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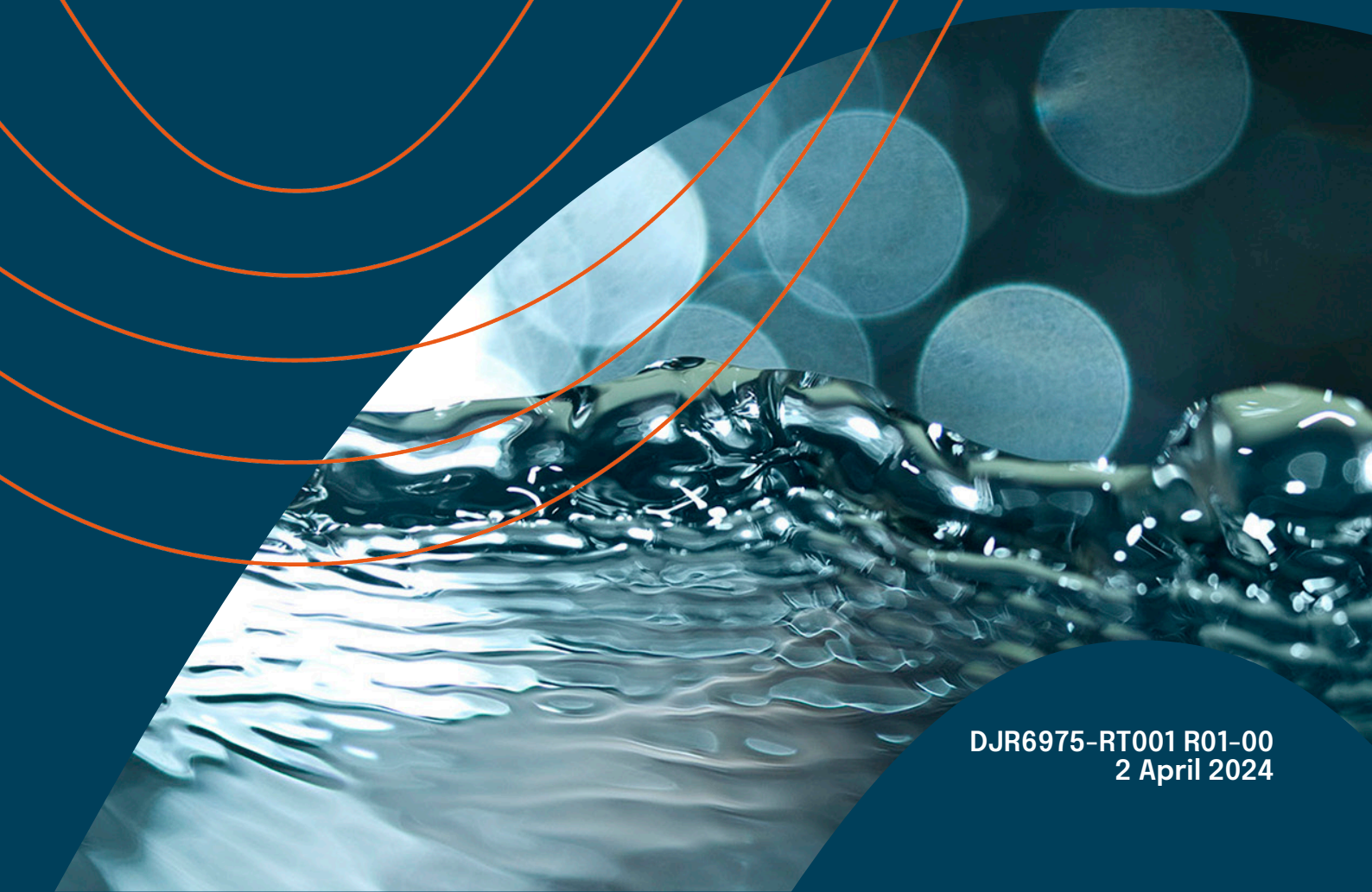
Defra 25 Year Environmental Plan

B6 - Estuarine and Coastal Waters Indicator - Phase III Report



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1 Feasibility study for 25 year environment plan

1.1 Indicator B6 development for estuarine and coastal waters

Defra's 25 Year Environment Plan (25YEP) contains a series of indicators, covering natural capital assets (for example, land, freshwater, air and seas) and together show the condition of these assets, the pressures acting upon them and the services or benefits they provide. Water is Indicator B (Defra, 2019).

As part of this indicator framework supporting the 25YEP, Natural England is leading on the development of Indicator B6 – natural functions of freshwater and wetland habitats. This indicator is being developed in four parts:

- Rivers and streams;
- Lakes and ponds;
- Freshwater wetlands; and
- Estuarine and coastal waters* (previously TRAC).

*Estuarine and coastal waters have previously been referred to as transitional and coastal waters (TRAC) as defined for the Water Framework Directive[1]. However as the language used in The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 assessments have updated to 'estuarine and coastal', this terminology is also used for the B6 development and throughout this report.

As the units of assessment (estuarine or coastal water bodies) are taken directly from the WFD, it is helpful to define these in the context of the WFD, and hence within this B6 indicator development report:

- Estuarine water bodies – bodies of surface water in the vicinity of river mouths which are partly saline in character as a result of their proximity to coastal waters but are substantially influenced by freshwater flows. Estuarine water bodies were defined from Mean High Water (MHW) boundaries, taken directly from OS 1:50K MeridianTM 2 and Environment Agency estuarine boundaries defined for the Urban Waste Water Treatment Directive (UWWTD)[2].
- Coastal water bodies – a surface water on the landward side of a line, every point of which is at a distance of one nautical mile on the seaward side from the nearest point of the baseline from which the breadth of territorial waters is measured, extending where appropriate up to the outer limit of transitional waters. Coastal waters were defined by territorial waters 1 nautical mile from the MHW coastline taken directly from OS 1:50K MeridianTM 2. The delineation between coastal and estuarine waters was delineated by the Environment Agency defined transitional waterbodies[2].

This report provides the first completed scoring of naturalness for the estuarine and coastal part of the B6 indicator, on behalf of Natural England. The work builds on initial development of the other, non-estuarine and coastal elements by Natural England, CEH and the Environment Agency, to provide a framework for assessing the naturalness of the freshwater habitat resource for the purposes of setting and reporting against strategic biodiversity targets (Mainstone and others, 2018). This framework was further refined, mostly for river and headwaters by Mainstone and others (2021), and has also been used during the development of the estuarine and coastal component.

[1] TRAC waters as defined for the Water Framework Directive extend from mean high water (MHW) to 1 nautical mile from the coast
[2] https://www.data.gov.uk/dataset/3a75ec5f-a361-475c-80e3-52d93bbc5dbe/wfd-transitional-and-coastal-waterbodies-cycle-2

This report builds on an Indicator Development Report by Bleach (2022) and progressed further in Bleach (2023) that provides initial consideration of the development of B6 naturalness indicators for estuarine and coastal waters. The 2022 report should be read in conjunction with this report, as that details the initial process used to identify potential attributes.

The majority of the 2023 report (Bleach, 2023) is included within this report, as this is required to provide a complete reference for the scoring of naturalness in estuarine and coastal waters. Whereas the 2023 report provided outputs on naturalness at the water body level, this 2024 report provides the basis for assessment of naturalness at the habitat level.

The hierarchy of indicators and attributes provided in Bleach (2022) is summarised below:

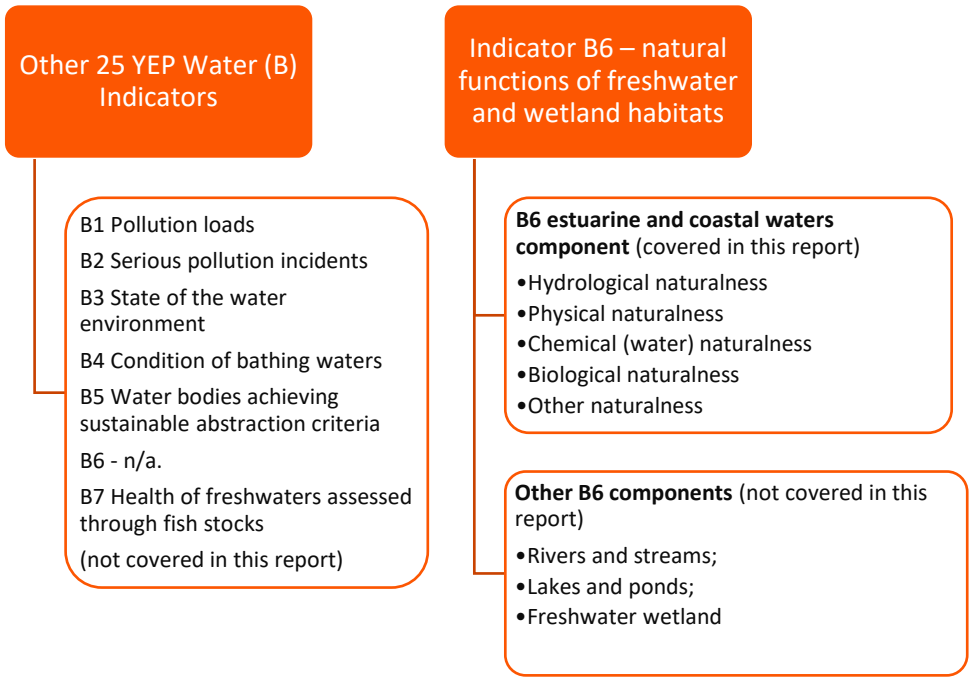

Figure 1.1: Hierarchy of indicators

The approach to the B6 indicator development for estuarine and coastal waters has, wherever possible, kept attributes consistent across the four components of B6. This is because they must work together to form one compound B6 indicator.

2 Project Tasks

2.1 Introduction

The main tasks for Phase III of the B6 estuarine and coastal waters indicator development are to:

1. Agree the finalised attribute list following guidance from Natural England;
2. Finalise the spatial framework for aggregating data and scoring of each attribute per water body;
3. Complete the information sheets for the Estuaries and Coastal Waters Indicators as part of B6; and
4. Progress the B6 Estuaries & Coastal Waters Indicator from development stage to operational phase.

The 'attribute' noted in Task 1, refers to a quantifiable or scorable part of the B6 component indicator. For example, an attribute may consider the presence of non-native species within a

particular area, another attribute may consider the levels of a particular chemical contaminant, or group of chemicals.

2.2 Report objectives

This report provides the finalised attribute list following guidance from Natural England and details of the scoring of naturalness for each of the final estuarine and coastal attributes. The scoring of naturalness for the estuarine and coastal part of the B6 indicator at the habitat level is also provided. Due to the level of detail included in the scoring at the habitat level, these naturalness scores are provided in separate deliverable (DJR6975_Score_Attribute_Habitat_R02-00-Final.xlsx).

Attribute factsheets are provided as a separate, stand-alone deliverable and as Appendix F.

2.3 Report structure

This report contains the following sections:

- Section 3: Initial considerations for development of the estuarine and coastal waters indicator;
- Section 4: Results of stakeholder consultation and the final list of attributes;
- Section 5: Phase III scoring update;
- Section 6: Hydrological naturalness component attributes;
- Section 7: Physical naturalness component attributes;
- Section 8: Chemical (water) naturalness component attributes;
- Section 9: Biological naturalness component attributes;
- Section 10: Other naturalness component attributes;
- Section 11: Summary.

2.4 Data suitability

During the tasks completed as part of the initial phase (Bleach, 2022), consideration was given to the likelihood of data being available that is suitable for the B6 estuarine and coastal waters indicator. An updated data summary for each dataset utilised for the scoring of the B6 estuarine and coastal waters attributes was presented in Bleach (2023) and remains unchanged for this current report. The data summary includes the following criteria:

- Data source;
- Data model/type;
- Status (colour coded green – ready for operationalisation; amber – nearly ready; red – requires significant further work);
- Updating process (colour coded as status column).

The data suitability summary for each dataset that has been used in the scoring of the B6 estuarine and coastal waters attributes is provided as Appendix E. This includes a list of data sets used for each of the attribute scoring that is presented within this report. It also notes the licence agreements for each of the data sets used for attributing a naturalness score.

3 Initial considerations for the development of B6 indicator attributes

3.1 B6 Naturalness components

Attributes identified for the B6 estuarine and coastal waters indicator should together form a robust assessment of the level of natural function of estuarine and coastal waters. There is a requirement to align with work on other elements of the B6 indicator, which along with the estuarine and coastal waters component include: Rivers and streams; Lakes and ponds; and Freshwater wetlands.

Each of the estuarine and coastal waters attributes of the B6 indicator should sit under one of the four naturalness components that were developed by Mainstone and others (2021). The four naturalness components identified in Mainstone (2021) are:

- Hydrological;
- Physical;
- Chemical (Water chemistry);
- Biological.

The initial work to develop estuarine and coastal waters attributes (Bleach, 2022 and developed further in Bleach, 2023) kept within these four naturalness components, however following engagement with Natural England, a number of attributes did not fall into any of these categories, and so a fifth component was included, this being:

- Other.

As with the development of the other three elements of the B6 indicator, estuarine and coastal waters attributes have been considered where they are able to determine the degree of artificial (man-made) modification. The approach of using artificial modification, as opposed to a direct assessment of naturalness was developed by Mainstone and others (2021), as this is likely to be practicable to obtain on a consistent basis to ascertain than attributes that seek to characterise natural function directly. In order to measure naturalness directly, it would be necessary to know the state/condition in the absence of any modifications, for which reliable and consistent data are rarely available.

3.2 EA data provision

3.2.1 2019 WFD data

Most of the data for the B6 Rivers and streams component is collected by the Environment Agency for WFD monitoring, to allow for reporting under the Water Environment (WFD) Regulations. WFD data collected by the Environment Agency within estuarine and coastal waters is also an important dataset for the estuarine and coastal waters B6 indicator development. It is understood that recent targeting of WFD monitoring has been at sites likely to change status (mainly for the worse) and so recent data collection may not be representative of water body status more generally.

When subsequent B6 indicator assessments are completed, the assessment may need to be adjusted to take account of updates to WFD monitoring in future years. If this is the case, subsequent B6 assessments may not be completely comparable, where changes may be partially due to alterations in monitoring data available, rather than actual changes to the naturalness. This will depend on the level and nature of the changes to the WFD monitoring programme, which are not currently known.

Where data are reported as part of the WFD by the Environment Agency, it is usual that data are considered over the full reporting period of 6 years. For example, Cycle 3 WFD reporting (2019)

considers data from the preceding 6 years. As such, where WFD data are utilised as an attribute score, only the last reporting round (Cycle 3, 2019) is used as it already covers data from an extended period of time.

3.2.2 Influencing future data collection

As per some of the outputs and recommendations during the development of the Rivers and streams element, developments of the B6 estuarine and coastal waters indicator may mean that additional, more comprehensive monitoring is required in future, as part of a combined WFD/25-YEP indicator monitoring programme.

Where this has been identified as part of this B6 estuarine and coastal waters indicator work, it is noted in the corresponding attribute (See Sections 5 to 10).

Following discussion as part of the consultation with Natural England and the Environment Agency for this report, consideration was given to how to report water bodies where there is no monitoring as it is not a surveillance water body. Although not fully comprehensive, those water bodies where data are missing could be considered in one of three ways:

- Extrapolation of data or naturalness scores from adjacent water bodies;
- Scoring all to a default position on the naturalness scale (this is equivalent to some WFD water bodies defaulting to a status of 'good' where data are unavailable); or
- Not providing a naturalness score for these water bodies as insufficient data are available.

Following input from the Environment Agency (personal comms) it was concluded that the last option would be the most appropriate, and water bodies without corresponding WFD data or status reporting should also not have a naturalness score for that attribute. This is represented as a N/D (no data) in the spreadsheets that are provided with this report, and on tables that provide overall water body naturalness scores per attribute. The mapped outputs of naturalness scores at water body level provided in Appendix C, indicate these 'no data' for certain water bodies and are shown as grey polygons.

4 Final attribute list

4.1 Stakeholder consultation

For the development of a final list of attributes for the estuarine and coastal waters B6 indicator, a review meeting was held between the project team (HR Wallingford), Natural England and the Environment Agency, who provide data and analysis for the reporting of the B6 indicator as part of the work during Phase II. During the start of Phase III, the final list of attributes was reconfirmed with specialists and project leads at Natural England.

Table 4.1 provides the final list of attributes that are utilised for the scoring of naturalness of estuarine and coastal waters. The table remains unchanged from that presented in Bleach (2023). The comment column captures the results of the consultation and how the regulator comments have been addressed within the final scoring process.

Table 4.1: Final list of B6 estuarine and coastal attributes

Naturalness component	Attributes	Data available	Consultation comment and action taken
Hydrological	Flows (H1)	Environment Agency - Water Resources GIS (WRGIS) data	Natural England provided Environment Agency data (WRGIS) that was used for the Rivers element. Natural England recommended: ● That the same data are used for estuarine and coastal waters and a score provided for each of the four flow percentiles separately;

Naturalness component	Attributes	Data available	Consultation comment and action taken
			• That for coastal waters, flow from both rivers and estuaries into coastal waters could be used to provide a flow score. Both of these recommendations have been implemented during the scoring. See Section 6.1.
	Obstacles (H2)	Environment Agency – River obstacles dataset	Natural England recommended: • Scoring should consider the area of a water body, as for example, three obstacles on a small water body may be less natural than three obstacles on a large water body; • That each different obstacle should be scored individually, i.e. a sluice may be more or less natural than a weir. Or a weir from one river may be more or less natural than the same weir in a different water body. Only the first recommendation has been implemented during the scoring. It is not possible to individually score obstacles consistently throughout the country and would provide less comparative results than a more simpler consideration of No. of obstacles per area of water body. See Section 6.2.
	Coastal protection (H3)	Environment Agency – National Coastal Erosion Risk Management (NCERM) and Flood Risk Zone 3 map data	The Environment Agency noted: • The two identified datasets are produced using the same base information. In that the 'floodable' defence type record is derived from the areas that flood as represented with the Flood Risk Zone 3 map; • That NCERM data does not cover all water bodies. This is most apparent in upper reaches of larger estuaries (such as the Humber and Thames) and some smaller transitional water bodies have no data at all. Natural England recommended: • Care should be taken when considering defences that have been breached to provide habitat compensation sites. Although an unnatural occurrence, it aims to reintroduce a natural environment; • Areas that flood should be seen as favourable (in terms of naturalness) regardless of the presence of human structures. Both notes and recommendations have been implemented during the scoring. See Section 6.3.
Physical	Built structures (P1)	OS MasterMap Topographical layer	Natural England recommended: • That data are collected from Historic England regarding the presence of historical installations, such as pill boxes. The recommendation was not carried forward to the scoring. In most cases pill boxes are not installed within intertidal areas and would not, as such, be a consideration for this attribute. In addition, historical buildings, such as pill boxes are included with the OS Topo layer as manmade structures. See Section 7.1.
	Fishing pressure (P2)	Natural England – FisherMap data	Natural England fisheries specialists noted:

Naturalness component	Attributes	Data available	Consultation comment and action taken
			• There are a number of other fishing datasets available, however most are based on landings and are not site specific; • Inshore VMS (iVMS) will provide a good dataset once it becomes fully operational. Until then, although FisherMap is a relatively old dataset and generated through a combination of data and questionnaires with fishermen, it provides the best available current dataset. Natural England fisheries specialists recommended: • To use FisherMap to provide an activity based risk map for English waters. Where possible to leave resolution at a level greater than water body level. The comments were noted and will form part of the future requirements section of the fishing pressure note. The recommendation was carried forward to the processing stage. Although fishing pressure was scored at the water body level during Phase II for consistence with other attributes, the fishing pressure is also mapped at higher resolution with results provided per habitat as part of the Phase III work (See Figure 7.6) and provided as a layer in the geodatabase. See Section 7.2.
	Combined other activities (P3)	Marine Management Organisation (MMO) open data and The Crown Estate (TCE) open data	Natural England noted: • There are a number of datasets available that may provide additional combined datasets, including the Kingfisher dataset[3]; • Are not aware of one single dataset that includes all activity data. Natural England hold a dataset that is a combination of a number of available datasets to produce an activity dataset. However likely that most cables, dredging and disposal sites are available through a combination of MMO and TCE open data portals; • Due to the crossover between some activities being licenced and some unlicenced, would suggest the attribute name is changed to Combined activities, without reference to licenced/unlicenced; • Care would be needed to determine the unnaturalness score per activity. The activity data for the attribute assessment was obtained through a combination of all suitable MMO and TCE openly available datasets. The Kingfisher data were not used as it mostly reused data available from other sources. The name for the attribute has been changed to Combined other activities. Due to the difficulties in providing an unnaturalness score per activity, it was decided that the scoring should be based on the percentage area of water body that was covered by an activity, as this was likely to be more consistent and able to be applied in the same way for future assessments. See Section 7.3.

[3] Kingfisher dataset - KIS-ORCA (Offshore Renewables and Cables Awareness) - Seafish 2019. Published at: https://kis-orca.org/map/

Naturalness component	Attributes	Data available	Consultation comment and action taken
Chemical (water quality)	Water quality (C1)	Environment Agency - WFD Cycle 3 (2019) dataset	The Environment Agency recommended: ● Scoring of water quality will need to use the same system as is reported under the WFD and should not use a score based on No. of individual chemicals that fail; ● To only use Cycle 3 (2019) data, as that already takes into account data over proceeding 6 years; ● Where data were not available it should not be extrapolated. All of these recommendations have been implemented during the scoring. See Section 8.2.
	Dissolved Oxygen (DO) (C2)	Environment Agency - WFD Cycle 3 (2019) dataset	The Environment Agency recommended: ● Scoring of DO will need to use the same system as is reported under the WFD; ● To only use Cycle 3 (2019) data as that already takes into account data over proceeding 6 years; ● Where data were not available it should not be extrapolated. All of these recommendations have been implemented during the scoring. See Section 8.3.
	Dissolved Inorganic Nitrogen (DIN) (C3)	Environment Agency - WFD Cycle 3 (2019) dataset	The Environment Agency recommended: ● Scoring of DIN will need to use the same system as is reported under the WFD; ● To only use Cycle 3 (2019) data as that already takes into account data over proceeding 6 years; ● Where data were not available it should not be extrapolated. All of these recommendations have been implemented during the scoring. See Section 8.4. Discussion with Natural England and Environment Agency regarding the possibility of also including attribute for Phosphorus. Concluded that phosphorus in not currently a limiting factor in marine environment and that where it is an issue, is likely to be picked up in eutrophication targets under WFD. At present not sufficient justification to include phosphorus as an attribute but may review for future assessment rounds.
	Opportunistic macroalgae (C4)	Environment Agency - WFD Cycle 3 (2019) dataset	The Environment Agency recommended: ● Scoring of Opportunistic macroalgae will need to use the same system as is reported under the WFD; ● To only use Cycle 3 (2019) data as that already takes into account data over proceeding 6 years; ● Where data were not available it should not be extrapolated. All of these recommendations have been implemented during the scoring. See Section 8.5. Discussion with the Environment Agency regarding the possibility of using the weight of evidence for eutrophication as an attribute in place of the opportunistic macroalgae status. At present there is insufficient justification to use the weight of evidence data, as it is less geared towards being able to show

Naturalness component	Attributes	Data available	Consultation comment and action taken
			unnaturalness. At present use of opportunistic macroalgae status has been retained but may review for future assessment rounds.
Biological	Infaunal Quality Index (IQI) (B1)	Environment Agency – WFD IQI Assessments NBB (2019)	The Environment Agency recommended: ● Scoring of IQI will need to use the same system as is reported under the WFD; ● To only use Cycle 3 (2019) data as that already takes into account data over proceeding 6 years; ● Where data were not available it should not be extrapolated. All of these recommendations have been implemented during the scoring. See Section 9.1. Discussion with the Environment Agency regarding ability of the IQI to show future change. In most cases IQI already at required status and unlikely to show future change. Also noting the placement of sampling and the degrees of heterogeneity of habitats will highly influence IQI scoring. Noted that a new tool was in development that would look at results of sampling over a range of habitats and be linked to more complex habitats, including non-sediment habitats that are currently outside of IQI. At present the metric to determine habitat mosaic complexity is not developed. At present IQI status has been retained but may review for future assessment rounds.
	INNS (B2)	National Biodiversity Network (NBN) Atlas	Natural England recommended: ● Scoring based on No. of INNS within a water body may not be sufficient detail as unable to consider the density/ abundance of certain species. A high density of one species may be more unnatural/destructive than a low density of a number of other INNS; ● To use a similar approach as the Rivers and streams component, whereby the scoring is based on UKTAG impact category. The scoring system for this attribute has utilised the UKTAG impact category for estuarine and coastal species to weight the scoring based on known impact. See Section 9.2.
	Saltmarsh (B3)	Environment Agency – WFD SKIPPER (2019)	The Environment Agency recommended: ● Scoring of Saltmarsh will need to use the same system as is reported under the WFD; ● To only use Cycle 3 (2019) data as that already takes into account data over proceeding 6 years; ● Saltmarsh is limited in distribution around the country and so only present in ca. a third of water bodies. Where it is not available it should not be extrapolated. Where data not present it should not be scored; ● That the Saltmarsh extent as proportion of historic saltmarsh (SMAh) WFD status should not be used within the scoring for this attribute, as it was obtained from a snap-shot in time and does not represent a baseline, and in addition is unable to show any future change.

Naturalness component	Attributes	Data available	Consultation comment and action taken
			All of these recommendations have been implemented during the scoring. See Section 9.3.
Other	Anthropogenic light (O1)	Campaign for Rural England (CPRE) – Night Blight	Natural England commented: • The placement of anthropogenic light under a biological component heading may be incorrect and should be moved to a different component; • What justification was there in including anthropogenic light as a measure of unnaturalness and if changes in unnaturalness levels equates to changes in biological status. The anthropogenic light attribute has been moved (along with noise and litter) to a new component of Other, which is a deviation from the other B6 elements being developed. The use of anthropogenic light as an attribute is supported by the alteration to biological patters and in behaviour for animals (including estuarine and marine) and the introduction of light is a man-made, unnatural occurrence. See Section 10.1.
	Underwater noise (O2)	JNCC noise register	Natural England commented: • The placement of underwater noise under a biological component heading may be incorrect and should be moved to a different component. The underwater noise attribute has been moved (along with anthropogenic light and litter) to a new component of Other, which is a deviation from the other B6 elements being developed. See Section 10.2.
	Litter (O3)	MCS Beach Clean data	n/a

Source: HR Wallingford

To note there was one further attribute, developed following the publication of Bleach (2022) for Litter. As such, marine litter was not discussed in the consultation but is an additional Other component attribute for the estuarine and coastal waters B6 indicator (See Section 10.3).

4.2 Estuarine and coastal waters attribute list

The final list of B6 estuarine and coastal waters attributes are:

- Hydrological:
  - Flows (H1);
  - Obstacles (H2);
  - Coastal protection (H3).
- Physical:
  - Built structures (P1);
  - Fishing pressure (P2);
  - Combined activities (P3).
- Chemical (water quality):
  - Water quality (C1);
  - DO (C2);

  - DIN (C3);
  - Opportunistic macroalgae (C4).
- Biological:
  - IQI (B1);
  - INNS (B2);
  - Saltmarsh (B3).
- Other:
  - Anthropogenic light (O1);
  - Underwater noise (O2);
  - Litter (O3).

To note: The alpha-numeric label in parenthesis in the bullets above, indicates the code used in the geodatabase and within the scoring spreadsheets and attribute factsheets that accompany this report.

Each of the attributes are outlined in more detail in the following chapters.

5 Phase III scoring update

5.1 Scoring at habitat level

The scoring of naturalness that was presented during Phase II (reported in Bleach, 2023) was at the water body level. A task for Phase III was, wherever possible, to provide the score of naturalness at the habitat level. In order to determine naturalness at a habitat level, a suitable habitat classification level would need to be agreed and a suitable habitat baseline map sourced.

5.2 Habitat classification and level

There are a number of habitat classification and levels that could potentially be utilise for the purpose of providing a level at which to assess naturalness.

Annex I habitats

For example, habitats protected by the Habitats Regulations, known as Annex I Habitats could potentially provide a basis for assessment against. Marine Annex I habitats include:

- 1110 Sandbanks which are slightly covered by sea water all the time;
- 1130 Estuaries;
- 1140 Mudflats and sandflats not covered by seawater at low tide;
- 1150 Coastal lagoons;
- 1160 Large shallow inlets and bays;
- 1170 Reefs;
- 1210 Annual vegetation of drift lines;
- 1220 Perennial vegetation of stony banks;
- 1310 Salicornia and other annuals colonising mud and sand;
- 1320 Spartina swards (*Spartinion maritimae*);
- 1330 Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*).

The numbers provided in the bullet list are the classification number for each habitat as provided in Annex I.

However, the use of Annex I habitats would be not provide a score for naturalness of all English estuarine and coastal habitats, as not all areas are covered with a representative Annex I habitat. In addition, there is overlap for some of the Annex I habitats. For example a Reef (1170) and a Mudflat and sandflat not covered by seawater at low tide (1140) may both be present within an Estuary (1130). There are potential further level of overlap, as for example, the mudflat that is present within an estuary may also include saltmarsh on the mudflat, such as Salicornia and other annuals colonising mud and sand (1320).

UK Marine habitat classification

The Marine Habitat Classification for Britain and Ireland (JNCC[4]) is based on the empirical analysis of benthic survey data, scientific literature, and consultation with marine experts. It describes the majority of the marine benthic habitats around the coasts and seas of Britain and Ireland.

Due to the near complete coverage of habitats that can be mapped for English estuarine and coastal waters, the Marine Habitat Classification for Britain and Ireland is a potential candidate as a suitable habitat classification.

The classification is provided at 6 levels. An example of which is provided below:

- Level 1 - Level, e.g. 2 (Marine);
- Level 2 - Broad Habitat e.g. LR (Littoral rock (and other hard substrata));
- Level 3 - Habitat Complex e.g. LR.HLR (High energy littoral rock);
- Level 4 - Biotope Complex e.g. LR.HLR.MusB (Mussel and/or barnacle communities);
- Level 5 - Biotope e.g. LR.HLR.MusB.MytB (Mytilus edulis and barnacles on very exposed eulittoral rock);
- Level 6 - Sub-biotope Code e.g. LR.HLR.MusB.Sem.Sem (*Semibalanus balanoides*, *Patella vulgata* and Littorina spp. on exposed to moderately exposed or vertical sheltered eulittoral rock).

EUNIS Classification

The European Nature Information System (EUNIS) habitat classification is a comprehensive system covering the terrestrial and marine habitat types of the European land mass and its surrounding seas. It is hierarchical in structure and includes a key with criteria for identification of habitats at the first three levels.

The classification is provided at 6 levels. An example of which is provided below:

- Level 1 - Level, e.g. A (Marine);
- Level 2 - Broad Habitat e.g. A1 (Littoral rock and other hard substrata);
- Level 3 - Habitat Complex e.g. A1.1 (High energy littoral rock);
- Level 4 - Biotope Complex e.g. A1.11 (Mussel and/or barnacle communities);
- Level 5 - Biotope e.g. A1.111 (Mytilus edulis and barnacles on very exposed eulittoral rock).

There are numerous similarities between EUNIS and UK Marine habitat classification. The above example is identical in description and only varies for unitisation, with EUNIS using an alpha numeric system. There are some differences at lower levels, but most of the first three levels are identical.

Due to the near complete coverage of habitats that can be mapped for English estuarine and coastal waters, EUNIS is a potential candidate as a suitable habitat classification.

[4] Available at: https://mhc.jncc.gov.uk/ [Accessed March 2024]

5.3 Suitable habitat mapping

Annex I Habitats

A suitable dataset for Marine Habitat Classification for Britain and Ireland can be obtained from a number of online sources. For this project, data were sourced from data.gov.

An example of the data is indicated in Figure 5.1, showing two Annex I habitats in the area between Sussex and Kent.

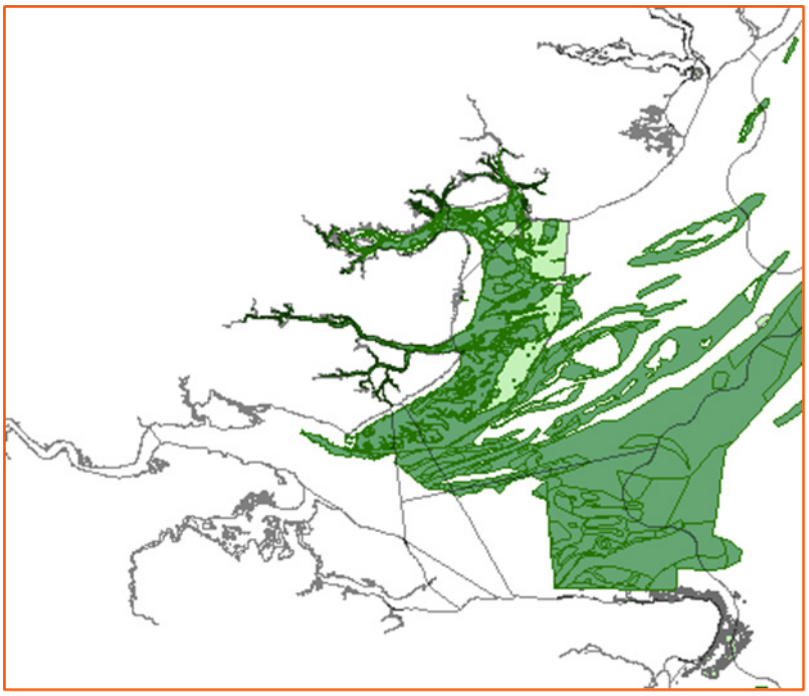

Figure 5.1: Example of Annex I habitats showing 1170 Reefs (light green) and 1110 Sandbanks which are slightly covered by sea water all the time (dark green)

Source: data.gov

UKSeaMap

A suitable dataset for Marine Habitat Classification for Britain and Ireland can be obtained from a number of online sources. For this project, data were sourced from UKSeaMap, created by JNCC.

An example of the data is indicated in Figure 5.2, showing a range of Marine Habitat Classification for Britain and Ireland habitats in the area between Essex and North Kent. To note, the data product does not fully cover all water bodies, with much less data present in upper reaches of estuaries. Areas where there is no corresponding habitat data are indicated as grey polygons in Figure 5.2.

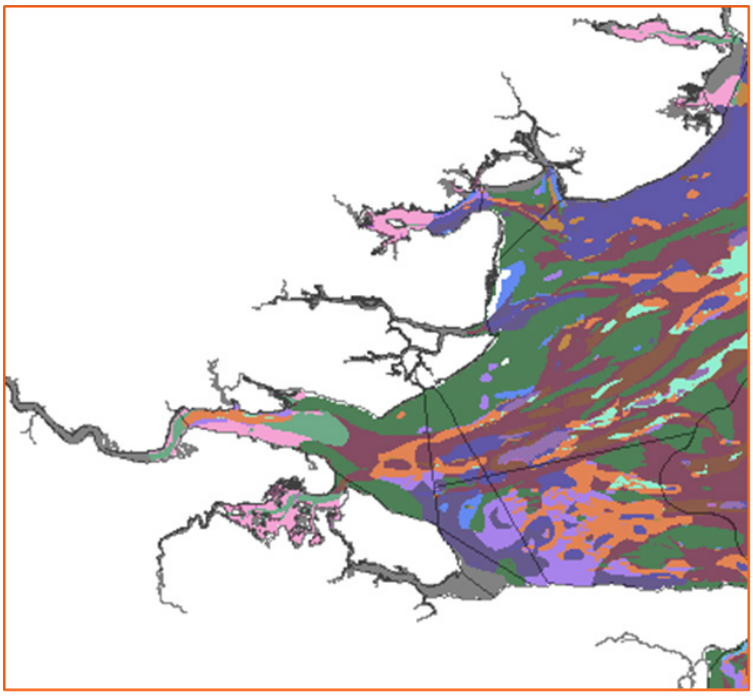

Figure 5.2: Example of UKSeaMap data polygons: purple polygon = circalittoral fine sand; orange = circalittoral coarse sediment

Source: JNCC, UKSeaMap 2018 Version 2

The UKSeaMap data product also has layers for EUNIS habitats and Marine Strategy Framework Directive (MSFD) Benthic Broad Habitat Types.

EUNIS Level III

A suitable dataset for EUNIS Level III basemap can be obtained from a number of online sources. However, unlike the UKSeaMap and the Annex I habitat maps above, the different online sources provide different EUNIS Level III habitat maps. They are often derived from the same (or similar) base data, however the different organisations have then augmented the map with additional data products.

Following discussions with Natural England, it was decided that a EUNIS Level III basemap should be used for the B6 assessment, and that a Natural England data product should be used as the preferred basemap.

An example of the Natural England data is indicated in Figure 5.3, showing a range of EUNIS Level III habitats in the area between Essex and North Kent. To note, the data product does not fully cover all water bodies, with less data present in upper reaches of estuaries. Areas of no habitat data are indicated as white polygons in Figure 5.3.

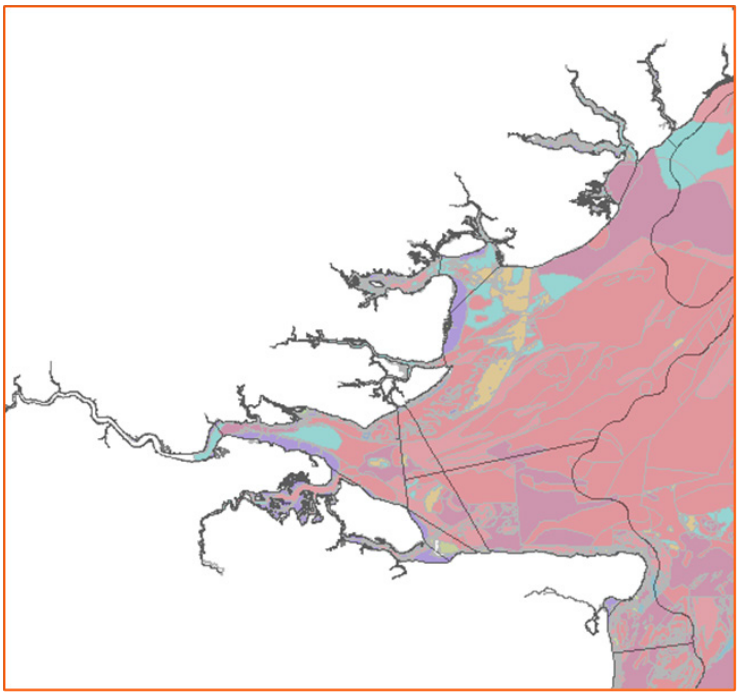

Figure 5.3: Natural England EUNIS III data product. Example polygons: pink = A5.2 (subtidal sand); green = A5.3 (sublittoral mud)

Source: Natural England

The Natural England data product also has layers for Annex I habitats, Marine Conservation Zone (MCZ) features and Marine Special Area of Conservation (SAC) complex features.

5.4 Mapping limitations

At the direction of Natural England, the EUNIS attribute category within the larger Natural England mapping data product was used as the baseline habitat map for the basis of the B6 naturalness scoring. There were, however, a number of issues with the dataset which are detailed below.

No EUNIS Level III data

There is a significant amount of area that is present within the Natural England dataset, where there are habitat polygons, however no EUNIS level III habitat is associated with the polygon. This is noted as 'Unknown' data in Figure 5.6.

An example is provided below in the coastal area outside of the Tees Estuary. Figure 5.4 indicates large areas of no EUNIS III habitat data, shown as a red polygons.

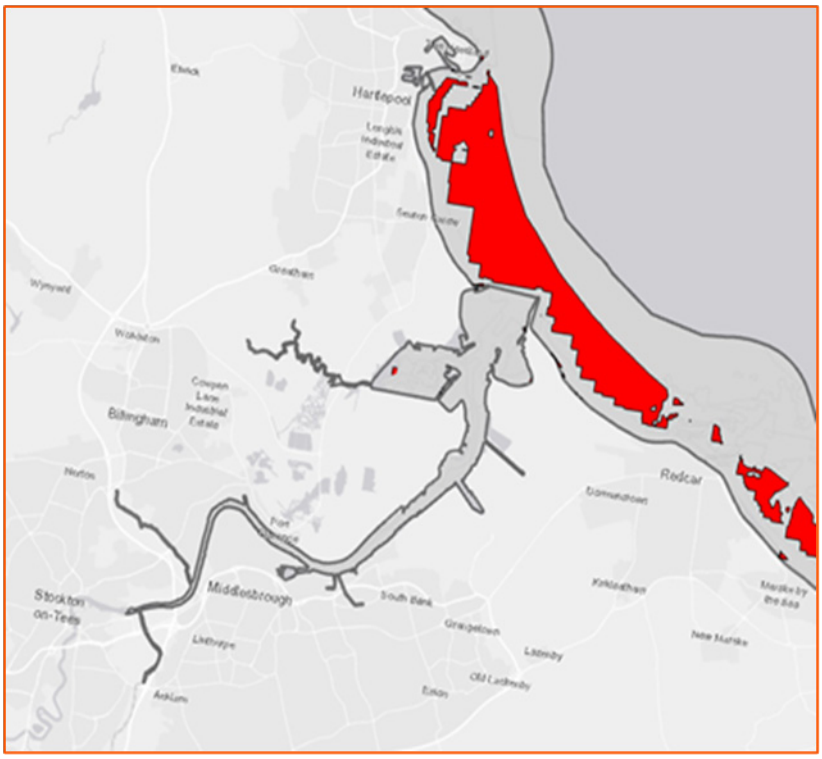

Figure 5.4: Example of Natural England dataset polygons with no EUNIS III data (shown in red) within Tees coastal water body

Source: Natural England

There are also polygons within the Natural England dataset that only contain a EUNIS level II description in the EUNIS Level III attribute. This is likely to be due to the modelled data originally derived as part of the UKSeaMap data that was incorporated within the Natural England data product to fill gaps, which was usually modelled to level II.

No data

There are a number of water bodies that contain at least some areas where there are no habitat polygons at all. This is especially prevalent at upper reaches of larger estuaries, or for large stretches of smaller estuaries. There are other smaller examples where the alignment of the WFD water body layer and the Natural England data product result in small slithers of no data at the land/water boundary. This is noted as 'no_data' in Figure 5.6.

Figure 5.5 below indicates a number of full WFD water bodies that are fully outside the Natural England data product. The figure shows an area around the Thames Middle water body where the Cliffe Fort Lagoon and the Higham Marshes water bodies are not represented in the Natural England data product.

Figure 5.5: Example of areas of waterbody that are outside of the Natural England data product, adjacent to the Thames Middle water body

Source: Natural England

Non-standard habitats

As the Natural England data product was originally developed to facilitate the MCZ designation process, there are a number of remnant MCZ habitat descriptions for a number of polygons within the EUNIS level III attribute. These MCZ habitats were investigated and the corresponding EUNIS level III habitat level derived as shown in Table 5.1. To note the first three (Non_ENG_20 to 22) could only be related to EUNIS level II. ENG relates to the Ecological Network Guidance[5] that was created by Natural England and JNCC for the MCZ designation process.

Table 5.1: MCZ to EUNIS habitat conversion

MCZ Feature	MCZ feature description	EUNIS to use for B6
Non_ENG_20	Infralittoral rock and thin sandy sediment	A3
Non_ENG_21	Infralittoral rock and thin mixed sediment	A3
Non_ENG_22	Circalittoral rock and thin mixed sediment	A4
Non_ENG_23	Infralittoral muddy sand	A5.2
Non_ENG_24	Infralittoral sand mud	A5.3

5.5 Naturalness scoring at water body level

As a number of attributes use Environment Agency data that have already been processed to give a water body score for WFD reporting, it is not possible to obtain a greater level of granularity in the naturalness score to the habitat level. An example of this would be all of the flows attributes (H1a to H1d) and all of the chemical attributes: water quality (C1); dissolved oxygen (C2); dissolved inorganic nitrogen (C3) and opportunistic macroalgae (C4).

[5] Available at: https://hub.jncc.gov.uk/assets/94f961af-0bfc-4787-92d7-0c3bcf0fd083 [Accessed March 2024]

In order to provide an estimation of the naturalness scoring at the habitat level for attributes that can only be scored at the water body level, it was decided after discussion with Natural England, that the area of each habitat will be calculated for each water body. That way, a naturalness score can be given to the area of each habitat present within each water body that is equivalent to the score for that waterbody.

The areas of different habitats present within each water body was derived within a GIS. Figure 5.6 provides an example of the resulting habitat areas for three water bodies.

The Adur estuarine water body is an example of a relatively small estuary, where the majority of the water body (92 out of 137 ha) is represented by polygons with no EUNIS Level III habitat data. The Avon estuary has a better representation of EUNIS Level III data, however there is still a proportion without suitable underlaying EUNIS level III data. The final example is from the Plymouth Sound coastal water body, with only a relatively small proportion of the site without corresponding Level III data (4 ha of no_data and 21 ha of Unknown polygons out of 1,789 ha in total).

wb name	ADUR
Habitat	Sum of Area (ha)
A2.3	31.37
A2.5	13.11
UNKNOWN	92.43
Grand Total	136.90

wb name	AVON
Habitat	Sum of Area (ha)
A1.1	6.37
A1.2	0.04
A1.3	5.66
A2.1	0.90
A2.2	83.25
A2.3	35.85
A2.4	1.19
A2.5	7.81
A2.8	1.27
A3.1	1.42
A5	8.04
A5.1	0.05
no_data	0.64
UNKNOWN	30.32
Grand Total	182.82

wb name	Plymouth Sound
Habitat	Sum of Area (ha)
A1.1	3.21
A1.2	54.47
A1.3	1.58
A2.1	2.53
A2.2	12.69
A2.4	0.35
A3.1	219.29
A3.2	243.44
A3.3	40.59
A4.1	41.58
A4.2	21.80
A4.3	10.38
A5	14.31
A5.1	486.85
A5.2	108.06
A5.3	411.26
A5.4	72.58
A5.5	18.59
no_data	3.83
UNKNOWN	21.23
Grand Total	1788.60

Figure 5.6: Output of calculation of habitats present in water bodies. Examples provided for Adur and Avon estuarine water bodies and Plymouth Sound coastal water body

Source: HR Wallingford

For the majority of naturalness attributes, scoring has been derived from the overall water body level naturalness score, for the area of each habitat (as shown in the Figure 5.6 examples). For example the Plymouth Sound coastal water body has a (H2) Obstacles naturalness score of 1, a (H3) Coastal protection score of 1 and a (P1) Built structures score of 3 (see Appendix B). The score of 1 for (H2) Obstacles and (H3) Coastal protection is used for each of the areas of each habitat for that water body (as shown in Figure 5.6), the score of 3 is used for the area of each habitat shown for (P1) Built structures.

The results for each naturalness attribute are provided at the habitat level for all estuarine and coastal water bodies in the accompanying spreadsheet (DJR6975_Score_Attribute_Habitat_R02-00-Final.xlsx).

Three attributes could be scored using attribute data directly at the habitat level where data exists to show the overlap of a pressure (or activity) with a habitat directly. This was the case for attributes (P2) Fishing pressure, (O1) Anthropogenic light and (O2) Underwater noise. All other attribute scores were derived from the overall water body scores (as shown in Appendix B).

The rational for scoring at the waterbody level or habitat level is included at the end of each attribute section below (Sections 6 to 10).

6 Hydrological naturalness component

6.1 Flows (H1)

6.1.1 Introduction

A natural flow regime is critical to the shaping of the estuarine and near coastal ecosystem and sustaining its characteristic biological communities. One of the attributes highlighted in the Rivers and headwaters element are flows and deviations from what would be considered natural flow, based on a modelled dataset, during different seasons of the year.

6.1.2 Data sourcing

Natural England provided Environment Agency data (Water Resources GIS - WRGIS) that were used for the Rivers element. To ensure consistency between each of the B6 elements, the same data and scoring methodology has been brought into the estuarine and coastal waters assessment.

Whilst the WRGIS data does not give a detailed spatial picture of hydrological modifications to flow regime within water bodies, it does provide a broad portrayal of naturalness levels that is consistent with the indicative nature of B6.

6.1.3 Flows (H1) scoring

The scoring system that was utilised for the estuarine and coastal waters attribute is the same as was used with the Rivers and streams element, however the coastal waters does include an additional step to consider flows from transitional waters into coastal water bodies.

The scoring breakdown can be seen in Appendix A.

For coastal waters, flow from both rivers and estuaries into coastal waters was used to provide a flow score for the coastal water bodies, as recommended by Natural England.

An output from the Environment Agency's WRGIS is shown in Figure 6.2, which is replicated from Mainstone and others (2018 – Figure 8.4) as an illustration. The WRGIS outputs already include a temporal averaging calculation, so averaging of the dataset to smooth out outliers (i.e. highly dry spells or highly wet periods) for the B6 attribute was not required.

As recommended by Natural England, each of the four WRGIS flow percentiles are scored separately. The four flow percentiles reported by the WRGIS are:

- (H1a) Flows QN30 - Recent actual scenario as a percentage of natural flows at Q30;
- (H1b) Flows QN50 - Recent actual scenario as a percentage of natural flows at Q50;
- (H1c) Flows QN70 - Recent actual scenario as a percentage of natural flows at Q70;
- (H1d) Flows QN95 - Recent actual scenario as a percentage of natural flows at Q95.

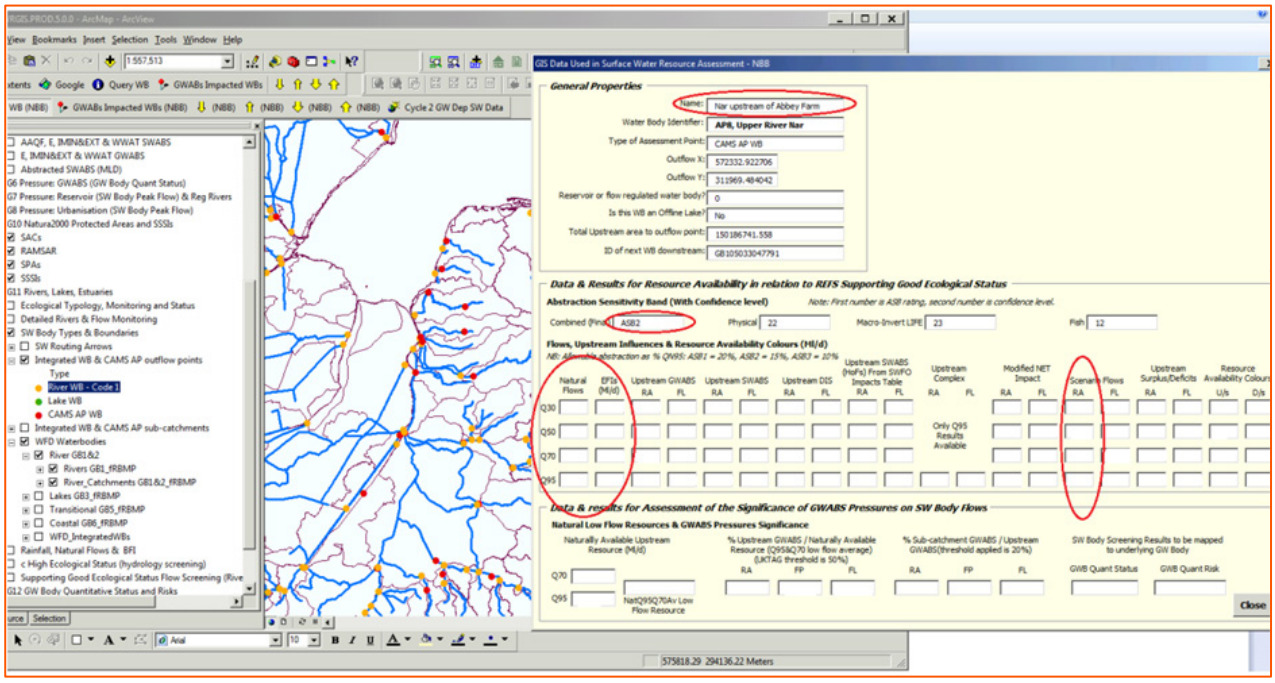

Figure 6.1: Standard output from the Environment Agency's water resources GIS

Source: Mainstone and others (2018) Figure 8.4

The scoring of each of the four Flows (H1) attribute is presented in Appendix A.

6.1.4 Flows (H1) results

The score per water body for Flows QN30 (H1a), QN50 (H1b), QN70 (H1c) and QN95 (H1d) is presented in Appendix B.

The figure showing the distribution for each of the 4 flow percentiles per water body is presented in Appendix C.

6.1.5 Habitat (H1) scoring

All habitat scores for Flows (H1) are provided at the waterbody level.

The data used to calculate the naturalness score are provided by the Environment Agency at the water body level. As such it is not possible to produce a score at the habitat level.

As such, the decision was made to base the habitat score on the water body score.

6.2 Obstacles (H2)

6.2.1 Introduction

There are thousands of man-made and natural obstacles in the rivers of the UK. Some of the man-made obstacles, such as weirs, dams, sluices and road culverts, perform important functions related to navigation or flood protection, but they can also cause problems such as restricting the upstream and downstream movement of fish or damaging river banks and beds by causing excessive erosion or deposition of sediment (Rivers Trust, 2022).

6.2.2 Data sourcing

The Environment Agency maintains a dataset on obstacles. This dataset included obstacles that are noted as (not exhaustive list):

- Waterfalls;
- Weirs;
- Locks;
- Dams;
- Sluices;
- Mills;
- Unknown.

There are also other descriptors that note the likely origin of the structure, as either man-made or natural. All of the obstacles are man-made, apart from most waterfall obstacles. The presence of any of these man-made obstacles is an unnatural feature that will, in some way, block movement of material (sediment/water) or animals and plant propagules towards the marine environment, or back from the marine into the freshwater environment.

Figure 6.2 provides an examples of the obstacles that are located adjacent to a number of south Devon estuaries.

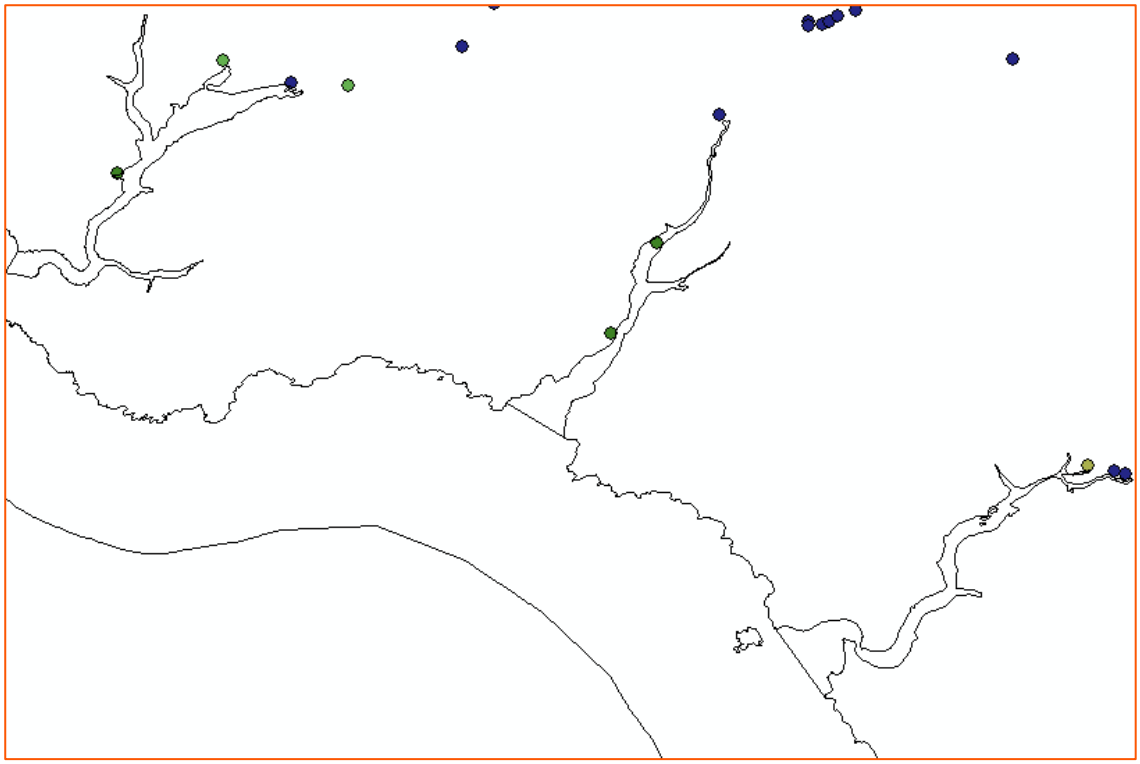

Figure 6.2: Obstacles data shown for a number of southwest estuaries: Yealm; Erme and Avon in Devon. Dark green = sluice; light green = weir; purple = culverts; light green = mill

Source: Environment Agency - The River Obstacles dataset is an inventory of weirs, waterfalls, sluices, dams, culverts, fords and flap gates

6.2.3 Data processing

When applying this data in the indicator analysis, there was a need include a buffer analysis to the obstacle data, as the data points are both inside estuarine and coastal water body areas and also just outside. Obstacles just outside the water body that were associated with a particular water body, within a buffer zone of 100 m, were initially retained in the analysis. The association of obstacles close to a particular water body was completed through an autonomous GIS association task. However, all of the outputs were then manually checked to ensure each were assigned to the correct water body.

Figure 6.3 and Figure 6.4 provide an indication of the manual process that was followed after the automated assignment of obstacles to water bodies. Figure 6.3 shows the upper part of the Tamar estuary with two obstacles inside the water body and three outside. Although the three outside obstacles were within the buffer distance, only the closest obstacle was retained and counted. Figure 6.4 shows a series of culverts that run into the Arun River, a total of 10 culverts. Again, only the closest culvert was counted. In this way the removal of the closest obstacle (i.e. culvert) will have no effect on the scoring as the next closest is then counted. If interventions were planned it would, for example, require work to address each of the series of culverts at that location. To avoid skewing the overall water body score where there are multiple obstacles at a given location, only one of these was counted at each location. However, when in the future obstacles are removed to improve the naturalness of water bodies, the whole series of obstacles will need to be removed to achieve an improvement of naturalness score.

To allow this manual process to be followed for future B6 assessment rounds, it is recommended that a how-to guide is provided as part of the next phase of this indicator development.

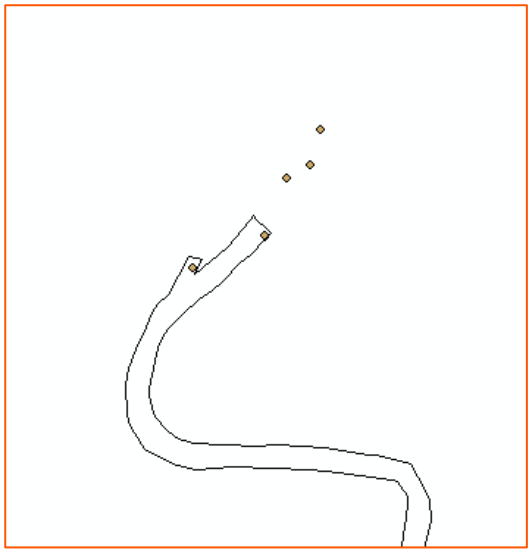

Figure 6.3: Upper Tamar estuary

Source: EA - Obstacles dataset

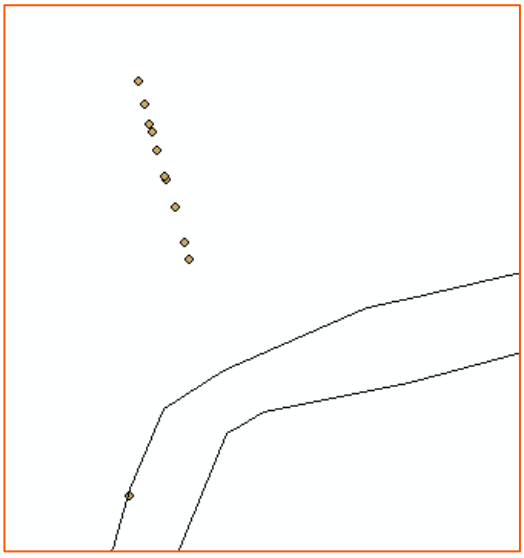

Figure 6.4: Part of the Arun River

Source: EA - Obstacles dataset

6.2.4 Obstacles (H2) scoring

Through consultation with Natural England on the scoring applied to obstacles, it was considered that each type of obstacle could potentially be attributed a particular naturalness score. The rationale was that one weir with a large water level difference may be more unnatural than a number of smaller culverts leading into a particular water body. Whilst this is potentially correct, this level of detail is extremely difficult to produce for a nationwide dataset. This may form part of a future assessment round for the B6 indicator but it has not been possible to accommodate separate scoring of obstacles for interim scoring.

As such the scoring only considers the number of obstacles that lead into each water body, once they have been processed as described in Section 6.2.3.

Following advice from Natural England, the scoring for this attribute considers the size of the water body, and so the overall score is related to the number of obstacles per water body area (Km^2). The scoring for obstacles is:

- No obstacles = 1 (most natural);
- Less than 0.1 obstacles per km^2 = 2;
- 0.1 to 0.5 obstacles per km^2 = 3;
- 0.5 to 2 obstacles per km^2 = 4;
- Over 2 obstacles per km^2 = 5 (most unnatural).

The scoring of the Obstacles (H2) attribute is presented in Appendix A.

6.2.5 Obstacles (H2) results

The score per water body for Obstacles (H2) is presented in Appendix B.

The figure showing the Obstacle (H2) score per water body is presented in Appendix C.

6.2.6 Habitat (H2) scoring

All habitat scores for Obstacles (H2) are provided at the waterbody level.

Although a particular obstacle will be adjacent to, or near to a particular habitat, the effect of the obstacle on reducing upstream movement of fish and downstream movement of water, cannot just be attributed to the adjacent habitats.

As such, the decision was made to base the habitat score on the water body score.

6.3 Coastal protection (H3)

6.3.1 Introduction

The degree to which a stretch of estuary or coastline includes coastal protection or coastal defence structures is the last hydrological estuarine and coastal waters attribute. This can determine the physical naturalness and determine if an estuarine or coastal system can interact with zones landward. It is closely linked to the ability of the estuarine or coastal water body's ability to flood into its natural flood zone.

6.3.2 Data sourcing

The main datasets (shown in the example in Figure 6.5) utilised for the H3 attribute scoring was the National Coastal Erosion Risk Mapping (NCERM) dataset. It was initially considered that a combination of the NCERM and the Zone 3 flood map (shown in Figure 6.6) would be used in combination to determine the attribute score. Both figures present the data for the Hamford Water, Stour and Orwell water bodies, on the east coast.

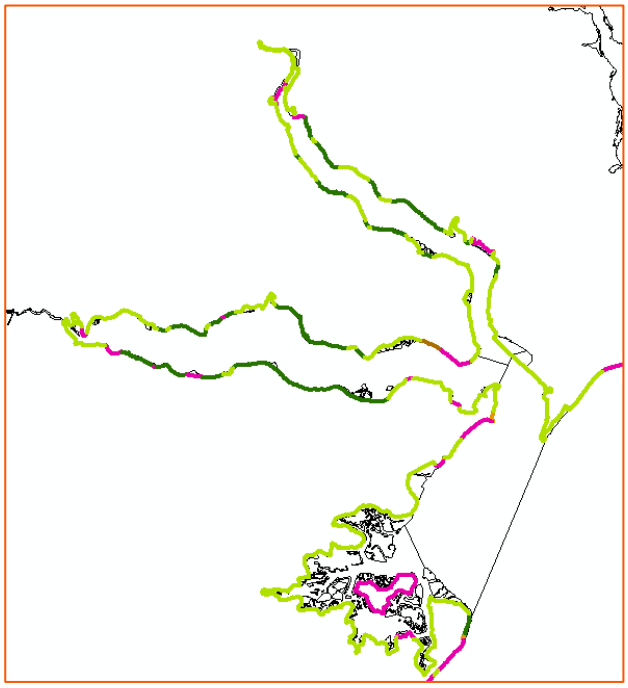

Figure 6.5: NCERM data layer showing floodable areas (light green); natural defence lines (dark green) and embankments (pink)

Source: National Coastal Erosion Risk Mapping data, Environment Agency

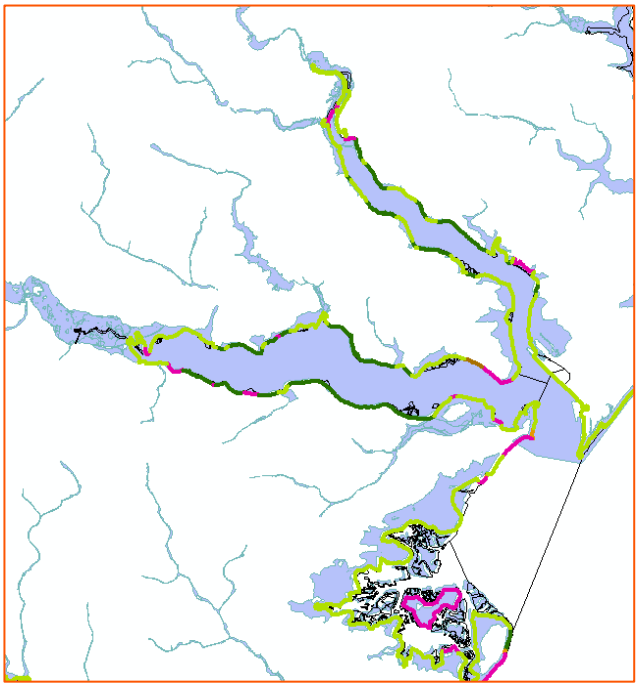

Figure 6.6: Zone 3 Flood map shown behind NCERM layer

Source: Flood Map For Planning Rivers And Sea Flood Zone 3, Environment Agency

As the NCERM is partially created using the same base data as the Flood Risk Zone 3 map, the main scoring for the attribute was calculated from the NCERM dataset only. The 'floodable' defence type record (NCERM) is derived from the areas that flood as represented with the Flood Risk Zone 3 map.

However, since the NCERM data does not cover all water bodies, or the full extent of all water bodies (for example upper Thames or upper Humber) the Flood Zone 3 map has been used to manually check water bodies where there is a lack of NCERM data.

6.3.3 Data processing

An initial step in the processing of the NCERM data, was to associate the defence type record to a particular water body. This was initially an automated GIS action, however it required manually checking and splitting and editing of boundaries. An example is provided in the two figures below. Figure 6.7 shows part of the Exe estuary. The area indicated by the green (western) oval shows an area of water body where the line of defence does not completely match the line of the water body, however it is considered a reasonable representation for this analysis. However, the area denoted by the blue oval indicates and area of defence which is completely outside of the water body.

As such the NCERM defence features within the blue (eastern) oval were 'snipped' in GIS so the line of defence well outside the water body was not associated with any estuarine or coastal water body and not included in the scoring. The resultant NCERM data included in the scoring is shown in Figure 6.8 for the Exe estuary.

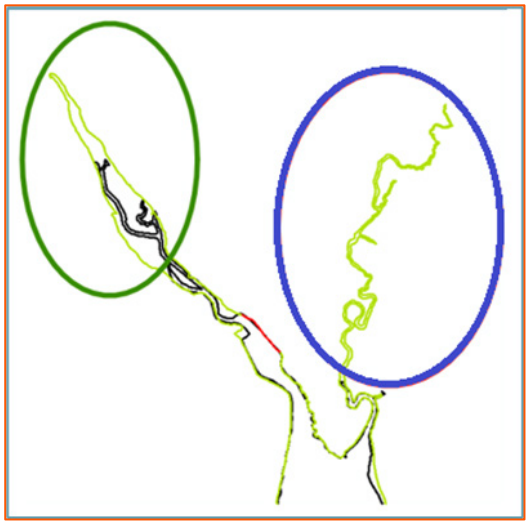

Figure 6.7: Exe estuary pre-snip

Source: Environment Agency - NCERM

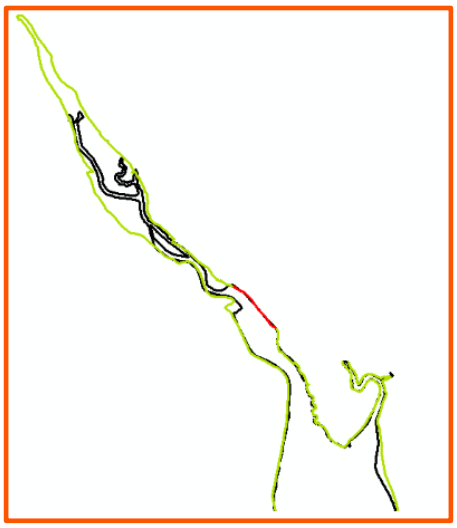

Figure 6.8: Exe estuary post-snip

Source: Environment Agency - NCERM

To allow this manual process to be followed for future B6 assessment rounds, it is recommended that a how-to guide is provided as part of the next phase of this indicator development.

6.3.4 Defence type

There were a number of different defence types noted within the NCERM dataset. This included both natural and manmade. The manmade defences were then divided between those that were floodable and those that were non-floodable. As it was difficult to consistently allocate different scores to each type of non-floodable manmade defences, each of these were treated the same when scoring the attribute. The score per defence line of each type is provided below:

- Natural = 1;
- Floodable = 2;
- Embankment (non-floodable) = 5;
- Gabions (non-floodable) = 5;
- Revetment (non-floodable) = 5;

- Seawall (non-floodable) = 5;
- Timber structure (non-floodable) = 5.

The final scoring for the water body was based on the overall length of defences used in the calculation.

6.3.5 Managed realignment areas

Managed realignment areas were highlighted as an important area to consider as, although they are unnatural human interventions, the intention is to create a natural marine system. All managed realignment sites are noted as 'Floodable' in the NCERM, and as such automatically obtain a naturalness score of 2.

6.3.6 Scoring of water bodies with insufficient NCERM data

There were a number of the smaller estuarine water bodies that had insufficient, or completely lacking NCERM data. This also included all lagoon sites.

A manual check was performed on these water bodies where the NCERM data were low or entirely lacking. An initial check of defence area versus water body boundary length provided an indication of likely coverage of the NCERM data to accurately represent the full water body. Each of the water bodies that had low (i.e. <50% NCERM boundary data compared to water body boundary length) were manually checked. This visual check included adding the Flood Zone 3 map layer to provide an indication of the floodable nature of these area.

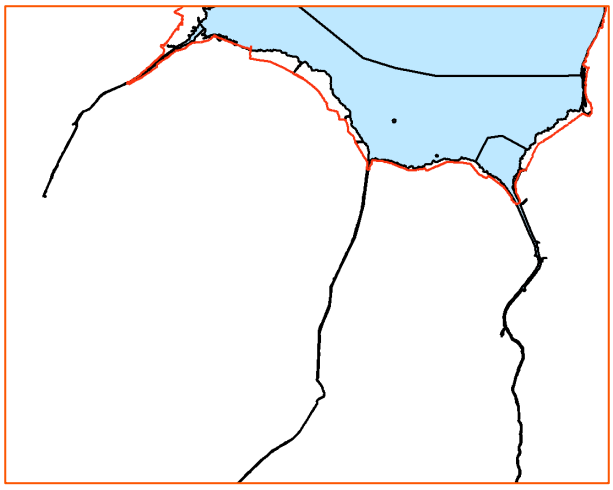

Figure 6.9: Wash Area NCERM data only

Source: Environment Agency

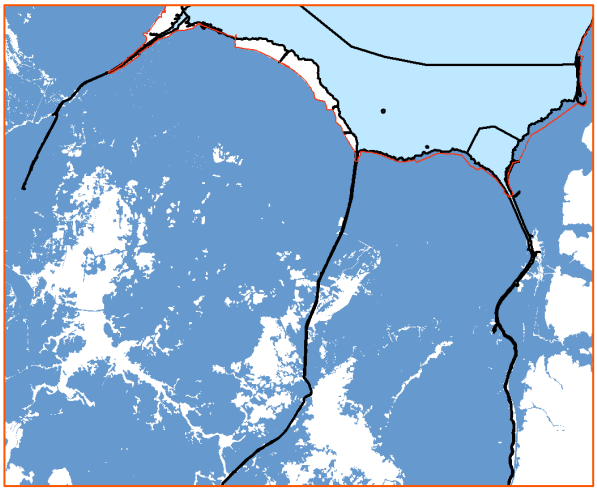

Figure 6.10: Wash area NCERM and Flood Zone 3

Source: Environment Agency

Figure 6.9 indicates an area just to the south of the Wash. There are three smaller estuarine water bodies: the Welland; the Nene; and the Great Ouse. The Welland is represented by c. 50% coverage by NCERM data (indicated by the red polyline representing floodable defences), whereas the Nene is not represented by any NCERM data. The Great Ouse includes approximately 20% coverage.

For each of these water bodies there was the need to manually check against the Flood Zone 3 map. This is shown in Figure 6.10, where the dark blue colour denotes flooded land. As it is clear that each of these water bodies are able, for the majority of their length to flood, this has been manually updated to 100% floodable. This included all of the ponds, pools, lagoons and marshes sites, which were manually scored as 2 (floodable).

Naturalness score calculated as an average of each of the scores from each of the different defence types, worked out for the total defence length present within the water body. As such there are not statistically defined classed. But in general:

- All natural defences = 1 (most natural);
- Floodable defences = 2;
- Some non-floodable defences = 3;
- Mostly non-floodable defences = 4;
- All non-floodable defences = 5 (lease natural).

The scoring of the Coastal protection (H3) attribute is presented in Appendix A.

6.3.7 Coastal protection (H3) results

The score per water body for Coastal protection (H3) is presented in Appendix B.

The figure showing the Coastal protection (H3) score per water body is presented in Appendix C.

6.3.8 Coastal protection (H3) future development

It would be beneficial for future development of the NCERM dataset to note the presence or absence of a boundary defence feature for all estuarine and coastal water bodies. This may include the notation of some polylines to show that there are defence lines missing. This will reduce the manual processing to removing some of defence that are outside of water bodies, and will ensure data are provided for all small water bodies.

6.3.9 Habitat (H3) scoring

All habitat scores for Coastal protection (H3) are provided at the waterbody level.

Although a particular section of coastal protection will be adjacent to, or near to a particular habitat, the effect of the coastal protection on reducing the ability of the adjacent area to flood naturally and the ability of the habitats to migrate landward, cannot just be attributed to the adjacent habitats.

As such, the decision was made to base the habitat score on the water body score.

7 Physical naturalness component

7.1 Built structures (P1)

7.1.1 Introduction

The degree to which structures have encroached onto the shore, as well as over watercourses, such as railway and road bridges has been investigated and is considered suitable as an attribute.

7.1.2 Data sourcing

It is possible to quantify the area that is taken up by structural components, which can be measured directly via area analysis of the Ordnance Survey's MasterMap Topography Layer. The benefits of using this dataset is that it is readily updated (every six weeks) and would allow for suitable change analysis, for example every 5 years that is envisaged for repeating the indicator scoring. The OS MasterMap Topography layer has attributes that can be symbolised by 'Make' which will allow for the required calculation of built structures. The 'Make' attribute included:

- Manmade: this is either buildings, roads, or on the coast jetties, piers, pontoons etc;

- Multiple: This is best illustrated by gardens next to residential properties;
- Natural: This is both natural grassland, forest, as well as natural foreshore at the coast;
- Unclassified: Not many examples at the coast; and
- Unknown: Not many examples at the coast.

An example is shown for a small stretch of the southern bank of the Thames Estuary in Figure 7.1 and Figure 7.2, immediately south of Tilbury 2.

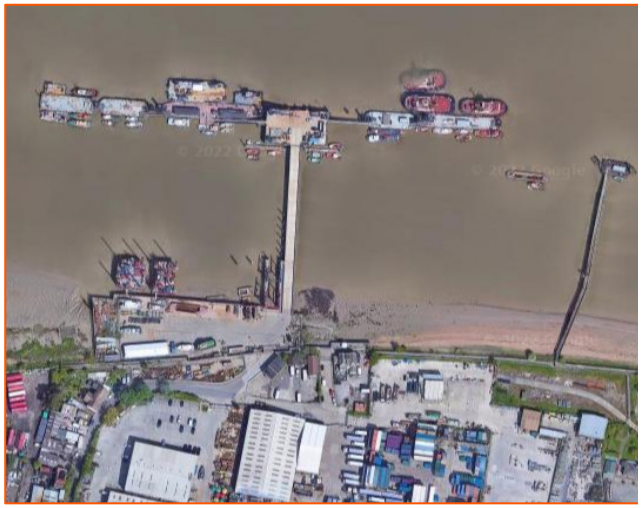

Figure 7.1: Aerial image of jetty (2021) on south bank of Thames estuary

Source: Google Earth

Figure 7.2: MasterMap Topo layer of same location (2011 data). Grey = manmade; green = natural; yellow (not on image) = multiple

Source: MasterMap. © Crown Copyright and database rights 2022. Ordnance Survey 100022861

Figure 7.1 provides an aerial image of the area in 2021. Figure 7.2 indicates the OS MasterMap Topography layer of the same area, however the data are from 2011. This example, using an older dataset, clearly shows where there has been development of the pier structure between 2011 and 2021.

7.1.3 Data processing

By clipping in GIS of all of the manmade (grey) polygons within a water body, a calculation of area was performed to determine the area of built structure per water body. There was no distinction made between any of the various structures that were classified as manmade, the scoring was simply based on the total area that was either within, or above a water body.

To better represent the area of built structures present within and across different water bodies, some consideration was required for the total area of the actual waterbody. For example the same area of built structures in a small water body, is likely to be less natural than the same area in a very large water body. This is especially apparent for coastal waterbodies that are, generally larger in size than transitional water bodies.

As such a GIS calculation was performed to determine the area of intertidal (or foreshore) within each water body. Then a manual process was followed to determine if the total water body area, or the area of foreshore present in a water body, should be used as the basis for comparison with the area of built structures.

In general:

- Smaller transitional water bodies (less than 10 km^2) used the whole water body area;
- Coastal water bodies used the mapped foreshore areas;
- Some manual assignment was required for transitional water bodies (greater than 10 km^2), where for the most part, used the available foreshore area for comparison.

The assignment of the area of each water body (whole area or foreshore area) is presented in an associated scoring spreadsheet for Built structures that accompany this report (P1_Built_Structures_Manmade_Scoring.xls).

To allow this manual process to be followed for future B6 assessment rounds, it is recommended that a how-to guide is provided as part of the next phase of this indicator development.

7.1.4 Built structures (P1) scoring

The scoring for built structures is provided below:

- No built structures in the water body = 1 (most natural);
- 0.1 to 1 built structure area (km^2) over total available water body area or foreshore area (km^2) = 2;
- 1 to 2 built structure area (km^2) over total available water body area or foreshore area (km^2) = 3;
- 2 to 5 built structure area (km^2) over total available water body area or foreshore area (km^2) = 4;
- More than 5 built structure area (km^2) over total available water body area or foreshore area (km^2) = 5 (most unnatural).

The scoring of the Built structures (P1) attribute is presented in Appendix A.

7.1.5 Built structures (P1) results

The score per water body for Built structures (P1) is presented in Appendix B.

The figure showing the Built structures (P1) score per water body is presented in Appendix C.

7.1.6 Habitat (P1) scoring

All habitat scores for Built structures (P1) are provided at the waterbody level.

Although a particular built structure will be adjacent to, over, or near to a particular habitat, the effect of the built structure cannot just be attributed to the adjacent habitats. This is especially the case where an area of previously marine habitat has been replaced with a revetment or other coastal protection or defence structure, or manmade seabed, which cannot be attributed to a particular habitat.

As such, the decision was made to base the habitat score on the water body score.

7.2 Fishing pressure (P2)

7.2.1 Introduction

One of the biggest impacts on marine areas is that associated with fishing pressure. The type of fishing activity, its duration and frequency in a particular area will produce varying degrees of pressure that could impact the naturalness of the area. Generally the most impacting method is bottom trawling, although it is known that there are various types of bottom trawling. Less direct impacts are associated with other forms of fishing, for example, potting, however naturalness is

likely to also be impacted by potting as it removes key species that form part of the ecological make-up of the area.

There is currently no data set that adequately shows fishing activity across all fishing vessels. The requirement for larger fishing vessels (over 12 m in length) to have a vessel monitoring system (VMS) means that the more predominantly offshore, or at least beyond 1 nm vessels are monitored.

7.2.2 Data sourcing

The fishing effort in estuarine and coastal waters is also made by many under 12 m vessels. As such the MMO data does not (currently) provide a suitable dataset that can be used for the B6 estuarine and coastal waters indicator. An alternative, that has been used for by a number of regulatory bodies over the last few years, is a composite dataset called FisherMap. FisherMap was first put together to assist in the designation process for the first tranche of Marine Conservation Zones (MCZ). The current FisherMap was last updated in 2012. Although this is dataset is now unlikely to reflect the current effort, it does show what can be achieved with a fishing effort dataset that covers all of the estuarine and coastal waters and displayed in a consistent format.

A snapshot of FisherMap data, indicating the dredging fishing pressure layer is shown in Figure 7.3.

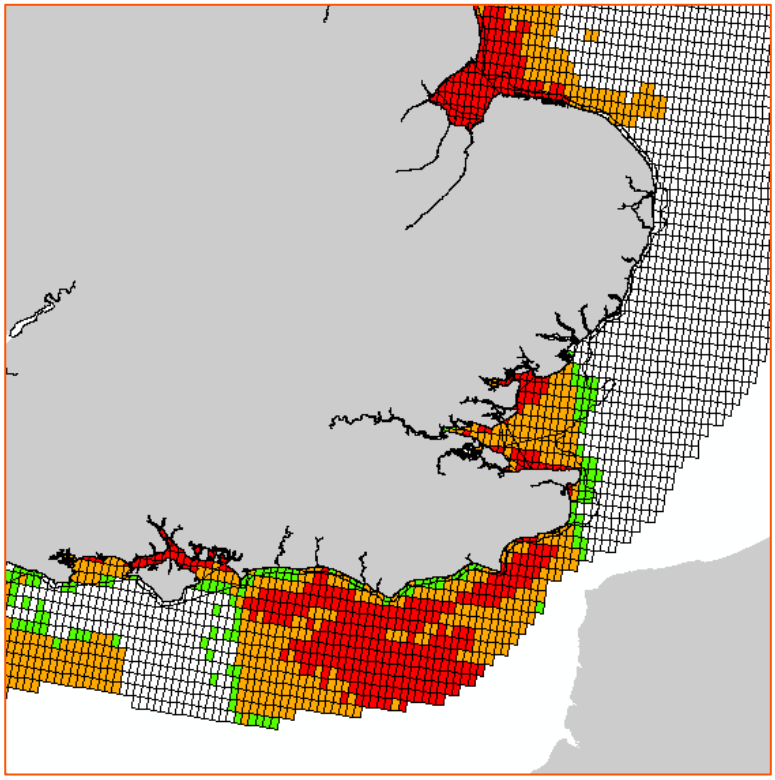

Figure 7.3: Snapshot of FisherMap data, showing Dredging fishing pressure
Source: Natural England

7.2.3 Data processing

The scoring that has been applied to the fishing data required stacking the various different fishing types included within the FisherMap data. Data are only included where there in an interaction with the seabed in some way, which includes the following three pressure layers:

- Dredging fishing;

- Demersal fishing; and
- Pots fishing.

These different fishing types were weighted in the order they are listed in the bullets above, with the dredging pressure layer having a higher weighting than the demersal layer, and the potting layer having the least weighting. This reflects the relative impact these fishing types are likely to have on the naturalness of the seabed.

7.2.4 Fishing pressure (P2) scoring

Initial processing of the FisherMap data were required to assign each of the fishing pressure polygons with a particular water body. Some water bodies, especially at the coast may only have a small part of a fishing pressure polygon. As such an initial GIS task was to generate a clean fishing pressure layer where there was no data outside of water bodies represented. Figure 7.4 indicates the fishing layer between the Thames and the Blackwater area for dredging. The same area is represented in Figure 7.5 for demersal fishing.

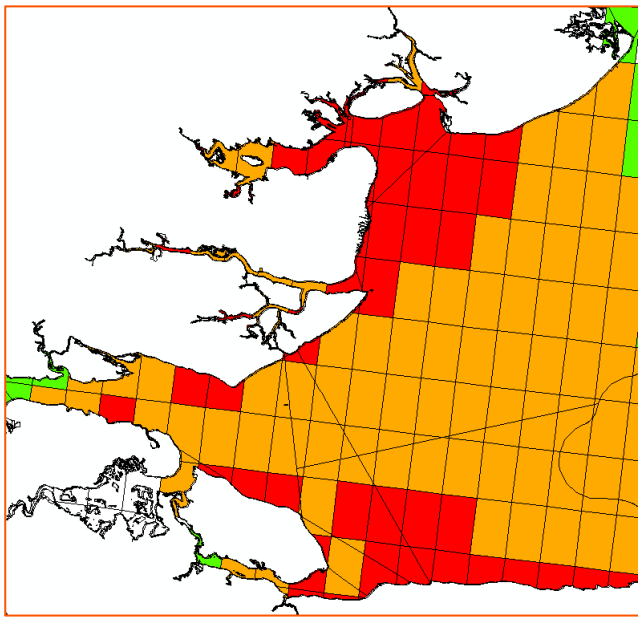

Figure 7.4: Dredging layer for Thames to Blackwater area

Source: FisherMap - Natural England

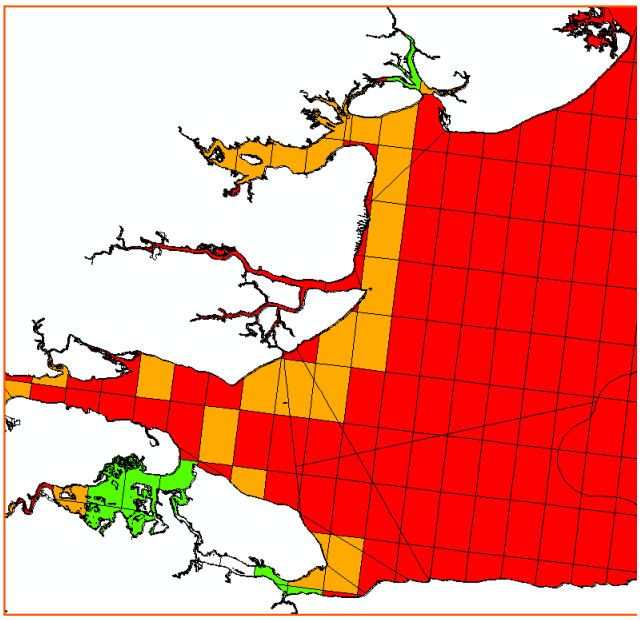

Figure 7.5: Demersal fishing layer from Thames to Blackwater area

Source: FisherMap - Natural England

Each of the small FisherMap activity polygons (representing an area of sea of c.19 km^2) was exported to Excel, each with a unique cell code. The activity exposure type (High; Moderate; Low and No exposure) was also exported for each cell for each of the three fishing types.

Each of the polygons was then scored on the basis of a combination of each of the fishing types and their associated exposure type. The cell-based scoring, for the dredging layer (Figure 7.4) was:

- High exposure (red) = Score 4;
- Moderate exposure (orange) = Score 3;
- Low exposure (green) = Score 2;
- No exposure (white) = Score 1.

The Demersal layer was then scored, with the score being added to the dredging score for each cell. The scoring applied for the demersal fishing type is provided below:

- High exposure (red) = Add 2 to dredging score;
- Moderate exposure (orange) = Add 1 to dredging score;
- Low exposure (green) = Add 0.5 to the dredging score;
- No exposure (white) = No addition to the dredging score.

The potting layer was then scored, with the score being added to the two combined scores above (dredging + demersal). The scoring of the potting layer is provided below:

- High exposure (red) = Add 1 to the dredging + demersal score;
- Moderate exposure (orange) = Add 0.5 to the dredging + demersal score;
- Low exposure (green) = Add 0.2 to the dredging + demersal score;
- No exposure (white) = No addition to the dredging + demersal score.

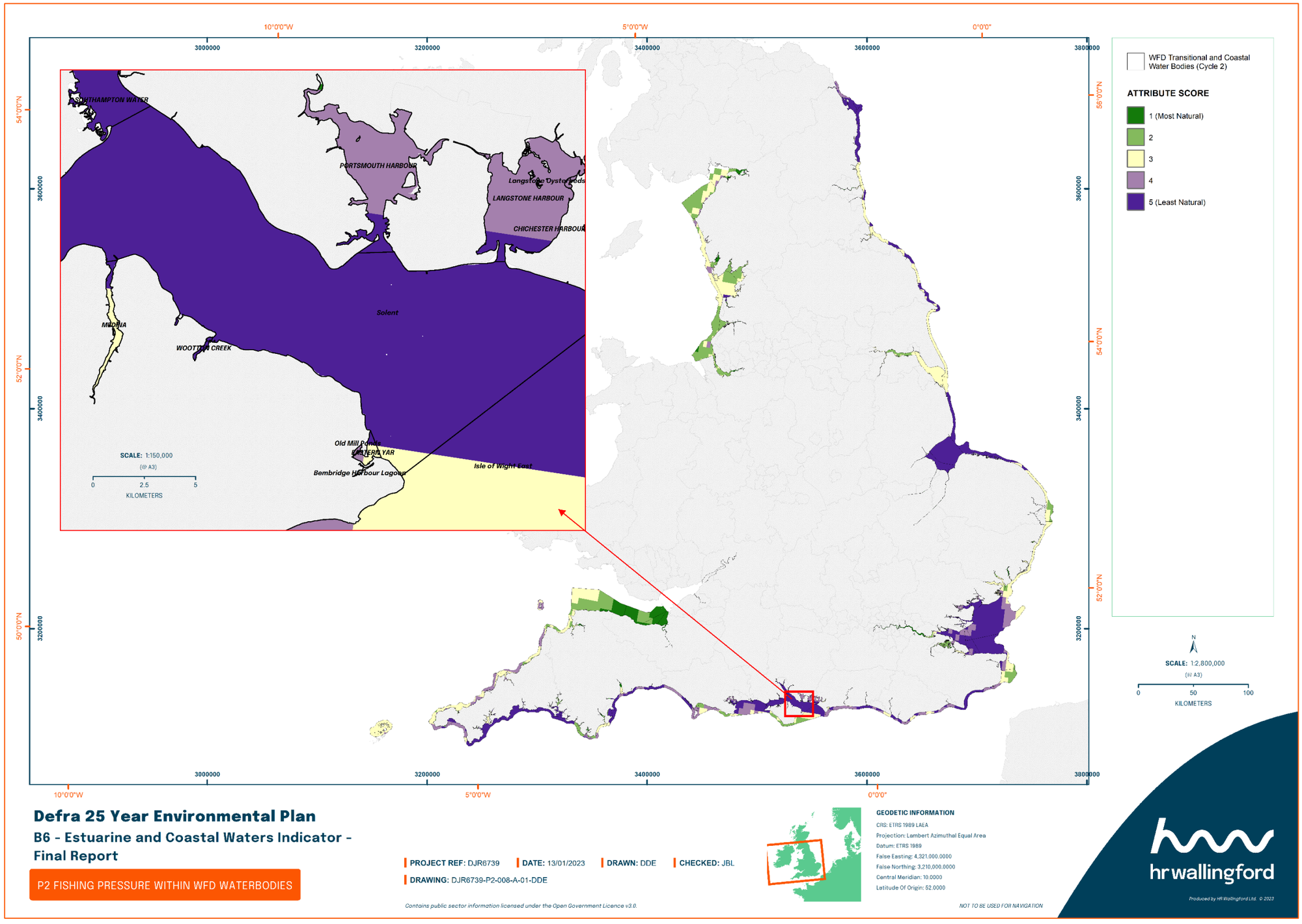

Figure 7.6: Combined fishing pressure map (not water body only score) – FisherMap (Natural England)

A high score for each of the three layers results in a score of 7, however the total score would be capped at 5 per unit area. This total fishing pressure score per unit area, (1-5) was then be mapped as a new layer within the GIS (shown in Figure 7.6). This will mean that some reductions in fishing pressure may not result in changes to the naturalness score, as changes in score from 7 to 6, or 6 to 5, will not register as a change in naturalness score. As fishing pressure, especially demersal dredging, is considered to cause high levels of disturbance to natural habitats, this is considered suitable for the assessment of naturalness. This approach may however be challenged by the fishing industry.

The final, combined score layer was clipped to water body boundaries, and a score per area calculated (Shown in Appendix B).

Finally the area of each of the 5 naturalness scores were derived from the GIS to give an area covered for each score for each water body. The overall water body score was derived as an average of pressure score over the area of the entire water body.

The scoring of the Fishing pressure (P2) attribute is presented in Appendix A.

7.2.5 Fishing pressure (P2) results

The score per water body for Fishing pressure (P2) is presented in Appendix B.

The figure showing the Fishing pressure (P2) score per water body is presented in Appendix C.

7.2.6 Fishing pressure (P2) future development

There are some known caveats with the FisherMap data product, such as the information level that went into the product was partly informed by verbal fisherman accounts. As such it is intended to be an interim data product that shows a proof of concept. There are plans to introduce monitoring systems onto smaller inshore vessels[6] (iVMS), which in combination with more digital recording of fishing kit usage and fishing times, will provide future datasets that are readily available and potentially suitable for future rounds of the B6 indicator scoring.

The FisherMap dataset does not include any pressures that are likely to be associated with aquaculture activities, apart from dredging activities for shellfish. Although a separate dataset had been obtained, which is a combination of MMO and Cefas data, and shows the range of activities that occur within English waters, it has not been possible to amalgamate the aquaculture aspect into the fishing pressure assessment at this stage. A future (potentially MMO derived) dataset that includes VMS, iVMS and aquaculture pressure would provide a definitive and consistent dataset for future rounds of the B6 indicator scoring.

7.2.7 Habitat (P2) scoring

All habitat scores for Fishing pressure (P2) are provided at the habitat level.

As underlying fishing pressure data is not at the water body level, and is available at a resolution that can be overlaid with habitat locations, the decision was made to base the habitat score on comparison of fishing pressure and EUNIS level III habitats directly.

[6] UK Government Guidance: Inshore Vessel Monitoring (I-VMS) for under-12 m fishing vessels registered in England. Available online at: https://www.gov.uk/guidance/inshore-vessel-monitoring-i-vms-for-under-12m-fishing-vessels-registered-in-england [Accessed Feb 2023]

7.3 Combined other activities (P3)

7.3.1 Introduction

There are a large range of other activities, both licensable and un-licensable that take place in estuarine and coastal waters that are likely to alter the naturalness of water bodies. One attribute containing an amalgamation of a number of different activities was therefore created, in part as the spatial distribution of activities in generally skewed in certain parts of the country. As such, having separate attributes per activity, would result in most water bodies containing no data.

7.3.2 Data sourcing

There are a number of activities that are licensable by The Crown Estate (TCE - Open Data Portal[7]), and activities that are either licenced or reported (but otherwise un-licensable at present) from the MMO. Data are also collated and provided as part of the European Marine Observation and Data Network (EMODNet)[8]. In addition, it is difficult to determine if activities that are presented in EMODNet data are duplicates of, or separate activities to that presented in the MMO data.

Due to the difficulties in adequately separating licensable and un-licensable activities, as well as the same activities but from a different data source, these have been combined and are scored as one attribute, covering all other activities that can affect the naturalness of the seabed. These activities are not evenly distributed throughout the country.

A list of the marine activities that have been included in the combined activity layer are shown below, with the main data source indicated in brackets:

- Offshore Wave Site Agreements (TCE);
- Offshore Wind Site Agreements (TCE);
- Offshore Minerals Aggregates Site Agreements (TCE);
- Offshore Wind Cable Agreements (TCE);
- Offshore Natural Gas Storage Pipeline Agreements (TCE);
- Offshore Minerals Mining Site Agreements (TCE);
- Powerboating or sailing with an engine: mooring and/or anchoring (MMO);
- Sailing without an engine: mooring and/or anchoring (MMO);
- Aggregate/navigation dredging locations (MMO);
- Pipelines (EMODNet);
- Telecom cables (EMODNet);
- Fibre cables (EMODNet);
- Telecommunication cables (EMODNet);
- Submarine cables (EMODNet);
- Cables (EMODNet);
- Dredge spoil dumping (EMODNet);
- Aggregate areas (EMODNet).

[7] The Crown Estate: Open Data Portal. Available online at: https://opendata-thecrownestate.opendata.arcgis.com/ [Accessed Jan 2023]
[8] European Marine Observation and Data Network (EMODnet) available online at: https://emodnet.ec.europa.eu/en [Accessed Jan 2023]

7.3.3 Data processing

During the development phase (Bleach, 2022) it was envisaged that each activity would have a naturalness score. This would represent the level of alteration from naturalness that was due to the activity occurring. However it has not proved possible to determine separate scores per activity, as ultimately what effect the activity has on naturalness will also depend on the local sensitivity of the environment and its ability to recover following the disturbing activity.

As such it was decided that all activities would be treated the same and would therefore consider the area of water body that is taken up by these combined activities, as a percentage of the total water body area. In addition, due to the fact different activities can occur in the same area, each of the different activities are calculated separately and then added together. This can mean one area of seabed is counted a number of times, if for example there is a cable route through the area, plus it is used for anchoring. This double-counting of some areas helps to represent a repeated disturbance to a particular area.

7.3.4 Buffering

Each of the activity layers was first buffered by 50 m, as its likely that most of the activities disturb an area that is ultimately larger than the represented polygon. For example, dredging and disposal activities are likely to also effect, to varying degrees, areas of seabed in the near vicinity. Cabling activities, for example can also effect wider areas by the methods used to install the routes, and also required to maintain and replace old systems. This will also include the need for rock armour or other scour protection in some cases.

A snapshot of the TCE data are provided in Figure 7.7 from the northwest coast. This shows the complexity of TCE data and how they are partially (sometimes fully) located within estuarine and coastal waters.

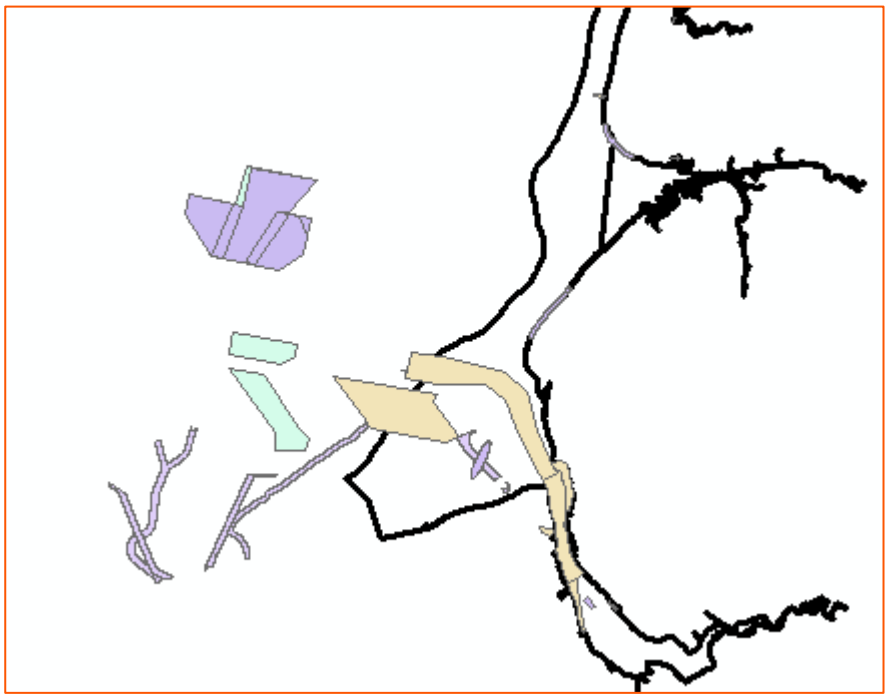

Figure 7.7: Snapshot of TCE licensable activities in the northwest, in the south east Liverpool Bay area

Note: Purple lines = cable routes; yellow polygon = navigational dredge areas; green polygon (although all offshore) = sand production area; purple polygon (although all offshore) = aggregate extraction site

The scoring for combined other activities follows the scheme below:

- No activities within water body = 1 (most natural);
- Less than 1% water body area covered by other activities = 2;
- 1 - 10 % water body area covered by other activities = 3;
- 10-20 % water body area covered by other activities = 4;
- Over 20% water body area covered by other activities = 5 (least natural).

The scoring of the Combined other activities (P3) attribute is presented in Appendix A.

7.3.5 Combined other activities (P3) results

The score per water body for Combined other activities (P3) is presented in Appendix B.

The figure showing the Combined other activities (P3) score per water body is presented in Appendix C.

7.3.6 Combined other activities (P3) future development

One master activities layer should be maintained for future rounds of the B6 indicator assessment. It is recommended that the activity layer that Natural England currently manages is maintained and used as the baseline for future assessments.

7.3.7 Habitat (P3) scoring

All habitat scores for Combined other activities (P1) are provided at the waterbody level.

The data used to calculate the naturalness score are provided by a number of data sources. Data are usually polygons or polylines that could potentially be assigned to a habitat which they go through, or are adjacent to. However the activity itself will often cause alterations to the habitat present, potentially changing it form one EUNIS level III habitat to another. An example would be continued maintenance dredging in a particular area or aggregate dredging, or the placement of rock armour as a result of cabling or pile installation and it is difficult to assess against a particular habitat.

As such, the decision was made to base the habitat score on the water body score.

8 Chemical (water) naturalness component

8.1 Introduction

Most of the Chemical (water) naturalness component attributes are closely related to those that have been developed for the Rivers and streams part of the B6 indicator.

The Environment Agency regularly collect water samples from a number of estuarine and coastal water bodies as part of their monitoring for the purpose of fulfilling obligations under the Water Environment (Water Framework Directive) Regulations.

At present, monitoring is done on a surveillance basis, where water bodies that are more likely to change status are monitored more frequently. As such this is not currently a fully representative dataset for all estuarine and coastal waters, however, if this is a requirement for the Defra Indicator programme, there is the potential that other water bodies can be monitored more frequently in the future.

As a result of the engagement with the Environment Agency following the development of initial list of indicators and scoring (Bleach, 2022), scoring of each of the attributes that rely on WFD data, should utilise the same status score as provided as part of the Cycle 3 outputs. Whilst it is noted that status for WFD reporting does not necessarily relate to a naturalness score for the

estuarine and coastal waters B6 indicator, as the WFD statuses are, for the most part, presented as one of 5 classes, for the purposes of this interim scoring, a direct read over was assumed appropriate. This would mean that:

- WFD High status = 1 B6 indicator (Most natural);
- WFD Good status = 2 B6 indicator;
- WFD Moderate = 3 B6 indicator;
- WFD Poor = 4 B6 indicator;
- WFD Bad = 5 B6 indicator (least natural).

For some WFD categories, status is not presented with the full 5 bands. Where this is the case the corresponding status and level is still used, noting the lack of some of the intermediary levels.

8.2 Water quality (C1)

8.2.1 Water quality (C1) scoring

Following discussions with the Environment Agency, this attribute is scored, on the same basis as the WFD reporting. Priority Hazardous Substances and Priority Substances both have a pass/fail status, whereas Specific pollutants are either reported as high or moderate. As such the scoring identified for the interim B6 indicator for estuarine and coastal waters, considers the Specific pollutants (non-pass/fail) first, per water body:

- High Specific pollutants status = 1 score;
- Moderate Specific pollutants status = 2 score.

The score generated from the pass/fail Priority for Hazardous Substances status is next considered:

- Fail Priority Hazardous Substances = Add 2 to the Specific pollutants initial score of 1 or 2;
- Pass Priority Hazardous Substances = Add 0 to the Specific pollutants initial score of 1 or 2.

The score for the pass/fail for Priority Substances status is then considered:

- Fail Priority Substances = Add 2 to the Specific pollutants and Priority Hazardous Substances score;
- Pass Priority Substances = Add 0 to the Specific pollutants and Priority Hazardous Substances score.

The overall score from the calculation above could (at worst) total 6, however it is capped to a score of 5.

Where there is not a full set of data for each of these chemical status results for WFD, such as Specific Pollutants WFD classification which is not reported for all water bodies (e.g. the Aln - GB510302203300), the overall water body naturalness class has been left blank and reported in the spreadsheets as N/D (no-data) as it is not possible to determine the status for specific pollutants, and hence the naturalness score cannot be derived.

The scoring system for the Water quality (C1) attribute is presented in Appendix A.

8.2.2 Worked examples

A worked example for Fleet Lagoon (GB510080077000):

- WFD Specific Pollutants Class – High (Score 1);
- WFD Priority Hazardous Substances Class – Fail (Score 2);
- WFD Priority Substances Class – Good (Score 0).

Overall B6 water quality naturalness score for Fleet lagoon (1 + 2 + 0) = 3.

A worked example for Mersey (GB531206908100):

- WFD Specific Pollutants Class – Moderate (Score 2);
- WFD Priority Hazardous Substances Class – Fail (Score 2);
- WFD Priority Substances Class – Fail (Score 2).

Overall B6 water quality naturalness score for Mersey lagoon (2 + 2 + 2) = 6. Mersey is one of a few water bodies that have a score of 6, however the scoring as per all naturalness components is capped at 5.

8.2.3 Water quality (C1) results

The score per water body for Water quality (C1) is presented in Appendix B.

The figure showing the Water quality (C1) score per water body is presented in Appendix C.

8.2.4 Habitat (C1) scoring

All habitat scores for Water Quality (C1) are provided at the waterbody level.

The data used to calculate the naturalness score are provided by the Environment Agency at the water body level. Although there is a greater resolution in the underlying monitoring data, as the EA collect WQ samples from a number of locations from within many water bodies, as the water moves throughout the water body, it cannot be assigned to any particular habitat. In addition, to ensure consistency of scoring with the EAs reporting for WFD, it was agreed that the same water body score would be used for B6 as for WFD reporting.

As such, the decision was made to base the habitat score on the water body score.

8.3 Dissolved Oxygen (C2)

8.3.1 DO (C2) scoring

The Environment Agency collect dissolved oxygen (DO) samples as part of regular monitoring of estuarine and coastal waters. DO is recorded on the same five point scale so it is easily be transferable to the estuarine and coastal waters assessment:

- High = 1 (most natural);
- Good = 2;
- Moderate = 3;
- Poor = 4;
- Fail = 5 (least natural).

DO is not collected for all water bodies. As such the naturalness score is left blank and reported in the spreadsheets as N/D (no-data) where DO data are not collected for a particular water body.

DO is sampled throughout the year and the status is based on the average over the last 6 years sampling as part of the WFD classification. No alterations are needed for the naturalness scoring which cover the same time periods.

The scoring system for the DO (C2) attribute is presented in Appendix A.

8.3.2 DO (C2) results

The score per water body for DO (C2) is presented in Appendix B.

The figure showing the DO (C2) score per water body is presented in Appendix C.

8.3.3 Habitat (C2) scoring

All habitat scores for DO (C2) are provided at the waterbody level.

The data used to calculate the naturalness score are provided by the Environment Agency at the water body level. Although there is a greater resolution in the underlying monitoring data, as the EA collect DO samples from a number of locations from within many water bodies, as the water moves throughout the water body, it cannot be assigned to any particular habitat. In addition, to ensure consistency of scoring with the EAs reporting for WFD, it was agreed that the same water body score would be used for B6 as for WFD reporting.

As such, the decision was made to base the habitat score on the water body score.

8.4 Dissolved Inorganic Nitrogen (C3)

The rivers and streams indicator, uses both nitrogen and phosphorus as an attribute. However phosphorus is not commonly monitored within English estuarine and coastal waters, as nitrogen is the limiting nutrient factor within estuarine and coastal waters.

The Environment Agency collect dissolved inorganic nitrogen (DIN) samples as part of regular monitoring of estuarine and coastal waters. Nitrogen is recorded on the same five point scale, so it is easily transferable to the B6 assessment:

- High = 1 (most natural);
- Good = 2;
- Moderate = 3;
- Poor = 4;
- Fail = 5 (least natural).

DIN is not collected for all water bodies. As such the naturalness score is left blank and reported in the spreadsheets as N/D (no-data) where DIN data are not collected for a particular water body.

DIN is sampled throughout the year and the status is based on the average over the last 6 years sampling as part of the WFD classification. No alterations are needed for the naturalness scoring which cover the same time periods.

The scoring system for the DIN (C3) attribute is presented in Appendix A.

8.4.1 DIN (C3) results

The score per water body for DIN (C3) is presented in Appendix B.

The figure showing the DIN (C3) score per water body is presented in Appendix C.

Habitat (C3) scoring

All habitat scores for DIN (C3) are provided at the waterbody level.

The data used to calculate the naturalness score are provided by the Environment Agency at the water body level. Although there is a greater resolution in the underlying monitoring data, as the EA collect DIN samples from a number of locations from within many water bodies, as the water moves throughout the water body, it cannot be assigned to any particular habitat. In addition, to

ensure consistency of scoring with the EAs reporting for WFD, it was agreed that the same water body score would be used for B6 as for WFD reporting.

As such, the decision was made to base the habitat score on the water body score.

8.5 Opportunistic Macroalgae (C4)

The WFD opportunistic macroalgae tool measures the extent and biomass of opportunistic macroalgae in inter-tidal habitats. The presence of opportunistic macroalgae within a water body provides some indication of the levels of nutrients that are present within the system. As such the opportunistic macroalgae classification results from the WFD assessments can be used to show deviations from a natural level of nutrients that a system would usually experience.

Opportunistic macroalgae is recorded on the same five point scale so it is easily be transferable to the estuarine and coastal waters assessment:

- High = 1 (most natural);
- Good = 2;
- Moderate = 3;
- Poor = 4;
- Fail = 5 (least natural).

Opportunistic macroalgae is not collected for all water bodies. As such the naturalness score is left blank and reported in the spreadsheets as N/D (no-data) where Opportunistic macroalgae data are not collected for a particular water body.

The scoring system for the DIN (C3) attribute is presented in Appendix A.

8.5.1 Opportunistic macroalgae (C4) results

The score per water body for opportunistic macroalgae (C4) is presented in Appendix B.

The figure showing the opportunistic macroalgae (C4) score per water body is presented in Appendix C.

8.5.2 Habitat (C4) scoring

All habitat scores for Opportunistic macroalgae (C4) are provided at the waterbody level.

The data used to calculate the naturalness score are provided by the Environment Agency at the water body level. As the Environment Agency use monitoring data only from within intertidal areas, the resulting B6 score could be limited to just intertidal habitats. However, the presence of Opportunistic macroalgae can be used as a proxy for the health of the surrounding waterbody as it is a good guide for high pressures including high nutrient inputs.

As such, the decision was made to base the habitat score on the water body score.

9 Biological naturalness component

9.1 Infaunal Quality Index (B1)

9.1.1 Introduction

The infaunal quality index (IQI) was created by the Environment Agency as a means to determine the condition of soft sediment invertebrate communities within coastal waters as part of their reporting requirements under the Water Framework Directive.

The index has been developed over a number of years, with categories that allow for the representation of disturbance to benthic invertebrate communities. Disturbance can be via a number of means, which may include a range of anthropogenic impacts and pressures. This can include contamination of water or sediment, disturbance through activities such as fishing or aggregate extraction, or high levels of inputs such as nitrates and phosphates within the marine environment. As such the results of the infaunal quality index are transferable to the B6 estuarine and coastal waters indicator.

9.1.2 IQI (B1) scoring

IQI data are recorded on the same five point scale so it will easily be transferable to the estuarine and coastal water assessment:

- High = 1 (most natural);
- Good = 2;
- Moderate = 3;
- Poor = 4;
- Fail = 5 (least natural).

IQI data are not collected for all water bodies. As such the naturalness score is left blank and reported in the spreadsheets as N/D (no-data) where IQI data are not collected for a particular water body.

The scoring system for the IQI (B1) attribute is presented in Appendix A.

9.1.3 IQI (B1) results

The score per water body for IQI (B1) is presented in Appendix B.

The figure showing the IQI (B1) score per water body is presented in Appendix C.

9.1.4 Habitat (B1) scoring

All habitat scores for IQI (B1) are provided at the waterbody level.

The data used to calculate the naturalness score are provided by the Environment Agency at the water body level. As the Environment Agency use monitoring data only from within sediment habitats, the resulting B6 score could be limited to just sediment habitats. However, the IQI score can be used as a proxy for the health of the surrounding waterbody as it is a good guide for pressures including direct impacts of disturbance.

As such, the decision was made to base the habitat score on the water body score.

9.2 Invasive non-native species (B2)

9.2.1 Introduction

Invasive non-native species (INNS) may affect both natural species composition and also directly impact habitats within coastal and estuarine waters. The presence of some INNS, such as those that form artificial reefs in locations where they may otherwise not be present, can modify the structural components of a habitat to the extent that a new community is present. Species such as the slipper limpet, *Crepidula fornicata,* can modify the broadscale habitat to the extent that a sandy area, or more muddy area develops into a coarse or mixed sediment area, due to the large number of shell fractions produced from the slipper limpet community. A number of INNS can be present at levels which considerably outcompete the natural species and can dramatically reduce the species diversity within some areas.

9.2.2 INNS species list

The first stage of the assessment of INNS, was to determine a standard list of INNS against which to search for species records. There is not one definitive list of INNS that is universally accepted in England, and as time progresses the list of INNS will likely be expanded, to include new introductions. A number of sources were considered to determine a suitable INNS list for the B6 indicator. These included:

- Eno, and others (1997). Non-native marine species in British waters: a review and directory – Although relatively old this is a thorough representation of INNS at the time;
- Harrower and others (2021). England Biodiversity Indicators 2021: Pressure from invasive species. Technical background document – Although more recent does miss out some prevalent marine INNS from the list;
- UKTAG[9] (2014) Revised classification of aquatic alien species according to their level of impact. Working paper – This document provided a list that covers most of the species present on the other two (above) papers.

Each of these three INNS data source lists were compared to see if one provided a satisfactory list to determine the basis list for the B6 indicator. Comparisons were completed and provided in a separate spreadsheet alongside this report. Overall the UK Technical Advisory Group (UKTAG) list data represented the best fit between the three resources investigated.

In addition, some research was required to update a number of species names that have changed since the UKTAG list was developed. The WoRMS[10] directory was consulted to determine alternative scientific names for particular species. As data records are provided to the National Biodiversity Network (NBN) over time, the records that the NBN hold are a combination of old and new species names. Whilst the NBN try and account for changes in species names when storing and reporting data by maintaining a unique code, irrespective to changes in names, this was not apparent for all species of interest. As such both historic and new species names were determined via a WoRMS search to include in new NBN species searched.

The list of INNS including new and previous scientific names to include on the NBN search is provided as Appendix D.

9.2.3 INNS impact category

Following engagement with Natural England on the draft set of attributes, it was decided to represent the severity of INNS to some extent within the scoring, as opposed to a simpler assessment based on the number of INNS present within each water body.

As such, the estuarine and coastal waters INNS attribute utilises the same approach that has been used within the Rivers and streams element. Initial categorisation of scoring is based on UKTAG impact category. The impact category is provided for each species as a table in Appendix D. Species are classified into one of four impact groups:

- High impact;
- Moderate impact;
- Low impact; and
- Unknown impact.

The unknown impact group largely consists of relatively new introductions or new identifications where there has not been sufficient time to determine the likely impact significance.

[9] The UK Technical Advisory Group ("UKTAG") develops and makes recommendations to the UK government administrations on standards for implementing the Water Framework Directive ("the Directive")
[10] World Register of Marine Species (WoRMS) available at: https://www.marinespecies.org/ [Accessed Jan 2023]

Utilisation of the impact groups aims to provide some assessment of the significance of different INNS as not all are of the same severity. For example the presence of a number of low impact species may be far less impactful than the presence of one high impact species.

9.2.4 Data sourcing

INNS species records were obtained from the National Biodiversity Network (NBN-Atlas), as the best known location for species record throughout the country.

Figure 9.1 has been obtained from the NBN Atlas, which indicates the distribution of slipper limpet in English waters. The data that are presented within the figure includes data that are more than five years old. As part of the scoring process, these records older than 2007 were removed from the data layer. The data time period is larger than the 6 year envisaged reassessment period for the Defra 25 Year Indicators, however it is deemed appropriate as it is unlikely that INNS that were present from over 6 years ago have since disappeared.

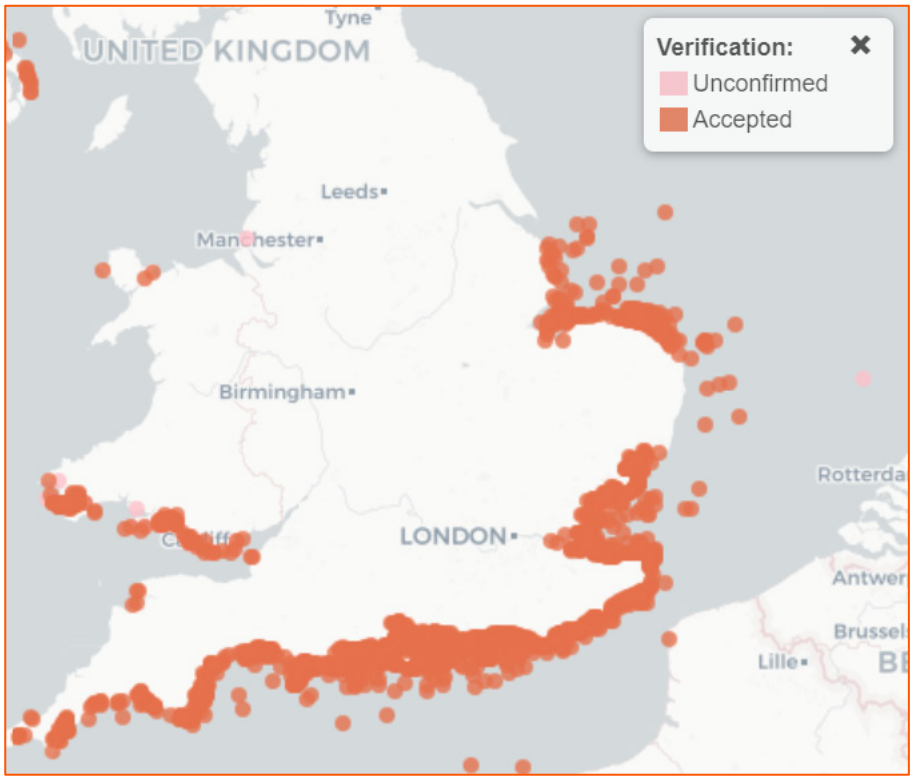

Figure 9.1: Presence of slipper limpet (*Crepidula fornicata*) in English and Welsh waters

Source: NBN Atlas [Accessed June 2022] (https://species.nbnatlas.org/species/NBNSYS0000174750)

9.2.5 INNS (B2) Scoring

Data records were obtained from the NBN at 10 km grid square resolution. The species records obtained from the NBN were initially scored per 10 km grid.

A non-linear set of rules to assign grid cells directly to naturalness classes was utilised that has been used within the Rivers and streams B6 element. Each cell was classified on the following basis:

- No species on UK TAG lists = 1 (most natural);
- Only low impact species = 2;
- Only unknown impact species = 3;
- Only low and moderate impact or no more than 1 high impact species = 4;

- More than 1 high impact species = 5 (least natural).

Each of the 10 km grids was scored using the above scoring system. These records were then remapped in a GIS with each 10 km cell scored from 1 to 5. A GIS output was then provided to determine the area of each water body at each naturalness class.

A final scoring process was completed within Excel. The final score per water body was an average of the score represented from each of the 5 naturalness classes.

The scoring system for the INNS (B2) attribute is presented in Appendix A.

9.2.6 INNS (B2) results

The score per water body for INNS (B2) is presented in Appendix B.

The figure showing the INNS (B2) per water body is presented in Appendix C.

9.2.7 INNS (B2) future development

The list of INNS that is used for the estuarine and coastal B6 indicator should be kept under review as knowledge and understanding of impact status changes over time, and to keep up with new introductions.

At present it is recommended that the UKTAG list is maintained.

9.2.8 Habitat (B2) scoring

All habitat scores for INNS (B2) are provided at the waterbody level.

The data used to calculate the naturalness score are provided by the NBN at 10 km grid level. Although data would have been collected at a point location, details have been reduced to 10 km grids which does not allow assignment of particular species records to specific habitats. Additionally, the lack of INNS records in a particular area does not mean there are no INNS present, just that they may not have been recorded. As it is generally accepted that INNS are unlikely to be removed once established, its is likely they will spread to other areas.

As such, the decision was made to base the habitat score on the water body score.

9.3 Saltmarsh (B3)

9.3.1 Introduction

Monitoring of saltmarsh by the Environment Agency is seen as a way to determine not only the state of saltmarsh itself, but also of the wider environment. Saltmarsh, extent, and the number and variety of different species and zones within the saltmarsh habitat can indicate of the overall health of a system, including the ability of that system to respond to the effects of changing climate.

One limitation on the use of saltmarsh as a B6 estuarine and coastal indicator attribute, is that it is present in a number, but not all water bodies. For example, the south east has a much lower percentage of water bodies with saltmarsh present. However, the extent to which saltmarsh is monitored, and the potential to show alterations to what would be a natural state, mean that it is still included as a estuarine and coastal waters indicator.

9.3.2 Data sourcing

The Environment Agency collects data on saltmarsh and reports using the SKIPPER tool (Saltmarsh Key Indicators Processed Precisely and Estimated Robustly). A snippet from the SKIPPER tool is provided as Figure 9.2.

EA_WB_ID	NAME	WATER_CAT	RBD_NAME	SURV	TYPE	Status Class						
						SMAh	SMAi	ΔSMA	Zn/5	ZnMax	Th or T15	FINAL
GB540704116000	ADUR	Transitional	South East	S		B	G	H	H	P		M
GB520503503800	ALDE & ORE	Transitional	Anglian	Nor		B	H	H	H	M	H	G
GB510503410700	BURE & WAVENEY	Transitional	Anglian	S		B	B	H	H	P	P	P
GB510503403500	BURN	Transitional	Anglian	Nor		G	H	H	H	P	G	G
GB530804906600	CAMEL	Transitional	South West	S		M	P	H	H	M	H	G
GB520804814400	CARRICK ROADS	Transitional	South West	S		H	M	H	H	M	H	G
GB510804605900	DART	Transitional	South West	S		G	P	H	H	P	P	M

Figure 9.2: Snippet from the SKIPPER tool

Source: Environment Agency

The SKIPPER tool is a multimetric index composed of six individual components known as metrics, these are:

a. Saltmarsh extent as proportion of historic saltmarsh (SMAh);
b. Saltmarsh extent as proportion of the intertidal (SMAi);
c. Change in saltmarsh extent over two or more time periods (ΔSMA);
d. Proportion of saltmarsh zones present (Zn/5);
e. Proportion of saltmarsh area covered by the dominant saltmarsh zone (ZnMax);
f. Proportion of observed taxa to historical reference value or proportion of observed taxa to 15 taxa (Th or T15).

Of the six metrics recorded above, two are combined to provide a B6 estuarine and coastal waters indicator attribute for saltmarsh. These are SMAi and ZnMax (see sections below).

9.3.3 b. Saltmarsh extent as proportion of the intertidal (SMAi)

It was initially thought that (c) *change in saltmarsh extends over two or more time* periods would provide an appropriate means for assessing change, and hence helpful for the assessment in alterations to naturalness, caused either by direct human pressures, or as a result of indirect pressures, such as climate change and the effect of coastal squeeze. However, between assessment periods, the extent boundaries that are set to identify change in status within the WFD reporting are too large to be used within the B6 indicator. In addition if there were a number of small changes over many different assessment periods within SKIPPER tool, this will not show up as a change in status, as it only refers back to the previous reporting period.

As such, (b) *saltmarsh extent as a proportion of the intertidal,* is a much better representation of changes over time. This also allows better comparison between water bodies of significantly different sizes, which vary widely in total area. Unlike the *change in saltmarsh extent over two or more time periods* which may hide actual changes in extent over more than one assessment, *saltmarsh extent as proportion of the intertidal* will show changes over the longer timeframe.

9.3.4 e. Proportion of saltmarsh area covered by the dominant saltmarsh zone (ZnMax)

Two metrics within the SKIPPER tool consider saltmarsh zones. Firstly (d) *the proportion of saltmarsh sounds present* was initially considered to be a suitable metric for the B6 indicator, a saltmarsh zone is considered to be present, even if it is present in one very small part of a water

body. As such, most water bodies (where saltmarsh is present), include the presence of most (if not all) of the saltmarsh zones.

The (e) *proportion of saltmarsh area covered by the dominant saltmarsh* zone is a much better representation of naturalness of saltmarsh in a particular water body. If there is a larger percentage of one or two dominant saltmarsh zones, this is an indication that either there is high levels of nutrients in the area which make one zone more dominant, or that there is an example of coastal squeeze where by the full range of zones are not able to exist. It is also a reflection of the presence and dominance of spartina, which lowers diversity of the marsh overall.

9.3.5 Saltmarsh extent as proportion of historic saltmarsh (SMAh)

Although initially included as a potential metric to include in the assessment, SMAh metric was removed after discussion with the Environment Agency as it will not show improvement over time and the initial extent calculation represented a snapshot in time and does not represent a reliable baseline.

9.3.6 Saltmarsh (B3) scoring

The scoring for WFD reporting for the two SKIPPER saltmarsh metrics, are also provided on a five point scale, which is converted into a naturalness score:

- High = 1 (most natural);
- Good = 2;
- Moderate = 3;
- Poor = 4;
- Bad = 5 (least natural).

Both of the SKIPPER metrics used (b and e), are converted to the 1-5 score, summed and then averaged.

As an example Water body GB520503503800, the Alde & Ore, a transitional water body in the Anglian region, has a SKIPPER status of:

- b. Saltmarsh extent as proportion of the intertidal = High = 1;
- e. Proportion of saltmarsh area covered by the dominant saltmarsh zone = Moderate = 3.

So the overall saltmarsh B6 indicator score for the Alde & Ore would be (1+3)/2 = 2.

The scoring system for the Saltmarsh (B3) attribute is presented in Appendix A.

9.3.7 Saltmarsh (B3) results

The score per water body for Saltmarsh (B3) is presented in Appendix B.

The figure showing the Saltmarsh (B3) per water body is presented in Appendix C.

9.3.8 Habitat (B3) scoring

All habitat scores for Saltmarsh (B3) are provided at the waterbody level.

The data used to calculate the naturalness score are provided by the Environment Agency at the water body level. As the Environment Agency use monitoring data only from within saltmarsh beds, the resulting B6 score could be limited to just saltmarsh habitats. However the B6 indicator is at the EUNIS level III resolution, and at that level there is no way to discern saltmarsh habitat apart from intertidal mud or sand habitat. Additionally, saltmarsh can be used as a proxy for the health of the surrounding waterbody as it is a good guide for low pressures including low nutrient inputs.

As such, the decision was made to base the habitat score on the water body score.

10 Other naturalness component

The initial reasoning for inclusion of anthropogenic light and underwater noise in the biological naturalness component was the potential change in naturalness of biological receptors due to, for example increases in either night light resulting in alterations to bird behaviour or alterations to marine mammals behaviour, and potentially injury or death due to increases in underwater noise.

Following input from Natural England, anthropogenic light and underwater noise have been moved out of the Biological naturalness component and are now included as an additional category of Other, as although they may ultimately result in changes to biological receptors, the measurement is of noise and light.

To note there is one further attribute that has been added to this category since Bleach (2022), this being Litter. This is detailed in Section 10.2.6.

10.1 Anthropogenic light (O1)

10.1.1 Introduction

Another anthropogenic pressure is the introduction of light into the night-time environment. Light levels can be detrimental to a number of marine animals, where natural processes are interrupted. The naturalness level would in this instance be the lack of anthropogenic light during the hours of darkness.

10.1.2 Data sourcing

There are a number of datasets that are available that look at night-time light levels. One that has been obtained for the B6 estuarine and coastal waters indicator, was developed by The Campaign for Rural England (CPRE) in a project supported by Natural England. The project used data captured by a satellite at 1.30 am throughout the month of September, which was picked as the most cloud free month during 2015. A composite map was produced taking averages per unit area for the whole country, as different parts of the country may have had more, or less cloud influence on certain nights. Data are viewable from the CPRE data portal[11].

Of importance for the B6 estuarine and coastal waters indicator, is the level to which light pollution can be seen within estuarine and coastal waters areas. Figure 10.1 shows part of the Thames middle water body, and the differences in light levels that are discernible that are reflecting from the water surface. The left of the figure is closer to central London, with dark red representing high light levels. The reflected light levels reduce through orange, to yellow and greens as the light levels decrease moving further from areas of intense light pollution. Figure 10.2 is an area of mudflat on the Essex coast, Maplin Sands, where it is still possible to determine different levels of light that are reflected either off the water, or also likely off the mudflat in this area. Unlike the example from further up the Thames Estuary, this figure shows light levels that are nearer the bottom of the scale, with light and dark blue bands.

[11] The Countryside Charity: England's Light Pollution and Dark Skies. Data discovery portal. Available online at: https://nightblight.cpre.org.uk/maps/ [Accessed Jan 2023]

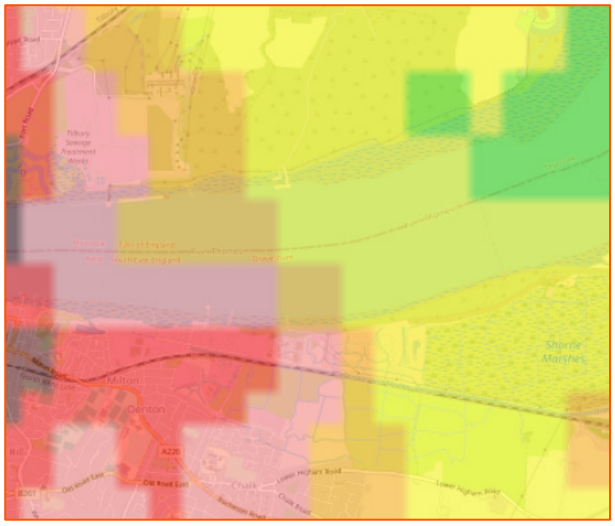

Figure 10.1: Thames Middle water body

Source: *https://nightblight.cpre.org.uk/maps/*

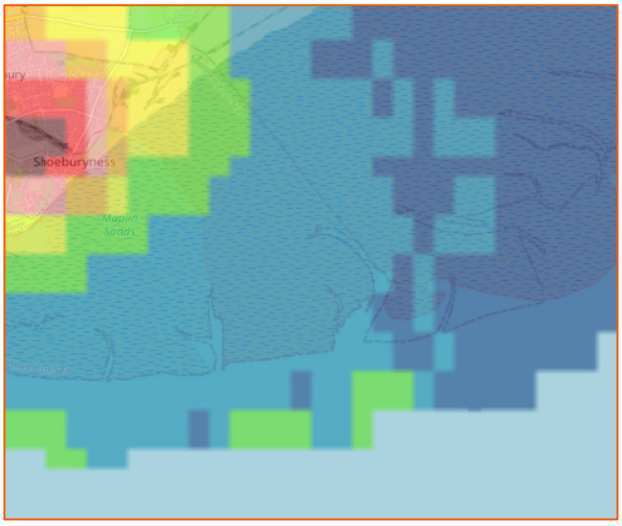

Figure 10.2: Essex coast: Maplin Sands

Source: *https://nightblight.cpre.org.uk/maps/*

10.1.3 Anthropogenic light (01) scoring

Scoring for anthropogenic light is based on the division of light levels shown below. To note light levels are recorded as Nano Watts/cm^2/sr. These are included in the brackets in the bullets below, and an indication given to the colour range represented on Figure 10.1 and Figure 10.2:

- Grey (<0.25) = 1 (most natural);
- Dark blue/light blue (0.25-1) = 2;
- Yellow/green (1-4) = 3;
- Pink/orange (4-16) = 4;
- Dark and light red (>16) = 5 (least natural).

The categories suggested above, are skewed to represent larger categories for the higher brightness levels. There are smaller categories in the 1 (most natural) to 3 group, which represent the lower levels of light which are more representative of light that is expected to be at the coast. The breakdown of classes is deemed to be representative of the full light levels that are found within water bodies.

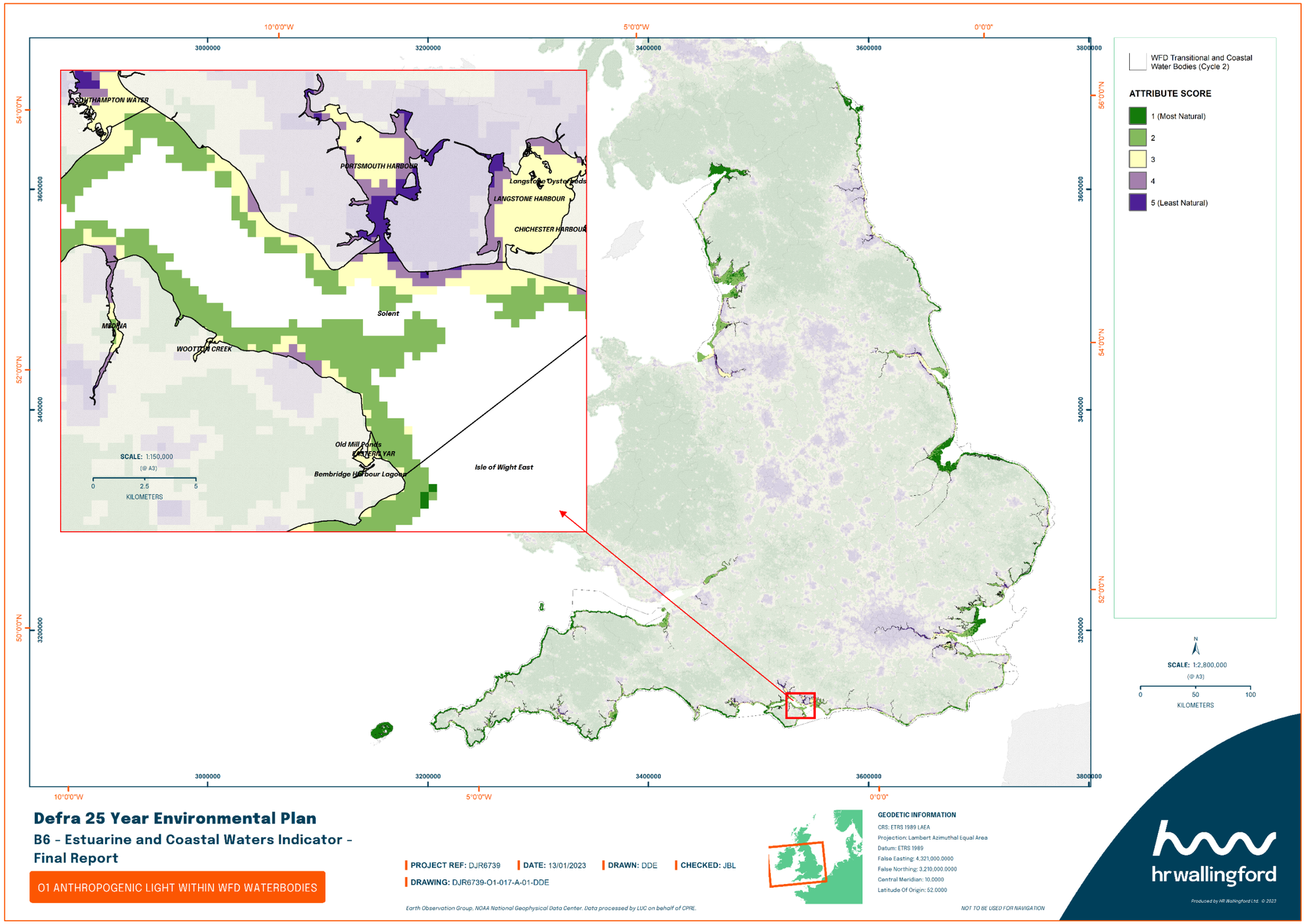

Figure 10.3: Anthropogenic light. Showing higher resolution than the final per water body Anthropogenic light score

The resulting country wide distribution of anthropogenic light is shown in Figure 10.4, which shows a higher resolution of data that the final per water body anthropogenic light map, which is shown in Appendix B.

The scoring system for the Anthropogenic light (O1) attribute is presented in Appendix A.

10.1.4 Anthropogenic light (O1) results

The score per water body for Anthropogenic light (O1) is presented in Appendix B.

The figure showing the Anthropogenic light (O1) per water body is presented in Appendix C.

10.1.5 Anthropogenic light (O1) future development

Although this data set is currently a one-off, there is the potential this could be reassessed in future years. If this is not the case other data sets may need to be found that provide a similar assessment of night time light levels, in and around the coast.

10.1.6 Habitat (O1) scoring

All habitat scores for Anthropogenic light (O1) are provided at the habitat level.

As underlying anthropogenic light data is not at the water body level, and is available at a resolution that can be overlaid with habitat locations, the decision was made to base the habitat score on comparison of Anthropogenic light and EUNIS level III habitats directly.

10.2 Underwater noise (O2)

10.2.1 Introduction

Another anthropogenic pressure that is introduced to the marine environment that has the potential to negatively impact marine life, is the introduction of underwater noise. Noise is already a naturally occurring component of that marine environment and can be created by many natural sources. However, additional noise, especially noise introduced at levels that are well above that which would be produced naturally can have negative impacts.

Anthropogenic noise can be separated into continuous noise and impact or impulse noise. As underwater noise is only more recently becoming a concern, data sources are not particularly well developed at present. As regulatory requirements increase in this area, including the need to map noise as part of the reporting requirements under the Marine Strategy Framework Directive[12], it is expected that assessments in future years will have more sophisticated underwater noise data to generate updates to the B6 indicator score for estuarine and coastal waters.

10.2.2 Data sourcing

A Marine Noise Registry[13] has been developed to record occurrences of impulsive sound from various activities in the UK seas, which feeds into a European registry through the OSPAR Convention. The registry holds data for seven different impulsive sound generating activities:

- Seismic survey;

[12] Defra: Marine Strategy Part One: UK updated assessment and Good Environmental Status. D11 matric Underwater noise. Available online at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/921262/marine-strategy-part1-october19.pdf [Accessed Jan 2022]

[13] Marine Noise Registry - Defra and JNCC developed the Marine Noise Registry (MNR) to record human activities in UK seas that produce loud, low to medium frequency (10 Hz – 10 kHz) impulsive noise, as a commitment made in the UK Marine Strategy

- Sub-bottom profiling;
- impact pile driving;
- unclassified Ministry of Defence activity;
- detonation of explosives;
- acoustic deterrent devices; and
- multi-beam echosounders (≤12 kHz).

These data have been sourced from the JNCC as data custodians for the last number of years. To note these records are of instances that have been recorded due to the requirement placed on operators and developers as part of the marine licencing process. As such this is a limiting factor in the data available.

Figure 10.4 provides an indication of the level, and resolution of information that is available. The recordable blocks are scored by the number of pulse days that are experienced over a year.

JNCC processed noise data records are available for 2016, 2017 and 2018 only. The data are provided at a resolution of blocks which represent an area of c.250 km^2 of seabed. Data are provided as number of pulse block days (PBDs). For example 20 PBDs implies 20 days over a particular year that impulsive noises were recorded in a particular block.

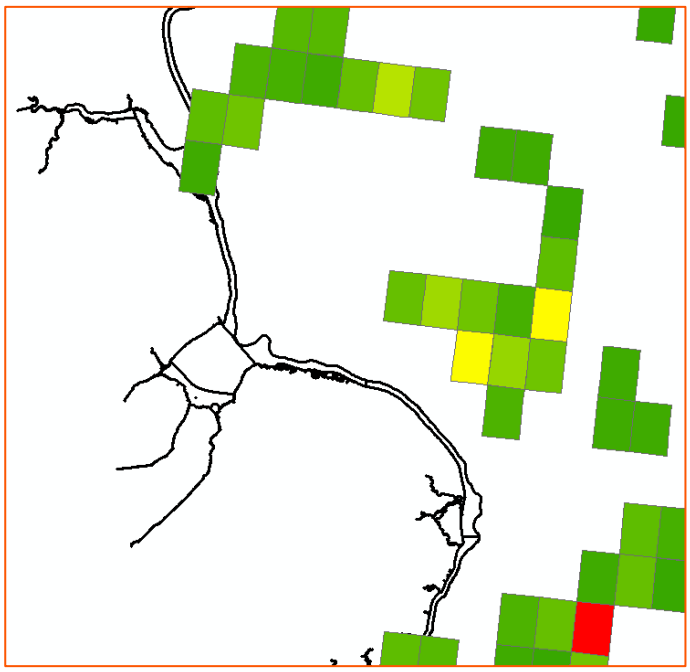

Figure 10.4: Display of the 2020 underwater noise records in the east of England
Source: JNCC Noise Registry

Note: Red = highest amount of pulse days; yellow = Moderate; Green = low; light green = very low

10.2.3 Underwater noise (O2) scoring

The criteria that was used to score underwater noise first compiles the JNCC data records for all of the years that data are available (2016, 2017 and 2018) into one database. This included giving a unique number to each of the blocks the JNCC data were presented in. The combined number of PBDs over the three years was then calculated.

The naturalness scoring for underwater noise is provided below. The colour that is included in the brackets provides an indication of the levels shown for each naturalness category on Figure 10.4:

- 0 PBD (white) = 1 (most natural);
- 1-25 PBD (dark and light green) = 2;
- 26-50 PBD (yellow and light orange) = 3;
- 51-75 PBD (dark orange and light red) = 4;
- 76-100 PBD (dark red) = 5 (least natural).

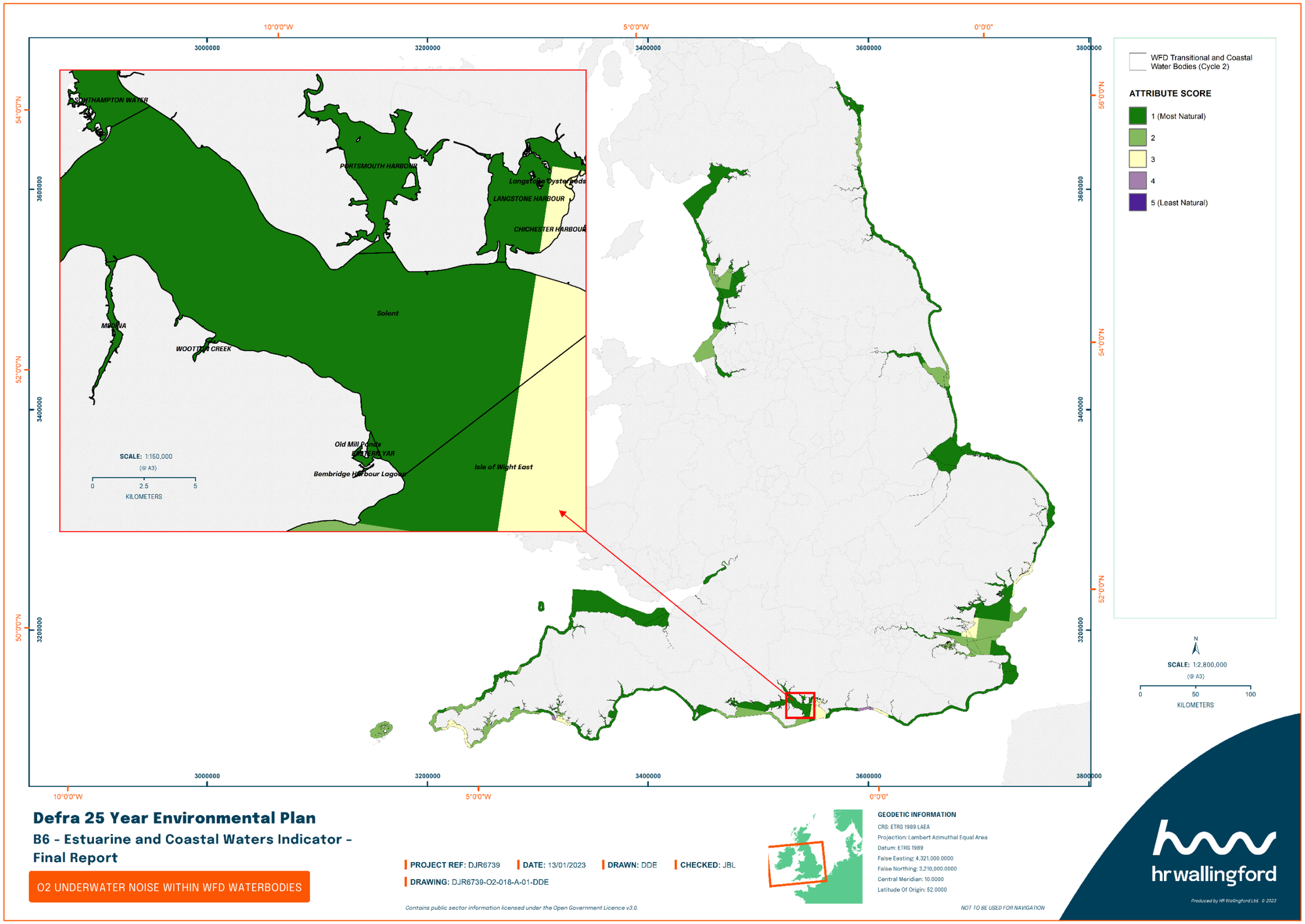

Figure 10.5: Underwater noise - amalgamated PBD classification for 2016, 2017 and 2018 (JNCC Noise Registry data)

The amalgamated PBD classification per block for the three years was displayed in a GIS. This is shown as Figure 10.5.

The areas of each class of data present in each water body have then been calculated to provide a score that is based on the amount of underwater noise that is experiences in a water body as a whole.

The scoring system for the Underwater noise (O2) attribute is presented in Appendix A.

10.2.4 Underwater noise (O2) results

The score per water body for Underwater noise (O2) is presented in Appendix B.

The figure showing the Underwater noise (O2) per water body is presented in Appendix C.

10.2.5 Underwater noise (O2) future development

The attribute development report (Bleach, 2022) included the suggestion of also considering continuous noise, such as that created by shipping. Whilst there are a number of datasets that have modelled the likely underwater noise levels introduced by shipping, data was not provided in a way that can be manipulated within the same GIS that has been used for all other assessments.

Figure 10.6 shows the country wide continuous underwater noise modelled data by Cefas of broadband (BB) sound pressure level (SPL) during 2017. The median noise levels are displayed (P50). The monitored data includes the removal of more natural sources of continuous noise, such as that derived from wind action on waves. It is recommended that continuous underwater noise is included in future rounds of the B6 indicator scoring, and that requests are made for this data to be updated and presented in a more easily combinable format.

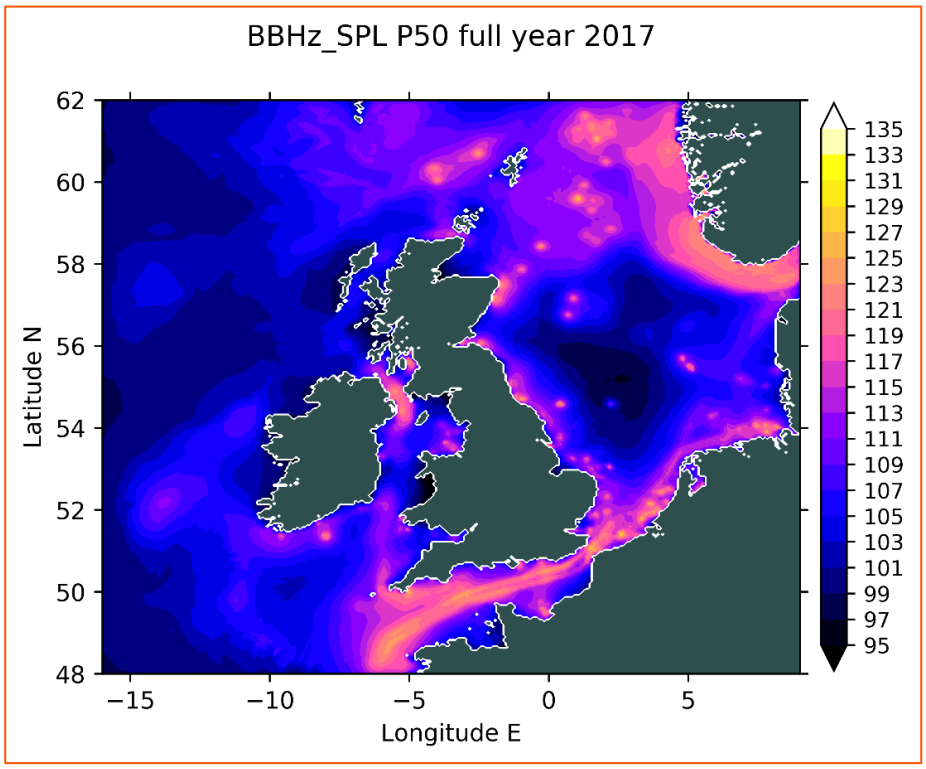

Figure 10.6: Continuous underwater noise produced from shipping
Source: Cefas

10.2.6 Habitat (O2) scoring

All habitat scores for Underwater noise (O2) are provided at the habitat level.

As underlying underwater noise data is not at the water body level, and is available at a resolution that can be overlaid with habitat locations, the decision was made to base the habitat score on comparison of underwater noise and EUNIS level III habitats directly.

This is shown in the two figures below. Figure 10.7 indicates the weighted fishing pressure layer between Suffolk and north Kent. Dark green indicates the most natural areas (1 = no to low fishing pressure), light green is the next naturalness score (2 = low fishing pressure) and yellow (3 = moderate fishing pressure). The larger dark green polygon, highlighted by the purple lines is replicated in Figure 10.8. As the fishing pressure layer is partially transparent, the purple lines have been included to show the same polygon on both figures. The area of habitat is then scored directly on the overlaying fishing pressure score layer.

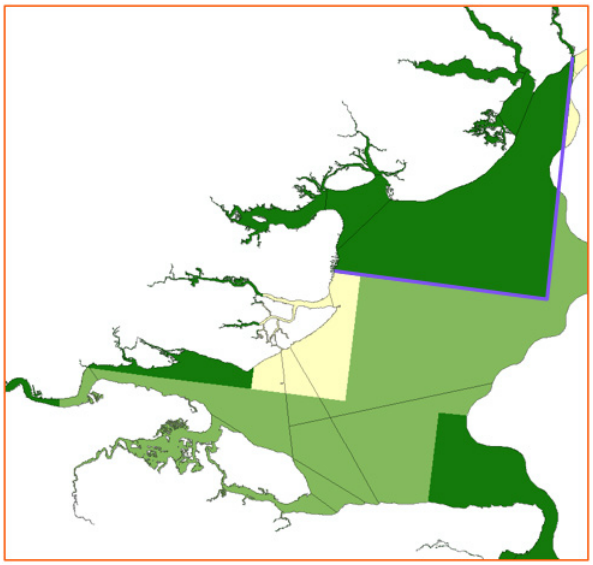

Figure 10.7: Weighted fishing pressure layer

Source: Natural England

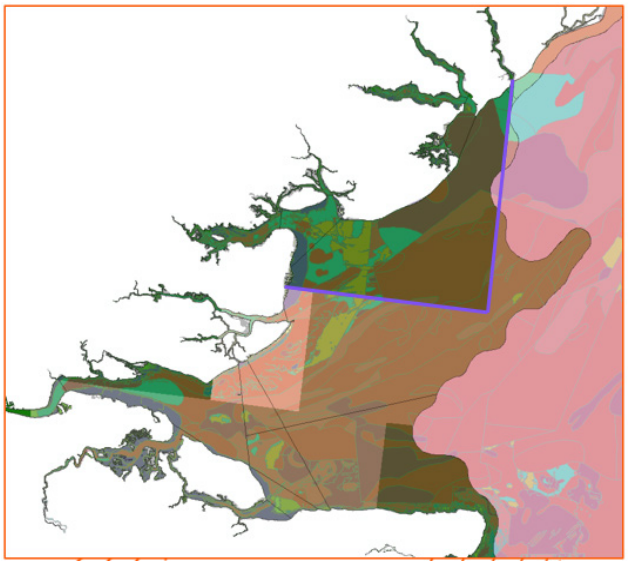

Figure 10.8: Overlay of fishing pressure and ENIS III habitat map

Source: Natural England

10.3 Litter (O3)

10.3.1 Introduction

Litter is an attribute that was not presented in the development report (Bleach, 2022), due in part to a lack of identifiable country-wide data that could be included in the B6 estuarine and coastal water assessment. A suitable data set has since been sourced (See Section 10.3.3).

Litter in the marine environment represents something that is manmade and inherently unnatural. Recording of marine litter has, so far, concentrated on assessing the macro-level of litter. This current assessment does not include any calculation or subsequent scoring that looks at micro-litter, including micro-plastics that are likely to be highly prevalent and ubiquitous within the marine environment.

It's likely that any resultant biological effects of litter are more likely to be caused by micro, rather than macro plastics, however at present this attribute looks as macro-litter data only, until such time that a reliable countrywide micro-litter recording scheme is developed.

10.3.2 Data sourcing

The Marine Conservation Society (MCS) coordinate a number of beach cleans throughout the country. As well as the beach cleans that they organise, they also collate data sent in by volunteers that collect litter from beaches. The MCS maintain a registry of litter collected, with data recorded per 100 m of beach cleaned.

We would like to thank the Marine Conservation Society for providing Beachwatch data from their volunteer beach litter monitoring programme to be included in the B6 indicator for estuarine and coastal waters.

Although there is some inconsistency in the way data are recorded, each litter record does include the number of bags of litter collected per 100 m. There is no set definition of the dimensions of a bag, other than being noted as a large bin bag. However, the level to which each bag is filled will vary according to the weight of items placed in the bags, and how comfortable each bag is for someone to carry. As such scoring can be derived on this attribute of the litter data in a consistent manner for all water bodies, noting that each bag may not be exactly the same size or filled to the same level.

To note whilst some records are provided with relatively accurate locations, it is apparent that in some locations, many beach cleans have been completed and recorded in the same location, even though the beach clean events are likely to be cleaning a different stretch of beach each time. However as this attribute is scored at a water body level, this level of geographic accuracy does not affect the overall water body score.

Data are available for four years (2016-2020).

10.3.3 Litter (O3) scoring

The total number of bags filled is first calculated for all of the four years data are available for each of the water bodies. If scoring were simply derived by litter collected per water body, it's likely that the scoring would be skewed according to the size of the water body. To more fully represent the amount of litter as a per water body the total number of bags was they calculated to provide a result per water body area [km^2].

A score of naturalness was then derived from this No. bags collected per water body area. The scoring for litter is presented below:

- 0 litter collected = 1 (most natural);
- Less than 1 bag per km^2 = 2;
- 1 to 10 bags per km^2 = 3;
- 11 to 100 bags per km^2 = 4;
- Over 100 bags per km^2 = 5 (least natural).

Due to the nature of the data presented, a lack of litter collected does not mean there is no litter present at a particular site, rather a lack of litter collectors to collect and report the data. In addition some water bodies seem to have a much higher level of volunteer action and participation. These water bodies may be more skewed towards higher naturalness scores (i.e. less natural) due to higher volunteer effort, rather than necessarily more litter per se.

The scoring system for the Litter (O3) attribute is presented in Appendix A.

10.3.4 Litter (O3) results

The score per water body for Litter (O3) is presented in Appendix B.

The figure showing the Litter (O3) per water body is presented in Appendix C.

10.3.5 Litter (O3) future development

It is recommended that the MCS litter is continued to be used to represent macro-litter, however a suitable monitoring and recording for micro-litter is recommended to provide data on litter that is more likely to cause alterations to biological naturalness.

10.3.6 Habitat (O3) scoring

All habitat scores for Litter (O3) are provided at the waterbody level.

The data used to calculate the naturalness score are provided by the MCS at locations at which the litter was removed during a beach clean. There is the potential that litter could then only be associated with intertidal areas where a beach clean takes place. However, the lack of beach clean data in other areas does not reliably indicate a lack of litter present. Additionally, although litter is not (generally) removed subtidally, it is expected that litter is also present in these areas.

As such, the decision was made to base the habitat score on the water body score.

11 Conclusions

11.1 Introduction

This report details the scoring process for the B6 naturalness as part of the Defra 25 Year Environmental Plan. This report provides the rationale and scoring procedure for estuarine and coastal water bodies. Wherever possible, attributes and scoring are consistent with those already produced for the Rivers and streams element of B6. This will, as far as possible ensure scores across the naturalness elements can be compared.

Scoring has been derived at the EUNIS level III habitat level, utilising a Natural England data product as a habitat baseline map. Where it has not been possible to assign a naturalness score directly to a habitat, the water body score has been used to score the habitat area within each water body.

11.2 Check of most natural and least natural

The average score per water body has been calculated to provide a high-level check on the naturalness score being produced. These water body scores are provided in a supplementary Excel spreadsheet (ALL_MASTER_Scoring_Per_WB).

The most natural ten water bodies as derived from an average of the B6 estuarine and coastal waters indicator scores are (with average scores in brackets):

- Benacre Broad (1.11);
- Walberswick Marshes (1.12);
- Ternery Pool (1.16);
- Duddon (1.45);
- Higham Marshes (1.46);
- Cliffe Fort Lagoon (1.47);
- Covehithe Broad (1.49);
- Bristol Channel Inner South (1.50);
- Bembridge Harbour Lagoon (1.51);
- Bristol Channel Outer South (1.53).

Of the more natural water bodies identified above, the majority are lagoonal or pond water bodies that are classified as 'Coastal'. This is in part due to the nature of the attributes

developed for the estuarine and coastal waters indicator, as lagoons and ponds generally have more data 'blanks' (insufficient data to make an assessment) as compared to estuarine or open coast water bodies. This in turn leads to some scoring of 0, when the majority of estuarine and coastal sited score 3-5 (such as water quality (C1)).

The ten least natural water bodies as derived from an average of the B6 estuarine and coastal waters indicator scores are (with average scores in brackets):

- Solent (3.04);
- Blackwater (3.07);
- Eastern Yar (3.16);
- Medina (3.17);
- Crouch (3.17);
- Chichester Harbour (3.18);
- Stour (Essex) (3.20);
- Medway (3.28);
- Orwell (3.40);
- Thames Upper (3.83).

As for the water bodies which are indicated as less natural in the list of bullets above, the less natural scores are due to a wide range of pressures and activities that are present within these water bodies, and cannot be attributed to a consistent attribute which scores badly.

11.3 Future assessments

The attributes and their scoring provides a systematic process for the consideration of the naturalness of estuarine and coastal water bodies as part of the Defra 25 Year Environmental Plan indicator assessment, utilising data that are currently available. Comments are made in the report on the future development of each attribute. The assessment can be recalculated in future years to show improvements or declines per attribute, and per water body.

Future years assessments are likely to be conducted in data from the preceding 6 years. As such, due to currently envisaged alterations to some monitoring programmes, e.g. the current WFD data monitoring programme, newly available data may allow for revisions and improvements to the attribute lists for B6 estuarine and coastal waters.

Future changes in the B6 score are likely to be highly impacted by improvements in the baseline map. It is highly recommended that every effort is made to improve the mapping accuracy within the Natural England data product. This will include provision of a EUNIS level III attribute for polygons that do not currently have any EUNIS data, and to fill data gaps at the water body boundaries and in areas where there is missing data, especially at mid and upper reaches of estuaries, and for almost all lagoon and marsh coastal water bodies.

12 References

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Appendix

A Classification rules used for assigning naturalness classes to estuaries and coastal waters

Table A.1: Classification rules used for assigning naturalness classes to estuaries and coastal waters

Estuarine and coastal waters - naturalness component and attribute	**Naturalness class**				
	1	**2**	**3**	**4**	**5**
Hydrological					
(H1) % deviation from monthly naturalised flow					
(H1a) Flows <Qn95	<5	5-10	10-25	25-40	>40
(H1b) Flows Qn95-50	<5	5-10	10-25	25-40	>40
(H1c) Flows Qn50-5	<5	5-10	10-25	25-40	>40
(H1d) Flows >Qn5	<5	5-10	10-25	25-40	>40
(H2) Obstacles - Number obstacles per km² of water body	0	<0.1	0.1-0.5	0.5-2	>2
(H2) Coastal protection score	1 (Natural – Mostly Floodable	2 (Floodable)	3 (Partially Non-floodable)	4 (Mostly Non-floodable)	5 (Non-floodable)
Physical					
(P1) Built structures - area (km²) over total available body area or foreshore area (km²)	0	0.1-1	1-2	2-5	>5
(P2) Fishing pressure – levels of fishing within water body	No fishing	Low fishing	Moderate fishing	High fishing	Very high fishing
(P3) Combined activities - % water body covered by other activities	0	<1%	1-10%	10-20%	>20%
Chemical (water quality) - expressed as mean value for waterbody					
(C1) Water quality – Combination of specific pollutants, hazardous substances and priority substances	HES	GES	MES	PES	BES
(C2) Dissolved oxygen (DO)	HES	GES	MES	PES	BES
(C3) Dissolved organic nitrogen (DIN)	HES	GES	MES	PES	BES
(C4) Macroalgae	HES	GES	MES	PES	BES
Biological					
(B1) Infaunal Quality Index (IQI)	HES	GES	MES	PES	BES
(B2) Invasive Non-native species (INNS) – using UKTAG list	No sp on TAG list	Only low impact sp	Only unknown impact sp	One or less high impact sp	More than 1 high impact sp
(B3) Saltmarsh	HES	GES	MES	PES	BES
Other					
(O1) Anthropogenic light (Nano Watts/ cm2/sr)	<0.25	0.25-1	1-4	4-16	>16
(O2) Underwater noise - number of pulse block days (PBD)	0	1-25	26-50	51-75	76-100
(O3) Litter – bags collected per km² of water body	0	<1	1-10	11-100	>100

B Naturalness score per water body for estuarine and coastal waters

Table B.1: Naturalness score per water body for estuarine and coastal waters

WFD water body name	WFD water body ID	River basin district name	Water body type	Water body total area (Km2)	H1 Flow QN30 Score per WB	H1b Flow QN50 Score per WB	H1c Flow QN70 Score per WB	H1d Flow QN95 Score per WB	H2 Obstacles Score per WB	H3 Coastal Protection Score per WB	P1 Built Structures Score per WB	P2 Fishing Pressure Score per WB
Langstone Oysterbeds	GB510070073000	South East	Estuarine	0.16481	1	1	1	1	1	5	1	4
Fleet Lagoon	GB510080077000	South West	Estuarine	4.93772	1	1	1	1	4	4	1	5
Tweed	GB510202110000	Solway Tweed	Estuarine	2.44074	5	5	5	5	4	4	3	3
Coquet	GB510302203000	Northumbria	Estuarine	0.62429	1	2	3	4	5	2	4	4
Blyth (N)	GB510302203200	Northumbria	Estuarine	1.68383	2	1	3	4	1	2	4	3
Aln	GB510302203300	Northumbria	Estuarine	0.45404	1	1	3	2	1	2	3	3
Wansbeck	GB510302210100	Northumbria	Estuarine	0.60492	2	2	3	3	5	4	3	1
Tyne	GB510302310200	Northumbria	Estuarine	8.09495	1	2	3	5	4	4	5	2
Wear	GB510302402900	Northumbria	Estuarine	2.08430	2	3	5	5	4	3	5	2
Tees	GB510302509900	Northumbria	Estuarine	11.44045	3	3	3	1	4	2	5	3
Esk (E)	GB510402703400	Humber	Estuarine	0.28321	1	1	3	2	5	2	5	5
Burn	GB510503403500	Anglian	Estuarine	4.73243	1	1	3	1	3	2	1	5
Bure & Waveney & Yare & Lothing	GB510503410700	Anglian	Estuarine	8.87849	1	2	3	2	5	2	4	1
Blyth (S)	GB510503503700	Anglian	Estuarine	2.60596	1	1	3	1	5	2	2	2
Wey	GB510804415700	South West	Estuarine	0.10099	2	2	3	3	5	2	4	1
Axe	GB510804505400	South West	Estuarine	0.33406	1	1	3	1	1	2	3	4
Otter	GB510804505500	South West	Estuarine	0.22947	2	3	3	3	5	1	4	2
Exe	GB510804505600	South West	Estuarine	18.00907	1	1	3	1	4	2	2	2
Teign	GB510804605800	South West	Estuarine	3.52627	1	1	3	1	3	2	3	3
Dart	GB510804605900	South West	Estuarine	8.31958	1	2	3	3	4	1	2	2
Avon	GB510804606000	South West	Estuarine	1.82761	1	1	3	1	4	1	2	2
Erme	GB510804606100	South West	Estuarine	1.35887	1	1	3	1	5	1	2	3
Fowey	GB510804806400	South West	Estuarine	2.64982	3	3	3	1	3	1	2	5
Stiffkey & Glaven	GB520503403600	Anglian	Estuarine	17.10711	1	2	3	3	3	2	2	5
Alde & Ore	GB520503503800	Anglian	Estuarine	10.86808	2	3	3	3	4	2	2	3
Deben	GB520503503900	Anglian	Estuarine	7.81943	2	3	3	3	4	2	2	2
Orwell	GB520503613601	Anglian	Estuarine	12.49248	4	5	5	5	4	2	5	3
Stour (Essex)	GB520503613602	Anglian	Estuarine	25.27534	5	5	5	5	4	2	2	3
Crouch	GB520503704100	Anglian	Estuarine	23.76147	5	5	5	5	4	2	4	5
Colne	GB520503713800	Anglian	Estuarine	9.33327	3	3	4	5	5	2	2	4
Blackwater	GB520503714000	Anglian	Estuarine	42.93664	4	5	5	5	4	2	2	4
Stour (Kent)	GB520704004700	South East	Estuarine	5.46736	2	2	3	3	5	2	3	4
Beaulieu River	GB520704201400	South East	Estuarine	3.07496	1	1	3	1	4	2	2	5
Lymington	GB520704202100	South East	Estuarine	2.45226	1	1	3	4	4	2	3	5
Southampton Water	GB520704202800	South East	Estuarine	30.91321	1	1	3	1	4	3	4	5
Medina	GB520710101600	South East	Estuarine	1.62704	3	4	4	5	5	2	4	3
Newtown River	GB520710101700	South East	Estuarine	1.91771	2	3	3	4	4	2	2	5
Western Yar	GB520710101800	South East	Estuarine	0.51031	1	1	3	1	5	2	4	4
Wootton Creek	GB520710101900	South East	Estuarine	0.22934	1	1	3	1	1	2	4	5
Eastern Yar	GB520710102000	South East	Estuarine	0.81061	3	3	4	4	4	3	3	4
Christchurch Harbour	GB520804315900	South West	Estuarine	2.78368	1	2	3	3	4	2	3	5
Poole Harbour	GB520804415800	South West	Estuarine	33.09812	1	1	3	1	3	2	4	4
Kingsbridge	GB520804609000	South West	Estuarine	5.19707	1	1	3	2	1	1	2	2
Yealm	GB520804706200	South West	Estuarine	2.03206	1	1	3	1	5	2	2	5
Plymouth Tamar	GB520804714300	South West	Estuarine	30.20762	1	1	3	2	4	2	4	4
Looe	GB520804806300	South West	Estuarine	0.47716	1	1	3	2	1	2	4	4
Helford	GB520804809100	South West	Estuarine	7.61929	1	1	3	1	4	1	2	4
Carrick Roads Inner	GB520804814400	South West	Estuarine	12.61090	1	1	3	4	3	1	2	3

Solway	GB530207614700	Solway Tweed	Estuarine	305.60425	2	2	3	1	2	2	1	2
Humber Lower	GB530402609201	Humber	Estuarine	247.86397	1	2	3	2	3	2	3	3
Humber Middle	GB530402609202	Humber	Estuarine	67.13978	1	2	3	2	3	0	4	2
Humber Upper	GB530402609203	Humber	Estuarine	12.33168	3	3	3	1	5	0	4	3
Witham	GB530503000100	Anglian	Estuarine	0.92247	2	4	5	4	5	2	4	3
Steeping	GB530503016300	Anglian	Estuarine	0.12124	3	3	3	4	5	1	5	3
Welland	GB530503100400	Anglian	Estuarine	1.76952	3	3	3	5	5	2	3	4
Nene	GB530503200200	Anglian	Estuarine	2.03194	2	3	3	5	5	2	5	2
Great Ouse	GB530503300300	Anglian	Estuarine	12.50044	3	3	3	4	4	2	5	4
Wash Inner	GB530503311300	Anglian	Estuarine	133.61635	1	1	3	1	2	2	1	5
Thames Lower	GB530603911401	Thames	Estuarine	201.03736	1	1	3	1	3	2	2	5
Thames Middle	GB530603911402	Thames	Estuarine	43.91257	1	1	3	1	4	2	5	1
Thames Upper	GB530603911403	Thames	Estuarine	3.14917	3	4	5	5	5	0	5	1
Medway	GB530604002300	Thames	Estuarine	56.56477	5	5	5	5	3	2	4	2
Swale	GB530604011500	Thames	Estuarine	29.05473	3	4	4	5	4	2	2	4
Camel	GB530804906600	South West	Estuarine	10.86862	1	1	3	1	3	2	3	3
Hayle	GB530804906700	South West	Estuarine	1.86912	1	1	3	1	4	3	4	2
Severn Middle	GB530905415402	Severn	Estuarine	62.16105	1	1	3	1	3	2	2	1
Severn Upper	GB530905415403	Severn	Estuarine	8.36376	2	2	3	2	5	2	2	1
Bristol Avon	GB530905415405	Severn	Estuarine	2.01944	1	1	3	3	5	2	5	1
Mersey	GB531206908100	North West	Estuarine	79.69867	2	3	4	5	3	2	4	2
Alt	GB531206908300	North West	Estuarine	0.26252	3	3	3	4	5	2	2	2
Ribble	GB531207112400	North West	Estuarine	45.27607	1	2	3	5	3	2	3	2
Lune	GB531207212100	North West	Estuarine	3.01253	1	1	3	1	4	2	3	3
Wyre	GB531207212200	North West	Estuarine	6.38104	2	3	3	3	4	3	2	3
Leven	GB531207311900	North West	Estuarine	29.23468	1	1	3	3	3	2	2	2
Kent	GB531207312000	North West	Estuarine	98.11435	1	1	3	2	2	2	1	2
Esk (W)	GB531207408400	North West	Estuarine	3.59389	1	1	3	2	1	2	2	3
Duddon	GB531207411800	North West	Estuarine	12.71494	1	1	3	1	3	2	2	1
Derwent	GB531207508700	North West	Estuarine	0.26931	2	2	3	1	1	5	4	2
Maryport	GB531207508800	North West	Estuarine	0.10398	1	1	3	2	1	2	5	2
Rother	GB540704016100	South East	Estuarine	0.38638	1	1	3	3	5	1	4	3
Cuckmere	GB540704104800	South East	Estuarine	0.36484	1	2	3	5	5	2	5	3
Ouse	GB540704104900	South East	Estuarine	1.39309	3	3	4	5	5	4	5	2
Arun	GB540704105000	South East	Estuarine	1.37853	2	3	3	3	5	2	5	2
Adur	GB540704116000	South East	Estuarine	1.36847	2	3	3	5	5	2	5	3
Gannel	GB540804906500	South West	Estuarine	1.08182	1	1	1	1	4	1	2	4
Taw/Torridge	GB540805015500	South West	Estuarine	14.58700	1	1	1	1	4	2	3	2
Parrett	GB540805210900	South West	Estuarine	70.84511	1	1	1	3	3	2	2	1
Barrow Clay Pits	GB560402916600	Humber	Estuarine	0.50962	0	0	0	0	1	2	1	1
North Killingholme Haven Pits	GB560402916700	Humber	Estuarine	0.17112	0	0	0	0	1	2	1	1
Northcoates Point Lagoon	GB560402917500	Humber	Estuarine	0.06006	0	0	0	0	1	2	1	1
Snettisham Lagoon Complex	GB560503316700	Anglian	Estuarine	0.24842	0	0	0	0	5	2	2	1
Allhallows Marshes	GB560504016800	Thames	Estuarine	0.09740	0	0	0	0	1	2	1	1
Murston Lakes	GB560604017400	Thames	Estuarine	0.46311	0	0	0	0	1	2	2	1
Higham Marshes	GB560604017600	Thames	Estuarine	0.92684	0	0	0	0	1	2	1	1
Cliffe Fort Lagoon	GB560604017700	Thames	Estuarine	0.49731	0	0	0	0	1	2	1	1
West Thurrock Lagoon	GB560604017900	Thames	Estuarine	0.05089	0	0	0	0	1	2	2	1
Pagham Lagoon	GB560704117300	South East	Estuarine	0.09519	0	0	0	0	1	2	1	1
Black Water Lagoons	GB560704217200	South East	Estuarine	0.11932	0	0	0	0	5	2	1	1
Old Mill Ponds	GB560710116900	South East	Estuarine	0.08040	0	0	0	0	1	2	2	4
Bembridge Harbour Lagoon	GB560710117000	South East	Estuarine	0.08931	0	0	0	0	1	2	2	1

Pagham Harbour	GB570704700000	South East	Estuarine	2.57240	3	4	5	5	5	2	2	3
Langstone Harbour	GB580705130000	South East	Estuarine	18.90755	1	1	2	2	4	3	2	4
Portsmouth Harbour	GB580705140000	South East	Estuarine	16.42455	3	3	4	3	3	3	4	4
Chichester Harbour	GB580705210000	South East	Estuarine	30.12664	4	5	5	5	4	2	2	4
Benacre Broad	GB610050071000	Anglian	Coastal	0.29314	0	0	0	0	1	2	1	1
Walberswick Marshes	GB610050076000	Anglian	Coastal	0.25661	0	0	0	0	1	2	1	1
Covehithe Broad	GB610050081000	Anglian	Coastal	0.15592	0	0	0	0	1	2	1	1
Blakeney Spit Lagoon	GB610050082000	Anglian	Coastal	0.11259	0	0	0	0	1	2	1	1
Ternery Pool	GB610070072000	South East	Coastal	0.05175	0	0	0	0	1	2	1	1
Great Deep	GB610070074000	South East	Coastal	0.16813	0	0	0	0	5	2	1	4
Sowley Marsh	GB610070075000	South East	Coastal	0.07744	2	2	3	3	5	2	1	4
Lands End To Trevose Head	GB610807680001	South West	Coastal	264.04155	1	1	1	1	2	1	2	3
Cornwall North	GB610807680002	South West	Coastal	191.60190	1	1	1	1	3	1	2	3
Barnstaple Bay	GB610807680003	South West	Coastal	111.14150	1	1	1	1	2	1	1	3
Bristol Channel Outer South	GB610807680004	South West	Coastal	825.30039	1	1	1	1	2	1	2	2
Lundy	GB610878040000	South West	Coastal	39.14954	0	0	0	0	1	1	3	4
Farne Islands To Newton Haven	GB620301100000	Northumbria	Coastal	70.20921	1	1	1	1	1	1	2	5
Dorset/Hampshire	GB620705550000	South West	Coastal	513.10556	1	3	3	3	2	2	4	4
St Austell	GB620806110001	South West	Coastal	123.05457	1	1	1	3	2	1	2	5
Devon South	GB620806110002	South West	Coastal	76.36857	1	1	1	1	2	1	1	3
Plymouth Coast	GB620806110003	South West	Coastal	126.83293	1	1	1	1	1	1	1	4
Lyme Bay East	GB620806560000	South West	Coastal	118.16211	1	1	1	1	2	1	3	4
Cornwall South	GB620806570000	South West	Coastal	122.36060	1	1	1	1	2	1	2	4
Scilly Isles	GB620807080000	South West	Coastal	189.06239	0	0	0	0	1	1	2	3
Yorkshire South	GB640402491000	Humber	Coastal	158.36867	1	1	2	3	2	2	2	3
Lincolnshire	GB640402492000	Anglian	Coastal	170.47649	1	1	1	1	2	2	2	4
Norfolk North	GB640503300000	Anglian	Coastal	167.11814	1	1	1	2	2	2	1	5
Wash Outer	GB640523160000	Anglian	Coastal	461.41496	2	3	3	3	2	2	1	5
Thames Coastal North	GB640603690000	Thames	Coastal	42.68336	5	5	5	5	1	2	1	5
Whitstable Bay	GB640604290000	South East	Coastal	25.72277	2	3	3	4	2	3	1	5
Thames Coastal South	GB640604640000	South East	Coastal	77.08066	1	1	1	1	1	4	1	5
Kent South	GB640704540001	South East	Coastal	248.37536	2	3	3	4	2	3	4	3
Sussex East	GB640704540002	South East	Coastal	130.59208	2	3	3	4	2	3	2	4
Sussex	GB640704540003	South East	Coastal	190.59696	2	3	3	1	2	3	4	4
Bristol Channel Inner South	GB640807670000	South West	Coastal	337.97433	1	1	1	1	2	2	1	1
Morecambe Bay	GB641211171000	North West	Coastal	362.38594	1	2	3	5	2	2	2	3
Duddon Sands	GB641211172000	North West	Coastal	27.86137	2	2	1	1	1	2	2	2
Mersey Mouth	GB641211630001	North West	Coastal	420.51556	2	3	4	5	2	3	2	2
Cumbria	GB641211630002	North West	Coastal	243.64630	1	1	1	1	2	2	1	3
Solway Outer South	GB641211630003	North West	Coastal	455.31293	1	1	1	1	2	3	2	2
Northumberland North	GB650301440000	Northumbria	Coastal	103.62569	5	5	5	5	2	1	2	5
Northumberland South	GB650301500001	Northumbria	Coastal	104.91400	1	1	1	2	2	2	2	5
Tyne And Wear	GB650301500002	Northumbria	Coastal	126.38777	2	2	1	4	2	2	3	3
Tees Coastal	GB650301500005	Northumbria	Coastal	88.38147	2	3	4	5	2	2	3	3
Hadston Links And Cresswell Ponds	GB650301600000	Northumbria	Coastal	0.18718	0	0	0	0	1	2	2	1
Yorkshire North	GB650401500004	Humber	Coastal	180.49136	1	1	1	1	3	2	2	4
Harwich Approaches	GB650503190000	Anglian	Coastal	24.39258	4	5	5	5	2	3	5	3
Blackwater Outer	GB650503200000	Anglian	Coastal	48.63540	3	4	4	5	2	2	1	5
Essex	GB650503520001	Anglian	Coastal	1195.90614	5	5	5	5	2	3	2	5
Suffolk	GB650503520002	Anglian	Coastal	146.53268	2	2	3	3	2	2	4	3
Norfolk East	GB650503520003	Anglian	Coastal	211.16770	1	1	2	2	2	3	5	3
Kent North	GB650704510000	South East	Coastal	450.00607	3	4	5	5	2	3	4	5

Solent	GB650705150000	South East	Coastal	259.58087	5	5	5	5	2	3	3	5
Isle Of Wight East	GB650705530000	South East	Coastal	263.69664	4	5	5	5	2	2	2	4
Plymouth Sound	GB650806230000	South West	Coastal	17.88275	1	1	1	2	1	1	3	5
Carrick Roads Outer	GB650806250000	South West	Coastal	14.75284	1	1	2	4	2	2	5	4
Fal/Helford	GB650806330000	South West	Coastal	123.40363	1	1	1	1	2	1	2	5
Penzance	GB650806340000	South West	Coastal	26.91961	2	3	3	3	2	3	4	5
Lyme Bay West	GB650806420000	South West	Coastal	136.80465	1	1	1	1	2	2	2	5
Bridgwater Bay	GB670807410000	South West	Coastal	91.81258	1	1	1	1	2	2	2	1
Holy Island & Budle Bay	GB680301430000	Northumbria	Coastal	30.38498	0	0	0	0	3	2	1	5
Hamford Water	GB680503713700	Anglian	Coastal	11.20278	0	0	0	0	4	3	3	3
Weymouth Bay	GB680805070000	South West	Coastal	7.90402	2	2	3	3	3	3	4	2
Portland Harbour	GB680805270000	South West	Coastal	10.24431	0	0	0	0	1	2	2	4
Tor Bay	GB680806320000	South West	Coastal	24.40821	0	0	0	0	1	2	5	5
Salcombe Harbour	GB680806460000	South West	Coastal	5.14064	1	1	1	2	3	1	2	4

Table B.2: Naturalness score per water body for estuarine and coastal waters

WFD water body name	WFD water body ID	River basin district name	Water body type	Water body total area (Km2)	P3 Combined Other Activities Score per WB	C1 Water Quality Score per WB	C2 DO Score per WB	C3 DIN Score per WB	C4 Opportunistic macroalgae Score per WB	B1 IQI Score per WB	B2 INNS Score per WB	B3 Saltmarsh Score per WB
Langstone Oysterbeds	GB510070073000	South East	Estuarine	0.16481	1	0	0	0	0	0	1	0
Fleet Lagoon	GB510080077000	South West	Estuarine	4.93772	1	3	1	3	0	0	2	0
Tweed	GB510202110000	Solway Tweed	Estuarine	2.44074	2	3	1	3	1	3	2	4
Coquet	GB510302203000	Northumbria	Estuarine	0.62429	3	0	1	3	3	0	1	0
Blyth (N)	GB510302203200	Northumbria	Estuarine	1.68383	2	0	1	3	1	0	1	0
Aln	GB510302203300	Northumbria	Estuarine	0.45404	1	0	0	0	1	2	2	0
Wansbeck	GB510302210100	Northumbria	Estuarine	0.60492	1	0	0	0	3	0	1	0
Tyne	GB510302310200	Northumbria	Estuarine	8.09495	5	3	1	3	1	0	1	0
Wear	GB510302402900	Northumbria	Estuarine	2.08430	2	0	1	3	1	0	1	0
Tees	GB510302509900	Northumbria	Estuarine	11.44045	3	5	1	3	3	3	2	3
Esk (E)	GB510402703400	Humber	Estuarine	0.28321	5	3	1	3	1	3	2	0
Burn	GB510503403500	Anglian	Estuarine	4.73243	3	3	1	0	2	3	3	3
Bure & Waveney & Yare & Lothing	GB510503410700	Anglian	Estuarine	8.87849	2	3	1	3	1	3	2	5
Blyth (S)	GB510503503700	Anglian	Estuarine	2.60596	1	0	1	3	2	0	1	0
Wey	GB510804415700	South West	Estuarine	0.10099	1	0	0	0	1	0	5	0
Axe	GB510804505400	South West	Estuarine	0.33406	1	0	0	0	1	1	1	0
Otter	GB510804505500	South West	Estuarine	0.22947	1	0	0	0	1	3	1	0
Exe	GB510804505600	South West	Estuarine	18.00907	4	3	1	3	2	2	2	4
Teign	GB510804605800	South West	Estuarine	3.52627	2	3	1	0	1	0	2	0
Dart	GB510804605900	South West	Estuarine	8.31958	3	3	1	3	1	3	3	4
Avon	GB510804606000	South West	Estuarine	1.82761	1	3	1	0	1	1	2	0
Erme	GB510804606100	South West	Estuarine	1.35887	1	0	0	0	1	3	2	0
Fowey	GB510804806400	South West	Estuarine	2.64982	5	3	1	0	1	2	2	0
Stiffkey & Glaven	GB520503403600	Anglian	Estuarine	17.10711	3	3	1	0	1	3	2	3
Alde & Ore	GB520503503800	Anglian	Estuarine	10.86808	4	3	1	3	1	2	3	2
Deben	GB520503503900	Anglian	Estuarine	7.81943	1	3	1	3	1	0	3	0
Orwell	GB520503613601	Anglian	Estuarine	12.49248	4	3	1	3	2	3	4	4
Stour (Essex)	GB520503613602	Anglian	Estuarine	25.27534	3	3	1	3	3	3	3	4
Crouch	GB520503704100	Anglian	Estuarine	23.76147	4	3	2	3	1	2	2	0
Colne	GB520503713800	Anglian	Estuarine	9.33327	4	3	1	3	1	0	2	0
Blackwater	GB520503714000	Anglian	Estuarine	42.93664	3	4	1	3	3	2	3	0
Stour (Kent)	GB520704004700	South East	Estuarine	5.46736	3	3	1	3	1	0	1	0
Beaulieu River	GB520704201400	South East	Estuarine	3.07496	4	3	1	2	2	2	3	2
Lymington	GB520704202100	South East	Estuarine	2.45226	3	0	1	3	3	0	3	0
Southampton Water	GB520704202800	South East	Estuarine	30.91321	3	3	1	3	2	2	4	3
Medina	GB520710101600	South East	Estuarine	1.62704	5	3	1	3	3	3	3	0
Newtown River	GB520710101700	South East	Estuarine	1.91771	5	0	1	3	0	3	3	3
Western Yar	GB520710101800	South East	Estuarine	0.51031	4	0	1	3	3	3	4	3
Wootton Creek	GB520710101900	South East	Estuarine	0.22934	5	0	1	3	3	0	3	0
Eastern Yar	GB520710102000	South East	Estuarine	0.81061	5	3	1	3	3	0	5	0
Christchurch Harbour	GB520804315900	South West	Estuarine	2.78368	2	0	1	3	2	0	3	0
Poole Harbour	GB520804415800	South West	Estuarine	33.09812	4	3	1	3	3	2	4	3
Kingsbridge	GB520804609000	South West	Estuarine	5.19707	2	3	1	3	3	3	3	0
Yealm	GB520804706200	South West	Estuarine	2.03206	5	3	1	0	2	0	3	0
Plymouth Tamar	GB520804714300	South West	Estuarine	30.20762	5	3	1	0	2	2	3	0
Looe	GB520804806300	South West	Estuarine	0.47716	3	0	0	0	1	0	1	0
Helford	GB520804809100	South West	Estuarine	7.61929	4	3	1	3	1	2	3	0
Carrick Roads Inner	GB520804814400	South West	Estuarine	12.61090	4	3	1	3	2	2	4	3

Solway	GB530207614700	Solway Tweed	Estuarine	305.60425	2	3	1	2	2	3	1	3
Humber Lower	GB530402609201	Humber	Estuarine	247.86397	3	5	1	3	1	3	1	3
Humber Middle	GB530402609202	Humber	Estuarine	67.13978	1	5	1	3	2	0	1	3
Humber Upper	GB530402609203	Humber	Estuarine	12.33168	3	5	2	0	1	0	1	2
Witham	GB530503000100	Anglian	Estuarine	0.92247	2	3	1	3	0	0	2	3
Steeping	GB530503016300	Anglian	Estuarine	0.12124	3	0	0	0	0	0	1	0
Welland	GB530503100400	Anglian	Estuarine	1.76952	1	0	1	3	0	0	1	0
Nene	GB530503200200	Anglian	Estuarine	2.03194	1	3	2	3	0	0	1	0
Great Ouse	GB530503300300	Anglian	Estuarine	12.50044	4	3	1	3	0	0	3	3
Wash Inner	GB530503311300	Anglian	Estuarine	133.61635	4	3	1	3	1	2	2	3
Thames Lower	GB530603911401	Thames	Estuarine	201.03736	3	5	1	3	1	2	1	4
Thames Middle	GB530603911402	Thames	Estuarine	43.91257	3	4	2	3	2	3	1	3
Thames Upper	GB530603911403	Thames	Estuarine	3.14917	2	5	0	0	0	0	1	0
Medway	GB530604002300	Thames	Estuarine	56.56477	3	5	2	3	2	2	3	0
Swale	GB530604011500	Thames	Estuarine	29.05473	4	3	2	3	2	2	2	0
Camel	GB530804906600	South West	Estuarine	10.86862	1	3	1	3	1	2	2	4
Hayle	GB530804906700	South West	Estuarine	1.86912	2	0	1	2	3	0	1	0
Severn Middle	GB530905415402	Severn	Estuarine	62.16105	2	3	1	2	3	0	2	4
Severn Upper	GB530905415403	Severn	Estuarine	8.36376	1	3	1	3	0	0	2	4
Bristol Avon	GB530905415405	Severn	Estuarine	2.01944	3	3	0	0	1	0	1	0
Mersey	GB531206908100	North West	Estuarine	79.69867	5	5	2	3	1	3	1	0
Alt	GB531206908300	North West	Estuarine	0.26252	1	0	0	0	0	0	1	0
Ribble	GB531207112400	North West	Estuarine	45.27607	2	3	1	3	2	2	1	3
Lune	GB531207212100	North West	Estuarine	3.01253	2	3	1	3	1	2	3	3
Wyre	GB531207212200	North West	Estuarine	6.38104	2	3	1	3	3	2	2	3
Leven	GB531207311900	North West	Estuarine	29.23468	1	3	1	2	1	0	1	0
Kent	GB531207312000	North West	Estuarine	98.11435	2	3	1	2	0	0	1	0
Esk (W)	GB531207408400	North West	Estuarine	3.59389	3	3	1	0	1	2	2	0
Duddon	GB531207411800	North West	Estuarine	12.71494	1	0	0	0	1	0	1	0
Derwent	GB531207508700	North West	Estuarine	0.26931	5	0	0	0	0	0	1	0
Maryport	GB531207508800	North West	Estuarine	0.10398	5	0	0	0	1	0	1	0
Rother	GB540704016100	South East	Estuarine	0.38638	1	3	1	3	1	0	2	0
Cuckmere	GB540704104800	South East	Estuarine	0.36484	1	0	0	0	1	0	2	0
Ouse	GB540704104900	South East	Estuarine	1.39309	2	0	1	3	1	0	2	0
Arun	GB540704105000	South East	Estuarine	1.37853	1	3	1	0	1	0	1	0
Adur	GB540704116000	South East	Estuarine	1.36847	3	3	1	3	1	2	1	3
Gannel	GB540804906500	South West	Estuarine	1.08182	2	0	0	0	1	3	2	0
Taw/Torridge	GB540805015500	South West	Estuarine	14.58700	1	3	1	3	1	2	2	3
Parrett	GB540805210900	South West	Estuarine	70.84511	1	3	0	0	1	0	1	0
Barrow Clay Pits	GB560402916600	Humber	Estuarine	0.50962	1	0	0	0	0	0	3	0
North Killingholme Haven Pits	GB560402916700	Humber	Estuarine	0.17112	1	0	0	0	0	0	1	0
Northcoates Point Lagoon	GB560402917500	Humber	Estuarine	0.06006	1	0	0	0	0	0	3	0
Snettisham Lagoon Complex	GB560503316700	Anglian	Estuarine	0.24842	1	0	0	0	0	0	1	0
Allhallows Marshes	GB560504016800	Thames	Estuarine	0.09740	1	0	0	0	0	0	4	0
Murston Lakes	GB560604017400	Thames	Estuarine	0.46311	1	0	0	0	0	0	2	0
Higham Marshes	GB560604017600	Thames	Estuarine	0.92684	1	0	0	0	0	0	1	0
Cliffe Fort Lagoon	GB560604017700	Thames	Estuarine	0.49731	1	0	0	0	0	0	1	0
West Thurrock Lagoon	GB560604017900	Thames	Estuarine	0.05089	1	0	0	0	0	0	1	0
Pagham Lagoon	GB560704117300	South East	Estuarine	0.09519	1	0	0	0	0	0	4	0
Black Water Lagoons	GB560704217200	South East	Estuarine	0.11932	1	0	0	0	0	0	1	0
Old Mill Ponds	GB560710116900	South East	Estuarine	0.08040	1	0	0	0	0	0	5	0
Bembridge Harbour Lagoon	GB560710117000	South East	Estuarine	0.08931	1	0	0	0	0	0	2	0

Pagham Harbour	GB570704700000	South East	Estuarine	2.57240	1	3	1	2	2	2	5	3
Langstone Harbour	GB580705130000	South East	Estuarine	18.90755	3	3	1	2	2	2	3	4
Portsmouth Harbour	GB580705140000	South East	Estuarine	16.42455	1	3	1	3	3	2	2	5
Chichester Harbour	GB580705210000	South East	Estuarine	30.12664	4	3	1	3	2	2	3	0
Benacre Broad	GB610050071000	Anglian	Coastal	0.29314	1	0	0	0	0	0	1	0
Walberswick Marshes	GB610050076000	Anglian	Coastal	0.25661	1	0	0	0	0	0	1	0
Covehithe Broad	GB610050081000	Anglian	Coastal	0.15592	1	0	0	0	0	0	1	0
Blakeney Spit Lagoon	GB610050082000	Anglian	Coastal	0.11259	1	0	0	0	0	0	2	0
Ternery Pool	GB610070072000	South East	Coastal	0.05175	1	0	0	0	0	0	1	0
Great Deep	GB610070074000	South East	Coastal	0.16813	1	3	0	0	0	0	3	0
Sowley Marsh	GB610070075000	South East	Coastal	0.07744	1	0	0	0	0	0	1	0
Lands End To Trevose Head	GB610807680001	South West	Coastal	264.04155	3	0	1	0	0	3	1	0
Cornwall North	GB610807680002	South West	Coastal	191.60190	2	3	1	1	1	2	1	0
Barnstaple Bay	GB610807680003	South West	Coastal	111.14150	3	3	1	2	2	0	1	0
Bristol Channel Outer South	GB610807680004	South West	Coastal	825.30039	3	3	1	2	0	0	1	0
Lundy	GB610878040000	South West	Coastal	39.14954	2	0	0	0	0	0	1	0
Farne Islands To Newton Haven	GB620301100000	Northumbria	Coastal	70.20921	4	3	1	1	1	2	1	4
Dorset/Hampshire	GB620705550000	South West	Coastal	513.10556	1	3	1	2	0	0	2	0
St Austell	GB620806110001	South West	Coastal	123.05457	3	3	1	1	0	0	1	0
Devon South	GB620806110002	South West	Coastal	76.36857	2	3	1	1	0	0	2	0
Plymouth Coast	GB620806110003	South West	Coastal	126.83293	3	0	1	1	0	2	2	0
Lyme Bay East	GB620806560000	South West	Coastal	118.16211	2	3	1	0	0	0	2	0
Cornwall South	GB620806570000	South West	Coastal	122.36060	3	3	1	1	2	2	1	0
Scilly Isles	GB620807080000	South West	Coastal	189.06239	3	0	0	0	0	2	1	0
Yorkshire South	GB640402491000	Humber	Coastal	158.36867	4	3	1	1	0	0	1	0
Lincolnshire	GB640402492000	Anglian	Coastal	170.47649	3	3	1	3	0	2	1	3
Norfolk North	GB640503300000	Anglian	Coastal	167.11814	3	3	1	3	0	2	1	4
Wash Outer	GB640523160000	Anglian	Coastal	461.41496	5	3	1	3	1	2	1	4
Thames Coastal North	GB640603690000	Thames	Coastal	42.68336	3	0	1	3	0	0	1	0
Whitstable Bay	GB640604290000	South East	Coastal	25.72277	3	3	1	3	0	3	2	0
Thames Coastal South	GB640604640000	South East	Coastal	77.08066	3	3	1	3	1	2	1	0
Kent South	GB640704540001	South East	Coastal	248.37536	3	3	1	2	2	2	1	0
Sussex East	GB640704540002	South East	Coastal	130.59208	2	3	1	0	0	0	1	0
Sussex	GB640704540003	South East	Coastal	190.59696	3	3	1	2	0	0	2	0
Bristol Channel Inner South	GB640807670000	South West	Coastal	337.97433	3	3	1	2	2	2	1	0
Morecambe Bay	GB641211171000	North West	Coastal	362.38594	4	3	1	3	1	3	1	0
Duddon Sands	GB641211172000	North West	Coastal	27.86137	2	4	1	0	1	0	2	0
Mersey Mouth	GB641211630001	North West	Coastal	420.51556	4	3	1	3	0	2	1	0
Cumbria	GB641211630002	North West	Coastal	243.64630	3	3	1	2	0	2	1	0
Solway Outer South	GB641211630003	North West	Coastal	455.31293	3	3	1	2	2	3	1	0
Northumberland North	GB650301440000	Northumbria	Coastal	103.62569	2	3	1	1	2	2	1	0
Northumberland South	GB650301500001	Northumbria	Coastal	104.91400	3	3	1	0	0	2	1	0
Tyne And Wear	GB650301500002	Northumbria	Coastal	126.38777	3	3	1	1	0	0	1	0
Tees Coastal	GB650301500005	Northumbria	Coastal	88.38147	4	3	1	0	0	0	1	0
Hadston Links And Cresswell Ponds	GB650301600000	Northumbria	Coastal	0.18718	1	0	0	0	0	0	1	0
Yorkshire North	GB650401500004	Humber	Coastal	180.49136	3	3	1	0	0	0	1	0
Harwich Approaches	GB650503190000	Anglian	Coastal	24.39258	2	0	1	3	0	0	1	0
Blackwater Outer	GB650503200000	Anglian	Coastal	48.63540	2	3	1	3	1	2	2	0
Essex	GB650503520001	Anglian	Coastal	1195.90614	3	3	1	3	0	2	1	0
Suffolk	GB650503520002	Anglian	Coastal	146.53268	4	0	1	3	0	0	1	0
Norfolk East	GB650503520003	Anglian	Coastal	211.16770	4	3	1	3	0	0	2	0
Kent North	GB650704510000	South East	Coastal	450.00607	4	3	1	2	0	0	1	0

Solent	GB650705150000	South East	Coastal	259.58087	3	3	1	3	2	2	2	4
Isle Of Wight East	GB650705530000	South East	Coastal	263.69664	3	0	1	1	0	0	2	0
Plymouth Sound	GB650806230000	South West	Coastal	17.88275	5	3	1	3	1	2	3	0
Carrick Roads Outer	GB650806250000	South West	Coastal	14.75284	4	3	1	2	0	2	4	0
Fal / Helford	GB650806330000	South West	Coastal	123.40363	3	0	1	1	0	2	1	0
Penzance	GB650806340000	South West	Coastal	26.91961	3	0	1	2	0	2	2	0
Lyme Bay West	GB650806420000	South West	Coastal	136.80465	3	3	1	0	0	3	2	0
Bridgwater Bay	GB670807410000	South West	Coastal	91.81258	3	3	1	3	3	3	1	0
Holy Island & Budle Bay	GB680301430000	Northumbria	Coastal	30.38498	1	3	1	3	3	1	1	3
Hamford Water	GB680503713700	Anglian	Coastal	11.20278	2	3	1	3	1	0	2	0
Weymouth Bay	GB680805070000	South West	Coastal	7.90402	1	0	1	0	0	0	3	0
Portland Harbour	GB680805270000	South West	Coastal	10.24431	1	3	1	2	0	0	5	0
Tor Bay	GB680806320000	South West	Coastal	24.40821	3	3	1	1	2	2	3	0
Salcombe Harbour	GB680806460000	South West	Coastal	5.14064	2	0	1	1	0	3	3	0

Table B.3: Naturalness score per water body for estuarine and coastal waters

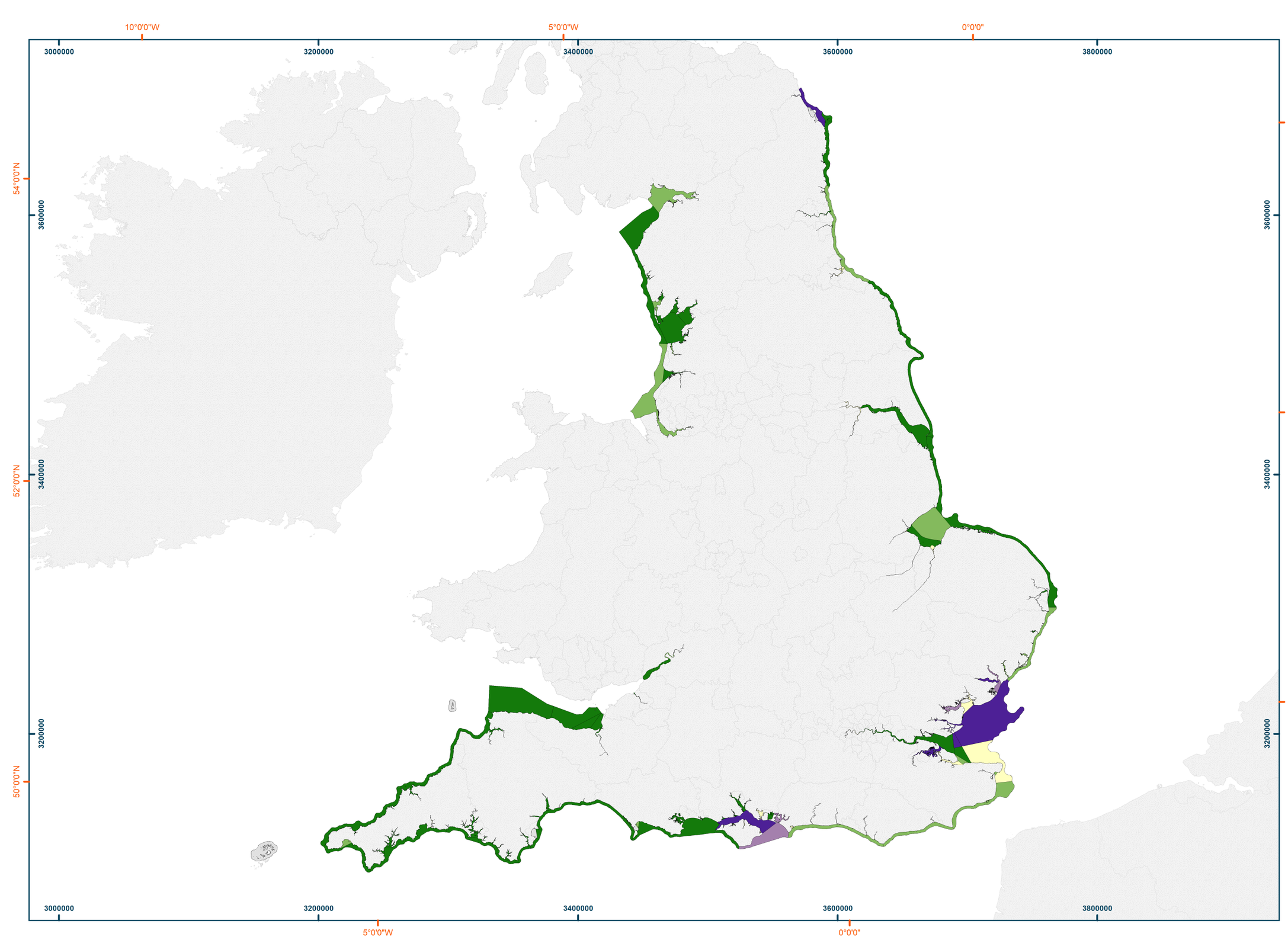
WFD water body name	WFD water body ID	River basin district name	Water body type	Water body total area (ha)	Water body total area (Km2)	O1 Anthropogenic Light Score per WB	O2 Underwater Noise per WB	O3 Litter Score per WB
Langstone Oysterbeds	GB510070073000	South East	Estuarine	16.48	0.16481	3	3	4
Fleet Lagoon	GB510080077000	South West	Estuarine	493.77	4.93772	2	1	2
Tweed	GB510202110000	Solway Tweed	Estuarine	244.07	2.44074	3	1	1
Coquet	GB510302203000	Northumbria	Estuarine	62.43	0.62429	3	2	3
Blyth (N)	GB510302203200	Northumbria	Estuarine	168.38	1.68383	4	1	1
Aln	GB510302203300	Northumbria	Estuarine	45.40	0.45404	3	1	1
Wansbeck	GB510302210100	Northumbria	Estuarine	60.49	0.60492	4	1	1
Tyne	GB510302310200	Northumbria	Estuarine	809.50	8.09495	5	1	3
Wear	GB510302402900	Northumbria	Estuarine	208.43	2.08430	5	1	4
Tees	GB510302509900	Northumbria	Estuarine	1144.05	11.44045	4	1	3
Esk (E)	GB510402703400	Humber	Estuarine	28.32	0.28321	4	1	3
Burn	GB510503403500	Anglian	Estuarine	473.24	4.73243	1	1	4
Bure & Waveney & Yare & Lothing	GB510503410700	Anglian	Estuarine	887.85	8.87849	3	1	1
Blyth (S)	GB510503503700	Anglian	Estuarine	260.60	2.60596	1	1	3
Wey	GB510804415700	South West	Estuarine	10.10	0.10099	5	1	1
Axe	GB510804505400	South West	Estuarine	33.41	0.33406	2	1	1
Otter	GB510804505500	South West	Estuarine	22.95	0.22947	2	1	1
Exe	GB510804505600	South West	Estuarine	1800.91	18.00907	2	1	3
Teign	GB510804605800	South West	Estuarine	352.63	3.52627	3	1	2
Dart	GB510804605900	South West	Estuarine	831.96	8.31958	2	1	1
Avon	GB510804606000	South West	Estuarine	182.76	1.82761	1	1	4
Erme	GB510804606100	South West	Estuarine	135.89	1.35887	1	1	2
Fowey	GB510804806400	South West	Estuarine	264.98	2.64982	2	1	3
Stiffkey & Glaven	GB520503403600	Anglian	Estuarine	1710.71	17.10711	1	1	3
Alde & Ore	GB520503503800	Anglian	Estuarine	1086.81	10.86808	1	3	3
Deben	GB520503503900	Anglian	Estuarine	781.94	7.81943	2	1	3
Orwell	GB520503613601	Anglian	Estuarine	1249.25	12.49248	3	1	4
Stour (Essex)	GB520503613602	Anglian	Estuarine	2527.53	25.27534	3	1	3
Crouch	GB520503704100	Anglian	Estuarine	2376.15	23.76147	2	2	1
Colne	GB520503713800	Anglian	Estuarine	933.33	9.33327	2	1	2
Blackwater	GB520503714000	Anglian	Estuarine	4293.66	42.93664	2	1	2
Stour (Kent)	GB520704004700	South East	Estuarine	546.74	5.46736	3	1	4
Beaulieu River	GB520704201400	South East	Estuarine	307.50	3.07496	2	1	1
Lymington	GB520704202100	South East	Estuarine	245.23	2.45226	2	1	1
Southampton Water	GB520704202800	South East	Estuarine	3091.32	30.91321	4	1	3
Medina	GB520710101600	South East	Estuarine	162.70	1.62704	3	1	1
Newtown River	GB520710101700	South East	Estuarine	191.77	1.91771	1	1	1
Western Yar	GB520710101800	South East	Estuarine	51.03	0.51031	3	1	1
Wootton Creek	GB520710101900	South East	Estuarine	22.93	0.22934	3	1	1
Eastern Yar	GB520710102000	South East	Estuarine	81.06	0.81061	3	1	3
Christchurch Harbour	GB520804315900	South West	Estuarine	278.37	2.78368	3	1	3
Poole Harbour	GB520804415800	South West	Estuarine	3309.81	33.09812	3	1	3
Kingsbridge	GB520804609000	South West	Estuarine	519.71	5.19707	2	1	3
Yealm	GB520804706200	South West	Estuarine	203.21	2.03206	2	3	1
Plymouth Tamar	GB520804714300	South West	Estuarine	3020.76	30.20762	3	2	2
Looe	GB520804806300	South West	Estuarine	47.72	0.47716	3	1	1
Helford	GB520804809100	South West	Estuarine	761.93	7.61929	1	2	1
Carrick Roads Inner	GB520804814400	South West	Estuarine	1261.09	12.61090	2	2	1

Solway	GB530207614700	Solway Tweed	Estuarine	30560.43	305.60425	1	1	2
Humber Lower	GB530402609201	Humber	Estuarine	24786.40	247.86397	2	2	2
Humber Middle	GB530402609202	Humber	Estuarine	6713.98	67.13978	3	1	3
Humber Upper	GB530402609203	Humber	Estuarine	1233.17	12.33168	3	1	1
Witham	GB530503000100	Anglian	Estuarine	92.25	0.92247	3	1	1
Steeping	GB530503016300	Anglian	Estuarine	12.12	0.12124	2	1	1
Welland	GB530503100400	Anglian	Estuarine	176.95	1.76952	2	1	1
Nene	GB530503200200	Anglian	Estuarine	203.19	2.03194	3	1	1
Great Ouse	GB530503300300	Anglian	Estuarine	1250.04	12.50044	2	1	1
Wash Inner	GB530503311300	Anglian	Estuarine	13361.64	133.61635	1	1	1
Thames Lower	GB530603911401	Thames	Estuarine	20103.74	201.03736	2	2	3
Thames Middle	GB530603911402	Thames	Estuarine	4391.26	43.91257	4	1	2
Thames Upper	GB530603911403	Thames	Estuarine	314.92	3.14917	5	0	5
Medway	GB530604002300	Thames	Estuarine	5656.48	56.56477	3	2	3
Swale	GB530604011500	Thames	Estuarine	2905.47	29.05473	2	2	2
Camel	GB530804906600	South West	Estuarine	1086.86	10.86862	2	1	2
Hayle	GB530804906700	South West	Estuarine	186.91	1.86912	3	2	3
Severn Middle	GB530905415402	Severn	Estuarine	6216.10	62.16105	2	1	2
Severn Upper	GB530905415403	Severn	Estuarine	836.38	8.36376	2	1	1
Bristol Avon	GB530905415405	Severn	Estuarine	201.94	2.01944	5	1	1
Mersey	GB531206908100	North West	Estuarine	7969.87	79.69867	4	1	1
Alt	GB531206908300	North West	Estuarine	26.25	0.26252	3	2	5
Ribble	GB531207112400	North West	Estuarine	4527.61	45.27607	2	1	2
Lune	GB531207212100	North West	Estuarine	301.25	3.01253	3	1	1
Wyre	GB531207212200	North West	Estuarine	638.10	6.38104	3	1	1
Leven	GB531207311900	North West	Estuarine	2923.47	29.23468	2	1	2
Kent	GB531207312000	North West	Estuarine	9811.43	98.11435	2	1	1
Esk (W)	GB531207408400	North West	Estuarine	359.39	3.59389	1	1	1
Duddon	GB531207411800	North West	Estuarine	1271.49	12.71494	1	1	1
Derwent	GB531207508700	North West	Estuarine	26.93	0.26931	5	1	1
Maryport	GB531207508800	North West	Estuarine	10.40	0.10398	4	1	5
Rother	GB540704016100	South East	Estuarine	38.64	0.38638	3	1	1
Cuckmere	GB540704104800	South East	Estuarine	36.48	0.36484	2	1	5
Ouse	GB540704104900	South East	Estuarine	139.31	1.39309	3	1	1
Arun	GB540704105000	South East	Estuarine	137.85	1.37853	2	1	1
Adur	GB540704116000	South East	Estuarine	136.85	1.36847	3	4	1
Gannel	GB540804906500	South West	Estuarine	108.18	1.08182	3	1	2
Taw/Torridge	GB540805015500	South West	Estuarine	1458.70	14.58700	3	1	2
Parrett	GB540805210900	South West	Estuarine	7084.51	70.84511	2	1	2
Barrow Clay Pits	GB560402916600	Humber	Estuarine	50.96	0.50962	3	1	5
North Killingholme Haven Pits	GB560402916700	Humber	Estuarine	17.11	0.17112	5	1	1
Northcoates Point Lagoon	GB560402917500	Humber	Estuarine	6.01	0.06006	2	2	1
Snettisham Lagoon Complex	GB560503316700	Anglian	Estuarine	24.84	0.24842	2	1	1
Allhallows Marshes	GB560504016800	Thames	Estuarine	9.74	0.09740	3	2	1
Murston Lakes	GB560604017400	Thames	Estuarine	46.31	0.46311	4	2	1
Higham Marshes	GB560604017600	Thames	Estuarine	92.68	0.92684	3	2	1
Cliffe Fort Lagoon	GB560604017700	Thames	Estuarine	49.73	0.49731	3	2	1
West Thurrock Lagoon	GB560604017900	Thames	Estuarine	5.09	0.05089	5	1	1
Pagham Lagoon	GB560704117300	South East	Estuarine	9.52	0.09519	3	1	1
Black Water Lagoons	GB560704217200	South East	Estuarine	11.93	0.11932	2	1	1
Old Mill Ponds	GB560710116900	South East	Estuarine	8.04	0.08040	3	1	1
Bembridge Harbour Lagoon	GB560710117000	South East	Estuarine	8.93	0.08931	3	1	1

Pagham Harbour	GB570704700000	South East	Estuarine	257.24	2.57240	2	1	1
Langstone Harbour	GB580705130000	South East	Estuarine	1890.75	18.90755	3	1	1
Portsmouth Harbour	GB580705140000	South East	Estuarine	1642.46	16.42455	4	1	3
Chichester Harbour	GB580705210000	South East	Estuarine	3012.66	30.12664	2	3	3
Benacre Broad	GB610050071000	Anglian	Coastal	29.31	0.29314	1	1	1
Walberswick Marshes	GB610050076000	Anglian	Coastal	25.66	0.25661	1	1	1
Covehithe Broad	GB610050081000	Anglian	Coastal	15.59	0.15592	1	1	4
Blakeney Spit Lagoon	GB610050082000	Anglian	Coastal	11.26	0.11259	1	1	5
Ternery Pool	GB610070072000	South East	Coastal	5.18	0.05175	1	1	1
Great Deep	GB610070074000	South East	Coastal	16.81	0.16813	3	3	1
Sowley Marsh	GB610070075000	South East	Coastal	7.74	0.07744	2	1	1
Lands End To Trevose Head	GB610807680001	South West	Coastal	26404.15	264.04155	1	2	2
Cornwall North	GB610807680002	South West	Coastal	19160.19	191.60190	1	1	2
Barnstaple Bay	GB610807680003	South West	Coastal	11114.15	111.14150	1	1	3
Bristol Channel Outer South	GB610807680004	South West	Coastal	82530.04	825.30039	1	1	1
Lundy	GB610878040000	South West	Coastal	3914.95	39.14954	1	1	1
Farne Islands To Newton Haven	GB620301100000	Northumbria	Coastal	7020.92	70.20921	1	1	2
Dorset/Hampshire	GB620705550000	South West	Coastal	51310.56	513.10556	1	1	2
St Austell	GB620806110001	South West	Coastal	12305.46	123.05457	1	2	2
Devon South	GB620806110002	South West	Coastal	7636.86	76.36857	1	1	3
Plymouth Coast	GB620806110003	South West	Coastal	12683.29	126.83293	1	2	3
Lyme Bay East	GB620806560000	South West	Coastal	11816.21	118.16211	1	1	3
Cornwall South	GB620806570000	South West	Coastal	12236.06	122.36060	1	3	3
Scilly Isles	GB620807080000	South West	Coastal	18906.24	189.06239	1	2	2
Yorkshire South	GB640402491000	Humber	Coastal	15836.87	158.36867	1	1	3
Lincolnshire	GB640402492000	Anglian	Coastal	17047.65	170.47649	1	1	2
Norfolk North	GB640503300000	Anglian	Coastal	16711.81	167.11814	1	1	2
Wash Outer	GB640523160000	Anglian	Coastal	46141.50	461.41496	1	1	2
Thames Coastal North	GB640603690000	Thames	Coastal	4268.34	42.68336	1	2	1
Whitstable Bay	GB640604290000	South East	Coastal	2572.28	25.72277	2	2	3
Thames Coastal South	GB640604640000	South East	Coastal	7708.07	77.08066	1	2	2
Kent South	GB640704540001	South East	Coastal	24837.54	248.37536	1	1	3
Sussex East	GB640704540002	South East	Coastal	13059.21	130.59208	2	1	3
Sussex	GB640704540003	South East	Coastal	19059.70	190.59696	2	2	3
Bristol Channel Inner South	GB640807670000	South West	Coastal	33797.43	337.97433	1	1	1
Morecambe Bay	GB641211171000	North West	Coastal	36238.59	362.38594	2	1	2
Duddon Sands	GB641211172000	North West	Coastal	2786.14	27.86137	2	1	1
Mersey Mouth	GB641211630001	North West	Coastal	42051.56	420.51556	2	2	3
Cumbria	GB641211630002	North West	Coastal	24364.63	243.64630	1	1	2
Solway Outer South	GB641211630003	North West	Coastal	45531.29	455.31293	1	1	2
Northumberland North	GB650301440000	Northumbria	Coastal	10362.57	103.62569	1	1	3
Northumberland South	GB650301500001	Northumbria	Coastal	10491.40	104.91400	1	2	2
Tyne And Wear	GB650301500002	Northumbria	Coastal	12638.78	126.38777	2	1	3
Tees Coastal	GB650301500005	Northumbria	Coastal	8838.15	88.38147	2	1	3
Hadston Links And Cresswell Ponds	GB650301600000	Northumbria	Coastal	18.72	0.18718	2	2	4
Yorkshire North	GB650401500004	Humber	Coastal	18049.14	180.49136	1	1	3
Harwich Approaches	GB650503190000	Anglian	Coastal	2439.26	24.39258	2	1	3
Blackwater Outer	GB650503200000	Anglian	Coastal	4863.54	48.63540	1	1	2
Essex	GB650503520001	Anglian	Coastal	119590.61	1195.90614	1	2	2
Suffolk	GB650503520002	Anglian	Coastal	14653.27	146.53268	1	2	3
Norfolk East	GB650503520003	Anglian	Coastal	21116.77	211.16770	1	1	3
Kent North	GB650704510000	South East	Coastal	45000.61	450.00607	1	1	2

Solent	GB650705150000	South East	Coastal	25958.09	259.58087	2	1	3
Isle Of Wight East	GB650705530000	South East	Coastal	26369.66	263.69664	1	2	2
Plymouth Sound	GB650806230000	South West	Coastal	1788.28	17.88275	2	2	3
Carrick Roads Outer	GB650806250000	South West	Coastal	1475.28	14.75284	2	2	2
Fal/Helford	GB650806330000	South West	Coastal	12340.36	123.40363	1	2	2
Penzance	GB650806340000	South West	Coastal	2691.96	26.91961	2	3	3
Lyme Bay West	GB650806420000	South West	Coastal	13680.47	136.80465	2	1	2
Bridgwater Bay	GB670807410000	South West	Coastal	9181.26	91.81258	1	1	2
Holy Island & Budle Bay	GB680301430000	Northumbria	Coastal	3038.50	30.38498	1	1	1
Hamford Water	GB680503713700	Anglian	Coastal	1120.28	11.20278	2	1	1
Weymouth Bay	GB680805070000	South West	Coastal	790.40	7.90402	3	1	3
Portland Harbour	GB680805270000	South West	Coastal	1024.43	10.24431	2	1	2
Tor Bay	GB680806320000	South West	Coastal	2440.82	24.40821	2	1	2
Salcombe Harbour	GB680806460000	South West	Coastal	514.06	5.14064	1	1	2

C Figures to illustrate Naturalness score per water body for estuarine and coastal waters



WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

- 1 (Most Natural)
- 2
- 3
- 4
- 5 (Least Natural)

N

SCALE: 1:2,800,000

(@ A3)

0 50 100

KILOMETERS

Defra 25 Year Environmental Plan

B6 - Estuarine and Coastal Waters Indicator - Final Report

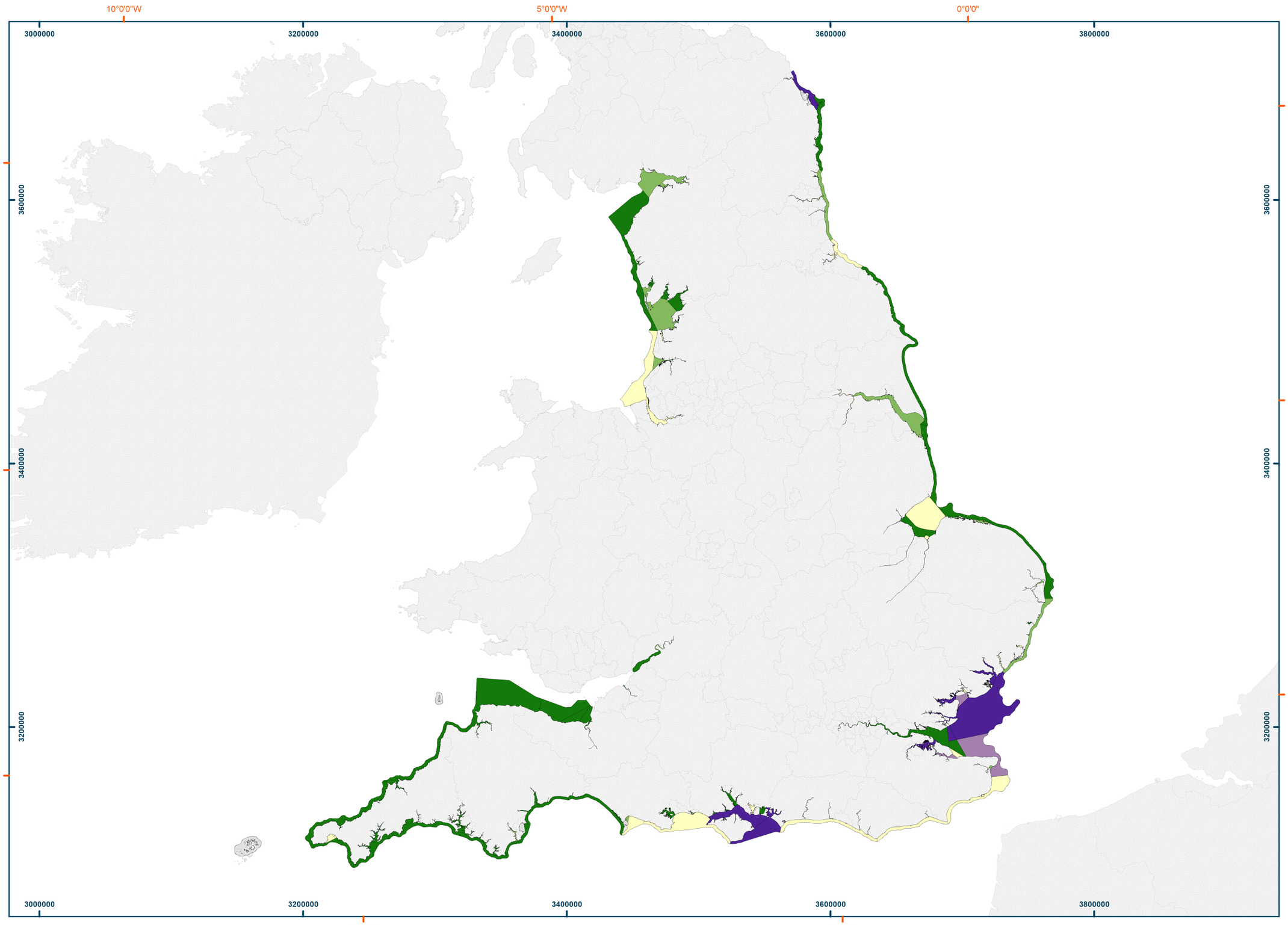
H1a FLOWS QN30 WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-H1a-001-01-DDE

GEODETIC INFORMATION

CRS: ETRS 1989 LAEA
Projection: Lambert Azimuthal Equal Area
Datum: ETRS 1989
False Easting: 4,321,000.0000
False Northing: 3,210,000.0000
Central Meridian: 10.0000
Latitude Of Origin: 52.0000



WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

- 1 (Most Natural)
- 2
- 3
- 4
- 5 (Least Natural)

N

SCALE: 1:2,800,000

(@ A3)

0 50 100

KILOMETERS

Defra 25 Year Environmental Plan

B6 - Estuarine and Coastal Waters Indicator - Final Report

H1b FLOWS QN50 WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-H1b-002-01-DDE

GEODETIC INFORMATION

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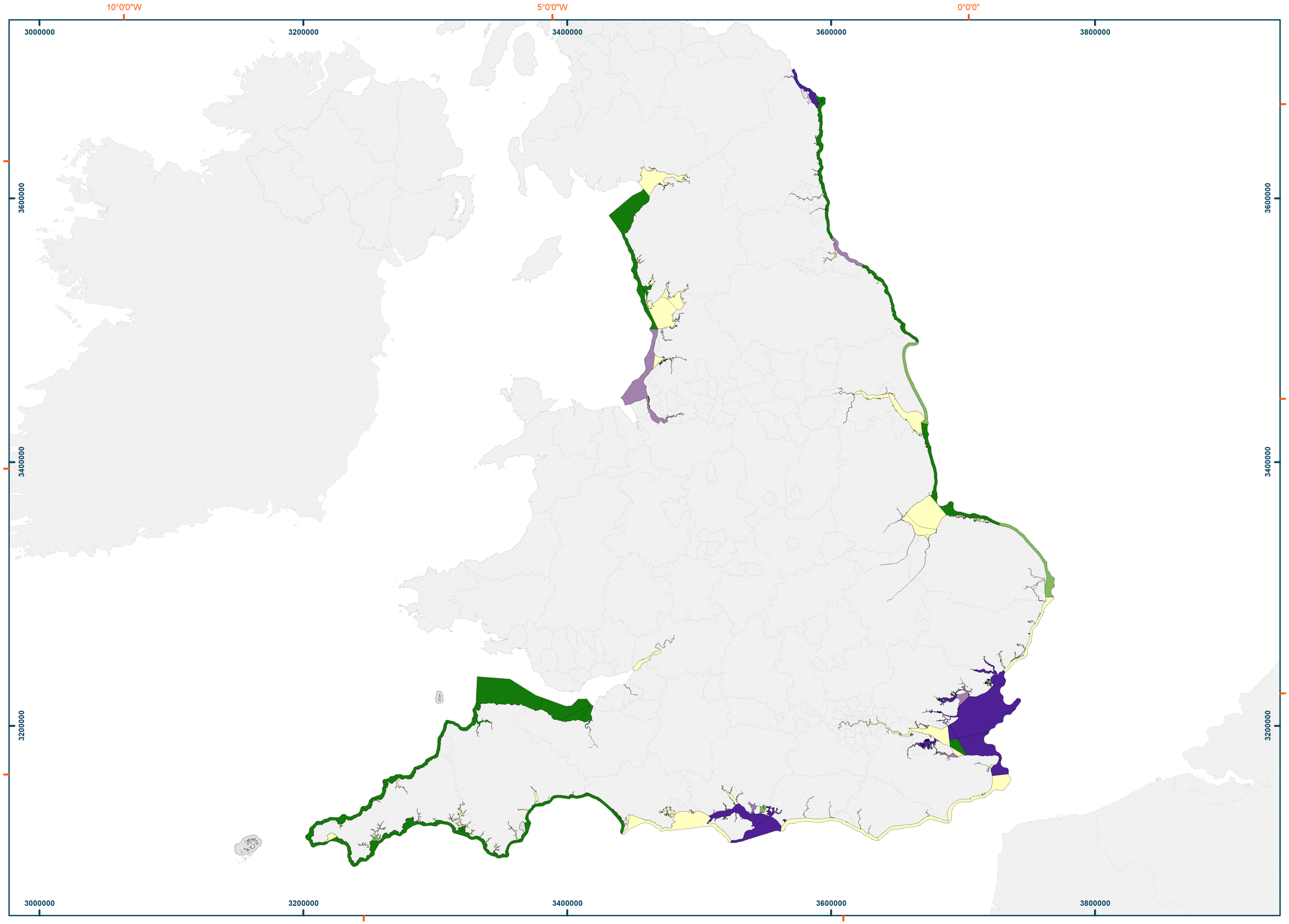

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

- 1 (Most Natural)
- 2
- 3
- 4
- 5 (Least Natural)

N

SCALE: 1:2,800,000

(@ A3)

0 50 100

KILOMETERS

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H1c FLOWS QN70 WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-H1c-003-01-DDE

GEODETIC INFORMATION

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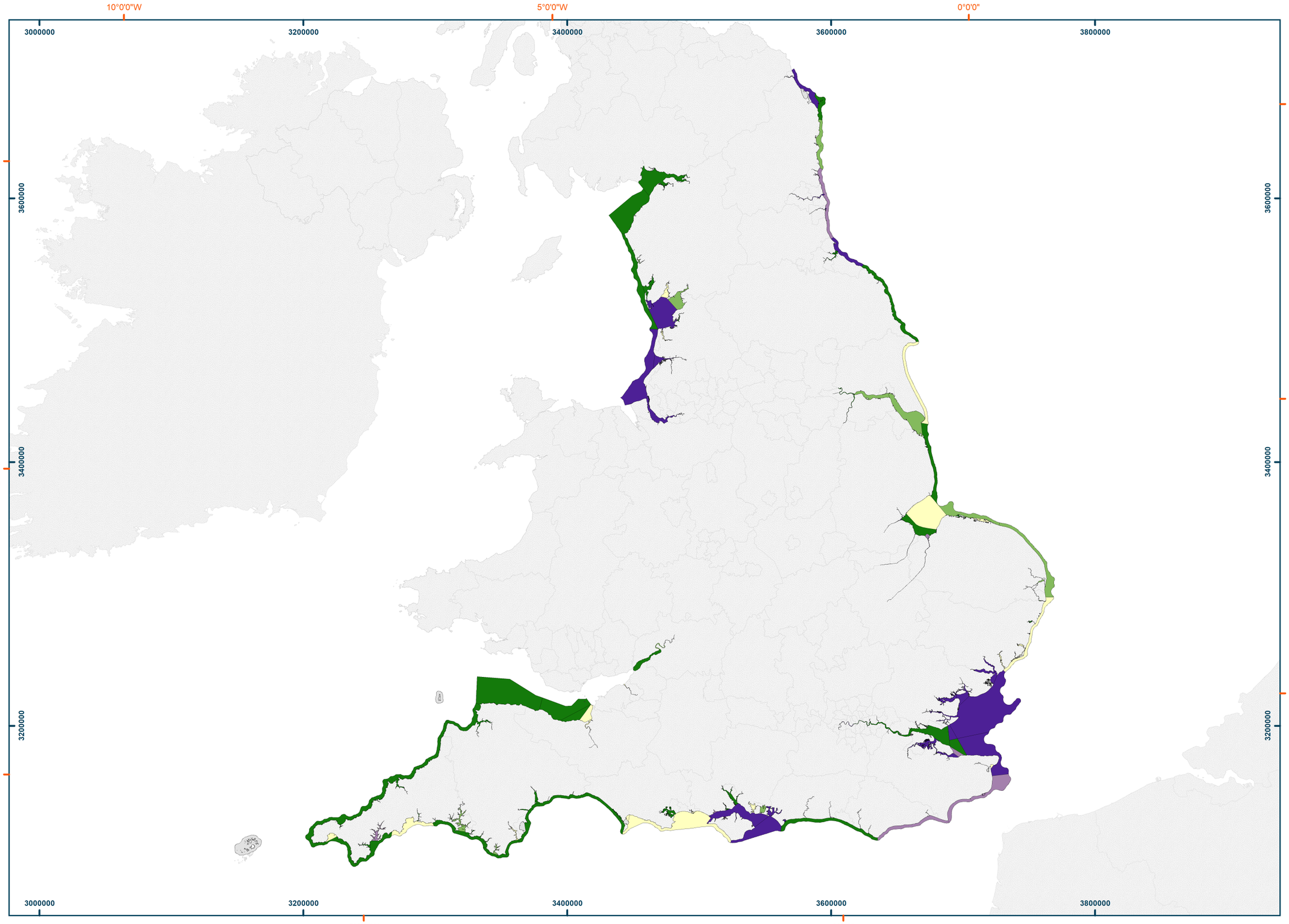

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

- 1 (Most Natural)
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- 5 (Least Natural)

N

SCALE: 1:2,800,000

(@ A3)

0 50 100

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H1d FLOWS QN95 WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-H1d-004-01-DDE

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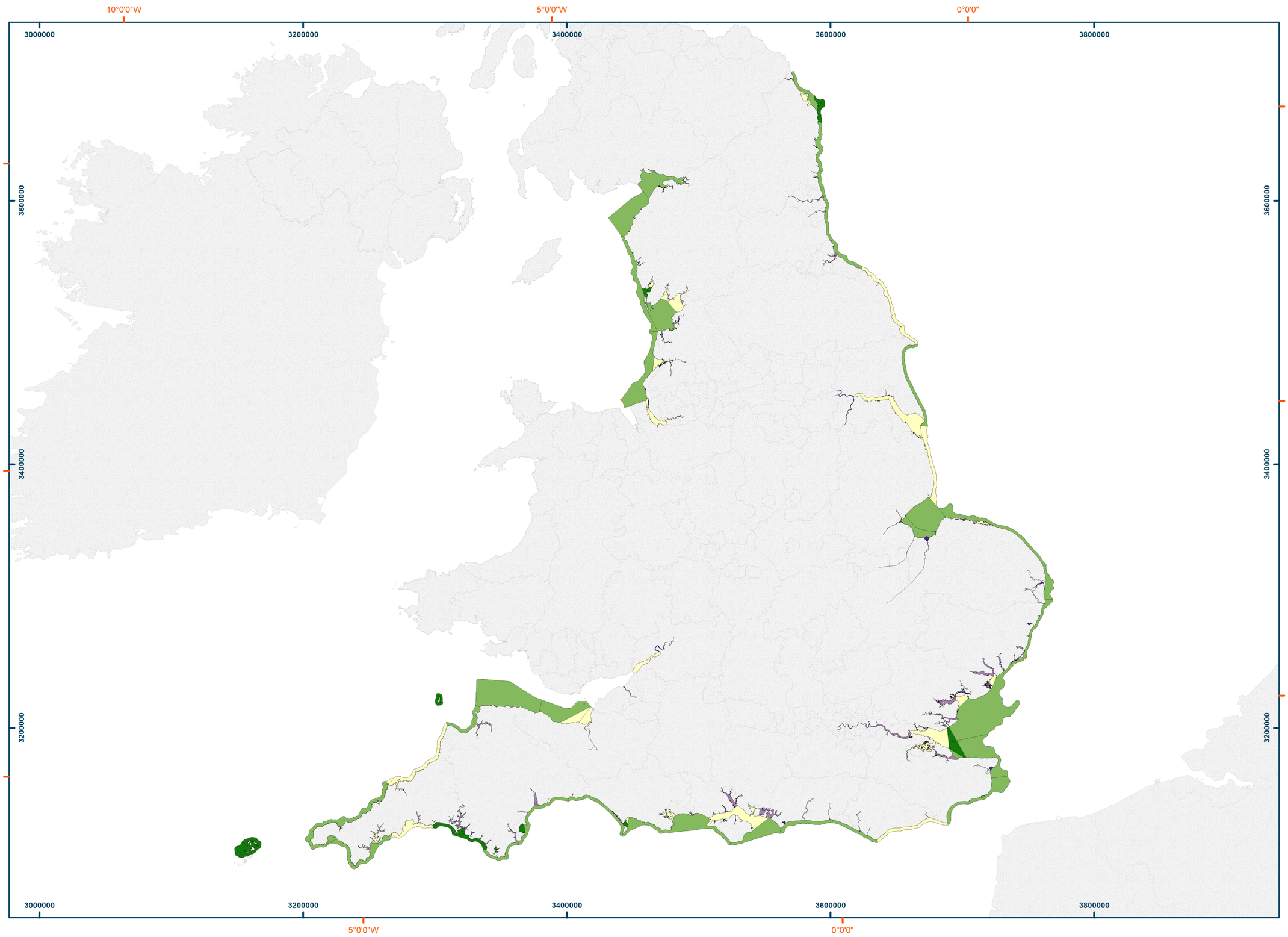

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

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N

SCALE: 1:2,800,000

(@ A3)

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H2 OBSTACLES WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-H2-005-01-DDE

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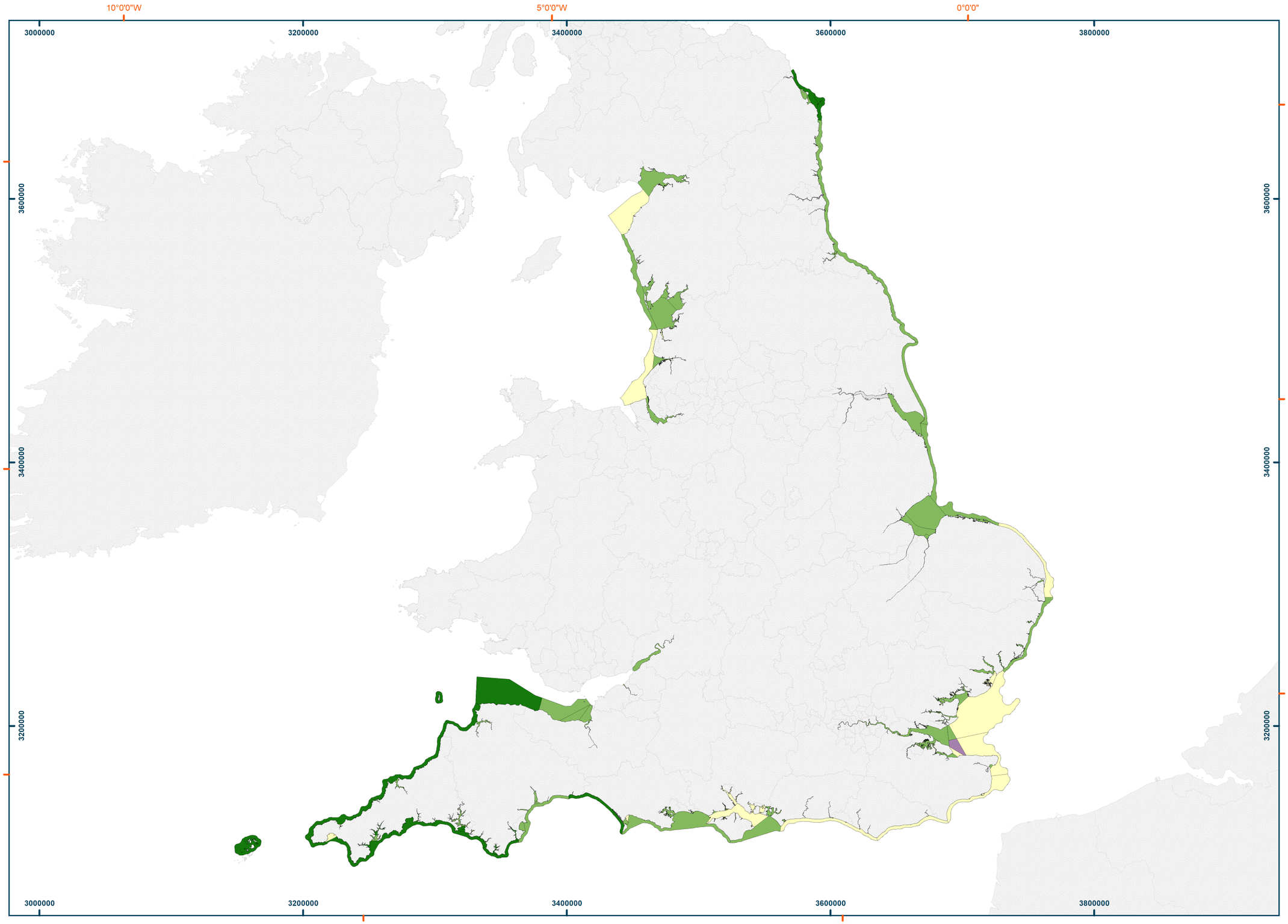

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

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- 5 (Least Natural)

N

SCALE: 1:2,800,000

(@ A3)

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H3 COASTAL PROTECTION WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-H3-006-01-DDE

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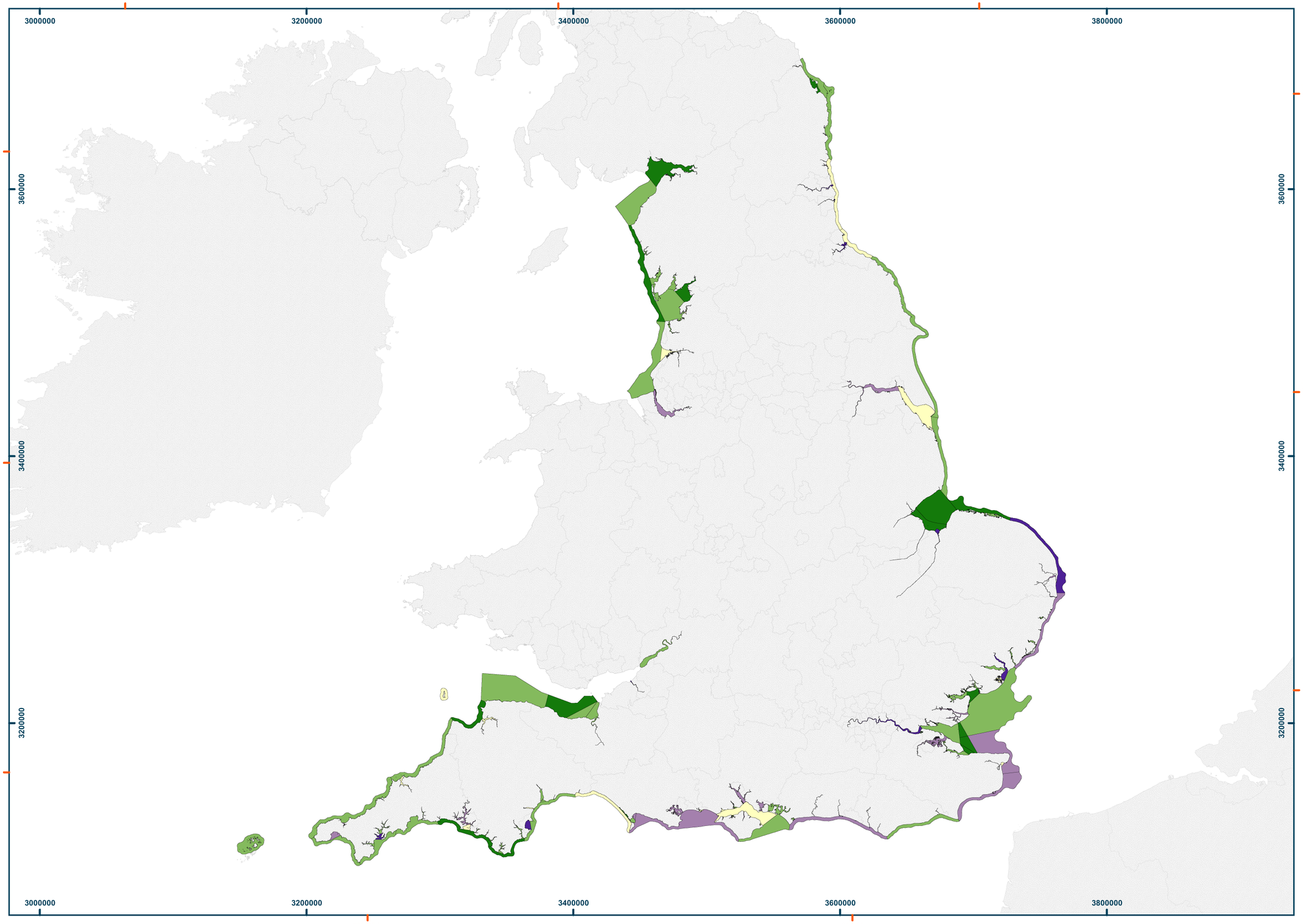

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

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N

SCALE: 1:2,800,000

(@ A3)

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P1 BUILT STRUCTURES WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 13/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-P1-007-01-DDE

GEODETIC INFORMATION

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Natural England Data Services Ref. no. NE-2022-11-9-11-31-43 (CR)

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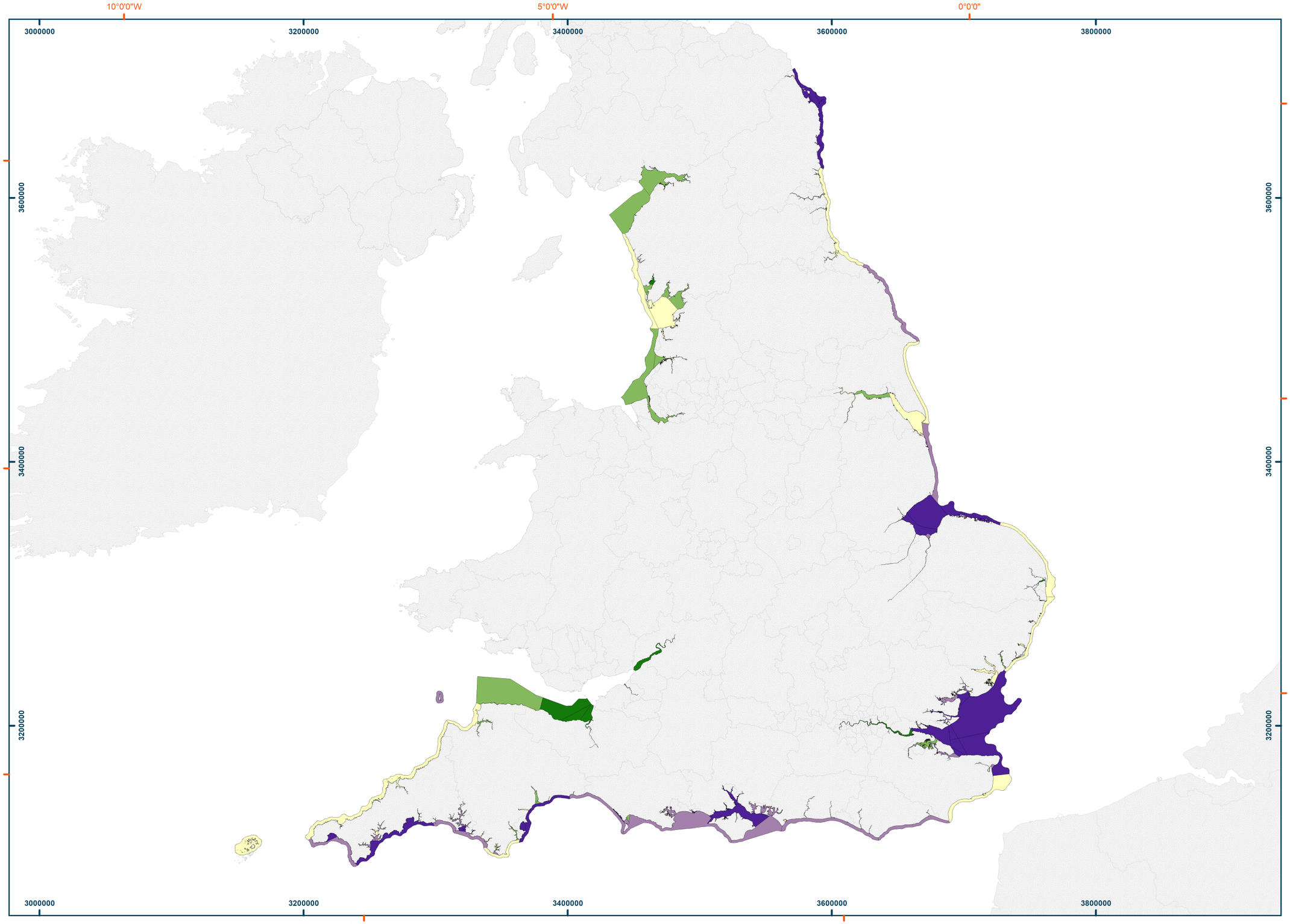

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

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- 5 (Least Natural)

N

SCALE: 1:2,800,000

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P2 FISHING PRESSURE WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-P2-008-01-DDE

GEODETIC INFORMATION

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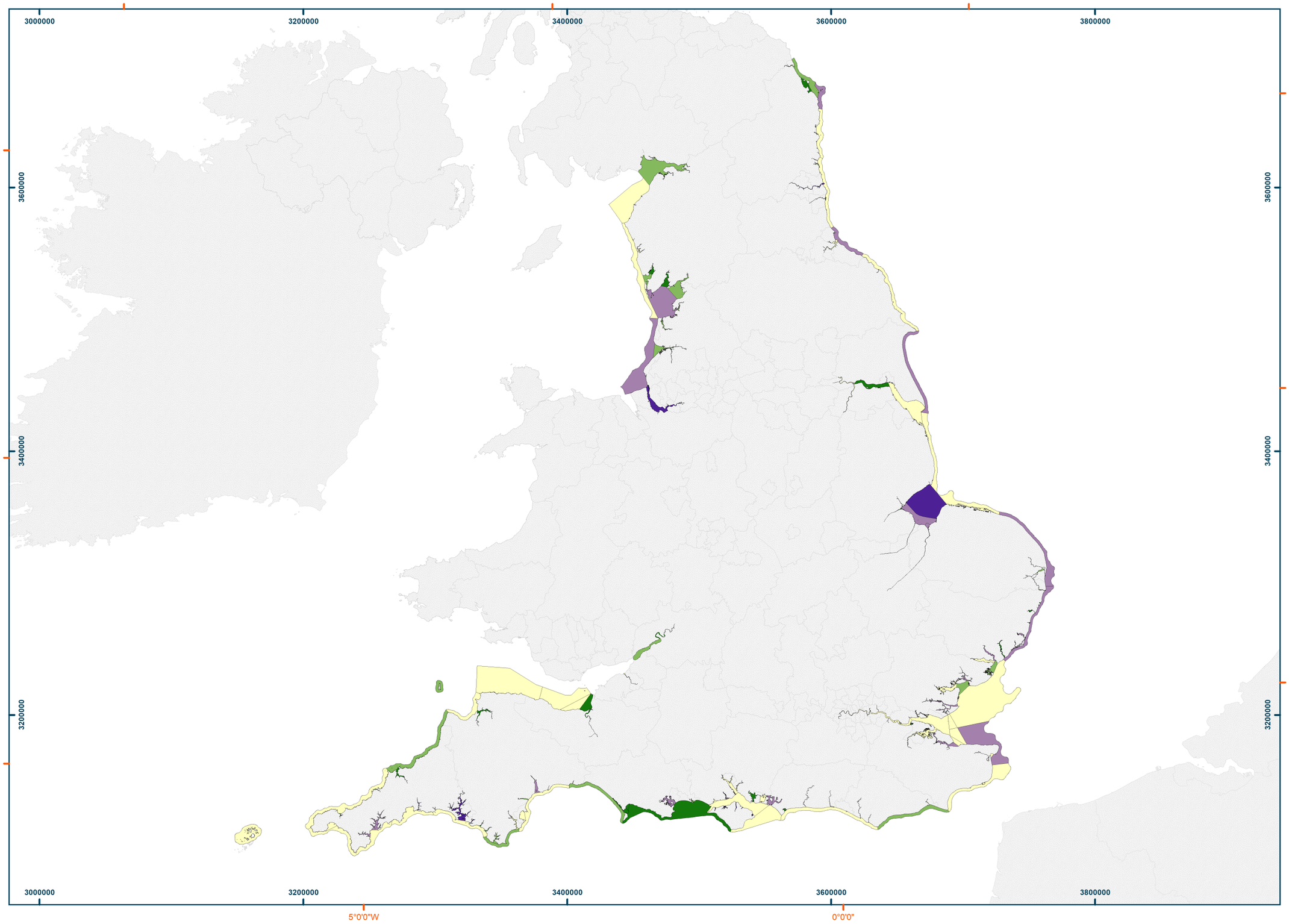

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

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- 5 (Least Natural)

N

SCALE: 1:2,800,000

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P3 COMBINED ACTIVITIES WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 16/01/2023 **DRAWN:** DDE **CHECKED:** JBL

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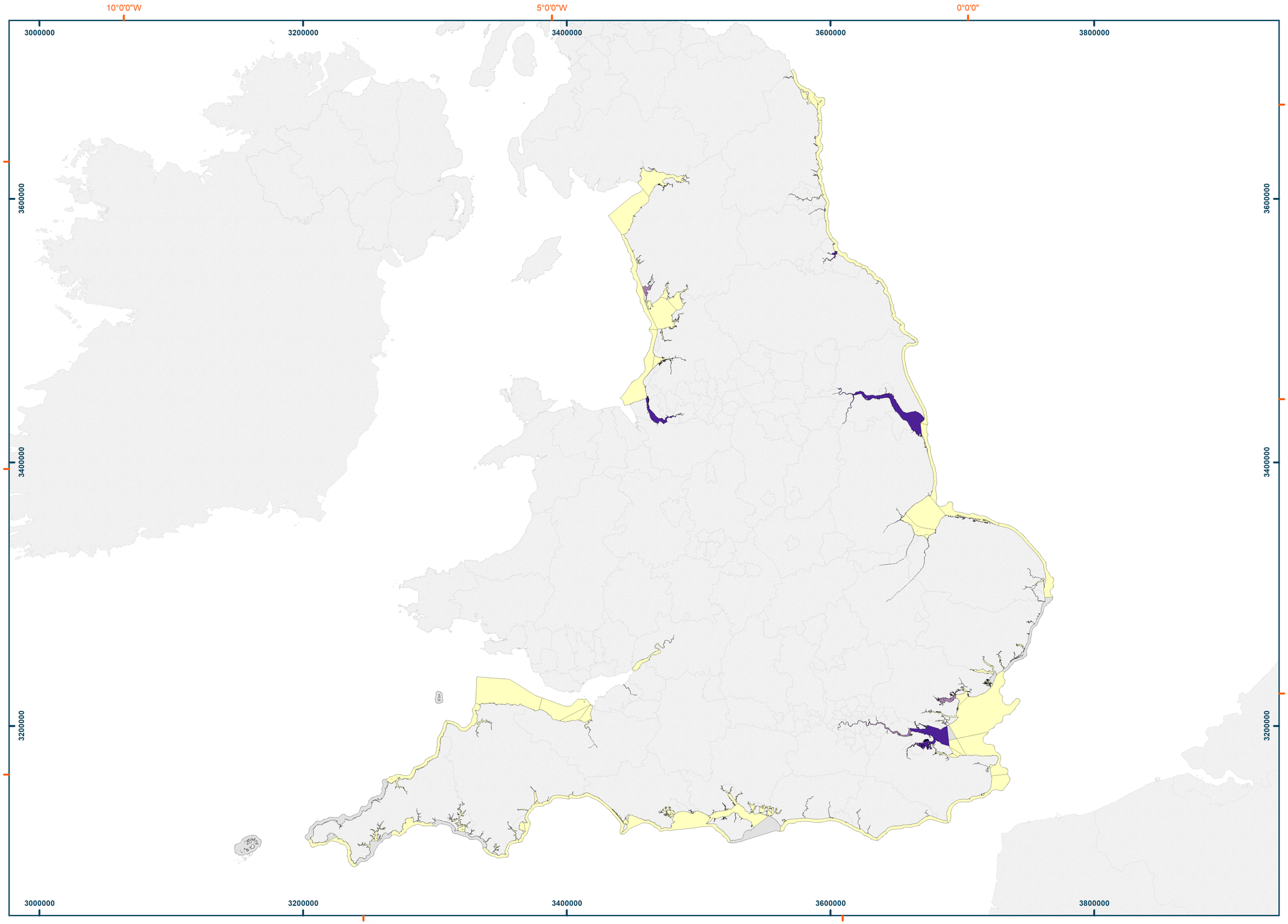

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

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- 2
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- 5 (Least Natural)

N

SCALE: 1:2,800,000

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C1 WATER QUALITY WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-C1-010-01-DDE

GEODETIC INFORMATION

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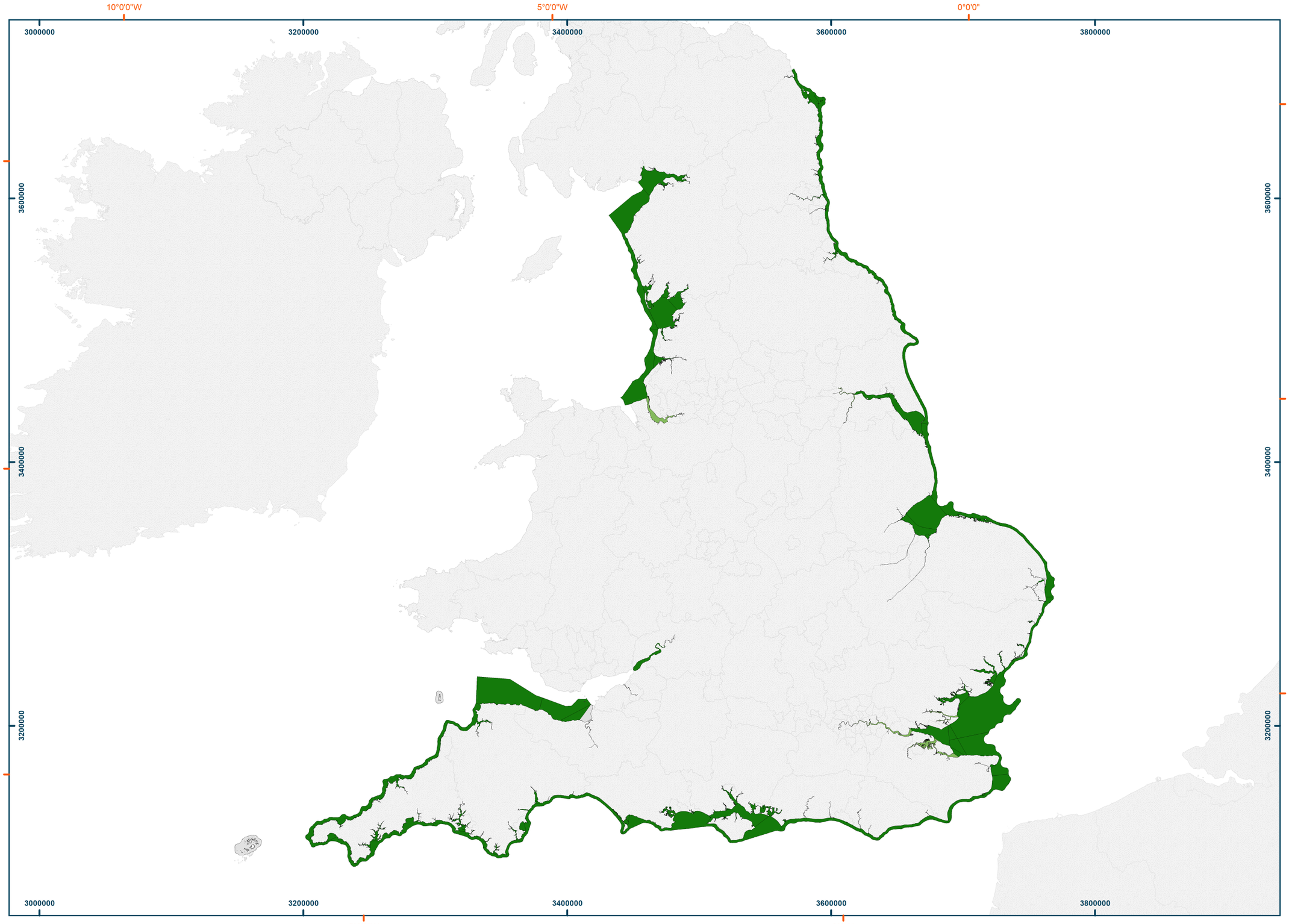

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

- 1 (Most Natural)
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- 5 (Least Natural)

N

SCALE: 1:2,800,000

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B6 - Estuarine and Coastal Waters Indicator - Final Report

C2 DISSOLVED OXYGEN (DO) WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-C2-011-01-DDE

GEODETIC INFORMATION

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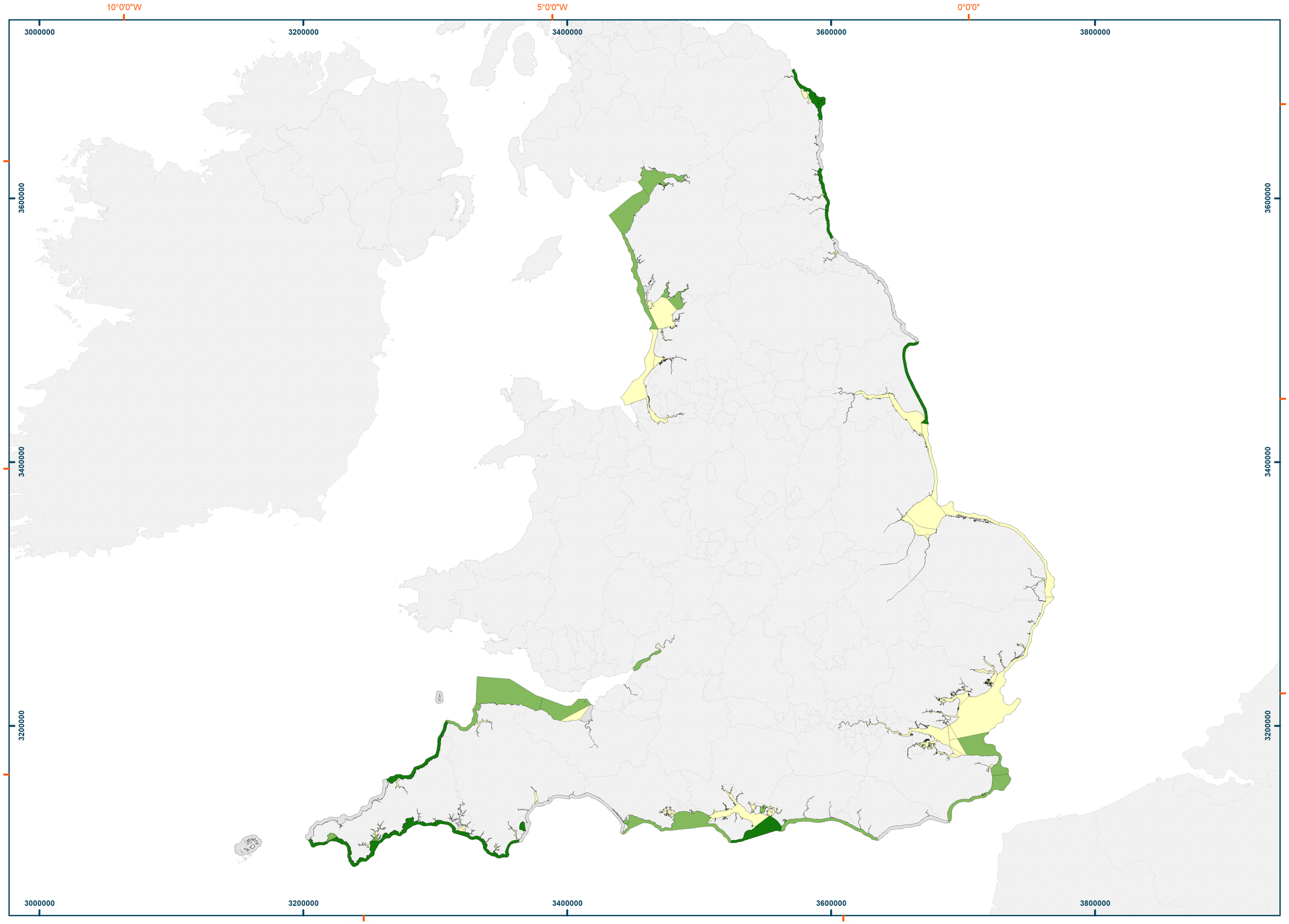

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

- 1 (Most Natural)
- 2
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- 5 (Least Natural)

N

SCALE: 1:2,800,000

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C3 DISSOLVED INORGANIC NITROGEN (DIN) WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

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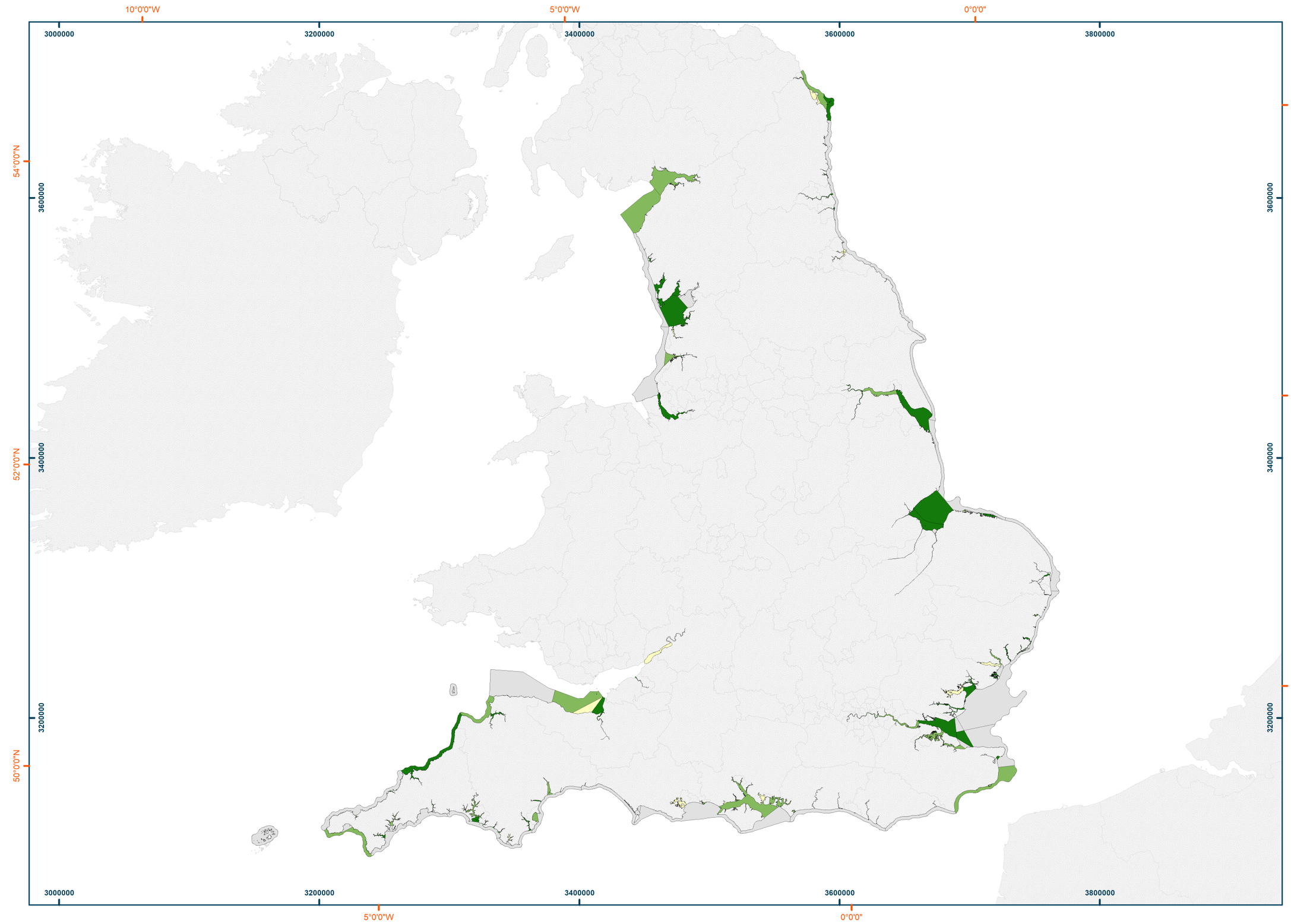

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

- 1 (Most Natural)
- 2
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- 5 (Least Natural)

N

SCALE: 1:2,800,000

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C4 OPPORTUNISTIC MACROALGAE WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

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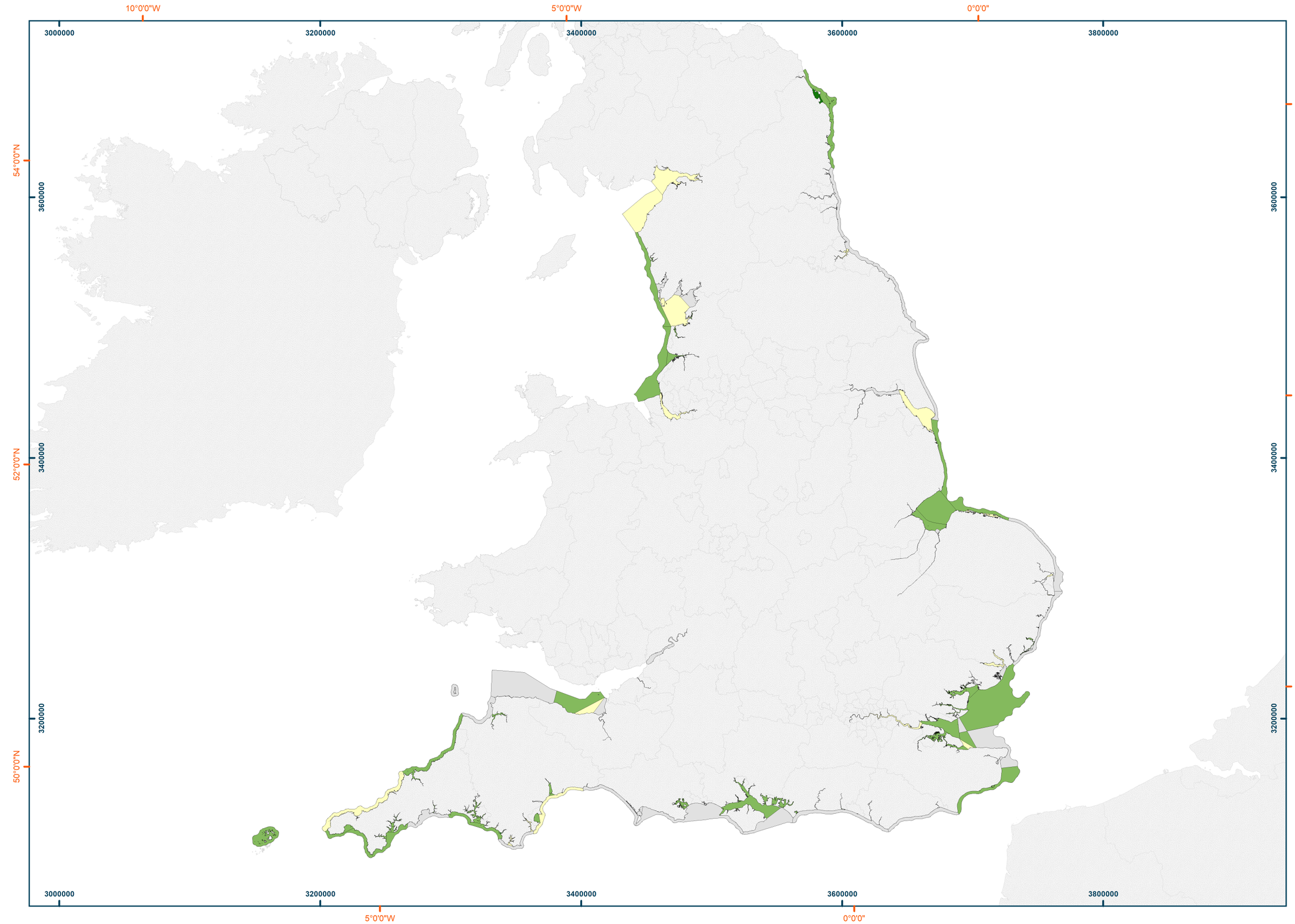

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

- 1 (Most Natural)
- 2
- 3
- 4
- 5 (Least Natural)

N

SCALE: 1:2,800,000

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B1 IQI WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

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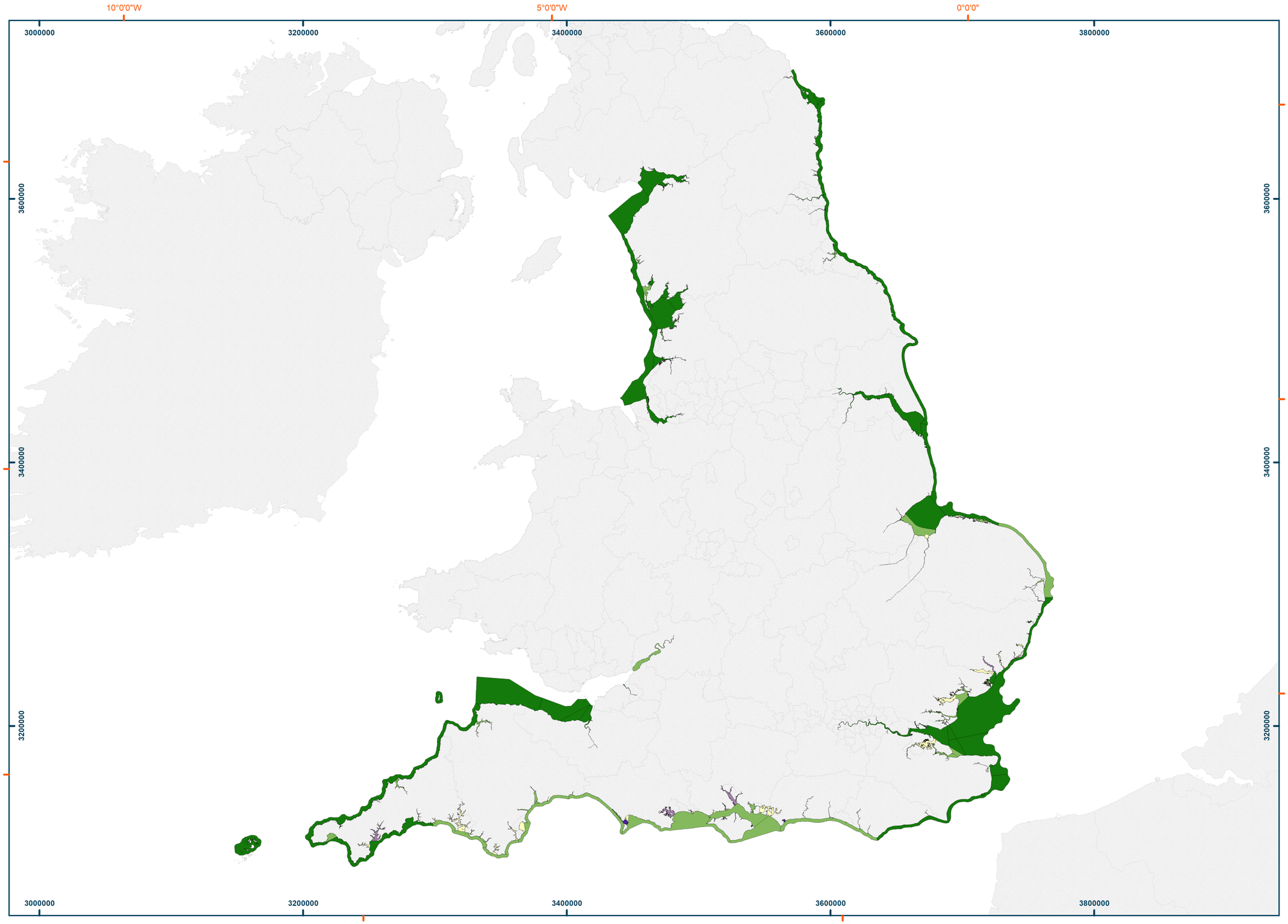

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

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N

SCALE: 1:2,800,000

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B2 INNS WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-B2-015-01-DDE

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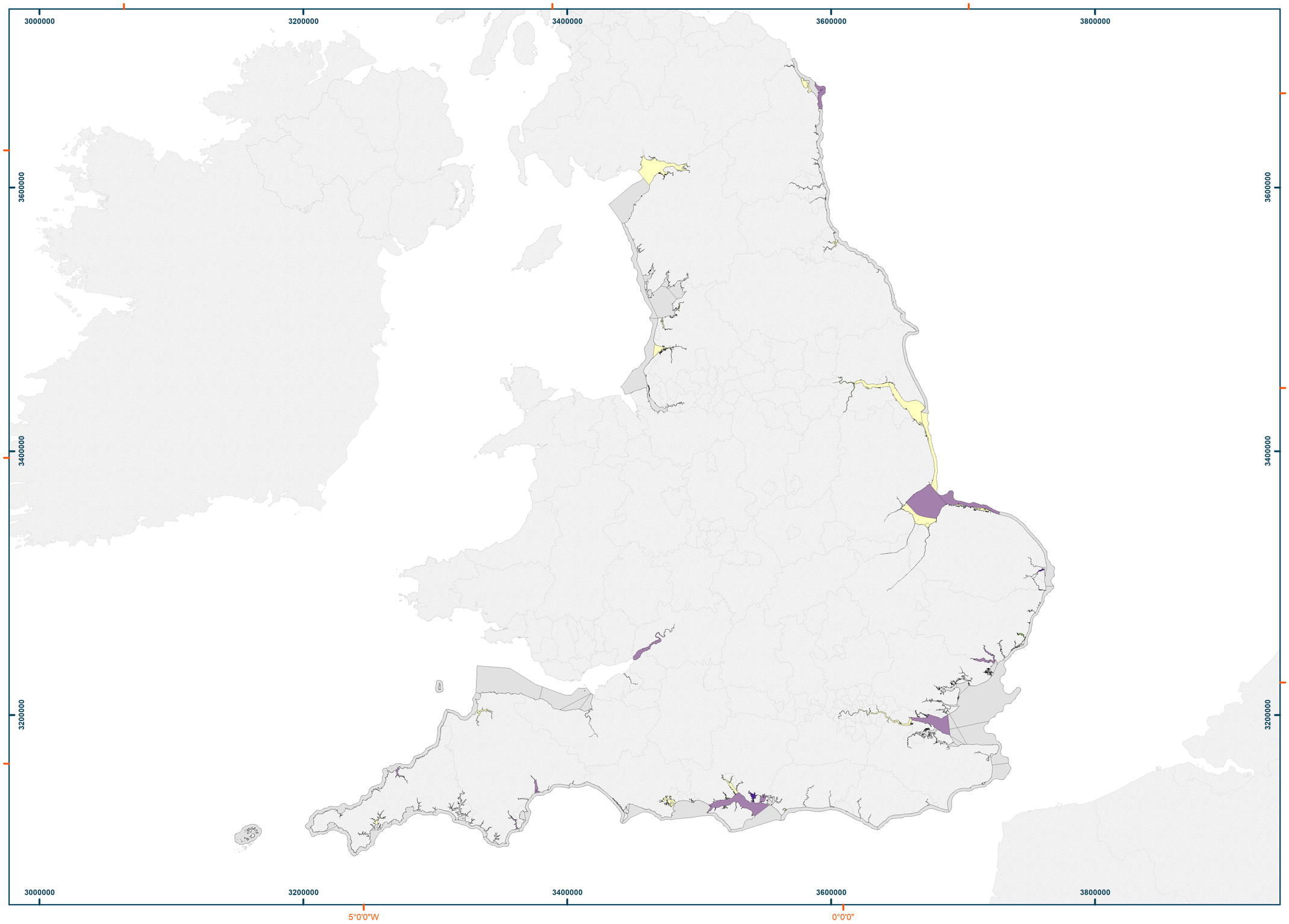

WFD Transitional and Coastal Water Bodies (Cycle 2)

ATTRIBUTE SCORE

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N

SCALE: 1:2,800,000

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B3 SALTMARSH WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-B3-016-01-DDE

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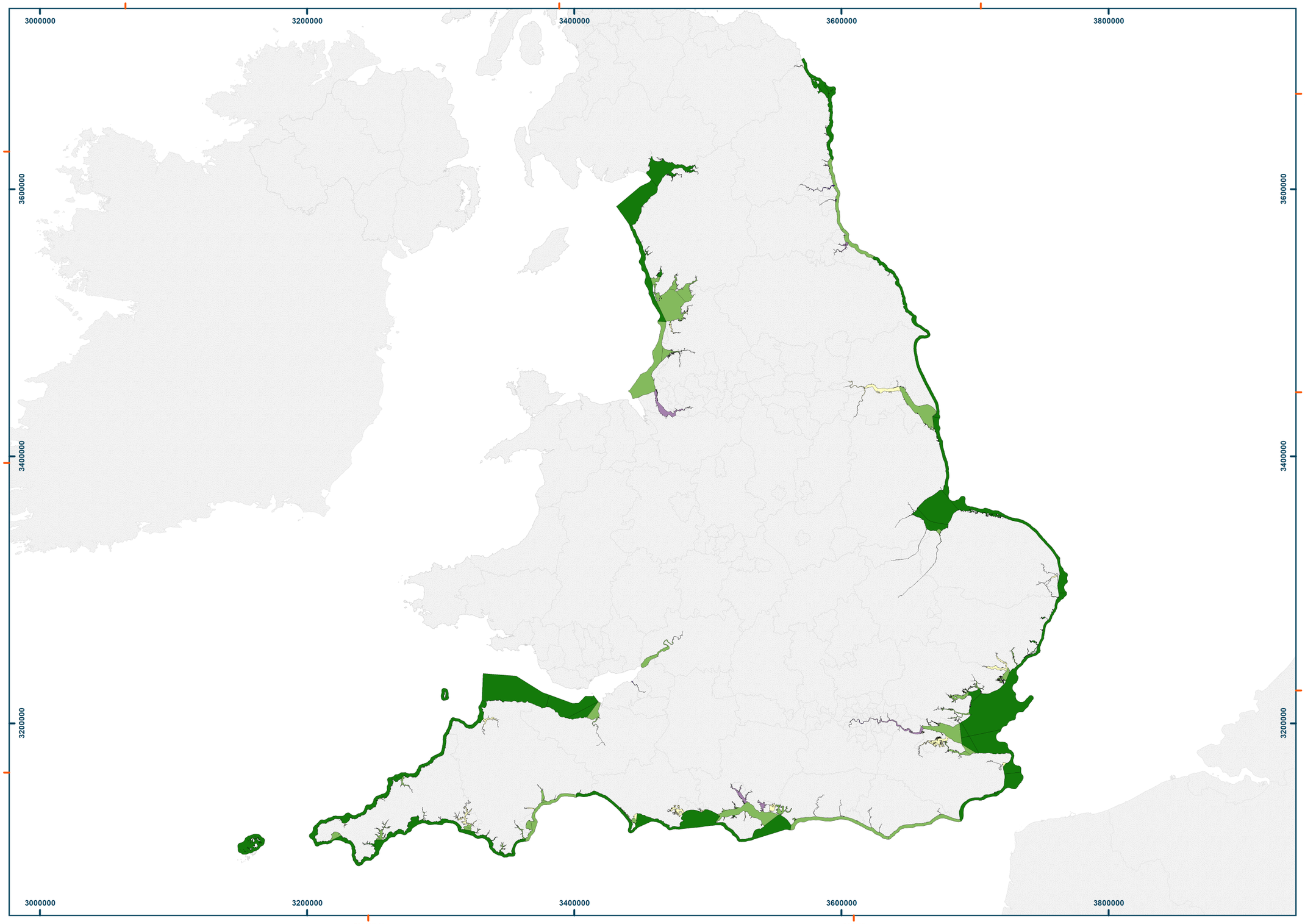

WFD Transitional and Coastal Water Bodies (Cycle 2)

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N

SCALE: 1:2,800,000

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O1 ANTHROPOGENIC LIGHT WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

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Earth Observation Group, NOAA National Geophysical Data Center. Data processed by LUC on behalf of CPRE.

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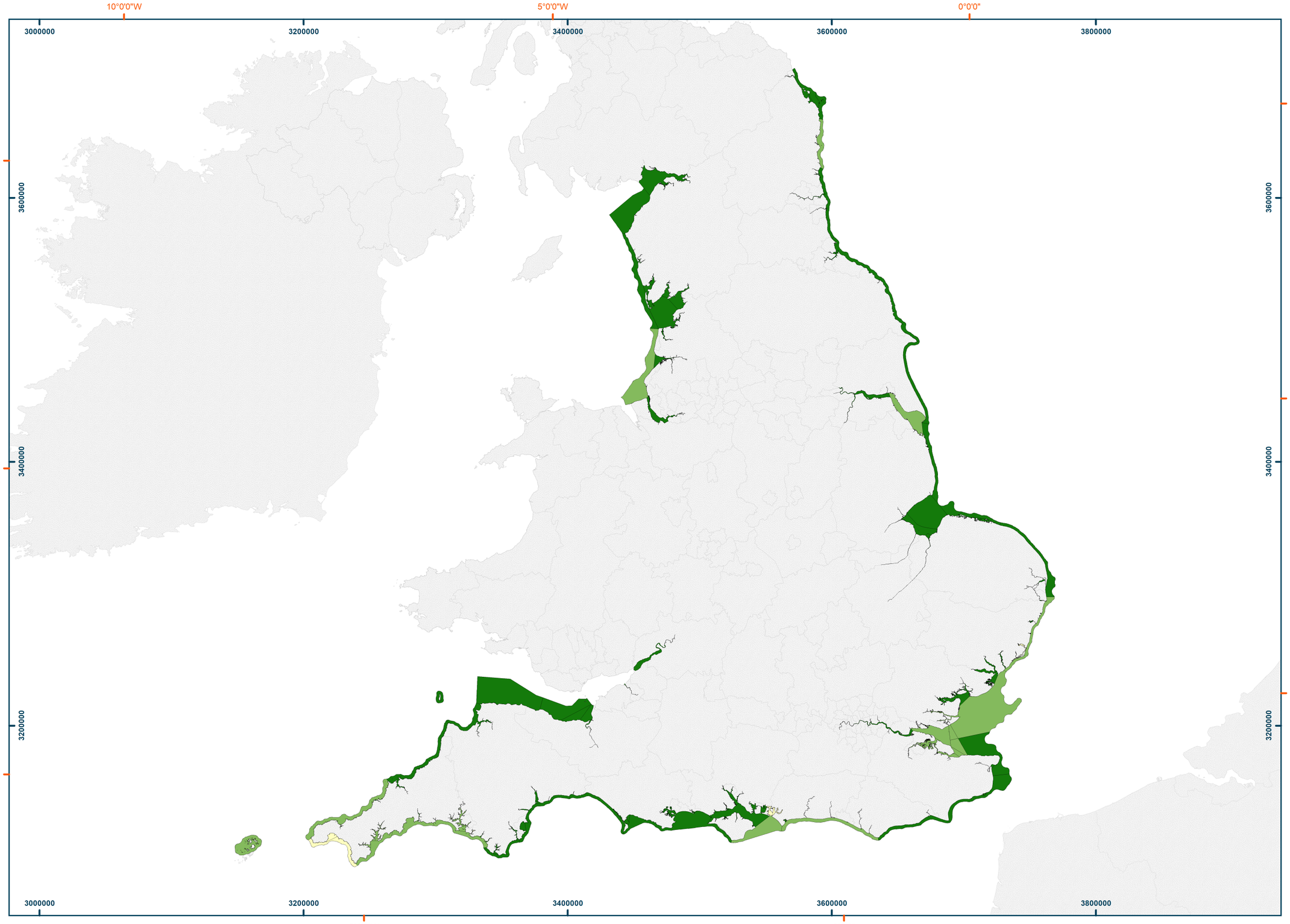

WFD Transitional and Coastal Water Bodies (Cycle 2)

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SCALE: 1:2,800,000

(@ A3)

0 50 100

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O2 UNDERWATER NOISE WITHIN WFD WATERBODIES

PROJECT REF: DJR6739 **DATE:** 12/01/2023 **DRAWN:** DDE **CHECKED:** JBL

DRAWING: DJR6739-O2-018-01-DDE

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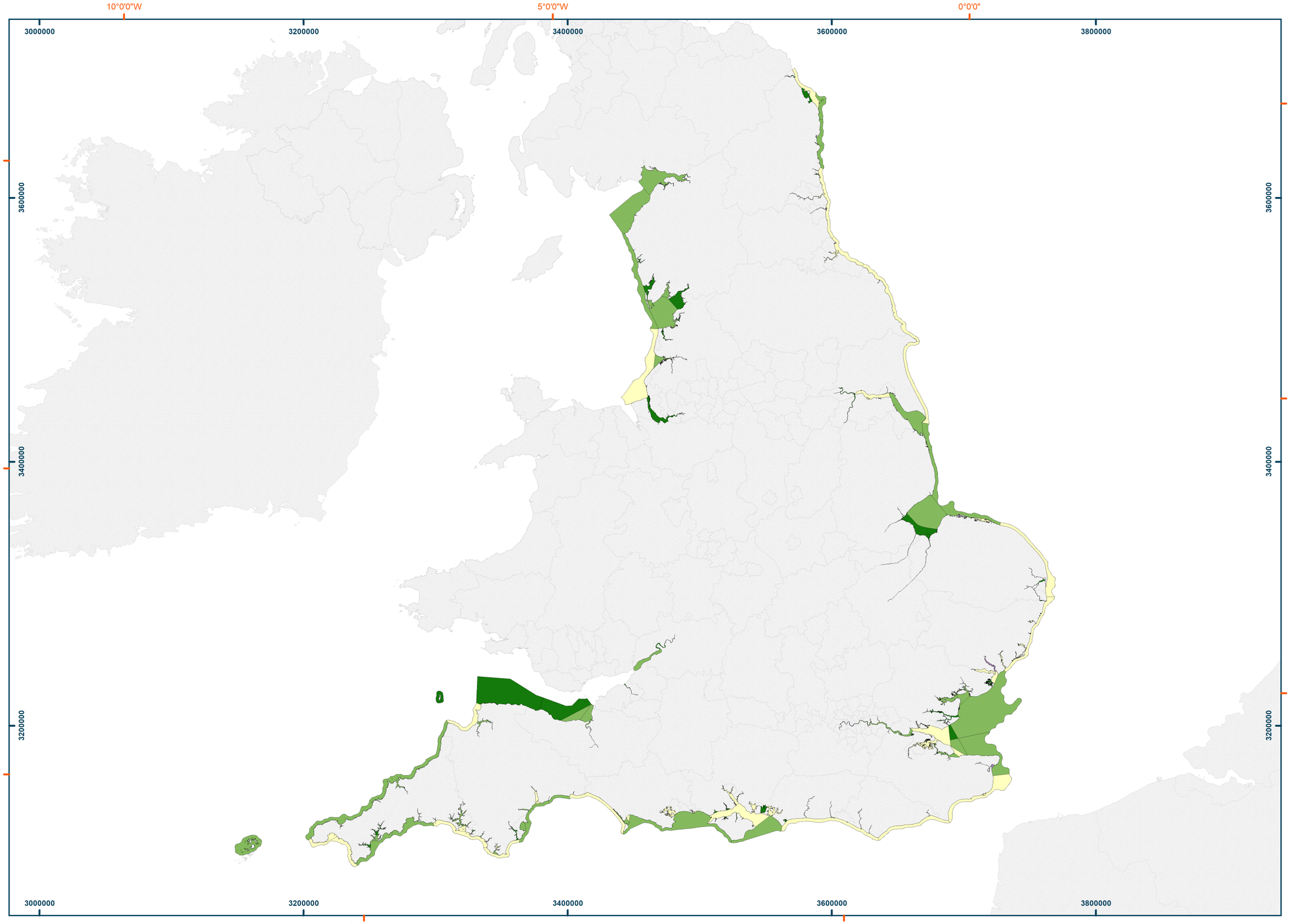

WFD Transitional and Coastal Water Bodies (Cycle 2)

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N

SCALE: 1:2,800,000

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B6 - Estuarine and Coastal Waters Indicator - Final Report

O3 LITTER WITHIN WFD WATERBODIES

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DRAWING: DJR6739-O3-019-01-DDE

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Marine Conservation Society (2022): Beachwatch dataset http://www.mcsuk.org/beachwatch/

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D INNS list and impact classification

Table D.1: INNS list prepared from UKTAG Classification of aquatic alien species found in the UK in terms of their impact on native habitats and biota

Common name	Species	Previous or new names to include in Search	Plant/Animal/Fish	*Habitat
High Impact				
Marine tubeworm	*Ficopomatus enigmaticus*		A	B
Slipper limpet	*Crepidula fornicata*		A	M
Colonial tunicate	*Didemnum spp. (Non-native)*	*Didemnum vexillum*	A	M
Asian shore crab	*Hemigrapsus sanguineus*		A	M
Asian shore crab	*Hemigrapsus takanoi*		A	M
American lobster	*Homarus americanus*		A	M
Leathery sea squirt	*Styela clava*		A	M
American oyster drill	*Urosalpinx cinerea*		A	M
Common cord-grass, Townsend's grass or rice grass	*Spartina anglica*		P	M
Japanese kelp	*Undaria pinnatifida*		P	M
Moderate Impact				
Japanese skeleton shrimp	*Caprella mutica*		A	M
Pacific oyster	*Crassostrea gigas*	*Magallana gigas*	A	M
Red seaweeds	*Bonnemaisonia hamifera*		P	M
Marine alga	*Gracilaria vermiculophylla*		P	M
Low Impact				
Marine copepod	*Acartia tonsa*	*Acartia (Acanthacartia) tonsa Dana*	A	M
Magellan mussel	*Aulacomya ater*	*Aulacomya atra*	A	M
Bamboo worm	*Clymenella torquata*		A	M
Marine amphipod	*Corophium sextonae*	*Monocorophium sextonae*	A	M
Barnacle species	*Elminius modestus*	*Austrominius modestus*	A	M
Marine polychaete	*Goniadella gracilis*		A	M
Marine hydrozoan	*Gonionemus vertens*		A	M
Marine polychaete	*Marenzellaria viridis*	*Marenzelleria viridis*	A	M
American hard-shell clam	*Mercenaria mercenaria*		A	M
American piddock	*Petricola pholadiformis*	*Petricolaria pholadiformis*	A	M
Zuiderzee or dwarf crab	*Rhithropanopeus harrisii*	*Rhithropanopeus harrisii*	A	M
Manilla Clam	*Ruditapes philippinarum*		A	M
New Zealand flat oyster	*Tiostrea lutaria*	*Ostrea chilensis*	A	M
Red seaweeds	*Agardhiella subulata*		P	M
Captain pike's weed	*Pikea californica*		P	M
Japanese weed	*Sargassum muticum*		P	M
Tapegrass	*Vallisneria spiralis*		P	M
Unknown Impact				
Sea spider	*Ammothea hilgendorfi*		A	M
Barnacle	*Balanus amphitrite*	*Amphibalanus amphitrite*	A	M
Marine hydroid	*Clavopsella navis*	*Pachycordyle navis*	A	M
Oyster thief	*Colpomenia peregrina*		A	M
American jack knife clam	*Ensis americanus*	*Ensis leei*	A	M
Marine copepod	*Eusarsiella zostericola*		A	M
Orange-striped sea anemone	*Haliplanella lineata*	*Diadumene lineata*	A	M
Marine tubeworms	*Hydroides dianthus*		A	M
Marine tubeworms	*Hydroides ezoensis*		A	M
Marine tubeworms	*Janua brasiliensis*	*Neodexiospira brasiliensis*	A	M
Kuruma prawn	*Marsupenaeus japonicus*	*Penaeus japonicus*	A	M
Soft-shelled clam	*Mya arenaria*		A	M
Dark false mussel	*Mytilopsis leucophaeata*		A	M
Marine tubeworms	*Pileolaria berkeleyana*		A	M
Marine mollusc	*Pinctada imbricata radiata*	*Pinctada radiata*	A	M
Red seaweeds	*Antithamnionella spirographidis*		P	M
Red seaweeds	*Antithamnionella ternifolia*		P	M
Red seaweeds	*Asparagopsis armata*		P	M
Wright's Golden Membrane Weed	*Chrysymenia wrightii*		P	M
Green seaweeds	*Codium fragile subspp. atlanticum and tomentosoides*	*Codium fragile*	P	M
Diatoms	*Coscinodiscus wailesii*		P	M
Red seaweeds	*Grateloupia doryphora*		P	M
Red seaweeds	*Grateloupia filicina var. luxurians*	*Grateloupia subpectinata Holmes*	P	M
Diatoms	*Odontella sinensis*	*Biddulphia sinensis Greville*	P	M
Diatoms	*Pleurosigma simonsensii*	*Pleurosigma simonsenii Hasle*	P	M
Red seaweeds	*Polysiphonia harveyi*	*Melanothamnus harveyi*	P	M
Red seaweeds	*Solieria chordalis*		P	M

Common name	Species	Previous or new names to include in Search	Plant/Animal/Fish	*Habitat
Diatoms	*Thalassiosira punctigera*	*Ethmodiscus punctiger*	P	M
Diatoms	*Thalassiosira tealata*	*Thalassiosira tealata*	P	M

**Yellow shading denotes species names that have changed. *Habitat – B = brackish; M = marine*

E Data suitability summary for the B6 estuarine and coastal waters indicator

Table E.1: Data suitability and data licence table for the data used in the estuarine and coastal waters B6 indicator attribute scoring

Code	Naturalness component	Transitional, coastal or both	Attribute	Data Origin	Licence	*Data Status	**Updating Process
H1a	Hydrological	Both	Flows QN30	Environment Agency	Open Government Licence (nationalarchives.gov.uk)		
H1b	Hydrological	Both	Flows QN50	Environment Agency	Open Government Licence (nationalarchives.gov.uk)		
H1c	Hydrological	Both	Flows QN70	Environment Agency	Open Government Licence (nationalarchives.gov.uk)		
H1d	Hydrological	Both	Flows QN95	Environment Agency	Open Government Licence (nationalarchives.gov.uk)		
H2	Hydrological	Both	Obstacles	Environment Agency	Open Government Licence (nationalarchives.gov.uk)		
H3	Hydrological	Both	Coastal protection	Environment Agency	Open Government Licence (nationalarchives.gov.uk)		
H3	Hydrological	Both	Coastal protection	Environment Agency	Open Government Licence (nationalarchives.gov.uk)		
P1	Physical	Both	Built structures	OS	Natural England Data Services Ref. no. NE-2022-11-9-11-31-43 (CR)		
P2	Physical	Both	Fishing pressure	Natural England	Open Government Licence (nationalarchives.gov.uk)		
P3	Physical	Both	Combined activities	EMODNET	© European Union, 2022. Reproduction is authorised, provided the source is acknowledged		
P3	Physical	Both	Combined activities	MMO	Open Government Licence (nationalarchives.gov.uk)		
P3	Physical	Both	Combined activities	The Crown Estate	Open Government Licence (nationalarchives.gov.uk)		
C1	Chemical (water quality)	Both	Water quality	Environment Agency	Open Government Licence (nationalarchives.gov.uk)	_	_
C2	Chemical (water quality)	Both	Dissolved Oxygen (DO)	Environment Agency	Open Government Licence (nationalarchives.gov.uk)		
C3	Chemical (water quality)	Both	Dissolved Inorganic Nitrogen (DIN)	Environment Agency	Open Government Licence (nationalarchives.gov.uk)	_	_
C4	Chemical (water quality)	Both	Opportunistic macroalgae	Environment Agency	Open Government Licence (nationalarchives.gov.uk)		
B1	Biological	Both	IQI	Environment Agency	Open Government Licence (nationalarchives.gov.uk)		
B2	Biological	Both	INNS	NBN	Open Gov Licence: https://docs.nbnatlas.org/data-licenses/ and also: https://creativecommons.org/licenses/by/4.0/		
B3	Biological	Both	Saltmarsh	Environment Agency	Open Government Licence (nationalarchives.gov.uk)		
O1	Other	Both	Anthropogenic light	CPRE	No licence required. However please use the following acknowledgement when using the data: Earth Observation Group, NOAA National Geophysical Data Centre. Data processed by LUC on behalf of CPRE.		
O2	Other	Both	Underwater Noise	JNCC	Open Government Licence (nationalarchives.gov.uk)		
O3	Other	Both	Litter	MCS	Marine Conservation Society (2022): Beachwatch dataset http://www.mcsuk.org/beachwatch/		

Note: **Status: Green - ready for operationalisation for the scoring for B6; Amber - nearly ready; Red - requires significant further work*

***Updating process: Green - ready for operationalisation for future rounds of scoring for B6; Amber - nearly ready; Red - requires significant further work*

F Attribute Factsheets

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the water body level. Freshwater input (flow regime), H1a-H1d (Estuaries), H1a-H1d (Coasts)

Rationale for inclusion: The natural flow regime is the foundation of the natural functioning of river and stream ecosystems and their associated wetland habitats which supply freshwater to estuarine and coastal areas. A natural flow regime is critical to the shaping of the estuarine and near coastal ecosystem and sustaining its characteristic biological communities. All components of the flow regime are important in shaping the upstream river and wetland ecosystems and as such all regime measurements are utilised to provide assessment of freshwater inputs to estuarine and coastal systems. These attributes provide an assessment of the levels of deviation from the natural flow regime in upstream freshwater systems at different flow magnitudes.

Source data: Environment Agency Water Resources GIS system. Regular updates are supplied to Natural England for use in the B6 data framework. The received dataset will be stored on Natural England systems.

Outline description of dataset including spatial coverage, representativeness, limitations: The dataset provides actual flows and modelled naturalised flows at a number of naturalised flow (Qn) values. For the initial version of the B6 indicator, data on actual flows are from the period 2016-2021 for most catchments. A single set of values is provided for each Water Framework Directive water body.

Data field	Description
EA_WB_ID	Water body ID number.
WB_NAME	Water body name.
Type_IWB	Type of water body.
CATCHMENT	Name of catchment.
ScenRA%QN30	Recent actual scenario as a percentage of natural flows at Qn30.
ScenRA%QN50	Recent actual scenario as a percentage of natural flows at Qn50.
ScenRA%QN70	Recent actual scenario as a percentage of natural flows at Qn70.
ScenRA%QN95	Recent actual scenario as a percentage of natural flows at Qn95.

Data ownership and licensing restrictions (if any): The data owner is the Environment Agency. The data are available under open government licence.

Data transfer arrangements: A standard data specification (table above) has been agreed with the Environment Agency.

Frequency of source data update/data transfer: Data on individual catchments are updated as and when possible. An update frequency of 3-5 years is considered appropriate.

Form of attribute: Calculated as the percentage deviation (negative or positive) of actual daily river flow from the modelled naturalised flow (in the absence of abstractions and discharges).

Data processing method for generating attribute output: Data are pre-processed by the Environment Agency within their Water Resources GIS system (EA WRGIS). These attributes relate to both estuaries and coastal water bodies. As there are sometimes multiple upstream freshwater inputs into a particular estuarine or coastal water body, the average of all of the various input freshwater systems are calculated for each Qn flow.

For coastal waters, flow from both rivers directly entering coastal water bodies and flow from estuaries into coastal waters was used to provide a flow score for the coastal water bodies. Where this was the case, the average of the river and estuarine input flows are calculated for each Qn flow.

Naturalness class boundaries:

	Qn	Class 1	Class 2	Class 3	Class 4	Class 5
H1a	95	<5	5-10	10-25	25-40	>40
H1b	70	<5	5-10	10-25	25-40	>40
H1c	50	<5	5-10	10-25	25-40	>40
H1d	30	<5	5-10	10-25	25-40	>40

Attribute robustness: The dataset is not able to characterise the effect of non-consumptive abstractions above the assessment points used in the EA WRGIS. Greater spatial discrimination in the dataset would therefore be preferable and is possible through additional modelling, e.g. via the Environment Agency's new hydroecology tool. The dataset is also based on comparison of frequency distributions of recent actual and naturalised flows, not a direct comparison of time series of data. Evaluation of data as time series would provide a more realistic picture of freshwater input.

Storage location for source dataset and processed data: Source data are available from the Environment Agency's WRGIS. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England at the water body level for each of the (Qn) flow levels.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the water body level.
Obstacles H2 (Estuaries), H2 (Coasts)

Rationale for inclusion: There are thousands of man-made and natural obstacles in the rivers of the UK. Some of the man-made obstacles, such as weirs, dams, sluices and road culverts, perform important functions related to navigation or flood protection, but they can also cause problems such as restricting the upstream and downstream movement of fish or damaging river banks and beds by causing excessive erosion or deposition of sediment. This attribute provides an assessment of the levels of deviation from the natural systems where there would be no obstacles to upstream or downstream water and associated biological movement.

Source data: The Environment Agency maintains a dataset on obstacles - The River Obstacles dataset[1]. The data are available via a web platform in partnership with The Rivers Trust. The downloaded dataset will be stored on Natural England systems.

Outline description of dataset including spatial coverage, representativeness, limitations: The River Obstacles dataset is an inventory of weirs, waterfalls, sluices, dams, culverts, fords and flap gates, compiled initially from digital Ordnance Survey maps and the Environment Agency's Detailed River Network AfA036 (DRN) and improved and extended using information submitted by users via the River Obstacles App. The information collected using the River Obstacles App is quality checked and verified before being added to the dataset. The dataset is provided at the UK level so fully covers all of the required areas for the B6 indicator. The dataset includes fields to record the date the obstacle was removed (not currently used) which would allow for recording and checking of barriers and obstacles that have been removed.

Data field	Description
OBJECTID	Obstacle ID number.
easting_uk	Location of obstacle – easting.
northing_uk	Location of obstacle – northing.
date	Date obstacle entry made.
obstacle_t	Obstacle type (i.e. weirs, waterfalls, sluices, dams, etc).
step_height	Height of the drop between water levels caused by the obstacle.
deletedAt	Field to show when obstacle removed (currently not used).
eel_p_no	Number of eel passes included in the obstacle (not consistently used).
Fish_p_no	Number of fish passes included in the obstacle (not consistently used).

The data includes a number of data fields, the main ones of which are indicated in the table above. There are a number of data fields that would be helpful to be filled out consistently, including step height and eel/fish pass.

Data ownership and licensing restrictions (if any): The data owner is the Environment Agency. The data are available under open government licence.

Data transfer arrangements: The data can be downloaded as a shapefile from The Rivers Trust website[1].

Frequency of source data update/data transfer: Data on individual obstacles are added to the data source regularly once notifications provided via the app are quality checked and verified. An update frequency of 3-5 years is considered appropriate.

[1] Available at: https://river-obstacles-theriverstrust.hub.arcgis.com/

Form of attribute: Calculated as the number of obstacles that are present that restrict natural flow (upstream and/or downstream) into each water body. It is expected that a natural water body will have no obstacles.

Data processing method for generating attribute output: New data delivered via the app are checked and verified before being included within the dataset by the Environment Agency.

When applying this data in the indicator analysis, there was a need to include a buffer analysis to the obstacle data, as the data points are both inside estuarine and coastal water body areas and also just outside. Obstacles just outside the water body that were associated with a particular water body, within a buffer zone of 100 m, were initially retained in the analysis. The association of obstacles close to a particular water body was completed through an autonomous GIS association task. However, all of the outputs were then manually checked to ensure each were assigned to the correct water body.

Figure H2.1 and Figure H2.2 provide an indication of the manual process that was followed after the automated assignment of obstacles to water bodies. Figure H2.1 shows the upper part of the Tamar estuary with two obstacles inside the water body and three outside. Although the three outside obstacles were within the buffer distance, only the closest obstacle was retained and counted. Figure H2.2 shows a series of culverts that run into the Arun River, a total of 10 culverts. Again, only the closest culvert was counted. In this way the removal of the closest obstacle (i.e. culvert) will have no effect on the scoring as the next closest is then counted. If interventions were planned it would, for example, require work to address each of the series of culverts at that location. To avoid skewing the overall water body score where there are multiple obstacles at a given location, only one of these was counted at each location. However, when in the future obstacles are removed to improve the naturalness of water bodies, the whole series of obstacles will need to be removed to achieve an improvement of naturalness score.

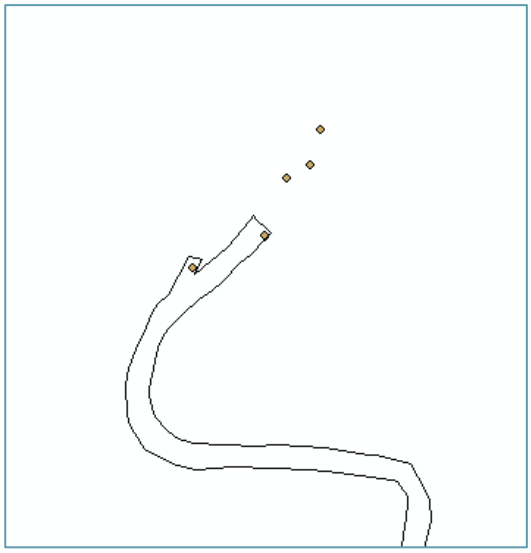

Figure H2.1: Upper Tamar estuary

Source: EA - Obstacles dataset

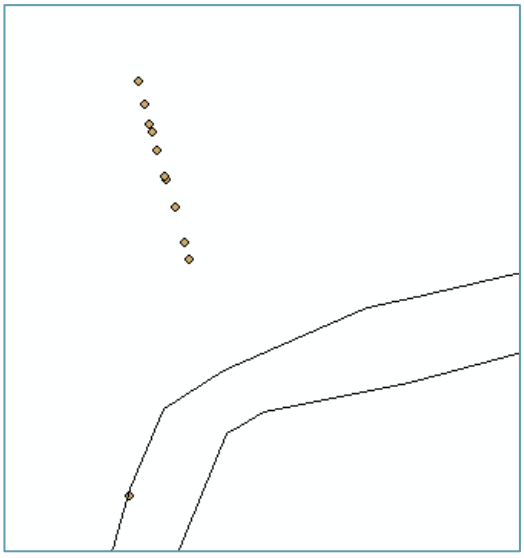

Figure H2.2: Part of the Arun River

Source: EA - Obstacles dataset

The scoring for this attribute considers the size of the water body, and so the overall score is related to the number of obstacles per water body area (Km^2).

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5
(H2) Number obstacles per km^2 of water body	0	<0.1	0.1-0.5	0.5-2	>2

Attribute robustness: Each type of obstacle could potentially be attributed a particular naturalness score. The rationale being that one weir with a large water level difference may be more unnatural than a number of smaller culverts leading into a the same water body. Whilst this is potentially correct, this level of detail is extremely difficult to produce for a nationwide dataset. As such all obstacles are currently score the same. The dataset will become more robust in future once records are received of obstacles that have been removed.

Storage location for source dataset and processed data: Source data are available from the Environment Agency via The Rivers Trusts website. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England at the water body level for obstacles.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the water body level.
Coastal protection, H3 (Estuaries), H3 (Coasts)

Rationale for inclusion: The degree to which a stretch of estuary or coastline includes coastal protection or coastal defence structures can determine the water bodies ability to move laterally. This can determine the physical naturalness and if an estuarine or coastal system can interact with zones landward. It is closely linked to the ability of the estuarine or coastal water body's ability to flood into its natural flood zone. The ability to migrate or move landward will be an important factor in the habitats ability to cope with sea level rise as a result of climate change. This attributes provide an assessment of the levels of deviation from a natural system, which is expected to have no coastal protection.

Source data: Environment Agency National Coastal Erosion Risk Mapping (NCERM)[2] dataset and the Flood Risk Zone 3[3] map. The datasets are updated regularly, although the timeframes may vary dependant on the number of new data available. The dataset can be downloaded from Data.gov. The downloaded dataset will be stored on Natural England systems.

Outline description of dataset including spatial coverage, representativeness, limitations: The National Coastal Erosion Risk dataset shows the coastal baseline. This baseline is split to 'frontages'. These are defined as lengths of coast with consistent characteristics based on the cliff behaviour characteristics and the defence characteristics, from the period 2018-2021. The data covers natural frontages, floodable frontages and those that are non-floodable, such as embankments, gabions, revetments and seawalls. The dataset represents the full country, however it is sometimes less complete for upper parts of some estuaries.

Data field	Description
OBJECTID	Defence ID number.
SMP_NAME	Shoreline Management Plan name.
DefType	Defence type (natural, embankment, gabion, revetment, etc).
MidX	Midpoint of defence (easting).
MidY	Midpoint of defence (northing).
FeatType	Information on type (i.e. erodible, floodable or complex cliff).
DefLgth_m	Length of defence in meters.

The data includes a number of data fields, the main ones of which are indicated in the table above.

Data ownership and licensing restrictions (if any): The data owner is the Environment Agency. The data are available under open government licence.

Data transfer arrangements: The Environment Agency data can be downloaded from Data.gov.

Frequency of source data update/data transfer: Data on individual frontages are updated as and when possible. An update frequency of 3-5 years is considered appropriate.

Form of attribute: Calculated as the deviation from fully natural frontages. Calculated at the water body level as an average of all frontages within the water body.

[2] Available at: https://www.data.gov.uk/dataset/7564fcf7-2dd2-4878-bfb9-11c5cf971cf9/national-coastal-erosion-risk-mapping-ncerm-national-2018-2021
[3] Available at: https://www.data.gov.uk/dataset/bed63fc1-dd26-4685-b143-2941088923b3/flood-map-for-planning-rivers-and-sea-flood-zone-3

Data processing method for generating attribute output: Data are pre-processed by the Environment Agency within their Water Resources GIS system. These attributes relate to both estuaries and coastal water bodies.

An initial step in the processing of the NCERM data was to associate the defence type record to a particular water body. This was initially an automated GIS action, however it required manually checking and splitting and editing of boundaries. An example is provided in the two figures below. Figure H3.1 and Figure H3.2 shows part of the Exe estuary. The area indicated by the green (western) oval shows an area of water body where the line of defence does not completely match the line of the water body, however it is considered a reasonable representation for this analysis and the NCERM data is kept in full. However, the area denoted by the blue oval indicates and area of defence which is completely outside of the water body.

As such the NCERM defence features within the blue (eastern) oval were 'snipped' in GIS so the line of defence well outside the water body was not associated with any estuarine or coastal water body and not included in the scoring. The resultant NCERM data included in the scoring is shown in Figure H3.2 for the Exe estuary.

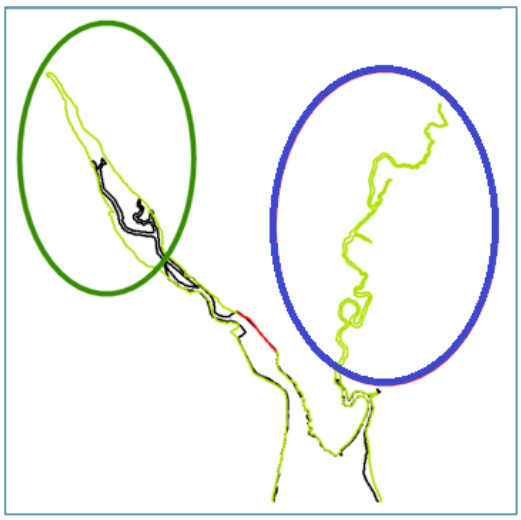

Figure H3.1: Exe estuary pre-snip

Source: Environment Agency - NCERM

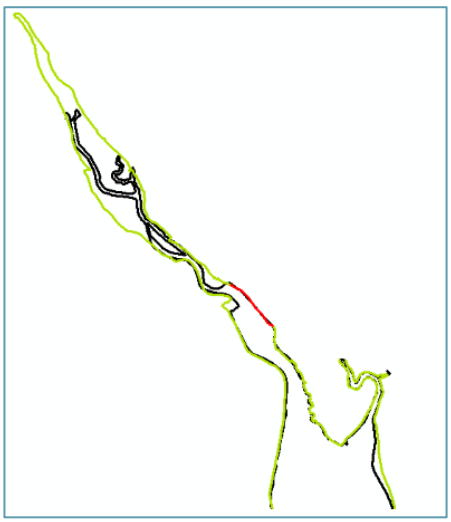

Figure H3.2: Exe estuary post-snip

Source: Environment Agency - NCERM

There were a number of the smaller estuarine water bodies that had insufficient, or completely lacking NCERM data. This also included all lagoon sites.

A manual check was performed on these water bodies where the NCERM data were low or entirely lacking. An initial check of defence area versus water body boundary length provided an indication of likely coverage of the NCERM data to accurately represent the full water body. Each of the water bodies that had low (i.e. <50% NCERM boundary data compared to water body boundary length) were manually checked. This visual check included adding the Flood Zone 3 map layer to provide an indication of the floodable nature of these areas.

Figure H3.3Figure indicates an area just to the south of the Wash. There are three smaller estuarine water bodies: the Welland; the Nene; and the Great Ouse. The Welland (most western estuary) is represented by c. 50% coverage by FNERM data (indicated by the red polyline representing floodable defences), whereas the Nene (middle estuary) is not represented by any NCERM data. The Great Ouse (most easterly estuary) includes approximately 20% coverage.

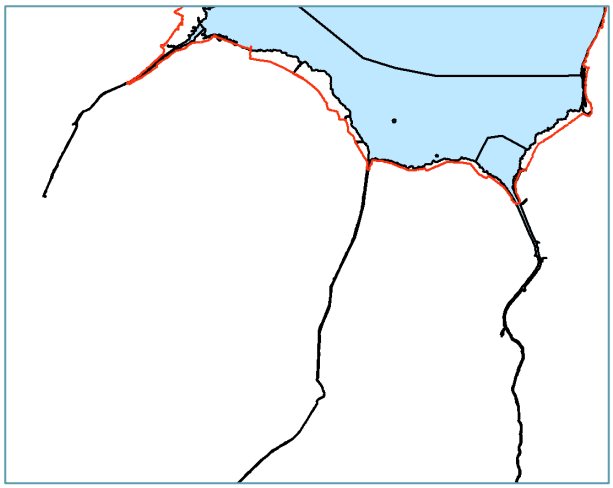

Figure H3.3 Wash Area NCERM data only

Source: Environment Agency

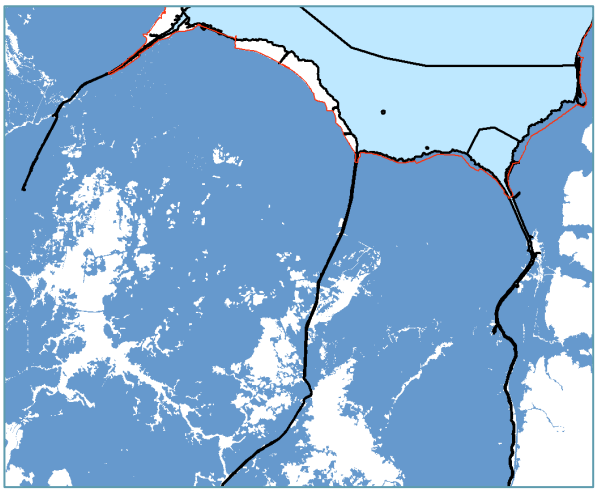

Figure H3.4: Wash area NCERM and Flood Zone 3

Source: Environment Agency

For each of these water bodies there was the need to manually check against the Flood Zone 3 map. This is shown in Figure H3.4, where the dark blue colour denotes flooded land. As it is clear that each of these water bodies are able, for the majority of their length to flood, this has been manually updated to 100% floodable. This included all of the ponds, pools, lagoons and marshes sites, which were manually scored as 2 (floodable).

Naturalness score is calculated by first determining the length of each of the different boundary types. A natural boundary was assigned the score 1, a floodable boundary a score of 2, and all other boundaries 5. The overall score for a water body was derived by multiplying the length of each boundary type, by the score provided above, and dividing by the total boundary length. The results are then shown rounded up or down to the nearest whole number to no decimal places, which provides a suitable scale from 1 to 5 for naturalness. A worked example is provided below for the Dart Estuary and Eastern Yar:

- Dart Estuary total boundary area = 68,229 m
    - 51,752 m Natural (Score 1)
    - 12,720 m Floodable (Score 2)
    - 3,757 m Sea wall (Score 5)

Calculation of naturalness (51,752 x 1)+(12,720 x 2)+(3,757 x 5) / 68,229 = 1.41 = 1 with no decimal place (rounded down).

- Eastern Yar total boundary area = 3,843 m
    - 669 m Natural (Score 1)
    - 1,899 m Floodable (Score 2)
    - 670 m Sea wall (Score 5)
    - 433 m Embankment (Score 5)
    - 172 m Timber (Score 5)

Calculation of naturalness (669 x 1)+(1,899 x 2)+(670 x 5)+(433 x 5)+(172 x 5) / 3,843 = 2.83 = 3 with no decimal place (rounded up).

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5

(H3) Coastal protection - score	1 (Natural – Mostly Natural)	2 (Floodable)	3 (Partially Non-floodable)	4 (Mostly Non-floodable)	5 (Non-floodable)

Attribute robustness: It would be beneficial for future development of the NCERM dataset to note the presence or absence of a boundary defence feature for all estuarine and coastal water bodies. This may include the notation of some polylines to show that there are defence lines missing. This will reduce the manual processing to removing some of the defences that are outside of water bodies, and will ensure data are provided for all small water bodies. Overall the data provides a robust assessment of defences across most of England.

Storage location for source dataset and processed data: Source data are available from the Environment Agency. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England at the water body level as an average of the frontages present within each water body.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the water body level.
Built structures, P1 (Estuaries), P1 (Coasts)

Rationale for inclusion: The degree to which structures have encroached onto the shore, as well as over watercourses, such as railway and road bridges has been investigated and is considered suitable as an attribute. A structure may replace the natural habitat with another habitat (such as a stone wall, rock structure or concrete slipway), or in cases where a reclamation is introduced, the area of 'marine' habitat may be removed entirely. Structures that span the water or encroach over the water, even if on piled foundations, will increase the levels of shading over the water. Any structures that protrude out of the seabed are also likely to cause some degree of scour. Although built structures are considered as a 'Physical' component, there are also hydrodynamic alterations due to the presence of structures that are either horizontally or vertically aligned to the flow of water.

Source data: Ordnance Survey OS MasterMap Topography layer. Natural England hold a licence to use OS Topography data. The dataset will be stored on Natural England systems.

Outline description of dataset including spatial coverage, representativeness, limitations: OS MasterMap Topography Layer provides a detailed and accurate large-scale representation of Great Britain available from Ordnance Survey. It contains features that represent objects in the physical environment, such as buildings, fields, fences. It also includes intangible objects, such as county boundaries and the lines of mean high or low waters. Coverage includes the whole of Great Britain.

The OS MasterMap Topography layer has attributes that can be symbolised by 'Make' which allow for the required calculation of built structures. The 'Make' attribute is presented in the table below.

Data field	Description
Make_manmade	This is either buildings, roads, or on the coast jetties, piers, pontoons etc.
Make_multiple	This is best illustrated by gardens next to residential properties.
Make_natural	This is both natural grassland, forest, as well as natural foreshore at the coast.
Make_unclassified	Not many examples at the coast.
Make_unknown	Not many examples at the coast.

Data ownership and licensing restrictions (if any): The data owner is the Ordnance Survey. The data are available under licence.

Data transfer arrangements: Updates to the data can be downloaded at any time from the online OS data portal. It would be sufficient to download one update prior to completing subsequent B6 assessments.

Frequency of source data update/data transfer: Updates are made to the dataset approximately every six weeks. Updates include addition of new structures and also the deletion of structures that no longer exist.

Form of attribute: Calculated as the percentage of the available foreshore within a water body that is taken up by built structures. For small water bodies, which includes all smaller estuaries and lagoons, the attribute is calculated as a percentage of the whole water body area.

Data processing method for generating attribute output: Clipping within a GIS of all of the 'manmade' (grey) polygons within a water body, from the OS MasterMap Topography layer. A calculation of the 'manmade' area was performed to work out area of built structure per water body. There was no distinction made between any of the various structures that were classified as manmade, the scoring was simply based on the total area that was either on the water body seabed or shore, or above a water body.

To better represent the area of built structures present within and across different water bodies, some consideration was required for the total area of the actual water body. For example the same area of built structures in a small water body is likely to be less natural than the same area in a very large water body. This is especially apparent for coastal water bodies that are generally larger in size than estuarine water bodies.

As such a GIS calculation was performed to determine the area of intertidal (or foreshore) within each water body. Then a manual process was followed to determine if the total water body area, or the area of foreshore present in a water body, should be used as the basis for comparison with the area of built structures.

In general:

- Smaller estuarine water bodies (less than 10 km^2) used the whole water body area;
- Coastal water bodies used the calculated foreshore area;
- Some manual assignment was required for estuarine water bodies (greater than 10 km^2), where for the most part, the available foreshore area was used for comparison.

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5
(P1) Built structures - area (km^2) / total available water body area or foreshore area (km^2)	0	0.1-1	1-2	2-5	>5

Attribute robustness: The current assessment used the current (2021) water body boundary area as a basis for the calculations. If water body areas are remapped in future, which may be as a result of manmade encroachments, it recommended that the current (2021) water body boundaries are retained and used as the basis of comparison.

Storage location for source dataset and processed data: Source data are available from the Ordnance Survey. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England at the water body level for built structures.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the habitat level.
Fishing, P2 (Estuaries), P2 (Coasts)

Rationale for inclusion: One of the biggest impacts on marine areas is that associated with fishing pressure. The type of fishing activity, its duration and frequency in a particular area will produce varying degrees of pressure that could impact the naturalness of the area. Generally, the most impacting method is bottom trawling, although it is known that there are various types of bottom trawling. Less direct impacts are associated with other forms of fishing, for example, potting, however naturalness is likely to also be impacted by potting as it removes key species that form part of the ecological make-up of the area. This attribute provides an assessment of the levels of deviation from the natural areas, which are expected to have no fishing, compared to areas with one or multiple fishing pressures.

Source data: Natural England Fishermap. Fishermap was last updated in 2012 as part of the MCZ designation process. The dataset is stored on Natural England systems. To note once vessel monitoring system (VMS) data are available for the full fishing fleet, it is the intention that VMS data will be used in place of the Fishermap data.

Outline description of dataset including spatial coverage, representativeness, limitations: Although the Fishermap dataset is now unlikely to reflect the current fishing effort, it does show what can be achieved with a fishing effort dataset that covers all of the estuarine and coastal waters and displayed in a consistent, England wide format. Data are provided for fishing effort at high, medium and low intensity for each of the three main fishing groups (dredging, demersal and potting). The data covers all England inshore areas and is recorded at ICES statistical rectangles scale.

Data ownership and licensing restrictions (if any): The data owner is Natural England. The data are available under open government licence.

Data transfer arrangements: The dataset is owned and stored at Natural England.

Frequency of source data update/data transfer: The Fishermap dataset has not been updated since 2012 and is unlikely to be updated in the future. It has been used as a proof of concept. Once VMS covers the majority of the fishing fleet, it is intended to replace the use of Fishermap data. VMS data is made available via the Marine Management Organisation (MMO) and it is expected that updates will be available annually.

Form of attribute: Calculated as a weighted percentage of seabed that is impacted by fishing pressures. Fishing pressure is weighted by type (see below).

Data processing method for generating attribute output: Initial processing of the Fishermap data were required to assign each of the fishing pressure polygons with a particular water body. Some water bodies, especially at the coast, may only have a small part of a fishing pressure polygon. As such an initial GIS task was to generate a clean fishing pressure layer where there was no data outside of the water bodies represented. Figure P2.1 indicates the fishing layer between the Thames and the Blackwater area for dredging. The same area is represented in Figure P2.2 for demersal fishing.

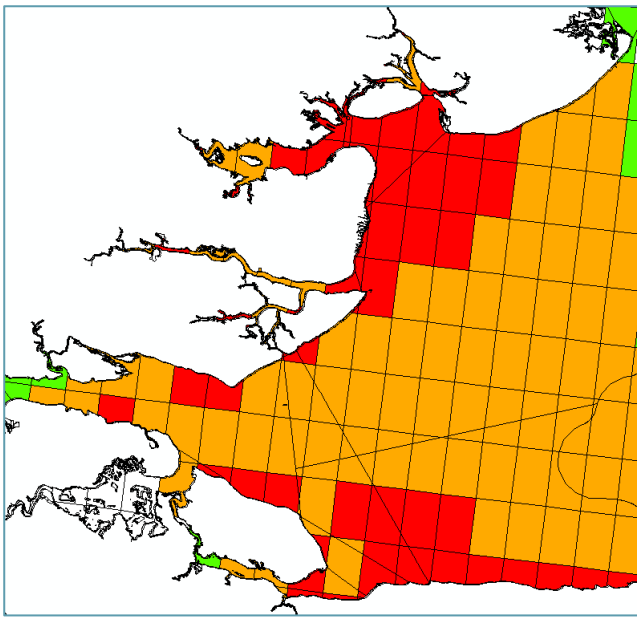

Figure P2.1: Dredging layer for Thames to Blackwater area

Source: Fishermap – Natural England

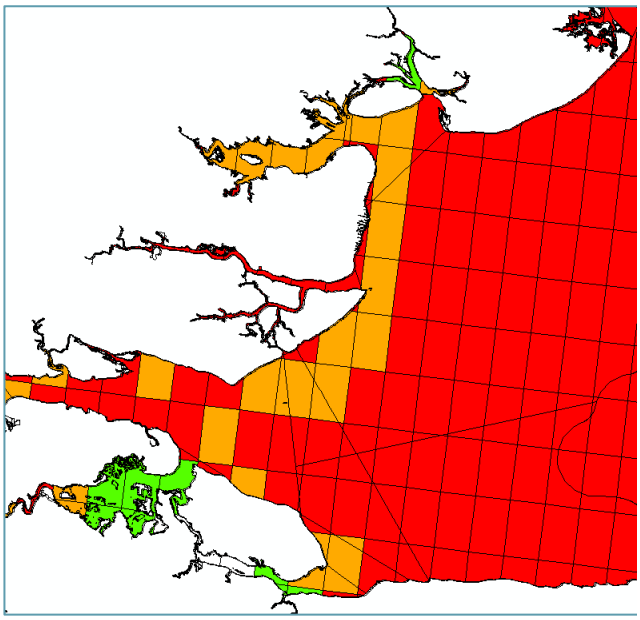

Figure P2.2: Demersal fishing layer from Thames to Blackwater area

Source: Fishermap – Natural England

Each of the small Fishermap activity polygons (representing an area of sea of c.19 km^2) was exported to excel, each with a unique cell code. The activity exposure type (High; Moderate; Low and No exposure) was also exported for each cell for each of the three fishing types.

Each of the polygons was then scored on the basis of a combination of each of the fishing types and their associated exposure type. The per cell-based scoring, for the dredging layer (Figure P2.1) is provided below:

- High exposure (red) = Score 4;
- Moderate exposure (orange) = Score 3;
- Low exposure (green) = Score 2;
- No exposure (white) = Score 1.

The Demersal layer was then scored, with the score being added to the dredging score for each cell. The scoring applied for the demersal fishing type is provided below:

- High exposure (red) = Add 2 to dredging score;
- Moderate exposure (orange) = Add 1 to dredging score;
- Low exposure (green) = Add 0.5 to the dredging score;
- No exposure (white) = No addition to the dredging score.

The potting layer was then be scored, with the score being added to the two combined scores above (dredging + demersal). The scoring of the potting layer is provided below:

- High exposure (red) = Add 1 to the dredging + demersal score;
- Moderate exposure (orange) = Add 0.5 to the dredging + demersal score;
- Low exposure (green) = Add 0.2 to the dredging + demersal score;
- No exposure (white) = No addition to the dredging + demersal score.

A high score for each of the three layers results in a score of 7, however the total score would be capped at 5 per unit area. This total fishing pressure score per unit area, (0-5) was then be mapped as a new layer within the GIS. This will mean that some reductions in fishing pressure may not result in changes to the naturalness score, as changes in score from 7 to 6, or 6 to 5, will not register as a change in naturalness score. As fishing pressure, especially demersal dredging, is considered to cause high levels of disturbance to natural habitats, this is considered suitable for the assessment of naturalness.

Finally the area of each of the 5 naturalness scores were derived from the GIS to give an area covered for each score for each water body. The overall water body score was derived as an average of pressure score over the area of the entire water body.

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5
(P2) Fishing pressure – levels of fishing over each habitat	No fishing	Low fishing	Moderate fishing	High fishing	Very high fishing

Attribute robustness: There is currently no dataset that adequately shows fishing activity across all fishing vessels. The requirement for larger fishing vessels (over 12 m in length) to have a vessel monitoring system (VMS) means that the more predominantly offshore, or at least beyond 1 nm vessels are monitored. There are some known caveats with the Fishermap data product, such as the information level that went into the product was partly informed by verbal fisherman accounts. As such, it is intended to be an interim data product that shows a proof of concept. There are plans to introduce monitoring systems onto smaller inshore vessels (iVMS), which in combination with more digital recording of fishing kit usage and fishing times, will provide future datasets that are readily available and potentially suitable for future rounds of the B6 indicator scoring.

The Fishermap dataset does not include any pressures that are likely to be associated with aquaculture activities, apart from dredging activities for shellfish. Although a separate dataset had been obtained, which is a combination of MMO and Cefas data, and shows the range of activities that occur within English waters, it has not been possible to amalgamate the aquaculture aspect into the fishing pressure assessment at this stage. A future (potentially MMO derived) dataset that includes VMS, iVMS and aquaculture pressure would provide a definitive and consistent dataset for future rounds of the B6 indicator scoring.

Storage location for source dataset and processed data: Source data are available from Natural England. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England for fishing pressure.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the water body level. Combined Other Activities, P3 (Estuaries), P3 (Coasts)

Rationale for inclusion: There are a large range of other activities, both licensable and un-licensable that take place in estuarine and coastal waters that are likely to alter the naturalness of water bodies. One attribute containing an amalgamation of a number of different activities was therefore created, in part as the spatial distribution of activities is skewed in certain parts of the country. As such, having separate attributes per activity, would result in most water bodies containing no data.

Source data: There are a number of activities that are licensable by The Crown Estate (TCE - Open Data Portal[4]), and activities that are either licenced or reported (but otherwise un-licensable at present) from the MMO[5]. Data are also collated and provided as part of the European Marine Observation and Data Network (EMODNet[6]). To note, it is difficult to determine if activities that are presented in EMODNet data are duplicates of, or separate activities to that presented in the MMO data.

Due to the difficulties in adequately separating licensable and un-licensable activities, as well as the same activities but from a different data source, these have been combined and are scored as one attribute, covering all other activities that can affect the naturalness of the seabed. These activities are not evenly distributed throughout the country. A list of the marine activities that have been included in the combined activity layer are shown below:

- The Crown Estate: Offshore Wave Site Agreements; Offshore Wind Site Agreements; Offshore Minerals Aggregates Site Agreements; Offshore Wind Cable Agreements; Offshore Natural Gas Storage Pipeline Agreements; Offshore Minerals Mining Site Agreements.
- The Marine Management Organisation: Powerboating or sailing with an engine; Mooring and / or anchoring; Sailing without an engine; Aggregate / navigational dredging areas.
- EMODNet: Pipelines; Telecom cables; Fibre cables; Telecommunication cables; Submarine cables; Dredge spoil dumping; Aggregate dredging areas.

Outline description of dataset including spatial coverage, representativeness, limitations: The dataset are generally presented as polygon layers, but in the case of some of the pipeline datasets they are presented as polylines. Data are provided throughout English waters, however are generally more present within coastal, as opposed to estuarine water bodies.

Data ownership and licensing restrictions (if any): The data owner is the MMO, The Crown Estate and EMODNet. The MMO and Crown Estate data are available under open government licence. The EMODNet data can be used provided the source is acknowledged.

Data transfer arrangements: Data are downloaded directly from the MMO data portal, the Crown Estate data portal and EMODNet data portal.

Frequency of source data update/data transfer: Data are updated as and when possible. An update frequency of 3-5 years is considered appropriate.

Form of attribute: Calculated as the percentage of seabed that is taken up by a combination of other activities, compared to a natural environment where it is expected no activities are undertaken.

[4] Available at: https://opendata-thecrownestate.opendata.arcgis.com/
[5] Data can be explored here https://explore-marine-plans.marineservices.org.uk/
[6] Available at: https://emodnet.ec.europa.eu/en

Data processing method for generating attribute output: All activities are treated the same, and as such calculations to determine naturalness would consider the area of water body that is taken up by these combined activities, as a percentage of the total water body area. Due to the fact different activities can occur in the same area, each of the different activities are calculated separately and then added together. This can mean one area of seabed is counted a number of times, if for example there is a cable route through the area, plus it is used for anchoring. This double-counting of some areas helps to represent a repeated disturbance to a particular area.

Each of the activity layers was first buffered by 50 m, as its likely that most of the activities disturb an area that is ultimately larger than the represented polygon, or polyline in the case of cabling. For example dredging and disposal activities are likely to also effect, to varying degrees, areas of seabed in the near vicinity. Cabling activities, for example can also effect wider areas, due to the methods used to install the routes, and also required to maintain and replace old systems. This will also include the need for rock armour or other scour protection in some cases.

A snapshot of the TCE data are provided in Figure P3.1 from the northwest coast. This shows the complexity of TCE data and how they are partially (sometimes fully) located within estuarine and coastal waters.

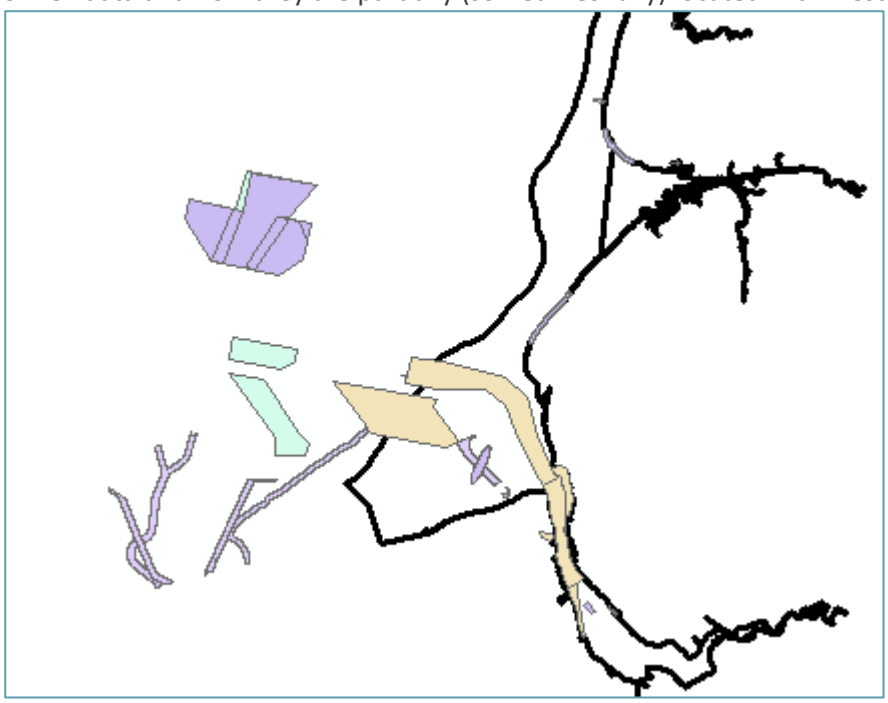

Figure P3.1: Snapshot of TCE licensable activities in the northwest, in the south east Liverpool Bay area

Note: Purple lines = Cable routes; Yellow polygon = Navigational dredge areas; Green polygon (although all offshore) = Sand production area; Purple polygon (although all offshore) = aggregate extraction site.

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5
(P3) Combined other activities - % water body covered by other activities	0	<1%	1-10%	10-20%	>20%

Attribute robustness: There is the potential that there is some over representation of activities that are available from different data portals. It is recommended that one master activities layer should be maintained for future rounds of the B6 indicator assessment. It is recommended that the activity layer that Natural England currently manages is maintained and used as the baseline for future assessments.

Storage location for source dataset and processed data: Source data are available from the MMO, EMODNet and The Crown Estate. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England at the water body level for combined activities.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the water body level.
Water quality, C1 (Estuaries), C1 (Coasts)

Rationale for inclusion: The chemical attributes have been selected to provide a broad indication of chemical naturalness, using chemical determinands for the most basic elements of chemical naturalness and biological metrics to indicate other chemical issues (hazardous chemicals, episodic pollution).

Source data: Environment Agency Catchment Data Explorer. The downloaded dataset will be stored on Natural England systems.

Outline description of dataset including spatial coverage, representativeness, limitations: The dataset provides the current ecological status class of each attribute at each monitoring point in the EA's Water Framework Directive monitoring programme, integrating data over a number of years to provide a complete picture for all monitoring locations. For the initial version of the indicator, the 2019 version of the dataset (the most recent available) has been used. The current monitoring programme includes a reasonable range of estuarine and coastal areas. Environment Agency monitoring design is changing to a representative surveillance network, the implications of this for the future sourcing of data is currently unclear.

Data ownership and licensing restrictions (if any): The data owner is the Environment Agency. The data are available under open government licence.

Data transfer arrangements: Data are downloaded directly from Catchment Data Explorer.

Frequency of source data update/data transfer: In future, data will be sourced from the EA's new surveillance programme, which will monitor sites on a rolling basis and complete a full cycle every 5 years. It is therefore recommended that these attributes are downloaded on a 5-year cycle.

Form of attribute: Ecological status class of each attribute, which is related to naturalness class directly.

Data processing method for generating attribute output: The data for each monitoring site are pre-processed by the Environment Agency, into ecological status class allocations and presented within the Catchment Data Explorer. Once extracted from Catchment Data Explorer, monitoring sites are then resolved into the spatial framework of WFD water bodies, each divided into estuarine and coastal areas.

Priority Hazardous Substances and Priority Substances both have a pass / fail status, whereas Specific pollutants are either reported as high or moderate status. As such the scoring identified for the interim B6 indicator for estuarine and coastal waters, considers the Specific pollutants (non-pass/fail) first, per water body:

- High Specific pollutants status = 1 score;
- Moderate Specific pollutants status = 2 score.

The score generated from the pass/fail Priority for Hazardous Substances status is next considered:

- Fail Priority Hazardous Substances = Add 2 to the Specific pollutants initial score of 1 or 2;
- Pass Priority Hazardous Substances = Add 0 to the Specific pollutants initial score of 1 or 2.

The score for the pass/fail for Priority Substances status is then considered:

- Fail Priority Substances = Add 2 to the Specific pollutants and Priority Hazardous Substances score;
- Pass Priority Substances = Add 0 to the Specific pollutants and Priority Hazardous Substances score.

The overall score from the calculation above could (at worst) total 6, however it is capped to a score of 5.

Where there is not a full set of data for each of these chemical status results for WFD, such as Specific Pollutants WFD classification which is not reported for all water bodies (e.g. the Aln - GB510302203300), the overall water body naturalness class has been left blank and reported in the spreadsheets as N/D (no-data) as it is not possible to determine the status for specific pollutants, and hence the naturalness score cannot be derived.

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5
(C1) Water quality – Combination of specific pollutants, hazardous substances and priority substances	High (HES)	Good (GES)	Mod (MES)	Poor (PES)	Bad (BES)

To note 'ES' in the table above relates to the WFD reporting of Ecological Status, e.g. MES = Moderate Ecological Status.

Attribute robustness: The robustness of these attributes will be dependent on the shape of future Environment Agency surveillance programmes. The density of monitoring sites, the adequacy of coverage of water bodies and potentially habitat types, and the coverage of individual determinands are all key factors.

Storage location for source dataset and processed data: Source dataset currently stored in Catchment Data Explorer. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England at the water body level.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the water body level. Dissolved inorganic nitrogen (C2), Dissolved Oxygen (C3), Macroalgae (C4)

Rationale for inclusion: These attributes have been selected to provide a broad indication of chemical naturalness, using chemical determinands for the most basic elements of chemical naturalness and biological metrics to indicate other chemical issues. Hazardous chemicals are also given more specific consideration under attribute C1.

Source data: Environment Agency Catchment Data Explorer. The dataset will be stored on Natural England systems.

Outline description of dataset including spatial coverage, representativeness, limitations: The dataset provides the current ecological status class of each attribute at each monitoring point in the EA's Water Framework Directive monitoring programme, integrating data over a number of years to provide a complete picture for all monitoring locations. For the interim version of the indicator, the 2019 version of the dataset (the most recent available) has been used. The current monitoring programme includes a reasonable range of estuarine and coastal areas. Environment Agency monitoring design is changing to a representative surveillance network, the implications of this for the future sourcing of data is currently unclear.

Data ownership and licensing restrictions (if any): The data owner is the Environment Agency. The data are available under open government licence.

Data transfer arrangements: Data are downloaded directly from Catchment Data Explorer.

Frequency of source data update/data transfer: In future data will be sourced from the EA's new surveillance programme, which will monitor sites on a rolling basis and complete a full cycle every 5 years. It is therefore recommended that these attributes are downloaded on a 5-year cycle.

Form of attribute: Ecological status class of each attribute, which is related to naturalness class directly.

Data processing method for generating attribute output: The data for each monitoring site are pre-processed by the Environment Agency, into ecological status class allocations and presented within the Catchment Data Explorer. Once extracted from the Catchment Data Explorer, monitoring sites are then resolved into the spatial framework of WFD water bodies, each divided into estuarine and coastal areas.

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5
(C2) Dissolved oxygen (DO)	High (HES)	Good (GES)	Mod (MES)	Poor (PES)	Bad (BES)
(C3) Dissolved organic nitrogen (DIN)	High (HES)	Good (GES)	Mod (MES)	Poor (PES)	Bad (BES)
(C4) Macroalgae	High (HES)	Good (GES)	Mod (MES)	Poor (PES)	Bad (BES)

To note 'ES' in the table above relates to the WFD reporting of Ecological Status, e.g. MES = Moderate Ecological Status.

Attribute robustness: The robustness of these attributes will be dependent on the shape of future Environment Agency surveillance programmes. The density of monitoring sites, the adequacy of coverage of water bodies and potentially habitat types, and the coverage of individual determinands are all key factors.

Storage location for source dataset and processed data: Source dataset currently stored in Catchment Data Explorer. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England at the water body level.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the water body level.
Infaunal Quality Index (IQI), B1 (Estuaries), B1 (Coasts)

Rationale for inclusion: The infaunal quality index (IQI) was created by the Environment Agency as a means to determine the condition of soft sediment invertebrate communities within coastal waters as part of their reporting requirements under the Water Framework Directive. The index has been developed over a number of years, with categories that allow for the representation of disturbance to benthic invertebrate communities. Disturbance can be via a number of means, which may include a range of anthropogenic impacts and pressures. This can include contamination of water or sediment, disturbance through activities such as fishing or aggregate extraction, or high levels of inputs such as nitrates and phosphates within the marine environment. As such the results of the infaunal quality index are transferable to the B6 estuarine and coastal waters indicator.

Source data: Environment Agency Catchment Data Explorer. The dataset will be stored on Natural England systems.

Outline description of dataset including spatial coverage, representativeness, limitations: The dataset provides the current ecological status class of each attribute at each monitoring point in the EA's Water Framework Directive monitoring programme, integrating data over a number of years to provide a complete picture for all monitoring locations. For the interim version of the indicator, the 2019 version of the dataset (the most recent available) has been used. The current monitoring programme includes a reasonable range of estuarine and coastal areas. Environment Agency monitoring design is changing to a representative surveillance network, the implications of this for the future sourcing of data is currently unclear.

Data ownership and licensing restrictions (if any): The data owner is the Environment Agency. The data are available under open government licence.

Data transfer arrangements: Data are downloaded directly from Catchment Data Explorer.

Frequency of source data update/data transfer: In future data will be sourced from the EA's new surveillance programme, which will monitor sites on a rolling basis and complete a full cycle every 5 years. It would therefore be sensible to download these attributes on a 5-year cycle.

Form of attribute: Ecological status class of each attribute, which is related to naturalness class directly.

Data processing method for generating attribute output: The data for each monitoring site are pre-processed into ecological status class allocations within Catchment Data Explorer. Once extracted from Explorer, monitoring sites are then resolved into the spatial framework of WFD water bodies, each divided into estuarine and coastal areas.

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5
(B1) Infaunal Quality Index (IQI)	High (HES)	Good (GES)	Moderate (MES)	Poor (PES)	Bad (BES)

To note 'ES' in the table above relates to the WFD reporting of Ecological Status, e.g. MES = Moderate Ecological Status.

Attribute robustness: The robustness of these attributes will be dependent on the shape of future Environment Agency surveillance programmes. The density of monitoring sites, the adequacy of coverage of water bodies and potentially habitat types.

Storage location for source dataset and processed data: Source dataset currently stored in Catchment Data Explorer. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England at the water body level, as far as this can be shown with available datasets.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the water body level.
Invasive Non-Native Species (INNS) B2 (Estuaries), B2 (Coasts)

Rationale for inclusion: Invasive non-native species (INNS) may affect both natural species composition and also directly impact habitats within coastal and estuarine waters. The presence of some INNS, such as those that form artificial reefs in locations where they may otherwise not be present, can modify the structural components of a habitat to the extent that a new community is present. Species such as the slipper limpet, *Crepidula fornicata*, can modify the broadscale habitat to the extent that a sandy area, or more muddy area develops into a coarse or mixed sediment area, due to the large number of shell fractions produced from the slipper limpet community. A number of INNS can be present at levels which considerably outcompete the natural species and can dramatically reduce the species diversity within some areas.

Source data: National Biodiversity Network (NBN-Atlas[7]) data portal.

Outline description of dataset including spatial coverage, representativeness, limitations: A data search can be conducted for a list of INNS[8] on the NBN Atlas, to produce a .csv file of occurrences of INNS. The NBN dataset covers all of England, with most data provided at 10 km grid squares. The NBN Atlas download includes a large number of data fields. The most useful are presented in the table below.

Data field	Description
ID	NBN Atlas record ID.
occurrence_ID	Occurrence ID.
taxon_name	Scientific name.
occurrence_status	Occurrence status.
individual_count	Individual count - number (not always filled in).
Start date year	Year of record.
identification_verification_status	Notification of the verification of the species record.
grid_ref_10000	OS Great Britain 10 km grid square reference.

Data ownership and licensing restrictions (if any): The data owner is the National Biodiversity Network. The data are available under open government licence or creative commons licence. Although NBN do hold data under other licences, this data was not used.

Data transfer arrangements: The standard INNS list[8] should be used as an initial search list. New INNS can be added as they are recognised as invasive within English waters. NBN data search can be completed at any time. Recommended to research just prior to each reporting cycle.

Frequency of source data update/data transfer: Data on individual species or form individual projects or associated organisations are updated as and when possible. An update frequency of 1 year is considered appropriate.

Form of attribute: Calculated as the number of INNS within each water body. The scoring is weighted to represent the likely severity of impact from the various impact groups (see data processing below). A natural area is expected to have no INNS present.

[7] Available at: https://nbnatlas.org/?gad_source=1&gclid=EAIaIQobChMI1ereh-OAhQMVMYdQBh1WEwcJEAAYASAAEgKRn_D_BwE

[8] The list of INNS and their relative severity rating can be found in Appendix D of Bleach, J. (2023). Defra 25 Year Environmental Plan B6 – Estuaries & Coastal Waters Indicator. Final Report Number RT001. Unpublished report available from Natural England.

Data processing method for generating attribute output: The first stage of the assessment of INNS, was to determine a standard list of INNS against which to search for species records. There is not one definitive list of INNS that is universally accepted in England, and as time progresses the list of INNS will likely be expanded, to include new introductions. Overall the UK Technical Advisory Group (UKTAG) list data represented the best list of those investigated. Where required species names were investigated to determine if taxonomic changes had occurred since the list was originally created. As the NBN record includes historic records, old and new taxonomic names were included in the search.

Initial categorisation of individual INNS was based on UKTAG impact category. The impact category is noted for each species. Species were classified into one of four impact groups:

- High impact;
- Moderate impact;
- Low impact; and,
- Unknown impact.

The unknown impact group largely consists of relatively new introductions or new identifications where there has not been sufficient time to determine the likely impact significance. Utilisation of the impact groups aims to provide some assessment of the significance of different INNS as not all are of the same severity. For example the presence of a number of low impact species may be far less impactful than the presence of one high impact species.

As part of the scoring process, records older than 2007 were removed from the data layer. The data time period is larger than the 6 year envisaged reassessment period for the Defra 25 Year Indicators, however it is deemed appropriate as it is unlikely that INNS that were present from over 6 years ago have since disappeared.

Data records were obtained from the NBN at 10 km grid square resolution. The species (sp) records obtained from the NBN were initially scored per 10 km grid. A non-linear set of rules to assign grid cells directly to naturalness classes was utilised that has been used within the Rivers and Streams B6 element. Each cell was classified on the following basis:

- no species on UK TAG lists = 1 (most natural);
- only low impact species = 2;
- only unknown impact species = 3;
- only low and moderate impact or no more than 1 high impact species = 4;
- more than 1 high impact species = 5 (least natural).

Each of the 10 km grids was scored using the above scoring system. These records were then remapped in a GIS with each 10 km cell scored from 1 to 5. A GIS output was then provided to determine the area of each water body at each naturalness class.

A final scoring process was completed within Excel. The final score per water body was an average of the score represented from each of the 5 naturalness classes.

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5
(B2) Invasive Non-native species (INNS) – using UKTAG list	No sp on TAG list	Only low impact sp	Only unknown impact sp	One or less high impact sp	More than 1 high impact sp

Attribute robustness: The dataset is available at a good resolution throughout England. Data records are validated at the NBN prior to inclusion in the searchable data. Data are slightly skewed towards areas of development, as this is where more survey has been undertaken. In addition it favours conspicuous species as these are more readily spotted and identified by volunteer recorders. However the dataset provides the best available record of INNS occurrence throughout England.

Storage location for source dataset and processed data: Source data are available from the NBN Atlas portal. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England at the water body level for INNS.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the water body level. Saltmarsh, B3 (Estuaries), B3 (Coasts)

Rationale for inclusion: Monitoring of saltmarsh by the Environment Agency is seen as a way to determine not only the state of saltmarsh itself, but also of the wider environment. Saltmarsh, extent, and the number and variety of different species and zones within the saltmarsh habitat can indicate the overall health of a system, including the ability of that system to respond to the effects of changing climate.

Source data: The Environment Agency collects data on saltmarsh and reports using the SKIPPER tool (Saltmarsh Key Indicators Processed Precisely and Estimated Robustly).

Outline description of dataset including spatial coverage, representativeness, limitations: The dataset provides the current ecological status class of each attribute at each monitoring point in the EA's Water Framework Directive monitoring programme, integrating data over a number of years to provide a complete picture for all monitoring locations. For the interim version of the indicator, the 2019 version of the dataset (the most recent available) has been used. The current monitoring programme includes a reasonable range of estuarine and coastal areas. Environment Agency monitoring design is changing to a representative surveillance network – the implications of this for the future sourcing of data is currently unclear.

Data ownership and licensing restrictions (if any): The data owner is the Environment Agency. The data are available under open government licence.

Data transfer arrangements: Data can be requested from the Environment Agency.

Frequency of source data update/data transfer: In future data will be sourced from the EA's new surveillance programme, which will monitor sites on a rolling basis and complete a full cycle every 5 years. It is therefore recommended that these attributes are downloaded on a 5-year cycle.

Form of attribute: Ecological status class of each attribute, which is related to naturalness class directly.

Data processing method for generating attribute output: The SKIPPER tool is a multimetric index composed of six individual components known as metrics. Of the six metrics recorded, two are combined to provide a B6 estuarine and coastal waters indicator attribute for saltmarsh. These are Saltmarsh extent as a proportion of the intertidal (SMAi) and Proportion of saltmarsh area covered by the dominant saltmarsh zone (ZnMax).

Saltmarsh extent as a proportion of the intertidal (SMAi) is selected as it can highlight changes over time. This also allows better comparison between water bodies of significantly different sizes, which vary widely in total area. Unlike the change in saltmarsh extent over two or more time periods which may hide actual changes in extent over more than one assessment, saltmarsh extent as a proportion of the intertidal will show changes over the longer timeframe.

The proportion of saltmarsh area covered by the dominant saltmarsh zone (ZnMax) is selected as a good representation of naturalness of saltmarsh in a particular water body. If there is a larger percentage of one or two dominant saltmarsh zones, this is an indication that either there are high levels of nutrients in the area which make one zone more dominant, or that there is an example of coastal squeeze where by the full range of zones are not able to exist. It is also a reflection of the presence and dominance of spartina, which lowers diversity of the marsh overall.

The overall saltmarsh B6 indicator score is the combined average of the SMAi and ZnMax score. To note when the average is between values (i.e. the average is 2.5), the score is conservatively rounded up.

The scoring for WFD reporting for the two SKIPPER saltmarsh metrics, are also provided on a five point scale, which is converted into a naturalness score:

- High = 1 (most natural);
- Good = 2;
- Moderate = 3;
- Poor = 4;
- Bad = 5 (least natural).

Both of the SKIPPER metrics used (SMAi and ZnMax), are converted to the 1-5 score, summed and then averaged.

As an example Water body GB520503503800, the Alde & Ore, a transitional water body in the Anglian region, has a SKIPPER status of:

- SMAi. saltmarsh extent as proportion of the intertidal = High = 1;
- ZnMax. proportion of saltmarsh area covered by the dominant saltmarsh zone = Moderate = 3.

So the overall saltmarsh B6 indicator score for the Alde & Ore would be (1+3)/2 = 2.

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5
Ecological status	High (HES)	Good (GES)	Moderate (MES)	Poor (PES)	Bad (BES)

To note 'ES' in the table above relates to the WFD reporting of Ecological Status, e.g. MES = Moderate Ecological Status.

Attribute robustness: One limitation on the use of saltmarsh as a B6 estuarine and coastal indicator attribute is that it is present in a number of, but not all, water bodies. For example, the south east has a much lower percentage of water bodies with saltmarsh present. However, the extent to which saltmarsh is monitored, and the potential to show alterations to what would be a natural state, mean that it is still included as a estuarine and coastal waters indicator.

Storage location for source dataset and processed data: The saltmarsh data is stored in SKIPPER tool and at the Environment Agency. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England at the water body level, as far as this can be shown with available datasets.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the habitat level
Light, O1 (Estuaries), O1 (Coasts)

Rationale for inclusion: Light levels can be detrimental to a number of marine animals, where natural processes are interrupted. Artificial light at night alters the behaviour of many marine animals and has also been shown to disrupt the development of ecological communities in the marine environment. The naturalness level would in this instance be the lack of anthropogenic light during the hours of darkness.

Source data: The Campaign for Rural England (CPRE), UK-wide light pollution map, is a project supported by Natural England. The dataset will be stored on CPRE systems, although Natural England do hold a copy as project partner. The dataset includes Earth Observation Group NOAA National Geophysical Data Centre satellite data. Data was processed by Land Use Consultants (LUC) on behalf of CPRE.

Outline description of dataset including spatial coverage, representativeness, limitations: There are a number of datasets that are available that look at night-time light levels. One that has been obtained for the B6 estuarine and coastal waters indicator, was developed by The Campaign for Rural England (CPRE) in a project supported by Natural England. The project used data captured by a satellite at 1.30 am throughout the month of September, which was picked as the most cloud free month during 2015. A composite map was produced taking averages per unit area for the whole country, as different parts of the country may have had more, or less cloud influence on certain nights. Of importance for the B6 estuarine and coastal waters indicator, is the level to which light pollution can be seen within estuarine and coastal waters areas.

The CPRE data are provided in an image (.TIF) format that can be viewed in a GIS. Each pixel shows the level of radiance (night light) shining up into the night sky. These were categorised into nine colour bands to distinguish between different light levels. Dark blues represent the low brightness values, to dark reds representing high brightness values. The categories are shown in the table below.

Pixel colour	Colour band (description)	Reflectance level (NanoWatts / cm2 /sr)
	Colour band 1 (Darkest)	<0.25
	Colour band 2	0.25-0.5
	Colour band 3	0.5-1
	Colour band 4	1-2
	Colour band 5	2-4
	Colour band 6	4-8
	Colour band 7	8-16
	Colour band 8	16-32
	Colour band 9 (Brightest)	>32

Data ownership and licensing restrictions (if any): The data owner is The Campaign for Rural England. The data are available under licence from CPRE.

Data transfer arrangements: Currently no data transfer arrangements in place as data is currently a one-off production.

Frequency of source data update/data transfer: Currently no plans to repeat the dataset, however this can be updated if required and funding available in future.

Form of attribute: Calculated as an area of coverage of each of the combined (see processing below) light levels over the each habitat.

Data processing method for generating attribute output:
Scoring for anthropogenic light is based on the division of light levels shown below. To note light levels are recorded as Nano Watts / cm2 / sr. These are included in the brackets in the bullets below, and an indication given to the colour range represented in the table above:

- Grey (<0.25) = 1 (most natural);
- Dark blue / light blue (0.25-1) = 2;
- Yellow / Green (1-4) = 3;
- Pink / Orange (4-16) = 4;
- Dark and light red (>16) = 5 (least natural).

The categories above, are skewed to represent larger categories for the higher brightness levels. There are smaller categories in the 1 (most natural) to 3 group, which represent the lower levels of light which are more representative of light that is expected to be at the coast. The breakdown of classes is deemed to be representative of the full light levels that are found in estuarine and coastal waters.

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5
(O1) Anthropogenic light (Nano Watts / cm^2 / sr)	<0.25	0.25-1	1-4	4-16	>16

Attribute robustness: The dataset is collected over a suitable time period and processed to ensure that cloud does not unduly skew the dataset. The data provides a robust and standard output for the whole of the UK area. Although this dataset is currently a one-off, there is the potential this could be reassessed in future years. If this is not the case, other datasets may need to be found that provide a similar assessment of night time light levels, in and around the coast.

Storage location for source dataset and processed data: Source data are available from The Campaign for Rural England. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the habitat level.
Noise O2 (Estuaries), O2 (Coasts)

Rationale for inclusion: Another anthropogenic pressure that is introduced to the marine environment that has the potential to negatively impact marine life, is the introduction of underwater noise. Noise is already a naturally occurring component of that marine environment and can be created by many natural sources. However, additional noise, especially noise introduced at levels that are well above that which would be produced naturally can have negative impacts. Anthropogenic noise can be separated into continuous noise and impact or impulse noise. As underwater noise is only more recently becoming a concern, data sources are not particularly well developed at present. As regulatory requirements increase in this area, including the need to map noise as part of the reporting requirements under the Marine Strategy Framework Directive, it is expected that assessments in future years will have more sophisticated underwater noise data to generate updates to the B6 indicator score for estuarine and coastal waters.

Source data: Joint Nature Conservation Committee (JNCC) Marine Noise Registry[9]. Noise records are supplied by industry that are stored by JNCC. Each year, JNCC publishes maps and tables depicting the spread of impulsive noise across UK seas relative to the year before.

Outline description of dataset including spatial coverage, representativeness, limitations: A Marine Noise Registry has been developed to record occurrences of impulsive sound from various activities in the UK seas, which feeds into a European registry through the OSPAR Convention. The registry holds data for seven different impulsive sound generating activities:

- seismic survey.
- sub-bottom profiling.
- impact pile driving.
- unclassified Ministry of Defence activity.
- detonation of explosives.
- acoustic deterrent devices.
- multi-beam echosounders (≤12 kHz).

JNCC processed noise data records are available for 2016, 2017 and 2018 only. The data are provided at a resolution of blocks which represent an area of c.250 km^2 of seabed. Data are provided as number of pulse block days (PBDs). For example 20 PBDs implies 20 days over a particular year that impulsive noises were recorded in a particular block. The data includes a number of data fields, the main fields are indicated in the table below.

Data field	Description
FID	Noise data ID number.
Shape	Shape of data (always polygon).
block-code	Block unique ID code (includes quadrant below).
quadrant	Combined with block-code (above) to give unique block code.
Actvty_dt	Activity date.
activity	Type of activity (such as piling, acoustic deterrents, explosives, etc).
pbd	Pulse block days (number)

Data ownership and licensing restrictions (if any): The data manager is the JNCC. The data are available under open government licence.

[9] Available at: https://mnr.jncc.gov.uk/

Data transfer arrangements: Data should be available yearly, however the compiled noise maps are irregularly updated.

Frequency of source data update/data transfer: Yearly unprocessed data are available. Yearly noise maps are available at lower frequency. An update frequency of 3-5 years is considered appropriate.

Form of attribute: Calculated as areas of seabed that are exposed to different levels of anthropogenic impact noise.

Data processing method for generating attribute output: The criteria that was used to score underwater noise first compiles the JNCC data records for all of the years that data are available (2016, 2017 and 2018) into one database. This included giving a unique number to each of the blocks in which the JNCC data were presented in. The combined number of PBDs over the three years was then calculated. Figure O2.1 provides an indication of the level, and resolution of information that is available. The recordable blocks are scored by the number of pulse days that are experienced over a year.

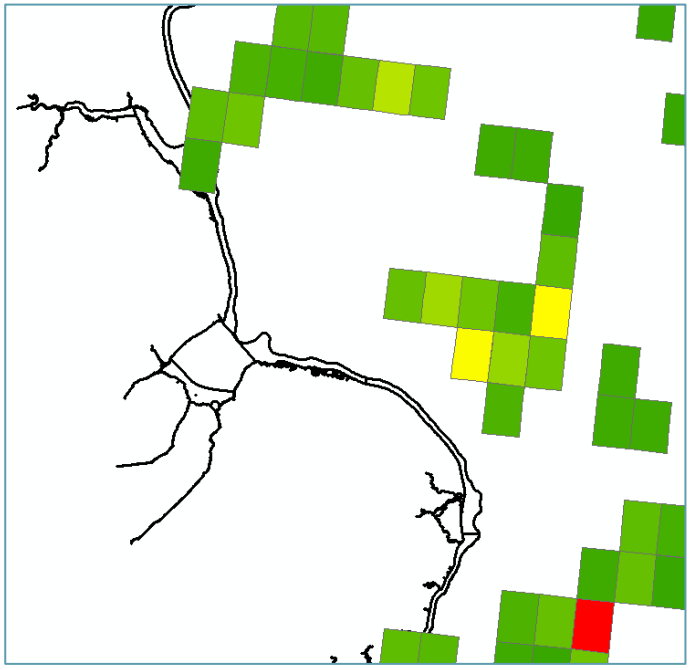

Figure O2.1: Display of the 2020 underwater noise records in the east of England

Note: Red = Highest amount of pulse days; Yellow = Moderate; Green = Low; Light green = Very low. Source JNCC Noise Registry

The naturalness scoring for underwater noise is provided below. The colour that is included in the brackets provides an indication of the levels shown for each naturalness category on Figure O2.1.

The naturalness scoring for underwater noise is provided in the table below. The colour that is included in the brackets provides an indication of the levels shown for each naturalness category on Figure O2.1 (noting not all colours described in the table are shown in the figure example).

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5
(O2) Underwater noise - number of pulse block days (PBD)	0 (white)	1-25 (dark and light green)	26-50 (yellow and light orange)	51-75 (dark orange and light red)	76-100 (dark red)

Attribute robustness: These data have been sourced from the JNCC as data custodians for the years where PBD maps are available. To note these records are of instances that have been recorded due to the requirement placed on operators and developers as part of the marine licencing process. As such this is a limiting factor in the data available. For future rounds of B6 scoring, it is envisaged that the number of available years will improve, likely to be 6 years of preceding years data for each subsequent 6 yearly reporting. As such, all 6 years of data should be combined and a score derived from the total number of PBD represented over the proceeding 6 years.

Storage location for source dataset and processed data: Source data are available from the JNCC. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England at the habitat level for underwater noise.

Attribute information sheet

Principal habitat components: Estuaries and Coasts. Outputs provided at the water body level.
Litter O3 (Estuaries), O3 (Coasts)

Rationale for inclusion: Litter in the marine environment represents something that is manmade and inherently unnatural. Recording of marine litter has, so far, concentrated on assessing the macro-level of litter. This current assessment does not include any calculation or subsequent scoring that looks at micro-litter, including micro-plastics that are likely to be highly prevalent and ubiquitous within the marine environment. It is likely that any resultant biological effects of litter are more likely to be caused by micro, rather than macro plastics, however at present this attribute looks at macro-litter data only, until such time that a reliable countrywide micro-litter recording scheme is developed.

Source data: Marine Conservation Society (MCS) Beach Beachwatch data. The provided dataset will be stored on Natural England systems.

Outline description of dataset including spatial coverage, representativeness, limitations: The Marine Conservation Society (MCS) coordinate a number of beach cleans throughout the country. As well as the beach cleans that they organise, they also collate data sent in by volunteers that collect litter from beaches. The MCS maintain a registry of litter collected, with data recorded per 100 m of beach cleaned.
Although there is some inconsistency in the way data are recorded, each litter record does include the number of bags of litter collected per 100 m. There is no set definition of the dimensions of a bag, other than being noted as a large bin bag. However, the level to which each bag is filled will vary according to the weight of items placed in the bags, and how comfortable each bag is for someone to carry. As such scoring can be derived on this attribute of the litter data in a consistent manner for all water bodies, noting that each bag may not be exactly the same size or filled to the same level.

To note whilst some records are provided with relatively accurate locations, it is apparent that in some locations, many beach cleans have been completed and recorded in the same location, even though the beach clean events are likely to be cleaning a different stretch of beach each time. However as this attribute is scored at a water body level, this level of geographic accuracy does not affect the overall water body score. Data are available for four years (2016-2020).

The data includes a number of data fields, the main ones of which are indicated in the table below. There are a number of data fields that would be helpful to be filled out consistently, including weight of litter.

Data field	Description
Year	Year of beach clean.
SurveyID	Beach clean unique ID number.
BeachID	Beach unique number.
OrganiserID	Organiser unique ID.
Beach_Name	Name of beach.
Beach_County	Location of beach (county)
BeachLat/Long	Location of beach lat/long.
Date_Survey	Date of beach clean.
Number_bin_bags_filled	Number of bags filled during the beach clean.
Date_beach_last_cleaned	Date of last beach clean.
Weight_of_litter	Weight of litter collected (not always filled in).

Data ownership and licensing restrictions (if any): The data owner is the Marine Conservation Society. The data are available under licence from MCS. We would like to thank the Marine Conservation Society for providing Beachwatch data from their volunteer beach litter monitoring programme to be included in the B6 indicator for estuarine and coastal waters.

Data transfer arrangements: Data can be requested at any time form the MCS. Although it is suggested that data are requested prior to each reporting cycle.

Frequency of source data update/data transfer: Data are provided to the MCS when beach cleans are completed. Data are available yearly on request from the MCS.

Form of attribute: Calculated as number of bag litter collected over the preceding reporting period (will usually be 6 yearly, however only 4 years data available for this initial scoring), shown per square kilometre of the water body area.

Data processing method for generating attribute output: The total number of bags filled is first calculated for all of the four years data are available for each of the water bodies. If scoring were simply derived by litter collected per water body, it's likely that the scoring would be skewed according to the size of the water body. To more fully represent the amount of litter per water body, the total number of bags was they calculated to provide a result per water body area [km^2].

Naturalness class boundaries:

	Class 1	Class 2	Class 3	Class 4	Class 5
(O3) Litter – bags collected per km^2 of water body	0	<1	1-10	11-100	>100

Attribute robustness: Due to the nature of the data presented, a lack of litter collected does not mean there is no litter present at a particular site, rather a lack of litter collectors to collect and report the data. In addition some water bodies seem to have a much higher level of volunteer action and participation. These water bodies may be more skewed towards higher naturalness scores (i.e. less natural) due to higher volunteer effort, rather than necessarily more litter per se.

Storage location for source dataset and processed data: Source data are available from the Marine Conservation Society. Summarised processed data are stored in a structured spreadsheet attached to the B6 information pack. A geodatabase is available that indicates the naturalness scores across England at the water body level for litter.

hrwallingford

We design smarter, more resilient solutions across both the natural and built environment to help everyone live and work more sustainably with water.

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