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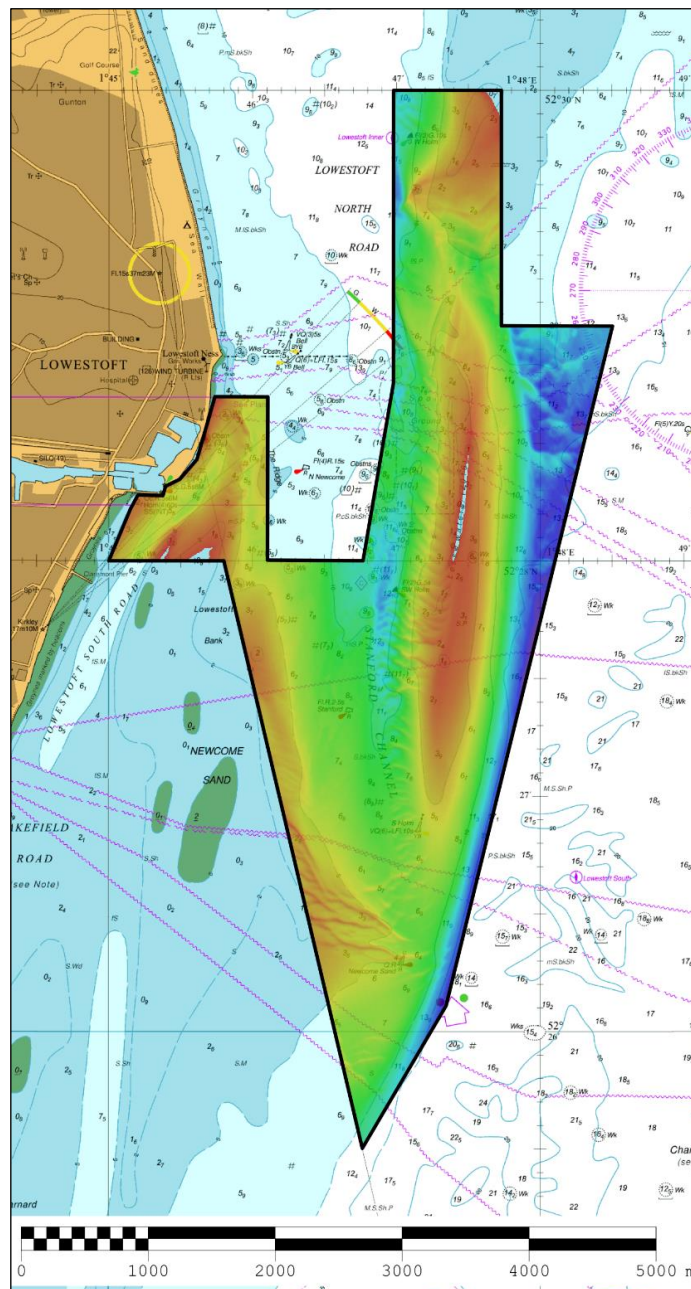
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Maritime &
Coastguard
Agency

EAST ANGLIA APPROACHES TO LOWESTOFT (EA10) ASSESSMENT EA10/2016-V3

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



CONTENTS

1.	Executive Summary	1
2.	Introduction	2
3.	Area History	2
4.	Description of the Area	3
5.	Shipping in the Area	6
6.	Reference Survey Detail	7
7.	Comparison Survey Detail	7
8.	Description of Recent Bathymetric Change	7
9.	Implications for Shipping	13
10.	Recommendations for Future Surveys	13

APPROACHES TO LOWESTOFT, EA10, 2016

1. EXECUTIVE SUMMARY

The Area and Recent Changes

- 1.1 EA10 is surveyed as part of the East Anglia Routine Resurvey Programme, which covers the approaches to Great Yarmouth and Lowestoft. The 2016 survey examined in this assessment is a full 3-year survey, initially scheduled for survey in 2015 but postponed due to weather and time constraints.
- 1.2 EA10 also comprises 2 focussed areas, EA10A which is resurveyed annually to monitor depths at the buoyed entrance to Stanford Channel, which provides the southern approach to Lowestoft Harbour. Focussed area EA10B is located at the final approach to Lowestoft Harbour, and is surveyed annually to monitor changing depths along the mobile seabed.
- 1.3 The 2016 survey data indicates shoaling at South Holm Buoy and Newcome Sand Buoy, which mark the southern entrance for shipping into Stanford Channel.
- 1.4 Depths along a ridge across the final approach to Lowestoft Harbour have decreased since 2012. The controlling depth within the white sector light is 3.3m in 2016, compared to 4.3m in 2012. This continues the trend observed in the 2015 survey of focus area EA10B.
- 1.5 In the far north of EA10, the western bank of Holm Sand near West Holm Buoy has migrated westwards, into Lowestoft North Road.

Reasons for Continuing to Resurvey the Area

- 1.6 A mobile seabed features at the entrance to Stanford Channel and the final approach to Lowestoft Harbour. Frequent changes to shoal depths at these locations pose a risk to shipping traffic into Lowestoft.
- 1.7 South Holm Sand and Newcome Sand continue to encroach into the buoyed south entrance to Stanford Channel.

Recommendations

- 1.8 The focus areas EA10A and EA10B should remain at the annual resurvey interval to continue monitoring depths in the areas.
- 1.9 An additional focus area EA10C, covering the northern limit of EA10, should be added to the annual resurvey programme to monitor rapidly changing depths in the area.
- 1.10 Generally stable depths outside the focused areas support the current 3-year re-survey interval for EA10.

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
1994	M2261	HH090/624/01	s.d.	2006	M4528	SDRA 2006-379698	m.*
1995	M2481	HH090/663/01	s.d.	2007	M4654	SDRA 2007-007489	m.
1996	M2613	HH090/688/01	s.d.	2008	M4789	SDRA 2008-026404	m.*
1997	M2814	HH090/735/01	s.d.	2009	HI1292	SDRA 2009-29527	m.
1998	M3007	HH090/767/01	s.d.	2010	HI1338	SDRA 2010-213940	m.*
1999	M3212	HH090/849/01	s.d.	2011	HI1367	SDRA 2011-106141	m.*
2000	M3349	HH090/884/01	s.d.	2012	HI1397	SDRA 2012-117402	m.
2001	M3542	HH090/941/01	s.d.	2013	HI1432	SDRA 2013-261940	m.*
2002	M3722	HH090/999/01	s.d.	2014	HI1458	SDRA 2014-142852	m.*
2003	M3913	HH090/021/01	s.t.d.	2015	HI1482	SDRA 2015-83468	m.*
2004	M4158	HH091/076/01	m.*	2016	HI1521	SDRA 2016-181422	m.
2005	M4268	HH091/112/01	m.*				

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

3.2 Summary of historical recommendation enacted

Year	Remarks
1980	Area C1 established (H3912/80)
1993	Change of limits to include Newcome sand up to the 10m line. Inshore of the 2m contour only to be surveyed every 3/6 years. Department of Transport accepted recommendations on 15 Oct 93 (HA145/02/03/04)
1994	Report amends limits. Department of Transport accepted recommendations Jul 95 (HA145/02/03/04).
1997	Limits amended. Identifier changed from C1 to EA10
2002	Limits revised, transferring Lowestoft South Road to EA12.
2004	Introduction of focused annual surveys.
2007	Revision of focused area (Splitting into 3 sub areas)
2008	Continue annual surveying Extend east and northern limits of focus areas A and C to monitor changes to Holm Sand.
2009	Extend northern limits of 3 year survey area to monitor changes in Holm Sand, north of West Holm buoy. Revise focus area A to take account of eastward migration of 10m contour. Extend focus area B to monitor shoaling outside Lowestoft Harbour
2010	Extend resurvey interval to 3 years
2011	Consider adjusting annual survey frequency following next full area survey
2012	Reduce resurvey interval for area within Stanford Channel and Towards Lowestoft Road from 3 yr to 12 yr. Transfer this area to EA8 Re-align outer limit of EA10 to take account of seaward expansion of southern part of Holm Sand. Reduce frequency of 'The Ridge' in focus area B from 1 to 3 years.
2013	Area A – reduce limits with 40% reduction. Applied to 2014 report. Continue remaining limits and survey interval.
2015	Full survey of EA10 postponed until 2016 due to poor weather and time constraints, Requirement changed to a focused Survey of Area EA10A and EA10B Following CHWG EA10B and EA10 limits expanded seaward to beyond 10metre contour on the west side of Holm Sand (Transfer southern part of area EA8)

4. DESCRIPTION OF THE AREA

- 4.1 EA10 covers Stanford Channel, which provides the main approach route to Lowestoft Harbour from the south. It was buoyed and opened to shipping in 1994, at which time the controlling depth across the entrance was 4.6m. At the same time, buoys marking Pakefield Road and Lowestoft South Road (EA12 and EA12A) were discontinued but area remain as part of the Routine Resurvey Programme. The full EA10 area is surveyed every 3 years as part of the routine resurvey programme.
- 4.2 EA10 was established in 1997 as an annual survey area. The area was revised following the 2001 survey analysis to focus on areas of concern to shipping. The southwest part of the area

was transferred to EA12, and the southern limit was extended to take account of sediment transport along Newcome Sand.

- 4.3 From 2004, annual surveying was restricted to the buoyed channel and approach to Lowestoft, with the whole area being fully surveyed every 3 years. In 2008 this was further restricted, with the relatively deep and stable areas of Stanford Channel removed from the annual programme.
- 4.4 Within the EA10 area, two focus areas (A and B) are surveyed annually. EA10A covers the ridge and sandwaves that lie at the southern entrance to Stanford Channel, while EA10B covers the final approach to Lowestoft Harbour.
- 4.5 Area Covered: EA10 Full Area 3.59 NM² (12.3km²) as shown in Figure 1 below.

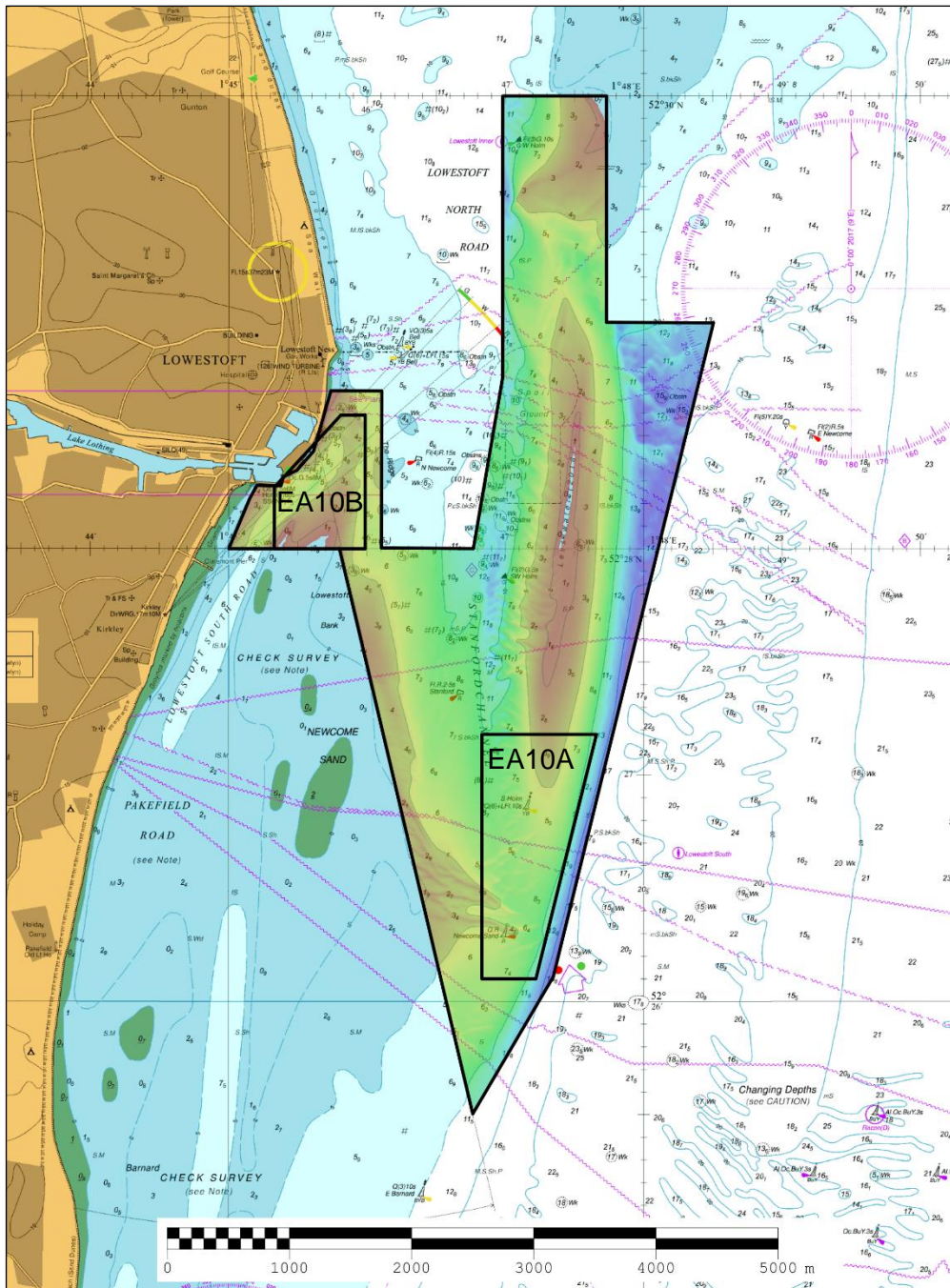


Figure 1 – 2016 survey data sun-illuminated view overlaid on BA Chart 1535

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

Point	Latitude (N)	Longitude (E)
A	52.46668	1.77947
B	52.47927	1.78299
C	52.50000	1.78300
D	52.50000	1.79550
E	52.48333	1.79550
F	52.48330	1.80838
G	52.43515	1.78910
H	52.42506	1.77940
I	52.46667	1.76333
J	52.46667	1.75000
K	52.47033	1.75250
L	52.47133	1.75338
M	52.47130	1.75628
N	52.47196	1.75658
O	52.47244	1.75821
P	52.47384	1.76021
Q	52.47830	1.76229
R	52.47828	1.76843
S	52.46672	1.76840

4.2 Survey interval at time of resurvey: 3 yrs (Focused areas: 1yr)

4.3 Largest scale chart: BA1535 (Scale 1:25,000)

5. SHIPPING IN THE AREA

- 5.1 Stanford Channel and North Roads are used by both commercial vessels and by leisure users approaching Lowestoft Harbour; with the port of Lowestoft being the operation and maintenance base for Greater Gabbard offshore wind farm.
- 5.2 Shipping data from satellite AIS data for 2016 of vessels larger than 2000GT shows the maximum registered draught of vessel to transit through the area was 6.6m.
- 5.3 A spoil ground located approximately 1.5km east of Lowestoft Harbour is used frequently by a hopper dredger carrying out maintenance dredging in Lowestoft, which has a draught of 5.7m.

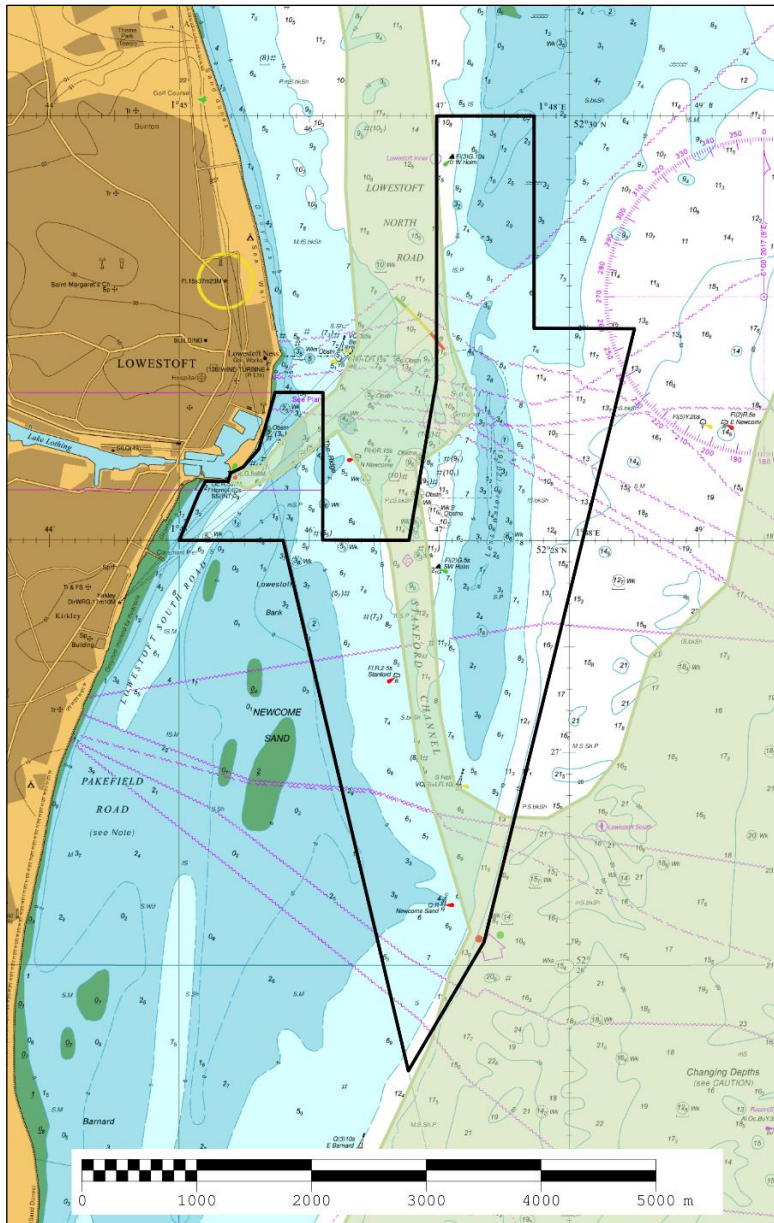




Figure 2 – Indicative shipping routes overlaid on BA Chart 1535

	Limits of survey Area
	Indicative shipping routes through area

6. REFERENCE SURVEY DETAIL

- 7.1 The last historical Routine Resurvey undertaken of the full EA10 area was in 2012 under HI1397 and has been used as the reference to compile this assessment. The survey was conducted from 22nd September to the 6th October in conjunction with other East Anglia areas. Weather in the area was variable with sea states smooth to moderate (2-4) experienced during survey work, and some time spent alongside due to weather.
- 6.1 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.
- 6.2 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).
- 6.3 The survey was validated by UKHO and met IHO S44 (5th Edition) Order 1a standards.
- 6.4 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.

7. COMPARISON SURVEY DETAIL

- 7.1 The latest survey undertaken as part of the CHP Routine Resurvey was in 2016 under HI1521. The survey was originally programmed for 2015, however due to time and weather constraints the survey was postponed until 2016. Survey operations in shallow areas were carried out between the 19th and 21st October 2016 on the survey vessel EGS Pioneer. Operations were continued in deeper areas on the vessel Wessex Explorer between October 29th and November 3rd 2016. Sea state during operations ranged from smooth to moderate (2 to 4).
- 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).
- 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 5m Contour Plot shown in Figure 3 and the Variability Plot in Figure 4 shows significant eastward expansion of the southern area of Holm Sand with the southern tip migrating up to 210m south-east since 2012. The 2015 assessment (EA10A-B/2015) reported no significant change in the location of the 5m contour at South Holm cardinal Buoy however a comparison of the 2015 assessment with 2016 survey data shows a 100m movement south-east has occurred since 2015. Sandwaves along the western edge of South Holm continue to migrate southwards and no significant change to the western extent of the Holm Sand 5m contour since 2012.

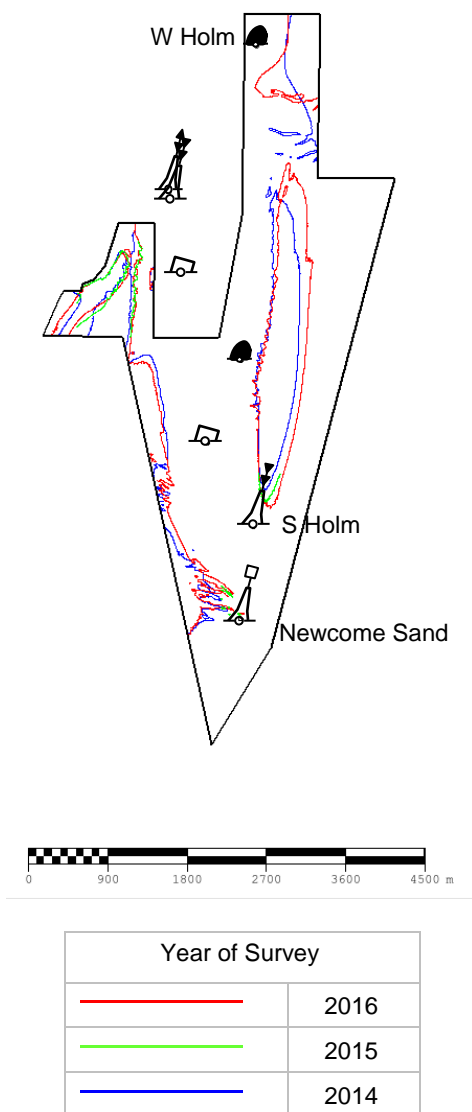


Figure 3 – 5m Contour Plot from the 2012, 2015 and 2016 Surveys

- 8.2 Figures 3 and 4 show in the far south of EA10, sandwaves along the eastern edge of Newcome Sand have migrated north and eastward; encroaching into the main entrance to Stanford channel, with the 5m contour now reaching Newcome Sand Buoy. This has coincided with the southward expansion at the southern tip of Holm Sand.
- 8.3 Sediment movement in the northern Extents of EA10 is also highlighted in Figures 3 and 4, with a north-westward migration of the 5m contour. The western edge of Holm Sand now extends up to West Holm Buoy, which marks the main shipping route along Lowestoft North Road.

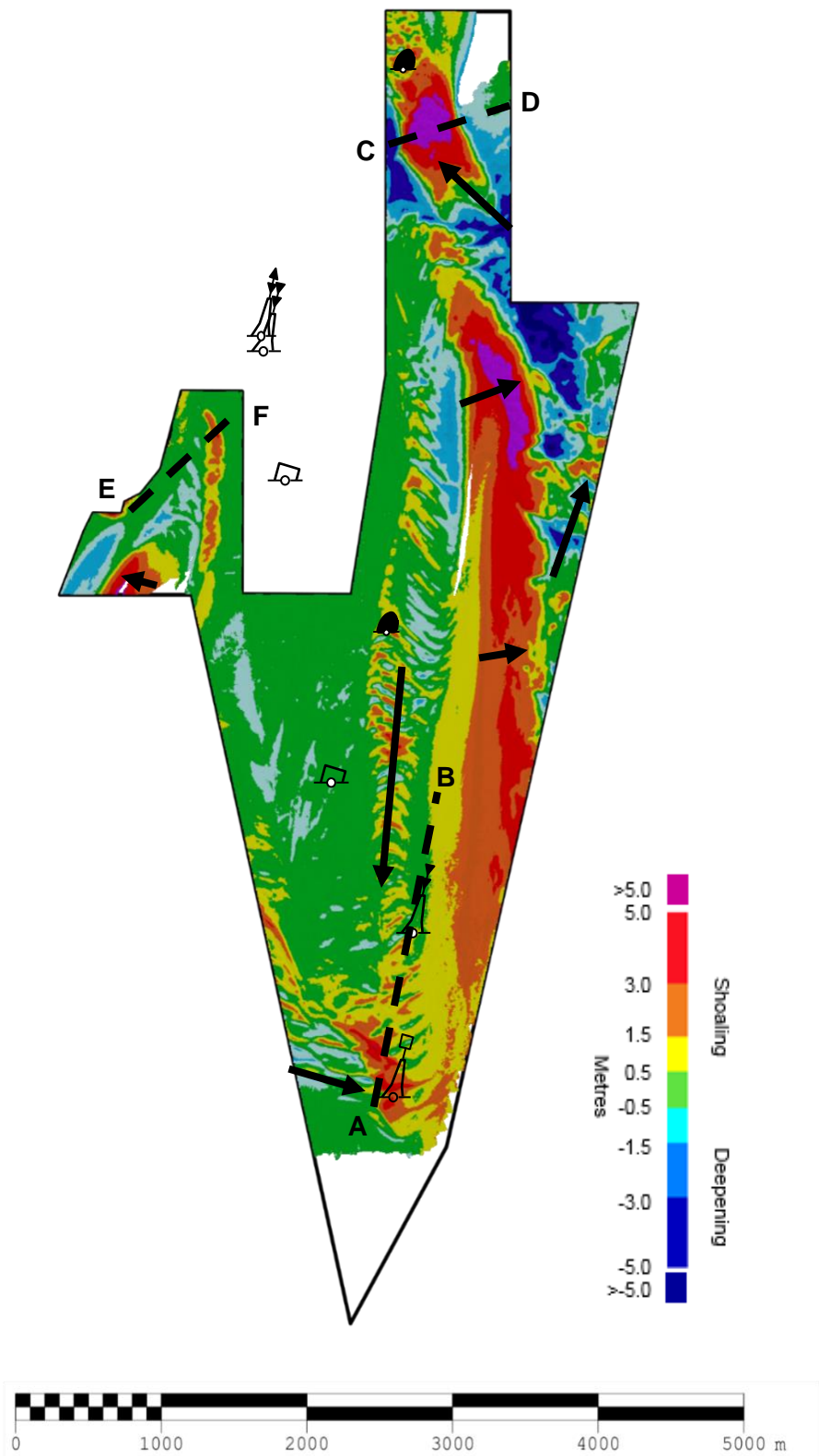


Figure 4 – Variability Plot showing Bathymetric Changes between the 2012 and 2016 Surveys

8.4 Profile Comparison A-B in Figure 5 and Sounding Plot in Figure 6, highlights a decrease in depths by up to 3m in the vicinity of Newcome Sand Buoy and up to 1.7m at the entrance to Stanford Channel marked by South Holm and Newcome Sand Buoy.

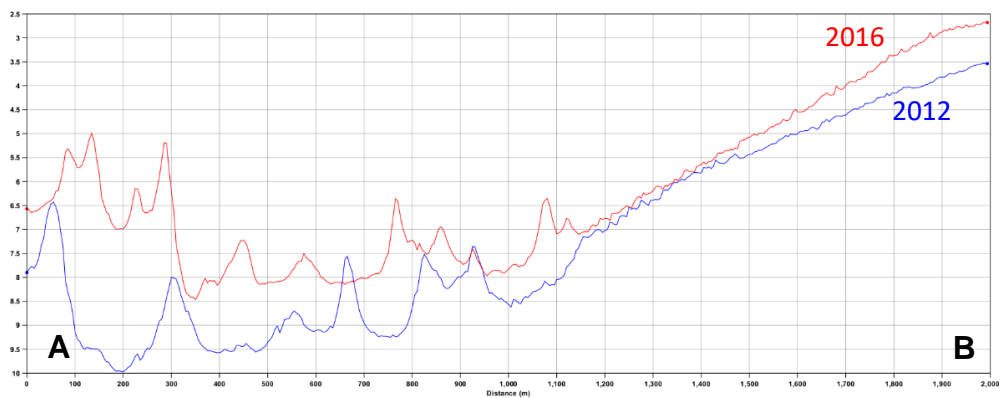
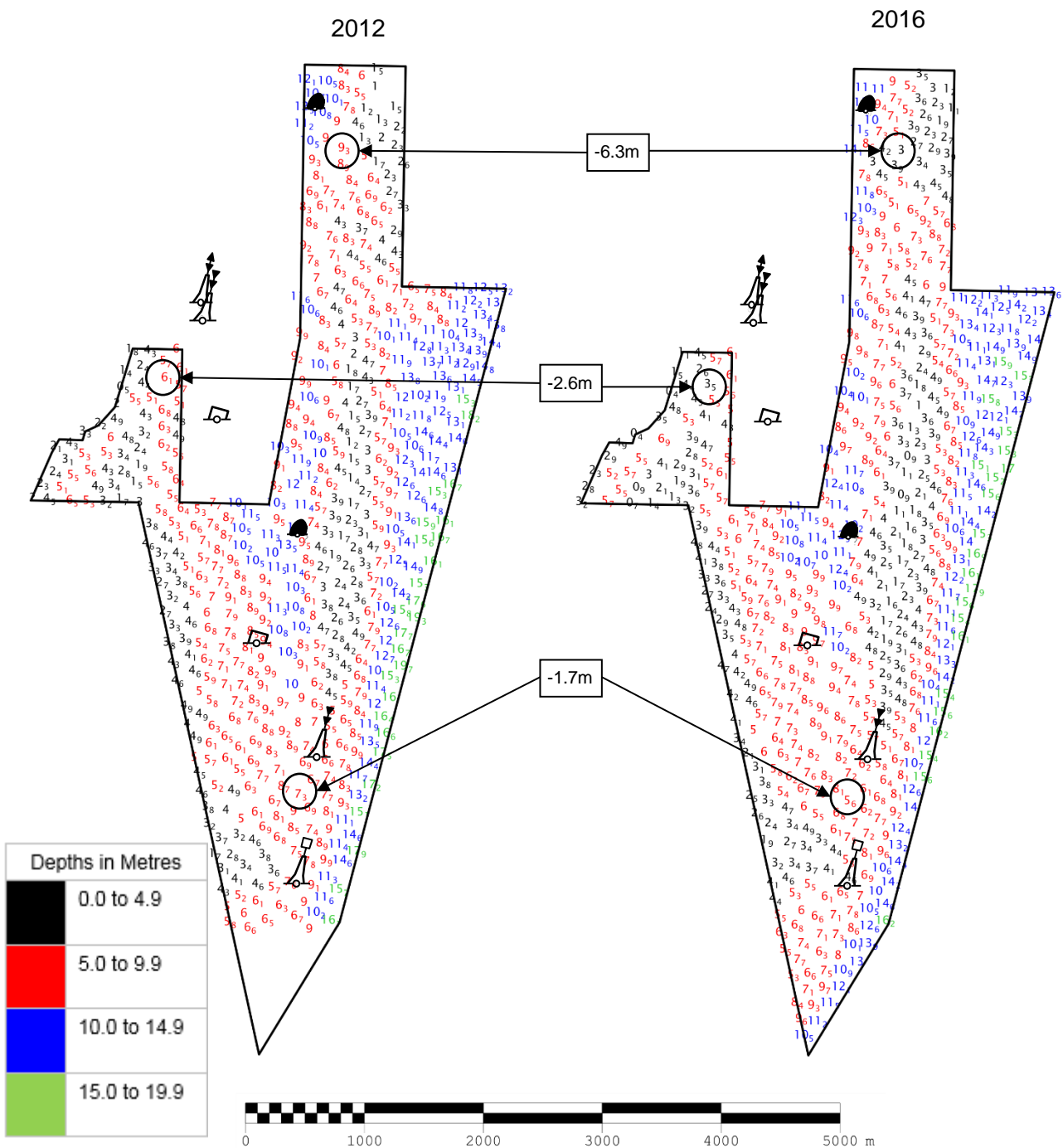


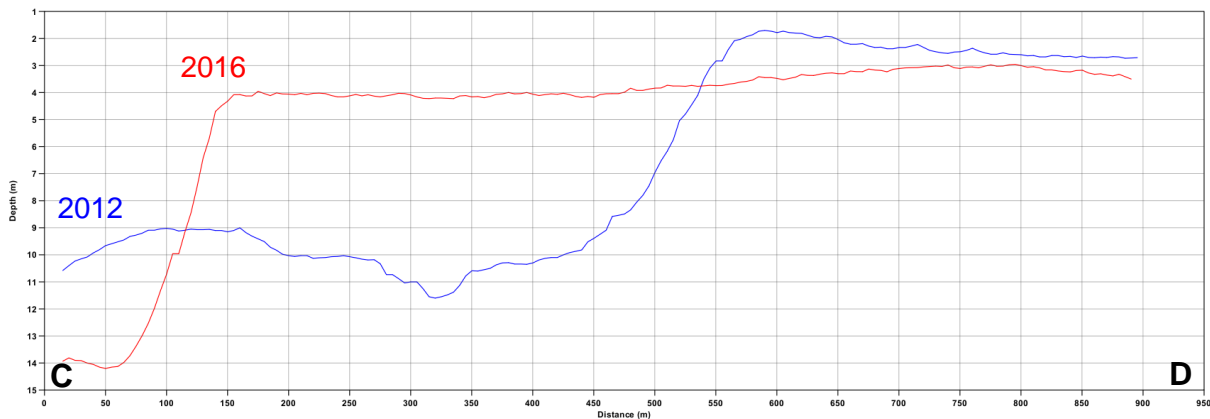
Figure 5 – Profile Comparison A-B



Depth changes indicated above are from the closest corresponding 2012 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 6 – Depth Plot showing sounding selection from 2012 (left) and 2016 (right) surveys

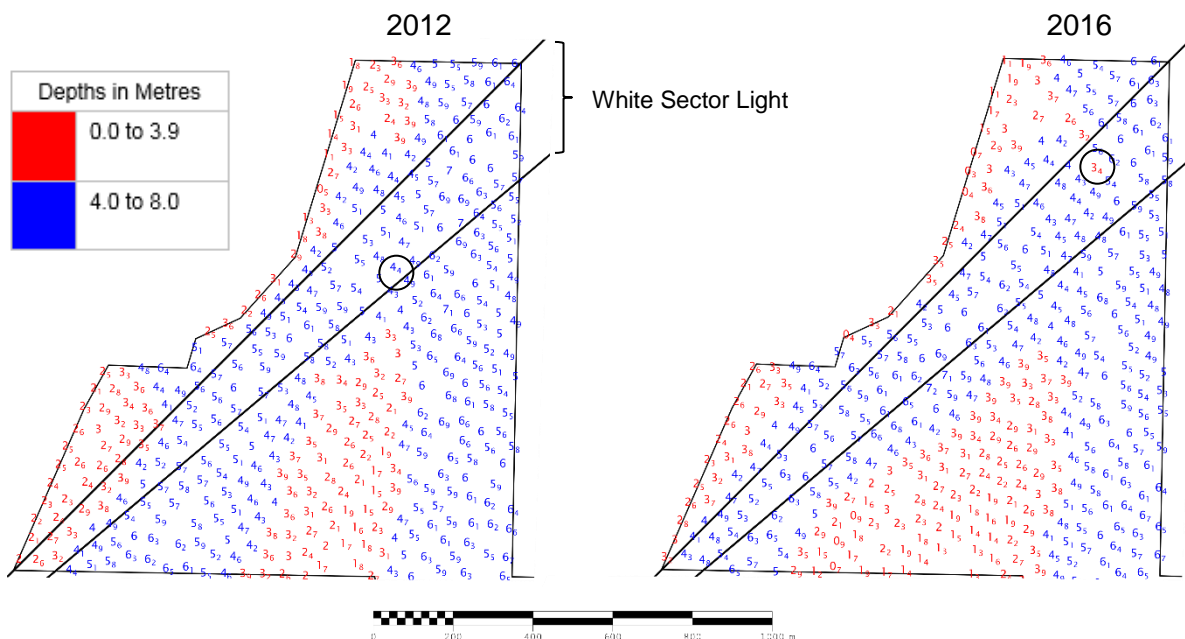
8.5 The Profile Comparison C-D in Figure 7 below supports the statement in paragraph 8.3 and shows the western edge of Holm Sand now extends up to West Holm Buoy, a migration of 330 to 350m since 2012. Depths in this area have decreased by up to 6.3m as highlighted by the Depth Plot in Figure 6.



D Figure 7 – Profile Comparison C-D

8.6 The overlying ridge across the final approach to Lowestoft from the north, detailed in the 2014 assessment, has migrated up to 70m to the east since 2012, with depths generally decreasing in the area.

8.7 The controlling depth within the Kirkley white sector light marking the approach has decreased to 3.4m from 4.3m in 2012, as shown by the Focused Depth Plot in Figure 8 and Profile Comparison E-F in Figure 9. It should be noted that the controlling depth of 3.4 in 2016m is the same as that reported since 2014 albeit approximately 70m south of its location in 2015.



Depth changes indicated above are from the closest corresponding 2012 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 – Focused Depth Plot - showing sounding selection from 2012 (left) and 2016 (right) surveys.

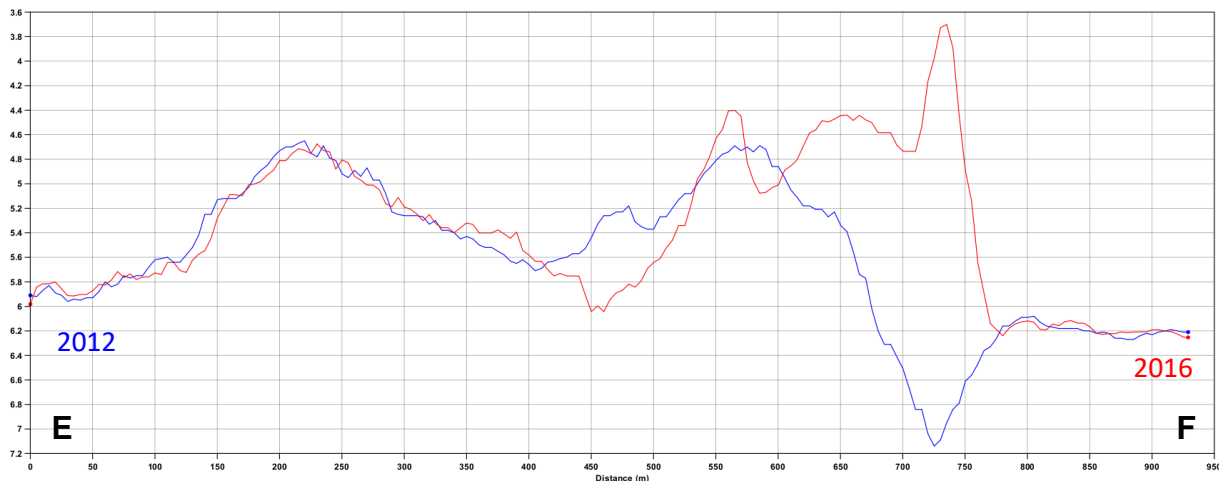


Figure 9 – Profile Comparison E-F

- 8.8 Since 2012 the north entrance to Lowestoft South Road has narrowed due to the encroachment of the western side of Lowestoft Bank by up to 250m and due to the lesser migration west of the shoreward side of Lowestoft South Road by up to 100m. This is illustrated by the 5m Contour Plot and the Focused Depth Plot shown previously in Figures 3 and 8 respectively. This trend has been reported in historical assessments albeit it is noted that there is slight reduction compared to the 75m reported in 2015 assessment (EA10A-B/2015) as comparing 2015 and 2016 this is now 50 to 60m.
- 8.9 The changes which are impacting both the overlying ridge passing through the Kirkley white sector light and Lowestoft South Road appear to be due to a clockwise rotation of the northern end of Lowestoft Bank changing from bearing of 15.5° in 2012 to 24° in 2015 and 2016 shown previously in the 5m Contour Plot in Figure 3.

9. IMPLICATIONS FOR SHIPPING

- 9.1 Depths in the southern entrance to Stanford Channel have decreased since the 2012 survey, with the maximum draught of vessels entering the channel exceeding depths in the area (not allowing for tide). The southward migration of Holm Sand and the north-east migration of Sandwaves from Newcome sand have narrowed the channel between Newcome sand and South Holm Buoys.
- 9.2 Holm Sand in the north of EA10 has extended westwards into Lowestoft North Road, with the 5m contour extending as far west as West Holm Buoy.

10. RECOMMENDATIONS FOR FUTURE SURVEYS

- 10.1 Significant bathymetric changes in focus areas EA10A and EA10B suggest annual resurveying should be continued to monitor depth along key shipping routes into Lowestoft Harbour.
- 10.2 Depths through the main part of Stanford Channel have remained constant, with little change in the extents of Newcome Sand to the west and the western bank of South Holm to the east which support retaining the resurvey interval for EA10 full area at 3 years.
- 10.3 Area EA10 and EA10B focused area was enlarged in 2017 following the 2016 CHWG to include the southern portion of EA8 as indicated in Figure 10 below. This amendment could not be included for the 2016 Routine Resurvey Programme, however the both the adjusted 2016 limits should be retained.

10.4 Significant movement of the 5m contour towards West Holm Buoy may pose a risk to marine traffic along Lowestoft North Road. This area previously formed the northern limit of focus area EA10C, which was removed from the annual resurvey programme following the 2010 survey. Given the change to the 5m contour observed between 2012 and 2016, the focused area should be reintroduced to the resurvey programme to monitor the migration of Holm Sand in this area, as shown in Figure 10 below

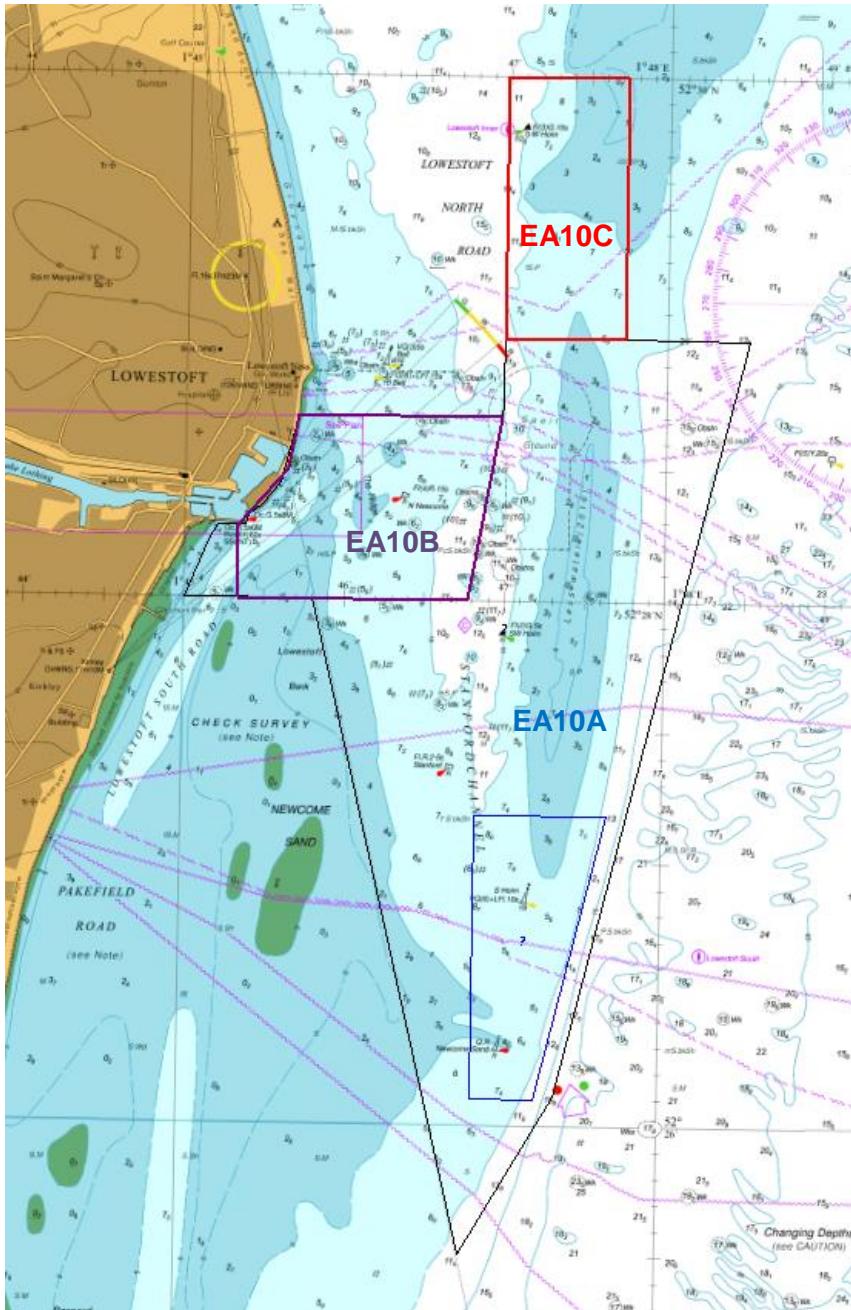


Figure 10 – Proposed change to include EA10C focused area

The coordinates of the proposed focused area EA10C are shown below.

Focused Area C: 1.57km² / 0.46NM²

- a) 52.50000N 1.783000E
- b) 52.50000N 1.795500E
- c) 52.48333N 1.795500E
- d) 52.48333N 1.783000E