

North Thames Estuary & Marshes Aquatic Macroinvertebrate Survey Report 2024

June 2026

Natural England Commissioned Report NECR608

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Foreword

Aquatic habitats across the North Thames Estuary & Marshes were surveyed in 2024 to determine their quality for aquatic invertebrates and collect evidence to inform the case for notification as a Site of Special Scientific Interest (SSSI). This survey was to collect additional evidence to support the case for notification, following surveys undertaken in 2022.

The report does not itself make a case for notification, rather it provides an objective record of survey findings to support Natural England's independent assessment of special interest. Natural England commission a range of reports from external contractors to provide evidence and advice to assist us in delivering our duties. The views in this report are those of the authors and do not necessarily represent those of Natural England.

Executive summary

Abrehart Ecology Ltd was commissioned by Natural England, to update the records and status of macroinvertebrates within eight survey compartments from Tilbury Fort to north of Mucking Marshes. Additionally, the survey was used to evaluate the conservation value of each compartment and the overall condition of the site.

Samples were taken from 57 locations in May, July and August/September 2024. The eight survey compartments were:

- Mucking Wetlands (Compartment A),
- Mucking Church Woodland (Sub-Compartment B2),
- Mucking Landfill inc. Golden Gates Lake (Enovert) (Compartment C),
- Fields East of Coalhouse Battery (Compartment L),
- Coalhouse Fort and surrounds (Compartment E),
- Ashfields & Goshem's Farm (Compartment G),
- Low Street Pit & surrounds (Compartment J) and
- Tilbury Fort Marshes (Compartments TFM and K).

Summary of overall biodiversity value:

1. In total, 239 taxa of aquatic invertebrates were recorded within the survey area, of these, 180 were identified to species level. Site Analysis for Freshwater Invertebrate Scoring (SAFIS) scoring indicates that all of the compartments are of a 'Very High' conservation value (Community Conservation Index (CCI) score) with up to 21 species of interest in a single waterbody. The Biological Monitoring Working Party (BMWP) score indicated that water quality was 'good' to 'excellent'.
2. 27,687 specimens were recorded. These records included 90 species of aquatic Coleoptera (water beetles), 26 species of Hemiptera (True bugs), six species of crustacean, 12 species of Odonata larvae (damselfly and dragonflies), seven species of Hirudinea (leeches) and 18 taxa of aquatic molluscs (water snails) (fourteen gastropods and four bivalves).
3. All compartments supported a number of Endangered (EN), Nationally Rare; Vulnerable (NR/VU), Nationally Rare (NR), Nationally Scarce (NS); Near Threatened (NS;NT) and Nationally Scarce (NS) species. In total one species of EN Odonata, one NR/VU beetle, two NR beetles, six NS;NT beetles, one NS;NT mollusc, 21 NS beetle species and two NS Hemiptera and two NS Trichoptera were recorded.

Invasive Non-Native Species

Four invasive non-native species (INNS) were found across the survey area, the common freshwater shrimp *Crangonyx pseudogracilis*, and three molluscs: the nationally common *Potamopyrgus antipodarium*, the increasing *Physella acuta* and the new to the UK mollusc *Heleobia charruca*.

Table 1. Summary of rare species diversity and abundance. Blank cells indicate where species were not recorded. Status codes in column one relate to the IUCN GB Red List statuses and include Endangered (EN), Vulnerable (VU), Near Threatened (NT) and Least Concern (LC). National rarity statuses include Nationally Rare (NR, 15 or fewer 10x10km squares) and Nationally Scarce (NS, 16-100 10x10km squares).

Status	No. species	No. sampling points	Total No.	No. Beetles	No. Hemiptera	No. Molluscs	No. Odonata	No. Crustacean	No. Caddis
EN	1	1	1				1		
NR/VU	1	1	1	1					
NR	1	1	1	1					
NR;LC	1	11	74	1					
NS;NT	6	29	112	5		1			
NS;LC	19	86	210	16	2				1
NS	3	3	7	3					

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Methods

Sample point locations

Sampling points, mapped in Figure 1, were chosen once on site to allow the most diverse habitats to be sampled. Data and sample collection were undertaken by two surveyors, including an experienced on-site surveyor (Toby Abrehart FLS MCIEEM) and a second team member responsible for recording abiotics, health and safety, and assisting with sample collection (Sorrel Kaimil BSc (Hons) MSc, and Alister Killingsworth BSc (Hons) MSc GradCIEEM). All the sampling was undertaken during summer 2024 (May to September). The broad sample sites were provided by Natural England and identified by Toby Abrehart as suitable to survey and verified in the field.

Aquatic Survey of 'North Thames Estuary & Marshes' 2024

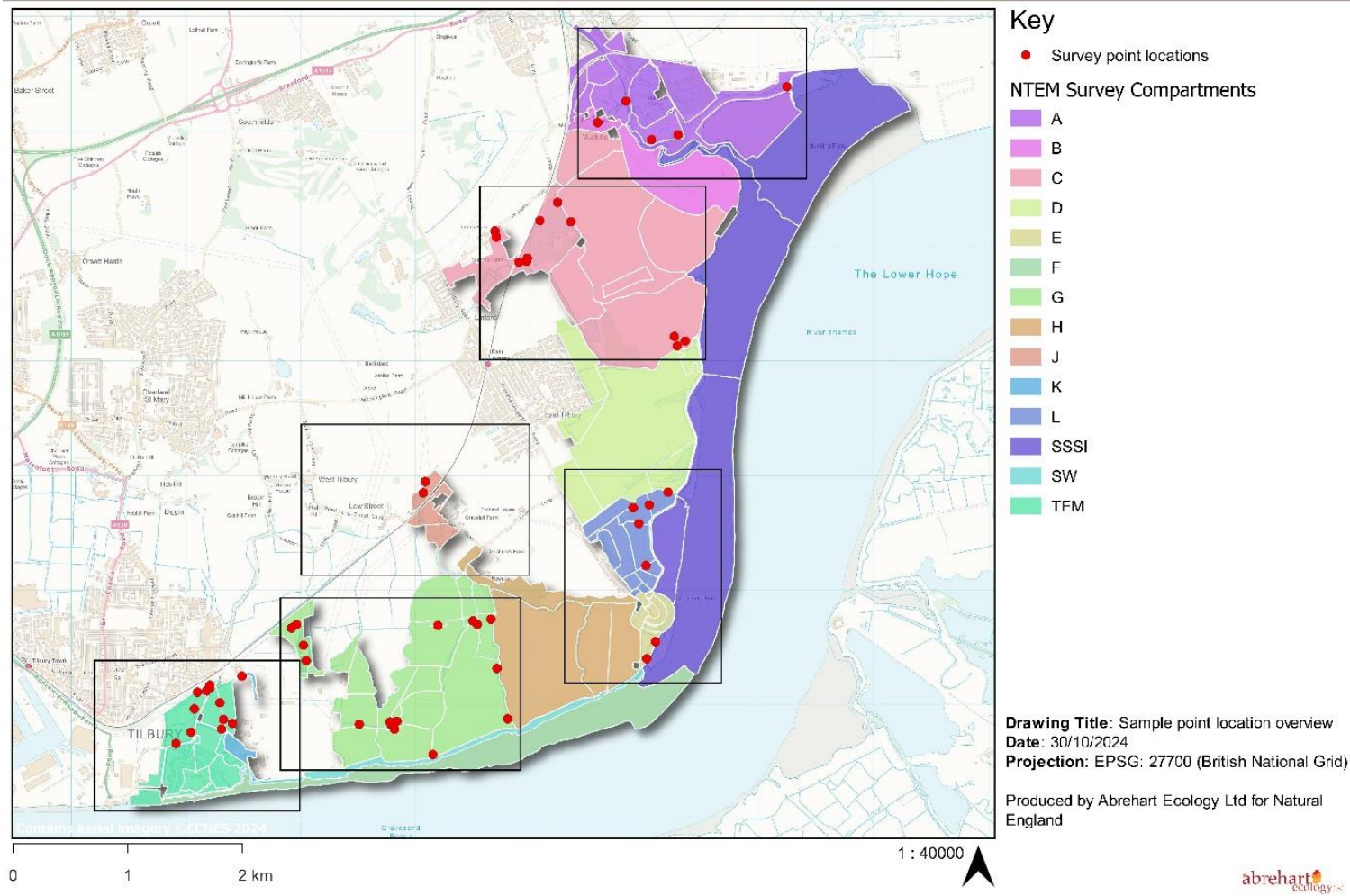


Figure 1. Sample point locations. Map data Aerial Imagery Copyright is from ©ECNES 2024

Table 2. Locations of the survey areas and sampling points

Sampling Code	Compartment Name	April-May	Early July	Late Aug/Early Sept	Location
A1A	Stanford Warren Wetland (South)	No	No	Yes	TQ69068093
A1B	Stanford Warren Wetland (South)	No	No	Yes	TQ69298097
A3	Stanford Wharf (Creekside Mosaic)	No	No	Yes	TQ70248139
A6	Stanford Warren Wetland (North)	No	No	Yes	TQ6883881265
B2	Mucking Church Woodland	Yes	No	No	TQ6859181078
C1A	Mucking Landfill (South)	No	Yes	Yes	TQ6928479132
C1B	Mucking Landfill (South)	No	Yes	Yes	TQ6935579173
C1C	Mucking Landfill (South)	No	Yes	Yes	TQ6925979213
C6A	Golden Gates Lake	Yes	Yes	No	TQ6797179868
C6B	Golden Gates Lake	Yes	Yes	No	TQ6790479859
C6C	Golden Gates Lake	Yes	Yes	No	TQ6797879896
C6D	Golden Gates Lake	Yes	Yes	No	TQ6808780224
C6E	Golden Gates Lake	Yes	Yes	No	TQ6824180382
C6F	Golden Gates Lake	Yes	Yes	No	TQ6835780214

Sampling Code	Compartment Name	April-May	Early July	Late Aug/Early Sept	Location
C9A	Linford Wood	Yes	Yes	No	TQ6769580134
C9B	Linford Wood	Yes	Yes	No	TQ6770780080
E1A	Coalhouse Fort Lower Meadows	No	Yes	Yes	TQ6909576552
E1B	Coalhouse Fort Lower Meadows	No	Yes	Yes	TQ6901976404
G3A	Goshem's Landfill	No	Yes	Yes	TQ6780575880
G3B	Goshem's Landfill	No	Yes	Yes	TQ6771276319
G3C	Goshem's Landfill	No	No	No	TQ6715475569
G3/G2	Goshem's Landfill	No	Yes	Yes	TQ6754076703
G2	Field North of Goshem's Landfill	No	Yes	Yes	TQ6766076748
G6A	Goshem's Pool	No	Yes	Yes	TQ66797583
G6B	Goshem's Pool	No	Yes	Yes	TQ6678075853
G6C	Goshem's Pool	No	Yes	Yes	TQ66827579
G6D	Goshem's Pool	No	Yes	Yes	TQ6684075859
G9/G10	Ash C1/C2	No	Yes	Yes	TQ6719776693
G9/G10B	Ash C1/C2	No	Yes	No	TQ6750376734
G13	Ash A2	No	Yes	Yes	TQ6651275833
G16A	Tilbury2 Mitigation Area	Yes	Yes	No	TQ6592176671

Sampling Code	Compartment Name	April-May	Early July	Late Aug/Early Sept	Location
G16B	Tilbury2 Mitigation Area	Yes	Yes	No	TQ6602476521
G16C	Tilbury2 Mitigation Area	Yes	Yes	No	TQ6604876386
G16D	Tilbury2 Mitigation Area	Yes	No	No	TQ6596476701
J3	Station Road Lake	Yes	Yes	No	TQ6707077850
J3B	Station Road Lake	Yes	No	No	TQ6708277948
K2	Infill North of Sewage Treatment Works	Yes	Yes	Yes	TQ6548976252
L7A	Thamesview Campsite	No	Yes	Yes	TQ68907772
L7B	Thamesview Campsite	No	Yes	Yes	TQ6904077745
L7C	Thamesview Campsite	No	Yes	Yes	TQ6895077581
L8	Walsh Field	No	Yes	Yes	TQ6920377855
L3	n/a	No	Yes	Yes	TQ6901277216
TFM6a (formerly TFM6/TFM7)	Northern Marsh North of road to Water treatment plant	No	Yes	No	TQ6531175791
TFM6/TFM7	Northern Marsh East of Fort Road (central ditch)	Yes	Yes	Yes	TQ6529776020
TFM6/TFM8	Northern Marsh East of Fort Road (central ditch)	Yes	Yes	Yes	TQ6532775874
TFM7	Northern Marsh East of Fort Road (eastern half)	Yes	Yes	Not applicable	TQ6540675839

Sampling Code	Compartment Name	April-May	Early July	Late Aug/Early Sept	Location
TFM8	Northern Marsh West of Fort Road	Yes	Yes	Yes	TQ6510176112
TFM9	Northern Marsh West of Fort Road	Yes	Yes	Yes	TQ6507475966
TFM10	Northern Marsh West of Fort Road	Yes	Yes	Yes	TQ6504575763
TFM11	Northern Marsh West of Fort Road	Yes	Yes	Yes	TQ6491475665
TFM12A	Attenuation Ponds	Yes	Yes	Yes	TQ6517976125
TFM12B	Attenuation Ponds	Yes	Yes	Yes	TQ6520976146
TFM12C	Attenuation Ponds	Yes	Yes	Yes	TQ6521076173

Aquatic invertebrate sampling

Samples were collected using ten-second sweeps with a net with 0.5mm mesh. Sweeps were repeated three times in different sections of the waterbody profile, that is, floating vegetation (where present), the benthic layer, and the submerged edge of the nearside bank. Once collected each sample was placed into a 5-litre bucket and preserved in 10% Formaldehyde for storage prior to identification. Once identified the picked-out specimens will be stored for one year in 99% Iso-propyl alcohol.

For identification, all invertebrates were separated from the retained sediment, detritus and vegetation under 40 - 80x stereo binocular microscopes. All specimens were then separated into major taxonomic groups, preserved in fresh 99.9% ethanol, and referred to an appropriate taxonomist for identification. Where possible, all specimens were identified to species level. Exceptions to this are groups that require specialist, time-consuming preparatory techniques such as head capsule dissection for chironomid larvae and prolonged clearing procedures for oligochaetes species.

Water chemistry sampling

At each sample point, waterbody characteristics and a range of other environmental features were recorded. These included exposed and submerged bank profiles, channel width and depth, and levels of grazing, poaching, and shelving. Abiotic parameters were recorded in the surface 10cm of water including pH, conductivity, total dissolved solids, temperature (all measured using a Hanna HI83303 Aquaculture Photometer). Each sample point was recorded on an Archer2 sub-metre DGPS unit.

Water samples were taken using a five-litre bucket within the surface 15cm of water. These were generally taken from banksides, as these areas were most accessible during survey visits and prevented excessive disturbance which would have been caused through entering the waterbodies.

Biocontrol

As sampling comprised moving from one system to another, the check, clean, and dry methods were employed as standard. However, protocol also included changing of nets and trays from one waterbody to another. Prior to entering a new waterbody, the net and trays from one site were washed in a solution of Virkon and left to dry. A clean and dry set was then used in the new waterbody. This prevented species or pathogens being transmitted from one area to another. On return to the laboratory the nets were washed again in Virkon solution and left to dry for at least one day before being taken into the field.

On site, in addition to the nets, only waterproof boots enter the waterbody, and these too are washed in Virkon at the end of sampling effort within a marsh system and between water bodies.

Laboratory methods

Samples were treated as recommended by the Environment Agency (Murray-Bligh, 1999). Each sample was sorted a little at a time in a white tray. Most samples required at least 10 trays' worth of detritus to be sorted. All beetles, bugs and fly larvae were removed as well as representative specimens of other macroinvertebrate groups (for example, gammarids, mayflies). The abundance of groups not removed from the tray was estimated on a three-point scale. Most molluscs sank during the washing procedure and were recovered at the end. Usually there were vast numbers of snails, so a subsample was taken of between one twelfth and a half (but usually a third to a quarter) of the mollusc sample collected. The subsample was dried and the whole subsample identified under a microscope at low magnification. Many Succineids were kept in spirit rather than dried since they needed to be dissected for accurate identification. Dissected vouchers were sent to an independent authority (Sharon Flint) for verification.

All adult water beetles and molluscs were identified to species. Water beetles in the samples comprised the families Gyrinidae (whirligigs), Haliplidae, Hygrobiidae (screech beetles), Noteridae, Dytiscidae (diving beetles), Hydraenidae, Helophoridae, Hydrochidae, Hydrophilidae (crawling water beetles), Scirtidae, Elmidae (riffle beetles), and Dryopidae. Several groups within other families were also identified - Donacinae (reed beetles) in Chrysomelidae, Stenus within Staphylinidae (rove beetles), and Coccinellidae (ladybirds).

Abundances were estimated or converted from actual counts to an approximately geometric scale:

- A - 1-9, B - 10-99, C - 100-999 and D - >1000.

SAFIS analysis

Data collected during the surveys were processed using SAFIS analysis (Site Analysis for Freshwater Invertebrate Surveys v.30.0, (Chalkley, 2016). The SAFIS routine uses an inbuilt species dictionary to automate the calculation of metrics relating to conservation values and water quality, outlined below. The SAFIS analysis allowed an assessment of conservation value and water quality and also highlighted any species of conservation interest present. For each of the sample sites, six standard measurements or metrics have been calculated allowing an assessment of the condition of the watercourse as revealed by the invertebrate community it supports. These metrics are:

- The Biological Monitoring Working Party Score (BMWP) (Hawkes, 1998)
- The Average Score Per Taxon (ASPT) (Hawkes, 1998)
- The Community Conservation Index (CCI) (Chad & Extence, 2004)

For a full explanation of these methods the original research papers should be consulted. However, to interpret the results shown within the current analysis, the following may be a useful summary:

BMWP is a measure of the water quality (oxygenation and cleanliness). BMWP scores are industry standard and reflect the sensitivity of the aquatic invertebrate families to pollution. The higher the family score, the more sensitive to oxygen depletion the family is and therefore their presence indicates a cleaner or less impacted site. The effects of pollution generally are to impose a Biological Oxygen Demand upon the receiving waters and so sensitive families are progressively excluded as the BOD increases. The revised BMWP system (2007) was used for this survey and the following classification may be used as a guide (Table 3).

Table 3. Biological Monitoring Working Party (BMWP) categories & definitions

BMWP score	Definition
< 25	poor water conditions
26-50	moderate
51-100	good
101-150	very good
more than 150	exceptional

ASPT is based on the BMWP score and so is also a measure of water quality. The BMWP score for each family present is totalled to give a site score. A high score can be achieved through a large number of low scoring families as well as a small number of high scoring families. Therefore, an Average Score Per Taxa (ASPT) is also calculated which allows further interpretation of the results (Table 4). The higher the ASPT, the greater the proportion of more sensitive families in the sample and therefore the better the site condition. It is a useful criterion for showing year to year changes and trends in the invertebrate population supported by the water body. Being an average score, the higher its value, the more ecologically valuable the population should be. Any value greater than four generally indicates good water quality but productive water bodies with large and varied populations will usually have an ASPT value between 4.5 and 5.0.

Table 4. Average Score Per Taxa (ASPT) water quality values.

ASPT value	Definition
<4	poor water quality
>4	moderate quality
>5	good quality
>6	very good

CCI is based on the rarity of the individual invertebrates living in the water. It gives a numerical value to the conservation importance of the aquatic community. The higher the CCI value the greater the conservation interest. CCI values can range from less than five

for a site with little or no conservation value to a score greater than 20 for sites with very high conservation interest. This group of highest CCI values often indicate a site that is of national importance.

Table 5. Community Conservation Index (CCI) categories and definitions.

CCI	Conservation value	
0 – 5	Low	Site supporting only common species and/or low taxon richness
5 – 10	Moderate	At least one species of restricted distribution and/or moderate taxon richness.
10 – 15	Fairly high	At least one uncommon species, or several of restricted distribution, and/or high taxon richness.
15 – 20	High	Several uncommon species, at least one may be nationally rare, and/or high taxon richness
>20	Very high	Several rarities, including species of national importance or at least one RDB /Threatened species, and/or very high taxon richness

Generally, the species rarity is given first followed by the IUCN Threat category for those species with a modern IUCN Species Status review.

Limitations

Species within the orders Hirudinea (leeches) and Tricladida (flatworms) can be affected by preservation in ethanol (damage to eyes and genital pores – often key features of identification). During the survey these species were found and identified in the field and released. The remainder of the specimens were preserved as normal in isopropanol alcohol as above.

Some of the survey visits were carried out in non-optimal conditions (choosing the best available weather windows) due to access issues, meaning that the surveys were carried out on predetermined days rather than optimal ones. This may have reduced the diversity recorded as some sampling was carried out on dull days.

Some of the habitats were ephemeral and in the first surveys in May 2024 the water of several of the ponds and ditches was receding. In the second survey period several of

these were dry and accordingly no second samples were taken. At the central ditch of Northern Marsh East of Fort Road in survey compartment TFM6 and TFM7 located at grid reference TQ6529776020, no samples were taken due to dry conditions.

The current survey draws its conclusions from extrapolating findings from a representative selection of the waterbodies within the survey area; sampling alternative waterbodies or sections of waterbody would inevitably yield subtly different findings. The reader is encouraged to read this 2024 survey report in conjunction with the published 2022 survey report by the same author, to give a more rounded picture of the aquatic fauna found in the North Thames Estuary & Marshes area.

Results

The waterbodies and wetland habitats were located mainly within the eight compartments between Tilbury Fort and the north Mucking Marshes and nearby lagoons.

Table 6. Basic water chemistry results. Blank cells present where data was not recorded.

Compartment	Site name	Location	No. of Surveys	Spring Survey Date	Summer Survey Date	Autumn Survey Date	Spring pH	Spring ms	Spring ppt	Spring temp (°C)	Summer pH	Summer ms	Summer ppt	Summer temp (°C)	Autumn pH	Autumn ms	Autumn ppt	Autumn temp (°C)
B2	Mucking Church Woodland	TQ6859181078	Once in one location	26.04.24			8.1	1.83	1.295	15.4								
C6A	Golden Gates Lake	TQ6797179868	Twice, in two locations (C6A and C6B)	26.04.24	08.07.24		8	0.69	0.492	15.3	8.4	0.81	0.582	17.2				
C6B	Golden Gates Lake	TQ6790479859	Twice, in two locations (C6A and C6B)	26.04.24	08.07.24		8	1.83	0.545	15.7	8.4	0.81	0.582	17.4				
C6C	Golden Gates Lake	TQ6797879896	Twice, in four locations. (C6C-C6F)	26.04.24	08.07.24		8.1	0.66	0.617	15.5	8.3	1.19	0.859	17.2				

Compartment	Site name	Location	No. of Surveys	Spring Survey Date	Summer Survey Date	Autumn Survey Date	Spring pH	Spring ms	Spring ppt	Spring temp (°C)	Summer pH	Summer ms	Summer ppt	Summer temp (°C)	Autumn pH	Autumn ms	Autumn ppt	Autumn temp (°C)
C6D	Golden Gates Lake	TQ6808780224	Twice, in four locations (C6C-C6F)	26.04.24	08.07.24		7.7	1.12	0.799	15.2	8.3	1.19	0.859	17.2				
C6E	Golden Gates Lake	TQ6824180382	Twice, in four locations (C6C-C6F)	26.04.24	08.07.24		8.1	0.86	0.617	16.2	8.9	1.12	0.805	17.3				
C6F	Golden Gates Lake	TQ6835780214	Twice, in four locations (C6C-C6F)	26.04.24	08.07.24		8	1.06	0.769	15.2	8.3	1.16	0.834	17.3				
C9A	Linford Wood	TQ6769580134	Twice, at two locations. (C9A and C9B)	30.05.24	11.07.24		6.8	0.91	0.634	15.5	10	0.66	0.475	26.1				
C9B	Linford Wood	TQ6770780080	Twice, at two locations. (C9A and C9B)	30.05.24	11.07.24		6.8	0.92	0.634	15.6	10	0.65	0.475	26				
G16A	Tilbury2 Mitigation Area	TQ6592176671	Twice, in one location (G16A and G16B)	01.05.24	09.07.24		7.4	3.25	6	16.1	8.9	3.04	6	19				
G16B	Tilbury2 Mitigation Area	TQ6602476521	Twice, in one location	01.05.24	09.07.24		7.7	3.19	5	16.2	8.5	3.82	5	19.2				

Compartment	Site name	Location	No. of Surveys	Spring Survey Date	Summer Survey Date	Autumn Survey Date	Spring pH	Spring ms	Spring ppt	Spring temp (°C)	Summer pH	Summer ms	Summer ppt	Summer temp (°C)	Autumn pH	Autumn ms	Autumn ppt	Autumn temp (°C)
			(G16A and G16B)															
G16C	Tilbury2 Mitigation Area	TQ6604876386	Twice, in one location	01.05.24	09.07.24		8.3	2.9	5	16.1	8.9	2.88	5	18.8				
G16D	Tilbury2 Mitigation Area	TQ6596476701	Once, in one location	01.05.24			8.3	2.9	5	16.1								
J3	Station Road Lake	TQ6707077850	Twice, in one location	01.05.24	11.07.24		7.8	0.98	3	16.2	9.1	0.89	0.645	24.5				
J3B	Station Road Lake	TQ6708277948	Took extra sample as it was a large waterbody	01.05.24														
TFM6a (formerly TFM6/TFM7)	Northern Marsh North of road to Water treatment plant	TQ6531175791	TFM6/TFM7 waterbody dry so moved to this location and surveyed once in one location		11.07.24						7.9	6.48	10	16.4				
TFM6/TFM7	Northern Marsh East of Fort Road (central ditch)	TQ6529776020	Waterbody was dry so no survey	Dry	Dry	Dry												
TFM6/TFM8	Northern Marsh East of Fort Road (central ditch)	TQ6532775874	Only one of the three surveys took place	Dry	09.07.24	Dry					7.8	6.51	9	14.8				

Compartment	Site name	Location	No. of Surveys	Spring Survey Date	Summer Survey Date	Autumn Survey Date	Spring pH	Spring ms	Spring ppt	Spring temp (°C)	Summer pH	Summer ms	Summer ppt	Summer temp (°C)	Autumn pH	Autumn ms	Autumn ppt	Autumn temp (°C)
			due to the waterbody being dry															
TFM7	Ephemeral Horse Field Pond	TQ6540675839	Only two of the three surveys took place due to the waterbody being dry	16.05.24	09.07.24	Dry	9.1	2.45	1.865	15.8	9.2	2.35	1.757	15.8				
TFM8	Northern Marsh West of Fort Road	TQ6510176112	Three times, in one location	16.05.24	09.07.24	29.08.24	7.2	4.81	9	14.6	7.4	5.46	9	14.7	8.2	5.5	9000	17.2
TFM9	Northern Marsh West of Fort Road	TQ6507475966	Three times, in one location	16.05.24	09.07.24	29.08.24	7.3	4.65	9	14.3	7.2	4.81	9	14.6	8.4	5.62	10000	21.5
TFM10	Northern Marsh West of Fort Road	TQ6504575763	Three times, in one location	16.05.24	09.07.24	29.08.24	7.4	5.46	9	14.7	7.3	4.65	9	14.3	7.8	5.45	10000	18.2
TFM11	Northern Marsh West of Fort Road	TQ6491475665	Three times, in one location	16.05.24	09.07.24	29.08.24	8.1	6.13	10	15.9	7.4	4.98	9	14.1				
TFM12 A	Attenuation Ponds	TQ6517976125	Three times, in one location	16.05.24	09.07.24	29.08.24	7	5.44	11	14.7	8.1	6.13	10	15.9	9.1	6.04	10000	17.9
TFM12 B	Attenuation Ponds	TQ6520976146	Three times, in one location	16.05.24	09.07.24	29.08.24	7.3	3.05	8	16.3	7	5.44	11	14.7	7.9	5.53	12000	17.2

Compartment	Site name	Location	No. of Surveys	Spring Survey Date	Summer Survey Date	Autumn Survey Date	Spring pH	Spring ms	Spring ppt	Spring temp (°C)	Summer pH	Summer ms	Summer ppt	Summer temp (°C)	Autumn pH	Autumn ms	Autumn ppt	Autumn temp (°C)
TFM12 C	Attenuation Ponds	TQ6521076173	Three times, in one location	16.05.24	09.07.24	29.08.24	7.6	6.23	9	12.9	7.3	3.05	8	16.3	7.6	1.88	8	19.3
K2	Infill North of Sewage Treatment Works	TQ6548976252	Twice times, in one location	16.05.24	09.07.24	29.08.24	7.4	4.98	9	14.1	7.6	6.23	9	12.9				
L7A	Thamesview Campsite	TQ68907772	Twice, in one location		11.07.24	24.09.24					8.8	3.9	12	20.3	6.9	5.1	10	15.1
L7B	Thamesview Campsite	TQ6904077745	Twice, in one location		11.07.24	24.09.24					8.1	3.59	12	18.4	7.5	4.38	9	15.8
L7C	Thamesview Campsite	TQ6895077581	Twice, in one location		11.07.24	24.09.24					9.3	2.3	1.746	22.8				
L8	Walsh Field	TQ6920377855	Twice, in one location		11.07.24	24.09.24					8.1	5.66	10	16.2	7.8	5.56	10	15.1
L3	-Coalhouse Marsh Ditch	TQ6901277216	Only one of the two surveys took place due to being too dry		11.07.24	Dry					8.3	0.4	0.289	24.4				
E1A	Coalhouse Fort Lower Meadows	TQ6909576552	Twice, in one location		11.07.24	24.09.24					8.6	9.05	36	17.2	7.2	9.19	30	16.5
E1B	Coalhouse Fort Lower Meadows	TQ6901976404	Twice, in one location		11.07.24	24.09.24					8.6	9.06	36	17.4	7.5	9.36	35	16.6

Compartment	Site name	Location	No. of Surveys	Spring Survey Date	Summer Survey Date	Autumn Survey Date	Spring pH	Spring ms	Spring ppt	Spring temp (°C)	Summer pH	Summer ms	Summer ppt	Summer temp (°C)	Autumn pH	Autumn ms	Autumn ppt	Autumn temp (°C)
G3A	Goshem's Landfill	TQ67805758 80	Twice, in one location		10.07 .24	23.09 .24					8.8	4.33	10	19.2	8.0 ₁	7.36	15	16.7
G3B	Goshem's Landfill	TQ67712763 19	Twice, in one location		10.07 .24	23.09 .24					8.7	452	10	18.2	8.3	7.25	15	16.8
G3C	Goshem's Landfill	TQ67154755 69	Neither of the surveys took place as the waterbody had been filled in	Filled in	Filled in	Filled in												
G3/G2	Goshem's Landfill	TQ67540767 03	Twice, in one location		10.07 .24	23.09 .24					8.8	4.63	10	18.1	8.5	5.77	12	16.9
G2	Field North of Goshem's Landfill	TQ67660767 48	Twice, in one location		10.07 .24	23.09 .24					8.8	4.39	10	18.3	8.5	5.13	10	17.1
G13	Ash A2	TQ66512758 33	Twice, in one location		10.07 .24	23.09 .24					8.8	6.93	10	18.3	7.5	4	10	17.9
G9/G10	Ash C1/C2	TQ67197766 93	Twice, in one location		10.07 .24	23.09 .24					8.6	3.32	8	18.5	7.3	3.39	7	17.1
G9/G10B	Ash C1/C2	TQ67503767 34	Once		10.07 .24	Dry					8.3	3.12	8	19.6				
G6A	Goshem's Pool	TQ66797583	Twice, in two locations		10.07 .24	23.09 .24					8.1	5.89	10	18.3	7.8	5.76	10	18.1
G6B	Goshem's Pool	TQ66780758 53			10.07 .24	23.09 .24					7.9	5.67	10	18.2	7.8	5.76	10	18.1

Compartment	Site name	Location	No. of Surveys	Spring Survey Date	Summer Survey Date	Autumn Survey Date	Spring pH	Spring ms	Spring ppt	Spring temp (°C)	Summer pH	Summer ms	Summer ppt	Summer temp (°C)	Autumn pH	Autumn ms	Autumn ppt	Autumn temp (°C)
G6C	Goshem's Pool	TQ66827579	Twice, in two locations		10.07.24	23.09.24					7.7	5.77	10	18.3	7.8	5.76	10	18.1
G6D	Goshem's Pool	TQ6684075859	Twice, in two locations		10.07.24	23.09.24					8.6	4.32	9	18.2	7.8	5.76	10	18.1
C1A	Mucking Landfill (South)	TQ6928479132	Twice, in one location		08.07.24	23.09.24					6.9	3.23	8	18.2	6.8	3.14	9	19.6
C1B	Mucking Landfill (South)	TQ6935579173	Twice in two locations		08.07.24	23.09.24					7.9	3.54	8	18.9	8.2	3.64	9	19.1
C1C	Mucking Landfill (South)	TQ6925979213	Twice in two locations		08.07.24	23.09.24					7.9	3.54	8	18.9	8.2	3.64	9	19.1
A1A	Stanford Warren Wetland (South)	TQ69068093	Once			24.09.24									8.3	3.46	7	15.1
A1B	Stanford Warren Wetland (South)	TQ69298097	Once			24.09.24									7.4	2.01	6	15.4
A3	Stanford Wharf (Creekside Mosaic)	TQ70248139	Once			24.09.24									7	1.58	5	16
A6	Stanford Warren Wetland (North)	TQ6883881265	Once			24.09.24									6.7	0.72	5	14.1

Compartment A (Mucking Wetlands) (aka Stanford Warren reserve) and B2 (Mucking Church Woodland)

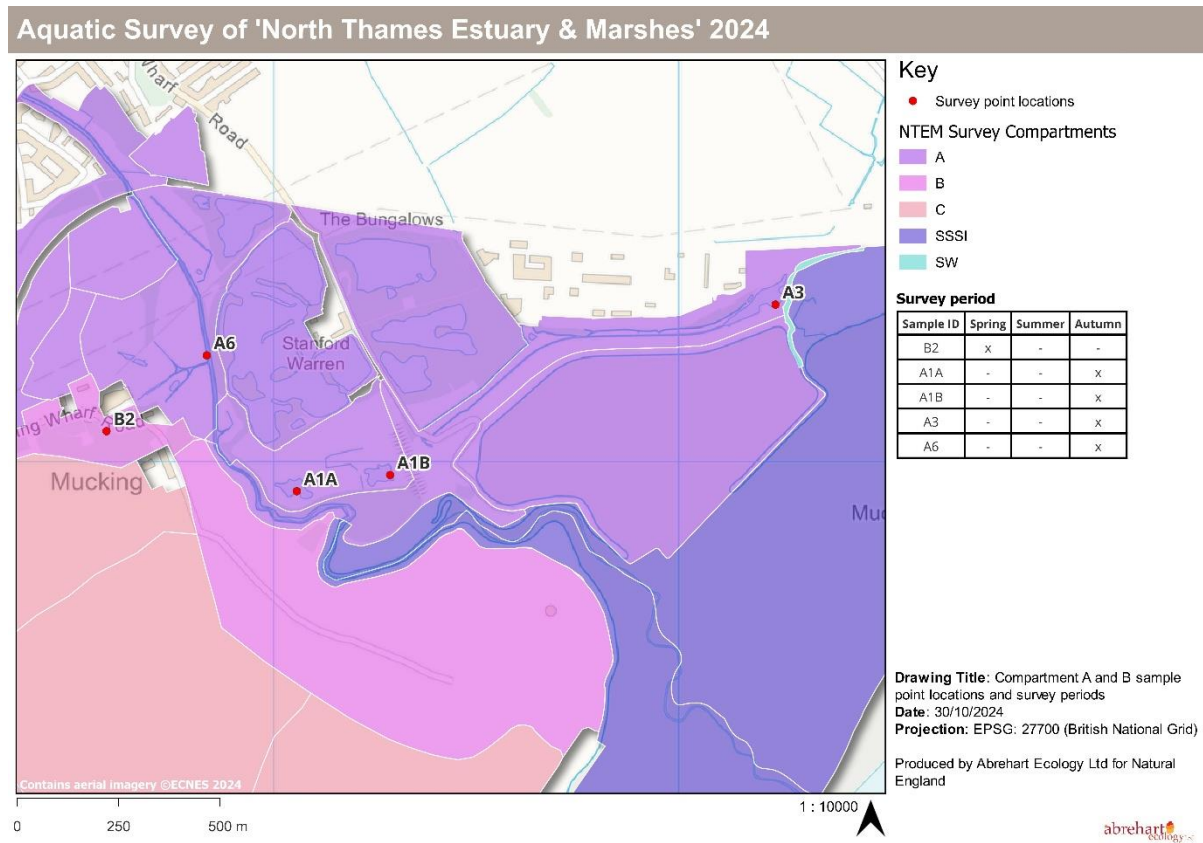


Figure 2. Mucking Marshes – Compartment A sample locations Map data_(Aerial Imagery Copyright: ©ECNES 2024)

Compartment A (including sub-compartment B2) covered the area of restored old quarry and landfill sites North of the Enover landfill site and the Essex Wildlife Trust (EWT) Thameside Nature Park. Three waterbodies were surveyed these were reed-fringed ponds one with significant public access in the east of the compartment. The other two are within the EWT lands and have limited access. Large numbers of wildfowl use this pond and are frequently fed by visitors. All the sites were saline in character with those closest to the River Thames the most saline.

EWT 1 (TQ69068093) – sub-compartment A1 – map sample no.A1A (Figure 2)

This was the western of the three ponds; it was created in 2003/4 and was originally 0.18ha and now is 0.1ha. This pond was fringed with a wide band of common reed *Phragmites australis* and smaller stands of sea club-rush *Bolboscheonus maritimus* on the southeast of the pond. Macrophytes were limited with spiked water milfoil *Myriophyllum spicatum*. The base was of soft clays over a firmer clay base.

The water body was 69m wide with a width of 33m and a depth of around 1m.

A total of 194 specimens were identified of 8 taxa (6 identified to species). These samples were dominated by the crustaceans *Gammarus duebeni* and *Paleomonetes varians*.

Table 7. Water chemistry results for compartment A1A

Acidity	Conductivity	Turbidity	Temperature
pH 8.3	3.46µS/cm	7ppt	15.1°C

EWT 2 (TQ69298097) – sub-compartment A1 – map sample no. A1B (Figure 2)

This was the middle of the three ponds, it was created in 2003/4 and was originally 0.24ha and now is 0.03ha. This pond was fringed with a wide band of common reed *Phragmites australis* and smaller stands of sea club-rush *Bolboscheonus maritimus* on the southeast of the pond. Macrophytes were limited with spiked water milfoil *Myriophyllum spicatum*. The base was of soft clays over a firmer clay base.

The water body was 39m by 13m with a depth of around 1m.

A total of 144 specimens were identified of 21 taxa (17 identified to species). These samples were dominated by *Gammarus duebeni*, Hemiptera and Coleoptera. One NS;NT beetle *Hydrochus elongatus* and one NR;LC beetle *Ochthebius pusillus* were recorded here

Table 8. Water chemistry results for compartment A1B

Water Chemistry	Conductivity	Turbidity	Temperature
pH 7.4	2.01µS/cm	6ppt	15.4°C

Table 9. Species of Interest found at pond 'EWT2'. Blank cells present where non-native species not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Hydrochus elongatus</i>	NS;NT	
<i>Ochthebius pusillus</i>	NR	

‘Carex divisa Pond’ (TQ70248139) – sub-compartment A1 – map sample no. A3 (Figure 2)

This was a pond in the east of the compartment, it was partially reed-fringed along the northeastern and eastern side of the pond, the remaining areas were wildfowl grazed. The water was turbid with limited aquatic macrophyte growth, it was heavily grazed. There were smaller stands of sea club-rush *Bolboscheonus maritimus* and divided sedge *Carex divisa*. The combined samples were taken from the southern bank of the pond.

The water body was 186m long with a width of 45m, when full. At the survey it was at least 1m deep.

A total of 704 specimens were identified of 25 taxa (18 identified to species). These samples were dominated with the introduced molluscs *Physella acuta*, *Potamopyrgus antipodarum* with *Corixidae* sps and *Chironomidae* larvae. Small numbers of five species of *Corixidae* with *Sigara lateralis* most frequent. The NR;LC beetle *Ochthebius pusillus* was the only species of note with one present in the sample.

Table 10. Water chemistry results for compartment A3

Water Chemistry	Conductivity	Turbidity	Temperature
pH 7	1.58µS/cm	5000	16°C

Table 11. Species of Interest found at the ‘Carex divisa pond’. Blank cells present where non-native species not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Ochthebius pusillus</i>	NR;LC	

Reedbed Ditch (TQ6883881265) – sub-compartment A6 – map sample no. A6 (Figure 2)

This was a ditch edge within the dense reedbed within this portion of the compartment, there were smaller stands of sea club-rush *Bolboscheonus maritimus*. The samples were taken from the western bank of the ditch.

The water body was 6m wide and at the survey it was at least 1m deep.

A total of 108 specimens were identified of 19 taxa (16 identified to species). These samples were dominated with the crustaceans *Gammarus pulex* and *Asellus*

aquaticus. The NR;LC beetle *Ochthebius pusillus* was frequent with 21 individuals found in the sample, all other species were present in low numbers.

Table 12. Water chemistry results for compartment A6

Water Chemistry	Conductivity	Turbidity	Temperature
pH 6.7	0.72µS/cm	5ppt	14.1°C

Table 13. Species of Interest found at the A6 ditch. Blank cells present where non-native species not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Ochthebius pusillus</i>	NR;LC	

Mucking Church Woodland Pond (TQ6859181078) – sub-compartment B2 – map sample no. B2

This was a heavily shaded pond with limited marginal vegetation and a dense cover of common duckweed *Lemna minor*. The samples were taken from the western bank of the ditch.

The water body was 20m wide and at the survey it was at least 1m deep.

A total of 90 specimens were identified of 11 taxa (10 identified to species). These samples were dominated with the Annelida and the local beetle *Hygrotus confluens*. Four beetles of note were recorded with *Berosus affinis* and *Enochrus halophilus* the rarest with two individuals of the rare backswimmer *Corixa affinis*.

Table 14. Water chemistry results for compartment B2

Water Chemistry	Conductivity	Turbidity	Temperature
pH 8.1	1.83µS/cm	1.2ppt	15.4°C

Table 15. Species of Interest found at the B2 pond. Blank cells present where no species of interest were recorded and therefore no conservation status was applicable.

Species of Interest	Conservation Status	Non-native Species
		<i>Physella acuta</i>
		<i>Potamopyrgus antipodarum</i>

Compartment C - Mucking Landfill (Enovert)

Compartment C covered the area of restored old quarry and landfill sites of the Enovert land, Golden Gates Lake to the west and Linford Lake to the west of the railway line. These water bodies were mainly old settling ponds, newly created lagoons and old gravel quarries. The majority of these water bodies were reed-fringed with large areas of open water, with good numbers of wildfowl breeding. All the waterbodies were saline in character with those closest to the river Thames the most saline.

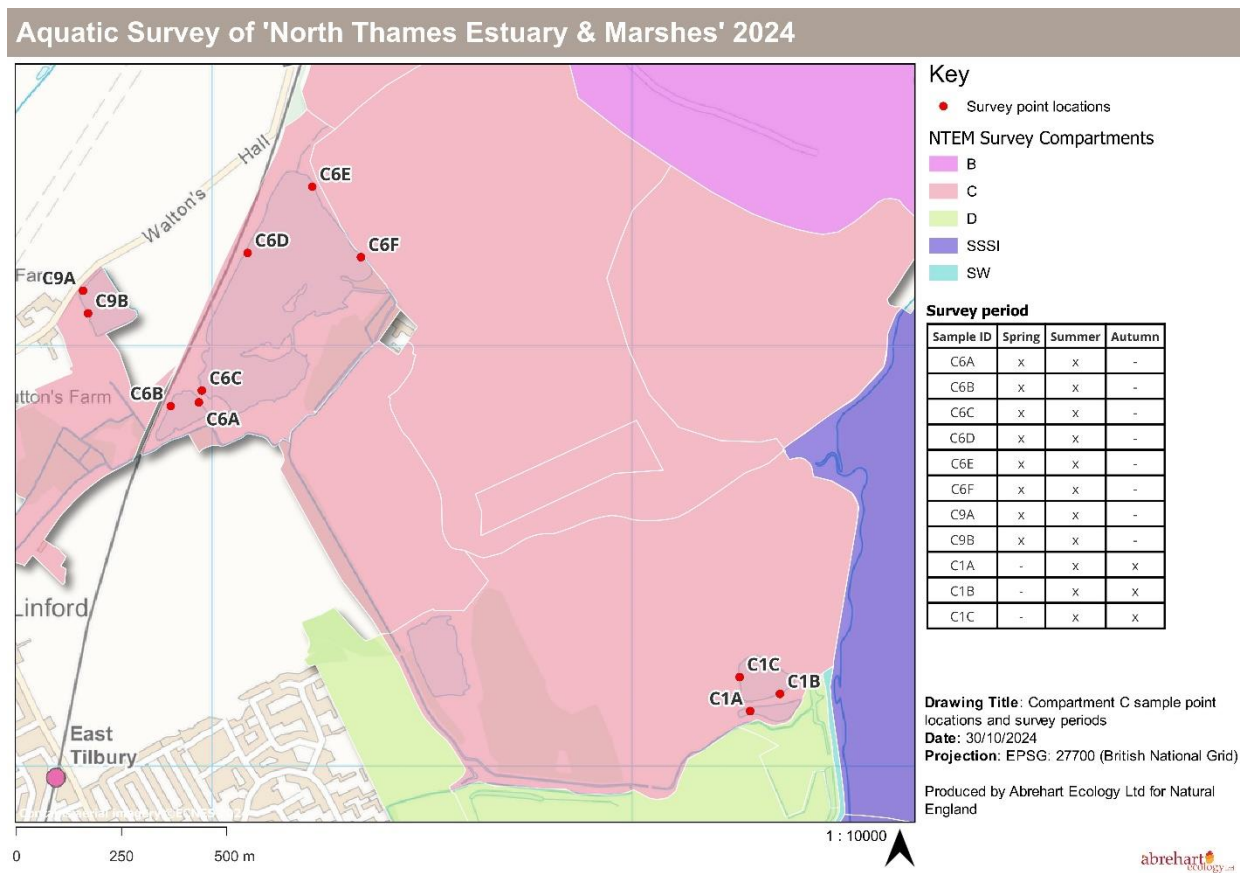


Figure 3. Mucking Marshes – Compartment C sample locations (Aerial Imagery Copyright: ©ECNES 2023) Mucking Marshes 1 (TQ6928479132) – sub-compartment C1 – map sample C1a.

This was the smaller southern settling pond in the southeast of the Enover landfll site. There was a ditch further south that transported water off the site to the south. This pond was fringed with a wide band of common reed *Phragmites australis* and smaller stands of sea club-rush *Bolboscheonus maritimus*. The sample from the first visit was from the western end in the reed-choked section and the sample from the second visit was from the deeper water off the northern bank. The pond was surveyed twice, once in the Summer and once in the Autumn.

The water body was 148m long with a width of 41m, when full. It was at least 1m deep. The pond was created in 2003/4 with a size of 0.3ha, this has changed little in size since creation with only a limited common reed *Phragmites australis* development around the edges of the pond.

A total of 814 specimens were identified of 14 taxa (12 identified to species). These samples were dominated by *Chiromonidae* and *Coroxidae*, with the invasive mollusc *Physella acuta*. Two local species were present with *Sigara stagnalis* and *Corixa panzeri*. All other species were found in low numbers with *Sigara dorsalis* and *Asellus aquaticus* more frequent.

Table 16. Water chemistry results for compartment C1A

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Summer	pH 6.9	3.23µS/cm	8ppt	18.2°C
Autumn	pH 6.8	3.14µS/cm	9ppt	19.6°C

Table 17. Species of Interest found at Mucking Marshes 1 (C1a). Blank cells present where no species of interest were recorded and therefore no conservation status was applicable.

Species of Interest	Conservation Status	Non-native Species
		<i>Physella acuta</i>
		<i>Potamopyrgus antipodarum</i>

Mucking Marshes (TQ6935579173 + TQ6925979213) – sub-compartment C1 – map sampling numbers C1b and C1c

This was the larger northern settling pond in the southeast of the Enover landfill site. This pond was fringed with a wide band of common reed *Phragmites australis* and smaller stands of sea club-rush *Bolboscheonus maritimus*. The first sample was from the northern end in the reed-choked steep bank, with the second sample from the southern edge where there was a gentle slope into the water. The dominant aquatic macrophytes were horned pondweed *Zannichellia palustris*, with no other species noted.

The water body was 127m by 105m with a depth of around 1m. The pond was created around 2007 as a shallow depression with limited water in it and an area of 0.11ha with a size of 0.3ha, by 2011 the pool had begun to fill with an area of 0.96ha, this has changed little in size since creation reducing to 0.85ha by 2022 with only limited common reed *Phragmites australis* development around the edges of the pond.

A total of 522 specimens were identified of 26 taxa (24 identified to species). These samples were dominated by the invasive mollusc *Physella acuta*. Uncommon beetles were frequent in these samples, *Enochrus bicolor* and *Octhebius marinus* being notable with single specimens each, Hemiptera were present in low numbers with *Sigara concinna* and *Plea minutissima* featuring.

Table 18. Water chemistry results for compartment C1B

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Summer	pH 6.9	3.54µS/cm	8ppt	18.9°C
Autumn	pH 6.8	3.64µS/cm	9ppt	19.1°C

Table 19. Species of Interest found at Mucking Marshes pond (south-east larger pond – Previously Mucking Marsh 7). Blank cells present where non-native species were not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Berosus luridus</i>	NS	<i>Physella acuta</i>
<i>Enochrus bicolor</i>	NS	

Golden Gates Lakes (aka Gobion's Lake) (south-west) (TQ6797179868 + TQ6790479859 +- sub-compartment C6 – map sampling numbers C6a & b.

This waterbody was the mature quarry pond in the west of the Enover site, to the south-west of the public footpath (i.e. the smaller of the two lakes). The lake supported a large number of waterfowl, especially geese. The lake supported various wide bands of common reed *Phragmites australis* which created a hover margin in places. In the first survey visit (April), two samples were taken from the eastern and northern sides of the lake. In the second survey visit (July) two samples were taken from the same locations. Aquatic macrophytes were limited in both survey periods, with Canadian pondweed *Elodea canadensis* and soft hornwort *Ceratophyllum submersum*.

The water body was 135m by 85m with a depth of around 2/3m. This lake was created prior to 1984. Between 1999 and 2014 it was turned from a flooded gravel pit to a more natural water body. The final water area in 2022 was around 11.3ha with a common reed *Phragmites australis* fringed margin in the north, east and south with a willow fringe of trees on the western side.

A total of 729 specimens were identified of 63 taxa (46 identified to species). These samples were dominated by the invasive *Crangonyx pseudogracilis* and *Physella acuta*. There were high numbers of blue-tailed damselflies *Ischnura elegans*, *Noterus clavicornis*, *Cloeon dipterum* and *Asellus aquaticus*. One Endangered Norfolk hawker dragonfly *Aeshna isosceles* () was found, along with the NS;NT beetle, *Limnoxenus niger*, the NS;LC *Hygrotus parallellogrammus*, *Helophorus fulgidicollis*. Other species of interest

included the beetles *Enochrus halophilus* and *Cercyon sternalis*. Twelve uncommon species including the Hemiptera *Microvelia reticulata* and *Plea minutissima*.

Table 20. Water chemistry results for compartment C6A

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 8	0.69µS/cm	0.492ppt	15.3°C
Summer	pH 8.4	0.81µS/cm	0.582ppt	17.2°C

Table 21. Species of Interest found at Golden Gates Lakes (south-west). Blank cells indicate where non-native species not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Aeshna isosceles</i>	EN	<i>Physella acuta</i>
<i>Helophorus fulgidicollis</i>	NS;LC	
<i>Hygrotus parallelogrammus</i>	NS;LC	
<i>Limnoxenus niger</i>	NS;NT	

Golden Gates Lakes (north-east) (TQ6797879896 + TQ6808780224 + TQ6824180382 + TQ6835780214) – sub-compartment C6 – map sampling numbers C6c, d, e & f.

This waterbody was the mature quarry pond in the north-west of the Enover landfill site. The lake was used for fishing and supported a large number of waterfowl, especially geese. These geese grazed the common reed *Phragmites australis* margin on the edges of the islands in the centre of the lake. The lake supported various wide bands of common reed *Phragmites australis* which created a hover margin in places. In the first survey visit (May), two samples were taken from the western and southern sides of the lake. In the second survey visit (July) four samples were taken with the two additional samples taken from the margins of both sides of the largest island in the centre of the site. Aquatic macrophytes were limited in both survey periods, with Canadian pondweed *Elodea canadensis* and soft hornwort *Ceratophyllum submersum* present.

The water body was 601m by 301m with an unknown depth. This lake was created prior to 1984. Between 1999 and 2014 it was turned from a flooded gravel pit to a more natural water body. The final water area in 2022 was around 11.3ha with a common reed *Phragmites australis* fringed margin in the north, east and south with Willow fringe of trees on the west of the site.

A total of 2493 specimens were identified of 81 taxa (55 identified to species). These samples were dominated by the invasive *Crangonyx pseudogracilis* and *Potamopyrgus antipodarum*, with frequent *Ilyocoris cimicoides* and *Asellus aquaticus*. The NS;NT beetle *Limnoxenus niger* was present with the NS;LC beetles *Helophorus fulgidicollis*, *Helophorus griseus*, *Haliplus mucronatus*, and *Peltodytes caesus*, one Hemipteran *Sigara selecta*.

Table 22. Water chemistry results for compartment C6C

Season	Acidity	Conductivity	Turbidity	Temperature
Spring	pH 8.1	0.66µS/cm	0.617ppt	15.5°C
Summer	pH 8.3	1.19µS/cm	0.859ppt	17.2°C.

Table 23. Species of Interest found at Golden Gates Lakes (north-east). Blank cells indicate where non-native species were not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Haliplus mucronatus</i>	NS;LC	
<i>Helophorus fulgidicollis</i>	NS;LC	
<i>Limnoxenus niger</i>	NS;NT	
<i>Peltodytes caesus</i>	NS;LC	
<i>Sigara selecta</i>	NS;LC	

Linford Wood Lake (TQ6769580134 + TQ6770780080) – sub-compartment C9 – map sampling numbers. C9a & b.

This waterbody was the mature quarry pond across the railway track from the Enovert landfill site. The lake is privately owned and occasionally used for fishing and supported a good number of waterfowl, especially pochard. Two samples were taken in both the Spring and Summer in the north and western sides of the lake. Aquatic macrophytes were limited in both survey periods, with Canadian pondweed *Elodea canadensis* and soft hornwort *Ceratophyllum submersum* present.

The water body was 132m by 89m with a depth of around 1m. This lake developed following the gravel extraction. The pit was used by locals on motorbikes in the past. Once left alone it filled with water and it was turned from a flooded gravel pit to a more natural water body. The lake had a fringe of common reed *Phragmites australis* with scattered stands of bulrush *Typha latifolia* and dying willows.

A total of 729 specimens were identified of 63 taxa (46 identified to species). These samples were dominated by the invasive *Crangonyx pseudogracilis*, *Physella acuta* and *Potamopyrgus antipodarum*, with frequent blue-tailed damselfly *Ischnura elegans* and *Cloeon dipterum*. One NS;NTbeetle was present *Hydrophilus piceus*, one NS;LC species of beetle *Helophorus fulgidicollis*, one NS;LC Hemiptera *Corixa affinis*.

Table 24. Water chemistry results for compartment C9A

Season	Acidity	Conductivity	Turbidity	Temperature
Spring	pH 6.8	0.91µS/cm	0.634ppt	15.5°C
Summer	pH 10	0.66µS/cm	0.475ppt	26.1°C.

Table 25. Species of Interest found at Linford Wood Lake. Blank cells indicate where non-native species or species of interest were not recorded (therefore conservation status is not applicable).

Species of Interest	Conservation Status	Non-native Species
Corixa affinis	NS;LC	<i>Physella acuta</i>
Helophorus fulgidicollis	NS;LC	<i>Potamopyrgus antipodarum</i>
Hydrophilus piceus	NS;NT	

Compartment E - Coalhouse Fort and surrounds

Coalhouse Fort and surrounding marshes support a range of habitats with the large moats around the fort with common reed *Phragmites australis* choked ditches, saline ditches and a pond. The land to the south of the moats was rough tussocky grasslands with a ditch running through it fed from the moats.

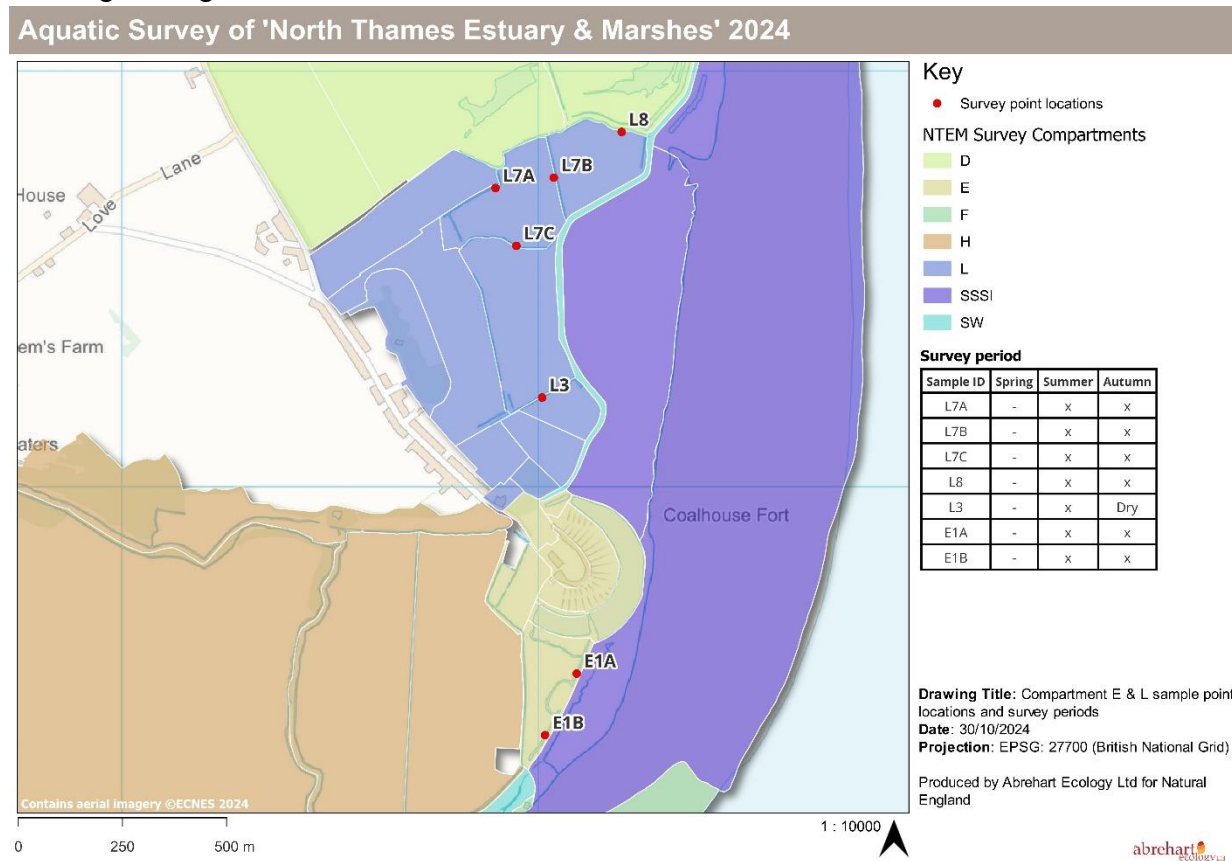


Figure 4. Coalhouse Fort and surrounds sample locations (Aerial Imagery Copyright: ©ECNES 2024). Coalhouse Fort Lower Meadows (TQ6909576552 & TQ6901976404) - sub-compartment E2 - map sampling E1a & b.

This sample was taken from the ditch running south from the southern moat of Coalhouse Fort. This was a steep-sided ditch with limited emergent vegetation with only sea club-rush *Bolboschoenus maritima* present as an emergent species. Water from the ditch at Coalhouse Fort runs into the River Thames via a convoluted route ending at the Bowaters sluice. Two samples were taken from the ditch in the north and south, in the Summer and Autumn.

The water body was 5m wide and a depth of 60cm, of which 35cm was water the remaining being soft silts and sediment.

A total of 727 specimens were identified of 14 taxa (12 identified to species). Saline lagoonal species dominated the sample with *Gammarus duebeni*, *Idotea chelipes* and *Paleomentes varians* abundant. All other species were recorded in low numbers. Three species of beetle were present with the NS;NT *Berosus luridus* a notable b species. The only other NS;NT species was the mollusc *Hydrobia acuta neglecta*. The bivalve *Cerastoderma glaucum* was rare in the sample.

Table 26. Water chemistry results for compartment E1A

Season	Acidity	Conductivity	Turbidity	Temperature
Summer	pH 8.6	9.05µS/cm	36ppt	17.2°C
Autumn	pH 7.2	9.19µS/cm	30ppt	16.5°C

Table 27. Species of Interest found at Coalhouse Fort Lower Meadows E1a & b.
Blank cells indicate where no non-native species were recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Hydrobia acuta</i>	NS;NT	

Compartment G – Ashfields and Goshem's Farm

Sampling occurred within compartment G. The compartment ranged from a series of previously grazing marsh ditches in the east, which were fringed with common reed *Phragmites australis*. Within the bulk of the site there were small pools where material had been removed from the coal spoil areas creating water filled holes with limited vegetation. In the northwest of the compartment was the Tilbury2 Mitigation area, this was a series of ponds and ditches established for water vole mitigation, these areas were heavily reed fringed.

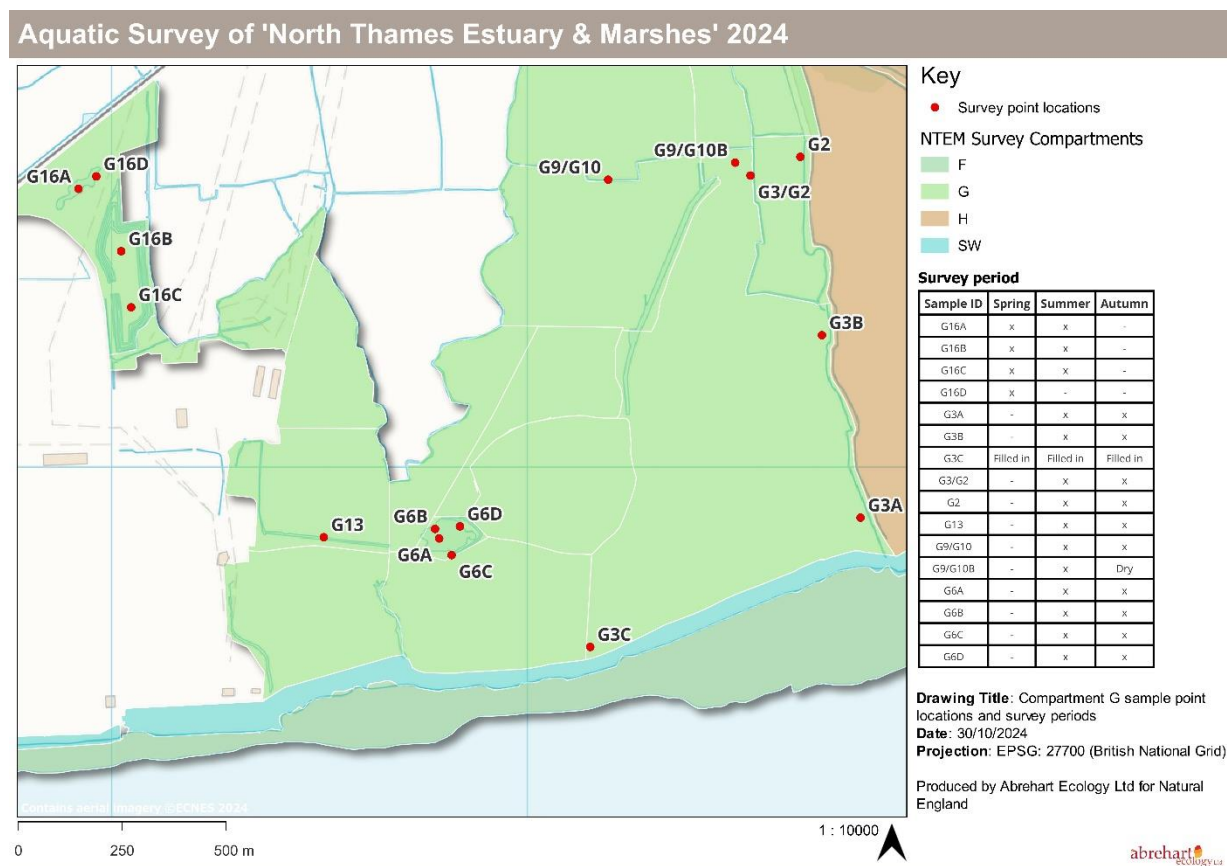


Figure 5. Goshems) – Compartment G sample locations (Aerial Imagery Copyright: ©ECNES 2024). Field North of Goshem's Landfill (TQ6754076703) – Sub-Compartment G2 – Map sampling numbers. G3/2.

This sampling site was the northeast of the compartment, within a reed choked ditch with small open shallow areas of water. It supported no submerged macrophytes but had abundant emergent vegetation dominated with common reed *Phragmites australis* and sea club-rush *Bolboscheonus maritimus*. This was sampled in the Summer and Autumn.

The water body was a ditch with a width of 5m with a depth of around 20cm.

A total of 556 specimens were identified of 10 taxa (7 identified to species). These samples were dominated by unidentified Corixidae (early instar) and the invasive mollusc *Potamopyrgus antipodarum*. *Gammarus duebeni* was rare with seven found and the NS;LC beetle *Hygrotus parallellogrammus* was present.

Table 28. Water chemistry results for compartment G3/G2

Season	Acidity	Conductivity	Turbidity	Temperature
Summer	pH 8.8	4.63µS/cm	10ppt	18.1°C
Autumn	pH 8.5	5.77µS/cm	12ppt	16.9°C

Table 29. Species of Interest at Ashfields & Goshem's Farm G3/2. Blank cells indicate where species of interest were not recorded and therefore conservation status was not applicable.

Species of Interest	Conservation Status	Non-native Species
<i>Hygrotus parallellogrammus</i>	NS;LC	<i>Physella acuta</i>
		<i>Potamopyrgus antipodarum</i>

Ashfields & Goshem's Farm (TQ6766076748) – Compartment G2 – map sampling numbers. G2

This sampling site was a small pond on the top of the landfill. There were limited macrophytes with floating sweet grass *Glyceria fluitans* present in the shallow pool. This was a shallow pond with exposed muds present in the bottom. The pond was 5m x 5m in extend with abundant beetles present. This was surveyed twice, once in the summer and once in the autumn.

A total of 395 specimens were identified of 53 taxa (41 identified to species). There were a high number of invertebrates in these samples, beetles dominated the sample with 29 species recorded. Rare beetles included the NR;LC *Octhebius pusillus*, the NR *Heterocerus obsoletus*, the NS;LC species *Graptodytes bilineatus* *Agabus conspersus*, *Berosus affinis*, *Enochrus bicolor*, *Enochrus halophilus*, *Rhantus frontalis*.

Table 30. Water chemistry results for compartment G2

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Summer	pH 8.8	4.39µS/cm	10ppt	18.3°C
Autumn	pH 8.5	5.13µS/cm,	10ppt	17.1°C

Table 31. Species of Interest found at Ashfields & Goshem's Farm G2/G3. Blank cells indicate where non-native species were not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Agabus conspersus</i>	NS	<i>Physella acuta</i>
<i>Enochrus bicolor</i>	NS;LC	
<i>Enochrus halophilus</i>	NS;LC	
<i>Graptodytes bilineatus</i>	NS;LC	
<i>Helochaeres punctatus</i>	NS;LC	
<i>Helophorus fulgidicollis</i>	NS;LC	
<i>Heterocerus obsoletus</i>	NR	
<i>Ochthebius auriculatus</i>	NS;LC	
<i>Ochthebius pusillus</i>	NR;NT	
<i>Ochthebius viridis</i>	NS;LC	
<i>Rhantus frontalis</i>	NS;LC	

Ashfields & Goshem's Farm (TQ6780575880 & TQ6771276319) – sub-Compartment G3 – map sampling numbers. G3a & G3b.

These sampling sites were on the north and south of the eastern borrow dyke within the Goshem's landfill site. This was a reed choked ditch with limited water present in the few open gaps available to sample. This was surveyed twice in the summer and twice in the autumn.

A total of 321 specimens were identified of 19 taxa (15 identified to species). There were a high number of invertebrates in these samples with *Gammarus duebeni* most frequent, with Cuculidae larvae abundant and *Gammarus pulex* present with 20 recorded. Beetles dominated the sample with 11 species recorded. Rare beetles included the NR;LC *Ochthebius pusillus*. The NS;LC, *Helophorus fulgidicollis* and *Rhantus frontalis*. There were

four uncommon species recorded, two beetles including *Berosus affinis*, one hemiptera and one crustacean.

Table 32. Water chemistry results for compartments G3A and G3B

Compartment	Season	Acidity	Conductivity	Turbidity	Temperature
G3a	Summer	pH 8.8	4.33µS/cm	10ppt	19.2°C
G3a	Autumn	pH 8.01	7.36µS/cm	15ppt	16.7°C
G3b	Summer	pH 8.7	4.52µS/cm	10ppt	18.2°C
G3b	Autumn	pH 8.3	7.25µS/cm	15ppt	16.8°C

Table 33. Species of Interest found at Ashfields & Goshem's Farm 3a & 3b. Blank cells indicate where non-native species were not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Helophorus fulgidicollis</i>	NS;LC	<i>Potamopyrgus antipodarum</i>
<i>Ochthebius pusillus</i>	NR;LC	
<i>Rhantus frontalis</i>	NS;LC	

Ashfields & Goshem's Farm (TQ6715475569) – sub-Compartment G3 – map sampling numbers. G3c.

Samples from location G3c could not be taken as this former pond had been filled in.

Ashfields & Goshem's Farm (TQ6677475835, TQ6678075853, TQ66827579 and TQ6684075859) – Compartment G6 (Goshem's Pool) – map sampling numbers. G6a, G6b, G6c & G6d.

These samples were taken from four locations within a lagoon in the centre of the Ashfields & Goshem's Farm landfill compartment. This water body was ephemeral but filled this year with limited drawdown zones. The aquatic macrophytes were limited to horned pondweed *Zannichellia palustris* and grass kelp *Enteromorpha intestinalis*. There was limited emergent vegetation with small areas of common reed *Phragmites australis* and sea club-rush *Bolboscheonus maritima*. 127m long x 77m wide.

A total of 2472 specimens were identified of 55 taxa (42 identified to species). There were a very high number of invertebrates in these samples with *Corixia* sps, the invasive

mollusc *Physella acuta*, Chironomidae, *Plea minutissima* and *Potamopyrgus antipodarum* the most frequent. There were 21 species of note with 419 specimens local, notable or rare. There was one NR;LC beetle *Ochthebius pusillus*, nine NS;LC species with five beetles including *Enochrus bicolor*, *Hygrotus nigrolineatus*, *Hygrotus parallellogrammus*, *Peltodytes caesus* and *Rhantus frontalis* with and one Hemiptera, the back swimmer *Corixa affinis*. Eleven uncommon species were recorded, *Berosus affinis* and *Ochthebius marinus* four Hemiptera. Of interest was the Corixidae *Cymatia rogenhoferi*, with two present in the sample. This is a newly arrived species to the UK from Europe.

Table 34. Water chemistry results for compartment G6A

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Summer	pH 8.1	5.89µS/cm	10ppt	18.3°C
Autumn	pH 7.8	5.76µS/cm	10ppt	18.1°C

Table 35. Species of Interest found at Ashfields & Goshem's Farm sub-compartment G6 (Goshem's Pool) 6a, 6b, 6c & 6d. Blank cells indicate where non-native species or species of interest were not recorded (therefore conservation status was not applicable).

Species of Interest	Conservation Status	Non-native Species
<i>Corixa affinis</i>	NS;LC	<i>Physella acuta</i>
<i>Cymatia rogenhoferi</i>	Rare	<i>Potamopyrgus antipodarum</i>
<i>Enochrus bicolor</i>	NS;LC	
<i>Helophorus strigifrons</i>	NS	
<i>Hygrotus nigrolineatus</i>	NS;LC	
<i>Hygrotus parallellogrammus</i>	NS;LC	
<i>Ochthebius pusillus</i>	NR;LC	
<i>Ochthebius viridis</i>	NS;LC	
<i>Peltodytes caesus</i>	NS;LC	

Ashfields & Goshem's Farm (TQ6719776693) – Sub-Compartment G9/G10 (Tilbury Main) – map sampling numbers. G9/G10.

These sampling locations were on the north side of the ditch, which is also known as the 'Tilbury Main' and classified as a 'main' river by the Environment Agency. This was a reed choked ditch with steep sides and deep water. Macrophyte cover was dominated with horned pondweed *Zannichellia palustris*. This was surveyed twice in the Summer and Autumn.

A total of 1030 specimens were identified of 22 taxa (17 identified to species). There were a high number of invertebrates in these samples with *Ampullecena balthica* dominant with 740 present. Chironomidae larvae were abundant along with *Gammarus duebeni* and *Plea minutissima*. Beetles were the only NS;LC species was *Berosus luridus*. There were four uncommon species recorded *Berosus affinis*, two Hemiptera, one Odonata and one crustacean.

Table 36. Water chemistry results for compartment G9/G10

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Summer	pH 8.6	3.32µS/cm	8ppt	18.5°C
Autumn	pH 7.3	3.39µS/cm	7ppt	17.1°C

Table 37. Species of Interest found at Ashfields & Goshem's Farm G9/G10.

Species of Interest	Conservation Status	Non-native Species
<i>Berosus luridus</i>	NS;LC	<i>Potamopyrgus antipodarum</i>

Ashfields & Goshem's Farm (TQ6750376734) – Sub-Compartment G3 – map sampling numbers. G9/10b.

This sample was taken within a small pond in the north of the compartment. This had a small amount of reed on the margins with floating sweet-grass *Glyceria fluitans* within the pool itself. The pool was shallow 30cm and small 5m x 5m.

A total of 165 specimens were identified of 21 taxa (15 identified to species). There were a low number of invertebrates in these samples with *Cloeon dipterum* most frequent with the

beetle *Agabus nebulosus* frequent and Notanecidae common. All other species were found in low numbers (with 1-5 individuals). There were three NS;LC beetles *Hygrotus parallellogrammus* and *Rhantus frontalis*.

Table 38. Water chemistry results for compartment G9/G10B

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Summer	pH 8.3	3.12µS/cm	8ppt	19.6°C
Autumn	pH 7.3	3.39 µS/cm	7ppt	17.1°C

Table 39. Species of Interest found at Ashfield's & Goshem's Farm 9/10b. Blank cells indicate where non-native species not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Hygrotus parallellogrammus</i>	NS;LC	
<i>Rhantus frontalis</i>	NS;LC	

Ashfields & Goshem's Farm (TQ6651275833) – Sub-Compartment G13 – map sampling numbers. G13.

This sample was taken within a ditch running west to east, dividing Ashfield A1 from Ashfield A2. This was a five metre wide deep ditch half dominated with horned pondweed *Zannichellia palustris*. The sides of the ditch were dominated with sea couch *Elytrigia atherica* and false oat grass *Arrhenatherum elatius* on the south with common reed *Phragmites australis* on the north in this section of the ditch.

A total of 450 specimens were identified of 23 taxa (17 identified to species). There were a high number of invertebrates in these samples with *Corixia* sps and the rare mollusc *Heleobia charruana* most frequent. 182 specimens were local, notable or rare, with one NR;LC beetle *Octhebius pusillus*, the uncommon beetle *Berosus affinis*.

Table 40. Water chemistry results for compartment G13

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Summer	pH 8.8	6.93µS/cm	10ppt	18.3°C
Autumn	pH 7.5	4µS/cm	10ppt	17.9°C

Table 41. Species of Interest found at Ashfields & Goshem's Farm G13. Blank cells indicate where species of interest were not recorded and therefore conservation status was not applicable.

Species of Interest	Conservation Status	Non-native Species
<i>Ochthebius pusillus</i>	NR;LC	<i>Potamopyrgus antipodarum</i>
		<i>Heleobia charruana</i>

Ashfields & Goshem's Farm (TQ6592176671 & TQ6596476701) – sub-Compartment G16 – map sampling numbers. G16a & G16d.

These sampling sites were from the northern lake in the Tilbury2 mitigation area, two samples were taken from the southern and eastern sides of the lake. This waterbody had a wide reed dominated margin with scattered aquatic macrophytes present. This was 138m long and 28m deep, with a water depth of approximately 1m. This was surveyed twice, once in the Spring and once in the Summer.

A total of 685 specimens were identified of 53 taxa (41 identified to species). There were a high number of invertebrates in these samples with *Ampullecena balthica*, *Physella acuta*, *Cloeon dipterum*, *Crangonyx pseudogracilis*, *Asellus aquaticus* and *Chironomidae* larvae dominant with 472 specimens present. Two RDB3 beetles were present with the NR/VU *Graphoderus cinereus* and the NR;LC *Ochthebius pusillus*. Seven notable species were found, all beetles, with NS;NT *Limnoxenus niger* and the NS;LC beetles, , *Enochrus halophilus*, *Enochrus melanocephalus*, *Helocares lividis*, *Peltodytes caesus* and *Rhantus frontalis*.

Table 42. Water chemistry results for compartment G16A

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 7.4	3.25µS/cm	6ppt	16.1°C
Summer	pH 8.9	3.04µS/cm	6ppt	19°C

Table 43. Species of Interest found at Ashfields & Goshem's Farm G16a & G16d. Blank cells indicate where non-native species and species of interest were not recorded (and therefore conservation status was not applicable).

Species of Interest	Conservation Status	Non-native Species
		<i>Physella acuta</i>
		<i>Potamopyrgus antipodarum</i>
<i>Enochrus halophilus</i>	NS;LC	
<i>Graphoderus cinereus</i>	NS;VU	
<i>Limnoxenus niger</i>	NS;NT	
<i>Ochthebius pusillus</i>	NR;LC	
<i>Peltodytes caesus</i>	NS;LC	
<i>Rhantus frontalis</i>	NS;LC	

Ashfields & Goshem's Farm (TQ6604876386 & TQ6602476521) – Compartment G16 – map sampling numbers. G16b & G16c.

These sampling sites were from the water vole lakes in the Tilbury2 mitigation area. Two samples were taken from the northern and southern lakes/ponds. These waterbodies had a wide reed dominated margin with scattered aquatic macrophytes present. The northern pond was 70m long and 23m deep, with a water depth of approximately 1m. This was surveyed twice, once in the Spring and once in the Summer.

A total of 1730 specimens were identified of 72 taxa (53 identified to species). There were a very high number of invertebrates in these samples with *Physella acuta*, *Noterus clavicornis*, *Asellus aquaticus*, *Potamopyrgus antipodarum*, *Corixidae* and *Chironomidae* larvae dominant with 1180 specimens present. One RDB3 beetle was present with *Graptodytes bilineatus*. Twelve uncommon species were found, beetles, with NS;NR *Limnoxenus niger*, the NS;LC species *Enochrus halophilus*, *Helocares punctatus*,

Peltodytes caesus, *Hydrovatus clypealis* and *Rhantus frontalis*. The rare Corixide *Cymatia rogenhoferi* was present in one sample and the uncommon *Enochrus melanocephalus*, *Enochrus ochropterus*, *Helocares lividis*, *Hydroglyphus geminus* and *Cercyon sternalis*.

Table 44. Water chemistry results for compartment G16C

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 8.3	2.9µS/cm	5ppt	16.1°C
Summer	pH 8.9	2.88µS/cm	5ppt	18.8°C

Table 45. Species of Interest found at Ashfields & Goshem's Farm G16b & G16c. Blank cells indicate where non-native species and species of interest were not recorded (therefore conservation status was not applicable).

Species of Interest	Conservation Status	Non-native Species
<i>Cymatia rogenhoferi</i>	Rare	<i>Physella acuta</i>
<i>Enochrus halophilus</i>	NS;LC	<i>Potamopyrgus antipodarum</i>
<i>Enochrus melanocephalus</i>	NS;LC	
<i>Graptodytes bilineatus</i>	NS;LC	
<i>Helocares punctatus</i>	NS;LC	
<i>Helophorus nubilus</i>	NS;LC	
<i>Hydrovatus clypealis</i>	NS;LC	
<i>Limnoxenus niger</i>	NS;NT	
<i>ecetis furva</i>	NS;LC	
<i>Peltodytes caesus</i>	NS;LC	
<i>Rhantus frontalis</i>	NS;LC	

Compartment J – Low Street Pit & surrounds.

Sampling occurred within compartment J, known as Low Street Pit & surrounds. The compartment ranged from a flooded gravel quarry, heavy industrial area some areas of woodland, marsh and open vegetation habitats. The flooded gravel pit was fringed with willow and tall forbs. There were large areas of open water with good numbers of wildfowl using the site. All the sampling points were fresh in character with a Spring and Summer sample taken.

Aquatic Survey of 'North Thames Estuary & Marshes' 2024

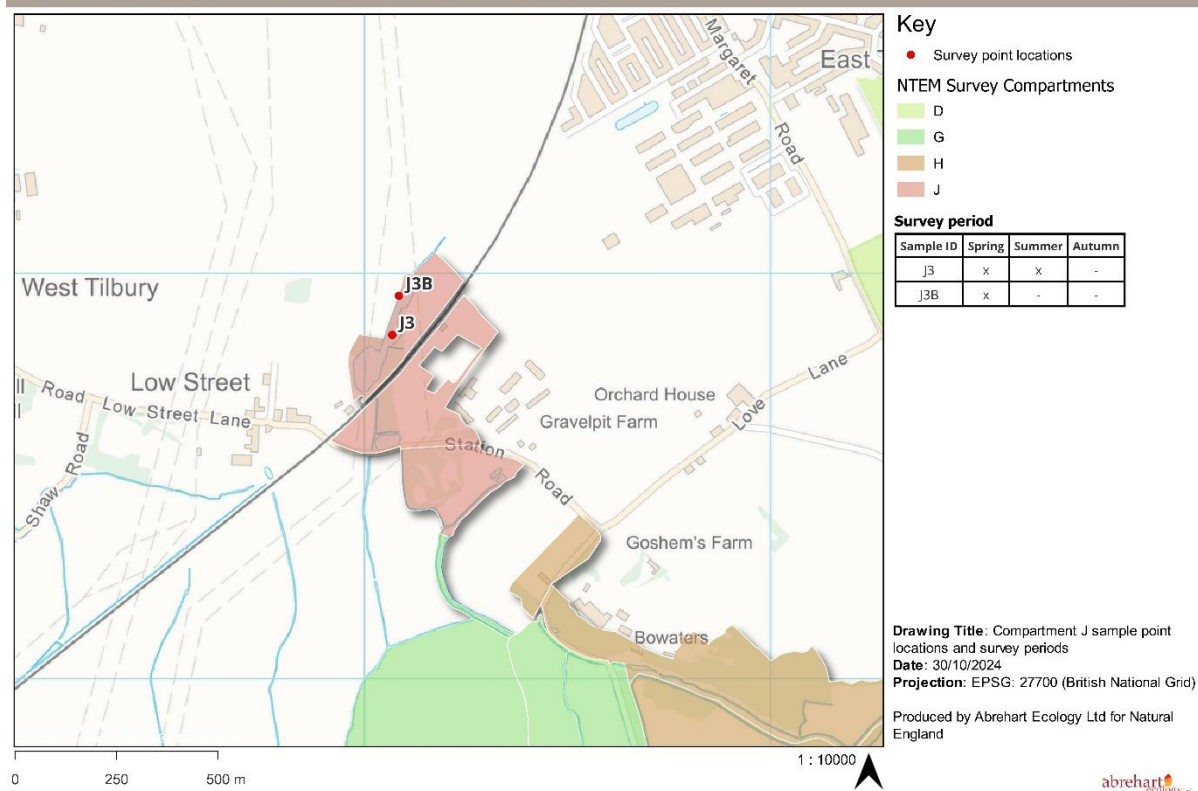


Figure 6. Low Street Pit & surrounds– Compartment J sample locations (Aerial Imagery Copyright: ©ECNES 2024). Low Street Pit & surrounds - J3 Station Road lake (TQ6707077850 & TQ6708277948) - Compartment J – Lake. Map sampling no. J3 & J3b.

Two samples were taken from the lake, no emergent vegetation was present and there were significant areas of drawdown exposed mud. There were filamentous algae around the margins though the water was clear.

A total of 542 specimens were identified of 60 taxa (47 identified to species). Dominant species were Hemiptera with *Sigara lateralis* common with a high density of *Asellus aquaticus* and *Gammarus duebeni*. The mollusc *Gyraulus albus* was common, along with *Cloeon dipterum* and *Plea minutissima*. Three NS;LC beetles, *Graptodytes bilineatus*, *Helophorus filgidicollis* and *Peltodytes caesus*. Uncommon species included *Berosus affinis*, *Enochrus melanocephalus* and *Helocares lividus*.

Table 46. Water chemistry results for compartment J3

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 7.8	0.98µS/cm	3ppt	16.2°C
Summer	pH 9.1	0.89µS/cm	0.645ppt	24.5°C

Table 47. Species of Interest at Low Street Pit & surrounds, sub-compartment J3 & J3b (Station Road Lake). Blank cells indicate where non-native species were not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Graptodytes bilineatus</i>	NS;LC	<i>Physella acuta</i>
<i>Peltodytes caesus</i>	NS;LC	<i>Potamopyrgus antipodarum</i>

Compartment L - Fields East of Coalhouse Battery

The fields encompassing sub-compartments L2-9 had good access, with access available through the Campsite in the north of the compartment. All ditches supported water in both sampling seasons except L3 that was dry in the Autumn.

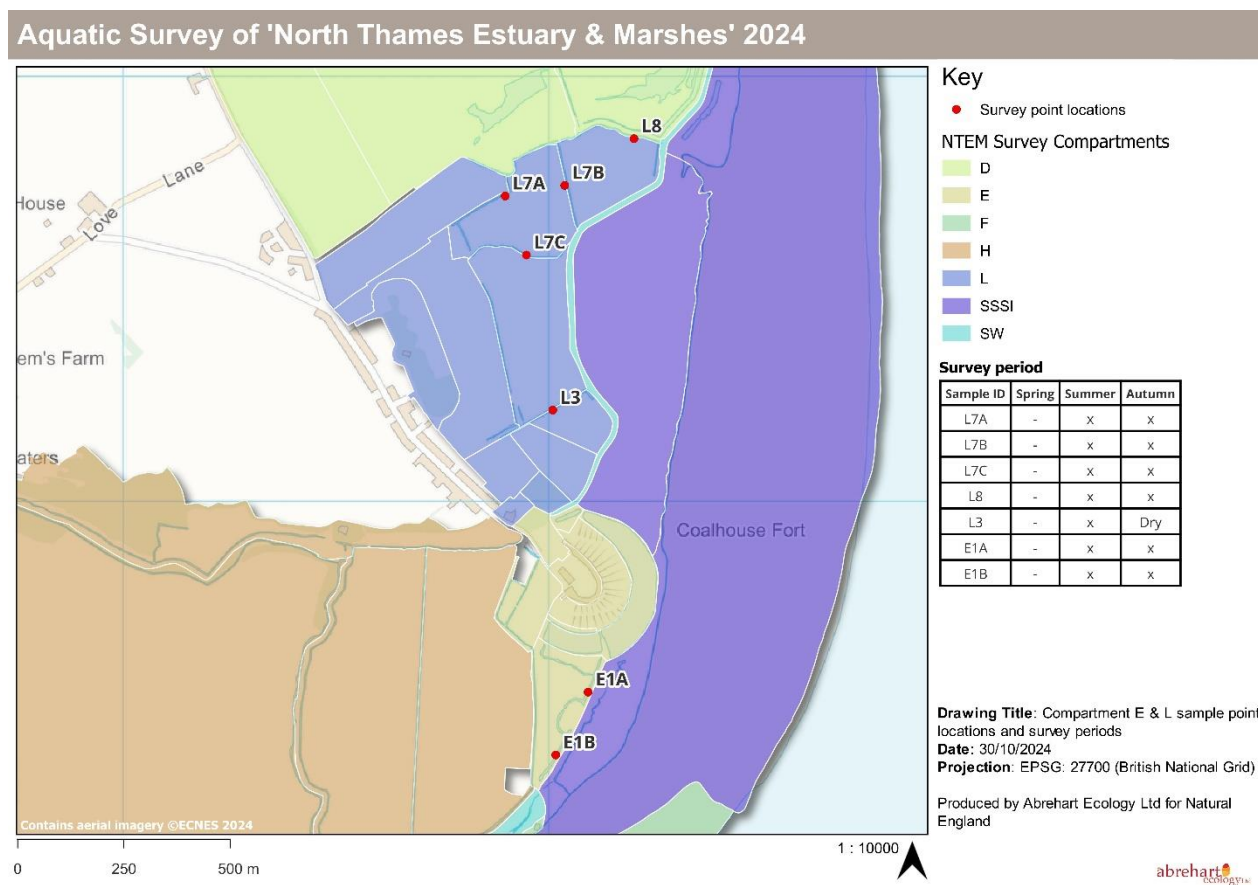


Figure 7. Fields east of Coalhouse Fort sample locations (Aerial Imagery Copyright: ©ECNES 2023). Fields East of Coalhouse Battery - Ditch (TQ6901277216) – sub-compartment L3 - map sampling no. L3

This sample was taken from the ditch in the south of the compartment nearest to Coalhouse Fort. This was a steep-sided ditch with abundant scrub encroachment, and the ditch had significant sediment and an orange hue. There was limited emergent vegetation with only common reed *Phragmites australis* present as an emergent species. This was only sampled once as it was dry in the Autumn survey period.

The water body was 3m wide and had a depth of only 30cm of water, with the remaining depth being soft silts and sediment.

A total of 125 specimens were identified of 16 taxa (12 identified to species). These were dominated by *Asellus aquaticus*, *Cloeon dipterum* and *Gyraulys crista*. Six beetle species

were present with the NS;LC *Helophorus fulgidicollis* and local *Ochthebius dilitatus*. The only uncommon Hemiptera was *Notonecta viridis*.

Table 48. Water chemistry results for compartment L3

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Summer	pH 8.3	0.4µS/cm	0.289ppt	24.4°C

Table 49. Species of Interest found at the Fields East of Coalhouse Battery L3 ditch. Blank cells indicate where non-native species were not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Helophorus fulgidicollis</i>	NS;LC	

Fields East of Coalhouse Battery Campsite Ditch (TQ6891277727) – sub-compartment L7a - map sampling no. L7a

This sample was taken from the ditch on the northern side of the campsite. This was a steep-sided ditch that had been cleared in the past two years. The material had been removed and placed in a large pile in the corner of the field. There was limited emergent vegetation with only common reed *Phragmites australis* present as an emergent species. The water flows to the east of the site, then discharges into the River Thames. The margins of the ditch supported a range of species with false fox sedge *Carex otrubae* and parsley water-dropwort *Oenanthe lachinellii* as the most noteworthy species, with a supporting act of sea couch *Elytrigia atherica* as the dominant grass. The ditch supported a number of emergent plants, with sea club-rush *Bolboscheonus maritimus* the most frequent. The aquatic macrophytes were dominated with horned pondweed *Zannichellia palustris*. This species, along with brackish water-crowfoot *Ranunculus baudotii*, filled the ditch along most of its length.

The water body was 3m wide and had a depth of only 30cm of water, with the remaining depth being soft silts and sediment.

A total of 472 specimens were identified of 38 taxa (30 identified to species). These were dominated by *Ampullaceana balthica* and *Illyocoris cimicoides*, early instar Coenagrionidae and *Potamoprygus antipodarum*. The NR;LC beetle *Ochthebius pusillus*, the NS;LC beetles *Helophorus fulgidicollis*, *Peltodytes caesus*, and *Hygrotus parallelogrammus* were recorded multiple times. Fourteen species of beetle were found.

Table 50. Water chemistry results for compartment L7A

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Summer	pH 8.8	3.9µS/cm	12ppt	20.3°C
Autumn	pH 6.9	5.1µS/cm	10ppt	15.1°C

Table 51. Species of Interest found at the Fields East of Coalhouse Battery Campsite ditch L7a. Blank cells indicate where non-native species and species of interest were not recorded (therefore conservation status was not applicable).

Species of Interest	Conservation Status	Non-native Species
<i>Helophorus fulgidicollis</i>	NS;LC	<i>Potamopyrgus antipodarum</i>
<i>Hygrotus parallellogrammus</i>	NS;LC	
<i>Limnoxenus niger</i>	NS;NT	
<i>Ochthebius pusillus</i>	NR;LC	
<i>Peltodytes caesus</i>	NS;LC	

Campsite Ditch East (TQ6904077745) – sub-compartment L7 - map sampling no. L7b

This sample was taken from the ditch on the eastern side of the campsite. The margins of the ditch supported a range of species with false fox sedge *Carex otrubae* and common reed *Phragmites australis*. Parsley water-dropwort *Oenanthe lachenalii* as the most noteworthy species, with a supporting act of sea couch *Elytrigia atherica* as the dominant grass. The ditch supported a number of emergent plants, with sea club-rush *Bolboscheonus maritimus* the most frequent. The aquatic macrophytes were dominated with horned pondweed *Zannichellia palustris*. This location was sampled in the Summer and Autumn.

The water body was 3m wide and had a depth of only 60cm of water, with the remaining depth being soft silts and sediment.

A total of 639 specimens were identified of 36 taxa (33 identified to species). These were dominated by *Ampullaceana balthica*, *Potamopyrgus antipodarum*, *Gyraulus crista* and *Berosus affinis*. Seventeen species of beetle were found, with two NS';NT, *Hydrochus elongatus*, *Hydrochus ignicollis* and the NS;LC *Ochthebius pusillus*, seven NS;LC species with *Hygrotus parallellogrammus* most frequent.

Table 52. Water chemistry results for compartment L7B

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 8.1	3.59µS/cm	12ppt	18.4°C
Summer	pH 7.5	4.38µS/cm	9ppt	15.8°C

Table 53. Species of Interest found at the Fields East of Coalhouse Battery Campsite ditch east L7b. Blank cells indicate where non-native species were not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Berosus luridus</i>	NS;NT	
<i>Helophorus fulgidicollis</i>	NS;LC	
<i>Hydrochus elongatus</i>	NS; NT	
<i>Hydrochus ignicollis</i>	NS; NT	
<i>hygrotus parallellogrammus</i>	NS;LC	
<i>Octhebius pusillus</i>	NR;LC	
<i>Rhantus frontalis</i>	NS;LC	

Campsite Ditch South (TQ6895077581) – sub-compartment L7 - map sampling no. L7c

This sample was taken from the ditch on the southern side of the campsite. The margins of the ditch supported a range of species with false fox sedge *Carex otrubae* and common reed *Phragmites australis*. The ditch supported a number of emergent plants, with sea club-rush *Bolboscheonus maritimus* the most frequent. The aquatic macrophytes were dominated with horned pondweed *Zannichellia palustris*. This location was only sampled in the Summer as it was dry in the Autumn.

The water body was 3m wide and had a depth of only 60cm of water, with the remaining depth being soft silts and sediment.

A total of 299 specimens were identified of 32 taxa (28 identified to species). These were dominated by *Ampullaceana balthica*, *Hygrotus inaequalis*, *Noterus clavicornis*, and the NR;LC beetle *Octhebius pusillus*. NS;NT beetle species were found in low numbers, with *Limnoxenus niger*, and the NS;LC *Agabus conspersus*.

Table 54. Water chemistry results for compartment L7C

Season	Acidity	Conductivity	Turbidity	Temperature
Summer	pH 9.3	2.3µS/cm	1.746ppt	22.8°C

Table 55. Species of Interest found at the Campsite ditch south L6c. Blank cells indicate where non-native species were not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Agabus conspersus</i>	NS	
<i>Enochrus bicolor</i>	NS;LC	
<i>Helophorus fulgidicollis</i>	NS;LC	
<i>Limnoxenus niger</i>	NS;NT	
<i>Ochthebius pusillus</i>	NR;LC	

Ditch (TQ6920377855) – sub-compartment L8 - map sampling no. L8

This sample was taken from the ditch in the north of the sub-compartment, this was a steep-sided ditch with abundant scrub encroachment and the ditch had significant sediment and an orange hue. There was limited emergent vegetation with only common reed *Phragmites australis* present as an emergent species. This was only sampled twice, in the summer and autumn.

The water body was 3m wide and had a depth of only 30cm of water, with the remaining depth being soft silts and sediment.

A total of 49 specimens were identified of 9 taxa (7 identified to species). These were dominated by *Ampullecena balthica* and *Physella acuta*. No species of interest or non-native species were present.

Table 56. Water chemistry results for compartment L8

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Summer	pH 8.1	5.66µS/cm	10ppt	16.2°C
Autumn	pH 7.8	5.56µS/cm	10ppt	15.1°C

Compartment TFM (North): Tilbury Fort and Marshes (North)

This compartment sample locations were to the north of Tilbury Fort, where the marshes were horse-grazed throughout and dominated by a range of grass species with meadow barley *Hordeum secalinum* a common component. Common reed *Phragmites australis* was scattered across the compartment with sea club-rush *Bolboscheonus maritima* common in some of the ditch margins. Open water was found in some of the ditches sampled with a range of habitats present. These included ephemeral pools and fresh-water ditches. Open water was present in the northern portion of the marsh, which was intersected by a number of Sustainable Urban Drainage System (SUDS) and ditches. Aquatic macrophytes were present in some of the water bodies, horned pondweed *Zannichellia palustris* was most frequent, although brackish water-crowfoot *Ranunculus baudotii* was scattered in the ditches and ephemeral pools to the south of the survey area.

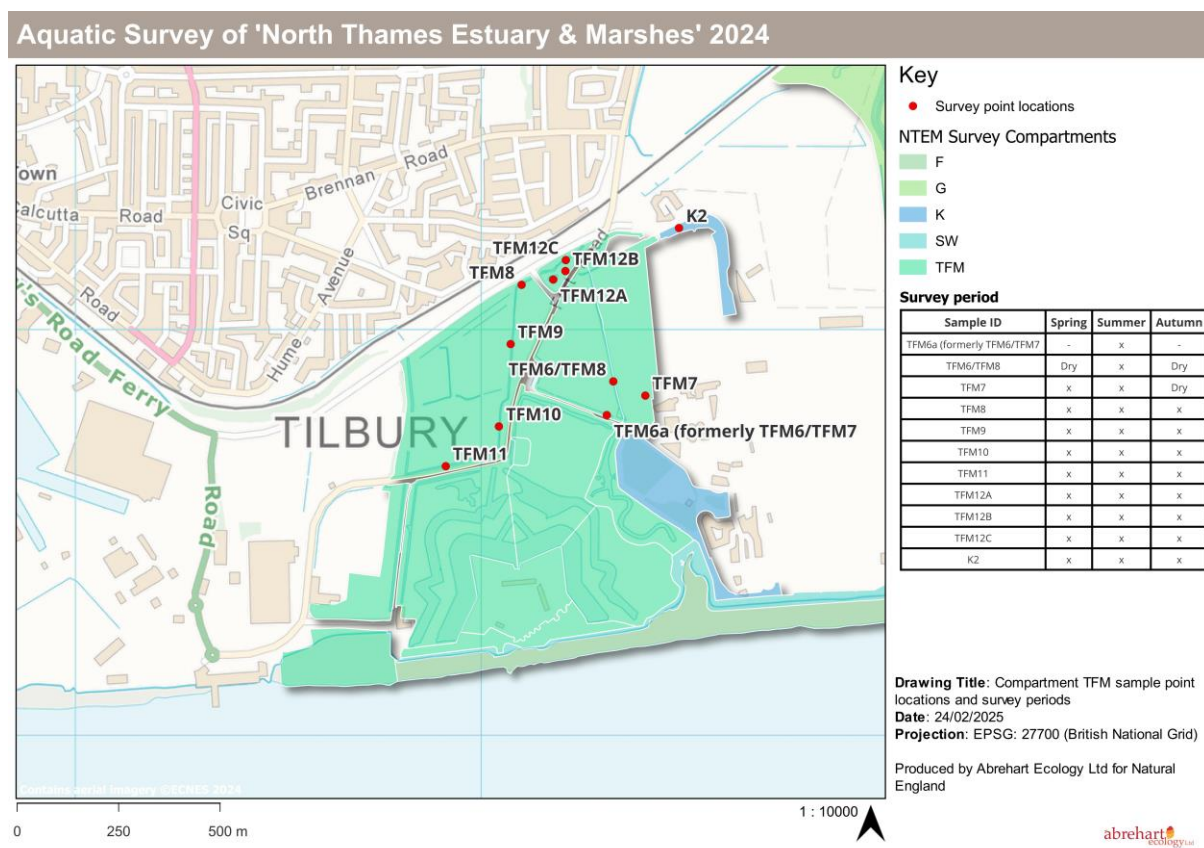


Figure 8. Tilbury Fort and marshes sample locations (Aerial Imagery Copyright: ©ECNES 2024). Tilbury Fort Marshes North – sub compartment TFM6 (TQ6531175791). Map sampling numbers. TFM6a

This sample was taken from a rapidly drying pool close to the roadside in the marsh in the south of the sub-compartment. The vegetation was limited with bare muds and heavily poached, water depth at most 5cm.

A total of 174 specimens were identified of 16 taxa (9 identified to species). These were dominated by caddis flies, *Limnephilus lunatus* and *Limnephilus affinis*. One NS;LC species were present with a single *Haliphus mucronatus* and nine *Hesperocroixa moesta* and *Notonecta viridis* and *Haliphus obliquus* were rare.

Table 57. Water chemistry results for compartment TFM6a

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Summer	pH 7.9	6.48µS	10ppt	16.4°C

Table 58. Species of Interest found at sub-compartment Tilbury Fort Marshes North TFM6a. Blank cells indicate where non-native species were not recorded. Tilbury Fort Marshes (North) Drying ditch in northern marsh - sub compartment TFM6 (TQ6540675839)- map sampling no. TFM7

Species of Interest	Conservation Status	Non-native Species
<i>Haliphus mucronatus</i>	NS;LC	

This sample was taken from a large ephemeral pool in the east of the site. This was dry on the Spring visit but supported water on the latter two visits.

A total of 351 specimens were identified of 23 taxa (17 identified to species) from this one sample. These were dominated by beetles with *Octhebius* sp, *Helophorus fulgidicollis* and *Corixia* sp. Six NS;LC species of beetle *Graptodytes bilineatus*, *Enochrus bicolor*, *Enochrus halophilus*, *Helophorus fulgidicollis*, *Peltodytes caesus* and *Rhantus frontalis* and one Hemiptera, *Corixa affinis*. Uncommon species included *Berosus affinis* and *Hydroglyphus geminus*.

Table 59. Water chemistry results for compartment no. TFM7

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 9.1	1865µS/cm	2.45ppt	15.8°C
Summer	pH 9.2	1757µS/cm	2.35ppt	15.8°C

Table 60. Species of Interest found at sub-compartment Tilbury Fort Marshes (North) TFM7. Blank cells indicate where non-native species were not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Corixa affinis</i>	NS;LC	
<i>Enochrus bicolor</i>	NS;LC	
<i>Enochrus halophilus</i>	NS;LC	
<i>Graptodytes bilineatus</i>	NS;LC	
<i>Helophorus fulgidicollis</i>	NS;LC	
<i>Peltodytes caesus</i>	NS;LC	
<i>Rhantus frontalis</i>	NS;LC	

Tilbury Fort Marshes (North) sub-compartment TFM6 (TQ6532775874) - map sampling no. TFM6/TFM8

The sample was taken from a drying heavily poached ditch running north south through the marsh, where there were old tyres dumped and pigs wallowing. Only exposed mud was present with divided sedge *Carex divisa* on the edges of the ditch. There was no vegetation and the whole area comprised soft mud. This was only sampled in the Summer visit, it was dry at other times.

A total of 61 specimens were identified of 11 taxa (8 identified to species). These were dominated with *Asellus aquaticus* and Chironomidae larvae. All species were otherwise common and not species of interest.

Table 61. Water chemistry results for compartment TFM6/TFM8

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Summer	pH 7.8	9000µS/cm	6.51ppt	14.8°C

Tilbury Fort Marshes (North) Northern ditch – sub-compartments TFM8 (TQ6510176112) and TFM12 (TQ6517976125) - map sampling numbers. TFM8 and TFM12a

These samples were taken along the same water course connected under the road. The vegetation was similar in both sections. The ditch supported a large amount of aquatic macrophytes with soft hornwort *Ceratophyllum submersum* dominated with water starwort *Callitriche* spp. too. The margin of the ditch had a steep slope leading into some deep soft

mud further into the ditch. The material here was soft and silty with a high clay component. The water where the sampling was undertaken was up to 50cm deep at full reach.

A total of 6634 specimens were identified of 62 taxa (53 identified to species) from these six samples. These were dominated by molluscs *Physella acuta* (643), *Ampullecena balthica* (3746), *Potamopyrgus antipodarum* (542), *Gammarus duebeni* (710). Twenty-six species of beetle and eleven species of Hemiptera. One NS;NT beetle *Limnoxenus niger*, six NS;LC species included the beetles *Berosus luridus*, *Enochrus bicolor*, *Enochrus melanocephalus*, *Helophorus fulgidicollis*, and *Rhantus grapii*, with the Hemiptera *Corixa affinis* and *Hesperocorixa moesta*.

Table 62. Water chemistry results for compartment TFM8

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 7.2	4.81µS/cm	9ppt	14.6°C
Summer	pH 7.4	5.46µS/cm	9ppt	14.7°C
Autumn	pH 8.2	5.5µS/cm	9ppt	17.2°C

Table 63. Water chemistry results for compartment TFM12a

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 7	5.44µS/cm	11ppt	14.7°C
Summer	pH 8.1	6.13µS/cm	10ppt	15.9°C
Autumn	pH 9.1	6.04µS/cm	10ppt	17.9°C

Table 64. Species of Interest found at sub-compartment Tilbury Fort Marshes (North) TFM8 & TFM12a. Blank cells indicate where non-native species were not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Berosus luridus</i>	NS;LC	<i>Potamopyrgus antipodarum</i>
<i>Corixa affinis</i>	NS;LC	

Species of Interest	Conservation Status	Non-native Species
<i>Enochrus bicolor</i>	NS;LC	
<i>Helophorus alternans</i>	NS	
<i>Helophorus fulgidicollis</i>	NS;LC	
<i>Limnoxenus niger</i>	NS;NT	

Tilbury Fort Marshes (North) Marshes west of Fort Road – sub-compartment TFM10 (TQ6507475966, TQ6504575763 & TQ6491475665) - map sampling numbers. TFM9, TFM10 & TFM11

These three sample locations were all taken from the same ditch running north to south through the marshes. This ditch was filled with emergent vegetation dominated with common reed *Phragmites australis* and a small amount of the invasive bachelor's buttons *Cotula australis*. The ditch was covered in a layer of fine algae which quickly clogged the sampling net. Floating macrophytes were not present. The ditch was 30cm deep and supported a deep layer of soft muds at the bottom. The western side of the ditch was heavily grazed by horses and the southern side (the sample side) was fenced off from the horses.

The water body was 6m wide with a depth of up to 50cm and there was a large amount of manmade debris fallen across the ditch, creating several hazards. Bramble scrub also encroached across the ditch in some areas.

A total of 5350 specimens were identified of 35 taxa (22 identified to species). These were dominated by the molluscs, *Potamopyrgus antipodarum* (2665), *Ampullecena balthica* (257), and the crustacean *Gammarus duebeni* (2001). Two NS;LC beetles were present with *Dryops striatellus* and *Helophorus fulgidicollis*. Three uncommon beetles were found with *Berosus luridus*, *Enochrus melanocephalus*

Table 65. Water chemistry results for compartment TFM9

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 7.3	4.65µS/cm	9ppt	14.3°C
Summer	pH 7.2	4.81µS/cm	9ppt	14.6°C
Autumn	pH 8.4	5.62µS/cm	10ppt	21.5°C

Table 66. Water chemistry results for compartment TFM10

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 7.4	5.46µS/cm	9ppt	14.7°C
Summer	pH 7.3	4.65µS/cm	9ppt	14.3°C
Autumn	pH 7.8	5.45µS/cm	10ppt	18.2°C

Table 67. Water chemistry results for compartment TFM11

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 8.1	6.13µS/cm	10ppt	15.9°C
Summer	pH 7.4	4.98µS/cm	9ppt	14.1°C

Table 68. Species of Interest found at sub-compartment Tilbury Fort Marshes (North) TFM8, map sampling numbers. TFM9, TFM10 & TFM11. Blank cells indicate where non-native species were not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Dryops striatellus</i>	NS;LC	
<i>Helophorus fulgidiollis</i>	NS;LC	

Tilbury Fort Marshes (North) Attenuation pond – sub-compartment TFM12 (TQ6520976146) - map sampling numbers. TFM12b

This sample was taken from one of the attenuation ponds in the north of the Tilbury Marshes created as mitigation for the road scheme. This was a narrow channelised waterbody, with a clay bottom and steep sides. The dominant flora was bulrush *Typha latifolia* and soft hornwort *Ceratophyllum submersum*. The ditch was 60cm deep and is unlikely to dry throughout the year.

The water body was 8m wide with a depth of 60cm.

A total of 2369 specimens were identified of 44 taxa (41 identified to species). These were dominated by *Ampullecena balthica*, (1496), *Gammarus duebeni* (274) and *Potamopyrgus*

antipodarum (168). Twenty-four species of beetle were found: One beetle NR *Heterocerus obsoletus*, one NS;NT beetle *Limnoxenus niger*, three were NS;LC, *Hydrovatus clypealis*, *Peltodytes caesus* and *Rhantus frontalis*. Uncommon beetles included *Berosus affinis*, *Berosus luridus*, *Cercyon sternalis*, *Helocares lividus*, , Six local species were found including five beetles and one Hemiptera. One locally common species was *Gammarus duebeni*.

Table 69. Water chemistry results for compartment TFM12B

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 7.3	3.05µS/cm	8ppt	16.3°C
Summer	pH 7	5.44µS/cm	11ppt	14.7°C
Autumn	pH 7.9	5.53µS/cm	12ppt	17.2°C

Table 70. Species of Interest found at sub-compartment Tilbury Fort Marshes (North) TFM12 map sampling no. TFM12b. Blank cells indicate where non-native species were not recorded.

Species of Interest	Status	Non-native Species
<i>Berosus luridus</i>	NS;LC	
<i>Heterocerus obsoletus</i>	NR	
<i>Hydrovatus clypealis</i>	NS;LC	
<i>Limnoxenus niger</i>	NS; NT	
<i>Peltodytes caesus</i>	NS;LC	
<i>Rhantus frontalis</i>	NS;LC	

Tilbury Fort Marshes (North) North-West of Fort Road – sub-compartment TFM12 (TQ6521076173) - map sampling reference TFM12c

These samples were taken from the ditch in the north of the survey area. This was a steep sided channel with steep margins. The vegetation was dominated with common reed *Phragmites australis* and bulrush *Typha latifolia*.

The water body from which both samples were taken was 25m by 18m with a depth of 30-50cm.

A total of 1224 specimens were identified of 45 taxa (39 identified to species). These were dominated by the invasive *Physella acuta* (373), Chironomidae larvae (357) and *Cloeon dipterum* (142). Two species of beetle were NS;LC *Helophorus fulgidicollis* and *Rhantus frontalis*. With uncommon species including *Anacaena bipustulata* and *Berosus affinis*. Nine local species, four Hemiptera, one Odonata and one beetle. The locally common *Gammarus duebeni* was present in the samples.

Table 71. Water chemistry results for compartment TFM12C

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 7.6	6.23µS/cm	9ppt	12.9°C
Summer	pH 7.3	3.05µS/cm	8ppt	16.3°C
Autumn	pH 7.6	1.88µS/cm	8ppt	19.3°C

Table 72. Species of Interest found at sub-compartment Tilbury Fort Marshes (North) TFM12 map sampling reference TFM12c. Blank cells indicate where non-native species were not recorded.

Species of Interest	Conservation Status	Non-native Species
<i>Helophorus fulgidicollis</i>	NS;LC	
<i>Rhantus frontalis</i>	NS;LC	

Infill North of Sewage Treatment Works North-East of Fort Road – sub-compartment K2 (TQ6548976252) - map sampling reference K2

These samples were taken from the heavily vegetated ditch in the north of the survey compartment. This was dominated with common reed *Phragmites australis*, and was difficult to access with limited open water.

The water body from which both samples were taken was 5m wide and a depth of 10-30cm.

A total of 777 specimens were identified of 40 taxa (30 identified to species). These were dominated by the invasive *Potamopyrgus antipodarum* (231), the crustacean *Gammarus duebeni* (112), the invasive *Crangonyx pseudogracilis* (86) and the Hemiptera *Plea*

minutissima (86). The NS;NT beetle *Limnoxenus niger* and three species were NS;LCthe beetles, *Helophorus fulgidicollis*, and *Rhantus frontalis*, and one Hemiptera *Corixa affinis*..

Table 73. Water chemistry results for compartment K2

Season	Water Chemistry	Conductivity	Turbidity	Temperature
Spring	pH 7.4	4.98µS/cm	9ppt	14.1°C
Summer	pH 7.6	6.23µS/cm	9ppt	12.9°C

Table 74. Species of Interest found at sub-compartment K2. Blank cells indicate where non-native species were not recorded.

Species of Interest	Status	Non-native Species
<i>Helophorus fulgidicollis</i>	NS;LC	
<i>Limnoxenus niger</i>	NS;NT	
<i>Rhantus frontalis</i>	NS	

Discussion

Nature conservation evaluation

In total, 249 taxa of aquatic invertebrates were recorded within the study area, of these, 182 were identified to species level, of which 90 species were of aquatic beetle and three species of vertebrate - two fish and one amphibian.

Overview

Endangered (EN)

One EN species was found, *Aeshna isosceles* (Norfolk hawker) was found as a larva in C6a.

Nationally Rare; Vulnerable (NR/VU)

One NR/VU beetle *Graphoderus cinereus* was collected once from a pond edge in G16a.

Nationally Rare; (NR;LC)

One NR;LC beetle *Octhebius pusillus* was the most frequent rare beetle (NR) found in eleven locations with 74 specimens identified.

Nationally Rare (NR)

One NR beetle *Heterocerus obsoletus* was present once in TFM12b.

Nationally Scarce; Near Threatened (NR;NT)

Six NS;NT species included a *Hydrophilus piceus* was collected twice from C9a and C9b. *Berosus luridus* was collected from four sites with 54 specimens collected. Four *Hydrochus elongatus* were collected from A1b and L7b. One *Hydrochus ignicollis* was found in L7b. The most frequent NS;NT was *Limnoxenus niger* found in 13 samples with 18 specimens collected. One rare mollusc was found, this was the lagoon specialist *Hydrobia acuta neglecta*, this was found once in E1b

Nationally Scarce; Locally Common (NR;LC)

19 species of NS;LC status were found across the compartments 16 were beetles and two Hemiptera and one caddisfly. 210 specimens were collected of all these species. The most frequent species were *Helophorus fulgidicollis* (16 locations with 102 specimens), *Rhantus frontalis* (13 locations with 30 specimens) and *Hygrotus parallellogrammus* (6 locations with 15 specimens).

Other notable NS/LC species here included *Ochthebius viridis* and *Ochthebius auriculatus* with one specimen each at one location each. *Enochrus halophilus* (4 locations; 5 specimens), *Haliphus mucronatus* (2 locations; 2 specimens), *Helophorus alternans* (1 location; 1 specimen), *Hydrovatus clypealis* (2 locations; 3 specimens), *Hygrotus nigrolineatus* (2 locations; 3 specimens) and *Enochrus halophilus* (6 locations; 9 specimens) *Graptodytes bilineatus* was collected four times with five specimens, twice from G16c and J3a. Two *Dryops striatellus* were found in TFM9. Two hemiptera species, *Sigara selecta* and *Corixa affinis* were found. *Sigara selecta* was only recorded once in C6. *Corixa affinis* was collected seven times with eleven specimens, in locations B2, C6, G16 and TFM7 sections of the site. Many of these species are associated with coastal levels and marshes systems and often strongly associated with brackish waters and are mainly restricted to the east coast of the UK.

Table 75. SAFIS data per compartment (bold row) and broken down into individual / combinations of water bodies

	Sample ID / map number	Taxa	Species Contributing to SAFIS	Specimen Count	Revised BMWP	ASPT	Families Contributing to BMWP	Water Quality	LQI	CCI	Conservation Value	Species of Interest
A1a	Stanford Warren Wetland (South)	8	5	194	19.1	3.82	5	Moderate	E	6	Moderate	1
A1b	Stanford Warren Wetland (South)	21	17	144	44	4.4	10	Good	C	28.1	Very High	6
A3	Stanford Wharf (Creekside Mosaic)	25	20	740	51.5	3.96	13	Good	C	27.2	Very High	6
A6	Stanford Warren Wetland (North)	19	16	188	40.9	4.09	10	Moderate	D	25	Very High	4
B2	Mucking Church Woodland	11	8	90	13.6	4.53	3	Poor	D	34.1	Very High	6
C1a	Mucking Landfill (South)	14	12	814	32.9	4.11	8	Good	C	13.6	Fairly High	2
C1b, c	Mucking Landfill (South)	26	23	522	45.7	3.81	12	Moderate	D	22.6	Very High	8
C6a & b	Golden Gates Lake	63	45	729	108.3	4.51	24	Good	A++	47.9	Very High	17

	Sample ID / map number	Taxa	Species Contributing to SAFIS	Specimen Count	Revised BMWP	ASPT	Families Contributing to BMWP	Water Quality	LQI	CCI	Conservation Value	Species of Interest
C6c, d, e& f	Golden Gates Lake	81	65	2493	144.4	4.51	32	Good	A++	21.9	Very High	21
C9a	Linford Wood	55	45	2174	96.5	4.39	22	Good	A++	28.5	Very High	15
E1a, b	Coalhouse Fort Lower Meadows	15	8	727	21.3	4.26	5	Moderate	D	31.3	Very High	3
G16a & d	Tilbury2 Mitigation Area	53	41	685	71.7	4.22	17	Good	B	35.7	Very High	9
G16b & c	Tilbury2 Mitigation Area	72	58	1730	100.1	4.55	22	Good	A+	38.4	Very High	12
G3a, b	Goshem's Landfill	19	13	321	22	4.4	16	Moderate	D	41.3	Very High	9
G3/G2	Goshem's Landfill	10	9	556	23.8	3.97	9	Moderate	E	23	Very High	2
G2	Field North of Goshem's Landfill	53	43	359	54.6	4.55	12	Excellent	A	40.8	Very High	16

	Sample ID / map number	Taxa	Species Contributing to SAFIS	Specimen Count	Revised BMWP	ASPT	Families Contributing to BMWP	Water Quality	LQI	CCI	Conservation Value	Species of Interest
G13	Ash A2	24	18	450	39.5	4.39	9	Good	C	39.2	Very High	8
G9/G10	Ash C1/C2	22	17	1030	45.7	3.81	12	Moderate	D	21	Very High	6
G9/G10b	Ash C1/C2	21	20	165	30.4	4.34	7	Good	C	19.6	High	5
G6a - d	Goshem's Pool	56	47	2427	70.4	4.14	17	Good	B	39	Very High	21
J3	Station Road Lake	60	51	542	81.6	4.08	20	Good	A+	30.7	Very High	13
K2	Infill North of Sewage Treatment Works	65	27	1110	66.9	4.18	16	Good	B	36.3	Very High	6
L7a	Thamesview Campsite	38	15	472	57.6	4.43	13	Good	B	33.9	Very High	10
L7b	Thamesview Campsite	36	32	640	58	3.87	15	Good	C	38.33	Very High	10
L7c	Thamesview Campsite	32	26	299	43.6	4.36	10	Good	C	40	Very High	11
L8	Walsh Field	9	7	49	24.1	4.02	6	Moderate	E	5.5	Moderate	0

	Sample ID / map number	Taxa	Species Contributing to SAFIS	Specimen Count	Revised BMWP	ASPT	Families Contributing to BMWP	Water Quality	LQI	CCI	Conservation Value	Species of Interest
L3	-	32	14	125	32.7	4.09	8	Moderate	D	15.8	High	3
TFM6a (formerly TFM6/TFM7)	Northern Marsh North of road to Water treatment plant	16	11	174	28.7	4.78	6	Good	B	24.1	Very High	4
TFM7	Pond	23	18	351	17.6	4.4	4	Moderate	D	53.53	Very High	10
TFM6/TFM7	Northern Marsh East of Fort Road (central ditch)	16	12	119	25.7	4.28	6	Moderate	C	25.5	Very High	2
TFM6/TFM8	Northern Marsh East of Fort Road (central ditch)	11	9	68	14.4	3.6	4	Poor	F	1.38	Low	0
TFM8 - 12a	Northern Marsh West of Fort Road	62	53	6634	105.9	4.6	12	Excellent	A++	25.23	Very High	10
TFM9, 10 & 11	Northern Marsh West of Fort Road	36	25	5350	62.9	4.49	14	Good	B	33.91	Very High	4
TFM12b	Attenuation Ponds	44	26	2369	58.2	3.64	36	Good	C	24.6	Good	15

	Sample ID / map number	Taxa	Species Contributing to SAFIS	Specimen Count	Revised BMWP	ASPT	Families Contributing to BMWP	Water Quality	LQI	CCI	Conservation Value	Species of Interest
TFM12c	Attenuation Ponds	45	35	1224	86.2	4.31	20	Excellent	A	23.2	Very High	13

Community Conservation Index (CCI)

The survey data were collated and grouped according to geographic unit or Compartment, creating eleven main areas to assess using the CCI system. Fifty-two sample points were surveyed and the SAFIS analysis showed that of the combined water body areas (Table 75), all but six had a CCI above 20, with eight areas over 30, four over 40 and one over 50 (TFM7). 'High' conservation status starts at 20, indicating that the whole survey area is of 'very high' conservation value. Aquatic beetles are good indicators of habitat quality, and this survey recorded 90 species, 33 of these species are of EN to NS;LC status. The species recorded across the survey area indicate that each compartment is of very high conservation status and should be considered for conservation protection.

Compartment A - Mucking Wetlands: this area comprised two clay-lined ponds surrounded with *Phragmites australis* with an additional pond to the east of the compartment closer to the estuary edge. This pond supported a range of emergent species with sea club-rush *Bolboscheonus maritima* and common reed *Phragmites australis* with stands of divided sedge *Carex divisa*. This pond was well used by ducks that were often fed, macrophytes were limited and often grazed. A further sample was taken from a ditch in the reedbeds to the west.

The combined four sample sites had 48 taxa (1231 specimens), of which 40 were identified to species. These samples were dominated by *Gammarus duebeni*, Hemiptera and Coleoptera. Two NS;NT *Hydrochus elongatus* and several NR;LC *Octhebius pusillus* were found. Two species of interest included the beetles, *Berosus affinis* and the hemiptera *Sigara connicina*.

The sites were all with low salinity (5-7ppt). Three of the waterbodies had a very high conservation value with a CCI score of 25 -28.1.

Compartment B - Mucking Church Wood (B2): this area comprised a single pond in deep shade with willows surrounding the sample site.

The site had 11 taxa (90 specimens), of which 10 were identified to species. These samples were dominated by *Annelida* sp. and *Hygrotus confluens*. One NS;LC beetle *Enochrus halophilus* and one NS;LC hemiptera *Corixa affinis* were present, with a single uncommon *Berosus affinis*.

The pond was fresh water. The sample location had a very high conservation value with a CCI score of 34.1.

Compartment C – Mucking Landfill (Enovert) & Golden Gate Lakes: This compartment was divided into three sub-areas for reporting. The large lake at the west of the compartment (Golden Gate Lake) and the adjacent lake to the west, the two ponds in the south-east edge of the Enovert landfill site and the water filled disused quarry to the west of the railway track. Golden Gate Lake was a common reed *Phragmites australis* fringed

lake supporting abundant waterfowl. It is a disused aggregates quarry, now under Essex Wildlife Trust management. The remaining three ponds were all settling ponds from previous quarrying activities all with dense common reed *Phragmites australis* fringed margins.

Golden Gate Lake (Also known as Gobion's Lake) had 76 taxa, of which 54 were identified to species. The One NS;NT beetle *Limnoxenus niger* and two NS;LC beetles with *Helophorus fulgidicollis*, and *Peltodytes caesius*. Of the thirteen uncommon species six were Hemiptera, four were beetles *Enochrus melanocephalus* and *Helophorus griseus* and two were dragonflies. Two locally common species were crustaceans with one introduced species *Crangonyx pseudogracilis*. The sample locations were all fresh water with low salinity, Gobions / Golden Gate Lake had a CCI score of 21.9.

West Golden Gate Lake had 63 taxa, of which 44 were identified to species (729 specimens). One EN, one NS;NT and two NS;LC species. The EN was *Aeshna isocetes* (Norfolk hawker dragonfly), NS;NT *Limnoxenus niger* the two NS;LC species were all beetles with *Helophorus fugidicollis*, *Hygrotus parallellogrammus* and of the ten uncommon species four were Hemiptera, five were beetles with *Cercyon sternalis*, one caddisfly. Two locally common species were crustaceans with one introduced species *Crangonyx pseudogracilis*. The sample locations were all with low salinity. Gobions / Golden Gate Lake had a very high CCI score of 47.9.

The combined two smaller ponds of the Enover landfill had 32 taxa, of which 29 were identified to species (1336 specimens). Two were NS;LC and seven were uncommon. These were beetles with *Berosus luridus* and *Enochrus bicolor*. Of the seven uncommon species five were Hemiptera and two were beetles with *Octhebius marinus*. The ponds were slightly brackish and have a very high conservation value with a CCI score of 22.6.

The lake in the west had 56 taxa, of which 42 were identified to species (2174 specimens). One was NS;NT *Hydrophilus piceus*, one was NS;LC *Helophorus fulgidicollis* and one NS;LC hemiptera *Corixa affinis*. Eleven were uncommon, four were Hemiptera, six were beetles and one caddisfly. The lake was freshwater with a very high conservation value with a CCI score of 28.5.

Compartment E – Coalhouse Fort & surrounds: This compartment comprised the main saline lagoons of the moats and associated ditch running south. These were all turbid with a limited fauna.

Across the two sampling points a total of 14 taxa were recorded with 12 species. The saline lagoons had a limited fauna dominated with lagoon cockle *Cerastoderma glaucum* and *Idotea chelipes*, with notable molluscs being the NR;NT *Hydrobia acuta neglecta*. Although this site is saline the CCI was 31.3 and the water had a high conductivity of 36ppt.

Compartment G (Tilbury2 Mitigation Area): The samples were taken from three ponds within the mitigation area all with common reed *Phragmites australis* and sea club-rush *Bolboscheonus maritima* dominating.

The samples supported 87 taxa were recorded with 67 species (2421 specimens). The NR/VU beetle *Graphoderus cinereus* was found once with two specimens, the NS;NT beetle *Limnoxenus niger* was present. NS;LC species included *Graptodytes bilineatus* and *Octhebius pusillus*, *Helocares punctatus*, *Enochrus halophilus*, *Peltodytes caesus*, *Hydrovatus clypealis* and *Rhantus frontalis*. Other uncommon species included the beetles, *Cercyon sternalis*, *Enochrus melanocephalus*, *Enochrus ochropterus*, *Hydroglyphus geminus* and *Helocares lividus*. Of the 12 locally common species nine were beetles, two Hemiptera and one caddisfly. One species of note was the Hemiptera *Cymatia rogenhoferi* a species only recently arrived in the UK from Europe. The sampling locations (G16 b, c & G6b) showed brackish water conditions with a value of 5ppt. The ditch has a very high conservation value with a CCI score of 38.4.

Compartment G6a, b, c & d (Goshem's pool): The samples were taken from an ephemeral lagoon and a nearby ditch. With marginal vegetation of common reed *Phragmites australis* and sea club-rush *Bolboscheonus maritima* dominating.

The samples supported 61 taxa, and recorded 48 species (2922 specimens). There was one NR;NT, eight were NS;LC 11 were uncommon. The NR;NT beetle was *Octhebius pusillus*. The eight beetles were *Enochrus bicolor*, *Helophorus strigifrons*, *Hygrotus parallellogrammus*, *Hygrotus nigrolineatus*, *Octhebius viridis*, *Peltodytes caesus*, *Rhantus frontalis* and the NS;LC Hemiptera was *Corixa affinis*. Of the 122 locally common species eleven were beetles including *Berosus affinis*, *Octhebius marinus*, and four were Hemiptera including the rare *Cymatia rogenhoferi*. The sampling location showed brackish water conditions with a turbidity value of 10ppt. The ditch has a very high conservation value with a CCI score of 39.2.

Compartment G (Goshem's Farm) (G2, 3, 9 and 10): The samples were taken from a range of ditches and pools in the north east of the Goshems site, with marginal vegetation of common reed *Phragmites australis* and sea club-rush *Bolboscheonus maritima* dominating.

The samples supported 80 taxa and recorded 64 species (2532 specimens). One NR;NT, eight NS;LC and three NS; species were present. The NR;NT species was *Octhebius pusillus*. The eleven NS;LC and NS beetles were *Agabus conspersus*, *Berosus luridus*, *Enochrus bicolor*, *Enochrus halophilus*, *Graptodytes bilineatus*, *Helochares punctatus*, *Helophorus fulgidicollis*, *Hygrotus parallellogrammus*, *Octhebius auriculatus*, *Octhebius viridis*, and *Rhantus frontalis*. Of the 12 local species six were beetles, five were Hemiptera and one dragonfly. The sampling location showed brackish water conditions with a value of 10ppt. The samples had a very high conservation value with a CCI score of 41.3.

Compartment J3 – Station Road lake: This was a large lake with abundant wildfowl. It was steep sided with limited aquatic macrophytes, the marginal vegetation present was dominated with common reed *Phragmites australis*. The lake was sampled at two locations.

Across the five samples of the marsh ditches, a total of 60 taxa were recorded with 47 species (542 specimens). One was a RDB3 beetle, five were Notable b (Nb) and six were local. The NS;LC beetles were *Graptodytes bilineatus*, *Helophorus fulgidicollis* and *Peltodytes caesus*. Other uncommon beetles included, *Berosus affinis*, *Enochrus melanocephalus* and *Helocares lividus*. The sampling locations showed brackish to freshwater conditions with a maximum value of 3ppt. The ditch has a very high conservation value with a maximum CCI score of 30.7.

Compartment K – Tilbury2 Access Road Ditch: The ditch sampled was on the northern edge of the compartment, running east along the top of the land parcel. The ditch was choked with common reed *Phragmites australis*.

Across the five samples of the marsh ditches a total of 40 taxa were recorded with 31 species (777 specimens). Three were NS;Nt the NS species were beetles, *Helophorus fulgidicollis*, *Limnoxenus niger*, and *Rhantus frontalis*. The uncommon hemiptera included the NS;LC *Corixa affinis* and the uncommon *Hesperocorixa moesta*. The sampling locations showed brackish to freshwater conditions with a value of 9ppt. The ditch has a very high conservation value with a maximum CCI score of 36.3.

Compartment L - Fields east of Coalhouse Battery: One ditch sampled was on the northern edge of the compartment, running east along the top of the campsite. This had been cleared in the previous year and was filled with horned pondweed *Zannichellia palustris*.

Across the five samples of the marsh ditches a total of 70 taxa were recorded with 59 species (1584 specimens). There were twelve species of beetle including one that was NR;LC four that were NS;NT and seven that were NS;LC. The NR;LC beetles was *Octhebius pusillus* and the NS:NT beetles were *Berosus luridus*, *Hydrochus elongatus*, *Hydrochus ignicollis* and *Limnoxenus niger*. The six NS;LC beetles, *Agabus conpersus*, *Enochrus bicolor*, *Helophorus fulgidicollis*, *Hygrotus parallellogrammus*, *Peltodytes caesus*, *Rhantus frontalis*. Of the locally common species were beetles *Anacaena bipustulata*, *Berosus affinis*, *Enochrus affinis* and three were Hemiptera. The sampling locations showed brackish to freshwater conditions with a value of 6ppt. The ditch has a very high conservation value with a maximum CCI score of 40.

Compartment Tilbury Fort Marshes (North) (TFM): This compartment was a series of ephemeral ditches, drying pools and SUDS. Most of these are within a heavily horse-grazed marsh system. Many of the ditches had aquatic macrophytes.

Across the ditch and pool samples a total of 99 taxa were recorded with 77 species (9413 specimens). One NR, one NS;NT and seven NS;LC species. The one NR beetle was *Heterocerus obsoletus*. The NS;NT species was *Limnoxenus niger* and the remainder species of interest were *Berosus luridus*, *Dryops striatellus*, *Haliphus mucronatus* and *Hydrovatus clypealis*, *Helophorus fulgidicollis*, *Peltodytes caesus* and *Rhantus frontalis*, with the Hemiptera *Hesperocorixa moesta*. Of the locally common species included the beetles *Anacaena bipustulata*, *Berosus affinis*, *Berosus luridus*, *Berosus signaticollis*, *Cercyon sternalis*, *Enochrus melanocephalus*, *Helocares lividus*, four Hemiptera and one Odonata. Sampling locations showed brackish water conditions with a value of 9ppt. The ditch has a very high conservation value with a maximum CCI score of 51.

Table 76. Table showing Saline Lagoonal species found during the survey with conservation status (Blank cells indicate where IUCN Red List category not available).

Listed Species	Common Name	Wildlife and Countryside Act 1981 – Schedule 5 or 8	Common Specialist species	Listed species E = England,	IUCN Red List (Based on 2001 guidelines, unless otherwise stated)	Nationally Rare Marine Species *	Nationally Scarce Marine Species *	Nationally Rare (Ra) or Scarce (Sc) Plants
<i>Idotea chelipes</i>	An amphipod	N	Y	S		N	Y	N
<i>Cerastoderma glaucum</i>	Lagoon cockle	N	Y	S		N	N	N
<i>Hydrobia acuta neglecta</i>	Mud snail	N	Y	S	NS;NT	N	N	N

Norfolk Hawker (*Aeshna isosceles*)

The Norfolk hawker is a rare dragonfly species that has recently experienced a notable range expansion in the United Kingdom.

The Norfolk hawker had specific habitat requirements, favouring slow-flowing water bodies with abundant vegetation. It thrived in unspoilt grazing marsh dyke systems with clean, non-saline water, rush margins, and an abundance of water soldier (*Stratiotes aloides*).

Now it uses well-vegetated lakes and ponds, often with reed fringes, which provide suitable habitats for this species, this is more similar to the continental habitats. At Western Golden Gate lakes west, where this was present, the macrophytes were dominated with soft hornwort *Ceratophyllum submersum*.

Historically, the Norfolk hawker was restricted to the Norfolk Broads and northeast Suffolk. However, since 2001, it has undergone a significant range expansion. Prior to 2013, breeding sites were limited to East Norfolk and East Suffolk, but the species has since spread across Norfolk, Suffolk, and into Cambridgeshire, Kent, and Herefordshire. Recent sightings have been reported in Lancashire, South Devon, Sussex, and other southern counties. This expansion is potentially attributed to factors such as climate change and habitat improvements.

To support Norfolk hawker populations, management strategies should focus on maintaining grazing marshes, controlling saline intrusion, managing nutrient enrichment, and preserving dyke vegetation and surrounding terrestrial habitats. Creating and restoring suitable habitats, particularly in inland areas less vulnerable to sea-level rise, is also crucial for the species' conservation.

The Norfolk hawker enjoys legal protections as it is listed as Endangered in the Odonata Red Data List for Great Britain and is protected under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended). However, its status may be downgraded due to the recent range expansion. A licence from Natural England is required to disturb this species (Abrehart - 2022-63366-SCI-SCI).

While specific data on salinity tolerance is limited, it's known that the Norfolk hawker prefers non-saline water. The original East Anglian breeding sites are vulnerable to saline intrusion, highlighting the importance of maintaining clean water quality in its habitats. Further research on the specific salinity tolerances and water chemistry requirements of the Norfolk hawker would be beneficial for conservation efforts, as this information could inform more targeted habitat management strategies.

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Appendix A– Sample data

Available in separate Excel documents, published alongside this report named:

Appendix A1: 'NECR608 Appendix A1 Tilbury Surveys Data and Locations v4'

Appendix A2: 'NECR608 Appendix A2 Inverts Tilbury Aquatics'

Appendix B– Site photos

All photographs in this appendix are © 2026: Toby Abrehart.

Mucking Marshes

Pond 1 - TQ69068093 – A1a



Pond 2 - TQ69298097 – A1b



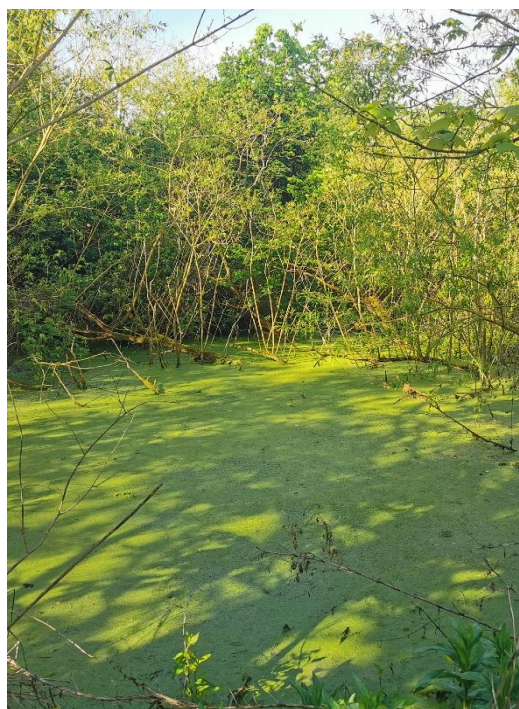
Pond 3 - TQ70248139 – A3



Ditch – TQ6883881265 A6

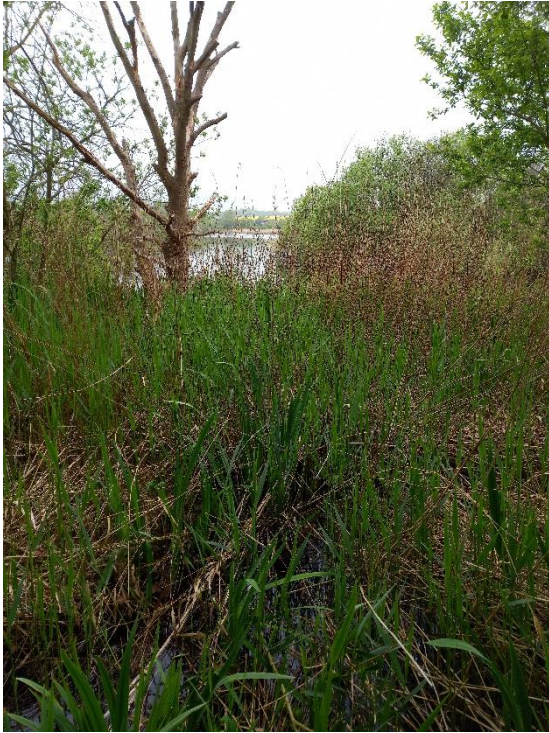


Pond - TQ6859181078 – B2



Golden Gates Lake

West shore - TQ6790479859



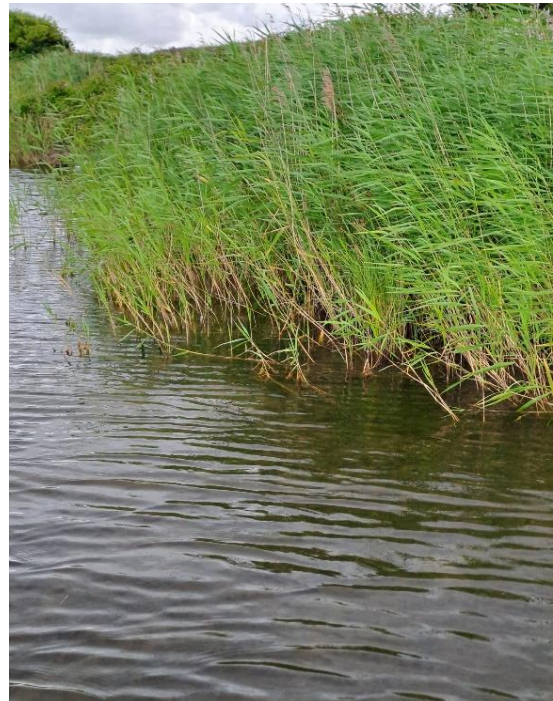
Linford Wood Lake - TQ6770780080



C9a - TQ6769580134



C9b - TQ6770780080



Coalhouse Fort and surrounds

Campsite - TQ6904077745 – L7b



Campsite - TQ6920377855 – L8



Ditch - TQ6901277216 – L3



TQ6707077850

Southern Ditch - TQ6901976404 – E1b



J3b - TQ670827794

J3a

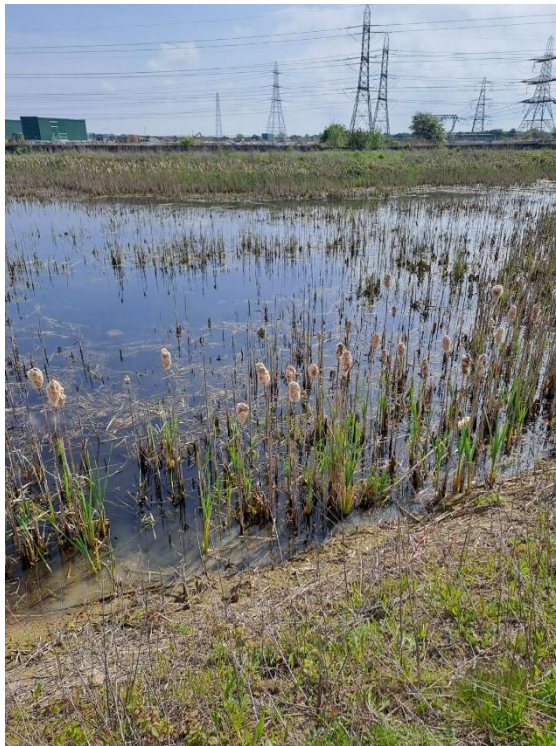
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Goshems – Tilbury Mitigation Area

Southern Pond - TQ6592176671 – G16a

Middle pond - TQ6602476521 – G16b



Northern Pond - TQ6596476701 – G16c

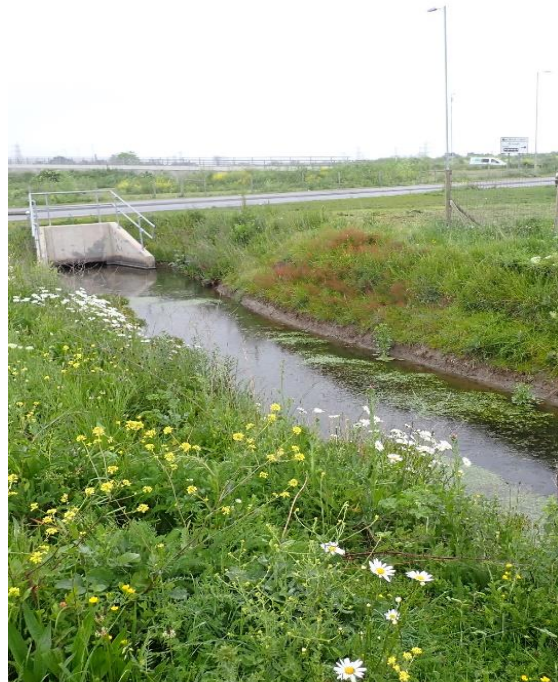


Northern ditch - TQ6651275833 –G13

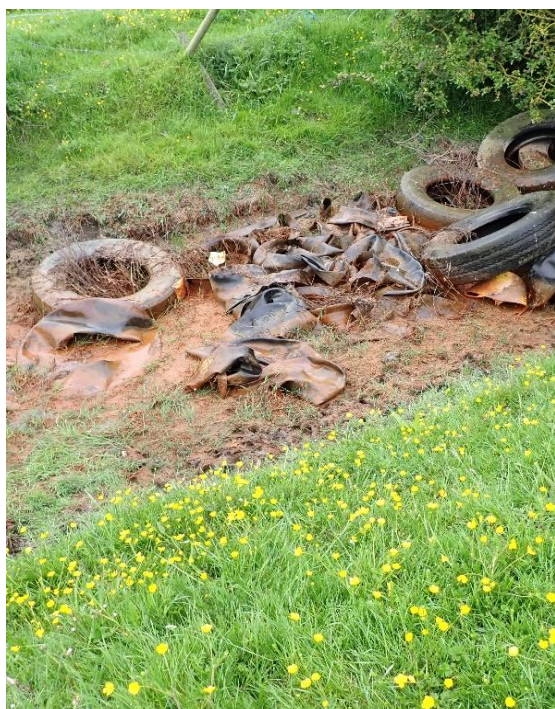


SUDS Habitat creation site - TFM

Northern ditch - TQ6521076173 –TFM12c Southern SUDS - TQ6517976125 –
TFM12a



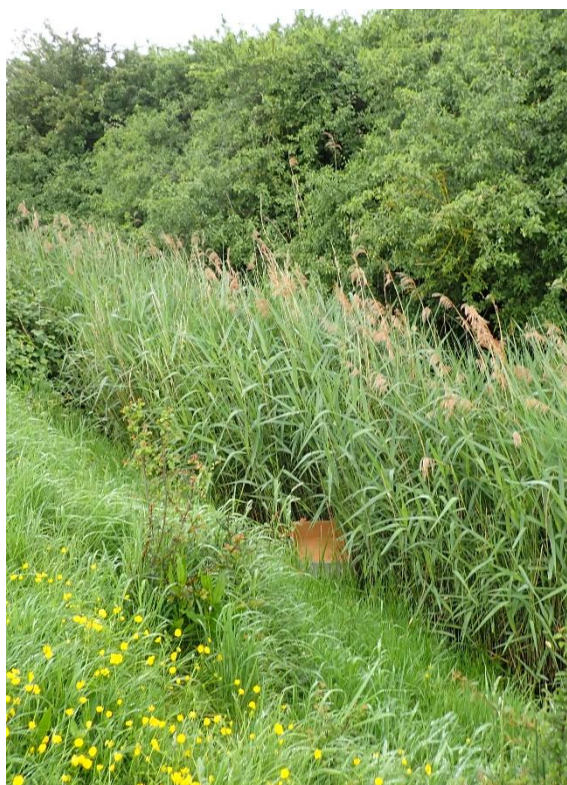
Ephemeral pool - TQ6540675839 – TFM7



Ditch - TQ6532775874 – TFM6/8



Tilbury Ditch - TQ6504575763 – TFM10



Tilbury Ditch-TQ6491475665 –TMF11



Appendix C: Invertebrate Status Codes

The new IUCN status codes

Many British invertebrate species have been assigned a formal status code. These codes are paramount in the definition of noteworthy species and accordingly, it is necessary to explain them here.

Natural England has recently instigated a new programme of invertebrate status reviews, in which species are assessed according to universally accepted criteria set by the International Union for the Conservation of Nature (IUCN) (IUCN 2012a, 2012b, 2014). In contrast to previous status assessments, which focussed largely on absolute rarity, the IUCN approach places each species into a threat category that also takes historic population trends into account. Species qualifying for a threat status (Critically Endangered, Endangered or Vulnerable) are those that are not only rare, but also have a history of decline or extreme population fluctuations. Species not assigned to a threat category are categorised as Near Threatened, Least Concern, Data Deficient or Not Applicable.

As of 2016, a total of almost 4000 species have been reviewed in accordance with IUCN guidelines. All of these belong to groups that have readily available identification keys, active recorders and a history of recording. Progress with the IUCN invertebrate status review programme has recently been afforded a very useful summary (Webb & Brown, 2016).

A key to the IUCN status codes is given below and summarised in Fig. 1.
(IUCN.,2001)

REGIONALLY EXTINCT (RE)

A taxon is Extinct when there is no reasonable doubt that the last individual has died.

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered. Critically Endangered species that are likely to be Extinct, but for which confirmation is still required are reported as Critically Endangered (Possibly Extinct), abbreviated as CR(PE).

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered.

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable.

NEAR THREATENED (NT)

A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)

A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)

A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate.

NOT EVALUATED (NE)

A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

NOT APPLICABLE (NA)

This category is typically used for introduced non-native species whether this results from accidental or deliberate importation. It may also be used for recent colonists (or attempted colonists) responding to the changing conditions available in Britain as a result of human activity and/or climate change. The IUCN regard 1500 as the cut-off date after which a species is classed as 'non-native'.

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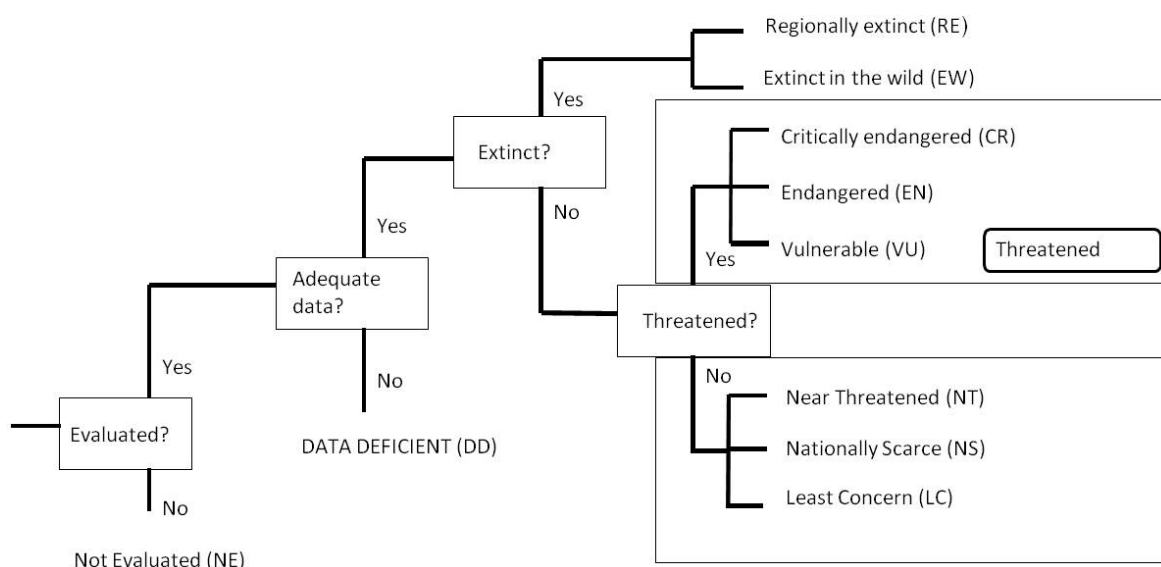


Fig. 1. Hierarchical relationships of the categories (IUCN, 2001). (© BY Creative Commons Image)

Taxa listed as Critically Endangered, Endangered or Vulnerable are defined as Threatened (Red List) species. For each of these threat categories there is a set of five main criteria A-E, with a number of sub-criteria within A, B and C (and an additional sub criterion in D for the Vulnerable category), and one of which qualifies a taxon for listing at that level of threat. The qualifying thresholds within the criteria A-E differ between threat categories and are summarised in Table 75.

Table 77. Summary of the thresholds for the IUCN Criteria (IUCN., 2001)

Criterion	Main thresholds		
	Critically Endangered	Endangered	Vulnerable
A. Rapid decline	>80% over 10 years or 3 generations in past or future	>50% over 10 years or 3 generations in past or future	>30% over 10 years or 3 generations in past or future

Criterion	Main thresholds		
	Critically Endangered	Endangered	Vulnerable
B. Small range + fragmented, declining or fluctuating	Extent of occurrence <100 km² or area of occupancy <10 km² + two of the following: - severely fragmented or only a single location - continuing decline - extreme fluctuations	Extent of occurrence <5,000 km² or area of occupancy <500 km² + two of the following: - severely fragmented or no more than 5 locations - continuing decline - extreme fluctuations	Extent of occurrence 20,000 km² or area of occupancy <2,000 km² + two of the following: - severely fragmented or no more than 10 locations - continuing decline - extreme fluctuations
C. Small population and declining	<250 mature individuals, population declining	<2,500 mature individuals, population declining	<10,000 mature individuals, population declining
D. Very small population	<50 mature individuals	<250 mature individuals	D1. <1,000 mature individuals
D2. Very small area of occupancy	Not applicable	Not applicable	D2. <20 km ² or 5 or fewer locations
E. Quantifiable probability of extinction	>50% within 10 years or three generations	>20% within 20 years or five generations	>10% within 100 years

