Somerset Health and Wellbeing

SOMERSET
County Council

Somerset: Our County
Joint Strategic Needs Assessment – Health Impacts of the Climate Emergency 2019/2020

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Foreword

Welcome to Somerset's Joint Strategic Needs Assessment (JSNA) for 2019/20.

In February 2019, Somerset County Council declared a Climate Emergency. As the Chair of Somerset's Health and Wellbeing Board, with responsibility for Public Health and Wellbeing, I believe climate change to be one of the biggest threats to the healthy future of our planet. It is timely that our JSNA focuses on this key global issue and considers in local terms how we can act to mitigate climate change and improve lives for future generations.

The JSNA sits alongside Somerset's Climate Change Strategy and has benefited from the expertise and input of a broad range of colleagues all working in partnership. I thank you all for that. It looks at the existing and potential health impacts we face as a county and how we can respond, not only in terms of health and care systems (contributing to national change), but as the people of Somerset, highlighting the argument locally, that small changes, hopefully by us all can make a significant difference.

Mitigation is the watchword; to enable us to thrive in the future, we need to evidence and act on the damage that has already been done, to reverse it where we can, to reduce our waste and ensure our carbon emissions are reduced. It's not an easy task, we know that, responsibility to mitigate climate change sits at every level of our society, from Government to individual, and we all have something to contribute.

This JSNA examines the effect of global warming and the increase in extreme weather events affecting our county. It looks at a range of key issues including housing, food, transport, wellbeing, employment, changes to our environment and biodiversity, and the importance of stronger and more resilient communities. It shows how reducing our carbon footprint and improving our health and wellbeing can and should go hand in hand.

As we are now discovering, due to the impact of COVID-19, helping and supporting each other and acting together to reduce the spread of this virus has implications for how we in Somerset, tackle climate change. The reaction to the pandemic demonstrates how we can modify our behaviours for the public good.

This JSNA makes fascinating reading and it is not, by any means, all negative news. The real focus is on studying the evidence, recognising what we can expect, and understanding how we can act and what this all means for the county's future and indeed the planet's future.

Cllr. Clare Paul – Chair
Health and Wellbeing Board

Trudi Grant
Director of Public Health

Executive summary

Part 1 – The impact of climate change on health

There will be changes in health need in coming decades as a result of climate change, and the health and care system will need to respond to them. The weather's variation from year to year, indeed from day to day, means that the necessary responses are best thought of in terms of risk.

- Extreme conditions – heat, cold, floods and droughts – have the greatest adverse impacts on health.
- The risks associated with heatwaves are likely to increase considerably by the second half of the 21st century.
- The risks associated with cold snaps (and impact on 'winter pressures') are likely to be lowered by the effects of global warming.
- The most vulnerable in heatwaves are people with circulatory and respiratory conditions; this group may, though, benefit from reduction in winter cold.
- People in poor housing will continue to have poor health outcomes associated with heat and cold.
- The risks associated with flooding will rise. This will be particularly in the 'usual' flood zones (such as the lowland moors and low-lying coastal areas) and the 'rapid rise catchments' vulnerable to flash flooding, but no areas are exempt. The biggest health impact is mental.
- Flooding will affect provision of services, notably home-based social care.
- The risk of Lyme disease is likely to rise, as may West Nile virus.
- Longer term effects, within Somerset but probably to a greater extent in the poorer and environmentally marginal parts of the world, may have economic and social consequences with highly unpredictable and almost certainly harmful results.

Part 2 – Mitigating and Adapting to Climate change

The response to climate change depends decisions made at the international, national and local level. In Somerset, the Climate Emergency Strategy is the principal vehicle for coordinating action, and it is through this that the Health and Wellbeing Board, and its members, will tend to respond.

- *Housing*

The climate emergency highlights the important link between health and housing, and low-carbon dwellings are typically healthy dwellings. Stressing the gains to be had in health, including reducing the costs of treatment, reinforces the value of improvements in insulation, ventilation and heating, especially through better design, that can help towards carbon neutrality.

- *Transport*

Active travel – walking and cycling – is good for health, both physical through exercise and mental through increased social contact. It is also carbon neutral, so shifting from cars to active travel is beneficial for both health and climate. Electric vehicles reduce hydrocarbon emission (and thereby low–level ozone), some particulates (compared to diesel) and carbon dioxide from the vehicles directly but do not have the social benefits. Making such changes while addressing the needs of rural areas is a particular challenge.

- *Food*

A reduction in consumption of dairy products and meat (especially highly processed) may produce health benefits for the majority of people; these foodstuffs tend to have a higher carbon footprint than vegetables or grains. In a rural county where food production is more important economically than the national average, a multiplicity of factors come into play. This includes the relationship between farming, biodiversity and land-use, and how this can affect other elements such as the risk of flooding.

Conclusion

Climate change will see weather patterns change, and so will environmental risks to health. Preparation for flooding of all sorts may be the biggest requirement. The Health and Wellbeing Board has the opportunity to engage with carbon reduction initiatives in order to maximize the health benefits of mitigation.

Introduction

Whilst the earth's climate has never been static, recent decades have seen the beginnings of dramatic changes as a result of greenhouse gases being released into the atmosphere by human activity. Even if emissions were to stop now, the accumulated impacts would continue to be felt for 40 years before that became evident. The consequent global heating has been described as the greatest threat to global security[1] and health[2].

This JSNA considers how this threat might play out in Somerset. It sits alongside the Somerset Climate Emergency Strategy (2020), which has been developed jointly in response to a 'climate emergency' being declared by the county's local authorities in 2019. As will become clear in this report, the health and wellbeing of the population is not a simple, passive outcome of changes in climate; rather, the environmental changes and our responses, both in adapting to them and in trying to reduce their severity (mitigation) are intertwined with physical and mental health, and with strength and resilience at a community level.

Somerset Climate Emergency Strategy

The Climate Emergency Strategy has nine workstreams within it, as shown below. Health is not one of them. Four of the themes are of particular relevance. Water (flooding and drought) will be considered under the direct impacts on health, whilst discussion of housing, travel and food will focus on how health co-benefits can be derived from the mitigation response. Other themes have a less direct or strong relationship and will not be considered in such detail.

Table 1: Relationship between this JSNA and the Somerset Climate Strategy themes

Strategy Theme	Relationship with health status	Consideration in this report
Built environment	Direct and Strong	Mitigation
Energy	Indirect and Minor	Incidental
Farming and food	Direct and Strong	Mitigation
Industry	Indirect and Minor	Incidental
Nature	Direct and Medium	Impact – vectors and pollen, psychological value
Transport	Direct and Strong	Mitigation
Waste	Indirect and Minor	Incidental
Water	Direct and Strong	Impact – Drought and flooding
Communications	Indirect and Medium	Impact – Drought and flooding

This report is intended to guide the commissioning of services in Somerset in the context of likely changes to weather patterns in future, to ensure that the population is best sheltered from increased risk, and able to respond to emerging opportunities. It also shows how the response to climate change – in adaptation but especially in mitigation – can be done in a way that also has significant benefits for health.

The climate is changing and warming, significantly changing the nature and scale of risk to health. This report does not attempt detailed, quantitative modelling of health impacts by specific dates – the impacts and trends are clear enough to set the direction of policy. Emissions of greenhouse gases continue to have weather impacts for 40 years – we currently experience the climate impacts of emissions from 1980. Even with immediate, global (and wholly implausible) carbon-neutrality now the health impacts would need to be dealt with for decades. Unmitigated, longer term impacts would be far more severe.

Think globally, act locally

This aphorism, probably derived from the town planner, Patrick Geddes, has been widely adopted in the environmental movement and is useful context here. Global mean temperatures are shown in Figure 1. The average temperature of the United Kingdom, around 10°C, is clearly in the middle of the global range; it has neither the existing extremely high temperatures of the tropics nor the ice cover of the poles and highest mountains, where melting of ice sheets and glaciers can mean transformative change.

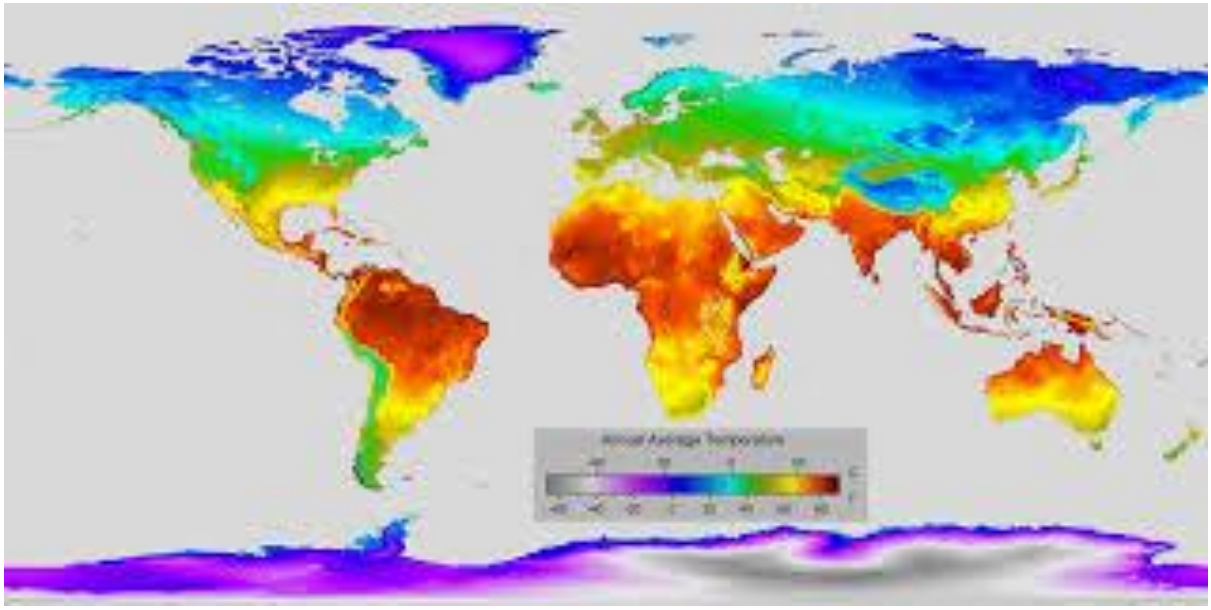

Figure 1: Global Mean Temperature

As will become clear in this report, averages tell only part of the story. Figure 2 shows the daily variation in temperature, and whilst Somerset does not have the very limited diurnal range seen in the west of Scotland, for instance, it is much less subject to this variation than more continental climates.

This means that Somerset is in a relatively favoured place to avoid the extreme impacts of global heating. In areas of the world, such as those dependent on Himalayan glaciers where mass water supply is threatened,[3] parts of Australia that might become uninhabitable as a result of heat[4] or cities in sub-Saharan Africa facing 'extreme risk'[5] this report could be apocalyptic. Put another way, a discussion just focusing on Somerset would give an entirely misleading picture of the scale of change that has already started. Whilst a global rise of 2-4°C may seem minor – it is worth reflecting that a rise like that in body temperature would constitute a severe fever.

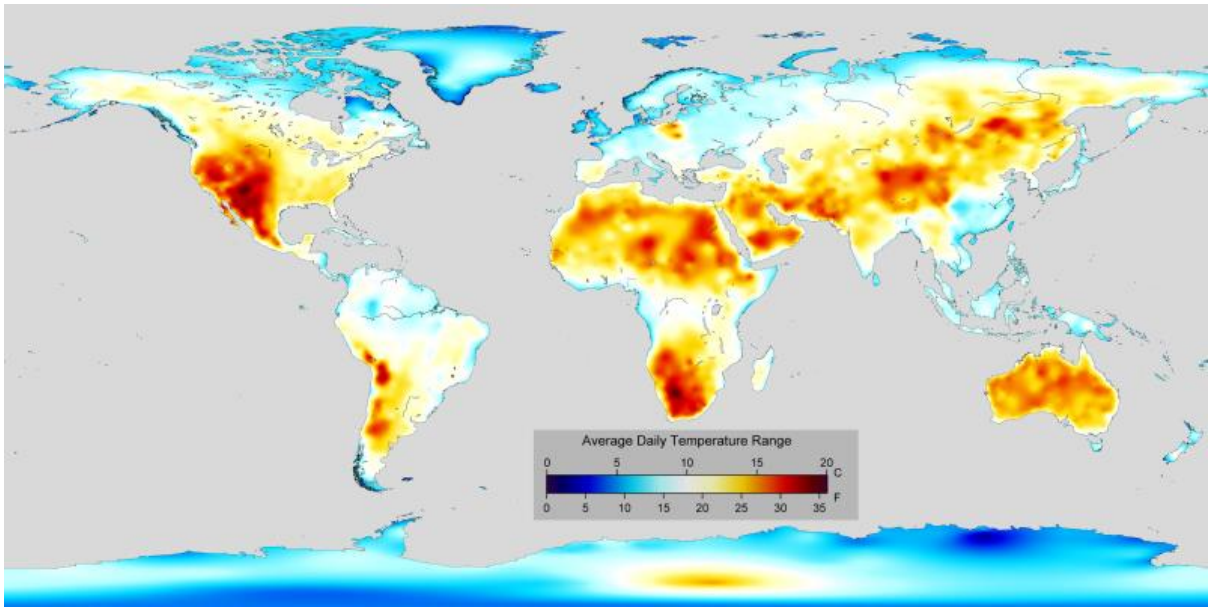

Figure 2; Day-night temperature variation

Somerset is, of course, a contributor to the global crisis:

> 'In 2017 a total of 3285 kt (kilotons) of CO2 were emitted in Somerset from industrial, domestic and transport-related sources. For context, a kiloton of carbon is emitted by 200 average cars in 1 year. In fact, the majority of emissions in Somerset derive from the transport sector – 47% [26% of which are from the M5], compared to 30% from industry and 24% from the domestic sector.'[6]

The commitment by all Somerset to reduce these emissions towards being carbon neutral by 2030 means that considerable and rapid change in behaviour will be needed – by households and businesses, at an individual and a systemic level. Inevitably, these changes will have effects on health. As will be seen in section 2, they are overwhelmingly beneficial to health.

Section 1:

The health impacts of weather and climate change

The impacts described here are deliberately couched in terms of risk and probability, rather than quantitative modelling. The climate is 'chaotic' – perfect prediction is not possible – and the extent of climate change will vary according to the level of reduction in greenhouse emissions achieved, especially in the longer term.

Temperature

In summary, the expected changes in the period to about 2070 are:

- Hotter days, on average about 2-4.5°C hotter, depending on the emissions scenario.
- Consecutive days over 30°C currently occur about once every four years increasing to four times per year by 2070.
- Cold snaps in the winter will become significantly milder; milder spells will warm slightly.

Even in Somerset's temperate, maritime climate, the weather is a complex system, with chaotic elements that make *specific* forecasts near impossible more than a week or so ahead. Within all that complexity, though, every fraction of a degree in global heating matters.

How do heat and cold affect health?

The main direct effects of heat, taken from the national Heatwave Plan are as follows:

- Above 25°C, and particularly above 27°C, the problems start, especially for people who can't sweat. For every degree above 27°C there are approximately 75 more deaths in England.
- The hypothalamus regulates temperature and can be impaired in long-term ill and elderly, who may be prone to dehydration.
- Children are hotter than adults anyway, sweat less and are also at risk of dehydration.

- Most deaths are from cardio-vascular or respiratory disease, worsened by particulate pollution from tyres, brakes, diesel, wood-burners and others, and low-level ozone related to hydrocarbons in exhausts.
- Heat can lead to cramps, rashes, oedema, syncope (fainting) and exhaustion. Heatstroke is a very serious condition and can be fatal.
- **Most deaths are preventable.**

The prevention of health harm from heat is mostly a question of drinking water, keeping in the shade and having adequate ventilation, including the use of fans. To an extent this is a matter of individual responsibility, but we all benefit from social support in looking after ourselves, and 'strong communities' – keeping an eye on neighbours and family in heatwaves – helps this resilience. In the words of Paul Cosford, Medical Director and Director for Public Health at Public Health England:

> 'It is clear to me that a heatwave is essentially a community resilience issue, and a community resilience response is needed.'[7]

It should also be noted that some medicines are degraded by hot weather.

And the main direct effects of cold are[8]:

- Below 8°C, and particularly 4°C, health impacts become evident.
- Most deaths are from cardio-vascular or respiratory disease.
- The population of England does not always take the cold seriously, and is more affected than, say, Scandinavia.
- Hypothermia is a minor contributor.
- Falls are exacerbated by ice and the impact on arthritis.
- 'Winter pressures' are exacerbated by staff illness and absence (especially when schools close).

It is worth remarking that the groups at risk – those with respiratory and cardio-vascular illness – are the same in both groups. Unsurprisingly, the elderly and those in otherwise poor health are particularly vulnerable.

Table 2: Vulnerable Groups - increased temperatures[9]

	Somerset	**England**
Vulnerable Groups		
Chronic Obstructive Pulmonary Disorder	2.3% registered patients	1.9% registered patients
Asthma	6.8% registered patients	6.0% registered patients
Homeless	1.65% households (homeless and in priority need)	2.51% households (homeless and in priority need)
Infants	29,560 children aged 0-4, 5.4% of population	5.9% population (UK)
Elderly	136,900 people aged 65+; 24.5% of population	18.3% population (UK)
Alzheimers	1.0% of those on GP registers (affected by rates of diagnosis)	0.8% of those on GP registers (affected by rates of diagnosis)
Athletes	35.0% of Somerset adults participate in more than one exercise session/week.	Lower than England (36.1%) but may reflect elderly population structure in Somerset.
Risk factors		
Smoking	15.9% of adults (18+)	14.4% of adults (18+)
Hypertension	16.7% of all ages (there is a data quality issue with this figure)	14.0% of all ages (there is a data quality issue with this figure)

The relatively high proportion of vulnerable groups, shown in Table 2, reflects Somerset's elderly population structure. Additionally, the role of 'wider determinants of health', especially poor quality housing, will greatly exacerbate risk. There are, at present, three times more excess winter deaths in the coldest quartile of houses than the warmest[10]. Rough sleepers, of course, are especially vulnerable.

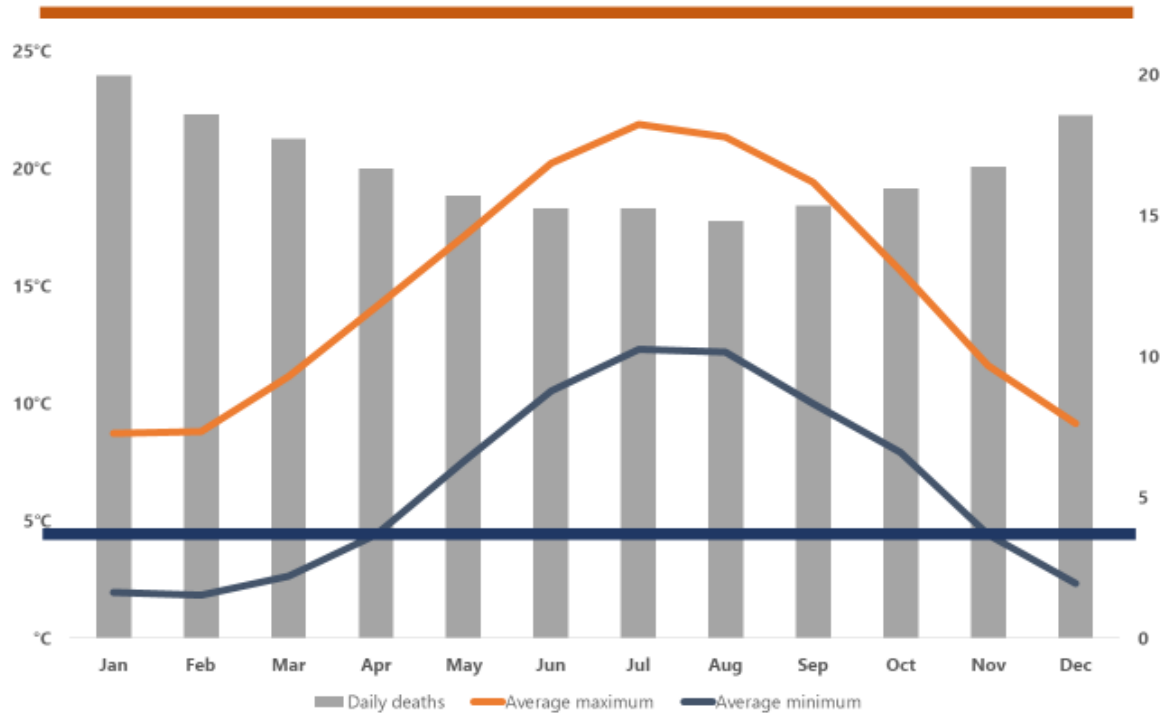

Figure 3: Average daily temperature (Yeovilton) and average daily deaths, Somerset, 2000-2018

As shown in Figure 3, there is a very smooth relationship between the number of deaths and average temperatures in Somerset, with the highest numbers of deaths in the cold winter months and lowest in the warm summer months. There is a very slight 'blip' in the trend, with more deaths in July -the warmest month – than in June or August. This excess may be an indicator of heatwave deaths and may become more obvious with increasing temperatures. Towns and cities are at higher risk than the countryside because of the urban heat island effect[11]. Early summer heatwaves may be more harmful than later as the population is not yet prepared for the heat[12].

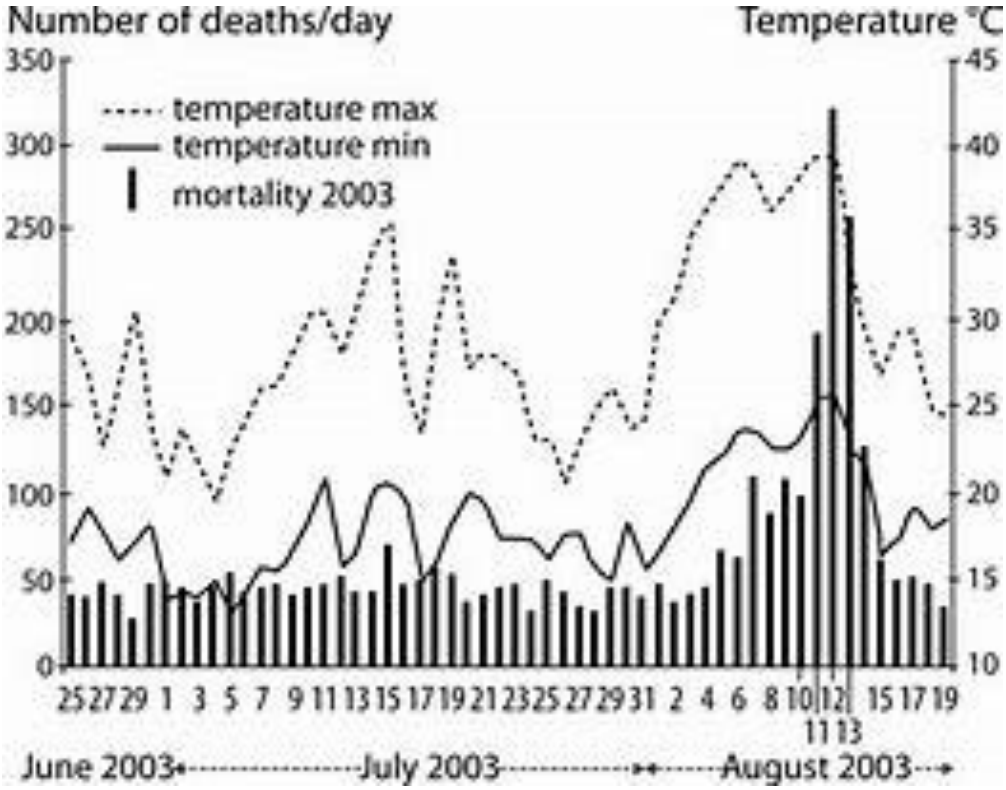

Figure 4: Mortality and temperature in Paris, 2003[13]

Although neither the temperatures nor the number of deaths in Somerset have reached levels where the relationship can be demonstrated, Figure 4 shows that, as was clear in the heatwave of 2003 (which may have led to about 20,000 deaths across the continent) it is the unrelenting stress of high overnight temperatures that make conditions particularly harmful to health[14]. There is no maximum permitted workplace temperature, but this may need to be reconsidered.

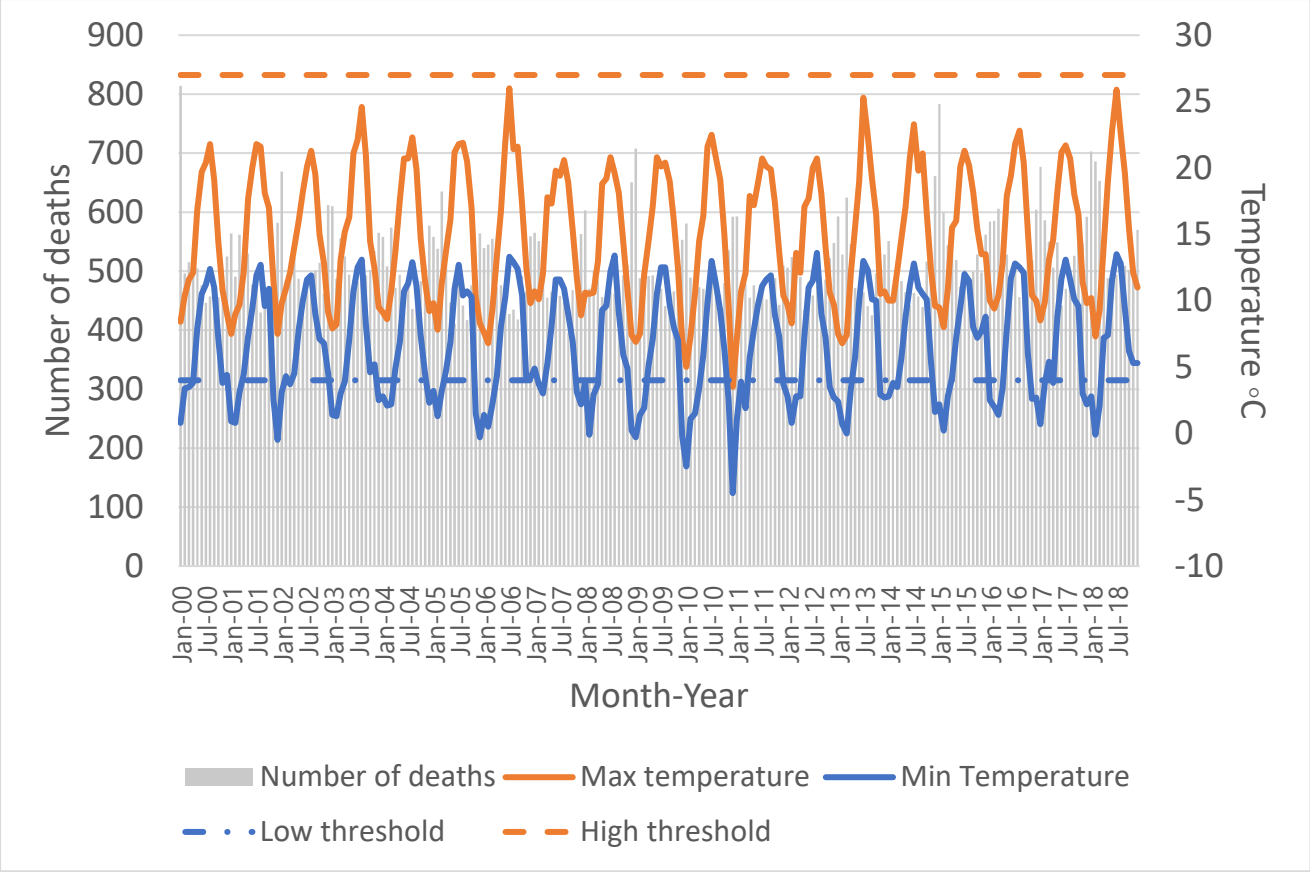

Figure 5: Somerset monthly average temperature series and deaths 2000-2018

This relationship is shown in more detail in Figure 5. This graph shows the variation from month to month, and the simplicity of Figure 3 is less apparent. Firstly, it is notable that the undoubted *global* warming trend cannot be seen at this local scale and relatively short term[15]. Secondly, this is a 'noisy' pattern, with variation from year to year greater than the expected level of average warming. Thirdly, every winter in the period has seen minimum monthly average temperatures fall below the approximate threshold for ill health, while no *months* have crossed the monthly average for heat (even though some days have).

Figure 5 demonstrates that responding to climate change is about a shift in *risks*, with the likelihood and intensity of periods of winter cold reducing, while the likelihood and intensity of summer heat increases. These monthly averages are good indicators, but to understand the impact on health it is necessary to consider the weather in greater detail. A single day of hot or cold weather has significantly less impact than a period of three days or more. These elements of temperature and duration contribute to the declaration of a Heat Health Alert or Cold Weather Alert, as shown in Figure 6.

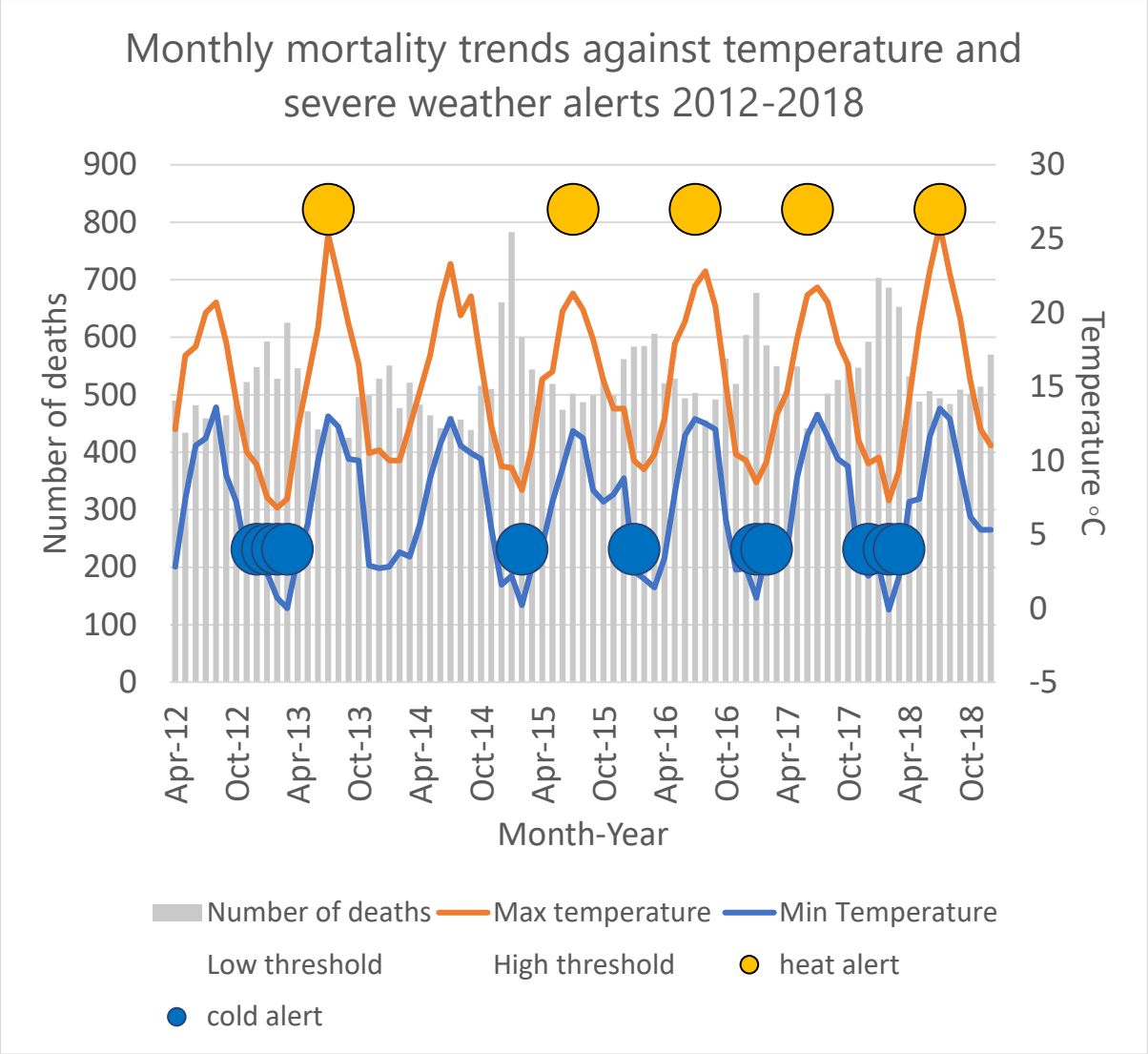

Figure 6: Mortality and severe weather alerts

Figure 6 shows that cold weather alerts are closely associated with spikes in the number of deaths, and that no such spike can be identified for hot weather alerts. Other things being equal, the warming of the Somerset climate will reduce the deaths from cold more than increase the deaths from heat. This will be discussed later; however, things are not equal.

Bacteria, Pollen, Mould and Spores

Some pathogens in food, such as Salmonella and Campylobacter show a seasonal pattern, with a higher incidence in the summer than the winter. It is likely then, that in longer, warmer summers associated with climate change these diseases will become more prevalent. The processes of human infection are not simple however, and so this increased risk will only become apparent if there are no changes in behaviour. With greater care taken over storage and preparation of food, these

dangers can be effectively protected against. Similarly, the concentration of pathogens in rivers or at beaches may change to an extent, but this will be a far smaller factor than how people behave there.

An extended summer season may bring earlier pollen allergens for hay fever sufferers and a longer hay fever season.

Wetter conditions are likely to increase the presence of moulds and spores, although with most people spending 90% of their time inside it is the indoor environment that has the most impact. Flooded houses are particularly vulnerable, but others can be affected. This is clearly strongly related to the complex question of housing, which is the subject of its own workstream in the Somerset Climate Emergency Strategy, and considered in terms of mitigation later in this report[16].

Precipitation – Flooding and Drought

Flooding

Rainfall patterns will continue to change as part of the changing climate.

- Summers are likely to be drier and winters wetter, especially for Southern England
- An increase in the intensity of summer and winter precipitation
- Risk of 85% more river flooding by 2080
- Sea level has already risen by 0.17m since 1900; a further rise of about 0.5m by 2100 is expected, although the range is between 0.3 and 1.15m

The impacts are likely to be exacerbated by a continuing rise in sea level. These changes are summarized above, with the increased risk of flooding being a clear consequence of climate change. The risk of major coastal flooding is set to rise, and increasingly stormy weather increases the risk of coastal inundation, and of low-lying land in the Levels and Moors. Higher sea levels make it slower for water to drain off the land.

The lowland levels and moors of Somerset are often wet in winter, but experienced particularly extensive and long-lasting floods from December 2013 until early March 2014. This saw about 600 households affected, with 280 dwellings flooded, especially at Moorland, and more cut off for up to 12 weeks, notably in Muchelney. An area of about 65km^2 was underwater for most of the period, as shown in Figure 7.

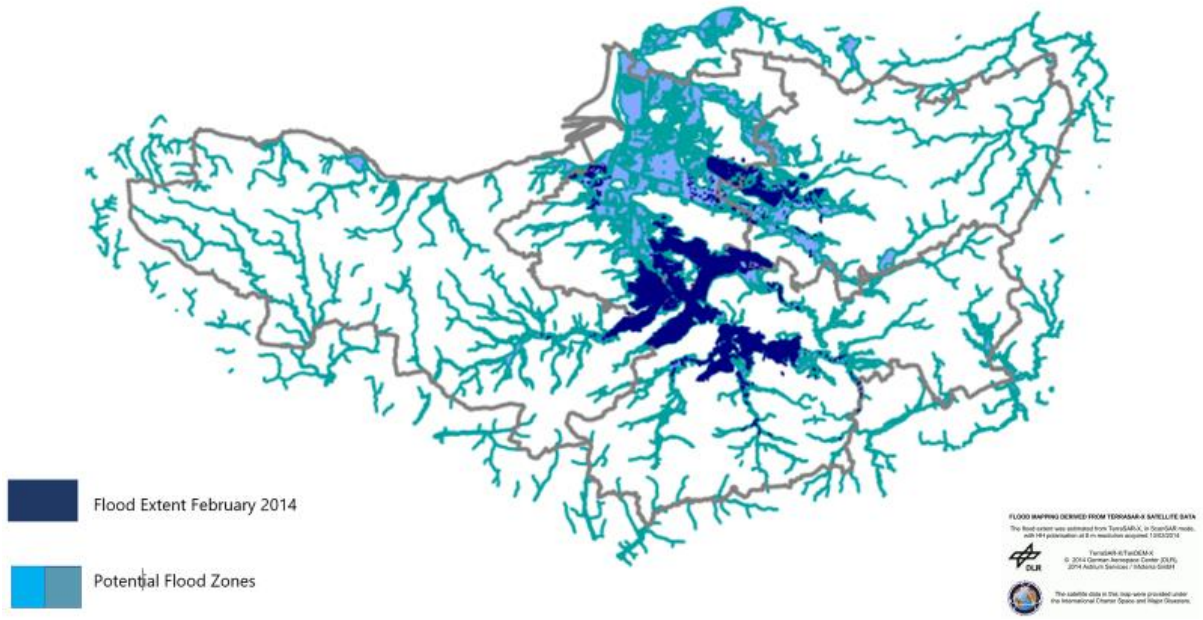

Figure 7: Area flooded in winter of 2013-14

The health impacts of flooding were especially on mental health, with depression, anxiety and post-traumatic stress disorder evident for many. The emotional toll is well described on video[17]. It was found that those households who had to be evacuated or felt a loss of control were particularly hard hit, and the shorter the warning and longer the evacuation the worse it was. Those people and communities who were most socially connected and given longer warning were more resilient in the face of flooding, which reinforces the frequent public health message of community strength being a powerful general protective factor. There is evidence that some community ties were strengthened by the experience of needing to help each other: 1000 people attended 83 community events in the year afterwards.[18]

The severity of the 2013-14 floods has perhaps given those communities some greater resilience for the future. Not only has the physical infrastructure been invested in, such as a causeway linking Muchelney to nearby Drayton, higher riverbanks and more powerful pumps, but also some social ties within the communities have been strengthened.

Flooding risk is also increasing in low-lying coastal areas, because of the steady rise in sea level. This risk is, naturally, highest at times of high tide and storm surge, with the latter potentially exacerbated by stronger winds associated with climate change. The highest risk of coastal flooding in Somerset is around Porlock Weir. Other areas, near the mouth of the River Parrett and Burnham-on-Sea would be similarly vulnerable if it were not for coastal and riverbank defences (which are already being prepared for a 1.0m sea level rise). In this area, the holiday lets that make up a significant proportion of dwellings are at particular risk.

The flooding of low-lying parts of the county when rivers overflow their banks is *relatively* predictable (hours or days in advance). Much less easy to prepare for though, is flash flooding, where short bursts of intense rainfall exceed the capacity of streams and drains, leading to very sudden and massively forceful water flow that can destroy buildings and bridges[19]. With less chance to prepare, this form of flooding can have disproportionately harmful consequences and has been identified by civil contingencies officers in Somerset as a particular developing risk. The catchment areas where steep slopes and impermeable surfaces mean that heavy rain can quickly lead to deep and fast-flowing water are described as 'rapid rise', as shown in Figure 8. There is a concentration of such catchments on the north side of Exmoor around Porlock. This is only 17km from Lynmouth in Devon, where in 1952 a summer storm led to 34 deaths; Porlock's relatively high risk of sea flooding has been identified earlier in this report.

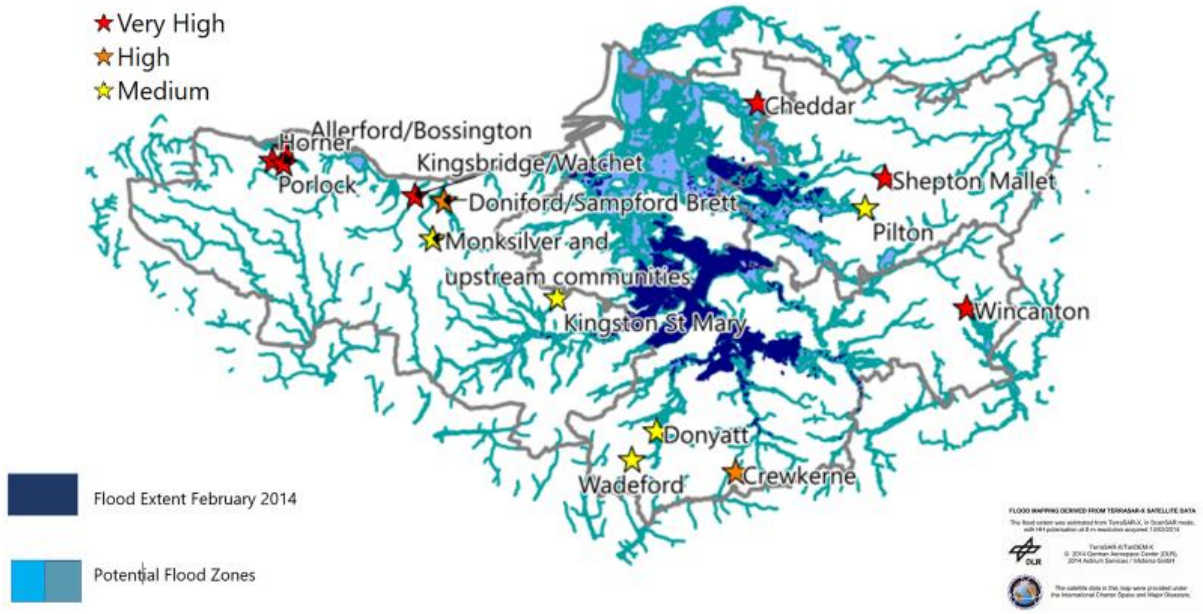

Figure 8: Somerset Rapid Rise catchments

Significantly, however, the location as well as the timing of flash floods is very unpredictable. It is likely that such floods occur rapidly and do damage even before emergency vehicles can arrive. Figure 9 shows an example of flash flooding outside the high and medium risk zones. With increased heavy and intense rainfall in future climate, as well as more hard surfaces with increasing housing and road development, such incidents become more likely. This is simply a further example of the general importance of 'stronger communities', resilient and able to withstand emergencies, in the county's wellbeing[20].

One way in which flood *risk* (rather than flooding itself) may have an impact on wellbeing and inequality is through its effect on the capital value of dwellings, especially if it renders some uninsurable. This may create, effectively, slums and ghettos, and make it harder for some households to obtain formal credit, and so increase indebtedness.


NEWS

8th February 2016

PICTURE: Curry Rivel Primary School closed after classrooms flood

Figure 9: Flash flooding in lower-risk area of Somerset[21]

Flooding impact on services

Whilst some settlements (such as Moorland) were inundated in 2014, others (such as Muchelney) were 'merely' cut off. As well as the inconvenience to everyday life, this also affected their access to health services. The SW Ambulance trust (SWAST) had to use its specialist 'HART' team to get access to Muchelney, for instance. The greatest impact of this sort was perhaps for people receiving regular visits for social care.

Drought

The increase in winter rainfall is expected to be offset by a decrease in summer rainfall (albeit with more intense convective showers). In drought conditions, the

absence of the cooling effect of water evaporating can make temperatures higher, with the consequences described earlier. Although a drier atmosphere can feel more comfortable than a humid one, humidity is a minor factor in health impact[22]. For most people, it is unlikely that drought will lead to water shortages that have harmful impacts on health, although it can encourage algal blooms and increase dust[23]. However, there is potentially a disproportionate impact on those people who rely on private water supplies. This is a relatively small section of the population, as shown in Table 3, but makes up a higher proportion of the population in Somerset than nationally.

Table 3: Households with private water supplies

Area	Private Water Supplies	Households 2018	Rate
Mendip	145	49,194	0.29%
Sedgemoor	37	52,918	0.07%
South Somerset	431	73,325	0.59%
Taunton Deane	248	50,635	0.49%
West Somerset	713	15,772	4.52%
Somerset	1574	241,845	0.65%
South-West	11,293	2,394,010	0.47%
England	36,450	23,222,538	0.16%
ONS 2016 based household projection mid-year 2018			

Private water supplies have a higher likelihood of being substandard or contaminated. Increased drought and more intense rainfall have the potential to affect water quality, especially if the 'catchment hygiene' is not maintained at the highest level[24]. Dwellings dependent on private sources are disproportionately in isolated rural areas and used as short-term holiday lettings. It may be that long-term residents would develop resistance to local bacteria, whereas temporary arrivals will be at higher risk.

Snow

According to the headline findings of the UK climate forecasts published in 2019,

> 'By the end of the 21st century, lying snow decreases by almost 100% over much of the UK, although smaller decreases are seen over mountainous regions in the north and west.[25]'

It would, though, be premature to reduce preparedness for lying snow having an impact on health and access to services. It was only in March 2018 that snow associated with Storm Emma led to a red severe weather warning in Somerset.

Indirect effects of changes in the weather

As well as temperature and precipitation having direct health impacts as just described, there may well be changes in behaviour that have their own strong relationship with health and wellbeing.

Biodiversity and new diseases

Climate change is only one factor in changes in the number and distribution of wildlife. Changes in weather and land-use have seen, for instance, Great, Little and Cattle Egrets colonize Somerset in recent decades; these changes may also see less desirable creatures establish themselves, with harmful impacts on health. An increase in the number and distribution of sheep and deer ticks is likely to see an increase in Lyme Disease. Potentially, the UK could also see the brown dog tick, which carries Mediterranean Spotted Fever, or *Hyalomma marginatum*, the most important vector of Crimean-Congo haemorrhagic fever, become established. Mosquitoes may increase in number and new species – most likely *Aedes albopictus* may appear. There is a possibility that West Nile virus – for which *A. albopictus* is the vector – will become established, but it is unlikely that malaria will return to Somerset. The potential impact of increased pesticide use in response to these changes will also need to be considered[26].

The relationships between insects, the environment, disease and its transmission to the human population is complex. For mosquitoes, for instance, the salinity of water and the extent to which water bodies dry up in the coming hotter and drier summers will affect their numbers; the extent to which they suck human blood and transmit disease will vary with how much people keep their windows open at night to keep cool. Where West Nile Fever is established community hygiene measures include checking for standing water in, for example, gutters, old tyres and open water butts. Environmental management that creates habitats and wildlife corridors to help wildlife adapt to change will also need to take into consideration the fact that not all the creatures taking advantage will be beneficial to health.

Outdoor activity – skin cancer, accidents and exercise

Climate change will probably bring warmer weather for most of the year, and longer dry periods in the summer. Whilst the sunshine itself will be no stronger, and indeed the continuing recovery of the ozone layer after its damage from CFCs and such gases may mean that intensity of dangerous radiation at the surface is reduced, more people may spend longer outdoors. Without protection, this will increase the risk of skin cancer. Somerset has a higher than national incidence of skin cancer, which is mostly a reflection of the age of the population, for whom much of the damage will have been done in their younger years. A relationship between skin cancer and the proportion of the population spending time outdoors in agricultural occupations has been suggested, but not established.

Dry, warm weather may encourage more people to spend time engaged in outdoor exercise and sport or walk or cycle to work. Such physical activity is overwhelmingly good for health but will probably also lead to more accidental injuries. As an illustration, warm Bank Holidays are usually associated with higher demands on urgent care, some from visitors to the county.

Broad psychological effects

The psychological impact of flooding on individuals has already been discussed; climate change as a whole may also have adverse effects on mental health. The increased uncertainty may have particular impacts on farmers, either through the potential loss of harvests or grazing from drought or flood, inability to plant or damage to crops from new pests such as flea beetle. More generally, the fear of climate change, including landscape changes and loss of biodiversity can increase anxiety about the potential harm[27]. These effects may be more pronounced in a rural county such as Somerset.

Inequalities

Not all groups in Somerset can expect to be equally affected by climate change, with some at greater risk than others. Examples are shown in Table 4.

Table 4: At-risk groups in Somerset climate change[9]

Likely to benefit in health terms		
Milder winters	**Evidence for Somerset**	**Notes**
COPD	2.3% registered patients	Higher than England (1.9%), but reflects elderly population structure in Somerset.
Asthma	6.8% registered patients	Higher than England (6.0%)
Coronary Heart Disease	3.8% registered patients	Higher than England (3.1%), but reflects elderly population structure in Somerset.
Poor health generally, especially elderly	24.5% of the Somerset population are aged 65 and over, an increase of about 3% since the 2011 Census	7% higher than the UK proportion (17.5%)
Those at risk of falls, especially elderly		
Those in fuel poverty	10.2% of Somerset households	Lower than England (11.1%). In Somerset particularly those dependent on expensive heating (oil rather than gas)
Residents of cold but dry housing	Not identifiable from current statistics.	
Drier summers		
Those taking outdoor exercise	35.0% of Somerset adults participate in more than one exercise session/week. Outdoor exercise not separately reported.	Lower than England (36.1%) but may reflect elderly population structure in Somerset. Potential health benefits offset by increased skin cancer risk and incidence of tick-borne disease
Likely to lose out in health terms		
Heatwaves		
COPD	2.3% registered patients	Higher than England (1.9%), but reflects elderly population structure in Somerset.
Coronary Heart Disease	3.8% registered patients	Higher than England (3.1%), but reflects elderly population structure in Somerset.

Poor health generally, especially elderly	24.5% of the Somerset population are aged 65 and over, an increase of about 3% since the 2011 Census	7% higher than the UK proportion (17.5%)
Residents of hard-to-cool housing, especially in urban areas	Not available.	
Drought		
Dwellings dependent on private water supply	1574 households (0.65% of Somerset households)	Visitors to holiday lets at particular risk.
Fluvial and marine flooding, and coastal erosion		
Low-lying dwellings in existing fluvial flood zones	560km out of 3452 km (16%) in Somerset are in the Environment Agency flood zone 3.	Such areas have long been left free from most permanent habitation
Low-lying coastal dwellings		
Coastal settlements vulnerable to erosion		
Communities at risk of being cut off	Many are former islands, such as Muchelney and Oath.	The largest of these in 2014, Muchelney, is now joined to the upland.
Flash flooding		
Dwellings in flood catchments, especially structurally unsound.		Location (and timing) of such flooding is highly unpredictable.

All impacts		
Poorer people	Around 47,000 Somerset residents live in a neighbourhood (LSOA) identified as one of the 20% most deprived in England (index of multiple deprivation).	Making the changes needed to adapt to changing climate will require resources, and those without the money or credit to make them will be disadvantaged.

As a very broad range of changes to a 'noisy', chaotic weather system, and much variation within the groups at risk, it is difficult to quantify the differential impact.

Global equity and risk

Hardest of all to predict are the impacts on Somerset that may come from effects elsewhere on the globe. If weather effects, or indirect effects such as locusts[28], lead to crop destruction, if glacier melting diminishes water supplies or exacerbates international tensions, the consequences could threaten global security (including forced migration within and across borders[29]) and it is unlikely that Somerset would be unaffected by the consequences. Food production is a complex, international system faced with change at an unprecedented scale and pace, and more people are likely to find their access to food becoming precarious. In the longer term, disruption to global oceanic currents may lead to even more dramatic, and perhaps quite different, changes to the climate from the ones described here[30].

This is highly speculative, but 'thinking globally' is essential in order to understand the extent of the climate emergency. This is also a matter of international equity – Somerset produces more than its fair share of global pollution but is at less risk than, say, Bangladesh, which produces a far smaller proportionate amount. The likely impacts of climate change on health in Somerset, which involve a changing level of risk where some threats decrease (such as winter cold) and others increase (such as flooding and summer heatwaves), do not reflect the global scale of danger. Nor do they suggest the transformational scale of response required; this is considered in Section II.

Section II:

Mitigation, Adaptation and Behaviour Change

As is evident throughout the Somerset Climate Emergency declaration and strategy, adapting to the changes, and perhaps even more *acting* to reduce the damage being done to the environment (mitigation) will require wide-ranging changes in how we live. The health impacts of these have been described forcefully in the '*Stern Report*'

> 'Climate change threatens the basic elements of life for people around the world - access to water, food production, health, and use of land and the environment.'[31]

and by *The Lancet Planetary Health:*

> 'Climate change is the biggest global health threat of the 21st century.'[32]

However, the 2015 *Lancet* Commission on Health and Climate Change concluded that:

> 'tackling this threat could be the greatest health opportunity of the 21st Century.'
>
> In a world embracing the Paris Agreement's ambition via…uptake of clean energy, electrification of transport, support for plant-rich diets, increased green space, and active commuting opportunities, a child born today will experience cleaner air, decreased chronic disease, strengthened social ties.'[33]

The three most significant areas of change in terms of opportunities in health in Somerset, as nationally, are housing, food and transport[34]. Each of these has its own workstream in the Somerset Climate Emergency Strategy, and so is covered comprehensively there. The health opportunities are summarised below. Energy production is not considered in detail here, but has significant implications globally, notably from reducing the use of oil and coal, which produce major pollutants as well as carbon dioxide[35].

Built environment - housing and workplaces

Those in poor housing have already been identified as a group at risk. Figure 10, taken from the UK government advisory Committee on Climate Change[36] gives a

summary of the recommendations for existing housing stock and new building. To this has been added areas of health where such changes can also be beneficial. These include not only overheating, flooding and fuel poverty, but also physical inactivity and social isolation as harmful factors that can be reduced through the design of dwellings and residential areas – such as tree planting. The benefits of better housing can be felt as widely as in improved child school attendance[37]

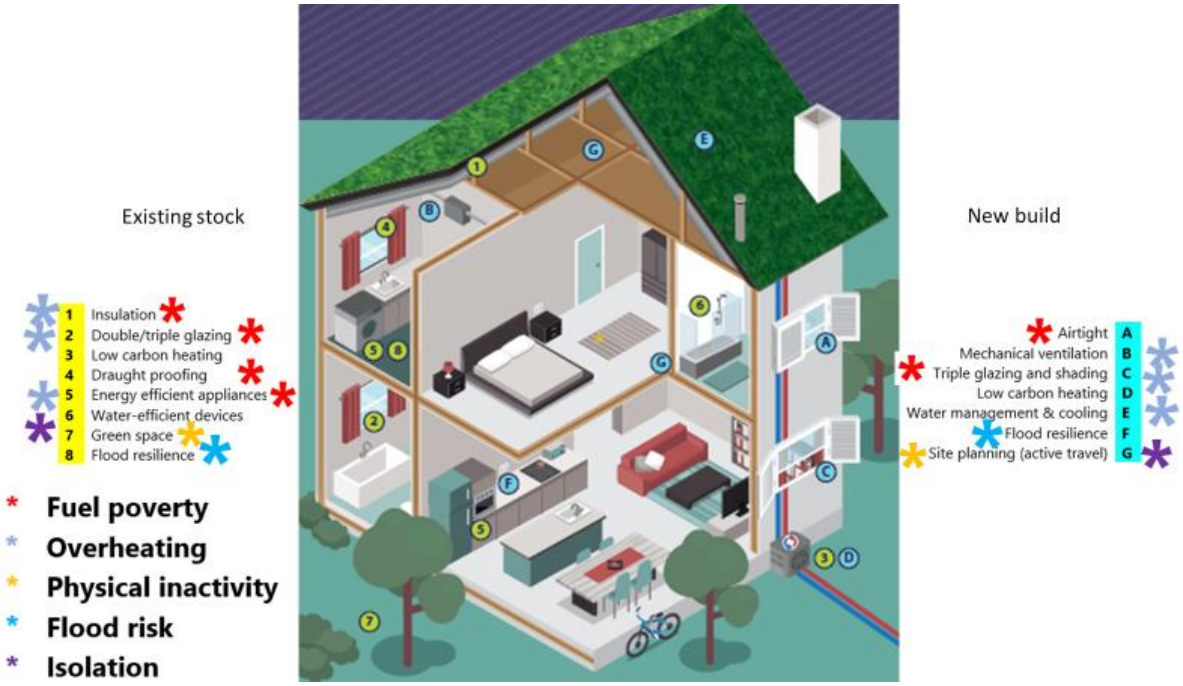

Figure 10: Summary housing changes to mitigate and adapt to climate change

Figure 11 shows the patterns of fuel poverty in Somerset. In contrast to many maps of disadvantage, urban housing estates do not appear prominently. Social housing is usually relatively well-constructed; terraced houses and flats 'keep each other warm'. Urban dwellings typically use mains gas, which is a cost-effective form of heating. Somerset has 76,400 dwellings off the gas network – at 30% this is twice the national rate of 14%[38]. Rural dwellings are often detached, and frequently use heating oil. Both, of course, are fossil fuels and whilst improved insulation can reduce emissions, an affordable source of heat will still need to be found.

Housing that is well prepared for climate change needs insulation, ventilation and shading. These are not contradictory, and dwellings require good design to support good health. For example, ventilation should be mechanical, rather than relying on draughts, and summer shade needs to be combined with winter sun, such as by angled louvres or deciduous trees. Insulation can keep dwellings cool as well as warm. The majority of accommodation in Somerset is, of course, existing stock

rather than new-build, and retro-fitting will be a challenge in many cases. This will be most difficult for low income households (many of whom are renters), but may benefit single households in particular as they spend a higher proportion of income on household energy[39].

The environment surrounding the dwellings themselves can also have an impact, as is indicated in Figure 10. This can be in encouraging outdoor exercise and active travel, or in the direct air quality impact of vegetation. The Centre for Ecology and Hydrology estimates that vegetation in Somerset removes pollutants from the air to an extent that health costs in the county are reduced by £14.97 per person, close to the national average[40].

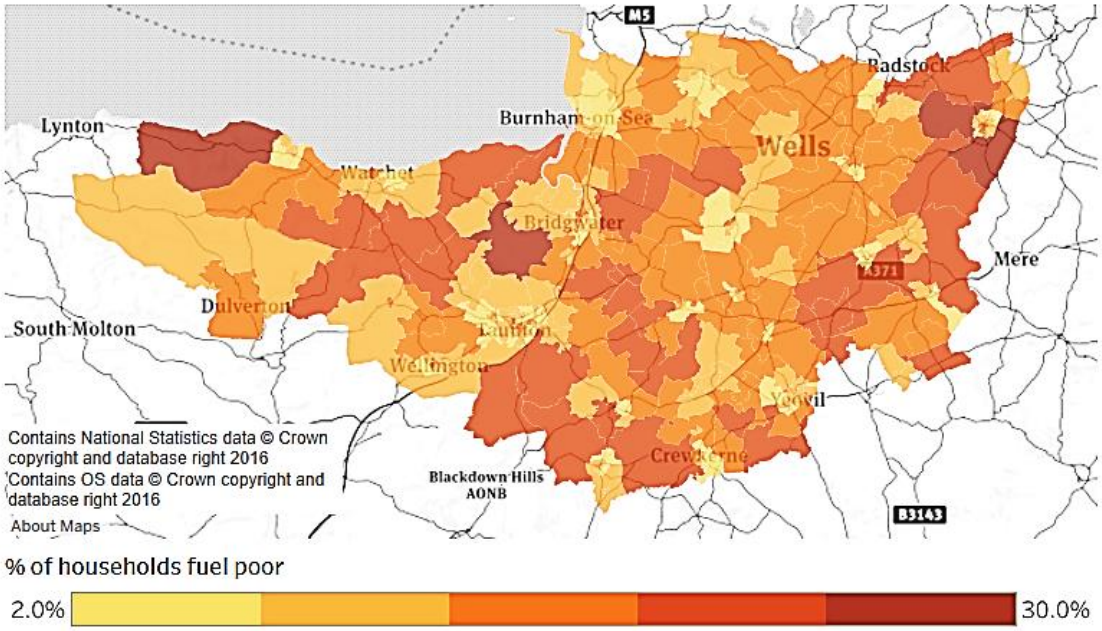

Figure 11: Fuel Poverty - estimates of the proportion of households with low income and high fuel costs[41]

Workplaces and working environments may require as many changes as dwellings, with passive heating and cooling, ventilation and the heat and emissions generated by lights, computers and other equipment all to be considered. Commuting may need to be reduced, with local work hubs having the potential to strengthen geographical communities as well as limiting pollution from travel. Working hours may need to change to mirror those in southern European countries (starting earlier and with a break during the day) to make the working environment more bearable in the hottest weather.

Hospitals may be at particular risk in relation to overheating. The design of their buildings does not typically take account of summer over-heating (the body heat of

patients is a significant contributor to this) and residents are, necessarily, in generally poor health. It is reported that Musgrove Park Hospital in Taunton already has issues of overheating during heatwaves. The NHS has a range of guidance for mitigating the climate emergency[42]. Understanding the potential health gains from mitigation needs to contribute to a full assessment of costs and benefits in making policy on housing and planning.

Transport

The harm from pollutants such as hydrocarbons in exhaust fumes, and particulates from brakes and tyres, has already been described. Reduction in motor transport generally will lead to a concomitant reduction in all these, and shifting from internal combustion engines to electric will reduce the former. Motor vehicles are also contributors to social isolation, as shown in Figure 12. This well-known map, based on research in San Francisco, shows how comparable streets had very different levels of social contact between neighbours as a result of different traffic density. Where there was only light traffic, most people knew about three of their neighbours, whereas in heavy traffic the average was less than one. Social cohesion has already been identified here as an important defence against the extreme weather events, and it has many other beneficial health impacts as well.

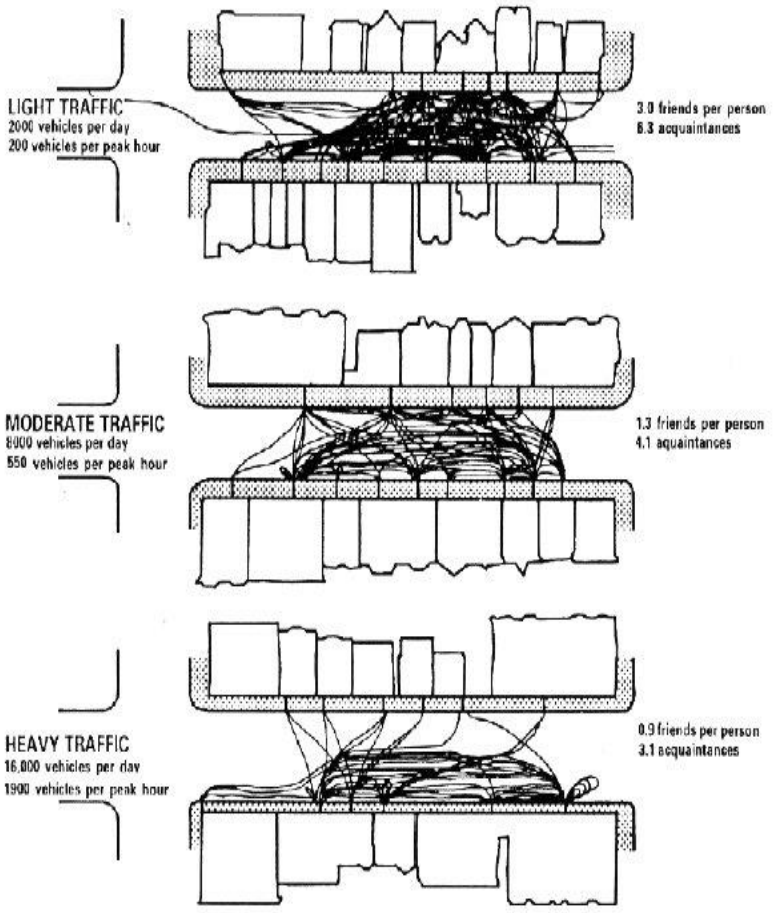

Figure 12: Motor traffic density and social cohesion

The impact of car travel can be reduced by a decrease in use, and by reducing the level of pollution produced by individual cars *in situ*[43], with a wide range of actions that can produce benefits. These include:

- More charging points for electric vehicles
- Incentives for car sharing
- Integrating transport, such as making it easier to put bicycles on trains or buses, or using 'park and ride' hubs to reduce car-only journeys
- Reducing speeds
- Encouraging on-line work and 'meetings', including out-patient appointments.

Transport, especially rural transport, almost always emerges as a challenge for Somerset health and wellbeing in themed JSNAs. Getting access to employment, services and social events is difficult for many, and especially those without cars. On the principle that one should never fail to take advantage of a period of significant

change, developing a new, low carbon transport system may just be the incentive to make the reforms needed.

Diet

It is perhaps over-simplistic to think there is a single 'good' diet - this is certainly not an uncontentious area. Whilst fresh fruit and vegetables have undoubted benefits, there is more dispute about the value of carbohydrates, for instance. The current Public Health England advice – the 'eat well plate' - is shown in Figure 13. This shows that a climate change mitigating diet, with reduced consumption of meat to reduce the greenhouse gas emissions from the livestock sector, is also a healthier diet[44].

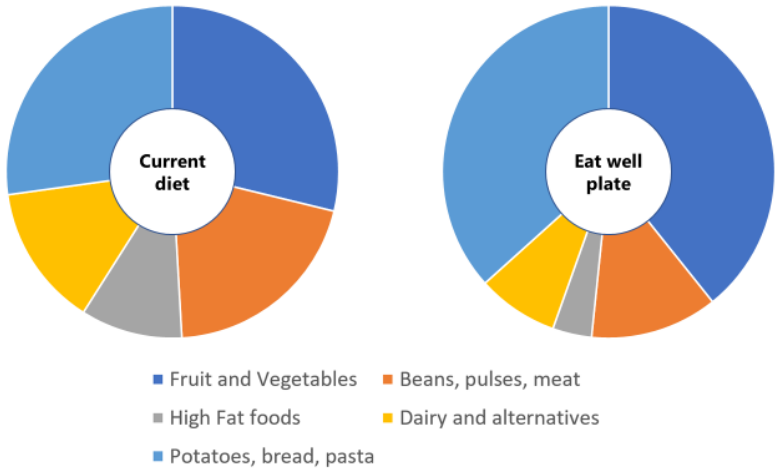

Figure 13: Current average England diet and the 'eat well plate'

It is, though, worth stating that not only is diet debated, but that the type of food alone is an imperfect guide to emissions, as shown in Figure 14. For an agricultural county like Somerset, questions of food production, processing and transport need to be brought into consideration, especially given that many parts of the county are not suitable for arable agriculture. Already there are reports that farmers' wellbeing and mental health is adversely affected by their portrayal as environmentally irresponsible[45]. This may include supporting farmers to diversity and promoting quality (and hence a reduced carbon footprint from local production) over quantity in the most carbon-intensive foodstuffs.

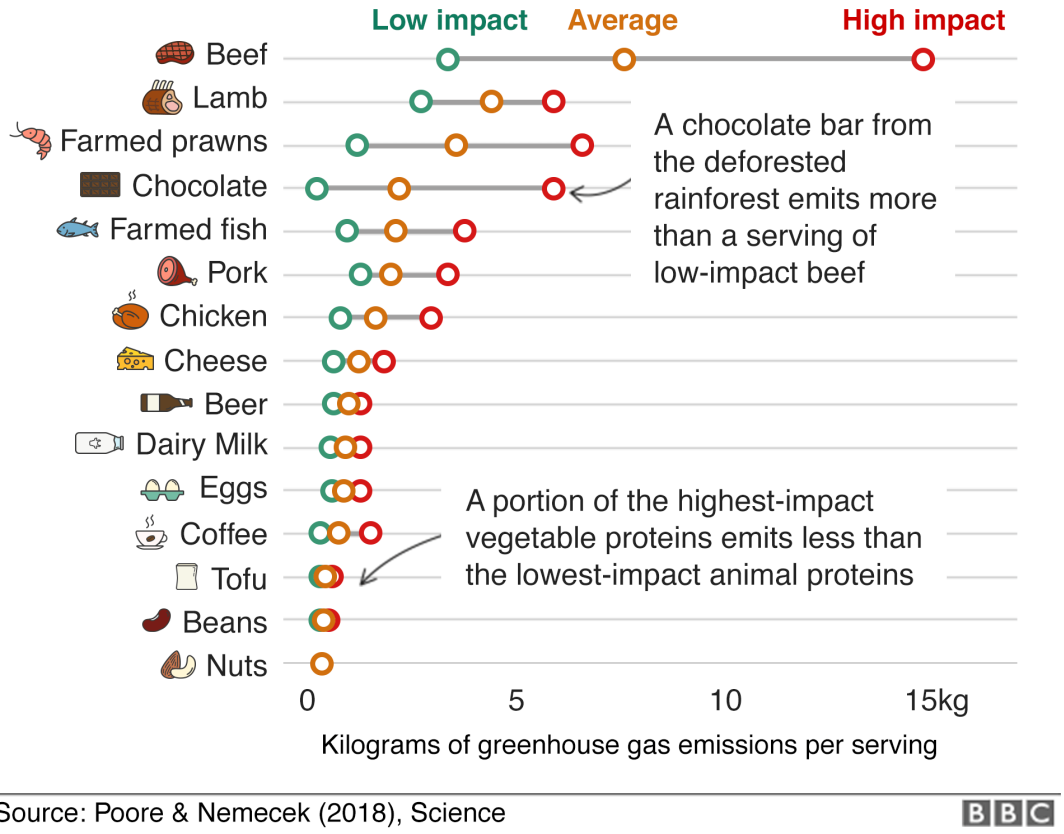

Figure 14: Food types and range of impacts[46]

Changing behaviour

The brief discussion of these mitigation actions, which achieve health benefits and environmental benefits at the same time, here should not disguise the fact that behaviour change is *difficult*. 'Loss aversion' means that most human beings value what is taken away twice as much as what is gained[47], leading to a natural inertia. Making changes in behaviour involves many elements, covering opportunity, capability and motivation, and within that the interventions can include education, persuasion and coercion, in a policy context ranging from guidelines and taxation through to legislation and regulation[48].

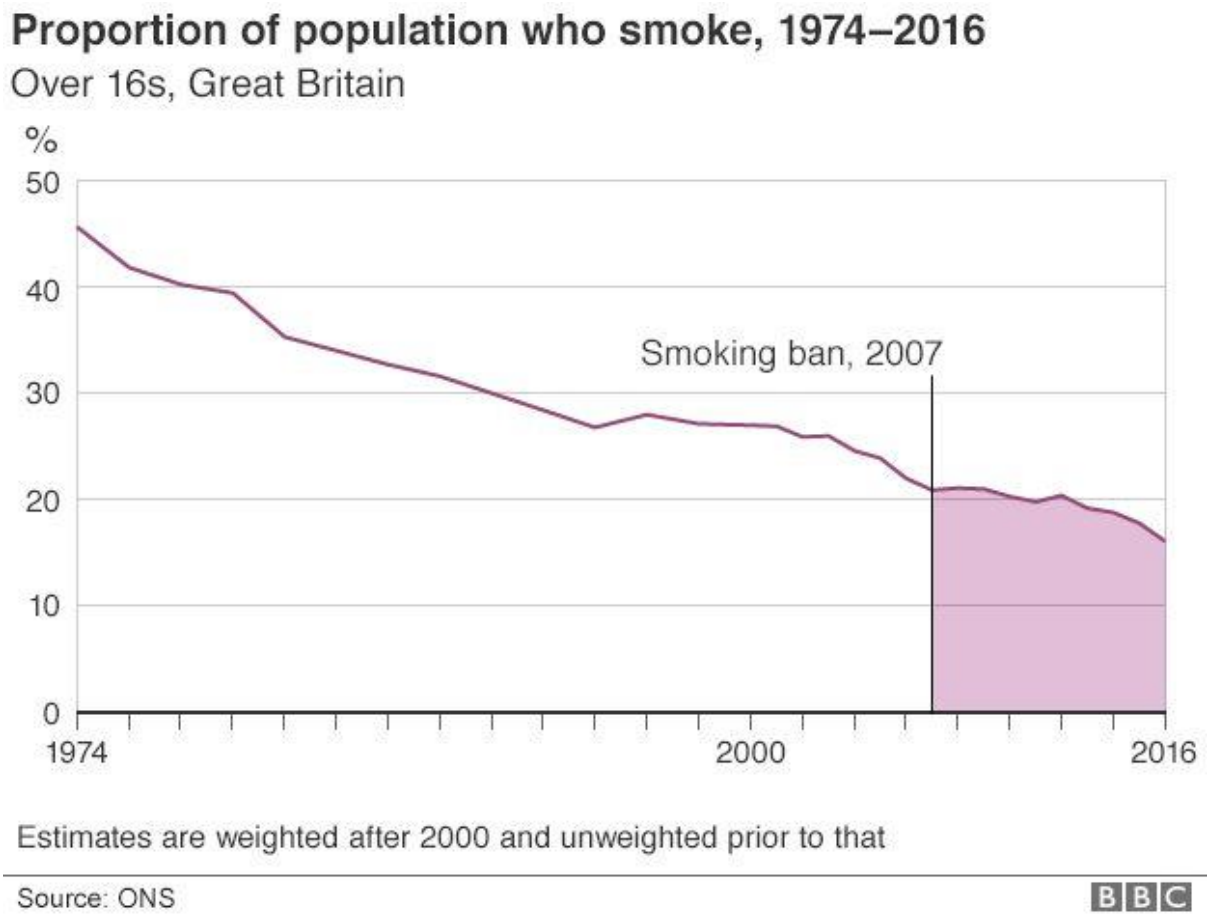

Figure 15: Smoking rates

Figure 15 shows how long the process of reducing the rate of smoking has taken. This is not exactly comparing like with like, but the behaviour changes needed to reach carbon neutrality will have to be brought in with considerably more urgency. Even with clear benefits to individual health from stopping smoking or wearing seatbelts, the changes have required large scale communication and indeed legislative efforts to bring them about.

The photographs in Figure 16 show a shopping street in Walthamstow before traffic calming and pedestrianization were brought in for parts of the Borough (1), and after their implementation (2); photograph 3 shows the largest protests in the borough's history that greeted the changes. After a time, the health and environmental benefits, and economic benefits of increased shop footfall became apparent, and changes were popular (including at the ballot box) – but it was not a smooth transition. Such 'mini-Holland' schemes are to be funded across the country following a recent government announcement[49].

Figure 16: 'Mini-Holland', Walthamstow, London

A similar example is illustrated in Figure 17. Congestion charging in Stockholm had less than 50% popular support before its introduction and fell as its trial application approached. As commuters saw the effects, so popularity rose. In the words of the city's director of transport, Jonas Eliasson:

> 'The closer you get to implementation, the more the drawbacks stand out. If you survive this valley of political death, and people actually see the benefits, and also realize that, in addition to the benefits, it's actually not as bad as you thought — it's not so hard adapting to this — then support starts going up again.'[50]

Many of the potential changes discussed here – such as new ways of heating and cooling houses and electric vehicles – give financial savings as well as environmental and health benefits. However, these savings tend to be over the long-term, whereas the costs are up-front and immediate. Behaviour change will require ways of smoothing over the economic cost of investing if they are not to limit the benefits to the wealthy, not only reducing their impact but also *increasing* inequalities.

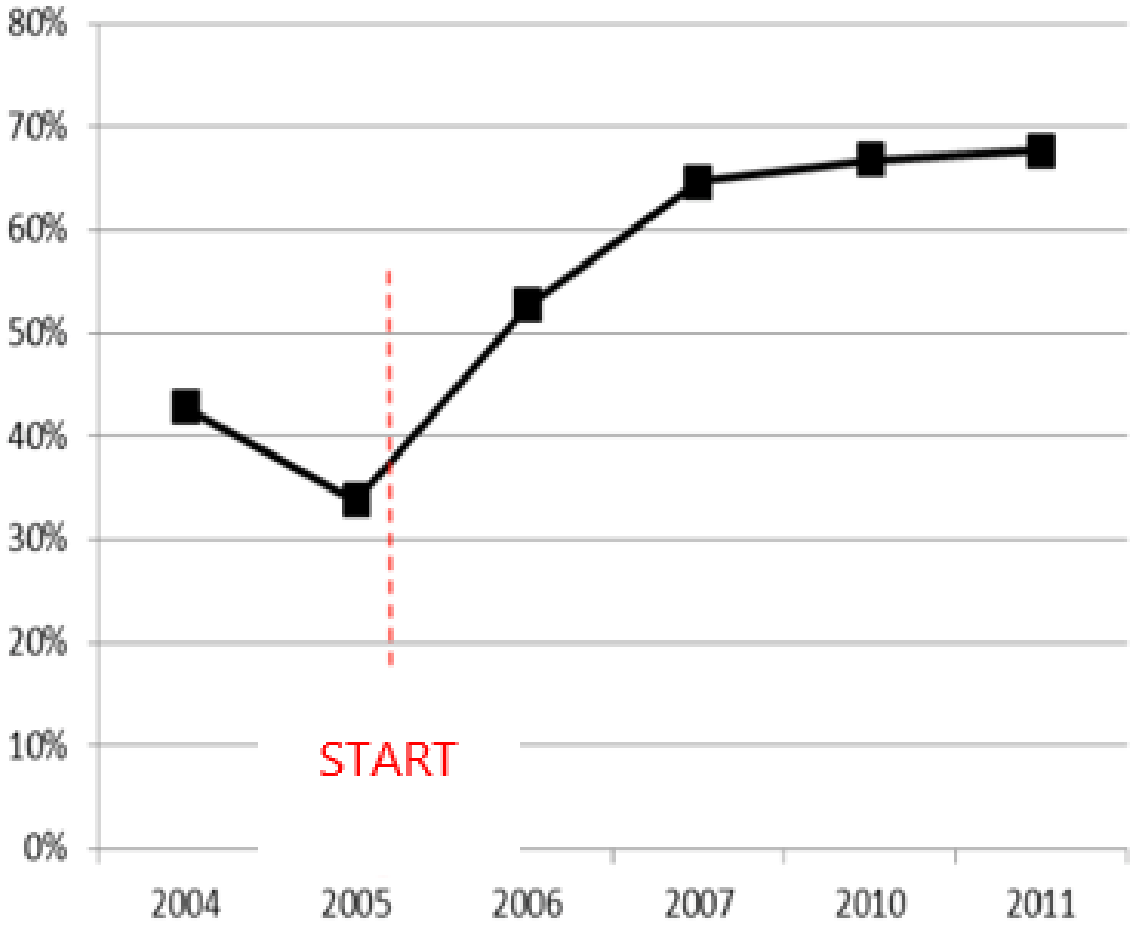

Figure 17: Stockholm - popularity of congestion charging over time

Coronavirus/Covid-19

At the time of writing, daily life across the globe is being transformed as governments, communities and individuals try to mitigate the risks from Covid-19. For all its urgent immediacy, this is arguably a less unprecedented and less wide-ranging a threat than the climate emergency. Many of the changes – dramatic reductions in travel, especially by plane, home-working and even limiting meat consumption[51] - are consistent with reducing greenhouse gas emissions. The UK government has set aside 15% of GDP in loans and grants to deal with the economic costs – vastly higher than the 1% of GDP advocated in the Stern Report to mitigate climate change.

Interestingly, Figure 18 shows how the peak of deaths in the French heatwave of August 2003 far exceeded that of April 2020 linked to covid-19. Whilst far from comparing like with like, this points up the relative scale of the two emergencies.

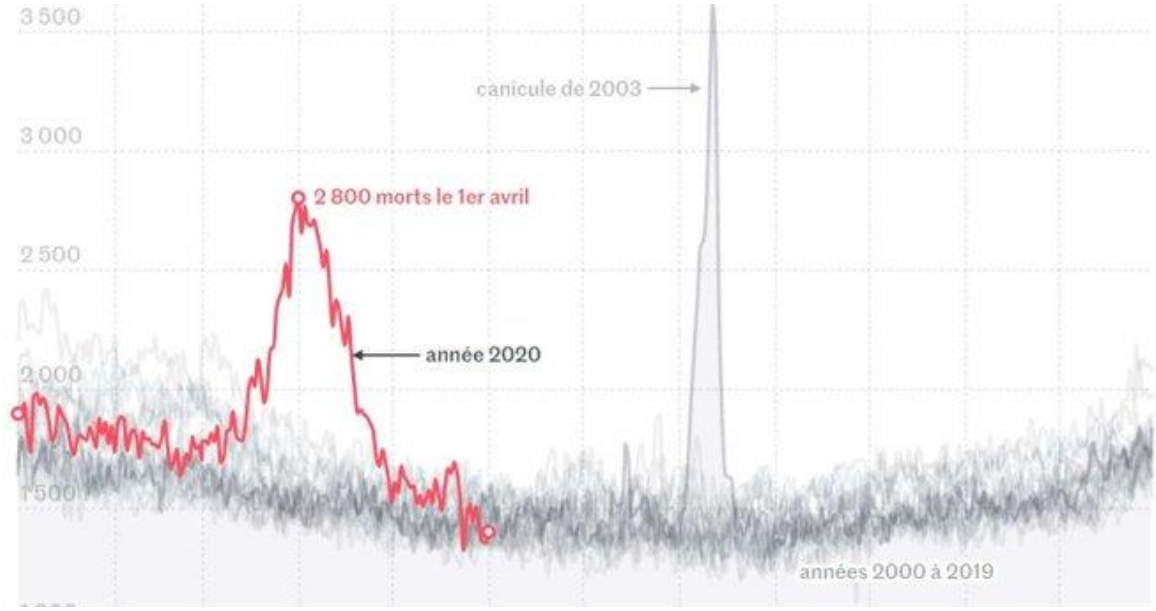

Figure 18: 21st Century Daily Deaths, France[52]

Conclusion

The expected changes in climate over the rest of the century will see changes in the way that the physical and biological environment will affect health. Some may be beneficial, such as a reduction of winter cold, others will be harmful such as an increased frequency of heatwaves and more active vectors such as ticks. The most harmful impacts may well be from flooding, especially destructive and unpredictable flash floods. The range and intensity of risks is likely to grow, and the health and care system will need to be prepared for the worst.

The changes in our behaviour that will be needed to mitigate and adapt to climate change have a role to play in a preventative, as well as low-carbon, way of life. Actively managed, this could see a reduction in health inequalities.

Implications for the Health and Wellbeing Board

Part 1 – The impact of climate change on health

There will be *unavoidable* changes in health need in coming decades as a result of climate change, and the health and care system will need to respond to them. The weather's variation from year to year, indeed from day to day, means that the necessary responses are best thought of in terms of risk.

- Risk registers and medium-term plans may need to be reassessed to reflect likely changes
- The increased likelihood of flooding shows the value of investment in mental health services
- 'Stronger communities' have a significant role to play in supporting people through crises, including those related to climate change, and should be supported
- Changes in the natural environment and biodiversity may well evince their importance in physical and mental wellbeing
- Poor housing in particular is reinforced as a major 'wider determinant of health'

Part 2 – Mitigating and Adapting to Climate change

There are *choices* to be made about the response to the climate emergency, at the international, national and local level. In Somerset, the Climate Emergency Strategy is the principal vehicle for coordinating action, and it is through this that the Health and Wellbeing Board, and its members, will tend to respond.

- Housing
  Improvements to energy efficiency, insulation, ventilation and local planning can bring health benefits and carbon reduction. Health and Wellbeing Board engagement with the Strategy can support those improvements being made by demonstrating the value in health (and so financial) terms.

- Food
  There is a complex set of relationships between diet and health, and food production. The Board can help this aspect of the Strategy by ensuring health and wellbeing of consumers and producers is fully taken into account in decisions about reducing carbon emissions.

- Transport
  Active transport can significantly reduce carbon emissions and other pollution if it takes the place of car travel. Other interventions, such as electric vehicles, may reduce greenhouse gases without giving the same level of health benefits. The perennial question of rural transport is even more difficult to resolve than urban. Again, engagement with the Strategy can promote health, wellbeing and community cohesion gains alongside carbon reduction.

- Behaviour change
  There is a strong correlation between the health benefits to be gained from carbon reduction and the extent to which we will all have to change the way we live and work. Changing is hard, and the Health and Wellbeing Board could consider the extent to which it wishes to encourage and support these changes.
  There are many aspects to behaviour change, and many tools from informing to legislating. The Board may find it useful to consider the levers available to it, from decisions in their own organizations to lobbying central government.

Other

The Board may wish to include a 'Climate Impact Assessment' section within the templates for papers submitted.

References and notes

[1] https://www.un.org/en/chronicle/article/greatest-threat-global-security-climate-change-not-merely-environmental-problem
[2] https://www.thelancet.com/pdfs/journals/lancet/PIIS0140-6736(09)60935-1.pdf
[3] https://www.bbc.co.uk/news/science-environment-47122641
[4] https://www.theguardian.com/australia-news/2019/dec/18/too-hot-for-humans-first-nations-people-fear-becoming-australias-first-climate-refugees
[5] https://www.maplecroft.com/insights/analysis/84-of-worlds-fastest-growing-cities-face-extreme-climate-change-risks/
[6] https://www.somerset.gov.uk/waste-planning-and-land/climate-emergency/
[7] https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/826/826.pdf
[8] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/652568/Cold_Weather_Plan_Making_the_Case_2017.pdf
[9] Data from Somerset Intelligence (http://www.somersetintelligence.org.uk/) and PHE Fingertips (https://fingertips.phe.org.uk/) .
[10] Public Health England *Cold Weather Plan for England* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/652568/Cold_Weather_Plan_Making_the_Case_2017.pdf
[11] https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-factsheet-local-2.2km.pdf
[12] https://www.who.int/globalchange/publications/WMO_WHO_Heat_Health_Guidance_2015.pdf?ua=1 ; https://publications.parliament.uk/pa/cm201719/cmselect/cmenvaud/826/826.pdf
[13] https://www.nasa.gov/topics/earth/features/heat-island-sprawl.html
[14] https://www.carbonbrief.org/climate-change-driving-surge-in-day-night-hot-extremes-in-northern-hemisphere
[15] And nor can the long-term increase in the number of deaths, as the population grows and ages in structure.
[16] 'Water and food-borne diseases under climate change', G Nichols and I Lake, in *Health Effects of Climate Change*, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/371103/Health_Effects_of_Climate_Change_in_the_UK_2012_V13_with_cover_accessible.pdf
[17] https://vimeo.com/167347918
[18] These findings are based on interviews undertaken by Exeter University. Others working in the area have suggested that some who were warned responded with

denial of the problem, and when their homes were inundated were severely affected. In other words, they felt that they were not warned because they were badly hit by the floods, rather than the other way round (pers. com.).
http://hdl.handle.net/10871/25565
[19]
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291430/LIT_8904_df2d47.pdf
[20] http://www.somerset.gov.uk/EasySiteWeb/GatewayLink.aspx?alId=134347 . See also PHE on heatwaves (7)
[21] https://www.somersetcountygazette.co.uk/news/14260933.picture-curry-rivel-primary-school-closed-after-classrooms-flood/
[22]
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/371103/Health_Effects_of_Climate_Change_in_the_UK_2012_V13_with_cover_accessible.pdf
[23] Public Health England, *Heatwave Plan for England*
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/429572/Heatwave_plan_-Making_the_case_-_2015.pdf
[24] https://iwaponline.com/jwh/article/7/1/1/9911/Rainfall-and-outbreaks-of-drinking-water-related
[25]
https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp-headline-findings-v2.pdf
[26] https://www.theccc.org.uk/wp-content/uploads/2016/07/UK-CCRA-2017-Chapter-5-People-and-the-built-environment.pdf
[27] https://www.apa.org/news/press/releases/2017/03/mental-health-climate.pdf
[28] http://www.fao.org/emergencies/resources/photos/photo-detail/en/c/1258345/
[29] https://www.unhcr.org/uk/climate-change-and-disasters.html
[30] https://www.nature.com/articles/s41598-019-56435-6
[31] https://webarchive.nationalarchives.gov.uk/+/http:/www.hm-treasury.gov.uk/media/4/3/executive_summary.pdf
[32] https://storage.googleapis.com/lancet-countdown/2019/10/briefing-for-the-global-health-community.pdf
[33] https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(19)32596-6/fulltext
[34] https://www.theccc.org.uk/wp-content/uploads/2019/10/Behaviour-change-public-engagement-and-Net-Zero-Imperial-College-London.pdf
[35] https://jamanetwork.com/journals/jama/fullarticle/2762321
[36] https://www.theccc.org.uk/publication/uk-housing-fit-for-the-future/
[37] New Zealand saw a 21% fall in children's absence from school in areas where housing was improved

(https://www.dropbox.com/sh/tvc0ao7bxw2wx0m/AAC2NQhI-sEB-gw18lr90Tida?dl=0&preview=Ashden+Toolkit+launch+Bristol+PDF.pdf)

[38] http://www.gov.uk/government/statistics/sub-national-estimates-of-households-not-connected-to-the-gas-network

[39] https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/articles/thecostoflivingalone/2019-04-04?utm_source=govdelivery&utm_medium=email

[40] https://www.ons.gov.uk/economy/environmentalaccounts/articles/ukairpollutionremovalhowmuchpollutiondoesvegetationremoveinyourarea/2018-07-30?utm_source=govdelivery&utm_medium=email

[41] http://www.somersetintelligence.org.uk/fuel-poverty.html

[42] NHS planning guidance for 2020/21 includes:

- All organisations to consider signing up for a free Green Fleet Review.
- Ensure all fleet vehicles purchased or leased after 1 April 2020 support transition to low and ultra-low emission.
- Ensure that car leasing schemes restrict availability of high-emission vehicles.
- End business travel reimbursement for any domestic flights within England, Wales and Scotland.
- Move to purchasing 100% renewable electricity by April 2021.
- Providers replace lighting with LED alternatives during routine maintenance.
- All NHS organisation to ensure new build and refurbishment projects are delivered to net zero carbon standards.
- Reduce single use plastics in the NHS by signing up to and delivering the NHS Plastics Pledge.
- Reduce carbon impact of Metered Dose Inhalers by:
    - increasing inhaler prescriptions that are for Dry Powder inhalers where clinically appropriate;
    - reducing overall carbon impact of all inhalers; and
    - encourage patients to return spent devices.
- Appropriately reducing the proportion of desflurane to sevoflurane used in surgery to less than 20% by volume.
- Systems and providers to assess the potential to reduce unnecessary emissions of nitrous oxide.

See also:

- Video from Barts Health NHS trust https://www.bartshealth.nhs.uk/sustainability;
- Reducing the carbon footprint of hospital-based care https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6465872/ ;

- NHS Sustainable Development Unit tool for quantifying impact: https://www.sduhealth.org.uk/delivery/measure/health-outcomes-travel-tool.aspx
- Case study here of a community trust saving 1/3 on mileage in a year: https://www.sduhealth.org.uk/documents/case_study/Sussex%20community%20-%20travel%20-%20designed.pdf
- Cornwall community trust investment in electric vehicles: https://www.sduhealth.org.uk/resource/register.aspx?ResourceID=406&token=74429587-9085-4076-858e-bfa6e3006803

[43] A car using a battery will not produce hydrocarbons or carbon dioxide itself, but if the battery has been charged using energy from, say, coal, the global environmental impact may be same or greater than using petrol.
[44] Reduced fat in the diet, reducing 'fatbergs' that can block drains, may help reduce flooding.
[45] https://www.theguardian.com/society/2020/feb/25/celebrities-promoting-veganism-damages-farmers-mental-health-says-nfu-river-phoenix
[46] https://science.sciencemag.org/content/360/6392/987; graphic from https://www.bbc.co.uk/news/science-environment-46384067
[47] Compare the pleasure from finding a £5 note with the disappointment of losing £5. See Kahneman, D. *Thinking Fast and Slow,* 2011.
[48] https://implementationscience.biomedcentral.com/articles/10.1186/1748-5908-6-42
[49] https://www.bbc.co.uk/news/uk-politics-51453457
[50] https://nyc.streetsblog.org/2017/11/28/congestion-pricing-was-unpopular-in-stockholm-until-people-saw-it-in-action/
[51] https://www.theguardian.com/business/2020/mar/17/four-items-per-shopper-restrictions-at-uk-supermarkets-as-demand-soars
[52] Insee, https://www.lemonde.fr/sante/article/2020/06/12/coronavirus-la-mortalite-est-revenue-a-un-niveau-normal-en-mai-selon-l-insee_6042674_1651302.html?utm_medium=Social&utm_source=Twitter#Echobox=1591977043