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	Classification: ☒**Unclassified,** ☐**Restricted,** ☐**Internal,** ☐**Confidential**			

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Juliet
Comparative Assessment Report

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Revision Change Notices

Rev	Location of Change	Brief Description of Change
A01	Issued for Client Comment	
A02	Re-Issued for Client Comment	Report updated based on external CA workshop discussions and findings
C01	Issued for Client Use	Clearance of HOLDS
C02	Re-Issued for Client Use	Addition of Appendix 3 based on OPRED comments
C03	Re-Issued for Client Use	Update based on OPRED comments

Classification Definitions

Classification Level	Definition
Unclassified	Information which may be made public without consequences for the entity or Neptune Energy.
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*where CONTRACTOR aligns to COMPANY Document Numbering convention there is no requirement to complete this information

CONTENT

TERMS, ABBREVIATIONS AND ACRONYMS

AHP	Analytical Hierarchy Process
BAT	Best Available Technology
BEIS	Department of Business, Energy and Industrial Strategy
BEP	Best Environmental Practice
CA	Comparative Assessment
CoP	Cessation of Production
CSV	Construction Support Vessel
DSV	Dive Support Vessel
EMT	Environmental Management Team
ENVID	Environmental factors Identification
FAR	Fatal Accident Rate
HIRA	Hazard Identification and Risk Assessment
HSE	Health & Safety Executive
JNCC	Joint Nature Conservation Committee
MCDA	Multi-Criteria Decision Analysis
MFE	Mass Flow Excavation
NFFO	National Federation of Fisherman’s Organisations
ODU	Offshore Decommissioning Unit
OGA	Oil & Gas Authority
OPRED	Offshore Petroleum Regulator for Environment & Decommissioning
OSPAR	Oslo/Paris convention (for the Protection of the Marine Environment of the North-East Atlantic)
P&A	Plugging & Abandonment
PLL	Potential for Loss of Life
TGT	Theddlethorpe Gas Terminal
ToR	Terms of Reference
UKCS	United Kingdom Continental Shelf

1 EXECUTIVE SUMMARY

A Comparative Assessment (CA) Evaluation Workshop for the short-listed decommissioning options for the Juliet subsea pipelines and infrastructure was held at Neptune Energy Aberdeen office on Thursday 20th September with external stakeholders. This followed an internal workshop involving Neptune, Juliet field partners and Xodus.

Included in the Evaluation Workshop was one minimal intervention option and two full removal options. These options are summarised below.

- Option 1B – Leave *in situ* Minimal Intervention – Disconnect Ends, Rockdump Ends
- Option 5A – Full Removal – Deburial and Reverse Reel
- Option 5C – Full Removal – Deburial, Pipeline Cut and Lift, Umbilical Reverse Reel

These options were compared based on the CA sub-criteria previously agreed with Neptune. The sub-criteria were based on Safety, Environmental, Technical, Societal and Economic considerations. The results of the assessment showed that Option 1B (Leave *in situ*) ranked the highest for eight of the twelve sub-criteria (four of the five main criteria). These findings are summarised in Figure 1.1.

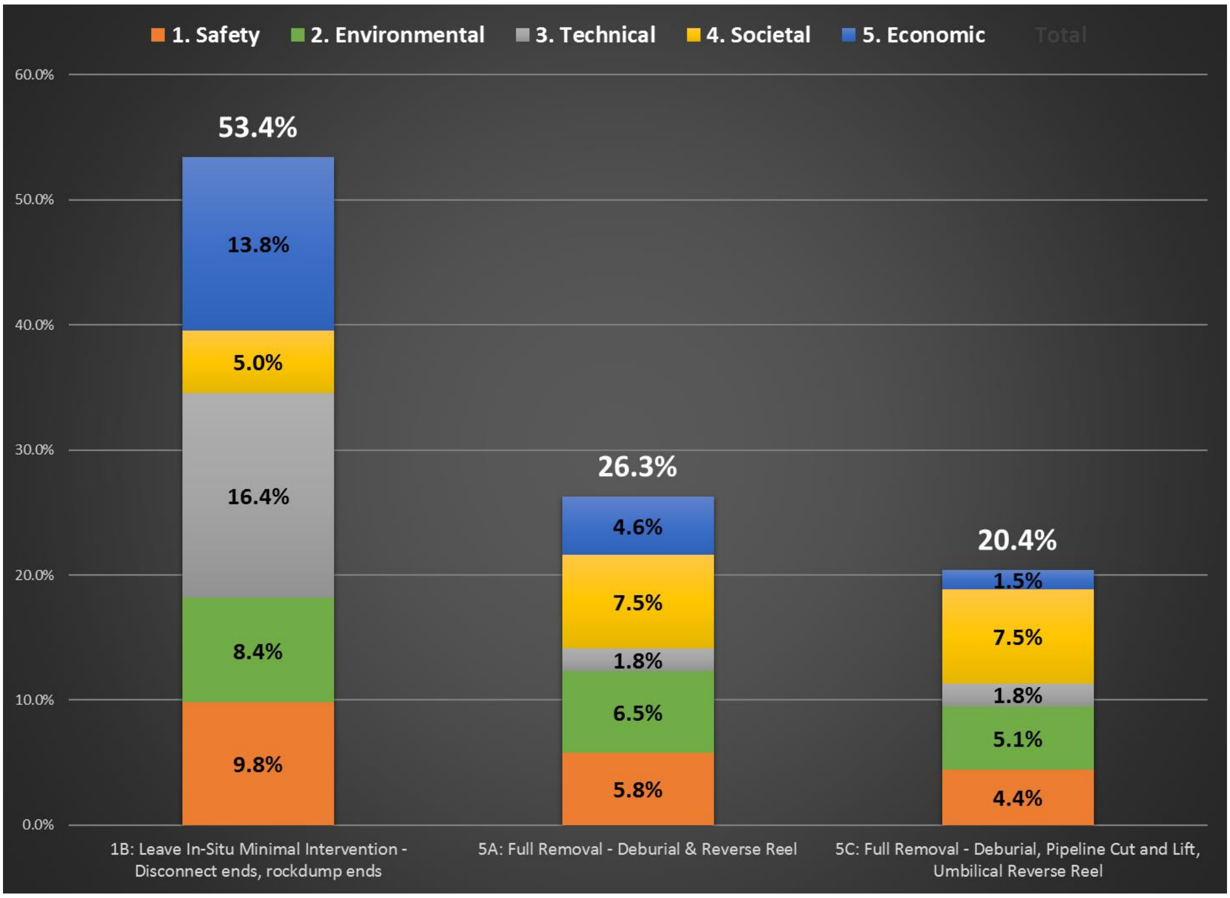


Figure 1.1 Results of Juliet Comparative Assessment Workshop

As the above figure shows, Option 1B is the overall preferred decommissioning solution for the Juliet pipelines and associated stabilisation material. Based on the discussions from all CA workshops (internal and external), sensitivities were performed on many of the sub-criteria including:

- Sub-Criteria 1.2 – Safety risk to other users of the sea
- Sub-Criteria 3.1 – Technical risk
- Sub-Criteria 4.1 – Societal impact on fishing activities
- Sub-Criteria 4.2 – Socio-economic impact on communities and amenities
- Sub-Criteria 5.1 – Operational and legacy costs.

The sensitivity cases did not alter the findings of the assessment therefore no single criterion was adversely driving the results of the CA.

Please note that these findings are based on the discussions from the external CA workshop however the conclusions are consistent with the internal session held on Wednesday 22nd August.

2 INTRODUCTION

2.1 BACKGROUND

The Juliet Field is located in Block 47/14b of the UK Southern North Sea some 40km due east from the Humberside estuary and approximately 9km to the south of the Amethyst gas field. Juliet was discovered in December 2008 with well 47/14b-10 and subsequently developed by a two well subsea tieback in a water depth of 55m to the Pickerill A facilities.

The Juliet Field layout is shown in Figure 2.1 below.

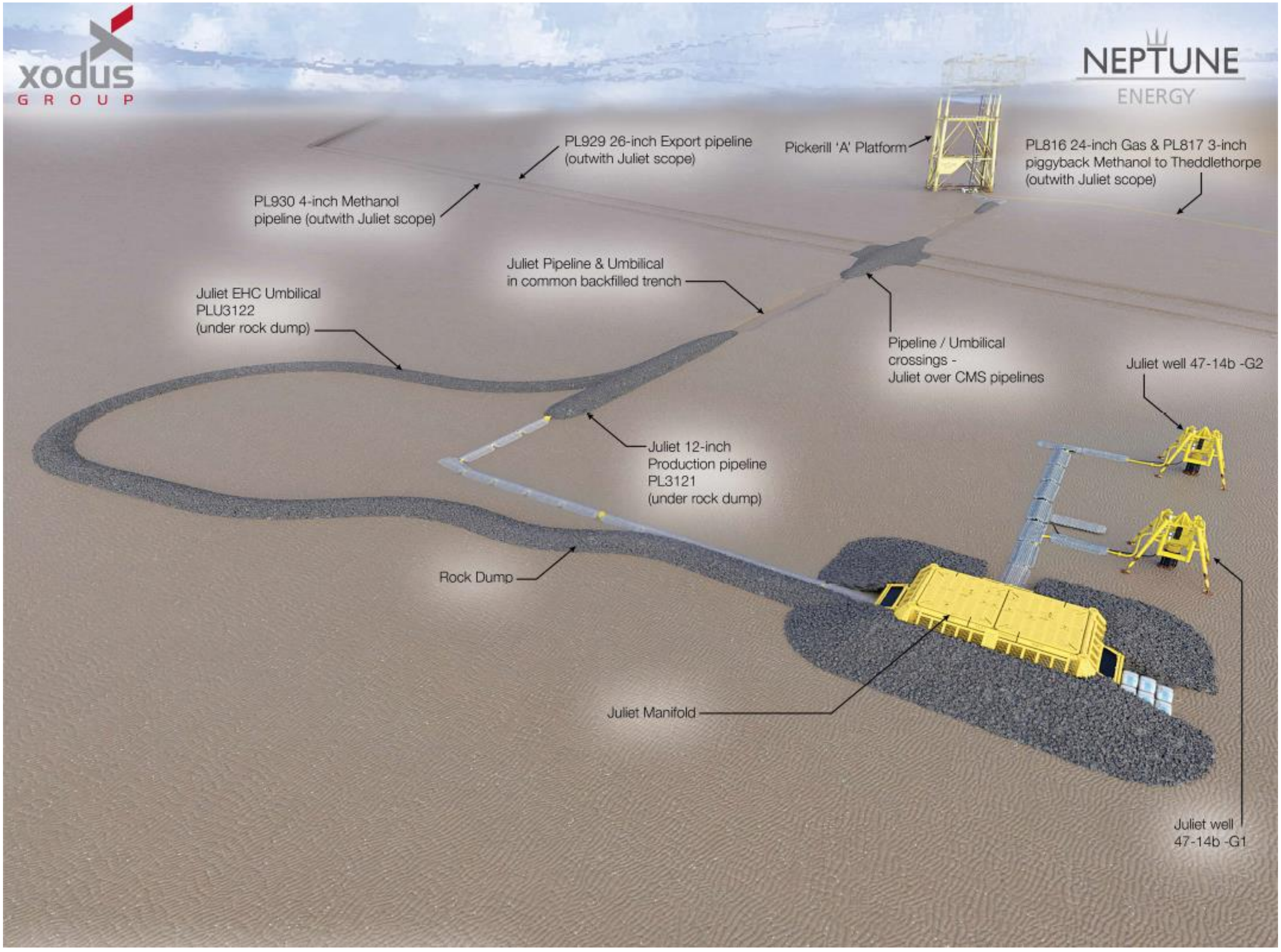


Figure 2.1 Juliet Field Layout

Gas from the two Juliet wells is comingled into a subsea manifold and transported back to Pickerill A via a 22 km long 12” pipeline (PL3121). The subsea manifold comprises three production piping slots, two that are used for each of the production wells and one spare designated for future use. The Juliet pipeline ties into the base of the Pickerill A platform via a 12” riser. Control between Pickerill A and the Juliet wells is via a dedicated subsea electro-hydraulic control and chemical injection umbilical (PLU3122). The Juliet pipeline and umbilical were trenched and buried for protection from trawl gear and dragged anchors. On the platform, the gas from Juliet is comingled with the other Pickerill production gases, and then exported through a 24” pipeline back to Theddlethorpe Gas Terminal (TGT).

The Juliet field came onto production in Jan 2014 from 47/14b-G1. 47/14b-G2 well came into production in March 2014. Cessation of Production (CoP) has been submitted for Juliet in July 2018.

2.2 COMPARATIVE ASSESSMENT OVERVIEW

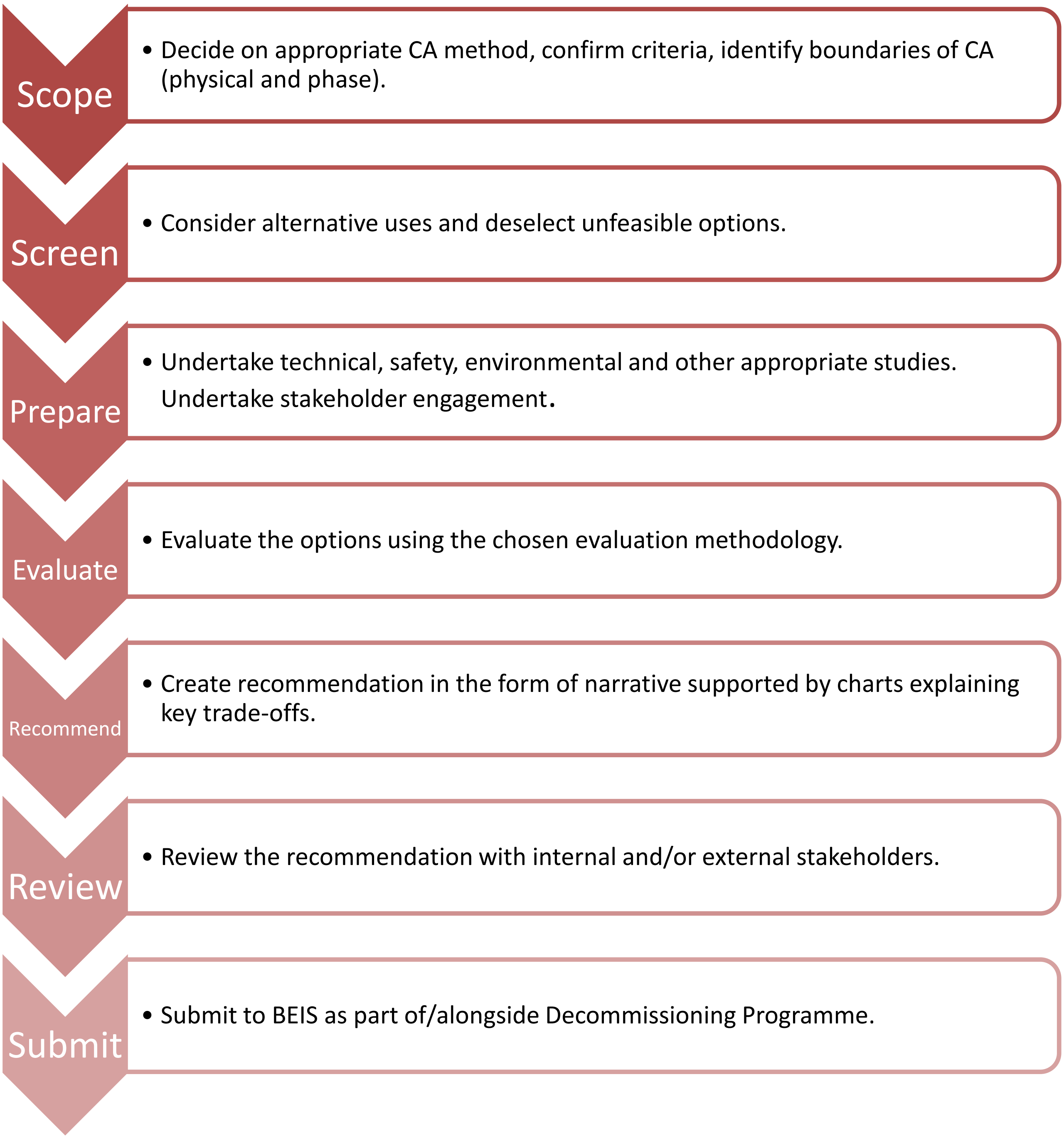
The decommissioning of offshore oil and gas installations and pipelines on the United Kingdom Continental Shelf (UKCS) is controlled through the Petroleum Act 1998, as amended by the Energy Act 2008. In the UK, decommissioning is also regulated under the Marine and Coastal Act 2009 and Marine (Scotland) Act 2010. The UK's international obligations on decommissioning are primarily governed by the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (the OSPAR Convention). The responsibility for ensuring compliance with the Petroleum Act 1998 rests with Department of Business, Energy and Industrial Strategy (BEIS). BEIS is also the Competent Authority on decommissioning in the UK for OSPAR purposes and under the Marine Acts.

The Juliet subsea infrastructure is the subject of a comparative assessment (CA) of options under guidance provided by the BEIS forming a core part of the overall decommissioning planning process. The methodology for Comparative Assessment is described in detail in the Juliet Comparative Assessment Terms of Reference Report [1]. This Comparative Assessment Report will be submitted alongside the DP (BEIS).

2.3 COMPARITIVE ASSESSMENT PROCESS

The Comparative Assessment utilises a Multi Criteria Decision Analysis (MCDA) tool which employs pairwise comparisons of quantitative and qualitative data [2]. A detailed description of this process is described in the Juliet Comparative Assessment Terms of Reference [1].

A schematic of the Comparative Assessment process is detailed in Figure 2.2 below.



Scope
- Decide on appropriate CA method, confirm criteria, identify boundaries of CA (physical and phase).

Screen
- Consider alternative uses and deselect unfeasible options.

Prepare
- Undertake technical, safety, environmental and other appropriate studies. Undertake stakeholder engagement.

Evaluate
- Evaluate the options using the chosen evaluation methodology.

Recommend
- Create recommendation in the form of narrative supported by charts explaining key trade-offs.

Review
- Review the recommendation with internal and/or external stakeholders.

Submit
- Submit to BEIS as part of/alongside Decommissioning Programme.

Figure 2.2 Overview of the Comparative Assessment process

3 COMPARATIVE ASSESSMENT WORKSHOP

3.1 OVERVIEW

As outlined in the Juliet Comparative Assessment Terms of Reference Report [1], the Juliet Field Decommissioning Project External CA Workshop was held from 08:30 to 12:00 on Thursday 20th September at Neptune Energy's Aberdeen Office at 16 North West Esplanade, Aberdeen, AB11 5RJ. The workshop was facilitated by Xodus Group.

3.2 ATTENDEES

The attendees of the Juliet Field Decommissioning Project CA Stakeholder Workshop are detailed in Table 3-1 below.

Name	Company	Role
Alan Muirhead	Neptune Energy	Developments and Decommissioning Manager
Pierre Girard	Neptune Energy	Asset Manager
Eddie Anderson	Neptune Energy	HSE
David Hawkins	Neptune Energy	Environment
Joanne Rostant	Neptune Energy	Tech Safety
Justin Heath	Neptune Energy	Communications
Francis Barrett	Xodus Group	Subsea and Pipelines
Rebecca Allan	Xodus Group	Project Representation
Gareth Jones	Xodus Group	Facilitator
Kim Woods	BEIS OPRED ODU	Stakeholder Representative
Audrey Banner	BEIS OPRED	Stakeholder Representative
Fiona Livingston	BEIS	Stakeholder Representative

Table 3.1 CA Workshop Attendees

Please note that a representative from the NFFO was invited to the workshop but unfortunately could not attend. The NFFO were informed of the workshop outcome and confirmed they were in agreement with what had been presented and had no further comments to add.

3.3 OUTCOMES AND ACTIONS

This report summarises the finding from the external presentation of the Juliet Field Decommissioning Project CA Workshop.

4 PROJECT DESCRIPTION

4.1 GROUPINGS

The decommissioning programme underwent a scoping process in which four groupings of subsea infrastructure were identified (Table 4.1). Each component has been allocated to a common scoping group based on physical properties and installation conditions. Two of these groupings were surface laid infrastructure to be fully removed (groups J2 and J3), and thus did not require comparative assessment. The other two groupings contain buried infrastructure; they include: trenched and buried pipelines and umbilicals (group J1); and buried mattresses and grout bags (group J4).

Group Number	Description
J1	Trenched and Buried Pipelines and Umbilicals - PL3121 - PLU3122
J2	Surface Laid Spoolpieces and Control Jumpers
J3	Subsea Structures - Manifold Structure - Wellhead Protection Structures
J4	Buried Mattresses and Grout Bags

Table 4.1 Juliet Scoping Groups

4.2 OPTIONS

Following the initial scoping and screening, two Groups were selected for the evaluation phase of the Comparative Assessment: Groups J1 and J4 (for buried mattresses and grout bags only). The process behind selection is detailed in reference [3]. During discussions in the internal CA workshop, it became apparent that the option for the Group 4 items were fully dependent on the Group 1 option. For example, if the pipeline is fully removed (Group 1), then all Group 4 items would be fully removed also. It was deemed unnecessary to take Group 4 items further in the CA process, since their outcome was dependent on Group 1.

A summary of the options identified for screening is detailed in Table 4.2. The highlighted options were selected in the internal validation workshop for further evaluation in the Comparative Assessment Workshop and subsequent External Stakeholder Engagement Workshop. These options are discussed in detail in below.

Group	Category	Option
J1– Trenched & Buried Pipelines & Umbilicals	Leave *in situ* (minimal intervention)	1a - Leave as-is
		🟩 1b – Disconnect ends, rock-dump ends
		1c – Accelerated decomposition
	Leave *in situ* (minor intervention)	2a - Disconnect ends at trench, remove surface laid sections, rockdump ends
		2b - Disconnect ends, lower surface laid section
	Leave *in situ* (major intervention)	3a - Disconnect Ends & Re-trench Entire Line
		3b - Disconnect Ends & Full Rock Placement
	Leave *in situ* (re-use)	4a - Re-use in New Development
	Full removal	🟩 5a – Deburial & Reverse Reel
		5b – Reverse Reel, No Deburial
		🟩 5c - Deburial, Pipeline Cut and Lift, Umbilical Reverse Reel
		5d - De-burial, Pipeline Reverse S-Lay and Cut on Vessel, Umbilical Reverse Reel

Table 4.2 Option Screening Summary; options put forth for Comparative Assessment in green

4.2.1 Option 1B: Disconnect & Rock-dump Ends

For this option, the trenched and buried pipeline and umbilical will be left *in situ* and disconnected at the ends (where the pipeline and umbilical exits rockdump) and the ends removed (note that the umbilical at Juliet manifold end exits rockdump at the manifold tie-in location). The surface laid pipeline/umbilical sections with rock cover shall be left on the seabed. Mattresses which are buried beneath rockdump shall also be left *in situ*.

A comparison of the existing infrastructure and the results of the minimal intervention decommissioning programme proposed in Option 1B is illustrated in Figure 4.1 below. Comparisons of the existing infrastructure to the outcomes of Option 1B are additionally provided for:

(1) The manifold (Figure 4.2);

(2) The riser (Figure 4.3); and

(3) Crossings (Figure 4.4).

To aid clarity, the following schematics are provided on a larger scale in Appendix 3.

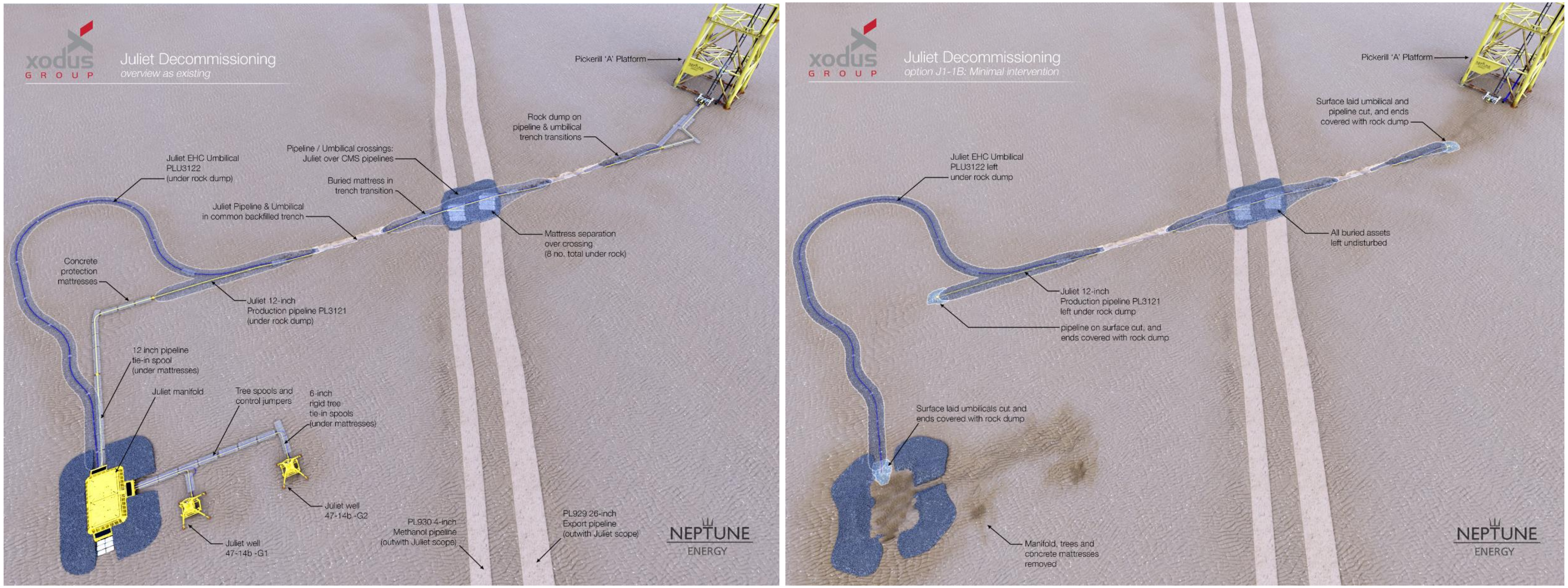


Figure 4.1 Comparison of existing infrastructure (left) with Option 1B decommissioning outcome (right)

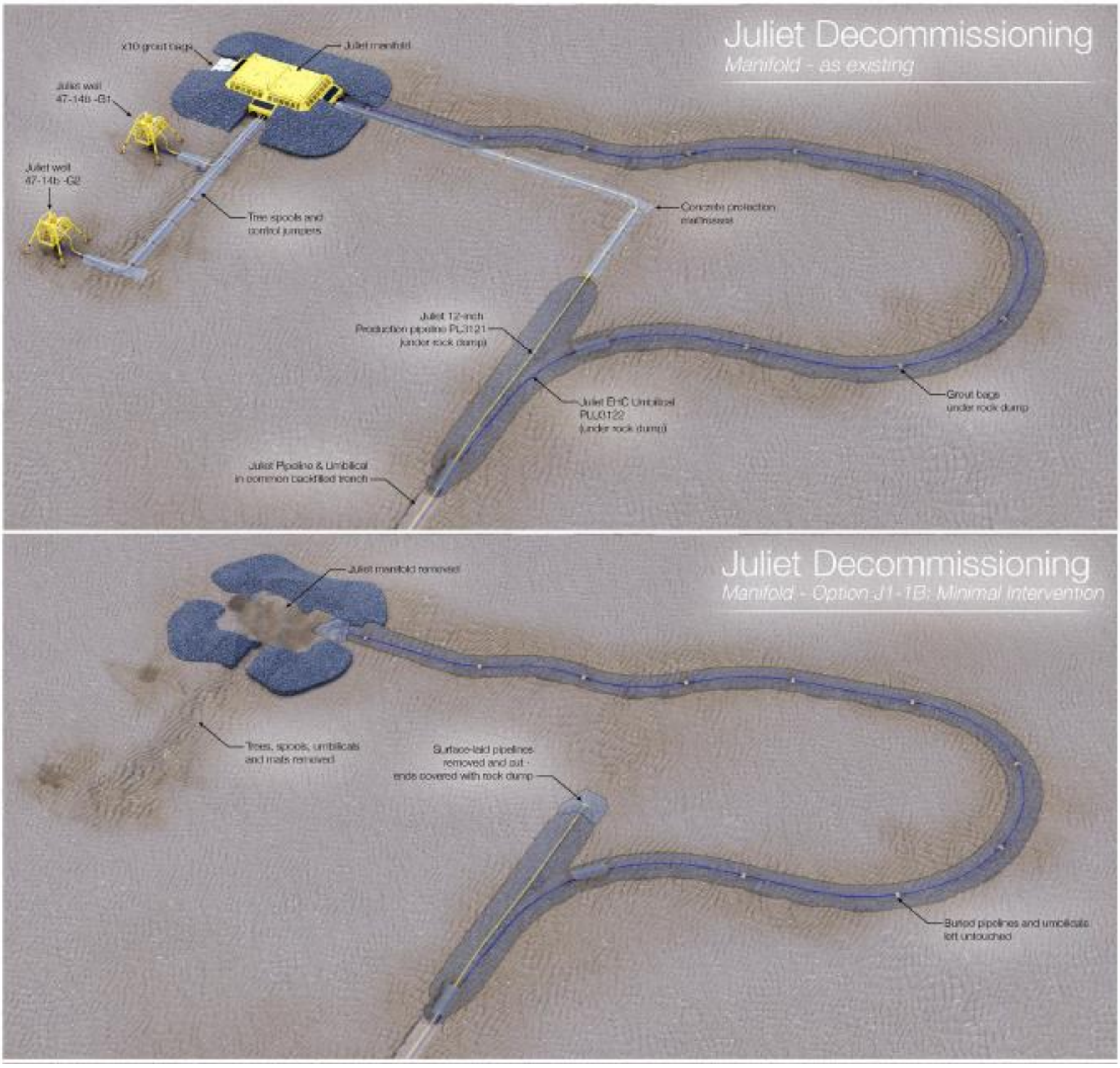


Figure 4.2 Comparison of existing manifold infrastructure (top) with Option 1B manifold decommissioning outcome (bottom)

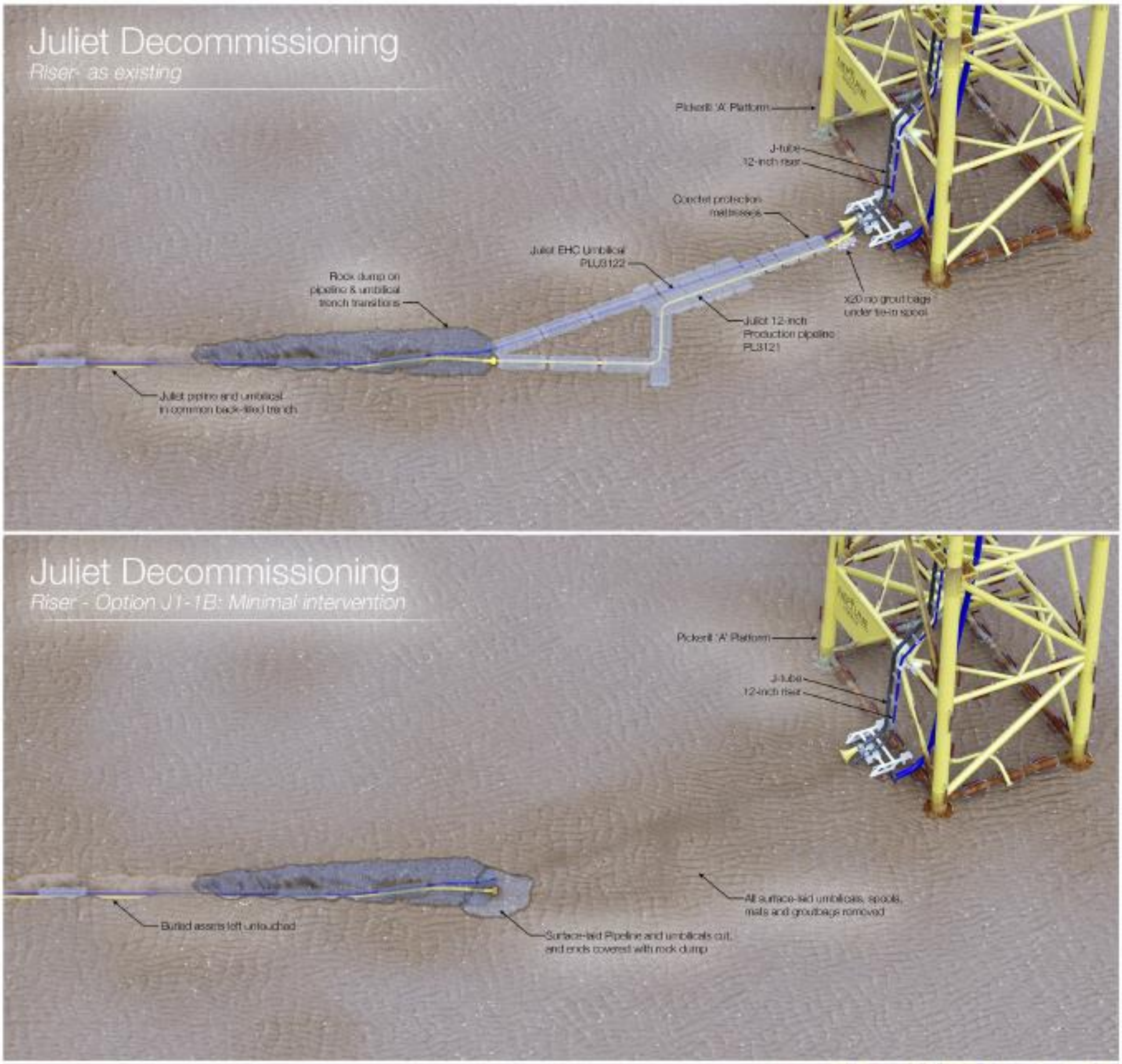


Figure 4.3 Comparison of existing riser infrastructure (top) with Option 1B riser decommissioning outcome (bottom)

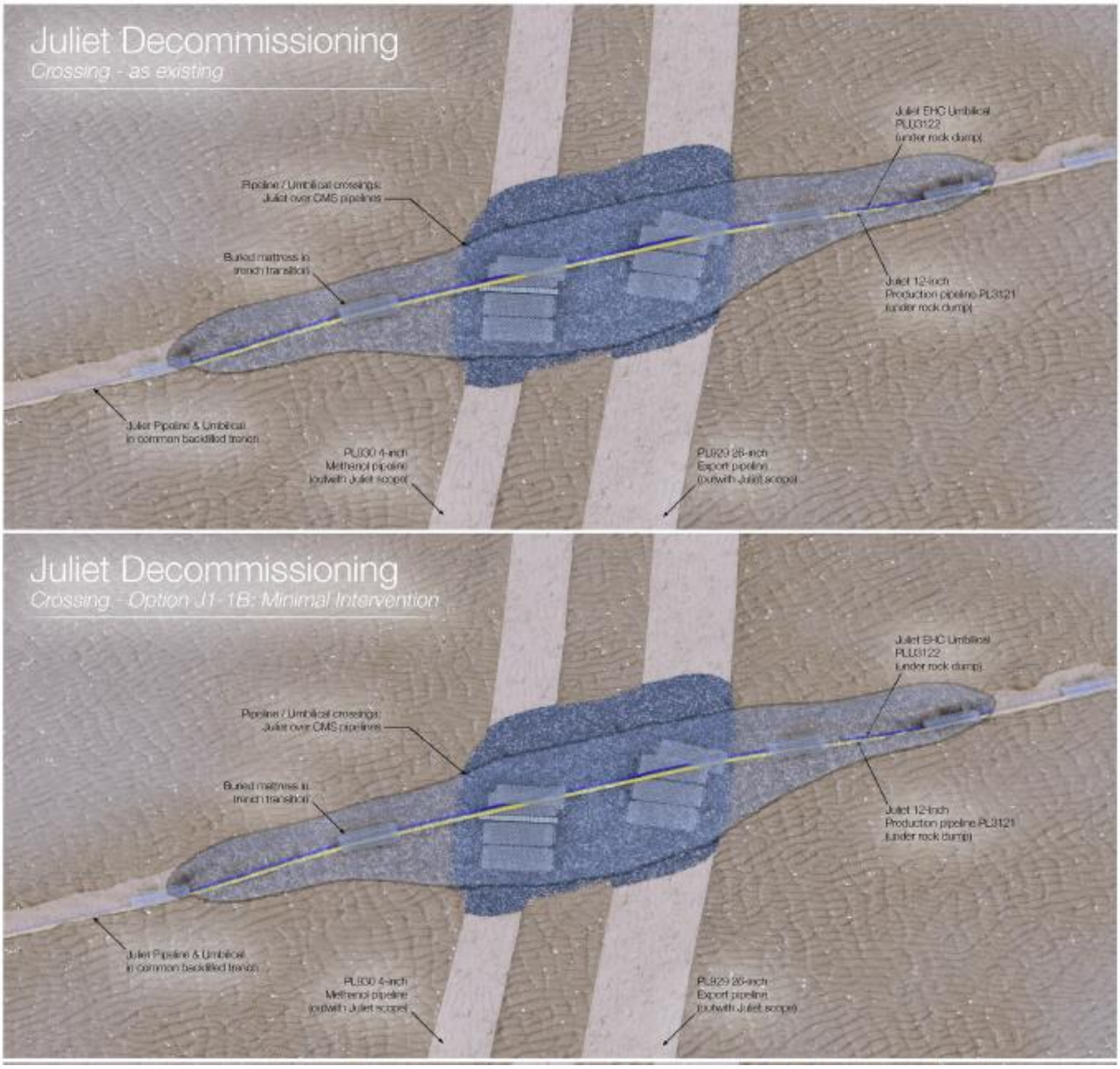


Figure 4.4 **Comparison of existing crossing infrastructure (top) with Option 1B crossing decommissioning outcome (bottom)**

4.2.2 Option 5A: Deburial & Reverse Reel

The offshore operations for this option consist of performing a pre-works survey, deburial of the lines along its length using a mass flow excavator (by CSV, noting that this shall include the rockdumped CMS crossing section which shall be non-operational at the time of Juliet decommissioning), an additional inspection survey in order to establish the status of the lines and confirm feasibility of reverse reel operations, followed by DSV operations to connect recovery heads.

A reel vessel will then recover the pipeline and umbilical via reverse reeling. The items shall be returned to shore for recycling/ final disposal.

4.2.3 Option 5C: Deburial, Pipeline and Umbilical Cut & Lift

The offshore operations for this option consist of performing a pre-works survey, deburial of the lines along the length using a mass flow excavator, followed by operations to cut the pipeline in double joints, rigging of each section and recovery to surface (a CSV is assumed for deburial and cutting operations. Noting that deburial shall include the rockdumped CMS crossing section which shall be non-operational at the time of Juliet decommissioning. A DSV and barge are assumed for rigging and recovery of the cut pipeline and connection of recovery head). A reel vessel will then recover the umbilical via reverse reeling. The items shall be returned to shore for recycling/ final disposal.

A comparison of the existing infrastructure and the results of the full removal decommissioning programmes proposed in Options 5A and 5C is illustrated in Figure 4.5 below. Comparisons of the existing infrastructure to the outcomes of both Options 5A and 5C are additionally provided for:

(1) The manifold (Figure 4.6);

(2) The riser (Figure 4.7); and

(3) Crossings (Figure 4.8).

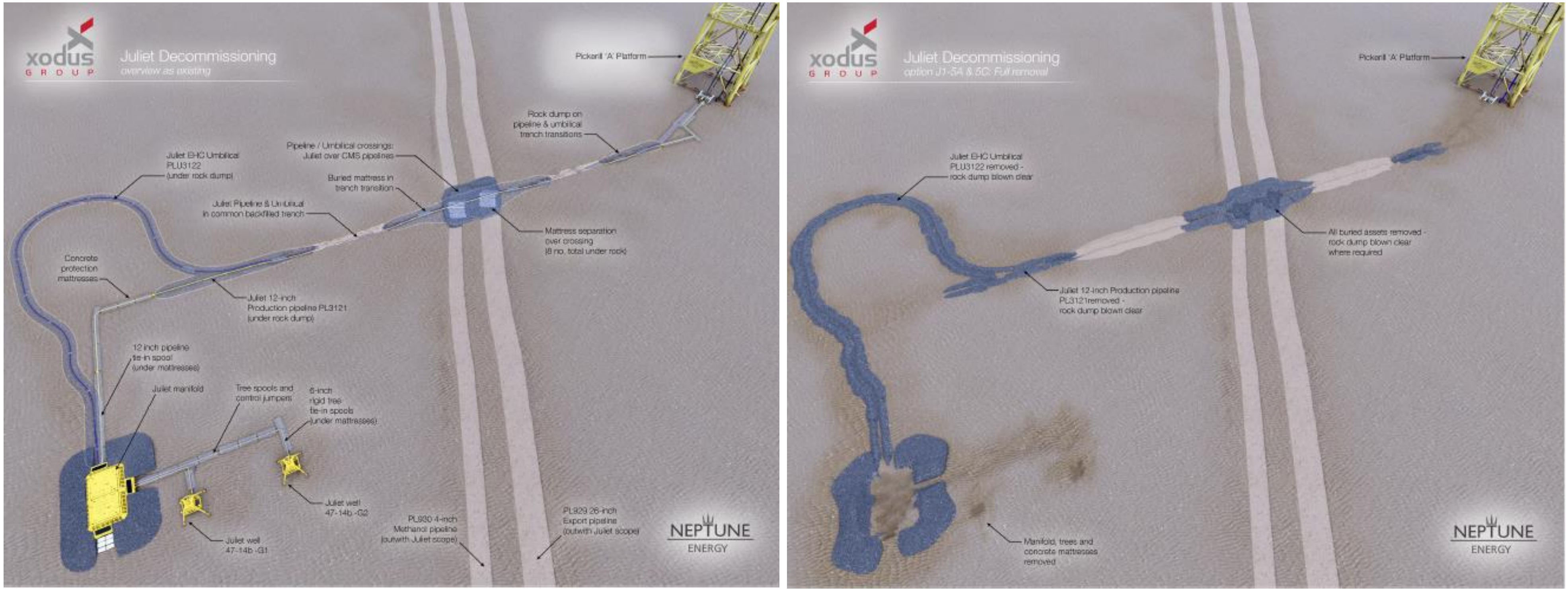


Figure 4.5 Comparison of existing infrastructure (left) with Option 5A and 5C decommissioning outcomes (right)

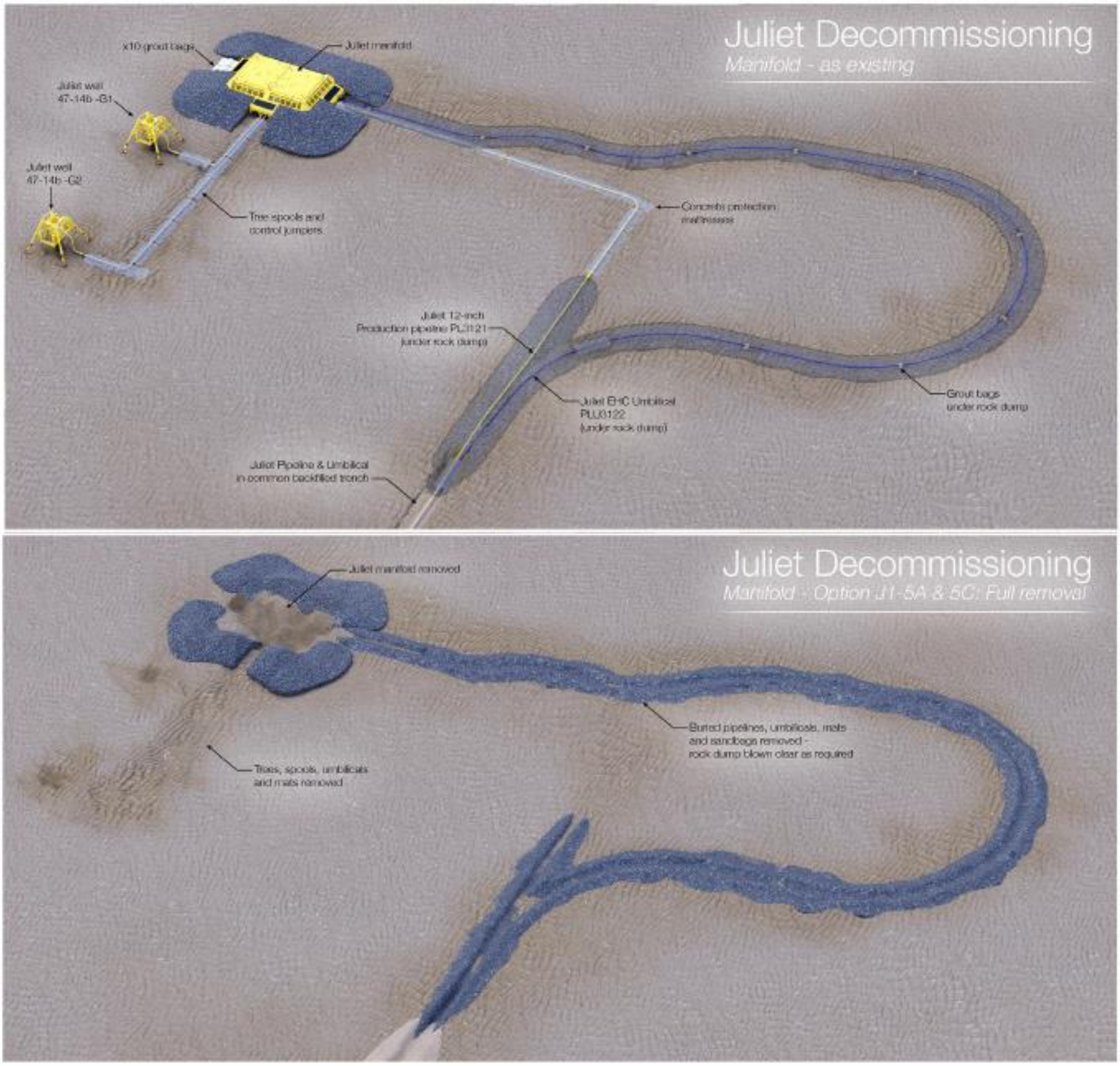


Figure 4.6 Comparison of existing manifold infrastructure (top) with Option 5A and 5C manifold decommissioning outcome (bottom)

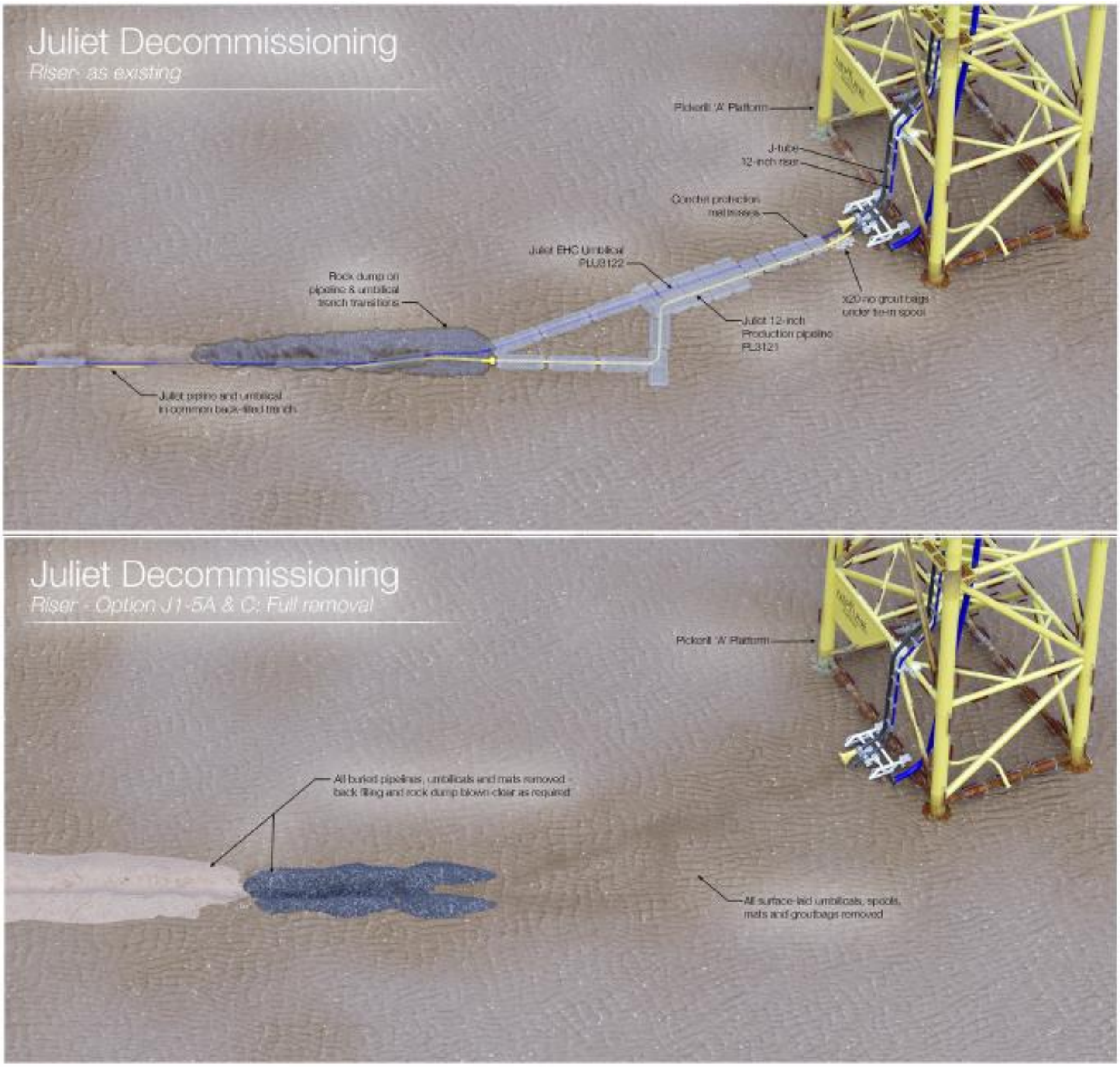


Figure 4.7 Comparison of existing riser infrastructure (top) with Option 5A and 5C riser decommissioning outcome (bottom)

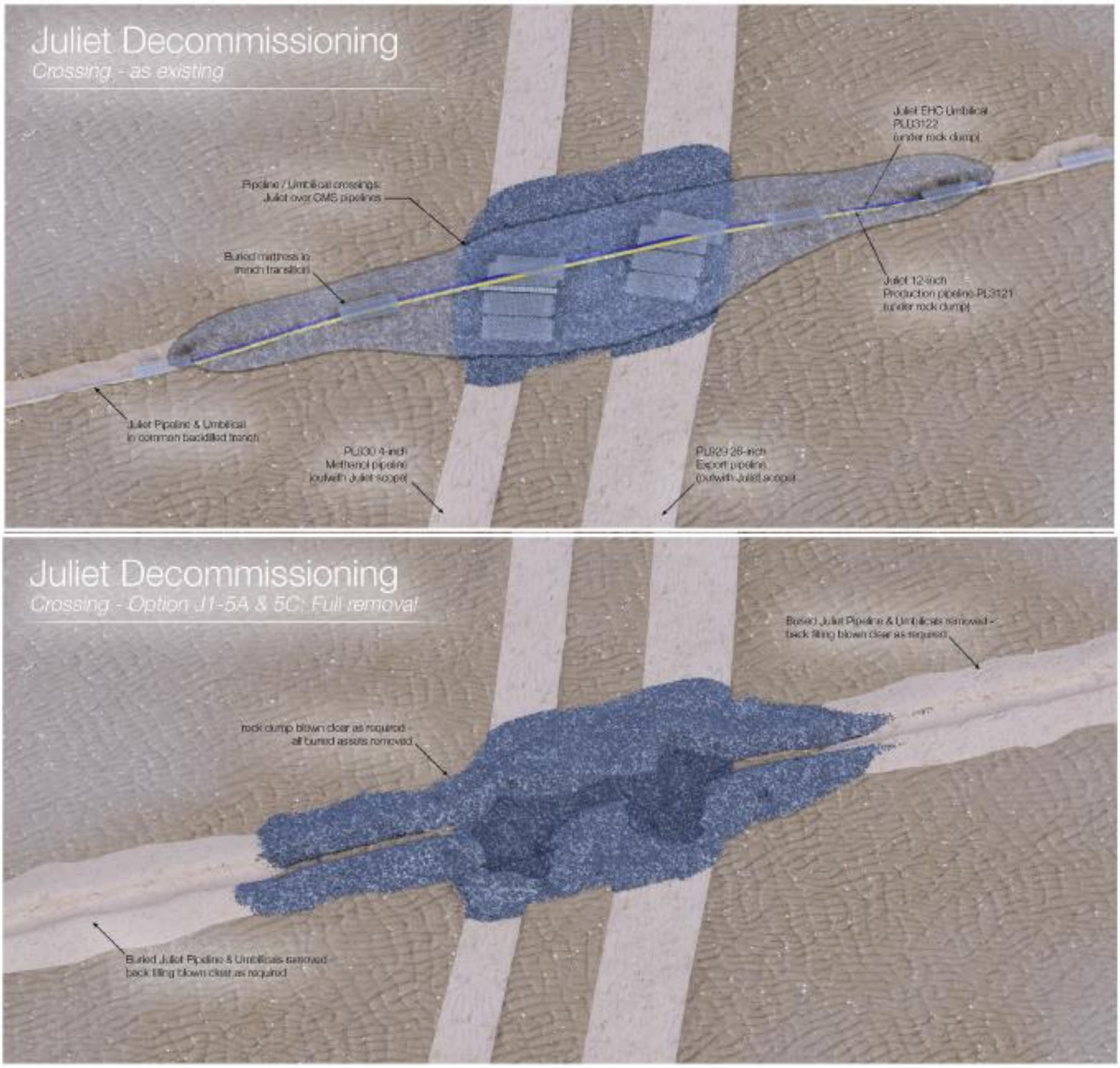


Figure 4.8 Comparison of existing crossing infrastructure (top) with Option 5A and 5C crossing decommissioning outcome (bottom)

5 COMPARITIVE ASSESSMENT

5.1 QUANTITATIVE REVIEW

Following the scoping and internal validation processes, further work was needed to refine the three identified options using quantitative data. This work included: outlining the cost and schedule for each option through a detailed methods and technical feasibility (methodology) review; study of environmental factors (e.g. characterisation of natural habitat, noise, seabed disturbance, and vessel emissions); study of safety risk to fishermen; assessment of safety risk to operational personnel, quantified as Potential for Loss of Life (PLL); Hazard Identification Risk Assessment (HIRA); and Environmental factors Identification (ENVID), including quantification of impacts required for differentiation.

The resulting quantified attributes for each option are then compared through the Comparative Assessment Tool, as described in [1]. The attributes for each option are summarised in Table 5.1 below.

Data Type	Option 1B	Option 5A	Option 5C
Life Cycle Emissions	7,187 te	3,759 te	3,759 te
Vessel Days (Total)	47 (21 op.)	68	421
Overall PLL	5.2 e^{-4}	5.5 e-3	4 e-2
Seabed Disturbance	250 m^2	44,676 m^2	44,676 m^2
Risk to Fisherman	Low	Low	Low
Vessel CO_2 Emissions	1,251 te	4,702 te	30,131 te
Relative Cost	1x	2.4x	10.9x

Note 1: Area of disturbance presented above is the differentiating element (i.e. excluding overtrawl footprint (2,203,300 m^2) which applies to all options).

Table 5.1 Quantitative data used in the Comparative Assessment of the three identified Options

Please note that the attributes given in Table 5.1 refer to the pipeline removal / remediation only. If the mattresses are to be removed, it will be executed in the same campaign as the pipeline activities hence the emissions, PLL, seabed disturbance and costs will be higher but only marginally. The safety risk to fisherman will still be classed as ‘Low’.

5.2 EVALUATION METHODOLOGY

The options were evaluated using criteria defined by BEIS; they include the following equally-weighted factors: Safety; Environment; Technical; Societal; and Economics. These five criteria, their sub-criteria and relative weightings are detailed in Table 5.2 below.

Criteria	Sub-Criteria and Weightings
Safety [20%]	Operations Personnel [6.67%] Other Users [6.67%] Legacy Risk [6.67%]
Environmental [20%]	Operational Marine Impacts [4%] Fuel and Emissions [4%] Legacy Marine Impacts [4%] Materials and Residuals [4%] Seabed disturbance [4%]
Technical [20%]	Project Technical Risk [20%]
Societal [20%]	Fishing Industry [10%] Socio-economic impacts on communities and amenities [10%]
Economics [20%]	Operational and Legacy Costs [20%]

Table 5.2 Evaluation criteria for Comparative Assessment

The definitions of each sub-criteria addressed in the Comparative Assessment are specified in Table 5.3.

Criteria	Sub-Criteria	Description	Approach to Assessment
1. Safety	1.1 Operations Personnel	This sub-criterion considers elements that impact risk to offshore and onshore personnel. The offshore assessment includes, project team, project vessel crew, diving teams, supply boat crew, and survey vessel crew. It should be noted that crew changes are performed via port calls. The onshore assessment considers any requirement for dismantling, disposal operations, material transfer and onshore handling may impact onshore personnel.	Potential for Loss of Life (PLL) metrics were calculated for each option. This allows a quantified direct comparison between options. A quantitative assessment based on the number of vessel days 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. A coarse HIRA was conducted to identify elements associated with the options that had potential for High Consequence Events. The HIRA also addressed the legacy risk component associated with the options. A qualitative risk assessment of the risk to fishermen as a result of potential subsea elements (pipelines / umbilicals and associated rock cover, mattresses and grout bags) left on/in the seabed was performed.
	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.	
	1.3 Legacy Risk	This sub-criterion addresses any personnel risk exposure associated with long-term monitoring in a similar way to 1.1. The assessment considers all exposure activities associated with legacy future survey requirements and any intervention allowance. Hazards identified in the Safety Risk to Fisherman report are also considered here.	

Criteria	Sub-Criteria	Description	Approach to Assessment
2. Environmental	2.1 Operational Marine Impacts	Marine environmental impact caused by: Project Vessels, Supply Boats, Survey vessels i.e. noise generated by vessels, cutting operations, any explosives etc. during the operational phase. This excludes any P&A work.	Assessment based on number of vessel days for this activity and quantifying noise generated by decommissioning activities in the short term.
	2.2 Fuel & Emissions	Marine environmental impact caused by: Project Vessels, Supply Boats, Survey vessels, etc. Assessment is for the atmospheric emissions associated with a particular option and covers fuel use which is tightly correlated to atmospheric emissions. This also includes energy / emissions / resource consumption required to replace materials not recovered for re-use or recycle i.e. indirect. NOTE: Onshore related emissions are excluded. This is calculated for both the operational phase and legacy phase of the project. Marine environmental impact caused by the amount of resource consumption associated with the option is included in this criterion. It covers elements such as environmental burden from processing returned materials, use of quarried rock or other new material and any production of replacement materials.	Assessment based on quantifying the volume of fuel used and the associated emissions. A life-cycle emissions assessment has been carried out capturing: • Recycling of materials • Reuse of materials • Production of new materials These life-cycle CO_2 emissions figures allow a direct, quantitative comparison between options.

Criteria	Sub-Criteria	Description	Approach to Assessment
2. Environmental	2.3 Legacy Marine Impacts	Marine environmental impact caused by: Project Vessels, Supply Boats, Survey vessels i.e. noise generated by vessels, cutting operations, any explosives, survey/monitoring techniques or remediation requirements etc. during the legacy phase.	Combination of qualitative and quantitative assessments based on number of vessel days for this activity and quantifying noise generated by legacy inputs to the environment either from ongoing survey/ monitoring requirements or from potential remediation works.
	2.4 Materials and Residuals	Assessment is made of the total weight/quantity of materials recovered or left *in situ* as well as the status of any minimal liquid volumes, including volume of hydraulic fluid left in the umbilical.	Assessment based on impact of weight of each type of material and final material location for each option. Weights based on asset inventory report. Volumes based on methods and technical feasibility (methodology) review.
	2.5 Seabed Disturbance	Both direct and indirect seabed disturbance, permanent and temporary in nature, caused by the operations.	Assessment based on quantifying the area (in m^2) of disturbance by type of disturbance (rock placement, trenching, mass flow excavation and overtrawling), in combination with an understanding of the baseline environment in the area as shown by the outputs from the environmental surveys.

Criteria	Sub-Criteria	Description	Approach to Assessment
3. Technical	3.1 Technical Risk	This sub-criterion relates to the various technical risks that could result in a major project failure. Concepts such as: Technical Novelty and Potential for Showstoppers can be captured along with impact on the schedule due to overruns from technical issues such as operations being interrupted by the weather. Long offshore campaigns are susceptible to risk of WoW delays. Contracting strategy is assessed with focus on the risk to the project of whether the contracting strategy is restricted by a particular option (e.g. if the option involves only one possible vendor). Technical Feasibility and Technical Maturity is also considered.	Qualitative assessment of technical risk for each decommissioning, including schedule. Application of Technology Readiness Level (TRL) for each option is proposed as per guidance in API RP 17N [Ref 4].
4. Societal	4.1 Fishing	This sub-criterion addresses the impact of the option on commercial fishing operations. It includes consideration of impacts from both the decommissioning activities any residual impacts post decommissioning such as reinstatement of access to area.	A qualitative judgement that provides a narrative (rather than quantification) regarding the influence of each decommissioning option on the availability of the area of seabed for fisheries or any other commercial impacts.
	4.2 Socio-Economic Impact on Communities and Amenities	This sub-criterion addresses any socio-economic impacts on other users both onshore where the impact may be from dismantling, treating, recycling and land filling activities relating to the option and offshore. Issues such as impact on the health, well-being, standard of living, structure or coherence of communities or amenities are considered here e.g. business or jobs creation, increase in noise, dust or odour pollution during the process which has a	Assessment is made using a narrative of the positive and negative impact of the decommissioning option on all groups of society (excluding fishing industry).

Criteria	Sub-Criteria	Description	Approach to Assessment
		negative impact on communities, residual risk of snagging gear and consequential loss of gear, etc.	
5. Economic	5.1 Operational and Legacy Costs	This sub-criterion addresses the cost of delivering the option as described. This includes both operational phase and legacy phase costs (including intervention allowance).	Quantified in detailed methods and technical feasibility (methodology) review.

Table 5.3 Definitions of sub-criteria addressed in the Comparative Assessment

6 RESULTS OF THE COMPARATIVE ASSESSMENT

6.1 SAFETY DIFFERENTIATION

The safety criteria assessed in the Comparative Assessment considered safety risks to operations personnel and other users, and any legacy impacts on safety. Operational hours, operational PLL, vessel days, vessel transits, the number of vessels, and safety risks to fishermen were considered in this assessment.

In the review of safety risks to operations personnel, the minimal intervention option (Option 1B) came out much stronger and very much stronger than the two full removal options, 5A & 5C, respectively. This decision reflects the safety risks associated with the pipeline removal requirements for Options 5A & 5C, particularly the greater demand for personnel and protracted operations hours of each. Option 5C poses the greatest safety risks to operations personnel due to the prolonged period of operations, and the fact that divers are required for cutting and lifting of the pipeline. Option 5A would involve reverse reeling of the pipeline, which is a non-routine activity, and could pose unforeseen hazards to personnel, particularly if the pipeline's integrity is compromised. Consequently, the PLL values for Options 5A and 5C were one and two orders of magnitude greater than that of Option 1B, respectively.

In terms of safety impacts on other users, Option 1B had the least potential to generate vessel-related impacts. This option has 21 days of vessel time allocated to operations during a single transit, with a remaining balance of 26 days devoted to legacy operations and monitoring which are to be spread out over an anticipated 50-year period. Neither of the full removal options require legacy operations to be considered, however their vessel requirements during the operations phase is more extensive than the minimal intervention option. Option 5A has 68 vessel days allocated solely to operations; these are to be divided between 5 vessels and 6 vessel transits. Option 5C has a significantly greater vessel requirement: 421 total vessel days across divided between 6 vessels across 7 transits. The increased vessel days and number of transits are attributable to the technical and personnel constraints associated with cutting and lifting the production pipeline during its removal. Moreover, the full removal options may impact other users as increased vessel presence will include vessels moving along the entirety of the length of the pipeline during operations for both options.

As discussed, neither of the full removal options have an associated legacy impact therefore for this sub-criteria Option 1B was viewed as the weakest option.

Given the increased requirement for vessels and the intrinsic risks to operations personnel posed in the full removal options, Option 1B was identified as the recommended option for minimising safety risks during the decommissioning of the Juliet subsea infrastructure.

6.2 ENVIRONMENTAL DIFFERENTIATION

The Comparative Assessment addressed various environmental criteria, including operational marine impact, fuel and emissions, legacy marine impact, materials and residuals, and seabed disturbance. As with the safety criteria assessment, vessel days were also considered for impacts to the environment, but instead the cumulative marine noise emissions they generate were assessed. Total fuel usage, vessel CO_2 emissions, materials life cycle energy consumption and CO_2 emissions, total tonnage of material types, the requirement for additional rock-dump, discharge of control fluids, and Mass Flow Excavation (MFE), trenching and overtrawling impacts on seabed sediments were all additionally considered in the assessment of impacts of the project on the marine environment.

Noise formed the primary concern in the assessment of operational marine impacts. Although the vessel noise levels generated are estimated to be marginally above the NOAA thresholds for injury, due to the duration of activities being very short and the behavioural natures of the marine mammals present, vessel noise was not considered a significant impact. This was discussed and agreed with the stakeholders present during the CA workshop. Marine mammals will avoid injury by temporarily displacing from the area during this short period of concentrated vessel activity. The following table summarises the estimated marine noise levels associated with each decommissioning option in relation to the NOAA thresholds.

Option 1B	Option 5A	Option 5C	NOAA Threshold
3.12 TPa^2S (245 dB)	22.92 TPa^2S (254 dB)	189.73 TPa^2S (263 dB)	173 dB

Note 2: Noise levels for Options 1B, 5A and 5C represent the cumulative noise experienced at a distance of 1 metre from the source. The NOAA threshold quoted is the lowest threshold of all hearing groups considered and is based upon the assumption that the marine mammal would remain stationary during exposure which is very unlikely.

Table 6.1 Summary of Marine Noise Levels and NOAA Threshold

Noise from mechanical cutting associated with Option 5C's removal method was considered the biggest noise-related issue, however its potential impacts are minimised by the fact that this activity will be temporary and spatially constrained. In this respect, Option 1B was only considered marginally better than Option 5A & much better than Option 5C.

The total fuel usage and vessel CO_2 emissions were greatest for Option 5C, which had values close to ten times greater than Option 5A and close to 20 times those of Option 1B. However, the greatest materials lifecycle CO_2 emissions came from Option 1B, which was nearly double both Option 5A and 5C. This is because the leave *in situ* method precludes recycling or reuse of the Juliet infrastructure's component parts. Still, when considering the total CO_2 emissions (from vessels and materials combined), Option 5C came out the worst and Options 1B and 5A roughly the same. In the end, the increased fuel consumption of Option 5A made it slightly less desirable than Option 1B.

Legacy marine impacts were only described for Option 1B, as the full removal of the Juliet subsea infrastructure precludes legacy operations obligations. Still, the legacy marine impacts of Option 1B were deemed minor, in that the number of vessel days and cumulative noise generated by legacy operations were minimal and the volume of additional rock-dump is not expected to have any significant impacts on the seabed habitat, with any impact being highly localised.

All three options had equivalent values for the discharge of control fluids, however, Option 1B would see residual fluids discharged over a period of decades rather than instantaneously, as is the case with the full removal options. Neither full removal option would leave any volume of material remaining on the seabed, nor would they require additional rock-dump. Option 1B, however, would have nearly 3800 tons of steel, 300 tons of plastic and a little over 18 tons of non-ferrous materials decommissioned *in situ*. For this reason, Option 1B was seen as weaker than the other two options, which were equally desirable for their minimal materials and residuals impacts.

For the seabed disturbance impacts, decommissioning plans for Option 1B had an additional 250 m^2 (500 Te) of rock dump to consider, but this was considered to have a minor potential impact on the seabed habitat. The full removal options had significantly higher MFE values, however, making Option 1B a much stronger option for reducing seabed disturbance impacts.

Overall, Option 1B was identified as the recommended option because of its minimal impacts to the seabed habitat, reduced fuel and emissions impacts and its decreased marine impacts during the operations phase.

6.3 TECHNICAL DIFFERENTIATION

The technical risk criteria addressed in the Comparative Assessment included the contracting strategy, scheduling risk and technical maturity of each option. As the contracting strategies of each option are relatively flexible, the main differentiator for technical risk relates to scheduling. All of the options will incur risks associated with weather issues, but the potential impacts of scheduling issues are potentially more numerous and harder to recover from for both of the full removal options. The long schedule for Option 5C will inherently bring greater technical risk. The extended subsea works and risk of failure associated with this Option could result in significant cost and scheduling impacts and potentially the requirement for an alternative decommissioning method to be used.

There is significant technical risk associated with the reverse reeling of the pipeline in Option 5A. While reel installation of pipelines is a standard subsea operation and reverse reeling has been carried out elsewhere, there is a relatively limited track record of reverse reeling for removal of pipelines in the UKCS and a low track record of unburial over extensive distances. As such, the technical maturity of Option 5A is considered very low.

After considering the schedule and technical maturity associated with each of the options, it was determined than Option 1B was the preferred option for minimising technical risks.

6.4 SOCIETAL DIFFERENTIATION

In the assessment of societal impacts, impacts to the fishing industry and communities and amenities were considered.

In regard to the fishing industry, the current state of the Juliet subsea infrastructure is that it is overtrawlable. However, there is potential for segments of the pipeline to need additional rock-dump in future, should spans develop. Given Options 5A and 5C remove legacy risk altogether, and that dispersed rock from the removal of the pipelines is likely to be better for fisheries, Option 1B is considered the weaker option and both full-removal options are deemed equally weighted.

Despite Option 1B not returning any material to shore, the amount of material generated by the other two options is so small that there is very little difference between the options in terms of socio-economic impacts on communities and amenities. While the majority of infrastructure can be recycled, all of the recycling will likely to be processed at an existing facility and so is unlikely to create any additional jobs. Moreover, as full removal is likely to generate equal amounts of recycling and waste to go landfill, the benefits of potential jobs created by recycling is outweighed by the cost of processing the waste going to landfill. As such, Options 5A and 5C are considered equally weighted and only slightly better than Option 1B.

6.5 ECONOMIC DIFFERENTIATION

The economic criteria covered in the Comparative Assessment focused on costs associated with operations and legacy activities. When undertaking the assessment, it was assumed that all activities are carried out successfully. As such, the economic assessment didn’t consider costs associated with any technical risks, such as issues arising during reverse reeling or bad weather days. Rather, a 30% contingency value was added to each option once the operations and legacy costs were summed. This qualitative assessment resulted in costings of the full removal options at 2.4 times and 10.9 times the value of Option 1B for Options 5A and 5C, respectively. As a result, the leave *in situ* option was viewed as being the best option in terms of reducing economic impacts on the project.

6.6 CONCLUSIONS

While the full removal options were preferred to the leave *in situ* option for four of the twelve sub-criteria, Option 1B was the preferred option overall. This is due to the fact that, when all of the sub-criteria were drawn together, Option 1B scored highest in four of the five main criteria categories.

The results suggest that there wasn’t a single driving factor for this decision, rather, the majority of the sub-criteria indicated that the leave *in situ* option is best at minimising risks associated with safety, environment, technical operations, and economic expenditures.

The results of the Comparative Assessment, in which each of the criteria are weighted against one another are presented in Figure 6.1 below.

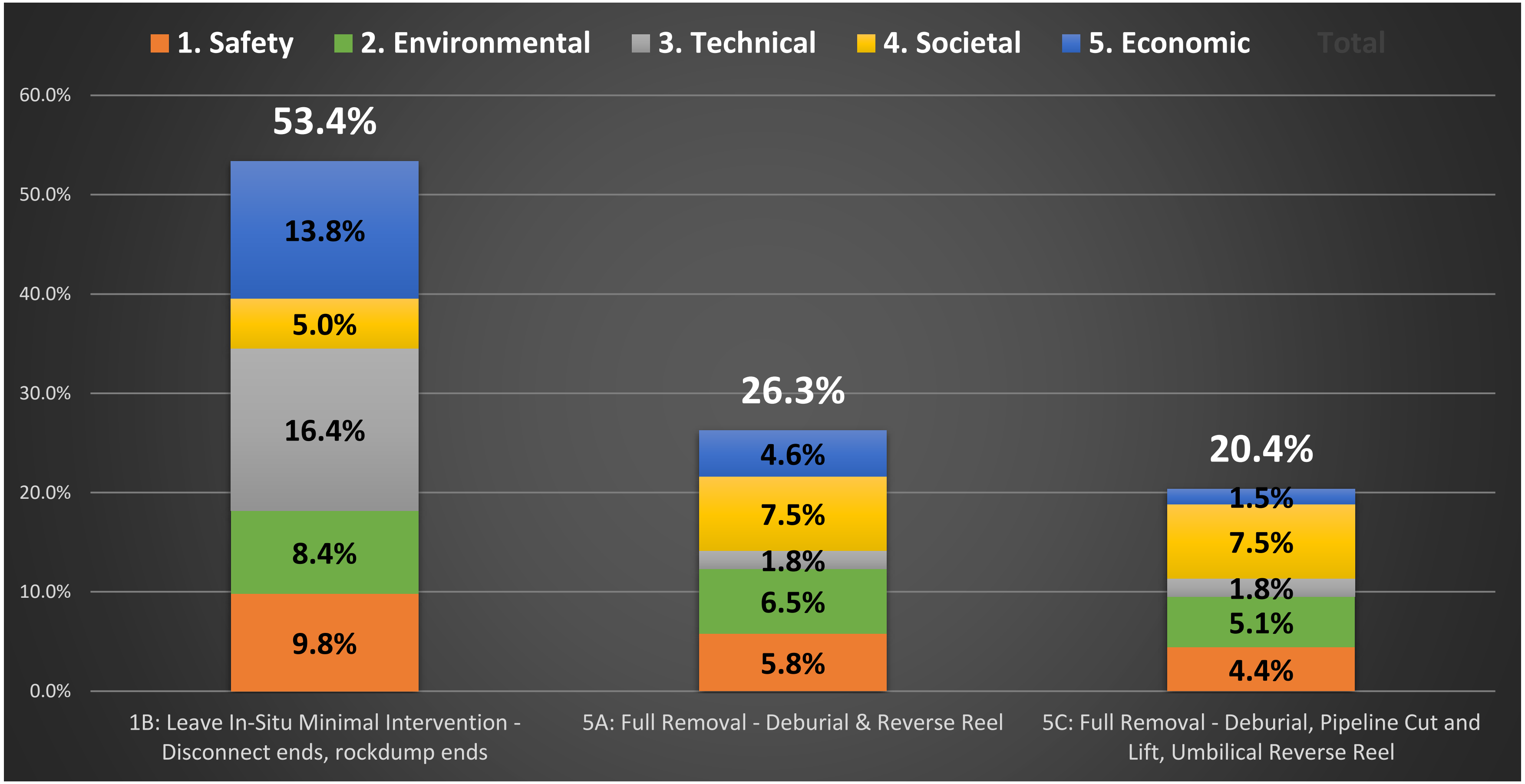


Figure 6.1 Graphical representation of the results of the Comparative Assessment

6.6.1 Sensitivity Analysis

There were a series of sensitivity analyses undertaken to provide additional support for the results of the Comparative Assessment. This included evaluating the sensitivities of the following sub-criteria by testing the scorings of each option therein: safety impacts to other users; technical risks; societal impacts on the fishing industry; and socio-economic impacts on communities and amenities.

Moreover, the CA results were considered further by removing one criterion weighting at a time to look at the subsequent effects on the results for the other criteria. In this process, it became apparent that no single criterion was driving the results of the CA assessment. The following figure shows the assessment results with the Economics criteria removed.

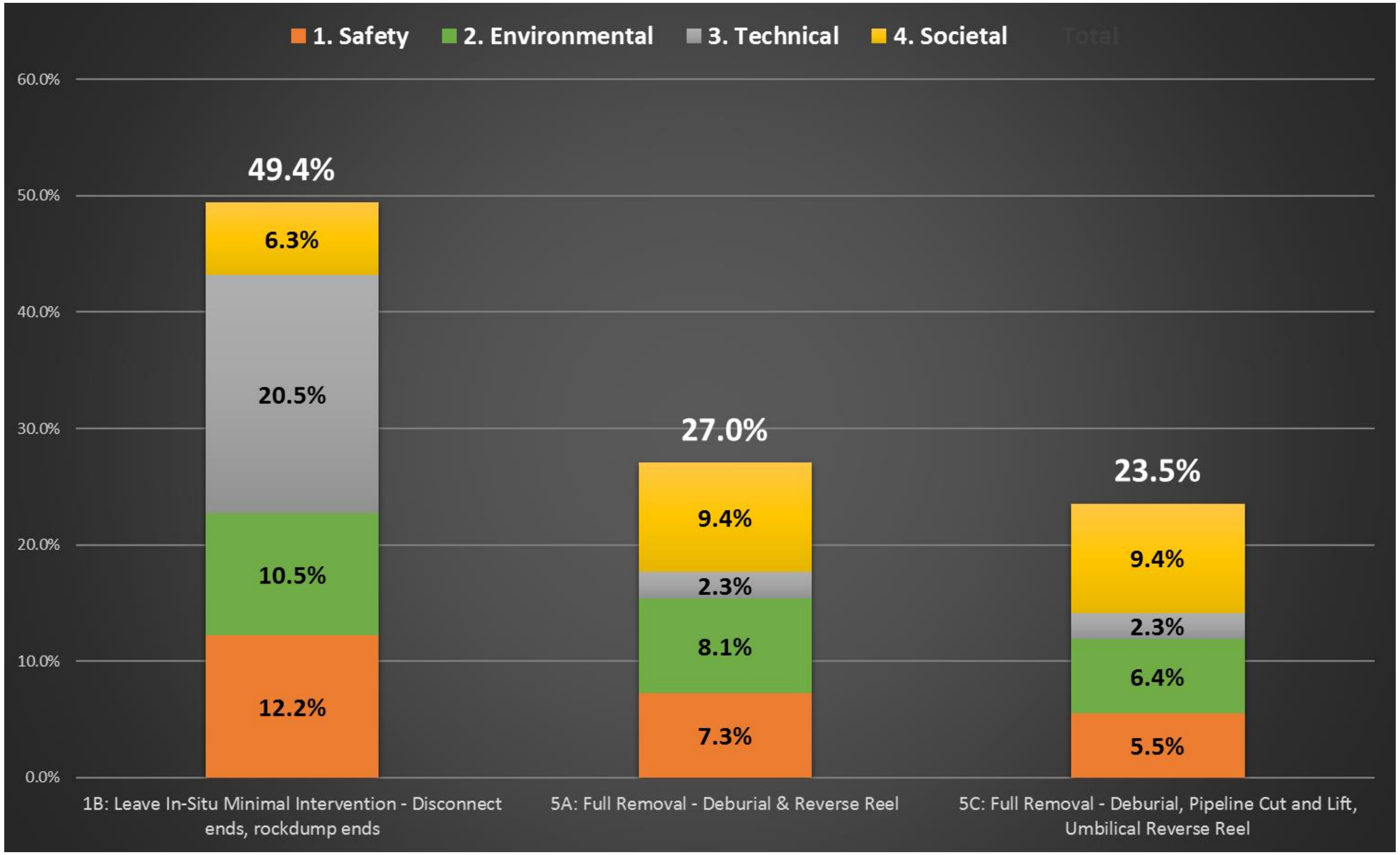


Figure 6.2 Graphical representation of the results of the Comparative Assessment with economic risks removed

7 REFERENCES

7.1 SUPPORTING DOCUMENTATION

1	Juliet Comparative Assessment Terms of Reference	JF00-09-AN-103-00001_C01, August 2018
2	Analytical Hierarchy Process	The Analytical Hierarchy Process by T.L. Saaty, McGraw Hill, 1980.
3	Juliet and Minke Comparative Assessment Scoping and Screening Report	JF00-09AN-72-00302, C01, June 2018
4	API RP 17N	API RP 17N Recommended Practice for Subsea Production System Reliability, Technical Risk and Integrity Management 2014

All references available upon request.

8 APPENDICES

8.1 APPENDIX 1: MEETING RECORD

Name	**Position / Company**	**Date**
Alan Muirhead	Developments and Decommissioning Manager, Neptune Energy	20/09/2018
Pierre Girard	Asset Manager, Neptune Energy	20/09/2018
Eddie Anderson	HSE, Neptune Energy	20/09/2018
David Hawkins	Environment, Neptune Energy	20/09/2018
Joanne Rostant	Tech Safety, Neptune Energy	20/09/2018
Justin Heath	Communications, Neptune Energy	20/09/2018
Francis Barrett	Subsea and Pipelines, Xodus Group	20/09/2018
Rebecca Allan	Project Representation, Xodus Group	20/09/2018
Gareth Jones	Facilitator, Xodus Group	20/09/2018
Kim Woods	Stakeholder Representative, BEIS OPRED ODU	20/09/2018
Audrey Banner	Stakeholder Representative, BEIS OPRED	20/09/2018
Fiona Livingston	Stakeholder Representative, BEIS	20/09/2018

8.2 APPENDIX 2: COMPARATIVE ASSESSMENT TOOL FOLLOWING INTERNAL WORKSHOP

<table>
<tr><th></th><th></th><th colspan="2">1B: Leave In-Situ Minimal Intervention - Disconnect ends, rockdump ends</th><th>5A: Full Removal - Deburial & Reverse Reel</th><th>5C: Full Removal - Deburial, Pipeline Cut and Lift, Umbilical Reverse Reel</th></tr>
<tr><td></td><td></td><td colspan="2">For this option, the trenched and buried pipeline and umbilical will be left in-situ and disconnected at the ends (where the pipeline and umbilical exits rockdump) and the ends removed (note that the umbilical at Juliet manifold end exits rockdump at the manifold tie-in location).
The surface laid pipeline/umbilical sections with rock cover shall be left on the seabed. Mattresses which are buried beneath rockdump shall also be left in-situ.</td><td>For this option, the trenched and buried pipeline and umbilical will be deburied and recovered from the seabed via the reverse reeling method.
The pipeline and umbilical presently cross the CMS, which shall be non-operational at the time of Juliet decommissioning.</td><td>For this option, the trenched and buried pipeline and umbilical will be deburied. The pipeline shall then be cut in 24 m lengths, with each section rigged and recovered to surface. The umbilical shall be recovered from the seabed via the reverse reeling method.
The pipeline and umbilical presently cross the CMS, which shall be non-operational at the time of Juliet decommissioning.</td></tr>
<tr><td>1. Safety</td><td>1.1 Operations Personnel</td><td colspan="2">Total operational hours = 8,920
Total Operational PLL = 5.20E-04
Routine activities, relatively short duration. No diving - ROV and shears only.</td><td>Total option hours = 72,983
Total Operational PLL = 5.51E-03
Non-routine activity for pipeline reverse reeling.
Potential for integrity issues of pipeline - from a safety perspective this could mean potential for hazardous event during reverse reeling. Note - technical feasibility of this option is captured under 3.1 below and not here under safety.</td><td>Total option hours = 382,364
Total Operational PLL = 4.02E-02
More diving intensive (reflected in PLL) - 18,000 manhours of diving versus 600 hours in option 5A.</td></tr>
<tr><td></td><td></td><td>MS</td><td>VMS</td><td>S</td><td></td></tr>
<tr><td></td><td>Summary</td><td colspan="4"></td></tr>
<tr><td>1. Safety</td><td>1.2 Other Users</td><td colspan="2">During this operation there will be three vessels operating for 21 days in total. Further legacy operations require 3 survey type vessels for a total duration of 26 days.
Total Days = 47 Vessel Days
Over half the total vessel days relate to legacy activities over a several year period. Intensity of activity during decom operation is only 3 vessels over 21 days.</td><td>Vessels will only be present for the operational phase of this option with no legacy as all equipment is removed.
Total Days = 68 Vessel Days
Total Transits = 6 Vessel Transits
Approximately three times the number of vessel days compared to 1B. Five vessels.</td><td>Vessels will only be present for the operational phase of this option with no legacy as all equipment is removed.
Total Days = 421 Days
Total Transits = 7 Transits
Approximately 20 times the number of vessel days as 1B. Six vessels.</td></tr>
<tr><td></td><td></td><td>S</td><td>MS</td><td>S</td><td></td></tr>
<tr><td></td><td>Summary</td><td colspan="4">Option 1B has 21 days of vessel time allocated to operations during a single transit, with a remaining balance of 26 days devoted to legacy operations and monitoring which are to be spread out over an anticipated 50-year period. Neither of the full removal options require legacy operations to be considered, however their vessel requirements during the operations phase is more extensive than the minimal intervention option, which impacts the scoring. Option 5A has 68 vessel days allocated solely to operations; these are to be divided between 5 vessels and 6 vessel transits. Option 5C has a significantly greater vessel requirement: 421 total vessel days across divided between 6 vessels across 7 transits.</td></tr>
<tr><td>1. Safety</td><td>1.3 Legacy Impact</td><td colspan="2">Return survey, diving and rock dump activities assumed to be required for this option.
Total Legacy hours = 7,278
Total Legacy PLL = 2.01E-03
Primarily static pot fishing for Crab, Lobster and dredging for Scallops. Some small scale demersal trawling.
36F0 (2017) = Moderate Activity, 2938 days. £11m landed
36F1 (2017) = Low Activity, 475 days, £2m landed
The Juliet pipeline has more potential for spans. Trawling in the area tends to be Otter type which is more likely to result in snagging if a free span occurs. This is however offset by the very low trawling activity level.</td><td>All equipment removed and no further work required
Legacy Hours = 0
Legacy PLL = 0
Fully removed infrastructure, minimal legacy footprint (dispersed rock dump only).</td><td>All equipment removed and no further work required
Legacy Hours = 0
Legacy PLL = 0
Fully removed infrastructure, minimal legacy footprint (dispersed rock dump only).</td></tr>
<tr><td></td><td></td><td>W</td><td>W</td><td>N</td><td></td></tr>
<tr><td></td><td>Summary</td><td colspan="4">Whilst this sub-criteria compares legacy hours against zero legacy, when the volume of activity is put in the context of normal operations it is relatively small. Option 1B considers crossing remediation using divers - dealing with grout bags rather than ROVs. Snagging risk would be higher, but trawling activity is low.</td></tr>
<tr><td>2. Environmental</td><td>2.1 Operational Marine Impact</td><td colspan="2">Vessels will be used to disconnect pipeline ends and rockdump the ends.
Vessel Days = 21 days
Cumulative Marine Noise = 3.12 TPa^{2}s</td><td>Vessels will be used to debury and reverse reel the pipelines for this option.
Vessel Days = 68.3 days
Cumulative Marine Noise = 22.92 TPa^{2}s</td><td>Vessels will be used to debury, cut and remove for this option.
Vessel Days = 418.3 days
Cumulative Marine Noise = 189.73 TPa^{2}s</td></tr>
<tr><td></td><td></td><td>S</td><td>MS</td><td>MS</td><td></td></tr>
<tr><td></td><td>Summary</td><td colspan="4">Options 1B and 5A are considered reasonably comparable, but with Option 1B being marginally better from an operational marine impact perspective, whilst both are Much Stronger than Option 5C. NOTE: Noise associated with legacy activities is very low. General vessel noise is not considered a significant contributor to marine mammal disturbance in the area. Mechanical cutting would be the biggest noise issue, however this would be temporary and spatially constrained.</td></tr>
</table>

2. Environmental	**2.2 Fuel and Emissions**	Operational and Legacy Phase Vessel Fuel Usage: Total Fuel Usage = 595 Te Total Vessel CO2 Emissions = 1251 Te Materials Life Cycle Energy consumption, including recycling of steel, plastics etc: Materials Lifecycle CO2 Emissions = 7187 Te	Operational and Legacy Phase Vessel Fuel Usage: Total Fuel Usage = 1651 Te Total Vessel CO2 Emissions = 4702 Te Materials Life Cycle Energy consumption, including recycling of steel, plastics etc: Materials Lifecycle CO2 Emissions = 3759 Te	Operational and Legacy Phase Vessel Fuel Usage: Total Fuel Usage = 11,127 Te Total Vessel CO2 Emissions = 30,131 Te Materials Life Cycle Energy consumption, including recycling of steel, plastics etc: Materials Lifecycle CO2 Emissions = 3759 Te
		S	**MS**	**S**
	Summary	Combined CO2 emissions (vessel and lifecycle together) are comparable for Options 1B and 5A. The vessels are not yet selected. Comparison based on medium sized vessels using marine diesel fuel, however if larger vessel are used there could be heavy marine fuel (leading to stronger CO2 emissions). Note- Using IOP guidance on vessel emissions.		
2. Environmental	**2.3 Legacy Marine Impact**	Vessels will be used to survey the equipment left insitu over the longer term. Vessel Days = 25.6 days Cumulative Marine Noise = 8.87 TPa^2s Volume of rock and seabed disturbance is low.	As all equipment is removed there is no legacy marine impact. Vessel Days = 0 days Cumulative Marine Noise = N/A	As all equipment is removed there is no legacy marine impact. Vessel Days = 0 days Cumulative Marine Noise = N/A
		W	**W**	**N**
	Summary	There are 2 surveys and crossing remediation accounted for in Option 1B. 500 Te rockdump is added for this option also		
2. Environmental	**2.4 Materials and Residuals**	The following volumes of material will remain once the option has been completed. Steel = 3793.3 te Plastic = 299.6 te Non-Ferrous = 18.2 te Rock dump required = 500 Te (includes legacy) Control fluids discharged = 8.8 m^3 over an extended period	The following volumes of material will remain once the option has been completed. Steel= 0 te Plastic = 0 te Non-Ferrous = 0 te Rock dump required = 0 Te Control fluids discharged = 8.8 m^3 instantaneous release during removal	The following volumes of material will remain once the option has been completed. Steel= 0 te Plastic = 0 te Non-Ferrous = 0 te Rock dump required = 0 Te Control fluids discharged = 8.8 m^3 instantaneous release during removal
		W	**W**	**N**
	Summary	Scored Option 1B W with other options due to additional rock dump required for this option. Potential to put a seal on the end to retain fluids when reverse-reeling umbilical and avoid release, however the volume associated with the water based product is small. There is no contingency for spans or additional rock dump for remediation of such spans.		
2. Environmental	**2.5 Seabed Disturbance**	Sea bed disturbance data for this option is noted below: Rockdumping = 250 m^2 (includes legacy) Mass flow excavation (MFE) = N/A Trenching = N/A Overtrawl = 220,300 m^2	Sea bed disturbance data for this option is noted below: Rockdumping = N/A Mass flow excavation (MFE) = 44,676 Trenching = N/A Overtrawl = 220,300 m^2	Sea bed disturbance data for this option is noted below: Rockdumping = N/A Mass flow excavation (MFE) = 44,676 Trenching = N/A Overtrawl = 220,300 m^2
		MS	**MS**	**N**
	Summary	Have accounted for overtrawl in all three cases and it is therefore not a differentiator. Mass flow excavation is the significant contributor, which makes Option 1B stronger than the removal options.		

3. Technical	3.1 Technical Risk	Contracting Strategy - Established methods and technology. No special requirements that would limit number of available decommissioning contractors. Good flexibility in terms of contracting strategy. Schedule – No particular technological factors or major risk factors that could extend schedule. In field time of 21 days. Technical Maturity - TRL 7. Established methods and technology. Fully mature.	Contracting Strategy - Reel vessel of suitable capacity required. Vessels are generally available from a number of vendors. Reasonably flexible contracting strategy. Schedule - In field time of 70 days. Potential for extension to schedule due to possible entanglement of pipeline and umbilical within trench and possible failure of pipeline during reverse reeling. Technical Maturity - Reel installation of pipelines is a standard subsea operation but, while reverse reeling has been carried out elsewhere, there is a relatively limited track record of reverse reeling for removal of pipelines in the UKCS. Low track record of unburial over extended distance. ***Current understanding of pipeline integrity is that this option is feasible when considering production life, pipeline age, wall thickness design report and required wall thickness for reverse reel scenario.*** ***Technical risk with transition section and the number of reel changeouts required etc. Other unkowns are associated with how bending stresses, thermo cycling etc may have effected the integrity of the line for lifting or reeling. Nothing of this scale has been attempted before in the UKCS.***	Contracting Strategy - CSV, DSV and Barge required for pipeline removal. Generally, vessels and equipment widely available. Suitable diverless technology limited. Special lifting tool may be required. Reel vessel of suitable capacity required for umbilical. Vessels are generally available from a number of vendors. Schedule - Long offshore schedule. In field time of 421 days. Potential for extension to schedule due to possible entanglement of pipeline and umbilical within trench. Cut and lift considered challenging over large distance. May require diver support. Extended subsea works and risk of failure, which would result in significant cost and schedule impact / requirement for alternative decommissioning method. Technical Maturity - Routine operations but track record low for cut & lift over extended distance. Low track record of unburial over extended distance. ***Activity is over a much longer duration so chances of lost time due to waiting on weather, or other general technical issues is higher.***
		VMS	**VMS**	**N**
	Summary	Whilst technology and techniques are relatively mature across all options, the main differentiator relates to the long schedule for Option 5C which will inherently bring greater technical risk. All have been upgraded by one level because of the risks associated with weather issues, which pose a significant risk to schedule. No example of this length of pipeline (rigid flowline) being reverse reeled....so potentially Options 5A & 5C should be downgraded because of technical risk associated with using a technique which has not been proven for long distances.		
4. Societal	4.1 Impact on Fishing Industry	Small area of natural seabed disturbed. Seabed would be left with rock dump of ends. No spans or exposures. Rock dump profile likely to remain as it currently is (long term legacy of infrastructure remaining in situ).	Large area of seabed temporarily disturbed but this will revert to natural condition over time and there would be no impact on fisheries after this time. Pipeline and umbilical are permanently removed, leaving a clear seabed. Dispersed rock will remain on seabed. Slight dip where infrastructure removed from trench. Use of MFE has potential to create a berm but this will be mitigated through testing in an over-trawl trial. Anticipate natural back filling of trench over time. No other legacy impact.	Large area of seabed temporarily disturbed but this will revert to natural condition over time and there would be no impact on fisheries after this time. Pipeline and umbilical are permanently removed, leaving a clear seabed. Dispersed rock will remain on seabed. Slight dip where infrastructure removed from trench. Use of MFE has potential to create a berm but this will be mitigated through testing in an over-trawl trial. Anticipate natural back filling of trench over time. No other legacy impact.
		W	**W**	**N**
	Summary	Given Options 5A and 5C remove legacy risk altogether, and that dispersed rock is likely to be better for fisheries, Option 1B is considered weaker. 5A and 5C are considered neutral to each other. There is also a potential continued low risk to fishing gear for legacy Option 1B.		
4. Societal	4.2 Socio-Economic Impact on Communities and Amenities	Small impact on communities and amenities only as no material returned to shore.	Some impact on communities and amenities as majority of pipeline and umbilical would be returned to shore for dismantling/recycling.	Some impact on communities and amenities as majority of pipeline and umbilical would be returned to shore for dismantling/recycling.
		W	**W**	**N**
	Summary	Overall there is very little difference between the options. For example, the majority of infrastructure can be recycled, all likely to be processed at an existing facility and unlikely to create any additional jobs. Assumption is receiving facility will also do the treatment, so no onshore transportation required. The volumes of recyclables and waste to landfill is small. Some of the subsea inventory is relatively new and shouldn't be too depredated. Where possible items will be reused e.g. mattresses could be reused subject to testing. Most of the removed material shall be recycled.		
5. Economic	5.1 Operational & Legacy Costs	Total Cost including 30% contingency (Operational + Legacy) = X ***Given limited track record of operation, and the recent span (now remediated), anticipate 2 further surveys***	Total Cost including 30% contingency (Operational + Legacy) = 2.4X ***Availability of appropriate vessels may put up price or extend schedule***	Total Cost including 30% contingency (Operational + Legacy) = 10.9X ***Availability of appropriate vessels may put up price or extend schedule***
		MS	**VMS**	**MS**
	Summary	The costs do not allow for issues arising from reverse reeling. There is a 30% contingency to reflect cost estimate accuracy.		

8.3 APPENDIX 3: JULIET INFRASTRUCTURE SCHEMATICS – BEFORE AND AFTER DECOMMISSIONING

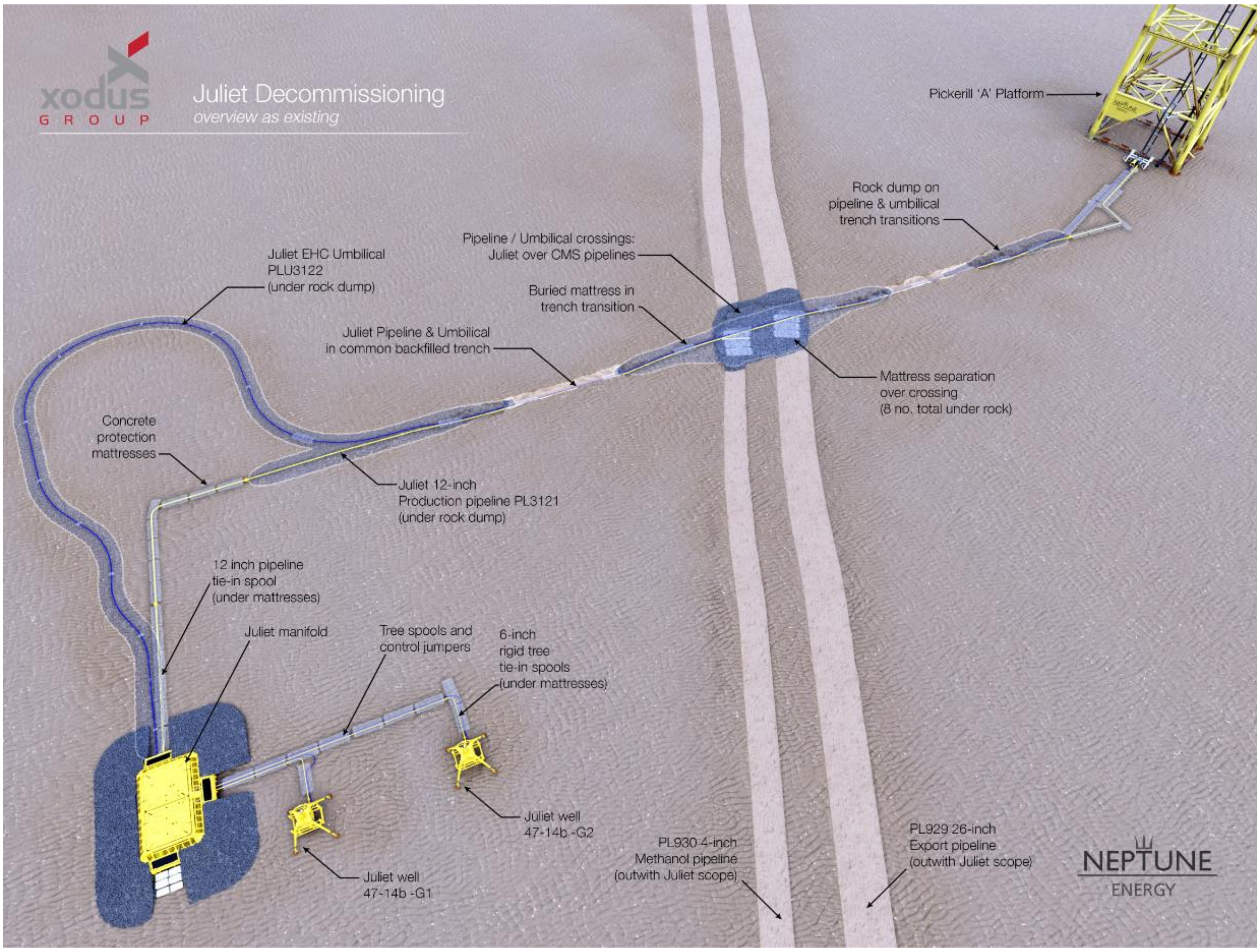


Figure 8.1 Existing Juliet Infrastructure

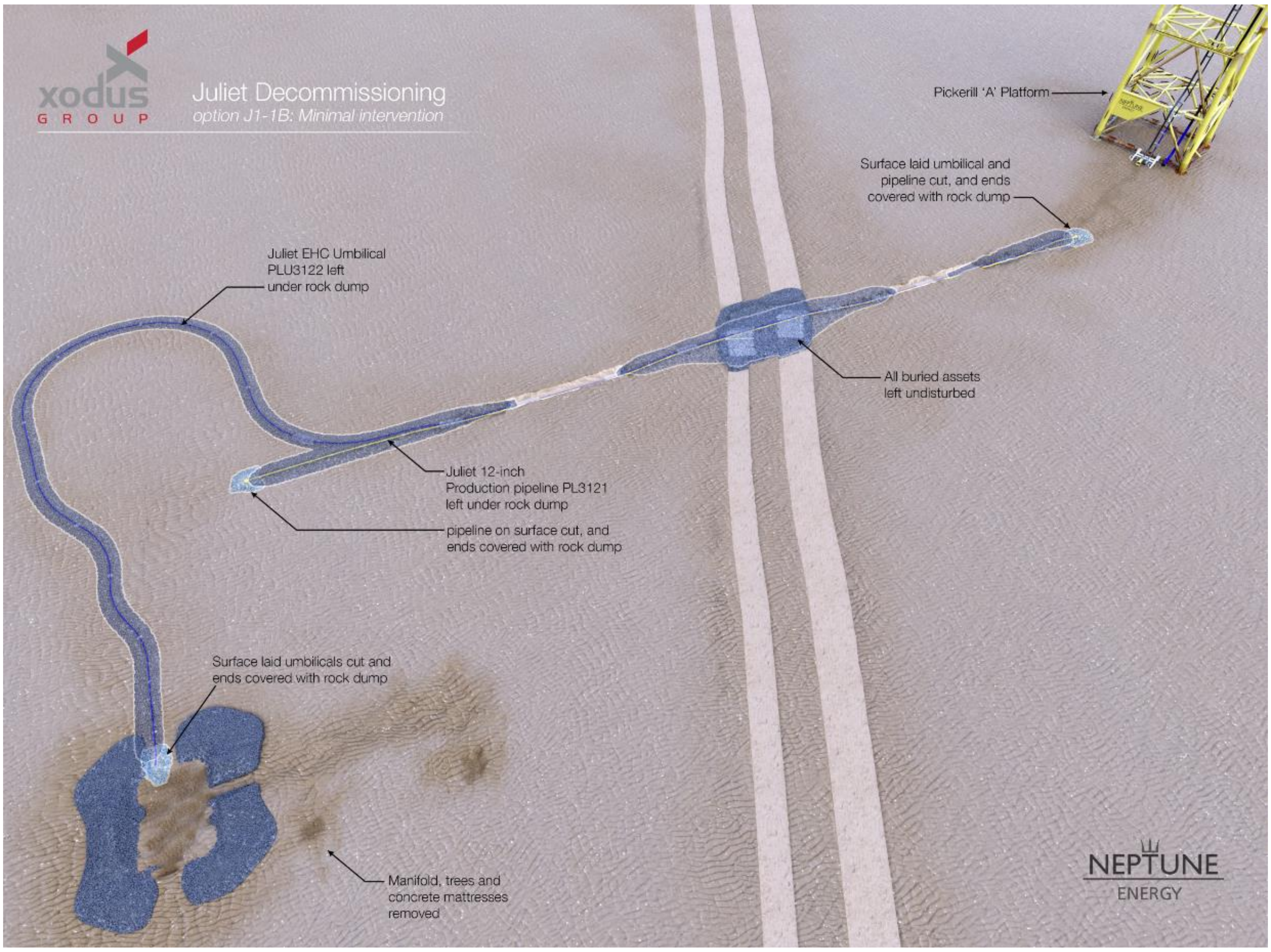


Figure 8.2 Option 1B Decommissioning Outcome - Disconnect Pipeline & Rock-Dump Ends

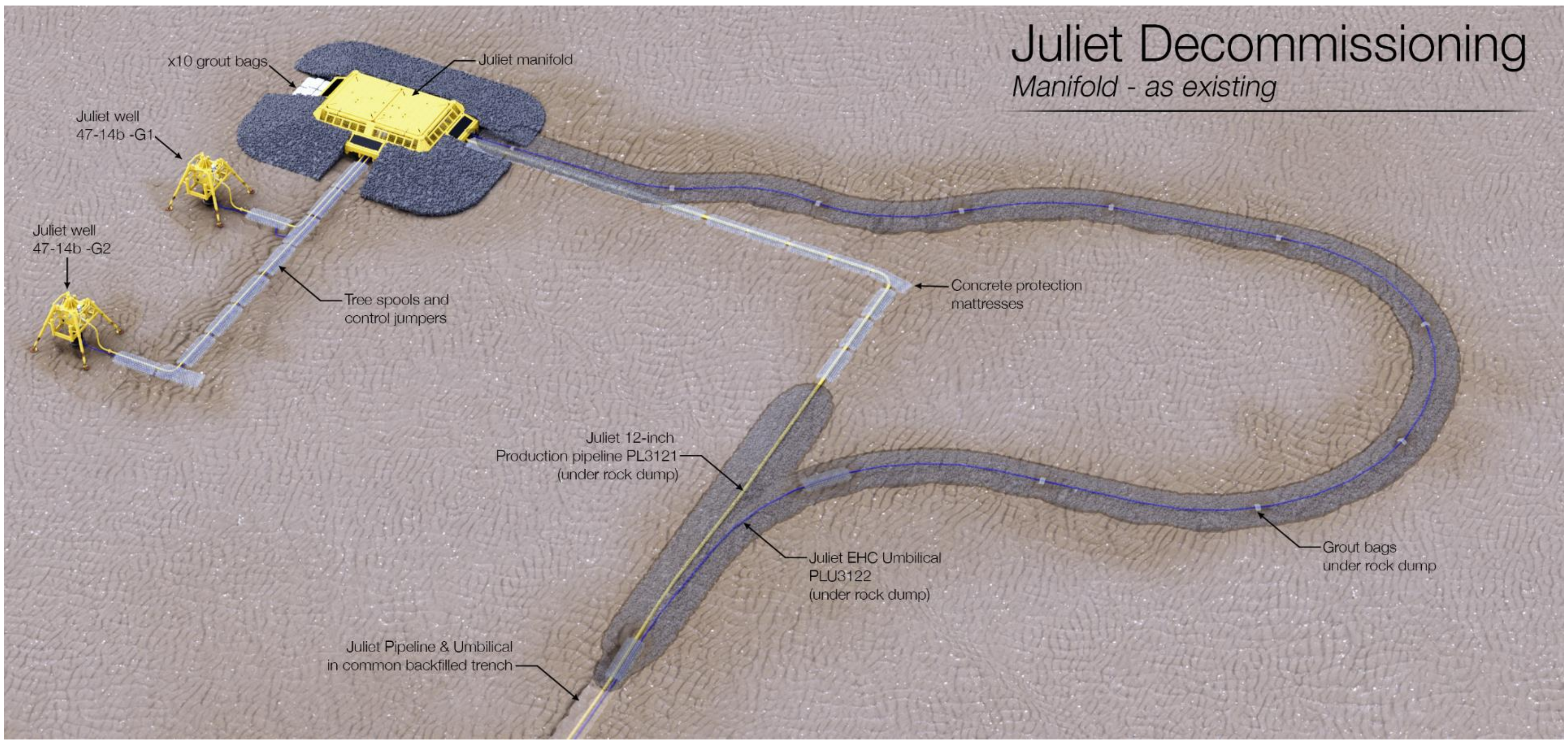


Figure 8.3 Existing Juliet Manifold

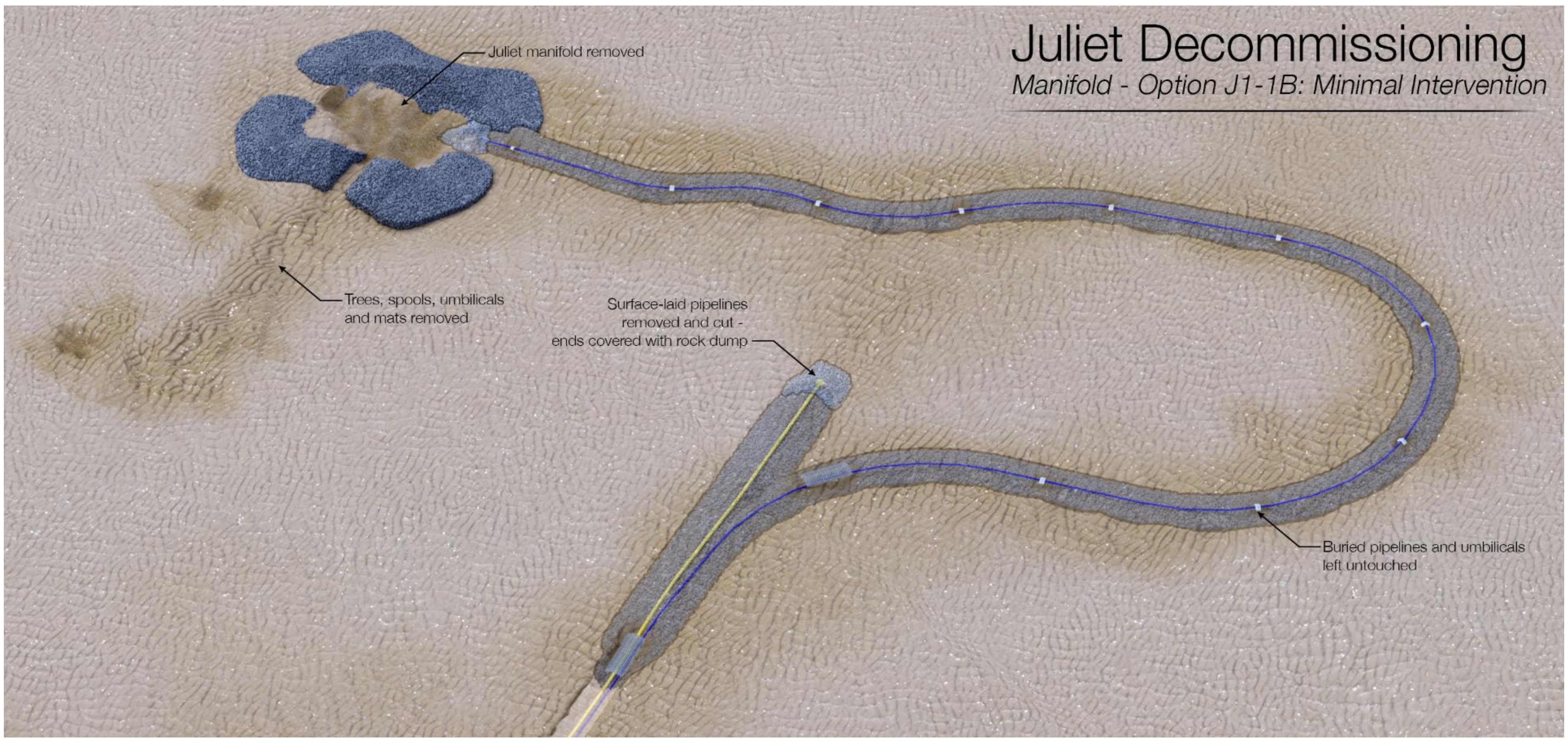


Figure 8.4 Option 1B Decommissioning Outcome - Removal of Manifold

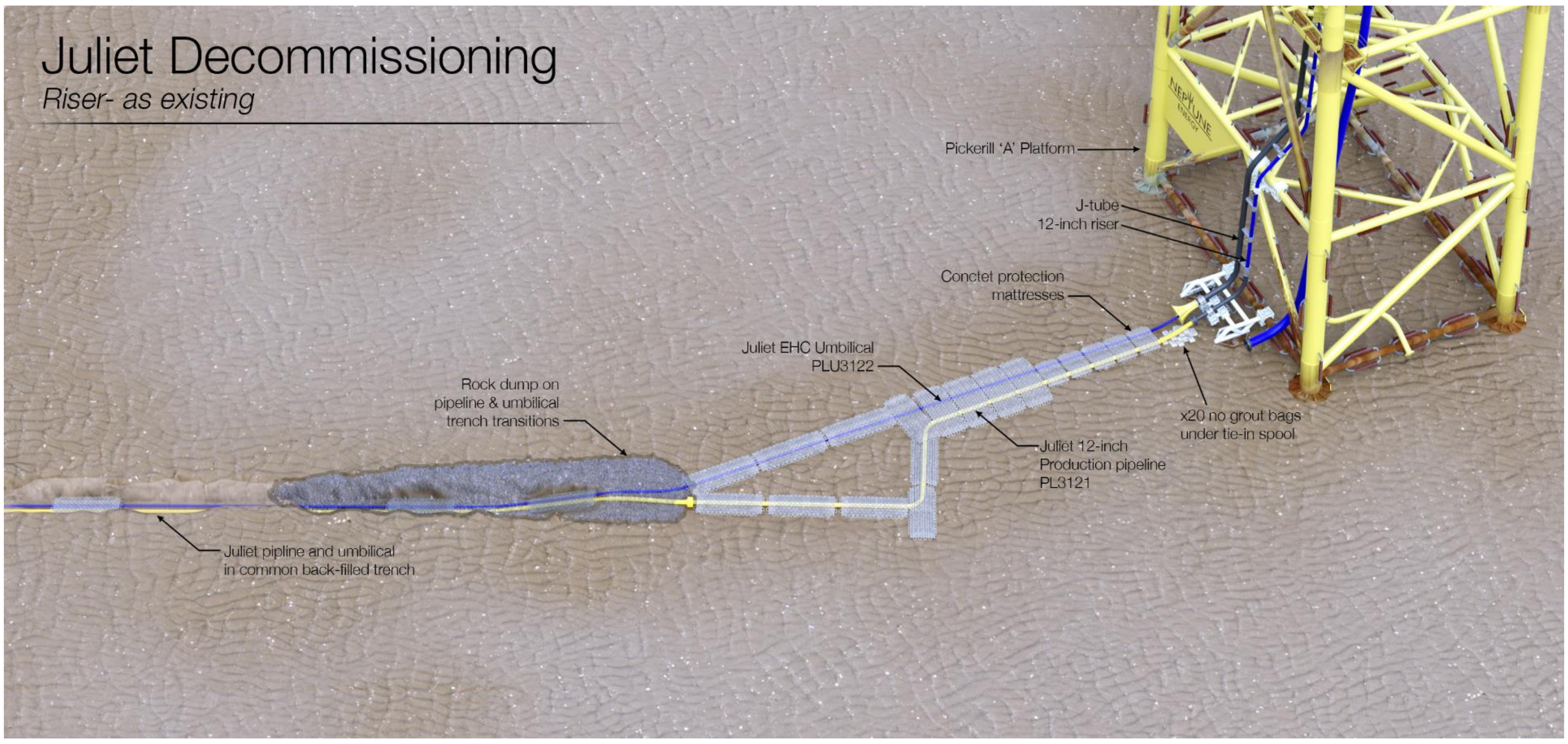


Figure 8.5 **Existing Juliet Riser**

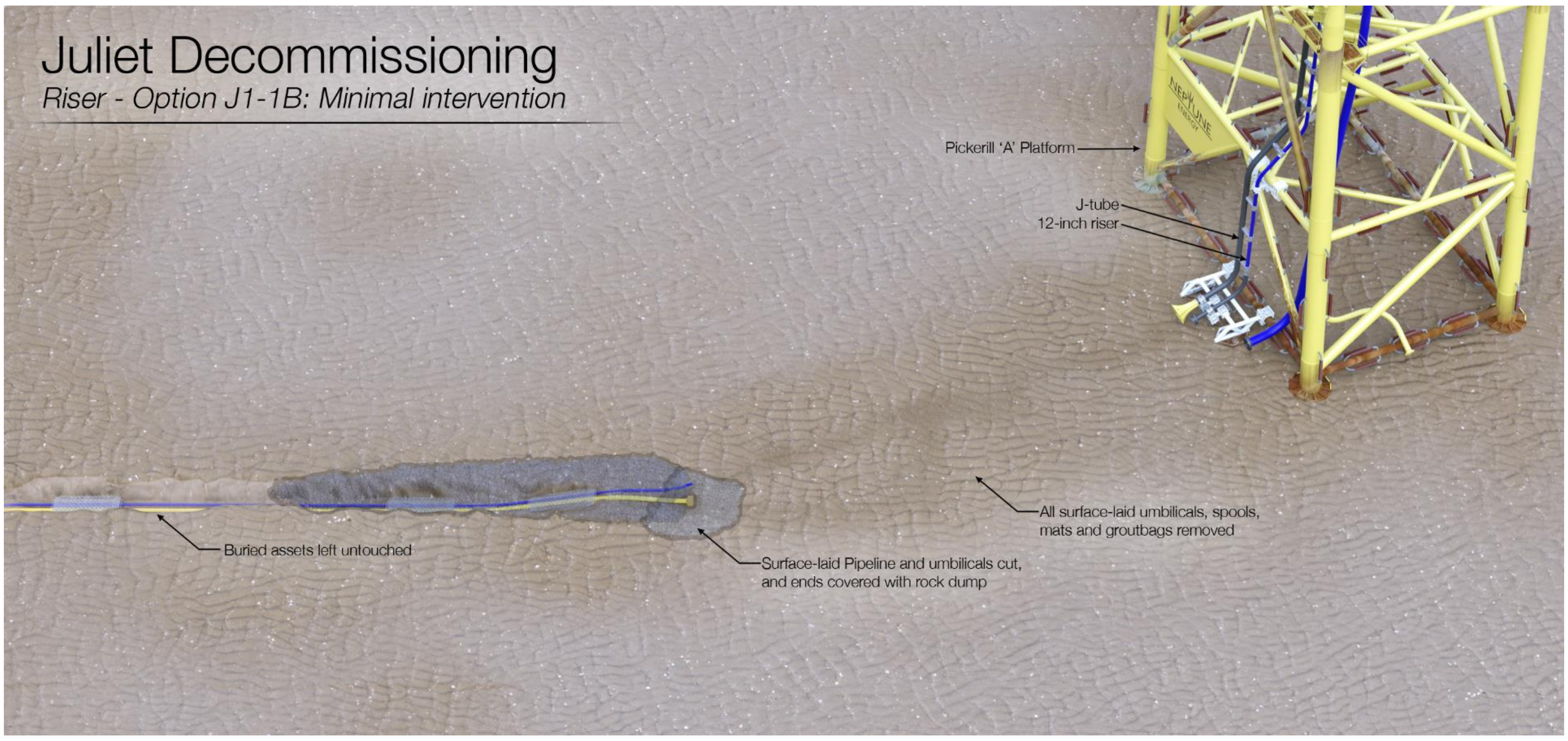


Figure 8.6 **Option 1B Decommissioning Outcome - Minimal Intervention**