CHRYSAOR

LOGGS Area Decommissioning – LOGGS LDP2 – 5 Comparative Assessment Report

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CONTENTS

REVISION CHANGE NOTICES

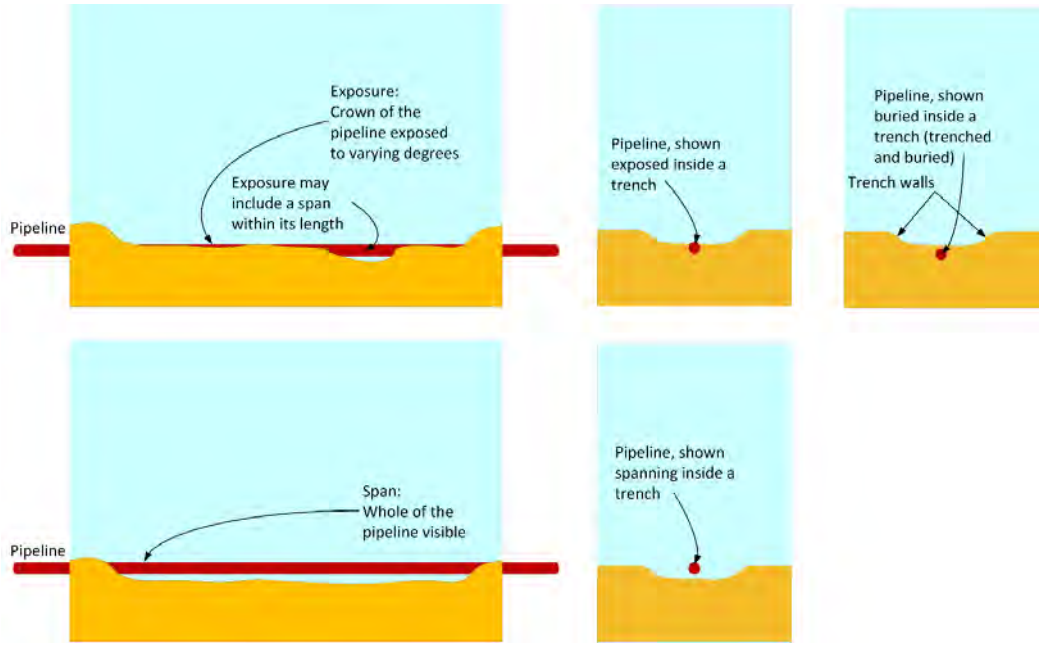
Revision	Location of Change	Brief Description of Change
C1	Throughout document	Implementation of responses to OPRED comments
C2		Minor updates
C3		Minor updates
C4		Minor updates
C5		Implementation of responses to OPRED comments
C6		Implementation of responses to OPRED comments

GLOSSARY OF TERMS

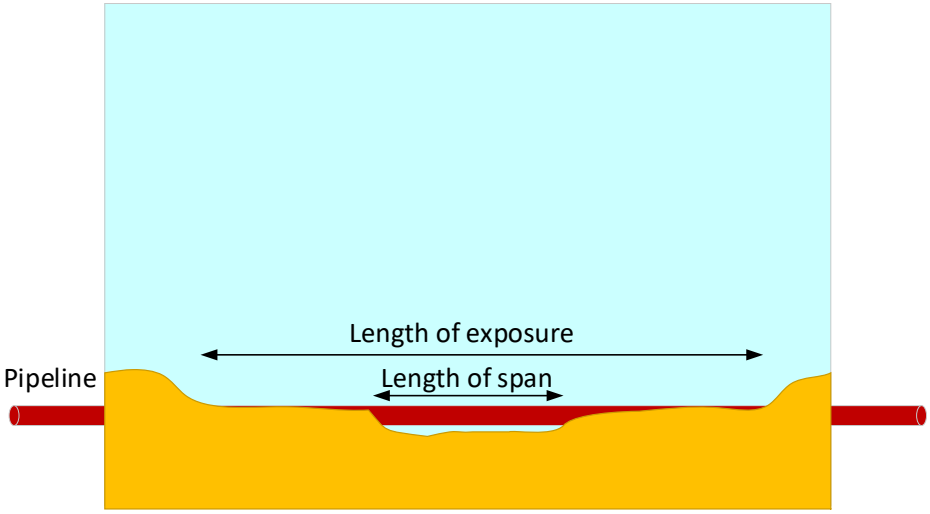
Abbreviations

AHP	Analytical Hierarchy Process
BEIS	Department for Business, Energy and Industrial Strategy
Buried	Not “exposed”. Covered in sediment or deposited rock
CA	Comparative Assessment
CMS	Caister Murdoch System
CO_2	Carbon Dioxide
CSV	Construction Support Vessel
Cut End	refer definition for “Pipeline End”
DWC	Diamond Wire Cutting
Exposure	Pipeline exposure occurs when the crown of the pipeline or umbilical can be seen. In this document, an exposure may be spanning or non-spanning.
FAR	Fatal Accident Rate
FishSAFE	The FishSAFE database contains a host of oil & gas structures, pipelines, and potential fishing hazards. This includes information and changes as the data are reported for pipelines and cables, suspended wellheads pipeline spans, surface & subsurface structures, safety zones& pipeline gates (www.fishsafe.eu).
FLTC	UK Fisheries Offshore Oil and Gas Legacy Trust Fund Limited
HAT	Highest Astronomical Tide
HazMat	Hazardous Material
JNCC	Joint Nature Conservation Committee
LDP	LOGGS Decommissioning Programme
LOGGS	Lincolnshire Offshore Gas Gathering System
MCDA	Multi-criteria Recommendation Analysis
MeOH	Methanol
MFE	Mass Flow Excavator
NORM	Naturally Occurring Radioactive Material
NW	North West

OGA	Oil and Gas Authority
OGUK	Oil and Gas UK
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
OSPAR	Oslo/Paris convention (for the Protection of the Marine Environment of the North-East Atlantic)
Pipeline End	Point at which a pipeline is severed from infrastructure. This may be exposed or buried.
PL	Pipe Line (OGA designated pipeline number)
PLL	Potential for Loss of Life
Reportable span	A reportable span is a significant span which meets set criteria (FishSAFE criteria) of height above the seabed and span length (10m long x 0.8m high)
SAC	Special Areas of Conservation
SFF	Scottish Fishermen's Federation
SNS	Southern North Sea
Span	Sometimes referred to as a 'freespan'. Similar to an exposure except that the whole of the section of pipeline is visible above the seabed rather than just part of it. Once the height and length dimensions meet or exceed certain criteria the span becomes a reportable span. Please also refer figure below
Surface laid	Part of pipeline (or umbilical) that was not trenched when originally installed. At installation surface laid pipeline would typically be overlain by protection and stabilisation features such as mattresses in various forms and grout bags. Such features may also be overlain by deposited rock, but this is usually at locations where the pipeline is entering a trench. Pipelines are usually "surface laid" on the final approach to an installation or pipeline manifold, for example.
TGT	Theddlethorpe Gas Terminal
UKCS	United Kingdom Continental Shelf
UM	Umbilical (as in the umbilicals UM2 and UM3)



The difference between pipeline burial, exposures, and spans[1]



The length of exposure may include a span length[2]

CLEAR SEABED VERIFICATION POLICY

Readers to note that OPRED's updated clear seabed verification policy now requires that non-intrusive survey methods be used where there are environmental sensitivities - this will include the 500m zones covered by this document. The appropriate method for clear seabed verification will be agreed with OPRED.

Where there are references to overtrawl/trawl sweeps within this document these should be read as understanding that non-intrusive means of clear seabed verification will now be required where there are environmental sensitivities.

In the first instance the reader is directed to the respective Decommissioning Programmes for specifics on what is proposed for verification of a clear seabed.

[1] Trench walls may or may not be prominent

EXECUTIVE SUMMARY

Chrysaor Production (U.K.) Ltd is in the process of decommissioning its operated facilities in the LOGGS area of the Southern North Sea that ceased production in August 2018. The LOGGS area consists of the manned LOGGS Gathering Station which is comprised of five bridge linked platforms and several unmanned platforms. The platform structures are expected to be fully removed.

There is approximately 573 km of pipelines associated with the LOGGS area infrastructure of which the decommissioning approach for 48 km has already been approved as part of the LDP1 Decommissioning Programme. The remaining 525 km (255.5 km gas export, 255.5 km methanol import and 14 km umbilicals) and associated mattresses and supporting material of LDP2, LDP3, LDP4 and LDP5 Decommissioning Programmes have been subjected to a Comparative Assessment (CA) to determine the preferred decommissioning strategy in compliance with the Department for Business, Energy and Industrial Strategy (BEIS) Guidance Notes ref. [**4**].

The infrastructure covered by the CA are as follows:

- LDP2: 6 pipelines: 3 gas export pipelines, 3 methanol import pipelines
- LDP3: 10 pipelines: 4 gas export pipelines, 4 methanol import pipelines, 2 umbilicals (control fluids)
- LDP4: 8 pipelines: 4 gas export pipelines, 4 methanol import pipelines
- LDP5: 2 pipelines: 1 gas export pipeline, 1 methanol import pipeline

The Decommissioning Programmes for LDP3 were approved in May 2020 and the Decommissioning Programmes for LDP5 were approved in April 2021.

The subsea infrastructure was aggregated into groups of similar characteristics and the CA process was applied to each group. The initial groups were as follows:

- Group 1 – Trunkline
- Group 2 – Mattress Covered Short Umbilical & Associated Pipeline
- Group 3a – Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤ 16”
- Group 3b – Trenched Interfield Non-concrete Coated Non-piggyback MeOH Pipeline ≤ 16”
- Group 3c – Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16”
- Group 4 – Trenched Interfield Concrete Coated Piggyback Pipelines > 16”
- Group 5 – Subsea structures
- Group 6 – Rigid spools / Flexible jumpers
- Group 7 – Trenched and Buried Umbilical
- Group 8 – Mattresses and Grout Bags

Group 5, 6 and 8 of LOGGS Area (LDP2 – 5) were excluded from the CA at the Scoping and Screening stages:

- Group 5 – Subsea Structures were confirmed to be subject to full removal in accordance with the Decommissioning Guidelines ref. [**4**], and therefore not subject to further consideration within the CA.
- Group 6: Rigid Spools and Flexible Jumpers were confirmed to be excluded from the CA process as they would be treated as part of the corresponding pipeline that they are tied into.
- Group 8: Mattresses and grout bags provide stabilisation to underlying subsea infrastructure and hence would be considered as part of the infrastructure under consideration in the CA process rather than a standalone group.
    - Where infrastructure is to be removed, the associated mattresses moved to gain access to the infrastructure will be fully removed and disposed of onshore and therefore not subject to further CA consideration.
    - Where infrastructure is to be decommissioned in-situ, the associated mattresses will be left in-situ to continue to provide the necessary stabilisation to the pipelines decommissioned in-situ. Where mattresses are left in-situ, an overtrawl test will be conducted to ensure that there is no snagging risk to fishing trawl gear.
    - Where pipeline removal exposes supporting grout bags and/ or mattresses, these will be recovered where safe to do so.

The CA process followed the 'Guidelines for CA' that were published by Oil and Gas UK in 2015 ref. [6], where seven steps to the CA process were recommended. The evaluation of the decommissioning options was undertaken by qualitatively comparing the data of five criteria using a pair-wise methodology.

The decommissioning options considered in the CA process for each pipeline grouping were as follows:

1. Decommission in-situ – minimum intervention (Physical intervention at pipeline ends only)
    a. Removal of pipeline ends and rock placement/ burial of cut ends only
    b. As 1a but also the introduction of a corrosive substance to accelerate decomposition
2. Decommission in-situ – minor intervention (Physical intervention at pipeline ends and remediation of snagging hazards only)
    a. Removal of pipeline ends and rock placement over cut ends and all exposed pipeline sections
    b. Removal of pipeline ends and re-trench and burial of all cut ends and exposed pipeline sections
3. Decommission in-situ – major intervention (Physical intervention at pipeline ends and remediation of full pipeline length)
    a. Removal of pipeline ends and rock cover over the full pipeline
    b. Removal of pipeline ends and re-trenching and burial of the full pipeline length

4. Partial removal – cut and lift (Physical intervention at pipeline ends and removal by cut and lift of all pipeline exposure)
    a. Exposed pipeline sections removed by cut and lift and rock cover over exposed pipeline ends
5. Full removal – reverse installation
    a. Full removal by reverse reel
    b. Full removal by reverse s-lay
6. Full removal – cut and lift
    a. Full pipeline removal by cut and lift techniques

Options 1b, 2b, 3a, 3b were excluded from the evaluation phase for all the pipeline groupings:

- Option 1b: Accelerated decomposition was screened out of all options as the concept is un-proven and the impact of potential chemical agents into the marine environment is not understood and cannot be quantified.
- Option 2b: Burial of exposed ends and pipeline sections is not considered a permanent solution for the pipelines in this location due to the dynamic seabed movement, rendering a burial solution vulnerable to unburial over time.
- Option 3a: Rock cover over the full pipeline length is not considered a feasible solution as large magnitude rock cover is considered detrimental to the free movement of sand in the protected area.
- Option 3b: Reburial of the full pipeline length is not considered a permanent solution due to the dynamic seabed movement, rendering a burial solution vulnerable to unburial over time.

The pipelines and umbilicals being decommissioned are located within the North Norfolk Sandbanks and Saturn Reef and cross through the Inner Dowsing Race Bank and North Ridge Special Area of Conservation. Both areas have been designated for the protections of two European Annex 1 habitats. These habitats are ‘Sandbanks which are slightly covered by sea water all the time’ and ‘Reefs’, the biogenic reef Sabellaria spinulosa. The Joint Nature Conservation Committee (JNCC) has classified the North Norfolk Sandbanks and North Ridge as representing good ‘conservation’ examples of these habitats. Rock cover in this area is therefore restricted to situations where safety considerations deem this action necessary and the environmental impact considered insignificant.

The only areas where physical decommissioning could be taking place would be the North Norfolk Sandbanks and Saturn Reef SAC and the Southern North Sea SAC further to the north.

CA Evaluation and Recommendations for each pipeline group

Group 1: 36” Trunkline (PL454)

The emerging recommendation for the 118 km 36” trunk line is Option 1a: to decommission the gas export pipeline in-situ with minimum intervention. This would require disconnection and removal of the pipeline connected to the LOGGS PP platform and at the tee locations with local rock placement at the cut pipeline ends only. The remaining pipeline, left in its current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning pipeline (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

The larger removal scopes (Option 4 and Option 6) would result in greater safety exposure for personnel and greater environmental impact than Option 1a due to the extended offshore operations, while Option 2a requires significant rock cover leading to habitat change making it less preferred. The larger removal scopes are also more technically challenging due to the scale of the operations. The larger removal scopes would also have greater impact societally due to the disruption to the fishing industry from the removal and the use of landfill capacity for the concrete pipeline coating.

Group 2: NW Bell – Mattress Covered Short Umbilical & Associated Pipeline (PL1690, PL1691 and PLU4177 (UM3))

The emerging recommendation for the Mattress Covered Short Umbilical & Associated Pipeline is that both the full removal or the leave in-situ option may be progressed. Should the leave in-situ option be progressed, the remaining pipelines and umbilical, left in their current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning pipelines (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

Group 3a: Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤ 16" (PL1694, PL1695, PL2234, PL2235, PL2236, PL2237)

The emerging recommendation for the Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤ 16" is Option 1a: to decommission the lines in-situ with minimum intervention. This comprises removal of the ends of the pipelines and placing spot rock cover at the cut ends only. The remaining pipelines, left in their current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning pipelines and umbilical (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

The larger removal scopes (Option 5a and Option 6) would result in greater safety exposure for personnel and greater environmental impact than Option 1a from the longer offshore durations and the MFE deburial of the lines. The larger removal scopes are also more technically challenging due to the scale of the operations and the reverse reeling of the piggybacked, rigid lines. The larger removal scopes would also have greater impact societally due to the disruption to the fishing industry from the removal and the use of landfill capacity for the pipeline coatings.

Group 3b: Trenched Interfield Non-concrete Coated Non-piggyback MeOH Pipeline ≤ 16" (PL455)

The emerging recommendation for the 118 km 4" MeOH line is that any of the partial removal (Option 4) or leave in-situ (Option 2a and Option 1a) options may be executed as the decommissioning option. This would require disconnection and removal of the pipeline connected to the LOGGS PP platform and at the tee locations with local rock placement at the cut pipeline ends in all cases. The exposures will be risk assessed to determine whether remediation is necessary, with the outcome of this assessment influencing whether the exposures will be removed (Option 4), rock covered (Option 2a) or left in-situ (Option 1a). The remaining pipeline, left in its current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning pipeline (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

The larger removal scopes (Option 5a and Option 6) would result in greater safety exposure for personnel and greater environmental impact than the other options from the longer offshore durations and the MFE deburial of the line. The larger removal scopes are also more technically challenging due to the scale of the operations / integrity concerns surrounding reverse reeling. The

larger removal scopes would also have greater impact societally due to the disruption to the fishing industry from the removal and the use of landfill capacity for the pipeline coating.

Group 3c: Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16" (PL456, PL457, PL460, PL461, PL470, PL471, PL1091, PL1092)

The emerging recommendation for the Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16" is that any of the partial removal (Option 4) or leave in-situ (Option 2a and Option 1a) options may be executed as the decommissioning option. This comprises removal of the ends of the pipelines and placing spot rock cover at the cut ends in all cases. The exposures will be risk assessed to determine whether remediation is necessary, with the outcome of this assessment influencing whether the exposures will be removed (Option 4), rock covered (Option 2a) or left in-situ (Option 1a). The remaining pipelines, left in their current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning pipelines (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

The large removal scope (Option 6) would result in greater safety exposure for personnel and greater environmental impact than the other options from the longer offshore durations and the MFE deburial of the lines. The larger removal scope is also more technically challenging due to the scale of the operations. The larger removal scope would also have greater impact societally due to the disruption to the fishing industry from the removal and the use of landfill capacity for the concrete pipeline coatings.

Group 4: Trenched Interfield Concrete Coated Piggyback Pipelines > 16" (PL458, PL459, PL1093, PL1094, PL2107 and PL2108)

The emerging recommendation for the Trenched Interfield Concrete Coated Piggyback Pipelines > 16" is that any of the partial removal (Option 4) or leave in-situ (Option 2a and Option 1a) options may be executed as the decommissioning option. This comprises removal of the ends of the pipelines and placing spot rock cover at the cut ends in all cases. The exposures will be risk assessed to determine whether remediation is necessary, with the outcome of this assessment influencing whether the exposures will be removed (Option 4), rock covered (Option 2a) or left in-situ (Option 1a). The remaining pipelines, left in their current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning pipelines (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

The large removal scope (Option 6) would result in greater safety exposure for personnel and greater environmental impact than the other options from the longer offshore durations and the MFE deburial of the lines. The larger removal scope is also more technically challenging due to the scale of the operations. The larger removal scope would also have greater impact societally due to the disruption to the fishing industry from the removal and the use of landfill capacity for the concrete pipeline coatings.

Group 7: Trenched and Buried Umbilical (PLU4178 (UM2))

The emerging recommendation for the Trenched and Buried Umbilical is that any of the partial removal (Option 4) or leave in-situ (Option 2a and Option 1a) options may be executed as the decommissioning option. This comprises removal of the ends of the umbilical and placing spot rock cover at the cut ends in all cases. The single 11 m exposure will be risk assessed to determine whether remediation is necessary, with the outcome of this assessment influencing whether the

exposure will be removed (Option 4), rock covered (Option 2a) or left in-situ (Option 1a). The remaining umbilical, left in its current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning umbilical (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

The large removal scope (Option 5a) would result in greater safety exposure for personnel and greater environmental impact than the other options from the longer offshore durations and the MFE deburial of the line. The larger removal scope is also more technically challenging due to the scale of the operations and the deburial required. The larger removal scope would also have greater impact societally due to the disruption to the fishing industry from the removal and the use of landfill capacity for polymers from the umbilical.

The table below contains a summary of the CA recommendation for all groups.

Group	Infrastructure Type	Decommissioning Recommendation
1	Trunk Line	Option 1a – Leave In-situ (Minimum Intervention)
2	Mattress Covered Short Umbilical & Associated Pipeline	Either Option 6 – Full Removal or Option 1a – Leave In-situ (Minimum Intervention may be progressed
3a	Trenched[1] Interfield Non-concrete Coated Piggyback Pipelines ≤ 16”	Option 1a – Leave In-situ (Minimum Intervention)
3b	Trenched Interfield Non-concrete Coated Non-piggyback MeOH Pipeline ≤ 16”	Either Option 4 – Partial Removal, Option 2a – Leave In-situ (Minor Intervention) or Option 1a – Leave In-situ (Minimum Intervention may be progressed
3c	Trenched[1] Interfield Concrete Coated Piggyback Pipelines ≤ 16”	Either Option 4 – Partial Removal, Option 2a – Leave In-situ (Minor Intervention) or 1a – Leave In-situ (Minimum Intervention may be progressed
4	Trenched[1] Interfield Concrete Coated Piggyback Pipelines > 16”	Either Option 4 – Partial Removal, Option 2a – Leave In-situ (Minor Intervention) or Option 1a – Leave In-situ (Minimum Intervention may be progressed
5	Subsea Structures	Full Removal
6	Rigid Spools / Flexible Jumpers	Treated as part of the relevant pipelines group
7	Trenched and Buried Umbilical	Either Option 4 – Partial Removal, Option 2a – Leave In-situ (Minor Intervention) or Option 1a – Leave In-situ (Minimum Intervention may be progressed
8	Mattresses and Grout Bags	Leave In-situ where providing pipeline stabilisation

[1] Trenched pipelines are those that were installed in a trench and buried. Varying degrees of exposures, crossings and rock placement occur along these pipelines.

1 Introduction

1.1 Overview

The Lincolnshire Offshore Gas Gathering System (LOGGS), operated by Chrysaor Production (U.K.) Ltd. (Chrysaor), is in the Southern North Sea (SNS) and located near other Chrysaor operated gas areas: Viking and Caister Murdoch System (CMS). The Chrysaor operated SNS assets and the Theddlethorpe Gas Terminal (TGT) ceased production in August 2018 and are in the process of being prepared for decommissioning.

The LOGGS complex commenced operations in 1988. The facility received natural gas from the V-fields (North Valiant, South Valiant, Vangard and Vulcan), Vampire, Viscount, Valkyrie, the Saturn Unit (Mimas, Saturn and Tethys), the Jupiter area natural gas fields (Ganymede, Callisto, Europa and NW Bell) as well as third party fields. Natural gas from the Viking, Victor, Vixen and Victoria fields was also transported through the LOGGS facilities. Gas from all these fields was comingled at the LOGGS complex and transported to TGT via the LOGGS to TGT trunkline for processing.

Figure 1-1 illustrates the SNS field layout and infrastructure.

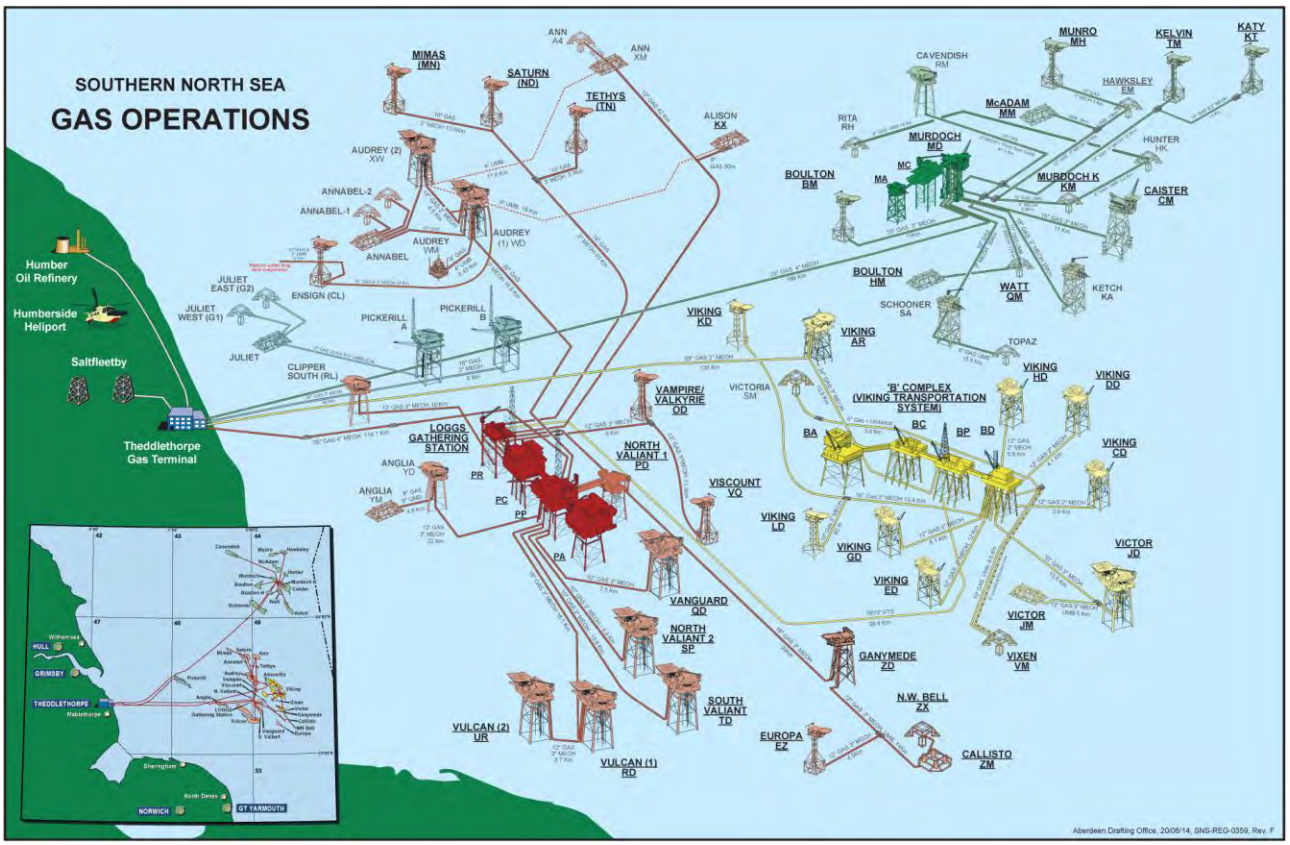


Figure 1-1: Chrysaor SNS Gas Operations, incl. LOGGS Area

Decommissioning of the SNS infrastructure hubs and satellites is being carried out in a phased manner. The initial phase of decommissioning works commenced in the Viking Area followed by the LOGGS area ahead of the CMS Area. The sequencing of activities within the phased model is subject to change with the potential for decommissioning works to be undertaken in all three areas simultaneously depending on campaign related cost efficiencies and economic and commercial factors.

LDP1 (Vulcan UR, Vampire OD and Viscount VO and associated pipelines), LDP3 (Ganymede ZD Jacket, Europa EZ, Callisto ZM and NW Bell ZX & Associated Infield Pipelines), LDP3b (Ganymede ZD Topside), and LDP5 (LOGGS PR, LOGGS PC, LOGGS PP, LOGGS PA, North Valiant PD, & Associated Pipelines) Decommissioning Programmes have been approved by the Secretary of State and Chrysaor is now preparing four decommissioning programmes for the remaining LOGGS Area (LDP2 and LDP4), the grouping of which has been based on asset partnerships (LDP2, LDP3, LDP4), and decommissioning methodology (LDP5). The numbering of the LOGGS Decommissioning Programmes is not an indication of the order in which the activity is to be completed.

The majority of LOGGS infrastructure and pipelines are located within the North Norfolk Sandbanks and Saturn Reef Special Area of Conservation (SAC) which is designated for 'sandbanks which are slightly covered by seawater all of the time' and the presence of biogenic reefs (*Sabellaria spinulosa*) (JNCC, 2016). The process of designation of the North Norfolk Sandbanks and Saturn Reef as a SAC started in 2007, when the LOGGS complex was already established and operational. The Southern North Sea SAC has also been identified as an area of importance for the Annex II species the harbour porpoise.

The LOGGS assets included in LDP2, LDP3, LDP4, LDP5 are highlighted in red in the schematic in Figure 1-2. LDP3 and LDP5 were approved in 2020 and 2021 respectively.

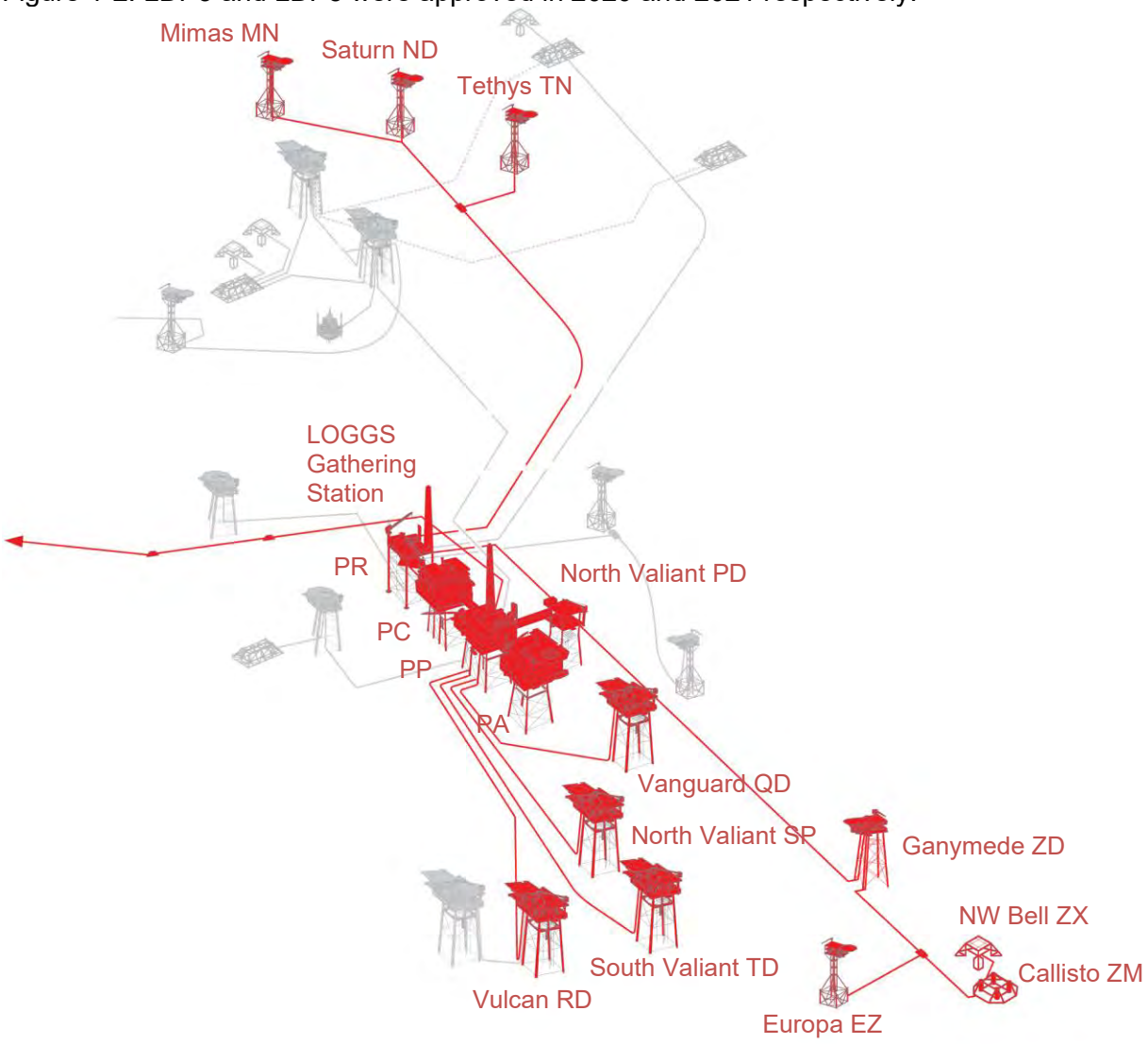


Figure 1-2: Chrysaor LDP2, LDP3, LDP4, LDP5 Decommissioning Programmes Assets in the LOGGS Area

1.2 Purpose

The purpose of this document is to present a Comparative Assessment (CA) for the LOGGS Area (LDP2 – 5) subsea infrastructure in support of the decommissioning programmes. The document describes the field infrastructure, the decommissioning options considered, the overall CA process, the evaluation method used during the evaluation phase of the CA, and the emerging recommendations obtained from the CA process.

1.3 Report Structure

This CA Report contains the following:

- Section 1 – Introduction; this section provides an overview of the LOGGS Area and purpose of this document
- Section 2 – CA Methodology; the seven-step process, as recommended within OGUK's guidelines for CA, and the specific approach taken is explained herein
- Section 1 – Scoping Outcome; the results of the initial scoping exercise are summarised here to establish the infrastructure groups considered within the remainder of the document
- Section **4** – Screening Outcome, the results of the option screening exercise are summarised here to detail the decommissioning options considered for each group and these that were discarded and retained
- Section **5** – CA Preparation; a description of the studies conducted to inform the evaluation is provided here
- Section **6** – CA Evaluation Results; organised by group, the results of the evaluation phase are presented. For each group, analysis was performed within a workshop(s) by an informed and expert group
- Section **7** – Summary and recommendations; the emerging recommendations from the analysis performed for each group is summarised here
- Section **8** – References
- Appendix A – Pairwise Methodology Explanation; details of the analysis method are provided.
- Appendix B – Detailed Group 1 evaluation results including attributes tables and pairwise comparisons
- Appendix C – Detailed Group 2 evaluation results
- Appendix D – Detailed Group 3a evaluation results
- Appendix E – Detailed Group 3b evaluation results
- Appendix F – Detailed Group 3c evaluation results
- Appendix G – Detailed Group 4 evaluation results
- Appendix H – Detailed Group 7 evaluation results

2 Comparative Assessment Methodology

2.1 Overview

The LOGGS Decommissioning CA for LDP2-LDP5 followed the CA process as recommended by the Oil and Gas UK (OGUK) Guidelines ref. [6]. The guidelines recommend a 7-stage process that was followed and is summarised in Table 2-1.

Step Title	Scope	Commentary
Scoping	Identify pipeline groupings and boundaries of CA (physical and phase). Determine appropriate CA method. Establish assessment criteria. Identify stakeholders.	Preliminary Inventory and Scoping Report prepared for all LOGGS Area equipment. Criteria reviewed and agreed. CA methodology and criteria established for screening by mid-2017. Stakeholders identified and mapped.
Screening	Determine all potential decommissioning options. Review and screen out impractical options.	Screening workshops held Q3 2017 for LOGGS Area (LDP2 – 5). Review of all options available, unfeasible options were screened out. Options that were feasible were carried into CA evaluation phase. CA methodology and criteria were reviewed following screening to ensure that the option evaluation was effectively supported.
Preparation	Undertake technical, safety, environmental studies. Stakeholder engagement.	Section 2.4 highlights the relevant studies undertaken and provides a reference to the study reports listed in Section 5. Continued stakeholder engagement as part of the greater SNS-wide decommissioning campaign.
Evaluation	Evaluate the options using the chosen CA methodology.	Chrysaor conducted three internal CA workshops as part of the evaluation phase. The first, in August 2017, identified areas where further information was needed to make a recommendation (recycling to the preparation phase). A second internal workshop was held in September 2017 where the results of recent study work was used to discuss and update the recommendation tool. Following a project hiatus in 2018, a further, final evaluation workshop was held in Q1 2019 where the emerging recommendations detailed in this document were obtained.
Recommendation	Create recommendation in the form of narrative supported by charts explaining key trade-offs.	The workshops conducted in the Evaluation stage produced emerging recommendations that Chrysaor prepared for presentation to the stakeholders.
Review	Review the emerging recommendations with stakeholders.	This report will be issued to internal stakeholders for review. Recommendations will be shared with external stakeholders. Comments raised will be included in the report prior to formal submission to OPRED.
Submit	Submit to OPRED as part of/alongside Decommissioning Programme	This report will be submitted to OPRED with the LDP2-LDP5 Decommissioning Programmes.

Table 2-1: CA Process and Status Overview

Each of these steps is described briefly in the following sub-sections.

2.2 Scoping

The scoping phase of the CA process addresses the following elements:

- Boundaries for CA
- Physical attributes of equipment
- Decommissioning options

These are addressed in the following sub-sections.

2.2.1 CA Boundaries

The boundaries (battery limits) adopted by Chrysaor for the subsea infrastructure of the LOGGS Area are detailed below. Inclusions are as follows:

- All subsea structures including their foundations
- All rigid and flexible subsea pipelines / flowlines
- All control and chemical jumpers
- All spools
- All umbilicals / cables
- All mattresses / grout bags and deposits

Exclusions are as follows:

- Platform riser tie-in flanges that would be removed as part of the platform removals: (LOGGS PP, LOGGS PR, North Valiant PD, Mimas MN, Saturn HD, Tethys TN, Vanguard QD, North Valiant SP, South Valiant TD, Vulcan RD, Ganymede ZD, Europa EZ)
- Subsea tie-in flanges that would be removed as part of the manifold/ tee subsea structure removal: (Europa Sinope Tee, NW Bell ZX, Callisto ZM, Saturn In-Line Tee, Tethys Tee and LOGGS Tees)
- TGT to LOGGS 36” Trunk line and TGT to LOGGS 4” MeOH line from TGT to the low water mark as this is outside the boundaries of the Offshore Decommissioning Programme and will be considered separately as part of the onshore TGT decommissioning strategy.

2.2.2 Physical Attributes of Equipment

All subsea infrastructure within the scope of the LOGGS Area LDP2 - 5 is summarised in Section 1 along with the physical attributes that define the equipment. Attributes considered include the following:

- Pipelines / Flowlines / Spools
  - Pipeline number
  - Type (rigid / flexible)
  - Service (gas / oil / water)
  - Material / diameter / wall thickness / coatings / length

  - Seabed configuration (trenched / buried / surface laid)
  - Details of crossings / mattresses
  - As-left cleanliness / ability to clean lines
  - Integrity issues
- Umbilicals / Cables / Jumpers
  - Material / diameter / wall thickness / coatings / length
  - Seabed configuration (trenched / buried / surface laid)
  - Details of crossings / mattresses
  - As-left cleanliness / ability to clean lines / chemicals used
  - Integrity issues
- Protection & Support
  - Fronded protection mattresses
  - Concrete protection mattresses
  - Concrete blocks
  - Grout bags (25 kg, 1Te)
  - Deposited rock

2.2.3 Decommissioning Groups

Once the equipment to be decommissioned and their physical attributes are captured, they are grouped appropriately into common attribute classifications to allow the CA process to be streamlined.

As part of the scoping activity, those decommissioning groups that are required to be fully removed are identified. In addition, any decommissioning groups that may have the potential to be left in-situ are also specified according to the OPRED Guidelines ref. [**4**].

For the subsea infrastructure of the LOGGS Area LDP2 - 5, the decommissioning groups, along with a list of each individual item that makes up the population of those groups, and the assessment whether these items are to be fully removed or subject to full comparative assessment is summarised in section 1.

2.2.4 Decommissioning Options

With the decommissioning groups established, all potential decommissioning options for each of the groups are identified. The base case for all groups is full removal as per the OPRED Guidelines ref. [**4**] and it is only those decommissioning groups where default full removal is not considered to be the clear optimum solution, that alternative decommissioning options are considered.

Alongside full removal options, the following decommissioning scenarios should be considered as specified in the OPRED Guidelines ref. [**4**]:

- Re-use
- Minimal Intervention i.e. exposed end removal
- Minor Intervention i.e. exposed end / spans / exposure removal
- Major Intervention i.e. full re-trench or rock placement

The decommissioning options proposed for those groups where full removal was not considered the clear optimum solution, are summarised in section 4.

2.3 Screening

The CA screening phase considers the identified decommissioning options for each group being fully comparatively assessed against the recommended primary criteria, as defined within the CA Guidelines ref. [6]. These are:

- Safety
- Environmental
- Technical
- Societal
- Economic

LOGGS Area LDP2 – 5 the screening phase was carried out during a series of workshops held in 2017 and updated in 2019. The methodology adopted is summarised below:

1. Identify decommissioning groups for full removal
2. Review proposed decommissioning options for each remaining group
3. Assess decommissioning options against the primary criteria and record assessment and outcome in screening worksheets
4. Record actions required to support retained decommissioning options

The assessment was performed using a coarse assessment method, as recommended in the CA Guidelines ref. [**6**]. A summary of the outcomes obtained from the screening activity are summarised in section 4.

2.4 Preparation Phase

Once the decommissioning options remaining after the screening phase were identified, detailed studies and analyses were identified to provide information to support the evaluation phase of the CA. The studies identified and conducted are detailed in section 5.

The studies produced were identified early in the CA process and were supplemented by additional work identified during the screening phase of the CA.

2.5 Evaluation Phase

The evaluation phase of the CA is where the decommissioning options remaining after the screening phase for each group were assessed against each other. Evaluation was conducted according to the OGUK Guidelines ref. [**6**] and employed the data obtained during the preparation phase as described above.

The evaluation phase incorporated a number of workshops attended by the decommissioning project team, where each of the remaining decommissioning groups was assessed individually, with options scored against five key criteria and their respective sub-criteria (see **Appendix A.2** for detailed criteria descriptions).

Weighting of the individual criteria was removed from the assessment to avoid subjectivity and bias when determining the preferred decommissioning options. Environmental data including seabed

disturbance, habitat loss and underwater noise was equally considered when compared to other options in line with the conservation objectives and sensitivities of the protected areas.

Options were scored against each other on a pair-wise basis, using the qualitative terms Neutral, Stronger, Much Stronger, Very Much Stronger, Weaker, Much Weaker and Very Much Weaker.

By this means the assessment team was able to debate the strengths and weaknesses of each option at the sub-criteria level and reach a consensus without having to apply quantitative scoring. The preferences were processed within the worksheet to produce a percentage split for each sub-criterion and this was cumulatively displayed to provide a score for each option.

The main criteria have been weighted equally. Given the differing, and sometimes conflicting, considerations that are represented by the criteria it was considered appropriate that they be weighted equally to one another to avoid favouring any particular aspect or group. Similarly, the sub-criteria have been weighted neutrally within their primary criterion.

More detail of the methodology adopted for the evaluation phase of the LOGGS Area LDP2 – 5 is detailed in **Appendix A**. The outcomes obtained from the evaluation phase are detailed in section 6.

2.6 Emerging Recommendation, Review & Submit

The outcomes obtained from the evaluation phase were presented as emerging recommendations for each group to OPRED and key stakeholders followed by discussion. Formal minutes of these discussions were taken and any relevant feedback captured.

3 Comparative Assessment – Scoping

All LOGGS Area infrastructure from Decommissioning Programmes LDP2 through LDP5, being considered under this comparative assessment is listed in Table 3-1 for Pipelines, Table 3-2 for Subsea Structures and

DP	Mattresses[1]				Grout Bags[1] (in meters)	Associated Pipeline	Selected Decommissioning Group	Justification
	Concrete	Frond	Linklok	Unknown				
LDP2	11	20	0	0	2	PL2234 / PL2235	Group 8 – Mattresses and Grout Bags	Mattresses of all types and grout bags are grouped together
	44	15	0	0	3	PL2236 / PL2237		
	12	1	1	0	4	PL2107 / PL2108		
LDP3	31	8	0	0	0	PL1091 / PL1092		
	4	0	0	0	1	PL1093 / PL1094		
	21	13	0	0	0	PL1690 / PL1691		
	15	28	0	0	0	PL1694 / PL1695		
	8	1	0	0	0	PLU4178 (UM2)		
	18	6	0	0	2	PLU4177(UM3)		
LDP4	0	0	Unknown	0	0	PL456 / PL457		
	0	0	0	0	7	PL458 / PL459		
	0	0	0	0	10	PL460 / PL461		
	0	0	0	0	9	PL470 / PL471		
LDP5	0	0	1	1	0	PL454 / PL455		
Total	164	91	3	1	38			

Table 3-3: Mattress & Grout Bag Scoping

Note 1: LDP3 and LDP5 were approved in 2020 and 2021 respectively.

[1] Quantities of mattresses and grout bags are detailed in the LOGGS Pipeline Burial and Stabilisation Material Report ref. [9]. The quantities in this report are based on observed historical inspection data, and are also referenced in the LOGGS Environmental Appraisal.The

decommissioning programmes reference the quantities found in the original as-built drawings. for Mattresses and Grout Bags. These tables are a summary of the scoping process conducted. They show the key characteristics of the equipment and the decommissioning group that they have been grouped together in along with the associated justification. The burial profiles for each pipeline are provided in the appendices of the relevant Decommissioning Programmes.

3.1 Pipeline Scoping

DP	ID	Description	CA Battery Limits		Diameter (inches)	Length (m)	Exposure (m)	Selected Decommissioning Group	Justification
			From	To					
LDP2	PL2107	Saturn ND to LOGGS PR 14" Gas Line	Saturn ND	LOGGS PR	14 Note 1	43,240	14	Group 4 – Trenched Interfield Concrete Coated Piggyback Pipelines > 16”	Gas export pipeline diameter greater than 16” Gas export pipeline has concrete coating Main line has associated methanol line in piggyback arrangement
	PL2108	LOGGS PR to Saturn ND 3" MeOH	LOGGS PR	Saturn ND	3	43,250	Piggyback to PL2107		
	PL2234	Tethys TN to Saturn ND / LOGGS PR Tee 10" Gas Line	Tethys TN	Saturn ND / LOGGS PR Tee	10	3,877	18	Group 3a – Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤ 16”	Gas export pipeline diameter less than 16” Gas export pipeline has no concrete coating Gas export line has associated methanol line in piggyback arrangement
	PL2235	LOGGS PR / Saturn ND Tee to Tethys TN 3" MeOH	Saturn ND / LOGGS PR Tee	Tethys TN	3	3,878	Piggyback to PL2234		
	PL2236	Mimas MN to Saturn ND 10" Gas Line	Mimas MN	Saturn ND	10	13,603	7		
	PL2237	Saturn ND to Mimas MN 3" MeOH Line	Saturn ND	Mimas MN	3	13,606	Piggyback to PL2236		

DP	ID	Description	CA Battery Limits		Diameter (inches)	Length (m)	Exposure (m)	Selected Decommissioning Group	Justification
			From	To					
LDP3	PL1091	Callisto ZM to Ganymede ZD 12" Gas Line	Callisto ZM	Ganymede ZD	12	14,300	132	Group 3c – Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16”	Gas export pipeline diameter less than 16” Gas export pipeline has concrete coating Gas export line has associated methanol line in piggyback arrangement
	PL1092	Ganymede ZD to Callisto ZM 3" MeOH Line	Ganymede ZD	Callisto ZM	3	14,300	Piggyback to PL1091		
	PL1093	Ganymede ZD to LOGGS PR 18" Gas Line	Ganymede ZD	LOGGS PR	18	19,501	75	Group 4 – Trenched Interfield Concrete Coated Piggyback Pipelines > 16”	Gas export pipeline diameter greater than 16” Gas export pipeline has concrete coating Gas export line has associated methanol line in piggyback arrangement
	PL1094	LOGGS PR to Ganymede ZD 3" MeOH	LOGGS PR	Ganymede ZD	3	19,492	Piggyback to PL1093		
	PL1690	NW Bell ZX to Callisto ZM 8" Gas Line	NW Bell ZX	Callisto ZM	8	80	8	Group 2 – Mattress Covered Short Umbilical & Associated Pipeline	Lines are very short in length
	PL1691	Callisto ZM to NW Bell ZX 3" MeOH Line	Callisto ZM	NW Bell ZX	3	80	Connected to PL1690		
	PL1694	Europa EZ to Callisto ZM / Ganymede ZD Tee 12" Gas Line	Europa EZ	PL1091 Tee	12	4,498	4	Group 3a – Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤ 16”	Gas export pipeline diameter less than 16” Gas export pipeline has no concrete coating Gas export line has associated methanol line in piggyback arrangement
	PL1695	Ganymede ZD / Callisto ZM Tee to Europa EZ 3" MeOH Line	PL1091 Tee	Europa EZ	3	4,500	Piggyback to PL1694		
	PLU4178 (UM2)	Ganymede ZD to Callisto ZM Umbilical	Ganymede ZD	Callisto ZM	4.3	14,000	11	Group 7 – Trenched and Buried Umbilical	Significant length umbilical
	PLU4177 (UM3)	Callisto ZM to NW Bell ZX Umbilical	Callisto ZM	NW Bell ZX	4.3	80	0	Group 2 – Mattress Covered Short Umbilical & Associated Pipeline	Lines are very short in length

DP	ID	Description	CA Battery Limits		Diameter (inches)	Length (m)	Exposure (m)	Selected Decommissioning Group	Justification
			From	To					
LDP4	PL456	Vanguard QD to LOGGS PP 10" Gas Line	Vanguard QD	LOGGS PP	10	7,548	102	Group 3c – Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16”	Gas export pipeline diameter less than 16” Gas export pipeline has concrete coating Gas export line has associated methanol line in piggyback arrangement
	PL457	LOGGS PP to Vanguard QD 3" MeOH Line	LOGGS PP	Vanguard QD	3	7,510	Piggyback to PL456		
	PL458	Vulcan RD to LOGGS PP 18" Gas Line	Vulcan RD	LOGGS PP	18	16,147	253	Group 4 – Trenched Interfield Concrete Coated Piggyback Pipelines > 16”	Gas export pipeline diameter greater than 16” Gas export pipeline has concrete coating Gas export line has associated methanol line in piggyback arrangement
	PL459	LOGGS PP to Vulcan RD 3" MeOH Line	LOGGS PP	Vulcan RD	3	16,100	Piggyback to PL458		
	PL460	South Valiant TD to LOGGS PP 10" Gas Line	South Valiant TD	LOGGS PP	10	10,663	120	Group 3c – Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16”	Gas export pipeline diameter less than 16” Gas export pipeline has concrete coating Gas export line has associated methanol line in piggyback arrangement
	PL461	LOGGS PP to South Valiant TD 3" MeOH Line	LOGGS PP	South Valiant TD	3	10,662	Piggyback to PL460		
	PL470	North Valiant SP to LOGGS PP 10" Gas Line	North Valiant 2 SP	LOGGS PP	10	4,395	130		
	PL471	LOGGS PP to North Valiant SP 3" MeOH Line	LOGGS PP	North Valiant 2 SP	3	4,395	Piggyback to PL21070470		
LDP5	PL454	LOGGS PP to TGT 36" Gas	LOGGS PP	Shore approach low water line	36	118,382	28,741	Group 1 – Trunk Line	Pipeline is large diameter trunk line
	PL455	TGT to LOGGS PP 4" MeOH Line	TGT	LOGGS PP	4	118,382	338	Group 3b – Trenched Interfield Non-concrete Coated Non-piggyback MeOH Pipeline ≤ 16”	Pipeline is long length, small diameter methanol line

Table 3-1: Pipeline Scoping

Note 1: Whilst this group is for pipelines greater than 16” in diameter, it was agreed to include PL2107 in this group as, once the concrete coating is included, the overall diameter is greater than 16”.

Note2: LDP3 and LDP5 were approved in 2020 and 2021 respectively.

3.2 Subsea Structure Scoping

DP	Item	Description	Selected Decommissioning Group	Justification
LDP2	Tethys / Saturn Tee Structure	Tee Protection Structure on pre-installed "Tethys" tee for pipeline tie-ins from Tethys TN.	Group 5 – Subsea Structures	Subsea structures of all types are grouped together
	Subsea Valve Assembly (Tethys Tee)	Valve assemblies pre-installed on Tethys pipelines for Saturn pipeline tie-ins via Tethys Tee.		
LDP3	N.W. Bell WHPS	Wellhead protection Structure (WHPS) protecting the N.W. Bell wellhead and manifold.		
	Callisto ZM WHPS	WHPS protecting the Callisto ZM wellhead and manifold.		
	Subsea Pigging Skid (Sinope Tee)	Subsea pigging skid installed to allow Europa EZ pipeline tie into the Callisto Pipelines via Sinope Tee.		
	ZM Tee Structure (Sinope Tee)	Tee Protection Structure on pre-installed "Sinope" tees for pipeline tie-ins from Europa EZ.		
LDP4		No subsea structures associated with LDP4.		
LDP5	Tee Structures (Subsea Housing No.1 & 2)	2 Tee Protection Structures on pre-installed subsea tees for possible future pipeline tie-ins.		

Table 3-2: Subsea Structure Scoping

Note 1: LDP3 and LDP5 were approved in 2020 and 2021 respectively.

3.3 Mattress & Grout Bags Scoping

DP	Mattresses[1]				Grout Bags[1] (in meters)	Associated Pipeline	Selected Decommissioning Group	Justification
	Concrete	Frond	Linklok	Unknown				
LDP2	11	20	0	0	2	PL2234 / PL2235	Group 8 – Mattresses and Grout Bags	Mattresses of all types and grout bags are grouped together
	44	15	0	0	3	PL2236 / PL2237		
	12	1	1	0	4	PL2107 / PL2108		
LDP3	31	8	0	0	0	PL1091 / PL1092		
	4	0	0	0	1	PL1093 / PL1094		
	21	13	0	0	0	PL1690 / PL1691		
	15	28	0	0	0	PL1694 / PL1695		
	8	1	0	0	0	PLU4178 (UM2)		
	18	6	0	0	2	PLU4177(UM3)		
LDP4	0	0	Unknown	0	0	PL456 / PL457		
	0	0	0	0	7	PL458 / PL459		
	0	0	0	0	10	PL460 / PL461		
	0	0	0	0	9	PL470 / PL471		
LDP5	0	0	1	1	0	PL454 / PL455		
Total	164	91	3	1	38			

Table 3-3: Mattress & Grout Bag Scoping

Note 1: LDP3 and LDP5 were approved in 2020 and 2021 respectively.

[1] Quantities of mattresses and grout bags are detailed in the LOGGS Pipeline Burial and Stabilisation Material Report ref. [9]. The quantities in this report are based on observed historical inspection data, and are also referenced in the LOGGS Environmental Appraisal.The decommissioning programmes reference the quantities found in the original as-built drawings.

3.4 Scoping Summary

Grouping similar types of pipelines together resulted in the following decommissioning groups:

- Group 1 – Trunkline
- Group 2 – Mattress Covered Short Umbilical & Associated Pipeline
- Group 3a – Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤ 16”
- Group 3b – Trenched Interfield Non-concrete Coated Non-piggyback MeOH Pipeline ≤ 16”
- Group 3c – Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16”
- Group 4 – Trenched Interfield Concrete Coated Piggyback Pipelines > 16”
- Group 7 – Trenched and Buried Umbilical

Note on trenching: When the pipelines were originally installed, they would have been trenched and backfilled to suit design requirements. If the depth of cover did not suit design requirements, it would have been remediated at the time. The data to support this assumption is not available, but usually they are mechanically backfilled for these types of pipelines. Inspection data evaluated the burial profile of the pipelines thereafter.

All subsea structures and mattresses & grout bags were grouped together respectively resulting in the following additional groups:

- Group 5 – Subsea Structures
- Group 8 – Mattresses and Grout Bags

Group 8, Mattresses and Grout Bags, were taken out of the CA. Where these need to be moved to gain access to underlying infrastructure they will be fully removed and disposed of onshore. Where these are providing stabilisation of pipelines or sections of pipelines that will be left in-situ, no further action is required.

- Group 6 – Rigid Spools / Flexible Jumpers

A group was added for the rigid spools and flexible jumpers associated with the pipelines and umbilicals. These items were treated as part of the pipelines to which they were connected and not assessed as separate items within the remainder of the CA.

The pipeline groups were subject to comparative assessment in accordance with OPRED Guidance Note requirements to determine the proposed decommissioning outcome. The assessment is summarised in Table 3-4.

Group	Infrastructure Type	Basis for Group	Scoping Recommendation
1	Trunk Line	Long large diameter pipeline. This pipeline is significantly dissimilar to all other field infrastructure.	Subject to full CA
2	Mattress Covered Short Umbilical & Associated Pipeline	Short step out. These lines were considered to be significantly dissimilar to all other field infrastructure.	Subject to full CA
3a	Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤ 16”	Non-concrete coated pipelines less than 16” diameter may be recovered by reverse reeling.	Subject to full CA

Group	Infrastructure Type	Basis for Group	Scoping Recommendation
3b	Trenched Interfield Non-concrete Coated Non-piggyback MeOH Pipeline ≤ 16”	Non-concrete coated MEOH pipeline less than 16” diameter may be recovered by reverse reeling.	Subject to full CA
3c	Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16”	Concrete coated pipelines less than 16” diameter may be recovered by cut and lift. Not applicable for reverse installation due to concrete coating.	Subject to full CA
4	Trenched Interfield Concrete Coated Piggyback Pipelines > 16”	Concrete coated pipelines greater than 16” diameter. Not applicable for reverse installation due to concrete coating.	Subject to full CA
5	Subsea Structures	Any discrete item which is not a pipeline, umbilical or jumper.	Full Removal, in accordance with Decommissioning Guidelines ref. [4]
6	Rigid Spools / Flexible Jumpers	Short connecting spools and jumpers.	Incorporated into each associated pipeline group
7	Trenched and Buried Umbilical	Single long field umbilical.	Subject to full CA
8	Mattresses and Grout Bags	Protection and supporting materials.	Full Removal[3]

Table 3-4: LOGGS Area (LDP2 – 5) Infrastructure Groups

[3] Unless providing pipeline stabilisation, in which case mattresses and grout bags would be left in-situ

4 Comparative Assessment – Screening

The LOGGS Area (LDP2-5) infrastructure groups identified as being subject to full CA were progressed to the screening phase. All potential decommissioning options considered are summarised in Table 4-1.

Category	Option	Description
Leave in-situ (minimal intervention)	1a Do 'Nothing'	- Disconnection of line ends - Cut line ends on seabed into short sections, - Bundle cut sections together and recover - Place rock to mitigate snag hazard from cut ends - Post decommissioning survey and trawl sweep
	1b Accelerated Decomposition	- Disconnection of line ends - Introduce accelerant to decompose the lines - Lines to be left in-situ
Leave in-situ (minor intervention)	2a Rock Cover Exposures	- Disconnection of line ends - Cut line ends on seabed into short sections - Bundle cut sections together and recover - Place rock to mitigate snag hazard from cut ends - Place rock to cover areas of exposure - Post decommissioning survey and trawl sweep
	2b Trench & Bury Exposures	- Disconnection of line ends - Trench and bury line ends on seabed - Trench and bury areas of exposure - Post decommissioning survey and trawl sweep
Leave in-situ (major intervention)	3a Rock Cover Full Line	- Disconnection of line ends - Rock cover full length of line - Post decommissioning survey and trawl sweep
	3b Trench & Bury Full Line	- Disconnection of line ends - Trench and bury full length of line - Post decommissioning survey and trawl sweep
Partial Removal	4 Remove Exposures	- Disconnection of line ends - Cut line ends on seabed into short sections - Bundle cut sections together and recover - Cut and remove areas of exposure - Place rock to mitigate snag hazard from cut ends - Post decommissioning survey and trawl sweep

Category	Option	Description
Full removal	5a Reverse Reel	- Disconnection of line ends - De-burial of entire line using Mass Flow Excavator (MFE) - Removal of line by reverse reel - Post decommissioning survey and trawl sweep
	5b Reverse S-lay	- Disconnection of line ends - De-burial of entire line using MFE - Removal of line by reverse s-lay - Post decommissioning survey and trawl sweep
	6 Cut & Lift	- Disconnection of line ends - De-burial of entire line using MFE - Cut entire line into short sections - Bundle cut sections together and recover - Post decommissioning survey and trawl sweep

Table 4-1: Potential Decommissioning Options

Each of the decommissioning options were assessed for suitability against each of the decommissioning groups in a workshop environment. Table 4-2 shows a summary of each group, the decommissioning options considered, and the results from the screening.

Grp	Group Description	ID	Description	Diameter (inches)	Length (m)	Exposure (m)	Leave In-situ						Partial Removal	Full removal		
							Minimal Intervention		Minor Intervention		Major Intervention					
							1a – Do ‘ Nothing’	1b – Accelerated Decomposition	2a – Rock Cover Exposures	2b – Trench & Bury Exposures	3a – Rock Cover Full Line	3b – Trench & Bury Full Line	4 – Remove Exposures	5a – Reverse Reel	5b – Reverse S-lay	6 – Cut & Lift
1	Trunk Line	PL454	36” Gas Trunkline LOGGS PP to TGT	36	118,382	28,741	Screened In – potentially viable execution and as-left	Screened Out – the concept is un-proven	Screened In – potentially viable execution and as-left	Screened Out – mobile seabed may lead to future pipeline exposure despite re-trench and burial so not considered a permanent solution	Screened Out – extensive rock placement in this sensitive area not appropriate	Screened Out – mobile seabed may lead to future pipeline exposure despite re-trench and burial so not considered a permanent solution	Screened In – potentially viable execution and as-left	Screened Out – no track record of reverse reel of concrete coated pipeline in North Sea	Screened Out – no track record of reverse s-lay of concrete coated pipeline in North Sea	Screened In – potentially viable execution and as-left
2	Mattress Covered Short Umbilical & Associated Pipeline	PL1690	8” Gas Pipeline NW Bell ZX to Callisto ZM	8	80	8	Screened In – potentially viable execution and as-left	Not Applicable – option does not apply to umbilicals	Screened Out – there are no exposures	Screened Out – there are no exposures	Screened Out – there are no exposures	Screened Out – there are no exposures	Screened Out – there are no exposures	Screened Out – for such short lines cut & lift would be preferred solution	Screened Out – for such short lines cut & lift would be preferred solution	Screened In – potentially viable execution and as-left
		PL1691	3" MeOH Pipeline Callisto ZM to NW Bell ZX	3	80	Connected to PL1690										
		PLU4177 (UM3)	Umbilical Callisto ZM to NW Bell ZX	4.3	80	0										

Grp	Group Description	ID	Description	Diameter (inches)	Length (m)	Exposure (m)	Leave In-situ						Partial Removal	Full removal		
							Minimal Intervention		Minor Intervention		Major Intervention					
							1a – Do ‘ Nothing’	1b – Accelerated Decomposition	2a – Rock Cover Exposures	2b – Trench & Bury Exposures	3a – Rock Cover Full Line	3b – Trench & Bury Full Line	4 – Remove Exposures	5a – Reverse Reel	5b – Reverse S-lay	6 – Cut & Lift
3a	Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤ 16”	PL2234	10" Gas Pipeline Tethys TN to Saturn ND / LOGGS PR Tee	10	3,877	18	Screened In – potentially viable execution and as-left	Screened Out – the concept is un-proven	Screened Out – once line ends removed there are no remaining exposures	Screened Out – once line ends removed there are no remaining exposures	Screened Out – once line ends removed there are no remaining exposures	Screened Out – once line ends removed there are no remaining exposures	Screened Out – once line ends removed there are no remaining exposures	Screened In – potentially viable execution and as-left	Screened Out – reverse reel considered more appropriate albeit technically challenging for steel pipelines.	Screened In – potentially viable execution and as-left
		PL2235	3" MeOH Pipeline LOGGS PR / Saturn ND Tee to Tethys TN	3	3,878	Piggybacked to PL2234										
		PL2236	10" Gas Pipeline Mimas MN to Saturn ND	10	13,603	7										
		PL2237	3" MeOH Pipeline Saturn ND to Mimas MN 3"	3	13,606	Piggybacked to PL2236										
		PL1694	12" Gas Pipeline Europa EZ to Callisto ZM / Ganymede ZD Tee	12	4,498	4										
		PL1695	3" MeOH Pipeline Ganymede ZD / Callisto ZM Tee to Europa EZ	3	4,500	Piggybacked to PL1694										

Grp	Group Description	ID	Description	Diameter (inches)	Length (m)	Exposure (m)	Leave In-situ						Partial Removal	Full removal		
							Minimal Intervention		Minor Intervention		Major Intervention					
							1a – Do ‘ Nothing’	1b – Accelerated Decomposition	2a – Rock Cover Exposures	2b – Trench & Bury Exposures	3a – Rock Cover Full Line	3b – Trench & Bury Full Line	4 – Remove Exposures	5a – Reverse Reel	5b – Reverse S-lay	6 – Cut & Lift
3b	Trenched Interfield Non-concrete Coated Non-piggyback MeOH Pipeline ≤ 16”	PL455	4" MeOH Pipeline TGT to LOGGS PP	4	118,382	338	Screened In – potentially viable execution and as-left	Screened Out – the concept is un-proven	Screened In – potentially viable execution and as-left	Screened Out – mobile seabed may lead to future pipeline exposure despite re-trench and burial so not considered a permanent solution	Screened Out – extensive rock placement in this sensitive area not appropriate	Screened Out – mobile seabed may lead to future pipeline exposure despite re-trench and burial so not considered a permanent solution	Screened In – potentially viable execution and as-left	Screened In – potentially viable execution and as-left	Screened Out – reverse reel considered more appropriate albeit technically challenging for steel pipelines.	Screened In – potentially viable execution and as-left

Grp	Group Description	ID	Description	Diameter (inches)	Length (m)	Exposure (m)	Leave In-situ						Partial Removal	Full removal		
							Minimal Intervention		Minor Intervention		Major Intervention					
							1a – Do 'Nothing'	1b – Accelerated Decomposition	2a – Rock Cover Exposures	2b – Trench & Bury Exposures	3a – Rock Cover Full Line	3b – Trench & Bury Full Line	4 – Remove Exposures	5a – Reverse Reel	5b – Reverse S-lay	6 – Cut & Lift
3c	Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16"	PL1091	12" Gas Pipeline Callisto ZM to Ganymede ZD	12	14,300	132	Screened In – potentially viable execution and as-left	Screened Out – the concept is un-proven	Screened In – potentially viable execution and as-left	Screened Out – mobile seabed may lead to future pipeline exposure despite re-trench and burial so not considered a permanent solution	Screened Out – extensive rock placement in this sensitive area not appropriate	Screened Out – mobile seabed may lead to future pipeline exposure despite re-trench and burial so not considered a permanent solution	Screened In – potentially viable execution and as-left	Screened Out – no track record of reverse reel of concrete coated pipeline in North Sea	Screened Out – no track record of reverse s-lay of concrete coated pipeline in North Sea	Screened In – potentially viable execution and as-left
		PL1092	3" MeOH Pipeline Ganymede ZD to Callisto ZM	3	14,300	Piggybacked to PL1091										
		PL456	10" Gas Pipeline Vanguard QD to LOGGS PP	10	7,548	102										
		PL457	3" MeOH Pipeline LOGGS PP to Vanguard QD 3" MeOH Line	3	7,510	Piggybacked to PL456										
		PL460	10" Gas Pipeline South Valiant TD to LOGGS PP	10	10,663	120										
		PL461	3" MeOH Pipeline LOGGS PP to South Valiant TD 3" MeOH Line	3	10,662	Piggybacked to PL460										
		PL470	10" Gas Pipeline North Valiant SP to LOGGS PP	10	4,395	130										
		PL471	3" MeOH Pipeline LOGGS PP to North Valiant SP 3" MeOH Line	3	4,395	Piggybacked to PL470										

Grp	Group Description	ID	Description	Diameter (inches)	Length (m)	Exposure (m)	Leave In-situ						Partial Removal	Full removal		
							Minimal Intervention		Minor Intervention		Major Intervention					
							1a – Do 'Nothing'	1b – Accelerated Decomposition	2a – Rock Cover Exposures	2b – Trench & Bury Exposures	3a – Rock Cover Full Line	3b – Trench & Bury Full Line	4 – Remove Exposures	5a – Reverse Reel	5b – Reverse S-lay	6 – Cut & Lift
4	4 – Trenched Interfield Concrete Coated Piggyback Pipelines > 16"	PL458	18" Gas Pipeline Vulcan RD to LOGGS PP 18" Gas Line	18	16,147	253	Screened In – potentially viable execution and as-left	Screened Out – the concept is un-proven	Screened In – potentially viable execution and as-left	Screened Out – mobile seabed may lead to future pipeline exposure despite re-trench and burial so not considered a permanent solution	Screened Out – extensive rock placement in this sensitive area not appropriate	Screened Out – mobile seabed may lead to future pipeline exposure despite re-trench and burial so not considered a permanent solution	Screened In – potentially viable execution and as-left	Screened Out – no track record of reverse reel of concrete coated pipeline in North Sea	Screened Out – no track record of reverse s-lay of concrete coated pipeline in North Sea	Screened In – potentially viable execution and as-left
		PL459	3" MeOH Pipeline LOGGS PP to Vulcan RD 3" MeOH Line	3	16,100	Piggybacked to PL458										
		PL1093	19" Gas Pipeline Ganymede ZD to LOGGS PR	18	19,501	75										
		PL1094	3" MeOH Pipeline LOGGS PR to Ganymede ZD 3" MeOH	3	19,492	Piggybacked to PL1093										
		PL2107	10" Gas Pipeline Saturn ND to LOGGS PR	14 Note 1	43,240	14										
		PL2108	3" MeOH Pipeline LOGGS PR to Saturn ND 3" MeOH	3	43,250	Piggybacked to PL2107										

Grp	Group Description	ID	Description	Diameter (inches)	Length (m)	Exposure (m)	Leave In-situ						Partial Removal	Full removal		
							Minimal Intervention		Minor Intervention		Major Intervention					
							1a – Do 'Nothing'	1b – Accelerated Decomposition	2a – Rock Cover Exposures	2b – Trench & Bury Exposures	3a – Rock Cover Full Line	3b – Trench & Bury Full Line	4 – Remove Exposures	5a – Reverse Reel	5b – Reverse S-lay	6 – Cut & Lift
7	Trenched and Buried Umbilical	PLU4178 (UM2)	Umbilical Ganymede ZD to Callisto ZM	4.3	13,875	11	Screened In – potentially viable execution and as-left	Not Applicable – option does not apply to umbilicals	Screened In – potentially viable execution and as-left	Screened Out – mobile seabed may lead to future pipeline exposure despite re-trench and burial so not considered a permanent solution	Screened Out – extensive rock placement in this sensitive area not appropriate	Screened Out – mobile seabed may lead to future pipeline exposure despite re-trench and burial so not considered a permanent solution	Screened In – potentially viable execution and as-left	Screened In – potentially viable execution and as-left	Screened Out – reverse reel considered more appropriate for umbilicals.	Screened Out – retained option to reverse reel as more attractive

Table 4-2: Screening Outcome

Note 1: Whilst this group is for pipelines greater than 16" in diameter, it was agreed to include PL2107 in this group as, once the concrete coating is included, the overall diameter is greater than 16";

Note 2: Option 2b refers to retrenching and burial of cut pipeline ends along with exposures, in cases where the pipeline is cut at surface and thereafter the section in transition between surface and trench depth would be (post or re-) trenched and buried. Experience would suggest that pipelines do not always remain buried if trenched in areas where the seabed sediment is mobile, however stable burial is possible in immobile sediment;

Note 3: Option 3b refers to retrenching of the whole pipeline. Experience would suggest that pipelines do not always remain buried if trenched in areas where the seabed sediment is mobile, however stable burial is possible in immobile sediment;

Note 4: The pipelines in Group 3a, 3c, 4 were trenched and backfilled.

Options 1b, 2b, 3a, 3b were excluded from the evaluation phase for all the pipeline groupings:

- Option 1b: Accelerated decomposition was screened out of all options as the concept is un-proven and the impact of potential chemical agents into the marine environment is not understood and cannot be quantified.
- Option 2b: Burial of exposed ends and pipeline sections is not considered a permanent solution for the pipelines in this location due to the dynamic seabed movement, rendering a burial solution vulnerable to unburial over time.
- Option 3a: Rock cover over the full pipeline length is not considered a feasible solution as large magnitude rock cover is considered detrimental to the free movement of sand in the protected area.
- Option 3b: Reburial of the full pipeline length is not considered a permanent solution due to the dynamic seabed movement, rendering a burial solution vulnerable to unburial over time.

Trench and re-burial (Options 2b and 3b) was discounted because there is no information that is known of these pipelines to suggest that sufficient burial will result in no subsequent exposure in this area where dynamic seabed conditions persist (shallow water, strong tidal influence with mega-ripple sediment features).

There is a lot of uncertainty associated with the chance of success in the achievement of burial of pipeline ends and exposures in this dynamic seabed environment. As the assets were trenched and buried in construction phase, it is unlikely that re-burial will achieve permanent burial of exposures. Despite advances in pipelaying techniques since the time of installation, the methods used for the burial of these types of pipelines within the dynamic area have not changed significantly to increase the level of assurance that the pipelines will remain buried. Furthermore, in this locality the dynamic seabed is the dominant factor that influences pipeline exposure (with the exception of the 36” trunkline which was trenched and left to backfill naturally, also contributing to the exposures present).

The analysis of the pipeline depth of cover survey information does not appear to correlate between installation burial depth and areas of exposure. This is evident in the LOGGS area where surficial soils are generally hard and sandy but of varying depths overlaying clay. If reburial were to be attempted, the localised variability of the soil and seabed profile contributes to the uncertainty of success of permanent burial.

The burial under natural sediment of pipeline ends has also been discounted for the same reasons (Options 2b and 3b) as this option will require an unknown length and depth of pipeline trenching and excavation back to sufficient depth to ensure some degree of success. Furthermore trenching and burial will result in widespread, short term disturbance of the seabed within the marine protected area with limited long term success.

Due to the dynamic seabed environment, rock remediation on pipeline ends is expected to provide the safest profile for other users of the sea. Burial is not considered a permanent solution in the dynamic seabed conditions exposing other users of the sea to potential snag hazards should unburial of ends occur.

Rock cover over the full pipeline was excluded from the evaluation phase for all the pipeline groupings. The key reason for discounting this option was the impact of permanent habitat loss associated with the deposit of hard substrate within the marine protected area. The placement of rock material is still considered feasible in other options selected for further consideration on the basis that the options provide a high certainty of long term success whilst the impact of habitat loss through the deposit of hard substrate is localised in comparison. Whilst rock deposits provide long

term success,the potential for rock influenced scour adjacent to the deposits has been considered in the comparative assessment of the feasible options.

4.1 Screening Summary

Following the screening activity, the decommissioning options that were screened out, and those that were retained for evaluation are summarised in Table 4-3.

Group	Retained for Evaluation	Screened Out
1 – Trunkline	1a Removal of pipeline ends and rock placement on cut ends only 2a Removal of pipeline ends and rock placement on all exposures 4 Partial removal – cut & lift exposures and rock placed on all cut ends 6 Full removal by cut and lift	1b Accelerated decomposition 2b Burial of exposed ends and all exposures 3a Removal of exposed ends and full rock cover of pipeline 3b Reburial of full pipeline length 5a Full removal by reverse reel 5b Full removal by reverse s-lay
2 – Mattress Covered Short Umbilical & Associated Pipeline	1a Removal of pipeline ends and rock placement on cut ends only 6 Full removal by cut and lift	1b Accelerated decomposition 2a Removal of pipeline ends and rock placement on all exposures 2b Burial of exposed ends and all exposures 3a Removal of exposed ends and full rock cover of pipeline 3b Reburial of full pipeline length 4 Partial removal – cut & lift exposures and rock placed on all cut ends 5a Full removal by reverse reel 5b Full removal by reverse s-lay
3a – Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤ 16”	1a Removal of pipeline ends and rock placement on cut ends only 5a Full removal by reverse reel 6 Full removal by cut and lift	1b Accelerated decomposition 2a Removal of pipeline ends and rock placement on all exposures 2b Burial of exposed ends and all exposures 3a Removal of exposed ends and full rock cover of pipeline 3b Reburial of full pipeline length 4 Partial removal – cut & lift exposures and rock placed on all cut ends 5b Full removal by reverse s-lay

Group	Retained for Evaluation	Screened Out
3b – Trenched Interfield Non-concrete Coated Non-piggyback MeOH Pipeline ≤ 16”	1a Removal of pipeline ends and rock placement on cut ends only 2a Removal of pipeline ends and rock placement on all exposures 4 Partial removal – cut & lift exposures and rock placed on all cut ends 5a Full removal by reverse reel 6 Full removal by cut and lift	1b Accelerated decomposition 2b Burial of exposed ends and all exposures 3a Removal of exposed ends and full rock cover of pipeline 3b Reburial of full pipeline length 5b Full removal by reverse s-lay
3c – Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16	1a Removal of pipeline ends and rock placement on cut ends only 2a Removal of pipeline ends and rock placement on all exposures 4 Partial removal – cut & lift exposures and rock placed on all cut ends 6 Full removal by cut and lift	1b Accelerated decomposition 2b Burial of exposed ends and all exposures 3a Removal of exposed ends and full rock cover of pipeline 3b Reburial of full pipeline length 5a Full removal by reverse reel 5b Full removal by reverse s-lay
4 – Trenched Interfield Concrete Coated Piggyback Pipelines > 16	1a Removal of pipeline ends and rock placement on cut ends only 2a Removal of pipeline ends and rock placement on all exposures 4 Partial removal – cut & lift exposures and rock placed on all cut ends 6 Full removal by cut and lift	1b Accelerated decomposition 2b Burial of exposed ends and all exposures 3a Removal of exposed ends and full rock cover of pipeline 3b Reburial of full pipeline length 5a Full removal by reverse reel 5b Full removal by reverse s-lay

Group	Retained for Evaluation	Screened Out
7 – Trenched and Buried Umbilical	1a Removal of pipeline ends and rock placement on cut ends only 2a Removal of pipeline ends and rock placement on all exposures 4 Partial removal – cut & lift exposures and rock placed on all cut ends 5a Full removal by reverse reel	1b Accelerated decomposition 2b Burial of exposed ends and all exposures 3a Removal of exposed ends and full rock cover of pipeline 3b Reburial of full pipeline length 5b Full removal by reverse s-lay 6 Full removal by cut and lift

Table 4-3: Screening Summary

5 Comparative Assessment Preparation

5.1 Introduction

A range of safety, environmental, societal, engineering and economic studies were carried out in support of the evaluation phase of the CA. The findings of the studies / analyses were gathered in preparation for the evaluation phase of the CA. The key information obtained from these studies / analyses used during the evaluation phase are provided in data sheets included within the LOGGS Area Decommissioning Method Statement ref. [1].

5.2 Safety Studies

Personnel safety risk associated with each option was identified as follows:

- Offshore personnel exposure (diver activity and vessel operations)
- Onshore personnel exposure for the scope duration including disposal and recycling
- Legacy activities (future surveys and remediation activities)
- Unique high consequence events from major accident hazards. (Major accident hazards were defined as those events with the potential for serious injury or fatality to more than 4 personnel)
- Residual risk associated with other users of the sea that are impacted by, but not directly linked to, the decommissioning operations

Options were evaluated by determining the Potential Loss of Life (PLL) for each criterion. The Fatal Accident Rates (FAR) for each personnel type defined within Safetec's Risk Analysis of Decommissioning Activities study ref. [5] were used to provide a consistent approach to assessing Potential Loss of Life (PLL) values.

The resultant quantitative data (PLLs) produced allowed for a direct comparison of personnel risk associated with each option. The results are recorded for each option in the attributes tables in Appendix B to Appendix H.

The Fisheries Impact Assessment, conducted by Brown & May, also contributed to the evaluation. It provided an indication of the extent and type of fishing activity in the LOGGS area ref. [7]. This provided an indication of the level of risk to fishermen during decommissioning operations and the degree of residual risk for decommissioning options where it was proposed to leave infrastructure in-situ.

The safety hazards identified a balance between the short-term project personnel risks of the decommissioning operations and the long-term risk to mariners from snagging on spanning pipelines left in-situ. All the hazards are expected to be managed to be as low as reasonably practicable (ALARP) and therefore no significant hazard was identified from any decommissioning option. The quantitative results were associated with the degree of removal operations in comparison to the degree of spanning associated with that pipeline group.

5.3 Environmental Studies

Most of the pipelines and umbilicals being decommissioned are located within the North Norfolk Sandbanks and Saturn Reef special Area of Conservation. The PL454 and PL455 trunklines also cross through the Inner Dowsing Race Bank and North Ridge Special Area of Conservation and the Greater Wash Special Protection Area. Both SACs have been designated for the protection of two

European Annex 1 habitats. These habitats are 'Sandbanks which are slightly covered by sea water all the time' and 'Reefs', the biogenic reef Sabellaria spinulosa. The Joint Nature Conservation Committee (JNCC) has classified the North Norfolk Sandbanks and North Ridge as representing good 'conservation' examples of these habitats. Rock cover in this area is therefore restricted to situations where safety considerations deem this the only solution and the environmental impact considered insignificant.

This infrastructure is also within the Southern North Sea Special Area of Conservation for harbour porpoise and one of the conservation objectives relates to their supporting habitat.

The environmental and societal assessment considered the impacts of the decommissioning options.

Short-term environmental impacts included:

- Atmospheric emissions and fuel use to deliver the decommissioning options (quantity of fuel used, amount of energy used and atmospheric emissions such as CO_2, SO_x and NO_x)
- Marine discharges (quantity of pipeline contents discharged into the water column during pipeline severing operations, vessel waste discharge from oil, sewage and macerated food, vessel ballast uptake and discharge into the water column)
- Underwater noise (level / extent of noise and the subsequent impact on marine mammals)
- Seabed disturbance (indirect disturbance such as anchoring of vessels and direct disturbance related to the quantity of area disturbed by dredging and trenching activities on the seabed)
- Onshore recycling and disposal (CO_2 emissions, impact on the local community – traffic disturbance on minor roads and use of landfill capacity)

Long-term environmental impacts included:

- Loss of Habitat (quantity of the marine protected area lost due to the introduction of hard substrate such as rock)
- Consumption of resources for example quarried rock and replacement material for left in-situ infrastructure
- Impact associated with the degradation of material left in-situ

All calculations were performed by discipline specialists and are documented within the Decommissioning Method Statement ref. [1].

The analysis indicated that the associated atmospheric emissions are unlikely to significantly contribute to greenhouse gas emissions or global warming impacts as the CO_2 released from any decommissioning option (approximately 19,000 tonnes for all options) is significantly lower than the CO2 produced from UKCS vessel operations of 7.8 million tonnes from 2017 UK Greenhouse Gas Emissions ref. [8], at less than 0.3%. In addition, any physical disturbance to the seabed was considered temporary due to the dynamic nature of the currents that result in rapid seabed recovery.

The most significant environmental impact was associated with the long-term loss of habitat in the marine protected environment due to the introduction of rock for the burial of exposed infrastructure. Since the LOGGS infrastructure is located within the North Norfolk Sandbanks and Saturn Reef and in the Inner Dowsing Race Bank and North Ridge Special Area of Conservation, the introduction of a large quantity of rock could represent a localised change to the seabed environment and qualifying features of the SAC.

5.4 Societal Studies

Societal studies were qualitative and based on the impact to commercial fishing and onshore socio-economic benefits.

Societal impacts that benefitted from the decommissioning options were socio-economic in nature, relating to employment and development of facilities to execute the decommissioning options. The magnitude on societal impact relating to full removal (which is likely to have the greatest impact on employment) is assessed as being low and therefore not considered a differentiator between options. This assessment was based on the expectation that pipeline decommissioning operations are expected to result in a continuation of existing services, and consequently existing employment, rather than the creation of new services and opportunities.

Offshore decommissioning operations may result in the disruption to commercial fishing activity through the prevention of access to fishing areas, resulting in the loss of revenue. Full removal is expected to have a greater loss of access due to the greater extent of offshore operations and therefore greater impact to revenue loss in the short term. Long term impacts relate to the loss in revenue due to the presence of survey vessels required to inspect legacy infrastructure remaining in-situ.

5.5 Engineering Studies

The technical feasibility and risk of project failure assessment that supports the technical assessment required the following information to be available and is documented in the LOGGS Area Decommissioning Method Statement ref. [1] for each option:

Execution Method Statement, including:

- Sequence of operations
- List of vessels and equipment specifications and durations
- Materials requirements
- Execution Schedule
- Cost estimate
- Long term liability estimation (considering material remaining in-situ, material degradation, seabed mobility)

The technical evaluation was a qualitative comparison of the feasibility of each method and the risk of major operational failure in relation to the complexity (ability to proceed without major consequence, or failure, if it is adequately planned and executed).

5.6 Stakeholder Engagement

Throughout the SNS decommissioning campaign, Chrysaor has striven to comply with regulations and guidelines and achieve a common understanding amongst stakeholders. The LOGGS decommissioning campaign is part of the greater SNS-wide decommissioning campaign. Stakeholder engagement has therefore been ongoing throughout the campaign to identify stakeholder priorities rather than specifically ahead of the CA workshops.

6 Comparative Assessment – Evaluation

6.1 CA Outcome – Group 1 – 36" Trunk Line

6.1.1 Group Characteristics

Group 1 consists of the 36" gas export trunk-line (PL454) from the LOGGS PP platform to the Theddlethorpe Gas Terminal (TGT). The pipeline is a large diameter, 118 km long, concrete-coated trunkline that was constructed in 1987. The pipeline has multiple pipeline crossings along its length and exhibits exposure of approximately 24% that is consistent with the construction methodology (trench laid to the top of the pipe and left to backfill). A single anomalous span has been identified on the pipeline length that has been caused by scour around a pipeline crossing. The anomaly has been marked on FishSafe. (First observed as reportable in 2016: 46m x 0.7m; also in 2017: 14.3 m x 0.75m and not reportable in 2018: 36.6 m x 0.4m. Due to the variability in length, the exposure has been cited in the Decommissioning Programme at an average length of 20m).

The pipeline is shown in context in Figure 6-1 and its key characteristics are shown in Table 6-1.

ID	Description	CA Battery Limits		Diameter (inches)	Length (km)	Crossings	Exposure (km)
		From	To				
PL454	LOGGS PP to Theddlethorpe Gas Terminal (TGT) 36" Gas	LOGGS PP	Shore approach low water line	36	118	13	29

Table 6-1: Group 1 Characteristics

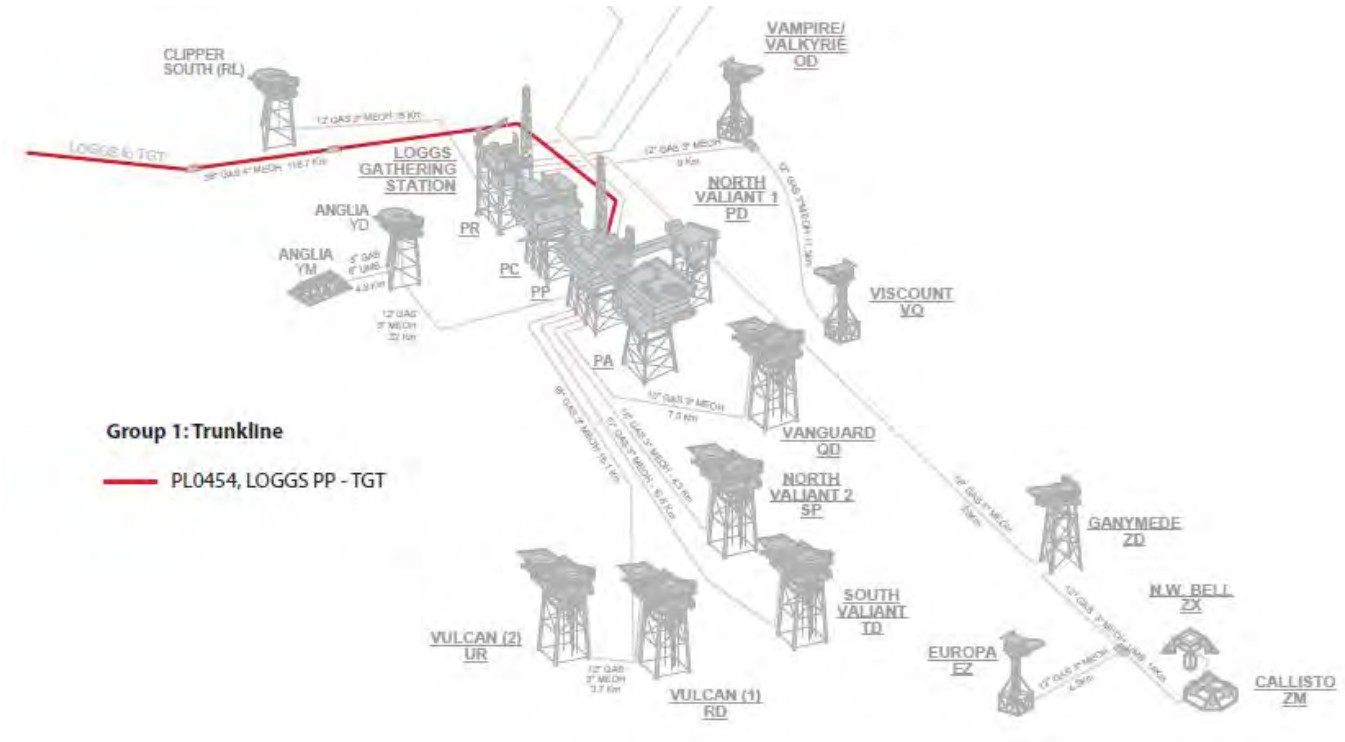


Figure 6-1: LOGGS Area (LDP2 – 5) Group 1

6.1.2 Decommissioning Options Retained for Evaluation

Ten options were presented at CA screening stage with six of those screened out. The four decommissioning options retained for CA evaluation were:

- Option 1a: Leave in-situ (Minimum Intervention) – Removal of pipeline ends and rock placement over cut ends only
- Option 2a: Leave in-situ (Minor Intervention) – Removal of pipeline ends and rock placement on all ends and exposures
- Option 4: Partial Removal – Cut and lift exposures and rock placed on all cut ends
- Option 6: Full Removal – Cut and lift

6.1.3 Evaluation

During the evaluation phase of the CA, the remaining decommissioning options associated with Group 1 - Trunkline were assessed using the evaluation methodology introduced in section 2.5 and further detailed in Appendix A. The visual output representing the outcome of the evaluation for Group 1 is shown in Figure 6-2.

The evaluation process identified Option 1a, the leave in-situ option (minimum intervention), to be preferred for the environmental, technical, societal and economic criteria of the trunkline. The safety criteria favours leave in-situ albeit that there is a preference for minor intervention requiring rock cover over the exposed areas to remove the long-term legacy risk that may result from pipeline exposure. The 36” diameter 118km concrete coated trunkline poses technical challenges to the full removal option and a greater safety risk during extensive removal operations. Partial removal and in-situ (minor intervention) require the introduction of large quantities of rock considered environmentally damaging as it will result in the extensive loss of habitat in a marine protected area.

The evaluation indicated that the preferred option for the trunkline is leave in-situ (minimum intervention). Leaving the pipeline in-situ is expected to be managed through an agreed post decommissioning inspection plan that will identify existing and emerging snag hazards to fishermen.

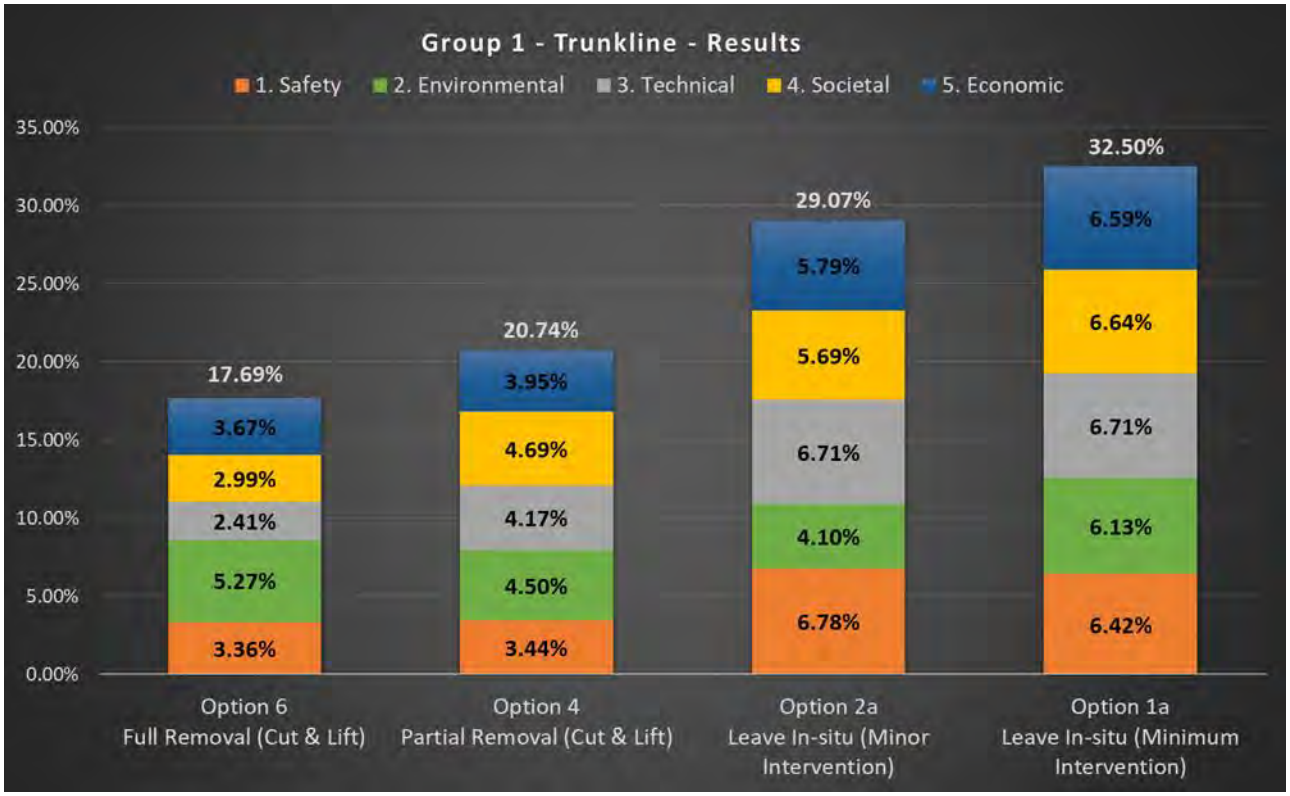


Figure 6-2: Group 1 Evaluation Results

A discussion of the relative preference of each of the decommissioning options against each of the assessment criteria is provided in the following sub-sections.

6.1.3.1 Safety Criteria Discussion

The workshops considered the leave in-situ options (Options 1a and 2a) to be less hazardous (therefore assessed as stronger) than either of the removal options, Options 4 (Partial Removal) and 6 (Full Removal).

The results of the evaluation of the short-term safety sub-criteria favoured the Option 1a leave-in-situ option because of the lower operational activity associated with this option:

- The smaller offshore scope and minor diving scope required for leaving the trunkline in-situ and hence reduced offshore personnel safety risk.
- The minimal material removed for the in-situ option that limits the amount of material required to be handled, transported and processed onshore hence minimising the onshore personnel risk.
- The limited number of additional vessels required reducing the number of vessel transits and hence low additional risk to other marine users (shipping, fishing vessels). Full removal would result in additional offshore activity that may lead to transient obstructions to existing marine traffic movements and a heightened risk of collision.
- The minor exposure to dropped object hazards due to the low number of heavy lifts required for in-situ decommissioning. In comparison, the full and partial removal options results in large scale cut and lift operations of the 36” trunkline that will provide increased exposure to personnel to high consequence events relating to the dropped object hazard offshore and onshore.

The full removal option removed all residual long-term safety risk. Pipelines remaining in-situ present greater risk to fishermen with trawl gear, as anomalous spans are a snagging hazard to these fishermen, hence full removal negates this outcome. However, the pipeline infrastructure contains a single anomalous span that has been recorded on FishSafe and any emerging issues will be identified during decommissioning inspections.

Option 1a is stronger from a short-term safety perspective owing to the reduced activity associated with this option. The residual long-term safety risk associated with leaving the pipelines in-situ is highest for option 1a as existing exposures are not eliminated (by removal or rock), however the long-term risk associated with leaving the pipelines in-situ is mitigated by adopting an inspection plan and rigorous communication of any anomalies to fishermen.

6.1.3.2 Environmental Criteria Discussion

The workshops considered the leave in-situ option 1a to have the least environmental impact than any other option.

This result was related to the in-situ option 1a having the least operational activity:

- Low vessel usage reducing the negative impact of noise and discharges to sea.
- Limited pipeline remediation and hence a lower seabed disturbance with limited requirement for pipeline unburial by Mass Flow Excavation and minor rock consumption.

Of primary environmental concern in this area is the vulnerability of the protected habitat that is potentially lost by the introduction of a hard substrate (rock) within the existing sandbank. The Option 1a leave in-situ option and full removal Option 6 score best as there is limited rock placement resulting from these options. The greatest negative environmental impact from habitat loss is associated with the options that require large scale rock placement Option 4 (50,000 m^2) and Option 2a (300,000 m^2).

The long-term marine impact from the degradation of remaining in-situ pipeline infrastructure is the only evaluation sub-criteria where Option 1a does not score strongest. In Option 1a and 2a, the remaining 118 km pipeline length is left to degrade and release degradation products into the water column over time. The full removal Option 6 scores best due to full pipeline removal.

The combined short-term and long-term environmental impact of the options associated with the decommissioning of the trunkline favours in-situ, minimum intervention (Option 1a) predominantly due to this option having the lowest short-term operational marine impact and minor long-term impact from minimal rock at the cut pipeline ends only. Option 2a delivers the greatest negative environmental impact because the full pipeline length remains in-situ to degrade and approximately 28 km of rock is placed over the exposed sections of the pipeline leading to potentially extensive habitat loss.

6.1.3.3 Technical Criteria Discussion

Both leave in-situ options - Option 1a (disconnection of the pipeline ends only) and Option 2a (disconnection of the 36” pipeline end and rock placement over 28km exposure) - are equally feasible activities that are performed as part of existing operations and hence are mature operations with the low technical risk.

Cut and lift techniques are undertaken in the UKCS on concrete pipelines as part of existing decommissioning operations (pipeline disconnection from the platform). Partial removal (Option 4 – removal of all spans) and full removal (Option 6), however, requires large scale diving intensive Diamond Wire Cutting (DWC) operations to sever multiple sections of the concrete coated 36”

trunkline. There is no track record of this magnitude of DWC diving operations in the UKCS and therefore carries high technical risk for the removal options. In addition, the integrity of the concrete coating on this pipeline is unknown and concrete spalling may occur during cutting operations, further complicating cutting operations and exposing divers to additional risk. Further development of new technologies to improve the efficiency of existing DWC techniques and automation of the operations to reduce diver exposure is required to improve the viability of this scale of operations on a large diameter concrete-coated pipeline.

6.1.3.4 Societal Criteria Discussion

The societal criteria compared the economic impact of the options on commercial fishing operations, as well as the impact the activities have on the recycling of material, landfill use and traffic disruption caused by the volume of scrap material returned to shore for handling.

Option 1a has the least impact on commercial fishing as this option requires disconnection to the platform 500m end only without impediment to fishing activity. Option 6, however, is the least attractive option to commercial fishing as the pipeline removal operations would disrupt fishing activity (although this disruption would be temporary in nature) and in addition static creel pots would require to be removed near-shore to facilitate pipeline removal (again, a temporary disruption). The trunkline is generally overtrawlable in its current state with approximately 72% of its length buried and only one anomalous span at a pipeline crossing that has been recorded on FishSafe. The fishing intensity in the LOGGS area is low-to-moderate and vessel traffic survey reports indicated that trawling activity is currently taking place across the trunkline. Removal of the trunkline is therefore unlikely to result in a significant increase to the current commercial fishing activity.

The legacy impact of pipeline exposure to fishermen that could potentially result in damage or loss of gear when being overtrawled associated with Option 1a, should be mitigated by an appropriate post-decommissioning monitoring regime.

Leaving the pipeline in-situ was shown to have a more positive impact on the societal criteria compared to the removal options, driven by the higher quantity of material that would be required to be recycled if full or partial removal took place. The greater the quantity of material that is removed, the greater the amount of material that will be brought to shore. Although recycling is a positive societal impact, it is outweighed by the requirement to use landfill because the trunkline is coated with concrete and coal tar enamel that reduces its applicability for recycling. Since the leave in-situ options 1a and 2a require less recycling (and therefore no use of landfill and no traffic disruption onshore) these options are more favourable than removal (Options 6 and 4).

Overall Option 1a is the most attractive option from both a societal (recycling) and commercial fishing (disruption) perspective. The removal options are the least attractive because they contribute to large-scale landfill use and are likely to lead to disruptions in current fishing activity.

6.1.3.5 Economic Criteria Discussion

The economic criteria compare the short-term execution cost of undertaking the decommissioning options and the long-term legacy cost of undertaking post decommissioning monitoring surveys, contribution to the Fisheries Legacy Trust Fund to support pipeline snagging hazard awareness amongst fishermen and potential remedial works for leave-in-situ options. Overall, the leave in-situ options are more favourable economically than the removal options driven by the short-term costs which are a much higher magnitude than the long-term monitoring costs.

The short-term full removal cost for Option 6 is £350 million compared to £2.5 million for leave in-situ Option 1a. The high cost of the full removal is derived from the scale of activity required to remove the large diameter, 118 km length pipeline.

6.1.4 Recommendation

The leave in-situ options (Option 1a and Option 2a) were considered more attractive than the partial and full removal options (Option 4 and Option 6) for the Safety, Technical and Societal criteria. In addition, Option 1a was most attractive, followed by Option 6 for the Environmental criterion.

The larger removal scopes (Option 4 and 6) would result in greater safety exposure for personnel, both onshore and offshore. There is also a greater exposure to other users from the partial and full removal options compared to the leave in-situ options due to the greater number of vessel days leading to a greater number of transits to and from site. Only with residual risk was there a preference for the full removal option, as with the pipeline fully removed there would be no residual risk; however, it is noted that as part of any partial removal or leave in-situ solution being selected, any potential hazards along the pipeline would be risk assessed and remediated and / or monitored to ensure that any emerging hazards do not develop into an unacceptable snagging risk to fishing operations.

From an environmental perspective the larger scope associated with the partial or full removal options generally results in the leave in-situ options being preferable. This is skewed somewhat by the environmental impact associated with the significant use of rock placement to deliver Option 2a which introduces a hard substrate to the area that has a potential to prevent the free movement of sediment within the protected area..

Technically, both the leave in-situ options are equally preferable than either the full or partial removal options, as there is far less technical risk associated with them. However, there are no novel techniques involved with the full or partial removal options other than the scale of the operations.

With the site shown to be currently over-trawlable, there is no discernible advantage to the fishing industry from removal of the pipeline, with the larger scopes resulting in greater disruption to the fishing industry. From a communities / amenities perspective Options 4 and 6 were seen as less attractive than the leave in-situ options due to the use of landfill for the returned pipeline coating.

The emerging preference for Option 1a was further enhanced when the Economic criterion was included. This is due to the cost for implementing Option 1a being significantly less than the next closest option (2a) and vastly less than the partial or full removal options.

The emerging recommendation from the CA is therefore to leave the trunk-line in-situ with minimum intervention. This would entail disconnection and removal of the LOGGS end of the pipeline and the ends at the tee locations. Spot rock placement would be installed at the cut pipeline ends only to mitigate any potential snag hazard. The remaining pipeline, left in its current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea and left to degrade over time. The post decommissioning pipeline (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

6.2 CA Outcome – Group 2 – Mattress Covered Short-umbilical & Associated Pipeline

6.2.1 Group Characteristics

Group 2 consists of a single 8” gas pipeline (PL1690) with a 3” MeOH pipeline (PL1691) piggybacked to it. They connect the NW Bell ZX well to the Callisto ZM manifold and are approximately 80 m in length. Group 2 also includes the 4” hydraulic umbilical (PLU4177 (UM3)), which is situated near PL1690 and PL1691 and is of a similar length. These short lines were installed in 1990 and are mattress covered.

The lines are shown in context in Figure 6-3 and their key characteristics are shown in Table 6-2

ID	Description	CA Battery Limits		Diameter (inches)	Length (m)	Exposure (m)
		From	To			
PL1690	NW Bell ZX to Callisto ZM 8" Gas Line	NW Bell ZX	Callisto ZM	8	80	8
PL1691	Callisto ZM to NW Bell ZX 3" MeOH Line	Callisto ZM	NW Bell ZX	3	80	Connected to PL1690
PLU4177 (UM3)	Callisto ZM to NW Bell ZX Umbilical	Callisto ZM	NW Bell ZX	4.3	80	0

Table 6-2: Group 2 Characteristics

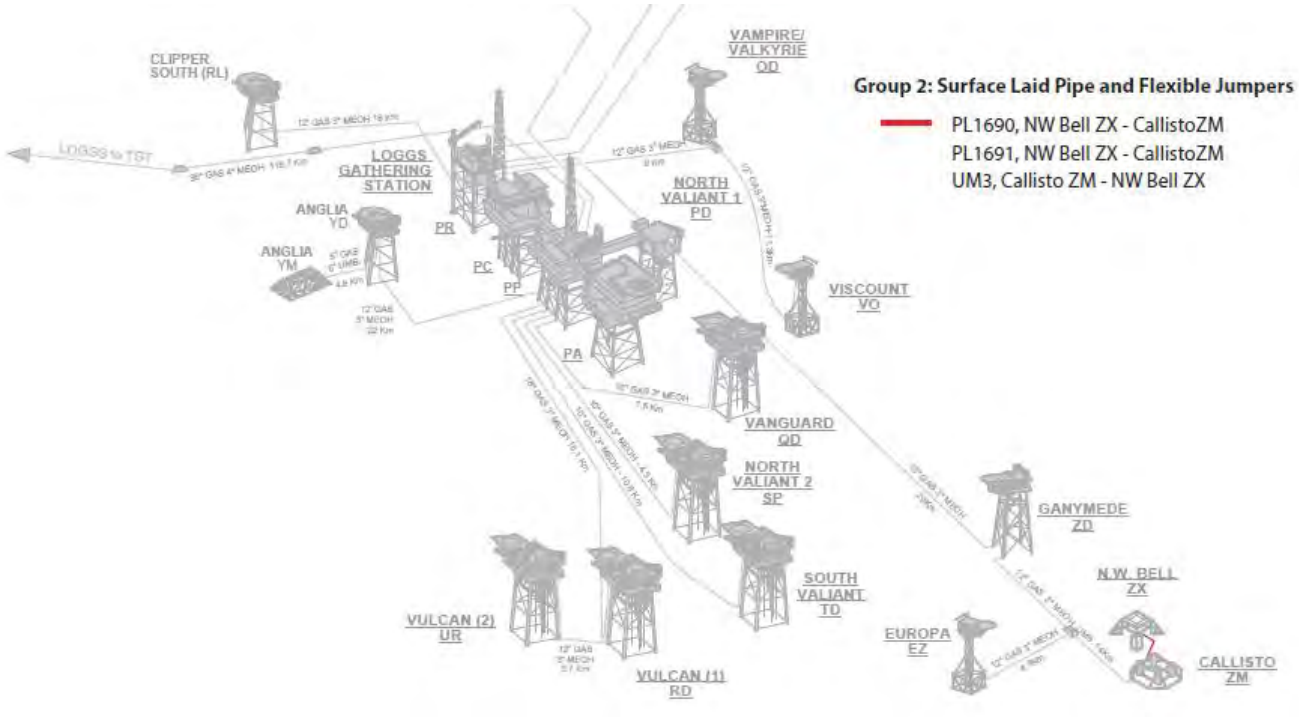


Figure 6-3: LOGGS Area (LDP2 – 5) Group 2

6.2.2 Decommissioning Options for Evaluation

Ten options were presented at CA screening stage with eight of those screened out. The two decommissioning options retained for CA evaluation were:

- Option 1a: Leave in-situ (Minimum Intervention) – Removal of pipeline ends and rock placement over cut ends only
- Option 6: Full Removal – Cut and lift

6.2.3 Evaluation

During the evaluation phase of the CA, the remaining decommissioning options associated with Group 2 – Mattress Covered Short-umbilical & Associated Pipeline were assessed using the evaluation methodology introduced in section 2.5 and further detailed in Appendix A. The visual output representing the outcome of the evaluation for Group 2 is shown in Figure 6-4.

The evaluation process identified both the leave in-situ option (minimum intervention) Option 1a and the full removal Option 6 to be equally preferred from a safety and societal perspective.

The full removal option scored marginally higher from reduced long term environmental marine impacts (removal of pipelines removes the pipeline and associated degradation material as well as eliminating the requirement to introduce additional rock into the protected habitat). Balancing this, the full removal option scored weaker from the technical feasibility perspective due to the challenges associated with the large-scale mattress removal required to unbury the pipelines. Once economics were added, the small preference for Option 1a was reduced.

Given the closeness of the assessment outcome, and the short nature of the lines in this group, there is a reasonable argument that there is no preference for an individual option indicated for this group.

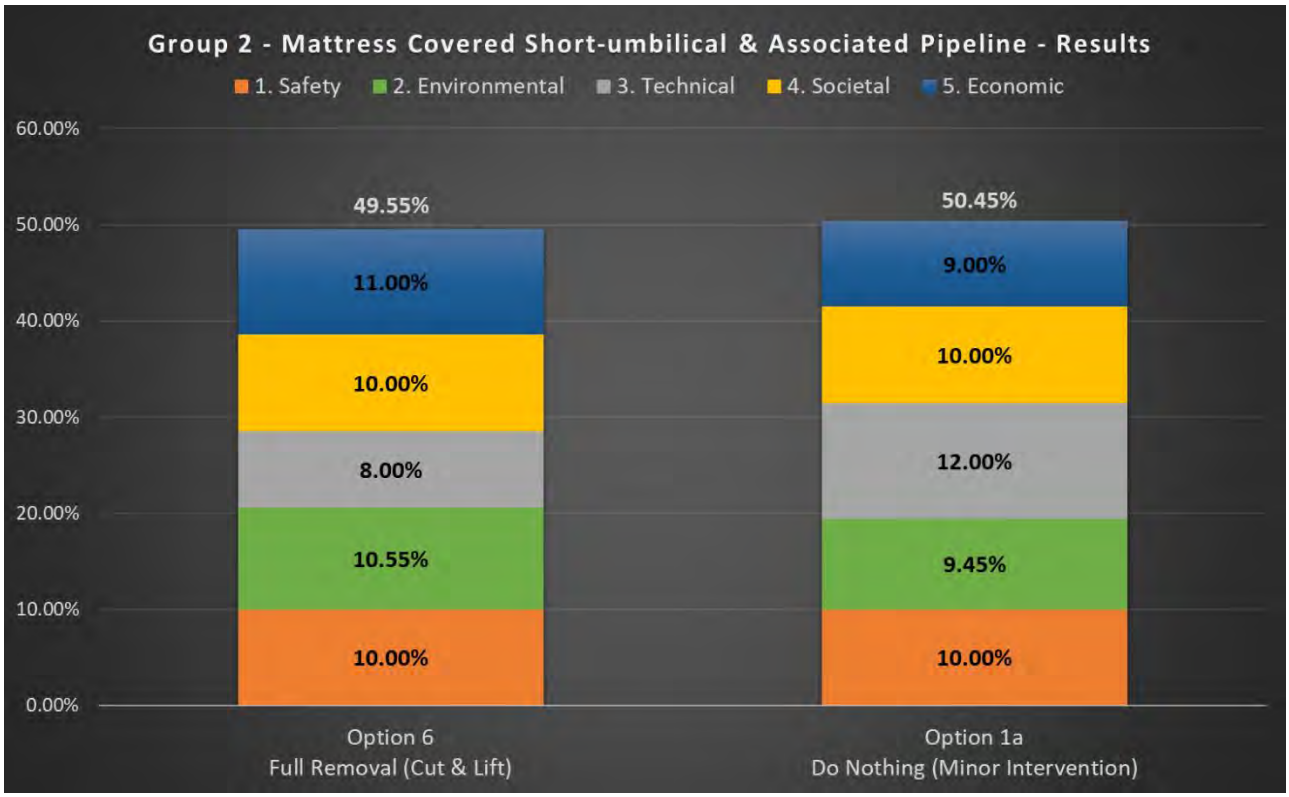


Figure 6-4: Group 2 Evaluation Results

A discussion of the relative preference of each of the decommissioning options against each of the assessment criteria is provided in the following sub-sections.

6.2.3.1 Safety Criteria Discussion

The workshops considered the leave in-situ option and the full removal option to be equally preferred.

Despite Leave In-Situ (Option 1a) requiring less operational effort and less risk exposure to onshore personnel for materials handling, there is no appreciable offshore or marine risk from the removal of these pipelines due to their short length (80m) and the requirement to undertake subsea operations to remove the manifolds proximate to the pipelines.

Full removal (Option 6) clears the seabed of potential snagging hazards for fishermen and therefore minimises the residual risk. However, these pipelines are buried by sand on mattresses and therefore the in-situ option is not expected to present a high risk to fishing operations.

6.2.3.2 Environmental Criteria Discussion

The workshops considered the full removal option 6 to have a slightly lower environmental impact than the leave in-situ option.

There is no difference between the options as regards the environmental impact from the operations due to similar vessel usage (fuel use, emissions, consumption of natural resources). Although there is a short-term impact from marine disturbance for full removal (Option 6), leaving the pipeline in-situ scored marginally lower than full removal due to the long-term environmental impact of the remaining pipeline:

- The requirement for rock placement to stabilise pipeline ends for the remaining pipeline. This introduction of rock would result in additional habitat loss in the marine protected area.
- The long-term marine impact from the degradation of remaining in-situ pipeline infrastructure.

6.2.3.3 Technical Criteria Discussion

The leave in-situ (Option 1a) has been assessed as being marginally stronger than full removal (Option 6).

The feasibility of Option 6 is less well understood as this option requires extensive mattress removal of these surface-laid pipelines. This presents greater technical difficulty as the mattresses require unburial and degradation may present challenges to the pipeline removal.

6.2.3.4 Societal Criteria Discussion

The societal criteria compared the economic impact of the options on commercial fishing operations, as well as the impact the activities have on the recycling of material, landfill use and traffic disruption caused by the volume of scrap material returned to shore for handling.

Both options are equally preferred for both criteria as the operational activities are similar and material brought to shore for handling was considered small.

6.2.3.5 Economic Criteria Discussion

The economic criteria indicated that there is a preference for the full removal (Option 6) over the leave in-situ (Option 1a). The short-term execution costs are a little higher for Option 6, but not enough to express a preference, however the long-term legacy cost of undertaking post

decommissioning monitoring surveys and the contribution to the Fisheries Legacy Trust Fund associated with Option 1a was sufficient to express a preference for Option 6.

6.2.4 Recommendation

Both options were equally preferred against the Safety and Societal criteria. Option 6 was narrowly preferred from an Environmental perspective, driven by the reduced legacy impact from the full removal option and the lower impact in terms of Loss of Habitat. The narrow preference for Option 6 was more than offset by the preference for Option 1a from a Technical perspective due to the challenges associated with de-burial and mattress removal in Option 6. This indicated that Option 1a would be the overall preferred option.

Once the Economic criterion was included, despite Option 6 being preferred from an Economic perspective, this was insufficient to overturn the overall small preference for Option 1a.

However, given the closeness of the assessment and the short length of these lines, there is a reasonable argument to support the full removal of these lines, despite the outcome of the CA showing a small preference for leave in-situ.

The emerging recommendation from the CA is that either leave in-situ or full removal may be selected. It is noted that, should the leave in-situ option be progressed, the remaining lines, left in their current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea and left to degrade over time. The post decommissioning line (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

6.3 CA Outcome – Group 3a – Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤16”

6.3.1 Group Characteristics

Group 3a consists of three non-concrete coated, rigid pipelines that are 16 inches or less in diameter (PL1694, PL2234 and PL2236). Each of the gas lines has an associated piggyback methanol line (PL1695, PL2235 and PL2237 respectively). Each of the gas lines were laid within a trench and buried and have minimal areas of exposure. These areas of exposure are located at the pipeline ends and would be removed under all decommissioning options. The Europa lines were installed in 1999 and the Saturn lines in 2006 / 2007. There are no crossings associated with these lines.

The pipeline is shown in context in Figure 6-5 and its key characteristics are shown in Table 6-3.

ID	Description	CA Battery Limits		Diameter (inches)	Length (m)	Exposure (m)
		From	To			
PL2234	Tethys TN to Saturn ND / LOGGS PR Tee 10" Gas Line	Tethys TN	Saturn ND / LOGGS PR Tee	10	3,877	18
PL2235	LOGGS PR / Saturn ND Tee to Tethys TN 3" MeOH	Saturn ND / LOGGS PR Tee	Tethys TN	3	3,878	Piggybacked to PL2234
PL2236	Mimas MN to Saturn ND 10" Gas Line	Mimas MN	Saturn ND	10	13,603	7
PL2237	Saturn ND to Mimas MN 3" MeOH Line	Saturn ND	Mimas MN	3	13,606	Piggybacked to PL2236
PL1694	Europa EZ to Callisto ZM / Ganymede ZD Tee 12" Gas Line	Europa EZ	Callisto ZM / Ganymede ZD Tee	12	4,498	4
PL1695	Ganymede ZD / Callisto ZM Tee to Europa EZ 3" MeOH Line	Callisto ZM / Ganymede ZD Tee	Europa EZ	3	4,500	Piggybacked to PL1694

Table 6-3: Group 3a Characteristics

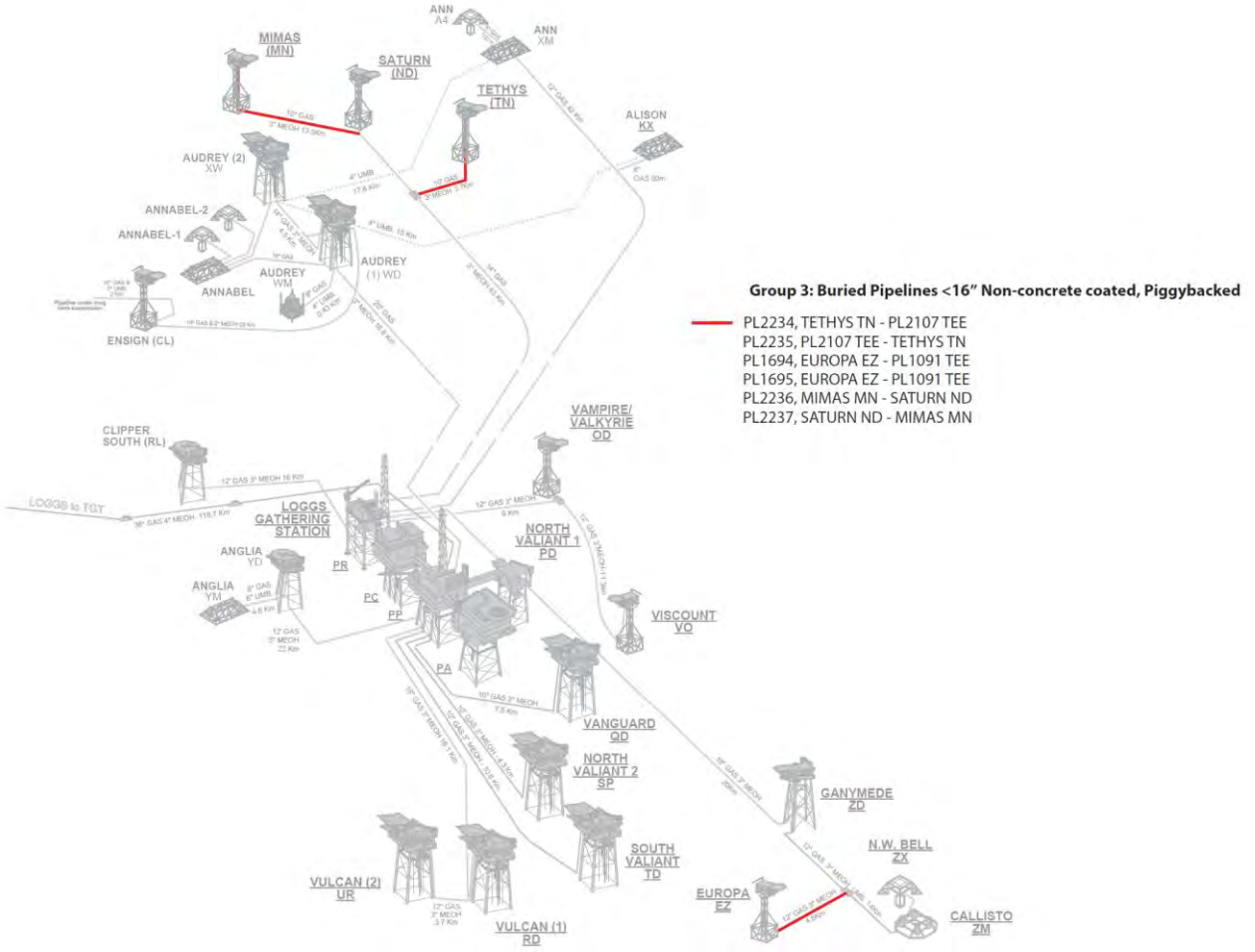


Figure 6-5: LOGGS Area (LDP2 – 5) Group 3a

6.3.2 Decommissioning Options for Evaluation

Ten options were presented at CA screening stage with seven of those screened out. The three decommissioning options retained for CA evaluation were:

- Option 1a: Leave in-situ (Minimum Intervention) – Removal of pipeline ends and rock placement over cut ends only
- Option 5a: Full Removal – Reverse reel
- Option 6: Full Removal – Cut and lift

6.3.3 Evaluation

During the evaluation phase of the CA, the remaining decommissioning options associated with Group 3a – Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤16" were assessed using the evaluation methodology introduced in section 2.5 and further detailed in Appendix A. The visual output representing the outcome of the evaluation for Group 3a is shown in Figure 6-6.

The evaluation process identified Option 1a, the leave in-situ option (minimum intervention) to be preferred for all criteria.

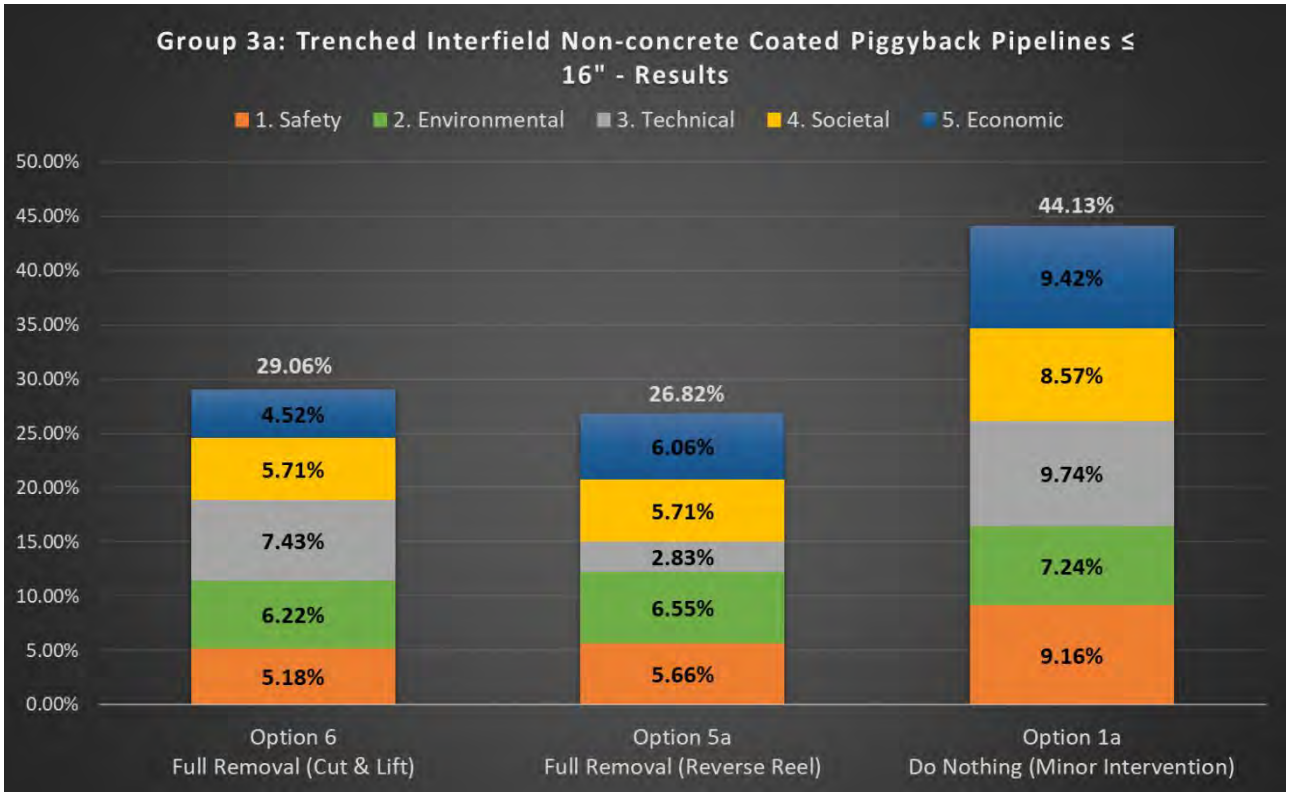


Figure 6-6: Group 3a Evaluation Results

A discussion of the relative preference of each of the decommissioning options against each of the assessment criteria is provided in the following sub-sections.

6.3.3.1 Safety Criteria Discussion

The workshops considered the leave in-situ options (Options 1a) to be less hazardous (therefore assessed as stronger) than either of the full removal options, Options 5a (Reverse Reel) and 6 (Cut and Lift).

The results of the evaluation of the short-term safety sub-criteria favoured the Option 1a leave in-situ option because of the lower operational activity associated with this option:

- The smaller offshore scope and minor vessel usage required for leaving the lines in-situ and hence reduced offshore personnel safety risk.
- The minimal material removed for the in-situ option that limits the amount of material required to be handled, transported and processed onshore hence minimising the onshore personnel risk.
- The minor exposure to dropped object hazards due to the low number of heavy lifts required for in-situ decommissioning. In comparison, the full removal options required significantly greater lifting and deck operations for the reverse reel activities to recover the pipelines thus increasing the exposure of personnel to high consequence events.

The full removal options removed all residual long-term safety risk. Pipelines remaining in-situ present greater risk to fishermen with trawl gear, as anomalous spans are a snagging hazard to these fishermen, hence full removal negates this outcome. However, no anomalous spans have been identified and any emerging issues will be identified during decommissioning inspections.

Option 1a is stronger from a short-term safety perspective owing to the reduced activity associated with this option. The residual long-term safety risk associated with leaving the pipelines in-situ is similar for all the options as no snagging hazard remains regardless of the option.

6.3.3.2 Environmental Criteria Discussion

The workshops considered the leave in-situ option 1a to have the least environmental impact than any other option.

This result was related to the in-situ option 1a having the least operational activity:

- Low vessel usage reducing the negative environmental impact of noise and discharges to sea.
- Limited pipeline remediation and hence a lower seabed disturbance with no requirement for pipeline unburial by Mass Flow Excavation and minor rock consumption.

The long-term marine impact from the degradation of remaining in-situ pipeline infrastructure is the only evaluation sub-criteria where Option 1a does not score strongest. In Option 1a, the remaining pipelines are left to degrade and release degradation products into the water column over time. The full removal Option 5a and 6 score best for this criterion due to full pipeline removal.

The full removal operations using cut and lift (Option 6) and reverse reel (Option 5a) results in greatest marine disturbance and noise from mass flow excavation activities required to unbury the pipeline prior to removal. Both removal operations are vessel intensive over extended periods that negatively impacts the marine environment due to vessel noise, discharges, fuel use and atmospheric emissions.

Overall, the combined short-term and long-term environmental impact of the options associated with the decommissioning of these pipelines, favours in-situ, minimum intervention (Option 1a) predominantly due to this option having the lowest short-term operational marine impact and minor long-term impact from minimal rock at the cut pipeline ends only.

6.3.3.3 Technical Criteria Discussion

Leave in-situ - Option 1a (disconnection of the pipeline ends only) scored as the most feasible both in terms of concept maturity and technical risk.

The full removal options have comparatively greater risk as the operations would be conducted over large pipeline lengths requiring de-burial which may present difficulties that lengthen the removal duration. Of greatest technical risk and least technical maturity is the reverse reel option (Option 5a) of the rigid piggybacked pipelines which is yet to be proven operationally. In addition, the integrity of the degraded pipelines may present complications during the plastic deformation applied during reel recovery.

6.3.3.4 Societal Criteria Discussion

The societal criteria compared the economic impact of the options on commercial fishing operations, as well as the impact the activities have on the recycling of material, landfill use and traffic disruption caused by the volume of scrap material returned to shore for handling.

Option 1a has the least impact on commercial fishing as this option requires disconnection to the platform 500m ends only presenting the least disruption and disturbance to the fishing industry. However, the full removal options require extended offshore operations and hence greater disruption to the fishing activities that are highest in the Europa EZ and Tethys TN areas predominantly

conducted by Dutch beam trawlers. The legacy impact of pipeline exposure to fishermen that could potentially result in damage or loss of gear when being overtrawled associated with Option 1a, is to be mitigated by an appropriate post-decommissioning monitoring regime.

Leaving the pipeline in-situ was shown to have a more positive impact on the societal criteria compared to the removal options, driven by the higher quantity of material that would be required to be recycled if full removal took place. The greater the quantity of material that is removed, the greater the amount of material that will be bought to shore. Although recycling is a positive societal impact, it is outweighed by the requirement to use landfill because of the polymer contents within the pipelines that reduces its applicability for recycling. Since the leave in-situ options 1a requires less recycling (and therefore no use of landfill and no traffic disruption onshore) this option was more favourable than full removal (Options 5a and 6).

Overall Option 1a is the most attractive option from both a societal (recycling) and commercial fishing (disruption) perspective. The removal options are the least attractive because they contribute to large-scale landfill use and are likely to lead to disruptions in current fishing activity.

6.3.3.5 Economic Criteria Discussion

The economic criteria compare the short-term execution cost of undertaking the decommissioning options and the long-term legacy cost of undertaking post decommissioning monitoring surveys, contribution to the Fisheries Legacy Trust Fund to support pipeline snagging hazard awareness amongst fishermen and potential remedial works for leave in-situ options. Overall, the leave in-situ option 1a is more favourable economically than the removal options driven by the short-term costs. The pipelines are fully buried and therefore no additional long-term legacy costs will be attributable to the Leave in-situ Option 1a.

The short-term full removal cost for Option 6 is £29 million compared to £2.5 million for leave in -situ Option 1a. Reverse reel, Option 5a, is a lower cost (£10 million) than cut and lift operations, but higher than the cost of leaving the pipelines in-situ with the risk of cost escalation for difficulties associated with the reeling operations.

6.3.4 Recommendation

The leave in-situ option (Option 1a) was considered more attractive than the full removal options (Option 5a and Option 6) for the Safety, Environmental, Technical, and Societal criteria.

The larger removal scopes (Option 5a and 6) would result in greater safety exposure for personnel, both onshore and offshore. Only with residual risk was there a preference for the full removal options, as with the pipeline fully removed there would be no residual risk; however, it is noted that as part of any partial removal or leave in-situ solution being selected, any potential hazards along the pipeline would be risk assessed and remediated and / or monitored to ensure that any emerging hazards do not develop into an unacceptable snagging risk to fishing operations.

From an environmental perspective the larger scope associated with the full removal options generally results in the leave in-situ option being preferable.

Technically, the leave in-situ option is preferred to either of the full removal options, as there is less technical risk and the operations are routine.

With the site shown to be currently over-trawlable, there is no discernible advantage to the fishing industry from removal of the pipeline, with the larger scopes resulting in greater disruption to the fishing industry. From a communities / amenities perspective Options 5a and 6 were less attractive than the leave in-situ option due to the use of landfill for the returned pipeline coatings.

The emerging preference for Option 1a was further enhanced when the Economic criterion was included. This is due to the cost for implementing Option 1a being significantly less than the other options.

The emerging recommendation from the CA is therefore to leave the trenched interfield, non-concrete coated, piggyback pipelines less than or equal to 16" in diameter in-situ with minimum intervention. This would entail disconnection and removal of the pipeline ends. Spot rock placement would be installed at the cut pipeline ends only to mitigate any potential snag hazard. The remaining pipeline, which is fully trenched and buried, would be left in its current state, marked on sea charts and notifications issued to fishermen / other users of the sea and left to degrade over time. The post decommissioning pipeline (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

6.4 CA Outcome – Group 3b – Trenched Interfield Non-concrete Coated Non-piggyback Pipelines ≤16”

6.4.1 Group Characteristics

Group 3b consists of a single 4” methanol pipeline (PL455) from TGT to the LOGGS PP platform. The pipeline is 118 km long, non-concrete-coated and is trenched and buried along the majority of its length, with only minimal areas of exposure. It was installed in 1987. There are multiple pipeline crossings. PL455 is piggybacked on PL454 for the first 400m from LOGGS PP and for ~2km from KP116.685 to HAT at KP118.724.

The pipeline is shown in context in Figure 6-7 and its key characteristics are shown in Table 6-4.

ID	Description	CA Battery Limits		Diameter (inches)	Length (km)	Exposure (m)
		From	To			
PL455	TGT to LOGGS PP 4" MeOH Line	TGT	LOGGS PP	4	118	338

Table 6-4: Group 3b Characteristics

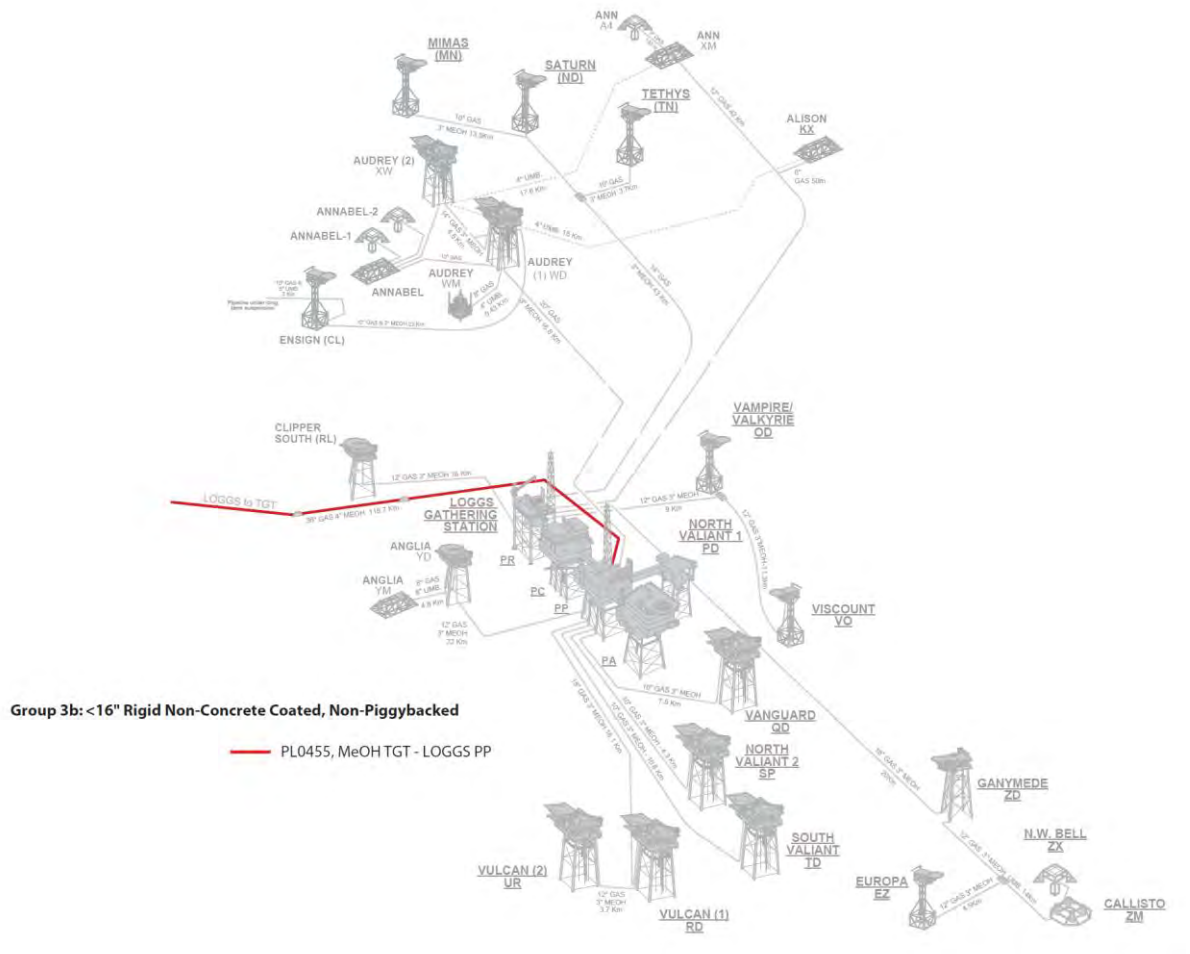


Figure 6-7: LOGGS Area (LDP2 – 5) Group 3b

6.4.2 Decommissioning Options for Evaluation

Ten options were presented at CA screening stage with five of those screened out. The five decommissioning options retained for CA evaluation were:

- Option 1a: Leave in-situ (Minimum Intervention) – Removal of pipeline ends and rock placement over cut ends only
- Option 2a: Leave in-situ (Minor Intervention) – Removal of pipeline ends and rock placement on all ends and exposures;
- Option 4: Partial Removal – Cut and lift exposures and rock placed on all cut ends
- Option 5a: Full Removal – Reverse reel
- Option 6: Full Removal – Cut and lift

6.4.3 Evaluation

During the evaluation phase of the CA, the remaining decommissioning options associated with Group 3b – Trenched Interfield Non-concrete Coated Non-piggyback Pipelines ≤16" were assessed using the evaluation methodology introduced in section 2.5 and further detailed in Appendix A. The visual output representing the outcome of the evaluation for Group 3b is shown in Figure 6-8.

The evaluation process identified the leave in-situ option (minimum intervention) to be the highest score by a narrow margin as it is preferred for all criteria, apart from a slight reduction in the safety criteria due to the legacy risk that the exposed pipeline presents. Option 2a and Option 4 that rock cover or remove the exposures in the pipeline, derive similar results to Option 1a. However, both these options require the introduction of rock into the marine protected environment resulting in habitat loss and although these options remove pipeline exposure, the long-term legacy risk to fishermen associated with the existing pipeline exposure is ranked as low due to the short overall length of a small diameter pipeline and lack of reported free spans on this pipeline.

Full removal by reverse reel (option 5a) and by cut and lift (option 6) were not preferred against partial removal and in-situ. This pipeline is a rigid 118 km length line, has an unknown integrity resulting in significant safety and technical challenges when considering the removal options.

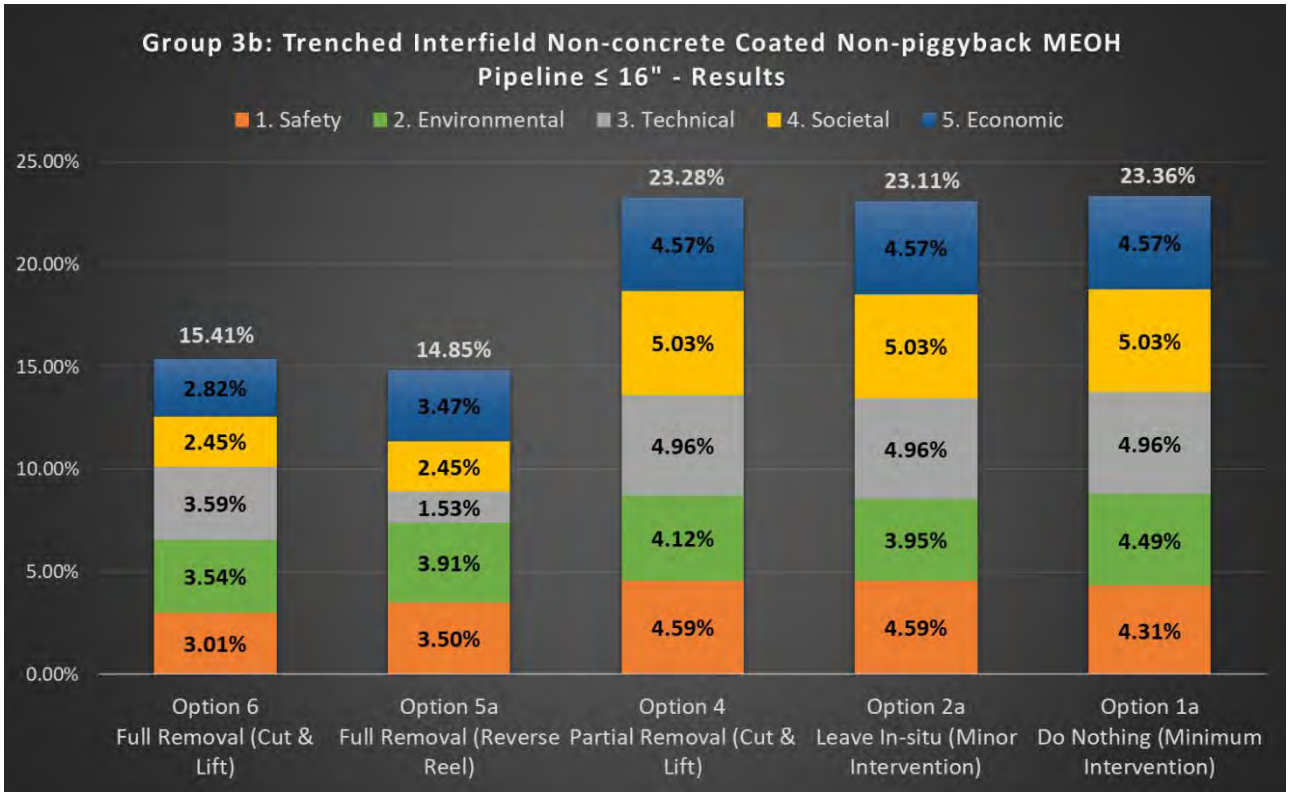


Figure 6-8: Group 3b Evaluation Results

A discussion of the relative preference of each of the decommissioning options against each of the assessment criteria is provided in the following sub-sections.

6.4.3.1 Safety Criteria Discussion

Option 2a and Option 4 removes all exposures to snag hazards for fishermen with minimal intervention, and hence scores highest in terms of safety compared to all the other options.

The results of the evaluation of the short-term safety sub-criteria favoured the Option 1a (minimum intervention), Option 2a (rock remediation) and Option 4 (partial removal) because of the lower operational activity associated with these options.

The 118 km 4” methanol pipeline has been reported as being predominantly buried with various minor exposures totalling around 338 m. Therefore, the activity required to support the removal of the exposure (either by rock cover or removal of exposed sections) is relatively small. Hence negligible additional short-term safety risk is expressed for executing the operations compared to leaving the pipeline in-situ (minimum intervention), Option 1a.

The full removal options, result in greater exposure to short term operational safety risks during execution:

- Longer offshore scope durations therefore higher offshore personnel safety risk (durations and hence safety exposure higher for cut and lift than for reverse reeling).
- Greater amounts of material required to be handled, transported and processed onshore hence higher onshore personnel risk.

- Greater number of additional vessels required for cut and lift removal, increasing the number of vessel transits and a heightened risk of collision. This risk was significant for the cut and lift operations only as the increase in vessel traffic was not expected to be substantial for the reverse reel operations compared to existing marine traffic.

- Increased exposure offshore and onshore to dropped object hazards due to the high number of heavy lifts required for full removal of the 118 km methanol pipeline.

Conversely, the results of the evaluation of the long-term safety sub-criteria favoured the full removal options because it eliminates the residual long-term safety risk. Pipelines remaining in-situ present greater risk to fishermen with trawl gear, as anomalous spans are a potential snagging hazard to these fishermen.

Overall, the most attractive options from a safety perspective are the options that intervene by removing the exposures (remediating the exposure with rock placement: 2a and partial removal: 4), hence reducing the long-term residual risk, the long term residual risk is also mitigated by the trenched nature of these pipelines. There is minor exposure reported on this pipeline and hence additional scopes to remove exposure does not increase the safety risk appreciably.

6.4.3.2 Environmental Criteria Discussion

The workshops considered the leave in-situ option 1a to have the least environmental impact although the alternative options were evaluated to have a similar cumulative environmental impact with little obvious preference between them.

Option 1a leave in-situ (minimum intervention) was most attractive overall due to this option having the least operational activity:

- Low vessel usage reducing the negative environmental impact of noise and discharges to sea.

- Limited pipeline remediation and hence a lower seabed disturbance with no requirement for pipeline unburial by Mass Flow Excavation and minor rock consumption.

The long-term marine impact from the degradation of remaining in-situ pipeline infrastructure is the evaluation sub-criteria where Option 1a does not score strongest. In Option 1a, the remaining pipelines are left to degrade and release degradation products into the water column over time. The full removal Option 5a and 6 score best for this criterion due to full pipeline removal.

The full removal operations using reverse reel (Option 5a) results in greatest marine disturbance and noise from mass flow excavation activities required to unbury the pipeline prior to removal. Both removal operations are vessel intensive over extended periods that negatively impacts the marine environment due to vessel noise, discharges, fuel use and atmospheric emissions.

Partial removal of the exposures (Option 4) and leave in-situ, minor intervention (Option 2a) score weakest in terms of habitat loss as they require the application of rock introducing hard substrate into the existing sandbank.

Overall, the combined short-term and long-term environmental impact of the options associated with the decommissioning of these pipelines, favours in-situ, minimum intervention (Option 1a) predominantly due to this option having the lowest short-term operational marine impact and minor long-term habitat loss from minimal rock at the cut pipeline ends only. Full removal options (5a and 6) score weakly due to the extensive marine disturbance over the 118 km pipeline from unburial and

removal activities and exposure remediation (options 4 and 2a) score weakly due to habitat loss from rock placement.

6.4.3.3 Technical Criteria Discussion

The Leave in-situ options (1a and 2a) and partial removal (option 4) scored the most feasible both in terms of concept maturity and technical risk.

The full removal options have comparatively greater risk as the operations would be conducted over large pipeline lengths requiring de-burial which may present difficulties that lengthen the removal duration. Of greatest technical risk and least technical maturity is the reverse reel option (Option 5a) of the rigid pipeline which is yet to be proven operationally. In addition, the integrity of the degraded pipelines may present complications during the plastic (non-elastic) deformation of the steel pipeline applied during reel recovery.

6.4.3.4 Societal Criteria Discussion

The societal criteria compared the economic impact of the options on commercial fishing operations, as well as the impact the activities have on the recycling of material, landfill use and traffic disruption caused by the volume of scrap material returned to shore for handling.

The partial removal, Option 4 and leave in-situ options (Option 1a and Option 2a) have the least impact on commercial fishing as they present the least disruption and disturbance to the fishing industry. Conversely, the full removal options require extended offshore operations and hence greater disruption to the fishing activities most significantly to near-shore fishing operations where static creel pots may need to be removed to allow access for full pipeline removal.

Leaving the pipeline in-situ was shown to have a more positive impact on the societal criteria compared to the removal options, driven by the higher quantity of material that would be required to be recycled if full removal took place. The greater the quantity of material that is removed, the greater the amount of material that will be bought to shore. Although recycling is a positive societal impact, it is outweighed by the requirement to use landfill because of the polymer contents within the pipelines that reduces its applicability for recycling. Since the leave in-situ options 1a, 2a and partial removal of the negligible 338 m of exposure require less recycling (and therefore minor use of landfill and no traffic disruption onshore) these options were more favourable than full removal (Options 5a and 6).

Overall Option 1a, Option 2a and Option 4 are the equal most attractive options from both a societal (recycling) and commercial fishing (disruption) perspective. The removal options are the least attractive because they contribute to large-scale landfill use and are likely to lead to disruptions in current fishing activity.

6.4.3.5 Economic Criteria Discussion

The economic criteria compare the short-term execution cost of undertaking the decommissioning options and the long-term legacy cost of undertaking post decommissioning monitoring surveys, contribution to the Fisheries Legacy Trust Fund to support pipeline snagging hazard awareness amongst fishermen and potential remedial works for leave in-situ options. Overall, the leave in-situ options (1a and 2a) and the partial removal option 4 are more favourable economically than the removal options driven by the short-term costs.

The short-term full removal cost for Option 6 is £132 million compared to £2.3 million for leave in-situ Option 1a. Reverse reel, Option 5a, is a lower cost (£28 million) than cut and lift operations, but higher than the cost of leaving the pipelines in-situ with the risk of cost escalation for difficulties associated with the reeling operations.

6.4.4 Recommendation

The leave in-situ and partial removal options all scored relatively closely with Option 1a, the leave in-situ option (pipeline disconnected at the LOGGS end and at the tee locations only) being marginally the most attractive option overall. This is due to it being assessed as the most preferred option in the Environmental, Technical and Societal criteria, largely due to it having the shortest offshore durations of all the options. Option 1a was also very close to being the most attractive option from a safety perspective, again due to the shorter durations offshore and lower quantity of material returned, with only the legacy risk element from leaving the line in place with areas of exposure resulting Option 4 and Option 2a being marginally preferred.

Although the leave in-situ options 1a and 2a as well as the partial removal option 4, were the most attractive from an economic perspective, the inclusion of the economic criterion did not impact the overall preference for Option 1a.

Option 4, the partial removal option where the line ends and the exposures are removed was next most attractive, followed closely by Option 2a, where the line ends are removed and the areas of exposure are rock covered. These options were slightly less preferred to Option 1a in the Environmental, Technical and Societal criteria due to the habitat loss from the increased rock required and the additional disturbance to the fishing industry from the extended offshore work scopes. They were marginally preferred over Option 1a from a safety perspective, with the key differentiator being the residual risk presented by the left in-situ pipeline with the exposures remediated by removal (Option 4) or rock cover (Option 2a).

The full removal options were considered significantly less attractive than the leave in-situ or partial removal options with Option 6, full removal by cut & lift being preferred over Option 5a, full removal by reverse reel. This is mainly due to the increased offshore work scopes increasing the safety risk, the environmental impact and the disruption to the fishing industry. In addition, the extra material being returned by removing the full pipeline had additional impact in terms of onshore personnel safety exposure and use of landfill from the polymer returned. There was also a significant impact from the de-burial of the line to allow removal. The positive attributes of these full removal options such as no residual safety risk and no legacy environmental impact were insufficient to offset the impacts.

Overall, given the similar total score for the leave in-situ options (Option 1a and Option 2a) and partial removal (Option 4), these options are considered equally preferred. As such, the emerging recommendation from the CA is that any of these options may be executed as the decommissioning solution. Common to each of these options is the disconnection and removal of the LOGGS end of the pipeline and the ends around the two tee locations. Spot rock placement would be installed at the cut pipeline ends to mitigate any potential snag hazard.

The exposures will be risk assessed to determine whether remediation is necessary, with the outcome of this assessment influencing whether the exposures will be removed (Option 4), rock covered (Option 2a) or left in-situ (Option 1a). The remaining pipeline, would be marked on sea charts and notifications issued to fishermen / other users of the sea and left to degrade over time. The post decommissioning pipeline (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

6.5 CA Outcome – Group 3c – Trenched Interfield Concrete Coated Piggyback Pipelines ≤16”

6.5.1 Group Characteristics

Group 3c consists of four concrete coated, rigid pipelines that are 16 inches or less in diameter (PL456, PL460, PL470 and PL1091). Each of the gas lines has an associated piggyback methanol line (PL457, PL461, PL471 and PL1092 respectively). Each of the gas lines were laid within a trench and buried and have minimal areas of exposure. The Ganymede lines were installed in 1999 and the other lines connected to LOGGS PP were installed in 1987. There are no crossings associated with these lines.

The pipeline is shown in context in Figure 6-9 and its key characteristics are shown in Table 6-5.

ID	Description	CA Battery Limits		Diameter (inches)	Length (m)	Exposure (m)
		From	To			
PL1091	Callisto ZM to Ganymede ZD 12" Gas Line	Callisto ZM	Ganymede ZD	12	14,300	132
PL1092	Ganymede ZD to Callisto ZM 3" MeOH Line	Ganymede ZD	Callisto ZM	3	14,300	Piggybacked to PL1091
PL456	Vanguard QD to LOGGS PP 10" Gas Line	Vanguard QD	LOGGS PP	10	7,548	102
PL457	LOGGS PP to Vanguard QD 3" MeOH Line	LOGGS PP	Vanguard QD	3	7,510	Piggybacked to PL456
PL460	South Valiant TD to LOGGS PP 10" Gas Line	South Valiant TD	LOGGS PP	10	10,663	120
PL461	LOGGS PP to South Valiant TD 3" MeOH Line	LOGGS PP	South Valiant TD	3	10,662	Piggybacked to PL460
PL470	North Valiant SP to LOGGS PP 10" Gas Line	North Valiant 2 SP	LOGGS PP	10	4,395	130
PL471	LOGGS PP to North Valiant SP 3" MeOH Line	LOGGS PP	North Valiant 2 SP	3	4,395	Piggybacked to PL470

Table 6-5: Group 3c Characteristics

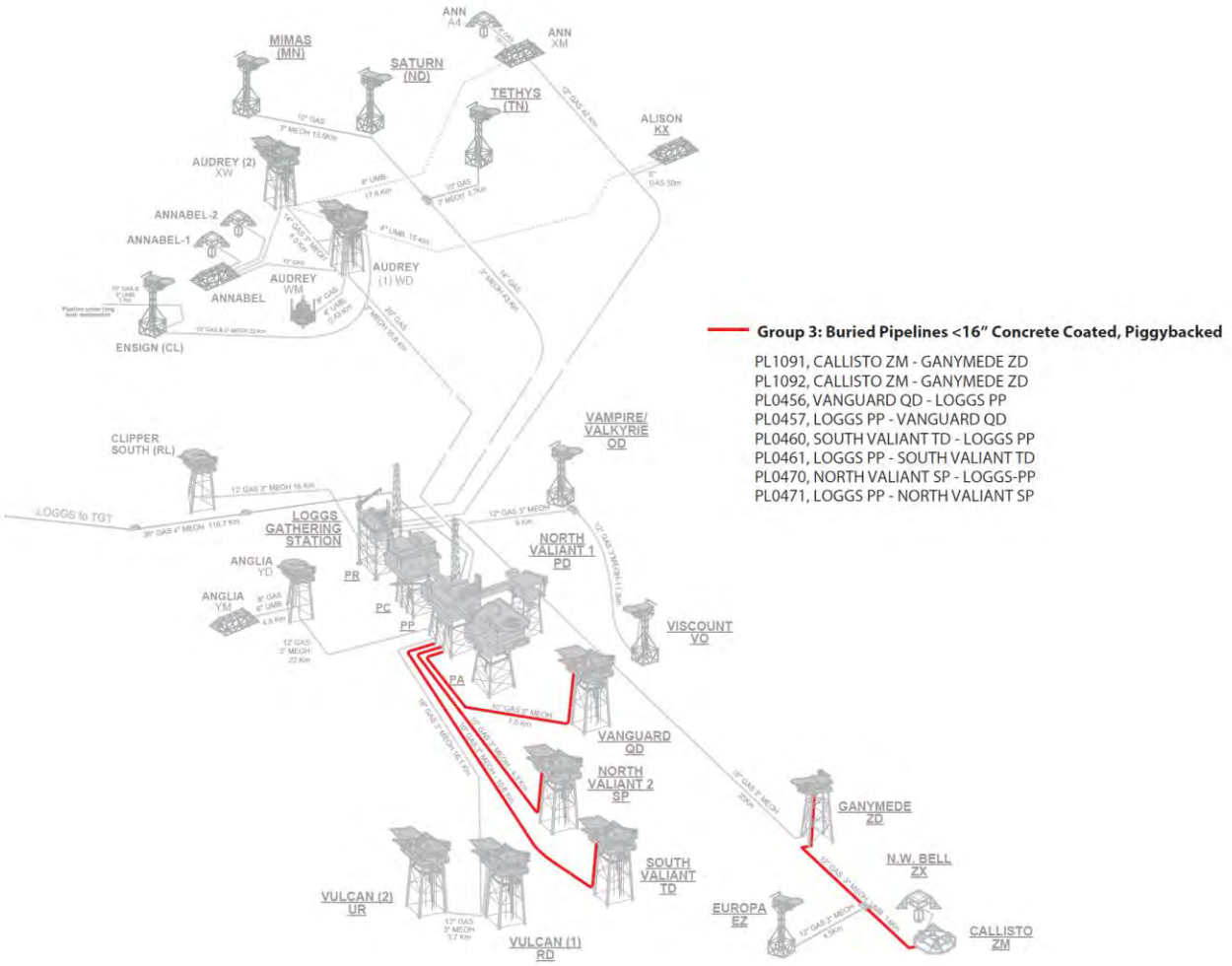


Figure 6-9: LOGGS Area (LDP2 – 5) Group 3c

6.5.2 Decommissioning Options for Evaluation

Ten options were presented at CA screening stage with six of those screened out. The four decommissioning options retained for CA evaluation were:

- Option 1a: Leave in-situ (Minimum Intervention) – Removal of pipeline ends and rock placement over cut ends only
- Option 2a: Leave in-situ (Minor Intervention) – Removal of pipeline ends and rock placement on all ends and exposures
- Option 4: Partial Removal – Cut and lift exposures and rock placed on all cut ends. Exposed pipeline disposed of onshore
- Option 6: Full Removal – Cut and lift

6.5.3 Evaluation

During the evaluation phase of the CA, the remaining decommissioning options associated with Group 3c – Trenched Interfield Concrete Coated Piggyback Pipelines ≤16" were assessed using the

evaluation methodology introduced in section 2.5 and further detailed in Appendix A. The visual output representing the outcome of the evaluation for Group 3c is shown in Figure 6-10.

The evaluation process identified the leave in-situ option (minimum intervention) to be the highest score by a narrow margin as it is to be preferred for all criteria, apart from a slight reduction in the safety criteria due to the legacy risk that the exposed pipeline presents. Option 2a and 4 that remove the exposures in the pipeline, derive similar results to Option 1a. However, both these options require the introduction of rock into the marine protected environment resulting in habitat loss and although these options remove pipeline exposure, the long-term legacy risk to fishermen associated with the existing pipeline exposure is ranked as low due to the short overall length and lack of reported free spans on this pipeline.

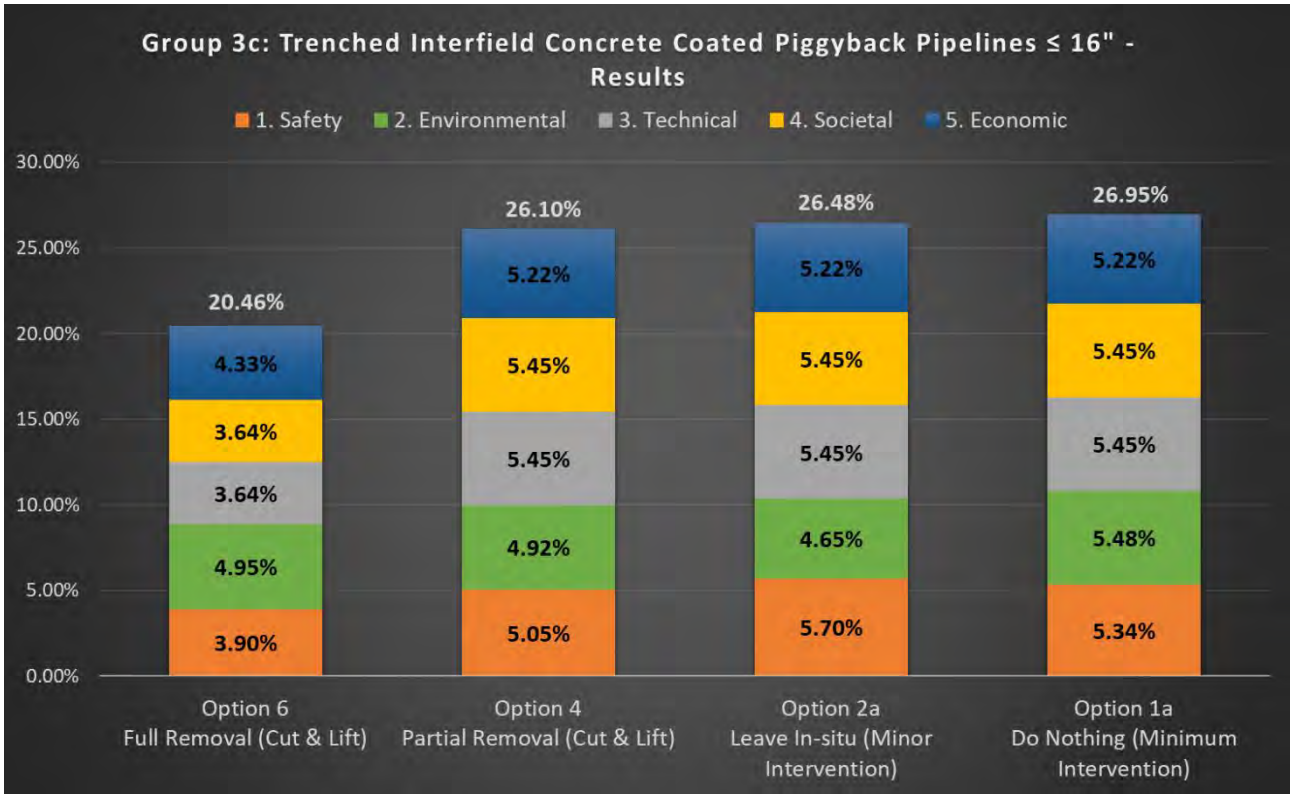


Figure 6-10: Group 3c Evaluation Results

A discussion of the relative preference of each of the decommissioning options against each of the assessment criteria is provided in the following sub-sections.

6.5.3.1 Safety Criteria Discussion

Option 2a is the most attractive option overall. The short-term operational safety risk associated with remediating approximately 500m of exposures with rock cover can be undertaken in a relatively short duration, thereby limiting the risk exposure to offshore personnel, with minor materials handling onshore minimising the onshore personnel risk. In addition, the marine vessel support to place the rock is not substantial therefore the risk to other users of the sea does not increase from this activity. The long-term safety risk posed by pipeline exposures is reduced for Option 2a as the current exposures would be eliminated by the rock.

Option 1a leave in-situ, indicates similar low short-term risks as for Option 2a, although the exposures are retained, which penalises this option with respect to Option 2a for the long-term residual risk element.

Option 4 was less attractive than Option 1a and 2a due the additional onshore safety risk posed by the materials handling onshore, the greater offshore scope, although the long-term safety risk is minimised by the partial removal of the exposures.

Full removal, Option 6, is the least attractive for all safety criteria except for the long-term safety element as full removal eliminates the residual risk posed by pipeline exposures.

Overall, the most attractive options from a safety perspective is the option that intervenes by removing the exposures (remediating the exposure with rock placement: 2a), hence reducing the long-term residual risk, whilst also requiring minimal offshore and onshore support to execute. The long term residual risk is also mitigated by the trenched nature of the pipelines in this group.

6.5.3.2 Environmental Criteria Discussion

The workshops considered the leave in-situ option 1a to have the least environmental impact although the alternative options were evaluated to have a similar cumulative environmental impact with little obvious preference between them.

Option 1a leave in-situ (minimum intervention) was most attractive overall due to this option having the least operational activity:

- Low vessel usage reducing the negative environmental impact of noise and discharges to sea.
- Limited pipeline remediation and hence a lower seabed disturbance with limited requirement for pipeline unburial by Mass Flow Excavation (unburial limited to disconnection from the infrastructure, which is a common requirement for all options) and minor rock consumption.

The long-term marine impact from the degradation of remaining in-situ pipeline infrastructure is the evaluation sub-criteria where Option 1a does not score strongest. In Option 1a, the remaining pipelines are left to degrade and release degradation products into the water column over time. The full removal Option 6 scores best for this criterion due to full pipeline removal.

Partial removal of the exposures (Option 4) and leave in-situ, minor intervention (Option 2a) score weakest in terms of habitat loss as they require the application of rock introducing hard substrate into the existing sandbank.

Overall, the combined short-term and long-term environmental impact of the options associated with the decommissioning of these pipelines, favours in-situ, minimum intervention (Option 1a) predominantly due to this option having the lowest short-term operational marine impact and minor long-term habitat loss from minimal rock at the cut pipeline ends only. Full removal Option 6 scores marginally less attractively than 1a due to the extensive marine disturbance from unburial and removal activities. Options 4 and 2a score the least attractively due to habitat loss from rock placement.

6.5.3.3 Technical Criteria Discussion

The Leave in-situ options (1a and 2a) and partial removal (option 4) scored the most feasible both in terms of concept maturity and technical risk as a result of the routine nature of these operations.

The full removal option has comparatively greater risk as the operations would be conducted over a longer duration and requires de-burial which may present difficulties that lengthen the removal duration further.

6.5.3.4 Societal Criteria Discussion

The societal criteria compared the economic impact of the options on commercial fishing operations, as well as the impact the activities have on the recycling of material, landfill use and traffic disruption caused by the volume of scrap material returned to shore for handling.

Option 1a, 2a and 4 have the least impact on commercial fishing as this option requires the least disruption and disturbance to the fishing industry. Conversely, the full removal option requires extended offshore operations and hence greater disruption to the fishing activities.

Leaving the pipeline in-situ was shown to have a more positive impact on the societal criteria compared to the removal options, driven by the higher quantity of material that would be required to be recycled if full removal took place. The greater the quantity of material that is removed, the greater the amount of material that will be bought to shore. Although recycling is a positive societal impact, it is outweighed by the requirement to use landfill because of the polymer contents within the pipelines that reduces its applicability for recycling. Since the leave in-situ options 1a, 2a and partial removal of the 500m of exposure requires less recycling (and therefore minor use of landfill and no traffic disruption onshore) these options were more favourable than full removal (Options 6).

Overall Option 1a, 2a and 4 are equally attractive from both a societal (recycling) and commercial fishing (disruption) perspective. The removal option 6 is the least attractive because it contributes to large-scale landfill use and is likely to lead to disruptions in current fishing activity during execution.

6.5.3.5 Economic Criteria Discussion

The economic criteria compare the short-term execution cost of undertaking the decommissioning options and the long-term legacy cost of undertaking post decommissioning monitoring surveys, contribution to the Fisheries Legacy Trust Fund to support pipeline snagging hazard awareness amongst fishermen and potential remedial works for leave in-situ options. Overall, the leave in-situ options (1a and 2a) and the partial removal option 4 are more favourable economically than the removal options driven by the short-term costs. The short-term full removal cost for Option 6 is £43 million compared to £2.9 million for leave in -situ Option 1a.

6.5.4 Recommendation

The partial removal (Option 4) and leave in-situ options (Options 1a and 2a) all score relatively closely and were significantly preferred over the full removal option. These close scores reflect the similar nature of the partial and leave in-situ options in terms of scope. The most attractive option by a narrow margin is Option 1a, where the line ends are removed with the remainder left in-situ. This was the most attractive option from an environmental perspective due to the limited scope and lack of rock cover compared to some of the other options. It was also equally preferred for Option 2a and Option 4 from a technical and societal perspective as they are all similar to execute and have similar fishing and other societal impacts. Option 1a was not the most attractive from a safety perspective due to the residual risk of leaving the lines with exposures but was close enough to still be the overall preferred option. The emerging preference for Option 1a was maintained when the Economic criterion was included.

The full removal option 6 was considered significantly less attractive than the leave in-situ or partial removal options. This is in mainly due to the increased offshore work scopes required for full removal increasing the safety risk, the environmental impact and the disruption to the fishing industry. In addition, the extra material being returned by removing the full pipeline had additional impact in terms of onshore personnel safety exposure and use of landfill from the polymer returned. There was also a significant impact from the de-burial of the line to allow removal. The positive attributes of these

full removal options such as no residual safety risk and no legacy environmental impact were insufficient to offset the impacts.

Overall, given the similar total score for the leave in-situ options (Option 1a and Option 2a) and partial removal (Option 4), these options are considered equally preferred. As such, the emerging recommendation from the CA is that any of these options may be executed as the decommissioning solution. Common to each of these options is the disconnection and removal of the pipeline ends. Spot rock placement would be installed at the cut pipeline ends to mitigate any potential snag hazard.

The exposures will be risk assessed to determine whether remediation is necessary, with the outcome of this assessment influencing whether the exposures will be removed (Option 4), rock covered (Option 2a) or left in-situ (Option 1a). The remaining pipelines, would be marked on sea charts and notifications issued to fishermen / other users of the sea and left to degrade over time. The post decommissioning pipelines (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

6.6 CA Outcome – Group 4 – Trenched Interfield Concrete Coated Piggyback Pipelines >16”

6.6.1 Group Characteristics

Group 4 consists of three concrete coated, rigid pipelines that are greater than 16 inches in diameter (PL458, PL1093 and PL2017). Each of the gas lines has an associated piggyback methanol line (PL459, PL1094 and PL2108 respectively). Each of the gas lines were laid within a trench and buried to 1m and have minimal areas of exposure. The Vulcan lines were installed in 2011 and the Saturn and Ganymede lines in 2015. The Saturn lines have seven pipeline crossings and the Ganymede lines have two pipeline crossings.

The pipeline is shown in context in Figure 6-11 and its key characteristics are shown in Table 6-6.

ID	Description	CA Battery Limits		Diameter (inches)	Length (m)	Exposure (m)
		From	To			
PL458	Vulcan RD to LOGGS PP 18" Gas Line	Vulcan RD	LOGGS PP	18	16,147	253
PL459	LOGGS PP to Vulcan RD 3" MeOH Line	LOGGS PP	Vulcan RD	3	16,100	Piggybacked to PL458
PL1093	Ganymede ZD to LOGGS PR 18" Gas Line	Ganymede ZD	LOGGS PR	18	19,501	75
PL1094	LOGGS PR to Ganymede ZD 3" MeOH	LOGGS PR	Ganymede ZD	3	19,492	Piggybacked to PL1093
PL2107	Saturn ND to LOGGS PR 14" Gas Line	Saturn ND	LOGGS PR	14 Note 1	43,240	14 Note 3
PL2108	LOGGS PR to Saturn ND 3" MeOH	LOGGS PR	Saturn ND	3	43,250	Piggybacked to PL2107

Table 6-6: Group 4 Characteristics

Note 1: Whilst this group is for pipelines greater than 16” in diameter, if was agreed to include PL2107 in this group as, whilst its diameter is 14”, once the concrete coating is included, the overall diameter is greater than 16”.

Note 2: All pipelines are believed to have been trenched and mechanically backfilled during construction. No “as-built “ data have been found to confirm this. However, extensive sediment coverage indicates trenching and backfill was carried out.

Note 3: The exposure detailed for the pipelines PL2107/ PL2108 is at the pipeline ends only.

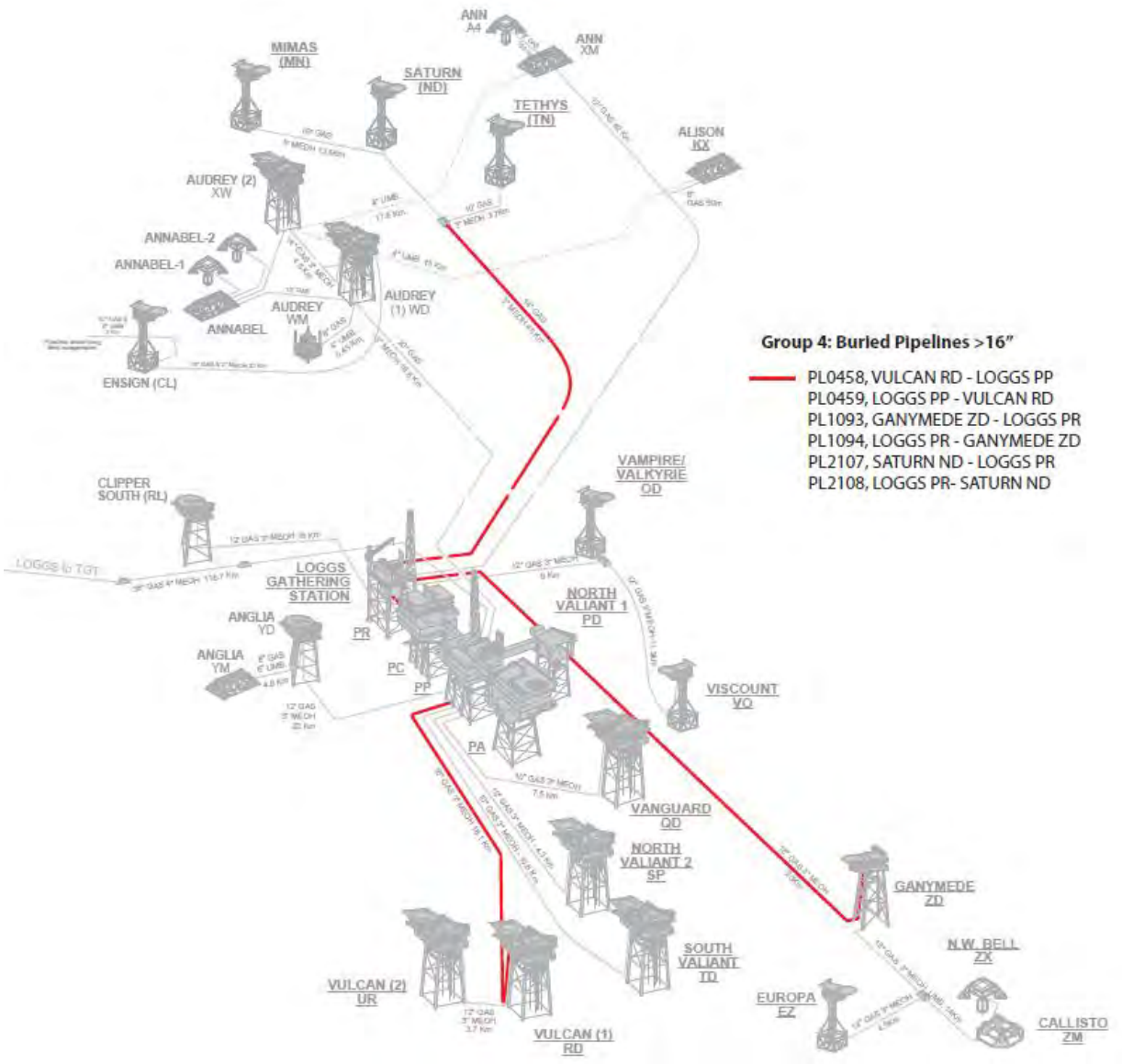


Figure 6-11: LOGGS Area (LDP2 – 5) Group 4

6.6.2 Decommissioning Options for Evaluation

Ten options were presented at CA screening stage with six of those screened out. The four decommissioning options retained for CA evaluation were:

- Option 1a: Leave in-situ (Minimum Intervention) – Removal of pipeline ends and rock placement over cut ends only
- Option 2a: Leave in-situ (Minor Intervention) – Removal of pipeline ends and rock placement on all ends and exposures
- Option 4: Partial Removal – Cut and lift exposures and rock placed on all cut ends
- Option 6: Full Removal – Cut and lift

6.6.3 Evaluation

During the evaluation phase of the CA, the remaining decommissioning options associated with Group 4 – Trenched Interfield Concrete Coated Piggyback Pipelines >16" were assessed using the evaluation methodology introduced in section 2.5 and further detailed in Appendix A. The visual output representing the outcome of the evaluation for Group 4 is shown in Figure 6-12.

The evaluation process identified the leave in-situ option 1a (minimum intervention) to be the highest score by a narrow margin as it is preferred for all criteria, apart from a slight reduction in the safety criteria due to the legacy risk that the exposed pipeline presents. Option 2a and 4 that remove the exposures in the pipeline, derive similar results to Option 1a. However, both these options require the introduction of rock into the marine protected environment resulting in habitat loss to remove pipeline exposure. The leave in-situ Option 1a retains the long-term legacy risk to fishermen associated with pipeline exposure, however this will be risk assessed and remediated and/ or monitored to ensure that any emerging hazards do not develop into an unacceptable snagging risk to fishing operations.

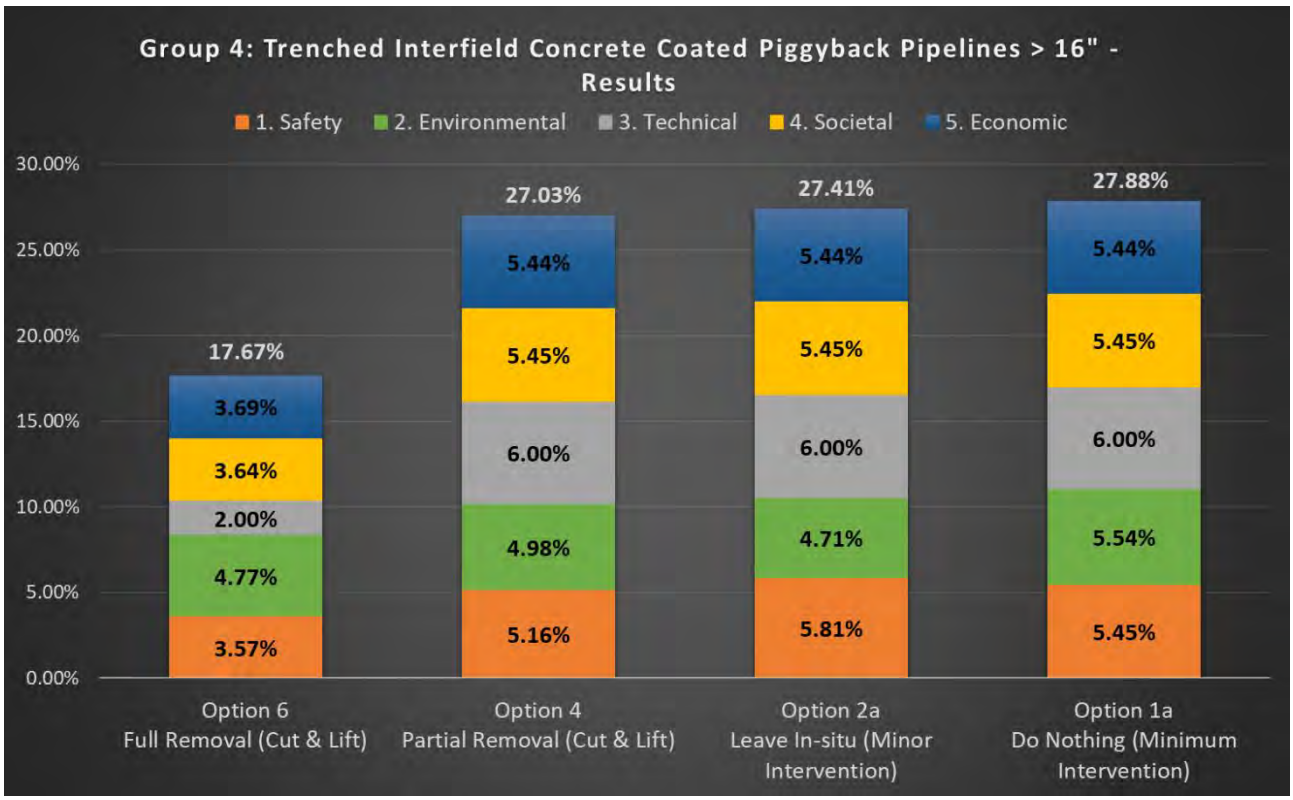


Figure 6-12: Group 4 Evaluation Results

A discussion of the relative preference of each of the decommissioning options against each of the assessment criteria is provided in the following sub-sections.

6.6.3.1 Safety Criteria Discussion

Option 2a is the most attractive option overall. The short-term operational safety risk associated with remediating approximately 500m of exposures with rock cover can be undertaken in a relatively short duration, reducing the risk to offshore personnel, with minor materials handling onshore minimising the onshore personnel risk. In addition, the marine vessel support to place the rock is not substantial therefore the risk to other users of the sea does not increase from this activity. The long-term safety risk posed by pipeline exposures is reduced for Option 2a as the current exposures would be eliminated by the rock.

Option 1a leave in-situ, indicates similar low short-term risks as for Option 2a, although the exposures are retained, which penalises this option with respect to Option 2a for the long-term residual risk element.

Option 4 was less attractive than Option 1a and 2a due the additional onshore safety risk posed by the materials handling onshore, the greater offshore scope, although the long-term safety risk is minimised by the partial removal of the exposures. Note that in the case of PL2107/PL2108 there are only exposures present at the pipeline ends and no exposures on the pipeline length compared to the other pipelines in this group that have exposures along the pipeline length, hence the onshore materials handling safety risk for PL2107/ PL2108 is significantly less than for the other pipelines.

Full removal, Option 6, is the least attractive for all safety criteria except for the long-term safety element as full removal eliminates the residual risk posed by pipeline exposures.

Overall, the most attractive options from a safety perspective is the option that intervenes by removing the exposures (remediating the exposure with rock placement: 2a), hence reducing the long-term residual risk, whilst also requiring minimal offshore and onshore support to execute.

6.6.3.2 Environmental Criteria Discussion

The workshops considered the leave in-situ option 1a to have the least environmental impact although the alternative options were evaluated to have a similar cumulative environmental impact with little obvious preference between them.

Option 1a leave in-situ (minimum intervention) was most attractive overall due to this option having the least operational activity:

- Low vessel usage reducing the negative environmental impact of noise and discharges to sea.
- Limited pipeline remediation and hence a lower seabed disturbance with no requirement for pipeline unburial by Mass Flow Excavation and minor rock consumption.

The long-term marine impact from the degradation of remaining in-situ pipeline infrastructure is the evaluation sub-criteria where Option 1a does not score strongest. In Option 1a, the remaining pipelines are left to degrade and release degradation products into the water column over time. The full removal Option 6 scores best for this criterion due to full pipeline removal.

Partial removal of the exposures (Option 4) and leave in-situ, minor intervention (Option 2a) score weakest in terms of habitat loss as they require the application of rock introducing hard substrate into the existing sandbank. Although both Option 2a and Option 4 require the introduction of rock, the environmental results for Option 4 are higher than Option 2a because Option 2a will require more rock (full length of exposure) than Option 4 (pipeline ends only). For the Saturn ND to LOGGS pipeline, there is no difference between Option 4 and Option 2a because this pipeline does not involve exposures requiring remediation. However, for the other pipelines within the group, there are exposures along the pipeline(s) that would be removed in Option 4 and 2a.

Overall, the combined short-term and long-term environmental impact of the options associated with the decommissioning of these pipelines, favours leave in-situ, minimum intervention (Option 1a) predominantly due to this option having the lowest short-term operational marine impact and minor long-term habitat loss from minimal rock at the cut pipeline ends only. Partial removal Option 4 requires additional rock to stabilise cut ends, reducing its attractiveness compared to Option 1a whereas Option 2a and Option 6 score least attractively. Option 2a requires additional 3560 tonnes of rock to be introduced into the protected sandbank and Option 6 detrimentally impacts the

environment from short-term operations due to extensive marine disturbance and significantly higher operational vessel activity to undertake the removal of approximately 80km of pipeline.

6.6.3.3 Technical Criteria Discussion

The Leave in-situ options (1a and 2a) and partial removal (option 4) scored the most feasible both in terms of concept maturity and technical risk as a result of the routine nature of these operations.

The full removal option has comparatively greater risk as the operations would be conducted over a longer duration and requires de-burial which may present difficulties that lengthen the removal duration further.

6.6.3.4 Societal Criteria Discussion

The societal criteria compared the economic impact of the options on commercial fishing operations, as well as the impact the activities have on the recycling of material, landfill use and traffic disruption caused by the volume of scrap material returned to shore for handling.

Option 1a, 2a and 4 have the least impact on commercial fishing as this option requires the least disruption and disturbance to the fishing industry. Conversely, the full removal option requires extended offshore operations and hence greater disruption to the fishing activities.

Leaving the pipeline in-situ was shown to have a more positive impact on the societal criteria compared to the removal options, driven by the higher quantity of material that would be required to be recycled if full removal took place. The greater the quantity of material that is removed, the greater the amount of material that will be bought to shore. Although recycling is a positive societal impact, it is outweighed by the requirement to use landfill because of the polymer contents within the piggybacked methanol pipelines that reduces its applicability for recycling. Since the leave in-situ options 1a, 2a and 4 (partial removal) of the 342m of exposure requires less recycling (and therefore minor use of landfill and no traffic disruption onshore) these options were more favourable than full removal (Options 6).

Overall Option 1a, 2a and 4 are equally attractive from both a societal (recycling) and commercial fishing (disruption) perspective. The removal option 6 is the least attractive because it contributes to large-scale landfill use and is likely to lead to disruptions in current fishing activity during execution.

6.6.3.5 Economic Criteria Discussion

The economic criteria compare the short-term execution cost of undertaking the decommissioning options and the long-term legacy cost of undertaking post decommissioning monitoring surveys, contribution to the Fisheries Legacy Trust Fund to support pipeline snagging hazard awareness amongst fishermen and potential remedial works for leave in-situ options. Overall, the leave in-situ options (1a and 2a) and the partial removal option 4 are more favourable economically than the removal options driven by the short-term costs. The short-term full removal cost for Option 6 is £212million compared to £2.8million for leave in -situ Option 1a.

6.6.4 Recommendation

The partial removal (Option 4) and leave in-situ options (Options 1a and 2a) all score relatively closely and were significantly preferred over the full removal option. These close scores reflect the similar nature of the partial and leave in-situ options in terms of scope. The most attractive option by a narrow margin is Option 1a, where the line ends are removed with the remainder left in-situ. This was the most attractive option from an environmental perspective due to the limited scope and lack of rock cover compared to some of the other options. It was also equally preferred for Options 2a

and Option 4 from a technical and societal perspective as they are all similar to execute and have similar fishing and other societal impacts. Option 1a was not the most attractive from a safety perspective due to the residual risk of leaving the lines with exposures, but was close enough to still be the overall preferred option. The emerging preference for Option 1a was maintained when the Economic criterion was included.

The full removal option 6 was considered significantly less attractive than the leave in-situ or partial removal options. This is mainly due to the increased offshore work scopes required for full removal increasing the safety risk, the environmental impact and the disruption to the fishing industry. In addition, the extra material being returned by removing the full pipeline had additional impact in terms of onshore personnel safety exposure and use of landfill from the polymer (associated with the methanol pipelines) returned. There was also a significant impact from the de-burial of the line to allow removal. The positive attributes of these full removal options such as no residual safety risk and no legacy environmental impact were insufficient to offset the impacts.

Overall, given the similar total score for the leave in-situ options (Option 1a and Option 2a) and partial removal (Option 4), these options are considered equally preferred. As such, the emerging recommendation from the CA is that any of these options may be executed as the decommissioning solution. Common to each of these options is the disconnection and removal of the pipeline ends. Spot rock placement would be installed at the cut pipeline ends to mitigate any potential snag hazard.

The exposures will be risk assessed to determine whether remediation is necessary, with the outcome of this assessment influencing whether the exposures will be removed (Option 4), rock covered (Option 2a) or left in-situ (Option 1a). The remaining pipelines, would be marked on sea charts and notifications issued to fishermen / other users of the sea and left to degrade over time. The post decommissioning pipelines (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

6.7 CA Outcome – Group 7 – Trenched & Buried Umbilical

6.7.1 Group Characteristics

Group 7 consists of a single 4" umbilical (PLU4178 (UM2)). The umbilical was laid within a trench and buried and has a single area of exposure of 11 m in length midline. The umbilical was installed in 1995 and there are no crossings associated with this line.

The pipeline is shown in context in Figure 6-13 and its key characteristics are shown in Table 6-7.

ID	Description	CA Battery Limits		Diameter (inches)	Length (m)	Exposure (m)
		From	To			
PLU4178 (UM2)	Ganymede ZD to Callisto ZM Umbilical	Ganymede ZD	Callisto ZM	4.3	13,875	11

Table 6-7: Group7 Characteristics

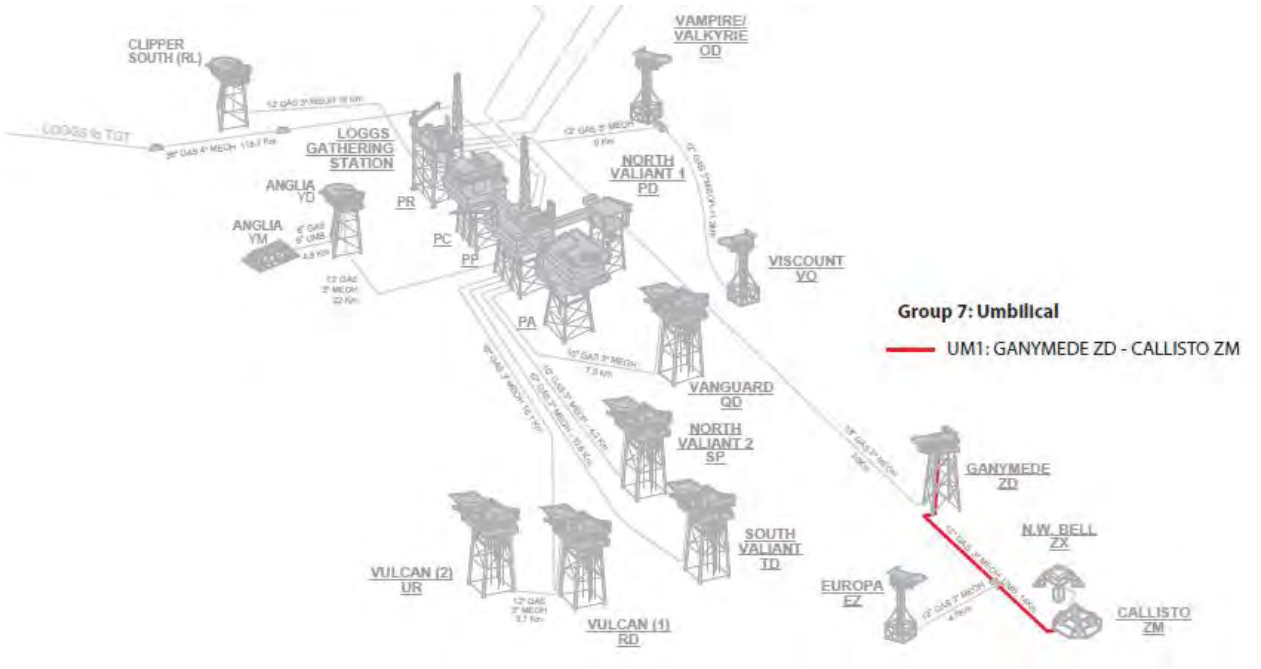


Figure 6-13: LOGGS Area (LDP2 – 5) Group 7

6.7.2 Decommissioning Options for Evaluation

Ten options were presented at CA screening stage with six of those screened out. The four decommissioning options retained for CA evaluation were:

- Option 1a: Leave in-situ (Minimum Intervention) – Removal of pipeline ends and rock placement over cut ends only
- Option 2a: Leave in-situ (Minor Intervention) – Removal of pipeline ends and rock placement on all ends and exposures
- Option 4: Partial Removal – Cut and lift exposures and rock placed on all cut ends
- Option 5a: Full Removal – Reverse reel

6.7.3 Evaluation

During the evaluation phase of the CA, the remaining decommissioning options associated with Group 7 – Trenched & Buried Umbilical were assessed using the evaluation methodology introduced in section 2.5 and further detailed in Appendix A. The visual output representing the outcome of the evaluation for Group 7 is shown in Figure 6-14.

Overall, Option 1a leave in-situ (minimum intervention) scores the highest by a narrow margin. The evaluation process identified the leave-in situ options, (Option 1a and Option 2a) and the partial removal option (Option 4) to be equally preferred for all criteria apart from the environmental criterion associated with habitat loss which scores less favourably for Option 2a and 4 due to the need to place rock to stabilise the 11m exposure mid pipeline for option 2a and to place over the cut ends for option 4. Full removal by reverse reel scored the least favourably for all criteria apart from the environmental criteria due to the positive long-term benefits associated with the removal of the umbilical that removes umbilical degradation that includes polymers and no requirement for rock placement.

Full removal was also not the preferred option due to the technical challenges that surround the unburial of this 14km umbilical in combination with an unknown structural integrity.

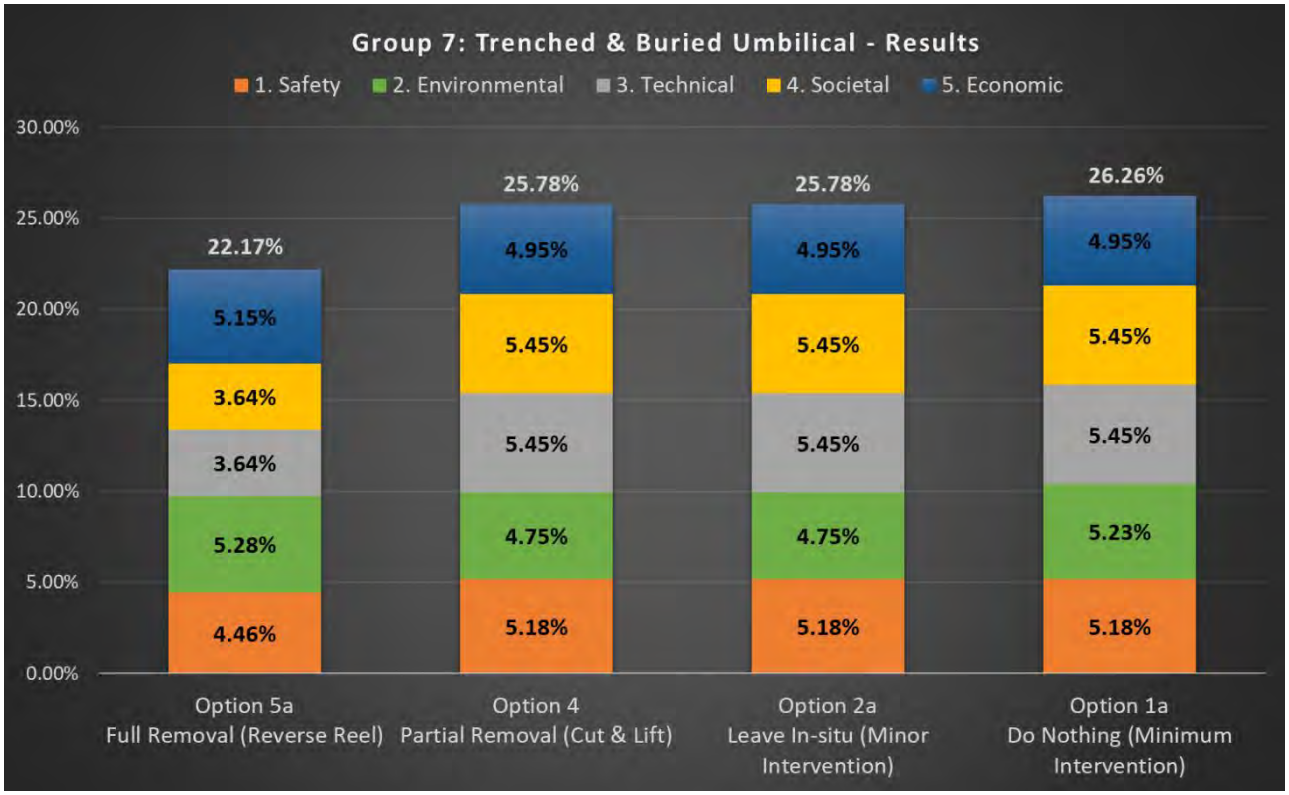


Figure 6-14: Group 7 Evaluation Results

A discussion of the relative preference of each of the decommissioning options against each of the assessment criteria is provided in the following sub-sections.

6.7.3.1 Safety Criteria Discussion

Leave in-situ (Options 1a and 2a) and Partial removal (Option 4) are equally attractive from the safety perspective. This is because there is a minor 11m exposure recorded on the pipeline that would require minimal operational scope to remove by cut and lift operations (Option 4) or by rock

placement (Option 2a). Therefore, any scopes of work associated with Options 2a and 4 are ranked similarly to Option 1a that only entails the disconnection of pipeline ends. All these options have low short-term operational safety risks both onshore and offshore. In addition, the marine vessel support is not substantial therefore the risk to other users of the sea does not increase from these activities.

Full removal by reverse reel, Option 5a, is the least attractive for all safety criteria except for the long-term safety element as full removal eliminates the residual risk posed by pipeline exposures.

Overall, the most attractive options from a safety perspective are the in-situ or partial removal options as the pipeline is generally buried apart from limited exposure. The much larger operational scope associated with full removal Option 5a has the greatest operational hazards and therefore is the least attractive.

6.7.3.2 Environmental Criteria Discussion

The workshops considered the full removal by reverse reel Option 5a to have the least environmental impact and the alternative options (1a, 2a and 4) were evaluated to have a similar cumulative environmental impact with little obvious preference between them.

Option 5a full removal by reverse reel was the most attractive overall due to this option having the least long-term impacts:

- No requirement for additional rock placement and therefore no loss of habitat
- Elimination of the legacy impact from degradation products or polymers as a result of the full removal of the umbilical

From a short-term environmental perspective, Option 1a scored highest as there was less vessel activity and therefore less noise generated, whereas full removal Option 5a requires extensive vessel operations. In addition, there was the least marine disturbance, whereas reverse reeling operations associated with Option 5a requires extensive Mass Flow Excavation that disturbs the seabed in order to unbury the 14km pipeline length during removal operations.

Partial removal of the exposures (Option 4) and leave in-situ, minor intervention (Option 2a) score weakest in terms of habitat loss as they require the application of rock introducing hard substrate into the existing sandbank.

Overall, the combined short-term and long-term environmental impact of the options associated with the decommissioning of these pipelines, favours full removal (Option 5a) predominantly due to this option having the most favourable long-term marine impacts.

6.7.3.3 Technical Criteria Discussion

The Leave in situ options (1a and 2a) and partial removal (option 4) scored the most feasible both in terms of concept maturity and technical risk as a result of the routine nature of these operations.

The full removal by reverse reel option has comparatively greater risk as the operations would be conducted over a longer duration and requires de-burial which may present difficulties that lengthen the removal duration further.

6.7.3.4 Societal Criteria Discussion

The societal criteria compared the economic impact of the options on commercial fishing operations, as well as the impact the activities have on the recycling of material, landfill use and traffic disruption caused by the volume of scrap material returned to shore for handling.

Option 1a, 2a and 4 have the least impact on commercial fishing as this option requires the least disruption and disturbance to the fishing industry. Conversely, the full removal option requires extended offshore operations and hence greater disruption to the fishing activities.

Leaving the pipeline in situ was shown to have a more positive impact on the societal criteria compared to the removal options, driven by the higher quantity of material that would be required to be recycled if full removal took place. The greater the quantity of material that is removed, the greater the amount of material that will be bought to shore. Although recycling is a positive societal impact, it is outweighed by the requirement to use landfill because of the polymer coating and high pressure tubes of the umbilical that reduces its applicability for recycling. Since the leave in situ options 1a, 2a and partial removal of the 11m of exposure requires less recycling (and therefore minor use of landfill and no traffic disruption onshore) these options were more favourable than full removal of the 14km umbilical (Option 5a).

Overall Option 1a, 2a and 4 are equally attractive from both a societal (recycling) and commercial fishing (disruption) perspective. The removal Option 5a is the least attractive because it contributes to large-scale landfill use and is likely to lead to disruptions in current fishing activity during execution.

6.7.3.5 Economic Criteria Discussion

The economic criteria compare the short-term execution cost of undertaking the decommissioning options and the long-term legacy cost of undertaking post decommissioning monitoring surveys, contribution to the Fisheries Legacy Trust Fund to support pipeline snagging hazard awareness amongst fishermen and potential remedial works for leave-in situ options. Overall, the leave in situ options (1a and 2a) and the partial removal option 4 are more favourable economically than the removal options driven by the short-term costs. The short-term full removal cost for Option 6 is £6million compared to £1.7million for leave in -situ Option 1a.

6.7.4 Recommendation

The partial removal (Option 4) and leave in-situ options (Options 1a and 2a) all score relatively closely and were preferred over the full removal option. These close scores reflect the similar nature of the partial and leave in-situ options in terms of scope, as the pipeline is recorded to be sufficiently buried with a minor 11m exposure to which remediation is necessary in Options 2a and 4.

Option 1a, where the line ends are removed with the remainder left in-situ, is marginally more attractive overall. The driver for this result, is the minor short-term work scope required to implement this option. Where Option 1a does not score favourably is the environmental criteria, where rock is required to be applied on the pipeline ends and the umbilical (together with its polymer contents) are left to degrade in the marine environment. The emerging preference for Option 1a was maintained when the Economic criterion was included.

The full removal by reverse reel Option 5a was considered less attractive than the leave in-situ or partial removal options. This is mainly due to the greater offshore work scopes required for full removal increasing the safety risk, the technical challenges associated with umbilical de-burial and the short-term disruption to the fishing industry during operations. In addition, the extra material being returned by removing the full pipeline had additional impact in terms of onshore personnel safety exposure and use of landfill from the polymer returned. The positive attributes of these full removal options such as no residual safety risk and no legacy environmental impact were insufficient to offset the impacts.

Overall, given the similar total score for the leave in-situ options (Option 1a and Option 2a) and partial removal (Option 4), these options are considered equally preferred. As such, the emerging recommendation from the CA is that any of these options may be executed as the decommissioning

solution. Common to each of these options is the disconnection and removal of the umbilical ends. Spot rock placement would be installed at the cut umbilical ends to mitigate any potential snag hazard.

The single 11 m exposure will be risk assessed to determine whether remediation is necessary, with the outcome of this assessment influencing whether the exposure will be removed (Option 4), rock covered (Option 2a) or left in-situ (Option 1a). The remaining umbilical, would be marked on sea charts and notifications issued to fishermen / other users of the sea and left to degrade over time. The post decommissioning umbilical (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

7 Summary of Final Recommendations

The LOGGS Area infrastructure was consolidated into a total of ten groups for Comparative Assessment purposes with the decommissioning approach for three of the groups being selected without performing the full CA process. These are:

- Group 5 – Subsea Structures: The subsea structures, as detailed in Table 3-2, were confirmed at the CA Scoping and Screening stage to be full removal in accordance with OPRED Guidelines ref. [4].

- Group 6 – Rigid Spools / Flexible Jumpers: The spools and jumpers were confirmed at the CA Scoping and Screening stage to be excluded from the remaining CA process as rigid spools and flexible jumpers would be treated as part of the corresponding pipeline to which they are connected and dealt with within the applicable pipeline groups.

- Group 8 – Mattresses and Grout Bags: The mattresses and grout bags were confirmed at the CA Scoping and Screening stage to be excluded from the remaining CA process. Group 8 are the protection and stabilisation mattresses and grout bags used within the fields. Where mattresses and grout bags require to be moved to gain access to infrastructure that is to be removed, they will be fully removed and disposed of onshore in accordance with guidelines ref. [4]. Mattresses and grout bags that are providing stabilisation of pipelines or sections of pipelines that will be left in-situ, shall be left in-situ with minimal disturbance.

The remaining seven groups were subjected to the full CA process as detailed in Section 4 to 6. The emerging recommendations for the decommissioning option selected for each of these groups are as follows:

- Group 1 – Trunkline: This group consists of the single, 36”, 118 km trunk line from LOGGS PP to TGT. The evaluation workshops considered four options; full removal by cut and lift (Option 6), partial removal by cut and lift (Option 4), leave in-situ minor intervention (Option 2a) and leave in-situ minimum intervention (Option 1a). The emerging recommendation from the CA is to leave the Trunkline in-situ with minimum intervention. This would entail disconnection and removal of the pipeline at the LOGGS end and at the tee locations. Spot rock placement would be installed at the cut pipeline ends only. The remaining pipeline, left in its current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning pipeline (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.
- Group 2 - Mattress Covered Short Umbilical & Associated Pipeline: This group consists of the two short pipelines (80 m) and one short umbilical (80 m) running between NW Bell and Callisto. The evaluation workshops considered two options, full removal by cut and lift (Option 6) and leave in-situ with minimum intervention (Option 1a). The assessment showed little to choose between these options and as such, the emerging recommendation from the CA is that either the full removal or the leave in-situ could be progressed. Should the leave in-situ option be progressed, the remaining pipelines and umbilical, left in their current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning pipelines and umbilical (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.
- Group 3a – Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤ 16”: This group consists of the three gas lines (two 10” and one 12”) with their piggybacked MeOH lines in the Saturn and Europa areas. Three options were evaluated for these lines, full removal by

cut and lift (Option 6), full removal by reverse reel (Option 5a) and leave in-situ with minimum intervention (Option 1a). The emerging recommendation from the CA is to leave the trenched pipelines in-situ with minimum intervention. This entails removal of the ends of the pipelines and placing spot rock cover at the cut ends only. The remaining pipelines, left in their current state will have no remaining exposures and would be marked on navigational charts and notifications issued to fishermen / other users of the sea. The post decommissioning pipeline (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

- Group 3b – Trenched Interfield Non-concrete Coated Non-piggyback MeOH Pipeline ≤ 16": This group consists of the single, 4", 118 km MeOH pipeline from TGT to LOGGS PP. The evaluation workshops considered five options; full removal by cut and lift (Option 6), full removal by reverse reel (Option 5a), partial removal by cut and lift (Option 4), leave in-situ minor intervention (Option 2a) and leave in-situ minimum intervention (Option 1a). The emerging recommendation from the CA is that any of the partial removal (Option 4) or leave in-situ (Option 2a and Option 1a) options may be executed as the decommissioning option. This would entail disconnection and removal of the pipeline at the LOGGS end and at the tee locations with spot rock placement installed at the cut pipeline ends in all cases. The exposures will be risk assessed to determine whether remediation is necessary, with the outcome of this assessment influencing whether the exposures will be removed (Option 4), rock covered (Option 2a) or left in-situ (Option 1a). The remaining pipeline, left in its current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning pipeline (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.
- Group 3c – Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16": This group consists of the four gas lines (three 10" and one 12") with their piggybacked MeOH lines in the Vanguard, North Valiant SP and Ganymede ZD to Callisto ZM. Four options were evaluated for these lines, full removal by cut and lift (Option 6), partial removal of the spanning and exposed sections (Option 4), leave in-situ minor intervention (Option 2a) and leave in-situ with minimum intervention (Option 1a). The emerging recommendation from the CA is that any of the partial removal (Option 4) or leave in-situ (Option 2a and Option 1a) options may be executed as the decommissioning option. This would entail disconnection and removal of the pipeline ends with spot rock placement installed at the cut pipeline ends in all cases. The exposures will be risk assessed to determine whether remediation is necessary, with the outcome of this assessment influencing whether the exposures will be removed (Option 4), rock covered (Option 2a) or left in-situ (Option 1a). The remaining pipelines, left in their current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning pipeline (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.
- Group 4 – Trenched Interfield Concrete Coated Piggyback Pipelines > 16": This group consists of the three gas lines (two 18" and one 14") with their piggybacked MeOH lines in the Vulcan, Ganymede and Saturn areas. Four options were evaluated for these lines, full removal by cut and lift (Option 6), partial removal of the spanning and exposed sections (Option 4), leave in-situ minor intervention (Option 2a) and leave in-situ with minimum intervention (Option 1a). The emerging recommendation from the CA is that any of the partial removal (Option 4) or leave in-situ (Option 2a and Option 1a) options may be executed as the decommissioning option. This would entail disconnection and removal of the pipeline ends with spot rock placement installed at the cut pipeline ends in all cases. The exposures will be risk assessed to determine whether remediation is necessary, with the outcome of this assessment influencing whether the exposures will be removed (Option 4), rock covered (Option 2a) or left in-situ (Option 1a). The remaining pipelines, left in their current state,

would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning pipeline (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

- Group 7 – Trenched and Buried Umbilical: This group consists of a single umbilical running between Ganymede and Callisto. The evaluation workshops considered four options, full removal by reverse reel (Option 5a), partial removal by cut and lift (Option 4), leave in-situ minor intervention (Option 2a) and leave in-situ with minimum intervention (Option 1a). The emerging recommendation from the CA is that any of the partial removal (Option 4) or leave in-situ (Option 2a and Option 1a) options may be executed as the decommissioning option. This would entail disconnection and removal of the umbilical ends with spot rock placement installed at the cut umbilical ends in all cases. The single 11 m exposure will be risk assessed to determine whether remediation is necessary, with the outcome of this assessment influencing whether the exposure will be removed (Option 4), rock covered (Option 2a) or left in-situ (Option 1a). The remaining umbilical, left in its current state, would be marked on sea charts and notifications issued to fishermen / other users of the sea. The post decommissioning umbilical (and associated stabilisation features) monitoring programme will be agreed with OPRED and will be in accordance with OPRED guidance in operation at that time.

The above emerging recommendations are summarised in Table 7-1.

Group	Infrastructure Type	Decommissioning Recommendation
1	Trunk Line	Option 1a – Leave In-situ (Minimum Intervention)
2	Mattress Covered Short Umbilical & Associated Pipeline	Either Option 6 – Full removal or Option 1a – Leave In-situ (Minimum Intervention may be progressed
3a	Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤ 16”	Option 1a – Leave In-situ (Minimum Intervention)
3b	Trenched Interfield Non-concrete Coated Non-piggyback MeOH Pipeline ≤ 16”	Either Option 4 – Partial Removal, Option 2a – Leave In-situ (Minor Intervention) or Option 1a Option 1a – Leave In-situ (Minimum Intervention may be progressed
3c	Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16”	Either Option 4 – Partial Removal, Option 2a – Leave In-situ (Minor Intervention) or Option 1a Option 1a – Leave In-situ (Minimum Intervention may be progressed
4	Trenched Interfield Concrete Coated Piggyback Pipelines > 16”	Either Option 4 – Partial Removal, Option 2a – Leave In-situ (Minor Intervention) or Option 1a Option 1a – Leave In-situ (Minimum Intervention may be progressed
5	Subsea Structures	Full Removal
6	Rigid Spools / Flexible Jumpers	Treated as part of the relevant pipelines group
7	Trenched and Buried Umbilical	Either Option 4 – Partial Removal, Option 2a – Leave In-situ (Minor Intervention) or Option 1a Option 1a – Leave In-situ (Minimum Intervention may be progressed
8	Mattresses and Grout Bags	Leave In-situ where providing pipeline stabilisation

Table 7-1: Final LOGGS Area (LDP2 – 5) Recommendations

8 References

1. LOGGS Area Decommissioning Method Statement	Xodus Group, LOGGS Area Decommissioning Method Statement, A400274-S00-REPT-002, Rev. A01, Dated 18/10/2017.
2. Risk Analysis of Decommissioning Activities	Joint Industry Project Report "Risk Analysis of Decommissioning Activities" (Safetec 2005) [http://www.hse.gov.uk/research/misc/safetec.pdf]
3. Analytical Hierarchy Process	The Analytical Hierarchy Process by T.L. Saaty, McGraw Hill, 1980.
4. Guidance Notes Decommissioning of Offshore Oil & Gas Installations and Pipelines	OPRED (2018) Offshore Oil and Gas Decommissioning Guidance Notes. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/760560/Decom_Guidance_Notes_November_2018.pdf
5. Decommissioning Risk	Safetec – Risk Analysis of Decommissioning Activities, Doc. No. ST-20447-RA-1, Rev. 03, Dated 03/03/2005
6. CA Guidelines	OGUK, Guidelines for Comparative Assessment in Decommissioning Programmes, J60073A-A-RT-00001, October 2015
7. Fisheries Impact Assessment	Brown & May Marine Limited, Commercial Fisheries Baseline Characterisation: LOGGS South, LOGGS North and CMS Areas, August 2017
8. 2017 UK Greenhouse Gas Emissions	2017 UK Greenhouse Gas Emissions, Final Figures. Statistical release: National Statistic, online at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/776085/2017_Final_emissions_statistics_-_report.pdf
9. LOGGS Pipeline Burial and Stabilisation Material Report	BMT Cordah Limited, Lincolnshire Offshore Gas Gathering System (LDP2, LDP3, LDP4, LDP5) Pipeline Burial and Stabilisation Material Report, BMT_SNS-L-XX-P-HS-02-00001, Rev C1, January 2017
10. Navigational Risk Assessment	Anatec (2017) Navigational Risk Assessment – LOGGS Area Decommissioning. Anatec report no. No. A309-CoP-NRA-1. Revision C1 (Final), November 2017

APPENDIX A EVALUATION METHODOLOGY

Appendix A.1 Introduction

Chrysaor has selected a Multi Criteria Decision Analysis (MCDA) methodology for the evaluation phase of the CA. This methodology uses a pairwise comparison system based on the methodologies of the Analytical Hierarchy Process (AHP) by T.L. Saaty, described in various publications, such as the Analytical Hierarchy Process ref. [3]. This allows the relative importance of each differentiating criteria to be judged against each other in a qualitative way, supported by quantification where appropriate. The key steps for the evaluation phase of the CA are as follows:

- Define Differentiating Criteria (listed in Appendix A.2).
- Define Options – completed as part of CA Screening.
- Pre-populate worksheets for internal CA workshop(s) – based on all the studies undertaken the worksheets were pre-populated in advance of the internal CA workshops.
- Perform internal CA workshop.
- Discuss attributes of each option against each differentiating criterion – the discussion was recorded 'live' during the workshop in order that informed opinion and experience was factored into the decision-making process.
- Perform scoring (see **Appendix A.3**).
- Perform sensitivity analyses to test the decision outcomes.
- Export worksheets as a formal record of the workshop attendees' combined opinion on the current preferred options, the 'Emerging Recommendations'.
- Evaluate whether the CA needs to 'recycle' study work (Preparation Phase) to obtain any further information to help inform decision making.
- Discuss Emerging Recommendations with stakeholders.
- Recycle process as required prior to decision on the selected options that will be presented in the Decommissioning Programme and assessed in the Environmental Appraisal.

The sections below describe how the MCDA methodology has been applied.

Appendix A.2 Differentiating Criteria & Approach to Assessment

A key step in setting up the CA was agreeing and defining the appropriate criteria that differentiates between each of the tabled options. As a starting point, the criteria considered for this CA were taken from the Guidelines for Decommissioning of Offshore Oil and Gas Installations and Pipelines ref. [4], which are as follows (in no particular order):

- Safety
- Environmental
- Technical
- Societal
- Economic

These differentiating criteria were found to be appropriate for the decommissioning options tabled and were taken forward as the main differentiating criteria for the CA. Additional sub-criteria and definitions were added for clarity and are shown in Table 8-1 alongside the approach used for assessment under each criteria or sub-criteria.

Differentiating Criteria	Sub-Criteria	Description	Approach to Assessment
1 - Safety	1.1 Personnel Offshore	This sub-criterion considers elements that impact risk to offshore personnel and includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls. Any requirement for handling HazMat / NORM shall also be addressed here.	Summed PLL numbers allow a quantified direct comparison between options. See section 5.2 for information on study work undertaken. Assessment made based on summed PLL numbers and narrative around other factors such as high consequence events or residual risk where there was a differentiator.
	1.2 Personnel Onshore	This sub-criterion considers elements that impact risk to onshore personnel. Factors such as any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel. Any requirement for handling HazMat / NORM shall also be addressed here.	
	1.3 Other Users	This sub-criterion covers the impact associated with the risk to other users. Considers elements such as collision impact whilst performing activities. Users such as fishing vessels, commercial transport vessels, recreational vessels and military vessels are considered.	
	1.4 High Consequence Events	This sub-criterion relates to any inherent potential for high consequence events i.e. major accident hazard type events. It applies to all onshore and offshore personnel involved in the project. Considerations such as dropped object concerns, support vessel risks, are considered.	
	1.5 Residual Risk	This sub-criterion addresses residual safety risk to other sea users i.e. fishermen, military vessel crews, commercial vessel crews and passengers, other sea users, that is provided by the option. Issues such as residual snag risk, collision risk, etc. may be considered.	

Differentiating Criteria	Sub-Criteria	Description	Approach to Assessment
2. Environmental	2.1 Operational Marine Impact	This sub-criterion covers elements such as noise generated by vessels, cutting operations, any explosives etc. This sub-criterion also covers elements such as discharges to environment from vessels and / or activities performed. Consideration is also given to major environmental incident type events that may occur during the operations here.	Assessment based on discussion of underwater noise generated by decommissioning activities in the short term. Also considers planned and unplanned discharges on a qualitative basis.
	2.2 Legacy Marine Impact	This sub-criterion covers all legacy environmental impacts from any material left in-situ. Elements such as the discharge of any contents over time (leaching) and the impact from plastics or other potential harmful materials left behind are considered. Consideration is also given here to major environmental incident type events that may occur after the decommissioning activities are complete. Note: Impact of any remediation measures that may be required in the future is not included due to the uncertain nature of future remediation. Where future remediation is required, options for the best approach for that remediation will be explored at that time.	Qualitative assessment of the impact associated with any infrastructure left in-situ.
	2.3 Fuel Use & Atmospheric Emissions	This sub-criterion relates to the amount of atmospheric emissions associated with a particular option. It also covers fuel use which is tightly correlated to atmospheric emissions.	Quantified estimate of the fuel use and atmospheric emission generated during a decommissioning option. The output CO_2 figures allow a direct, quantitative comparison between options.
	2.4 Other Consumptions	This sub-criterion relates to the amount of resource consumption associated with the option. It covers elements such as environmental burden from processing returned materials, use of quarried rock or other new material and any environmental burden associated with the production of replacement materials for material left in-situ.	Assessment based on quantifying the volume of fuel and new material used.
	2.5 Disturbance	This sub-criterion relates to both direct and indirect seabed disturbance. Consideration is given to the type and area of disturbance encountered and the impact this may have in the short-term.	Assessment based on quantifying the area of disturbance by type of disturbance (dredging, trenching, backfilling), in combination with an understanding of the baseline environment in the area as shown by the outputs from the environmental surveys.
	2.6 Loss of Habitat	This sub-criterion relates to the long-term loss of, or material change to, the seabed habitat that occurs from performing the decommissioning option. Consideration is given to the area and nature of any permanent habitat change.	Assessment based on quantifying the area of loss of habitat by type activity (rock placement), in combination with an understanding of the baseline environment in the area as shown by the outputs from the environmental surveys.

Differentiating Criteria	Sub-Criteria	Description	Approach to Assessment
3 – Technical	3.1 Technical Feasibility	This sub-criterion relates to the various technical risks associated with the decommissioning options, that could result in a major project failure i.e. failure to deliver the decommissioning option broadly within the timescale / budget / endorsed decommissioning programme. Consideration is given to two key areas. Concept Maturity, where the technical novelty of the decommissioning option is addressed and Technical Risks, where the factors that may result in an inability to deliver the decommissioning option as defined are described.	Assessment based on engineering studies (see section 5.5) and captures: • Concept Maturity • Technical Risk
4 – Societal	4.1 Fishing	This sub-criterion addresses the economic impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities and residual impacts post decommissioning such as reinstatement of access to area.	Commercial Fisheries Baseline Study provides a base level of understanding for the importance of the area for fisheries. This is combined with narrative (rather than quantification) regarding the influence of each decommissioning option on the availability of the area of seabed for fisheries.
	4.2 Other Users	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc.	Assessment of impacts on other users is a qualitative narrative considering both positive and negative impacts on waste disposal, recycling, business interruption and general community impacts. Potential employment benefits have been considered but at the scale of any individual option and in context with the wider full removal the potential employment benefits are not deemed to be a differentiator.
5 – Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. No long-term cost element is considered here.	See engineering studies, section 5.5.
	5.2 Long-term Costs	This sub-criterion addresses the costs associated with any long-term liabilities such as on-going monitoring and any potential future remediation costs. It also addresses any contributions required to the Fishing Legacy Fund (FLTC).	See engineering studies, section 5.5. Timeframe assumed for the purposes of the CA is 10 years.

Table 8-1: Sub-criteria Definition

Appendix A.3 Differentiator Weighting

The 5 main differentiating criteria all carry a 20% weighting, that is, all criteria are neutral to each other. Figure 8-1 shows the pairwise comparison matrix. Chrysaor decided that equal weightings for the main criteria offers the most transparency and a balanced view from all perspectives.

Criteria	1. Safety	2. Environmental	3. Technical	4. Societal	5. Economic	Weighting
1. Safety	N	N	N	N	N	20%
2. Environmental	N	N	N	N	N	20%
3. Technical	N	N	N	N	N	20%
4. Societal	N	N	N	N	N	20%
5. Economic	N	N	N	N	N	20%

Figure 8-1: Example Pairwise Comparison Matrix (N = Neutral)

The next step in the CA process was to describe and discuss the attributes of each option with respect to each of the differentiating criteria. In preparation, all relevant data and information developed during the preparation phase were pre-populated into the attributes table for each option. **Appendix B** to **Appendix H** contains the completed Attributes Tables.

Any additional discussion around the relative merits of the options was also recorded in the attributes matrix. A summary discussion of why options are considered more or less attractive with respect to each of the differentiating criteria was also recorded.

Once the option attributes were compiled and discussed, a pair-wise comparison was performed for each of the differentiating criteria where the proposed options were compared against each other. The pairwise comparison adopted in this case used phrases such as stronger, much stronger, weaker, much weaker, etc. to make qualitative judgements (often based on quantitative data) of the options against each other. Adopting these phrases rather than the more common numerical 'importance scale' from the Analytical Hierarchy Process (AHP) is often more intuitive and representative of the sentiment of a workshop.

One of the challenges of applying the numerical importance scale historically, is that often when scoring a pair of options against each other as a score of 3, delegates implied the comparison was 3 times better, etc. rather than 'slightly better' as the importance scale suggests.

To manage this, the team chose to apply the principles of the AHP by replacing numbers in the pairwise comparison matrix with a narrative or descriptive approach. This is already programmed

into the AHP in the importance scale explanations (see Table 8-2). It was agreed that three positions from equal (and their reciprocals) would be sufficient for this CA. These positions were:

Title	Scope	Relative Preference Ratio
Neutral	Equal Importance, equivalent to 1 in the AHP importance scale.	50 / 50
Stronger (S) / Weaker (W)	Moderate importance of one criteria / option over the other, equivalent to 1.5 in the AHP importance scale.	60 / 40
Much Stronger (MS) / Much Weaker (MW)	Essential / strong importance of one criteria / option over the other equivalent to 5 or 6 in the AHP importance scale.	75 / 25
Very Much Stronger (VMS) / Very Much Weaker (VMW)	Extreme importance of one criteria / option over the other equivalent to 8 or 9 in the AHP importance scale.	90 / 10

Table 8-2: Explanation of Phrasing Adopted for Pairwise Comparison

Using this transposed scoring system made it simpler and, more importantly, more effective at capturing the mind-set and feeling of the attendees at the workshops. Phrases such as 'what are the relative merits of pipeline removal on a project versus rock cover from a safety perspective? Are these Neutral to each other? Is it stronger? If so, how much stronger? If you had to prioritise one over the other, which would it be?' This promoted a collaborative dynamic in the workshop and enabled the collective mind-set of the attendees to be captured. Where there was quantitative data to provide back-up and evidence to support the collective assertions, so much the better.

A summary example of the completed pair-wise comparisons for differentiating criteria versus options are shown in Figure 8-2.

1.1 Personnel Offshore	2a Leave in Situ Minor Intervention – Trench and Bury Exposures	2b Leave in Situ Minor Intervention – Cut and Remove Exposures	2c Leave in Situ Minor Intervention – Rock Cover Exposures	3 Full Removal – Reverse Reeling	Weighting
2a Leave in Situ Minor Intervention – Trench and Bury Exposures	N	N	N	MS	30.0%
2b Leave in Situ Minor Intervention – Cut and Remove Exposures	N	N	N	MS	30.0%
2c Leave in Situ Minor Intervention – Rock Cover Exposures	N	N	N	MS	30.0%
3 Full Removal – Reverse Reeling	MI	MI	MI	N	10.0%

4.2 Impact on Commercial Fisheries	2a Leave in Situ Minor Intervention – Trench and Bury Exposures	2b Leave in Situ Minor Intervention – Cut and Remove Exposures	2c Leave in Situ Minor Intervention – Rock Cover Exposures	3 Full Removal – Reverse Reeling	Weighting
2a Leave in Situ Minor Intervention – Trench and Bury Exposures	N	N	S	N	27.3%
2b Leave in Situ Minor Intervention – Cut and Remove Exposures	N	N	S	N	27.3%
2c Leave in Situ Minor Intervention – Rock Cover Exposures	S	S	N	N	27.3%
3 Full Removal – Reverse Reeling	N	N	N	N	18.2%

2.1 Impact of Decommissioning Operations Offshore	2a Leave in Situ Minor Intervention – Trench and Bury Exposures	2b Leave in Situ Minor Intervention – Cut and Remove Exposures	2c Leave in Situ Minor Intervention – Rock Cover Exposures	3 Full Removal – Reverse Reeling	Weighting
2a Leave in Situ Minor Intervention – Trench and Bury Exposures	N	N	S	S	27.3%
2b Leave in Situ Minor Intervention – Cut and Remove Exposures	N	N	S	S	27.3%
2c Leave in Situ Minor Intervention – Rock Cover Exposures	S	S	N	S	27.3%
3 Full Removal – Reverse Reeling	S	S	S	N	18.2%

5.1 Cost for decommissioning / removal activities	2a Leave in Situ Minor Intervention – Trench and Bury Exposures	2b Leave in Situ Minor Intervention – Cut and Remove Exposures	2c Leave in Situ Minor Intervention – Rock Cover Exposures	3 Full Removal – Reverse Reeling	Weighting
2a Leave in Situ Minor Intervention – Trench and Bury Exposures	N	N	N	S	27.3%
2b Leave in Situ Minor Intervention – Cut and Remove Exposures	N	N	N	S	27.3%
2c Leave in Situ Minor Intervention – Rock Cover Exposures	N	N	N	S	27.3%
3 Full Removal – Reverse Reeling	W	W	W	N	18.2%

Figure 8-2: Example Option Pair-Wise Comparison

The decision-making tool used the above pairwise comparisons to automatically generate a visual output indicating the highest scoring option i.e. the option which represents the most 'successful' solution in terms of its overall contribution to the set of differentiating criteria. At this stage, an opportunity was provided to test the judgements provided, to ensure that all attendees were happy to endorse the outcome. The visual outputs from each decision point are included in Appendix B to Appendix H.

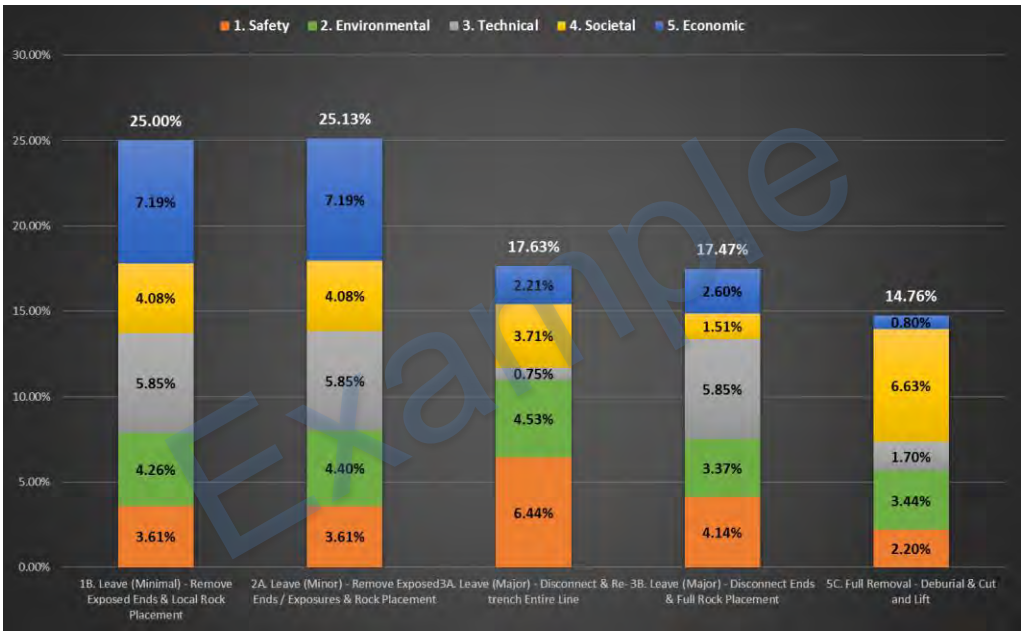


Figure 8-3: A Visual Output Example

The CA output can then easily be stress tested by the workshop attendees by undertaking a sensitivity analysis:

- By applying a modification to the weighting of the criteria – bearing in mind that the base case for this assessment is to have all criteria equally weighted, and / or

- Modifying the pair-wise comparison of the options against each other within the criteria where appropriate

These sensitivities will help inform workshop attendees as to whether a particular aspect is driving a preferred option, or indeed if the preferred option remains the same when the sensitivities are applied.

APPENDIX B **GROUP 1 – DETAILED EVALUATION RESULTS**

Appendix B.1 Group 1 Attributes Table

Group 1: Trunkline

- 118 km 36" concrete trunkline from LOGGS PP platform to Theddlethorp Gas Terminal (PL0454), 13 crossings, 2 in-line tees and 28 km of exposure

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)
		- Unbury entire pipeline with Mass Flow Excavator (MFE) - Cut (with diamond wire) pipeline into 20 m lengths - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline at LOGGS end - Cut (with diamond wire) 10 m of pipeline at LOGGS end and recover - Cut (with diamond wire) all exposed sections into 20 m lengths - Bundle cut sections and recover - Place rock to remediate exposed cut ends (incl. tee locations) - Post decommissioning survey | Seabed trawl sweep - 28 km of exposures along length will be removed	- Dredge to uncover pipeline at LOGGS end - Cut (with diamond wire) 10 m of pipeline at LOGGS end and recover - Place rock to remediate exposed ends (incl. tee locations i.e. 5 ends total) - Place rock across all exposed sections - Post decommissioning survey | Seabed trawl sweep - 28 km of exposures along length will be rock dumped	- Dredge to uncover pipeline at LOGGS end - Cut (with diamond wire) 10 m pipeline (at LOGGS) end and recover - Place rock to remediate exposed ends (incl. tee locations i.e. 5 ends total) - Post decommissioning survey | Seabed trawl sweep - 118 km 36" concrete coated pipeline - 28 km of exposures along length will remain, currently no reportable spans
1. Safety	1.1 Personnel Offshore	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 1,029.7 / 1,359,244 / 1.02E-01 Divers: 18 / 1,029.7 / 444,843 / 4.31E-01 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 18.0 / 9,478 / 7.11E-04 CSV: 76 / 1,200.9 / 1,095,257 / 8.21E-02 Total offshore hours: 2,909,302 hrs Total offshore PLL: 6.16E-01	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 253.4 / 334,528 / 2.51E-02 Divers: 18 / 253.4 / 109,482 / 1.06E-01 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 18.0 / 9,478 / 7.11E-04 CSV: 76 / 273.9 / 249,824 / 1.87E-02 Rockdump Vessel: 20 / 54.4 / 13,046 / 9.78E-04 Total offshore hours: 716,838 hrs Total offshore PLL: 1.52E-01	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 4.8 / 6,389 / 4.79E-04 Divers: 18 / 4.8 / 2,091 / 2.03E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 18.0 / 9,478 / 7.11E-04 Rockdump Vessel: 20 / 110.2 / 26,455 / 1.98E-03 Total offshore hours: 44,892 hrs Total offshore PLL: 5.24E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 5.1 / 6,666 / 5.00E-04 Divers: 18 / 5.1 / 2,182 / 2.12E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 18.0 / 9,478 / 7.11E-04 Total offshore hours: 18,805 hrs Total offshore PLL: 3.36E-03
		W / **MW** / **MW**	**MW** / **MW**	**N**	
	Summary	The assessment of the Personnel Offshore sub-criterion is as follows: Option 6 is assessed as being Weaker than Option 4 as the risk exposure for offshore personnel is 4 times higher for Option 6 due to the increased work scope durations associated with the greater length of pipeline removal for Option 6. Option 6 is assessed as being Much Weaker than Option 2a as the risk exposure is more than 100 times higher for Option 6 due to the much longer work scope durations required to remediate the pipeline compared to rock placement over exposures. Option 6 also assessed as being Much Weaker than Option 1a as the risk exposure is more than 100 times higher for Option 6 due to the much longer work scope durations compared to minimal intervention required for Option 2a and 1a. Option 4 is assessed as being Much Weaker than both Option 2a and 1a as the risk exposure is 30 times and 45 times higher respectively for Option 4 due to the much longer work scope durations. Option 2a is assessed as being Neutral to Option 1a as whilst there is a small difference in the risk exposure between the two options due to the small difference in work scope durations, this difference is insufficient to express a preference. **Overall, Option 2a and Option 1a are equally preferred from a risk to Offshore Personnel perspective.**			
1. Safety	1.2 Personnel Onshore	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 4,858.0 / 310,912 / 3.82E-02 Total onshore hours: 310,912 hrs Total onshore PLL: 3.82E-02	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1,180.0 / 75,520 / 9.29E-03 Total onshore hours: 75,520 hrs Total onshore PLL: 9.29E-03	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06
		W / **VMW** / **VMW**	**VMW** / **VMW**	**N**	
	Summary	The assessment of the Personnel Onshore sub-criterion is as follows: Option 6 is assessed as being Weaker than Option 4 as the risk exposure for onshore personnel is 4 times higher for Option 6 due to the increased work scope durations associated with handling 118 km of pipeline in Option 6 versus 28 km of pipeline in Option 4. Option 6 is assessed as being Very Much Weaker than both Option 2a and Option 1a due to the much higher risk exposure (almost 5000 times higher) for onshore personnel due to handling 118 km of pipeline versus the short 10m pipeline end section from the LOGGS end. Option 4 is assessed as being Very Much Weaker that both Option 2a and Option 1a due to the much higher risk exposure (over 1000 times higher) for onshore personnel due to handling 28 km of pipeline versus the short 10m pipeline end section from the LOGGS end. Option 2a is assessed as being Neutral to Option 1a as the risk exposure from handling the short 10m pipeline end section is the same in both cases. **Overall, Option 2a and Option 1a are equally preferred from a risk to Onshore Personnel perspective.**			

NOTE: Pipeline Numbers in Appendix with a "0" after the "PL" are equivalent to those in the main body of the document with the same numbering but that do not contain the "0" in front of the "PL". The Main body of the text utilises the correct reference for the pipeline numbers.

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)
		- Unbury entire pipeline with Mass Flow Excavator (MFE) - Cut (with diamond wire) pipeline into 20 m lengths - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline at LOGGS end - Cut (with diamond wire) 10 m of pipeline at LOGGS end and recover - Cut (with diamond wire) all exposed sections into 20 m lengths - Bundle cut sections and recover - Place rock to remediate exposed cut ends (incl. tee locations) - Post decommissioning survey | Seabed trawl sweep - 28 km of exposures along length will be removed	- Dredge to uncover pipeline at LOGGS end - Cut (with diamond wire) 10 m of pipeline at LOGGS end and recover - Place rock to remediate exposed ends (incl. tee locations i.e. 5 ends total) - Place rock across all exposed sections - Post decommissioning survey | Seabed trawl sweep - 28 km of exposures along length will be rock dumped	- Dredge to uncover pipeline at LOGGS end - Cut (with diamond wire) 10 m pipeline (at LOGGS) end and recover - Place rock to remediate exposed ends (incl. tee locations i.e. 5 ends total) - Post decommissioning survey | Seabed trawl sweep - 118 km 36" concrete coated pipeline - 28 km of exposures along length will remain, currently no reportable spans
1. Safety	1.3 Other Users	Vessel Days: DSV: 1,029.7 Divers: 1,029.7 Trawler: 8.0 Survey Vessel: 18.0 CSV: 1,200.9 Total vessel days: 2,256.6 days Total Number of Transits: 376	Vessel Days: DSV: 253.4 Divers: 253.4 Trawler: 8.0 Survey Vessel: 18.0 CSV: 273.9 Rockdump Vessel: 54.4 Total vessel days: 607.7 days Total Number of Transits: 100	Vessel Days: DSV: 4.8 Divers: 4.8 Trawler: 8.0 Survey Vessel: 18.0 Rockdump Vessel: 110.2 Total vessel days: 141.0 days Total Number of Transits: 32	Vessel Days: DSV: 5.1 Divers: 5.1 Trawler: 8.0 Survey Vessel: 18.0 Total vessel days: 31.0 days Total Number of Transits: 8
		W / MW / MW	W / W	N	
	Summary	The assessment of the Other Users sub-criterion is as follows: Option 6 is assessed as being Weaker that Option 4. Whilst there are many more vessel days to remove the full pipeline length, these are spread over a longer operational duration and so the impact on safety of other users from vessel activity is likely to be similar for both options at any one time. There are however, a higher number of vessel transits to / from the work site (376 versus 100) which provide a small increase in the potential safety impact on other users. Option 6 is assessed being Much Weaker than both Option 2a and Option 1a due to a combination of more vessels days and, more significantly, the higher number of transits to / from the work site (376 versus 32 or 8). Option 4 is assessed as being Weaker than both Option 2a and Option 1a due to the higher number of vessel days and the higher number of transits to / from the work site (100 versus 32 or 8). Option 2a and Option 1a are assessed as being Neutral to each other as, whilst there are differences in the number of vessel days and transits, these differences are insufficient to result in a material difference on the safety impact of other users of the sea. **Overall, Option 2a and Option 1a are equally preferred from a risk to Other Users perspective.**			
1. Safety	1.4 High Consequence Events	The potential for High Consequence Events is assessed as Medium for this option. This is based on the number of both cutting and lifting operations that would need to take place to fully remove the pipeline. It should be noted that there are number of pipeline crossings within this group and it has been assumed that all 3rd party pipelines will be hydrocarbon live. Number of Lifts: 1,480	The potential for High Consequence Events is assessed as Low to Medium for this option. This is based on the number of both cutting and lifting operations that would need to take place to remove the pipeline exposures and pipeline ends. Number of Lifts: 360	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the pipeline ends only. Number of Lifts: 1	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the pipeline ends only. Number of Lifts: 1
		W / W / W	W / W	N	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options as there is a high number of lifting operations for onboarding the bundled, cut sections of pipeline which presents the potential for a dropped object hazard, compared to a lower number of lifts for Option 4 and just the one lift for Option 2a and Option 1a. Option 4 is also assessed as being Weaker than Option 2a and Option 1a, due to the high number of lifting operations for onboarding the bundled, cut sections of pipeline, versus just the one lift, resulting in greater potential for a dropped object. Option 2a is assessed as being Neutral to Option 1a as the potential for High Consequence Events is considered similar for these options. **Overall, Option 2a and Option 1a are equally preferred from a High Consequence Events perspective.**			
1. Safety	1.5 Residual Risk	As the pipeline would be fully removed from the seabed, there would be no legacy risk associated with this full removal option.	The majority of the 118 km pipeline is trenched and buried to an appropriate depth. There is 28 km of exposed pipeline which will be removed with the potential snag hazard associated the cut ends mitigated by spot rock placement designed to be overtrawlable. A post-decommissioning trawl sweep will be conducted. As such, the potential snag hazard post-decommissioning activities is adequately mitigated and lower than for the pipeline in its current state of exposure. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.	The majority of the 118 km pipeline is trenched and buried to an appropriate depth. There is 28 km of exposed pipeline which will be rock dumped to mitigate the potential snag hazard associated with these exposed areas. The areas of rock placement will be designed to be overtrawlable and a post-decommissioning trawl sweep will be conducted. As such, the potential snag hazard post-decommissioning activities is adequately mitigated and lower than for the pipeline in its current state of exposure. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.	The majority of the 118 km pipeline is trenched and buried to an appropriate depth. There is 28 km of exposed pipeline which will remain in its current state (no reportable spans). The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.
		S / S / MS	N / S	S	
	Summary	The assessment of the Residual Risk sub-criterion is as follows: Option 6 is assessed as being Stronger than both Option 4 and Option 2a due to there being no residual risk associated with the full removal option versus potential for a snag hazard in Option 4 and Option 2a, albeit these potential snag hazards are mitigated by rock. Option 6 is assessed as Much Stronger than Option 1a as there is no residual risk associated with the full removal option versus potential for a snag hazard in Option 1a. Note: existing potential for snag hazard in Option 1a will be monitored to ensure that any emerging risks are managed as appropriate. Option 4 is assessed as being Neutral to Option 2a as the residual risk is similar due to the potential snag hazard from pipeline exposure being mitigated in both cases. Option 4 is assessed as being Stronger than Option 1a due to the remaining potential for a snag hazard to emerge from the exposed pipeline in Option 1a (albeit this option includes an appropriate monitoring programme to identify and manage emerging hazards). Option 2a is assessed as being Stronger than Option 1a due to the remaining potential for a snag hazard to emerge from the exposed pipeline in Option 1a (albeit this option includes an appropriate monitoring programme to identify and manage emerging hazards). **Overall, Option 6 is the most preferred from a Residual Risk perspective.**			

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): Survey Vessel - 10 days | CSV - 606 days | DSV - 989 days | Trawler - 5 days Tooling Noise: Diamond Wire Cutting - 987 days | MFE for Unburial - 49 days Operational Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. Level of cutting swarf would be significantly higher in this option compared to the other options. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore will be significant for this option. All planned discharges will be in accordance with MARPOL.	Vessel Noise (days on-site): Survey Vessel - 10 days | CSV - 126 days | DSV - 240 days | Rock Dump Vessel - 48 days | Trawler - 5 days Tooling Noise: Dredging - 0.25 days | Diamond Wire Cutting - 240 days | Rock Dumping - 45 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. Level of cutting swarf would be present in this option but less than full removal. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore will be less for this option than Option 6 but more than Option 2a and Option 1a. All planned discharges will be in accordance with MARPOL.	Vessel Noise (days on-site): Survey Vessel - 10 days | DSV - 1 day | Rock Dump Vessel - 74 days | Trawler - 5 days Tooling Noise: Dredging - 0.25 days | Diamond Wire Cutting - 0.17 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. Negligible level of cutting swarf would be present in this option. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore will be less for this option than Option 6 and Option 4 and similar to Option 1a. All planned discharges will be in accordance with MARPOL.	Vessel Noise (days on-site): Survey Vessel - 10 days | DSV - 1 day | Trawler - 5 days Tooling Noise: Dredging - 0.25 days | Diamond Wire Cutting - 0.17 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. Negligible level of cutting swarf would be present in this option. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore will be less for this option than Option 6 and Option 4 and similar to Option 2a. All planned discharges will be in accordance with MARPOL.
		W W W	W W	N	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 6 is assessed as being Weaker than Option 4, Option 2a and Option 1a as, whilst the actual environmental marine impacts from the increased noise, operational discharges (swarf) and vessel discharges is low for Option 6, cumulatively, they are greater than the other options due to greater pipeline cutting and vessel activity for Option 6. Option 4 is assessed as being Weaker than Option 2a and Option 1a as, whilst the actual environmental marine impacts from the increased noise, operational discharges (swarf) and vessel discharges is low for Option 4 compared to the other options, cumulatively, they are significant enough to express a small preference for the other options. Option 2a is assessed as being Neutral to Option 1a as the differences in terms of environmental marine impacts were insufficient to express a preference. **Overall, Option 2a and Option 1a are equally preferred from an Operational Marine Impact perspective.**			
2. Environmental	2.2 Legacy Marine Impact	There will be no legacy marine impacts from this full removal option.	The majority of the 118 km pipeline is trenched and buried to an appropriate depth. There is 28 km of exposed pipeline which will be removed with the cut ends rock dumped. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried 36" diameter steel pipeline, which is concrete coated with a coal tar layer between the steel and the concrete. Given the material being left in-situ and the pipeline having been cleaned the legacy marine impact is considered low.	The majority of the 118 km pipeline is trenched and buried to an appropriate depth. There is 28 km of exposed pipeline which will be rock dumped. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried 36" diameter steel pipeline, which is concrete coated with a coal tar layer between the steel and the concrete. Given the material being left in-situ and the pipeline having been cleaned the legacy marine impact is considered low.	The majority of the 118 km pipeline is trenched and buried to an appropriate depth. There is 28 km of exposed pipeline which will be left as-is. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried 36" diameter steel pipeline, which is concrete coated with a coal tar layer between the steel and the concrete. Given the material being left in-situ and the pipeline having been cleaned the legacy marine impact is considered low.
		MS MS MS	S S	N	
	Summary	The assessment of the Legacy Marine Impact sub-criterion is as follows: Option 6 is assessed as being Much Stronger than Option 4, Option 2a and Option 1a due to the pipeline being removed from the marine environment in Option 6 (zero potential for degradation products) versus the potential for degradation products to be released into the marine environment from the remaining material with the other options. Option 4 is assessed as being Stronger than Option 2a and Option 1a as there is 28 km of pipeline removed from the marine environment in Option 4 versus the potential for degradation products to be released into the marine environment from the remaining material with the other options. Option 2a is assessed as being Neutral to Option 1a as the potential legacy marine impacts are the same due to the amount of remaining material being the same. Note: No distinction is made between the legacy marine impact of material left either buried, rock dumped or exposed. **Overall, Option 6 is most preferred from a Legacy Marine Impact perspective.**			
2. Environmental	2.3 Fuel Use & Atmospheric Emissions	Vessel Emissions (in tonnes): Fuel: 54,149 CO2e: 177,490 NOx: 3,216.47 SO2: 216.60 Vessel Energy Use: 2,328,422 GJ	Vessel Emissions (in tonnes): Fuel: 14,371 CO2e: 47,104 NOx: 853.62 SO2: 57.48 Vessel Energy Use: 617,941 GJ	Vessel Emissions (in tonnes): Fuel: 2,936 CO2e: 9,624 NOx: 174.40 SO2: 11.74 Vessel Energy Use: 126,249 GJ	Vessel Emissions (in tonnes): Fuel: 1,075 CO2e: 3,522 NOx: 63.83 SO2: 4.30 Vessel Energy Use: 46,210 GJ
		MW MW MW	W W	N	
	Summary	The assessment of the Fuel Use & Atmospheric Emissions sub-criterion is as follows: Option 6 is assessed as being Much Weaker than Option 4, Option 2a and Option 1a as the fuel used and emissions generated by the vessel over an extended period to remove the trunkline for this option are much higher than for the other options where there is significantly lower vessel usage. Option 4 is assessed as being Weaker than both Option 2a and Option 1a as, whilst the fuel used and emissions generated for Option 4 are higher, when considered in context, these differences are only sufficient to express a small preference for Option 2a and Option 1a. Option 2a is assessed as being Neutral to Option 1a as, whilst there are differences in the fuel use and emissions between the options, these differences are considered insufficient when considered in context, to express a preference. **Overall, Option 2a and Option 1a are equally preferred from a Fuel Use & Atmospheric Emissions perspective.**			

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)
2. Environmental	2.4 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 147,306 Remaining Material: N/A Total: 147,306 Rock: N/A	Material Emissions (CO2 in tonnes): Recovered Material: 35,760 Remaining Material: 148,851 Total: 184,611 Rock: 26,550 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 26 Remaining Material: 196,540 Total: 196,565 Rock: 287,435 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 26 Remaining Material: 196,540 Total: 196,565 Rock: 125 tonnes
		S / MS / N	S / W	MW	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: Option 6 is assessed as being Stronger than Option 4 as there is no requirement for rock in Option 6 versus a requirement for a reasonable amount of rock for Option 4 to stabilise multiple pipeline ends. Option 6 is assessed as being Much Stronger than Option 2a due to no requirement for rock versus a significant amount required to be placed over 28 km of exposure in Option 2a. Option 6 is assessed as being Neutral to Option 1a as whilst there is a small amount of rock required in Option 1a, this was insufficient to express a preference from a consumption perspective. Note: the differences between the options in tonnage of CO2 associated with processing returned material and / or to produce replacement material left in-situ were considered insignificant in terms of this assessment. As such, the preference judgements were driven by the quantity of rock consumption required for each option. Option 4 is assessed as being Stronger than Option 2a as there is a much higher amount of rock required for Option 2a. Option 4 is assessed as being Weaker than Option 1a (where rock is placed at the LOGGS end only) as there is more rock required to stabilise multiple pipeline ends for Option 4. Option 2a is assessed as being Much Weaker than Option 1a as there is much more rock required for Option 2a to address 28 km of exposure compared to the spot placement of rock at LOGGS end only for Option 1a. **Overall, Option 6 and Option 1a are equally preferred from an Other Consumptions perspective.**			
2. Environmental	2.5 Disturbance	Short Term Disturbance (MFE): 448,205 m2 Full pipeline to be unburied using MFE.	There is some short-term disturbance resulting from removing the 28 km of exposures along this line (approx. 23% of the line length).	There is limited short-term disturbance for this option from the rock dump only.	There is limited short-term disturbance for this option from the rock dump only.
		W / MW / MW	W / W	N	
	Summary	The assessment of the Seabed Disturbance (short-term impact) sub-criterion is as follows: Option 6 is assessed as being Weaker than Option 4 due to the large area of seabed disturbance from the unburial of the 118 km pipeline using an MFE when compared to smaller area of disturbance associated with removing the 28 km of exposures without the use of an MFE. Option 6 is assessed as being Much Weaker than Option 2a and Option 1a due to the large area of seabed disturbance from the unburial of the 118 km pipeline using a Mass Flow Excavator when compared to the small area of low impact disturbance with the other options which require no unburial. Option 4 is assessed as being Weaker than Option 2a and Option 1a due to the disturbance caused from removing the 28 km of exposures versus limited disturbance in the other options which require no unburial. Option 2a is assessed as being Neutral to Option 1a as the seabed disturbance is considered negligible and similar for these options. **Overall, Option 2a and Option 1a are equally preferred from a Seabed Disturbance perspective.**			
2. Environmental	2.6 Loss of Habitat	Habitat Loss (Rockdump): N/A	Habitat Loss (Rockdump): 53,020 m2	Habitat Loss (Rockdump): 287,430 m2	Habitat Loss (Rockdump): 100 m2
		S / MS / N	MS / W	MW	
	Summary	The assessment of the Loss of Habitat (legacy / long-term impact) sub-criterion is as follows: Option 6 is assessed as being Stronger than Option 4 as the rock required on multiple pipeline ends for Option 4 changes the current seabed habitat and thus results in an area of habitat loss whereas there is no long-term habitat loss in Option 6. Option 6 is assessed as Much Stronger than Option 2a as there is a large area of habitat loss associated with Option 2a from the 28 km of rock. Option 6 is assessed as being Neutral to Option 1a as whilst there is a small amount of rock required in Option 1a at the LOGGS end which, in terms of scale, is considered negligible when compared to the impact from the other remediation options (Option 4 and Option 2a). Option 4 is assessed as being Stronger than Option 2a as the area of habitat loss in Option 2a is much greater than Option 4. Option 4 is assessed as being Weaker than Option 1a as area of habitat loss in Option 1a is much smaller than Option 4. Option 2a is assessed as being Much Weaker than Option 4 as the area of habitat loss in Option 2a is much greater than Option 1a. Note: Habitat loss is from the replacement of the sandbank features with hard substrate (rock). **Overall, Option 6 and Option 1a are equally preferred from a Loss of Habitat perspective.**			
3. Technical	3.1 Technical Feasibility	**Concept Maturity:** DWC for cutting concrete coated pipeline of 28" has been demonstrated during the Viking decommissioning. It is believed that DWC cutting of concrete coated pipeline of this diameter (36") is achievable. (Score 3) **Technical Risks:** Risk to successfully achieving full removal by unburial and cut and lift of the pipeline due to the long durations involved and the potential for unforeseen unburial issues, particularly in the near-shore tidal zone. (Score 2)	**Concept Maturity:** DWC for cutting concrete coated pipeline of 28" has been demonstrated during the Viking decommissioning. It is believed that DWC cutting of concrete coated pipeline of this diameter (36") is achievable. (Score 3) **Technical Risks:** Limited technical risks from cutting and removal of pipeline sections as the areas being cut and removed are already exposed therefore no unburial risk. There may be some risk associated with multiple DWC cutting operations. (Score 3)	**Concept Maturity:** DWC for cutting concrete coated pipeline of 28" has been demonstrated during the Viking decommissioning. It is believed that DWC cutting of concrete coated pipeline of this diameter (36") is achievable. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required, no requirement for unburial and necessity for rock cover which is considered a routine operation. (Score 3)	**Concept Maturity:** DWC for cutting concrete coated pipeline of 28" has been demonstrated during the Viking decommissioning. It is believed that DWC cutting of concrete coated pipeline of this diameter (36") is achievable. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required, no requirement for unburial and rock cover at LOGGS end which is considered a routine operation. (Score 3)
		W / MW / MW	W / W	N	
	Summary	The assessment of the Technical Feasibility sub-criterion is as follows: Option 6 is assessed as being Weaker than Option 4 due to potential challenges associated with the unburial required to perform the DWC of the pipeline and the longer duration of operations. Option 6 is assessed as being Much Weaker than both Option 2a and Option 1 as there is less technical risk associated Option 2a and Option 1a as there is a single cut and no deburial. Option 4 is assessed as being Weaker than Option 2a and Option 1a as there is less technical risk associated Option 2a and Option 1a as there is a single cut and no deburial. Option 2a is assessed as being Neutral to Option 1a as the concept maturity and technical risks are considered largely similar. **Overall, Option 2a and Option 1a are equally preferred from a Technical Risk perspective.**			

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)
		- Unbury entire pipeline with Mass Flow Excavator (MFE) - Cut (with diamond wire) pipeline into 20 m lengths - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline at LOGGS end - Cut (with diamond wire) 10 m of pipeline at LOGGS end and recover - Cut (with diamond wire) all exposed sections into 20 m lengths - Bundle cut sections and recover - Place rock to remediate exposed cut ends (incl. tee locations) - Post decommissioning survey | Seabed trawl sweep - 28 km of exposures along length will be removed	- Dredge to uncover pipeline at LOGGS end - Cut (with diamond wire) 10 m of pipeline at LOGGS end and recover - Place rock to remediate exposed ends (incl. tee locations i.e. 5 ends total) - Place rock across all exposed sections - Post decommissioning survey | Seabed trawl sweep - 28 km of exposures along length will be rock dumped	- Dredge to uncover pipeline at LOGGS end - Cut (with diamond wire) 10 m of pipeline (at LOGGS) end and recover - Place rock to remediate exposed ends (incl. tee locations i.e. 5 ends total) - Post decommissioning survey | Seabed trawl sweep - 118 km 36" concrete coated pipeline - 28 km of exposures along length will remain, currently no reportable spans
4. Societal	4.1 Fishing	Whilst this option provides a clear seabed, the operational impact of removing the pipeline disturbs (displacement and restricted access) current fishing operations significantly. Low intensity / value fishing operations are conducted in the area of this pipeline which would be curbed due to the interference of transiting vessels on fishing operations. (Score 2)	Short term disturbance in localised areas. Low intensity / value fishing operations are conducted in the area of this pipeline however, the localised decommissioning activity of significantly shorter durations is expected to have minimal interference with fishing operations. (Score 3)	Short term disturbance in localised areas. Low intensity / value fishing operations are conducted in the area of this pipeline however, the rock placement will be overtrawlable and will be undertaken over a short duration therefore is expected to have minimal interference with fishing operations. (Score 3)	Left in-situ infrastructure may lead to damage / loss of fishing gear. Low intensity / value fishing operations are conducted in the area of this pipeline and any reportable spans will be addressed appropriately as part of the liability management post-decommissioning. (Score 3)
		MW | MW | MW	N | W	W	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 6 is assessed as being Much Weaker than Option 4, Option 2a and Option 1a due to the additional disruption caused to fishing operations, particularly to near-shore fishing operations where static creel pots may require to be removed during full removal (Option 6) operations. Note: given that fishing operations are already conducted in this area, presence of the pipeline is not considered a limitation to fishing activity. Option 4 is assessed as being Neutral to Option 2a as the disruption associated with exposure removal and / or rock dump is largely similar, as is remaining infrastructure. Option 4 is assessed as being Weaker than Option 1a as there is more disruption involved in delivering Option 4. Option 2a is assessed as being Weaker than Option 1a as there is more disruption involved in delivering Option 2a. **Overall, Option 1a is the most preferred from a Societal impact on Fishing perspective.**			
4. Societal	4.2 Communities / Ammenities	Materials Returned: Steel: 69,844 tonnes (recyclable) Concrete: 73,440 tonnes (landfill) Coal Tar: 2,446 tonnes (landfill) Mattress/Grout Bag: 14 tonnes (landfill) Whilst there are some societal benefits from the returning of significant tonnage of recyclable steel, this is more than offset by the significant tonnage of contaminated and difficult to segregate concrete, which will take up landfill capacity. (Score 2) Note: given the quantity of concrete destined for landfill, there may be an opportunity to look at alternative uses / disposal routes, although no credence for this has been given in this assessment.	Materials Returned: Steel: 16,957 tonnes (recyclable) Concrete: 17,830 tonnes (landfill) Coal Tar: 594 tonnes (landfill) Whilst there are some societal benefits from the returning of significant tonnage of recyclable steel, this is more than offset by the significant tonnage of contaminated and difficult to segregate concrete, which will take up landfill capacity. (Score 2) Note: given the quantity of concrete destined for landfill, there may be an opportunity to look at alternative uses / disposal routes, although no credence for this has been given in this assessment.	Materials Returned: Steel: 12 tonnes (recyclable) Concrete: 13 tonnes (landfill) Coal Tar: 1 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal derived from the disconnection of the pipeline at the platform end only, required to enable platform removal. (Score 3)	Materials Returned: Steel: 12 tonnes (recyclable) Concrete: 13 tonnes (landfill) Coal Tar: 1 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal derived from the disconnection of the pipeline at the platform end only, required to enable platform removal. (Score 3)
		N | W | W	W | W	N	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: Note: Assessment of the societal impact of options is dominated by any negative impacts from material returned as the positive impacts, such as recyclable material or any job creation / retention offered by an option is considered less significant than negative impacts such as using landfill capacity. Option 6 is assessed as being Neutral to Option 4 due to both options having proportionally large quantities of contaminated and difficult to segregate concrete that are likely to end up in landfill. Option 6 is assessed as being Weaker than both Option 2a and Option 1a due to the proportionally large quantity of concrete likely to end up in landfill versus very limited quantities. Option 4 is assessed as being Weaker than both Option 2a and Option 1a due to the proportionally large quantity of concrete likely to end up in landfill versus very limited quantities. Option 2a is assessed as being Neutral to Option 1a as they both have negligible utilisation of landfill. **Overall, Option 2a and Option 1a are equally preferred from a Societal impact on Other Users perspective.**			
5. Economic	5.1 Short-term Costs	£356.355 Million	£90.081 Million	£15.275 Million	£2.501 Million
		VMW | VMW | VMW	MW | MW	W	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 6 is assessed as being Very Much Weaker than all other options as the costs are much higher in all cases. Option 4 is assessed as being Very Much Weaker than Option 2a and Option 1a as the costs are 6 times higher than Option 2a and 45 times higher than Option 1a. Option 2a is assessed as being Much Weaker than Option 1a as the costs are around 6 times higher. **Overall, Option 1a is most preferred from a Short-term Cost perspective.**			
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million	Surveys: £0.467 Million FLTC: N/A Total Legacy Cost: £0.467 Million	Surveys: £0.538 Million FLTC: N/A Total Legacy Cost: £0.538 Million	Surveys: £0.538 Million FLTC: £0.355 Million Total Legacy Cost: £0.893 Million
		S | S | S	N | N	N	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: Option 6 is assessed as being Stronger than all other options as there are no legacy / long-term costs associated with this option versus similar long-term costs for all other options. Option 4 is assessed as being Neutral to Option 2a as the long-term costs are similar. Option 4 is assessed as being Stronger than Option 1a as the long-term costs with Option 1a are sufficiently higher to express a small preference for Option 4. Option 2a is assessed as being Stronger than Option 1a as the long-term costs with Option 1a are sufficiently higher to express a small preference for Option 2a. **Overall, Option 6 is most preferred from a Long-term Cost perspective.**			

Appendix B.2 Group 1 Pairwise Comparison Matrices

1.1 Personnel Offshore	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	MW	MW	11.3%
Option 4 Partial Removal (Cut & Lift)	S	N	MW	MW	13.8%
Option 2a Leave In-situ (Minor Intervention)	MS	MS	N	N	37.5%
Option 1a Leave In-situ (Minimum Intervention)	MS	MS	N	N	37.5%

1.2 Personnel Onshore	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	VMW	VMW	4.5%
Option 4 Partial Removal (Cut & Lift)	S	N	VMW	VMW	5.5%
Option 2a Leave In-situ (Minor Intervention)	VMS	VMS	N	N	45.0%
Option 1a Leave In-situ (Minimum Intervention)	VMS	VMS	N	N	45.0%

1.3 Other Users	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	MW	MW	12.0%
Option 4 Partial Removal (Cut & Lift)	S	N	W	W	20.8%
Option 2a Leave In-situ (Minor Intervention)	MS	S	N	N	33.6%
Option 1a Leave In-situ (Minimum Intervention)	MS	S	N	N	33.6%

1.4 High Consequence Events	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.0%
Option 4 Partial Removal (Cut & Lift)	S	N	W	W	22.1%
Option 2a Leave In-situ (Minor Intervention)	S	S	N	N	29.9%
Option 1a Leave In-situ (Minimum Intervention)	S	S	N	N	29.9%

1.5 Residual Risk	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	S	MS	38.1%
Option 4 Partial Removal (Cut & Lift)	W	N	N	S	23.6%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	S	23.6%
Option 1a Leave In-situ (Minimum Intervention)	MW	W	W	N	14.7%

2.1 Operational Marine Impact	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.0%
Option 4 Partial Removal (Cut & Lift)	S	N	W	W	22.1%
Option 2a Leave In-situ (Minor Intervention)	S	S	N	N	29.9%
Option 1a Leave In-situ (Minimum Intervention)	S	S	N	N	29.9%

2.2 Legacy Marine Impact	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MS	MS	MS	49.7%
Option 4 Partial Removal (Cut & Lift)	MW	N	S	S	20.3%
Option 2a Leave In-situ (Minor Intervention)	MW	W	N	N	15.0%
Option 1a Leave In-situ (Minimum Intervention)	MW	W	N	N	15.0%

2.3 Fuel Use & Atmospheric Emissions	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MW	MW	MW	9.9%
Option 4 Partial Removal (Cut & Lift)	MS	N	W	W	24.3%
Option 2a Leave In-situ (Minor Intervention)	MS	S	N	N	32.9%
Option 1a Leave In-situ (Minimum Intervention)	MS	S	N	N	32.9%

2.4 Other Consumptions	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	MS	N	33.6%
Option 4 Partial Removal (Cut & Lift)	W	N	S	W	20.8%
Option 2a Leave In-situ (Minor Intervention)	MW	W	N	MW	12.0%
Option 1a Leave In-situ (Minimum Intervention)	N	S	MS	N	33.6%

2.5 Disturbance	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	MW	MW	12.0%
Option 4 Partial Removal (Cut & Lift)	S	N	W	W	20.8%
Option 2a Leave In-situ (Minor Intervention)	MS	S	N	N	33.6%
Option 1a Leave In-situ (Minimum Intervention)	MS	S	N	N	33.6%

2.6 Loss of Habitat	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	MS	N	32.9%
Option 4 Partial Removal (Cut & Lift)	W	N	MS	W	24.3%
Option 2a Leave In-situ (Minor Intervention)	MW	MW	N	MW	9.9%
Option 1a Leave In-situ (Minimum Intervention)	N	S	MS	N	32.9%

3.1 Technical Feasibility	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	MW	MW	12.0%
Option 4 Partial Removal (Cut & Lift)	S	N	W	W	20.8%
Option 2a Leave In-situ (Minor Intervention)	MS	S	N	N	33.6%
Option 1a Leave In-situ (Minimum Intervention)	MS	S	N	N	33.6%

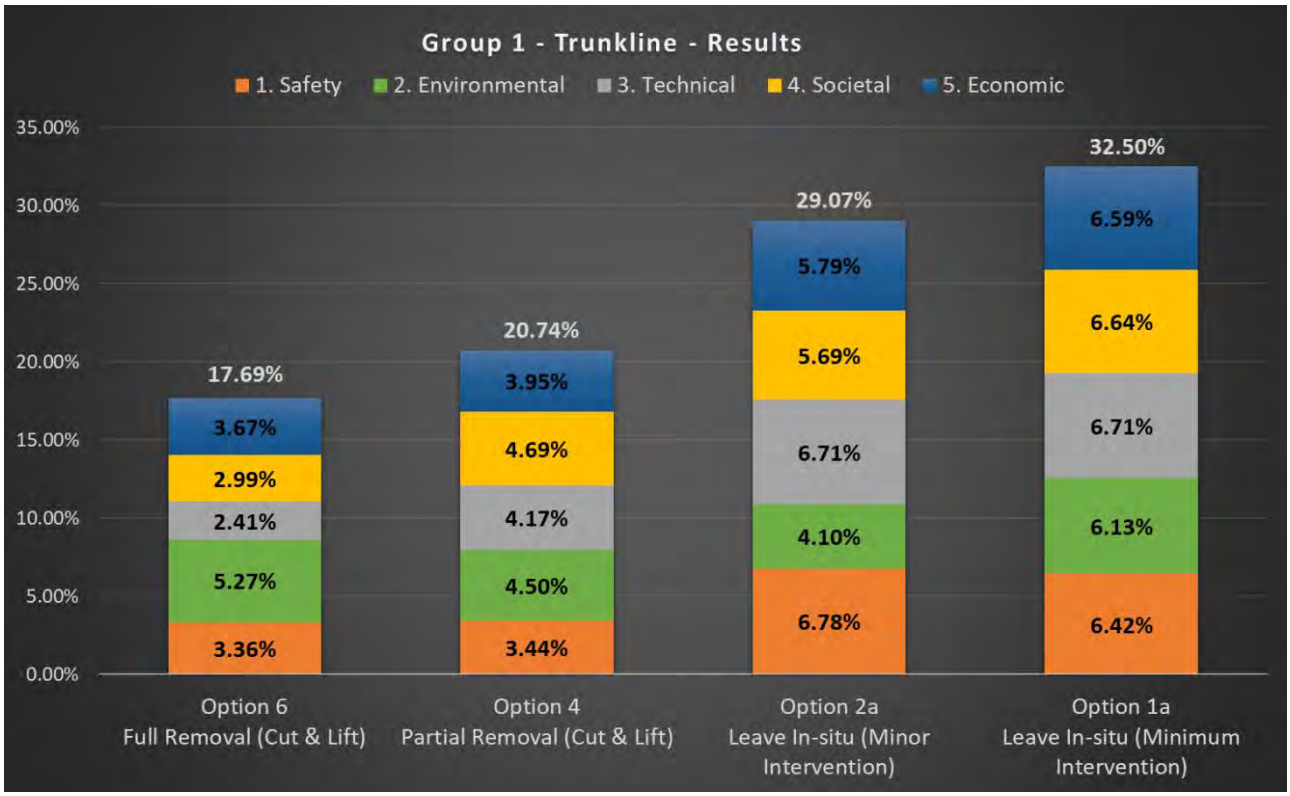
4.1 Fishing	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MW	MW	MW	9.9%
Option 4 Partial Removal (Cut & Lift)	MS	N	N	W	26.9%
Option 2a Leave In-situ (Minor Intervention)	MS	N	N	W	26.9%
Option 1a Leave In-situ (Minimum Intervention)	MS	S	S	N	36.4%

4.2 Communities / Ammenities	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	W	W	20.0%
Option 4 Partial Removal (Cut & Lift)	N	N	W	W	20.0%
Option 2a Leave In-situ (Minor Intervention)	S	S	N	N	30.0%
Option 1a Leave In-situ (Minimum Intervention)	S	S	N	N	30.0%

5.1 Short-term Costs	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	VMW	VMW	VMW	3.3%
Option 4 Partial Removal (Cut & Lift)	VMS	N	MW	MW	17.3%
Option 2a Leave In-situ (Minor Intervention)	VMS	MS	N	W	35.7%
Option 1a Leave In-situ (Minimum Intervention)	VMS	MS	S	N	43.7%

5.2 Long-term Costs	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Leave In-situ (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	S	S	33.3%
Option 4 Partial Removal (Cut & Lift)	W	N	N	N	22.2%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	N	22.2%
Option 1a Leave In-situ (Minimum Intervention)	W	N	N	N	22.2%

Appendix B.3 Group 1 Results Chart



Appendix B.4 Group 1 Detailed Evaluation Discussion

Appendix B.4.1 Safety – Personnel Offshore

The assessment of the options during the workshop indicated that the leave in-situ options (Option 1a and Option 2a) to be the most attractive against the Personnel Offshore sub-criterion. This was due to these options having the shortest offshore scope duration of the remaining decommissioning options as these options involve removing the pipeline ends at the LOGGS end and at the tee locations in both cases. Option 2a also allows for rock placement over areas of exposure. Whilst this increases the offshore scope from additional use of a Rockdump Vessel, this increase over Option 1a was insufficient to increase the risk exposure to offshore personnel sufficiently to express a preference between the two options.

Option 4 – Partial Removal was assessed as significantly less attractive than the leave in-situ options from a safety risk to offshore personnel perspective. This is due to increased safety risk from the greater offshore work scope associated with removing the areas of exposure (28 km) in Option 4 in addition to the pipeline end sections. Option 4 also requires an increase in operational support from divers over the leave in-situ options, further increasing the safety risk.

Option 6 – Full Removal was assessed as less attractive than Option 4 from a safety risk to offshore personnel perspective. This is due to increased safety risk from the greater offshore work scope associated with removing the entire pipeline (118 km) in Option 6 and the further increase in operational support from divers over Option 4.

Appendix B.4.2 Safety – Personnel Onshore

The safety risk associated with the onshore personnel is related to the quantity of material being returned to shore for onshore handling, transportation and processing. The leave in-situ options return the (equal) least material of the decommissioning options from the pipeline end sections, making these options assessed as the most attractive from a safety risk to onshore personnel perspective.

Option 4 returns significantly more material for onshore handling, transportation and processing, than the leave in-situ options due to returning the 28 km of exposed pipeline. Option 6 returns significantly more material than Option 4 as it returns the full 118 km pipeline length to shore. Both Option 4 and Option 6 are assessed as being significantly less attractive than the leave in-situ options, with a preference for Option 4 over Option 6.

Appendix B.4.3 Safety – Other Users

The impact of performing the decommissioning options on other users of the sea from a safety perspective is related to the duration of operations, the number of vessels involved, and significantly, the number of transits to and from port to the decommissioning site.

The assessment of the decommissioning options against this criterion has indicated that the leave in-situ options (Option 1a and Option 2a) to be the most attractive against the Safety – Other Users sub-criterion. This is due to these options having fewer vessels, fewer days of vessel operations and less vessel transits than the other options.

Option 4 is assessed as being more attractive than Option 6 as Option 4 has fewer vessels, fewer days of vessel operations and less vessel transits than Option 6.

Appendix B.4.4 Safety – High Consequence Events

The assessment during the workshop indicated that the leave in-situ options would have the least exposure to potential for High Consequence Events and would therefore, be the most attractive against this criterion. This is due to the limited cut and lift operations to recover the pipeline end sections at the LOGGS end and the tee locations.

Option 4 would be exposed to a greater potential for a High Consequence Event from a potential dropped object due to the additional lifting operations associated with the recovery of the 28 km of exposed pipeline.

Option 6 would be exposed to a greater potential for a dropped object as there is more lifting associated with the recovery of the entire 118 km pipeline in sections.

Appendix B.4.5 Safety – Residual Risk

The residual risk relates to the potential for any safety impact from the decommissioning options. Option 6 is assessed as the most attractive option from a residual safety risk perspective as it is a full removal option and therefore removes all residual risk.

Option 4 and Option 2a were assessed as being equally attractive from a residual risk perspective as the removal of the exposures in Option 4 or the rock placement over the exposures in Option 2a were considered to provide similar mitigation of any potential residual risk.

Option 1a was assessed as the least attractive option against this criterion due to the existing pipeline exposures remaining in this option.

It should be noted that, as part of any partial removal or leave in-situ solution being selected, any potential hazards along the pipeline would be risk assessed and remediated and / or monitored to ensure that any emerging hazards do not develop into an unacceptable snagging risk to fishing operations.

Appendix B.4.6 Safety – Overall

When combining the assessments conducted at sub-criterion level, the most attractive option, from a safety perspective is Option 2a, followed closely by Option 1a. These options were assessed as being equally preferred against all sub-criteria except the residual risk, where Option 2a was preferred.

Option 4 and Option 6 were assessed as significantly less attractive than the leave in-situ options in all areas except residual risk, with Option 6 being less attractive than Option 4. The residual risk criterion redresses this balance somewhat, where Option 6 is more attractive than Option 4 as it removes residual risk. This brings Option 4 and Option 6 closer together again.

Appendix B.4.7 Environment – Operational Marine Impact

The environmental impact on the marine environment from performing the decommissioning options was considered low across all options. However, there were sufficient, cumulative differences, to indicate preferences across the decommissioning options.

The assessment performed during the workshop indicated that the leave in-situ options are the most attractive from an operational marine impact perspective. This is due to these options having the least impact in terms of marine noise as they have the lowest number of vessel days and the lowest amount of subsea cutting operations.

All options have similar impacts in terms of discharges that occur from the pipeline whilst performing the decommissioning option as the pipeline is to have been cleaned successfully for all options. Options 4 and 6 do have increased quantities of cutting swarf over the leave in-situ options, which may have a small additional environmental impact.

The discharges from vessels relates to the number of vessels and the number of vessel days. Option 4 is considered less attractive than the leave in-situ options due to the additional vessel days required. Option 6 is worse again, due to the additional number of vessel days associated with the full removal option.

Appendix B.4.8 Environment – Legacy Marine Impact

The assessment indicated that Option 6, full removal of the pipeline, is the most attractive decommissioning option from a legacy marine environmental impact perspective. This is due to the full pipeline being removed and thus eliminating any legacy impact from degradation products.

Option 4 was assessed as being more attractive than the leave in-situ options as 28 km of pipeline material is removed from the marine environment which reduces the potential legacy environmental impact over the leave in-situ options where all material is left in-situ. No distinction was made between the impact of exposed pipeline versus buried or rock covered pipeline.

Appendix B.4.9 Environment – Fuel Use & Atmospheric Emissions

The assessment indicated that the leave in-situ options are the most attractive against the fuel use and atmospheric emissions criterion. This is due to these options having the least offshore work scope duration and hence vessel use and durations.

Option 4 has increased impact due to the additional offshore work scope associated with removing the 28 km of exposed pipeline. Option 6 has increased impact again, from the additional offshore work scope associated with removing the entire pipeline.

Appendix B.4.10 Environment – Other Consumptions

The environmental impact of the decommissioning options in terms of ‘other consumptions’ relates to the use of materials required to deliver that option such as the use of rock for rock placement. It also considers the environmental impact of replacing material that has been left in-situ and the impact from recycling any material returned.

All options were assessed as having a similar environmental impact when considering the material returned versus material left in-situ perspective. The assessment therefore focussed on the quantity of rock required for each option.

Option 6, the full removal option and Option 1a were assessed as being the most attractive as they require no rock and 125 tonnes of rock respectively.

Option 4 was less attractive than these options as it required more than 25,000 tonnes of rock, used to mitigate the snag hazard associated with the cut ends left after the exposures were removed in this option.

Option 2a was the least attractive of the options due to the extensive use of rock placement, which results in requiring almost 300,000 tonnes of rock.

Appendix B.4.11 Environment – Seabed Disturbance

The short-term, environmental impact on the seabed, of performing the decommissioning options, is addressed in this criterion.

The leave in-situ options are assessed as the most attractive decommissioning options here as the seabed impact is limited to the area relating to the sections of pipeline removal at the LOGGS end and the tee locations.

Option 4 is less attractive than the leave in-situ options as the seabed is impacted over a much greater area as it is disturbed in all the areas where the 28 km of pipeline exposures are being removed.

Option 6 is the least attractive option as the seabed is impacted over by far the largest area due to the de-burial along the entire pipeline length using a Mass Flow Excavator (MFE) prior to the pipeline being cut into section and removed.

Appendix B.4.12 Environment – Loss of Habitat

The long-term, environmental impact on the seabed, of performing the decommissioning options, is considered in this criterion, with a focus on any material change to or loss of existing habitat.

Option 6, the full removal option and Option 1a were assessed as being the most attractive options against this criterion as neither option results in a loss of, or material change to the marine habitat as it currently stands.

Option 4 is assessed as less attractive as it involves the introduction of rock to mitigate the snag hazard associated with the cut ends of the pipeline left after the exposures are removed. The introduction of this rock is a material change to more than 50,000 m^2 of habitat where the existing sandbank is replaced with a hard substrate.

Option 2a is assessed as the least attractive option as almost 300,000 m^2 of existing sandbank is replaced with a hard substrate.

Appendix B.4.13 Environment – Overall

When combining the assessments conducted at sub-criterion level, the most attractive option, from an environmental perspective is Option 1a, followed by Option 6, then Option 4 and finally Option 2a.

The leave in-situ Option 1a was assessed as being the most attractive or equal most attractive option against five of the six environment sub-criteria. This relates to the limited work scope associated with the leave in-situ option and the lack of rock required in this option.

Option 6, was also assessed as attractive as no rock is required for this option making it attractive in the Other Consumptions and Loss of Habit criteria. It was also the most attractive in the Legacy Marine Impact criterion. The longer duration work scopes and the associated environmental impact from these, and the short-term impact on the seabed for the de-burial with an MFE offset these positives.

Option 4 was assessed as average across all criteria making is less attractive than other options overall. Option 2a was attractive in some areas, however, the extensive use of rock was enough to make this the least attractive overall.

Appendix B.4.14 Technical – Technical Feasibility

The Technical Feasibility criterion considers two key areas, Concept Maturity – where the novelty and track record of the proposed solution is considered, and Technical Risks, where inherent technical risks associated with the option are assessed.

The key area for consideration in terms of concept maturity was in the subsea cutting of this large diameter, concrete coated pipeline. It was noted during the assessment that cutting of 28" diameter concrete coated pipeline has been proven during the Viking decommissioning programme and as such, it is believed that the cutting of this 36" concrete pipeline is achievable.

The operations associated with the leave in-situ options where there is a minimal number of subsea cuts and recovery of short sections of pipeline, along with routine rock placement, were considered to present the lowest technical risk of the decommissioning options, making Option 1a and Option 2a the most attractive from a Technical perspective.

Option 4 was considered to have a higher potential for technical risk than the leave in-situ options due to the subsea Diamond Wire Cutting (DWC) operations numbering around 1,500 with this option versus only a few with the leave in-situ options.

Option 6 was considered to have higher potential for technical risk than Option 4 due to almost 6,000 subsea DWC operations and the additional technical risk posed by the requirement to achieve de-burial prior to performing these subsea cuts.

Overall, Option 1a and Option 2a are the most attractive from a Technical perspective, followed by Option 4 and then Option 6.

Appendix B.4.15 Societal – Fishing Industry

The impact of the decommissioning options upon the fishing industry is addressed in this criterion. Consideration is given to the operational and legacy impacts.

Prior to discussing the assessment, some context is provided from the Fishing Baseline Characterisation ref. [7]. The fishing activity in the area of this pipeline is considered low, ranging from 5 to 20 days per annum fishing effort and relates mainly to beam trawling fishing operations from the Netherlands. UK beam trawling is less represented and generally target brown shrimp closer to shore. Potting activity by fleets under 15 m in length and scallop dredging have been observed, although the majority of sightings have not been in the immediate vicinity of the pipeline.

Given the above, Option 1a is assessed as being the most attractive option due to it presenting the least disruption and disturbance to the fishing industry due to it having the smallest offshore work scope i.e. removing the pipeline end at LOGGS (within existing 500m zone) and at the tee locations only.

Option 2a and Option 4 are assessed as being less attractive than Option 1a but similar to each other. Whilst Option 2a results in disruption from performing rock placement and Option 4 results in disruption from removing the exposures, the impact on fishing operations is consider similar.

Option 6 is assessed as the least attractive option due to the extensive disruption to the fishing industry from the removal of the entire 118 km of the pipeline. It was noted that this option is also likely to have the most significant impact on near-shore fishing operations where static creel pots may need to be removed to allow the full removal of the pipeline.

It was noted that, given that fishing operations are already conducted in the area along and around this pipeline, and any infrastructure remaining on the seabed will be subject to an appropriate post-

decommissioning monitoring regime, the residual presence of the pipeline was not considered a limitation to fishing activity.

Appendix B.4.16 Societal – Communities / Amenities

The impact of the decommissioning options on communities and amenities are considered in this criterion.

The leave in-situ options are assessed as being the most attractive due to them returning limited quantities of material for processing onshore. Whilst this limits the amount of useful material, such as steel, being returned for recycling, it also results in the least amount of material being returned that will be directed to landfill, such as the concrete coating of the pipeline.

Option 4 was assessed as being less attractive than the leave in-situ options due to the amount of concrete that would be returned with the pipeline exposures that would be directed to, and take up limited capacity in, onshore landfill. Option 6 was considered the least attractive option as this returns the most concrete, destined for landfill, of all the options.

Appendix B.4.17 Societal – Overall

When combining the assessments conducted at sub-criterion level, the most attractive option, from a Societal perspective is Option 1a, followed by Option 2a, then Option 4 and finally Option 6.

The leave in-situ Option 1a was assessed as being the most attractive option against both the Fishing Industry and Communities / Amenities criteria.

Option 2a, was considered marginally less attractive due to the higher impact on the fishing industry from the greater offshore work scope. Option 4 was less attractive again due to the greater impact on the fishing industry and the increased quantity of concrete being directed to landfill. Finally, Option 6 was the least attractive option overall, due to having the highest impact on the fishing industry and the greatest quantity of concrete being directed to landfill.

Appendix B.4.18 Economic – Short-term Costs

The impact of the decommissioning options in terms of short-term costs to perform the option is considered in this criterion.

Option 1a was assessed as the most attractive option from a short-term costs perspective. This is due to it being the lowest cost option at approx. £2.5 million.

Option 2a was the next lowest cost at around £15 million, with Option 4 at £90 million and finally, Option 6 at over £350 million.

Appendix B.4.19 Economic – Long-term Costs

The impact of the decommissioning options in terms of long-term costs i.e. any on-going survey and monitoring costs and Fishing Legacy Trust-fund Company (FLTC) payments, are considered in this criterion.

Option 6 is considered the most attractive option against this criterion. This is due to there being no long-term costs associated with this full removal option.

All other options are considered equally less attractive as the long-term costs associated with them is largely similar.

Appendix B.4.20 Economic – Overall

Overall, the assessment is dominated by the short-term costs as the differentials are much greater than for the long-term costs.

Option 1a is the most attractive option from an Economic perspective, followed by Option 2a, then Option 4 and finally Option 6.

APPENDIX C **GROUP 2 – DETAILED EVALUATION RESULTS**

Appendix C.1 Group 2 Attributes Table

Group 2: Mattress Covered Short-umbilical & Associated Pipeline

- 80 m 8" gas production pipeline from NW Bell to Callisto with 8.1 m of exposure (PL1690)
- 80 m 3" methanol pipeline from NW Bell to Callisto with 8.1 m of exposure (PL1691)
- 80 m umbilical from NW Bell to Callisto with no exposure (UM3)

		Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)
		- Recover concrete mattresses & grout bags - Unbury entire umbilical and pipeline with MFE - Cut umbilical and pipeline into 20m lengths with hydraulic shears - Bundle cut sections and recover - Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover umbilical & pipeline ends - Cut 10m umbilical and pipeline ends with hydraulic shears - Recover (6 x 10m) end sections - Place rock to remediate cut ends - Post decommissioning survey | Seabed trawl sweep
1. Safety	1.1 Personnel Offshore	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 10.6 / 13,952 / 1.05E-03 Divers: 24 / 10.6 / 6,088 / 5.91E-03 Trawler: 5 / 4.0 / 240 / 1.80E-05 Survey Vessel: 44 / 8.1 / 4,282 / 3.21E-04 Total offshore hours: 24,563 hrs Total offshore PLL: 7.29E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 7.4 / 9,808 / 7.36E-04 Divers: 24 / 7.4 / 4,280 / 4.15E-03 Trawler: 5 / 4.0 / 240 / 1.80E-05 Survey Vessel: 44 / 8.1 / 4,282 / 3.21E-04 Total offshore hours: 18,609 hrs Total offshore PLL: 5.23E-03
		N	
	Summary	The assessment of the Personnel Offshore sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 1a as the risk profiles are largely similar due to the effort required to disconnect the short, 80 m line lengths, at both ends to allow the associated subsea structures to be recovered, being the same for both options. The additional effort required to remove these short lines fully (Option 6) is considered negligible in terms of additional personnl risk exposure. **Overall, both options are equally preferred from a risk to Offshore Personnel perspective.**	
1. Safety	1.2 Personnel Onshore	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 14.0 / 896 / 1.10E-04 Total onshore hours: 896 hrs Total onshore PLL: 1.10E-04	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06
		W	
	Summary	The assessment of the Personnel Onshore sub-criterion is as follows: Option 6 is assessed as being Weaker than Option 1a as the risk profile is around 14 times higher due to the increased material being returned to shore for processing with the full removal option. **Overall, Option 1a is most preferred from a risk to Onshore Personnel perspective.**	
1. Safety	1.3 Other Users	Vessel Days: DSV: 10.6 Divers: 10.6 Trawler: 4.0 Survey Vessel: 8.1 Total vessel days: 22.7 days Total Number of Transits:- 10	Vessel Days: DSV: 7.4 Divers: 7.4 Trawler: 4.0 Survey Vessel: 8.1 Total vessel days: 19.5 days Total Number of Transits:- 8
		N	
	Summary	The assessment of the Other Users sub-criterion is as follows: Both options are assessed as being Neutral to each other as, the number of vessel days and transits are largely similar for both options. **Overall, both options are equally preferred from a risk to Other Users perspective.**	
1. Safety	1.4 High Consequence Events	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the pipelines and umbilical. Number of Lifts: 7	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the pipeline ends only. Number of Lifts: 2
		N	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 1a as the potential for High Consequence Events is considered similar as the number of lifts are minimal in both options. **Overall, both options are equally preferred from a Residual Risk perspective.**	

		Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)
		- Recover concrete mattresses & grout bags - Unbury entire umbilical and pipeline with MFE - Cut umbilical and pipeline into 20m lengths with hydraulic shears - Bundle cut sections and recover - Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover umbilical & pipeline ends - Cut 10m umbilical and pipeline ends with hydraulic shears - Recover (6 x 10m) end sections - Place rock to remediate cut ends - Post decommissioning survey | Seabed trawl sweep
1. Safety	1.5 Residual Risk	As the umbilical and pipeline would be fully removed from the seabed, there would be no legacy risk associated with this full removal option.	With the exposed ends removed, the remaining umbilical and pipelines are buried. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated in the future as appropriate.
		S	
	Summary	The assessment of the Residual Risk sub-criterion is as follows: Option 6 is assessed as being Stronger than Option 1a as the full removal option removes the potential for snag hazard completely. **Overall, Option 6 is the most preferred from a Residual Risk perspective.**	
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): Survey Vessel - 0.1 days | CSV - 0.35 days | DSV - 4 days | Trawler - 1 day Tooling Noise: MFE for Unburial - 0.1 days | Dredging - 3 days | Hydraulic Shears - 0.63 days Operational Discharges: Negligible potential for hydrocarbon releases through cutting operations due to umbilical and pipeline cleaning being carried out to a regulatory acceptable level. Planned discharges will be included in operational permits. No cutting swarf as cutting performed by hydraulic shears. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore will be similar for both options.	Vessel Noise (days on-site): Survey Vessel - 0.1 days | DSV - 3 days | Trawler - 1 day Tooling Noise: Dredging - 1.5 days | Hydraulic Shears - 0.25 days Operational Discharges: Negligible potential for hydrocarbon releases through minimal cutting operations due to umbilical and pipeline cleaning being carried out to a regulatory acceptable level. Planned discharges will be included in operational permits. No cutting swarf as cutting performed by hydraulic shears. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore will be similar for both options.
		N	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 1a as the marine impacts from low vessel and equipment usage along short line lengths are minimal in both options. **Overall, both options are equally preferred from an Operational Marine Impact perspective.**	
2. Environmental	2.2 Legacy Marine Impact	There will be no legacy marine impacts from this full removal option.	The remaining umbilical and pipelines are buried to an appropriate depth. Any area of exposure of these lines will be removed with the ends. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried 8" and 3" diameter steel pipelines and the umbilical. Given the buried status of the pipelines and the umbilical that are cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.
		S	
	Summary	The assessment of the Legacy Marine Impact sub-criterion is as follows: Option 6 is assessed as being Stronger than Option 1a as the full removal option removes all material whilst there is material left in-situ with Option 1a. Whilst the legacy environmental impact is expected to be low for these options, there is an umbilical remaining and this is enough to express a small preference for the full removal option. **Overall, Option 6 is the most preferred from a Legacy Marine Impact perspective.**	
2. Environmental	2.3 Fuel Use & Atmospheric Emissions	Vessel Emissions (in tonnes): Fuel: 368 CO2e: 1,206 NOx: 21.86 SO2: 1.47 Vessel Energy Use: 15,822 GJ	Vessel Emissions (in tonnes): Fuel: 480 CO2e: 1,573 NOx: 28.51 SO2: 1.92 Vessel Energy Use: 20,638 GJ
		N	
	Summary	The assessment of the Fuel Use & Atmospheric Emissions sub-criterion is as follows: Both options are assessed as being Neutral to each other as the fuel used and emissions generated are similar for these options. **Overall, both options are equally preferred from a Fuel Use & Atmospheric Emissions perspective.**	

		Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)
		- Recover concrete mattresses & grout bags - Unbury entire umbilical and pipeline with MFE - Cut umbilical and pipeline into 20m lengths with hydraulic shears - Bundle cut sections and recover - Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover umbilical & pipeline ends - Cut 10m umbilical and pipeline ends with hydraulic shears - Recover (6 x 10m) end sections - Place rock to remediate cut ends - Post decommissioning survey | Seabed trawl sweep
2. Environmental	2.4 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 424 Remaining Material: N/A Total: 424 Rock: N/A	Material Emissions (CO2 in tonnes): Recovered Material: 4 Remaining Material: 361 Total: 365 Rock: 150 tonnes
		N	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: Both options are assessed as being Neutral to each other as, whilst there are differences between the quantities consumed between the options, the differential was considered insufficient to express a preference. **Overall, both options are equally preferred from an Other Consumptions perspective.**	
2. Environmental	2.5 Disturbance	There is a small area of short-term disturbance caused by the unburial and removal of these short lines.	There is limited short-term disturbance for this option from the small area of rock dump only.
		W	
	Summary	The assessment of the Seabed Disturbance (short-term impact) sub-criterion is as follows: Option 6 is assessed as being Weaker than Option 1a as there is a small area of seabed disturbance caused by the unburial of these short lines compared to the small area of low impact disturbance from rock placement at pipeline ends with Option 1a. **Overall, Option 1a is the most preferred from a Seabed Disturbance perspective.**	
2. Environmental	2.6 Loss of Habitat	Habitat Loss (Rockdump): N/A	Habitat Loss (Rockdump): 120 m2
		S	
	Summary	The assessment of the Loss of Habitat (legacy / long-term impact) sub-criterion is as follows: Option 6 is assessed as being Stronger than Option 1a as the rock dump in Option 1a changes the current seabed habitat and thus results in an area of habitat loss whereas there is no habitat loss in Option 6. Note: Habitat loss is from the replacement of the sandbank features with hard substrate (rock). **Overall, Option 6 is most preferred from a Loss of Habitat perspective.**	
3. Technical	3.1 Technical Feasibility	**Concept Maturity:** All operations to deliver this option are considered routine. (Score 3) **Technical Risks:** There is potential for mattresses to be degraded and additional risk associated with the unburial operations. (Score 2)	**Concept Maturity:** All operations to deliver this option are considered routine. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required and short duration of work scopes. (Score 3)
		W	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 6 is assessed as being Weaker than Option 1a due to the potential challenges associated with unburial of the lines and the recovery of the mattresses. **Overall, Option 1a is most preferred from a Technical Risk perspective.**	
4. Societal	4.1 Fishing	The operational impact of removing the umbilical and pipelines may disturb (displacement and restricted access) current fishing operations. The impact is low due to the very short lengths of umbilical and pipelines. (Score 3)	Small volume of rock covering installed over cut ends, profiled to be overtrawlable. Left in-situ infrastructure may lead to damage / loss of gear however, the lines are buried along their full length. (Score 3)
		N	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 1a as the impact of both these options on the fishing industry is negligible due to the decommissioning operations being conducted within the existing 500m exclssion zone. **Overall, both options are equally preferred from a Societal impact on Fishing perspective.**	

Appendix C.2 Group 2 Pairwise Comparison Matrices

1.1 Personnel Offshore	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	50.0%
Option 1a Do Nothing (Minor Intervention)	N	N	50.0%

1.2 Personnel Onshore	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	40.0%
Option 1a Do Nothing (Minor Intervention)	S	N	60.0%

1.3 Other Users	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	50.0%
Option 1a Do Nothing (Minor Intervention)	N	N	50.0%

1.4 High Consequence Events	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	50.0%
Option 1a Do Nothing (Minor Intervention)	N	N	50.0%

1.5 Residual Risk	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	60.0%
Option 1a Do Nothing (Minor Intervention)	W	N	40.0%

2.1 Operational Marine Impact	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	50.0%
Option 1a Do Nothing (Minor Intervention)	N	N	50.0%

2.2 Legacy Marine Impact	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	60.0%
Option 1a Do Nothing (Minor Intervention)	W	N	40.0%

2.3 Fuel Use & Atmospheric Emissions	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	50.0%
Option 1a Do Nothing (Minor Intervention)	N	N	50.0%

2.4 Other Consumptions	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	50.0%
Option 1a Do Nothing (Minor Intervention)	N	N	50.0%

2.5 Disturbance	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	40.0%
Option 1a Do Nothing (Minor Intervention)	S	N	60.0%

2.6 Loss of Habitat	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	60.0%
Option 1a Do Nothing (Minor Intervention)	W	N	40.0%

3.1 Technical Feasibility	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	40.0%
Option 1a Do Nothing (Minor Intervention)	S	N	60.0%

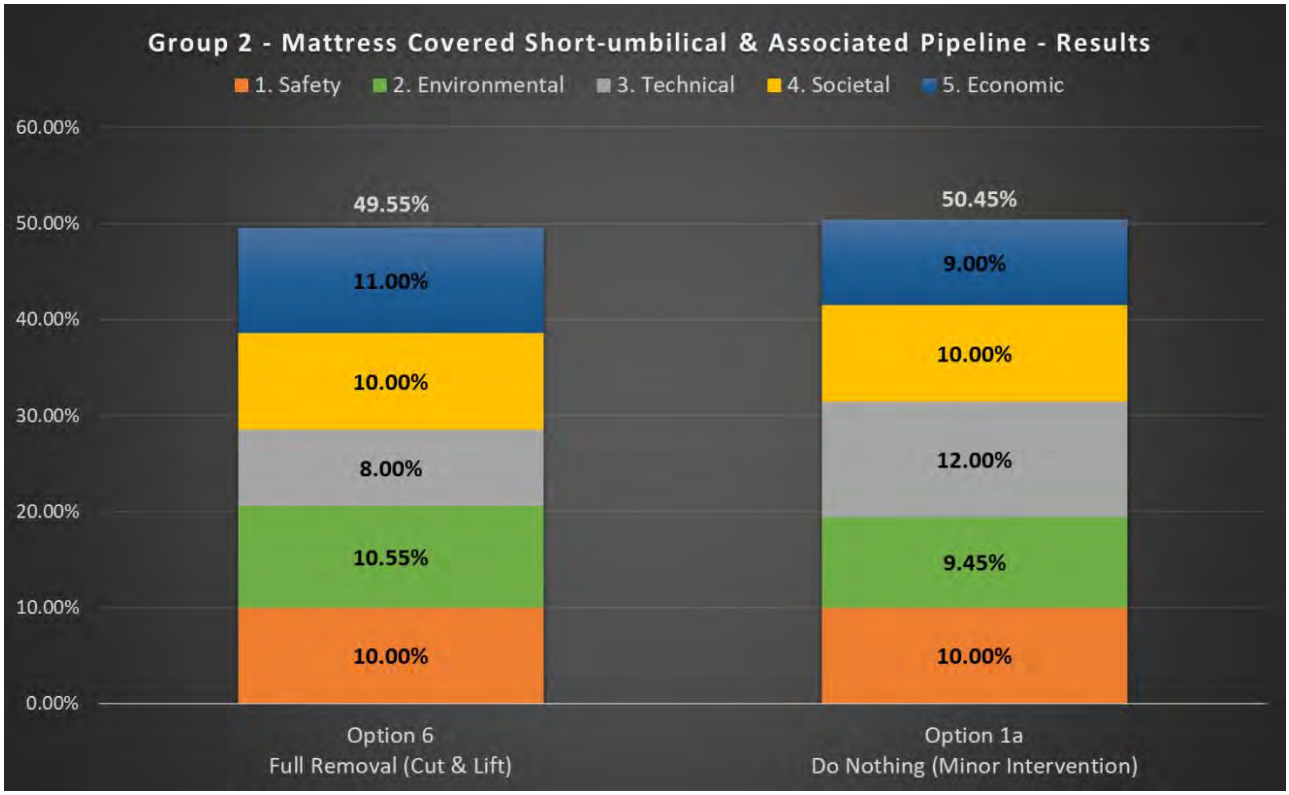
4.1 Fishing	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	50.0%
Option 1a Do Nothing (Minor Intervention)	N	N	50.0%

4.2 Communities / Ammenities	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	50.0%
Option 1a Do Nothing (Minor Intervention)	N	N	50.0%

5.1 Short-term Costs	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	50.0%
Option 1a Do Nothing (Minor Intervention)	N	N	50.0%

5.2 Long-term Costs	Option 6 Full Removal (Cut & Lift)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	60.0%
Option 1a Do Nothing (Minor Intervention)	W	N	40.0%

Appendix C.3 Group 2 Results Chart



Appendix C.4 Group 2 Detailed Evaluation Discussion

Appendix C.4.1 Safety – Personnel Offshore

The assessment of the options during the workshop indicated that the full removal and the leave in-situ options (Option 6 and Option 1a) were equally attractive against the Personnel Offshore sub-criterion. The full removal of these three, short (80 m) lines was shown to require a similar offshore duration to the removal and recovery of the six, short (10 m) line ends. As such, the options have similar risk exposures and no preference was indicated.

Appendix C.4.2 Safety – Personnel Onshore

The safety risk associated with the onshore personnel is related to the quantity of material being returned to shore for onshore handling, transportation and processing. Option 1a is the most attractive from a safety risk to onshore personnel perspective. This is due to there being 60 m of material returned for onshore handling, transportation and processing, versus 240 m of material for the full removal option. The differential in risk profile was considered sufficient to express a preference.

Appendix C.4.3 Safety – Other Users

The impact of performing the decommissioning options on other users of the sea from a safety perspective is related to the duration of operations, the number of vessels involved, and significantly, the number of transits to and from port to the decommissioning site.

The assessment of the decommissioning options against this criterion has indicated that both options have a similar, low impact on the safety of other users due to the low duration of operation and limited number of transits associated with the small offshore scope. Both options were assessed as equally attractive from a Safety – Other Users perspective.

Appendix C.4.4 Safety – High Consequence Events

The potential for High Consequence Events in both the full removal option and the leave in-situ option centred around the potential for a dropped object during the recovery of the cut sections of line from the seabed, through the water column to the vessel for return to shore. Whilst there are a few more lifts for Option 6 than Option 1a as there is more line being recovered, this differential was insufficient to express a preference. As such, both options are equally attractive from a High Consequence Events perspective.

Appendix C.4.5 Safety – Residual Risk

The residual risk relates to the potential for any legacy safety impact from the decommissioning options. Option 6 is assessed as the most attractive option from a residual safety risk perspective as it is a full removal option and therefore removes all residual risk. It should be noted however, that Option 1a leaves the lines in a fully buried state, and, as part of any partial removal or leave in-situ solution being selected, any potential hazards along the pipeline would be risk assessed and remediated and / or monitored to ensure that any emerging hazards do not develop into an unacceptable snagging risk to fishing operations. In addition, any infrastructure remaining on the seabed presents a low potential for future interaction ref. [7].

Appendix C.4.6 Safety – Overall

The options are assessed as being comparable from a safety to offshore personnel and safety to other users perspective. Option 1a is preferred from a safety to onshore personnel perspective and Option 6 is preferred from a residual risk perspective. Overall, there is little to separate these options from a safety perspective and as such, both are assessed as equally preferred.

Appendix C.4.7 Environment – Operational Marine Impact

The environmental impact on the marine environment from performing the decommissioning options was considered low across all options, with the impact considered similar enough to be unable to express a preference of one option over the other.

Appendix C.4.8 Environment – Legacy Marine Impact

The assessment indicated that Option 6, full removal of the lines, is the most attractive decommissioning option from a legacy marine environmental impact perspective. This is due to the full length of the lines being removed and thus eliminating any legacy impact from left in-situ materials such as degradation products or polymers.

Appendix C.4.9 Environment – Fuel Use & Atmospheric Emissions

The assessment indicated that, given the similar operational durations and numbers of vessels, there was little to choose between the options and both were equally attractive from a fuel use and atmospheric emissions perspective.

Appendix C.4.10 Environment – Other Consumptions

The assessment indicated that, given the minimal differences in quantity of material returned between the two options, and the requirement for only a small quantity of rock cover in Option 1a, both options have a similar environmental impact from an Other Consumption perspective. As such, both options were equally preferred.

Appendix C.4.11 Environment – Seabed Disturbance

The short-term environmental impact on the seabed from the de-burial of the lines using MFE under the full removal option was assessed as being greater than the leave in-situ option. As such, Option 1a, leave in-situ was assessed as being the most attractive option from a short-term seabed disturbance perspective.

Appendix C.4.12 Environment – Loss of Habitat

The long-term, environmental impact on the seabed, of performing the decommissioning options, is considered in this criterion, with a focus on any material change to or loss of existing habitat.

Option 6, the full removal option is assessed as being more attractive than Option 1a, the leave in-situ option as, whilst the area of rock cover is small at 120 m^2, the introduction of this rock is a material change to the habitat where the existing sandbank is replaced with a hard substrate.

Appendix C.4.13 Environment – Overall

When combining the assessments conducted at sub-criterion level, there is a small preference for Option 6 over Option 1a. The options were considered similar against the Operational Marine

Impact, Fuel Use & Atmospheric Emissions and Other Consumptions criteria. Option 6 was preferred against the Legacy Marine Impact and Loss of Habitat criteria with the preference for Option 1a being insufficient to overturn this preference.

Appendix C.4.14 Technical – Technical Feasibility

The assessment indicated that Option 1a is the most attractive option from a Technical Feasibility perspective. Whilst both options employ largely routine operations, the preference was due to the potential difficulties associated with removing the mattresses due to degradation and the challenges associated with the de-burial of the lines in Option 6, the full removal option.

Appendix C.4.15 Societal – Fishing Industry

Both options were equally preferred against the Societal – Fishing criterion. This is due to the limited disruption to fishing operations as both options have short operational durations. Additionally, any infrastructure left in-situ in Option 1a is adequately buried and is unlikely to impact commercial fishing operations. It is noted from the Fishing Baseline Characterisation ref. [7] that moderate to high fishing activity is recorded in the vicinity of the Jupiter area and is predominantly attributable to Dutch Beam Trawling.

Appendix C.4.16 Societal – Communities / Amenities

The impact of the decommissioning options on communities and amenities are assessed as similar as the quantities of material being returned are minimal in both cases with only small amounts of material being directed to landfill.

Appendix C.4.17 Societal – Overall

Given both options are equally preferred against both Societal sub-criteria, both options are equally preferred from an overall Societal perspective.

Appendix C.4.18 Economic – Short-term Costs

The assessment showed that both options were equally preferred from a short-term costs perspective as the cost of performing the decommissioning options are similar at £2.8 million for Option 6 and £2.2 million for Option 1a. This small difference in cost was considered insufficient to express a preference.

Appendix C.4.19 Economic – Long-term Costs

The full removal option has a zero legacy or long-term cost, whereas the leave in-situ option has a small legacy cost element from the on-going survey and monitoring costs and the FLTC payments. This was considered sufficient to express a preference for Option 6.

Appendix C.4.20 Economic – Overall

Overall, given the similar short-term costs for the two options, the economic assessment is driven by the requirement for on-going, long-term costs in Option 1a. This was considered sufficient for Option 6 to be the most attractive option from an Economic perspective.

APPENDIX D **GROUP 3A – DETAILED EVALUATION RESULTS**

Appendix D.1 Group 3a Attributes Table

Group 3a: Trenched Interfield Non-concrete Coated Piggyback Pipelines ≤ 16"

- 3.9 km 10" gas production pipeline with piggyback methanol pipeline from Tethys to ND-PR Tee with 17.9 m of exposure at pipeline ends (PL2234 & PL2235)
- 13.6 km 10" gas production pipeline with piggyback methanol pipeline from Mimas to Saturn with 7.1 m of exposure at pipeline ends (PL2236 & PL2237)
- 4.5 km 12" gas production pipeline with piggyback methanol pipeline from Europa to ZM to ZD Tee with 4.2 m of exposure at pipeline ends (PL1694 & PL1695)

		Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)
		- Unbury pipeline(s) with MFE - Mattress removal and recovery - Cut pipe into 20m sections | Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Unbury pipeline(s) with MFE - Mattress removal and recovery - Install recovery rigging for reverse reel and remove concrete mattresses - Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10m section with hydraulic shears (at each end) - Remove pipeline ends (6 x 10m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure at pipeline ends will be removed with ends
1. Safety	1.1 Personnel Offshore	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 55.9 / 73,814 / 5.54E-03 Divers: 18 / 55.9 / 24,157 / 2.34E-02 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 9.9 / 5,238 / 3.93E-04 CSV: 76 / 138.2 / 126,057 / 9.45E-03 Total offshore hours: 229,746 hrs Total offshore PLL: 3.89E-02	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 8.5 / 11,246 / 8.43E-04 Divers: 18 / 8.5 / 3,681 / 3.57E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 9.9 / 5,238 / 3.93E-04 CSV: 76 / 25.8 / 23,539 / 1.77E-03 Reel Vessel: 76 / 22.7 / 20,666 / 1.55E-03 Total offshore hours: 64,849 hrs Total offshore PLL: 8.16E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 7.7 / 10,138 / 7.60E-04 Divers: 18 / 7.7 / 3,318 / 3.22E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 9.9 / 5,238 / 3.93E-04 Total offshore hours: 19,173 hrs Total offshore PLL: 4.41E-03
		W **MW**	**W**	
	Summary	The assessment of the Personnel Offshore sub-criterion is as follows: Option 6 is assessed as being Weaker than Option 5 as the risk exposure for offshore personnel is 4 times higher for Option 6 due to the requirement for longer offshore duration and greater use of divers. Option 6 is assessed as being Much Weaker than Option 1a as the risk exposure for offshore personnel is almost 9 times higher for Option 6 due to the larger scope, greater use of divers and no requirement for a CSV in Option 1a. Option 5 is assessed as being Weaker than Option 1a as the risk exposure for offshore personnel is double for Option 5 due to the larger scope including CSV and Reel Vessel for usage Option 5. **Overall, Option 1a is most preferred from a risk to Offshore Personnel perspective.**		
1. Safety	1.2 Personnel Onshore	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 133.6 / 8,553 / 1.05E-03 Total onshore hours: 8,553 hrs Total onshore PLL: 1.05E-03	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 133.6 / 8,553 / 1.05E-03 Total onshore hours: 8,553 hrs Total onshore PLL: 1.05E-03	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06
		N **MW**	**MW**	
	Summary	The assessment of the Personnel Onshore sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as the risk exposure is the same due to the same quantity of material being returned to shore for processing. Option 6 is assessed as being Much Weaker than Option 1a due to the full pipeline lengths being returned to shore versus only 20 m in Option 1a. Option 5 is assessed as being Much Weaker than Option 1a due to the return of the full pipeline lengths being returned to shore versus only 20 m in Option 1a. **Overall, Option 1a is most preferred from a risk to Onshore Personnel perspective.**		

		Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)
		- Unbury pipeline(s) with MFE - Mattress removal and recovery - Cut pipe into 20m sections | Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Unbury pipeline(s) with MFE - Mattress removal and recovery - Install recovery rigging for reverse reel and remove concrete mattresses - Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10m section with hydraulic shears (at each end) - Remove pipeline ends (6 x 10m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure at pipeline ends will be removed with ends
1. Safety	1.3 Other Users	Vessel Days: DSV: 55.9 Divers: 55.9 Trawler: 8.0 Survey Vessel: 9.9 CSV: 138.2 Total vessel days: 212.1 days Total Number of Transits:- 24	Vessel Days: DSV: 8.5 Divers: 8.5 Trawler: 8.0 Survey Vessel: 9.9 CSV: 25.8 Reel Vessel: 22.7 Total vessel days: 74.9 days Total Number of Transits:- 16	Vessel Days: DSV: 7.7 Divers: 7.7 Trawler: 8.0 Survey Vessel: 9.9 Total vessel days: 25.6 days Total Number of Transits:- 8
		N | **N**	**N**	
	Summary	The assessment of the Other Users sub-criterion is as follows: All options are assessed as being Neutral to each other as, whilst there are more vessel days with Option 6, these are spread over a longer operational duration. Additionally, whilst there are differences in the number of vessel transits to / from the work site, the difference is not significant enough to indicate a differential impact on the safety of other users between the options. **Overall, all options are equally preferred from a risk to Other Users perspective.**		
1. Safety	1.4 High Consequence Events	The potential for High Consequence Events is assessed as Medium for this option. This is based on the number of both cutting and lifting operations that would need to take place to fully remove the pipeline. Number of Lifts: 275	The potential for High Consequence Events is assessed as Medium for this option. This relates to the on-deck cutting (for pipeline that is longer than reel capacity), lifting (for pipeline recovery for reeling) and integrity (whilst reverse reeling). Number of Lifts: 3	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the pipeline ends only. Number of Lifts: 3
		N | **MW**	**MW**	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as, whilst the causes of potential High Consequence Events are different between the two options i.e. lifting for Option 6 and deck handling for Option 5, the potential is considered similar for these options. Both Option 6 and Option 5 are assessed as being Much Weaker than Option 1a as there is potential for High Consequence Events versus very low potential in Option 1a due to limited lifting operations. **Overall, Option 1a is most preferred from a Residual Risk perspective.**		
1. Safety	1.5 Residual Risk	As the pipelines would be fully removed from the seabed, there would be no legacy risk associated with this full removal option.	As the pipelines would be fully removed from the seabed, there would be no legacy risk associated with this full removal option.	With the exposed ends removed, the remaining pipelines are trenched and buried in their current state with no reportable spans. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.
		N | **S**	**S**	
	Summary	The assessment of the Residual Risk sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as there is no residual risk associated with these full removal options. Both Option 6 and Option 5 are assessed as being Stronger than Option 1a as, the pipelines will remain in-situ for Option 1a where there is small potential for spans to develop. These pipelines however, do not exhibit historical spanning phenomenon and are considered stable in burial. **Overall, Option 6 and Option 5 are equally preferred from a Residual Risk perspective.**		

		Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)
		- Unbury pipeline(s) with MFE - Mattress removal and recovery - Cut pipe into 20m sections | Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Unbury pipeline(s) with MFE - Mattress removal and recovery - Install recovery rigging for reverse reel and remove concrete mattresses - Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10m section with hydraulic shears (at each end) - Remove pipeline ends (6 x 10m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure at pipeline ends will be removed with ends
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): Survey Vessel - 2 days | CSV - 127 days | DSV - 52 days | Trawler - 5 days Tooling Noise: MFE for Unburial - 9.16 days | Hydraulic Shears - 46 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipelines have been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. The level of cutting swarf would be significantly higher in this option compared to the other options. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and having the highest vessel usage will be the highest of the 3 options being evaluated.	Vessel Noise (days on-site): Survey Vessel - 2 days | CSV - 19 days | DSV - 4.5 days | Reel Vessel - 19 days | Trawler - 5 days Tooling Noise: MFE for Unburial - 9.16 days | Hydraulic Shears - 1 day Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipelines have been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf associated with this reverse reel option. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations. This option has less vessel usage than full removal (cut and lift) option and will therefore have a lower associated vessel discharges than full removal (cut & lift) option.	Vessel Noise (days on-site): Survey Vessel - 2 days | DSV - 3.67 days | Trawler - 5 days Tooling Noise: Dredging - 1.5 days | Hydraulic Shears - 1 day Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipelines have been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. Minimal cutting swarf associated with this option. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and having the least vessel usage this option has the lowest associated vessel discharges of the 3 options being evaluated.
		W	W	W
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 6 is assessed as being Weaker than both Option 5 and Option 1a as, whilst the actual environmental marine impacts from the increased noise, operational discharges (swarf) and vessel discharges is minimal for Option 6, cumulatively, they are significant enough to express a small preference for the other options. Option 5 is assessed as being Weaker than Option 1a as, whilst the actual environmental marine impacts from the increased noise and vessel discharges is minimal for Option 5, cumulatively, they are significant enough to express a small preference over Option 1a. **Overall, Option 1a is most preferred from an Operational Marine Impact perspective.**		
2. Environmental	2.2 Legacy Marine Impact	There will be no legacy marine impacts from this full removal option.	There will be no legacy marine impacts from this full removal option.	The remaining pipelines are trenched and buried to an appropriate depth. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried 10" and 12" diameter steel pipelines (gas production), and the piggybacked 3" steel pipelines (methanol), all of which have a polymer coating. Given the material being left in-situ and the pipeline having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low, albeit it with the limited potential (due to burial status) for polymer to enter the water column slowly over time.
		N	S	S
	Summary	The assessment of the Marine Impact (Discharges) sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as there is no legacy environmental impact associated with these full removal options. Each of the full removal options is assessed as being Stronger than Option 1a as, whilst the legacy environmental impact associated with Option 1a is expected to be low, the potential for legacy impacts remains. **Overall, Option 6 and Option 5 are equally preferred from a Marine Impact (Discharges) perspective.**		

		Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)
		- Unbury pipeline(s) with MFE - Mattress removal and recovery - Cut pipe into 20m sections | Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Unbury pipeline(s) with MFE - Mattress removal and recovery - Install recovery rigging for reverse reel and remove concrete mattresses - Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10m section with hydraulic shears (at each end) - Remove pipeline ends (6 x 10m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure at pipeline ends will be removed with ends
2. Environmental	2.3 Fuel Use & Atmospheric Emissions	Vessel Emissions (in tonnes): Fuel: 5,145 CO2e: 16,864 NOx: 305.61 SO2: 20.58 Vessel Energy Use: 221,232 GJ	Vessel Emissions (in tonnes): Fuel: 1,945 CO2e: 6,376 NOx: 115.55 SO2: 7.78 Vessel Energy Use: 83,644 GJ	Vessel Emissions (in tonnes): Fuel: 608 CO2e: 1,992 NOx: 36.10 SO2: 2.43 Vessel Energy Use: 26,130 GJ
		N **W**	**N**	
	Summary	The assessment of the Fuel Use & Atmospheric Emissions sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as, whilst there are differences in the fuel use and emissions, these are insufficient to express a preference. Option 6 is assessed as being Weaker than Option 1a as the differences in fuel use and emissions are just sufficient to express a small preference for Option 1a. Option 5 is assessed as being Neutral to Option 1a as, whilst there are differences in the fuel use and emissions, these are insufficient to express a preference. **Overall, Option 1a is most preferred from a Fuel Use & Atmospheric Emissions perspective.**		
2. Environmental	2.4 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 4,026 Remaining Material: N/A Total: 4,026 Rock: N/A	Material Emissions (CO2 in tonnes): Recovered Material: 4,026 Remaining Material: N/A Total: 4,026 Rock: N/A	Material Emissions (CO2 in tonnes): Recovered Material: 9 Remaining Material: 6,560 Total: 6,569 Rock: 150 tonnes
		N **N**	**N**	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: All options are assessed as being Neutral to each other as the consumptions associated with each option are largely similar, and the amount of rock consumed in the leave in-situ option is minor. **Overall, all options are equally preferred from an Other Consumptions perspective.**		
2. Environmental	2.5 Disturbance	Short Term Disturbance (MFE): 109,745 m2	Short Term Disturbance (MFE): 109,745 m2	There is limited short-term disturbance for this option from the small area of rock dump only.
		N **MW**	**MW**	
	Summary	The assessment of the Seabed Disturbance (short-term impact) sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as the seabed disturbance caused by the unburial of these pipelines is the same for both full removal options. Option 6 is assessed as being Much Weaker than Option 1a due to the large area of seabed disturbance from the unburial of the 22 km of pipelines using a Mass Flow Excavator compared to the small area of low impact disturbance with Option 1a. Option 5 is also assessed as being Much Weaker than Option 1a, again due to the large area of seabed disturbance from the unburial of the 22 km of pipelines using a Mass Flow Excavator compared to the small area of low impact disturbance with Option 1a. **Overall, Option 1a is most preferred from a Seabed Disturbance perspective.**		

		Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)
		- Unbury pipeline(s) with MFE - Mattress removal and recovery - Cut pipe into 20m sections | Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Unbury pipeline(s) with MFE - Mattress removal and recovery - Install recovery rigging for reverse reel and remove concrete mattresses - Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10m section with hydraulic shears (at each end) - Remove pipeline ends (6 x 10m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure at pipeline ends will be removed with ends
2. Environmental	2.6 Loss of Habitat	Habitat Loss (Rockdump): N/A	Habitat Loss (Rockdump): N/A	Habitat Loss (Rockdump): 120 m2
		N / **S**	**S**	
	Summary	The assessment of the Loss of Habitat (legacy / long-term impact) sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as there is no habitat loss associated with either of the full removal options. Both full removal options are assessed as being Stronger than Option 1a as, whilst the area of habitat loss associated with the rock dump in Option 1a is small, this will occur in a protected area and thus any loss of habitat is considered sufficient to express a preference. Note: Habitat loss is from the replacement of the sandbank features with hard substrate (rock). **Overall, Option 6 and Option 5 are equally preferred from a Loss of Habitat perspective.**		
3. Technical	3.1 Technical Feasibility	**Concept Maturity:** Cutting using hydraulic shears for non-concrete coated pipelines of this diameter is considered routine. (Score 3) **Technical Risks:** Risk to successfully achieving full removal by unburial and cut and lift of the pipeline due to the long durations involved and the potential for unforeseen unburial issues. (Score 2)	**Concept Maturity:** Whilst reverse reeling is proven for umbilicals and flexible flowlines, it is currently an unproven technical solution for rigid steel pipelines. (Score 2) **Technical Risks:** There are risks to successfully reverse reeling the piggybacked lines due to the potential for integrity failure of the lines during recovery and the challenges associated with decoupling the gas export and methanol import piggybacked lines on the reel vessel. (Score 1)	**Concept Maturity:** All operations to deliver this option are considered routine. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required and short duration of work scopes. (Score 3)
		MS / **W**	**MW**	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 6 is assessed as being Much Stronger than Option 5 due to reverse reeling being unproven for rigid steel pipelines and the associated technical risks from pipeline integrity and decoupling of the piggyback lines. Option 6 is assessed as being Weaker than Option 1a due to potential technical risks for achieving unburial of the pipelines to perform the cutting operations in Option 6 versus simple and routine operations. Option 5 is assessed as being Much Weaker than Option 1a due to unproven nature of the reverse reeling and the associated technical risks versus simple and routine operations in Option 1a. **Overall, Option 1a is most preferred from a Technical Risk perspective.**		
4. Societal	4.1 Fishing	Whilst this option provides clear seabed, the operational impact of removing the pipeline disturbs (displacement and restricted access) current fishing operations significantly. Fishing operations are currently conducted in the area of this pipeline. (Score 2)	Whilst this option provides clear seabed, the operational impact of removing the pipeline disturbs (displacement and restricted access) current fishing operations. Fishing operations are currently conducted in the area of this pipeline. (Score 2)	Short operation, small area of disturbance, introduction of a small volume of rock at pipeline ends will be profiled to be over-trawlable. (Score 2) Short term disturbance in localised areas. Infrastructure are unlikely to lead to damage / loss of gear because the pipelines demonstrate a history of burial along the full length. (Score 2)
		N / **W**	**W**	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as, whilst the disruption to fishing operations (disturbance and restricted access) in Option 6 is greater due to the longer durations, this it not significant enough to express a preference. Option 6 is assessed as being Weaker than Option 1a, due to the disruption to fishing operations being higher from the longer duration operations associated with Option 6, given that fishing operations are conducted in this area, the presence of the pipeline is not considered a limitation to the fishing activity. Option 5 is assessed as being Weaker than Option 1a, again due to the disruption to fishing operations being higher from the longer duration operations associated with Option 5. **Overall, Option 1a is most preferred from a Societal impact on Fishing perspective.**		

		Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)
		- Unbury pipeline(s) with MFE - Mattress removal and recovery - Cut pipe into 20m sections | Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Unbury pipeline(s) with MFE - Mattress removal and recovery - Install recovery rigging for reverse reel and remove concrete mattresses - Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10m section with hydraulic shears (at each end) - Remove pipeline ends (6 x 10m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure at pipeline ends will be removed with ends
4. Societal	4.2 Communities / Ammenities	Materials Returned: Steel: 3,063 tonnes (recyclable) Polymer: 50 tonnes (landfill) Mattress/Grout Bag: 899 tonnes (landfill) Whilst there are some societal benefits from returning recyclable steel, this is offset by returning polymer and mattress / grout bags, which will take up landfill capacity. (Score 2)	Materials Returned: Steel: 3,063 tonnes (recyclable) Polymer: 50 tonnes (landfill) Mattress/Grout Bag: 899 tonnes (landfill) Whilst there are some societal benefits from returning recyclable steel, this is offset by returning polymer and mattress / grout bags, which will take up landfill capacity. (Score 2)	Materials Returned: Steel: 9 tonnes (recyclable) Polymer: 1 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)
		N | **W**	**W**	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as the societal impacts are largely similar for these options. Both full removal options are assessed as being Weaker than Option 1a due to the larger quantity of material being returned that will go to landfill. **Overall, Option 1a is most preferred from a Societal impact on Other Users perspective.**		
5. Economic	5.1 Short-term Costs	£28.645 Million	£9.883 Million	£2.451 Million
		MW | **VMW**	**MW**	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 6 is assessed as being Much Weaker than Option 5 as the costs are almost three times higher. Option 6 is assessed as being Very Much Weaker as the costs are more than 10 times higher. Option 5 is assessed as being Much Weaker than Option 1a as the costs are around 4 times higher. **Overall, Option 1a is most preferred from a Short-term Cost perspective.**		
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million	Surveys: £0.297 Million FLTC: £0.066 Million Total Legacy Cost: £0.363 Million
		N | **S**	**S**	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 due to there being no long-term costs associated with either of these full removal options. Both the full removal options are assessed as being Stronger than Option 1a due to long-term costs for survey and monitoring of the left in-situ infrastructure and the contribution to the FLTC required for Option 1a. **Overall, Option 6 and Option 5 are equally preferred from a Long-term Cost perspective.**		

Appendix D.2 Group 3a Pairwise Comparison Matrices

1.1 Personnel Offshore	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	MW	18.6%
Option 5a Full Removal (Reverse Reel)	S	N	W	30.7%
Option 1a Do Nothing (Minor Intervention)	MS	S	N	50.7%

1.2 Personnel Onshore	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	MW	20.0%
Option 5a Full Removal (Reverse Reel)	N	N	MW	20.0%
Option 1a Do Nothing (Minor Intervention)	MS	MS	N	60.0%

1.3 Other Users	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	N	33.3%
Option 5a Full Removal (Reverse Reel)	N	N	N	33.3%
Option 1a Do Nothing (Minor Intervention)	N	N	N	33.3%

1.4 High Consequence Events	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	MW	20.0%
Option 5a Full Removal (Reverse Reel)	N	N	MW	20.0%
Option 1a Do Nothing (Minor Intervention)	MS	MS	N	60.0%

1.5 Residual Risk	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	S	38%
Option 5a Full Removal (Reverse Reel)	N	N	S	38%
Option 1a Do Nothing (Minor Intervention)	W	W	N	25%

2.1 Operational Marine Impact	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	24.8%
Option 5a Full Removal (Reverse Reel)	S	N	W	32.5%
Option 1a Do Nothing (Minor Intervention)	S	S	N	42.6%

2.2 Legacy Marine Impact	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	S	37.5%
Option 5a Full Removal (Reverse Reel)	N	N	S	37.5%
Option 1a Do Nothing (Minor Intervention)	W	W	N	25.0%

2.3 Fuel Use & Atmospheric Emissions	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	W	28.9%
Option 5a Full Removal (Reverse Reel)	N	N	N	33.1%
Option 1a Do Nothing (Minor Intervention)	S	N	N	37.9%

2.4 Other Consumptions	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	N	33.3%
Option 5a Full Removal (Reverse Reel)	N	N	N	33.3%
Option 1a Do Nothing (Minor Intervention)	N	N	N	33.3%

2.5 Disturbance	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	MW	20.0%
Option 5a Full Removal (Reverse Reel)	N	N	MW	20.0%
Option 1a Do Nothing (Minor Intervention)	MS	MS	N	60.0%

2.6 Loss of Habitat	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	S	38%
Option 5a Full Removal (Reverse Reel)	N	N	S	38%
Option 1a Do Nothing (Minor Intervention)	W	W	N	25%

3.1 Technical Feasibility	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MS	W	37.1%
Option 5a Full Removal (Reverse Reel)	MW	N	MW	14.2%
Option 1a Do Nothing (Minor Intervention)	S	MS	N	48.7%

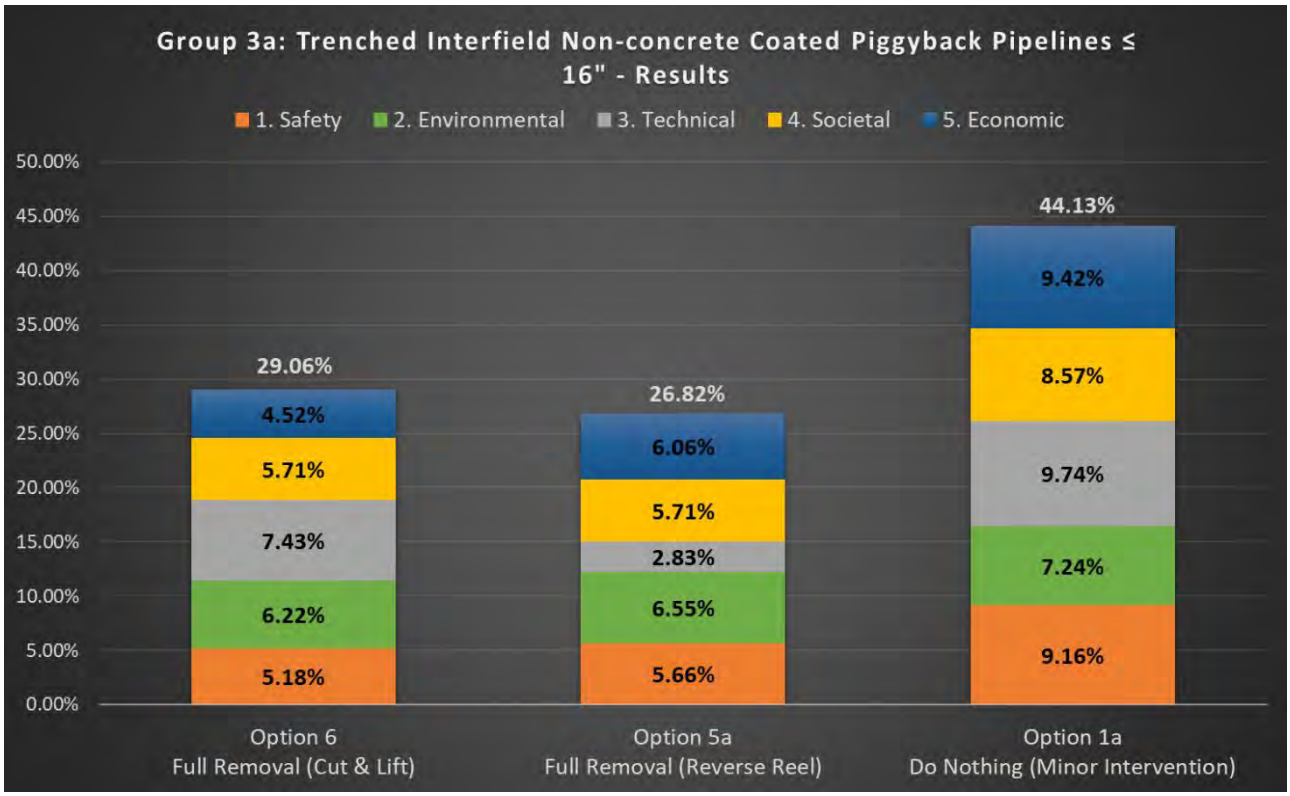
4.1 Fishing	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	W	28.6%
Option 5a Full Removal (Reverse Reel)	N	N	W	28.6%
Option 1a Do Nothing (Minor Intervention)	S	S	N	42.9%

4.2 Communities / Ammenities	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	W	28.6%
Option 5a Full Removal (Reverse Reel)	N	N	W	28.6%
Option 1a Do Nothing (Minor Intervention)	S	S	N	42.9%

5.1 Short-term Costs	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MW	VMW	7.7%
Option 5a Full Removal (Reverse Reel)	MS	N	MW	23.1%
Option 1a Do Nothing (Minor Intervention)	VMS	MS	N	69.2%

5.2 Long-term Costs	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 1a Do Nothing (Minor Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	S	37.5%
Option 5a Full Removal (Reverse Reel)	N	N	S	37.5%
Option 1a Do Nothing (Minor Intervention)	W	W	N	25.0%

Appendix D.3 Group 3a Results Chart



Appendix D.4 Group 3a Detailed Evaluation Discussion

Appendix D.4.1 Safety – Personnel Offshore

The assessment of the options indicated that the Option 1a, leave in-situ with minor intervention to be the most attractive against the Personnel Offshore sub-criterion. This was due to this option having the shortest offshore scope as it involves removing the pipeline ends only.

Option 5a, the full removal by reverse reeling option was assessed as less attractive than the leave in-situ option from a safety risk to offshore personnel perspective. This is due to increased safety risk from the greater offshore work scope associated with reverse reeling operations which requires additional vessels i.e. a Reverse Reel Vessel and a Construction Support Vessel (CSV).

Option 6, the full removal option by cut and lift was considered the least attractive option by some margin due to the much greater safety risk associated with the longer durations to cut the pipelines into short section and recover.

Appendix D.4.2 Safety – Personnel Onshore

As with previous assessments, the safety risk associated with the onshore personnel is related to the quantity of material being returned to shore for onshore handling, transportation and processing. Option 1a, leave in-situ returns the least material from 6 x 10 m pipeline end sections, making this the most attractive from a safety risk to onshore personnel perspective.

Option 5a and Option 6 both return significantly more material for onshore handling, transportation and processing, than the leave in-situ option as the full 22 km of pipelines are retuned in both cases. As such, the full removal options were assessed as being significantly less attractive than the leave in-situ option.

Appendix D.4.3 Safety – Other Users

The impact of performing the decommissioning options on other users of the sea from a safety perspective is related to the duration of operations, the number of vessels involved, and significantly, the number of transits to and from port to the decommissioning site.

The assessment of the decommissioning options against this criterion has indicated that all options have a similar, low impact on the safety of other users. This is justified on the basis that, whilst there is a significantly higher number of vessel days associated with the full removal options, these vessel days are spread over longer durations and thus the safety impact is similar. Additionally, whilst there are more transits associated with the full removal options, the differences in number of transits were not deemed sufficient to express a preference. As such, all three were assessed as equally attractive from a Safety – Other Users perspective.

Appendix D.4.4 Safety – High Consequence Events

The assessment indicated that the leave in-situ option would have the least exposure to potential for High Consequence Events and would therefore, be the most attractive against this criterion. This is due to the limited cut and lift operations to recover the pipeline end sections.

Option 5a and Option 6 were assessed as being significantly less attractive than the leave in-situ option due to the potential for High Consequence Events associated with the back of deck handling during the reverse reeling operations in Option 5a and the additional lifting operations associated with the recovery of the 22 km of pipeline in Option 6.

Appendix D.4.5 Safety – Residual Risk

The residual risk relates to the potential for any safety impact from the decommissioning options. As both Option 5a and Option 6 are full removal options, the residual risk is the lowest for these options and as such, they are equally preferred.

Option 1a was assessed as the least attractive option against this criterion due to the existing pipelines remaining in this option. There are no spans or exposures remaining with this option as they are removed with the pipeline ends. In addition, any partial removal or leave in-situ solution would have any potential hazards along the pipeline risk assessed and remediated and / or monitored to ensure that any emerging hazards do not develop into an unacceptable snagging risk to fishing operations.

Appendix D.4.6 Safety – Overall

When combining the assessments conducted at sub-criterion level, the most attractive option, from a safety perspective is Option 1a, with Option 5a and Option 6 being assessed as significantly less attractive.

Option 1a was the most attractive option against the Personnel Offshore, Personnel Onshore criteria due to the lowest risk exposure from the lowest offshore scope and lowest amount of material returned. It was also the most attractive against the High Consequence Events criterion due to limited lifting operations.

Option 1a was equally preferred against the safety impact to other users criterion and, whilst it was not as attractive from a residual risk perspective as the full removal options, the residual risk posed by the left in-situ pipelines was considered minimal as they are fully buried condition.

Appendix D.4.7 Environment – Operational Marine Impact

Option 1a, leave in-situ has the lowest impact in terms of marine noise as it has the lowest number of vessel days and the lowest amount of subsea cutting operations. It also has the lowest operational & vessel discharge impact for similar reasons.

Option 5a, Reverse Reel is less attractive than Option 1a as there is a greater impact in terms of marine noise from the increased number of vessels, their increased durations and the MFE de-burial operations. It is also likely to have higher vessel discharges from the increased number of vessels and longer durations.

Option 6, Cut & Lift is the least attractive option due to greater marine noise and vessel discharge impact than Option 5a from the longer durations of vessel operations. In addition, there is an additional environmental impact from the swarf generated by cutting these lines.

It is noted that, whilst there is a preference expressed for Option 1a over Option 5a and Option 6, the Operational Marine Impacts are considered low for all options.

Appendix D.4.8 Environment – Legacy Marine Impact

The assessment indicated that Option 6 and Option 5a, the full removal options were the equal most attractive options from a legacy marine environmental impact perspective. This is due to the full pipelines being removed and thus eliminating any legacy impact from degradation products or polymer.

Option 1a was the least attractive option due to the degradation products and polymer left in-situ with this option. No distinction was made between the impact of exposed pipeline versus buried or rock covered pipeline.

Appendix D.4.9 Environment – Fuel Use & Atmospheric Emissions

The assessment indicated that Option 1a, the leave in-situ option is the most attractive against the fuel use and atmospheric emissions criterion. This is due to this option having the least offshore work scope duration and hence vessel use and durations.

Option 5a has additional fuel use and atmospheric emissions over Option 1a due to the additional offshore work scope associated with reverse reeling the pipelines. Option 6 has additional impact again from the additional offshore scopes to cut and lift the pipelines.

It is noted that, whilst there is a preference expressed for Option 1a over Option 5a and Option 6, the Fuel Use & Atmospheric Emissions impacts are considered low for all options.

Appendix D.4.10 Environment – Other Consumptions

All options were assessed as having a similar environmental impact when considering the material returned versus material left in-situ perspective. The options were also considered comparable from a rock consumption perspective. This is due to Option 5a and Option 6 requiring no rock cover and Option 1a only requiring 150 tonnes, insufficient to express a preference from a consumption perspective.

Appendix D.4.11 Environment – Seabed Disturbance

The leave in-situ option is assessed as the most attractive decommissioning options here as the seabed impact is limited to the area relating to the sections of pipeline removal at the pipeline ends.

Option 5a ad Option 6 are assessed as significantly less attractive due to the short-term seabed disturbance associated with the de-burial operations using an MFE prior to the pipelines being reverse reeled or cut into sections and recovered.

Appendix D.4.12 Environment – Loss of Habitat

Option 5a and Option 6, the full removal options were assessed as being the most attractive options against this criterion as neither option results in a loss of, or material change to the marine habitat as it currently stands.

Option 1a is assessed as the least attractive option as almost whilst there is only a small area (120 m^2) of habitat affected by the introduction of rock cover to remediate the cut ends of the pipelines, this does present a material change to the habitat where existing sandbank is replaced with a hard substrate.

Appendix D.4.13 Environment – Overall

When combining the assessments conducted at sub-criterion level, the most attractive option, from an environmental perspective is Option 1a, followed by Option 5a and finally Option 6.

The leave in-situ Option 1a was assessed as being the most attractive or equal most attractive option against four of the six environment sub-criteria. This relates to the limited work scope associated with the leave in-situ and the limited short-term seabed disturbance associated with this option. It

was the least preferred option from a legacy and loss of habitat perspective due to the polymer coatings of these pipelines remaining in-situ, albeit fully trenched and buried, and the small area of altered habitat from the rock cover introduced at the cut pipeline ends.

Option 5a was less preferred due to the higher operational impact from the extended duration operations and the significant seabed disturbance from the de-burial using MFE operations.

Option 6 was less preferred than Option 5a due to the greater impact from the even longer duration associated with cutting the pipelines into sections for recovery.

Appendix D.4.14 Technical – Technical Feasibility

Option 1a was assessed as being the most attractive from a Technical Feasibility perspective due to the scope of removing the pipeline end sections and placing spot rock cover being considered routine subsea operations.

Option 6 was the next most attractive option with the technical risks associated with the longer durations to cut the pipelines into short sections and recover them, and successfully performing the de-burial operations to allow the subsea cutting to be performed being the main concerns.

Option 5a was the least attractive option by some margin due to concern surrounding the ability to reverse reel piggybacked lines and concerns around their integrity. The concept maturity was also assessed as being low as reverse reeling of rigid lines of this size is unproven.

Overall, Option 1a is the most attractive from a Technical perspective, followed by Option 6 and then Option 5a.

Appendix D.4.15 Societal – Fishing Industry

Prior to discussing the assessment, some context is provided from the Fishing Baseline Characterisation ref. [7]. The fishing activity around these pipelines ranges from very low in the northern extremity of the Mimas pipeline to higher fishing effort towards Tethys TN and Europa EZ. Activity is predominantly conducted by Dutch beam trawlers although potting has been observed around the MN and ND platforms.

Given the above, Option 1a is assessed as being the most attractive option due to it presenting the least disruption and disturbance to the fishing industry from it having the smallest offshore work scope i.e. removing the pipeline ends only.

Option 5a and Option 6 are equally less preferred due to the additional disruption to the fishing industry from the extended offshore operations to fully remove the pipelines. It was noted that, whilst the durations for the cut and lift full removal option (Option 6) are greater than for reverse reel (Option 5a), this was insufficient to express a preference for one option over the other.

Appendix D.4.16 Societal – Communities / Amenities

The leave in-situ option is assessed as being the most attractive due to it returning limited quantities of material for processing onshore. Whilst this limits the amount of useful material, such as steel, being returned for recycling, it also results in the least amount of material being returned that will be directed to landfill, such as the polymer coatings of the lines.

Option 5a and Option 6 were assessed as being less attractive than the leave in-situ option due to the amount of polymer (50 tonnes) that would be returned with the fully removed pipelines that would be directed to onshore landfill.

Appendix D.4.17 Societal – Overall

When combining the assessments conducted at sub-criterion level, the most attractive option, from a Societal perspective is Option 1a, followed by Option 5a and Option 6.

The leave in-situ Option 1a was assessed as being the most attractive option against both the Fishing Industry and Communities / Amenities criteria.

Option 5a and Option 6 were considered significantly less attractive due to the higher impact on the fishing industry from the greater offshore work scope and the impact from the returned polymer taking up limited onshore landfill capacity.

Appendix D.4.18 Economic – Short-term Costs

Option 1a was assessed as the most attractive option from a short-term costs perspective. This is due to it being the lowest cost option at approx. £2.4 million.

Option 5a was the next lowest cost at around £10 million, with the least attractive option being Option 6 at £28.6 million.

Appendix D.4.19 Economic – Long-term Costs

Option 5a and Option 6 are considered as the equal most attractive options against this criterion. This is due to there being no long-term costs associated with these full removal options.

Option 1a is assessed as less attractive due the long-term costs for surveying, monitoring and FLTC payments. It is noted that these long-term costs are small in comparison to the operation costs.

Appendix D.4.20 Economic – Overall

Overall, the assessment is dominated by the short-term costs as the differentials are much greater than for the long-term costs.

Option 1a is the most attractive option from an Economic perspective, followed by Option 5a and finally Option 6.

APPENDIX E **GROUP 3B – DETAILED EVALUATION RESULTS**

Appendix E.1 Group 3b Attributes Table

Group 3b: Trenched Interfield Non-concrete Coated Non-piggyback MEOH Pipeline ≤ 16"

- 118 km 4" non-concrete coated methanol pipeline from Theddlethorpe Gas Terminal to LOGGS PP platform with 338 m of exposure (PL0455)

		Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline with MFE - Cut pipe into 20m sections with hydraulic shears - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Unbury pipeline with MFE - Install recovery rigging for reverse reel - Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Cut all exposed sections into 20 m lengths with hydraulic shears - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - areas of exposure (338 m) will be removed by cut & lift	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Place rock at exposed ends & over exposed sections - Post decommissioning survey | Seabed trawl sweep - areas of exposure (338 m) will be rock dumped	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Place rock to remediate snag risk at exposed ends (inc. tee locations) - Post decommissioning survey | Seabed trawl sweep - areas of exposure will remain
1. Safety	1.1 Personnel Offshore	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 260.5 / 343,820 / 2.58E-02 Divers: 18 / 260.5 / 112,523 / 1.09E-01 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 18.0 / 9,478 / 7.11E-04 CSV: 76 / 625.3 / 570,246 / 4.28E-02 Total offshore hours: 1,036,547 hrs Total offshore PLL: 1.78E-01	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 4.5 / 5,940 / 4.46E-04 Divers: 18 / 4.5 / 1,944 / 1.89E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 18.0 / 9,478 / 7.11E-04 CSV: 76 / 107.0 / 97,602 / 7.32E-03 Reel Vessel: 76 / 63.8 / 58,213 / 4.37E-03 Total offshore hours: 173,657 hrs Total offshore PLL: 1.48E-02	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 6.7 / 8,844 / 6.63E-04 Divers: 18 / 6.7 / 2,894 / 2.81E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 18.0 / 9,478 / 7.11E-04 Rockdump Vessel: 20 / 7.0 / 1,675 / 1.26E-04 Total offshore hours: 23,371 hrs Total offshore PLL: 4.34E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 4.7 / 6,164 / 4.62E-04 Divers: 18 / 4.7 / 2,017 / 1.96E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 18.0 / 9,478 / 7.11E-04 Rockdump Vessel: 20 / 7.1 / 1,694 / 1.27E-04 Total offshore hours: 19,834 hrs Total offshore PLL: 3.29E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 4.8 / 6,283 / 4.71E-04 Divers: 18 / 4.8 / 2,056 / 1.99E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 18.0 / 9,478 / 7.11E-04 Total offshore hours: 18,297 hrs Total offshore PLL: 3.21E-03
		W MW MW MW	W W W	N N	N	
	Summary	The assessment of the Personnel Offshore sub-criterion is as follows: Option 6 is assessed as being Weaker than Option 5 as the risk exposure for offshore personnel is around 12 times higher for Option 6 due to the increased work scope durations for DSV and the additional use of divers. Option 6 is assessed as being Much Weaker than all other options as the risk exposure is around 50 times higher due to the larger scope and greater use of divers. Option 5 is assessed as being Weaker than all other options as the risk exposure is around 4 times higher due to the larger 118 km removal scope by reverse reel compared to 338 m of partial pipeline removal in Option 4 or rock placement activity over the reduced length. Option 4, Option 2a and Option 1a are assessed as being Neutral to each other as the risk exposures are largely similar due to the work durations and vessel usage being of similar magnitude. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a risk to Offshore Personnel perspective.**				
1. Safety	1.2 Personnel Onshore	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 136.0 / 8,704 / 1.07E-03 Total onshore hours: 8,704 hrs Total onshore PLL: 1.07E-03	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 136.0 / 8,704 / 1.07E-03 Total onshore hours: 8,704 hrs Total onshore PLL: 1.07E-03	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06
		N MW MW MW	MW MW MW	N N	N	
	Summary	The assessment of the Personnel Onshore sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as the risk exposure is the same due to the same quantity of material being returned to shore for processing. Option 6 is assessed as being Much Weaker than all other options as the risk exposure for onshore personnel is 135 times higher for Option 6 due to the full pipeline length of 118 km being recovered to shore compared to 338 m of pipeline in Option 4 and 10 m of pipeline in Option 2a and Option 1a. Option 5 is assessed as being Much Weaker than Option 4, Option 2a and Option 1a as the risk exposure for onshore personnel is 135 times higher for Option 5 due to the full pipeline length of 118 km being recovered to shore compared to 338 m of pipeline in Option 4 and 10 m of pipeline in Option 2a and Option 1a. Option 4, Option 2a and Option 1a are assessed as being Neutral to each other as the risk exposure associated with handling 338 m or 10 m of pipeline in these options is considered largely similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a risk to Onshore Personnel perspective.**				
1. Safety	1.3 Other Users	Vessel Days: DSV: 260.5 Divers: 260.5 Trawler: 8.0 Survey Vessel: 18.0 CSV: 625.3 Total vessel days: 911.7 days Total Number of Transits: 68	Vessel Days: DSV: 4.5 Divers: 4.5 Trawler: 8.0 Survey Vessel: 18.0 CSV: 107.0 Reel Vessel: 63.8 Total vessel days: 201.3 days Total Number of Transits: 22	Vessel Days: DSV: 6.7 Divers: 6.7 Trawler: 8.0 Survey Vessel: 18.0 Rockdump Vessel: 7.0 Total vessel days: 39.6 days Total Number of Transits: 10	Vessel Days: DSV: 4.7 Divers: 4.7 Trawler: 8.0 Survey Vessel: 18.0 Rockdump Vessel: 7.1 Total vessel days: 37.7 days Total Number of Transits: 10	Vessel Days: DSV: 4.8 Divers: 4.8 Trawler: 8.0 Survey Vessel: 18.0 Total vessel days: 30.7 days Total Number of Transits: 8
		W W W W	N N N	N N	N	
	Summary	The assessment of the Other Users sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options. There are more vessel days for Option 6 than any of the other options that are spread over a longer operational duration hence weakening the impact of Option 6 on other users of the sea at any one time. There are however, a higher number of vessel transits to / from the work site (68 versus 22 / 10 / 8) which provide a small increase in the potential safety impact on other users for Option 6 due to the increased exposure. All other options are assessed as being Neutral to each other as, whilst there are differences in the number of vessel days and transits, these differences are insufficient to result in a material difference in the safety impact on other users. **Overall, Option 5, Option 4, Option 2a and Option 1a are equally preferred from a risk to Other Users perspective.**				

NOTE: Pipeline Numbers in Appendix with a "0" after the "PL" are equivalent to those in the main body of the document with the same numbering but that do not contain the "0" in front of the "PL". The Main body of the text utilises the correct reference for the pipeline number.

		Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline with MFE - Cut pipe into 20m sections with hydraulic shears - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Unbury pipeline with MFE - Install recovery rigging for reverse reel - Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Cut all exposed sections into 20 m lengths with hydraulic shears - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - areas of exposure (338 m) will be removed by cut & lift	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Place rock at exposed ends & over exposed sections - Post decommissioning survey | Seabed trawl sweep - areas of exposure (338 m) will be rock dumped	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Place rock to remediate snag risk at exposed ends (inc. tee locations) - Post decommissioning survey | Seabed trawl sweep - areas of exposure will remain
1. Safety	1.4 High Consequence Events	The potential for High Consequence Events is assessed as Medium for this option. This is based on the number of both cutting and lifting operations that would need to take place to fully remove the pipeline. It should be noted that there are number of pipeline crossings within this group and it has been assumed that all 3rd party pipelines will be hydrocarbon live. Number of Lifts: 740	The potential for High Consequence Events is assessed as Medium for this option. This relates to the on-deck cutting (for pipeline that is longer than reel capacity), lifting (for pipeline recovery for reeling) and integrity (whilst reverse reeling). Number of Lifts: 2	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to remove the pipeline exposures and pipeline ends. Number of Lifts: 17	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the pipeline ends only. Number of Lifts: 1	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the pipeline ends only. Number of Lifts: 1
		N W W W	W W W	N N	N	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as, whilst the causes of potential High Consequence Events are different between the two options i.e. due to lots of lifting for Option 6 or deck handling for Option 5, the potential is considered similar for these options. Option 6 is assessed as being Weaker than all other options as there is a high number of lifting operations for onboarding the bundled, cut sections of pipeline which presents the potential for a dropped object hazard, compared to a lower number of lifts for Option 4 and just the one lift for Option 2a and Option 1a. Option 5 is assessed as being Weaker than Option 4, Option 2a and Option 1a as there is potential for a High Consequence Event from the deck handling during reverse reel operations versus the low potential from the limited lifting operations associated with Option 4, Option 2a and Option 1a. Option 4, Option 2a and Option 1a are assessed as being Neutral to each other as the potential for High Consequence Events is considered similar for these options due to limited lifting operations in each option. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a High Consequence Events perspective.**				
1. Safety	1.5 Residual Risk	As the pipeline would be fully removed from the seabed, there would be no legacy risk associated with this full removal option.	As the pipeline would be fully removed from the seabed, there would be no legacy risk associated with this full removal option.	The majority of the 118 km methanol 4" pipeline is trenched and buried to an appropriate depth. There is 338 m of exposed pipeline which will be removed with the potential snag hazard associated with the cut ends mitigated by spot rock placement designed to be overtrawlable. A post-decommissioning trawl sweep will be conducted. As such, the potential snag hazard post-decommissioning activities is adequately mitigated and lower than for the pipeline in its current state of exposure. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.	The majority of the 118 km methanol 4" pipeline is trenched and buried to an appropriate depth. There is 338 m of exposed pipeline which will be rock dumped to mitigate the potential snag hazard associated with these exposed areas. The areas of rock placement will be designed to be overtrawlable and a post-decommissioning trawl sweep will be conducted. As such, the potential snag hazard post-decommissioning activities is adequately mitigated and lower than for the pipeline in its current state of exposure. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.	The majority of the 118 km methanol 4" pipeline is trenched and buried to an appropriate depth. There is 338 m of exposed pipeline which will remain in its current state with no reportable spans. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.
		N S S MS	S S MS	N S	S	
	Summary	The assessment of the Residual Risk sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as there is no residual risk associated with either of these full removal options. Option 6 is assessed as being Stronger than both Option 4 and Option 2a due to there being no residual risk associated with the full removal option versus potential for a snag hazard in Option 4 and Option 2a, albeit these potential snag hazards are mitigated by rock placement. Option 6 is assessed as Much Stronger than Option 1a as there is no residual risk associated with the full removal option versus potential for a snag hazard in Option 1a. Note: existing potential for snag hazard in Option 1a will be monitored to ensure that any emerging risks are managed as appropriate. Option 5 is assessed as being Stronger than both Option 4 and Option 2a due to there being no residual risk associated with the full removal option versus potential for a snag hazard from pipeline exposure in Option 4 and Option 2a, albeit these potential snag hazards are mitigated by rock. Option 6 is assessed as Much Stronger than Option 1a as there is no residual risk associated with the full removal option versus potential for a snag hazard in Option 1a, which, whilst no higher than it is currently, the potential snag hazard is not further mitigated in this option. It is however, monitored to ensure it does not increase. Option 4 is assessed as being Neutral to Option 2a as the residual risk is similar due to the potential snag hazard being mitigated by rock dump in both cases. Option 4 is assessed as being Stronger than Option 1a due to the remaining potential for a snag hazard to emerge from the exposed pipeline in Option 1a (albeit this option includes an appropriate monitoring programme to identify and manage emerging hazards). Option 2a is assessed as being Stronger than Option 1a due to the remaining potential for a snag hazard to emerge from the exposed pipeline in Option 1a (albeit this option includes an appropriate monitoring programme to identify and manage emerging hazards). **Overall, Option 6 and Option 5 are equally preferred from a Residual Risk perspective.**				
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): Survey Vessel - 10 days | CSV - 614 days | DSV - 249 days | Trawler - 5 days Tooling Noise: MFE for Unburial - 49.33 days | Hydraulic Shears - 247 days Operational Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as cutting performed by hydraulic shears. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore will be highest for this option.	Vessel Noise (days on-site): Survey Vessel - 10 days | CSV - 99 days | DSV - 0.5 days | Reel Vessel - 60 days | Trawler - 5 days Tooling Noise: MFE for Unburial - 49.33 days | Hydraulic Shears - 0.17 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as (limited) cutting performed by hydraulic shears. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore will be less for this option than Option 6 but greater than for all other options.	Vessel Noise (days on-site): Survey Vessel - 10 days | DSV - 2.7 days | Rock Dump Vessel - 4 | Trawler - 5 days Tooling Noise: Dredging - 0.25 days | Hydraulic Shears - 0.17 days | Rock Dumping - 2.48 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as (limited) cutting performed by hydraulic shears. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore will be less for this option than Option 6 and Option 5 but similar for all other options.	Vessel Noise (days on-site): Survey Vessel - 10 days | DSV - 0.67 days | Rock Dump Vessel - 4 | Trawler - 5 days Tooling Noise: Dredging - 0.25 days | Hydraulic Shears - 0.17 days | Rock Dumping - 2.56 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as (limited) cutting performed by hydraulic shears. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore will be less for this option than Option 6 and Option 5 but similar for all other options.	Vessel Noise (days on-site): Survey Vessel - 10 days | DSV - 0.75 day | Trawler - 5 days Tooling Noise: Dredging - 0.25 days | Hydraulic Shears - 0.17 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits.. No cutting swarf as (limited) cutting performed by hydraulic shears . Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore will be less for this option than Option 6 and Option 5 but similar for all other options.
		W MW MW MW	W W W	N N	N	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 6 is assessed as being Weaker than Option 5 due to the vessel discharges associated with the longer duration of operations for Option 6. Option 6 is assessed as Much Weaker than all other options due to a combination of the greater vessel discharges from the much longer durations and the noise from the unburial operations. Option 5 is assessed as being Weaker than Option 4, Option 2a and Option 1a due to a the greater vessel discharges from the longer durations and the noise from the unburial operations. All remaining options are assessed being Neutral to each other as marine impact from these options are largely similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from an Operational Marine Impact perspective.**				

		Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline with MFE - Cut pipe into 20m sections with hydraulic shears - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Unbury pipeline with MFE - Install recovery rigging for reverse reel - Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Cut all exposed sections into 20 m lengths with hydraulic shears - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - areas of exposure (338 m) will be removed by cut & lift	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Place rock at exposed ends & over exposed sections - Post decommissioning survey | Seabed trawl sweep - areas of exposure (338 m) will be rock dumped	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Place rock to remediate snag risk at exposed ends (inc. tee locations) - Post decommissioning survey | Seabed trawl sweep - areas of exposure will remain
2. Environmental	2.2 Legacy Marine Impact	There will be no legacy marine impacts from this full removal option.	There will be no legacy marine impacts from this full removal option.	The majority of the 118 km pipeline is trenched and buried to an appropriate depth. There is 338 m of exposed pipeline which will be removed with the cut ends rock dumped. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried 4" diameter steel pipeline with a polymer coating. Given the buried status of the material being left in-situ and the pipeline having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.	The majority of the 118 km pipeline is trenched and buried to an appropriate depth. There is 338 m of exposed pipeline which will be rock dumped. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried 4" diameter steel pipeline with a polymer coating. Given the buried status of the material being left in-situ and the pipeline having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.	The majority of the 118 km pipeline is trenched and buried to an appropriate depth. There is 338 m of exposed pipeline which will be left as-is. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried 4" diameter steel pipeline with a polymer coating. Given the buried status of the material being left in-situ and the pipeline having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.
		N S S S	S S S	N N	N	
	Summary	The assessment of the Legacy Marine Impact sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as there is no legacy marine impact associated with either of the full removal options. Option 6 is assessed as being Stronger than all other options as this full removal option removes all material whilst the other options leave similar quantities and types of material in-situ. Whilst the legacy environmental impact is expected to be low for these options, there is polymer remaining and this is enough to express a small preference for the full removal option. Option 5 is assessed as being Stronger than Option 4, Option 2a and Option 1a as this full removal option removes all material whilst the other options leave similar quantities and types of material in-situ. All other options are assessed as Neutral to each other as the quantities and types of material and thus the legacy environmental impact is expected to be similar for these options. **Overall, Option 5 and Option 6 are equally preferred from a Legacy Marine Impact perspective.**				
2. Environmental	2.3 Fuel Use & Atmospheric Emissions	Vessel Emissions (in tonnes): Fuel: 23,030 CO2e: 75,488 NOx: 1,367.98 SO2: 92.12 Vessel Energy Use: 990,291 GJ	Vessel Emissions (in tonnes): Fuel: 6,057 CO2e: 19,853 NOx: 359.77 SO2: 24.23 Vessel Energy Use: 260,440 GJ	Vessel Emissions (in tonnes): Fuel: 1,191 CO2e: 3,902 NOx: 70.72 SO2: 4.76 Vessel Energy Use: 51,195 GJ	Vessel Emissions (in tonnes): Fuel: 1,153 CO2e: 3,779 NOx: 68.49 SO2: 4.61 Vessel Energy Use: 49,580 GJ	Vessel Emissions (in tonnes): Fuel: 1,070 CO2e: 3,506 NOx: 63.54 SO2: 4.28 Vessel Energy Use: 45,998 GJ
		W MW MW MW	W W W	N N	N	
	Summary	The assessment of the Fuel Use & Atmospheric Emissions sub-criterion is as follows: Option 6 is assessed as Weaker than Option 5 as the fuel used and the emissions generated for this option are around four times higher. Option 6 is assessed as being Much Weaker than all other options as the fuel used and emissions generated by the vessels over and expended period to remove the 118 km 4" pipeline for this option are much higher than for the other options where there is significantly lower vessel usage. Option 5 is assessed as Weaker than Option 4, Option 2a and Option 1a as the fuel used and the emissions generated for this option are around five times higher due to the higher vessel usage for reverse reel operations along the full pipeline length compared to the other options requiring significantly less vessel usage to remediate minimal pipeline lengths. All other options are assessed as Neutral to each other as the fuel used and emissions generated are similar for these options. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Fuel Use & Atmospheric Emissions perspective.**				
2. Environmental	2.4 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 4,052 Remaining Material: N/A Total: 4,052 Rock: N/A	Material Emissions (CO2 in tonnes): Recovered Material: 4,052 Remaining Material: N/A Total: 4,052 Rock: N/A	Material Emissions (CO2 in tonnes): Recovered Material: 12 Remaining Material: 7,579 Total: 7,591 Rock: 1,400 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 1 Remaining Material: 7,600 Total: 7,601 Rock: 3,430 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 1 Remaining Material: 7,600 Total: 7,601 Rock: 25 tonnes
		N S S N	S S N	N W	W	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as the impact in terms of consumptions are the same for these options. Option 6 is assessed as being Stronger than Option 4 and Option 2a as there is no requirement for rock in Option 6 versus a requirement for rock placement in Option 4 and Option 2a. Option 6 is assessed as being Neutral to Option 1a as whilst there is a small amount of rock required in Option 1a, this was insufficient to express a preference from a consumption perspective. Note: the differences between the options in tonnage of CO2 associated with processing returned material and / or to produce replacement material left in-situ were considered insignificant in terms of this assessment. As such, the preference judgements were driven by the quantity of rock consumption for each option. Option 5 is assessed as being Stronger than Option 4 and Option 2a as there is no requirement for rock in Option 5 versus a requirement for rock in Option 4 and Option 2a. Option 5 is assessed as being Neutral to Option 1a as whilst there is a small amount of rock required in Option 1a, this was insufficient to express a preference from a consumption perspective. Option 4 is assessed as being Neutral to Option 2a as whilst there are differences between the quantity of rock consumed between the options, the differential was considered insufficient to express a preference. Option 4 is assessed as being Weaker than Option 1a as there is a requirement for a reasonable amount rock versus a very small amount of rock. Option 2a is assessed as being Weaker than Option 1a as there is much more rock required in Option 2a. **Overall, Option 6, Option 5 and Option 1a are equally preferred from an Other Consumptions perspective.**				
2. Environmental	2.5 Disturbance	Short Term Disturbance (MFE): 590,220 m2 Full pipeline to be unburied using MFE.	Short Term Disturbance (MFE): 590,220 m2 Full pipeline to be unburied using MFE.	There is a small amount of short-term disturbance resulting from removing the 338 m of exposure along this line and rock dumping the cut ends. This is considered insignificant.	There is limited short-term disturbance from rock dumping the 338 m of exposed pipeline for this option.	There is limited short-term disturbance for this option from the small area of rock placed on pipeline ends only.
		N MW MW MW	MW MW MW	N N	N	
	Summary	The assessment of the Seabed Disturbance (short-term impact) sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as the disturbance caused by the unburial of this line is the same for both full removal options. Option 6 is assessed as being Much Weaker than all other options due to the large area of seabed disturbance from the unburial of the 118 km of pipeline using a Mass Flow Excavator when compared to the small area of low impact disturbance with the other options. Option 5 is also assessed as being Much Weaker than Option 4, Option 2a and Option 1a due to the large area of seabed disturbance from the unburial of the 118 km of pipeline using a Mass Flow Excavator compared to the small area of low impact disturbance with the other options. Option 4, Option 2a and Option 1a are all assessed as being Neutral to each other as the seabed disturbance is considered negligible and similar across these options. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Seabed Disturbance perspective.**				

		Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline with MFE - Cut pipe into 20m sections with hydraulic shears - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Unbury pipeline with MFE - Install recovery rigging for reverse reel - Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Cut all exposed sections into 20 m lengths with hydraulic shears - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - areas of exposure (338 m) will be removed by cut & lift	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Place rock at exposed ends & over exposed sections - Post decommissioning survey | Seabed trawl sweep - areas of exposure (338 m) will be rock dumped	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Place rock to remediate snag risk at exposed ends (inc. tee locations) - Post decommissioning survey | Seabed trawl sweep - areas of exposure will remain
2. Environmental	2.6 Loss of Habitat	Habitat Loss (Rockdump): N/A	Habitat Loss (Rockdump): N/A	Habitat Loss (Rockdump): 1,120 m2	Habitat Loss (Rockdump): 3,420 m2	Habitat Loss (Rockdump): 40 m2
		N S S S	S S S	S W	W	
	Summary	The assessment of the Loss of Habitat (legacy / long-term impact) sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as there is no loss of habitat associated with either of these full removal options. Option 6 is assessed as being Stronger than all other options as the rock placement in each of these options changes the current seabed habitat and thus results in an area of habitat loss whereas there is no habitat loss in Option 6. Option 5 is assessed as being Stronger than all other options as the rock dump in each of these options changes the current seabed habitat and thus results in an area of habitat loss whereas there is no habitat loss in Option 5. Option 4 is assessed as being Stronger than Option 2a as the area of habitat loss in Option 2a is greater than Option 4. Option 4 is assessed as being Weaker than Option 1a as area of habitat loss in Option 1a is much smaller than Option 4. Option 2a is assessed as being Weaker than Option 1a as the area of habitat loss in Option 2a is much greater than Option 1a. Note: Habitat loss is from the replacement of the sandbank features with hard substrate (rock). **Overall, Option 6 and Option 5 are equally preferred from a Loss of Habitat perspective.**				
3. Technical	3.1 Technical Feasibility	**Concept Maturity:** Cutting using hydraulic shears for pipelines of this diameter is considered routine. (Score 3) **Technical Risks:** Risk to successfully achieving full removal by unburial and cut and lift of the pipeline due to the long durations involved and the potential for unforeseen unburial issues, particularly in the near-shore tidal zone. (Score 2)	**Concept Maturity:** Whilst reverse reeling is proven for umbilicals and flexible flowlines, it is currently an unproven technical solution for rigid steel pipelines. (Score 2) **Technical Risks:** There are risks to successfully reverse reeling this 4" line due to the potential for integrity failure of the line during recovery and the challenges associated with having to load the recovered line onto multiple reels due to length. (Score 1)	**Concept Maturity:** Cutting using hydraulic shears for pipelines of this diameter is considered routine. (Score 3) **Technical Risks:** Limited technical risks from cutting and removal of pipeline sections as the areas being cut and removed are already exposed therefore no unburial risk. (Score 3)	**Concept Maturity:** All operations to deliver this option are considered routine. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required and short duration of work scopes. (Score 3)	**Concept Maturity:** All operations to deliver this option are considered routine. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required and short duration of work scopes. (Score 3)
		MS W W W	MW MW MW	N N	N	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 6 is assessed as being Much Stronger than Option 5 due to reverse reeling being unproven for rigid steel pipelines and the associated technical risks from pipeline integrity and loading recovered line onto multiple reels due to length. Option 6 is assessed as being Weaker than all other options due to potential technical risks for achieving unburial of the full pipeline length to perform the cutting operations in Option 6 and the technical risk associated with the duration of the operations, versus simple and routine operations for the other options. Option 5 is assessed as being Much Weaker than Option 4, Option 2a and Option 1a due to unproven nature of the reverse reeling of steel pipelines and the associated technical risks versus simple and routine operations in the other options. Option 4, Option 2a and Option 1a are assessed as being Neutral to each other as the concept maturity and technical risks are considered largely similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Technical Risk perspective.**				
4. Societal	4.1 Fishing	Whilst this option provides clear seabed, the operational impact of removing the pipeline disturbs (displacement and restricted access) current fishing operations. Fishing operations are conducted in the area of this pipeline which would be curbed due to interference of transiting vessels on fishing operations. (Score 2)	Whilst this option provides clear seabed, the operational impact of removing the pipeline disturbs (displacement and restricted access) current fishing operations. Fishing operations are conducted in the area of this pipeline which would be curbed due to interference of transiting vessels on fishing operations. (Score 2)	Short term disturbance in localised areas. Left in-situ infrastructure may lead to snagging in time. Fishing operations are conducted in the area of this pipeline. (Score 2)	Short term disturbance in localised areas. Left in-situ infrastructure may lead to snagging in time. Fishing operations are conducted in the area of this pipeline. (Score 2)	Short term disturbance in localised areas. Left in-situ infrastructure may lead to snagging in time. Fishing operations are conducted in the area of this pipeline. (Score 2)
		N MW MW MW	MW MW MW	N N	N	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as the impact on the fishing industry both in performing the removal and post-removal are similar for these full removal options. Option 6 is assessed as being Much Weaker than Option 4, Option 2a and Option 1a due to the additional disruption caused to fishing operations, particularly to near-shore fishing operations where creel pots may require to be removed during full removal operations. Note: given that fishing operations are already conducted in this area, presence of the pipeline is not considered a limitation to fishing activity. Option 5 is assessed as being Much Weaker than Option 4, Option 2a and Option 1a due to the additional disruption caused to fishing operations, particularly to near-shore fishing operations (creel pots), from the full removal of the full pipeline length compared to the limited remediation required for Option 4, Option 2a and Option 1a. Option 4, Option 2a and Option 1a are assessed as Neutral to each other as the disruption associated with the 338 m of exposure removal, rock placement or just line end removal is similar. **Overall, Option 1a is the most preferred from a Societal impact on Fishing perspective.**				
4. Societal	4.2 Communities / Ammenities	Materials Returned: Steel: 4,024 tonnes (recyclable) Polymer: 31 tonnes (landfill) Whilst there are some societal benefits from returning recyclable steel, this is offset by returning polymer which will take up landfill capacity. (Score 2)	Materials Returned: Steel: 4,024 tonnes (recyclable) Polymer: 31 tonnes (landfill) Whilst there are some societal benefits from returning recyclable steel, this is offset by returning polymer which will take up landfill capacity. (Score 2)	Materials Returned: Steel: 12 tonnes (recyclable) Polymer: 1 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)	Materials Returned: Steel: 1 tonnes (recyclable) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)	Materials Returned: Steel: 1 tonnes (recyclable) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)
		N W W W	W W W	N N	N	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: Note: Assessment of the societal impact of options is dominated by any negative impacts from material returned as the positive impacts, such as recyclable material or any job creation / retention offered by an option is considered less significant than negative impacts such as using landfill capacity. Option 6 is assessed as being Neutral to Option 5 as the societal impacts are largely similar for these options. Option 6 is assessed as being Weaker than the other options due to the quantity of material being returned that will be directed to landfill. Option 5 is assessed as being Weaker than Option 4, Option 2a and Option 1a due to the larger quantity of material being returned that will be directed to landfill. Option 4, Option 2a and Option 1a are assessed as being Neutral to each other as the positive and negative societal benefits are largely similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Societal impact on Other Users perspective.**				

		Option 6 Full Removal (Cut & Lift)				Option 5a Full Removal (Reverse Reel)			Option 4 Partial Removal (Cut & Lift)		Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline with MFE - Cut pipe into 20m sections with hydraulic shears - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep				- Unbury pipeline with MFE - Install recovery rigging for reverse reel - Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep			- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Cut all exposed sections into 20 m lengths with hydraulic shears - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - areas of exposure (338 m) will be removed by cut & lift	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Place rock at exposed ends & over exposed sections - Post decommissioning survey | Seabed trawl sweep - areas of exposure (338 m) will be rock dumped	- Dredge to uncover pipeline at LOGGS end - Cut 10m section with hydraulic shears (at LOGGS end) and recover - Place rock to remediate snag risk at exposed ends (inc. tee locations) - Post decommissioning survey | Seabed trawl sweep - areas of exposure will remain
5. Economic	5.1 Short-term Costs	£131.505 Million				£28.351 Million			£2.849 Million		£2.441 Million	£2.328 Million
		MW	VMW	VMW	VMW	MW	MW	MW	N	N	N	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 6 is assessed as being Much Weaker than Option 5 as the costs are almost five times higher. Option 6 is assessed as being Very Much Weaker than the other options as the costs are around 50 times higher. Option 5 is assessed as being Much Weaker than Option 4, Option 2a and Option 1a as the costs are around 10 times higher. Option 4, Option 2a, Option 1a are assessed as being Neutral to each other as the costs are around the same. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Short-term Cost perspective.**											
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million				Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million			Surveys: £0.538 Million FLTC: N/A Total Legacy Cost: £0.538 Million		Surveys: £0.538 Million FLTC: N/A Total Legacy Cost: £0.538 Million	Surveys: £0.538 Million FLTC: £0.355 Million Total Legacy Cost: £0.893 Million
		N	S	S	S	S	S	S	N	N	N	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: Option 6 is assessed as being Neutral to Option 5 as there are no legacy costs associated with either of these full removal options. Option 6 is assessed as being Stronger than all other options as there are no legacy / long-term costs associated with this option versus similar long-term costs for all other options. Option 5 is assessed as being Stronger than Option 4, Option 2a and Option 1a there are no legacy / long-term costs associated with this option versus similar long-term costs for all other options. All other options are assessed as being Neutral to each other as the long-term costs are largely similar. **Overall, Option 6 and Option 5 are equally preferred from a Long-term Cost perspective.**											

Appendix E.2 Group 3b Pairwise Comparison Matrices

1.1 Personnel Offshore	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	MW	MW	MW	9.1%
Option 5a Full Removal (Reverse Reel)	S	N	W	W	W	14.0%
Option 4 Partial Removal (Cut & Lift)	MS	S	N	N	N	25.6%
Option 2a Leave In-situ (Minor Intervention)	MS	S	N	N	N	25.6%
Option 1a Do Nothing (Minimum Intervention)	MS	S	N	N	N	25.6%

1.2 Personnel Onshore	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	MW	MW	MW	9.1%
Option 5a Full Removal (Reverse Reel)	N	N	MW	MW	MW	9.1%
Option 4 Partial Removal (Cut & Lift)	MS	MS	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	MS	MS	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	MS	MS	N	N	N	27.3%

1.3 Other Users	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	W	14.3%
Option 5a Full Removal (Reverse Reel)	S	N	N	N	N	21.4%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	N	21.4%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	N	21.4%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	N	21.4%

1.4 High Consequence Events	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	W	W	W	15.4%
Option 5a Full Removal (Reverse Reel)	N	N	W	W	W	15.4%
Option 4 Partial Removal (Cut & Lift)	S	S	N	N	N	23.1%
Option 2a Leave In-situ (Minor Intervention)	S	S	N	N	N	23.1%
Option 1a Do Nothing (Minimum Intervention)	S	S	N	N	N	23.1%

1.5 Residual Risk	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	S	S	MS	27.5%
Option 5a Full Removal (Reverse Reel)	N	N	S	S	MS	27.5%
Option 4 Partial Removal (Cut & Lift)	W	W	N	N	S	17.3%
Option 2a Leave In-situ (Minor Intervention)	W	W	N	N	S	17.3%
Option 1a Do Nothing (Minimum Intervention)	MW	MW	W	W	N	10.3%

2.1 Operational Marine Impact	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	MW	MW	MW	8.9%
Option 5a Full Removal (Reverse Reel)	S	N	W	W	W	15.8%
Option 4 Partial Removal (Cut & Lift)	MS	S	N	N	N	25.1%
Option 2a Leave In-situ (Minor Intervention)	MS	S	N	N	N	25.1%
Option 1a Do Nothing (Minimum Intervention)	MS	S	N	N	N	25.1%

2.2 Legacy Marine Impact	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	S	S	S	25.0%
Option 5a Full Removal (Reverse Reel)	N	N	S	S	S	25.0%
Option 4 Partial Removal (Cut & Lift)	W	W	N	N	N	16.7%
Option 2a Leave In-situ (Minor Intervention)	W	W	N	N	N	16.7%
Option 1a Do Nothing (Minimum Intervention)	W	W	N	N	N	16.7%

2.3 Fuel Use & Atmospheric Emissions	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	MW	MW	MW	8.9%
Option 5a Full Removal (Reverse Reel)	S	N	W	W	W	15.8%
Option 4 Partial Removal (Cut & Lift)	MS	S	N	N	N	25.1%
Option 2a Leave In-situ (Minor Intervention)	MS	S	N	N	N	25.1%
Option 1a Do Nothing (Minimum Intervention)	MS	S	N	N	N	25.1%

2.4 Other Consumptions	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	S	S	N	23.1%
Option 5a Full Removal (Reverse Reel)	N	N	S	S	N	23.1%
Option 4 Partial Removal (Cut & Lift)	W	W	N	N	W	15.4%
Option 2a Leave In-situ (Minor Intervention)	W	W	N	N	W	15.4%
Option 1a Do Nothing (Minimum Intervention)	N	N	S	S	N	23.1%

2.5 Disturbance	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	MW	MW	MW	9.1%
Option 5a Full Removal (Reverse Reel)	N	N	MW	MW	MW	9.1%
Option 4 Partial Removal (Cut & Lift)	MS	MS	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	MS	MS	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	MS	MS	N	N	N	27.3%

2.6 Loss of Habitat	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	S	S	S	24.9%
Option 5a Full Removal (Reverse Reel)	N	N	S	S	S	24.9%
Option 4 Partial Removal (Cut & Lift)	W	W	N	S	W	16.6%
Option 2a Leave In-situ (Minor Intervention)	W	W	W	N	W	14.1%
Option 1a Do Nothing (Minimum Intervention)	W	W	S	S	N	19.5%

3.1 Technical Feasibility	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MS	W	W	W	17.9%
Option 5a Full Removal (Reverse Reel)	MW	N	MW	MW	MW	7.6%
Option 4 Partial Removal (Cut & Lift)	S	MS	N	N	N	24.8%
Option 2a Leave In-situ (Minor Intervention)	S	MS	N	N	N	24.8%
Option 1a Do Nothing (Minimum Intervention)	S	MS	N	N	N	24.8%

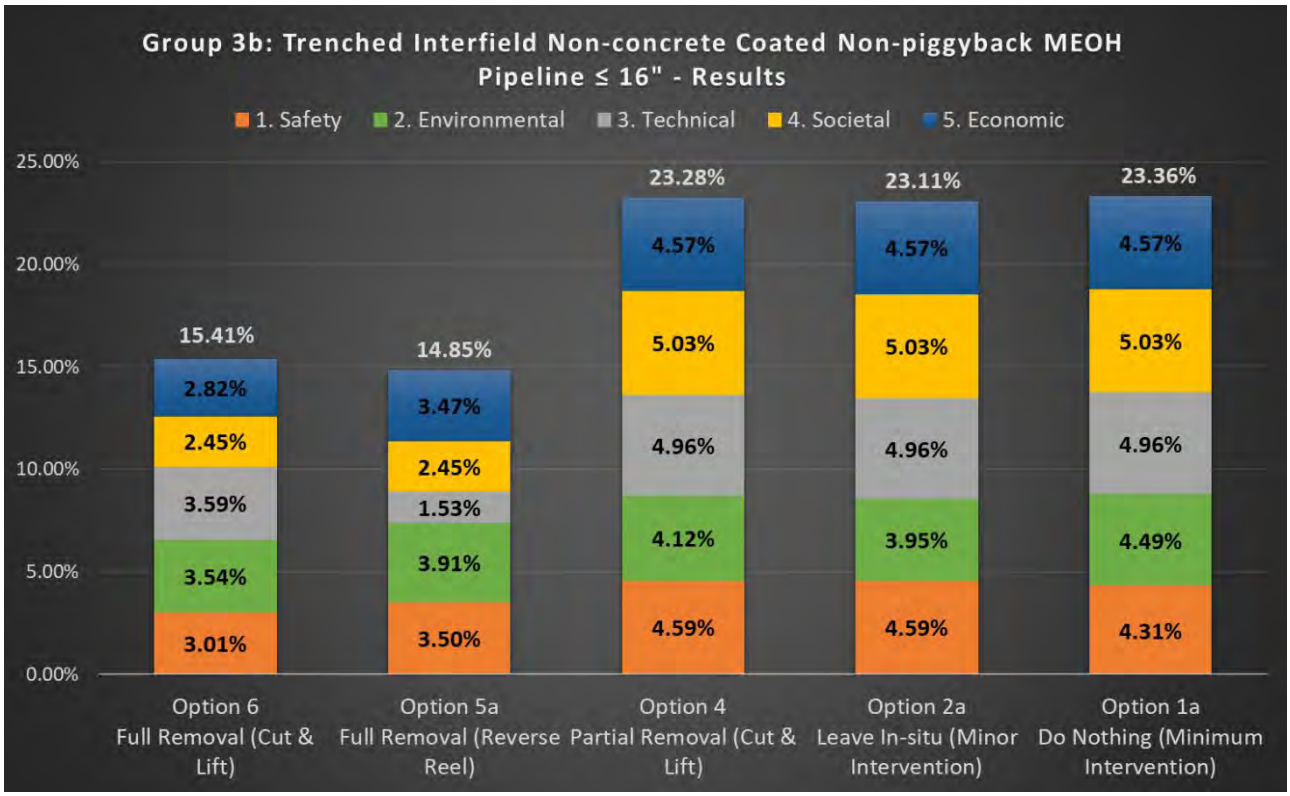
4.1 Fishing	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	MW	MW	MW	9.1%
Option 5a Full Removal (Reverse Reel)	N	N	MW	MW	MW	9.1%
Option 4 Partial Removal (Cut & Lift)	MS	MS	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	MS	MS	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	MS	MS	N	N	N	27.3%

4.2 Communities / Ammenities	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	W	W	W	15.4%
Option 5a Full Removal (Reverse Reel)	N	N	W	W	W	15.4%
Option 4 Partial Removal (Cut & Lift)	S	S	N	N	N	23.1%
Option 2a Leave In-situ (Minor Intervention)	S	S	N	N	N	23.1%
Option 1a Do Nothing (Minimum Intervention)	S	S	N	N	N	23.1%

5.1 Short-term Costs	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MW	VMW	VMW	VMW	3.2%
Option 5a Full Removal (Reverse Reel)	MS	N	MW	MW	MW	9.7%
Option 4 Partial Removal (Cut & Lift)	VMS	MS	N	N	N	29.0%
Option 2a Leave In-situ (Minor Intervention)	VMS	MS	N	N	N	29.0%
Option 1a Do Nothing (Minimum Intervention)	VMS	MS	N	N	N	29.0%

5.2 Long-term Costs	Option 6 Full Removal (Cut & Lift)	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	N	S	S	S	25.0%
Option 5a Full Removal (Reverse Reel)	N	N	S	S	S	25.0%
Option 4 Partial Removal (Cut & Lift)	W	W	N	N	N	16.7%
Option 2a Leave In-situ (Minor Intervention)	W	W	N	N	N	16.7%
Option 1a Do Nothing (Minimum Intervention)	W	W	N	N	N	16.7%

Appendix E.3 Group 3b Results Chart



Appendix E.4 Group 3b Detailed Evaluation Discussion

Appendix E.4.1 Safety – Personnel Offshore

The assessment of the options indicated that Option 1a, leave in-situ with minimum intervention, Option 2a, leave in-situ with minor intervention and Option 4, partial removal with cut & lift to be the equal most attractive options against the Personnel Offshore sub-criterion. This was due to these options having similar duration offshore scopes, all of which are significantly shorter than the full removal options, where the full 118 km of pipeline would be removed.

Option 5a, the full removal by reverse reeling option was assessed as less attractive than the leave in-situ or partial removal options from a safety risk to offshore personnel perspective. This is due to increased safety risk from the greater offshore work scope associated with reverse reeling operations which requires additional vessels i.e. a Reverse Reel Vessel and a Construction Support Vessel (CSV).

Option 6, the full removal option by cut and lift was considered the least attractive option by some margin due to the much greater safety risk associated with the longer durations to cut the pipeline into short sections and recovery.

Appendix E.4.2 Safety – Personnel Onshore

As with previous assessments, the safety risk associated with the onshore personnel is related to the quantity of material being returned to shore for onshore handling, transportation and processing. The leave in-situ and partial removal options (Option 1a, 2a and 4) were again, considered equally preferred as the quantity of material being returned is relatively similar across these options. It was noted that an additional quantity of material is returned in Option 4 where the exposures are removed and returned, but this additional quantity of material was not considered to increase the safety risk sufficiently to express a preference.

Option 5a and Option 6 both return significantly more material for onshore handling, transportation and processing, than the leave in-situ or partial removal options as the full 118 km of pipeline is retuned in both cases. As such, the full removal options were assessed as being significantly less attractive than the leave in-situ or partial removal options.

Appendix E.4.3 Safety – Other Users

The impact of performing the decommissioning options on other users of the sea from a safety perspective is related to the duration of operations, the number of vessels involved, and significantly, the number of transits to and from port to the decommissioning site.

The assessment of the decommissioning options against this criterion has indicated that all options except Option 6, full removal by cut & lift are equally preferred as they have a similar, low impact on the safety of other users. This is justified on the basis that, whilst there is a higher number of vessel days associated with Option 5a, full removal by reverse reeling than the partial removal and leave in-situ options, the number of transits of vessels to and from port are similar for these options.

Option 6 is considered to have a higher impact on the safety of other users and therefore is less preferred as there are more vessel days associated with the extended work scope and, more significantly, a much higher number of transits to and from port.

Appendix E.4.4 Safety – High Consequence Events

The assessment indicated that the leave in-situ and partial removal options would have the least exposure to potential for High Consequence Events and would therefore, be the most attractive against this criterion. This is due to the limited cut and lift operations to recover the pipeline end sections and exposures in these options.

Option 5a and Option 6 were assessed as being less attractive than the leave in-situ and partial removal options due to the potential for High Consequence Events associated with the back of deck handling during the reverse reeling operations in Option 5a and the additional lifting operations associated with the recovery of the 118 km of pipeline in Option 6.

Appendix E.4.5 Safety – Residual Risk

The residual risk relates to the potential for any safety impact from the decommissioning options. As both Option 5a and Option 6 are full removal options, the residual risk is the lowest for these options and as such, they are equally preferred.

Option 4 and Option 2a were less preferred than the full removal options as the pipeline remains in-situ, however, with the ends removed and the existing exposures either removed or rock covered, the residual risk is considered to be mitigated.

Option 1a was assessed as the least attractive option against this criterion due to the pipeline along with the existing exposures remaining in this option.

In addition, any partial removal or leave in-situ solution would have any potential hazards along the pipeline risk assessed and remediated and / or monitored to ensure that any emerging hazards do not develop into an unacceptable snagging risk to fishing operations.

Appendix E.4.6 Safety – Overall

When combining the assessments conducted at sub-criterion level, the most attractive options, from a safety perspective are Option 4, partial removal by cut & lift and Option 2a, leave in-situ with minimal intervention. Option 1a, leave in-situ with minimal intervention is a close second. Option 5a and Option 6, the full removal options were assessed as significantly less attractive.

The leave in-situ and partial removal options were closely scored as they are all equally preferred in the personnel offshore, personnel onshore, other users and high consequence events criteria. The key differentiator being that Option 1a is less preferred from a residual risk perspective due to the existing exposures remaining as is under this option whereas they are addressed by removal in Option 4 and by rock cover in Option 2a.

Appendix E.4.7 Environment – Operational Marine Impact

The environmental impact on the marine environment from performing the decommissioning options was considered low across all options. However, there were sufficient, cumulative differences, to indicate preferences across the decommissioning options.

The assessment performed during the workshop indicated that the leave in-situ and partial options are the most attractive from an operational marine impact perspective. This is due to these options having the least impact in terms of marine noise as they have the lowest number of vessel days and the lowest amount of subsea cutting operations.

All options have similar impacts in terms of discharges that occur from the pipeline whilst performing the decommissioning option as the pipeline is to have been cleaned successfully for all options. Options 4 and 6 do have increased quantities of cutting swarf over the leave in-situ options, which may have a small additional environmental impact.

The discharges from vessels relates to the number of vessels and the number of vessel days. Option 4 is considered less attractive than the leave in-situ options due to the additional vessel days required. Option 6 is worse again, due to the additional number of vessel days associated with the full removal option.

Appendix E.4.8 Environment – Legacy Marine Impact

The assessment indicated that Option 5a and Option 6, the full removal options, are the most attractive decommissioning option from a legacy marine environmental impact perspective. This is due to the full pipeline being removed and thus eliminating any legacy impact from degradation products or polymers.

The remaining options were assessed as being equally less attractive due to the majority of the 118 km of pipeline being left in-situ and the associated environmental impact from degradation products and polymers. No distinction was made between the partial removal and the leave in-situ options as the removal of 338 m of exposure in Option 4 was not considered sufficient to express a preference. Further, no distinction was made between the impact of exposed pipeline versus buried or rock covered pipeline.

Appendix E.4.9 Environment – Fuel Use & Atmospheric Emissions

The assessment indicated that the leave in-situ and partial removal options are the most attractive against the fuel use and atmospheric emissions criterion. This is due to these options having the least offshore work scope duration and hence vessel use and durations.

Option 5a has increased impact due to the additional offshore work scope associated with reverse reeling the 118 km pipeline and is therefore less preferred. Option 6 has increased impact again, from the additional offshore work scope associated with removing the entire pipeline using cut and lift methods and is the least preferred option.

Appendix E.4.10 Environment – Other Consumptions

All options were assessed as having a similar environmental impact when considering the material returned versus material left in-situ perspective. The assessment therefore focussed on the quantity of rock required for each option.

Option 5a and Option 6, the full removal options and Option 1a were assessed as being the most attractive as they require no rock for the full removal options and 25 tonnes of rock for Option 1a.

Option 4 and Option 2a were assessed as being less attractive than these options as they require 1,400 tonnes and 3,500 tonnes of rock respectively. This is used to mitigate the snag hazard associated with the cut ends left after the exposures were removed in Option 4 and to rock cover the areas of exposure in Option 2a.

Appendix E.4.11 Environment – Seabed Disturbance

The leave in-situ and partial removal options are assessed as the most attractive decommissioning options here as the seabed impact is limited to the area relating to the sections of pipeline removal at the LOGGS end and the tee locations.

Option 5a and 6 are significantly less attractive than the leave in-situ or partial removal options as a large area of seabed is impacted by the de-burial along the entire pipeline length using a MFE prior to the pipeline being reverse reeled or cut into sections and removed.

Appendix E.4.12 Environment – Loss of Habitat

Option 5a and Option 6, the full removal options were assessed as being the most attractive options against this criterion as neither option results in a loss of, or material change to the marine habitat as it currently stands.

Option 1a is assessed as less attractive due to the small quantity of rock placed at the cut pipeline end at LOGGS and the tee locations. Option 4 is assessed as less attractive again, as it involves the introduction of rock to mitigate the snag hazard associated with the cut ends of the pipeline left after the exposures are removed. The introduction of this rock is a material change to around 1,000 m^2 of habitat where the existing sandbank is replaced with a hard substrate.

Option 2a is assessed as the least attractive option as almost 3,500 m^2 of existing sandbank is replaced with a hard substrate.

Appendix E.4.13 Environment – Overall

When combining the assessments conducted at sub-criterion level, the most attractive option, from an environmental perspective is Option 1a, followed closely by Option 4, Option 2a, Option 5a and finally Option 6. It is noted that, reflecting the relatively minor environmental impacts across all options, the differences between the options are small.

The leave in-situ Option 1a was assessed as being the most attractive or equal most attractive option against four of the six environment sub-criteria. This relates to the limited work scope associated with the leave in-situ option and the lack of rock required in this option. It was less preferred from a legacy perspective due to the material being left in-situ and marginally less preferred than the full removal options due to the small amount of habitat loss from the minimal rock cover introduced at the cut pipeline locations at LOGGS and the tees.

Option 4 was assessed as being most attractive or equal most attractive in three of the six criteria, with the requirement for additional rock to cover the cut ends of pipeline at the removed exposure locations counting against it.

Option 5a and Option 2a were scored almost the same with a very small preference for Option 2a with the legacy benefits of full removal and no required rock in Option 5a being offset by the seabed disturbance, and the lack of seabed disturbance being offset by the required rock in Option 2a.

Option 6 was the least attractive option due to the additional impact from the extended duration of offshore activities and the seabed disturbance from the MFE de-burial of the line with the benefit of the lack of rock required being insufficient to offset these impacts.

Appendix E.4.14 Technical – Technical Feasibility

The leave in-situ and partial removal options were assessed as being the most attractive from a Technical Feasibility perspective due to the scope of removing the pipeline end sections, removing the exposures, placing rock cover over exposures and over the cut ends associated with these options being considered routine subsea operations.

Option 6 was the next most attractive option with the technical risks associated with the longer durations to cut the pipeline into short sections and recovering them, and successfully performing the de-burial operations to allow the subsea cutting to be performed being the main concerns.

Option 5a was the least attractive option by some margin due to concern surrounding the ability to reverse reel this line due to concerns around its integrity. The concept maturity was also assessed as being low as reverse reeling of rigid lines is unproven.

Overall, Option 4, Option 2a and Option 1a are the most attractive from a Technical perspective, followed by Option 6 and then Option 5a.

Appendix E.4.15 Societal – Fishing Industry

Prior to discussing the assessment, some context is provided from the Fishing Baseline Characterisation ref. [7]. As this line is laid alongside the trunkline, the discussion reflects that of Group 1. The fishing activity in the area of this pipeline is considered low, ranging from 5 to 20 days per annum fishing effort and relates mainly to beam trawling fishing operations from the Netherlands. UK beam trawling is less represented and generally target brown shrimp closer to shore. Potting activity by fleets under 15 m in length and scallop dredging have been observed, although the majority of sightings have not been in the immediate vicinity of the pipeline.

Given the above, the partial removal and leave in-situ options are assessed as being the most attractive options due to them presenting the least disruption and disturbance to the fishing industry from having the smallest offshore work scopes.

Option 5a and Option 6 are assessed as the least attractive options due to the extensive disruption to the fishing industry from the removal of the entire 118 km of the pipeline. It was noted that these options are also likely to have the most significant impact on near-shore fishing operations where static creel pots may need to be removed to allow the full removal of the pipeline.

It was noted that, given that fishing operations are already conducted in the area along and around this pipeline, and any infrastructure remaining on the seabed will be subject to an appropriate post-decommissioning monitoring regime, the residual presence of the pipeline was not considered a limitation to fishing activity.

Appendix E.4.16 Societal – Communities / Amenities

The impact of the decommissioning options on communities and amenities are considered in this criterion.

The leave in-situ and partial removal options are assessed as being the most attractive due to them returning limited quantities of material for processing onshore. Whilst this limits the amount of useful material, such as steel, being returned for recycling, it also results in the least amount of material being returned that will be directed to landfill, such as the polymer coating of the pipeline.

Option 5a and Option 6 were assessed as being the least attractive options as they return the entire 118 km of pipeline and the most quantity of polymer which takes up limited landfill capacity.

Appendix E.4.17 Societal – Overall

When combining the assessments conducted at sub-criterion level, the partial removal and leave in-situ options were considered the equal most attractive options as they were assessed as being the most attractive options against both the Fishing Industry and Communities / Amenities criteria.

Option 5a and Option 6 were less preferred as the impact from the disturbance to the fishing industry and the additional polymer to landfill from these full removal options, were assessed as less attractive.

Appendix E.4.18 Economic – Short-term Costs

Option 1a, Option 2a and Option 4 were assessed as the equal most attractive options from a short-term costs perspective. This is due to their costs being similar and the lowest cost options at £2.3 million, £2.4 million and £2.9 million respectively.

The costs for the full removal options was significantly higher with Option 5a being £28 million and Option 6 being significantly more expensive at over £130 million.

Appendix E.4.19 Economic – Long-term Costs

The impact of the decommissioning options in terms of long-term costs i.e. any on-going survey and monitoring costs and Fishing Legacy Trust-fund Company (FLTC) payments, are considered in this criterion.

Option 5a and Option 6 are considered the most attractive options against this criterion due to there being no long-term costs associated with these full removal options.

All other options are considered equally less attractive as the long-term costs associated with them is largely similar being between £500 k and £900 k.

Appendix E.4.20 Economic – Overall

Overall, the assessment is dominated by the short-term costs as the differentials are much greater than for the long-term costs.

Option 1a, Option 2a and Option 4 are the equal most attractive options from an Economic perspective, followed by Option 5a with Option 6 being the least preferred.

APPENDIX F **GROUP 3C – DETAILED EVALUATION RESULTS**

Appendix F.1 Group 3c Attributes Table

Group 3c: Trenched Interfield Concrete Coated Piggyback Pipelines ≤ 16"

- 14.3 km 12" concrete coated gas production pipeline with 3" piggyback methanol pipeline from Callisto to Ganymede with 132 m of exposure (PL1091 & PL1092)
- 7.5 km 10" concrete coated gas production pipeline with 3" piggyback methanol pipeline from Vanguard to LOGGS PP with 102.5 m of exposure (PL0456 & PL0457)
- 10.6 km 10" concrete coated gas production pipeline with 3" piggyback methanol pipeline from South Valiant to LOGGS PP with 119.7 m of exposure (PL0460 & PL0461)
- 4.4 km 10" concrete coated gas production pipeline with 3" piggyback methanol pipeline from North Valiant to LOGGS PP with 129.4 m of exposure (PL0470 & PL0471)

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline(s) with MFE | Recover mattresses and grout bags - Cut pipe into 20m sections with hydraulic shears - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10 m section with hydraulic shears (at each end) & recover (8 x 10 m) - Cut all exposed sections into 20 m lengths with hydraulic shears - Bundle cut sections and recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed	- Dredge to uncover pipeline ends - Cut 10 m section with hydraulic shears (at each end) & recover (8 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover pipeline ends - Cut 10m section with hydraulic shears (at each end) & recover (8 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure at pipeline ends will be removed with ends, other areas of exposure will remain
1. Safety	1.1 Personnel Offshore	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 87.1 / 114,932 / 8.62E-03 Divers: 18 / 87.1 / 37,614 / 3.65E-02 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 11.2 / 5,887 / 4.42E-04 CSV: 76 / 207.5 / 189,194 / 1.42E-02 Total offshore hours: 348,108 hrs Total offshore PLL: 5.98E-02	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 10.5 / 13,900 / 1.04E-03 Divers: 18 / 10.5 / 4,549 / 4.41E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 11.2 / 5,887 / 4.42E-04 Rockdump Vessel: 20 / 9.5 / 2,290 / 1.72E-04 Total offshore hours: 27,105 hrs Total offshore PLL: 6.10E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 8.2 / 10,784 / 8.09E-04 Divers: 18 / 8.2 / 3,529 / 3.42E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 11.2 / 5,887 / 4.42E-04 Rockdump Vessel: 20 / 9.6 / 2,311 / 1.73E-04 Total offshore hours: 22,992 hrs Total offshore PLL: 4.88E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 8.9 / 11,682 / 8.76E-04 Divers: 18 / 8.9 / 3,823 / 3.71E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 11.2 / 5,887 / 4.42E-04 Total offshore hours: 21,872 hrs Total offshore PLL: 5.06E-03
		W **W** **W**	**N** **N**	**N**	
	Summary	The assessment of the Personnel Offshore sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options as the risk exposure for offshore personnel is around 10 times higher for Option 6 due to the increased work scope durations and much greater of divers. Option 4, Option 2a and Option 1a are assessed as being Neutral to each other as the risk exposures are similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a risk to Offshore Personnel perspective.**			
1. Safety	1.2 Personnel Onshore	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 324.0 / 20,736 / 2.55E-03 Total onshore hours: 20,736 hrs Total onshore PLL: 2.55E-03	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 5.0 / 320 / 3.94E-05 Total onshore hours: 320 hrs Total onshore PLL: 3.94E-05	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06
		MW **VMW** **VMW**	**W** **W**	**N**	
	Summary	The assessment of the Personnel Onshore sub-criterion is as follows: Option 6 is assessed as being Much Weaker than Option 4 as the risk exposure for onshore personnel is 65 times higher for Option 6 due to the full pipeline length being returned to shore for in Option 6 versus less than 500 m of pipeline being returned in Option 4. Option 6 is assessed as being Very Much Weaker than both Option 2a and Option 1a due to the much higher risk exposure (more than 300 times higher) for onshore personnel due to handling 37 km of pipeline versus eight short 10m pipeline end sections in Option 2a and Option 1a. Option 4 is assessed as being Weaker than both Option 2a and Option 1a due to the risk exposure being around 5 times higher due to handling around 500 m of pipeline onshore versus eight short 10m pipeline end sections in Option 2a and Option 1a. Option 2a is assessed as being Neutral to Option 1a as the onshore handling is the same for both options. **Overall, Option 2a and Option 1a are equally preferred from a risk to Onshore Personnel perspective.**			
1. Safety	1.3 Other Users	Vessel Days: DSV: 87.1 Divers: 87.1 Trawler: 8.0 Survey Vessel: 11.2 CSV: 207.5 Total vessel days: 313.7 days Total Number of Transits: 100	Vessel Days: DSV: 10.5 Divers: 10.5 Trawler: 8.0 Survey Vessel: 11.2 Rockdump Vessel: 9.5 Total vessel days: 39.2 days Total Number of Transits: 10	Vessel Days: DSV: 8.2 Divers: 8.2 Trawler: 8.0 Survey Vessel: 11.2 Rockdump Vessel: 9.6 Total vessel days: 37.0 days Total Number of Transits: 10	Vessel Days: DSV: 8.9 Divers: 8.9 Trawler: 8.0 Survey Vessel: 11.2 Total vessel days: 28.0 days Total Number of Transits: 8
		W **W** **W**	**N** **N**	**N**	
	Summary	The assessment of the Other Users sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options as, although there are more vessel days for Option 6 than any of the other options, these are spread over a longer operational duration and so the actual impact in terms of safety of other users due to vessel traffic volumes increasing is likely to be negligible between these options. There are however, a higher number of vessel transits to / from the work site (100 versus 10 or 8) which provide a small increase in the potential safety impact on other users. All other options are assessed as being Neutral to each other as, whilst there are differences in the number of vessel days and transits, these differences are insufficient to result in a material difference in the safety impact on other users. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a risk to Other Users perspective.**			

NOTE: Pipeline Numbers in Appendix with a "0" after the "PL" are equivalent to those in the main body of the document with the same numbering but that do not contain the "0" in front of the "PL". The Main body of the text utilises the correct reference for the pipeline numbers.

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline(s) with MFE | Recover mattresses and grout bags - Cut pipe into 20m sections with hydraulic shears - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10 m section with hydraulic shears (at each end) & recover (8 x 10 m) - Cut all exposed sections into 20 m lengths with hydraulic shears - Bundle cut sections and recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed	- Dredge to uncover pipeline ends - Cut 10 m section with hydraulic shears (at each end) & recover (8 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover pipeline ends - Cut 10m section with hydraulic shears (at each end) & recover (8 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure at pipeline ends will be removed with ends, other areas of exposure will remain
1. Safety	1.4 High Consequence Events	The potential for High Consequence Events is assessed as Medium for this option. This is based on the number of both cutting and lifting operations that would need to take place to fully remove the pipeline. Number of Lifts: 460	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to remove the pipeline exposures and pipeline ends. Number of Lifts: 25	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the pipeline ends only. Number of Lifts: 8	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the pipeline ends only. Number of Lifts: 8
		W W W	N N	N	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options as there is a high number of lifting operations for onboarding the bundled, cut sections of pipeline which presents a heightened potential for a dropped object hazard, compared to a lower number of lifts for the other options. Option 4, Option 2a and Option 1a are assessed as being Neutral to each other as the potential for High Consequence Events is considered similar for these options due to limited lifting operations. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a High Consequence Events perspective.**			
1. Safety	1.5 Residual Risk	As the pipelines would be fully removed from the seabed, there would be no legacy risk associated with this full removal option.	The majority of the 36.8 km of pipelines are trenched and buried to an appropriate depth. There is 483 m of exposed pipeline which will be removed with the potential snag hazard associated with the cut ends mitigated by spot rock placement designed to be overtrawlable. A post-decommissioning trawl sweep will be conducted. As such, the potential snag hazard post-decommissioning activities is adequately mitigated and would be lower than for the pipelines in their current state of exposure. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.	The majority of the 36.8 km of pipelines is trenched and buried to an appropriate depth. There is 483 m of exposed pipeline which will be rock dumped to mitigate the potential snag hazard associated with these exposed areas. The areas of rock placement will be designed to be overtrawlable and a post-decommissioning trawl sweep will be conducted. As such, the potential snag hazard post-decommissioning activities is adequately mitigated and would be lower than for the pipelines in their current state of exposure. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.	The majority of the 36.8 km of pipelines is trenched and buried to an appropriate depth. There is 483 m of exposed pipeline which will remain in their current state. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.
		S S MS	N S	S	
	Summary	The assessment of the Residual Risk sub-criterion is as follows: Option 6 is assessed as being Stronger than both Option 4 and Option 2a due to there being no residual risk associated with the full removal option versus potential for a snag hazard in Option 4 and Option 2a, albeit these potential snag hazards are mitigated by rock placement. Option 6 is assessed as Much Stronger than Option 1a as there is no residual risk associated with the full removal option versus potential for a snag hazard in Option 1a. Note: existing potential for snag hazard in Option 1a will be monitored to ensure that any emerging risks are managed as appropriate. Option 4 is assessed as being Neutral to Option 2a as the residual risk is similar due to the potential snag hazard being mitigated by rock in both cases. Option 4 and Option 2a are assessed as being Stronger than Option 1a as the pipelines in Option 1a will remain in-situ where there is a minor potential for spans to develop. Any spanning identified to be a hazard in Option 1a will be risk assessed to determine an appropriate course of action to minimise the risk. **Overall, Option 6 is the most preferred from a Residual Risk perspective.**			

		Option 6 Full Removal (Cut & Lift)			Option 4 Partial Removal (Cut & Lift)		Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline(s) with MFE | Recover mattresses and grout bags - Cut pipe into 20m sections with hydraulic shears - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep			- Dredge to uncover pipeline ends - Cut 10 m section with hydraulic shears (at each end) & recover (8 x 10 m) - Cut all exposed sections into 20 m lengths with hydraulic shears - Bundle cut sections and recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed		- Dredge to uncover pipeline ends - Cut 10 m section with hydraulic shears (at each end) & recover (8 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover pipeline ends - Cut 10m section with hydraulic shears (at each end) & recover (8 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure at pipeline ends will be removed with ends, other areas of exposure will remain
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): Survey Vessel - 3 days | CSV - 196 days | DSV - 80 days | Trawler - 5 days Tooling Noise: MFE for Unburial - 15.33 days | Hydraulic Shears - 76.77 days Operational Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as cutting performed by hydraulic shears but potential for some concrete loss. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and having the highest vessel usage will be highest of the evaluated options.			Vessel Noise (days on-site): Survey Vessel - 3 days | DSV - 6.5 days | Rock Dump Vessel - 6.5 | Trawler - 5 days Tooling Noise: Dredging - 2 days | Hydraulic Shears - 2.34 days | Rock Dumping - 5 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as cutting performed by hydraulic shears but potential for some concrete loss. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and having a less intensive vessel usage than the full removal option, this option will have a lower discharge than Option 6 but similar for all other options.		Vessel Noise (days on-site): Survey Vessel - 3 days | DSV - 4 days | Rock Dump Vessel - 6.6 | Trawler - 5 days Tooling Noise: Dredging - 1 days | Hydraulic Shears - 1.33 days | Rock Dumping - 5 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as cutting performed by hydraulic shears but potential for some concrete loss. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and having a less intensive vessel usage than the full removal option, this option will have a lower discharge than Option 6 but similar for all other options.	Vessel Noise (days on-site): Survey Vessel - 3 days | DSV - 5 day | Trawler - 5 days Tooling Noise: Dredging - 2 days | Hydraulic Shears - 1.33 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as cutting performed by hydraulic shears . Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and having a less intensive vessel usage than the full removal option, this option will have a lower discharge than Option 6 but similar for all other options.
		W	W	W	N	N	N	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options as, whilst the actual environmental marine impacts from the increased noise, operational discharges and vessel discharges is minimal for Option 6, cumulatively, they are significant enough to express a small preference for the other options. All other options are assessed being Neutral to each other as marine impact from these options are similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from an Operational Marine Impact perspective.**							
2. Environmental	2.2 Legacy Marine Impact	There will be no legacy marine impacts from this full removal option.			The majority of the 36.8 km of pipelines is trenched and buried to an appropriate depth. There is 483 m of exposed pipeline which will be removed with the cut ends rock dumped. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried, concrete coated, steel pipelines, and the polymer coated methanol pipelines. Given the buried status of the material being left in-situ and the pipeline having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.		The majority of the 36.8 km of pipelines is trenched and buried to an appropriate depth. There is 483 m of exposed pipeline which will be rock dumped. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried, concrete coated, steel pipelines, and the polymer coated methanol pipelines. Given the buried status of the material being left in-situ and the pipeline having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.	The majority of the 36.8 km of pipelines is trenched and buried to an appropriate depth. There is 483 m of exposed pipeline which will be left as-is. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried, concrete coated, steel pipelines, and the polymer coated methanol pipelines. Given the buried status of the material being left in-situ and the pipeline having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.
		S	S	S	N	N	N	
	Summary	The assessment of the Legacy Marine Impact sub-criterion is as follows: Option 6 is assessed as being Stronger than all other options as the full removal option removes all material whilst the other options leave similar quantities and types of material in-situ. Whilst the legacy environmental impact is expected to be low for these options, there is polymer remaining and this is enough to express a small preference for the full removal option. All other options are assessed as Neutral to each other as the quantities and types of material and thus the legacy environmental impact is expected to be similar for these options. **Overall, Option 6 is the most preferred from a Legacy Marine Impact perspective.**							
2. Environmental	2.3 Fuel Use & Atmospheric Emissions	Vessel Emissions (in tonnes): Fuel: 7,730 CO2e: 25,339 NOx: 459.19 SO2: 30.92 Vessel Energy Use: 332,409 GJ			Vessel Emissions (in tonnes): Fuel: 870 CO2e: 2,852 NOx: 51.69 SO2: 3.48 Vessel Energy Use: 37,418 GJ		Vessel Emissions (in tonnes): Fuel: 827 CO2e: 2,711 NOx: 49.12 SO2: 3.31 Vessel Energy Use: 35,561 GJ	Vessel Emissions (in tonnes): Fuel: 710 CO2e: 2,328 NOx: 42.18 SO2: 2.84 Vessel Energy Use: 30,536 GJ
		W	W	W	N	N	N	
	Summary	The assessment of the Fuel Use & Atmospheric Emissions sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options as the fuel used and emissions generated for this option are higher than for the other options. All other options are assessed as Neutral to each other as the fuel used and emissions generated are similar for these options. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Fuel Use & Atmospheric Emissions perspective.**							

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline(s) with MFE | Recover mattresses and grout bags - Cut pipe into 20m sections with hydraulic shears - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10 m section with hydraulic shears (at each end) & recover (8 x 10 m) - Cut all exposed sections into 20 m lengths with hydraulic shears - Bundle cut sections and recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed	- Dredge to uncover pipeline ends - Cut 10 m section with hydraulic shears (at each end) & recover (8 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover pipeline ends - Cut 10m section with hydraulic shears (at each end) & recover (8 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure at pipeline ends will be removed with ends, other areas of exposure will remain
2. Environmental	2.4 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 9,685 Remaining Material: N/A Total: 9,685 Rock: N/A	Material Emissions (CO2 in tonnes): Recovered Material: 124 Remaining Material: 13,343 Total: 13,467 Rock: 2,750 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 21 Remaining Material: 13,488 Total: 13,510 Rock: 5,040 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 21 Remaining Material: 13,488 Total: 13,510 Rock: 200 tonnes
		S S N	N W	W	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: Option 6 is assessed as being Stronger than Option 4 and Option 2a as there is no requirement for rock in Option 6 versus a requirement for a reasonable amount of rock in Option 4 and Option 2a. Option 6 is assessed as being Neutral to Option 1a as whilst there is a small amount of rock required in Option 1a, this is insufficient to express a preference from a consumption perspective. Note: the differences between the options in tonnage of CO2 associated with processing returned material and / or to produce replacement material left in-situ were considered insignificant in terms of this assessment. As such, the preference judgements were driven by the quantity of rock consumption for each option. Option 4 is assessed as being Neutral to Option 2a as whilst there are differences between the quantity of rock consumed between the options, the differential was considered insufficient to express a preference. Option 4 is assessed as being Weaker than Option 1a as there is a requirement for a reasonable amount rock in Option 4 versus a very small amount of rock in Option 1a. Option 2a is assessed as being Weaker than Option 1a as there is much more rock required in Option 2a. **Overall, Option 6 and Option 1a are equally preferred from an Other Consumptions perspective.**			
2. Environmental	2.5 Disturbance	Short Term Disturbance (MFE): 181,555 m2	There is a small amount of short-term disturbance resulting from removing the 483 m of exposure along these lines and rock dumping the cut ends. This is considered insignificant.	There is limited short-term disturbance from rock dumping the 483 m of exposed pipelines for this option.	There is limited short-term disturbance for this option from the small area of rock dump only.
		MW MW MW	N N	N	
	Summary	The assessment of the Seabed Disturbance (short-term impact) sub-criterion is as follows: Option 6 is assessed as being Much Weaker than all other options due to the large area of seabed disturbance from the unburial of the 36.8 km of pipelines using a Mass Flow Excavator when compared to the small area of low impact disturbance with the other options. Option 4, Option 2a and Option 1a are all assessed as being Neutral to each other as the seabed disturbance is considered negligible and similar across these options. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Seabed Disturbance perspective.**			
2. Environmental	2.6 Loss of Habitat	Habitat Loss (Rockdump): N/A	Habitat Loss (Rockdump): 2,200 m2	Habitat Loss (Rockdump): 5,000 m2	Habitat Loss (Rockdump): 160 m2
		S S S	S W	W	
	Summary	The assessment of the Loss of Habitat (legacy / long-term impact) sub-criterion is as follows: Option 6 is assessed as being Stronger than Option 4, Option 2a and Option 1a as the rock placed in each of these options changes the current seabed habitat and thus results in an area of habitat loss whereas there is no habitat loss in Option 6. Option 4 is assessed as being Stronger than Option 2a as the area of habitat loss in Option 2a is greater than Option 4. Option 4 is assessed as being Weaker than Option 1a as area of habitat loss in Option 1a is much smaller than Option 4. Option 2a is assessed as being Weaker than Option 1a as the area of habitat loss in Option 2a is much greater than Option 1a. Note: Habitat loss is from the replacement of the sandbank features with hard substrate (rock). **Overall, Option 6 is the most preferred from a Loss of Habitat perspective.**			
3. Technical	3.1 Technical Feasibility	**Concept Maturity:** Cutting using hydraulic shears for concrete coated pipelines of this diameter is considered routine. (Score 3) **Technical Risks:** Risk to successfully achieving full removal by unburial and cut and lift of the pipeline due to the long durations involved and the potential for unforeseen unburial issues. (Score 2)	**Concept Maturity:** Cutting using hydraulic shears for concrete coated pipelines of this diameter is considered routine. (Score 3) **Technical Risks:** Limited technical risks from cutting and removal of pipeline sections as the areas being cut and removed are already exposed therefore no unburial risk. (Score 3)	**Concept Maturity:** All operations to deliver this option are considered routine. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required and short duration of work scopes. (Score 3)	**Concept Maturity:** All operations to deliver this option are considered routine. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required and short duration of work scopes. (Score 3)
		W W W	N N	N	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options as Option 6 faces challenges in performing the unburial required to gain access to perform the cutting and there is no technical complexity or unburial required in Option 4, Option 2a or Option 1a. Option 4 is assessed as being Neutral to both Option 2a and Option 1a as the concept maturity and technical risks are considered similar. Option 2a is assessed as being Neutral to Option 1a as the concept maturity and technical risks are considered similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Technical Risk perspective.**			

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline(s) with MFE | Recover mattresses and grout bags - Cut pipe into 20m sections with hydraulic shears - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10 m section with hydraulic shears (at each end) & recover (8 x 10 m) - Cut all exposed sections into 20 m lengths with hydraulic shears - Bundle cut sections and recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed	- Dredge to uncover pipeline ends - Cut 10 m section with hydraulic shears (at each end) & recover (8 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover pipeline ends - Cut 10m section with hydraulic shears (at each end) & recover (8 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure at pipeline ends will be removed with ends, other areas of exposure will remain
4. Societal	4.1 Fishing	Whilst this option provides clear seabed, the operational impact of removing the pipelines disturbs (displacement and restricted access) current fishing operations. The impact is low due to the relatively short lengths of pipelines. Fishing operations are conducted in the area of these pipelines. (Score 2)	Short term disturbance in localised areas. Relatively small volume of rock covering cut ends results in intermittent rock piles. Left in-situ infrastructure may lead to snagging in time. Fishing operations are conducted in the area of these pipelines. (Score 2)	Short term disturbance in localised areas. Relatively small volume of rock covering installed over exposures, profiled to be overtrawlable. Left in-situ infrastructure may lead to snagging in time. Fishing operations are conducted in the area of these pipelines. (Score 2)	Short term disturbance in localised areas. Relatively small volume of rock covering installed over cut ends, profiled to be overtrawlable. Left in-situ infrastructure may lead to snagging in time. Fishing operations are conducted in the area of these pipelines. (Score 2)
		W **W** **W**	**N** **N**	**N**	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options due to the additional disruption caused to fishing operations from the full removal of the pipeline versus minimal disruption due to shorter operational durations with the other options. All other options are assessed as being Neutral to each other as the disruption associated with exposure removal and / or rock dump is largely similar, as is the left in-situ infrastructure. Note: given that fishing operations are already conducted extensively in this area, no benefit is given for full removal of the pipeline in terms of impact to fishing industry as the improvement to fishing from removal of pipeline is considered negligible. **Overall, Option 4, Option 2a and Option 1a are the equally preferred from a Societal impact on Fishing perspective.**			
4. Societal	4.2 Communities / Ammenities	Materials Returned: Steel: 5,166 tonnes (recyclable) Concrete: 4,001 tonnes (landfill) Polymer: 265 tonnes (landfill) Mattress/Grout Bag: 273 tonnes (landfill) Whilst there are some societal benefits from the returning of significant tonnage of recyclable steel, this is more than offset by the significant tonnage of contaminated and hard to segregate concrete and polymer, which will take up landfill capacity. (Score 2)	Materials Returned: Steel: 68 tonnes (recyclable) Concrete: 53 tonnes (landfill) Polymer: 4 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)	Materials Returned: Steel: 12 tonnes (recyclable) Concrete: 9 tonnes (landfill) Polymer: 1 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)	Materials Returned: Steel: 12 tonnes (recyclable) Concrete: 9 tonnes (landfill) Polymer: 1 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)
		W **W** **W**	**N** **N**	**N**	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: Note: Assessment of the societal impact of options is dominated by any negative impacts from material returned as the positive impacts, such as recyclable material or any job creation / retention offered by an option is considered less significant than negative impacts such as using landfill capacity. Option 6 is assessed as being Weaker than all other options due to the large quantities of contaminated and difficult to segregate concrete and polymer that are likely to end up in landfill. All other options are assessed as being Neutral to each other as the positive and negative societal benefits are similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Societal impact on Other Users perspective.**			
5. Economic	5.1 Short-term Costs	£43.188 Million	£3.587 Million	£3.113 Million	£2.871 Million
		MW **MW** **MW**	**N** **N**	**N**	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 6 is assessed as being Much Weaker than all other options as the costs are more than ten times higher in all cases. All other options are assessed as being Neutral to each other as the costs are around the same. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Short-term Cost perspective.**			
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million	Surveys: £0.333 Million FLTC: N/A Total Legacy Cost: £0.333 Million	Surveys: £0.334 Million FLTC: N/A Total Legacy Cost: £0.334 Million	Surveys: £0.334 Million FLTC: £0.11 Million Total Legacy Cost: £0.444 Million
		S **S** **S**	**N** **N**	**N**	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: Option 6 is assessed as being Stronger than all other options as there are no legacy / long-term costs associated with this option versus similar long-term costs for all other options. All other options are assessed as being Neutral to each other as the long-term costs are largely similar. **Overall, Option 6 is most preferred from a Long-term Cost perspective.**			

Appendix F.2 Group 3c Pairwise Comparison Matrices

1.1 Personnel Offshore	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

1.2 Personnel Onshore	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MW	VMW	VMW	4.9%
Option 4 Partial Removal (Cut & Lift)	MS	N	W	W	20.8%
Option 2a Leave In-situ (Minor Intervention)	VMS	S	N	N	37.1%
Option 1a Do Nothing (Minimum Intervention)	VMS	S	N	N	37.1%

1.3 Other Users	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

1.4 High Consequence Events	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

1.5 Residual Risk	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	S	MS	38.1%
Option 4 Partial Removal (Cut & Lift)	W	N	N	S	23.6%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	S	23.6%
Option 1a Do Nothing (Minimum Intervention)	MW	W	W	N	14.7%

2.1 Operational Marine Impact	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

2.2 Legacy Marine Impact	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	S	S	33.3%
Option 4 Partial Removal (Cut & Lift)	W	N	N	N	22.2%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	N	22.2%
Option 1a Do Nothing (Minimum Intervention)	W	N	N	N	22.2%

2.3 Fuel Use & Atmospheric Emissions	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

2.4 Other Consumptions	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	S	N	30.0%
Option 4 Partial Removal (Cut & Lift)	W	N	N	W	20.0%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	W	20.0%
Option 1a Do Nothing (Minimum Intervention)	N	S	S	N	30.0%

2.5 Disturbance	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MW	MW	MW	10.0%
Option 4 Partial Removal (Cut & Lift)	MS	N	N	N	30.0%
Option 2a Leave In-situ (Minor Intervention)	MS	N	N	N	30.0%
Option 1a Do Nothing (Minimum Intervention)	MS	N	N	N	30.0%

2.6 Loss of Habitat	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	S	S	33.0%
Option 4 Partial Removal (Cut & Lift)	W	N	S	W	22.0%
Option 2a Leave In-situ (Minor Intervention)	W	W	N	W	18.0%
Option 1a Do Nothing (Minimum Intervention)	W	S	S	N	27.0%

3.1 Technical Feasibility	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

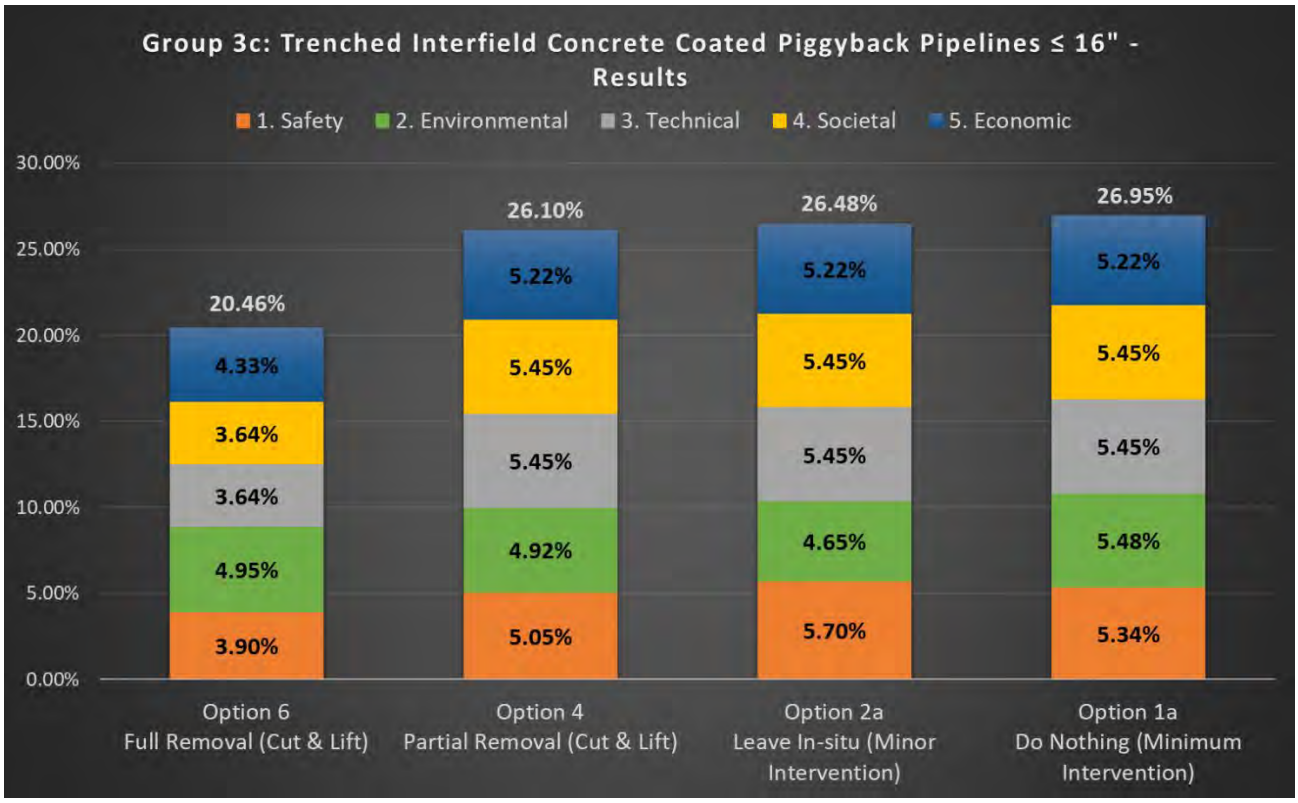
4.1 Fishing	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

4.2 Communities / Ammenities	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

5.1 Short-term Costs	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MW	MW	MW	10.0%
Option 4 Partial Removal (Cut & Lift)	MS	N	N	N	30.0%
Option 2a Leave In-situ (Minor Intervention)	MS	N	N	N	30.0%
Option 1a Do Nothing (Minimum Intervention)	MS	N	N	N	30.0%

5.2 Long-term Costs	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	S	S	33.3%
Option 4 Partial Removal (Cut & Lift)	W	N	N	N	22.2%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	N	22.2%
Option 1a Do Nothing (Minimum Intervention)	W	N	N	N	22.2%

Appendix F.3 Group 3c Results Chart



Appendix F.4 Group 3c Detailed Evaluation Discussion

Appendix F.4.1 Safety – Personnel Offshore

The assessment of the options indicated that Option 1a, leave in-situ with minimum intervention, Option 2a, leave in-situ with minor intervention and Option 4, partial removal by cut & lift to be the equal most attractive options against the Personnel Offshore sub-criterion. This was due to these options having similar duration offshore scopes, all of which are significantly shorter than the full removal option, where the full 36 km of pipelines would be removed.

Option 6, the full removal option by cut and lift was considered the least attractive option due to the greater safety risk associated with the longer durations to cut the pipelines into short sections and recover.

Appendix F.4.2 Safety – Personnel Onshore

As with previous assessments, the safety risk associated with the onshore personnel is related to the quantity of material being returned to shore for onshore handling, transportation and processing. The leave in-situ options (Option 1a and 2a) were considered equally preferred as the quantity of material from removing the pipeline ends is the same in both options.

The partial removal option (Option 4) returns more material for onshore handling, transportation and processing from the removed exposures which made this option marginally less preferred to the leave in-situ options.

The full removal option (Option 6) returns significantly more material for onshore handling, transportation and processing, than the leave in-situ or partial removal options as the full 36 km of pipelines are retuned. As such, the full removal option is assessed as being significantly less attractive than the leave in-situ or partial removal options.

Appendix F.4.3 Safety – Other Users

The assessment of the decommissioning options against this criterion has indicated that all options except Option 6, full removal by cut & lift are equally preferred as they have a similar, low impact on the safety of other users as the vessel days and transits to and from port is similar in these options.

Option 6 is considered to have a higher impact on the safety of other users and therefore is less preferred as there are more vessel days associated with the extended work scope and, more significantly, a much higher number of transits to and from port.

Appendix F.4.4 Safety – High Consequence Events

The assessment during the workshop indicated that the partial removal and leave in-situ options would have the least exposure to potential for High Consequence Events and would therefore, be the most attractive against this criterion. This is due to the limited cut and lift operations to recover the pipeline end sections in Option 1a and Option 2a with the increased number of cut and lift operations to remove the exposures in Option 4 being insufficient to differentiate from a potential for High Consequence Events perspective.

Option 6 would be exposed to a greater potential for a dropped object as there is significantly more lifting associated with the recovery of the entire 36 km of pipelines in sections.

Appendix F.4.5 Safety – Residual Risk

The residual risk relates to the potential for any safety impact from the decommissioning options. Option 6 is assessed as the most attractive option from a residual safety risk perspective as it is a full removal option and therefore removes all residual risk.

Option 4 and Option 2a were assessed as being equally attractive from a residual risk perspective as the removal of the exposures in Option 4 or the rock placement over the exposures in Option 2a were considered to provide similar mitigation of any potential residual risk.

Option 1a was assessed as the least attractive option against this criterion due to the existing pipeline exposures remaining in this option.

It should be noted that, as part of any partial removal or leave in-situ solution being selected, any potential hazards along the pipeline would be risk assessed and remediated and / or monitored to ensure that any emerging hazards do not develop into an unacceptable snagging risk to fishing operations.

Appendix F.4.6 Safety – Overall

When combining the assessments conducted at sub-criterion level, the most attractive option, from a safety perspective is Option 2a, followed closely by Option 1a. These options were assessed as being equally preferred against all sub-criteria except the residual risk, where Option 2a was preferred.

Option 4 was assessed as marginally less attractive than Option 1a due to the impact from returning more material for onshore handling.

Option 6 was assessed as significantly less attractive than the other options in all areas except residual risk.

Appendix F.4.7 Environment – Operational Marine Impact

The environmental impact on the marine environment from performing the decommissioning options was considered low across all options. However, there were sufficient, cumulative differences, to indicate preferences across the decommissioning options.

The assessment performed during the workshop indicated that the leave in-situ and partial removal options are the most attractive from an operational marine impact perspective. This is due to these options having the least impact in terms of marine noise as they have the lowest number of vessel days and the lowest amount of subsea cutting operations with the increases for partial removal by cut & lift over the leave in-situ options being insufficient to express a preference.

All options have similar impacts in terms of discharges that occur from the pipelines whilst performing the decommissioning option as they will have been cleaned successfully for all options. Options 4 and 6 do have increased quantities of cutting swarf over the leave in-situ options, which may have a small additional environmental impact.

The discharges from vessels relates to the number of vessels and the number of vessel days. Option 6 is less attractive than the options due to the additional number of vessel days associated with the full removal option.

Appendix F.4.8 Environment – Legacy Marine Impact

The assessment indicated that Option 6, full removal of the pipeline, is the most attractive decommissioning option from a legacy marine environmental impact perspective. This is due to the pipelines being fully removed and thus eliminating any legacy impact from degradation products or polymers.

The partial removal and leave in-situ options were assessed as less attractive than the full removal option as the majority of the lines are left in-situ in these options. The additional removal of 483 m of exposure was not considered sufficient to differentiate between Option 4 and the leave in-situ options. No distinction was made between the impact of exposed pipeline versus buried or rock covered pipeline.

Appendix F.4.9 Environment – Fuel Use & Atmospheric Emissions

The assessment indicated that the partial removal and leave in-situ options are the most attractive against the fuel use and atmospheric emissions criterion. This is due to these options having lower offshore work scope durations and hence lower vessel use and durations.

Option 6 has increased impact due to the additional offshore work scope associated with fully removing the 36 km of pipelines.

Appendix F.4.10 Environment – Other Consumptions

All options were assessed as having a similar environmental impact when considering the material returned versus material left in-situ perspective. The assessment therefore focussed on the quantity of rock required for each option.

Option 6, the full removal option and Option 1a were assessed as being the most attractive as they require no rock and 200 tonnes of rock respectively.

Option 4 was less attractive than these options as it required 2,750 tonnes of rock, used to mitigate the snag hazard associated with the cut ends left after the exposures were removed in this option. Option 2a was similarly less attractive which uses 5,040 tonnes of rock to cover the exposures.

Appendix F.4.11 Environment – Seabed Disturbance

The leave in-situ and partial removal options are assessed as the most attractive decommissioning options here as the seabed impact is limited to the area relating to the sections of pipeline removal at the line ends.

Option 6 is significantly less attractive than the leave in-situ or partial removal options as a large area of seabed is impacted by the de-burial along the pipelines using an MFE prior to them being cut into sections and removed.

Appendix F.4.12 Environment – Loss of Habitat

Option 6, the full removal option was assessed as being the most attractive option against this criterion as there is no loss of, or material change to the marine habitat as it currently stands.

Option 1a is assessed as less attractive due to the small quantity of rock placed at the cut pipeline ends. Option 4 is assessed as less attractive again, as it involves the introduction of rock to mitigate the snag hazard associated with the cut ends of the pipelines left after the exposures are removed.

The introduction of this rock is a material change to around 2,200 m^2 of habitat where the existing sandbank is replaced with a hard substrate.

Option 2a is assessed as the least attractive option as 5,000 m^2 of existing sandbank is replaced with a hard substrate.

Appendix F.4.13 Environment – Overall

When combining the assessments conducted at sub-criterion level, the most attractive option, from an environmental perspective is Option 1a, followed by Option 6 which is followed closely by Option 4 and Option 2a. It is noted that, reflecting the relatively minor environmental impacts across all options, the differences between the options are small.

The leave in-situ Option 1a was assessed as being the most attractive or equal most attractive option against four of the six environment sub-criteria. This relates to the limited work scope associated with the leave in-situ option and the lack of rock required in this option. It was less preferred from a legacy perspective due to the pipelines being left in-situ and marginally less preferred than the full removal option due to the small amount of habitat loss from the minimal rock cover introduced at the cut pipeline ends.

Option 6 was assessed as being most attractive in the legacy and loss of habitat criteria due to the full removal of the pipelines and no habitat loss from rock placement. The longer duration operations counted against it in other areas.

The lower environmental impact from the shorter durations associated with performing Option 4 and Option 2a were offset by the impact from the rock cover required under these options.

Appendix F.4.14 Technical – Technical Feasibility

The leave in-situ and partial removal options were assessed as being the most attractive from a Technical Feasibility perspective due to the scope of removing the pipeline end sections, removing the exposures, placing rock cover over exposures and over the cut ends associated with these options being considered routine subsea operations.

Option 6 was less attractive as the technical risks associated with the longer durations to cut the pipeline into short sections and recovering them, and successfully performing the de-burial operations to allow the subsea cutting to be performed being the main concerns.

Overall, Option 4, Option 2a and Option 1a are the most attractive from a Technical perspective, followed by Option 6.

Appendix F.4.15 Societal – Fishing Industry

Prior to discussing the assessment, some context is provided from the Fishing Baseline Characterisation ref. [7]. Fishing activity in the LOGGS south area, where the pipelines are installed, is moderate to high in terms of value and effort (up to 100 days of effort) and predominantly undertaken by Dutch beam trawl fleet with a minor amount of fishing undertaken by UK demersal fishing (generally beam trawling).

Given the above, the partial removal and leave in-situ options are assessed as being the most attractive options due to them presenting the least disruption and disturbance to the fishing industry from having the smallest offshore work scopes.

Option 6 is assessed as the least attractive option due to the extensive disruption to the fishing industry from the removal of the entire 36 km of pipelines.

It was noted that, given that fishing operations are already conducted in the area along and around this pipeline, and any infrastructure remaining on the seabed will be subject to an appropriate post-decommissioning monitoring regime, the residual presence of the pipeline was not considered a limitation to fishing activity.

Appendix F.4.16 Societal – Communities / Amenities

The impact of the decommissioning options on communities and amenities are considered in this criterion.

The leave in-situ and partial removal options are assessed as being the most attractive due to them returning limited quantities of material for processing onshore. Whilst this limits the amount of useful material, such as steel, being returned for recycling, it also results in the least amount of material being returned that will be directed to landfill, such as the polymer coating of the pipelines.

Option 6 was assessed as being the least attractive option as it returns the entire 36 km of pipeline and the most quantity of polymer which takes up limited landfill capacity.

Appendix F.4.17 Societal – Overall

When combining the assessments conducted at sub-criterion level, the partial removal and leave in-situ options were considered the equal most attractive options as they were assessed as being the most attractive options against both the Fishing Industry and Communities / Amenities criteria.

Option 6 was less preferred as the impact from the disturbance to the fishing industry and the additional polymer to landfill from the full removal option, being assessed as less attractive.

Appendix F.4.18 Economic – Short-term Costs

Option 1a, Option 2a and Option 4 were assessed as the equal most attractive options from a short-term costs perspective. This is due to their costs being similar and the lowest cost options at £2.9 million, £3.1 million and £3.6 million respectively.

The costs for the full removal option was significantly higher with Option 6 being £43 million.

Appendix F.4.19 Economic – Long-term Costs

The impact of the decommissioning options in terms of long-term costs i.e. any on-going survey and monitoring costs and Fishing Legacy Trust-fund Company (FLTC) payments, are considered in this criterion.

Option 6 is considered the most attractive option against this criterion. This is due to there being no long-term costs associated with this full removal option.

All other options are considered equally less attractive as the long-term costs associated with them is largely similar being between £300 k and £400 k.

Appendix F.4.20 Economic – Overall

Overall, the assessment is dominated by the short-term costs as the differentials are much greater than for the long-term costs.

The partial removal and leave in-situ options are all considered equal most attractive options from an Economic perspective. These are followed by Option 6 which is significantly less attractive.

APPENDIX G **GROUP 4 – DETAILED EVALUATION RESULTS**

Appendix G.1 Group 4 Attributes Table

Group 4: Trenched Interfield Concrete Coated Piggyback Pipelines > 16"

- 43.2 km 14" concrete coated gas production pipeline with piggyback methanol pipeline from Saturn to LOGGS PR with 14 m of exposure at pipeline ends (PL2107 & PL2108)
- 19.5 km 18" concrete coated gas production pipeline with piggyback methanol pipeline from Ganymede to LOGGS PR with 74.5 m of exposure (PL1093 & PL1094)
- 16.1 km 18" concrete coated gas production pipeline with piggyback methanol pipeline from Vulcan to LOGGS PP with 253.0 m of exposure (PL0458 & PL0459)

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline(s) with MFE | Recover mattresses and grout bags - Cut pipe into 20m sections with diamond wire - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10 m section with diamond wire (at each end) and recover (6 x 10 m) - Cut all exposed sections into 20 m lengths with diamond wire - Bundle cut sections and recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed	- Dredge to uncover pipeline ends - Cut 10 m section with diamond wire (at each end) and recover (6 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover pipeline ends - Cut 10m section with diamond wire (at each end) and recover (6 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: areas of exposure at pipeline ends will be removed with ends, other areas of exposure will remain
1. Safety	1.1 Personnel Offshore	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 687.5 / 907,434 / 6.81E-02 Divers: 18 / 687.5 / 296,978 / 2.88E-01 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 14.7 / 7,740 / 5.81E-04 CSV: 76 / 528.0 / 481,509 / 3.61E-02 Total offshore hours: 1,694,142 hrs Total offshore PLL: 3.93E-01	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 9.9 / 13,108 / 9.83E-04 Divers: 18 / 9.9 / 4,290 / 4.16E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 14.7 / 7,740 / 5.81E-04 Rockdump Vessel: 20 / 7.4 / 1,776 / 1.33E-04 Total offshore hours: 27,394 hrs Total offshore PLL: 5.89E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 7.2 / 9,464 / 7.10E-04 Divers: 18 / 7.2 / 3,097 / 3.00E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 14.7 / 7,740 / 5.81E-04 Rockdump Vessel: 20 / 7.5 / 1,798 / 1.35E-04 Total offshore hours: 22,580 hrs Total offshore PLL: 4.47E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 7.7 / 10,138 / 7.60E-04 Divers: 18 / 7.7 / 3,318 / 3.22E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 14.7 / 7,740 / 5.81E-04 Total offshore hours: 21,676 hrs Total offshore PLL: 4.60E-03
		MW | MW | MW	N | N	N	
	Summary	The assessment of the Personnel Offshore sub-criterion is as follows: Option 6 is assessed as being Much Weaker than all other options as the risk exposure for offshore personnel is around between 70 and 88 times higher for Option 6 due to the larger work scope required for full removal the greater use of divers compared to the partial removal options. Option 4, Option 2a and Option 1a are assessed as being Neutral to each others as the risk exposures are similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a risk to Offshore Personnel perspective.**			
1. Safety	1.2 Personnel Onshore	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 951.0 / 60,864 / 7.49E-03 Total onshore hours: 60,864 hrs Total onshore PLL: 7.49E-03	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 5.0 / 320 / 3.94E-05 Total onshore hours: 320 hrs Total onshore PLL: 3.94E-05	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06
		MW | VMW | VMW	W | W	N	
	Summary	The assessment of the Personnel Onshore sub-criterion is as follows: Option 6 is assessed as being Much Weaker than Option 4 as the risk exposure for onshore personnel is 190 times higher for Option 6 due to the full pipeline lengths being returned to shore for handling in Option 6 versus less than 500 m of pipeline being returned to shore in Option 4. Option 6 is assessed as being Very Much Weaker than both Option 2a and Option 1a due to the much higher risk exposure (almost 1000 times higher) for onshore personnel due to handling 79 km of pipeline versus six short 10m pipeline end sections in Option 2a and Option 1a. Option 4 is assessed as being Weaker than both Option 2a and Option 1a due to the risk exposure being around 5 times higher due to handling around 350 m of pipeline onshore versus six short 10m pipeline end sections Option 2a and Option 1a. Option 2a is assessed as being Neutral to Option 1a as onshore handling is the same for both options. **Overall, Option 2a and Option 1a are equally preferred from a risk to Onshore Personnel perspective.**			
1. Safety	1.3 Other Users	Vessel Days: DSV: 687.5 Divers: 687.5 Trawler: 8.0 Survey Vessel: 14.7 CSV: 528.0 Total vessel days: 1,238.1 days Transits: 91	Vessel Days: DSV: 9.9 Divers: 9.9 Trawler: 8.0 Survey Vessel: 14.7 Rockdump Vessel: 7.4 Total vessel days: 40.0 days Transits: 10	Vessel Days: DSV: 7.2 Divers: 7.2 Trawler: 8.0 Survey Vessel: 14.7 Rockdump Vessel: 7.5 Total vessel days: 37.3 days Transits: 10	Vessel Days: DSV: 7.7 Divers: 7.7 Trawler: 8.0 Survey Vessel: 14.7 Total vessel days: 30.3 days Transits: 8
		W | W | W	N | N	N	
	Summary	The assessment of the Other Users sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options as, although there are more vessel days for Option 6 than any of the other options, these are spread over a longer operational duration and so the actual impact in terms of safety of other users due to vessel traffic volumes increasing is likely to be negligible between these options. There are however, a higher number of vessel transits to / from the work site (91 versus 10 or 8) which provide a small increase in the potential safety impact on other users. All other options are assessed being Neutral to each other as, whilst there are differences in the number of vessel days and transits, these differences are insufficient to result in a material difference in the safety impact on other users. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a risk to Other Users perspective.**			

NOTE: Pipeline Numbers in Appendix with a "0" after the "PL" are equivalent to those in the main body of the document with the same numbering but that do not contain the "0" in front of the "PL". The Main body of the text utilises the correct reference for the pipeline numbers.

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline(s) with MFE | Recover mattresses and grout bags - Cut pipe into 20m sections with diamond wire - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10 m section with diamond wire (at each end) and recover (6 x 10 m) - Cut all exposed sections into 20 m lengths with diamond wire - Bundle cut sections and recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed	- Dredge to uncover pipeline ends - Cut 10 m section with diamond wire (at each end) and recover (6 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover pipeline ends - Cut 10m section with diamond wire (at each end) and recover (6 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: areas of exposure at pipeline ends will be removed with ends, other areas of exposure will remain
1. Safety	1.4 High Consequence Events	The potential for High Consequence Events is assessed as Medium for this option. This is based on the number of both cutting and lifting operations that would need to take place to fully remove the pipeline. Live pipeline - Shell Carrick Number of Lifts: 986	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to remove the pipeline exposures and pipeline ends. Number of Lifts: 17	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the pipeline ends only. Number of Lifts: 1	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the pipeline ends only. Number of Lifts: 1
		W W W	N N	N	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options as there is a high number of lifting operations for onboarding the bundled, cut sections of pipeline which presents a heightened potential for a dropped object hazard, compared to a lower number of lifts for the other options. Option 4, Option 2a and Option 1a are assessed as being Neutral to each other as the potential for High Consequence Events is considered similar for these options due to limited lifting operations. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a High Consequence Events perspective.**			
1. Safety	1.5 Residual Risk	As the pipelines would be fully removed from the seabed, there would be no legacy risk associated with this full removal option.	The majority of the 78.8 km of pipelines are trenched and buried to an appropriate depth. There is 342 m of exposed pipeline which will be removed with the potential snag hazard associated the cut ends mitigated by spot rock placement designed to be overtrawlable. A post-decommissioning trawl sweep will be conducted. As such, the potential snag hazard post-decommissioning activities is adequately mitigated and would be lower than for the pipeline in their current state of exposure. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.	The majority of the 78.8 km of pipelines are trenched and buried to an appropriate depth. There is 342 m of exposed pipeline which will be rock dumped to mitigate the potential snag hazard associated with these exposed areas. The areas of rock placement will be designed to be overtrawlable and a post-decommissioning trawl sweep will be conducted. As such, the potential snag hazard post-decommissioning activities is adequately mitigated and would be lower than for the pipeline in their current state of exposure. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.	The majority of the 78.8 km of pipelines are trenched and buried to an appropriate depth. There is 342 m of exposed pipeline which will remain in their current state. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.
		S S MS	N S	S	
	Summary	The assessment of the Residual Risk sub-criterion is as follows: Option 6 is assessed as being Stronger than both Option 4 and Option 2a due to there being no residual risk associated with the full removal option versus potential for a snag hazard in Option 4 and Option 2a, albeit these potential snag hazards are mitigated by rock placement. Option 6 is assessed as Much Stronger than Option 1a as there is no residual risk associated with the full removal option versus potential for a snag hazard in Option 1a. Note: existing potential for snag hazard in Option 1a will be monitored to ensure that any emerging risks are managed as appropriate. Option 4 is assessed as being Neutral to Option 2a as the residual risk is similar due to the potential snag hazard being mitigated by rock in both cases. Option 4 and Option 2a are assessed as being Stronger than Option 1a as the pipelines in Option 1a will remain in-situ where there is a minor potential for spans to develop. Any spanning identified to be a hazard in Option 1a will be risk assessed to determine an appropriate course of action to minimise the risk. **Overall, Option 6 is the most preferred from a Residual Risk perspective.**			

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline(s) with MFE | Recover mattresses and grout bags - Cut pipe into 20m sections with diamond wire - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10 m section with diamond wire (at each end) and recover (6 x 10 m) - Cut all exposed sections into 20 m lengths with diamond wire - Bundle cut sections and recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed	- Dredge to uncover pipeline ends - Cut 10 m section with diamond wire (at each end) and recover (6 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover pipeline ends - Cut 10m section with diamond wire (at each end) and recover (6 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: areas of exposure at pipeline ends will be removed with ends, other areas of exposure will remain
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): Survey Vessel - 6.5 days | CSV - 516 days | DSV - 662 days | Trawler - 5 days Tooling Noise: MFE for Unburial - 32.87 days | Diamond Wire Cutting - 657.4 days Operational Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as cutting performed by hydraulic shears but potential for some concrete loss. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and having the highest vessel usage will be highest of the evaluated options.	Vessel Noise (days on-site): Survey Vessel - 6.5 days | DSV - 6 days | Rock Dump Vessel - 4.4 | Trawler - 5 days Tooling Noise: Dredging - 1.5 days | Diamond Wire Cutting - 2.84 days | Rock Dumping - 2.9 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as cutting performed by hydraulic shears but potential for some concrete loss. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and having a less intensive vessel usage than the full removal option, this option will have a lower discharge than Option 6 but similar for all other options.	Vessel Noise (days on-site): Survey Vessel - 6.5 days | DSV - 3.17 days | Rock Dump Vessel - 4.5 | Trawler - 5 days Tooling Noise: Dredging - 1.5 days | Diamond Wire Cutting - 1 day | Rock Dumping - 3 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as cutting performed by hydraulic shears but potential for some concrete loss. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and having a less intensive vessel usage than the full removal option, this option will have a lower discharge than Option 6 but similar for all other options.	Vessel Noise (days on-site): Survey Vessel - 6.5 days | DSV - 4 days | Trawler - 5 days Tooling Noise: Dredging - 1.5 days | Diamond Wire Cutting - 1 day Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as cutting performed by hydraulic shears . Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and having a less intensive vessel usage than the full removal option, this option will have a lower discharge than Option 6 but similar for all other options.
		W W W	N N	N	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options as, whilst the actual environmental marine impacts from the increased noise, operational discharges and vessel discharges is minimal for Option 6, cumulatively, they are significant enough to express a small preference for the other options. All other options are assessed being Neutral to each other as marine impact from these options are similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from an Operational Marine Impact perspective.**			
2. Environmental	2.2 Legacy Marine Impact	There will be no legacy marine impacts from this full removal option.	The majority of the 78.8 km pipelines is trenched and buried to an appropriate depth. There is 342 m of exposed pipeline which will be removed with the cut ends rock dumped. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried, concrete coated, steel pipelines, and the polymer coated methanol pipelines. Given the buried status of the material being left in-situ and the pipeline having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.	The majority of the 78.8 km pipelines is trenched and buried to an appropriate depth. There is 342 m of exposed pipeline which will be rock dumped. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried, concrete coated, steel pipelines, and the polymer coated methanol pipelines. Given the buried status of the material being left in-situ and the pipeline having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.	The majority of the 78.8 km pipelines is trenched and buried to an appropriate depth. There is 342 m of exposed pipeline which will be left as-is. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried, concrete coated, steel pipelines, and the polymer coated methanol pipelines. Given the buried status of the material being left in-situ and the pipeline having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.
		S S S	N N	N	
	Summary	The assessment of the Legacy Marine Impact sub-criterion is as follows: Option 6 is assessed as being Stronger than all other options as the full removal option removes all material whilst the other options leave similar quantities and types of material in-situ. Whilst the legacy environmental impact is expected to be low for these options, there is polymer remaining and this is enough to express a small preference for the full removal option. All other options are assessed as Neutral to each other as the quantities and types of material and thus the legacy environmental impact is expected to be similar for these options. **Overall, Option 6 is the most preferred from a Legacy Marine Impact perspective.**			
2. Environmental	2.3 Fuel Use & Atmospheric Emissions	Vessel Emissions (in tonnes): Fuel: 28,526 CO2e: 93,501 NOx: 1,694.42 SO2: 114.10 Vessel Energy Use: 1,226,602 GJ	Vessel Emissions (in tonnes): Fuel: 1,048 CO2e: 3,436 NOx: 62.27 SO2: 4.19 Vessel Energy Use: 45,076 GJ	Vessel Emissions (in tonnes): Fuel: 997 CO2e: 3,268 NOx: 59.22 SO2: 3.99 Vessel Energy Use: 42,870 GJ	Vessel Emissions (in tonnes): Fuel: 914 CO2e: 2,995 NOx: 54.28 SO2: 3.65 Vessel Energy Use: 39,290 GJ
		MW MW MW	N N	N	
	Summary	The assessment of the Fuel Use & Atmospheric Emissions sub-criterion is as follows: Option 6 is assessed as being Much Weaker than all other options as the fuel used and emissions generated for this option are much higher than for the other options. All other options are assessed as Neutral to each other as the fuel used and emissions generated are similar for these options. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Fuel Use & Atmospheric Emissions perspective.**			

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline(s) with MFE | Recover mattresses and grout bags - Cut pipe into 20m sections with diamond wire - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10 m section with diamond wire (at each end) and recover (6 x 10 m) - Cut all exposed sections into 20 m lengths with diamond wire - Bundle cut sections and recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed	- Dredge to uncover pipeline ends - Cut 10 m section with diamond wire (at each end) and recover (6 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover pipeline ends - Cut 10m section with diamond wire (at each end) and recover (6 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: areas of exposure at pipeline ends will be removed with ends, other areas of exposure will remain
2. Environmental	2.4 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 28,789 Remaining Material: N/A Total: 28,789 Rock: N/A	Material Emissions (CO2 in tonnes): Recovered Material: 124 Remaining Material: 39,859 Total: 39,983 Rock: 1,550 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 23 Remaining Material: 40,001 Total: 40,024 Rock: 3,560 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 23 Remaining Material: 40,001 Total: 40,024 Rock: 150 tonnes
		S **S** **N**	**N** **W**	**W**	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: Option 6 is assessed as being Stronger than Option 4 and Option 2a as there is no requirement for rock in Option 6 versus a requirement for a reasonable amount of rock in Option 4 and Option 2a. Option 6 is assessed as being Neutral to Option 1a as whilst there is a small amount of rock required in Option 1a, this is insufficient to express a preference from a consumption perspective. Note: the differences between the options in tonnage of CO2 associated with processing returned material and / or to produce replacement material left in-situ were considered insignificant in terms of this assessment. As such, the preference judgements were driven by the quantity of rock consumption for each option. Option 4 is assessed as being Neutral to Option 2a as whilst there are differences between the quantity of rock consumed between the options, the differential was considered insufficient to express a preference. Option 4 is assessed as being Weaker than Option 1a as there is a requirement for a reasonable amount of rock in Option 4 versus a very small amount of rock in Option 1a. Option 2a is assessed as being Weaker than Option 1a as there is much more rock required in Option 2a. **Overall, Option 6 and Option 1a are equally preferred from an Other Consumptions perspective.**			
2. Environmental	2.5 Disturbance	Short Term Disturbance (MFE): 392,735 m2	There is a small amount of short-term disturbance resulting from removing the 342 m of exposure along these lines and rock dumping the cut ends. This is considered insignificant.	There is limited short-term disturbance from rock dumping the 342 m of exposed pipelines for this option.	There is limited short-term disturbance for this option from the small area of rock dump only.
		MW **MW** **MW**	**N** **N**	**N**	
	Summary	The assessment of the Seabed Disturbance (short-term impact) sub-criterion is as follows: Option 6 is assessed as being Much Weaker than all other options due to the large area of seabed disturbance from the unburial of the 78.8 km of pipelines using a Mass Flow Excavator when compared to the small area of low impact disturbance with the other options. Option 4, Option 2a and Option 1a are all assessed as being Neutral to each other as the seabed disturbance is considered negligible and similar across these options. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Seabed Disturbance perspective.**			
2. Environmental	2.6 Loss of Habitat	Habitat Loss (Rockdump): N/A	Habitat Loss (Rockdump): 1,240 m2	Habitat Loss (Rockdump): 3,530 m2	Habitat Loss (Rockdump): 120 m2
		S **S** **S**	**S** **W**	**W**	
	Summary	The assessment of the Loss of Habitat (legacy / long-term impact) sub-criterion is as follows: Option 6 is assessed as being Stronger than Option 4, Option 2a and Option 1a as the rock placed in each of these options changes the current seabed habitat and thus results in an area of habitat loss whereas there is no habitat loss in Option 6. Option 4 is assessed as being Stronger than Option 2a as the area of habitat loss in Option 2a is greater than Option 4. Option 4 is assessed as being Weaker than Option 1a as the area of habitat loss in Option 1a is much smaller than Option 4. Option 2a is assessed as being Weaker than Option 1a as the area of habitat loss in Option 2a is much greater than Option 1a. Note: Habitat loss is from the replacement of the sandbank features with hard substrate (rock). **Overall, Option 6 is the most preferred from a Loss of Habitat perspective.**			
3. Technical	3.1 Technical Feasibility	**Concept Maturity:** DWC for cutting concrete coated pipeline of 28" has been demonstrated during the Viking decommissioning. (Score 3) **Technical Risks:** Risk to successfully achieving full removal by unburial and cut and lift of the pipelines due to the long durations involved and the potential for unforeseen unburial issues. (Score 2)	**Concept Maturity:** DWC for cutting concrete coated pipeline of 28" has been demonstrated during the Viking decommissioning. (Score 3) **Technical Risks:** Limited technical risks from cutting and removal of pipeline sections as the areas being cut and removed are already exposed therefore no unburial risk. (Score 3)	**Concept Maturity:** DWC for cutting concrete coated pipeline of 28" has been demonstrated during the Viking decommissioning. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required and no requirement for unburial. Rock dump routine. (Score 3)	**Concept Maturity:** DWC for cutting concrete coated pipeline of 28" has been demonstrated during the Viking decommissioning. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required and no requirement for unburial. Rock dump routine. (Score 3)
		MW **MW** **MW**	**N** **N**	**N**	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 6 is assessed as being Much Weaker than all other options as Option 6 faces challenges in performing the unburial required to gain access to perform the cutting and there is no technical complexity or unburial required in Option 4, Option 2a or Option 1a. Option 4 is assessed as being Neutral to both Option 2a and Option 1a as the concept maturity and technical risks are considered similar. Option 2a is assessed as being Neutral to Option 1a as the concept maturity and technical risks are considered similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Technical Risk perspective.**			

		Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury pipeline(s) with MFE | Recover mattresses and grout bags - Cut pipe into 20m sections with diamond wire - Bundle cut sections and recover - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover pipeline ends - Cut 10 m section with diamond wire (at each end) and recover (6 x 10 m) - Cut all exposed sections into 20 m lengths with diamond wire - Bundle cut sections and recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed	- Dredge to uncover pipeline ends - Cut 10 m section with diamond wire (at each end) and recover (6 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover pipeline ends - Cut 10m section with diamond wire (at each end) and recover (6 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: areas of exposure at pipeline ends will be removed with ends, other areas of exposure will remain
4. Societal	4.1 Fishing	Whilst this option provides clear seabed, the operational impact of removing the pipelines disturbs (displacement and restricted access) current fishing operations. The impact is low due to the relatively short lengths of pipelines. Fishing operations are currently conducted in the area of these pipelines. (Score 2)	Short term disturbance in localised areas. Relatively small volume of rock covering cut ends results in intermittent rock piles. Left in-situ infrastructure may lead to snagging in time. Fishing operations are currently conducted in the area of these pipelines. (Score 2)	Short term disturbance in localised areas. Relatively small volume of rock covering installed over exposures, profiled to be overtrawlable. Left in-situ infrastructure may lead to snagging in time. Fishing operations are currently conducted in the area of these pipelines. (Score 2)	Short term disturbance in localised areas. Relatively small volume of rock covering installed over cut ends, profiled to be overtrawlable. Left in-situ infrastructure may lead to snagging in time. Fishing operations are currently conducted in the area of these pipelines. (Score 2)
		W W W	N N	N	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options due to the additional disruption caused to fishing operations from the full removal of the pipeline versus minimal disruption due to shorter operational durations with the other options. All other options are assessed as being Neutral to each other as the disruption associated with exposure removal and / or rock dump is largely similar, as is the left in-situ infrastructure. Note: given that fishing operations are already conducted extensively in this area, no benefit is given for full removal of the pipeline in terms of impact to fishing industry as the improvement to fishing from removal of pipeline is considered negligible. **Overall, Option 4, Option 2a and Option 1a are the equally preferred from a Societal impact on Fishing perspective.**			
4. Societal	4.2 Communities / Ammenities	Materials Returned: Steel: 15,198 tonnes (recyclable) Concrete: 12,745 tonnes (landfill) Polymer: 447 tonnes (landfill) Mattress/Grout Bag: 123 tonnes (landfill) Whilst there are some societal benefits from the returning of significant tonnage of recyclable steel, this is more than offset by the significant tonnage of contaminated and hard to segregate concrete and polymer, which will take up landfill capacity. (Score 2)	Materials Returned: Steel: 66 tonnes (recyclable) Concrete: 56 tonnes (landfill) Polymer: 2 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)	Materials Returned: Steel: 12 tonnes (recyclable) Concrete: 10 tonnes (landfill) Polymer: 1 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)	Materials Returned: Steel: 12 tonnes (recyclable) Concrete: 10 tonnes (landfill) Polymer: 1 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)
		W W W	N N	N	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: Note: Assessment of the societal impact of options is dominated by any negative impacts from material returned as the positive impacts, such as recyclable material or any job creation / retention offered by an option is considered less significant than negative impacts such as using landfill capacity. Option 6 is assessed as being Weaker than all other options due to the large quantities of contaminated and difficult to segregate concrete and polymer that are likely to end up in landfill. All other options are assessed as being Neutral to each other as the positive and negative societal benefits are similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Societal impact on Other Users perspective.**			
5. Economic	5.1 Short-term Costs	£211.784 Million	£3.444 Million	£2.873 Million	£2.846 Million
		VMW VMW VMW	N N	N	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 6 is assessed as being Very Much Weaker than all other options as the costs are much (100 times) higher in all cases. All other options are assessed as being Neutral to each other as the costs are similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Short-term Cost perspective.**			
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million	Surveys: £0.439 Million FLTC: N/A Total Legacy Cost: £0.439 Million	Surveys: £0.44 Million FLTC: N/A Total Legacy Cost: £0.44 Million	Surveys: £0.44 Million FLTC: £0.236 Million Total Legacy Cost: £0.676 Million
		S S S	N N	N	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: Option 6 is assessed as being Stronger than all other options as there are no legacy / long-term costs associated with this option versus similar long-term costs for all other options. All other options are assessed as being Neutral to each other as the long-term costs are largely similar. **Overall, Option 6 is most preferred from a Long-term Cost perspective.**			

Appendix G.2 Group 4 Pairwise Comparison Matrices

1.1 Personnel Offshore	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MW	MW	MW	10.0%
Option 4 Partial Removal (Cut & Lift)	MS	N	N	N	30.0%
Option 2a Leave In-situ (Minor Intervention)	MS	N	N	N	30.0%
Option 1a Do Nothing (Minimum Intervention)	MS	N	N	N	30.0%

1.2 Personnel Onshore	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MW	VMW	VMW	4.9%
Option 4 Partial Removal (Cut & Lift)	MS	N	W	W	20.8%
Option 2a Leave In-situ (Minor Intervention)	VMS	S	N	N	37.1%
Option 1a Do Nothing (Minimum Intervention)	VMS	S	N	N	37.1%

1.3 Other Users	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

1.4 High Consequence Events	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

1.5 Residual Risk	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	S	MS	38.1%
Option 4 Partial Removal (Cut & Lift)	W	N	N	S	23.6%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	S	23.6%
Option 1a Do Nothing (Minimum Intervention)	MW	W	W	N	14.7%

2.1 Operational Marine Impact	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

2.2 Legacy Marine Impact	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	S	S	33.3%
Option 4 Partial Removal (Cut & Lift)	W	N	N	N	22.2%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	N	22.2%
Option 1a Do Nothing (Minimum Intervention)	W	N	N	N	22.2%

2.3 Fuel Use & Atmospheric Emissions	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MW	MW	MW	10.0%
Option 4 Partial Removal (Cut & Lift)	MS	N	N	N	30.0%
Option 2a Leave In-situ (Minor Intervention)	MS	N	N	N	30.0%
Option 1a Do Nothing (Minimum Intervention)	MS	N	N	N	30.0%

2.4 Other Consumptions	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	S	N	30.0%
Option 4 Partial Removal (Cut & Lift)	W	N	N	W	20.0%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	W	20.0%
Option 1a Do Nothing (Minimum Intervention)	N	S	S	N	30.0%

2.5 Disturbance	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MW	MW	MW	10.0%
Option 4 Partial Removal (Cut & Lift)	MS	N	N	N	30.0%
Option 2a Leave In-situ (Minor Intervention)	MS	N	N	N	30.0%
Option 1a Do Nothing (Minimum Intervention)	MS	N	N	N	30.0%

2.6 Loss of Habitat	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	S	S	33.0%
Option 4 Partial Removal (Cut & Lift)	W	N	S	W	22.0%
Option 2a Leave In-situ (Minor Intervention)	W	W	N	W	18.0%
Option 1a Do Nothing (Minimum Intervention)	W	S	S	N	27.0%

3.1 Technical Feasibility	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	MW	MW	MW	10.0%
Option 4 Partial Removal (Cut & Lift)	MS	N	N	N	30.0%
Option 2a Leave In-situ (Minor Intervention)	MS	N	N	N	30.0%
Option 1a Do Nothing (Minimum Intervention)	MS	N	N	N	30.0%

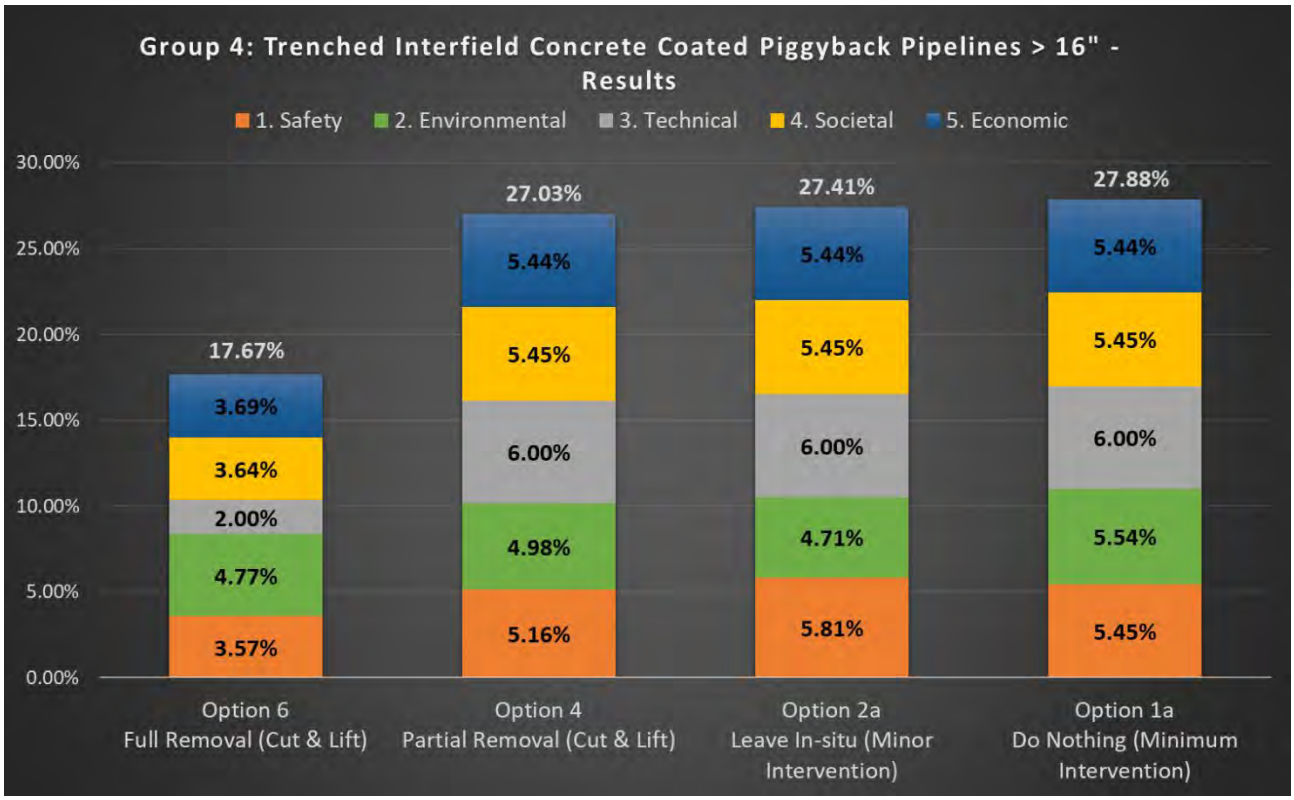
4.1 Fishing	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

4.2 Communities / Ammenities	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

5.1 Short-term Costs	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	VMW	VMW	VMW	3.6%
Option 4 Partial Removal (Cut & Lift)	VMS	N	N	N	32.1%
Option 2a Leave In-situ (Minor Intervention)	VMS	N	N	N	32.1%
Option 1a Do Nothing (Minimum Intervention)	VMS	N	N	N	32.1%

5.2 Long-term Costs	Option 6 Full Removal (Cut & Lift)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 6 Full Removal (Cut & Lift)	N	S	S	S	33.3%
Option 4 Partial Removal (Cut & Lift)	W	N	N	N	22.2%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	N	22.2%
Option 1a Do Nothing (Minimum Intervention)	W	N	N	N	22.2%

Appendix G.3 Group 4 Results Chart



Appendix G.4 Group 4 Detailed Evaluation Discussion

Appendix G.4.1 Safety – Personnel Offshore

The assessment of the options indicated that Option 1a, leave in-situ with minimum intervention, Option 2a, leave in-situ with minor intervention and Option 4, partial removal by cut & lift to be the equal most attractive options against the Personnel Offshore sub-criterion. This was due to these options having similar duration offshore scopes, all of which are significantly shorter than the full removal option, where the full 80 km of pipelines would be removed.

Option 6, the full removal option by cut and lift was considered the least attractive option due to the greater safety risk associated with the longer durations to cut the pipelines into short sections and recover.

Appendix G.4.2 Safety – Personnel Onshore

As with previous assessments, the safety risk associated with the onshore personnel is related to the quantity of material being returned to shore for onshore handling, transportation and processing. The leave in-situ options (Option 1a and 2a) were considered equally preferred as the quantity of material from removing the pipeline ends is the same in both options.

The partial removal option (Option 4) returns more material for onshore handling, transportation and processing from the removed exposures which made this option marginally less preferred to the leave in-situ options.

The full removal option (Option 6) returns significantly more material for onshore handling, transportation and processing, than the leave in-situ or partial removal options as the full 80 km of pipelines are retuned. As such, the full removal option is assessed as being significantly less attractive than the leave in-situ or partial removal options.

Appendix G.4.3 Safety – Other Users

The assessment of the decommissioning options against this criterion has indicated that all options except Option 6, full removal by cut & lift, are equally preferred as they have a similar, low impact on the safety of other users as the vessel days and transits to and from port is similar in these options.

Option 6 is considered to have a higher impact on the safety of other users and therefore is less preferred as there are more vessel days associated with the extended work scope and, more significantly, a much higher number of transits to and from port.

Appendix G.4.4 Safety – High Consequence Events

The assessment during the workshop indicated that the partial removal and leave in-situ options would have the least exposure to potential for High Consequence Events and would therefore, be the most attractive against this criterion. This is due to the limited cut and lift operations to recover the pipeline end sections in Option 1a and Option 2a with the increased number of cut and lift operations to remove the exposures in Option 4 being insufficient to differentiate from a potential for High Consequence Events perspective.

Option 6 would be exposed to a greater potential for a dropped object as there is significantly more lifting associated with the recovery of the entire 80 km of pipelines in sections.

Appendix G.4.5 Safety – Residual Risk

The residual risk relates to the potential for any safety impact from the decommissioning options. Option 6 is assessed as the most attractive option from a residual safety risk perspective as it is a full removal option and therefore removes all residual risk.

Option 4 and Option 2a were assessed as being equally attractive from a residual risk perspective as the removal of the exposures in Option 4 or the rock placement over the exposures in Option 2a were considered to provide similar mitigation of any potential residual risk.

Option 1a was assessed as the least attractive option against this criterion due to the existing pipeline exposures remaining in this option.

It should be noted that, as part of any partial removal or leave in-situ solution being selected, any potential hazards along the pipeline would be risk assessed and remediated and / or monitored to ensure that any emerging hazards do not develop into an unacceptable snagging risk to fishing operations.

Appendix G.4.6 Safety – Overall

When combining the assessments conducted at sub-criterion level, the most attractive option, from a safety perspective is Option 2a, followed closely by Option 1a. These options were assessed as being equally preferred against all sub-criteria except the residual risk, where Option 2a was preferred.

Option 4 was assessed as marginally less attractive than Option 1a due to the impact from returning more material for onshore handling.

Option 6 was assessed as significantly less attractive than the other options in all areas except residual risk.

Appendix G.4.7 Environment – Operational Marine Impact

The environmental impact on the marine environment from performing the decommissioning options was considered low across all options. However, there were sufficient, cumulative differences, to indicate preferences across the decommissioning options.

The assessment performed during the workshop indicated that the leave in-situ and partial removal options are the most attractive from an operational marine impact perspective. This is due to these options having the least impact in terms of marine noise as they have the lowest number of vessel days and the lowest amount of subsea cutting operations with the increases for partial removal by cut & lift over the leave in-situ options being insufficient to express a preference.

All options have similar impacts in terms of discharges that occur from the pipelines whilst performing the decommissioning option as they will have been cleaned successfully for all options. Options 4 and 6 do have increased quantities of cutting swarf over the leave in-situ options, which may have a small additional environmental impact.

The discharges from vessels relates to the number of vessels and the number of vessel days. Option 6 is less attractive than the other options due to the additional number of vessel days associated with the full removal option.

Appendix G.4.8 Environment – Legacy Marine Impact

The assessment indicated that Option 6, full removal of the pipeline, is the most attractive decommissioning option from a legacy marine environmental impact perspective. This is due to the pipelines being fully removed and thus eliminating any legacy impact from degradation products or polymers.

The partial removal and leave in-situ options were assessed as less attractive than the full removal option as the majority of the lines are left in-situ in these options. The additional removal of 342 m of exposure was not considered sufficient to differentiate between Option 4 and the leave in-situ options. No distinction was made between the impact of exposed pipeline versus buried or rock covered pipeline.

Appendix G.4.9 Environment – Fuel Use & Atmospheric Emissions

The assessment indicated that the partial removal and leave in-situ options are the most attractive against the fuel use and atmospheric emissions criterion. This is due to these options having lower offshore work scope durations and hence lower vessel use and durations.

Option 6 has increased impact due to the additional offshore work scope associated with fully removing the 80 km of pipelines.

Appendix G.4.10 Environment – Other Consumptions

All options were assessed as having a similar environmental impact when considering the material returned versus material left in-situ perspective. The assessment therefore focussed on the quantity of rock required for each option.

Option 6, the full removal option and Option 1a were assessed as being the most attractive as they require no rock and 150 tonnes of rock respectively.

Option 4 was less attractive than these options as it required 1,550 tonnes of rock, used to mitigate the snag hazard associated with the cut ends left after the exposures were removed in this option. Option 2a was similarly less attractive which uses 3,560 tonnes of rock to cover the exposures.

Appendix G.4.11 Environment – Seabed Disturbance

The leave in-situ and partial removal options are assessed as the most attractive decommissioning options here as the seabed impact is limited to the area relating to the sections of pipeline removal at the line ends.

Option 6 is significantly less attractive than the leave in-situ or partial removal options as a large area of seabed is impacted by the de-burial along the pipelines using an MFE prior to them being cut into sections and removed.

Appendix G.4.12 Environment – Loss of Habitat

Option 6, the full removal option was assessed as being the most attractive option against this criterion as there is no loss of, or material change to the marine habitat as it currently stands.

Option 1a is assessed as less attractive due to the small quantity of rock placed at the cut pipeline ends. Option 4 is assessed as less attractive again, as it involves the introduction of rock to mitigate the snag hazard associated with the cut ends of the pipelines left after the exposures are removed.

The introduction of this rock is a material change to around 1,240 m^2 of habitat where the existing sandbank is replaced with a hard substrate.

Option 2a is assessed as the least attractive option as 3,530 m^2 of existing sandbank is replaced with a hard substrate.

Appendix G.4.13 Environment – Overall

When combining the assessments conducted at sub-criterion level, the most attractive option, from an environmental perspective is Option 1a, followed by Option 4 which is followed closely by Option 6 and Option 2a. It is noted that, reflecting the relatively minor environmental impacts across all options, the differences between the options are small.

The leave in-situ Option 1a was assessed as being the most attractive or equal most attractive option against four of the six environment sub-criteria. This relates to the limited work scope associated with the leave in-situ option and the lack of rock required in this option. It was less preferred from a legacy perspective due to the pipelines being left in-situ and marginally less preferred than the full removal option due to the small amount of habitat loss from the minimal rock cover introduced at the cut pipeline ends.

Option 4 was also assessed as being equal most attractive in four of the six sub-criteria. It was less preferred from a habitat loss perspective as more rock is required at the locations where the exposures are removed.

Option 6 was assessed as being most attractive in the legacy and loss of habitat criteria due to the full removal of the pipelines and no habitat loss from rock placement. The longer duration operations counted against it in other areas.

The lower environmental impact from the shorter durations associated with performing Option 2a was offset by the impact from the rock cover required under this option.

Appendix G.4.14 Technical – Technical Feasibility

The leave in-situ and partial removal options were assessed as being the most attractive from a Technical Feasibility perspective due to the scope of removing the pipeline end sections, removing the exposures, placing rock cover over exposures and over the cut ends associated with these options being considered routine subsea operations.

Option 6 was less attractive as the technical risks associated with the longer durations to cut the pipeline into short sections and recovering them, and successfully performing the de-burial operations to allow the subsea cutting to be performed being the main concerns.

Overall, Option 4, Option 2a and Option 1a are the most attractive from a Technical perspective, followed by Option 6.

Appendix G.4.15 Societal – Fishing Industry

Prior to discussing the assessment, some context is provided from the Fishing Baseline Characterisation ref. [7]. Fishing activity in the LOGGS south area, where the pipelines are installed, is moderate to high in terms of value and effort (up to 100 days of effort) and predominantly undertaken by Dutch beam trawl fleet with a minor amount of fishing undertaken by UK demersal fishing (generally beam trawling).

Given the above, the partial removal and leave in-situ options are assessed as being the most attractive options due to them presenting the least disruption and disturbance to the fishing industry from having the smallest offshore work scopes.

Option 6 is assessed as the least attractive option due to the extensive disruption to the fishing industry from the removal of the entire 80 km of pipelines.

It was noted that, given that fishing operations are already conducted in the area along and around this pipeline, and any infrastructure remaining on the seabed will be subject to an appropriate post-decommissioning monitoring regime, the residual presence of the pipeline was not considered a limitation to fishing activity.

Appendix G.4.16 Societal – Communities / Amenities

The impact of the decommissioning options on communities and amenities are considered in this criterion.

The leave in-situ and partial removal options are assessed as being the most attractive due to them returning limited quantities of material for processing onshore. Whilst this limits the amount of useful material, such as steel, being returned for recycling, it also results in the least amount of material being returned that will be directed to landfill, such as the polymer coating of the pipelines.

Option 6 was assessed as being the least attractive option as it returns the entire 80 km of pipeline and the most quantity of polymer which takes up limited landfill capacity.

Appendix G.4.17 Societal – Overall

When combining the assessments conducted at sub-criterion level, the partial removal and leave in-situ options were considered the equal most attractive options as they were assessed as being the most attractive options against both the Fishing Industry and Communities / Amenities criteria.

Option 6 was less preferred as the impact from the disturbance to the fishing industry and the additional polymer to landfill from the full removal option, being assessed as less attractive.

Appendix G.4.18 Economic – Short-term Costs

Option 1a, Option 2a and Option 4 were assessed as the equal most attractive options from a short-term costs perspective. This is due to their costs being similar and the lowest cost options at £2.9 million, £2.9 million and £3.4 million respectively.

The costs for the full removal option was significantly higher with Option 6 being £211 million.

Appendix G.4.19 Economic – Long-term Costs

The impact of the decommissioning options in terms of long-term costs i.e. any on-going survey and monitoring costs and Fishing Legacy Trust-fund Company (FLTC) payments, are considered in this criterion.

Option 6 is considered the most attractive option against this criterion. This is due to there being no long-term costs associated with this full removal option.

All other options are considered equally less attractive as the long-term costs associated with them is largely similar being between £400 k and £700 k.

Appendix G.4.20 Economic – Overall

Overall, the assessment is dominated by the short-term costs as the differentials are much greater than for the long-term costs.

The partial removal and leave in-situ options are all considered equal most attractive options from an Economic perspective. These are followed by Option 6 which is significantly less attractive.

APPENDIX H **GROUP 7 – DETAILED EVALUATION RESULTS**

Appendix H.1 Group 7 Attributes Table

Group 7: Trenched & Buried Umbilical

- 13.9 km umbilical from Ganymede to Callisto with 11 m of exposure (UM2)

		Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury umbilical with MFE | Recover mattresses and grout bags - Install recovery rigging for reverse reel | Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover umbilical ends - Cut 10 m section with hydraulic shears (at each end) and recover (2 x 10 m) - Cut exposed section out (single 11 m length) with hydraulic shears & recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed	- Dredge to uncover umbilical ends - Cut 10 m section with hydraulic shears (at each end) and recover (2 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections (one run of 11 m) - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover umbilical ends - Cut 10m section with hydraulic shears (at each end) and recover (2 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: areas of exposure at pipeline ends will be removed with ends, other areas of exposure (11 m) will remain
1. Safety	1.1 Personnel Offshore	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 4.7 / 6,164 / 4.62E-04 Divers: 18 / 4.7 / 2,017 / 1.96E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 9.2 / 4,879 / 3.66E-04 CSV: 76 / 19.1 / 17,383 / 1.30E-03 Reel Vessel: 76 / 10.3 / 9,384 / 7.04E-04 Total offshore hours: 40,308 hrs Total offshore PLL: 4.83E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 6.0 / 7,933 / 5.95E-04 Divers: 18 / 6.0 / 2,596 / 2.52E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 9.2 / 4,879 / 3.66E-04 Total offshore hours: 15,888 hrs Total offshore PLL: 3.52E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 5.5 / 7,273 / 5.45E-04 Divers: 18 / 5.5 / 2,380 / 2.31E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 9.2 / 4,879 / 3.66E-04 Total offshore hours: 15,012 hrs Total offshore PLL: 3.26E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 5.3 / 6,943 / 5.21E-04 Divers: 18 / 5.3 / 2,272 / 2.20E-03 Trawler: 5 / 8.0 / 480 / 3.60E-05 Survey Vessel: 44 / 9.2 / 4,879 / 3.66E-04 Total offshore hours: 14,574 hrs Total offshore PLL: 3.13E-03
		N N N	N N	N	
	Summary	The assessment of the Personnel Offshore sub-criterion is as follows: All options are assessed as being Neutral to each other as the risk exposure for offshore personnel is largely similar for all options. Despite reverse reel requiring additional vessel usage, the operations along the 14 km pipeline length do not materially change the offshore risk profile. **Overall, all options are equally preferred from a risk to Offshore Personnel perspective.**			
1. Safety	1.2 Personnel Onshore	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 9.0 / 576 / 7.08E-05 Total onshore hours: 576 hrs Total onshore PLL: 7.08E-05	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06	Resource Type: Days / Hours / PLL Onshore Operations (Cleaning & Disposal): 1.0 / 64 / 7.87E-06 Total onshore hours: 64 hrs Total onshore PLL: 7.87E-06
		MW MW MW	N N	N	
	Summary	The assessment of the Personnel Onshore sub-criterion is as follows: Option 5 is assessed as being Much Weaker than all other options as the risk exposure for onshore personnel is around 10 times higher for Option 5 due to the full pipeline length being recovered to shore for handling compared to less than 50 m of umbilical in the other options. Option 4, Option 2a and Option 1a are all assessed as being Neutral to each other as the risk exposure from onshore handling the quantities of returned umbilical are largely similar. **Overall, Option 4, Option 2a and Option 1a are equal most preferred from a risk to Onshore Personnel perspective.**			
1. Safety	1.3 Other Users	Vessel Days: DSV: 4.7 Divers: 4.7 Trawler: 8.0 Survey Vessel: 9.2 CSV: 19.1 Reel Vessel: 10.3 Total vessel days: 51.3 days Total Number of Transits: 14	Vessel Days: DSV: 6.0 Divers: 6.0 Trawler: 8.0 Survey Vessel: 9.2 Total vessel days: 23.3 days Total Number of Transits: 8	Vessel Days: DSV: 5.5 Divers: 5.5 Trawler: 8.0 Survey Vessel: 9.2 Total vessel days: 22.8 days Total Number of Transits: 8	Vessel Days: DSV: 5.3 Divers: 5.3 Trawler: 8.0 Survey Vessel: 9.2 Total vessel days: 22.5 days Total Number of Transits: 8
		N N N	N N	N	
	Summary	The assessment of the Other Users sub-criterion is as follows: All options are assessed as being Neutral to each other as, whilst there are differences between the vessel days and number of transits between the options, these are insufficient to result in a material difference in the safety impact on other users. **Overall, all options are equally preferred from a risk to Other Users perspective.**			

		Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury umbilical with MFE | Recover mattresses and grout bags - Install recovery rigging for reverse reel | Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover umbilical ends - Cut 10 m section with hydraulic shears (at each end) and recover (2 x 10 m) - Cut exposed section out (single 11 m length) with hydraulic shears & recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed	- Dredge to uncover umbilical ends - Cut 10 m section with hydraulic shears (at each end) and recover (2 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections (one run of 11 m) - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover umbilical ends - Cut 10m section with hydraulic shears (at each end) and recover (2 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: areas of exposure at pipeline ends will be removed with ends, other areas of exposure (11 m) will remain
1. Safety	1.4 High Consequence Events	The potential for High Consequence Events is assessed as Medium for this option. This relates to the on-deck cutting (for umbilical that is longer than reel capacity), lifting (for umbilical recovery for reeling) and integrity (whilst reverse reeling). Number of Lifts: 2	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to remove the umbilical exposures and ends. Number of Lifts: 3	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the umbilical ends only. Number of Lifts: 2	The potential for High Consequence Events is assessed as Low for this option. This is based on the number of both cutting and lifting operations that would need to take place to the umbilical ends only. Number of Lifts: 2
		W **W** **W**	**N** **N**	**N**	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 6 is assessed as being Weaker than all other options as there is potential for a High Consequence Event from the deck handling during reverse reel operations versus the low potential due to limited lifting operations. Option 4, Option 2a and Option 1a are assessed as being Neutral to each other as the potential for High Consequence Events is considered similar for these options due to limited lifting operations. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a High Consequence Events perspective.**			
1. Safety	1.5 Residual Risk	As the umbilical would be fully removed from the seabed, there would be no legacy risk associated with this full removal option.	The majority of the 13.9 km umbilical is trenched and buried to an appropriate depth. There is 11 m of exposed umbilical which will be removed with the potential snag hazard associated with the cut ends mitigated by spot rock placement designed to be overtrawlable. A post-decommissioning trawl sweep will be conducted. As such, the potential snag hazard post-decommissioning activities is adequately mitigated and would be lower than for the umbilical in its current state of exposure. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.	The majority of the 13.9 km umbilical is trenched and buried to an appropriate depth. There is 11 m of exposed umbilical which will be rock dumped to mitigate the potential snag hazard associated with these exposed areas. The areas of rock placement will be designed to be overtrawlable and a post-decommissioning trawl sweep will be conducted. As such, the potential snag hazard post-decommissioning activities is adequately mitigated and would be lower than for the umbilical in its current state of exposure. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.	The majority of the 13.9 km umbilical is trenched and buried to an appropriate depth. There is 11 m of exposed umbilical which will remain in its current state of exposure. The survey & monitoring programme is committed to ensuring that the potential snag hazard from left in-situ infrastructure continues to be managed & mitigated as appropriate.
		S **S** **S**	**N** **N**	**N**	
	Summary	The assessment of the Residual Risk sub-criterion is as follows: Option 5 is assessed as being Stronger than all other options due to there being no residual risk associated with the full removal option versus potential for a snag hazard in Option 4, Option 2a and Option 1a, albeit these potential snag hazards are very short lengths and for Option 4 and Option 2a they are mitigated by rock dump. Option 4, Option 2a and Option 1a are all assessed as being Neutral to each other as the residual risk posed by the left in-situ infrastructure is largely similar due to the very small lengths of exposure / rock dump. **Overall, Option 5 is the most preferred from a Residual Risk perspective.**			
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): Survey Vessel - 1.2 days | CSV - 12 days | DSV - 0.67 days | Reel Vessel - 6.28 | Trawler - 5 days Tooling Noise: MFE for Unburial - 5.78 days Operational Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as no cutting performed. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and is slightly increased for reverse reel operations.	Vessel Noise (days on-site): Survey Vessel - 1.2 days | DSV - 0.08 days | Trawler - 5 days Tooling Noise: Dredging - 0.5 days | Hydraulic Shears - 2.34 days | Rock Dumping - 5 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as cutting performed by hydraulic shears. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and largely similar for all options except Option 5 which is slightly increased for reverse reel operations.	Vessel Noise (days on-site): Survey Vessel - 1.2 days | DSV - 1.5 days | Trawler - 5 days Tooling Noise: Dredging - 0.5 days | Hydraulic Shears - 0.08 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as cutting performed by hydraulic shears. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and largely similar for all options except Option 5 which is slightly increased for reverse reel operations.	Vessel Noise (days on-site): Survey Vessel - 1.2 days | DSV - 1.25 day | Trawler - 5 days Tooling Noise: Dredging - 0.5 days | Hydraulic Shears - 0.08 days Operation Discharges: Negligible potential for hydrocarbon releases through cutting operations because the pipeline has been cleaned successfully. Planned discharges would therefore be within acceptable limits and included in operational permits. No cutting swarf as cutting performed by hydraulic shears. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and largely similar for all options except Option 5 which is slightly increased for reverse reel operations.
		W **W** **W**	**N** **N**	**N**	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 5 is assessed as being Weaker than all other options due to the slightly increased vessel usage that will give rise to vessel discharges and tooling noise from the MFE. All other options are assessed as being Neutral to each other as, whilst there are small differences in marine impact from these options, these differences were insufficient to express a preference. **Overall, Option 4, Option 2a and Option 1a are equally preferred from an Operational Marine Impact perspective.**			

		Option 5a Full Removal (Reverse Reel)			Option 4 Partial Removal (Cut & Lift)		Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury umbilical with MFE | Recover mattresses and grout bags - Install recovery rigging for reverse reel | Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep			- Dredge to uncover umbilical ends - Cut 10 m section with hydraulic shears (at each end) and recover (2 x 10 m) - Cut exposed section out (single 11 m length) with hydraulic shears & recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed		- Dredge to uncover umbilical ends - Cut 10 m section with hydraulic shears (at each end) and recover (2 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections (one run of 11 m) - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover umbilical ends - Cut 10m section with hydraulic shears (at each end) and recover (2 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: areas of exposure at pipeline ends will be removed with ends, other areas of exposure (11 m) will remain
2. Environmental	2.2 Legacy Marine Impact	There will be no legacy marine impacts from this full removal option.			The majority of the 13.9 km umbilical is trenched and buried to an appropriate depth. There is 11 m of exposed umbilical which will be removed, with the cut ends rock dumped. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried umbilical which has a combination of polymer and steel layers. Given the buried status of the material being left in-situ and the umbilical having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.		The majority of the 13.9 km umbilical is trenched and buried to an appropriate depth. There is 11 m of exposed umbilical which will be rock dumped. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried umbilical which has a combination of polymer and steel layers. Given the buried status of the material being left in-situ and the pipeline having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.	The majority of the 13.9 km umbilical is trenched and buried to an appropriate depth. There is 11 m of exposed umbilical which will be left as-is. The legacy marine impacts relate to the left in-situ materials, i.e. the remaining trenched and buried umbilical which has a combination of polymer and steel layers. Given the buried status of the material being left in-situ and the pipeline having been cleaned to a regulatory acceptable level, the legacy marine impact is considered low but greater than the full removal option.
		S	S	S	N	N	N	
	Summary	The assessment of the Legacy Marine Impact sub-criterion is as follows: Option 5 is assessed as being Stronger than all other options as the full removal option removes all material whilst the other options leave similar quantities and types of material in-situ. Whilst the legacy environmental impact is expected to be low for these options, there is polymer remaining and this is enough to express a small preference for the full removal option. All other options are assessed as Neutral to each other as the quantities and types of material and thus the legacy environmental impact is expected to be similar for these options. **Overall, Option 5 is the most preferred from a Legacy Marine Impact perspective.**						
2. Environmental	2.3 Fuel Use & Atmospheric Emissions	Vessel Emissions (in tonnes): Fuel: 1,161 CO2e: 3,807 NOx: 68.98 SO2: 4.65 Vessel Energy Use: 49,936 GJ			Vessel Emissions (in tonnes): Fuel: 532 CO2e: 1,742 NOx: 31.58 SO2: 2.13 Vessel Energy Use: 22,858 GJ		Vessel Emissions (in tonnes): Fuel: 522 CO2e: 1,710 NOx: 31.00 SO2: 2.09 Vessel Energy Use: 22,438 GJ	Vessel Emissions (in tonnes): Fuel: 517 CO2e: 1,694 NOx: 30.71 SO2: 2.07 Vessel Energy Use: 22,229 GJ
		N	N	N	N	N	N	
	Summary	The assessment of the Fuel Use & Atmospheric Emissions sub-criterion is as follows: All options are assessed as Neutral to each other as the fuel used and emissions generated are similar for all options. **Overall, all options are equally preferred from a Fuel Use & Atmospheric Emissions perspective.**						
2. Environmental	2.4 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 248 Remaining Material: N/A Total: 248 Rock: N/A			Material Emissions (CO2 in tonnes): Recovered Material: 1 Remaining Material: 397 Total: 398 Rock: 200 tonnes		Material Emissions (CO2 in tonnes): Recovered Material: 1 Remaining Material: 397 Total: 398 Rock: 160 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 1 Remaining Material: 397 Total: 398 Rock: 50 tonnes
		N	N	N	N	N	N	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: All options are assessed as being Neutral to each other as, whilst there are differences between the amount of CO2 consumed to process returned material and / or generated during the production of replacement material left behind, and the amount of rock used, these are considered insufficient to express a preference for any of the options. **Overall, all options are equally preferred from an Other Consumptions perspective.**						
2. Environmental	2.5 Disturbance	Short Term Disturbance (MFE): 69,320 m2			There is a small amount of short-term disturbance resulting from removing the 11.4 m of exposure along this umbilical and rock dumping the cut ends. This is considered insignificant.		There is limited short-term disturbance for this option from the small area of rock dump only.	There is limited short-term disturbance for this option from the small area of rock dump only.
		W	W	W	N	N	N	
	Summary	The assessment of the Seabed Disturbance (short-term impact) sub-criterion is as follows: Option 5 is assessed as being Weaker than all other options due to the area of seabed disturbance from the unburial of the13.9 km umbilical using a Mass Flow Excavator when compared to the very small area impacted in the other options. Option 4, Option 2a and Option 1a are all assessed as being Neutral to each other as the seabed disturbance is considered negligible and similar across these options. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Seabed Disturbance perspective.**						

		Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury umbilical with MFE | Recover mattresses and grout bags - Install recovery rigging for reverse reel | Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep	- Dredge to uncover umbilical ends - Cut 10 m section with hydraulic shears (at each end) and recover (2 x 10 m) - Cut exposed section out (single 11 m length) with hydraulic shears & recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed	- Dredge to uncover umbilical ends - Cut 10 m section with hydraulic shears (at each end) and recover (2 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections (one run of 11 m) - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover umbilical ends - Cut 10m section with hydraulic shears (at each end) and recover (2 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: areas of exposure at pipeline ends will be removed with ends, other areas of exposure (11 m) will remain
2. Environmental	2.6 Loss of Habitat	Habitat Loss (Rockdump): N/A	Habitat Loss (Rockdump): 160 m2	Habitat Loss (Rockdump): 150 m2	Habitat Loss (Rockdump): 40 m2
		S S S	N W	W	
	Summary	The assessment of the Loss of Habitat (legacy / long-term impact) sub-criterion is as follows: Option 5 is assessed as being Stronger than Option 4, Option 2a and Option 1a as the rock placed for each of these options changes the current seabed habitat and thus results in an area of habitat loss whereas there is no habitat loss in Option 5. Option 4 is assessed as being Neutral to Option 2a as the area of habitat loss in these options is similar. Option 4 is assessed as being Weaker than Option 1a as area of habitat loss in Option 1a is smaller than Option 4. Option 2a is assessed as being Weaker than Option 1a as the area of habitat loss in Option 2a is greater than Option 1a. Note: Habitat loss is from the replacement of the sandbank features with hard substrate (rock). **Overall, Option 5 is the most preferred from a Loss of Habitat perspective.**			
3. Technical	3.1 Technical Feasibility	**Concept Maturity:** Reverse reeling of umbilicals is considered routine. (Score 3) **Technical Risks:** There are risks to successfully reverse reeling this umbilical due to the potential for integrity failure during recovery and any cutting required for a reel swap on the reel vessel (deck ops). (Score 2)	**Concept Maturity:** Cutting umbilicals with hydraulic shears and rock dumping considered routine. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required. Rock dump routine. (Score 3)	**Concept Maturity:** Cutting umbilicals with hydraulic shears and rock dumping considered routine. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required and no requirement for unburial. Rock dump routine. (Score 3)	**Concept Maturity:** Cutting umbilicals with hydraulic shears and rock dumping considered routine. (Score 3) **Technical Risks:** Limited technical risks due to the limited cutting required and no requirement for unburial. Rock dump routine. (Score 3)
		W W W	N N	N	
	Summary	The assessment of the Technical Risk sub-criterion is as follows: Option 5 is assessed as being Weaker than all other options as there are technical risks associated with the reverse reeling operations such as potential integrity failure and deck operations. All other options are assessed as being Neutral to each other as the technical risk profiles are largely similar, i.e. short duration, routine operations. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Technical Risk perspective.**			
4. Societal	4.1 Fishing	Whilst this option provides clear seabed, the operational impact of removing the umbilical disturbs (displacement and restricted access) current fishing operations. The impact is low due to the relatively short length of umbilical. Fishing operations are conducted in the area of this umbilical. (Score 2)	Short term disturbance in localised areas. Relatively small volume of rock covering cut ends results in intermittent rock piles. Left in-situ infrastructure may lead to snagging in time. Fishing operations are conducted in the area of this umbilical. (Score 2)	Short term disturbance in localised areas. Relatively small volume of rock covering installed over exposures, profiled to be overtrawlable. Left in-situ infrastructure may lead to snagging in time. Fishing operations are conducted in the area of this umbilical. (Score 2)	Short term disturbance in localised areas. Relatively small volume of rock covering installed over cut ends, profiled to be overtrawlable. Left in-situ infrastructure may lead to snagging in time. Fishing operations are conducted in the area of this umbilical. (Score 2)
		W W W	N N	N	
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 5 is assessed as being Weaker than all other options due to the disruption caused to fishing operations from the full removal of the pipeline versus minimal disruption due to shorter operational durations with the other options. All other options are assessed as being Neutral to each other as the disruption associated with exposure removal and / or rock dump is largely similar, as is the left in-situ infrastructure. Note: given that fishing operations are conducted extensively in this area, no benefit is given for full removal of the pipeline in terms of impact to fishing industry. **Overall, Option 4, Option 2a and Option 1a are the equally preferred from a Societal impact on Fishing perspective.**			
4. Societal	4.2 Communities / Ammenities	Materials Returned: Steel: 186 tonnes (recyclable) Polymer: 80 tonnes (landfill) Mattress/Grout Bag: 54 tonnes (landfill) Whilst there are some societal benefits from the returning recyclable steel, this is more than offset by the polymer and mattress / grout bags, which will take up landfill capacity. (Score 2)	Materials Returned: Steel: 1 tonnes (recyclable) Polymer: 1 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)	Materials Returned: Steel: 1 tonnes (recyclable) Polymer: 1 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)	Materials Returned: Steel: 1 tonnes (recyclable) Polymer: 1 tonnes (landfill) There are minimal societal benefits / impacts with this option due to the minimal onshore returns & disposal. (Score 3)
		W W W	N N	N	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: Note: Assessment of the societal impact of options is dominated by any negative impacts from material returned as the positive impacts, such as recyclable material or any job creation / retention offered by an option is considered less significant than negative impacts such as using landfill capacity. Option 5 is assessed as being Weaker than all other options due to the polymer and mattress / grout bags that are likely to end up in landfill compared to negligible amounts for Option 4, Option 2a and Option 1a. All other options are assessed as being Neutral to each other as the positive and negative societal benefits are largely similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Societal impact on Other Users perspective.**			

		Option 5a Full Removal (Reverse Reel)			Option 4 Partial Removal (Cut & Lift)		Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)
		- Unbury umbilical with MFE | Recover mattresses and grout bags - Install recovery rigging for reverse reel | Reverse reel onto reel vessel - Backfill trench | Post decommissioning survey | Seabed trawl sweep			- Dredge to uncover umbilical ends - Cut 10 m section with hydraulic shears (at each end) and recover (2 x 10 m) - Cut exposed section out (single 11 m length) with hydraulic shears & recover - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be removed		- Dredge to uncover umbilical ends - Cut 10 m section with hydraulic shears (at each end) and recover (2 x 10 m) - Place rock to remediate snag risk at exposed ends - Place rock across all remaining exposed sections (one run of 11 m) - Post decommissioning survey | Seabed trawl sweep - Note: all areas of exposure will be rock dumped	- Dredge to uncover umbilical ends - Cut 10m section with hydraulic shears (at each end) and recover (2 x 10 m) - Place rock to remediate snag risk at exposed ends - Post decommissioning survey | Seabed trawl sweep - Note: areas of exposure at pipeline ends will be removed with ends, other areas of exposure (11 m) will remain
5. Economic	5.1 Short-term Costs	£5.736 Million			£2.255 Million		£1.885 Million	£1.743 Million
		W	W	W	N	N	N	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 5 is assessed as being Weaker than all other options as the costs are around double in all cases. All other options are assessed as being Neutral to each other as the costs are similar. **Overall, Option 4, Option 2a and Option 1a are equally preferred from a Short-term Cost perspective.**						
5. Economic	5.2 Long-term Costs	Surveys: N/A FLTC: N/A Total Legacy Cost: £0 Million			Surveys: £0.277 Million FLTC: N/A Total Legacy Cost: £0.277 Million		Surveys: £0.277 Million FLTC: N/A Total Legacy Cost: £0.277 Million	Surveys: £0.277 Million FLTC: £0.042 Million Total Legacy Cost: £0.319 Million
		S	S	S	N	N	N	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: Option 5 is assessed as being Stronger than all other options as there are no legacy / long-term costs associated with this option versus similar long-term costs for all other options. All other options are assessed as being Neutral to each other as the long-term costs are largely similar. **Overall, Option 5 is most preferred from a Long-term Cost perspective.**						

Appendix H.2 Group 7 Pairwise Comparison Matrices

1.1 Personnel Offshore	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	N	N	N	25.0%
Option 4 Partial Removal (Cut & Lift)	N	N	N	N	25.0%
Option 2a Leave In-situ (Minor Intervention)	N	N	N	N	25.0%
Option 1a Do Nothing (Minimum Intervention)	N	N	N	N	25.0%

1.2 Personnel Onshore	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	MW	MW	MW	10.0%
Option 4 Partial Removal (Cut & Lift)	MS	N	N	N	30.0%
Option 2a Leave In-situ (Minor Intervention)	MS	N	N	N	30.0%
Option 1a Do Nothing (Minimum Intervention)	MS	N	N	N	30.0%

1.3 Other Users	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	N	N	N	25.0%
Option 4 Partial Removal (Cut & Lift)	N	N	N	N	25.0%
Option 2a Leave In-situ (Minor Intervention)	N	N	N	N	25.0%
Option 1a Do Nothing (Minimum Intervention)	N	N	N	N	25.0%

1.4 High Consequence Events	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

1.5 Residual Risk	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	S	S	S	33.3%
Option 4 Partial Removal (Cut & Lift)	W	N	N	N	22.2%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	N	22.2%
Option 1a Do Nothing (Minimum Intervention)	W	N	N	N	22.2%

2.1 Operational Marine Impact	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

2.2 Legacy Marine Impact	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	S	S	S	33.3%
Option 4 Partial Removal (Cut & Lift)	W	N	N	N	22.2%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	N	22.2%
Option 1a Do Nothing (Minimum Intervention)	W	N	N	N	22.2%

2.3 Fuel Use & Atmospheric Emissions	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	N	N	N	25.0%
Option 4 Partial Removal (Cut & Lift)	N	N	N	N	25.0%
Option 2a Leave In-situ (Minor Intervention)	N	N	N	N	25.0%
Option 1a Do Nothing (Minimum Intervention)	N	N	N	N	25.0%

2.4 Other Consumptions	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	N	N	N	25.0%
Option 4 Partial Removal (Cut & Lift)	N	N	N	N	25.0%
Option 2a Leave In-situ (Minor Intervention)	N	N	N	N	25.0%
Option 1a Do Nothing (Minimum Intervention)	N	N	N	N	25.0%

2.5 Disturbance	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

2.6 Loss of Habitat	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	S	S	S	33.1%
Option 4 Partial Removal (Cut & Lift)	W	N	N	W	19.9%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	W	19.9%
Option 1a Do Nothing (Minimum Intervention)	W	S	S	N	27.0%

3.1 Technical Feasibility	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

4.1 Fishing

	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

4.2 Communities / Ammenities

	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

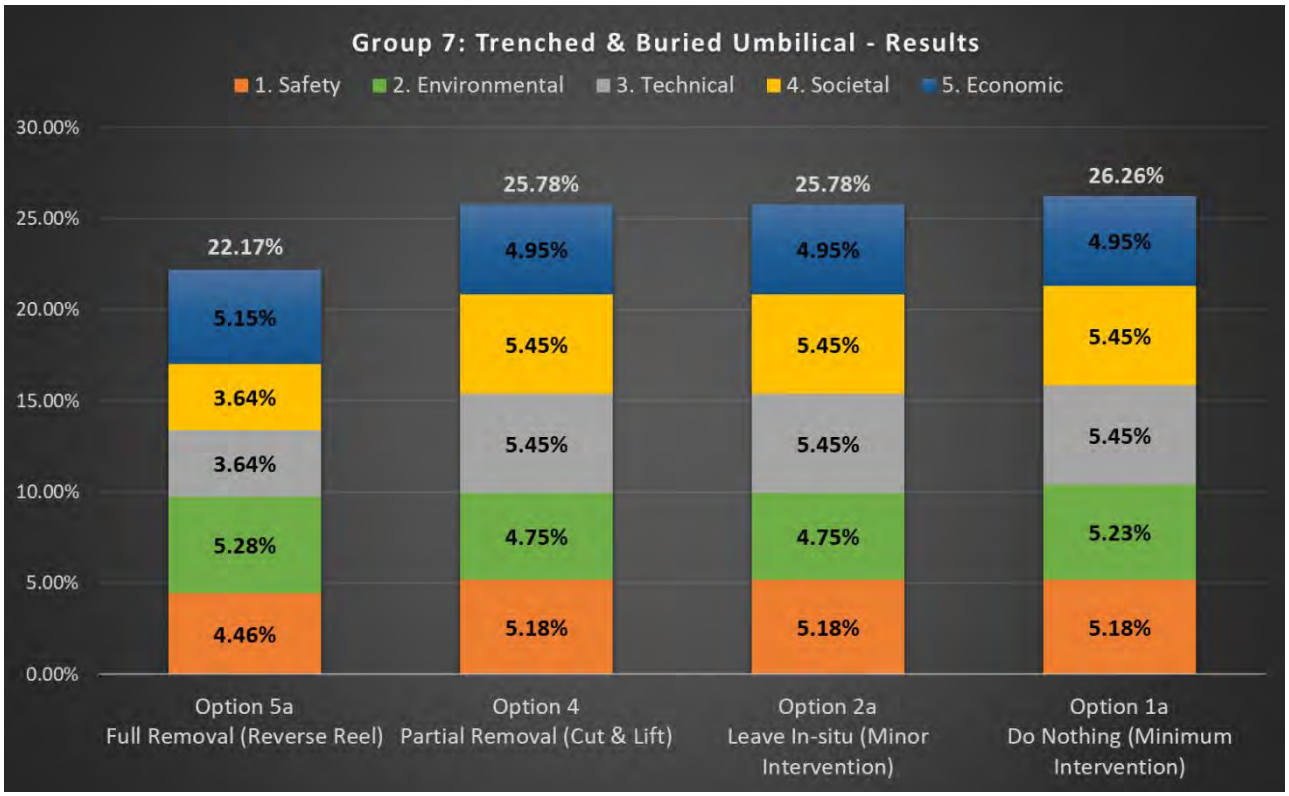
5.1 Short-term Costs

	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	W	W	W	18.2%
Option 4 Partial Removal (Cut & Lift)	S	N	N	N	27.3%
Option 2a Leave In-situ (Minor Intervention)	S	N	N	N	27.3%
Option 1a Do Nothing (Minimum Intervention)	S	N	N	N	27.3%

5.2 Long-term Costs

	Option 5a Full Removal (Reverse Reel)	Option 4 Partial Removal (Cut & Lift)	Option 2a Leave In-situ (Minor Intervention)	Option 1a Do Nothing (Minimum Intervention)	Weighting
Option 5a Full Removal (Reverse Reel)	N	S	S	S	33.3%
Option 4 Partial Removal (Cut & Lift)	W	N	N	N	22.2%
Option 2a Leave In-situ (Minor Intervention)	W	N	N	N	22.2%
Option 1a Do Nothing (Minimum Intervention)	W	N	N	N	22.2%

Appendix H.3 Group 7 Results Chart



Appendix H.4 Group 7 Detailed Evaluation Discussion

Appendix H.4.1 Safety – Personnel Offshore

The assessment of the options indicated that all options were equally preferred from a Personnel Offshore perspective. Whilst the full removal option is greater in scope as it removes the entire umbilical, with it being only 14 km in length, the differential in scope between the full and partial removal / leave in-situ options is smaller. This means the difference in safety risk exposure to offshore personnel is also smaller, and insufficient to express a preference in this case.

Appendix H.4.2 Safety – Personnel Onshore

As with previous assessments, the safety risk associated with the onshore personnel is related to the quantity of material being returned to shore for onshore handling, transportation and processing. The leave in-situ options (Option 1a and 2a) were considered equally preferred as the quantity of material from removing the umbilical ends is the same in both options.

The partial removal option (Option 4) returns slightly more material for onshore handling, transportation and processing from the removed exposures (11 m) but this was insufficient to express a preference.

The full removal by reverse reeling (Option 5a) returns more material for onshore handling, transportation and processing, than the leave in-situ or partial removal options as the full 14 km umbilical is retuned. As such, the full removal option is assessed as being less attractive than the leave in-situ or partial removal options.

Appendix H.4.3 Safety – Other Users

The assessment of the decommissioning options against this criterion has indicated that all options are equally preferred as they have a similar, low impact on the safety of other users as the vessel days and transits to and from port is similar in these options.

Appendix H.4.4 Safety – High Consequence Events

The assessment during the workshop indicated that the partial removal and leave in-situ options would have the least exposure to potential for High Consequence Events and would therefore, be the most attractive against this criterion. This is due to the limited cut and lift operations to recover the umbilical end sections in Option 1a and Option 2a with the small additional number of cut and lift operations to remove the exposures in Option 4 being insufficient to differentiate from a potential for High Consequence Events perspective.

Option 5a would be exposed to a greater potential for High Consequence Events from the back of deck handling and potential for integrity failure of the umbilical.

Appendix H.4.5 Safety – Residual Risk

The residual risk relates to the potential for any safety impact from the decommissioning options. Option 5a is assessed as the most attractive option from a residual safety risk perspective as it is a full removal option and therefore removes all residual risk.

The partial removal and leave in-situ options were assessed as being equally attractive from a residual risk perspective as the removal of the exposures in Option 4 or the rock placement over the exposures in Option 2a were considered to provide similar mitigation of any potential residual risk.

These were also considered similar to Option 1a as the 11 m of exposure left in this option was insufficient to express a preference.

It should be noted that, as part of any partial removal or leave in-situ solution being selected, any potential hazards along the umbilical would be risk assessed and remediated and / or monitored to ensure that any emerging hazards do not develop into an unacceptable snagging risk to fishing operations.

Appendix H.4.6 Safety – Overall

When combining the assessments conducted at sub-criterion level, the partial removal and leave in-situ options were all considered equal most attractive from a safety perspective. This reflects the similar work scopes associated with these options from addressing the 11 m of exposure along a 14 km umbilical.

Option 5a was assessed as significantly less attractive than the other options overall with it being the most attractive for residual risk being insufficient to offset the other contributions.

Appendix H.4.7 Environment – Operational Marine Impact

The environmental impact on the marine environment from performing the decommissioning options was considered low across all options. However, there were sufficient, cumulative differences, to indicate preferences across the decommissioning options.

The assessment performed during the workshop indicated that the leave in-situ and partial removal options are the most attractive from an operational marine impact perspective. This is due to these options having the least impact in terms of marine noise as they have the lowest number of vessel days and the lowest amount of subsea cutting operations with the increases for partial removal by cut & lift over the leave in-situ options being insufficient to express a preference.

All options have similar impacts in terms of discharges that occur from the umbilical whilst performing the decommissioning option as they will have been cleaned successfully for all options.

The discharges from vessels relates to the number of vessels and the number of vessel days. Option 5a is less attractive than the options due to the additional number of vessel days associated with the full removal option.

Appendix H.4.8 Environment – Legacy Marine Impact

The assessment indicated that Option 5a, full removal of the umbilical, is the most attractive decommissioning option from a legacy marine environmental impact perspective. This is due to the umbilical being fully removed and thus eliminating any legacy impact from degradation products or polymers.

The partial removal and leave in-situ options were assessed as less attractive than the full removal option as the majority of the umbilical is left in-situ in these options. The additional removal of 11 m of exposure was not considered sufficient to differentiate between Option 4 and the leave in-situ options. No distinction was made between the impact of exposed umbilical versus buried or rock covered umbilical.

Appendix H.4.9 Environment – Fuel Use & Atmospheric Emissions

The assessment indicated that the all options are equally the most attractive against the fuel use and atmospheric emissions criterion. This is due to the differences in terms of work scope being insufficient to express a preference from a fuel use and emissions perspective.

Appendix H.4.10 Environment – Other Consumptions

All options were assessed as equally preferred from an Other Consumptions perspective. This is due to the differences in terms of material returned, material left in-situ and rock cover required being insufficient to express a preference.

Appendix H.4.11 Environment – Seabed Disturbance

The leave in-situ and partial removal options are assessed as the most attractive decommissioning options here as the seabed impact is limited to the area relating to the umbilical end section removal.

Option 5a is less attractive than the leave in-situ or partial removal options as a large area of seabed is impacted by the de-burial along the umbilical using an MFE prior to it being reverse reeled.

Appendix H.4.12 Environment – Loss of Habitat

Option 5a, the full removal option was assessed as being the most attractive option against this criterion as there is no loss of, or material change to the marine habitat as it currently stands.

Option 1a is assessed as less attractive due to the small quantity of rock placed at the cut umbilical ends. Option 4 and Option 2a are assessed as less attractive again, as they involve the introduction of rock to mitigate the snag hazard associated with the cut ends of the umbilical left after the exposures are removed or to cover the exposures. The introduction of this rock is a material change to around 160 m^2 or 150 m^2 of habitat for Option 4 and Option 2a respectively, where the existing sandbank is replaced with a hard substrate.

Appendix H.4.13 Environment – Overall

When combining the assessments conducted at sub-criterion level, the most attractive option, from an environmental perspective is Option 5a, followed closely by Option 1a which is followed closely by Option 4 and Option 2a. It is noted that, reflecting the relatively minor environmental impacts across all options, the differences between the options are small.

The full removal by reverse reeling option was assessed as being the most attractive or equal most attractive option against four of the six environmental sub-criteria. Key contributions were provided in the legacy and loss of habitat criteria.

Option 1a was also most attractive or equal most attractive in four of the six sub-criteria with the impact from leaving the umbilical in-situ and the small amount of rock cover at the cut umbilical ends being sufficient to express a preference for Option 5a.

Option 4 and Option 2a were also assessed as being equal most attractive in four of the six sub-criteria. They were less preferred from legacy and a habitat loss perspective as the umbilical is left in-situ and a small quantity rock is required at the locations where there are exposures or where they are removed.

Appendix H.4.14 Technical – Technical Feasibility

The leave in-situ and partial removal options were assessed as being the most attractive from a Technical Feasibility perspective due to the scope of removing the umbilical end sections, removing the exposures, placing rock cover over exposures and over the cut ends associated with these options being considered routine subsea operations.

Option 5a was less attractive as the technical risks associated with successfully performing the de-burial operations to allow the reverse reeling of the umbilical to be performed being the main concern.

Overall, Option 4, Option 2a and Option 1a are the most attractive from a Technical perspective, followed by Option 5a.

Appendix H.4.15 Societal – Fishing Industry

Prior to discussing the assessment, some context is provided from the Fishing Baseline Characterisation ref. [7]. Fishing activity in the LOGGS south area, where the pipelines are installed, is moderate to high in terms of value and effort (up to 100 days of effort) and predominantly undertaken by Dutch beam trawl fleet with a minor amount of fishing undertaken by UK demersal fishing (generally beam trawling).

Given the above, the partial removal and leave in-situ options are assessed as being the most attractive options due to them presenting the least disruption and disturbance to the fishing industry from having the smallest offshore work scopes.

Option 5a is assessed as the least attractive option due to the added disruption to the fishing industry from the removal of the entire 14 km of umbilical.

It was noted that, given that fishing operations are already conducted in the area along and around this umbilical, and any infrastructure remaining on the seabed will be subject to an appropriate post-decommissioning monitoring regime, the residual presence of the umbilical was not considered a limitation to fishing activity.

Appendix H.4.16 Societal – Communities / Amenities

The impact of the decommissioning options on communities and amenities are considered in this criterion.

The leave in-situ and partial removal options are assessed as being the most attractive due to them returning limited quantities of material for processing onshore. Whilst this limits the amount of useful material, such as copper and steel, being returned for recycling, it also results in the least amount of material being returned that will be directed to landfill, such as the polymer coating and high-pressure tubes of the umbilical.

Option 5a was assessed as being the least attractive option as it returns the entire 14 km of umbilical and the most quantity of polymer which takes up limited landfill capacity.

Appendix H.4.17 Societal – Overall

When combining the assessments conducted at sub-criterion level, the partial removal and leave in-situ options were considered the equal most attractive options as they were assessed as being the most attractive options against both the Fishing Industry and Communities / Amenities criteria.

Option 5a was less preferred as the impact from the disturbance to the fishing industry and the additional polymer to landfill from the full removal option, being assessed as less attractive.

Appendix H.4.18 Economic – Short-term Costs

Option 1a, Option 2a and Option 4 were assessed as the equal most attractive options from a short-term costs perspective. This is due to their costs being similar and the lowest cost options at £1.7 million, £1.9 million and £2.3 million respectively.

The costs for the full removal option was higher with Option 5a being £5.7 million.

Appendix H.4.19 Economic – Long-term Costs

The impact of the decommissioning options in terms of long-term costs i.e. any on-going survey and monitoring costs and Fishing Legacy Trust-fund Company (FLTC) payments, are considered in this criterion.

Option 5a is considered the most attractive option against this criterion. This is due to there being no long-term costs associated with this full removal option.

All other options are considered equally less attractive as the long-term costs associated with them is largely similar being between £270 k and £320 k.

Appendix H.4.20 Economic – Overall

Overall, the assessment is dominated by the short-term costs as the differentials are much greater than for the long-term costs.

The partial removal and leave in-situ options are all considered equal most attractive options from an Economic perspective. These are followed by Option 5a which is significantly less attractive.