Heritage, natural capital and ecosystem services:
Case Studies for Coastal Grazing Marshes

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1. Summary

Place Services of Essex County Council was commissioned by Historic England to undertake an assessment of the Essex coastal grazing marshes using Natural Capital and Ecosystem Services methodologies, in order to establish how the historic environment could be accommodated within the existing frameworks. Coastal grazing marshes are a distinctive and complex historic landscape of national significance both for their ecological and historic environment assets.

The project tested how existing natural capital and ecosystem services methodologies can be used in ascribing values to historic environment assets associated with coastal grazing marshes in order to protect the historic environment within future environmental policy. The nationally-important marshes of Old Hall (RSPB) and Tollesbury Wick (EWT) have been used as case-studies for the project.

2. Introduction

Coastal grazing marshes are a distinctive and complex environment and a major heritage asset. They are man-made features created by the enclosure of salt marshes by sea-walls and dykes and drained by a series of sluices and creeks. Whilst some examples in England may have had their origins in the Roman period, they are largely a product of the medieval and early post-medieval period, with a further period of enclosure in the second half of the 18th and 19th century. The UK Biodiversity Action Plan describes the 'coastal and floodplain grazing marsh' Priority Habitat as periodically inundated pasture, or meadow with ditches, which maintain the water levels, containing standing brackish or fresh water. The ditches are especially rich in plants and invertebrates. Almost all areas are grazed and some are cut for hay or silage. Sites may contain seasonal water-filled hollows and permanent ponds with emergent swamp communities.

As a historic landscape they are highly sensitive to change; once ubiquitous around the Essex coast, enormous losses took place in the second half of the 20th century (approximately 72% lost since the 1930s) largely as a result of agricultural improvement. By the end of the 1990s it was estimated that there were around 6,500 hectares of surviving coastal grazing marsh in the county, which represents some 5.5% of the national resource. They are highly vulnerable to agricultural improvement, managed realignment, coastal erosion and coastal-based industries.

Over the last 25 years, key areas of extant grazing marsh have been brought into conservation ownership, mainly by bodies whose prime concern is with nature conservation. Essex County Council (ECC), has arranged detailed surveys of those reserves (approximately 2000 hectares in total) leading to an enhanced understanding of their historic significance and a more integrated approach to their

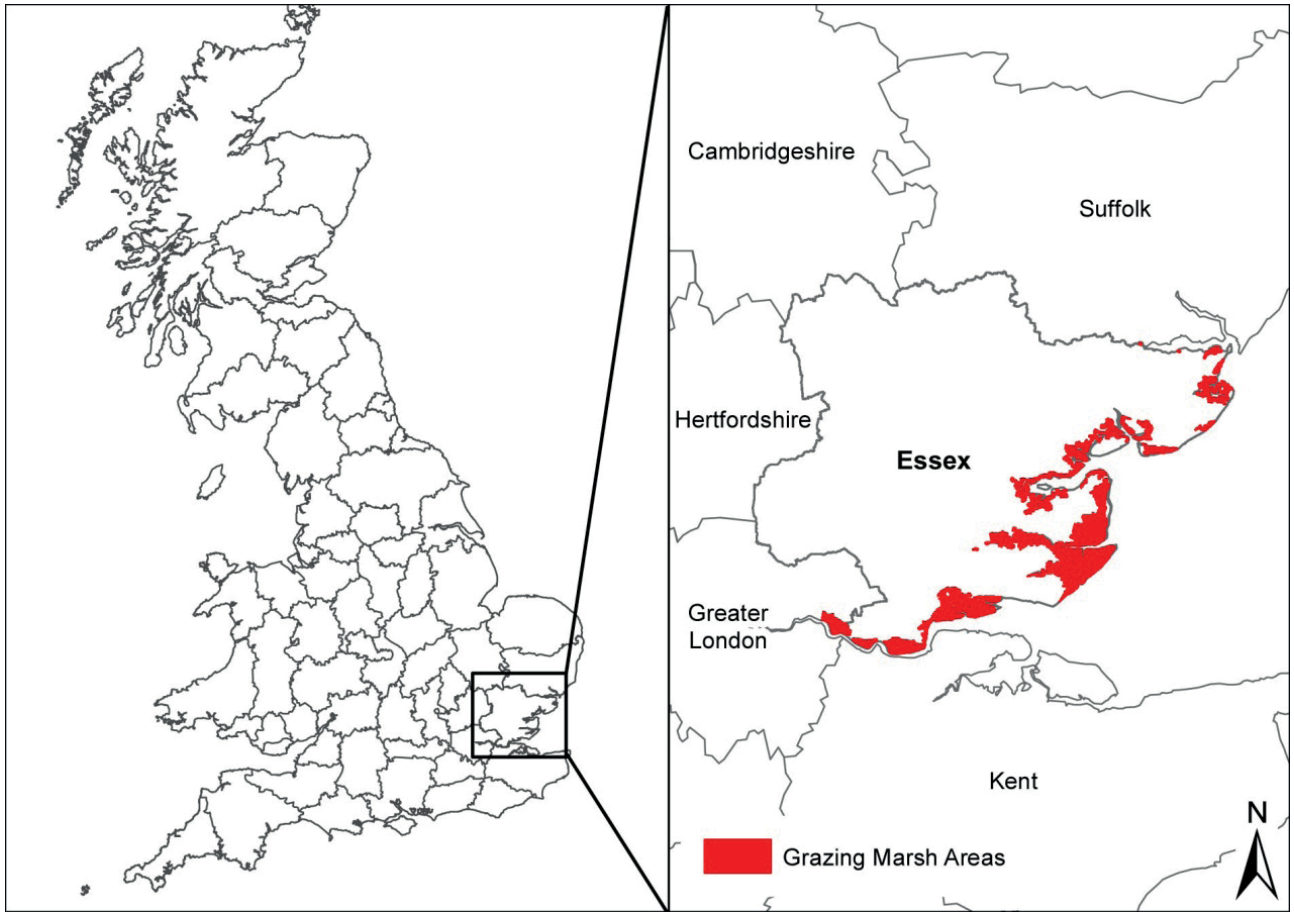

Figure 1 Former extent of coastal grazing marshes in Essex

management (Barker, 2000; Pattison and Barker 2000; Medlycott and Gascoyne, 2006; Clarke et al, 2007; Gascoyne et al, 2010). In the mid-2000s work on the provision of green infrastructure as part of the Thames Gateway initiative, facilitated by historic environment specialists at ECC, led the RSPB to adopt an integrated approach combining the natural and historic environment to the management and presentation of major marshland reserves in the south Essex marshes. However, work in preparing historic environment input into the development of the second Shoreline Management Plan (SMP2) demonstrated that the historic environment significance of coastal grazing marshes was not well understood at that time, and its geographical distribution poorly mapped, with only partial information incorporated into the Historic Environment Record (HER), and accordingly it proved rather difficult to properly accommodate the significance of the historic environment of extant grazing marsh into the SMP.

Figure 2 Unimproved grassland at Old Hall Marshes

In order to rectify that situation, in 2014 Place Services completed a study of the Essex Historic Grazing Marshes (Gascoyne and Medlycott 2014), funded by English Heritage (now Historic England). The project assessed significance and vulnerability of this historic landscape asset, in order to enable a more effective engagement with coastal flood risk management and other land management issues. The project included the assessment of the historic environment assets within each area of surviving coastal grazing marsh as well as a basic characterisation of the grazing marsh vegetation for each marsh. The project created a uniform, accessible assessment providing a golden thread linking HER, Historic Landscape Characterisation (HLC) and Historic Environment Characterisation (HEC) and provided an exemplar for historic grazing marsh assessment in other parts of England. The Historic Grazing Marsh project - English Heritage Project 6134 (https://www.historicengland.org.uk/images-books/publications/essex-historic-grazing-marshes-project/) was intended from the outset to provide a valuable source of information for any future consideration or valuation of the ecosystem services that are provided by coastal grazing marshes.

A number of values (economic or otherwise) can be ascribed to our environment, and the way in which it is diminished or enhanced can also be measured in many different ways. Natural capital, often defined as comprising our stocks of assets (such as geology, soil, air, water and species) produces a wide range of services for people. These are often characterised as "ecosystem services". Both the natural capital accounting and the ecosystem services approach are becoming increasingly popular with policymakers and land managers, as well as within the planning system. However, not all environmental capital is natural, and as such the historic environment is not always included in these assessments.

On a global scale the Millennium Ecosystem Assessment has undertaken an overview of wetland ecosystems (including lakes, rivers, marshes and coastal regions to a depth of 6m below low-tide) and made an initial assessment of ecosystem services provided by or derived from wetlands (Table 1).

Services	Comments and Examples
Provisioning	
Food	production of fish, wild game, fruits, and grains
Fresh water[a]	storage and retention of water for domestic, industrial, and agricultural use
Fiber and fuel	production of logs, fuelwood, peat, fodder
Biochemical	extraction of medicines and other materials from biota
Genetic materials	genes for resistance to plant pathogens, ornamental species, and so on
Regulating	
Climate regulation	source of and sink for greenhouse gases; influence local and regional temperature, precipitation, and other climatic processes
Water regulation (hydrological flows)	groundwater recharge/discharge
Water purification and waste treatment	retention, recovery, and removal of excess nutrients and other pollutants
Erosion regulation	retention of soils and sediments
Natural hazard regulation	flood control, storm protection
Pollination	habitat for pollinators
Cultural	
Spiritual and inspirational	source of inspiration; many religions attach spiritual and religious values to aspects of wetland ecosystems
Recreational	opportunities for recreational activities
Aesthetic	many people find beauty or aesthetic value in aspects of wetland ecosystems
Educational	opportunities for formal and informal education and training
Supporting	
Soil formation	sediment retention and accumulation of organic matter
Nutrient cycling	storage, recycling, processing, and acquisition of nutrients

[a] While fresh water was treated as a provisioning service within the MA, it is also regarded as a regulating service by various sectors.

Table 1 Ecosystem Services provided by or derived from wetlands (Millennium Ecosystem Assessment 2005, Table 1)

Amenity
Biodiversity
Carbon sequestration
Conversion of intertidal into terrestrial uses (historical)
Flood defence through storm and erosion buffering
Gathering of wild foodstuffs, including wildfowling
Gathering thatching materials (historical)
Gathering wild medicinal herbs (historical)
Health, a place for fresh air and exercise
Horticultural turf
Livestock farming
Manufacture of chemicals (historical)
Military defence and training
Nursery grounds for commercial fish/shellfish
Nutrient and sediment storage
Purification and filtration of water
Tourism
Water disposal (historical)

Table 2 Ecosystem Services provided by British saltmarshes (Chatters 2017, 295)

For Britain, Clive Chatters in his 2017 book on Saltmarshes undertook an assessment of the Ecosystem Services provided by British saltmarshes, much of which also applies to coastal grazing marshes (Table 2). The RSPB (Bolt and Ausden 2017) has produced a Natural Capital Account for its nature reserves in England as a contribution to the debate about how best to reflect the value of nature in decision-making, summarised here in Table 3.

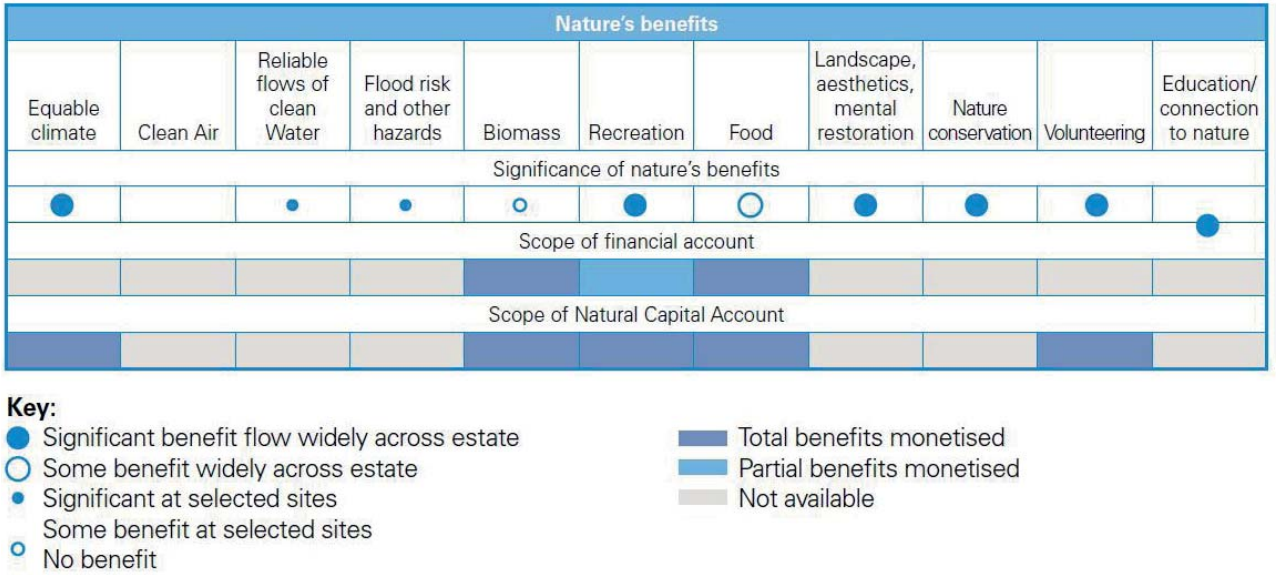

Table 3 Natural Capital goods and services provided by RSPB nature reserves in England (Bolt and Ausden 2017, Table 2)

3. Project Aims and Objectives

3.1 Aims

The Project Aims for this project have been derived from the Historic England Call for Proposals for Project No. 7705, Heritage, natural capital and ecosystem services: case studies. Historic England is pursuing a number of initiatives which aim to support the heritage sector in engaging with existing natural capital and ecosystem services methodologies in order to protect the historic environment within future environmental policy.

These initiatives will look at:-

1. What need is there for advice – what does the sector (natural environment and heritage sector) want?
2. How is the historic environment included at the moment?
3. How might the historic environment be better included – what might this look like?
4. Developing guidance/handbook on best practice and how to do this.

This coastal grazing marsh pilot-study is intended to primarily address Aim 3 above and also aims to inform the development of guidance for the heritage sector on how to engage with existing natural capital and ecosystem services approaches (Aim 4 above). Although this study will inform this guidance, the development of the guidance itself will be the subject of a separate project.

3.2 Objectives

By looking in detail at the heritage associated with particular environmental contexts, the objectives of this pilot-study is to:

A. Identify the heritage alongside the natural capital associated with these environments. To what extent do the two coincide? What is the relationship between the two?;

B. Set out information in the language of ecosystem services what public and environmental goods and services the heritage assets contribute to (including 'provisioning', 'supporting', 'regulatory' and 'cultural services');

C. Identify other values that fall outside the ecosystem services framework that can be ascribed to the heritage assets;

D. In doing the above develop a methodology that can be used to ensure that heritage can be reflected in a way that is compatible with existing natural capital and ecosystem services approaches;

E. Provide the heritage and natural environment sectors with two case study examples of how this might work for coastal grazing marshes.

4. Heritage asset register for coastal grazing marshes

4.1 Characteristic (contemporary) features of coastal grazing marsh

The range of characteristic contemporary features integral to coastal grazing marshes, such as sea-walls, sluices, duck decoy ponds, salterns and creeks were previously identified as part of the Essex Historic Grazing Marsh Project (Gascoyne and Medlycott 2014). The following table ranks them according to their degree of survival, historic environment significance and rarity.

Heritage Asset	Survival	Significance	Rarity
Sea-walls	Good	High	Widespread
Borrow dykes	Good	High	Widespread
Counter walls	Moderate	High	Localised
Farmsteads	Moderate	High	Localised
Agricultural buildings	Low	Medium	Rare
Fields (wet meadow grassland)	Moderate	High	Widespread
Irregular field boundaries (former creeks)	Moderate	High	Widespread
Regular field boundaries	Good	Moderate	Widespread
Tracks/causeways	Good	High	Rare
Fleets/creeks	Good	High	Widespread
Cultivation/drainage earthworks	Moderate	Moderate	Localised
Earthwork enclosures	Good	High	Widespread
Earthwork mounds: Medieval salterns	Good	High	Rare
Earthwork mounds: habitation site, livestock refuge	Moderate	High	Rare
Duck-decoy ponds	Good	High	Rare
Sluices	Good	High	Widespread

Table 4 The key heritage assets characteristic of coastal grazing marsh and their survival, significance and rarity

4.1.1 Assessment of key heritage assets characteristic of coastal grazing marsh against Ecosystem Services

Asset	Provisioning	Regulating	Supporting	Cultural
Sea-wall	Keeps water fresh and soils free from salt-water inundation	Prevents tidal flooding and regulates fresh water flooding, and consequent impact on soils	Help prevent coastal erosion of agricultural land	Historic landscape feature, location of long-distance coastal footpath
Borrow-dykes	Carry water, nursery for young fish	Prevents tidal flooding and regulates fresh water flooding, and consequent impact on soils	Help prevent coastal erosion, water management system	Historic landscape feature, attracts wildlife
Counter walls		Second line of defence in times of flooding		Historic landscape feature
Farmsteads	Managing land for agriculture			Historic landscape feature
Agricultural buildings	Managing land for agriculture			Historic landscape feature
Fields (wet meadow grassland)	Grazing-land, provision of meat and wool	Acts as filter and absorber of flood water	Rich in soil organisms and flora	Historic landscape, wildlife-watching, walking
Irregular field boundaries (former creeks)	Managing of stock, hold water	Hold water	Water management system	Historic landscape feature, attracts wildlife
Regular field boundaries	Managing of stock, hold water	Hold water	Water management system	Historic landscape feature, attracts wildlife
Tracks/causeways	Accessing fields			Historic landscape feature, walking
Fleets/creeks	Carry water, nursery for young fish	Regulate fresh water		Historic landscape feature, attracts wildlife
Cultivation/drainage earthworks	Enable drier grazing during wet periods	Enable different soil fauna		Historic landscape feature
Enclosures				Historic landscape feature
Salterns	Act as refuge during flooding events			Historic landscape feature
Mounds	Act as refuge during flooding events			Historic landscape feature
Duck-decoy ponds	Wildfowling and water supply	Hold water		Historic landscape feature
Sluices	Manage water-levels	Manage water		Historic landscape feature

Table 5 Key heritage assets assessed against primary Ecosystem Services

Heritage Asset	Food provision	Water availability	Genetic diversity	Biomass provision	Climate regulation	Water quality	Water flow	Soil quality	Soil erosion	Pollination	Pest regulation	Regulating coastal erosion	Cultural Heritage	Sense of Place	Tranquility	Recreation
Sea-walls	□	■				■	■	□	□			■	■	■	■	■
Borrow dykes	□	■				■	■	□	□			■	■	■		■
Counter walls												□	■	■		
Farmsteads	■												■	■		
Agricultural buildings	■												■	■		
Fields (wet meadow grassland)	■					□	□	■					■	■	■	■
Irregular field boundaries (former creeks)	□	■					■					□	■	■		■
Regular field boundaries	□	■					■					□	■	■		■
Tracks/causeways													■	■		■
Fleets/creeks		■				■	■					□	■	■		■
Cultivation/drainage earthworks	□							□					■	■		
Earthwork enclosures													■	■		
Earthwork mounds: Medieval salterns	□												■	■		□
Earthwork mounds: habitation site, livestock refuge	□												■	■		
Duck-decoy ponds	■	■											■	■		■
Sluices	□	■				■	■	□				■	■	■		

■ = directly contributes □ = indirectly contributes

Table 6 The key characteristic heritage assets assessed against Ecosystem Services functions

4.2 Characteristic non-contemporary features associated with coastal grazing marsh

The range of characteristic non-contemporary features often found associated with historic coastal grazing marshes, such as buried land surfaces, red hills, industrial and defensive structures were broadly recognised as part of the Essex Historic Grazing Marsh Project, but have been categorized in more detail for the purposes of this project.

Heritage Asset	Survival	Significance	Rarity
Prehistoric, Roman and Saxon sites			
Relict Forest	Good	High	Rare
Buried land-surfaces	Good	High	Localised
Prehistoric/Roman salterns/Red Hills	Good	High	Widespread
Palaeochannel	Good	High	Widespread
Burials – cremation, inhumation, ring-ditch	Good	High	Rare
Settlement	Good	High	Rare
Maritime sites			
Wharfs, quays and hythes	Good/moderate	High	Widespread
Revetment	Good/moderate	High	Localised
Wreck	Moderate/poor	High	Localised
Oyster beds	Good/moderate	High	Widespread
Industrial sites			
Explosive factories	Moderate	Medium	Rare
Oil refineries	Moderate	Medium	Rare
Lime kilns	Moderate/poor	High	Localised
Brickworks	Poor	Medium	Rare
Copperas Works	Poor	High	Rare
Tide mill	Good	High	Rare

Windmill	Poor	Medium	Rare
Canal	Moderate	High	Rare
Salt works/store	Good	High	Rare
Military sites			
Forts	Good	High	Localised
Martello towers	Good	High	Localised
Pill-boxes	Good	High	Widespread
Bombing decoys	Moderate	High	Localised
Anti-glider ditches	Moderate/poor	Medium	Widespread
Anti-tank ditch	Poor	Medium	Localised
WWII minefield	Poor	Low	Rare
Minefield Control Tower	Good	High	Rare
Machine gun post	Moderate	Medium	Rare
Anti-aircraft battery	Good	High	Rare
Searchlight battery	Good/moderate	High	Rare
Nuclear test site	Good	High	Rare
Army camp	Good	Medium	Rare
Observation post	Moderate	Medium	Rare
Spigot mortar emplacement	Moderate	Medium	Localised
Blockhouse	Good	High	Rare

Table 7 Key non-contemporary heritage assets associated with coastal grazing marsh and their survival, significance and rarity

Heritage Asset	Food provision	Water availability	Genetic diversity	Biomass provision	Climate regulation	Water quality	Water flow	Soil quality	Soil erosion	Pollination	Pest regulation	Regulating coastal erosion	Cultural Heritage	Sense of Place	Tranquility	Recreation
Prehistoric, Roman and Saxon sites																
Relict forest													■	■		
Buried land-surfaces													■			
Prehistoric/Roman salterns/Red Hills													■	■		
Palaeochannels													■	■		
Burials – cremation, inhumation, ring-ditch													■			
Settlement													■	■		
Maritime sites																
Wharfs, quays and hythes	□								□			■	■	■		■
Revetment	□								□			■	■	■		
Wreck	□		□										■	■		■
Oyster beds	■		□										■	■		
Industrial sites																
Explosive factories													■	■		
Oil refineries													■	■		
Lime kilns													■	■		
Brickworks													■	■		

Copperas Works													■	■		
Tide mill		□											■	■		■
Canal		□					■						■	■		
Salt works/store	□												■	■		
Military sites																
Forts													■	■		■
Martello towers													■	■		■
Pill-boxes													■	■		■
Bombing decoys													■	■		■
Anti-glider ditches													■			
Anti-tank ditch													■			
WWII minefield													■			
Minefield Control Tower			□										■	■		■
Machine gun post			□										■	■		■
Anti-aircraft battery			□										■	■		■
Searchlight battery													■	■		■
Nuclear test site													■	■		
Army camp			□										■	■		
Observation post													■	■		■
Spigot mortar emplacement			□										■	■		■
Blockhouse			□										■	■		■

■ = directly contributes □ = indirectly contributes

Table 8 The key characteristic of non-contemporary heritage assets assessed against Ecosystem Services functions

4.3 Intangible heritage

As a distinctive and complex historic environment, coastal grazing marshes are a major heritage asset, contributing to the special landscape character of many parts of the Essex coast. The intangible heritage forms one element of its historic environment character, as the name suggests it is most commonly used to describe things that are recognized but not easily quantified, such as traditions (often oral), social practices and traditional knowledge.

In the case of the historic grazing marshes of Essex the intangible heritage includes the form of place-names, the historical pattern of land-ownership and links to specific historic events, activities or people, such as the site of the Battle of Maldon or wild-fowling, as well as its role as a source of inspiration to painters and writers (Gascoyne and Medlycott 2014).

Heritage Asset	Survival	Significance	Rarity
Place-names	Good	High	Widespread
Land ownership patterns	Poor	High	Rare
Literature, art, music	Good	High	Localised
Historical events	Good	High	Rare
Wild-fowling	Moderate	High	Localised

Table 9 Key intangible heritage assets associated with coastal grazing marsh and their survival, significance and rarity

Heritage Asset	Food provision	Water availability	Genetic diversity	Biomass provision	Climate regulation	Water quality	Water flow	Soil quality	Soil erosion	Pollination	Pest regulation	Regulating coastal erosion	Cultural Heritage	Sense of Place	Tranquility	Recreation
Place-names													■	■		
Land ownership patterns													■	■		
Literature, art, music													■	■		■
Historical events													■	■		■
Wild-fowlingand oyster-fishing	■												■	■		■

■ = directly contributes □ = indirectly contributes

Table 10 Key intangible heritage assets associated with coastal grazing marsh assessed against Natural Capital and Ecosystem Services Functions

5. Heritage Ecosystems Services assessment methodology

An assessment methodology has been developed in order to assess the environmental context of the historic coastal grazing marsh. The assessment methodology aims to ensure that heritage is reflected in a way that is compatible with existing natural capital and ecosystem services approaches. It is intended that the methodology will not only be applicable to historic coastal grazing-marshes outside Essex but also for other types of historic landscapes, such as the chalk downlands, coppiced woodland or deer-parks.

The conceptual framework and methodologies outlined by the Natural Capital Committee and the UK National Ecosystem Assessment for Ecosystem Services (Provisioning, Regulating, Supporting and Cultural) have provided the basis for this methodology, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/608852/ncc-natural-capital-workbook.pdf and http://uknea.unep-wcmc.org/Resources/tabid/82/Default.aspx

To this initial framework and methodologies has been added the requirements needed to ensure that an understanding of the historic environment is reflected as an integral part of assessing the natural capital and ecosystem services of an area. This methodology has been applied to two coastal grazing marshes in Essex, the results of which are presented in Section 6 Case Studies.

5.1 Methodology

5.1.1 Scope - Determine the area of interest

What is the relevant geographical area? Establish what makes most sense from a biophysical or heritage point of view. Is it a river catchment area, or an ecosystem type, or a physical unit such as an island or a cultural unit such as a single farm or estate? It is important to consider the interdependencies with the wider landscape without being over ambitious in terms of what can be reasonably influenced by those parties that the assessment is being undertaken for.

What is the practical institutional area? Establish the governance structures, whether a county, National Park or landholder. There may be more than one group that have common interests and responsibilities and governance for an area.

What is the relevant benefits area? Establish who or what is affected by the benefits and costs provided by the natural capital and ecosystem services for the area of interest. This could range from tourists that travel to the site from around the UK to local properties benefitting from the reduction in flood risk.

These areas will overlap, but probably not completely so it is important to consider whether anything significant is missing when choosing a focus for a survey. At this stage the three areas should be mapped, together with major land-use classes, significant natural or heritage areas such as designated sites (SSSI, Scheduled Monuments etc.) and key infrastructure. The mapping should include an indication of owners and those assets which are overseen by people and institutions involved in the plan (e.g. are the marshes part of a wider RSPB holding in Essex?). If there are major assets that do not feature in the plan, or if there are major land managers that are not directly involved, it might be appropriate to include them if the plan is likely to impact on them or be impacted by them.

5.1.2 Scope – Identify the groups of people involved

As part of establishing the plan it is important to identify the partners, interested parties and agents who can contribute to it. This can include:

- Those who will benefit from the protection and improvement of the natural capital in relation to human health and wellbeing;
- Those who will bear the costs of the protection and improvement of natural capital; such as taxpayers or institutions;
- Local nature and heritage organisations;
- Organisations who use ecosystem services provided by natural capital – e.g. water companies, tourist boards, farmers, etc.;
- Businesses, such as developers, those involved in tourism, or who benefit from flood reduction or in sales of products such as timber;
- Those who have influence over how the land is used or managed, such as landowners, organisations and public bodies
- Those who may have an impact on natural capital as a consequence of their activities and may have a corresponding duty to mitigate or compensate, such as Highways England, the

Environment Agency or Network Rail;
- Existing authorities and partnerships that may help co-ordinate interests, such as flood partnerships, Local Nature Partnerships, etc.;
- Those who have expertise or information that maybe helpful, such as accountants, ecologists or archaeologists.

5.1.3 Scope – Identify existing work programmes and activities

The people and institutions involved in taking forward a natural capital and ecosystem services based approach in an agreed area are likely to be already involved in a range of environmental protection and improvement programmes. It could be useful to collate the following information to form the basis of future plans:
- The planned outcomes of existing work programmes with timings;
- The benefits these will provide for natural capital assets;
- The increase of benefits that could be achieved if an integrated approach is adopted with the pooling of resources where appropriate.

5.1.4 Evidence - Developing an asset register of the natural capital assets and services for coastal grazing marshes

An asset register is an inventory of the natural assets in an area, and their condition. For example, marsh could be defined by its type (historic pasture, improved), its area, quality (e.g. age, rotation, wildlife species and population, quality of run-off waters) and distribution. As part of this asset register an assessment will be made on the survival, significance and rarity of archaeological features present (this approach already used in historic environment scoring of coastal grazing marshes).

The following data will be included in the asset register:
- The boundary, extent and type of land cover;
- Significant land managers in the area (e.g. farmers, water companies);
- Major land use types (e.g. agricultural, recreational);
- Who owns which assets;
- What the asset is being managed for (e.g. wildlife, food, timber, recreation);
- The key species present and their state/condition (improving/stable/declining);
- The key heritage assets present and their survival, significance and rarity;
- The ecosystem services that it provides and its state/condition (improving/stable/declining).

5.1.5 Evidence - Developing a risk register of the natural capital assets and services for coastal grazing marshes

This will assess the current and future risks to the natural capital. By risk, we mean in this context the probability of changes in the delivery of benefits. The risk register will consider both the likelihood of such a change and the scale of its impact. This helps identify the priority to attach to managing or addressing particular risks. For example, if coastal grazing marsh is turned to managed retreat is not going to be capable of sustaining livestock and heritage assets will be lost, this needs to be recorded as a potential risk, and taken into account in the prioritisation of actions within a plan.

The Natural Capital Committee has developed a natural capital risk register that highlights where the benefits from natural assets (food, fibre, energy, clean water, clean air, recreation, aesthetics, hazard protection, wildlife and equable climate) are at risk using a Red/Amber/Green (RAG) scoring based on trends (improving, stable, declining).

5.1.6 Evidence - Developing a set of natural capital accounts

- The private value to an organisation of the natural assets that it currently owns and/or manages;
- The cost to the organisation of maintaining those assets;
- Changes in their condition over time;
- The risks (potential costs) and benefits to the organisation of either depleting or maintaining those assets;

- The costs and benefits to society of either depleting or maintaining those assets.

5.1.7 Ecosystems Services methodology (based on the UK National Ecosystem Assessment)

Ecosystem services are categorised as:

Provisioning services: The products obtained from ecosystems.	Regulating services: The benefits obtained from the regulation of ecosystem processes.	Supporting services: Ecosystem services that are necessary for the production of all other ecosystem services.	Cultural services: The non-material benefits people obtain from ecosystems.
For example, • food • fibre • fresh water • genetic resources	For example, • climate regulation • hazard regulation • noise regulation • pollination • disease and pest regulation • regulation of water, air and soil quality	For example, • soil formation • nutrient cycling • water cycling • primary production	• For example, through • spiritual or religious enrichment • cultural heritage • recreation and tourism • aesthetic experience

The heritage assets present in the two case-studies of coastal grazing marshes will be considered against these service groups; whilst it is probable that the majority will fall under the 'cultural heritage' grouping, other assets, such as sea-walls and counter-dykes will fit into multiple categories, in that they regulate the presence of fresh water and dry land (and hence contribute to provisioning services), regulate flooding and provide a means of accessing the coast (via sea-wall paths) contributing to recreation and tourism.

6. Case-studies

6.1 Old Hall Marsh, Tollesbury

Summary
Old Hall Marsh comprises a large area of unimproved grazing marsh, representing several phases of reclamation and incorporating several marshes, adjacent to the Blackwater Estuary between Salcott Creek and Tollesbury Fleet. A wide range of characteristic features include sea wall, borrow dyke, sinuous former creeks and rills, counter walls, mounds, including red hills, building platforms, and counter walls. The grassland is managed through grazing as an RSPB reserve with public access and is of international importance on the basis of its ecological designations.

6.1.1 Scope

The area of interest
Geographical Area: comprises The RSPB reserve at Old Hall Marsh, Tollesbury forms a narrow peninsula of reclaimed marsh on the northern side of the Blackwater Estuary, flanked by the Salcott Channel to the north and the Tollesbury Fleet channel to the south (Figure 4). The reserve area encompasses the whole of the coastal grazing marsh peninsula. There are interdependencies with both the adjoining dryland and the estuary itself.

Institutional area: The survey area comprises the RSPB holding of Old Hall Marsh, Maldon District, Essex.

Relevant benefits area: The area affected by the benefits and costs provided by the natural capital and ecosystem services for Old Hall Marsh includes the wider RSPB estate, Essex Wildlife Trust and other Local Wildlife and SSSI sites that benefit from the increased populations of birds and other wildlife in the area. Maldon District benefits from increased tourism numbers relating to wildlife viewing and walking the coastal footpath along the sea-wall. There are benefits to local residents, in the Salcott and Tollesbury area, in the form of reduction in flood risk through the sequestration of flood waters during weather events or particularly high-tides.

Figure 3 Sea-wall at Old Hall Marshes, Tollesbury

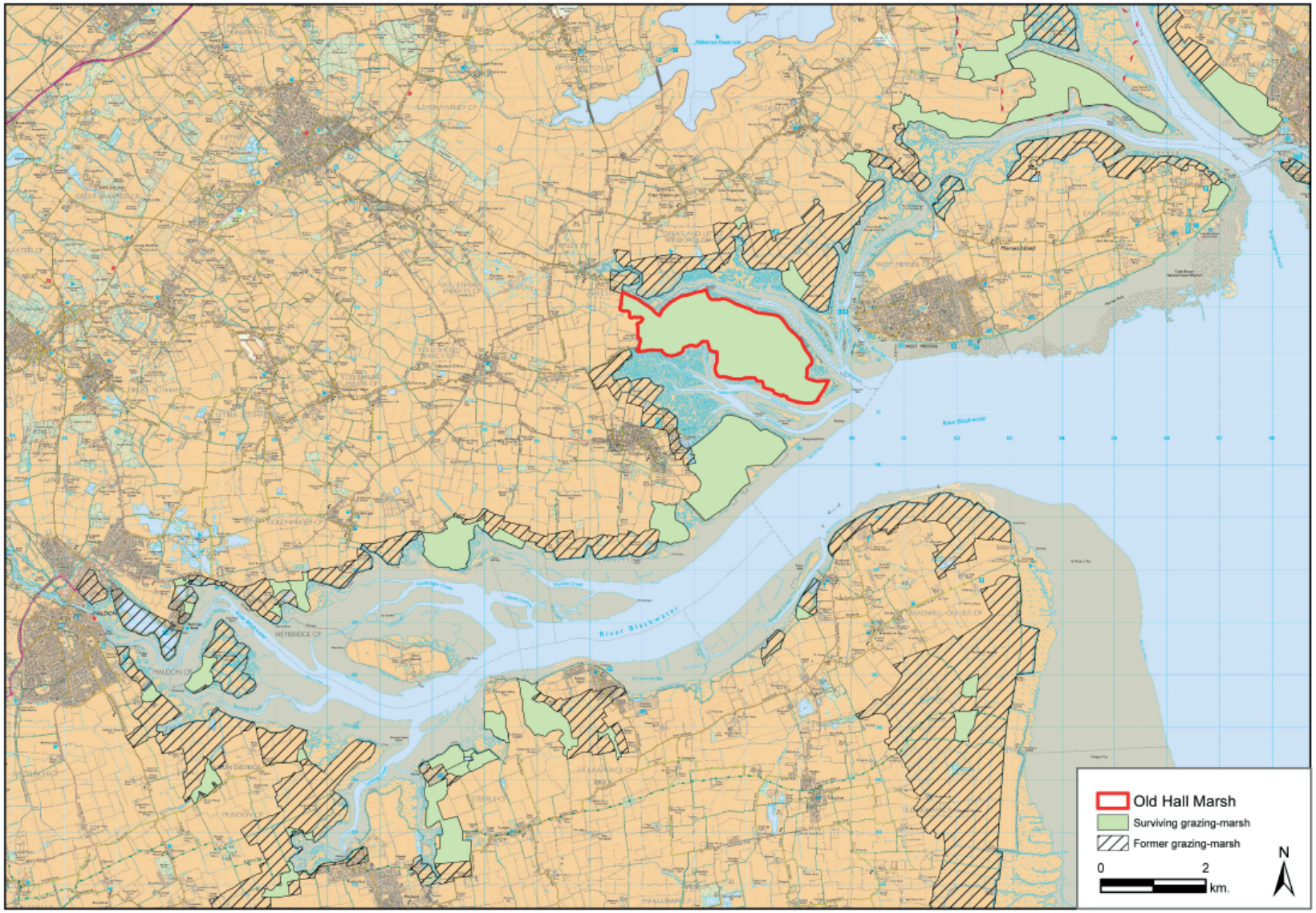

Figure 4 Old Hall Marsh, Tollesbury

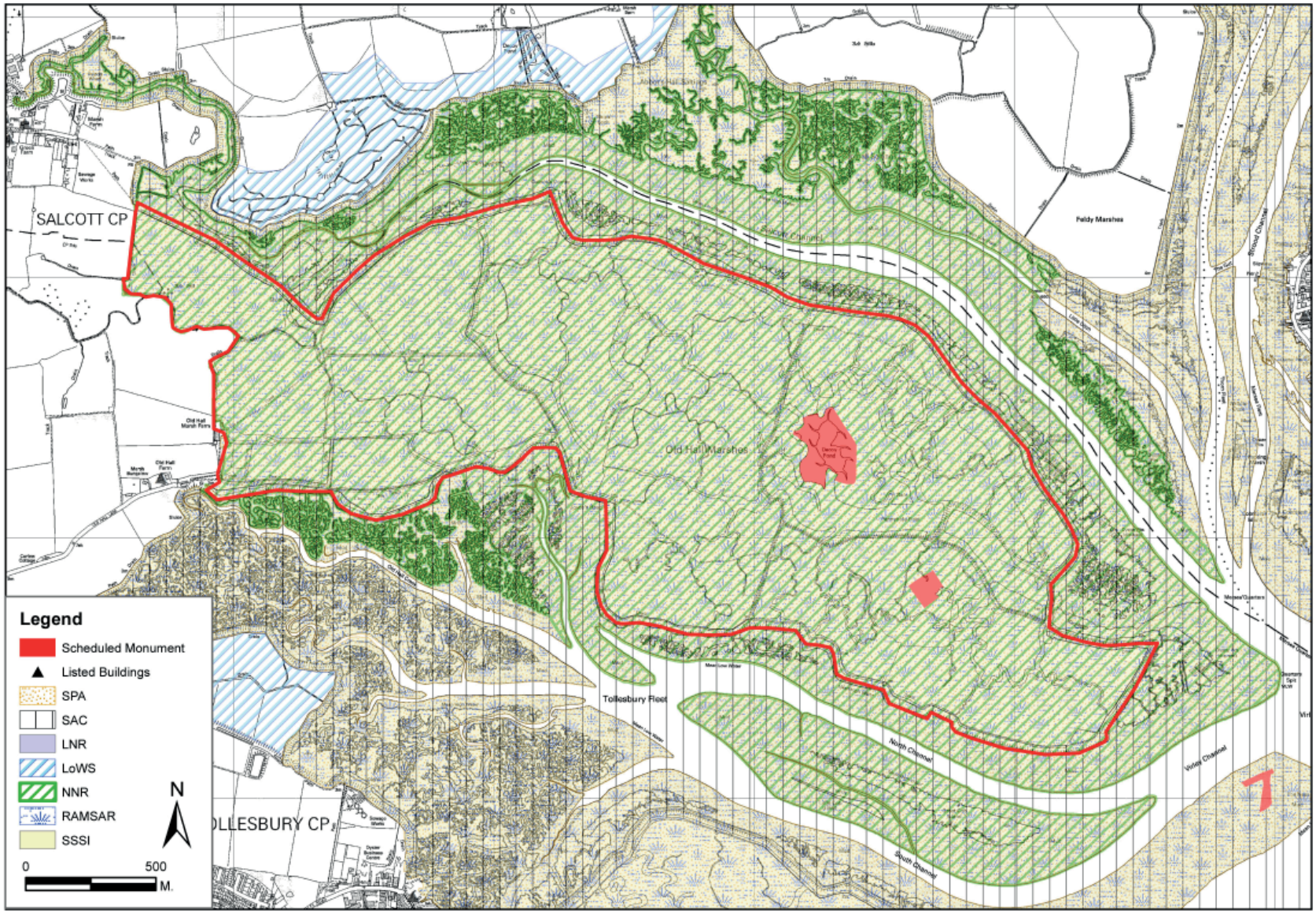

Figure 5 Location of Old Hall Marshes in relation to other significant associated ecological and heritage assets

6.1.2 The groups of people involved

The RSPB are the land-owners and managers of Old Hall Marsh.

Other interested parties include the residents of Salcott and Tollesbury who benefit from reduction of flood risk; residents and visitors to Maldon District and Essex who benefit from access to open spaces, wildlife and recreational opportunities; local nature and heritage organisations (including the Essex Wildlife Trust and the National Trust who have neighbouring holdings); the Environment Agency; Maldon District Council; Essex County Council including its Flood Team and Place Services which provides archaeological advice both to the County Council and to Maldon District Council.

6.1.3 Existing work programmes and activities

The RSPB has produced a Natural Capital Account for its nature reserves in England (Bolt and Ausden 2017) as a contribution to the debate as to how best to reflect the value of nature in decision-making. The study included grazing-marshes as a habitat type but did not focus either on individual habitats or sites.

6.2 Evidence

6.2.1 An asset register of the natural capital assets and services of Old Hall Marsh

Old Hall Marsh comprises 400 ha. of historic coastal grazing-marsh, a BAP priority habitat. It is owned and managed by the RSPB. The habitats represented include extensive grazing marshes with brackish water fleets, reed-beds, two small off-shore islands and saltmarsh. The asset is being managed for wildlife through extensive conservation grazing.

Natural Environment
Breeding bird species include avocet, lapwing, redshank, pochard, shoveler and bearded tit. During migration, marsh harriers, wheatears, whinchats and waders are also present.

Species	2014	2015	2016	2017	2018	Count Type
Avocet	25	9	7	20	25	Apparently occupied nest
Barn Owl		1	1	2		Apparently occupied nest
Black-headed Gull					60	Apparently occupied nest
Cetti's Warbler	19					Singing/Displaying male
Common Tern	4		18	24	68	Apparently occupied nest
Coot	72	44	6	67	57	Individual
Cuckoo			15			Singing/Displaying male
Gadwall	7	9	47	13	5	Pair
Garganey			10	1	1	Pair
Great Crested Grebe	9	12	2	15	6	Individual
Lapwing	43	38	35	53	46	Pair
Little Tern	0		5	9	5	Apparently occupied nest
Marsh Harrier	4	6	1	4		Pair
Oystercatcher	27	32		58	44	Pair
Pochard	36	30		17	41	Pair
Redshank	63	70		65	78	Pair
Ringed Plover				2	3	Apparently occupied nest
Shoveler	24	28		42	103	Pair
Tufted Duck	27			11	38	Pair

Table 11 Key breeding species for last five years, Old Hall Marsh (data supplied by RSPB)

Group	Species	No. Records	First Record	Last Record
Amphibian	2	5	01/06/2009	14/05/2013
Bird	226	59170	02/06/2008	29/05/2018
Bony fish (*Actinopterygii*)	5	17	01/06/2009	09/08/2014
Crustacean	7	18	01/06/2009	30/09/2011
False scorpion (*Pseudoscorpiones*)	1	1	22/06/2016	22/06/2016
Flowering plant	188	1069	27/04/2009	05/09/2017
Fungus	7	8	08/05/2009	05/08/2009
Insect - alderfly (*Megaloptera*)	1	2	01/06/2011	30/09/2011
Insect - beetle (*Coleoptera*)	213	439	14/07/2008	22/06/2016
Insect - butterfly	26	2803	10/06/2008	20/05/2018
Iinsect - caddis fly (*Trichoptera*)	2	2	01/06/2010	30/09/2011
Insect - dragonfly (*Odonata)*	24	1084	01/06/2008	20/05/2018
Insect - flea (*Siphonaptera*)	1	1	29/08/2008	29/08/2008
Insect - hymenopteran	25	111	24/06/2008	22/06/2016
Insect - mayfly (*Ephemeroptera*)	2	6	01/06/2009	30/09/2011
Insect - moth	468	5374	10/06/2008	18/04/2018
Insect - orthopteran	9	108	26/05/2009	17/08/2014
Insect - true bug (*Hemiptera*)	46	110	22/05/2009	22/06/2016
Insect - true fly (*Diptera*)	76	291	09/09/2008	22/06/2016
Marine mammal	2	17	10/11/2009	09/10/2013
Mollusc	9	25	01/06/2009	30/09/2011
Moss	2	12	01/06/2009	10/09/2014
Reptile	4	79	09/06/2008	07/11/2016
Spider (*Araneae*)	2	9	01/06/2009	27/07/2014
Stonewort	1	8	01/06/2009	30/09/2010
Terrestrial mammal	23	543	10/06/2008	20/04/2016

Table 12 Species recorded at Old Hall Marsh by RSPB (includes all records from datasets managed by the reserve which are not linked to off-reserve recording areas)

Character of vegetation: High quality grazing marsh, mosaic of grassland, reedbed and riparian vegetation. Ditches dominated by Common reed *Phragmites australis* and Sea club-rush *Scirpus maritimus*. with some Brackish water-crowfoot *Ranunculus baudotii* in waterway in less saline areas; Saltmarsh rush *Juncus gerardii*, Beaked tasselweed *Ruppia maritima* and nationally rare Spiral tasselweed *R. cirrhosa* towards the central creek in more saline areas. Nationally rare species Divided sedge *Carex divisa*, Sea Barley *Hordeum marinum* and Slender hare's ear *Bupleurum tenuissimum* along creek edges. Grassland dominated by Creeping Bent *Agrostis stolonifera*, Perennial rye-grass *Lolium perenne* and Red fescue *Festuca rubra* with diverse herb assemblage including Spiny *restharrow Ononis spinosa*, Narrow-leaved bird's-foot-trefoil *Lotus tenuis*, nationally rare Sea clover *Trifolium squamosum* and Bird's-foot clover *Trifolium ornithopodioides*. Two other notable nationally rare species, Mousetail *Myosurus minimus* and Red goosefoot *Chenopodium botryodes* occur on disturbed ground.

Historic Environment

There are numerous heritage assets on Old Hall marsh, including the grazing-marsh itself. It is a complex, well preserved and well-studied historic environment. The reclamation of Old Hall marsh from the original salt-marsh is thought to have been in an advanced, but piecemeal state by the late 16th century, by the time it was recorded on the Chapman and Andre map of 1777 it had reached its full extent. The sea walls have undergone a number of alterations since the late 17th century. The marsh has large fleets, water-filled creeks, relict salt marsh surface and raised causeways that cross the marsh. There are two surviving duck decoy ponds, both scheduled (SM 1021086 and 1016863). The undesignated assets include nine or more mounds, which probably represent red hills, midden sites, and sites of buildings, possibly barns, a decoy house and a house can be identified on the 1st edition OS map. The marsh is crossed by a number of counter walls, which appear as raised earthworks. The borrow dykes have occasional causeways across.

The marsh has a number of literary connections as well as a link to Isambard Kingdom Brunel who designed a syphon for the site in 1830-34.

Heritage asset	Survival	Significance	Rarity
Designated			
Duck-decoy ponds	Good	High	Rare
Undesignated			
Grazing-marsh (incl. fleets, creeks, irregular field boundaries)	Good	High	Rare
House site	Moderate	Moderate	Rare
Saltern/Red Hill	Good/moderate	High	Numerous
Saltworks (post-medieval)	Poor	Moderate	Rare
Settlement site (medieval)	Moderate	High	Rare
Enclosure	Moderate	Moderate	Rare
Earthworks	Poor	Moderate	Localised
Former sea-walls	Good	High	Numerous
Midden	Good	Moderate	Rare

Table 13 Key heritage assets present and their survival, significance and rarity

Values	Description	Rank	Score
Archaeological Potential	Sea wall, borrow dyke, ditches, creeks, fleets, red hills, middens, counter walls, medieval building platforms, sites of post medieval buildings	High	3
Archaeological Association	Concentration of red hill/salt making sites	Medium	2
Group Value (Association)	Old Hall Marsh Farm	Medium	1
Diversity	Sea walls, borrow dyke, drains, raised causeways, creeks, fleets, counter walls, earthwork mounds, duck decoys, counter walls, building platforms and house sites, wind pump	Very High	6
Historical Association	A number of literary associations including Mehalah; link to Isambard Kingdom Brunel; used for filming 2012 BBC adaptation of Great Expectations	High	3
Biodiversity	Internationally designated SPA & Ramsar.	Very High	3
Amenity	Good public access to RSPB reserve	High	3
Overall significance			**21**

Table 14 Old Hall Marsh assessment of significance (for scoring methodology see Gascoyne and Medlycott 2014)

6.2.2 Evidence - Developing a risk register of the natural capital assets and services for coastal grazing marshes

The risk register assesses the current and future risks to the natural capital. By risk, we mean in this context the probability of changes in the delivery of benefits. The risk register considers both the likelihood of such a change and the scale of its impact. This helps identify the priority to attach to managing or addressing particular risks. The risks for coastal grazing marshes were identified as part of the Essex Historic Grazing marsh Project (Gascoyne and Medlycott 2014). There are no current serious threats to the site, which is well managed with water levels maintained. There is the potential of unintentional impacts on the cultural environment, both to surviving landscape features and below-ground deposits through habitat creation/improvement schemes.

Potential risk	Likelihood	Scale of impact: Ecological	Scale of impact: Cultural	Comments
Urbanization	Low	High	High	Unlikely, RSPB reserve and in isolated rural area
Green infrastructure	Moderate/low	Moderate/low	Moderate/low	Impact dependent on nature of infrastructure. Car-parks will impact on below-ground deposits, increased visitors on sea-wall path could impact on wildlife populations and cause erosion
Natural Environment initiatives	High	Low	Moderate/low	Dependent on nature of work, digging of scrapes could impact on below-ground deposits, whilst increased water-levels are unlikely to have major negative effects
Climate change/sea level rise (incl. SMP)	High	High	High	Managed Realignment proposed 2055-2105
Change to agricultural regime	Low	High	High	Unlikely, site is RSPB reserve managed as historic grazing marsh. Ploughing or scrub encroachment would fundamentally change nature of site

Table 15 Potential risks for the study area

6.2.3 Evidence - Developing a set of natural capital accounts

An assessment was made of the expected ecosystem service and societal benefits provided by the Study Area. The categories in Table 11 are based on the data compiled by the RSPB and a review of the scientific literature, as summarised by Bolt and Ausden (2017, Table 2). The Study Area is judged to be particularly important for nature conservation, recreation, volunteering opportunities, climate change mitigation and landscape/aesthetic reasons. Within these categories Cultural Heritage and the historic environment is best represented under the heading landscape/aesthetics, but is also a contributor, either directly or indirectly, to the other goods and services.

Equable climate	Clean Air	Reliable flows of clean water	Flood risk, coastal erosion, other hazards	Biomass	Recreation	Food	Landscape, aesthetics, mental restoration	Nature Conservation	Volunteering	Education/ connection to nature
Some benefit		Some benefit	Significant benefit		Significant benefit	Some benefit	Significant benefit	Significant benefit	Significant benefit	Significant benefit
Scope of natural capital account										

Key:

	Total benefits monetised
	Partial benefits monetised
	Not available

Table 16 Natural Capital goods and services provided by Old Hall Marsh (based on the methodology used in Bolt and Ausden 2017, Table 2)

• The private value to the RSPB of Old Hall Marsh
A rough estimation of land value has been estimated by as £6,422,000 (based on average price for pasture land, https://dairy.ahdb.org.uk/market-information/farm-expenses/land-prices/land-prices-rics/#.W87302hKjlU)

The reserve and the contingent assets within it are valued at approximately £600,000. This does not include land value but rather the assets e.g. buildings, cattle control units etc.

• The cost to the RSPB of maintaining those assets
The annual budget is approximately 120k. The budget is covered by an annual payment from an Agri-environment scheme, an FBT tenancy and small amount of donation from the general public and visitors. This reduces the cost to the RSPB significantly.

• Changes in their condition over time
The reserve has been annual audited for progress on its management plan objectives for the last two years; each time returning an overall assessment of Green.

• The risks (potential costs) and benefits to the organisation of either depleting or maintaining those assets

Depletion risks to the RSPB:

- loss of nationally and internationally important biodiversity
- Loss of reputation
- Loss of agri-environment income
- Loss of locally important landscape
- Loss of cattle production/farming operation
- Loss of environmental and carbon offsetting

Maintenance risks to the RSPB:

- Ongoing operational costs
- Exposure to compliance risks
- Potential future seawall risks

Benefits of depletion to the RSPB:

- Reduction of fixed costs associated with the reserve
- Reduction in ongoing maintenance costs

Benefits of maintenance to the RSPB:

- Contribution to local, national and internationally important biodiversity
- Contribution to carbon offsetting
- Positive contribution to a historically important landscape
- Securing a nationally threatened habitat
- Opportunities for grant funding
- Fulfilling charitable objectives

• The costs and benefits to society of either depleting or maintaining those assets

The cost of depletion of assets to society:

- Loss of local, national and internationally important
- Loss of important flood storage area both marine and freshwater flooding
- Loss of carbon offsetting/climate change adaption
- Development not suiting historic landscape
- Loss of viable grazing land

Society costs of maintenance

- Tax payers funding in the form of agri-environment schemes funding
- Tax payers funding ongoing seawall maintenance burden

The benefits of maintenance to society

- Continuation of local, national and internationally biodiversity
- Locally important green space and resource
- Public footpaths and access to nature
- Local produce and food
- Culturally significant landscape

Society benefits of depletion

- Potential to save tax payers funding on seawall maintenance and agri environment schemes
- Reduction in road traffic and agricultural movements

6.2.4 Ecosystems Services assessment (based on the UK National Ecosystem Assessment methodology)

The ecological and heritage assets present at Old Hall Marsh have been considered against the Ecosystem Service groups of Provisioning, Regulating, Supporting and Cultural services (Table 12). As Old Hall Marsh is a historic man-made landscape it is unsurprising that many of these Services derive from a combination of ecological and cultural/heritage assets.

Provisioning services				Regulating services				Supporting services				Cultural services			
Food provision	Water availability	Genetic diversity	Biomass provision	Climate regulation	Water quality	Water flow	Soil quality	Soil erosion	Pollination	Pest regulation	Regulating coastal erosion	Cultural Heritage	Sense of Place	Tranquility	Recreation
□	■			■	■	■	□	□			■	■	■	■	■

■ = significant benefits □ = some benefits

Table 17 Ecosystem benefits identified for Old Hall Marshes

For an area as distinctive as historic coastal grazing marshes the concepts of Cultural Heritage and Sense of Place are largely interchangeable, in that the Cultural Heritage, in the form of both physical heritage assets and intangible heritage assets, combined with the natural assets in the form of wildfowl and a distinctive vegetative pallet, all directly contribute to the Sense of Place. Under the heading of Cultural Heritage it is possible to examine the role of different heritage assets in contributing towards Ecosystem Services. Some assets, such as sea-walls and counter-dykes will fit into multiple categories, in that they regulate the presence of fresh water and dry land (and hence contribute to provisioning services), regulate flooding and provide a means of accessing the coast (via sea-wall paths) contributing to recreation and tourism. Other assets, such as the prehistoric and Roman salterns (Red Hills) are more a reflection of past use of the landscape and although they may serve as a refuge for invertebrates that prefer slightly drier soils with a high salt content, they are largely of Cultural Heritage significance.

	Provisioning services				Regulating services				Supporting services				Cultural services			
Heritage Asset	**Food provision**	**Water availability**	**Genetic diversity**	**Biomass provision**	**Climate regulation**	**Water quality**	**Water flow**	**Soil quality**	**Soil erosion**	**Pollination**	**Pest regulation**	**Regulating coastal erosion**	**Cultural Heritage**	**Sense of Place**	**Tranquility**	**Recreation**
Sea-walls	□	■				■	■	□	□			■	■	■		■
Borrow dykes	□	■				■	■	□	□			■	■	■		
Counter walls												□	■	■		
Fields (wet meadow grassland)	■			■		□	□	■					■	■	■	■
Irregular field boundaries (former creeks)		■					■					□	■	■		
Fleets/creeks		■				■	■					□	■	■		■
Cultivation/drainage earthworks	□							□					■	■		
Earthwork mounds: habitation site, livestock refuge	□												■	■		
Duck-decoy ponds	■	■											■	■		■
Sluices	□	■				■	■	■				■	■	■		
Salterns/Red Hills													■	■		

■ = directly contributes □ = indirectly contributes

Table 18 Old Hall Marsh heritage assets assessed against Natural Capital and Ecosystem Services functions

6.3 Tollesbury Wick, Tollesbury

6.3.1 Summary

Tollesbury Wick comprises an extensive area of grazing marsh, representing several phases of reclamation and incorporating several marshes, adjacent to the Colne Estuary between Pyefleet Channel and Geedon Creek. Characteristic features include sea wall, borrow dyke, sinuous former creeks and rills, mounds, including red hills, raised cause-ways, counter walls, post medieval railway and WWII defences. The grassland is managed through grazing as an Essex Wildlife Trust (EWT) reserve with public access, and is of international importance for wildlife.

6.3.2 Scope

6.3.2.1 The area of interest

Geographical area: The EWT reserve at Tollesbury Wick, Tollesbury forms a peninsula of reclaimed marsh on the northern side of the Blackwater Estuary, flanked by Pyefleet Channel and Geedon Creek (Figure 6). The reserve area encompasses the whole of the coastal grazing marsh peninsula, as well as a small portion of dry-land improved grassland and some intertidal salt-marsh. There are interdependencies with both the adjoining dryland and the estuary itself.

Institutional area: The survey area comprises the EWT holding of Tollesbury Wick Marsh, Maldon District, Essex.

Relevant benefits area: The area affected by the benefits and costs provided by the natural capital and ecosystem services for Tollesbury Wick Marshes includes the wider EWT estate, the RSPB and other Local Wildlife and SSSI sites that benefit from the increased populations of birds and other wildlife in the area. Maldon District benefits from increased tourism numbers relating to wildlife viewing and walking the coastal footpath along the sea-wall. There are benefits to local residents, in the Tollesbury area, in the form of reduction in flood risk through the sequestration of flood waters during weather events or particularly high-tides.

Figure 6 Tollesbury Wick Marsh, Tollesbury

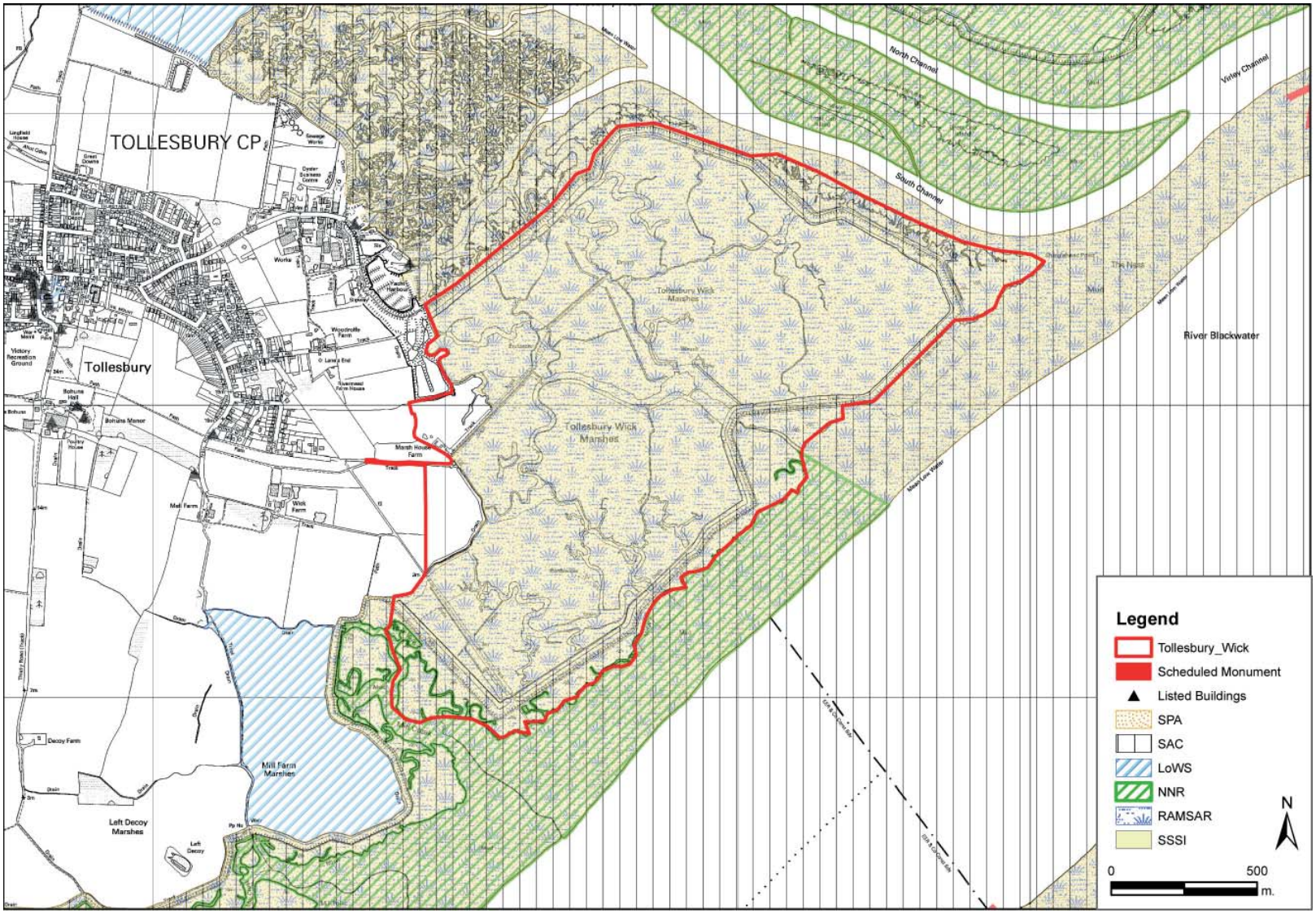

Figure 7 Location of Tollesbury Wick Marsh in relation to other significant associated ecological and heritage assets

6.3.2.2 The groups of people involved

The EWT are the land-owners and managers of Tollesbury Wick Marsh.
Other interested parties include the residents of Tollesbury who benefit from reduction of flood risk; residents and visitors to Maldon District and Essex who benefit from access to open spaces, wildlife and recreational opportunities; local nature and heritage organisations (including the RSPB and the National Trust who have neighbouring holdings); the Environment Agency; Maldon District Council; Essex County Council including its Flood Team and Place Services which provides archaeological advice both to the County Council and to Maldon District Council.

6.3.2.3 Existing work programmes and activities

Over the past three years there have been significant works at Tollesbury Wick to improve the site for ground nesting waders and other farmland birds with a focus on increasing populations of breeding Lapwing *Vanellus vanellus*, Redshank *Tringa totanus*, Skylark *Alauda arvensis* and Yellow Wagtail *Motacilla flava*. The hydrological management also benefits over-wintering and passage wildfowl and wader species such as *Tringa spp.*, Common Snipe *Gallinago gallinago*, Eurasian Curlew *Numenius arquata*, Golden Plover *Pluvialis apricaria*, Eurasian Wigeon *Mareca penelope*, Eurasian Teal *Anas crecca*, Northern Pintail *Anas acuta* and Dark-bellied Brent Goose *Branta bernicla*.

The recent groundworks have focused on the areas of the marsh that had little favorable topography with much of it flattened under the plough as the marsh was reverted to arable. The works have re-established a number of rill features; shallow, fresh-water filled channels, across the marsh. These features retain winter water through a series of bunds, with sluice structures installed for improved hydrological management. High water levels are retained across the marsh grassland throughout the winter for the grazing, diving and dabbling wildfowl and waders moving throughout the coastal landscape over the tidal cycle. During the spring and early summer, the water levels draw down exposing bare invertebrate rich soft mud which is used by breeding waders and chicks for foraging. These bare muddy edges can benefit a range of specialist plants including the nationally scarce saltmarsh goosefoot *Chenopodium chenopodioides*.

The current focus of practical management at Tollesbury Wick is reviewing the grazing regime and the livestock requirements for the site to improve the sward for the target species, this is been done alongside Essex County Council's Legacy Grazing team. The stocking densities and grazing timings are essential for the conservation success at the site. In addition to this, and due to the amount of disturbed ground on site there is a significant issue with weed burden. Over the past two years Creeping and Spear Thistle have colonised the disturbed ground. Under the current agri-environment scheme there is a need to control these invasive species. The means of control through timed cutting is being evaluated and has proved ineffective therefore the possibility of chemical treatment has not been ruled out.

Over the next year, Essex Wildlife Trust will write a new 5-year management plan which will further improve the site for both visitors and target species.

6.3.3 Evidence

6.3.3.1 An asset register of the natural capital assets and services of Old Hall Marsh

Tollesbury Wick Marsh comprises 242 ha. of historic coastal grazing-marsh, a BAP priority habitat. It is owned and managed by the EWT. The habitats represented include extensive grazing marshes with brackish water fleets, reed-beds, two small off-shore islands and saltmarsh. The asset is being managed for wildlife through extensive conservation grazing.

6.3.3.2 Natural environment

Wildlife is abundant in rough pasture, borrowdykes, seawalls, wet flushes, pools and saltmarsh. Large areas of rough pasture suit small mammals such as Field Voles and Pygmy Shrew. In addition, they in turn attract hunting Hen Harriers and Short-eared Owls.

Dry grassland on the slopes of the seawalls supports a wide variety of insects including butterflies, Bush Crickets and grasshoppers. In spring, Spiny Rest-harrow, Grass Vetchling, Slender Hare's Ear and many other wild flowers can be found in ungrazed areas. Golden plover, Lapwing, Brent Geese and Wigeon feed or roost on the winter wet grassland. Marsh harriers have been recorded on the reserve. A full list of protected and designated species recorded on the Reserve is presented in Appendix 1. **Character of vegetation**

Good quality grazing marsh dominated by grasses Creeping Bent *Agrostis stolonifera*, Perennial rye-grass *Lolium perenne*, Red fescue *Festuca rubra*, Meadow barley *Hordeum secalinum* and Meadow foxtail *Alopecurus pratensis*. Crested dog's-tail *Cynosurus cristatus*, Yellow oat-grass *Trisetum flavescens* and Marsh foxtail *A. geniculatus* abundant in wetter areas. Herbs Hairy buttercup *Ranunculus sardous*, Spiny restharrow *Ononis spinosa*, Narrow-leaved Bird's-foot-trefoil *Lotus tenuis*, and nationally rare Sea clover *Trifolium squamosum* and Slender hare's-ear *Bupleurum tenuissimum* frequent. Nationally rare Upright chickweed *Moenchia erecta* is present on ant hills.

Heritage asset	Survival	Significance	Rarity
Undesignated			
Grazing-marsh (incl. fleets, creeks, irregular field boundaries)	Good	High	Rare
Military (Allan-Williams turret, pillbox, WWII marine boom, minefield	Moderate/good	Moderate	Numerous
Saltern/Red Hill	Good/moderate	High	Numerous
Enclosure	Moderate	Moderate	Rare
Earthworks (medieval)	Poor	Moderate	Localised
Former sea-walls	Good	High	Numerous
Oyster pit	Moderate	Low	Numerous
Find-spot (human skeleton)	Poor	Moderate	Localised
Pier	Poor	Moderate	Localised
Railway	Moderate	Moderate	Localised

Table 19 Key heritage assets present and their survival, significance and rarity

Values	Description	Rank	Score
Archaeological Potential	Sea wall, borrow dyke, ditches, red hills, creeks, fleets, medieval salterns, WWII defences, post medieval railway, raised track-ways	High	3
Archaeological Association	Possible red hills, WWII pill box and mine field, post medieval railway	Medium	2
Group Value (Association)	Marsh House Farm and wider marshland landscape; oyster beds	Medium	1
Diversity	Sea walls, borrow dyke, drains, raised causeways, creeks, fleets, counter walls, earthwork mounds /medieval salterns, counter walls, livestock enclosure	Very High	6
Historical Association	None known	Low	0
Biodiversity	Internationally designated SPA & Ramsar	Very High	3
Amenity	Good public access around sea wall to EWT reserve	High	3
Overall significance			**18**

Table 20 Tollesbury Wick Marsh assessment of significance (for scoring methodology see Appendix 1)

6.3.3.3 Historic environment

There are numerous heritage assets on Tollesbury Wick Marsh, including the marsh itself. The marsh had been reclaimed by the time of the Chapman and Andre map of 1777. The marsh has large fleets, water filled creeks, extensive relict salt marsh surface and some raised causeways/trackways that cross it. There are also causeways from the sea wall across the borrow dyke. The majority of the boundaries are sinuous, but some have been straightened. A modern counter-wall has been constructed across this area. A sub-rectangular ditched enclosure, probably for livestock, survives as an earthwork. A concentration of mounds and ponds has the appearance of medieval salt manufacturing site. There are other individual mounds that may represent red hills. A railway embankment was built across the marsh leading to a pier in the 19th century. A WWII minefield was laid in the area and a pillbox is located on the sea wall.

6.3.4 Evidence - Developing a risk register of the natural capital assets and services for coastal grazing marshes

The risk register assesses the current and future risks to the natural capital. By risk, we mean in this context the probability of changes in the delivery of benefits. The risk register considers both the **likelihood** of such a change and the scale of its impact. This helps identify the priority to attach to managing or addressing particular risks. The risks for coastal grazing marshes were identified as part of the Essex Historic Grazing marsh Project (Gascoyne and Medlycott 2014). There are no current serious threats to the site, which is well managed with water levels maintained. There is the potential of unintentional impacts on the cultural environment, both to surviving landscape features and below-ground deposits through habitat creation/improvement schemes.

Potential risk	Likelihood	Scale of impact: Ecological	Scale of impact: Cultural	Comments
Urbanization	Low	High	High	Unlikely, EWT reserve and in rural area
Green infrastructure	Moderate/low	Moderate/low	Moderate/low	Impact dependent on nature of infrastructure. Car-parks will impact on below-ground deposits, increased visitors on sea-wall path could impact on wildlife populations and cause erosion
Natural Environment initiatives	High	Low	Moderate/low	Dependent on nature of work, digging of scrapes could impact on below-ground deposits, whilst increased water-levels are unlikely to have major negative effects
Climate change/sea level rise (incl. SMP)	High	High	High	Managed Realignment proposed 2055-2105.
Change to agricultural regime	Low	High	High	Unlikely, site is EWT reserve managed as historic grazing marsh. Ploughing or scrub encroachment would fundamentally change nature of site

Table 21 Potential risks for the study area

6.3.5 Evidence - Developing a set of natural capital accounts

An assessment was made of the expected ecosystem service and societal benefits provided by the Study Area. The Study Area is judged to be particularly important for nature conservation, recreation, volunteering opportunities, climate change mitigation and landscape/aesthetic reasons. Within these categories Cultural Heritage and the historic environment is best represented under the heading landscape/aesthetics, but is also a contributor, either directly or indirectly, to the other goods and services.

• *The private value to the EWT of Tollesbury Wick Marsh*: A rough estimation of land value has been estimated by as £3,885,310 (based on average price for pasture land, https://dairy.ahdb.org.uk/market-information/farm-expenses/land-prices/land-prices-rics/#.W87302hKjIU)

• *The cost to the EWT of maintaining those assets*: Approximately £100K per year but this may increase due to proposed visitor infrastructure improvements over the coming years.

• *Changes in their condition over time*: Habitat structure is improving which is leading to target species colonising areas of the reserve where they were previously absent. Unpredictability in the environmental conditions mean it's sometime difficult to manage water levels especially in the drought periods (especially dry winters). Longer growing seasons due to warmer autumns and winters mean that managing undesirable grassland species such as thistle is costly and time consuming as they now get a second opportunity to seed after an initial control management cut. This can have a detrimental impact on the structure of the grassland sward for ground nesting target avian species.

• *The risks (potential costs) and benefits to the organisation of either depleting or maintaining those assets*: These costs ensure that the Trust achieves its nature conservation objectives at Tollesbury and is a key site within the Blackwater Estuary. The key risk is that of the loss of agri-environment scheme grant funding and an uncertainty around Brexit, this could severely impact on the operational management and conservation delivery at the site and on wider EWT sites. This could possibly result in the degradation of threatened coastal grazing marsh habitats and landscapes.

Equable climate	Clean Air	Reliable flows of clean water	Flood risk, coastal erosion, other hazards	Biomass	Recreation	Food	Landscape, aesthetics, mental restoration	Nature Conservation	Volunteering	Education/ connection to nature
Some benefit		Some benefit	Significant benefit		Significant benefit	Some benefit	Significant benefit	Significant benefit	Significant benefit	Significant benefit
Scope of Natural Capital Account										
Declining	Stable	Declining	Declining	Improving	Improving	Improving	Improving	Improving	Improving	Improving

Key:

	Total benefits monetised
	Partial benefits monetised
	Not available

Table 22 Natural Capital goods and services provided by Old Hall Marsh (based on the methodology used in Bolt and Ausden 2017, Table 2)

6.3.6 Ecosystems Services assessment (based on the UK National Ecosystem Assessment methodology)

The ecological and heritage assets present at Tollesbury Wick Marsh have been considered against the Ecosystem Service groups of Provisioning, Regulating, Supporting and Cultural services (Table 23). As Tollesbury Wick Marsh is a historic man-made landscape it is unsurprising that many of these Services derive from a combination of ecological and cultural/heritage assets.

Provisioning services				Regulating services				Supporting services				Cultural services			
Food provision	Water availability	Genetic diversity	Biomass provision	Climate regulation	Water quality	Water flow	Soil quality	Soil erosion	Pollination	Pest regulation	Regulating coastal erosion	Cultural Heritage	Sense of Place	Tranquility	Recreation
☐	■			■	■	■	☐	☐			■	■	■	■	■

■ = significant benefits ☐ = some benefits

Table 23 Ecosystem benefits identified for Old Hall Marshes

For an area as distinctive as historic coastal grazing marshes the concepts of Cultural Heritage and Sense of Place are largely interchangeable, in that the Cultural Heritage, in the form of both physical heritage assets and intangible heritage assets, combined with the natural assets in the form of wildfowl and a distinctive vegetative pallet, all directly contribute to the Sense of Place. Under the heading of Cultural Heritage it is possible to examine the role of different heritage assets in contributing towards Ecosystem Services. Some assets, such as sea-walls and counter-dykes will fit into multiple categories, in that they regulate the presence of fresh water and dry land (and hence contribute to provisioning services), regulate flooding and provide a means of accessing the coast (via sea-wall paths) contributing to recreation and tourism. Other assets, such as the prehistoric and Roman salterns (Red Hills) are more a reflection of past use of the landscape and although they may serve as a refuge for invertebrates and rabbits that prefer slightly drier soils with a high salt content, they are largely of Cultural Heritage significance.

	Provisioning services				Regulating services				Supporting services				Cultural services			
Heritage Asset	**Food provision**	**Water availability**	**Genetic diversity**	**Biomass provision**	**Climate regulation**	**Water quality**	**Water flow**	**Soil quality**	**Soil erosion**	**Pollination**	**Pest regulation**	**Regulating coastal erosion**	**Cultural Heritage**	**Sense of Place**	**Tranquillity**	**Recreation**
Sea-walls	☐	■				■	■	☐	☐			■	■	■		■
Borrow dykes	☐	■				■	■	☐	☐			■	■	■		
Counter walls												☐	■	■		
Fields (wet meadow grassland)	■			■		☐	☐	■					■	■	■	■
Irregular field boundaries (former creeks)		■					■					☐	■	■		
Fleets/creeks		■				■	■					☐	■	■		■
Earthworks: saltern?, livestock refuge	☐												■	■		
Military remains													■	■		
Sluices	☐	■				■	■	■				■	■	■		
Salterns/Red Hills													■	■		
Oyster pit	■												■	■		
Railway													■	■		☐
Pier													☐	☐		

■ = directly contributes ☐ = indirectly contributes

Table 24 Tollesbury Wick Marsh heritage assets assessed against Natural Capital and Ecosystem Services functions

7. Analysis of the applicability of a Heritage Ecosystems Services Assessment approach to the inclusion of heritage assets in Natural Capital and Ecosystem Services approaches

It is possible to apply a Natural Capital and Ecosystem services approach to the heritage assets, as demonstrated through this project. However a number of key issues need to be considered before beginning an assessment:-.

1. The range of assets present and their significance, degree of survival and comparative rarity needs to be fully understood. The completion of a base-line survey is necessary in order to ensure that the full spectrum of heritage assets has been identified.

2. The role of the heritage assets need to be understood both individually and as groups. Thus the coastal grazing marshes contain a wide range of individual monument-types, but the sea-walls, sluices, borrow-dykes, counter-walls all form part of the means of draining and regulating water on the marshes and are the means by which this historic landscape is created, and their presence is integral to the physical survival of this historic landscape type. By comparison the salterns (Red Hills), which are characteristic of the Essex coastal landscape, actually pre-date the creation of the grazing marshes and have in effect become marooned within the grazing-marsh landscape when the salt-marshes which they were part of were enclosed. It is possible to have a coastal grazing marsh without the latter monument–type, but not the former.

3. In addition to physical heritage assets it is also possible to assess the role that intangible heritage assets play in contributing to the significance of the site. These can include being the site of a notable historic event, such as the Battle of Maldon, or as a source of inspiration to writers or painters, or in the survival of historic field-names or land-ownership patterns.

4. The majority of heritage assets identified will probably fall within the Cultural Heritage or Sense of Place categories. However, some of the assets will also fit within other categories. Thus sea-walls which may have their origin with the 17th reclamation of the marshes are integral to Water Availability and Regulating Coastal Erosion as well as being Cultural Heritage Assets and contributing to Sense of Place. In addition, as the location of the long-distance coastal foot-paths they are a means by which the coast is accessed for recreational purposes and their role in ensuring the separation of sea and land means that they contribute to food production on the marshes they protect.

5. Estimating the financial benefits of the heritage assets is more difficult. If the site being assessed is open to the paying-public it should be possible to establish how much income is generated through entry-tickets and other income streams, although separating out whether visitors are paying to see the heritage asset or the natural environment or the overall experience would need visitor surveys.

   However, if it is open access, as is the case with the two case-studies, it is harder to calculate how many visitors are accessing the heritage assets; here visitor surveys would be required to establish numbers, motivation for visit and average spend as a consequence of the visit.

   Estimating the value of the land and the profits from any agricultural produce can be relatively easily done, as can the costs of maintenance of the land. What is much harder to estimate is how much the heritage assets contribute to either the profits or the costs, and much of this is either unquantifiable or guess-work.

6. If a site is being assessed for Natural Capital or Ecosystem Services provided by the natural environment it is worthwhile undertaking an assessment for the historic environment at the same time and amalgamating the results. Not only would this give a more holistic overview of the Services provided by a site, but also it would ensure that the cultural heritage is not overlooked. This is of particular importance if the assessment of the Natural Capital and Ecosystem Services is being undertaken in advance of changes being made to the site, such as the removal of seawalls to create saltmarsh or the digging of scrapes to improve the habitats present for wildfowl. In such cases an assessment can be made as to how management for either natural or cultural heritage will impact on each other and on Ecosystem Services and establishing whether these are positive or negative impacts, e.g. will converting grazing marsh to salt-marsh benefit wading birds, but negatively impact on surviving archaeological features?.

7. If the site is largely a historic man-made landscape it is a means of establishing how much the historic environment contributes to the natural environment of that landscape. In the case of coastal grazing marshes they are entirely a man-made creation, and the present landscape would not exist without the past reclamation work. The same would apply to other landscape types, such as coppiced woodlands or the chalk downlands, where human intervention has created a specific habitat type .

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APPENDIX 1: Scoring of Significance of Historic Grazing Marshes methodology

'Significance' is the sum of the cultural and natural heritage values of a place (English Heritage 2008), and is a means by which the importance of a place and its component parts can be measured and compared. Understanding significance makes it possible to assess how the qualities that people value are vulnerable to harm or loss, and to develop proposals that will protect or enhance the cultural and natural values of a place.

In statutory terms, the significance of historic coastal grazing marshes in Essex has been primarily recognised through their nature conservation designations.
For the historic environment, statutory protection is much more limited. Individual heritage assets located on historic coastal grazing marshes have been designated as scheduled monuments, due to their national importance, and these can convey direct protection to an area of grazing marsh, such as the scheduled area of Coalhouse Fort (see East Tilbury Marsh in Section 3), or indirect protection through the contribution an historic coastal grazing marsh makes to the setting of a scheduled monument. The site of the Battle of Maldon is registered within the Register of Historic Battlefields due to its national importance, and also conveys protection to the grazing marsh that falls within its boundary. Otherwise, the only designation that relates to the historic environment of coastal grazing marsh in Essex is the Hadleigh Marshes Special Landscape, which is held as a development policy in Castle Point Borough Council's Adopted Local Plan (1998).

Whilst some historic grazing marshes and their associated heritage features have been assessed as special, or of national importance, this report demonstrates that historic character resides more widely in the typical and commonplace throughout the marshes. As an aid to logical decision-making, particularly in relation to future iterations of the Shoreline Management Plan, different stages of the planning process, and the prioritization of funding that may be available for positive conservation management e.g. via future agri-environment schemes, the current project has attempted to analyse the significance of each surviving historic coastal grazing marsh in more detail. This understanding of the significance of historic coastal grazing marshes can then inform and influence day to day management of the marshes and decisions about their future, taking account of the full range of heritage values that contribute to their significance.

A simple values-based methodology for assessing the Significance of surviving historic coastal grazing marshes in Essex was required to be developed and then applied to each of the surviving marshes in order to generate individual scores for Significance. The English Heritage Conservation Principles (2008) were chosen as the basis on which the scoring system would be developed, as a way of understanding the complexity of the historic environment through a logical consistent approach. The Conservation Principles define a family of values that in combination can be used to describe and understand the significance of a place at a range of scales. Four types of value were adopted by English Heritage under the following definitions:

Evidential Value, which derives from the potential of a place to yield evidence about past human activity.

Historical Value, which derives from the way in which past people, events and aspects of life can be connected through a place to the present.

Aesthetic Value, which derives from the way in which people draw sensory and intellectual stimulation from a place.

Communal Value, which derives from the meanings of a place for the people who relate to it or for whom it figures in their collective experience and memory.

Consideration of these high level values contained within Conservation Principles, and those inter-related heritage values that may be most appropriately attached to historic coastal grazing marshes and its characteristic features, led to the identification of a range of values by which the significance of the marshes would be assessed. Whilst the full range of heritage values that may be encompassed within an historic coastal grazing marsh have been considered, those values that contribute to the significance of the marshes as historic landscapes, are given particular weighting. This method of scoring is intended as a simple, but consistent, means of engaging with issues of value, importance and relative significance. It is not designed to be definitive and is likely to be subject to change as new information becomes available and understanding develops. The seven criteria that have been used and their associated high level values are shown in Table 25.

Criteria	High level heritage value(s)
Archaeological potential	Evidential Value
Archaeological association	Evidential Value
Group Value (association)	Evidential Value; Historical (illustrative) value
Diversity	Historical (illustrative) value; Aesthetic value
Amenity	Communal Value
Historical Association	Historical (associative) Value, Aesthetic value
Biodiversity	Evidential Value

Table 25 Significance criteria that have been used and their associated high level values

Each historic coastal grazing marsh has been scored on the full range of criteria for which separate scores are retained within the GIS metadata. Each criterion has been scored with a rating of 0, 1, 2, or 3, with the exception of diversity, which has been weighted by scoring using a rating of 0, 2, 4, 6, in recognition of the importance of characteristic historic landscape features to the historic environment significance of grazing marshes.

The criteria are discussed below with each of the individual criterion described along with the rationale behind them.

Archaeological Potential

Archaeological Potential is assessed with respect to the expected average circumstances within the area of marsh. The score considers the nature of the heritage assets based on current evidence, and indicates the likelihood of further assets being present given the chronology/time-depth of any given marsh and the levels of known disturbance that may have adversely affected them.

Description	Rank	Score
There is a general absence of known historic environment assets e.g. 19th century sea wall only; significant 'improvement' has taken place thus reducing the potential for surviving heritage assets within the marsh; potential for other surviving historic environment assets is limited e.g. potential for deeply buried deposits only due to 19th origin of the marsh.	Very Low	0
There are very few known historic environment assets and/or the assets have limited archaeological potential e.g. post medieval sea wall & borrow dyke, WWII anti-landing ditches and the marsh has been 'improved' e.g. through 19th/20th century drainage and cultivation reducing the potential for surviving heritage assets	Low	1
There is a moderate range of known heritage assets e.g. post medieval sea wall, borrow dyke, red hill, and raised causeway, but chronology/time depth of land claim and/or understanding of the features present, or of those in adjacent marshes/creeks, indicates a current lack of knowledge is probably the result of lack of investigation rather than absence of features. Disturbance to the marsh is very limited e.g. one or two 'straight' drainage ditches.	Medium	2
Current evidence indicates that a range of high quality assets survive, or are likely to survive, within the area of marsh e.g. buried prehistoric land surface, red hill, medieval counter walls, raised track-way, decoy pond, medieval sea wall, borrow dyke, post medieval farmstead, WWII anti-landing ditches	High	3

Archaeological (non-contemporary) Association

This criterion relates to whether the marsh has a non-contemporary spatial association with known archaeological sites. Non-contemporary is taken to mean prior to the medieval period or post 1880 after which new coastal grazing marshes were generally not created. Examples of strong associations with non-contemporary archaeological sites where a high score would be achieved include: a scheduled red hill or World War II defences (Fig. 18). A medium score might come from non-designated, plough flattened red hills, or where prehistoric or roman timber structures have been previously identified. A low score could equate to limited or poorly recorded finds of earlier archaeological material e.g. during ditch clearance work. Marshes with no recorded spatial association with non-contemporary archaeological features would score lowest.

Archaeological Association	Rank	Score
No known association with non-contemporary archaeological features	Negligible	0
The marsh has limited association with non-contemporary archaeological features	Low	1
The marsh has a strong association with one or more non-contemporary archaeological features	Medium	2
The marsh has a strong association with one or more designated or other nationally important, non-contemporary archaeological features	High	3

Group Value (contemporary association)

The value of a marsh may be enhanced by its spatial and/or functional association with other features of broadly the same date, e.g. other historic grazing marsh, listed agricultural buildings, and other sites on the HER such as timber jetties that are physically adjacent to the marsh, or where the marsh marks a significant historic boundary such as of an historic parish pre-dating 1850 (Fig. 19).

An historic grazing marsh which is still linked to another area(s) of historic grazing marsh, a medieval farmstead containing listed buildings on the edge of the marsh, or a scheduled red hill re-used during the medieval period, or a marsh that includes a parish boundary would score highly. A marsh with only limited links to contemporary features such as a surviving sea wall of an adjacent area of improved grazing marsh would score low.

Group Value (association)	Rank	Score
Limited associations between historic landscape features and other historic assets of broadly the same date	Low	0
Direct associations between more than one historic landscape feature or other significant historic asset of broadly the same date	Medium	1
The marsh has associations between a moderate range of contemporary historic landscape features and other historic assets of broadly the same date	High	2
The marsh has strong associations between a range of designated contemporary historic landscape features, and/or a wide range of non-designated contemporary historic landscape features/other historic assets of broadly the same date	Very high	3

Diversity (of characteristic features)
This criterion relates to the range of characteristic, component historic landscape features that an historic grazing marsh is made up of, not all of which will be demonstrated equally well at different marshes. A marsh which has a wide range of characteristic historic landscape features including sea walls, borrow dykes, counter walls, raised causeways, relict salt marsh, creeks etc will have high diversity. A marsh that just has a sea wall and borrow dyke will have low diversity.

Diversity	Rank	Score
Limited range of characteristic historic landscape features e.g. sea wall only	Low	0
Moderate range of characteristic historic landscape features	Medium	2
Good range of characteristic historic landscape features	High	4
Extensive range/concentration of characteristic historic landscape features	Very high	6

Amenity
This relates to the actual or potential amenity value of a marsh based on the level and ease of physical access to a marsh, and the size of the local population that may access it. In this instance, access is used as a proxy for measuring the communal values that are likely to be attached to a particular marsh, which would be beyond the scope of the present study i.e. the greater physical access there is to a marsh and the greater the number of people with access to it increases the likelihood of social values being attached to the it (Fig. 20).

Description	Rank	Score
No direct public access/use and away from population centre/visitor facilities	Negligible	0
Limited public access/use e.g. single footpath and/or away from population centre/visitor facilities	Low	1
Moderate public access/use e.g. small nature reserve and within walking distance (1km) of a village/visitor facilities	Medium	2
High level of public access/use e.g. well used nature reserve and within walking distance (1km) of a town/visitor facilities	High	3

Historical Association

The historical associative value of a marsh derives from its association with a notable family, person, event, or movement. Being at the place where something momentous happened e.g. the Battle of Maldon, can increase and intensify understanding through linking historical accounts of events with the place where they happened – provided, of course, that the place still retains some semblance of its appearance at the time. Marshes are also associated with the development of other aspects of cultural heritage, such as literature, art, music or film. Associative value also attaches to places closely connected with the work of people who have made important discoveries or advances in thought about the natural world.

Description	Rank	Score
No **direct** historical associations with a family, person, event or movement; no known literary, film, artistic or musical associations of local importance or; **Indirect** historical association with a family, person, event or movement and/or literary, film, artistic or musical associations of local importance	Low	0
Direct historical association with a family, person, event or movement and/or literary, film, artistic or musical associations of local importance; or **indirect** historical association with a family, person, event or movement, and/ or literary, film, artistic or musical associations of **regional** importance	Medium	1
Direct historical association with a family, person, event or movement, and/ or literary, film, artistic or musical associations of **regional** importance; or **indirect** historical association with a family, person, event or movement, and/or literary, film, artistic or musical associations of national or **international** importance	High	2
Direct historical association with a family, person, event or movement, and/or literary, film, artistic or musical associations of **national or international importance**	Very High	3

Biodiversity

The natural heritage values of a marsh can contribute to its illustrative value, for example through the survival of distinctive grazing marsh flora, and the interdependence of associated species.

Description	Designation	Rank	Score
Highly improved, low botanical diversity supporting a low diversity of other taxa. Very low structural diversity.	No site designation	Low	0
Slightly improved with low-medium biodiversity with some locally important species. Low structural diversity.	Locally designated (LoWS, LNR etc)	Medium	1
Unimproved, with a medium-highly diverse flora with locally and some nationally important species. Medium structural diversity. Supports some other important taxa.	Nationally designated (SSSI, etc)	High	2
Unimproved, with a highly diverse flora with nationally important species. High structural diversity. Supports other nationally important taxa.	Internationally designated (SAC, SPA, RAMSAR, etc)	Very High	3

APPENDIX 2: Tollesbury Wick - Protected and designated species records (source Essex Biological Records Centre)

SPECIES	LATIN NAME	COMMON NAME
amphibian	Rana temporaria	Common Frog
amphibian	Bufo bufo	Common Toad
bird	Sterna paradisaea	Arctic Tern
bird	Recurvirostra avosetta	Avocet
bird	Tyto alba	Barn Owl
bird	Branta leucopsis	Barnacle Goose
bird	Limosa lapponica	Bar-tailed Godwit
bird	Panurus biarmicus	Bearded Tit
bird	Cygnus columbianus	Bewick's Swan
bird	Turdus merula	Blackbird
bird	Chroicocephalus ridibundus	Black-headed Gull
bird	Podiceps nigricollis	Black-necked Grebe
bird	Limosa limosa	Black-tailed Godwit
bird	Gavia arctica	Black-throated Diver
bird	Cyanistes caeruleus	Blue Tit
bird	Branta bernicla	Brent Goose
bird	Buteo buteo	Buzzard
bird	Branta canadensis	Canada Goose
bird	Corvus corone subsp. corone	Carrion Crow
bird	Corvus corone	Carrion Crow
bird	Cettia cetti	Cetti's Warbler
bird	Streptopelia decaocto	Collared Dove
bird	Larus canus	Common Gull

bird	Actitis hypoleucos	Common Sandpiper
bird	Melanitta nigra	Common Scoter
bird	Sterna hirundo	Common Tern
bird	Fulica atra	Coot
bird	Phalacrocorax carbo	Cormorant
bird	Cuculus canorus	Cuckoo
bird	Numenius arquata	Curlew
bird	Calidris ferruginea	Curlew Sandpiper
bird	Branta bernicla subsp. bernicla	Dark-bellied Brent Goose
bird	Calidris alpina	Dunlin
bird	Prunella modularis	Dunnock
bird	Somateria mollissima	Eider
bird	Anser albifrons subsp. albifrons	European Greater White-fronted Goose
bird	Turdus pilaris	Fieldfare
bird	Regulus ignicapilla	Firecrest
bird	Anas strepera	Gadwall
bird	Morus bassanus	Gannet
bird	Anas querquedula	Garganey
bird	Plegadis falcinellus	Glossy Ibis
bird	Regulus regulus	Goldcrest
bird	Pluvialis apricaria	Golden Plover
bird	Bucephala clangula	Goldeneye
bird	Carduelis carduelis	Goldfinch
bird	Mergus merganser	Goosander

bird	Larus marinus	Great Black-backed Gull
bird	Podiceps cristatus	Great Crested Grebe
bird	Gavia immer	Great Northern Diver
bird	Dendrocopos major	Great Spotted Woodpecker
bird	Parus major	Great Tit
bird	Tringa ochropus	Green Sandpiper
bird	Picus viridis	Green Woodpecker
bird	Chloris chloris	Greenfinch
bird	Tringa nebularia	Greenshank
bird	Ardea cinerea	Grey Heron
bird	Perdix perdix	Grey Partridge
bird	Phalaropus fulicarius	Grey Phalarope
bird	Pluvialis squatarola	Grey Plover
bird	Motacilla cinerea	Grey Wagtail
bird	Motacilla cinerea	Grey Wagtail
bird	Motacilla cinerea	Grey Wagtail
bird	Motacilla cinerea	Grey Wagtail
bird	Anser anser	Greylag Goose
bird	Uria aalge	Guillemot
bird	Circus cyaneus	Hen Harrier
bird	Larus argentatus	Herring Gull
bird	Falco subbuteo	Hobby
bird	Delichon urbicum	House Martin
bird	Passer domesticus	House Sparrow

bird	Passer domesticus	House Sparrow
bird	Lymnocryptes minimus	Jack Snipe
bird	Corvus monedula	Jackdaw
bird	Garrulus glandarius	Jay
bird	Falco tinnunculus	Kestrel
bird	Falco tinnunculus	Kestrel
bird	Alcedo atthis	Kingfisher
bird	Rissa tridactyla	Kittiwake
bird	Calidris canutus	Knot
bird	Calcarius lapponicus	Lapland Bunting
bird	Vanellus vanellus	Lapwing
bird	Larus fuscus	Lesser Black-backed Gull
bird	Dendrocopos minor	Lesser Spotted Woodpecker
bird	Linaria cannabina	Linnet
bird	Alle alle	Little Auk
bird	Egretta garzetta	Little Egret
bird	Tachybaptus ruficollis	Little Grebe
bird	Athene noctua	Little Owl
bird	Charadrius dubius	Little Ringed Plover
bird	Calidris minuta	Little Stint
bird	Sternula albifrons	Little Tern
bird	Clangula hyemalis	Long-tailed Duck
bird	Pica pica	Magpie
bird	Anas platyrhynchos	Mallard

bird	Circus aeruginosus	Marsh Harrier
bird	Anthus pratensis	Meadow Pipit
bird	Anthus pratensis	Meadow Pipit
bird	Larus melanocephalus	Mediterranean Gull
bird	Falco columbarius	Merlin
bird	Turdus viscivorus	Mistle Thrush
bird	Gallinula chloropus	Moorhen
bird	Cygnus olor	Mute Swan
bird	Pandion haliaetus	Osprey
bird	Haematopus ostralegus	Oystercatcher
bird	Pluvialis fulva	Pacific Golden Plover
bird	Falco peregrinus	Peregrine
bird	Phasianus colchicus	Pheasant
bird	Motacilla alba	Pied Wagtail
bird	Anser brachyrhynchus	Pink-footed Goose
bird	Anas acuta	Pintail
bird	Aythya ferina	Pochard
bird	Alca torda	Razorbill
bird	Milvus milvus	Red Kite
bird	Branta ruficollis	Red-breasted Goose
bird	Mergus serrator	Red-breasted Merganser
bird	Netta rufina	Red-crested Pochard
bird	Alectoris rufa	Red-legged Partridge
bird	Podiceps grisegena	Red-necked Grebe

bird	Tringa totanus	Redshank
bird	Phoenicurus phoenicurus	Redstart
bird	Gavia stellata	Red-throated Diver
bird	Turdus iliacus	Redwing
bird	Emberiza schoeniclus	Reed Bunting
bird	Charadrius hiaticula	Ringed Plover
bird	Erithacus rubecula	Robin
bird	Anthus petrosus	Rock Pipit
bird	Corvus frugilegus	Rook
bird	Oxyura jamaicensis	Ruddy Duck
bird	Calidris pugnax	Ruff
bird	Riparia riparia	Sand Martin
bird	Calidris alba	Sanderling
bird	Sterna sandvicensis	Sandwich Tern
bird	Aythya marila	Scaup
bird	Phalacrocorax aristotelis	Shag
bird	Tadorna tadorna	Shelduck
bird	Asio flammeus	Short-eared Owl
bird	Anas clypeata	Shoveler
bird	Alauda arvensis	Skylark
bird	Podiceps auritus	Slavonian Grebe
bird	Mergellus albellus	Smew
bird	Gallinago gallinago	Snipe
bird	Plectrophenax nivalis	Snow Bunting

bird	Turdus philomelos	Song Thrush
bird	Accipiter nisus	Sparrowhawk
bird	Platalea leucorodia	Spoonbill
bird	Muscicapa striata	Spotted Flycatcher
bird	Tringa erythropus	Spotted Redshank
bird	Sturnus vulgaris	Starling
bird	Columba oenas	Stock Dove
bird	Saxicola rubicola	Stonechat
bird	Hirundo rustica	Swallow
bird	Apus apus	Swift
bird	Strix aluco	Tawny Owl
bird	Anas crecca	Teal
bird	Aythya fuligula	Tufted Duck
bird	Arenaria interpres	Turnstone
bird	Streptopelia turtur	Turtle Dove
bird	Linaria flavirostris	Twite
bird	Melanitta fusca	Velvet Scoter
bird	Rallus aquaticus	Water Rail
bird	Bombycilla garrulus	Waxwing
bird	Oenanthe oenanthe	Wheatear
bird	Numenius phaeopus	Whimbrel
bird	Saxicola rubetra	Whinchat
bird	Anser albifrons	White-fronted Goose
bird	Cygnus cygnus	Whooper Swan

bird	Anas penelope	Wigeon
bird	Phylloscopus trochilus	Willow Warbler
bird	Tringa glareola	Wood Sandpiper
bird	Scolopax rusticola	Woodcock
bird	Columba palumbus	Woodpigeon
bird	Troglodytes troglodytes	Wren
bird	Motacilla flava	Yellow Wagtail
bird	Emberiza citrinella	Yellowhammer
flowering plant	Puccinellia fasciculata	Borrer's Saltmarsh-grass
flowering plant	Inula crithmoides	Golden-samphire
flowering plant	Limonium humile	Lax-flowered Sea-lavender
flowering plant	Salicornia pusilla	One-flowered Glasswort
flowering plant	Sarcocornia perennis	Perennial Glasswort
flowering plant	Anacamptis pyramidalis	Pyramidal Orchid
flowering plant	Chenopodium chenopodioides	Saltmarsh Goosefoot
flowering plant	Hordeum marinum	Sea Barley
flowering plant	Suaeda vera	Shrubby Sea-blite
flowering plant	Bupleurum tenuissimum	Slender Hare's-ear
flowering plant	Vicia parviflora	Slender Tare
flowering plant	Spartina maritima	Small Cord-grass
flowering plant	Ruppia cirrhosa	Spiral Tasselweed
flowering plant	Puccinellia rupestris	Stiff Saltmarsh-grass
flowering plant	Salicornia fragilis	Yellow Glasswort

insect - beetle (Coleoptera)	Enochrus halophilus	Enochrus halophilus
insect - butterfly	Nymphalis polychloros	Large Tortoiseshell
insect - butterfly	Coenonympha pamphilus	Small Heath
insect - butterfly	Lasiommata megera	Wall
insect - dragonfly (Odonata)	Lestes dryas	Scarce Emerald Damselfly
insect - moth	Tyria jacobaeae	Cinnabar
insect - moth	Arctia caja	Garden Tiger
marine mammal	Phocoena phocoena	Common Porpoise
marine mammal	Phoca vitulina	Common Seal
marine mammal	Halichoerus grypus	Grey Seal
reptile	Zootoca vivipara	Common Lizard
reptile	Natrix natrix	Grass Snake
reptile	Anguis fragilis	Slow-worm
terrestrial mammal	Lepus europaeus	Brown Hare
terrestrial mammal	Muntiacus reevesi	Chinese Muntjac
terrestrial mammal	Pipistrellus pipistrellus	Common Pipistrelle
terrestrial mammal	Meles meles	Eurasian Badger
terrestrial mammal	Sorex araneus	Eurasian Common Shrew
terrestrial mammal	Neomys fodiens	Eurasian Water Shrew
terrestrial mammal	Arvicola amphibius	European Water Vole
terrestrial mammal	Micromys minutus	Harvest Mouse
terrestrial mammal	Pipistrellus	Pipistrelle Bat species

terrestrial mammal	Mustela erminea	Stoat
terrestrial mammal	Mustela nivalis	Weasel
terrestrial mammal	Erinaceus europaeus	West European Hedgehog

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