative effects is **Acceptable**.

3. EMISSIONS - UPDATE

3.1 Introduction

Sources of emissions that were included in the Southwark pipeline ES were:

- Emissions from all vessels associated with the pipeline installation and commissioning, and
- Emissions associated with potential future remedial operations associated with the pipeline should they arise.

The activity that was not included in the Southwark pipeline ES was:

- Venting of gases used in the pipeline dewatering process which is required prior to commissioning the line.

The emissions associated with the venting are calculated in Section 3.4 below. However, in addition to assessing the impact of the venting, the opportunity has also been taken to update other emissions data to ensure the most up-to-data is impact assessed.

3.2 The Proposed Dewatering Process

When installed, the Southwark pipeline will be full of chemically treated seawater. To commission it safely, this seawater needs to be removed from the pipeline. If the pipeline is not sufficiently dry before hydrocarbon gas is introduced, this can lead to the formation of hydrates which would ultimately block the pipeline. This process is referred to as 'dewatering' and is achieved using inert nitrogen gas to push a pig, or a series of pigs separated by chemicals (e.g., gels and glycol), through the pipeline[15].

Following successful displacement of the water, and prior to the commencement of production from the Southwark platform, the nitrogen within the pipeline must be displaced with hydrocarbon gas, introduced via the Thames 24" valve skid. During this displacement process, the hydrocarbon gas will mix with the nitrogen and this mixture will need to be safely disposed of leaving the pipeline full of hydrocarbon gas only, and ready for use.

Once the pipeline is dewatered it will be pressurised with nitrogen to 36bara. This is done to minimise the differential pressure between the existing and new sections of the main 24" pipeline prior to displacing the nitrogen with the hydrocarbon gas. If the pressure difference between the existing and new sections is not managed there is a risk that the temperature change could result in a fracture of the pipeline. As described in Section 3.3 below, numerous methods for disposing of the gas mix were considered. However, owing to technical feasibility and safety considerations, controlled venting of the gas at the Southwark Platform was considered the only viable option.

3.3 Consideration of Alternative Gas Disposal

Consideration was given to alternative means of disposing of the nitrogen/hydrocarbon gas mix in order to avoid venting the gas. However, owing to technical feasibility and safety concerns, the alternatives were not considered viable.

A key alternative considered was to flare the gas rather than vent it. However, the Southwark platform does not have a flare stack, use of the temporary flare booms on the drilling rig is not feasible and even if it were possible to flare the gas mix the concentrations of nitrogen in the gas stream would make ignition, and sustained combustion, problematic and potentially hazardous due to the risk of

[15] All chemicals used and/or discharged in the dewatering process will itemised and impact assessed within the relevant Chemical Permit.

flame out. The technical and logistical difficulties alongside the potential for risks to safety are such that flaring the gas is not considered to be a viable solution.

3.4 Quantification of greenhouse gas (GHG) emissions from the current operation

3.4.1 Venting Quantities

Following the dewatering process described in Section 3.2 above, the Southwark pipeline will contain approximately 348,000m^3 n.t.p[16] (i.e., 418 tonnes) of nitrogen at a pressure of 3.6MPa (36 bara). In the process of displacing the pipeline contents to natural gas, and to ensure that the nitrogen is fully purged from the line with a maximum nitrogen concentration of only 5% at any single location in the entire pipeline, it is estimated that up to 151 tonnes of hydrocarbon gas will be need to be vented alongside the nitrogen. This volume has been estimated using the back gassing and venting calculations that were developed for Blythe. Greater quantities of nitrogen and hydrocarbon gas are required for the back gassing process at Southwark than those used at Blythe in order to manage the temperature/pressure changes across the 24" skid valve (see Section 3.2). For Blythe, the starting pressure is 1bara while for Southwark the starting pressure is 36bara[17]. Further, a 20% contingency has been added to ensure a worst-case estimate.

Overall, the venting quantity has been estimated taking account of:

- Engineering efforts designed to reduce venting emissions to the atmosphere, drawing on improvements identified for Blythe and Elgood back gassing which have been corroborated through flow assurance modelling, and
- Availability of actual emissions data from the Blythe and Elgood wells.

3.4.2 Emissions Estimates

To better enable assessment of the impact of each emission, all gases are compared to CO_2, which has a GWP of 1. When the GWP is applied to each gas, this results in the tonnage of CO_2 equivalent (CO_2e) of each gas.

The addition of venting to the Southwark pipeline commissioning process leads to a change in the overall quantity and composition of greenhouse gas emissions associated with the project. It was expected that the venting would significantly increase the overall emissions in terms of the total CO_2e. However, since submission of the Southwark Pipeline ES in April 2021, the project has matured enabling more accurate estimates of all other associated emissions, based upon data that were unavailable in the earlier stages of the project planning process. The following changes can now be factored into the overall emissions estimate:

- The number of vessel days has been reduced (with the exception of vessel use associated with pipeline commissioning and tie-in, which has increased), and

[16] Normal Temperature and Pressure

[17] To avoid exceeding the pipeline minimum design temperature limit during the Southwark back gassing it will be necessary to manipulate the pressure profile across the 24" skid. On this basis, it is reasonable to assume a starting nitrogen pressure of 36bara will be required to result in a differential pressure across the 24" skid of approximately 55bar (taking downstream operating pressure as circa 90barg minus upstream nitrogen pressure of 35barg). With this pressure profile the associated cooling due to the pressure drop during back gassing will be approximately 27.5°C (applying the rule of thumb of 1°C fall per 2bar pressure drop). The ambient seabed temperature is anticipated to be in the order of 7.8°C resulting in a downstream temperature -19.7°C (which is just within the 24" skid design temperature of -20°C).

- The vessel fuel consumption rates have been reduced based on updated vessel specific information.

As a result of these changes, the projected atmospheric emissions from vessel usage during installation of the Southwark pipeline have been reduced from 57,454 tonnes CO_2e to 11,096 tonnes CO_2e (including the contingency remedial works). Table 3-1 itemises the current estimated emissions associated with vessel use during the installation and commissioning of the Southwark Pipeline. Table 3-1 also provides details on why or how the emissions from vessels has been reduced. All figures include a 50% contingency to account for additional vessel days should they be required, and thus represent the worst-case.

Table 3-2 shows the total estimate of all emissions associated with the Southwark Pipeline, and includes:

- Emissions from activities covered within the original Southwark Pipeline ES (e.g., vessels emissions), now updated owing to maturation of the project, and
- Emissions from the venting of the pipeline during commissioning, which is the subject of this document.

Table 3-2 shows that the emissions associated with the Southwark Pipeline Installation are estimated at 14,871 tonnes of CO_2e. The 151 tonnes of hydrocarbon gas associated with the Southwark pipeline back gassing operation will have a carbon dioxide equivalent (CO_2e) of up to 3,775 tonnes, which will be vented at the Southwark Platform. This figure assumes that the vented gas will be 100% methane. However, in reality, the hydrocarbon gas will have a lower methane content, around 85% - 92%, amounting to a predicted CO_2e tonnage in the range of 3,210 – 3,474 tonnes.

Table 3-1 Vessel emissions associated with the Southwark pipeline installation and commissioning

Aspect	Fuel Use (t/d)***	Days	Total Fuel Use (t)	Emissions (t)							
				CO_2	CO	NO_x	N_2O	SO_x	CH_4	VOC	CO_2-e
GWP Values				**1**			**298**		**25**		
Pipeline Installation, Tie-in and Commissioning											
Pipeline installation vessel	48.2	14.8*	713	2,281	11.2	42	0.16	0.71	0.13	1.43	2,331
Sand wave clearance vessels	11.2	12.3**	138	441	2.2	8	0.03	0.14	0.02	0.28	451
Trenching vessel	25.8	6.7***	172	550	2.7	10	0.04	0.17	0.03	0.34	562
Dive support vessel -spool tie ins, mechanical connectors, dewatering	14.4	48.9**	702	2,246	11.0	41	0.15	0.70	0.13	1.40	2,295
Construction Site Vessel – pre-commissioning	7.8	7.3**	57	182	0.9	3	0.01	0.06	0.01	0.11	186
Pipe supply vessel	6.9	14.8*	102	326	1.6	6	0.02	0.10	0.02	0.20	333
Guard vessel	0.4	14.8*	6	20	0.1	0	0.00	0.01	0.00	0.01	21
Anchor handling vessels (2vessels)	34.4	6.7*	229	734	3.6	14	0.05	0.23	0.04	0.46	750
Sub-Total	-	**126**	**2,119**	**6,780**	**33**	**125**	**0.5**	**2.1**	**0.4**	**4**	**6,929**
Total with 50% contingency added for vessel days	-	**189**	**3,178**	**10,171**	**50**	**188**	**0.7**	**3.2**	**0.6**	**6**	**10,393**
Remedial Operations											
Rock deposit vessel	21.5	4	86	275	1.4	5	0.02	0.09	0.02	0.17	281
Rock deposit vessel (50% contingency added for vessel days)	21.5	6	129	413	2.0	8	0.03	0.13	0.02	0.26	422
Worst case grand Total		**195**	**3,307**	**10,583**	**52**	**195**	**0.7**	**3.3**	**0.6**	**6.6**	**11,096**

* Inaccuracies in original Southwark pipeline ES, this was reflecting entire operation rather than actual pipelay vessel days.

** revised to reflect current scheduling programme.

*** refinement in fuel use per day due to availability of more accurate data.

Note: all figures have been rounded.

Table 3-2 Total emissions from Southwark Pipeline Installation and Commissioning

Activity	Source of information	Estimated tonnes CO_2e
Vessel emissions from Southwark pipeline installation and commissioning	Table 3-1 above.	10,393
Commissioning Southwark pipeline (degassing/venting) from Blythe/Thames tie-in to the Southwark platform.	Currently estimated 151 tonnes hydrocarbon gas.	3,775
Contingency remedial operations at Southwark	Table 3-1 above.	703
TOTAL Southwark Pipeline Installation Emissions		**14,871**

3.4.3 Emissions Summary

Table 3-3 aims to provide an overview of the Southwark pipeline emissions estimates as they currently stand following refinement of the operation, rationalisation of vessel use, and informed calculation of the worst-case venting volume. It also provides a comparison with the initial estimates from the initial Southwark Pipeline ES. While the configuration of the sources of emissions, and thus the composition of the emissions, has changed owing to the inclusion of the pipeline venting operation, the estimated emissions generated from the installation of Southwark pipeline have substantially reduced from 58,454 tonnes CO_2e to 14,871 tonnes CO_2e. This amounts to a 75% reduction in the total emissions associated with the Southwark pipeline installation and commissioning. The gas emitted due to the Southwark pipeline vent amounts to 25% of the total Southwark emissions (Table 3-3).

Table 3-3 Comparison of the original and current CO_2e estimations

	CO_2e (Tonnes) Worst-case Estimates		**% contribution to total Southwark Pipeline Emissions**	**Change from Original Estimates**
Work scope	**Initial Emissions Estimates in Southwark pipeline ES**	**Current Estimates based on updated data**		
Installation and Commissioning of Southwark Pipeline - vessels only	57,388.65	10,393	70%	82% reduction
Contingency remedial operations at Southwark*	1,065.78	703	5%	34% reduction
Venting of pipeline	0	3,775**	25%	100% increase
Total Southwark Pipeline Emissions (CO_2e)	**58,454**	**14,871**	**100%**	**75% reduction**

*This remedial work is included to account for remedial works that may be required in the 15-year lifespan of the pipeline.

** In IOG's response to Notice Pursuant to Regulation 12 (1) dated 10th December 2021, this value was estimated to be 69,012 tonnes CO_2e. This was an indicative and highly conservative worst case figure and commitments were made in December to reduce this by up to 45% (to 31,055 tonnes of CO_2e). Since then, engineering design has progressed and actual data from the commissioning of the Blythe pipeline is now available, allowing this figure to be reduced further to 3,775 tonnes of CO_2e.

3.5 Impact Assessment

Emissions from the Southwark Pipeline Installation could affect local air quality and contribute to climate change. However, as discussed in the Southwark pipeline ES, the effects of gases released from operations on local air quality is not considered to have a significant effect offshore given that there are no proximate receptors. The assessment below therefore focuses on the environmental impacts of greenhouse gas emissions of climate change.

Table 3-4 below lists the three direct greenhouse gases (i.e. gases that trap and absorb heat which raises the earth's temperature) which will be released during combustion and venting operations, and how these affect the climate. Although nitrous oxide and methane have higher GWP's (i.e. they are more effective at trapping heat), they are generally shorter lived within the atmosphere with methane remaining in the atmosphere for only about 10 years. CO_2 is released in much greater quantities when fossil fuels are burned and is persistent in the atmosphere for a greater period of time.

Of note, the nitrogen that will be vented alongside the methane during the proposed venting at Southwark is not a greenhouse gas and therefore will not contribute to climate impacts.

Average global temperatures have risen by more than 1°C since the 1850s. In the UK and globally, effects from climate change are already visible. Indeed, 2015-2020 were the hottest years ever recorded in the UK and by 2070 it is projected that:

- Winter will be between 1 - 4.5°C warmer and up to 30% wetter, and
- Summer will be between 1 - 6°C warmer and up to 60% drier[18].

Such increases in temperature result in many effects both globally and locally, including:

- Changing rainfall patterns,
- Rising sea levels,
- Increased risk of heatwaves, famine, species extinction, forest fires, floods and drought.

Table 3-5 shows the relative contributions of the Southwark pipeline installation to:

- The annual offshore GHG emissions from the UK offshore oil and gas industry, and
- The annual GHG emissions from UK industry as a whole.

These contributions are then compared to the 3rd carbon budget allocation as set out under the Climate Change Act 2008 (Table 3-5).

The Climate Change Act 2008 forms the basis of the UKs approach to tackling climate change. The Act commits the UK government, by law, to reduce greenhouse gas emissions by at least 100% of 1990 levels (net zero) by 2050 (including devolved nations). The Act requires that the UK government sets legally binding carbon budgets as stepping stones towards the 2050 net zero target[19]. Operations at Southwark fall within the 3rd carbon budget which lasts from 2018-2022.

According to the Climate Change Committee (CCC) the UK is currently on track to meet this target (3rd allocation budget). However, the UK is not on track to meet the 4th (2023 to 2027) or the 5th (2028 to 2032) carbon budget targets. The CCC has published its recommendations for the 6th carbon budget[20] which set out a far more challenging budget involving the decarbonisation of the power sector through fuel switching and measures to reduce unnecessary methane flaring and venting.

[18] Met Office (2021). Effects of climate change. [online] Available at: https://www.metoffice.gov.uk/weather/climate-change/effects-of-climate-change
[19] CCC (2021). A legal duty to act. [online] Available at: https://www.theccc.org.uk/the-need-to-act/a-legal-duty-to-act/
[20] CCC (2020). Policies for the Sixth Carbon Budget and Net Zero. . [online] Available at: https://www.theccc.org.uk/wp-content/uploads/2020/12/Policies-for-the-Sixth-Carbon-Budget-and-Net-Zero.pdf

The OGA Strategy, which came into force in 2021, incorporates a range of new net zero obligations for the UK oil and gas industry which include reducing, as far as reasonable in the circumstances, GHG from sources such as flaring and venting. The OGA also expects the industry to have zero routine flaring and venting by 2030. The venting proposed at Southwark as part of the pipeline dewatering process will not be a routine activity. It is a one-off event required to bring the pipeline into service.

Given the sensitivity of the atmosphere and climate as a receptor, it is unrealistic to conclude that the impact of any emissions, no matter how small, are 'acceptable'. However, Table 3-5 indicates that the contribution of the Southwark pipeline installation to the 3rd carbon budget allocation is very small. It is felt that the operations at Southwark are in-line with the OGA strategy and commitments of the Climate Change Act.

Table 3-4 Greenhouse gas emissions and effects

Greenhouse gas	Global warming potential	Source	Effect
Carbon dioxide CO_2	1	Released from fossil fuel combustion i.e. during flaring and from vessels. Once it is emitted into the atmosphere, 40 percent still remains after 100 years, 20 percent after 1,000 years, and 10 percent as long as 10,000 years later	Accounts for 76% of global human induced emissions. Traps and absorbs heat which raises the earth temperature. Dissolves into the ocean causing ocean acidification
Nitrous oxide N_2O	298	Released from fossil fuel combustion i.e. during flaring and from vessels. Remains in the atmosphere for approximately 100 years.	Accounts for 6% of human induced emissions.
Methane CH_4	25	Small quantities are released from fossil fuel combustion but the primary source of methane emissions in the oil and gas industry is venting. Remains in the atmosphere for approximately 10 years.	Accounts for 16% of human induced emissions.

Table 3-5 Contribution to UK greenhouse gas emissions and carbon budget

Work scope	Current CO_2e estimation from the project development	% of annual greenhouse gas emissions from the UK offshore oil and gas industry in 2018* (18.3 Mt, OGUK 2020)	% of total UK annual greenhouse emissions** (555 Mt, OCNS 2021)	% of 3rd Carbon budget*** (2,544 Mt Climate Change Act 2008)
Predicted Southwark Pipeline installation emissions (2022)	14,871	0.08	0.003	0.0006

*Based on OGUK 2020

** Based on ONS 2021

*** Based on Climate Change Act 2008, 3rd carbon budget

3.5.2 Mitigation

IOG appreciates that limiting impacts to climate change and transitioning to a more sustainable economy are critical challenges of our time. In this context, IOG recognise the importance of the UK's 2050 Net Zero target as part of global efforts to meet the goals of the 2015 Paris Accord. To help achieve this IOG has committed to eight targets within its Climate Change and Sustainability Policy. These targets aim to ensure that IOG routinely evaluates its greenhouse gas emissions and puts measures in place to mitigate the existing and projected emissions. IOG's Climate Change and Sustainability Policy and commitment is provided in full in Section 8 of the Southwark pipeline ES.

Further to the above, numerous measures will be taken to ensure that the emissions from the proposed venting are kept as low as is reasonably practicable. The following measures have been identified:

1. Venting will be completed at as low as possible pressure. The pressure regime is limited by the pressure drop which can be tolerated over the 24" valve skid while remaining within design conditions and is managed by increasing the Southwark pipeline pressure with nitrogen. Current basis is this pressure must be 36 bara to remain within design limits.
2. The limiting design condition of the 24" valve skid has been identified as the low temperature design limit (-20°C) and work is underway to evaluate whether this can be reduced without adverse effect on metallurgic limits to allow a greater pressure drop and thus reduce the nitrogen content between the 24" valve skid and Southwark.
3. The vent system will be temporarily modified for the optimised pressure regime.
4. In conjunction, specific dispersion modelling will be completed to identify whether the permissible venting rate can be temporarily altered for back gassing operations.
5. The vent method will be evaluated – to establish whether it is beneficial to vent at steady state pressure versus allowing pressure to increase and then be drawdown.
6. The Southwark start-up method will be reviewed to determine how the sequence of well start-up rate and timing can be optimised such that benefit can be realised from the blending effects with Blythe and Elgood production at the 24" valve skid to remain within the Bacton nitrogen entry specification (5 mol%) (this may allow for a greater residual nitrogen content to be acceptable in the Southwark export prior to mixing).
7. Flow assurance with compositional tracking will be completed to evaluate these measures and inform the vent estimate.

IOG remains committed to exploring further options to reduce the venting emissions and successes will be reflected in the vent consent which will be applied for prior to the venting activity.

3.5.3 Cumulative and transboundary impacts

The greatest contributions to greenhouse gas in the area are likely to be from the wider Blythe Hub Development. The Blythe Hub Development comprises the following:

- Drilling and well testing (including vessel emissions) of the Blythe and Elgood wells – operations complete.
- Drilling and well testing (including vessel emissions) of 3 x Southwark wells – planned to commence 2022.
- Project vessel emissions associated with Blythe platform and Elgood and Blythe pipeline installation– operations complete
- Emissions associated with commissioning the Blythe and Elgood pipelines – operations complete

The above activities were covered in the Blythe ES (reference D/4208/2018). The total estimated tonnes CO_2e from these activities is 99,053, resulting in a total of 113,643 tonnes of CO_2e with inclusion of Southwark pipeline installation emissions (14,871 tonnes of CO_2e) (Table 3-6). While the sensitivity of the global atmosphere as a receptor can only be considered highly sensitive, the GHG emissions associated with the overall Blythe Hub Development (including Southwark pipeline) represent a very small percentage of global GHG emissions and do not compromise the UK carbon budget targets (amounting to 0.004% of the UK allocation) (Table 3-6).

In addition to the Blythe Hub Development there are a marine aggregate site, shipping lanes and the proposed North Vanguard West offshore wind farm within 40km of the development. These other sea users will also generate atmospheric emissions contributing to the greenhouse gas emissions in the area. However, during the installation and commissioning phases, the Blythe Hub Development and Southwark Pipeline is likely to be the largest single contributor in the region as it will involve venting of the newly installed Southwark export line prior to its commissioning, well testing of the Southwark, Elgood and Blythe wells and all emissions associated with construction and installation vessels. However, following installation greenhouse gas emissions associated with the Blythe Hub Development (including Southwark pipeline) will drop to a low level.

Table 3-6 Cumulative contribution to UK greenhouse gas emissions and carbon budget

Work scope	Current CO_2e (tonnes) estimation from the project development (Blythe Hub Development and Southwark Pipeline)	% of annual greenhouse gas emissions from the UK offshore oil and gas industry in 2018* (18.3 Mt, OGUK 2020)	% of total UK annual greenhouse emissions** (555 Mt, OCNS 2021)	% of Carbon budget*** (2544 Mt Climate Change Act 2008)
Blythe Hub Development	99,053 *	0.54	0.02	0.004
Southwark ES Pipeline installation and commissioning	14,871	0.08	0.003	0.0006
TOTAL Cumulative CO_2e	113,643.00	0.62	0.02	0.004

*Based on OGUK 2020

** Based on ONS 2021

*** Based on Climate Change Act 2008, 3rd carbon budget

*Emissions data sourced from Environmental Emissions Monitoring System (EEMS) DR/2065/0/2 and DR/2129/2/1, Southwark drilling permits (DRA/893 and 893), Blythe Hub Development ES.

3.5.4 Assessment conclusion

This assessment respects the sensitivity of the global climate as a receptor and recognises that continued emissions of GHG gases will increase the risk of further climate change and long-lasting impacts.

Nonetheless, it is felt that the venting operation associated with commissioning the Southwark pipeline can be considered **Tolerable** given that:

1. The venting operation associated with the pipeline commissioning is a one-off,
2. The UK carbon budget is unlikely to be compromised by the emissions (with Southwark emissions amounting to 0.0006% of the UK allocation),
3. The alternatives considered all present safety and technical risks (Section 3.3),

4. Commitments are in place to further reduce the estimated venting quantities and efforts will be made to ensure the 20% contingency allowance is not used,
5. Once operational, the emissions from the Southwark development will be low by comparison to older oil and gas assets, and
6. While the sources of emissions now include venting such that the overall composition of the gases has changed, the quantity of CO_2e is lower than that estimated in the initial Southwark pipeline ES owing to the maturation of project data:
    a. The total Southwark emissions have reduced from 58,454 CO_2e to 14,871 CO_2e. Of this quantity, 25% arise from the venting activity.

4. OVERALL CONCLUSION

The present document itemises the changes to the proposed Southwark pipeline installation operation and quantifies the changes to key potential impacts with regard to:

- Added seabed deposits and the associated permanent and temporary footprints, and
- Changes in the emissions owing to:
    - The venting of the Southwark pipeline prior to commissioning, and
    - Rationalisation of the vessel use and fuel consumption

Table 4-1 summarises the changes between the original Southwark pipeline ES and the current document. As shown, there is no change to the overall EIA outcomes with the worst case impacts associated with the seabed deposits and the emissions being considered '**Tolerable**'.

Table 4-1 Comparison of the original Southwark pipeline ES outcome with the current assessment

Impact	Description	Worst Case ES Assessment (April 2021)	Incremental Change	Current Assessment (March 2022)
Seabed Deposits				
Physical Presence	Use of vessels and additional infrastructure on seabed and over existing pipelines at Sites A, B and C	**Acceptable**	No significant change to vessel numbers or movement and negligible increase in infrastructure in areas which already have infrastructure *in situ*	**Acceptable**
Seabed Disturbance	Increased footprint of permanent deposits and disturbance at Site C and increased footprint of temporary deposits at Sites A, B and C	**Tolerable**	Current changes amount to: ▪ 3% increase in temporary deposits, and ▪ 9% increase to permanent deposits	**Tolerable**
Emissions				
Emissions to air	▪ Increase in emissions of methane as a result of venting, and ▪ Decrease in emissions from vessel use	**Tolerable**	75% reduction in overall emissions	**Tolerable***

* Note that the total emissions from the Southwark pipeline installation and commissioning amount to only 0.0006% of the UK's 3rd carbon budget allocation (see Section 3.5 above). However, owing to the sensitivity of the global atmosphere as a receptor and IOG's Climate Change and Sustainability Policy, it is not considered appropriate to assess the impact of emissions as 'Acceptable' – hence set here to Tolerable.

APPENDIX I: OPRED NOTIFICATIONS

Following the statutory consultation process, two Notices Pursuant to Regulation 12 (1) were issued. The key comments of relevance to this document were as follows:

- OPRED Notice Pursuant to Regulation 12 (1) 3rd November 2021 in response to the original Southwark Pipeline ES submitted on the 19th April 2021:
  - Comment 7: Page 5-23. Section 5.5.1.1. The figure 57,389 tonnes carbon dioxide equivalent (CO2-e) is presented in the body of the text in relation to CO2e released from the proposed project, however this quantity appears to be different to that of the totals presented in Table 5-9, and
  - Comment 9: Will any back gassing of any gases, such as nitrogen, in the pipeline be required prior to commissioning the pipeline?
- OPRED Notice Pursuant to Regulation 12 (1) 10th December 2021 in response to IOG's response to the above:
  - Comment 2: Page 5-23. Section 5.5.1.1. Regarding the response provided to Comment 7, IOG has assessed the worst case scenario of associated emissions to atmosphere being 58,454 tonnes CO_2(e). However, this doesn't seem to have been very well presented/discussed/concluded on page 7-5, section 7.3.2.3 Greenhouse gas emissions. Please amend/clarify, and
  - Comment 3: Regarding the response provided to Comment 9 regarding the back gassing of the pipeline please could IOG qualify how the figures provided relate to the current impact assessment; have any changes occurred to the current conclusions presented in the ES? If so why? Present the information accordingly.
  - Comment 4: The supporting Pipeline Works Authorisation PA/3703 and Deposit Consent application PA/3707 submitted to the OGA contains information about temporary deposits, however this information does not seem to have been included in the ES. Please amend/clarify.

Following response to the above by IOG, an OPRED Notice Pursuant to Regulation 12 (3) was issued on the 4th February 2022 stating that the changes to the operation ought to be made public because the information is directly relevant to reaching a conclusion on whether the project is likely to have a significant effect on the environment. The Notice requested the following:

- All Further Information provided in response to No. 2, No. 3, and No. 4, of the Regulation 12 (1) notice sent by OPRED to IOG on 10th December 2021.