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Littoral and sublittoral biotope mapping and data capture exercise for the Essex estuaries candidate Marine Special Area of Conservation

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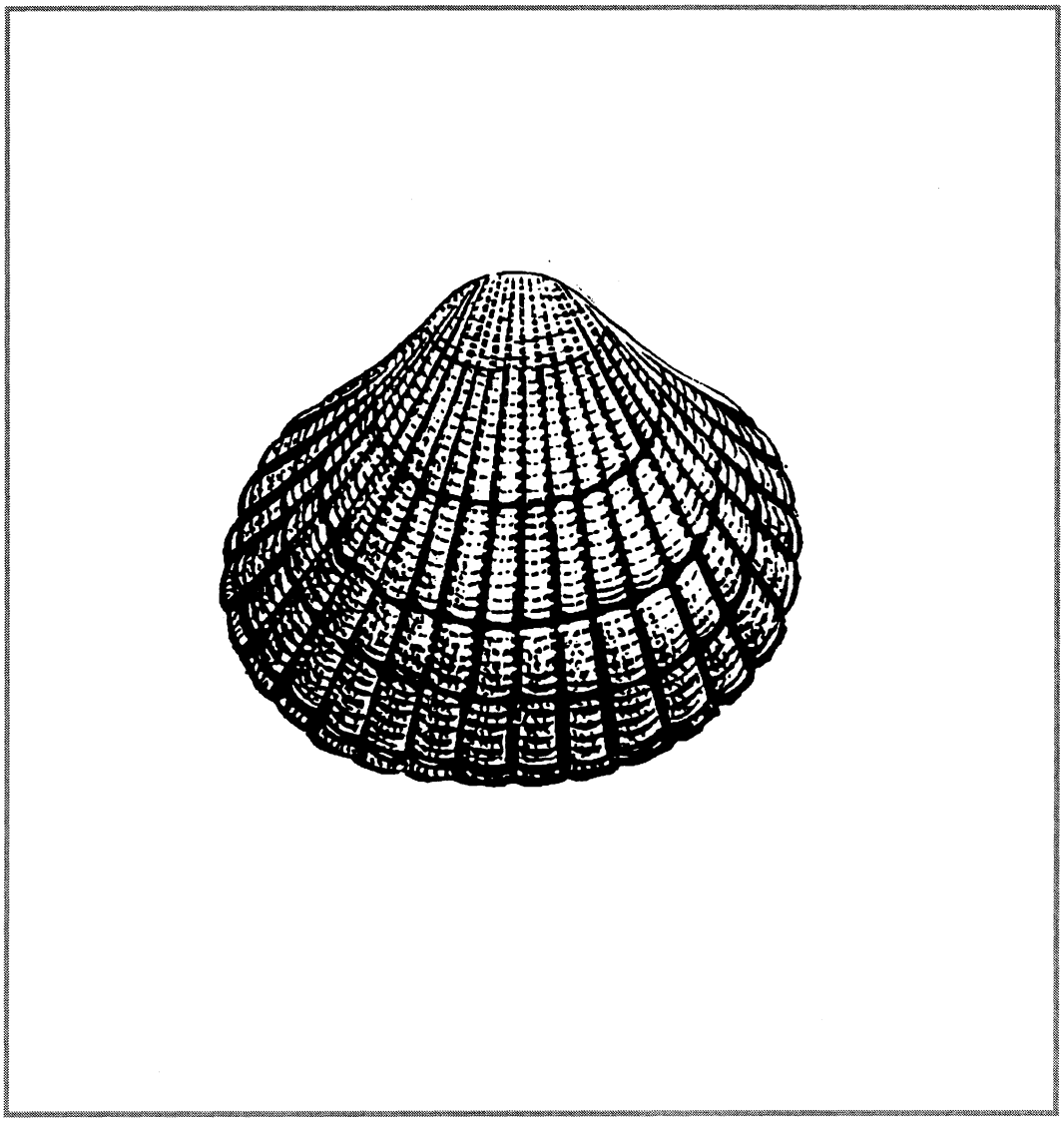

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No. 305

Essex Estuaries Candidate Marine Special Area Of Conservation Littoral And Sublittoral Biotope Mapping And Data Capture Exercise

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SECTION 1. INTRODUCTION

In 1996, English Nature (Peterborough) tendered a desk study to map the littoral habitats of selected marine Special Areas of Conservation (SAC), including the Essex Estuaries candidate SAC. A final report, and Geographical Information System (GIS), was submitted to English Nature in December 1996 (PDE, 1996).

The purpose of the 1996 study was to enable the extent and distribution of littoral habitats and biota to be established based on a review of existing data. This information would then be used to match conservation interests with current uses, and allow future management practices in the SACs to be determined. The 1996 study also identified locations where further investigation and study was thought to be necessary.

Using the findings of the 1996 study, English Nature (Essex, Hertfordshire and London Team) commissioned PDE to carry out further investigations within the Essex Estuaries cSAC. This work would build upon the previous report and its findings. The objectives of the work were:

To undertake field survey work, to Phase I level, on the intertidal mud/sand flats to assign definitive biotopes where the description of the biotope requires clarification.

To undertake field survey work, to Phase I level, on the intertidal mud/sand flats to establish the nature and distribution of biotopes where no information is available, using field methods relevant to Phase I survey.

To produce an overall summary report listing the sources of information used to: (a) complete and add to the intertidal biotope map and (b) compile the subtidal biotope map, including an assessment and location of any further survey work that may be required to complete the map.

- To update English Nature's digitised intertidal biotope maps from the newly collated field survey data
- To update the digitised intertidal biotope maps and reports with recent data that has come to light since 1996 (English Nature to provide reference source)
- To undertake a data capturing exercise in order to compile a digitised biotope map of the subtidal area
- To update the overall summary reports which accompany the intertidal biotope maps

In February of this year, PDE carried out a further data capture and survey exercise of the Essex Estuaries cSAC. This included data capture for the sublittoral zone, which was not undertaken as part of the 1996 study. Using the previous report as an indicator of areas that required further work, survey work in the littoral zone was carried out to quantify and qualify the biotopes present. This work primarily involved ground truthing the biotopes previously mapped and the identification of their specific boundaries and limits.

Additionally, littoral areas, which in 1996 were deemed to have little or no data, were surveyed. Sublittoral survey work was also undertaken in certain areas where no data existed. This was not one of the objectives of the study but was undertaken as time allowed. Standard MNCR (Phase I intermediate) techniques were used throughout the survey exercise.

In addition to the field survey work, an extensive data review and acquisition exercise was carried out as part of the study (particularly for the sublittoral zone). New data were available from a variety of sources including: Environment Agency (1997a), Environment Agency (1997b), PDE (1998), Reid (1997a) and Reid (1997b).

These data have been used to both qualify and quantify the biotope mapping undertaken. Part of this data review involved the use of aerial photographs for *Zostera* spp. mapping.

Revision of the GIS (Geographical Information System) and hard copy outputs has subsequently been undertaken, in addition to updating the biotope codes to the most recent version of the MNCR marine biotope classification (v97.06).

This report discusses the designation of the candidate SAC and the main features for which this site was selected. It then lists the biotopes present in the site and their approximate area (km^2). The site is then split into sections for a more detailed review of the littoral and sublittoral biotopes present. Maps are provided to show the distribution of the biotopes within the cSAC. All documents submitted as part of this report are intended to supersede those produced in 1996 (PDE, 1996).

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SECTION 2.

THE ESSEX ESTUARIES - CANDIDATE SPECIAL AREA OF CONSERVATION

2.1 LOCATION

Position: TR9383 to TM1212
County: Essex

2.2 MAIN FEATURES

Open Coast Linear Shores and Coastal Plain Estuaries
Total Area ~ 24 778 ha
Total Littoral Area ~ 19 280 ha
Total Shoreline ~ 460 km
Total Tidal Channel ~ 75 km

(Source: Davidson *et al.*, 1991, figures above relate to the entire estuarine complex; the area within the SAC is likely to be smaller).

2.3 BACKGROUND

The Essex Estuaries cSAC occupies an area just to the north of the Thames Estuary. It is considered the finest coastal plain estuarine system on the British North Sea coast. The Essex Estuaries, unlike many others in this area, have escaped substantial development, and, as such, remain relatively undisturbed.

The cSAC area includes the coastal plain estuaries of the Colne, Blackwater, Crouch and Roach rivers; and the linear shores of the Dengie Flats and Maplin Sands.

A variety of diverse habitats are supported throughout the cSAC area; those for which the cSAC has been nominated are shown in Table 2.4. The Colne and Blackwater support typical estuarine communities. However, more diverse and unusual habitats, such as rich sponge communities on mixed tide swept substrata, are also found. In addition, the Blackwater supports a limited spawning ground for a subspecies of *Clupea* spp. (Herring), and the Colne is the last known British site for the houting. Both estuaries are recognised as areas for *Sabellaria spinulosa*, brittlestars, crustacea and ascidians.

The Crouch and Roach rivers are intricately linked with the Dengie Flats and Maplin Sands. Both of these estuaries have characteristic communities; the Crouch is also the site of the most southerly breeding colony of the common seal in the North Sea.

Nationally important populations of eelgrass are found on Maplin Sands. Eelgrass (*Zostera* spp.) is reported to be extensive within the Maplin Sands and Dengie Flats area (cSAC citation), although no data exists to confirm the presence of *Zostera* spp. on Dengie Flats. Commercially fished cockle beds (*Cerastoderma* spp.) are found on Maplin Sands, Buxey Sand and Dengie Flats, with lugworm (*Arenicola marina*) also present in high densities. The shallow sublittoral area also supports part of the only commercial 'whiteweed' (*Sertularia* spp.) fishery in the UK.

2.4 cSAC SELECTION CRITERIA

The Essex Estuaries are being considered as a SAC because they contain habitats and/or species that are rare or threatened within a European context. These habitats and/or species are listed below (Table 2.4). Detailed descriptions of the selection criteria can be found in Appendix One.

Table 2.4. cSAC Selection Criteria

Essex Estuaries	Selection Criteria°	Corresponding Biotope+/
✓	**Glasswort and other annuals**	15.11
✓	**Atlantic salt meadows**	15.13
✓	**Mediterranean saltmarsh scrubs**	15.16
✓	**Littoral mudflats and sandflats**	LGS; LMS; LMU
✓	**Cordgrass swards**	15.12
✓	**Estuaries**	All codes
	Common Seal	

Footnotes

° Refer to Appendix One for full site description and selection criteria
+ Connor *et al.*, 1997
- European Commission, 1996
✓ Defined interest for SAC (features in italics indicate interest within SAC, but outside scope of this study, which may or may not be the primary reason for site selection)

2.5 FEATURES PRESENT AND MAPPED WITHIN THE cSAC

Using the GIS produced as part of this report (Appendices Two to Five) the area of coverage for each biotope observed has been calculated. These coverage's have been split into three categories: littoral, sublittoral and saltmarsh (Tables 2.5 a, b and c respectively).

Table 2.5a. Area (km^2) of coverage of littoral biotopes within the cSAC (corresponding to biotopes in Connor et al., 1997)

Feature/Sub Feature		Coverage
Littoral		**175.98**
LGS.BarSnd	Barren coarse sand shores	17.82
LGS.Tal	Talitrid amphipods in decomposing seaweed on the strandline	0.23
LGS.BarSh	Barren shingle or gravel shores	1.70
LGS.Lan	Dense *Lanice conchilega* in tide-swept lower shore sand	0.16
LMS.MacAre	*Macoma balthica* and *Arenicola marina* in muddy sand shores	22.17
LMS.PCer	Polychaetes and *Cerastoderma edule* in fine sand and muddy sand shores	77.90
LMU.HedMac	Hediste diversicolor and *Macoma balthica* in sandy mud shores	34.37
LMU.HedMac.Are	*Hediste diversicolor*, *Macoma balthica* and *Arenicola marina* in muddy sand or sandy mud shores	0.09
LMU.HedStr	*Hediste diversicolor* and *Streblospio shrubsolii* in sandy mud or soft mud shores	0.45
LMU.HedScr	Hediste diversicolor and *Scrobicularia plana* in reduced salinity mud shores	10.48
LMU.HedOl	Oligochaetes in reduced or low salinity gravel or coarse sand shores	4.87
LMS.Zos	Littoral *Zostera* (seagrass) beds	1.27
MLR.Myt.Pid	*Mytilus edulis* and piddocks on eulittoral firm clay	0.13
SLR.Fves	*Fucus vesiculosus* on sheltered mid eulittoral rock	0.35
SLR.Asc	*Ascophyllum nodosum* on very sheltered mid eulittoral rock	0.18
SLR.FserX.T	*Fucus serratus* with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata	0.53
SLR.FcerX	*Fucus ceranoides* on reduced salinity eulittoral mixed substrata	0.44
SLR.BLlit	Barnacles and *Littorina littorea* on unstable eulittoral mixed substrata	0.07
SLR.EphX	Ephemeral green and red seaweeds on variable salinity or disturbed eulittoral mixed substrata	0.61
SLR.MytX	*Mytilus edulis* beds on eulittoral mixed substrata	2.34

Table 2.5b. Area (km^2) of coverage of sublittoral biotopes within the cSAC (corresponding to biotopes in Connor et al., 1997 and Hill *et al., 1996)*

Feature/Sub Feature		Coverage (km^2)
Sublittoral		**28.75**
IGS	Infralittoral Gravelly Sands	2.72
IMS	Infralittoral Muddy Sands	1.54
IMU	Infralittoral Muds	3.95
IMU.EstMu	Estuarine sublittoral muds	1.61
IMU.AphTub	*Aphelochaeta marioni* and *Tubificoides* spp. in variable salinity infralittoral mud	2.85
IMU.NhomTub	*Nephtys hombergii* and *Tubificoides* spp. in variable salinity infralittoral soft mud	2.97
IMU.Tub	*Tubificoides* spp. in reduced salinity infralittoral muddy sediment	0.03
IMX	Infralittoral Mixed Sediments	1.67
IMX.FaMx	Shallow mixed sediment faunal communities	2.53
IMX.EstMx	Estuarine sublittoral mixed sediments	5.10
IMX.CreAph	*Crepidula fornicata* and *Aphelochaeta marioni* in variable salinity infralittoral mixed sediment	2.26
IMX.PolMtru	*Polydora ciliata*, *Mya truncata* and solitary ascidians in variable salinity infralittoral mixed sediment	1.01
R6.33	Sublittoral mixed muddy substrata with polychaetes, crustaceans and ascidians	0.48
R6.34	Variable salinity sublittoral sorted mud with *Hediste diversicolor* and *Corophium volutator*	0.03

Table 2.5c. Area (km^2) of coverage of saltmarsh within the cSAC (corresponding to codes in European Commission, 1996)

Feature/Sub Feature		Coverage (km^2)
Saltmarsh		**34.43**
15.11	*Salicornia* and other annuals colonising mud and sand	0.25
15.12	Spartina swards (*Spartinion*)	0.17
15.13	Atlantic salt meadows (*Glauco-Puccinellietalia*)	33.78
15.16	Mediterranean and thermo-Atlantic halophilous scrubs	0.23

2.6 GENERAL LITTORAL FEATURES

The Essex Estuaries are characterised by predominantly muddy sand to mud substrata. Areas of extensive muddy sand tend to be concentrated in the linear shores of Foulness and Maplin Sands, and Dengie Flats. Muddier substrata are found within the estuary systems of the Crouch, Roach, Blackwater and Colne; whilst predominantly mud sediments are found in the extreme upper reaches of these estuary systems.

Principal biotopes mapped in the Essex Estuaries cSAC include those characterised by *Hediste diversicolor, Macoma balthica, Cerastoderma edule, Hydrobia ulvae, Scrobicularia plana, Nephtys hombergii* and oligochaetes. These latter species tend to be confined to muddier sediments, such as those observed in the LMU biotope classification.

Linear shores were marked by sand and sandy-mud dwelling species. These include *Arenicola marina, Lanice conchilega, Scoloplos armiger, Cerastoderma edule, Macoma balthica* and oligochaetes. These species tend to be confined, but are not exclusive, to the LGS biotopes.

The LMS biotopes are transitional between the two previously described. These are characterised by species from both the LGS and LMU biotopes. Within the Essex Estuaries cSAC, LMS biotopes are confined, in general, to the open coast linear shores, and the mouth of the River Blackwater.

Biotopes of particular biological interest are found within the Rivers Blackwater and Colne. Areas of *Fucus serratus* with sponges, ascidians and seaweeds (SLR.FserX.T) are present in several locations. This biotope is also characterised by tide swept mixed substrata, and, as such, the biotope tends to occur in sheltered areas (see Table 2.6a). It is considered to be nationally uncommon (Connor *et al.*, 1997).

Table 2.6a. Occurrence of SLR.FserX.T biotope in the Essex Estuaries cSAC

Location	OS Grid	Blackwater	Colne
Westmarsh Point	TM077161	⊠	✓
Bradwell Creek	TL985070	✓	⊠
Rolls Farm	TL945082	✓	⊠
Mill Creek	TL975090	✓	⊠
Stansgate Abbey Farm	TL929058	✓	⊠

Additionally, an area of *Mytilus edulis* and piddocks on eulittoral firm clay (MLR.MytPid) is present in the River Blackwater (Rolls Farm TL945082). This biotope is considered to be rare (Connor *et al.*, 1997) and its occurrence was mapped using the data and observations of Hill *et al.* (1996). A further occurrence of this biotope occurs to the south of West Mersea. However, this area is not part of the Essex Estuaries cSAC.

Areas of seagrass (*Zostera* spp.) are found extensively along the length of the Foulness and Maplin Sands. This genus is important as a food source for littoral communities and avians (at low water), and is considered to be scarce within the UK. Isolated patches of *Zostera* are also found in the upper Blackwater. It is interesting to note that a large area of *Zostera* observed in 1975 appears to have receded.

Saltmarsh communities are present throughout the Essex Estuaries cSAC. The saltmarshes have been classified according to the Annex 1 habitats (Council Directive 92/43/EEC) based on the European CORINE Classification (European Commission, 1996). Overall the Essex cSAC is of European Importance for 15.11 (Glasswort and other annuals), 15.12 Cordgrass Swards, 15.13 (Atlantic Salt Meadows) and Mediterranean Saltmarsh Scrubs (15.16).

All four of these categories (Annex 1 Habitats - EU Council Directive 92/43/EEC) were observed and mapped within the scope of this study. The River Blackwater was the only system to exhibit all four habitat types, with at least two of the four observed in the other systems. The coverage of each saltmarsh habitat type are shown in Table 2.5c above.

Within the Blackwater system, the majority of the saltmarsh is mapped as 15.13. Several National Vegetation Classification (NVC) habitats were also observed; including SM13 (*Puccinellia maritima*) and SM14 (*Halimione portulacoides*). Large areas of these NVC habitats were observed on Northey Island and Tollesbury Fleet, amongst others.

Areas of 15.16, Mediterranean saltscrubs, are found within the Dengie and Colne systems. Atlantic salt meadows (15.13) were the most frequently encountered habitat throughout the Essex Estuaries cSAC. The remaining two habitats (15.11 and 15.12) were present throughout the cSAC, but, in significantly smaller quantities than the two habitats previously described.

The Essex estuary systems are designated and proposed internationally important wildlife areas (SPA and cSAC respectively) as well as nationally important nature conservation sites (including SSSI and NNR status sites). The coast itself supports more than 150 000 waterfowl (IECS, 1996). Despite having relatively few rare or uncommon biotopes, the estuaries support through their varied biotopes many primary and secondary consumers. The fauna and flora of the littoral zone, however typical, are essential to the conservation status of this area.

2.7 GENERAL SUBLITTORAL FEATURES

The majority of the sublittoral biotopes observed in the Essex Estuaries cSAC are infralittoral sands, muds, and sand/mud combinations. Typical biotopes mapped include IMU.EstMu and IMU.AphTub, both of which support a typically estuarine, muddy sediment community and include species of oligochaetes, polychaetes and bivalves.

Areas of the mixed sediment biotope IMX.EstMx (e.g. the majority of the Crouch) exhibit higher species diversity in comparison to pure mud areas. Such pure mud areas as the IMU.NhomTub biotope is, however, present in the middle reaches of the Crouch estuary (TQ914969). This biotope is characterised by the dominance of the polychaete *Nephtys hombergii* and *Tubificoides* spp..

Much of the sublittoral zone of the Blackwater estuary is assigned the biotope IMX.CreAph. The biotope is characterised by *Crepidula fornicata* (slipper limpet) and *Aphelochaeta marioni* (polychaete). In areas where the sediment is uniformly muddy, and in particular in the upper reaches of the estuary, the biotope IMU.AphTub occurs (TL880075). In areas of mixed sediment (TM020105) the biotope IMX.PolMtru occurs and is characterised by *Polydora ciliata* (polychaete) and *Mya truncata* (bivalve). The biotope IMU.NhomTub is also present at the inner mouth of the Blackwater estuary (TM035103).

A number of areas in the Blackwater estuary have been assigned regional biotope codes (R6.33 and R6.34) (TL970075, TL915045, TL870062) (NRA, 1991). At present, no equivalent national MNCR codes have been assigned to these biotopes (MNCR, pers. comm.).

The sublittoral zone of the upper reaches of the Colne estuary (TM020235) is characterised by the IMU.Tub biotope (NRA, 1992). The major feature of this biotope is that it is characterised by oligochaetes, particularly of the genus *Tubificoides*. Downstream of this area is a region of the LMU.HedOl biotope (TM033216). This biotope has a very low species diversity, with a high abundance of *Hediste diversicolor* (ragworm) and oligochaetes (NRA, 1992).

In the middle reaches of the estuary (TM060172) the biotope IMU.AphTub has been assigned due to the dominance of *Aphelochaeta marioni*. Parts of the lower reaches of the estuary were assigned IMX and IMU.EstMu. This was based largely on the physical characteristics of the area, as the available macrofaunal data for this area were less detailed than for other areas of the estuary. Areas that were classified as IMX were characterised by a larger proportion of shell material and gravel mixed with muddy sand.

Where the Colne and Blackwater estuaries meet, a range of sediment types are observed. Pure mud sediments are present, particularly in the area around the mouth of the Colne. The region also exhibits infralittoral muddy sand (IMS), through infralittoral mixed sediments (IMX), to infralittoral gravely sands (IGS) (Reid, 1997a; Environment Agency, 1997a). Areas of coarse shell gravel (IGS) were found to be less diverse than mixed sediment areas, but still supported a range of species. Areas of fine sandy mud (IMU) had low species diversity and were dominated by *Nephtys caeca*, which is characteristic of sublittoral sandy mud areas.

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SECTION 3.

FOULNESS AND MAPLIN SANDS (INCLUDING THE CROUCH AND ROACH ESTUARIES)

3.1 LOCATION AND NOTES

Position: TR005875
County: Essex

The Foulness and Maplin Sands are part of the Essex Estuaries cSAC. This part of the cSAC includes land within the Foulness SSSI and the Crouch and Roach Estuaries SSSI.

3.2 MAIN FEATURES

Open Coast Littoral Flats and Shoreline with Coastal Plain Estuary
Total Area ~ 11 519 ha
Littoral Area ~ 10 500 ha
Shoreline ~ 18.0 km (Foulness and Maplin Sands)

(Source: Davidson *et al.*, 1991, figures above relate to the entire estuary, the area within the SAC is likely to be smaller).

3.3 BACKGROUND

This area covers the littoral flats and coastline from Foulness Point to Shoebury Ness, including part of the River Crouch. Flood defences border the entire coastline. Seawards of the defences a narrow band of saltmarsh occurs. This band also continues along the majority of the coastline. The flats extend, at their maximum, to over 5 km from the flood wall, and continue for some distance to the north of Foulness Point.

The substratum of the area is predominantly sandy, with a characteristic change observed between the shore and low water (Kay and Knights, 1975). According to Kay and Knights (1975) the inshore area (up to 1 km seaward) consists of a finer sediment size than the low shore areas. Their report also states that the sediment characterising the southern end of the flats, around Shoebury Ness, tends to be coarser than that in the north.

The River Roach is a small estuary that opens into the River Crouch. Like the Crouch, it is very narrow and consequently the littoral area is small (60 ha). Kay and Knights (1975) describe the substratum as silt with a small proportion of fine sand. The two southern creeks split into several smaller creeks and eventually connect with Maplin Sands. The River Roach is bordered by small patches of saltmarsh, while the tributaries are almost continuously fringed with saltmarsh.

The Rivers Roach and Crouch are considered here only in part, with only the peripheries of the two systems considered in detail. A fuller description of these two rivers can be found in Section 4.

3.4 BIOTOPES PRESENT (corresponding to biotopes in Connor *et al.*, 1997)

LGS.BarSh
LGS.BarSnd
LMU.HedMac
LMU.HedScr
LMS
LMS.PCer
LMS.Zos

3.5 SALTMARSH PRESENT (from European Commission, 1996)

15.11 *Salicornia* and other annuals colonising mud and sand
15.12 Spartina swards (*Spartinion*)
15.13 Atlantic salt meadow (*Glauco - Puccinellietalia*)

3.6 LITTORAL FEATURES

The littoral flats of Maplin and Foulness exhibit a clear banding in the distribution of biotopes present. The substratum characteristics, outlined in the previously in Section 3.3, define the boundaries of the biotopes mapped (Kay and Knights, 1975). The upper shore fine muddy sediment is characterised by *Corophium arenarium* and *Hydrobia ulvae* (Kay and Knights, 1975). The former species is typical of muddy sands and is often replaced in true mud sediments by *Corophium volutator*. *H. ulvae* is typical of muds and its presence indicates a substratum that contains a higher proportion of fine particles than coarse. A wide variety of species occur throughout the shore and these include: *Cerastoderma edule, Scoloplos armiger, Nephtys hombergii, Macoma balthica, Bathyporeia sarsi, Pygospio elegans* and *Urothoë poseidonis*. The most frequently identified species were *C. edule* and *S. armiger; S. armiger* was present in the highest densities at the inshore sites and *C. edule* at the outer.

Thus, using this defined distribution of species and the substratum characteristics, it is possible to map the high shore area as a typical *Hediste diversicolor* and *Macoma balthica* in sandy mud shore biotope (LMU.HedMac). This biotope extends to cover the upper shore of the whole area under study, including the southern shore of the River Crouch. The seaward limit of this biotope is undefined, and the boundary shown is from a map by Kay and Knights (1975) showing the distribution of sites with greater than 40% faunal similarity. Kay and Knights (1975) do not mention the presence of *Hediste diversicolor* and its absence from their study is somewhat irregular. A small area of barren shingle occurs off Shoebury Ness (TQ932839) and is mapped as LGS.BarSh.

Seaward, of the saltmarsh that occurs on the extreme upper shore, areas of *Zostera* spp. occur. Extensive patches occur around Havengore Head (TQ985883) and at Shelford Head and Rugwood Head (TQ992890 to TR020913). Aerial photographs were used in the identification of these areas (Environment Agency, 1997).

The littoral area towards the mouth of the Rivers Crouch and Roach (in the north of the study area) is characterised by the LMU.HedMac biotope. Further upstream the littoral flats, of the River Roach, become significantly reduced and the infauna is characterised by *Hediste diversicolor, Macoma balthica, Hydrobia ulvae, Nephtys hombergii*, and *Scrobicularia plana* (Kay and Knights, 1975). Thus, the inner shores of the Roach, and the creeks to the south of the river, are mapped as LMU.HedScr.

Seawards of the LMU.HedMac biotope previously described, the littoral flats extend to the low water mark. The whole of this area has been mapped as LMS.PCer. Kay and Knights (1975) describe this area as being predominantly sandy in the nature of its substratum, and the infauna is representative of this classification. Particular examples include; *Bathyporeia sarsi, Urothoë poseidonis*, and the increased presence of *Cerastoderma edule*. All of the latter are characteristically limited to sandy substratum.

However, data were collected for Foulness Sands (TR100990) and Buxey Sands (TM130040), off the mouth of the Crouch estuary, as part of this study (PDE, 1998).

The substratum on Foulness Sands was found to be firm muddy sand, forming a 15-20 cm deep layer over shell material (cockles). A 100m wide belt of cockle shells was observed on the surface of the sediment, although no live cockles were seen. Few macrofauna were observed, although *Littorina littorea* were common and young *Mytilus edulis* were occasionally observed. Approximately 20 seals were observed on Foulness Sand. The area of survey is therefore mapped as the LGS.BarSnd biotope, whilst the remaining shore, in the absence of further data, remains unchanged as LMS.PCer.

A large area of Buxey Sands is mapped as LMS. A series of grab samples were taken in this area, although the extent of invasion into Buxey Sands was hampered by the water depth available at the time of survey. The substratum comprised of fine muddy sand, which was consolidated. No macrofauna were observed in the grab samples taken.

The majority of the saltmarsh is mapped as Annex 1 habitat type 15.13 (Atlantic salt meadows). The open coastline from Foulness point to Shoebury Ness is dominated by *Halimione portulacoides* and associated with a sub community of *Puccinellia spp.*. *Puccinellia spp* dominate along the rivers and creeks associated with sub-communities of *Halimione portulacoides*, *Limonium spp.* and *Agropyron repens* (NERC, 1974).

Areas of 15.12 (*Spartina* swards) occur fringing the upper saltmarsh on the open coastline. 15.11 (Glasswort and other annuals) also occurs in small patches, especially at Foulness Point and to the west of Haven Point.

A particular area of saltmarsh, in the lee of Foulness Head, was identified in 1974 as an area of pioneer saltmarsh (ITE, 1974) and appears to have increased in size. *Phragmites* stands are also present along the Roach and its tributaries.

Small disused oyster pits are present on the northern shores of the River Roach (NERC, 1974 and Burd, 1992). Pioneer *Puccinellia* communities have developed and have been mapped as 15.13 and 15.16.

3.7 SUBLITTORAL FEATURES

There are no sublittoral areas within this section of the cSAC. While Foulness Sands and Buxey Sand are located offshore, they are strictly littoral and, therefore, for the purposes of this report, are considered under Section 3.6 above.

3.8 FURTHER WORK/QUALIFICATION OF ASSIGNED BIOTOPES

The upper shore area of Foulness and Maplin Sands, mapped as LMU.HedMac, may require clarification and ground truthing. Data available from the original study (PDE, 1996) indicated that this biotope could have been mapped as LMU.HedMac.Nhom. However, in version 97.06 of the marine biotope classification (Connor *et al.*, 1997) this biotope has been incorporated into the LMU.HedMac biotope.

Attempts were made as part of this study to gain access to the upper shores of Foulness and Maplin Sands, via the Ministry of Defence (who control access to these areas). However, due to the prevailing political situation, access was not possible within the time frame of this study. Groundtruthing of the LMU.HedMac biotope mapped in the upper shore of these areas is recommended, as it remains unclear as to the accuracy and viability of the data used.

The advantage of using colour aerial photographs for the mapping of *Zostera* spp. is that large areas can be studied, allowing their distribution to be mapped rapidly. However, there are several drawbacks associated with using this method to map the distribution of *Zostera* spp. Whilst in relatively clear waters it is generally obvious as to whether *Zostera* spp. is present or not (as *Zostera* spp. can be clearly distinguished against the background sediment), the turbid waters that characterise estuaries do present some difficulties.

In addition, in some instances it is difficult to distinguish *Zostera* spp. from other vegetation, in particular *Enteromorpha* spp. This can be overcome to some extent as *Enteromorpha* spp. generally occurs at a higher level on the shore (*Zostera* spp. occurs on the lower littoral zone and extends up to 11 metres sublittorally).

It is, therefore, recommended that ground-truthing exercises of the areas of *Zostera* spp. mapped be carried out in order to verify its exact distribution and the species present.

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SECTION 4.

CROUCH AND ROACH ESTUARIES

4.1 LOCATION AND NOTES

Position: TO865955

The River Crouch is part of the Essex Estuaries cSAC. This part of the cSAC includes land within the Crouch and Roach Estuaries SSSI.

4.2 MAIN FEATURES

Coastal Plain Estuary
Total Area ~ 2 754 ha (Crouch and Roach Systems)
Littoral Area ~ 170 ha (whole estuary)
Tidal Channel 25.0 km
Tidal Range 4.9 m (Hill Bridge)

(Source: Davidson *et al.,* 1991, figures above relate to the entire estuary, the area within the SAC is likely to be smaller).

4.3 BACKGROUND

The River Crouch itself extends from Battlesbridge to its mouth between Foulness and the Dengie flats (Kay and Knights, 1975). The lower reaches of the River Crouch are described in the Foulness and Dengie Flats report.

The main substratum throughout the estuary is mud made up of fine particulates. Kay and Knights (1975) note that their faunal analysis did not show any clear correlation with the sediment type observed. The estuary is fringed by saltmarsh, with large areas being present at Bridgemarsh Island and North Fambridge.

4.4 BIOTOPES PRESENT (corresponding to biotopes in Connor *et al.*, 1997)

LMU.HedMac
LMU.HedScr
LMU.HedOl
SLR.EphX
LMS
LGS.BarSnd
IMU.AphTub
IMU.NhomTub
IMX.EstMx
IMU.EstMU

4.5 SALTMARSH PRESENT (from European Commission, 1996)

15.11 *Salicornia* and other annuals colonising mud and sand
15.13 Atlantic salt meadows (*Glauco-Puccinellietalia*)

4.6 LITTORAL FEATURES

One kilometre east of Battlebridge is a small area of saltmarsh, which is the most westerly point of the Crouch Estuary under consideration. North east of this area (TQ799973) is Fenn Creek. The stretch of Fenn Creek, from the railway bridge at (TQ798975) to (TQ798963) in the south, is mapped as the LMU.HedOl biotope. Around the railway bridge there is likely to be a large freshwater influence from the stream input and land run-off. Few macrofaunal species were observed here, although occasional *Corophium* spp. were present. Further south, small areas of mud at the creek edges were characterised by *Hediste diversicolor* and oligochaetes, whist several areas of saltmarsh (15.13) occurred on the inside of bends in the channel towards the confluence with the River Crouch.

The littoral flats of the River Crouch are primarily mapped as LMU.HedOl, with the numerous creeks feeding into the Crouch having slightly different biotopes.

The Clementsgreen Creek, immediately to the south of South Woodham Ferrers, exhibits a fine sediment size substratum. Molluscs were the most important species numerically, with *Macoma balthica* and *Cerastoderma* spp. making up 97% of the biomass. *Hediste diversicolor, Nephtys hombergii* and *Hydrobia ulvae* were also observed in abundance. In addition, mats of *Enteromorpha* spp. were observed by Wyer and Charman (1975). The littoral flats were thus mapped as LMU.HedScr despite the absence of *Scrobicularia plana.*

South of this area, on the southern banks of the Crouch, an extensive area of saltmarsh occurs. The latter covers an area of approximately 1 km^2. The littoral flats within this area are mapped as LMU.HedOl. This biotope indicates an impoverished infauna and although no data exists for this area specifically, adjacent sites surveyed by Kay and Knights (1975) were found to have a reduced species abundance. Additionally, Wyer and Charman (1975) observed patches of *Enteromorpha, Ascophyllum* and *Fucus* spp. in this area.

Stow Creek, to the east, is surrounded by saltmarsh. The littoral flats are further described as being covered by *Enteromorpha* spp. to low water. Infaunal species data are not described by Kay and Knights (1975), but, considering the nature of the channel, its exposure and certain reduced salinity, it appears likely that the flats are impoverished. Thus, the creek flats are mapped as LMU.HedOl.

Towards the mouth of Stow Creek, several tidal ponds exist. These ponds are interconnected by small channels, and are in an extremely sheltered location. The substratum is very soft, fluid mud. The main fauna observed were *Hediste diversicolor* and oligochaetes and therefore these ponds are mapped as LMU.HedOl. Small *Macoma balthica* were also occasionally observed, along with *Enteromorpha* spp. at the edges of the ponds.

The majority of flats to the north and south of Bridgemarsh Island are again mapped as LMU.HedOl. Kay and Knights (1975) recorded a generally impoverished infauna at the sites studied around this area. They observed an abundance of polychaetes, such as *Cirriformia tentaculata*, and a distinct absence of the mud snail, *Hydrobia ulvae*. Additionally, Wyer and Charman (1975) mapped extensive beds of *Enteromorpha* spp. around the whole of Bridgemarsh Island. The entire island is dominated by saltmarsh habitats.

The area along the north-eastern shore of Bridgemarsh Island (Althorne Creek) is mapped as SLR.EphX (PDE, 1998). The substratum varied here from sandy mud at the eastern tip of the island and became increasingly sandy further west. However, along the whole of this stretch of shore there was a significant proportion of gravel, pebbles and shell material. Strands of the ephemeral macroalgae *Enteromorpha* spp. were present along the upper shore in this area. It is likely that during the summer months, the *Enteromorpha* spp. will cover a wider area than was observed.

Occasional specimens of *Fucus vesiculosus* and *F. serratus* were observed attached to the larger pebbles, whilst at around 150m from the eastern tip of Bridgemarsh Island, a mussel bed was observed (PDE, 1998). The mussel bed was approximately 150m x 30m in area and consisted of reasonably dense clumps of *Mytilus edulis. Cerastoderma edule* (cockle) were also observed within the mussel bed.

To the west of the mussel bed *Littorina littorea* (periwinkle) were observed to be common. Occasional clumps of *Mytilus edulis* were also observed here. Within the finer sediments, polychaetes were common and small *Macoma balthica* were often observed (PDE, 1998).

Further downstream, Lion Creek feeds into the River Crouch, and was found by Kay and Knights (1975) to be typical of the community present throughout the whole estuary. Therefore, the area is mapped as LMU.HedScr. Wyer and Charman (1975) also observed extensive beds of *Ascophyllum nodosum, Enteromorpha* spp. and *Fucus* spp.. This biotope (LMU.HedScr) is often characterised by mats of filamentous algae, such as *Enteromorpha* spp. (Connor *et al.*, 1997).

Paglesham Creek feeds the upper reaches of the River Roach. The extreme upper reaches of the creek are surrounded by extensive areas of saltmarsh. The littoral area fronting this marsh is mapped as LMU.HedScr, with an infaunal community identical to that of the lower Roach and Lion Creek. Additionally, extensive algae and fucoid beds are present (Wyer and Charman, 1975).

The majority of the saltmarsh is mapped as Annex 1 habitat type 15.13 (Atlantic salt meadow). The dominant NVC communities include SM14 *Halimione portulacoides* (*H. portulacoides* and *Puccinellia maritima* sub-communities), SM13 *Puccinellia maritima* (*P. maritima* sub-community) and SM10 transitional low marsh vegetation (NCC, 1991). Smaller areas occur consisting of SM13 *Puccinellia maritima* (*Limonium/Armeria* sub-community), SM11 *Aster tripolium* var. *discoidens* and SM24 *Elymus pycnanthus* communities. Large areas of 15.13 are present at Bridgemarsh Island, west of North Fambridge (Stow Creek) and west of South Fambridge.

Areas of 15.11 (*Salicornia* and other annuals) are present on Bridgemarsh Island. Elsewhere 15.11 occurs in a few fringing patches. These communities are classified as SM8 Annual *Salicornia* under the NVC (NCC, 1991).

4.7 SUBLITTORAL FEATURES

The majority of the Crouch estuary is assigned either the IMU.AphTub (TQ833963, TQ862964, TQ942955) or IMX.EstMx (TQ852964, TQ865964, TQ950954) biotope (NRA, 1995). The sediments do not show any predictable change in composition with position in the estuary, and muddy and mixed sediments occur at various points along the length of the estuary. Areas of mixed sediment exhibit higher species diversity in comparison to pure mud areas.

The IMU.AphTub biotope is dominated by *Aphelochaeta marioni* and *Tubificoides* spp. Areas assigned IMX.EstMx are not characterised by a dominance of a particular species but show a greater evenness, in terms of abundance, amongst the species present. Due to the presence of mixed sediments, epifaunal as well as infaunal species can colonise the area and hence this biotope can have a relatively high species diversity.

An isolated area of the IMU.NhomTub biotope is present in the middle reaches of the estuary (TQ914969). This biotope is characterised by the dominance of the polychaete *Nephtys hombergii* and *Tubificoides* spp.

The biotopes present in the Roach estuary are similar to those occurring in the Crouch estuary. An additional biotope, IMU.EstMu, occurs in the middle reaches of the estuary at Paglesham Reach (TQ9491). This biotope supports a range of typically estuarine, muddy sediment species and includes oligochaetes, polychaetes and bivalves (NRA, 1995).

Areas assigned the IMU.AphTub biotope are dominated by the polychaete *Aphelochaeta marioni* and the oligochaetes *Tubificoides* spp. Although these species are present in the IMU.EstMu biotope, they are not dominant and therefore the IMU.EstMu biotope more adequately represents the community present in the estuarine sublittoral mud.

4.8 FURTHER WORK/QUALIFICATION OF ASSIGNED CODES

The saltmarsh data relates to 1988/89 and, due to the changeable nature of saltmarsh, many of the areas and communities may have changed. For example, Burd (1992) calculated that 26.5% of the Crouch's saltmarsh was lost between 1973 and 1988.

There are substantial areas within the estuary where no sublittoral survey work has been carried out and, therefore, no biotopes assigned. These areas should be targeted for future survey work. The areas already mapped could be resurveyed to observe any temporal trends in the species assemblage and/or species abundances.

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SECTION 5.

DENGIE FLATS AND SURROUNDING AREA

5.1 LOCATION AND NOTES

Position: TM055045

The Dengie flats are part of the Essex Estuaries cSAC. This part of the cSAC includes land within the Dengie SSSI and Dengie National Nature Reserve (NNR).

5.2 MAIN FEATURES

Open Coast Littoral Flats and Shoreline
Total Area ~ 2 986 ha
Littoral Area ~ 2 986 ha
Shoreline ~ 17.5 km

(Source: Davidson *et al.*, 1991, figures above relate to the entire estuary, the area within the SAC is likely to be smaller).

5.3 INTRODUCTION

The study area extends from Bradwell Power Station, in the mouth of the River Blackwater, to south of Holliwell Point, in the mouth of the River Crouch. Within this area are the Dengie Flats, which extend for virtually the whole length of the study area described. The entire length of the coastal strip is bounded by sea walls, which form the landward boundary of a continuous strip of saltmarsh. This saltmarsh belt varies in width from less than 100 m to over 1 km.

5.4 BIOTOPES PRESENT (corresponding to biotopes in Connor *et al.*, 1997)

LGS.BarSnd
LGS.Tal
LGS.BarSh
LMS.MacAre
LMU.HedOl
SLR.Fves
SLR.FcerX
SLR.MytX
LMS.MacAre

5.5 SALTMARSH PRESENT (from European Commission, 1996)

15.13 Atlantic salt meadow (*Glauco-Puccinellietalia*)
15.16 Mediterranean and thermo-Atlantic halophilous shrubs (*Arthrocnemetalia fructicosae*)

5.6 LITTORAL FEATURES

Kay and Knights (1975) describe the substratum of the area as being generally fine sand, with that in the north being slightly coarser than that in the south. However, many of the upper shore sites surveyed by these workers were actually found to have a higher silt content. This is reflected in the mapping of the biotope LMU.HedOl for a band running approximately 11 km along the upper shore (IECS, 1996).

In the north, around Sales Point, the LMS.MacAre biotope is mapped. The substratum over some of this area was found to be generally consolidated clay covered with a thin layer of very soft fluid mud. Much of the area consisted of muddy sand and evidence of large populations of juvenile *Arenicola marina* was observed. It was noted that the higher density of *A. marina* casts occurred in areas of standing water. No adult *A. marina* were observed and therefore the high density of juveniles was attributed to a high recent recruitment.

To the north of this area (around TM022096) an area of LGS.BarSnd is mapped where no macrofauna were observed. Similarly, two areas of LGS.BarSh within the above LMS.MacAre biotope were mapped which were devoid of macrofauna. A further area of LGS.BarSh occurs on the high shore, north of Tip Head (TM031088).

To the west, the lower shore is characterised by well drained shingle, and no macrofauna was observed by IECS (1996). Kay and Knights (1975) study does not extend to cover this area, and thus, it is mapped as per the IECS (1996) study (LGS.BarSh). The upper shore area from Bradwell Power Station to Sales Point is distinguished by a strand line of detritus and *Fucus* spp. (LGS.Tal) (IECS, 1996). As previously described the extreme upper shore (to the seawall) is typically described by saltmarsh. It should be noted that a small area of mixed substrata with *Fucus ceranoides* (SLR.FcerX) does occur between the sea wall and the LGS.Tal biotope at TM028090.

Beginning at the area around St. Peters Chapel (TM034084) a thin bank of 'chernier ridge' extends south for approximately 2.5 km. This bank is occasionally interrupted by inlets and creeks from the extensive saltmarsh bordering this area. IECS (1996) assign a code of LSHL.BAR to this biotope and, as yet, this has not been adopted into the MNCR biotope manual (Connor *et al.*, 1997). Thus, in this study the biotope is mapped as LGS.BarSh.

IECS (1996) also map a thin belt of "eroded mudflat with shell material" seaward of the latter biotope. A 'modified' code of LMUD.HO.SHL was assigned to this biotope. Again, this code has not been adopted in Connor *et al.* (1997); and, as IECS (1996) states that the modified biotope "grades into LMUD.HO", the LMU.HedOl biotope to seaward has been extended inland to cover the non-MNCR coding previously described.

The majority of the remaining littoral flats (St. Peters, Dengie and Ray Sand) are classified as LMS.MacAre. This biotope extends to the low water mark and is characterised by *Arenicola marina* with *Hediste diversicolor, Lanice conchilega, Macoma balthica* and *Cerastoderma edule*. The presence of *A. marina* was generally widespread throughout this area, with the other named species being somewhat more variable in their abundance (IECS, 1996). These observations are qualified to some extent by those of Kay and Knights (1975), although, rather surprisingly, the presence of *A. marina* is either not described or not recorded. In addition, a small area to the rear of Dengie Flats, around Marshhouse Outfall, is mapped as SLR.FcerX.

Within the Ray Sands LMS.MacAre biotope, an area of SLR.MytX is mapped by IECS (1996), and is described as "mussel beds on stable muddy sand on the mid to lower shore". Two small areas of LSHL.BAR are described by IECS (1996) on the upper shore of Ray Sand (TR034999 and TR024963) and are mapped as LGS.BarSh (see earlier). Additionally, two further biotopes are modified/created by IECS (1996) in this area.

An area of degenerated saltmarsh covered by a mat of *Enteromorpha* spp. is mapped at TR032988 and assigned the code LMUD.ENT. In this study the latter area is mapped as LMU.HedOl as this biotope can be described as covered by mats of *Enteromorpha* in summer. Immediately south, a stretch approximately 1 km long is mapped as LMUD.ARB.POL, a modified biotope of LMS.MacAre. As with other biotopes of this nature the code has not yet been accepted, and is thus mapped as LMS.MacAre. Within the latter area a small narrow region of sand and shell beach borders the flood defences (LGS.BarSnd), whilst the flood defences are colonised by *Fucus vesiculosus* (SLR.Fves) (IECS, 1996).

Around Holliwell Point itself, an area of mud occurs. This is mapped as LMU.HedMac. Landward of this biotope saltmarsh predominates to the flood defence; and small areas of LGS.BarSh occurs (mapped by IECS (1996) as LSHL.BAR. Finally, it should be noted that no *Zostera* spp. is indicated by IECS (1996) and, Wyer and Charman (1975) although the SAC citation (Appendix One) describes extensive beds of *Zostera* on Dengie Flats.

The saltmarsh was mapped from the Nature Conservancy Council's 1988/89 survey of the NVC saltmarsh communities (NCC, 1991). The majority of the saltmarsh is mapped as 15.13 (Atlantic salt meadows). The dominant NVC communities include SM14 *Halimione portulacoides* (*Puccinellia maritima* sub-communities) and SM13 *Puccinellia maritima* (*P. maritima* sub-communities) with areas of SM10 transitional low marsh vegetation fringing the lower marsh. The saltmarsh occurs along the majority of the coast being at its widest in the south. At the northern point, areas of 15.16 (Mediterranean salt scrubs) are present. These are characterised by SM25 *Suaeda vera* drift line NVC communities.

5.7 SUBLITTORAL FEATURES

There are no sublittoral areas within this section of the cSAC. While Buxey Sand is located offshore, it is strictly littoral and, therefore, for the purposes of this report, is considered under Section 3.6 (Foulness and Maplin Sands (including the Crouch and Roach Estuaries)).

5.8 FURTHER WORK/QUALIFICATION OF ASSIGNED CODES

The saltmarsh data relates to the 1988/89 distribution (NCC, 1991) and should be treated with caution, as many areas and communities may have changed due to variable erosion and accretion patterns. For example, Burd (1992) calculated that 10% of Dengie saltmarsh was lost between 1973 and 1988.

The areas in which the ICES (1996) study modified or created a biotope code requires further clarification. In this study, the adjacent area has often been extended to cover the IECS (1996) biotope. Further survey work could identify whether these areas merit new, or modified, biotope codes. In the meantime, readers should be aware of the location of these areas and caution should be adopted in the interpretation of the biotope codes assigned.

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SECTION 6.

BLACKWATER ESTUARY

6.1 LOCATION AND NOTES

Position: TL945061

The Blackwater Estuary is part of the Essex Estuaries cSAC. This part of the cSAC includes land within the Blackwater Estuary SSSI; some areas of which are excluded from the cSAC.

6.2 MAIN FEATURES

Coastal Plain Estuary
Area of Inlet ~ 5 184 ha
Littoral Area ~ 3 315 ha
Tidal Channel ~ 21.2 km
Tidal Range ~ 4.9m (Osea Island)

(Source: Hill *et al.*, (1996), figures above relate to the entire estuary, the area within the SAC is likely to be smaller).

6.3 BACKGROUND

The area of the River Blackwater included in the cSAC has a western border at Maldon and an eastern border at its confluence with the River Colne. The entire length of the channel is bordered by flood defences; and although the upper channel is narrow, the lower channels are considerably wider, thus exposing substantial littoral areas at low water.

To the west of Maldon, the channel separates into two channels that pass either side of Northey and Osea Islands. Further downstream the channels converge and are met by Lawling and Goldhanger Creeks. The river then continues east and widens considerably after Ramsey Island, with an extensive littoral area to the south of the channel. Towards its mouth, the Blackwater is joined by a series of creeks and channels. A similar situation is seen further east where the Salcott, Ray and Strood Channels join the river near West Mersea.

The estuary is fringed by saltmarsh with large areas being present on Northey Island, at the head of Tollesbury Fleet and in the Strood Channel.

6.4 BIOTOPES PRESENT (corresponding to biotopes in Connor *et al.*, 1997)

LMU.HedMac
LMU.HedMac.Are
LMU.HedStr
LMU.HedScr
LMU.HedOl
LMS.MacAre
LMS.Zos
LGS.Pec
MLR.Myt.Pid
SLR.Fves
SLR.Asc
SLR.FvesX
SLR.FserX.T
SLR.FcerX
SLR.MytX
SLR.EphX
IMU.AphTub
IMU.NhomTub
IMX.CreAph
IMX.PolMtru
R6.33
R6.34

6.5 SALTMARSH PRESENT (from European Commission, 1996)

15.11 *Salicornia* and other annuals colonising mud and sand
15.12 *Spartina* swards
15.13 Atlantic salt meadows (*Glauo-Puccinellietalia*)
15.16 Mediterranean and thermo-Atlantic halophilous scrubs (*Arthrocnemetalia fructicosae*)

6.6 LITTORAL FEATURES

Like most other estuaries in Eastern England, the Blackwater is bordered by sea walls. Hill *et al.* (1996) sited that the seaward side of the majority of the sea walls was colonised by zones of the ephemeral algae *Enteromorpha* spp. and the fucoid (*Fucus spiralis*). However, only two areas have been identified as part of this study. The defences to the south of Heybridge Basin and the upper reaches of the Salcott Channel both exhibit this ephemeral algal/fucoid biotope and are thus mapped as such (SLR.Fves).

The upper reaches of the River Blackwater (to Maldon) are characterised by a variable salinity sandy mud. Due to lower salinity the bivalve *Cerastoderma edule* is often restricted in its distribution; this was confirmed by the data of Kay and Knights (1975) and Hill *et al.* (1996). *Macoma balthica* is often encountered in this biotope, and the polychaetes *Hediste diversicolor* and *Manayunkia aestuarina* may be common. Kay and Knights (1975) found that the abundance of *H. diversicolor* was limited in the higher reaches of the Blackwater. Thus, the LMU.HedStr biotope is mapped and identified from Maldon to Hythe Yacht Club some 1 km downstream.

The Blackwater Channel to the north of Northey Island is distinguished from that to the south by the occurrence, although at a reduced frequency, of *Hediste diversicolor* (Kay and Knights, 1975). Consequently, the former has been mapped as the LMU.HedScr biotope, and the latter as LMU.HedOl. The LMU.HedOl biotope, although characterised by *H. diversicolor*, exhibits lower abundance of this species than LMU.HedScr.

To the east of Northey Island, which itself is entirely covered with saltmarsh, the sandy mud biotope of LMU.HedMac proliferates. This biotope extends to cover the flats to the south and north of Osea Island, and the entire Lawling Creek. Within the Mayland Creek, which feeds into the latter, the upper reaches are classified as LMU.HedScr due to the abundance of *Hydrobia ulvae* and *Hediste diversicolor* (Kay and Knights, 1975). Additionally, Hill *et al.* (1996) classified the area as low salinity mud with *Scrobicularia plana*, which is often abundant in this biotope.

A number of biotopes were mapped around the Decoy Point area (TL895068) (PDE, 1998). To the north of the causeway to Osea Island, the LMU.HedOl biotope was mapped due to the presence of oligochaetes and *Hediste diversicolor*. Two small isolated areas of the LMU.HedMac.Are biotope were also present.

To the south of the causeway, *Macoma balthica* was common in addition to *Hediste diversicolor* and therefore this area was assigned the LMU.HedMac biotope. However, neither species was abundant. A large number of live *Cerastoderma edule* (cockles) were observed on the surface of the sediment (PDE, 1998). This is likely to be a result of their avoidance of anoxic conditions in the sediment, as the anoxic layer extended up to approximately 2 mm below the surface.

A small area of the LMS.MacAre biotope was mapped on the upper shore around Decoy Point. Numerous *Arenicola marina* casts were observed in the sandy sediment in this area indicating the presence of a reasonably dense population of lugworms (PDE, 1998).

On the lower shore in this area the sediment was made up of gravel and coarse sand. Amphipods were common in this sediment and thus the area was mapped as LGS.Pec (PDE, 1998).

To the south east of Osea Island a belt of the biotope LMS.MacAre occurs in a north-east to south-west direction, with *H. diversicolor* and *C. edule* being present. In this particular area *Hydrobia ulvae* was present, but not in any significant abundance. As such the classification is still assigned.

In the Blackwater estuary, the main area of *Zostera* spp. distribution was along the northern shore of Osea Island (TL906068 to TL925065) (Environment Agency, 1997). Further, isolated patches of *Zostera* spp. occur at several other locations within the estuary.

Further west along the shore, along Mill beach, an area of SLR.FvesX was mapped (PDE, 1998). This area had numerous boulders on a sand/mud substratum. *Fucus vesiculosus* was commonly observed attached to the boulders. This biotope diminished further west and eventually merged into an extensive area of LMU.HedMac. The sediment here was very soft, fluid mud, which is untypical of this biotope. However, the species observed were typical of LMU.HedMac.

Along the top of the shore at Mill Beach an area of LGS.BarSh is mapped (PDE, 1998). This consisted of gravel and cobbles, although there was a significant proportion of coarse sand. No macrofauna were observed here, as is characteristic of this biotope.

To the north of Goldhanger Creek, areas of saltmarsh are bordered by mixed substrata, characterised by *Enteromorpha* spp., *Ulva lactuca* and *Porphyra* spp. (SLR.EphX). Patches of mud within this biotope are typically colonised by species including *C. edule, Macoma balthica* and polychaetes. Further upstream of this biotope the LMU.HedMac biotope continues (Upper Collins Flats).

The flats to the north of Thirstlet Creek exhibit several biotopes. The northern bank of the upper reaches is characterised by the LMU.HedMac biotope. Further east, directly south of Rolls Farm, an area of the SLR.FserX.T biotope occurs. This uncommon biotope is determined by muddy boulders, cobbles and pebbles; with *Fucus serratus*, sponges, ascidians and red seaweeds. Immediately below this biotope an area of exposed clay occurs. This biotope was mapped by Hill *et al.* (1996) and is categorised as MLR.Myt.Pid in this study. Upstream of this the LMU.HedMac biotope continues for approximately 4 km to 'The Nass'.

Around Mill Creek a distinct banding of biotopes is mapped based on the observations of Hill *et al.* (1996). The lower shore is characterised by mussel beds, whilst the mid shore is colonised by *Ascophyllum nodosum* (SLR.Asc). The upper mid shore exhibits an area of tide swept mixed substrata (SLR.FserX.T).

The littoral flats on the southern shore around Stansgate Abbey Farm (TL932059) exhibit a mixture of biotopes. A thin band of mixed substratum, with *Mytilus*, borders the sea defences to the east (SLR.MytX), whilst to the south SLR.FcerX occurs. To the west of this biotope, a patch of SLR.FserX.T occurs (Hill *et al.*, 1996). This biotope is bordered to the north by an area of muddy sand with polychaetes (LMS.PCer) (Hill *et al.*, 1996).

Further east, along the southern shore, a large area of SLR.FvesX occurs north of Ramsey Island. Immediately east, the substratum returns to that of mud and the LMU.HedMac biotope predominates to the cSAC boundary at TM000091. Within this latter region an area of *Zostera* spp. occurs in St. Lawrence Bay, and this is bordered to the north and east by mussel beds (SLR.MytX) (Hill *et al.*, 1996). This area is bordered, again to the north and east, by an area of ephemeral green and red seaweeds (SLR.EphX) which extends to the low water mark.

To the south of Bradwell Creek a further area of tide swept substrata occurs. This biotope extends east from TL982064 to TL992078, a distance of approximately 1.5 km.

The Virley Channel system in the north of the cSAC is dominated by LMU.HedMac. The upper reaches of Tollesbury Fleet are mapped entirely as LMU.HedMac based on the observations of Hill *et al.* (1996), with this biotope continuing into the lower reaches of the Salcott Channel. Different biotopes were assigned to the north and south banks of the South Channel of Tollesbury Fleet (TL985108). The northern shore was mapped as LMU.HedMac, and this biotope extended along the entire southern shore of Great Cob Island (TL987109). The southern bank of South Channel is muddier than the northern bank and is mapped as LMU.HedOl. *Macoma balthica* was absent here, presumably due to the muddier substratum in comparison to the northern bank.

Previously (PDE, 1996), the shores of the Salcott Channel (TL9813) were mapped as LMU.HedMac.Nhom. This biotope code has now been removed from the classification (Connor *et al.*, 1997) and incorporated into the LMU.HedMac biotope. Consequently, the shores of the Salcott Channel are mapped entirely as LMU.HedMac. The northern shore of the Salcott Channel is mapped as LMU.HedMac although this shore was less extensively sampled than the southern shore during the survey work (PDE, 1998). Other species observed in this area comprised *Hediste diversicolor, Macoma balthica* and *Hydrobia ulvae*. The Strood Channel and the Fleets of Besom and Mersea are characterised by LMU.HedMac.

To the immediate west of West Mersea two small areas of the biotope LMS.MacAre occur. Kay and Knights (1975) cited this area as being far sandier in the nature of its substratum and the samples surveyed were significantly different from those surveyed in the rest of the Blackwater.

The majority of saltmarsh is mapped as Annex 1 habitat type 15.13 (Atlantic salt meadows). The dominant NVC (National Vegetation Classification) communities include SM13 *Puccinellia maritima* (with *Puccinellia maritima* and *Liomonium/Armeria* sub-communities), and SM14 *Halimione portulacoides* (with *Halimione portulacoides* and *Puccinellia maritima* sub-communities) (NCC, 1991). The largest areas exist on Northey Island, Lawling Creek/Mayland Creek, Tollesbury Fleet and Strood Channel.

Smaller areas of 15.16 (Mediterranean salt scrubs) exist, especially on Osea Island, north of Goldhanger Creek and north of West Mersea. These are classified under NVC as SM25 *Suaeda vera* drift line. Two areas of 15.12 (*Spartina swards*) are present west of the mouth of Lawling Creek and south of the mouth of Tollesbury Fleet. Other smaller areas are also present in the Blackwater Estuary. These are classified under NVC as SM6 *Spartina anglica.*

Small patches of 15.11 (*Salicornia* and other colonising annuals) are scattered throughout the estuary. These are too small to map and are illustrated by target notes. The communities are classified under NVC as SM8 Annual *Salicornia* and SM9 *Suaeda maritima.*

Patches of *Phragmites* exist to the north of West Mersea, at the upper edge of the saltmarsh. These are illustrated by target notes on the GIS mapping outputs (Appendices Two to Five).

6.7 SUBLITTORAL FEATURES

Much of the sublittoral zone of the Blackwater estuary is assigned the biotope IMX.CreAph. The biotope is characterised by *Crepidula fornicata* (slipper limpet) and *Aphelochaeta marioni* (polychaete). This biotope exhibits a relatively high species diversity due to the mixed sediment in these areas enabling epifaunal as well as infaunal species to occur. For example, the presence of shell debris and cobbles allows ascidians and other species requiring a more stable substratum such as *Mytilus edulis* (mussel) to colonise the area. The muddy component of the biotope is colonised by typically estuarine oligochaetes and polychaetes, such as *Tubificoides* spp. and *Aphelochaeta marioni* (NRA, 1991). Other studies have also found that a heterogeneous sediment supports a more diverse fauna (Gray, 1974).

In areas where the sediment is uniformly muddy, and in particular in the upper reaches of the estuary, the IMU.AphTub biotope occurs (TL880075) (NRA, 1991). The dominant species in this biotope are *Aphelochaeta marioni* and *Tubificoides* spp. The pure muddy sediment in these areas limits the macrofauna observed to infaunal species.

The IMU.AphTub biotope is similar in composition to IMX.PolMtru which occurs in the Blackwater estuary in areas of mixed sediment (TM020105) and is characterised by *Polydora ciliata* (polychaete) and *Mya truncata* (bivalve) (NRA, 1991).

The biotope IMU.NhomTub is present at the inner mouth of the estuary (TM035103). *Nephtys hombergii* (polychaete) and *Tubificoides* spp. are present in high abundance in an area of muddy or sandy mud sediment (NRA, 1991).

A number of areas in the Blackwater estuary have been assigned regional biotope codes (R6.33 and R6.34) (TL990106, TL970075, TL915045, TL870062) (NRA, 1991). At present, no equivalent national MNCR codes have been assigned to these biotopes (MNCR, pers. comm.).

6.8 FURTHER WORK/QUALIFICATION OF ASSIGNED CODES

It is recommended that ground-truthing exercises of the areas of *Zostera* spp. be carried out in order to verify its exact distribution and species (see Section 3.8).

The saltmarsh data relates to the 1988/89 distribution (NCC, 1991) which has been mapped on GIS according to the NVC communities. Many of these areas and communities may have changed depending on erosion and accretion patterns. For example, Burd (1992) calculated that 23% of the Blackwater's saltmarsh was lost between 1973 and 1988, and, as such, significant changes in the extent of the saltmarsh may have occurred since the last detailed survey.

Although substantial areas of the sublittoral zone of the Blackwater estuary have been mapped, there remain large areas for which no data are currently available. Further survey work should be carried out in such areas, for example the inner estuary mouth between Bradwell Power Station and West Mersea, in order to build up a more comprehensive map of the sublittoral zone. This would also enable the boundaries and species composition of the currently mapped biotopes to be confirmed.

It is also important that mapped areas are resurveyed for monitoring purposes, as the communities present at any one location in the estuary are likely to fluctuate in composition over time.

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SECTION 7.

RIVER COLNE

7.1 LOCATION AND NOTES

Position: TM075180

The Colne Estuary is part of the Essex Estuaries cSAC. This part of the cSAC includes land within the Colne Estuary SSSI; some areas of which are excluded from the cSAC.

7.2 MAIN FEATURES

Coastal Plain Estuary
Area of Inlet ~ 2 335 ha
Littoral Area ~ 2 001 ha
Tidal Channel 16.2 km
Tidal Range 4.6 m (Brightlingsea)

(Source: Hill *et al.*, (1996), figures above relate to the entire estuary, the area within the cSAC is likely to be smaller).

7.3 BACKGROUND

The River Colne is a narrow estuary that extends south from Colchester, at its head, to the River Blackwater. Four creeks of considerable size join the River Colne along its short length. Despite the rather large size of these creek systems none appear to supply substantial quantities of freshwater to the system (Hill *et al.*, 1996). The majority of the estuary is bounded by a sea wall, much of which is bordered by salt marsh; with the largest areas occurring at Colne Point Nature Reserve, Fingringhoe Marsh, Geedon Saltings and Pyefleet Channel. Thus, the littoral flats exposed at low water are primarily narrow in nature.

7.4 BIOTOPES PRESENT (corresponding to biotopes in Connor *et al.*, 1997)

LGS.Lan
LMS.MacAre
LMU.HedMac
LMU.HedScr
LMU.HedOl
SLR.FserX
SLR.BLlit
SLR.FserX.T
SLR.MytX
SLR.EphX
IMU.Tub
IMU.NhomTub
IMU.AphTub
IMU.EstMu
IMX

7.5 SALTMARSH PRESENT (from European Commission, 1996)

15.11 *Salicornia* and other annuals colonising mud and sand
15.13 Atlantic salt meadows (*Glauco-Puccinellietalia*)
15.16 Mediterranean and thermo-Atlantic halophilous scrubs (*Arthrocnemetalia fructicosae*)

7.6 LITTORAL FEATURES

The vast majority of the main channel, and the associated creeks, are bordered by saltmarsh. The flats in front of the saltmarsh are composed of fine muds and characterised by populations of *Macoma balthica, Hydrobia ulvae, Hediste diversicolor, Nephtys hombergii* and oligochaetes. The littoral flats of the River Colne, to its confluence with Brightlingsea Creek, are classified as LMU.HedMac. The upper reaches of the Colne, Geedon, Brightlingsea and Pyefleet channels are mapped as LMU.HedScr (Hill *et al.*, 1996), although Kay and Knights (1975) give no description of *Scrobicularia* spp. being observed in this area.

The upper reaches of Pyefleet Channel are completely surrounded by saltmarsh and are narrow in their nature. Consequently they are completely drained at low tide and are characterised by very soft mud in low salinity conditions (LMU.HedOl). Similar characteristics are seen in the upper reaches of the three creeks: Geedon, Flag and Alresford.

The flats immediately to the south west of Brightlingsea, at Westmarsh Point, exhibit a rich tide-swept lower shore of mixed substrata. This area is characterised by a rich community of sponges, hydroids, ascidians and red algae (SLR.FserX.T) (Hill *et al.*, 1996). Lower down the shore an area of *Mytilus* bed is observed. North of this biotope the LMU.HedMac biotope borders the seawall.

South of a line between Mersea Stone (TM073155) and Stone Point (TM083159) the littoral area becomes less dominated by fine substrata, and is characterised by a mixed substrata of shingle and mud. The exception to the latter is the minor Ray Creek that is typical of those previously described (LMU.HedMac and LMU.HedOl).

The sedimentary flats to the east of Brightlingsea Reach (South Stone Point) are described by their predominately muddy sand nature. This area, to the north of Ray Creek, is dominated by *Lanice conchilega* (LGS.Lan) (Hill *et al.*, 1996).

South of Ray Creek (TM084150) the substratum increases in its variability and is distinctly mixed in its nature. It was observed that the sediment in this area (TM084150 to TM112124) comprised a clay base overlain with pebbles, gravel and some shell material, with varying proportions of coarse sand. Around Sandy Point (TM088145) and northwards towards the entrance to Ray Creek, it was observed that there is an increasing amount of fine sand amongst the pebble/gravel sediment. At the entrance to Ray creek is an extensive area of fine sand with a very low proportion of gravel and pebbles. To the east of TM112125 the shore narrows to a sloping shingle bank.

Isolated patches of mussel bed (*Mytilus edulis*) (SLR.MytX) occur in two locations around the Colne Bar area (TM096123 and TM099122). Barnacles (*Chthamalus montagui*) typically covered the mussels. *Mytilus edulis* was present at other locations but did not form any beds.

Littorinids were widespread along the shore north of Colne Bar, but were not common at any one location. Other invertebrate species present were *Ostrea edulis, Crepidula fornicata* and *Cerastoderma edule*. Additionally, pools of standing water were observed in a number of areas. Some of these contained the macroalgae *Chondrus crispus* and *Corallina officinalis*. Other macroalgae, which occurred at a number of locations on the shore, were *Fucus vesiculosus linearis*, and red seaweeds including *Polysiphonia.*

To the west of Brightlingsea Reach the Mersea flats are dominated by the LMS.MacAre biotope. This is characterised by *Macoma balthica* (bivalve) and *Arenicola marina* (polychaete). The sediment was typically muddy sand, and *A. marina* tended to occur in the areas that contained a lower proportion of mud.

Sporadic clumps of *Mytilus edulis* (mussel) were observed but these were not of sufficient density or extent to constitute mussel beds.

A stretch of shore along the south-eastern coast of Mersea Island (TM065144) was characterised by the LMU.HedMac biotope. To the east of this area a fairly extensive area of small mud creeks was observed. A sample was taken from an area of standing water between the creeks and was found to contain juvenile *Arenicola marina* (PDE, 1998).

A number of lower shore locations, between TM035123 and TM065135, consisted of very hard, consolidated clay with no observed macrofauna. At the limit of the cSAC an area of barren shingle occurs. This shingle was made up of shell material. The upper shore of this section is fringed by narrow strips of barren shingle and strand line vegetation. Small patches of SLR.EphX and SLR.BLlit also occur in this area. The tidal pools mapped in the 1996 study (PDE, 1996) were not observed during the ground truthing study. Amongst the shingle found on the lower shore, small barren pools of standing water were observed, but it is thought that these are not permanent due to the likely mobility of the shingle/shell substratum.

The majority of saltmarsh is mapped as Annex 1 habitat type 15.13 (Atlantic salt meadows). The dominant NVC communities are (SM10, SM24) SM13 *Puccinellia maritima* (with *P. maritima* and *Limonium/Aster* sub-communities) and SM14 *Halimione portulacoides* (with *H. portulacoides* and *Puccinellia maritima* sub-communities) (NCC, 1991). SM10 transitional low marsh vegetation and SM24 *Elymus pycnanthus* occur in smaller areas in the lower and upper saltmarsh zones respectively. The largest areas of 15.13 occur at Colne Point Nature Reserve, Fingringhoe Marsh, Geedon Salting and Pyefleet Channel.

Small areas of 15.16 (Mediterranean salt scrubs) occur on the eastern point of Mersea Island and in Colne Point Nature Reserve. The NVC classification is the SM25 *Suaeda vera* drift line community (NCC 1991). Scattered patches of 15.11 (*Salicornia* and other colonising annuals) are mapped with the largest area occurring at Colne Point Nature Reserve. The area is classified as SM9 *Suaeda maritima* and SM8 Annual *Salicornia* communities under NVC (NCC, 1991).

7.7 SUBLITTORAL FEATURES

The sublittoral zone of the upper reaches of the Colne estuary (TM020235) is characterised by the IMU.Tub biotope (NRA, 1992). The major feature of this biotope is that it is characterised by oligochaetes, particularly of the genus *Tubificoides*.

Tubificoides spp. are often present in reduced and low salinity muddy environments which are physically unstable and, therefore, allow the development of abundant populations of opportunistic species. Fine muddy sediments are also naturally rich in organic material and, again, are frequently characterised by opportunistic species.

Downstream of this area is a region of the LMU.HedOl biotope (TM033216). This biotope has a very low species diversity, with a high abundance of *Hediste diversicolor* (ragworm) and oligochaetes (NRA, 1992). This community is characteristic of the upper reaches of estuaries. Although this is classified as a littoral biotope, it is most applicable to the community observed in this area. The estuary is particularly narrow in this region and, therefore, it is likely that this biotope extends from the littoral zone into the sublittoral zone. Alternatively, this may be a littoral area that has been sampled before or after low water.

An area of IMU.NhomTub is present, in the area around Alresford, which is dominated by *Nephtys hombergii* and *Tubificoides* spp. (TM053207).

In the middle reaches of the estuary (TM060172) the biotope IMU.AphTub has been assigned due to the dominance of *Aphelochaeta marioni*. *Tubificoides* spp. were also common here but their abundance was decreased in comparison to the higher reaches of the estuary (NRA, 1992).

Parts of the lower reaches of the estuary were assigned IMX and IMU.EstMu. This was based largely on the physical characteristics of the area, as the available macrofaunal data for this area were less detailed than for other areas of the estuary. However, a number of species which are characteristic of the IMU.EstMu biotope were recorded as being present. Species, which are included in this biotope, are those which are typical of estuarine shallow sublittoral mud sediments. These comprise *Macoma balthica*, *Tubificoides* spp. and polychaetes.

The sediment in this area was predominantly consolidated mud, although some samples collected contained a small proportion of shell and gravel. The presence of coarser sediment within the mud is a feature which is characteristic of this biotope in the lowered salinity conditions which would be experienced at the inner mouth of the Colne estuary. Areas that were classified as IMX were characterised by a larger proportion of shell material and gravel mixed with muddy sand.

7.8 FURTHER WORK/QUALIFICATION OF ASSIGNED BIOTOPES

The saltmarsh data relates to the 1988/89 distribution (NCC, 1991). Many of these areas and communities may have changed depending on erosion or accretion patterns. For example between 1973 and 1988, Burd (1992) calculated that nearly 12% of the saltmarsh on the Colne was lost. It is, therefore, recommended that a survey of saltmarsh is carried out.

The Colne estuary is relatively small, with the area of the inlet being 2335 ha. The survey work that is reported here (PDE, 1998), together with the previous work carried out in the Colne estuary (NRA, 1992), has resulted in a good coverage of the sublittoral zone. This is especially true for the upper to middle reaches of the estuary. Further, more extensive, work could be carried out in the lower reaches of the Colne to clarify the biotopes that are present here and to define their boundaries. Such work would probably lead to more detailed biotopes, than the present IMU.EstMu and IMX, being assigned to the area.

7.9 REFERENCES

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SECTION 8.

MOUTH OF THE COLNE/BLACKWATER ESTUARIES - SUBLITTORAL

8.1 LOCATION AND NOTES

Position: TR0511 (centre grid)

This area, offshore of the Mersea Flats and the Colne Bar, has been considered separately as it is felt that it does not merit inclusion in either of the sections that describe the estuary systems that feed into it. Consequently, sections 6.1 to 6.3 (the River Blackwater) and 7.1 to 7.3 (the River Colne) should be read in conjunction with this section.

8.2 BIOTOPES PRESENT (corresponding to biotopes in Connor *et al.*, 1997)

IMU
IMS
IGS
IMX
IMX.EstMx
IMX.FaMx

8.3 SUBLITTORAL FEATURES

The data available for some parts of this area (the area bounded by TM060130, TM095121, TM050100, TM060040, TM120090) were not detailed enough to assign a biotope to a particular region. Although the presence of some species was recorded, no data on species abundance were available.

The few species that were recorded could have fitted into a number of biotope descriptions. As a result of this, habitat complex codes have been assigned using the physical and habitat data available. Species that occurred in several of the samples included; *Hediste diversicolor*, *Sabella pavonina* and *Ophiothrix fragilis*.

Where the Colne and Blackwater estuaries meet, a range of sediment types are observed. Pure mud sediments are present, particularly in the area around the mouth of the Colne. The region also exhibits infralittoral muddy sand (IMS), through infralittoral mixed sediments (IMX), to infralittoral gravelly sands (IGS) (Reid, 1997; Environment Agency, 1997). Given this range of sediment types it is reasonable to expect that a variety of biotopes will be present in this area.

This statement is supported by a survey carried out on the Eagle Bank (TM140095) off the mouth of the Blackwater estuary (Bamber, 1979). The survey generated quantified lists of macrofaunal species, along with a description of the sediment type. Three benthic communities were observed and all were related to the nature of the substratum.

The majority of the Eagle Bank was composed of mixed sediment with a diverse community of epifaunal and infaunal species (IMX.EstMx). Areas of coarse shell gravel (IGS) were less diverse than the mixed sediment areas, but still supported a range of species. Areas of fine sandy mud (IMU) had low species diversity and were dominated by *Nephtys caeca*, which is characteristic of sublittoral sandy mud areas.

Detailed data were also available for areas which had been sampled by dredging, allowing the more specific IMX.FaMx biotope to be assigned to a substantial area of the sublittoral zone (TM085050) (Reid, 1997). A number of species which are characteristic of the biotope are present, although the species composition between samples within a particular area was highly variable due to the heterogeneous nature of the sediment. Species that were present included *Ophiothrix fragilis*, *Eupagurus bernhardus*, *Asterias rubens, Psammechinus miliaris*, *Nucella lapillus*, *Chthamalus montagui*, *Mytilus edulis, Ostrea edulis* and *Obelia longissima.*

8.4 FURTHER WORK

It is necessary for targeted survey work to be carried out in order to map the sublittoral zone within this area. This also applies to the areas which have already been surveyed, but where the resulting data were of insufficient detail to confidently assign a biotope to an area. It is important that some indication of species abundance is available, as this enables a biotope to be more accuately assigned.

8.5 REFERENCES

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APPENDIX ONE
cSAC CITATION

Reasons for recommendation as a possible Special Area of Conservation

Area Name: **Essex Estuaries**

County/District: **Essex**

Component SSSI: **Blackwater Estuary**
Colne Estuary
Dengie
Foulness
River Crouch Marshes

This area is being considered as a possible Special Area of Conservation (SAC) because it contains habitat types and/or species which are rare or threatened within a European context. The SSSI citation describes the special interests for which the site was notified in the British context. [NB Not for marine interests below mean low water mark]. The interests for which the site was selected as SSSI may differ from the interests selected in a European context.

The habitats and/or species for which this area has been proposed as a possible SAC are listed below. The reasons for their selection are listed, together with a brief description of the habitats and species as they typically occur across the UK. This area contains the interests described although it may not contain all the typical features. (Please see the accompanying Natura 2000 booklet for further information on the approach to site selection.)

The area is considered to have a high diversity of habitats/species of European importance.

European interest(s):

1. **Glasswort and other annuals colonising mud and sand.†**

- **for which this is considered to be one of the best areas in the United Kingdom.**

†*Salicornia* and other annuals colonising mud and sand: These are areas of saltmarsh on intertidal mud and sand dominated by annual plants. The vegetation is dominated by open stands of glasswort *Salicornia* spp. and annual sea blite *Suaeda maritima*. These plants often form the lowest and most seaward zone of a saltmarsh where they are frequently flooded by the tide.

2. **Cordgrass swards.†**

- **for which this area is one of only 2 outstanding localities in the United Kingdom;**
- **for which the area contains more than 40% of the United Kingdom resource.**

†*Spartina* swards (Spartinion): Cordgrass *Spartina* spp. grows in saltmarshes around the coast and can occur at the lower reaches of saltmarshes or higher up the marsh. The native species, small cordgrass *S. maritima* and the introduced species, smooth cordgrass *S. alterniflora*, are very rare in the UK and only saltmarshes containing these species are proposed for conservation. Common cordgrass *S. anglica* is widespread and is not considered to be of great conservation importance in the UK.

3. Atlantic salt meadows.†

- for which this is considered to be one of the best areas in the United Kingdom;
- for which the area contains more than 10% of the United Kingdom resource.

†Atlantic salt meadows (Glauco-Puccinellietalia): This habitat encompasses saltmarsh vegetation containing perennial flowering plants that are regularly inundated by the sea. The species found in these saltmarshes vary according to duration and frequency of flooding with seawater, geographical location and grazing intensity, but may include salt-tolerant species such as common saltmarsh grass *Puccinellia maritima*, sea aster *Aster tripolium* and sea arrowgrass *Triglochin maritima*.

4. Mediterranean saltmarsh scrubs.†

- for which this area is one of only 3 outstanding localities in the United Kingdom;
- which is considered to be rare as its total extent in the United Kingdom is thought to be less than 1000 hectares;
- for which the area contains more than 10% of the United Kingdom resource.

†Mediterranean and thermo-Atlantic halophilous scrubs (Arthrocnemetalia fruticosae): This is a type of Mediterranean saltmarsh vegetation that occurs in the UK at the upper limit of the tide. It takes the form of low, shrubby vegetation often dominated by shrubby sea blite *Suaeda vera* and sea purslane *Halimione portulacoides*. It may also contain species such as sea heath *Frankenia laevis*, rock sea lavender *Limonium binervosum*, common sea lavender *L. vulgare* and the rare matted sea lavender *L. bellidifolium*. In the UK this habitat is restricted to the coasts of South and East England.

5. Estuaries.†

- for which this is considered to be one of the best areas in the United Kingdom.

†Estuaries: These are semi-enclosed bodies of water which have a free connection with the open sea and within which the seawater is measurably diluted by freshwater from the surrounding land. They are large features which often contain a complex range of habitats that reflect the variations in tidal influence and substrate type.

6. Intertidal mudflats and sandflats.†

- for which this is considered to be one of the best areas in the United Kingdom.

†Mudflats and sandflats not covered by seawater at low tide: These are mud and sand sediments on the shore that are exposed at low tide.

For agency use only:

Date compiled: 17 MAR 1993

Reference number or date of map: _____

Site name	**Essex estuaries**
Country	England (Essex)
Boundary	See map. Intertidal areas that are not SSSI which may be considered further include parts of the Roach and the Crouch

Reasons for recommendation of site

The site contributes to the essential range and variation of estuaries in the UK as the best example of southern North Sea estuaries. Extensive mudflats and sandflats contribute significantly to the habitat diversity of the site.

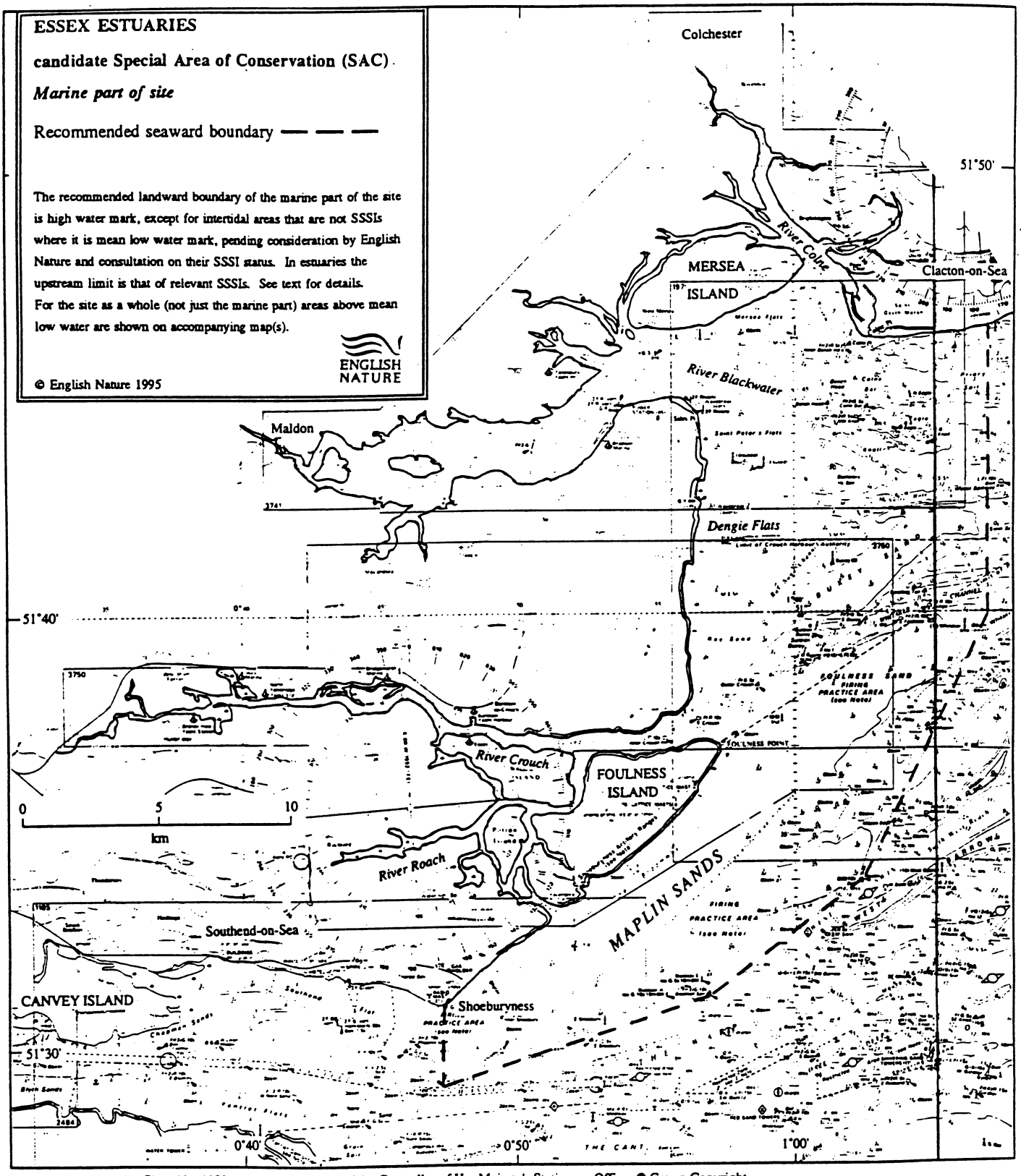
Marine habitats for which selected	Extent
Estuaries	Coastal plain estuarine systems cover around 40% of the area and include the Blackwater, Colne, Crouch and Roach
Mudflats and sandflats not covered by seawater at low tide	Occur extensively in the estuarine and open coast littoral zone (about 19,250 ha)

Site description

The recommended area lies just to the north of the Thames Estuary in the southern North Sea. It is the finest coastal plain estuarine system on the British North Sea coast and includes the least developed estuaries in south-east England, linked with very large areas of undisturbed open coast mud and sand flats and sublittoral sediment banks. It is comprised of the major coastal plain estuaries of the Colne, Blackwater, Crouch and Roach rivers and extensive littoral sediment flats, including the Dengie Flats, Maplin Sands, and sand and shingle spits. The area contains a very wide range of marine and estuarine sediment habitats and communities on the shore and in the subtidal, as well as large areas of saltmarsh and other important coastal habitats.

The linked estuaries of the Colne and the Blackwater adjoin the Dengie Flats. They support characteristic estuarine communities and some diverse and unusual marine communities in their lower reaches, including rich sponge communities on mixed tide-exposed substrata. Sublittoral areas have a very rich invertebrate fauna including the "reef-building" worm *Sabellaria spinulosa*, brittlestars, crustacea and ascidians. The Blackwater supports a small spawning ground for a distinct subspecies of herring whilst the Colne is the last known British site for the houting. The narrow Crouch and Roach estuaries, which are closely linked with the Dengie Flats and Maplin Sands, also have characteristic estuarine communities. In addition the Crouch is the site for the most southerly breeding colony of the common seal in the North Sea.

The open coast areas of Maplin Sands and Dengie Flats have very extensive mudflats and an unusually undisturbed nature. Characteristic habitats include a range of fully saline open coast sandy mudflats with extensive growths of eelgrass (*Zostera* spp). Invertebrate communities include commercially-fished cockle beds on Buxey Sands and Dengie Flats and extensive beds of the lugworm *Arenicola marina*. Maplin Sands, which is the eighth largest continuous area of sediment flats in the UK, is particularly important for its large, nationally-important population of eelgrass *Zostera noltii* and high density of the hydroid *Sertularia* spp., which supports the only 'whiteweed' fishery in the UK.



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APPENDIX TWO
COMBINED LITTORAL AND SUBLITTORAL BIOTOPE MAPS

Comparison Table for Littoral and Sublittoral Biotopes

v96.7[1]	v97.06[2]	
Littoral		
LGS.BarSnd	LGS.BarSnd	Barren coarse sand shores
LGS.Tal	LGS.Tal	Talitrid amphipods in decomposing seaweed on the strandline
LGS.BarSh	LGS.BarSh	Barren shingle or gravel shores
LGS.Lan	LGS.Lan	Dense *Lanice conchilega* in tide-swept lower shore sand
LMS.AreBv	LMS.MacAre	*Macoma balthica* and *Arenicola marina* in muddy sand shores
LMS.PCer	LMS.PCer	Polychaetes and *Cerastoderma edule* in fine sand and muddy sand shores
LMU.HedMac	LMU.HedMac	*Hediste diversicolor* and *Macoma balthica* in sandy mud shores
LMU.HedMac.Cer (in part)	LMU.HedMac.Are	*Hediste diversicolor, Macoma balthica* and *Arenicola marina* in muddy sand or sandy mud shores
LMU.HedMac.Man (in part)	LMU.HedStr	*Hediste diversicolor* and *Streblospio shrubsolii* in sandy mud or soft mud shores
LMU.HedScr	LMU.HedScr	*Hediste diversicolor* and *Scrobicularia plana* in reduced salinity mud shores
LMU.HedOl	LMU.HedOl	Oligochaetes in reduced or low salinity gravel or coarse sand shores
LMS.PCer.Znol	LMS.Zos	Littoral *Zostera* (seagrass) beds
MLR.Myt.Pid	MLR.Myt.Pid	*Mytilus edulis* and piddocks on eulittoral firm clay
SLR.Fves	SLR.Fves	*Fucus vesiculosus* on sheltered mid eulittoral rock
SLR.Asc	SLR.Asc	*Ascophyllum nodosum* on very sheltered mid eulittoral rock
SLR.FserX.T	SLR.FserX.T	*Fucus serratus* with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata
SLR.FcerX	SLR.FcerX	*Fucus ceranoides* on reduced salinity eulittoral mixed substrata
SLR.BLlit	SLR.BLlit	Barnacles and *Littorina littorea* on unstable eulittoral mixed substrata
SLR.EphX	SLR.EphX	Ephemeral green and red seaweeds on variable salinity or disturbed eulittoral mixed substrata
SLR.MytX	SLR.MytX	*Mytilus edulis* beds on eulittoral mixed substrata
Sublittoral		
IGS	IGS	Infralittoral Gravelly Sands
IMS	IMS	Infralittoral Muddy Sands
IMU	IMU	Infralittoral Muds
IMU	IMU.EstMu	Estuarine sublittoral muds
IMU.PhoSco	IMU.AphTub	Aphelochaeta marioni and Tubificoides spp. in variable salinity infralittoral mud
IMU	IMU.NhomTub	Nephtys hombergii and Tubificoides spp. in variable salinity infralittoral soft mud
IMU	IMU.Tub	Tubificoides spp. in reduced salinity infralittoral muddy sediment
IMX	IMX	Infralittoral Mixed Sediments
IMX.FaMX	IMX.FaMx	Shallow mixed sediment faunal communities
IMX	IMX.EstMx	Estuarine sublittoral mixed sediments
IMX	IMX.CreAph	Crepidula fornicata and Aphelochaeta marioni in variable salinity infralittoral mixed sediment
IMX	IMX.PolMtru	Polydora ciliata, Mya truncata and solitary ascidians in variable salinity infralittoral mixed sediment
R6.33	R6.33	Sublittoral mixed muddy substrata with polychaetes, crustaceans and ascidians
R6.34	R6.34	Variable salinity sublittoral sorted mud with Hediste diversicolor and Corophium volutator

[1] Connor, D. W., Brazier, D. P., Hill, T. O., Holt, R. H. F., Northern, K. O. and Sanderson, W. G. (1996). *Marine Nature Conservation Review: marine biotopes. A working classification for the British Isles.* Version 96.7. Peterborough, JNCC.

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LITTORAL


ELR.MB - Mytilus (mussles) and barnacles


MLR.BF - Barnacles and fucoids (moderately exposed shore)


MLR.RPid - Ceramium Sp. and piddocks on eulittoral fossilised peat


MLR.MF - Mytilus (mussels) and fucoids (moderately exposed shores)


MLR.MytPid - Mytilus edulis and piddocks on eulittoral firm clay


MLR.Salv - Sabellaria alveolata reefs on sand abraided eulittoral rock


SLR.Fves - Fucus vesiculosus on sheltered mid eulittoral rock


SLR.Asc - Ascophyllum nodosum on very sheltered mid eulittoral rock


SLR.BLit - Barnacles and Littorina littorea on unstable eulittoral mixed substrata


SLR.FvesX - Fucus vesiculosus on mid eulittoral mixed substrata


SLR.FserX - Fucus serratus on lower eulittoral mixed substrata


SLR.FserX.T - Fucus serratus with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata


SLR.EphX - Ephemeral green and red seaweeds on variable salinity or disturbed eulittoral mixed substrata


SLR.FcerX - Fucus ceranoides on reduced salinity eulittoral mixed substrata


SLR.MytX - Mytilus edulis beds on eulittoral mixed substrata


LGS - Littoral gravels and sands


LGS.BarSh - Barren shingle or gravel shores


LGS.Pec -Pectenogammarus planicrurus in mid-shore well sorted gravel or coarse sand


LGS.Tal - Talitrid amphipods in decomposing seaweed on the strand line


LGS.BarSnd - Barren coarse sand shores


LGS.AEur - Burrowing amphipods and Eurydice pulchra in well drained clean sand shores


LGS.AP - Burrowing amphipods and polychaetes in clean sand shores


LGS.AP.P - Burrowing amphipods and polychaetes (often Arenicola marina) in clean sands


LGS.AP.Pon - Burrowing amphipods, Pontocrates spp. and Bathyporeia spp. in lower shore clean sand


LGS.Lan - Dense Lanice conchilega in tide-swept lower shore sand


LMS - Littoral muddy sands


LMS.PCer - Polychaetes and Cerastoderma edule in fine sand or muddy sand shores


LMS.MacAre - Macoma balthica and Arenicola marina in muddy sand shores


LMS.Zos - Littoral Zostera (seagrass) beds


LMU.HedMac - Hediste diversicolor and Macoma balthica in sandy mud shores


LMU.HedMac.Are - Hediste diversicolor, Macoma balthica and Arenicola marina in muddy sand or sandy mud shores


LMU.HedScr - Hediste diversicolor and Scrobicularia plana in reduced salinity mud shores


LMU.HedStr - Hediste diversicolor and Streblospio shrubsolii in sandy mud or soft mud shores


LMU.HedOl - Hediste diversicolor and oligochaetes in low salinity mud shores


15.11 - Salicornia and other annuals colonising mud and sand


15.12 - Spartina swards (Spartinion)


15.13 - Atlantic salt meadows (Glauco-Puccinellietalia)


15.15 - Mediterranean salt meadows (Juncetalia maritimi)


15.16 - Mediterranean and thermo-atlantic halophilous scrubs (Arthrocnemetalia fruticosae)


Offshore intertidal

No information available

SUBLITTORAL

IGS - Infralittoral gravel and sands

IMS - Infralittoral muddy sands

IMU - Infralittoral muds

IMU.EstMu - Estuarine sublittoral muds

IMU.AphTub - Aphelochaaeta marioni and Tubificoides spp. in variable salinity infralittoral mud

IMU.NhomTub - Nephyts hombergii and Tubificoides spp. variable salinity infralittoral soft mud

IMU.Tub - Tubificoides spp. in reduced salinity infralittoral muddy sediment

IMX - Infralittoral mixed sediments

IMX.FaMx - Shallow mixed sediment faunal communities

IMX.EstMx - Estuarine sublittoral mixed sediments

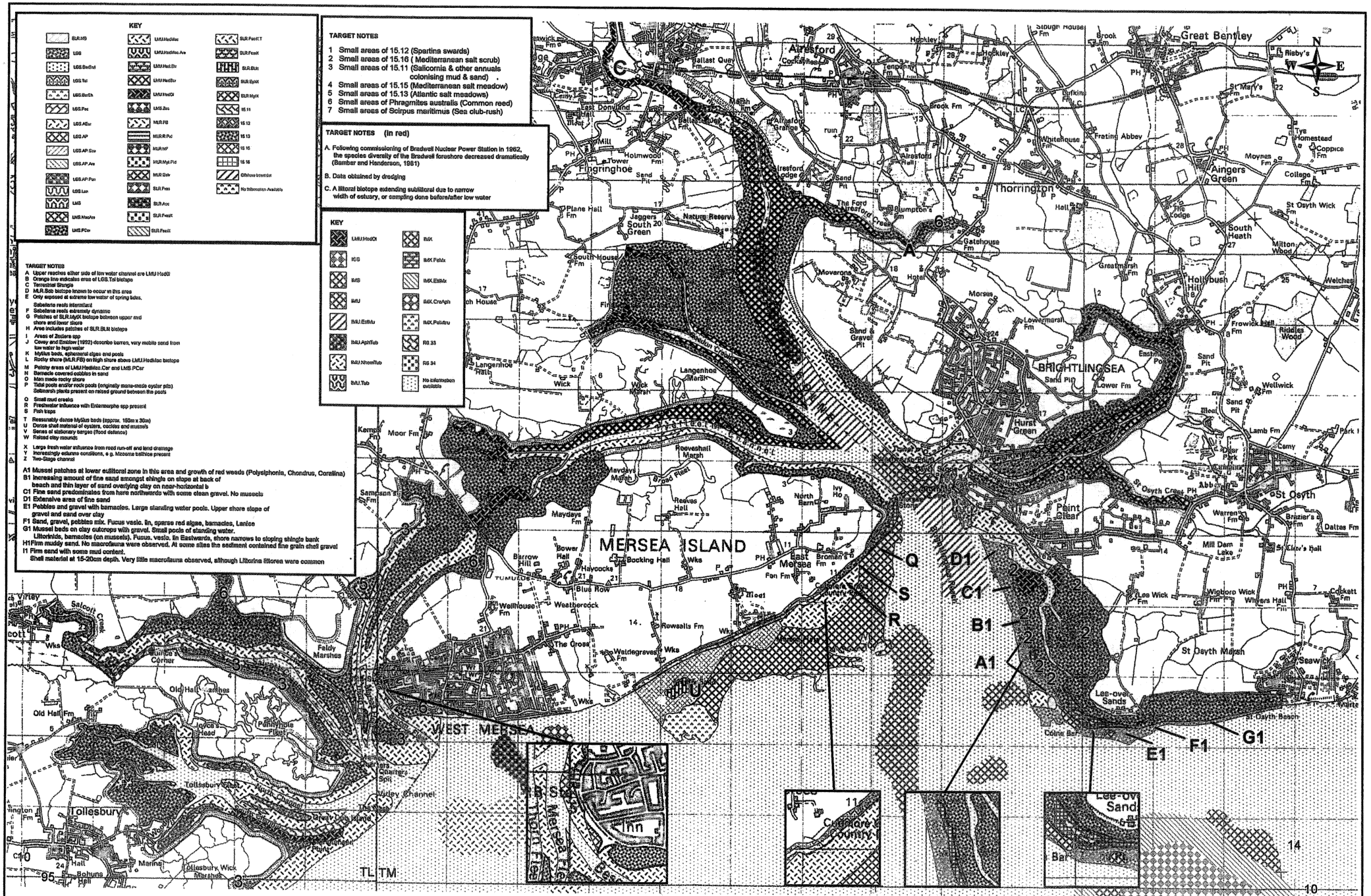
IMX.CreAph - Crepidula fornicata and Aphelochaeta marioni in variable salinity salinity infralittoral mixed sediment

IMX.PolMtru - Polydora ciliata, Mya truncata and solitary ascidians in variable salinity infralittoral mixed sediments

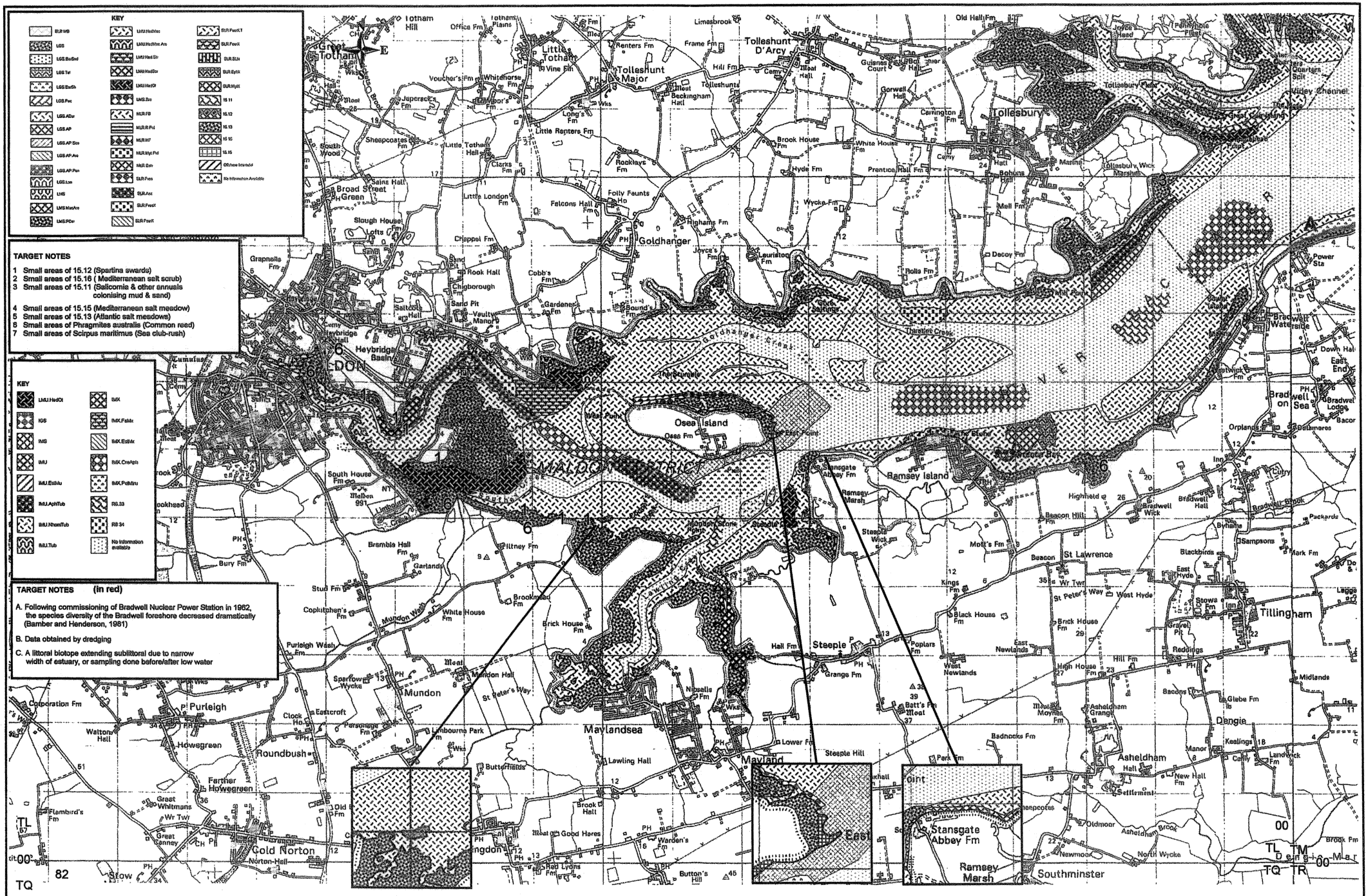
R6.33 - Sublittoral mixed muddy substrata with polychaetes, crustaceans and ascidians

R6.34 - Variable salinity sublittoral poorly sorted mud with Hediste diversicolor and Corophium volutator

No information available



ENGLISH NATURE	MAPPING OF SELECTED MARINE SAC's ESSEX ESTUARIES INTERTIDAL & SUBTIDAL	POSFORD DUVIVIER ENVIRONMENT	Based upon the Ordnance Survey 1:50,000 maps with the permission of the controller of H.M Stationary Office. GD272299 © Crown copyright. © English Nature 1998. Based on best of available information. May 1998 Boundaries illustrative not definitive	Date: May 1998	Drawn By: J.L.H	Checked By: C.S.A
					Map 1 of 6	Scale : 1:50,000



ENGLISH NATURE

MAPPING OF SELECTED MARINE SAC's ESSEX ESTUARIES INTERTIDAL & SUBTIDAL

POSFORD DUVIVIER ENVIRONMENT

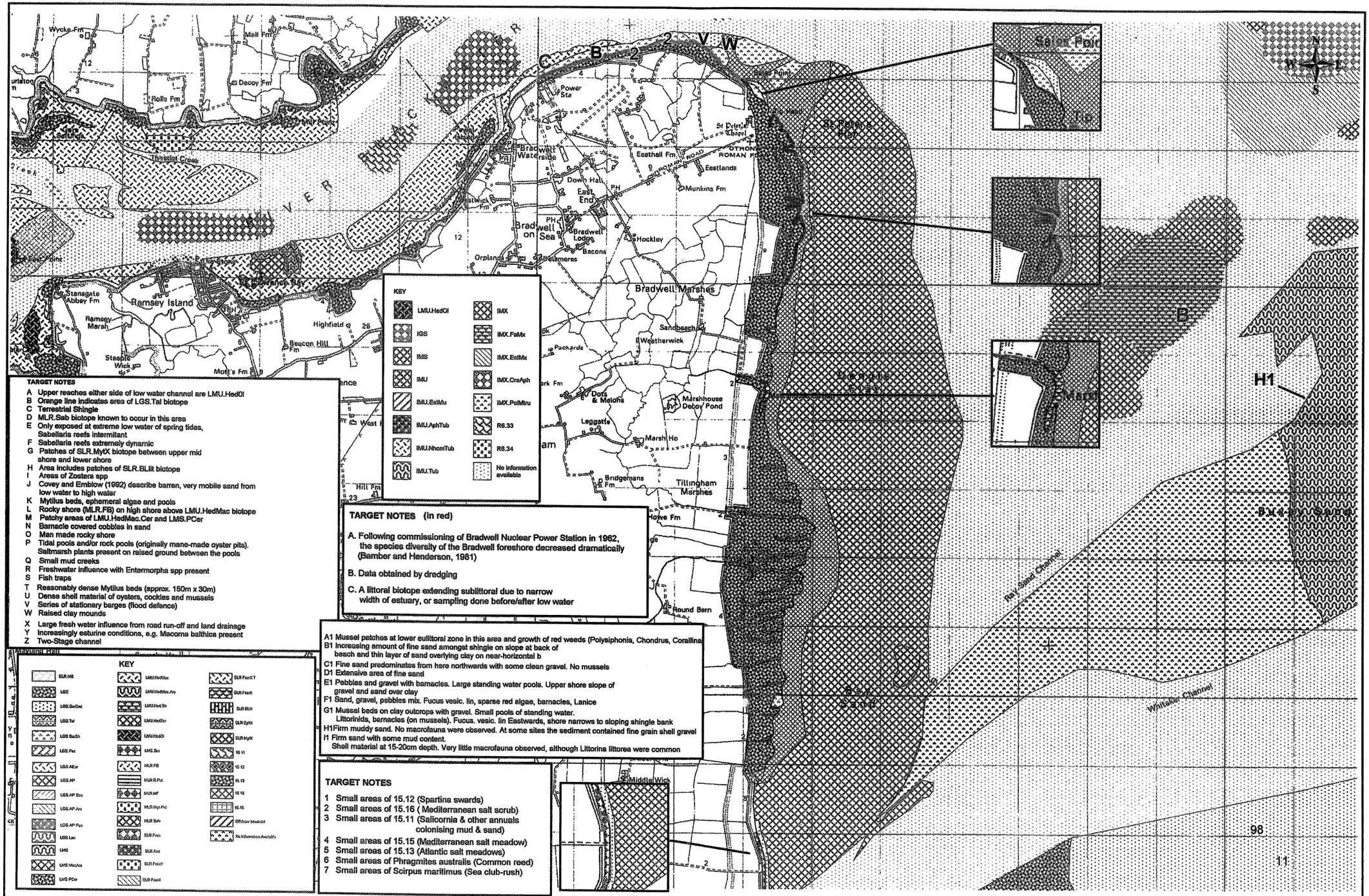
Date: May 1998

Drawn By: J.L.H

Checked By: C.S.A

Map 2 of 6

Scale : 1:50,000



KEY

- LMU.HedOl
- IGS
- IMS
- IMU
- IMU.EstMu
- IMU.AphTub
- IMU.NhomTub
- IMU.Tub
- IMX
- IMX.PalMx
- IMX.EstMx
- IMX.CreAph
- IMX.PolMiru
- R6.33
- R6.34
- No information available

TARGET NOTES

- A Upper reaches either side of low water channel are LMU.HedOl
- B Orange line indicates area of LGS.Tal biotope
- C Terrestrial Shingle
- D MLR.Sab biotope known to occur in this area
- E Only exposed at extreme low water of spring tides, Sabellaria reefs intermitant
- F Sabellaria reefs extremely dynamic
- G Patches of SLR.MytX biotope between upper mid shore and lower shore
- H Area includes patches of SLR.BLit biotope
- I Areas of Zostera spp
- J Covey and Emblow (1992) describe barren, very mobile sand from low water to high water
- K Mytilus beds, ephemeral algae and pools
- L Rocky shore (MLR.FB) on high shore above LMU.HedMac biotope
- M Patchy areas of LMU.HedMac.Cer and LMS.PCer
- N Barnacle covered cobbles in sand
- O Man made rocky shore
- P Tidal pools and/or rock pools (originally mane-made oyster pits). Saltmarsh plants present on raised ground between the pools
- Q Small mud creeks
- R Freshwater influence with Entermorpha spp present
- S Fish traps
- T Reasonably dense Mytilus beds (approx. 150m x 30m)
- U Dense shell material of oysters, cockles and mussels
- V Series of stationary barges (flood defence)
- W Raised clay mounds
- X Large fresh water influence from road run-off and land drainage
- Y Increasingly esturine conditions, e.g. Macoma balthica present
- Z Two-Stage channel

TARGET NOTES (in red)

- A. Following commissioning of Bradwell Nuclear Power Station in 1962, the species diversity of the Bradwell foreshore decreased dramatically (Bamber and Henderson, 1981)
- B. Data obtained by dredging
- C. A littoral biotope extending sublittoral due to narrow width of estuary, or sampling done before/after low water

- A1 Mussel patches at lower eulittoral zone in this area and growth of red weeds (Polysiphonia, Chondrus, Corallina
- B1 Increasing amount of fine sand amongst shingle on slope at back of beach and thin layer of sand overlying clay on near-horizontal b
- C1 Fine sand predominates from here northwards with some clean gravel. No mussels
- D1 Extensive area of fine sand
- E1 Pebbles and gravel with barnacles. Large standing water pools. Upper shore slope of gravel and sand over clay
- F1 Sand, gravel, pebbles mix. Fucus vesic. lin, sparse red algae, barnacles, Lanice
- G1 Mussel beds on clay outcrops with gravel. Small pools of standing water. Littorinids, barnacles (on mussels). Fucus. vesic. lin Eastwards, shore narrows to sloping shingle bank
- H1 Firm muddy sand. No macrofauna were observed. At some sites the sediment contained fine grain shell gravel
- I1 Firm sand with some mud content. Shell material at 15-20cm depth. Very little macrofauna observed, although Littorina littorea were common

TARGET NOTES

- 1 Small areas of 15.12 (Spartina swards)
- 2 Small areas of 15.16 (Mediterranean salt scrub)
- 3 Small areas of 15.11 (Salicornia & other annuals colonising mud & sand)
- 4 Small areas of 15.15 (Mediterranean salt meadow)
- 5 Small areas of 15.13 (Atlantic salt meadows)
- 6 Small areas of Phragmites australis (Common reed)
- 7 Small areas of Scirpus maritimus (Sea club-rush)

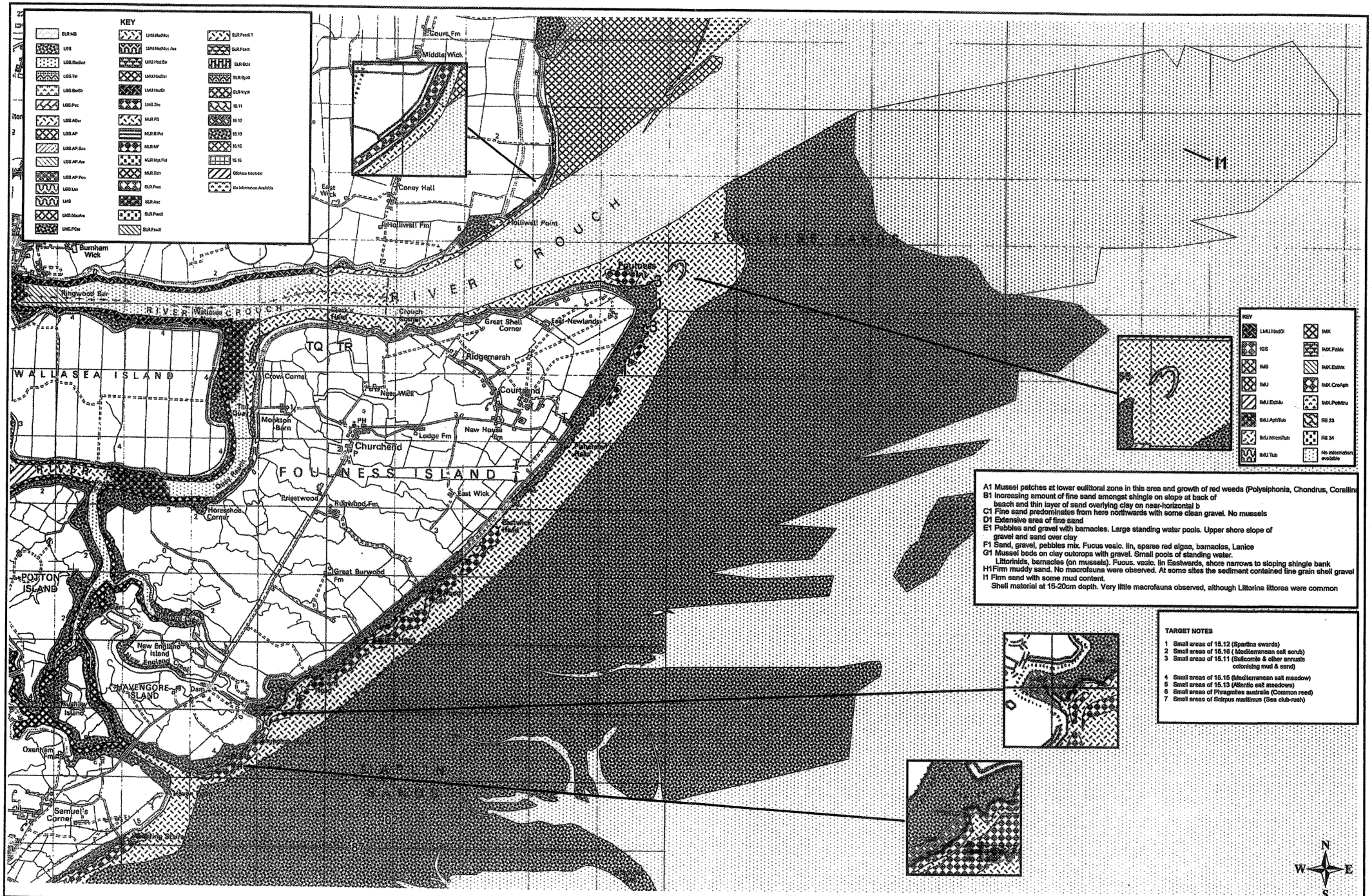
ENGLISH NATURE

MAPPING OF SELECTED MARINE SAC's ESSEX ESTUARIES INTERTIDAL & SUBTIDAL

POSFORD DUVIVIER ENVIRONMENT

Based on best of available information. May 1998
Boundaries illustrative not definitive

Date: May 1998	Drawn By: J.L.H	Checked By: C.S.A
	Map 3 of 6	Scale : 1:50,000



ENGLISH NATURE

MAPPING OF SELECTED MARINE SAC's
ESSEX ESTUARIES
INTERTIDAL & SUBTIDAL

POSFORD DUVIVIER ENVIRONMENT

Based on best of available information. May 1998
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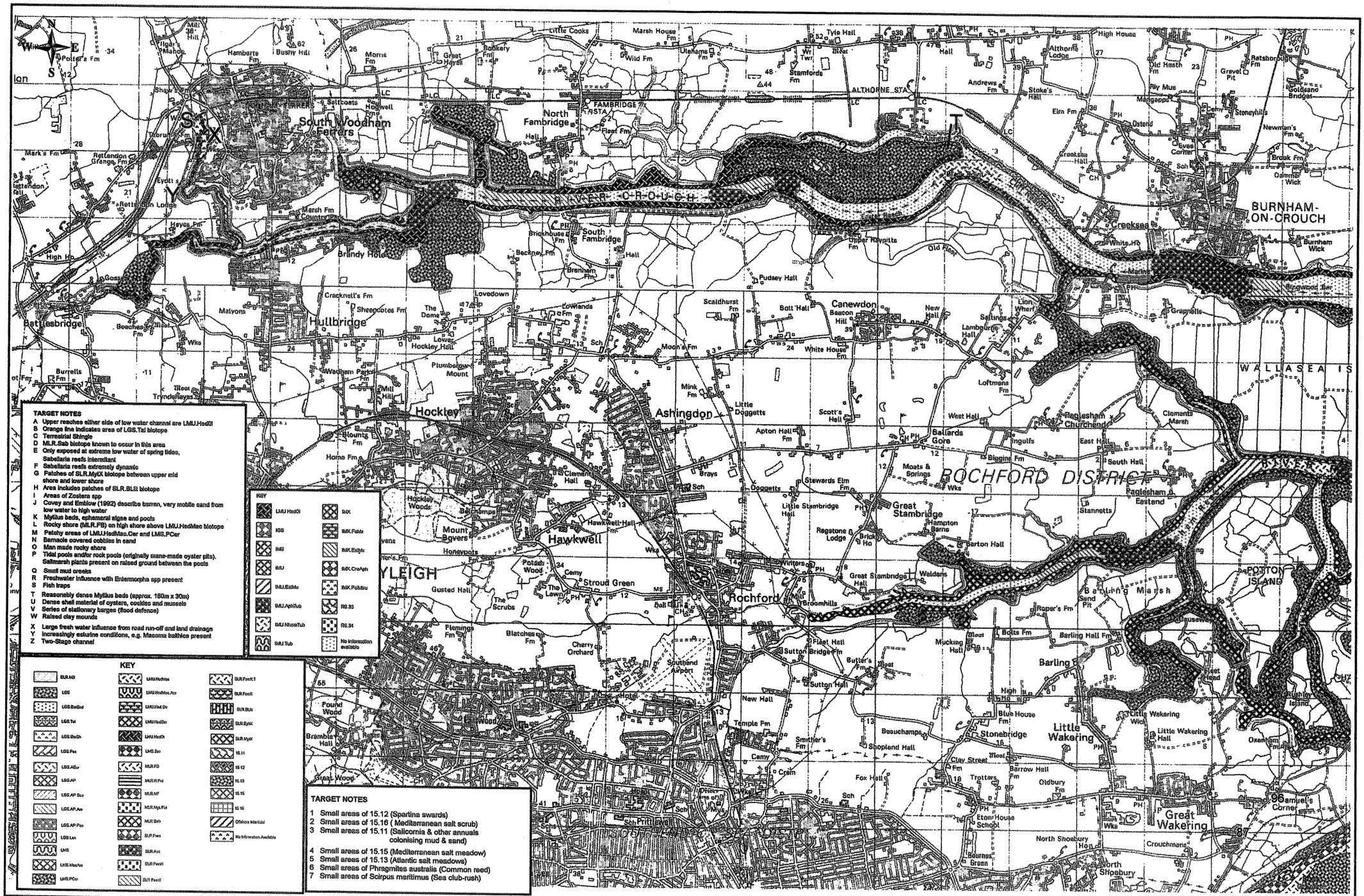
Date: May 1998	Drawn By: J.L.H	Checked By: C.S.A
	Map 4 of 6	Scale : 1:50,000



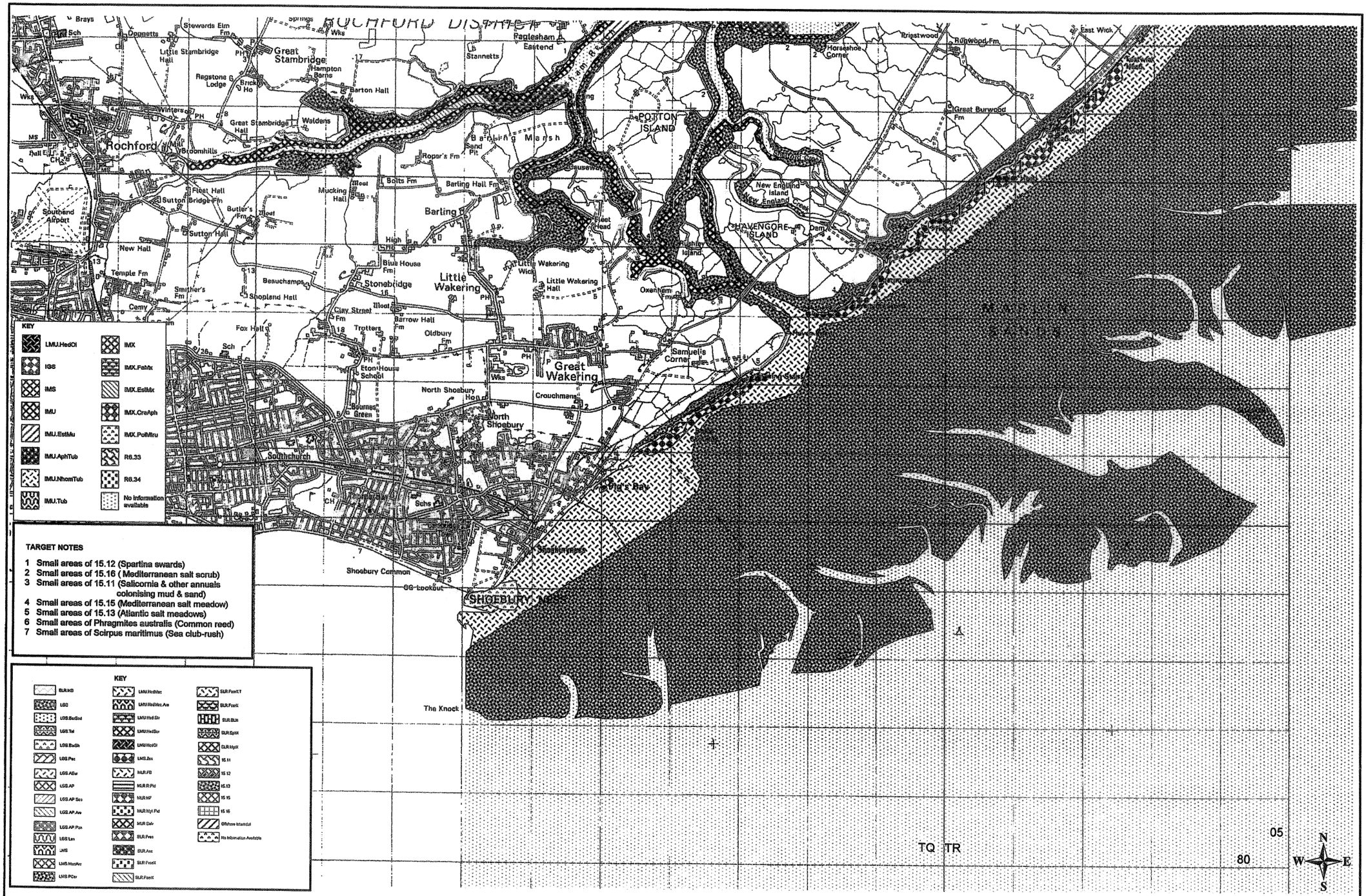
ENGLISH NATURE

MAPPING OF SELECTED MARINE SAC's ESSEX ESTUARIES INTERTIDAL & SUBTIDAL

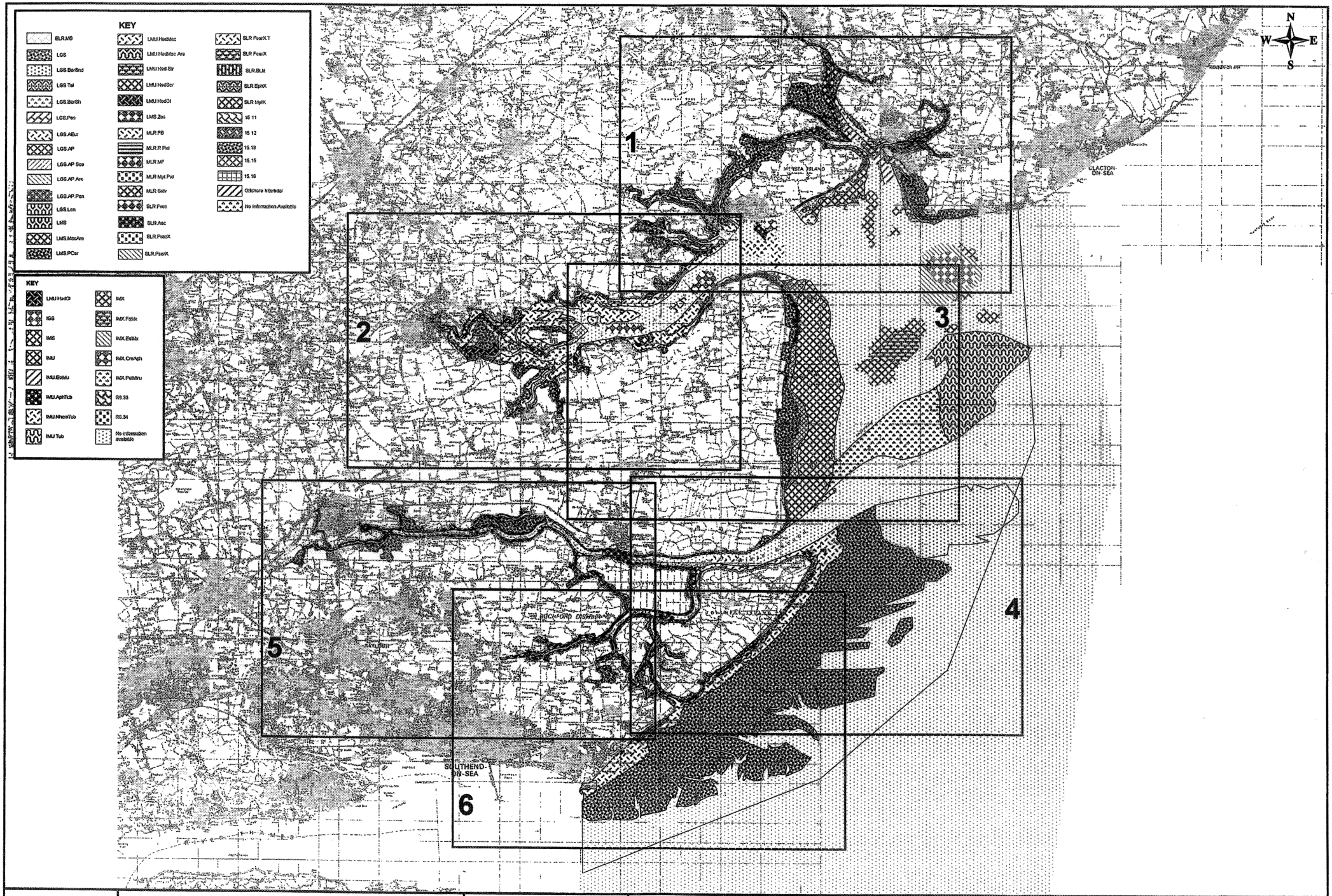
POSFORD DUVIVIER ENVIRONMENT

Based on best of available information. May 1998
Boundaries illustrative not definitive

Date: May 1998	Drawn By: J.L.H	Checked By: C.S.A
	Map 5 of 6	Scale : 1:50,000



ENGLISH NATURE	MAPPING OF SELECTED MARINE SAC's ESSEX ESTUARIES INTERTIDAL & SUBTIDAL	POSFORD DUVIVIER ENVIRONMENT	Based upon the Ordnance Survey 1:50,000 maps with the permission of the controller of H.M Stationary Office. GD272299 © Crown copyright. © English Nature 1998. Based on best of available information. May 1998 Boundaries illustrative not definitive	Date: May 1998	Drawn By: J.L.H Checked By: C.S.A Map 6 of 6 Scale : 1:50,000



ENGLISH NATURE	MAPPING OF SELECTED MARINE SAC's ESSEX ESTUARIES INTERTIDAL & SUBTIDAL	POSFORD DUVIVIER ENVIRONMENT	Based upon the Ordnance Survey 1:50,000 maps with the permission of the controller of H.M Stationary Office. GD272299 © Crown copyright. © English Nature 1996. Based on best of available information. May 1998 Boundaries illustrative not definitive	Date: May 1998	Drawn By: J.L.H	Checked By: C.S.A
				Key Map	Map 1 of 1	Scale : 1:170,000