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Interpretive Report
for
Magheraroarty Approaches



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Contents

Contents 2
1. Summary 3
2. Orientation 4
3. Pre-Survey Desktop Research 7
Previous Reports 7
Tidal Correction 7
4. Analysis 8
The Transition and Channel 10
5. Conclusions 12
Aids to Navigation 13
References 14

1. Summary

This report is intended to fulfil the requirements as a final report as specified in the tender documents "Magheraroarty Approach Channel Survey", October 2019. It is the first in a family of four reports.

1. Final/Interpretative Report (this report)
2. Bathymetric Report for Magheraroraty Approaches
3. Side Scan Report for Magheraroraty Approaches
4. Magnetometry Report for Magheraroraty Approaches

This report is a summary only and is accompanied by high resolution copies of all figures and data extracts as specified below.

Donegal County Council requirements were specified as:

1. Identify the surface topology in the survey area.
2. Identify and describe any significant obstacles, natural or man-made, exposed at the surface or within 5m of the sediment surface.
3. Identify the optimal channel for the ferry; approx. 30m wide.
4. Characterize the reef to the south-west of the survey box.

The tender assumed that much of the approaches were sand. As it became apparent that the reef extends over the entire survey area, it was decided not to perform a sub-bottom survey. This is effective over soft sediments only.

The objectives specified above are carried out in the context of the Works Requirements, Description of Works for this project.

"*Access to Magheraroarty pier has ever more been challenging due to the shallow approach and continuous siltation within the berthing area of the pier. Annual dredging is required to maintain navigable depths at the pier, however, there is also a difficulty on the final approach to the pier where Donegal Co. Council would now like to obtain an accurate profile of the approach channel.*

It is proposed to carry out a number of surveys to determine the most suitable approach route and from this provide Aids to Navigation. Donegal Co. Council would also like to determine the profile and make-up of the seabed in this area to establish whether or not it is possible to dredge the access channel to make the pier accessible at all levels of tide".

This report draws on the information presented in the other three reports and is intended for a non-technical reader.

2. Orientation

Magheraroarty (also spelled Magheroraty in some references) is a Gaeltacht village located in the north-west of county Donegal, accessed by the R257.

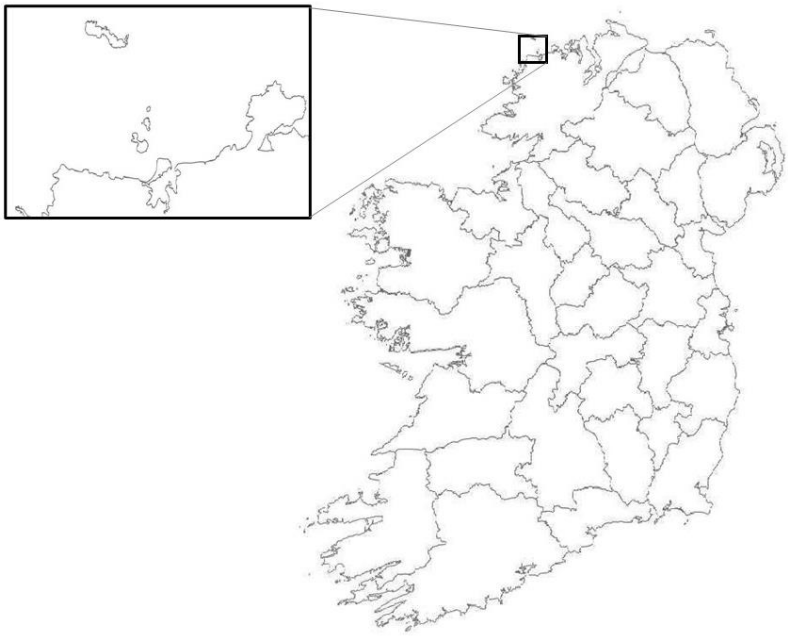


Figure 1. The region of interest

4km north of the harbour are three islands, part of the Inishbofin, Inishdooey and Inishbeg SPA [004083]. 23km north of the harbour is Tory. The peninsula to the east of Magheraroarty is Dooey. To the east of this area are the Ballyness Bay SAC (001090) and the Falcarragh to Meenlaragh SPA (004149) Natura 2000 site. To the west is the Gweedore Bay and Islands SAC [001141].



Figure 2. Significant areas of interest in the region

The area between Inishbofin and the mainland is Inishbofin Bay. There is an on-going issue of siltation with the movement of sediment clockwise about the bay, accumulating at the east side of the pier. Maintenance dredging and beach nourishment activities have taken place since 2008 [1]. Annually, sand is removed from the east side of the pier and used to replenish the beach at Dooey Strand. From 2011, this work was licensed by the EPA [2] as a foreshore license and under renewed licensing, the work continues annually, normally in springtime.



Figure 3. Locations of significance for harbour maintenance

UK Admiralty charts refer to the harbour as Port Marsh, although this name does not seem to be used locally. The harbour supports the ferry service to Tory, and during visits for this survey through 2020, it was observed to be busy with other diverse activities; small local fishing boats, water sports (wind surfing, surfing, paddle boarding, canoeing, etc.) charter and leisure boats.

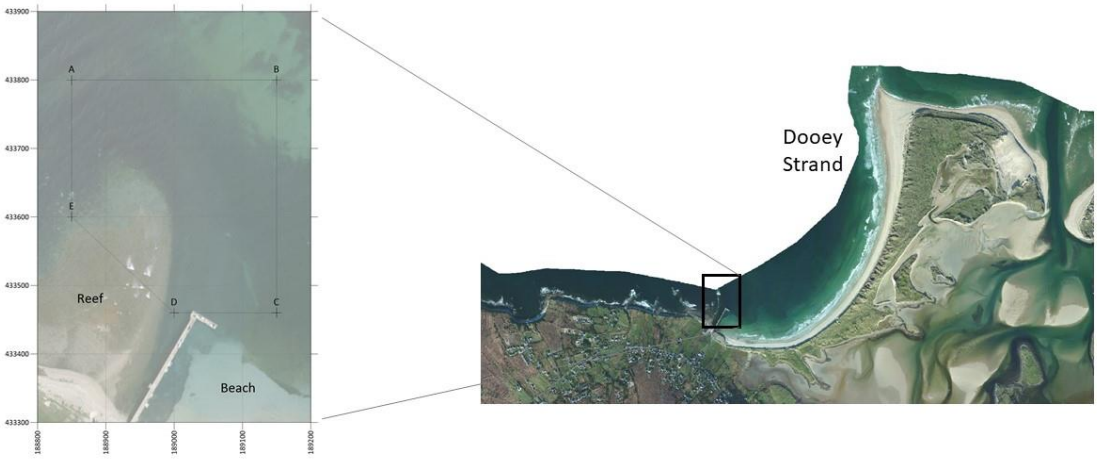


Figure 4. The survey area in its local context

Figure 5 is in the Irish Grid coordinate system (IG) as specified by Donegal County Council; this converts directly to meters. The survey area is marked by points A to E and as an example, the distance from point A to point E is 200m. Throughout this document set, the grid coordinates of this figure are maintained for consistency and clarity.

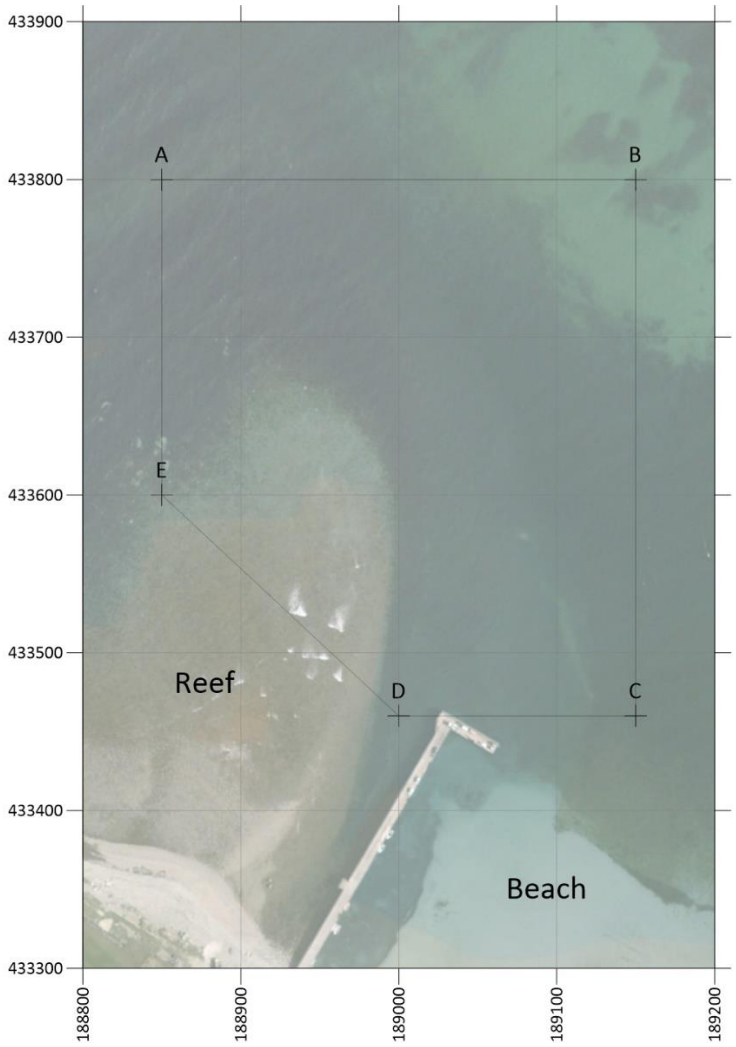


Figure 5. The survey area in relation to the pier and reef, coordinate system is Irish Grid (IG)

The reef extends well into the survey area, but the beach area is sharply demarked on the aerial photograph. Another area of submerged sand is shown around point B. The pier has a dogleg design, providing shelter from the north-west, which is exposed to the open Atlantic.

Annual maintenance dredging maintains a turning circle and berth appropriate for the ferry and is carried out using tracked excavators at low tide from the beach. A long-reach excavator may be used to extend the clear channel north and this been successful.

The target is to maintain navigable depths to -2.5m Chart Datum (CD) or c. -4.5m to Mean Sea Level (MSL) for the ferry. Detailed explanations of these levels are contained in the accompanying Bathymetry Report and are explained in section 4 of this report.

No previous investigation has been identified which has taken place beyond the inter-tidal zone. This suite of surveys is a first reconnaissance and baseline survey of the harbour area.

3. Pre-Survey Desktop Research

Previous Reports

Very few previous reports relating to the harbour have been identified in the public domain.

Foreshore Application Magheraroarty 2013 (determination March 2015 as FS005988) had an associated report (Doran Consulting) giving the rationale for maintenance dredging. Four sediment samples are analysed, in each the sample is described as *yellow light grey brown slightly silty fine to coarse SAND*. The report includes a report on the chemical composition of the sand and of nuclides. Spot levels along the beach east of the pier are documented.

Foreshore Application Magheraroarty May 2020 (FS007140) had no new site investigation.

Although the coverage and data provided by the INFOMAR project has revolutionised marine data availability, no data has yet been published for the immediate coastline of Donegal.

Tidal Correction

The absence of good tidal data was discussed in detail in the associated Bathymetry report, Section 2. It is expected that a permanent tide gauge installation is imminent.

4. Analysis

Maritime navigational charts have their origins with the British Admiralty and original surveys dating back to at least the 19th century. As a depth reference, mariners use the Chart Datum (CD) established then, which was normally the estimated Lowest Astronomical Tide (LAT) at the time.

Land based engineering uses the Ordinance Survey (OD) datum based on the Mean Sea Level at Malin Head (MSL) which is c. 2m higher than CD at Magheraroarty. All depths quoted in this report set are to MSL. For estimation purposes only, subtract 2m to convert to CD. For a more detailed discussion, see the Bathymetry Report, Section 3.

For local reference, the deck of Magheraroarty pier is c. +3m to MSL, or c. +5m to CD. Figures 6 and 7 show a summary of bathymetric data to MSL.

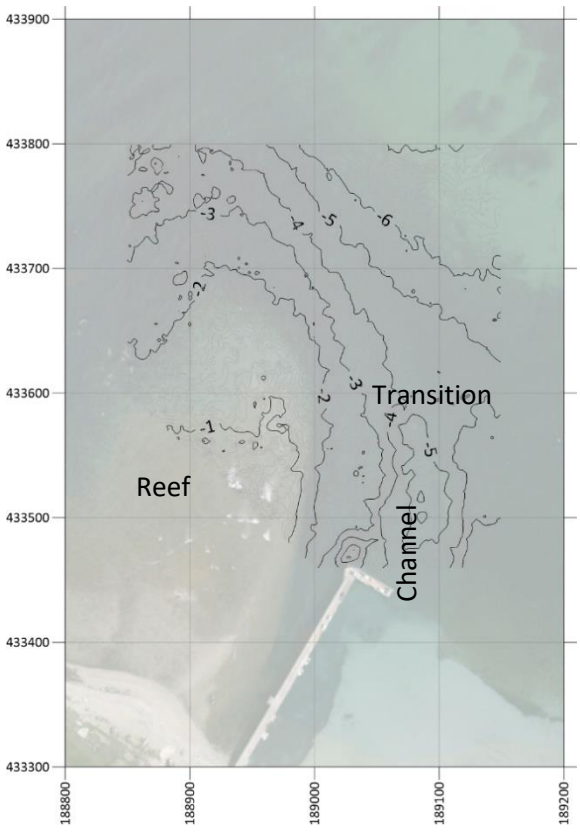


Figure 6. The 1m contours to MSL overlaid on aerial photography

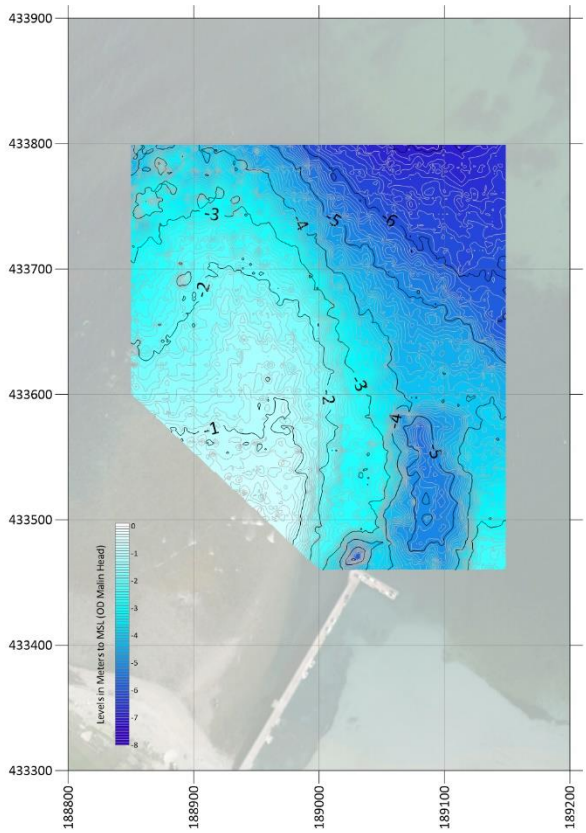


Figure 7. The 1m colour contours to MSL overlaid on aerial photography

For orientation, the -2m contour roughly corresponds with CD/LAT. No accurate charts of this area existed prior to this survey, in hindsight, much of the reef area may have been examined conventionally.

The approaches are a natural channel extending to a ridge c. 160m north of the pier. Bottom hardness measurement (Bathymetry Report, section 5.3) and Side Scan (Side Scan Report, section 5) confirm the bed of the natural channel to be sand.

An abrupt transition occurs at this ridge, confirmed by hardness and side scan measurements, to be sand to the south and rock and cobbles to the north.

The topography of the survey area may better be presented using a three-dimensional view as shown in Figure 8. The natural approach channel is clearly visible, transitioning from sand to rock/cobbles c. 160m north of the pier.

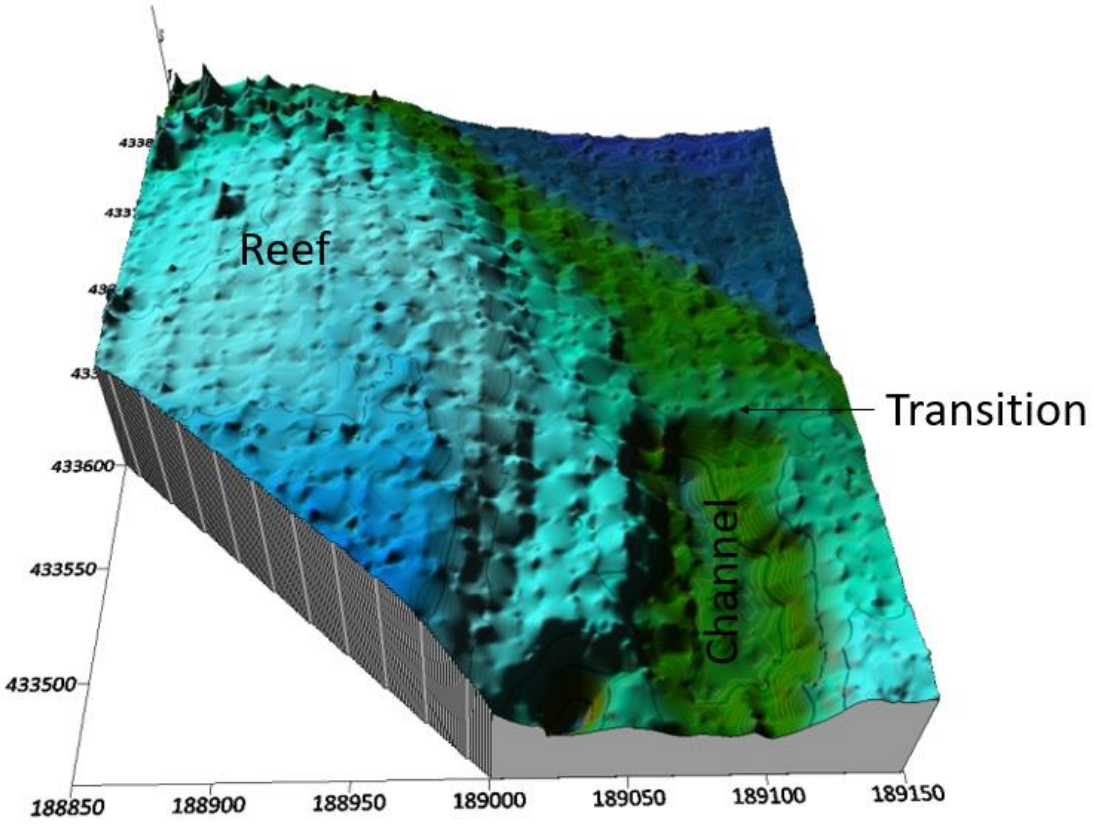


Figure 8. A 3D view looking north with Z axis exaggerated

The Transition and Channel

The side scan report gives a detailed analysis line-by-line of the survey area. Combining side scan lines from R007N to R007P into a mosaic yields the 2D plot shown in Figure 9.

Highlighting the -4.2m MSL contour clearly demarks the boundary between rock and sand on the approaches and the ridge marking the shallowest point. The shallowest point on this ridge is c. -4m MSL or c. -2m to CD/LAT.

The shallower area outside this boundary is rock, cobbles and gravel with some trapped sand. The area inside the boundary is sand with occasional visible cobbles and gravel.

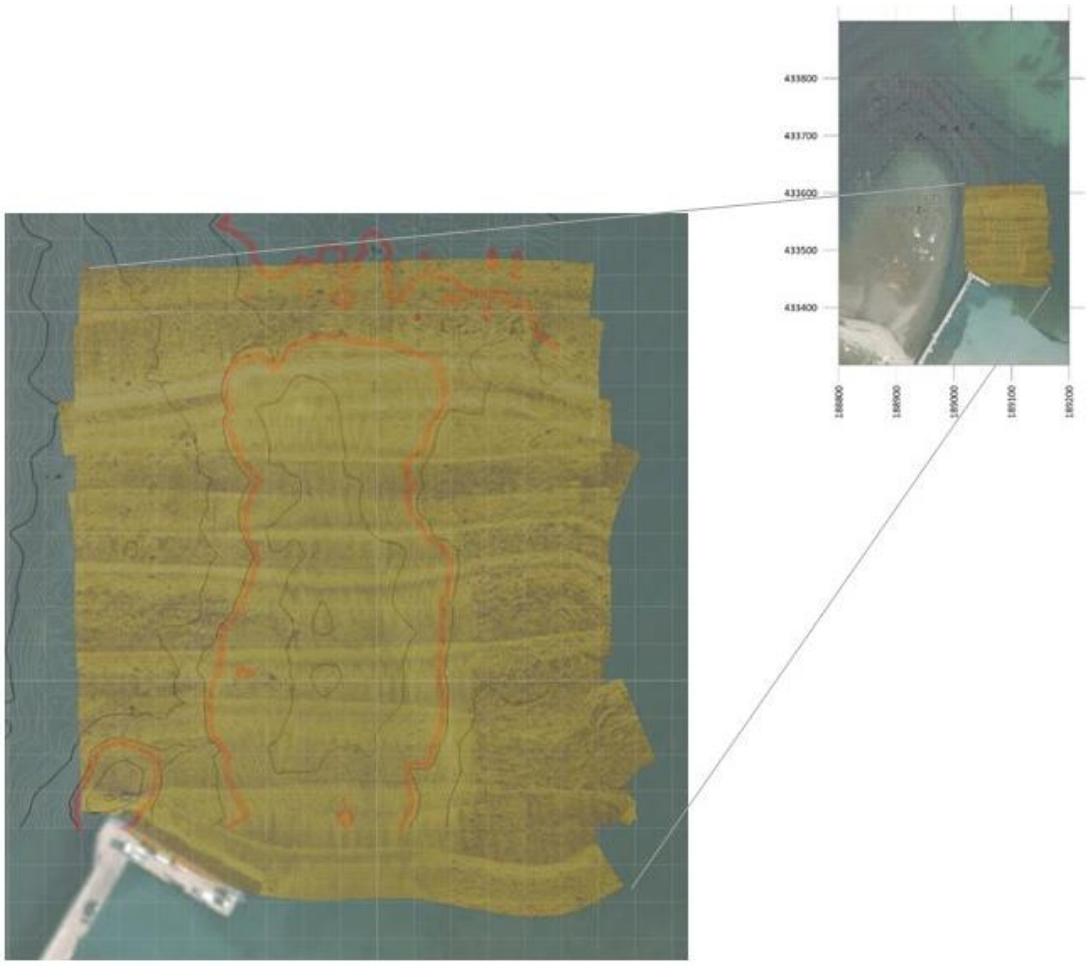


Figure 9. Mosaic of the approaches with -4.2m to MSL highlighted

This transition may be more clearly demonstrated in a 3D overlay with bathymetry and a side-scan mosaic. The channel is sand with an occasional small boulder. The reef on either side shows exposed bedrock, stones and some gravel.

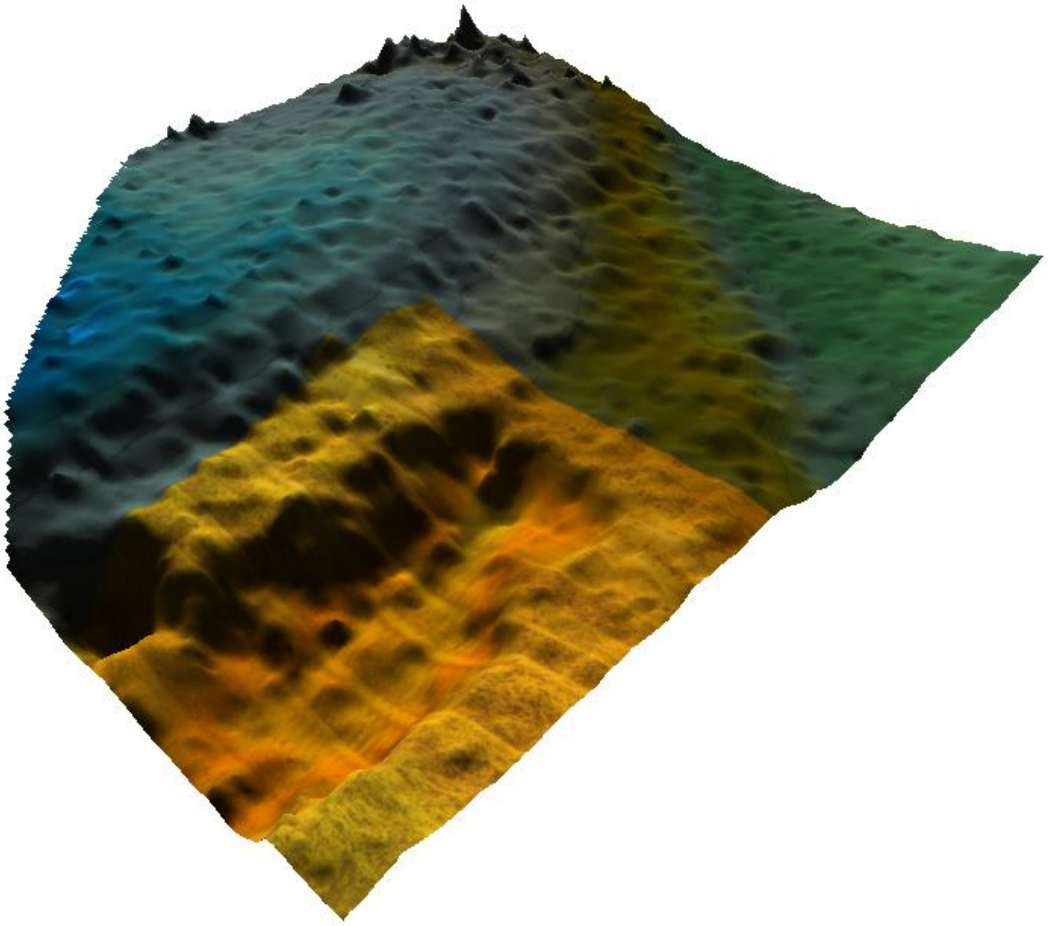


Figure 10. 3D overlay with bathymetry and mosaic, looking from the south-east

The Magnetometer Survey Report goes into some detail on the underlying geology of the survey area. There is little interesting in the detail of the magnetometer lines, however, this is significant, it seems most likely that the bedrock of the survey area is homogenous.

The channel may be formed as a result of erosion with lower sea levels after the last glaciation. The Ordinance Survey Historic 6” maps shows a minor stream and estuary just east of the pier, this is still visible in the OSI aerial photographs of 1995. It seems this stream was piped under the car park to the east of the pier.

5. Conclusions

This is a busy harbour during Summer months with continuous traffic through the middle of the survey area. There are also lobster pots located throughout the east of the survey area and occasionally around point D, just off the pier.

The absence of good tidal curve data was not a significant problem in planning operations. However, the natural shape of Inishbofin Bay makes it an ideal location for surfing and a potentially hazardous location for inshore operations. The survey area includes an area of reef which is exposed at low spring tide. This would be more appropriately studied using terrestrial methods. During survey at high tide, the south-west corner of the survey area had an actual depth less than 2m.

To operate in shallow conditions on an exposed reef, it was necessary to only survey on days with no swell. During late summer 2020, this was c. one day in each two weeks. To survey requires that these conditions correspond with tide, weather, and daylight. Future survey plans should note that even in perfectly calm conditions, sets of waves occur periodically and randomly, 1-2m in amplitude, sufficient to be a danger to boats operating over the reef area.

Drawing on the material of the three associated reports and the synthesis of this information, the following conclusions are made.

1. In the absence of a tidal curve or real-time telemetry of tidal levels, it is impossible to safely navigate the approaches to any harbour without local knowledge. This harbour may be unique in having commercial services, without relevant tidal data.
2. A natural channel exists with a sandy bed c. 50m wide, extending to c. 160m north of the pier.
3. Annual dredging at the south of the channel has exposed cobbles and gravel under the sandy bed, the sand layer is shallow.
4. The channel rises steeply to a rocky ridge c. -4m to MSL c. 160m north of the pier.
5. At low spring tide, this ridge will be c. -2m to sea level and may be exposed in conditions of very heavy swell.
6. To level the ridge and slope to the depth of the channel (-5m MSL) would require the removal of gravel, cobbles and rock for c. 100m (see Bathymetry Report, Figure 7).
7. The rising nature of the ridge followed by the steep drop-off, forms a natural protection to wave energy from the north. The removal of the ridge and slope would completely change the characteristics of the harbour on what is a high-energy coastline.
8. The rocky nature of the survey area in addition to the high-energy nature of the coastline, makes it very unlikely that any material of an archaeological nature will be located at this site. The sandy bed of the channel cannot be completely eliminated as an area of interest, but as the sand layer is very shallow, the presence of artefacts is very unlikely. The techniques used showed no locations of archaeological interest.

Aids to Navigation

A final determination on aids to navigation should be made by the responsible parties.

Port and starboard lateral marks at the point of transition would mark both the end of the channel and the hazard of its shallowest point. Indicative positions are provided in Table 1.

Starboard	189074	433594
Port	189104	433594

Table 1. Indicative positions of lateral marks

A sector light at the east end of the pier would indicate the safe channel.

Leading lights could be placed at the end of the pier and east of the car park for the same purpose.

References

[1] Dumping at Sea Permit No. 389 (Department of Agriculture)

[2] Permit EPA S0014-01

[3] Geology of North Donegal, GSI 1997