**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.

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[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.
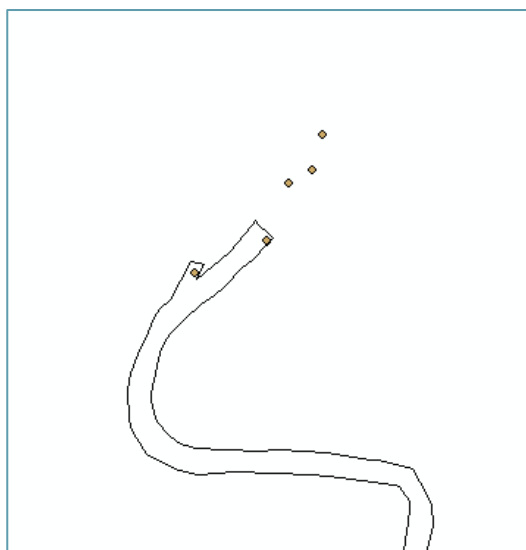


**Figure H2.1: Upper Tamar estuary**
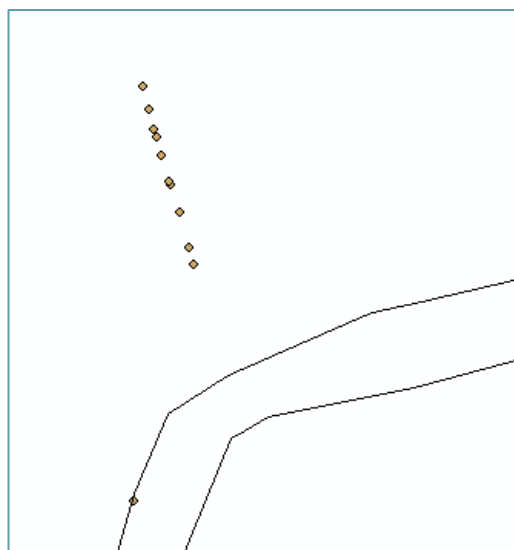
*Source:   EA - Obstacles dataset*



**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.

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[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.
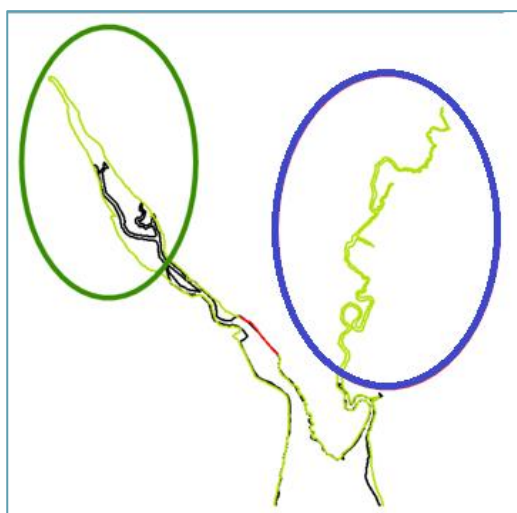


**Figure H3.1: Exe estuary pre-snip**
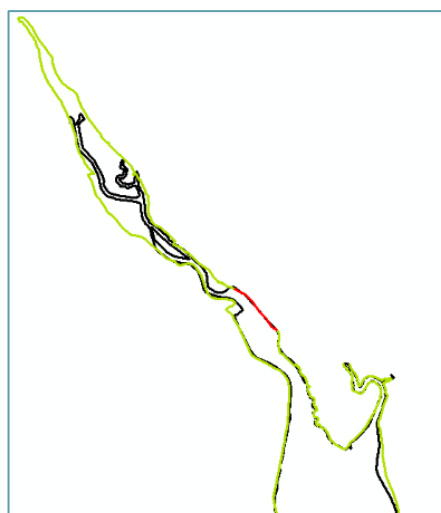
*Source:   Environment Agency - NCERM*

**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.
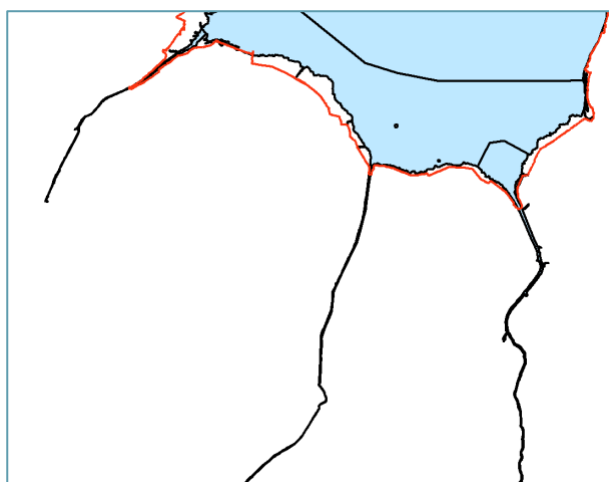
**Figure H3.3 Wash Area NCERM data only**
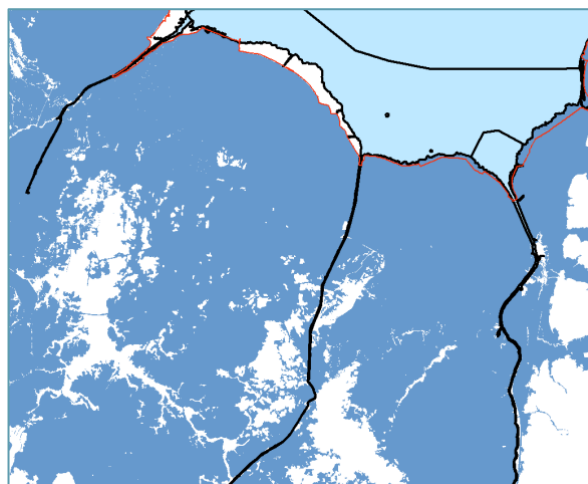
*Source: Environment Agency*



**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.
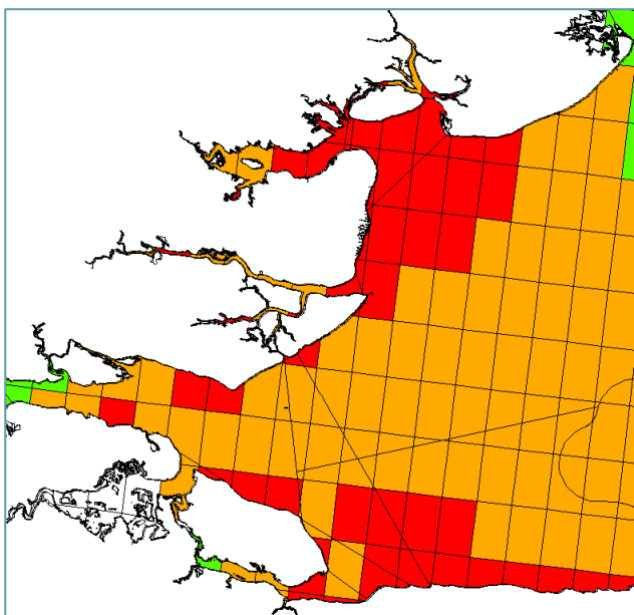
**Figure P2.1: Dredging layer for Thames to Blackwater area**
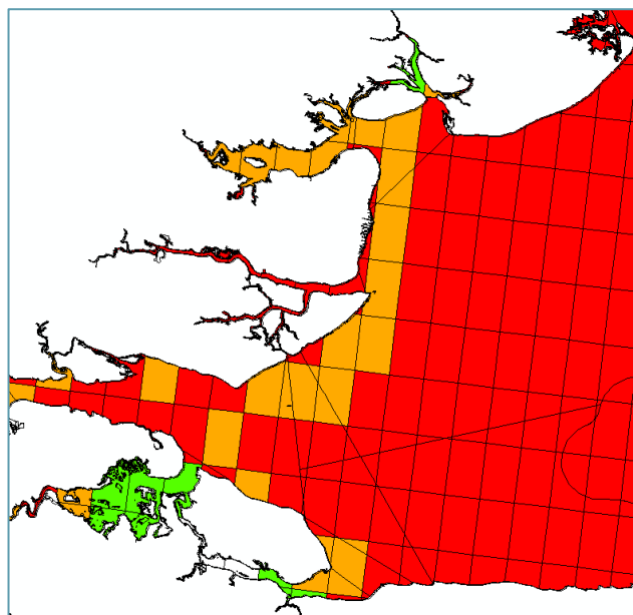
*Source: Fishermap – Natural England*



**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.

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[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.
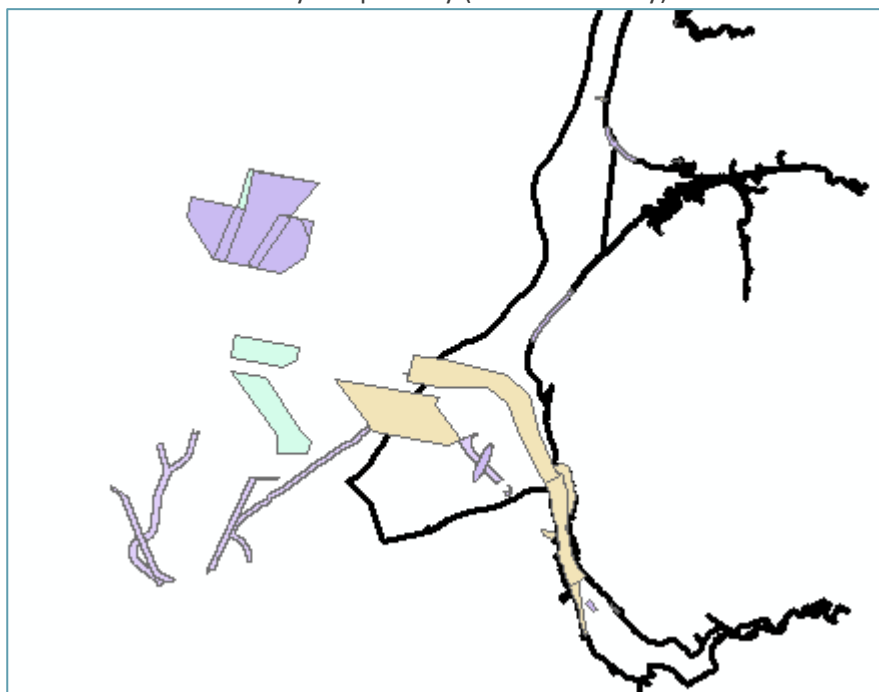


**Figure P3.1: Snapshot of TCE licensable activities in the northwest, in the south east Liverpool Bay area**

*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.

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[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.

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[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.
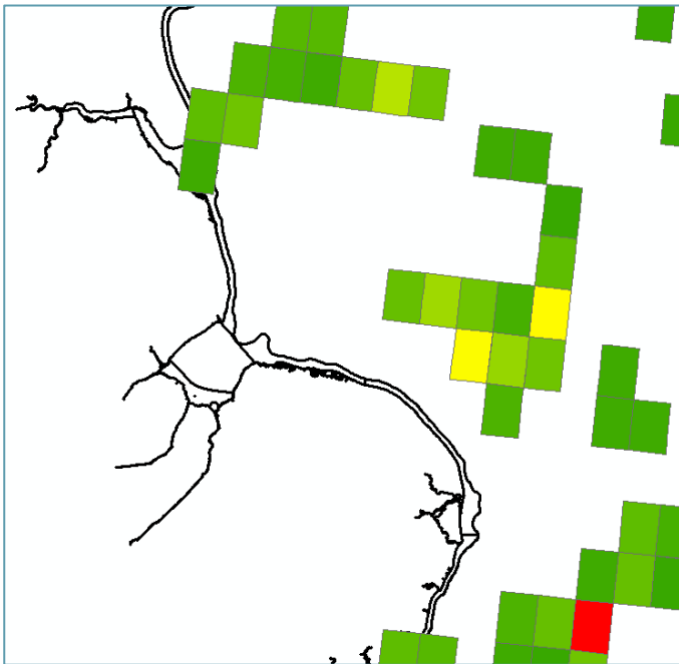


**Figure O2.1: Display of the 2020 underwater noise records in the east of England**

*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.