WALDORF
PRODUCTION

Helvellyn Pipeline and Umbilical (PL1956 and PLU1957) Decommissioning Options Comparative Assessment

REV 8

January 2024

Document Number: - APR_HV_PMGT_005

AMENDMENT AND APPROVALS RECORD - Revision Control

Revision No	Reference	Changes/Comments	Issue Date
0	Draft issued for Review and Comment following stage 1 screening	N/A	26/3/2021
1	Screening issue	OPRED comments addressed	28/4/2021
2	Pre detailed assessment workshop revision	OPRED comments and pre decommissioning survey info added	29/5/2022
3	Post detailed assessment revision	Conclusions added	30/10/22
4	Post environmental baseline survey revision	References added	15/01/23
5	Issue for public consultation	OPRED comments addressed	15/05/23
6	Issue for public consultation	OPRED comments addressed	10/08/23
7	Final	Consultee Comments	10/10/23
8	Final	Final Approved	04/01/23

Document control

	Name	Signature	Date
Originator	G Sharman	G Sharman	04/01/24
Approver	C Davies	C Davies	04/01/24
Approver	M MacLeod	M MacLeod	04/01/24

Distribution List

Name	Company	No of Copies
I Rowe	NFFO	Electronic
T Fey	JNCC	Electronic
F Dobson	Orbis	Electronic
M Leadbetter	HSE	Electronic

Contents

List of tables

List of figures

Terms and Abbreviations

API	American Petroleum Institute (reference organisation used to define pipeline specifications)
BEIS	Department for Business, Energy & Industrial Strategy
CoP	Cessation of Production
FBE	Fusion Bonded Epoxy
GWA SPA	Greater Wash Area Special Protection Area
HDPE	High Density Polyethylene
HO MCZ	Holderness Offshore Marine Conservation Zone
JNCC	Joint Nature Conservation Committee
KM	Kilometres

KP	Kilometre Point (KP -0.048 at the Helvellyn structure, ~KP 15.4 at Amethyst A2D bottom riser flange)
MCZ	Marine Conservation Zone
MBES	Multi beam echo sounder (seabed mapping equipment)
NFFO	National Federation of Fishermen's Organisations
NSTA	North Sea Transition Authority
OD	Outside Diameter
OEUK	Offshore Energies UK
OPRED	Offshore Petroleum Regulator for Environment and Decommissioning
PUK	Perenco UK Ltd
SAC	Special Area of Conservation
Spool goose necks	Term used to describe the bends on pipework that lifts the pipe off the seabed to a connection point above it (usually a riser flange)
ToP	Top of Pipe (term used to describe the level below natural seabed of a buried pipeline or umbilical)
UHB	Upheaval buckling (the process where pipelines expand when filled with warm gas pushing the pipeline upward unless physically restrained by soil or rock above it)
WHPS	Well Head Protection Structure

1. EXECUTIVE SUMMARY

A Comparative Assessment of potential decommissioning options has been completed for the PL1956 8" gas export pipeline from and including Helvellyn Wellhead Protection Structure to and not including Amethyst A2D Riser Flange, and the PLU1957 3" umbilical from and not including Amethyst A2D J-Tube bellmouth to and including Helvellyn Subsea Wellhead Stab Plate. The PUK owned A2D riser sections of the pipeline and umbilical will be decommissioned under a separate DP for the A2D jacket. This Comparative Assessment is in support of Helvellyn Decommissioning Programmes (DP) document APR_HV_PMGT_014 which is further supported by the Helvellyn Decommissioning Environmental Appraisal (EA) document APR_HV_PMGT_008.

The Helvellyn field comprises one gas field and is in the Southern Basin of the UKCS in licence P001, Block 47/10a. The development consists of a single subsea well which is completed with a subsea production tree protected by an over-trawlable structure which ties back to the Perenco (UK) Limited operated Amethyst A2D platform.

The Amethyst A2D platform has had its Cessation of Production (CoP) and Topside DP approved and decommissioning is underway. Consequently as Helvellyn no longer has a connected export route for the production gas and remaining reserves are not sufficient to support an alternative export route investment, a Helvellyn CoP application to North Sea Transition Authority (NSTA) and DP to OPRED are submitted.

The pipeline and umbilical are both ~15.7km long and run between the Helvellyn WHPS and the Amethyst A2D platform riser base flange (for the PL1956) or J tube bellmouth (for PLU 1957). At Amethyst A2D export gas was comingled with other fields gas and exported to shore. The pipeline is a welded carbon steel pipeline, and the umbilical is an onshore fabricated bundle of small diameter steel alloy tubes. The umbilical PLU1957 was installed simultaneously to the larger PL1956 pipeline into the same protection trench for the majority of the route. Neither pipeline or umbilical is concrete coated. Approximately 97.8% of the route is trenched with the pipeline buried to 1.5-1.8m below the natural surrounding seabed level. Rock dump, concrete mattresses and gravel bags were used to protect pipeline sections laid on the seabed at the A2D platform and Helvellyn WHPS approaches that were not trenched. There are also approximately 40 locations along the route where rock has been placed within the trench to mitigate potential UHB. Much of the definition of these locations has disappeared over the operational life of the field as natural backfilling of the trench has occurred. This report presents a description of the potential decommissioning options considered, the method used to complete the Comparative Assessment and the findings of the work undertaken.

Three main options have been considered:

- Complete removal – this involves the full removal of both pipeline and umbilical including the de-burial of the pipeline and umbilical and return to shore of the materials removed.
- Partial removal – this involves the removal to shore of various elements of the pipeline, umbilical and protection materials, but leaves the majority of the trenched sections in situ. Sub options for the pipeline approaches at each platform end have also been considered.

- Full leave in situ – this option involves leaving in place all pipeline sections and protection materials other than short sections of the riser spool that will be cut and returned to shore to allow the Amethyst A2D jacket and the sub-sea production tree / protection structure to be removed.

The options were assessed using the BEIS Decommissioning Guidance Notes and project specific guidelines developed for a detailed assessment workshop. During the assessment process, evaluations were made principally on a qualitative basis, however, where quantitative data was available this has been used. The following components were assessed from a short-term (project) and longer-term (legacy) perspective:

• Safety;

• Environmental;

• Technical;

• Societal;

• Economic.

As a result of the screening assessment, it was recommended that for both the PL1956 pipeline and the PLU1957 pipeline that all three main options should be considered in the detailed comparative assessment stage.

Following the detailed assessment workshop, it has been recommended for both the PL1956 and PLU1957 pipeline and umbilical that a partial removal option is adopted for the decommissioning work. Option 2b (Leave pipeline as is but remove only mat covered pipeline and spool sections) as further detailed in this report along with an amendment to option 2d (leave pipeline as is but remove anode skid structures) is the preferred option. This reflects recovery of the pipeline and spool sections of pipe along with the equivalent lengths of umbilical and their respective protective concrete mats at the Helvellyn WHPS approach and A2D platform approach. The remainder of the pipeline and umbilical that are either buried under rock dump or below 0.6m of natural seabed material will be left in situ. It is also recommended that the anode sled structures will be left in situ but if any individual anodes at the anode sled location 2 can be seen on the seabed surface at the time of decommissioning these will be cut and recovered.

2. INTRODUCTION

The purpose of this Comparative Assessment is to provide an assessment of potential decommissioning options available for the Helvellyn PL1956 pipeline and PLU1957 umbilical against a set of assessment criteria derived from BEIS Guidance Documents and in line with OEUK's 'Guidelines for Comparative Assessment in Decommissioning Programmes: Issue 1: Oct 2015'. The output of this Comparative Assessment will assist in identifying the preferred decommissioning options and methods and supports the submission of the Decommissioning Programme to OPRED.

Details of the seabed sections of the pipelines are shown in table 2.1.

Pipeline	Size, OD	Length	Material	Wall Thickness	Corrosion coating	Design pressure	Burial status *
PL1956	219.1 mm	15702 m	API 5L X52 carbon steel	12.7 mm	0.3mm FBE	253.8 barg	Trenched, mat/rock dumped at ends
PLU1957	76.2 mm	15700 m	3 x 316L stainless steel tubes	Each tube 1.65-1.24mm	Rubber sheath	344 barg	Trenched, mat/rock dumped at ends

Table 2.1 PL1956 and PLU1957 pipeline and umbilical data

*97.8% of the pipeline is trenched with 2.2% surface laid. Of the surface laid sections ~47% is mattress protected and ~53% is rock dump protected. In total 9.9% of the route is rock protected either within or outside the trenched sections.

Helvellyn comprises of one gas field (Block 47/10a) which is located 48 km east of the Spurn Point on the East Riding of Yorkshire coast / Dimlington Gas Terminal, approximately 10km north of the Amethyst gas field. A single sub-sea well is tied back to the Perenco (UK) Limited operated Amethyst A2D platform. After metering, Helvellyn fluids flowed via the existing Amethyst export trunkline PL649 to the onshore Storage Terminal at Easington. Figure 2.1 shows the pipeline and umbilical routing between the facilities. The Helvellyn subsea well protection structure is classed as an installation and is subject to international obligations for decommissioning under the terms of OSPAR Decision 98/3. As such it will be removed and is not part of this Comparative Assessment.

Figure 2.4 on page 11 shows the Helvellyn location relative to nearby marine protected areas. The Helvellyn subsea protection structure and approximately 12.5km of the pipeline route is located within the boundary of the Holderness Offshore Marine Conservation Zone (MCZ) designated for the protection of three broad-scale habitat types (A5.1: Subtidal coarse sediment, A5.2: Subtidal sand and A5.4: Subtidal mixed sediments), Ocean quahog (*Arctica islandica*) and North Sea glacial tunnel valleys. In addition, the Southern North Sea Special Area of Conservation (SAC), designated for protection of harbour porpoise, is located approximately 7.3km to the North East of the Helvellyn subsea protection structure. It should also be noted that vessel transits to and from the Helvellyn location may involve passage through the Greater Wash SPA.

The Helvellyn development is situated in an area of seabed mainly of coarse sand and gravels with sand ripples. Water depths vary from ~26m to ~44m along the pipeline route with the

deepest section around 3.5km from Helvellyn and 27m and 26m respectively at the Helvellyn and Amethyst A2D ends.

Chemicals for hydrate and corrosion inhibition were supplied from Amethyst A2D via the PLU1957 umbilical which also includes a number of hydraulic fluid cores for valve functioning and pressure monitoring. The umbilical PLU1957 was installed simultaneously to the larger PL1956 pipeline into the same protection trench for the majority of the route. The two only separate at the final approaches to the A2D platform and sub-sea well.

Helvellyn production is currently shut in following the CoP of the Amethyst A2D platform. Remaining reserves are not sufficient to support an alternative export route investment and a Cessation of Production (CoP) application submitted to NSTA.

Prior to decommissioning activities commencing the PL 1956 pipeline and the chemical injection cores within the PLU1957 umbilical have been flushed and cleaned and left filled with filtered seawater.

This document will be used to help determine the scope of work for decommissioning activities associated with the Helvellyn pipeline and umbilical.

Figure 2.1 Helvellyn overall field layout

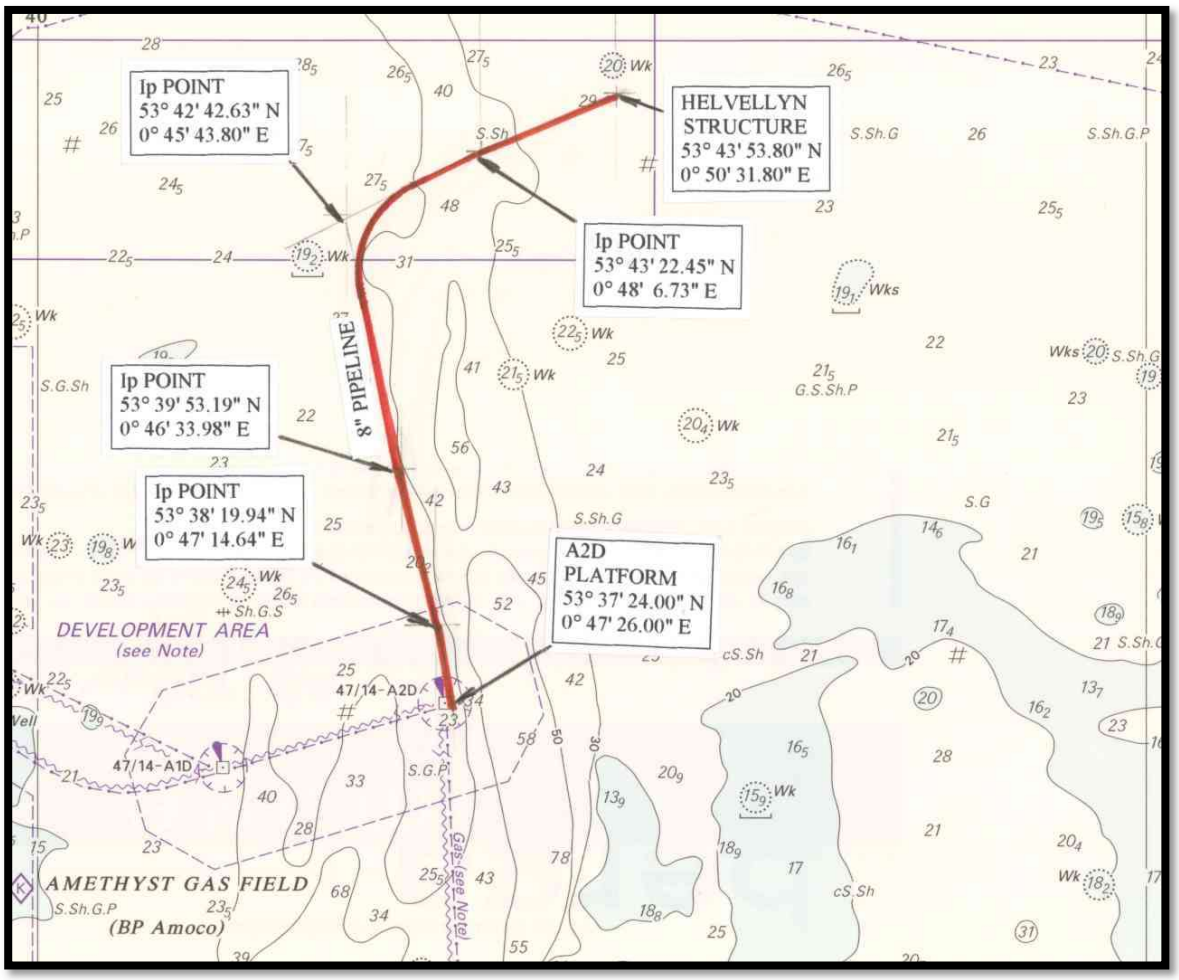


Figure 2.2 Helvellyn and Amethyst Infrastructure

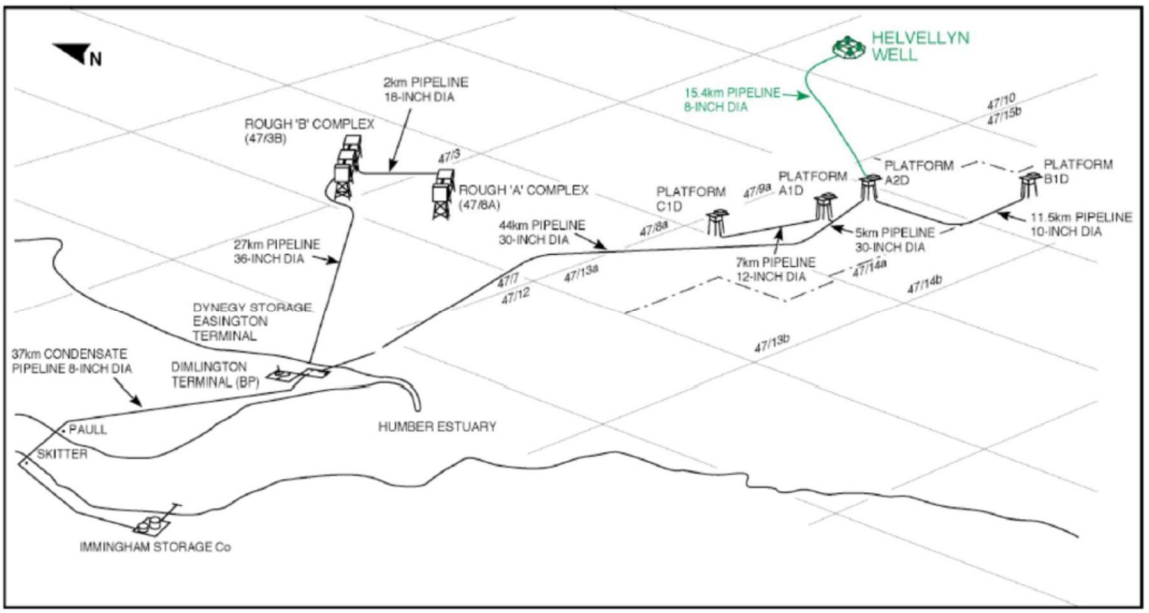


Fig 2.3 Helvellyn and Amethyst schematic

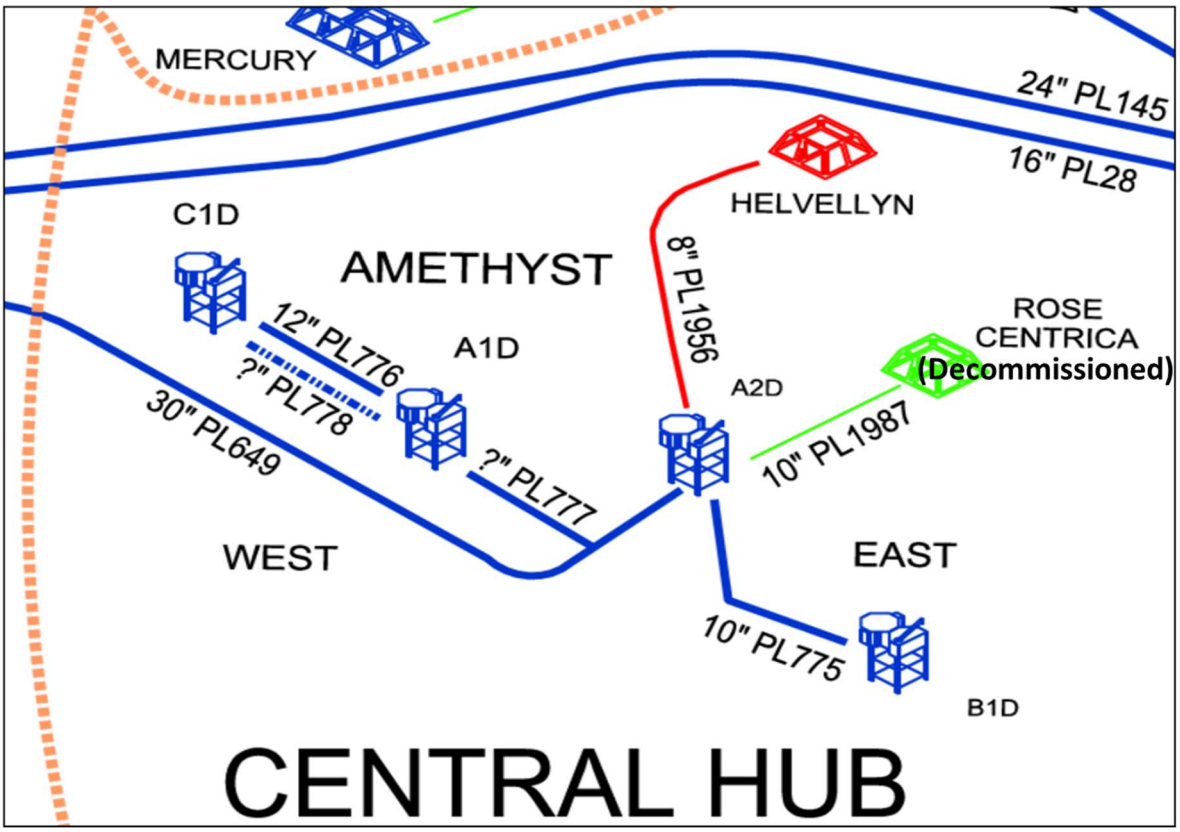
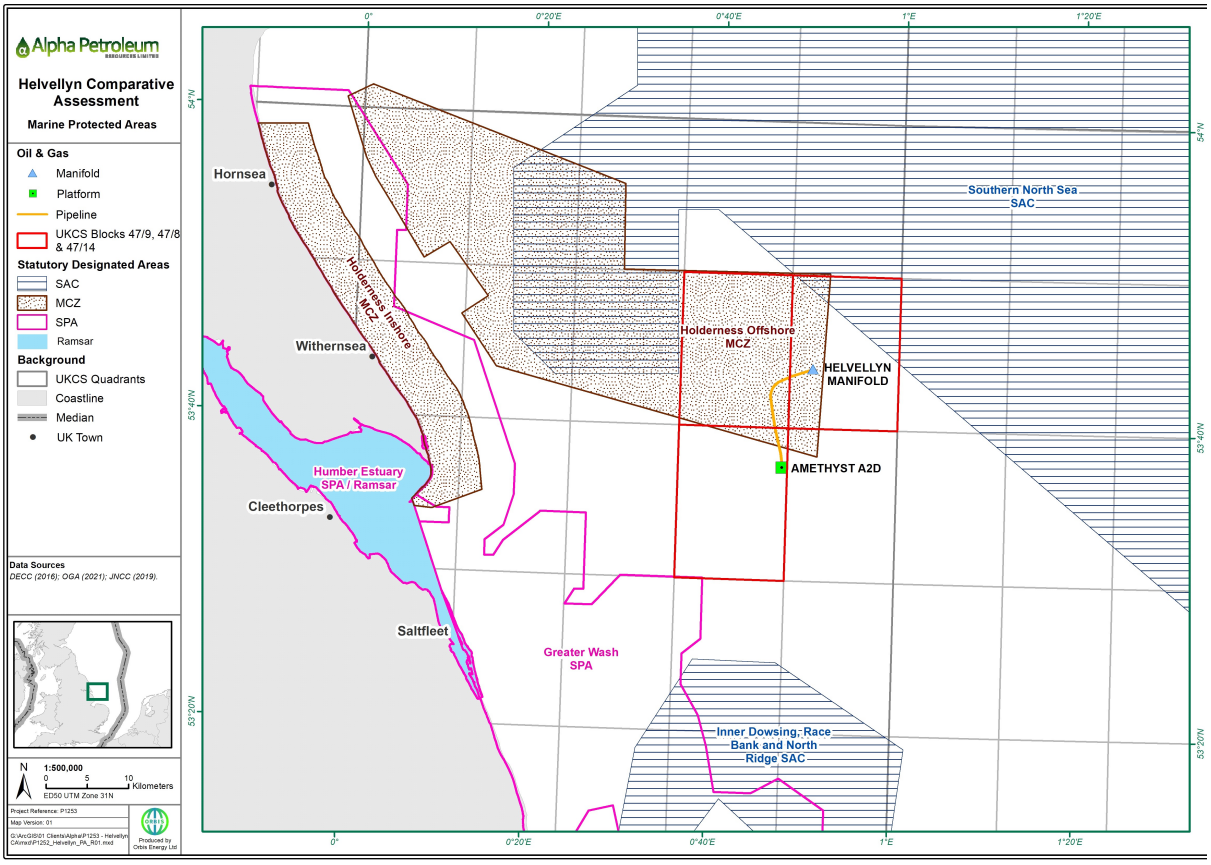


Fig 2.4 Marine Protected Areas in the Helvellyn proximity



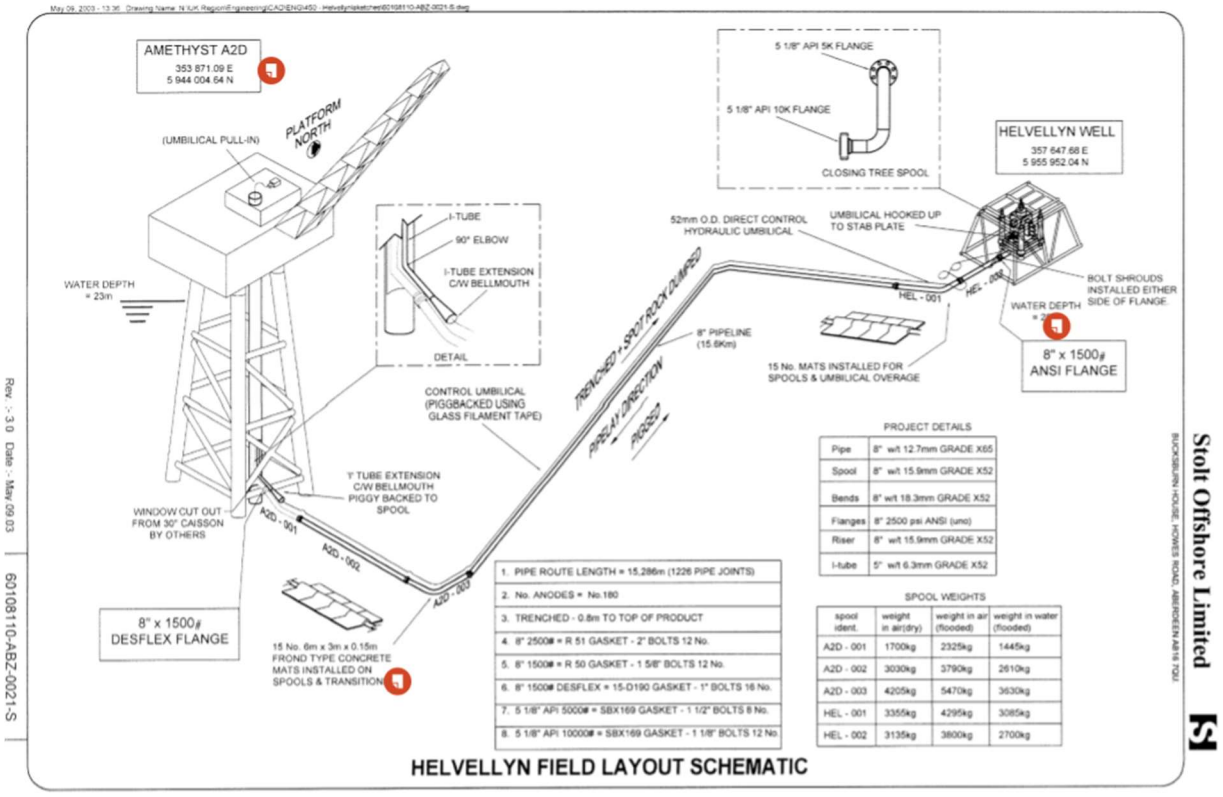
3. STATUS OF THE INFRASTRUCTURE

This section contains a summary of the overall pipeline and umbilical route and key features along it. Survey charts and video footage of the platform approaches are available on request along with the full route as trenched charts and intermediate MBES survey data.

3.1 Overall layout

An overall field layout schematic of the route is shown below.

Figure 3.1 Overall Helvellyn field layout schematic



The pipeline and umbilical were installed with the umbilical strapped to the main pipeline and trenched to a depth of approximately 1.5m. At the platform and sub-sea well approaches the pipelines were not trenched and concrete mattresses or rock dump were installed over the pipelines to provide protection. A total of 30 mattresses were used. In addition, multiple locations along the route were rock dumped as well as being trenched in order to provide down force on the pipelines to prevent upheaval buckling (UHB) on the pipelines during their operational life.

3.2 Burial status

Based upon the original as trenched surveys and operational life interim general inspection surveys, it can be concluded that the full length of pipeline is currently buried to a depth well in excess of 0.6m and normally between 1.0 and 1.5m deep with the exception of the pipeline approaches at the platform and sub-sea well ends which are detailed in section 3.4.

The latest operational survey of the full route was completed in December 2021/January 2022 with the latest visual inspections of the mattress protection sections in March 2022. Interim operational surveys have been carried out in 2004, 2008, 2013 and 2015 on the full route with visual mattress surveys also in 2006, 2013, 2016 and 2018. These surveys have been taken into account in preparing this document.

The Helvellyn pipeline and umbilical run along a route of predominantly dense shelly sand and gravels which overlies a stiffer sandy clay (0.2-0.5m below the top sand layer). Water depth comparisons for the original as trenched survey in 2002 and operational interim surveys in 2013 and 2015 have shown no significant migration of the seabed is occurring. These comparisons are detailed in Appendix A, figures A1-A3. A gradual infilling of the pipeline and umbilical trench appears to be occurring. The recent 2022 surveys have further confirmed the gradual trench infill and seabed stability. Appendix A figure A.4 provides an example of this.

From the surveys it can also be seen that the seabed has a number of ripples of less than 0.2m in height throughout the route of the pipelines. Although no evidence from the various surveys show that these ripples are migrating along the seabed surface, it has been known for ripples to do so in other locations. Given the burial depths of the pipelines, even if this does occur the pipelines will remain buried below 0.6m. Appendix A, figure A5 shows further illustrations of the impact of potential ripple migration.

The PL1956 line is made of carbon steel, API grade 5L X52 with a 0.5mm FBE coating. It also has its offshore welded pipe joints covered with a sheet of HDPE as an outer coating overlapping with the FBE coating. As part of the design for the pipeline system, stability and upheaval buckling calculations were performed to ensure no movement of the pipeline during operational life was expected. In this operational condition the gas export pipeline was filled with warm gas which is more buoyant than water. The PLU1957 umbilical design is such that even when filled with controls, hydrate and corrosion inhibition fluids it is negatively buoyant. In a water flooded condition both pipeline and umbilical are significantly negatively buoyant and so no upward movement of the pipeline or umbilical would be expected.

From the 2013 operational survey, short sections of umbilical/pipe exposure were noted at five locations. These exposures were a maximum of 40% of the pipe diameter and all are in the bottom of the ‘V’ cut trench with the minimum depth of cover to the ToP noted as 0.8m. In the 2015 operational survey none of these exposures were identified indicating that further natural backfill in the years since 2013 have removed these exposures. Further evidence of natural trench backfill at these locations is shown in the Appendix, figures A10-A13.

3.3 Crossings

There are no crossings along the Helvellyn pipeline routes.

3.4 Pipeline, Umbilical and Spools at A2D and Helvellyn subsea protection structure approaches

The pipeline spool sections at the A2D approaches are laid on the seabed surface and protected with concrete mats. At the riser to spool goose necks the pipeline and umbilical are supported with grout bags. Beyond the spool sections running away from the platform there is a short section of the pipeline (~20m) that are also laid on the seabed and protected with concrete mats. The concrete mats at both approaches were originally fitted with plastic fronds to encourage

sediment settlement over the mats. Many of these fronds appear to have detached themselves over time and are not present during the 2022 visual surveys. Appendix A figures A6 and A8 has details of current known status of each mat. At Amethyst A2D KP 15.261 where the mat cover ends, the pipelines have been rock dumped to provide a minimum of 0.9m cover. This continues through the pipeline trench transitions for approximately 84m where the pipeline and umbilical are then buried 1.5 m below the adjacent seabed level.

At the Helvellyn approaches the PL1956 pipeline has a short section of exposed goose neck pipe where the spools connect to the subsea protection structure. The spools are then laid on the seabed surface and protected with concrete mats and gravel bags up to the start of a section of protective rock dump. The connection location for the PLU1957 umbilical is on the opposite corner to the pipeline connection flange but on the same south west face of the subsea protection structure. There is a short section of shallow buried umbilical looped on the seabed before the umbilical joins the same route as the pipeline spools. Approximately 47m of spool pipe and a further 23m of welded pipe are covered by 15 concrete mats. The start of the rock dump protection is at KP 0.023 and runs for 800m until the pipeline and umbilical are protected within the trench. Rock cover along this section is greater than 0.8m.

Layouts and MBES images of both the A2D platform and Helvellyn subsea protection structure approaches are detailed in Appendix A figures A6-A9.

3.5 Anode sleds

During the initial trenching of the pipeline and umbilical a number of the cathodic protection anodes were damaged at the northern end of the pipeline route during the ploughing process. In order to ensure sufficient cathodic protection still remained, four additional anode sleds were placed within the trench and attached to the pipeline with continuity straps. These were at KP 1.295, KP 0.945, KP 0.586 and KP 0.245. From the 2022 visual inspection survey the sled at KP 0.945 (sled 2) appears to be marginally exposed whilst sleds at KP 0.586 and KP 0.245 (sleds 3 and 4) are fully buried and rock dumped within the trench. The sled at KP 1.295 (sled 1) appears fully buried under natural backfill material and some rock within the trench. Further detail of the anode sleds is described in Appendix A figures A14 and A15.

3.6 UHB locations

Rock dump was placed at the following locations set out in table 3.1 with a top width of 1m and side slopes with a 1:3 gradient. Heights were determined based upon UHB calculations and varied between 0.2m and 1.4m. No erosion or displacement has been noticed on or around these locations during the operational life of the Helvellyn field.

Table 3.1 UHB rock dump locations

KP from/to	Max height (m)	Length (m)
Helvellyn 0.023 - 0.824	1.2	801
0.899 - 0.910	0.3	11
1.401 -1.426	0.3	25
1.449 - 1.462	0.3	13
1.497 - 1.509	0.3	12
1.621 - 1.647	0.3	26
1.667 - 1.681	0.5	14

KP from/to	Max height (m)	Length (m)
1.716 - 1.733	0.5	17
1.771 - 1.794	0.5	23
2.063 - 2.076	0.5	13
2.182 – 2.200	0.5	18
2.221 - 2.233	0.5	12
2.267 - 2.274	0.5	7
2.238 - 2.343	0.5	5
2.406 - 2.409	0.5	3
2.422 - 2.439	0.5	17
2.496 - 2.506	0.5	10
2.553 - 2.561	0.5	8
2.609 - 2.628	0.5	19
2.700 - 2.719	0.2	19
2.736 - 2.783	0.2	47
2.921 - 2.952	0.4	31
2.971 - 2.984	0.2	13
3.009 – 3.023	0.5	14
3.052 - 3.056	0.5	4
3.161 - 3.175	0.5	14
3.197 – 3.228	0.5	31
3.320 - 3.335	0.5	15
3.366 - 3.385	0.5	19
3.400 - 3.411	0.5	11
3.439 - 3.448	0.5	9
3.472 - 3.493	0.5	21
3.920 - 3.946	0.3	26
4.008 - 4.036	0.5	28
4.053 - 4.076	0.5	23
4.237 - 4.257	0.5	20
5.619 - 5.639	0.5	20
6.026 - 6.051	0.4	25
14.840 - 14.845	0.6	5
14.939 - 14.959	0.8	20
15.109 - 15.113	0.5	4
Amethyst A2D 15.177 - 15.261	1.4	84

4. COMPARATIVE ASSESSMENT PROCESS

The CA has been undertaken in line with BEIS Guidance Documents. Comparative assessment decisions have also been made broadly in line with principals set out in the OEUK's report 'Guidelines for Comparative Assessment in Decommissioning Programmes: Issue 1: Oct 2015'.

A two-stage process with an early option screening assessment to narrow options to a manageable number followed by a detailed comparative assessment of selected options has been adopted.

Stage 1: Option screening

A list of potential decommissioning options was developed for each pipeline / umbilical which included an option for full removal of pipeline by reverse reeling and cut and lift methods, leave full pipeline in situ (including buried, rock dumped and mattressed sections) option and several partial removal options. This list initially identified reverse S and reel lay options along with cut and lift options for the full removal option. Cutting and recovery of separate sections along the whole route or reverse S lay would involve significantly greater vessel time and risk to a combined reserve reeling and cut and lift option and so these were not included as viable options for screening. The partial removal options included various combinations of leave in situ or removal of rock dump, fronded and non-fronded concrete mats and anode sleds. In a desktop exercise each of these options were then evaluated against the categories and considerations detailed in Table 4.1. They were then given a traffic light rating where green represents an acceptable solution, amber represents a solution that may be acceptable with appropriate actions or control measures and red represents an unacceptable option. Each option was then reviewed across all categories to establish whether the option should be selected for a more detailed comparative assessment. The outcome of this desktop exercise was then peer reviewed by an independent subsea specialist from Subsea and Sea Limited and was shared with OPRED to ensure agreement that all potentially viable options were considered as part of the stage 2 detailed assessment.

Table 4.1 Categories and Considerations considered during stage 1 option screening.

Category	**Considerations**
Safety	
Risk to other users (post ops)	Snagging, collision, seabed movement, scouring, inspection survey risks
Risk to those offshore (during ops)	Dropped objects, number of lifts involved, sea fastening of retrieved items, contamination, NORM, duration of offshore vessel days
Risk to 3rd parties (during ops)	Collision, snagging,
Durations of diving intervention	Manual operations, ROV operations, confined space working
Risk to those onshore (during ops)	Handling of recovered items, volume of road transportation, extent of marine growth
Environmental	

Discharges	Chemical or hydrocarbon leaks, erosion due to high volume flows, sewage/food waste
Seabed disturbance	Volume of disturbance, durations for seabed to recover, impact on flora and fauna (smothering), Impact to MCZ
Energy usage (during and post ops)	Fuel consumption required; type of fuel used
Atmospheric emissions	Vessel emissions, onshore emissions
Noise (underwater and onshore)	Disassembly onshore, cutting operations offshore, excavation techniques
Accidental spills	Duration of ROV work, onshore contamination, vessel lubes/chemicals
Technical	
Technical challenge	Difficulty level of operations, established technology or not, access to work locations, seabed currents, consumables required, integrity of protection materials
Weather sensitivity	Limiting sea states, susceptibility to fog, tidal current limitations
Risk of major project failure	Break up of items being recovered during recovery operation, damage to other infrastructure (on and offshore)
Societal	
Access to site for other users	Any restrictions to fisheries during or post ops, impact to merchant shipping during ops
Community disturbance (onshore)	Visibility of materials brought onshore, traffic volume increase, job creation, any benefit from use of recycled materials, volume of disposal materials
Economic	
Cost of work	Fixed cost or what is the range of cost outcome, any scrappage value/resale of equipment
Ongoing cost liabilities	Any inspection surveys required post ops; any further intervention required at later stage

Stage 2: Detailed assessment

Following development and approval of the 'Helvellyn pipelines (PL1956 and PLU1957) Terms of Reference for Stage 2 Comparative Assessment Workshop - APR_HV_PMGT_015' a workshop with available stakeholders and Waldorf decommissioning project team members was held. The workshop was conducted in the Waldorf offices and via MS Teams. This, along with pre workshop reading material and post workshop sharing of the output result worksheets ensured all relevant parties' input to the assessment was captured.

In order to rate the impact of the selected options a review against each of the below criteria set out in table 4.3 was carried out. Each subcategory was initially allocated a red, green or amber rating code for each option. A guide table to the ratings codes is included as Appendix B. It should be noted that for this initial impact rating the colour allocation indicates the relative impact of each option and does not define acceptability/non acceptability at this stage. Once

the impacts were allocated the workshop attendees assigned an overall rating for each Category along with a degree of definition based on;

1- High certainty (high understanding of the methods to be used, status of the infrastructure, equipment required, public opinion perception and any hazards)
2- Mid certainty
3- Low certainty (low understanding of the methods to be used, status of the infrastructure, equipment required, public opinion perception or any hazards)

The workshop group initially reviewed the 3 main options. Complete removal (option 3b), partial removal (options 2b, 2c and option 2d) and complete leave in situ (option 1). Option 2d was also considered to either leave in situ anode sleds 1 and 2 or remove them.

On completion of the sheets the workshop group reviewed the option summaries and allocated a final colour rating to each option/sub option in line with the below table 4.2.

Table 4.2 Final rating options

Preferred solution	
Broadly acceptable	
Tolerable not preferred	
In tolerable, not acceptable	

Table 4.3 Categories and Considerations reviewed during the detailed assessment workshop.

Category	**Considerations**
Safety	
Risk to other users (post ops)	Snagging, collision, seabed movement, scouring, inspection survey risks
Risk to those offshore (during ops)	Dropped objects, number of lifts involved, sea fastening of retrieved items, contamination, NORM, duration of offshore vessel days
Risk to 3rd parties (during ops)	Collision, snagging, proximity of work to host facilities, status of host facilities
Durations of diving intervention	Manual operations, ROV operations, confined space working
Risk to those onshore (during ops)	Handling of recovered items, volume of road transportation, extent of marine growth
High consequence event	Event needing de/re-mobilisation of vessel(s) or yard, significant delay to work, etc
Environmental	
Discharges	Chemical or hydrocarbon discharges, erosion due to high volume flows, sewage/food waste
Seabed disturbance	Volume of disturbance, durations for seabed to recover, impact on water column, impact on seabed communities (physical loss, smothering etc.)

Impact on Marine protected area (Holderness Offshore MCZ)	Impact on qualifying features of Holderness Offshore MCZ (Subtidal coarse sediment, Subtidal sand and Subtidal mixed sediments, Ocean quahog and North Sea glacial tunnel valleys). Will option help or resist MCZ objective to recover rather than maintain current status or create further difference.
Impact on Marine protected area (Greater Wash Area SPA)	Amount of Marine traffic and duration in the SPA. Is the marine traffic limited to shipping lanes? Impact to Red Throated Diver bird.
Energy usage (during and post ops)	Fuel consumption required; type of fuel used
Atmospheric emissions	Vessel emissions, onshore emissions
Noise (underwater and onshore)	Disassembly onshore, cutting operations offshore, excavation techniques
Accidental spills	Duration of ROV work, onshore contamination, vessel lubes/chemicals
Smell (onshore)	Amount of marine growth decay at disassembly yard
Waste processing	Tonnage sent to landfill
Technical	
Technical challenge	Difficulty level of operations, established technology or not, access to work locations, seabed currents, consumables required, integrity of protection materials
Weather sensitivity	Limiting sea states, susceptibility to fog, tidal current limitations
Risk of major project failure	Break up of items being recovered during recovery operation, damage to other infrastructure (on and offshore)
Repurposing opportunity	Pipeline availability in full or part for a repurposing use after decommissioning. Is this opportunity available for a short or long term period
Societal	
Access to site for other users	Any restrictions to fisheries during or post ops, impact to merchant shipping during ops
Community impact (onshore)	Visibility of materials brought onshore, traffic volume increase, job creation, any benefit from use of recycled materials, volume of disposal materials
Reputational Impact	Are Companies seen to be setting good or poor precedents, are stakeholders representing their interests, how visible in the public eye is the project
Economic	

Cost of work Ongoing cost liabilities	Fixed cost or what is the range of cost outcome, any scrappage value/resale of equipment Any inspection surveys required post ops; any further intervention required at later stage

5. COMPARATIVE ASSESSMENT SCREENING (Stage 1 results)

The below table shows the outcome of the comparative assessment screening for the pipeline PL1956 and the umbilical PLU1957.

Table 5.1 Helvellyn pipeline and umbilical Comparative Assessment option screening.

Number	Option	Safety	Environment	Technical	Societal	Economic	Selected for further study
1	Leave full pipeline in situ (including buried, rock dumped and mattressed sections)						SELECTED
2	Partial removal of pipeline (see below for sub options considered)						SELECTED
3	Full removal of pipeline by reverse reeling and cut and lift methods						SELECTED

Number	Sub Options	Safety	Environment	Technical	Societal	Economic	Selected for further study
1a	Rock dump all mattress protection areas and leave in situ						
2a	Leave pipeline as is but remove surface laid pipeline sections (including rock removal)						
2b	Leave pipeline as is but remove only mat covered pipeline and spool sections						SELECTED
2c	Leave pipeline as is and remove only non fronded mats and pipe/spool sections						SELECTED
2d	Leave pipeline as is but remove anode skid structures						SELECTED
3a	Remove by reeling (but leave in situ rock dumped sections)						
3b	Removal of rockdump along the route to recover full pipeline length						SELECTED

Given the pipeline and umbilical systems have been laid together with the umbilical piggybacked to the 8” pipeline the assessment screening is the same for both pipelines.

Full removal option

A full recovery of all infrastructure for each pipeline has been considered in the screening assessments. For most of the pipeline length the most appropriate option considered for this was the removal by reverse reeling. The A2D platform approach section and the Helvellyn approach sections would require separate recovery solutions but have also been considered in the screening exercise as separate sub options to the partial removal. Other full recovery solutions could exist such as cutting and recovery of separate sections or reverse S lay but as these would involve significantly greater vessel time and risk, these were not identified as viable options for screening.

As a consequence of the burial condition of the pipeline prior to reverse reel lay recovery the full length of the pipelines would require de-burial (*mostly 1.5m deep with full or close to full natural backfill and numerous rock dump locations for trench transitions and UHB prevention along the route*). This would require extensive disturbance of the seabed likely using a mass flow technique. Large volumes of sediment would be put into suspension. This carries a risk of smothering of benthic animals and so has been assessed as a red unacceptable option in the Environmental category. Similarly, the high number of vessel days and subsequent onshore handling of materials involved in this option mean the cost associated with it is extremely high. It was also given a red ranking in the Economic category. There is also a higher safety risk associated with reeling back the pipeline and umbilical given the unknown level of corrosion through the pipe wall. Where the pipe has a thinner wall thickness there is an increased risk that the pipeline may part in an uncontrolled manner during the re-reeling process. In addition, the condition of the strapping attaching the umbilical to the pipeline is unknown and may part causing risks in recovering the two products on the stern ramp of the reel vessel. These will further be considered in the detailed assessment workshop; however, it was the opinion of the independent peer reviewer that the amber ranking in the safety category may well also be considered a red.

As a result of the large number of rock-dump locations along the route and at the trench transitions the full recovery option has two sub options to either leave rock dump covered lengths in situ (3a) or recover the full length after mass flow excavation including the rock dump

lengths (3b). To remove the non-rock dumped pipeline and umbilical lengths it would require multiple cut and lift operations as well many start up and stop operations for the reel vessel. Many of these operations would need to be carried out below natural seabed level in an unstable seabed environment. This would involve significant vessel time and carry higher Safety risks. For this reason, option 3b was the full removal option selected to be taken forward to the detailed assessment stage. It should be noted, however, that option 3b carries an increased volume of disturbance to the seabed and potential to leave a very uneven seabed until such time as natural backfill evens out hollows created by the mass excavation technique.

Partial removal option

Sub options 2a and 2d (sleds 1 and 2) involve the removal of rock dump prior to recovering the pipeline, umbilical or anode sleds. This would require similar mass flow excavations of the rock as for the full removal options described above but on a reduced total length basis. As such the red rankings in the Environmental and Economic categories were assessed as amber. Option 2a would also not involve working below the natural seabed level as the pipeline and umbilical were laid on the seabed before being rock dumped in these areas. The option was therefore given a green ranking in the Safety category. Given that the rock dump sections are of graded rock with profiled side slopes to allow passage of any fishing gear and show no evidence of migration or of damage from or to fishing gear, no concerns have been raised about leaving this rock in situ. Using a mass flow excavator will not recover the rock but will redistribute it over the seabed leaving a more irregular seabed. As a result, it is not recommended to carry the rock dump removal options 2a and 2d (sleds 3 and 4) forward to the detailed assessment stage.

Option 2d (sleds 1 and 2) will require some removal of rock dump and would involve similar natural backfill removal to expose the anode sleds over a very localised area. Removal or not of sleds 1 and 2 is therefore recommended to be carried through to the detailed assessment stage.

Full leave in situ and Rock dump and leave in situ options

During the operational life of the field no interventions have been required and no issues with other sea users have been reported. There is no evidence of any protection features moving or creating a snagging impact with fishing gear. Option 1 to leave all stabilisation features and pipelines as is will therefore be further assessed during the detailed assessment.

The option to rock dump areas covered by protection mattresses was identified as an option for screening (1a) but is highly likely to be opposed by some stakeholders especially as some of the areas lie within the Holderness Offshore MCZ. It is only likely to be considered by all stakeholders as an acceptable solution where no other viable option exists. This does not appear to be the case for the Helvellyn pipeline and umbilical and therefore the rock dump solution has not been carried forward to the detailed assessment stage.

6. SELECTED OPTIONS COMPARATIVE ASSESSMENT (Stage 2 results)

The full impact assessment worksheets with all main and subcategory ratings are included in Appendix C for reference, however, the following is a brief overview of each of the assessed options.

Leave in situ (option 1)

The full leave in situ option was found to be tolerable but not a preferred solution. This option has the least scope and impact during decommissioning activities with the work limited to the cutting and removal of the exposed goose neck sections of pipeline at the A2D platform and Helvellyn WHPS along with the exposed sections of umbilical at similar locations. Safety risks and onshore impacts are therefore low during the work. Legacy surveys are likely to be required over a longer time frame to ensure the status of the left in situ infrastructure does not change and create hazards to other users. There are some legacy snagging risks associated with this option with the potential for a high consequence legacy event. As a result of this the option was given a medium overall safety rating.

Given the relatively small surface area of the mats and the stable fully buried nature of the majority of the pipeline it is felt this option would not adversely impact the existing seabed communities or other users of the area. The Helvellyn approach mats are, however, located within the Holderness Offshore Marine Conservation Zone (MCZ) and in this option no seabed area is being returned to the natural habitat condition. Given this is one of the objectives of the MCZ it was given a red ranking in the legacy subcategory for impact on the Holderness Offshore MCZ. No known snagging events or damage to the mats has been seen during the operational life of the pipeline systems with some fronded mats seeing some natural seabed material deposition. As a result, the option was ranked amber in the environmental category.

The removal work and ongoing surveys that would be required are well within existing technologies for the industry. The non-removal of the mats would not be in compliance with OPRED expectations to remove protective items that are less than 0.6m below seabed. Consequently, the option was given a red ranking within the legacy regulatory compliance subcategory and an overall technical amber ranking.

The workshop group felt there is some uncertainty around the public perception associated with not removing infrastructure and the subsequent impact this may have on stakeholders but did not think this is of high concern to prevent the option being considered.

This option represents the lowest cost of the options taken into the detailed assessment stage and therefore was given a green ranking in the overall economic category.

Partial removal (Option 2b)

The partial removal option 2b was found to be broadly acceptable and the preferred solution of the detailed workshop options. In addition to the spool goose neck sections of pipeline and exposed sections of umbilical at similar locations this considered removal of all the concrete protection mats (fronded and non-fronded) and underlying pipeline sections at the Helvellyn and A2D platform approaches. The remainder of the buried and rock dumped pipeline sections would be left in situ. In order to recover the mats and cut sections of pipework an

MSV or DSV will be required to make a significant number of lifts to the deck of the vessel. It is anticipated that the mats will be stacked subsea, and bulk lifted to deck reducing the number of lifts required and the risk of break-up of individual mats during the recovery process. Similarly, there will be a significant number of lifts required onshore for the breakup and recycling of the recovered materials. Given the relatively stable nature of the seabed no left in situ facilities would be expected to be seen over time at the seabed surface. For these reasons the option was given a medium risk rating in the safety category.

There are also some localised seabed disturbances associated with the recovery work. It is estimated that 10 days vessel time would be required to recover the mats and underlying pipe sections. A greater volume of emissions and waste is associated with these vessel days compared to the leave in situ option. As a result, there are some medium ratings associated with this option in the environmental category, however, given the short term and temporary impacts on seabed and/or marine communities and that the seabed area under the mats is being returned to the natural habitat condition within the Holderness Offshore MCZ, the workshop group felt an overall low environmental impact is associated with this partial removal option.

Equipment and technologies required to recover and break up the materials are well known to the industry and are not technically challenging although some care will be required to recover the fronded mats if using ROV based equipment.

The workshop group felt there is no real impact on other users associated with this option and given the relatively small scale of the scope would not have any significant reputational impacts. The option was given a green ranking in the overall societal category.

The costs for this option are expected to be approximately 2 times those of the leave in situ option but given the high level of available survey information, the on seabed location and known condition of the infrastructure a high level of definition is expected with this cost outcome.

Partial removal (Option 2c)

This option is very similar to option 2b but considered leaving the fronded mats and underlying pipe and umbilical sections in situ. In comparison to option 2b this option has a slightly higher risk associated with a legacy high consequence event because of the snagging possibility associated with the mats but overall the safety category ranking remains medium.

The overall environmental ranking was considered medium mainly as a result of the reduced seabed area within the Holderness Offshore MCZ being returned to the natural habitat condition and the potential for the plastic fronds to free themselves over time from the mats, effectively becoming plastic pollution in the sea.

The risks of using ROV based equipment around the fronded mats are not there compared to option 2b. Although some deposition can be seen over parts of the fronded mats the fronds do not appear to have attracted significant seabed material deposition and any deposition is significantly less than 0.6m. Leaving the mats in situ would therefore not comply with regulatory guidelines and was given a red ranking in this subcategory. Overall the technical category risk was considered medium.

Although the expected vessel days required for this option and the tonnages being returned to shore and to landfill are slightly reduced compared to option 2b they are not significantly different. The overall rankings for the societal and economics are the same as for option 2b.

Partial removal (Option 2d)

This option considered removal or not of anode sled 2. Given that anode sled 1 is fully buried within the 1.5-1.8 meter deep trench by a combination of rock and natural deposition the workshop group felt that this sled should be left in situ.

To leave sled 2 in situ has very low impact within nearly all the reviewed subcategories. The exceptions to this are in the legacy high consequence event (slight risk of sled becoming exposed over time and creating a snagging hazard) and the repurposing opportunity (internal pipeline is exposed to seawater leading to corrosion). A medium ranking was assigned in both these subcategories.

Removing sled 2 increases the time on site required for the decommissioning vessel(s). It would also require divers or an ROV to work within the excavated trench to cut the continuity straps between the anode sled and the pipeline. There is also some uncertainty around the condition of the lifting padeyes and how much rock is within the trench which would be redistributed over the local seabed area whilst exposing the sled prior to lifting. As a result, there are a number of subcategories within safety, environmental and technical that have been given a medium ranking for this option.

Both removal and leave in situ were broadly acceptable, however, given the above the leave in situ option was considered the preferred solution, however, any exposed sections of the sled found at the time of decommissioning should be cut and removed to surface.

Full removal (Option 3b)

This option considers recovering the whole of the pipeline and umbilical in their entirety. This would be done most likely by a combination of mass flow excavation to expose the buried pipeline and umbilical, reverse reeling or reverse S lay, mat recovery and cut and lifting of the WHPS and platform approach section. The option was considered to be tolerable but not preferred and will not be undertaken.

A number of safety concerns that may occur during the removal work were highlighted at the workshop. These include those associated with reverse reeling/s lay of the pipeline and umbilical where the remaining wall thickness of the pipeline and therefore the residual strength of the pipeline is not a definitive number. When applying tension to the pipeline to recover it back to the lay vessel deck there will be a chance of pipeline failure with an associated sudden release of tension. The unknown ‘suction’ effect of pulling up the pipeline and umbilical through the excavated trench will also increase the risk of a pipeline failure during recovery. The status of the piggyback attachment strapping is also unknown and there is a significant risk that attachment straps may have corroded. There is therefore a risk that the pipeline and umbilical separate during recovery or that the pipeline and umbilical need to be recovered separately after having first cut any remaining attachment straps. These concerns also led the workshop group to assign a low certainty to the level of definition in the safety category and medium certainties to the economic and technical categories. There is a high level of lifts required with this option both offshore and onshore along with working at height

issues associated with personnel working on the reel lay vessel ramp to detach piggyback strapping. Overall, this option was given a high impact rating in the safety category.

The environmental impacts associated with this option are also much higher than for other considered options. The area of seabed disturbance is vastly increased in comparison to other options and volume of seabed material put into temporary solution (smothering risk) is a lot higher, although not in a highly sensitive location. Over the longer term once the re exposed protection trench has naturally backfilled the seabed area within the Holderness Offshore MCZ being returned to the natural habitat condition will be maximised although the rock dump is likely to be spread over a wider area than it is currently. Fuel usage, emissions and noise are increased as a result of the increased durations of vessels and cutting operations that are required for the option. Although the recycling tonnage is increased the associated waste tonnages and landfill are also increased as most of the pipeline and umbilical materials are all returned to shore. This will have more visibility and impact to the public onshore. Overall, the workshop group gave the option a medium impact rating in the environmental category.

Technically each of the operations required for this option are feasible and are within the industries capabilities, however, the combination of the activities is not common practise for the industry and would require some new procedures and risk assessment processes. The requirement to subsequently attach the reel vessel abandonment and recovery winch line to severed sections of pipeline may preclude the use of hydraulic cutters which also flatten the pipeline sections at the cut location preventing the use of ball grab type recovery tools. Other recovery techniques would need to be specifically engineered for the operation(s). There is no repurposing opportunity with this option. The option was therefore given a medium risk rating with mid certainty in the technical category.

The community impact onshore was given a medium impact rating due to both positive and negative impacts associated with the option. The higher tonnages being return to shore create a boost to the local economy, however, increased traffic, noise and landfill need to be accounted for. Overall, the societal category was given a medium rating.

The cost for the decommissioning work with this option is almost eight times that of the lowest cost option and over 3 times that of the workshop's preferred option. It also carries a significant risk for cost escalation. Legacy surveys would still be required to confirm that the excavated pipeline trench has naturally backfilled itself close to or to the natural surrounding seabed level. The option was given a high impact rating with some uncertainty in the economic category.

7. RECOMMENDATIONS OF THE COMPARATIVE ASSESSMENT PROCESS

The below summary table shows the final outcome of the detailed assessment with a recommendation to adopt the partial removal option (2b). Option 2d is independent of options 2b and 2c and so also has a preferred solution to leave the anode sleds in situ. This represents removal of the concrete protection mats and underlying pipeline and umbilical sections at the Helvellyn WHPS and A2D platform approaches. The remainder of the buried and rock dumped pipeline sections should be left in situ. If any individual anodes at the anode sled location 2 can be seen on the seabed surface at the time of decommissioning these will be cut and recovered.

Table 7.1 Final detailed assessment ratings table

	Main Options						
Aspect	**Complete removal (option 3b)**	**Partial removal (option 2b)**	**Partial removal (option 2c)**	**Partial removal (option 2d) leave**	**Partial removal (option 2d) remove**	**Full leave in situ (option 1)**	**Comment**
Safety overall rating							
Safety overall definition	3	1	1	1	2	1	
Environmental overall rating							
Environmental overall definition	1	1	1	1	1	1	
Technical overall rating							
Technical overall definition	2	1	1	1	2	1	
Societal overall rating							
Societal overall definition	2	1	1	1	1	2	
Economic overall rating							
Economic overall definition	2	1	1	1	2	1	
Final rating							1

Comments

1 Consider cutting of protruding anodes on sled 2. See action 1 on main options

Key

Preferred solution	
Broadly acceptable	
Tolerable not preferred	
In tolerable, not acceptable	

1 high certainty
2 mid certainty
3 low certainty

8. REFERENCES

1. APR_HV_PMGT_014 Helvellyn Decommissioning Programme
2. APR_HV_PMGT_008 Helvellyn Decommissioning Environmental Appraisal
3. Department for Business, Energy and Industrial Strategy (BEIS) 'Guidance Notes: Decommissioning of Offshore Oil and Gas Installations and Pipelines under the Petroleum Act 1998' (November 2018)
4. OEUK's, Guidelines for Comparative Assessment in Decommissioning Programmes: Issue 1: Oct 2015
5. 220318-R-005 Pre-Decommissioning Environmental Baseline Survey Helvellyn Field Southern North Sea, Block 47/10 Environmental Baseline Report
6. JNCC Southern North Sea SAC. https://sac.jncc.gov.uk/site/UK0030395
7. JNCC Holderness Offshore MPA https://jncc.gov.uk/our-work/holderness-offshore-mpa/
8. 220318-R-003 Pre-Decommissioning Environmental Baseline Survey Helvellyn Field Southern North Sea, Block 47/10 Habitat Report

APPENDIX A

Water depth comparisons

Water depths along the route have been compared from the original as installed surveys (2002) and the latest interim 2015 operational survey to establish if any migration of the seabed along the route has occurred. These have further been compared with the most recent 2022 survey reports to confirm a stable seabed environment and a continual gradual natural backfill of the trench. Figure A.1 below shows the 2002 as trenched survey chart over the initial 1km of the pipeline and umbilical route. The blue line shows natural seabed level, and the red lines show the as trenched pipeline/umbilical position. Green is the seabed level within the 'V' shaped trench immediately after trenching indicating very little natural backfill during or shortly after the trenching process. It should be noted that the chart scales are highly exaggerated to emphasise features on what is essentially a flat seabed. The horizontal scale is in kilometres versus a vertical scale in metres.

From the 2015 interim operational survey, evidence of the trench naturally backfilling can now be seen. Figure A.2 shows a comparison section of the seabed level within the trench found in the 2015 operational survey (purple) superimposed onto the original 2002 as trenched survey chart. Figure A.2 also includes a MBES image of the section where the top of the trench is still visible, and the spot rock locations can be seen still in place. A similar pattern of stable trench and natural backfill is seen throughout the pipeline and umbilical route.

Figure A.3 shows MBES images of an example section of the route from operational surveys taken in 2013 and 2015. Seabed features (ripples and slight mounds) are clearly visible on both images and are all but identical. Stable rock dump locations within the trench are also noted and a slight infilling of the trench is seen.

Figure A.4 shows the most recent 2022 survey imagery against the 2015 MBES image and again the same features are clearly visible.

Full route survey data from the original as trenched charting and the interim 2013, 2015 and 2022 operational surveys are available on request.

Fig A.1 2002 As Trenched survey chart (KP 0 – 1.2)

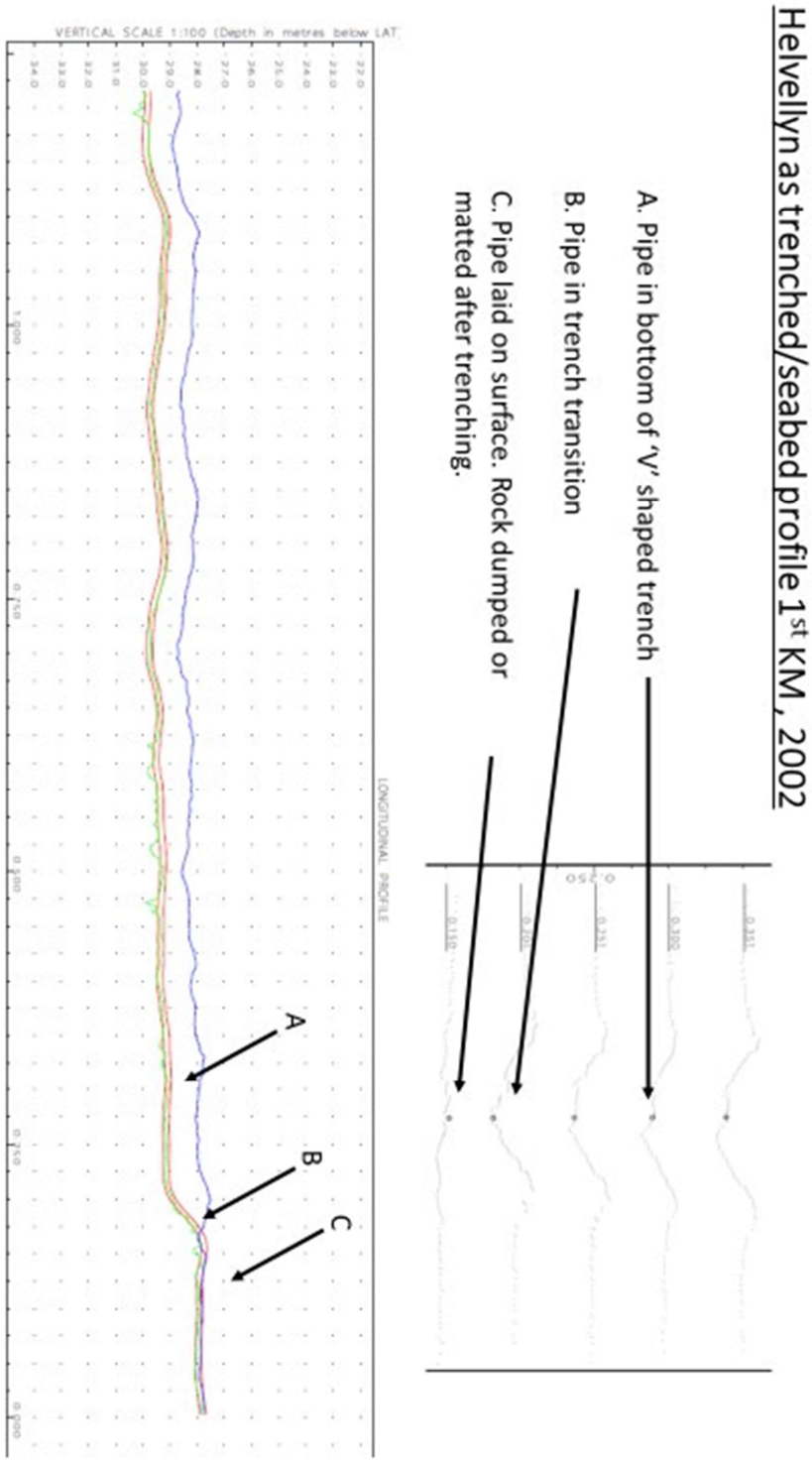


Fig A.2 2002 and 2015 seabed survey profile comparisons

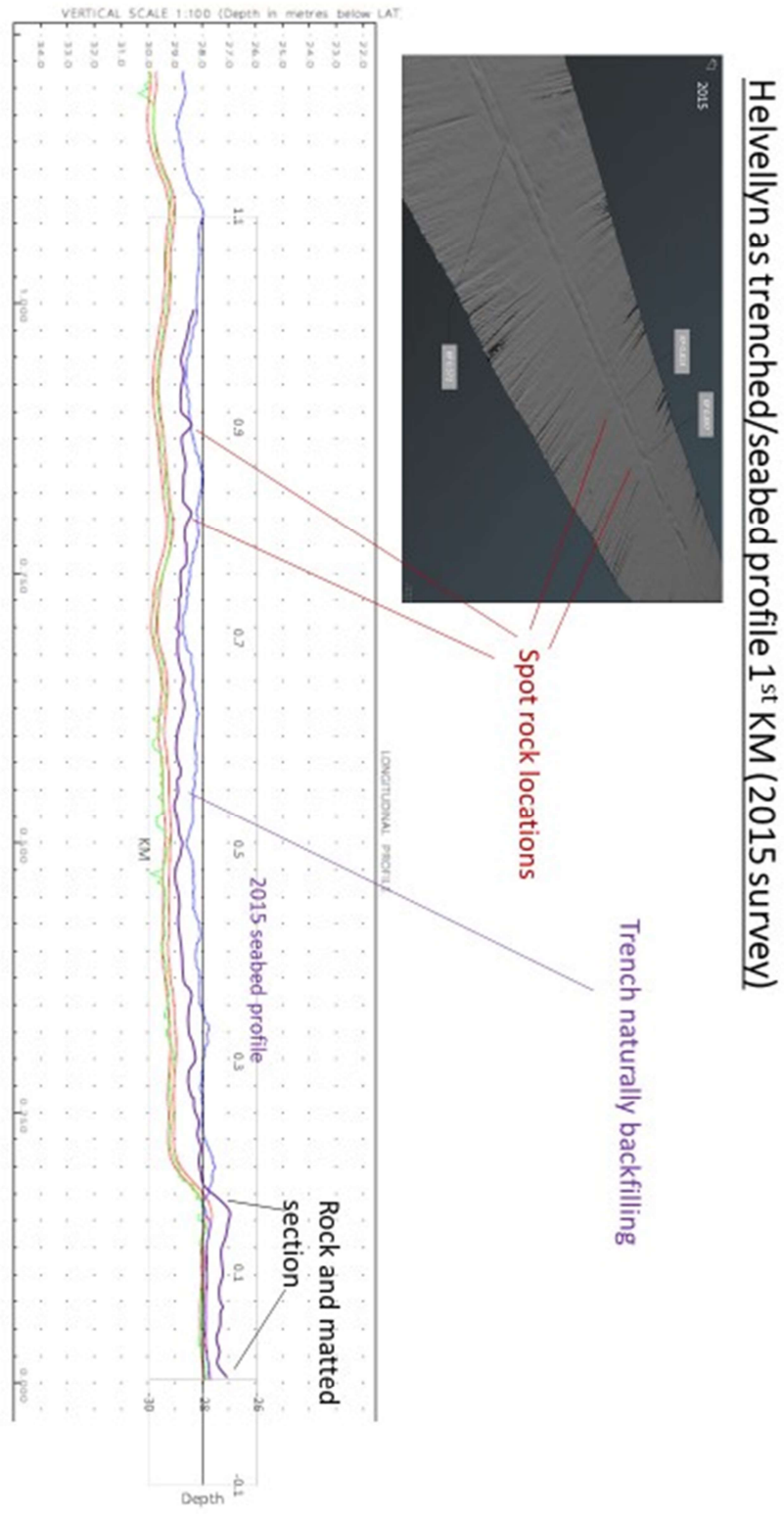


Fig A.3 2013 and 2015 MBES comparisons (KP 3.9-4.6)

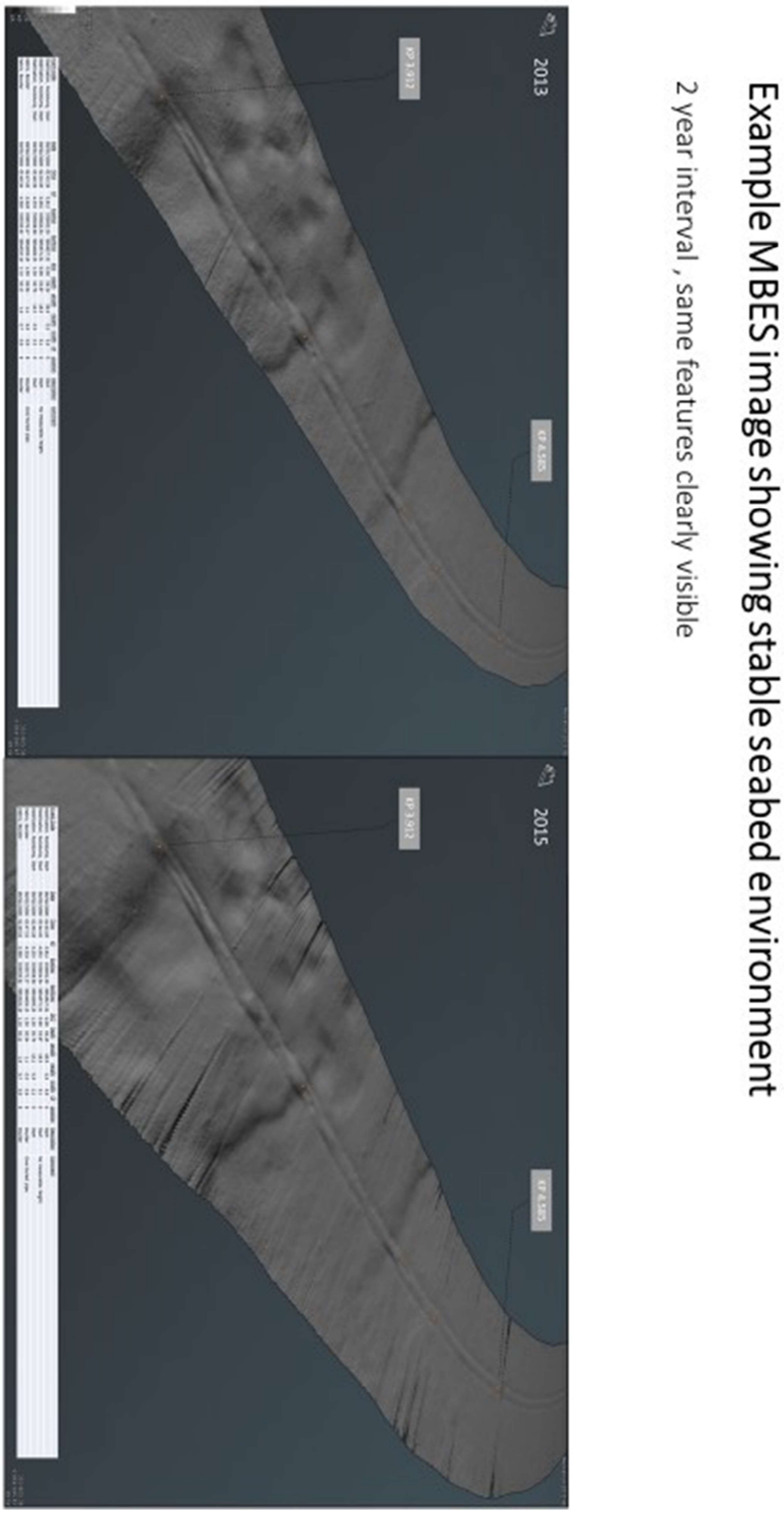
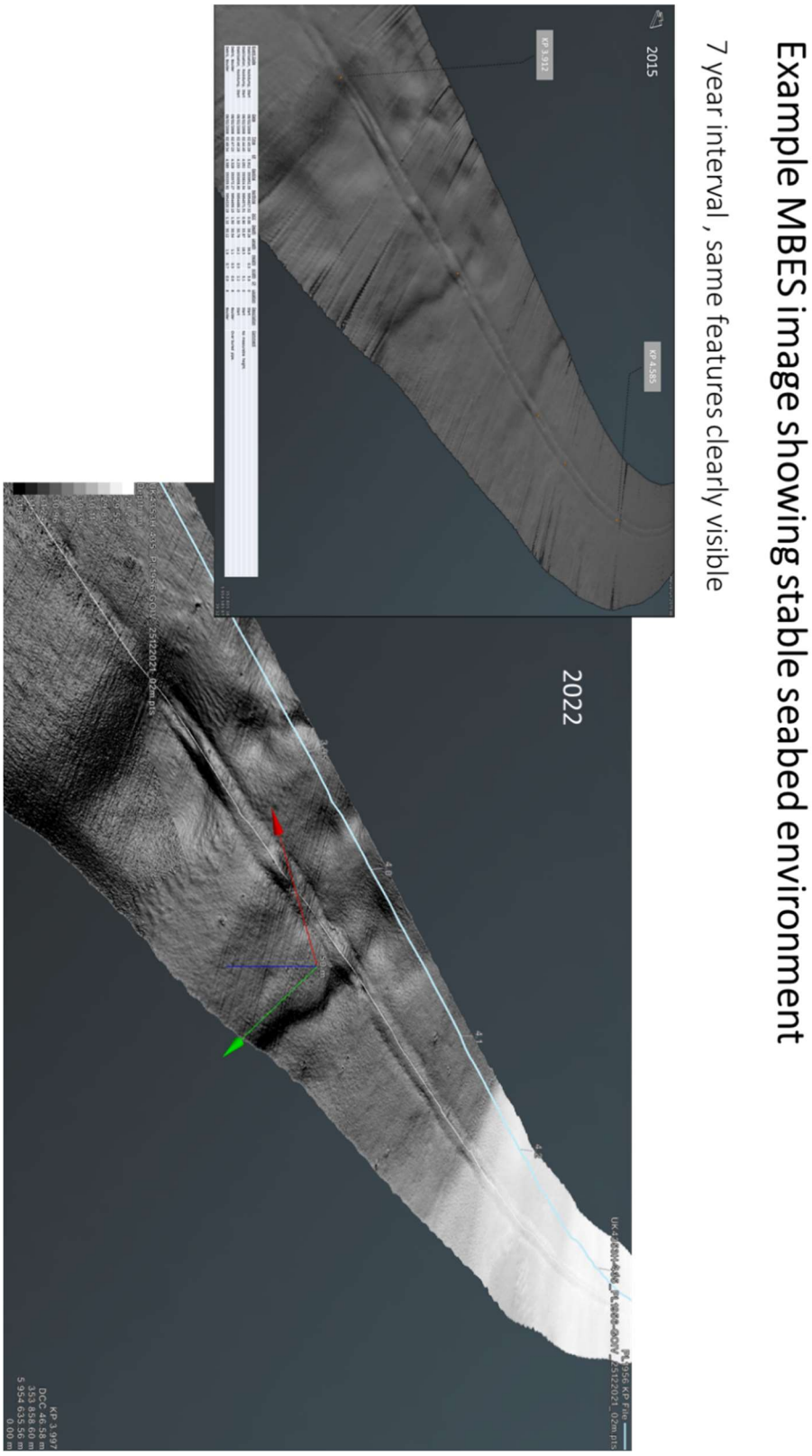


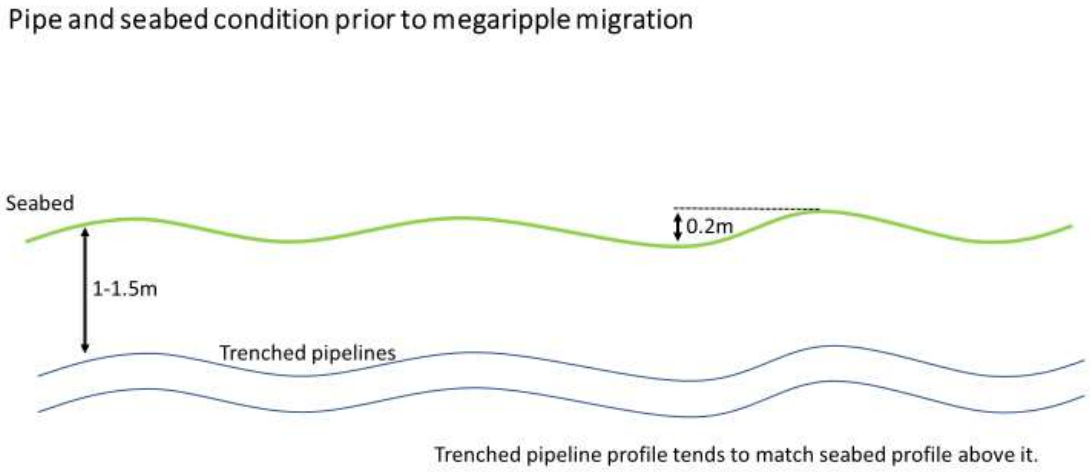
Fig A.4 2015 and 2022 MBES comparisons (KP 3.9-4.6)

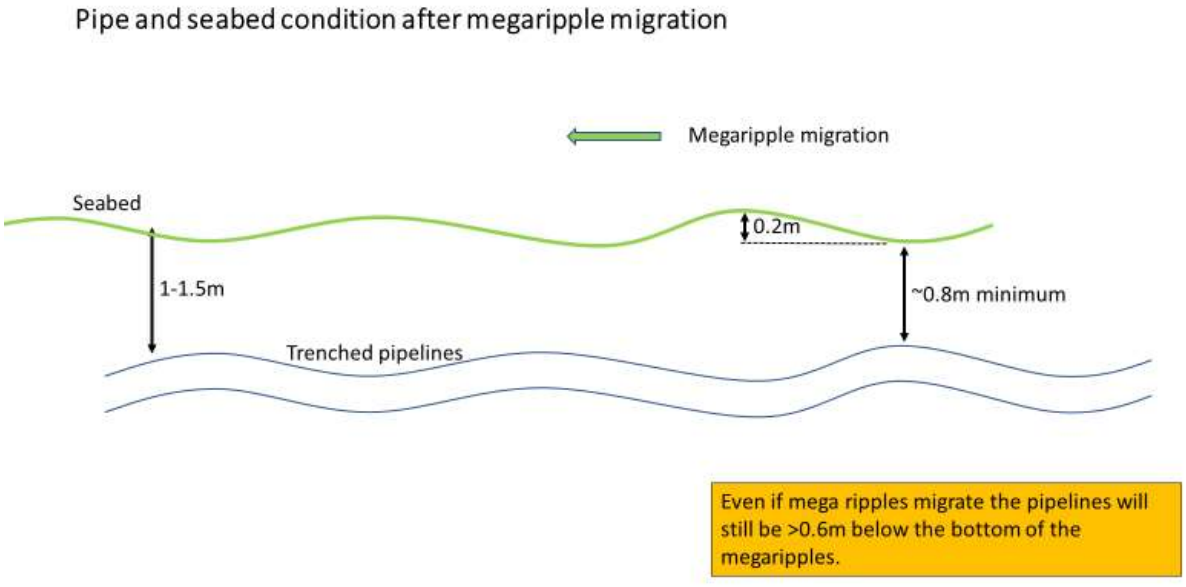


Potential mega ripple migration impact on burial depths

The below figures show the minimum remaining burial depth even should Helvellyn experience megaripple migration and a megaripple trough matches with the peak from the as trenched pipeline profile.

Fig A.5 Minimal burial depths after megaripple migration

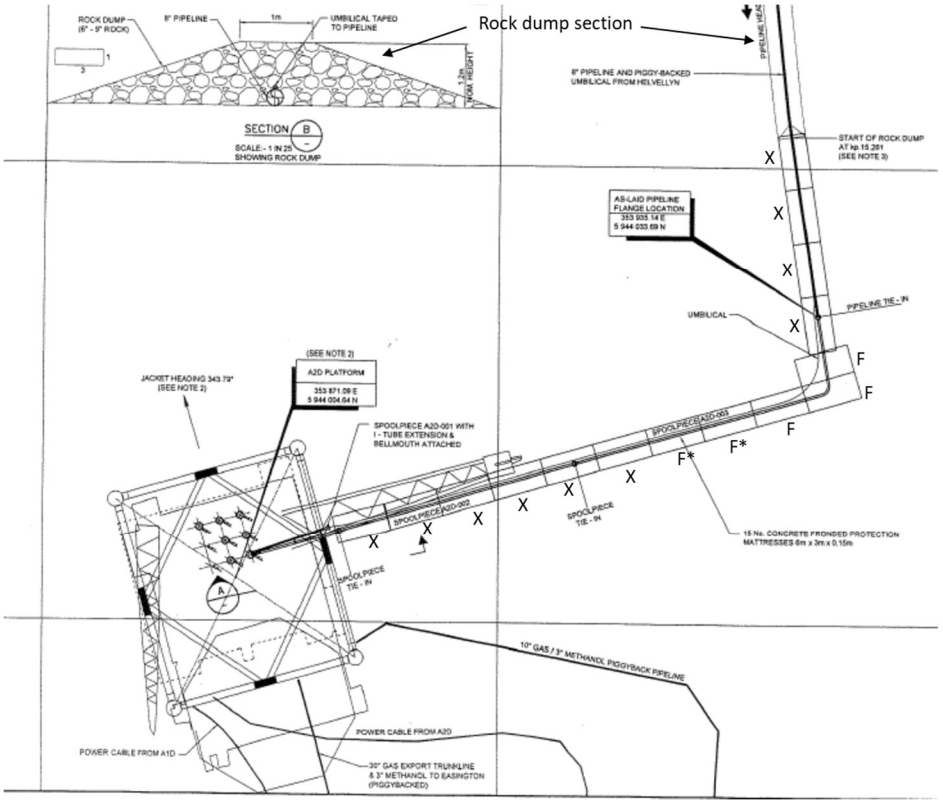




A2D Platform and Helvellyn subsea protection structure approaches

Fig A.6 shows the A2D platform approach layout and the current known status of the fronds on the concrete mattresses from the 2022 operational inspection survey.

Fig A.6 A2D platform approach layout



Key
F – Fronds observed
F*- Fronds overlaid with sandy seabed deposits
X – no fronds observed

Fig A.7 2022 MBES mapping of A2D approaches

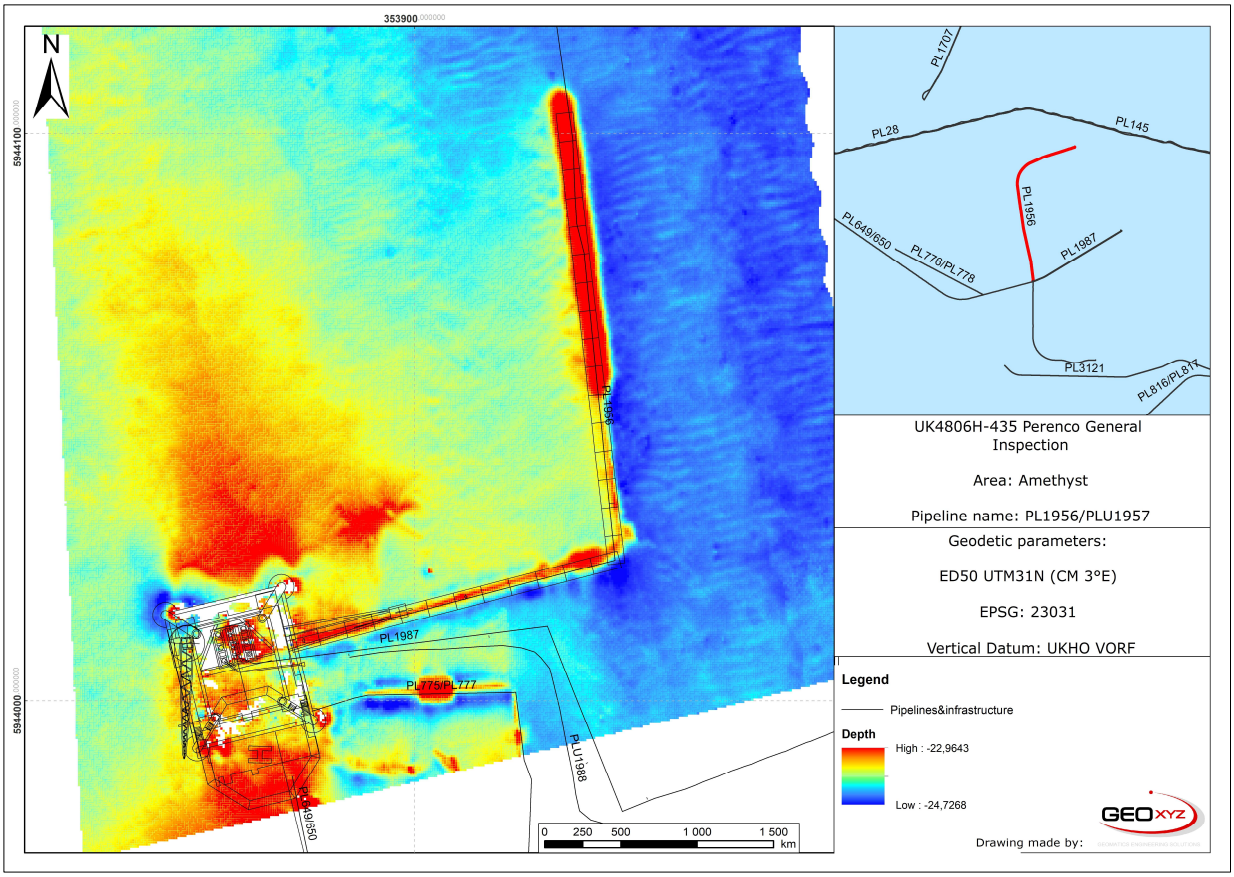


Fig A.8 shows the Helvellyn WHPS approach layout and the current known status of the fronds on the concrete mattresses from the 2022 operational inspection survey. The mats between the end of the rock dump and the spool 90 degree elbow all have retained their fronds.

Fig A.9 has a 2015 MBES image of this area.

Fig A.8 Helvellyn subsea protection structure approach layout

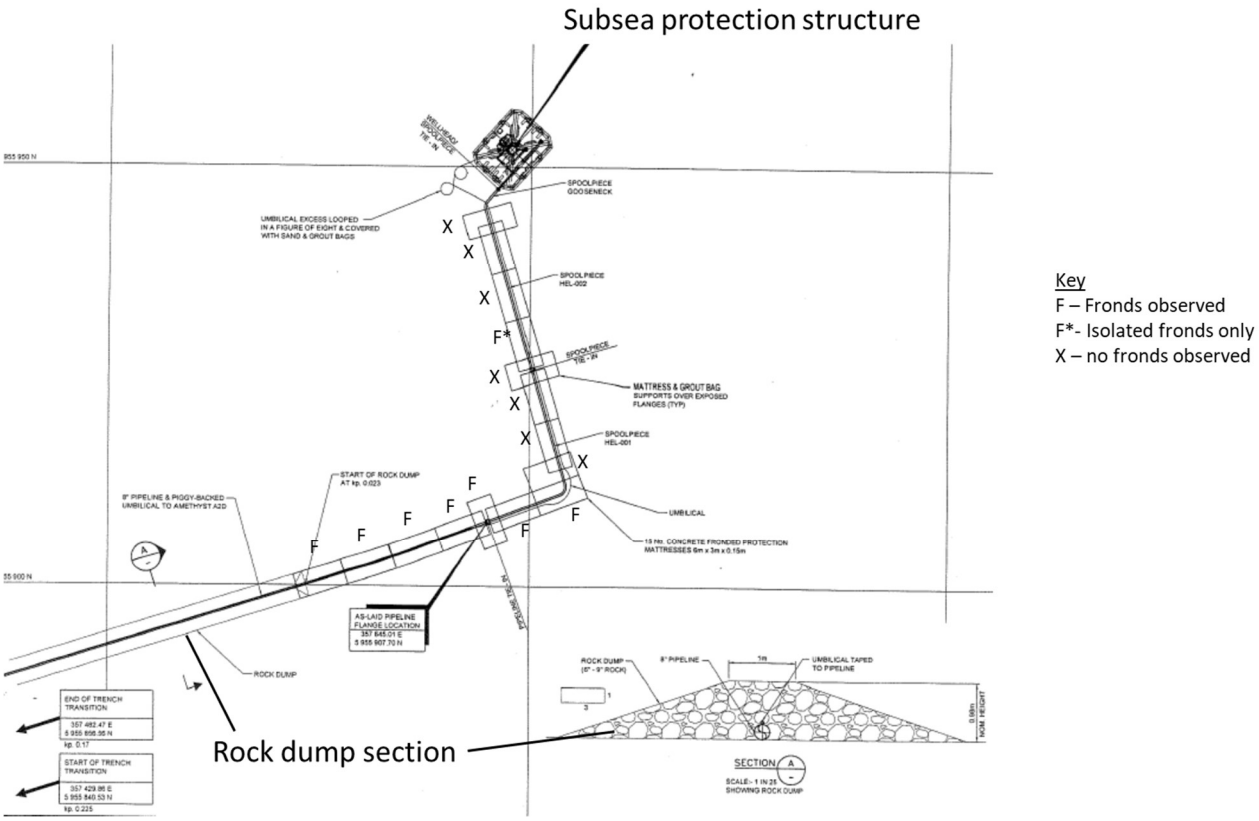
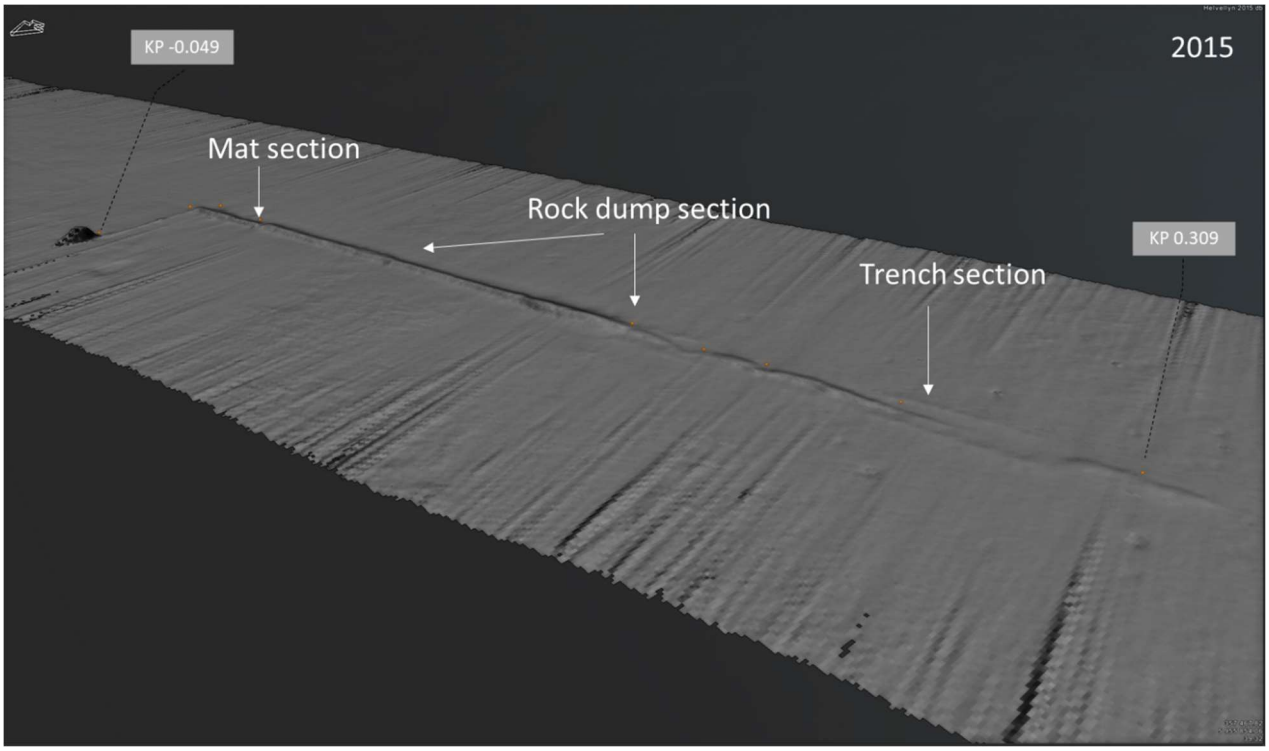


Fig A.9 2015 MBES image of Helvellyn subsea protection structure



Pipeline/umbilical exposures within the ‘V’ shaped trench

From the 2013 operational survey short sections of umbilical/pipe exposure were noted at five locations detailed in table A.1 below.

Table A.1 Pipeline/umbilical exposures in bottom of trench

Event Code	Date	Time	KP	Length	Description	Comment	ToP as trenched depth (m)	2013 status	Decommissioning scope recommendation
Exposure, Start	02/03/2004	06:55:27	3.907	4.2	Start	Possible	0.8	no visible change	None. KP3.920-3.946 has been rockdumped within the trench. Part of pipe exposured at bottom of trench
Exposure, Anomalous Start	02/03/2004	06:55:31	3.907	4.0	Anomalous Start	Up to 30% Exposed. Possible			
Exposure, Start	02/03/2004	06:56:07	3.954	6.0	Start		1.5	no visible change	None. KP3.920-3.946 has been rockdumped within the trench. Part of pipe exposured at bottom of trench
Exposure, Anomalous Start	02/03/2004	06:56:12	3.954	5.8	Anomalous Start	Up to 40% exposed			
Exposure, Start	02/03/2004	06:56:37	3.994	4.4	Start		1.2	no visible change	None. KP 3.967-3.980 has been rockdumped within the trench. Part of pipe exposured at bottom of trench
Exposure, Anomalous Start	02/03/2004	06:56:43	3.995	4.2	Anomalous Start	Up to 30% exposed			
Exposure, Start	02/03/2004	06:58:51	4.179	8.3	Start		1.5	no visible change	None. Part of pipe exposed at bottom of trench
Exposure, Anomalous Start	02/03/2004	06:59:16	4.179	8.1	Anomalous Start	Up to 20% exposed			
Exposure, Start	02/03/2004	07:19:48	5.682	2.8	Start	Possible	1.3	no visible change	None. Part of pipe exposed at bottom of trench
Exposure, Anomalous Start	02/03/2004	07:20:20	5.682	2.6	Anomalous Start	Up to 20% exposed. Possible			

These exposures were a maximum of 40% of the pipe diameter and all are in the bottom of the ‘V’ cut trench with the minimum depth of cover to the ToP noted as 0.8m. As such none are considered a snagging hazard. It is also noted that further natural backfill in the years since 2013 appear to have removed these exposures.

Fig A.10 Exposure locations KP 3.75 – 4.4

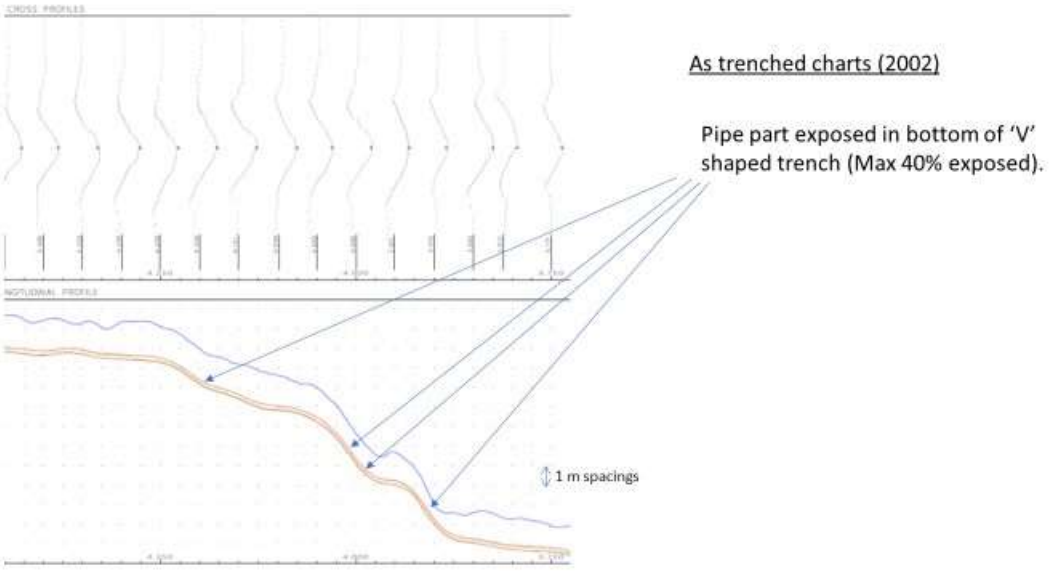


Fig A.11 2015 MBES image KP 3.75 -4.4

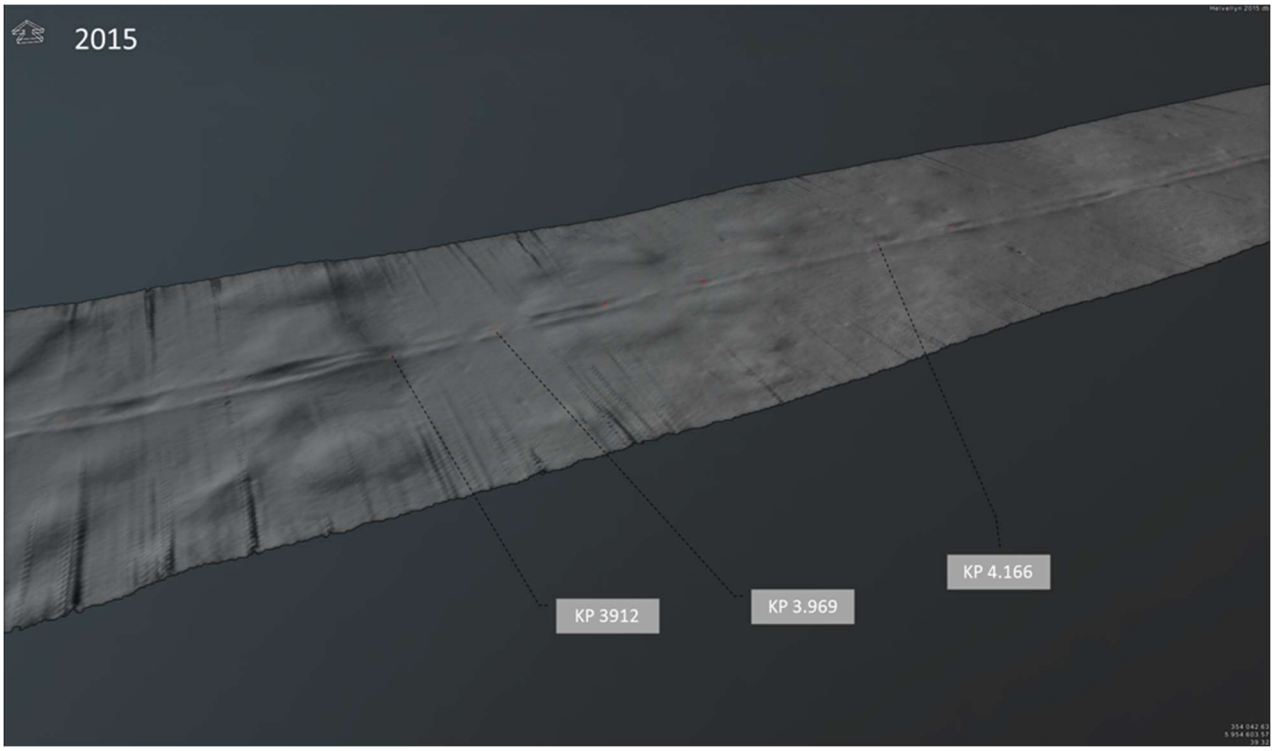


Fig A.12 Exposure location KP 5.682

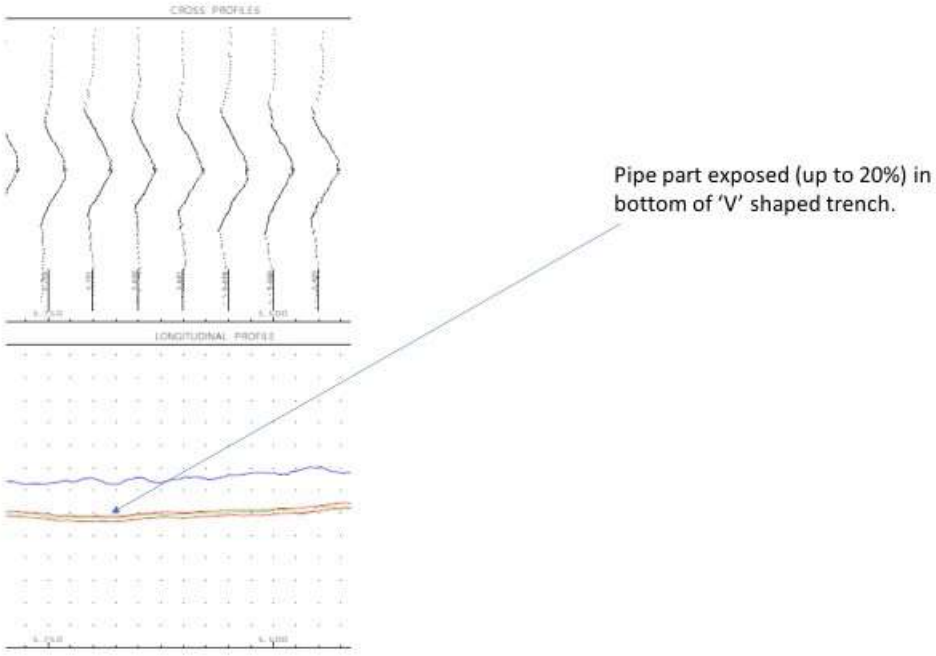
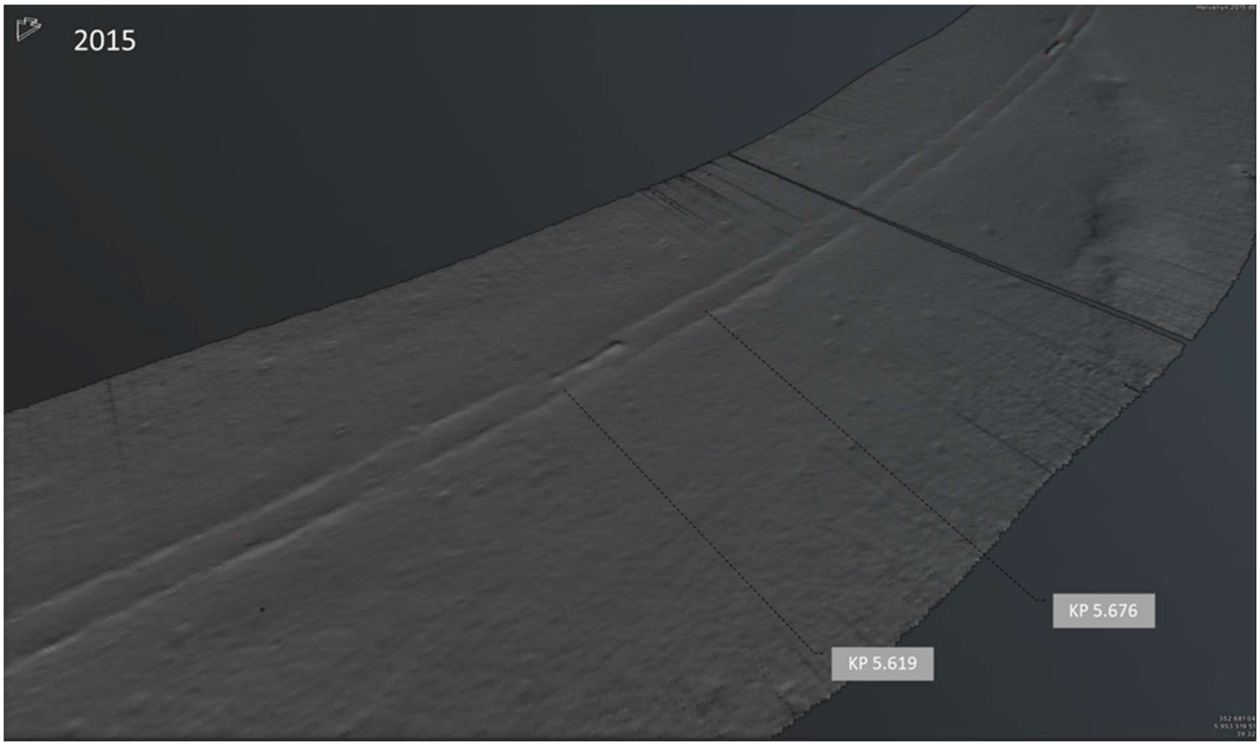


Fig A.13 2015 MBES image KP 5.682



Anode sleds

The four anode sleds were placed as shown in Figure A.13 on the northern side of the pipeline and umbilical within the 'V' shaped trench. The sleds were installed by divers and connected to the pipeline with electrical cables running between the sleds and the pipeline. Figure A.14 shows details of the individual sleds.

Fig A.14 Anode sled locations

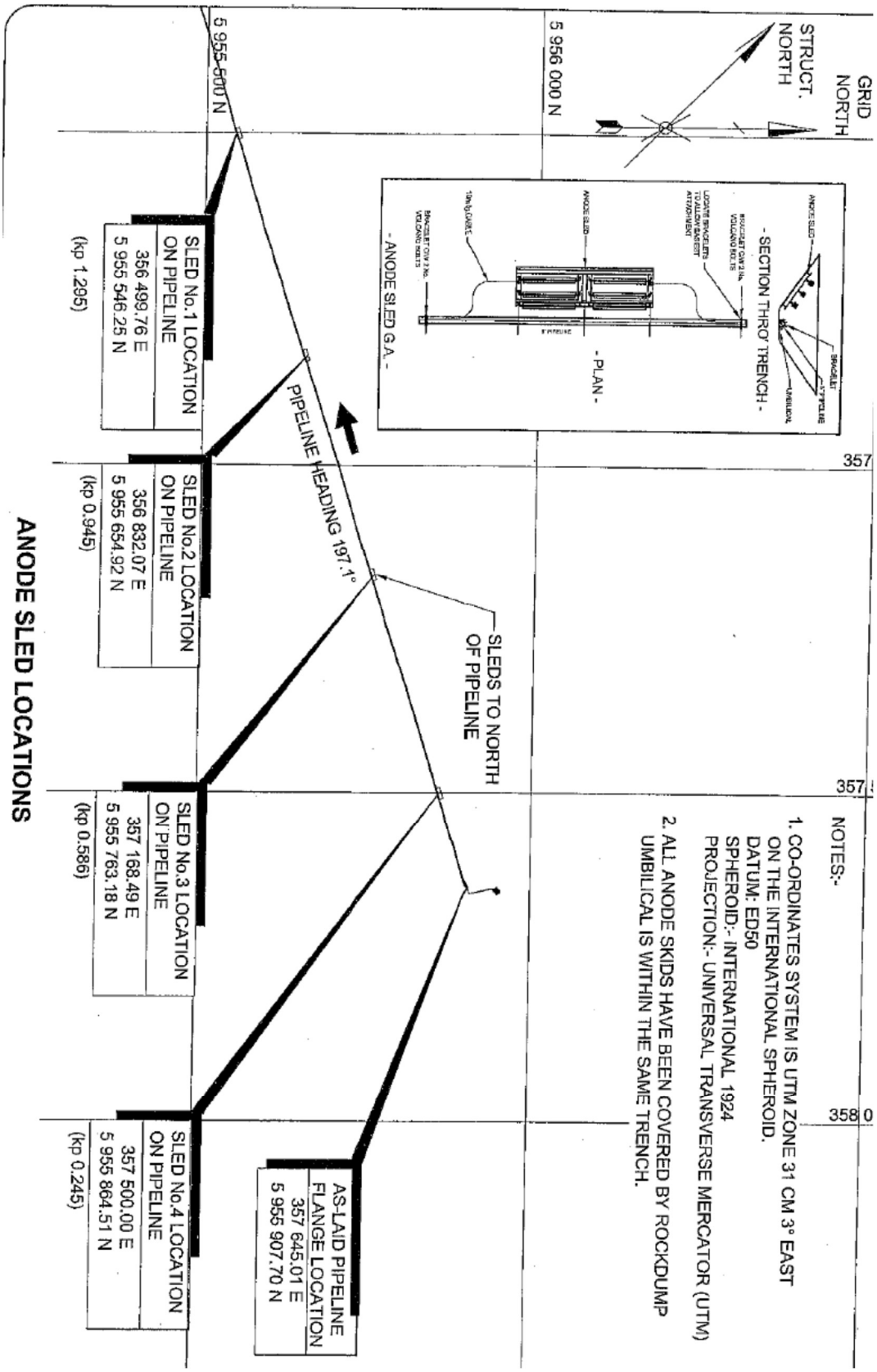
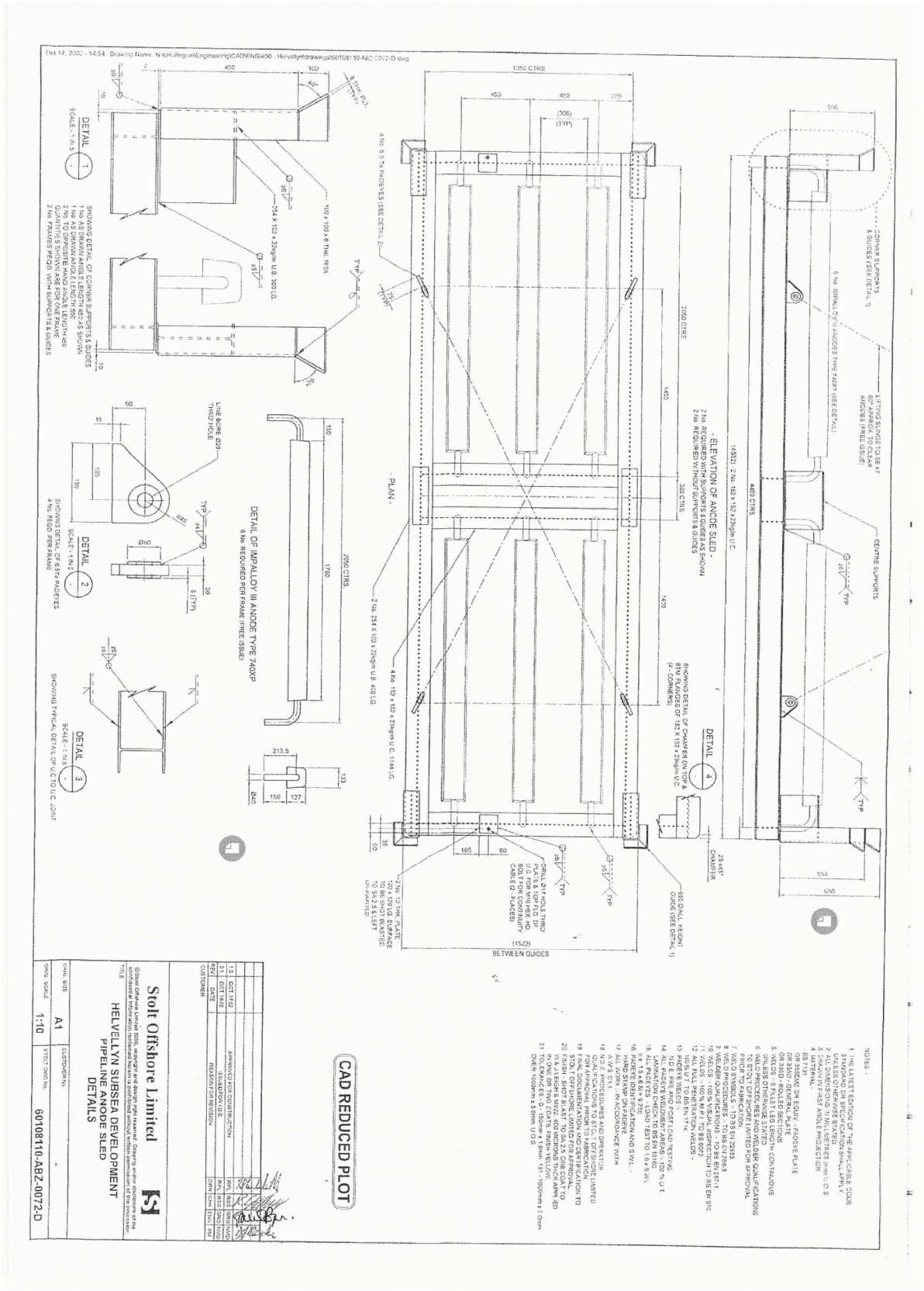


Fig A.15 Anode sled details



APPENDIX B

Category	Impact Assessment criteria		
	Low	Medium	High
Safety			
Risk to other users (post ops)	None to minor snagging, no personal injuries likely	Snagging hazard if protection deteriorates or is moved, minor damage or loss to equipment (fishing gear), minor injury (1st aid case to RWC)	Full loss of fishing gear and/or damage to vessel, 1 LTI to multiple fatalities or long term injuries
Risk to those offshore (during ops)	None to 2 vessel days reqd, low number of lifts to deck, no recovery of hydrocarbon contacted surfaces, no hot work reqd (seafastening)	3-20 vessel days, <20 deck lifts, recovery of cleaned pipework sections to deck (<200m of sections), minor hot work (eg cutting seafastening)	>20 vessel days, >20 deck lifts, multiple lifts to deck or working at height reqd, recovery of uncleaned hydrocarbon contacted surfaces or NORM contaminated equipment, welding or multiple hot work
Risk to 3rd parties (during ops)	None to 10 vessel days in field (zero to 7 days work outside marked 500m zones), no seabed obstructions left unattended during removal work,	11- 30 vessel days in field (8-14 outside marked 500m zones), snagging obstructions on seabed for short durations (port calls, WDT)	>30 days in field (>15 outside marked 500m zones), Obstructions left for long period unmarked on seabed.
Durations of diving intervention	None (tasks can be performed by remote tooling)	Intervention work requiring no tools or structure entry	Multiple diver time required with equipment left in situ over more than 1 dive
Risk to those onshore (during ops)	Zero to 50T returned to shore, minimal break up required before recycling/disposal	50-500T returned to shore, some break up and double handling of materials reqd	>500T returned to shore, multiple lifting, transportation and break up reqd as part of recycling/disposal
High consequence event	Low probability of collision dropped object or pressure release near personnel. No working at height required	Some short term working at height, no lifts above 10Te, short term working with pressure or high voltage equipment	Major regular lifts required to deck, regular working at height, vessels working in congested areas (close to 'live' platforms)
Environmental			
Discharges	No or negligible discharge	Discharges may cause short term change to the ecosystem but with good recovery potential	Discharges cause long term or permanent change to the ecosystem
Seabed disturbance	No or negligible disturbance. Short term seabed clouding from ROV/diver/equipment	Localised disturbance up to 5000m2 footprint, limited seabed material put	Wide area of disturbance >5000m2 footprint, Large volumes of seabed

	movement, no or very low impact on seabed communities	into solution, short term impact on seabed communities from smothering	material put into solution (dredging or mass flow excavation equipment reqd), risk of smothering and loss of seabed communities
Impact on Marine protected areas (HO MPA)	At least 50m2 is returned to subtidal coarse sediment seabed. No negative impact to current situation (eg additional rock dump).	Minor impacts which negatively impact less than 50m2 from current situation	Impacts that negatively affect >50m2 of subtidal coarse sediment seabed
Impact on Marine protected areas (GWA SPA)	No work in or minimal marine traffic passing through SPA	<10 transits through SPA or <30 restricted to shipping lanes	Work located within SPA. >10 transit through or >30 restricted to shipping lanes
Energy usage (during and post ops)	None to 10 vessel days in field, low energy equipment reqd (eg surveys)	11- 30 vessel days in field, some short term high energy equipment required (eg crane lifts, hydraulic cutters)	>30 days in field, high energy equipment used (eg trenching or mass flow excavators, multiple lifting)
Atmospheric emissions	None to 10 vessel days in field, up to 250Te fuel consumed, low onshore odour	11- 30 vessel days in field, up to 1000te fuel consumed, short term onshore odour	>30 days in field, >1000Te fuel consumed, weeks of onshore odour
Noise (underwater and onshore)	Low levels of subsea cutting/piling, minimal onshore handling/crushing/ cleaning of materials	Some subsea cutting/piling activities, short term noise from onshore activities	High levels of subsea cutting/piling, mass onshore handling/crushing/ cleaning of materials
Accidental spills	Zero to 10l of low hydrocarbon concentrations/ chemicals or very gradual release (drips/bubbles)	11l to 10 cu m of low hydrocarbon concentrations/ chemicals	>10 cu m of low hydrocarbon concentrations/ chemicals
Smell (onshore)	No or short term smell. <10 days to process materials returned to shore	Period of smell from returned materials up to 1 month	Long term exposure to smells >1 month to process materials
Waste processing	<50T returned to shore, materials readily recyclable, no or negligible landfill	50-500T returned to shore, partially recyclable materials	>500T returned to shore, some materials non-recyclable, significant landfill anticipated
Technical			
Technical challenge	Regular construction tasks involved with common procedures, track record of similar tasks, tasks relatively independent of seabed conditions	Some new task specific procedures required; tasks partly influenced by seabed conditions	Untried working practise(s), Tasks volume/complexity vary with seabed conditions

Weather sensitivity	Generally workable operations for average operational downtime statistics for time of year	Small number of tasks require reduced weather window for short periods	Sustained periods of reduced weather required to complete tasks
Risk of major project failure	Standard equipment used; equipment spares readily available	Material breaks up or equipment failure leads to delay of up to 3 months	Likely break up of materials during recovery, requires new mobilisation with new equipment/procedures , major equipment damage incurred, delay in excess of 3 months
Repurposing opportunity	Full length of pipeline is available for others to use for up to 5 years	Full length or partial length of pipeline is available at time of decommissioning but may corrode quickly without intervention	None or very limited length of pipeline available for reuse.
Societal			
Access to site for other users	No or minimal access restriction to site, <100m^2	Short term access restriction over a wide area during decommissioning work, permanent access restriction <1000m^2	Permanent access restrictions over a wide area >1000m^2
Community impact (onshore)	Low or positive impact (jobs without significant noise/traffic/dust/odour impact)	Short term impact during material handling (noise/traffic/ dust/odour)	Long term impact, significant volume of landfill, eyesore, sustained noise/traffic/ dust/odour
Reputation impact	Very low project visibility, no 'new' precedents, costs within acceptable benchmark ranges, all regulator & stakeholder interests addressed in CA	Minor deviations from OSPAR derogation guidelines (eg small protection structure left in situ, <20m^2 area)	High project visibility, new precedents, low or high costs, some regulator stakeholder interests not addressed. Significant media interest.
Economic			
Cost of work	Within 50% of lowest option, high certainty of cost outcome (likely lump sum work)	50-300% of lowest option, likely part lump sum part reimbursable work	>300% of lowest option, low certainty of cost outcome
Ongoing cost liabilities	Zero to £100,000	£100,000 - £500,000	>£500,000

APPENDIX C

Main Options Worksheet

Aspect	Sub Category	Timing (D-during decom work L-post decom legacy)	Complete removal (option 3b)	Partial removal (option 2b)	Partial removal (option 2c)	Partial removal (option 2d) leave	Partial removal (option 2d) remove	Full leave in situ (option 1)	Comments	Action
Safety	Risk to those offshore performing the work	D							8	
	Risk to other offshore users	D								
	Risk to other offshore users	L							9	1
	Durations of diving interventions	D							1	
	Risk to those onshore	D								
	High consequence event	D								
	High consequence event	L								
Safety overall rating									2	
Safety definition level			3	1	1	1	2	1		
Environmental	Discharges	D							10	
	Seabed disturbance	D								
	Seabed disturbance (scour or other)	L								
	Impact on Marine Protected areas (HO MCZ)	D							3	
	Impact on Marine Protected areas (HO MCZ)	L							10	
	Impact on Marine Protected areas (GWA SPA)	D							4	
	Impact on Marine Protected areas (GWA SPA)	L							4	
	Energy useage	D								
	Energy useage	L								
	Atmospheric emissions	D								
	Atmospheric emissions	L								
	Noise (underwater and onshore)	D								
	Accidental spills	D								
	Smell (onshore)	D								
	Waste processing	D								
Environmental overall rating										
Environmental definition level			1	1	1	1	1	1		
Technical	Technical challenge	D								
	Weather sensitivity	D								
	Risk of major project failure	D								
	Regulatory compliance	L								1
	Repurposing opportunity	L								
Technical Overall rating									5	
Technical definition level			2	1	1	1	2	1		
Societal	Access to site for other users	D								
	Access to site for other users	L								
	Community impact (onshore)	D								
	Impact on reputation of stakeholders	D								
	Impact on reputation of stakeholders	L							6,7	
Societal overall rating										
Societal definition level			2	1	1	1	1	2		
Economic	Cost of the work	D								
	Ongoing cost liabilities	L								1
Economic overall rating										
Economic definition level			2	1	1	1	2	1		

Comments
1. Partial removal option has higher liklihood of diving activity than full leave in situ
2. Partial removal option is considered only marginally amber (close to green)
3. Legacy situation for the MCZ is more important than the during decommissioning phase
4. Best practise will be to use main shipping lanes. Preference to carry out work outside Nov-Mar period.
5. Technical challenge is considered higher weighting than repurposing opportunity
6. Full removal scored amber as full removal would set an industry 1st.
7. Full leave in situ and 2c option considered amber as precedent would be set to leave unburied mats in situ
8. Only sled 2 would be considered for removal. Sled 1 appears to be buried and rock covered.
9. Slightly increased risk for 2 anodes seen at surface level in option 2d but not sufficient to be risked as amber.
10. Fronds left in situ are plastics that may become detached (as a discharge)

Action
1. Consider removal of 2 exposed anodes on sled 2 , not complete sled.