Report of survey

For West Harris Trust

Wave renewable project

Survey carried out between 18 Aug 15 and 9 Sep 15

(101445ZXSEP_WHT_001)

Heb MetOcean

Innovate-Explore-Understand

1. Disclaimer and limitations.

101. **Weather.** Due to limited good weather windows during the survey periods and the survey vessel not being equipped with an Inertial Motion Unit (IMU), soundings may vary in confidence by up to 50cm over the period of this operation. Cross line error checks were made at each stage and an overall standard deviation across lines of 0.25m was achieved.

102. **Reconnaissance survey.** This survey was a reconnaissance level survey with average line spacing of 25m and cross lines at 75m utilising a fine beam width (4 degree) 420Khz survey echo sounder. Complete sonar coverage of the seabed was NOT achieved, therefore shoal patches or obstructions between sounding lines may have been missed. This survey was primarily tasked to provide an appreciation and verification of seabed relief and larger scale features in order to inform future planning.

103. **Seaweed and Bio.** The high frequency echo sounder regularly gave strong near seabed bottom like returns from seaweed, large shoals of fish (visible) and moving silt. Therefore, some areas may show false depths due to seaweed and high levels of biologic returns near the sea bed. A high level of Bio activity was observed, with porpoises and pinnipeds observed at close range causing large periods of survey time being lost through sonar silence.

104. **Seabed sediment.** Without a full sub bottom geophysical survey the depth of sediment and sand cannot be fully assessed. The Side scan data may show sand, however this will only indicate the immediate ocean seabed interface and provides no guarantee of sediment depth. In addition, the area is subject to Atlantic storms, therefore areas that appear to be sand may change and seabed depths may change exposing firmer seabed or rock.

2. Tidal readings

201. **Tide gauge.** A tide gauge was established at West Loch Tarbert along with a GNSS station and an RTK GNSS system was set up on the vessel to record vertical height. Due to the distance from West Loch Tarbert the measured RTK tide differed from the measured tide heights at West Loch Tarbert, with a closer correlation with the predicted tide at Leverburgh. For this reason RTK GNSS tides were used, with corrections being sent form a shore based station (WHT1) at the nearest point of land.

3. Echo sounder (single beam) survey.

301. A fine beam (4 degree) high frequency echo sounder was utilised for the survey to provide the first return from the water sediment interface. The sounder operates at 420khz and will give the first return from softer sediment. This reading may differ from lower frequency echo sounders that will penetrate soft sediment missing the softer sediment interface. Lines were run at 25m with cross lines at 75m as requested, however in key areas for investigation lines were closed and additional lines were run to provide greater resolution.

A standard deviation of 0.25 m was achieved during the final phase and areas of large deviation were visually examined. A single beam line along with side scan runs were carried out along the route of the proposed power cable. Close to the shore and around the rock headland, additional side scan and single beam lines were carried out to provide greater fidelity. The bathymetric contour chart is shown at Enclosure 2 for the main area.

4. Control of Survey

401. One control station was established utilising long duration GNSS static measurements (4 sets of 5 hourly readings). The data was processed utilising Ashtech GNSS solutions with repeatability within 15mm. The survey was carried out utilising GNSS in RTK mode in ETRS89. Heights were transformed to OSGB using the OSGN02 Geoid to provide height and CD separation from the GRS80 spheroid. An RTK base station was established at the point overlooking the survey are to provide precise corrections to the survey boat.

401. The control stations was:

a. WHT 1; ETRS89 57 51’ 26.20696’’N 006 59’ 59.56638’’W ht 72.589m above GRS80 spheroid (15.423m above OD OSTN02 transformation)

402. Further rounds of measurements were taken and processed to ensure repeatability.

5. Side Scan Operations.

501. The main area was fully side scanned (Enclosure 3) with a number of seabed features detected, with some objects presenting man-made appearances. The stronger returns and rougher seabed texture clearly matches the survey contours as shown in Enclosure 3. A low frequency side scan run was carried out along the cable route shown in Enclosure 4.

502. Drop down video was attempted in the shallow areas to identify the features for the cable run. However, due to the swell and sediment movement the images were not clear enough to offer useful analysis. Therefore it was decided to run a greater number of short range higher frequency side scan runs towards the termination of the cable in order to provide greater perspective Enclosure 5, as well as photography from 180ft to provide a better shallow water appreciation.

6. Photography

601. Due to the amount of sediment movement and poor underwater visibility in the critical shallow water area for the cable run it was decided to carry out airborne photography to provide wider perspective and indications of differing seabed type along the proposed cable run results are shown in Enclosure 1.

7. Conclusion.

701. The deeper area for the proposed mooring system shows a uniform seabed texture at approximately 20m depth. Here are however two areas of rock to the East that the cable system will be required to traverse between. Further East along the track there are two extensive firmer rock like seabed areas. The first is immediately after the turn to the East with the second approximately 150m further down the track. Enclosure 4 shows the additional HF side scan runs close inshore to highlight the rock areas.

702. As no seabed penetrating geophysical assessment has been carried out, sand and sediment depth cannot be accurately assessed. Areas that appear as smooth textured seabed or sand waves may only be shallow areas of sand over rock, with these areas likely to shift during the winter storms. From local knowledge and assessment, the seabed sediment in this area is in a constant state of flux and movement. This survey was a reconnaissance level survey aimed to identify the key bathymetric features with single beam and side scan sonar. A more detailed geophysical survey with sub bottom assessment focusing on the cable routing and protection of the cable is recommended. Future surveys should concentrate on the shallow water near shore area for cable routing.

J Toor

Director

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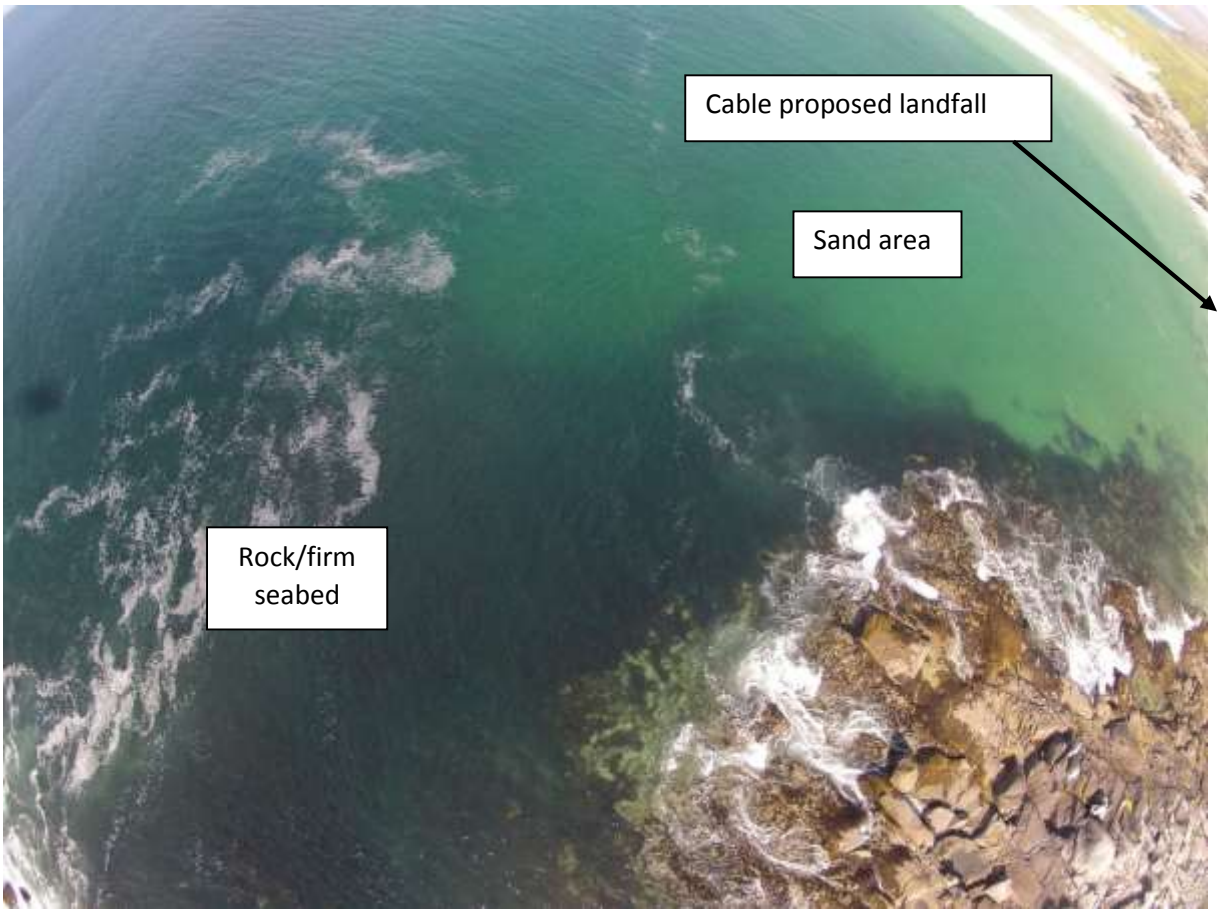
Enclosures:

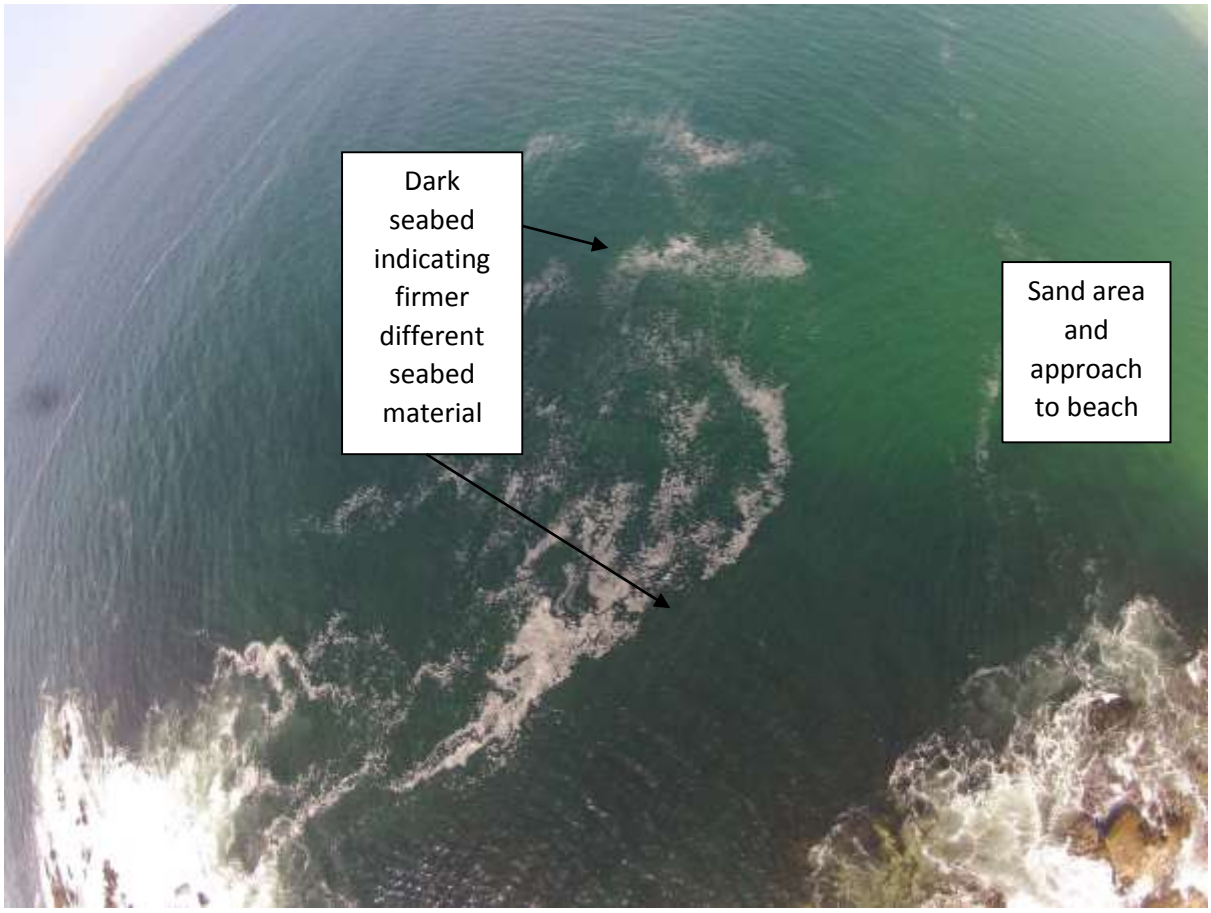
1. Photography
2. Main area bathymetric contour chart
3. Main area side scan
4. Cable track bathymetry and side scan
5. Cable track HF side scan.

Enclosure 1 to West Harris Wave renewable Survey of Pairc Nisabost

Photographs



From the photograph above it can be seen that the final approach to landfall is lighter sand seabed. The main rock headland in the lower right of the photograph appears to extend out to sea across the proposed cable track as shown in Enclosure 5 side scan image.



From the second photograph above the darker areas indicate a change in seabed type from sand to possible extension of the rock headland out to seaward. The darker appearance could be a change in depth (deeper) but could also be a change in seabed material with rock and marine growth.

The photograph above gives the overall perspective, with the proposed cable landing area on the beach to the right, along with the darker seabed indicating a change in seabed type to the far left.

Photograph above shows detail of the proposed cable landing area.

Wider overview of approach to beach.