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Inundation scenarios in a changing climate: assessing potential impacts of sea-level rise on the coast of South-East England

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Front cover image: Coastal flooding near the town of Selsey, on the Manhood Peninsula, in southern England. Credit: UK Environment Agency/Andrew Breiner

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Master thesis, 30 credits, in Geographical Information Science

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Abstract

The aim of this study was to explore sea-level rise (SLR) exposure in South-East England by conducting a broad analysis of some of the possible impacts of inundation in the region under different SLR scenarios in a warming climate. The potential effects of coastal inundation were mapped and quantified by applying a modified bathtub modelling approach in GIS to a low-elevation coastal Digital Terrain Model (DTM) derived from up-to-date, high-resolution, high-accuracy LiDAR data. Mapping of areas susceptible to inundation was referenced to the Mean High Water (MHW) tide line, with all land situated below each water level assessed, and connected to the sea, being counted as submerged. The inundation modelling was performed for three projected scenarios, with SLR magnitudes of 1m, 3m and 5m. Based on these models, future SLR inundation was estimated to have varied possible consequences on the land, transport infrastructure, built-up, agricultural land, woodland, protected areas, landmarks and population, in the absence of adaptation. As first estimates of some of the possible consequences of SLR-induced inundation in the region, the findings should be taken as reasonable guesses and as first steps towards future investigations. SLR is a long-term threat which will continue through the 21st century and beyond, therefore a timely and ongoing adaptation response from policy-makers is vital for building resilient and sustainable coastal communities.

Keywords: Geography, GIS, Climate Change, Sea-Level Rise, Coastal Inundation, LiDAR, South-East England

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List of abbreviations

AONB	Area of Outstanding Natural Beauty
AR5	Fifth Assessment Report of the IPCC
BNG	British National Grid
BUA	Built-Up Area
DEM	Digital Elevation Model
DSM	Digital Surface Model
DTM	Digital Terrain Model
GIS	Geographic Information System
HAT	Highest Astronomical Tide
IDW	Inverse Distance Weighted
IPCC	Intergovernmental Panel on Climate Change
LiDAR	Light Detection And Ranging
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MLW	Mean Low Water
MSL	Mean Sea Level
NDA	Nuclear Decommissioning Authority
NOAA	National Oceanic and Atmospheric Administration
ODN	Ordnance Datum Newlyn
ONS	Office for National Statistics
OS	Ordnance Survey
RCP	Representative Concentration Pathway
SLR	Sea-Level Rise
SRTM	Shuttle Radar Topography Mission
UKCP09	United Kingdom Climate Projections 2009

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1. INTRODUCTION

Entire island nations and coastal communities are in danger to become completely submerged due to anthropogenic climate change (Nicholls 2011), a major global problem with underlying causes that are all too often brushed aside as too inconvenient to deal with, but with implications for society that are impossible to ignore. While the gentle oscillations in sea levels throughout geological history have occurred due to natural causes (Gornitz 2005), Anthropocenic[1] sea-level rise (SLR) is principally a human-induced fact. Abiding to the immutable law of cause and effect, this largely climate-driven phenomenon is expected to have profound consequences on coastal populations, economies and ecosystems in the 21st century and beyond.

Despite the certitude and inevitability of SLR, the slow onset of this coastal hazard means that its effects are often understudied. Although various predictions of future SLR have been made at both global and regional level, the assessment of its impacts on coastal areas is still incomplete. Given the considerable length of the world's coastlines, nearly all of which are expected to be affected to some extent by the global rise in sea level (Cazenave and Cozannet 2014), and towards which the global population gravitates with a density on average two to three times higher than further inland (Brown et al. 2013), insufficient analyses focus on exposure (i.e. potential impacts) at the sub-national and local level. While, in previous years, the lack of accurate elevation data may have impeded the impact assessment of forecasted rise in sea level, its availability is no longer a concern in several countries.

The United Kingdom (UK), an island nation, is thought to be the second most exposed country in Europe to coastal impacts caused by the rise in sea level (Strauss et al. 2015). Despite attempts, limited by uncertainties, to make predictions of future sea levels around the UK coastline, which are updated every few years as the global scientific understanding registers progress (Hulme et al. 2002; Lowe et al. 2009), there is little locally-relevant information available about what is at risk of being indefinitely lost, and which would help coastal planners and residents to better understand and visualise what the future territory of Great Britain could be reduced to in the absence of adaptation.

South-East England is one of the most exposed regions in Britain to the SLR-induced inundation due to its lower elevation and larger population. Most attention to sea-levels so far has been concentrated on East England (Mokrech et al. 2008; Randon et al. 2008), mainly due to past flood events, while the South-East has received much less attention (Haigh et al. 2011). This study aims to assess potential SLR impacts on the land, population, infrastructure, protected areas and landmarks of the South-East, under different inundation scenarios in a warming climate, using up-to-date, accurate, bare earth elevation data.

[1] The "Anthropocene" is a concept used to refer to the era in which humans have contributed to global climate change (Crutzen and Stoermer 2000).

1.1. Sea-level rise

Prior to presenting the objectives of the study, this introductory section briefly describes the causes and the impacts of SLR, explains the difference between global sea level and local sea level, between absolute sea level change and relative sea level change, provides an overview of past trends and future projections, and, finally, focuses on sea-level changes around the British coastline.

1.1.1. Causes of global sea-level rise

A response to the warming of the Earth's average surface temperature, influenced by the surging level of atmospheric carbon dioxide, which is largely caused by the ever-increasing use of fossil fuels, deforestation and agricultural practices (Ballard 2014), the global rise in sea level is driven by two main mechanisms: (1) the thermal expansion of the ocean water, which is warmed initially at the surface and over centuries at depth, and (2) the melting of ice sheets and glaciers, which lose mass due to higher temperatures and/or insufficient precipitation (Gornitz 2005; Church and White 2011; Church et al. 2013; Cazenave and Cozannet 2014; Hansen et al. 2016). It should be noted that the latter refers to grounded ice only, specifically the land-based ice sheets of Greenland and Antarctica, and that the melting of Arctic ice and ice shelves which are already floating on the ocean does not directly contribute to SLR[1].

A third, although minor, contributor to the rise in sea level is the change in land water storage, which is largely caused by anthropogenic activities, such as groundwater mining, irrigation and deforestation (Brown et al. 2013; Church et al. 2013; Wada et al. 2017).

1.1.2. Past global sea-level rise

A subject of growing interest in the scientific community, and not only, sea-level changes have been measured for more than a century using *in situ* tide gauges and in recent decades also from space using satellite laser altimeters (Cazenave and Cozannet 2014). These measurements have been used to estimate the average level of the surface of the Earth's oceans, known as the global Mean Sea Level (MSL). It has thus been identified an increase in sea level, with a "significant acceleration" since 1880 and especially since 1900, although with "considerable variability" in the pace of rise (Church and White 2011). Throughout most of the 20th century, global MSL rose with 1.7 mm/year on average, however, since the early 1990s, this pace nearly doubled, reaching approximately 3.2 mm/year (Cazenave and Cozannet 2014; Watson et al. 2015). This coincided with an acceleration in the melting of ice sheets (Chen et al. 2006; Rignot et al. 2011) and glaciers (Meier et al. 2007).

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[1] Although the melting of sea ice does have an indirect contribution, since in the absence of bright surfaces with a high albedo, such as snow and ice, more sunlight is absorbed by the Earth, instead of being reflected back into space. This reduction in surface reflectivity accelerates warming, thus contributing to the melting of land ice.

1.1.3. Future global sea-level rise

Projections of future SLR vary widely due to several factors, including different carbon pathways and ice sheet dynamics. Nonetheless, two main ideas surface from literature: (1) how much the sea level will rise depends mainly on the rate of future greenhouse gas emissions, and (2) how fast it will rise is largely subject to the rate of ice sheet and glacier melting.

Global MSL is set to continue to rise due to the increase in global temperature, which is likely to get between 2°C and 4°C higher by the end of the 21st century than in pre-industrial times based on the likely range of possible outcomes from the climate negotiations at COP21 in Paris (UNFCCC 2015). Limiting global warming to 2°C – and, by extension, SLR – could only be achieved if the world's heavy reliance on fossil fuels (coal, oil and gas), which represent the greatest source of humanity's carbon emissions, was reduced as rapidly as possible (Hansen et al. 2016).

Set temperature increases have been equated with post-2100 sea levels that could be "locked-in" or "committed" (meaning rendered inevitable to take place someday, with long-term effects) this century. For each sustained 1°C increase in the mean global temperature, an average rise of roughly 2.3 metres is expected within the next 2000 years (Levermann et al. 2013). Global analysis from Climate Central (Strauss et al. 2015) determines values of SLR for four warming amounts: 1.5°C, 2°C, 3°C, and 4°C (**Table 1**). Warming of 1.5°C, which is the preferred goal of many low-lying island nations, would correspond to a median of 2.9 metres of committed global SLR. If the world remains 2°C warmer than in pre-industrial times, which is a long-standing international target (UNFCCC 2010), a median of 4.7 metres of global sea level could be locked-in. Warming of 3°C, which would be the result of the current sum of intended "nationally determined contributions" to reducing emissions, would correspond to a median of 6.4 metres of committed global SLR. Warming of 4°C, which is closer to our current path of carbon emissions, would cause a median of 8.9 metres of global SLR to be locked-in someday. Over longer timeframes, the sea may rise even higher (Winkelmann et al. 2015).

It is also possible to associate fixed levels of locked-in SLR with carbon pathways (**Table 2**). In its fifth Assessment Report (AR5), the Intergovernmental Panel on Climate Change

Table 1. Locked-in global SLR for different warming levels (shaded column indicates the 66% confidence interval) (Source: Strauss et al. 2015)

Warming (°C)	Locked-in SLR (metres)	
1.5	2.9	1.6 – 4.2
2	4.7	3.0 – 6.3
3	6.4	4.7 – 8.2
4	8.9	6.9 – 10.8

Table 2. Locked-in global SLR for different carbon pathways (Source: Strauss et al. 2015)

Carbon pathway		Carbon pollution (GtC)	Warming (°C)	Locked-in SLR	
				(metres)	(feet)
RCP 8.5	Unchecked pollution	2,430	3.3	7.1	23.3
RCP 6.0	Minor carbon cuts	1,678	2.3	5.0	16.4
RCP 4.5	Moderate carbon cuts	1,266	1.7	2.6	11.8
RCP 2.6	Extreme carbon cuts	840	1.1	2.4	7.9
Historical scenario (end of 2015)		560	0.7	1.6	5.2

(IPCC 2014) adopted four *Representative Concentration Pathways* (RCPs) which describe four possible climate futures derived from four greenhouse gas concentration trajectories. The scenarios are based on possible radiative forcing[1] values of +2.6, +4.5, +6.0, and +8.5 Watts per square metre in the year 2100 relative to pre-industrial values, which is why the RCPs are named RCP2.6, RCP4.5, RCP6, and RCP8.5, respectively. SLR estimates for each of these pathways have been suggested by Climate Central analysis, which assumes no carbon pollution after 2100 (Strauss et al. 2015). For instance, RCP 4.5, the pathway of moderate carbon cuts, which implies 1,266 gigatonnes of carbon (GtC) by 2100 and 1.7 °C of warming (Clarke et al. 2007), is associated with a commitment to an SLR of 2.6 metres. Under RCP 6.0, the pathway of minor carbon cuts, with 1,678 GtC in total carbon pollution by 2100 and 2.3 °C of warming (Hijioka et al. 2008), a global SLR of 5 metres would be locked in. The study also indicates that, no matter what carbon pathway we were currently on, a global SLR of roughly 1.6 metres is now inevitable, based on the estimation that at the end of 2015 the amount of carbon in the atmosphere reached 560 GtC, matching to 0.7 °C of warming.

Most uncertainty surrounds the pace of future rises, with projections ranging from sooner than 200 years from now (Kopp et al. 2014) to 2000 years (Levermann et al. 2013). This uncertainty is primarily related to the potential loss of ice from the Greenland and West Antarctic ice sheets, which, if completely melted, could elevate the sea level with roughly 7 metres and, respectively, 5 metres, and which are more unstable than the large East Antarctic ice sheet, which holds roughly 56 metres of SLR equivalent (Church et al. 2001; Bamber et al. 2009; Cazenave and Cozannet 2014). By comparison, the ice contained in mountain glaciers, which are highly sensitive to global warming, corresponds to only 0.4 metres of global sea level (Church et al. 2001; Ice2Sea 2013).

The only certainty is that the global MSL will continue to rise for centuries to come,

[1] Radiative forcing is the difference between sunlight absorbed by the Earth and energy radiated back into space, being used as a measure of atmospheric energy changes caused by greenhouse gas emissions. Positive radiative forcing produces warming, while negative radiative forcing generates cooling.

according to the IPCC (2014), whose latest climate change publication, AR5, draws conclusions with equal or greater confidence than previous reports. In other words, the upward trend in sea level will continue long after greenhouse gas concentrations in the atmosphere have been stabilised, until warming of the oceans reaches equilibrium (Gornitz 2005). The time lag between an observed temperature rise and the oceans' thermal response is referred to as "the commitment to SLR" (Anthoff et al. 2010; Brown et al. 2013; Levermann et al. 2013).

Over the 21st century, it is considered very likely that the global rise in sea level will occur at a higher rate than during the late 20th century (Cazenave et al. 2014). IPCC projections for 2100 estimate that the rise is *likely* to be in the range 0.28–0.61 (with a central value of 0.44) metres for a low emissions scenario (RCP2.6), and 0.52–0.98 (with a central value of 0.74) metres for a high emissions scenario (RCP8.5) (Church et al. 2013). However, the probability of staying within these ranges is estimated to be at only 67%. Hinkel et al. (2015) warn that the IPCC scenarios are not necessarily appropriate for the management of high-risk coastal areas since they exclude the potential for rapid SLRs (over 1 metre per century), those from the upper tail end of the distribution. Moreover, it has been previously demonstrated that past IPCC reports underestimated 21st century sea-level projections (Rahmstorf et al. 2012). IPCC numbers have often been considered too conservative, because they do not consider a possible acceleration of ice sheet melt (Weissenberger and Chouinard 2015; Hansen et al. 2016). Hansen et.al. (2016) argue that the rate of SLR is not linear but exponential, suggesting, based on paleo-evidence, that a rise of up to 5 metres in a century is possible even at 2°C of global warming. Even the IPCC admits a lack of knowledge about ice sheet behaviour, hence the 0.98-metre value should not be considered a worst-case upper limit. Higher rises are possible, nevertheless they are associated with more uncertainty.

1.1.4. Relative sea-level rise

Local sea-level changes can differ significantly from global SLR. The elevation in sea-level is not spread evenly across the world's oceans, as revealed by satellite altimetry (Church and White 2011). While space-based altimeters measure *absolute* (or eustatic) sea-level changes, as driven by global climate warming, land-bound tide gauges reflect *relative* sea-level changes, which are specific to each location on Earth (Gornitz 2005; Cazenave and Cozannet 2014; Cipollini et al. 2017).

Regional and local sea-level oscillations are influenced by several factors: (1) ocean circulation, temperature and salinity fluctuations, (2) perturbations in the Earth's gravitational field as the polar ice sheets lose mass (known as static-equilibrium effects), and (3) vertical land motions caused by uplift or subsidence of the land due to post-glacial rebound (also known as glacial isostatic adjustment)[1], tectonic and volcanic activity, groundwater withdrawal, oil and gas extraction, and natural sediment compaction and transport (Brown et al. 2013; Church et al. 2013; Ice2Sea 2013; Cazenave and Cozannet 2014; Kopp et al. 2014; Weissenberger and Chouinard 2015).

These factors may trigger local and regional sea-level variations of tens of centimetres from the global mean. European coastlines, for instance, are expected to experience a rise in sea level with 10% to 20% lower than the global average (Ice2Sea 2013). Localised impact assessments are, therefore, essential. Since it takes into account vertical land movement as measured by tide gauges, it is the relative SLR that is of interest when studying coastal impacts.

1.1.5. Impacts of sea-level rise

While the exact pace and amount of future SLR at different points on the planet is still open to question, there is one certainty: SLR will have varied consequences on human populations, social and economic infrastructures, as well as ecosystems in coastal areas (Nicholls 2011). The elevation in sea level is expected to have multiple effects around the world: to cause inundation, to exacerbate extreme marine flooding, to intensify coastal erosion, and to increase saltwater intrusion into coastal aquifers (Brown et al. 2013; Cazenave and Cozannet 2014). Each of these consequences may pose serious problems to coastal communities and each are complex enough to constitute the topic of individual research.

It is important to distinguish coastal *flooding* from *inundation*. Small but imminent rises in sea level are expected to amplify the frequency of coastal flood events, by providing a higher starting point for storm surges and storm tides (Church et al. 2013; Muis et al. 2016). A storm surge is a short-term, higher-than-predicted rise in sea level caused by low atmospheric pressure, strong winds and waves, and which, combined with the highest tides, may give rise to extreme sea levels, potentially with devastating impacts (Haigh et al. 2011; Muis et al. 2016). The term “flooding” is commonly used when dry areas become wet temporarily, typically due to severe storms, while “inundation” is used to describe the gradual process of a low-lying dry area being permanently submerged, as it is happening in the context of SLR (Flick et al. 2012).

Coastal inundation is the most obvious consequence of SLR and the focus of this study. Through inundation, SLR could have many, direct, negative impacts on coastal

[1] During the last ice age, around 20,000 years ago, massive ice sheets covered much of the Northern Hemisphere. Under the burden of several kilometre thick ice, the Earth’s crust sank, while the displacement of mantle material led to a rise of the crust around the ice sheet periphery. Although the ice melted a long time ago, allowing the crust to rebound, the vertical movement of land still continues today (Ice2Sea 2013).

communities, for instance, submerging coastal infrastructure, built environment, agricultural land, and displacing people (Nicholls 2011). Moreover, in the natural world, rising seas would exert stress on coastal ecosystems that provide not only protection from storms and recreation for people, but also habitat for wildlife.

In order to adapt to the potential impacts of future SLR, the inundation extents under various SLR scenarios and the associated impacts on infrastructure, population, and ecosystems must be quantified. Having detailed information can help decision-makers to avoid potential socio-economic and environmental problems caused by this coastal hazard. The information derived from studies on local SLR can serve as a basis for planning the necessary adaptation efforts.

1.1.6. Sea-level trends around the British coastline

Rising tides threaten the British coastline. Sea levels around the UK have risen by approximately 1 mm/year over the 20th century (DEFRA 2009). The most recent climate projections for the UK (UKCP09) predict absolute SLR in the range 0.12–0.76 metres, with a low probability upper limit projection in the range 0.93–1.90 metres, by 2100 (Lowe et al. 2009). These estimates are based on previous IPCC projections, published in the Fourth Assessment Report a decade ago, and have not yet been revised upwards.

In certain parts of Great Britain, the rise in the sea relative to land will be exacerbated due to subsidence. Sea levels around South-East England could be with roughly 5 centimetres higher by 2100 than the global average, if we consider a land subsidence of 3 centimetres over the 21st century, based on local subsidence rates indicated by Shennan et al. (2009), plus an absolute SLR in the region with 2 centimetres higher than the global average, based on central estimates by Lowe et al. (2009).

Due to the uncertainty of SLR predictions, it is important for coastal communities to be prepared for different scenarios. Although coastal defence structures protect about one third of the English and Welsh coastlines from floods (de la Vega-Leinert and Nicholls 2008), they may be insufficient in the context of high sea-level rises. In light of this, there is evidently a need for a high-resolution assessment of potential SLR impacts.

1.2. Study objectives

This study focused on the possible consequences of inundation under different SLR scenarios, aiming to paint a picture of what could be lost for the foreseeable future, should no adaptation measures be implemented. The inventory of elements that could potentially be impacted by a hazard such as SLR is commonly known as *exposure*. The general objective of the research was to provide precise estimates of exposure of South-East England under a range of inundation scenarios (1-metre, 3-metre and 5-metre SLR), using up-to-date and detailed elevation data which has become available in recent years.

The specific objectives for each SLR scenario were the following:

(i) To quantify the total area exposed to inundation,

(ii) To identify the county most exposed to inundation,

(iii) To quantify the length of roads (including that of different types of roads) exposed to inundation,

(iv) To quantify the length of railways exposed to inundation,

(v) To quantify the area of built-up exposed to inundation,

(vi) To quantify the area of agricultural land exposed to inundation,

(vii) To quantify the area of woodland exposed to inundation,

(viii) To quantify the number and area of protected areas (including that of different types of protected areas) exposed to inundation,

(ix) To quantify the number of cultural landmarks (including that of different types of cultural landmarks) exposed to inundation,

(x) To determine if the region's nuclear power plant is exposed to inundation, and

(xi) To quantify the number of people that may be displaced by inundation.

In addition to quantifying areas, lengths and numbers, the study aimed to provide a variety of cartographic materials, by creating maps of the above-mentioned features at the extent of the study area under different inundation scenarios, as well as more detailed maps of individual built-up areas affected under each scenario. Maps are necessary to provide illustrations of possible local impacts of SLR so that coastal residents and local officials become aware of the hazard and plan for it.

2. BACKGROUND

Given the widespread awareness of the fact that the global sea level is rising, a number of coastal assessments have been done at global (e.g. Anthoff et al. 2010; de Sherbinin et al. 2012; Blankespoor et al. 2014; Neumann et al. 2015; Strauss et al. 2015), continental (e.g. Demirel et al. 2015), national (e.g. Flood and Sweeney 2012; Kulp and Strauss 2016; Paprotny and Terefenko 2016), and sub-national or local scale (e.g. Cooper et al. 2008; Mokrech et al. 2008; Zhang 2011; Camill et al. 2012; Crapoulet et al. 2016; Dawson et al. 2016; Yunus et al. 2016; Ju et al. 2017).

Since coastal exposure to SLR has social, economic and environmental components, a variety of potential impacts have been analysed. Some studies focus only on some aspects of exposure, such as impacts on land (Crapoulet et al. 2016; Yunus et al. 2016; Ju et al. 2017), population (Neumann et al. 2015; Strauss et al. 2015), transport network (Demirel et al. 2015; Dawson et al. 2016), economy (Anthoff et al. 2010), or wetlands (de Sherbinin et al. 2012; Blankespoor et al. 2014), while other studies aim to assess a variety of impacts (Cooper et al. 2008; Mokrech et al. 2008; Zhang 2011; Camill et al. 2012; Flood and Sweeney 2012; Paprotny and Terefenko 2016), with or without consideration of adaptation.

These studies use various approaches, from simple inundation models, which are usually sufficient for assessing coastal exposure (e.g. Strauss et al. 2015; Paprotny and Terefenko 2016; Yunus et al. 2016), to more complex vulnerability assessments tools, which are necessary to determine the ability of coastal communities (influenced by their adaptive capacity) to cope with adverse impacts (e.g. Mokrech et al. 2008; Anthoff et al. 2010; Neumann et al. 2015). The data used to evaluate threats from SLR also vary from global, low-resolution, satellite-derived data to accurate, fine-resolution data, depending on data availability and scope of the analysis. For instance, Climate Central analysis uses global data to compare possible impacts of SLR around the world, identifying the UK as the 12th country most at risk in terms of total population (in Europe, 2nd most at risk, after the Netherlands) and the 15th most at risk in terms of national population percentage (Strauss et al. 2015). However, while global analysis allows to compare the exposure of different countries to SLR, global data is not appropriate for making local impact assessments, being characterised by a high degree of generalisation. In fact, as elucidated by Kulp and Strauss (2016), errors in global surface elevation data may underpredict coastal exposure to SLR.

Studies which investigate the SLR threat to the British coast are more concerned with predicting extreme sea levels caused by intense storms and the risk of flooding within the time frame up to 2100 (Randon et al. 2008; Batstone et al. 2013; Dawson et al. 2016; Yunus et al. 2016) than with quantifying potential losses caused by SLR inundation. It is considered that British preparations for adaptation to the rising sea levels are more progressive than in most European coastal countries (de la Vega-Leinert and Nicholls 2008; Haigh et al. 2011).

It has been recommended, however, that coastal planning include a better response to the uncertainties of climate change by designing new coastal defences that consider an allowance for accelerated SLR (de la Vega-Leinert and Nicholls 2008). Despite the inevitability of this distant threat, there are no published studies that have quantified potential SLR impacts on exposed regions of the UK, such as South-East England, under a range of scenarios, which made this research necessary.

3. METHOD

When studying potential impacts of climate change, scenarios can be created with the help of computer visualisation, which is capable of showing us views into the future, being thus of notable use in fields such as coastal planning. Geographic Information Systems (GIS) are an important technology for spatial analysis, providing powerful tools to analyse high-resolution data for the quantification and visualisation of coastal exposure to the rising sea levels. Quantifying and mapping impacts of SLR on a variety of geographical features, whilst aiming for a reasonable degree of accuracy, requires vast amounts of data and multiple operations of spatial analysis, all of which are described in this section, following a description of the area selected to be studied. The activities performed in order to achieve the objectives of the study can be divided into four major steps: obtaining and preparing data, preparing water levels, mapping inundation and assessing impacts. The computer software used for processing the data at each of these steps was ESRI's *ArcGIS* (version 10.3.1), with the *Spatial Analyst* extension enabled.

3.1. Study area

South-East England is one of the most exposed regions in the UK to the SLR-induced inundation (de la Vega-Leinert and Nicholls 2008). Its exposure to inundation is a combination of two main factors: (1) a large (and increasing) population, and (2) a gentle (and subsiding) topography, dominated by low hills and plains, with large areas only a few metres above the current sea level. In more detail, while the north of Britain experiences land uplift, most of the south-east is sinking at a rate of approximately 0.3 millimetres per year (Lowe et al. 2009; Shennan et al. 2009).

Lying in the south-east of the island of Great Britain, the region is separated from continental Europe by the English Channel to the south and the North Sea to the east. The coast of Britain experiences two high tides and two low tides per lunar day, known as a semi-diurnal regime. There are large variations in tidal range along Britain's indented coastline, however macrotidal[1] conditions predominate in the South-East (Bird 2008).

One of the nine regions[2] of England, the South-East is the third largest, having an area of 19,096 square kilometres. The South-East is itself divided into nine counties, four of which are inland counties (Berkshire, Buckinghamshire, Oxfordshire and Surrey), four are coastal

[1] Coasts can be classified based on the mean spring tide range (the largest tidal range which occurs every fortnight, around times of new and full Moon) into four classes: microtidal (less than 2 metres), mesotidal (2-4 metres), macrotidal (4-6 metres) and megatidal (more than 6 metres) (Bird 2008).

[2] Since 2011, following a decision to abolish regional strategies and return spatial planning powers to local government, the nine regions of England, previously known as Government Office Regions (GORs) are referred to, for the purposes of statistical analysis, simply as 'Regions' (ONS 2011).

counties (East Sussex, West Sussex, Hampshire and Kent) and one is an isle county (Isle of Wight) (**Figure 1**).

The South-East has the largest population of the nine regions, 8.9 million people, with a density of 465 inhabitants per square kilometre in 2014, and growing (ONS 2016b). The largest conurbations of the region, Brighton/Worthing/Littlehampton, Portsmouth, and Southampton, have a population of around 400,000 – 500,000 people and are all situated on the coast. Other densely populated towns and cities constellate around the Greater London region. In fact, the Greater London Built-up Area extends beyond the region's administrative boundary, into the South-East.

In terms of transport, the South-East, which runs in an arc around London, is crossed by major roads radiating from the capital city. The region has 22% of the nation's motorway network and 14% of the A roads (Surrey County Council 2008).

Agricultural land, which covers over 70% of England (Macgregor and Cowan 2011), represents the largest part of the study region's land cover area. The elevation in sea level may pose a real threat to agricultural production, given that more than half of the nation's best agricultural land is found within five metres above MSL (Nagle 1998).

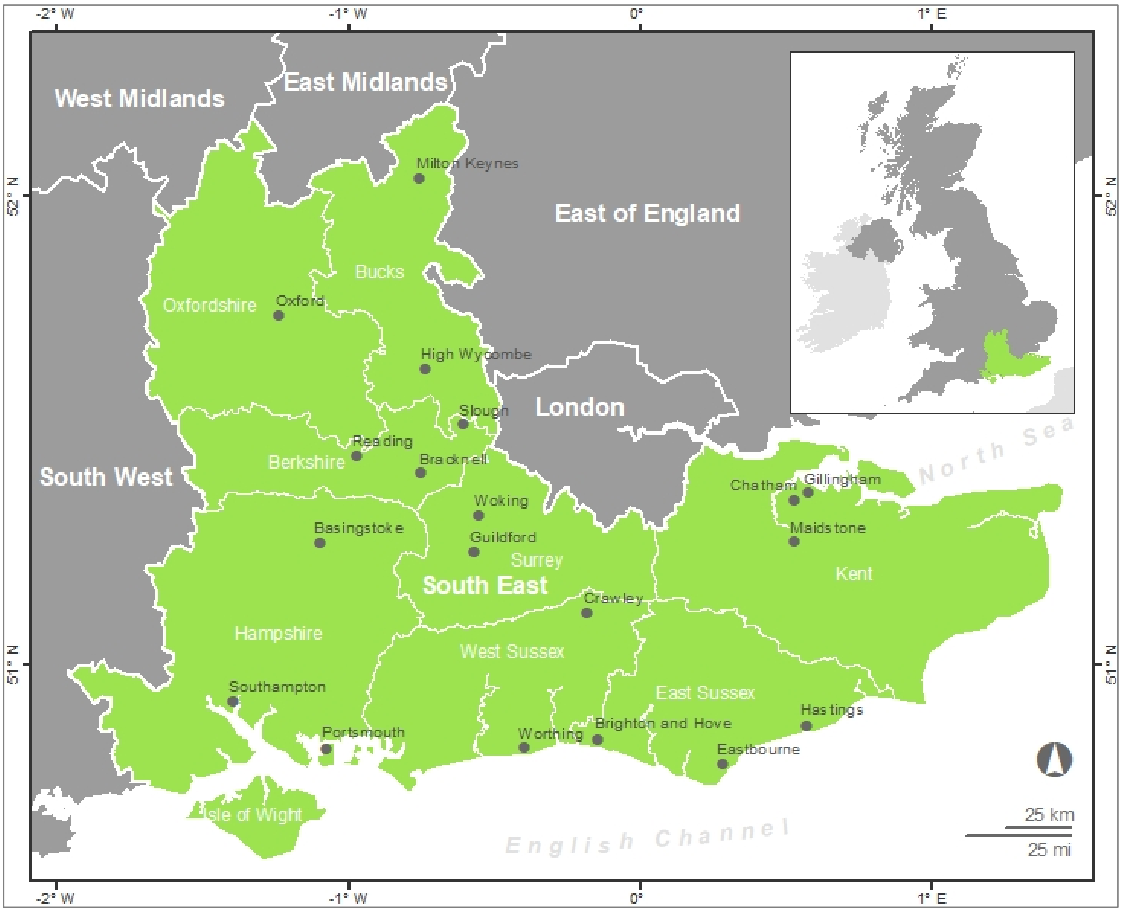

Figure 1. South-East England, the study area

The region is known for its beautiful countryside, being home to nine Areas of Outstanding Natural Beauty (AONBs), some of which extend to neighbouring regions, as well as two national parks, the New Forest and the South Downs. It is also home to a biosphere reserve, Brighton and Lewes Downs, 37 national nature reserves and almost 300 local nature reserves. In addition, the South East's coastline supports many wetlands of international significance, specifically 17 Ramsar sites, representing 10% of the sites in the UK, which is the country with the highest number of Ramsar wetland sites in the world (JNCC 2014).

The South-East is dotted by man-made structures which define its landscape. Of the cultural landmarks, two have World Heritage Site status (Blenheim Palace in Oxfordshire and the site that hosts Canterbury Cathedral, St Augustine's Abbey and St Martin's Church in Kent), while more than two thousand archaeological sites and historic buildings of national importance are classified as Scheduled Monuments (Historic England 2017).

Other structures of interest to this study are nuclear powers stations, which are commonly located in coastal areas to draw seawater for cooling purposes (Brown et al. 2013). South-East England has one of the eight operating nuclear power stations of the UK, the power station situated at Dungeness, a headland in southern Kent (NDA 2016).

3.2. Data acquisition and preparation

The starting point for any impact assessment study is the acquisition of the data that characterise the problem and the area of concern. This study was based on secondary data which is publicly and freely available on the internet (open data), bearing in mind the available time and (zero-)budget constraints. In other words, the research relied entirely on data gathered from various online sources (**Appendix A**), without requiring any data collection in the field. Wherever possible, the most detailed datasets were opted for, giving consideration to the importance of accurate boundary locations of the sites of interest, especially when their use could contribute, *inter alia*, to climate change adaptation measures (de Sherbinin et al. 2012).

Prior to acquiring the data, it was determined which squares of the *British National Grid* (BNG) correspond to South-East England in order to limit the data gathering (where possible) and the data preparation to the study area. Devised by the Ordnance Survey (OS), Britain's mapping agency, the National Grid is a hierarchical system of geographic grid references using a combination of letters and numbers to identify locations in Great Britain. It divides the island into squares of 100km x 100km, each described by two letters, for example TL in **Figure 2**. South-East England is crossed by the grid lines of seven of these squares: SP, SU, SZ, TL, TQ, TR and TV. Each square is sub-divided into smaller squares of 10 km by 10 km, numbered from 0 to 9 starting from the south-west corner in an easterly (left to right) and northerly (upwards) direction, and identified by two letters and two

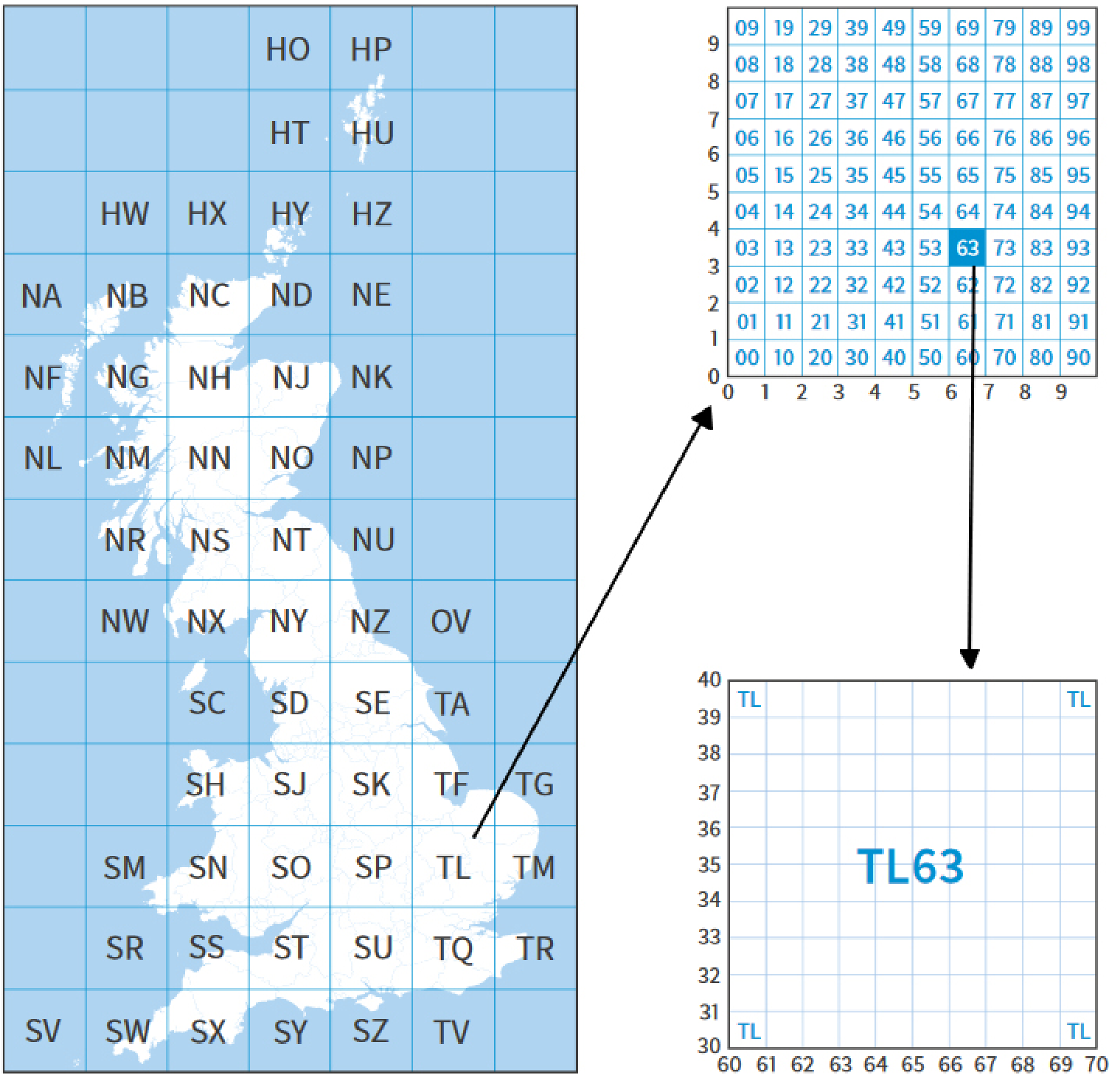

Figure 2. Illustration of the National Grid of Great Britain (Source: Ordnance Survey 2016a)

numbers, e.g. TL63. Each of these squares is further sub-divided into smaller squares of 1 km by 1 km, defined by two letters and four numbers, and so on, up to squares with a size of 1m by 1m (Ordnance Survey 2016a). The larger squares of the National Grid were used to select those parts of larger UK datasets corresponding to South-East England (the UK elevation and roads datasets, for instance, are supplied in small batches).

3.2.1. Elevation data

Elevation data is necessary to use as base data layer for mapping coastal inundation (NOAA 2012). The data may be acquired using a range of techniques, from direct land surveying to remote sensing methods (photogrammetry, airborne laser scanning, radar interferometry etc.) (Li et al. 2005). Digital elevation models come in a variety of forms, with the terms DEM (Digital Elevation Model), DTM (Digital Terrain Model), and DSM (Digital Surface Model) being used in the literature. They generally consist of gridded arrays of numbers representing the ground elevation above sea level. A DEM is a digital representation of elevation values over a landscape, in the form of a raster or a set of vector contours. A DSM is an elevation model of the terrain which includes surface objects such as vegetation, buildings and vehicles. A DTM is a "bare earth" model which has surface objects such as vegetation, buildings and other non-ground objects filtered out (Environment Agency 2016b). The term DEM is commonly used as a generic term for both DSMs and DTMs. Many studies around the world have used digital elevation data to model the exposure of coastal regions to inundation as a result of SLR (e.g. Cooper et al. 2008; Zhang 2011; Flood and Sweeney 2012; Kopp et al. 2014; Strauss et al. 2015; Crapoulet et al. 2016; Paprotny and Terefenko 2016; Yunus et al. 2016). It has been observed that using surface elevations (instead of bare earth elevations) to estimate SLR impacts may lead to major underestimates (Kulp and Strauss 2016; Yunus et al. 2016), so a DTM was the preferred choice in this study.

The use of *LiDAR-derived elevation data* has become increasingly popular in SLR impact assessments. An airborne mapping technique, aerial LiDAR (short for Light Detection And Ranging) is an active remote sensing technology that measures the height of the terrain and surface objects on the ground with greater vertical accuracy (often less than 0.15 metres) than traditional techniques. The distance between the aircraft and the target is determined with light pulses from a scanning laser that can register up to 100,000 measurements per second, thereby creating highly-detailed land surface models (Environment Agency 2016b). In modelling coastal changes and quantifying areas vulnerable to the elevation in sea level, it is important to use up-to-date, high-accuracy, high-resolution elevation data. The vertical accuracy of a DEM significantly influences the delineation of inundation areas, having a greater effect than its horizontal resolution (Zhang 2011). The use of high-resolution, high vertical accuracy elevation data derived from LiDAR measurements is, therefore, recommended when performing local assessments of SLR as it leads to a more detailed delineation of the potential inundation zone (Gesch 2009; de Sherbinin et al. 2012). The availability of LiDAR-based elevation data, despite remaining globally limited, has increased in recent years, leading to its use in coastal exposure estimates in a few select countries (Zhang 2011; Camill et al. 2012; Crapoulet et al. 2016; Kulp and Strauss 2016; Paprotny and Terefenko 2016; Yunus et al. 2016; Ju et al. 2017).

LiDAR data is available for more than 72% of England, being supplied by the UK's Environment Agency as both DSM and DTM at 2-metre, 1-metre, 50-centimetre, and 25-centimetre horizontal resolution, presented as raster tiles in British National Grid OSGB 1936 projections, with elevations recorded above Ordnance Datum Newlyn (ODN) (Environment Agency 2016b). The *LiDAR Composite DTM 2m* (Environment Agency 2016a) was sourced for this research being considered to offer sufficient detail for a study area of such extent. Since there should be about 15,000 adjacent DTM tiles of 1 km by 1 km available for South-East England, and, in order to minimise processing time, a visual

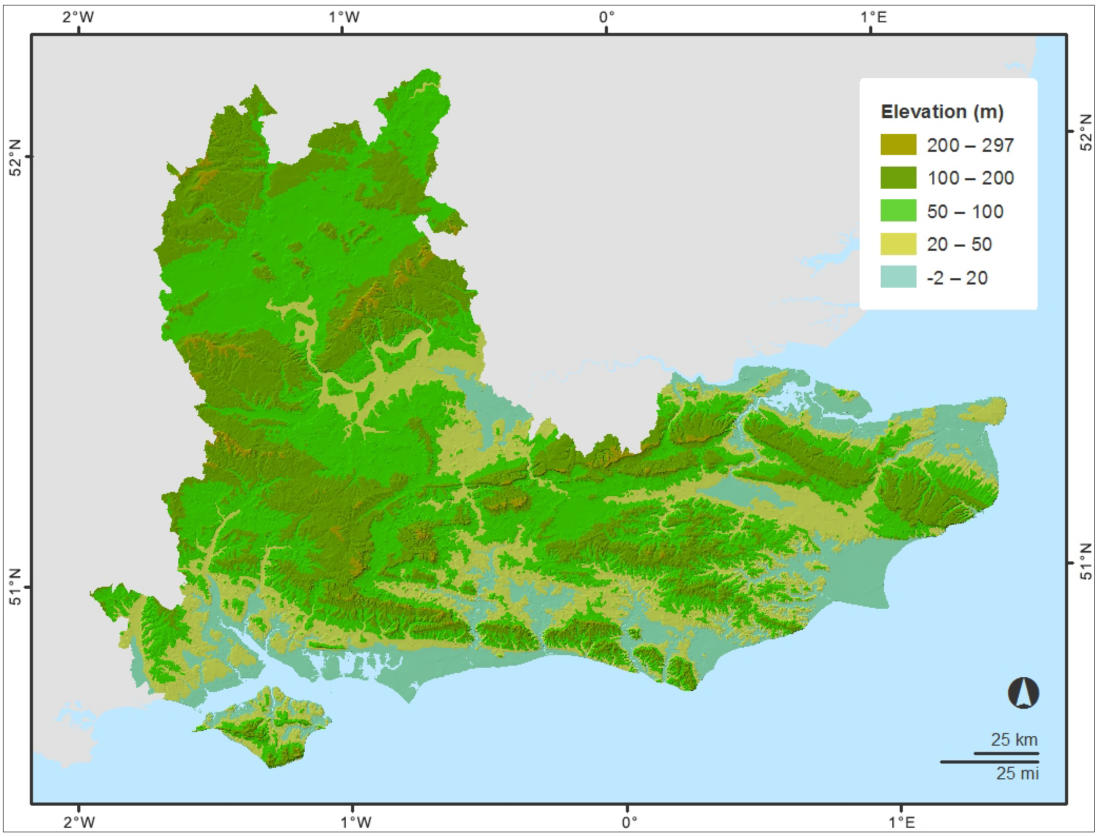

Figure 3. Topographic map of South-East England

selection was applied based on the 20-metre terrain elevation contour line from the *OS Terrain 50 (Contours)* vector dataset (Ordnance Survey 2016d), which was merged and used to provide topographic context (**Figure 3**). The selection reduced the number of DTM tiles to only those tiles in coastal lowlands with cells containing elevation values below 20 metres (corresponding to cells in 122 National Grid squares of 10 km by 10 km). These were considered to be sufficient for further analysis based on the assumption that a 20-metre elevation "ceiling" should be ample enough to determine the inundation surface of a 5-metre rise in sea level at high tide, and would absorb any possible inaccuracy in the contour lines. Due to computing limitations and in order to obtain a single DTM file that would be practical to employ for spatial analysis, the coastal tiles were mosaicked and downsized to a 5-metre horizontal resolution, which is similar to the resolution of the LiDAR-derived elevation data used in other studies that assess SLR impacts (Zhang 2011; Kulp and Strauss 2016; Yunus et al. 2016; Ju et al. 2017). The operation was performed using the *Mosaic to New Raster* tool, with the 32_BIT_FLOAT decimal-supporting pixel type selected and the mosaic operator set to BLEND, which ensures that the output cell value in overlapping areas is a horizontally weighted calculation of the values of the cells that overlap. Although LiDAR data is available for only 72% of England, there is excellent coverage in low-lying coastal areas, allowing to obtain a coastal DTM with no gaps up to 10 metres in elevation and with very few gaps closer to the 20-metre "ceiling".

Tidal data is necessary to determine the possible extent of SLR inundation on land. Tide values are available from the *OS Terrain 50 (Contours)* vector dataset, which includes mean low and mean high water boundaries (Ordnance Survey 2016d). These are based on average values of low and high tides around the coast of Britain that have been determined from local tide tables. The mean high tide values have been used in this study.

3.2.2. Transport data

Transport network data was obtained from two distinct OS vector datasets. The *OS Open Roads* dataset is described as the most detailed open data roads network product available for Great Britain (Ordnance Survey 2016c). It contains various classes of roads under different classifications. The main classes of roads are: motorways (multi - carriageway public roads connecting important cities), A roads (major roads designed to provide large-scale transport links within or between areas), B roads (roads designed to connect different areas, and to feed traffic between A roads and smaller roads), and other, smaller, roads that include minor roads (public roads that provide interconnectivity to higher classified roads or lead to a point of interest) and local roads (roads intended for local traffic, representing the majority of roads in the UK). Private roads and shorter cul-de-sacs are not included in the dataset. Since the OS Open Roads data is supplied as 100 km by 100 km tiles, based on the National Grid, those tiles of road links corresponding to South-East England had to be merged to obtain a single, continuous roads layer. *Rail line* data, representing all standard gauge passenger rail tracks, was already provided as a single file in the *OS Meridian 2* dataset (Ordnance Survey 2016b).

3.2.3. Land cover data

Land cover data was acquired in vector format from different sources. The boundaries of *Built-Up Areas* (BUA) are made available by the Office for National Statistics (ONS, 2015a) as a polygon file carrying identifying names, which makes it useful for mapping impacts of SLR inundation on individual areas. *Agricultural land*[1] data was extracted from the *Corine land cover 2012 for the UK, Jersey and Guernsey* (Cole et al. 2015), which, although highly generalised, was the most detailed land cover dataset available at no cost. *Woodland* data was found represented at a more detailed scale in the *OS Meridian 2* dataset (**Appendix A**).

3.2.4. Protected areas data

Most of the vector data on protected natural areas (AONBs, biosphere reserves, local nature reserves, national nature reserves and Ramsar sites) were sourced from Natural England (2016a, b, c, d, e). National Park boundaries were sourced from the ONS (2016a), being available at full resolution and clipped to the coastline.

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[1] Agricultural land refers to both crops and pastures, while arable land refers only to crops.

3.2.5. Landmarks data

Data on *cultural landmarks*, sites which are protected for their cultural heritage value, specifically World Heritage Sites and Scheduled Monuments, was obtained in vector (polygon) format from Historic England (2017).

Data on *nuclear power plants* in the UK was sourced in vector (point) format through OpenStreetMap (2017), a collaborative project that aims to create and provide free geospatial data. Based on the "volunteered geographical information", a single nuclear power plant was identified in the South-East region. Its point location was later confirmed on the website of the Nuclear Decommissioning Authority (NDA 2016). The power station at Dungeness, in Kent, which houses both closed and operating reactors, and a radioactive waste store, is on the list of nuclear power plants to be decommissioned.

3.2.6. Population data

Population density data was found available as a grid with a spatial resolution of 1 km by 1 km. The dataset is based on *2011 UK Census population data* and *Land Cover Map 2007* land-use classes 'urban' and 'suburban' (Reis et al. 2016).

3.2.7. Administrative boundaries data

Regional and county boundaries were sourced from the ONS (2015b) at full resolution (not generalised) and clipped to the coastline (mean high tide mark). Prior to commencing any spatial analysis, it was ensured that all the data collected had the same spatial reference system as the elevation data, British National Grid OSGB 1936, and projections were performed where necessary. As a final data preparation step, the boundaries of South-East England were used to clip the England/Britain-wide features of interest, in order to obtain layers of the features in the study area.

3.3. Water level preparation

The preparation of the water levels required two steps: selecting an appropriate tidal datum and creating a tidal model.

3.3.1. Selection of a tidal datum

Before performing tidal modelling, it was important to choose a relevant tidal datum – that is a vertical datum used as a reference point for elevations of water levels. Each coastline experiences a specific tidal range, meaning a difference in height between high tide and low tide (**Figure 4**). MSL is the average level of the sea surface observed at a given location over a long period, ideally 19 years[1], to minimise sea level variations. In other words, MSL is the

[1] The tides vary from year to year with a cycle of approximately 18.6 years, representing one lunar epoch, a period which is rounded to 19 years to obtain closure on the annual cycle (NOAA 2012).

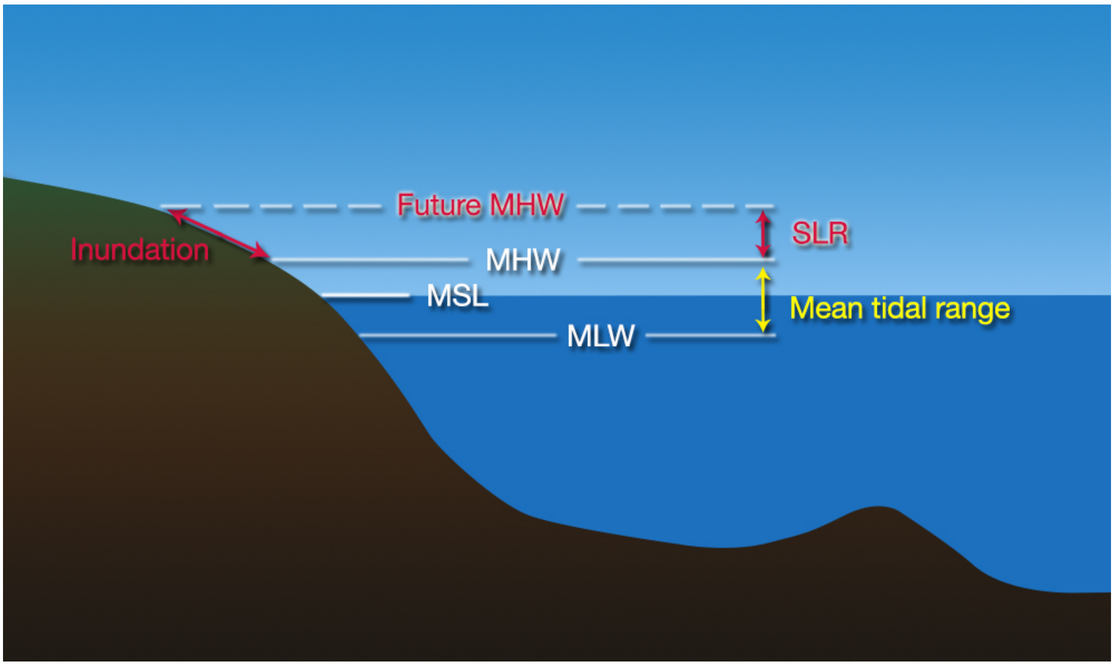

Figure 4. Illustration of the tidal range and SLR inundation above the high tide line

average sea level which would exist in the absence of tides. This is the vertical datum commonly used for measuring the height of objects on land. Zero elevation, or MSL, differs from a country to another. For instance, the national vertical datum for Great Britain, Ordnance Datum Newlyn (ODN), was defined by MSL measurements over a period of six years (1915 – 1921) at the most important sea level station in the UK, the Newlyn Tidal Observatory (Woodroffe and Barlow 2015; Bradshaw et al. 2016). Other tidal datums such as Mean High Water (MHW) and Mean Low Water (MLW) are defined as the average of all high or low waters, caused by the gravitational effects of the moon and the sun, and commonly observed over a 19-year period (Woodroffe and Barlow 2015). In areas with diurnal tides, Mean Higher High Water (MHHW) or Mean Lower Low Water (MLLW) may be used as the base elevation.

In SLR inundation studies for which estimates are required to determine the area of land affected, coastal exposure analysis is usually applied within the first few vertical metres above high tide lines (Kulp and Strauss 2016). The elevation of a tidal datum such as MHW or MHHW is commonly used as reference from which inundation begins to occur, tidal models being often based on high tide values from tide gauges or high-water mark surveys (NOAA 2012). Those portions of the coastal sites that are above the high tide mark are considered at risk of SLR, when assessing, for instance, potential impacts on wetlands (de Sherbinin et al. 2012). Since anything landward of the high tide line is normally dry ground, seawater that rises above that line due to the elevation in sea level is considered inundation (while seawater that rises above it in cases of extreme high tides or storm surges is considered flooding). Hence, inundated land is defined in this study as the submerged land

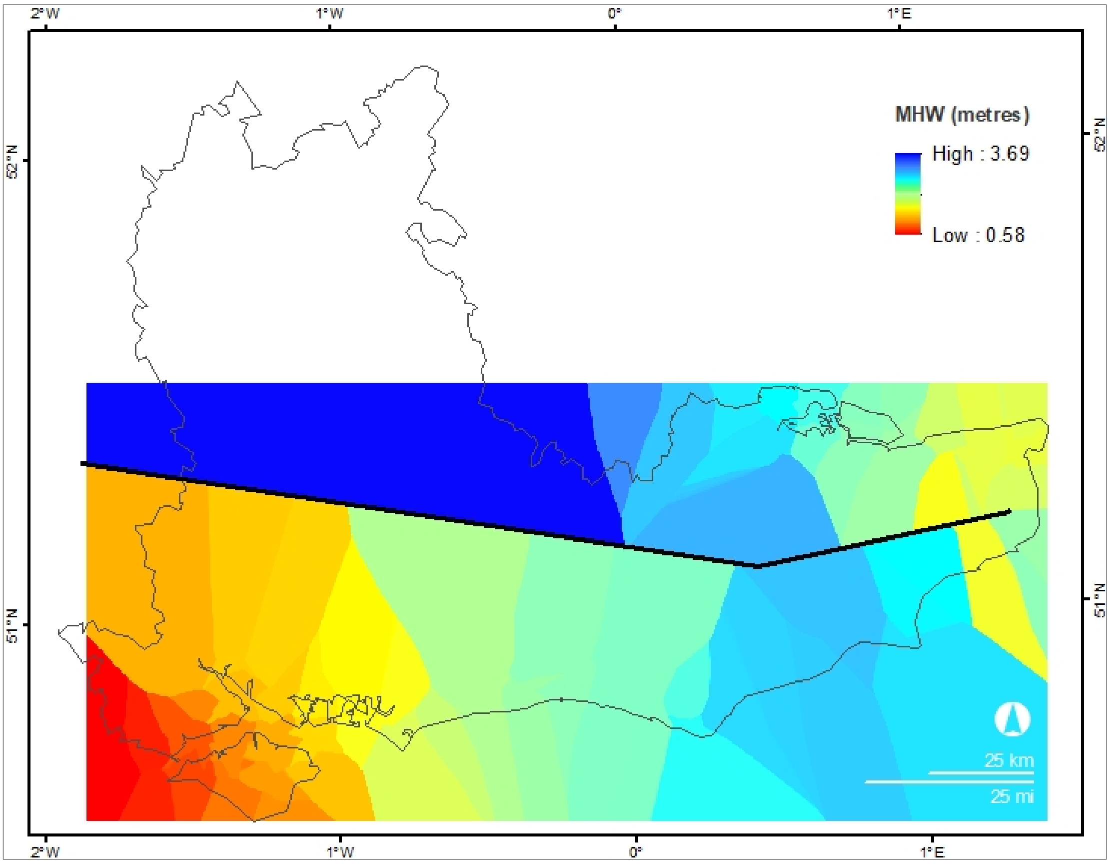

Figure 5. Tidal surface obtained through interpolation of MHW points constrained by a simple barrier

situated between the high tide line of the present sea level and the future high tide line under a SLR scenario (**Figure 4**). The MHW line is the only high tide line present in British spatial datasets (regional boundaries and elevation contours), so this tidal datum was the one chosen to be used. MHW values for the South-East range between 0.58 and 3.69 metres (**Figure 5**).

3.3.2. Creation of a tidal model

Since the elevation of the sea surface varies from a place to another, and to ensure due accuracy in the predicted sea surfaces, an interpolation that captures tidal variability within an area has to be performed, resulting in a tidal model. The preparation of a "modelled" water surface (or raster) that would depict tidal variability across the coastal area of South-East England was carried out largely following the tide gauge approach in the method for mapping SLR inundation described by the National Oceanic and Atmospheric Administration of the United States (NOAA 2017).

First, it was necessary to convert to points the vertices of the MHW contour lines extracted from the *OS Terrain 50* dataset. Then, an interpolation between the resulting 162,276 points was performed using the *Inverse Distance Weighted* (IDW) spatial technique, as recommended by NOAA (2017), with a 50-metre cell size output and the tool's default setting. The technique is based on the assumption that things which are close to one another are more alike than those which are farther apart. It thus gives greater weight to measured values which are closer to the predicted values than those which are farther away. In this case a simple barrier was drawn, while observing the higher elevation contour lines in the background, to prevent the interpolator from using samples points from coastal areas on the opposite side of it (**Figure 5**). An input barrier polyline is an optional feature when performing an interpolation in ArcGIS. It was considered to be useful, however, because employing a breakline limits the search for input sample points to only those located on the same side of the barrier as the current processing cell. Drawn along areas with higher elevations in the landscape of the South-East, the polyline used had only three vertices. Employing a more complex barrier, ideally the 20-metre contour line, would have considerably extended the processing time. The tidal surface thus created, and represented in the same vertical datum as the elevation data, was ready to be employed as a current conditions surface upon which SLR would be superimposed.

3.4. Inundation mapping

When assessing potential impacts of SLR, the most relevant concern is the amount and spatial distribution of land loss that can occur as a result of inundation. Mapping inundation in South-East England relied on the tidal surface created at the previous step, in addition to two other inputs, specifically the DTM and the values of SLR for which the impact assessment would be performed.

3.4.1. Selection of SLR values

Impact assessment under multiple scenarios is suitable in situations of high uncertainty and complexity such as SLR. Scenario development explores plausible futures, providing a tool to inform coastal planning and to manage risk while maintaining flexibility in decisions (Rowland et al. 2014). In this study, three distinct scenarios were explored: a rise of 1 metre (3.3 feet), 3 metres (9.8 feet) and 5 metres (16 feet) above the present sea levels. All these magnitudes of SLR are rounded values that were taken as a given, and all may be interpreted both as projections of 21st century SLR and as projections of locked-in SLR beyond 2100.

An elevation in sea level of 1 metre is taken from the upper part of the range of sea level-increase values which were given by the IPCC in AR5 as *likely* to occur this century (adjusted to the South-East, the maximum likely global SLR of 0.98 metres would translate to a relative rise of around 1.10 metres). The 5-metre rise value was chosen because it represents the *maximum* possible SLR that may occur by 2100 as estimated by Hansen et al. (2016), despite being considered highly unlikely. At the same time, accepting the projection that the world's global temperature will increase with at least 2°C, and given the commitment to SLR, it was assumed that a 5-metre rise is *unavoidable* and will occur at some point in the future. As an example that would further support this scenario, in the vicinity of the South-East, London is one of the few locations in the world fully preparing for a rise up to 5 metres, implicitly beyond 2100 (Nicholls, 2011). A median scenario of 3-metre rise was also analysed. Although high-end scenarios (over 1 metre) this century are deemed unlikely, whilst being scientifically plausible, it seems wise to take them into account as a cautious approach when evaluating potential adaptation options. Their consideration is relevant for long-term coastal risk management, particularly in densely-populated coastal lowlands, where coastal planners need all available information, including for the high-end scenarios that lie in the 0-33% range of uncertainty, to avoid damage under all circumstances (Hinkel et al. 2015).

Given the time constraints, storm surge effects, which may raise the water levels in the region with one or two metres above normal, particularly in the North Sea[1], were not considered. However, contemplating the very low likelihood that the rise in sea level may reach 5 metres this century, one may assume that, by highlighting those low-lying areas which are exposed to permanent 3-metre or even 5-metre SLR inundation, the study would also (very roughly) highlight those areas that, after a rise in sea level of 1 metre and, respectively, 3 metres, may be exposed to temporary flooding caused by a 2-metre surge.

3.4.2. Modified bathtub modelling

The method used for mapping inundation is a "modified bathtub" modelling approach, which takes into account local tidal variability and hydrological connectivity, being often used in studies that estimate SLR inundation (Yunus et al. 2016). The process involved adding the SLR amount to the water surface, subtracting the elevation values from this surface to obtain an initial inundation depth raster (with a 5-metre cell size), evaluating the connectivity of inundated areas to the open sea (in this case, with two Maximum Values selected for the lower SLR scenario and one value for each of the higher SLR scenarios) using the eight-sided connectivity rule recommended by Poulter and Halpin (2008), and creating the inundation depth raster for connected areas. These steps are described in more detail by NOAA (2017).

Evaluating the connectivity of inundated areas to the open sea, which reduced the final values obtained, was a step justified by the elevation data used. The initial inundation rasters contained several isolated, low-lying areas with elevation below the water level but unconnected to the sea, being protected from inundation by either the natural topography of the land or man-made flood control structures. The resolution of the elevation data used in the analysis was considered sufficiently detailed to identify unconnected areas, therefore they were discarded from the final inundation maps.

[1] During the winter of 2013/2014, the North Sea coast of Britain experienced its highest recorded storm surges since 1953, reaching more than 2 metres above the forecasted high tide and causing damage in the east of England (Huntingford et al. 2014).

Furthermore, the resulting floating raster for each inundation scenario was converted to integer before performing a conversion to polygon features. These were subsequently dissolved, intersected with the region's boundaries clipped to the MHW mark, and, finally, converted to a projection that minimises area distortion (Lambert Azimuthal Equal Area). This mapping process allowed to obtain the connected inundation surfaces for each of the three SLR scenarios, and thereby to calculate the total area affected. The flowchart in **Figure 6** displays a rough sketch of the methodology.

3.5. Impact assessment

The inundation surfaces obtained were intersected, consecutively, with the features of interest in order to assess the exposure and impacts (**Figure 6**). As a result, areas and/or lengths and/or numbers of features could be determined for transport infrastructure, land cover categories, protected areas, landmarks and population. A projection that preserves distances (Europe Equidistant Conic) was used to quantify the length of roads and rail lines affected, while a projection that preserves areas (Lambert Azimuthal Equal Area) was used to determine the areas of inundated features. Since some protected areas (several Ramsar sites and the Biosphere Reserve) extend beyond land and over the sea, their land area, rather than their total area, was considered when calculating the inundation percentage. All the new fields created to store geometry data (areas and lengths), before applying summary statistics on them to obtain sums, were of double data type, meant to store double-precision floating-point numbers. Area and length attributes were calculated from the planimetric coordinates, without taking into account the effect of slope, with the assumption that there would be no significant difference between the final percentages determined from two-dimensional, planimetric coordinates, and those determined from three-dimensional, topographic coordinates.

The nuclear power plant data was supplied as a 'point' feature indicating the location of the power station, rather than a polygon which shows its extent. Therefore, it was necessary to overlay it with the small built-up area of Dungeness to assess its exposure more effectively.

Determining the population exposed to SLR inundation under each scenario required further calculation. The population grid, which provides total estimated populations living in 1 square kilometre cells across the region, extends beyond the coastal boundaries and over the sea (**Figure 7**). The analysis assumed uniform population distribution within the inhabited grid cells, except those located within one kilometre of the coastal boundary. Seeking to obtain greater accuracy in the numbers of coastal inhabitants potentially displaced due to SLR inundation, those cells of the population grid intersecting the coastal boundaries were selected by location and their specific land area calculated. That way, when quantifying the exposed population along the coast, instead of using the knowledge that each cell of the population grid covered 1,000,000 square metres, their individual area was

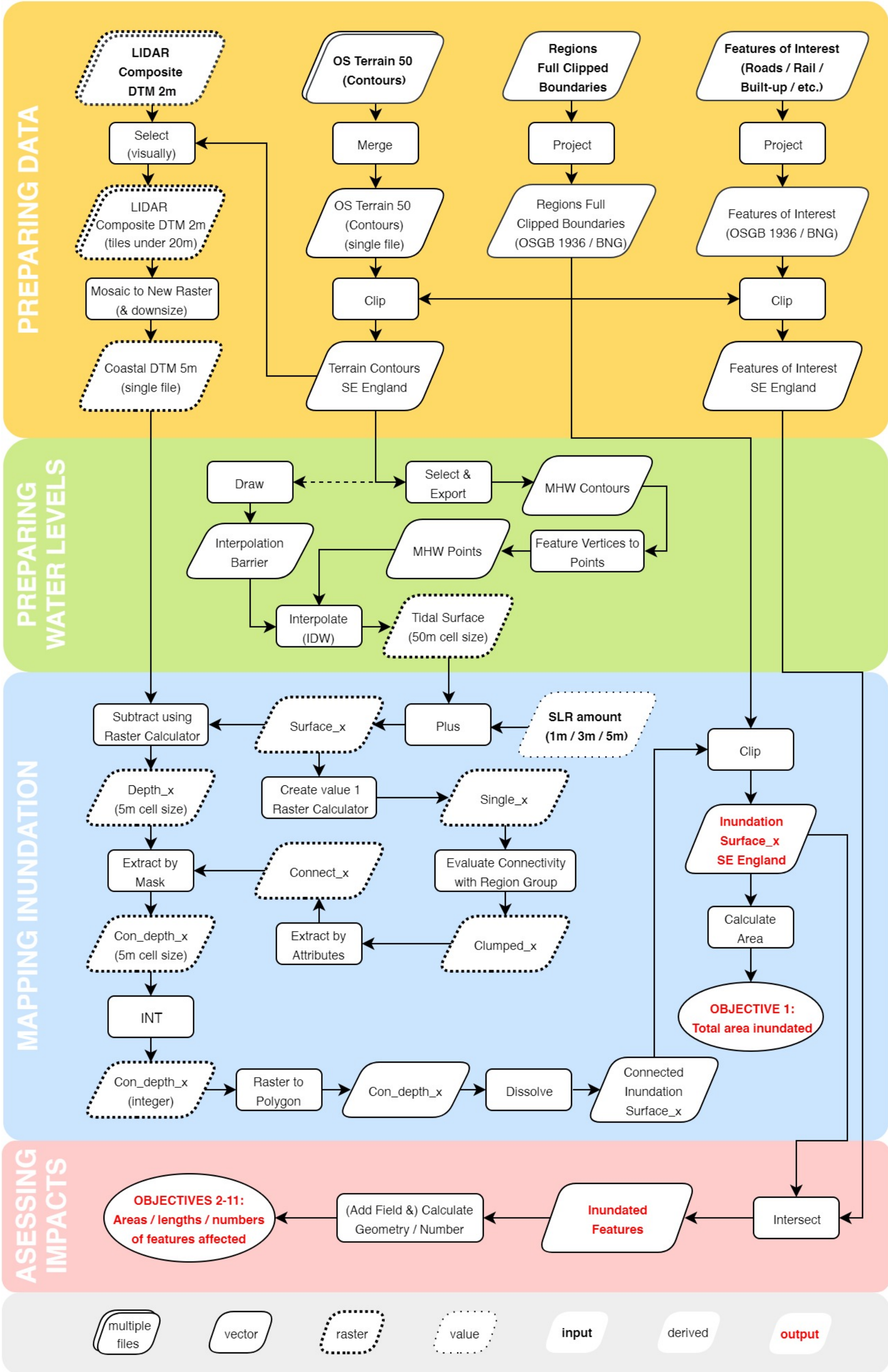

Figure 6. Methodological flowchart (simplified)

Figure 7. Gridded population detail in coastal area of South-East England

considered in the formula: [population displaced] = [population] * [area inundated] / [area]. This approach yields population on land below each SLR, thus avoiding to underestimate the potential number of people that could be displaced.

It is important to emphasise that the analysis did not consider any protection structures that might be built. As noted by Anthoff et al. (2010), potential SLR impacts are usually presented without taking coastal protection measures into account.

4. RESULTS

This section provides answers to all the research objectives listed in the introduction. The spatial analysis performed allowed to map scenarios of future SLR inundation, as well as to quantify potential impacts in the study region – specifically areas, lengths and/or numbers of roads, railways, built-up, agricultural land, woodland, protected areas and landmarks inundated, and population exposed to inundation.

This study assumed that, in the absence of adaptation, all low-lying coastal areas connected to the sea would be indefinitely submerged due to sea-level increases of 1 metre, 3 metres and 5 metres. To better highlight how likely SLR inundation is to occur in the not too distant future (or rather to highlight where it will occur sooner), the following colour code is used in maps and graphs across this report to illustrate exposure:

Red	1m SLR	High exposure
Orange	3m SLR	Medium exposure
Yellow	5m SLR	Low exposure [1]

4.1. Total area and counties exposed to inundation

The inundation surfaces calculated based on LiDAR-derived elevation data and mean high tide values extend along most of the South-East's coast, reaching farther inland along rivers or estuaries and across low-lying coastal plains. The sea would reclaim land in all of the five coastal counties, however, even under the high scenario, none of the inland counties would be affected (**Figure 8**). An interactive map available at adelanistora.com/maps/sealevelrise allows to explore the potential extent of inundation in more detail.

A 1-metre SLR could submerge 3.1% of the total land area of South-East England, corresponding to roughly 601 square kilometres (60,100 hectares). Southern Kent would have the largest area affected, with other sizeable inundated areas located in northern Kent and along the coast of East Sussex.

Looking further into the future, a 3-metre SLR would threaten to inundate approximately 5% of the current area of South-East England, or 946 square kilometres (94,600 hectares). This subsequent inundation would particularly affect northern Kent and would completely submerge the county's southern tip, which would become isolated into small islands under the first scenario. The coast of West Sussex would also be affected, especially the area between Chichester and Littlehampton.

The total area inundated could increase to 6.2%, corresponding to almost 1,186 square

[1] Yellow and orange aim to indicate areas which are less likely to be inundated in the next hundred years, however, these are, still, low-lying areas that should be prepared for temporary floods, set to occur with increasing regularity.

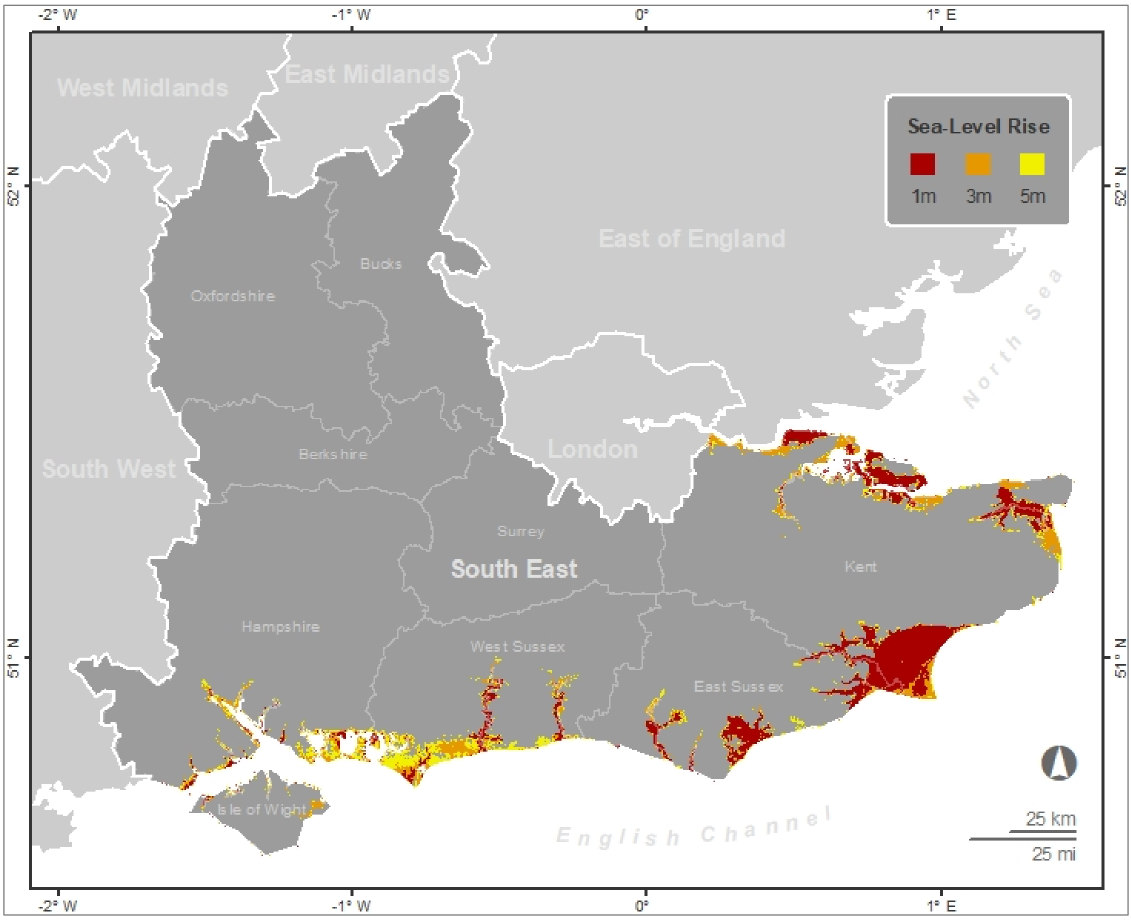

Figure 8. Potential inundation caused by 1m, 3m and 5m SLR on the coast of South-East England

kilometres (118,600 hectares) under the more distant scenario of a 5-metre SLR. Most of the new inundation would occur on the coasts of West Sussex and Hampshire, where the English Channel would engulf more land. Kent would remain, nonetheless, the county most affected by the rise in sea level (**Figure 9** and **Appendix B**).

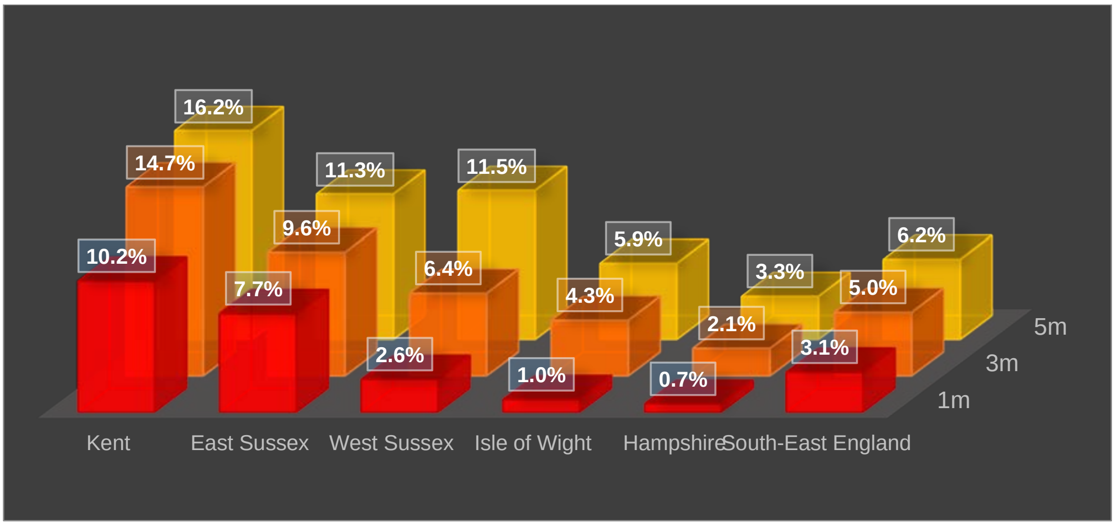

Figure 9. Total area and counties of South-East England exposed to 1m, 3m and 5m SLR inundation

4.2. Transport infrastructure exposed to inundation

The overlay analysis of transport features with the inundation surfaces allowed to identify potential weak links threatened by SLR. Both roads and rail lines located in low-lying coastal areas would be submerged. However, under each of the projected scenarios, rail lines would be more affected than roads.

4.2.1. Roads exposed to inundation

A 1-metre SLR would inundate roughly 1.4% of roads, corresponding to 929 kilometres (577 miles). The number would increase to 4%, or 2,588 kilometres (1,608 miles), under the middle scenario. A 5-metre SLR would submerge 6.5% of roads, or 4,149 kilometres (2,578 miles). Out of all the different road categories, motorways would be the least affected with between 0.03% (under the low scenario) and 1.1% (under the high scenario) of their length inundated. At the other end of the road function spectrum, minor and local roads would be the most affected, with between 1.5% (under the low scenario) and 6.7% (under the high scenario) of their length submerged (**Figure 10**).

4.2.2. Railways exposed to inundation

The elevation in sea level would submerge 2%, 7.4% and 10.2% of rail lines in South-East England under the 1-metre, the 3-metre, and, respectively, the 5-metre inundation scenario (**Figure 10**). These percentages correspond to summed lengths of approximately 43 kilometres (26 miles), 155 kilometres (96 miles) and, respectively, 214 kilometres (133 miles) of rail line (**Appendix B**).

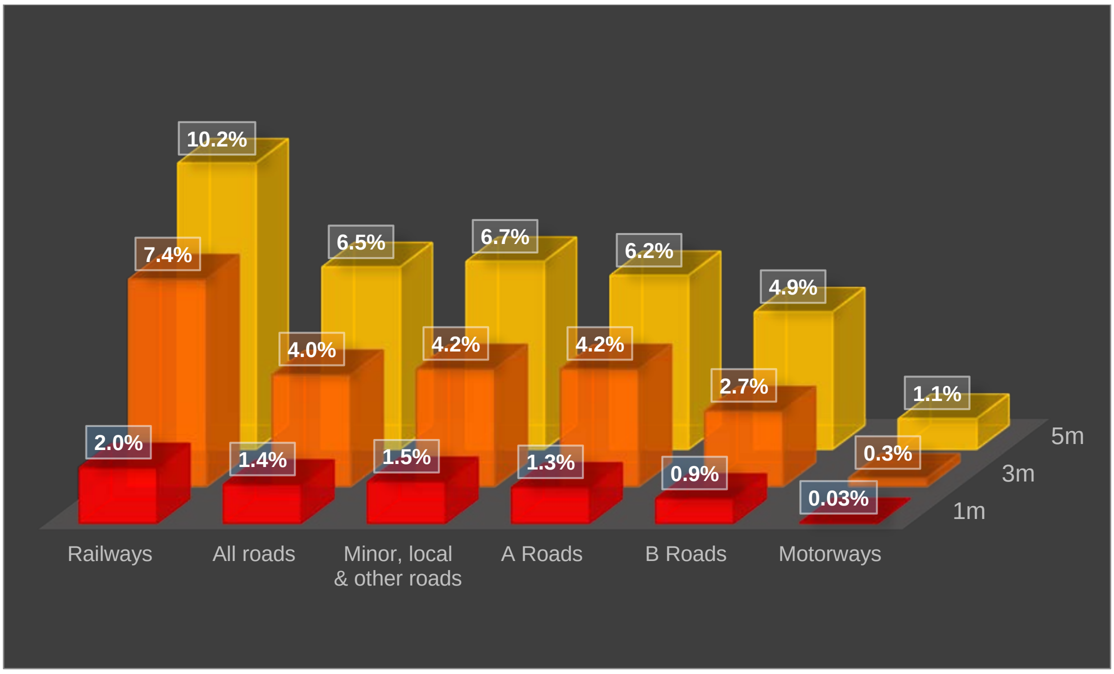

Figure 10. Length of roads and railways in South-East England exposed to 1m, 3m and 5m SLR inundation

4.3. Land cover exposed to inundation

Out of the different land cover categories assessed, woodland appears to be the least at risk of being submerged. The area percentages of exposed built-up and agricultural land are closer to the values of total area inundated.

4.3.1. Built-up exposed to inundation

Many of the region's BUAs (**Appendix C**), especially in large conurbations (Brighton/ Worthing/Littlehampton, Portsmouth and Southampton), are situated on the coast and are thus threatened by SLR. Under the 1-metre SLR scenario, roughly 1.3% of the total built-up area, or 32 square kilometres, would be exposed to inundation. SLR of 3 metres would submerge approximately 4.3% of built-up, corresponding to an area of 107 square kilometres. These numbers would increase to nearly 7.4%, or 185 square kilometres, under the high scenario (**Appendix B**).

4.3.2. Agricultural land exposed to inundation

The area percentages of agricultural land exposed to inundation resemble most closely the values of total land inundated (**Figure 11**). The rising sea would engulf approximately 3.7%, 5.3% and 6.3% of the region's total agricultural land area under the three inundation scenarios. These percentages correspond to 512, 717 and 857 square kilometres, respectively.

4.3.3. Woodland exposed to inundation

A land cover category underrepresented in the South-East's coastal areas, woodland would scarcely be affected by inundation (**Figure 11**). A 1-metre rise in sea level would submerge approximately half a square kilometre of woodland, representing as little as 0.03% of its total area in the region. Even under the 5-metre SLR inundation scenario, only 0.2% of woodland, or 3.6 square kilometres, might one day vanish underwater (**Appendix B**).

4.4. Protected areas exposed to inundation

The level of exposure of protected areas would also be similar to the general level of exposure of the study region, however the wet types concentrated along the coast would be more affected. The rising sea would inundate roughly 3.4% (256 square kilometres), 4.8% (357 square kilometres) and 5.4% (406 square kilometres) of the total protected area under the three scenarios, in order of increasing sea level (**Figure 11**). National nature reserves and Ramsar sites could lose between almost a third and nearly a half of their total land area in the region. By contrast, AONBs and national parks would have only up to 3% of their areas at risk of inundation, even under the higher scenario (**Figure 12**).

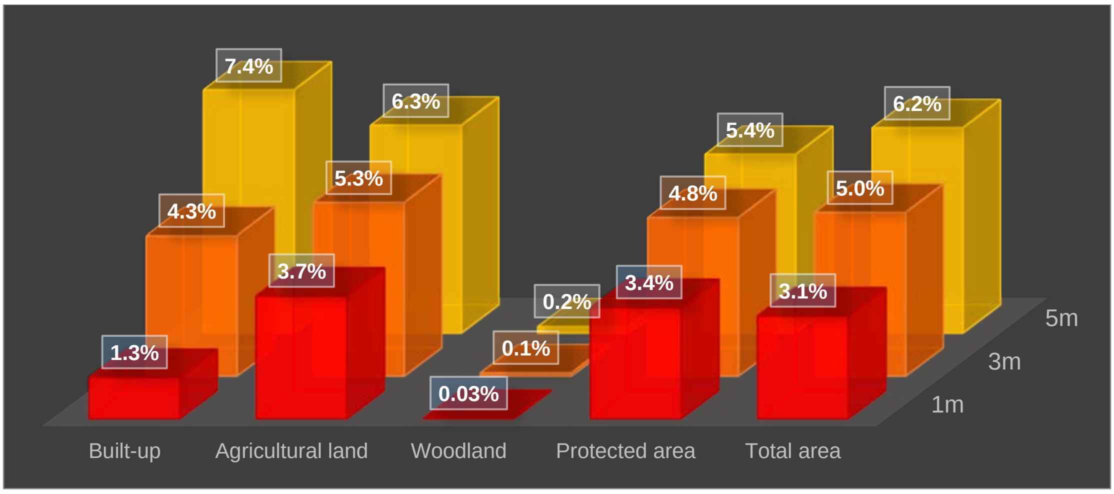

Figure 11. Area of built-up, agricultural land, woodland, protected area and total area of South-East England exposed to 1m, 3m and 5m SLR inundation

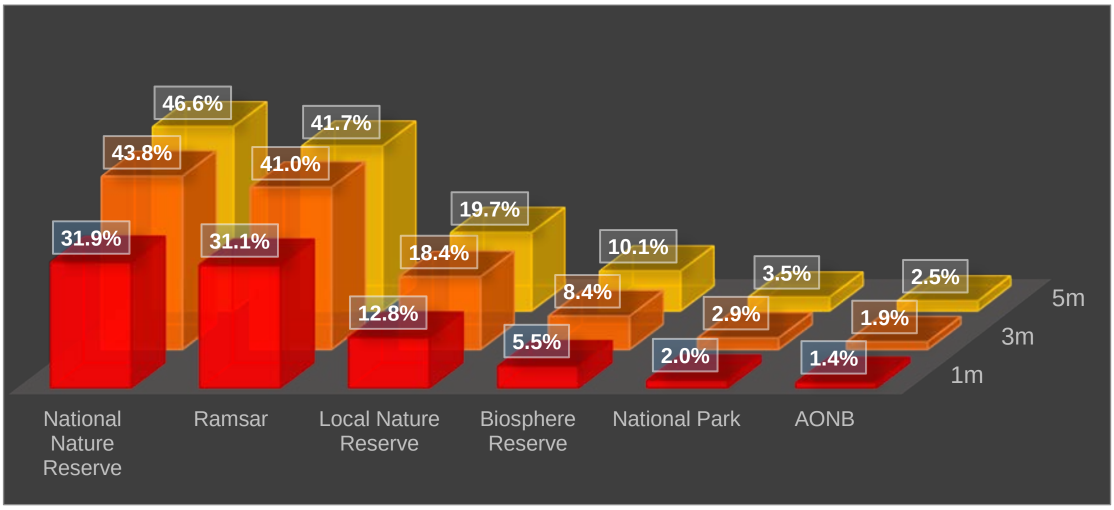

Figure 12. Area of different types of protected areas in South-East England exposed to 1m, 3m and 5m SLR inundation

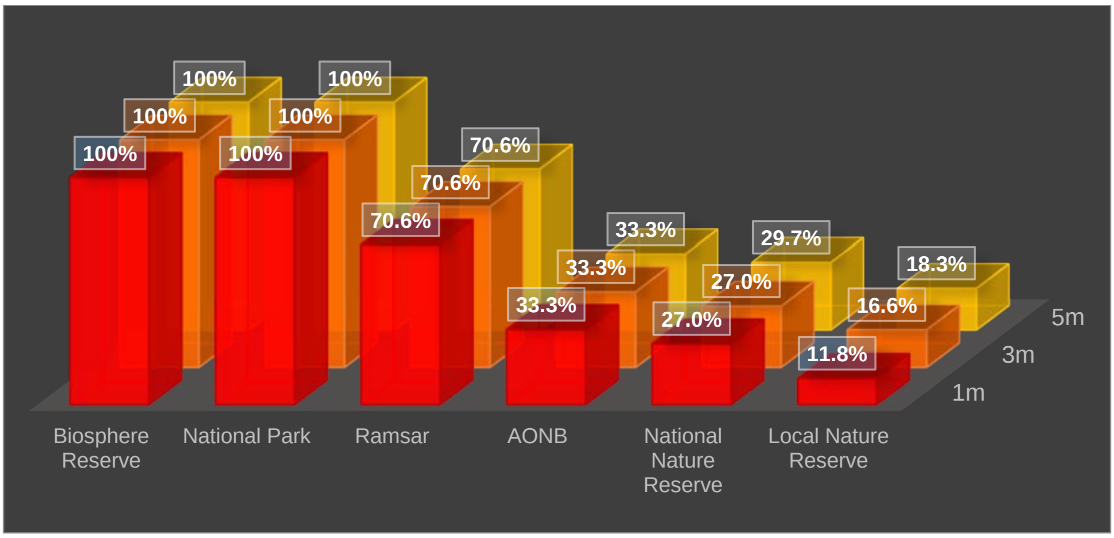

Figure 13. Number of different protected areas types in South-East England exposed to 1m, 3m and 5m SLR inundation

In addition, quantifying the numbers of protected areas potentially affected (to any extent, so long as at least 1% of their area is exposed to inundation) shows that the South East's only biosphere reserve, Brighton and Lewes Downs, and both of its two national parks, New Forest and South Downs, would be affected by inundation even at 1-metre SLR, albeit only in a small proportion (**Appendix D**). More than two thirds of the 17 Ramsar sites would be affected. Three of the nine AONBs declared in the region (Chichester Harbour, High Weald and Isle of Wight) would see a part of their landscape transformed into a waterscape under each of the three scenarios. Local and national nature reserves would be the safest in numbers, with less than a fifth and, respectively, less than a third of their numbers exposed to SLR inundation (**Figure 13**).

4.5. Landmarks exposed to inundation

The elevation in sea level would pose different threats to the two types of landmarks analysed, cultural landmarks and nuclear power plants, under the three scenarios.

4.5.1. Cultural landmarks exposed to inundation

The two World Heritage Sites in South-East England, Blenheim Palace in Oxfordshire and the site of Canterbury Cathedral, St Augustine's Abbey and St Martin's Church in Kent, are not located in low-lying coastal areas. The spatial analysis carried out suggests that both sites would remain completely dry even under the 5-metre SLR inundation scenario.

By contrast, the substantial number of Scheduled Monuments, many of which are located along the coast, signifies that a part of these historical landmarks may not remain safe from inundation (**Appendices E** and **F**). Approximately 4% (106), 8.3% (220) and 10.2% (271) of these landmarks would be affected to some extent (with at least 1% of their area affected) by 1-metre, 3-metre and, respectively, 5-metre SLR inundation (**Figure 14**).

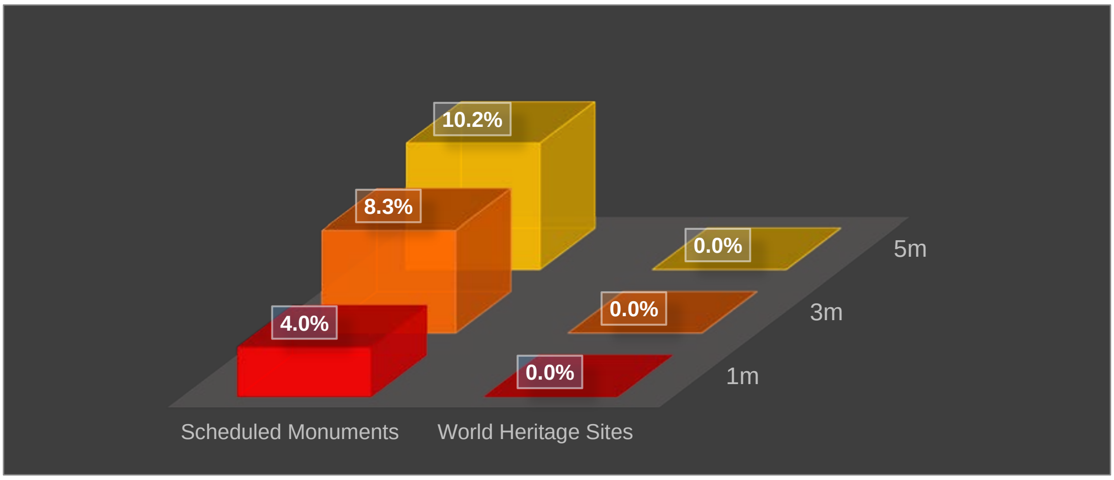

Figure 14. Number of cultural landmarks in South-East England exposed to 1m, 3m and 5m SLR inundation

4.5.2. Nuclear power plants exposed to inundation

The nuclear power station at Dungeness, on the southern coast of Kent, is located in an area of low-lying land which would become the South East's largest inundated area under each of the three SLR scenarios. Although surrounded by inundation, the built-up area of Dungeness, which hosts the nuclear site, would not be affected by it under a 1-metre rise in sea level. However, Dungeness would be almost entirely submerged by a 3-metre rise, and would completely disappear under a 5-metre rise (**Appendix F**).

4.6. Population exposed to inundation

A 1-metre SLR would threaten to displace approximately 1.5% of the population, corresponding to more than 128,000 people that inhabit the South-East's coastal area today. A 3-metre rise could displace 5% of the population, presently corresponding to almost 432,000 inhabitants. The number would rise to 8.9% of the population, or 771,000 people, under the high scenario (**Figure 15**).

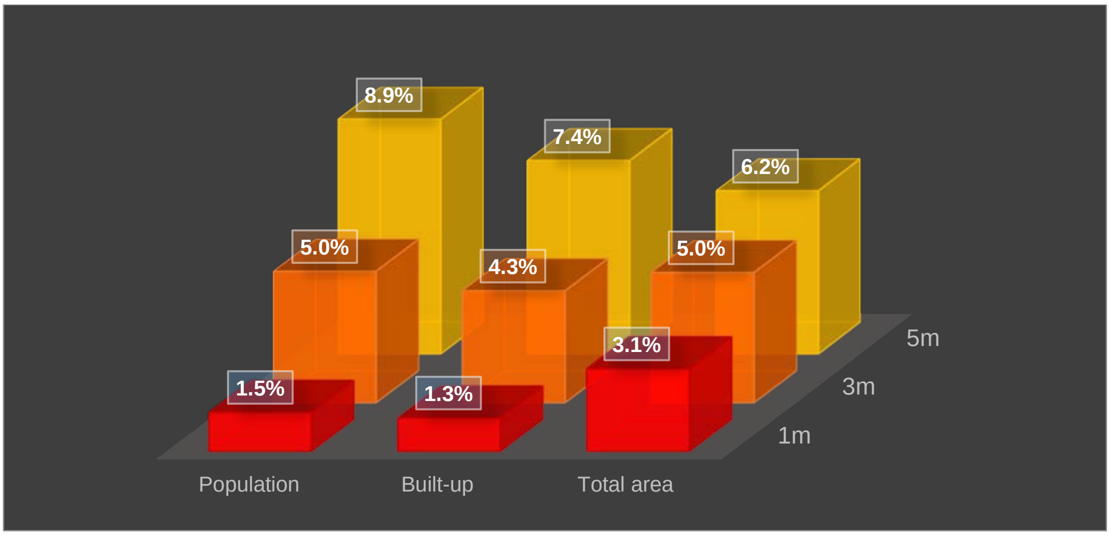

Figure 15. Population, built-up and total area of South-East England exposed to 1m, 3m and 5m SLR inundation

5. DISCUSSION

By applying projections of 1-metre, 3-metre and 5-metre SLR, this study quantified the total area of coastal land and the areas, lengths and/or numbers of various coastal features in South-East England susceptible to direct inundation, showing that the region would suffer minor to major losses under each scenario. Many of the inundated areas identified in this analysis correspond to areas considered to be exposed to floods today, such as Romney Marsh, Pevensey/Eastbourne, Littlehampton and the Solent (Haigh et al. 2011). Many areas with a high natural value are located along the coast, the exposure of wetlands in the region being high, with more than two thirds of the Ramsar sites potentially affected under the low SLR scenario – these results being in line with those of the global analysis conducted for the Ramsar Convention's Scientific and Technical Review Panel (STRP), which found that 85% of coastal Ramsar sites in the world would be affected in some way by a 1-metre rise in sea level (de Sherbinin et al. 2012). The loss of vitally important and critically vulnerable coastal ecosystems indicates that the ecological costs of SLR may be dramatic. Of the cultural landmarks, many Scheduled Monuments, being located immediately adjacent to the coast, will be lost unless they are protected. On the other hand, the two World Heritage Sites would remain completely dry, being located further inland. Similarly, woodland would remain almost intact, since coastal areas are dominated by agricultural land and built-up, the land classes which will be more at risk (**Appendix F**). Since the submerged agricultural land would represent a significant proportion of the region's best agricultural land, its loss would make it difficult to support the entire population (including the relocated population) living on the remaining high ground. While the larger BUAs would be only partially affected, some of the smaller ones, such as Brookland, would almost completely disappear, especially under the higher scenarios (**Appendices C** and **F**). Railways would be more affected than roads, a significant proportion of which gravitate towards Greater London, farther away from the coast (**Appendix F**). Even a short road link or rail line that became inundated, however, could cause wider problems in the transportation network. The South-East's single nuclear power plant would be submerged under the higher scenarios, the main concern being that inundation may cause nuclear waste leaks. Even if the power plant is set to be decommissioned, the radioactive waste stored at the site will continue to generate heat, so it would need to be recovered and moved to higher ground in order to prevent radioactive leaks. Social impacts would be felt especially under the higher scenarios, with SLR projected to displace a significant proportion of the region's population concentrated along the coast (**Appendix F**). The percentage of population exposed to inundation is higher than the percentages of built-up and total area exposed to inundation under the high scenario, but lower under the low scenario (**Figure 15**).

The results presented in the previous section must be interpreted with caution because they provide only rough estimates of possible coastal losses. This section attempts to identify sources of error, to explore uncertainties, to compare these findings to those from other studies, as well as to provide recommendations for future research.

5.1. Spatial accuracy limitations

First, it is important to remark that the research was constrained by the spatial accuracy limitations of the available data sets. The vertical error in the LiDAR data is generally of ±5 cm – this accuracy is excellent, nonetheless, compared to that of elevation data derived from other sources. The lowering of the DTM resolution from the original 2-metre grid cells to 5-metre grid cells, performed to accommodate computing limitations, may have also caused the loss of some topographic detail, such as smaller ditches.

Further uncertainties are associated with the spatial accuracy of the input data used to derive the exposure of various features, particularly land cover classes and population, which have a coarse resolution or are highly generalised and too broad in scale to be employed effectively with high-resolution LiDAR data for local analysis. For instance, the detail-poor data on agricultural land and built-up may be more appropriate for modelling exposure at national scale. In terms of population per grid cell, there may be a relative misplacement error (i.e. a part of the population not being located in the correct grid cell) in the data used, while the coarse resolution of the grid may introduce uncertainties in exposure estimates. Therefore, the values obtained should not be presumed to be exact, but rather seen as estimates of the relative magnitude of potential SLR impacts in the region. At the local scale, more detailed datasets would produce more accurate results.

5.2. Tidal uncertainties

Second, there may be inaccuracies in the tidal model, particularly in those areas where water level data was obtained through interpolation. In addition, there may be uncertainties associated not only with tidal datum elevations, which depend on the length of the time series over which the data were collected, but also with the tidal datum employed as reference for some aspects of costal exposure. For simplicity, the approach used only the MHW vertical datum to assess a variety of potential SLR impacts. The sea could still reach further inland during maximum tides, possibly affecting infrastructure and landmarks that have not been quantified in this study. For instance, a benchmark of Highest Astronomical Tide (HAT), the highest tide predictable from the effects of gravity, may be more appropriate for assessing potential SLR impacts on infrastructure, as it has been previously used by Camill et al. (2012). From this perspective, this study could be underestimating coastal exposure, therefore the estimates and inundation surfaces mapped for each SLR scenario could be seen as likely lower bounds. Given the window of time available, it would have been impractical to carry out a more complex analysis that would employ different tidal datums – based on different stages of the tidal cycle – for assessing specific impacts. However, in terms of awareness-raising, a simple, first-order assessment of coastal exposure in South-East England is valuable.

The above-mentioned limitations, related to data resolution and accuracy, and to the tidal model and datum, may be explored briefly in the context of a map comparison. Since there are no other studies that published findings on exposure to SLR in South-East England, the results cannot be quantitatively compared with others. It is possible, however, to visually compare the extent of inundation delineated in this study with that mapped by Climate Central (2015), zoomed onto a small coastal area of South-East England (**Figure 16**). Both maps show the extent of inundation that could occur under the 5-metre SLR scenario, which corresponds to the pathway of minor carbon cuts (**Table 2**). The global analysis uses satellite-derived surface elevation data with a roughly 90-metre (300-foot) horizontal resolution generated from NASA's Shuttle Radar Topography Mission (SRTM) and a global grid of high tide lines, employing the MHHW line as threshold at which inundation begins to occur. Comparing the inundated area in the town of Selsey (see cover photo of this report) disproves the assumption (despite this regional study using the MHW tidal datum) that the LiDAR-based inundation surface would be larger. While SRTM is biased too high on average, it is biased low in some locations (Kulp and Strauss 2016). Also, we are using not only different tidal datums, but different tidal models. Naturally, the result of the present study, being based on LiDAR-derived bare earth elevation data and local tidal data, can be trusted more than the global scale model of Climate Central, as confirmed by Strauss (pers. comm.).

5.3. Dynamic effects uncertainties

Third, the model did not incorporate dynamic effects such as coastal erosion and sedimentation (wetland accretion). The study is based on a static approach, the bathtub models characterising a fixed representation which does not take into account the constant changes in coastal geomorphology, erroneously assuming that present conditions in the complex coastal systems will persist (Zhang 2011). In some contexts, erosion could amplify the impacts of SLR, especially by destroying the natural or manmade barriers separating the inland from seawater. Erosion is considered, however, to be a much smaller source of land losses than direct inundation (Paprotny and Terefenko 2016). Since the model cannot predict future inundation with full accuracy, some uncertainties remain that would need to be resolved by local-level assessments, for instance by mapping areas at risk of erosion as done by Crapoulet et al. (2016).

Due to dynamic effects, there are also uncertainties related to the number of Ramsar sites susceptible to permanent inundation. An accelerated SLR will limit the capacity of coastal ecosystems to adapt, but, if they can keep pace with the future rise, coastal wetlands may be able to vertically accrete or migrate inland, as long as their migration is not impeded by topographical barriers, urban development or shoreline defence structures, which would result in “coastal squeeze” (Nagle 1998; Cooper et al. 2008; Zhang 2011; de Sherbinin et al. 2012; Blankespoor et al. 2014). The simple analysis performed in this study is sufficient to suggest that future SLR could have a significant impact on the South-East’s coastal ecosystems. However, considering that coastal wetlands provide a large number of ecosystem services, including storm buffering, shoreline stabilisation, carbon sequestration and climate regulation (Brown et al. 2013; Blankespoor et al. 2014), their potential for landward migration in the region should be investigated in order to trigger action aimed at protecting them.

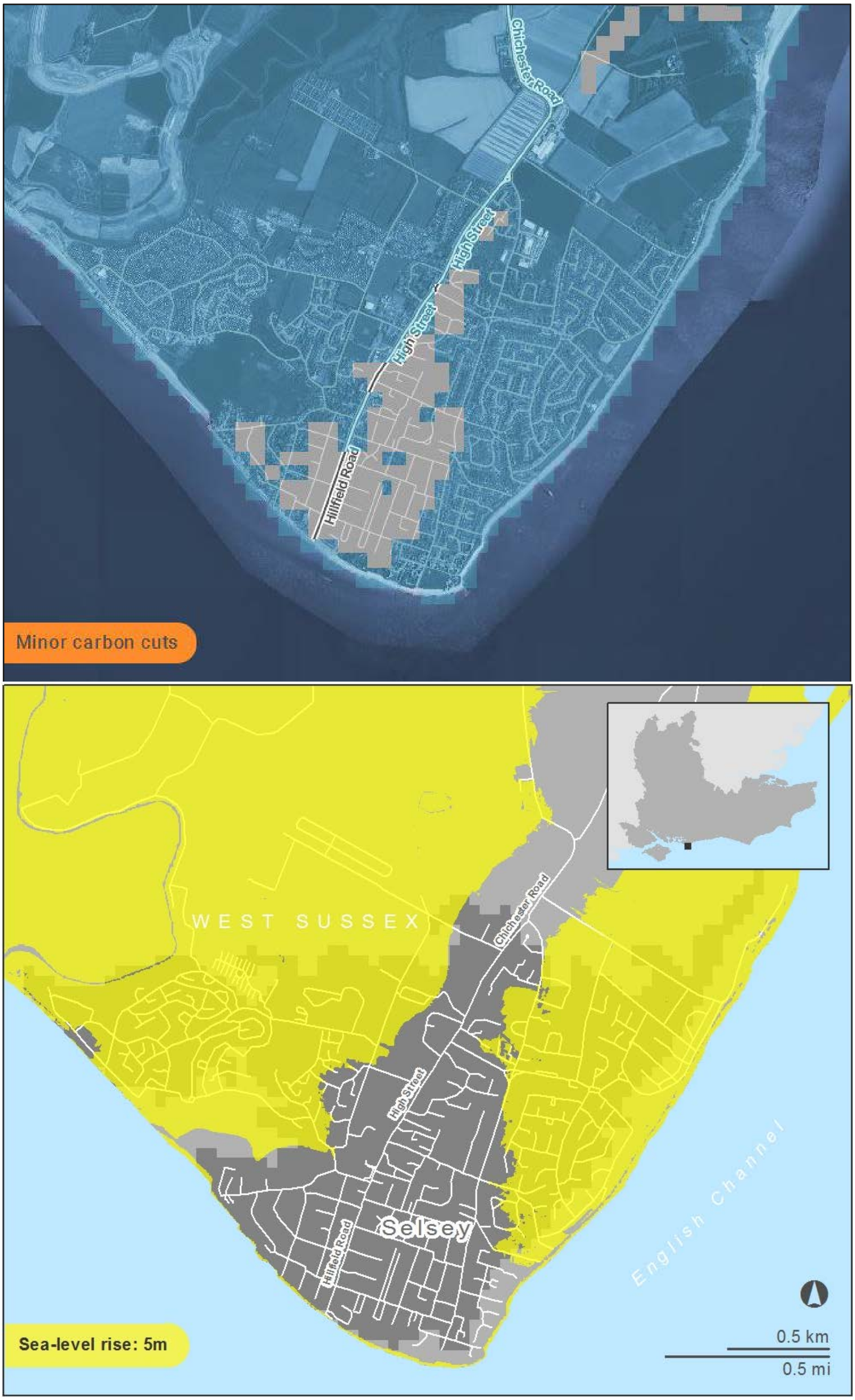

Figure 16. A 5m SLR inundation (corresponding to the pathway of minor carbon cuts) in the town of Selsey as illustrated by the Mapping Choices sea-level interactive map tool from Climate Central (above; source: http://choices.climatecentral.org/) compared with present study (below)

5.4. Adaptation uncertainties

Fourth, the model did not take into account coastal protection structures, such as levees (sea walls), which would have been difficult to incorporate into the analysis due to uncertainty about their extent and form. Future impacts will depend not only on the magnitude of SLR but also on the implementation of adaptation measures which may be planned as a response to the gradual rise in sea level, amongst other factors (Nicholls 2011). As suggested by Anthoff et al. (2010), protection structures have the potential to significantly reduce total damages. Therefore, by not considering shoreline defences, this analysis may have led to an overestimation of the inundated area.

It is recommended that future studies compare coastal impacts in the region with and without adaptation measures, as in the study by Mokrech et al. (2008). Prior to designing new coastal defence structures, the effect of SLR inundation on storm surge flooding will also need to be mapped.

The information derived from this study is extremely relevant for local policy-makers and coastal planners. In some areas, particularly in those that are more densely populated, protection measures may need to be taken, such as soft or hard engineering defences (e.g. broadening coastal dunes, strengthening sea and river dikes, constructing sea walls), as well as drawing up worst-case plans for evacuations and relocations. In some cases, it will be necessary to decide if the land really needs to be protected or whether it would make more economic sense to abandon it to the sea. It is recommended that, especially in areas with a high social, economic and environmental value, adaptation measures for a 5m SLR inundation scenario are implemented without delay.

5.5. Socioeconomic uncertainties

Fifth, the results do not account for future socioeconomic changes, such as expansion of the transport infrastructure, urban development, and population growth, decline or relocation. Since such factors have not been modelled jointly with the SLR simulation, this analysis did not consider their interaction. We do not know how the residents of South-East England will respond to gradual SLR. By ignoring a growing coastal population and expanding infrastructure in the coastal lowlands, this study may be underestimating the potential damage. Anticipating these changes, however, is essential for the sustainable development of coastal areas. It is recommended, therefore, that SLR impacts are further examined under future social and economic scenarios, which would allow to assess the vulnerability to the elevation in sea level, similarly to how it has been previously explored in other studies (Mokrech et al. 2008; Anthoff et al. 2010; Demirel et al. 2015; Neumann et al. 2015).

This study did not consider in any detail the economic costs of SLR impacts, for example the cost of insuring property, the value of wetlands, or the cost of recovering hazardous waste along the coast and moving it to higher ground – nor did it consider the costs of adaptation measures that may be implemented to reduce these impacts. Given that inundation may result in substantial economic costs, it is recommended to assign a currency value to potential impacts (Camill et al.

2012). Further research should, therefore, estimate the value of inundated assets, which would allow to identify the most appropriate type and magnitude of adaptation measures.

Although this analysis was designed to highlight various social, economic and environmental impacts of SLR that would interest most community members, a complete analysis of SLR impacts was beyond the scope of this research. In order to effectively implement SLR impact and vulnerability assessments, future studies should promote a bottom-up development of regional planning, instead of a top-down, one-way flow of information. As recommended by Camill et al. (2012), science-based information at the local level should identify and incorporate the needs, values and beliefs of the local community and stakeholders, i.e. those who must decide what legacy to leave for future generations.

5.6. Temporal uncertainties

Finally, important sources of uncertainty remain – not only spatial uncertainty, but also temporal uncertainty. This analysis assumed three different rises in sea level that are set to occur at some point in the future, without necessarily accounting for the time period over which such rises may occur. The time profiles of a 1-metre, a 3-metre and a 5-metre rise in sea-level are not assessed – these scenarios being taken as a given – because it is difficult to pinpoint *when* exactly these coastal changes could take place. We know that a 5-metre SLR, set to be locked-in due to the unavoidable 2°C of warming, may occur well-beyond 2100, but that, at the same time, such a high rise this century is not impossible.

As the global scientific knowledge advances, more precise temporal forecasts should be made to trigger timely local adaptation responses. Until then, despite all these uncertainties, initial estimates of SLR impacts in the region, such as those provided by this research, are valuable. Local communities cannot wait for the arrival of extensive and direct evidence of SLR consequences before starting to take measures. In the words of Nicholls (2011), "the most appropriate timing for an adaptation response needs to be considered in terms of anticipatory versus reactive planned adaptation (or, in practical terms, what should we do today, versus wait and see until tomorrow)".

6. CONCLUSIONS

A clear indicator of climate change and one of its main consequences, the gradual elevation of the sea level is projected to affect most coastlines around the world. The aim of this study was to explore SLR exposure on the coast of South-East England by conducting a broad analysis of some of the possible impacts of marine inundation in the region. The potential effects of SLR on the total land area, transport infrastructure, built-up, agricultural land, woodland, protected areas, landmarks and population were mapped and quantified by applying a modified bathtub modelling approach in GIS to a low-elevation coastal DTM derived from the latest, high-resolution, high-accuracy LiDAR data. The inundation modelling was performed for three projected scenarios, with SLR magnitudes of 1 metre, 3 metres and 5 metres, chosen from the range of possible SLR scenarios in the literature. Mapping of areas at risk of inundation was referenced to the MHW high tide line, with all land situated below each water level assessed, and connected to the sea, being counted as submerged. Based on these models, future SLR was estimated to have varied possible consequences in the British region due to permanent inundation, in the absence of adaptation. The findings of the study were the following:

(i) The total land area inundated would have approximately 601 km^2 (3.1% of South-East England) under the 1-metre SLR scenario, jumping to 946 km^2 (5%) under the 3-metre scenario, and to almost 1,186 km^2 (6.2%) under the 5-metre scenario.

(ii) Kent would be the county with the largest proportion of its area submerged, under all scenarios analysed.

(iii) Roads would have 1.4% (929 km), 4% (2,588 km), and 6.5% (4,149 km) of their total length in the region submerged under the low, the medium, and, respectively, the high scenario. Minor roads would be more affected than major roads.

(iv) Railways would be more affected than roads, with roughly 2% (43 km), 7.4% (155 km) and, respectively, 10.2% (214 km) of the rail lines' length threatened by inundation.

(v) The area of built-up exposed to permanent submergence represents roughly 1.3% (32 km^2), 4.3% (107 km^2) and 7.4% (185 km^2), respectively, of the total built-up area in the region.

(vi) The area of agricultural land exposed to inundation represents approximately 3.7% (512 km^2), 5.3% (512 km^2), and, respectively, 6.3% (857 km^2) of the region's total agricultural land area.

(vii) Woodland would remain almost untouched by inundation, with as little as 0.03% (0.5 km^2), 0.1% (1.8 km^2), and, respectively, 0.2% (3.6 km^2) of its total area in the region potentially submerged.

(viii) Protected areas would have roughly 3.4% (256 km^2), 4.8% (357 km^2) and, respectively, 5.4% (406 km^2) of their total land area in the region submerged. National nature reserves and Ramsar sites could lose up to nearly a half of their total land area in the region. Inundation would affect to some extent more than two thirds of the Ramsar sites, the biosphere reserve, the two national parks and three of the nine AONBs, while local and national nature reserves would have less than a third of their numbers affected.

(ix) Of the cultural landmarks, as many as 4% (106), 8.3% (220) and, respectively, 10.2% (271) of the Scheduled Monuments are situated below future high tide levels. The two World Heritage Sites in the region would remain safe from inundation.

(x) The South-East's single nuclear power station, at Dungeness, is exposed to inundation under the 3-metre and the 5-metre SLR scenarios.

(xi) The number of people that would need to be relocated rises to 1.5% of the population (presently corresponding to over 128,000 people) under the low scenario, 5% (almost 432,000 people) under the medium scenario, and 8.9% (approximately 771,000 people) under the high scenario.

While this study has not been a comprehensive analysis of coastal exposure in the region, it has provided first estimates of some of the possible consequences of SLR-induced inundation, which should be taken as reasonable guesses and as first steps towards future investigations. One should consider that the analysis was constrained by the spatial accuracy limitations of the input data sets, as well as by simplifications of the model used, which may be under-portraying or over-portraying the potential extent of inundation and damage in the region. The next step would be to carry out a more in-depth analysis of the full exposure and vulnerability to SLR, by employing complex modelling techniques that incorporate various factors, such as the dynamics of coastal processes, population and economic projections, and the impact of protection structures on the future coastline. Moreover, involving local stakeholders in the assessment process and assigning a currency value to coastal assets would help to determine the most appropriate adaptation measures that would need to be considered in the face of rising seas – these will also need to take into account the effect of SLR on storm surges. Much uncertainty is associated with the possible timescale of SLR, so how soon these scenarios could become reality remains to be seen, depending on the continuous increase in greenhouse gas emissions which is altering the delicate balance between the Earth's systems, as well as on human responses in the coastal zone. Accelerated or not, the elevation of the sea level is a long-term threat which will continue through the twenty-first century and beyond, therefore a timely and ongoing adaptation response is vital for building resilient and sustainable coastal communities.

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APPENDIX A. Table of data used in the assessment

DATA		TYPE	RESOLUTION / ACCURACY / SCALE / OTHER NOTES	SOURCE(S)
ADMINISTRATIVE BOUNDARIES	Regions (Dec. 2015) in England	Vector (Polygon)	Full resolution (not generalised) - clipped to the coastline (MHW mark)	Office for National Statistics, Ordnance Survey data © Crown copyright and database right 2015
	Counties (Dec. 2015) in England	Vector (Polygon)		
ELEVATION	Elevation contours ("OS Terrain 50")	Vector (Contours)	Vertical interval: 10 m; Scale: 1:50,000	Ordnance Survey data © Crown copyright and database right 2016
	LiDAR data ("Composite DTM 2m")	ASCII Grid	Resolution: 2 m; Vertical accuracy: +/-5 to 15 cm	© Environment Agency copyright and database right 2016
	Tidal data (MHW from "OS Terrain 50")	Vector (Contours)	Vertical interval: 10 m; Scale: 1:50,000	Ordnance Survey data © Crown copyright and database right 2016
TRANSPORT	Roads ("OS Open Roads")	Vector (Polyline)	Nominal viewing scale: 1:25,000	Ordnance Survey data © Crown copyright and database right 2016
	Railways (from "OS Meridian 2")	Vector (Polyline)	Nominal viewing scale: 1:50,000	
LAND COVER	Built-up areas (Dec. 2011) Boundaries	Vector (Polygon)	Boundaries generalised and based on a 50-m grid	Office for National Statistics, Ordnance Survey data © Crown copyright and database right 2015
	Agricultural land (from "Corine land cover 2012 for the UK, Jersey and Guernsey")	Vector (Polygon)	Scale: 1:100,000; Min. mapping unit: 25 ha; Min. mapping width: 100 m; Geometric accuracy (satellite data): ≤25m; Geometric accuracy (CLC): <100 m;	Natural Environment Research Council © European Commission 2012
	Woodland (from "OS Meridian 2")	Vector (Polygon)	Nominal viewing scale: 1:50,000	Ordnance Survey data © Crown copyright and database right 2016
PROTECTED AREAS	Areas of Outstanding Natural Beauty (England)	Vector (Polygon)	No further information available	© Natural England. Ordnance Survey data © Crown copyright and database right 2016
	Biosphere Reserves (England)	Vector (Polygon)		
	Local Nature Reserves (England)	Vector (Polygon)		
	National Nature Reserves (England)	Vector (Polygon)		
	Ramsar (England)	Vector (Polygon)		
	National Parks (Aug. 2016) Full Clipped Boundaries in Great Britain	Vector (Polygon)	Full resolution - clipped to the coastline (MHW mark)	Office for National Statistics. Ordnance Survey data © Crown copyright and database right 2016
LANDMARKS	Scheduled Monuments in England	Vector (Polygon)	Capture scale (different for each feature): 1:1,250 – 1: 25,000	© Historic England 2017. Ordnance Survey data © Crown copyright and database right 2017
	World Heritage Sites in England	Vector (Polygon)	Capture scale: 1:10,000	
	Nuclear power plants in the UK	Vector (Point)	(Location confirmed on the NDA website)	© OpenStreetMap contributors 2017
POPULATION	UK Gridded Population (based on Census 2011 and Land Cover Map 2007)	Vector (Polygon) Grid	Spatial resolution:1 km x 1 km	© Natural Environment Research Council 2016. National Statistics data © Crown copyright and database right 2011

APPENDIX B. Table of impact assessment results

FEATURES ASSESSED		TOTAL AREA / LENGTH / NUMBER	AREA / LENGTH / NUMBER OF INUNDATED FEATURES			PERCENTAGE OF INUNDATED FEATURES		
			1m SLR	3m SLR	5m SLR	1m SLR	3m SLR	5m SLR
			AREA (km²)			%		
Total area – South-East England		19,100.92	600.91	946.14	1,185.63	3.15	4.95	6.21
Counties	Kent	3,739.86	382.78	548.07	604.91	10.24	14.65	16.17
	East Sussex	1,796.02	138.29	172.55	202.20	7.70	9.61	11.26
	West Sussex	1,991.94	51.34	128.07	229.89	2.58	6.43	11.54
	Isle of Wight	380.52	3.81	16.49	22.44	1.00	4.33	5.90
	Hampshire	3,772.75	24.70	80.95	126.20	0.65	2.15	3.34
Land cover	Built-up	2,510.33	31.97	106.85	184.71	1.27	4.26	7.36
	Agricultural land	13,644.48	511.53	716.99	857.38	3.75	5.25	6.28
	Woodland	1,894.20	0.52	1.81	3.64	0.03	0.10	0.19
Protected areas	AONBs	4,941.14	68.77	93.60	122.88	1.39	1.89	2.49
	Biosphere Reserves	290.80	16.11	24.52	29.38	5.54	8.43	10.10
	Local Nature Reserves	92.55	11.82	17.05	18.25	12.77	18.42	19.72
	National Nature Reserves	79.86	25.46	34.96	37.22	31.88	43.77	46.61
	National Parks	2,174.37	42.65	62.48	75.33	1.96	2.87	3.46
	Ramsar	520.32	161.92	213.28	216.91	31.12	40.99	41.69
	Total protected area *	7,467.24	255.56	356.89	405.84	3.42	4.78	5.43
			LENGTH (km)			%		
Roads	Motorways	908.53	0.28	3.04	10.33	0.03	0.33	1.14
	A Roads	5,590.34	74.11	232.03	348.62	1.33	4.15	6.24
	B Roads	3,074.70	26.35	82.37	151.29	0.86	2.68	4.92
	Minor/local/other roads	54,470.73	827.80	2,270.02	3,638.25	1.52	4.17	6.68
	All roads	64,044.30	928.55	2,587.46	4,148.49	1.45	4.04	6.48
Railways		2,085.67	42.52	154.76	213.58	2.04	7.42	10.24
			NUMBER			%		
Protected areas **	AONBs	9	3	3	3	33.33	33.33	33.33
	Biosphere Reserves	1	1	1	1	100.00	100.00	100.00
	Local Nature Reserves	289	34	48	53	11.76	16.61	18.34
	National Nature Reserves	37	10	10	11	27.03	27.03	29.73
	National Parks	2	2	2	2	100.00	100.00	100.00
	Ramsar	17	12	12	12	70.59	70.59	70.59
	All protected areas	355	62	76	82	17.46	21.41	23.10
Landmarks **	Scheduled Monuments	2,650	106	220	271	4.00	8.30	10.23
	World Heritage Sites	2	-	-	-	-	-	-
	Nuclear Power Plants	1	-	1	1	-	100.00	100.00
Population		8,634,750	128,428	431,793	771,128	1.49	5.00	8.93

*** Note:** The total protected area takes into account the fact that some types of protected areas (or parts of them) overlap.

**** Note**: All protected areas and landmarks with over 1% of their land area in South-East England exposed are taken into account.

APPENDIX C. Table of built-up areas exposed to inundation

NO°	BUA *	TOTAL AREA **	AREA EXPOSED TO INUNDATION (ha)			AREA EXPOSED TO INUNDATION (%)		
			1m SLR	3m SLR	5m SLR	1m SLR	3m SLR	5m SLR
1	Brookland	25.49	25.49	25.49	25.49	100.00	100.00	100.00
2	Lydd Airport	120.71	112.44	120.71	120.71	93.15	100.00	100.00
3	St Mary's Bay	92.22	88.24	92.22	92.22	95.69	100.00	100.00
4	Dymchurch	153.95	153.66	153.88	153.95	99.81	99.96	100.00
5	Shripney	25.76	-	25.69	25.76	-	99.70	100.00
6	Pevensey Bay	102.26	91.02	101.40	102.26	89.01	99.16	100.00
7	Lydd	134.22	51.56	132.27	134.22	38.42	98.55	100.00
8	North Hayling	31.05	1.06	19.87	31.05	3.42	63.99	100.00
9	West Wittering	61.35	0.25	24.41	61.35	0.40	39.78	100.00
10	Dungeness	91.47	-	77.87	91.46	-	85.13	99.99
11	New Romney	337.64	87.24	295.61	337.59	25.84	87.55	99.99
12	East Wittering	213.56	0.18	34.88	213.33	0.08	16.33	99.89
13	Thorney Island	99.06	29.98	73.25	98.95	30.26	73.94	99.89
14	Stoke (Havant)	58.05	0.09	34.21	57.94	0.15	58.92	99.81
15	Warehouses, nr Kemsley	20.25	16.80	20.10	20.21	82.99	99.28	99.81
16	Rye Harbour	27.97	18.02	27.08	27.89	64.43	96.83	99.71
17	Sheerness	269.06	205.90	262.45	268.25	76.52	97.54	99.70
18	Almodington	77.05	-	0.42	76.56	-	0.55	99.37
19	Sandwich Bay Estate	23.73	-	22.18	23.54	-	93.44	99.16
20	Camber	69.74	52.62	67.54	68.68	75.46	96.85	98.49
21	Ridham Dock	26.89	16.64	25.79	26.47	61.88	95.89	98.42
22	Wouldham	13.94	2.83	9.80	13.57	20.31	70.30	97.35
23	Kingsnorth	122.10	17.97	94.01	117.74	14.72	77.00	96.43
24	Bosham Hoe	19.66	1.28	6.60	18.75	6.50	33.58	95.39
25	Great Stonar	133.94	11.34	110.27	126.77	8.47	82.33	94.65
26	Sandwich	157.33	57.62	112.48	148.28	36.62	71.50	94.25
27	Ower	48.94	1.25	43.95	45.30	2.55	89.81	92.57
28	Grain	606.13	297.94	524.96	544.99	49.15	86.61	89.91
29	Bognor Regis	1,656.71	6.29	566.37	1,476.67	0.38	34.19	89.13
30	South Hayling	447.57	16.84	174.72	396.69	3.76	39.04	88.63
31	Yapton	199.11	0.55	13.72	167.38	0.28	6.89	84.06
32	Highleigh/Street End	207.37	6.18	50.67	169.82	2.98	24.43	81.89
33	West Itchenor	96.94	12.03	25.90	78.22	12.41	26.71	80.68
34	Birdham	109.83	0.27	2.85	88.49	0.25	2.60	80.57
35	Winchelsea Beach	99.99	67.47	74.22	74.95	67.48	74.23	74.96
36	Selsey	373.30	60.41	192.55	271.34	16.18	51.58	72.69
37	Hoo Marina Park	21.07	0.02	5.27	14.52	0.08	25.02	68.89
38	Bosham	121.52	3.24	32.38	82.66	2.66	26.65	68.02
39	Hunston	30.77	-	1.63	19.57	-	5.31	63.60
40	Worth	57.22	-	9.29	33.48	-	16.24	58.51
41	Rye	172.04	67.05	86.42	89.77	38.98	50.24	52.18
42	Marchwood	246.35	1.11	96.54	125.67	0.45	39.19	51.01
43	Lower Halstow	33.60	0.05	4.30	17.14	0.16	12.81	51.01
44	Hamstreet	47.49	8.68	18.77	23.96	18.27	39.53	50.46
45	Amberley	20.26	7.77	8.81	10.08	38.33	43.49	49.73
46	Westham	75.01	10.30	24.93	34.18	13.74	33.24	45.57
47	Yarmouth	41.66	1.81	11.60	18.56	4.34	27.85	44.55
48	Deal	681.31	-	158.06	301.22	-	23.20	44.21
49	Wingham	46.98	8.05	15.19	20.24	17.14	32.32	43.09
50	Leysdown-on-Sea	163.69	0.09	36.00	69.45	0.06	21.99	42.43

51	Newhaven	357.15	74.54	120.65	133.84	20.87	33.78	37.48
52	Minster (Swale)	646.50	104.89	191.52	242.08	16.22	29.62	37.45
53	Eastbourne	2,512.81	548.03	758.15	899.14	21.81	30.17	35.78
54	Appledore	52.99	6.02	10.23	17.51	11.37	19.31	33.04
55	Ditton	868.84	-	178.32	240.19	-	20.52	27.64
56	Yorkletts	73.73	-	6.18	18.56	-	8.38	25.17
57	Lower Stoke	21.75	-	1.33	5.39	-	6.10	24.77
58	Brighton and Hove	8,902.64	210.18	729.57	2,203.94	2.36	8.19	24.76
59	Lewes	370.75	0.10	68.02	90.94	0.03	18.35	24.53
60	Arundel	105.23	10.91	22.64	25.59	10.37	21.52	24.32
61	Cuxton	155.75	0.08	15.92	37.25	0.05	10.22	23.92
62	Cliff End	36.50	5.02	7.48	8.65	13.75	20.49	23.70
63	Faversham	434.58	1.06	36.30	101.22	0.24	8.35	23.29
64	Steyning	293.78	8.37	45.41	68.32	2.85	15.46	23.26
65	Lympne	61.23	8.24	13.17	14.04	13.45	21.52	22.94
66	Minster (Thanet)	128.43	3.21	14.01	29.02	2.50	10.91	22.60
67	South Hampshire	18,982.84	288.14	2,203.78	3,994.79	1.52	11.61	21.04
68	Milford on Sea	275.67	4.03	19.02	57.76	1.46	6.90	20.95
69	Sittingbourne	1,162.42	9.35	95.29	240.85	0.80	8.20	20.72
70	Snodland	219.70	0.07	23.62	43.36	0.03	10.75	19.74
71	Beaulieu	19.79	0.23	1.25	3.88	1.18	6.30	19.58
72	Herne Bay/Whitstable	1,845.47	2.41	183.87	333.67	0.13	9.96	18.08
73	Cliffe	50.00	4.66	6.54	8.65	9.32	13.08	17.29
74	Emsworth	612.60	4.94	40.16	105.92	0.81	6.56	17.29
75	Lymington	666.29	12.82	52.12	101.90	1.92	7.82	15.29
76	Rookery Hill	39.26	2.90	5.05	5.41	7.38	12.88	13.78
77	Woodchurch	60.74	-	0.05	8.12	-	0.08	13.36
78	Rodmell	27.76	0.91	2.30	3.48	3.30	8.30	12.53
79	Folkestone	1,673.08	109.71	186.87	207.82	6.56	11.17	12.42
80	Nurseries, nr Ash (Dover)	27.48	-	0.07	3.41	-	0.26	12.40
81	Chichester	1,106.61	2.48	21.51	130.34	0.22	1.94	11.78
82	Hamble-le-Rice	160.91	0.27	6.81	18.94	0.17	4.23	11.77
83	Sturry	254.16	0.25	23.21	29.76	0.10	9.13	11.71
84	Freshwater	347.14	13.37	26.65	39.93	3.85	7.68	11.50
85	Blackfield	838.09	25.22	72.87	94.93	3.01	8.69	11.33
86	Sandown/Shanklin	605.14	0.05	46.41	65.34	0.01	7.67	10.80
87	Bembridge	269.91	0.21	17.81	27.68	0.08	6.60	10.25
88	Totton	1,033.22	1.41	42.09	104.34	0.14	4.07	10.10
89	Seaford	632.64	6.79	10.54	62.57	1.07	1.67	9.89
90	Ryde	748.64	1.04	51.05	70.13	0.14	6.82	9.37
91	Dover	1,010.30	2.72	26.89	94.40	0.27	2.66	9.34
92	Brading	69.80	-	2.47	6.23	-	3.54	8.93
93	Norton (Isle of Wight)	42.27	0.13	1.59	3.73	0.30	3.77	8.82
94	Allhallows-on-Sea	53.41	0.11	1.25	4.67	0.21	2.35	8.74
95	Cowes	605.57	4.39	38.04	51.89	0.73	6.28	8.57
96	Hythe	567.99	3.59	30.82	48.16	0.63	5.43	8.48
97	Bury	42.77	<0.01	0.99	3.44	0.01	2.31	8.03
98	Medway Towns	5,135.74	38.87	315.94	399.89	0.76	6.15	7.79
99	Crowhurst	67.50	-	-	4.69	-	-	6.95
100	Westergate	550.81	-	5.75	33.97	-	1.04	6.17
101	Stubbington	654.68	8.48	20.77	39.73	1.30	3.17	6.07
102	Standford Hill Prison	56.49	-	1.24	3.36	-	2.19	5.95
103	Wootton (Isle of Wight)	220.91	0.17	7.85	12.81	0.08	3.55	5.80
104	Works, nr Hythe	36.52	-	0.08	1.95	-	0.23	5.34
105	Canterbury	1,319.23	-	11.77	56.92	-	0.89	4.31

106	Hastings	3,319.00	5.17	14.65	142.79	0.16	0.44	4.30
107	Newport (Isle of Wight)	670.90	-	10.03	22.81	-	1.50	3.40
108	Preston (Dover)	27.74	0.04	0.27	0.93	0.14	0.98	3.35
109	St Helens	58.79	-	1.74	1.95	-	2.95	3.31
110	Kingsdown (Dover)	78.70	-	2.00	2.48	-	2.54	3.15
111	Netley	145.63	0.68	2.18	4.10	0.46	1.50	2.82
112	West Chiltington Common	500.32	0.30	4.34	13.92	0.06	0.87	2.78
113	Greater London	30,021.41	35.19	620.35	807.30	0.12	2.07	2.69
114	Upchurch	43.44	0.01	0.22	1.12	0.03	0.50	2.59
115	Thanet	2,729.99	5.26	25.85	70.62	0.19	0.95	2.59
116	Maidstone	2,544.69	-	25.02	62.72	-	0.98	2.46
117	Fittleworth	52.28	-	0.14	1.17	-	0.28	2.25
118	Iwade	56.24	-	-	1.20	-	-	2.14
119	Shalfleet	20.76	-	0.02	0.41	-	0.09	1.98
120	Teynham	74.74	-	0.59	1.41	-	0.79	1.88
121	Winford (Isle of Wight)	71.05	-	0.15	1.27	-	0.21	1.79
122	Cliffs End	400.21	0.07	4.50	6.08	0.02	1.13	1.52
123	Alfriston	41.01	-	0.02	0.58	-	0.05	1.41
124	Ash (Dover)	89.70	-	-	1.26	-	-	1.40
125	Small Dole	56.52	-	-	0.74	-	-	1.30
126	Newchurch	31.27	-	-	0.36	-	-	1.16
127	Coldwaltham	29.02	-	0.01	0.29	-	0.04	1.01

*** Note**: All BUAs with over 1% of their area exposed to inundation are taken into account.

**** Note**: The total area represents the BUA area within the region of South-East England, not considering the area of BUAs that may extend into neighbour regions.

APPENDIX D. Tables of protected areas exposed to inundation

Table 1. Areas of Outstanding Natural Beauty in South-East England exposed to sea-level rise inundation

NO°	AONB	TOTAL AREA *	AREA EXPOSED TO INUNDATION (ha)			AREA EXPOSED TO INUNDATION (%)		
			1m SLR	3m SLR	5m SLR	1m SLR	3m SLR	5m SLR
1	Chichester Harbour	4,175.19	678.75	1,788.35	3,407.72	16.26	42.83	81.62
2	High Weald	146,094.78	5,174.51	6,115.38	7,068.31	3.54	4.19	4.84
3	Isle of Wight	18,903.38	285.14	658.84	946.52	1.51	3.49	5.01

Table 2. Ramsar sites in South-East England exposed to sea-level rise inundation

NO°	RAMSAR	TOTAL AREA *	AREA EXPOSED TO INUNDATION (ha)			AREA EXPOSED TO INUNDATION (%)		
			1m SLR	3m SLR	5m SLR	1m SLR	3m SLR	5m SLR
1	Portsmouth Harbour	25.84	17.06	23.45	25.84	66.00	90.73	100.00
2	Pagham Harbour	290.80	188.04	271.85	290.50	64.66	93.49	99.90
3	Stodmarsh	470.37	453.54	468.17	469.46	96.42	99.53	99.81
4	Dungeness, Romney Marsh & Rye Bay	5,283.30	3,925.81	5,192.97	5,272.18	74.31	98.29	99.79
5	Arun Valley	528.98	503.59	523.76	527.02	95.20	99.01	99.63
6	The Swale	3,650.33	2,914.35	3,602.65	3,626.94	79.84	98.69	99.36
7	Pevensey Levels	3,586.51	3,434.61	3,514.69	3,554.14	95.76	98.00	99.10
8	Thames Estuary & Marshes	2,863.99	1,488.15	2,820.61	2,829.13	51.96	98.49	98.78
9	Medway Estuary & Marshes	1,596.49	1,257.15	1,536.82	1,569.31	78.74	96.26	98.30
10	Chichester & Langstone Harbours	699.79	504.97	647.46	673.95	72.16	92.52	96.31
11	Thanet Coast & Sandwich Bay	854.47	119.49	782.28	822.74	13.98	91.55	96.29
12	Solent & Southampton Water	2,103.48	1,385.55	1,939.20	2,000.99	65.87	92.19	95.13

Table 3. National Parks in South-East England exposed to sea-level rise inundation

NO°	NATIONAL PARK	TOTAL AREA *	AREA EXPOSED TO INUNDATION (ha)			AREA EXPOSED TO INUNDATION (%)		
			1m SLR	3m SLR	5m SLR	1m SLR	3m SLR	5m SLR
1	New Forest	52,429.28	850.78	1,527.11	2,078.51	1.62	2.91	3.96
2	South Downs	165,007.79	3,414.21	4,721.21	5,454.55	2.07	2.86	3.31

*** Note**: The total area represents the land area within the region of South-East England, as calculated from the MHW line, and does not take into account the area of protected land that may extend into neighbour regions.

Table 4. National Nature Reserves in South-East England exposed to sea-level rise inundation

NO°	NATIONAL NATURE RESERVE	TOTAL AREA *	AREA EXPOSED TO INUNDATION (ha)			AREA EXPOSED TO INUNDATION (%)		
			1m SLR	3m SLR	5m SLR	1m SLR	3m SLR	5m SLR
1	Dungeness	1,020.89	330.08	959.79	1,020.71	32.33	94.01	99.98
2	Sandwich & Pegwell Bay	138.26	43.13	109.20	136.49	31.20	78.98	98.73
3	Pevensey Levels	183.60	177.92	179.42	180.43	96.91	97.72	98.27
4	The Swale	219.21	200.65	211.06	214.35	91.53	96.28	97.78
5	Titchfield Haven	119.73	109.63	113.72	116.22	91.57	94.98	97.07
6	Elmley	1,208.21	1,078.25	1,138.34	1,170.38	89.24	94.22	96.87
7	Stodmarsh	249.72	235.08	239.03	240.28	94.14	95.72	96.22
8	North Solent	718.03	325.77	487.36	575.08	45.37	67.88	80.09
9	Newtown Harbour	104.09	43.63	53.51	61.07	41.91	51.41	58.67
10	High Halstow	52.52	1.57	3.93	5.23	2.99	7.48	9.96
11	Ham Street Woods	97.08	-	0.43	1.88	-	0.44	1.94

Table 5. Local Nature Reserves in South-East England exposed to sea-level rise inundation

NO°	LOCAL NATURE RESERVE	TOTAL AREA *	AREA EXPOSED TO INUNDATION (ha)			AREA EXPOSED TO INUNDATION (%)		
			1m SLR	3m SLR	5m SLR	1m SLR	3m SLR	5m SLR
1	Calshot Marshes	19.67	19.67	19.67	19.67	100.00	100.00	100.00
2	Eames Farm	115.08	112.57	115.08	115.08	97.82	100.00	100.00
3	Boldre Foreshore	1.24	1.21	1.24	1.24	97.31	100.00	100.00
4	Nutborne Marshes	4.99	4.57	4.99	4.99	91.59	100.00	100.00
5	Mercury Marshes	2.95	2.45	2.95	2.95	83.18	100.00	100.00
6	The Kench, Hayling Island	1.18	0.85	1.18	1.18	72.57	100.00	100.00
7	Seasalter Levels	71.40	-	71.40	71.40	-	100.00	100.00
8	The Brooks	19.12	-	19.12	19.12	-	100.00	100.00
9	Oare Marshes	71.31	66.97	71.30	71.31	93.92	100.00	100.00
10	Farlington Marshes	119.74	115.03	119.74	119.74	96.06	100.00	100.00
11	Lymington-Keyhaven Marshes	167.55	156.11	167.42	167.55	93.17	99.92	100.00
12	Pilsey Island	4.21	2.80	4.19	4.21	66.62	99.65	100.00
13	Gutner Point	10.58	6.68	10.54	10.58	63.15	99.61	100.00
14	South Bank of The Swale	60.78	21.20	59.46	60.78	34.88	97.82	100.00
15	Rye Harbour	320.01	208.95	312.07	320.01	65.29	97.52	100.00
16	Sturt Pond	10.95	8.66	10.57	10.95	79.14	96.60	100.00
17	Widewater Lagoon	8.76	7.72	8.27	8.76	88.17	94.48	100.00
18	Prince's Beachlands	6.00	-	5.25	6.00	-	87.41	100.00
19	West of the River Alver	11.56	-	10.97	11.56	-	94.93	100.00
20	Titchfield Haven	93.03	90.77	92.75	93.03	97.56	99.70	99.99
21	Romney Warren	10.89	3.72	10.46	10.89	34.17	95.99	99.99
22	Sandy Point	18.17	12.89	17.00	18.17	70.94	93.55	99.97
23	Hayling Billy	40.62	3.09	34.93	40.60	7.60	85.99	99.96
24	Railway Land Lewes	10.93	0.20	10.79	10.93	1.80	98.70	99.95
25	Brook Meadow (Emsworth)	3.95	-	3.71	3.95	-	93.90	99.95
26	West Beach	4.13	0.99	3.32	4.13	23.86	80.33	99.91
27	Pagham Harbour	287.28	175.06	272.30	286.90	60.94	94.78	99.87
28	Afton Marshes	14.66	11.41	14.21	14.59	77.79	96.89	99.51
29	Shoreham Beach	14.70	<0.01	0.74	14.60	<0.01	5.06	99.33
30	West Hayling	5.15	0.78	4.59	5.11	15.05	89.07	99.07
31	Filsham Reed Bed	18.52	-	-	18.16	-	-	98.06
32	Baty's Marsh	5.17	4.01	4.64	4.81	77.57	89.63	92.97
33	Chessel Bay	0.85	0.35	0.57	0.79	40.67	66.33	92.57
34	The Wild Grounds	28.44	-	14.84	26.13	-	52.17	91.88
35	Alverstone Mead	15.21	-	11.72	12.73	-	77.08	83.68
36	Hackett's Marsh	16.61	6.77	11.03	13.43	40.75	66.36	80.84
37	Newtown Marshes	6.18	2.07	3.56	4.71	33.46	57.64	76.16
38	Lepe Point	4.50	0.86	1.60	3.02	19.18	35.47	67.09
39	Berengrave Chalk Pit	9.50	-	-	6.14	-	-	64.61
40	Dodnor Creek	9.59	-	5.63	6.16	-	58.72	64.19
41	Hook with Warsash	152.37	65.89	84.74	93.43	43.24	55.61	61.32
42	Seaford Head	144.85	60.03	62.77	64.05	41.44	43.33	44.22
43	Milford on Sea	20.62	-	2.45	7.44	-	11.89	36.09
44	Foxes Cross Bottom	3.95	-	0.74	1.15	-	18.78	29.13
45	Bishopstone Cliffs	23.11	2.69	4.12	5.34	11.66	17.84	23.11
46	Warsash Common	23.40	0.28	1.63	3.21	1.21	6.95	13.70
47	Manor Farm	142.72	3.67	6.63	10.29	2.57	4.65	7.21
48	Holly Hill Woodland Park	28.15	0.17	0.92	1.85	0.62	3.25	6.56
49	Folkestone Warren	55.23	-	2.94	3.50	-	5.33	6.34
50	Arlington Reservoir	100.61	-	0.52	3.53	-	0.52	3.51
51	Westwood Woodland Park	49.52	-	0.71	1.60	-	1.44	3.24
52	Hastings Country Park	330.12	1.19	2.74	3.83	0.36	0.83	1.16
53	Castle Hill, Newhaven	16.39	-	0.09	0.17	-	0.58	1.05

APPENDIX E. Table of landmarks exposed to inundation

NO°	SCHEDULED MONUMENTS	TOTAL AREA	AREA EXPOSED TO INUNDATION (ha)			AREA EXPOSED TO INUNDATION (%)		
			1m SLR	3m SLR	5m SLR	1m SLR	3m SLR	5m SLR
1	Chatham Dockyard, Queen's Stairs	<0.001	<0.001	<0.001	<0.001	100.00	100.00	100.00
2	Early medieval flood defence at Botolph's Bridge, West Hythe	0.659	0.659	0.659	0.659	100.00	100.00	100.00
3	Halstow Marshes Decoy Pond	2.781	2.781	2.781	2.781	100.00	100.00	100.00
4	Martello tower no 24 at Dymchurch	0.011	0.011	0.011	0.011	100.00	100.00	100.00
5	Medieval farmstead at Pilchers, 340m north east of Codhall	5.798	5.798	5.798	5.798	100.00	100.00	100.00
6	Moated site and associated fields, 460m north east of Pickney Bush Farm	12.904	12.904	12.904	12.904	100.00	100.00	100.00
7	Redbridge old bridges	<0.001	<0.001	<0.001	<0.001	100.00	100.00	100.00
8	St Helen's Fort	0.059	0.059	0.059	0.059	100.00	100.00	100.00
9	World War II underground operational base 500yds (457m) SW of Bentley Cottage	0.008	0.008	0.008	0.008	100.00	100.00	100.00
10	World War II underground operational post, 1/3 mile (540m) SW of Chapel Farm	0.004	0.004	0.004	0.004	100.00	100.00	100.00
11	Moat and associated closes at Marshall's Bridge	2.691	2.691	2.691	2.691	100.00	100.00	100.00
12	Newenden Bridge	0.040	0.040	0.040	0.040	99.23	100.00	100.00
13	Part of the Rhee Wall, a medieval canal, at Snargate	4.807	4.766	4.807	4.807	99.15	100.00	100.00
14	Eastbridge Church	0.149	0.147	0.149	0.149	98.85	100.00	100.00
15	Royal Military Canal, Iden Lock	0.081	0.080	0.081	0.081	98.66	100.00	100.00
16	Shinewater Bronze Age settlement	1.027	1.007	1.027	1.027	98.06	100.00	100.00
17	Royal Military Canal, Warehorne Bridge to Ham Street Bridge	6.313	5.937	6.313	6.313	94.04	100.00	100.00
18	Queenborough Lines	23.509	21.937	23.509	23.509	93.31	100.00	100.00
19	Medieval moated site and associated earthworks, Pound Piece, Manxey	2.490	2.301	2.490	2.490	92.38	100.00	100.00
20	Abandoned Medieval Church and Graveyard, Midley	0.101	0.092	0.101	0.101	90.71	100.00	100.00
21	Martello tower no 30, 300m east of Gate Borough Cottage	0.579	0.503	0.579	0.579	86.84	100.00	100.00
22	Group of salterns and a possible moat 250m east of Bramber Castle	3.572	3.040	3.572	3.572	85.10	100.00	100.00
23	Royal Military Canal, Coastguard Cottages to Wickham Cliff	9.526	8.086	9.526	9.526	84.89	100.00	100.00
24	Royal Military Canal, Ham Street Bridge to Bilsington Bridge	18.898	15.868	18.898	18.898	83.97	100.00	100.00
25	Stopham Bridge	0.037	0.031	0.037	0.037	82.60	100.00	100.00
26	Former guardhouse	0.008	0.006	0.008	0.008	82.24	100.00	100.00
27	Royal Military Canal, Wickham Cliff to Strand Bridge, Winchelsea	12.146	9.982	12.146	12.146	82.18	100.00	100.00
28	Royal Military Canal, Iden Lock to Kent Ditch	3.984	3.155	3.984	3.984	79.20	100.00	100.00
29	Royal Military Canal, Cliff End to Coastguard Cottages	2.592	2.051	2.592	2.592	79.13	100.00	100.00
30	Sandwich town walls: section from New Gate to Woodnesborough Gate	1.046	0.800	1.046	1.046	76.48	100.00	100.00
31	Hope All Saints', remains of church	0.393	0.297	0.393	0.393	75.75	100.00	100.00
32	Royal Military Canal, Honeypot Cottage to West Hythe Dam	15.110	11.399	15.110	15.110	75.44	100.00	100.00
33	Old Swan Bridge, Pulborough	0.003	0.002	0.003	0.003	71.17	100.00	100.00
34	Royal Military Canal, Bilsington Bridge to Bonnington Bridge	7.835	5.565	7.835	7.835	71.02	100.00	100.00

35	Royal Military Canal, Bonnington Bridge to Gigger's Green Bridge	6.940	4.826	6.940	6.940	69.53	100.00	100.00
36	'Castle Rough' Medieval moated site	0.744	0.495	0.744	0.744	66.51	100.00	100.00
37	Royal Military Canal, Gigger's Green Bridge to Honeypot Cottage	8.813	5.213	8.813	8.813	59.15	100.00	100.00
38	Sandwich town walls: section from Woodnesborough Gate to Canterbury Gate	1.236	0.723	1.236	1.236	58.43	100.00	100.00
39	Royal Military Canal, Town Bridge to Twiss Road Bridge	3.003	1.735	3.003	3.003	57.77	100.00	100.00
40	Chatham Dockyard, Dry Docks Nos 2, 3 and 4	1.720	0.856	1.720	1.720	49.79	100.00	100.00
41	Chatham Dockyard, covered slip to N of No 5 Slip	0.541	0.259	0.541	0.541	47.90	100.00	100.00
42	Sandwich town walls: section at NW corner (150ft long)	0.009	0.005	0.009	0.009	47.87	100.00	100.00
43	Artillery castle and associated earthworks at Camber	6.361	2.795	6.361	6.361	43.93	100.00	100.00
44	Greatham Bridge	0.099	0.040	0.099	0.099	40.45	100.00	100.00
45	Chatham Dockyard, Assistant Queen's Harbour Master's office	0.010	0.003	0.010	0.010	34.03	100.00	100.00
46	Three acoustic early warning devices 2360m east of Jack's Court	0.128	0.026	0.128	0.128	20.44	100.00	100.00
47	Sandwich town walls: section extending 40yds (36m) on N side of Strand Street	0.017	0.002	0.017	0.017	12.20	100.00	100.00
48	Chatham Dockyard, No 3 Boat Store	0.382	0.037	0.382	0.382	9.76	100.00	100.00
49	Gunboat Traverser System	0.400	0.037	0.400	0.400	9.14	100.00	100.00
50	Yarmouth Castle	0.191	0.016	0.191	0.191	8.50	100.00	100.00
51	Romano-British villa and traces of Iron Age occupation 500m WSW of New Barn	4.484	0.221	4.484	4.484	4.93	100.00	100.00
52	Group of salterns north of St Peter's Church	7.155	0.093	7.155	7.155	1.29	100.00	100.00
53	Pickett Hamilton fort, Hilsea	0.005	<0.001	0.005	0.005	0.18	100.00	100.00
54	Chatham Dockyard, the Lower Boat Store	0.166	-	0.166	0.166	-	100.00	100.00
55	Former Board of Ordnance Gunwharf, HMS Vernon	0.217	-	0.217	0.217	-	100.00	100.00
56	St Denys Priory (remains of)	0.048	-	0.048	0.048	-	100.00	100.00
57	Aspdin's kiln	0.010	-	0.010	0.010	-	100.00	100.00
58	Aylesford Bridge	0.017	-	0.017	0.017	-	100.00	100.00
59	Beckett's Barn and adjoining earthworks	1.406	-	1.406	1.406	-	100.00	100.00
60	Brook Low Level Pumping Station	0.029	-	0.029	0.029	-	100.00	100.00
61	Canute's Palace, Porters Lane	0.008	-	0.008	0.008	-	100.00	100.00
62	Chatham Dockyard, former working Mast House and Mould Loft	0.220	-	0.220	0.220	-	100.00	100.00
63	Chatham Dockyard, site of South Mast Pond	1.203	-	1.203	1.203	-	100.00	100.00
64	Chatham Dockyard, South Pumping Station	0.030	-	0.030	0.030	-	100.00	100.00
65	Chatham Dockyard, the Mast Pond	0.972	-	0.972	0.972	-	100.00	100.00
66	Chatham Dockyard, the Wheelwrights' Shop	0.108	-	0.108	0.108	-	100.00	100.00
67	Eastney sewage pumping station	0.622	-	0.622	0.622	-	100.00	100.00
68	Gravesend blockhouse	0.081	-	0.081	0.081	-	100.00	100.00
69	Medieval saltern 1.05km north east of Monkshill Farm, one of a group of six on Seasalter Level	1.051	-	1.051	1.051	-	100.00	100.00

70	Medieval saltern 1.15km north east of Monkshill Farm, one of a group of six on Seasalter Level	0.462	-	0.462	0.462	-	100.00	100.00
71	Medieval saltern 800m north of Monkshill Farm, one of a group of six on Seasalter Level	0.426	-	0.426	0.426	-	100.00	100.00
72	Part of a Cistercian grange, north of New Romney High Street, also known as Romney Priory	0.064	-	0.064	0.064	-	100.00	100.00
73	Portsmouth Dockyard, the Block Mills and Stores 35 and 36	0.109	-	0.109	0.109	-	100.00	100.00
74	Saltern in Saltings Field, 220m north of Beeding Bridge	1.038	-	1.038	1.038	-	100.00	100.00
75	Sandwich town walls: section incorporated in the old East Kent Brewery (35ft long)	0.004	-	0.004	0.004	-	100.00	100.00
76	Sandwich town walls: site of the Round House	0.005	-	0.005	0.005	-	100.00	100.00
77	Second World War QF P-series oil bombing decoy	4.671	-	4.671	4.671	-	100.00	100.00
78	Shoreham Airfield dome trainer, 240m south west of Sussex Pad Hotel	0.015	-	0.015	0.015	-	100.00	100.00
79	St Mary's Priory: an alien Benedictine priory 100m east of St Mary's Church	0.648	-	0.648	0.648	-	100.00	100.00
80	The Fisher Gate	0.002	-	0.002	0.002	-	100.00	100.00
81	Town wall: Gods House Gate and Tower	0.036	-	0.036	0.036	-	100.00	100.00
82	Town wall: the Water Gate, High Street	0.012	-	0.012	0.012	-	100.00	100.00
83	Town wall: the West Gate	0.006	-	0.006	0.006	-	100.00	100.00
84	Castle (part of)	<0.001	-	<0.001	<0.001	-	100.00	100.00
85	Fairburn-type crane, Wellington Dock	0.005	-	0.005	0.005	-	100.00	100.00
86	Portsmouth Garrison church	0.102	-	0.102	0.102	-	100.00	100.00
87	Royal Military Canal, Appledore Bridge to Kenardington Bridge	19.824	16.981	19.821	19.824	85.66	99.99	100.00
88	Royal Military Canal, Kenardington Bridge to Warehorne Bridge	7.502	6.957	7.499	7.502	92.74	99.97	100.00
89	Netley Castle	0.012	-	0.012	0.012	-	99.78	100.00
90	Royal Military Canal, Twiss Road Bridge to Seabrook Lodge Bridge	5.335	2.934	5.313	5.335	55.00	99.59	100.00
91	Chatham Dockyard, Naval Store Department	0.060	-	0.059	0.060	-	99.32	100.00
92	Calshot Castle: a 16th century artillery castle	0.369	0.194	0.367	0.369	52.62	99.32	100.00
93	Royal Military Canal, Kent Ditch to Heron House, Folkestone	15.623	11.189	15.464	15.623	71.61	98.98	100.00
94	Chapel of St James' Hospital	0.006	-	0.006	0.006	-	98.62	100.00
95	Romano-British site S of Bodiam Bridge	6.364	5.263	6.268	6.364	82.70	98.50	100.00
96	Artillery castle at Deal	0.780	-	0.766	0.780	-	98.21	100.00
97	Royal Military Canal, West Hythe Bridge to Scanlon's Bridge	16.566	10.514	16.264	16.566	63.46	98.17	100.00
98	Medieval saltern 800m north east of Monkshill Farm, one of a group of six on Seasalter Level	1.828	-	1.786	1.828	-	97.66	100.00
99	Site of medieval port, Stonar	4.315	1.290	4.200	4.315	29.89	97.33	100.00
100	Tourner Bury, Hayling Island, South Hayling	4.320	0.418	4.205	4.320	9.68	97.33	100.00
101	Medieval saltern 700m NNE of Monkshill Farm, one of a group of six on Seasalter Level	0.941	-	0.912	0.941	-	96.90	100.00
102	Portsmouth Dockyard, the Docks	2.316	1.353	2.240	2.316	58.41	96.73	100.00
103	Royal Military Canal, Scanlon's Bridge to Town Bridge	2.262	1.679	2.161	2.262	74.23	95.51	100.00

104	Royal Military Canal, Heron House to Appledore Bridge	3.369	2.276	3.217	3.369	67.56	95.50	100.00
105	Medieval saltern 950m north east of Monkshill Farm, one of a group of six on Seasalter Level	0.301	-	0.286	0.301	-	95.07	100.00
106	Hoo Fort	2.587	1.082	2.423	2.587	41.84	93.65	100.00
107	Royal Military Canal, Seabrook Lodge Bridge to Seabrook Sluice	5.788	3.054	5.418	5.788	52.76	93.60	100.00
108	World War II Heavy Anti-aircraft gunsite (P2) at Sinah Common, 570m south east of Sinah Farm	2.192	-	2.052	2.192	-	93.59	100.00
109	Fort Darnet, Darnet Ness	1.720	0.480	1.609	1.720	27.89	93.52	100.00
110	Royal Military Canal, West Hythe Dam to West Hythe Bridge	3.526	1.734	3.293	3.526	49.18	93.40	100.00
111	Site of 17th century dockyard	1.303	0.026	1.193	1.303	2.00	91.56	100.00
112	Teston Bridge, over the Medway	0.050	-	0.046	0.050	-	90.96	100.00
113	Town wall: remains of E side of town wall S of East Street and N of Gods House Tower	0.019	-	0.017	0.019	-	90.74	100.00
114	Bitterne (Clausentum) Roman station	2.617	0.460	2.317	2.617	17.57	88.51	100.00
115	Hurst Castle and lighthouse	4.091	0.660	3.554	4.091	16.13	86.87	100.00
116	St Mary's Church, West Hythe	0.054	-	0.042	0.054	-	77.50	100.00
117	Chart gunpowder mills	0.150	-	0.114	0.150	-	75.78	100.00
118	Medieval moated site, Cooden	0.309	-	0.234	0.309	-	75.61	100.00
119	Deserted medieval village of Northeye, 885m south-west of Old Road Farm	8.340	3.789	6.175	8.340	45.43	74.04	100.00
120	Chatham Dockyard, Rigging House No 1 and Storehouse No 2	0.271	-	0.196	0.271	-	72.36	100.00
121	Town wall: section between Simnal Street and the site of the Bugle Tower excluding the West Gate	0.051	-	0.035	0.051	-	67.58	100.00
122	Town wall: section between Bugle Street and Bugle Tower	0.010	-	0.006	0.010	-	60.56	100.00
123	Medieval farmstead at Downash, 300m north east of Freshfield Farm	1.665	0.338	0.955	1.665	20.33	57.36	100.00
124	Quilter's and adjoining vaults in High Street	0.037	-	0.021	0.037	-	56.62	100.00
125	Gateway to Brook Farm, Hillborough	0.010	-	0.005	0.010	-	55.63	100.00
126	Medieval moated site and Tudor ruins, Laughton Place	2.139	0.002	1.126	2.139	0.08	52.64	100.00
127	Medieval earthworks E and SE of St Mary's Church	2.926	0.407	1.471	2.926	13.91	50.26	100.00
128	Lower Fittleworth North Bridge	0.072	-	0.026	0.072	-	35.51	100.00
129	Chatham Dockyard, No 1 Smithery	0.434	-	0.146	0.434	-	33.52	100.00
130	Stony Bridge, Titchfield	0.011	-	0.004	0.011	-	30.94	100.00
131	Chatham Dockyard, MCD Joiners' Shop	0.168	-	0.041	0.168	-	24.59	100.00
132	Temple Manor, Strood	0.230	-	0.044	0.230	-	19.19	100.00
133	Remains of a medieval manor house and associated dovecote 130m and 110m north west of Westdean Manor	0.054	-	0.010	0.054	-	18.13	100.00
134	Martello tower no 15 at Hythe Ranges	0.015	-	0.001	0.015	-	6.79	100.00
135	Martello tower no 55, 500m south west of Normans' Bay Station	0.021	-	0.001	0.021	-	3.52	100.00
136	Admiralty Pier Turret 636m south east of Lord Warden House	0.007	-	-	0.007	-	-	100.00
137	Bridge Chapel	0.010	-	-	0.010	-	-	100.00
138	Cakeham Manor (uninhabited parts)	0.026	-	-	0.026	-	-	100.00
139	Chatham Dockyard, engine or boiler house	0.023	-	-	0.023	-	-	100.00

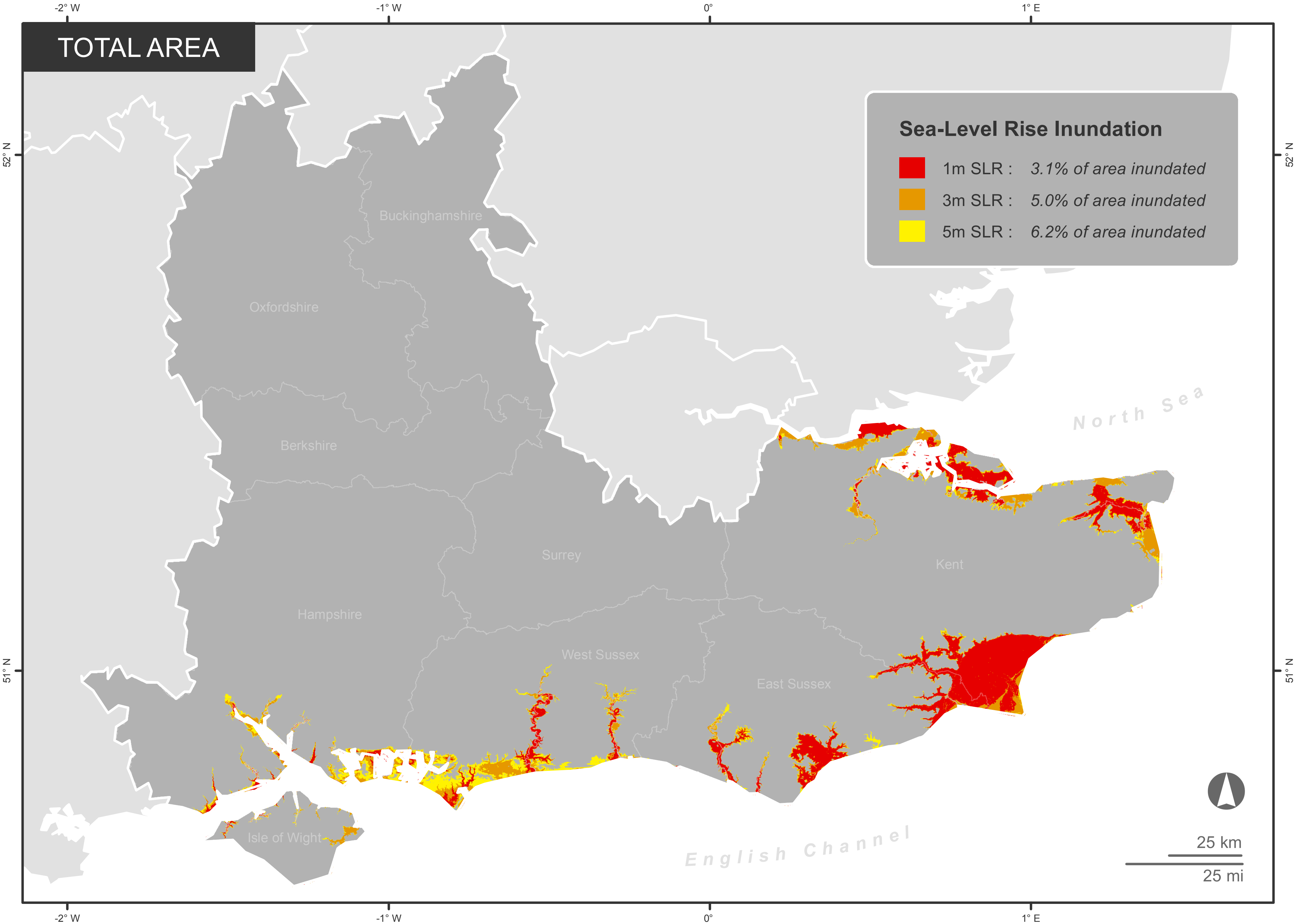
140	Hastings Town Wall	0.017	-	-	0.017	-	-	100.00
141	Keep of Tote Copse castle, 400m north of Decoy Farmhouse	0.023	-	-	0.023	-	-	100.00
142	Lade Fort	0.286	-	-	0.286	-	-	100.00
143	Martello tower no 14 at Hythe Ranges	0.013	-	-	0.013	-	-	100.00
144	Martello tower no 64 at the Crumbles, 1.3km north east of Langney Point	0.023	-	-	0.023	-	-	100.00
145	Martello tower no 66, 320m north east of Langney Point	0.023	-	-	0.023	-	-	100.00
146	Medieval crypt, Church Street	0.005	-	-	0.005	-	-	100.00
147	The Marlipins	0.019	-	-	0.019	-	-	100.00
148	Vault SW of Gloucester Square	0.005	-	-	0.005	-	-	100.00
149	Vault in High Street opposite Gloucester Square	0.011	-	-	0.011	-	-	100.00
150	Chatham Dockyard, the Main Offices	0.100	-	0.075	0.100	-	75.28	99.93
151	Promontory defined by an Iron Age linear earthwork, St Andrew's Castle and additional remains on Hamble Common	20.731	1.704	16.380	20.716	8.22	79.01	99.93
152	Fort Blockhouse	1.702	0.019	1.552	1.700	1.11	91.17	99.91
153	East Farleigh Bridge, over the Medway	0.070	-	0.051	0.070	-	73.66	99.81
154	Castle Toll Saxon burgh and medieval fort	7.264	1.197	4.427	7.245	16.48	60.95	99.74
155	Portchester Castle	7.427	0.290	4.394	7.387	3.91	59.16	99.46
156	Chatham Dockyard, No 61 Boat Store, Nos 4 and 5 Slips	1.368	0.105	1.337	1.359	7.69	97.73	99.33
157	Chatham Dockyard, Medway House	0.063	-	0.016	0.063	-	24.58	99.01
158	Roman villa 200m north of church	0.674	0.011	0.024	0.667	1.56	3.54	99.00
159	Artillery castle at Walmer	0.624	-	-	0.617	-	-	98.78
160	Cliffe Fort	1.451	0.448	0.969	1.432	30.85	66.76	98.69
161	'The Rookery' medieval hythe and associated earthworks at Milton Court	1.676	-	1.444	1.646	-	86.13	98.21
162	Saxon shore fort bastion, Queen Street	0.009	-	-	0.009	-	-	97.26
163	Maison Dieu	0.231	-	0.077	0.222	-	33.49	96.01
164	Point Battery including King Edward's Tower and Square Tower	0.383	0.023	0.233	0.367	6.00	60.82	95.80
165	Neolithic sites near Ebbsfleet	0.511	-	0.459	0.488	-	89.70	95.38
166	Lower Fittleworth South Bridge	0.088	-	0.033	0.083	-	37.22	95.31
167	Martello tower no 74 on Seaford Esplanade	0.107	-	-	0.102	-	-	94.99
168	Hatchelling House, Chatham Dockyard	0.030	-	-	0.028	-	-	94.77
169	Queenborough Castle	1.060	-	0.059	1.004	-	5.53	94.71
170	Lewes Town Wall, section called The Green Wall	0.023	-	0.006	0.022	-	24.36	94.51
171	Chatham Dockyard, Storehouse No 3	0.277	-	0.112	0.261	-	40.28	94.20
172	Motte and bailey castle near Apple Dumpling Bridge, south of Rowner	0.297	-	0.217	0.278	-	72.97	93.41
173	'King John's Palace'	0.022	-	0.015	0.021	-	65.63	93.30
174	Chatham Lines, section at Chatham Gun Wharf	0.650	-	0.344	0.605	-	52.83	92.99
175	Monastic grange and pre-Conquest nunnery at Minster Abbey	1.574	-	0.230	1.464	-	14.58	92.99
176	Sheerness defences	4.118	1.708	2.943	3.774	41.49	71.47	91.66
177	Eastbourne Redoubt	0.752	-	0.502	0.680	-	66.79	90.49
178	Fort Cumberland	14.692	0.001	0.940	13.288	0.01	6.40	90.45

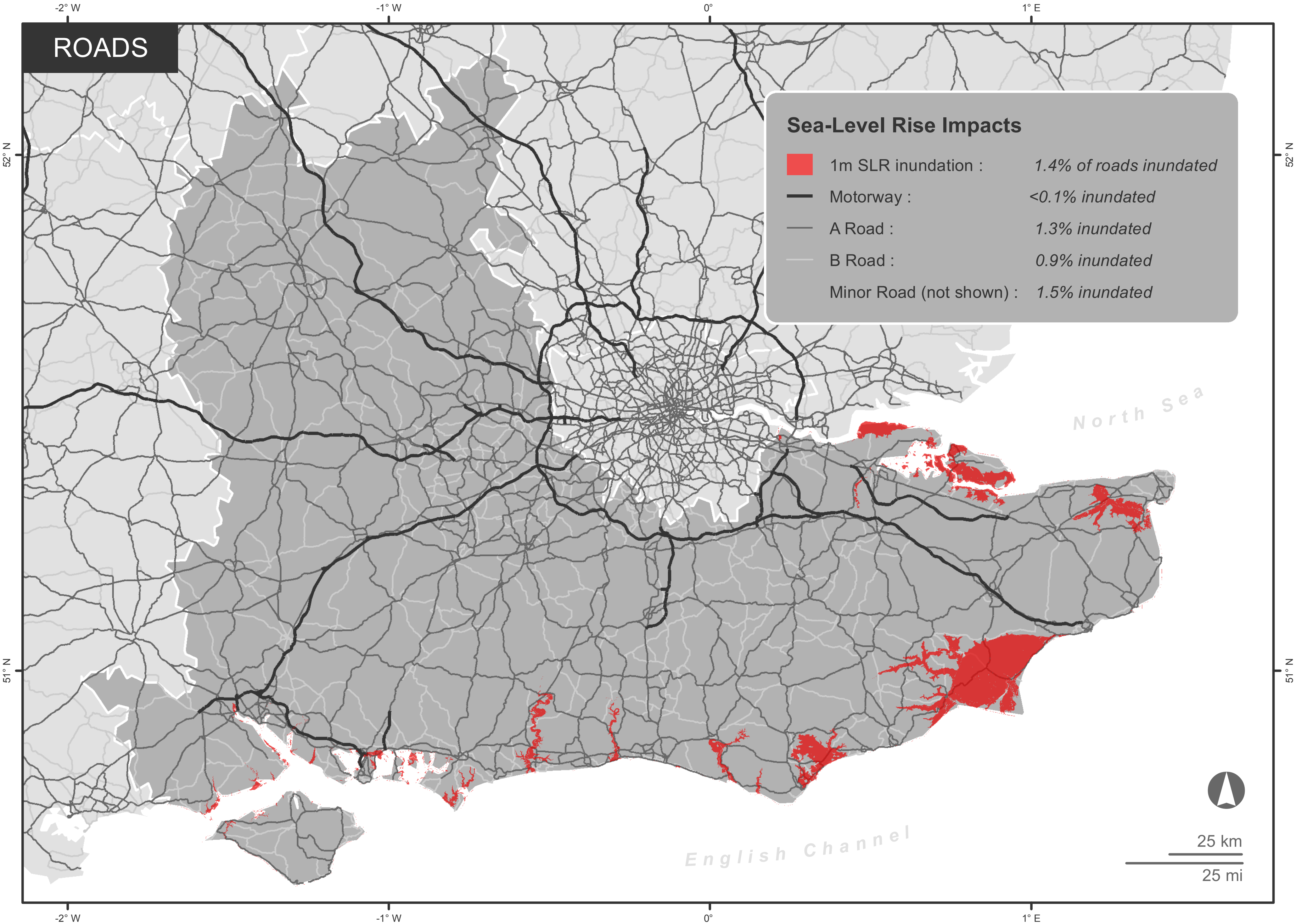
179	Vault S of junction of High Street and Castle Way	0.017	-	-	0.016	-	-	90.06
180	Cooling Castle and its associated landscaped setting	3.845	1.851	2.636	3.423	48.15	68.55	89.02
181	Chatham Dockyard, the Expense Account Department, Wages Division	0.040	-	-	0.036	-	-	88.96
182	Dymchurch Redoubt	2.351	0.451	1.572	2.081	19.20	66.84	88.51
183	Fort Monckton	10.909	0.014	8.025	9.531	0.13	73.56	87.37
184	Sandwich town walls: section from a point E of gasworks to site of New Gate (including The Bulwark and Mill Wall)	1.661	0.115	1.180	1.448	6.92	71.06	87.20
185	Site of Norman town house in curtilage of St Michael's House	0.049	-	0.010	0.042	-	19.44	85.72
186	The site of St Saviour's Abbey, including the remains of an Iron Age farmstead and Faversham Roman villa	4.188	-	1.475	3.567	-	35.22	85.18
187	Fishbourne Roman site	7.779	0.020	3.979	6.553	0.26	51.15	84.24
188	Earthwork defences at Priddy's Hard	3.940	0.010	1.839	3.310	0.25	46.66	84.00
189	Martello tower no 28 at Rye Harbour	0.422	0.018	0.204	0.352	4.15	48.36	83.38
190	No. 5 Battery, Stokes Bay Lines	0.307	-	0.051	0.256	-	16.54	83.31
191	Fortifications S of Trinity Church	2.044	1.150	1.476	1.670	56.24	72.23	81.70
192	Moated site at Ewhurst Manor	0.942	-	0.100	0.759	-	10.58	80.56
193	Shoreham Fort, 120m SSE of East House	0.662	-	-	0.532	-	-	80.37
194	Chatham Dockyard, the Iron Store	0.132	-	-	0.101	-	-	76.18
195	Hilsea Lines	19.955	11.030	13.767	15.169	55.27	68.99	76.02
196	No 1 Battery, Stokes Bay Lines	0.044	-	0.001	0.033	-	2.25	73.50
197	Rye town walls	0.014	-	0.002	0.010	-	12.80	71.86
198	Len Bridge, Mill Street	0.022	-	0.014	0.016	-	63.08	69.38
199	Barn, remains of, at St Leonards Grange	0.146	-	-	0.101	-	-	69.26
200	Medieval moated site and adjoining fishpond, Moat Farm	3.671	-	-	2.528	-	-	68.88
201	A 19th century artillery fort known as Littlehampton Fort, 317m south west of the Windmill Theatre	0.455	-	-	0.312	-	-	68.63
202	St Martin's Church	0.156	-	-	0.107	-	-	68.61
203	Town ditch N of New Gate, Winchelsea	0.333	0.038	0.134	0.228	11.30	40.30	68.44
204	Long Curtain, King's Bastion and Spur Redoubt	2.155	0.748	1.174	1.442	34.70	54.49	66.90
205	Roman site 400yds (370m) S of Fairthorn	2.017	0.251	0.930	1.336	12.46	46.12	66.21
206	Sandown Castle	0.209	0.042	0.058	0.132	20.05	27.58	63.12
207	Southsea Castle	3.212	-	1.158	1.939	-	36.05	60.35
208	Puckpool mortar battery	4.217	-	0.993	2.440	-	23.55	57.88
209	Ringwork south of St Wilfred's Chapel	0.509	-	0.122	0.286	-	23.92	56.07
210	Tortington Augustinian priory and ponds, including part of priory precinct	4.209	0.367	1.130	2.329	8.72	26.85	55.34
211	Robertsbridge Abbey	6.456	-	0.061	3.545	-	0.94	54.91
212	Oare gunpowder works	9.669	-	2.170	5.232	-	22.44	54.11
213	Beaulieu Abbey	3.874	-	0.976	2.074	-	25.20	53.54
214	New Tavern Fort, Gravesend, including Milton Chantry	2.043	-	0.695	1.058	-	34.03	51.79
215	Rochester city wall	0.069	-	0.025	0.036	-	36.06	51.78
216	Cockham Wood Fort	0.538	0.044	0.156	0.277	8.14	28.91	51.53

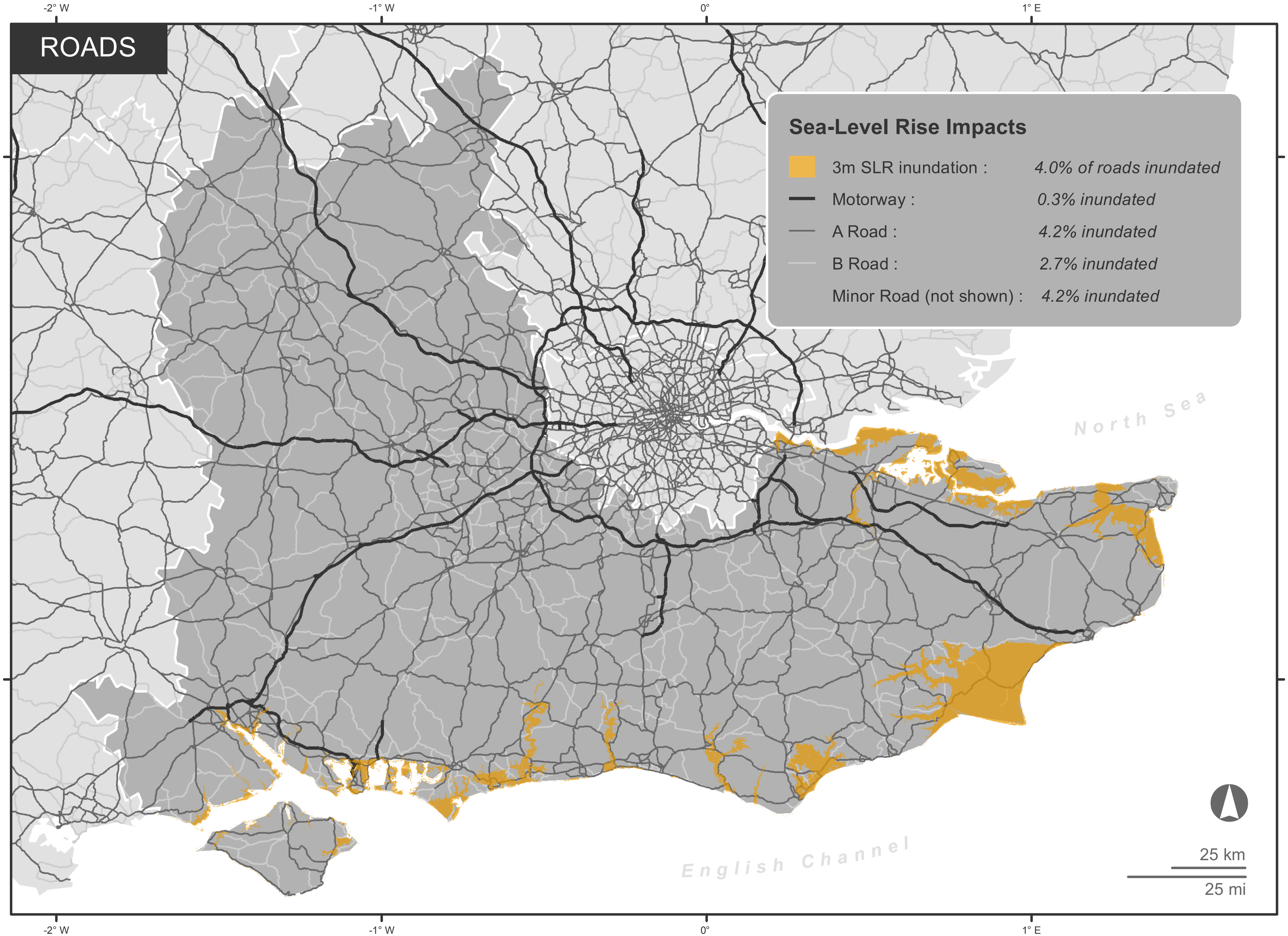
217	Medieval moated site and adjacent hythe, Lowden Farm	3.852	-	0.792	1.956	-	20.56	50.78
218	New Gate, Winchelsea	0.006	-	-	0.003	-	-	50.40
219	Vault under Head Post Office	0.013	-	-	0.007	-	-	50.15
220	Reculver Saxon Shore fort, Anglo-Saxon monastery and associated remains	4.332	-	0.684	2.167	-	15.80	50.03
221	Priory of St Pancras	2.402	-	0.980	1.184	-	40.79	49.31
222	World War II Heavy Anti-aircraft gunsite (TS3) at Wetham Green, 460m north of Red Brick Cottage	1.647	-	0.106	0.775	-	6.42	47.02
223	Dispersed medieval settlement remains at Frog Firle, 290m south east of Tile Barn	0.878	0.122	0.292	0.410	13.91	33.24	46.75
224	Gilkicker fort	1.240	-	0.435	0.568	-	35.03	45.83
225	Eastney forts and perimeter defences of barracks	2.278	-	-	1.001	-	-	43.94
226	Knepp Castle	1.845	-	-	0.809	-	-	43.86
227	Napoleonic Barracks 480m south-west of Foxhole Farm, Cuckmere Haven	0.582	-	0.009	0.217	-	1.57	37.23
228	Coastal artillery defences on the Isle of Grain, immediately east and south east of Grain village	12.183	-	3.052	4.437	-	25.05	36.42
229	Wingham Roman villa, 100m south of Glendale Cottage	1.424	-	-	0.502	-	-	35.23
230	Chatham Dockyard, Officers' Reading Room and Admirals' Conference Room	0.029	-	-	0.010	-	-	35.08
231	Town wall: section from 75yds (70m) E of Arundel Tower to limit of castle site including Arundel and Catchcold Towers	0.037	-	0.005	0.012	-	12.91	33.82
232	A quadrangular castle and its landscaped setting, an associated millpond, medieval crofts and cultivation earthworks, and a World War II pillbox at Bodiam	9.302	2.454	2.805	2.811	26.38	30.15	30.22
233	Pevensey Castle: a Saxon Shore fort, Norman defences, a medieval enclosure castle, and later associated remains	5.010	0.146	0.547	1.372	2.92	10.92	27.38
234	Moat at Old Place	0.438	-	-	0.114	-	-	25.94
235	Sandgate Castle	0.259	-	-	0.064	-	-	24.89
236	Chatham Dockyard, the Ropery	0.580	-	-	0.140	-	-	24.21
237	The 'Gatehouse', Palace Gardens, Mill Street	0.014	-	0.003	0.003	-	19.83	19.83
238	Burpham camp	11.532	0.890	1.531	2.025	7.71	13.28	17.56
239	The College of All Saints	1.504	-	0.079	0.258	-	5.23	17.16
240	Amberley Castle	0.683	-	0.021	0.115	-	3.02	16.85
241	Fortifications N of Mumby Road	4.932	-	0.278	0.810	-	5.64	16.42
242	Quarr Abbey	10.905	-	0.492	1.762	-	4.51	16.16
243	Group of ring ditches 400yds (360m) NW of Great Brooks End Farm	9.275	-	0.344	1.457	-	3.71	15.71
244	Lime kilns, canal, engine sheds, etcetera	2.771	0.291	0.406	0.432	10.52	14.64	15.59
245	Brunel Sawmills, Chatham Dockyard	0.685	-	0.010	0.091	-	1.53	13.33
246	Ringwork 400m NNW of Batworthpark House	0.382	-	-	0.046	-	-	12.10
247	Artillery castle at Upnor	0.480	0.009	0.035	0.056	1.80	7.23	11.66
248	Bishop's palace at Halling	0.052	-	-	0.006	-	-	11.01
249	Saxon Shore fort now called Stutfall Castle, 468m south-west of St Stephen's Church	5.690	0.014	0.233	0.586	0.24	4.10	10.31

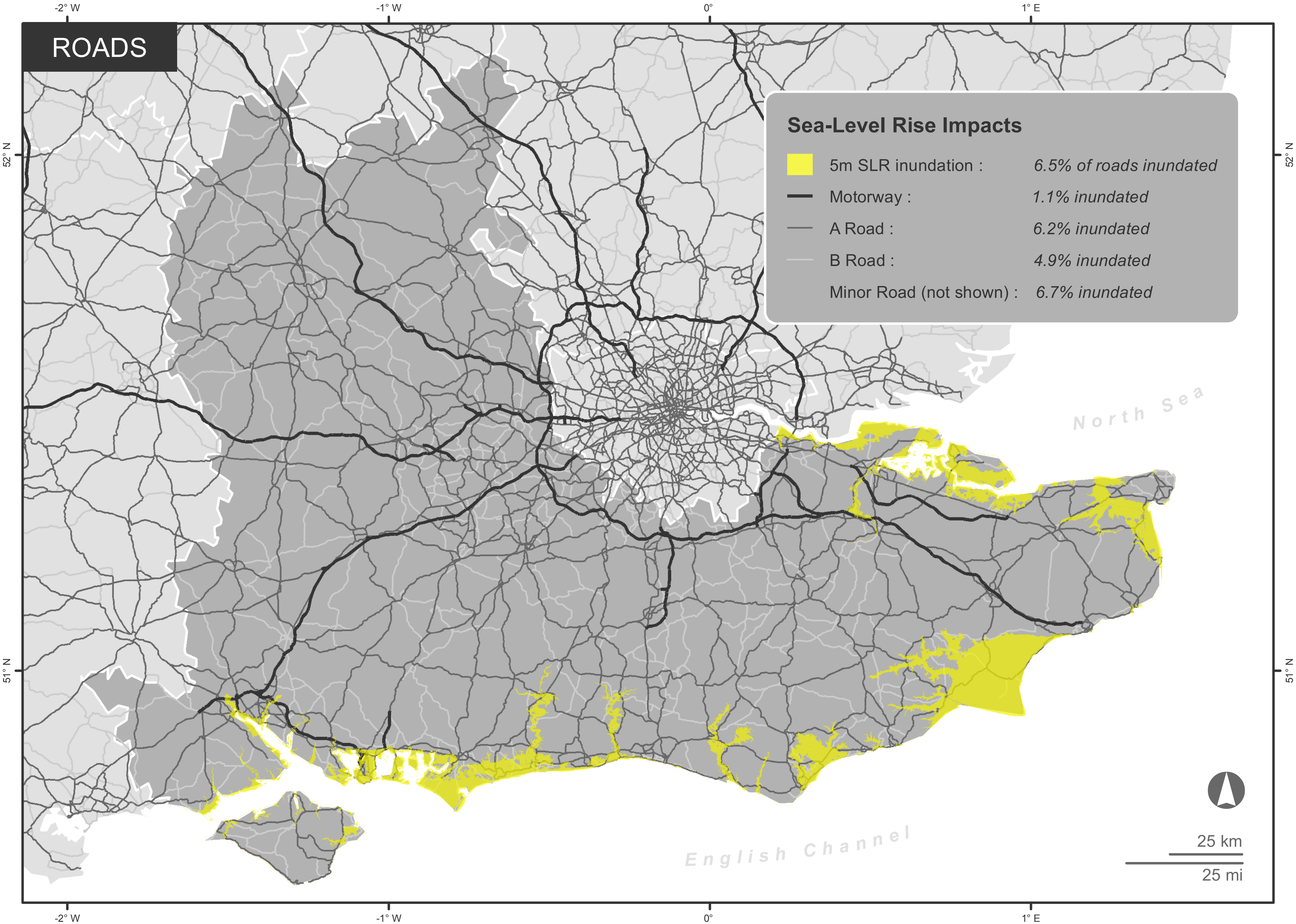
250	Newhaven military fort and lunette battery	4.158	-	0.068	0.407	-	1.63	9.78
251	Abbot's Mill and sluice at Blackfriars Street	0.032	-	-	0.003	-	-	9.37
252	Hardham Priory	4.674	0.143	0.331	0.427	3.06	7.09	9.14
253	Chatham Dockyard, Chain Cable shed	0.060	-	-	0.005	-	-	8.77
254	Town wall: section from Bargate E and including Polymond Tower	0.017	-	-	0.001	-	-	8.63
255	Arundel Castle	23.663	0.910	1.551	2.030	3.85	6.55	8.58
256	Holy Rood Church	0.056	-	-	0.004	-	-	7.79
257	Bramber Castle	3.955	0.040	0.219	0.301	1.02	5.53	7.62
258	Open areas within Roman, Saxon and medieval town	1.814	-	-	0.131	-	-	7.23
259	A Saxon Shore fort, Roman port and associated remains at Richborough	41.088	<0.001	0.395	2.841	<0.01	0.96	6.91
260	World War II Heavy Anti-aircraft gunsite (TS2), 300m east of Chetney Cottages	3.417	-	-	0.207	-	-	6.07
261	Royal Military Canal, Shorncliffe Battery wall	0.656	-	-	0.038	-	-	5.78
262	Medieval town of Winchelsea	37.757	0.764	1.274	2.154	2.02	3.38	5.70
263	Medieval settlement and cultivation remains at Newtown	10.490	0.032	0.165	0.556	0.30	1.57	5.30
264	Camp near Belle Tout lighthouse, Birling Gap	23.762	0.981	1.138	1.182	4.13	4.79	4.97
265	Romano-Celtic temple and Iron Age site S of Worth	1.594	-	-	0.066	-	-	4.12
266	Chatham Dockyard, the Dockyard wall	0.007	<0.001	<0.001	<0.001	0.40	2.10	2.84
267	Medieval settlement remains immediately west of St Pancras's Church	2.669	-	-	0.072	-	-	2.69
268	Dovecote at Charleston Manor	0.009	-	-	<0.001	-	-	2.21
269	Rochester Castle	2.160	-	0.012	0.036	-	0.57	1.68
270	Motte and bailey castle, fishpond and associated earthworks, SW of Isfield Church	2.151	-	-	0.033	-	-	1.51
271	Castle wall	0.016	-	<0.001	<0.001	-	1.34	1.48

APPENDIX F. Maps of sea-level rise impacts

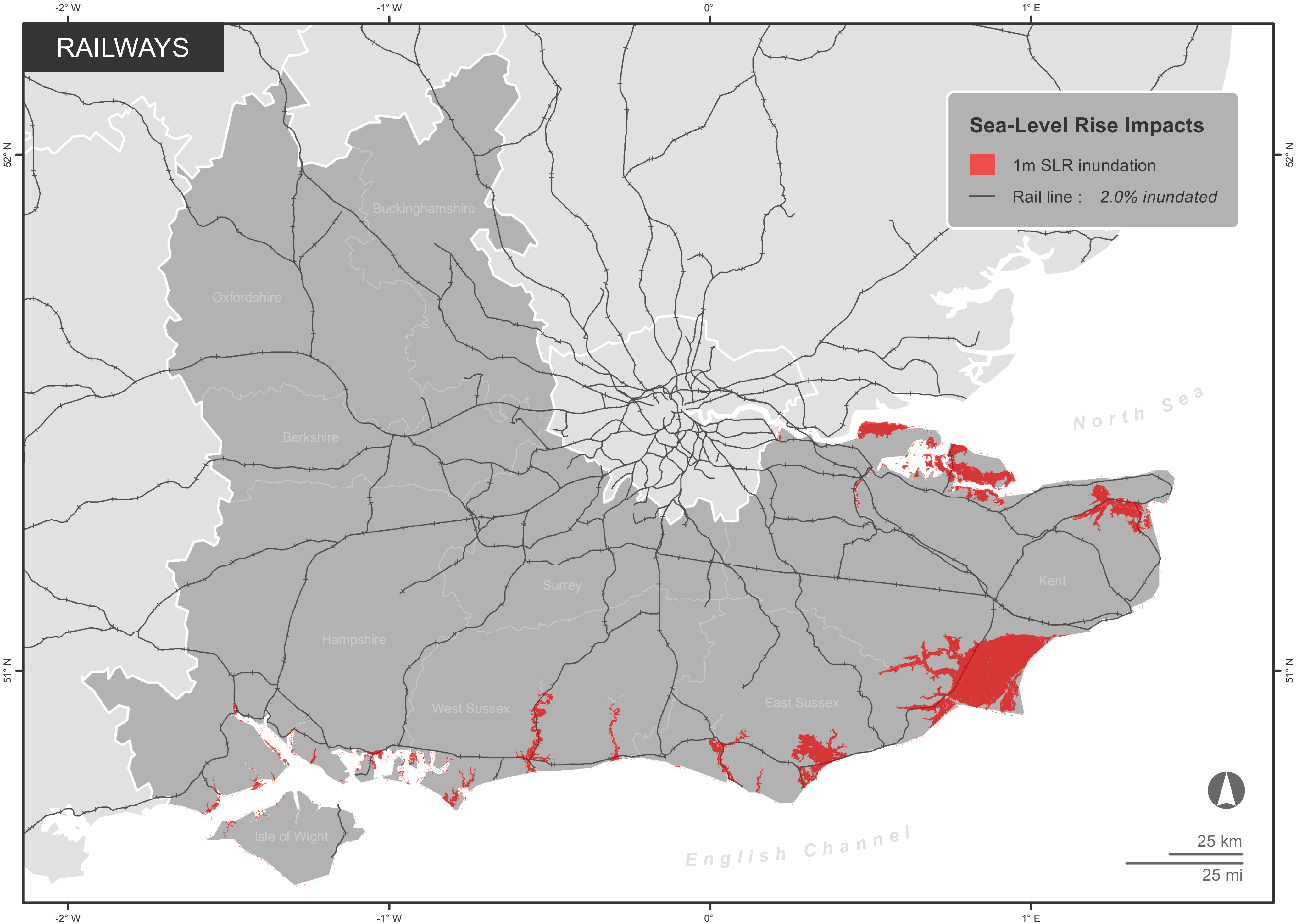

TOTAL AREA
Sea-Level Rise Inundation
1m SLR : 3.1% of area inundated
3m SLR : 5.0% of area inundated
5m SLR : 6.2% of area inundated
Buckinghamshire
Oxfordshire
Berkshire
Surrey
Kent
Hampshire
West Sussex
East Sussex
Isle of Wight
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N

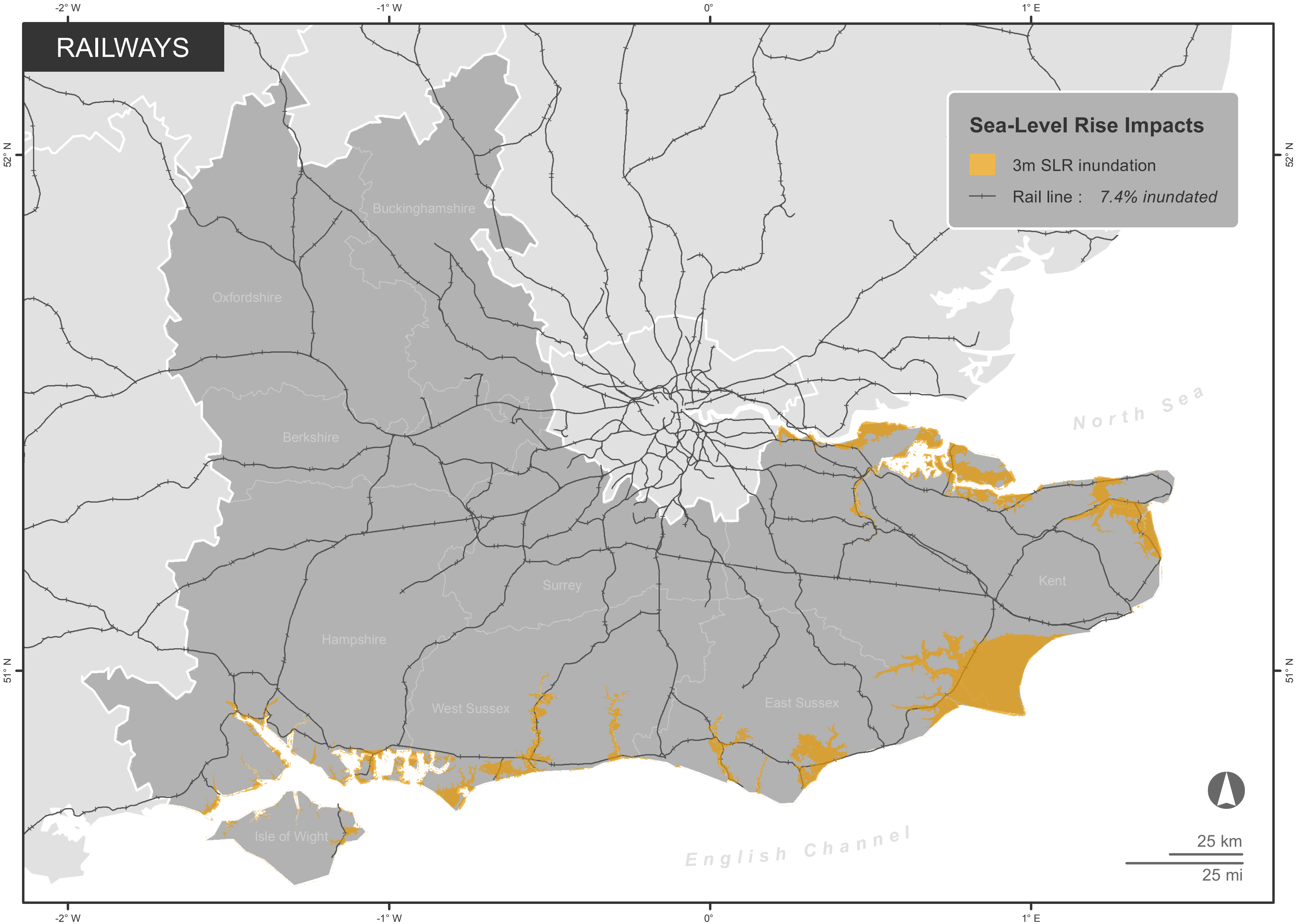

ROADS
Sea-Level Rise Impacts
1m SLR inundation : 1.4% of roads inundated
Motorway : <0.1% inundated
A Road : 1.3% inundated
B Road : 0.9% inundated
Minor Road (not shown) : 1.5% inundated
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N

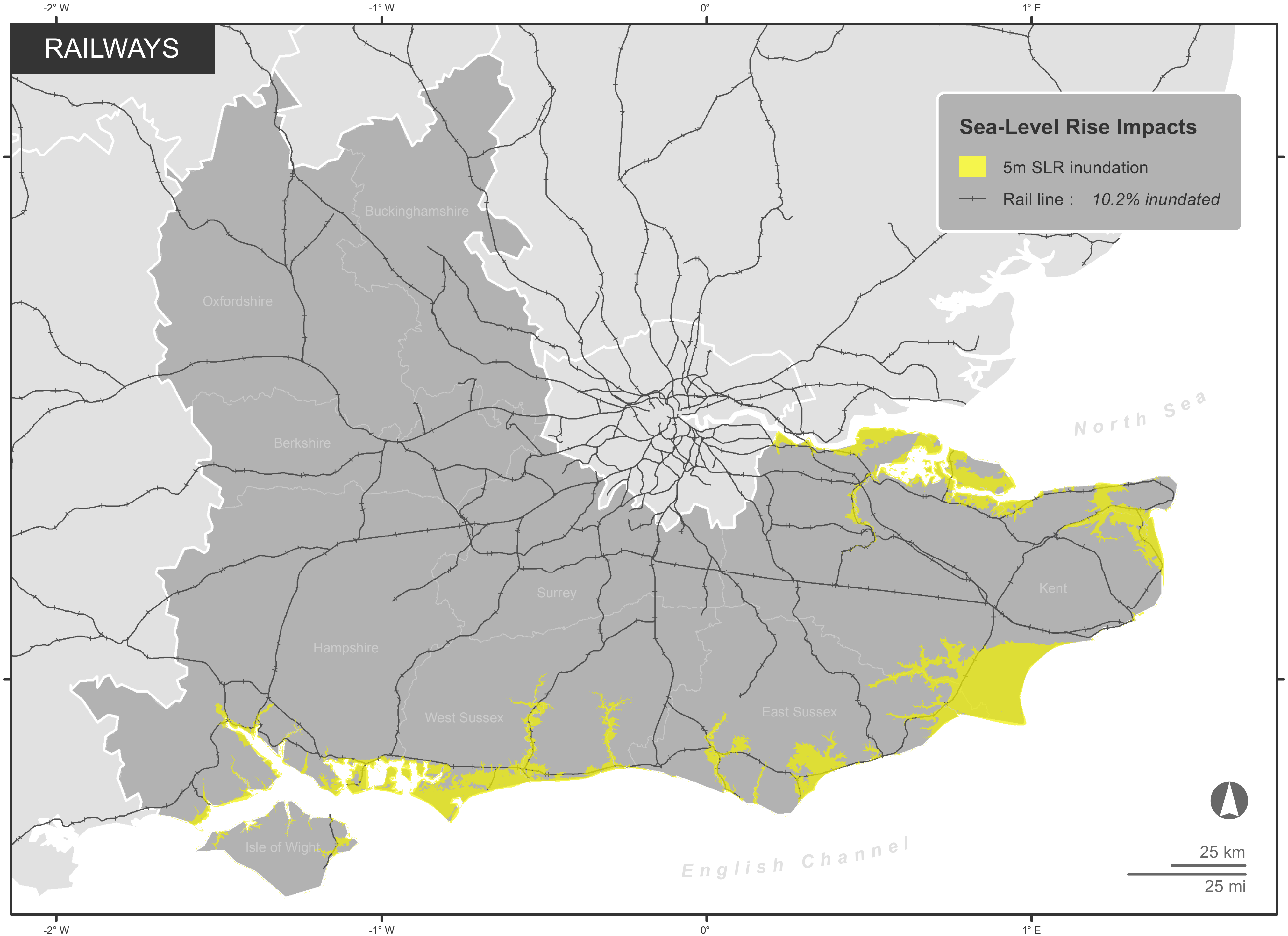

ROADS
Sea-Level Rise Impacts
3m SLR inundation : 4.0% of roads inundated
Motorway : 0.3% inundated
A Road : 4.2% inundated
B Road : 2.7% inundated
Minor Road (not shown) : 4.2% inundated
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N



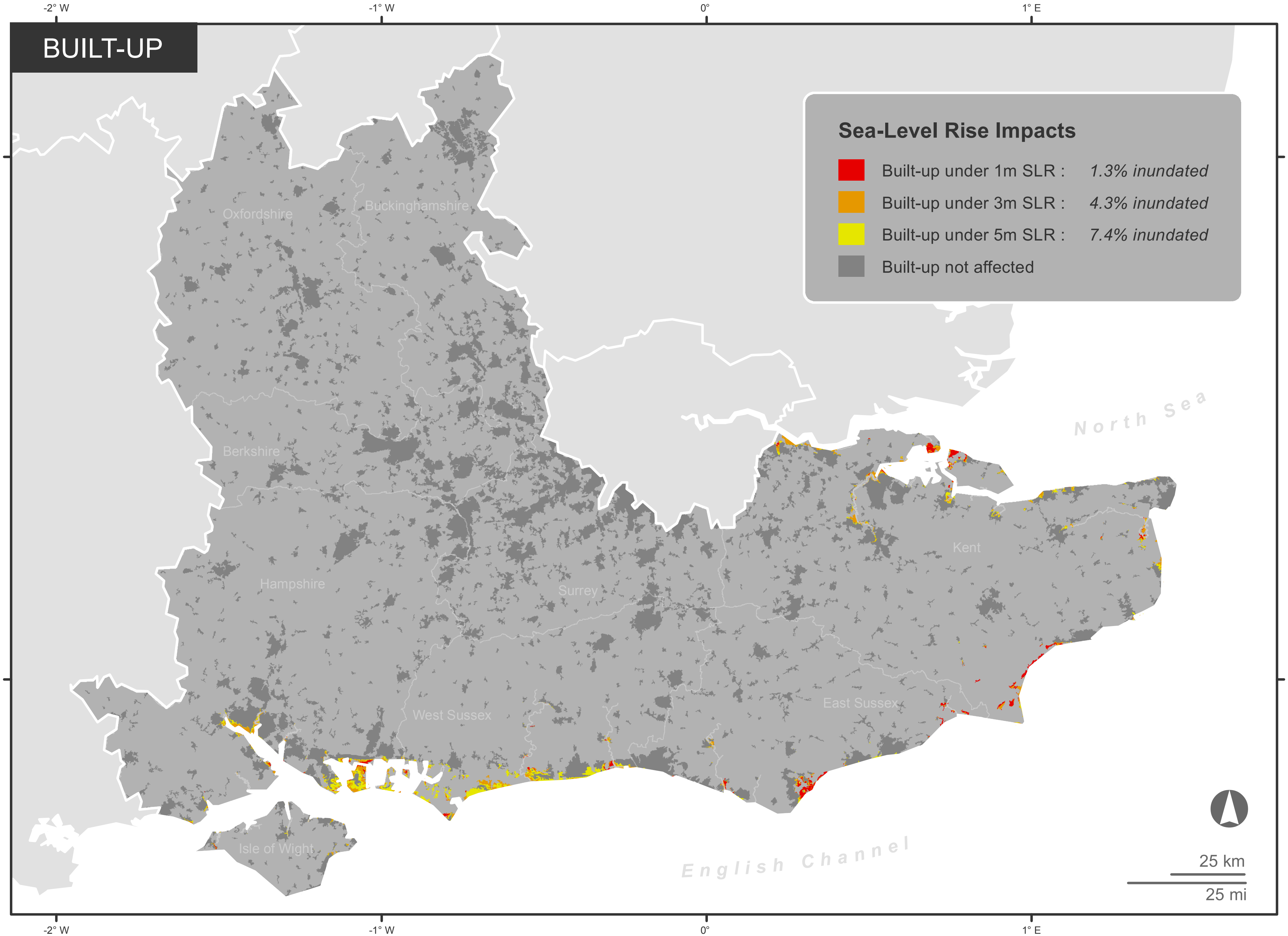
ROADS
Sea-Level Rise Impacts
5m SLR inundation : 6.5% of roads inundated
Motorway : 1.1% inundated
A Road : 6.2% inundated
B Road : 4.9% inundated
Minor Road (not shown) : 6.7% inundated
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N

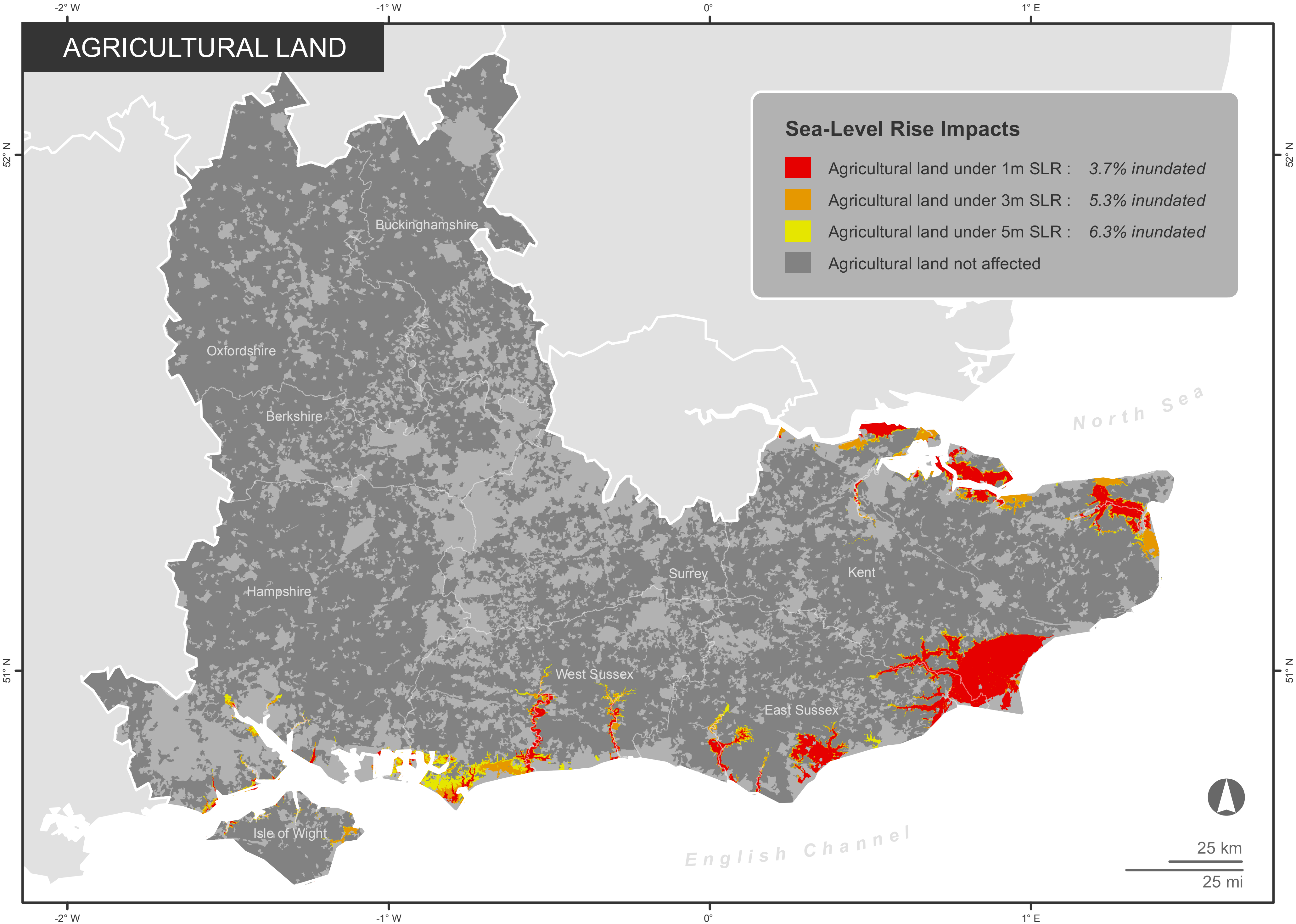

RAILWAYS
Sea-Level Rise Impacts
1m SLR inundation
Rail line : 2.0% inundated
Buckinghamshire
Oxfordshire
Berkshire
Surrey
Hampshire
West Sussex
East Sussex
Kent
Isle of Wight
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N


RAILWAYS
Sea-Level Rise Impacts
3m SLR inundation
Rail line : 7.4% inundated
Buckinghamshire
Oxfordshire
Berkshire
Surrey
Hampshire
West Sussex
East Sussex
Kent
Isle of Wight
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N

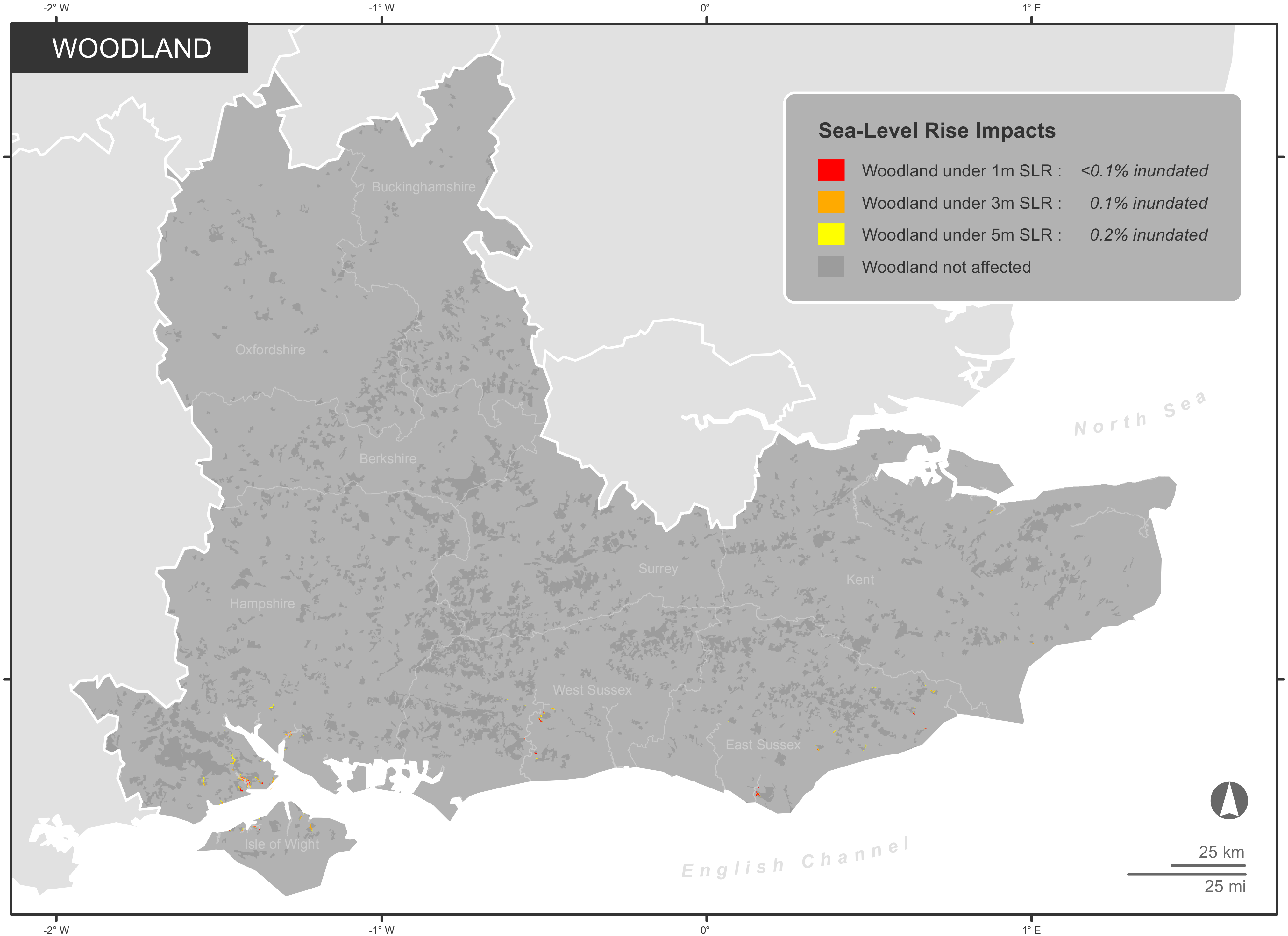


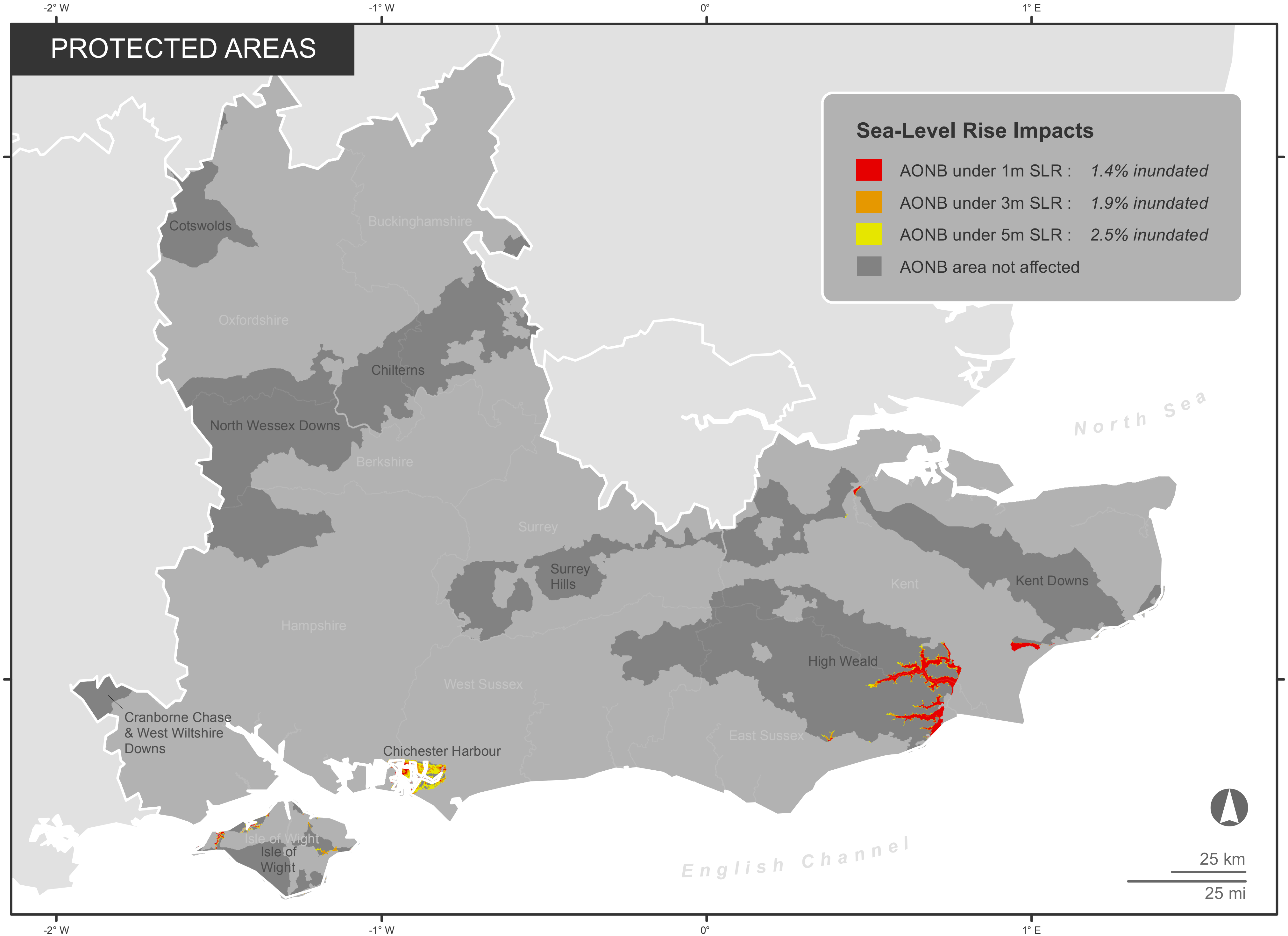
RAILWAYS
Sea-Level Rise Impacts
5m SLR inundation
Rail line : 10.2% inundated
Buckinghamshire
Oxfordshire
Berkshire
Surrey
Hampshire
West Sussex
East Sussex
Kent
Isle of Wight
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N

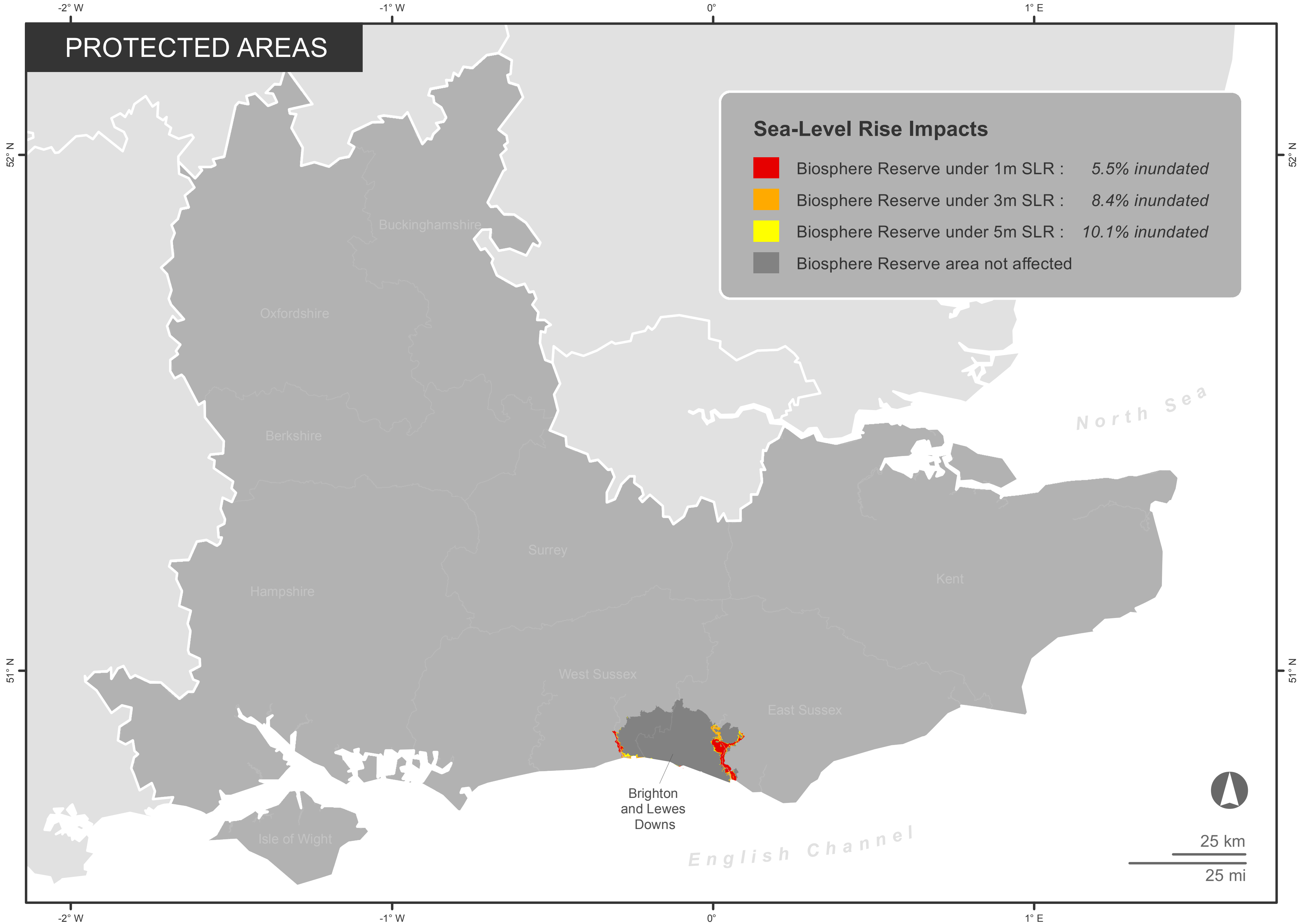

BUILT-UP
Sea-Level Rise Impacts
Built-up under 1m SLR : 1.3% inundated
Built-up under 3m SLR : 4.3% inundated
Built-up under 5m SLR : 7.4% inundated
Built-up not affected
Oxfordshire
Buckinghamshire
Berkshire
Hampshire
Surrey
Kent
West Sussex
East Sussex
Isle of Wight
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N

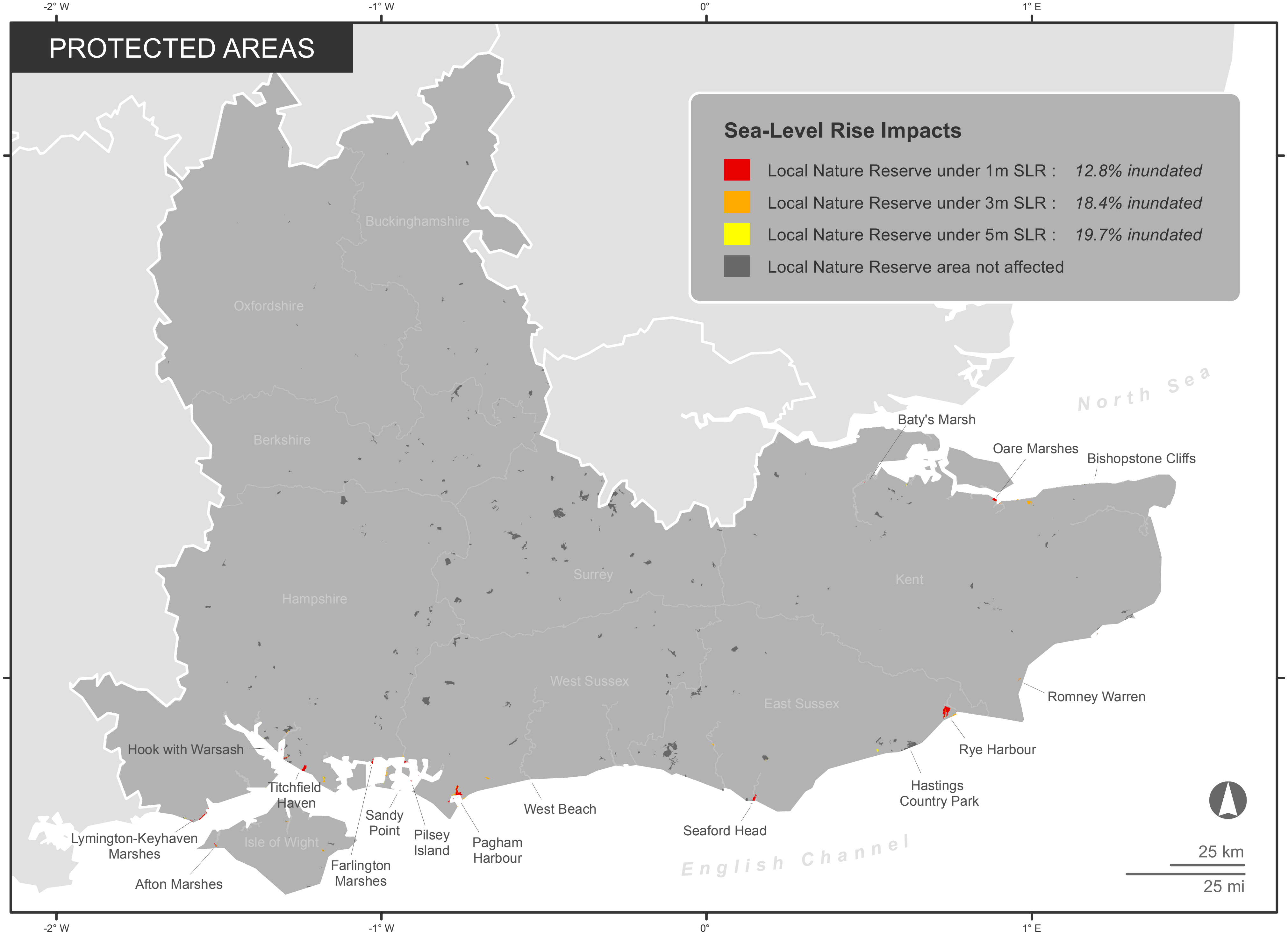


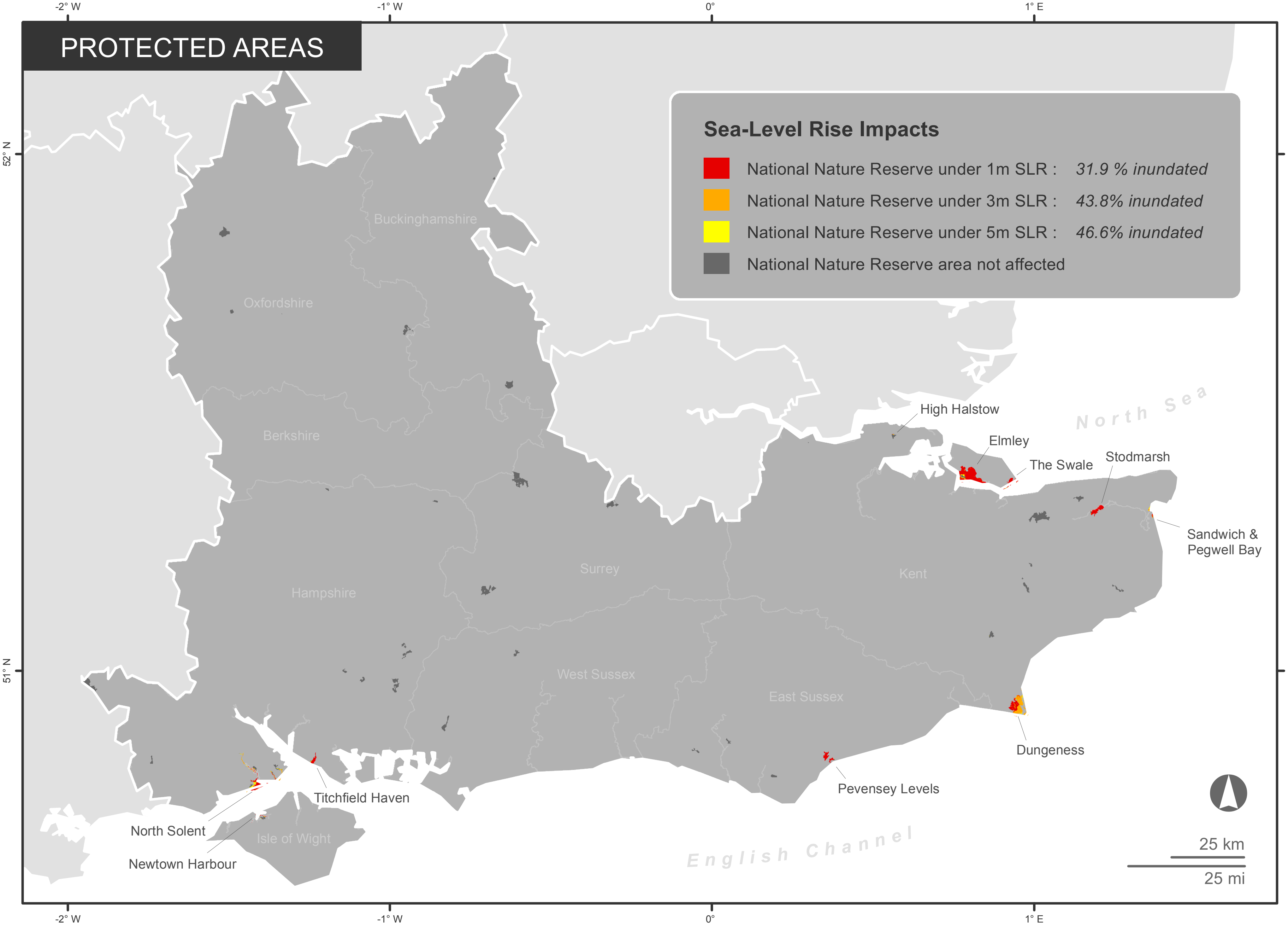
AGRICULTURAL LAND
Sea-Level Rise Impacts
Agricultural land under 1m SLR : 3.7% inundated
Agricultural land under 3m SLR : 5.3% inundated
Agricultural land under 5m SLR : 6.3% inundated
Agricultural land not affected
Buckinghamshire
Oxfordshire
Berkshire
Hampshire
Surrey
Kent
West Sussex
East Sussex
Isle of Wight
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N

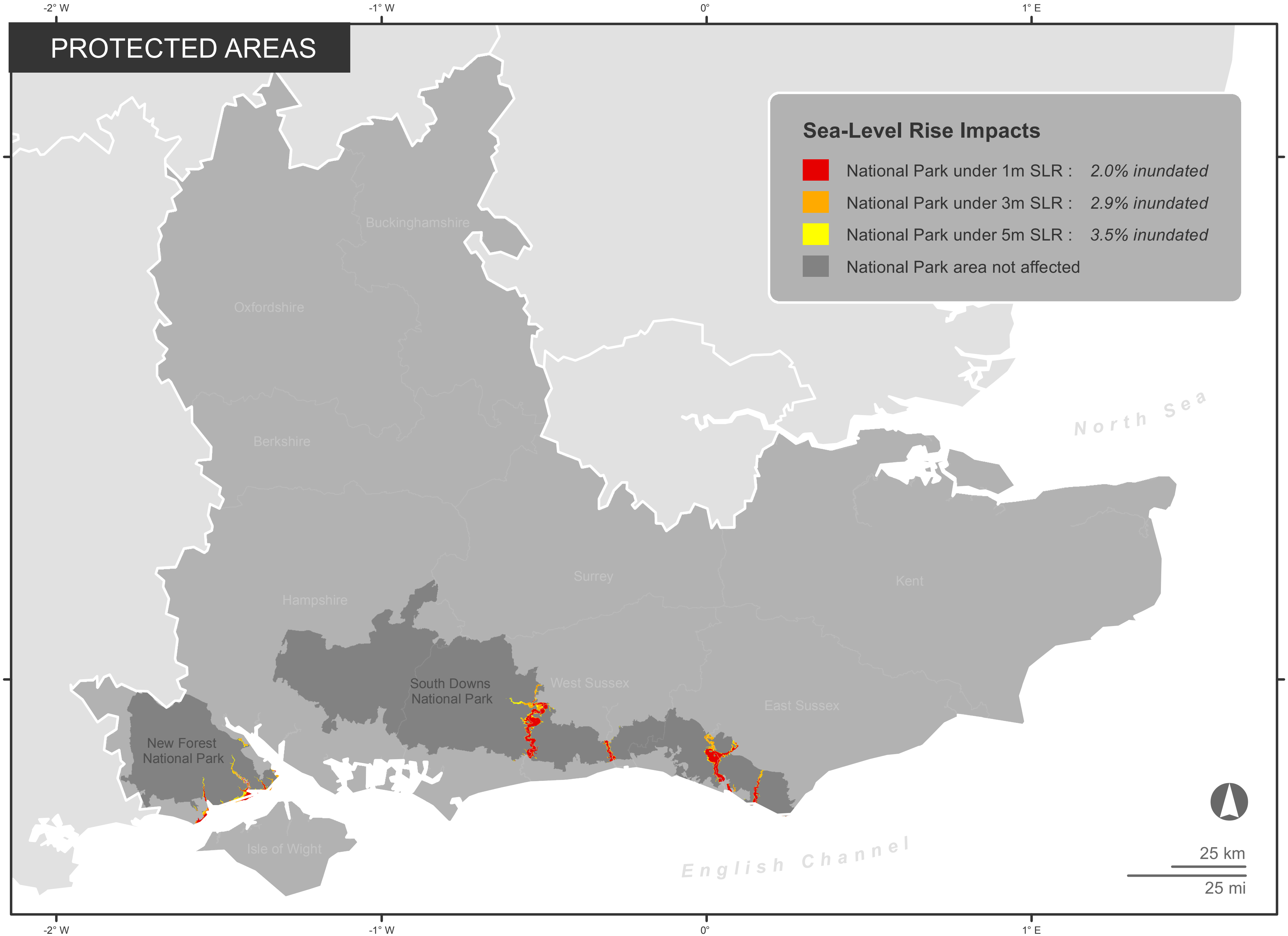

WOODLAND
Sea-Level Rise Impacts
Woodland under 1m SLR : <0.1% inundated
Woodland under 3m SLR : 0.1% inundated
Woodland under 5m SLR : 0.2% inundated
Woodland not affected
Buckinghamshire
Oxfordshire
Berkshire
Surrey
Kent
Hampshire
West Sussex
East Sussex
Isle of Wight
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N


PROTECTED AREAS
Sea-Level Rise Impacts
AONB under 1m SLR : 1.4% inundated
AONB under 3m SLR : 1.9% inundated
AONB under 5m SLR : 2.5% inundated
AONB area not affected
-2° W
-1° W
0°
1° E
52° N
51° N
Cotswolds
Buckinghamshire
Oxfordshire
Chilterns
North Wessex Downs
Berkshire
Surrey
Surrey Hills
Kent
Kent Downs
Hampshire
High Weald
West Sussex
Cranborne Chase & West Wiltshire Downs
Chichester Harbour
East Sussex
Isle of Wight
Isle of Wight
North Sea
English Channel
25 km
25 mi

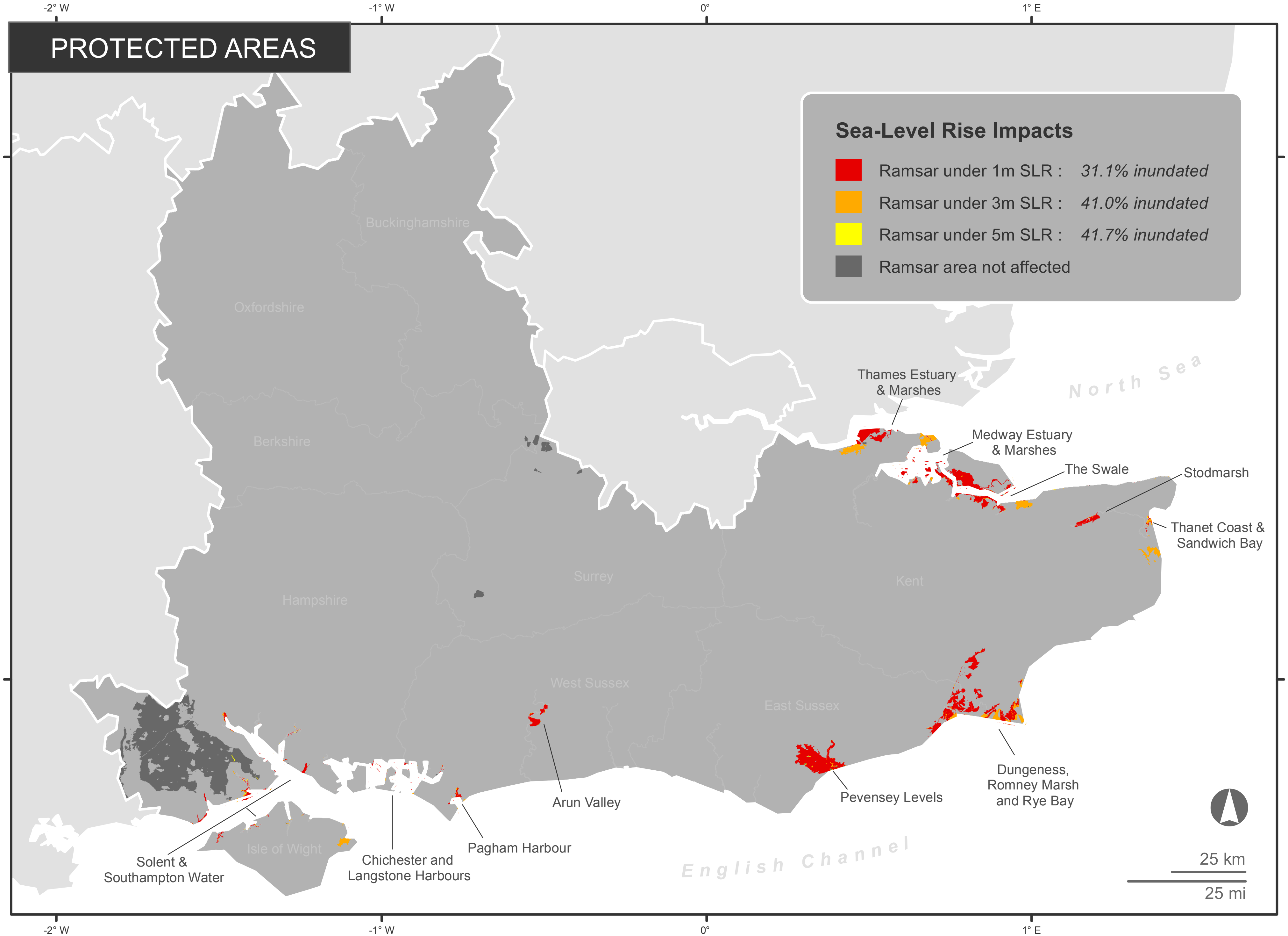

PROTECTED AREAS
Sea-Level Rise Impacts
Biosphere Reserve under 1m SLR : 5.5% inundated
Biosphere Reserve under 3m SLR : 8.4% inundated
Biosphere Reserve under 5m SLR : 10.1% inundated
Biosphere Reserve area not affected
-2° W
-1° W
0°
1° E
52° N
51° N
Buckinghamshire
Oxfordshire
Berkshire
Surrey
Hampshire
Kent
West Sussex
East Sussex
Isle of Wight
Brighton and Lewes Downs
North Sea
English Channel
25 km
25 mi


PROTECTED AREAS
Sea-Level Rise Impacts
Local Nature Reserve under 1m SLR : 12.8% inundated
Local Nature Reserve under 3m SLR : 18.4% inundated
Local Nature Reserve under 5m SLR : 19.7% inundated
Local Nature Reserve area not affected
-2° W
-1° W
0°
1° E
52° N
51° N
Buckinghamshire
Oxfordshire
Berkshire
Hampshire
Surrey
Kent
West Sussex
East Sussex
Isle of Wight
North Sea
English Channel
Baty's Marsh
Oare Marshes
Bishopstone Cliffs
Romney Warren
Rye Harbour
Hastings Country Park
Seaford Head
West Beach
Pagham Harbour
Pilsey Island
Sandy Point
Farlington Marshes
Titchfield Haven
Hook with Warsash
Lymington-Keyhaven Marshes
Afton Marshes
25 km
25 mi

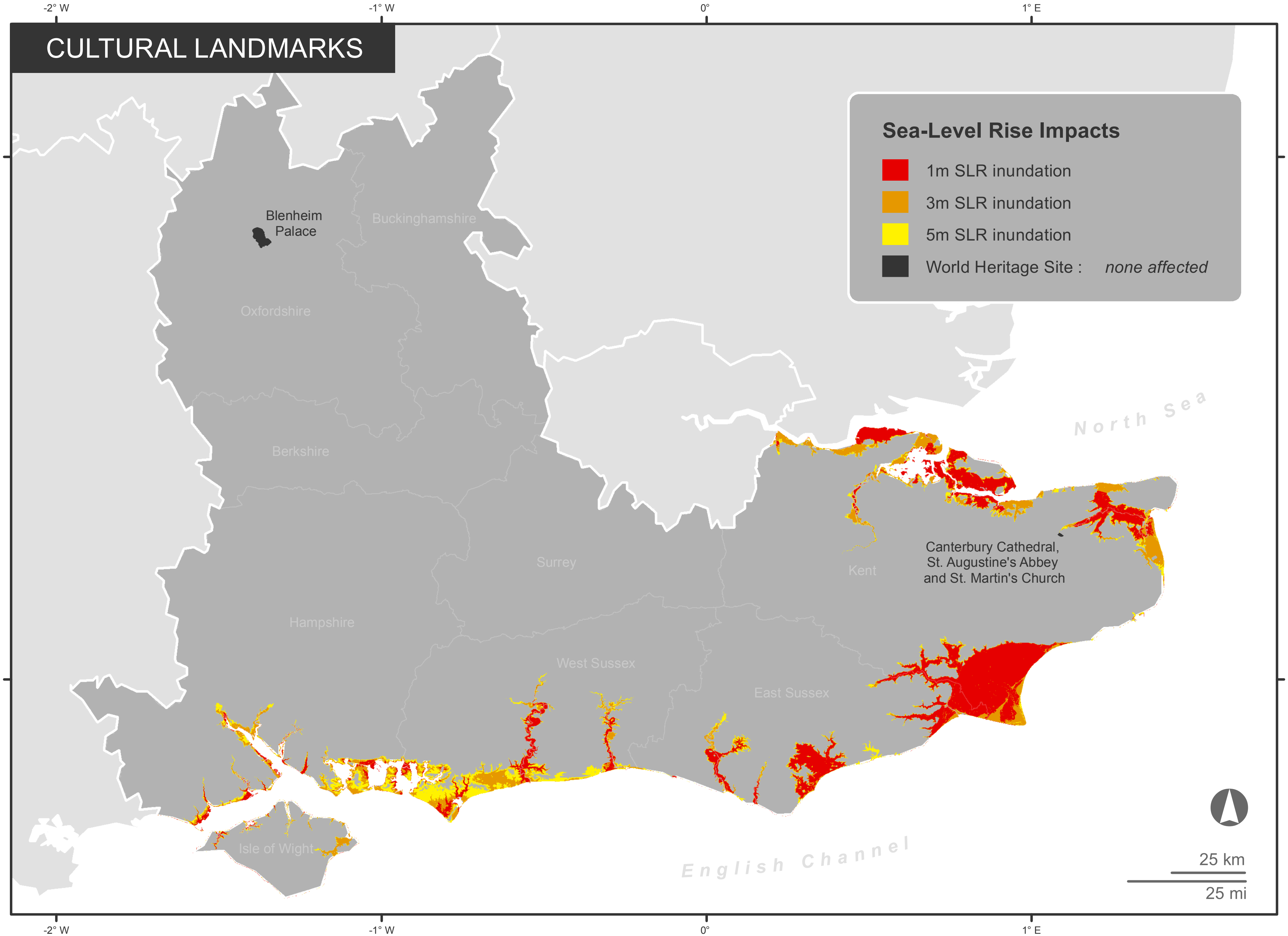

PROTECTED AREAS
Sea-Level Rise Impacts
National Nature Reserve under 1m SLR : 31.9 % inundated
National Nature Reserve under 3m SLR : 43.8% inundated
National Nature Reserve under 5m SLR : 46.6% inundated
National Nature Reserve area not affected
-2° W
-1° W
0°
1° E
52° N
51° N
Buckinghamshire
Oxfordshire
Berkshire
Surrey
Kent
Hampshire
West Sussex
East Sussex
Isle of Wight
High Halstow
Elmley
The Swale
Stodmarsh
Sandwich &
Pegwell Bay
Dungeness
Pevensey Levels
Titchfield Haven
North Solent
Newtown Harbour
North Sea
English Channel
25 km
25 mi



PROTECTED AREAS
Sea-Level Rise Impacts
National Park under 1m SLR : 2.0% inundated
National Park under 3m SLR : 2.9% inundated
National Park under 5m SLR : 3.5% inundated
National Park area not affected
-2° W
-1° W
0°
1° E
52° N
51° N
Buckinghamshire
Oxfordshire
Berkshire
Surrey
Kent
Hampshire
West Sussex
East Sussex
South Downs National Park
New Forest National Park
Isle of Wight
North Sea
English Channel
25 km
25 mi

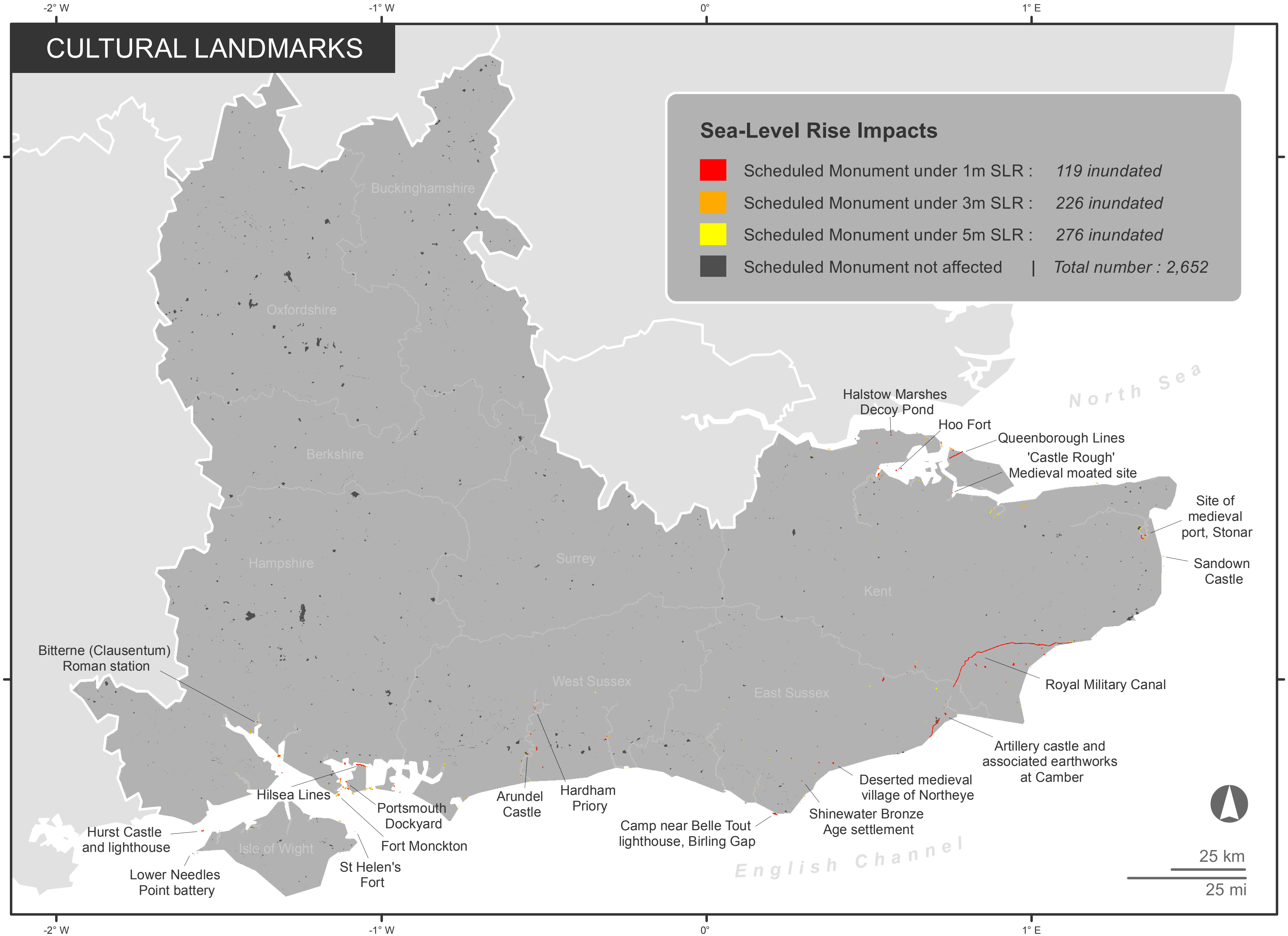


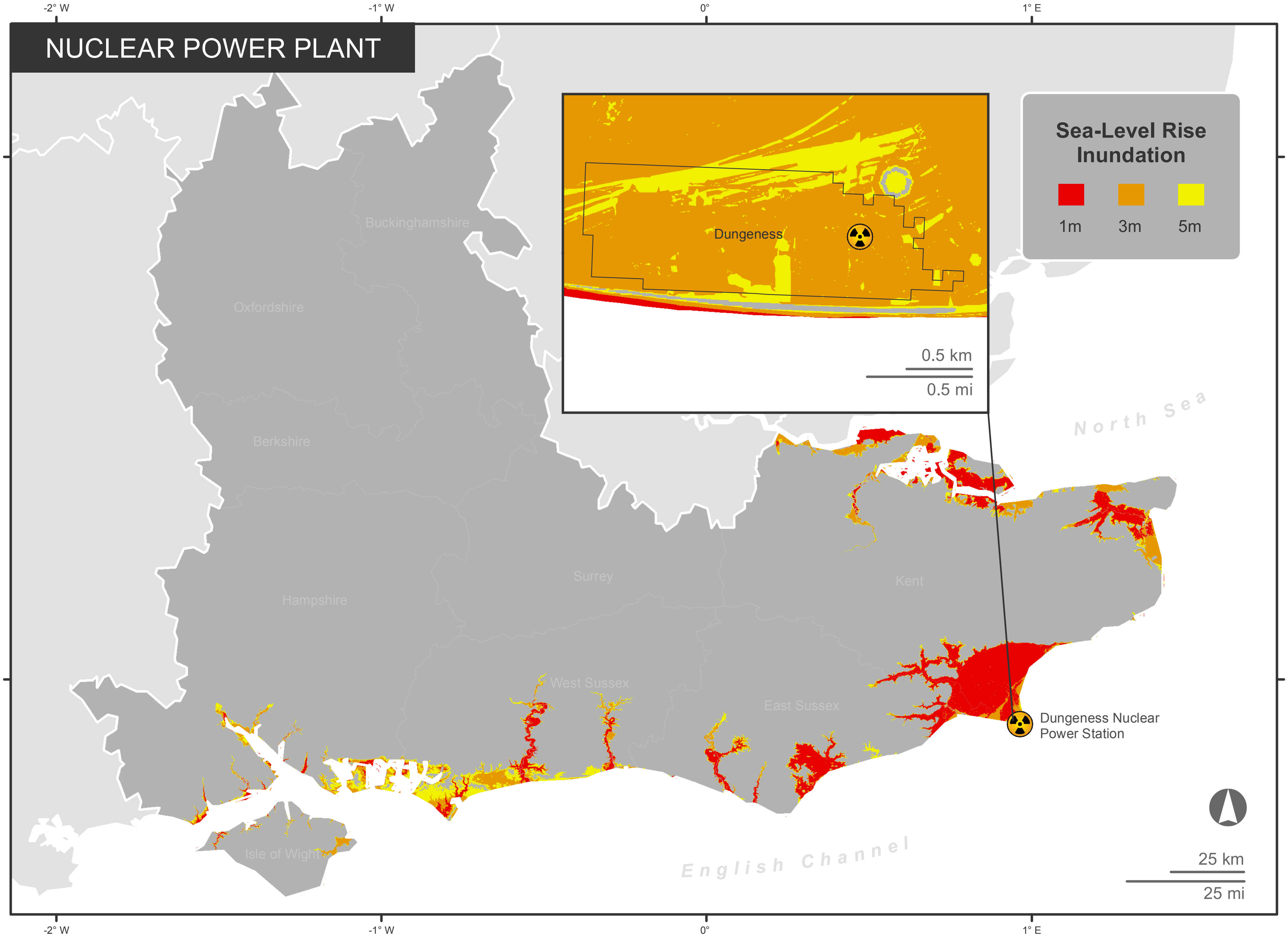
PROTECTED AREAS
Sea-Level Rise Impacts
Ramsar under 1m SLR : 31.1% inundated
Ramsar under 3m SLR : 41.0% inundated
Ramsar under 5m SLR : 41.7% inundated
Ramsar area not affected
-2° W
-1° W
0°
1° E
52° N
51° N
Buckinghamshire
Oxfordshire
Berkshire
Hampshire
Surrey
Kent
West Sussex
East Sussex
Isle of Wight
North Sea
English Channel
Thames Estuary & Marshes
Medway Estuary & Marshes
The Swale
Stodmarsh
Thanet Coast & Sandwich Bay
Dungeness, Romney Marsh and Rye Bay
Pevensey Levels
Arun Valley
Pagham Harbour
Chichester and Langstone Harbours
Solent & Southampton Water
25 km
25 mi

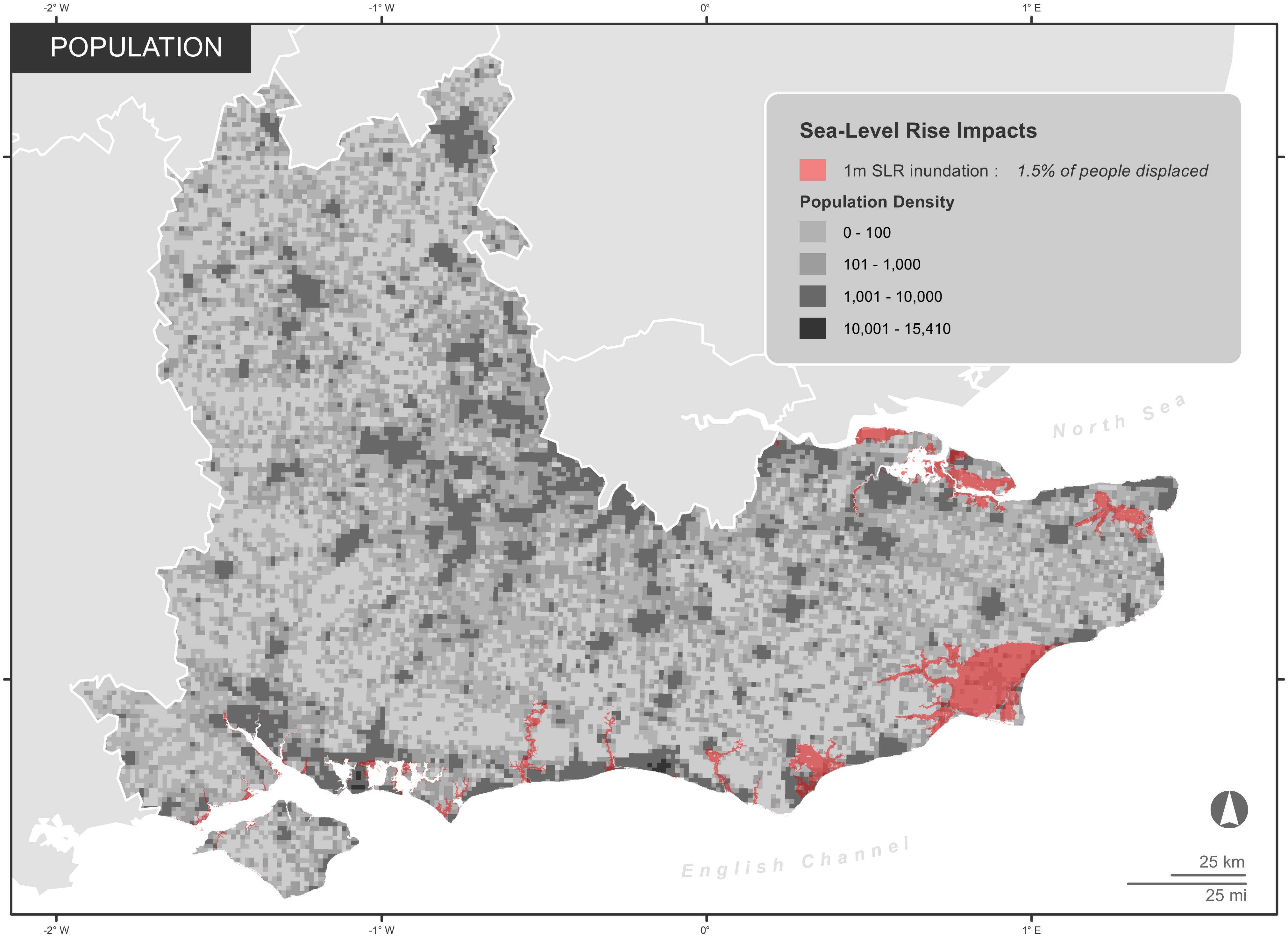


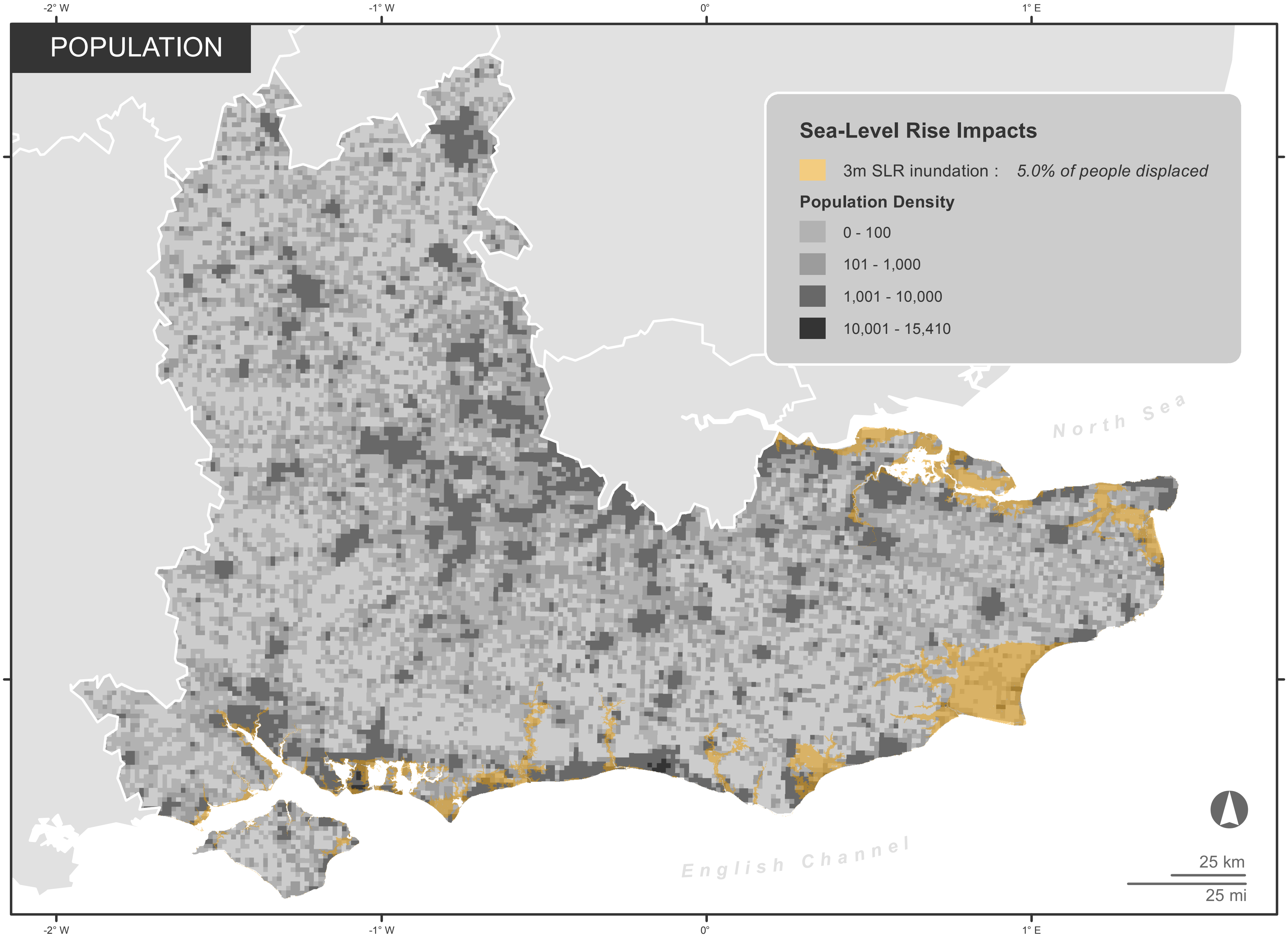
CULTURAL LANDMARKS
Sea-Level Rise Impacts
1m SLR inundation
3m SLR inundation
5m SLR inundation
World Heritage Site : none affected
Blenheim Palace
Canterbury Cathedral, St. Augustine's Abbey and St. Martin's Church
Buckinghamshire
Oxfordshire
Berkshire
Surrey
Kent
Hampshire
West Sussex
East Sussex
Isle of Wight
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N

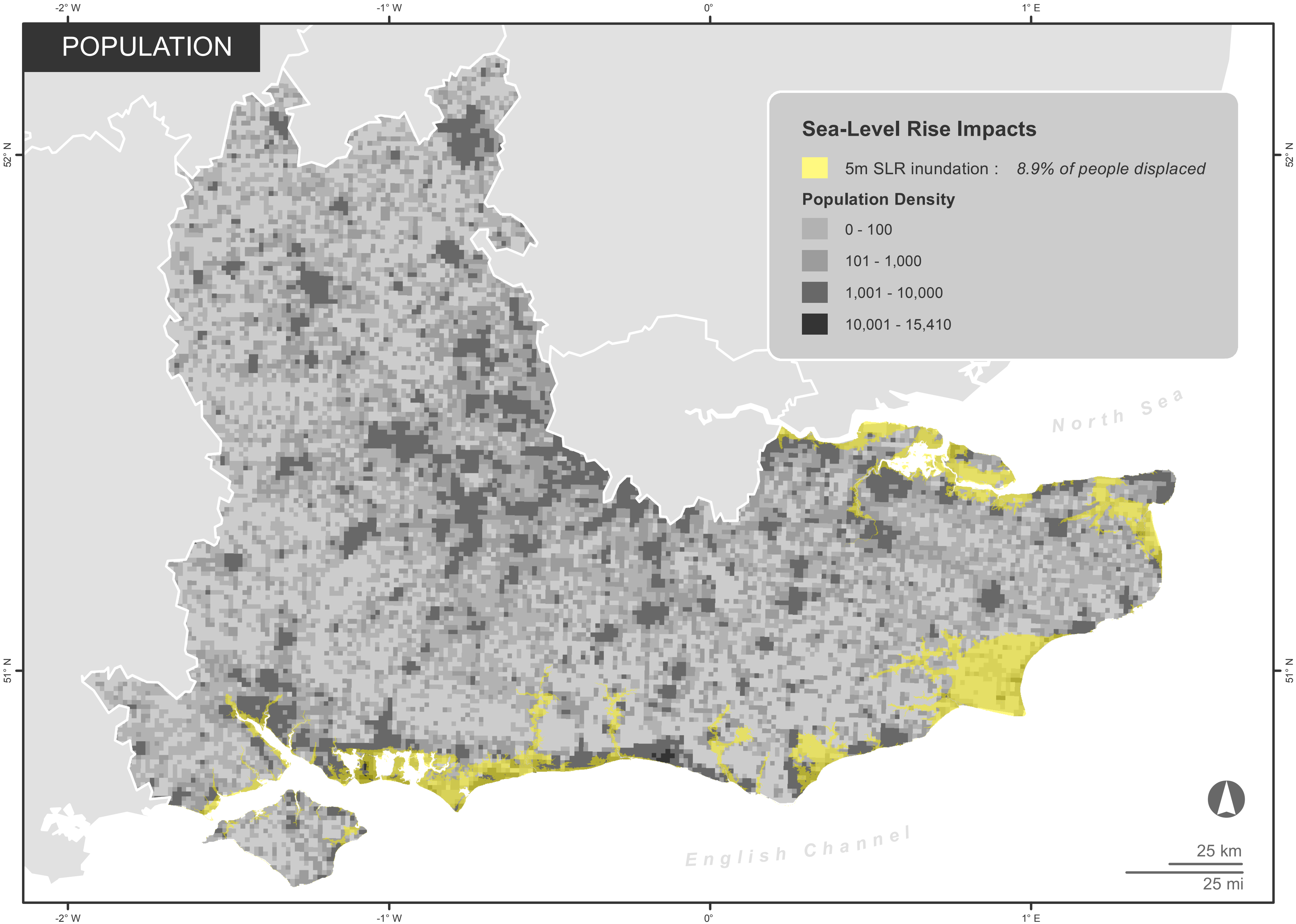
CULTURAL LANDMARKS



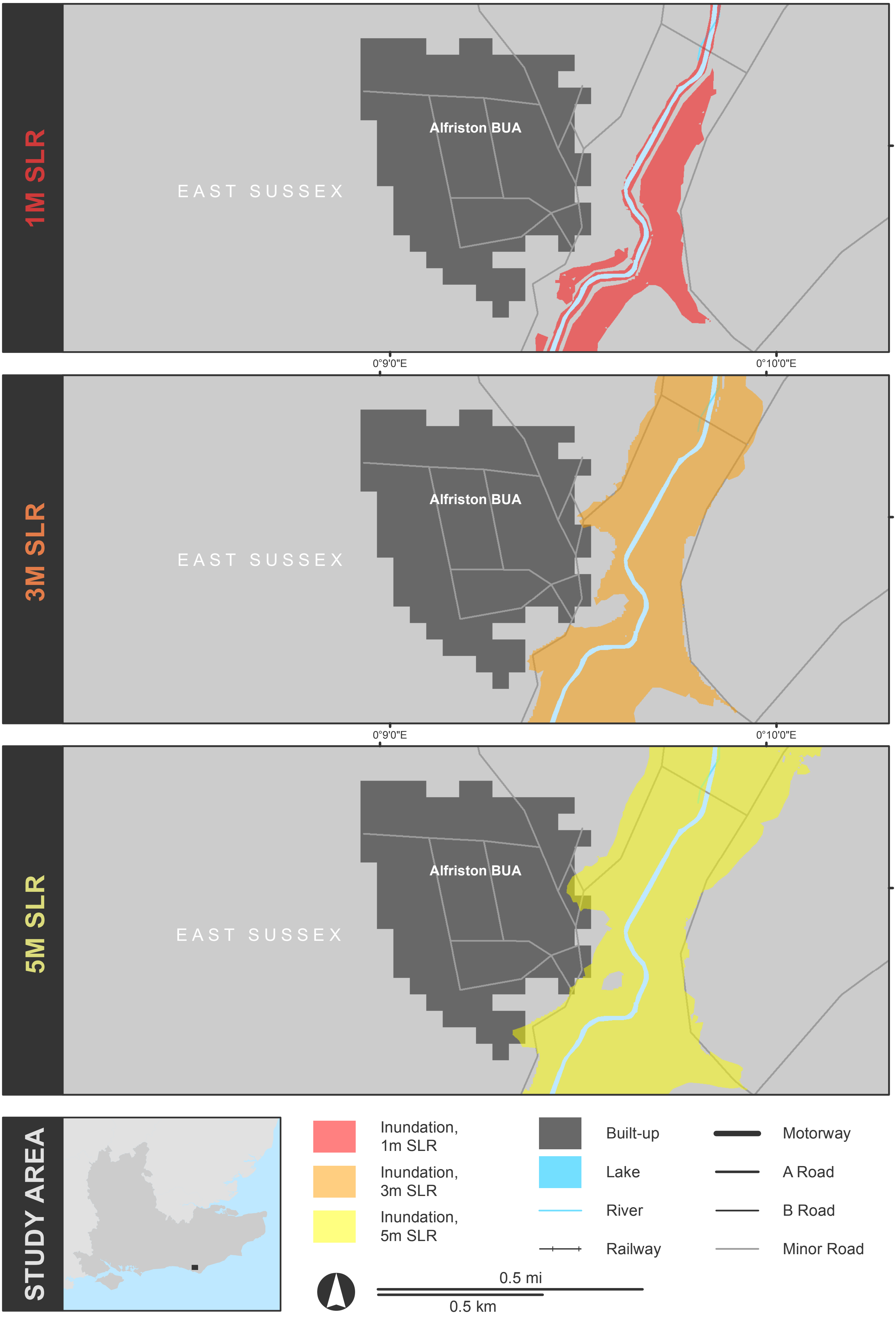

NUCLEAR POWER PLANT
Sea-Level Rise Inundation
1m
3m
5m
Dungeness
0.5 km
0.5 mi
Buckinghamshire
Oxfordshire
Berkshire
Surrey
Kent
Hampshire
West Sussex
East Sussex
Isle of Wight
North Sea
English Channel
Dungeness Nuclear Power Station
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N


POPULATION
Sea-Level Rise Impacts
1m SLR inundation : 1.5% of people displaced
Population Density
0 - 100
101 - 1,000
1,001 - 10,000
10,001 - 15,410
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N

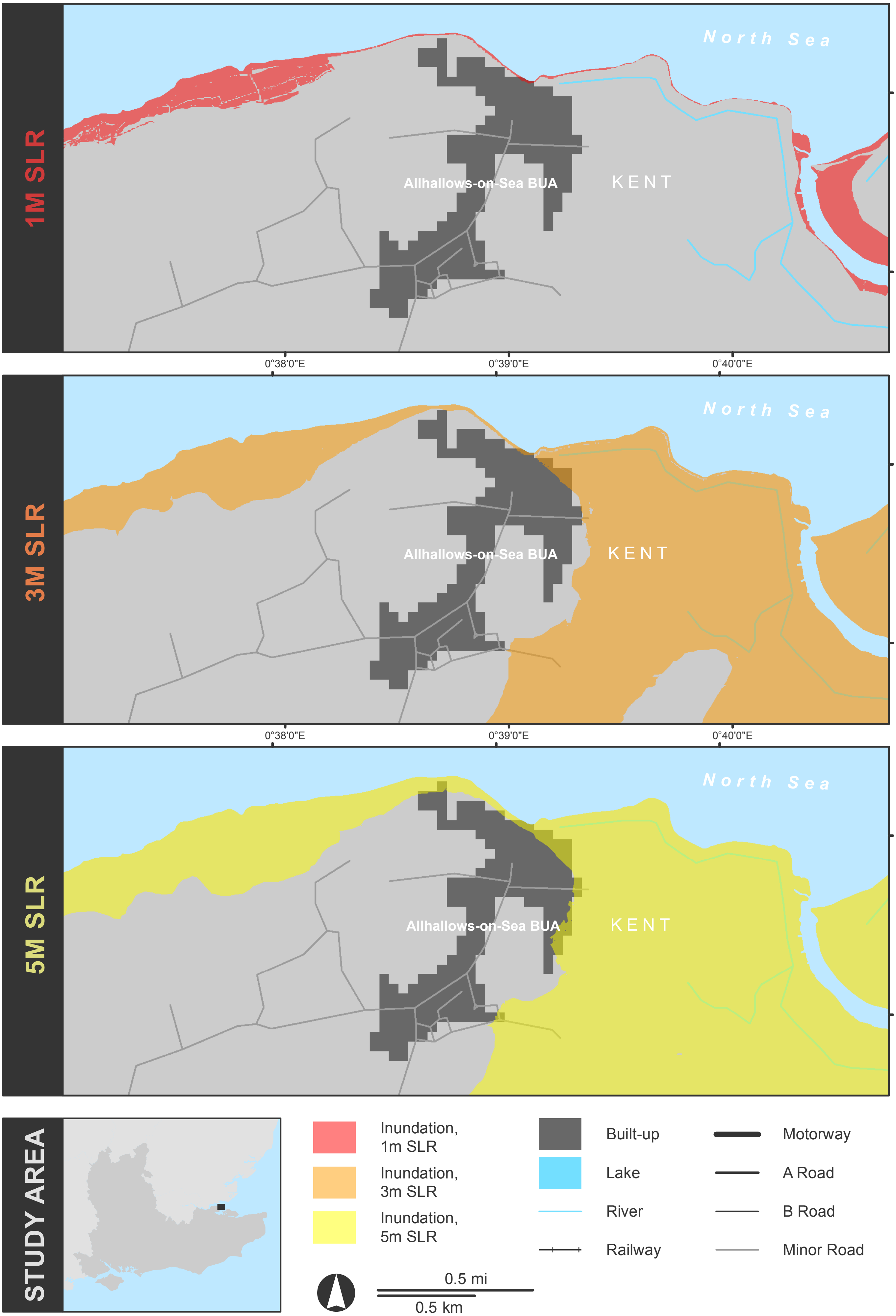

POPULATION
Sea-Level Rise Impacts
3m SLR inundation : 5.0% of people displaced
Population Density
0 - 100
101 - 1,000
1,001 - 10,000
10,001 - 15,410
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N


POPULATION
Sea-Level Rise Impacts
5m SLR inundation : 8.9% of people displaced
Population Density
0 - 100
101 - 1,000
1,001 - 10,000
10,001 - 15,410
North Sea
English Channel
25 km
25 mi
-2° W
-1° W
0°
1° E
52° N
51° N

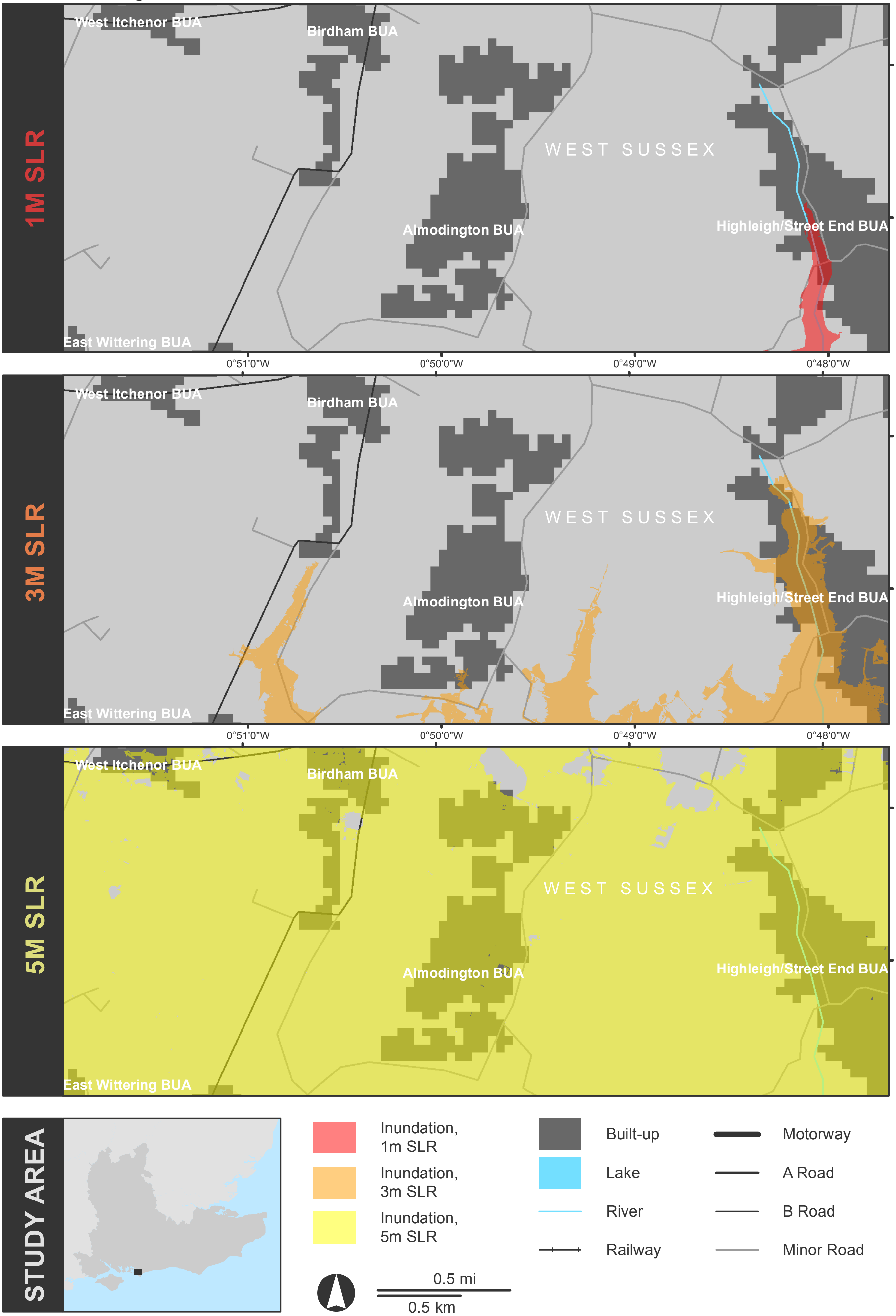
Alfriston BUA



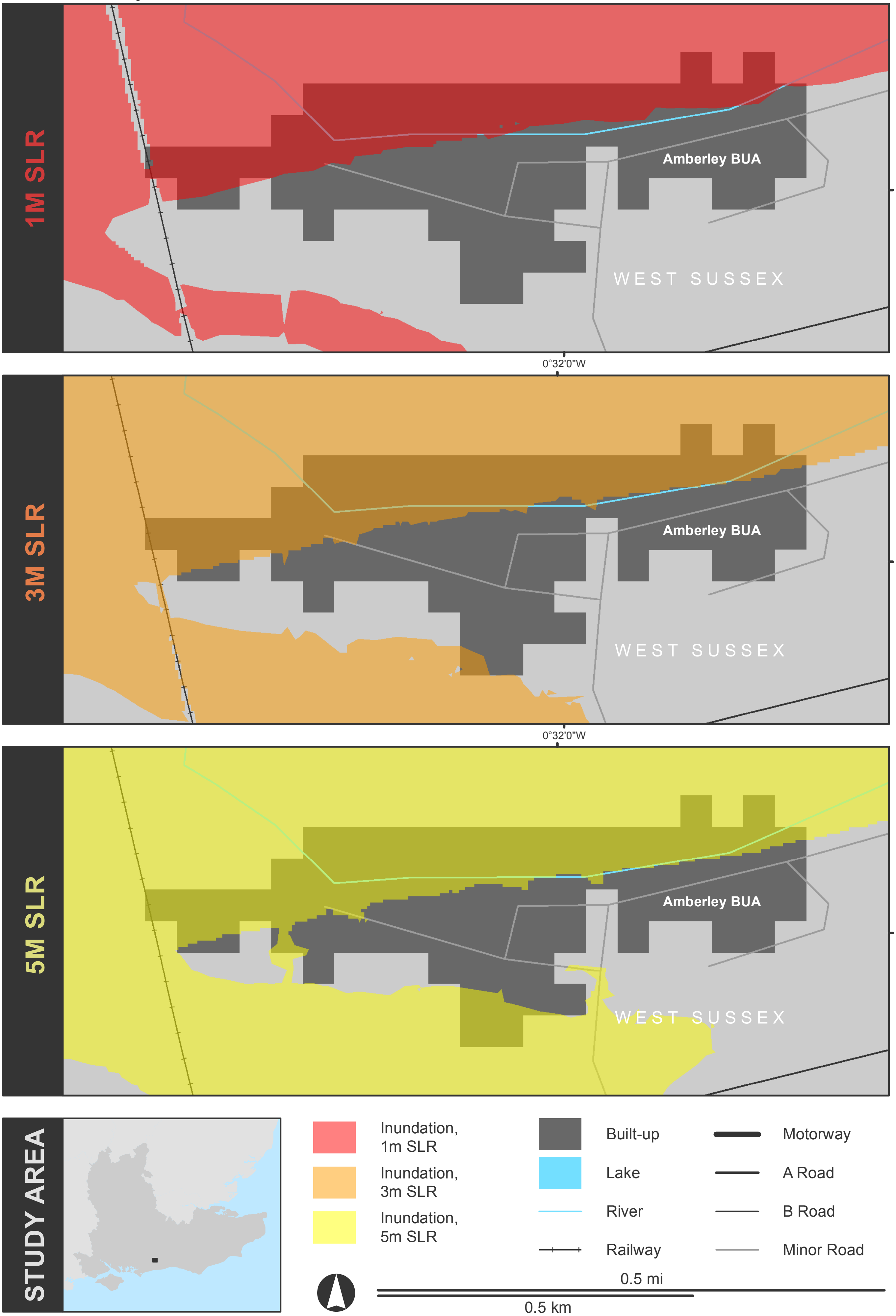
Allhallows-on-Sea BUA



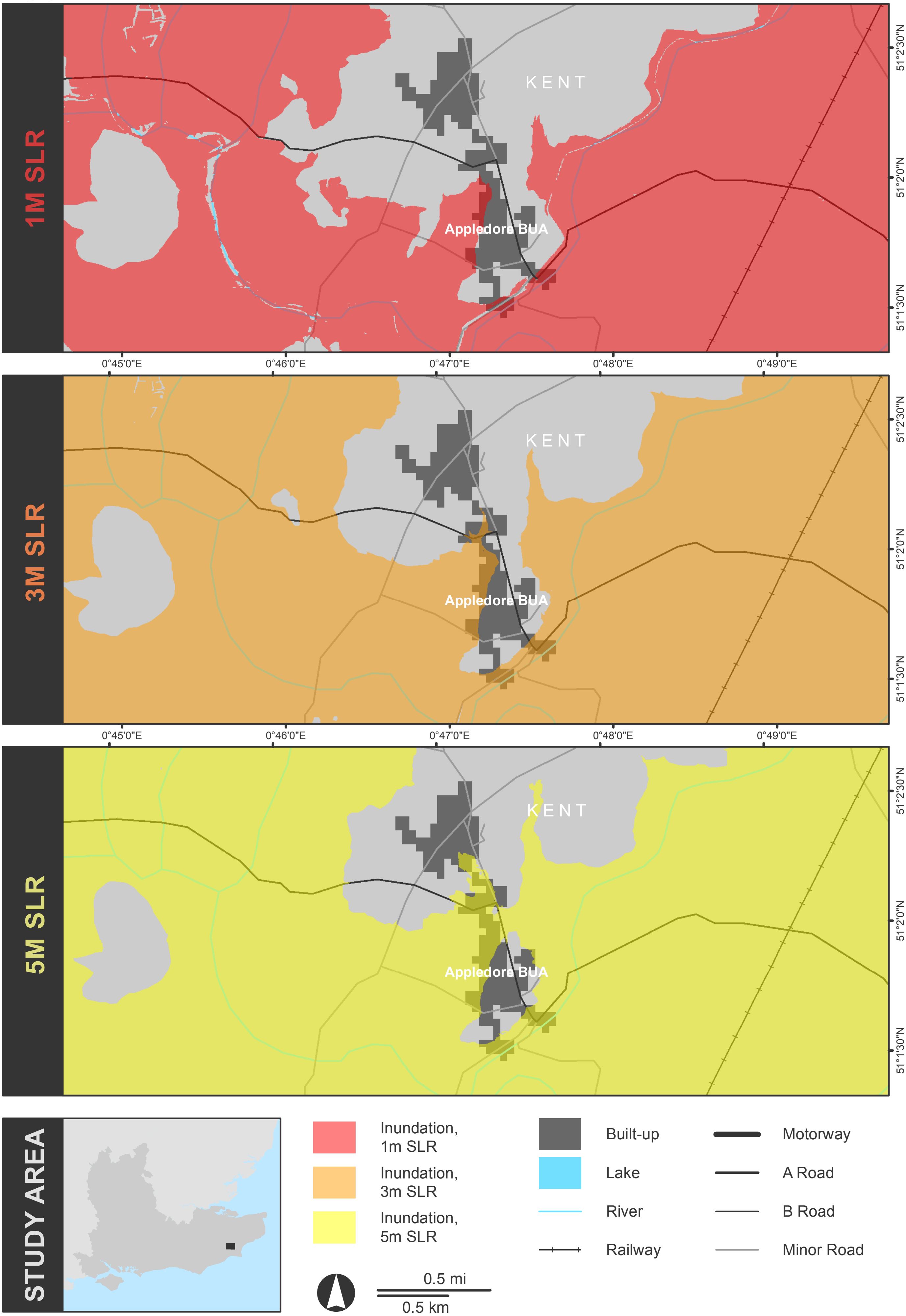
Almodington BUA



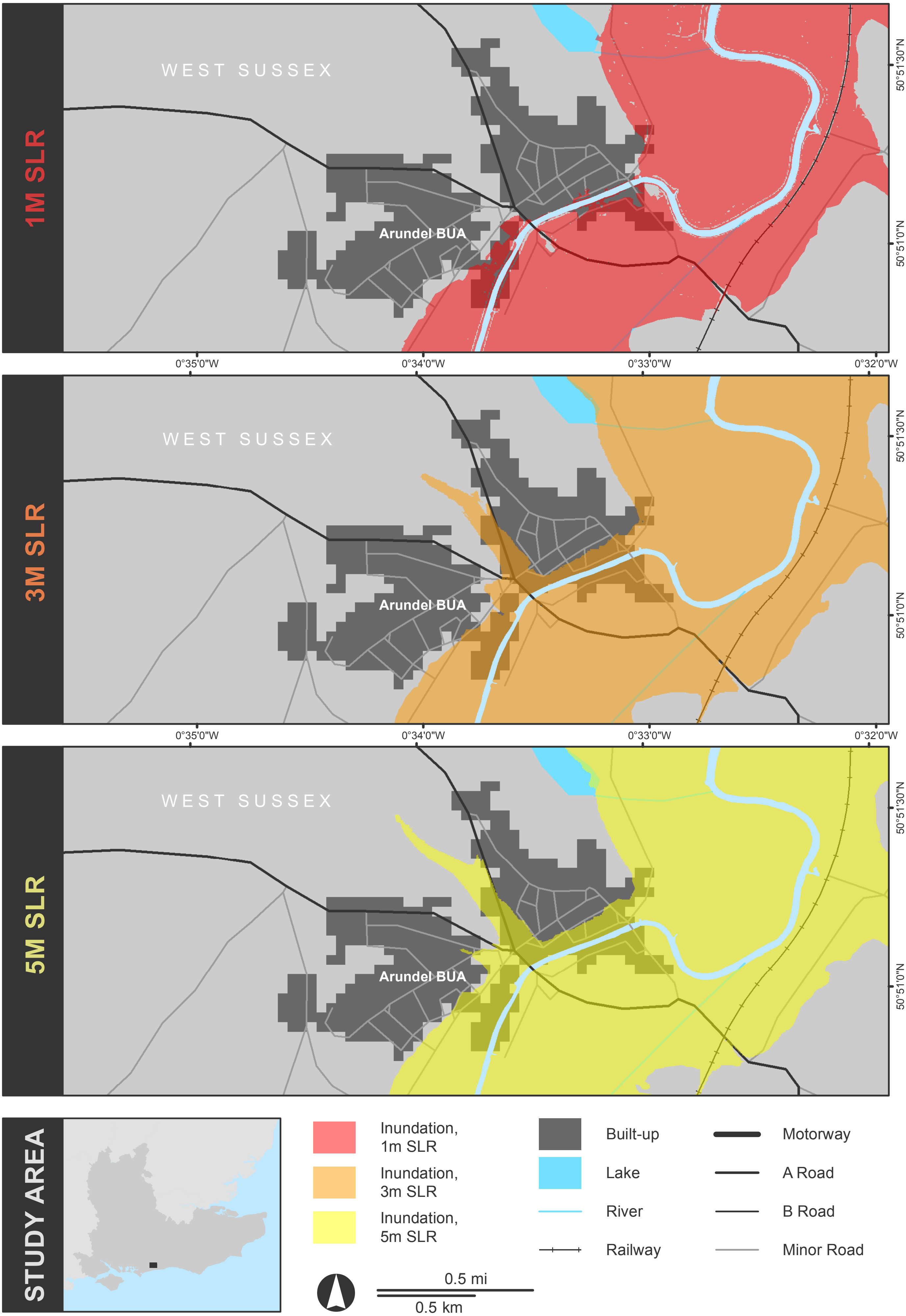
Amberley BUA



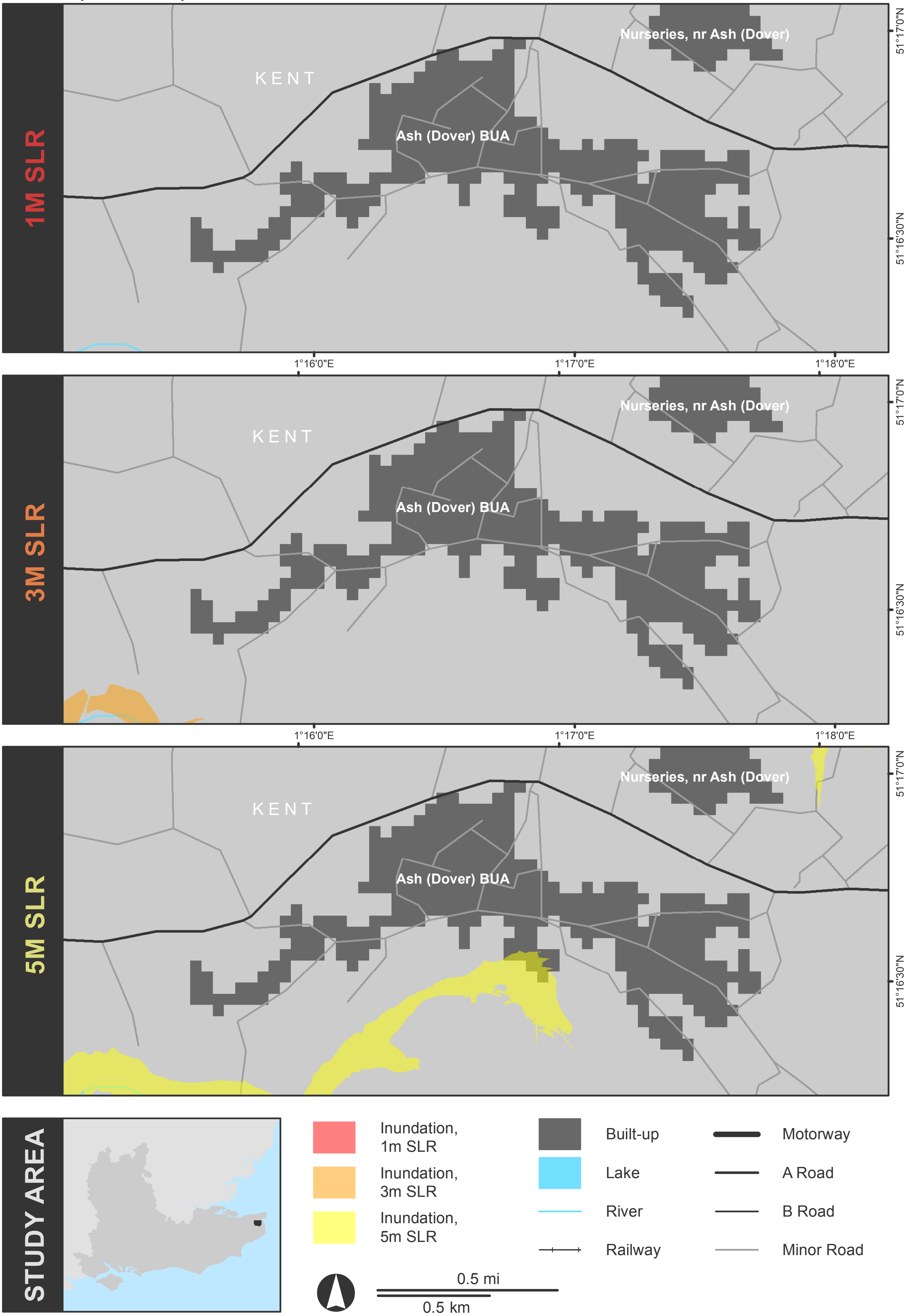
Appledore BUA



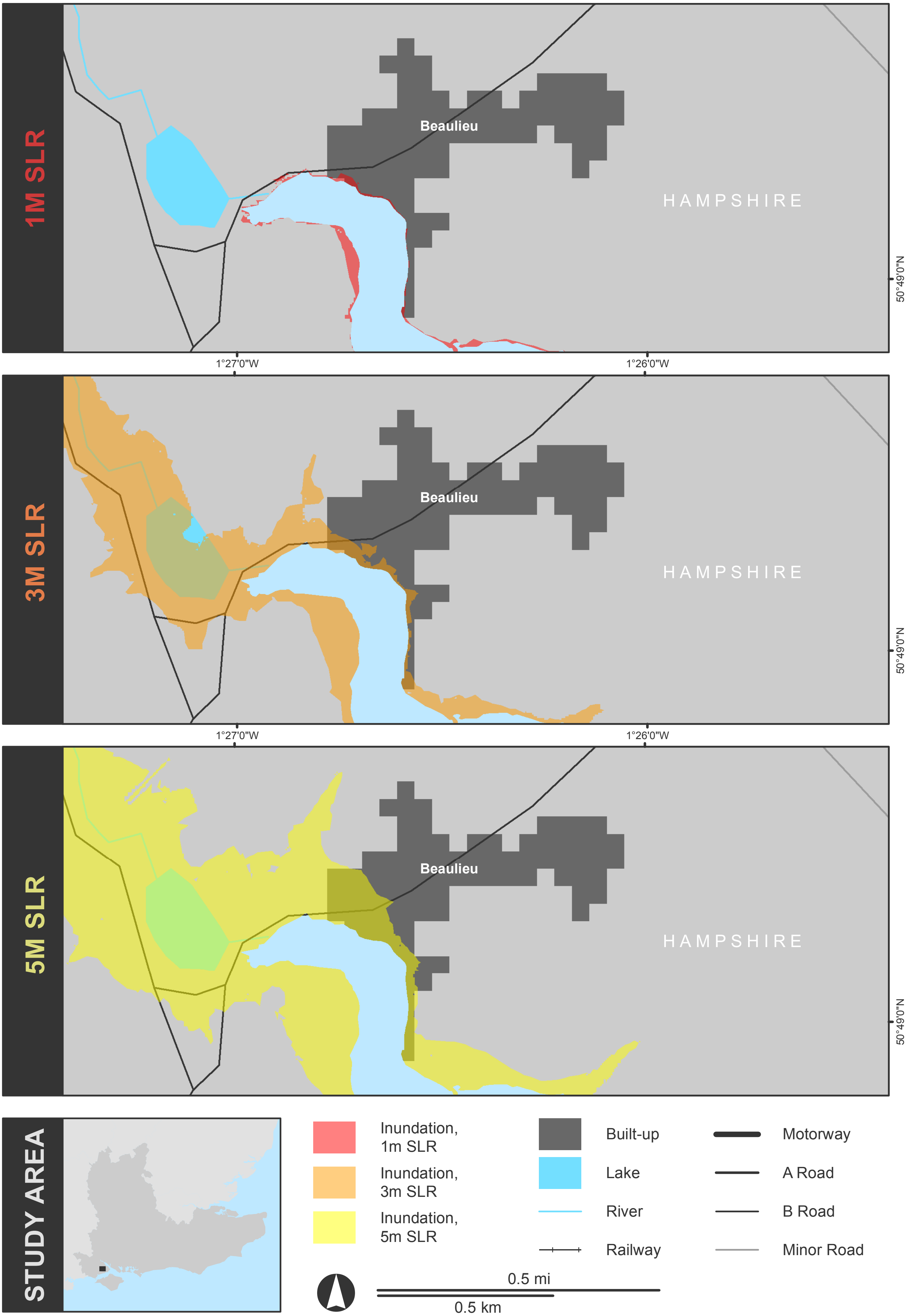
Arundel BUA


1M SLR
3M SLR
5M SLR
WEST SUSSEX
Arundel BUA
0°35'0"W
0°34'0"W
0°33'0"W
0°32'0"W
50°51'30"N
50°51'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

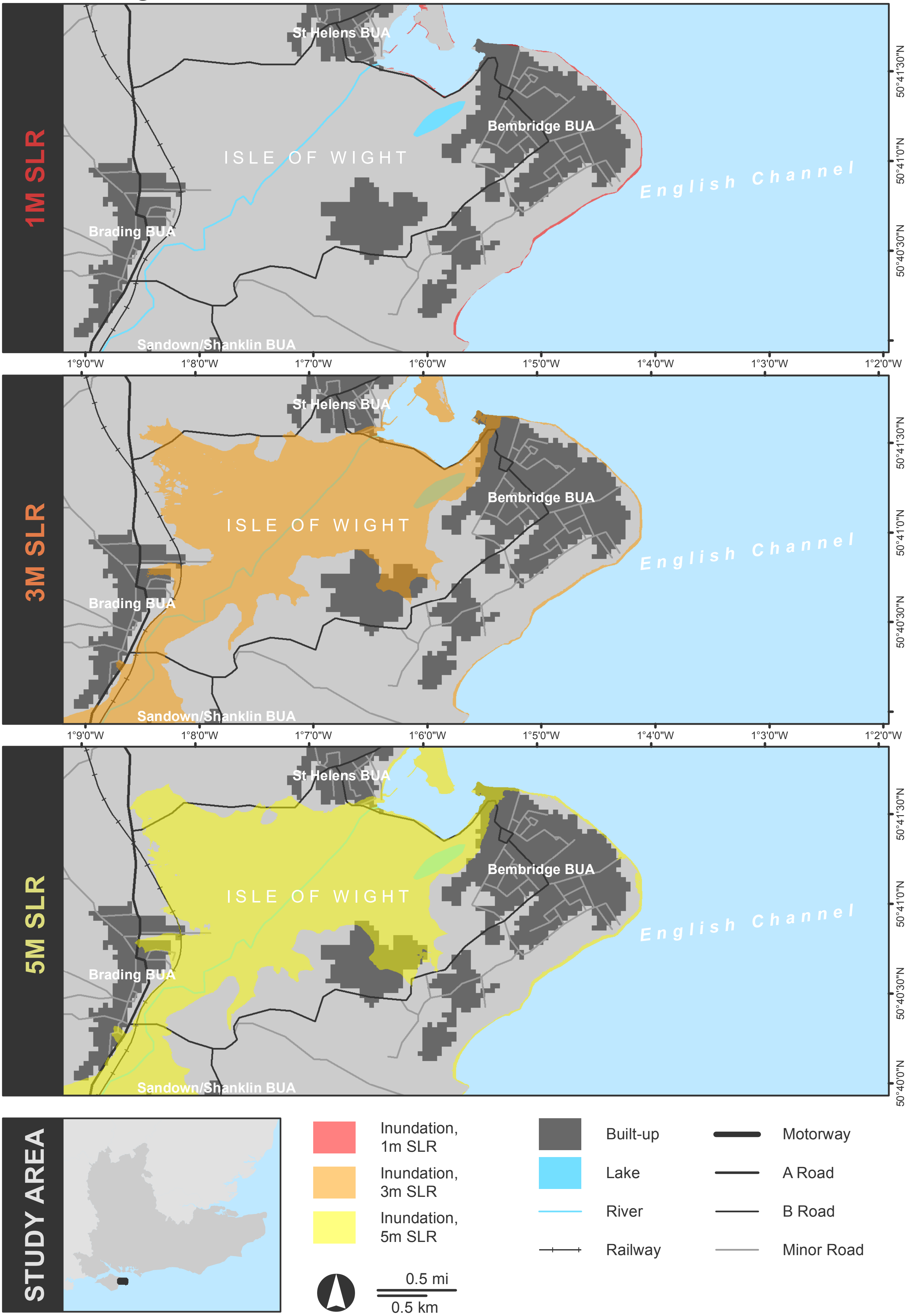
Ash (Dover) BUA



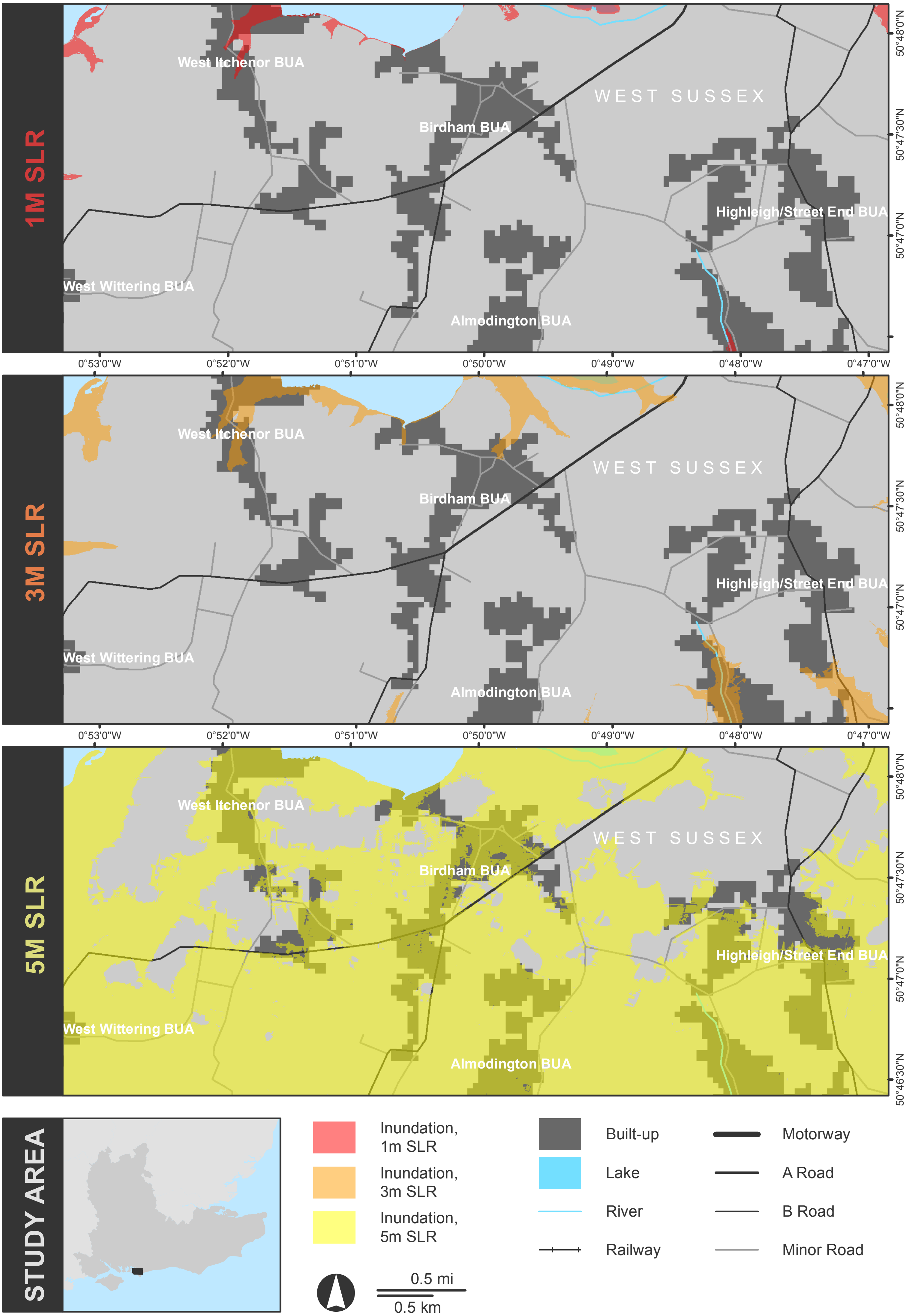
Beaulieu


1M SLR
Beaulieu
HAMPSHIRE
50°49'0"N
1°27'0"W
1°26'0"W
3M SLR
Beaulieu
HAMPSHIRE
50°49'0"N
1°27'0"W
1°26'0"W
5M SLR
Beaulieu
HAMPSHIRE
50°49'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

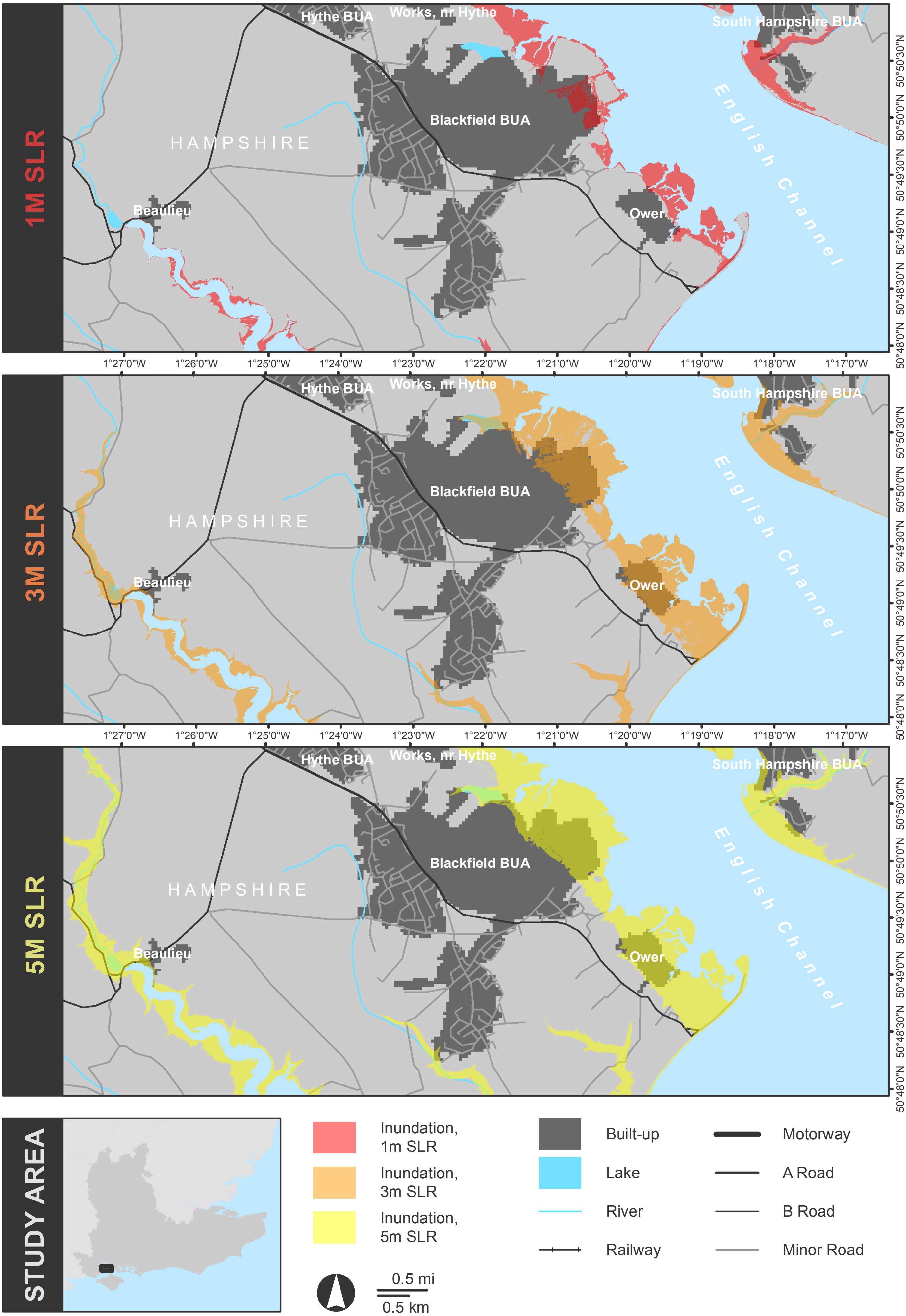
Bembridge BUA



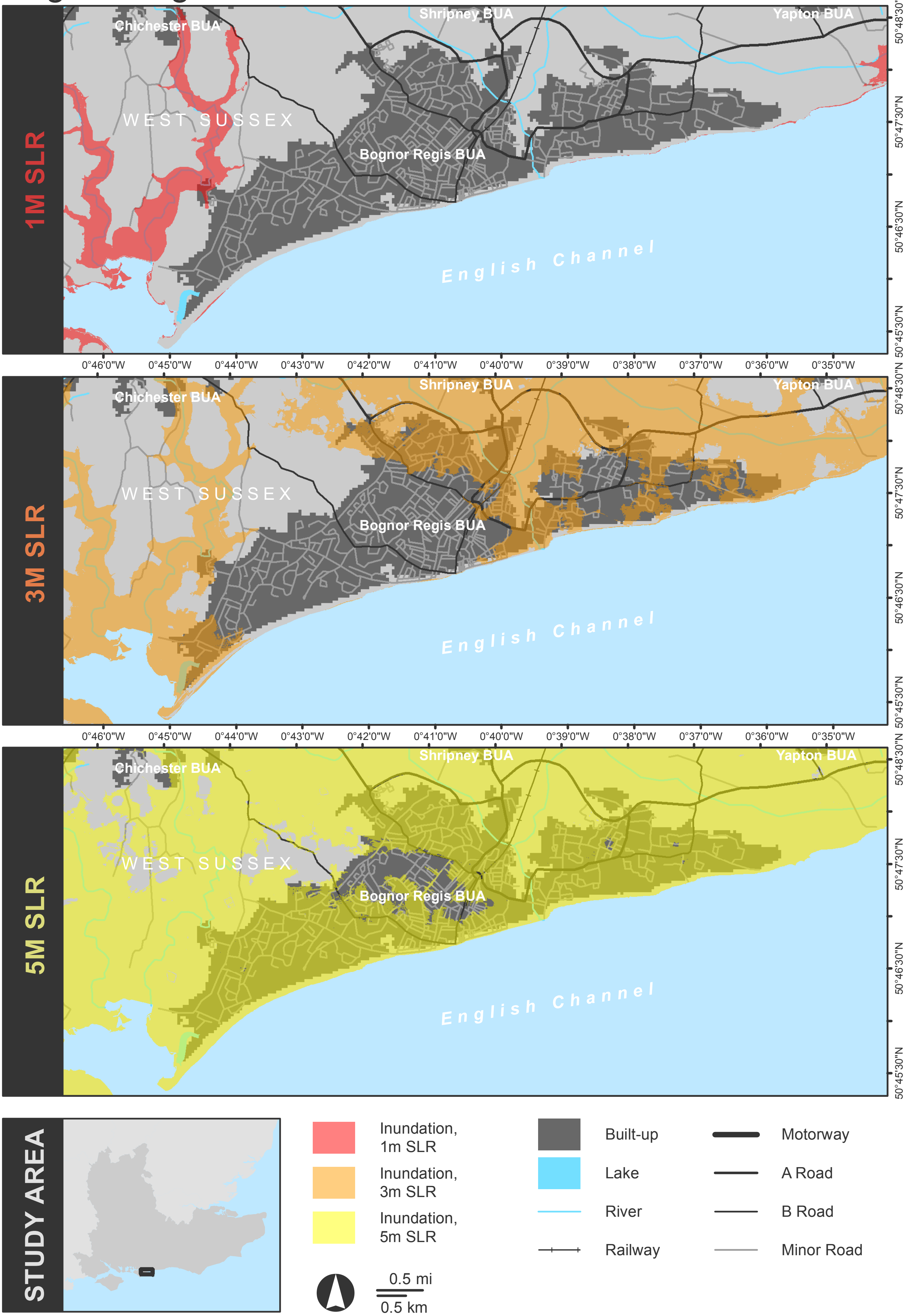
Birdham BUA


1M SLR
3M SLR
5M SLR
STUDY AREA
West Itchenor BUA
Birdham BUA
WEST SUSSEX
Highleigh/Street End BUA
West Wittering BUA
Almodington BUA
0°53'0"W
0°52'0"W
0°51'0"W
0°50'0"W
0°49'0"W
0°48'0"W
0°47'0"W
50°48'0"N
50°47'30"N
50°47'0"N
50°46'30"N
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

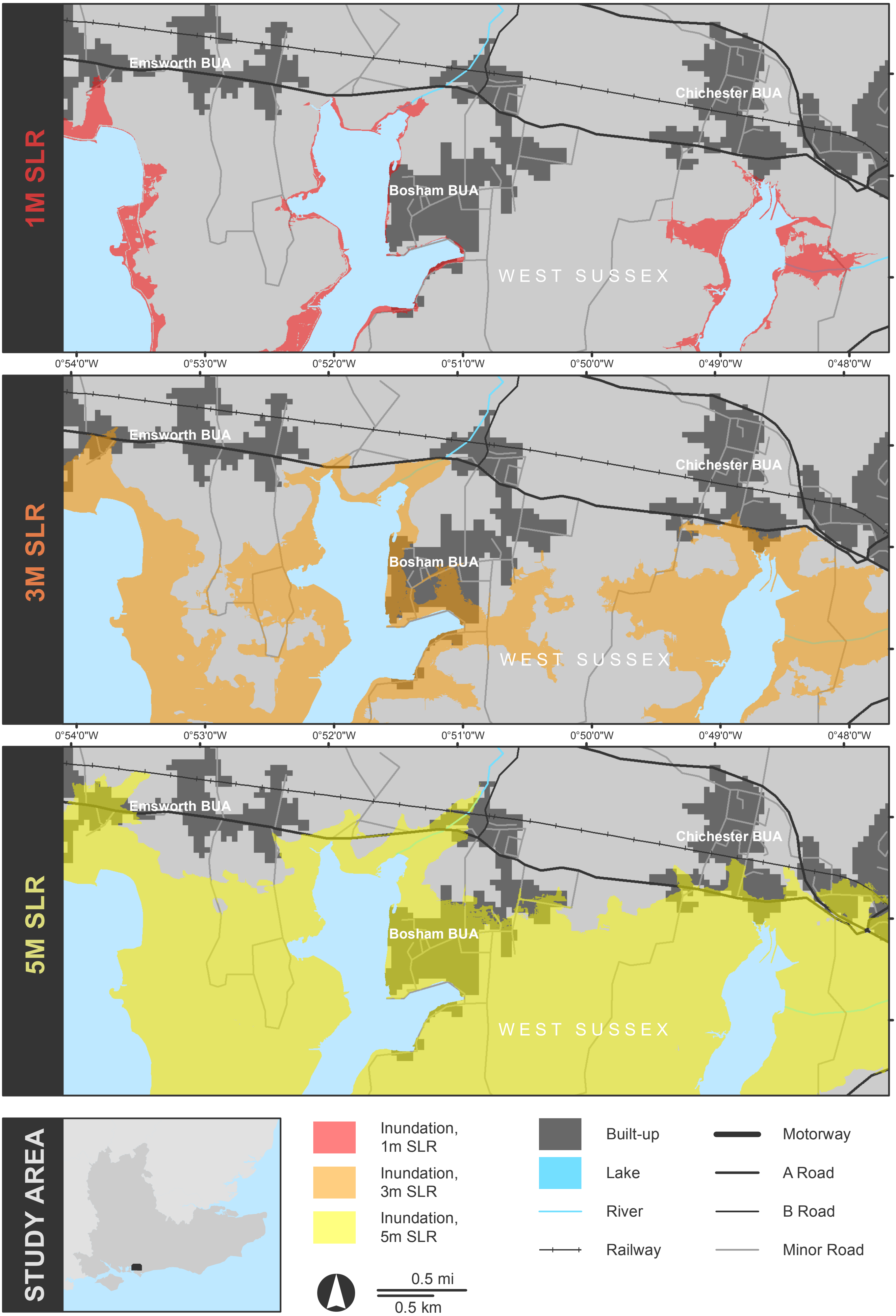
Blackfield BUA



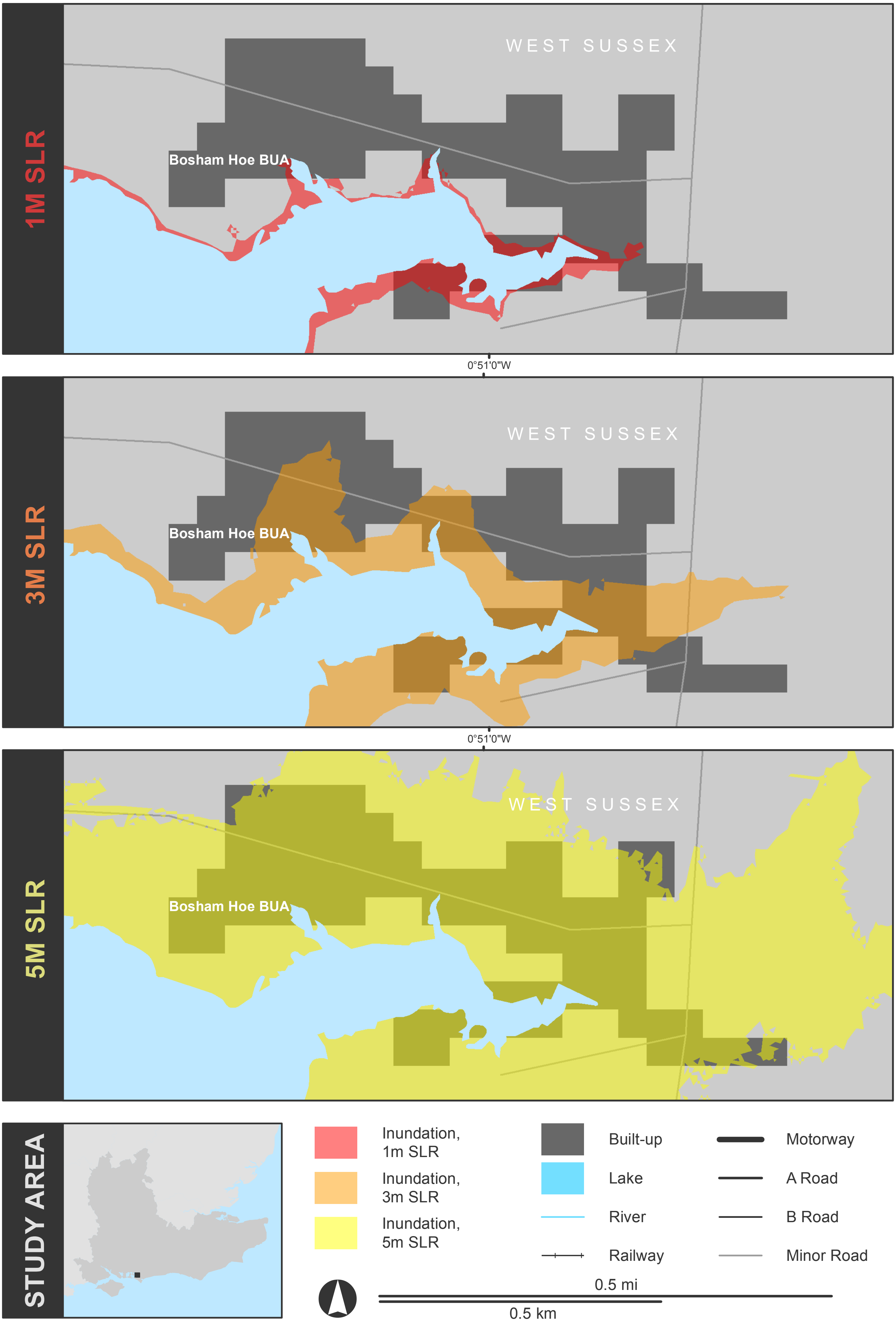
Bognor Regis BUA



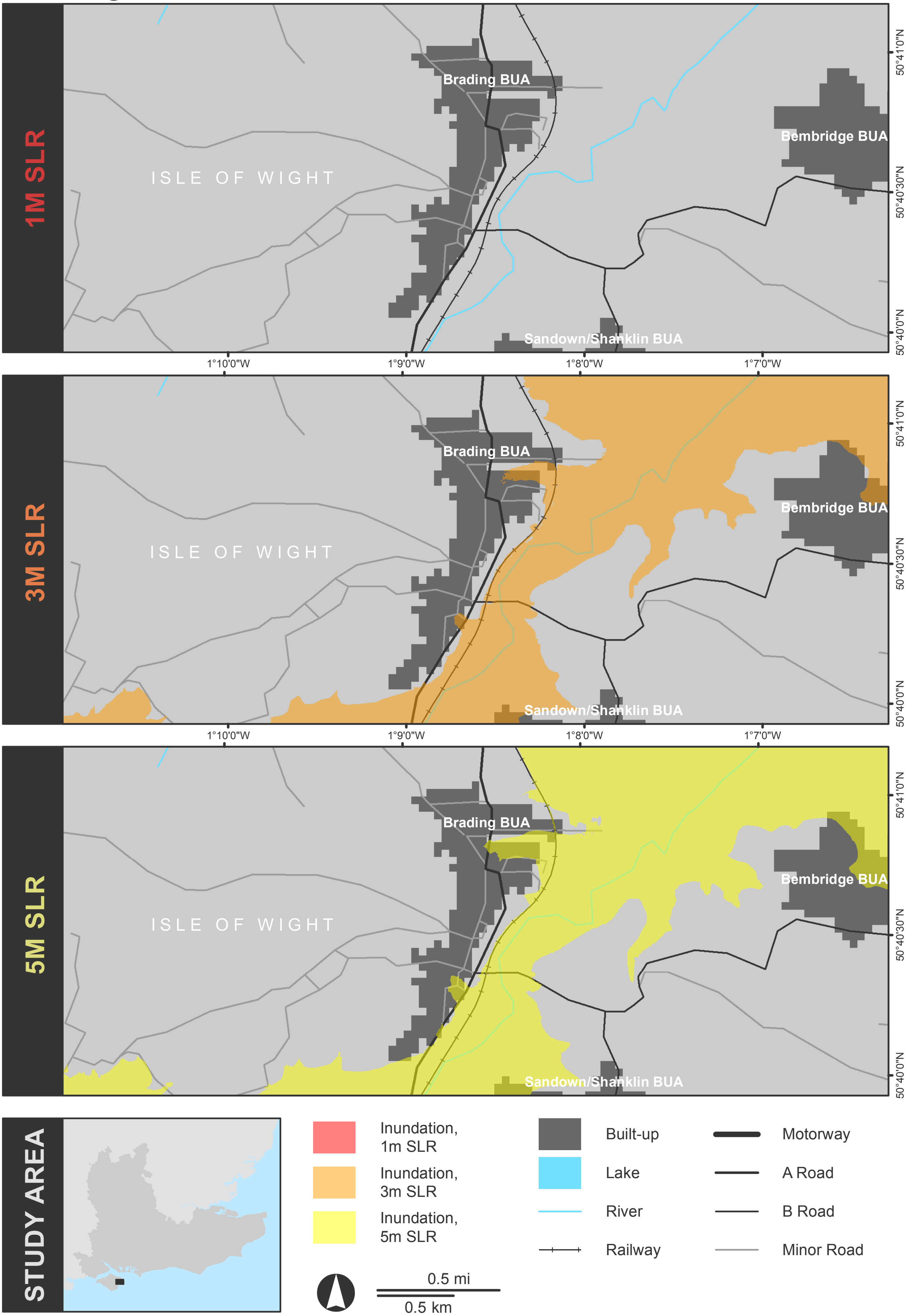
Bosham BUA


1M SLR
3M SLR
5M SLR
Emsworth BUA
Chichester BUA
Bosham BUA
WEST SUSSEX
0°54'0"W
0°53'0"W
0°52'0"W
0°51'0"W
0°50'0"W
0°49'0"W
0°48'0"W
50°50'30"N
50°50'0"N
50°49'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

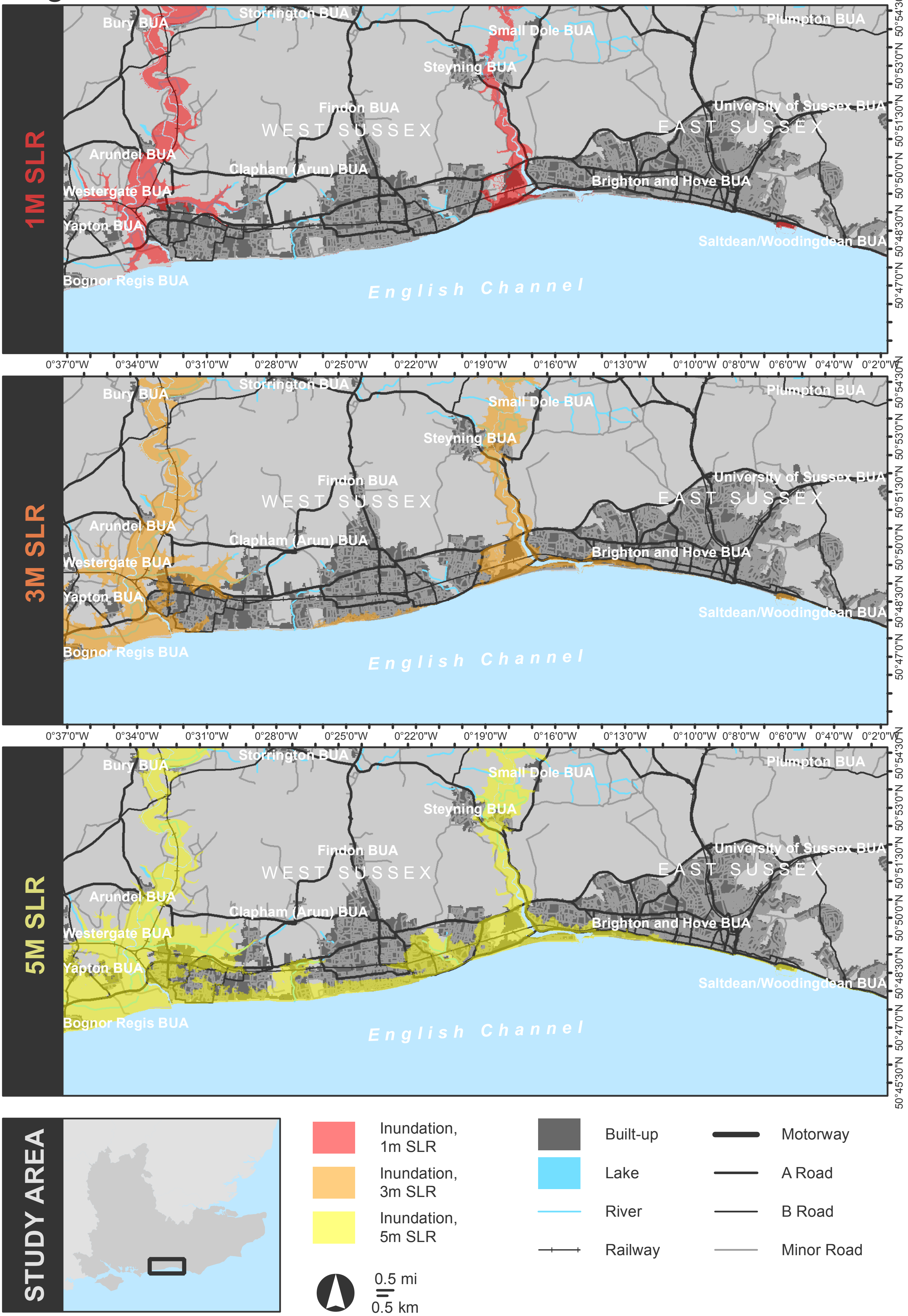
Bosham Hoe BUA



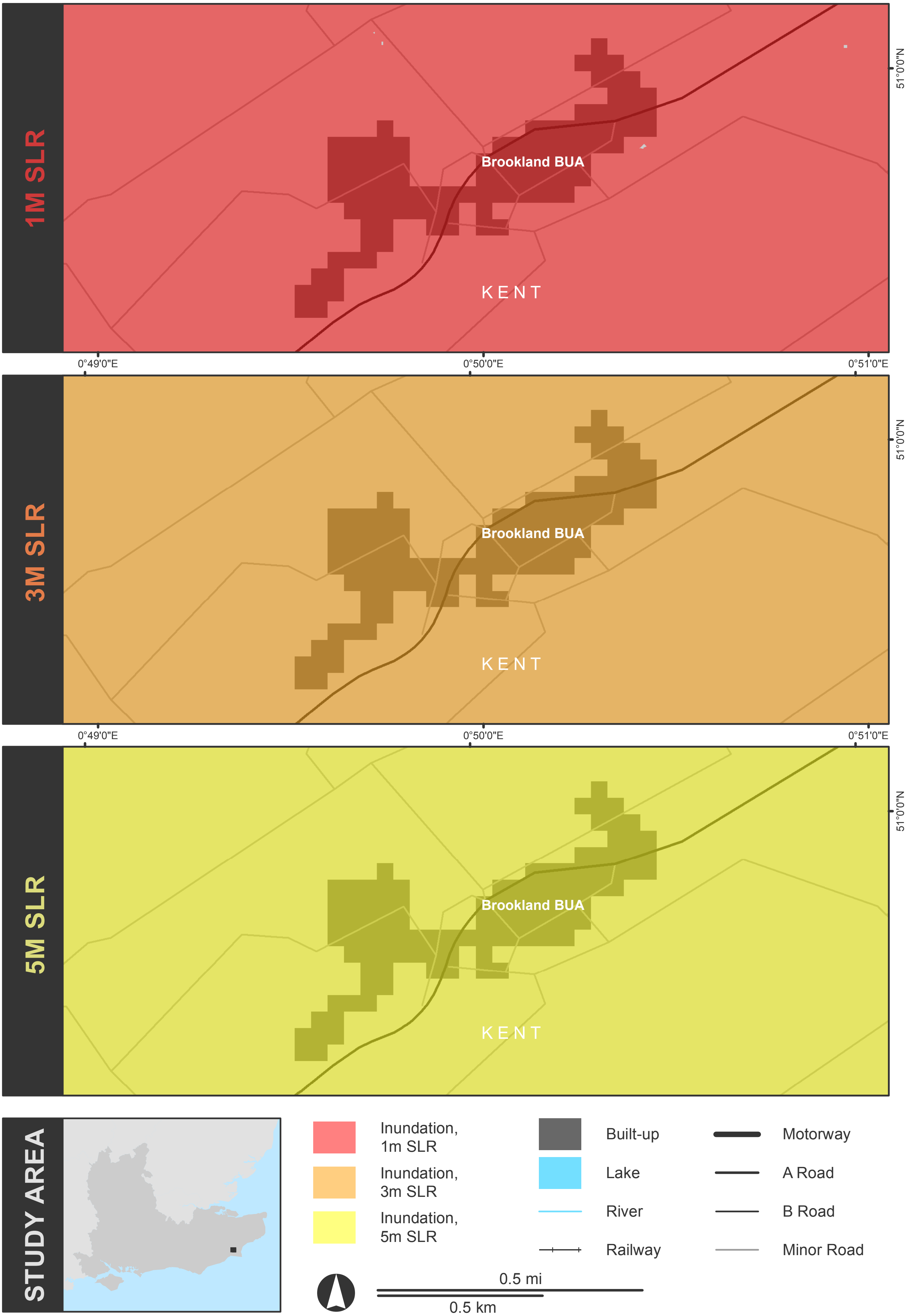
Brading BUA


1M SLR
Brading BUA
Bembridge BUA
ISLE OF WIGHT
Sandown/Shanklin BUA
1°10'0"W
1°9'0"W
1°8'0"W
1°7'0"W
50°41'0"N
50°40'30"N
50°40'0"N
3M SLR
Brading BUA
Bembridge BUA
ISLE OF WIGHT
Sandown/Shanklin BUA
1°10'0"W
1°9'0"W
1°8'0"W
1°7'0"W
50°41'0"N
50°40'30"N
50°40'0"N
5M SLR
Brading BUA
Bembridge BUA
ISLE OF WIGHT
Sandown/Shanklin BUA
50°41'0"N
50°40'30"N
50°40'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

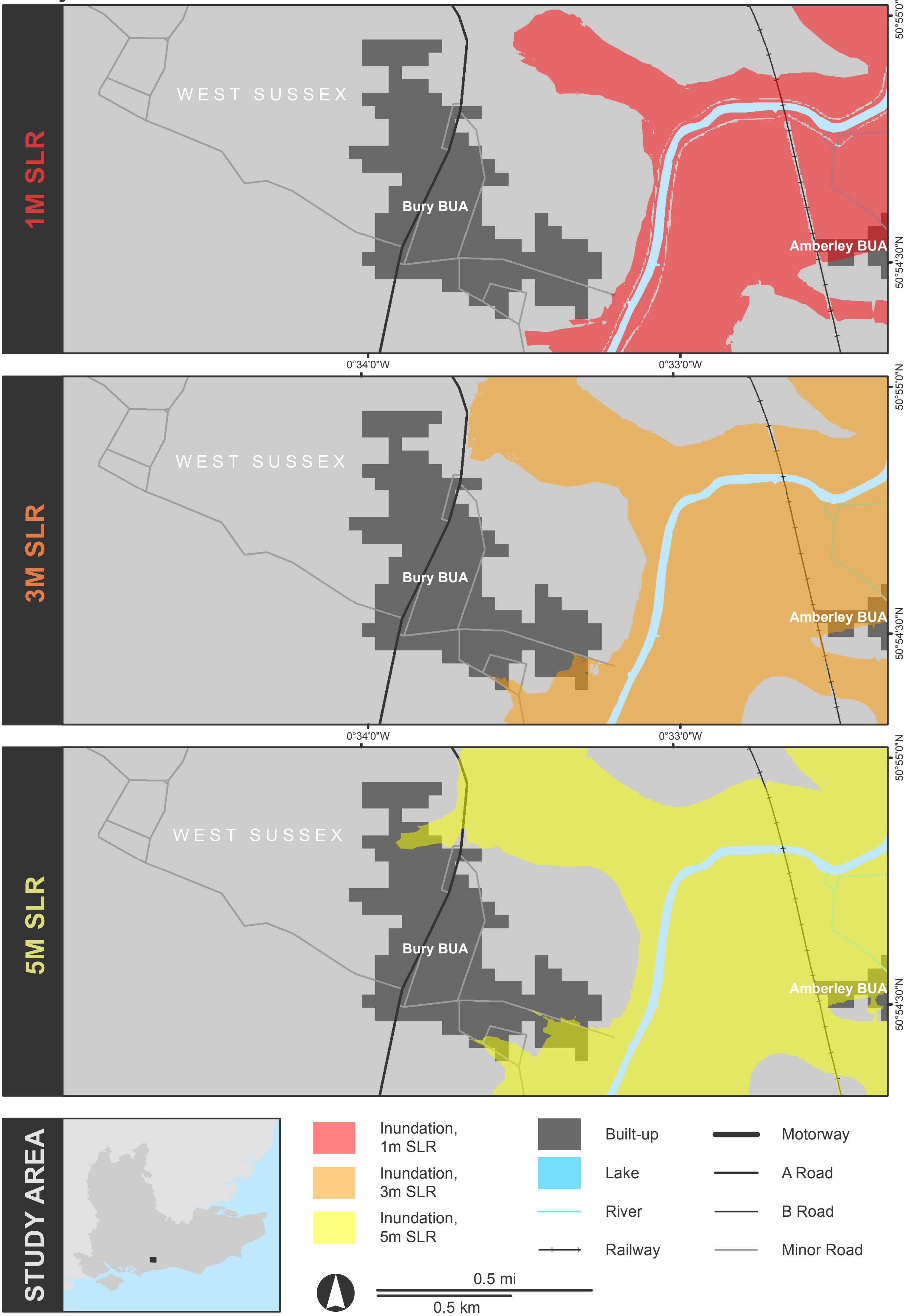
Brighton and Hove BUA



Brookland BUA

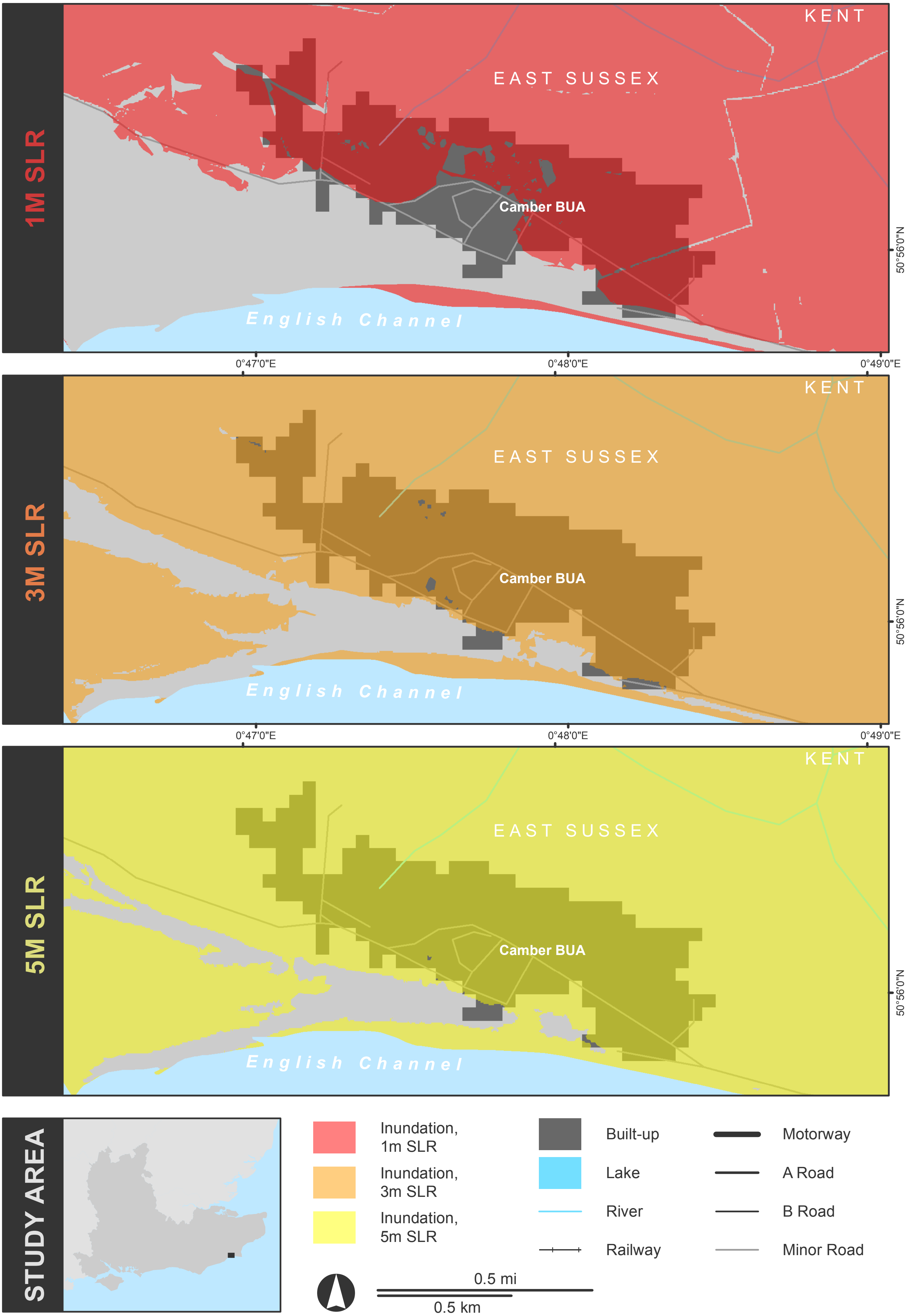


Bury BUA

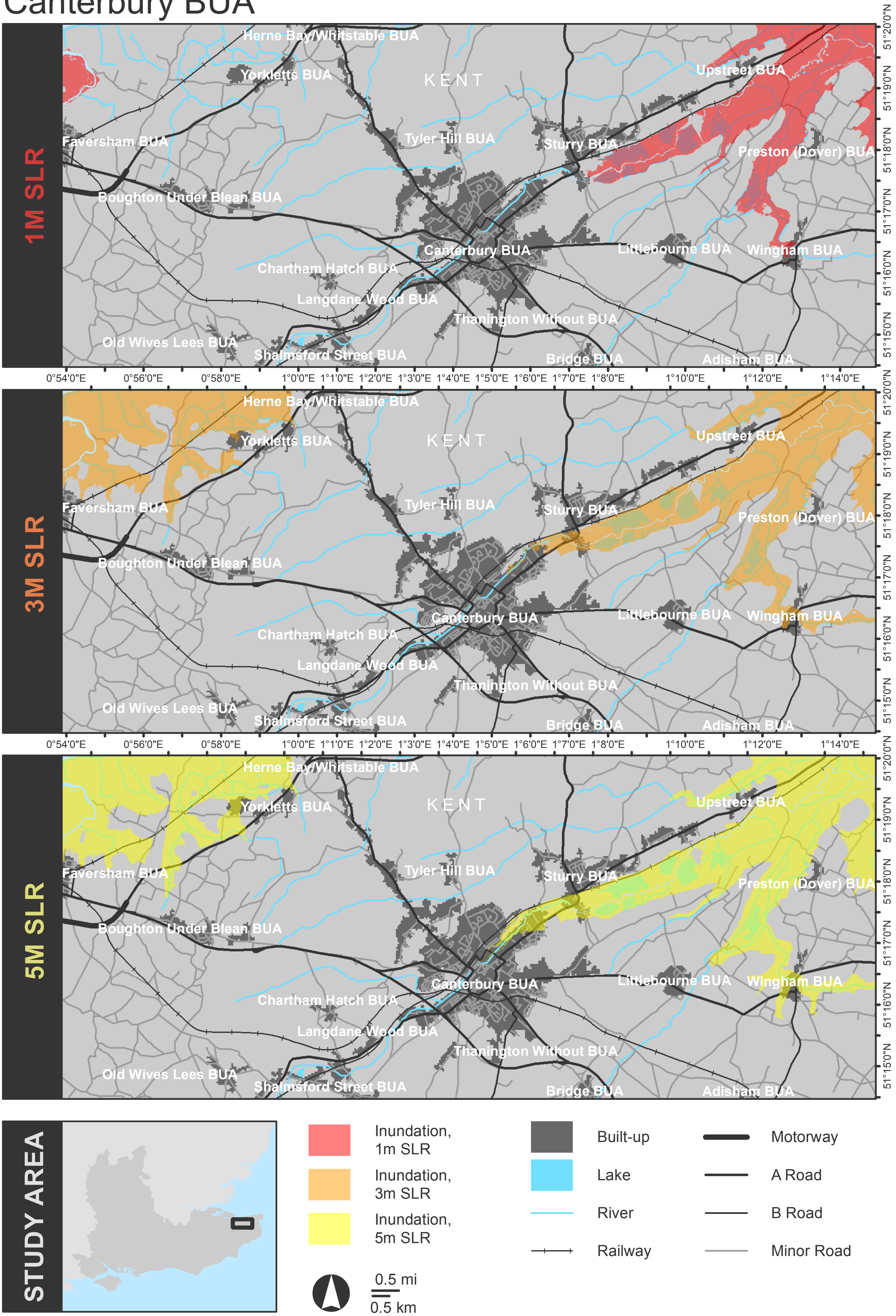


1M SLR
WEST SUSSEX
Bury BUA
Amberley BUA
0°34'0"W
0°33'0"W
50°55'0"N
50°54'30"N
3M SLR
WEST SUSSEX
Bury BUA
Amberley BUA
0°34'0"W
0°33'0"W
50°55'0"N
50°54'30"N
5M SLR
WEST SUSSEX
Bury BUA
Amberley BUA
50°55'0"N
50°54'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

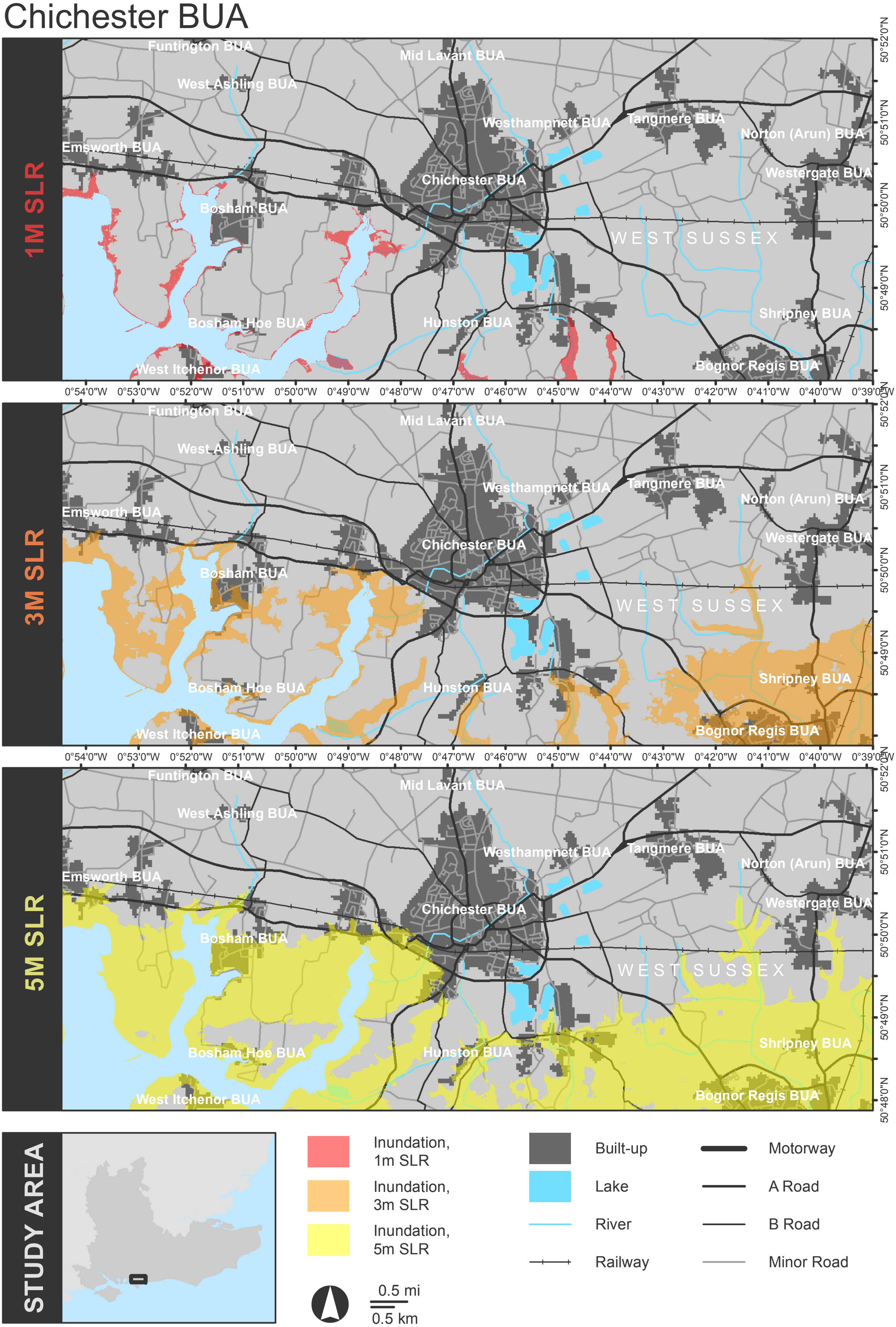
Camber BUA


1M SLR
3M SLR
5M SLR
KENT
EAST SUSSEX
Camber BUA
English Channel
0°47'0"E
0°48'0"E
0°49'0"E
50°56'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

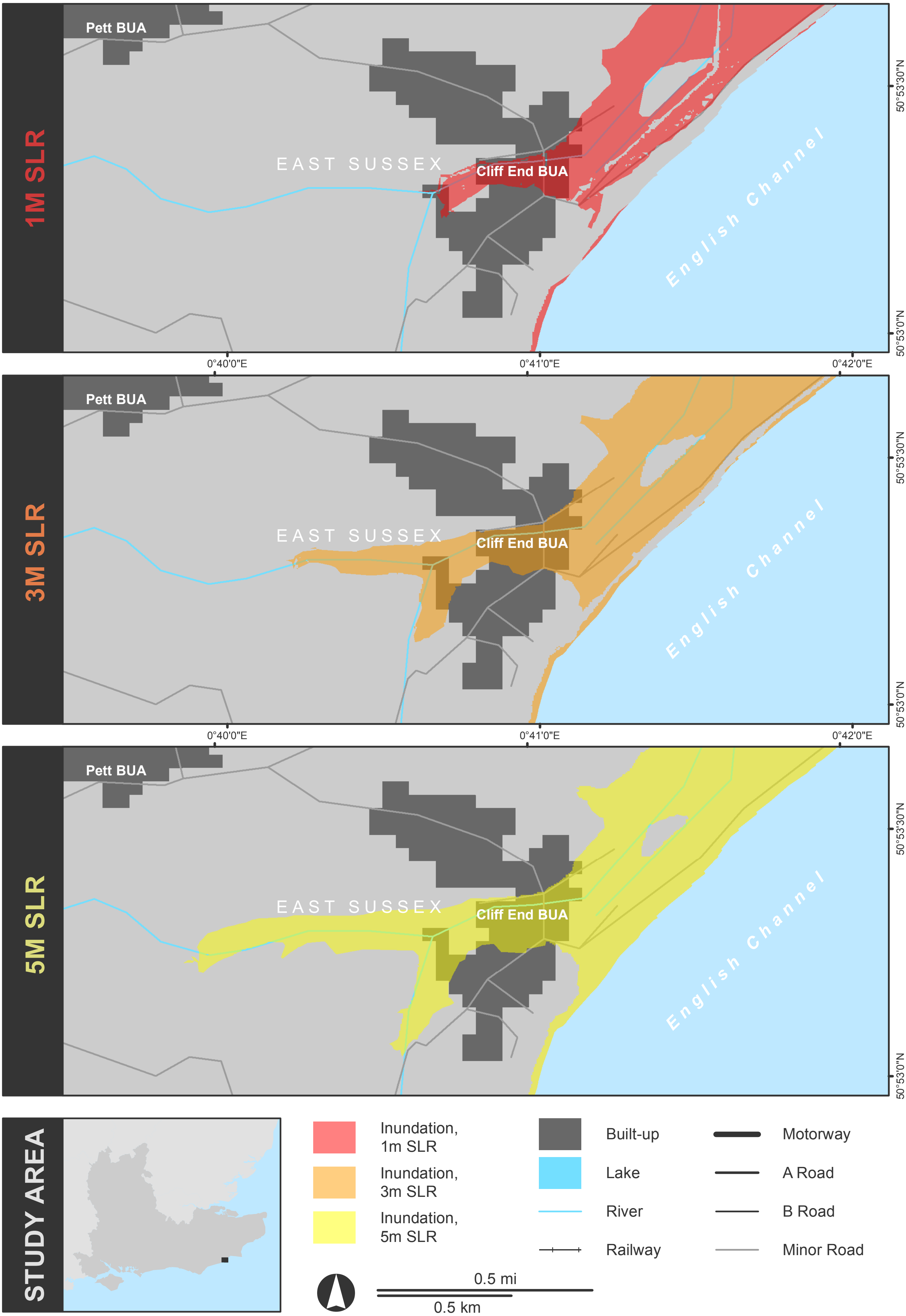
Canterbury BUA



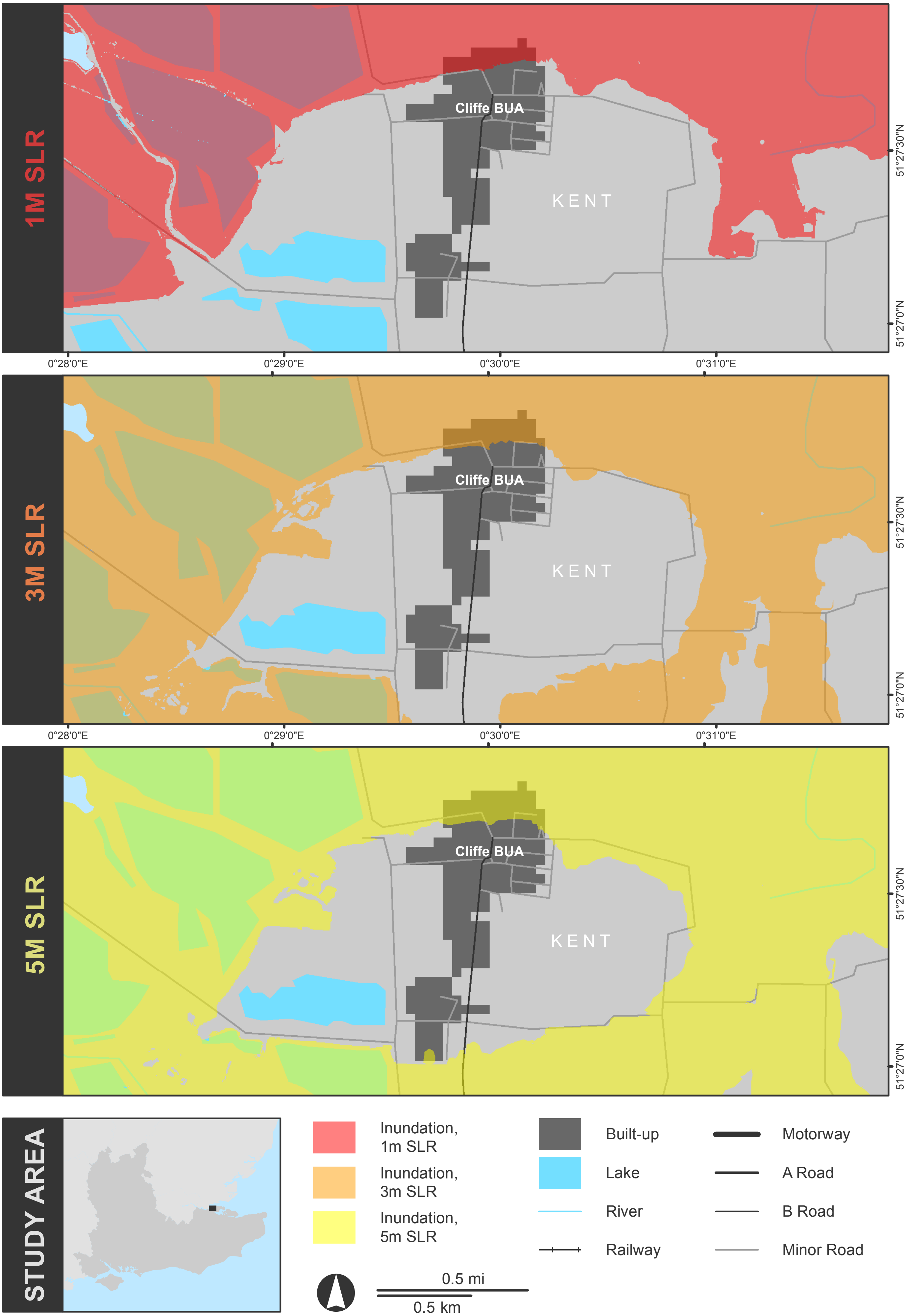
Chichester BUA



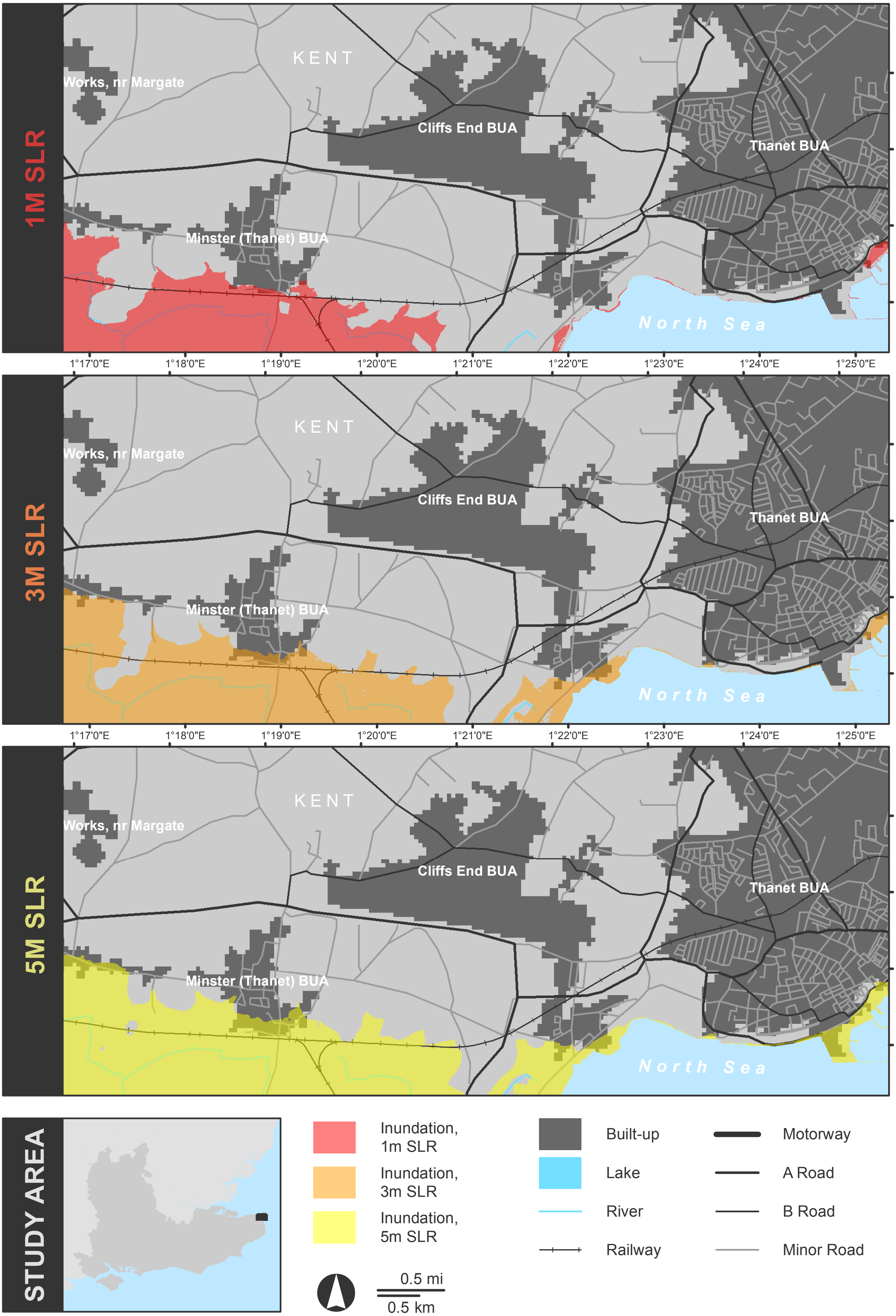
Cliff End BUA



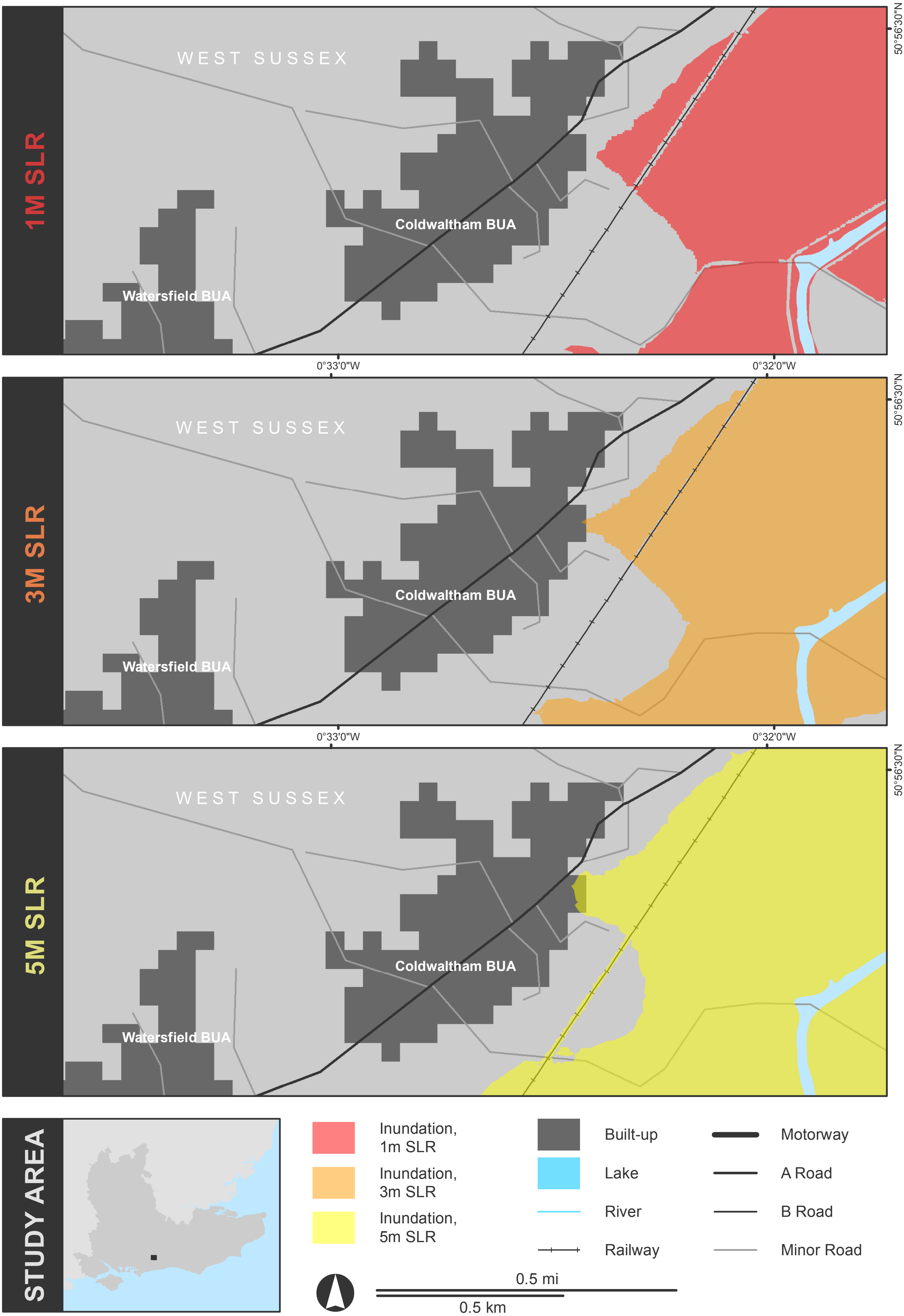
Cliffe BUA


1M SLR
Cliffe BUA
KENT
51°27'30"N
51°27'0"N
0°28'0"E
0°29'0"E
0°30'0"E
0°31'0"E
3M SLR
Cliffe BUA
KENT
51°27'30"N
51°27'0"N
0°28'0"E
0°29'0"E
0°30'0"E
0°31'0"E
5M SLR
Cliffe BUA
KENT
51°27'30"N
51°27'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

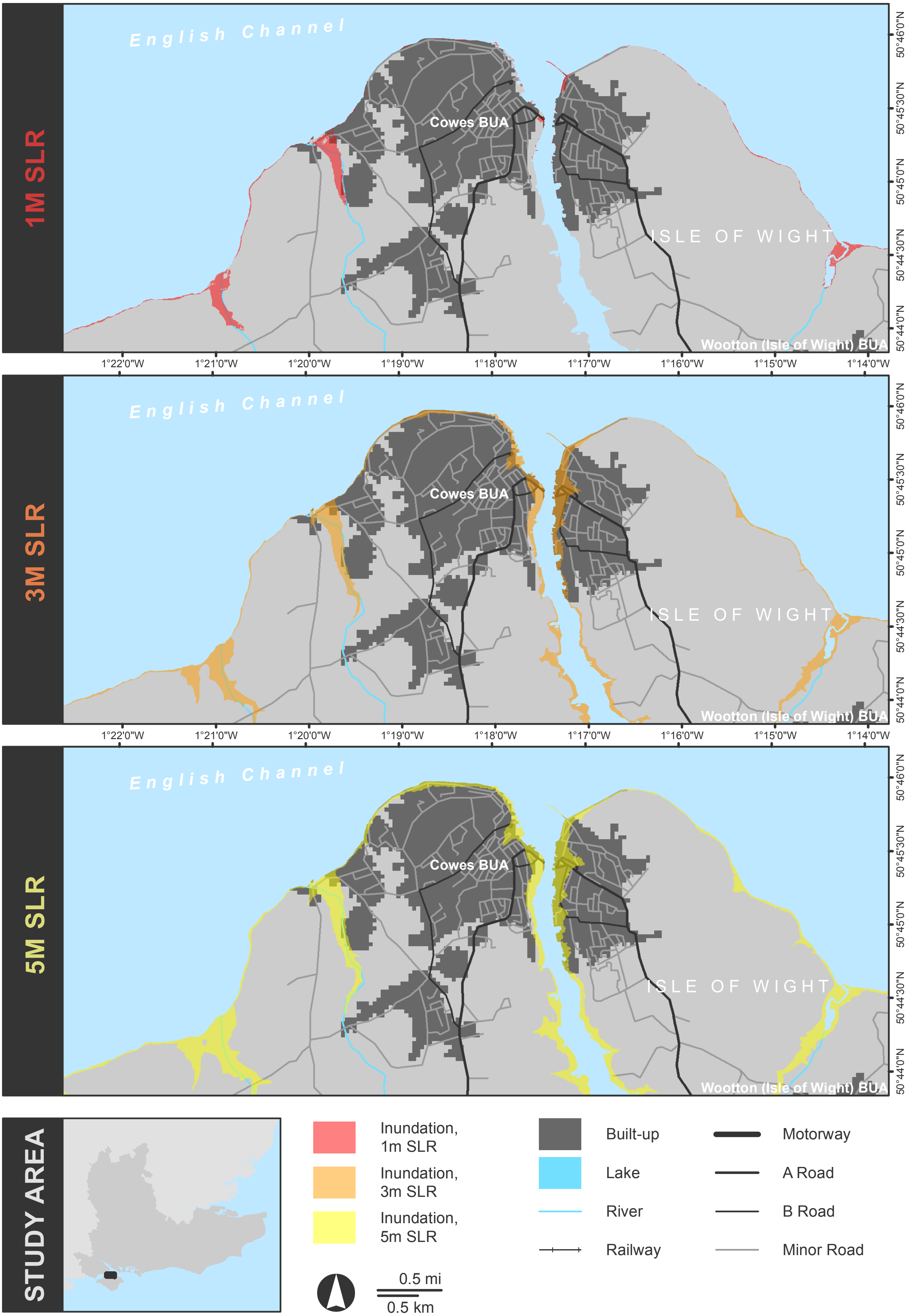
Cliffs End BUA



Coldwaltham BUA

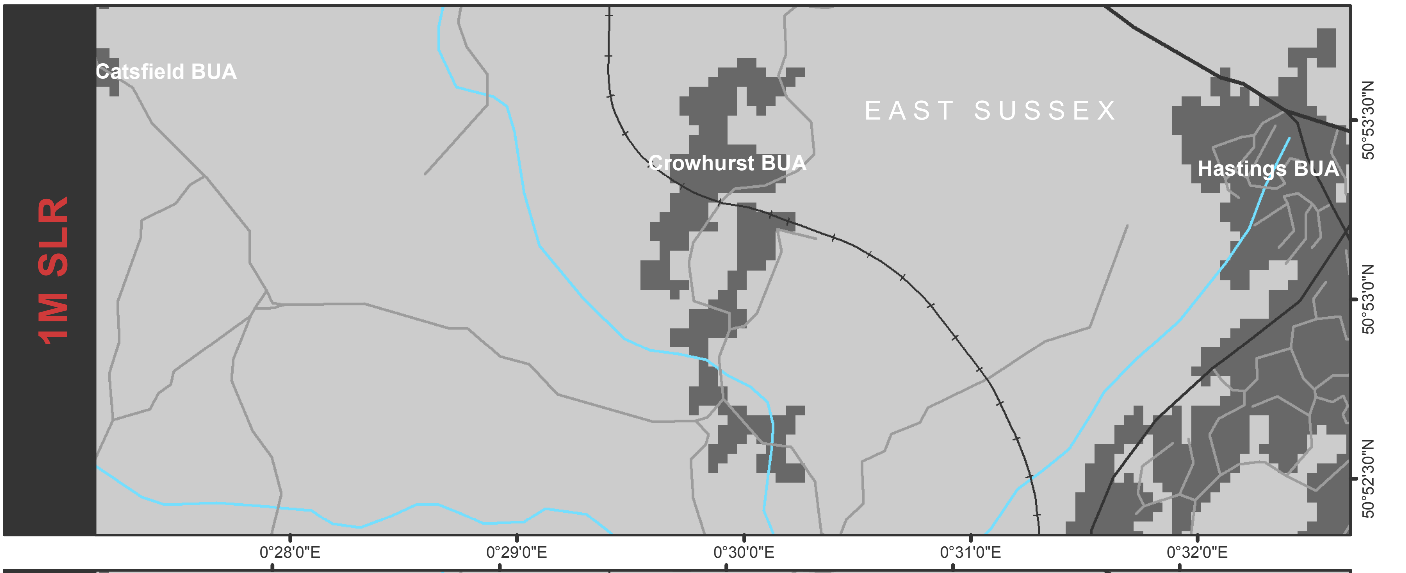


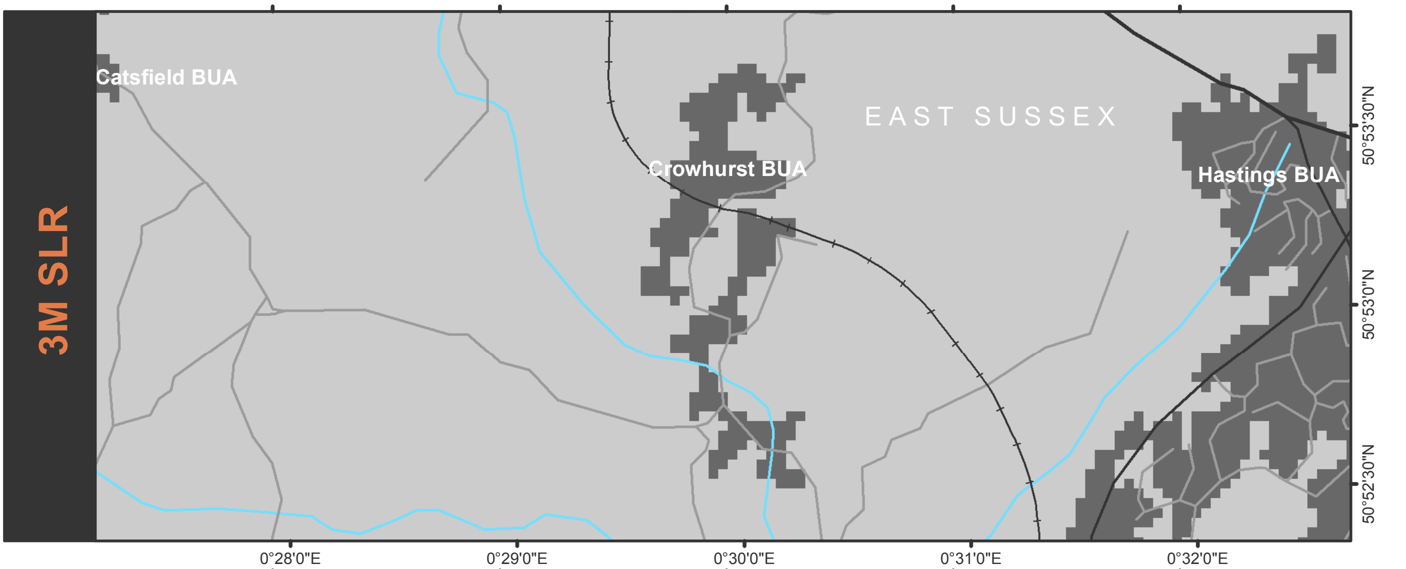
Cowes BUA

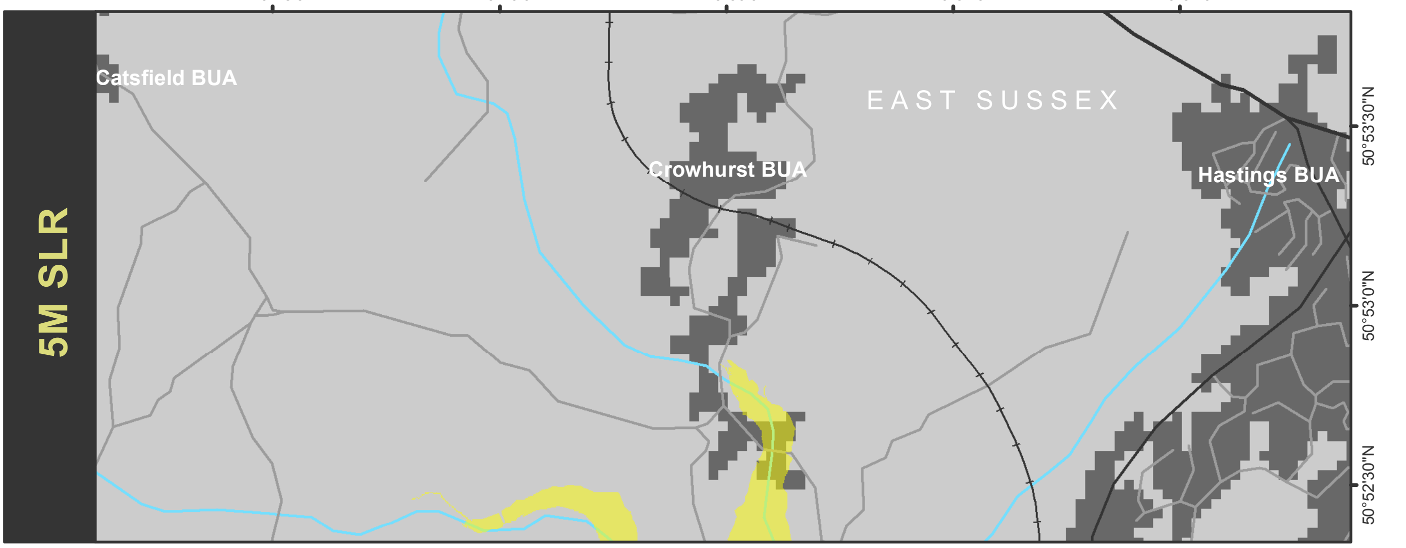


1M SLR
3M SLR
5M SLR
English Channel
Cowes BUA
ISLE OF WIGHT
Wootton (Isle of Wight) BUA
1°22'0"W
1°21'0"W
1°20'0"W
1°19'0"W
1°18'0"W
1°17'0"W
1°16'0"W
1°15'0"W
1°14'0"W
50°46'0"N
50°45'30"N
50°45'0"N
50°44'30"N
50°44'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

Crowhurst BUA







Inundation, 1m SLR

Inundation, 3m SLR

Inundation, 5m SLR

Built-up

Lake

River

Railway

Motorway

A Road

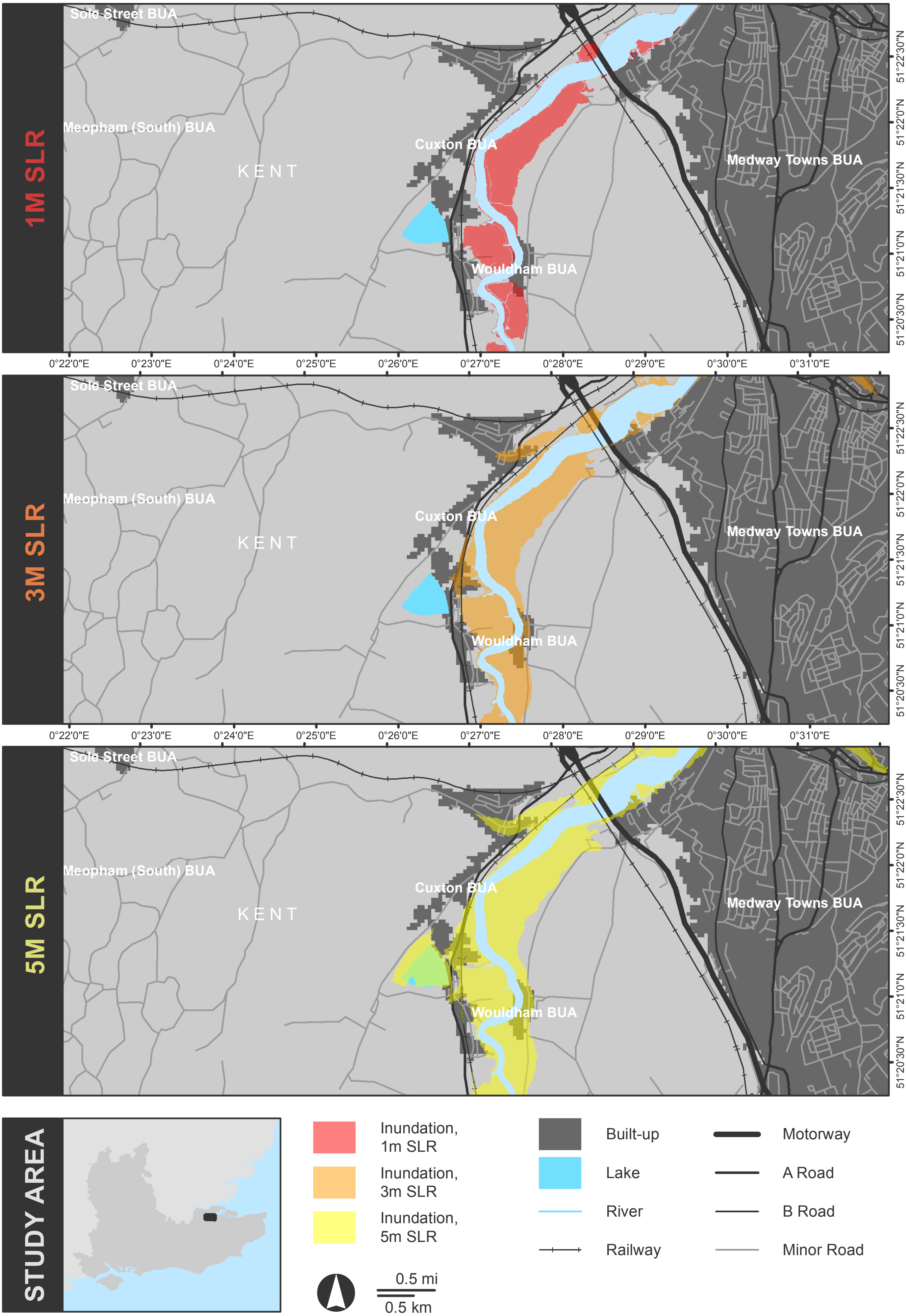
B Road

Minor Road

0.5 mi

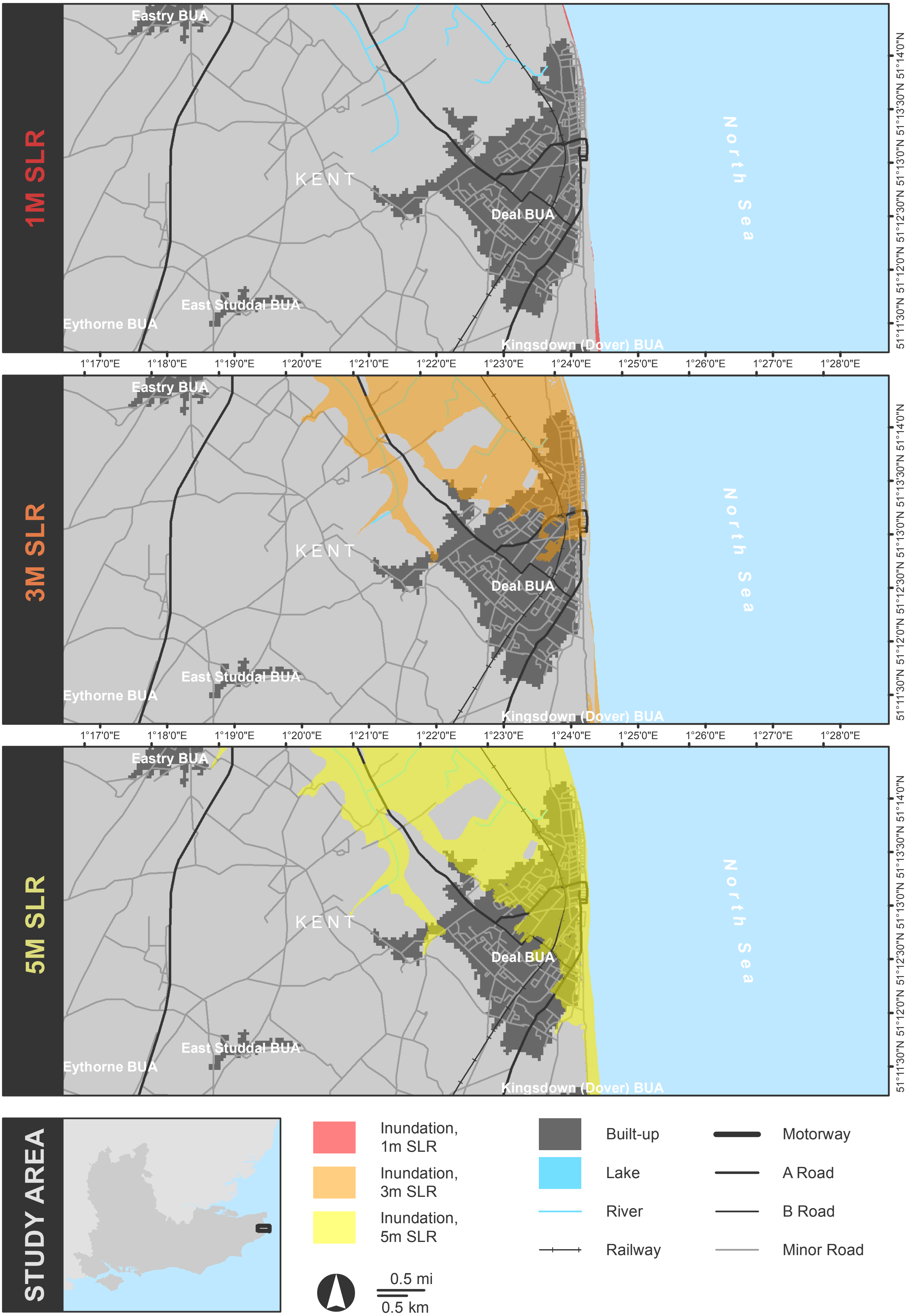
0.5 km

Cuxton BUA

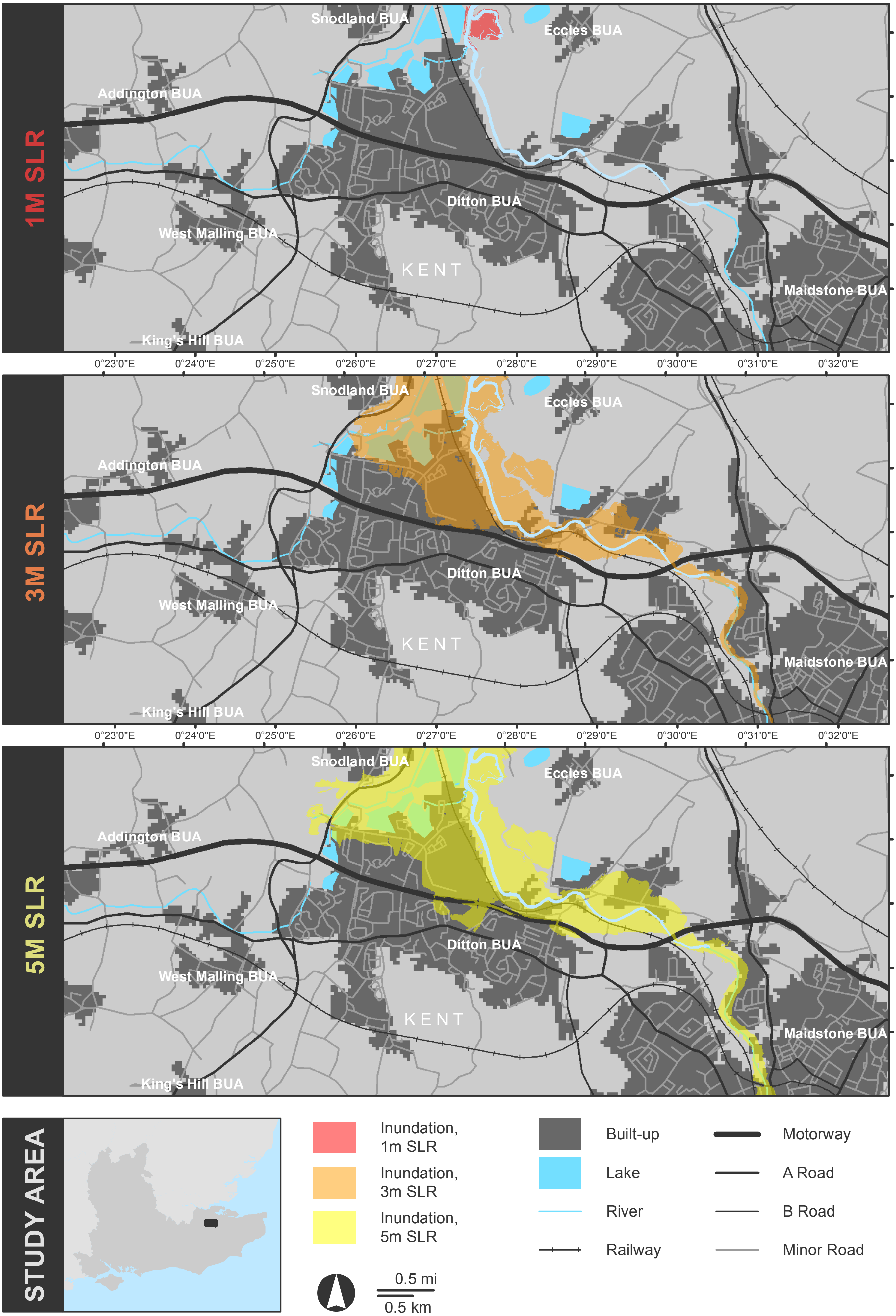


1M SLR
3M SLR
5M SLR
Sole Street BUA
Meopham (South) BUA
KENT
Cuxton BUA
Wouldham BUA
Medway Towns BUA
0°22'0"E
0°23'0"E
0°24'0"E
0°25'0"E
0°26'0"E
0°27'0"E
0°28'0"E
0°29'0"E
0°30'0"E
0°31'0"E
51°22'30"N
51°22'0"N
51°21'30"N
51°21'0"N
51°20'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

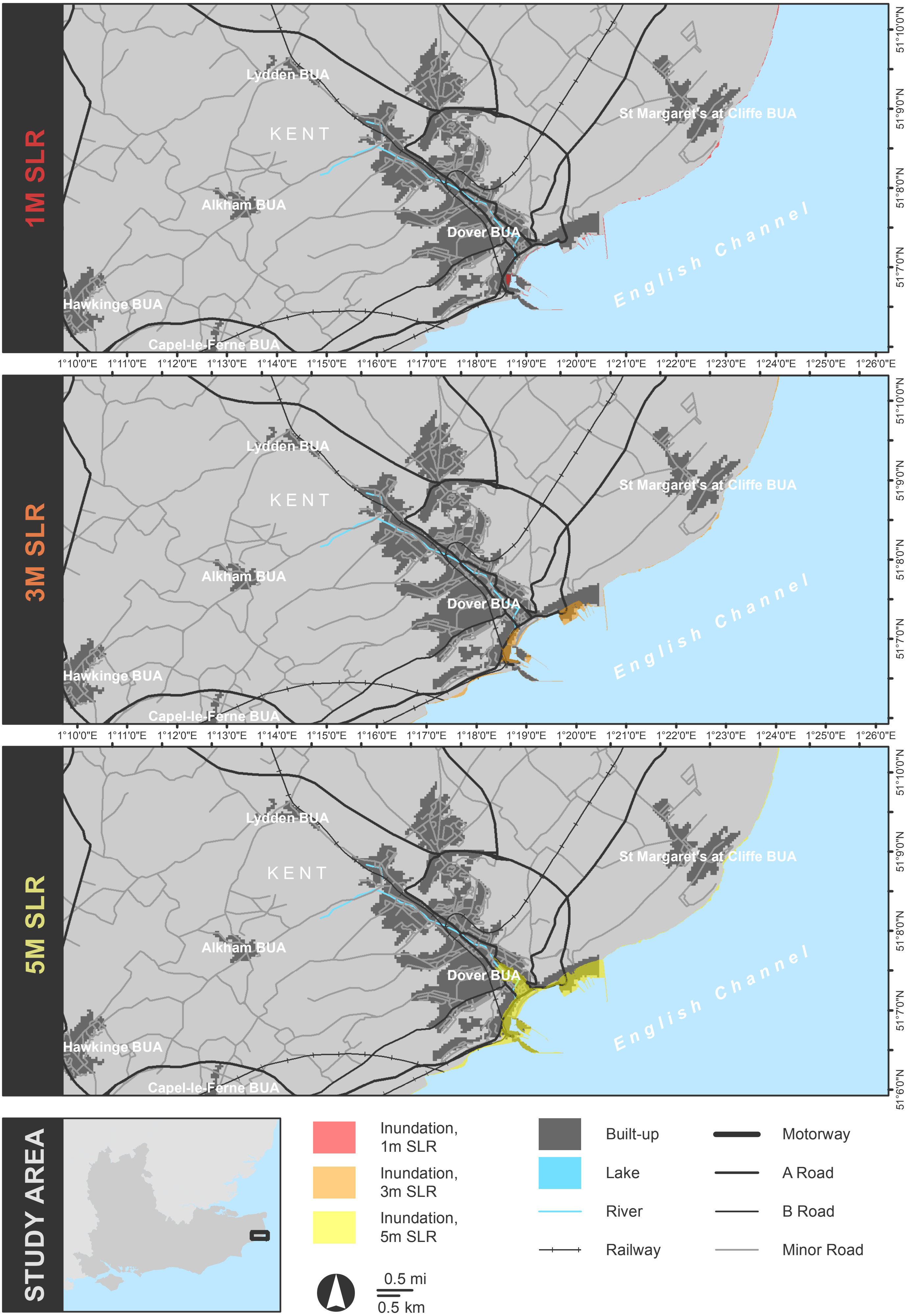
Deal BUA


1M SLR
3M SLR
5M SLR
Eastry BUA
KENT
Deal BUA
East Studdal BUA
Eythorne BUA
Kingsdown (Dover) BUA
North Sea
1°17'0"E
1°18'0"E
1°19'0"E
1°20'0"E
1°21'0"E
1°22'0"E
1°23'0"E
1°24'0"E
1°25'0"E
1°26'0"E
1°27'0"E
1°28'0"E
51°11'30"N
51°12'0"N
51°12'30"N
51°13'0"N
51°13'30"N
51°14'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

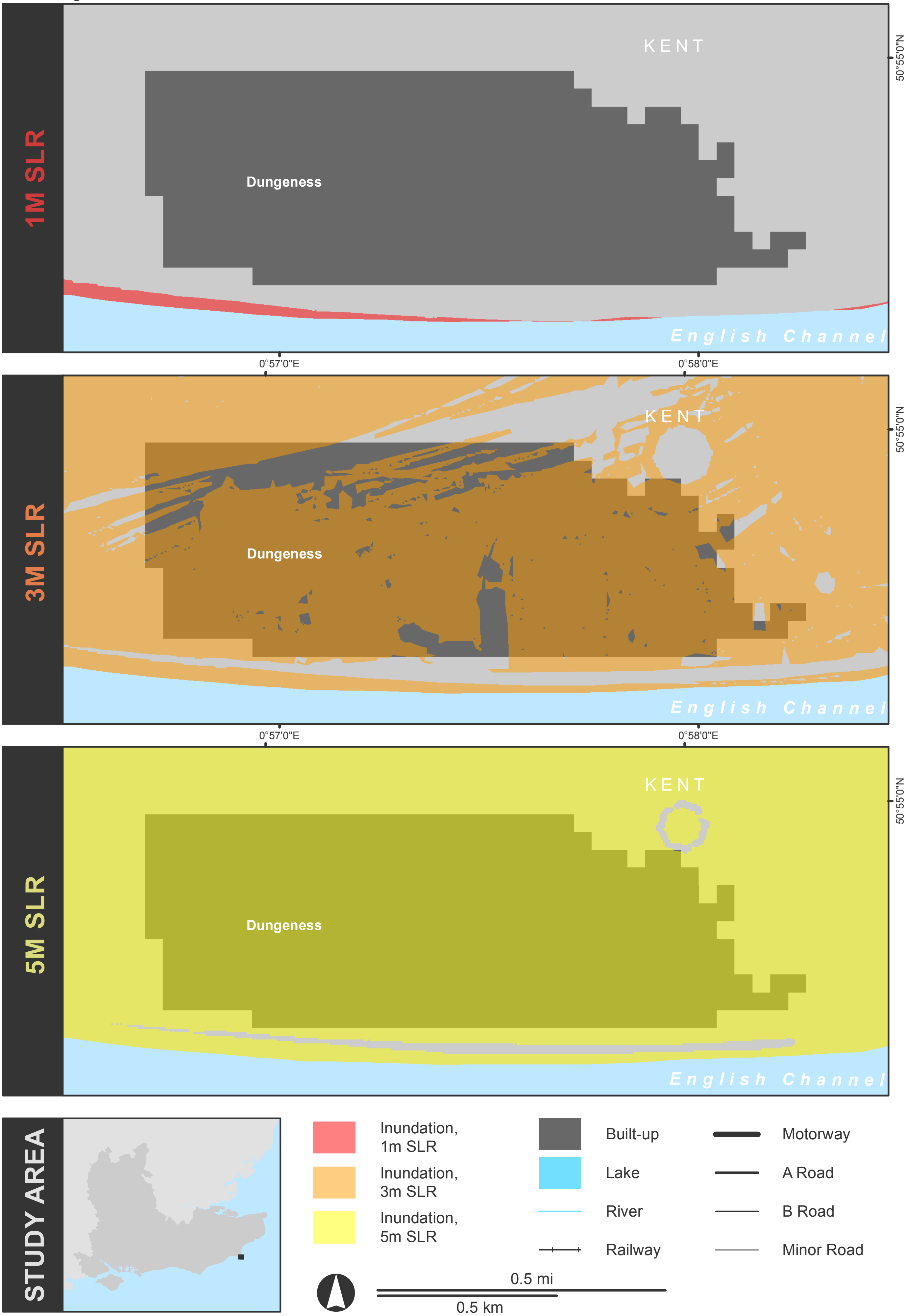
Ditton BUA


1M SLR
3M SLR
5M SLR
Snodland BUA
Eccles BUA
Addington BUA
Ditton BUA
West Malling BUA
KENT
Maidstone BUA
King's Hill BUA
0°23'0"E
0°24'0"E
0°25'0"E
0°26'0"E
0°27'0"E
0°28'0"E
0°29'0"E
0°30'0"E
0°31'0"E
0°32'0"E
51°19'0"N
51°18'30"N
51°18'0"N
51°17'30"N
51°17'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

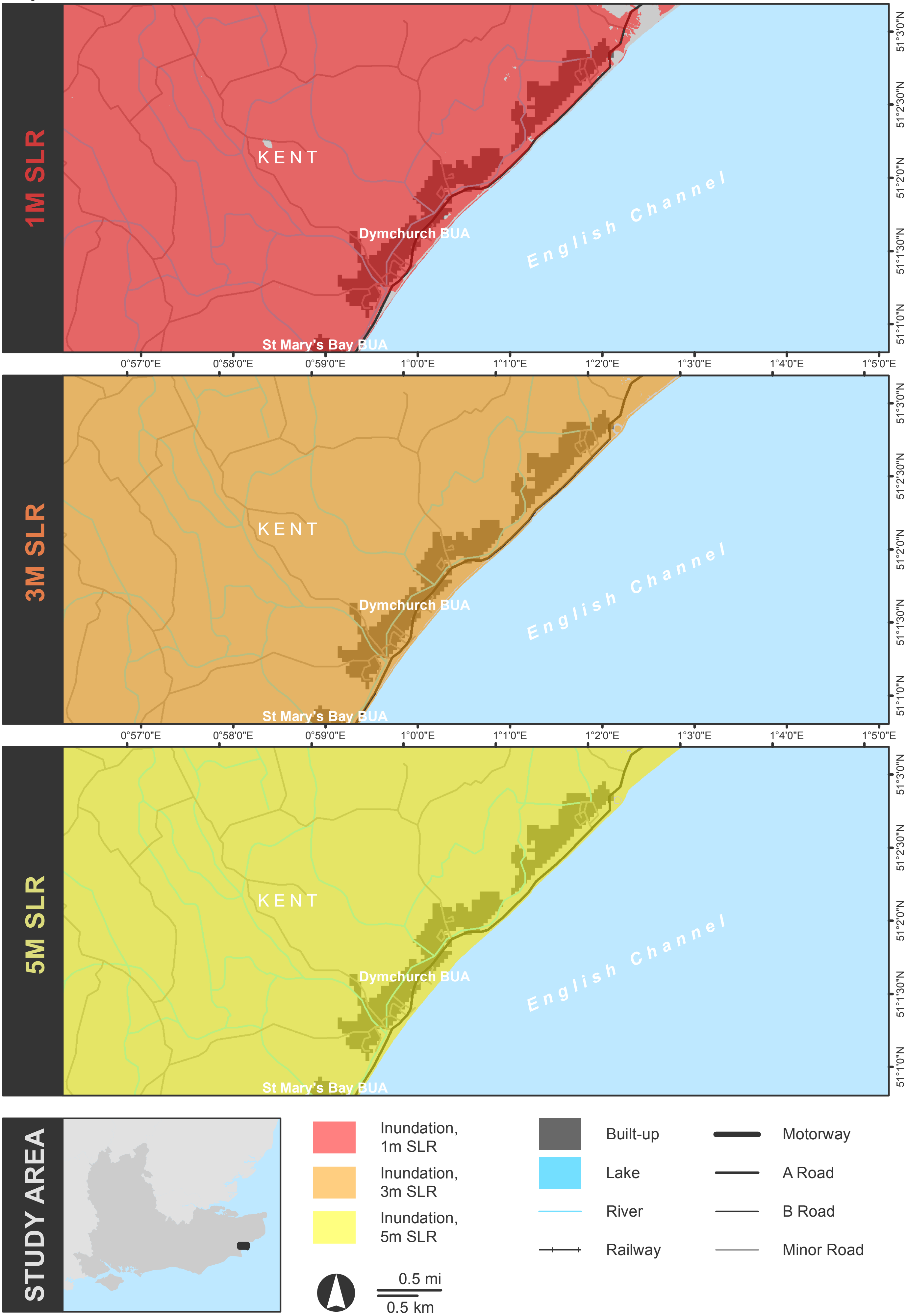
Dover BUA


1M SLR
3M SLR
5M SLR
Lydden BUA
KENT
St Margaret's at Cliffe BUA
Alkham BUA
Dover BUA
English Channel
Hawkinge BUA
Capel-le-Ferne BUA
1°10'0"E 1°11'0"E 1°12'0"E 1°13'0"E 1°14'0"E 1°15'0"E 1°16'0"E 1°17'0"E 1°18'0"E 1°19'0"E 1°20'0"E 1°21'0"E 1°22'0"E 1°23'0"E 1°24'0"E 1°25'0"E 1°26'0"E
51°10'0"N
51°9'0"N
51°8'0"N
51°7'0"N
51°6'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

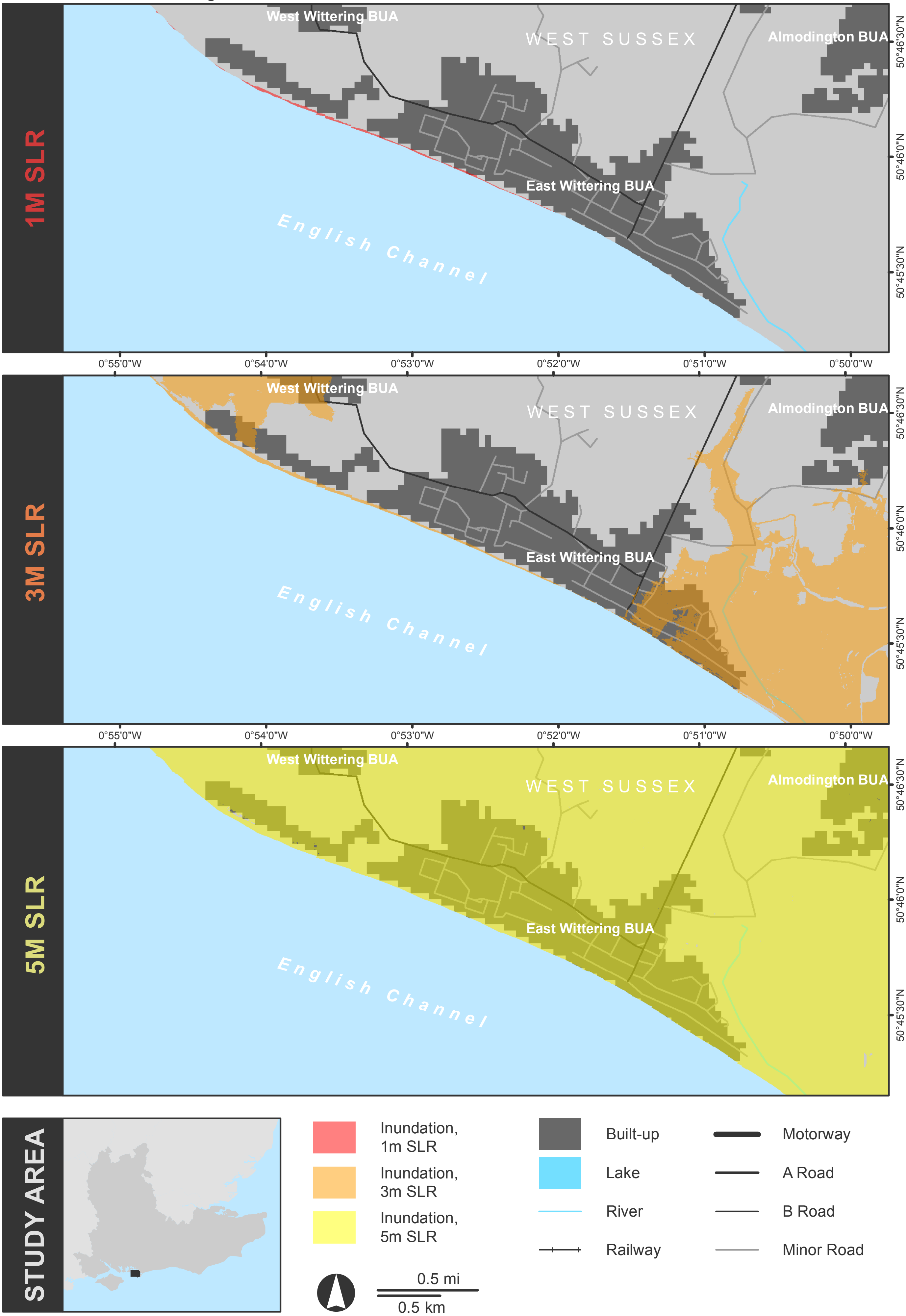
Dungeness


1M SLR
KENT
Dungeness
English Channel
50°55'0"N
0°57'0"E
0°58'0"E
3M SLR
KENT
Dungeness
English Channel
50°55'0"N
0°57'0"E
0°58'0"E
5M SLR
KENT
Dungeness
English Channel
50°55'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

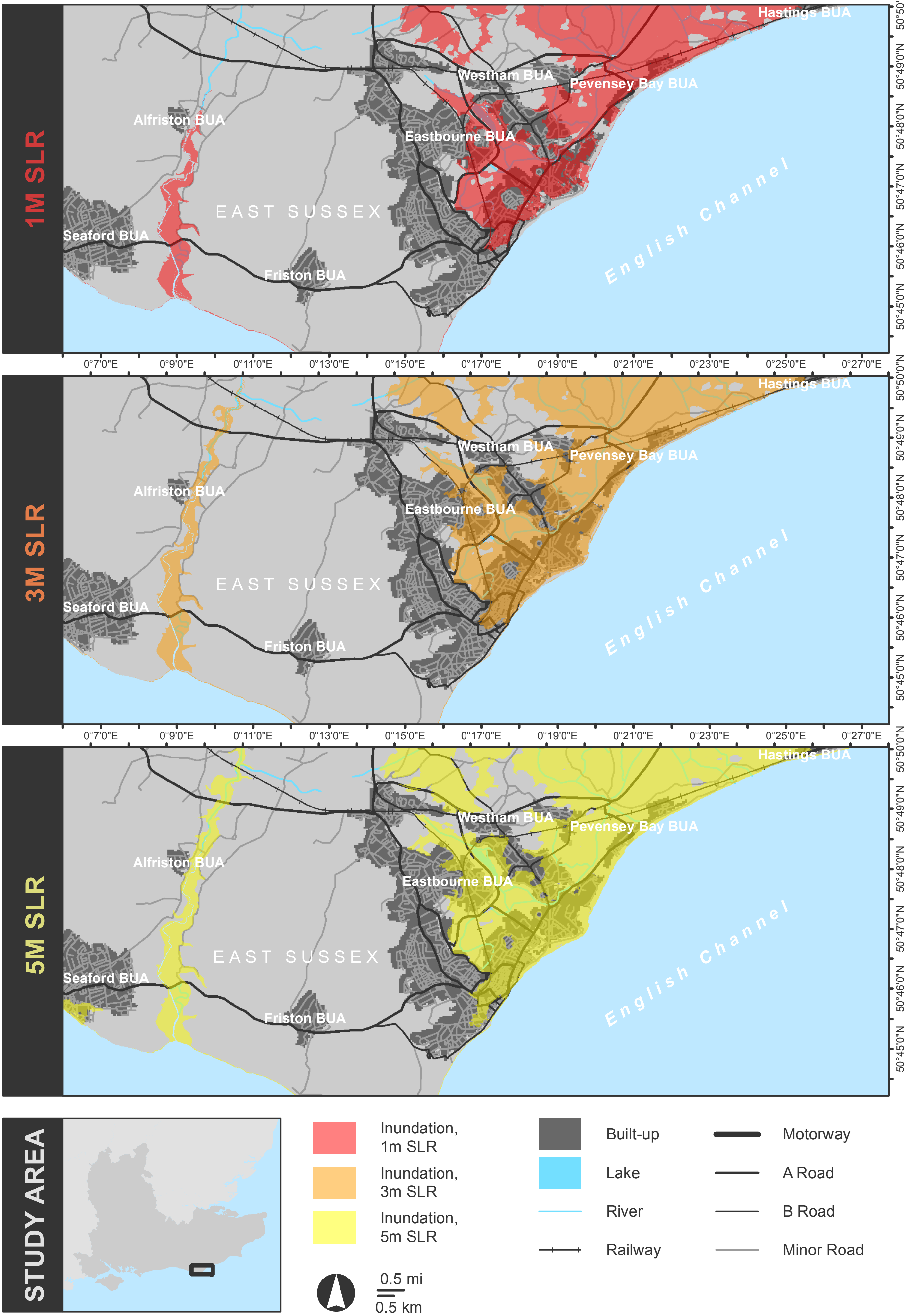
Dymchurch BUA



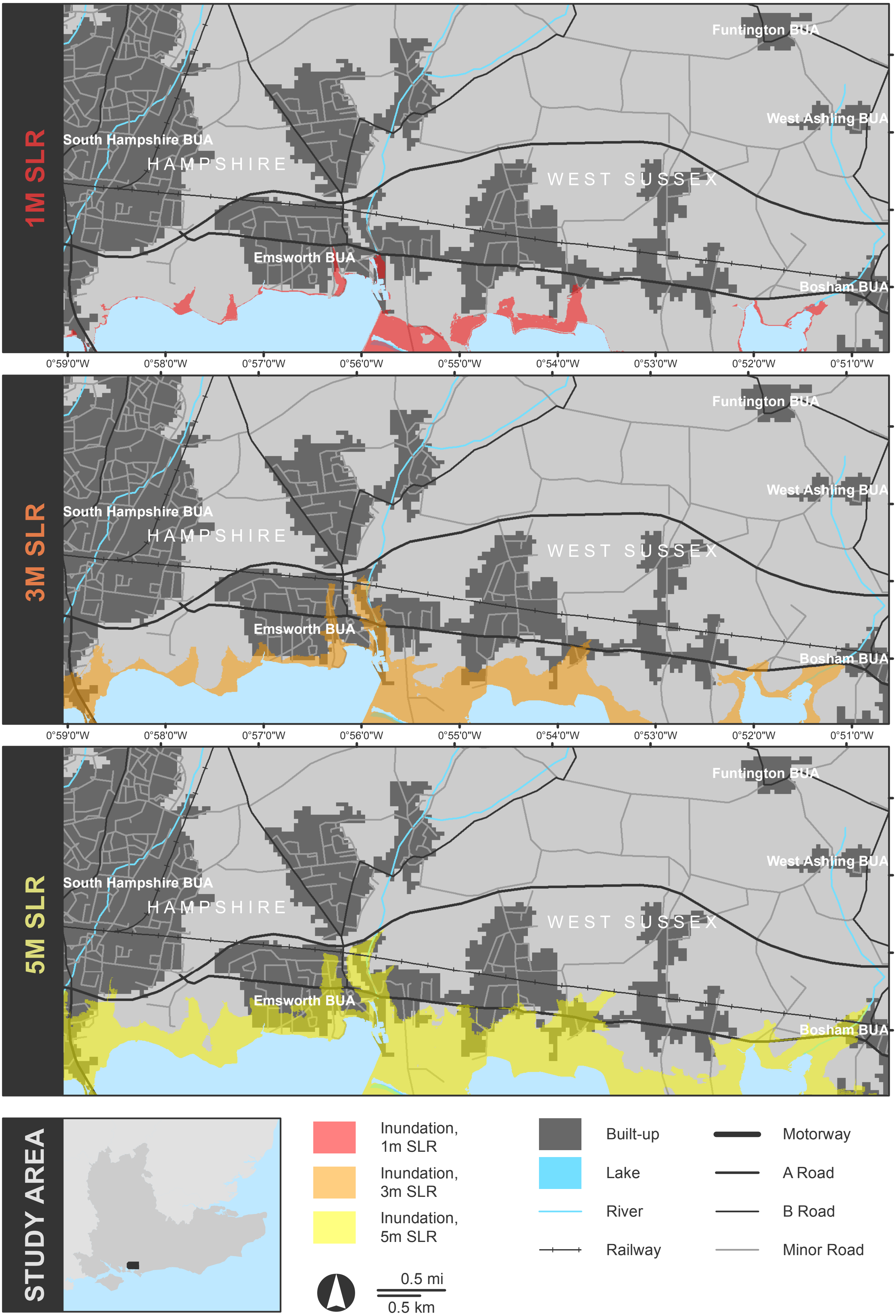
East Wittering BUA



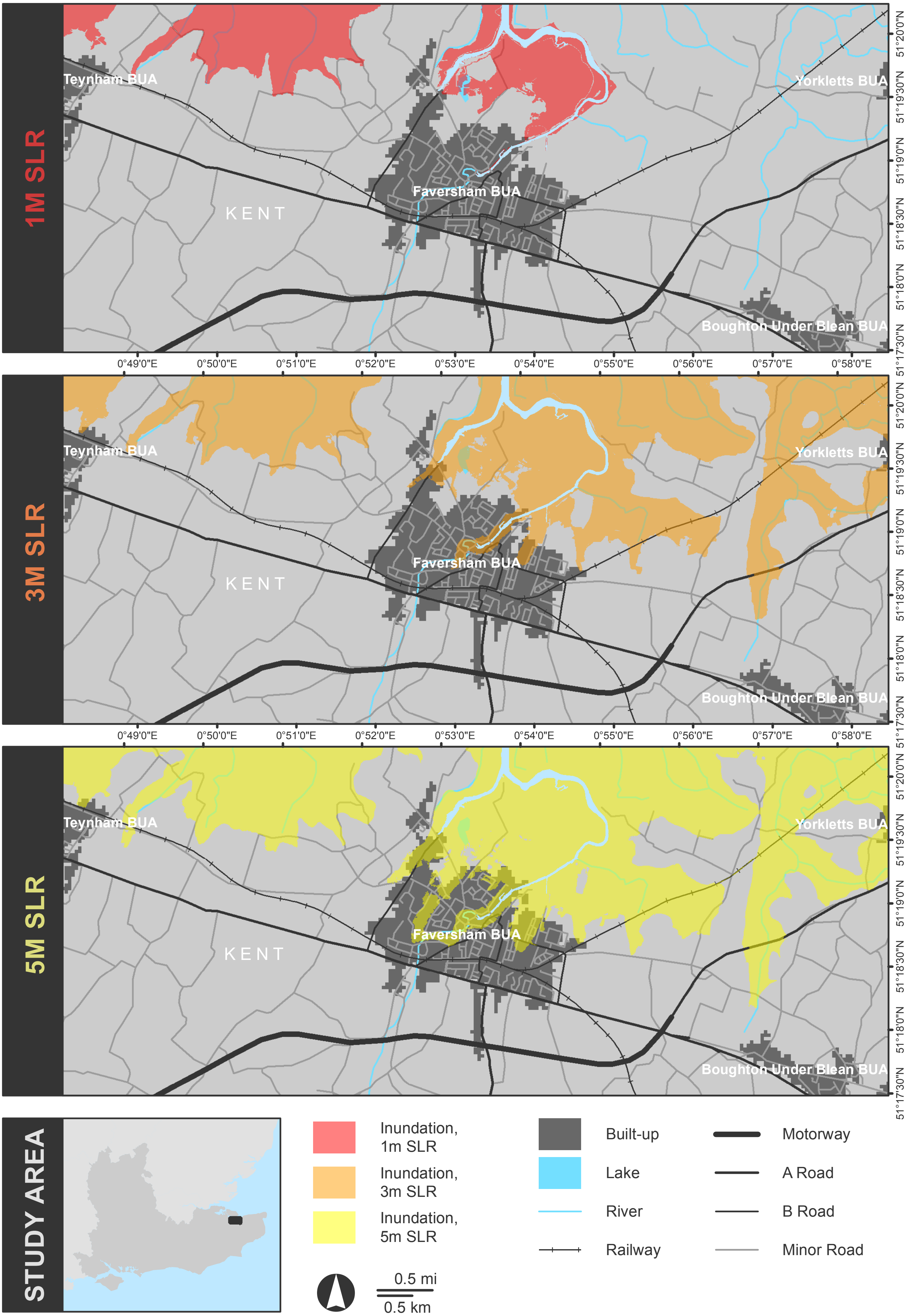
Eastbourne BUA



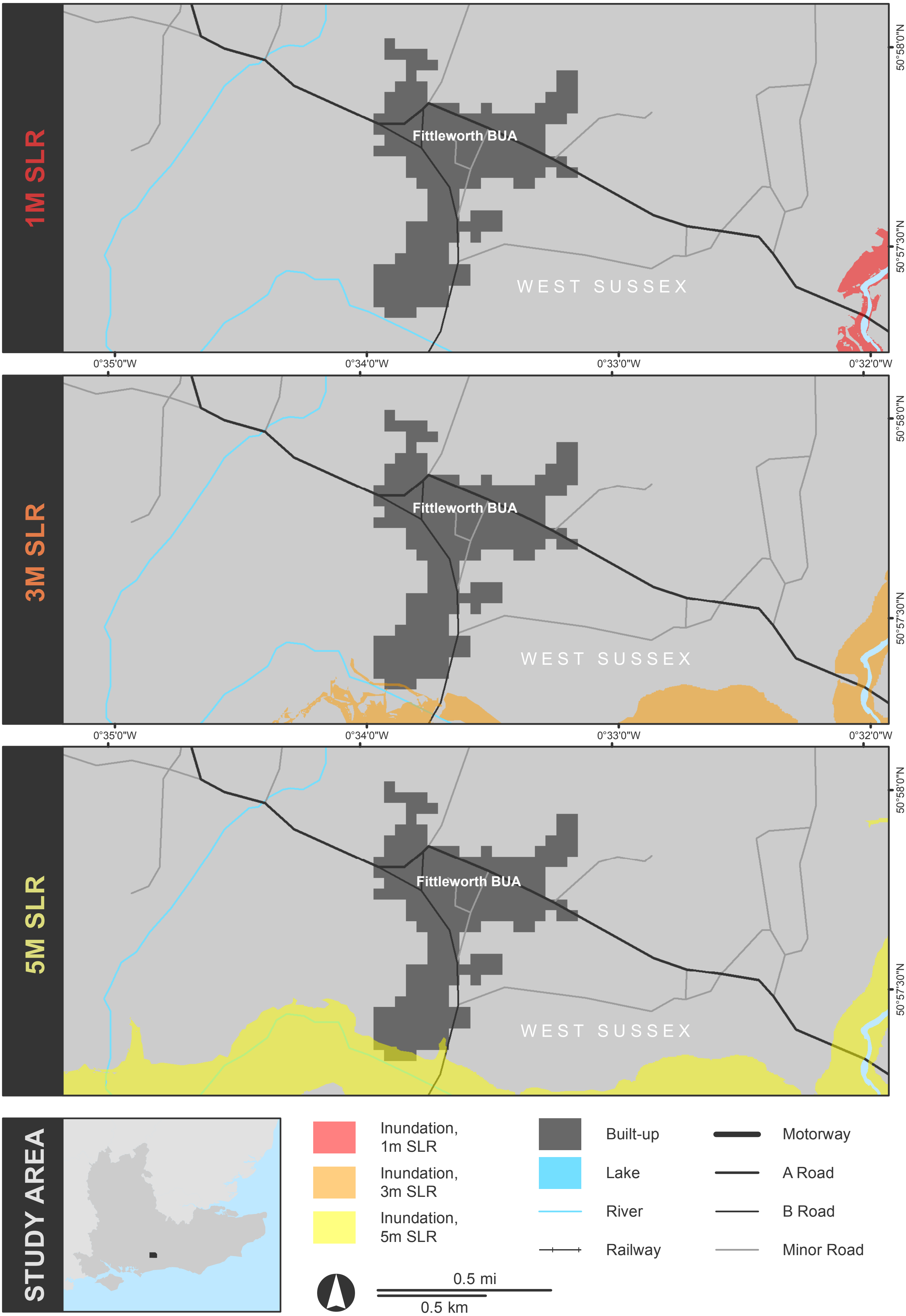
Emsworth BUA



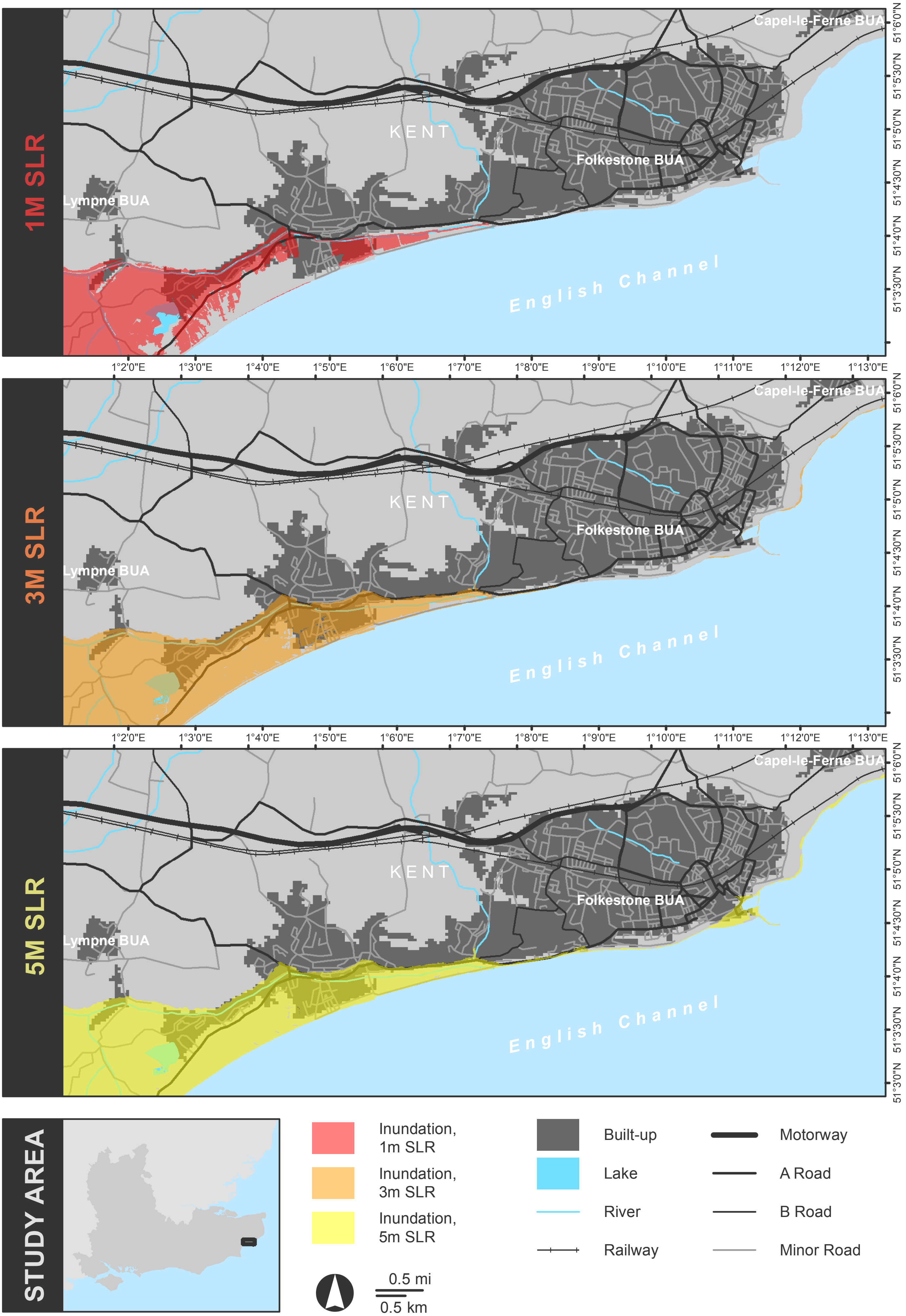
Faversham BUA



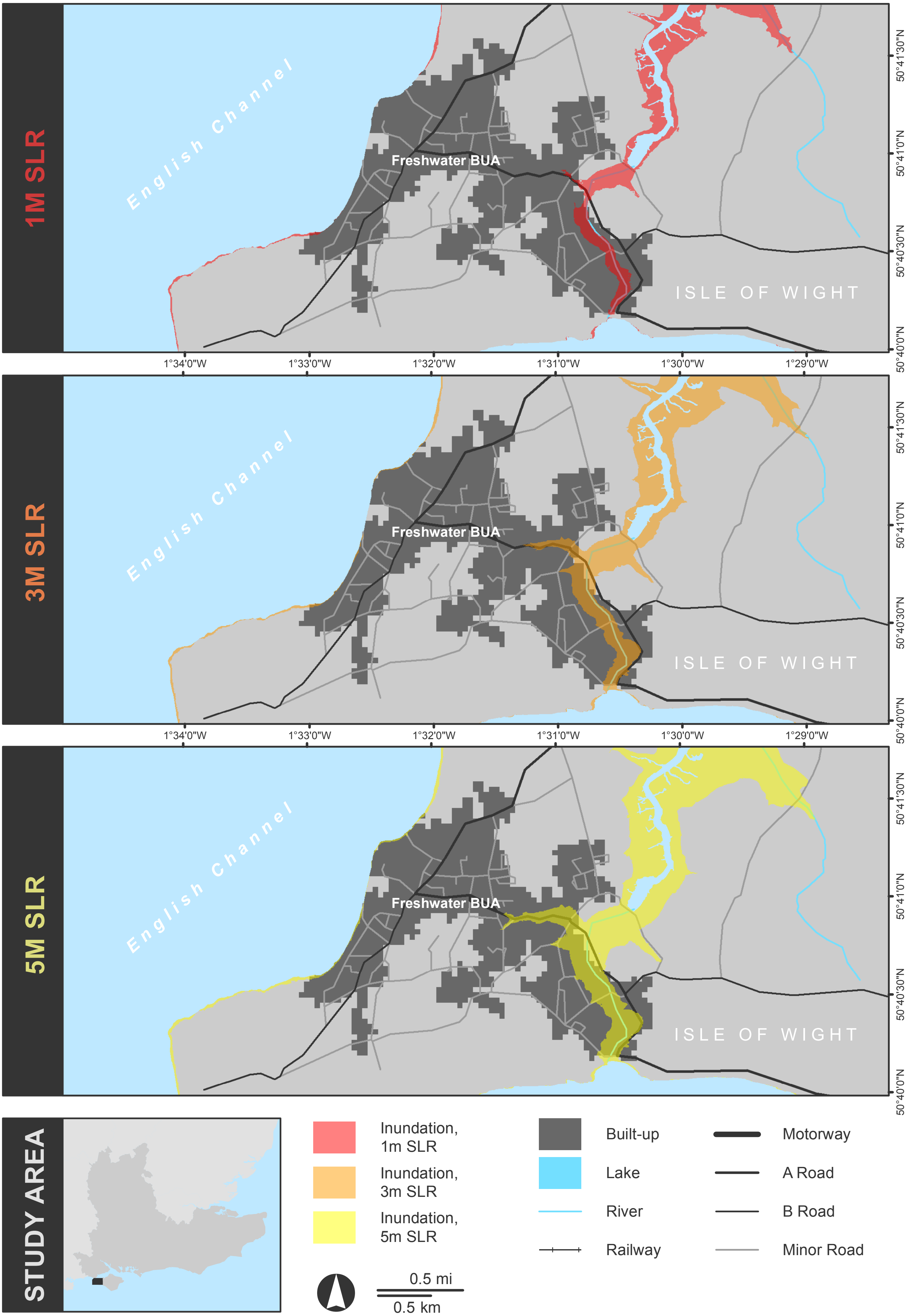
Fittleworth BUA



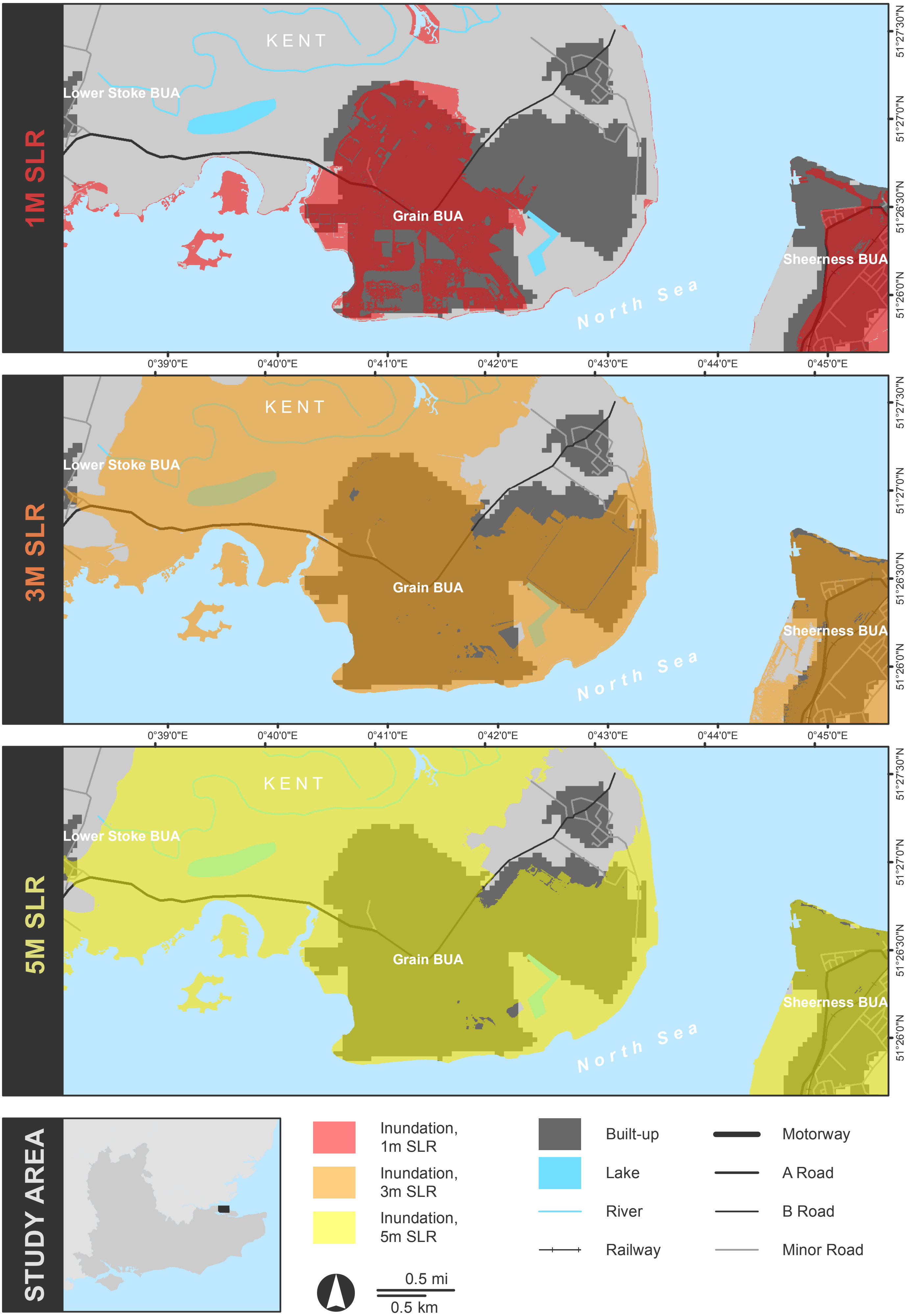
Folkestone BUA



Freshwater BUA

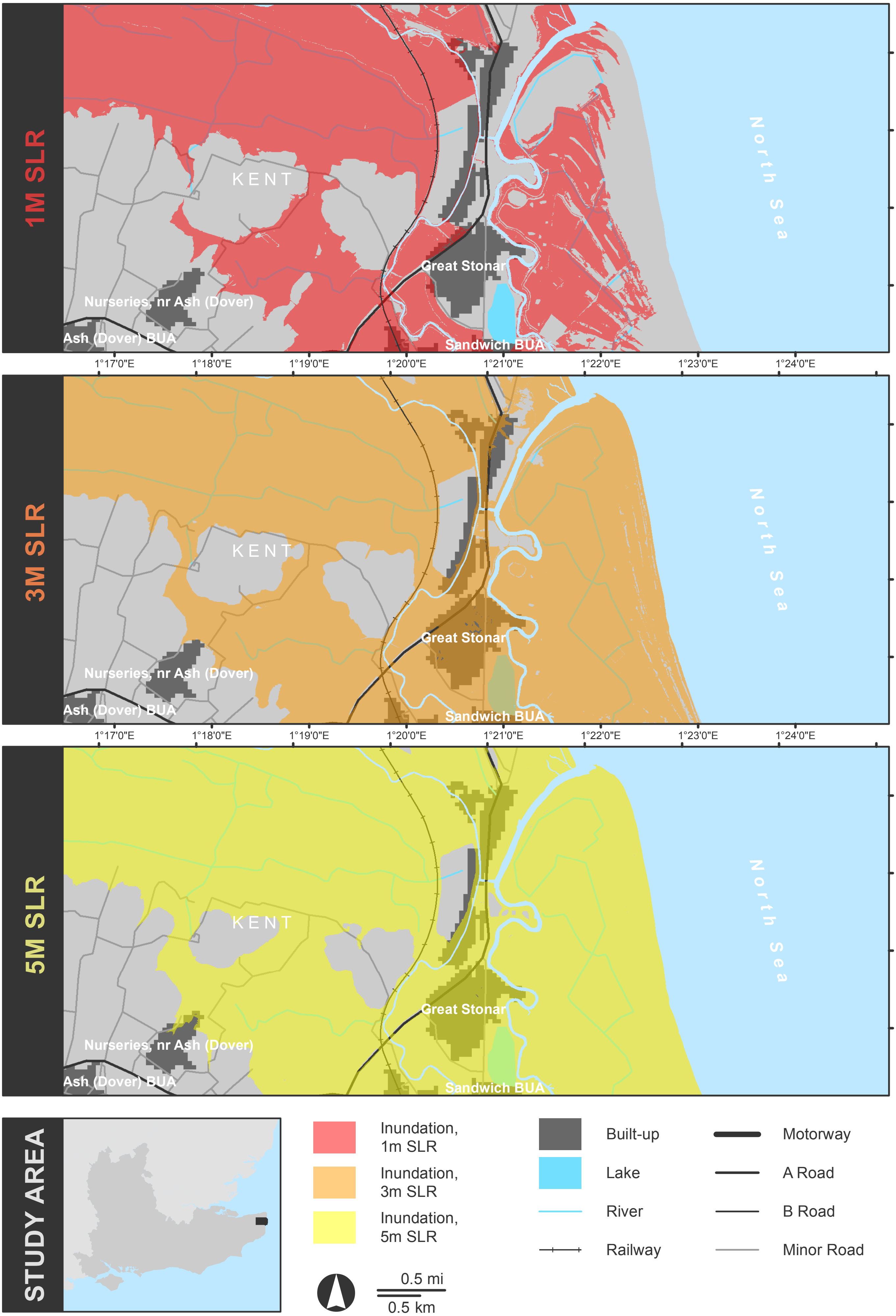


Grain BUA

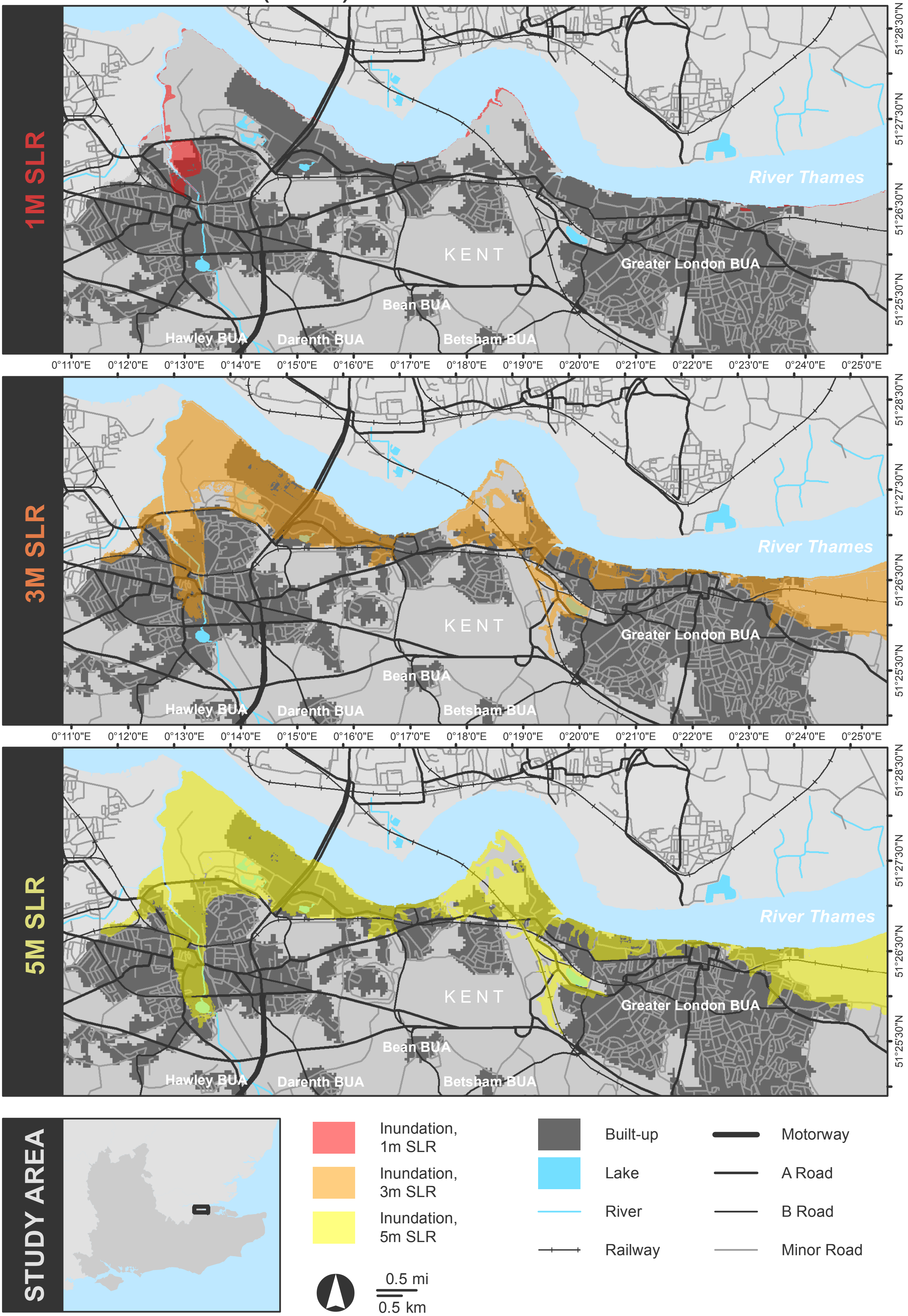


1M SLR
KENT
Lower Stoke BUA
Grain BUA
Sheerness BUA
North Sea
3M SLR
KENT
Lower Stoke BUA
Grain BUA
Sheerness BUA
North Sea
5M SLR
KENT
Lower Stoke BUA
Grain BUA
Sheerness BUA
North Sea
0°39'0"E
0°40'0"E
0°41'0"E
0°42'0"E
0°43'0"E
0°44'0"E
0°45'0"E
51°27'30"N
51°27'0"N
51°26'30"N
51°26'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

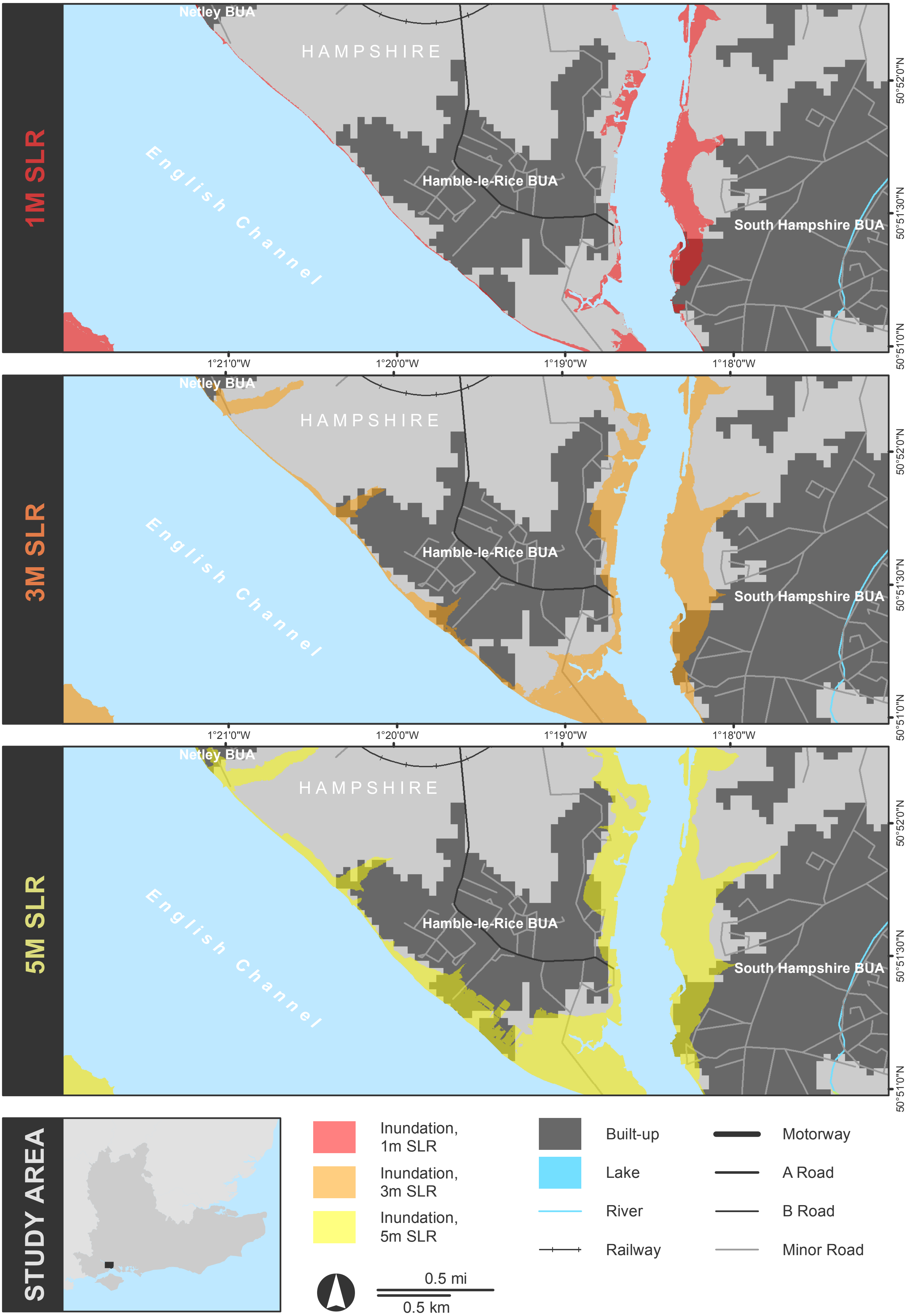
Great Stonar



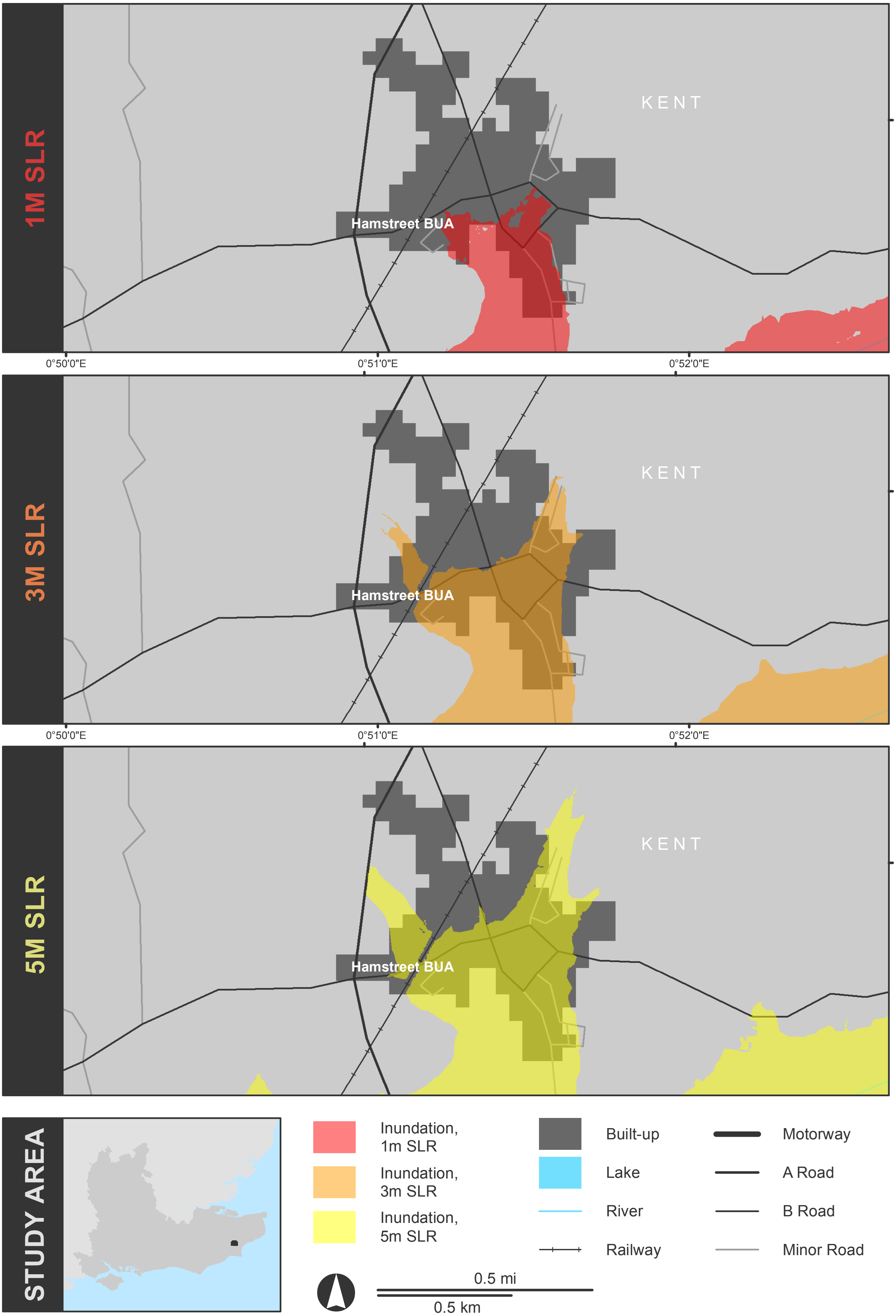
Greater London (East) BUA



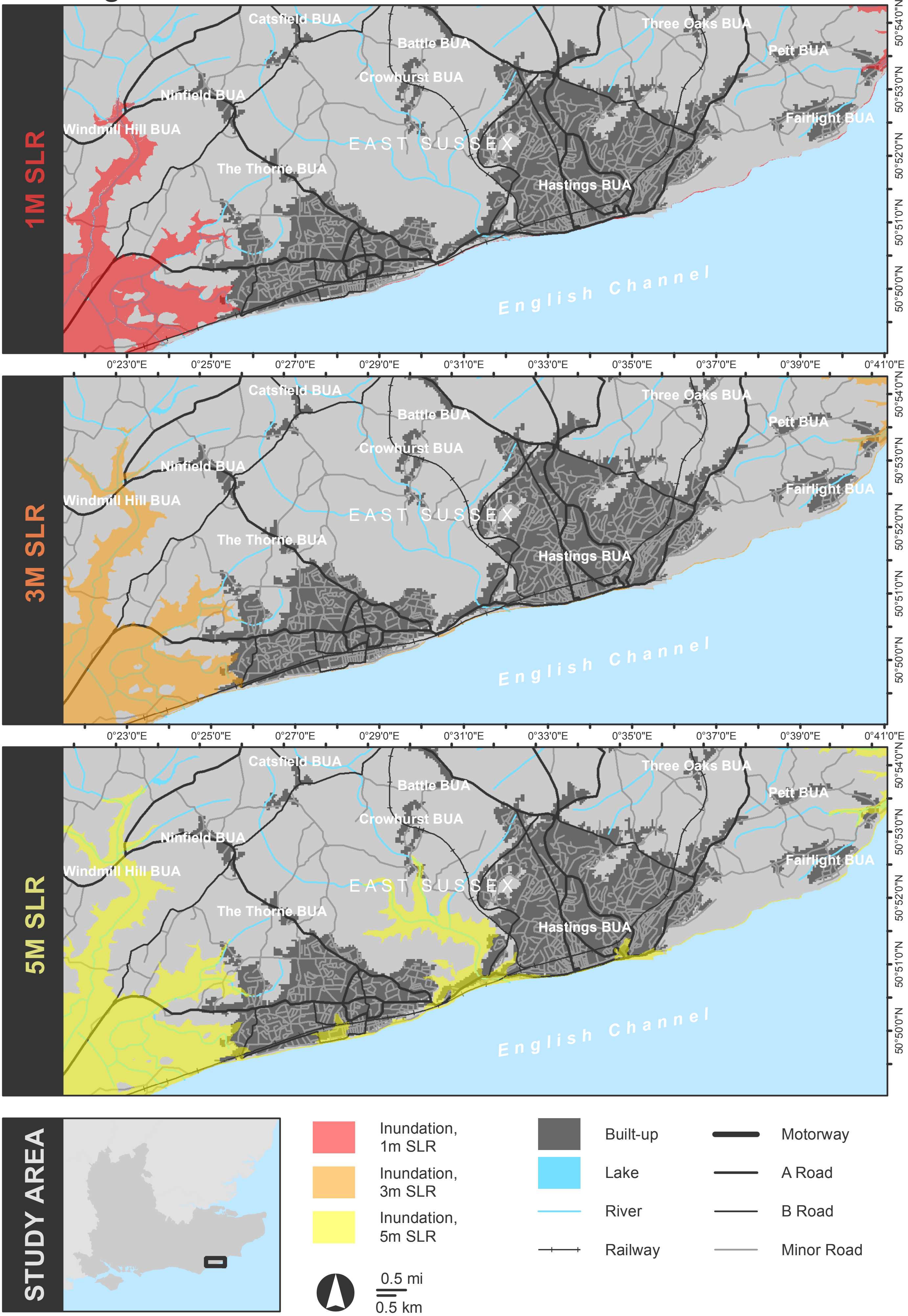
Hamble-le-Rice BUA



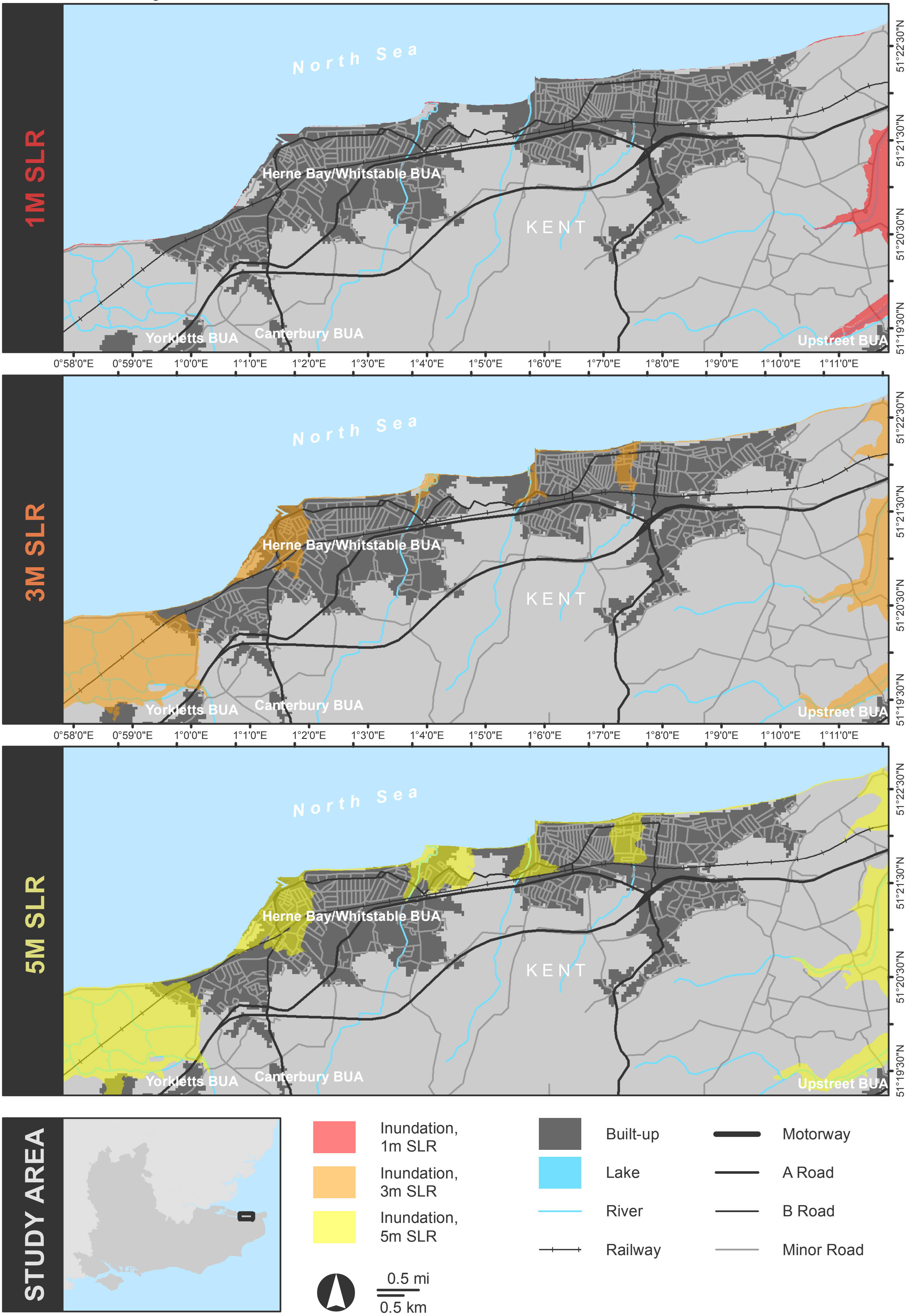
Hamstreet BUA



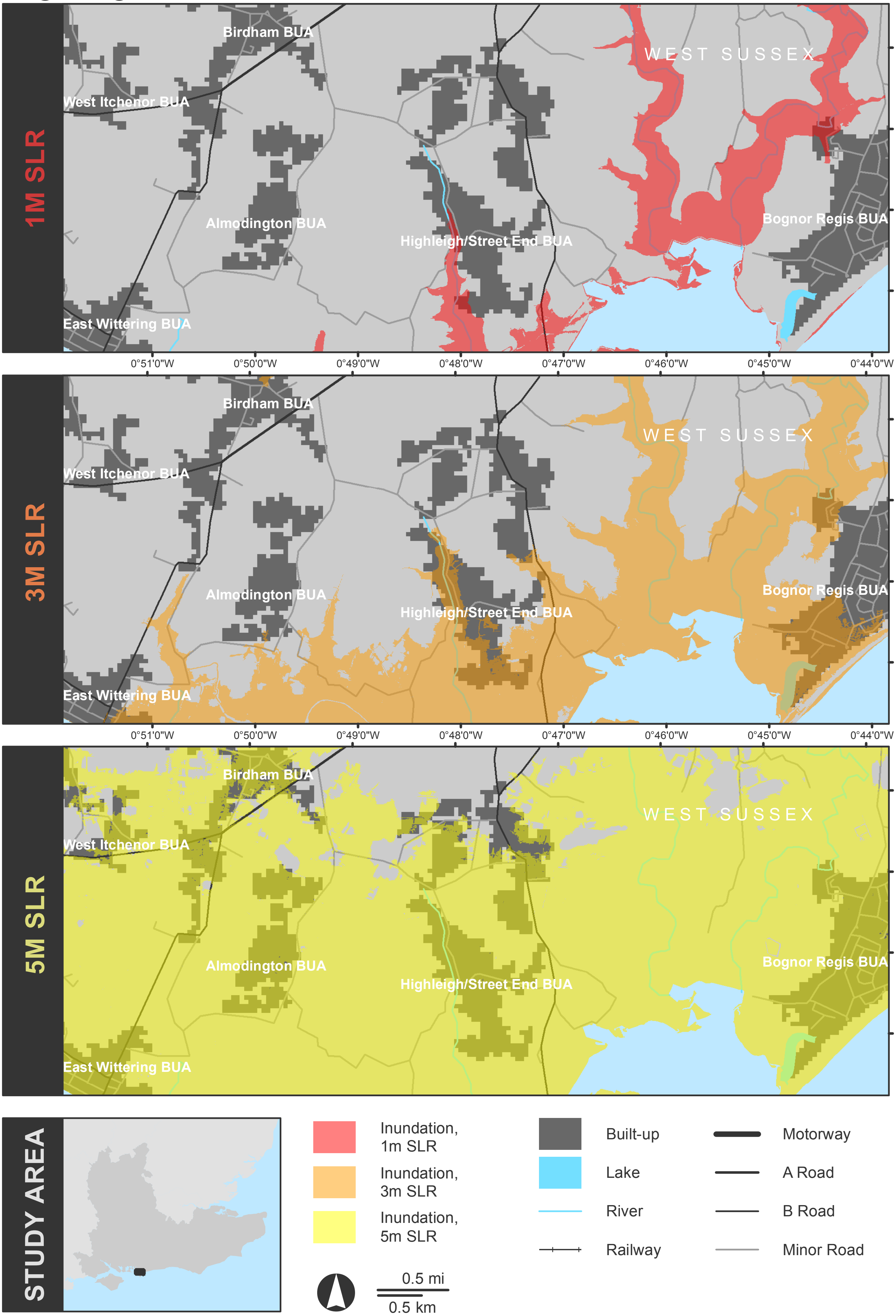
Hastings BUA



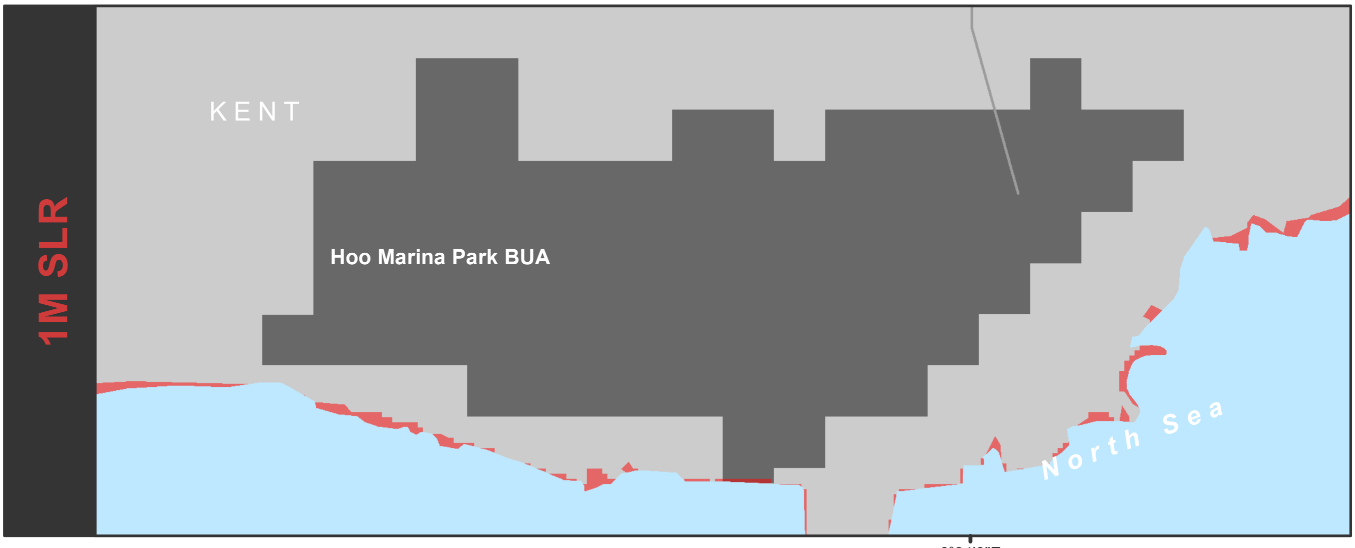
Herne Bay/Whitstable BUA

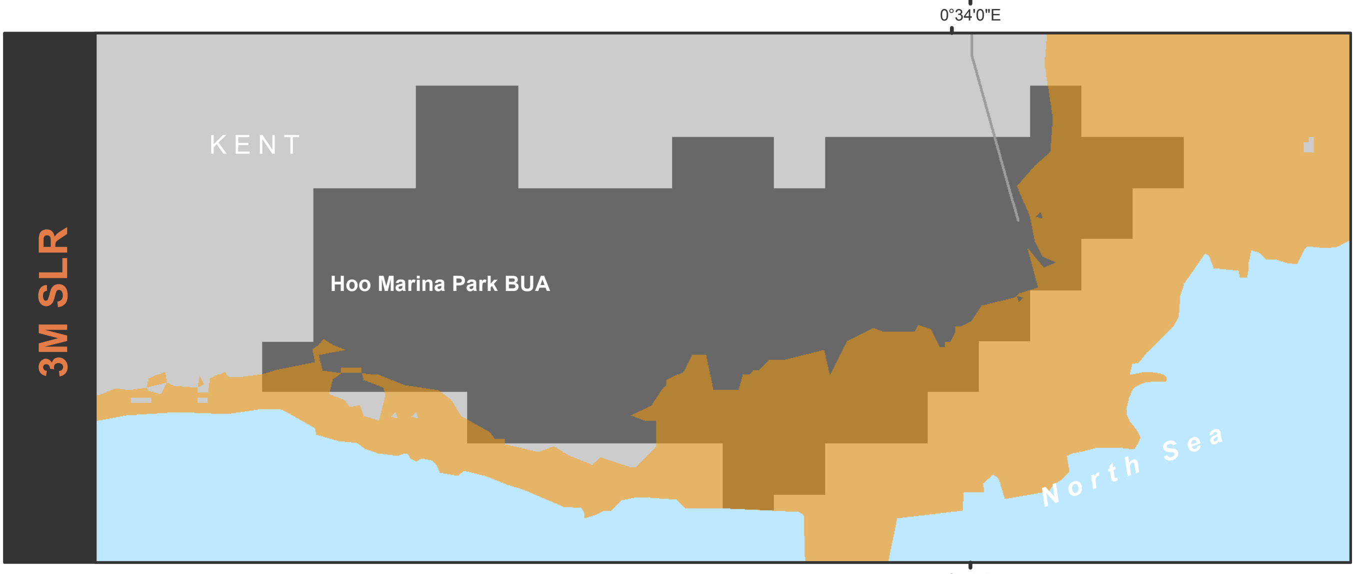


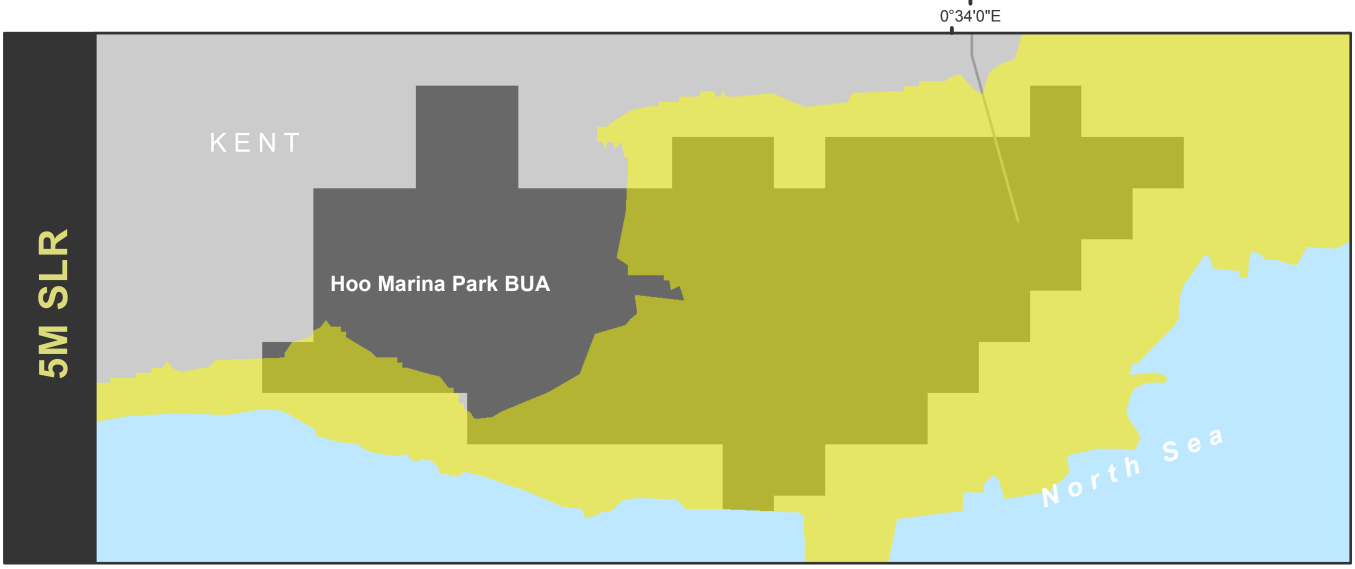
Highleigh/Street End BUA

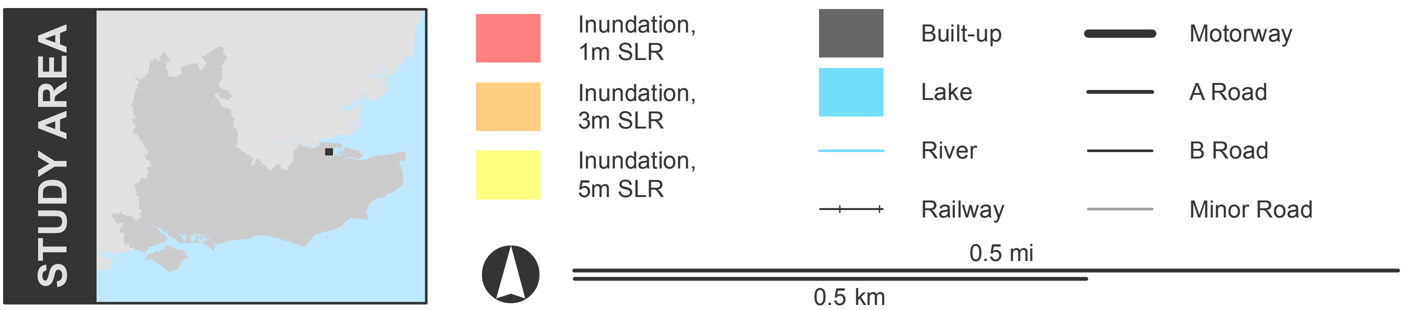


Hoo Marina Park BUA

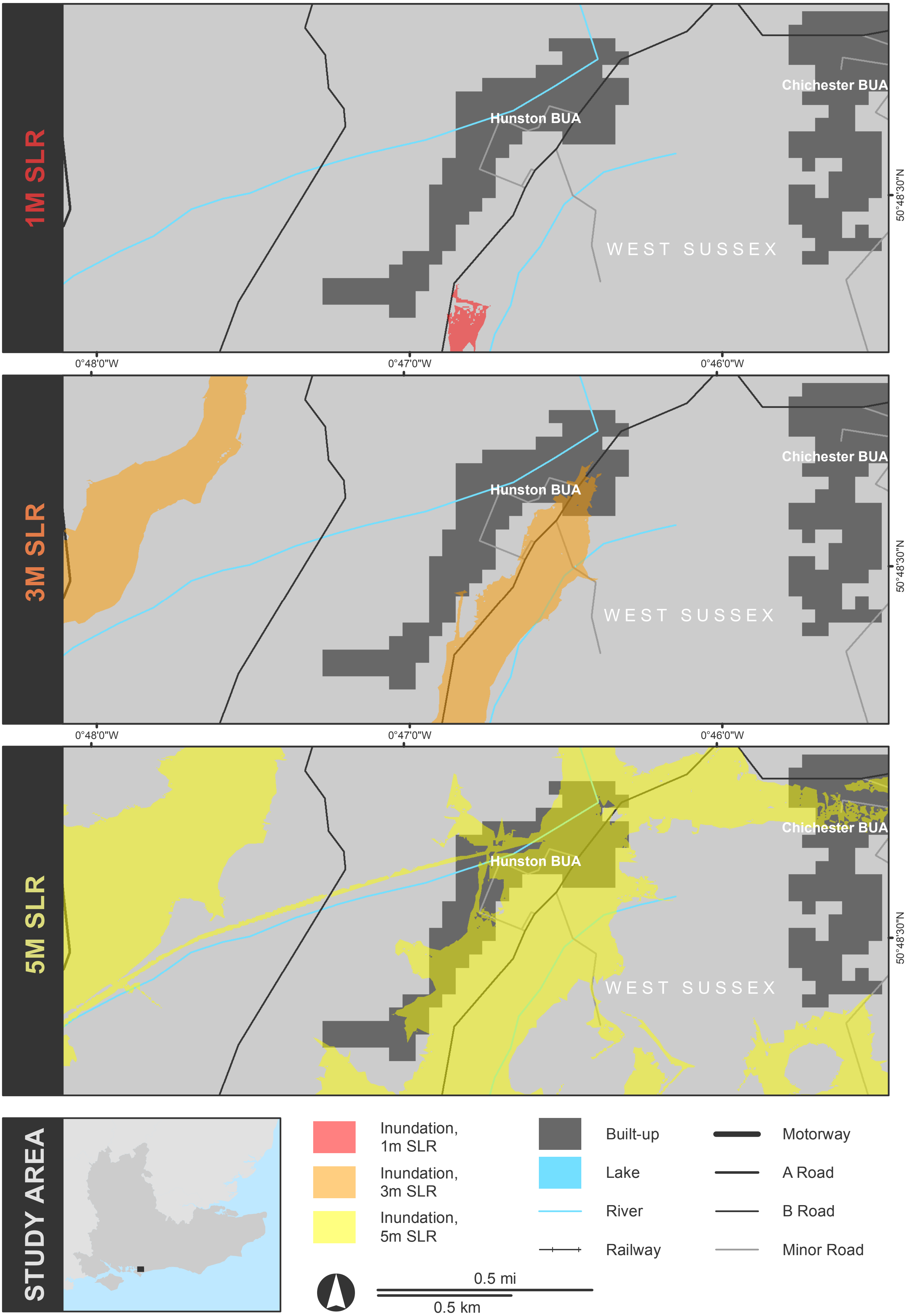






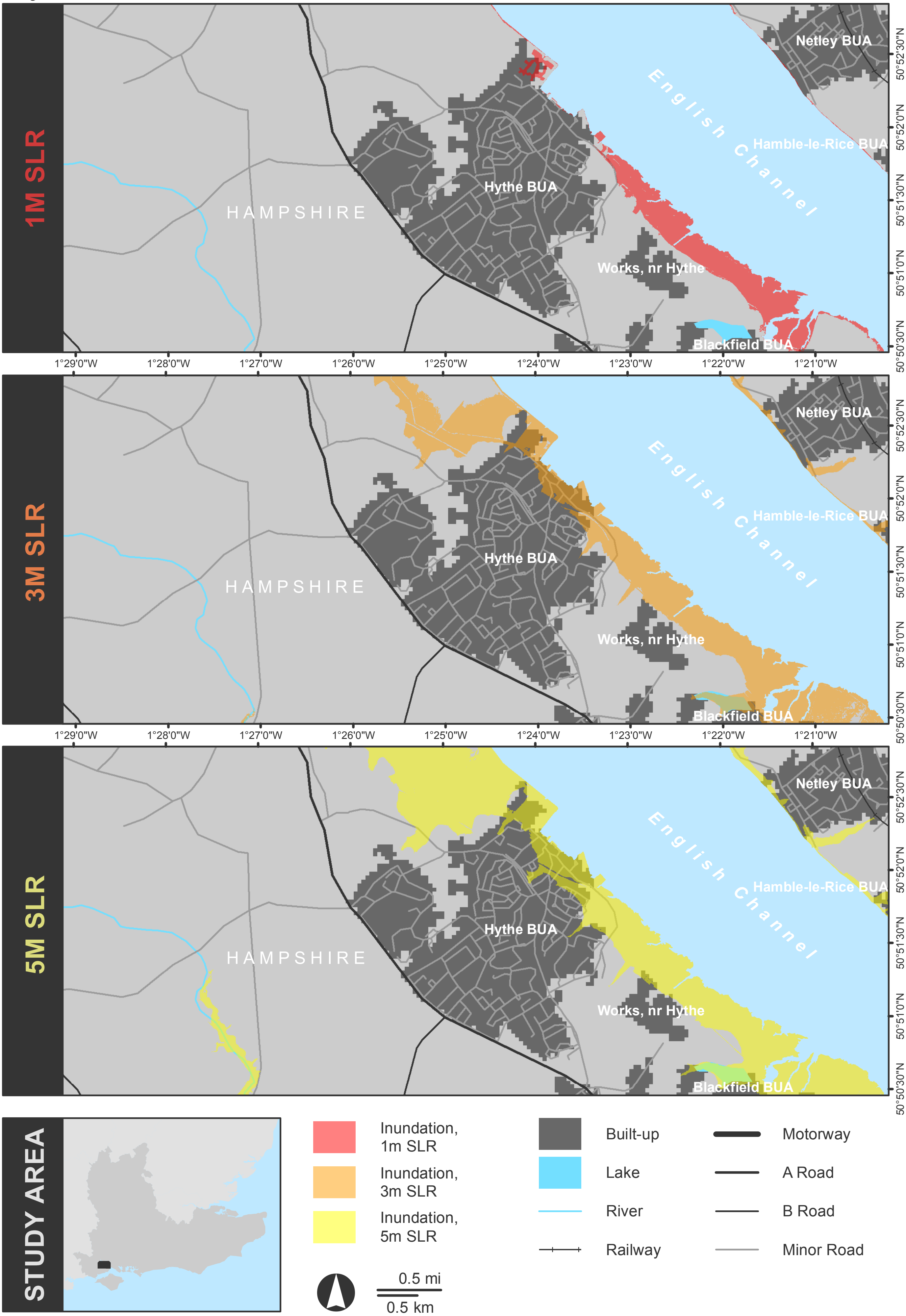


Hunston BUA



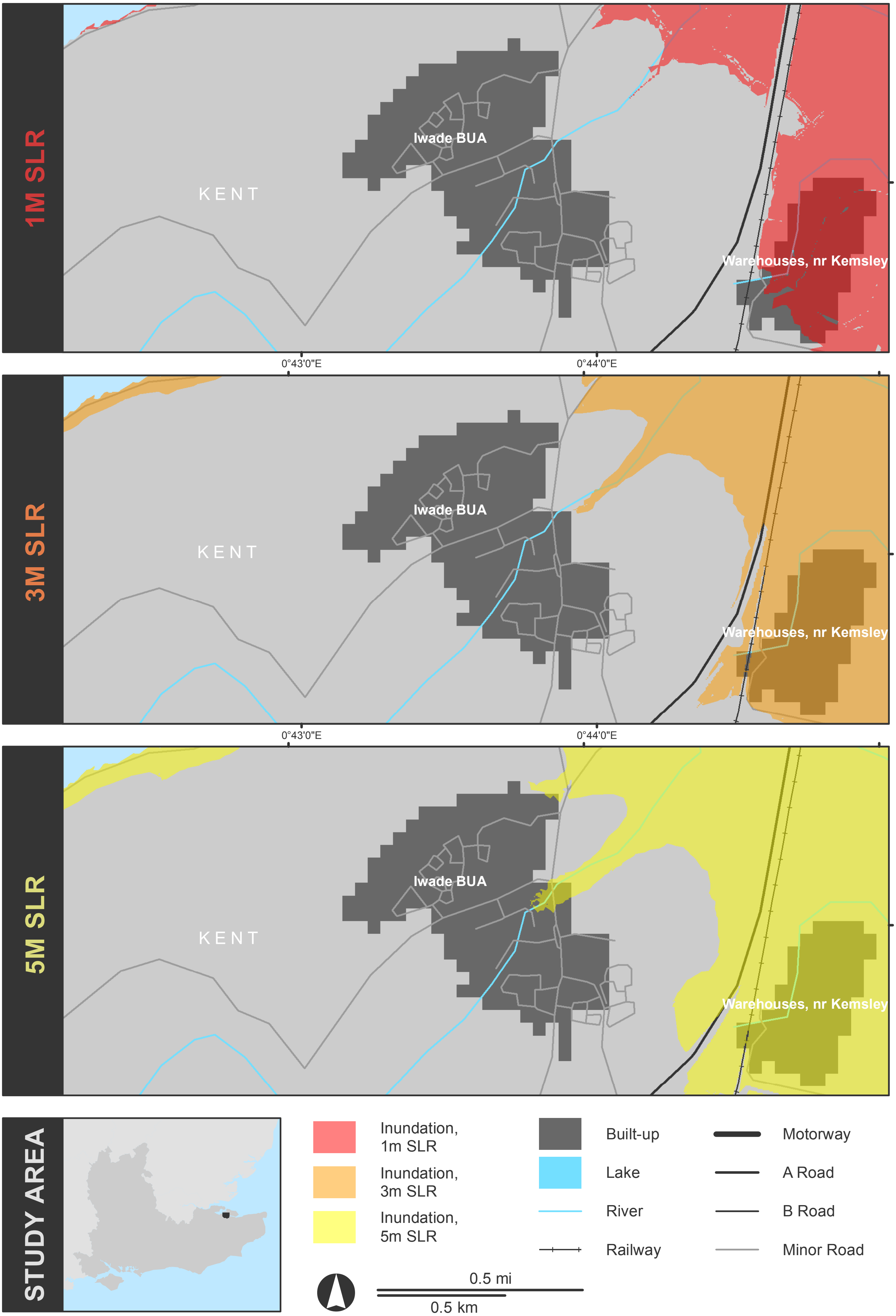
1M SLR
3M SLR
5M SLR
Hunston BUA
Chichester BUA
WEST SUSSEX
0°48'0"W
0°47'0"W
0°46'0"W
50°48'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

Hythe BUA

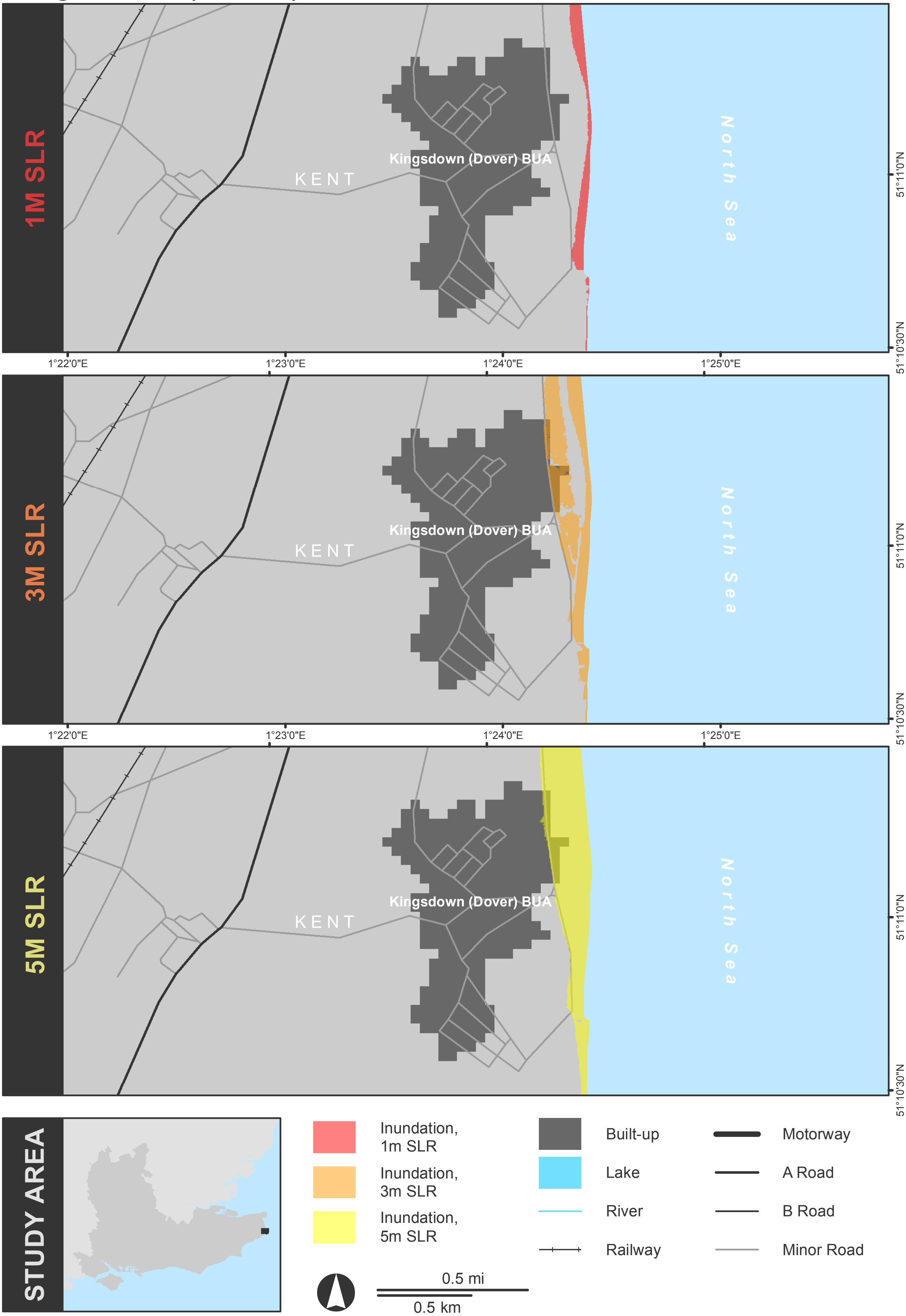


1M SLR
3M SLR
5M SLR
STUDY AREA
Netley BUA
Hamble-le-Rice BUA
English Channel
Hythe BUA
HAMPSHIRE
Works, nr Hythe
Blackfield BUA
1°29'0"W
1°28'0"W
1°27'0"W
1°26'0"W
1°25'0"W
1°24'0"W
1°23'0"W
1°22'0"W
1°21'0"W
50°52'30"N
50°52'0"N
50°51'30"N
50°51'0"N
50°50'30"N
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

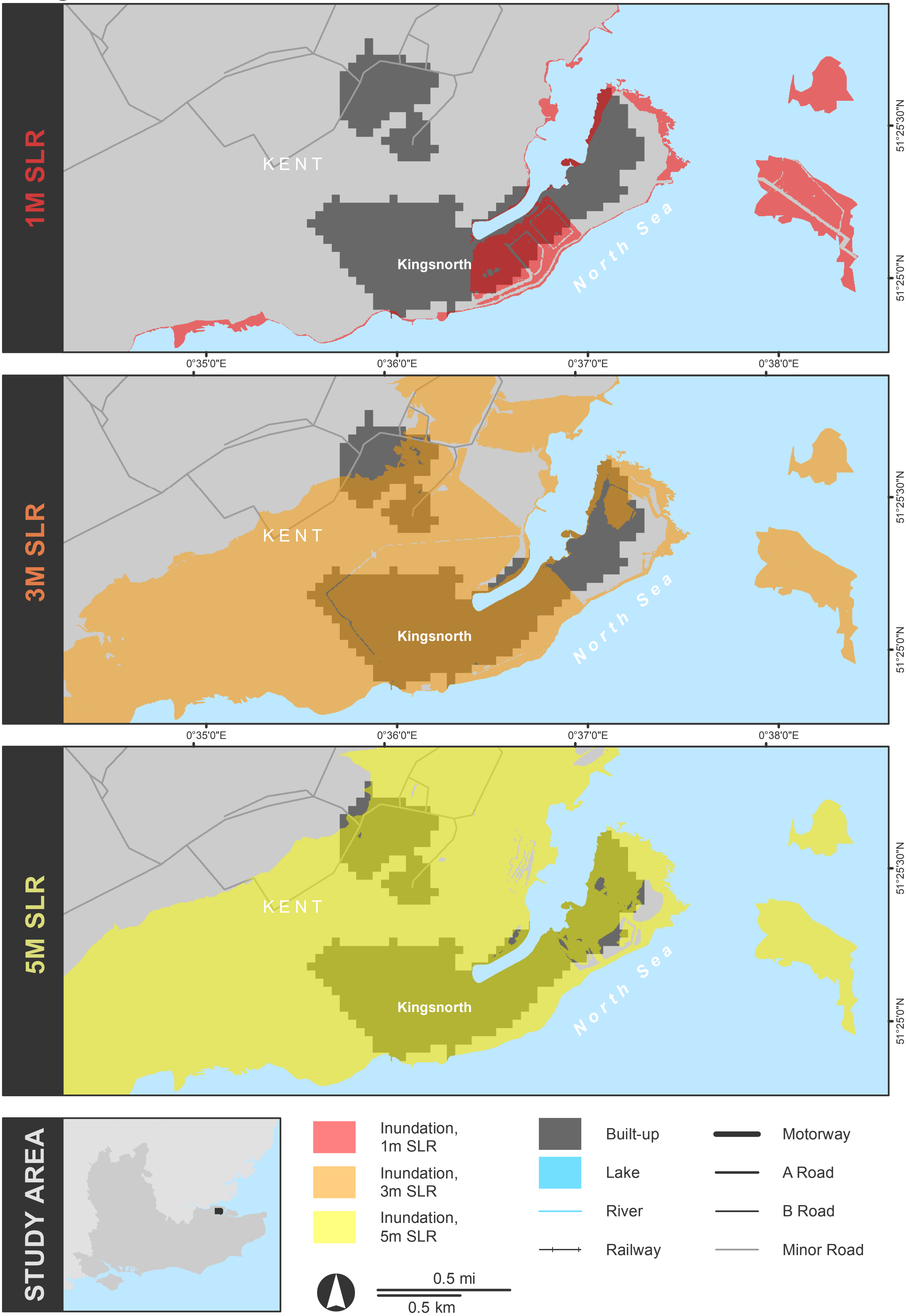
Iwade BUA


1M SLR
Iwade BUA
KENT
Warehouses, nr Kemsley
51°22'30"N
0°43'0"E
0°44'0"E
3M SLR
Iwade BUA
KENT
Warehouses, nr Kemsley
51°22'30"N
0°43'0"E
0°44'0"E
5M SLR
Iwade BUA
KENT
Warehouses, nr Kemsley
51°22'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

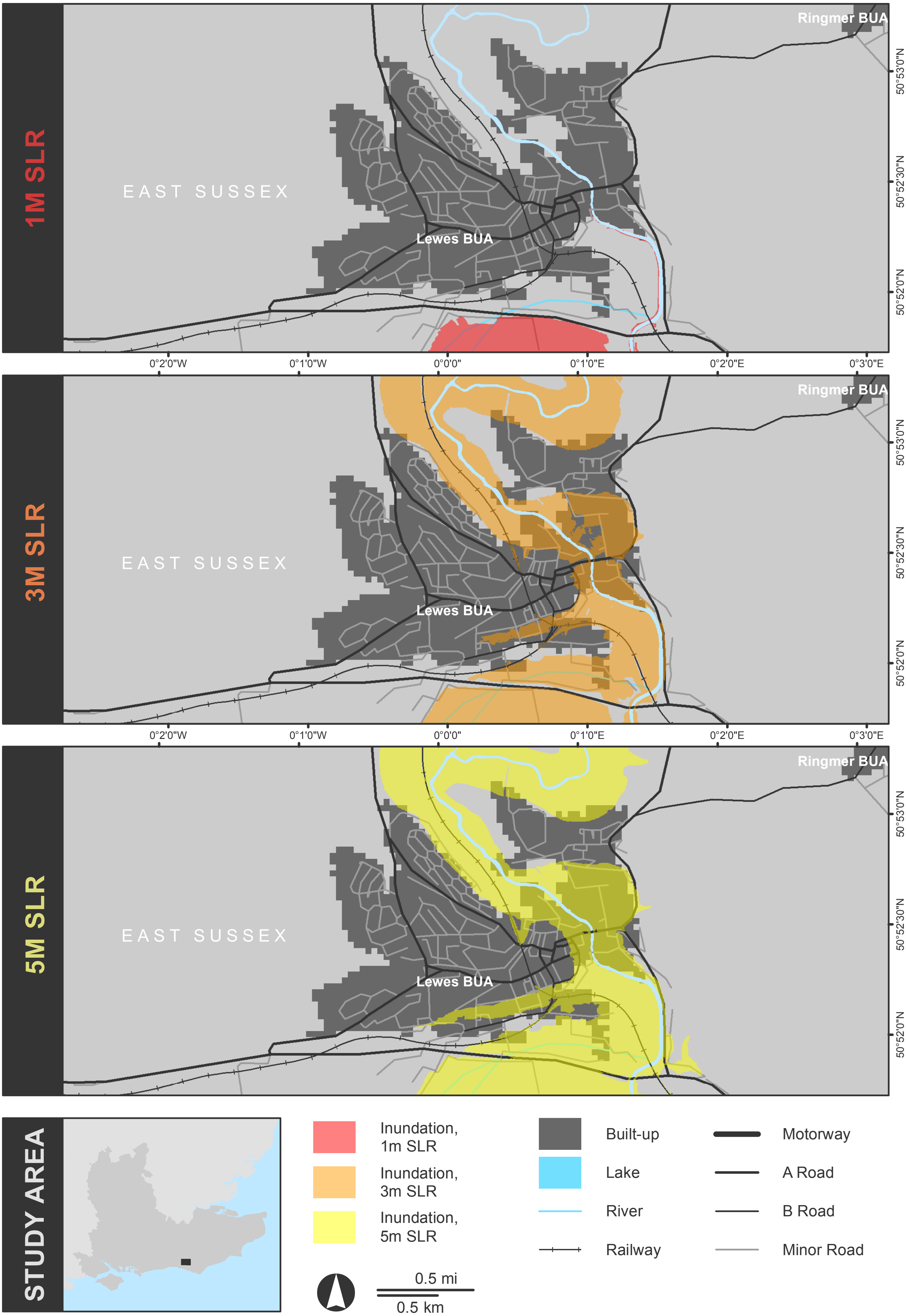
Kingsdown (Dover) BUA



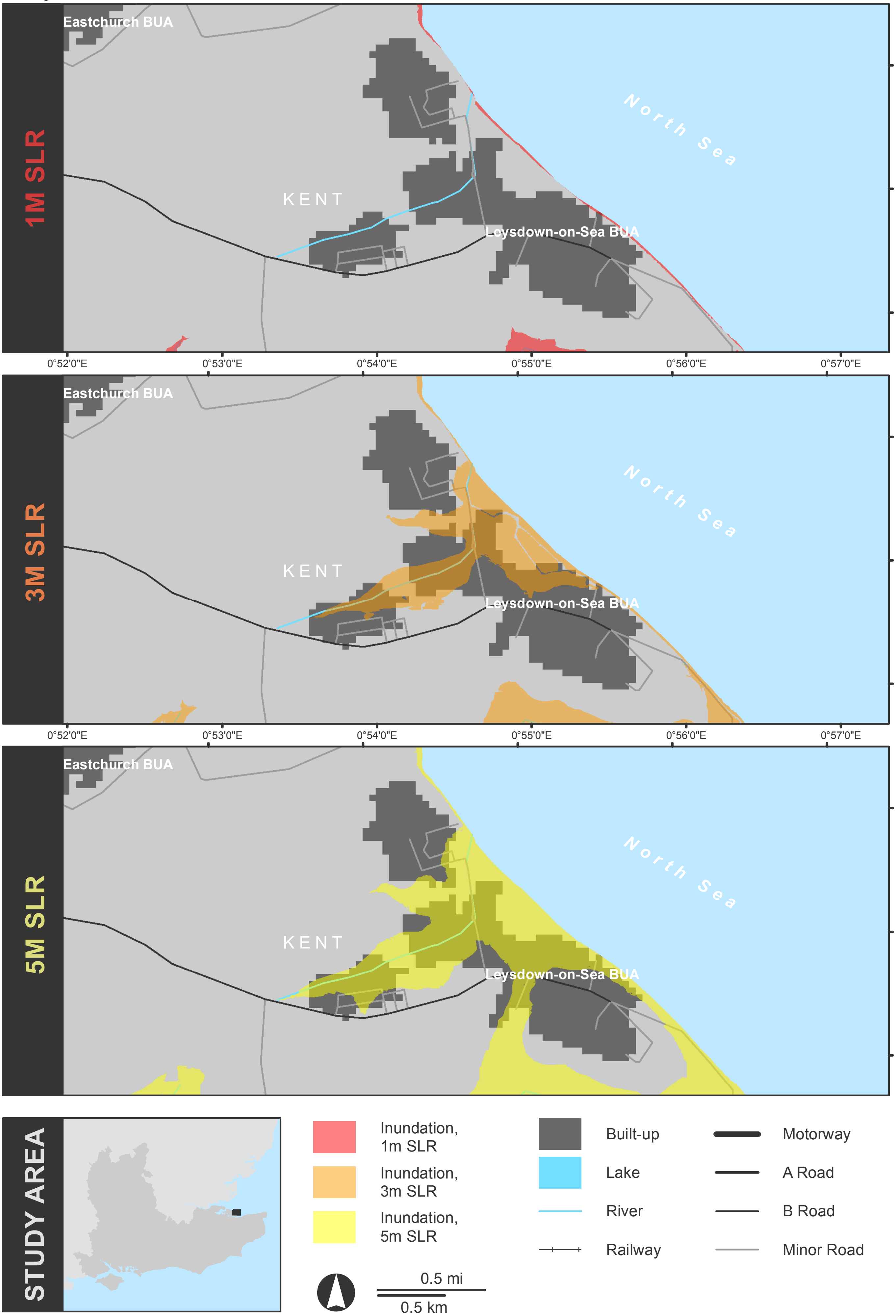
Kingsnorth


1M SLR
KENT
Kingsnorth
North Sea
51°25'30"N
51°25'0"N
0°35'0"E
0°36'0"E
0°37'0"E
0°38'0"E
3M SLR
KENT
Kingsnorth
North Sea
51°25'30"N
51°25'0"N
0°35'0"E
0°36'0"E
0°37'0"E
0°38'0"E
5M SLR
KENT
Kingsnorth
North Sea
51°25'30"N
51°25'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

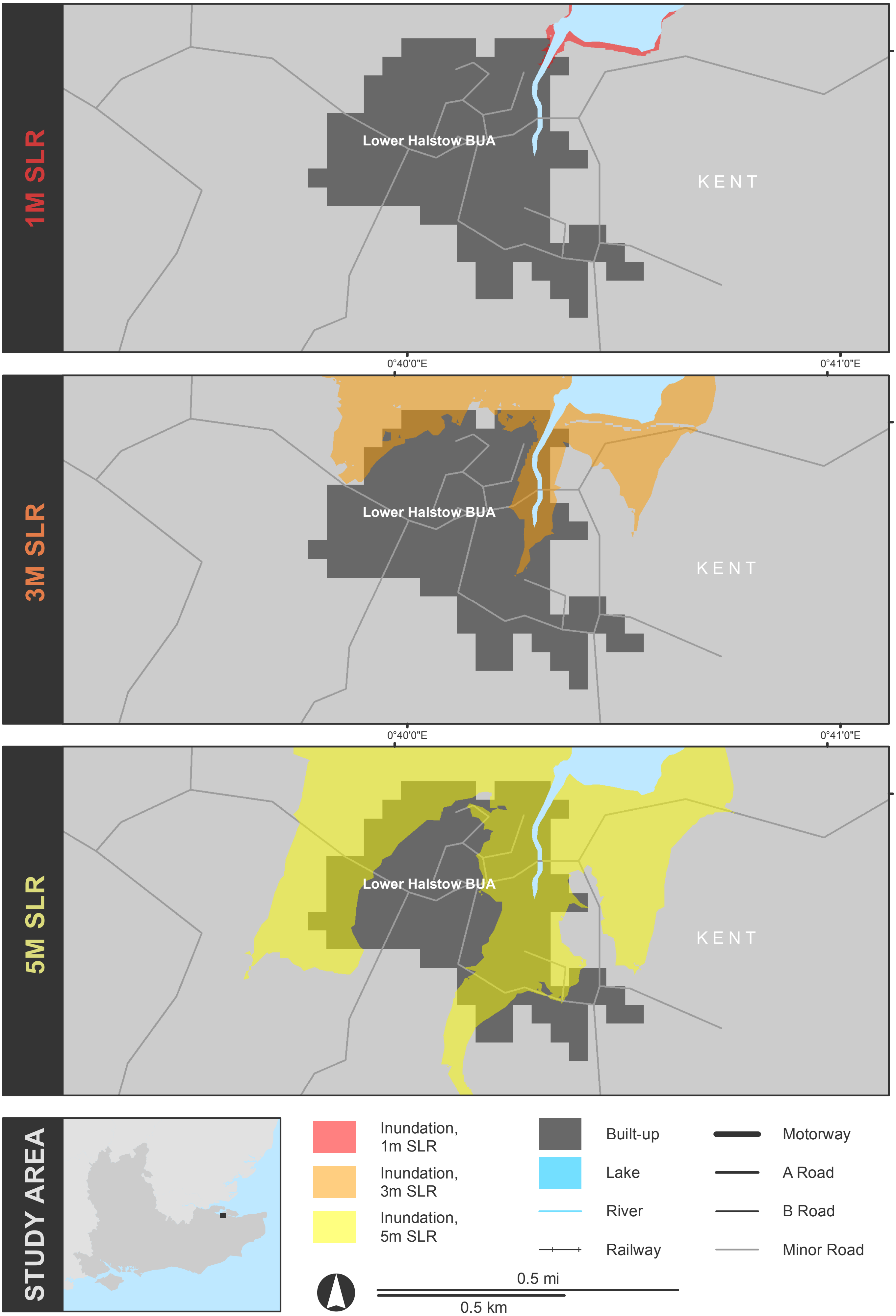
Lewes BUA


1M SLR
3M SLR
5M SLR
EAST SUSSEX
Lewes BUA
Ringmer BUA
0°2'0"W
0°1'0"W
0°0'0"
0°1'0"E
0°2'0"E
0°3'0"E
50°53'0"N
50°52'30"N
50°52'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

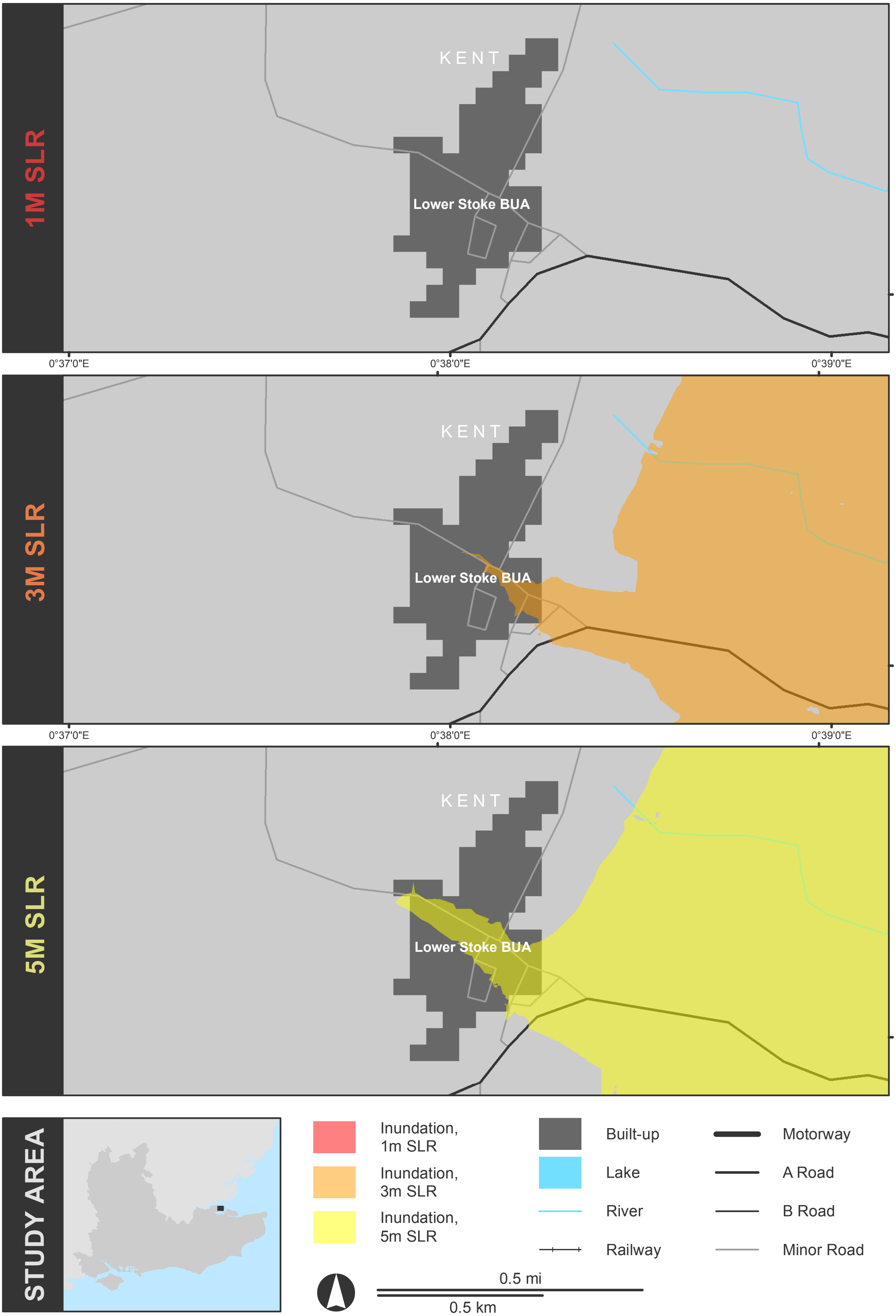
Leysdown-on-Sea BUA



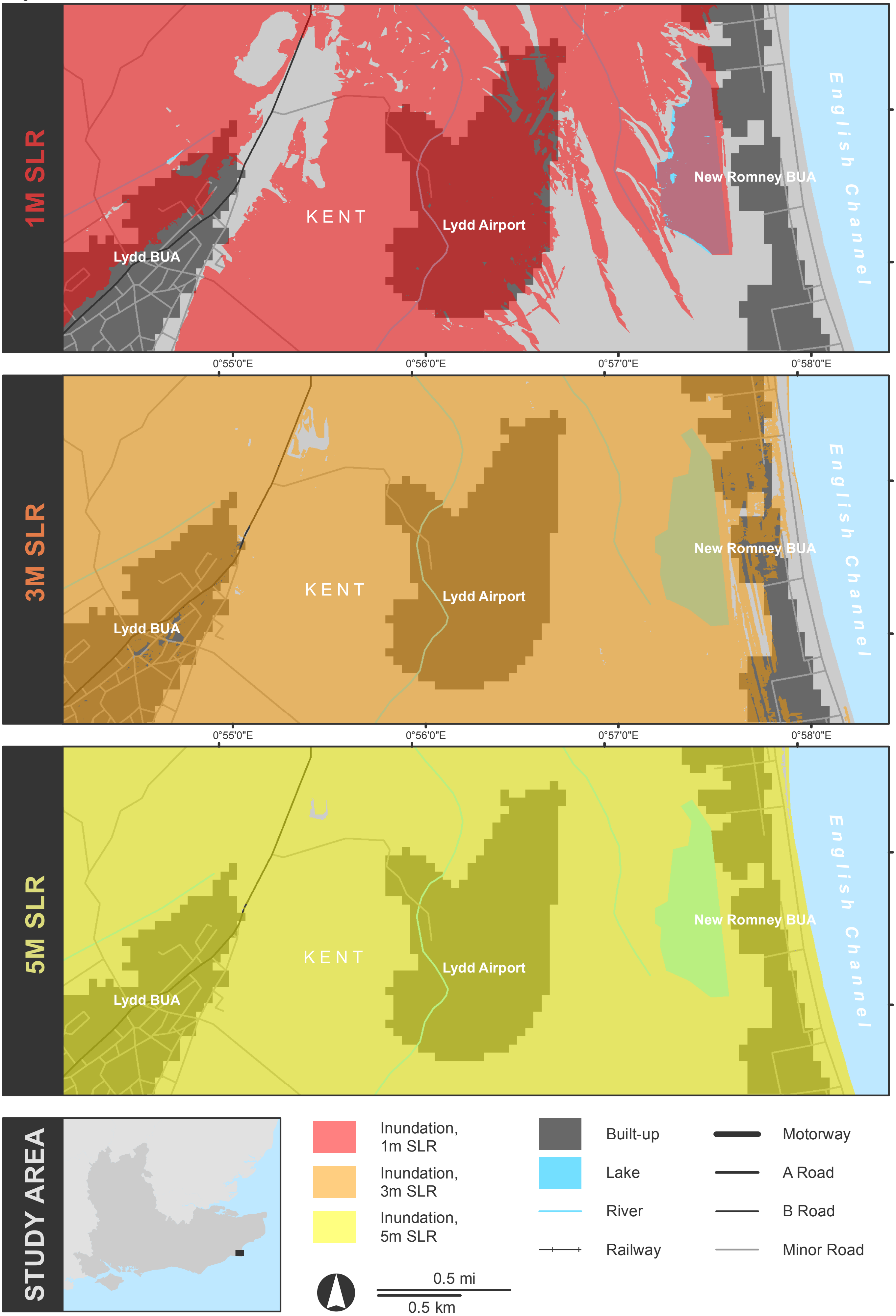
Lower Halstow BUA



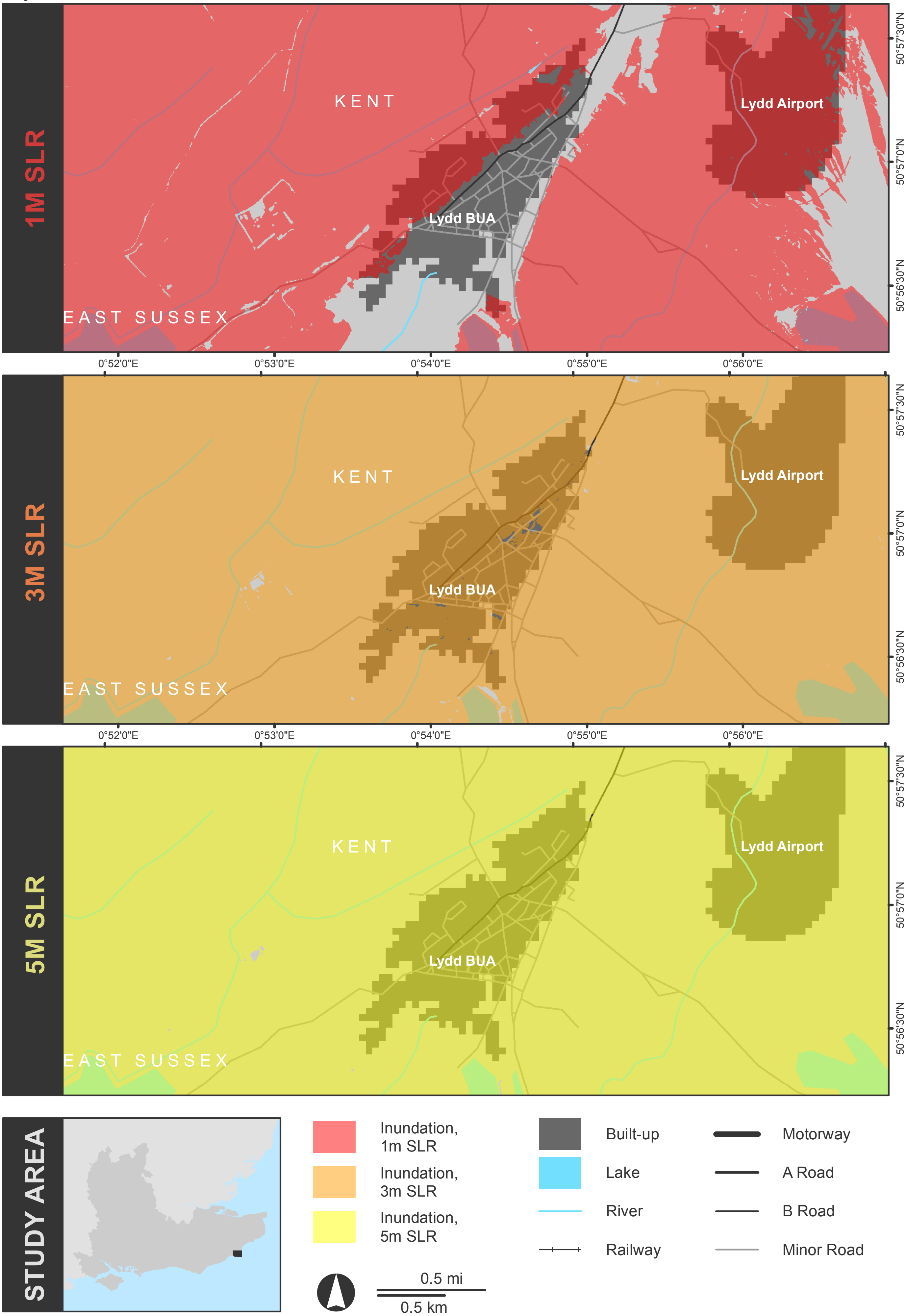
Lower Stoke BUA



Lydd Airport

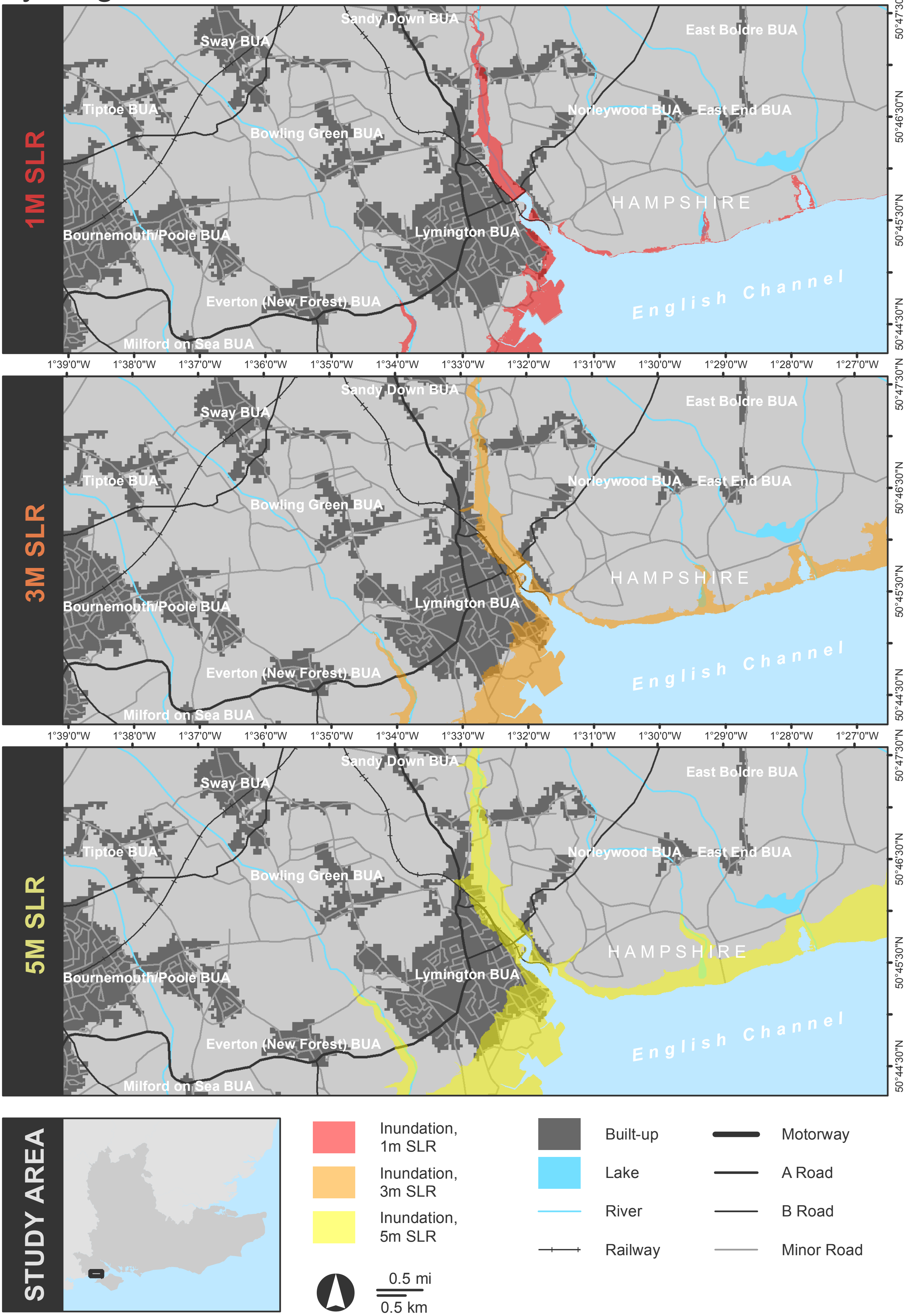


Lydd BUA

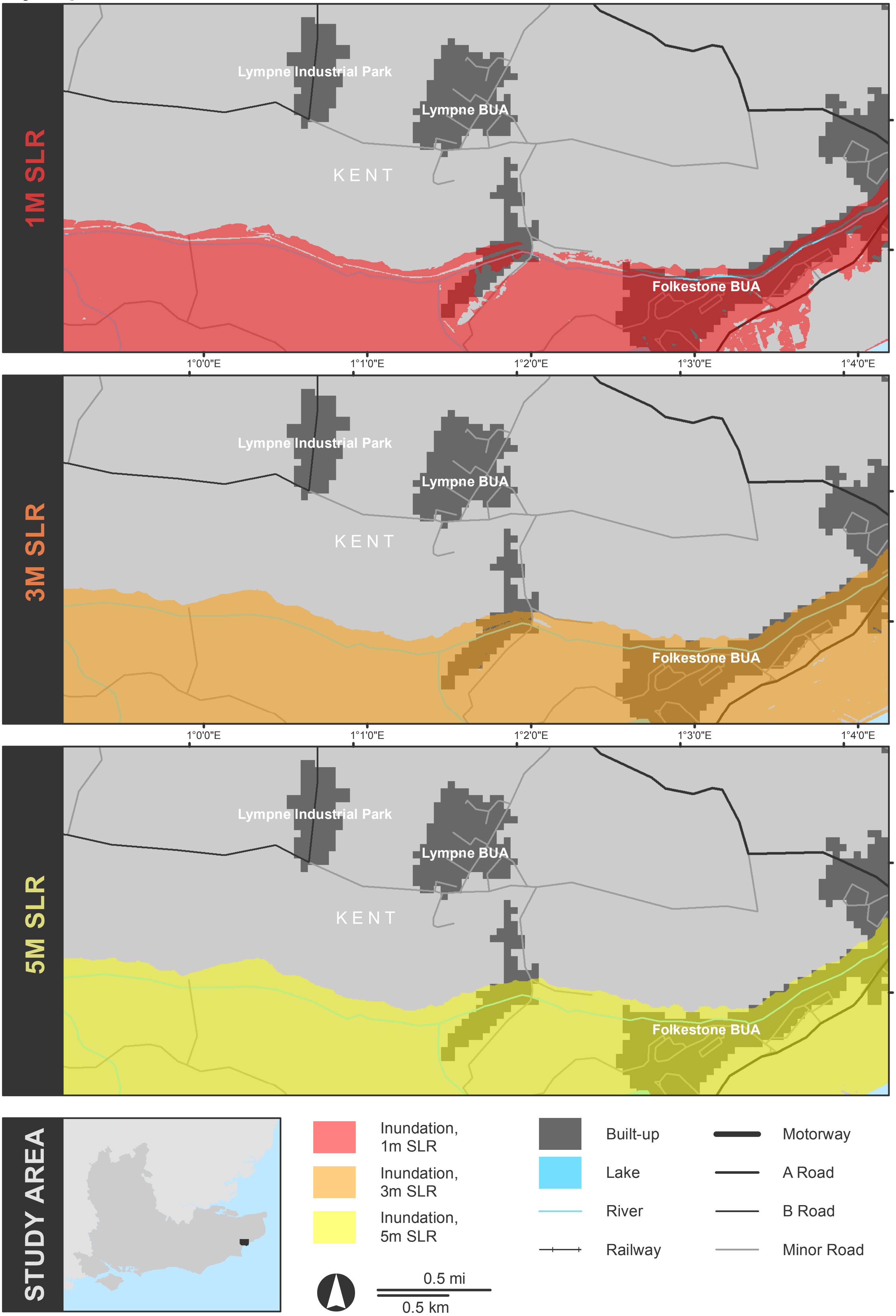


1M SLR
KENT
Lydd BUA
Lydd Airport
EAST SUSSEX
3M SLR
5M SLR
0°52'0"E
0°53'0"E
0°54'0"E
0°55'0"E
0°56'0"E
50°57'30"N
50°57'0"N
50°56'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

Lymington BUA

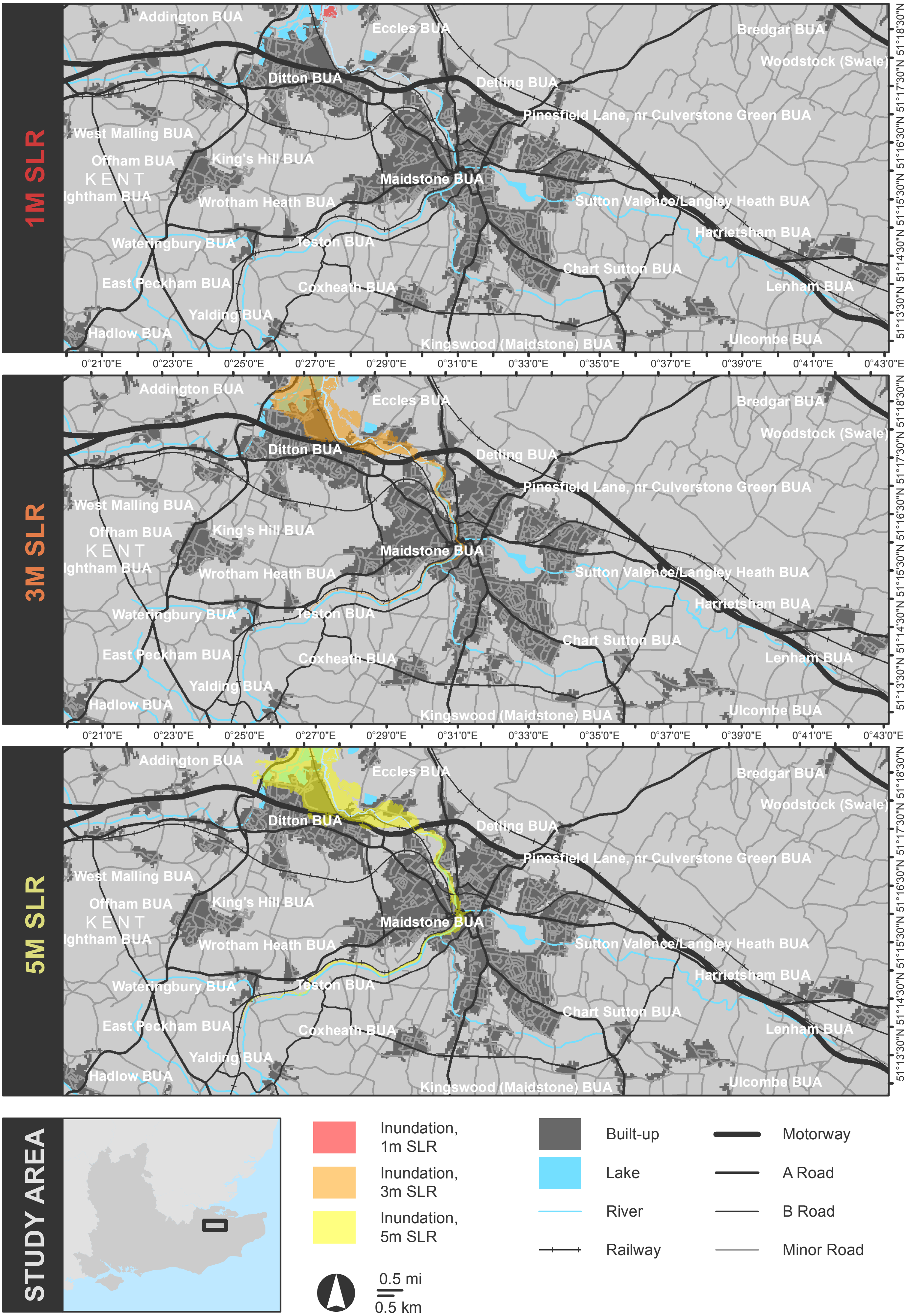


Lympne BUA

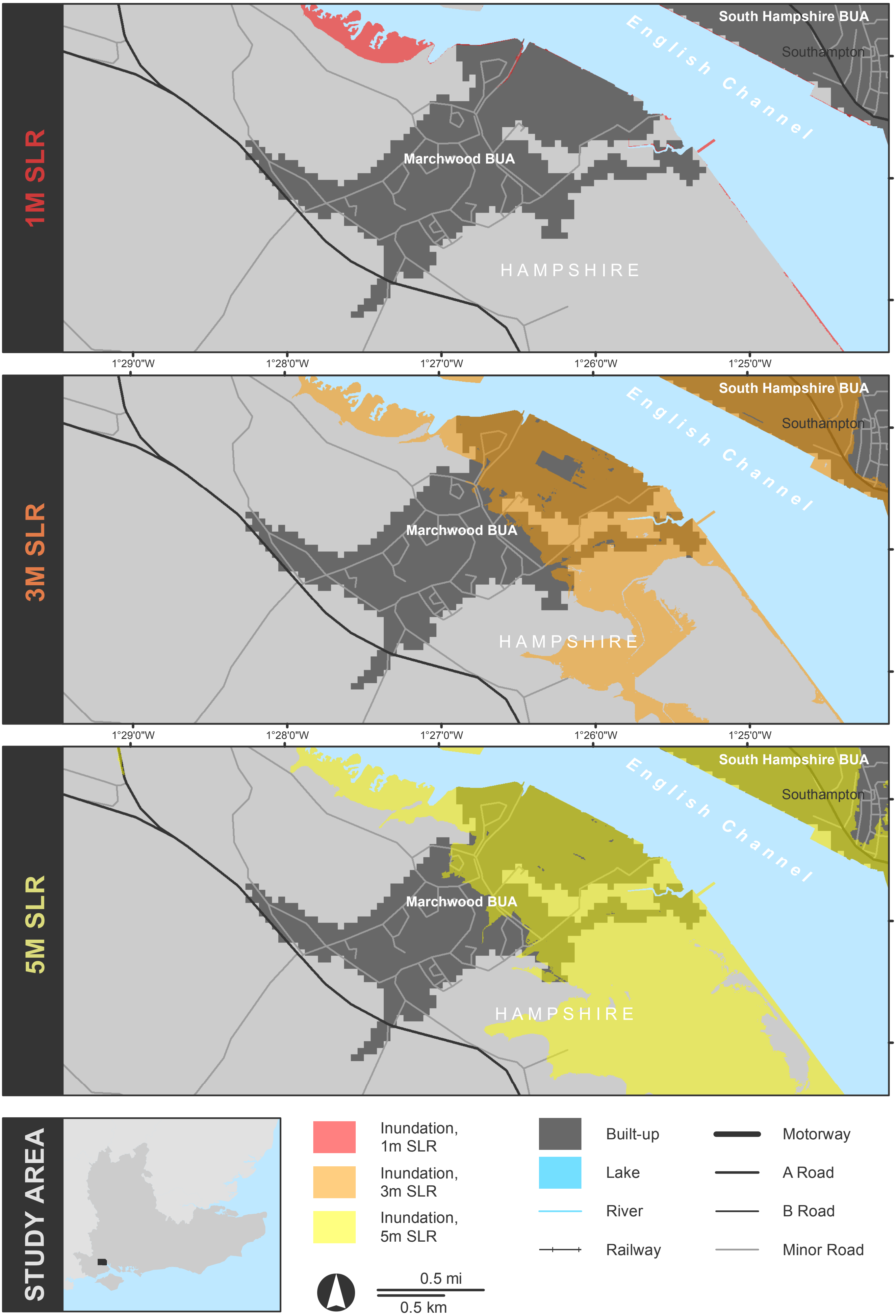


1M SLR
Lympne Industrial Park
Lympne BUA
KENT
Folkestone BUA
1°0'0"E
1°1'0"E
1°2'0"E
1°3'0"E
1°4'0"E
51°4'30"N
51°4'0"N
3M SLR
Lympne Industrial Park
Lympne BUA
KENT
Folkestone BUA
1°0'0"E
1°1'0"E
1°2'0"E
1°3'0"E
1°4'0"E
51°4'30"N
51°4'0"N
5M SLR
Lympne Industrial Park
Lympne BUA
KENT
Folkestone BUA
51°4'30"N
51°4'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

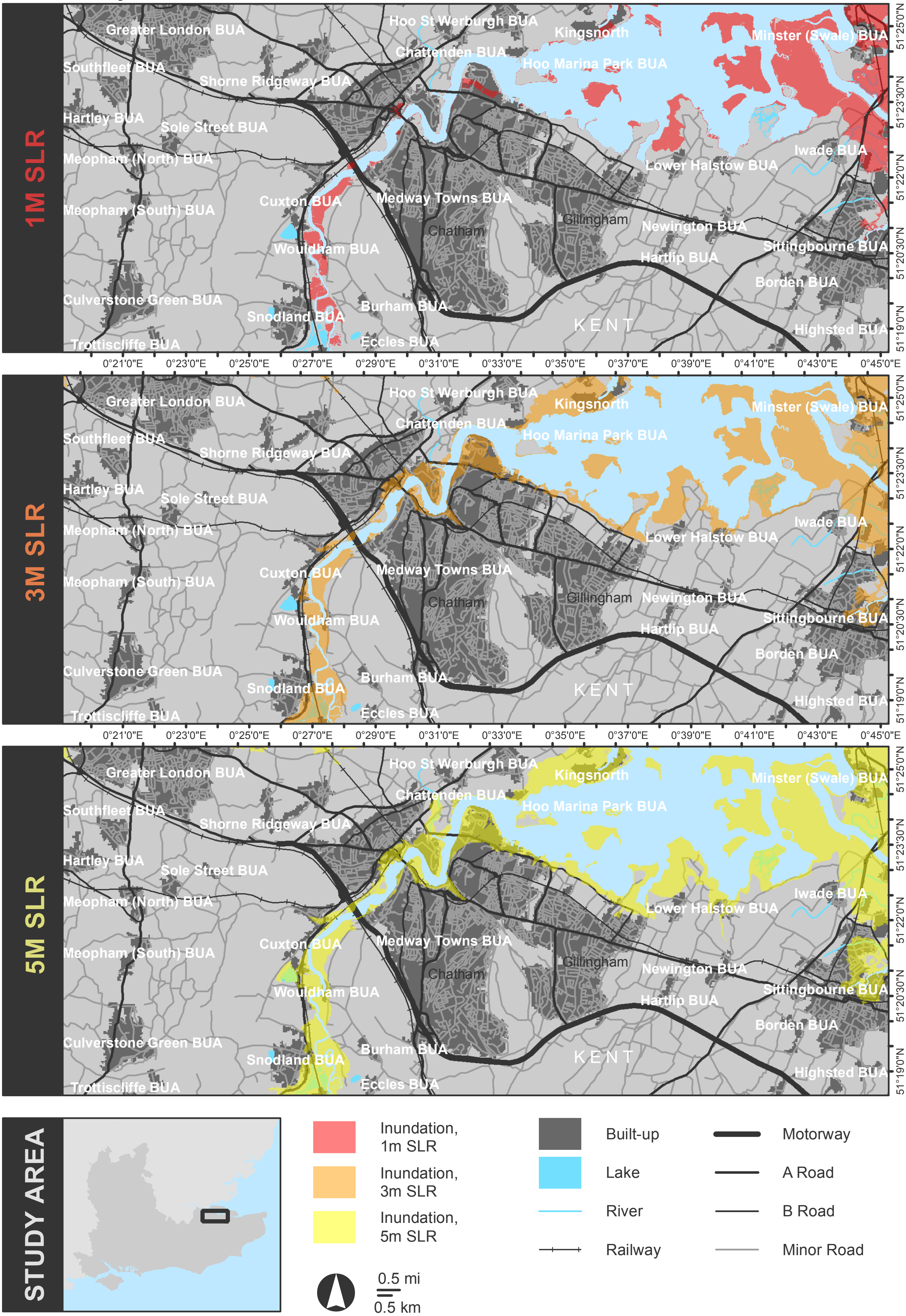
Maidstone BUA



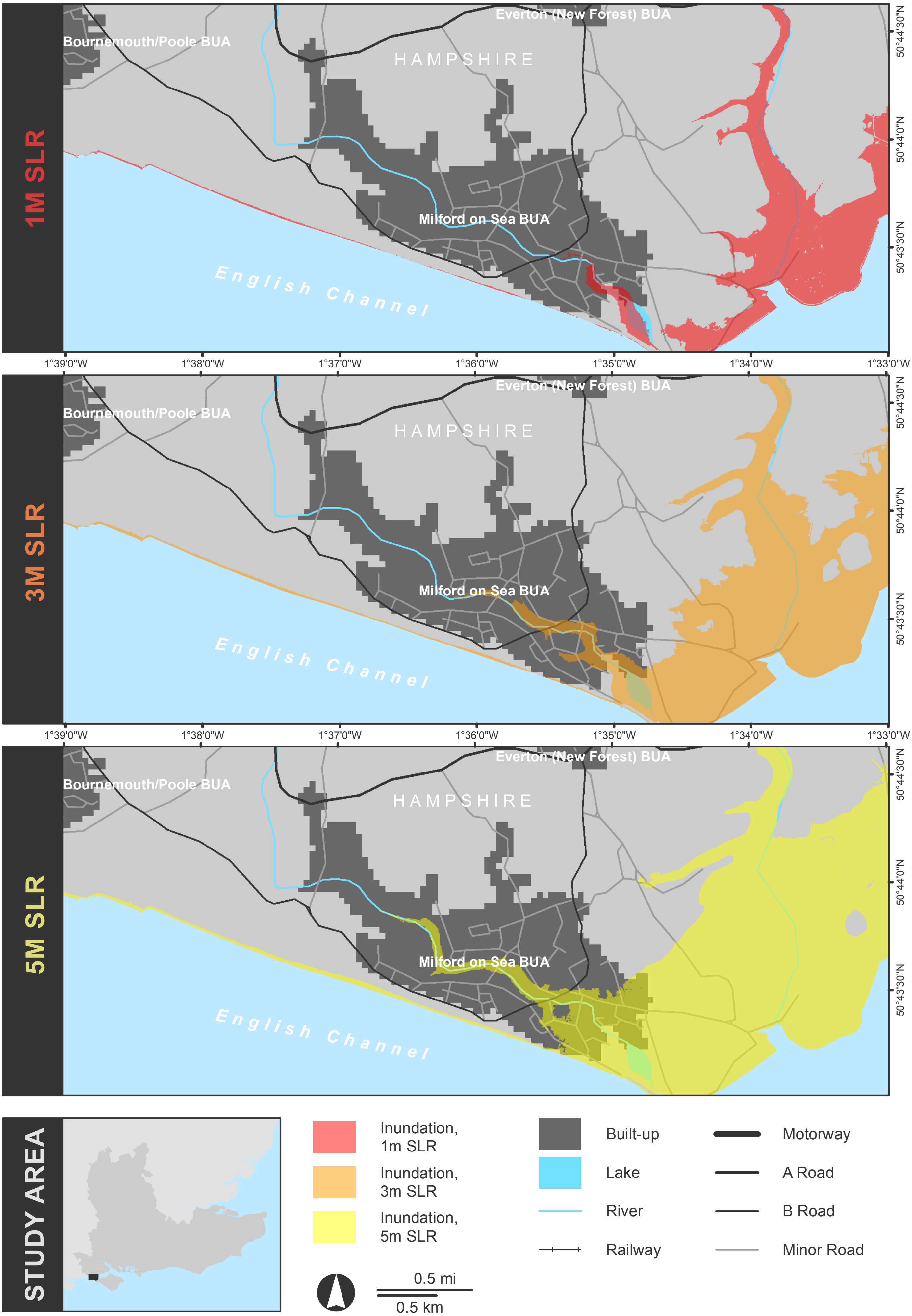
Marchwood BUA



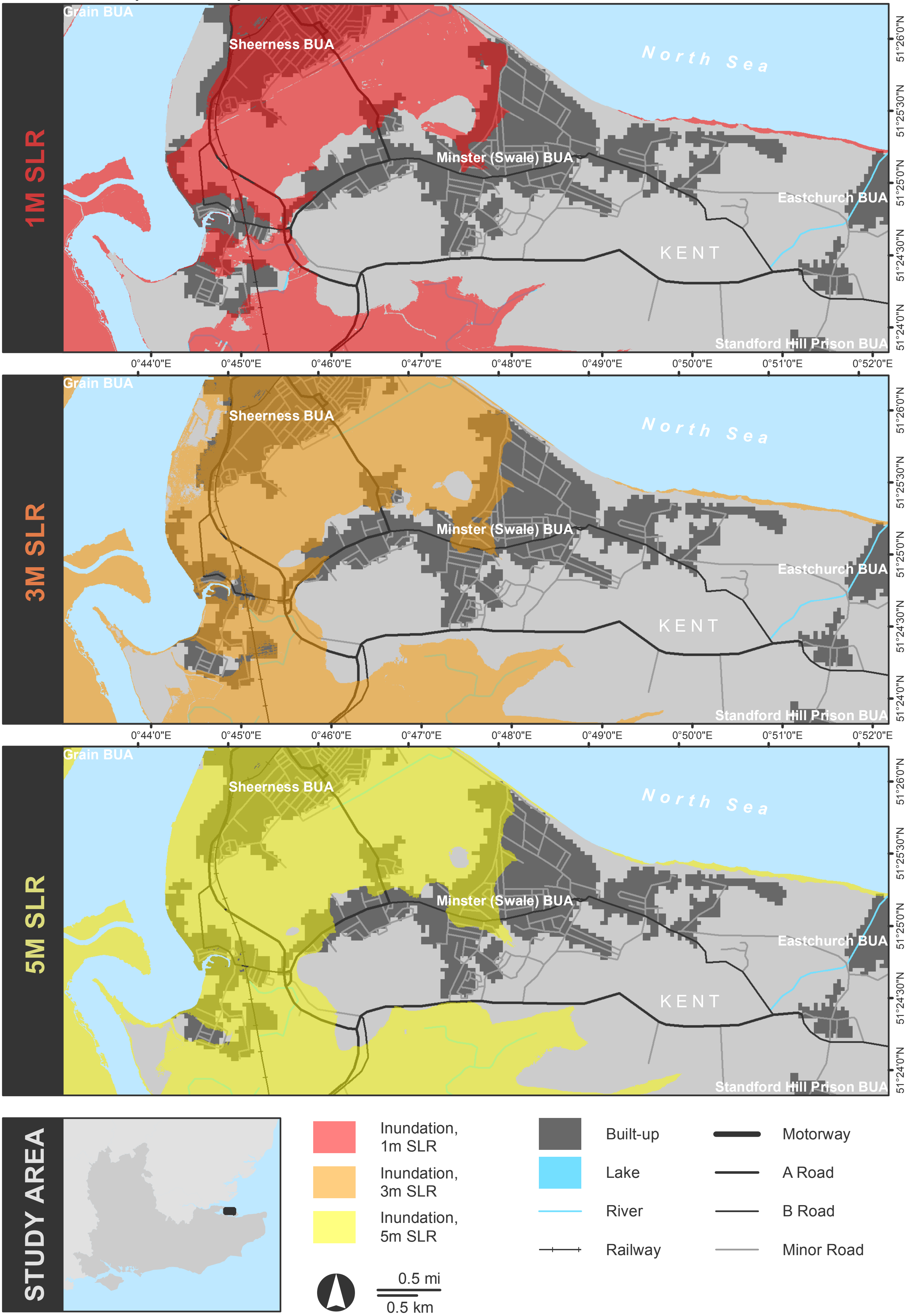
Medway Towns BUA



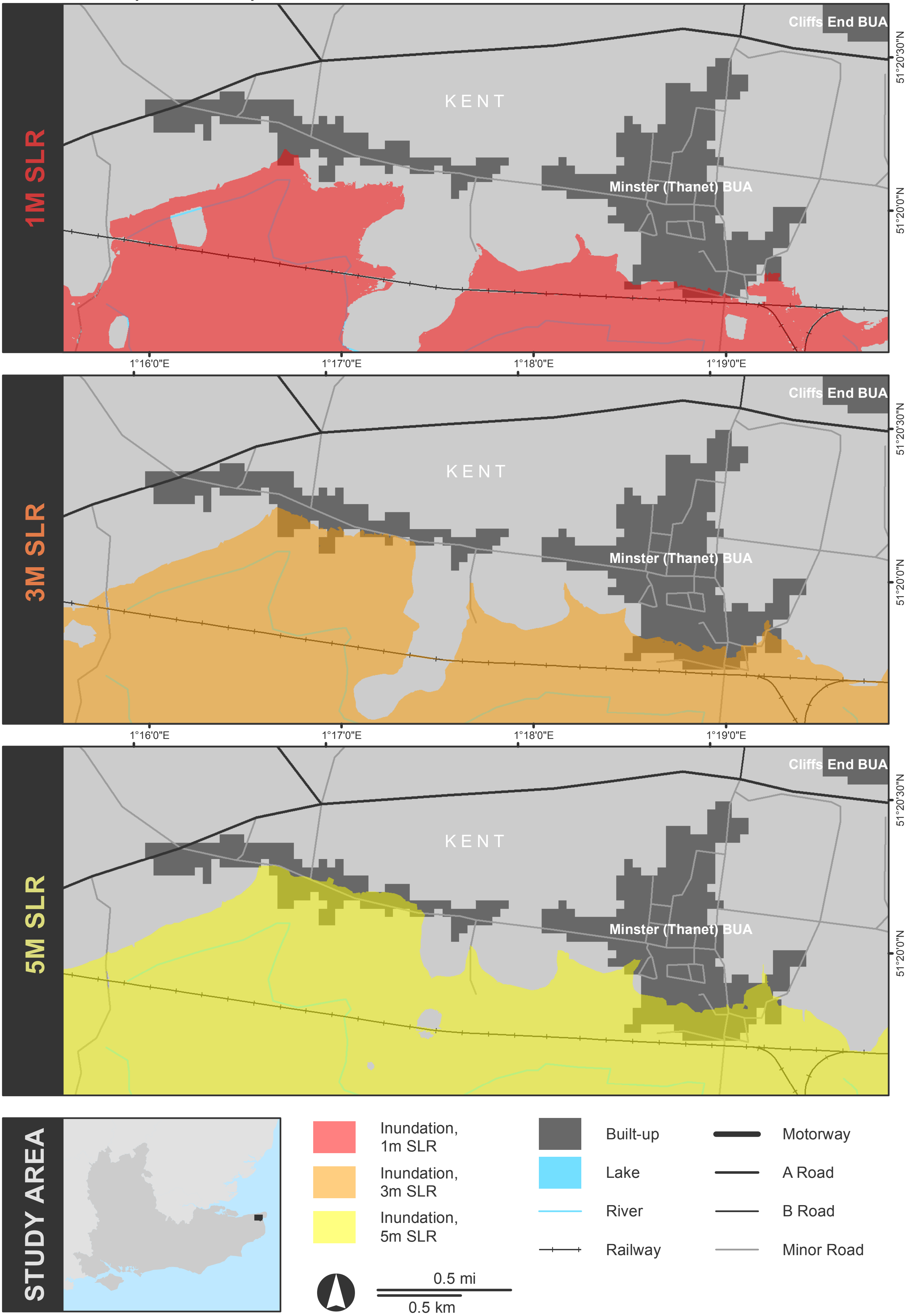
Milford on Sea BUA



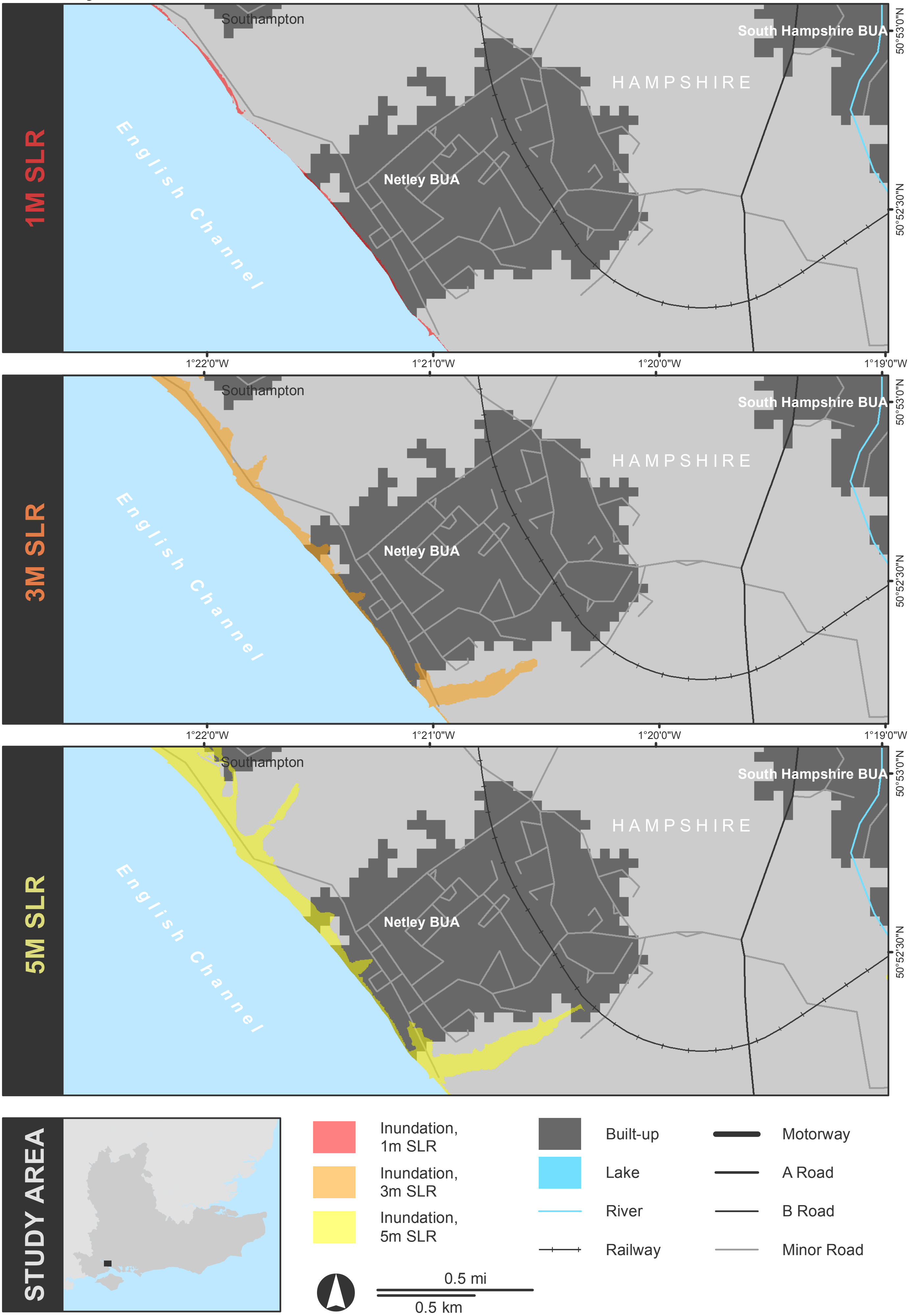
Minster (Swale) BUA



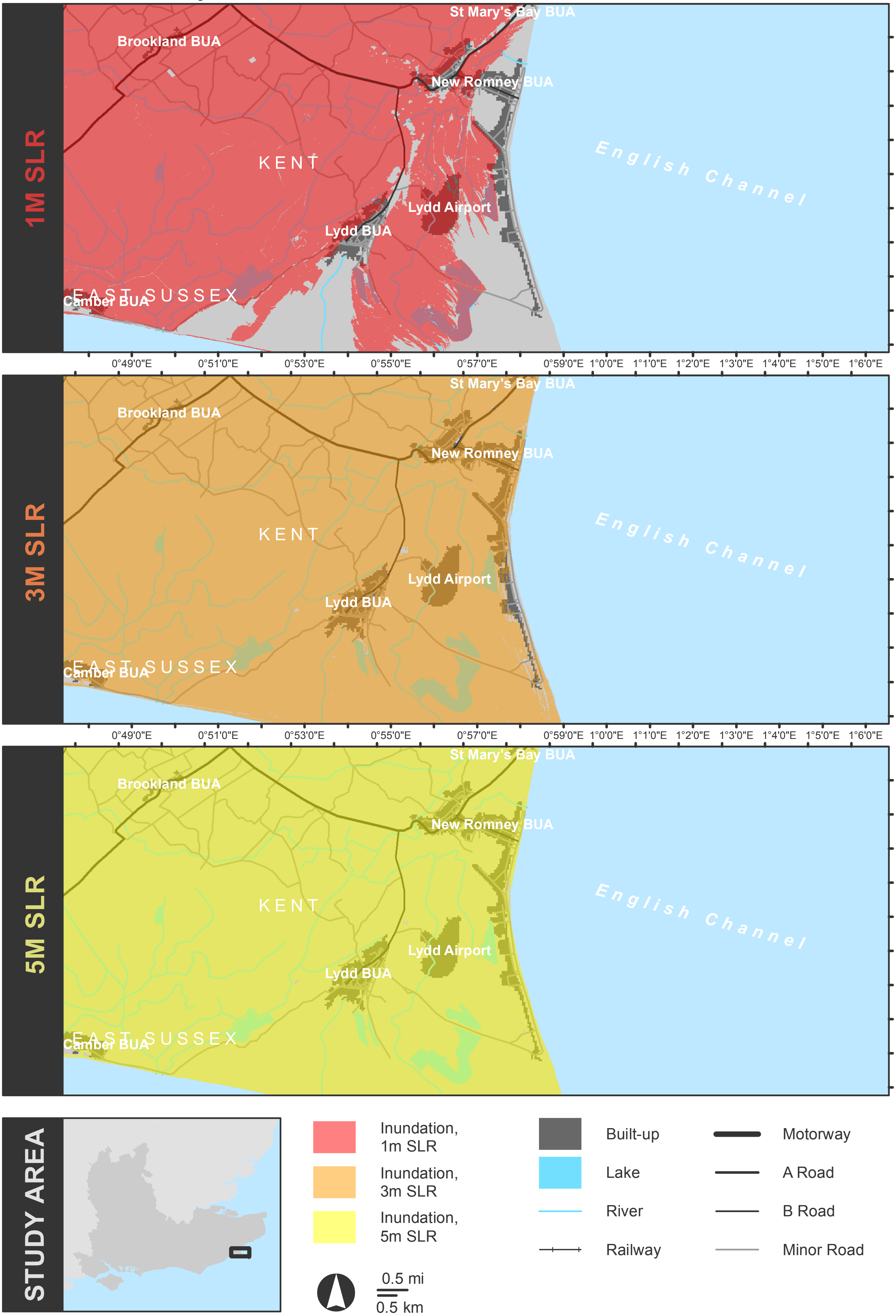
Minster (Thanet) BUA



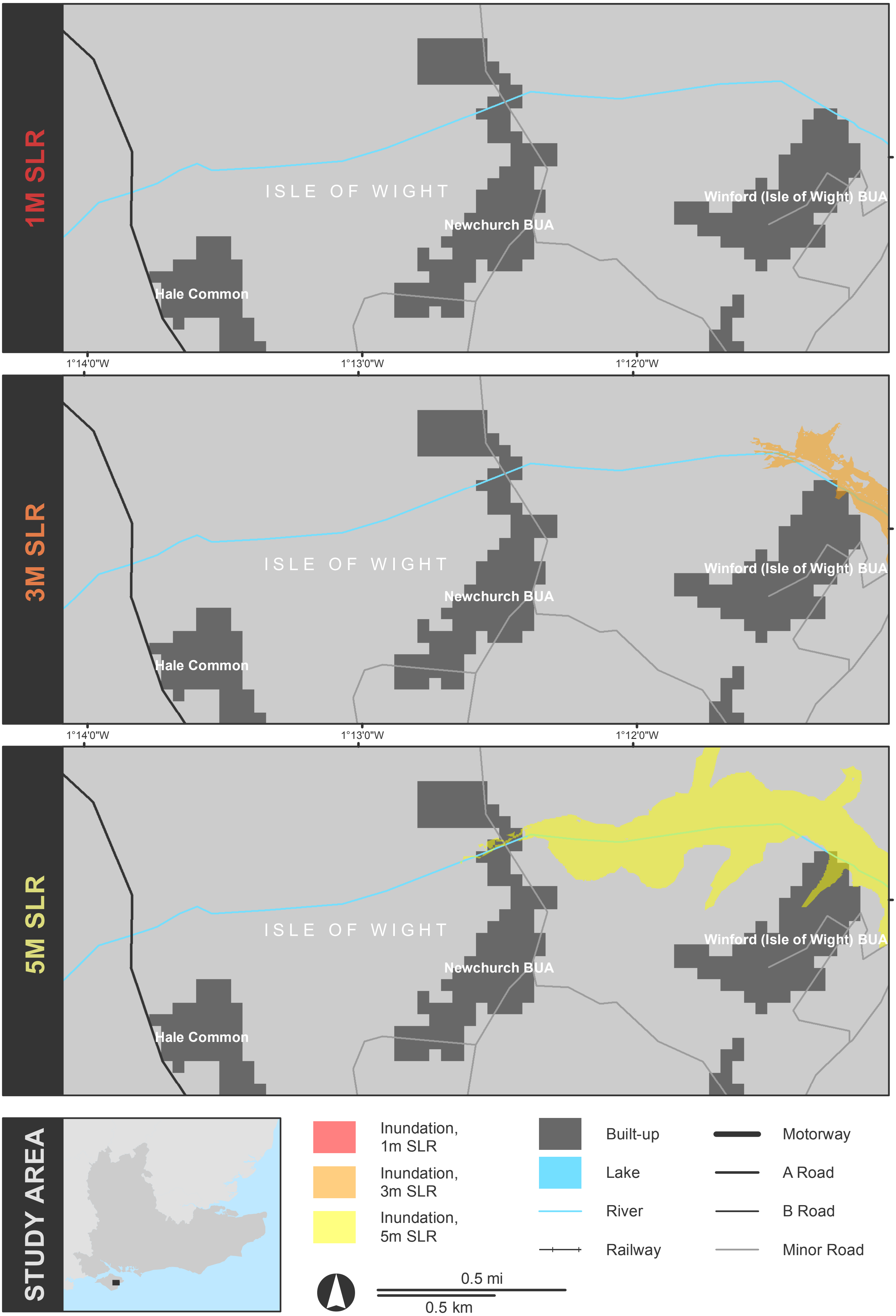
Netley BUA


1M SLR
3M SLR
5M SLR
Southampton
South Hampshire BUA
HAMPSHIRE
Netley BUA
English Channel
1°22'0"W
1°21'0"W
1°20'0"W
1°19'0"W
50°53'0"N
50°52'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

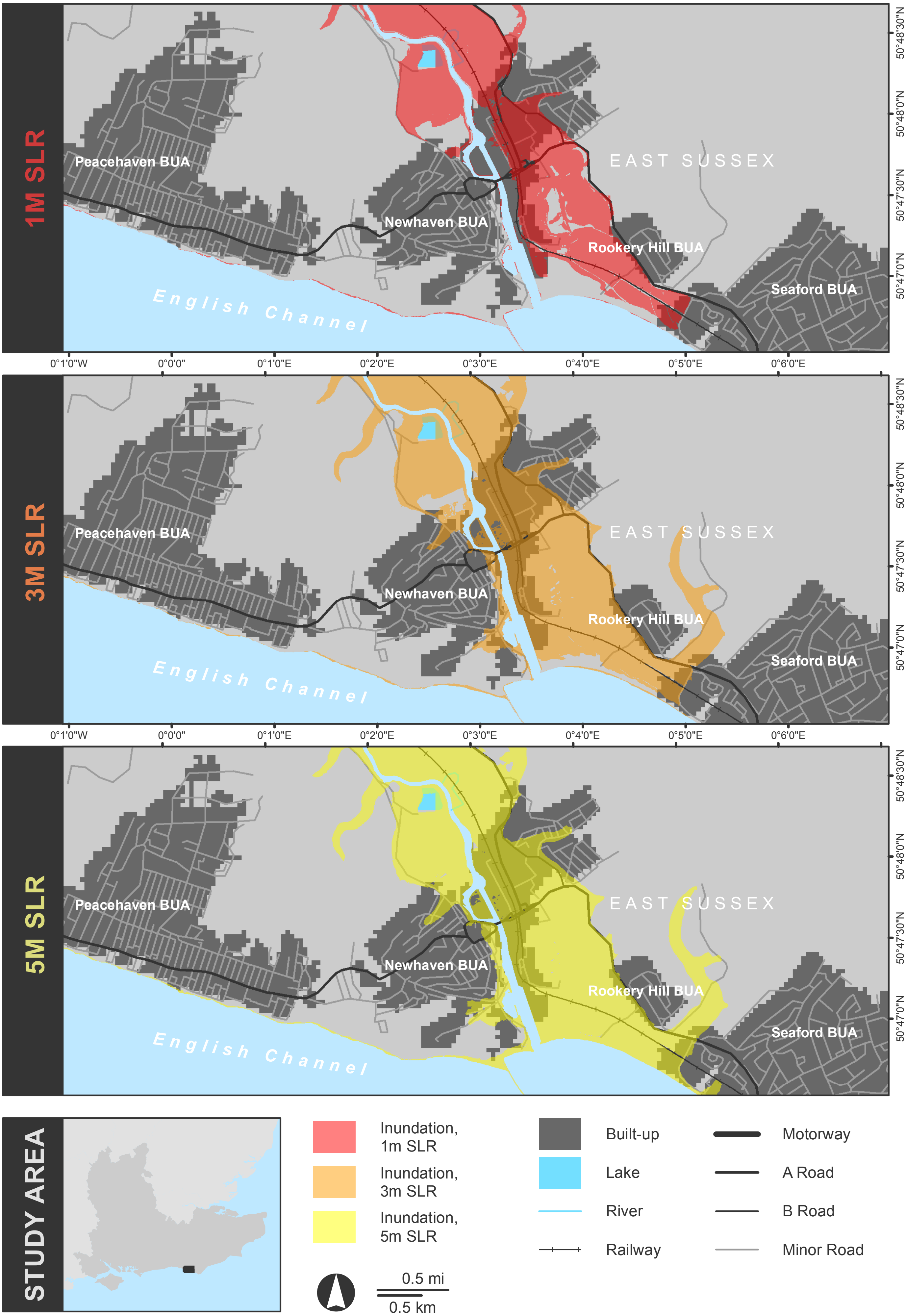
New Romney BUA



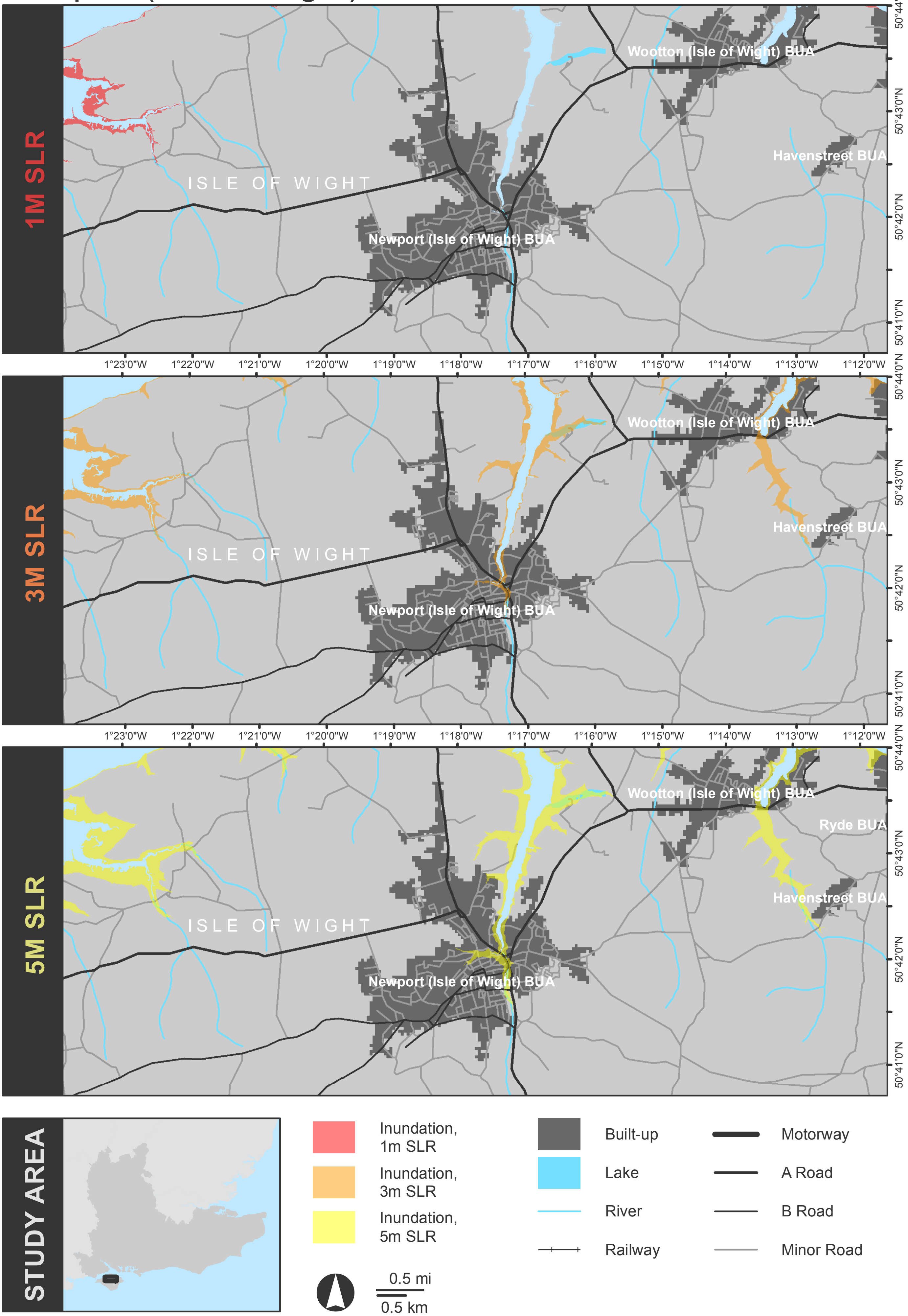
Newchurch BUA



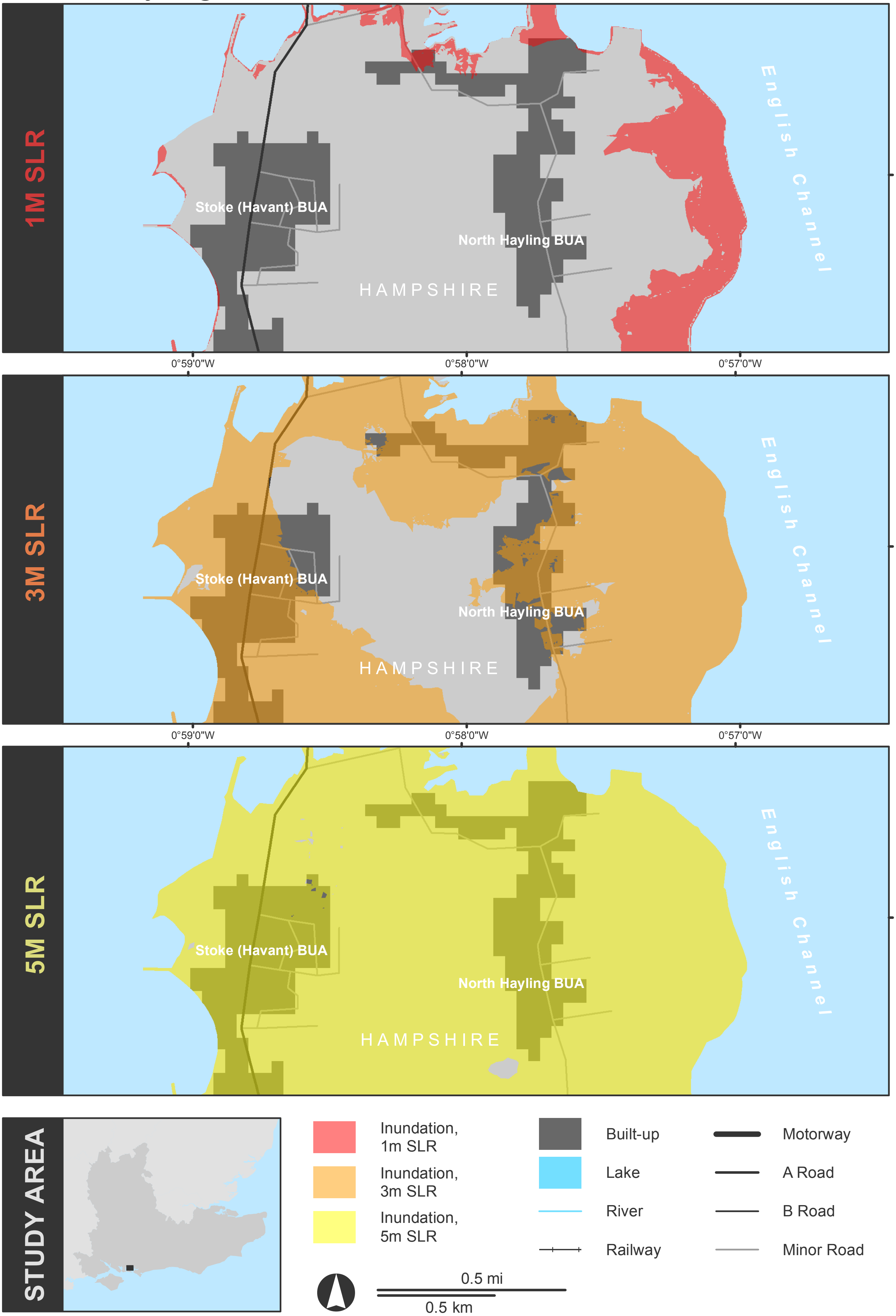
Newhaven BUA



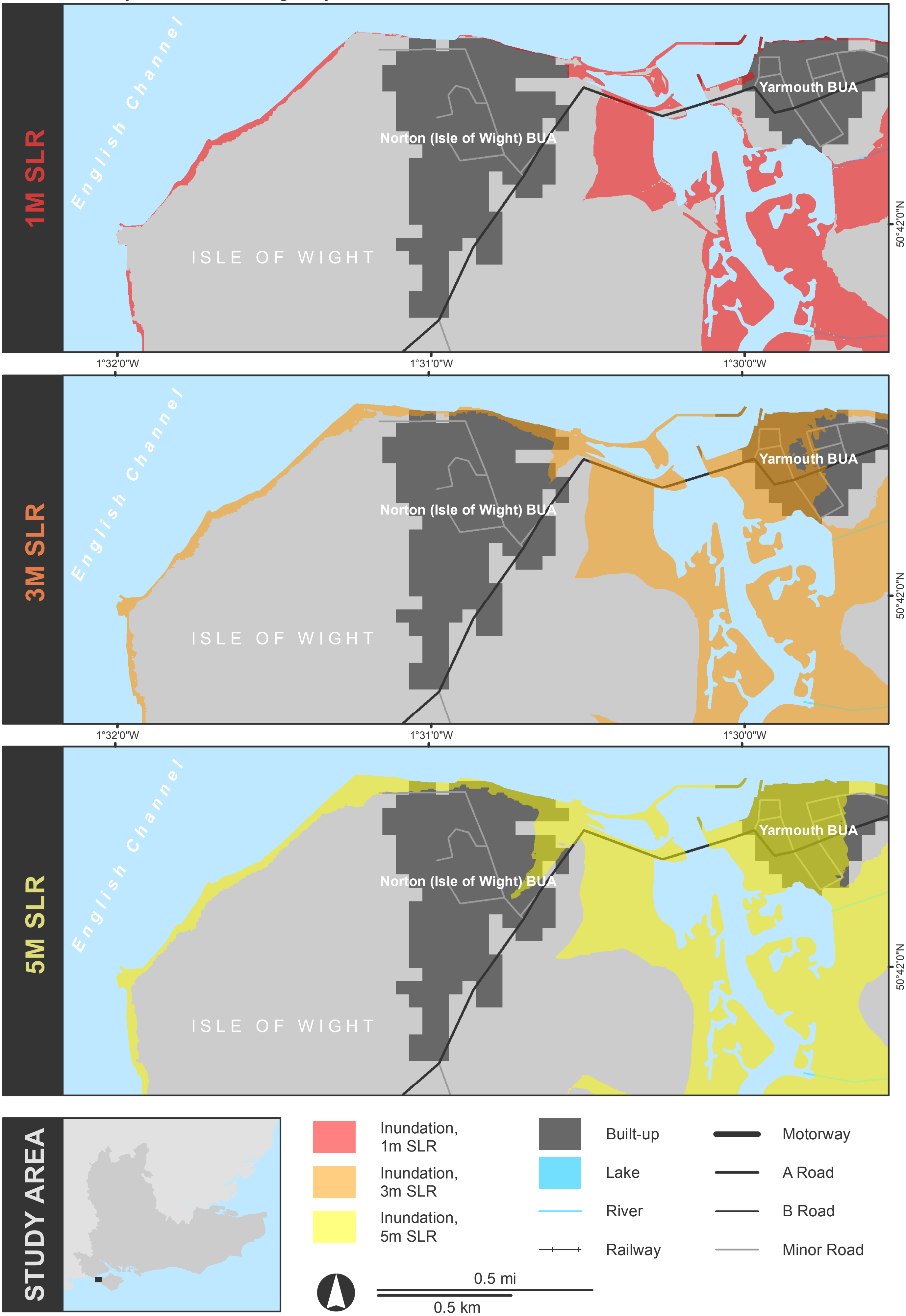
Newport (Isle of Wight) BUA



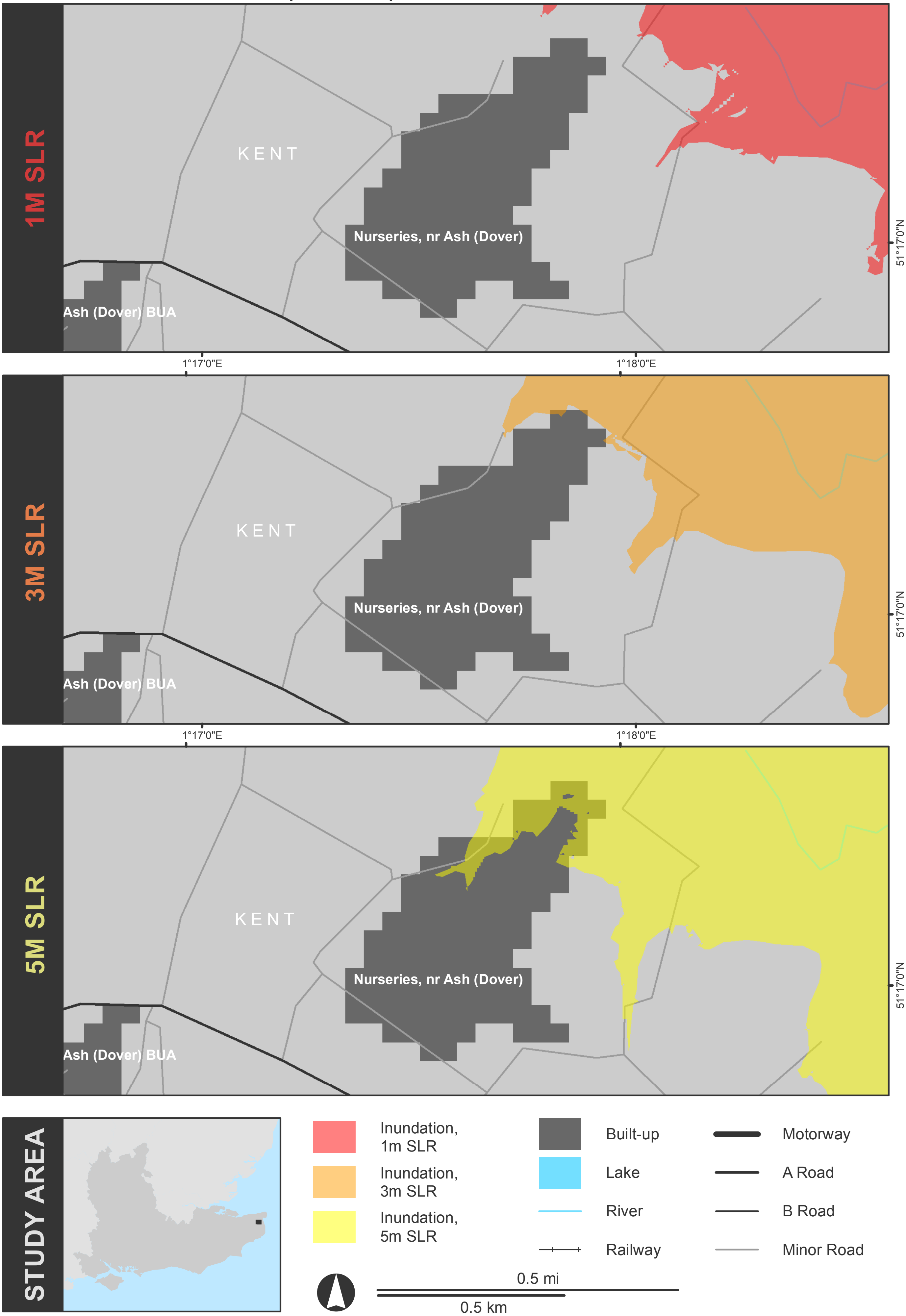
North Hayling BUA



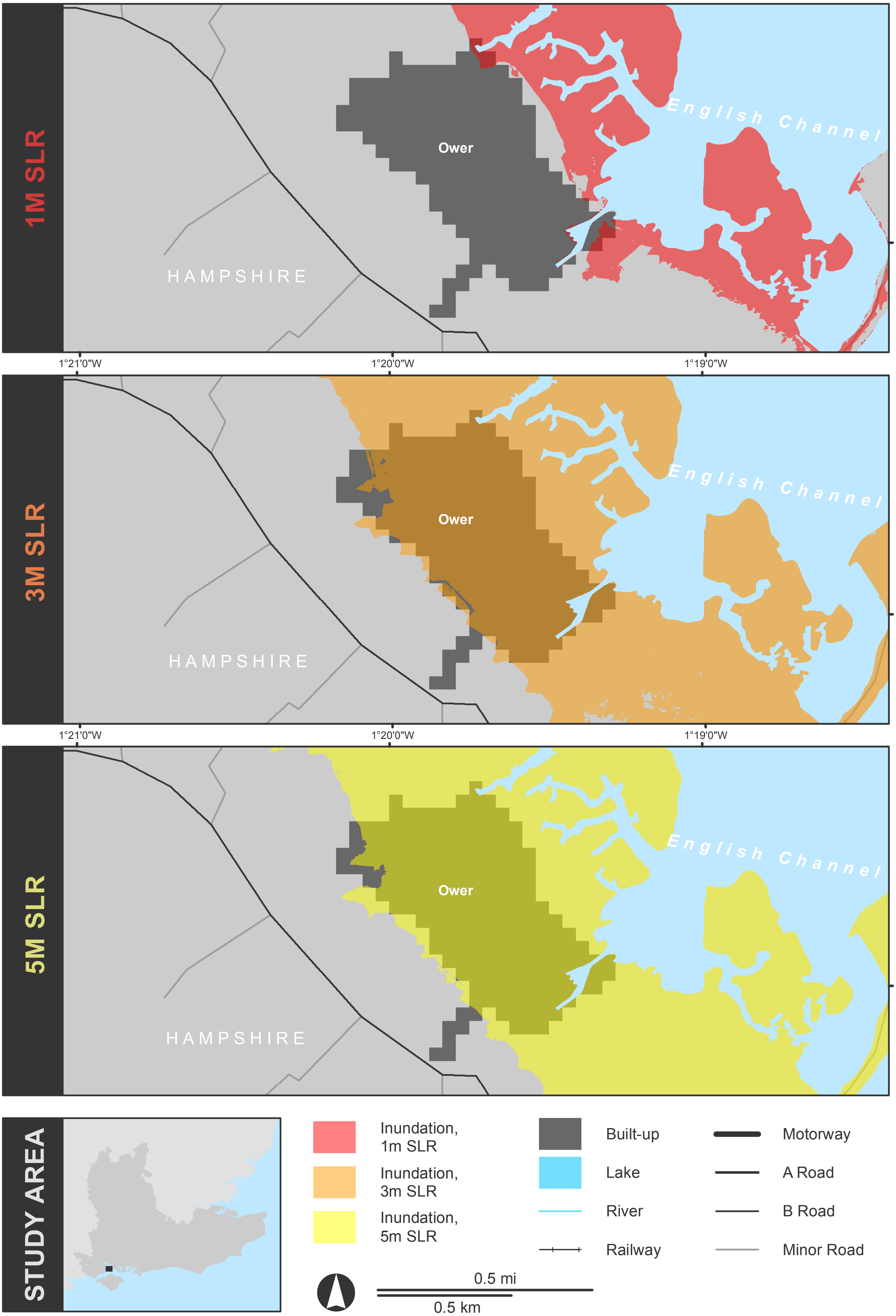
Norton (Isle of Wight) BUA



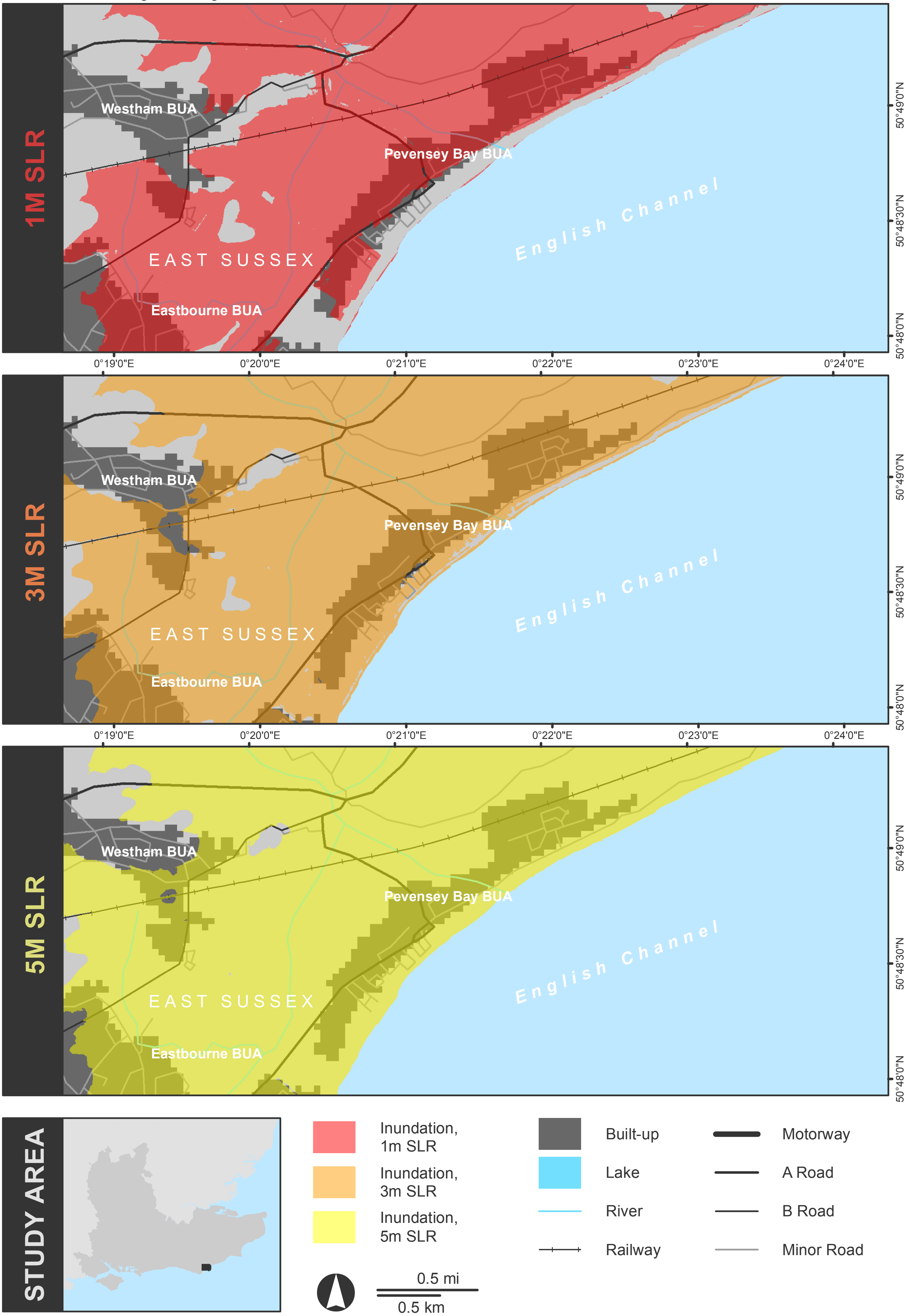
Nurseries, nr Ash (Dover)



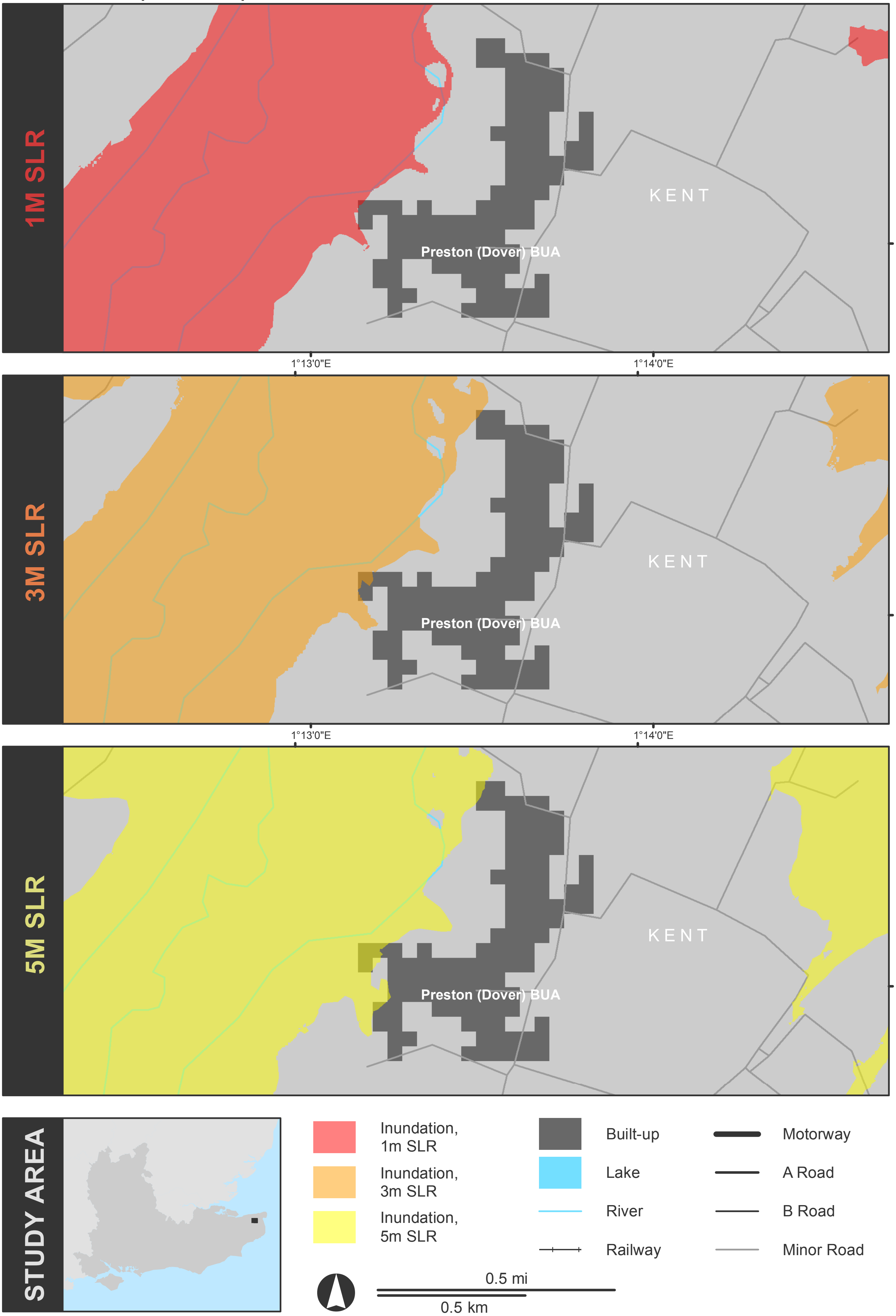
Ower


1M SLR
Ower
English Channel
HAMPSHIRE
50°49'0"N
1°21'0"W
1°20'0"W
1°19'0"W
3M SLR
Ower
English Channel
HAMPSHIRE
50°49'0"N
1°21'0"W
1°20'0"W
1°19'0"W
5M SLR
Ower
English Channel
HAMPSHIRE
50°49'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

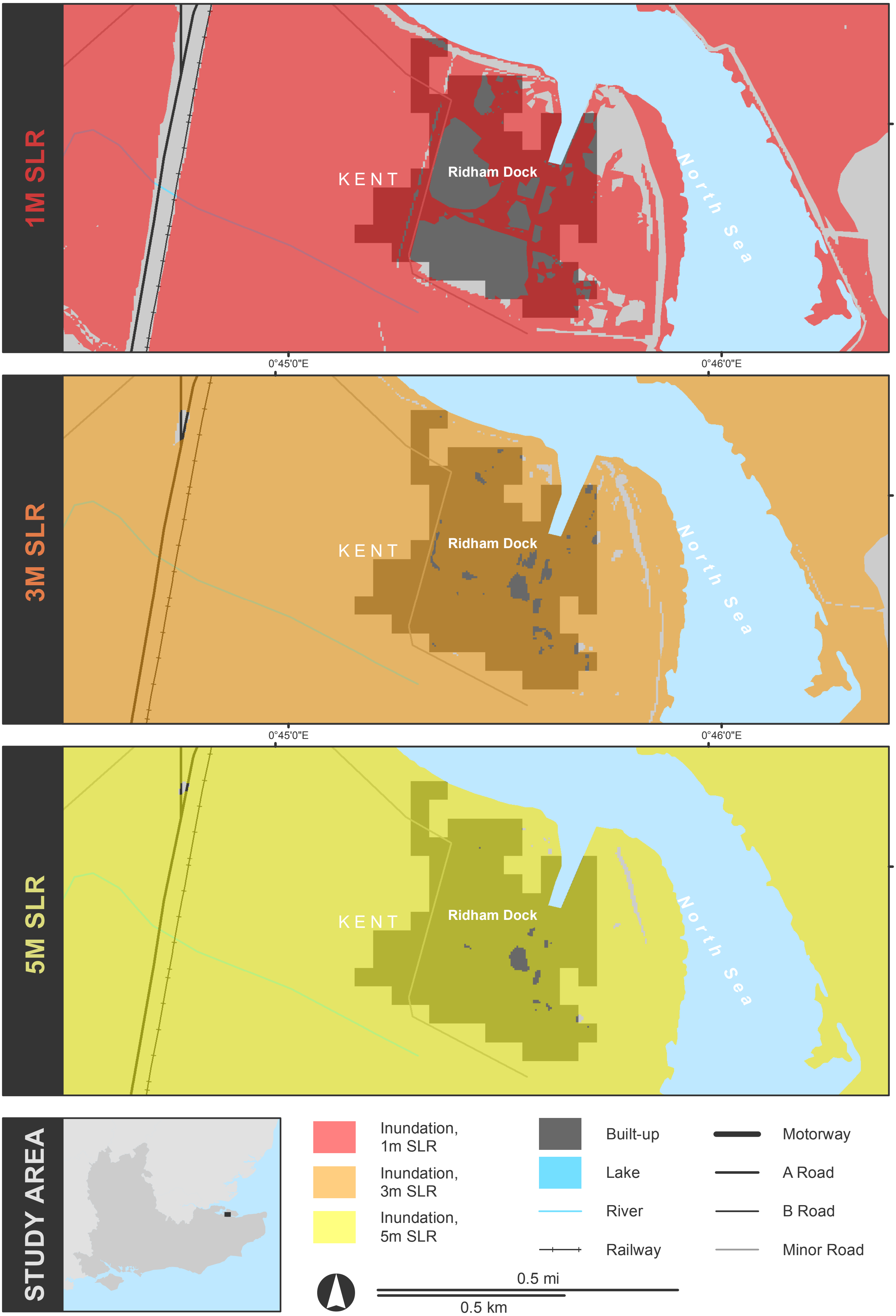
Pevensey Bay BUA



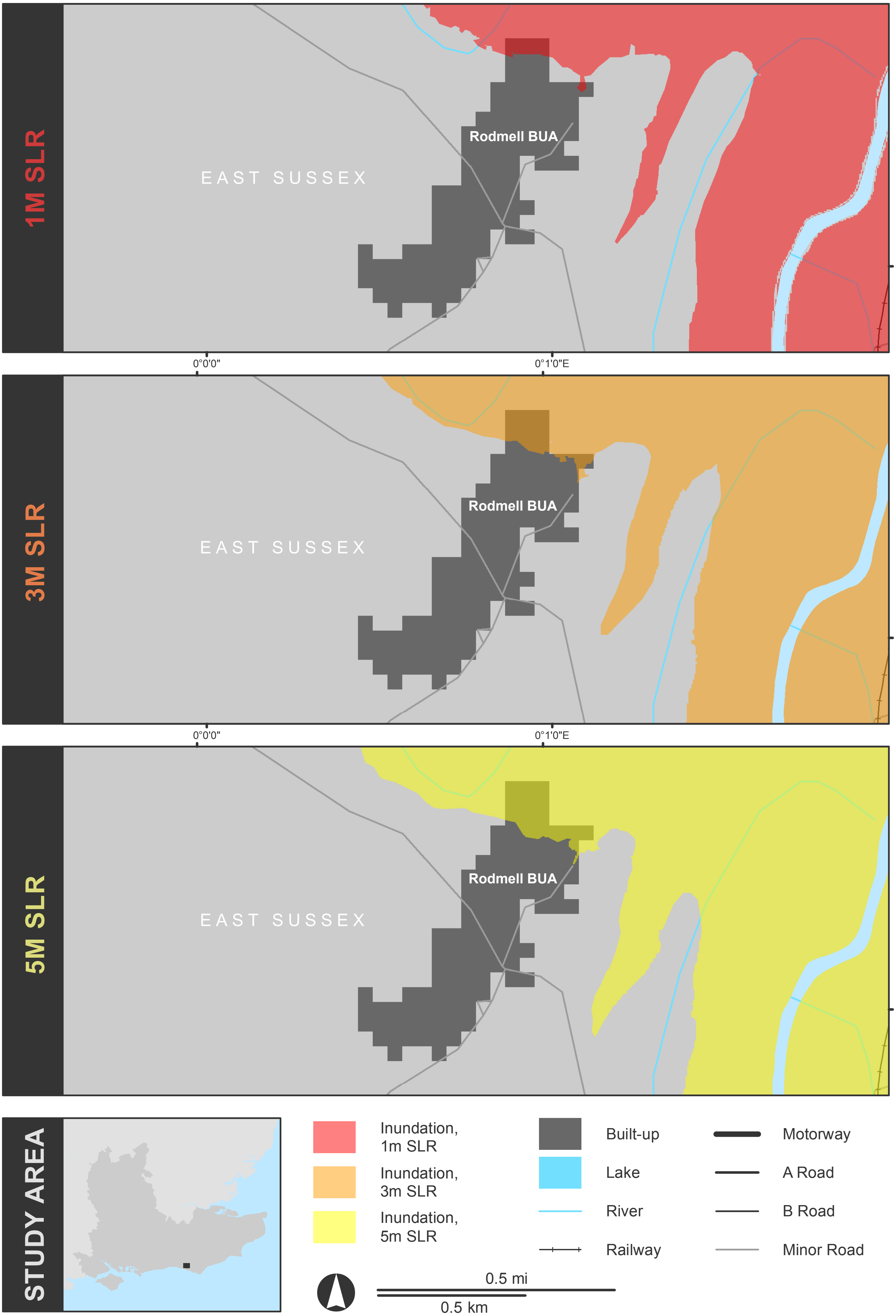
Preston (Dover) BUA



Ridham Dock

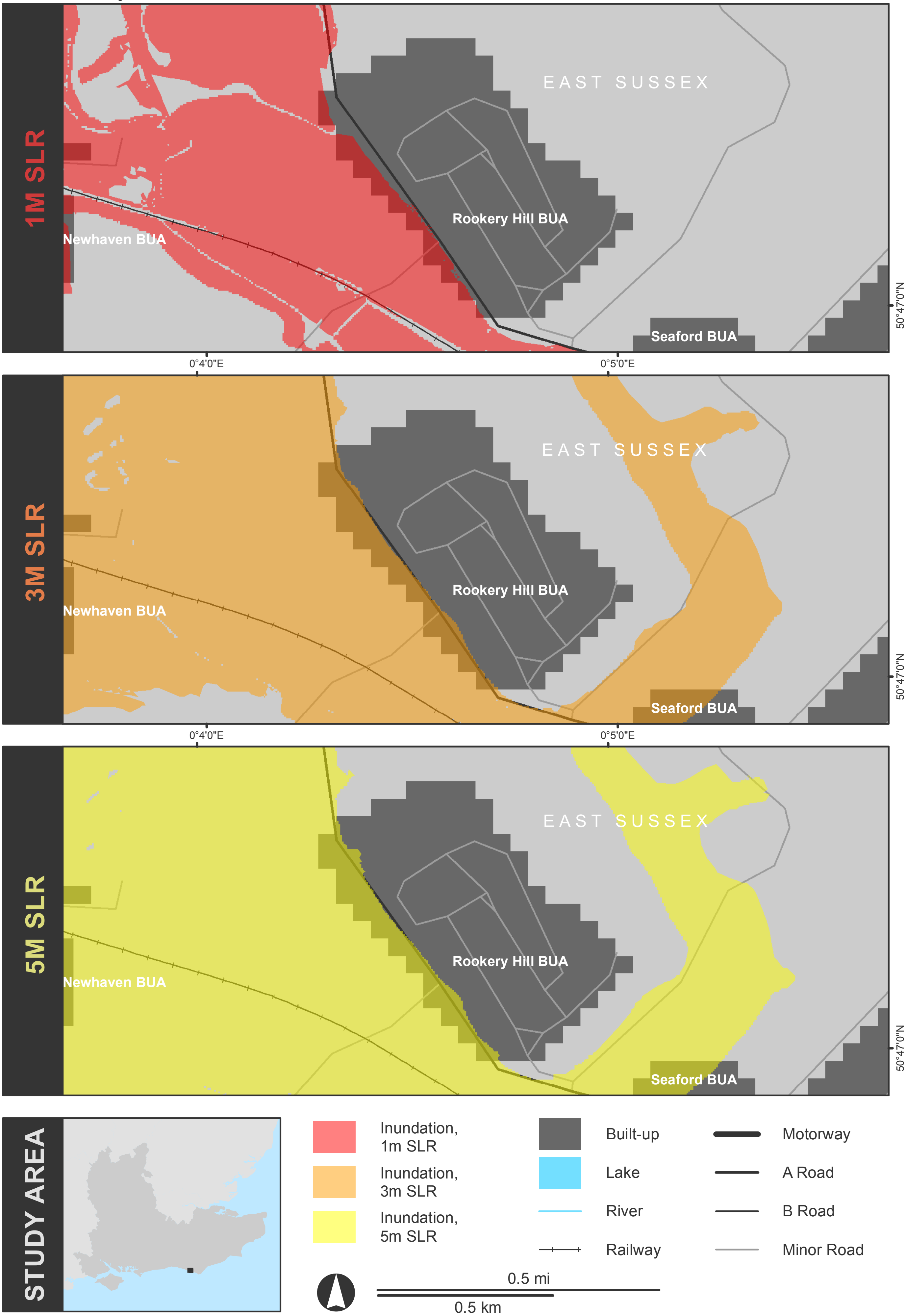

1M SLR
3M SLR
5M SLR
KENT
Ridham Dock
North Sea
0°45'0"E
0°46'0"E
51°23'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

Rodmell BUA

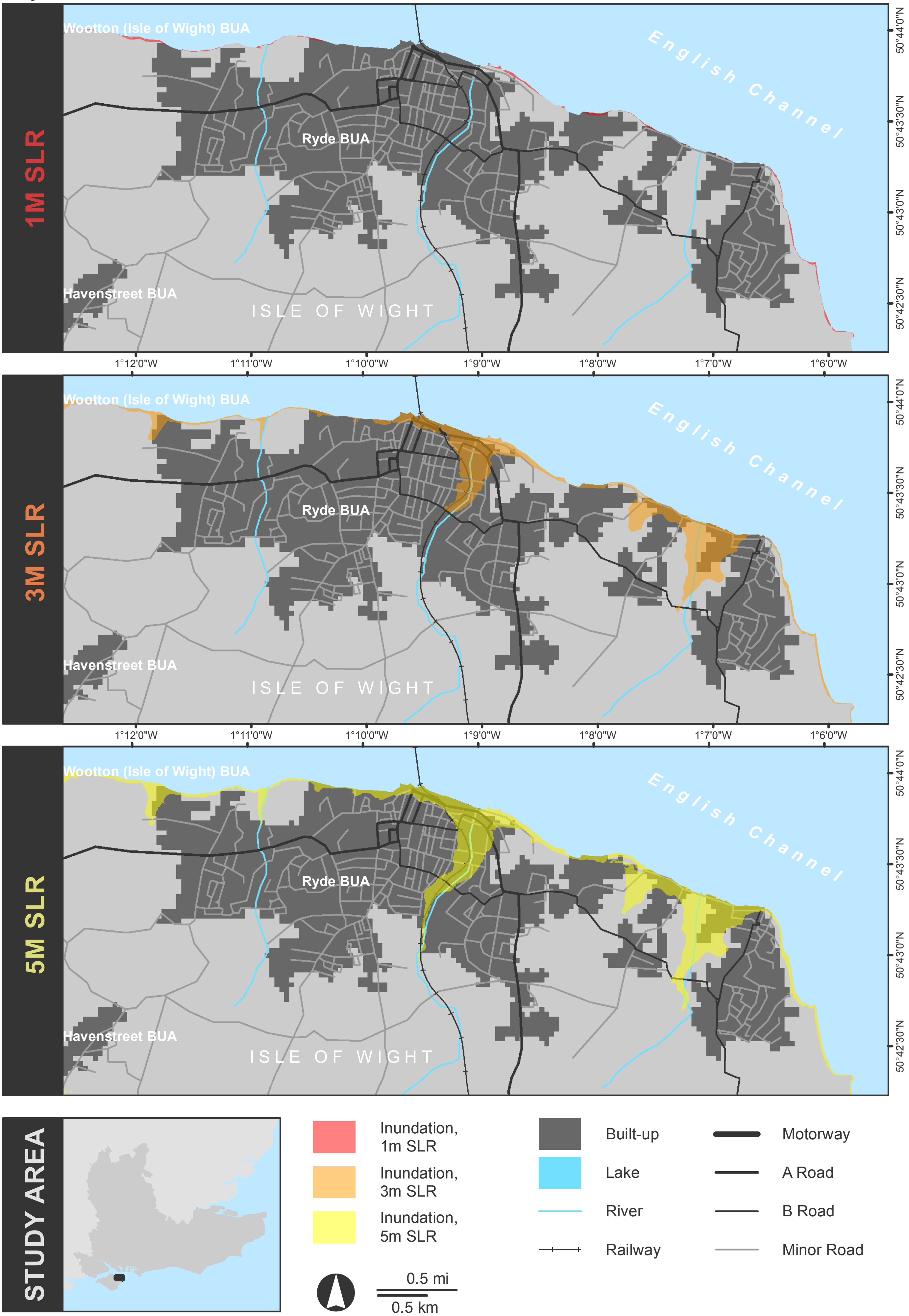


1M SLR
Rodmell BUA
EAST SUSSEX
50°50'0"N
0°0'0"
0°1'0"E
3M SLR
Rodmell BUA
EAST SUSSEX
50°50'0"N
0°0'0"
0°1'0"E
5M SLR
Rodmell BUA
EAST SUSSEX
50°50'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

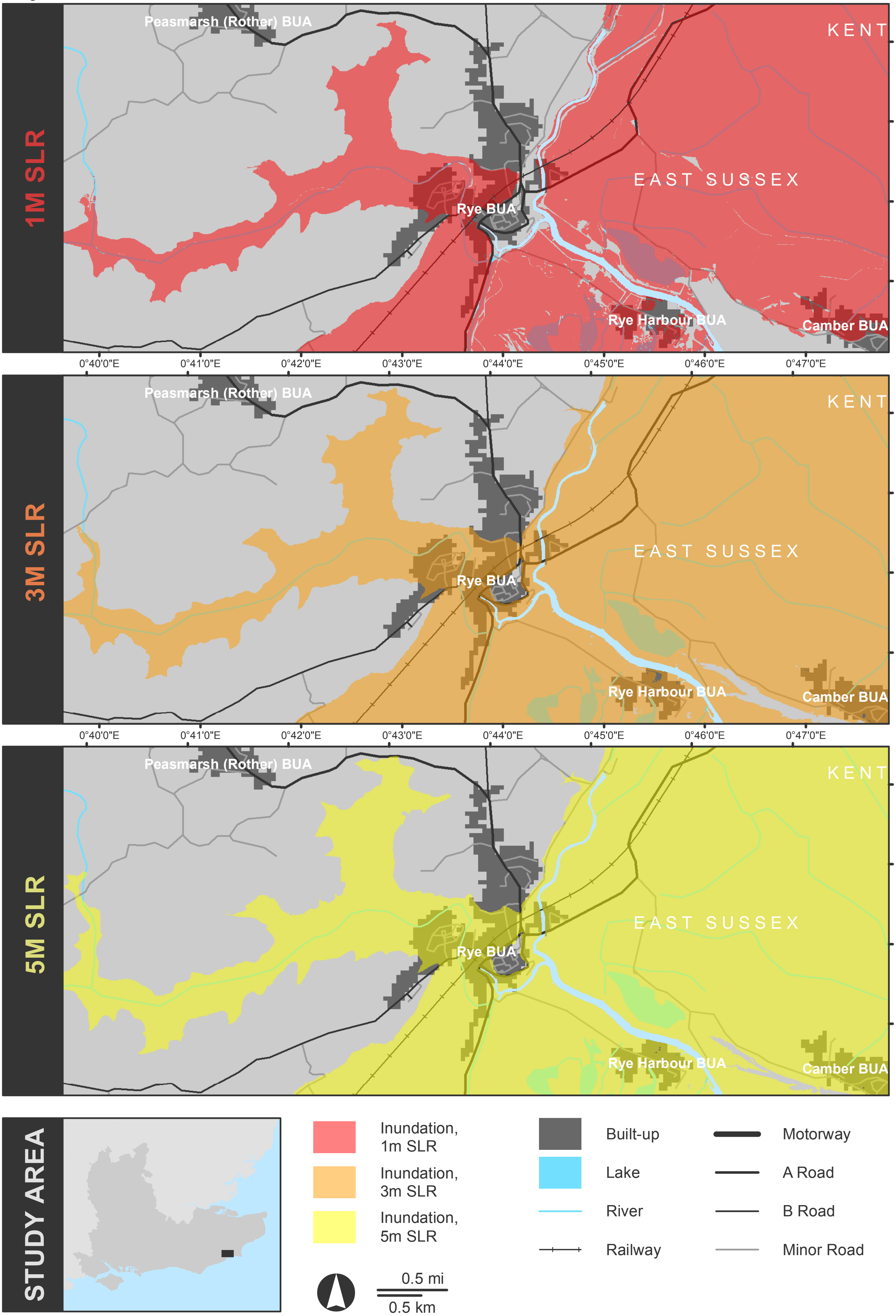
Rookery Hill BUA



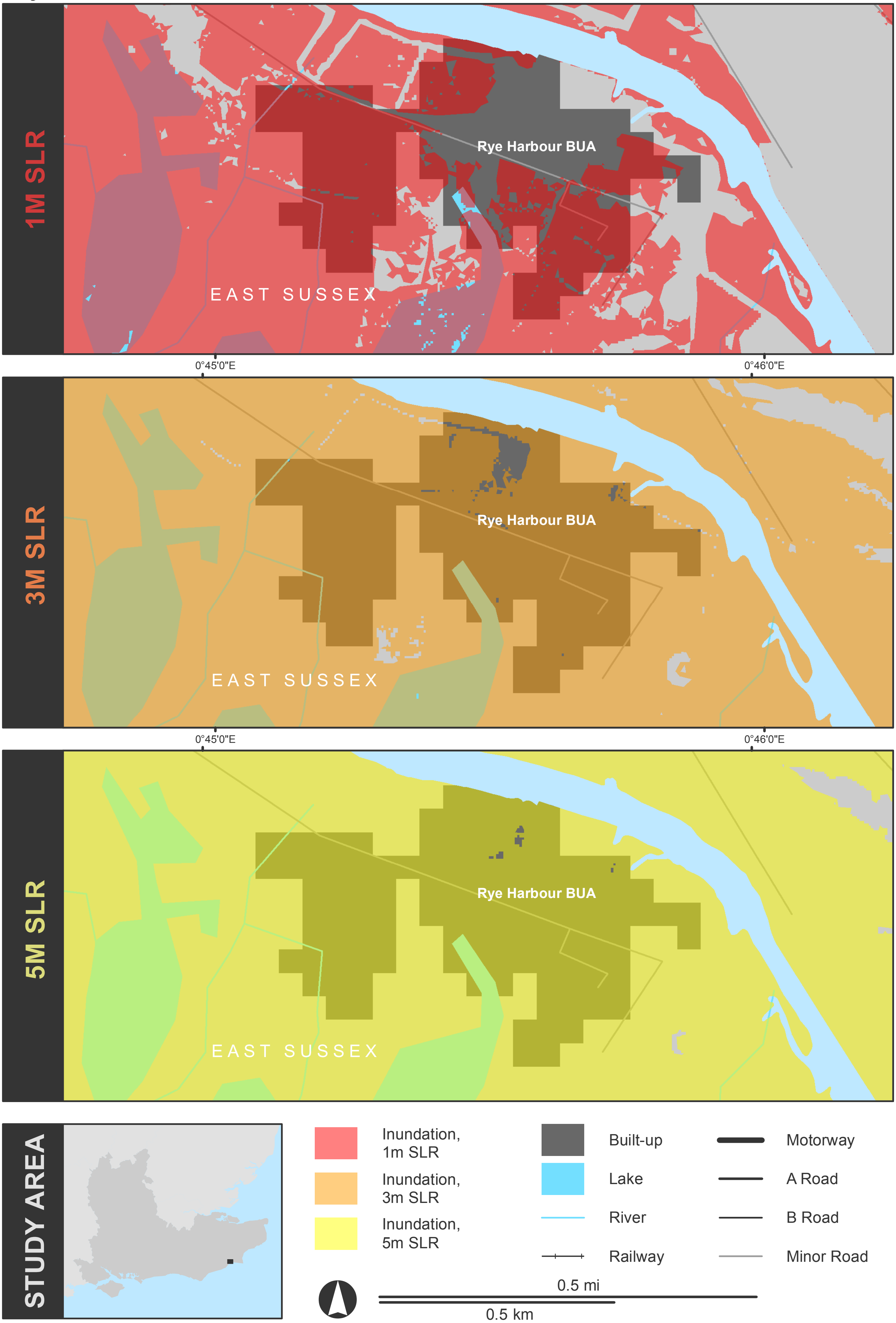
Ryde BUA


1M SLR
3M SLR
5M SLR
STUDY AREA
Wootton (Isle of Wight) BUA
Ryde BUA
Havenstreet BUA
ISLE OF WIGHT
English Channel
1°12'0"W
1°11'0"W
1°10'0"W
1°9'0"W
1°8'0"W
1°7'0"W
1°6'0"W
50°44'0"N
50°43'30"N
50°43'0"N
50°42'30"N
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

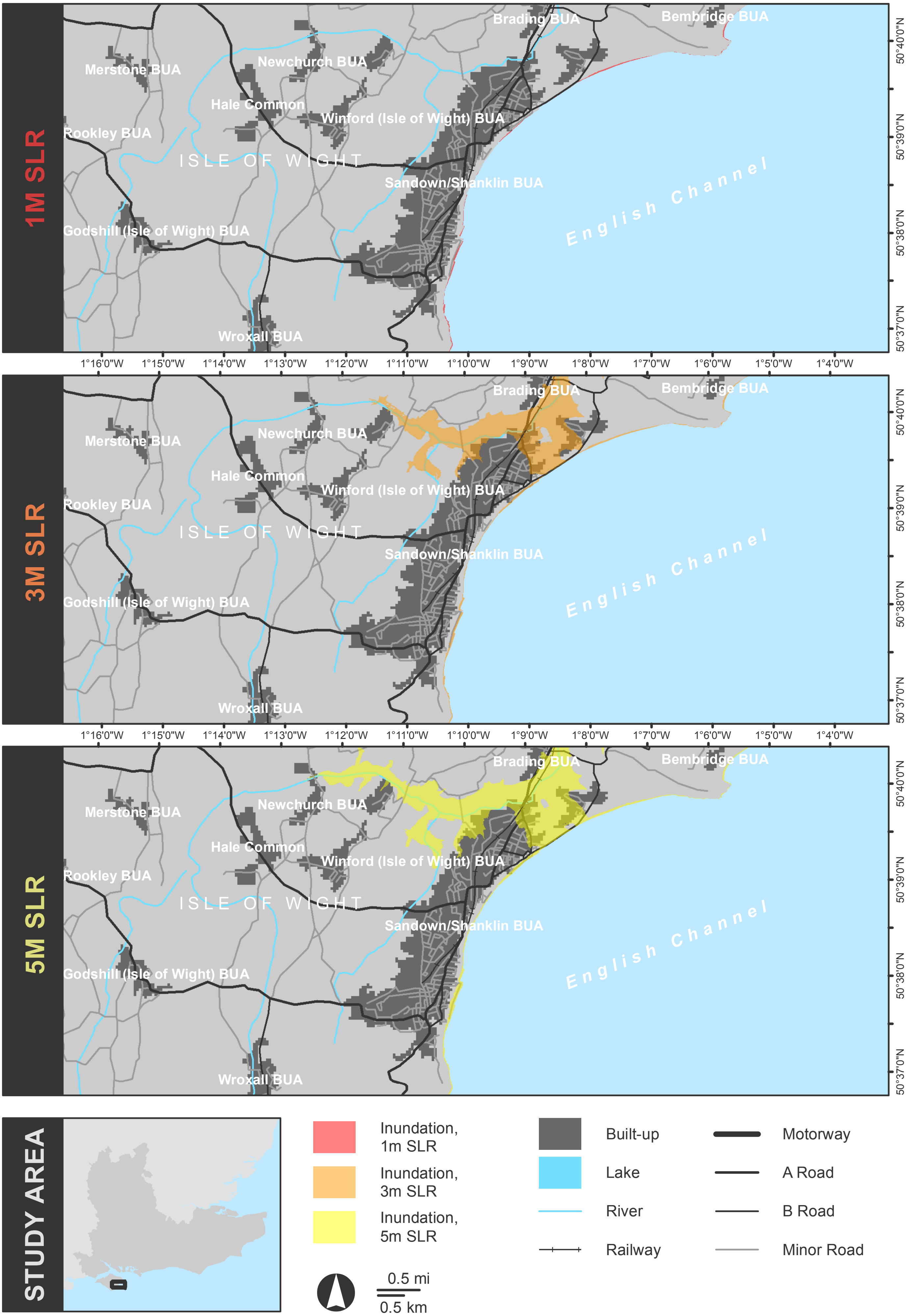
Rye BUA


1M SLR
3M SLR
5M SLR
Peasmarsh (Rother) BUA
KENT
EAST SUSSEX
Rye BUA
Rye Harbour BUA
Camber BUA
0°40'0"E
0°41'0"E
0°42'0"E
0°43'0"E
0°44'0"E
0°45'0"E
0°46'0"E
0°47'0"E
50°58'0"N
50°57'30"N
50°57'0"N
50°56'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

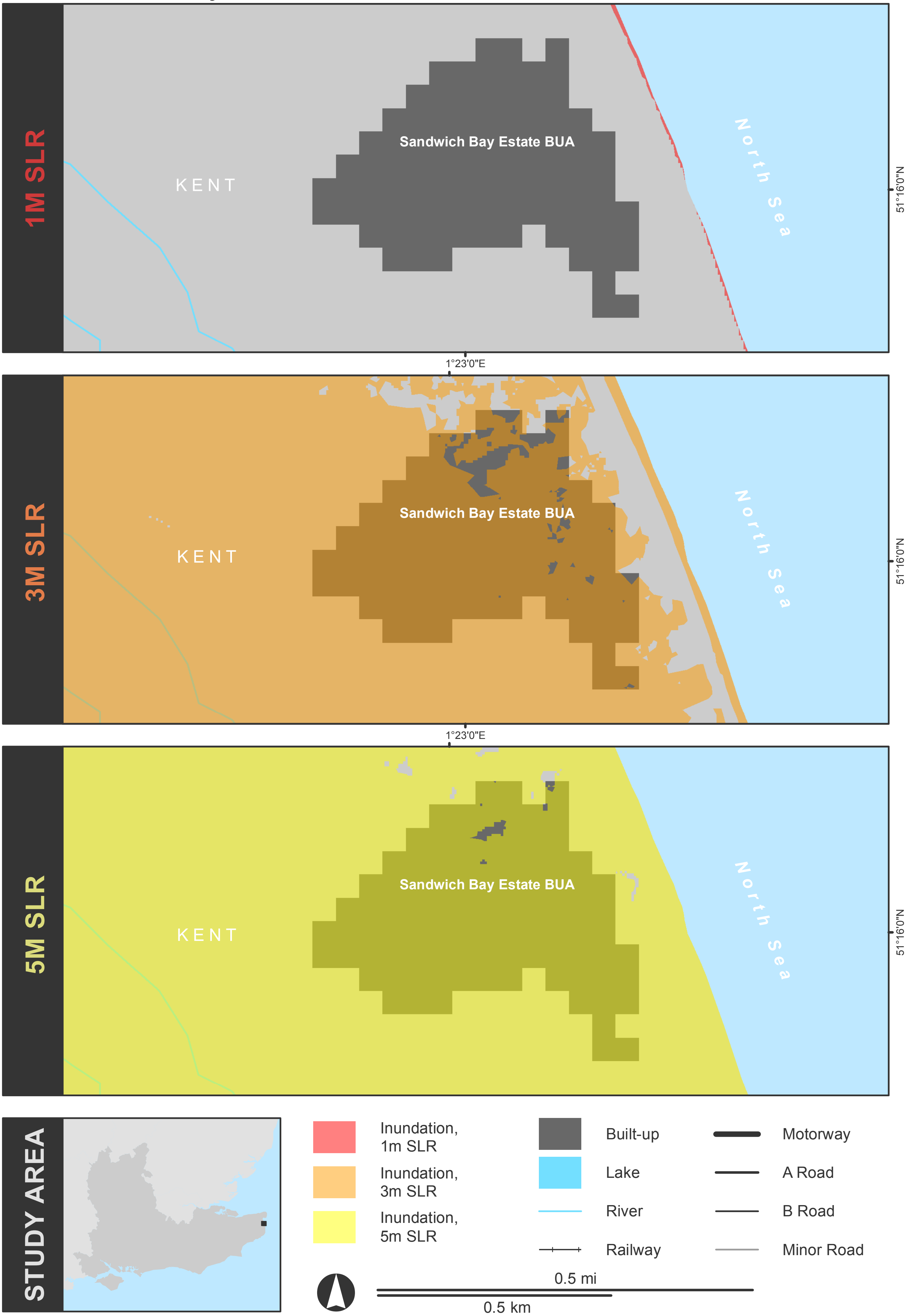
Rye Harbour BUA



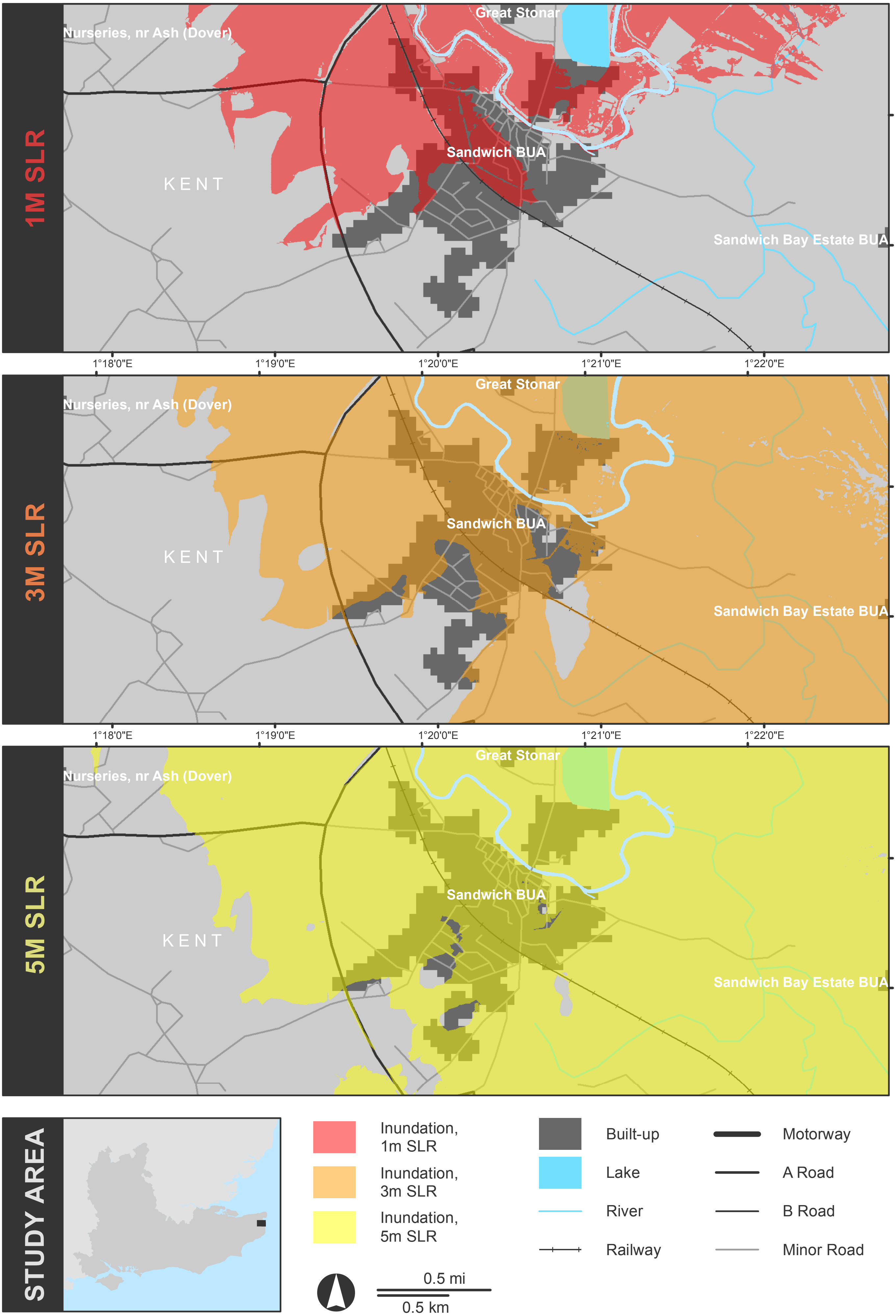
Sandown/Shanklin BUA



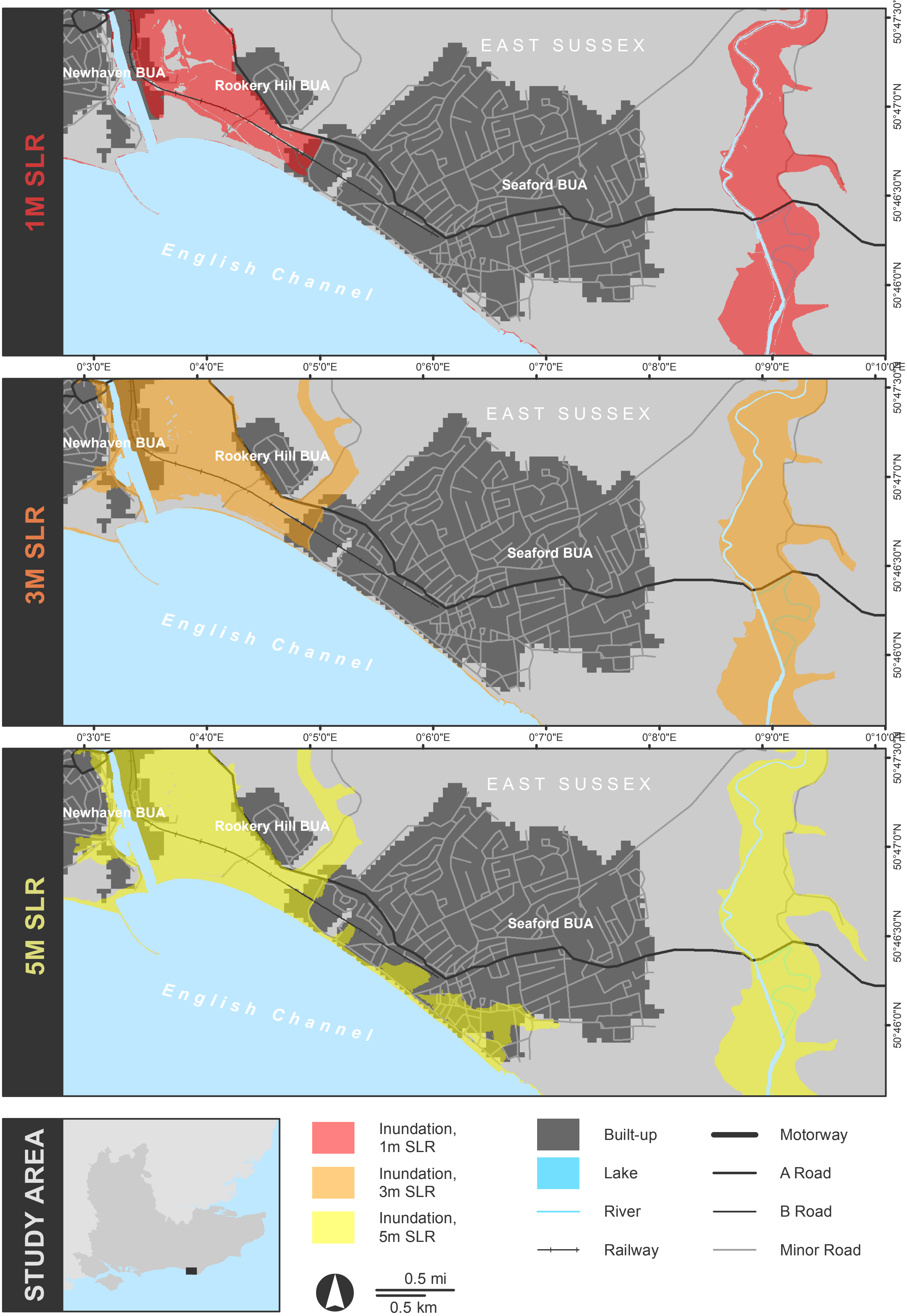
Sandwich Bay Estate BUA



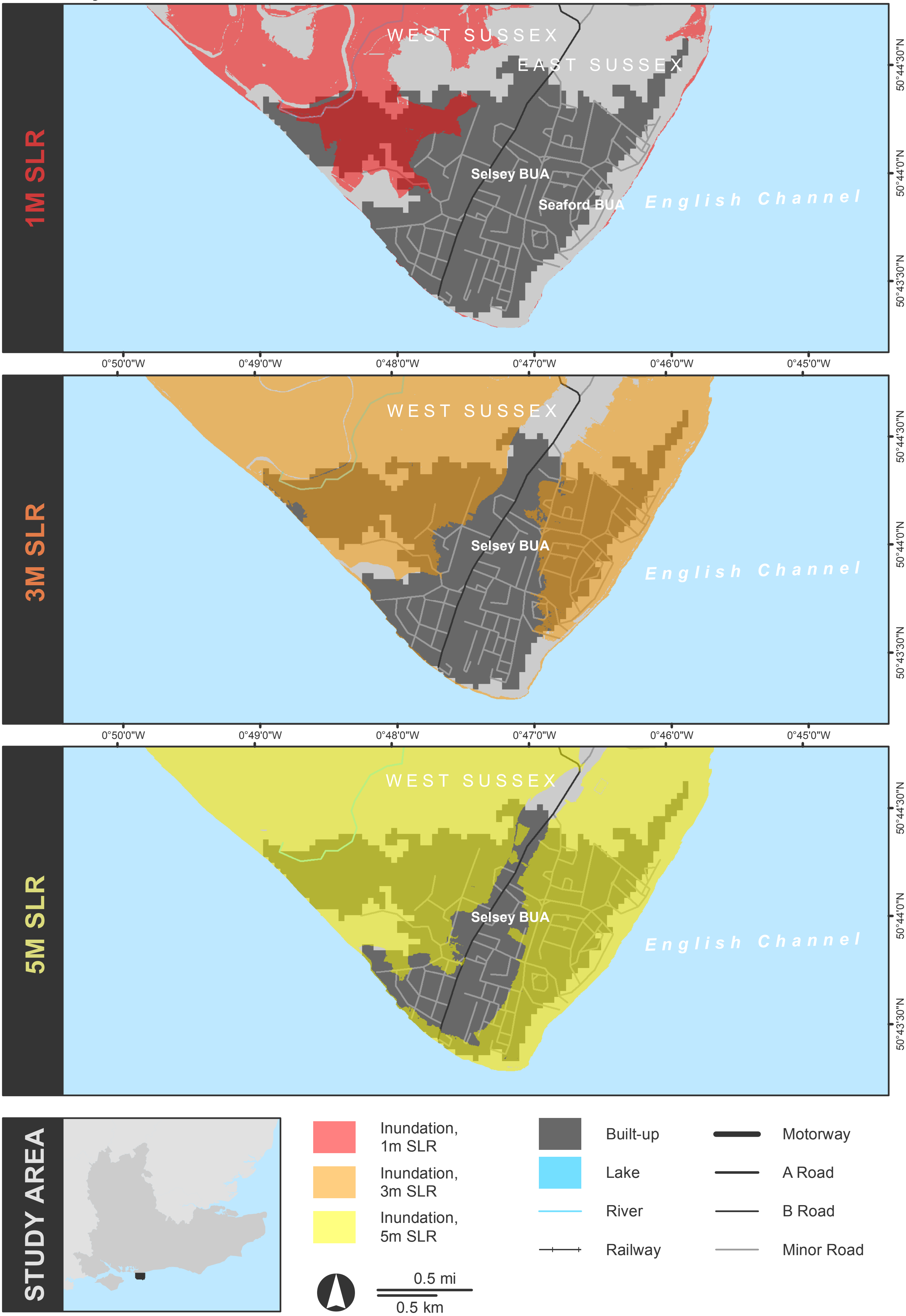
Sandwich BUA



Seaford BUA


1M SLR
3M SLR
5M SLR
EAST SUSSEX
Newhaven BUA
Rookery Hill BUA
Seaford BUA
English Channel
0°3'0"E
0°4'0"E
0°5'0"E
0°6'0"E
0°7'0"E
0°8'0"E
0°9'0"E
0°10'0"E
50°47'30"N
50°47'0"N
50°46'30"N
50°46'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

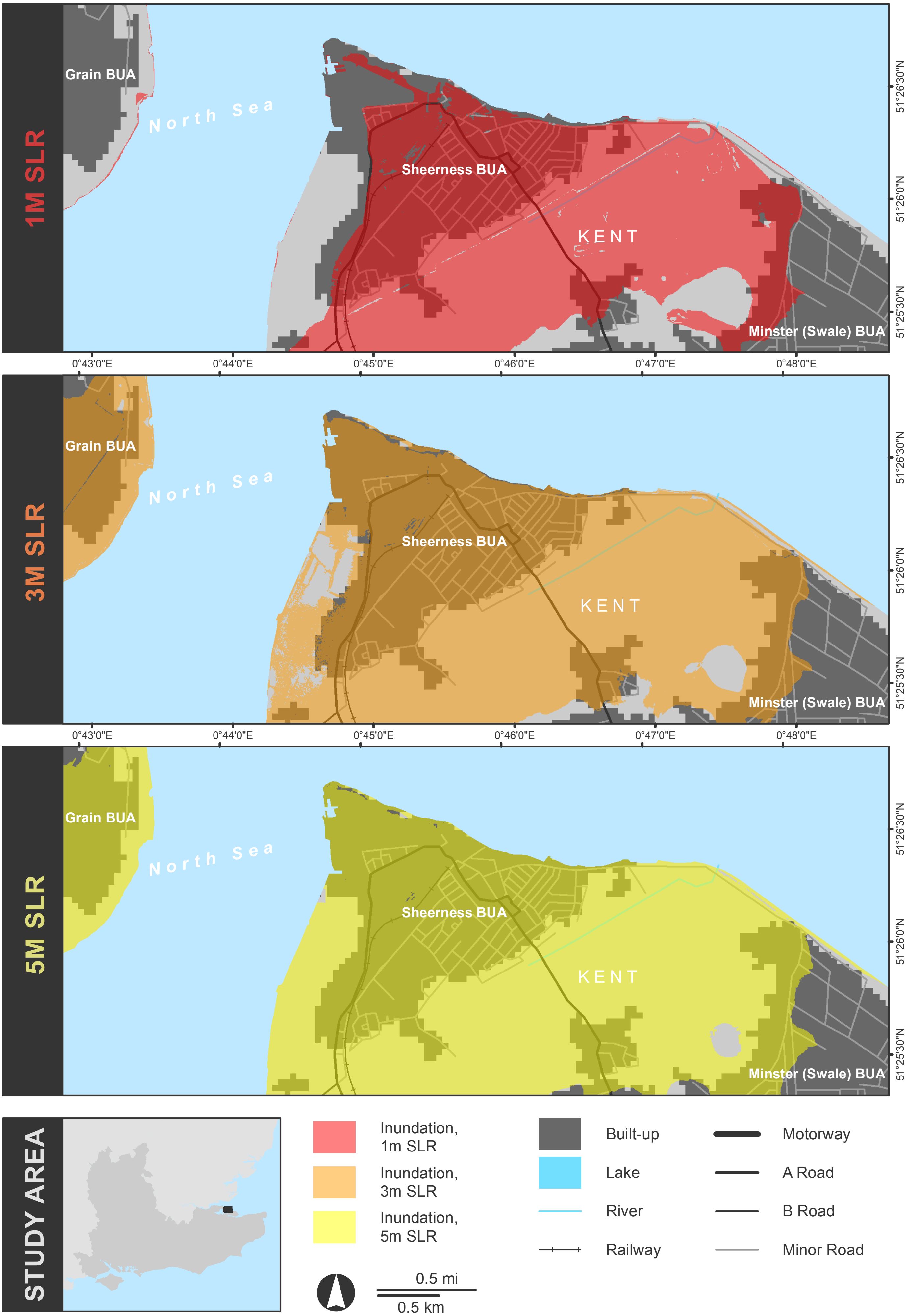
Selsey BUA



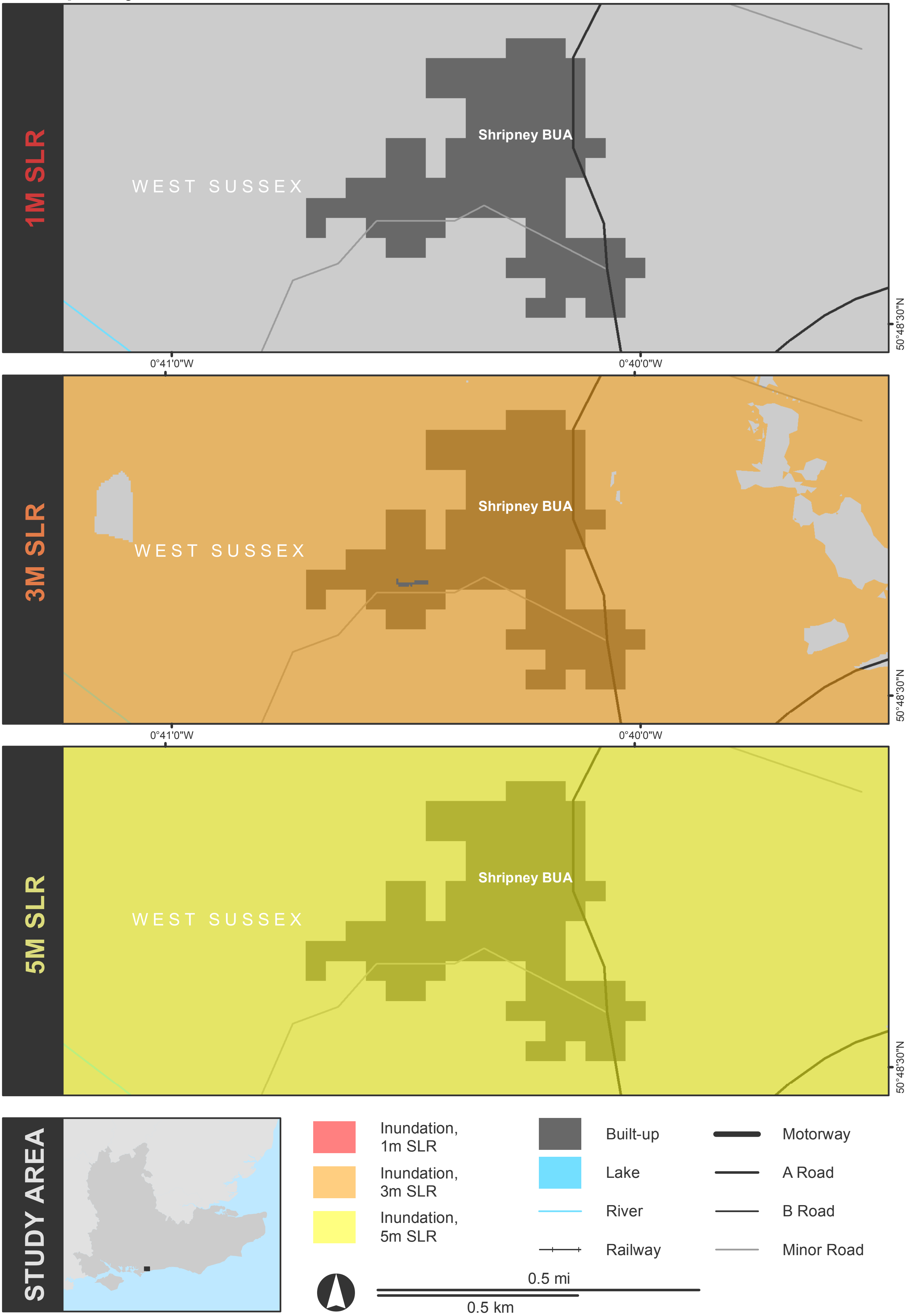
1M SLR
WEST SUSSEX
EAST SUSSEX
Selsey BUA
Seaford BUA
English Channel
50°44'30"N
50°44'0"N
50°43'30"N
0°50'0"W
0°49'0"W
0°48'0"W
0°47'0"W
0°46'0"W
0°45'0"W
3M SLR
WEST SUSSEX
Selsey BUA
English Channel
50°44'30"N
50°44'0"N
50°43'30"N
0°50'0"W
0°49'0"W
0°48'0"W
0°47'0"W
0°46'0"W
0°45'0"W
5M SLR
WEST SUSSEX
Selsey BUA
English Channel
50°44'30"N
50°44'0"N
50°43'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

Shalfleet BUA

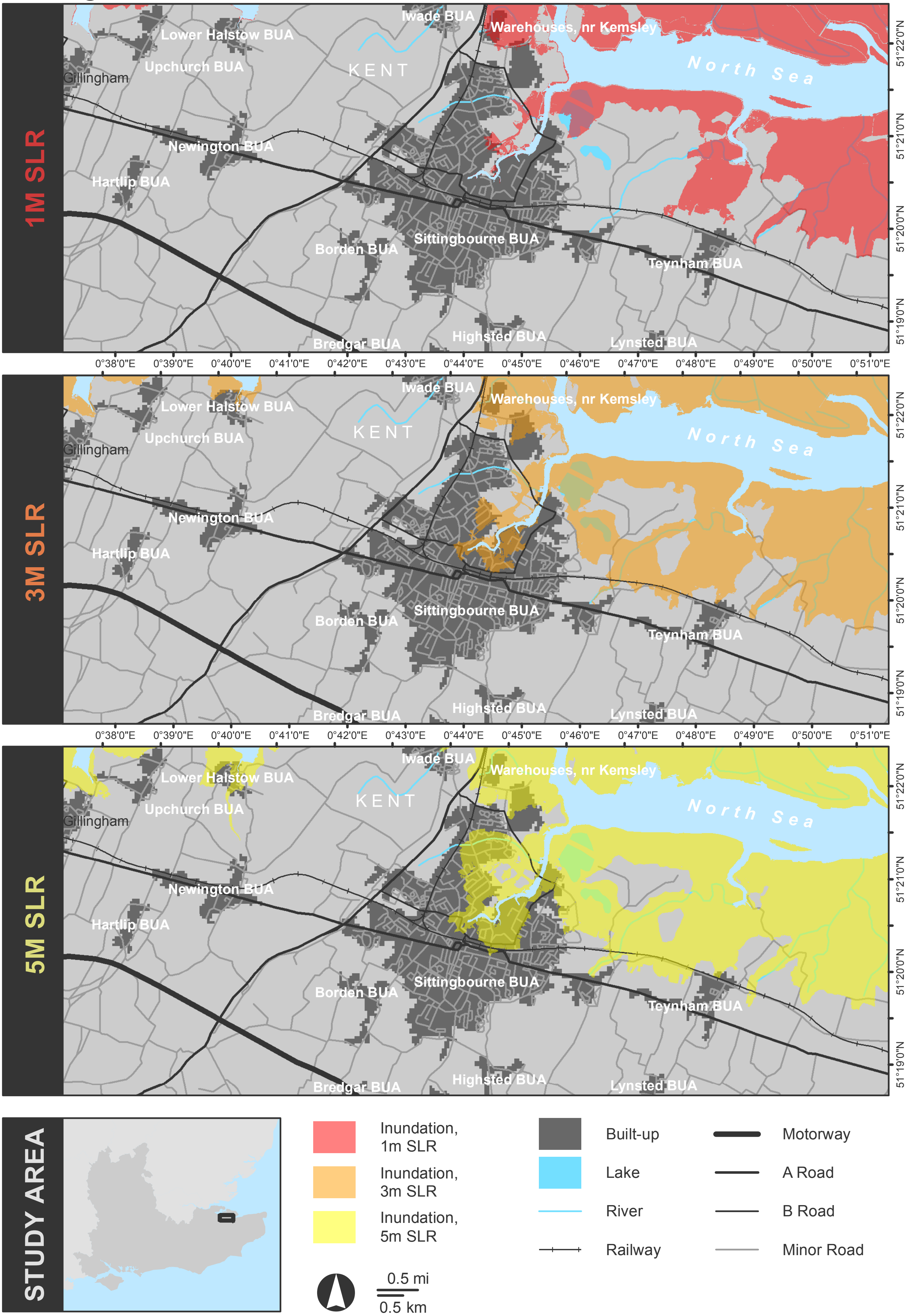
Sheerness BUA



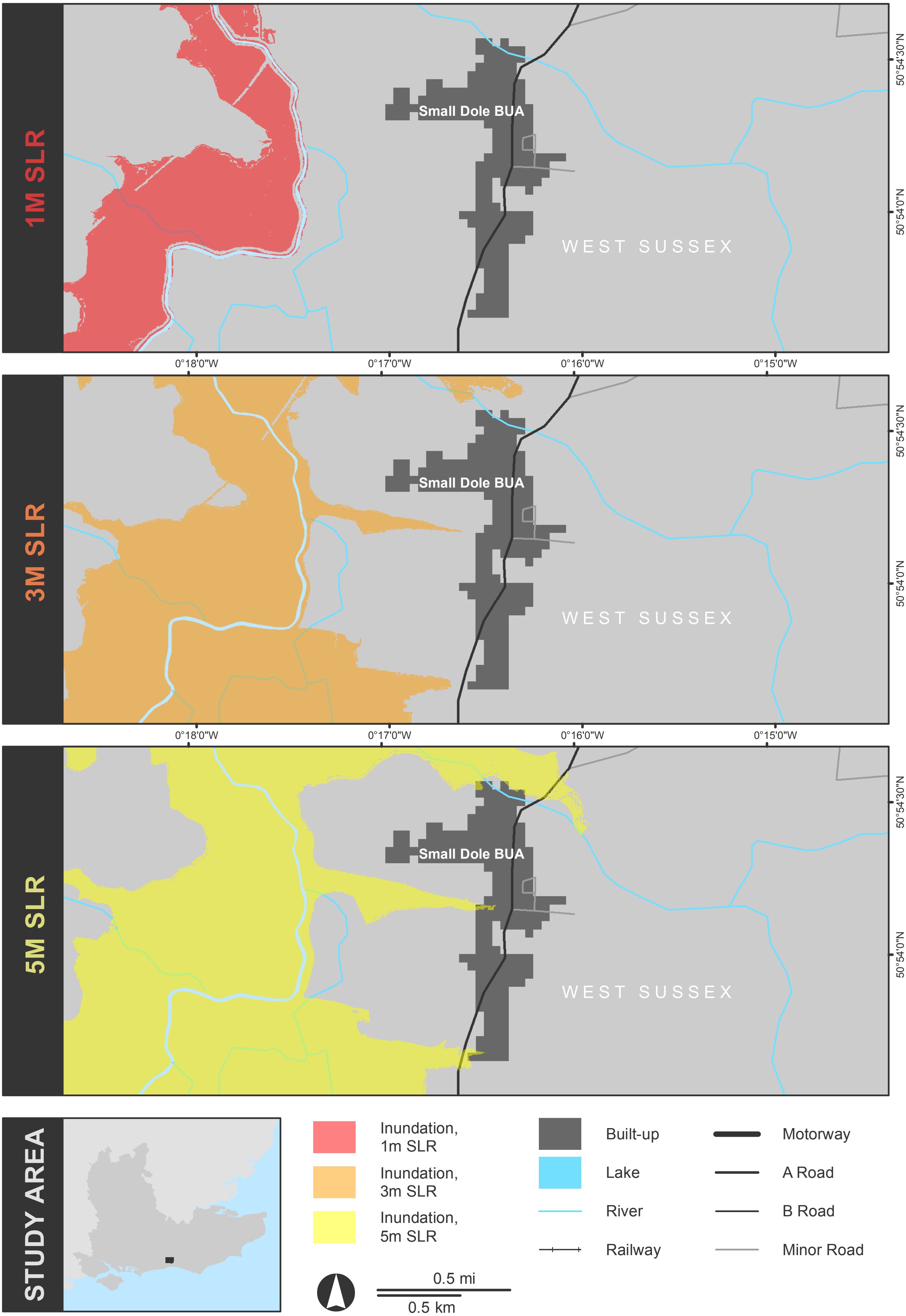
Shripney BUA



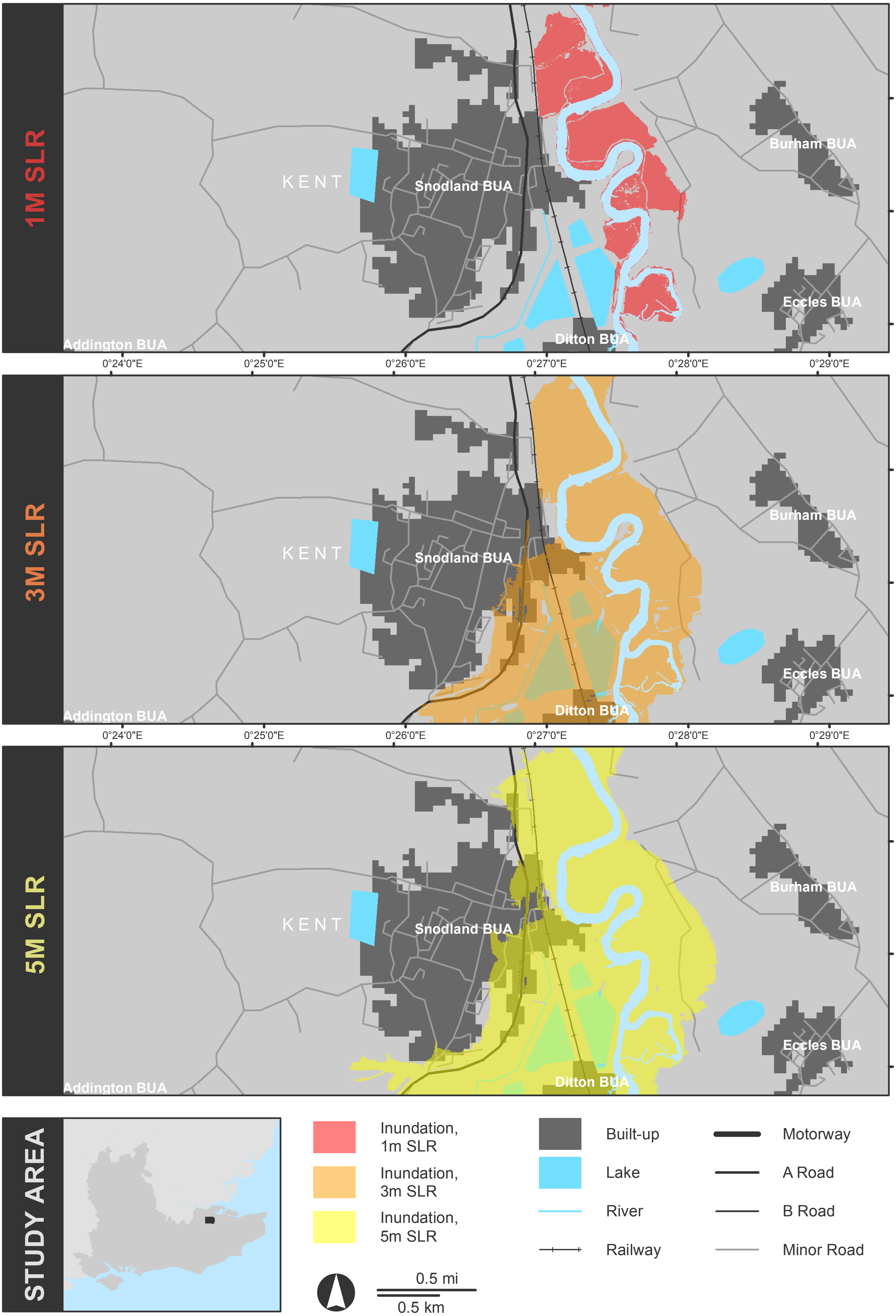
Sittingbourne BUA



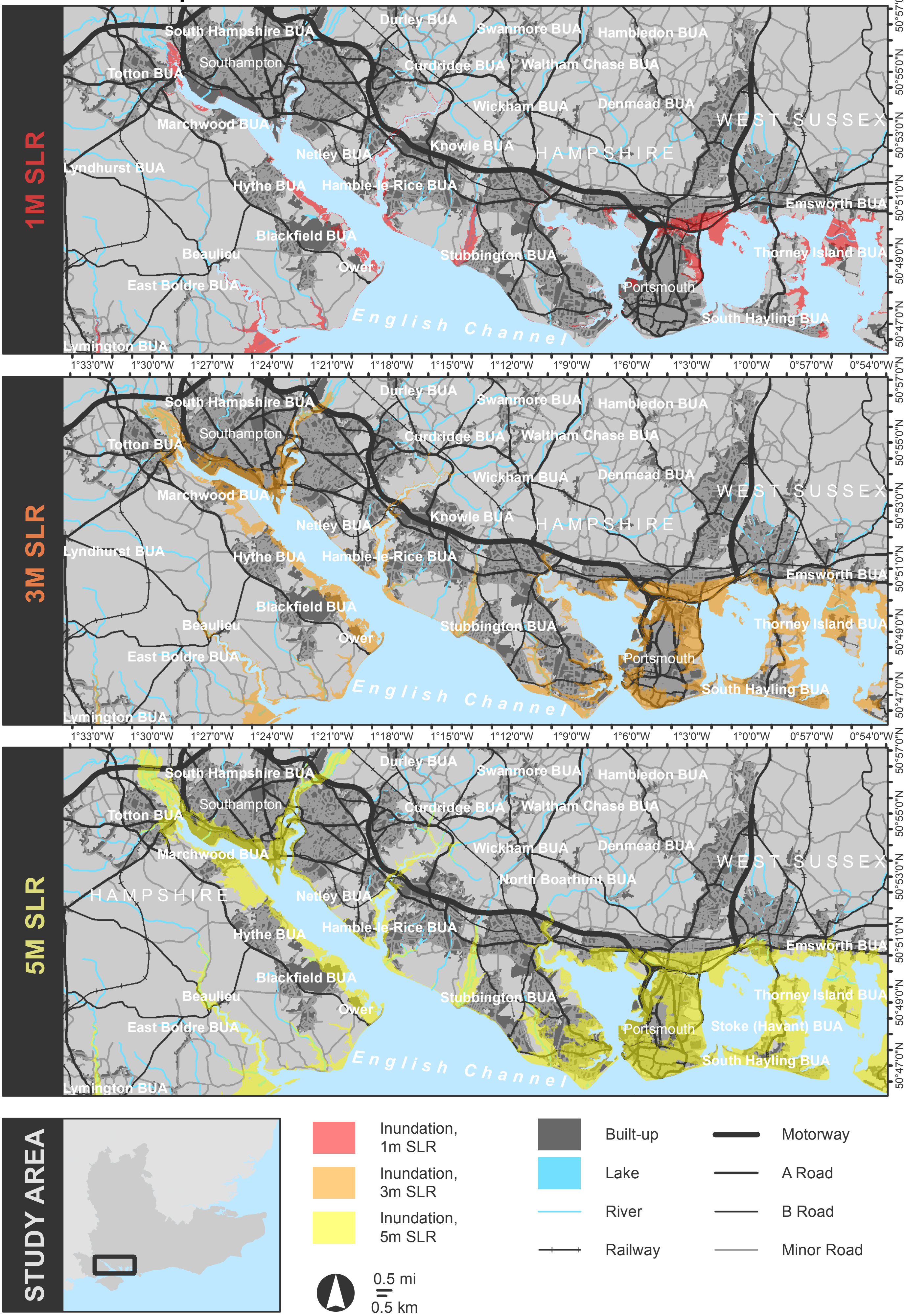
Small Dole BUA



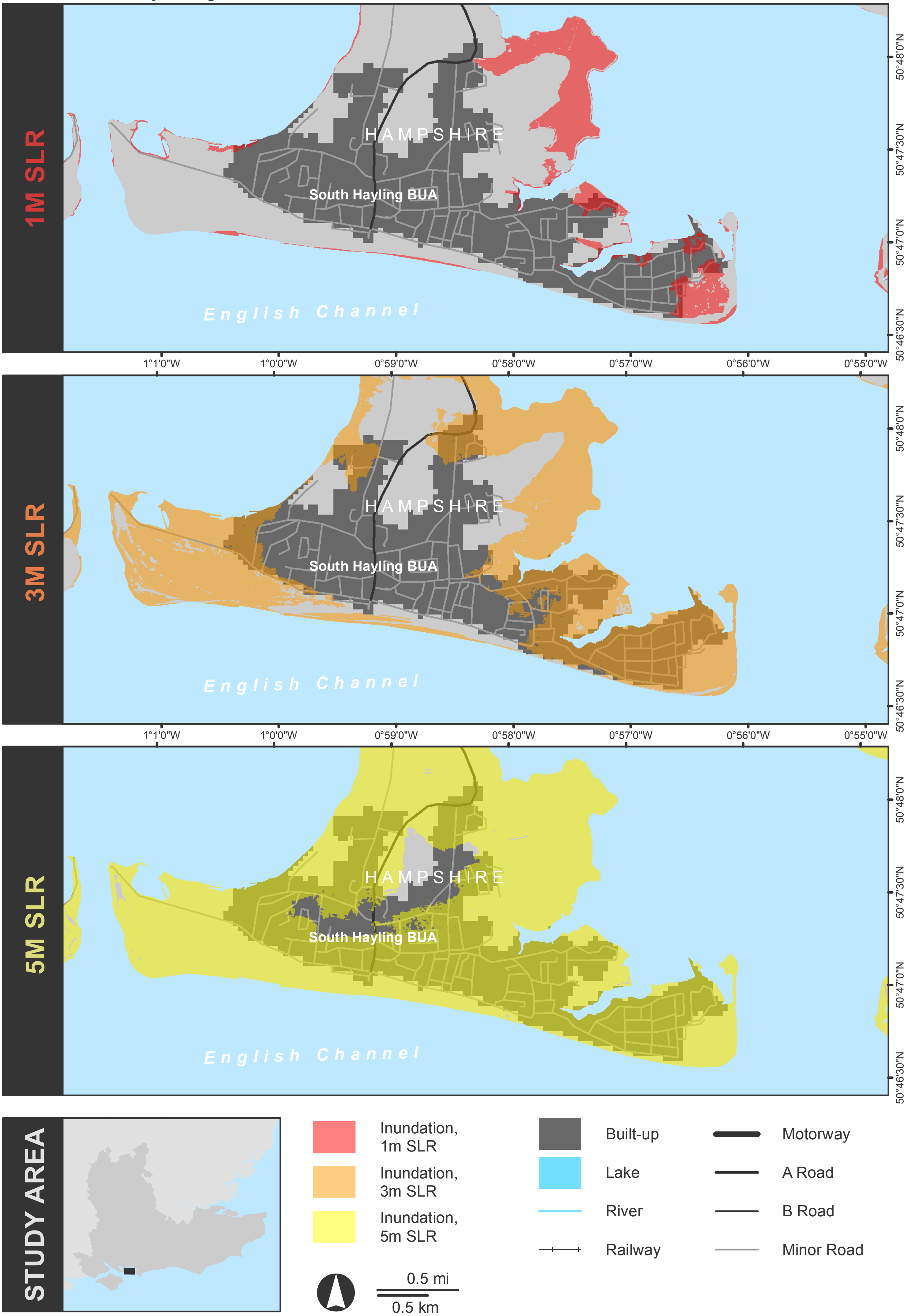
Snodland BUA



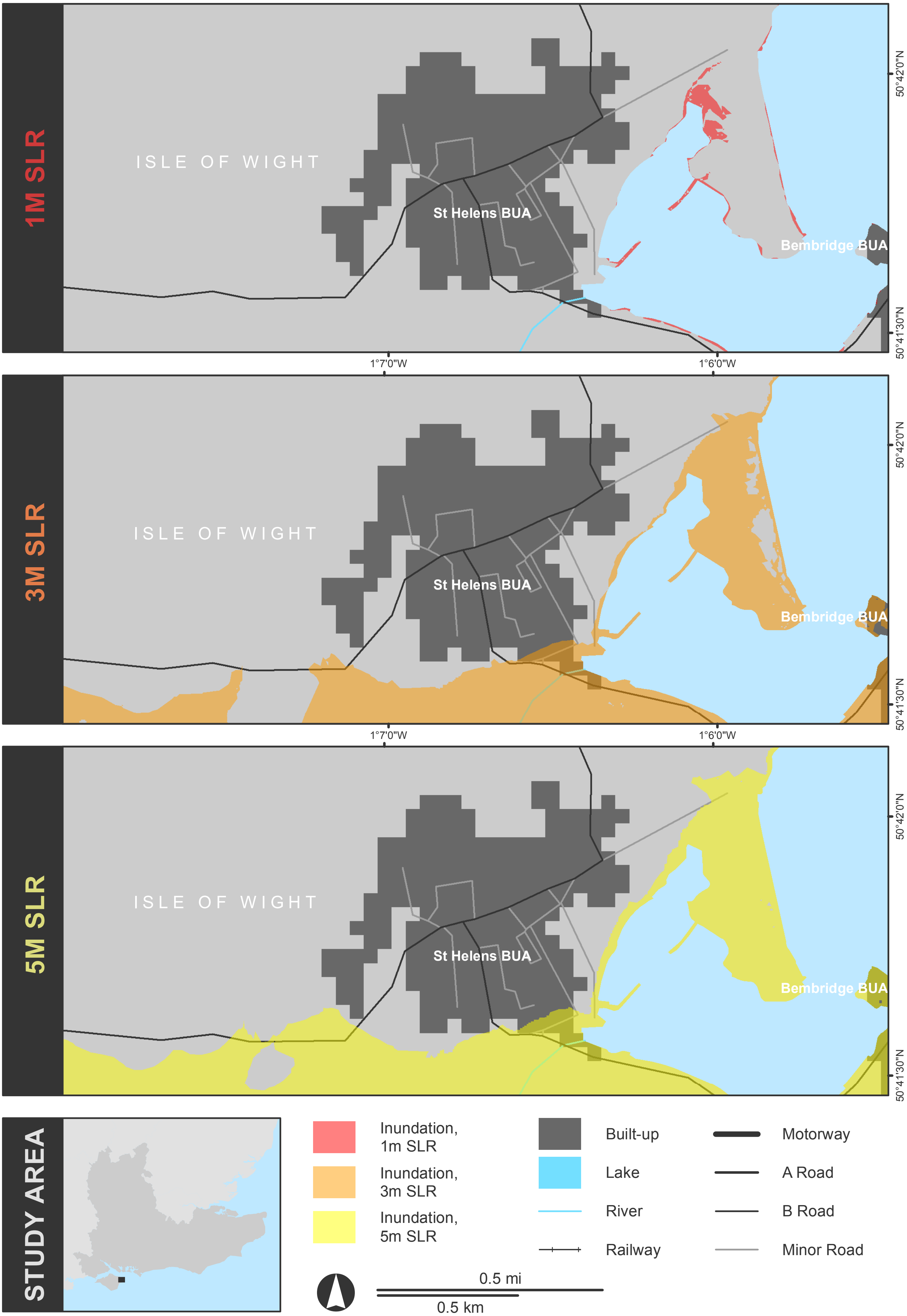
South Hampshire BUA



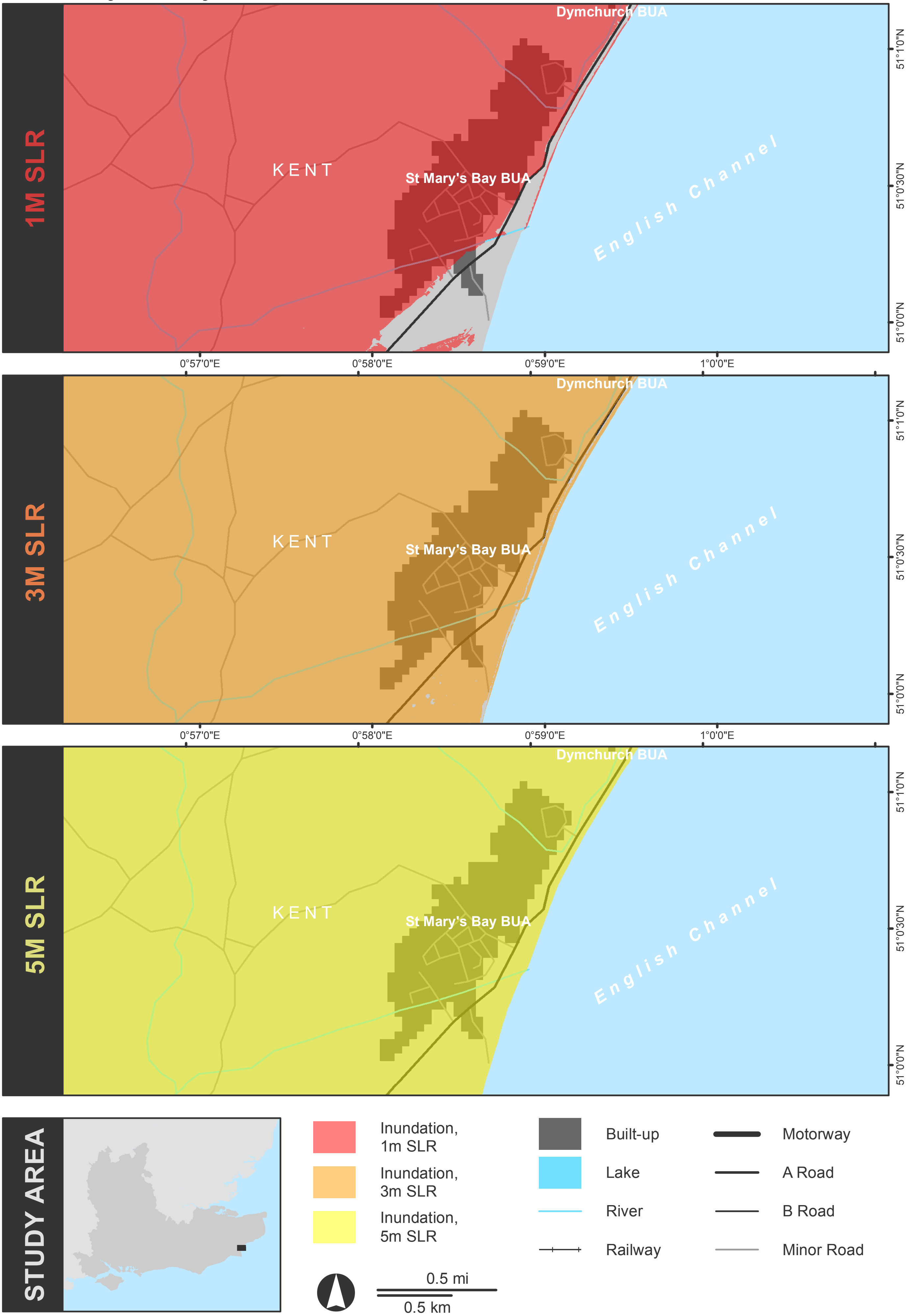
South Hayling BUA



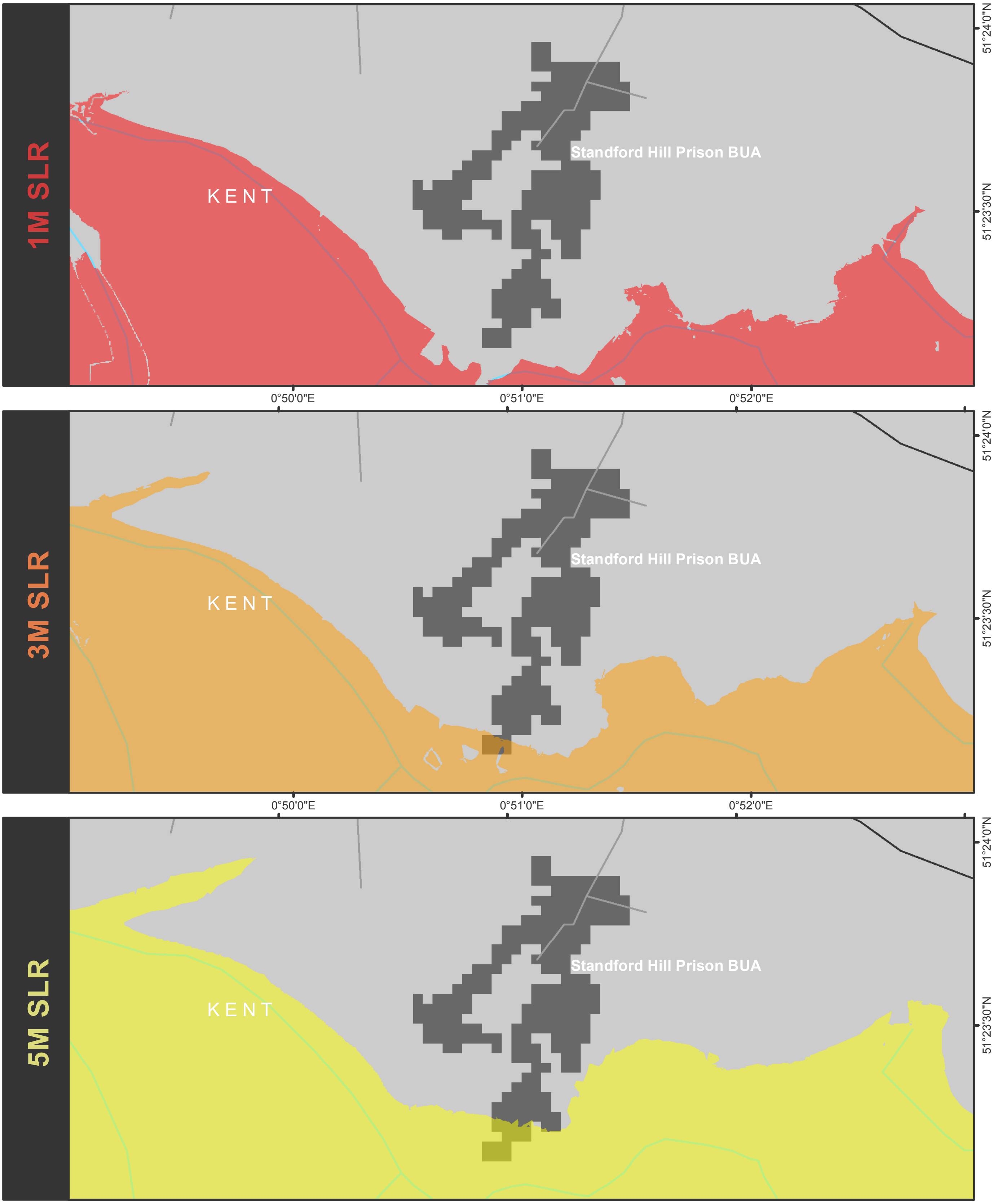
St Helens BUA



St Mary's Bay BUA



Standford Hill Prison BUA



Inundation, 1m SLR

Inundation, 3m SLR

Inundation, 5m SLR

Built-up

Lake

River

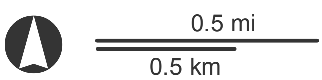
Railway

Motorway

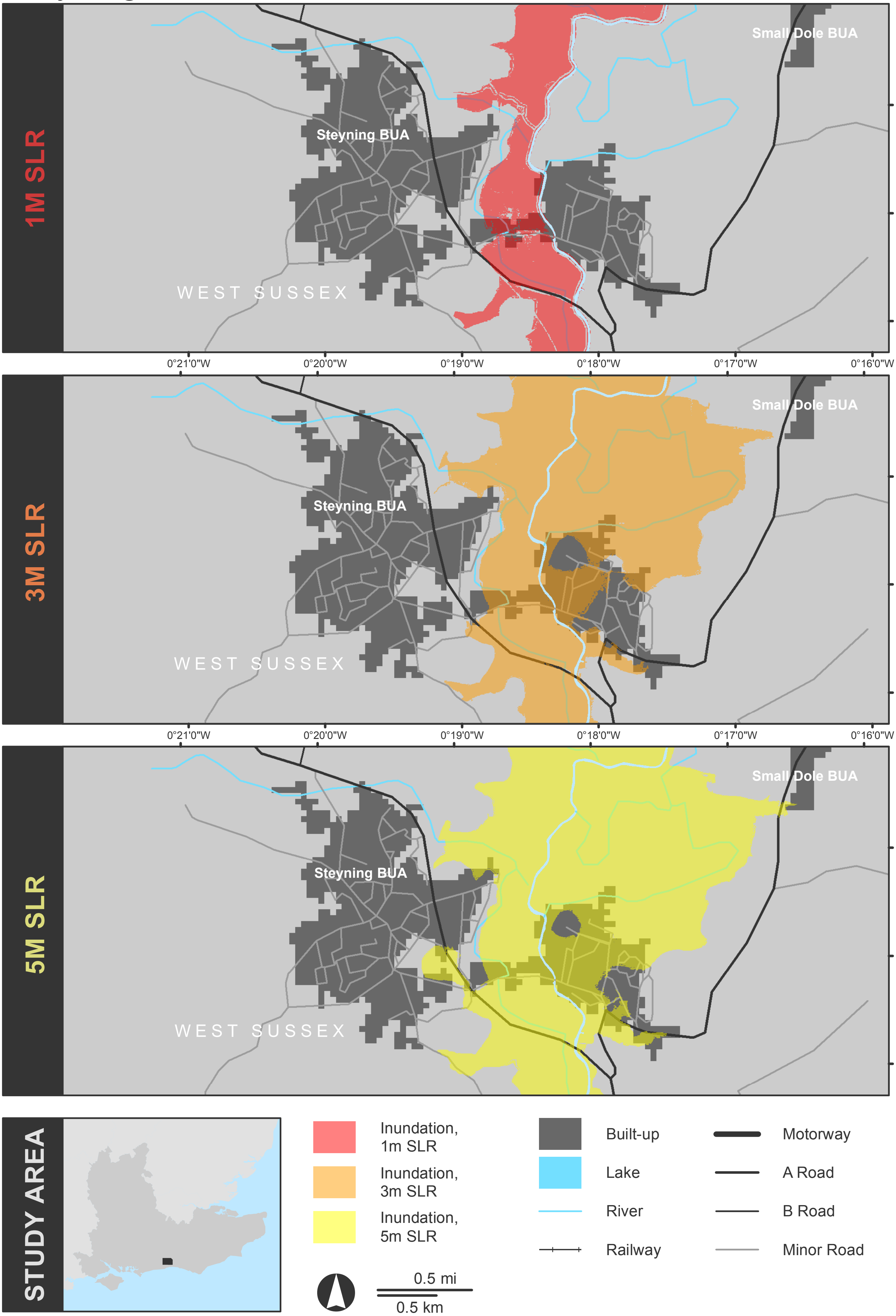
A Road

B Road

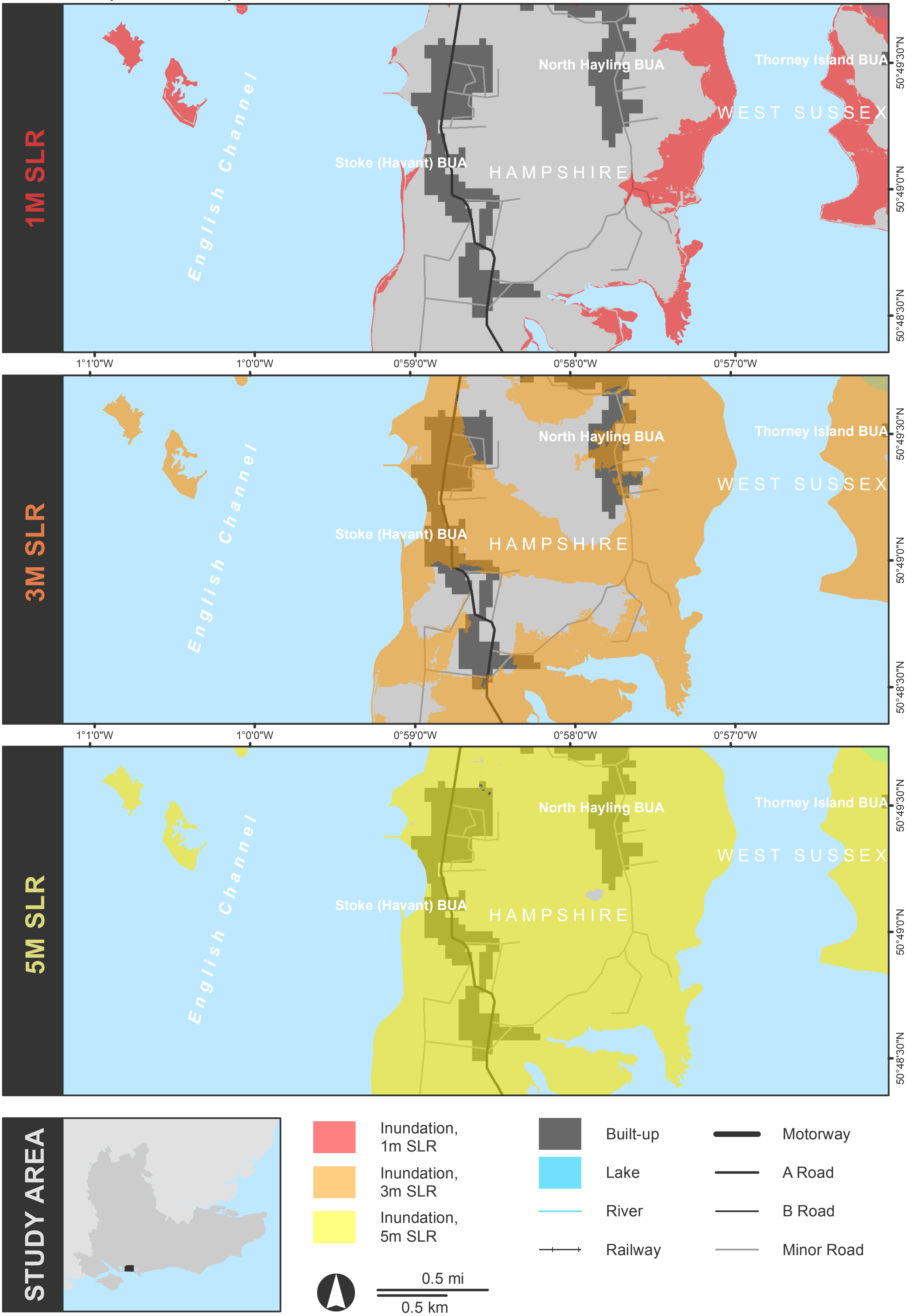
Minor Road



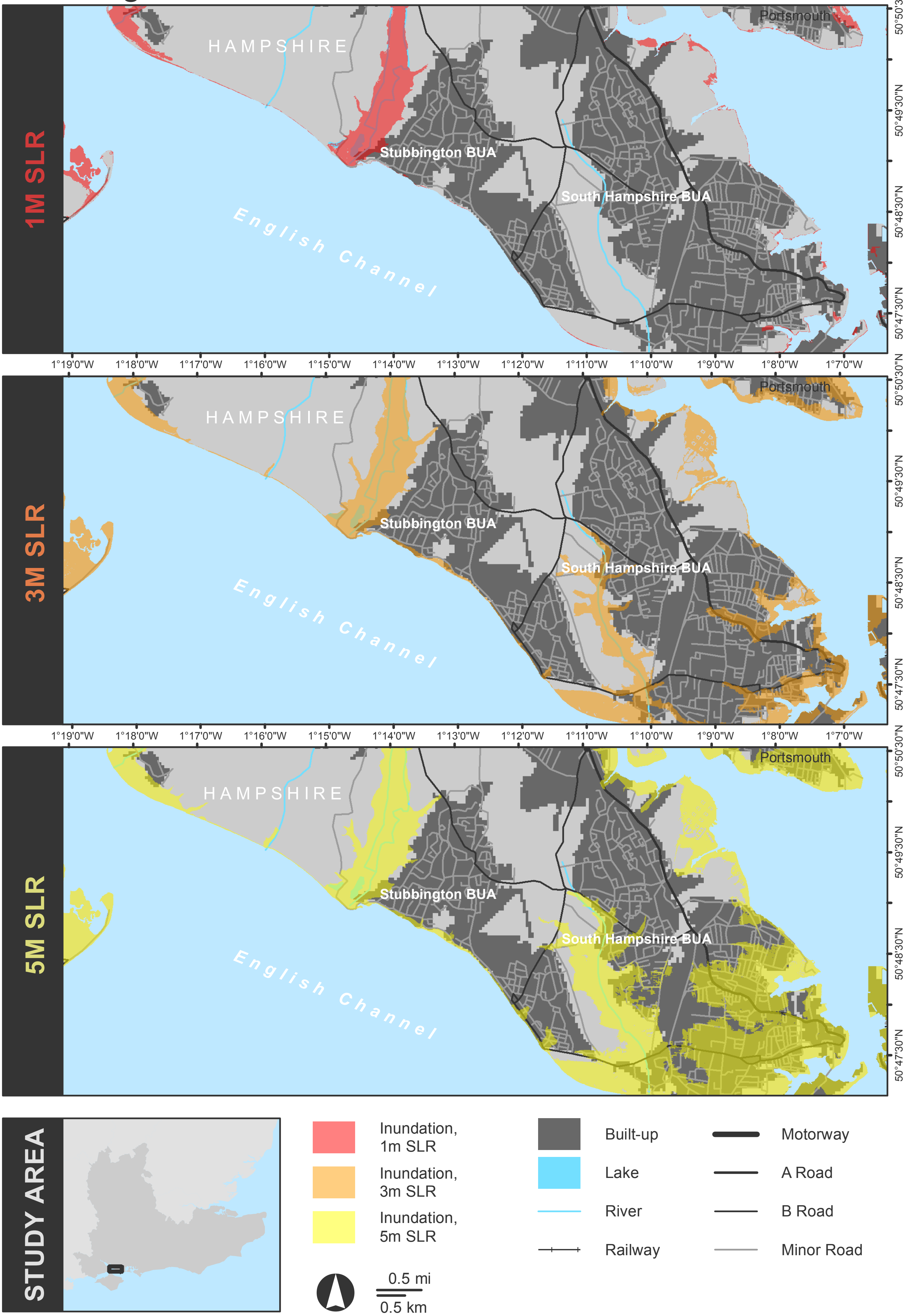
Steyning BUA



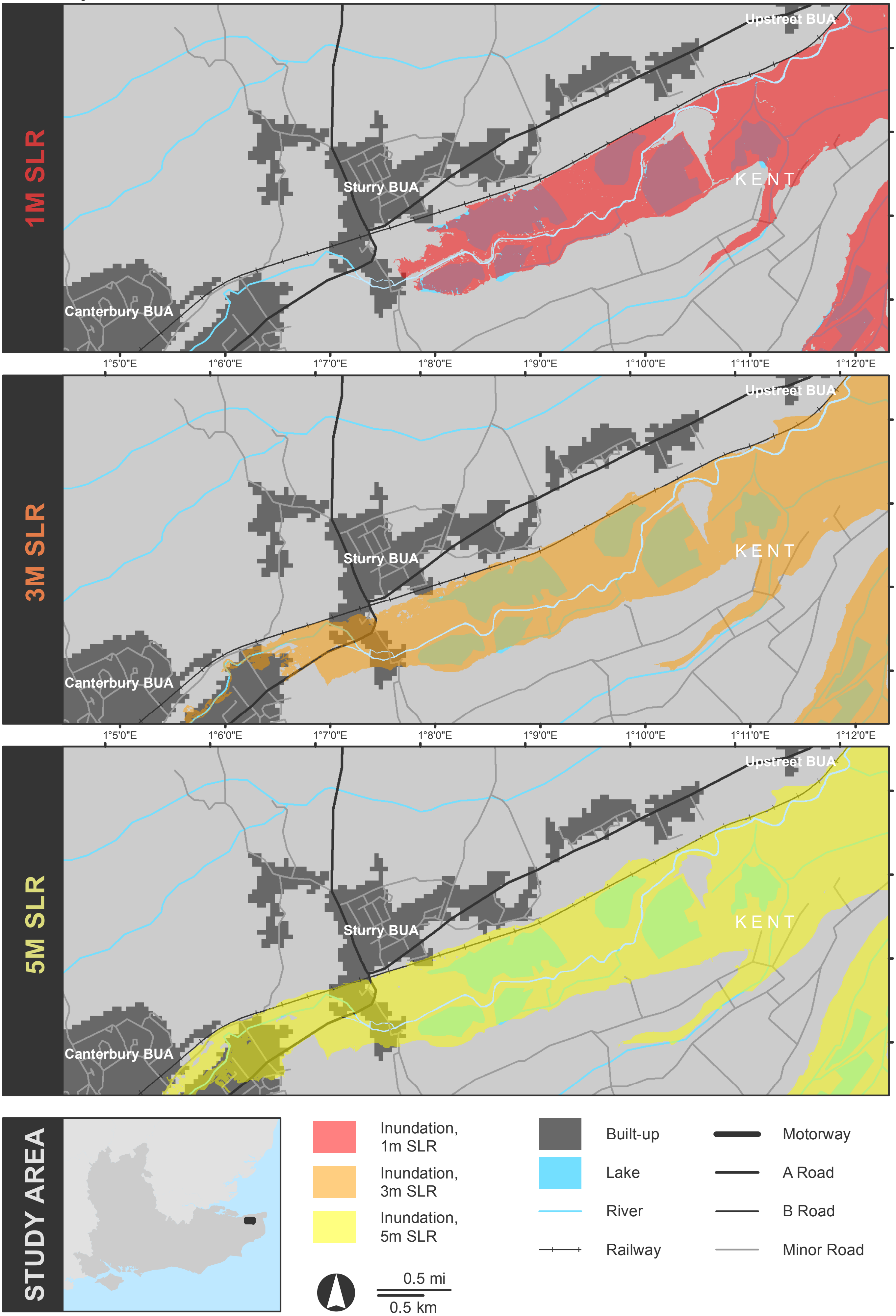
Stoke (Havant) BUA



Stubbington BUA

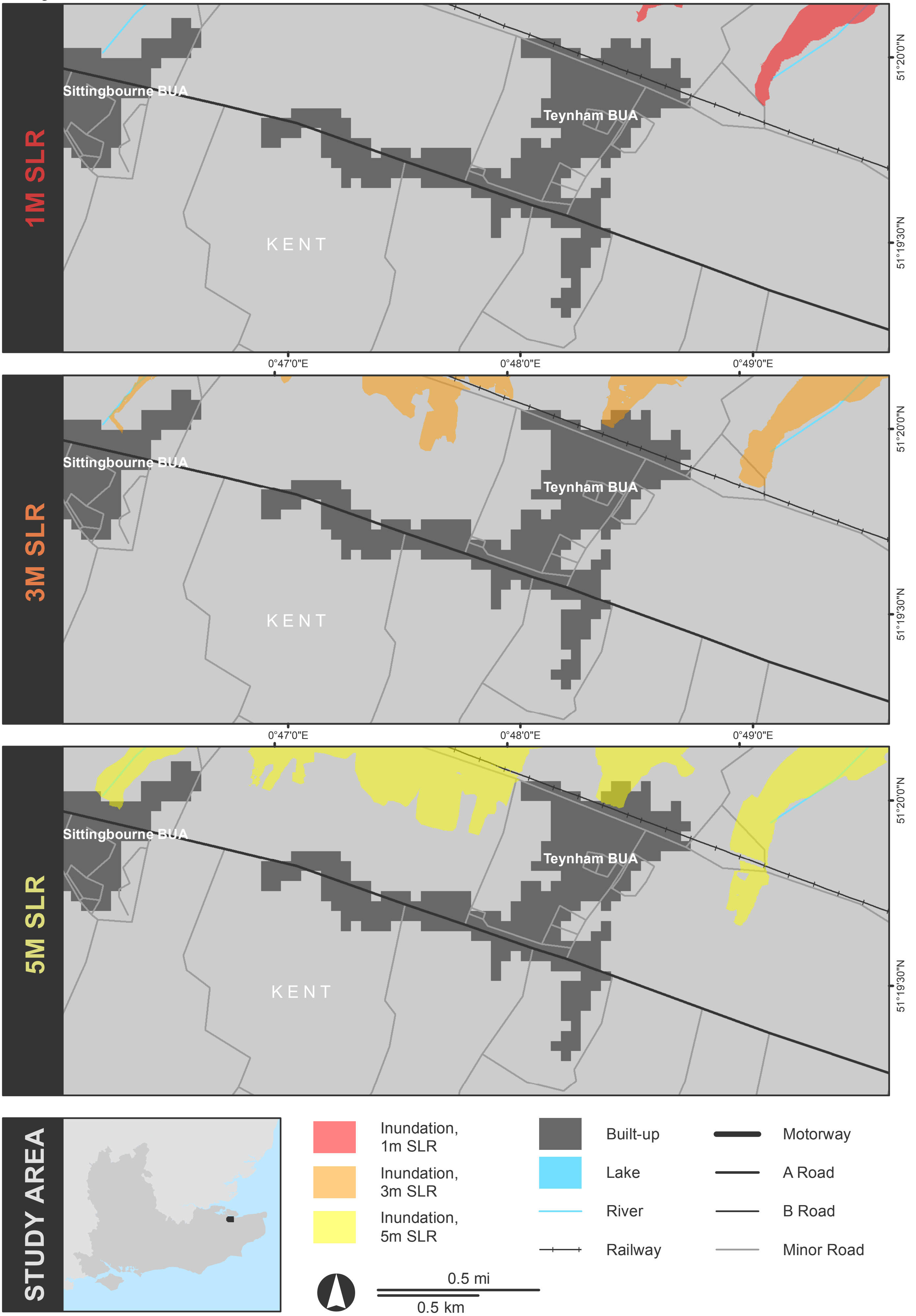


Sturry BUA



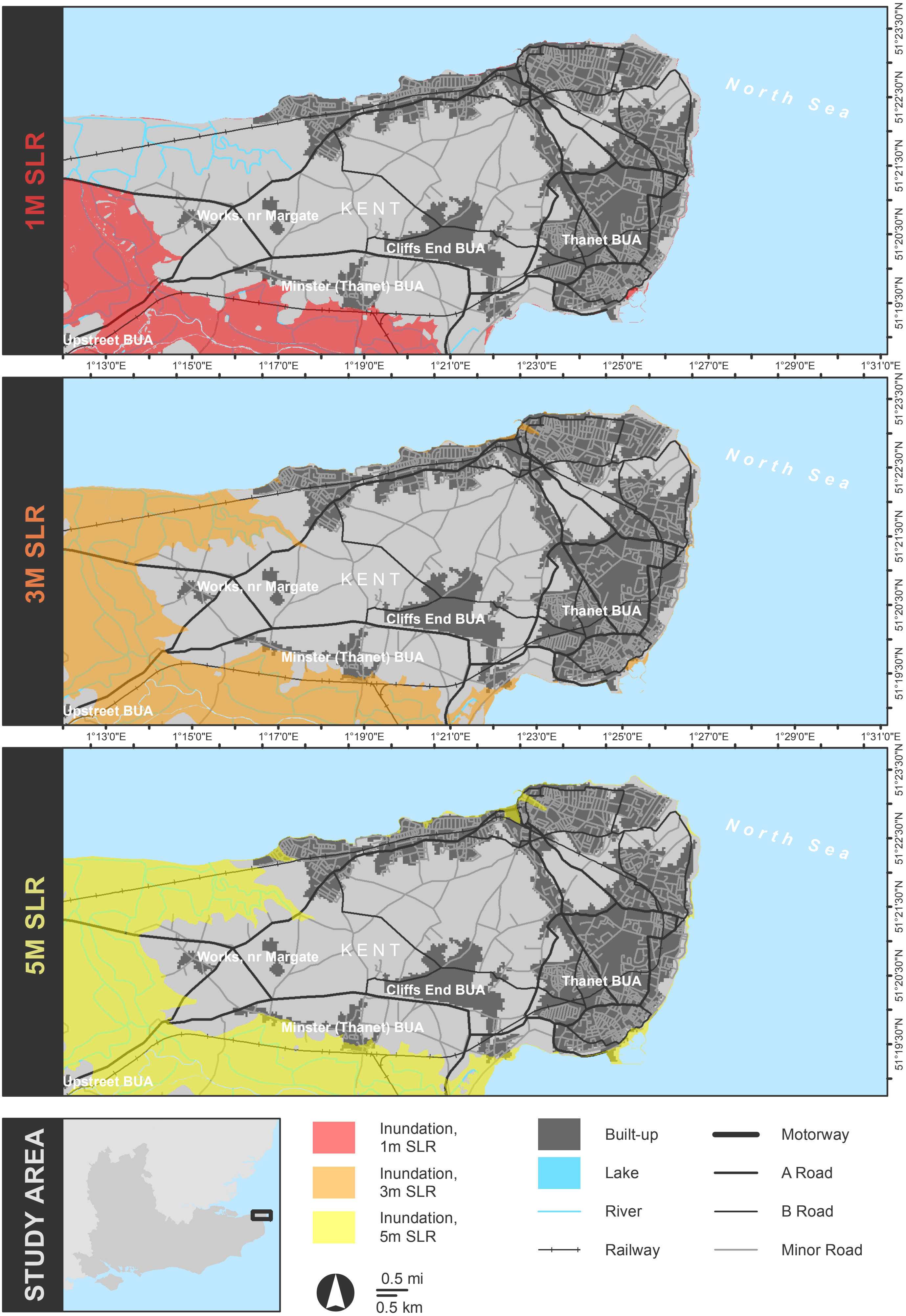
1M SLR
3M SLR
5M SLR
Upstreet BUA
Sturry BUA
Canterbury BUA
KENT
1°5'0"E
1°6'0"E
1°7'0"E
1°8'0"E
1°9'0"E
1°10'0"E
1°11'0"E
1°12'0"E
51°19'0"N
51°18'30"N
51°18'0"N
51°17'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

Teynham BUA



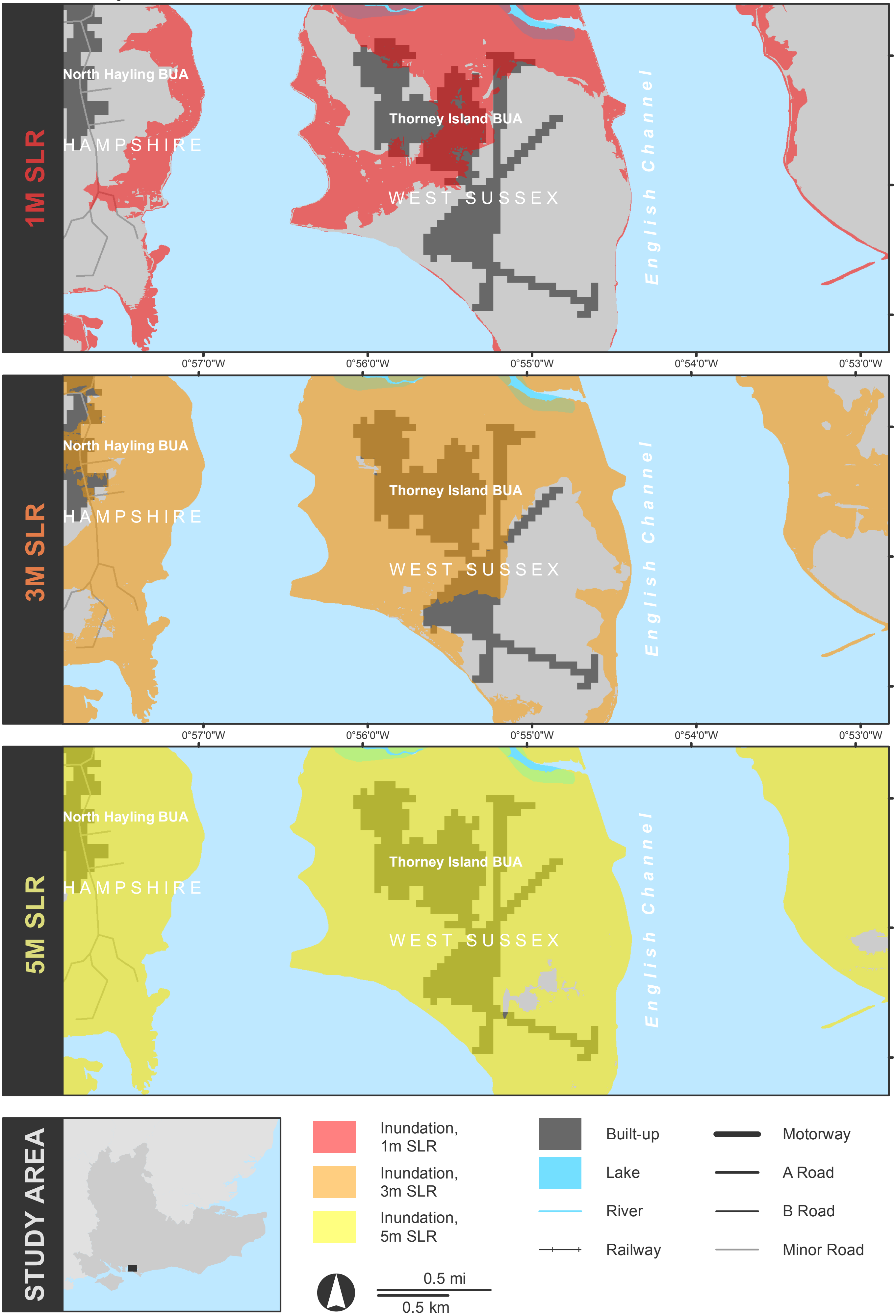
1M SLR
Sittingbourne BUA
Teynham BUA
KENT
0°47'0"E
0°48'0"E
0°49'0"E
51°20'0"N
51°19'30"N
3M SLR
Sittingbourne BUA
Teynham BUA
KENT
0°47'0"E
0°48'0"E
0°49'0"E
51°20'0"N
51°19'30"N
5M SLR
Sittingbourne BUA
Teynham BUA
KENT
51°20'0"N
51°19'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

Thanet BUA

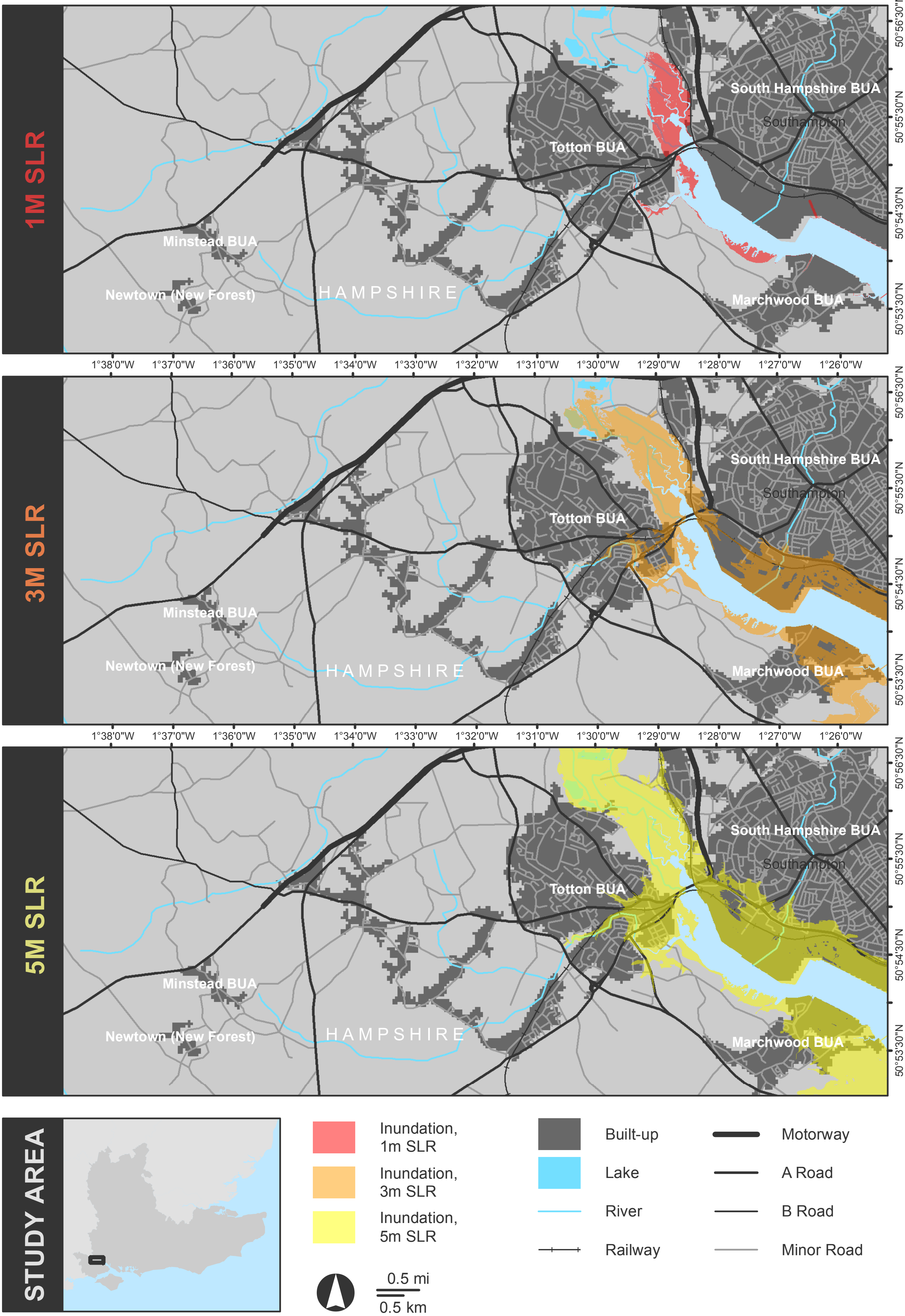


1M SLR
3M SLR
5M SLR
North Sea
KENT
Works, nr Margate
Cliffs End BUA
Thanet BUA
Minster (Thanet) BUA
Upstreet BUA
1°13'0"E
1°15'0"E
1°17'0"E
1°19'0"E
1°21'0"E
1°23'0"E
1°25'0"E
1°27'0"E
1°29'0"E
1°31'0"E
51°23'30"N
51°22'30"N
51°21'30"N
51°20'30"N
51°19'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

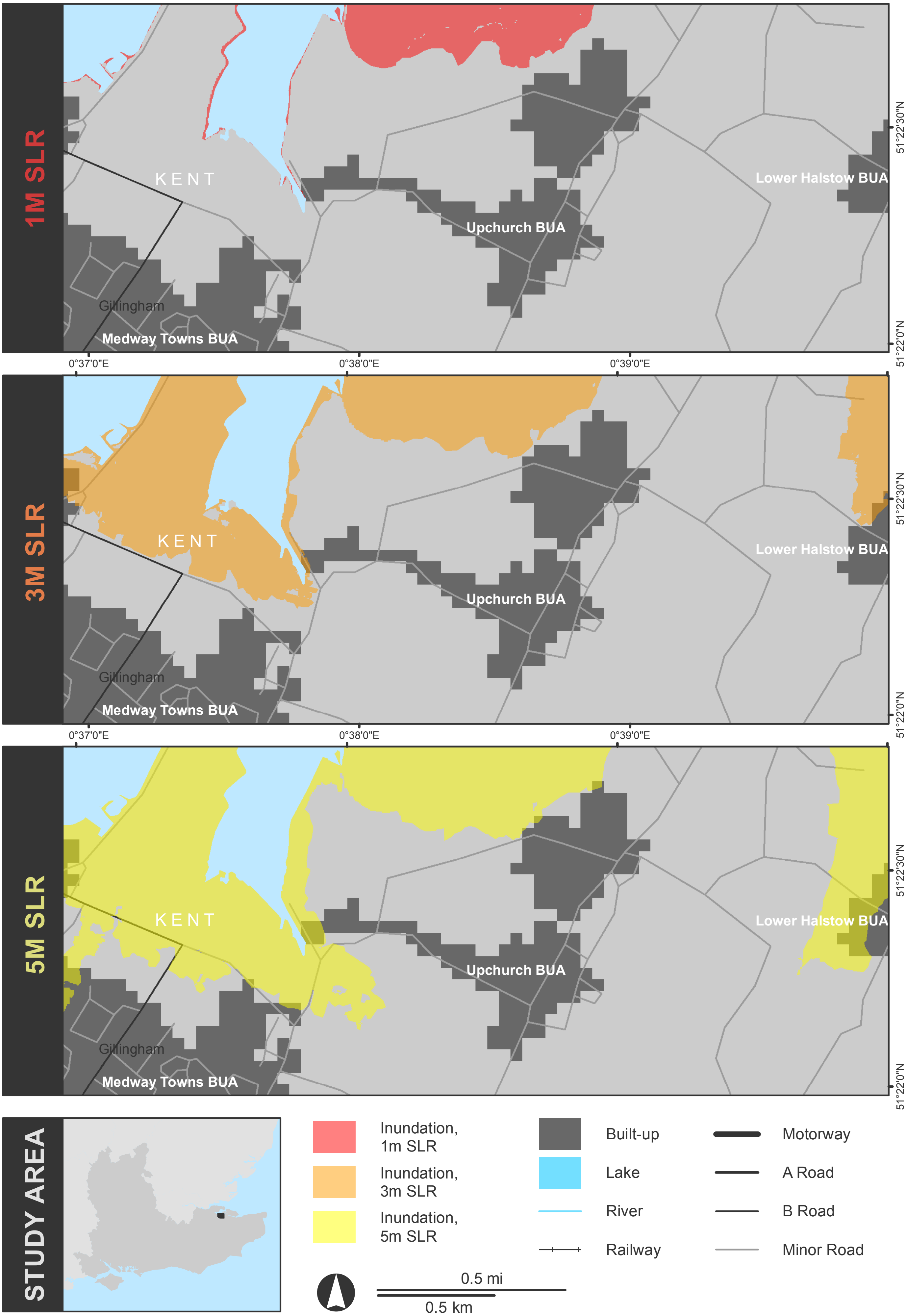
Thorney Island BUA



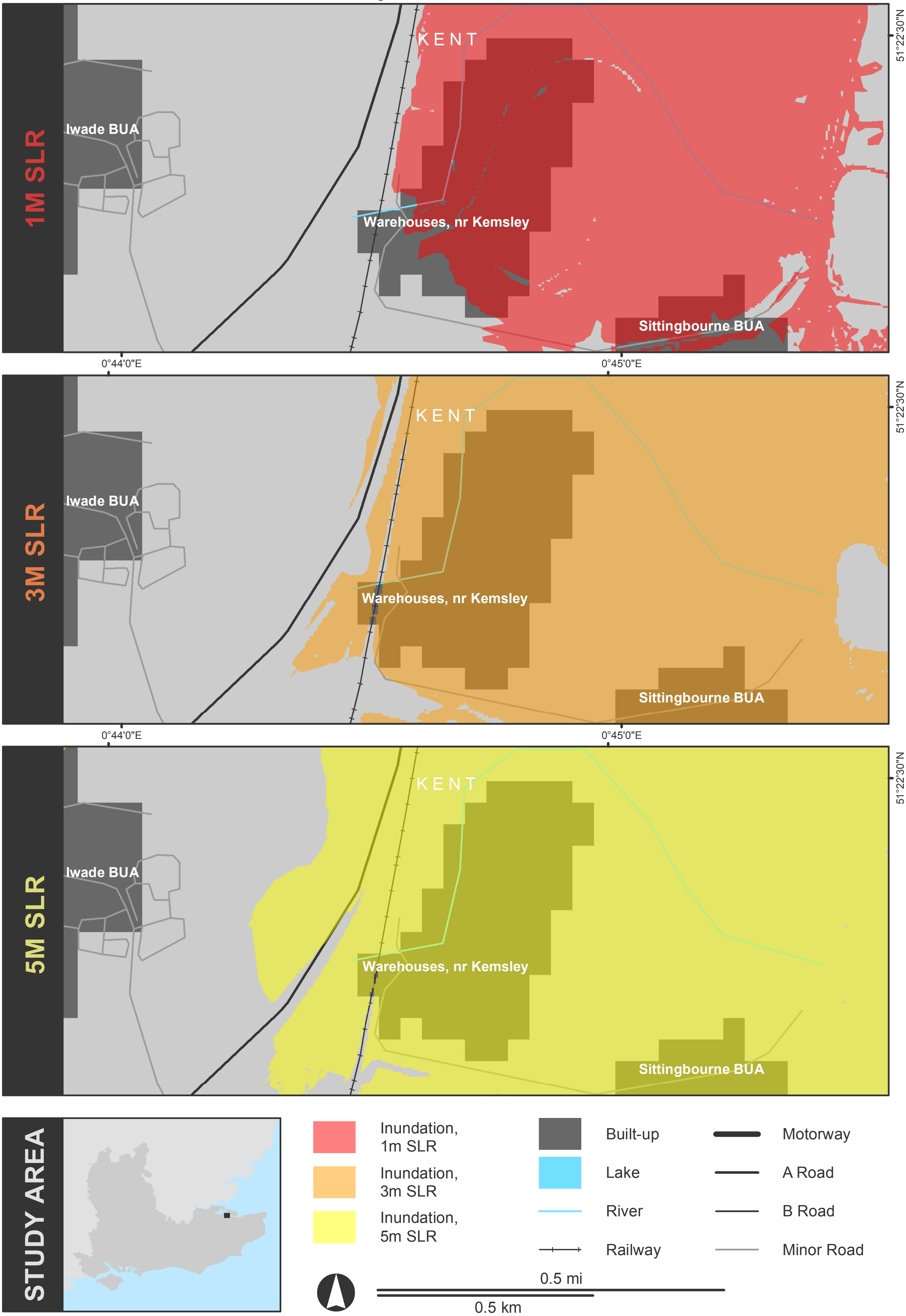
Totton BUA


1M SLR
3M SLR
5M SLR
South Hampshire BUA
Southampton
Totton BUA
Minstead BUA
Newtown (New Forest)
HAMPSHIRE
Marchwood BUA
1°38'0"W
1°37'0"W
1°36'0"W
1°35'0"W
1°34'0"W
1°33'0"W
1°32'0"W
1°31'0"W
1°30'0"W
1°29'0"W
1°28'0"W
1°27'0"W
1°26'0"W
50°56'30"N
50°55'30"N
50°54'30"N
50°53'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

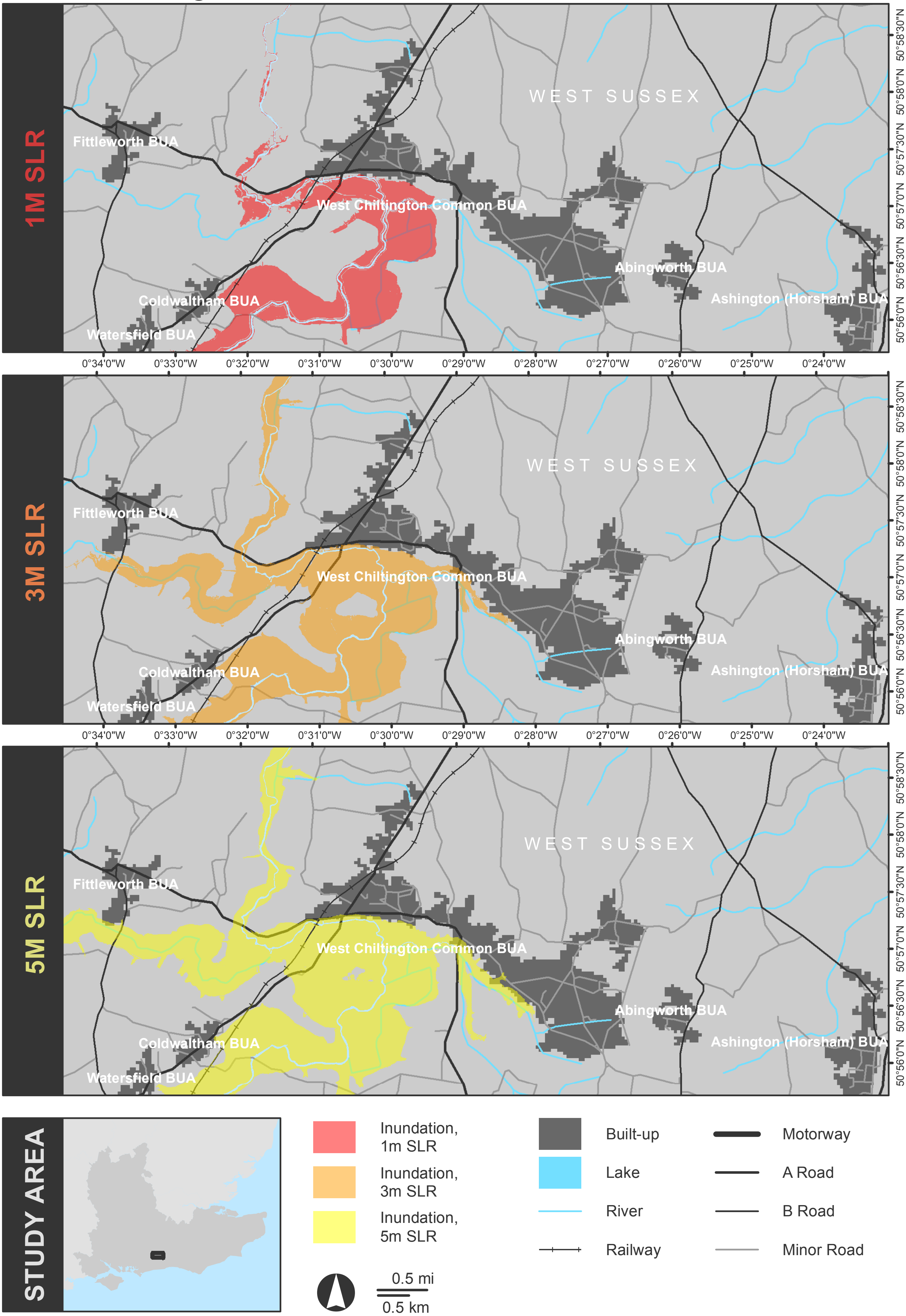
Upchurch BUA



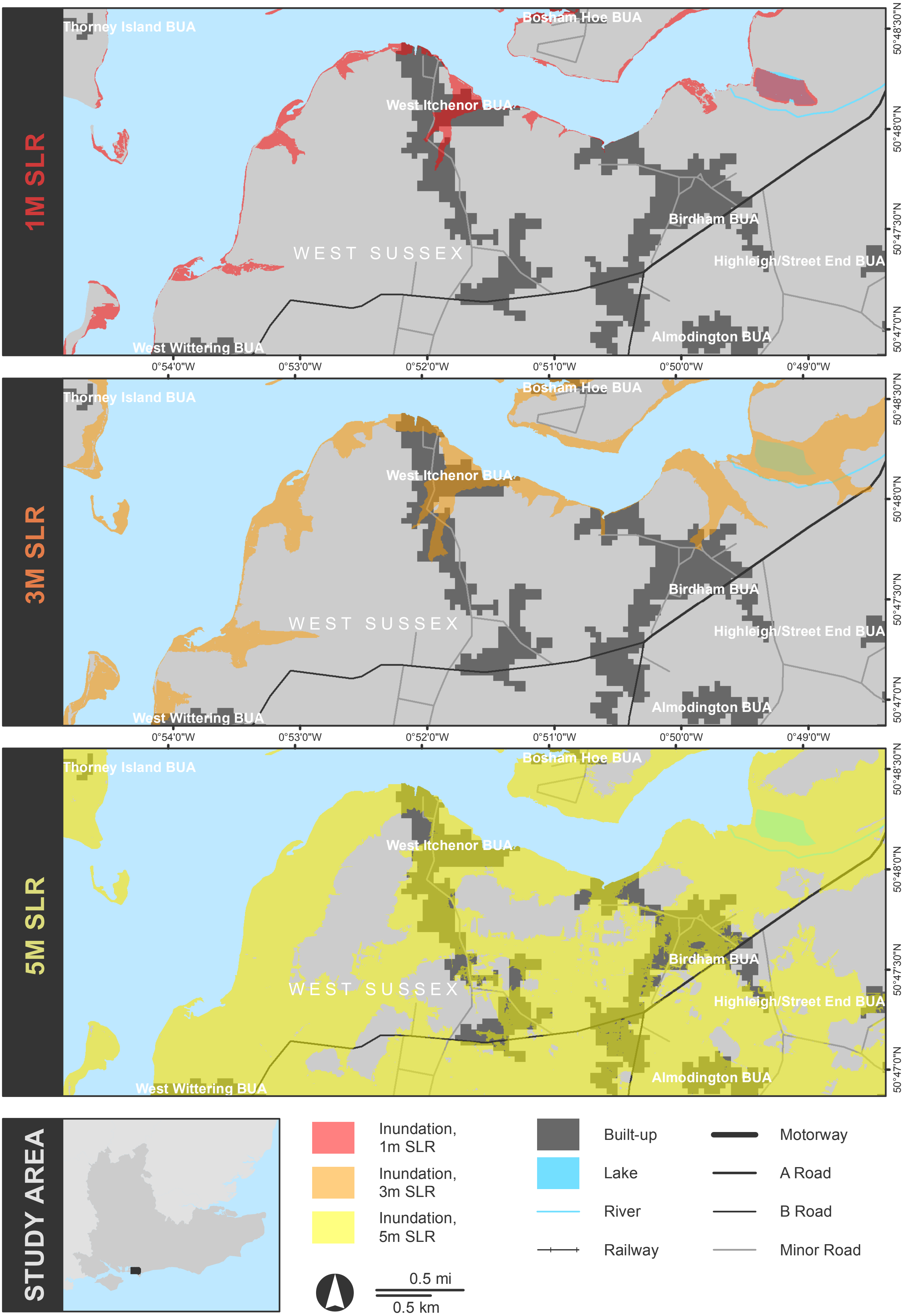
Warehouses, nr Kemsley



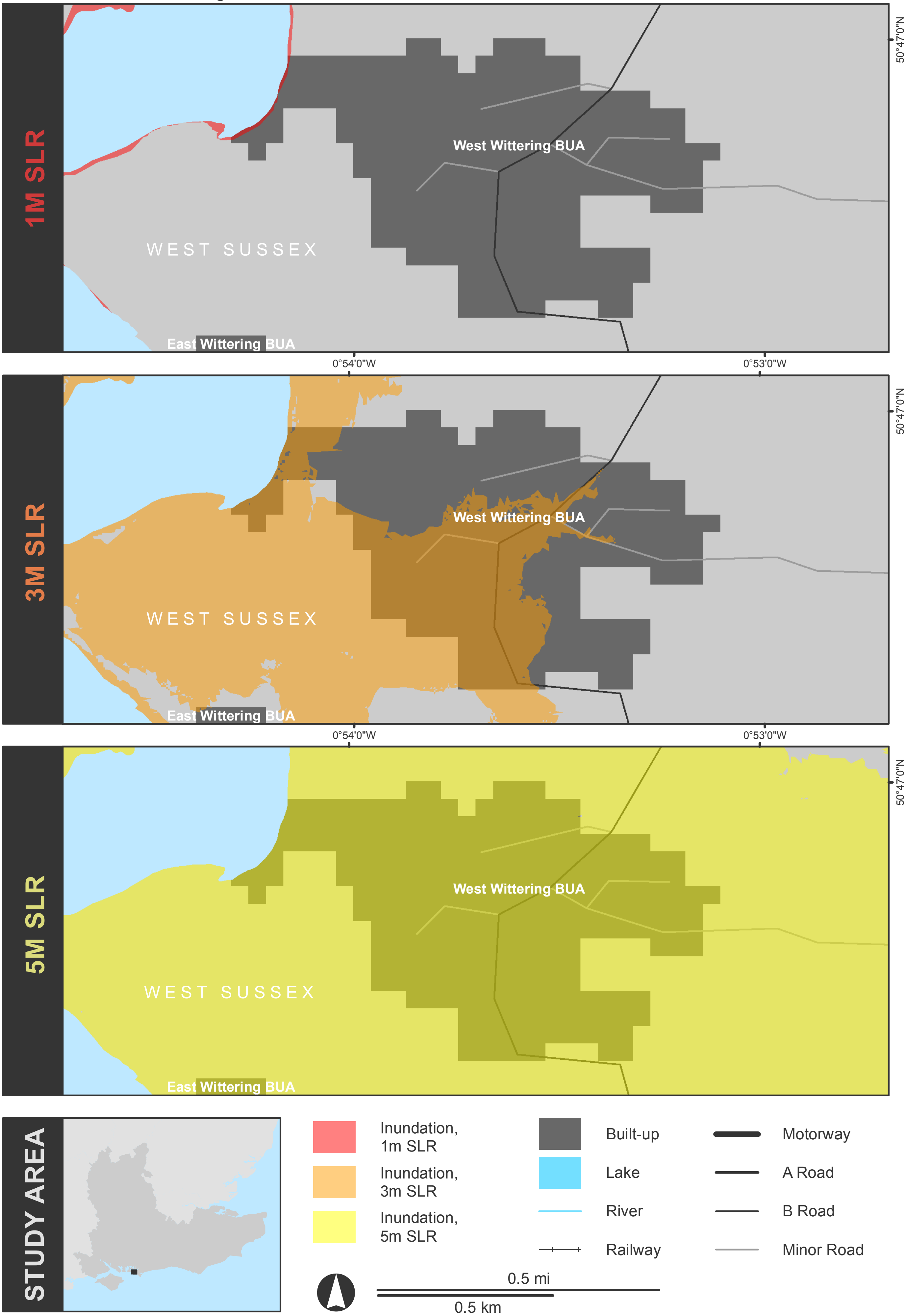
West Chiltington Common BUA



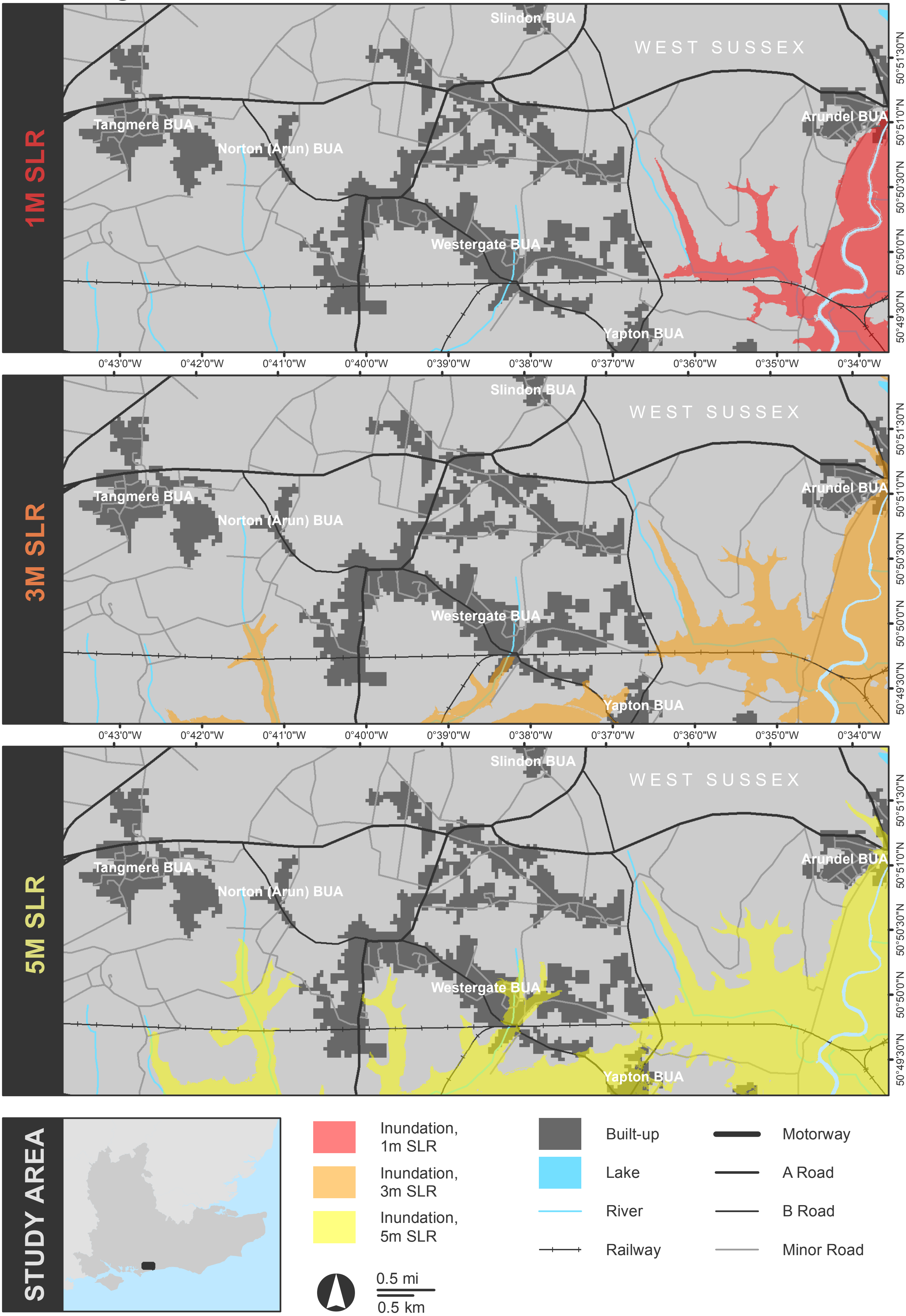
West Itchenor BUA



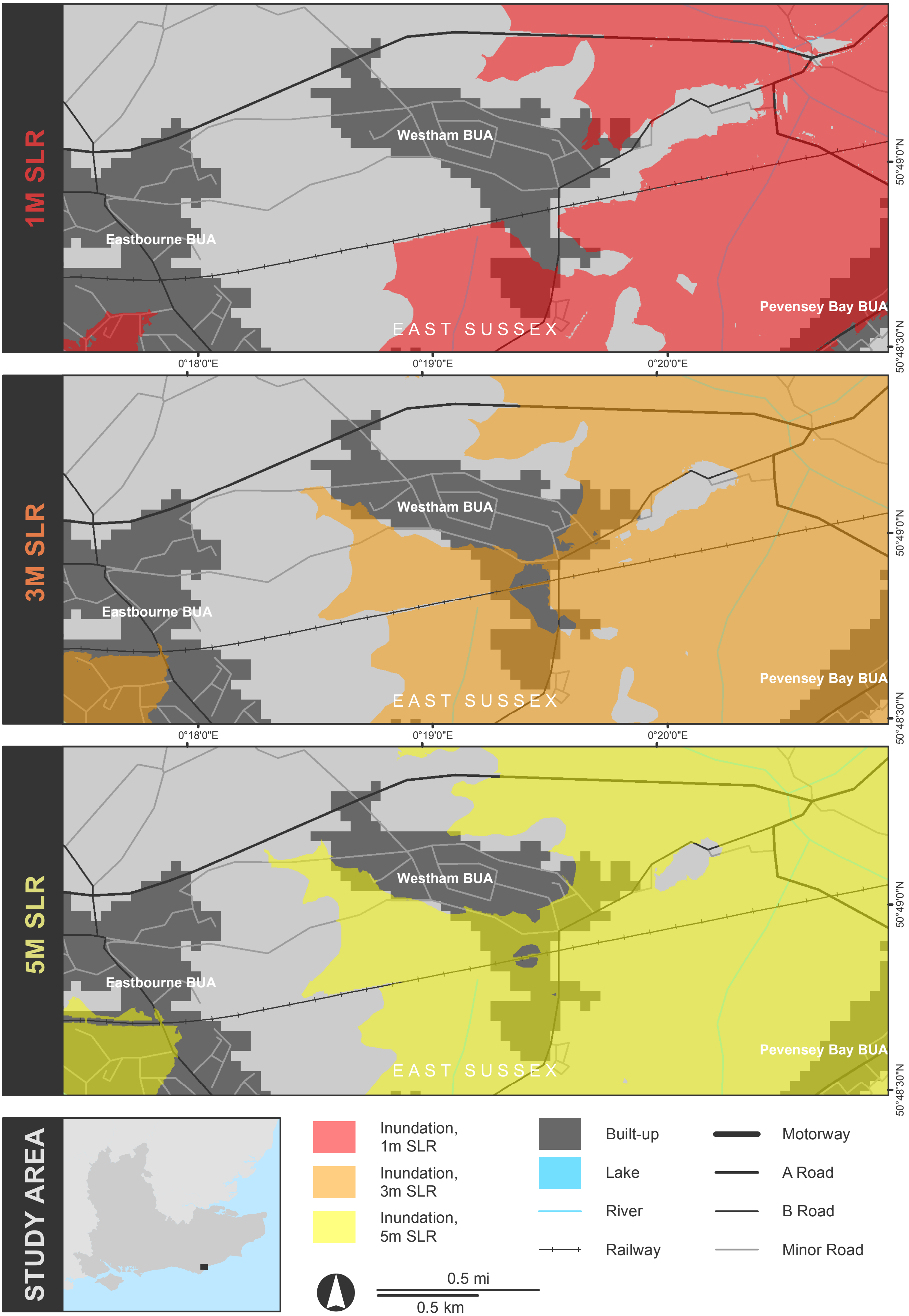
West Wittering BUA



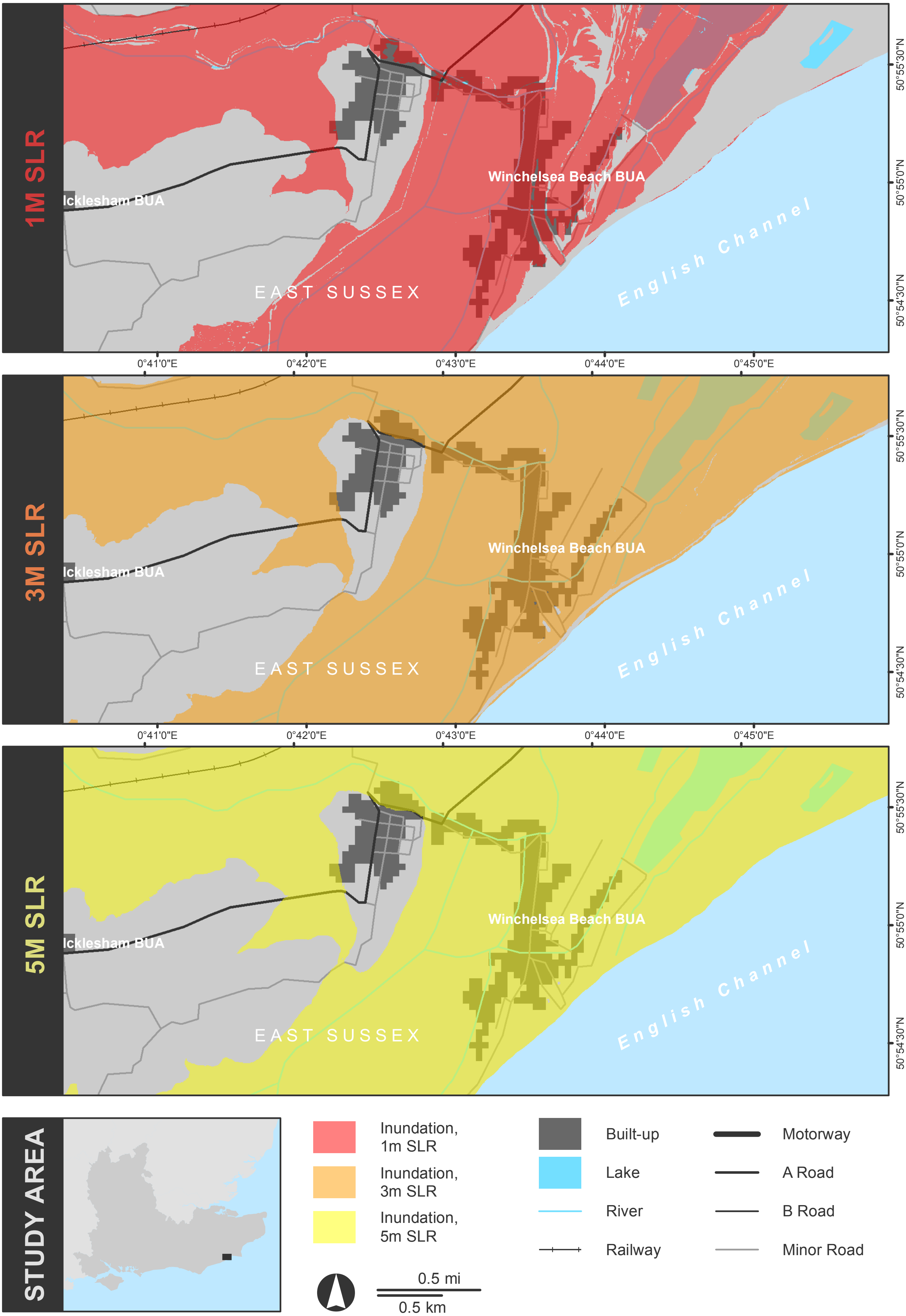
Westergate BUA



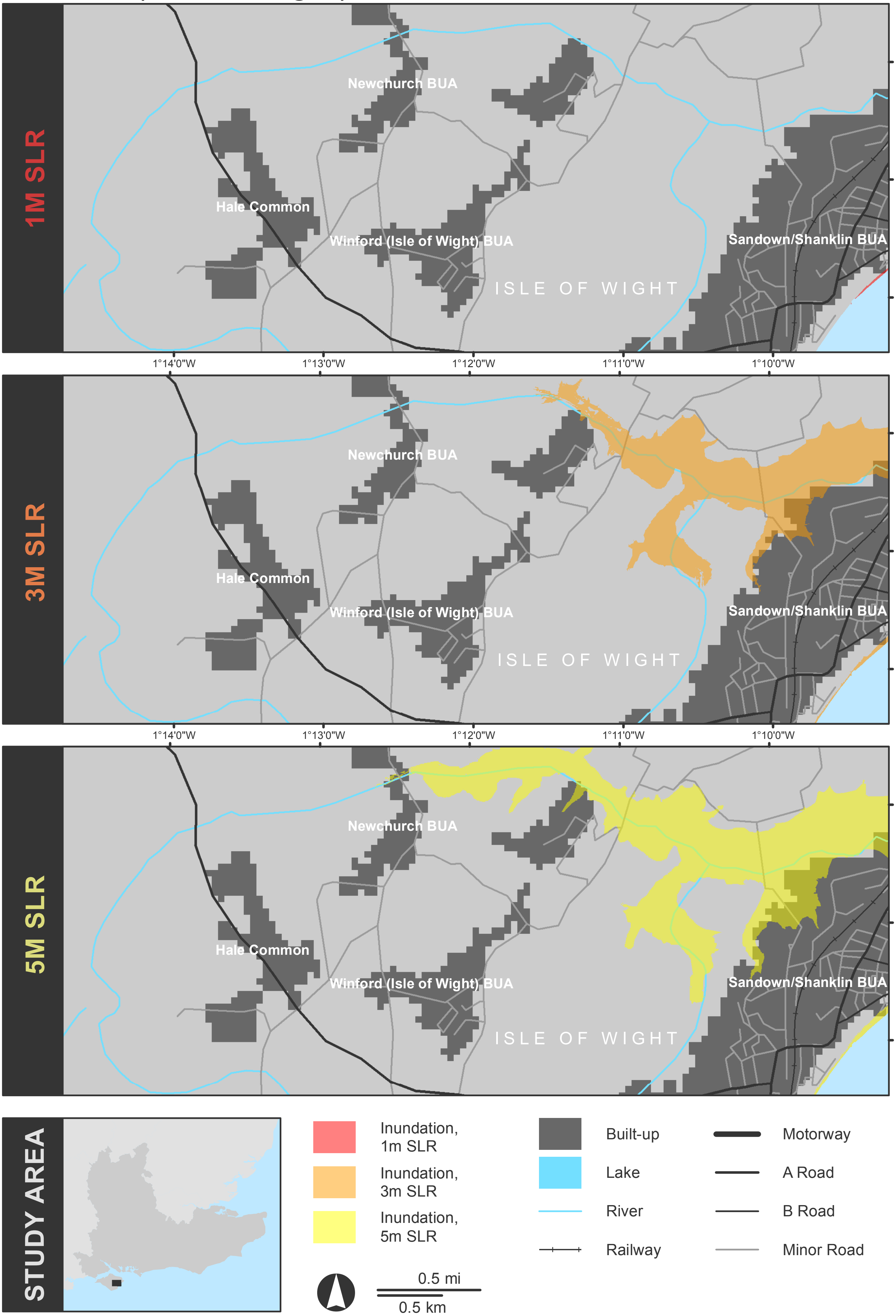
Westham BUA


1M SLR
Westham BUA
Eastbourne BUA
Pevensey Bay BUA
EAST SUSSEX
0°18'0"E
0°19'0"E
0°20'0"E
50°49'0"N
50°48'30"N
3M SLR
Westham BUA
Eastbourne BUA
Pevensey Bay BUA
EAST SUSSEX
0°18'0"E
0°19'0"E
0°20'0"E
50°49'0"N
50°48'30"N
5M SLR
Westham BUA
Eastbourne BUA
Pevensey Bay BUA
EAST SUSSEX
50°49'0"N
50°48'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

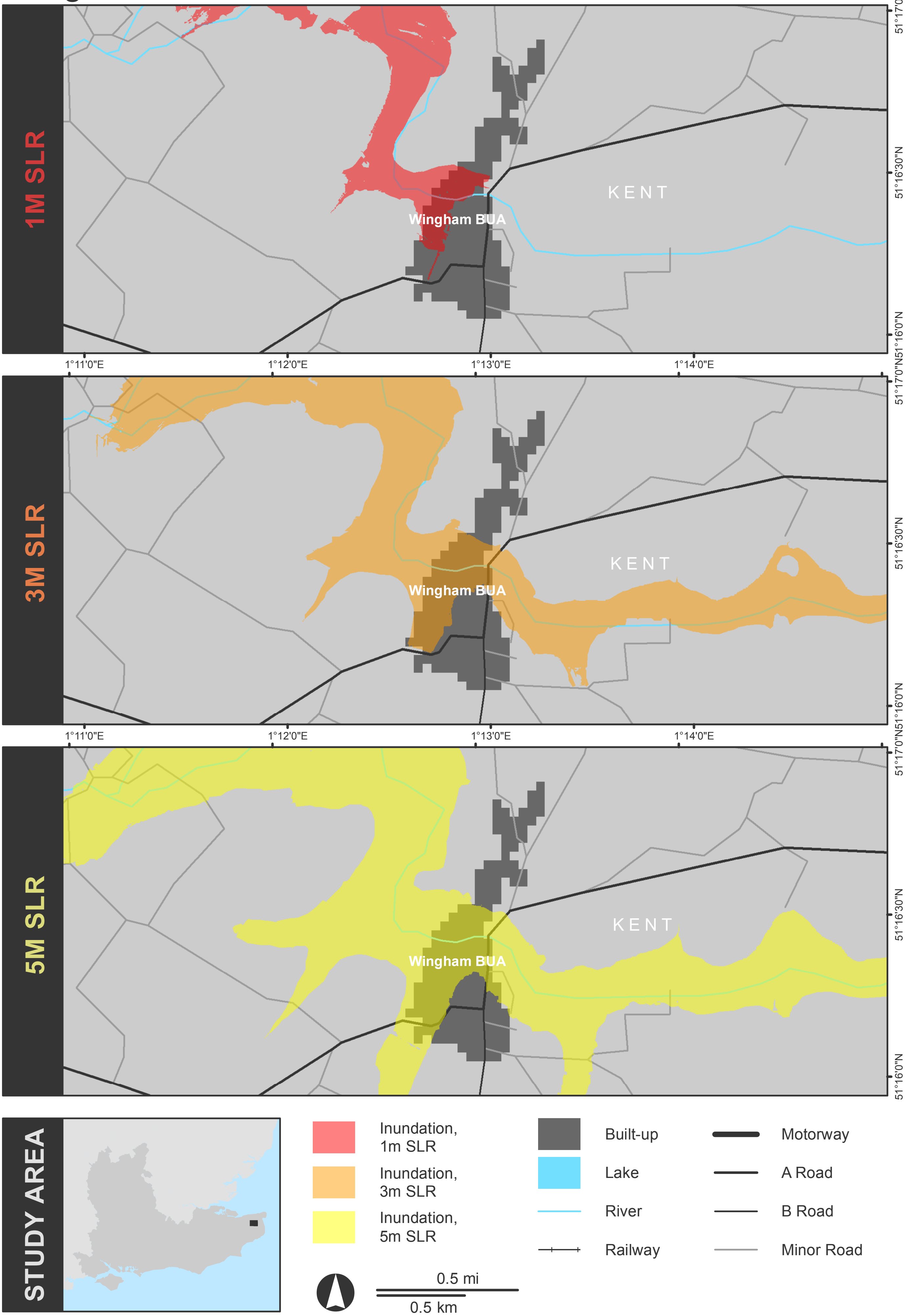
Winchelsea Beach BUA



Winford (Isle of Wight) BUA

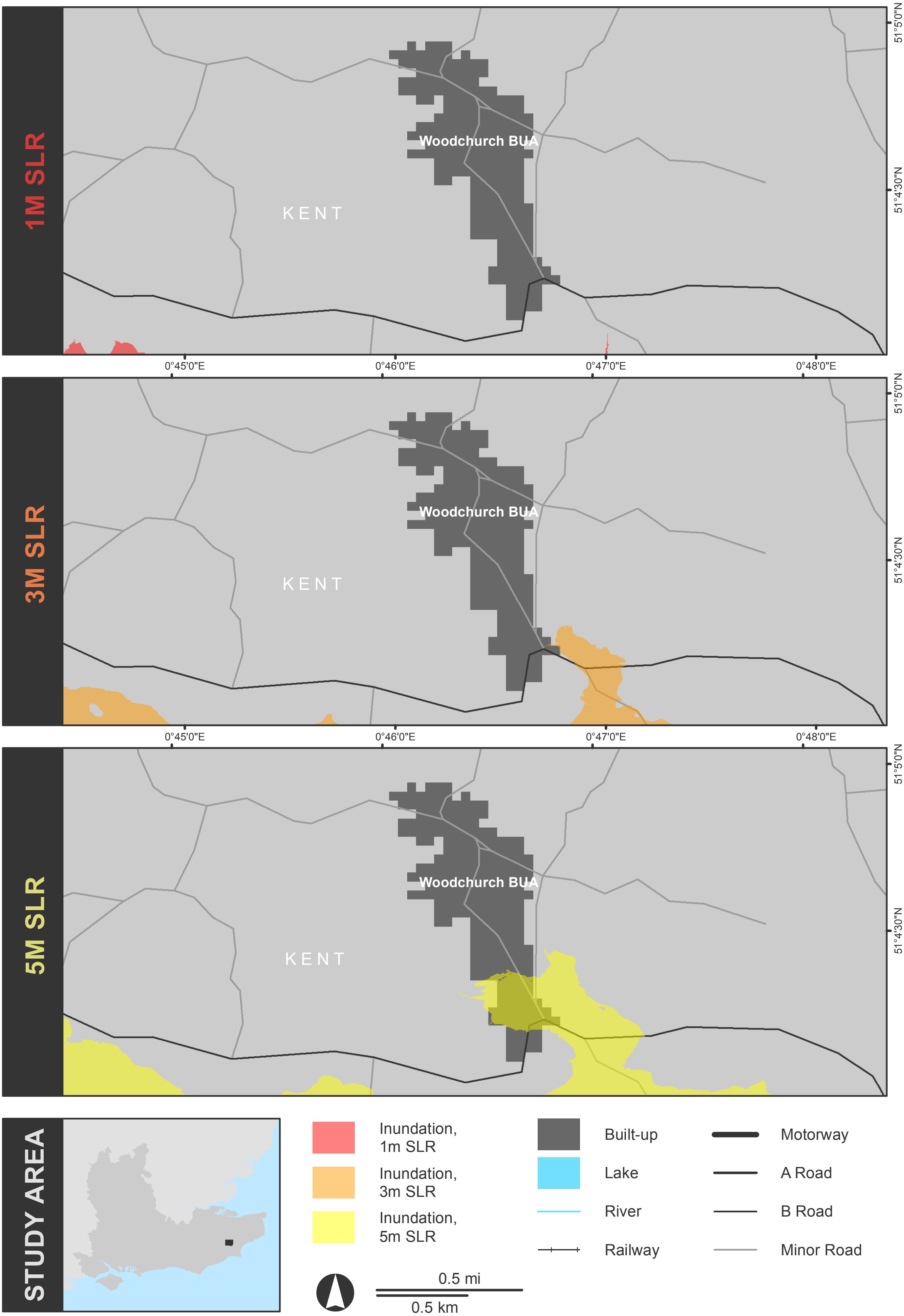


Wingham BUA

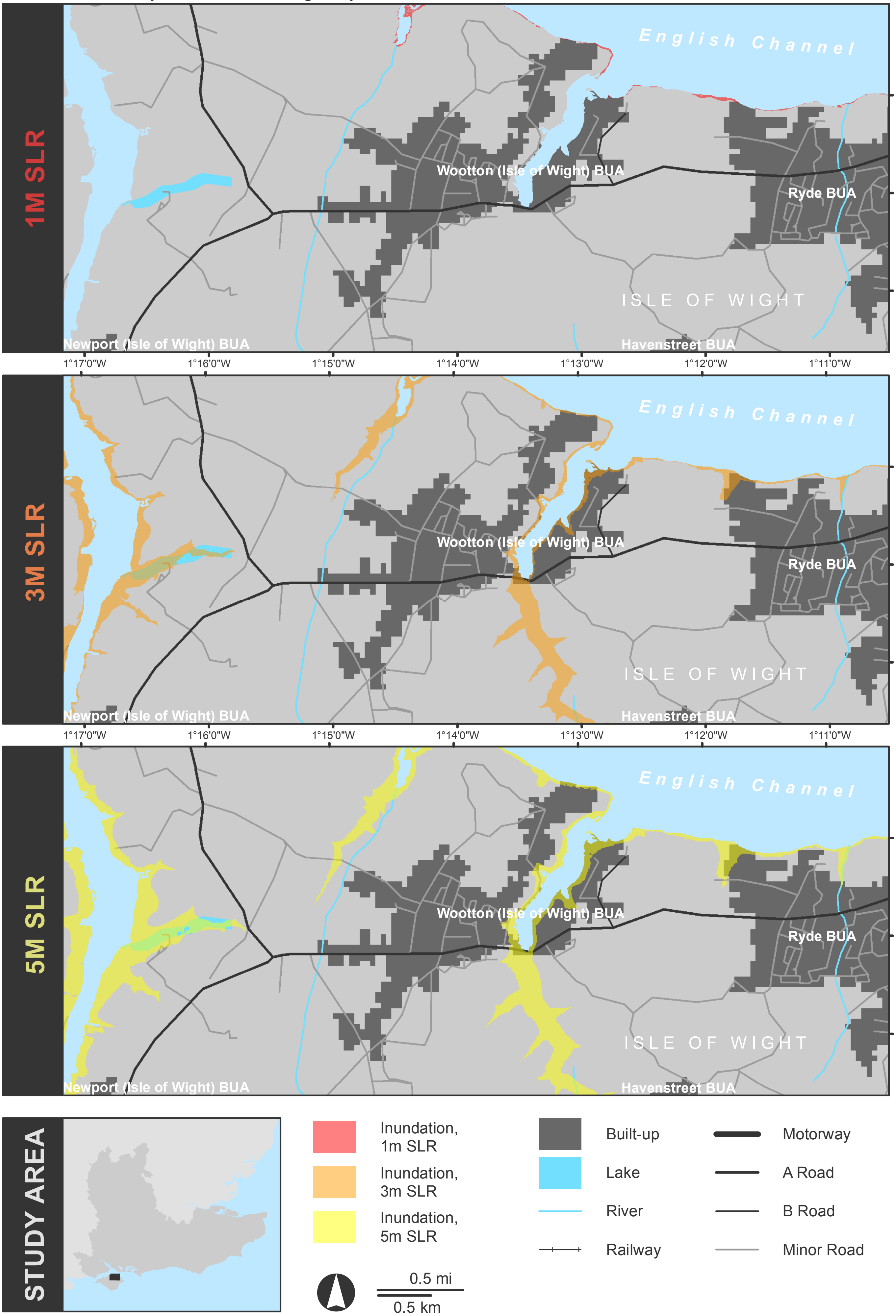


1M SLR
KENT
Wingham BUA
1°11'0"E
1°12'0"E
1°13'0"E
1°14'0"E
51°17'0"N
51°16'30"N
51°16'0"N
3M SLR
KENT
Wingham BUA
1°11'0"E
1°12'0"E
1°13'0"E
1°14'0"E
51°17'0"N
51°16'30"N
51°16'0"N
5M SLR
KENT
Wingham BUA
51°17'0"N
51°16'30"N
51°16'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

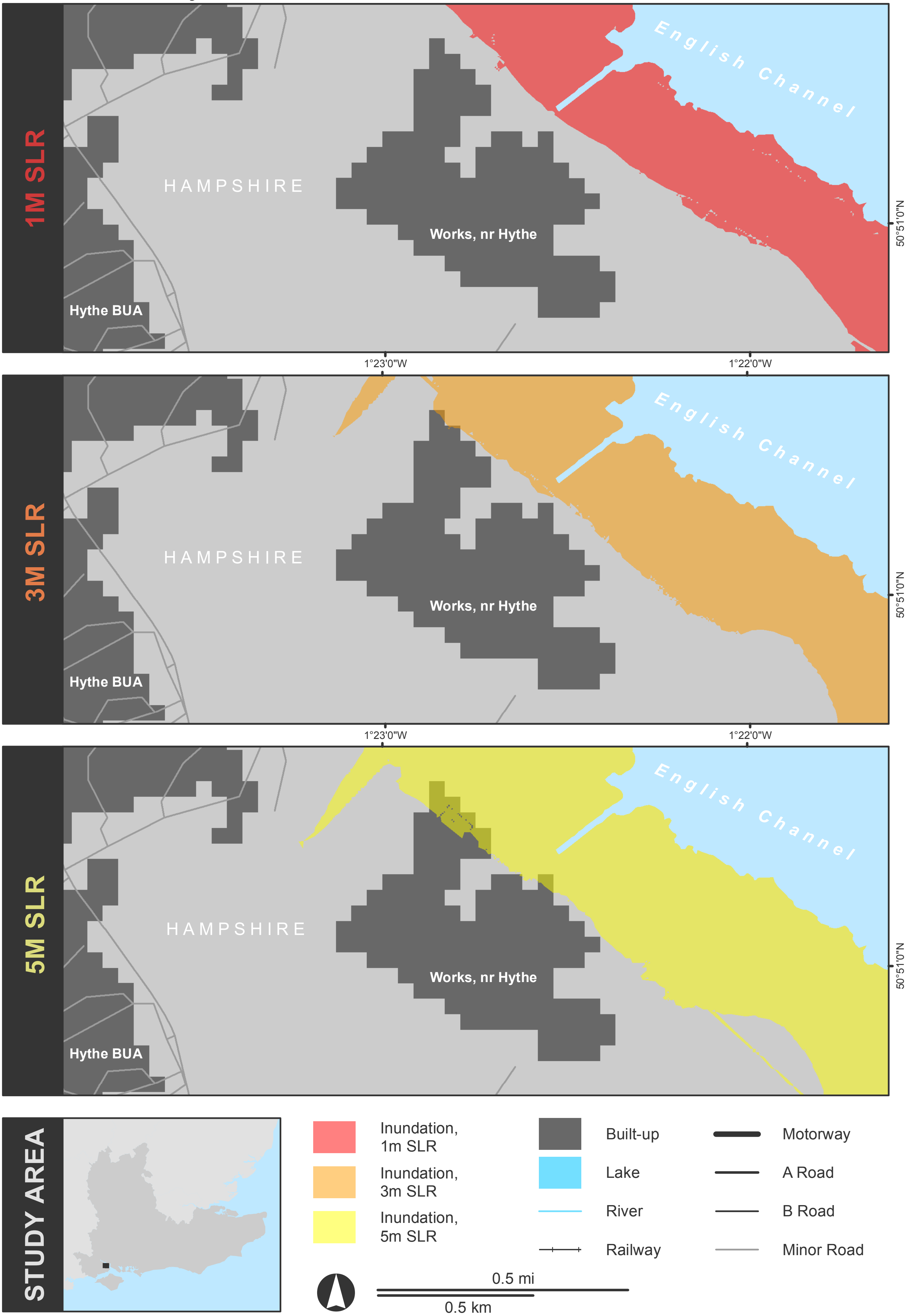
Woodchurch BUA



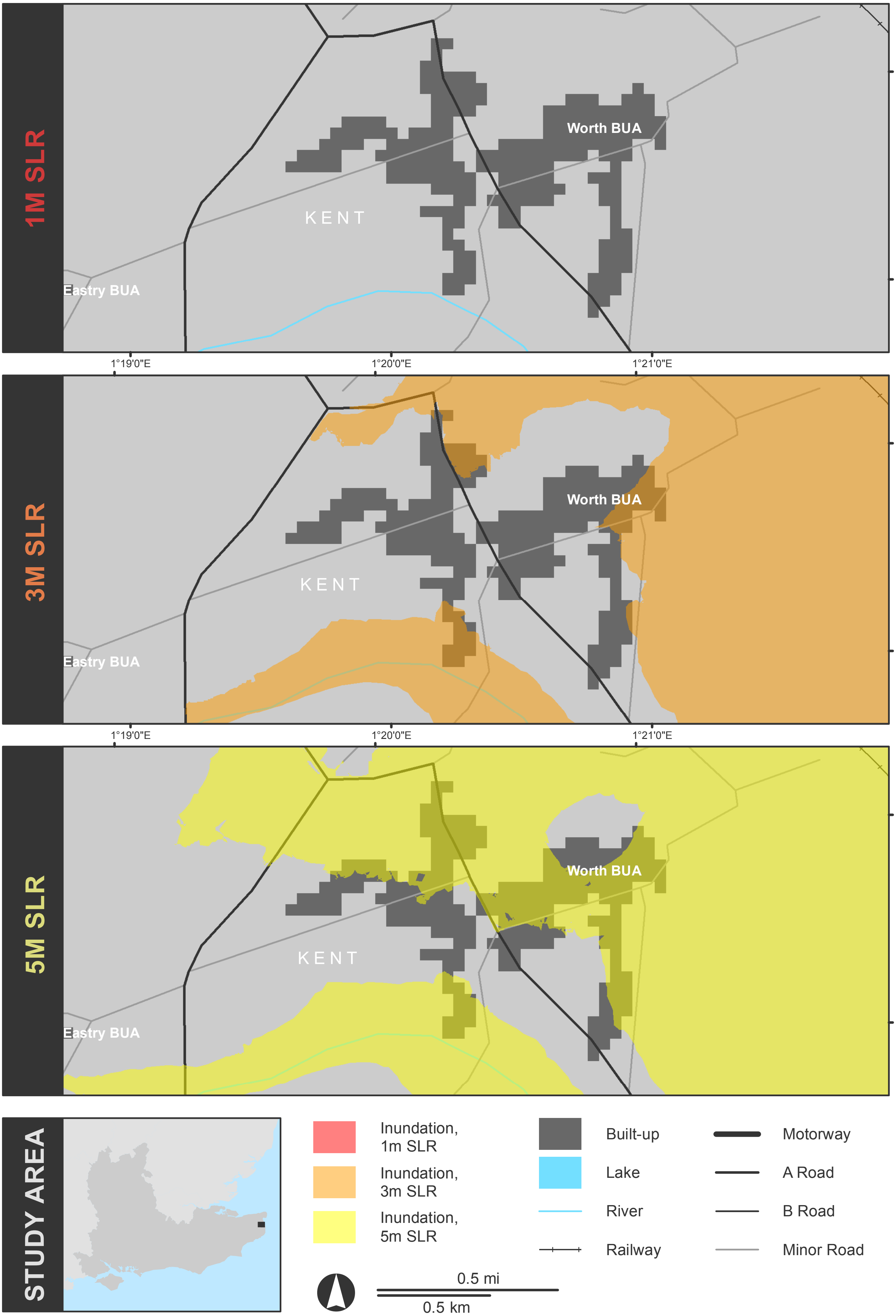
Wootton (Isle of Wight) BUA



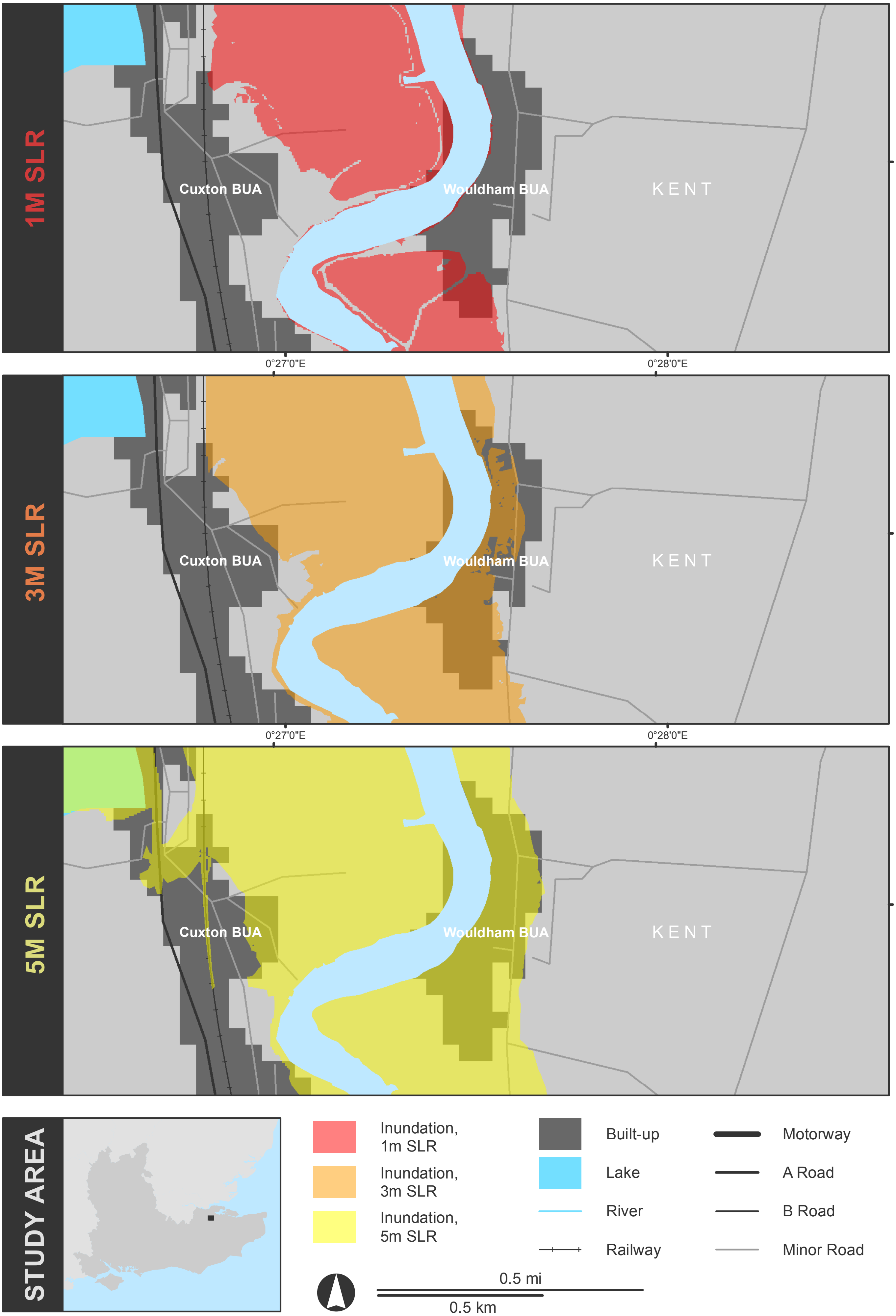
Works, nr Hythe



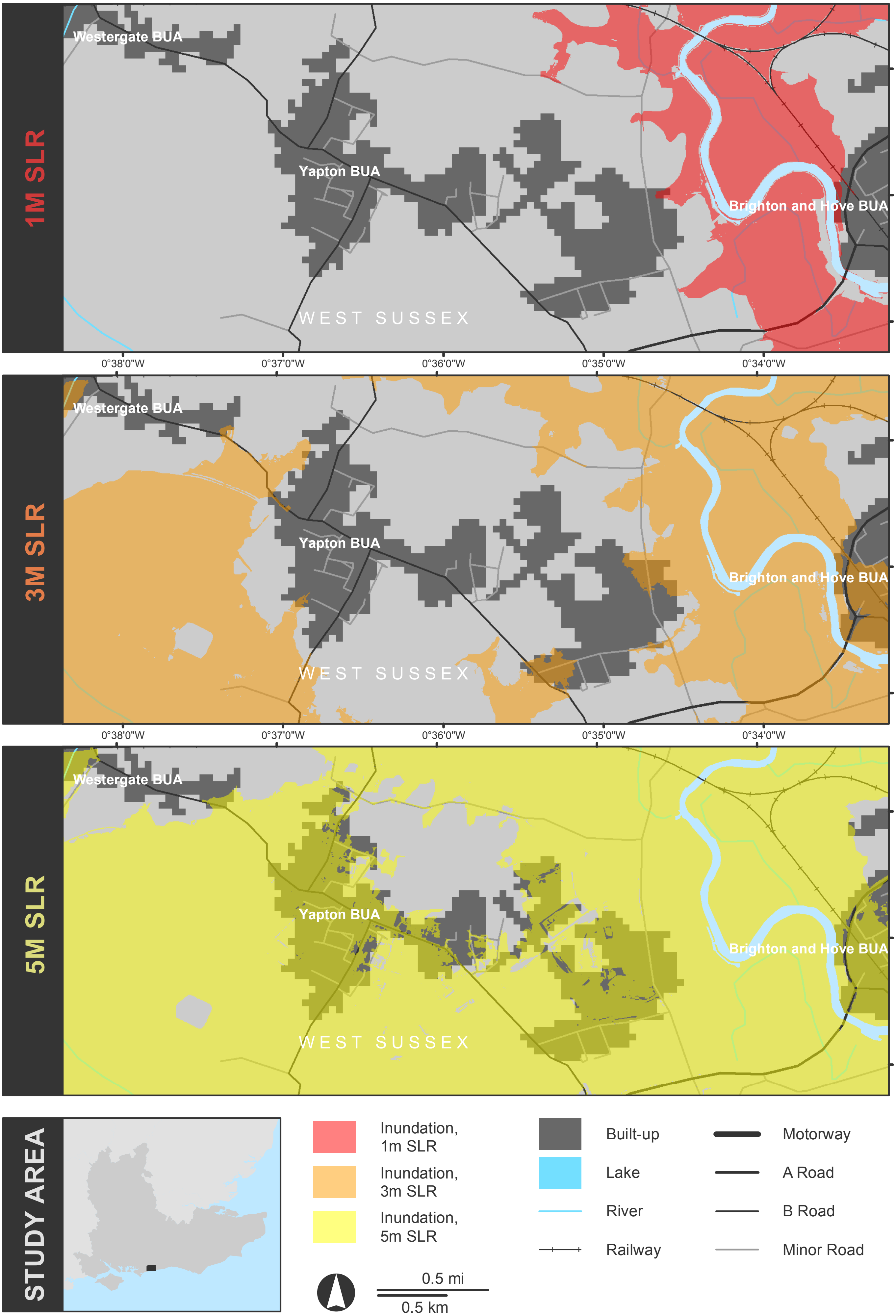
Worth BUA


1M SLR
Worth BUA
KENT
Eastry BUA
51°15'30"N
51°15'0"N
1°19'0"E
1°20'0"E
1°21'0"E
3M SLR
Worth BUA
KENT
Eastry BUA
51°15'30"N
51°15'0"N
1°19'0"E
1°20'0"E
1°21'0"E
5M SLR
Worth BUA
KENT
Eastry BUA
51°15'30"N
51°15'0"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

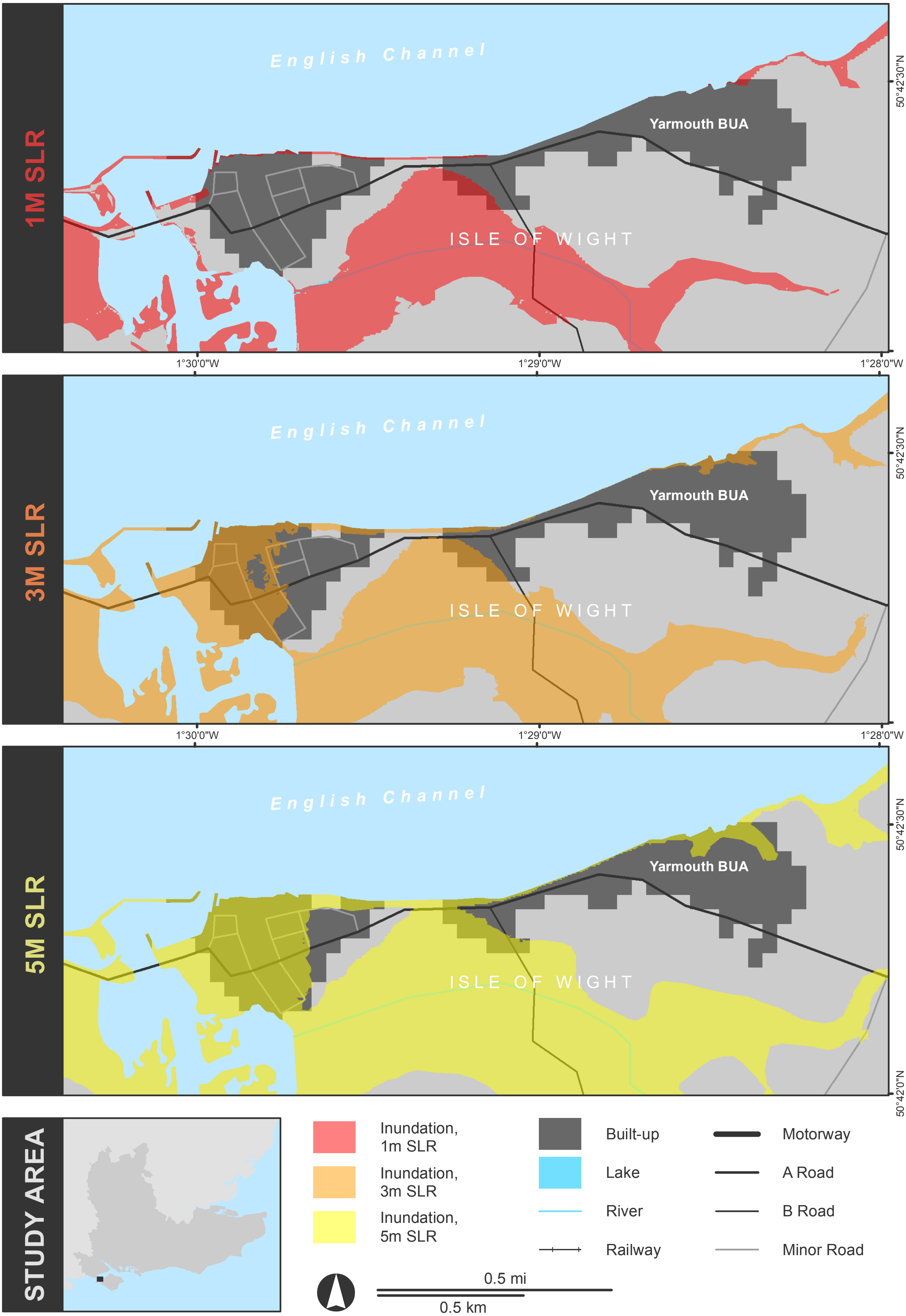
Wouldham BUA



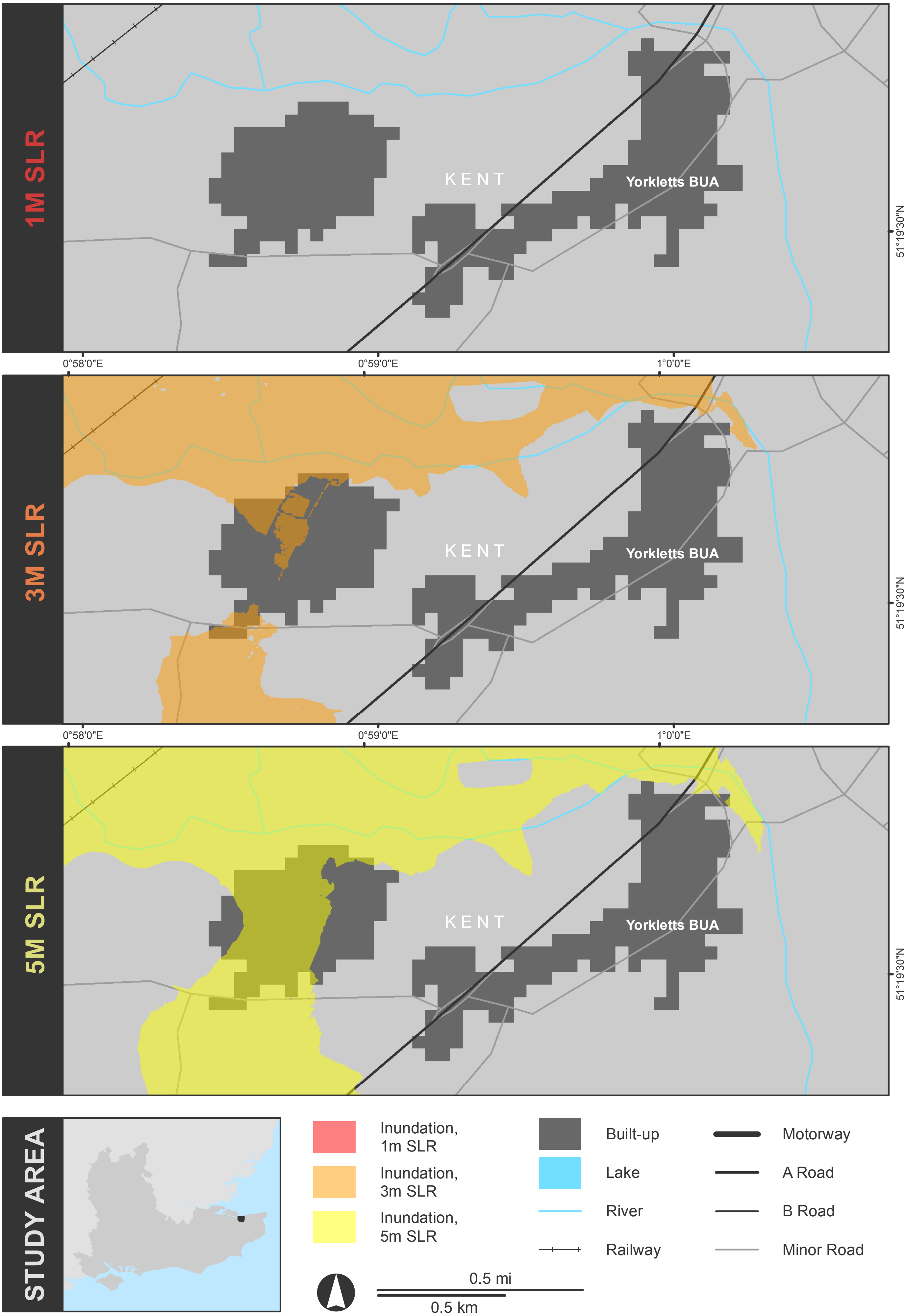
Yapton BUA


1M SLR
3M SLR
5M SLR
Westergate BUA
Yapton BUA
Brighton and Hove BUA
WEST SUSSEX
0°38'0"W
0°37'0"W
0°36'0"W
0°35'0"W
0°34'0"W
50°49'30"N
50°49'0"N
50°48'30"N
STUDY AREA
Inundation, 1m SLR
Inundation, 3m SLR
Inundation, 5m SLR
Built-up
Lake
River
Railway
Motorway
A Road
B Road
Minor Road
0.5 mi
0.5 km

Yarmouth BUA



Yorkletts BUA



Series from Lund University

Department of Physical Geography and Ecosystem Science

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