

SEEING THE UNSEEABLE: USING GEOPHYSICAL DATA TO VISUALISE HISTORIC SHIPWRECKS

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Of the 37,000+ known ships lost in English territorial waters, 54 are listed as Protected Wrecks on the National Heritage List for England. Protected Wrecks are restricted areas protected under the Protection of Wrecks Act 1973. While a licence to visit a Protected Wreck is freely available through Historic England (<https://historicengland.org.uk/advice/planning/consents/protected-wreck-sites/applying-for-licensing/>), the logistics of visiting many of these wrecks can be challenging, and impossible for those who cannot dive. Virtual Dive Trails have been commissioned to enable access for all to Protected Wreck sites. The first Historic England Virtual Dive Trail was launched in April 2014, and to date 18 Virtual Dive Trails have been created (<https://historicengland.org.uk/get-involved/visit/protected-wrecks/virtual-dive-trails/>).

Shipwrecks can be hard to visualise. Large scale photogrammetric mosaics, like that of the SS *Thistlegorm*, are only viable for coherent wrecks with a certain level of visibility and are less informative for

more dispersed wrecks or those in difficult conditions. As a result, multibeam echo sounding (MBES) has been used to create most of the models used in the trails and to present the wrecks.



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3D model of the sea bed around the wreck of the Association, built from MBES data. Archaeological features have been enhanced and can be identified by clicking on the numbered information points. Full model available at <https://vdt.cismas.org.uk/trails/association/>. Credit: CISMAS/Historic England

Geophysical data is used in different ways, depending on the requirements of the wreck being showcased. For example, five wrecks in the Isles of Scilly (including the *Association*, the flagship of Sir Cloudesley Shovell, which sank in a storm in 1707) use MBES data to construct a 3D model of the seabed, with points of interest marked. Large objects detected by the surveys are visible on the model, but are highlighted and numbered, allowing greater detail about the history of the ship, the wreck, its discovery and investigation to be explored. Archaeological features are more prominent on the *Wheel Wreck*, where a large mound of mining equipment is visible in the data. A separate visualisation of the cargo mound of the *Wheel Wreck* has been further enhanced with photogrammetry to produce a stunning model that can be viewed in 3D.

Other dispersed and multiple-focus sites such as the *Rooswijk* (a Dutch East Indiaman sunk in 1739) and the

London (a second-rate ship of the line sunk following an explosion in 1665) use data plots as maps to bring the viewer to different parts of the wreck and to show how parts of the wreck assemblage relate to each other over a relatively large area of sea bed. This is particularly important for the *London*, where diving conditions are extremely difficult and few people can access the site in person.

Metal wrecks offer different options as most survive as relatively complete remains. The virtual dive trail of the wreck of SM U-8 (launched in 1911 and sunk in 1915, the first U-boat to be sunk in English territorial waters) was constructed using diver photogrammetry laid over MBES data. The resulting model concentrated only on the wreck itself, rather than on the surrounding seabed. Accurate technical information from dockyard drawings allowed the creation of two models, pre and post wreck, that can be compared online.

Photogrammetric overlay of MBES data of the cargo mound of the Wheel Wreck, showing a pumping engine packed for transport. Features can be identified by clicking on the numbered information points. Full model available at <https://vdt.cismas.org.uk/trails/the-wheel-wreck/>. Credit: CISMAS/Historic England



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3D model of the 1911 builders' model of HMS Falmouth positioned over MBES data showing the wreck today. Features can be identified by clicking on the numbered information points. Full model available at <https://historicengland.org.uk/research/current/discover-and-understand/military/the-first-world-war/first-world-war-home-front/what-we-already-know/sea/hms-falmouth/>. Credit: Fjordr Ltd/Historic England

A broadly similar approach was taken with the wreck of HMS *Falmouth* (a Town-class cruiser sunk in 1916 and now a Protected Place under the Protection of Military Remains Act 1986). Although not presented as a dive trail, a digital 3D model was created of the ship based on the builders' model and scaled and aligned over multibeam imagery of the wreck in its current form, with additional information available by clicking at relevant points on the model.

It is clear from these examples that the capabilities of geophysical data extend far beyond prospection and site investigation. The data are used here not only to record the sites, but to present them in an easily interpretable manner to non-specialists with an interest in marine heritage. They contribute to the interpretation of the site and (certainly for steel wrecks) can illustrate site formation processes in a clear visual manner. There is scope to add time depth to the trails, using geophysical data to illustrate change in the condition of wrecks and across the sea bed over time.

The dive trails are a key part of affording greater access to marine heritage. The original dive trails (designed to help divers navigate historic wrecks) were recognised by UNESCO as being examples of best practice for audience engagement and the virtual dive trails extend that engagement to those who do not or cannot dive.



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Historic England staff demonstrating the dive trails using virtual reality. Most of the 3D models created for the virtual dive trails are VR compatible, allowing for a completely immersive experience without getting wet. Credit: Ken Hamilton

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