AQUIND Limited

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Environmental Statement – Volume 3 – Appendix 28.3 Climate Resilience Baseline

The Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulation 5(2)(a)

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

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APPENDIX 28.3 CLIMATE RESILIENCE BASELINE

1.1. CURRENT CLIMATE

1.1.1.1. The Proposed Development in the south east of England which has a warm, dry climate, compared to UK average. Information on long term average observed climate variables over the period 1980 – 2010 is presented below. This information is taken from the UKCP09 report, The Climate of the United Kingdom and Observed Trends (Jenkins, Perry, & Prior, 2008) and the Met Office regional climate profile for Southern England (Met Office UK, 2017).

1.1.2. PRECIPITATION

1.1.2.1. Rainfall tends to be associated with Atlantic depressions (autumn and winter) or with convection (summer) (Met Office UK, 2017). Plate 1 shows the long-term average monthly rainfall for the South-East Region between 1981 and 2010. It shows that the region is considerably drier than most parts of the UK, with the lowest monthly rainfall in July and the highest in October. Rainfall is generally well-distributed throughout the year but with an autumn/early winter maximum that is more pronounced in counties bordering the English Channel.

1.1.2.2. The occurrence of snow is linked closely with temperature, with falls rarely occurring if the temperature is higher than 4 °C. For snow to lie for any length of time, the temperature normally has to be lower than this. Over most of the area, snowfall is normally confined to the months from November to April. Snow rarely lies outside the period from December to March. The Proposed Development is in the least snow-prone part of the region, with less than 10 days of lying snow per year (Met Office UK, 2017).

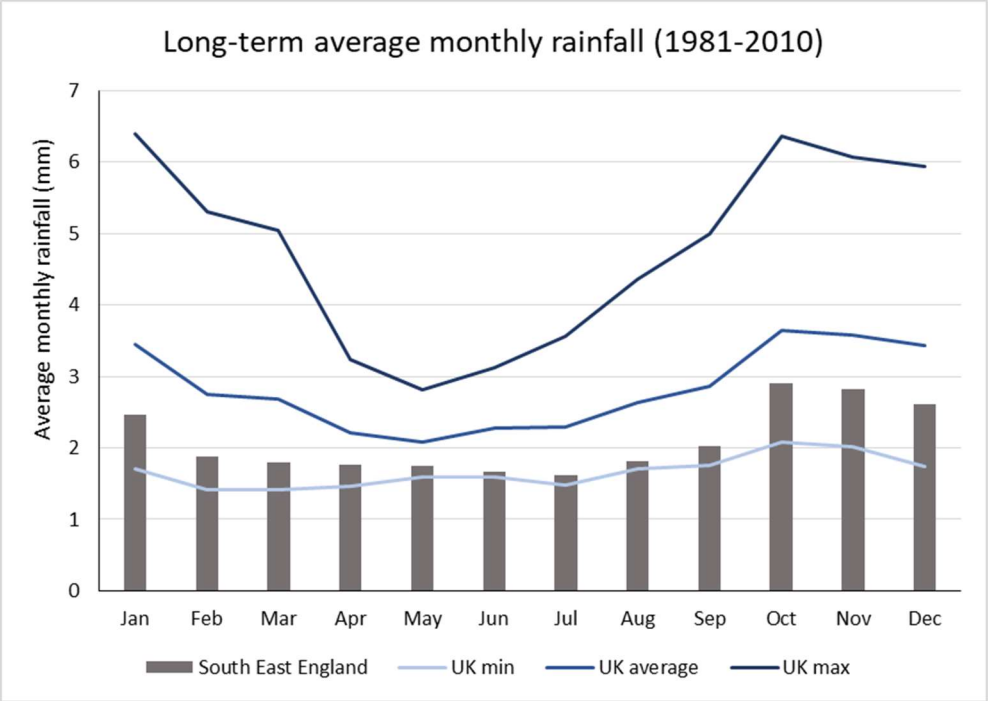

Plate 1 - Long Term Average Mean Monthly Rainfall

1.1.3. TEMPERATURE

1.1.3.1. Plate 2 shows the long-term average mean monthly temperature for the south-east region between 1981 and 2010. It shows that the region is warmer than the UK average, with July being the warmest month and February being the coldest month.

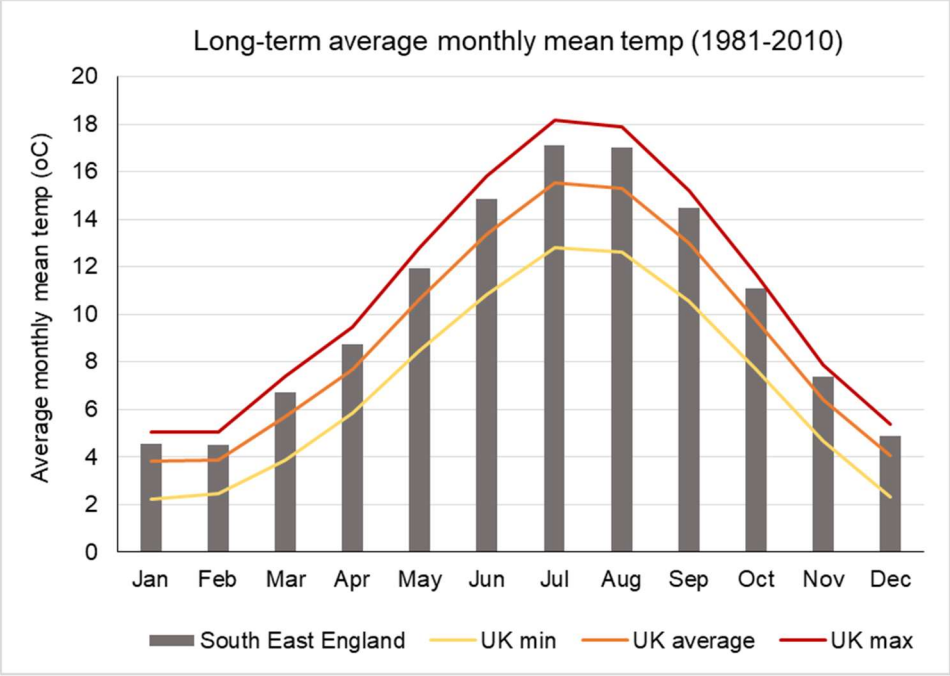

Plate 2 - Long Term Average Monthly Mean Temperature (1981-2010)

1.1.3.2. Extreme maximum temperatures can occur in July or August, and are usually associated with heat waves lasting several days. Examples include that of late June/early July 1976, when 35.6 °C was recorded at Southampton on 28 June. Heat waves are usually accompanied by warm nights, and notable examples include minimum temperatures of 23.9 °C at Brighton on 4 August 1990 (setting a UK record) and 23.2°C at Ventnor, Isle of Wight on 10 August 2003 (Met Office UK, 2017).

1.1.4. SUNSHINE

1.1.4.1. The number of hours of bright sunshine is controlled by the length of day and by cloudiness. In general, December is the dullest month and June the sunniest. Southern England includes the sunniest places in mainland UK: on the coast average annual sunshine durations can exceed 1800 hours (Met Office UK, 2017).

1.1.5. WIND

1.1.5.1. Southern England is one of the more sheltered parts of the UK, the windiest areas being in western and northern Britain, closer to the Atlantic. The strongest winds are associated with the passage of deep areas of low pressure close to or across the UK. The frequency and strength of these depressions is greatest in the winter half of the year, especially from December to February, and this is when mean speeds and gusts (short duration peak values) are strongest (Met Office UK, 2017). Plate 3 shows the long-term average monthly mean wind speed in the south-east region between 1981 and 2010.

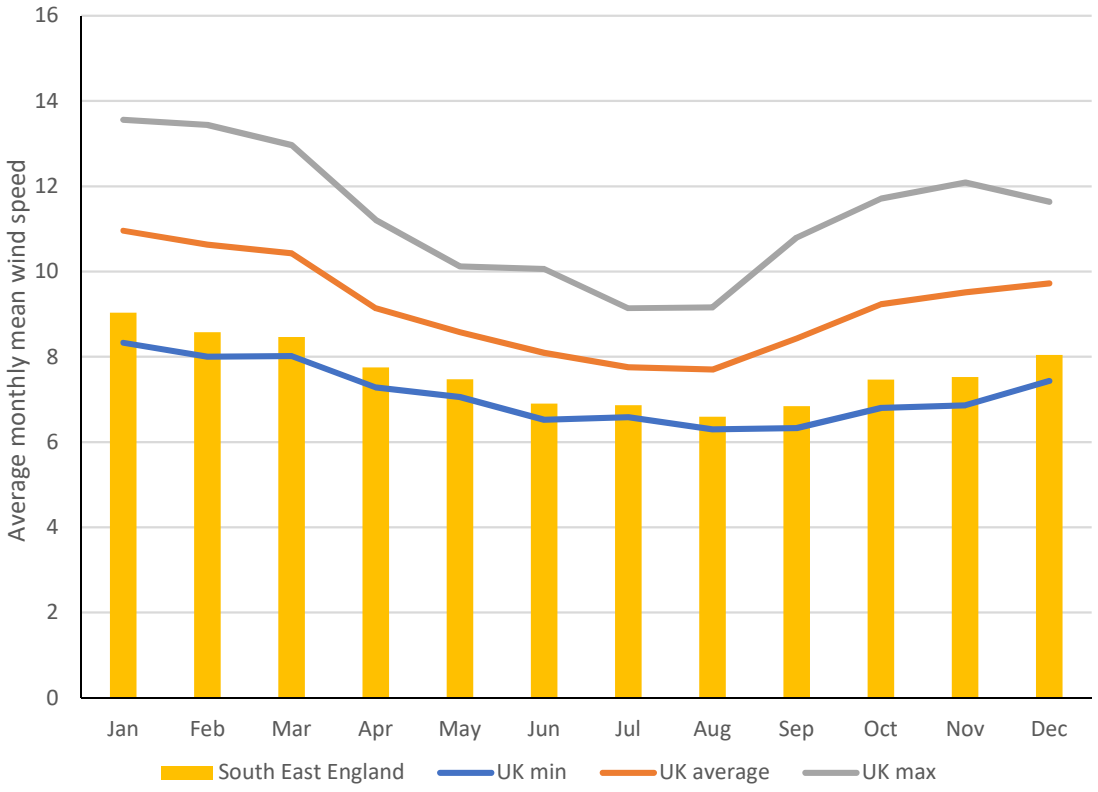

Plate 3 - Long Term Average Monthly Mean Wind Speed (1981 – 2010)

1.1.6. SEA

1.1.6.1. Sea level change is controlled by two main factors: eustatic (changes related to the expansion and contraction of sea water plus changes in the volume of water stored on land as ice sheets/glaciers) and isostatic (changes related to movement of the land in responses to the effect of glaciers on the Earth's crust). The mean sea level ('MSL') trend at Portsmouth between 1900 and 2010 was an increase of 1.21mm/year (+-0.27) (Haigh, Nicholls, & Wells, 2010).

1.2. PROJECTED CLIMATE

1.2.1.1. Information on projected climate is taken from the UK Climate Projections 2018 (UK Met Office, 2019) where available. The UK Climate Projections 2018 (UKCP18) are the most up-to-date projections of climate change for the UK. UKCP18 includes probabilistic projections of a range of climate variables for different emissions scenarios (Representative Concentration Pathways ('RCP's)) and for a range of timeslices to the end of the 21st Century. The probabilistic projections mean that rather than a single 'best-guess' of the impact of climate change they provide a range of outcomes based on an 'ensemble' of multiple climate model runs. This better represents the uncertainty of climate prediction science. To help demonstrate consideration of uncertainty inherent within climate modelling, projections for the 10th, 50th (central) and 90th percentiles are stated, where possible.

1.2.1.2. In this baseline section, the 10th, 50th and 90th percentiles are presented for the 2050s and 2080s high emissions scenario (RCP8.5). The 50th percentile is the 'central estimate' across the models and is considered the level for which as much evidence points to a lower outcome as a higher one. It is therefore taken as the median value of predicted change. The 10th and 90th percentiles reflect the lowest 10% and highest 10% of the model results - the value at which 10% of the model runs fall at or below (10th percentile) or at and above (90th percentile).

1.2.1.3. At the time of writing, not all UKCP18 data has been released, for example, projections for extreme precipitation were not available.

1.2.2. PRECIPITATION

1.2.2.1. Over land, UKCP18 projects that general trends of climate changes in the 21st century will be similar to the UKCP09 projections, with a move towards warmer, wetter winters and hotter, drier summers. However, natural variations mean that some cold winters, some dry winters, some cool summers and some wet summers will still occur. The projections generally show a pattern of larger increases in winter precipitation over southern and central England and some coastal regions towards the end of the century. Summer rainfall reductions tend to be largest in the south of England.

1.2.2.2. The projected changes to average summer (JJA) and winter (DJF) rainfall for the 2050s and 2080s are summarised in Table 1.

Table 1 - Projected change in mean summer and winter precipitation (%) for the 2050s and 2080s for the South East

Season/time slice		Percentile Change		
		10th	**50th**	**90th**
Summer	**2050s**	-48%	-22%	5%
	2080s	-69%	-36%	-1%
Winter	**2050s**	-5%	13%	34%
	2080s	-3%	25%	58%

1.2.2.3. Table 1 presents the percentile changes for the range of precipitation predicted. The 10th and 90th percentile provide the lower and upper estimates of precipitation change. For example, for the summer in the 2050s, precipitation is very unlikely to decrease by 48% or increase by 5%.

1.2.2.4. For the summer, by the 2080s in the South-East region, mean summer precipitation is expected to decrease by up to 36% (50th percentile) under RCP8.5. Plate 4 and Plate 5 show changes in mean summer precipitation for the 2050s and 2080s under RCP8.5.

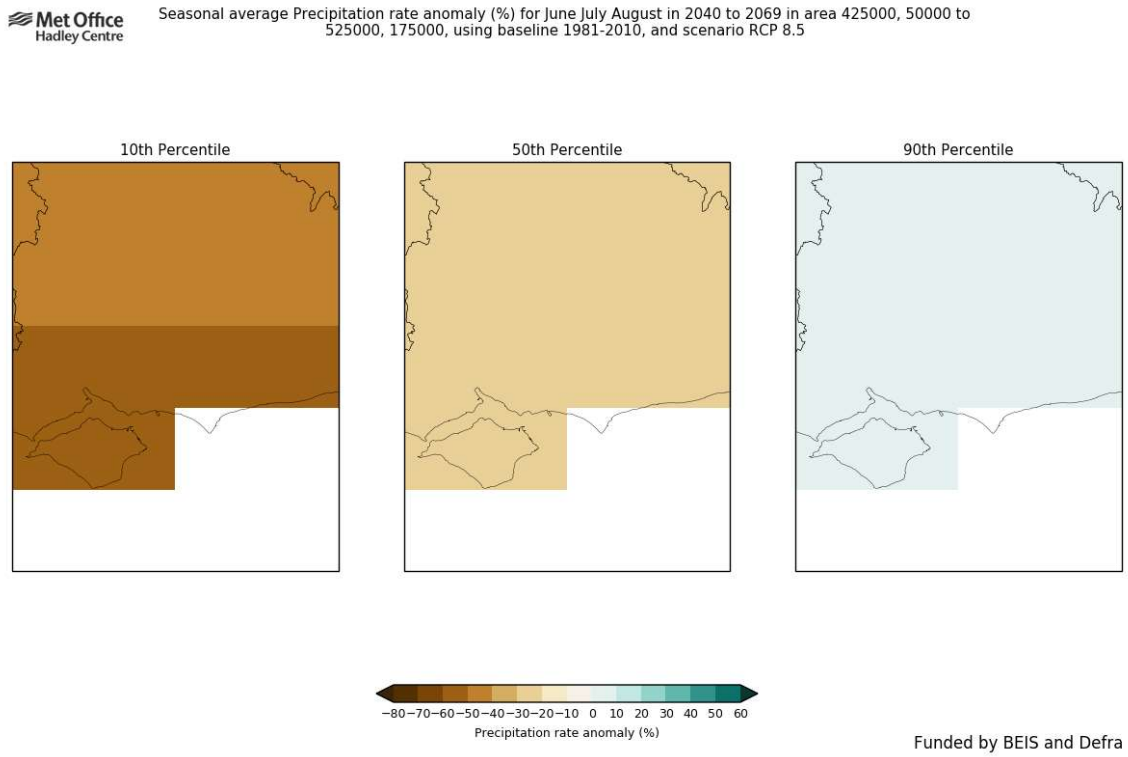

Plate 4 - UKCP18 projections for changes in summer precipitation for the 2050s under RCP8.5

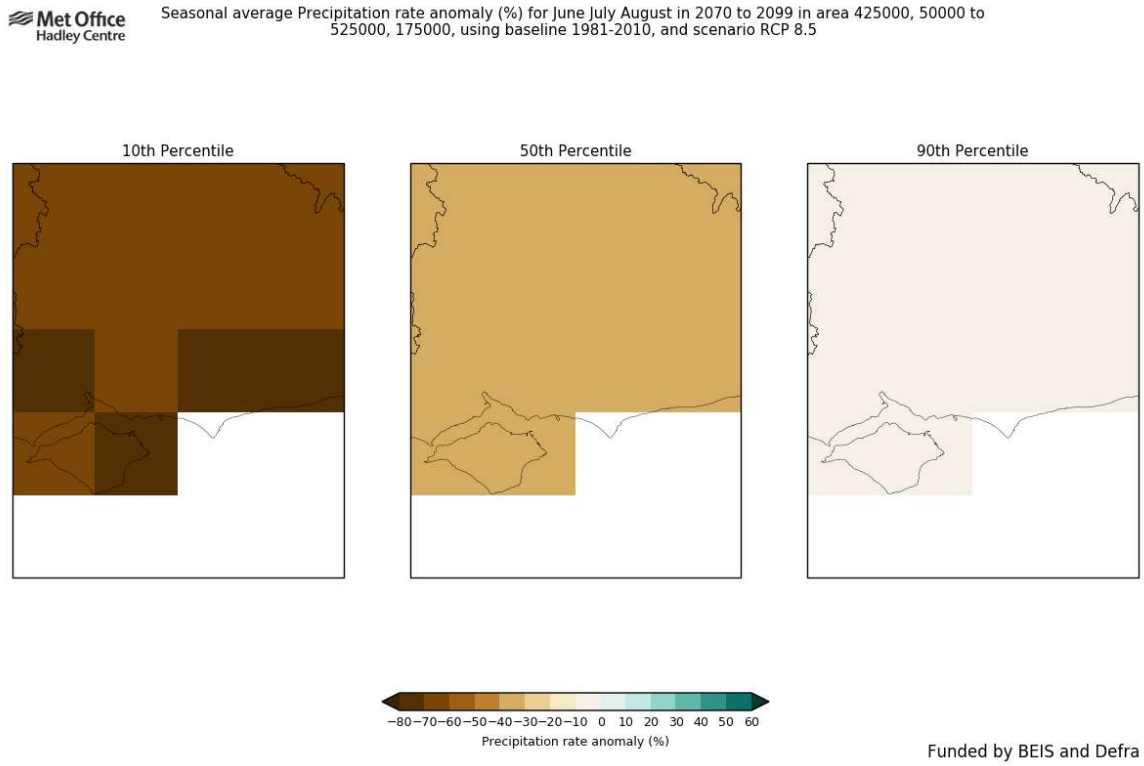

Plate 5 - UKCP18 projections for changes in summer precipitation for the 2080s under RCP8.5

1.2.2.5. UKCP18 suggests that by the 2080s in the South-East region, mean winter precipitation is expected to increase by up to 25% (50th percentile) under RCP8.5. Plate 6 and Plate 7 shows changes in mean winter precipitation for the 2050s and 2080s under RCP8.5.

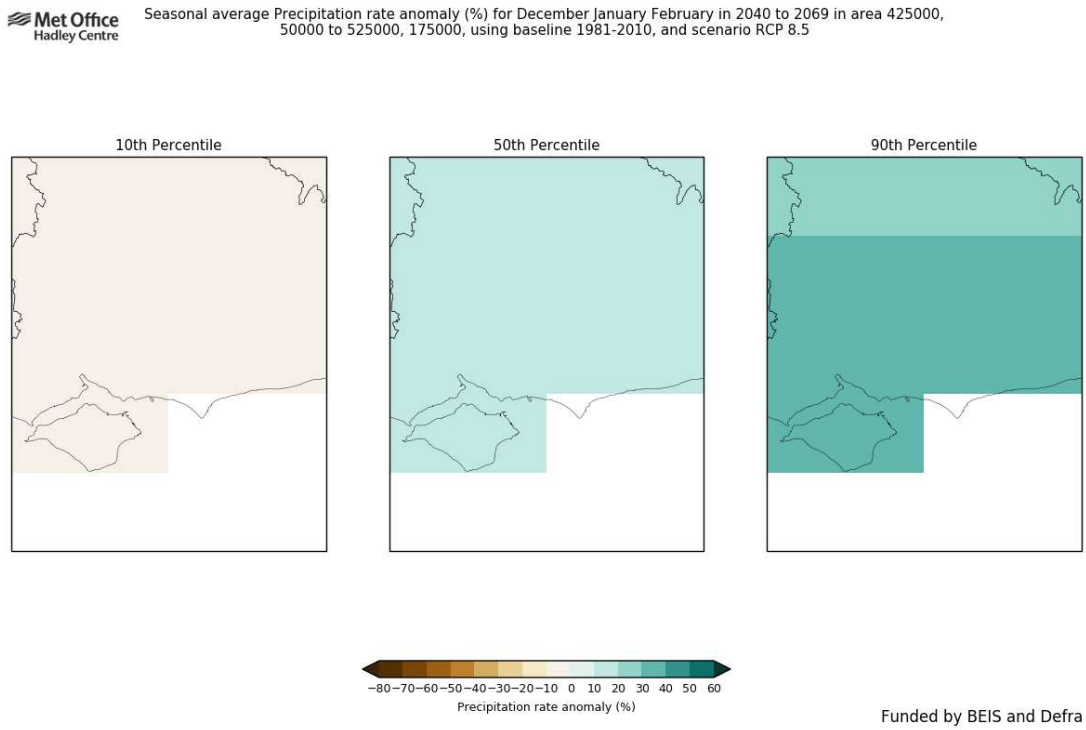

Plate 6 - UKCP18 projections for changes in winter precipitation for the 2050s under RCP8.5

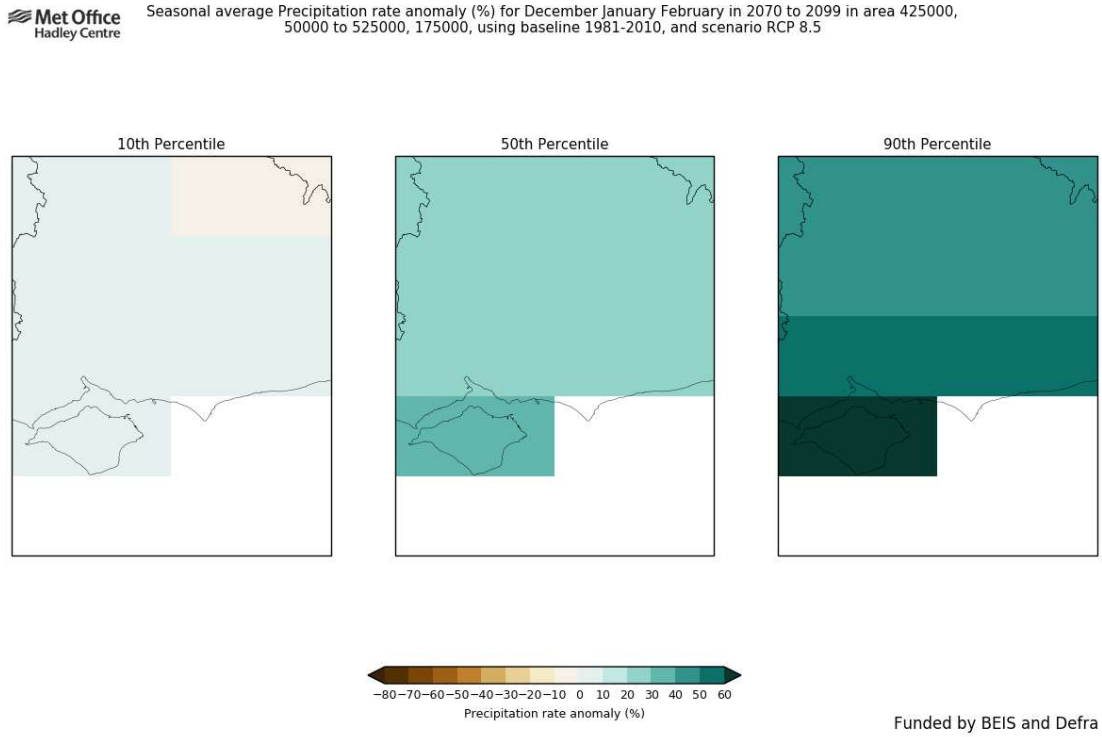

Plate 7 - UKCP18 projections for changes in winter precipitation for the 2080s under RCP8.5

Extreme Precipitation

20.1.1 Climate change means that more rainfall will fall during 'intense' events, particularly in winter. UKCP18 indicates an increase in precipitation intensity on wet days in winter across the UK though decreases in summer rainfall intensity is more confined across central and southern UK. UKCP18 released projections for heavy daily precipitation events for the winter and summer at the local (2.2km) scale in September 2019 however the Met Office have detailed that further research is needed to establish the importance of known biases in the heaviest events for future projections.

20.1.2 Considering this, a high-level summary on precipitation extremes produced by the Met Office have been presented here rather than local UKCP18 projections for the scheme area.

20.1.3 Plate 8 shows the median response of the regional model set for changes in the intensity of extreme wet days at the 12km scale and for winter and summer.

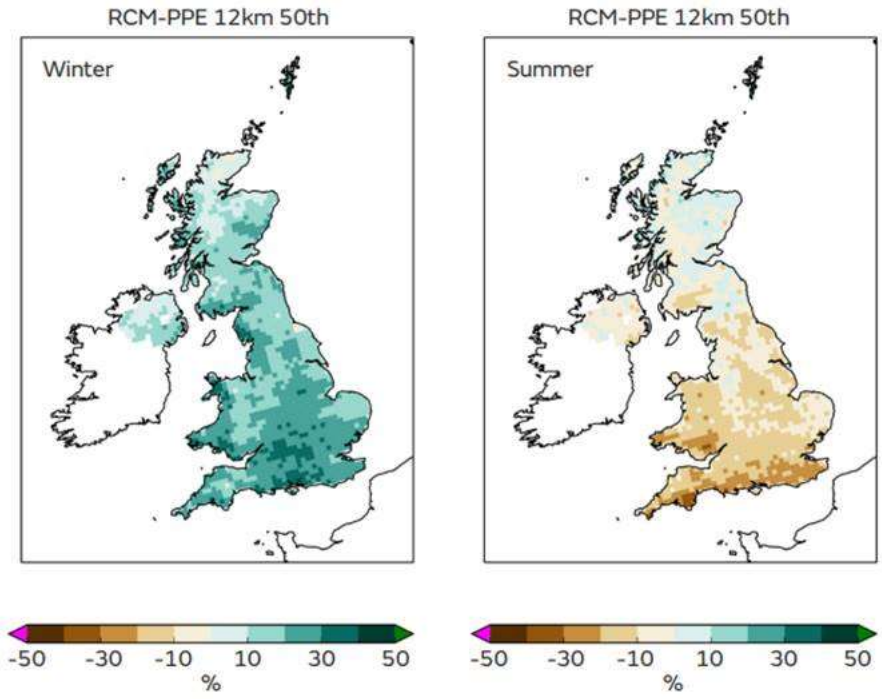

Plate 8 - Median estimate from the 12km model projections of the precipitation intensity of extreme seasonal wet days (%) in winter (left) and summer (right) between 2060-2080.

1.2.3. TEMPERATURE

1.2.3.1. Climate change is projected to lead to hotter summers and warmer winters. The probabilistic projections show that there is more warming in the summer than in the winter. Additionally, in summer there is a pronounced north-south contrast at the scale of the UK, with greater increases in maximum summer temperatures over the southern UK compared to northern Scotland.

1.2.3.2. Table 2 summarises the UKCP18 projections for changes in mean temperature from the baseline in the South East in the 2050s and 2080s under RCP 8.5.

Table 2 - Projected change in mean summer and winter temperature (°C) for the 2050s and 2080s

Season/time slice		Percentile Change		
		10th	50th	90th
Summer	**2050s**	1.1	2.5	4
	2080s	2.3	4.8	7.4
Winter	**2050s**	0.5	1.7	2.9
	2080s	1.2	3	5

1.2.3.3. Table 2 presents the percentile changes for the range of warming predicted. The 50th percentile (central estimate) is considered the level for which as much evidence points to a lower outcome as a higher one and is therefore taken as the median value of predicted change. The 10th and 90th percentile provide the lower and upper estimates of warming. For example, for the summer in the 2050s, temperature increase is very unlikely to be less than a 1.1 °C increase, or more than a 4 °C increase.

1.2.3.4. Mean summer and winter temperature predictions for the 2050s and 2080s for the region are presented in the Figures below.

1.2.3.5. For the summer, by the 2080s, mean summer temperature is expected to increase by between 4 and 5ºC (50th percentile) under RCP8.5. Plate 9 and Plate 10 summarise changes in mean summer temperature for the 2050s and 2080s under RCP8.5.

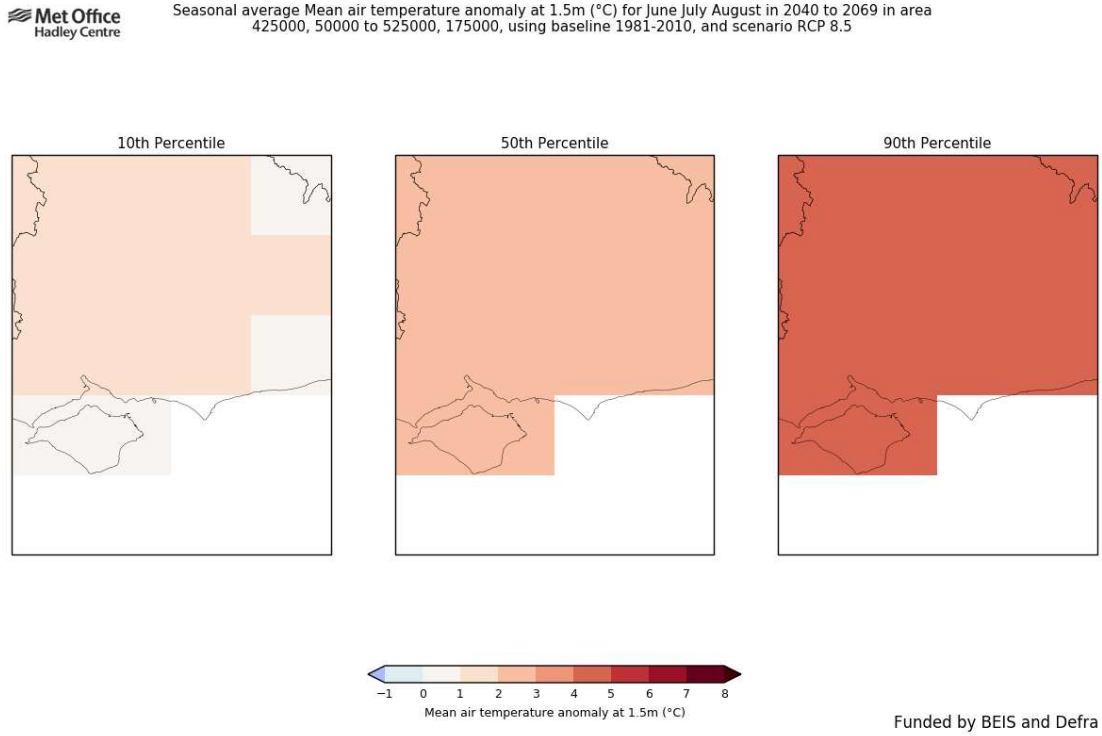

Plate 9 - UKCP18 projections of change in mean summer temperature for the 2050s under RCP8.5

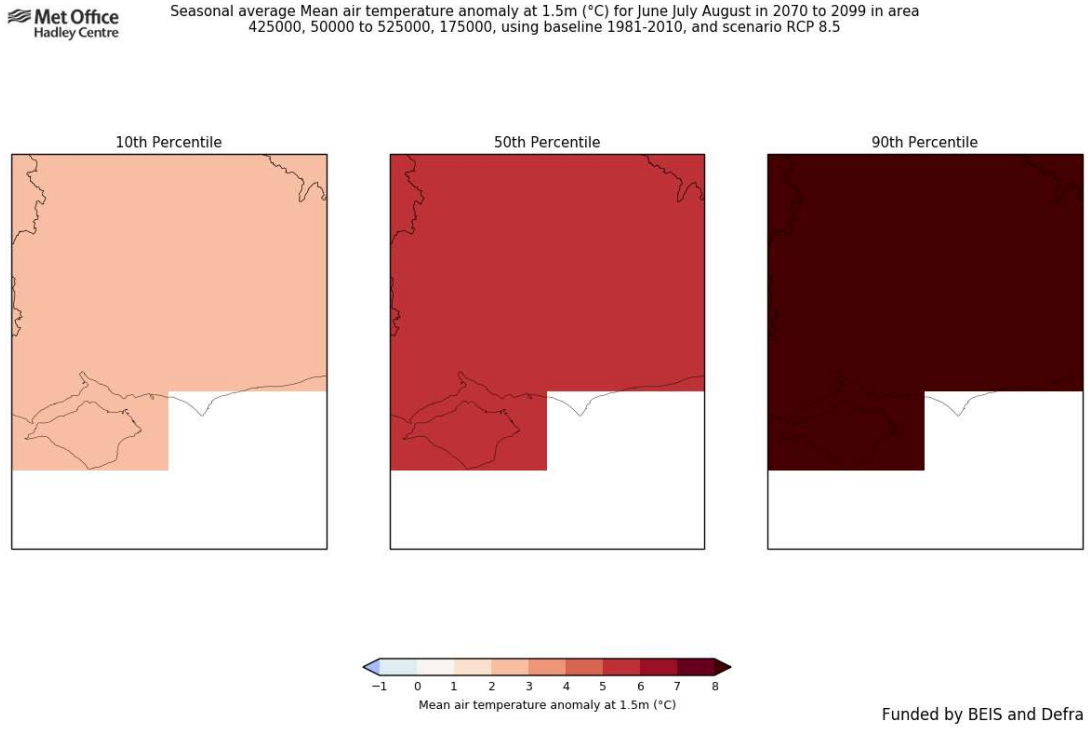

Plate 10 - UKCP18 projections of change in mean summer temperature for the 2080s under RCP8.5

1.2.3.6. UKCP18 suggests that by the 2080s, mean winter temperature in the region is expected to increase by between 2 and 3ºC (50th percentile) under RCP8.5. Plate 11 and Plate 12 summarise changes in mean winter temperature for the 2050s and 2080s under RCP8.5.

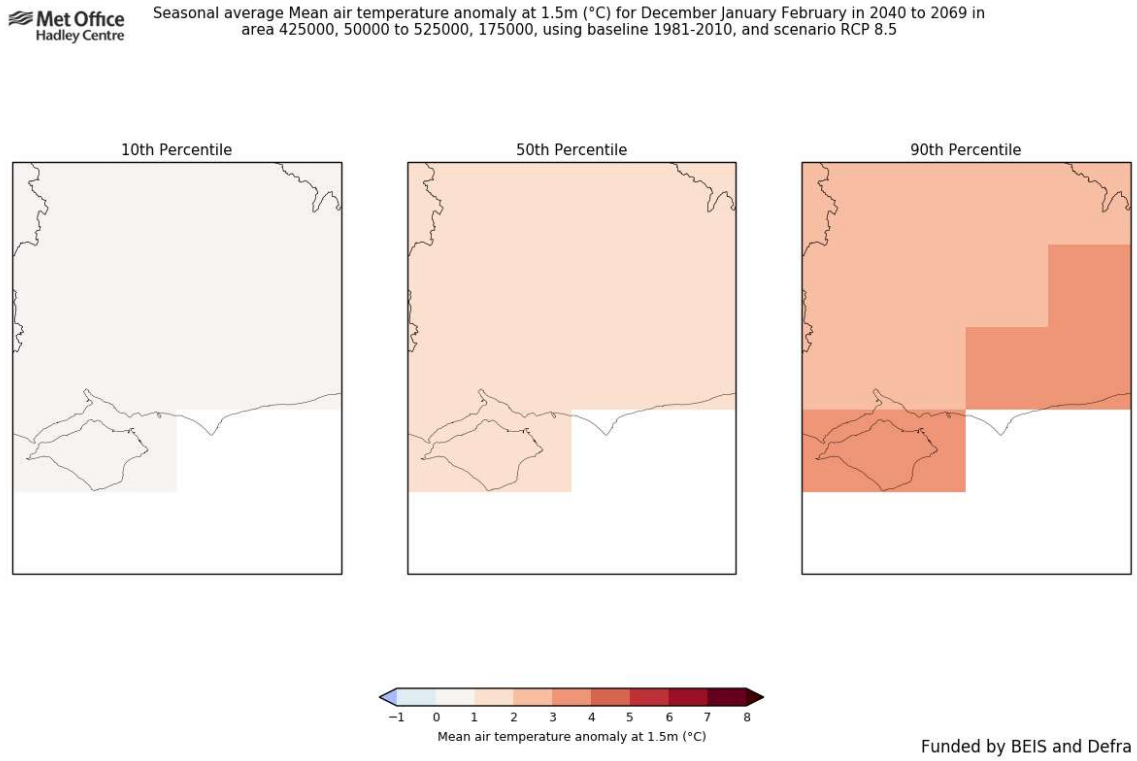

Plate 11 - UKCP18 projections of change in mean winter temperature for the 2050s under RCP8.5

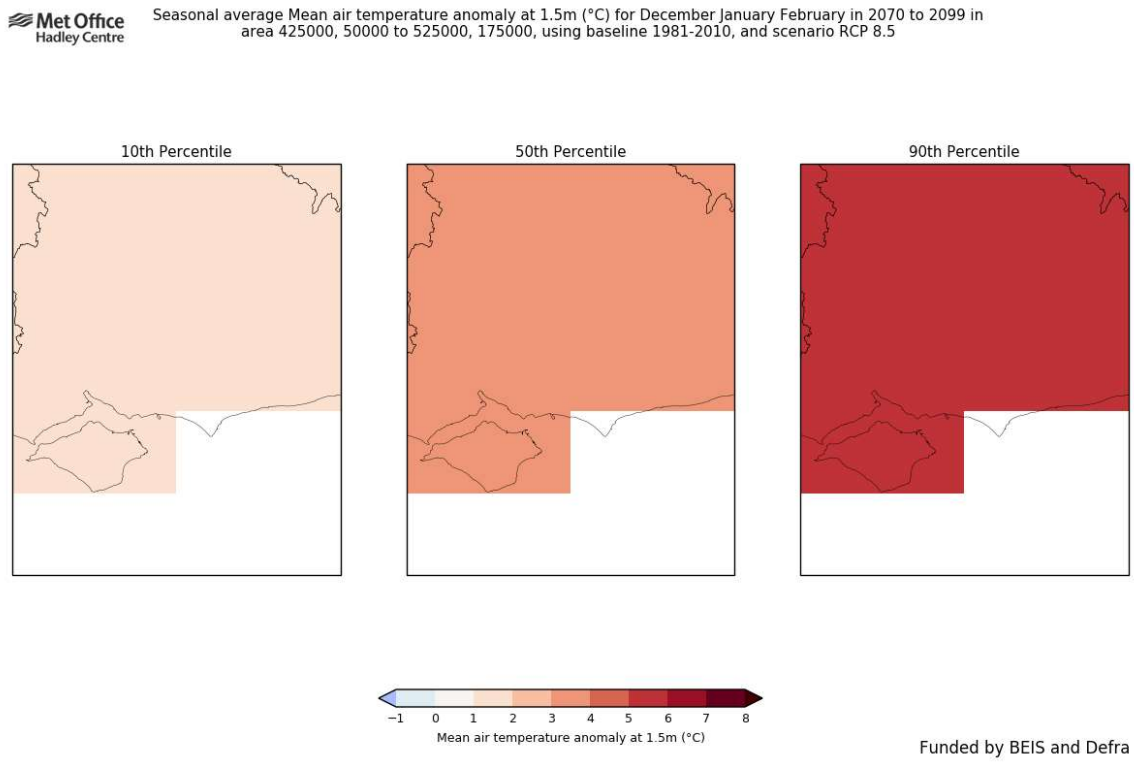

Plate 12 - UKCP18 projections of change in mean winter temperature for the 2080s under RCP8.5

Extreme Temperature

1.2.3.7. Table 3 summarises the UKCP18 projections for changes in maximum and minimum temperature for summer and winter in the 2050s and 2080s under the RCP 8.5. Note, the values below represent mean maximum and minimum temperature changes therefore, individual days may exceed these values.

Table 3 - Projected change in maximum and minimum mean summer and winter temperatures (°C) for the 2050s and 2080s under RCP 8.5

Season/time slice		Percentile Change					
		Maximum (^{0}C)			Minimum (^{0}C)		
		10TH	50TH	90TH	10TH	50TH	90TH
Summer	**2050s**	0.8	2.2	3.7	0.6	1.6	2.7
	2080s	2.1	4.5	7.1	1.5	3.3	5.4
Winter	**2050s**	0.6	1.6	2.7	0.3	1.5	3
	2080s	1.3	2.9	4.7	0.9	2.9	5.4

1.2.4. WIND

1.2.4.1. The UKCP18 projections show an increase in near surface wind speeds over the UK for the second half of the 21st century for the winter season when more significant impacts of wind are experienced. This is accompanied by an increase in frequency of winter storms over the UK.

1.2.4.2. There is large uncertainty in projected changes in circulation over the UK and natural climate variability contributes much of this uncertainty (Brown, Boorman, McDonald, & Murphy, 2012). It is therefore difficult to represent regional wind extreme winds and gusts within regional climate models (Brown, et al., 2008).

1.2.5. SEA

1.2.5.1. Global sea level has risen over the 20th century and will continue to rise over the coming centuries. Climate change is predicted to lead to a rise in sea level due to the impact of increased temperatures and rainfall.

1.2.5.2. The UKCP18 projections provide sea level rise predictions for the UK coastline. The section of coastline most relevant to this assessment for which predictions are available is presented in Plate 13.

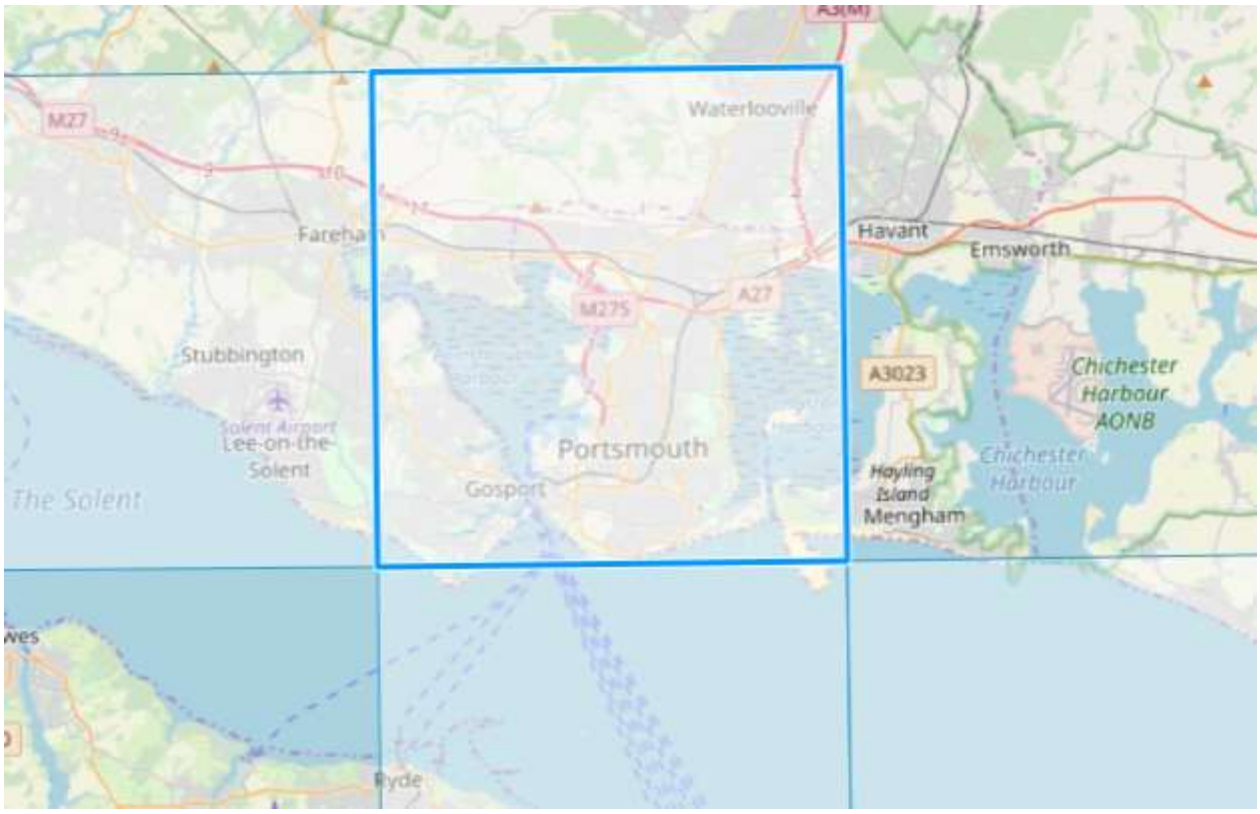

Plate 13 – UKCP18 sea level rise projections study area of relevance to proposed development

1.2.5.3. Table 4 presents the sea level change (m) within the area presented in Plate 13 for the 2050s and 2080s relative to 1981-2000 average for RCP8.5.

1.2.5.4. Whilst sea level rise over the coming centuries may affect tidal characteristics substantially (including tidal range), UKCP18 finds that the atmospheric contribution to storm surges is unlikely to change (UKCP18).

Table 4 - Predicted sea level change (m) within the scheme area relative to 1981-2000 average for RCP8.5

Year	Sea level rise (m)		
	10th	50th	90th
2050	0.22	0.29	0.36
2080	0.42	0.56	0.73

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