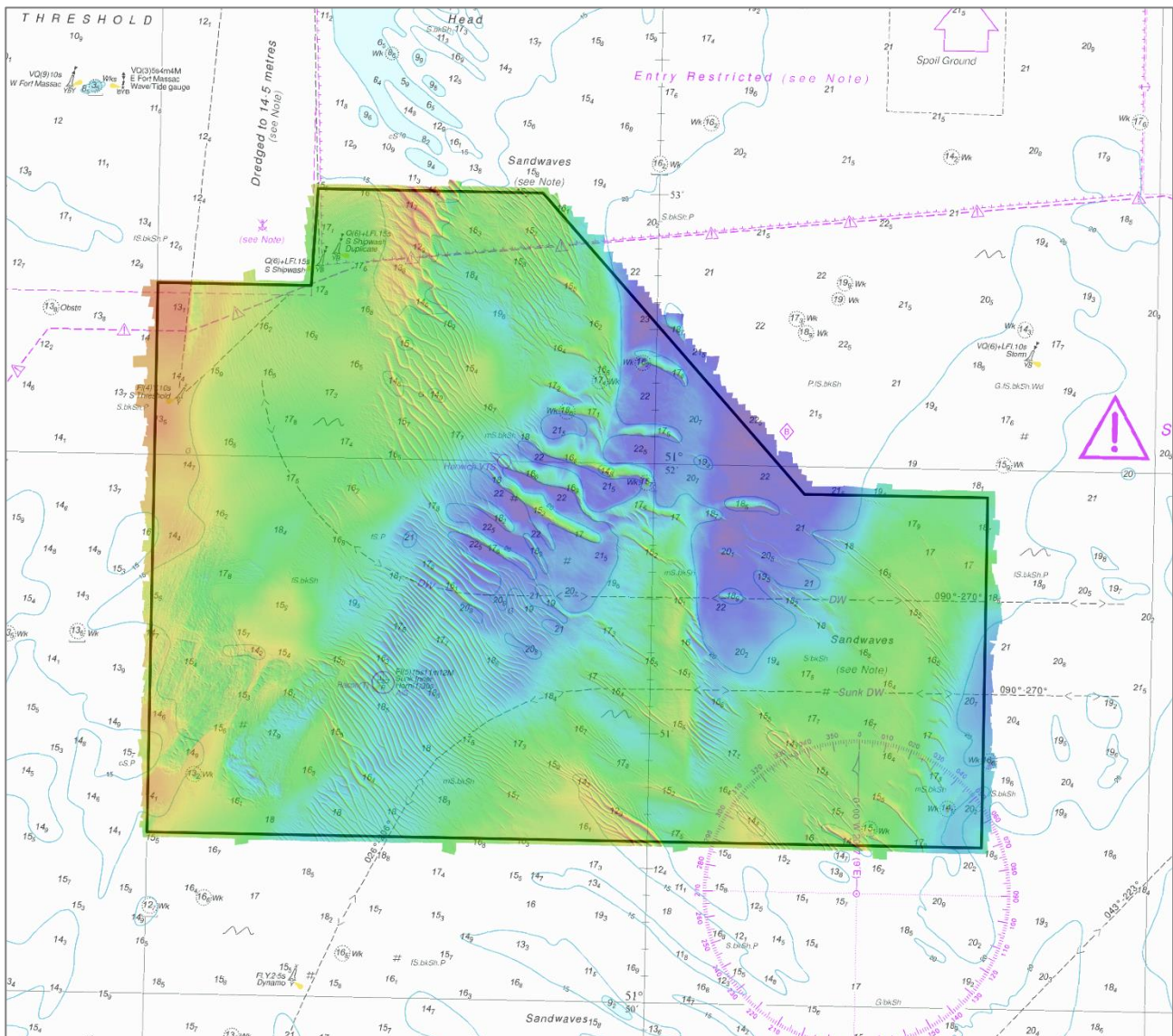




THAMES ESTUARY SUNK (TE3A) ASSESSMENT TE3A/2016-V3

An assessment of the 2016 hydrographic survey of the area TE3A: to monitor recent seabed movement; to identify any implications for shipping; and to make recommendations for future surveys.



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SUNK TE3A, 2016

1. EXECUTIVE SUMMARY

The Area and Recent Changes

- 1.1 The area covers the approach to the Harwich Deep Water Channel, which is dredged to 14.5m and forms the main approach to Felixstowe. The area also covers part of the Sunk Deep Water Route (DWR) leading into Black Deep.
- 1.2 Area TE3A is fully surveyed every 2 years. In the intervening year, a focused survey is conducted covering most of the Harwich Deep Water track and shoal features in the vicinity. The 2016 survey was a full area 2-year survey and the analysis in this report has been made against the previous full survey in 2014 and the focused survey in 2015.
- 1.3 Sandwaves in the area are up to 6m high and are following a historical trend of migrating in a south to south-westerly direction across a gently undulating seafloor. Minimum depths over sandwaves are broadly similar to those found in the 2014 survey.
- 1.4 The minimum depth over the survey area is 11.5m in the northern sandwave area, which is in close proximity to the DWR approaching the Harwich Channel.
- 1.5 The largest draught of vessel transiting the survey area is registered at 16.5m. The controlling depth along the Harwich Deep Water track is 15.1m and the controlling depth along the Sunk Deep Water track is 16.4m.

Reasons for Continuing to Resurvey the Area

- 1.6 Sandwaves cover much of the area, with most slowly migrating across the area. Their heights fluctuate with time and, near the Deep Water tracks, remain close to being critical to shipping.
- 1.7 Shipping density in the area is high and the deepest draught vessels potentially transit the area with small under-keel clearances.
- 1.8 The area requires regular resurveying to ensure the location and depth of sandwaves are adequately charted.

Recommendations

- 1.9 The Full Area survey should be postponed until FY2019-2020 and a Focused Area survey should be undertaken again in FY2018-2019.
- 1.10 The full 2-year frequency with focused survey in the intervening year to recommence following the amendments in 1.9 above, as well as the full and focused survey limits should be retained (see Table 1 in Section 4.5).
- 1.11 At the Next CHWG a long-term analysis should be presented including surveys utilising the available data sets from both Full Area and Focused Area limits for TE3A.

2. INTRODUCTION

- 2.1 This Assessment is produced by the United Kingdom Hydrographic Office (UKHO) for the Maritime and Coastguard Agency (MCA).
- 2.2 Analysis of the Routine Resurvey Areas forms part of the Civil Hydrography Programme and the reports are made available to all interested parties through the UKHO website and are

presented to the Civil Hydrography Working Group. When approved, the recommendations are incorporated into the Routine Resurvey Programme.

- 2.3 The Admiralty Chart extracts, other graphics and tables in this Report are included for illustrative purposes only and are NOT TO BE USED FOR NAVIGATION.
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3. AREA HISTORY

3.1 Summary of Surveys:

Year	Survey	File Ref	Data	Year	Survey	File Ref	Data
1989	M1386	H3933/88	s.t.d.	2003	M3942	HH091/023/01	s.d.
1990	M1580	HH090/494/01	s.t.d.	2004	M4183	HH091/087/01	m.
1991	M1797	HH090/515/01	s.d.	2005	M4356	HH091/116/01	m.
1992	M1888	HH090/548/01	s.d.	2006	M4576	HH091/165/01	m.
1993	M2129	HH090/573/01	s.d.	2007	M4639	2007-7600	m.
1994	M2257	HH090/625/01	s.d.	2008	HI1264	2008-26408	m.
1995	M2504	HH090/653/01	s.d.	2009	HI1293	2009-29528	m.
1996	M2631	HH090/690/01	s.t.d.	2010	HI1339	2010-175484	m.
1997	M2822	HH090/742/01	s.d.	2011	HI1368	2011-112084	m.
1998	M3008	HH090/768/01	s.d.	2012	HI1398	2012-117404	m.
1999	M3225	HH090/851/01	s.d.	2014	HI1459	2014-153152	m.
2000	M3367	HH090/885/01	s.d.	2015	HI1483	2015-83469	m.
2001	M3543	HH090/935/01	s.d.	2016	HI1522	2016-181430	m.
2002	M3739	HH090/993/01	s.t.d.				

Key: s = sonar sweep, t = seabed texture tracing, d = digital data, m = multibeam digital data
Single-beam surveys (prior to 2004) conducted at 1:25,000 scale

3.2 Summary of historical recommendation enacted

Year	Remarks
1985	Area 3A established (H0423/85).
1989	Area 3B incorporated with area 3A.
1989	Harwich Harbour Authority limits extended; BA NM 1138/89 (HH242/470/01).
1993	Harwich Haven Authority further extension of limits; NM3018/93 (HH242/470/02).
1996	Dredging in this area (HH242/168/06 E23&43).

1998	Expansion of area (HA145/002/003/07 E27).
2003	Area Limits reduced.
2005	Focused area introduced.
2007	Minor revision to focused area.
2014	The full 2-year survey limits and frequency retained.
2015	The focused survey limits and 2-year frequency retained. Due to the apparent stability of the majority of the survey area a longer-term study should be conducted to confirm the sandwave movement is in a continuous direction and may encroach on the charted DWR.

4. DESCRIPTION OF THE AREA

- 4.1 The TE3A full survey area includes two recommended deep water tracks. Harwich Deep Water track leads to the entrance of the Harwich Deep Water Channel, which has a maintained depth of 14.5m. This forms the main approach to Felixstowe, which has berth depths of up to 16m. The Sunk Deep Water track is used by deep draught vessels as an approach to Black Deep and onwards into the Thames Estuary. The northern limit includes the southern extremity of South Ship Head, which lies to the east of the dredged channel. The shallowest depths in TE3A are found in this area.
- 4.2 In the middle of the area there is an area of large sandwaves up to 6m high. These are strongly asymmetrical with their steeper side facing towards the southwest. To the south of these lies an extensive area of symmetrical sandwaves up to 3m high.
- 4.3 The remainder of the area contains smaller bands of sandwaves and ripples and a gently undulating seabed with depths ranging from around 11.5 to 23.8m. In the west of the area there is a charted Extraction Area.
- 4.4 Area Covered: 5.94 NM² (20.4 km²) as shown in Figure 1 below.

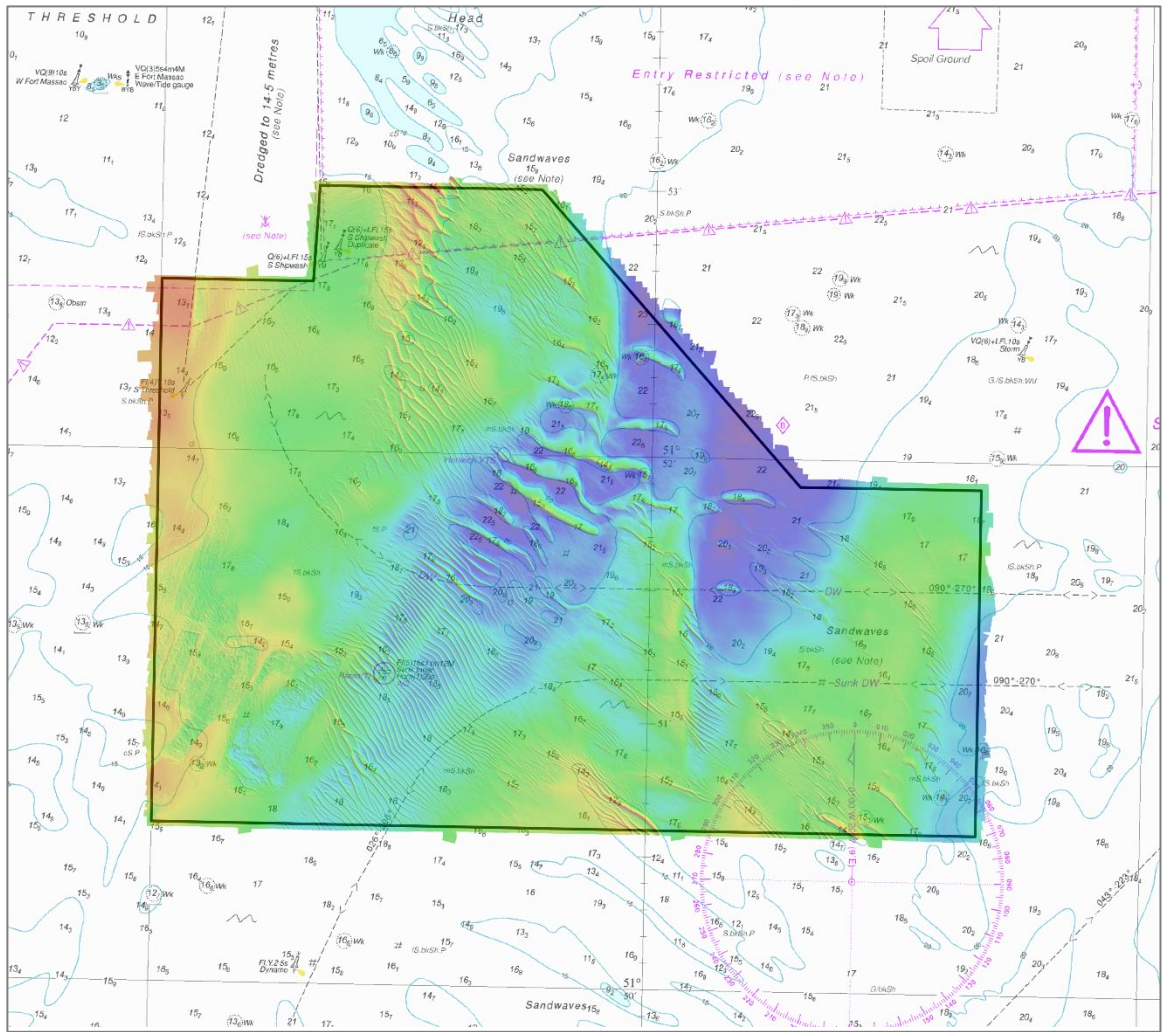


Figure 1 – HI1522 TE3A survey data sun-illuminated view overlaid on BA Chart 2692

4.5 The geographic limits at the time of resurvey are shown in the Table 1 below and coordinates are in Decimal Degrees referenced to WGS84:

Table 1: TE3A 2016 Survey Limits

Point	Latitude (N)	Longitude (E)
01	51.877333	1.550000
02	51.877333	1.565333
03	51.883333	1.565833
04	51.883333	1.588300
05	51.865000	1.615000
06	51.865000	1.633300
07	51.843333	1.633333
08	51.843333	1.550000
01	51.877333	1.550000

4.6 Survey interval at time of resurvey: 2 yr

4.7 Largest scale chart: BA2692 (Scale 1:25,000)

5. SHIPPING IN THE AREA

5.1 Shipping data from satellite AIS data for 2016 of vessels larger than 2000GT shows the maximum registered draught vessel to transit through the area was 16.5m.

5.2 Vessels with up to 10m draught transit throughout the survey area, yet vessels with between 10 and 16.5m draught largely stick to the recommended Deep Water routes (as shown in Figure 2).

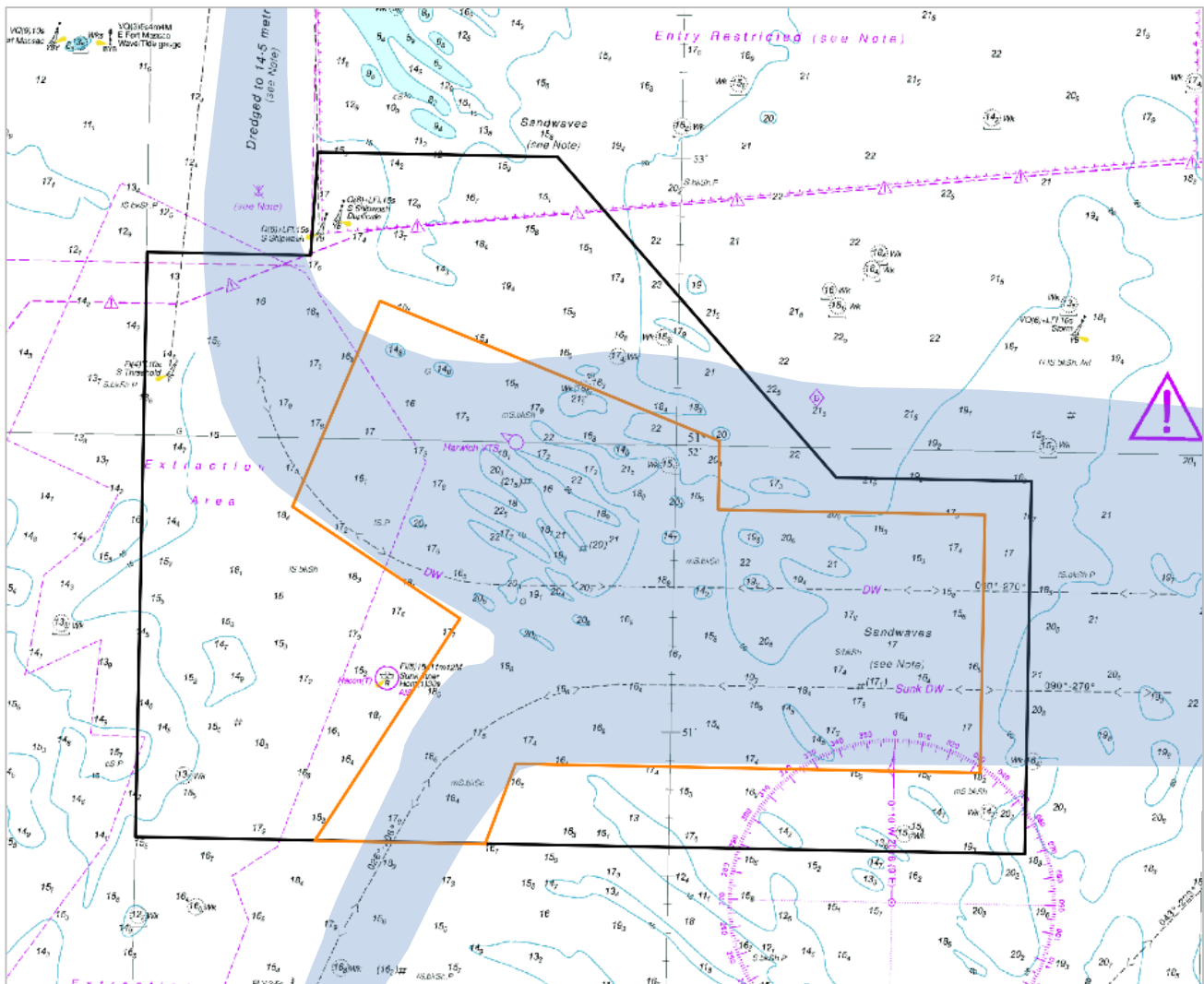


Figure 2 – Indicative shipping routes of vessels with 10-16.5m draught overlaid on BA Chart 2692

-----	Deep Water Track
—————	2016 Survey Area Limits
—————	2015 Survey Area Limits
■	Indicative shipping routes of vessels with 10-16.5m draught

6. REFERENCE SURVEY DETAIL

- 6.1 The historical routine resurveys gathered via the Civil Hydrography Programme (CHP) for area TE3A which have been used to compile this assessment are as follows
- A focused area survey gathered between the 15th and 17th August 2015 under Hydrographic Instruction (HI) 1483.
 - A full area survey gathered between the 22nd and 28th June 2014 under HI1459.
- 6.2 The survey data in both datasets was acquired using multibeam echosounder system. The primary reference position system used GNSS and was supplemented by a dynamic GNSS Precise Point measuring system. The surveys are referred to International Terrestrial Reference Framework 2005 (ITRF05).
- 6.3 Observations from GNSS 3D positioning in both datasets were combined with the UKHO Vertical Offshore Reference Frame (VORF) to reduce depths to Chart Datum. The final deliverable in each HI was a 1m resolution CUBE (Combined Uncertainty and Bathymetry Estimator) surface.
- 6.4 Both surveys were validated by UKHO and met IHO S44 (5th Edition) Order 1a standards.
- 6.5 Both Report of Survey are available upon request from the UKHO and the validated bathymetric surfaces are available to download from INSPIRE portal and MEDIN Bathymetry Data Archive Centre.

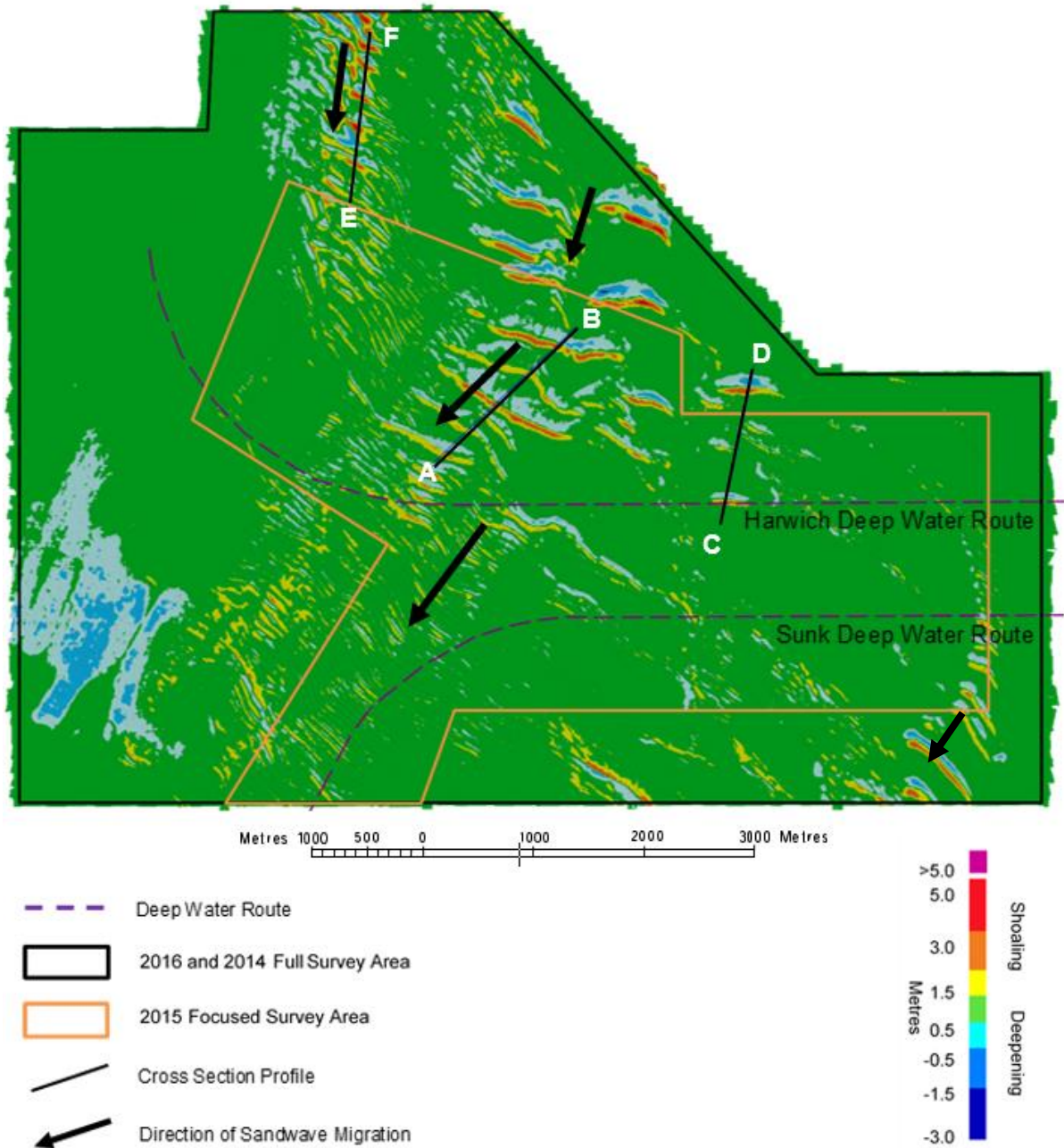
7. COMPARISON SURVEY DETAIL

- 7.1 The latest survey undertaken as part of the CHP Routine Resurvey was in 2016 under HI1522. Area TE3A was surveyed between 11th and 14th August.
- 7.2 The survey data was acquired using multibeam echosounder system. The primary reference position system used GNSS and was supplemented by a dynamic GNSS Precise Point measuring system. The survey is referred to the European Terrestrial Reference Frame 1989 (ETRF89) datum.
- 7.3 Observations from GNSS 3D positioning were combined with the UKHO Vertical Offshore Reference Frame (VORF) to reduce depths to Chart Datum. The final deliverable was a 1m resolution CUBE (Combined Uncertainty and Bathymetry Estimator) surface.
- 7.4 The survey was validated by UKHO and met IHO S44 (5th Edition) Order 1a standards.
- 7.5 The Report of Survey for this surveys is available upon request from the UKHO and the validated bathymetric surfaces are available to download from INSPIRE portal and MEDIN Bathymetry Data Archive Centre.

8. DESCRIPTION OF RECENT BATHYMETRIC CHANGE

- 8.1 The Variability Plot in Figure 3 and Profile Comparisons in Figures 4 to 6 show that sandwaves in the central area (Profile A-B) are generally migrating in a south-southwest direction by 15 to 25m a year. In the eastern part of the area (Profile C-D) sandwave migration is southward at 10 to 20m a year. In the north of the area (Profile E-F) sandwaves have migrated 40 to 50m southwards since 2014 averaging 20 to 25m per year. All profiles are consistent with historical sandwave movement in this area reported in the assessment for 2015.

- 8.2 Profile A-B shows that sandwaves are up to 5-6m high in the centre of the survey area. Profile C-D shows that sandwaves are 2-5m high in the east of the survey area. Profile E-F shows that sandwaves are 3-4m high in the north of the survey area. In all areas these sandwave heights are in broad agreement to those in the 2015 and 2014 surveys.
- 8.3 Figure 3 also illustrates that the bank in the northwest corner has shown little sign of movement towards the Harwich DW route.



8.4

Figure 3 – Variability Plot showing Bathymetric Changes between the 2016, 2015 and 2014 Surveys

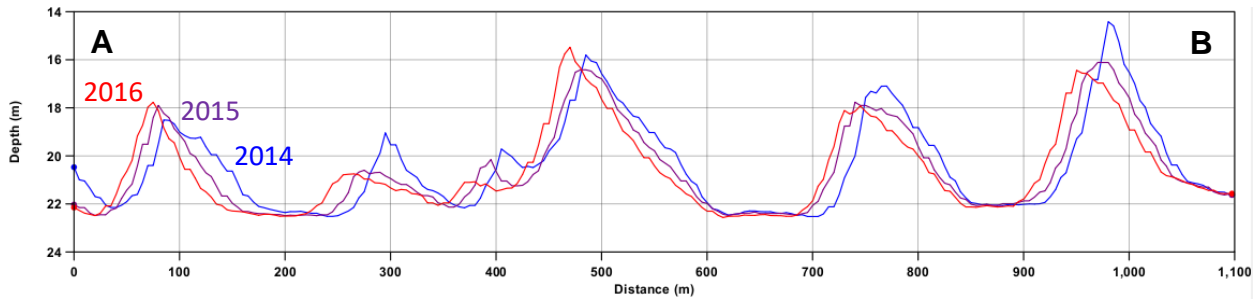


Figure 4 – Profile A-B comparison of bathymetric change between 2014, 2015 and 2016 surveys

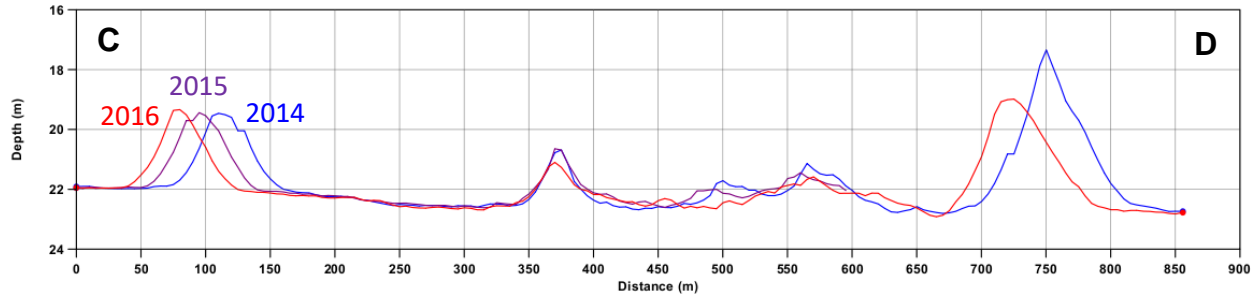


Figure 5 – Profile C-D comparison of bathymetric change between 2014, 2015 and 2016 surveys

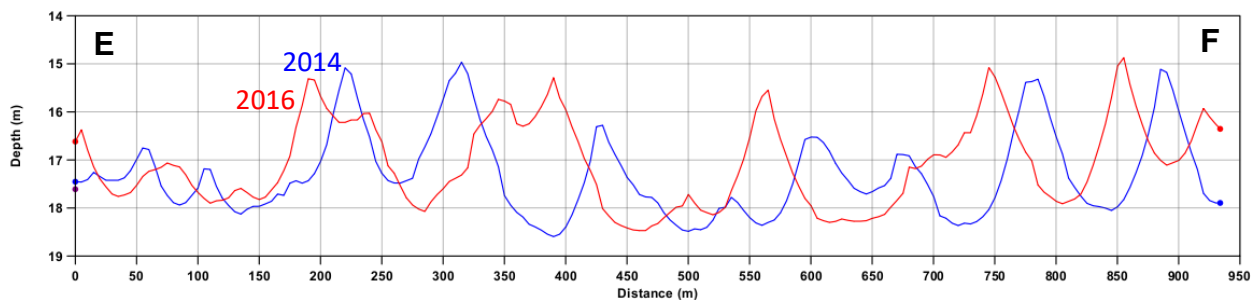


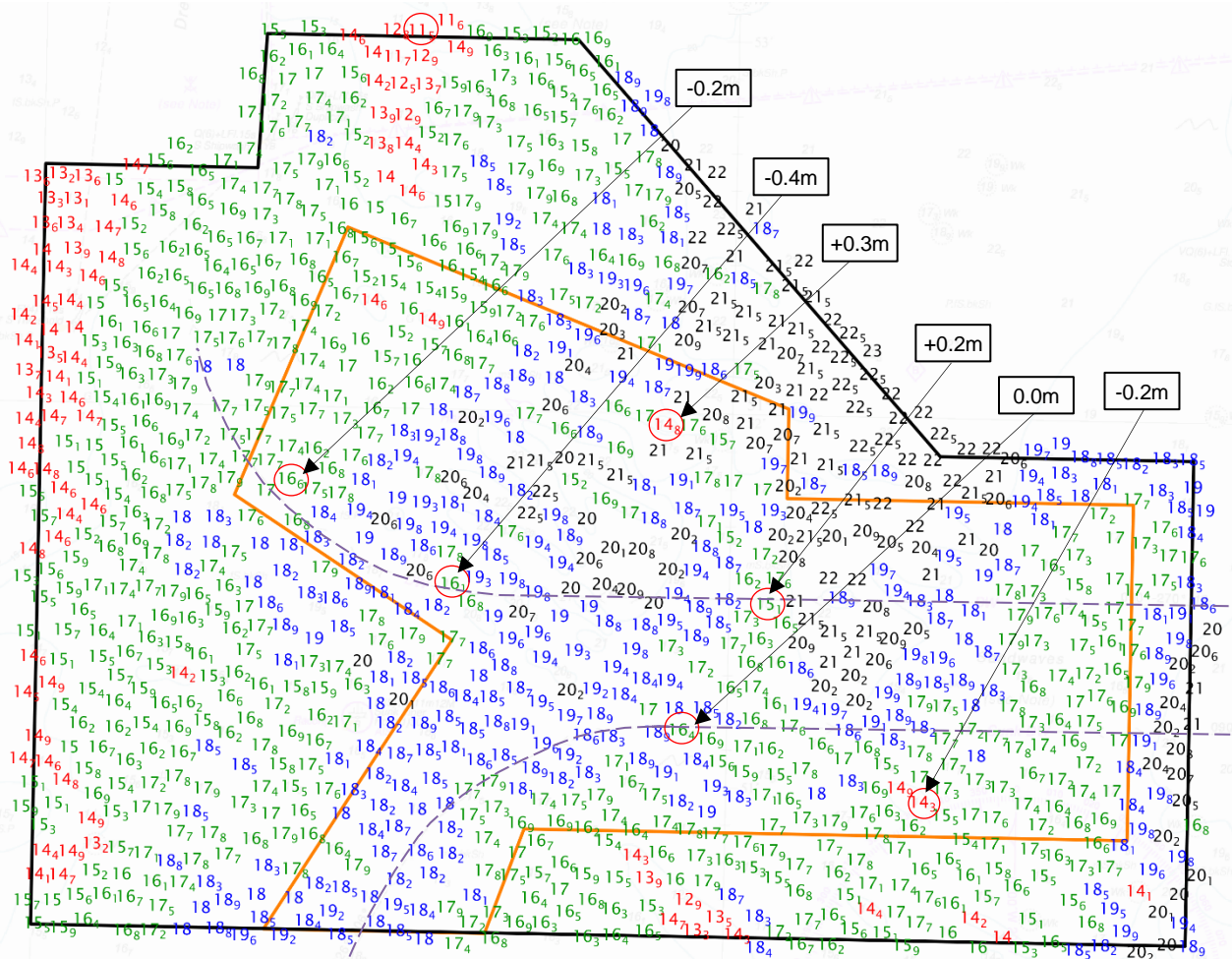
Figure 6 – Profile E-F comparison of bathymetric change between 2014 and 2016 surveys

Year of Survey	
—	2016
—	2015
—	2014

8.5 The colour banded depth plots in Figures 7 and 8 highlights local shoals and controlling depths from the 2016 survey, as well as changes in depth since the last focused survey in 2015 and the last full survey in 2014. Depths have generally not changed significantly across the survey area, including along the Deep Water Routes. Selected depth changes in Figures 7 and 8 show that some controlling depths have deepened, some have stayed the same and some have shoaled since 2015.

- a. The controlling depth in the survey area is 11.5m in the northern area of sandwaves, located towards the boundary of the current full area survey limits which is 0.5m shoaler than in 2014.
- b. Depths along the Harwich Deep Water Route have generally not changed significantly. The controlling depth on Harwich Deep Water track within TE3A has fluctuated between 15.3m in 2014, to 14.9m in 2015 to 15.1m in 2016.
- c. Depths along the Sunk Deep Water Route have generally not changed significantly. The controlling depth on Sunk Deep Water track within TE3A has remained 16.4m since 2014.

d. Minimum depths over sandwaves are broadly similar to those found in the 2014 and 2015 surveys, but with ongoing migration of sandwaves as detailed in paragraph 8.1.



Depth changes indicated above are from the closest corresponding 2015 sounding available. Hence depth differences will be from different positions from the 2016 sounding selection as an automatic shoal bias sounding selection tool has been utilised which produces a representation of the shoal values in a data set. Positive values (+) represent deepening. Negative values (-) represent seabed depths becoming shallower.

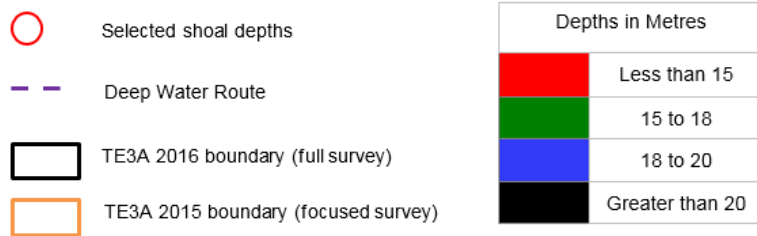
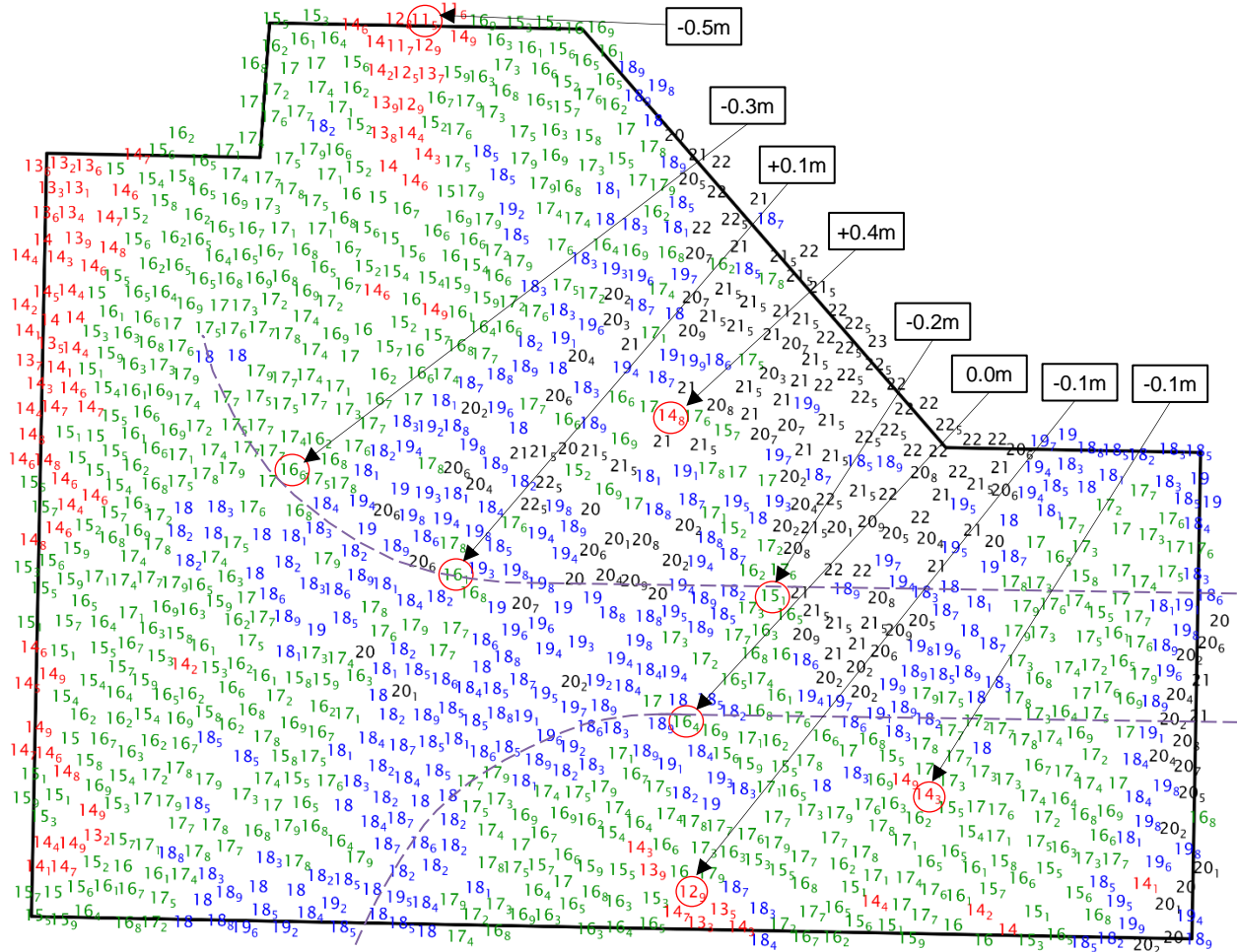


Figure 7 – Colour Banded Depth Plot from the 2016 Full Survey with selected depth changes since the 2015 Focused Survey



Depth changes indicated above are from the closest corresponding 2014 sounding available. Hence depth differences will be from different positions from the 2016 sounding selection as an automatic shoal bias sounding selection tool has been utilised which produces a representation of the shoal values in a data set. Positive values (+) represent deepening. Negative values (-) represent seabed depths becoming shallower.

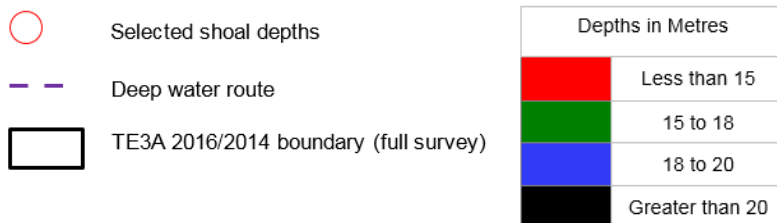


Figure 8 – Colour Banded Depth Plot from the 2016 Full Survey with selected depth changes since the 2014 Full Survey

9. IMPLICATIONS FOR SHIPPING

- 9.1 The Harwich Deep Water Channel is dredged to 14.5m and depths of less than this in the approach to the channel would be of concern to shipping. The controlling depth in the DW routes within the survey area are still deeper than the maintained depth.
- 9.2 The heights of sandwaves remain close to being critical to shipping. The continuous southwest migration of the sandwave areas in the centre and north of the survey area towards the Harwich DWR may be of concern to shipping and impact the maintenance of the route if sandwaves become shoaler in the future.
- 9.3 The largest registered draught of vessel transiting the survey area is 16.5m. The controlling depths along the Harwich and Sunk Deep Water tracks have not changed significantly since the last full and focused surveys of this area. Most depths across the survey area remain deeper than the draught of shipping using the area. However, vessels continue to transit the area with a larger registered draught than the controlling depths in the Deep Water Routes covered by the limits of TE3A.

10. RECOMMENDATIONS FOR FUTURE SURVEYS

- 10.1 There is apparent stability over the majority of the survey area, however there is continuous southwest sandwave migration which may encroach on the charted DWR. Therefore, the Full Area survey scheduled for FY 2018-2019 should be postponed until FY2019-2020 and a Focused Area survey should be undertaken again in FY2018-2019.
- 10.2 Following the alteration in 11.1 above the 2-year frequency of the Full Area surveys should be resumed (with focused survey in the intervening year) until the long-term analysis of the area has been presented to the CHWG
- 10.3 The full and focused survey limits should be retained to ensure the location and depth of sandwaves are adequately charted until the long-term analysis of the area has been presented to the CHWG.
- 10.4 At the Next CHWG a long-term analysis should be presented including surveys utilising the available data sets from both Full Area and Focused Area limits for TE3A.