Somerset Coast, Levels & Moors Economic Assessment

Final Report

Somerset Coast, Levels and Moors Nature Recovery Project

April 2023

This document has been prepared for the Somerset Coast, Levels and Moors Nature Recovery Project by:

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Disclaimer

Document evolution

Interim Report	31/10/2022	Reviewed by Ian Dickie
Final Report	16/02/2023	Reviewed by Rob Tinch

This report is based on eftec's Version 3 – November 2021 report template.

Foreword

The Somerset Levels and Moors is a special area. The landscape is however seeing changes that must be managed. Due to climate change causing less predictable weather patterns and more extreme rainfall events we are seeing increased flooding, more periods of drought and detrimental impacts on the environmental landscape. This change is real and is happening, so decisions will need to be made about how this landscape is managed in the future.

I am delighted to have worked with eftec on publishing this valuable report. The report has been in development for some time and can offer meaningful contributions to influence and facilitate change on the Somerset Levels and Moors to achieve positive outcomes for nature and the climate but importantly also for communities, businesses and agriculture. Too often we are presented with false binary choices about farming, nature and the economy, particularly on the Somerset Levels and Moors. I frequently hear people say that we (collectively, the communities of the Levels and Moors) have to choose what we want from this landscape; do we want nature or do we want food? However, to ensure a sustainable future, the two should not be considered separately.

Somerset Local Nature Partnership sought to better understand how the current management of this special landscape is contributing to a range of outputs from economic value to job creation to health and wellbeing to environmental impact. We wanted to assess some of the common assumptions about the landscape and discover the true benefits and costs of the key local economic drivers. We started out collecting some data ourselves and working with academics to analyse it but quickly realised we needed to bring in some independent experts to understand this complex landscape.

eftec's approach to identify comparable data sets helped us understand our current situation. It is probably not a surprise to most people to learn that the carbon emissions coming from current management of peat soils is very high. eftec were able to assess the cost of these emissions to us all, which far outweigh any economic benefit from any industry. The timing of this report from eftec is important as it coincides with the release of the Lowland Agriculture Peatland Task Force Chair's Report setting out how we all must take action to protect and restore our peat soils because 'arguably the greatest threat to food security is climate change'. Not a binary choice but interlinked approaches.

The Scenarios are important tools to help us with decisions today which could affect future outcomes. Scenario 2 appears to show that deciding to restore our deep peat soils and nature on the Levels can bring economic benefits as well, if we all work together and there is support for the businesses and communities of the Levels and Moors.

This eftec report shows, what I think many living and working on the Levels and Moors already know, that there are positive choices we can make that will improve the environment and reduce carbon emissions while supporting farmers, businesses and communities. Scenario 2 shows us that farming is hugely important to the Levels and Moors for many reasons and can, and is already in many places, play a positive role in restoring nature and reducing carbon emissions.

Many individuals and organisations have been involved in discussions with eftec about this report, contributing data, considering the results and how we might use the report in the future. Thank you to everyone who has given their time and contributed so much and to Natural England for funding the report through the Somerset Coast, Levels and Moors Nature Recovery Project. Particular thanks to those organisations that have worked closely with eftec in workshops and discussion sessions to ensure the report represents accurately the issues, challenges and opportunities of the Somerset Levels and Moors: Environment Agency, Natural England, National Farmers Union, National Trust, Somerset Wildlife Trust.

This report isn't the beginning, lots of work has and continues to happen across the Levels and Moors to protect this landscape for future generations. It isn't a roadmap or a plan, the scenarios are there to highlight where there could be opportunities and benefits that can help inform the decisions that will inevitably need to be made about the landscape, and in fact are already being made today. The future isn't binary, by working together we can create a positive future for wildlife, for the climate, for our food security and the wonderful communities of the Somerset Levels and Moors.

Georgia Stokes

CEO, Somerset Wildlife Trust

Executive summary

This project has modelled the socio-economic and environmental impacts of existing land use (baseline) and the implications of future land use scenarios in the Somerset Coast, Levels and Moors (SCLM) Nature Recovery project area. It assesses the costs to the public purse, return on investment, and the economic and environmental and social benefits and costs (including carbon emissions, water quality and biodiversity) of ***in-scope economic sectors that utilise, and impact upon, natural assets in the study area***, namely: ***farming, peat extraction, tourism, and nature conservation/restoration plus the supporting activity of water level management which is crucial in enabling these sectors***. The assessment looks at a 60 year period, to 2082, and results are in 2022 prices.

The SCLM nature recovery area (40,700 ha) is a flat landscape which is chiefly influenced by water, being wet for much of the year. As a result of plentiful water, the area produces lush grasslands for grazing livestock (70% of area). Most agricultural activity is seasonal (as it is largely too wet in the winter months) and is highly dependent on the management of water levels and flooding. The biodiversity of the area is of national and international importance, reflected in the designation of a third of this area, and is noted for its wetland and wading birds.

Baseline Findings

Key findings from the baseline assessment of existing land use are:

- The natural assets of the study area support 2,000 jobs and contribute £30 million[1] of Gross Value Added (GVA) to the local economy from the five sectors assessed. For context this is around 0.2% of the GVA of Somerset and 0.8% of total employment (237,700) in Somerset. Farming is the main employer (1,400 jobs or 70% of total), income from farming is low and faces major uncertainties in the future (e.g., reform to agri-environment schemes, disruption and volatility of global food markets/supply chains and impacts of climate change). Whilst farming provides the lion share of employment (70%) it contributes 30% of the GVA (£9 million).
- The farmland area of SCLM represents 12% of the agricultural area of Somerset but produces 5% of the county's agricultural GVA. This is largely because the area has limited grazing during the winter months, and hence only fully productive for 6 months of the year. The water level management activity contributes most to local GVA (40% or £12 million), with tourism the next biggest (£5 million). Peat extraction turnover is not publicly reported, but estimates suggest that this contributes up to 6% of SCLM GVA (£1.9 million), and employs around 50 people, but the use of peat is steadily declining as the industry looks to alternative materials to reduce carbon footprint.
- SCLM is the second largest area of lowland deep peat in England (14,500 ha of deep peat, or 35% of the study area) and stores substantial quantities of carbon. However, drained deep peat is a major source of Greenhouse Gas (GHG) emissions (along with on-going peat extraction). Research suggests that there is a linear relationship between carbon emissions from deep peat soils and the level of water below field surface. Water levels in the SCLM are typically managed to 30-45 cm or more below field surface which leads to substantial carbon losses. This suggests that carbon emissions from deep peat can be in the region of 240,000 tCO_2e/year and adding in estimates of losses from peat

[1] All monetary figures are presented in 2022 prices unless otherwise stated.

extraction could put annual carbon loss as high as 255,000 tCO_2e per year. At the current non-traded cost of carbon (£255/ tCO_2e), these emissions have a cost of £65 million per year. This social cost value is greater than the market value of all output from the study area.

- Habitat fragmentation and poor water quality is a major pressure on biodiversity. The status of almost all designated sites in the Levels and Moors is unfavourable declining, mostly due to excessive nutrient leading to poor water quality, and overgrowth of duckweed and algae on the water's surface. This in turn leads to a loss of dissolved oxygen and intense shading of the water column, which reduces plant diversity and reduces the quality of habitat for invertebrates and other aquatic animals. Dissolved oxygen can fall to levels that can kill many fish species.

Key Messages from Scenario Assessments

Scenario 1 (Business as Usual with Future Trends) modelled the impacts of expected future climate change and population growth, assuming a business as usual approach to land use. ***Scenario 2 (Nature Recovery with Sustainable Farming)*** modelled the same future trends, but assumed major land use change, including the re-wetting of deep peat and moving to 50% of land cover being managed primarily for nature recovery by 2050. The remaining farmland was assumed to adopt catchment and nature sensitive farming practices by 2050. These scenarios provide modelled results and do not predict or prescribe a set pattern of land use in the SCLM area. Some results are subject to moderate or high a degree of uncertainty, but are still useful to indicate the degree of change possible from different management approaches.

Results for key indicators by scenario are:

	Employment (FTE)	GVA £'m (2022 prices)	GHG Flow tCO_2e[1]	Nature Recovery Area (ha)
Baseline (in 2022)	2,004	30.0	-328,089	6,507
Scenario 1 in 2050	2,038	34.1	-310,856	6,507
Scenario 2 in 2050	2,008	38.4	-22,975	20,000

Table note 1: Negative rates denote that the habitat/activity emits CO2e, positive rates denote sequestration.

Key implications from the scenarios results are:

- ***Climate change is predicted to have negative impacts*** through more floods, droughts and extreme weather patterns that reduce agricultural-productivity and increase pressure on wildlife. It will also drive increased reliance on public expenditure to manage water levels and flood risk.
- ***Eliminating (or at least reducing) carbon emissions from deep peat should be a top priority***. In economic terms, the benefits in abating carbon emissions from peat soils can justify significant land use change. The economic value of GHG savings from eliminating deep peat emissions are subject to some uncertainty but are very large and estimated at £39 -116 million per year, (reflecting the broad range of government non-traded carbon forecasts). As the challenge of meeting net zero becomes progressively harder, the value of carbon saving is expected to rise steadily, by a further 50% in real terms, towards mid-century. Even at the current lower level of estimated value, the magnitude of these emissions is greater than the local GVA of economic activity of current land use (£30 million in 2022). Scenario 2 illustrates that steadily abating these emissions by 2050 has a present value of £1,500 million over 60 years (+/- 50% confidence level).
- ***Rewetting the deep peat areas of the SCLM (14,700 ha) is necessary to abate these emissions.***

Research suggests that the optimum water level to abate GHG emissions (achieving net zero flow) from lowland deep peat is 10 cm below field surface. This is significantly higher than existing water level management targets and would require collective negotiation of revised target water levels with local landowners and stakeholders. It is important to note that this level should be maintained throughout the year (i.e., throughout the summer and not just in the winter months). However, even if the optimum water level cannot be achieved, any sustained increase in water levels would avoid some carbon emissions. Restoring and rewetting deep peat would require cessation of arable cultivation and peat extraction, and transition to alternative land uses, including conservation grazing, creation of fen and wetland habitat, and possibly the adoption of paludiculture.

- ***The SCLM area produces less food per hectare than average for Somerset or England***: it contains 12% of the farmland in Somerset but produces 5% of its agricultural GVA. There is 9,700 ha of the most productive agricultural land (Grade 1&2) in SCLM, or 0.44% of England's total Grade 1&2 land. Hence any reduction in land available for food production and/or farming intensity will have a low impact on UK food security.
- ***Diversification can help maintain the level of employment***. The modelled results for wildlife, carbon emissions and agriculture help understand the local economy impacts of pursuing nature restoration and rewetting deep peat. There will be negative impacts on local employment and GVA from existing land uses. These can be largely offset through new opportunities in tourism and conservation jobs, and further reduced through potential new opportunities (e.g., paludiculture).
- ***Re-wetting deep peat areas would overlap substantially with the core designated sites of the Levels and Moors and hence presents an opportunity for habitat restoration in the flood plain.*** Excluding the large coastal designated site of Bridgwater Bay (3,600 ha), 63% of the remaining designated sites overlap with deep peat soils and hence rewetting deep peat presents an opportunity to both improve habitat as well as abate carbon losses. Suitable habitat restoration and creation would mitigate climate change pressures on wildlife and create the potential for reversing population declines for key species (in particular, waders and breeding bird assemblages) in the SCLM. Consequently, the central deep peat zones should be prioritised for habitat conservation and provide a conservation core.
- Whilst, these land use changes would be beneficial for biodiversity, it is important to note that ***wildlife recovery is also crucially dependent on improving water quality***, in particular the reduction of phosphate concentrations that lead to hyper-eutrophication across the 'Levels'. This will require coordinated effort across the catchments (particularly with farmers) to reduce diffuse pollution.
- ***Nature recovery investment could support a substantial increase in tourism, providing significant income opportunities for local people and businesses***. Scenario 2 suggests that economic turnover in the area could be increased by £5 million GVA per year by doubling income from tourism and conservation. Doubling nature based visits to 750,000 per year is not large relative to the numbers attracted to areas of high-quality habitat in other parts of the UK, (e.g., Broads National Park). This would require some investment, for example in access, catering and accommodation tailored for wildlife visitor's needs. In addition, investment to facilitate recreation could double its benefits to visitors and the local population, providing £23 million per year in welfare value and avoided health costs. Finally, improvement of the natural environment can also contribute to attracting and retaining other businesses to the area, (e.g., the Gravity campus seeking to generate 7,500 jobs). Hence, whilst many sectors will still rely on public funding (e.g., water level management and conservation), ***nature recovery can play a major role in the diversification of this rural economy.***

Abbreviations

AES	Agri-environment schemes
BAU	Business as Usual
BD	Business development
BEIS	Department for Business, Energy and Industrial Strategy
BPS	Basic Payment Scheme
CC	Climate change
CLAD	Customer and Land Database
CO_2	Carbon dioxide
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
ELMS	Environment Land Management scheme
ENCA	Enabling a Natural Capital Approach
FCRM	Flood and Coastal Erosion Risk Management
FT	Full-time
FTE	Full-time equivalent
GHG	Greenhouse gas
GVA	Gross value added
ha	Hectare
IDB	Internal Drainage Board
NE	Natural England
NFU	National Farmers' Union
NNR	National Nature Reserve
NT	National Trust
ONS	Office for National Statistics
PT	Part-time
RPA	Rural Payments Agency
SCLM	Somerset Coast, Levels and Moors Nature Recovery project area
SRA	Somerset Rivers Authority
SSSI	Site of Special Scientific Interest
UK	United Kingdom
UKCP18	UK Climate Projections 2018
WFD	Water Framework Directive
WL	Water levels
WLM	Water Level Management
WRT	Westcountry Rivers Trust

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1. Introduction

The Somerset Coast, Levels and Moors (SCLM) nature recovery area (40,700 ha) is a flat landscape which is chiefly influenced by water, being wet for much of the year. As a result of plentiful water, the area produces lush grasslands for grazing livestock (70% of area). Most agricultural activity is seasonal (as it is largely too wet in the winter months) and is highly dependent on the management of water levels and flooding. The biodiversity of the area is of national and international importance, reflected in the designation of a third of the area for nature conservation, and is noted for its wetland and wading birds.

1.1 Aims

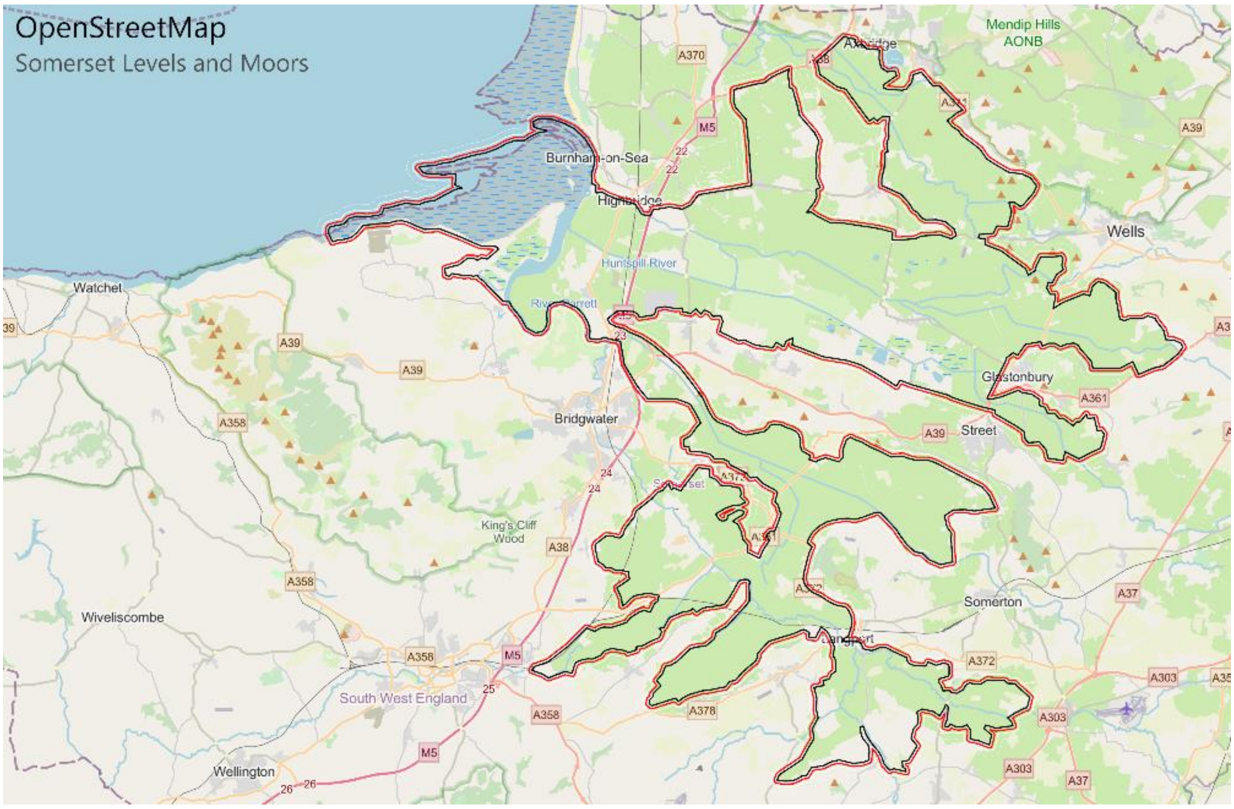
The aim of this study is to analyse the socio-economic and environmental implications of future land use scenarios in the SCLM Nature Recovery project area. It assesses the costs to the public purse, return on investment, and the environmental and social benefits and costs (including carbon emissions, water quality and biodiversity) of five sectors. These cover the four main industries that utilise, and impact upon, natural assets, namely: farming, peat extraction, tourism, and nature conservation/restoration, plus the supporting activity of water level management which is crucial in enabling these sectors. The analysis in this study includes the public spend, employment and economic turnover of these sectors, as well as their environmental impacts.

A baseline economic assessment provides a snapshot of existing land use (in 2022), and evaluates current economic and environmental benefits and costs. This serves to provide an understanding of current issues of land use within the study area. Two future scenarios are then projected to account for future trajectories of change (in particular, climate change) over the 60 year time frame to 2082. The first scenario is business as usual with forecast trends, highlighting the future implications of maintaining existing patterns of land use. The second is a nature recovery scenario, developed in discussion with the project steering board.

1.2 Scope of Study

The study area was defined by the SCLM Nature Recovery Project and is generally defined by the 10-metre contour line (see Figure 1.1).

The study has been conducted in two phases. Firstly, to establish the baseline economic and environmental impacts of land use in the SCLM. Secondly, to analyse the economic and environmental impacts of 2 scenarios for future land use change that have been developed in conjunction with the project steering board.



Source: Contains OS data © Crown copyright and database right 2023.

Figure 1.1: Map of study area boundary

Baseline

The baseline assessment measures the current key economic and environmental impacts of interest to this study, based on existing land use and patterns of land management practice (in 2022, which was taken as the baseline year). The following key economic and environmental impacts are measured and described for the baseline and the modelled scenarios:

- Land Use & Condition
- Level of Public Spend
- Economic Activity by sector
- Employment levels
- Greenhouse gas (GHG) flows
- Non-market ecosystem services
- Biodiversity status

1.3 Approach

The development of land use scenarios within the study area boundary has been informed by existing evidence and discussions with local stakeholders. Discussions with stakeholders involved those with knowledge of key land uses (e.g., farming and nature restoration). Two discussion workshops were held, first exploring the key themes for the scenarios, and second to specify the different scenarios.

The baseline economic figures and environmental measures assessed in this report have been developed using various data sources and assumptions. In general:

- Publicly available data sets have been used wherever possible to assess local economic data, for example the Department for Environment, Food and Rural Affairs (Defra) produces agricultural statistics for the Somerset Levels and Moor National Character area, and this data set has been used, in combination with local Rural Payments Agency (RPA) claims data, to assess farming type by area, output and employment levels. Similarly, local tourism statistics for Somerset were used to estimate the share that is attributable to the natural assets of the study area.
- Some local data has been provided directly by project partners (e.g., spend on flood risk and water level management, level of agri-environment spend in the study area).
- National data sets have also been used to assess environmental condition, such as Water Framework Directive (WFD) status and designated site status.
- Methods for calculating monetary values for environmental outcomes have generally followed well-established methods and guidance as listed in Defra's Enabling a Natural Capital Approach (ENCA) (e.g., valuation of GHG flows, recreation, air quality benefits, etc.)

The detailed methods are described in Appendix 1.

2. Scenario Definition

2.1 Baseline and Approach to Scenarios

The baseline analysis (see results in section 3) assesses the current economic and environment impacts of existing land use within the study area (as at 2022). The key economic/environmental aspects measured are listed in Section 1.2. The baseline is a snapshot of existing land use and makes no assumptions about the future viability of, or potential for change to, existing economic outputs or environmental outcomes. The aspects of future changes are assessed in the following scenarios for land use change.

Scenarios

In addition to the baseline economic assessment, two scenarios are modelled over the 60-year time frame to 2082. These are used to enable the analysis, informed by expert advice. They do not necessarily reflect what will happen. The two scenarios are:

1. **Business as Usual (BAU) + Expected Future Trends**: Business as Usual with Foreseeable Future Trends (e.g., climate change, population growth and phasing out of the Basic Payment Scheme (BPS))
2. **Nature Recovery with Sustainable Farming**: This scenario includes landscape Scale Nature Restoration, with the adoption of sustainable farming practices and nature based diversification of the local economy.

The modelling of each scenario entails future projections of key variables over this 60-year time frame, though the timing and significance of when these variables will materially impact on outcomes will vary. For example:

Near term impacts (2022-30s)	Medium term impacts (2040-50s)	Longer term impacts (2060-70s)
• Phasing out of BPS by 2028 and consequent impacts on farm incomes. • Climate change causes some impacts on crop production and livestock grazing from erratic weather patterns due to	• Major impacts on crop production and livestock grazing from more erratic precipitation/ weather patterns due to climate change (become more prominent).	• Impacts of sea level rise become more significant over this timeframe (up to 1 metre by 2100), leading to higher coastal flood protection expenditure, some costal land changes due to saline intrusion and increased flood risk in the SCLM from prolonged tide locked rivers

The two scenarios are described in more detail in this section. For each scenario, the assumed changes in the in-scope economic sectors are described, namely:

- Farming
- Peat extraction
- Nature restoration

- Tourism and recreation[2], and
- Water level management, as a supporting activity for the above.

The main assumptions and impacts on these in-scope sectors are shown in the columns of the tables that follow. The rows provide detail on the main assumed items of change, to enable an understanding of the specific assumptions made in modelling the scenarios. The scenario results will be presented at total scenario level only (see section 4) and not presented at this lower level of detail as many of the detail items interact to produce an overall modelled outcome for the scenario.

The aim of the scenarios is to make the economic and environmental consequences for each scenario clear. It is not the aim of these scenarios to forecast the level of public spending, but rather to highlight the benefits and dis-benefits of each scenario as evidence for informing decisions around the case for public funding.

2.2 Scenario 1: Business as Usual with Foreseeable Future Trends

In consultation with the project board, the following key trends were considered the most material changes to assess and model:

- **Climate change** – UKCP18 projections show greater chance of hotter, drier summers and warmer, wetter winters. However, there is also likely to be a higher frequency of extreme events (e.g., very cold winter events or hot summers followed by very high precipitation events). The study area has a long coast and large areas of low-lying land making it one of the UK's most climate-vulnerable areas, facing increased risks from sea level rise, river flooding and drought. Specifically:
  - Somerset's peak river flows increasing, "The Environment Agency, as part of the 'Climate Change Allowances' have developed projections which show ***peak river flows are expected to increase by around 40%***" (Climate Resilient Somerset, 2020). Upper case may be up to 85% by 2080 - 2100.
  - Sea levels – The UK Climate Projections 2018 (UKCP18) show Somerset is facing a probable sea level rise of between 0.27 and 1.11m by 2100[3]. This will impact the capacity for drainage of the 'Levels' and increase the periods of "tide lock".
  - Total water supply is forecast to decrease by 7% by 2045 in the UK as a result of climate change and the need to reduce abstraction to restore sustainability (Climate Resilient Somerset, 2020).
  - Summer droughts are likely to become more common and intense, low rainfall combined with higher temperatures. Towards the end of the century, heat stress events will become

[2] Tourism and recreation are distinguishable by the length of visits to natural areas, visitor type, and their value. Tourism is defined as visits that are more than 3 hours (as published by Kantar (2019a, 2019b)), are either local to the region or from outside the region (i.e., overnight stays), and their value to the levels is through spend. Recreation is visits up to 3 hours, limited to locals, and the value is non-market benefits to the visitor as published by Orval (2018).

[3] https://www.gov.uk/guidance/flood-and-coastal-risk-projects-schemes-and-strategies-climate-change-allowances

a new feature for the UK climate.

- Population growth (10% in Somerset by 2043 (Office for National Statistics, 2019), plus an ageing population (25% over 64 years of age in 2022 to 33% by 2043) will influence many aspects such as recreation.
- Reform to farming subsidies, in particular the run-down of BPS by 2028, and the introduction of the Environmental Land Management Schemes (ELMS) will have implications for farm incomes.

The assumed trends and their anticipated impacts are listed below; impacts on major land use and activity are described in Table 2.1. Trends:

- Sea level in Bridgwater Bay could rise by 1.11m to 2100 (Met Office, 2018). Over £100 million is being invested in the tidal barrier for Bridgwater, but additional defences and higher costs of maintaining and managing water level management infrastructure will be required within the 'Levels'.
- More droughts, floods and extreme weather events per decade (2 in 2030s to 4 in 2050s) and in combination these major impacts are modelled as follows:
  - Arable crops – water stress and flooding leading to decreased yields (by 20% in a 'bad' year).
  - Heat stress for cattle leads to reduced milk yield, and adverse climate impacts reducing grazing on the 'Levels' and increase costs (up to 20% more bought in feed in an adverse year).
- Phase out of BPS by 2028, combined with ELMS reform, mean farmers will increasingly look to new sources of income to sustain livelihoods.

Table 2.1: Scenario 1 description, Business As Usual with Foreseeable Future Trends

Land Use/Activity Assumptions	Impacts		
	Near Term (2022-30s)	**Medium Term (2040-50s)**	**Long Term (2060 and beyond)**
Farming No change in practice. Productivity reduced due to Climate Change (CC) floods making land inaccessible for grazing, but some drought impacts too.	Reduced agri- productivity. 10-20% reduction per adverse year of weather. Loss of BPS drives down farm incomes by 2028. Some restructuring and consolidation of holdings likely.	Reduction in agri-productivity increases with frequency of more adverse years of precipitation.	Reduction in agri-productivity increases with frequency of more adverse years of precipitation, causing the land to remain wetter for more months or to flood more often
Deep Peat Areas and Peat Extraction Existing water levels maintained leading to ongoing carbon losses from deep peat. Retail sale of peat ends 2024, but extraction persists for horticulture and agriculture to 2042 when licenses expire.	Carbon losses from deep peat continue at current rate.	Carbon losses from deep peat continue at current rate. Peat extraction ends 2042.	Carbon losses from deep peat continue at current rate.
Nature Conservation Reserves have same level of funding but struggle to adapt to CC. Pressure on nature reserves increases as wider landscape declines. Increased risk of invasive species & diseases	Risks from pests, disease and colonisation of invasive/ non-native species Drought impacts on water quality and wildlife. Spring flooding – loss of nesting habitats.	Climate impacts increase. There will be more losses than gains in species abundance and habitats. Risks from pests, disease and colonisation of invasive/ non-native species increase.	Greater risk of saline intrusion with consequent reduction of freshwater wetland and grassland habitats.
Water Level Management (WLM) Existing water levels maintained.	WLM costs increase with precipitation (more pumping). Continued tension over water levels including calls to hold water for longer & more pumping.	Higher WLM infrastructure and flood and coastal defence expenditure from 2050 onwards. Continued tension over water levels including calls to hold water for longer & more pumping.	Higher flood and coastal defence expenditure in later half of the century. Increase in 'Tide lock' increasing duration of prolonged flooding.
Tourism & Recreation No significant change in provision or patterns of activity.	Little change over this timeframe.	Some disruption to tourism with more flood events. Increase in property damage.	Some disruption to tourism with extreme flood events. Increase in property damage.

2.3 Scenario 2: Nature Recovery with Sustainable Farming

In this scenario hydrological blocks of land (whole moors) are managed for nature recovery. This assumes 30% of land in the study area is dedicated to nature restoration by 2030 (as specified in international targets[4]), and 50% (20,000 ha) by 2050. In addition, other land contributes to nature recovery through nature sensitive farming and regenerative practices and continues to provide income and employment in the local area. Overall, a total of 36,500 ha is either dedicated to nature recovery or strongly supports nature recovery through sustainable farming. The transition of land to nature recovery is shown in Figure 2.1, and more detail on assumed land management changes is provided in Table 2.2. Ecological function will be restored at large scale from 2050 onwards with habitats allowed to form naturally, with restored natural processes and a comprehensive nature recovery network with comprehensive connectivity, dispersal sites and buffer zones. Water level on all areas of deep peat soil is at optimum 10cm below surface level (Evans et al., 2021). to eliminate carbon losses, resulting in mosaic of wetland plant communities. In addition, 10% of farm area is set aside for nature, including field margins, hedgerows, ponds etc

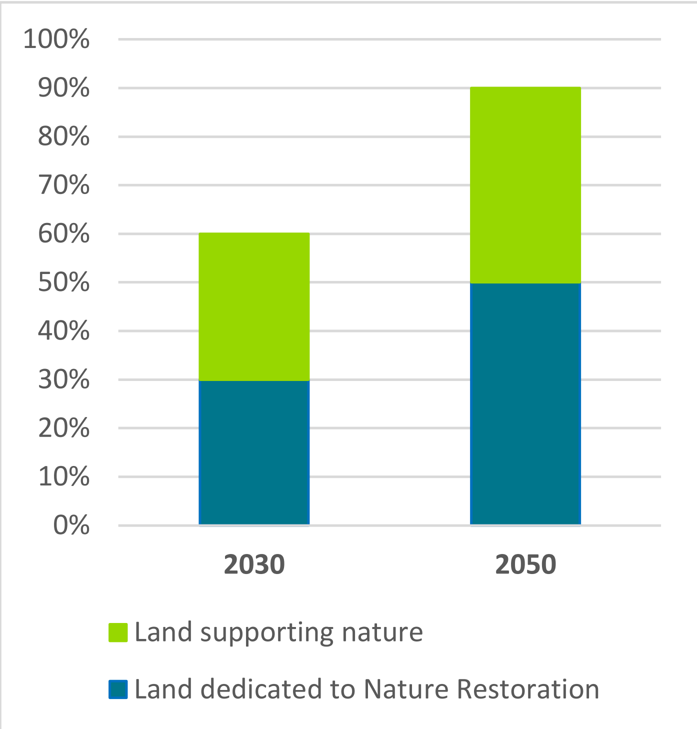


Figure 2.1: Assumed proportion of study area dedicated to or supporting nature restoration.

Farming practice regenerative to support nature recovery. Permanent vegetative cover over all farmland, and farmers focus on regenerative techniques using the five pillars[5]:

1. Don't disturb the soil
2. Keep the soil surface covered
3. Keep living roots in the soil – including hedge restoration
4. Grow a diverse range of crops – in Somerset's case herbal leys
5. Bring grazing animals back to the land –including mob grazing.

[4] https://www.gov.uk/government/news/pm-commits-to-protect-30-of-uk-land-in-boost-for-biodiversity
[5] https://groundswellag.com/principles-of-regenerative-agriculture/

Table 2.2: Scenario 2 description, Nature Recovery with Sustainable Farming

Land Use/Activity Assumptions	Near Term (2022-30s)	Medium Term (2040-50s)	Near Term (2022-30s)
Farming Significant area of land (20,000 ha i.e. 50%)[1] given over to nature restoration, and 40% to farming that is nature sensitive. Some land taken out of production altogether, but most grazed for both nature and agricultural output. Regenerative farming practice the norm.	On deep peat, progressive switch to lower density and conservation grazing. No maize growing on peat. Farming practices are increasingly regenerative. Reduction in inputs, e.g., fertilizers, no use of pesticides and reduced diffuse pollution (e.g., Phosphate reduction). Building soil organic matter and resilience to climate change.	All deep peat areas under nature restoration (most by 2030, all by 2050). Set aside margins, hedgerows, and target features to provide connectivity benefits. Farm income from diversified nature-based tourism, and ES funding. New crops may become viable (e.g., paludiculture).	As previous but incorporate new knowledge and techniques as appropriate. Coping with extreme weather becomes more crucial.
Deep Peat Areas and Peat Extraction Deep peat soils are progressively re-wetted, raising water levels to optimum height. Assume by 2025 all peat extraction ceases.	Peat extraction ends in 2025. Water levels are progressively raised on deep peat area.	Where peat remains, it is restored/fully rewetted to enable full restoration. All GHG losses from deep peat abated by 2050. Peat remaining voids given to nature (mandatory) and turned into appropriate habitat (wetland / reedbed), may be possible to use to create phosphate mitigation sites.	Maintain water levels on deep peat and respond to extreme weather events as necessary.
Nature Conservation Significant area of land (50% of scope area, 20,000 ha)[1] managed for conservation and restoration.	Lowest lying land to change to fen/reed bed, giving mosaic of habitats. Areas kept wet all year round for deep peat and carbon storage. Grazing employed as a grassland management tool. Wet woodland restored appropriately.	Land managed at landscape scale – removed boundaries with landowners working together. Large blocks of land (whole Moors) managed for nature recovery. Significant floodplain connection to hold water in the system providing flood mitigation for local villages. Other species restored for the environmental management they bring e.g., beavers' role as ecosystem engineers.	Land managed at landscape scale – removed boundaries with landowners working together. Large blocks of land (whole Moors) managed for nature recovery. Significant floodplain connection to hold water in the system providing flood mitigation for local villages.

Land Use/Activity Assumptions	Near Term (2022-30s)	Medium Term (2040-50s)	Near Term (2022-30s)
Water Level Management Water levels raised in deep peat areas, (and others as needed). Communities have appropriate levels of protection.	Water levels progressively raised. Reduction in pumping costs, and GHG emissions (but very small compared to emissions from other sources).	Water levels raised on all deep peat soils to 10cm below surface level. Increased water storage, flood risk management benefits for populated areas. By 2050 all pumping energy assumed to be from low carbon sources.	Water courses play significant role in nature recovery with good water quality & restored riparian buffers & naturalised, meandering channels with flood plain connection.
Tourism & Recreation Landscape scale zoned access, with access routes (e.g., cycling) and visitor facilities to enable access in appropriate areas.	Increase in nature-based tourism. Accessible sites on edges of Glastonbury, Street and Bridgwater for new nature explorers that act as Gateways to the 'Levels' with cafes, play areas & car parks. Travel integrated from these areas to Levels proper including via water ways if appropriate.	People come to see special species in the landscape, e.g., Cranes, beavers etc and are willing to pay for the experiences. Active travel and good integration with public transport and access to towns – health and well-being benefits.	Ongoing investment as necessary

Table Note 1: As a 2050 target this 20,000 ha would include, 9,000 ha of grassland, 6,000 ha of fen and freshwater (mainly within designated sites and deep peat), 4,000 ha of saltmarsh and 1,000 ha of woodland (mainly wet woodland). Current designated sites and nature reserves cover 13,000 ha. See **Error! Reference source not found.**. Areas to p rioritise for nature recovery include deep peat soils, existing designated sites, and those areas of the Levels most prone to flooding.

Figure 2.2 highlights the extent to which these priority areas overlap, (deep peat in brown, designated sites, and nature reserves in bright green). This combined area covers just over 25,000 ha and could form the basis of identifying the core area for prioritised nature restoration. In terms of specific land cover changes assumed necessary (for the next phase of scenario modelling) to meet the above goals by 2050, these are highlighted in Table 2.3.

For the 20,000 ha target for nature restoration, discussions with the NE partners determined that the most appropriate land cover split for this target is as shown in the first column of. Table 2.3. Of this target area, 13,016 ha are already within designated sites or managed nature reserves and would be expected to form the core of nature recovery efforts. The most significant shift required is the nine-fold increase in fen, marsh and freshwater habitat (to 6,000 ha) which would be achieved by converting arable and grassland on deep peat into wet fen/marsh. Remaining grassland would be wet and diverse grassland, again targeted on deep peat areas.

This would leave nearly 7,000 ha of the nature restoration target to be delivered outside existing designated sites which would involve improving/creating 5,790 ha of wet grassland from existing grazing land. Finally, the target would also require an increase in saltmarsh (mainly from existing grazing land on the coast), and an extra 980 ha of woodland (mainly wet woodland), in the most appropriate locations.

Table 2.3: Possible Target for Land Cover for Nature Restoration (50% of study area by 2050), ha Target (Column A) achieved by sum of Columns C and D

Land use/type	Nature Restoration Target Area by 2050 (A)	Within existing Designated sites/ Nature Reserves		Outside existing Designated sites, Nature Reserves	Notes
		Existing land cover (2021) (B)	2050 land cover [1] for Nature restoration (C)	Other land [2] for nature restoration by 2050 (D)	
Grassland	9,000	7,656	3,210	5,790	This should target 8,900 ha of deep peat outside SSSIs/National Nature Reserves (NNRs)
Arable	-		-	-	Negligible arable within existing designated sites
Peat Extraction	-	-		-	End of peat extraction
Fen and freshwater	6,000	1,554	6,000	-	Target to be achieved on all deep peat within SSSIs/NNRs
Saltmarsh/sediment	4,000	3,788	3,788	212	
Woodland	1,000	18	18	982	Increase in wet woodland to be achieved in farmland
Total	**20,000**	**13,016**	**13,016**	**6,984**	

Table notes:

1. Future land cover of existing designated sites to contribute to 50% nature restoration target.
2. Other land change required outside existing designated sites/nature reserves to meet 50% nature restoration target.

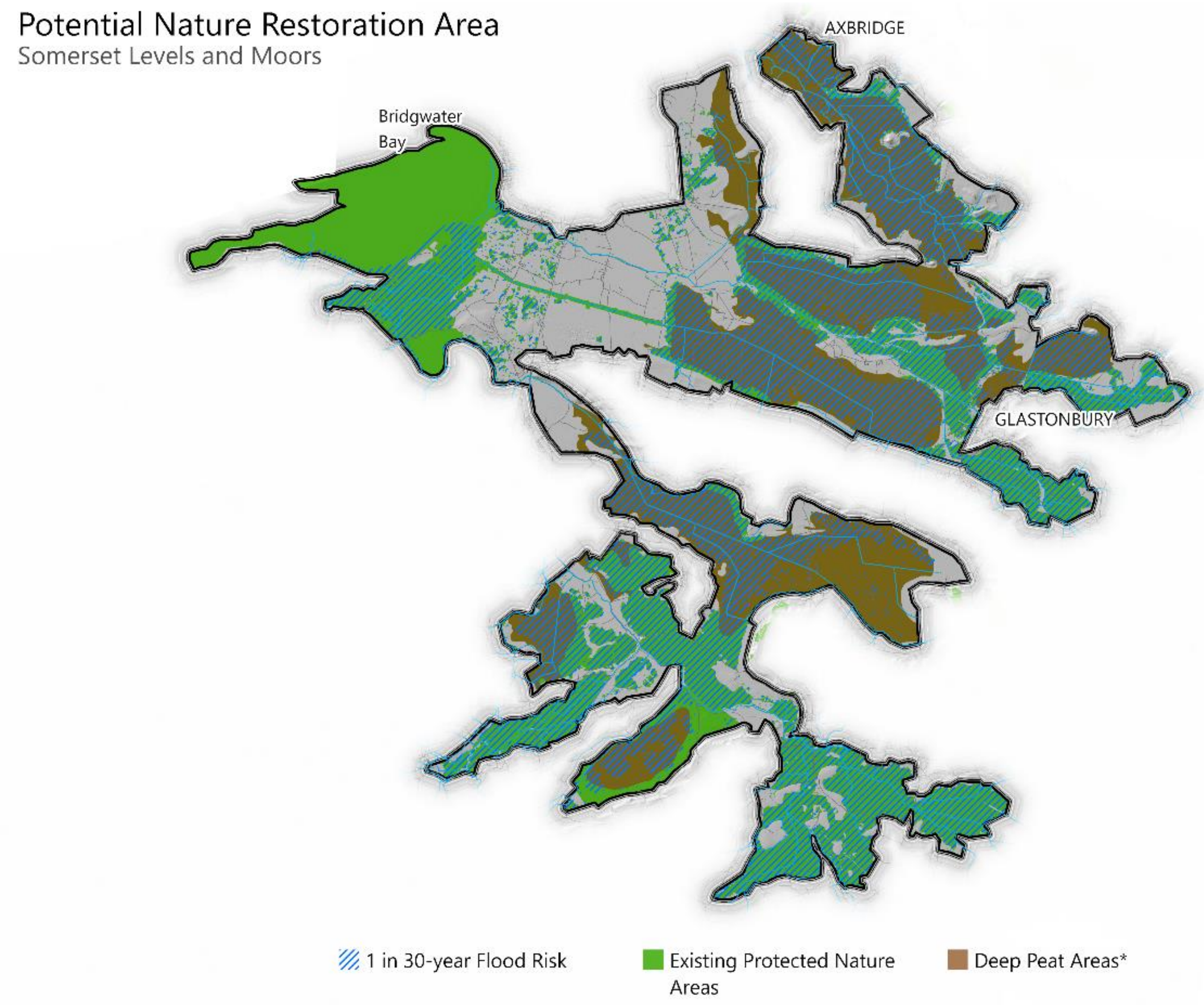


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Figure 2.2: Priority areas for Nature Restoration

3. Baseline Results

3.1 Baseline

The economic and environmental characteristics of the baseline are described under the following headings, which were defined above in the scope discussion (Section 1.2).

- Land Use & Condition
- Level of Public Spend
- Economic Activity by sector
- Employment levels
- Greenhouse gas (GHG) flows
- Non-market ecosystem services
- Biodiversity status

3.1.1 Land Use & Condition

Baseline land use is mainly for grazing (73%), with a much smaller amount of land used for arable (6%). Land use on deep peat is particularly important as lowland peat areas are major stores of carbon but can also be significant sources of GHG emissions if these are excessively drained and/or the soil disturbed. Activities on peatland, such as draining for grazing land, peat off-take during crop harvest, peat extraction, impact these benefits by reducing peat volume and thereby the benefits associated with carbon storage and other economic and social benefits. Deep peat soils cover 35% of the SCLM (UKCEH, 2021) and a major issue for the UK and Somerset is the rate of GHG emissions from peat soils[6]. The distribution of land uses by soil type is given in Table 3.1 and illustrated in Figure 3.1 and Figure 3.2.

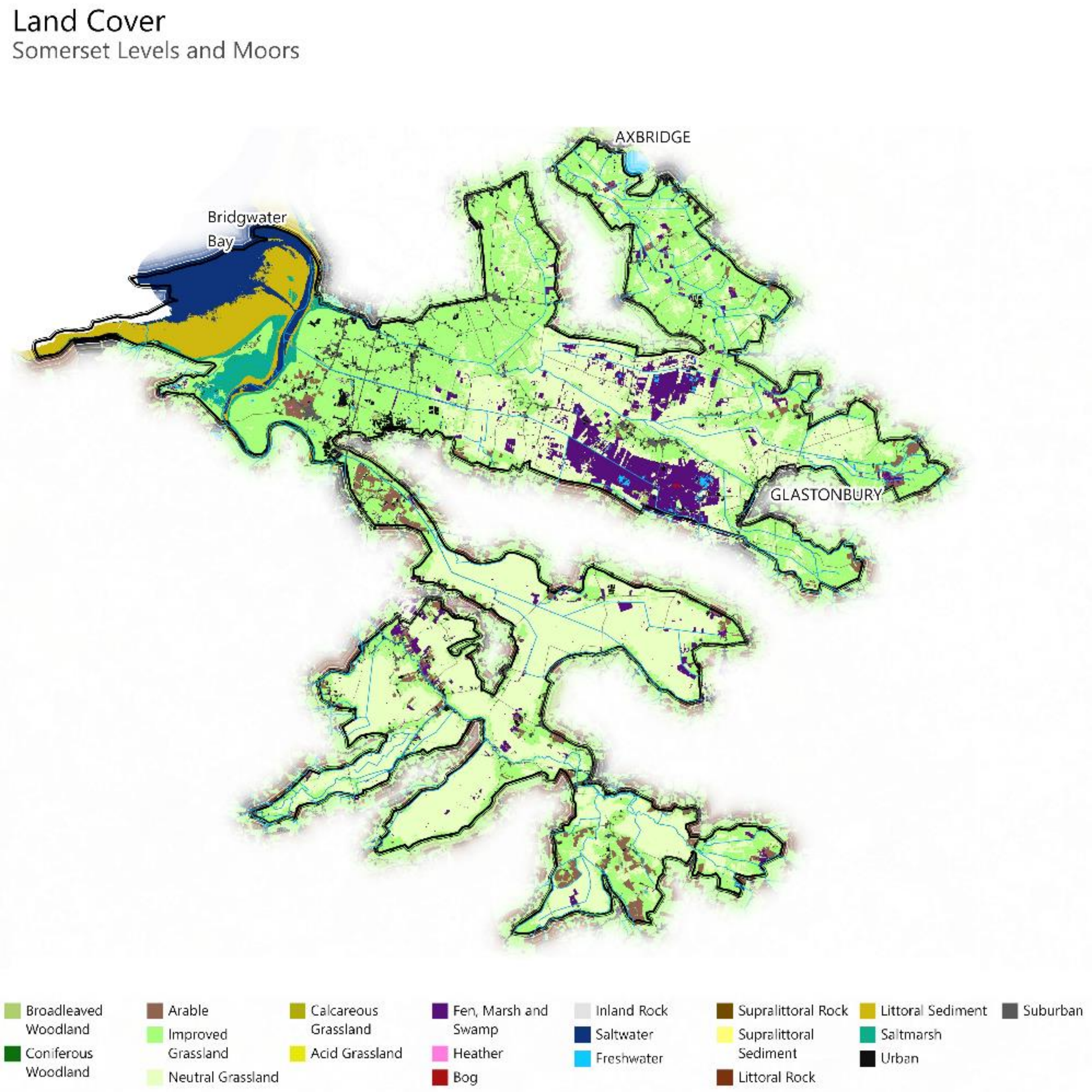
Table 3.1: Land Type in the Study Area, hectares

Land use/type	Deep Peat	Non-deep Peat	Total	%
Arable	476	1,823	2,298	6%
Grazing (permanent)	11,718	18,058	29,776	73%
Fen and freshwater	2,106	695	2,801	7%
Saltmarsh/sediment	8	3,817	3,825	9%
Woodland	-	443	443	1%
Other (urban, sub-urban)	200	1,397	1,597	4%
Total	**14,508**	**26,234**	**40,742**	**100%**

Source: UKCEH, (2021) Land Cover Map

[6] Peat soils that are not fen, freshwater or saltmarsh wetlands are drained and are a significant source of carbon emissions.See: https://post.parliament.uk/research-briefings/post-pn-0668/.

Land cover in Figure 3.1 and Figure 3.2 is based on the UKCEH land cover map (2021) and whilst it may be prone to some inaccuracies (for example the area of improved grassland may be overstated), it provides an indication of the main pattern of land use in the study area.



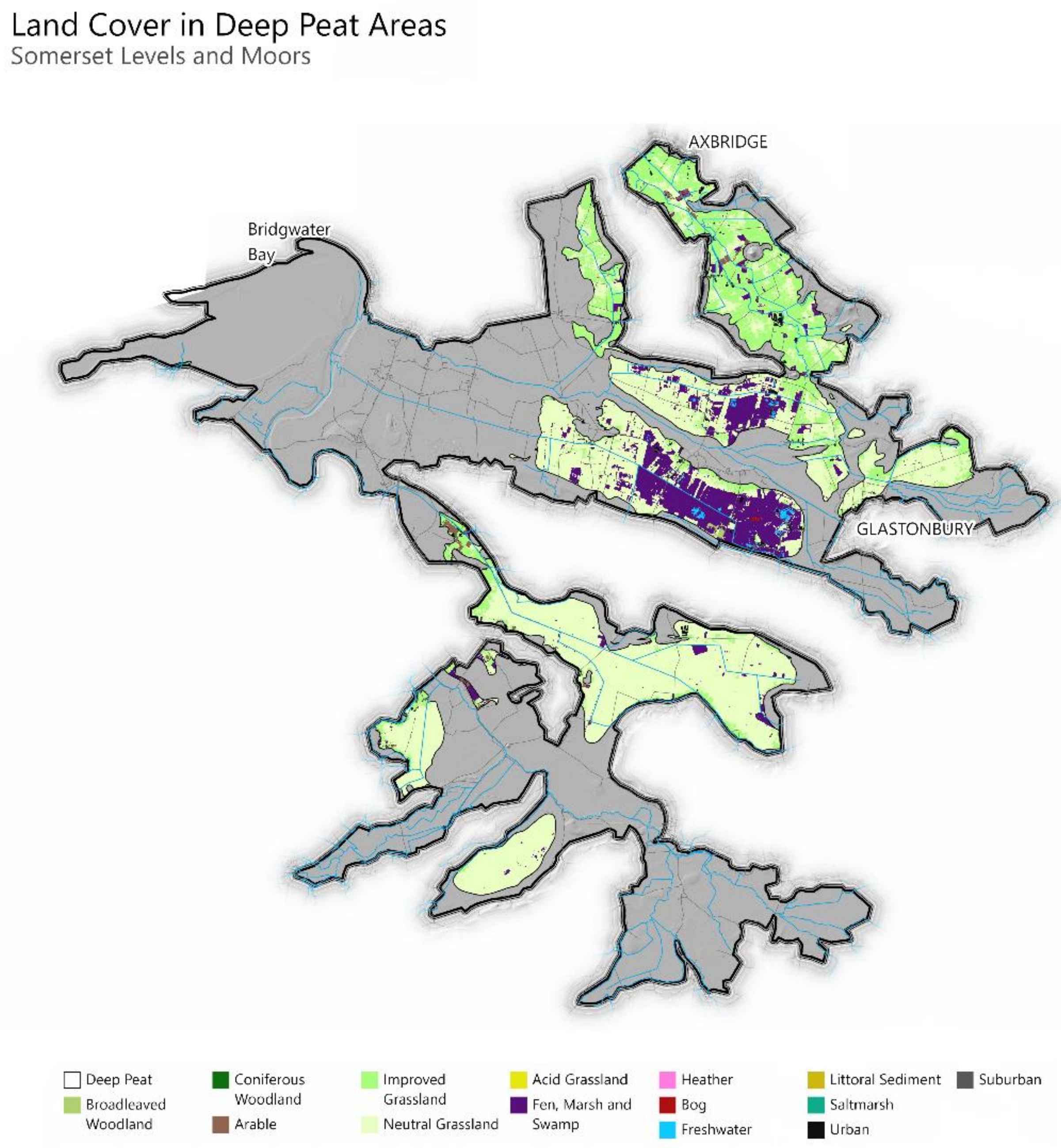
Source: Marston, C., Rowland, C. S., O'Neil, A. W., & Morton, R. D. (2022). Land Cover Map 2021 (10m classified pixels, GB) [Data set]. NERC EDS Environmental Information Data Centre. https://doi.org/10.5285/A22BAA7C-5809-4A02-87E0-3CF87D4E223A

Figure 3.1: Land Cover in the Study Area

Agricultural land use is the main land use in the study area (at 32,000 ha) this represents around 12% of the farmland in Somerset[7]. Much of the farmland in the study area, (46%) is Agricultural Land Class (ALC) 3

[7] Farmed area in Somerset 266,454 ha in 2021. Source: https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june

(good to moderate)[8]. 26% of the farmland is classed as very good (ALC 1 and 2, mainly on the deep peat areas), and 27% is classed as poor (ALC 4, much of this is also on deep peat soils). Hence on balance the land is neither particularly high nor low in terms of agricultural productivity. For context, the ALC 1 & 2 land in the study area is 9,700 ha or 0.44 % of the England total[9].



Source: Marston, C., Rowland, C. S., O'Neil, A. W., & Morton, R. D. (2022). Land Cover Map 2021 (10m classified pixels, GB) [Data set]. NERC EDS Environmental Information Data Centre. https://doi.org/10.5285/A22BAA7C-5809-4A02-87E0-3CF87D4E223A. © NERC.National Soils map © Cranfield University (NSRI) © Crown Copyright and database rights 2023. © Natural England copyright 2023, reproduced with the permission of Natural England, Ordnance Survey licence number 100022021

Figure 3.2: Land Cover on deep peat soils

[8] Source NE Agricultural Land Classification maps: http://publications.naturalengland.org.uk/category/5954148537204736

[9] England ALC 1& 2 assessed as 2.2 million ha. See CPRE (2022) Building on our food security. Online at: https://www.cpre.org.uk/wp-content/uploads/2022/07/Building-on-our-food-security.pdf

The SCLM is the second largest area of lowland peat in the UK and contains around 11 million tonnes of carbon (an average of 750tC/ha) (Climate Resilient Somerset, 2020). The important areas of carbon storage in deep peats soils are demonstrated in Figure 3.3.

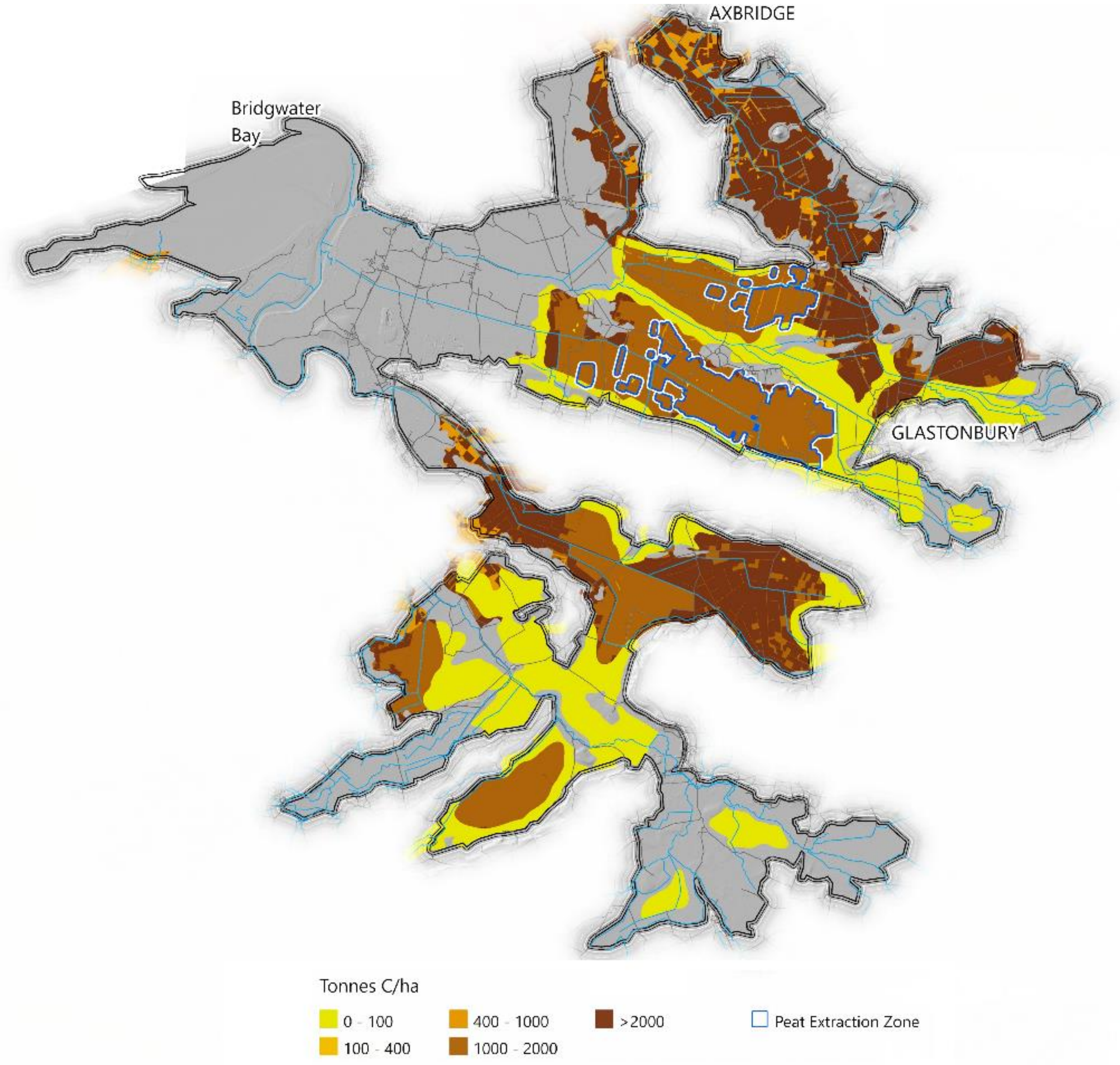


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Figure 3.3: Peat soil carbon content

Some of this land is used for peat extraction. The exact area used for extraction is not known but around a dozen sites are known and are estimated to cover an area in the region of 50-100 ha in total, (or 0.1-0.2% of the study area). Given that most of the deep peat extraction zone coincides with fen/marsh/swamp (Figure 3.2 and Figure 3.3) it seems reasonable to assume it occurs on fen, marsh and freshwater as in Table 3.1.

Land use on deep peat has a significant impact on greenhouse gas emissions (in particular, arable cultivation and drainage for grazing can lead to significant carbon losses (AHDB, 2021)), and land use on deep peat is highlighted in Figure 3.2.

Deep peat areas typically contain more than 100 tonnes of carbon per ha (Evans et al., 2017b), but some areas hold more than others.

Figure 3.3 illustrates the area licenced for peat extraction (in the Brue valley to the west of Glastonbury) and this correlates to a lower level of carbon content as much of the peaty soil has been removed through peat extraction. However, most peat throughout the study area is excessively drained which has caused the shrinkage of peaty soils. Drained peat is prone to oxidation and erosion which leads to CO_2 emissions (see estimates in section 3.1.5), and silt to rivers and drainage systems. Climate change is likely to exacerbate this problem.

Natural Habitat: Designated Sites and Nature Reserves

The wet grassland, mire, lowland fen as well as rhynes and ditches of the SCLM have particular importance for a range of wetland and wading birds, invertebrates and aquatic and wetland plant life (Natural England, 2021a). They are one of the most important locations in southern Britain for breeding waders, providing habitat during winter months for waterfowl such as Wigeon, Teal, Golden Plover, Lapwing and Snipe. The area is home to many rare invertebrates such as raft spiders, and horseshoe bats that feed on them, and support a range of plant life including, marsh marigold, purple loosestrife, ragged robin and meadowsweet (Natural England, 2021a). A substantial area (16,300 ha or 40% of study area) is either designated or managed as nature reserves (including land managed by WWT, SWT, RSPB and Hawk & Owl Trust as managed sites). Seventeen sites (Table 3.2) provide a major draw for visitors to the area and cover an area of over 6,400 ha (15% of the study area).

Table 3.2: List of Managed Reserves in the SCLM

Site	Area, ha	Managed by…
Huntspill River	148	Environment Agency
Bridgwater Bay (Steart Marshes)	2,940	Natural England and WWT
Shapwick Heath	530	Natural England
Moorlinch, Kings Sedgemoor, Southlake Moor, Tealham and Tadham Moors, Westhay Moor, Catcott Eddington & Chiltern Moors.	646	Natural England and SWT
Wisteria Farm & North Moor	240	Natural England
Ham Wall and Greylake	276	RSPB
West Sedgemoor	1,285	RSPB
Shapwick Moor	138	Hawk & Owl Trust
Honeygar Farm (not a reserve, but managed for conservation)	81	SWT
Burtle Moor, Catcot, Street heath, Sharpham Moor, Westhay heath	140	SWT
Total	**6,424**	

Designated sites are concentrated in the lower lying areas coinciding with much of the deep peat soils (around the Axe/Brue in the north, and the Parrett in the south), and on the coast around Bridgwater Bay (see Figure 3.4). There is a high degree of overlap between reserves and designated sites, although some substantial reserves are outside designated SSSIs (e.g., much of WWT site at Steart Marshes and the RSPB reserve at Ham Wall).

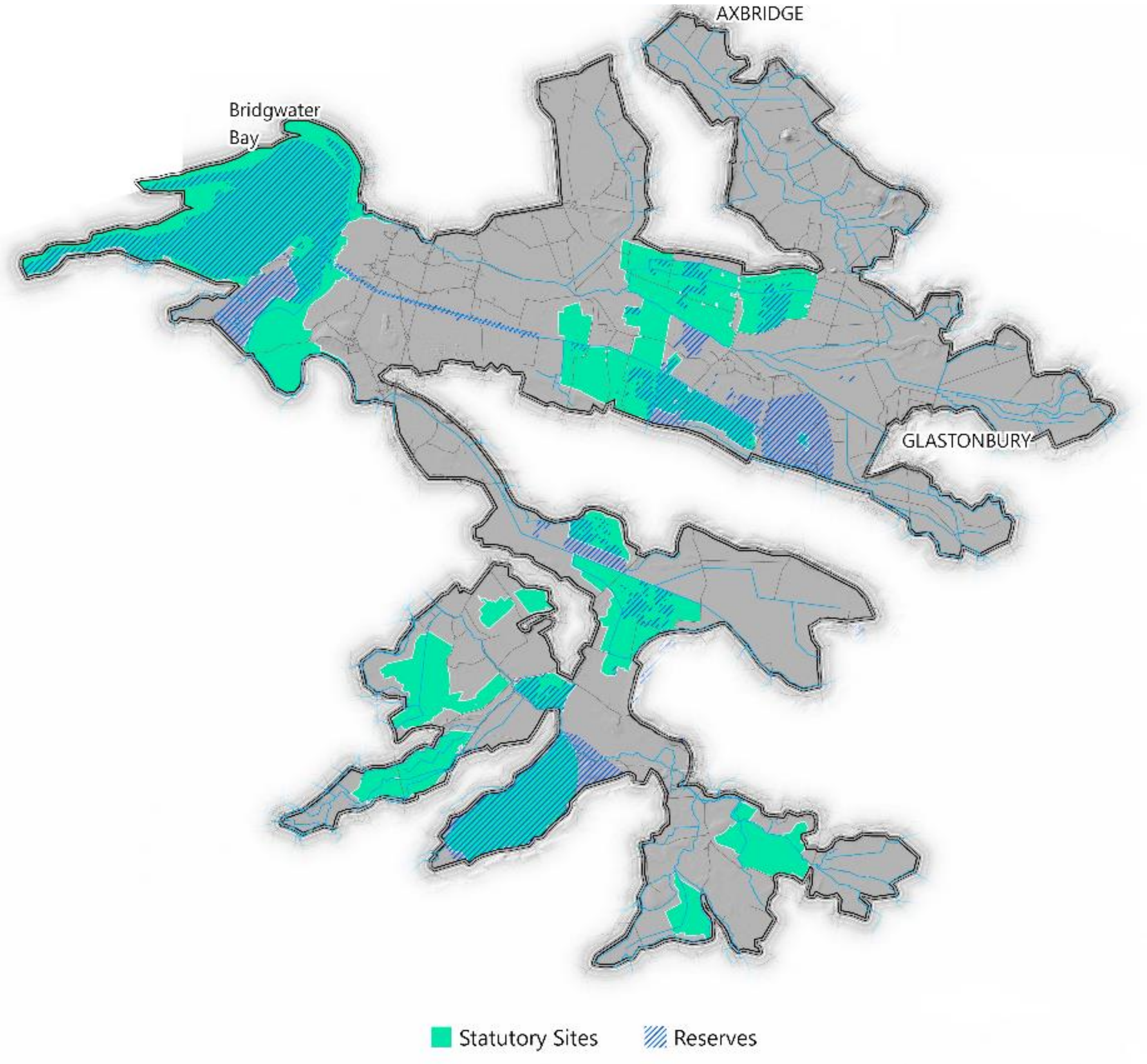

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Figure 3.4: Location of Designated Sites and Nature Reserves

Figure 3.5 illustrates which organisation manages which sites and shows the extent to which these sites connect and overlap with existing designated sites.

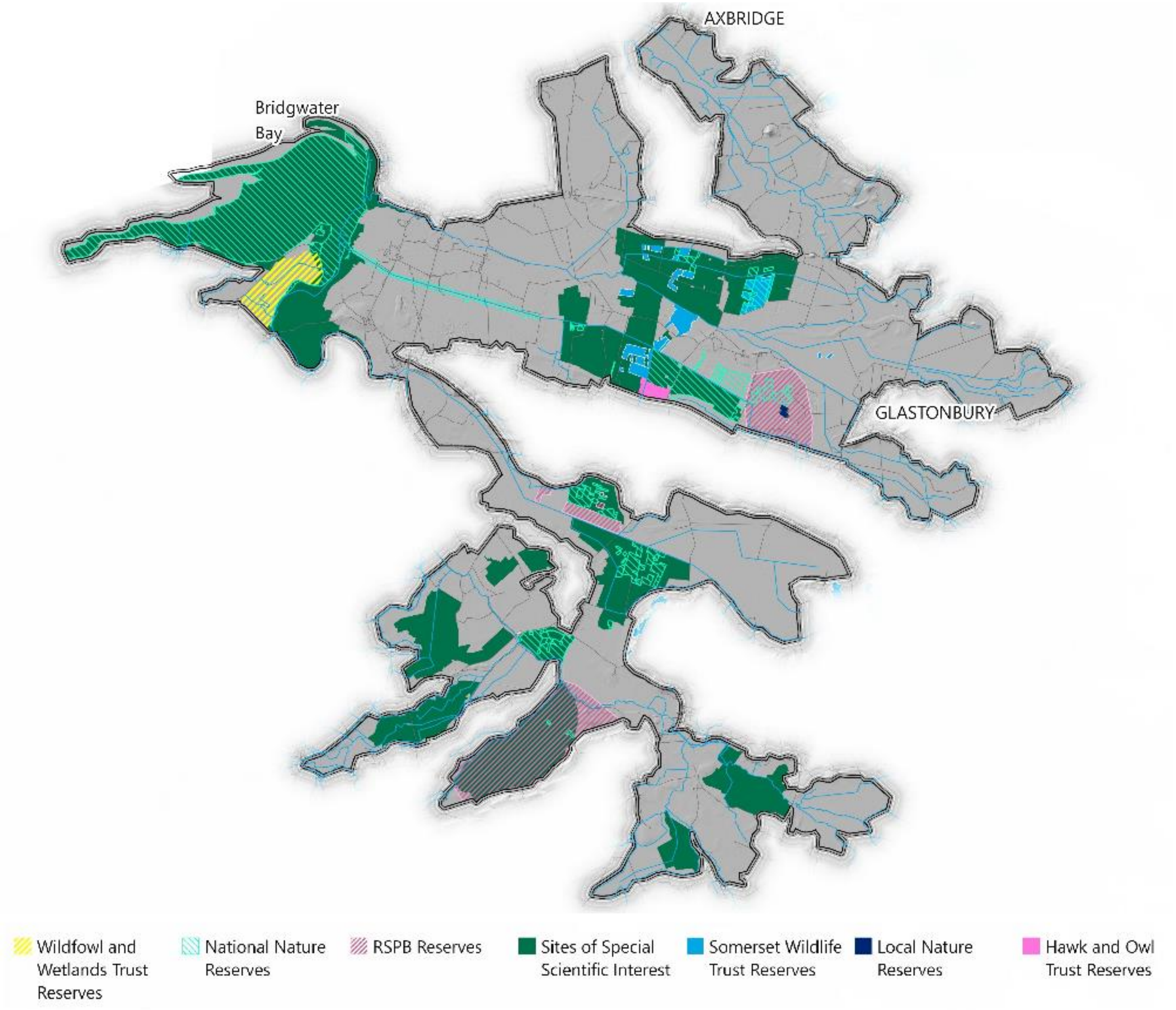

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Figure 3.5: Managed reserves and overlap with SSSI sites

The condition of these sites is shown in section 3.1.7 and in Figure 3.8.

Water Quality

Water quality plays a pivotal role in the health of the SCLM because water is such an essential feature of most habitat in the area. However, the area is prone to hyper-eutrophication, as high nutrient concentrations have accumulated in the study area water bodies, which lead to overgrowth of duckweed and algae on the water's surface. This in turn leads to a loss of dissolved oxygen and intense shading of the water column, which reduces plant diversity and reduces the quality of habitat for invertebrates and other aquatic animals. Dissolved oxygen can fall to levels that can kill many fish species. The accumulation of dying algal and plant matter on ditch beds further contributes to deoxygenation.

Water quality as measured by ecological health via Water Framework Directive (WFD) status in the 'Levels' is not good, with most water bodies (29) classified (under WFD classification) as moderate, and 3 as poor (see Figure 3.6). The main reasons for not achieving good status are due to diffuse phosphate pollution, causing phosphate levels to be around 3 times the concentration that is considered necessary to support good status. Phosphate pollution is mainly caused by discharges from wastewater treatment works and agricultural activity, particularly the application of phosphates used in fertiliser. Excessive phosphate levels are the main cause of hyper-eutrophication and reduction in dissolved oxygen levels (Natural England, 2021b).

The Common Standards Monitoring Guidance (CSM) for the assessment of ditch SSSIs state that total Phosphorus (P) concentrations in water feeding these sites, and within the ditches themselves, should be less than 0.1mg P/l to be in "favourable condition" (Natural England, 2021b). Monitoring indicates that the annual mean concentrations of Phosphate in the river inputs into the SSSIs, are at least 3 times the CSMG target in numerous locations.

Following planned and on-going improvements to sewerage treatment works, it is now forecast that from 2024, most of the phosphate nutrient loading will be diffuse pollution from agriculture (Natural England, 2021b). Consequently, the priority for further improvement will be to reduce diffuse pollution from farming activity, both within the SCLM and in the upper catchments (see Figure 3.6).

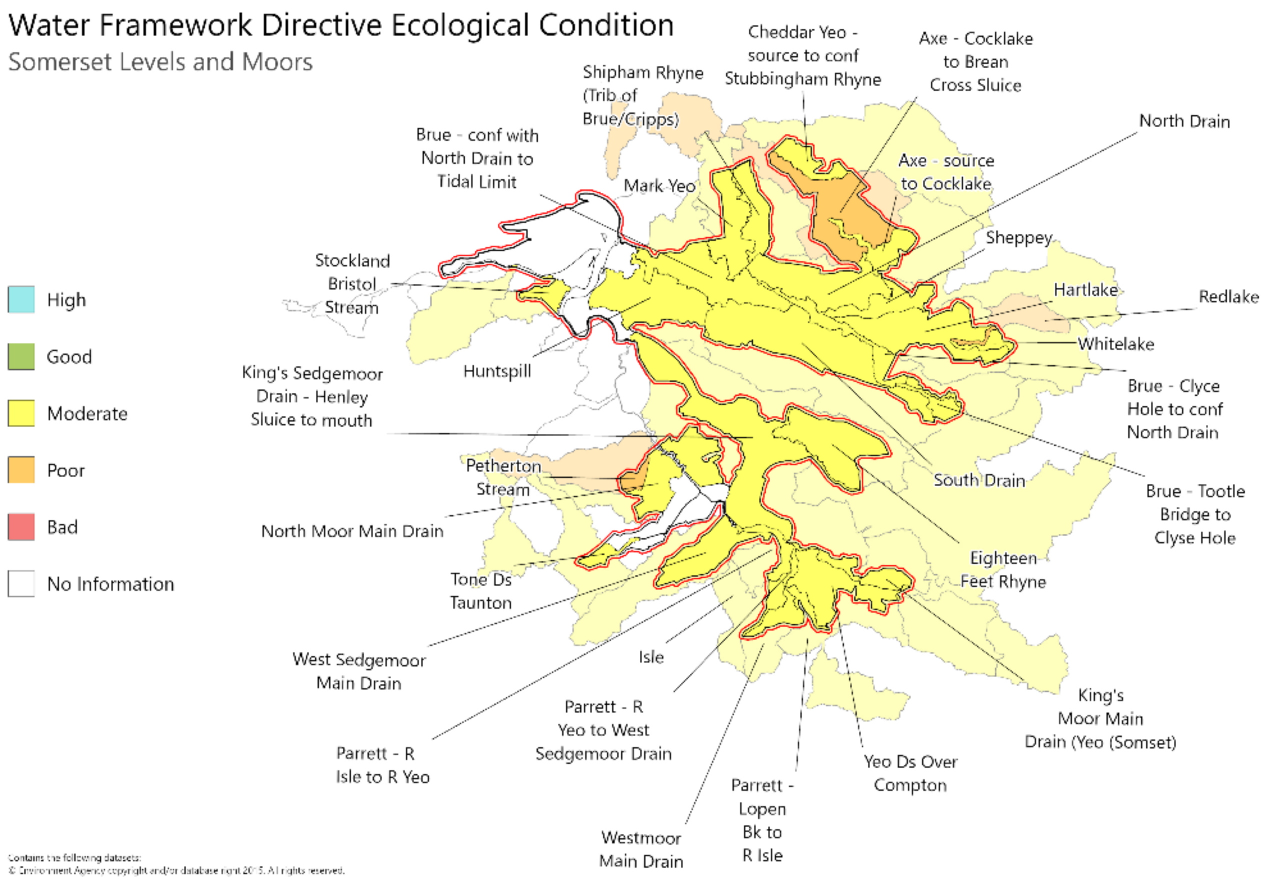

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Figure 3.6: WFD Ecological Status by water body

Water Level Management

Over many centuries, the SCLM have been extensively altered and managed to regulate the water levels in the landscape, largely to facilitate agricultural use. Managing water levels, and flood and coastal erosion risk, are complex activities, involving several organisations and authorities (EA, the internal drainage boards, and the Somerset Rivers Authority). The complex water management practices on the 'Levels and Moors' require considerable long-range planning, investment, and capital maintenance, and have moderately high energy demands due to it being a pump drained landscape.

Key features of existing water level management are:

- A large proportion of the area is prone to high to medium risk of flooding (See Figure 3.7) and relies heavily on the existing pump drained system to reduce flood risk.
- In the south, substantial areas are managed as flood storage areas (See Figure 3.7), which store water in the winter to prevent flooding to communities. These areas are currently pumped dry and in the Summer are used for seasonal grazing.
- In the north, the moors rely more heavily on gravity-based systems to drain water but use pumping to maintain water levels in fields during the Summer.
- As the climate changes, sea level rise becomes increasingly significant in the second half of the century, (probable sea level rise of between 0.27 and 1.11m by 2100, see section 2.1), which will impact the capacity for drainage of the 'Levels' and increase the periods of "tide lock". This level of sea level rise will also impact on planning for coastal flood defences. This will require frequent reappraisal of long-term flood defence plans, alongside communities adapting to become more resilient. Vital road and rail links to the Southwest of England pass through this study area and consequently are a high protection priority, which will require greater investment to provide an adequate level of protection.

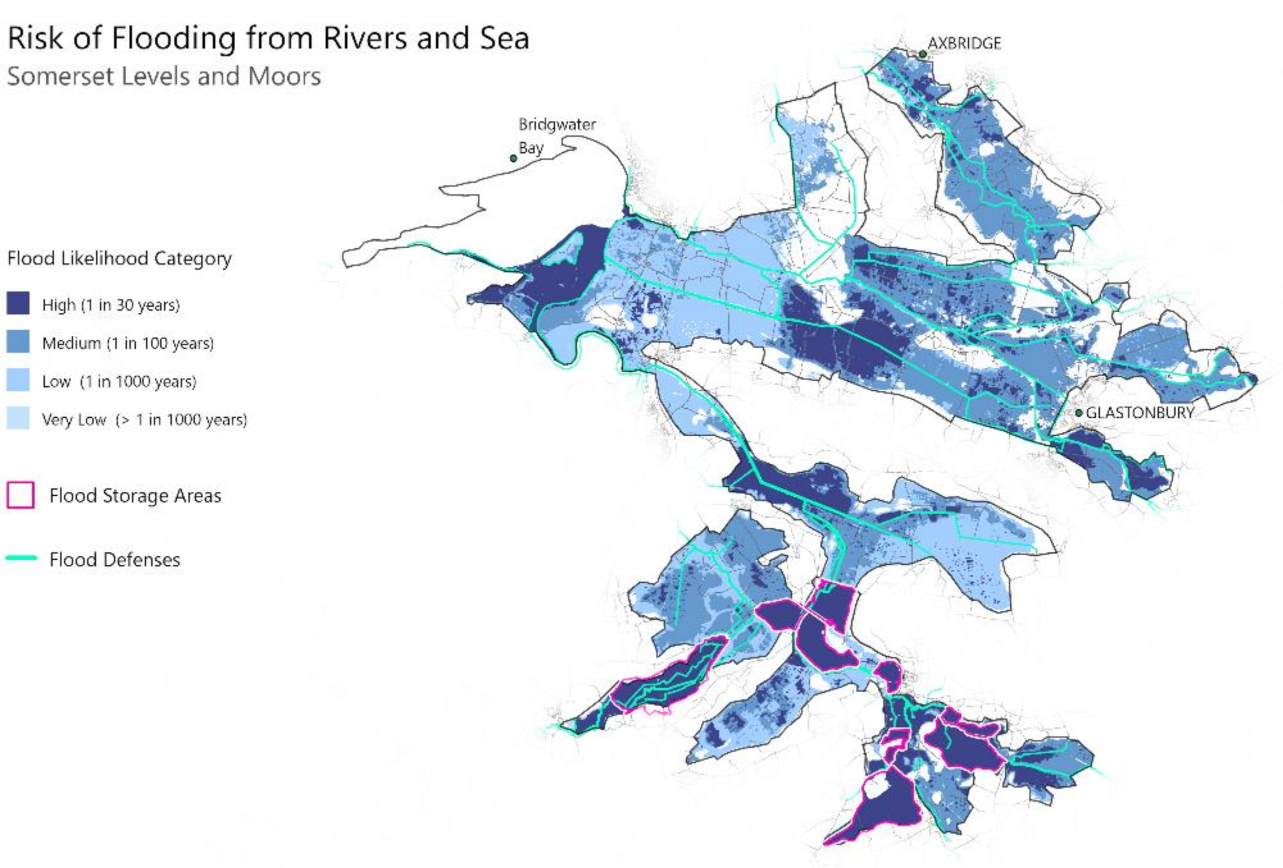

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Figure 3.7: Flood risk likelihood by Category

3.1.2 Level of Public Spend

There is a considerable level of public spend to support in-scope economic sectors within the study area. As Table 3.3 shows, this is mainly for activity to control/regulate the water levels within the SCLM, and agri-environment payments to farmers and land managers.

Table 3.3: Baseline Public Spend to support in-scope sectors (2021/22)

Area of spend	Item	£'m
Farming and agri-environment	Agri Pillar 1 – Basic Payment Scheme (BPS)	6.0
	Agri-environment schemes (AES)	3.2
Water level and flood risk management	Flood and Coastal erosion Risk Management Capital investment [1]	12.8
	EA operational/revenue spend	7.0
	Internal Drainage Boards (IDB) and Somerset Rivers Authority (SRA) funding [2]	5.0
Conservation	Nature Reserve management by NE [3,4]	0.6
Total		**34.6**

Table notes:

1. Source EA, and EA expert view is that 80% of total Somerset average annual spend (£16m) relates to work in the SCLM

2. IDB and SRA figures from annual accounts.
3. Natural England are not eligible for agri-environment scheme funding, they are provided with separate public sector funding.
4. In addition to routine spend £1.4 million of capital spend has been approved for the final phase of building a visitor centre at Avalon Marshes but not included in this annual spend figure.

BPS expenditure was estimated by using the standard rate per ha for 2021/22 applied to farm area (32,000 ha), and the aggregate AES payments in the study area for 2021/22 were provided by NE. This gives a total of £9.2m spent on agriculture in 2021/2.

Public spend on water level management (£24.8 million total) is predominately to enable agricultural activity in SCLM and relates to: capital investment in flood defences (both coastal and fluvial); operational and maintenance activities of the Environment Agency; and the spend of the internal drainage boards (IDBs) and funding managed by Somerset Rivers Authority (SRA) on the 'Levels'. In addition, there are some surface water drainage activities of Somerset County Council (highway drainage) and Wessex Water (public sewers), but these have not been possible to estimate for this study. The costs of water level and flood risk management have been estimated through discussions with EA, taking a long run average view of annual spend on flood and coastal erosion risk management (FCRM) capital costs and maintenance, annual EA operating spend, and annual spend of the internal drainage boards and SRA.

In addition to the figures quoted in Table 3.3, over £130 million [10] is being invested in the Bridgwater tidal barrier over the next five years. Whilst this investment is mainly to protect 11,300 houses, 1,500 businesses, the A38 and M5 road corridor and mainline rail link, it does also offer some level of protection to some farmland in the study area. No element of this investment has been included in Table 3.3, and the tidal barrier investment does not negate the need for on-going investment on water level management infrastructure within the SCLM. This issue is addressed in the scenarios in Section 4.

Local authorities do provide some project funding for recreation and tourism related activities. In addition, the Heart of the South West Local Enterprise Partnership and the Great South West Tourism Partnership do aim to increase the tourism offer and have made some significant investments to boost tourism spend[11]. The latest plans aim to boost tourism in the South West by 25% by 2030 compared to pre-covid levels in 2019[12]. These investments cover a broad area in the South West and include traditional tourist destinations such as Devon, Cornwall, coastal resorts and the national parks. Somerset represents only 12.5% of tourism spend in the South West[12]. There will need to be some targeted investment and activity to promote and raise the profile of the SCLM. Finally, whilst tourism is a priority for the region, it is difficult to attribute spend to the natural assets of the SCLM, and hence no funding on recreation/tourism infrastructure has been included in this spend assessment.

Total public spend in SCLM, at £34.6 million per annum, represents around £830/ha of public spend in the study area. The majority of this spend (over 70%) relates to the cost of regulating water levels, which is a unique feature of land management for the 'Levels' and drives the high public spend per hectare. This

[10] See: https://www.gov.uk/government/publications/defra-accounting-officer-assessments/16-february-2022-bridgwater-tidal-barrier-project-accounting-officer-assessment

[11] For example : Heart of the South West LEP invests £500k to support Regional Tourism Data Hub – Exeter Chamber. Available at: https://exeterchamber.co.uk/blog/2022/10/21/heart-of-the-south-west-lep-invests-500k-to-support-regional-tourism-data-hub/

[12] See: Towards 2030 Reimagining the Visitor Economy in the South West, at: https://heartofswlep.co.uk/wp-content/uploads/2021/07/Towards-2030-Reimaging-the-Visitor-Economy-in-the-South-West.pdf

compares with an average per hectare government grant funding in England of £270/ha[13].

3.1.3 Economic Activity by Sector

This subsection analyses the four main land use sectors in the SCLM, plus the contribution of water level management to the local economy. Table 3.4 outlines the sectors evaluated, their gross economic output value, and their Gross Value Added (GVA). Gross economic output measures total market value of all output produced (£65 million in 2022) and is shown in Table 3.4. GVA is the value of output minus the value of intermediate consumption (i.e., purchased goods and services) and provides a measure of the economic value of the human, manufactured and natural capital employed in that industry/sector output. It must be stressed that these measures are derived from market values, and as such do not necessarily reflect all value as certain benefits are not traded in markets (e.g., the full value of natural capital for biodiversity, climate regulation, recreation, and well-being are not traded in any market).

Farming and water level management represent the most significant land-based economic activities (in terms of economic turnover), followed by nature-related tourism[14]. These estimates are based on data from the study area and selected assumptions for the key sectors which are explained below.

Table 3.4: Economic activity by in-scope sector, £ million (2022)

Key sectors	Gross output value	Gross value added (GVA) [1]	% of Total GVA
Agriculture	20.1	9.2	31%
Peat extraction	3.9	1.9	6%
Recreation/tourism	12.9	4.8	16%
Nature conservation	2.8	1.9	6%
Supporting industry – water level management [2]	24.8	12.2	41%
Total	**64.5**	**30.0**	**100%**

Table notes:

1. Gross value added (GVA) is an economic productivity metric that measures contribution to an economy and is calculated taking the income (including subsidies) and minus the cost of purchases goods and services.
2. Water level expenditure is taken as a proxy for output value. GVA is calculated based on construction industry GVA per FTE for Somerset multiplied by estimate of workers in study area.

For context, the GVA from agriculture and the water industry in Somerset[15] is £193 million and £151 million, respectively. Hence the study area includes around 12% of the agricultural area of Somerset but generates only 5% of the agricultural GVA. Water level management of the SCLM represents around 8% of water industry GVA in Somerset. Also, for context, the gross tourism spend for Somerset was around £870 million per annum[16] in the pre-covid years (2017-19). Hence our estimates of the contribution of the natural assets

[13] Estimated as total government farm spend in England of £2.400 million divided by 8.9 million ha of utilised agricultural area. https://www.gov.uk/government/news/increased-government-funding-to-boost-farming-productivity

[14] Nature-related tourism refers to the portion of tourism that is related to visits to natural areas, e.g., nature reserves in the Levels

[15] The GVA figures cover Mendip, Sedgemoor, South Somerset, and Taunton Deane as reported in (Somerset County Council, 2016). Monetary figures were originally in 2011 prices and were uplifted using (HM Treasury, 2022). Note, there is a moderate confidence rating in these figures as the report has not been updated since 2016 and used historic data.

[16] Three year pre-covid average to 2019. Source Kantar (2019).

of the SCLM to this spend (£12.9 million) represents around 3% of this tourism value. Finally, total GVA in Somerset is estimated at £11,900 million in 2022[17], thus the economic contribution of natural assets represents 0.25% of Somerset's GVA.

Agriculture

Agriculture is the main economic land use in the study area (around 80% of land area) and is characterised by many small holdings. Over 70% of holdings are less than 50 ha and cover only 23% of the farmland area, whilst the largest 100 holdings cover over half the farmland area, (see Table 3.5). According to the Defra Somerset Levels and Moors Natural Character Area survey, 73% of the land is owned and 27% tenanted.

Table 3.5: Farm holdings by size (2021)

Holdings by size [1]	Area (ha)	% of all Farmland	Number of holdings
<5ha	228	1%	165
5 ha to 20 ha	2,506	8%	224
20 ha to 50 ha	4,946	15%	146
50 ha to 100 ha	7,679	23%	108
>100 ha	17,364	53%	102
Total	**32,723**	**100%**	**745**

Table note: Calculated from Somerset Levels and Moors Natural Character Area data (Natural England, 2021a), on the basis that the study area overlaps with 75% of the farmland area in the Natural Character Area.

Defra Natural Character Area (NCA) (Defra, 2022a) farming statistics have been used to infer agricultural land use on both deep peat and non-deep peat soils (Table 3.6), based on the area of each as a proportion of the total NCA farmland area. This data has a high confidence rating as the study farmland area overlaps with 75% of the NCA farmland area. Natural Character Area statistics indicate that 13% of grazing holdings are dairy holdings and this proportion was applied to all grazing land (See Table 3.1) to estimate the grazing area of dairy in the Area. These statistics also provide the total number of livestock (split by sheep and cattle) which were applied to the remaining grazing land in combination with typical livestock units for each type[18] to estimate a further split of land use by beef cattle and sheep (See Appendix Table 1 for data used). The Defra farm statistics indicated a few specialist pig and poultry holdings[19] within the Levels and Moors Natural Character area, but these are assumed to use a negligible area of land and have been excluded from the analysis. However, these businesses could be highly polluting to local water quality but have not been included due to lack of information on the number and type of business in the study area.

[17] GVA for Somerset was £11.7 billion in 2020, inflating to 2022 prices and assuming no growth provides estimate of £11,900 million in 2022. See SCC Economy and Planning team trends at: https://www.somersettrends.org.uk/topics/summary/

[18] Assume 1 LU per head of cattle and 0.12 LU per sheep.

[19] 13 specialist pig holdings and 12 specialist poultry holdings.

Table 3.6: Estimated Land use by Agricultural activity (2022)

Summary of Farmland by Use	Deep Peat (ha)	Non-Deep peat (ha)	Total (ha)	%
Arable	476	1,823	2,298	7%
Dairy	1,565	2,412	3,976	12%
Beef cattle	8,949	13,790	22,739	71%
Sheep	1,204	1,856	3,060	10%
Total	**11,718**	**18,058**	**32,075**	**100%**

The land area split for livestock was multiplied by average heads per hectare to find total heads of livestock in the scope area. These assumptions produced an estimate of over 48,000 head of cattle (beef and dairy) and 46,000 sheep. An estimate of the number of breeding females by type was calculated using England livestock population split (Defra, 2022b). These figures were used to calculate flows form farming activity (e.g., value from output and GHG flows). Livestock estimates are summarised in Table 3.7.

Table 3.7: Estimated Livestock Count by Type (2022)

Heads by Livestock type	Deep Peat	Non-Deep peat	Total	Heads/ha
All Livestock:				
Dairy	2,869	4,421	7,290	1.83
Cattle (beef)	16,406	25,282	41,689	1.83
Sheep	18,400	28,355	46,755	15.25
Total (all livestock)	**37,676**	**58,058**	**95,734**	
Breeding Female Livestock:				
Dairy cows	2,037	3,139	5,176	1.3
Breeding cows (Beef)	4,430	6,826	11,256	0.5
Ewes	8,648	13,327	21,975	7.2
Total (breeding females)	**15,115**	**23,292**	**38,407**	-

Care must be used to interpret these figures as these are based on headcount returns to the Defra agriculture survey and represent total heads of livestock and do not account for the seasonal nature of grazing within the SCLM. Key points to note:

- Traditional farming on the SCLM has been mainly in the summer and on higher ground in winter when the 'Levels' flood. Much of the 'Levels' are either not grazed, or only lightly grazed in the winter. This is particularly the case for the lower lying, wetter areas of the SCLM, corresponding to the areas of deep peat. Hence the stocking rates represent a maximum intensity which is only achievable in the summer months. According to views of local farmers participating in the workshops, around 50% of feed and grazing will occur off the SCLM, and the farming system is therefore dependent on a combination of floodplain ('Levels'), adjacent (raised) land and bought-in feed. Consequently, estimates of food output and greenhouse gas footprint that are attributable to the SCLM are based on 50% of the summer level of livestock.

- In absence of any firm basis to differentiate between stocking densities on deep-peat areas and non-deep peat areas, the same stocking density assumptions have been used for both. It is reasonable to believe that densities will be lower on the lower lying, wetter grassland, but to assign a robust differential in stocking rate to apply is difficult.

Agricultural yield from cereals and livestock was estimated based on local landholding and average national yield data for cereals (Redman, 2021) and livestock headcount data for breeding livestock (see Table 3.6 and Table 3.7). Farmgate prices (i.e., revenue to farmers) and costs were estimated using the John Nix pocketbook and averaged over a 4-year time period (2018 – 2021) to account for fluctuations in pricing (Redman, 2021). Though the John Nix Pocketbook contains national averages, local price and cost data was either not available or not considered substantive enough for the scale of this study. A sensitivity check was performed comparing output, prices, and costs to values published by local reports, and figures have a high confidence level of comparability[20]. The output and gross sales value of the agricultural output of the study area is shown in Table 3.8. This assumes that only 50% of livestock output is derived from the SCLM, the remainder being attributed to land off the SCLM for Winter feeding.

Table 3.8: Estimated agricultural output and value, 2022 prices.

Output (units)	Deep Peat	Non-deep peat	Total	Per ha
Arable crops (tonnes)	3,747	14,353	18,101	7.9 t/ha
Dairy ('000s litres)	8,148	12,556	20,704	5.2 '000 l/ha
Cattle (heads sold)	2,215	3,413	5,628	0.25 t/ha
Sheep (heads ewes)	4,324	6,663	10,987	0.22 t/ha
Gross value £'000				£k/ha
Arable	600	2,297	2,896	1.26
Dairy	2,363	3,641	6,004	1.51
Cattle (beef)	3,946	6,080	10,026	0.44
Sheep	450	693	1,143	0.37
Total	**7,358**	**12,711**	**20,069**	
Gross margin £'000				£k/ha
Arable	399	2,096	2,494	1.09
Dairy	830	1,279	2,108	0.53
Cattle (beef)	1,563	2,408	3,971	0.17
Sheep	242	373	615	0.20
Total	**3,033**	**6,156**	**9,189**	

[20] For the most substantive available local report see (Steer, 2021)

The gross value of agricultural production in the study area is around £20 million/year (in 2022 prices), but current (2022/23) food prices are considerably higher than previously due to the recent disruption to global food markets (see discussion below). The value of food production on deep peat soil is around £7.4 million/year, but again this is highly dependent on prevailing food market prices. Whilst current food prices are higher, many input costs are also significantly higher than previously, notably industrial fertilisers, bought-in feed and fuel. This means that that the gross margin would be similar to the figures in Table 3.8, which are based on prices and costs calculated on a 4-year average (2018 – 2021) to account for fluctuations in the market. Prices are presented in 2022 values. Key points to note:

- Arable crops output is assumed 50% of arable land (see Table 3.6) is used for fodder maize production and 50% for cereals[21]. Both have similar yields and output prices, giving a gross sales value (farmgate price) of £1,260/ha, but at gross margin level (77% of gross sales value) this is around £1,090/ha, assuming a sales value of £160/t[22].
- Dairy output is estimated at over 20 million litres/year with estimated value of £6 million per year calculated using the farmgate price of 29p/litre (Redman, 2021), (however recent prices are reaching around 45p/litre (AHDB, 2022a). Current gross output value is £1,500/ha. Dairy gross margin is around 35% of gross sales value, giving a gross margin of £525/ha.
- Beef cattle output is valued at over £10 million/year and provides a gross income of £440/ha. Margins vary greatly with the type of beef system, however a range of 20-50% of gross sales value is typical, depending upon the range and cost of bought-in feed (here the margin is about 40%). The gross margin is £170/ha.
- Sheep output is relatively low in the study area, and consequently valued at £1.1 million. Gross margins of 54% of gross sales value are not unreasonable, giving a gross margin per ha of £200/ha.

Gross margins need to cover farming businesses' other expenses such as fixed overheads (fuel, rates, plant and machinery maintenance etc), and they need to make a viable income for farmers to continue to farm the land. Currently most farm businesses do not make a net income from food production alone and rely upon diversified income from other sources, including agri-environment income, to make a viable living. For example, from the Farm Business Survey (2021/22) mixed farms in the South West of England make a loss of £168/ha from agriculture, and only make a positive income once agri-environmental payments and diversified income are included[23]. From the same survey, lowland grazing enterprises make £320 loss per hectare from farm activity alone. However, the gross margin per ha is a key factor is determining land use and will be compared to other opportunities to generate income from the land.

Remaining non-agrarian sectors

Detailed methodology relating to the remaining sectors, i.e., peat extraction, recreation/tourism, conservation, and water level management, is described in Appendix 1. Additional points to note on these sectors include:

[21] Based on expert views from the workshop participants.

[22] Since spring of 2021, fuel and energy price increases have impacted the gross value and costs to the farmer. For example, the farmgate price of cereals has been higher in recent years at £270/t (AHDB, 2022b)

[23] Regional report for South West England (2021/22) at: http://www.farmbusinesssurvey.co.uk/regional/Reports-on-Farming-in-the-Regions-of-England.asp

- In the peat extraction industry, licenses for around 500 ha of extraction remain valid to 2042, and four large local peat businesses employ around 56 staff. Exact ***amounts of peat extracted annually is unknown***. For calculations, 35,000 m^3 of annual extraction is assumed (see discussion in Appendix A1.2 for details) and has been used as the basis for subsequent calculations. ***For context this assumption represents around 50% of the peat extraction in England in 2021***[24]. The government plans to cease retail sale by 2024, however even with a retail ban, peat extraction for non-retail markets, professional use and exports may continue at some level, even as the proportion of peat content in all growing media declines. Many licensed sites have already been exhausted of peat and some are now nature reserves.
- Tourism visits and spend estimates were derived from Great Britain Visitor data for Somerset and a proportion attributable to nature assumed (see Appendix 1). Tourists are defined as visitors who spend more than 3 hours visiting nature and can include both locals to the region and over-night stays.
- Conservation activity was based on returns of financial spend and headcount from the main conservation site managers (Natural England, SWT, RSPB, WWT, National Trust, FWAG, and the Hawk and Owl Trust). In addition to paid conservation activity, the sector benefits from the work of volunteers. The benefits to an individual of volunteering are many and varied, including physical and mental health benefits, skills training, as well as a sense of contribution to wider society.
- Water level management sector estimate was based on costs derived in section 3.1.2.

3.1.4 Employment

The scope of the employment analysis covers jobs that are land-based and dependent upon the natural capital of the SCLM. Employment is largely reflective of trends covered in Section 3.1.3 above. For example, farming is the largest employer, making up nearly 70% of total FTE jobs in the area. The exception is that the ratio of jobs compared to GVA in water level management is significantly lower than the other sectors, due to its high GVA per employee. Employment in the SCLM are summarised below, and methods are described in Appendix 1:

- The agricultural sector is a significant source of jobs in the area (69%) and is subject to a high level of confidence as this is sourced from Defra statistics from the Somerset Levels and Moors NCA.
- Nature-related tourism employment is estimated at about 230 FTEs. Whilst employment in the tourism sector is measured at Somerset and local authority level, it is challenging to estimate the proportion that is attributable to the nature of the SCLM. Here we have used an ONS estimate of tourism expenditure attributable to nature (8%), but this is subject to a moderate range of uncertainty. This sector has capacity for growth if investment is made into improving nature-related infrastructure and to draw more tourists to the area (Heart of South West LEP, 2021). Though these jobs are mostly located in the urban areas surrounding the SCLM at restaurants and hotels, their existence is highly related to tourists visiting nature sites.
- Jobs in water level management are numerically comparable to the tourism industry, but is subject

[24] 69,400 cubic metres extracted in England 2021. This compares with 555,000 cubic metres extracted in the rest of the UK and 700,000 cubic metres sourced from the Republic of Ireland. Defra/HTA Growing Media report, HTA (2022), available at: https://hta.org.uk/media/omiojakk/2021-growing-media-monitoring-report-vf.pdf.

to a significant range of uncertainty, as it is not clear what proportion of employment may be within the SCLM (and not contactors from outside the area).

- There is relatively low employment in both conservation and peat extraction and estimates have been based on survey returns from conservation NGOs and company returns for peat extraction businesses so have a fairly high degree of confidence. Jobs in the peat extraction sector also involve the mixing and packaging of peat and other growth media into products for both the retail and professional growing markets. These jobs may exist in future without extraction of peat from the 'Levels' if material were sourced from elsewhere, but would no longer depend upon the natural assets of the 'Levels'.

Table 3.9 summarises FTE by land use sector and water level management and percent of total employment in the project area. Detailed methodology on employment calculations is included in Appendix A1.2.

Table 3.9: Estimated Full-Time Equivalent (FTE) by in-scope sector

Employment	FTE	%
Agriculture	1,383	69%
Peat extraction	56	3%
Water level management	280	14%
Recreation/tourism	234	12%
Conservation*	51	3%
Total	**2,004**	**100%**

Table note: *Conservation includes provision of visitor facilities and management of sites.

For context:

- Total employment in farming in Somerset 10,418 FTE heads[25]. Hence the study area represents 13% of the agricultural employment in the county (and 12% of the farming area).
- Employment overall in Somerset was 237,700 in 2021[26]. Hence the land of the SCLM supports less than 1% of the jobs in Somerset.
- Water industry employment was 1,800 FTE in Somerset in 2013. Assuming similar employment in 2022, then the water level management activity of the study area is 18% of water industry total.
- Tourism provided 8,881 FTE jobs in Somerset in 2018 (pre-covid)[27], hence the SCLM represents 2.6% of the county total.

[25] See: https://www.gov.uk/government/statistical-data-sets/structure-of-the-agricultural-industry-in-england-and-the-uk-at-june

[26] SCC Somerset trends (Somerset County Council, 2023); https://www.somersettrends.org.uk/topics/employment-workforce/employment/#:~:text=Data%20from%20the%20Labour%20Force,%2C%20a%20rate%20of%2075.2%25

[27] Heart of SWLEP tourism data 2018

3.1.5 GHG Footprint

Table 3.10 shows the current GHG flow within the study area related to land use and management[28], with full methods explained in Appendix A1.3. This shows sequestration (for example in saltmarsh and wet fen), and emissions (highlighted in red brackets) from farming on drained deep peat soils and from farm operations. The most substantial GHG emissions source is carbon loss from deep peat soils due to cropping and grazing (64% of total emissions). The 14,500 ha of deep peat within the study area stores large quantities of carbon, but 12,800 ha of this land is drained and used for farming. Drained peat soils are substantial emitters of carbon, and annual emissions have been estimated based on (Evans et al., 2017), assuming 39 tCO_2e/year emissions from arable peat land and 19 tCO_2e/year from grazed peat land. Actual rates of emissions will depend upon many factors, but chiefly the extent to which the land is drained. There is a linear relationship between water level and GHG losses from deep peat. To avoid carbon losses, peat soils should be permanently wet to an optimum depth of 10 cm below field surface (Evans et al., 2021).

Table 3.10: GHG flow by land use/activity

Activity/land use	On Deep peat tCO2e/year	Non-deep peat tCO2e/year	Total tCO2e/year
Woodland	-	2,539	2,539
Fen and marsh [1]	-	-	-
Saltmarsh	90	13,055	13,145
Peat extraction	(13,475)	-	(13,475)
Water level management [2]			(900)
GHG flows deep peat land used for farming:			
Arable land use	(18,548)	-	(18,548)
Grazing land use	(222,882)	-	(222,882)
GHG flows from farming activity			
Arable production [3]	(1,124)	(4,306)	(5,430)
Livestock production [4]	(32,482)	(50,055)	(82,537)
Total	**(288,421)**	**(38,768)**	**(328,089)**

Table notes:

1. In the absence of any data on condition no sequestration or emissions estimate has been made for fen and marsh.
2. Water level management emissions are not attributed to either deep peat or non-deep peat land areas.
3. Arable emissions are based on average total emissions (including scope 3) per tonne of crop produced.
4. Livestock emissions are based on UK average emissions per litre of milk or deadweight of beef or lamb produced. These include enteric methane emissions (the most significant element), energy use and emissions from inputs (e.g., fertilisers and feed). All emissions are adjusted to 50% to reflect that livestock production is assumed to be 50% derived from the SL&M and 50% from outside the study area.

The extent of peat extraction on the 'Levels' is difficult to quantify as there are no records of quantities extracted. Whilst peat extraction removes considerable quantities of carbon, the main emissions arise from

[28] Land use and management include agricultural management and water level management. GHG emissions from transportation, residential or non-nature related businesses (i.e., not peat extraction or farming) buildings and activity were not included.

the draining and disturbance of peat soils. Extraction is currently carried out on a small scale, typically involving a few businesses extracting from tens of hectares at a time (see section 3.1.1). The estimates here are based on the rough assessment of extraction (35,000 cubic metres per year, which represents around 50% of the extraction in England in 2021) (Somerset County Council, 2015) (see discussion in Appendix A1.2 for details). Whilst this is a high emissions intensity per hectare, the overall scale of losses is small compared to the losses from farming on deep peat as active peat extraction land use is significantly smaller than agricultural land cover.

GHG emissions from water pumping on the SCLM was estimated by an expert from EA for the purpose of this report. The annual emissions rate of 900 tCO_2e is a maximum figure. Further, the EA are aiming to be a net zero organisation by 2030. The UK Government plans to fully decarbonise electricity generation by 2035.

Other land used for farming activity (i.e., excluding impacts on deep peat soil) is responsible for around 22% of GHG emissions (Table 3.11). Beef and dairy are the most significant sources of emissions (over 70,000 tCO_2e), arising mainly from enteric methane emissions accounting around 50% of emissions. In terms of emissions intensity per hectare, dairy has the highest impact, followed by cattle, sheep and arable.

Table 3.11: Analysis of GHG emissions by farming activity (as summarised in Table above)

GHG Output by activity (tCO_2e)	Deep Peat	Non-Deep peat	Total	Per ha
Arable	(1,124)	(4,306)	(5,430)	(2.4)
Dairy	(9,778)	(15,067)	(24,845)	(6.2)
Cattle	(19,435)	(29,950)	(49,386)	(2.2)
Sheep	(3,269)	(5,037)	(8,306)	(2.7)
Total	**(33,606)**	**(54,361)**	**(87,967)**	

Around 75% of farming emissions are scope 1 (i.e., arising from direct activity, mainly due to methane emissions from livestock), and 25% are scope 2 and 3 (emissions from grid electricity, and in the supply chain, notably for production of inorganic fertilisers).

The above analysis has been based on national average GHG flow assumptions per unit of output and applied to a robust assessment of output from land use within the SCLM. Actual emissions in the study area could be higher or lower than these estimates, depending upon farming practices (e.g., use of inorganic fertilisers or manures). Within farming businesses there can be significant variation on GHG emissions performance. For example, best practice arable techniques can cut cereal intensity by 40%, from 0.3 tCO_2e/t to 0.18 tCO_2e/t[29]. Similarly, the top third of beef enterprises can achieve around 60% of the emissions of the lowest performing third[30].

Whilst this analysis is based on national average assumptions, the results do support the following key

[29] See: https://adas.co.uk/news/benchmarking-crop-carbon-footprints-reveals-opportunities-for-cutting-emissions/
[30] See: https://www.qmscotland.co.uk/sites/default/files/qms_cattle_and_sheep_enterprise_profitability_2020.pdf

messages and conclusions:

- Farming on deep peat soils entails draining these soils and results in the most significant source of GHG emissions in the study area. Re-wetting these soils represents a major opportunity to abate carbon losses but would mean changing land use for grazing and a potential reduction in certain crop production.
- As the most significant emission source is enteric fermentation emissions from livestock, any reduction in stocking density would have the greatest impact on overall GHG emissions.
- Most farm enterprises can significantly reduce their GHG footprint by switching to regenerative and other less intensive farming techniques. This is likely to be a significant area of opportunity for GHG reduction in the SCLM.
- Water level management energy consumption (from pumping) is a minor driver of emissions (currently 900 tCO_2e), and over time this should reduce as grid electricity carbon intensity reduces (to net zero by 2035[31]) and the EA becomes net zero by 2035.
- Opportunities for sequestration in habitats are likely to be smaller in scale but could be achieved through expansion of saltmarsh and woodland creation (on the right soils).

3.1.6 Non-market Ecosystem Services

Non-market benefits consider costs/benefits that are not represented in market values discussed in Section 3.1.3. Non-market benefits can be difficult to evaluate, and often use costs of activities as a proxy for value (such as costs of GHG abatement as a proxy for the value of carbon sequestration). Estimates of non-market benefits are shown in Table 3.12 (see A1.3A1.4 for methodology). This demonstrates that the value of the dis-benefits of GHG emissions (largely from drainage of deep peat soils and farm operations) far outstrip other benefits of natural capital and hence should be a priority for emissions reduction measures.

Table 3.12: Economic valuation of non-market benefits and dis-benefits.

Non-market benefit	**£'m (2022)**
GHG sequestration in habitats	4.0
GHG emissions from deep peat	(64.9)
GHG emissions (all other)	(22.6)
Recreation	15.3
Physical Health	5.6
Air quality	0.2
Total	**(62.4)**

[31] Plans unveiled to decarbonise UK power system by 2035: https://www.gov.uk/government/news/plans-unveiled-to-decarbonise-uk-power-system-by-2035

Note that major non-market benefits such as water quality, flood regulation, pollination services, aesthetic/cultural value of landscape have not been possible to evaluate within the timescales and resources of this project, and hence are not included in this table. However, it must be borne in mind that these are still major benefits that the SCLM provide.

The value of biodiversity is captured to some extent in the table above (for example in supporting the value of recreation). However, attributing a monetary value to species and habitat diversity is complex and not fully supported by available evidence. Consequently, it is assessed in qualitative terms in the next section.

GHG flows

GHG flows have been valued at the central non-traded value of carbon (BEIS, 2021). Flows have been organized in three categories: climate regulation, emissions from deep peat, and all other. Emissions from deep peat include all habitat types and agricultural land use on areas with deep peaty soils and peat extraction. For agricultural land-use, e.g., cropland and grazing land, flow rates are significantly higher than on non-peaty soils.

Recreation

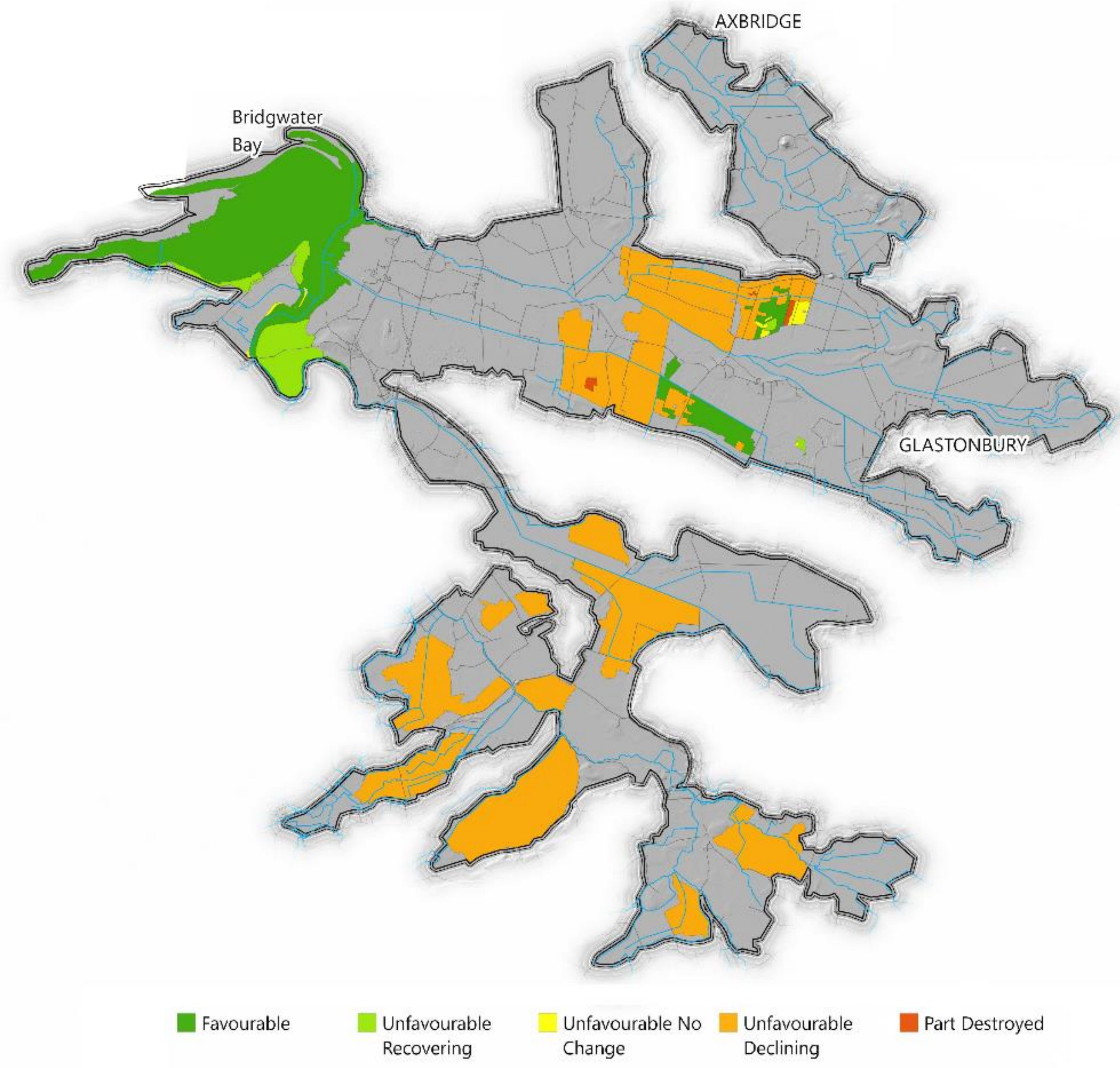
Non-market values for recreation differ from GVA in nature-related tourism as the value for recreation is taken from the ORVal[32] tool (2018), which estimates the welfare value of visits to accessible open space (sites and paths). Both Orval and Kantar (2019a, 2019b), from which tourist visits are calculated, both use MENE data (MENE, 2019). In order to avoid double counting visits to the SCLM, only visits under 3 hours (MENE breaks down visits by length) were used to estimate the non-market value of recreation. Visits over 3 hours are assumed to be included in tourism spend (covered under tourism economic activity). See Appendix 1 for detailed methodology.

3.1.7 Biodiversity

Biodiversity makes a range of use and non-use contributions to human welfare than can potentially be given an economic value (eftec, 2019). Some of these contributions are captured in other ecosystem service values. However, evidence is not available to fully measure the value to people, in particular the non-use value of biodiversity conservation (i.e., that people want biodiversity conserved irrespective of their uses of it), in monetary terms. Therefore, a range of qualitative measures are used for biodiversity.

Condition of SSSIs by condition category is given in Table 3.13.

[32] ORVal is a spatial model that shows the recreational sites, number of visits and the benefit to visitors using data from mapping tools, Monitor of Engagement in Natural Environment (MENE) survey, and economic valuation literature.



Source: © Natural England copyright. Contains Ordnance Survey data © Crown copyright and database right 2023.

Figure 3.8: Condition of SSSI

Table 3.13: Condition of SSSIs in the study area

Condition	Area (ha)	%
SSSI - Favourable	3,482	32%
SSSI - Unfavourable recovering	593	5%
SSSI - Unfavourable no change	83	1%
SSSI - Unfavourable declining	6,697	61%
SSSI - Part destroyed	36	0%
Total	**10,975**	**100%**

Key measures of condition:

- Designated sites in favourable or recovering condition is 37% vs unfavourable no change or declining at 63%. However, most of this favourable area is the Bridgwater Bay SSSI. Most of the area of the 'Levels' is unfavourable declining.
- The most common cause of poor condition is poor water quality phosphorus (P) concentrations being the major problem and should be less than 0.1mg P/l to support "favourable condition" (Natural England, 2021b). Monitoring indicates that the annual mean concentrations of phosphate in the river inputs into the SSSIs, are at least 3 times this target in numerous locations.
- Proportion of land under management for nature (current = 32% designated plus manage reserves).

3.2 Summary, Interpretation and Key Messages

Overall, around £35 million of public money (section 3.1.2) supports the in-scope sectors (farming, peat extraction, tourism, and conservation, plus the supporting activity of water level management). Alignment between items of public spend and specific industries is not feasible as line items of expenditure support multiple sectors and benefits, (e.g., water level management enables agricultural use but also supports raised water levels to support conservation and nature-based tourism). Consequently, the overall return on public expenditure must be assessed considering the impacts of all sectors relative to the total public investment.

The economic benefits and costs by each industry is shown in Table 3.14. At the total level, the analysis illustrates that £35 million of public spend supports:

- local GVA of £30 million, 30% of which is from farming.
- around 2,000 FTE jobs, with 70% in the farming sector
- £15 million of public benefit arising from public access to nature.
- but with a net disbenefit of £87 million in GHG emissions. This is largely due to cultivation and grazing on deep peat soils, and due to farming operations.
- The above monetary values exclude impacts on biodiversity, which are described qualitatively in the final column.

Overall, the net loss (measured as GVA plus monetary benefits, minus disbenefits and public investment) in monetary value is £67 million. This loss is driven by GHG emissions from drained deep peat and farming emissions. The analysis shows that:

- **There is a clear case for re-wetting deep peat** (to optimum water level of 10cm below surface). The economic value of GHG losses from deep peat (£65 million in 2022) far outweighs the associated income from farming. This makes the case for providing incentives to landowners to rewet the key areas of deep peat in the 'Levels'. 14,500 ha of the SCLM are deep peat soils and of this area 88% is farmed. Depending upon the type of farming, peat emissions from deep-peat soils can be in the range 19-38 tCO2e/ha per year. Using the central Department for Business, Energy and Industrial Strategy (BEIS) non-traded value of carbon this emission has a disbenefit in the range of £4.75 – 9.5k per ha. The BEIS range of non-traded values has upper and lower ranges of +/- 50%, but even at the lower range, the value of avoided carbon emissions is substantially greater than returns from farming. If all emission from deep peat soils were eliminated this could save around 255,000 tCO_2e per year with a value range of £33 to £98 million. For comparison the gross value of food output from deep peat soils is around £8 million and GVA of around £2.5 million.
- **The GHG costs of peat extraction are likely to exceed market income from this activity**. The economic value of peat extraction on the 'Levels' is very difficult to estimate as the existing level of extraction is not known, however the costs of carbon losses are at least comparable to any gross sales value of peat and certainly greater than the level of profit from the business.
- **Tourism provides a reasonable income and employment opportunity within the SCLM** There is a well-established range of nature reserves in the study area (covering over 6,000 ha or 15% of

the area) that support nature-based tourism and outdoor recreation. It is estimated that this generates a minimum of £13 million tourism/recreational expenditure per year in Somerset and supports employment of around 270 FTE (tourism and conservation employment combined).

- There are likely to be opportunities for regenerative farming practice to improve support to biodiversity and reduce GHG emissions from farming. Key issues are:
  - Water quality is generally poor in the SCLM with the main problem arising from high phosphate concentrations. This is the most significant issue to address to support improvements in habitat condition for the wetlands. Wessex Water is in the process of reducing discharges with on-going improvement plans, Agriculture is now the main source of diffuse phosphate pollution and will require concerted efforts to reduce application rates, both within and upstream of the SCLM.
  - Setting aside more land for margins for nature (buffer zones around water courses and pollinator strips) would support the wider landscape to improve and allow species to move between conservation sites.
  - GHG footprint can be reduced, for example, through reductions in industrial fertiliser use, improving livestock diet and reducing stocking density on areas that require light grazing for conservation benefits.

Table 3.14: Analysis of net benefit by sector (£ 2022 prices)

Sector	Public Spend £'m	GVA £'m	Employ-ment (FTE)	GHG Benefits[1] £'m	Other Public Benefits [2] £'m	Net Benefit £'m	Biodiversity impacts
	A	B	C	D	E	B+D+E-A	
Farming		9.2	1,383	(84)		(75)	Poor WQ, and eutrophication Lack of habitat for pollinators and winter waders Low diversity grassland
Peat extraction		1.9	56	(3.4)		(1.5)	Lack of habitat on extraction sites
Tourism		4.8	234			5	Small – but visitor pressure a risk
Conservation		1.9	51	4	21	27	Maintained habitats (over 6,000 ha) for wetland, wet grassland and coastal margins
Water level management		12.2	280	(0.2)		12	
Total public expenditure	35					(35)	
Total	**35**	**30.0**	**2,004**	**(84)**	**21**	**(67)**	

Table notes:

1. Dis-benefits are shown as a cost (in brackets)
2. Recreation benefit (non-fee paying) is shown under conservation.

4. Scenario Results

This section presents details of the two scenarios used for the study, outlined in Section 2. Assumptions are made to enable the analysis, informed by expert advice. The section also presents results of the analysis.

Figures are presented at three time intervals, 2022 (baseline), 2035 and 2050 to show change over time. For Scenario 1 and 2, change occurs from the baseline date up to 2070 to account for gradual impacts from climate change then is assumed constant thereafter. Detailed methodology for each of the impacts assessed is included in the appendix 1.

4.1 Scenario 1: Business As Usual with Future Trends

Scenario 1: 'Business As Usual with Foreseeable Future Trends' focuses primarily on three material changes: Climate change, population growth and phasing out of the BPS. A detailed description of the scenario is in Section 2.2.

4.1.1 Land use & Condition

For the purposes of the analysis, it is assumed that land use and condition gradually change over the period with some significant consequences from climate change:

- Continued deep peat loss arising from ongoing drainage (up to 19 million tCO_2e over 80 years);
- Water quality likely to decline with ongoing use of inputs (Phosphate in particular); and
- Designated habitat likely to deteriorate further with consequential impact of key wildlife invertebrates/ fish and birds (see section on biodiversity Section 4.1.7).

Climate change may also impact habitat cover through changing weather patterns and rising sea levels, but an accurate forecast of where these changes will occur and to what extent is difficult to predict. For this reason, habitat cover is assumed to remain the same as in the baseline throughout the forecast time horizon. See Table 3.1 for breakdown of habitat cover.

4.1.2 Public Spend

It is not the aim of this project to forecast future government spend in the SCLM. However, to illustrate known likely increases these are added to current levels of spend and illustrate major changes over time in Table 4.1.

Table 4.1: Public spend impacts for Scenario 1

Area	2022	2035	2050 +	Reasons and commentary
Agri-env	9.2	9.2	9.2	Consolidation of smaller holdings likely but assume overall agri-environment spend is constant.
WLM and FRM	25.0	>25.0	40.0	Significant spend to mitigate CC. £750 million needed from 2050 to 2100 (i.e., £15 m/year).
Conservation	2.5	2.5	2.5	Assume constant but more is likely needed to meet conservation goals
Total	**36.7**	**>36.7**	**>51.7**	

4.1.3 Economic Activity

- GVA in the agriculture sector decreases with climate change due to decreases in productivity from erratic weather patterns and increases in costs as farmers will likely spend more to try to keep similar levels of productivity as the baseline, e.g., moving livestock and spending more on feed more often because of flooding outside of regular season.
- Peat extraction is assumed to cease in the SCLM in 2042 when licenses to extract expire. Continuing employment in the growing media sector will depend upon how successful local businesses are in developing alternative media and ensuring security of supply chains. This may be some combination of locally sourced media (e.g., moss, compost or wood based matter), and sources from further afield. Until 2042, levels of extraction are assumed to remain constant as companies are incentivised to continue production until the end of their license. There is evidence that producers are significantly reducing the use of peat in growing media. In the UK, peat as a percentage of total media has fallen from 48% in 2019 to 36% in 2021 (HTA, 2022). Some of the major growing media businesses in the SCLM are publicly committing to a peat free future (e.g., Dunstan's). However, assuming that in future the industry will not depend upon the natural assets of the 'Levels' for growing media, no employment has been assumed from 2042 onwards.
- A small growth in the tourism sector is assumed in line with population increase in Somerset (10% by 2040). In this scenario it is assumed that there is no significant tourism investment in the SCLM area (investment to boost tourism being targeted elsewhere in the Southwest). Following assumptions in the baseline, there is a risk that worsening land condition may negatively impact the number of tourists, hence investment in promoting tourism may be wasted expenditure if there is no corresponding investment in improving natural habitat. Note scenario 2 assumes significant investment aligned with nature improvement.
- Conservation activity is assumed constant at the baseline level. Costs may need to increase with attempts to mitigate declining land condition from climate change but are not calculated as effort to mitigate will be restricted by funding.
- Water level management activity increases with the need to build more infrastructure and pump water more often to cope with climate change (increase rainfall and flooding outside normal wet period). EA has estimated that £750 million extra spend will need to be spent in the remainder of

this century to maintain the network of inland drainage systems to cope with climate change. This equates to an additional £15 million a year by 2050.

Overall, GVA from the four land use sectors and water level management is expected to be higher in 2050 than in the baseline (2022), largely due to the increase in need for activity on water level management. Agricultural output is likely to drop with climate impacts, but tourism shows a small increase with population growth. Though there is a risk this improvement may be counteracted by decreasing interest by visitors in the SCLM as land condition worsens.

Table 4.2 summarises the change in GVA for the four main land use sectors and water level management in Scenario 1. Impacts from climate change are as follows:

- GVA in the agriculture sector decreases with climate change due to decreases in productivity from erratic weather patterns and increases in costs as farmers will likely spend more to try to keep similar levels of productivity as the baseline, e.g., moving livestock and spending more on feed more often because of flooding outside of regular season.
- Peat extraction is assumed to cease in the SCLM in 2042 when licenses to extract expire. Continuing employment in the growing media sector will depend upon how successful local businesses are in developing alternative media and ensuring security of supply chains. This may be some combination of locally sourced media (e.g., moss, compost or wood based matter), and sources from further afield. Until 2042, levels of extraction are assumed to remain constant as companies are incentivised to continue production until the end of their license. There is evidence that producers are significantly reducing the use of peat in growing media. In the UK, peat as a percentage of total media has fallen from 48% in 2019 to 36% in 2021 (HTA, 2022). Some of the major growing media businesses in the SCLM are publicly committing to a peat free future (e.g., Dunstan's[33]). However, assuming that in future the industry will not depend upon the natural assets of the 'Levels' for growing media, no employment has been assumed from 2042 onwards.
- A small growth in the tourism sector is assumed in line with population increase in Somerset (10% by 2040). In this scenario it is assumed that there is no significant tourism investment in the SCLM area (investment to boost tourism being targeted elsewhere in the Southwest). Following assumptions in the baseline, there is a risk that worsening land condition may negatively impact the number of tourists, hence investment in promoting tourism may be wasted expenditure if there is no corresponding investment in improving natural habitat. Note scenario 2 assumes significant investment aligned with nature improvement.
- Conservation activity is assumed constant at the baseline level. Costs may need to increase with attempts to mitigate declining land condition from climate change but are not calculated as effort to mitigate will be restricted by funding.
- Water level management activity increases with the need to build more infrastructure and pump water more often to cope with climate change (increase rainfall and flooding outside normal wet period). EA has estimated[34] that £750 million extra spend will need to be spent in the remainder of this century to maintain the network of inland drainage systems to cope with climate change. This

[33] See: https://www.durstongardenproducts.co.uk/
[34] Private comms via the SCLM nature recovery team.

equates to an additional £15 million a year by 2050.

Overall, GVA from the four land use sectors and water level management is expected to be higher in 2050 than in the baseline (2022), largely due to the increase in need for activity on water level management. Agricultural output is likely to drop with climate impacts, but tourism shows a small increase with population growth. Though there is a risk this improvement may be counteracted by decreasing interest by visitors in the SCLM as land condition worsens.

Table 4.2: GVA over time in Scenario 1, £'m

Activity	2022	2035	2050 +
Agriculture	9.2	9.0	8.7
Peat extraction	1.9	1.9	-
Recreation/tourism	4.8	5.1	5.3
Conservation	1.9	1.9	1.9
Water level management	12.2	14.0	18.2
Total	**30.0**	**31.9**	**34.1**

Table note: Monetary figures are presented in 2022 prices to avoid skewing comparison between values over time.

4.1.4 Employment

Overall, the total level of employment is likely to be roughly the same over time and is summarised in Table 4.3. but there are likely to be some sectors that gain and some that lose jobs. Overall, employment in the area will likely be c 2,000 FTE jobs. Jobs in agriculture will likely decrease as BPS is phased out and the costly impacts of climate change reduce output. At present, an accurate understanding of how climate change will impact jobs in the sector is difficult to forecast but, a feasible impact may be a 5% reduction by 2050, which is in line with assumed reductions in output. In this scenario, increases in water level management activity and a small growth in tourism offset the small fall in agricultural employment.

Other notable impacts include:

- The peat industry is the process of transitioning to peat free alternatives for growing media (driven both by government policy and consumer demand). Forecasting the rate of change is a challenge, but Jobs are assumed to rely upon local peat until extraction ends when current licenses expire in 2042. Jobs are assumed to remain stable until 2035, but depend entirely upon non-locally sourced material thereafter (e.g., imported coir/coconut husk, or wood based material). As these will not depend upon media sourced from the 'Levels', these jobs are no longer included in the analysis post 2042.
- Jobs in the nature-related tourism industry increase as number of tourists increases, and there will be some knock on benefit to tourism in general, although in this scenario it will be small. There are risks that worsening land condition will likely negatively impact the number of tourists wanting to visit the SCLM, but it is assumed that this is small.

- Employment in water level management is assumed to increase in line with higher expenditure on water level management infrastructure.
- Employment in conservation is assumed to remain constant at current levels. Growth in this sector is included in Scenario 2.

Table 4.3: Employment over time in Scenario 1, (FTE)

Activity	2022	2035	2050 +
Agriculture	1,383	1,352	1,311
Peat extraction	56	56	-
Recreation/tourism	234	250	256
Conservation	51	51	51
Water level and flood risk management	280	322	420
Total	**2,004**	**2,031**	**2,038**

4.1.5 GHG Footprint

As discussed, climate change will impact the use and condition of land in the SCLM, which will impact the GHG emissions from this area. Overall, GHG emissions will likely decrease from almost 370,000 to 310,000 tCO2e annually as emissions from peat extraction ending in 2042, and water level management emissions become net zero by 2035. There is a risk that carbon emissions from deep peat may increase with drier summers (greater peat oxidation and erosion), but this impact is difficult to quantify and hence has not been included in the future estimates.

Table 4.4: GHG emissions per land type in Scenario 1

	2022	2035	2050
Emissions form Deep Peat	(87,967)	(87,441)	(85,109)
Agri-production	(241,430)	(241,430)	(241,430)
Natural habitats [1]	15,684	15,684	15,684
Peat extraction	(13,475)	(13,475)	-
Water level management	(900)	-	-
Total	**(328,089)**	**(326,662)**	**(310,856)**

Table note: Climate change may influence sequestration in various ways. For example, higher temperatures (longer growing seasons) and higher atmospheric $C0_2$ concentration may lead to higher sequestration; however, lower rainfall and more extreme events might work in opposite direction. In the absence of any firm evidence in either direction sequestration has been assumed constant.

4.1.6 Non-market Ecosystem Services

Benefits that are not traded through the economy, i.e., non-market benefits are summarised in Table 4.5. Like the baseline, the value of dis-benefits from GHG emissions (largely due to drainage of deep peat soils and emissions from farm operations) far outweigh the value of other benefits of natural capital. This scenario emphasises that emissions reduction measures should be prioritized.

Monetary disbenefits from GHG emissions increase over the period due to the increase in the unit value of non-traded carbon in real terms to 2050 (from £255/tCO_2e currently to £388/tCO_2e by 2050, (BEIS, 2021)). This reflects the increase in costs to achieve GHG emissions mitigation as progress is made towards the net zero target of 2050. However, as discussed in Section 4.1.5, this increase in disbenefit value is offset very slightly by the small decrease in physical flows for GHG emissions across agriculture, peat extraction and water level management progressively towards 2050. For more information see Appendix A1.4.

Recreation and physical health have increasing non-market benefits due to greater recreational use through population rise and assumed to increase in linearly with local population growth.

The value from air quality regulation by trees is relatively small and remains constant as the hectares of trees remains the same as in the baseline.

Table 4.5: Summary of non-market benefits and dis benefits in Scenario 1, (£'m 2022 prices)

Non-market benefit	2022	2035	2050
GHG sequestration in habitats	4.0	4.9	6.1
GHG emissions (agriculture and WLM)	(22.6)	(27.1)	(33.0)
GHG emissions - deep peat and peat extraction)	(64.9)	(79.0)	(93.7)
Recreation	15.3	16.4	16.8
Physical Health	5.6	6.0	6.2
Air quality	0.2	0.2	0.2
Total	**(62.4)**	**(78.7)**	**(97.4)**

Table note: Monetary figures are presented in 2022 prices and are not inflated as to avoid skewing comparison between the slices of time.

Note, the benefit of biodiversity is a very significant non-market benefit, however it is very difficult to adequately capture this in monetary terms. The value of biodiversity is discussed qualitatively in Section 4.1.7 below.

4.1.7 Biodiversity

Biodiversity will be impacted by many factors, including:

- Farming practice (in particular, continuing diffuse pollution of nutrients through fertiliser use which will adversely impacts water quality),
- Climate change which will adversely affect habitat in many ways, such as more frequent and prolonged periods of drought, more frequent and severe floods, and extreme temperature events.
- Population increases (10% increase in local population by 2042), which may increase pressures on local land use, but are likely to be relatively small compared to the factors above.

Predicting quantitative changes in biodiversity with these potential impacts is very challenging. Anticipated changes may produce some gains for some species and habitat types, but it is more likely that there will be more losses for some key species on the SCLM (wintering birds and breeding waders). A Natural England report on climate change impact on key bird species in Somerset Levels & Moors SPA[35] shows that most species are likely to experience populations declines (Table 4.6).

Table 4.6: Climate change impact on key bird species in the Levels and Moors, number of species

Species Impact	2050	2080
Number of species populations that fall by more than 50%	13	16
Number of species that fall by less than 50%	5	3
Number of species that maintain current levels	2	2
Number of species that increase	7	5
Total species count	**27**	**26[1]**

Table notes: Population projections were not calculated in the 2080 scenario for little egrets.

Species that face the highest levels of potential population decline are:

- Winter warders: Golden Plover, Lapwing and Ringed Plover
- Water birds reliant on shallow water: Bewick's Swan, Whooper Swan, Coot, Gadwall, Wigeon, Pintail and Mallard
- Open Water birds: Cormorant, Goldeneye, Goosander, Tufted Duck, Little Grebe.

Lowland fen, raised bog, grassland, and coastal saltmarsh are highly sensitive habitats to climate change [36]. NE have conducted climate change risk assessments to NNRs in the study area, based on assessing the likely impacts of;

- changing rainfall patterns (wetter winters and drier summers),
- temperatures (warmer winters and summers), and
- the impact of extreme events.

The impacts of these three climate factors were assessed as high, medium or low risk for selected features of importance, and on overall risk rating was assessed as a combination of these climate factors. These assessments are reproduced in Appendix A1.5, and features at high overall risk are shown in Table 4.7 (for the Somerset levels NNR) and Table 4.8 (for Bridgwater Bay NNR).

[35] Franks, S.E,Pearce-Higgins, J.W., Ausden, M. & Massimino, D. 2016. Increasing the Resilience of the UK's Special Protection Areas to Climate Change – Case study: Somerset Levels and Moors. Natural England Commissioned Reports, Number 202d.

[36] NE Climate Change Adaptation Manual (2020): http://publications.naturalengland.org.uk/publication/5679197848862720

Table 4.7: Vulnerability Assessment for Somerset Levels NNR (Features at high risk):

Group	Specific Features	Reasoning
Habitats	Fen grassland Traditional Orchards Ditches	Affected by flooding and drought
	Grasslands Species rich neutral grassland	Particularly vulnerable to heavy rain in summer / extreme events
	Remnant raised bog or mire	Particularly vulnerable to drought conditions
Wildlife	Wintering Bird Assemblage Breeding Bird Assemblage Invertebrate Assemblage	Affected by flooding and drought
	Reptiles & Amphibians	Vulnerable to extreme events cold spring, wet summer
	Water vole	Can move but limited and reliant on water network
	Butterflies and moths Bumblebees and other pollinators	Particularly vulnerable to extreme conditions

A similar assessment has been carried out for the Bridgwater Bay NNR which covers the coastal range of the study area (Table 4.8).

Table 4.8: Vulnerability Assessment for Bridgwater Bay NNR (Features at high risk):

Group	Specific Features	Reasoning
Habitats	Saltmarsh Shingle Beach	At risk of coastal squeeze due to rising sea levels and more frequent storm surges.
	Intertidal Mudflats	Vulnerable to rising sea levels and extreme events
	Coastal & Floodplain Grazing Marsh	Likely to be subject to sea water floods and or drought with increasingly prevalent extreme weather events and sea level rise.
	Ponds & Ditches	Highly vulnerability to changing weather patterns especially droughts.
Wildlife	Wintering Birds	Changing range, impacts of rising sea level and shifting habitat assemblage will all impact wintering birds.
	Breeding Birds	Unpredictable weather patterns, extreme events, changing range, impacts of rising sea level and shifting habitat assemblage will all impact breeding birds.

The above habitats face significant risks from a combination of flooding, drought, extreme weather events and rising sea levels. This will impact not only the water birds and waders for which many sites have been designated, but many other species too.

4.1.8 Summary & Key Messages

Climate change presents the greatest threat to the economic and environmental benefits of the SCLM, although other foreseeable changes have some impact too. These impacts are wide ranging but the most significant are:

- Climate change is likely to cause steady and sustained falls in agricultural productivity (mainly through changes in rainfall, and extreme weather events) and hence reduce farm profitability. These impacts are being realised now and will get steadily worse with each decade throughout the remainder of this century. This, coupled with the phase out of BPS and the implementation of future ELMS in the 2020s, is likely to provide weak incentives for farmers on small holdings to remain in the industry. Some level of consolidation of holdings may well occur over the late 2020s to 2050 to maintain the viability of farm business. Consequently it as assumed that overall agricultural employment is likely to reduce its contribution to local employment by 5% by 2050 (roughly in line with reductions in output due to climate change). There will be greater impetus to supplement agricultural income with diversified income to provide viable livelihoods and support the local economy and community.
- Under a business as usual scenario, (with current levels of diffuse pollution form agriculture) not only will ongoing declines in overall water quality and biodiversity persist (e.g., increase in eutrophication, and reductions in dissolved oxygen leading to less plant diversity and pressures on invertebrates and other aquatic animals), but in combination with climate change this will intensify. The ‘Levels’ are particularly important for wintering and breeding bird assemblages, and it is likely that most of the key species will suffer population declines to varying degrees (such as, Golden Plover, Lapwing, Bewick’s Swan, Whooper Swan, Coot, Gadwall, Wigeon, and Pintail). However, there may be some increase for some species (such as Snipe, Curlew, Shelduck and Teal). These impacts are being seen now but will become more acute by mid-century with continued declines in the second half of the century.
- Climate Change also leads to the requirement for significant extra spend in the SCLM to provide the same level of protection against rising sea levels, higher rainfall over prolonged periods and more erratic weather patterns. An estimated £750 million will need to be spent in the remainder of this century to maintain the network of inland drainage systems to cope with climate change. With significant planned investment, coastal defence can cope with around a metre of sea level rise by the end of the century. Any further rise in sea levels likely contributing to an increase in costs, but this is very difficult to predict.
- Current (baseline) levels of GHG flow will be broadly the same, but with rising costs to society as the need to achieve net zero becomes progressively more difficult by mid-century. The largest element of emissions will be ongoing carbon losses from deep peat, which will persist without significant re-wetting of deep peat soils. Climate change impacts of prolonged drought increase the risks of accelerated carbon losses from deep peat, but this impact is difficult to predict.
- Rising population (10% in Somerset by 2040, but also similar levels of growth throughout the UK) will drive a corresponding increase in demand for tourism and recreation but the level of provision will be no better than current. Adverse impacts on biodiversity will impact on levels of nature-based recreation and tourism.

The overall impacts of scenario 1 are summarised in Table 4.9. and Table 4.10.

Table 4.9: Summary of Scenario 1, 60 year present values (£'m 2022 prices)

Market GVA	PV (60) £'m
Agri-env	232
Peat extraction	30
Recreation/tourism	135
Conservation	49
WLM and FRM	399
Total	**845**
Non-market benefit/(dis-benefit)	
GHG sequestration (climate regulation)	146
GHG emissions (agriculture and WLM)	(798)
GHG emissions (deep peat and peat extraction)	(2,314)
Recreation & physical health	675
Air quality	8
Total	**(2,283)**

Table 4.10: Summary of Scenario 1

<table>
<tr><td colspan="2">Drivers of change:
The objective of this scenario is to model expected Climate change impact (same impacts assumed for scenarios 1 and 2). Climate change is assumed to impact SCLM primarily through increased severe weather instances such as drought (mainly in the summer) and flooding (mainly in the winter but also in the summer), and sea level rise.
Population growth (10% in Somerset by 2042[37]), and an ageing population will influence benefits such as recreation and tourism.
Reform to farming subsidies, in particular, the run-down of BPS by 2028, will have implications for farm incomes and employment in the industry.</td></tr>
<tr><td colspan="2">Scenario:
Impacts of climate change on agricultural production are modelled by decreasing arable production by 2% starting 2030[38], modelled annually, and decreasing cumulatively by 2% each decade through 2060 then remaining constant thereafter. Costs for keeping livestock will increase at the same rate over the same period. This will negatively impact gross margins from agriculture.
Sea level and peak river flow rise are described qualitatively in relation to scenario assumptions due to difficulty in modelling exact locations and which land types would be impacted. The UK Climate Projections 2018 (UKCP18) show Somerset is facing a probable sea level rise of between 0.27 and 1.11 metres by 2100[39]. Peak river flows are expected to increase by around 40%" (Climate Resilient Somerset, 2020). Upper case may be up to 85% by 2080 - 2100. We cannot realistically predict the area of farmland that could be lost to sea level rise, however given the need to protect the vital road and rail network in the SCLM it is safe to assume that most farmland will be protected by these defences.
Population is assumed to increase by 10% to 2042 and tourism/recreation will increase in proportion.</td></tr>
<tr><td colspan="2">Monetised management costs:
Additional capital and operational costs vs baseline include an estimated additional WLM capital spend £750 million to 2100 for drainage systems within the SCLM. Coastal flood protection costs are substantial (hundreds of million pounds over this century), but maintenance and asset replacement are mainly linked to the age of the assets, whereas the height (and therefore standard of protection) will cause relatively small levels of additional cost.</td></tr>
<tr><td colspan="2">Key land use impacts and management costs:</td></tr>
<tr><td>Farming</td><td>• Land area for farming remains the same.
• Productivity of arable will decrease by around 10-20% for an extreme event year, and these events will double in frequency by 2050.
• Costs for keeping livestock will increase by at least 20% for extreme event years, reducing profitability.</td></tr>
</table>

[37] https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/datasets/localauthoritiesinenglandtable2

[38] Assume an adverse year impact yields or livestock costs by 20% per event and 1 bad year event per decade in 2030= 2% margin reduction per year. This reduction becomes more severe with each decade.

[39] https://www.gov.uk/guidance/flood-and-coastal-risk-projects-schemes-and-strategies-climate-change-allowances

<table>
<tr><td>Deep peat and peat extraction</td><td>Peat extraction stops in 2042 to align with when license agreements end. This cumulative carbon loss to 2042 is highly uncertain as extraction quantities are not measured but could be as high as 270,000 tCO_2e.
Deep peat emissions continue at baseline level and considered at risk from higher rates of loss during periods of prolonged drought, but no change is modelled in this scenario. Emissions can vary widely with water level, but cumulatively could be around 6.7 million tonnes of CO_2e cumulatively by 2050.</td></tr>
<tr><td>Nature Conservation</td><td>Land used for nature conservation (c.6,400 ha) remains the same. Costs to manage land may increase to deal with increase rainfall wetting of certain areas and upkeep of visitor infrastructure, but due to uncertainty of climate change affects this is not modelled.
Key species likely to decline with climate change, but some species will increase in abundance – [see Section 4.1.7].</td></tr>
<tr><td>Tourism & Recreation</td><td>Adverse changes in the quality of the nature reserves may also affect the number of tourists that visit the SCLM, but this is not modelled in this scenario. It is assumed that visits increase in line with population.</td></tr>
<tr><td>Water Level and Flood Risk Management</td><td>Costs increase by £750 million and are modelled to increase linearly between 2030 and 2050, thereafter changes to operational costs are uncertain and assumed constant. Costs are bound to increase as more infrastructure and pumping will be needed to handle climate change impacts, e.g., more frequent flooding outside the traditionally wet period.
Emissions from pumping will become net zero by 2035.</td></tr>
<tr><td colspan="2">Socio-economic impacts:
Net employment impact
Employment for the farming sector is assumed to decrease as farming becomes less economically viable and farmers ‘age out.’. ELMS may lead to some consolidation of holdings.
Employment in the other land use sectors is assumed to remain constant due to lack of known significant and/or quantifiable changes.
Net turnover/GVA impact
GVA in the farming sectors will decrease as productivity of arable activities decrease and costs of keeping livestock increase.
GVA/employment for the peat industry has been excluded after 2042 when the licenses end, as the industry will depend upon other materials (assumed sourced from outside the SCLM area).
The conservation sites activity and costs assumed constant (as baseline) due to lack of real term increase in resources.
The tourism industry GVA assumed constant from the baseline due to uncertainties.
GVA for the water sector will increase as costs increase to manage more sporadic weather patterns and higher sea levels.</td></tr>
</table>

Monetised environmental benefits:

Net environmental impacts (PV for 60 years to 2082):

- The total net environmental benefits from food production fall £28 million from baseline to £232 million due to the impacts of climate change.
- The PV cost of carbon emissions from farming and land use is around £3,112 million – well over twenty times the value of food production.
- The present value of recreation and physical health benefits is £675 million.

Key non-monetised management costs and other benefits:

- Change in farming subsidies may have an impact on the number of principal farmers who choose to remain in the industry. It may mean a decrease in income for certain farmers, especially impacting those with holdings of less than 50 ha.
- Climate change impacts on deep peat will have irreversible effects on the quality of the land and have negative influence on heritage stored in the peat.
- Decrease in the quality of conservation sites and subsequent cost increases to manage changes may mean less resources to support volunteers and visitors. It may also mean less recreation benefits to locals, which are associated with health and wellbeing.
- Climate change will likely impact species populations, changing the ecology of the SCLM. Though some species will increase in abundance, most species in the SCLM will decrease.

Key assumptions/uncertainties:

- Climate change is assumed to increase severe weather patterns and therefore costs to maintain land or facility usage. The winters are assumed to be wetter than present patterns and the summer drier, but extreme patterns are more likely too, which will have cost and environmental impacts (Evans et al., 2021)
- Climate change will increase sea level and river flows which will change the land use across the SCLM. For example, saltmarsh may increase land coverage or grassland become wetland. This change is difficult to quantify as the extent and location of these changes is difficult to model.

Distribution (across society and over time):

Main groups experiencing negative impacts:

- Some principal farmers will likely leave the industry as farming becomes less economically viable.
- Locals and tourists visiting the managed nature sites will experience disbenefits from species and ecological losses in the SCLM.

Main groups experiencing positive impacts

- There will likely be an increase in the population of some species to the area (Franks et al, 2016)

Timing of main impacts

- Impacts are being felt now, but the majority of climate related changes will occur from 2030 and increasing in severity through 2100.

4.2 Scenario 2: Nature Recovery with Sustainable Farming

Scenario 2: "Nature Recovery with Sustainable Farming" differs from Scenario 1 in that it assumes significant land use shifts, modelled between 2025 and 2050. Aside from the land use change assumptions, Scenario 2 employs the same assumptions as Scenario 1, specifically the assumptions that account for impacts due to climate change and population growth. For example, scenario 1 assumptions on climate change impacts on agricultural productivity are used in Scenario 2 in combination with assumptions of land use change. Further discussion on scenario definition is provided in Section 2.3.

Some significant benefits are realised by these land use changes, and some consequences of climate change impacts are mitigated:

- Re-wetting all deep peat soils means that all carbon losses could be abated by 2050.
- Water quality is likely to improve with reduction in grazing on deep peat and lower use of inputs (Phosphate in particular) on all other farmland.
- Pressures on designated habitats are likely to be reduced with consequential impact on key wildlife invertebrates/ fish and birds (although impacts are difficult to quantify with any degree of confidence - See section 4.2.7 on biodiversity).
- Setting aside more land for wildlife and investment in access for recreation and nature-watching creates opportunities for nature-based tourism, and enhanced recreation and well-being benefits for the local population.

4.2.1 Land use & Condition

Land use in Scenario 2 is significantly altered by 2050. Table 4.11 outlines the land use change by 2050 on deep and non-deep peat areas. Change in land use is modelled linearly between 2025 and 2050, which is feasible (if slightly ambitious) as a period of change for new land management adoption.

All deep peat is assumed to be rewetted by 2050 (to optimum of 10 cm water level below field surface). This land is converted to either conservation grassland, where grazing is in the interests of conservation and any agricultural benefit is incidental, or to fen, marsh and bog, increasing the latter from about 2,000 hectares on deep peat to 6,000 hectares. Land designated for nature conservation on deep peat increases by over 80% as all arable and grazing land is removed from intensive production on deep peat. This reduces the area of land used for agriculture by about 40% (including some grazing land removed on non-deep peat).

Habitat change on non-deep peat is not as great as changes on deep peat. For the purposes of the analysis, it is assumed that almost 600 hectares of grazing land is assumed to be converted to woodland, more than doubling the land cover compared to the baseline. Alder, Poplar and Willow trees are considered flood tolerant (Mulholland et al., 2020) and could provide alternative income for farmers, where planting does not disturb deep peat. Saltmarsh land cover is increased from 687 to 870 hectares.

Table 4.11: Land use by 2050 in Scenario 2, (ha)

Land Use/type	Deep peat	Non deep peat	Total
Arable	-	1,823	1,823
Grazing	-	17,318	17,318
Conservation grassland	8,232	-	8,232
Woodland	-	1,000	1,000
Fen, marsh & bog	6,000	635	6,635
Freshwater	68	60	128
Saltwater, rock & sediment	3	3,130	3,133
Saltmarsh	5	870	875
Urban/sub-urban	200	1,397	1,597
Total	**14,508**	**26,234**	**40,742**

As discussed in Section 2.3, these land use changes were selected to eliminate carbon losses from deep peat and improve conditions on the SCLM through concentrated efforts to return more land back to nature. Farming on peat would be limited to grazing for conservation and possibly paludiculture, which will be discussed in Section 4.2.3. Additionally, farming on non-deep peat is assumed to follow sustainable and regenerative farming practices.

Conditions in natural habitats (i.e., conservation grassland, woodland, wetland, and saltmarsh) will improve over time, from 2050 onwards as the full scale of change is realised. This scenario assumes that joint effort between all landowners and water level managers (via IDBs and EA) and more and better-connected land reserved for nature conservation will encourage targeted efforts to improve outcomes. For example, nature sensitive farming methods will lead to biodiversity and water quality improvements. These actions will be contingent on available financial means, which is discussed in Section 4.2.2.

Overall, total land managed for nature increases from about 6,400 to 20,000 hectares. This land would be either managed as nature sites (by an appropriate NGO), or by farmers paid to manage the land for nature (assumed to be made economically viable, through public funding, private sources of funding or a combination of both). Alongside these changes, habitat conditions will improve through concentrated land management efforts by farmers, conservation groups, and water level managers. The impacts on land condition are:

- Carbon stored in deep peat is conserved from 2050 onwards.
- Nature sensitive farming on other soils is likely to increase carbon storage and resilience, although precise improvement is difficult to quantify.
- Nature sensitive farming practices will reduce diffuse pollution, but alone will not be sufficient to raise WFD status.

The impacts of these land use and condition changes on economic activity and employment, GHG emissions, and non-market values will be discussed in the following sections below.

4.2.2 Public Spend

As mentioned in section 4.1.2, it is not the aim of this project to forecast future government spend in the SCLM. The changes in land use for this scenario are extensive and difficult to estimate. Furthermore, the mix of funding from private and public services is also difficult to predict. However, Table 4.12 shows the known and likely changes to annual public spend over time.

Table 4.12: Public spend over time in Scenario 2, £'m (2022 prices)

Area	2022	2035	2050 +	Reasons
Agri-env	9.2	>9.2	>9.2	Little farming on deep peat, but agri-environment funding may need to increase to incentive farmers to cease grazing.
WLM and FRM	25.0	>25.0	40.0	Significant spend to mitigate CC. Estimated £750 million needed to 2100.
Conservation	2.5	5.0	5.0	Assume doubling by 2035 to reflect area under management for nature restoration.
Total	**36.7**	**>39.2**	**>>54.2**	

The most significant change is that there will be additional spend required to maintain the water level management infrastructure. This is in line with the assumptions made in Scenario 1, and whilst water levels are raised, the costs of maintaining infrastructure will not be significantly different to scenario 1[40]. Public support for conservation and agriculture (mainly through future ELMS) is likely to need to increase. Note that some land use changes may be privately funded. In particular, the expansion of the UK Peatland code to include lowland peatlands may provide an important mechanism and funding source for restoring deep peat.

4.2.3 Economic Activity

Differences in economic activity compared to the baseline are primarily due to land use changes. The most significant change occurs in the agricultural sector as all production on deep peat transitions to conservation grazing. Decreases in agricultural production are assumed in proportion to land switched to nature restoration, i.e., both land and production fall by about 40%, not including reductions caused by climate change. From 2022 to 2050, GVA decreases from £9 million to £5 million. The decreases in production would reduce some costs as well as revenue for farmers (and is informed by analysis of net gross margin of farming actvity). Alternative income streams may be provided by payments for managing land for nature restoration, carbon credits, nutrient trading, or from other diversified income sources.

Potential alternative funding streams, include public or private funding for nature restoration, peatland restoration (discussed above), agrotourism, nature-based tourism, and production of crops compatible

[40] Expert view from EA team in the Project Board

with rewetted deep peat, through paludiculture. On non-deep peat, short-rotation coppice willow may be a viable land use. Agrotourism, i.e., tourist visits to farmland, is considered within the tourism sector, which will be discussed below.

Modelled changes in GVA over time are shown in Table 4.13. This demonstrates that the increase in recreation and tourism total can more than offset the loss in economic activity from agriculture.

Table 4.13: Economic activity over time in Scenario 2 GVA £'m (2022 prices)

Activity	2022	2035	2050 +	Reasons for change
Agri-production	9.2	7.5	5.2	Deep peat used for conservation hence lower agricultural production
Peat extraction	1.9	-	-	Peat ban from 2025
Recreation/tourism	4.8	7.3	10.1	Major investment in eco-tourism
Conservation	1.9	3.3	4.8	Expanded land management roles for farmers (e.g., maintaining field margins for biodiversity) plus doubling of spend on existing sites.
WLM and FRM	12.2	14.0	18.2	Significant spend to mitigate CC
Total	**30.0**	**32.1**	**38.4**	

Several studies (Mulholland et al., 2020) suggest that paludiculture sites (i.e., growing crops that can thrive in raised water levels) could not only avoid deep peat emissions but also become net carbon sinks. Hence sequestering CO_2 by uptake of paludiculture techniques has the potential to contribute to agricultural income in the area whist supporting the UK's zero carbon goal. Many of these crops are new to UK farming. For example, Typha can be used as a building or packaging material and act as a sink for 30-60kg of Phosphorus per hectare per year[41], and sphagnum moss can be an alternative growing medium for peat[42]. The economics of these new crops are uncertain and there are significant challenges to develop markets and supply chains. Whilst the prospects for uptake are highly uncertain, this could be a viable option for some farmers in the SCLM and strongly support the aims of scenario 2. Given the high degree of uncertainty around scale and returns for these new opportunities, no figures have been included in this assessment, but the opportunities provided by paludiculture should be monitored very closely.

More conventional crops like willow may also provide opportunities. Increasing woodland habitat could be translated into willow cultivation for the purpose of making artisanal goods, such as baskets and other home goods, fences, and caskets. Willow growing could be a regenerative farming activity. Presently, there are 4 companies in Somerset that make products from willow grown in and around the 'Levels'. There is at least one major willow business in the SCLM employing over a dozen staff and selling many local willow-based products. Local production adds to employment and helps sustain the local community. This

[41] See Fens for the Future at: https://fensforthefuture.org.uk/creating-the-future/wetland-crop-typha
[42] See: https://fensforthefuture.org.uk/creating-the-future/wetland-crop-sphagnum-moss

provides a degree of confidence that similar businesses could be established in the SCLM. Whilst these enterprises are likely to be few and niche, they have the potential to be high value businesses employing several local people. Given the uncertain potential scale of these businesses, no figures have been modelled in this assessment.

The second most significant impact on economic activity due to land use change involves the nature-related tourism and conservation sectors. Expansion and improved condition of natural habitats managed for nature has impacts on the nature-related tourism industry by drawing more tourists to see nature sites in the SCLM. The economic value of tourism is assumed to double compared to the baseline, which is modest considering current visit numbers and the current facilities, being relatively limited (e.g., car parks, signposting, and simple viewing facilities). Areas of high-quality biodiversity can attract significant numbers of visitors for activities such as birdwatching and 'wetland safaris' along waterways. The level of visitors that the modelling assumes can be attracted to the study area is a significant increase but is considered feasible. It is not large relative to the numbers attracted to areas of high-quality habitat in other parts of the UK. For example, Broads National Park estimated 6.5 million visitors, bringing in £375 million in 2013, of which 27% reported birdwatching as one of their activities (The Tourism Company, 2016). However, increasing the number of tourists to the area is contingent on investment in visitor facilities, both enhancing the existing and new, more signposting/interpretation, easier wildlife viewing opportunities, and supporting services (e.g., parking hubs with access to bike trails, cafés and accommodation tailored for wildlife visitor's needs, such as accommodation on boats within high biodiversity habitats). This would provide wider integration with local economy, particularly local towns, providing significant income opportunities for local people and businesses.

The main increase in WLM economic activity is associated with climate change drivers to upgrade both water level management infrastructure of inland drainage systems and flood and coastal risk mitigation defences (mainly in the second half of this century). Some of these costs may be mitigated by raising water levels but expert opinion suggests that any savings would be marginal/negligible, which is in line with assumptions in Scenario 1.

Finally, it is worth noting that the natural environment can contribute to attracting and retaining other businesses to the area. An example of a major development opportunity is the Gravity campus [43] within the study area, which hopes to create 7,500 new jobs. Whilst good transport connections are an important aspect for attracting businesses to this site, its location within an attractive rural environment also plays an important role in promoting the site for businesses and prospective employees.

4.2.4 Employment

In this scenario the distinction between agriculture and conservation employment will become more blurred. As pressure to supplement agricultural income increases, farmers may derive more income from conservation work and undertake activity that supports both conservation and farming (e.g., conservation grazing), making the demarcation of each more difficult. In Table 4.14 the split of full-time equivalent employment splits work assuming that all grazing on deep peat is conservation work (even though it will

[43] https://thisisgravity.co.uk/resources/

be conducted by farmers and support farm output).

Table 4.14: Changes in Employment over time (FTE)

Employment (FTE)	2022	2035	2050
Agriculture	1,383	1,136	786
Peat extraction	56	-	-
Recreation/tourism	234	354	494
Conservation	51	178	308
Water Level Management	280	322	420
Total	**2,004**	**1,989**	**2,008**

The table illustrates that agricultural employment could fall from around 70% of total land-based employment today to around 40% in 2050. However, it must be borne in mind that many people may undertake several different work activities that fall between categories, and a fall in farming employment may be offset by conservation work, or nature-based tourism. In this scenario an extra 200 roles for conservation partly offset the loss in agricultural employment. The table also demonstrates that whilst overall employment remains roughly the same, the figures in Table 4.13 show that total GVA increases, highlighting the higher GVA per employee generated in the tourism and water level management and conservation sectors.

4.2.5 GHG Footprint

Table 4.15 shows how GHG sequestration and emissions (denoted in red brackets) vary over the timeframe 2022-2050 by the major sinks or source. For scenario 2, change in land use causes net emissions fall by 93% from 328,000 tCO_2e emissions today (baseline) to around 23,000 tCO_2e in 2050. The most significant reduction is in the abatement of all deep peat losses by 2050 (saving of over 240,000 tCO_2e per year versus baseline). Other significant reductions come from a fall in agricultural emissions (mainly from the reduction on heads of livestock) and the cessation of peat extraction. Finally, there is a small increase in sequestration in non-deep peat habitats arising from the small areas of woodland and saltmarsh creation.

Table 4.15: Change in GHG Flow by sink/(source) in tCO_2e/year

Sink/(Source)	2022	2035	2050	Change 2022-50
Agri-production	(87,967)	(67,129)	(50,609)	37,358
Losses from deep peat soils	(241,430)	(135,201)	-	241,430
Non deep-peat habitats	15,684	20,976	27,634	11,950
Peat extraction	(13,475)	-	-	13,475
WLM and FRM	(900)	-	-	900
Total	**(328,089)**	**(181,354)**	**(22,975)**	**305,114**

4.2.6 Non-market Ecosystem Services

Many benefits of natural assets are not traded in the market economy. Table 4.16 demonstrates how these non-market values vary over time for scenario 2. This highlights that the value of the dis-benefits of GHG emissions (largely from drained deep peat soils, and to a lesser extent emissions from agriculture and water level management) fall by 2050. This reduction coupled with the growth in carbon sequestration in habitats and the growth in the benefits of recreation and physical health mean that total net non-market benefits increase by nearly £100 million a year by 2050. This is significantly greater than the improvement in GVA of economic turnover presented section 4.1.3.

Table 4.16: Value of non-market ecosystem benefits over time (£'m/year in 2022 prices)

Non-market benefit	2022	2035	2050
GHG sequestration in habitats	4.0	6.5	10.7
GHG emissions (agriculture and WLM)	(22.6)	(20.8)	(19.6)
GHG emissions (deep peat and peat extraction)	(64.9)	(41.9)	-
Recreation	15.3	23.3	32.6
Physical Health	5.6	8.6	12.0
Air quality	0.2	0.2	0.2
Total	**(62.4)**	**(24.1)**	**35.9**

Whilst these benefits are not typically traded in markets at present, emerging green finance opportunities are enabling more of these benefits to be realised (in part) through traded market. There is significant potential for green finance to support land management for nature through the voluntary carbon market, as high integrity schemes like Wilder Carbon and other codes are expanded, Biodiversity Net Gain becomes mandatory and nutrient neutrality is required in Somerset. Peatland restoration could provide significant income through carbon codes. The scope for woodland and saltmarsh creation is smaller but could provide opportunities for generating carbon credit income in the study area.

Note, the benefit of biodiversity is a very significant non-market benefit, however it is very difficult to adequately capture this in monetary terms. The value of biodiversity is discussed qualitatively in Section 4.2.7.

4.2.7 Biodiversity

The main benefit of scenario 2 is the creation and restoration of substantial areas of natural habitat that would support important features of biodiversity in the SCLM. Areas of new or restored habitat assumed in the scenario include:

- An extra 3,200 ha of fen and bog, which is well connected to existing fen (2,800 ha), providing a total of 6,000 ha of important habitat for fish, invertebrates, and wading birds.

- Enhancement and creation of 9,000 ha of wet grassland which also supports wintering and breeding wading bird assemblages.
- A small extension (170 ha) of saltmarsh along the coastal margins of Bridgwater Bay
- Creation of 560 ha of (mainly wet) woodland.

Water quality should improve over the long term with lower livestock numbers and more sensitive use of agri-inputs (particularly phosphates). However, it is recognised that these changes alone will not be sufficient to achieve favourable condition for the freshwater sites designated for nature conservation. To achieve this, more action is needed on farms and water recycling centres upstream of the SCLM study area, and assessing the scale of that challenge is outside the remit of this project, but is the focus of other activity from EA and NE.

Some of the benefits of biodiversity enhancement have been recognised in some of the economic and monetary valuations in previous sections (for example increase in nature-based tourism and higher recreational value for local visitors). However, predicting in quantifiable terms any expected measure of improvement in biodiversity is impossible to evaluate, given the high level of uncertainty in how nature would respond to the scenario's land use change, and to the uncertainties around the impacts of climate change.

However, what can be done is to highlight what aspects of climate risk these habitat improvements would mitigate. For example, more fen and wetter grassland will provide more habitat for wintering and breeding wading bird assemblages and provides a slightly higher margin of protection against drought. This does not however help mitigate the impacts of very wet summers, for example species rich neutral grassland is particularly vulnerable to heavy rain in summer.

4.2.8 Summary & Key Messages

The main features of scenario 2 are the rewetting of all deep peat soils and the creation and restoration of substantial areas of natural habitat that would support important features of biodiversity in the SCLM. The most significant impacts include:

- The creation and enhancement of 20,000 ha of various habitat (but mainly fen, bog and wet grassland) supports many unique biodiversity features of the SCLM and provides a high level of mitigation against climate pressures (particularly drought).
- The value of GHG emission savings from deep peat is the greatest economic benefit, potentially providing a saving of £1,700 million PV over the 60 years. This saving is two and a half times the combined GVA of the sectors evaluated in this study in the area over the same period (£600 million PV over 60 years). This saving from GHG emissions serves to make the case for forgoing some agricultural production in exchange for greater GHG savings.
- Growth in nature-based recreation is significant upside for the area. A doubling of tourism income would represent an increase in GVA of over £5 million per year (or £140 million in present value terms over 60 years).

Climate change also leads to requirement for significant extra spend in the SCLM (estimated £750 million present value) to provide the same level of protection as at present against rising sea levels and higher and more erratic patterns of rainfall. The extent to which land use changes in Scenario 2 can mitigate any of these costs is complex and difficult to assess, and therefore has not been included in the savings presented.

Table 4.17; Summary of Scenario 2, 60 year present values (£'m 2022 prices)

Market GVA	PV (60) £'m
Agri-env	183
Peat extraction	7
Recreation/tourism	207
Conservation	95
WLM and FRM	399
Total	**891**
Non-market benefit/(dis-benefit)	
GHG sequestration (climate regulation)	219
GHG emissions (agriculture and WLM)	(566)
GHG emissions (deep peat and peat extraction)	(798)
Recreation & physical health	1,067
Air quality	10
Total	**(70)**

Table 4.18: Summary of Scenario 2

<table>
<tr><td colspan="2">Drivers of change:
Objectives of this scenario are to increase land managed for nature to 50% of the scope area (20,000 ha), remove intensive farming from deep peat (12,800), set aside 10% of remaining land as margins for nature (ponds, field margins), and end peat extraction by 2025. There is also a drive to invest in nature and access to increase both tourism and recreation and well-being of local residents.</td></tr>
<tr><td colspan="2">Scenario:
In this scenario large blocks of land (whole Moors) are managed for nature recovery. Some of the agricultural land is used for nature recovery and transitions to conservation grassland. Overall, 90% of the scope area will be managed for, or support nature in some way.</td></tr>
<tr><td colspan="2">Monetised management costs:
Increase in WLM defences as climate change impacts intensify (assume as scenario 1).</td></tr>
<tr><td colspan="2">Key land use impacts and management costs:</td></tr>
<tr><td>Farming</td><td>Land used for agriculture on deep peat (12,800 ha) is rewetted and less intensively productive by 2050, becoming conservation grassland or wetland.
90% of the remaining agricultural land (20,000 ha) becomes farmed and supportive of nature by 2050. Assume 10% set aside for margins for nature.
Arable farming on deep peat ends by 2030.</td></tr>
<tr><td>Deep peat and peat extraction</td><td>Peat extraction stops by 2025.
Emissions from deep peatland decrease to zero by 2050, saving 0.25 million tonnes CO_2e per year compared to scenario 1.</td></tr>
<tr><td>Nature Conservation</td><td>Land managed for nature increases from about 6,500 ha to about 20,000 ha, which is 50% of the scope area. Target habitat types are included in the table below
<table>
<tr><th>Habitat</th><th>Scenario 2</th></tr>
<tr><td>Woodland</td><td>1,000</td></tr>
<tr><td>Conservation grassland</td><td>9,000</td></tr>
<tr><td>Swamp, fen, and heather</td><td>6,000</td></tr>
<tr><td>Saltmarsh and other coastal habitats</td><td>4,000</td></tr>
<tr><td>Total</td><td>20,000</td></tr>
</table>
Conservation grassland is managed for nature by stocking cattle and sheep
There will likely be an increase in capital costs around 2030 to meet increased visitor demand, though this is not quantified due to insufficient cost data.</td></tr>
<tr><td>Tourism & Recreation</td><td>Tourism increases by 100% from about 373,500 tourists to about 747,000 by 2050, as improved land for nature conservation attracts</td></tr>
</table>

<table>
<tr><td></td><td>new tourists, boosting the local economy and creating jobs
Value from recreation for local residents is improved and so is physical health.</td></tr>
<tr><td>Water Level and Flood Risk Management</td><td>£750 million in capital costs by 2100
GHG emissions from pumping will decrease compared to the baseline reaching net zero by 2035.</td></tr>
<tr><td colspan="2">Socio-economic impacts:
Net employment impact
Farming employment will decrease as a result of land area being shifted from managed for agriculture to managed for nature. Uncertainty exists given the actual decrease in farmers as it is difficult to assume which farming jobs (i.e., managers or seasonal crew) will change and by how much. Overall employment would reduce by around 40% in this scenario.
Employment for peat extraction will become be nil from 2025, as growing media businesses source materials from elsewhere.
Doubling of employment for nature conservation likely due to new visitor demand and conservation needs as land is shifted from agricultural uses to managed for nature. In addition, new employment of 200 FTE for land managers/farmers in conservation roles.
Employment in the water levels management sector is likely to remain the same in this scenario as for scenario 1.
Employment opportunities created through increased tourism including in nearby towns such as Glastonbury, Street and Bridgwater.
Net turnover/GVA impact
GVA from the farming sector will decrease by 40% compared to the baseline (from £9 million to £5 million) by 2050. GVA from peat extraction will be nil by 2025.
GVA from nature conservation and tourism will increase over time after an initial increase in capital costs to meet increased demand.
Further opportunities to develop new outputs from rewetted Levels and Moors could provide economic income growth (such as paludiculture or an expansion of willow), but these markets are highly uncertain at this stage.</td></tr>
<tr><td colspan="2">Monetised environmental benefits:
Net environmental impacts (Present Value over 60 years):
The total net non-market environmental dis-benefits from GHG emissions improves by £1,772 million to £ (1,364) million.
Gross value of positive environmental impact (PV)
The value of recreation and physical health benefit increases by £436 million from baseline to £1,067 million.
The value (PV over 60 years) of PM2.5 sequestered from trees (air quality) increases from about £7.6 million to £9.7 million.</td></tr>
<tr><td colspan="2">Key non-monetised management costs and other benefits:</td></tr>
</table>

Any other material considerations (e.g., increased conservation means more environmental volunteering and associated health and wellbeing) • Change in biodiversity due to climate change will be mitigated as more available land with improved connectivity will benefit already existing species. • Water quality would improve but not sufficiently to meet designated site favourable status. • Volunteering at managed nature sites will likely increase as the land area increases. This will have increased benefits for both the management of nature sites and for volunteering as more opportunities are available.
Key assumptions/uncertainties: • Improved value from increased land area for managed nature sites is largely dependent on funding to make conservation improvements on newly acquired land as well as build and maintain new visitor infrastructure. Increased jobs for nature conservation are also dependent on this. • Peatland extraction will end in 2025 but will require government action to enforce. Licenses do not expire until 2042.
Distribution (across society and over time): Main groups experiencing negative impacts: • Farmers will experience decreased income from agricultural activities. This may be offset by incentives to leave certain land for nature. Main groups experiencing positive impacts • Conservation land managers, locals, tourists, and companies in the tourist industry are the main groups to experience positive impacts assuming that environmental and land management improvements in the SCLM improves value from the land for locals (e.g., through improved bike and walking lanes, volunteering opportunities). Timing of main impacts. • The majority of change occurs between 2025 and 2050 then is assumed constant until 2100.

5. Comparison & Interpretation

This section compares some key outcomes between the scenarios and draws conclusions from the analysis.

5.1 Scenario Comparison

Economic Activity

Economic activity for the four main land use sectors in the SCLM (measured by the GVA and employment levels for each sector), plus the contribution of water level management to the local economy, are compared across the baseline and two scenarios. These sectors are discussed in detail in the main body of the report and include agri-production, recreation/tourism, conservation, and peat extraction.

The profile of economic activities (measured by GVA) and jobs (FTEs) across the scenarios in 2050 are shown in Figure 5.1. and Figure 5.2. respectively. Economic activity in Scenario 1 increases slightly compared to the baseline. This is largely due to increases in activity and employment in water level management needed to cope with climate change offsetting decreases in agricultural productivity (impacting GVA in this sector), and the fact that the growth media sector no longer extracts peat from the 'Levels' by 2050. Economic value is added by scenario 2, mainly due to the higher value added per FTE in the recreation/tourism sector, despite very little change in total employment overall. The stable total employment results from reduced employment in agriculture being compensated by increases in employment in water level management, conservation and tourism.

In scenario 2 the increase in recreation and tourism jobs is based on the increased area of land managed for nature, and an assumed investment in associated visitor infrastructure. The increase in conservation jobs reflects both a growth in employment at conservation sites and that more land managers/farmers will be occupied in conservation work. The water level management GVA and employment is as scenario 1.

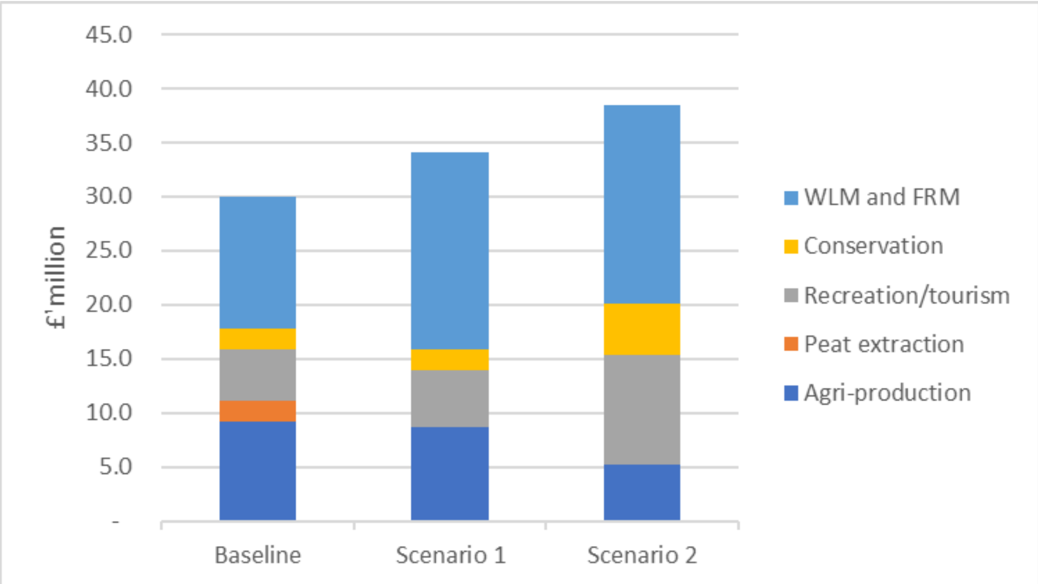


Figure 5.1: In-scope sector GVA by scenario in 2050 vs baseline (£'m in 2022 prices)

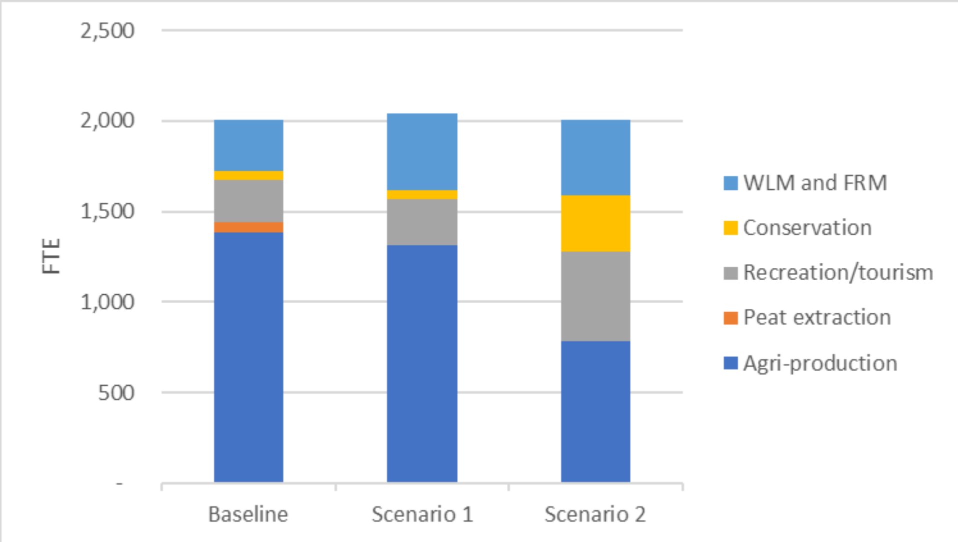


Figure 5.2: In-scope sector employment in 2050 by scenario vs baseline (FTEs)

Scenario 2 reflects a more evenly distributed spread of employment activity across the sectors compared to baseline and indicates that GVA can grow despite a reduction in agricultural employment and output. It is also possible that local people could undertake several different employment activities and derive income form more than one source (e.g., conservation work, or nature-based tourism as well as farming).

GHG flows

Figure 5.3. presents the GHG flows by major cause for the three scenarios, emissions being negative and sequestration positive. The main reduction in scenario 2 is due to land use change to restore nature, which also reduces emissions from deep peat.

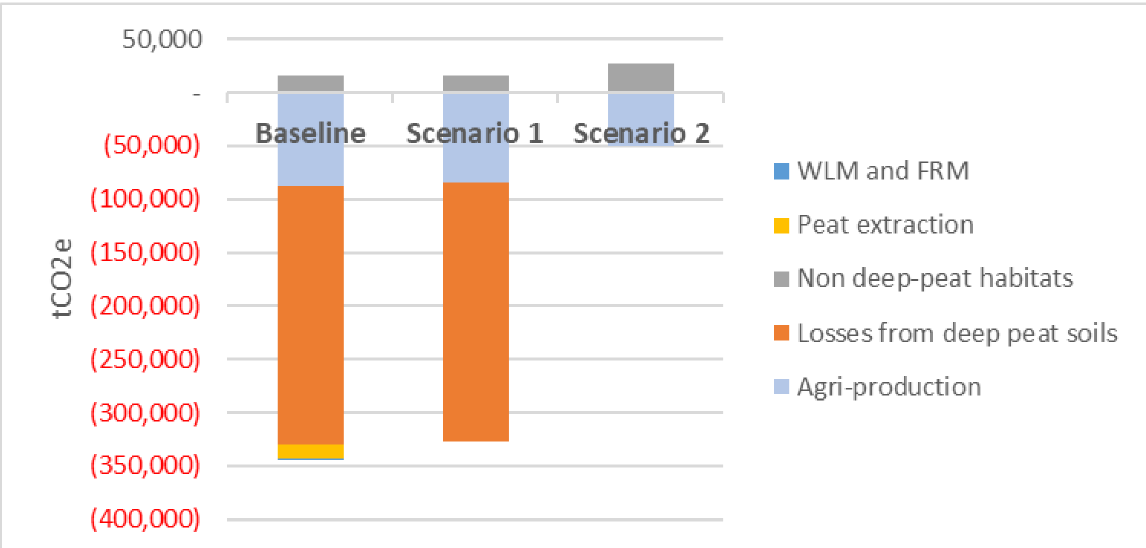


Figure 5.3: GHG flows by scenario in 2050 vs baseline (tCO_2e)

Note that the value of carbon sequestration and emissions per tonne of CO_2e increases steadily towards

2050 as it becomes progressively more challenging to meet the net-zero target. Furthermore, the 60 year present value of carbon sequestered or emitted also depends upon the profile of change overtime, (i.e., more rapid reductions will lead to a lower 60-year present value). Table 5.1 shows the present value of GHG emissions over 60 years by scenario and shows that scenario 2 produces a £2,021 million saving over 60 years, relative to the baseline.

Table 5.1: Present value of GHG flows (PV over 60 years at 2022 prices)

PV60 value of net GHG flow (£'million)	Baseline	Scenario 1	Scenario 2
Total	(2,990)	(2,966)	(1,146)

Benefits to wider society

The 60-year present value of benefits to wider society by scenario is shown in Figure 5.4. Benefits are presented as positive values (i.e., recreation & physical health, GHG sequestration and air quality benefits), whilst dis-benefits (i.e., GHG emissions) are presented as negative values. Local residents benefit from air quality, recreation and physical health benefits, whilst GHG sequestration or emissions impact on the global population.

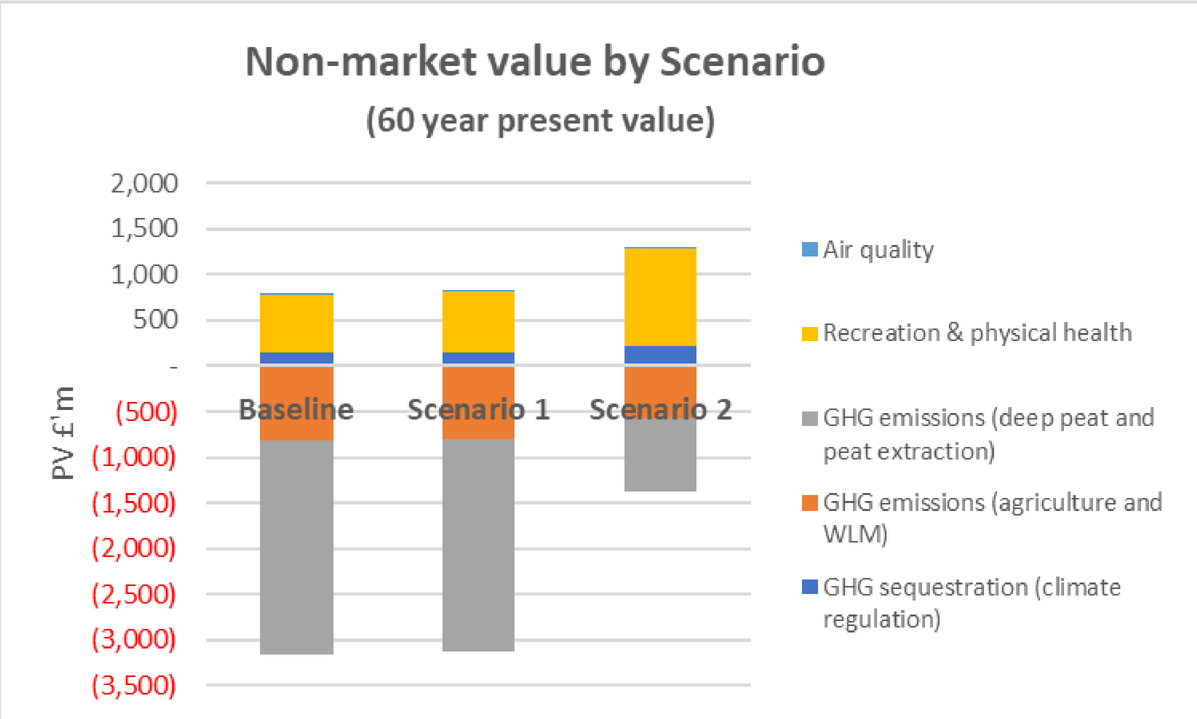


Figure 5.4: Value of Non-market Benefits by Scenario

Note this excludes some important benefits and disbenefits that cannot be evaluated in monetary terms (e.g., biodiversity and flood risk mitigation). Whilst difficult to evaluate in monetary terms, scenario 2 does provide more than double the area of land managed for nature conservation (see Section 4.2.7).

This chart illustrates the negligible differences in non-market values between baseline and scenario 1 and reveals the extent to which the dis-benefit of GHG emissions dominates these societal values. The main improvement in scenario 2 is the elimination of deep peat carbon losses (to zero by 2050) and this reduces this dis-benefit by £1,500 million over 60 years. However, it should be noted that other potential sources of emissions are not included in the analysis. For example, increases in recreation and tourism activity would be expected to result in increased transport emissions. However, the scale of these depends on progress in decarbonising the transport system, which is beyond the scope of this study. Scenario 2 also improves recreation and physical health values by £430 million and reduces agricultural emissions by £260 million (mainly by reductions in livestock).

5.2 Interpretation and Key Messages

The scenarios analysed in this report illustrate a potential course for the SCLM to invest in nature recovery for this unique landscape and to progress the transition to a lower carbon economic model. As with other sector/ regional transitions, this will bring economic challenges and opportunities. They bring together thinking about future change in several areas of land management activity, such as agricultural production, flood risk management and nature recovery. Each of these is subject to sources of uncertainty, including from the effects of climate change, and so combining them produces an analysis that ***has a moderate level of confidence***. The overall results should be regarded as indicative – they can inform policy development but should not be the sole basis for decision-making.

The key points to emerge from this analysis are:

- The economic value of GHG savings from reducing/eliminating deep peat emissions are difficult to measure precisely (due to the range of assumptions around peat emissions and lack of detailed data) but are clearly very large (in the region of £65 million per year in 2022 at the central non-traded value of carbon). Government values for non-traded carbon have a confidence range of +/- 50% hence the annual cost of deep peat emissions is in the range £33 million to £98 million in 2022 terms. Even at the lower level of estimate, reducing emissions can justify significant land use change from wider society's perspective. Over 60 years the upper bound of the saving in deep peat emissions (assuming all emissions eliminated) is £1,500 million (at BEIS central non-traded values). The value of the gross margin of food production from the deep peat soils (12,500 ha) is in the region of £5 million per year (in 2022) which is more than an order of magnitude smaller than this GHG emissions saving.
- Re-wetting deep peat areas overlaps with the core designated sites of the 'Levels' and can be used to support habitat enhancement and creation that would mitigate climate change pressures. This would in turn help reverse population declines for key species (in particular, winter waterfowl and breeding bird assemblages) in the SCLM.
- The nature recovery scenario demonstrates that overall economic turnover in the area increases. Investing in visitor infrastructure around the core areas of high nature value habitat could realistically double income from tourism and conservation and increase GVA by £5 million per year. In addition, investment in access could also double the recreational and physical health benefits for the local population adding a further £23 million per year.

- SCLM produces proportionately less food and economic value (GVA of £290/ha in 2022) than in the rest of Somerset or the UK average (£670/ha)[44]. Hence any reduction in land available for food production will have low impact on UK food security.

Overall, the results provide an insight into the potential economic implications of a major investment in nature recovery and its support to a transition to a low-carbon economic model (represented by scenario 2 as compared to scenario 1).

- The potential impacts on employment levels in agriculture are potentially significant, particularly to the communities in and around the SCLM. This is not surprising, as adaptation of all sectors including agriculture and other land use, to climate change and net zero targets is expected to be disruptive to economic activity[45]. Like all high carbon intensity sectors facing the prospect of significant climate-related changes, there is potential for negative impacts on employment.
- Scenario 2 illustrates that alternative employment and economic activities can provide significant new opportunities (e.g., conservation and nature-based tourism), that can result in a more diversified economy that roughly maintains the current level of employment. The transition to these activities would benefit from being supported by policy measures to encourage new activities, and to mitigate the potential socio-economic consequences of the transition. Again, this is a common finding with other carbon-dependent sectors and illustrates the significant challenges across the UK economy of adaptation to net zero targets. The findings for the SCLM show it is not immune from these pressures, but also that the impacts are not as severe as in some of the most carbon-intensive sectors, and that alternative opportunities area readily available.
- The local economic changes under Scenario 2 show an increasing proportion of GVA in the SCLM arising from water level management. This sector is anticipated to grow in response to climate change pressures. Nature conservation land management also increases in economic importance under Scenario 2. Currently, (like agriculture), both water level management and nature conservation rely on public sector support. However, they can also bring in private sources of funding to the SCLM area. For water level management this could be from private sector contributions (e.g., for flood protection). For nature conservation, this includes income channelled through conservation organisations (originating from the public and from other sources that would not otherwise flow to the SCLM). Both water level management and nature conservation will also indirectly support economic activity in the nature-based visitor economy. Overall, the SCLM may become more dependent on public spending in future, but in return can provide very high value of public goods, both from major carbon emissions reductions and biodiversity gains.
- The diversification of land use activities is already underway in Somerset. The scenario results help make the case for continued and additional central and local Government funding, and LEP and other support, for this transition. It should be noted that the scenarios are based on current understanding of alternative land use technologies. They therefore do not fully reflect the expected

[44] GVA of UK Agri-sector (in 2021) was £11.2 billion, divided by agricultural area of 17.2 million ha .See: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1106562/AUK_Evidence_Pack_2021_Sept22.pdf

[45] Climate Change Committee (2023) Progress in adapting to climate change 2023 Report to Parliament. Online at: https://www.theccc.org.uk/publication/progress-in-adapting-to-climate-change-2023-report-to-parliament/

impacts of low-carbon technologies currently under development which could be deployed in the SCLM. Examples include:

- The potential for paludiculture on areas of peat soils (Mulholland et al., 2020), and outputs could sustain existing local businesses (e.g., production of peat free compost using locally grown moss). The latter could use the existing production and mixing facilities in the SCLM, but using alternative inputs (e.g., some from above-ground locally produced biomass, some imported).
- Potential to create a low carbon visitor economy, generating more GVA per hectare of land managed for nature in the SCLM, through investment in relevant facilities (e.g., more extensive cycle paths and visitor interpretation).

- The distribution of the potential socio-economic impacts illustrated by the scenarios is important to understand. It should be noted that many farm businesses in the SCLM have the land management skills required in the new employment opportunities identified, and also have some existing involvement in the visitor economy/ tourism. Therefore, the negative impacts on agricultural employment, and the potential new opportunities, may well occur within same businesses and households.

It is also worth noting the major areas of uncertainty:

- The value of GHG sequestration and emissions reduction is subject to a degree of uncertainty. The BEIS recommended non-traded carbon values are subject to a +/- 50% range around the central values used in this assessment However, even at the low value of carbon the case for reducing emissions is still very strong.
- The level of emissions from deep peat are a key assumption in this analysis and are also subject to some degree of uncertainty. They are based on the widely quoted estimate used for drained deep peat soils (at around 20 tCO_2e per ha per year for a water level of around 60 to 90 cm below field surface (Evans et al 2021). Also, the extent to which these emissions could be abated entirely is the subject of on-going research. Evans et al., (2021) also shows that the optimum water level to achieve net zero emissions from deep peat is 10 cm below field surface. This is much higher than existing water levels for 30-45 cm as a minimum. However, this research also suggests that there is a linear relationship between water level and emissions. Hence any sustained raising of water level should provide some carbon emissions saving.
- The extent to which potential losses of biodiversity in the face of climate change can be reversed (or even enhanced) by land use change on the SCLM is a major area of uncertainty. As well as increasing the extent of high quality habitat, a major factor is water quality, and whilst the steps suggested in scenario 2 would reduce pressures, it recognised that action is required upstream of the SCLM to improve WFD status and designated site status.

Endword

The report raises questions about the future outlook of the Somerset Levels and Moors, which we understand may raise concerns. We want to continue the discussion and work on these findings, alongside other research through the Somerset Local Nature Partnership with opportunities for all stakeholders to engage.

To be clear, this is not setting out a plan or a road map for change but can be used as a reference to inform decision making. It could also be argued that we are already working towards Scenario 2, with a lot of work already happening through many organisations, businesses, farmers and individuals to find ways to manage the precious peat soils, increase space and connectivity for wildlife and continue to provide economic benefit. Therefore, further joined up working across the Somerset Levels and Moors is vital, to ensure a positive economic, social and environmental outlook.

We see the LNP has a key role to play in sharing these positive examples and bringing people together to discuss how change will affect the landscapes of Somerset, and how we can manage that change to create positive outcomes for people, for nature and for the climate.

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Appendix 1 : Method

The appendix outlines the underlying methodologies that were used to calculate the economic assessment of the SCLM that were not detailed in the main body of the report.

A1.1 Land use and condition

This is described in full in section 3.1.1.

A1.2 Economic activity and employment

Agriculture

Detailed methodology on agricultural calculations and assumptions were detailed in Section 3.1.3 as part of the baseline discussion. The sources used and assumptions made in the baseline are consistent in Scenarios 1 and 2. Appendix Table 1 presents the livestock units and share of livestock, which was used to calculate total livestock in the scope area.

Appendix Table 1 Total share of livestock type and heads in the somerset NCA

Livestock type	Area, ha	Heads	% share of scope area
Dairy	5,185	9,506	13%
Cattle (beef)	29,651	54,359	76%
Sheep	3,990	60,965	10%
Total	38,826	124,830	100%

Table notes:

1. Area represents the total area of land used for livestock in the somerset NCA.
2. Heads and % share of scope area was calculated based on number of holdings reported in (Natural England, 2021c)

For scenario 1, agricultural productivity decrease is calculated by applying a linear decrease of 1% per decade equally across all agricultural outputs (i.e., cereals, dairy, beef, and sheep) until 2070. Costs are increased across all agricultural outputs at a linear rate of 1% per decade starting 2030 until 2070. That is, costs increase by 1% by the end of 2030, 2% by the end of 2040, and etc until 2070.

For Scenario 2, all agricultural activity on deep peat is removed. Productive activity on the land was divided by deep peat and not deep peat areas (See Table 3.6). To remove productive activity from deep peat, all agricultural outputs on the land were decreased linearly from 2025 to 2050 until reaching 0. Employment in farming decreases at the same rate as agricultural production (about 40%) until 2050 and remains constant.

Appendix Table 2 provides an outline of changes in agricultural production per scenario.

Appendix Table 2 Scenarios outline for agricultural production

Agri type	2022	2035	2050	% change (2022 - 2050)
Scenario 1				
Arable crops (tonnes)	18,101	17,992	17,513	-3%
Dairy ('000s litres)	20,704	20,580	20,031	-3%
Cattle (beef heads/yr)	20,844	25,131	20,167	-3%
Sheep (heads/yr)	10,987	10,922	10,630	-3%
Scenario 2				
Arable crops (tonnes)	18,101	16,366	13,887	-23%
Dairy ('000s litres)	20,704	17,025	12,148	-41%
Cattle (beef heads/yr)	20,844	15,163	11,729	-44%
Sheep (heads/yr)	10,987	8,118	6,182	-44%

Agricultural workers, employment data was taken from (Defra, 2022b), which provides labour data for the Somerset Levels and Moors natural character area (NCA), and adjusted to reflect only labour within the scope area. Data included number of heads for principal farmers, salaried managers, other full-time workers, part-time workers, and casual workers. Part time workers and casual workers were assumed to be worth 0.5 FTE and 0.25 FTE, respectively. These figures were summed and total almost 1,400 FTE.

Breakdown of farming employment has been derived from the Defra Farm survey for the Somerset Levels and Moors Natural Character Area and pro-rated on the area of overlap with the study area (74% of the total).

Appendix Table 3 Farming employment, FTE

Farming Employment	Number
Principal farmers	1,560
Salaried managers	33
Full-time (FT) workers	168
Part-time (PT) workers	152
Casual / gang workers	122
Total (FT & PT)	2,035
Total FTE	1,383

Peat Extraction

Actual peat extraction is not publicly reported, though the following evidence was used in building estimates of the likely range of extraction from the 'Levels':

- 45,000 m^3 is quoted as an annual extraction estimate in the Somerset Mineral Plan (Somerset County Council, 2015).
- A recent BBC News article[46] reported that EJ Godwin produces 3 million bags of growing media product per year, and they are down to 30% peat content. Assuming a typical 25 litre bag size that makes 75,000 cubic metres of product, of which 22,500 m^3 is peat. Scaling up for the other three main peat businesses based on number of employees gives an estimate of around 35,000 cubic metres for the 'Levels'.
- Latest peat extraction figures for England suggest 70,000 cubic metres in 2021[47]. The main areas of extraction outside of Somerset being mainly Cumbria. Hence it is possible that Somerset could be 50% of the England total, but a range of 25-50% may be more likely, suggesting 17,500 to 35,000 cubic metres.
- Current trends are for sharp falls in peat content as manufacturers move to a peat free future, but the rate of future decline is still highly uncertain and depends crucially upon the availability of alternative materials.

For the purpose of calculating economic output and emissions the higher value of 35,000 cubic metres per year was used. This represents about 50% of the peat production in England in 2021 (HTA, 2022). Four main businesses[48], plus many minor players extract peat on the 'Levels'. The Planning & Development Manager at Somerset County Council noted that tens of ha are excavated at a time (mixing local peat with imported peat and other growth media to produce a more consistent product). FTE employment connected to peat extraction was found using publicly available data for the four known businesses that operate within the scope area. Based on this information there are at least 56 FTE workers in peat/growing media businesses on the 'Levels'[49].

The growing media business mixes many different ingredients (such as, peat, household compost, wood waste and imported materials such as coir) to produce a broad range of products to the retail and professional growers' market (e.g., soil improvers, multi-purpose compost, some of which may be peat free). The purpose of this study is to estimate the proportion of economic turnover that relates to the extraction of peat from the 'Levels', as distinct from growing media manufacture, packaging and distribution. Given that there is no public data on peat extraction, it is difficult to estimate the proportion of growing media that is extracted from the 'Levels'. In the UK, peat as a percentage of total media has fallen from 48% in 2019 to 36% in 2021 (HTA, 2022). This trend is reflected by some of the major growing media businesses in the SCLM are publicly committing to a peat free future and are progressively reducing peat content. The approach taken was to take an assumed volume of extraction (35,000 cubic

[46] see: https://www.bbc.co.uk/news/uk-england-somerset-64406213
[47] See: https://hta.org.uk/media/omiojakk/2021-growing-media-monitoring-report-vf.pdf
[48] The largest known businesses in the scope area are Durston, EJ Godwin, Magnolia Peat Products, and Michael King's ltd
[49] FTE refers to the number of hours considered full-time. For example, a part-time employee who works 20-hours a week would be worth 0.5 FTE compared to a full-time employee at 40-hours a week.

metres) and multiply by the UK average turnover of £111.11 per cubic metre for growing media[50] to give total output value at £3.9 million in 2022. GVA was assumed to be 50% of this value giving an indicative GVA figure of £1.9 million.

For both scenarios, economic activity and FTE employment was assumed constant until assumed date of peat extraction ceases. In scenario 1, monetary figures were forecasted as remaining constant until 2042 when the licenses expire. All economic activity is assumed to cease from 2042 onwards. In scenario 2, monetary and employment figures were forecasted consistently until 2025 and cease from that year onwards.

Tourism

Calculations for tourism, that is day visits over 3 hours and overnight visits, were estimated using Kantar (2019a, 2019b) day visit and overnight visit data, which is organized per local authority (district council) and estimates 29 million visits to the four local authorities (Appendix Table 4). The data at local authority level was scaled down to the proportion of the scope area in the four local authorities[51], providing a study area estimate of 4.7 million visits.

To find the proportion of visits attributed to nature (i.e., visits to natural areas as the prime motivation), the total visits was multiplied by the Office for National Statistics (ONS) percent applied to tourist expenditure attributed to nature (8%) (ONS, 2021). This estimate does not necessarily reflect the % of visits that are to nature but is used in the absence of better data. The total visits attributed to nature are estimated at about 370,000.

Appendix Table 4 Summary of tourist visits attributed to nature calculation

	Mendip	Sedgemoor	South Somerset and Taunton Deane (combined)	Total
Percent overlap between scope area and total local authority	13%	36%	7%	
Volume of tourist visits per local authority, thousand visits	4,690	6,930	17,520	29,140
Volume of tourist visits in the scope area, thousand visits	594	2,775	1,299	4,669
Volume of tourist visits attributed to nature ('000s)	48	222	104	374

Tables note: Tourist visits include day visits over 3 hours and overnight stays.

This figure was sensitivity checked against visits to 5 managed nature sites that can be estimated using trail counter data. The total visits from these 5 sites were almost 200,000 in 2020 (Avalon Marshes Centre, 2020)[52]. Assuming an average across all twelve of the other sites in the area, the total number of visits

[50] Value of Retail Growing Medium Market in UK (2021) market worth at least £400 million in 2021 for 3.6 million cubic metres of product (hence £111.11 per cubic metre as an average price): https://www.gov.uk/government/publications/report-impact-of-a-proposed-ban-of-the-sale-of-horticultural-peat-in-england-on-the-effective-operation-of-the-uk-internal-market/impact-of-a-proposed-ban-of-the-sale-of-horticultural-peat-in-england#the-market-for-growing-media-in-the-uk

[51] The local authorities include Mendip, Sedgemoor, South Somerset, and Taunton Deane. Note that from 1 April 2023, these local authorities have been replaced by the unitary authority of Somerset.

[52] Note that this data was estimated to the nearest 10,000 in the Avalon Marshes Baseline report, and may not be accurate.

would be over 450,000, which is probably an overestimate as the size and accessibility of the 5 sites the data for are higher than the remaining managed nature sites in the scope area. Considering this, the chosen visits figure and visits using this methodology are closely related.

The value from tourism in Somerset is a market value, i.e., represents spend from tourists at restaurants and accommodation etc, and can be understood as turnover from tourism. The value was estimated using Kantar (Kantar, 2019a, 2019b) spend from day visit and overnight visit data, which is organized per local authority. The data at local authority level was scaled down to the proportion of the scope area, and value inflated to 2022 prices. The total spend was found by adding spend per visit type within the scope area, which equals almost £149 million. This figure includes spend in urban areas and festivals that are unrelated to nature (i.e., visits to natural areas) which makes the number alone too high an estimate. To find the proportion of spend from tourism attributed to nature, the total spend was multiplied by the ONS percent applied to tourist expenditure attributed to nature (8%). The total spend from tourism attributed to nature is estimated at about £12.8 million.

Appendix Table 5 Summary of value from tourism attributed to nature calculation

	Mendip	Sedgemoor	South Somerset and Taunton Deane (combined)	Total
Percent overlap between scope area and local authority	13%	36%	7%	
Value from tourism per local authority, £ million	207	252	412	871
Estimated value from tourism in the scope area, £ million	26	92	31	149
Value from tourism attributed to nature, £ million	2.3	7.9	2.6	12.8

Tables note: Tourism refers to spend from tourist visits over 3 hours and overnight stays.

Gross value added in the tourism sector related to nature (£4.8 million) was calculated assuming that the percent of cost share for labour (37%) for the food and beverage industry (Defra, 2022a), is a suitable proxy for GVA in the sector.

FTE employment from nature related tourism was estimated by dividing the total GVA of tourism related to nature in the study area, by the average annual salary of a full-time worker in the tourism industry (£20,500 in 2022 prices) (Visit Somerset, 2020). This provided a baseline estimate of 234 FTE.

For Scenario 1, the GVA from nature related tourism is multiplied by the rate of increase of population in Somerset by year published by the Office for National Statistics (2019), which is a cumulative 10% increase in population from 2022 to 2040, and is assumed to remain constant thereafter to 2080. This figure reflects anticipated increases in recreation by locals in the region and may not reflect the change in tourism by the wider UK population, and by overseas visitors (which are forecast to grow at slightly lower rates). For Scenario 2, the GVA is estimated to grow linearly by 100% by 2050 in addition to the increase in GVA due to population increase, i.e., the 2050 figure for Scenario 2 is 10% more than double (100%) the baseline figure, and remain constant until 2080.

Appendix Table 6 provides an outline of the economic changes in the tourism industry per scenario.

Appendix Table 6 Scenarios outline for GVA and FTE in the tourism industry

	2022	2035	2050	% change (2022 - 2050)
Scenario 1				
GVA from tourism (£ million)	4.8	5.1	5.3	10%
Employment in tourism, FTE	234	250	256	10%
Scenario 2				
GVA from tourism (£ million)	4.8	7.3	10.1	111%
Employment in tourism, FTE	234	354	494	111%

Conservation

Project partners provided estimates of employment (FTE) and spend on conservation costs in the SCLM. Information was provided by seven organisations; NE, SWT, RSPB, Wildfowl and Wetlands Trust, FWAG, National Trust and the Hawk & Owl Trust for the most recent year (2022). These organisations cover most of the reserve managed area and conservation costs in the area, hence provide an estimate that has a high degree of confidence. Labour costs were provided by some organisations/sites and this average employment cost per FTE (£36,500) was used to estimate the costs for headcount where no labour cost was provided. This produced an estimate of 51.2 FTE and £1.87 million for employment costs and was sued as a proxy to GVA (in the absence of any other data).

Appendix Table 7 Summary on Conservation Employment & Expenditure (2022)

Item of expenditure	FTE	Annual Spend £'000
Reserves Staff	21.0	
Visitor engagement staff	6.9	
Land advisors covering SCLM	9.6	
Direct delivery in local projects	9.0	
Other roles	4.6	
Total employment	**51.2**	**1,870**
Habitat management cost		481
Visitor Facilities cost		356
Capital spend		140
Total Spend		**2,847**

These organisations also provided estimates of non-labour spend on the habitat management, visitor facilities and an estimate of ongoing capital spend. These estimates are summarised in Appendix Table 6. Total conservation cost across all managed nature sites is £2.8 million.

For scenario 1, employment levels, GVA and overall expenditure were assumed to be constant at baseline levels throughout the forecast period. For scenario 2 there were two assumed elements of growth:

- Conservation employment increases for two reasons, i) in line with the rise in nature-based tourism (see above), more than doubling by 2050, and ii) due to the assumption that the equivalent of 200 FTE roles are created for land managers (mainly farmers) to undertake conservation work.
- An additional 200 FTE roles are required for land managers to preform conservation roles which may be carried out in addition to other employment (e.g., farming).

These additional roles were valued for GVA estimates at the same GVA/FTE for agriculture (£11,500) to avoid overstating the GVA of this activity relative to farming. Attributing a GVA to conservation work is a complex challenge, but this assumption serves as a conservative under-estimate of value.

Water level management

For water level management the estimated proportion of annual spend on the SCLM (provided in discussion with EA staff) was used as a proxy for turnover. GVA was estimated at around 50% of this spend value and is in line with typical GVA per head in the construction industry (£43,500 per head) (Somerset County Council, 2016).Employment was estimated based on water industry figures by local authority (Somerset County Council, 2016), and shown in Appendix Table 8 . There is a reasonable degree of confidence in these figures as the employment level and GVA assumption tie into the forecast level of spend provided by EA.

Appendix Table 8 Summary of employment in WLM calculation

	Mendip	Sedgemoor	South Somerset and Taunton Deane (combined)	Total
Percent overlap between scope area and total local authority	13%	36%	7%	
Number of employees in water industry by local authority	200	600	700	1,500
Number of employees in WLM in the scope area	25	203	51	280

For scenario 1, employment in WLM is assumed to grow by 50% linearly between 2030 and 2050 to account for increased labour needs to meet climate change impacts. The same assumptions apply to scenario 2.

A1.3 GHG Flows

This economic assessment includes multiple habitat types and land management activities, including water level management and agricultural outputs (e.g., cereal and livestock production). Appendix Table 9 shows the GHG flow rates used for the baseline calculations, by land type and activity. In some cases, rates are different depending on if the habitat or activity was located on deep peat (for example deep peat drained for agriculture produces very significant emissions). For this reason, flow rates are listed separately in the table if rates differ between soil types or merged across both if consistent. Negative rates denote that the habitat/activity emits CO_2e, positive rates denote sequestration.

Appendix Table 9 GHG assumptions used

	Deep peat	Non-deep peat	Source
Habitat GHG flow rates			
Arable land use	-38.98 $tCO_2e/ha/yr$	0	(Evans et al., 2017b)
Grazing land use	-19.02 $tCO_2e/ha/yr$	0	(Evans et al., 2017b)
Woodland	5.7 $tCO_2e/ha/yr$		(Forestry Commission, 2017; ONS, 2019)
Conservation Grassland	0.64 $tCO_2e/ha/yr$		(Soussana et al., 2009)
Fen, swamp and marsh	0		(Evans et al., 2017b)
Saltmarsh	19 $tCO_2e/ha/yr$		(WWT, 2021)
Activity GHG flow rates			
Peat extraction	-1.4 $tCO_2e/m^3/yr$	NA[1]	(Berks Buckingham and Oxford WT, 2022)
Cereal production	-0.3 $tCO_2e/t/yr$		(AHDB, 2021)
Dairy	-0.0012 $tCO_2e/litre/yr$		(AHDB, 2021)
Cattle	-8.8 $tCO_2e/head/yr$		(AHDB, 2021)
Sheep	-0.8 $tCO_2e/head/yr$		(AHDB, 2021))

Table note: Peat extraction only occurs on areas with deep peat.

Habitat GHG flows

The total amount of CO_2 equivalent sequestered or emitted by habitat type is estimated by multiplying per hectare rates with the total hectares of the respective habitat type, as recorded in Table 3.1 for the baseline and scenario 1, and Table 4.11 for Scenario 2 by 2050.

Deep peat soils drained for farming are a major source of GHG emissions and the unit emissions factor for arable and grazing land on deep peat soils are taken from Evans et al., (2017b). Net carbon flow on non-deep peat soils used for farming (both arable and grazing) is assumed to be net-zero.

The unit sequestration factor for woodland covers both coniferous and broadleaved woodland using a UK average sequestration rate. Conservation grassland uses the rate for improved grassland by (Soussana et al., 2009), which is estimated as 0.64 tonnes of CO_2e per hectare. Sequestration rates are assumed to remain constant over time.

Peatland stores significant quantities of carbon. If peat is in pristine or near natural condition the rate of carbon sequestration is significant but is roughly offset by the warming potential of methane emissions (produced under anaerobic conditions by microbes). Consequently, the net greenhouse gas sequestration potential of peatland in good condition is low or close to zero. However, peatland in drained or eroding condition can emit very large quantities of carbon and other greenhouse gases. Likewise, the quality and depth of peaty soils in wetland habitats have an impact on carbon sequestration rates, which can range from -6.37 tC/ha/yr for rewetted fen to 0.61 tC/ha/yr for near natural fen (Evans et al., 2017b). As the quality and depths of wetland on peaty soils is not known, sequestration rates for fen, marsh and swamp were estimated to have net zero annual GHG emissions.

Agricultural activities and peat extraction

This economic assessment has measured the emissions rates from cereal and livestock production, specifically dairy, cattle, and sheep. Appendix Table 10 shows the emissions rates for these activities for scopes 1, 2 and 3 published by (AHDB, 2021). Negative rates denote that the habitat/activity emits CO2e, positive rates denote sequestration.

Appendix Table 10 GHG emissions rates for agricultural activities

Activity	Average (as reported)	Conversion	Factor Used
Dairy	-1.2 kg CO_2e/litre	Divide by 1,000 to convert to tCO_2e	-0.0012 tCO2e/litre/yr
Beef	-23.4 kg CO_2e/kg dwt	Multiply by av deadweight of 375kg/head and divide by 1,000 to convert to tCO_2e	-8.8 tCO2e/head/yr
Sheep	-25.2 g CO_2e/kg dwt	Multiply by av deadweight of 30kg/head and divide by 1,000 to convert to tCO_2e	-0.8 tCO2e/head/yr
Cereals	-0.3 tCO_2e/tonne	Used as is.	-0.3 tCO_2e/tonne

Source: (AHDB, 2021)

The average rates in Appendix Table 10 were converted to tonnes CO2e/head for cattle and sheep and tonnes CO2e/litre of milk for dairy. Total GHG emissions from agricultural activity were calculated by multiplying annual tonnes of cereals, litres of milk, and heads of cattle and sheep produced in the SCLM.

GHG emissions from peat extraction were calculated by taking the average tonne of carbon in a volumetric cube of peat by the Berks Buckingham and Oxford Wildlife Trust (2022) . This factor was converted to tonnes CO_2e using a conversion factor of 3.67 (Intergovernmental Panel on Climate Change, 2018) and multiplied by the cubic metres of peat extracted annually.

Water level management

The GHG emissions from water level management (900 tCO_2e/year) was provided per comms from a reputable source at EA and is presented as the total annual GHG emissions from power used to pump water from the 'Levels'. Emissions decrease to net zero from the baseline year to 2050 as power sources used are switched to renewables.

A1.4 Non-market ecosystem services

GHG flow value

The flow of CO_2e sequestered or emitted per habitat or activity type is valued following the UK government guidance, BEIS (2021), for the non-traded central price, £254 per tonne of CO_2e in 2022. This is multiplied by the estimated tonnes of CO_2e sequestered (positive value) or emitted (negative value). Future flows of carbon are valued using the annual forecast, BEIS (2021) of carbon values series until 2050. Following BEIS (2021) advice, a real annual growth rate (1.5%) is then applied from the last published value (in 2050) into the future.

Recreation and physical health

The ORVal[53] tool (2018) was used to estimate the number and welfare value of visits to the accessible open spaces (sites and paths) in the scope area. Recreational visits are defined as visits under 3 hours, whereas tourism visits are 3 or more hours and overnight stays (which have been accounted for in the economic turnover of tourism reported in A1.2). The Orval tool uses MENE data (MENE, 2019), which breaks down visits by length. Using the MENE breakdown, visitor data for trips lasting 3 hours or more were excluded by multiplying the total volume and welfare values by 78%. The total volume of recreational visits is about 3.1 million visits. The annual welfare value from recreation per visit was calculated by inflating the Orval data to 2022 figures (£4.84) and multiplying it by total recreation visits under 3 hours.

It should be noted that the welfare value calculated from ORVal takes into account the location of the recreation asset, the surrounding population, habitat type(s) and local alternatives, but makes the assumption that accessible green space is in average condition for its type. Where this is not the case, green space with better/ worse condition than average will likely have higher/lower values for number and welfare value of visits. Similarly, as the model underlying ORVal is based on MENE data[54], it does not consider visits by children or overseas visitors to the UK, hence is likely to underestimate total recreational value.

In addition to improving the general welfare of visitors, if people are active during their visits, recreation can also have measurable physical health benefits. White et al. (2016) estimate that 51.5% of recreation visits[55] are 'active', where an 'active visit' is defined as those who met recommended daily physical activity guidelines either fully, or partially, during visits. The White et al. (2016) proportion of active visits is applied to the annual visits to greenspaces within the account boundary[56], producing the number of annual active visits which is assumed to remain constant over time.

The benefit is valued as the health benefits of active recreation (in terms of improvements in Quality Adjusted Life years – QALYs[57]) and the economic value of health improvement (in terms of the avoided

[53] ORVal is an online spatial model that shows recreational sites, number of visits and the benefit to visitors from those visits, using data from mapping tools, Monitor of Engagement in Natural Environment (MENE) survey, and economic valuation literature.

[54] See: https://www.gov.uk/government/collections/monitor-of-engagement-with-the-natural-environment-survey-purpose-and-results

[55] Refers to recreation visits that are under three hours.

[56] As described in 'Recreation' calculation.

[57] QALY is a health measurement used widely in health and health economics research. QALY of zero denotes death, and 1 denotes full health.

health cost due to improvement in QALY). Beale et al. (2007) analysed Health Survey for England data, estimating that 30 minutes a week of moderate-intense physical exercise, if undertaken 52 weeks a year, would be associated with 0.0106768 QALYs per individual per year. Beale et al. (2007) assume this relationship between physical activity and QALYs is both cumulative and linear. Claxton et al. (2015) estimate a cost-effectiveness threshold of a QALY to be roughly £12,900/QALY in 2008 prices. This figure is used as a proxy for health costs, reflecting the avoided health costs when QALY is improved by one unit. Based on this information, the avoided health cost is estimated as £3.46 per active visit in 2022 prices. The monetary unit value is assumed to remain constant over time.

Air quality

Air quality benefit arises from the ability of different types of vegetation to remove pollutants from the air. This benefit is estimated for the amount of PM2.5 removed by woodland (which makes up more than 70% of this benefit in the UK (Jones et al., 2017) and the human health benefits of this removal.

Jones et al. (2017) modelled this benefit for the UK national accounts reflecting the variety of different levels of PM2.5 concentration, types and extent of vegetation and density of human population across the country. An update to this study has produced estimates of PM2.5 removal per hectare of woodland by local authority. The kilograms PM2.5 removed by hectare of woodland (eftec and CEH, 2019) is multiplied by the total woodland area in a given local authority in each reporting area. The PM2.5 removal per ha of mature (i.e., existing) woodland is falling over 2015-2030 based on the assumption about emissions and concentrations falling over time.

The economic value of this service is estimated through the resulting avoided healthcare cost at local authority level (eftec and CEH, 2019). The account shows the benefits as the result of: £ per ha of woodland (in terms of avoided health care cost due to PM2.5 removed, in 2020 prices) for a given local authority area (eftec and CEH, 2019), which is multiplied by the total woodland area in that area (as produced by further GIS analysis). This produces the annual value of PM2.5 removal by woodland.

Future benefits decline in line with lower emission / concentration assumption mentioned above but are discounted at lower levels using the lower health discount rates (HM Treasury, 2020).

A1.5 Biodiversity

NE commissioned a report (Franks et al 2016) into the impacts of climate change on the Somerset Levels and Moors SPA. The assessment modelled impacts on the following species groups:

- Waders (non-breeding);
- Waterbirds reliant on shallow water, margins, and grassland (breeding and nonbreeding);
- Bittern (breeding and non-breeding);
- Breeding waders (lapwing, snipe, redshank, and curlew);
- Marsh harrier (breeding and non-breeding);
- Crane (breeding and non-breeding);

- Black-winged stilt and Baillon's crake (breeding);
- Great white egret, little egret, little bittern, purple heron, night-heron (breeding and non-breeding);
- Bluethroat.

The projected population trends are summarised in section 4.1.7 and based on the table in section 5 of the report. Of the 27 species assessed the table lists:

- Number of species populations that fall by more than 50% by 2050 and 2080
- Number of species that fall by less than 50% by 2050 and 2080
- Number of species that maintain current population levels by 2050 and 2080
- Number of species that are forecast to increase in population by 2050 and 2080

NE has also conducted climate change risk assessments, based on UKCP18 climate assumptions, for two NNRs within the study area. These have been used to establish the high risk features listed in section 4.1.7.

The vulnerability Assessment for Somerset Levels NNR is reproduced below:

Appendix Table 11 : Somerset Levels NNR vulnerability assessment

Feature	Rainfall	Temp	Extreme Events	In Combin-ation	Reasoning
Wintering Bird Assemblage	Medium	Medium	High	High	Affected by flooding and drought
Breeding Bird Assemblage	High	High	High	High	Affected by flooding and drought
Grasslands	High	High	High	High	Particularly vulnerable to heavy rain in summer / extreme events
Traditional Orchards	High	High	High	High	Affected by flooding and drought
Ditches	High	High	High	High	Affected by flooding and drought
Remnant raised bog or mire	High	High	High	High	Particularly vulnerable to drought conditions
Fen grassland	High	High	High	High	Vulnerable to high water levels, flooding and drought
Species rich neutral grassland	High	High	High	High	Particularly vulnerable to heavy rain in summer / extreme events
Reedbeds and open water	Low	Medium	Medium	Medium	Robust but continuous drought may have impact
Scrub & Pollards	Low	Medium	High	High	Vulnerable to drought and storms
Mammals	Medium	Medium	Medium	Medium	Can move around landscape
Water vole	High	High	High	High	Can move but limited and reliant on water network
Bat assemblage	Medium	Medium	High	Medium	Adaptable species can move in the landscape
Reptiles & Amphibians	High	Medium	High	High	Vulnerable to extreme events cold spring, wet summer
Invertebrate Assemblage	High	Medium	High	High	Affected by flooding and drought
Butterflies and moths	High	High	High	High	Particularly vulnerable to extreme conditions
Bumblees and other pollinators	High	High	High	High	Particularly vulnerable to extreme conditions
SL&M NCA	High	High	High	High	Flood management, drought, effect on peat soils.

The assessment for the coastal area of Bridgwater Bay NNR is shown below:

Appendix Table 12 : Bridgwater Bay coastal area

Feature	Rainfall	Temp	Extreme Events	In Combin-ation	Reasoning
Estuary - Geological and geomorphological processes	M	M	M	H	Prolonged intervals of high temperatures followed by intense rainfall could (particularly if the drought had impacted significantly on vegetation) make the soils vulnerable to erosion and facilitate the mobilisation of sediment
Submarine Forest	L	L	L	L	So long as the forest remains submerged during part of the tidal cycle there is unlikely to be a problem.
Intertidal Mudflats	L	L	H	H	Vulnerable to rising sea levels and extreme events.
Saltmarsh	M	M	H	H	At risk of coastal squeeze due to rising sea levels and more frequent storm surges.
Shingle Beach	M	M	H	H	At risk of coastal squeeze due to rising sea levels and more frequent storm surges.
Reedbed	L	L	M	M	Vulnerable to drought conditions. In theory could be vulnerable to coastal squeeze but currently accelerating in this location.
Ponds	H	H	H	H	Highly vulnerable to changing weather patterns especially droughts.
Coastal & Floodplain Grazing Marsh	M	M	H	H	Likely to be subject to sea water floods and or drought with increasingly prevalent extreme weather events and sea level rise.
Ditches	H	H	H	H	Affected by flooding, drought and sea level rise.
Wintering Birds	M	M	H	H	Changing range, impacts of rising sea level and shifting habitat assemblage will all impact wintering birds.
Breeding Birds	H	H	H	H	Unpredictable weather patterns, extreme events, changing range, impacts of rising sea level and shifting habitat assemblage will all impact breeding birds.

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