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Liverpool Bay CCS Post Consent Support

Pre-construction Survey Method Statement

MSDS Marine



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1.0 Introduction

- 1.0.1 MSDS Marine Limited (MSDS Marine) have been contracted by Tetra Tech RPS Energy Ltd (TTRPSE) to produce an archaeological method statement in relation to pre-construction survey operations for the Hynet Carbon Dioxide Transportation and Storage Project – Liverpool Bay. The survey operations are being undertaken as part of pre-construction route clearance works, and for the identification of potential Unexploded Ordnance (pUXO). The data collected will be subject to archaeological assessment to inform the known archaeological resource, and establish mitigation measures to ensure robust, but proportional protection for the historic environment.

2.0 Project location and status

- 2.0.1 As part of the offshore components of the Project, the existing offshore natural gas import pipeline from Point of Ayr (PoA) Gas Terminal will be repurposed to become a CO₂ export pipeline and will transport the CO₂ to the newly constructed Douglas Carbon Capture and Storage (CCS) platform. From the Douglas CCS platform, CO₂ will be transported along repurposed natural gas pipelines to the Hamilton Main platform for injection into the Hamilton Main reservoir, to the Hamilton North platform for injection into the Hamilton North reservoir, and to the Lennox platform for injection into the Lennox reservoir. The Project will also require new electrical and fibre optic transmission infrastructure seawards of Mean High Water Springs (MHWS), connecting the PoA Terminal to the offshore infrastructure.
- 2.0.2 The development area has recently been revised within the foreshore area to mitigate impacts on vessel traffic navigation in and out of the Port of Mostyn. However, the offshore development area remains unchanged. The development area Red Line Boundary (RLB) is shown in Figure 1.

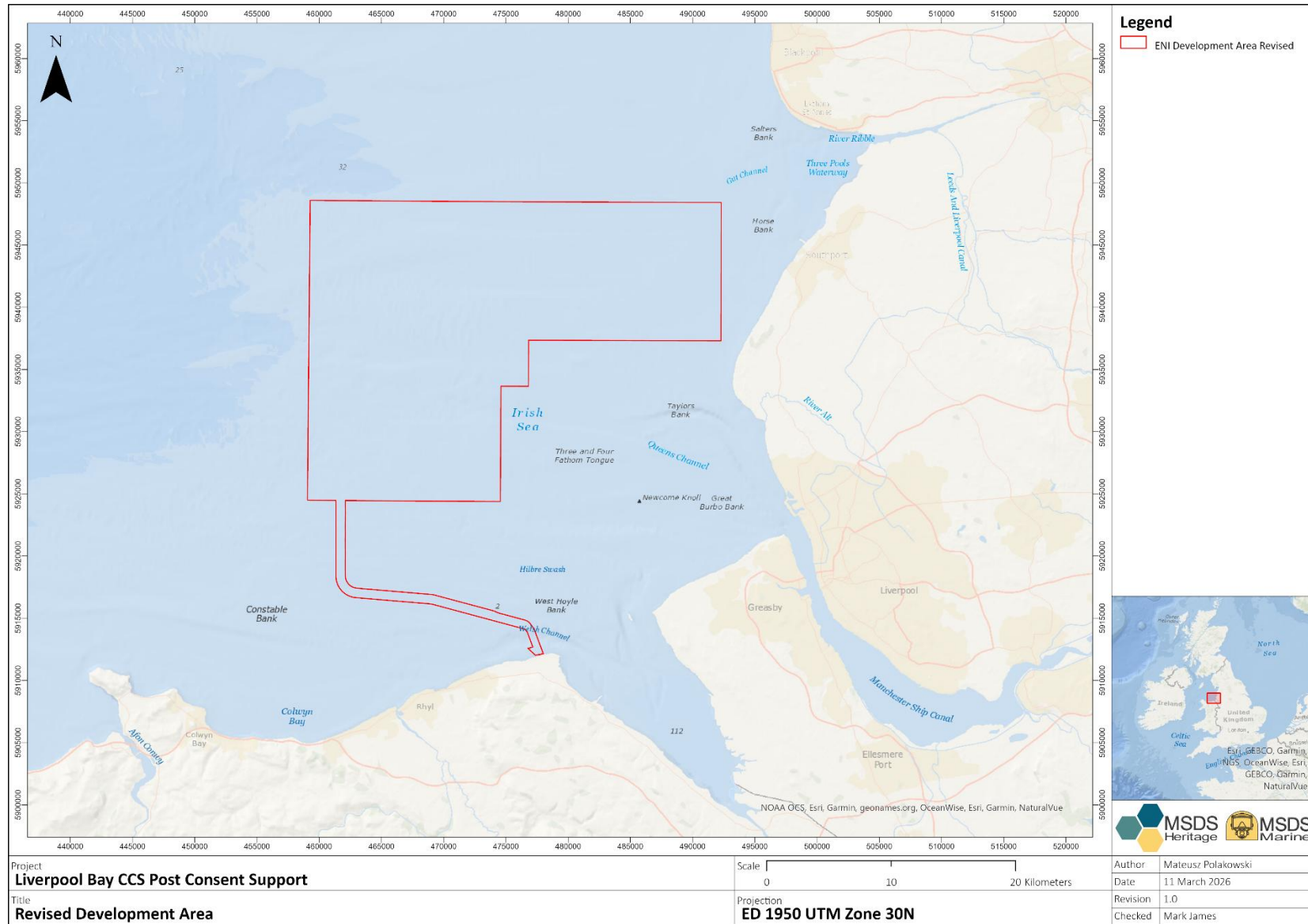


Figure 1: Revised development area

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3.0 Aims and objectives

3.1 Archaeological review of geophysical and hydrographic data

3.1.1 The principal aim of the archaeological review of geophysical and hydrographic data is to establish the presence of material of potential archaeological significance on the seabed. The identification of material allows for strategies to be recommended to mitigate against any negative effects that may be caused by the development process.

3.1.2 The objectives of the archaeological interpretation can be summarised as follows;

- To establish the presence of anthropogenic material of archaeological potential;
- To interpret the identified anomalies as to their potential to be of archaeological significance;
- To recommend mitigation strategies for the anomalies appropriate to their archaeological potential;
- To recommend further works that may be required and their specifications.

4.0 Methodology

4.0.1 Geophysical and hydrographic data will be collected in two back to back campaigns, the first informing the scope of the second.

4.1 Campaign one

4.1.1 Survey campaign one will commence mid-March 2026, and will be undertaken by Boskalis Subsea Cables (Boskalis) onboard the dedicated survey vessels MV *Ocean Geograph* (offshore) and *Titan Discovery* (nearshore). The aim of the survey will be identifying the presence of pUXO for either avoidance during construction, or more detailed inspection during campaign two. The data specification exceeds that for an investigation survey as detailed in Historic England's *Marine Geophysics. Data acquisition, Processing, and Interpretation Guidance Notes (2nd Edition)*¹ and will be subject to archaeological assessment.

4.1.2 The survey will include the mobilisation of Multibeam Echosounder (MBES), Sidescan Sonar (SSS), and magnetometer. The magnetometers will be in a gradiometer configuration of eight magnetometers spaced at 1.25 m.

4.1.3 The survey will cover the full extents of the installation corridors, c.60 m in width, which lie within the RLB. The survey line spacing is planned for 6.0 m in water depths less than 12 m Lowest Astronomical Tide (LAT) and 10 m in water depths greater than 12 m LAT. The anticipated equipment specifications are given below in Table 1.

	Manufacturer	Model	Frequency
SSS	Edgetech	4205	230/540 kHz
MBES	Kongsberg	EM2040	400 kHz
Magnetometer	Geometrics	G-882 x 8	10 Hz update rate

Table 1: Geophysical and hydrographic sensor specifications

5.1.1 The data will be collected to a specification appropriate to achieve the following interpretation requirements:

- SSS: ensonification of anomalies > 0.3 m
- MBES: ensonification of anomalies > 1.0 m
- Magnetometer: detection of anomalies with a ferrous mass;
 - >25 kg in water depths below 12 m LAT
 - >120 kg in water depths greater than 12 m LAT

¹ Historic England. *Marine Geophysics. Data acquisition, Processing, and Interpretation Guidance Notes (2nd Edition)*. Historic England: Swindon.

5.2 Campaign two

- 5.2.1 Survey campaign two will commence late-March 2026, and will be undertaken by Boskalis onboard the dedicated survey vessels MV *Ocean Geograph* (offshore) and *Titan Discovery* (nearshore). The aim of the survey will be to undertake detailed investigation of pUXO and potential Archaeology (pArch) anomalies identified during survey campaign one, as well as existing Archaeological Exclusion Zones (AEZs) and Temporary AEZs (TAEZs). To note, TAEZs were implemented around magnetic only anomalies during the 2023 review of geophysical and hydrographic data.
- 5.2.2 The survey will include the mobilisation of Sub-bottom Imager (SBI) equipment, the data from which will be processed to create 3D volumes, and therefore images, of sub-seabed anomalies.
- 5.2.3 The survey will be undertaken within the final route corridor (c. 20 m to 25 m in width), targeting both pUXO and pArch anomalies identified within survey campaign one so that they (and any recommended exclusion zones) can be avoided, or reassessed, as appropriate.
- 5.2.4 The anticipated equipment specifications are given below in Table 2.

	Manufacturer	Model	Frequency
<12 m LAT	Kongsberg	3D chirp	1.5k Hz to 13.0 kHz
>12 m LAT	Kraken Robotics	SBI (On SeaKite)	Unknown

Table 2: SBI sensor specifications

- 6.1.1 The data will be collected to a specification appropriate to achieve the following interpretation requirements:
- SBI: visualisation of anomalies;
 - >125 mm in water depths below 12 m LAT
 - >100 mm in water depths greater than 12 m LAT

6.2 Positioning

- 6.2.1 All data will be collected with reference to the European Terrestrial Reference System 1989 (ETRS89) datum and Universal Transverse Mercator (UTM) Zone 30 North projection (ETRS89 Z30N). All vertical depths will be relative to LAT and will be reduced to LAT using Vertical Offshore Reference Frames (VORF).
- 6.2.2 Towed sensors will be positioned using an Ultra Short Baseline (USBL) positioning system to ensure positional accuracy throughout the survey. USBL ensures the actual position of the sensor is recorded, as opposed to when the position is estimated based upon the direction of the vessel and the amount of cable out (layback).
- 6.2.3 Although the accuracy of the USBL system is dependent on the angle, and the distance of the beacon from the transceiver, tolerances of between 0.5 m and 2.0 m can be achieved. Positional accuracy is further increased through the correlation of the SSS dataset with the MBES dataset.

7.0 Archaeological assessment methodology

7.1 Campaign one

Guidance and best practise

7.1.1 The archaeological assessment of geophysical data will follow industry best practice and will make use of relevant guidance and associated documents including (but not limited to):

- Code of Practice for Seabed Development (JNAPC, 2008);
- Historic Environment Guidance for the Offshore Renewable Energy Sector (COWRIE, 2007);
- Standard and Guidance for Historic Environment Desk Based Assessment (ClfA, 2020);
- Standard and Guidance for Archaeological Geophysical Survey (ClfA, 2014);
- Marine Geophysics Data Acquisition, Processing, and Interpretation: Guidance Notes (2nd Edition) (MSDS Marine, 2025);
- Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector (Gribble and Leather, 2011); and
- Archaeological Written Schemes of Investigation for Offshore Wind Farm Projects (The Crown Estate, 2021).

Surface and sub-surface anomalies

7.1.2 The archaeological review of data will be undertaken by a qualified and experienced maritime archaeologist with a background in geophysical and hydrographic data acquisition, processing, and interpretation.

7.1.3 Following delivery of the required datasets, an initial review of the datasets will be undertaken to gain an understanding of the geological and topographic make-up of the survey area. Within the extent of the survey area, the potential for variations in the seabed are high and can affect the interpretation of anomalies.

7.1.4 The interpretation report will consider the full data extents. Whilst some of the data extends beyond the site boundary, the purpose of the assessment is to characterise the historic environment and therefore all available data will be considered, with the focus of the mitigation measures being on anomalies within the site boundary, or where mitigation measures will impact activities within the site boundary.

Sidescan Sonar

7.1.5 SSS is considered the best tool for the identification of anthropogenic anomalies on the seabed, due to the ability to ensonify small features and, as such, forms the basis of any archaeological assessment of data. SSS data in .xtf format will be imported into Moga Seaview software (latest release), navigation and positioning will be checked and corrected where required and optimal gains applied to ensure the consistent presentation of data.

7.1.6 Data will be reviewed on a line-by-line basis and all anomalies of potential anthropogenic origin identified and recorded. Records will include, as a minimum:

- An image of the anomaly;
- Dimensions; and
- A description.

- 7.1.7 An archaeological potential rating will be assigned to the anomaly, following the criteria outlined in Table 3, below.
- 7.1.8 Following assessment of the individual lines, a mosaic will be created and a Geotiff exported to allow for the checking of positional accuracy against MBES data and to identify the extents of any anomalies that may have extended past the limits of individual lines.

Magnetometer

- 7.1.9 Magnetometer data indicates the presence of ferrous, and thus usually anthropogenic, material both on and under the seabed. The specification of the survey is for the detection of UXO, therefore the magnetometer data can provide accurate positions of buried ferrous anomalies. Where possible, magnetic anomalies will be correlated with anomalies visible on the seabed.
- 7.1.10 Magnetometry data will be provided as .xyz files and potentially as a gazetteer, detailing all anomalies greater than 5 nT. An assessment will be made by MSDS Marine as to the suitability of the gazetteer for archaeological interpretation. Where required, the .xyz magnetometer data will be imported into either Geometrics MagPick or Moga Seaview software (latest release), where the data will be smoothed and a 'baseline' identified and removed from the data to highlight ferrous anomalies, whilst taking into account geological variations in the data.
- 7.1.11 Magnetic anomalies will be identified within the data and the position, intensity and dimensions recorded. An archaeological potential rating will be assigned to each anomaly, following the criteria outlined in Table 3, below. The data will be gridded to visually identify areas where the distribution of anomalies may represent a wider feature, such as a buried but dispersed wreck or modern features, such as buried cable or chain.

Multibeam Bathymetry

- 7.1.12 Due to the minimum anomaly detection size of MBES data being larger than that of SSS data, the primary use of MBES data during archaeological assessment (beyond seabed characterisation) is the corroboration of anomalies identified within other datasets and the visualisation of anomalies that may otherwise be obscured by shadow. Features such as mounds and depressions are also often easier to identify in MBES data.
- 7.1.13 Corrected MBES data will be provided to MSDS Marine as .xyz files. The data will be imported into QPS Fledermaus or Moga Seaview software (latest release), where it will be hill-shaded; shading will be adjusted to ensure the optimal presentation of data. The resulting 3-Dimensional image will be viewed on a block-by-block basis alongside the SSS data and all anomalies of potential anthropogenic origin identified and recorded.
- 7.1.14 Records will include, at a minimum:
- An image of the anomaly;
 - Dimensions; and
 - A description.
- 7.1.15 An archaeological potential rating will be assigned to the anomaly, following the criteria outlined in Table 3, below. Where the interpretation of an anomaly is unclear, the data will be loaded into point cloud visualisation software, such as Cloud Compare, in order to view the un-

gridded data. The gridded surface image will be exported as a Geotiff to allow further assessment against other datasets.

Potential	Criteria
Low	An anomaly potentially of anthropogenic origin but that is unlikely to be of archaeological significance – Examples may include discarded modern debris such as rope, cable, chain, or fishing gear; small, isolated anomalies with no wider context; or small boulder-like features with associated magnetometer readings.
Medium	An anomaly believed to be of anthropogenic origin but that would require further investigation to establish its archaeological significance – Examples may include larger unidentifiable debris or clusters of debris, unidentifiable structures, or significant magnetic anomalies.
High	An anomaly almost certainly of anthropogenic origin and with a high potential of being of archaeological significance – high potential anomalies tend to be the remains of wrecks, the suspected remains of wrecks, or known structures of archaeological significance.

Table 3: Criteria for the assessment of archaeological potential

Combined assessment

- 7.1.16 Following the assessment of all datasets, the results will be loaded into ESRI ArcGIS Pro (latest release) or other Geographical Information System (GIS) and reviewed alongside each other, along with Geotiffs of the SSS, MBES, and Magnetometer data. The concurrent review allows the amalgamation of duplicate anomalies, the assessment of the wider context and an understanding of the extents of a feature that may be partially buried.
- 7.1.17 Data from the UKHO, including the positions of wrecks and obstructions, as well as all other relevant data and the locations of third-party assets, will also be assessed, to ensure that any additional information is drawn upon and that anomalies are not unnecessarily identified as having archaeological potential when the origination can be identified as otherwise. The resultant remaining anomalies assessed as having archaeological potential will be compiled into a gazetteer (to be included in the technical report) and a shapefile.
- 7.1.18 The interpretation of geophysical data is subjective, however, with experience and by analysing the form, size and characteristics of an anomaly, a reasonable degree of certainty as to its origin can be achieved.
- 7.1.19 Measurements can be taken in most data processing software and, whilst largely accurate, discrepancies can be noted due to several factors. Where there is uncertainty as to the potential of an anomaly or its origin, a precautionary approach is always taken to ensure the most appropriate mitigation for the historic environment.
- 7.1.20 It should be noted that there may be instances where an anomaly may exist on the seabed but not be visible in the geophysical data. This may be due to being covered by sediment or being obscured from the line of sight of the sonar. The use of both SSS and MBES data mitigates this by visualising anomalies from multiples angles, including from above.

7.1.21 Anomalies will be named following the standard MSDS Marine convention which follows the format; PROJECTYEAR_ID.

Mitigation

7.1.22 To ensure the most appropriate and robust mitigation for the historic environment without unnecessarily impacting the development, mitigation recommendations will be determined on an anomaly-by-anomaly basis and will consider all available data, including potential significance, size, seabed type, seabed dynamics, the development type and potential negative impact. Relevant guidance as set out above will also be considered when recommending mitigation strategies. Mitigation strategies will be based on the criteria in Table 4, below.

Potential	Criteria
Low	No archaeological significance interpreted. Maintain an operational awareness of the anomaly's location and reporting through the agreed protocol should material of potential archaeological significance be encountered.
Medium	Avoidance of the anomaly's position and where appropriate an archaeological exclusion zone may be recommended. Ground truthing of the anomaly through the use of divers or an ROV would establish the archaeological potential.
High	Archaeological exclusion zones will be recommended based on the size of the anomaly, any outlying debris and the seabed dynamics as interpreted from the SSS and MBES data.

Table 4: Mitigation criteria for archaeological anomalies

7.1.23 Where an anomaly is visible in the MBES data, that position will generally be used for the implementation of mitigation recommendations. The position obtained from the MBES data is generally more accurate due to the sensor and the GPS receiver being fixed to the vessel in known planes. SSS sensors are towed and thus the margin for error is greater even with USBL, as the positional tolerance can be between 0.5 and 2.0 m.

7.1.24 The mitigation strategies will include the use of Archaeological Exclusion Zones (AEZs). Mitigation strategies are detailed in Table 5, below.

Potential	Criteria
Archaeological Exclusion Zones (AEZs)	For archaeologically significant anomalies that are clearly identifiable in the survey data and where the extents are largely known, Archaeological Exclusion Zones (AEZs) will be recommended. AEZs will remain for the life of the project or until ground truthing or higher resolution data determines a reduction in potential, significance, or extents.

Table 5: Archaeological mitigation strategies

7.1.25 Furthermore, existing AEZs and TAEZs, where subject to data coverage within campaign one, will be reassessed using the most recent and highest resolution data. The reassessment will

result in the presentation of revised mitigation inline with those presented in Table 5. With the project progressing into the construction phase, and no further surveys being undertaken, any exclusion zones will be considered permanent and thus TAEZs will not be used.

Archaeological input into campaign two

- 7.1.26 The culmination of the archaeological assessment of the campaign one geophysical and hydrographic data will be a detailed list of archaeological anomalies, and associated AEZs.
- 7.1.27 The list of anomalies and exclusion zones will be compiled by Boskalis, alongside the pUXO targets, to create a detailed constraints map for the project. Where anomalies, both pUXO and pArch, impact the proposed route they will be subject to SBI inspection during survey campaign two.

7.2 Campaign two (SBI)

Methodology

- 7.2.1 The methodology for the archaeological assessment of SBI data is much less defined, although its use is being developed within the UXO industry, and MSDS Marine will work closely with Boskalis and the UXO consultants to develop and refine the methodology as the project progresses. Campaign two should be considered as the equivalent of Remotely Operated Vehicle (ROV) inspections.
- 7.2.2 Given the efficiency with which data can be collected, when compared to traditional ROV inspections, it is highly likely that the use of SBI data will be used more and more within the industry. As such, it is important that its use with archaeology is investigated. This project will result in a methodology that can be applied to future projects across the sector.
- 7.2.3 The data from the SBI systems will result in a 3D volume, where the data can be interrogated from all angles to identify anomalies. All anomalies of potential anthropogenic origin will be identified and recorded. Records will include, as a minimum:
- An image of the anomaly;
 - Dimensions; and
 - A description.
- 7.2.4 An archaeological potential rating will be assigned to the anomaly, following the criteria outlined in Table 3. The potential rating will take into consideration the results of both the SBI data, and the results of survey campaign one.
- 7.2.5 As the overall survey campaign will be dynamic, with the results of survey campaign one informing the coverage of survey campaign two, mitigation (in the form of AEZs - see previous section) will be finalised following completion of survey campaign two. As is typical during the inspection of anomalies identified in magnetometer data (and subject to AEZs), a significant number will be identified as modern debris, or ferrous items but of no archaeological interest and therefore a number of AEZs are expected to be removed or refined as the archaeological potential changes.

8.0 Reporting and archiving

8.1 Reporting

- 8.1.1 Following the completion of the survey campaigns, the results will be detailed within a technical report following the structure as detailed within Historic England's *Marine Geophysics. Data acquisition, Processing, and Interpretation Guidance Notes (2nd Edition)*². The report will include a final list of AEZs that will be recommended for implementation, and which will be carried forward into the WSI.
- 8.1.2 All reports will be submitted within 120 days of the completion of data collection. Reporting will follow the appropriate standards and guidance for reporting, that detailed above, and the guidance produced by the Chartered Institute for Archaeologists (CIfA)³ and the Crown Estate⁴.

8.2 Archiving

- 8.2.1 Following review by the archaeological curator the agreed report will be deposited with the Royal Commission on Ancient and Historic Monuments Wales (RCAHMW), by submitting an OASIS (Wales) form with a digital copy of the report, within six months of agreement. The RCAHMW will be notified that the OASIS (Wales) form has been submitted within two weeks of submission.
- 8.2.2 For offshore digital data, the RCAHMW acts as a Marine Environmental Data and Information Network (MEDIN) Data Archive Centre (DAC). Data will be archived directly with the RCAHMW. Geophysical survey data for any medium and high potential archaeological anomalies (including those subject to AEZs), will be archived with the RCAHMW, the format of which is to be agreed prior to deposition. It is anticipated that data will be clipped to the AEZs extents for each anomaly.

² Historic England. *Marine Geophysics. Data acquisition, Processing, and Interpretation Guidance Notes (2nd Edition)*. Historic England: Swindon.

³ CIfA, 2014. *Standards and Guidance for Historic Environment Desk Based Assessment*.

⁴ The Crown Estate, 2021. *Model Clauses for Archaeological Written Schemes of Investigation: Offshore Renewable Projects*. The Crown Estate.