Centre for Environment Fisheries & Aquaculture Science

Cefas

C6278

Thames Estuary, Barrow Deep Native Oysters

Provisional RMP Assessment

David Walker
9th May 2016

Cefas Document Control

Report Title	Thames Estuary, Barrow Deep Native Oysters pRMP Assessment
Project Name	Provisional RMP and boundary assessment for new shellfish harvesting areas – England & Wales
Client/Customer	Food Standards Agency
Cefas Project Reference	C6278
Document Number	C6728-2016-E8
Revision	V1.0
Date	09/05/2016

Revision History

Revision number	Date	Pages revised	Reason for revision
0.1	05/05/2016	-	Draft for internal review
1.0	09/05/2016	-	Report to customer

Approvals

	Name	Position	Date
Author	David Walker	Provisional RMP Assessment team	05/05/2016
Checked	Michelle Price-Hayward	Group Manager Food Safety	09/05/2016
Approved	Michelle Price-Hayward	Group Manager Food Safety	09/05/2016

This report was produced by Cefas for its Customer, FSA, for the specific purpose of providing a provisional RMP assessment as per the Customer's requirements. Although every effort has been made to ensure the information contained herein is as complete as possible, there may be additional information that was either not available or not discovered during the assessment. Cefas accepts no liability for any costs, liabilities or losses arising as a result of the use of or reliance upon the contents of this report by any person other than its Customer.

Centre for Environment, Fisheries & Aquaculture Science, Weymouth Laboratory, Barrack Road, The Nothe, Weymouth DT4 8UB. Tel 01305 206 600 www.cefas.co.uk

Contents

Fishery

An application was received to classify a native oyster (*Ostrea edulis*) bed in Barrow Deep on the approaches to the Thames Estuary. The requested classification area is bounded by lines drawn from 51°42.017'N 1°20.207'E to 51°41.939'N 1°22.935'E to 51°40.307'N 1°15.713'E to 51°39.787'N 1°17.513'E to 51°37.576'N 1°13.455'E to 51°37.255'N 1°14.399'E. Much of this area had previously been classified as B for cockles (*Cerastoderma edule*) until 2002 and has not been included in any sanitary surveys. No native oysters have been sampled in close proximity to the application area, and there has been no sampling for classification of any shellfish within 10 km in the last 10 years.

Harvesting is to be undertaken by dredging from wild beds and the application identified this would occur seasonally from August to April. The application did not identify any limitations to rights to harvest from this area and no estimated annual production (tonnage) was given.

Sources of Faecal Contamination

Figure 1 shows the location of potentially significant sources of contamination to the application area. This includes sewage discharges with flows of ≥5 m³/day that may have an impact on the application area based on distance (<50 km) and tidal flows (Figure 3) taken from the Environment Agency permitted discharge database (November 2015). The largest discharges (based on flow percentiles) are presented in Table 1 and Table 2.

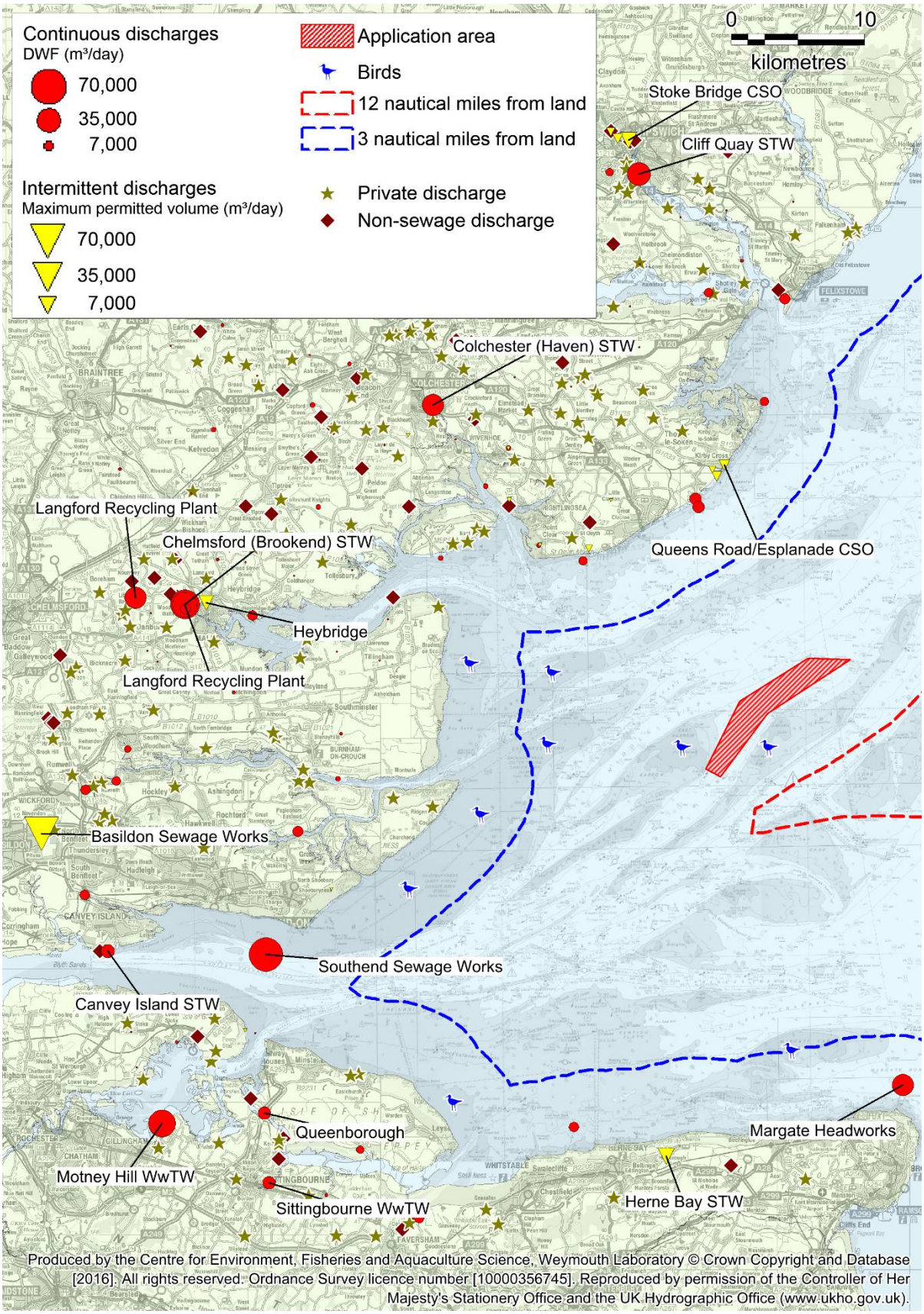

Figure 1: Potential sources of contamination to the application area

Table 1: Water company owned continuous sewage discharges with dry weather flows in the 90th percentile for all discharges impacting the harvesting area.

Name	Dry weather flow (m^3/day)	Treatment type	NGR	Receiving environment
Southend Sewage Works	68,274	2° (Activated Sludge)	TQ9070081920	Thames Estuary
Chelmsford (Brookend) STW	52,050	2° (Activated Sludge)	TL8409008140	Blackwater River
Motney Hill WwTW	44,582	Unspecified	TQ8315069000	Medway Estuary
Langford Recycling Plant	40,000*	3° (3° Biological)	TL8408008130	River Chelmer
Cliff Quay STW	34,213	2° (Activated Sludge)	TM1714041440	Tidal River Orwell
Langford Recycling Plant	30,000	3° (UV Disinfection)	TL8037008560	River Chelmer
Colchester (Haven) STW	29,284	3° (UV Disinfection)	TM0225023610	River Colne
Margate Headworks	29,120	2° (Activated Sludge)	TR3885073460	North Sea
Canvey Island STW	13,000	2° (High Rate Biological)	TQ7882081900	Thames Estuary
Sittingbourne WwTW	11,800	2° (Biological Filtration)	TQ9128064740	Milton Creek
Queenborough	11,225	2° (Oxidation Ditch)	TQ9085069970	Swale Estuary

2° - secondary, 3° - tertiary
Data from Environment Agency
*Maximum daily volume permitted

The largest sewage works discharging to the Thames Estuary is the Southend Sewage Works, which provides secondary treatment for a consented dry weather flow of 68,274 m^3/day. Although the discharge is located approximately 36 km upstream of the application area, due to its large size it is likely to have an impact further downstream. Similarly, the Motney Hill WwTW which discharges to the River Medway is almost 50 km from the application area but is likely to impact downstream. Norovirus has been shown to have lower decay rates than E. coli in environmental waters (Campos *et al*, 2015) and so it is possible that while levels faecal indicator bacteria from sewage works may be low at the application area due to the large distances, norovirus levels may remain high.

The outfalls from the Rivers Colne and Blackwater converge to the northwest of the application area. Chelmsford (Brookend) STW is the second largest discharge that is likely to have an impact the application area, with a secondary treated DWF of 52,050 m^3/day to the River Blackwater. While the Colchester (Haven) STW has and Langford Recycling Plant have large DWFs (29,284 and 40,000/30,000 m^3/day respectively), these discharges are tertiary treated and so are likely to contribute a lower number of *E. coli* to the application area.

While it is possible that Cliff Quay STW, Sittingbourne WwTW, Queensborough and Margate Headworks may have some impact on the application area due to their sizes, the tidal flow between these areas and the application area is relatively low, and so are less likely to have an impact as those discharging from the Thames, Medway, Colne or Blackwater Rivers.

There are several private sewage discharges within the area. These discharges are too small to have a significant impact on the application area due to the large distances between the discharges and the application area (minimum 18 km). However, they are likely to contribute to the overall background level of contamination in the area.

Intermittent sewage discharges

Intermittent discharges can create issues in management of shellfish hygiene however infrequently they spill (Kay *et al*, 2008). Basildon Sewage Works is by far the largest

intermittent discharge that is likely to impact the application area, with a maximum permitted volume of 65,700 m³/day. Basildon Sewage Works discharges to Pitsea Creek which converges with the Thames Estuary to the west of Canvey Island.
Other significant intermittent discharges in the area include Herne Bay STW to the south of the application area, Heybridge to the west and upstream of the Blackwater River, Queens Road/Esplanade CSO and Stoke Bridge CSO to the north of the application area. These discharges are likely to have a smaller impact on the application area than Basildon Sewage Works due to their smaller sizes and lower tidal exchange between their receiving waters and the application area.

Table 2: Water company owned intermittent sewage discharges with maximum permitted flows in the 75th percentile for all discharges impacting the harvesting area.

Name	Maximum permitted volume(m^3/day)	NGR	Receiving environment
Basildon Sewage Works	65,700	TQ7370090650	Pitsea Creek
Herne Bay STW	5,903*	TR2117067521	Hogwell Sewer & R.Great Stour
Heybridge	3,700*	TL8567908298	Non-Tidal Heybridge
Queens Road/Esplanade CSO	1,263	TM2409019710	North Sea
Stoke Bridge CSO	5,926	TM1629043980	Tidal River Orwell

Data from Environment Agency
*Dry weather flow

Wildlife

The Thames Estuary has the fourth largest aggregation of water birds in the UK (Holt *et al*, 2015), with a 5 year (2009-2014) average count of 164,114 birds. Many of these birds are waders that will forage and defecate on the sand banks surrounding the southern end of the application area, as well as the large banks further inshore. This may therefore be a significant source of faecal contamination to the native oysters in the application area. The majority of waterbirds migrate to other areas to breed in spring and summer, and so contamination from bird faeces is likely to be most significant in the winter.
There are large populations of harbour seal (*Phoca vitulina*) and grey seals (*Halichoerus gypus*) in the out Thames Estuary (Barker et al, 2014). These animals forge widely and so their impacts on faecal contamination are likely to be diffuse away from their haulout sites onshore.

Boats

The Thames Estuary is a major shipping route for the London ports. Merchant ships may not make overboard discharges within 3 nautical miles (5.5 km) from the nearest land for treated sewage or 12 nautical miles (22 km) from the nearest land for untreated sewage[1]. The definition of nearest land in this case refers to the baseline for territorial waters and does not include intertidal areas. It is therefore possible that treated sewage may be legally discharged from merchant vessels within the application area. Untreated sewage can legally be discharged by merchant vessels 4 km southeast of the application area. However, there is

[1] Merchant Shipping (Prevention of Pollution by Sewage and Garbage from Ships) Regulations 2008

only a small area in which it is legal to discharge untreated sewage (part of Black Deep) that is in close proximity to the application area and that merchant vessels are likely to navigate. Additionally, the exchange of water between Black Deep and Barrow Deep is likely to be relatively low due to tidal flows.
There is also a large volume of small vessel traffic (such as pleasure craft and fishing boats) in the estuary. Small boats might make overboard sewage discharges from time to time. Occasional discharges are likely from boats with on-board toilets (heads), but the timings and locations of these discharges will be unpredictable.

Classification and monitoring history

The classification history for bivalves in the Thames Estuary is shown in Table 1.

Table 3: Classification history of the area from 2006 to present

Bed name	Species	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Foulness Sands	Cockles	A	A	A	A	B	A	A	B-LT	B-LT	B-LT
Leigh Foreshore	Cockles	B	B	B	C	C	C	C	C	C	C
Mid Maplin Sands	Cockles	A	B	B	B	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT
NE Maplin Sands	Cockles	A	A	A	B	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT
Phoenix	Cockles	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT
Scrapsgate	Cockles	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT
Shoebury Island	Cockles	A	B	B	B	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT
Southend Flats	Cockles	B	B	B	B	C	C	C	C	C	C
Leigh Foreshore	Mussels	B	B	B	C	C	C	C	C	C	C
Sheppey	Mussels	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT	n/c
Southend Flats	Mussels	B	B	B	B	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT
Southend Flats West	Mussels	B	B	B	B	n/c	n/c	n/c	n/c	n/c	n/c
East of Southend Pier	Pacific oysters	n/c	n/c	n/c	n/c	n/c	C	C	C	C	C
West of Southend Pier	Pacific oysters	B	B	B	B	B-LT	B-LT	B-LT	B-LT	B-LT	B-LT

No native oysters have been sampled in close proximity to the application area, and there has been no sampling for classification of any shellfish within 10 km in the last 10 years.
Those areas that are classified within the Thames Estuary have tended to maintain the same classification over a long period.

Table 4 shows the summary statistics for the shellfish flesh monitoring results for Thames Estuary for the last 5 years, and Figure 2 shows the locations of the sampling sites.

Table 4: Summary statistics for *E. coli* classification monitoring results (MPN/100g) by RMP – 2011 to 2016

Sampling Site	Species	No.	Date of first sample	Date of last sample	Geometric mean	Min.	Max.	% over 230	% over 4,600	% over 46,000
Corporation Jetty	Cockle	1	19/04/2011	19/04/2011	330.0	330	330	100.0	0.0	0.0
Foulness Sands	Cockle	49	04/04/2011	20/04/2015	48.8	<18	1,300	10.2	0.0	0.0
Leigh Foreshore	Cockle	58	19/04/2011	11/04/2016	1,649.9	<20	54,000	93.1	24.1	1.7
Maplin Sands West	Cockle	49	04/04/2011	20/04/2015	61.0	<18	2,400	14.3	0.0	0.0
Shoebury Island	Cockle	49	04/04/2011	20/04/2015	88.9	<18	3,300	24.5	0.0	0.0

N E Maplin Sands	Cockle	48	04/04/2011	20/04/2015	58.0	<20	1,300	14.6	0.0	0.0
Phoenix	Cockle	60	04/04/2011	06/04/2016	308.7	<20	13,000	60.0	3.3	0.0
East of Shoebury Buoy	Cockle	11	03/06/2015	06/04/2016	151.4	20	3,300	27.3	0.0	0.0
East of Havengore Creek	Cockle	11	03/06/2015	06/04/2016	120.9	<18	1,700	27.3	0.0	0.0
Crouch Approach	Cockle	11	03/06/2015	06/04/2016	135.9	20	1,700	27.3	0.0	0.0
Sheppey Barton Pt	Mussel	50	13/04/2011	21/05/2015	122.5	<20	1,700	30.0	0.0	0.0
Southend Leisure Centre	Mussel	58	19/04/2011	11/04/2016	911.5	<20	22,000	87.9	12.1	0.0
West of Southend Pier	Pacific oyster	58	19/04/2011	11/04/2016	402.9	<20	5,400	63.8	3.4	0.0
East of Southend Pier	Pacific oyster	19	16/07/2014	11/04/2016	526.9	20	3,300	84.2	0.0	0.0

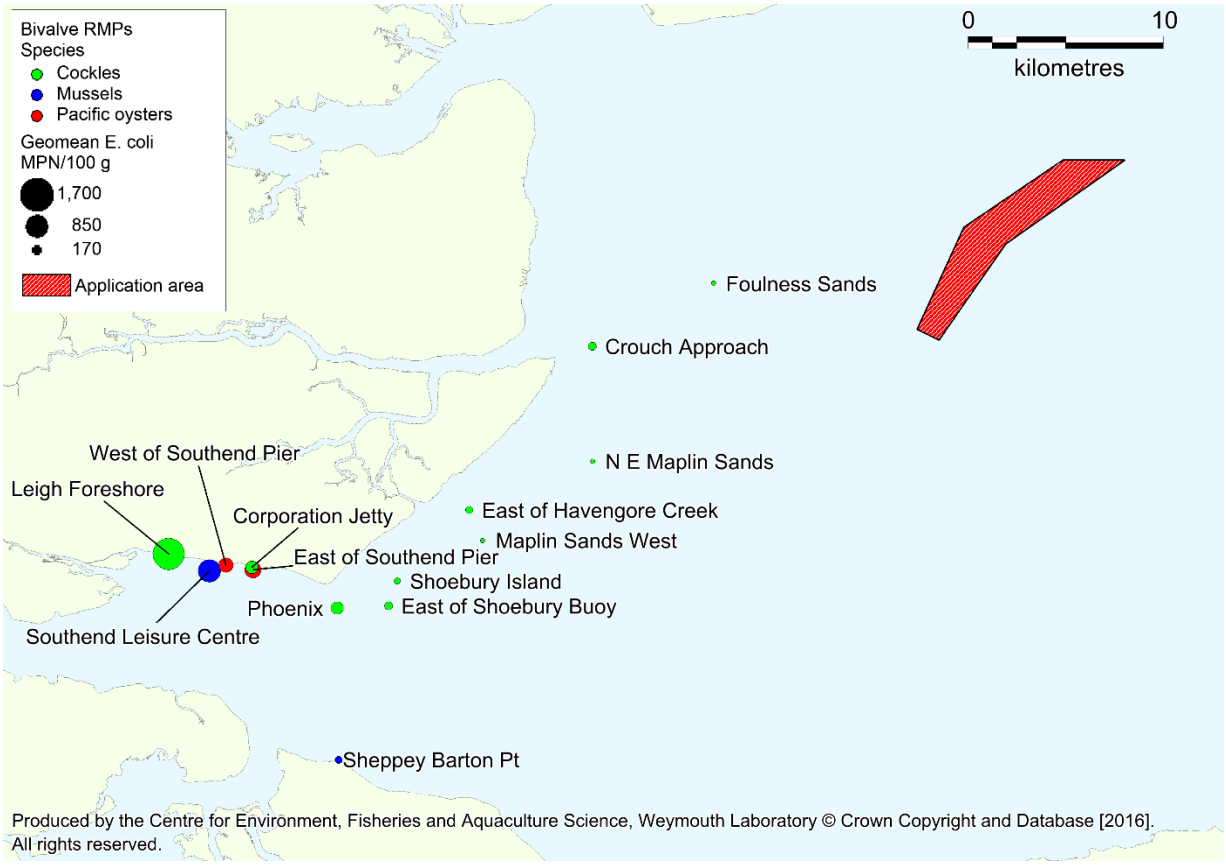

Figure 2: Locations of RMPs and geometric mean E. coli MPN/100 g in the Thames estuary from 2011 to 2016.

These summary statistics show that the concentration of *E. coli* found in shellfish flesh is highest around Southend, and is lower in the outer Thames Estuary.

Chemical contaminants

There are no immediately apparent potential sources of chemical contaminants according to the discharges database available at the time of writing.

Water circulation

The application area lies mainly within Barrow Deep, which is one of several channels used by shipping that navigates the Thames Estuary. The southern part of the application area is flanked by sandbanks to the west and east rising to 1.3 m above chart datum, and the channel itself falls to around 22 m below chart datum. To the north and east of the application area, Barrow Deep and Middle Deep converge into King's Channel, bringing water from the River Thames. At this point, the Deeps also converge with Whitaker Channel bringing water from the River Crouch. North of King's Channel, Buxey Sand and Gunfleet Sand provide some shelter from the outfalls of the River Blackwater and River Colne. The tidal flows in this area (Figure 3) appear to indicate that there are relatively low levels of exchange between the waters to the north and south of Buxey Sand and Gunfleet Sand.

Tidal diamonds in close proximity to the application area indicate tidal flows of up to 2 knots on the spring tide, and up to 1.3 knots on the neap tide.

Movement of pollutants by tidal currents is likely to be the main mode of contaminant transport in the Thames Estuary. The flood tide will convey relatively clean water originating from the North Sea into the estuary, whereas the ebb tide will carry contamination from pollution sources, including sewage discharges and surface water outfalls out through the estuary.

Strong winds may modify surface currents, and the prevailing wind in this area is south westerly. This means that for most of the time, the wind will push waters from the Thames towards the application area. However, northerly and westerly winds will push waters from the Crouch, Blackwater and Colne estuaries towards the application area.

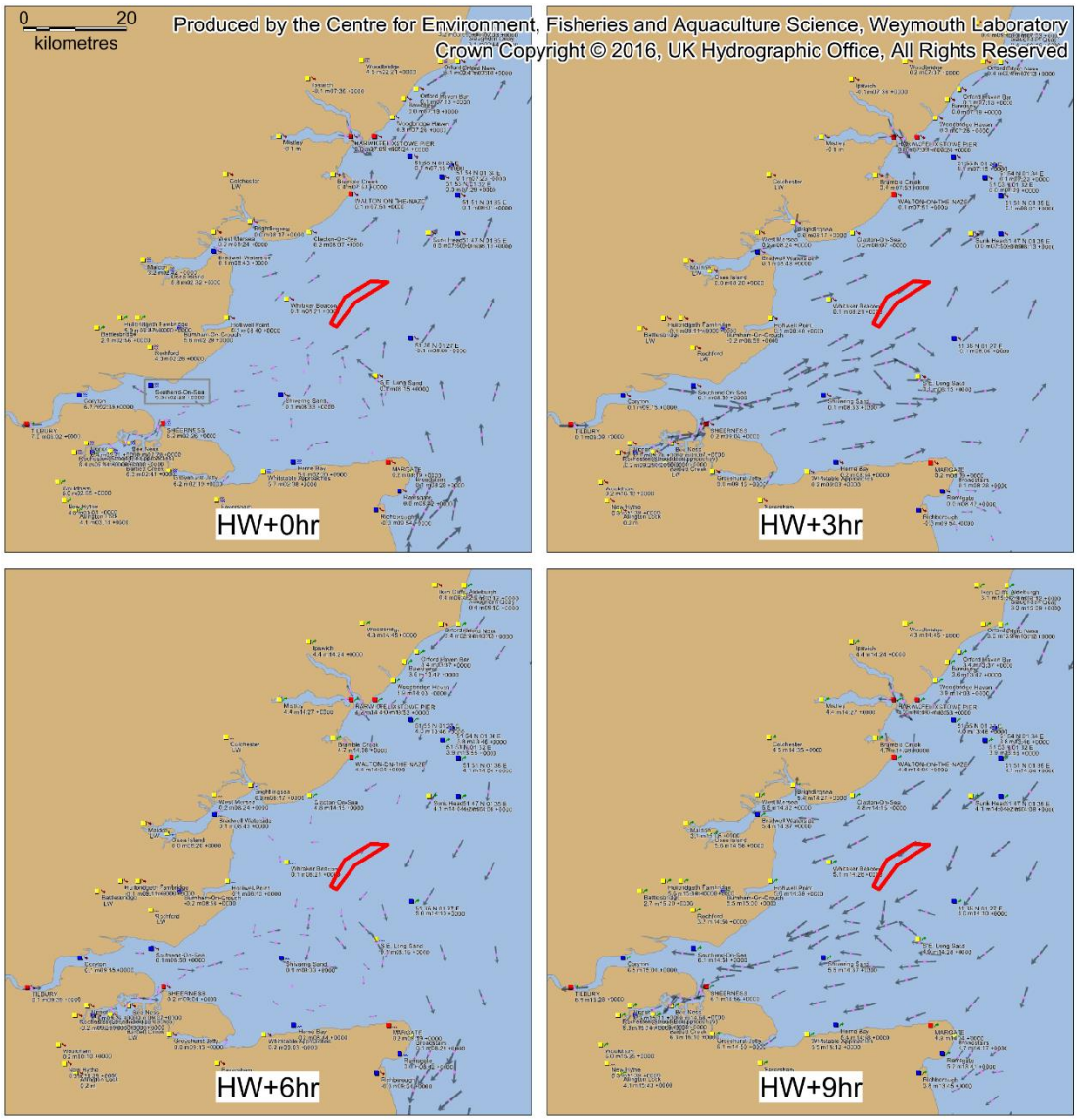

Figure 3: Tidal flows in the Thame Estuary area 0, 3, 6 and 9 hours after high-water at Southend. Data from Admiralty TotalTide software V 8.1.0.267.

Recommendations regarding provisional RMP and production area

Provisional production area

It is recommended that the provisional production area (classification zone) boundaries be set as the area within lines drawn from 51°42.017'N 1°20.207'E to 51°41.939'N 1°22.935'E to 51°40.307'N 1°15.713'E to 51°39.787'N 1°17.513'E to 51°37.576'N 1°13.455'E to 51°37.255'N 1°14.399'E as requested.

Provisional RMP

The application area lies approximately 14.5 km from mean high water (MHW) to the north, 18.5 km from MHW to the west and 27 km from MHW to the south. As such, it is unlikely that a single point source of faecal contamination will be the major contributor to the area. Much of

the water flowing over the application area during the ebb tide will have originated from the River Thames, and to a lesser extent from the River Crouch. There are several sewage works that discharge to the Thames Estuary including the largest continuous discharge (Southend Sewage Works) and the largest intermittent discharge (Basildon Sewage Works) in the area. Water from the River Blackwater and Colne may also influence the level of contamination in this area, but it is likely to be to a much lower extent than from the River Thames due to tidal flows.
Additional contamination sources may be from birds on the sand banks at low tide. The sand banks are towards the southern end of the application area, and the largest is to the south west.
It is therefore recommended that the RMP is located towards the southwestern end of the production area to best account for contamination from the river Thames and the sand banks.

The following sampling criteria should apply at native oyster RMPs:

- Individuals of *O. edulis* sampled should be of a marketable size.
- Sampling should be by dredging, and a tolerance of 100 m applies to allow repeated sampling of wild stocks.
- The sampling frequency should be monthly and on a year round basis
- Should the LEA determine that employing a local gatherer to collect samples will be the best practical option, the LEA should consult with the FSA to ensure that all the appropriate requirements can be met. Should such a strategy be pursued, the LEA should contact the FSA to propose gatherer supplied samples. Proposals must comply with the official control sampling protocols, ensure adequate training and supervision is provided, and be documented accordingly.

Table 5: Provisional Sampling Plan

Production Area	Thames Deeps
pRMP name	Barrow Deep
NGR	TR 23539 96912
Latitude	51°37.596'N
Longitude	01°13.697'E
Species	Wild native oyster (*Ostrea edulis*)
Collection method	Dredge
Sampling tolerance	100 m
Sampling frequency	Monthly sampling
Provisional production area boundary	Area bounded by lines drawn from 51°42.017'N 1°20.207'E to 51°41.939'N 1°22.935'E to 51°40.307'N 1°15.713'E to 51°39.787'N 1°17.513'E to 51°37.576'N 1°13.455'E to 51°37.255'N 1°14.399'E.

(Lat/Long datum WGS84)

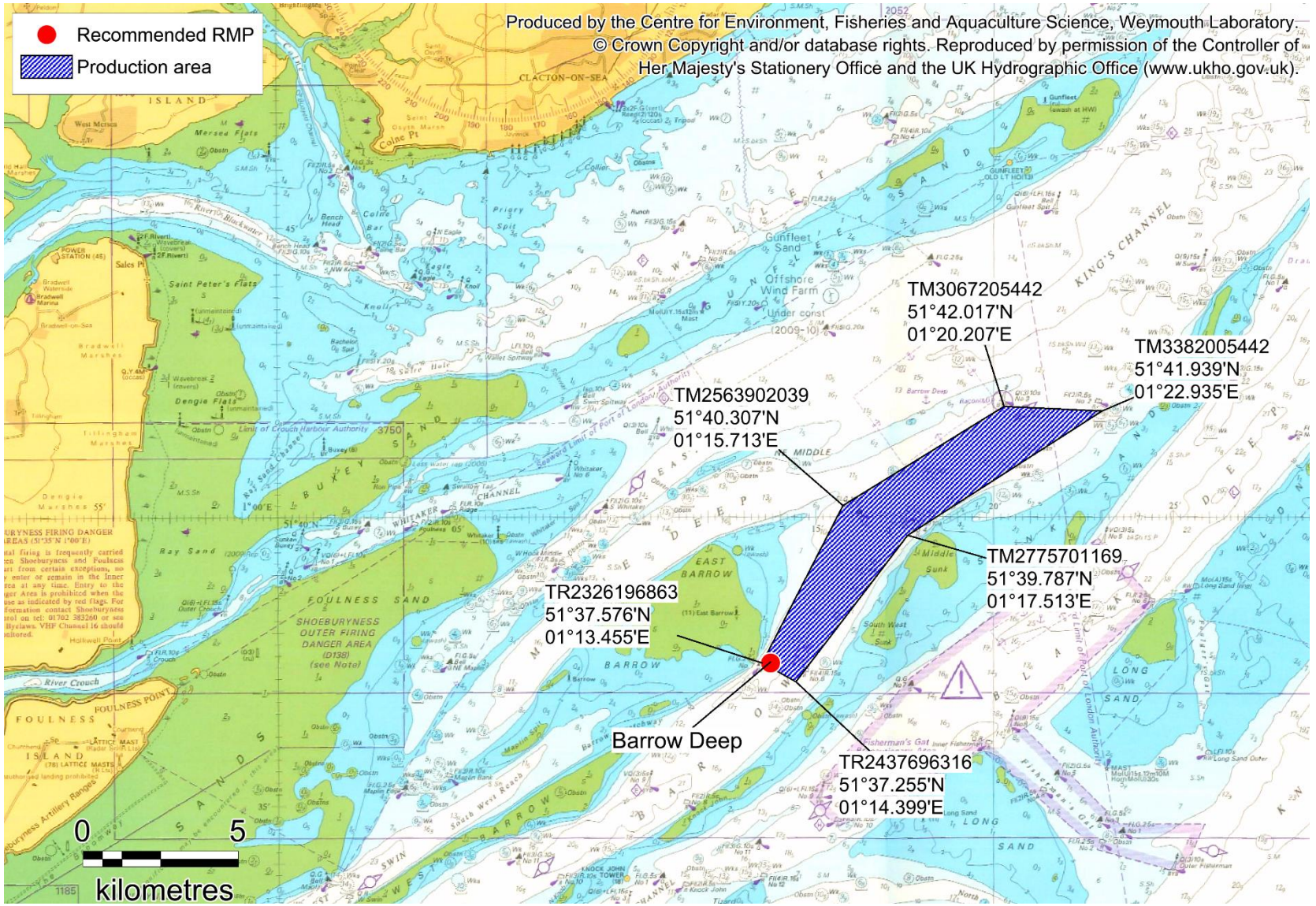

Figure 4: Recommended provisional production area RMP

References

Barker, J., Seymour, A., Mowat, S., Debney, A., 2014. Thames Harbour Seal Conservation Project. Zoological Society for London. Available at: http://www.zsl.org/sites/default/files/media/2014-06/Thames%20Harbour%20Seal%20Conservation%20Project%20Report.pdf. Accessed May 2016.

Campos, C.J.A., Avant, J., Gustar, N., Lowther, J., Powell, A., Stockley, L., Lees, D.N., 2015. Fate of Human Noroviruses in Shellfish and Water Impacted by Frequent Sewage Pollution Events. Environmental Science and Technology 49 (14):8377–8385.

Holt, C.A., Austin, G.E., Calbrade, N.A., Mellan, H.J., Hearn, R.D., Stroud, D.A., Wotton, S.R. & Musgrove, A.J. 2015. Waterbirds in the UK 2013/14: The Wetland Bird Survey. BTO, RSPB and JNCC, in association with WWT. British Trust for Ornithology, Thetford.

Kay, D., Kershaw, S., Lee, R., Wyer, M.D., Watkins, J., Francis, C., 2008. Results of field investigations into the impact of intermittent sewage discharges on the microbiological quality of wild mussels (Mytilis edulis) in a tidal estuary. Water Research 42:3033-3046.

Centre for Environment Fisheries & Aquaculture Science

Cefas

About us

The Centre for Environment, Fisheries and Aquaculture Science is the UK's leading and most diverse centre for applied marine and freshwater science.

We advise UK government and private sector customers on the environmental impact of their policies, programmes and activities through our scientific evidence and impartial expert advice.

Our environmental monitoring and assessment programmes are fundamental to the sustainable development of marine and freshwater industries.

Through the application of our science and technology, we play a major role in growing the marine and freshwater economy, creating jobs, and safeguarding public health and the health of our seas and aquatic resources

Head office
Centre for Environment, Fisheries & Aquaculture Science
Pakefield Road
Lowestoft
Suffolk
NR33 0HT
Tel: +44 (0) 1502 56 2244
Fax: +44 (0) 1502 51 3865

Weymouth office
Barrack Road
The Nothe
Weymouth
DT4 8UB

Tel: +44 (0) 1305 206600
Fax: +44 (0) 1305 206601

Customer focus

We offer a range of multidisciplinary bespoke scientific programmes covering a range of sectors, both public and private. Our broad capability covers shelf sea dynamics, climate effects on the aquatic environment, ecosystems and food security. We are growing our business in overseas markets, with a particular emphasis on Kuwait and the Middle East.

Our customer base and partnerships are broad, spanning Government, public and private sectors, academia, non-governmental organisations (NGOs), at home and internationally.

We work with:

- a wide range of UK Government departments and agencies, including Department for the Environment Food and Rural Affairs (Defra) and Department for Energy and Climate and Change (DECC), Natural Resources Wales, Scotland, Northern Ireland and governments overseas.
- industries across a range of sectors including offshore renewable energy, oil and gas emergency response, marine surveying, fishing and aquaculture.
- other scientists from research councils, universities and EU research programmes.
- NGOs interested in marine and freshwater.
- local communities and voluntary groups, active in protecting the coastal, marine and freshwater environments.

www.cefas.co.uk

Printed on paper made from a minimum 75% de-inked post-consumer waste