Dana Petroleum E&P

Western Isles Decommissioning Programme

Comparative Assessment Recommendations Report

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XODUS

Aberdeen

Xodus House
50 Huntly Street . Aberdeen
AB10 1RS . UK

T +44 (0)1224 628300

www.xodusgroup.com

REVISIONS & APPROVALS

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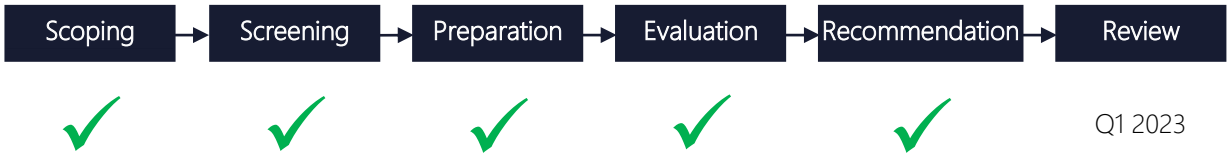
EXECUTIVE SUMMARY

Dana Petroleum (E&P) Limited have conducted a Comparative Assessment (CA) for the decommissioning of the infrastructure associated with their Western Isles Development (Harris and Barra fields). The following steps from the Oil and Gas UK CA Guidelines have been completed:



This CA report for the Western Isles Development presents the methodology, decisions taken, the preparation works carried out, and the outcomes (recommendations) from the internal and external (with stakeholders) workshops.

A total of 12 decommissioning groups were considered during the CA with 10 groups being confirmed at the CA Scoping and Screening stage to be required to be fully removed from the field. Full evaluation was conducted on the remaining two decommissioning groups with the outcomes obtained as described in the table below. Overall, the emerging recommendations from the CA process are as follows:

GROUP	TITLE	DECOMMISSIONING APPROACH
1	FPSO	Full Removal selected during scoping phase.
2	Mooring Lines (Upper Section)	Full Removal selected during scoping phase.
3	Mid-water Arches	Full Removal selected during scoping phase.
4	Dynamic Flexible Risers	Full Removal selected during scoping phase.
5	Dynamic Umbilicals	Full Removal selected during scoping phase.
6	Bundles	Option 5 – Remove Ends and Remediate Snag Risk • Bundles will be disconnected / cut from towheads; • Rock placement to remediate snag risk at cut ends from towhead removal; • Rock placement at areas of spanning (minimal in size and number of locations); • Removal of venting appurtenances (vent valve assemblies and cages) and ballast chains (assumed diver operations); and • Future survey & monitoring programme.
7	Rigid Pipelines (Trenched and Backfilled)	Option 5 – Remove Ends and Remediate Snag Risk • Pipeline will be disconnected / cut from structures; • Removal and recovery of pipeline ends (out with existing trench) by cutting into sections; • Rock placement to remediate snag risk from cut ends; and • Future survey & monitoring programme.
8	Spools	Full Removal selected during scoping phase.

GROUP	TITLE	DECOMMISSIONING APPROACH
9	Jumpers	Full Removal selected during scoping phase.
10	Structures	Full Removal selected during scoping phase.
11	Protection Materials	Full Removal selected during scoping phase.
12	Mooring Lines (Lower Chain & Anchor Piles)	Full Removal selected during scoping phase.

1 INTRODUCTION

1.1 Background

Dana Petroleum (E&P) Limited (referred to as Dana from this point forward) have engaged Xodus Group to conduct a Comparative Assessment (CA) of options for the decommissioning of the infrastructure related to the Western Isles (Barra & Harris) fields. The infrastructure is located in the Northern North Sea and is summarised in Figure 1.1.

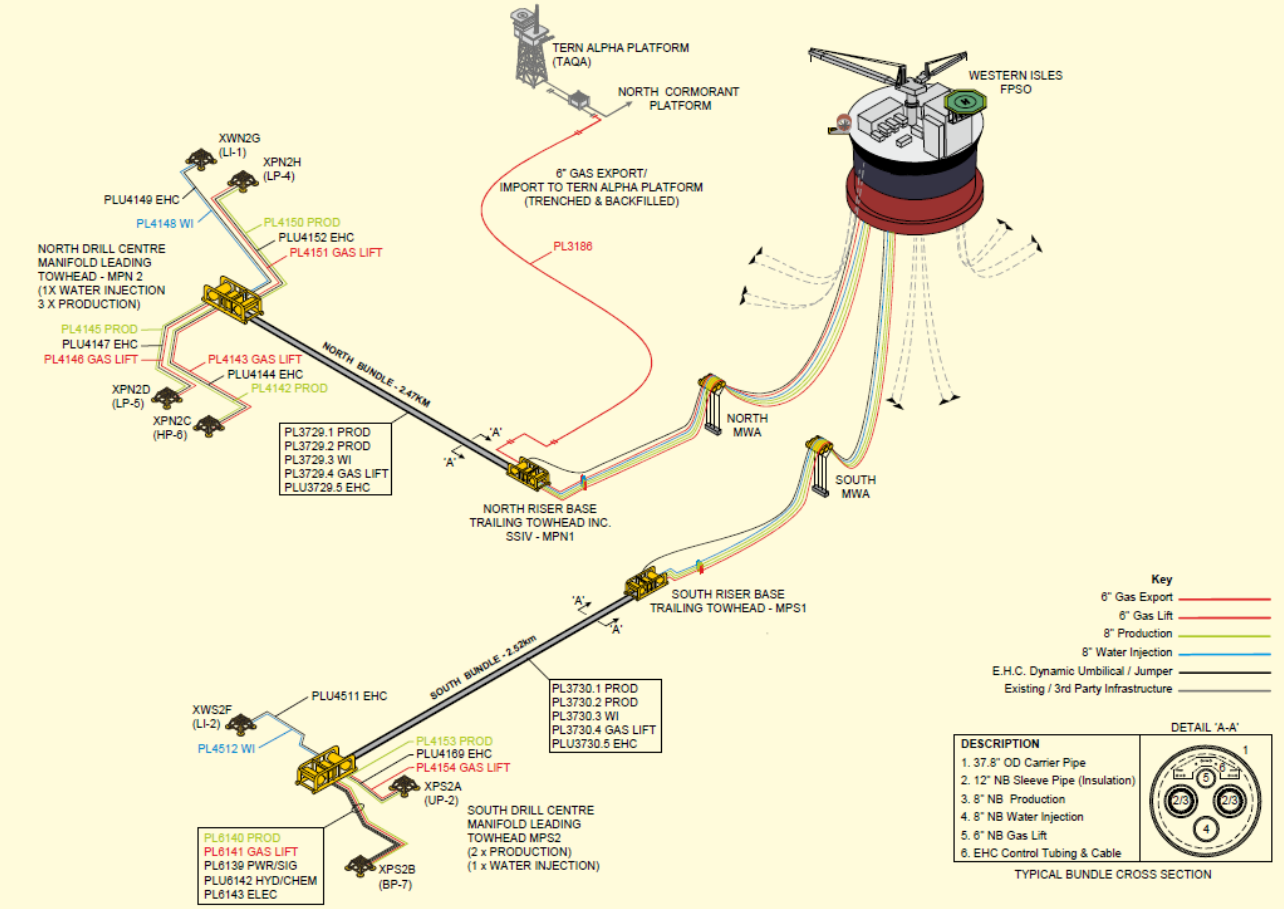


Figure 1.1 Overview of the Western Isles Development

The Western Isles Development comprises the Barra and Harris reservoirs and is located in the UKCS, Block 210/24a situated 93km to the North East of Shetland and 12km west of the Tern platform as the crow flies, which is the nearest fixed facility. The mean water depth of the field is approximately 155m LAT and ranges from 150-165m. The production and injection wells are located around two drill centres; the North Drill Centre (NDC) and the South Drill Centre (SDC). There are currently three (3) production wells, one (1) water injection well at the NDC; and two (2) production wells and one (1) water injection well at the SDC. There was also an Exploration and Appraise (E&A) Well with Plugging and Abandonment (P&A) completed and removal scheduled for Q1 2023).

The fields have been developed using a floating production, storage, and offloading (FPSO) facility. Oil is exported by shuttle tanker and excess produced gas was initially exported through a dedicated pipeline to the Tern-North Cormorant gas pipeline. Later in field life due to a reduction of produced gas, gas has been continuously imported to balance the fuel gas deficit.

1.2 Purpose

The purpose of this document is to present the CA process and emerging recommendations for the CA of the Western Isles infrastructure in support of the both the FPSO and Subsea infrastructure Decommissioning Programmes (DP) submitted by Dana. It is produced to satisfy the requirement to perform a CA for any potential derogation application as specified within the BEIS Decommissioning Guidelines ref. [1].

This document describes the field infrastructure addressed, the decommissioning options considered, the CA methodology conducted, and the recommendations concluded during the CA process.

1.3 Report Structure

This CA Report contains the following:

- Section 1 – An introduction to the document and project, including acronyms and references.
- Section 2 – An overview of the CA methodology and definition of the scoping and boundaries of the CA.
- Section 3 – The decommissioning groups identified and the initial decommissioning approach.
- Section 4 – The CA summary for Group 6 – Bundles.
- Section 5 – The CA summary for Group 7 – Rigid Pipelines (Trenched and Backfilled).
- Section 6 – Discussion and Recommendations.
- Appendix A – Evaluation Methodology.
- Appendix B – Stakeholder CA Workshop Minutes.
- Appendix C – Group 6 – Detailed Evaluation Results.
- Appendix D – Group 7 – Detailed Evaluation Results.

1.4 Terms, Abbreviations and Acronyms

AHP	Analytical Hierarchy Process
BEIS	Department for Business, Energy and Industrial Strategy
CA	Comparative Assessment
CoP	Cessation of Production
CP	Cathodic Protection
CSV	Construction Support Vessel

DP	Decommissioning Programme
DSV	Dive Support Vessel
DWC	Diamond Wire Cutting
E&A	Exploration and Appraise
ESDV	Emergency Shutdown Value
EMT	Environmental Management Team
FAR	Fatal Accident Rate
FPSO	Floating Production, Storage and Offloading
HCE	High Consequence Events
HSE	Health and Safety Executive
ICES	International Council for the Exploration of the Sea
IP	Institute of Petroleum (now the Energy Institute)
JIP	Joint Industry Project
JNCC	Joint Nature Conservation Committee
LAT	Lowest Astronomical Tide
MCDA	Multi-Criteria Decision Analysis
MFE	Mass Flow Excavator
MS	Much Stronger
MW	Much Weaker
NDC	North Drill Centre
NORM	Naturally Occurring Radioactive Material
NRB	North Riser Base
O&G	Oil and Gas
OD	Outside Diameter
ODU	Offshore Decommissioning Unit
OGUK	Oil & Gas UK
OPRED	Offshore Petroleum Regulator for Environment & Decommissioning
OSPAR	Convention for the Protection of the Marine Environment of the Northeast Atlantic
P&A	Plugging and Abandonment
PL	Pipeline
PLL	Potential for Loss of Life
POB	Personnel on Board
S	Stronger
SDC	South Drill Centre
SFF	Scottish Fisherman's Federation
SRB	South Riser Base
SSIV	Subsea Isolation Valve
TRL	Technical Review Level
UK	United Kingdom

UKCS	United Kingdom Continental Shelf
VC	Video Conference
VMS	Very Much Stronger
VMW	Very Much Weaker
W	Weaker
WI	Western Isles
WT	Wall Thickness

1.5 References

1. **BEIS Guidance Notes**	BEIS, Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines, Nov 2018. **HTTPS://ASSETS.PUBLISHING.SERVICE.GOV.UK/GOVERNMENT/UPLOADS/SYSTEM/UPLOADS/ATTACHMENT_DATA/FILE/760560/DECOM_GUIDANCE_NOTES_NOVEMBER_2018.PDF**
2. **OGUK Decommissioning CA Guidelines**	OGUK – Guidelines for Comparative Assessment in Decommissioning Programmes, Dated: October 2015, ISBN: 1 903 004 55 1, Issue: 1.
3. **CA Scoping & Screening Report**	Xodus, CA Scoping & Screening Report, Doc. No.: A-303550-S00-K-REPT-001, Rev.: A01, Dated: 09/05/2022.
4. **OGUK North Sea Pipeline Decommissioning Guidelines**	Decommissioning of Pipelines in the North Sea Region – 2013, Issued by Oil & Gas UK. https://oeuk.org.uk/product/guidelines-on-decommissioning-of-pipelines-in-the-north-sea-region-issue-1/
5. **Bundle Methodology & New Technology Assessment Technical Note**	Dana, Western Isles Subsea Decom - Methodology & New Technology Assessment Technical Note, Doc. No.: UK-WIS-DC-SUB-TEN-0001, Rev.: 00, Dated: 14 Feb 2023.
6. **Methodologies Report**	Xodus, CA Methodologies Report, Doc. No.: A-303550-S00-K-REPT-002, Rev.: A01, Dated: 16/08/2022.
7. **Risk Analysis of Decommissioning Activities**	Safetec, Joint Industry Project Report "Risk Analysis of Decommissioning Activities (http://www.hse.gov.uk/research/misc/safetec.pdf), 2005.
8. **Institute of Petroleum (IP) 2000**	Institute of Petroleum - Guidelines for the Calculations of estimates of energy use and gaseous emissions in the decommissioning of offshore structures.
9. **Analytical Hierarchy Process**	T.L. Saaty, The Analytical Hierarchy Process, 1980.

2 COMPARATIVE ASSESSMENT METHODOLOGY

2.1 Overview

CA is a process by which decisions on the most appropriate approach to decommissioning are informed. As such it is a core part of the overall decommissioning planning process being undertaken by Dana for the Western Isles infrastructure.

The OGUK Decommissioning CA Guidelines ref. [2] were prepared in 2015 by Oil and Gas UK, now Offshore Energies UK, where seven steps to the CA process were recommended. Table 2.1 introduces each of these steps, along with a status and commentary to demonstrate the current position.

TITLE	SCOPE	STATUS	COMMENTARY
Scoping	Decide on appropriate CA method, confirm criteria, identify boundaries of CA (physical and phase).	✓	CA methodology and criteria established for screening to ensure appropriate evaluation phase. Detailed in Section 2.2 and Appendix A.
Screening	Consider alternative uses and deselect unfeasible options.	✓	Screening workshops were held in March and April 2022 and were attended by members of the project team and appropriate Dana subject matter experts.
Preparation	Undertake technical, safety, environmental and other appropriate studies. Undertake stakeholder engagement.	✓	Studies identified during screening phase undertaken to inform the evaluation of the remaining options. Detailed in Section 2.4.
Evaluation	Evaluate the options using the chosen evaluation methodology.	✓	Internal workshops were held in May 2022 and the Stakeholder Workshop was held on 17th August 2022.
Recommendation	Document the recommendation in the form of narrative supported by charts explaining key trade-offs.	✓	The emerging recommendations for the decommissioning options selected are as identified during the Stakeholder Workshop and as detailed in the CA Report (this document). Recommendations can be found in Section 6.
Review	Review the recommendation with internal and/or external stakeholders.	Planned Q1 2023	The emerging recommendations as detailed in this report are to be submitted for review Q1 2023.
Submit	Submit to OPRED in support of Decommissioning Programme(s).	Planned Q1 2023	Submission to OPRED planned Q1 2023

Table 2.1 - CA Process Overview and Status

2.2 Scoping

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

- Boundaries for the CA;
- Physical attributes of equipment; and
- Decommissioning options.

These are addressed in the following sub-sections.

2.2.1 CA Boundaries

The CA Scoping phase includes the definition of the boundaries of the CA. Offshore oil and gas production systems are complex and are often interconnected, and as a result of that, it is important to understand the limitations of the scope. The FPSO and various subsea wells within the Western Isles development are linked together via the subsea infrastructure including bundles, pipelines and subsea installations. The boundaries of the FPSO decommissioning scope (as covered by the FPSO DP) is to the riser bases and includes the upper sections of the mooring systems. The boundaries of the subsea infrastructure (as covered by the Subsea Infrastructure DP) are from the riser bases to the wellhead tie-in flanges and the tie-in flange at the Tern Subsea Isolation Valve (SSIV). The subsea installations are also included in the Subsea Infrastructure DP as are the lower sections of the mooring systems (Lower Chain & Anchor Piles). The boundary limits of the infrastructure are detailed fully in the CA Scoping and Screening Report ref. [3].

A description of the Western Isles Infrastructure included for consideration in this CA, along with quantities and the associated DP is provided in Table 2.2. As a brief summary, the infrastructure that will be considered under this CA is as follows:

- The Western Isles FPSO.
- The FPSO mooring lines including piles.
- All subsea structures (installations) including their foundations.
- All bundles.
- All flexible and umbilical risers.
- All rigid subsea pipelines.
- All umbilicals.
- All spools.
- All control and chemical jumpers.
- All mattresses and deposits (protection materials).

The starting conditions for the CA are defined below:

- The FPSO will be prepared for sail away, including flushing and cleaning of risers / umbilicals which will be disconnected and laid on the seabed. The mooring systems will also be disconnected.

- The following will be complete prior to the subsea infrastructure decommissioning scope commencing:
  - The bundles will be flushed and cleaned.
  - The pipelines will be flushed, cleaned and cut / disconnected from subsea infrastructure.
  - The umbilical cores will be flushed, cleaned and cut / disconnected from subsea infrastructure.

2.2.2 Physical Attributes of Equipment

All equipment within the scope of the Western Isles infrastructure is considered along with the physical attributes that define the equipment. Attributes considered include the following:

- Structures:
  - Type.
  - Weight / size / shape.
  - General arrangement.
  - Installation method / foundation type.
  - Integrity issues.
- 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 / Jumpers:
  - Materials / diameter / length.
  - Seabed configuration (trenched / buried / surface laid).
  - Details of crossings / mattresses.
  - As-left cleanliness / ability to clean lines / chemicals used.
  - Integrity issues.

2.2.3 Decommissioning Groups

Once the equipment to be decommissioned and their attributes are captured, it is desirable to group similar items of equipment together. This has the benefit that many items can be considered as a single group and can reduce the number of items for consideration from potentially hundreds, down to a few, thus streamlining the process.

For the Western Isles infrastructure, the decommissioning groups, along with quantities and associated DP are summarised in Table 2.2 below.

GRP	TITLE	DESCRIPTION	ASSOCIATED DP	QUANTITY
1	FPSO	The Floating Production, Storage and Offloading (FPSO) and all associated topside equipment (boundary at the riser bases).	FPSO Decommissioning Programme	1 off
2	Mooring Lines (Upper Section)	The mooring chains at the FPSO end (top chain), the polyester lines between the FPSO top chain and bottom chain, the associated buoyancy elements and the lower H-shackle.	FPSO Decommissioning Programme	12 off
3	Mid-water Arches	The Mid-water Arch structures, their upper sink weights, their gravity bases and the associated synthetic tether arrangements.	FPSO Decommissioning Programme	2 off
4	Dynamic Flexible Risers	The Dynamic Risers running from the subsea infrastructure to the FPSO.	FPSO Decommissioning Programme	7 off
5	Dynamic Umbilicals	The Dynamic Umbilicals running from the FPSO to the subsea infrastructure.	FPSO Decommissioning Programme	2 off
6	Bundles	The two bundles between the Dynamic Risers / Umbilicals and the North and South drill centres.	Subsea Decommissioning Programme	2 off
7	Rigid Pipelines (Trenched and Backfilled)	The 6" rigid gas export pipeline from Tern Subsea Isolation Valve (SSIV) to North Riser Base (NRB), trenched and backfilled.	Subsea Decommissioning Programme	1 off
8	Spools	All production, water injection and gas injection spools between the subsea wells / bundle towheads / structures / pipelines.	Subsea Decommissioning Programme	20 off
9	Jumpers	All electrical / hydraulic / chemical jumpers between the subsea wells / riser bases / and the bundle towheads.	Subsea Decommissioning Programme	5 off

GRP	TITLE	DESCRIPTION	ASSOCIATED DP	QUANTITY
10	Structures	All subsea structures i.e. the North Drill Centre (NDC) Leading Townhead, the South Drill Centre (SDC) Leading Towhead, the North Riser Base (NRB) Trailing Towhead and the South Riser Base (SRB) Trailing Towhead (collectively referred to as the bundle towheads) and Wellhead Protection Structures (WHPSs).	Subsea Decommissioning Programme	Towheads – 4 off WHPS – 7 off
11	Protection Materials	All mattresses and grout bags across the subsea infrastructure.	Subsea Decommissioning Programme	Mattresses – 77 off Grout Bags – 2,160 off
12	Mooring Lines (Lower Chain & Anchor Piles)	The mooring anchor piles and bottom chain elements of the FPSO mooring system.	Subsea Decommissioning Programme	12 off

Table 2.2 - Decommissioning Groups

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 BEIS Guidance Notes ref. [1] and it is only those decommissioning groups where default full removal is not considered to be the clear recommended solution, that alternative decommissioning options are considered.

The following scenarios were considered for applicable bundles / pipelines as specified in the BEIS Guidance Notes ref. [1] and OGUK North Sea Pipeline Decommissioning Guidelines ref. [4].

- Reuse Opportunities.
- Full Removal:
  - Cut and Lift - Cut pipe into small sections and recover.
  - Reverse Installation with de-burial – Recover pipe using reverse s-lay or reverse reeling without prior de-burial.
  - Reverse Installation without de-burial – Recover pipe using reverse s-lay or reverse reeling with de-burial of any existing cover.
  - Reverse Installation (Re-float) – Recover bundle by re-floating the towheads and towing to shore (bundle only)
  - Cut, Lift and Float – Cut bundles into smaller sections, float each cut section and tow to shore (bundle only).
- Decommissioning *In situ* – Major Intervention:
  - Rock Placement over entirety of lines.
  - Trench and bury entirety of lines.
- Decommissioning *In situ* – Minor Intervention:
  - Rock Placement over areas of Spans / Exposure / Shallow Burial and remove line ends.
  - Trench and bury areas of Spans / Exposure / Shallow Burial and line ends.
  - Remove areas of Spans / Exposure / Shallow Burial and line ends.
  - Accelerated Decomposition of lines using reverse cathodic protection / chemicals / etc.
- Decommissioning *In situ* – Minimal Intervention:
  - Remove line ends only.
- Decommissioning *In situ* – No Intervention:
  - Leave lines *in situ* as is.

In parallel with the CA process Dana are undertaking a study to review potential reuse options for the project infrastructure.

Table 3.1 lists the decommissioning groups and identifies those which were judged to be appropriate for decommissioning by full removal and those where full removal was not considered the clear recommended solution.

2.3 Screening Phase

The screening phase of the CA was carried out during a series of workshops held in Q1 2022. The methodology adopted, workshop attendance and outcomes obtained are detailed fully in the CA Screening Report ref. [3]. The methodology is briefly summarised below.

- Identify Western Isles Infrastructure common groups for full removal.
- Review proposed decommissioning options for each remaining group.
- Assess decommissioning options against the primary criteria and record assessment and outcome in screening worksheets.
- Primary Criteria:
  - Safety.
  - Environmental.
  - Technical.
  - Societal.
  - Economic.
- Record any actions required to support retained decommissioning options.
- Compile combined Scoping and Screening Report.

The assessment was performed using a coarse Red / Amber / Green method, as recommended in the OGUK Decommissioning CA Guidelines ref. [2]. An additional category of 'showstopper', coloured dark grey, was used as described below. These categories are described Table 2.3.

Table 2.3 – Screening Assessment Categories

CATEGORY	DESCRIPTION
Attractive	The option is considered attractive i.e. it has positive attributes in terms of the criterion being assessed.
Acceptable	The option is considered acceptable i.e. its attributes are not positive or negative in terms of the criterion being assessed.
Unattractive	The option is considered unattractive i.e. it has negative attributes in terms of the criterion being assessed.
Showstopper	The option is considered unacceptable. Should an option be assessed as unacceptable against any of the criteria, no further assessment is required.

The cumulative assessment for each decommissioning option was then captured based on some basic ground rules. These were:

- Three or more criteria assessed as red resulted in the option being screened out (red).

- For similar full removal options, the likely least onerous option was retained (green) with any more onerous option considered as a sub-set of the less onerous option (light grey). Should the easiest full removal option be selected, the manner in which the removal would be conducted would be agreed with the removal contractor during execution to maintain flexibility.
- For similar leave *in situ* options, the most onerous option was retained (green) with any less onerous options considered as a sub-set of the more onerous option (light grey). This approach promotes the principle of not unduly 'burdening' the retained full removal option.
- This approach was considered appropriate to ensure that the best-case full removal options were compared to the most onerous leave *in situ* options. This ensures, during the evaluation phase, that the assessment is not skewed in favour of leave *in situ* options over full removal options.

The outcomes for each group are summarised in Table 4.3 and Table 5.3..

2.4 Preparation Phase

During the preparation phase, detailed studies / analyses are conducted to provide information to support the Evaluation phase of the CA. The detailed studies / analyses that may be required are often identified early in the CA process. These studies / analyses are then supplemented by additional studies / analyses identified during the Screening phase of the CA.

The studies / analyses conducted during the preparation phase of the Western Isles infrastructure CA process were as follows:

- Bundle Decommissioning Study — A study to investigate the detail associated with performing decommissioning of bundles detailed in the Bundle Methodology & New Technology Assessment Technical Note [5]. Consideration of new or emerging technologies was included.
- Bundle New Technology Review — A review of new or emerging technology developments that may be considered for bundle removals, detailed in the Bundle Methodology & New Technology Assessment Technical Note [5].
- Bundle Geotechnical Review — A review of the geotechnical conditions in the area of the bundles along with a review of available trenching techniques with specific consideration given the bundle diameter, appurtenances and carrier pipe, summarised in Methodologies Report ref. [6].
- Burial Status Review — Review of historical survey data to understand current and historical burial status of lines summarised in the Methodologies Report ref. [6] and included in Appendix E.
- Cost Estimate — The methodologies for each option were defined along with necessary resources to execute the option, detailed in the Methodologies Report ref. [6]. From this, indicative costs were able to be calculated, also detailed in the Methodologies Report.

- Safety Calculations — Using the methodologies detailed within the Methodologies Report, safety calculations are made for each of the options using the Fatal Accident Rates from the JIP conducted by Safetec ref. [7] into decommissioning activities. This allows cumulative PLL values to be provided to represent the risk exposure for the options for comparative purposes.
- Emissions Assessment — Fuel consumption and atmospheric emissions assessment performed for each option carried forward based upon activities and resources identified within the cost estimates and according to the factors from IP2000 ref. [8] and detailed in the Methodologies Report ref. [6].
- Environmental Impact Review — Environmental impact reviews were conducted for options carried forward in areas of planned discharges, unplanned discharges and seabed disturbance based on activities and resources identified in cost estimates. Underwater noise impact was based on a qualitative assessment of the vessels and activities employed as detailed in the Methodologies Report ref. [6].
- Summary Data Sheets — Compiling all necessary data for evaluation purposes, data sheets were prepared for each option as detailed in the Methodologies Report ref. [6].

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 the attributes tables included in Appendix C and Appendix D.

2.5 Evaluation Phase

The evaluation phase of the CA is where the remaining decommissioning options for each group are evaluated against each other. This evaluation process is conducted according to the OGUK CA Guidelines ref. [2] and employs the data obtained during the preparation phase as summarised in the attributes tables, included in Appendix C and Appendix D.

The evaluation phase was performed during several evaluation workshops where the decommissioning project team were represented. This enabled the supporting information for each of the decommissioning groups and associated decommissioning options to be thoroughly interrogated and amended as required.

Once the evaluation of the remaining decommissioning groups and options was ready, a CA Workshop was convened with external stakeholders; the CA process to date was described and the evaluation of the remaining options was reviewed.

This CA Stakeholder Workshop enabled the invited stakeholders to gain familiarity with the evaluation methodology and the information generated through the supporting studies and analyses. It also allowed the evaluation to be challenged in key areas and, at the culmination of the workshop, outcomes for each of the decommissioning groups were validated.

The CA Stakeholder Workshop was held in Xodus' Huntly Street office with additional attendance via VC / Microsoft Teams on Wednesday 17th August 2022. The attendees were as detailed in Table 2.4. Note: an asterisk beside the attendee indicates attendance via VC / Microsoft Teams.

COMPANY	NAME	ROLE
JNCC	Niki Piesinger	Offshore Industry Advisor
OPRED ODU Note 1	Jade Jones	Decommissioning Policy Advisor
	Sam Pattie	Assistant Decommissioning Manager
	Susan Laing	Senior Decommissioning Policy Manager
SFF	Andrew Third	Industry Advisor
	Fahim Hashimi	Offshore Energy Policy Officer
	Steven Alexander	Offshore Liaison
HSE	Bruce Appleton	Inspector (Dana Focal Point)
	Marc Nunn	Inspector Management Team Leader
	Robert Hardy	Inspector (Dana Focal Point (Oct 2022 onward))
Dana	Andrew Jones*	Head of Communications and Stakeholder Relations
	Carol Barbone	Stakeholder Engagement Advisor
	Chris Ward*	Joint Venture Manager
	Matthew Garden*	Commercial Student Placement
	Niall Bell	Environmental Team Lead
	Steve Beddows	Consultant Manager / WI Decom Joint PM
	Stuart Wordsworth	Decommissioning Manager / WI Decom Joint PM
NEO Energy	Andrew Lowrie	Decommissioning and Asset Manager
	Russell Reekie*	Asset Lead
Xodus Group	Christina McIntyre*	Consultant – Environment
	Jeff McCleary	Consultant Engineer - Subsea & Decommissioning
	John Foreman	Consultant Engineer – TSR Lead/Workshop Facilitator
	Jolanda Cameron*	Xccelerator - X-Academy
	Rama Sharma*	Consultant Engineer - Decommissioning
	William Parker	Lead Consultant – Environment

Table 2.4 - Stakeholder Workshop Attendees & Roles

Note 1: OPRED attended in an observational capacity only.

3 WESTERN ISLES INFRASTRUCTURE DECOMMISSIONING GROUPS

3.1 Decommissioning Scoping Groups

Early CA scoping and screening activities, detailed in the CA Screening Report ref. [3], identified the decommissioning groups where full removal is the recommended decommissioning approach. The remaining groups are subjected to the remainder of the CA process to identify the recommended decommissioning option. These outcomes are also captured in Table 3.1.

GRP	TITLE	DESCRIPTION	DECOMMISSIONING APPROACH	ASSOCIATED DP
1	FPSO	The Floating Production, Storage and Offloading (FPSO) and all associated topside equipment (boundary at the riser bases).	Full Removal	FPSO Decommissioning Programme
2	Mooring Lines (Upper Section)	The mooring chains at the FPSO end (top chain), the polyester lines between the FPSO top chain and bottom chain, the associated buoyancy elements and the lower H-shackle.	Full Removal	FPSO Decommissioning Programme
3	Mid-water Arches	The Mid-water Arch structures, their upper sink weights, their gravity bases and the associated synthetic tether arrangements.	Full Removal	FPSO Decommissioning Programme
4	Dynamic Flexible Risers	The Dynamic Risers running from the subsea infrastructure to the FPSO.	Full Removal	FPSO Decommissioning Programme
5	Dynamic Umbilicals	The Dynamic Umbilicals running from the FPSO to the subsea infrastructure.	Full Removal	FPSO Decommissioning Programme
6	Bundles	The two bundles between the Dynamic Risers / Umbilicals and the North and South drill centres.	Subject to full Comparative Assessment	Subsea Decommissioning Programme
7	Rigid Pipelines (Trenched and Backfilled)	The 6" rigid gas export pipeline from Tern Subsea Isolation Valve (SSIV) to North Riser Base (NRB), trenched and backfilled.	Subject to full Comparative Assessment	Subsea Decommissioning Programme
8	Spools	All production, water injection and gas injection spools between the subsea wells / bundle towheads / structures / pipelines.	Full Removal	Subsea Decommissioning Programme

GRP	TITLE	DESCRIPTION	DECOMMISSIONING APPROACH	ASSOCIATED DP
9	Jumpers	All electrical / hydraulic / chemical jumpers between the subsea wells / riser bases / and the bundle towheads.	Full Removal	Subsea Decommissioning Programme
10	Structures	All subsea structures i.e. bundle towheads and Wellhead Protection Structures (WHPSs).	Full Removal	Subsea Decommissioning Programme
11	Protection Materials	All mattresses and grout bags across the subsea infrastructure.	Full Removal	Subsea Decommissioning Programme
12	Mooring Lines (Lower Chain & Anchor Piles)	The mooring anchor piles and bottom chain elements of the FPSO mooring system.	Full Removal Note 1	Subsea Decommissioning Programme

Table 3.1 - Decommissioning Groups and Initial Decommissioning Recommendation

Note 1: The approach to decommissioning the Lower Mooring Chain is full removal. The Anchor Piles will be cut at a depth of 3m below seabed level and the cut section recovered. This is deemed full removal as per the BEIS Decommissioning Guidelines ref. [1].

3.2 Decommissioning Groups for Evaluation

In summary, the decommissioning groups for the Western Isles infrastructure where full removal was not considered to be the clear recommended solution and that are to be subjected to the full CA process are:

- Group 6 – Bundles
- Group 7 – Rigid Pipelines (Trenched and Backfilled)

4 GROUP 6 – BUNDLES

4.1 Group 6 Characteristics

The items that make up Group 6 and their key characteristics are listed in Table 4.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (m)
PL3729.1 PL3729.2 PL3729.3 PL3729.4 PLU3729.5	North Bundle (containing 4 pipelines and one umbilical)	37.5	2,469
PL3730.1 PL3730.2 PL3730.3 PL3730.4 PLU3730.5	South Bundle (containing 4 pipelines and one umbilical)	37.5	2,524

Table 4.1 - Group 6 Items

4.2 Group 6 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Scoping and Screening Report ref. [3] and summarised in Table 4.2 below.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Reuse	1 – Reuse	Leave bundles *in situ* for use in any potential new developments	A review of potential reuse options has indicated that there are no viable reuse options in this location (detailed in the CoP application). Screened out as a Technical showstopper on that basis.
Full Removal	2A – Cut and Lift	Bundles will be disconnected (cut) from towheads Entire bundle system surface laid so no de-burial required Recover bundles by cutting into sections and recover to vessel Cutting assumed by Diamond Wire Cutting (DWC) (hydraulic shears as fall back due to Technology Readiness Level (TRL) of shears at this size)	This option has been assessed as being unattractive in 3 of the 5 criteria, acceptable in 1 of the 5 criteria and attractive in the remaining criterion. This could be eliminated on a cumulative basis but will be retained as the most credible full removal option.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Full Removal	2B – Reverse S-lay	Bundles will be disconnected (cut) from towheads Entire bundle system surface laid so no de-burial required 1st end lifting arrangement installed subsea (bespoke) Recover to vessel using reverse S-lay approach Bundle cut on vessel into manageable sections 2nd end prepped subsea for recovery (bespoke)	There are various technical challenges associated with reverse s-lay of the bundles that were never designed to be installed / recovered using this approach. Screened out as a Technical showstopper on that basis.
	2C – Reverse Installation (Re-float)	To reverse install (re-float) assume that towheads will remain connected to support re-float operations No de-burial required as entire bundle system is surface laid Perform re-float by reinstating original buoyancy from towheads and dewatering of bundle carrier > Retrofit external buoyancy tanks > Re-fluidise and displace barite weighting solution from towhead members > Recharge towheads with nitrogen > Dewater carrier/pipe void Replace all Controlled Depth Tow Method (CDTM) chains Entirety of bundles returned to shore via tow Transfer to shore using Self-propelled Modular Transport (SPMTs) (or similar) / winch / under roller approach / inshore cut and lift	This option has been assessed as being unattractive in 3 of the 5 criteria, acceptable in 1 of the 5 criteria and attractive in the remaining criterion. This could be eliminated on a cumulative basis but should be retained as a potential full removal option with study work conducted to allow a decision as to whether this is a more credible full removal option than cut and lift. Post-screening Update: During preparation phase of the CA process, detailed study work was conducted by Subsea 7 to better inform Option 2C – Reverse Installation (Re-float). The findings of the study work are detailed in the Bundle Methodology & New Technology Assessment Technical Note [5] but in summary, there were significant challenges identified to the successful delivery of this option. These included: - Reinstating buoyancy / removing barite used during installation to sink bundle towheads. - Weight control for towing bundle – challenging to implement accurately in offshore environment. - Tow approvals for route – estimated as required over 14 assets. - Highly sensitive to weather conditions. - Reception facilities at shore location not available and have increased challenges / requirements when retrieving bundles as opposed to launching bundles. In summary, Reverse Installation (Re-float) option considered significantly more onerous than Option 2A – Cut & Lift and screened out accordingly.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Full Removal	2D – Cut, Float & Transport	Bundles will be disconnected (cut) from towheads No de-burial required as entire bundle system is surface laid Cut into manageable sections, cutting assumed by DWC (hydraulic shears as fall back due to TRL of shears at this size) Float to surface (solid buoyancy, or bespoke / novel buoyancy system) Return to shore on vessel / towed in basket / retained buoyancy system	There are various technical challenges associated with this option and, it represents the challenges associated with the cut and lift and re-float options. Screened out as a Technical showstopper on that basis.
Leave *In situ* (Major Intervention)	3A – Rock Placement over Entire Line	Bundles will be disconnected (cut) from towheads Rock placement over full length of surface laid bundle systems No recovery of bundles	This option has been assessed as being unattractive in 2 of the 5 criteria, acceptable in 2 of the 5 criteria and attractive in the remaining criterion. This option is considered a worse outcome than Option 3B (Trench & Bury) across the majority of criteria and would not be executed ahead of Option 3B and is screened out accordingly. Post-screening Update: During the screening phase of the CA process, Option 3A – Rock Placement over Entire Line was screened out as this was considered less attractive than Option 3B – Trench and Bury Entire Line. Once the geotechnical review for Option 3B was conducted, it was clear that there were significant challenges associated with trenching these bundles due to the geotechnical conditions in the area and the diameter of the bundles. Accordingly, Option 3A was reinstated as a viable option as it could no longer be considered a less attractive option than Option 3B in light of the findings of the geotechnical review.
	3B – Trench & Bury Entire Line	Bundles will be disconnected (cut) from towheads Trenching performed over entire surface laid bundle system Trenching by plough (water jet or mechanical trencher) No recovery of bundles No introduction of new material Possible prep work required to recover appurtenances (vent valve assemblies and cages) and ballast chains	This option has been assessed as being acceptable in 2 of the 5 criteria and attractive in the remaining 3 criteria and will be carried forward for further assessment. Consider requirement for a trenchability review given diameter of bundle and trenching capabilities. Post-screening Update: During preparation phase of the CA process, a geotechnical review was conducted to better inform the feasibility associated with trenching and burying the bundles along their entire length. This study concluded that the only credible trenching approach for the geotechnical conditions in the area, and at the diameter required, would be using ploughs.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave *In situ* (Minor Intervention)	4A - Rock Placement Over Areas of Spans	Bundles will be disconnected (cut) from towheads Rock placement to address areas of spans Rock placement to remediate snag risk at cut ends from towhead removal	This option has been assessed as being acceptable in 2 of the 5 criteria and attractive in the remaining 3 criteria and should be retained and carried forward for further assessment. Post-screening Update: A high level review of the burial status of the line showed limited areas of natural undulating seabed below the bundle (none of which constitute a reportable) and no areas of exposure / shallow burial (as surface laid). Addressing these limited areas of undulating seabed by rock cover have been included in Option 5. Subsequently Screened out a Technical showstopper accordingly.
	4B - Trench & Bury Areas of Spans	Bundles will be disconnected (cut) from towheads Trench / bury areas of spans Rock placement to remediate snag risk at cut ends from towhead removal Minimal introduction of new material	This option has been assessed as being acceptable in 3 of the 5 criteria and attractive in the remaining 2 criteria and should be retained and carried forward for further assessment. Post-screening Update: A high level review of the burial status of the line showed limited areas of natural undulating seabed below the bundles (none of which constituted a reportable span) and no areas of exposure / shallow burial (as surface laid). Addressing these limited areas of undulating seabed by trenching is not appropriate given their size. Subsequently Screened out a Technical showstopper accordingly.
	4C - Remove Areas of Spans	Bundles will be disconnected (cut) from towheads Removal of areas of spans using cut and lift techniques Rock placement to remediate snag risk at cut ends from towhead removal and removal of spans	This option has been assessed as being unattractive in 1 of the 5 criteria, acceptable in 3 of the 5 criteria and attractive in the remaining criterion and should be retained and carried forward for further assessment. Post-screening Update: A high level review of the burial status of the line showed limited areas of naturally undulating seabed below the bundles (none of which constitute a reportable span) and no areas of exposure / shallow burial (as surface laid). Addressing these limited areas of undulating seabed by removal of sections is not appropriate given their size. Subsequently Screened out a Technical showstopper accordingly.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave *In situ* (Minor Intervention)	4D - Accelerated Corrosion	Bundles will be disconnected (cut) from towheads Rock placement to remediate snag risk at cut ends from towhead removal Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Accelerated corrosion / decomposition approach not proven for any lines, least of all bundles. Internal elements such as insulation, polymer liners, spacers etc. would remain. Screened out as a Technical showstopper on that basis.
Leave *In situ* (Minimum Intervention)	5 - Remove Ends & Remediate Snag Risk	Bundles will be disconnected (cut) from towheads Rock placement to remediate snag risk at cut ends from towhead removal All appurtenances and ballast chains shall be removed (assume diver operation)	This option has been assessed as being acceptable in 2 of the 5 criteria and attractive in the remaining 3 criteria and should be retained and carried forward for further assessment.
Leave As-is and Monitor	6 - Leave as is	Bundles will be disconnected (cut) from towheads There will be no planned subsea intervention Appropriate legislative considerations shall be addressed and any advisory zones implemented for remaining subsea infrastructure Existing ends relatively low snag-risk, however degradation overtime will increase snag risk	Leaving the ends of these bundles as is would present an unacceptable snag hazard. Considered a safety showstopper accordingly. Screened out as a safety showstopper

Table 4.2 - Group 6 Decommissioning Options & Screening Summary

4.3 Group 6 Decommissioning Options for Evaluation

The decommissioning options for Group 6 that remained after screening and which were taken forward to the evaluation phase are therefore:

- Full Removal
  - 2A – Cut and Lift
- Leave *In situ* (Major intervention)
  - 3A – Rock Cover entire line
  - 3B – Trench and Bury entire line
- Leave *In situ* (Minimal intervention)
  - 5 – Remove Ends and Remediate Snag Risk

4.4 Bundles Spans

The burial status review of the bundles (see Appendix E) showed limited areas of naturally undulating seabed below the bundles (none of which constitute a reportable span). Provision is made in Option 5 for addressing these areas, however, it is recognised that their remediation may not be required given their minimal nature.

4.5 Bundles Appurtenances

The venting appurtenances of the bundles (vent valve assemblies and cages) are elements that were used during the installation of the bundles. Provision is made within Option 5 for their removal with their details as shown in Figure 4.1.

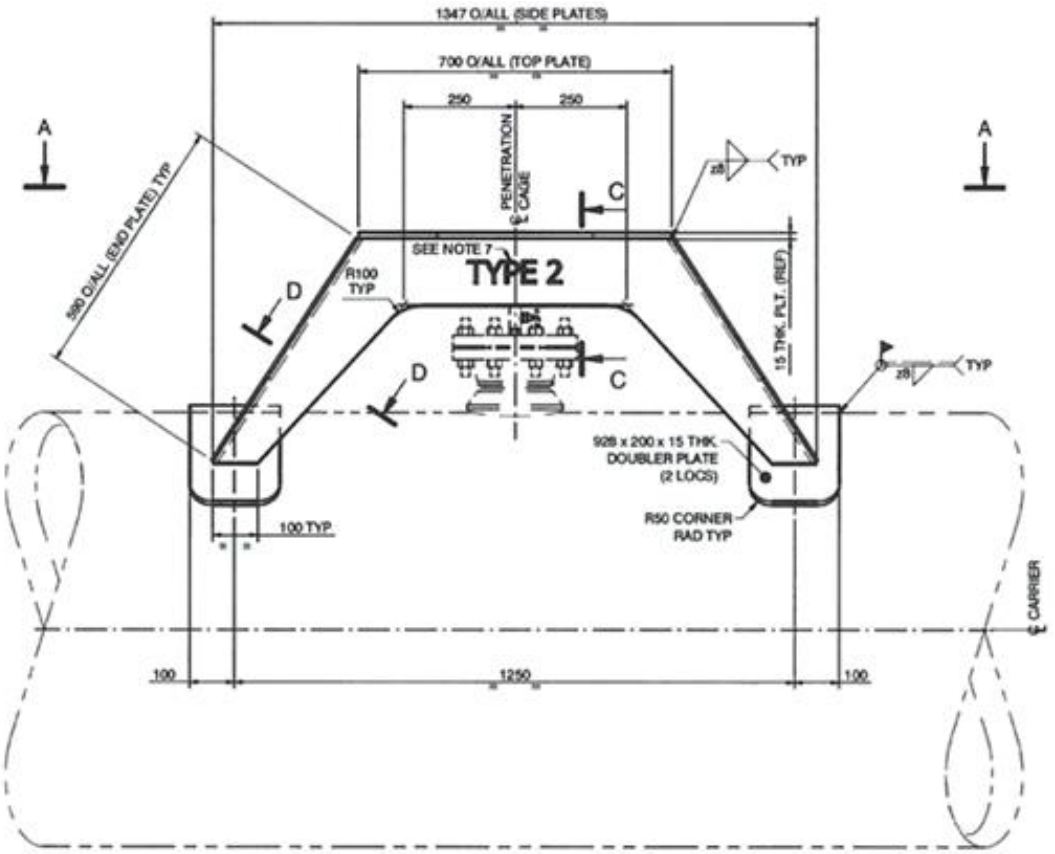


Figure 4.1 – Venting Appurtenances Diagram

4.6 Group 6 Evaluation Summary

GROUP 6 – BUNDLES (See Section 6.1 for detailed discussion and Appendix C for full attributes table and assessment)	
Safety	**Option 3A is assessed as being preferred from a Safety perspective.** Option 3A (rock cover line) is preferred against the Operations Personnel criterion due to it having the lowest duration of activities and the lowest risk profile of the options. Both Option 3B (re-trench line) and Option 5 (remove ends and remediate snag risk) are less preferred as they have a greater risk profile due to the significant diver scope to remove ballast chains and appurtenances (vent valve assemblies / cages) from the bundles. Option 2A (cut and lift) is least preferred due to having much longer offshore durations to fully remove the bundles. Option 5 is preferred against the Other Users criterion due to this option having the lowest number of days of vessel operations and the fewest transits thus resulting in the smallest impact on other users of the sea. Option 2A is the least preferred against this criterion as it has by far the highest number of days of vessel operations and transits of all the options. Option 3A is preferred against the High Consequence Events criterion due to there being minimal offshore lifting associated with the rock cover option. Option 3B and Option 5 are marginally less preferred than Option 3A as there is more potential for dropped object from the deployment and retrieval of trenching equipment (Option 3B) and cutting equipment (Option 5). Option 2A is significantly less preferred due to the numerous (hundreds) of offshore lifting operations to deploy and retrieve cutting equipment and recovery of the bundle cut sections. Option 2A is significantly preferred from a legacy risk perspective as the bundles are fully removed thus removing any legacy risk. Option 3B is less preferred as, while the bundles would be fully trenched and buried in this option, they would remain *in situ* thus a residual risk remains. Option 3A and Option 5 are least preferred due to the bundles remaining *in situ* and surface laid. The legacy risk is mitigated by the bundles being fully rock covered in Option 3A and being designed for overtrawlability (especially as ballast chains and appurtenances will be removed) in Option 5.
Environment	**Option 2A is assessed as being preferred from an Environment perspective.** Option 3A, Option 3B and Option 5 are equally preferred over Option 2A (full removal) against the Operational Marine Impact criterion due to the higher noise impact from the longer duration of vessels on-site and cutting operations in the full removal option. There is additional impact from the discharges of bundle contents and loss of insulation material at all cut locations in the full removal option although, given these releases will be post-flushing operations, the environmental impact is considered negligible. Option 3A, Option 3B and Option 5 are also equally preferred over Option 2A (full removal) against the Atmospheric Emissions & Fuel Use criterion due to the full removal option generating significantly greater atmospheric emissions and having greater fuel consumption than the other options. Option 2A, Option 3B and Option 5 are equally preferred over Option 3A against the Other Consumptions criterion. This is due to the much greater quantity of rock required in Option 3A. The impact, in terms of CO_2 associated with the recycling of returned material / generation of replacement material for equipment left *in situ* is considered minimal and similar for all options. The full removal option is marginally preferred over Option 3B and Option 5 as it has a small area of temporary seabed disturbance associated with the cutting the bundle into sections for removal, whereas Option 3B has a much larger area of temporary disturbance associated with the trenching operations. Both Option 3B and Option 5 also have areas of permanent seabed impact from the introduction of rock cover at the cut ends of the bundles. Option 3A is significantly less preferred than the other options due to the large area of permanent habitat change from the introduction of rock cover over the entirety of the bundles. The full removal option is significantly preferred over the other options from a Legacy Marine Impacts perspective. This is due to there being no legacy environmental impact from the full removal of these bundles versus a small impact associated with the slow discharge of line contents / degradation products with the leave *in situ* options. Again, it is noted that the legacy impact associated with the leave *in situ* options are expected to be minimal given the prior flushing of the lines within the bundle. These impacts are also expected to occur over a long time-frame.

GROUP 6 – BUNDLES (See Section 6.1 for detailed discussion and Appendix C for full attributes table and assessment)	
Technical	**Option 3A and Option 5 are assessed as being equally preferred from a Technical perspective.** Option 3A and Option 5 are equally preferred against the Technical Readiness / Concept Maturity criterion. This is due to the routine nature, and hence extensive track record for the rock cover operations associated with Option 3A and Option 5. Option 3B is significantly less preferred due to the minimal track record of trenching bundles and the diameter of these bundles being at the limit of existing trenching plough capabilities. Option 2A is similarly less preferred due to the limited track record for cutting bundles using diamond wire cutting techniques, particularly at this diameter. Further, there is limited track record for the recovery of cut bundle sections, which will have loose internals once cut into sections. Similarly, Option 3A and Option 5 are equally preferred against the Risk / Consequence of Project Failure criterion. This is again, due to the relatively routine nature of the operations associated with these options. Option 3B is significantly less preferred due to the uncertainty surrounding the ability to trench and achieve the depth of lowering required for bundles of this diameter in this area. Should trenching be unsuccessful, there may be the potential to perform remedial rock cover options to address any failure of trenching / depth of lowering. Option 2A is also considered to have a high potential for failure due to the limited track record for the cutting and lifting operations required along more than 5km of bundles. This could leave to significant extension to the offshore durations.
Societal	**Option 2A is assessed as being preferred from a Societal perspective.** Option 2A is significantly preferred against the Societal – Fishing criterion due to the bundles being fully removed. Option 3B is less preferred as, while the bundles would be fully trenched and buried in this option, they would remain *in situ*. Option 3A and Option 5 are significantly less preferred due to the bundles remaining *in situ* and surface laid albeit rock covered in Option 3A or being designed for overtrawlability (especially as ballast chains and appurtenances will be removed) in Option 5. There is also a small preference for Option 2A from Societal – Other Users perspective due to the quantity of useful, recyclable material (steel / copper) returned in the full removal option. This is offset by the quantity of polymer that is also returned that would potentially end up in landfill. The societal impacts from the other options are considered negligible and similar.
Economic	**Option 5 is assessed as being preferred from an Economic perspective.** Option 5 is preferred from a Short-term Costs perspective as it has the lowest cost of all the options. The costs associated with Option 3B are almost double and Option 3A are almost triple that associated with Option 5. Option 2A is the highest cost option at almost 6 times higher than Option 5. All options are equally preferred from a Long-term Costs perspective as, while there are no costs associated with Option 2A, the costs associated with survey and monitoring of the bundles left *in situ* in the remaining options are modest and occur over a long period. These differences are considered insufficient to express a preference.

GROUP 6 – BUNDLES
(See Section 6.1 for detailed discussion and Appendix C for full attributes table and assessment)

Summary

Overall Option 5 is the emerging recommendation.

The outcome shows that there is a preference for Option 5 (remove ends and remediate snag risk). Option 3A is marginally preferred over Option 5 against the Safety and Societal criteria. This is offset by the preference for Option 5 over Option 3A against the Environmental criterion. Both Option 3A and Option 5 are equally preferred against the Technical criterion. It is noted that, while Option 2A (full removal) is marginally preferred from an Environmental perspective and strongly preferred from a Societal perspective, these preferences are more than offset by the option being significantly less preferred against the Technical criterion due to the challenging activities required to perform full removal of the bundles using cut and lift techniques.

Once the Economics criterion is included, the small preference for Option 5 is strengthened and hence Option 5 is the emerging recommendation for Group 6.

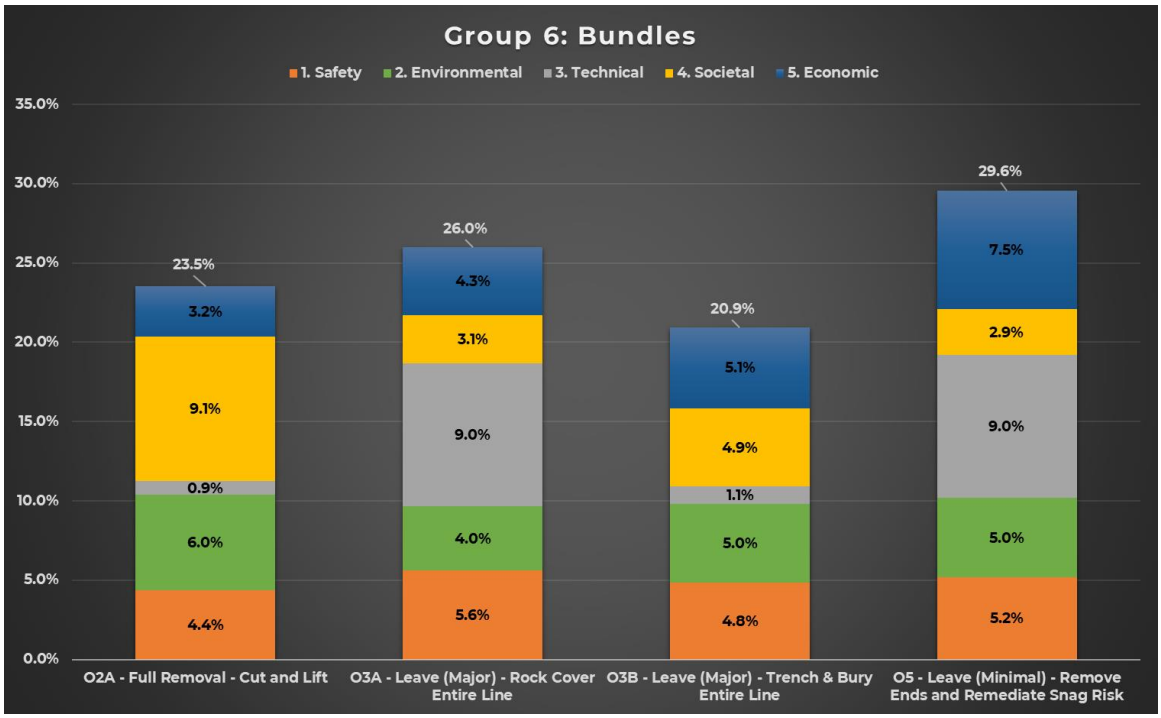


Table 4.3 – Group 6 Evaluation Summary

4.7 Group 6 Evaluation Sensitivities & Actions

During the CA Stakeholder Workshop, when reviewing the evaluation of group 6, the following actions and sensitivities were identified:

- Sensitivity – A challenge was raised regarding the weight of criterion 1.2 – Safety – Other Users. The base case for the evaluation is for all criteria to have equal weighting (see Appendix A.3). The challenge raised was that the weight for criterion 1.2. should be reduced (see Appendix B, item 4.3.2). A sensitivity was conducted and the impact on the outcome and discussion is provided in Section 4.7.1.
- Action 01 – a challenge was raised where consideration should be given to making provision for future remediation for developing snag hazards (see Appendix B, item 4.3.4 and 4.8.2). The response to this action is included in Section 4.7.2.

- Action 02 – a challenge was raised where consideration should be given to including the environmental impact associated with the transportation of rock required for options (see Appendix B, item 4.4.2). The response to this action is included in Section 4.7.3.

4.7.1 Criterion 1.2 Sensitivity

A reduction in the weight of criterion 1.2 – Safety – Other Users was explored, with adjustments as detailed in Table 4.4.

CRITERION	BASE CASE WEIGHT	SENSITIVITY CASE WEIGHT
1.1 Operations Personnel	25%	27%
1.2 Other Users	25%	18%
1.3 High Consequence Events	25%	27%
1.4 Legacy Risk	25%	27%

Table 4.4 – Safety Criteria Weights – Sensitivity Case

Once the adjustment had been made to the safety criteria weights, the revised outcome chart (without economics) is shown in Figure 4.2.

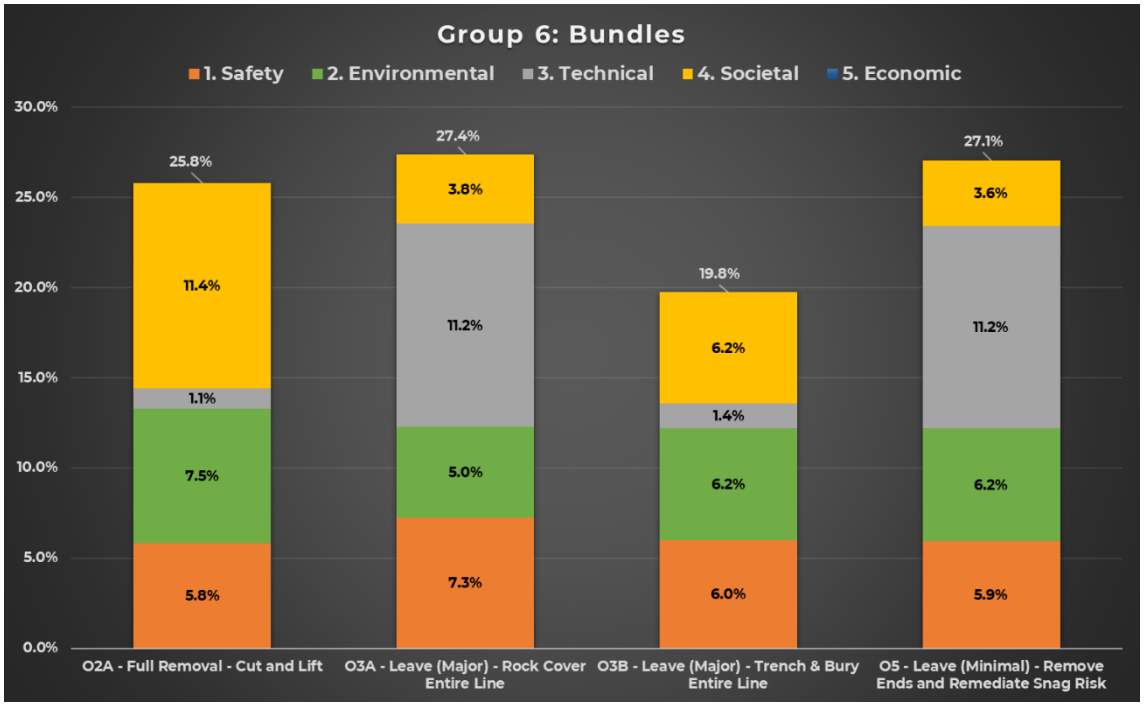


Figure 4.2 – Group 6 Outcome – Sensitivity Case – No Economics

As can be seen from the results chart in Figure 4.2, the adjustment in the weight of the safety criteria has resulted in a switch from a small preference for Option 5 over Option 3A, to a very small preference for Option 3A over Option 5. Once the economics criteria were included, the revised outcome chat is shown in Figure 4.3.

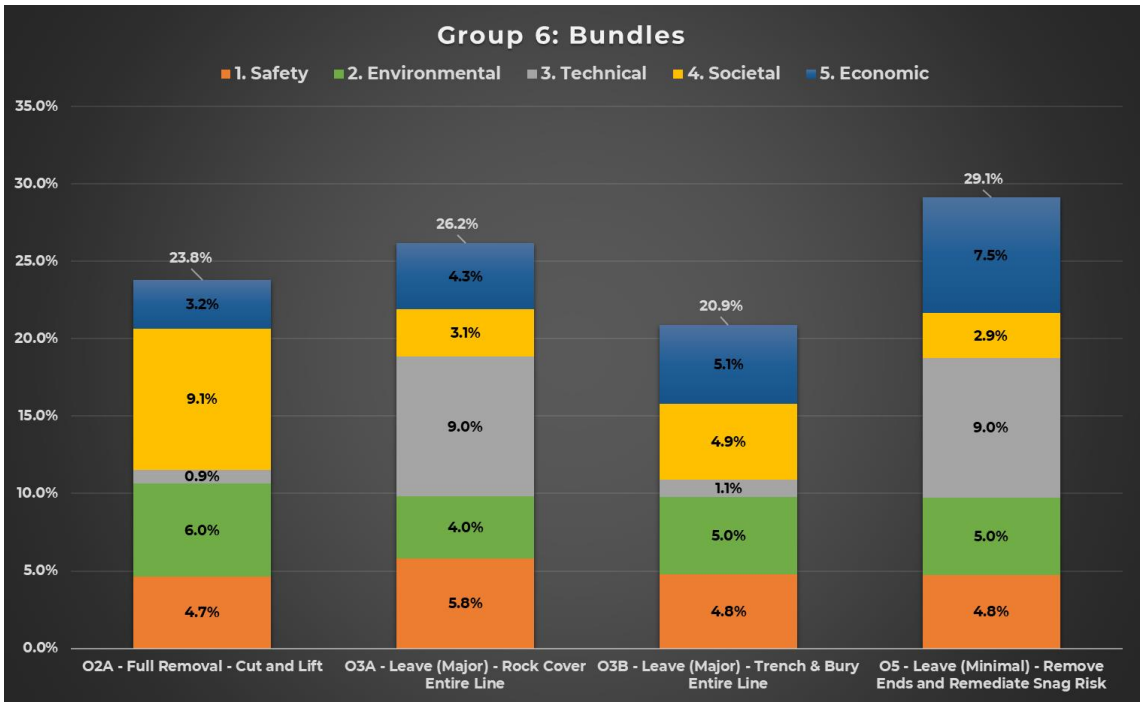


Figure 4.3 – Group 6 Outcome – Sensitivity Case – With Economics

As can be seen from the results chart in Figure 4.3, including economics re-instates Option 5 as the preferred option. Given this sensitivity case changes the emerging recommendation from a small preference for Option 5 over Option 3A to being, to all intents and purposes equally preferred, it is appropriate to consider economic considerations, which, when included in the sensitivity case, maintains Option 5 as the emerging recommendation.

4.7.2 Group 6 Action 01

Consideration has been given to including future remediation provision in the options, with particular attention given to Option 5 – Leave *In situ* Remove Ends and Remediate Snag Risk. Option 5 includes provision for rock placement at the ends of the bundle and in key areas along the bundle where minimal areas of spanning have occurred (most likely during bundle installation due to natural seabed undulation) as part of the planned decommissioning associated with this option. The future remediation requirement due to spanning, is considered highly unlikely to be required during a reasonable future lookahead (of around 30 years and beyond). This is supported by the highly stable nature of the seabed environment in this location and by the static nature of the spans (associated with natural seabed undulation) along the bundle which were likely introduced during their installation. A commitment has also been made to remove vent valve assemblies, associated cages and ballast chains as part of Option 5, further reducing potential snag risk.

Additionally, the time scale for the eventual degradation of the bundle carrier pipe due to corrosion, which could present an elevated risk of snagging, has been calculated to occur over an extended timeframe, well outside a reasonable future lookahead of 30 years. It should be noted that should bundle carrier pipe degradation due to corrosion occur, snag risk remediation will be conducted on a case-by-case basis as appropriate.

As such, Dana believes there to be no credible justification for the inclusion of significant remediation activities to mitigate snag risk over a foreseeable future time period. This does not preclude performing remediation activities on a case-by-case basis, based on the findings of the survey and monitoring programme of equipment left *in situ* under Option 5.

4.7.3 Group 6 Action 02

Consideration has been given to the inclusion of the atmospheric emissions and fuel use associated with the quarrying and transportation of the significant quantity of rock required in Option 3A – Rock Cover over Entire Line and, to a lesser extent, the rock required in Option 3B – Trench Entire Line and Option 5 – Remove Ends and Remediate Snag Risk.

As it stands, the boundary for atmospheric emissions and fuel use associated with the rock required for the relevant options, is drawn at the quayside. Dana believe this boundary to be acceptable as the rock that would be used would be drawn from existing rock provision provided for routine offshore rock placement activities and would not be quarried / transported 'on-demand' for this application.

Further, additional consideration, beyond atmospheric emissions and fuel use, for the environmental impact from the consumption of rock as a resource is covered within the CA process under criterion 2.3 – Other Consumptions.

Finally, the exclusion of 'Scope 3' emissions is the traditional approach when considering the appropriate boundaries for the CA process.

In summary, Dana believe there to be no justification for increasing the boundary for the atmospheric emissions and fuel use associated with rock cover operations, beyond the current boundary, which is at the quayside.

5 GROUP 7 – RIGID PIPELINES (TRENCHED AND BACKFILLED)

5.1 Group 7 Characteristics

The items that make up Group 7 and their key characteristics are listed in Table 5.1.

ID	DESCRIPTION	OD (INCHES)	LENGTH (KM)
PL3186	Rigid Gas Import / Export Line	6	11.274

Table 5.1 – Group 7 Items

PL3186 is adequately buried at more than 1m depth along the entirety of its length (average depth of burial is 1.6m from the 2018 survey and 1.4m from the 2023 survey., see Appendix E for depth of burial charts).

5.2 Group 7 Decommissioning Options & Screening Outcome

During the Screening Phase, all potential decommissioning options were assessed against the Safety, Environmental, Technical, Societal and Economic criteria using a coarse screening methodology. The assessment performed and the resultant outcomes are detailed fully in the CA Screening Report ref. [3] and summarised in Table 5.2 below.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Reuse	1 – Reuse	Leave pipeline *in situ* for use in any potential new developments	A review of potential reuse options has indicated that there are no viable reuse options in this location (detailed in the CoP application). **Screened out as a Technical showstopper on that basis.**
Full Removal	2A – Cut and Lift	Line will be disconnected De-burial of line using Mass Flow Excavator (MFE) Recover by cutting into sections (assumed by hydraulic shears) Recover cut sections to vessel Return to shore for recycling / processing	This option has been assessed as being unattractive in 2 of the 5 criteria, acceptable in 1 of the 5 criteria and attractive in the remaining two criteria and could be retained. However, the reverse reel with de-burial option is considered viable and a less onerous full removal option. **Screened out as considered a more onerous full removal option than Option 2B – Reverse Reel with De-burial**
	2B – Reverse Reel with De-burial	Line will be disconnected De-burial of line using MFE Recover by reverse reel to reel lay vessel Return to shore for recycling / processing	Given the age and service of the line, it is expected that it will have the integrity required to reverse reel with prior de-burial. As this option has been assessed as being acceptable in 3 of the 5 criteria and attractive in 2 of the 5 criteria it is **retained for further assessment as the best full removal option.**

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Full Removal	2C – Reverse Reel without De-burial	Line will be disconnected Recover by reverse reel to reel lay vessel Pipeline pulled through existing cover Return to shore for recycling / processing	There is high uncertainty that reverse reeling without prior de-burial can be conducted as there is significant (more than 1m) of cover over the line along its entire length. Considered unlikely to be able to achieve the level of confidence in the strength of the line required to execute this option. Screened out a Technical showstopper accordingly.
Leave *In situ* (Major Intervention)	3A – Rock Placement over Entire Line	Line will be disconnected Rock placement over full length of lines to address areas of spans, exposure & shallow burial No recovery of line	A high-level review of the burial status of the line showed no areas of spans / exposure / shallow burial. As such there is no benefit in rock covering the entire line. Screened out a Technical showstopper accordingly.
	3B – Trench & Bury Entire Line	Line will be disconnected Re-trench and backfill full length of line to remove areas of spans, exposure & shallow burial No recovery of line No introduction of new material	A high-level review of the burial status of the line showed no areas of spans / exposure / shallow burial. As such there is no benefit in re-trenching the entire line. Screened out a Technical showstopper accordingly.
Leave *In situ* (Minor Intervention)	4A – Rock Placement Over Areas of Spans / Exposure / Shallow Burial	Line will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) (assumed by hydraulic shears) Rock placement to remediate snag risk from cut ends Rock placement at all areas of spans, exposure and shallow burial	A high-level review of the burial status of the line showed no areas of spans / exposure / shallow burial. As such there are no areas to rock cover with this option. Screened out a Technical showstopper accordingly.
	4B – Trench & Bury Areas of Spans / Exposure / Shallow Burial	Line will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) (assumed by hydraulic shears) Rock placement to remediate snag risk from cut ends Trench / bury areas of spans, exposure and shallow burial Minimal introduction of new material	A high-level review of the burial status of the line showed no areas of spans / exposure / shallow burial. As such there are no areas to re-trench with this option. Screened out a Technical showstopper accordingly.

CATEGORY	OPTION	DESCRIPTION	DISCUSSION
Leave *In situ* (Minor Intervention)	4C – Remove Areas of Spans / Exposure / Shallow Burial	Line will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) (assumed by hydraulic shears) Rock placement to remediate snag risk from cut ends Removal of areas of spans, exposure and shallow burial depth using cut and lift techniques (including de-burial where required) (assumed by hydraulic shears)	A high-level review of the burial status of the line showed no areas of spans / exposure / shallow burial. As such there are no areas to remove with this option. Screened out a Technical showstopper accordingly.
	4D – Accelerated Corrosion	Line will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) Rock placement to remediate snag risk from cut ends Introduce material / techniques to accelerate the decomposition process Potential options include reverse polarity CP, Sulphate Reducing Bacteria (SRBs), chemicals, etc.	Accelerated corrosion / decomposition not proven for any lines. Screened out a Technical showstopper accordingly.
Leave *In situ* (Minimum Intervention)	5 – Remove Ends & Remediate Snag Risk	Line will be disconnected Removal and recovery of surface laid sections out with existing trench (including transitions) (assumed by hydraulic shears) Rock placement to remediate snag risk from cut ends	This option has been assessed as being acceptable in 2 of the 5 criteria and attractive in the remaining 3 criteria and it is retained for further assessment. Retained for evaluation, with removal methodology, cost estimate, environmental impact and safety impacts to be developed.
Leave As-is and Monitor	6 – Leave as is	Line will be disconnected There will be no planned subsea intervention Appropriate legislative considerations shall be addressed and any advisory zones implemented for remaining subsea infrastructure Lines will remain *in situ*	Potential snag risk from line ends left *in situ* likely to be considered unacceptable and this option would be ruled out as a safety showstopper. Screened out as a safety showstopper

Table 5.2 – Group 7 Decommissioning Options and Screening Summary

5.3 Group 7 Decommissioning Options for Evaluation

The decommissioning options for Group 7 that remained after screening and which were taken forward to the evaluation phase are therefore:

- Full Removal
  - 2B – Reverse Reel with De-burial
- Leave *In situ* (Minor intervention)
  - 5 – Remove Ends and Remediate Snag Risk

5.4 Group 7 Evaluation Summary

GROUP 7 – RIGID PIPELINES (TRENCHED AND BACKFILLED) (See Section 6.2 for detailed discussion and Appendix D for full attributes table and assessment)	
Safety	**Option 2B is assessed as being preferred from a Safety perspective.** Option 5 (remove ends and remediate snag risk) is preferred against the Operations Personnel criterion due to the lower offshore and onshore scopes with this option. The full removal option was less preferred due to the risk exposure associated with the extended durations to de-bury and recover (reverse reeling) 11.3 km of line and the associated onshore handling for recycling. Both options are equally preferred against the Other Users criterion due them having a similar number of days of vessel operations and a similar number of transits. This leads to the options having a similar (negligible) level of safety impact to other users of the sea. Option 2B is preferred against the High Consequence Events criterion due to there being minimal offshore lifting in Option 2B (deployment and retrieval of de-burial equipment only) versus numerous offshore lifting operations in Option 5 to deploy and recover de-burial equipment, cutting equipment and the surface laid sections of the pipeline out with the trench. This leads to a higher potential for High Consequence Events in Option 5. Option 2B (full removal) is preferred from a legacy risk perspective as the line is fully removed versus remaining *in situ* in Option 5.
Environment	**Option 2B is assessed as being preferred from an Environment perspective.** Both options are equally preferred against the Operational Marine Impact criterion. There is a greater noise profile from the longer duration of vessels on-site and the longer de-burial operations using MFE associated with Option 2B (full removal). There is also a larger release of residual line contents during reverse reeling operations although these residual contents will be post-flushing operations). The noise profile and releases from the line associated with Option 5 will be marginally lower than Option 2B but overall, the Operational Marine Impacts associated with both others are considered negligible and insufficient to express a preference. Both options are also equally preferred against the Atmospheric Emissions & Fuel Use criterion as while there are differences in the emissions generated and fuel consumed between the two options, the impact from theses emissions is considered negligible and insufficient to express a preference. Again, both options are equally preferred against the Other Consumptions criterion as the impact from recycling returned material or generating replacement material related to the line being left *in situ* is negligible and similar for both options. The small amount of rock required in Option 5 is not considered significant. Option 5 is preferred over Option 2B against the Seabed Disturbance criterion. This is due to the small area impacted by rock cover (permanent habitat change) in Option 5, as opposed to the much larger area of seabed impact associated with the de-burial operations in Option 2B. It is noted that the impact on the seabed from the de-burial operations would be temporary in nature hence the marginal preference for Option 5 over Option 2B. The Option 2B (full removal) is significantly preferred over the partial removal option (Option 5) from a Legacy Marine Impacts perspective. This is due to there being no legacy environmental impact from the full removal of this line versus a small impact associated with the slow discharge of line contents / degradation products with the partial removal option as the line remains *in situ*. This is mitigated by the remaining line being fully trenched and buried.
Technical	**Option 5 is assessed as being preferred from a Technical perspective.** Option 5 is marginally preferred against the Technical Readiness / Concept Maturity criterion. This is due to the relative immaturity of performing reverse reeling operations for full line removal (more commonly used for rectifying issues during line installation i.e. buckling). Approaches for executing Option 5 are well proven. Option 5 is also marginally preferred against the Risk / Consequence of Project Failure criterion. This is due to potential for line failure during reeling operation which would require leaving the line exposed until reeling can be reinstated / continued. This is considered a low likelihood but does have a greater potential for issues than the operations associated with Option 5.

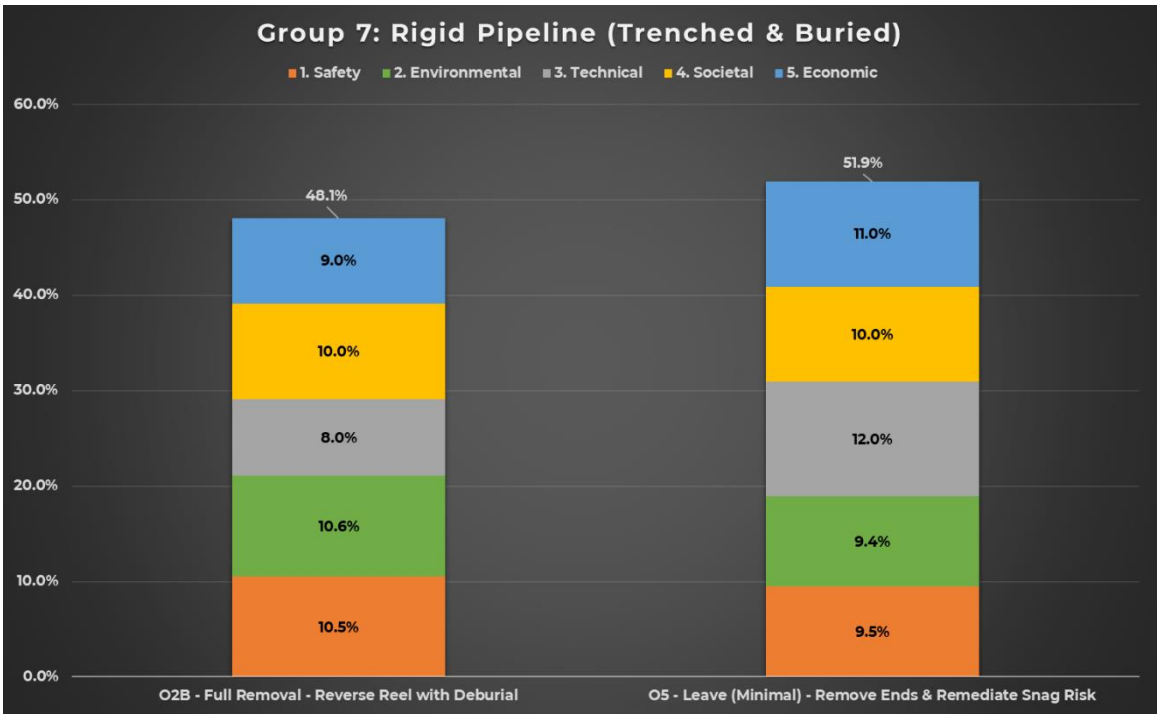
GROUP 7 – RIGID PIPELINES (TRENCHED AND BACKFILLED) (See Section 6.2 for detailed discussion and Appendix D for full attributes table and assessment)	
Societal	**Option 2B and Option 5 are assessed as being equally preferred from a Societal perspective.** Both options are equally preferred from a Societal – Fishing perspective as the line is fully removed or left fully trenched and buried thus the impact on fishing operations is similar and negligible in both options. Both options are also equally preferred from a Societal – Other Users perspective with the societal impacts being minimal and similar for both options.
Economic	**Option 5 is assessed as being preferred from an Economic perspective.** There is a small preference for Option 5 over Option 2B from a Short-term Costs perspective as the cost to deliver Option 2B is around 3 times higher than the cost to deliver Option 5. Both options are equally preferred from a Long-term Costs perspective as, while there are no costs associated with Option 2B, the costs associated with survey and monitoring of the line left *in situ* in Option 5 are modest and occur over a long period. These differences are considered insufficient to express a preference.
Summary	**Overall Option 5 is the emerging recommendation.** The outcome shows that there is an overall preference for Option 5 (remove ends and remediate snag risk). There are marginal preferences for Option 2B over Option 5 against the Safety and Environmental criteria. These marginal preferences are offset by the preference for Option 5 from a Technical perspective with both options being equally preferred from against the Societal criterion. Once the Economics criterion is included, the preference for Option 5 is strengthened and hence Option 5 is the emerging recommendation for Group 7. 

Table 5.3 – Group 7 Evaluation Summary

5.5 Group 7 Evaluation Sensitivities & Actions

During the CA Stakeholder Workshop, when reviewing the evaluation of group 7, the following sensitivity was identified:

- Sensitivity – A challenge was raised regarding the assessment of the options against the Risk/Consequence of Project Failure. The challenge was that the recorded assessment (where Option 2B – Full Removal – Reverse Reel with De-burial was assessed as being weaker than Option 5 – Remove Ends and Remediate Snag Risk) should be increased to Much Weaker due to there being greater concerns in the ability to successfully deliver Option 2B. A sensitivity was conducted and the impact on the outcome and discussion is provided in Section 5.5.1.

5.5.1 Risk / Consequence of Failure Sensitivity

A change in the assessment of the two options against criterion 3.2 – Technical – Risk / Consequence of Failure was explored, with the assessment increasing from Option 2B being Weaker than Option 5 to Option 2B being Much Weaker than Option 5. The outcome obtained under this sensitivity is shown in Figure 5.1 and Figure 5.2.

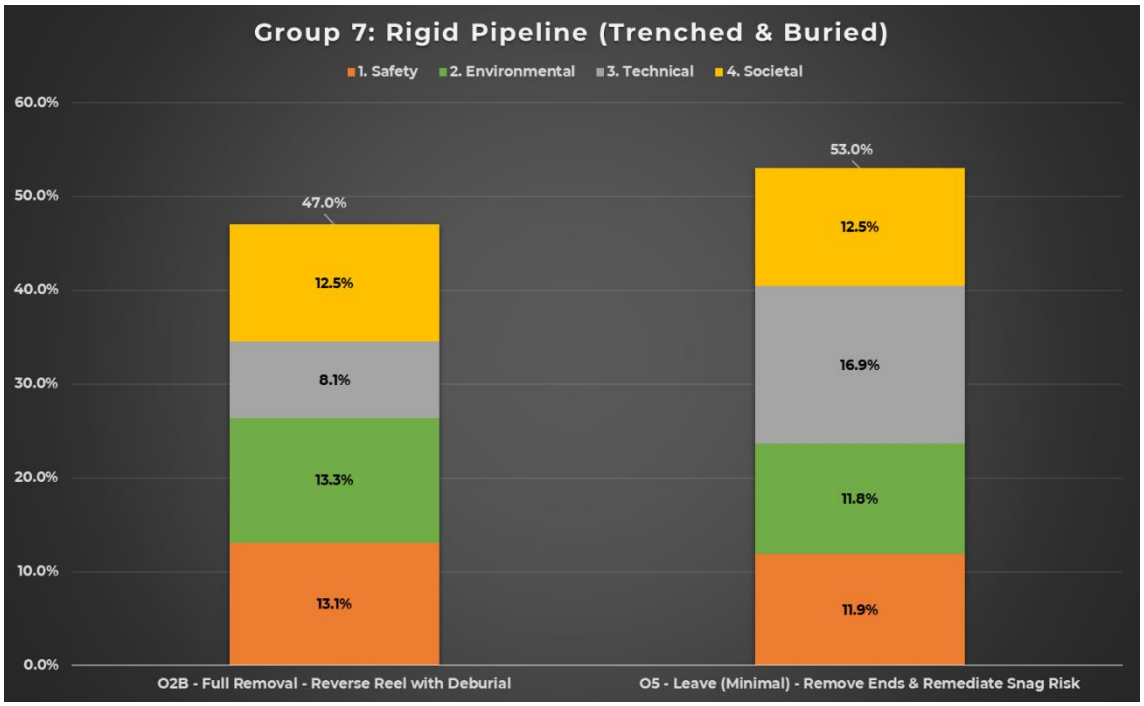


Figure 5.1 – Group 7 Outcome – Sensitivity Case – No Economics

As can be seen from the results chart in Figure 5.1, the adjustment in the assessment has resulted in a strengthening of the preference for Option 5 over Option 2B. Once the economics criteria were included, the preference was further strengthened as shown in Figure 5.2.

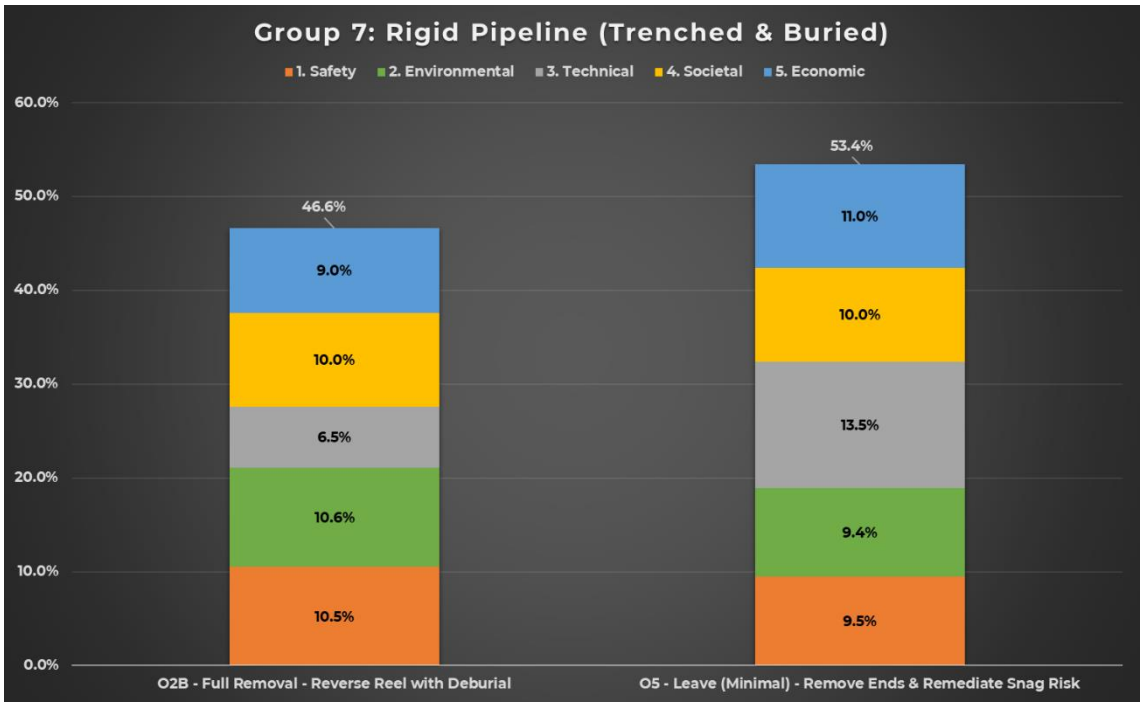


Figure 5.2 – Group 7 Outcome – Sensitivity Case – With Economics

6 DISCUSSION AND RECOMMENDATIONS

The CA of each of the decommissioning groups for the Western Isles infrastructure has identified several groups where the recommended decommissioning approach was full removal, with no further evaluation necessary. These are:

- Group 1 – FPSO
- Group 2 – Mooring Lines (Upper Section)
- Group 3 – Mid-water Arches
- Group 4 – Dynamic Flexible Risers
- Group 5 – Dynamic Umbilicals
- Group 8 – Spools
- Group 9 – Jumpers
- Group 10 – Structures
- Group 11 – Protection Materials
- Group 12 – Mooring Lines (Lower Chain & Anchor Piles)

The full CA process was applied to the remaining decommissioning groups as follows:

- Group 6 – Bundles
- Group 7 – Rigid Pipelines (Trenched and Backfilled)

6.1 Group 6 – Bundles Discussion

The following sections provide a discussion of the evaluation of the four most viable Group 6 – Bundles decommissioning options (Option 2A – Full Removal by Cut and Lift, Option 3A – Rock Cover over Entirety of Line, Option 3B – Trench and Bury Entire Line and Option 5 – Remove Ends and Remediate Snag Risk) against the five criteria.

6.1.1 Safety

Against the Operations Personnel criterion, Option 3A (rock cover) is preferred as it has the lowest risk profile due to short offshore durations with limited personnel exposure from the rock cover activities. Option 5 (remove ends) is less preferred as, while the offshore durations are the lowest for this option, there is greater risk exposure due to a greater number of personnel being exposed on the Dive Support Vessel (DSV) (versus a rock dump vessel in Option 3A). Additionally, there is further risk exposure due the use of the high-risk worker group of divers to perform the appurtenance (vent valve assemblies / cages) and ballast chain removal included in Option 5. Option 3B (trench and bury) is also less preferred due greater offshore durations to perform the trenching operations (from a

Construction Support Vessel) and the same appurtenance and ballast chain removal (using divers) as in Option 5. Option 2A (full removal) has significantly greater offshore durations than the other options and, while there is no diver support, has the greatest risk profile of all the options and is the least preferred.

Against the Other Users criterion, Option 5 is preferred as it has the fewest days of vessel operations and fewest vessel transit from shore to the field thus presenting the smallest safety risk to Other Users. Option 3B is less preferred than Option 5 as it has a more days of vessel operations and more transits. Option 3A is less preferred than Option 3B as, while the number of days of vessel operations is similar in these options, Option 3A has more transits associated with the rock cover operations where trips to shore to replenish rock are required. Option 2A has the highest number of days of vessel operations and the highest number of transits and is therefore the least preferred option from a safety of other users perspective.

Against the High Consequence Events criterion, Option 3A is marginally preferred over Option 3B and Option 5 as there are fewer offshore lifting operations (potential for dropped object) associated with the rock cover operations versus numerous offshore lifting operations to deploy and recover cutting and trenching equipment and to recover the appurtenances and ballast chains in Option 3B and Option 5. Option 2A is the least preferred option due to the hundreds of offshore lifting operations required to recover the bundles in sections.

Against the Legacy Risk criterion, Option 2A is preferred over Option 3B as, while both options effectively leave a clear seabed, the line does remain *in situ* in Option 3B and there is the legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the bundles left *in situ*. Option 3A is less preferred than Option 3B as the bundles will remain on the seabed with large rock berms over their entire length (fully rock covered to mitigate legacy risk). Option 5 is the least preferred option due the bundles being on the seabed, although it should be noted that the bundles were designed to be overtrawlable. To further mitigate legacy risk due to snagging, provision has been made to remove the appurtenances and ballast chains in this option. Again, each of these options has an associated legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the lines left *in situ*.

Option 3A is significantly preferred from an Operations Personnel perspective and moderately preferred from a High Consequence Events perspective. While it is less preferred from an Other Users perspective (Option 5 is most preferred) and the least preferred option from a Legacy Risk perspective (Option 2A is most preferred), overall, there remains a preference for Option 3A from a Safety perspective.

6.1.2 Environment

Against the Operational Marine Impact criterion, all partial removal options are equally preferred over Option 2A (full removal). This is due to the greater noise impact from the longer durations that vessels are on-site and the longer duration cutting operations using diamond wire. It is noted that, while there is a preference for the partial removal operations, that preference is marginal as the greater noise impact is minor. There is an additional preference for the partial removal options due to the discharges of line contents within the bundle and loss of insulation material that occurs at each cut location in the full removal option, but again, the impacts are minor.

Against the Atmospheric Emissions and Fuel Use criterion, all partial removal options are equally preferred over Option 2A. This is due to the increased emissions generated and fuel used from the extended offshore scope in the

full removal option. There are differences in the emission generated and fuel used across the partial removal options, however these differences are considered minor and insufficient to express a preference within these options.

Against the Other Consumptions criterion, Option 2A (full removal), Option 3B (trench and bury) and Option 5 (remove ends) are equally preferred as, while the environmental impact from recycling returned material in Option 2A is greater than the impact associated with generating replacement material for the bundles left *in situ*, the differences were considered insufficient to express a preference between these options. Option 3A (rock cover) is less preferred than the other options due to the quantity of rock required to deliver Option 3A is much greater than the other options, where the rock required is either minimal or zero.

Against the Seabed Disturbance criterion, Option 2A is preferred as there is only a small area of temporary seabed disturbance associated with the MFE de-burial required at the cut locations of the bundles. Option 3B and Option 5 are less preferred but for different reasons. Option 3B is less preferred due to the large area of seabed impacted by trenching operations to bury the lines. While the area impacted is large, the impact is temporary in nature, with the seabed habitat recovering quickly. Option 5 has a much smaller area of impact but as the impact is from the introduction of rock cover (over the cut line ends), this represents a greater impact on the seabed as it is a permanent habitat change. Option 3A is the least preferred option due to it having the largest area of permanent habitat change from rock covering the entirety of the bundles.

Against the Legacy Marine Impact criterion, Option 2A is preferred as there are no legacy marine impacts associated with these bundles being fully removed. All partial removal options are less preferred than the full removal option, as the bundles will be left *in situ* although their legacy impact on the marine environment is mitigated by them being flushed and cleaned and any degradation occurring over a long time period. There is a small preference for Option 3A (fully rock covered) and Option 3B (fully trenched and buried) over Option 5 as, while the bundles remain *in situ* in each of these options, they will be isolated from the marine environment in Option 3A and Option 3B due to their coverage. Accordingly, degradation of the bundles will occur at a faster rate in Option 5 but still over a long time period.

Option 2A is the least preferred option from an Operational Marine Impact and Atmospheric Emissions and Fuel Use perspective, although the preference for the partial removal options is relatively minor. Option 2A is however, preferred from a Seabed Disturbance and Legacy Marine Impact perspective. These preferences, along with an equal preference from an Other Consumptions perspective, results in an overall preference for Option 2A from an Environmental perspective.

6.1.3 Technical

Against the Technical Readiness / Concept Maturity criterion, Option 3A (rock cover) and Option 5 (remove ends) are equally (and significantly) preferred over Option 2A (full removal) and Option 3B (trench and bury). This is due to the relatively routine rock cover operations employed in Option 3A and Option 5. Option 2A requires a significant programme of subsea cutting of bundles using diamond wire techniques which has a limited field track record in bundle applications (largely limited to cutting of towheads from bundles only). There are also significant concerns regarding the lift stability and retention of loose internal equipment when recovering sections of these bundles. To mitigate these concerns, a subsea basket approach has been used in the methodology for recovery of bundle sections to the vessel, however this approach has a very limited track record. Option 3B (trench and bury) requires the use

of a plough due to the geotechnical conditions in the area. The diameter of the bundles would require the largest ploughs currently available in the market and trenching bundles using ploughs is unproven. It is noted that all options require diamond wire cutting to remove the towheads which has a limited field track record, however there are only four cuts required to remove the towheads versus hundreds of cuts to fully remove the bundles in Option 2A.

Against the Risk / Consequence of Failure criterion, Option 3A and Option 5 are equally (and significantly) preferred over Option 2A and Option 3B. This is again, due to the relatively routine rock cover operations employed in Option 3A and Option 5. Again, Option 2A requires a significant programme of subsea cutting and lifting of bundles which are considered to have a high risk of failing to deliver within the estimates provided given their limited field track record. Similarly, Option 3B has a high chance of being unable to achieve the depth of lowering required and may require a revised approach such as rock cover. Again, it is noted that all options require diamond wire cutting to remove the towheads which has a limited field track record, however there are only four cuts required to remove the towheads versus hundreds of cuts to fully remove the bundles in Option 2A.

6.1.4 Societal

Against the Societal – Fishing criterion, Option 2A (full removal) is preferred over Option 3B (trench and bury) as, while both options effectively leave a clear seabed, the bundles do remain *in situ* in Option 3B. These options are significantly preferred over Option 3A (rock cover) and Option 5 (remove ends) due to the large rock berms created (Option 3A) or the bundles remaining on the seabed (Option 5) although it is noted that the bundles were designed to be overtrawlable.

Against the Societal – Other Users criterion, Option 2A is preferred marginally over the partial removal options. This is due to the societal benefits of returning the steel, copper and aluminium alloy for recycling in the full removal option. The benefit of this is tempered by the challenges that are associated with separating the useful steel from the insulation material surrounding the internal lines in these bundles. Additionally, there is polymer returned which is likely to go to landfill and is therefore considered a negative societal impact.

As Option 2A (full removal) is preferred from a Fishing and Other Users perspective, overall, there is a moderate preference for Option 2A from a Societal perspective.

6.1.5 Economic

Against the Short-term Costs criterion, Option 5 (remove ends) is preferred over the other options. This is due to the costs to execute this option being the lowest of all the options at £6.3 million. The remaining options get progressively less preferred as the costs increase with Option 3B (trench and bury), Option 3A (rock cover) and Option 2A (full removal) all being significantly more expensive than Option 5 at £10.1 million, £15.1 million and £34.5 million respectively.

Against the Long-term Costs criterion, all options are equally preferred. While there are no long-term costs associated with the full removal option, the long-term costs associated with the survey and monitoring of the bundles left *in situ* in the partial removal options are minor (less than £1 million) and would be spread out over many years. As such, the differences between the options are insufficient to express a preference.

As Option 5 is preferred from a Short-term Costs perspective (with all options being equally preferred from a Long-term Costs perspective) overall, Option 5 is preferred from an Economic perspective.

6.1.6 Group 6 Recommendation

The recommended decommissioning option for Group 6 – Bundles is Option 5 – Remove Ends and Remediate Snag Risk. This option involves the following key activities:

- Bundles will be disconnected / cut from towheads
- Rock placement to remediate snag risk at cut ends from towhead removal
- Rock placement at areas of spanning (minimal in size and number of locations)
- Removal of venting appurtenances (vent valve assemblies and cages) and ballast chains (assumed diver operations)
- Future survey & monitoring programme

6.2 Group 7 – Rigid Pipelines (Trenched and Backfilled) Discussion

The following sections provide a discussion of the evaluation of the most viable Group 7 – Rigid Pipeline (Trenched and Buried) decommissioning options (Option 2B – Full Removal by Cut and Lift and Option 5 – Remove Ends and Remediate Snag Risk) against the five criteria.

6.2.1 Safety

Against the Operations Personnel criterion, Option 5 (remove ends) is significantly preferred over Option 2B as it has the lowest risk profile due to shorter offshore durations and less material handling onshore than the full removal option.

Against the Other Users criterion, both options are equally preferred as they both have a low number of days of vessel operations and minimal transits.

Against the High Consequence Events criterion, Option 2B is preferred over Option 5 as there are fewer offshore lifting operations (potential for dropped object) associated with the reverse reeling operations (deployment and recovery of MFE for de-burial only) compared to Option 5 which has more lifting operations to deploy and recover cutting equipment, MFE and recovery of the surface laid ends of the lines (out with the existing trench) in sections.

Against the Legacy Risk criterion, Option 2B is preferred over Option 5 as, while both options effectively leave a clear seabed, the line does remain *in situ* in Option 5 and there is the legacy risk exposure from the future survey and monitoring to mitigate future snag risk of the line left *in situ*.

Option 2B is significantly preferred from a High Consequence Events perspective, moderately preferred from a Legacy Risk perspective and equally preferred from an Other Users perspective. While it is significantly less preferred

from an Operations Personnel perspective, overall, there remains a preference for Option 2B from a Safety perspective.

6.2.2 Environment

Against the Operational Marine Impact criterion, both options are equally preferred. While Option 2B (full removal) does have a greater noise profile from the longer durations that vessels are on-site and the MFE operations to de-bury the line prior to reeling compared to Option 5, the impact of these is negligible and are insufficient to express a preference. Similarly, it is recognised that the entire contents of the line could be released in a single location during reeling operations in Option 2B, however given this is a gas export line and it will be flushed and cleaned prior to performing the selected decommissioning option, the impact will be negligible.

Against the Atmospheric Emissions and Fuel Use criterion, both options are equally preferred as, while there are differences in the emissions generated and fuel used across the options, these differences are considered minor and insufficient to express a preference.

Against the Other Consumptions criterion, both options are equally preferred as, while there are differences in the emissions generated recycling returned material in Option 2B and generating replacement material for the line left *in situ*, these differences are considered minor and insufficient to express a preference. In addition, the small amount of rock required for Option 5 was considered negligible.

Against the Seabed Disturbance criterion, Option 5 is marginally preferred over Option 2B as there is only a small area of temporary seabed disturbance associated with the MFE de-burial required at the cut locations of the surface laid portions of the line and a very small area of rock cover (over the cut ends within the existing trench transition). In Option 2B, the entire line must be de-buried using MFE to enable removal using reverse reeling techniques. This impacts a large area of the seabed although it is a temporary impact hence the small preference.

Against the Legacy Marine Impact criterion, Option 2B is preferred as there are no legacy marine impacts associated with the line being fully removed. Option 5 is marginally less preferred, as the line will be left *in situ* although its legacy impact on the marine environment is mitigated by being flushed and cleaned and any degradation occurring over a long time period as it will be left fully trenched and buried.

Option 2B is the least preferred option from a Seabed Disturbance perspective. This is offset by the stronger preference for Option 2B over Option 5 from a Legacy Marine Impact perspective. These preferences, along with an equal preference in the other Environmental criteria, results in small overall preference for Option 2B from an Environmental perspective.

6.2.3 Technical

Against the Technical Readiness / Concept Maturity criterion, there is a small preference for Option 5 over Option 2B due to the relatively limited track record for reverse reeling lines on this scale, whereas the operations used in Option 5 are routine.

Against the Risk / Consequence of Failure criterion, there is also a small preference for Option 5 over Option 2B due to the challenges associated with reeling and the recovery activities that would be required should the line suffer and integrity failure during reeling.

Option 5 is therefore preferred from an overall Technical perspective.

6.2.4 Societal

Against the Societal – Fishing criterion, both options are equally preferred as a clear seabed is presented in both cases.

Against the Societal – Other Users criterion, again both options are equally preferred. It was noted that a useful quantity of recyclable steel is returned in Option 2B, polymer is also retuned which is likely to go to landfill. Across the options, there were limited Societal impacts hence no preference was expressed.

As both options are equally preferred across the Societal criteria, there is no preference from a Societal perspective.

6.2.5 Economic

Against the Short-term Costs criterion, Option 5 (remove ends) is preferred over Option 2B (full removal). This is due to the costs to execute this option being the lower at £1.5 million versus £4.9 million.

Against the Long-term Costs criterion, both options are equally preferred. While there are no long-term costs associated with the full removal option, the long-term costs associated with the survey and monitoring of the line left *in situ* in Option 5 are minor (less than £1 million) and would be spread out over many years. As such, the differences between the options are insufficient to express a preference.

As Option 5 is preferred from a Short-term Costs perspective (with both options being equally preferred from a Long-term Costs perspective) overall, Option 5 is preferred from an Economic perspective.

6.2.6 Group 7 Recommendations

The recommended decommissioning option for Group 7 – Rigid Pipeline (Trenched and Buried) is Option 5 – Remove Ends and Remediate Snag Risk. This option involves the following key activities:

- Pipeline will be disconnected / cut from structures
- Removal and recovery of line ends (out with existing trench) by cutting into sections
- Rock placement to remediate snag risk from cut ends
- Future survey & monitoring programme

APPENDIX A EVALUATION METHODOLOGY

A.1 CA Evaluation Methodology

Dana have 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. [9]. 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 – this was completed during 2022 and listed in Appendix A.2.
- Define Options – completed as part of CA Screening.
- Pre-populate worksheets for internal CA workshops – 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.5).
- 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' to the Preparation phase to obtain any further information to help inform decision making.

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

A.2 Differentiating Criteria

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 BEIS Guidelines for Decommissioning of Offshore Oil and Gas Installations and Pipelines which are as follows:

- Safety
- Environmental
- Economic
- Technical
- Societal

These differentiating criteria were found to be appropriate for the decommissioning options tabled and were taken forward as the primary differentiating criteria for the CA. Additional sub-criteria and definitions were added for clarity and are shown in Table A.1 below.

CRITERIA	SUB-CRITERIA	DESCRIPTION	APPROACH TO ASSESSMENT
1. Safety	1.1 Operations Personnel	This sub-criterion considers elements that impact risk to offshore personnel and includes, project teams, project vessel crews, diving teams, and survey vessel crews. This sub-criterion also considers elements that impact risk to onshore personnel and includes, dismantling, recycling or disposal operations, material transfer, and onshore handling. It should be noted that crew changes are performed via port calls. Any requirement for handling HazMat / NORM shall also be addressed here.	Quantitative data is used to compare the decommissioning options against this criterion. Potential for Loss of Life (PLL) metrics are calculated based on the Fatal Accident Rate (FAR) x Hours of Exposure for each of the worker groups and is considered a suitable metric for CA purposes. The FAR is taken from the summary report of the Joint Industry Project investigating the Risk Analysis into Decommissioning Activities issued by Safetec ref. [7]. The Hours of Exposure is taken from the various studies / cost estimates developed to define the decommissioning options.
	1.2 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 and military vessels are considered. Elements such as duration of vessel operations, number of operational vessel and their locations and number of transits to / from port may be considered.	A quantitative assessment is made based on the number of vessel days, durations and port transits associated with each of the decommissioning options. This is considered acceptable as the Safety impact on other users is a function of the operational vessel numbers / durations / movements.
	1.3 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 lifting operations, dropped object, operational vessel collision risks and back of deck working may be considered.	A review of the methodologies for each option is conducted to identify activities associated with the decommissioning options that have potential for High Consequence Events. This is a qualitative assessment.

CRITERIA	SUB-CRITERIA	DESCRIPTION	APPROACH TO ASSESSMENT
	1.4 Legacy 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 remains after performing the decommissioning option. Issues such as residual snag risk, collision risk, etc. may be considered.	A review of the proposed as-left status of the infrastructure post-decommissioning us is conducted to identify areas of potential legacy risk associated with the decommissioning options.
2. Environmental	2.1 Operational Marine Impact	This sub-criterion addresses the marine environmental impact caused by performing the decommissioning option. Covers both planned impacts (inherent to the option being assessed) and potential unplanned impacts (accidental releases, both large and small in scale and encompassing Major Environmental Incidents (MEIs)).Impacts may be from Project Vessels, Supply Boats, Survey vessels, etc. Examples include; Noise generated by vessels, cutting operations, any explosives, etc., discharges from vessels and from removing infrastructure such as residual pipeline contents.	Planned and unplanned marine impacts are narrative judgement informed by estimates of volumes (m^3) / composition of any releases. Impacts from vessels are qualitative in nature. Marine noise impact is calculated based on the vessel durations, subsea cutting operations and other operations that generate marine noise and is a qualitative measure. Impact on marine mammals is a key focus.
	2.2 Atmospheric Emissions & Fuel Consumption	This sub-criterion addresses the atmospheric emissions, fuel consumption and energy consumption from performing the decommissioning option. This may be from Project Vessels, Survey vessels, etc. Impacts may be greenhouse gas emissions such as CO_2, NOx, SO_2, etc. Fuel and energy consumption are included and are tightly correlated to atmospheric emissions. Not considered: Energy / emissions / resource consumption required to replace materials not recovered for reuse or recycling which is covered in 2.3 Other Consumptions.	Fuel use, emissions and energy consumption are calculated from vessel operations using IP2000 ref. [8] factors for vessel fuel use and emissions. Fuel use, and emissions provided in metric tonnes. Energy provided in joules.

CRITERIA	SUB-CRITERIA	DESCRIPTION	APPROACH TO ASSESSMENT
	2.3 Other Consumptions	This sub-criterion addresses the environmental impact caused by the amount of resource consumption associated with the option. It covers elements such as environmental impact from processing returned materials, the use of quarried rock or other new material and any production of replacement materials for equipment left *in situ*.	Other consumptions such as rock / steel / other fabrications are quoted in metric tonnes. Impact of recycling / processing returned material and replacing leave *in situ* material is quoted in CO_2 in metric tonnes. The output CO_2 figures allow a direct, quantitative comparison between options.
	2.4 Seabed Disturbance	This sub-criterion addresses the direct and indirect seabed disturbance caused by performing the decommissioning option. Impacts that are both permanent and temporary in nature are considered. The level of impact caused and any specific seabed concerns, such as protected areas or habitat changes may be covered.	Assessment based on quantifying the area of disturbance by type of disturbance (dredging, rock dump, trenching, backfilling, mass flow excavation) in combination with an understanding of the baseline environment in the area as shown by the outputs from the environmental surveys.
	2.5 Legacy Marine Impacts	This sub-criterion addresses the marine environmental impact caused after the decommissioning option has been performed. Covers the long-term impact of any infrastructure left *in situ* such as release of materials into the marine environment, environmental impact from legacy monitoring and remediation i.e. planned and unplanned releases from vessels, vessel noise, etc.	Marine impacts are narrative judgement informed by estimates of volumes (m^3) / composition of any releases and the duration these may occur over. Impacts from vessels are qualitative in nature. Marine noise is calculated based on the vessel durations, subsea cutting operations and is a qualitative measure of cumulative sound energy level.

CRITERIA	SUB-CRITERIA	DESCRIPTION	APPROACH TO ASSESSMENT
3. Technical	3.1 Technical Readiness / Concept Maturity	This sub-criterion relates to the technical readiness / maturity of the option. Consideration is given to: Technical Novelty / Track Record.	Assessment based on definition of the decommissioning option provided in the method statements. Qualitative judgement is provided in areas of novelty / track record.
	3.2 Risk / Consequence of Project Failure	This sub-criterion relates to the technical risks 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: Technical Challenges / Consequence of Failure to deliver the decommissioning option as defined.	Assessment based on definition of the decommissioning option provided in the method statements. Qualitative judgement is provided in areas of Technical Challenges / Consequence of Failure.
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the decommissioning option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities themselves and any residual impacts post decommissioning such as reinstatement of access to area.	A qualitative judgement that provides a narrative (rather than quantification) regarding the positive and negative impacts of the decommissioning option on commercial fishing operations. Area of impact in m^2 may be included.
	4.2 Other Aspects	This sub-criterion addresses any positive or negative socio-economic impacts on other users, where the impact may be from dismantling, transporting, treating, recycling and land filling activities relating to the decommissioning option. Additionally, 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 decommissioning option which has a negative impact on communities, increased traffic disruption due to extra-large transport loads, etc.	Assessment of impact on other users is a qualitative narrative considering both positive and negative impacts of the decommissioning option on waste paths, recycling, employment and general community impacts. Tonnage and types of material returned may be included.

CRITERIA	SUB-CRITERIA	DESCRIPTION	APPROACH TO ASSESSMENT
5. Economic	5.1 Short-term Costs	This sub-criterion addresses the cost of delivering the option as described. An assessment of cost risk or cost uncertainty may also be provided. Not considered: No long-term cost element is considered here.	The cost for delivering the decommissioning option, along with an indication of the cost risk / uncertainty is calculated in the method statements.
	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.	The long-term cost for the monitoring and potential remediation for the decommissioning option, along with an indication of the cost risk / uncertainty is calculated in the method statements.

Table A.1 - Criteria and Sub-criteria Definitions

A.3 Differentiator Weighting

The five differentiating criteria all carry a 20% weighting. That is, all criteria are neutral to each other. The figure below shows the pairwise comparison matrix. Dana decided that equal weightings offer the most transparency and a balanced view from all perspectives.

Primary Criteria	1. Safety	2. Environmental	3. Technical	4. Societal	5. Economic	Weighting
1. Safety	N	N	N	N	N	20.0%
2. Environmental	N	N	N	N	N	20.0%
3. Technical	N	N	N	N	N	20.0%
4. Societal	N	N	N	N	N	20.0%
5. Economic	N	N	N	N	N	20.0%

Figure A.1 - Example Pairwise Comparison Matrix (N = Neutral)

A.4 Option Attributes

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. The attributes tables for Group 6 and Group 7 are shown in Appendix C and Appendix D respectively.

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

A.5 Option Pair-Wise Comparison

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, Dana 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 below). 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

Figure A.2 - Explanation of Phrasing Adopted for Pairwise Comparison

It should be noted that the relative preference ratios depicted above relate to a two-option example. Where there are more than two options being compared, the relative preference ratios vary according to the preferences selected but will always be a share of the 100% available for that judgement. For the relative preferences derived for each option within each group against each criterion, see the pairwise matrices in Appendix C and Appendix D.

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 dumping from a safety perspective? Are these Neutral to each other? Are they 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 the Figure below.

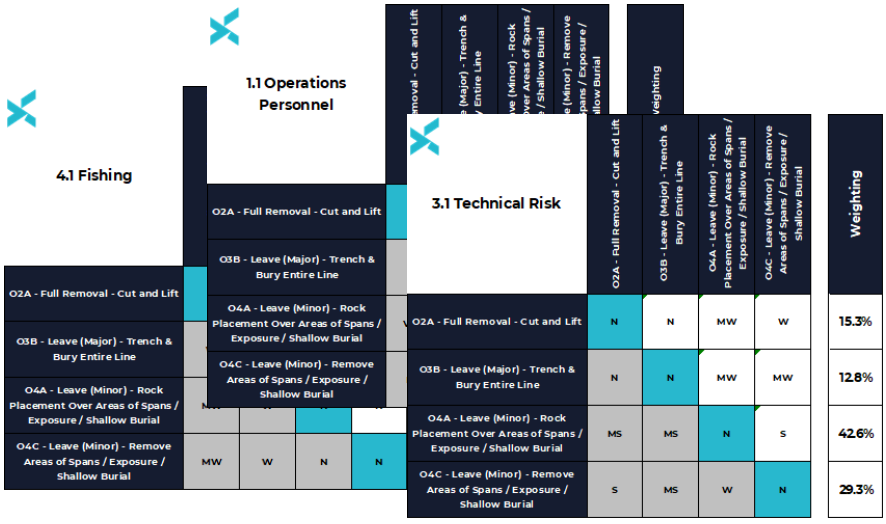


Figure A.3 - Example Option Pairwise Comparison

A.6 Visual Output and Sensitivities

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, opportunity was provided to fine tune 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 C and Appendix D. An example of the visual output obtained is shown in the Figure below.

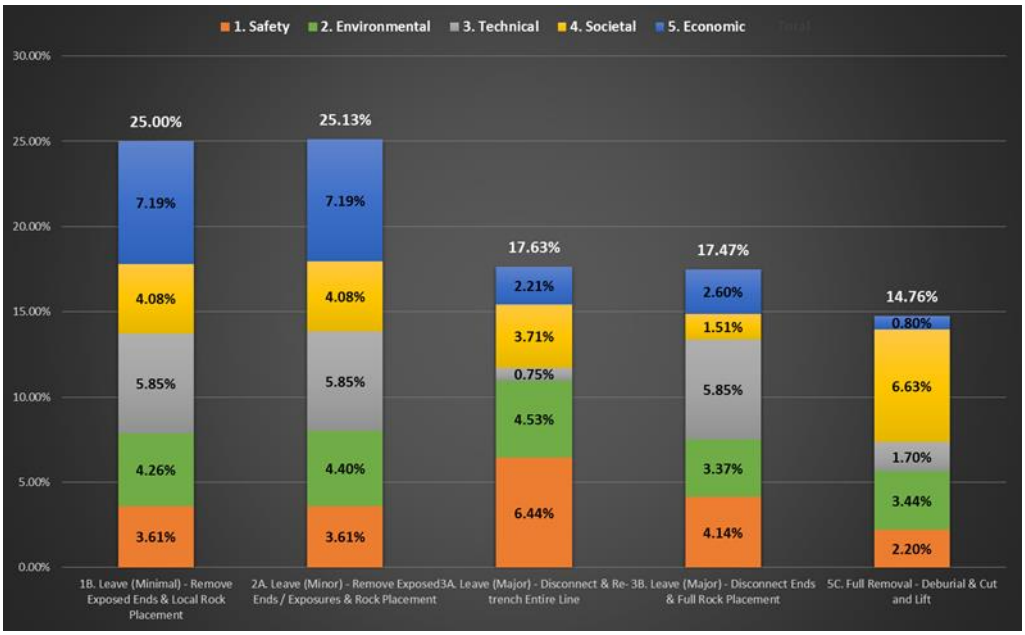


Figure A.4 - Visual Output Example

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 EVALUATION STAKEHOLDER WORKSHOP MINUTES

Subject: Dana Western Isles Decommissioning Programmes – Stakeholders CA Workshop

Location: Xodus offices, 50 Huntly Street, Aberdeen AB10 1RS

Date: 17/08/2022

Assignment: A303550-S00

Reference: A-303550-S00-MINS-001

Minuted by: Jeff McCleary

Issued on: 26/08/2022

Attending: (asterix denotes attendance via VC)

Organisation	Attendee
Joint Nature Conservation Council (JNCC)	Niki Piesinger – Offshore Industry Advisor
Offshore Petroleum Regulator for Environment and Decommissioning (OPRED)	Jade Jones - Decommissioning Policy Advisor (ODU) Sam Pattie – Assistant Decommissioning Manager (ODU) Susan Laing – Senior Decommissioning Policy Manager (ODU)
Scottish Fishermen's Federation (SFF)	Steven Alexander – Offshore Liaison Andrew Third – Industry Advisor Fahim Hashimi – Offshore Energy Policy Officer
Health and Safety Executive (HSE)	Bruce Appleton – Inspector (Dana Focal Point) Marc Nunn – Inspector Management Team Leader Robert Hardy – Inspector (Dana Focal Point (*Oct 2022 onward*))
Dana Petroleum	Stuart Wordsworth – Decommissioning Manager / WI Decom Joint PM Steve Beddows – Consultant Manager / WI Decom Joint PM Carol Barbone – Stakeholder Engagement Advisor Chris Ward* – JV Manager Niall Bell – Environmental Team Lead Andrew Jones* – Head of Communications and Stakeholder Relations Matthew Garden* – Commercial Student Placement
NEO Energy	Russell Reekie* – Asset Lead Andrew Lowrie – Decommissioning and Asset Manager
Xodus Group	John Foreman – Consultant Engineer – TSR Lead/Workshop Facilitator Rama Sharma* – Consultant Engineer - Decommissioning Jeff McCleary – Consultant Engineer - Subsea & Decommissioning William Parker – Lead Consultant – Environment Christina McIntyre* –Consultant – Environment Jolanda Cameron* – Xccelerator - X-Academy

Distribution: Attendees plus:

Organisation	
Marine Scotland Science	Jared Wilson – Renewables and Energy Programme Manager
Offshore Petroleum Regulator for Environment and Decommissioning (OPRED)	Ruth Ledingham – Senior Financial Governance Manager (ODU) Audrey Banner – Head of Policy and Financial Governance (ODU) Environmental Manager (EMT)
Dana Petroleum	Dave Montague – HSSE Manager
NEO Energy	Stuart Gardner – Subsea Manager

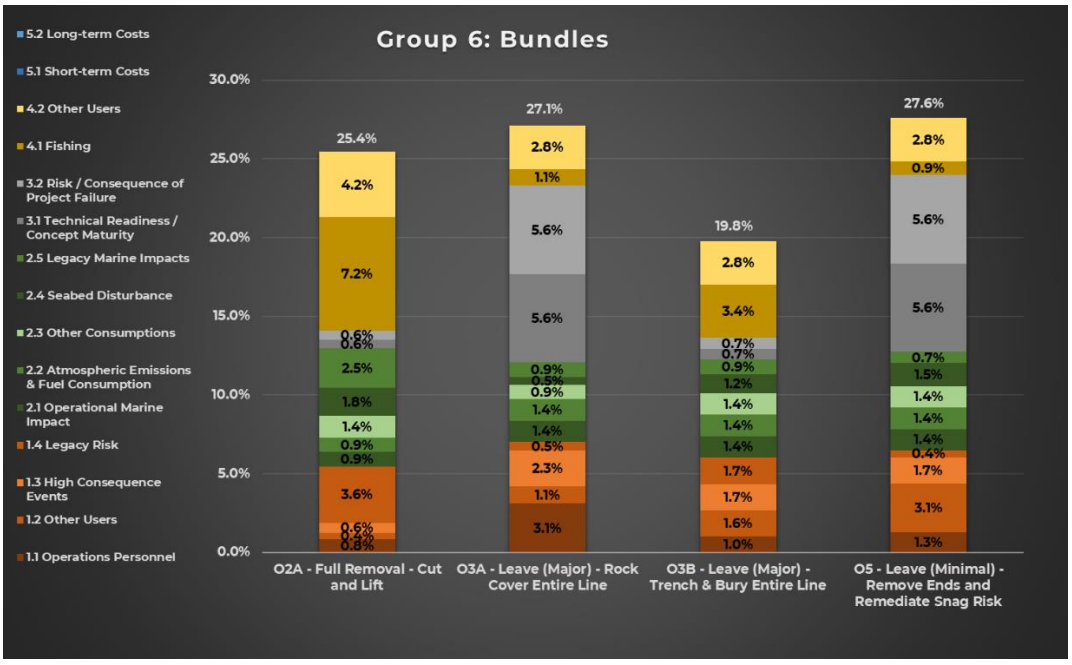
Item	Comment	Action
1.0	Introductions & Background	
1.1	The Western Isles (Barra & Harris) Fields Decommissioning Project was introduced by Stuart Wordsworth (SW) of Dana Petroleum (Dana) followed by a brief overview of the fields and relevant infrastructure under consideration as well as the potential decommissioning schedule. The slide deck for the meeting had also been circulated to invitees the previous week to facilitate review and participation and is attached as an appendix to these minutes.	Info
2.0	Environmental & Societal Summary	
2.1	An environmental summary including details of the benthic environment, threatened and/or declining habitats and species as well as relevant conservation sites was described by William Parker (WP) of Xodus Group (Xodus).	Info
2.2	A summary of commercial fisheries effort in the area (ICES rectangle 51F0) was also presented by WP in order to inform later discussions regarding societal impacts.	Info
2.3	Steven Alexander (SA) of the Scottish Fishermen's Federation (SFF) sought clarification on the date of installation of the bundle infrastructure, in conjunction with the rules around dumping of assets at sea given that the infrastructure was installed post 1999. SW (Dana) confirmed that the infrastructure was installed in 2015. Susan Laing (SL) of Offshore Petroleum Regulator for Environment and Decommissioning (OPRED) provided clarification that OSPAR Decision 98/3 relates only to installations and that bundles are considered pipelines. As such the provisions of OSPAR Decision 98/3 do not apply to bundles. Jeff McCleary (JM) of Xodus Group (Xodus) added that a full removal option was included within the options for assessment but any decision of whether the bundle may be removed was dependant on the emerging recommendations from this workshop.	Info.

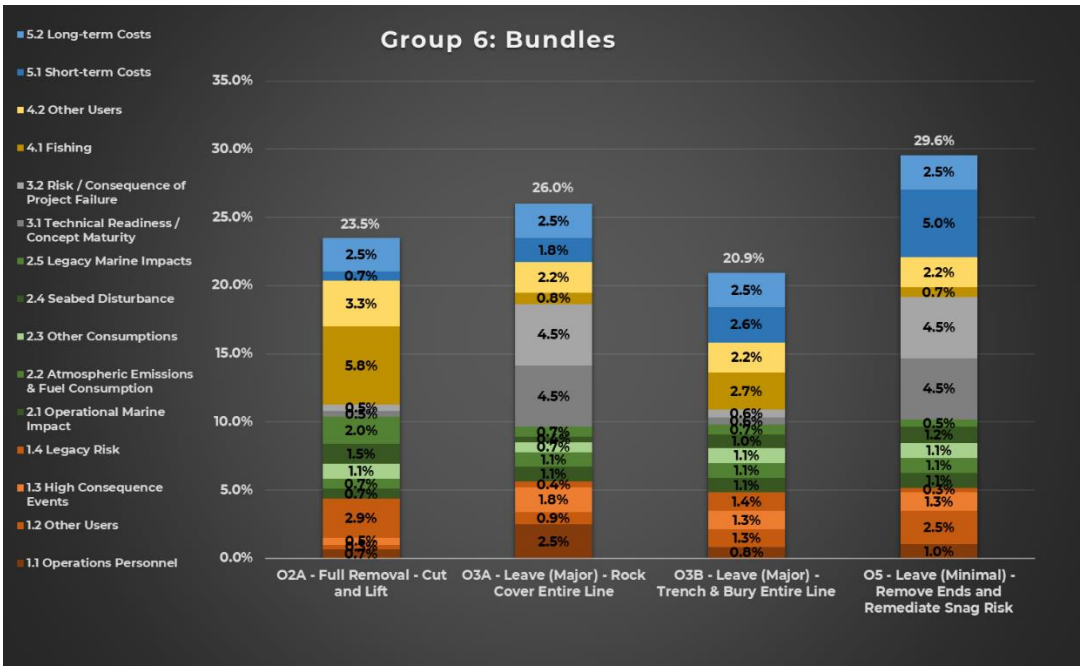
Item	Comment	Action
3.0	Comparative Assessment	
3.1	The background to the Comparative Assessment (CA) process and work conducted to date was provided by JM (Xodus). A summary of the Scoping & Screening phase of the CA Process showing the grouping of equipment, the groups that are to be fully removed and the groups that remain for evaluation, along with the retained decommissioning options were presented.	Info
3.2	An overview of the preparation performed to date, including the purpose of the method statements and supporting studies, was provided by JM (Xodus) Further details of the subsea infrastructure which had been identified for review as part of the CA were also presented. This included: • Group 6 - 2 x 37.8" Dia. X ~ 2.5km Bundles • Group 7 - 6" Gas Import/Export Pipeline, North Riser Base (NRB) Trailing Towhead to Tern SSIV (PL3186) Findings from key supporting studies where then further elaborated on.	Info
3.2.1	PL3186 (6" Gas Import/Export Pipeline) Burial Status was presented indicating that the line is buried to >1m over its entire length.	Info
3.2.2	The technical challenges associated with Bundle Re-float were highlighted, as identified during screening and key findings from the independent review performed by Subsea 7, in order to inform the workshop assessment process. Marc Nunn (MN) of the Health and Safety Executive (HSE) queried whether diving operations were expected as part of bundle decommissioning work scopes. JM (Xodus) clarified that although it is anticipated that it may be possible to perform all operations diver-less, and that Dana would prefer to minimise diving activity where possible, the removal of penetrations and their associated protection cages had been considered as diver activities, such that the possibility of requiring diving was acknowledged and incorporated into the removal methodologies.	Info
3.2.3	The findings from a high-level review of site-specific geotechnical information and PL3186 as-built trenching records were discussed. The use of a mechanical plough for trenching and backfill was highlighted as the most feasible trenching technique. However, the requirement to remove more than 300 appurtenances was highlighted as well as the fact that bundle dimensions and weights were at the upper end of tooling limitations.	Info
3.2.4	With post screening reviews flagging a number of technical challenges associated with trenching JM (Xodus) highlighted that the decision was taken to reintroduce the option for Rock Placement over the entire bundle. Estimated quantities of rock and the associated number of vessel trips were presented to inform the room and aid the subsequent assessment process.	Info

Item	Comment	Action
3.2.5	A summary of existing and emerging technology as identified from desktop review was presented along with an indication of their respective technology readiness levels. It was highlighted that Diamond Wire Cutting was the most feasible cutting technique despite having only been performed on bundles in idealised yard trials to date. The loose internals of bundles were identified as a key challenge and the requirement for bespoke subsea baskets to aid lifting operations.	Info
3.3	Updates to the retained options to be considered during this review workshop were discussed and presented for Group 6 - Bundles based on findings from the supporting studies.	Info
3.4	Having heard the summary of options a general discussion was had between stakeholders with a number of points raised. These are summarised below: • SA (SFF) expressed disappointment that having been involved in discussions regarding removing bundles on several occasions over the past 20 years it appeared the industry was no further forward at this stage. • SA (SFF) made clear his view that if the SFF had known that bundles were not likely to be removed they would not have supported their installation in the first place. • BA (HSE) raised the question whether options would change if the lines were 1km long and suggested industry-wide thinking was needed. • BA (HSE) Queried whether it was possible to cut the bundles into 3 sections and float. JF (Xodus) responded that it was not impossible but was technically challenging for its own reasons and asserted that, from the preparatory study work conducted, the least onerous full removal option remains to cut/lift in smaller sections hence being the retained full removal option. • BA (HSE) raised concerns that if there are too many problems with taking "a new one out" where does that leave us when dealing with "older ones"? He went on to further emphasise that he felt an industry-wide conversation about bundles was required, not individual project-by-project review. • BA (HSE) noted that options had been reinstated following screening and sought clarification whether options could be reinstated at the end of the workshop. JF (Xodus) responded that the outcome of the workshop was to identify an emerging recommendation having sought opinions and feedback from the stakeholders and that time would be taken to reflect on that outcome before submitting a draft decommissioning programme.	Info
3.5	Details of the CA Evaluation Methodology were presented by John Foreman (JF) of Xodus Group, followed by a walk-through description of individual steps/tasks considered for each option under review.	Info

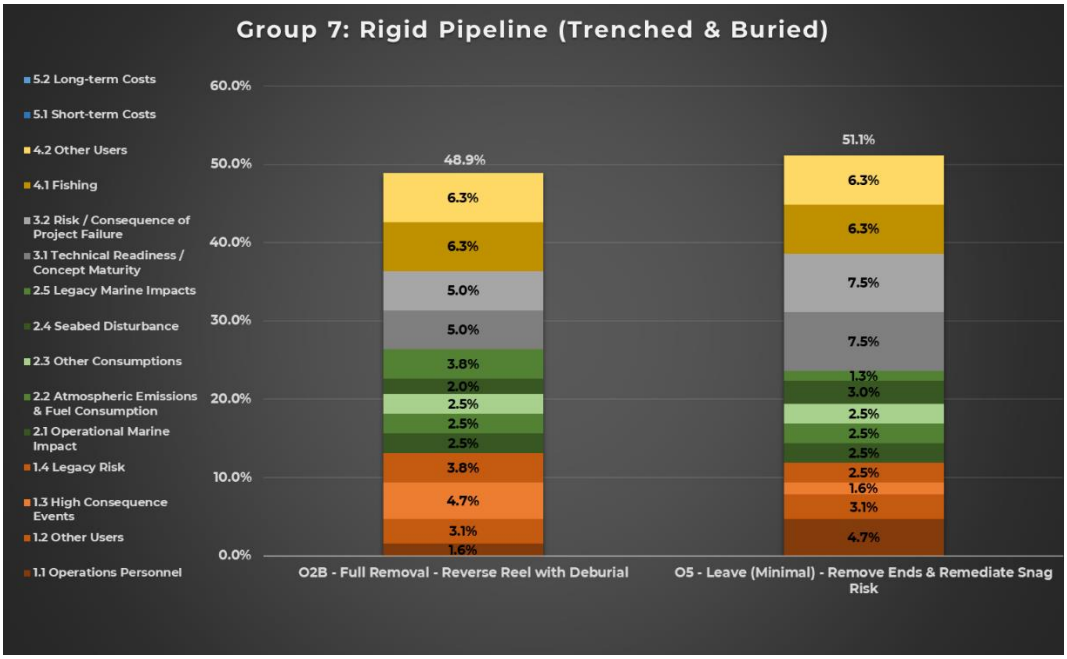
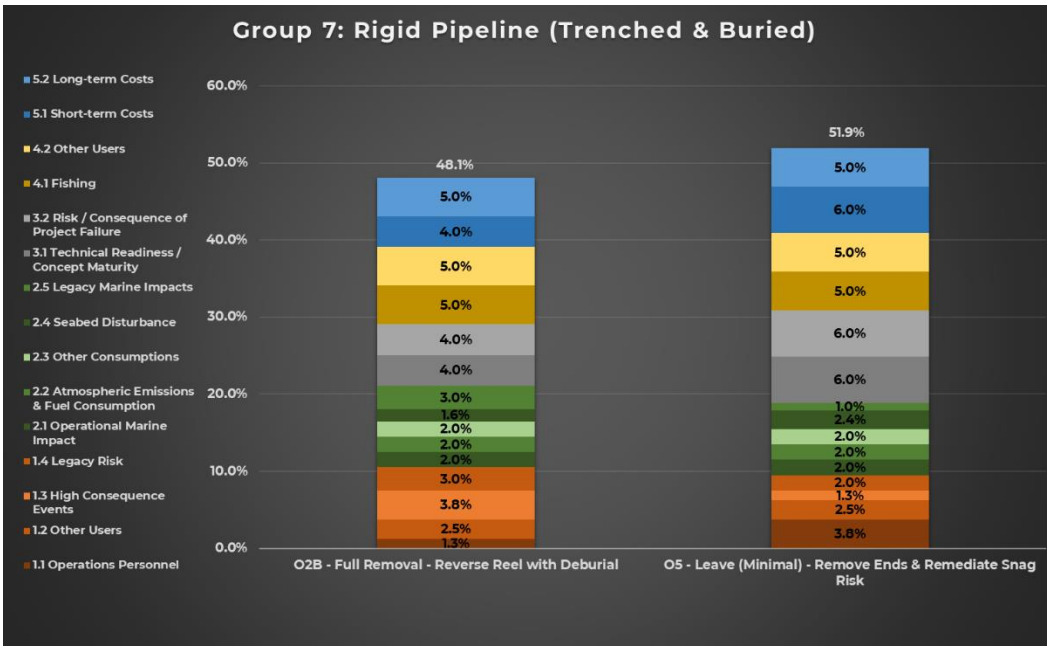
Item	Comment	Action
3.6	• Handouts provided for the workshop included: A set of the criteria and sub-criteria definitions used within the assessment; • Preliminary scorings developed in advance for each option for re-appraisal during this CA workshop.	Info
4.0	Group 6: Bundles	
4.1	As part of the introduction a summary of the infrastructure and key features within this group was provided: • 2 x 37.8" Dia. X ~ 2.5km Bundles o 2 x 37.8" Dia x ~2.5km Surface Laid Bundles o Nominal cross-sectional weight in Air =755kg/m o No FishSafe reportable spans identified o Does not lie in any designated sites	Info
4.2	Four options were evaluated for this group: • Option 2a – Full removal cut and lift with de-burial. • Option 3a – Leave *In situ*, Major Intervention, rock placement over entire line • Option 3b – Leave *In situ*, Major Intervention, trench & bury entire line • Option 5 – Leave *In situ*, minimal intervention, remove ends and remediate snag risk.	Info
4.3	Safety	
4.3.1	Operational Personnel – The assessment presented with no challenges raised. SA (SFF) queried whether vessel durations used accounted for trawl sweeps and highlighted that the SFF's preference is for trawl sweeps to be performed. JM (Xodus) clarified that post decommissioning survey obligations were accounted for in vessel durations, but trawl sweeps were not. However, an ACTION was taken to make specific reference within the Decommissioning Programme of appropriate methods to verify that no snag hazards remain.	Info
4.3.2	Other Users – The assessment was presented and debated. SA and Andrew Third (AT) of the SFF suggested that given the bundles were already surface laid and have been so since installation that this criterion could potentially be a less important evaluation aspect. The existing assessment was to remain as the base case with a sensitivity conducted to reduce the influence of this sub-criteria. ACTION: Sensitivity case where the influence of criterion 1.2 – Safety – Other Users is reduced to be presented within CA Report.	Info

Item	Comment	Action
4.3.3	High Consequence Events – The assessment was presented and debated. MN (HSE) queried whether the data considered diving operations. JF (Xodus) clarified that as the Potential Loss of Life (PLL) figures used in criterion 1.1 – Operational Personnel already captured risk to divers it is not normally included in this sub criterion as it would be considered a 'double dip'. The existing assessment was to remain as the base case.	Info
4.3.4	Legacy Risk – The assessment was presented and debated with adjustments made based on input from SFF. SL (OPRED) enquired as to the logic behind 6 surveys covering a 30 year look ahead being stated for the options presented. JM (Xodus) clarified that it is based on the assumption that survey requirements would be established through a risk-based approach and as such there is a likelihood of a reducing survey frequency. On this basis it is considered that 6 surveys would capture 30+ years. SL (OPRED) suggested that provision for future remediation of snag hazards should be considered. ACTION: Consider inclusion of potential future remediation (rock cover) within Option 5. Adjust assessment in accordance with outcome. SA (SFF) asked how technology advancements would be considered. JF (Xodus) responded that a periodic review of technology would be committed to but no fixed timeline had yet been established.	Info
4.4	Environmental	
4.4.1	Operational Marine Impacts – The assessment was presented with no challenges raised.	Info
4.4.2	Atmospheric Emissions & Fuel Consumption – The assessment was presented and debated. BA (HSE) enquired whether emissions associated with quarrying rock were captured. JF (Xodus) clarified that the boundary had been set at the quayside so only vessel emissions for the duration of load-out had been accounted for. It was further discussed that where to set the boundary, and for what activities, is often a point of debate. JM (Xodus) explained that on the basis that the quarrying of rock and associated emissions were locally licensed/permitted, exclusion from CA of the emissions related to physical quarrying is usual. ACTION: Consider the inclusion of environmental impact of quarrying/transportation of rock.	Info
4.4.3	Other Consumptions – The assessment was presented with no challenges raised.	Info
4.4.4	Seabed Disturbance – The assessment was presented with no challenges raised.	Info
4.4.5	Legacy Marine Impacts – The assessment was presented with no challenges raised.	Info

4.5	Technical	
4.5.1	Technical Readiness/Concept Maturity – The assessment was presented with no challenges raised.	Info
4.5.2	Risk/Consequence of Project Failure – The assessment was presented with no challenges raised.	Info
4.6	Societal	
4.6.1	Fishing – The assessment was presented and debated with adjustments made to the assessment based on input from SFF and in alignment with criterion 1.4 (Safety Legacy Risk).	Info
4.6.2	Other Users – The assessment was presented with no challenges raised.	Info
4.7	Economic	
4.7.1	Short-Term Costs – The assessment was presented with no challenges raised.	Info
4.7.2	Long-Term Costs – The assessment was presented with no challenges raised.	Info
4.8	Results	
4.8.1	The base case outcome of the assessment is shown in the chart below. The emerging recommendation for Group 6: Bundles is a small preference for Option 5 - Leave *In situ*, minimal intervention, remove ends and remediate snag risk. 	

4.8.2	This preference is strengthened with the inclusion of the assessment against the Economics criterion. 	
4.8.3	Following a review of the results SA (SFF) raised the point that Option 5 may not be the preferred solution if burdened with the requirement to fall back on rock placement as a future remediation methodology. ACTION: Consider inclusion of potential future remediation (rock cover) within Option 5. Adjust assessment in accordance with outcome.	Info
5.0	Group 7: Rigid Pipelines (Trenched & Backfilled)	
5.1	As part of the introduction a summary of the infrastructure and key features within this group was provided: • 6" Gas Import/Export Pipeline, Northern Riser Base (NRB) Trailing Towhead to Tern SSIV o Rigid 6" x 11.274km, Gas Export/Import Pipeline o 168.3mm OD x 7.92mm WT o NRB Trailing Towhead to Tern SSIV o Carbon Steel (3LPP coating) o Trenched and backfilled along entire length o Rock placement at trench transitions o 1 crossing over the associated spools at Tern o Does not lie in any designated sites	Info

5.2	Two options were evaluated for this group: • Option 2b– Full Removal, Reverse Installation (S-lay or Reel) with de-burial) • Option 5 – Leave *In situ*, minimal intervention, remove ends and remediate snag risk.	Info
5.3	Safety	
5.3.1	Operational Personnel – The assessment was presented with no challenges raised.	Info
5.3.2	Other Users – The assessment was presented with no challenges raised.	Info
5.3.3	High Consequence Events – The assessment was presented with no challenges raised.	Info
5.3.4	Legacy Risk – The assessment was presented with no challenges raised.	Info
5.4	Environmental	
5.4.1	Operational Marine Impacts – The assessment was presented with no challenges raised.	Info
5.4.2	Atmospheric Emissions & Fuel Consumption – The assessment was presented with no challenges raised.	Info
5.4.3	Other Consumptions – The assessment was presented with no challenges raised.	Info
5.4.4	Seabed Disturbance – The assessment was presented with no challenges raised.	Info
5.4.5	Legacy Marine Impacts – The assessment was presented with no challenges raised.	Info
5.5	Technical	
5.5.1	Technical Readiness/Concept Maturity– The assessment was presented with no challenges raised.	Info
5.5.2	Risk/Consequence of Project Failure – The assessment was presented and debated. Andrew Lowrie (AL) of NEO Energy (NEO) suggested that the risks and consequence associated with only partially achieving pipeline removal may have been underestimated. It was agreed that the existing assessment would remain as the base case with a sensitivity conducted to establish any influence of this sub-criteria. ACTION: Sensitivity case where the assessment of Option 2B v Option 5 against the Risk/Consequence of Project Failure is increased from Weaker to Much Weaker to be presented within CA Report.	Info
5.6	Societal	
5.6.1	Fishing – The assessment was presented with no challenges raised.	Info
5.6.2	Other Users – The assessment was presented with no challenges raised.	Info
5.7	Economic	
5.7.1	Short-Term Costs – The assessment was presented with no challenges raised.	Info
5.7.2	Long-Term Costs – The assessment was presented with no challenges raised.	Info

5.8	Results (Note: charts repeated at end of minutes in larger format to aid legibility)	
5.8.1	The base case outcome of the assessment is shown in the chart below. The emerging recommendation for Group 7: Rigid Pipelines (Trenched & Backfilled) is a small preference for Option 5 - Leave *In situ*, minimal intervention, remove ends and remediate snag risk.  This preference is strengthened with the inclusion of the assessment against the Economics criterion.  	

6.0	Additional Points	
6.1	Further discussion took place regarding the earlier point raised by SA (SFF) in relation to the rules around leaving bundles *in situ* given that the bundle infrastructure was installed post 1999. JM (Xodus) reiterated that OSPAR Decision 98/3 relates only to installations and as such its provisions do not apply to bundles. SL (OPRED) confirmed again that this was correct, adding that OPRED guidance post 1999 nevertheless suggests that their removal should be considered, although this was just guidance and not a regulation.	Info
6.2	SL (OPRED) mentioned that 2 other operators with bundles which had gained approval to be left *in situ*, had been required to commit to an annual review of emerging technology to assess whether their decommissioning solution remained valid given technology advancements.	Info
6.3	SW (Dana) explained the effort around the Subsea 7 bundle removal review (supporting study) where Subsea 7 had been given free rein to look at all options and emerging technologies to ensure that all potential approaches were considered. SW (Dana) emphasised that while technology (such as cutting techniques) is being developed, commercial use is still a long way off (years down the line). SW (Dana) elaborated further to state that emerging cutting techniques are unlikely to apply to the Dana bundle recovery which is a larger diameter than most bundles.	Info
6.4	SA (SFF) raised the point that given his experience of the decommissioning of bundles to date, SFF would be less inclined to support the use of bundles for future developments as they appear to be less likely to be removed upon decommissioning than pipelines. He suggested further discussions were needed with Subsea 7 on this matter.	

APPENDIX C GROUP 6 – DETAILED EVALUATION RESULTS

C.1 Group 6 Attributes Table

Group 6: Bundles

North Bundle - 37.5" 2.4 km | South Bundle - 37.5" 2.5 km
contain 4 off pipelines (production / gas lift / water injection) and associated power / signal / hydraulic / chemical)

		O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk
		- Bundles cut from towheads (using DWC) - Bundle cut into 12m sections using DWC - MFE used at cut locations to enable DWC equipment to gain access to bottom of bundle - Ballast chains cut by divers, placed in subsea baskets and recovered - Cut bundle sections lifted to subsea basket and recovered - Batch transfer of cut sections to barge - Cut sections / chains offloaded at quayside for recycling / disposal	- Bundles cut from towheads (using DWC) - Rock cover placed over entire bundles using fall pipe vessel to appropriate depth of cover - Rock berm profiled to be overtrawlable	- Bundles cut from towheads (using DWC) - Ballast chains and vent appurtenances cut by divers, placed in subsea baskets and recovered - Plough trenching performed - 2 passes required to get required depth - Backfill performed to fill in trench - Small area of rock cover placed at trench transitions	- Bundles cut from towheads (using DWC) - Ballast chains and vent appurtenances cut by divers, placed in subsea baskets and recovered - Rock cover placed at limited areas of small spans (fall pipe) - Rock cover placed over bundle ends (fall pipe) - Bundles will remain in-situ, surface laid
1. Safety	1.1 Operations Personnel	Vessel Type: PoB / Days / Hours / PLL Barge / Pipehaul: 20 / 134.8 / 32,357 / 1.78E-03 Tug: 7 / 287.6 / 24,161 / 3.19E-03 CSV: 76 / 139.9 / 127,607 / 9.57E-03 Total offshore hours: 184,125 hrs Total offshore PLL: 1.45E-02 Resource Type: Days / Hours / PLL Engineering & Management: 3,882.4 / 31,059 / 1.24E-04 Project Management: 2,431.0 / 19,448 / 7.78E-05 Onshore Operations (includes Cleaning & Disposal): 164.0 / 10,496 / 1.29E-03 Total onshore hours: 61,003 hrs Total onshore PLL: 1.49E-03 Total operational hours: 245,128 hrs Total operational PLL: 1.60E-02	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 6.4 / 5,837 / 4.38E-04 Rockdump Vessel: 20 / 52.0 / 12,470 / 9.35E-04 Total offshore hours: 18,307 hrs Total offshore PLL: 1.37E-03 Resource Type: Days / Hours / PLL Engineering & Management: 1,141.2 / 9,129 / 3.65E-05 Project Management: 1,075.0 / 8,600 / 3.44E-05 Total onshore hours: 17,729 hrs Total onshore PLL: 7.09E-05 Total operational hours: 36,037 hrs Total operational PLL: 1.44E-03	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 21.5 / 28,367 / 2.13E-03 Divers: 18 / 21.5 / 9,284 / 9.01E-03 Rockdump Vessel: 20 / 7.5 / 1,802 / 1.35E-04 Large Deck CSV: 76 / 25.8 / 23,539 / 1.77E-03 Total offshore hours: 62,992 hrs Total offshore PLL: 1.30E-02 Resource Type: Days / Hours / PLL Engineering & Management: 1,150.0 / 9,200 / 3.68E-05 Project Management: 699.0 / 5,592 / 2.24E-05 Total onshore hours: 14,792 hrs Total onshore PLL: 5.92E-05 Total operational hours: 77,784 hrs Total operational PLL: 1.31E-02	Vessel Type: PoB / Days / Hours / PLL DSV: 110 / 21.5 / 28,367 / 2.13E-03 Divers: 18 / 21.5 / 9,284 / 9.01E-03 Rockdump Vessel: 20 / 7.1 / 1,694 / 1.27E-04 Total offshore hours: 39,345 hrs Total offshore PLL: 1.13E-02 Resource Type: Days / Hours / PLL Engineering & Management: 660.3 / 5,282 / 2.11E-05 Project Management: 435.0 / 3,480 / 1.39E-05 Total onshore hours: 8,762 hrs Total onshore PLL: 3.50E-05 Total operational hours: 48,107 hrs Total operational PLL: 1.13E-02
		MW	**MS**	**MS**	**W**
Summary		The assessment of the Operations Personnel sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 3A due to the risk exposure being significantly higher in Option 2A due to the extended offshore scope for full removal and the onshore handling of the entirety of the bundles. Option 2A is assessed as being Weaker than Option 3B due to the slightly higher risk exposure from the extended offshore scope to remove and process the entirety of the bundles versus the smaller scope associated with the trench and bury of the bundles. Note: the use of diver time to perform chain and appurtenance removal adds significantly to the risk exposure associated with Option 3B. Option 2A is also assessed as being Weaker than Option 5, again due to the slightly higher risk exposure from the full removal scope versus the smaller scope to remove bundle ends and remediate snag risk in Option 5. Note: the use of diver time to perform chain and appurtenance removal adds significantly to the risk exposure associated with Option 5. Option 3A is assessed as being Much Stronger than both Option 3B and Option 5 as there are longer durations and diver time required to deliver Option 3B and Option 5 versus the shorter duration, lower risk activities to deliver Option 3A. Option 3B is assessed as being Weaker than Option 5 due to the slightly higher risk exposure to deliver the greater offshore scope to trench and bury the bundles in Option 3B. **Overall, Option 3A is preferred from a risk to Operations Personnel perspective.**			

		O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk
1. Safety	1.2 Other Users	Vessel Days: Barge / Pipehaul: 134.8 Tug: 287.6 CSV: 139.9 Total vessel days: 562.4 days Transits: 28	Vessel Days: CSV: 6.4 Rockdump Vessel: 52.0 Total vessel days: 58.4 days Transits: 20	Vessel Days: DSV: 21.5 Rockdump Vessel: 7.5 Large Deck CSV: 25.8 Total vessel days: 54.8 days Transits: 8	Vessel Days: DSV: 21.5 Rockdump Vessel: 7.1 Total vessel days: 28.6 days Transits: 4
		MW MW VMW	W MW	W	
	Summary	The assessment of the Other Users sub-criterion is as follows: Option 2A is assessed as being Much Weaker than both Option 3A and Option 3B due to the much higher number of days of vessel time and greater number of transits associated with Option 2A presenting an increase to the potential safety impact to other users of the sea when compared to Option 3A and 3B. Option 2A is assessed as being Very Much Weaker than Option 5 as the number of vessel days and transits and hence the safety impact to other users of the sea is even lower in Option 5. Option 3A is assessed as being Weaker than Option 3B as while the number of vessel days is similar, there are more transits in Option 3A due to reloading the rock dump vessel with rock. Option 3A is assessed as being Much Weaker than Option 5 due to the greater number of vessel days and transits to deliver Option 3A. Option 3B is assessed as being Weaker than Option 5 due to the greater number of vessel days and transits to deliver Option 3B. **Overall, Option 5 is preferred from a risk to Other Users perspective.**			
1. Safety	1.3 High Consequence Events	Challenging cut and lift operations. High number of lifts (940) through the water column to deploy and recover MFE and DWC and to recover bundle sections. Additional lifting to transfer bundle sections to quayside.	Routine, low risk rock placement operations using fall pipe vessel. Low number of lifting operations (16) through the water column to deploy and recover cutting equipment to address bundle ends only.	Challenging but low risk plough trenching operations. Moderate number of lifting operations (66) through the water column to deploy and recover trenching equipment and to recover ballast chains and appurtenances removed to enable plough trenching.	Routine, low risk rock placement operations using fall pipe vessel. Moderate number of lifting operations (54) through the water column to deploy and recover cutting equipment to address bundle ends only and to recover ballast chains and appurtenances removed.
		MW MW MW	S S	N	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 2A is assessed as being Much Weaker than all other options due to the much higher number of lifting operations and hence potential for dropped objects, to deploy and recover cutting and deburial equipment, and to recover the bundles in sections in baskets. Option 3A is assessed as being Stronger than both Option 3B and Option 5 as there are minimal lifting operations associated with the rock cover operations versus moderate lifting operations to deploy and recover cutting and trenching equipment in Option 3B and cutting equipment in Option 5. Option 3B is assessed as being Neutral to Option 5 as while there are small differences in the number of lifting operations between the options, these are considered insufficient to express a preference. **Overall, Option 3A is preferred from a High Consequence Events perspective.**			
1. Safety	1.4 Legacy Risk	No legacy risk from this full removal option.	The bundles would remain in-situ with this option although they would be fully rock covered. 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. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 4.8 / 2,508 / 1.88E-04	The bundles would remain in-situ with this option although they would be trenched and buried with small areas of rock cover at the trench transitions. 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. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 4.8 / 2,508 / 1.88E-04	The bundles would remain in-situ and surface laid with this option. The snag risk from the limited areas of small spans and bundle ends will be remediated with rock cover. Appurtenances removed. 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. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 4.8 / 2,508 / 1.88E-04
		VMS S VMS	MW S	MS	
	Summary	The assessment of the Legacy Risk sub-criterion is as follows: Option 2A is assessed as being Very Much Stronger than Option 3A and Option 5 as the bundles are fully removed versus there being a potential residual snag risk associated with the bundles remaining in-situ in Option 3A and Option 5. The residual potential snag risk is mitigated by the bundles being rock covered in Option 3A and overtrawlable in Option 5 (with local rock cover at areas of spans and chains and appurtenances removed). Option 2A is assessed as being Stronger than Option 3B as while both options present a clear seabed, the bundles remain (albeit trenched and buried) in Option 3B. Option 3A is assessed as being Much Weaker than Option 3B due to the large rock berm introduced versus clear seabed in Option 3B. Option 3A is assessed as being Stronger than Option 5 as the snag risk presented by the overtrawlable bundles (with local rock cover at areas of spans and chains and appurtenances removed) is considered greater than bundles that are fully rock covered. Option 3B is assessed as being Much Stronger than Option 5 due to it presenting a clear seabed versus the bundles remaining in-situ in Option 5 although they are overtrawlable with local rock cover at areas of spans and chains and appurtenances removed. **Overall, Option 2A is preferred from a Legacy Risk perspective.**			

		O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): 454.0 days Tooling Noise (MFE) = 8.3 days Tooling Noise (DWC) = 32.9 days Operation Discharges: Line cleaning and flushing operations adopt 3 line volume flush as industry best practice to minimise as far as possible residual hydrocarbon / chemical levels in various lines which make up the bundles. This will minimise discharges to the marine environment during flushing activities and during any subsequent removal operations. There will be potential for the release of residual contents at cut locations, however, given the prior cleaning of the lines, the concentration and quantity of discharge should still be low overall. Therefore, the related impact is also anticipated to be low. There will also be potential for release of small amounts of swarf and line insulation material at each of the (many) cut locations. Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 454 days is by far the highest of all the options. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 16.0 days Tooling Noise (MFE) = 0.08 days Tooling Noise (DWC) = 0.34 days Operation Discharges: Line cleaning and flushing operations adopt 3 line volume flush as industry best practice to minimise as far as possible residual hydrocarbon / chemical levels in various lines which make up the bundles. This will minimise discharges to the marine environment during flushing activities and during any subsequent removal operations. There will be potential for the release of residual contents at cut locations (bundle ends only - four off), however, given the prior cleaning of the lines, the concentration and quantity of discharge should still be low overall. Therefore, the related impact is also anticipated to be low. There will also be potential for release of small amounts of swarf and line insulation material at these cut locations (bundle ends only - four off). Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 16 days is the lowest of the options. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 29.0 days Tooling Noise (MFE) = 0.09 days Tooling Noise (DWC) = 0.34 days Tooling Noise (Plough) = 3.16 days Operation Discharges: Line cleaning and flushing operations adopt 3 line volume flush as industry best practice to minimise as far as possible residual hydrocarbon / chemical levels in various lines which make up the bundles. This will minimise discharges to the marine environment during flushing activities and during any subsequent removal operations. There will be potential for the release of residual contents at cut locations (bundle ends only - four off), however, given the prior cleaning of the lines, the concentration and quantity of discharge should still be low overall. Therefore, the related impact is also anticipated to be low. There will also be potential for release of small amounts of swarf and line insulation material at these cut locations (bundle ends only - four off). Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 29 days is not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 19.0 days Tooling Noise (MFE) = 0.09 days Tooling Noise (DWC) = 0.34 days Operation Discharges: Line cleaning and flushing operations adopt 3 line volume flush as industry best practice to minimise as far as possible residual hydrocarbon / chemical levels in various lines which make up the bundles. This will minimise discharges to the marine environment during flushing activities and during any subsequent removal operations. There will be potential for the release of residual contents at cut locations (bundle ends only - four off), however, given the prior cleaning of the lines, the concentration and quantity of discharge should still be low overall. Therefore, the related impact is also anticipated to be low. There will also be potential for release of small amounts of swarf and line insulation material at these cut locations (bundle ends only - four off). Vessel Discharges: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 19 days is not considered significant. The environmental impact is considered to be negligible.
		W W W	N N	N	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 2A is assessed as being Weaker than all other options due to the slightly higher environmental impact associated with the noise generated from the longer durations of on site vessel operations and tolling operations and the discharges associated with cutting and lifting the bundles under the full removal option. It is noted these operational marine impacts are considered negligible / low. All other options are assessed as being Neutral to each other as ,while there are small differences in the durations and operations across these options, the impact on the marine environment are similar and negligible. **Overall, Option 3A, Option 3B and Option 5 are equally preferred from an Operational Marine Impact perspective.**			
2. Environmental	2.2 Atmospheric Emissions & Fuel Consumption	Vessel Emissions (in tonnes): Fuel: 13,136 CO2: 41,641 NOx: 780.28 SO2: 52.54 Vessel Energy Use: 564,848 GJ	Vessel Emissions (in tonnes): Fuel: 1,004 CO2: 3,184 NOx: 59.66 SO2: 4.02 Vessel Energy Use: 43,186 GJ	Vessel Emissions (in tonnes): Fuel: 1,285 CO2: 4,073 NOx: 76.33 SO2: 5.14 Vessel Energy Use: 55,253 GJ	Vessel Emissions (in tonnes): Fuel: 791 CO2: 2,508 NOx: 46.99 SO2: 3.16 Vessel Energy Use: 34,019 GJ
		W W W	N N	N	
	Summary	The assessment of the Atmospheric Emissions & Consumptions sub-criterion is as follows: Option 2A is assessed as being Weaker than all other options as the longer duration vessel operations for perform the full removal of the bundles generates significantly greater atmospheric emissions than any of the other options. It is noted that while the emissions in Option 2A are greater, the actual impact is negligible. All other options are assessed as being Neutral to each other as ,while there are small differences in the emissions across the options, these differences are insufficient to express a preference. **Overall, Option 3A, Option 3B and Option 5 are equally preferred from an Atmospheric Emissions & Consumptions perspective.**			

		O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk
2. Environmental	2.3 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 3,436 Remaining Material: Total: 3,436 Rock: N/A tonnes	Material Emissions (CO2 in tonnes): Recovered Material: Remaining Material: 6,506 Total: 6,506 Rock: 283,500 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: Remaining Material: 6,506 Total: 6,506 Rock: 2,000 tonnes	Material Emissions (CO2 in tonnes): Recovered Material: Remaining Material: 6,506 Total: 6,506 Rock: 15,000 tonnes
		S N N	W W	N	
	Summary	The assessment of the Other Consumptions sub-criterion is as follows: Option 2A is assessed as being Stronger than Option 3A due the requirement for significant rock to deliver Option 3A. Option 2A is assessed as being Neutral to both Option 3B and Option 5 as while there are differences in the consumptions between the returned / remaining material in terms of CO2 and the quantities of rock required, these differences are considered insufficient to express a preference. Option 3A is assessed as being Weaker than both Option 3B and Option 5 due the requirement for significant rock to deliver Option 3A. Option 3B is assessed as being Neutral to Option 5 as while there are differences in the quantities of rock required, these differences are considered insufficient to express a preference. **Overall, Option 2A, Option 3B and Option 5 are equally preferred from an Other Consumptions perspective.**			
2. Environmental	2.4 Seabed Disturbance	Seabed Disturbance (m2): MFE: 3,546 No rock cover in this option.	Seabed Disturbance (m2): Rock Cover: 68,810 Habitat Loss / Change (m2): Rock Cover: 68,810	Seabed Disturbance (m2): Rock Cover: 2,000 Trenching: 49,030 Habitat Loss / Change (m2): Rock Cover: 2,000	Seabed Disturbance (m2): Rock Cover: 800 MFE: 36 Habitat Loss / Change (m2): Rock Cover: 800
		MS S S	MW MW	W	
	Summary	The assessment of the Seabed Disturbance sub-criterion is as follows: Option 2A is assessed as being Much Stronger than Option 3A due to the limited area of temporary seabed disturbance associated with the full removal versus the larger area of temporary and permanent impact from the introduction of rock in Option 3A. Option 2A is assessed as being Stronger than both Option 3B and Option 5, again due to the smaller area of temporary impact to the seabed in Option 2A versus a greater area of temporary impact from the trenching operations in Option 3B and the small areas of permanent impact from the rock introduced in Option 3B and Option 5. Option 3A is assessed as being Much Weaker than both Option 3B and Option 5 due to the larger area of temporary and permanent impact from the introduction of rock in Option 3A. Option 3B is assessed as being Weaker than Option 5 due to large area of temporary impact from the trenching operations and the larger area of permanent impact from the introduction of rock in Option 3B. **Overall, Option 2A is preferred from a Seabed Disturbance perspective.**			
2. Environmental	2.5 Legacy Marine Impacts	No legacy marine impact from this full removal option.	Line cleaning and flushing operations adopt 3 line volume flush as industry best practice to minimise as far as possible residual hydrocarbon / chemical levels in bundle lines post flush. The legacy marine impact from the slow release of these low concentration / quantity discharges is therefore expected to be low overall. The rate of release / degradation will be reduced by rock cover.	Line cleaning and flushing operations adopt 3 line volume flush as industry best practice to minimise as far as possible residual hydrocarbon / chemical levels in bundle lines post flush. The legacy marine impact from the slow release of these low concentration / quantity discharges is therefore expected to be low overall. The rate of release / degradation will be reduced by burial.	Line cleaning and flushing operations adopt 3 line volume flush as industry best practice to minimise as far as possible residual hydrocarbon / chemical levels in bundle lines post flush. The legacy marine impact from the slow release of these low concentration / quantity discharges is therefore expected to be low overall.
		MS MS MS	N S	S	
	Summary	The assessment of the Legacy Marine Impacts sub-criterion is as follows: Option 2A is assessed as being Much Stronger than all other options as there is no legacy marine impact associated with the full removal option whereas there will be slow degradation of the bundles and minor releases over a long time period with the other options. Option 3A is assessed as being Neutral to Option 3B as the legacy marine impact is expected to be similar for both options as the bundles remain in situ and isolated from the marine environment in both cases. Option 3A is assessed as being Stronger than Option 5 as the bundles are isolated from the marine environment in Option 3A due to them being rock covered while they remain exposed to the marine environment in Option 5 leading to a shorter (but still long) duration for degradation processes and subsequent minor releases. Option 3B is assessed as being Stronger than Option 5 due to the bundles being isolated from the marine environment in Option 3B due to them being trenched and buried while they remain exposed to the marine environment in Option 5 leading to a shorter (but still long) duration for degradation processes and subsequent minor releases. **Overall, Option 2A is preferred from a Legacy Marine Impacts perspective.**			

			O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk
3. Technical	3.1 Technical Readiness / Concept Maturity		The required cutting techniques are field proven (TRL 7) however utilisiation on bundles is limited to yard trials (TRL5) . Subsea tools and vessel requirements are broadly supported across the market. (Score 3)	Extensively field proven techniques (TRL7). Vessel requirements are broadly supported across the market but rock quantities suggest larger vessels more suited to the scope hence availability requires early market engagement. (Score 3)	Well proven techniques. Subsea tools and vessel requirements are broadly supported across the market (TRL7), however requirements are at upper limits of trench and backfill capabilities. Technique not used previously to lower bundle carrier pipe. (Score 2)	Cutting technique (TRL7), use on bundles only in yard trials (TRL5) and rock placement field proven (TRL 7) . Subsea tools and vessel requirements are broadly supported across the market. (Score 3)
		VMW	**W**	**VMW**	**VMS**	**N**	**VMW**
	Summary	The assessment of the Technical Readiness / Concept Maturity sub-criterion is as follows: Option 2A is assessed as being Very Much Weaker than Option 3A and Option 5 due to the significant challenges associated with the cutting of the bundles, especially on this scale (diameter / length), using diamond wire cutting which, while trialled has yet to be proven in use. In addition, there remain challenges associated with the lifting of the bundle sections due to the potential for loose internal elements. The operations associated with Option 3A and Option 5 are much more routine / proven in nature. Option 2A is assessed as being Weaker than Option 3B due to the challenges to cut and lift the bundles versus the challenges to trench the bundles which, given their diameter, are at the limit of trenching capabilities and the unproven nature of using trenching techniques on bundles. Option 3A is assessed as being Very Much Stronger than Option 3B due to the routine nature of rock cover activities versus the trenching activities being unproven for bundles and their diameter being at the limit of trenching capabilities. Option 3A is assessed as being Neutral to Option 5 as both options employ routine activities. Option 3B is assessed as being Very Much Weaker than Option 5 due to the trenching activities being unproven for bundles and their diameter being at the limit of trenching capabilities versus routine operations in Option 5. **Overall, Option 3A and Option 5 are equally preferred from a Technical Readiness / Concept Maturity perspective.**			
3. Technical	3.2 Risk / Consequence of Project Failure		<5km of surface laid bundle is feasible to remove by cut and lift with several trips to offload recovered materials. Risk of extension to schedule as multiple local cut & dredge operations. (Score 3)	Limited technical risks, rock placement is a well established process hence low chance of project failure. (Score 3)	Weights, diameters at limit of plough spec/capacity, bundle carrier pipe at risk of buckling, large bollard pull vessel required and low trenching rates anticipated. Low alternate equipment availability in event of primary tool failure. Part buried line may require remedial rock placement. (Score 1)	Limited technical risks, small quantity of diamond wire end cuts and limited scope for rock placement . (Score 3)
		MW	**N**	**MW**	**MS**	**N**	**MW**
	Summary	The assessment of the Risk / Consequence of Failure sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 3A and Option 5 due to the potential for failure associated with the high number of cutting and lifting operations in Option 3A versus the routine operations in Option 3A and Option 5 having a low chance of failure. Option 2A is assessed as being Neutral to Option 3B as the challenges associated with both options have a similar likelihood of failure. Option 3A is assessed as being Much Stronger than Option 3B due to the challenges and potential for remedial rock cover as a fall back position associated with the successful delivery of the trench and bury option. Option 3A is assessed as being Neutral to Option 5 as they have a similar, low likelihood of project failure. Option 3B is assessed as being Much Weaker than Option 5 due to the challenges and potential for remedial rock cover as a fall back position associated with the successful delivery of the trench and bury option. **Overall, Option 3A and Option 5 are equally preferred from a Risk / Consequence of Failure perspective.**			
4. Societal	4.1 Fishing		Long duration operation, small area of disturbance, Fishing operations are conducted in vicinity of the pipeline. Line removed (Score 3)	Relatively short operation requiring multiple transits, large area of disturbance and extensive permenant rock berms, Fishing operations are conducted in vicinity of the pipeline. (Score 1)	Short operation, temporary large area of disturbance but removes obstruction from seabed, Fishing operations are conducted in vicinity of the pipeline. (Score 3)	Short operation, small area of disturbance, Fishing operations are conducted in vicinity of the pipeline. (Score 2)
		VMS	**S**	**VMS**	**MW**	**S**	**MS**
	Summary	The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 2A is assessed as being Very Much Stronger than Option 3A and Option 5 as while there is greater disruption to fishing operations in the area to perform the full removal, a clear seabed will be presented versus large rock berms being left in Option 3A and the bundles remaining in situ albeit overtrawlable in Option 5. Option 2A is assessed as being Stronger than Option 3B as while both options present a clear seabed, the bundles remain in Option 3B. Option 3A is assessed as being Weaker than Option 3B as large rock berms are left in Option 3A versus a clear seabed in Option 3B. Option 3A is assessed as being Stronger than Option 5 as, while large rock berms are left in Option 3A, these are preferable to the bundles being left in situ albeit overtrawlable in Option 5. Option 3B is assessed as being Much Stronger than Option 5 as it presents a clear seabed versus the bundles remaining in situ albeit overtrawlable in Option 5. **Overall, Option 2A is preferred from a Societal impact on Fishing perspective.**			

		O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk
4. Societal	4.2 Other Users	Returned steel , coppper can be recycled. (Score 3) Materials Returned: Steel: 3,392 tonnes (recyclable) Aluminium Alloy: 16 tonnes (recyclable) Copper: 7 tonnes (recyclable) Polymer: 53 tonnes (landfill)	No returned steel, copper, etc for recycling. Large amount of rock procured/deposited. (Score 2) Materials Returned: None.	No returned steel, copper, etc for recycling. (Score 2) Materials Returned: None.	No returned steel, copper, etc for recycling. (Score 2) Materials Returned: None.
		S S S	N N	N	
	Summary	The assessment of the Societal impact on Other Users sub-criterion is as follows: Option 2A is assessed as being Stronger than all other options as there is a significant quantity of useful, recyclable material returned (steel, aluminium alloy, copper) with only a small proportion of material returned (polymer) that may end up in landfill versus no material returned in the other options. All other options are assessed as being Neutral to each other as the societal impacts / benefits are similar (and negligible) in all cases. **Overall, Option 2A is preferred from a Societal impact on Other Users perspective.**			
5. Economic	5.1 Short-term Costs	£34.466 Million	£15.134 Million	£10.056 Million	£6.332 Million
		MW MW VMW	W MW	W	
	Summary	The assessment of the Short-term Costs sub-criterion is as follows: Option 2A is assessed as being Much Weaker than Option 3A due to the costs to deliver this option being more than double (£19.5 million more) than Option 3A. Option 2A is assessed as being Much Weaker than Option 3B due to the costs to deliver this option being more than triple (£24.4 million more) than Option 3B. Option 2A is assessed as being Very Much Weaker than Option 5 due to the costs to deliver this option being more than five times higher (£28.1 million more) than Option 5. Option 3A is assessed as being Weaker than Option 3B due to the costs to deliver this option being around 50% higher (£5.0 million more) than Option 3B. Option 3A is assessed as being Much Weaker than Option 5 due to the costs to deliver this option being more than double (£8.7 million more) than Option 5. Option 3B is assessed as being Weaker than Option 5 due to the costs to deliver this option being around 50% higher (£3.7 million more) than Option 5. **Overall, Option 5 is 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: £0.913 Million FLTC: N/A Total Legacy Cost: £0.913 Million	Surveys: £0.913 Million FLTC: N/A Total Legacy Cost: £0.913 Million	Surveys: £0.913 Million FLTC: £0.015 Million Total Legacy Cost: £0.927 Million
		N N N	N N	N	
	Summary	The assessment of the Long-term Costs sub-criterion is as follows: All options are assessed as being Neutral to each other as, while there is no long-term costs associated with the full removal option versus long-term costs for survey and monitoring with the other options, these long-term costs are small and are considered insufficient to express a preference. **Overall, all options are equally preferred from a Long-term Cost perspective.**			

C.2 Group 6 Pairwise Comparison Matrices – Safety

1.1 Operations Personnel

	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	W	W	13.5%
O3A - Leave (Major) - Rock Cover Entire Line	MS	N	MS	MS	49.7%
O3B - Leave (Major) - Trench & Bury Entire Line	S	MW	N	W	16.6%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	S	MW	S	N	20.3%

1.2 Other Users

	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	VMW	6.6%
O3A - Leave (Major) - Rock Cover Entire Line	MS	N	W	MW	17.8%
O3B - Leave (Major) - Trench & Bury Entire Line	MS	S	N	W	25.9%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	VMS	MS	S	N	49.7%

1.3 High Consequence Events

	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	MW	9.9%
O3A - Leave (Major) - Rock Cover Entire Line	MS	N	S	S	36.4%
O3B - Leave (Major) - Trench & Bury Entire Line	MS	W	N	N	26.9%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	MS	W	N	N	26.9%

1.4 Legacy Risk

	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	VMS	S	VMS	57.6%
O3A - Leave (Major) - Rock Cover Entire Line	VMW	N	MW	S	8.4%
O3B - Leave (Major) - Trench & Bury Entire Line	W	MS	N	MS	27.1%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	VMW	W	MW	N	6.9%

C.3 Group 6 Pairwise Comparison Matrices – Environment

2.1 Operational Marine Impact

	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.2%
O3A - Leave (Major) - Rock Cover Entire Line	S	N	N	N	27.3%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	N	27.3%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	S	N	N	N	27.3%

2.2 Atmospheric Emissions & Fuel Consumption

	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	W	W	W	18.2%
O3A - Leave (Major) - Rock Cover Entire Line	S	N	N	N	27.3%
O3B - Leave (Major) - Trench & Bury Entire Line	S	N	N	N	27.3%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	S	N	N	N	27.3%

2.3 Other Consumptions

	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	N	N	27.3%
O3A - Leave (Major) - Rock Cover Entire Line	W	N	W	W	18.2%
O3B - Leave (Major) - Trench & Bury Entire Line	N	S	N	N	27.3%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	N	S	N	N	27.3%

2.4 Seabed Disturbance

	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MS	S	S	36.3%
O3A - Leave (Major) - Rock Cover Entire Line	MW	N	MW	MW	9.9%
O3B - Leave (Major) - Trench & Bury Entire Line	W	MS	N	W	24.2%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	W	MS	S	N	29.6%

2.5 Legacy Marine Impacts

	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MS	MS	MS	49.8%
O3A - Leave (Major) - Rock Cover Entire Line	MW	N	N	S	18.4%
O3B - Leave (Major) - Trench & Bury Entire Line	MW	N	N	S	18.4%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	MW	W	W	N	13.5%

C.4 Group 6 Pairwise Comparison Matrices – Technical

3.1 Technical Readiness / Concept Maturity	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	VMW	W	VMW	4.5%
O3A - Leave (Major) - Rock Cover Entire Line	VMS	N	VMS	N	45.0%
O3B - Leave (Major) - Trench & Bury Entire Line	S	VMW	N	VMW	5.5%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	VMS	N	VMS	N	45.0%

3.2 Risk / Consequence of Project Failure	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	N	MW	12.5%
O3A - Leave (Major) - Rock Cover Entire Line	MS	N	MS	N	37.5%
O3B - Leave (Major) - Trench & Bury Entire Line	N	MW	N	MW	12.5%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	MS	N	MS	N	37.5%

C.5 Group 6 Pairwise Comparison Matrices – Societal

4.1 Fishing	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	VMS	S	VMS	57.6%
O3A - Leave (Major) - Rock Cover Entire Line	VMW	N	MW	S	8.4%
O3B - Leave (Major) - Trench & Bury Entire Line	W	MS	N	MS	27.1%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	VMW	W	MW	N	6.9%

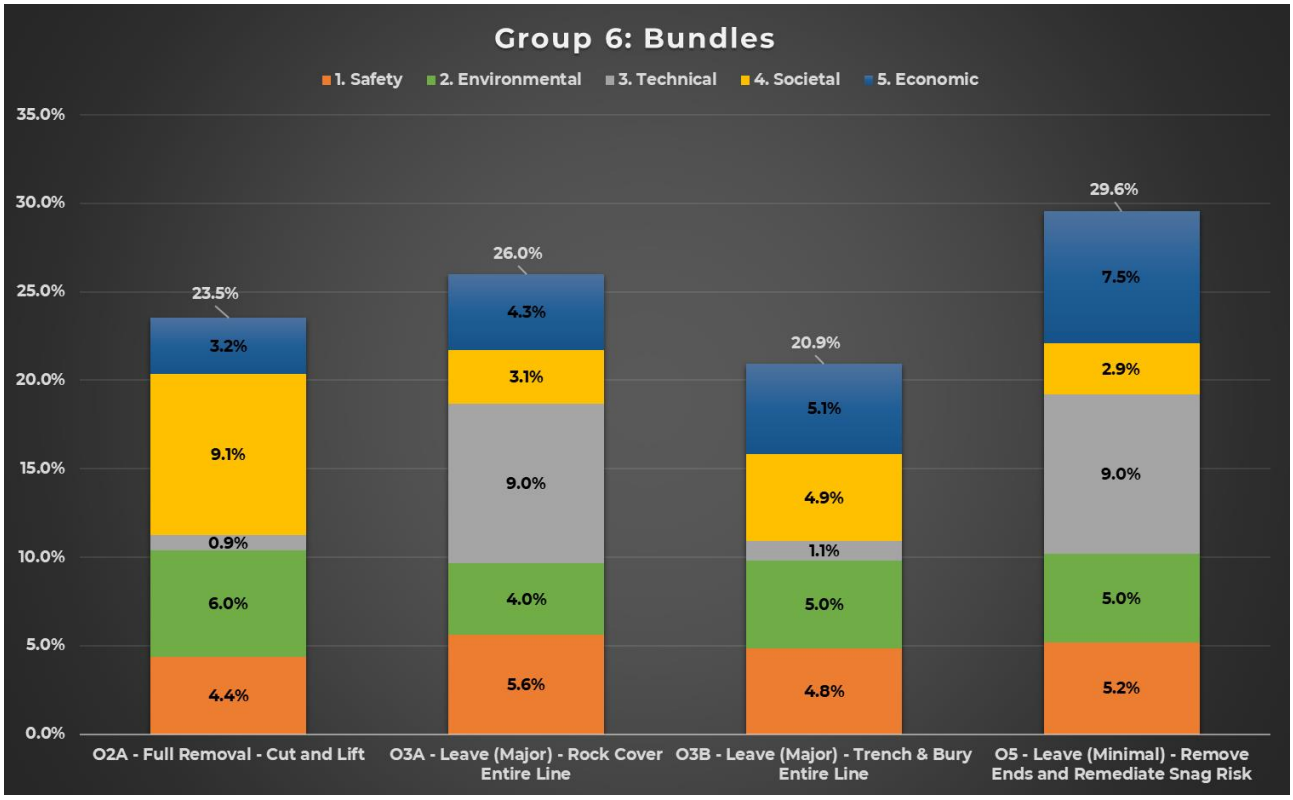
4.2 Other Users	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	S	S	S	33.3%
O3A - Leave (Major) - Rock Cover Entire Line	W	N	N	N	22.2%
O3B - Leave (Major) - Trench & Bury Entire Line	W	N	N	N	22.2%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	W	N	N	N	22.2%

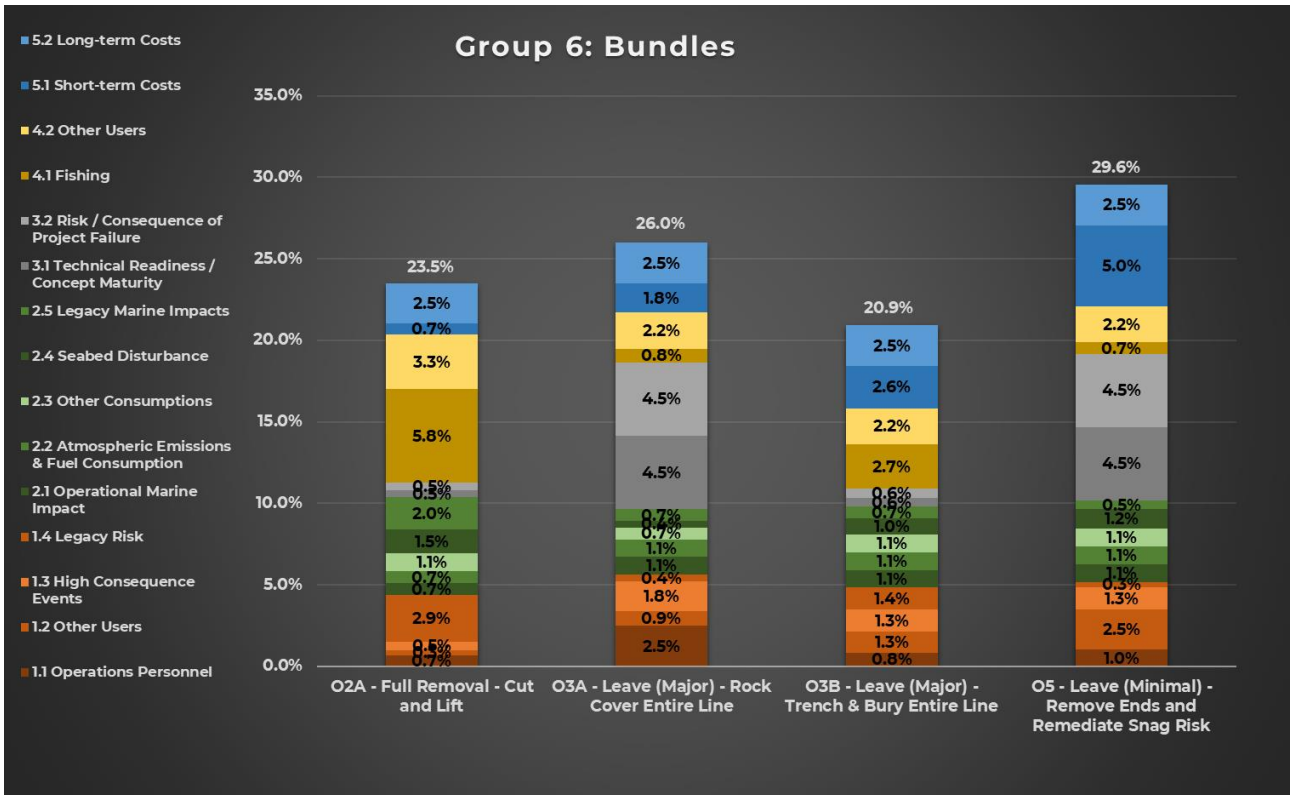
C.6 Group 6 Pairwise Comparison Matrices – Economic

5.1 Short-term Costs	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	MW	MW	VMW	6.6%
O3A - Leave (Major) - Rock Cover Entire Line	MS	N	W	MW	17.8%
O3B - Leave (Major) - Trench & Bury Entire Line	MS	S	N	W	25.9%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	VMS	MS	S	N	49.7%

5.2 Long-term Costs	O2A - Full Removal - Cut and Lift	O3A - Leave (Major) - Rock Cover Entire Line	O3B - Leave (Major) - Trench & Bury Entire Line	O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	Weighting
O2A - Full Removal - Cut and Lift	N	N	N	N	25.0%
O3A - Leave (Major) - Rock Cover Entire Line	N	N	N	N	25.0%
O3B - Leave (Major) - Trench & Bury Entire Line	N	N	N	N	25.0%
O5 - Leave (Minimal) - Remove Ends and Remediate Snag Risk	N	N	N	N	25.0%

C.7 Group 6 Results Charts





APPENDIX D GROUP 7 – DETAILED EVALUATION RESULTS

D.1 Group 7 Attributes Table

Group 7: Rigid Pipeline (Trenched & Buried)

PL3186 - 6" Gas Import / Export Pipeline - 11.3km in length

		O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
		- Pipeline is disconnected - De-burial of line by MFE (2 passes) - Line is fully recovered by reverse reeling - Line trans-spooled from reeling vessel to quayside for recycling / disposal	- Pipeline is disconnected - De-burial of rock cover over surface laid sections of line ends (out with trench) by MFE - Cut surface laid portions of the line into 12m sections (hydraulic shears) - Cut sections recovered to vessel - Rock placement over cut line ends (at trench transitions) - Cut sections offloaded at quayside for recycling / disposal
1. Safety	1.1 Operations Personnel	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 13.9 / 12,713 / 9.53E-04 Reel Vessel: 76 / 9.9 / 8,983 / 6.74E-04 Total offshore hours: 21,696 hrs Total offshore PLL: 1.63E-03 Resource Type: Days / Hours / PLL Engineering & Management: 486.8 / 15,576 / 6.23E-05 Project Management: 346.0 / 5,536 / 2.21E-05 Onshore Operations (includes Cleaning & Disposal): 376.0 / 24,064 / 2.96E-03 Total onshore hours: 45,176 hrs Total onshore PLL: 3.04E-03 Total operational hours: 66,873 hrs Total operational PLL: 4.67E-03	Vessel Type: PoB / Days / Hours / PLL CSV: 76 / 8.3 / 7,570 / 5.68E-04 Total offshore hours: 7,570 hrs Total offshore PLL: 5.68E-04 Resource Type: Days / Hours / PLL Engineering & Management: 132.4 / 4,235 / 1.69E-05 Project Management: 92.0 / 1,472 / 5.89E-06 Onshore Operations (includes Cleaning & Disposal): 8.0 / 512 / 6.30E-05 Total onshore hours: 6,219 hrs Total onshore PLL: 8.58E-05 Total operational hours: 13,789 hrs Total operational PLL: 6.54E-04
		MW	
	Summary	The assessment of the Operations Personnel sub-criterion is as follows: Option 2B is assessed as being Much Weaker than Option 5 as the risk exposure is around 7 times higher due to the longer duration offshore operations and onshore operations to process the returned pipeline. **Overall, Option 5 is preferred from a risk to Operations Personnel perspective.**	
1. Safety	1.2 Other Users	Vessel Days: CSV: 13.9 Reel Vessel: 9.9 Total vessel days: 23.8 days Transits: 4	Vessel Days: CSV: 8.3 Total vessel days: 8.3 days Transits: 2
		N	
	Summary	The assessment of the Other Users sub-criterion is as follows: Option 2B is assessed as being Neutral to Option 5 as while there are more vessel days and transits in Option 2B, these are considered insufficient to express a preference. **Overall, both options are equally preferred from a risk to Other Users perspective.**	
1. Safety	1.3 High Consequence Events	Routine deburial and reverse reeling operations. Low number of lifts (9) through the water column to initiate reeling and deploy and recover MFE equipment. Pipeline will be trans-spooled to quayside.	Routine deburial and cut and lift operations. Moderate number of lifting operations (39) through the water column to deploy and recover MFE and Hydraulic Shear equipment and to recover line ends in sections. Additional lifting to transfer pipeline sections to quayside.
		MS	
	Summary	The assessment of the High Consequence Events sub-criterion is as follows: Option 2B is assessed as being Much Stronger than Option 5 as there is more lifting associated with the deployment and retrieval of tooling and the recovery of line ends sections in Option 5 leading to a higher potential for high consequence events from dropped object. **Overall, Option 2B is preferred from a High Consequence Events perspective.**	

		O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
1. Safety	1.4 Legacy Risk	No legacy risk from this full removal option.	The line would remain in-situ with this option although it is trenched and buried along its entire length. 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. Vessel Type: PoB / Days / Hours / PLL Survey Vessel (Legacy): 44 / 5.3 / 2,788 / 2.09E-04 Total offshore hours: 2,788 hrs Total offshore PLL: 2.09E-04
		S	
	Summary	The assessment of the Legacy Risk sub-criterion is as follows: Option 2B is assessed as being Stronger than Option 5 as while both options present a clear seabed (with the remaining line being fully buried in Option 5) the line does remain in situ as opposed to being fully removed in Option 2B. **Overall, Option 2B is preferred from a Legacy Risk perspective.**	
2. Environmental	2.1 Operational Marine Impact	Vessel Noise (days on-site): 14.0 days Tooling Noise (MFE) = 9.4 days Operation releases: Line cleaning and flushing operations adopt 3 line volume flush as industry best practice to minimise as far as possible residual hydrocarbon levels in the line. This will minimise discharges to the marine environment during flushing activities and during any subsequent removal operations. There will be potential for the release of all residual contents in one location at one time during the reverse reeling operations. However, given the prior cleaning of the lines, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at around 14 days is the highest of all options but not considered significant. The environmental impact is considered to be negligible.	Vessel Noise (days on-site): 4.0 days Tooling Noise (MFE) = 0.2 days Tooling Noise (Shears) = 0.5 days Operation releases: Line cleaning and flushing operations adopt 3 line volume flush as industry best practice to minimise as far as possible residual hydrocarbon levels in the line. This will minimise discharges to the marine environment during flushing activities and during any subsequent removal operations. Cutting of line ends would lead to a release of fluids from within the line. However, given the prior cleaning of the line, the concentration and quantity of release should still be low overall. Therefore, the related impact is also anticipated to be low. Vessel releases: This includes Ballast, Grey and Black Water, this is driven by duration of vessel operations and therefore at 4 days is the lowest of the options. The environmental impact is considered to be negligible.
		N	
	Summary	The assessment of the Operational Marine Impact sub-criterion is as follows: Option 2B is assessed as being Neutral to Option 5 as while there are differences in the noise generated from vessels on site and tooling operations, and there is greater potential for releases during the reeling operations in Option 2B, these differences are considered minimal and insufficient to express a preference. **Overall, both options are equally preferred from an Operational Marine Impact perspective.**	
2. Environmental	2.2 Atmospheric Emissions & Fuel Consumption	Vessel Emissions (in tonnes): Fuel: 612 CO2: 1,939 NOx: 36.33 SO2: 2.45 Vessel Energy Use: 26,301 GJ	Vessel Emissions (in tonnes): Fuel: 252 CO2: 798 NOx: 14.95 SO2: 1.01 Vessel Energy Use: 10,822 GJ
		N	
	Summary	The assessment of the Atmospheric Emissions & Consumptions sub-criterion is as follows: Option 2B is assessed as being Neutral to Option 5 as while there are small differences in the atmospheric emissions generated across the options, these differences are considered insufficient to express a preference. **Overall, both options are equally preferred from an Atmospheric Emissions & Consumptions perspective.**	

		O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
2. Environmental	2.3 Other Consumptions	Material Emissions (CO2 in tonnes): Recovered Material: 324 Remaining Material: Total: 324 Rock: N/A tonnes	Material Emissions (CO2 in tonnes): Recovered Material: 7 Remaining Material: 594 Total: 602 Rock: 80 tonnes
		N	
Summary		The assessment of the Other Consumptions sub-criterion is as follows: Option 2B is assessed as being Neutral to Option 5 as while there are small differences in the CO2 associated with recovered or replacement material across the options and there being a small quantity of rock required in Option 5, these differences are considered insufficient to express a preference. **Overall, both options are equally preferred from an Other Consumptions perspective.**	
2. Environmental	2.4 Seabed Disturbance	Seabed Disturbance (m2): MFE: 56,370 No rock cover in this option.	Seabed Disturbance (m2): Rock Cover: 50 MFE: 1,150 Habitat Loss / Change (m2): Rock Bags: 50
		W	
Summary		The assessment of the Seabed Disturbance sub-criterion is as follows: Option 2B is assessed as being Weaker than Option 5 due to greater area of temporary disturbance associated with the deburial of the line in Option 2B. Note: the small area of permanent impact from the rock cover introduced in Option 5 is considered negligible due to seabed conditions in this area. **Overall, Option 5 is preferred from a Seabed Disturbance perspective.**	
2. Environmental	2.5 Legacy Marine Impacts	No legacy marine impact from this full removal option.	Line cleaning and flushing operations adopt 3 line volume flush as industry best practice to minimise as far as possible residual hydrocarbon levels in line post flush. The legacy marine impact from the slow release of these low concentration / quantity releases is therefore expected to be low overall.
		MS	
Summary		The assessment of the Legacy Marine Impacts sub-criterion is as follows: Option 2B is assessed as being Much Stronger than Option 5 due to there being no legacy marine impacts as the line is removed. While the line will remain in Option 5, the legacy marine impact is expected to be low given the long duration for degradation and subsequent residual contents discharges, especially given the remaining line will be isolated from the marine environment as it is fully buried. **Overall, Option 2B is preferred from a Legacy Marine Impacts perspective.**	
3. Technical	3.1 Technical Readiness / Concept Maturity	Well proven lay system (TRL7) and techniques but minimal track record in use for recovery purposes (only in event of buckle during lay). Subsea tools and vessel requirements are broadly supported across the market. (Score 2)	Well proven techniques (TRL7). Subsea tools and vessel requirements are broadly supported across the market. (Score 3)
		W	
Summary		The assessment of the Technical Readiness / Concept Maturity sub-criterion is as follows: Option 2B is assessed as being Weaker than Option 5 as while the operations in both options are largely routine, there is limited track record for the full removal of lines using reverse reel. **Overall, Option 5 is preferred from a Technical Readiness / Concept Maturity perspective.**	

		O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk
3. Technical	3.2 Risk / Consequence of Project Failure	Limited technical risks as line integrity will have been considered during recovery analysis however system designed for lay of new product therfore may experience delay. Failure to recover leaves line exposed and extensive remediation required. (Score 2)	Limited technical risks, ~230m of buried line is feasible to remove by cut and lift . (Score 3)
		W	
Summary		The assessment of the Technical Risk sub-criterion is as follows: Option 2B is assessed as being Weaker than Option 5 as while the technical risks and likelihood of successful delivery are largely similar across the options, should the reverse reeling operations fail, there would be significant recovery / rectification work required to address the line which may be left exposed while reeling operations are reinstated. **Overall, Option 5 is preferred from a Technical Risk perspective.**	
4. Societal	4.1 Fishing	Short operation, large area of temporary disturbance, Fishing operations are conducted in vicinity of the pipeline. (Score 3)	Short operation, small area of disturbance, Fishing operations are conducted in vicinity of the pipeline. (Score 3)
		N	
Summary		The assessment of the Societal impact on Fishing sub-criterion is as follows: Option 2B is assessed as being Neutral to Option 5 as the duration of execution and the as left condition (clear seabed) is largely similar from a fishing operations perspective. **Overall, both options are equally preferred from a Societal impact on Fishing perspective.**	
4. Societal	4.2 Other Users	Returned steel can be recycled. (Score 3) Materials Returned: Steel: 322 tonnes (recyclable) Polymer: 2 tonnes (landfill)	Minimal returned steel, for recycling. (Score 2) Materials Returned: Steel: 7 tonnes (recyclable)
		N	
Summary		The assessment of the Societal impact on Other Users sub-criterion is as follows: Option 2B is assessed as being Neutral to Option 5 as while there is more recyclable material (steel) returned in Option 2A, there is also polymer returned which is likely to end up in landfill. The differences in the societal benefits / detriments across the options were deemed insufficient to express a preference. **Overall, both options are equally preferred from a Societal impact on Other Users perspective.**	
5. Economic	5.1 Short-term Costs	£4.846 Million	£1.48 Million
		W	
Summary		The assessment of the Short-term Costs sub-criterion is as follows: Option 2B is assessed as being Weaker than Option 5 due to the costs to deliver this option being more than triple (£3.4 million more) than Option 5. **Overall, Option 5 is 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: £1.015 Million FLTC: N/A Total Legacy Cost: £1.015 Million
		N	
Summary		The assessment of the Long-term Costs sub-criterion is as follows: Option 2B is assessed as being Neutral to Option 5 as, while there is no long-term costs associated with the full removal option versus long-term costs for survey and monitoring with Option 5, these long-term costs are small and are considered insufficient to express a preference. **Overall, both options are equally preferred from a Long-term Cost perspective.**	

D.2 Group 7 Pairwise Comparison Matrices – Safety

1.1 Operations Personnel	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	MW	25.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MS	N	75.0%

1.2 Other Users	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

1.3 High Consequence Events	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	MS	75.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	N	25.0%

1.4 Legacy Risk	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	S	60.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	W	N	40.0%

D.3 Group 7 Pairwise Comparison Matrices – Environment

2.1 Operational Marine Impact	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

2.2 Atmospheric Emissions & Fuel Consumption	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

2.3 Other Consumptions	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

2.4 Seabed Disturbance	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	W	40.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	60.0%

2.5 Legacy Marine Impacts	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	MS	75.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	MW	N	25.0%

D.4 Group 7 Pairwise Comparison Matrices – Technical

3.1 Technical Readiness / Concept Maturity	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	W	40.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	60.0%

3.2 Risk / Consequence of Project Failure	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	W	40.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	60.0%

D.5 Group 7 Pairwise Comparison Matrices – Societal

4.1 Fishing	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

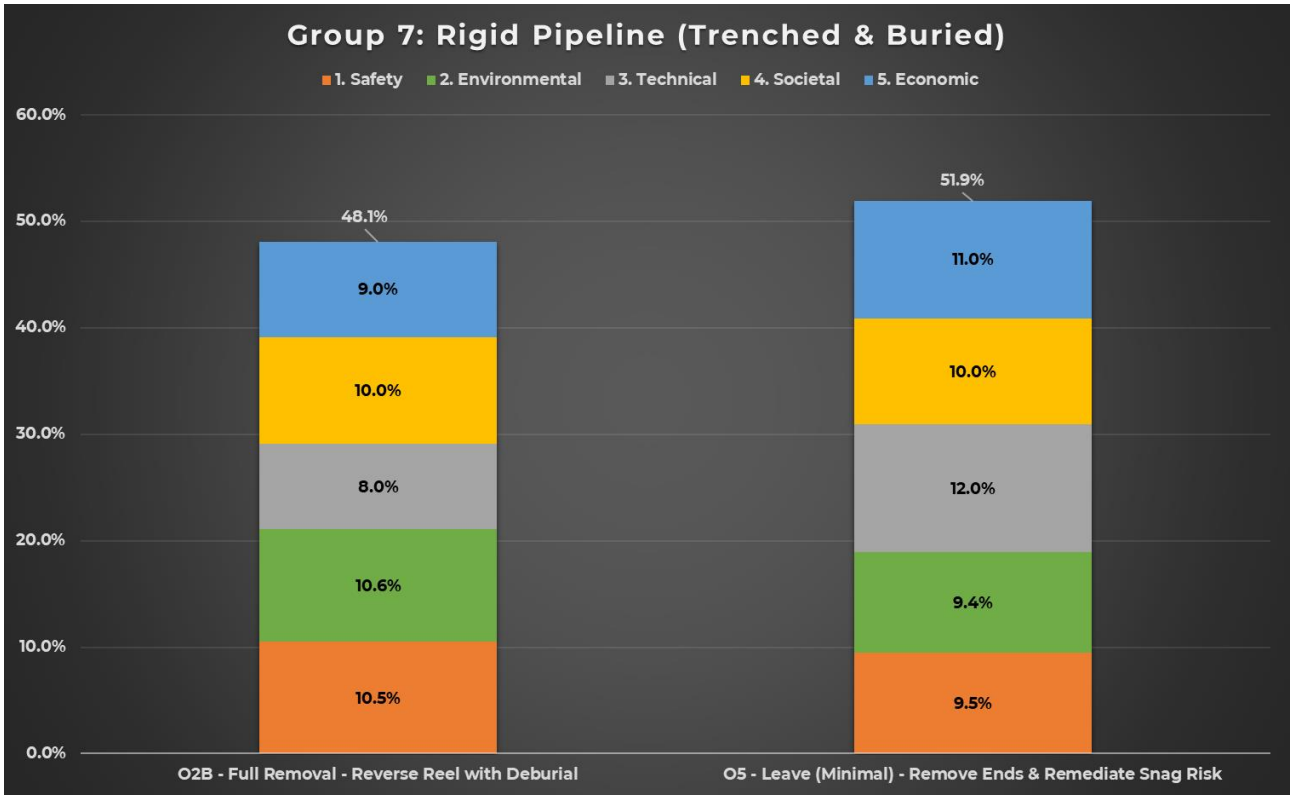
4.2 Other Users	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

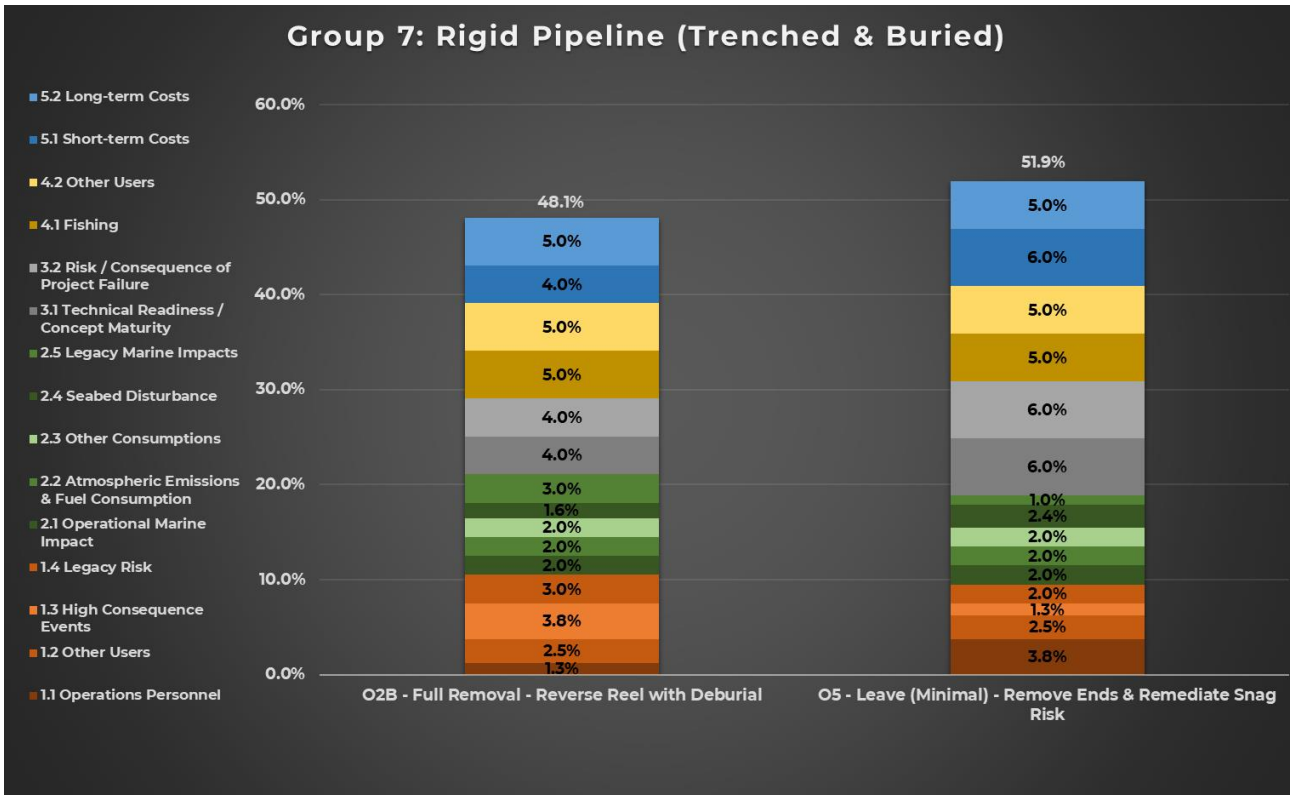
D.6 Group 7 Pairwise Comparison Matrices – Economic

5.1 Short-term Costs	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	W	40.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	S	N	60.0%

5.2 Long-term Costs	O2B - Full Removal - Reverse Reel with Deburial	O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	Weighting
O2B - Full Removal - Reverse Reel with Deburial	N	N	50.0%
O5 - Leave (Minimal) - Remove Ends & Remediate Snag Risk	N	N	50.0%

D.7 Group 7 Results Charts





APPENDIX E BURIAL STATUS REVIEW

E.1 Group 6 – Bundles – Burial Status Review

The burial status review for the North Bundle shows the depth of cover (the seabed in this case as the bundle is surface laid) being approximately 1m below the top of the bundle along its entire length. This is consistent with the assertion the surface laid bundle is subject to minimal areas of 'spans' (none of which are reportable and are more akin to 'natural seabed undulations').

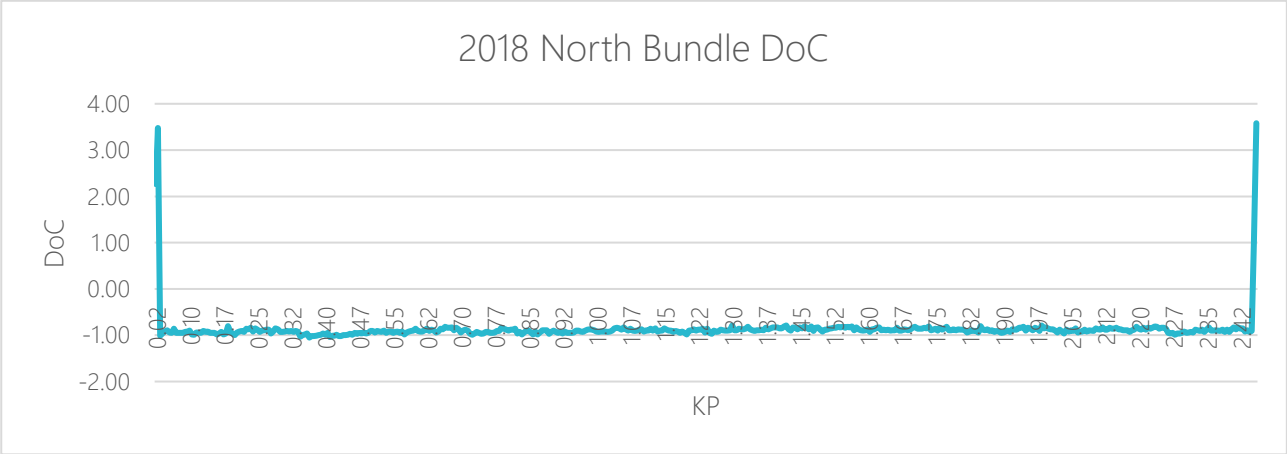


Figure E.1 – North Bundle 2018 Depth of Cover Chart

The burial status review for the South Bundle shows the depth of cover (the seabed in this case as the bundle is surface laid) being approximately 1m below the top of the bundle along its entire length. This is consistent with the assertion the surface laid bundle is subject to minimal areas of 'spans' (none of which are reportable and are more akin to 'natural seabed undulations').

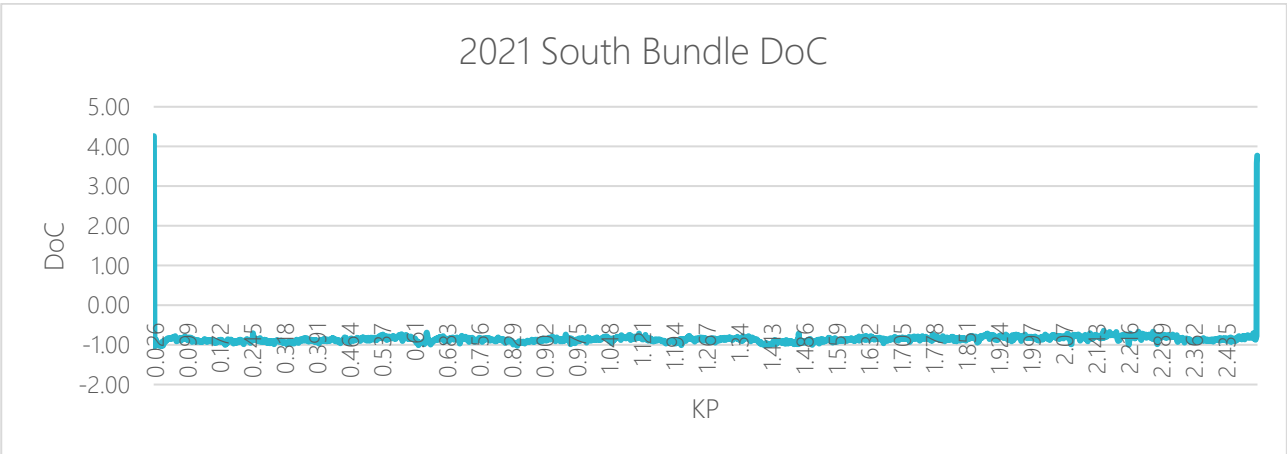


Figure E.2 – South Bundle 2021 Depth of Cover Chart

E.2 Group 7 – Rigid Pipeline (Trenched & Buried) - Burial Status Review

The burial status review for the PL3186 pipeline has shown that the line is adequately buried at more than 1m along the entirety of its length (average depth of burial is 1.6m from the 2018 and 1.4m from the 2023 survey). This status has been shown to be stable given the similarity in the charts from the 2014 as-laid survey (Figure E.3) the 2018 survey (Figure E.4) and the 2023 survey (Figure E.5).

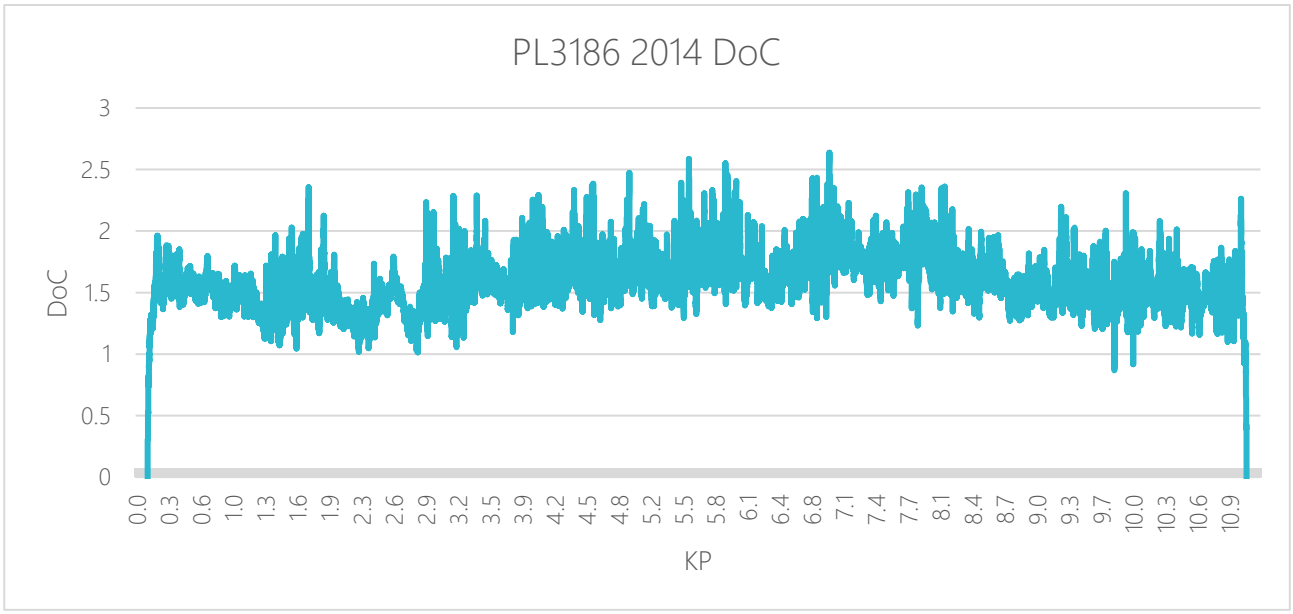


Figure E.3 – PL3186 2014 Depth of Cover Chart

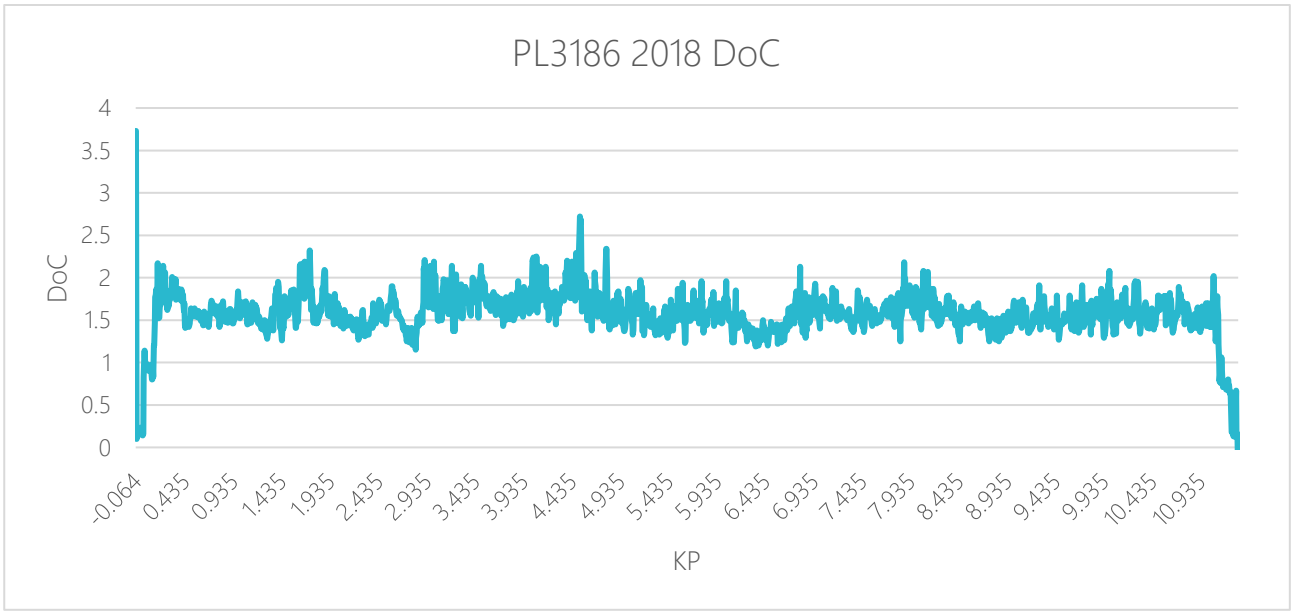


Figure E.4 – PL3186 2018 Depth of Cover Chart

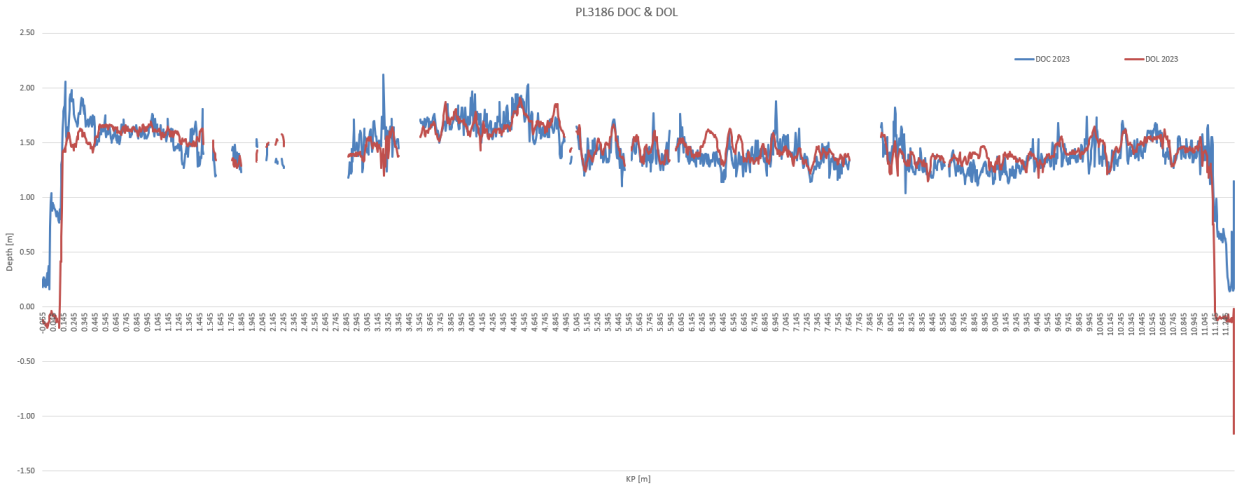


Figure E.5 - PL3186 2023 Depth of Cover / Lowering Chart

Note: In areas where no DOC / DOL are reported for 2023, Fugro can confidently state that due to a combination of the ROV flying altitude at the time and the detection capabilities of the 440 Pipetracker system for a 6" pipeline, the pipeline is out of range and therefore must have a depth of burial of over 1 m.