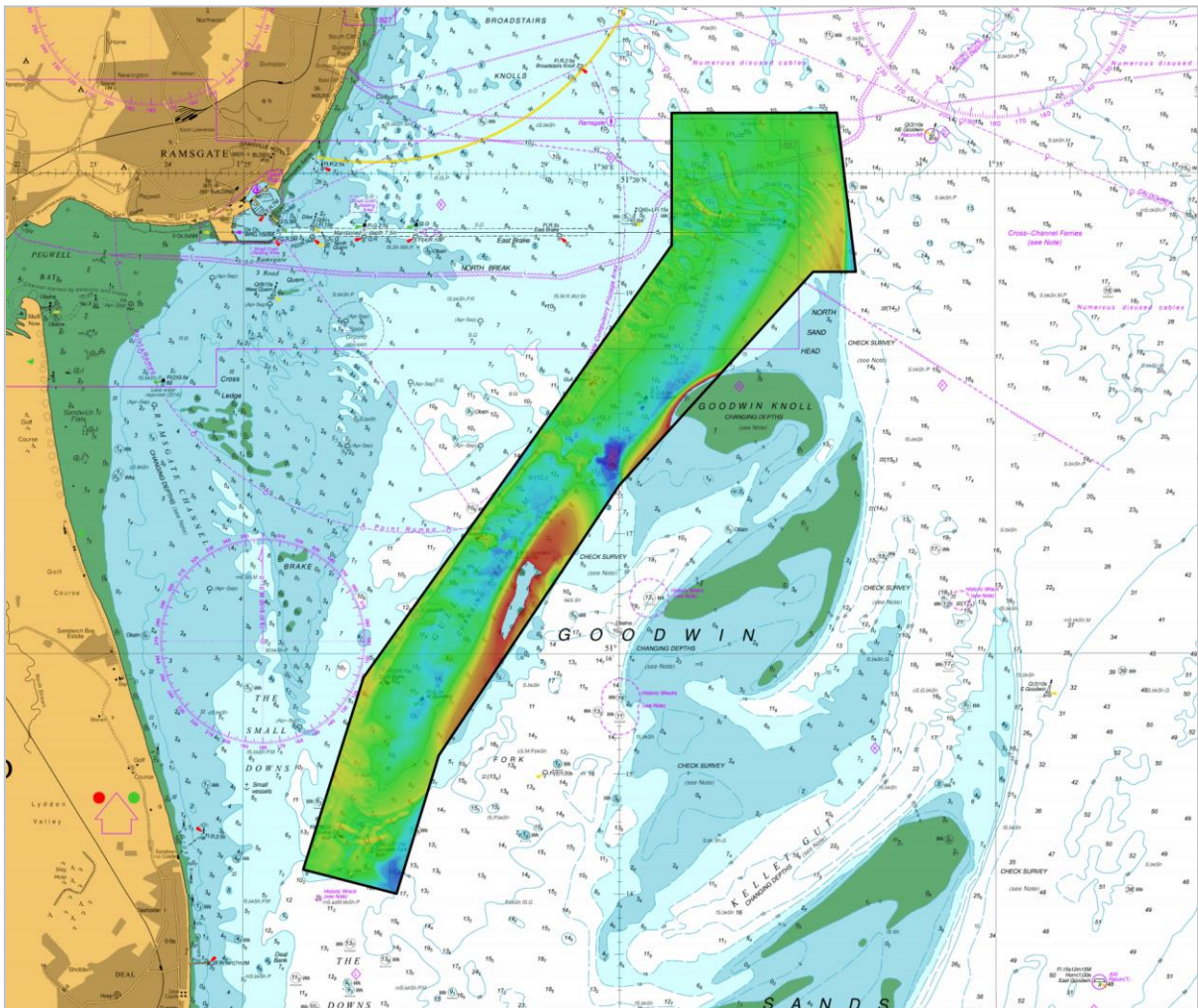




United Kingdom  
Hydrographic Office

## GOODWIN SANDS GULL STREAM & NORTH SAND HEAD

ASSESSMENT ON THE ANALYSIS OF ROUTINE RESURVEY AREA GS2  
FROM THE 2015 SURVEY



ENGLAND - GOODWIN SANDS  
GULL STREAM & NORTH SAND HEAD  
Assessment GS2/2015

An assessment of the 2015 hydrographic survey of the area: to monitor recent seabed movement; to identify any implications for shipping; and to make recommendations for future surveys.

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.

This material is protected by Crown Copyright. It may be downloaded from the UK Hydrographic Office's (UKHO) web site and printed in full for personal or non-commercial internal business use. Extracts may also be reproduced for personal or non-commercial internal business use on the condition that the UK Hydrographic Office is acknowledged as the publisher and the Crown is acknowledged as the copyright owner.

Applications for permission to reproduce the material for any other purpose (including any distribution of the material or extracts to third parties) can be made interactively on the UKHO's web site ([www.ukho.gov.uk](http://www.ukho.gov.uk)), by e-mail to [intellectualproperty@ukho.gov.uk](mailto:intellectualproperty@ukho.gov.uk) or in writing to Intellectual Property, UK Hydrographic Office, Admiralty Way, Taunton, Somerset, TA1 2DN.

## CONTENTS

1.	Executive Summary	1
2.	Introduction	1
3.	History	1
4.	Description of the Area	2
5.	Shipping in the Area	2
6.	2009 Survey Details	2
7.	2015 Survey Details	3
8.	Description of Recent Bathymetric Change	3
9.	Implications for Shipping	4
10.	Recommendations for Future Surveys	4

## ANNEXES

A.	Area Specifications (Including Survey History)	5
B.	Shipping Routes	7
C.	2015 Survey Data Overlaid on Chart 1828 Dover to North Foreland with Locations of Cross Section Comparisons (shown at Annex D)	8
D.	Cross Section Comparisons	9
E.	Colour Banded Depth Plot from the 2009 Survey showing Selected Depths	10
F.	Colour Banded Depth Plot from the 2015 Survey showing Selected Depths	11
G.	Variability Plot showing Bathymetric Changes between the 2009 and 2015 Surveys and Charted Contours from the 2015 Survey	12
H-1.	Composite Diagram of the 5 metre Contour from the 2009 and 2015 Surveys	13
H-2.	Composite Diagram of the 10 metre Contour from the 2009 and 2015 Surveys	14
I-1.	Proposed Revised Limits GS2 – Gull Stream Focused Area	15
I-2.	Proposed Revised Limits GS2 – North Sand Head Focused Area	16
I-3.	Proposed Revised Limits GS2 – Full 6-year survey area	17

## **GULL STREAM & NORTH SAND HEAD, 2015**

### **1. EXECUTIVE SUMMARY**

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

- 1.1. Area GS2 covers the Gull Stream area to the West of Goodwin Sands and the Northern limits around North Sand Head, and is currently surveyed every 6 years, with focused surveys every 3 years under the Civil Hydrography Programme.
- 1.2. North Sand Head has undergone minor change showing sediment migrating North, with the 10 metre contour moving more than 395 metres and beyond the survey boundary for 2015.
- 1.3. Gull Stream has had further sediment migrate into the deeper areas from the banks in the East, restricting the width of the passage shown to be regularly used by vessels.

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

- 1.4. The continued migration of sediment and resulting shoaling of areas regularly used by vessels requires ongoing monitoring of these locations within the GS2 area to ensure up to date bathymetric information is available.

#### **Recommendations**

- 1.5. Following the analysis of the 2015 survey it is recommended to extend the focused survey area of Gull Stream to cover additional area in the centre of the channel and around the West side of Goodwin Knoll to ensure adequate future coverage of these areas that are currently showing a trend of sediment migration.
- 1.6. It is also advised to extend the Northern part of both the North Sand Head focused and the six year full survey area to better encompass the sediment migration to the North of this area.
- 1.7. The revised limits of these areas are found at Annex I-a, I-b and I-c.

### **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 members of the Committee On Shipping Hydrography (COSH) through the UKHO website, before being presented to the Civil Hydrography Working Group. When approved, the recommendations are incorporated into the Routine Resurvey Programme. The report is governed by a Memorandum of Understanding between the DfT (including the MCA) and the MOD (including the UKHO).

### **3. HISTORY**

- 3.1. The Goodwin Sands area has been surveyed numerous times since 1979. With the full area last being surveyed in 2009 and a focused survey conducted in 2012.
- 3.2. Following a full survey analysis in 1997 it was decided to merge areas A, C1 and C2 that covered Gull Stream into one single area called GS2, and to resurvey this area

every 3 years. Analysis of the 2003 survey determined that it was adequate to extend the full resurvey to 6 year periods, but to include a 3 year focused survey covering the areas subject to the largest seabed changes on the East side of Gull Stream and the area around North Sand Head.

3.3. Area specification and survey history shown at Annex A.

#### **4. DESCRIPTION OF THE AREA**

4.1. Goodwin Sands comprises of a complex and dynamic system of banks cut by relatively deep ebb and flood channels. Sandwaves overlies the banks, with notable sandwave fields at the northern ends of them.

4.2. The Gull Stream channel lies to the west of Goodwin Sands, the Western side of the channel is less dynamic with static thinly covered or exposed shoal ledges and ridges with slow migrating and occasionally drying sand banks on the Eastern side. Sandwave areas are seen at both ends of the channel.

4.3. North Sand Head lies to the North of Goodwin Knoll and comprises of a migratory sand bank with adjoining sandwave area that crosses 3km East of the maintained channel leading into Ramsgate Port.

4.4. Area GS2 covers Gull Stream and North Sand Head and encompasses an area of 24.57 SQ KM (7.16 SQ NM), the area limits are shown overlaid on chart BA 1828, Dover to North Foreland (1:37,500) in Annex C.

#### **5. SHIPPING IN THE AREA**

5.1 The shoal and changing banks of the Goodwin Sands are generally avoided by shipping. Most pass well to the East but, where draught permits, some choose to use the inshore buoyed route of Gull Stream.

5.2 The cessation of ferry service operations out of Ramsgate Port has meant a decline in passenger vessel activity in and around the GS2 area; however recent developments of offshore windfarms have seen an increase in commercial vessels using Ramsgate Port. There is continued use of the inner passage of Gull Stream by both commercial and pleasure craft when weather and draught permit.

5.3 Sample AIS data for 2015 shows vessels up to a draught of 7.9 metres using Gull Stream. While most vessels keep to the buoyed channel, in the north some leave the channel when not constrained by draught.

5.4 Trinity Bay and The Downs, lying between the Goodwin Sands and Kent coast, just to the south of Gull Stream, provides a waiting area for ferry traffic in the event of the Port of Dover being closed and sheltered anchorage for large draught vessels.

5.5 Overview of general shipping routes in relation to GS2 shown at Annex B.

#### **6. 2009 SURVEY DETAILS**

6.1. The four Goodwin Sand areas were surveyed from the 23<sup>rd</sup> July to the 1<sup>st</sup> September under HI1294. Weather in the area was generally good throughout the survey period, with sea states ranging from 2 (Smooth) to 3 (Slight). Survey work was undertaken by two vessels, *MV Triad* and *MV Seabeam* to obtain full seafloor coverage up to the 2 metre contour.

- 6.2. The survey was conducted using Kongsberg Maritime EM3002D Multibeam Echo Sounder (MBES). Positioning was by Applanix POS/MV, combining GPS and inertial Measurement Unit data to produce the navigation solution.
- 6.3. The survey is referred to the International Terrestrial Reference Frame 2000 (ITRF2000) Datum. Depths were reduced to Chart Datum using GPS heights, with ellipsoidal height to chart datum separation values taken from the UKHO supplied Vertical Offshore Reference Framework (VORF).
- 6.4. The survey was validated by the UKHO and met IHO S44 (5<sup>th</sup> Edition) Order 1a standard.

## **7. 2015 SURVEY DETAILS**

- 7.1. The survey HI1484 covering the area of GS2 – Gull Stream and North Sand Head was conducted between the dates of the 8<sup>th</sup> August to the 15<sup>th</sup> August 2015. Sea states ranged from 2 (Smooth) to 3 (Slight), with an increase in adverse weather conditions between the 12<sup>th</sup> August to the 14<sup>th</sup> August meant survey operations were temporarily halted.
- 7.2. Data acquisition was conducted on board MV Morven using a Dual head Kongsberg EM2040C MBES. The primary horizontal reference was provided by A V5 Applanix POS MV system together with GPS data from C&C Technologies C-Nav 3050 system.
- 7.3. The survey was referred to the International Terrestrial Reference Frame 2005 (ITRF05). Vertical reference positions were obtained using post processed GPS derived heights together with the UKHO Vertical Offshore Reference Frame (VORF) to reduce heights to Chart Datum (CD).
- 7.4. The final dataset was supplied as a 1m gridded Combined Uncertainty & Bathymetry Estimated (CUBE) surface and was validated by the UKHO and found to achieve IHO S44 (5<sup>th</sup> Edition) order 1a standard.

## **8. DESCRIPTION OF RECENT BATHYMETRIC CHANGE**

- 8.1. Colour banded depth plots showing general depths, as well as selected depth comparisons from the 2009 and 2015 surveys are at Annexes E and F.
- 8.2. A variability plot showing any changes in depth between the 2009 and 2015 surveys is found at Annex G.
- 8.3. Comparison plots of the 5 and 10 metre contours from the 2009 and 2015 surveys are at Annexes H-1 and H-2 respectively.
- 8.4. Gull Stream has seen no significant change in depth on the Western side of the channel. However migrating sediment is indicated on the Eastern side encroaching further towards the centre of the channel, with the 5m contour, at NW Goodwin buoy, moving into Gull Stream 155 metres and shoaling by a maximum of 9.6 metres since 2009, with a shoalest depth of 0.2 metres, previously 9.9 metres in the same location in 2009, shown in Profile E-F at Annex D and the selected soundings in the colour banded depth plot at Annex E and F. Goodwin Knoll is also encroaching further into Gull Stream, with the 5 metre and the 10 metre contours moving 120 metres further into Gull Stream, shoaling by up to 10.8 metres shown in Profile C-D at Annex D and the selected soundings in the colour banded depth plot at Annex E and F.

- 8.5. North Sand Head shows a general migration of sediment to the North, with the 10 metre contour moving more than 395 metres, causing a shoaling of depths between 0.1 metres up to a maximum of 1.2 metres, as seen by the selected sounding in the colour banded depth plot at Annex E and F. However, the surveyed area no longer covers the extent of the 10 metre contour (shown at Annex H-2) and the survey limits will need revising to allow for future coverage and monitoring of seabed change in this area.
- 8.6. Large asymmetrical sandwaves are still present on the North-Western side of North Sand Head bank, indicated from the Variability Plot (Annex G) there are now smaller wave heights of 0.75 to 1.5 metres (compared to 2009 with 1.4 to 2.9 metre heights), with similar wavelengths of 100 to 130 metres with a general directional heading of 38 degrees, as with 2009. Profile A-B shows a section of this area at Annex D.

## **9. IMPLICATIONS FOR SHIPPING**

- 9.1. As mentioned in Section 5.2. there are no longer ferries operating out of Ramsgate port, but the routes over North Sand Head and through Gull Stream are still regularly used by pleasure craft and commercial vessels.
- 9.2. While there is currently no immediate impact on shipping and all shoal areas are adequately marked with buoys, with the migration of sediment continuing to encroach further into Gull Stream and to the North of North Sand Head it is important to continue to monitor these areas, especially for increased shoaling of the areas frequented by this shipping traffic.

## **10. RECOMMENDATIONS FOR FUTURE SURVEYS**

- 10.1. An extension of the 3yr focused survey area for Gull Stream is required to allow additional coverage of the centre of the channel and around the West side of Goodwin Knoll. This area has shown increasing migration of sediment into deeper areas of Gull Stream and needs to be monitored with enough coverage allowance to see any future seabed change. This will increase the Gull Stream focused area by 0.42 sq NM (1.45 sq km)
- 10.2. The migration of sand to the North of North Sand Head is causing shoaling of the seabed which, if left un-monitored, could cause future implications for vessel movement. The 10 metre contour is now passing outside of the extents of the surveyed area. To continue to monitor future changes it is recommended to extend the full GS2 6-year survey area and focused 3-year survey area to the North to enable full coverage of predicted sediment movements. This will increase the North Sand Head focused area by 0.32 sq NM (1.09 sq km) and the full GS2 survey area by 0.49 sq NM (1.68 sq km).
- 10.3. The revised coordinates and limits of these areas are found at Annex I-1, I-2 and I-3.

## AREA SPECIFICATIONS

(Including Survey History)

**REGION:** Goodwin Sands  
**AREA:** GS2

**NAME:** Gull Stream & North Head Sand

**LIMITS:****Full**

a) 51°20.50 N 001°30.70 E  
b) 51°20.50 N 001°32.90 E  
c) 51°19.17 N 001°33.15 E  
d) 51°19.17 N 001°32.58 E  
e) 51°17.40 N 001°30.00 E  
f) 51°15.15 N 001°27.60 E  
g) 51°14.00 N 001°27.04 E  
h) 51°14.20 N 001°25.80 E  
i) 51°15.80 N 001°26.60 E  
j) 51°19.40 N 001°30.70 E

**Focused – Gull Stream**

a) 51°16.76 N 001°28.32 E  
b) 51°18.35 N 001°30.52 E  
c) 51°18.35 N 001°31.08 E  
d) 51°16.60 N 001°28.64 E  
e) 51°15.60 N 001°27.60 E  
f) 51°14.05 N 001°26.71 E  
g) 51°14.20 N 001°25.80 E  
h) 51°15.64 N 001°27.09 E

**Focused-North Head Sand**

a) 51°20.00 N 001°32.16 E  
b) 51°20.00 N 001°33.00 E  
c) 51°19.17 N 001°33.15 E  
d) 51°19.17 N 001°32.16 E

**FULL AREA SIZE:** 7.16 SQ NM (24.57 SQ KM)

**FOCUSED AREA – GULL STREAM:** 1.66 SQ NM (5.69 SQ KM)

**FOCUSED AREA – NORTH HEAD SAND:** 0.47 SQ NM (1.62 SQ KM)

**SURVEY INTERVAL:** Full Area 6 yrs, Focused Area 3 yrs

**PREVIOUS SURVEYS:** (conducted at 1:25,000 scale (not applicable to multibeam surveys))

Year	Survey	File Ref	Data	Year	Survey	File Ref	Data
1979	K8237	H1937/78		1997	M2864	HH090/736/01	s.t.d.
1980	K8552	H1938/78		1997	M2865	HH090/738/01	s.t.d
1981	K8629	H1951/80	s.t.	1997	M2882	HH090/738/01	s.t.d
1983	K9179	H3650/78		2000	M3432	HH090/892/01	s.t.d
1984	K9564	H2907/83	s.t.	2003	M3936	HH090/1028/01	s.t.d
1985	K9883	H2331/85	s.t.	2006	M4586	HH090/1028/01	m
1988	M1263	H6342/87	s.t.d	2009	HI1294	SDRA200929529	m
1991	M1777	HH090/511/01	s.t.d	2012	HI1399	SDRA2012131314	m
1994	M2287	HH090/629/01	s.d.				

**KEY:** s - sonar sweep, t - seabed texture tracing, d - digital data available, m – multibeam.

**REPORTS** 1980 Latest survey included K8237 (H3650/78).  
1981 Latest survey included K8629 (H3650/78).  
1985 Latest survey included K9564 (H0423/85).  
1986 Latest survey included K8552 (H0423/85).  
1999 Latest survey included M2864 (HA145/010/019/01)

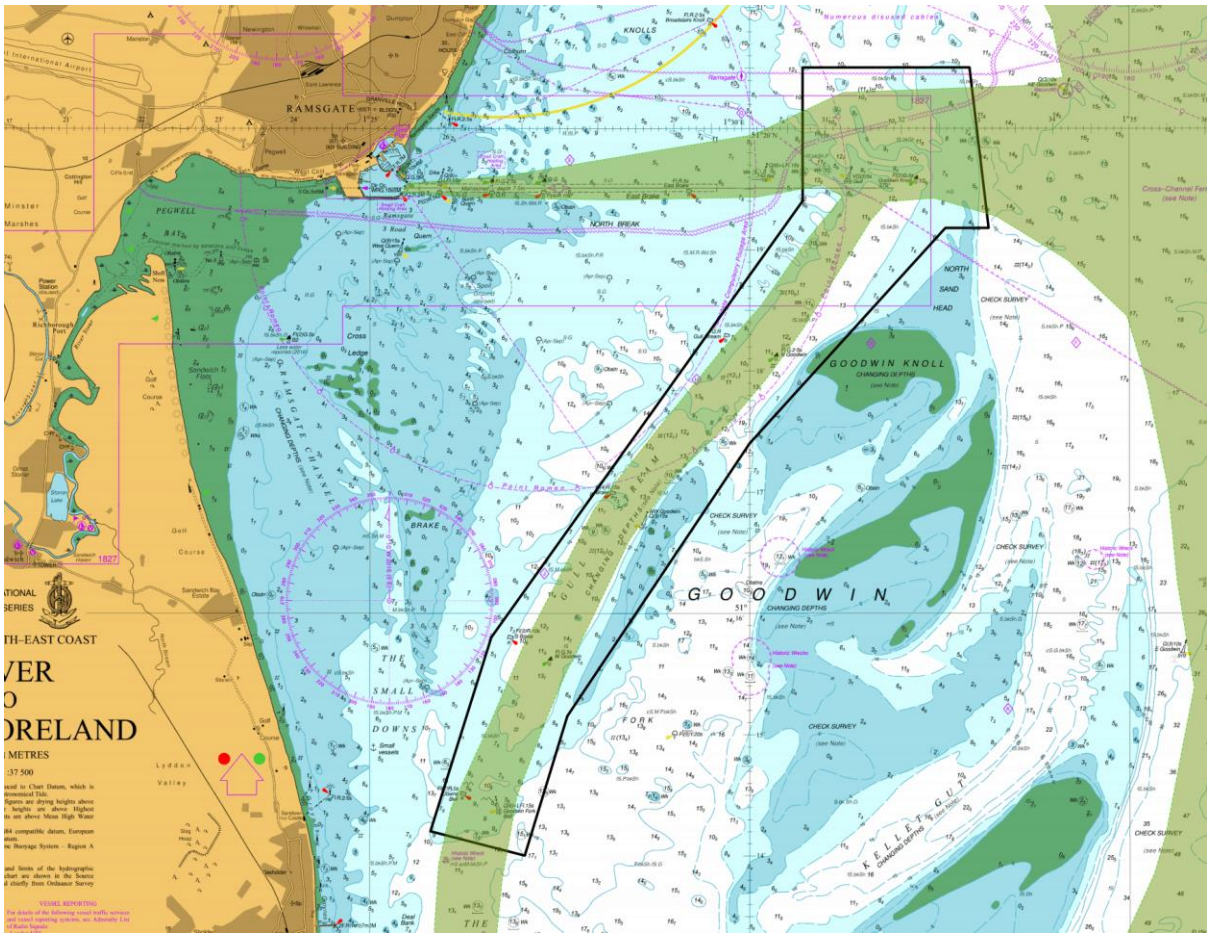
**ASSESSMENTS:** 2010 Assessment of 2009 survey (SDRA200929529)  
2013 Assessment of 2012 focused surveys (SDRA2012131314)



**REMARKS:** 1999 Report amalgamates A, C1 & C2 into one area GS2 (limits altered).  
2001 GS2 limits altered, also affects GS4 (Assessment March 2001).  
2004 Re-survey period changed 3 to 6 yrs; focused 3 yr area created.  
2009 Full survey areas limit change; additional focus area for North Head Sand area.  
2012 GS2 Gull Stream focused survey area revised.

**LARGEST SCALE CHART:** BA 1828, Dover to North Foreland (1:37,500)  
BA 1827, Approaches to Ramsgate (1:12,500) – northern part  
of area only

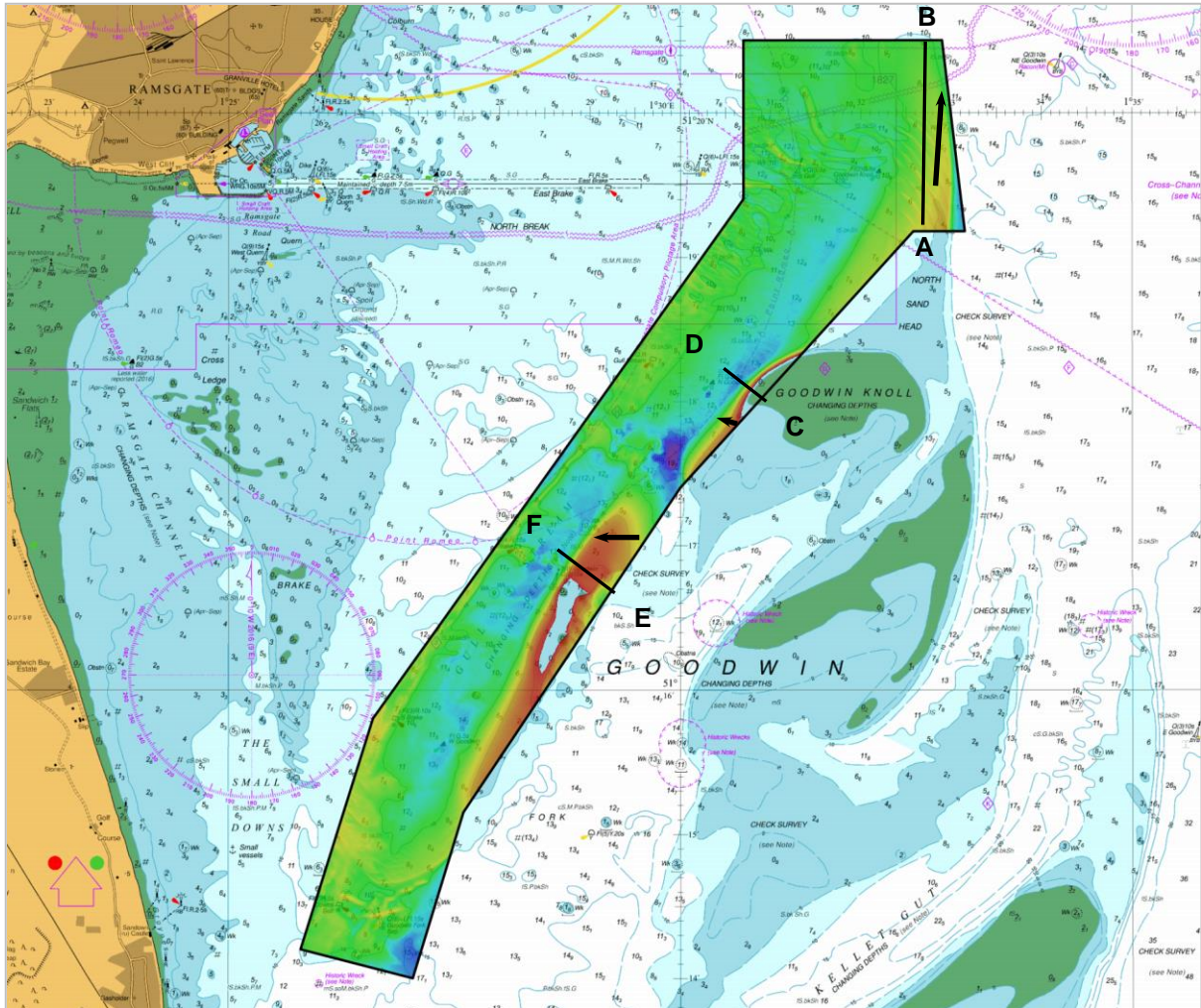
SHIPPING ROUTES






- Indicative shipping routes through area GS2
- Limits of GS2 survey area

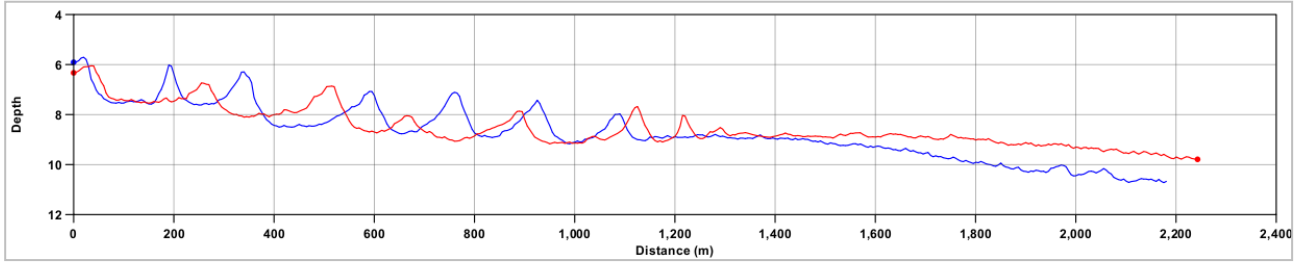
Note: Data from satellite AIS data for FY2015/2016 of vessels larger then 2000GT

2015 SURVEY DATA OVERLAID ON CHART 1828  
 DOVER TO NORTH FORELAND  
 WITH LOCATION OF CROSS SECTION COMPARISONS  
 (Shown at Annex D)

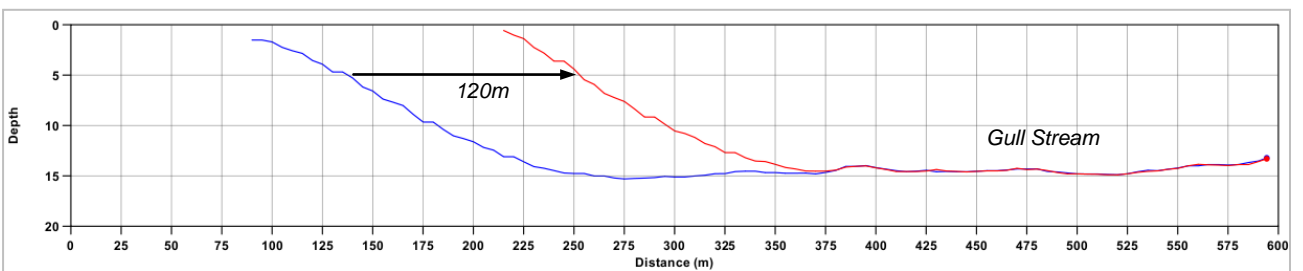


-  Limits of GS2 survey area Limits
-  Direction of sediment movement
-  Cross section locations (Profiles shown at Annex D)

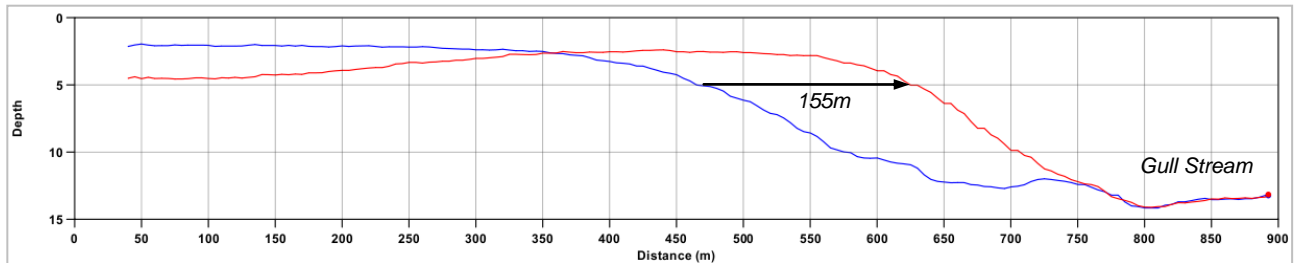
CROSS SECTION COMPARISONS  
(See Annex C for Locations)



A Profile A-B B



C Profile C-D D

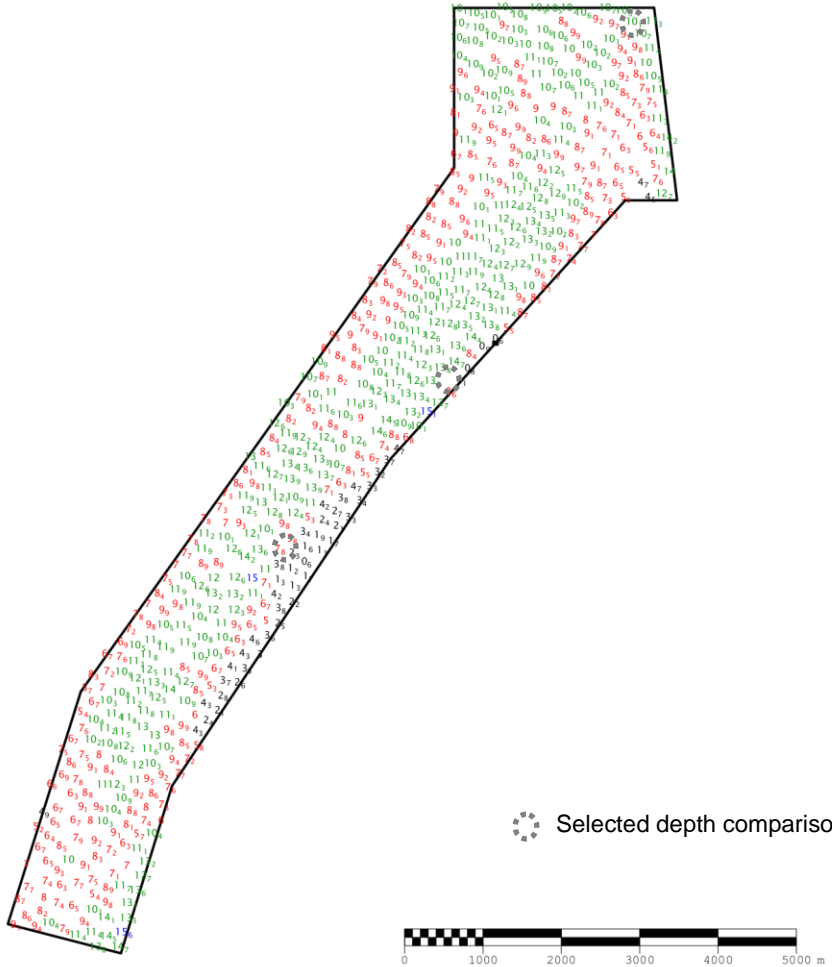


E Profile E-F F

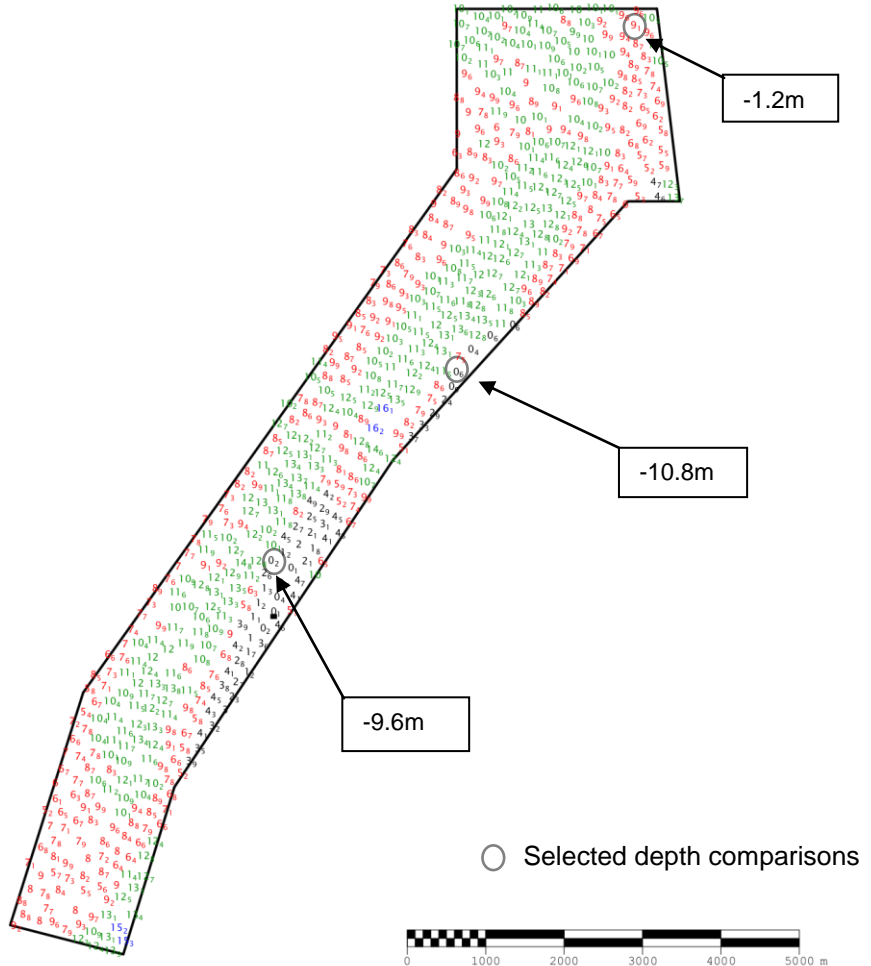
Year of Survey	
<span style="color: red;">—</span>	2015
<span style="color: blue;">—</span>	2012

COLOUR BANDED DEPTH PLOT  
 FROM THE 2009 SURVEY  
 SHOWING SELECTED DEPTHS  
 SCALE 1:50,000

Depths in Metres	
	Drying to 4.9
	5.0 to 9.9
	10.0 to 14.9
	15.0 to 20



COLOUR BANDED DEPTH PLOT  
FROM THE 2015 SURVEY  
SHOWING SELECTED DEPTHS  
SCALE 1:50,000

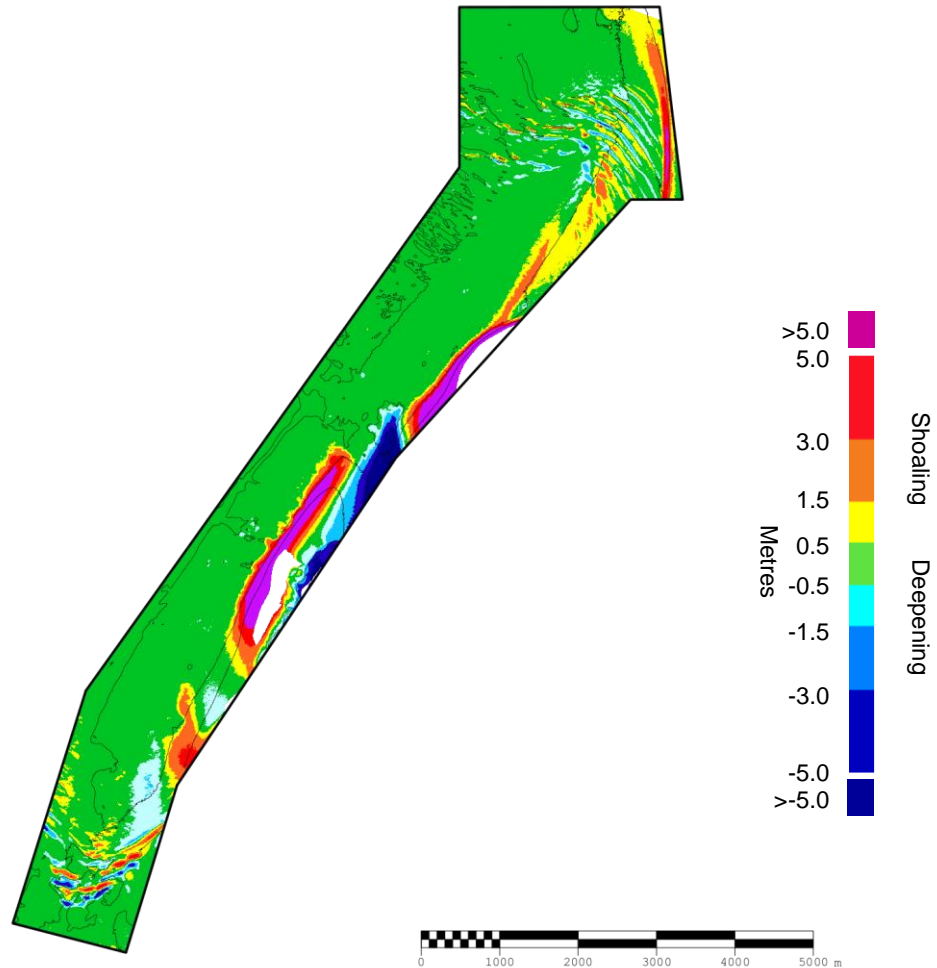


Depths in Metres	
	Drying to 4.9
	5.0 to 9.9
	10.0 to 14.9
	15.0 to 20

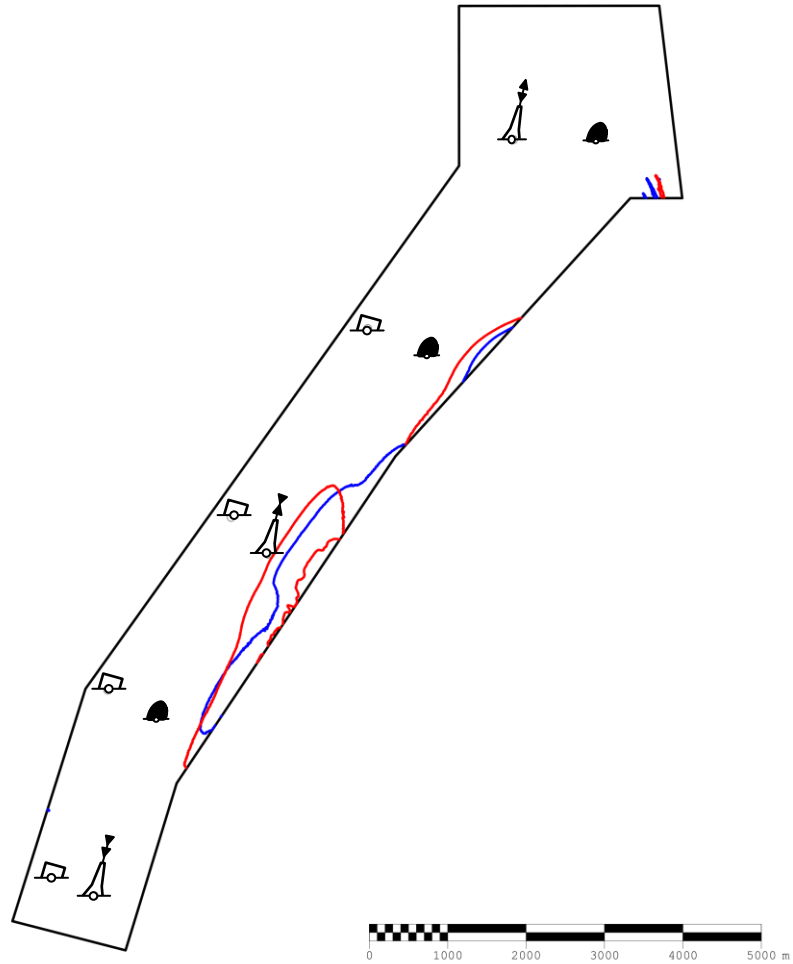
Note: Depth changes indicated above are for the same location as the sounding derived from the 2015 survey data. Hence values may not match the difference between the soundings shown in the 2009 and 2015 depth plots above as shoal bias sounding selection will select different positions that best represent the shoal values in a data set.



Deepening + Positive value / Shoaling - Negative value

VARIABILITY PLOT SHOWING  
BATHYMETRIC CHANGES BETWEEN THE 2009 AND 2015 SURVEYS  
AND CHARTED CONTOURS FROM THE 2015 SURVEY  
SCALE 1:50,000



COMPOSITE DIAGRAM OF THE  
5 METRE CONTOUR FROM THE 2009 AND 2015 SURVEYS  
SCALE 1:50,000





Year of Survey	
	2015
	2009

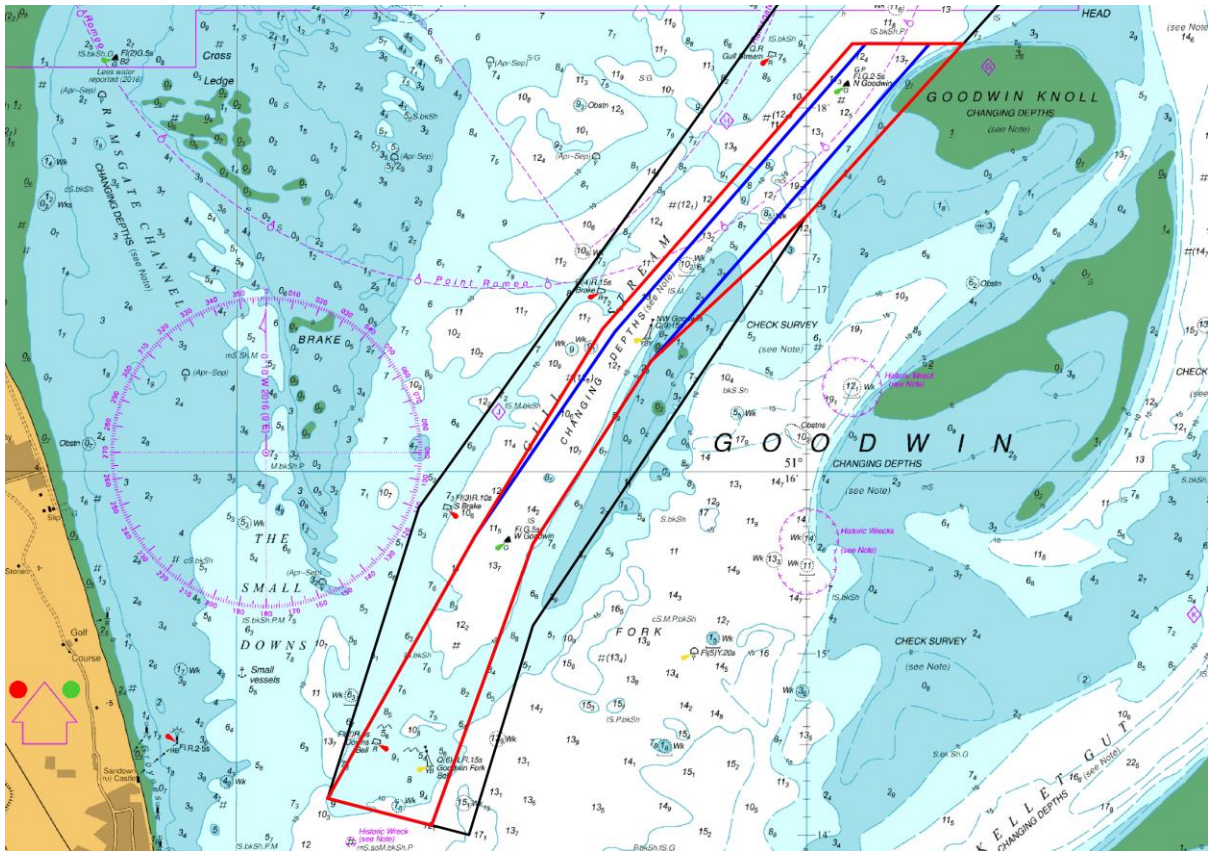





COMPOSITE DIAGRAM OF THE  
10 METRE CONTOUR FROM THE 2009 AND 2015 SURVEYS  
SCALE 1:50,000



Year of Survey	
	2015
	2009

PROPOSED REVISED LIMITS  
GS2 – GULL STREAM FOCUSED AREA

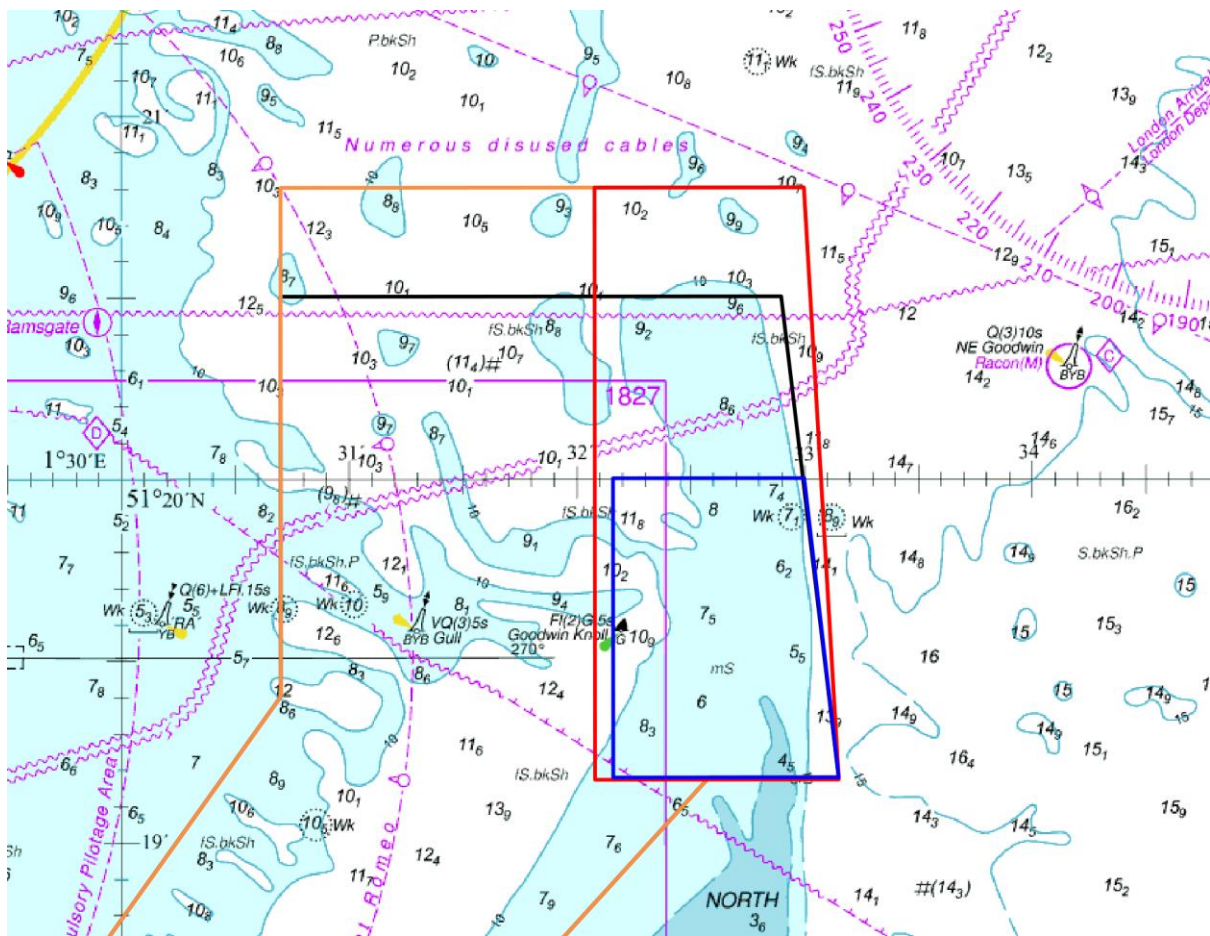






	Existing Limits for GS2 full area
	Existing Limits for GS2 – Gull Stream Focused Area
	Revised Limits for GS2 – Gull Stream Focused Area

The coordinates for the adjusted focused survey area GS2 – Gull Stream are shown below and describe a total area of 7.14km<sup>2</sup> (2.08 NM<sup>2</sup>)

	Latitude	Longitude
a	51°16.80 N	001°28.21 E
b	51°18.35 N	001°30.40 E
c	51°18.35 N	001°31.38 E
d	51°17.40 N	001°30.00 E
e	51°16.60 N	001°28.65 E
f	51°15.60 N	001°27.60 E
g	51°14.05 N	001°26.70 E
h	51°14.20 N	001°25.80 E
i	51°15.64 N	001°27.09 E

PROPOSED REVISED LIMITS  
GS2 – NORTH SAND HEAD FOCUSED AREA

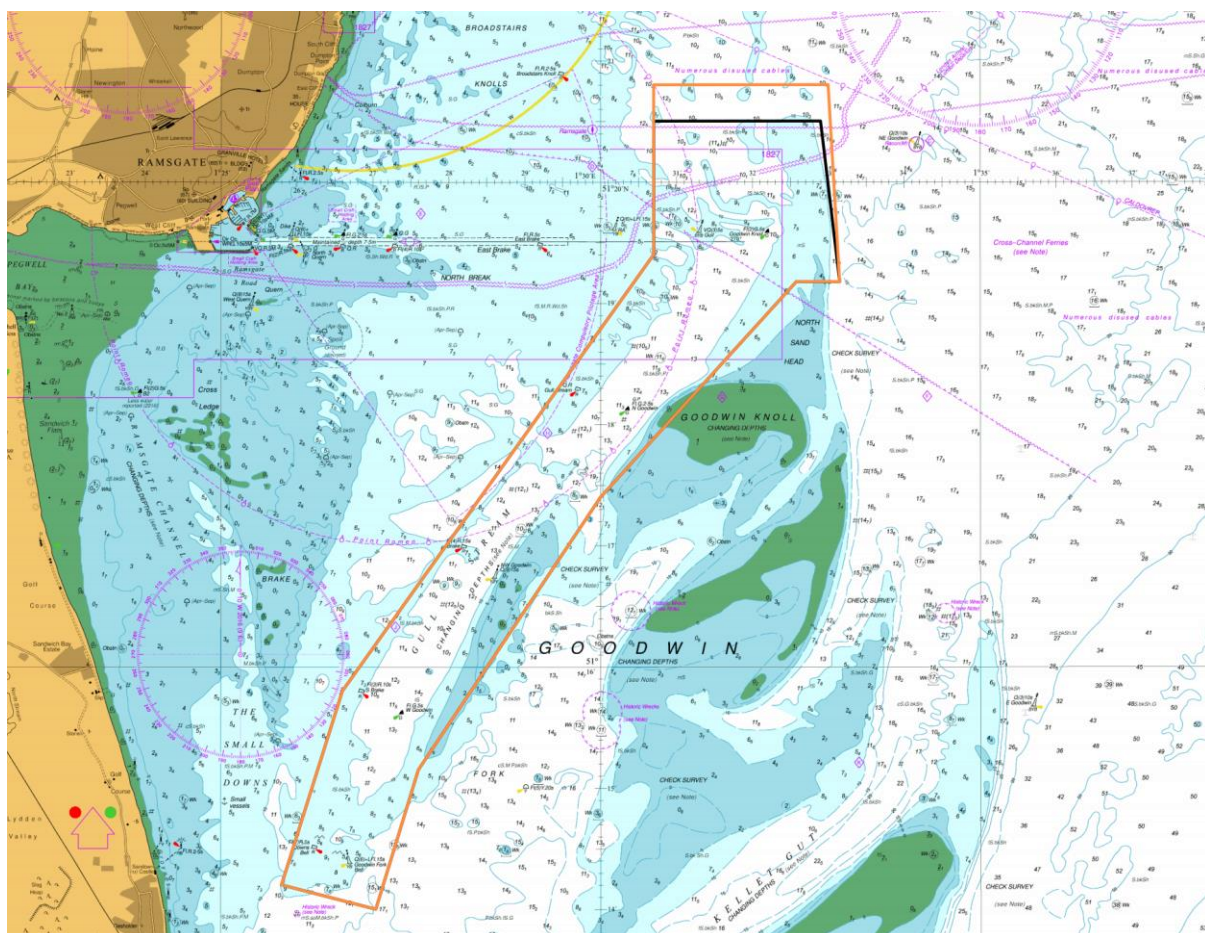




	Existing Limits for GS2 full area
	Revised Limits for GS2 full area
	Existing Limits for GS2 – North Sand Head Focused Area
	Revised Limits for GS2 – North Sand Head Focused Area

The coordinates for the adjusted focused survey area GS2 – North Sand Head are shown below and describe a total area of 2.71km<sup>2</sup> (0.79 NM<sup>2</sup>)

	Latitude	Longitude
a	51°20.80 N	001°32.08 E
b	51°20.80 N	001°33.00 E
c	51°19.17 N	001°33.15 E
d	51°19.17 N	001°32.08 E

PROPOSED REVISED LIMITS  
GS2 – FULL 6-YEAR SURVEY AREA



	Existing Limits for GS2 full area
	Revised Limits for GS2 full area

The coordinates for the adjusted Full survey area of GS2 are shown below and describe a total area of 26.25km<sup>2</sup> (7.65 NM<sup>2</sup>)

	Latitude	Longitude
a	51°20.80 N	001°30.70 E
b	51°20.80 N	001°33.00 E
c	51°19.17 N	001°33.15 E
d	51°19.17 N	001°32.58 E
e	51°17.40 N	001°30.00 E
f	51°15.15 N	001°27.60 E
g	51°14.00 N	001°27.04 E
h	51°14.20 N	001°25.80 E
i	51°15.80 N	001°26.60 E
j	51°19.40 N	001°30.70 E