Oxford to Cambridge Arc Environmental Pressures and Risks

A summary review of existing pressures and likely future issues affecting the natural environment across the Arc

Introduction

The Oxford to Cambridge (OxCam) Arc is the name given to a cross-government initiative that supports planning for the future of the five ceremonial counties of Oxfordshire, Bedfordshire, Buckinghamshire, Cambridgeshire and Northamptonshire up until 2050. Because of the commitments to green growth, its governance, and scale, the Arc represents a unique opportunity to put the Government's 25 Year Environment Plan into action. The Local Natural Capital Plan (LNCP) Project is co-creating a natural capital plan and approach for the Arc with partners to help ensure that the concept of natural capital is woven into the fabric of decision making, putting nature at the heart of progress.

Early in the production of the OxCam LNCP, the team commissioned a review of natural capital tools and approaches to inform our way forward. What came out of this was a 6 step approach for creating a LNCP. Within this report we are looking at step 3, highlighting the pressures that the environment will face and creating a risk register of them. This pressures and risk document is intended to be a broad summary of current issues and those likely to arise relating to natural capital in the Arc. It is not a systematic analysis of impacts, in part because the LNCP project's focus and remit is enabling a natural capital approach for the Arc rather than completing all aspects of the work; also because the size of the Arc means that it is not feasible to create a detailed register, which we believe would be more appropriately created on a smaller geographical scales.

The receptors for risks have broken down into topics to explore within this document enabling focused expert input into this review. Two main categories of pressure have been identified:

- **Population increase and development of land for homes and businesses** - This is a common pressure across the UK, however with up to 1 million new homes planned to be built across the Arc by 2050 this pressure is heavily represented across the Arc. To provide this in context, according to Ministry of Housing, Communities & Local Government statistics in 2016 the OxCam Arc Authorities contained 1.5 million dwellings.

- **Climate Change** - The Earth's climate is changing and these changes threaten the ability for species to survive in the habitats and locations that we currently find them.

These two main pressures are explored in each of the following sections. At the end of each section (excluding Soils, Sense of Place, Tranquillity and Climate Change) a list of metrics of risks. These metrics can be used to provide a benchmark of the current risks that we hope can be used to track changes against in the future. Appropriate polices and plans are signposted where appropriate

Soils

[i]Soil is a fundamental natural capital asset, on which most other environmental assets depend. This can however be easily overlooked if we focus our attention on habitats and land use – we must not forget that soil underpins these landscapes. Because we have a finite area of soil, the delivery of a whole range of ecosystem services depend on how well the soil functions. This includes food production, biodiversity, carbon storage, clean water and flood protection. The delivery of these services is strongly governed by the activity of soil organisms which can rebuild soil structure, maintain water storage, recycle nutrients, facilitate soil organic matter storage, process pollutants and help control pests and diseases. You can find out more about the state of soil within England by reading the Environment Agency's the state of the environment: soil report.

Key risks to soil in the Ox-Cam Arc are those associated with growth, both physical (buildings, infrastructure and other hard development), economic (e.g. increased requirement for minerals, waste management sites, recreational facilities etc.). Other key risks include and the impact of changing and the intensity of land use (e.g. loss of farmland or other greenfield soils and pressure for more intensive land uses). Poor soil management and some types of land use change can reduce the ability of soil to function and is directly linked to various other risks within the OxCam Arc including water quality, flood risk management, loss of biodiversity and reduction in agricultural productivity and profitability. Healthy soil is also an important contributor to future climate and food system resilience, and intensity of land use for eample by providing natural flood management.

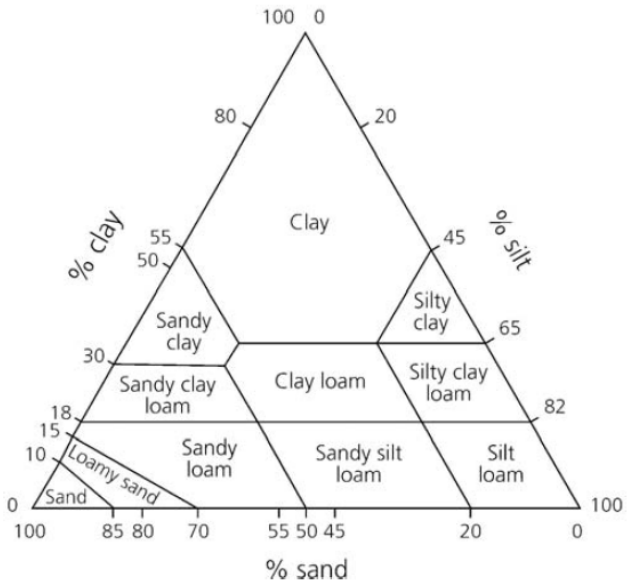

Figure 1. Soil texture pyramid (Natural England)

The 25 Year Environment Plan (25 YEP) sets out the Government's ambition to have all soils sustainably managed by 2030. This ambition to improve the health of our soils will also directly contribute to delivering wider 25 YEP outcomes, primarily those relating to sustainable resource use. This includes: reduced environmental hazards; mitigation of and adaptation to climate change; thriving plants and wildlife; and clean and plentiful water. This includes, for instance, sustainable soil management on construction sites and elsewhere where land use change is planned. Specific objectives for soil in land use planning in the 25 YEP relate to, 'ensuring that new development happens in the right places delivering economic benefit and avoiding environmental damage, delivery of net environmental gain, and protection of our best agricultural land'. Alongside the 25 YEP, the National Adaptation Programme (NAP) has a section dedicated to protecting soils and natural carbon stores from climate change risks.

Soil type, land cover and slope are the three main factors affecting a soil's vulnerability to degradation. Using the British Geological Survey's *Soil Parent Material model - 1 kilometre resolution* dataset we can start to build a picture of the soils present within the Arc. In this dataset the Arc is split into 11,991 1km^2 grid squares. 2,376 (19.81%) of these are classed as loam to clay loam, 1,586 (13.23%) are loam to clay and 1,130 (9.42%) are clay to loam.

Soil texture describes the combination of inorganic particle sizes making up a particular soil. Particle sizes are described as; Sand (2 - 0.05mm) Silt (0.05 – 0.002mm) and clay (< 0.002mm). Figure 1, the soil texture pyramid shows how these different sized particles combine to give a soil texture class. This dataset and the Landis interactive soilscape database show that the predominant soil texture within the Arc is clay. Clay rich soils are documented to have a high resistance to erosion due to the strong bonds between particles[ii] which gives soils across the Arc

protection against erosion. Clay soils are however more likely to accelerate water run-off which can increase flood risk.

There is generally a scarcity of information on the state of soils, but over the last few years there has been a great deal more research into the issues affecting soils and the risks associated with soil degradation or loss of soil function which is explored in more detail in the following paragraphs.

Land use and management is a key factor in determining the potential for soil degradation. The Arc is predominantly agricultural, the detailed basemap classifies 54% of the Arc as cultivated / disturbed land and 19.6% of land as improved grassland (land used for grazing). This agricultural land is also highly productive, with the Arc containing approximately 20% of England's Class 1 agricultural land, see Figure 2. The principal physical factors influencing agricultural production are climate, site and soil and this largely agricultural profile raises the risk of soil degradation, for example through soil loss from water erosion.

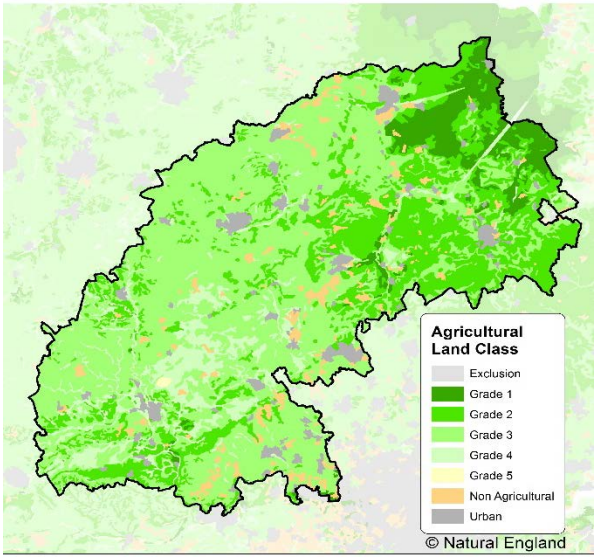

Figure 2. Agricultural land class in the Arc

Protecting the best and most versatile agricultural land is a Natural England statutory function and they are consulted on any planning application where over 20 ha of Grade 1, 2 or 3 land is to be lost to agriculture. Natural England's guidance is that where significant development of agricultural land is demonstrated to be necessary, local planning authorities should seek to use areas of poorer quality land in preference to that of higher quality. Since high grade agricultural land is widespread across the arc future development risks losing highly versatile, high yielding agricultural land

	Erosion rates for soilscape type category (t ha^{-1} a^{-1})			
Land use	Clay	Silt	Sand	Peat
Urban	0	10	5	0
Horticulture	2	20	5.08[1]	15
Arable intensive	1.92[1]	22.4[2,3]	20.3[2,3,4,5]	20
Arable extensive	1[6,7]	6.3[6,7,8,9]	3.46[6,7,8,9,10]	10
Grassland improved	0.36[8]	4.49[8]	4.09[1]	7
Grassland unimproved	1.29[8]	2.071[1,8]	1.5	10
Rough grassland	0.05	0.75	0.22[8]	10
Forestry	0.01	0.5	0.05	0.7
Woodland	0.01	0.5	0.05	0.7
Wildscape	0.01	0.5	0.05	0.7

Table 1. Relative erosion rates for different soilscape types (G, Graves et al 2011). Type of erosion not specified

Table 1 shows the relative erosion rates from various broad 'soilscapes', and the table suggests that the soil type, land use, and how it is managed (e.g. intensive vs extensive) is influential in determining erosion rates. From Table 1 we can see that the biggest risk for soil erosion is where intensive arable land coincides with silt, sand or peat soils. Figure 3 highlights areas of the Arc the soils are predominantly peat or sand and the land is currently used for agriculture. These are the high risk areas for soil erosion (there are no predominantly silt soils in this dataset for the Arc).

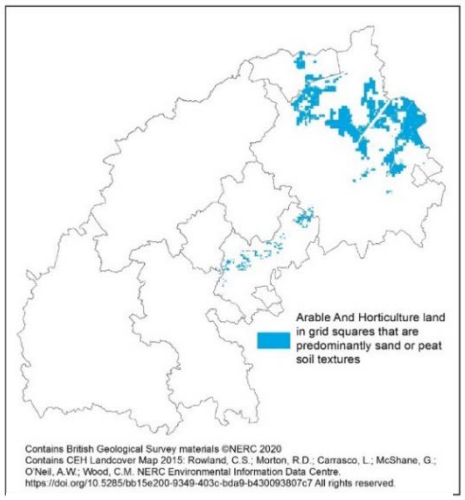

Figure 3. Areas of land used for agriculture where soil is

Soil is a living system, covering it with an impermeable surface such as concrete or tarmac – known as 'soil sealing' prevents its normal function. Soil sealing has multiple impacts that are set out below:

Water

Using the Environment Agency's data on groundwater vulnerability to pollutants as a proxy dataset, the areas where soil is actively contributing to aquifer recharge can be identified.
Where soil is sealed off through development there is less water able to filter down to top up our drinking water supply. Soil can also help to filter pollutants out of runoff before it reaches rivers.

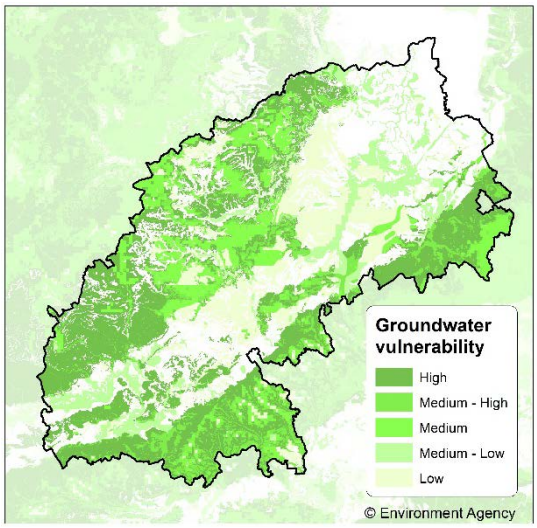

Figure 4. Map of groundwater vulnerability. This is being used as a proxy to areas where soils allow recharge of aquifers

Food supply

Reducing agricultural land puts greater pressure on the agricultural sector to meet the demand for food, energy and other raw materials. This will inevitably lead to higher land prices and more intensive land management with the associated negative environmental impacts.

Climate change

Soil contains a large amount of carbon and when soil is removed for building it can release some of this carbon back into the atmosphere. Soil also captures CO_2 and if the soil is sealed, it is no long able to perform this function increasing CO_2 in the atmosphere.

The Second UK Climate Change Risk Assessment [iii](CCRA2) also highlights risks to soils from increased seasonal aridity and wetness (Risk #4).

Loss of biodiversity

One of the key aspects of soil is the life that lives within it. Healthy soil supports micro-organisms, larger organisms (like earthworms and moles) and plants, which in turn supports life above ground. By sealing a surface we effectively remove this interface between the surface and the sub surface worlds, which increases biodiversity loss.

Water

The water environment is a vital part of the natural capital of the Arc. There are three main aspects: Flood risk; water resources; and water quality. Across the Arc there are 5,710km of rivers and streams, all of which need to be maintained and looked after. The Environment Agency is responsible for the health and monitoring of the main rivers in England. One element of this is the application of the Water Framework Directive (WFD). The WFD is a European directive to protect and improve our waterways by taking a river basin approach and aiming to achieve 'good' status by 2027. It looks at both surface water (where it accesses ecological, chemical, quantity & other aspects) and also groundwater (where it accesses chemical and quantitative status).

Flood Risk

Flood risk is the combination of the likelihood and the potential impact of flooding. There are various ways that flooding can occur: rain falling so heavily that it runs over the surface before reaching a river or draining into the ground – surface water risk; rivers getting so full the water over spills their banks – fluvial risk; sea levels rising due to high tides often combined with winds pushing the water on to the shore and forming large waves – coastal/tidal risk, and groundwater aquifers filling to the point water flows out of the ground where no river normally exists – groundwater risk.

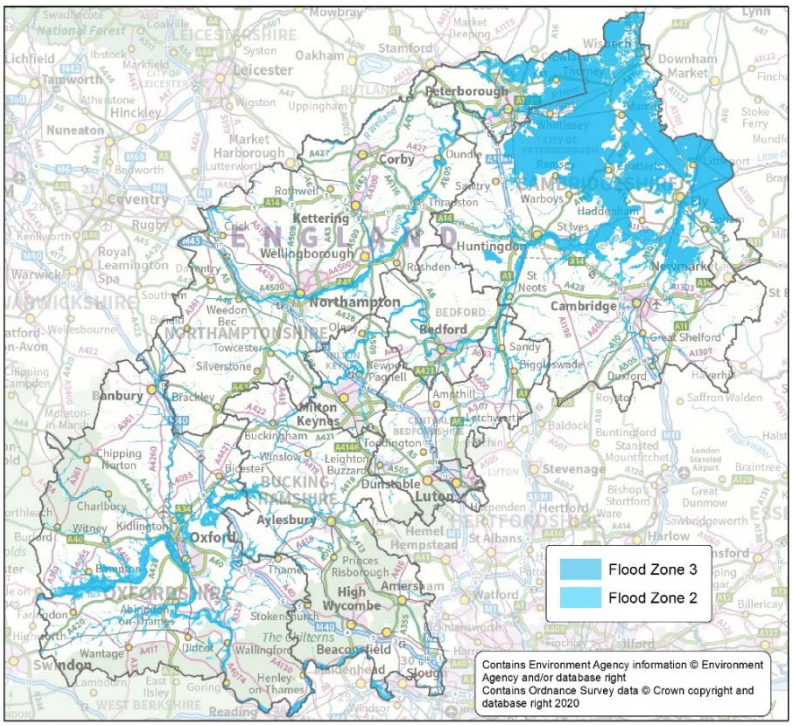

Figure 5. Fluvial and coastal flood zones in the Arc

Across the Arc there are currently 74,000 properties (From the EA Floodmap) within the Environment Agency's flood zone 2 (0.1% or greater risk of flooding in any year) which covers both fluvial and coastal flooding. There are also many more properties that are susceptible to surface water flooding. 14.7% of the Arc's land area is at a high risk of flooding (land having a 1% or greater annual probability of river flooding; or land having a 0.5% or greater annual probability of sea flooding). 61% of these high risk areas are within Cambridgeshire as can be seen in Figure 5 – mostly the Fens.

There have been various large floods across the Arc in recent years. There was a large fluvial flood in Oxford in the winter of 2013/2014 and in the summer of 2018 there was extensive surface water flooding in Milton Keynes. The Intergovernmental Panel on Climate Change released a report in 2014 on climate change which indicates that the UK will see more annual rainfall over the next 100 years and it is very likely that we will see more heavy rainfall events. This increases the likelihood of an increased number and severity of floods. The Environment Agency is working towards reducing the risk of flooding to as many properties as possible with a number of schemes in development such as the Oxford Flood Alleviation scheme.

It is generally agreed that due to an increase in sealed surfaces urbanisation can increase flood risk both from surface water flooding (due to drains being overwhelmed) and from fluvial sources

(by reducing catchment response time - water gets into the fluvial system quicker which raises the peak of the flooding and causes it to occur earlier). England has non-statutory technical standards produced by Defra for Sustainable Urban Drainage Systems (SuDS) to mitigate against this risk. Although SuDS are not mandatory for planning applications and on new developments, the revised National Planning Policy Framework[iv] states that major developments should incorporate SuDS unless it would be inappropriate to do so.

When looking at flood risk during the development of the Arc we need to ensure that decisions and evidence are based on assessing data at a catchment scale, be it smaller catchments or across river basins. Urbanisation does not only have the potential to increase the severity of a flood event, but it also increases the number of people who have the potential to be at risk as more people live, work and move through a flood risk area. Urbanisation can increase the severity of flood events through various processes. The replacement, for example, of permeable green surfaces/soil with impermeable concrete increases surface runoff and the loss of trees/vegetation equals loss of leaf capture and soil moisture uptake, which enables the ground to reach saturation point faster, increasing overland flow and peak discharge.

Urbanisation is not the only contribution to a heightened flood risk across the Arc. As previously discussed the Arc is a largely agricultural landscape, with 54% of the Arc being cultivated / disturbed land and 19.6% improved grassland. The UK Government provides guidelines and payments to land owners to create natural flood risk management features or farming 'good practice', which can involve planting field edges with flora that slows down the flow of water off the land. Bare soil, which is often seen pre planting or post-harvest is frequently the worst contributor to surface water run off because there is no vegetation to slow the movement of water which would allow it to soak into the earth. Bare soil is both a risk to soil erosion and flooding.

As the result of climate change (which is looked at in its own section) flood risk will increase in the coming years. The main aspect of climate change for consideration here is the likelihood of extreme events increasing. An increase in extreme events means that where a flooding event currently has a small chance of occurring in any given year, that same event could in the future have a higher percentage chance of occurring. This increase in risk due to climate change covers all of the different sources of flooding.

Section Summary

Main Pressures

- **Climate Change**
- **Land use change**
- **Increased population** living, working and moving through at risk areas

Metrics of Risk

Properties at Fluvial & Coastal Risk 1 in 30 risk (NAFRA Data)	7,013
Properties at Fluvial & Coastal Risk 1 in 100 risk (NAFRA Data)	39,071 – Note this is different to the figure generated when using the EA flood map
Properties at Fluvial & Coastal Risk 1 in 1000 risk (NAFRA Data)	61, 417
Properties at Surface Water Risk 1 in 30 risk	7,596
Properties at Surface Water Risk 1 in 100 risk	15,641
Properties at Surface Water Risk 1 in 1000 risk	55,118

Grade 1 Farmland 1 in 100 Fluvial	60,086 ha (83% of Grade 1 land in Arc)
Grade 2 Farmland 1 in 100 Fluvial	42,515 ha (15% of Grade 2 land in Arc)
Grade 3 Farmland 1 in 100 Fluvial	34,568 ha (6% of Grade 3 land in Arc)
Grade 4 Farmland 1 in 100 Fluvial	25,399 ha (24% of Grade 4 land in Arc)

Examples of past flood events: Oxford 2007 (fluvial); Milton Keynes 2018 (Surface Water) Banbury 1997 (Fluvial) and Aylesbury 1990 (Fluvial)

Mitigation, plans and targets

- **Flood Schemes**: Oxford Flood Alleviation Scheme;
- The Environment Agency are a **statutory consultee** on planning applications and provide advice on construction of new properties in at risk areas.
- **SUDs Planning Guidance**[v]: *Local planning policies and decisions on planning applications relating to major development - developments of 10 dwellings or more; or equivalent non-residential or mixed development - to ensure that sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate*
- Green Infrastructure Standards (a 25 YEP commitment) are expected to be added to the National Planning Policy Framework for a soft launch in spring 2021
- The Environment Agency are aiming to **better protect 300,000** homes by 2021 (across England)
- The Government's Flood and coastal erosion risk management Policy Statement alongside the EA's National Flood and Coastal Erosion Risk Management Strategy for England

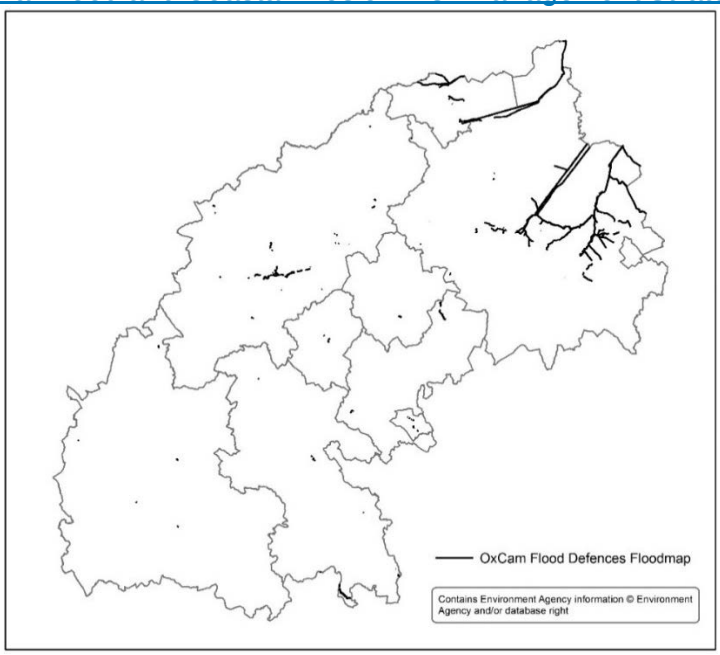

Figure 6. Flood Defences on the Environment Agencies Flood map. Note there are other defences that are not depicted in this map

Water Resources

There are three main aspects to water resources demand: public water supply; water abstraction for agriculture / industry, and water needed to maintain a healthy environment. Availability of water for all uses is one of the major challenges for the OxCam Arc and the balancing of these different needs is critical. The population will grow with increased development in the Arc so it is necessary that future demand is understood, demand management maximised and sustainable supply in place at the right time.

There is a multi-sector dependency on water resources, after public water supply, cooling uses by the electricity generation sector and the agricultural sector make up the other most significant users. For example, if there are any additional electrical generation sites needed to power the new developments we might see an increase of water use in the electrical generation sector. Also although we are unlikely to see an increase in farmland, with climate change and the potential for dryer summers farmers are likely to need to abstract more water at times where it is most scarce. Water is also needed by the environment to maintain habitats for plants and wildlife.

The Environment Agency as the regulator must balance each of these needs and licence how much water people can be abstracted from our rivers and groundwater to ensure that nature has enough to thrive.

Public water supply

Defra's consultation on measures to reduce personal water use (2019) states that currently a person in England uses 141 litres of water per day on average. As of 2016 there were 3.8 million people living in the Arc which means that an estimated 535,800 m^3 of water is used per day by the public. To put the future water requirements into perspective, taking the average household size as 2.4 people, the potential 1 million new homes planned for the Arc by 2050 would potentially increase domestic demand by 338,000 m^3 per day.

There are existing national policy requirements for new development, including new homes which must to be built to either a standard of 125 litres per person per day (Part G of the Building Regulations) or an optional requirement of 110 litres per person per day, which local authorities in water stressed areas can apply for where there is a clear need. If all new houses across the Arc are built to this higher optional standard of 110 litres per day (and people continue to only use that amount) the public water supply demand will rise by 264,000m^3 per day.

It is clear that to accommodate housing and economic development across the Arc, demand management measures including record low levels of leakage, water reuse technology and water efficiency need to be part of the demand management strategy. One option could be understanding how water neutrality, (by offsetting the impacts of new development through water efficiency improvements in existing housing stock) could be achieved.

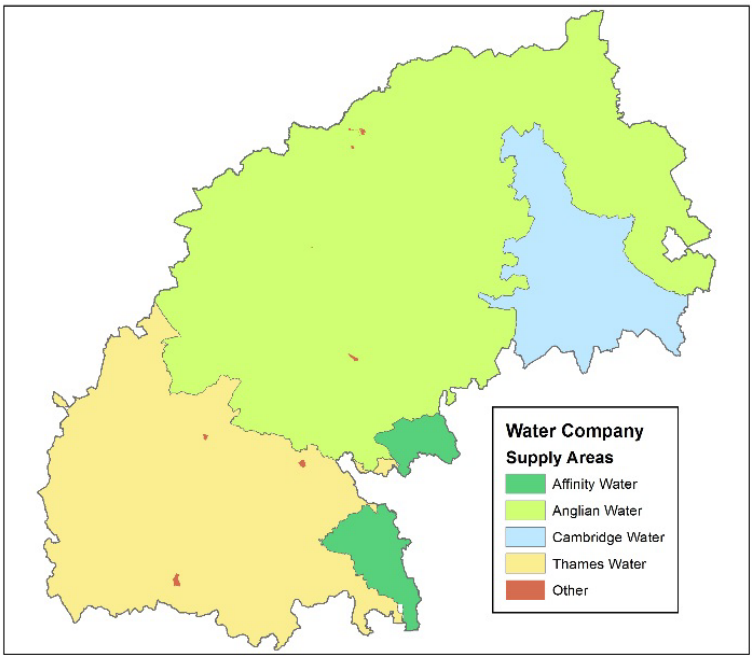

Figure 7. Map of water company supply areas within the Arc

While existing abstraction licenses may be able to accommodate some increase in demand, supply options will need to be considered against wider sustainability considerations including seasonal differences. Each water company sets out the twin track approach to supply/demand balance in their Water Resource Management Plan (WRMP), which sets out the long term plan for managing water resources covering a range of climate and growth scenarios. Covering a statutory 25 year time period but extending to a 50-80+ year scenario WRMPs use the latest local authority targets as the basis for forecasting population and economic growth to calculate future demand. Current adopted WRMPs do not include the OxCam Arc growth scenarios because it is not yet captured in local authority plans but it will inform the next round being prepared for 2024.

Water for the environment

20% of waterbodies in the Arc that are not achieving good status under the Water Framework Directive have flow (lack of) listed as one of the reasons, this equates to 66 (out of 344) waterbodies across the Arc. The underlying reasons for these failures include: surface water abstraction; groundwater abstraction; land drainage; and low flow (not drought). As evidenced by the 66 waterbodies, water abstraction from rivers and aquifers is already having a detrimental effect on our watercourses within the Arc.

Water Framework Directive
Reasons for Failure: Flow

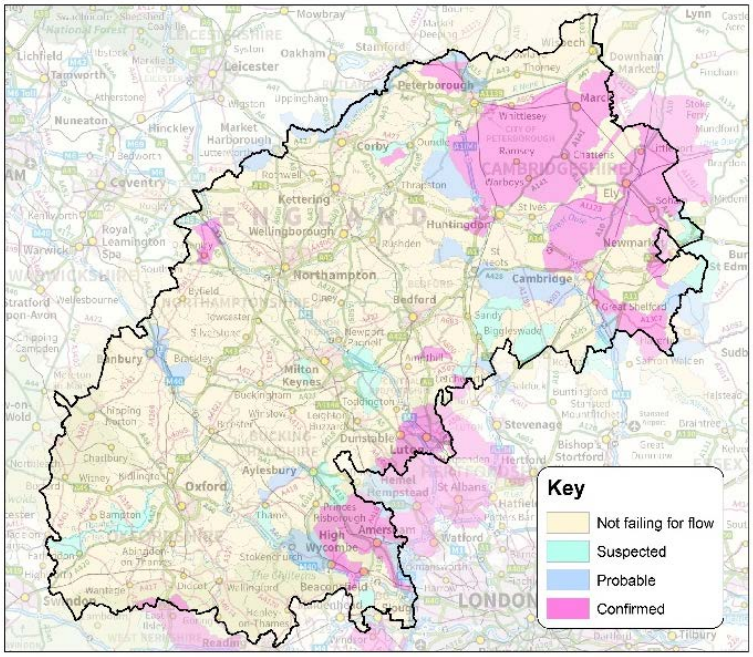

Figure 8. Map WFD waterbodies where flow is listed as a reason for not achieving good status

All rivers are assessed against the "Environmental Flow Indicator" (EFI) to see if they meet the levels to achieve good status. The EFI is not a target or objective, but indicates where abstraction might be unsustainable, this is the basis on which new abstraction licences or variations to existing abstraction licences are assessed.

To protect the environment many abstraction licences have a hands-off flow condition, which means abstraction has to stop when the river flow falls below a set threshold. This can be set to protect the environment or another abstraction licensee's right to water. During dry summers many surface water (river) abstractions are limited to how much they can abstract due to these rules to try and protect river habitats. Although these hands off flow conditions can help to mitigate these risks many licences were granted before hands off flows were introduced so are not covered by the legislation. The Environment Agency are in contact with licences holders to try to modify licences when they come in for renewals or for variation.

Section Summary

Main Pressures

- **Climate Change**: Re-distribution of rain through the year with less rain in summer
- **Population Increase**: There are more people to supply water for

- **Land use change**: Potential for more surface runoff and less ground water recharge

Metrics of Risk

"Serious" Water Stressed areas 2013 Classification	Affinity Anglian Thames Water
Groundwater at good quantitative condition %	68.6 %
WFD Reason for failure: Flow	66 surface waterbodies (out of 344)

Mitigation, plans and targets

- Targets for **reduction in per capita water consumption** (Part G of the Building Regulations)

- **Water Resource Management Plans** – These are set out and owned by the water companies and cover a statutory 25 year time period but extending to a 50-80+ year outlook.

- Environment Agency **regulated water abstraction licences** and the controls they can put in place such as hands off flow conditions.

- The Environment Agency's National Framework for Water Resources (published in March 2020) recently set an expectation for water company's regional plans to reduce demand to 110 litres per person per day by 2050, and to drive down water use across all sectors.

- In July 2019 Defra launched a consultation and call for evidence on measures to reduce personal water use. Measures consulted on included compulsory metering (including the use of smart meters), water efficiency labelling and amendments to building regulations. The Environment Agency will be publishing a position in late 2020 setting out intended next steps.

- On 19 August Defra published a policy paper outlining target proposals under consideration. This included a possible target on water demand to reduce the volume of water taken from the environment by water companies and could encompass leakage, household and non-household water use.

Water Quality

Water is an important aspect to our natural environment, there are over 5,000 km of rivers within the Arc which underpin multiple benefits that we gain from nature. Water quality is an aspect of the water environment that is often not visible but which has a great effect on the environment. There are also 35 groundwater bodes that make up the subterranean water story across the Arc, however there are large areas of the Arc that do not have a designated aquifer below it, particularly through central Cambridgeshire.

There are two main sources of pollution that can affect water quality in rivers and lakes. Point source, which is regulated, and diffuse source, which is often unregulated and includes drainage from roads and housing estates and runoff of soil, nutrients & pesticides from agricultural fields.

There are 344 WFD river waterbodies that make up the Arc and 251 of them have a reason of not achieving good status attributed to point source pollution (this pollution is classified as either confirmed (116), probable (87) or suspected (48)). 83% of these cases have highlighted the source being sewage discharge. With more houses being built across the Arc there is going to be an inevitable increase in the volume of waste water being received at the Sewage Treatment Works (STW). Without substantial investment there is a risk that the current infrastructure will not be able to sustain good water quality across the Arc. There are 649 active discharge consents for STWs across the Arc which form part of a wider network including private houses and caravan sites as well as other types of site. It not just sewage works that could struggle to cope – runoff from roads and hardstanding can be a significant source of diffuse urban pollution with traditional surface water drainage offering little protection to the receiving watercourse.

As well as protecting water quality that supports a high-quality environment we also need to protect it because it provides our drinking water supply. The WFD requires us to identify Drinking Water Protected Areas where water is abstracted from the environment to provide public drinking water. These areas have extra protection that is in place to prevent deterioration of raw water quality and ultimately, reduce the need for additional treatment of the water further down the line. To further protect these areas they are surrounded by two types of safeguard zones: Surface Water Safeguard Zones which are river catchment areas upstream of 'at risk' protection areas; and Groundwater Safeguard Zones which highlight areas that could have an adverse impact on protected areas through groundwater. Safeguarding our water supply is of increasing importance as demand rises and more pressure is put on the environment with an increased human presence.

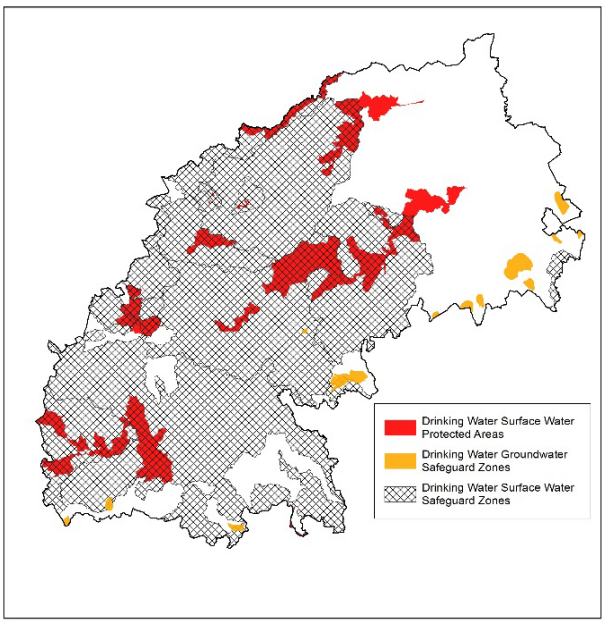

Figure 9. Map showing drinking water protection areas

Through development we will see an increase in hard surface areas which can cause more run off, this may contain contaminants (from roads or industry) which will impact water quality. It is essential that SUDS are developed in the design stage of development to prevent this. The Environment Agency can regulate point source pollution such as improving discharges from STWs, however they do not have the ability to implement improvements to urban drainage once it has been built. It is therefore essential that this is included in the plans from the outset.

The other source of pollution to watercourses, diffuse source pollution, is listed as a reason for failure to achieve good status in 234 water bodies, of which 45% have poor nutrient management within agriculture listed as a reason. Impacts such as eutrophication, deoxygenation and silt build up can all impact on fish and invertebrates leading to a decline in water-based wildlife. There is significant potential therefore, to use catchment solutions to identify and address these impacts across the Arc to improve overall water quality from all sources.

One way in which we can ensure sustainable growth, is to identify locations which don't impact the environment. Through local plans, the local councils and the water companies need to work closely together to establish what and where infrastructure may need to be improved to accommodate growth. Future development must be in locations which have environmental capacity and have a viable engineering solution. Through the planning stage, the infrastructure improvements that are needed to protect the environment need to be carried out first before occupation, and a clear time line needs to be established to ensure that the environment is not damaged before the infrastructure is provided.

Section Summary

Main Pressures

- **Population Increase** – More people create more waste water and sewage water
- **Agricultural production** – As agricultural land decreases farmers will look to get more out of their remaining land. There are a few main risks directly related to this: soil degradation; and the increased use of pesticides / fertilisers.
- **Increase in Sealed Surfaces** – This will increase surface run off. Across the Arc currently nearly 10% of water bodies are not reaching good status due to urban diffuse pollution.

Metrics of Risk

Surface Waterbody high overall status	0 %
Surface Waterbody good overall status	20 %
Surface Waterbody moderate overall status	55 %
Surface Waterbody poor overall status	21 %
Surface Waterbody high ecological status	0 %
Surface Waterbody good ecological status	5.5 %
Surface Waterbody moderate ecological status	62.7 %
Surface Waterbody poor ecological status	27.1 %
Surface Waterbody bad ecological status	3.8 %
Surface Waterbody good chemical status	98 %
Surface Waterbody Reason for failure low flow	19.2 %
Surface Waterbody Reason for failure non-native invasive species	14.6 %
Surface Waterbody Reason for failure physical modifications	56.3 %
Surface Waterbody Reason for failure diffuse pollution	68.2 %
Surface Waterbody Reason for failure rural diffuse pollution	54.2 %
Surface Waterbody Reason for failure urban diffuse pollution	9.9 %
Surface Waterbody Reason for failure point source	73.2 %
Surface Waterbody Reason for failure waste water treatment discharges	63.8 %
Groundwater bodies that fall (Partially) within the arc at good chemical status	54.3 %
Groundwater bodies that fall (Partially) within the arc at good quantitative status	68.6 %

Mitigation, plans and targets

- **Water Framework Directive** – Monitoring, assessment, investigation, interventions.
- **Regulation** – Environment Agency waste permits, discharge licences
- **Management plans** – Water company plans

Air Quality

Air quality is a high profile issue in the United Kingdom and across the world. Effects of poor air quality can be local, for example from a wood burning stove increasing air pollution in a village, to greenhouse gases which can affect the world's climate. The Environment Agency's State of the Environment report on air quality is a good resource examining different types of air pollutants, their impacts on health and their sources. Some of the main sources of pollution in England are: Industrial emissions, household wood burning, transport and agriculture. As the Arc develops and more people live and work in it, some of these sources of pollutants will increase and this will put an increased pressure on the environment.

Natural Capital plays a role in reducing the health impacts of these emissions, for example with trees and foliage providing; surfaces that capture the particles from the air, cooling shade reducing the need for air conditioning, and lowering local ozone levels. However, the relationship between vegetation and air quality is very complex especially at a very local scale, and it varies throughout the year (based on weather, foliage density etc.).[vi] Changes in natural capital across the Arc in the future may exacerbate or improve air quality.

Across the Arc local authorities are already working hard to improve air quality in our cities and towns. Oxford City has had a low emission zone for a number of years which stipulated that bus services within the streets affected must be operated exclusively by buses whose engines meet the Euro V emission standard (for nitrogen oxides (NOx)) and are working on plans to launch the Oxford Zero Emission Zone in the Summer of 2021.

The Arc has diverse set of environments and urban forms. A recent study by the Birmingham and Lancaster Universities (MacKenzie et al 2019[vii]) looked at both the air pollution emissions and a modelled dispersal of emission. At one end of the scale Luton had the poorest results, Luton's emissions are about as expected for its population but the compactness limits dispersal thus lowering the results. At the other end of the table is Milton Keynes, which is a result of it being low density and spread out allowing pollutants to disperse. This study highlights the risks and options that need to be considered in the urban planning of new towns or urban extensions.

Public Health England state[viii] that poor air quality is the largest environmental risk to public health in the UK, specifically in reference to conditions such as cardiovascular and respiratory diseases that long term exposer can cause. It is therefore essential that with more and more people arriving to live and work in the Arc, we need to ensure that air quality does not get any worse and, if possible, to improve it for new residents and the existing population.

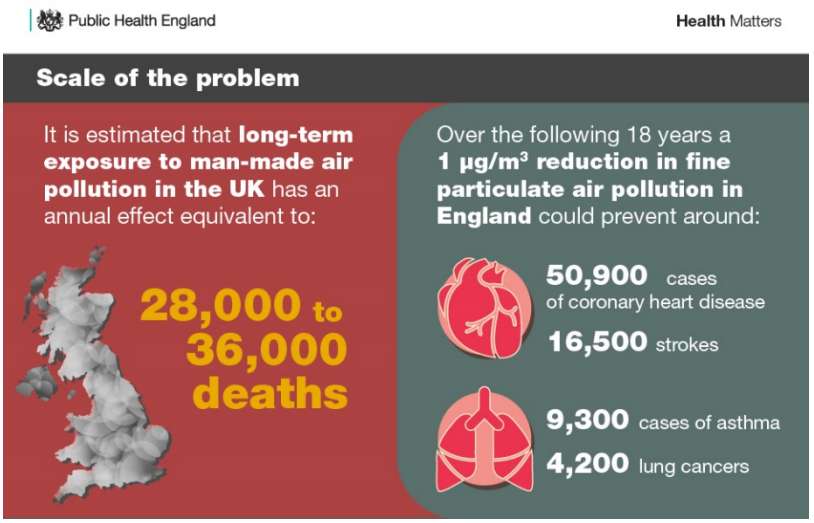

Figure 10. Infographic showing the cost of poor air Quality in the UK

Nature has a strong ability to improve air quality as it absorbs the air around us before releasing purified air back into the atmosphere. Nature cannot indefinitely improve increasing volumes of pollution but it can be used to compliment other methods that we employ to improve air quality. Across the Arc the environment is already providing benefits and we need to protect these assets. The Arc's natural capital is already providing an estimated £35m of benefit per year from avoided healthcare costs due to the removal of PM10 (particulate matter 10 micrometres or less in diameter) and PM2.5 (particulate matter 2.5

micrometres or less in diameter) and other air pollutants from the atmosphere. The majority of this is provided by trees and woodland and a significant proportion is provided by farmland. Woodland removes 33 times more tonnes of PM2.5 per hectare than farmland.

Natural capital also removes sulphur dioxide (Woodland - 3.81kg/ha/yr., enclosed farmland - 1.62kg/ha/yr., semi natural grasslands – 1.19kg/ha/yr.) which across the Arc provides around £65k of benefit per year. With the urbanisation of the Arc and the building of up to a million new homes and associated workplaces, and transport networks this natural capital is at risk. We need to ensure that through the development of the Arc we take into account the services that the environment is providing us and we must protect it as much as possible.

The air purification service that nature provides is a valuable resource and there is a risk that as the Arc develops we could see a reduction of the most valuable habitats and in turn a reduction in the benefits they are providing. This is a risk right across the Arc and whilst local authorities are planning to meet air quality targets by reducing pollutants and we need to ensure that nature is seen and utilised as a complimentary tool which can be employed alongside other options. It is critical that the location of green space and type of planting are given appropriate consideration.

Section Summary

Main Pressures

- **Increased transport infrastructure** and increased vehicle pollution
- **Increased jobs** might mean increased manufacturing

Metrics of Risk

Number of air quality management areas*	56 across the Arc

*If a local authority finds any places where air quality objectives are not likely to be achieved, it must declare an Air Quality Management Area there.

Mitigation, plans and targets

- UK and EU Air Quality Limits
- Air Quality management areas
- The 'UK Plan for Tackling Roadside Nitrogen Dioxide Concentrations' [ix](the NO2 plan)
- The Clean Air Strategy 2019[x]

Habitat Fragmentation

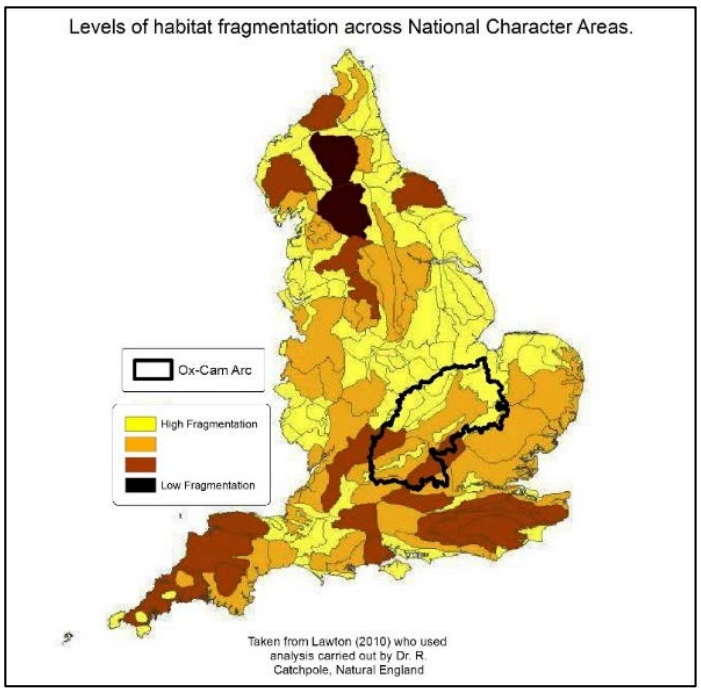

Figure 11. Map showing scale of habitat fragmentation per national character area

Across England biodiversity has been declining over the past few hundred years (Natural England 2020[xi]), and Lawton et al. (2010)[xii] stated that semi-natural habitats are now largely confined to small and isolated fragments, particularly in the lowlands. The Arc is a lowland area with no part of it extending above the moorline so it is prudent to take these statements and concerns seriously. A central issue of fragmentation is that small sites are much more vulnerable to the external pressures and are more likely to lose species. The vulnerability of these small patches also means that the species are not viable and have a built in 'species debt' which means their population may continue to fall in the future as a result of actions that have already happened. Across the Arc current SSSI designations can show how fragmented our protected habitats are with only 4 of our SSSI sites within the largest (in size) designations within England (Ouse Washes 72nd, Nene Washes 109th, Upper Nene Valley Gravel Pits 119th and Grafham Water 168th).

When looking at the habitats within the arc the fragmentation is very clear. Habitat fragmentation often occurs due to human activity, such as building roads, railways or cultivating land. Across England over the past few hundred years we have seen habitat fragmentation on a vast scale. The conversion of natural habitats into farmland and large urban areas, and the linear infrastructure to link settlements has created a major environmental risk in the Arc. With more settlements and large settlement extensions planned this risk is ever increasing. This risk applies both in relation to future fragmentation of habitats and through preventing the reconnection of the existing network. This second point is especially important to note to note since development of land will reduce the opportunity to expand existing habitat patches in the future resulting in an irreversible pressure on these habitats.. It is important that these habitat expansion and reconnection opportunities are the first things to be considered when areas begin to develop.

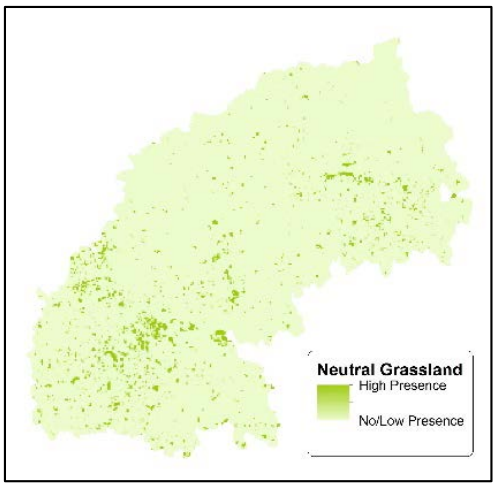

Figure 12. Map showing presence of natural grassland in the Arc

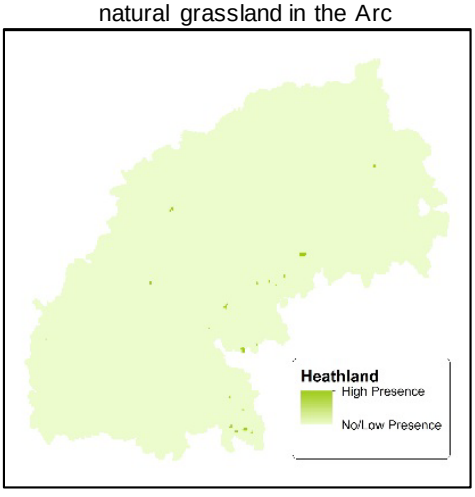

Figure 13. Map showing presence of Heathland in the Arc

The Woodland Trust also note[xiii] that fragmented habitats are often reduced in quality. As a habitat is fragmented into smaller sections, the proportion of edge - where one habitat meets another increases and this 'edge' environment is often more difficult for certain species to thrive in. It is possible to use development to help improve habitats where possible, Forest Research[xiv] highlights that although new development poses a risk of further fragmenting habitats, new urban developments could be utilised to help to counteract fragmentation, simply by

protecting existing patches of high-quality habitat within them or including new kinds of habitat in their design and ensuring that all green spaces are arranged to encourage species movement.

Underhill and Angold (2000)[xv] produced a study into the effects of roads on species in the UK and the paper stated that small mammals rarely crossed roads wider than 30m. Also although medium / large mammals do cross lager roads, the frequency of crosses decreases with size and traffic density. As you can see in Figure 14 most of the larger linear infrastructure in the Arc currently runs North to South (Motorways and Railways) which explains why the two big infrastructure projects in the area are East West Rail and the Expressway (which also runs East – West). Although logistically it will be essential for the human population to be able to move east to west if the Arc is to develop as planned, it also causes new lines of fragmentation to the environment which will physically block the movement of different species across the Arc. There are ways to mitigate this risk, one being the introduction and construction of really good quality green bridges over new and existing linear infrastructure.

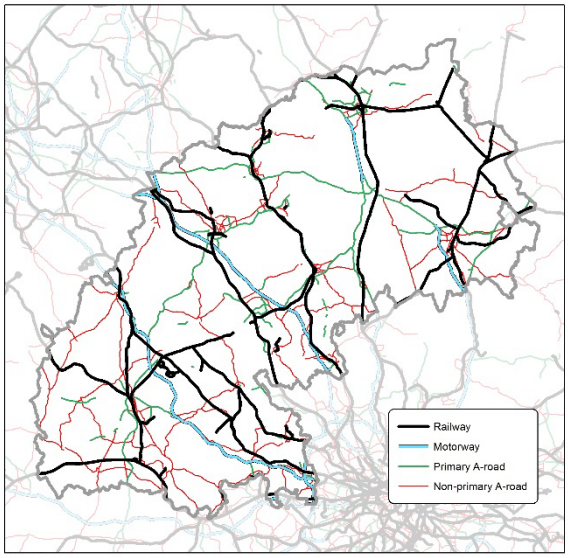

Figure 14. Map showing linear transport infrastructure in the Arc

Keinath et al (2017)[xvi] looked into the fauna that were found within habitats after fragmentation. Their conclusions were that the resultant habitat size had the largest effect on the presence of species following fragmentation. The smaller the unit the fewer species present. Specialist species are also less likely to be present than generalists and species in forest and shrub land were more sensitive to fragmentation than those in grasslands.

There is ancient woodland across the Arc, the largest designated ancient woodland unit is Wytham Great Wood in Oxfordshire which covers 264 hectares. It is 1 out of only 22 Ancient woodland units in the Arc that is over 100 hectares in size (out of nearly 4000 units), and although this seems like a small number it does not quite give the full picture, as many of these ancient woodland units are in close proximity or joined with other units which provide a higher combined area and reduces the edge effect. It is therefore important that this and other habitat type are protected and growth promotes greater habitat connectivity.

Infrastructure Class	Length (KM)
Railway	971.48
Motorway	261.70
Primary A road	604.77
No-primary A road	1,295.05
B road	1,506.88

Table 2. Lengths of transport infrastructure in the Arc

Natural England's Nature Networks Evidence Handbook[xvii] provides a host of references to rules of thumbs of land use to mitigate against fragmentation and although it is dependent on species, configuration and habitats they suggest that at least 20% cover of semi-natural habitat would help to improve connectivity and resilience of populations and 'stepping stone' habitats need to be less than 200m apart for habitat-specialised species and less than 1 km apart for more generalist species to be able to move through the landscape. The Nature Networks Evidence Handbook also suggest that we need to create core habitat sites which are 40 to 100 ha in size, along with a few larger sites up to 20,000 ha.

Section Summary

Main Pressures

- **Development:** Including new settlements and linear infrastructure like roads and railways
- **Existing Fragmentation**: Species and habitats are already under great pressure and highly fragmented, so are vulnerable to further change
- **Increasing population**: Additional development pressure, plus more people living in an area leads to more human-nature interactions, many of which can be damaging when not appropriately managed. For example, many species and habitats are vulnerable to disturbance by people and their pets, such as ground nesting birds, and animals killed on the road increases with more vehicles

Metrics of Risk

SSSI Habitat Condition	Area Hectares	Percent of SSSI Landcover in Arc
Destroyed	18.22	0.09%
Unfavourable declining	237.59	1.17%
Unfavourable no change	1639.23	8.10%
Unfavourable recovering	8805.3	43.48%
Favourable	9549.1	47.16%

Habitat Size

Number of SSSIs over 40 ha	110 Sites (Not Units)
Number of Ancient Woodlands over 40 ha	234 Sites (Not Units)

Mitigation, plans and targets

- 25 YEP goals:
    - Restoring 75% of our one million hectares of terrestrial and freshwater protected sites to favourable condition, securing their wildlife value for the long term
    - Creating or restoring 500,000 hectares of wildlife-rich habitat outside the protected site network, focusing on priority habitats as part of a wider set of land management changes providing extensive benefits
    - Increasing woodland in England in line with our aspiration of 12% cover by 2060: this would involve planting 180,000 hectares by end of 2042
- Nature's Arc have set specific targets[xviii] related to this for the Arc and the hope is that these will be adopted by local leaders as targets for the Arc
- Local Biodiversity Action Plans (BAP), which set out habitat targets at a county level.
- Cambridgeshire's Doubling Nature [xix] ambition
- Natural England's Nature Recovery Network

Sense of place

A sense of place is about the emotions and relationships that an individual has with a location. What feeds into a person's sense of place is often intangible and highly personal but it is also about the character of a landscape. The distinct and recognisable pattern of elements such as geology, relief, vegetation and human settlement that make each landscape unique and so gives it a particular sense of place. For the OxCam Arc, sense of place is very important which is why it makes up one of the four pillars or work streams which are bringing together different Government and local bodies to help ensure the growth of the Arc is sustainable.

To help manage the risks and pressures that sense of place faces we need to be conscious of two key aspects. Firstly what is it is about the current sense of place (what is it that is characteristic or valued about the Arc's landscapes) that encourages people to continue to live and work within the Arc. The second aspect is what sense of place do we want to create through the development of the Arc. The Arc will grow, and so by having an understanding of its existing sense of place it can help to influence the planning and design of development in the Arc in a way which works with the existing landscapes and leads to the protection and enhancement of the Arc's sense of place.

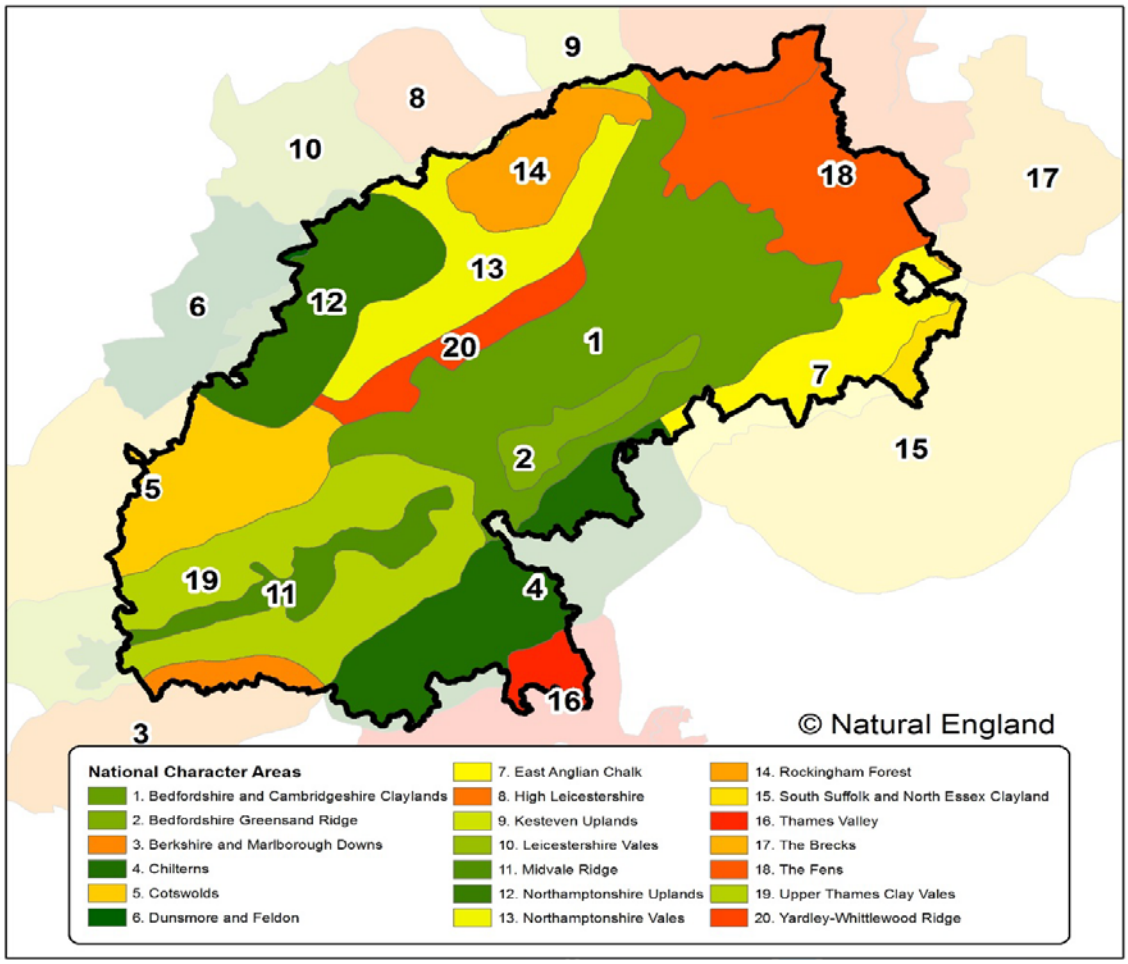

Figure 15. Map of National Character Areas that make up the OxCam Arc

Character of the Arc

The Arc is made up of diverse range of different landscape types that are not traditionally seen as a coherent unit. We need to understand this to design new developments, both urban and rural,

that are respectful to existing landscape characteristics, and to use these characteristics to enhance the landscape of the Arc.

Natural England has sub divided England into 159 National Character Areas (NCAs), each of which has a distinctive 'sense of place'. As you can see in Figure 15, the Arc is at least partly covered by up to 20 of these NCAs. It is important to recognise the difference in these NCA's and it would not be appropriate for the Arc to seek one cohesive character or 'sense of place'; rather, it needs to respond to the distinctive character of the different areas that it covers. The NCAs have associated profiles that provide 'Statements of Environmental Opportunities' which suggest where it might be appropriate to conserve, enhance or restore an area's character. There may also be places within the Arc where development could bring positive landscape change.

In addition to the 20 NCAs the OxCam Arc also encompasses the Chilterns, Cotswolds, and North Wessex Downs Areas of Outstanding Natural Beauty (AONB). These AONBs represent important landscapes that are protected to conserve and enhance their natural beauty. It is key that the future growth of the Arc works with these AONBs to ensure they continue to be protected and enhanced through growth.

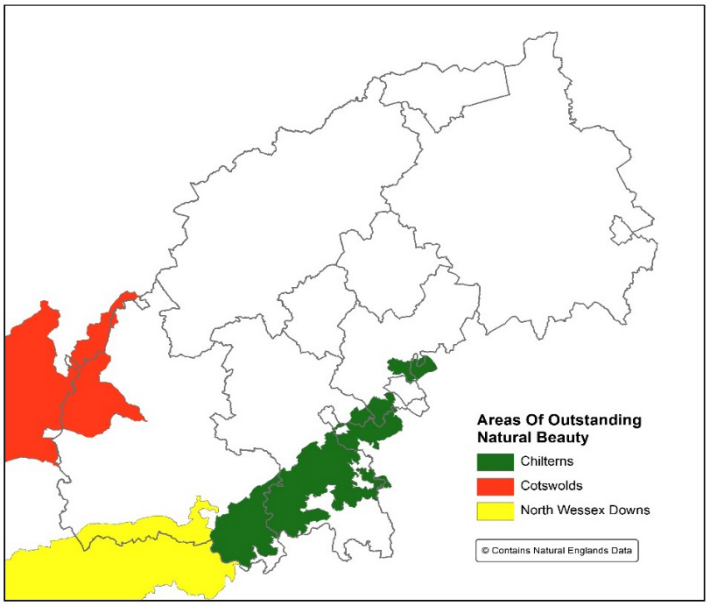

Figure 16. Map of AONBs within the Oxford to

Main Pressures

The majority of land use within the Arc is agricultural with 54% of the land used for arable farming and 19.6% used for livestock. Most of the landscape character areas are dominated by farming patterns e.g. large scale arable fields, except in a few location such as the Chilterns where Beech woodlands dominate.

The sense of place of the Arc faces a range of risks and pressures. Primarily these will come from changes to the landscape character of the Arc through the influx of new people and new housing that will come from building up to 1 million new homes (as either urban expansions or new towns) over the next 50 years. There are already large urban extensions being built within the Arc, as part of local plan allocations, and settlements such as Didcot in Oxfordshire have increased in population by 17% between 2006 and 2016 from edge of town housing developments.

This increase in population and change of land use can have a profound effect on how existing residents of a settlement, or visitors to that area, perceive their local environment. A village character can quickly change to that of a small town through the expansion of housing and infrastructure resulting in a loss of the rural features which gave it its original sense of place.

The sense of place of the Arc is also at risk from other activities within the Arc. The new East-West Rail line and Oxford to Cambridge Expressway, as well as the new local roads that will come with housing development, will also alter the landscape of the Arc and an individual's perception of that location.

Mitigation, plans and targets

The National Planning Policy Framework (NPPF) offers a strong method of protecting and enhancing the Arc's sense of place. Within the NPPF it states that 'planning policies and decisions should contribute and enhance the natural and local environment by:

- Protecting and enhancing valued landscapes
- Recognising the intrinsic character and beauty of the countryside'

The NPPF also outlines, in reference to AONBs, that 'great weight should be given to conserving and enhancing landscapes and scenic beauty in National Parks, the Broads and Areas of Outstanding Natural Beauty… the conservation and enhancement of wildlife and cultural heritage are also important consideration in these areas'. Public bodies also have a duty of regard to AONBs and their conservation and enhancement goals.

The growth of the Arc should adhere to the NPPF, and the duties of other public bodies, and so through this, the development of the Arc should help to conserve and enhance its sense of place.

A Strategic Environment Assessment would also help to mitigate the risk and pressures on the Arc's sense of place as the cumulative effects of developments could be taken into account at an early-stage of planning. As part of this, consideration can be given to how landscape character could be conserved and enhanced and valued landscapes protected.

Finally the development of green infrastructure will also help the Arc's sense of place and this can be achieved through the sympathetic and functional integration of existing landscapes, environmental features, historical landmarks and new development. This will require a full inventory of those existing assets and an approach which blends old and new within a strategically planned green infrastructure that creates a powerful sense of place. This green infrastructure will also provide other benefits related to climate change adaptation, health and well-being, green transport and ecological connectivity.'

Case study

One of the biggest New Town examples to be found in the UK, Milton Keynes, already sits within the Arc. Although Milton Keynes was created as a new town in the 1970, it was not created on empty space, in fact there were already existing towns and villages within the area designated for the Milton Keynes new town, and one of these villages is where Milton Keynes obtained its name. These villages, now districts of Milton Keynes, retain many of their original buildings and elements of their local character, which now contribute to the wider sense of place that Milton Keynes alone has.

T Bendixson & J Platt (1992[xx]) explored how those who designed Milton Keynes were concerned with how to create a strong sense of place. One thought was that its lack of traditional landmarks that you would expect to find in a city would impact on its sense of place and so the original designers discussed the creation of towers and spires to help create this sense of identity. At the time however no further action was taken.

A British sense of what a town or city is, directly relates to what we have traditionally been used to, and yet when Milton Keynes was created and designed it broke the norms and incorporated an abundance of green spaces, footpaths and cycleways to allow movement through the urban space. Milton Keynes as it is now provides its own sense of place, but this is certainly different to the sense of place created by the rural villages that were there before. If the Arc is to be expanded in terms of housing there is a real risk to people's perception of their sense of place and this needs to be handled delicately by developers across the whole of the Arc.

Other new settlements such as Cambourne and Trumpington Meadows also exist within the Arc and these developments, although smaller than Milton Keynes, showcase good design which can help to generate a sense of place. The design of Cambourne's Green Infrastructure won a landscape Institute Award in 2010[xxi], the development encompasses two villages, each one provided with a public green at its centre with greenways (designed to mimic traditional tracks) and a recreational path network running between them to encourage wildlife and sustainable travel[xxii].

Tranquillity

The majority of work on tranquillity in England is done by the Campaign to Protect Rural England (CPRE) and they have created a map[xxiii] of England which rates places on how likely they are to make someone feel 'tranquil'.

There has been much debate on how best to assess the tranquillity of a place and CPREs mapping is based on a survey of countryside users on what they find in a landscape that provides them with tranquillity and what they do not. They have then assessed various different geographical datasets, such as roads and flight paths, to assign a score for each grid square for each tranquillity indicator. These scores were then combined to produce an overall score.

Traditionally tranquillity has been something that we have seen as needing to protect and maintain for human populations. It is a hugely important aspect of landscape character and sense of place but there is more research being done into the effect it can have on other animals such as insects and birds.

Tranquillity in the Arc

Tranquillity can be felt by all of our senses, but the two most focused on are sight and sound. There is sufficient evidence that humans need to be protected from noise pollution that it is regulated in England through the Environmental Noise (England) Regulations 2006[xxiv]. These regulations apply to the noise that humans are exposed to in places such as built-up areas or near schools & hospitals. The general rule for the relationship between tranquillity and noise is that man made noises are seen as less tranquil and natural noises, such as wind or water, can improve the perceived tranquillity.

There has also been research done into how light pollution affects different animals, particularly moths and bats. The Bat Conservation trust have produced a guidance note[xxv] on artificial light. In it they explore how light affects bats, and causes increased predation and the disturbance of roosts.

Across England we are building more houses, commercial properties and transport infrastructure, all of which CPRE highlight as lowering the likelihood of a person feeling tranquil. This is especially important to consider within the context of the OxCam Arc as the government hopes to assist economic growth through enabling and encouraging large scale housing development.

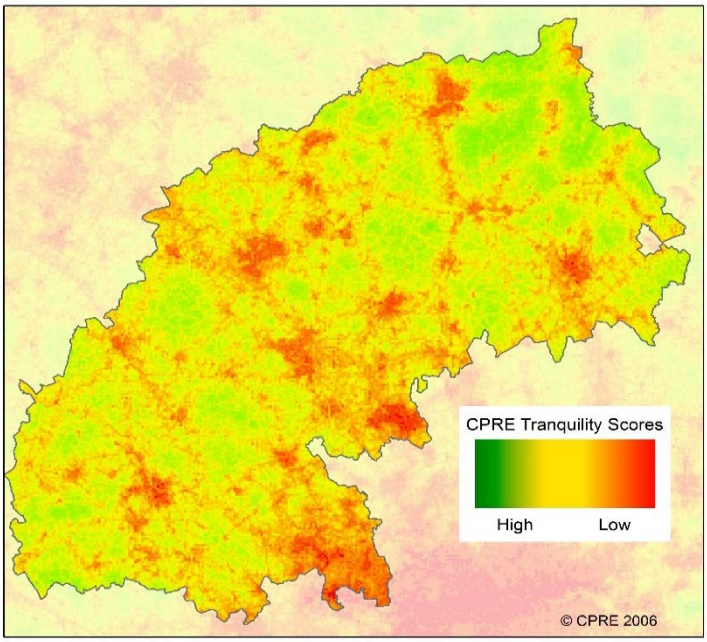

Figure 17. Map showing places most and least likely to make people feel tranquil.

In Figure 17 you can already see the large urban areas in the maps as dark red with low tranquillity, but you can also see areas of green with high levels of tranquillity that are at serious risk of being eroded by growth within the Arc.

Climate Change

The earth's atmosphere is warming. Human processes have created this warming through the production of greenhouse gasses – CO_2 being one of the main gases that are causing this effect. Climate change is an umbrella term given to the changes that we are likely to see as a result of the earth's atmosphere warming up, differing rainfall patterns and other extreme weather. Evidence shows that climate change and biodiversity losses are interlinked and need to be addressed through an integrated approach. Investing in nature through the creation, restoration and protection of our woodlands, peatlands, grassland, coastal and marine habitats, will help us to; capture carbon and reduce biodiversity loss. It will also support the resilience of communities and ecosystems to climate change such as through natural flood management, natural cooling and connectivity. These habitats can also provide wider benefits for people, such as improved wellbeing.

The changes in climate will vary in different parts of the world, however the result in the UK is that we will likely see higher average temperatures all year round, more frequent extreme weather events, increased winter rainfall leading to a greater risk from flooding and hotter, drier summers, increasing the risk of drought. This report has already briefly looked at flood risk and water resources, and climate change will exacerbate these issues further. Another component of climate change is sea level rise: as the world heats up the water that is currently being stored in land-based ice is melting, which in turn raises the level of the sea which adds to the effects of thermal expansion. Although the Arc is not on the coast, there are some tidal influences and there is a large area of land that is less than 1 metre above sea level which could be affected by the rise in sea level..

More information can be found on the UK Climate Projections website which provides the most up-to-date assessment of how the climate of the UK may change over the 21st century. The second UK Climate Change Risk Assessment[xxvi] (CCRA) sets out the key priority risks that the UK faces from climate change including, flooding and coastal change, risks to health and wellbeing from high temperatures, risks of shortages in public water supply and risks to natural capital. The third CCRA [xxvii]evidence report will be published in 2021 and will provide more up to date information

[xxviii]Organisations across the environmental sector and beyond are working on how to adapt and plan for a changing climate. Severe natural environment degradation over previous decades needs to be recovered in the face of a changing climate that will exacerbate current issues and decrease the resilience of the natural environment and society.

There are two aspects to the management of this risk:

1. What we must do to reduce the human drivers of climate change (mitigation)

2. What we need to do to adapt to the effects of it (adaptation).

Natural England, alongside the RSPB, have released a second edition of their Climate Change Adaptation Manual which outlines that the projected scale and rate of climate change, coupled with existing environmental pressures, has serious implications for the natural environment

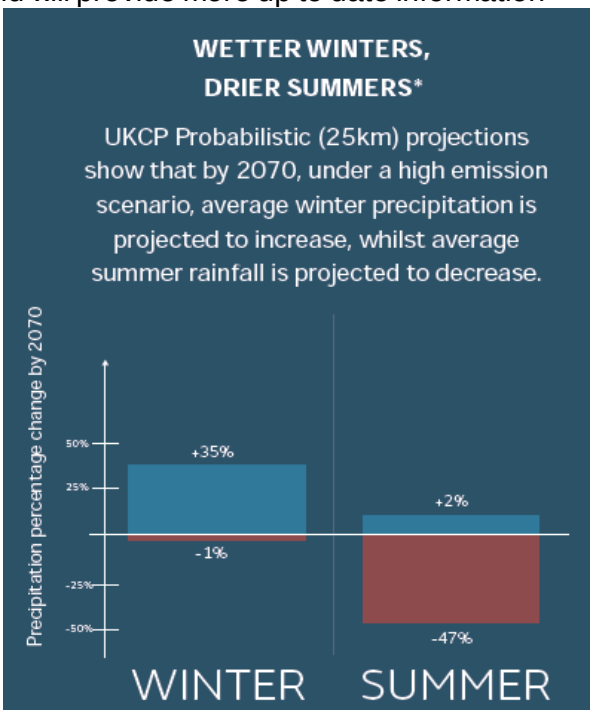

Figure 18. Infographic showing how weather patterns are predicted to change due to climate change (Met Office 2019)

and the services it provides. Some habitats have been identified as having particularly high sensitivity to climate change risks including standing water, lowland fen and rivers & streams. Whilst others such as lowland calcareous grassland, arable field margins and lowland wood pasture & parkland are in the low category. The climate change adaptation manual provides work sheets for a variety of habitats that look in more detail at how climate change will affect them and what actions can be taken to help them adapt. It covers species, geology, access and recreation, and green infrastructure and provides climate change vulnerability assessment methods. The manual also sets out practical steps that conservationists and land managers can take to protect these crucial habitats and support their natural capacity to adapt to climate change risks. The UK also has a legally binding target to achieve Net Zero emissions by 2050. The Committee on Climate Change (CCC) has set out how land use needs to change to achieve this (also see this infographic).

Outlined below are a few examples of the impacts that climate change will have on our environment

Lowland fens

Based on the OxCam LNCP baseline map there are around 500 hectares of Mire (which includes Lowland fens) across the Arc, with over half of this habitat found within Cambridgeshire. Natural England have identified various impacts to this habitat that will be brought on by climate change and that will exacerbate the current degradation of this habitat, which include the following examples:

- Warmer temperatures will increase the growing season which will require a change in habitat management practices.
- Drier summers could see fens drying out, which may be exacerbated by draining for agricultural purposes, leading to a loss of individual species
- An increased frequency of flooding could produce a shift in species composition to favour those species able to cope with long-term inundation.

Rivers and streams

Rivers and streams are vulnerable to climate change for a variety of reasons which Natural England have reviewed. Increases in annual average water temperatures will affect cold water species and give rise to a great abundance of other species. Webb and Walsh (2004) identified that under a high climate change scenario 20 out of 27 study sites in the UK will see temperature rises in excess of 1.5 degrees. Climate change in rivers will have a number of impacts, with two examples given below:

- Drier summers will produce temporary reductions in habitat size, along with isolating sections of rivers in the upper catchments which would require fish rescues to move the fish downstream where the river is still connected and flowing.
- Increases in annual average water temperatures will affect cold water species and give rise to a great abundance of other species.

Coastal habitats

Coastal flooding is not a significant impact for the Arc but there is a risk in Cambridgeshire. It is one of the top four priority risk for the UK Government. Generally models forecast a ¼ - 1 metre rise in sea levels in the 21st century, although some forecast up to 2.5 metres. Figure 19 shows the areas of land that are below 1 mAOD (and so more at risk from sea level rises) the map shows that

across the Arc this land falls within Cambridgeshire and Peterborough with a number of settlements likely to be affected.

The OxCam Arc is set to be developed over the next 50 years, but we need to ensure that our designs are appropriate over a much greater timeline. Over this length of time we will see significant changes due to climate change. These changes need to be monitored and any activities that take place within the Arc need to be carried out using an adaptive management approach. This includes considering the changing climate when restoring ecosystems and adopting measures that build resilience. We must also not allow development to hinder habitat protection and restoration in the future, for example blocking an important site for future habitat creation which would protect or enhance the habitat network.

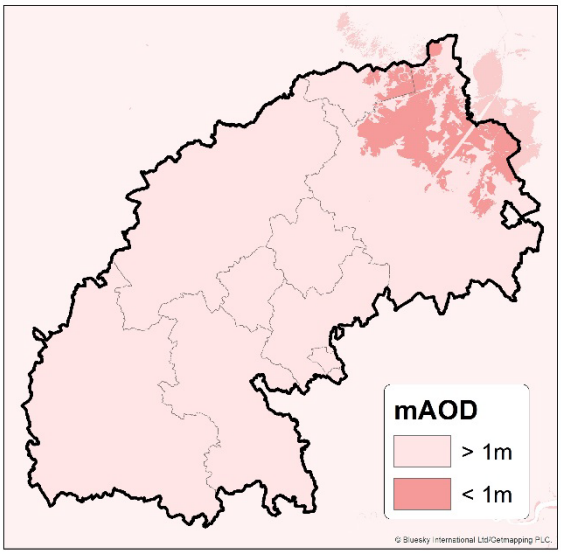

Figure 19. Map showing land lower than 1 mAOD

All development must be carried out with climate change adaptation and mitigation in mind, this calls for a new net zero, nature-based solutions approach. Development will continue to contribute to economic growth so we need to ensure we mitigate against our climate change impacts, by ensuring that any emissions from our growth are balanced by schemes to offset an equivalent amount of greenhouse gases from the atmosphere, such as planting trees or using technology like carbon capture and storage.

The UK became the first major economy to pass a net zero emissions law which is a new target that requires the UK to bring all greenhouse gas emissions to net zero by 2050[xxix]. To reach net zero there are various aspects that the UK government needs to consider, and with widespread development planned across the OxCam Arc, it would be an ideal location to drive them forward. These include; resource and energy efficiency, extensive electrification (particularly of transport and heating); major expansion of renewable and other low-carbon power generation, and the development of a hydrogen economy to service demands for some industrial processes e.g. for energy-dense applications in long-distance HGVs and ships, and for electricity and heating in peak periods.

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