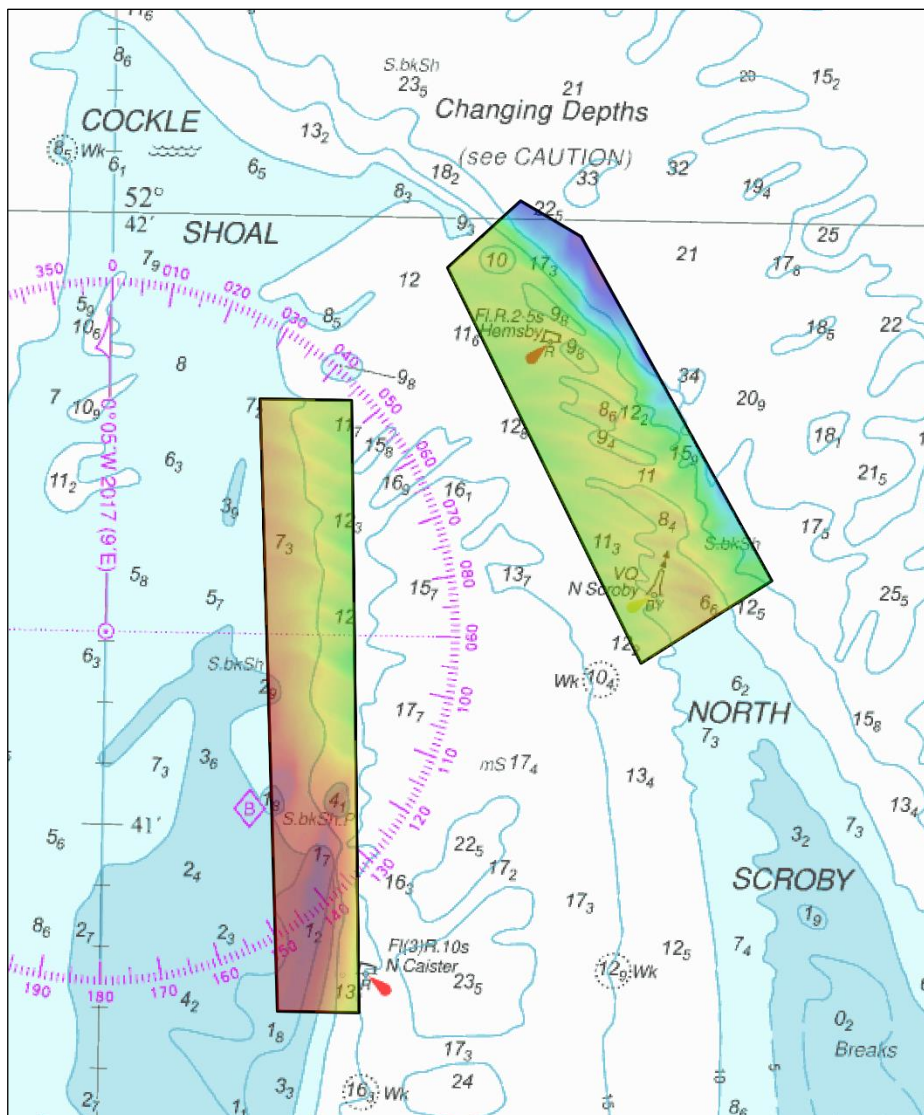




## EAST ANGLIA COCKLE SHOAL

### ASSESSMENT EA3A & EA3B/2016 V3

An assessment of the 2016 hydrographic survey of the focus areas: EA3A and EA3B to monitor recent seabed movement; to identify any implications for shipping; and to make recommendations for future surveys.



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## **COCKLE SHOAL, EA3A & EA3B, 2016**

### **1. EXECUTIVE SUMMARY**

#### **The Area and Recent Changes**

- 1.1 Area EA3 covers the north entrance to Caister Road, including part of the adjacent banks to Caister Shoal to the west, North Scroby to the east and Cockle Shoal to the north; and includes two focused areas (EA3A and EA3B), which are re-surveyed annually. The full extents of area EA3 is surveyed every 3 years and was last surveyed in 2014. This report covers the changes identified in the focused areas.
- 1.2 Area EA3A has experienced continued eastward migration of Caister shoal in the south of the area, as observed in previous reports. The eastern extent of the 10m contour now extends beyond the eastern boundary of EA3A.
- 1.3 Sandwaves in EA3B continue to migrate southwards with North Scroby receding south. Sandwaves between Hemsby and North Scroby Buoys have become shallower by up to 0.5m since the 2015 survey. The eastward expansion of Cockle Shoal has slowed during this resurvey period with only minor changes to eastern extent of the 20m contour.

#### **Reasons for Continuing to Resurvey the Area**

- 1.4 The eastward migration of Caister Shoal into Caister Road has continued during this reporting period with the 10m contour now extending beyond the current eastern limit of the EA3A area. Recent reports have observed a seaward migration of Cockle shoal in the northern part of EA3B, impacting on marine traffic between Hemsby Buoy and North Scroby Cardinal Buoy, where depths along sandwaves have decreased over this survey interval.

#### **Recommendations**

- 1.5 The north/north-east migration of Caister shoal into Caister Road, observed in the 2015 report, has continued during this reporting period with the 10m contour now extending beyond the current eastern limits of EA3A. The EA3A survey area should be extended beyond its current eastern limits, as recommended in the 2015 report to accommodate this migration.
- 1.6 The current survey area of EA3B should remain unchanged to continue monitoring depths along migrating sandwaves between Hemsby Buoy and North Scroby Buoy.
- 1.7 The annual resurvey interval of both focus areas should remain unchanged.

### **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 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	Reference	Data	Year	Survey	Reference	Data
1985	K9599	H2337/84		2001	M3530	HH090/940/01	d
1986	K9820	H2338/85		2002	M3708	HH090/986/01	t,d
1987	M1028	H4021/86	t	2003	M3900	HH091/019/01	d
1988	M1194	H6332/87	T,d	2004	M4131	HH091/073/01	m
1989	M1333	H3930/88	d	2005	M4265	HH091/109/01	m
1990	M1549	HH090/487/01	d	2006	M4525	HH091/161/01	m
1991	M1716	HH090/512/01	d	2007	M4629	HH091/221/01	m
1992	M1866	HH090/544/01	d	2008	M4786	20080-26400	m
1993	M2083	HH090/569/01	d	2009	HI1292	2009-29527	m
1994	M2232	HH090/622/01	d	2010	HI1338	2010-213940	m
1995	M2456	HH090/660/01	t,d	2011	HI1367	2011-106141	m
1996	M2600	HH090/686/01	d	2012	HI1397	2012-117402	m
1997	M2796	HH090/732/01	d	2013	HI1432	2013-261940	m
1998	M2995	HH090/765/01	d	2014	HI1458	2014-249144	m
1999	M3176	HH090/844/01	t,d	2015	HI1482	2015-83468	m
2000	M3335	HH090/882/01	d	2016	HI1521	2016-181422	m

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
1980	Area A1 established; part of old areas C and E1 (H3912/80).
1996	Area A1 Assessment – Increase limits to include 10m contour.
1997	Area identifier changed to EA3. Summary report 1997 (HA145/002/001/03).
2002	Area limits revised following changes to Buoyage.
2003	Area limits reduced.
2005-8	Area limits adjusted to reflect migration of the banks.
2008	Focussed areas EA3A and EA3B proposed.
2009	First annual survey of focussed areas.
2011	Focused area B extended to include wreck off southern point for 2012 survey.
2012	Shift focus area A eastwards to account for eastward migration of 10m contour. Reduce western extent, and increase northern extent of focus area B to account for eastward migration.
2013	Retain limits and survey interval.
2015	EA3A survey extended southwards into area EA4 to monitor extensive shoaling. The southern limits of EA3A to be reassessed following the 2017 survey of EA4. Northern limit of EA3B extended and western boundary reduced to account for north-eastwards migration of Cackle Shoal.

## 4. DESCRIPTION OF THE AREA

- 4.1 Area EA3 is fully surveyed every 3 years, with focused areas EA3A and EA3B surveyed annually. EA3 covers the northern entrance to Caister Road, including part of the adjacent banks to Caister Shoal to the west, North Scroby to the east and Cackle Shoal to the north.
- 4.2 Area EA3A is sited on the western side of Caister Road Channel, approximately centred over the 10m contour that joins Cackle Shoal to the north and Caister Shoal to the south west. During recent surveys, the eastern limit of Caister Shoal has gradually migrated eastward, causing the narrowing of Caister Road. Between the 2015 and 2016 survey, North Caister buoy was moved approximately 70m eastwards, to beyond the eastern limits of EA3A.
- 4.3 The area EA3B is sited over the Buoyed entrance to Caister Road (Hemsby Buoy to North Scroby Cardinal Buoy) and covers an area between Cackle shoal to the north and North Scroby to the south. Recent surveys have observed a gradual eastward migration of Cackle shoal in the north of the area, by 60m between 2014 and 2015. Sandwaves situated between Hemsby Buoy and North Scroby Cardinal Buoy generally migrate in a southwards direction as the northern end of North Scroby recedes.
- 4.4 Cackle Shoal is a broad ridge of sand at the head of Caister Road and links the banks of Caister Shoal and North Scroby. It was formed by an ebb-residual current transporting sediment northwards through Caister Road. Much of Cackle Shoal lies north and outside of the current focused survey limits.

4.5 Area Covered: EA3A - 0.15 NM<sup>2</sup> (0.50 km<sup>2</sup>); EA3B – 0.17 NM<sup>2</sup> (0.6 km<sup>2</sup>) as shown in Figure 1 below.

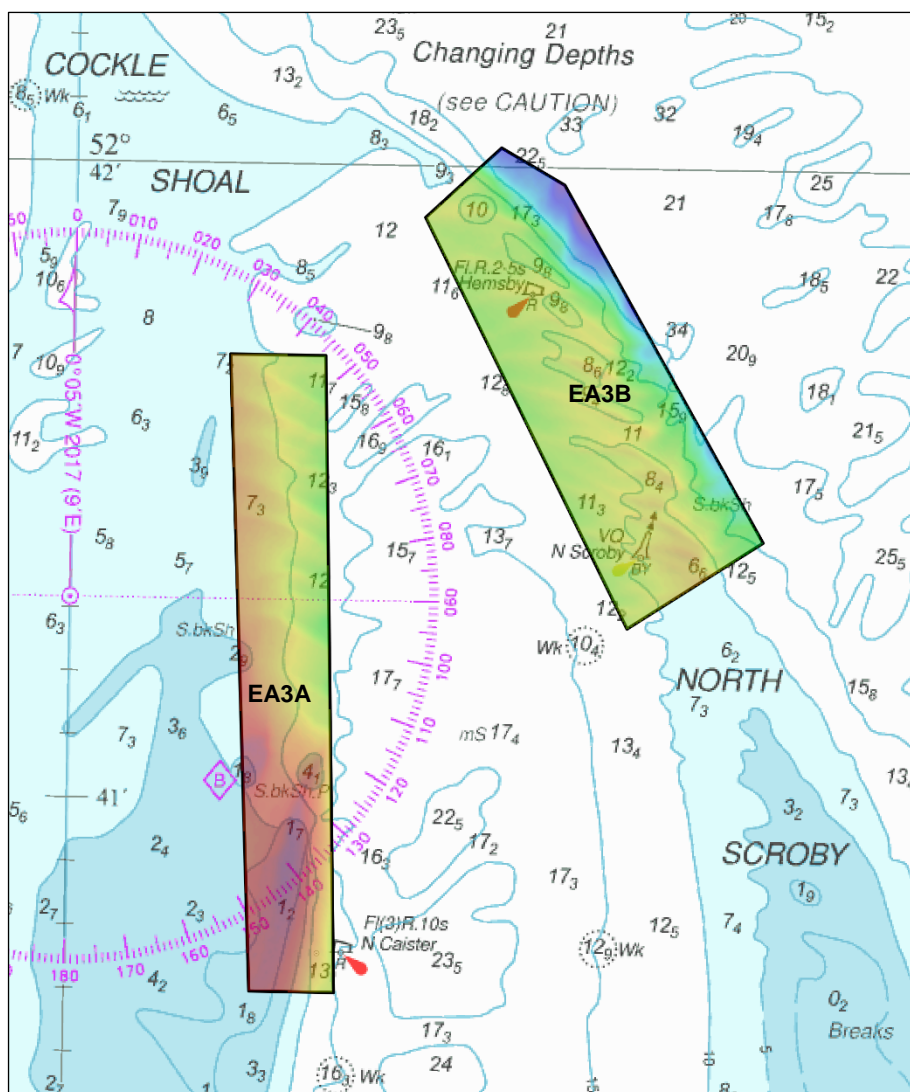


Figure 1 – HI1516 survey data sun-illuminated view overlaid on BA Chart 1534

4.6 The geographic limits at the time of resurvey are shown in the Table 1 and 2 below and coordinates are in Decimal Degrees referenced to WGS84:

Table 1: HI1521 EA3A Survey Limits

Point	Latitude (N)	Longitude (E)
01	52.67833	1.76160
02	52.67833	1.75790
03	52.69500	1.75670
04	52.69500	1.76080

Table 2: HI1521 EA3B Survey Limits

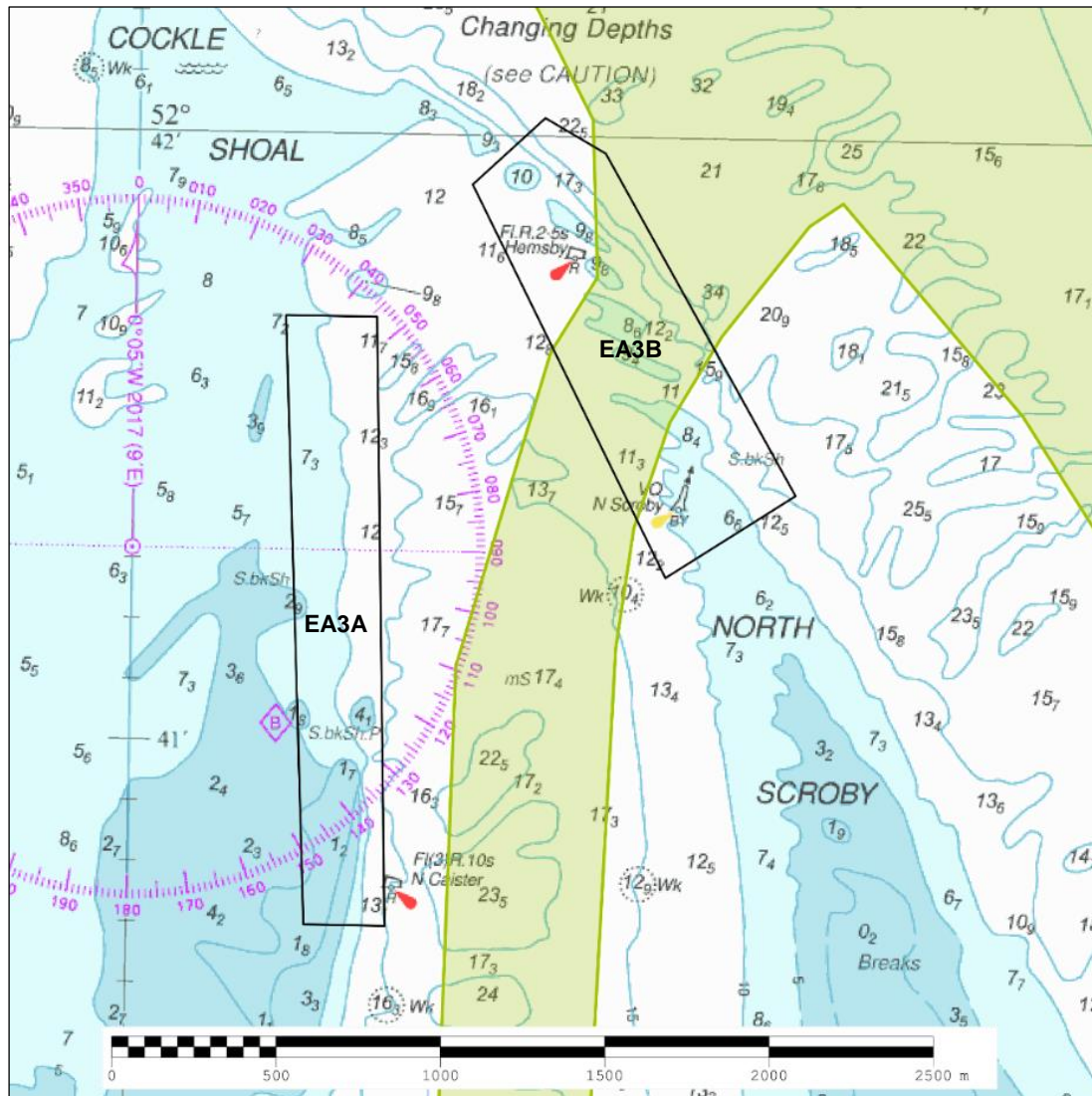
<b>Point</b>	<b>Latitude (N)</b>	<b>Longitude (E)</b>
01	52.69957	1.77097
02	52.69028	1.77977
03	52.68798	1.77398
04	52.69866	1.76500
05	52.70051	1.76823

4.7 Survey interval at time of resurvey: Focused EA3A and EA3B - 1 yr, Full EA3 – 3 yrs

4.8 Largest scale chart: BA1534 (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 8.25m. A small number of vessels pass north of Hemsby Buoy, with the majority confined to the area indicated in Figure 2 below.





	Limits of survey Area
	Indicative shipping routes through area

Figure 2 – Indicative shipping routes overlaid on BA Chart 1534



## 6. REFERENCE SURVEY DETAIL

- 6.1 The last historical Civil Hydrography Programme (CHP) Routine Resurvey of the area EA3A and EA3B was in 2015 under Hydrographic Instruction (HI) 1482 and this has been used as the reference to compile this assessment. The 2015 survey HI1482 was conducted from the 3<sup>rd</sup> October until the 8<sup>th</sup> October 2015 with weather downtime reported from the 4<sup>th</sup> October until the 7<sup>th</sup> October. Sea state on the days of data collection ranged from 1 (smooth) to 2 (slight).
- 6.2 The survey data was acquired using a 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 International Terrestrial Reference Frame 2005 (ITRF2005) datum.
- 6.3 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.
- 6.4 The survey was validated by UKHO and met IHO S44 (5<sup>th</sup> Edition) Order 1a standards.
- 6.5 The Report of Survey 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.

7. **COMPARISON SURVEY DETAIL**The latest survey undertaken as part of the CHP Routine Resurvey was in 2016 under HI1521. Data collection in EA3B was carried out on the 21<sup>st</sup> September 2016 followed by survey acquisition for area EA3A on the 17<sup>th</sup> and 18<sup>th</sup> October 2016. Sea state on the days of data collection ranged from 1 (smooth) to 2 (slight) however 12 days of weather down time was encountered.

- 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 System 1989 (ETRS89) 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 (5<sup>th</sup> Edition) Order 1a standards.
- 7.5 The Report of Survey for this survey 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

### Focused Area EA3A

8.1 The Variability Plot shown in Figure 3 and Profile Comparison in Figure 4 shows a significant north/north-eastwards migration of Caister Shoal in the south of the area. The changes in the 5m contour between 2015 and 2016 report (Figure 5) shows the maximum extent of the migration is approximately 200m and indicates the eastern edge will extend beyond the current limits of the EA3A area. This follows the trend observed between the 2014 and 2015 surveys where the 5m contour migrated approximately 400m.

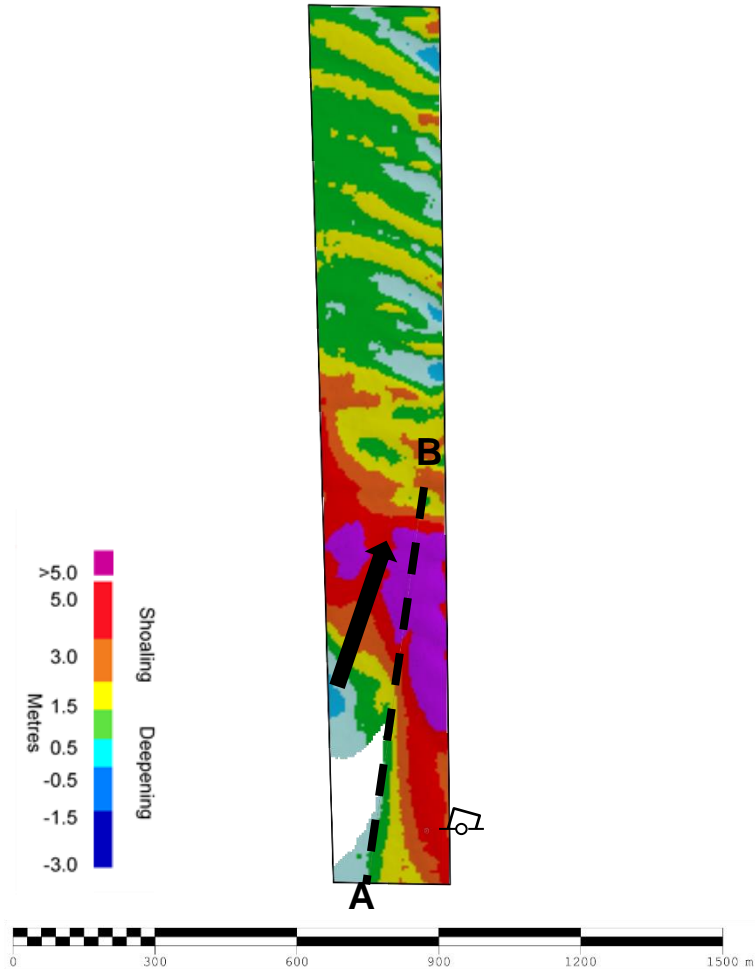


Figure 3 – Variability plot showing Bathymetric Changes between the 2015 and 2016 Surveys. Arrows indicate the general direction of sediment movement.

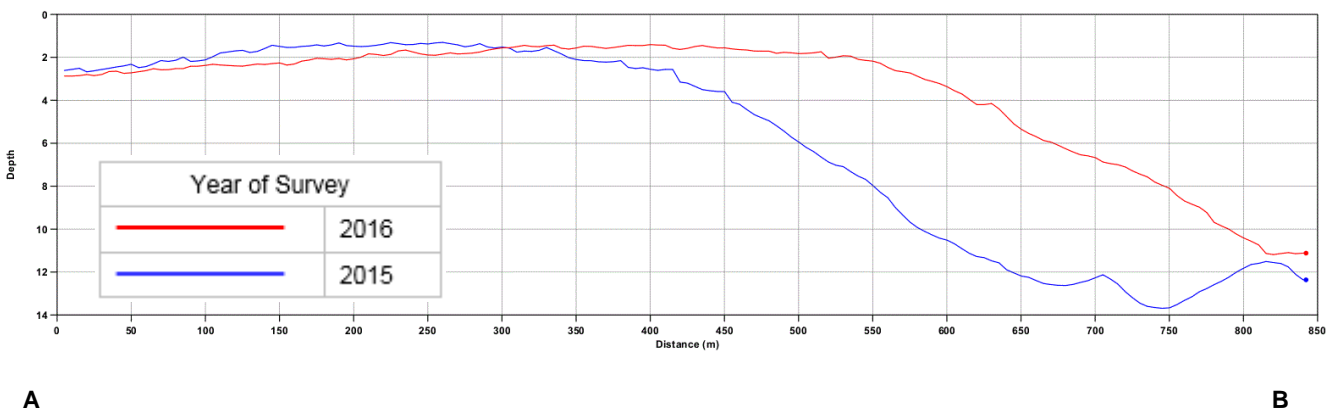


Figure 4 – Profile Comparison A-B

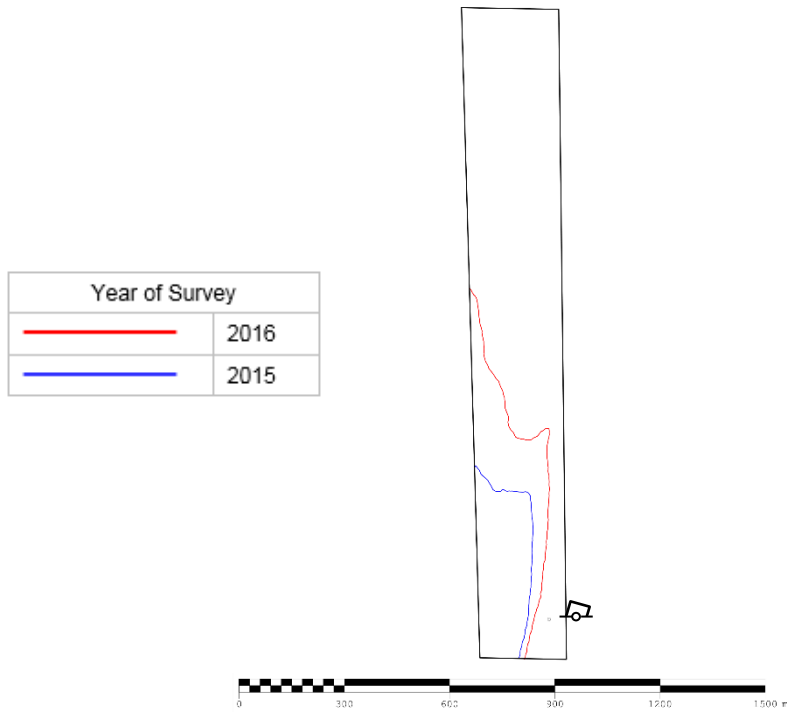


Figure 5 – 5m contour from the surveys carried out in 2015 and 2016

8.2 The 10m contour has migrated eastwards by over 60m, as shown in Figure 5, and now extends beyond the current survey limit, with depths decreasing by up to 8.5m in the area north of North Caister Buoy. Figure 6 shows this gradual migration from its position in 2011 through to the recent survey period.

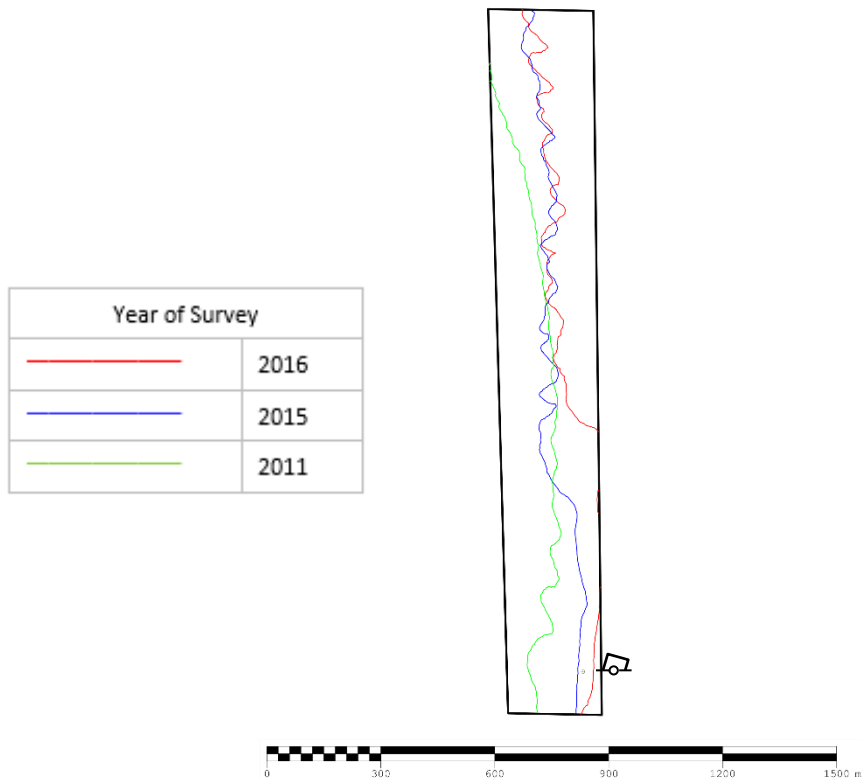


Figure 6 – 10m contour from the surveys carried out in 2011, 2015 and 2016

### Focused Area EA3B

8.3 The 2016 survey shows changes in depths compared with the 2015 survey, as seen in figure 7 (Incomplete coverage along the eastern limits due to an increase to the eastern limits in 2016). The 10m contour and profile C-D shows a southward migration of sandwaves by 50m in the area between North Scroby and Hemsby Buoys; following the general southward recession of North Scroby observed in previous reports. With this sandwave migration, the route between Hemsby Buoy and North Scroby Cardinal Buoy has gradually opened, as indicated by the 10m contour in Figure 9. The minimum depth within the main shipping route has, however, decreased with a minimum depth along a sandwave crest of 8.7m in the 2016 survey, compared with 9.2m in 2015 at a similar location, as shown by the Soundings Plot in Figure 10.

Figure 7 – Variability Plot showing Bathymetric Changes between the 2015 and 2016 Surveys in EA3B. Arrows indicate

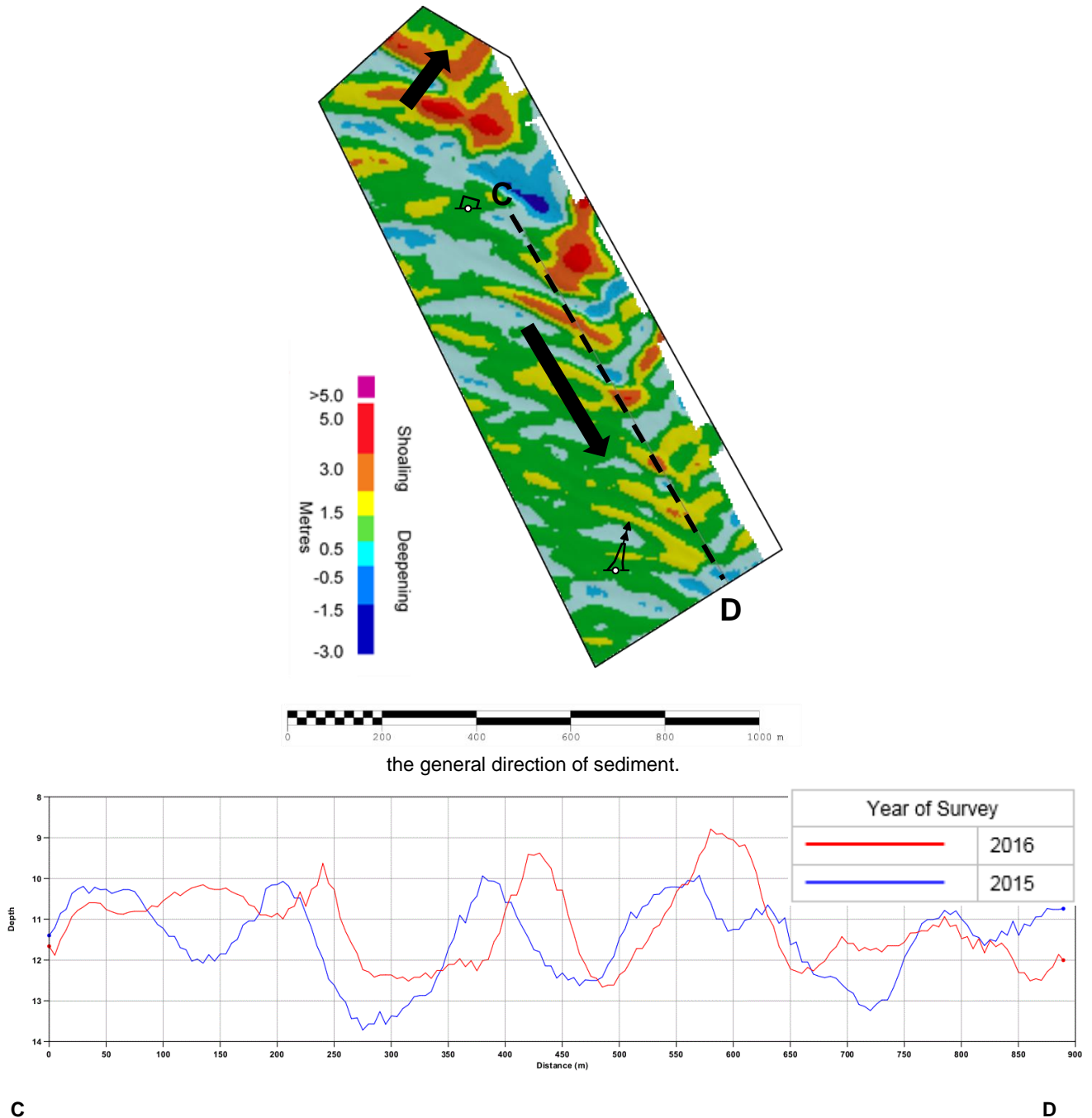


Figure 8 – Profile Comparison C-D

8.4 The long-term trend indicates an overall increase of depths in the area surrounding Hemsby Buoy, as shown by the 10m contour from 2011, 2015 and 2016 in Figure 9.

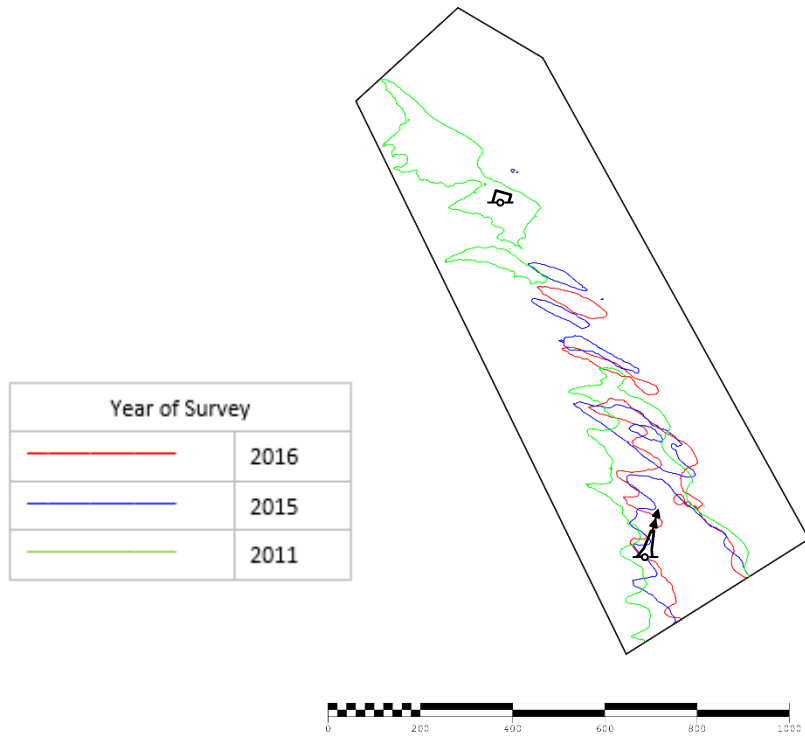
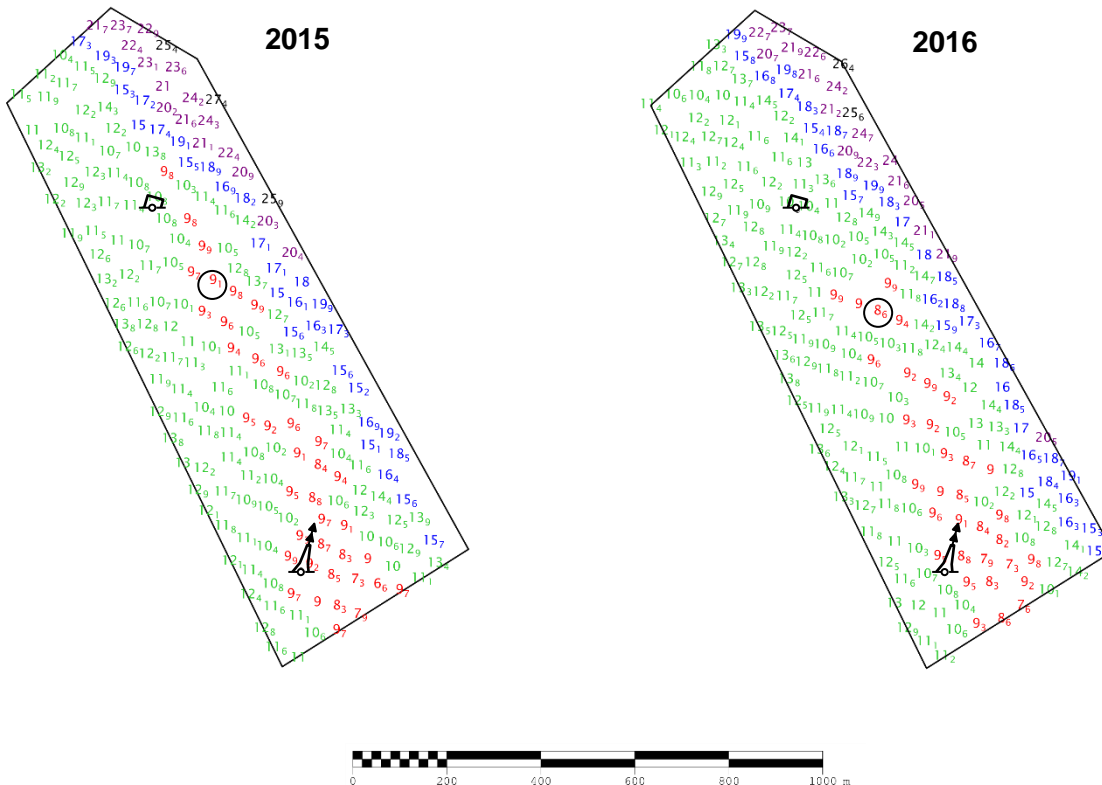


Figure 9 – 10m contour in area EA3B from the 2011, 2015 and 2016 Surveys



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 10 – Depth Plot showing Sounding selection from 2015 (left) and 2016 (right) Surveys

8.5 Previous reports have shown a continuous eastward migration of Cockle shoal in the northern part of area EA3B. Since 2015, the eastward migration has slowed with only a minor change in the position of the 20m contour, as shown in Figure 11.

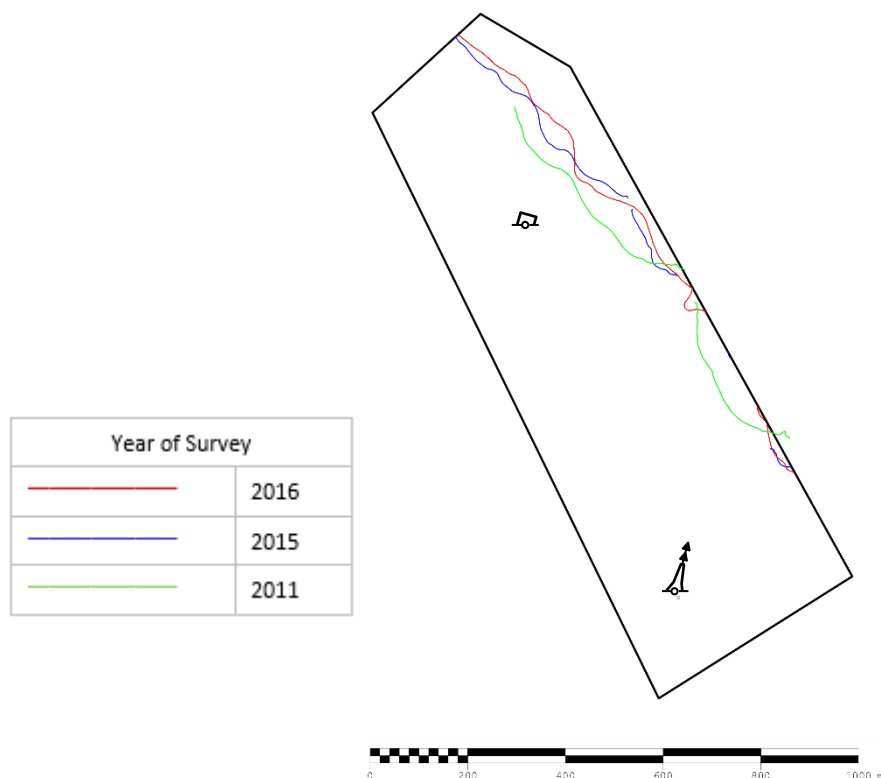


Figure 11 – 20m contour in area EA3B in the 2011, 2015 and 2016 Surveys

## 9. IMPLICATIONS FOR SHIPPING

- 9.1 The narrowing of Caister Road in EA3A due to the eastward migration of Caister shoal follows the trend observed in recent reports. North Caister Buoy, which marks the eastern edge of Caister shoal has been moved approximately 70m eastwards during the period following the previous report.
- 9.2 The 10m contour in the south-east corner of EA3A remains over 200m from the main traffic along Caister road. The largest vessel draught observed in the 2016 AIS data is 8.25m, with most traffic under 7.0m.
- 9.3 The minimum depth along sandwaves within the main shipping route in area EA3B is 8.6m which is 0.5m shallower than the minimum observed in 2015. Although this remains deeper than the largest registered draught of vessel observed transiting through the survey area the indicated underkeep clearance is within the vertical uncertainty of the survey. AIS data suggests shipping in the area currently follows a narrow track through Caister road and between Hemsby and North Scroby Buoys.

## 10. RECOMMENDATIONS FOR FUTURE SURVEYS

- 10.1 The 2016 survey suggests continued migration of Caister shoal eastwards into Caister Road channel, with the 10m contour extending beyond the current eastern limit of the survey area. The proposed eastward limits of EA3A given in the 2015 focused survey report should be used

to continue monitoring the migration of Caister Shoal and that the western Limits be brought seaward to limit the coverage in waters shallower than 10m. See Figure 12 below for details of the proposed limits.

- 10.2 The next Hydrographic Instruction for focused area EA3A should be limited to a defined depth contour of 5m CD.
- 10.3 The routine resurvey of area EA4, planned for 2017 under HI1545, which extends south of EA3 will provide additional information on the nature of the seabed just south of EA3, allowing a comparison against the proposed extended limits of EA3A.
- 10.4 The lack of change seen along the eastern extent of Cackle Shoal suggests the current survey area of EA3B should remain unchanged. The annual re-survey interval of EA3B should continue, to ensure the monitoring of changing depths along migrating sandwaves between Hemsby Buoy and North Scroby Buoy.
- 10.5 The resurvey interval of both focus areas should remain unchanged.

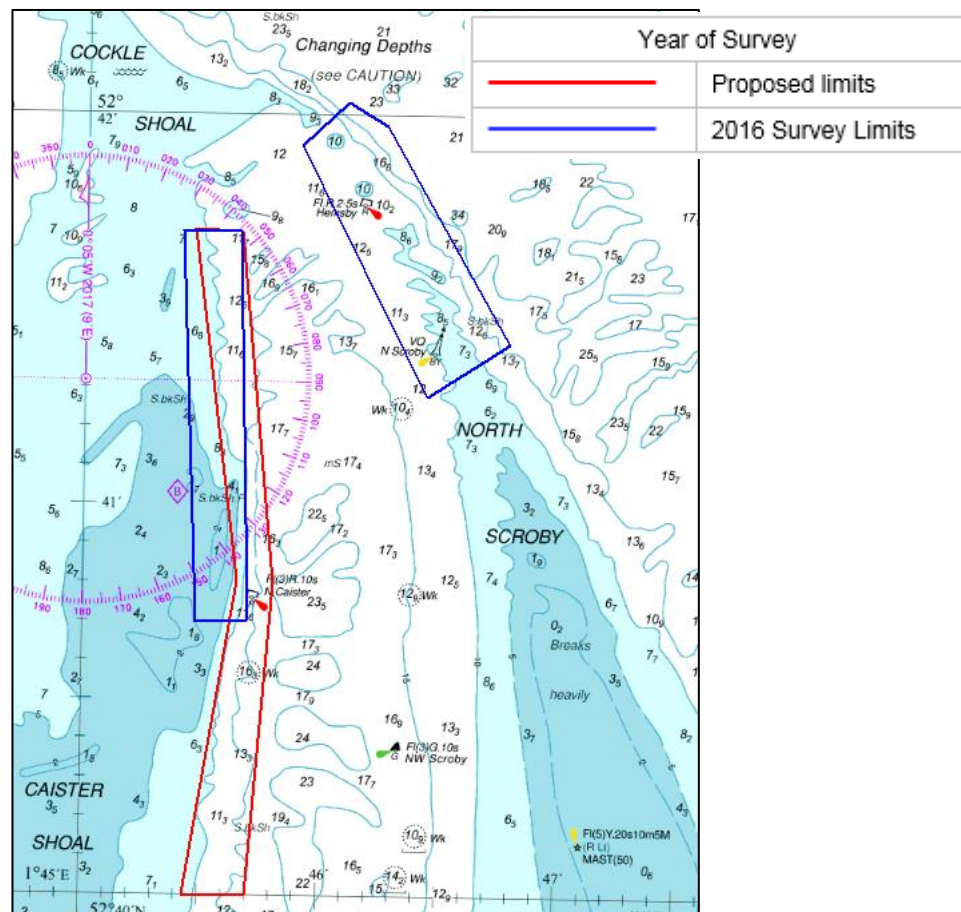


Figure 12 – Proposed change to the extent of EA3A focus area

- 10.6 The coordinates of the adjusted survey area limits for the annual focused area EA3A are shown below. EA3A total area 1.25km<sup>2</sup> / 0.37 NM<sup>2</sup>

- a) 52° 40.80 N 1° 45.80 E
- b) 52° 40.00 N 1° 45.70 E
- c) 52° 40.00 N 1° 45.43 E
- d) 52° 40.80 N 1° 45.65 E
- e) 52° 41.70 N 1° 45.45 E
- f) 52° 41.70 N 1° 45.65 E