Valuing the mental health costs of coastal erosion

FCRM Research and Development Programme research report

Environment Agency

03 November 2026

Version: FRS22240/R

We are the Environment Agency

We're here to protect homes and habitats – not just to safeguard what exists, but to create places of resilience and renewal, where nature returns and futures can take root.

We're regulators and reformers, engineers and ecologists, inspectors and incident responders. Some of us are in labs and offices. Others on riverbanks. Many in boots, hi-vis, or waders.

But wherever you find us, and whatever we're doing, we're one team – all guardians.

Published by:

Environment Agency

Horizon House, Deanery Road, Bristol BS1 5AH

www.gov.uk/environment-agency

© Environment Agency 2026

All rights reserved. This document may be reproduced with prior permission of the Environment Agency.

Further copies of this report are available from our publications catalogue: www.gov.uk/government/publications or our National Customer Contact Centre: 03708 506 506

Email: fcerm.evidence@environment-agency.gov.uk

Authors:
Douglas Hardman, Charlotte Taylor, Maria Evangelina Filippi, Christophe Viavattene, Clare Twigger-Ross, Sally Priest

Editor:
Charlie O'Brien

Keywords:
coastal erosion, mental health, depression, valuation methods, economic appraisal, England, Wales

Research contractor:
Eunomia Research & Consulting Ltd, 37 Queen Square, Bristol, BS1 4QS

Environment Agency's Project Sponsor: Harry Walton, Project Executive: Carolann Simmonds, Project Manager: Charlie O'Brien

Project number:
FRS22240

To support our final edit of this report we used the artificial intelligence tool M365 Copilot. The content has been checked and approved by the Environment Agency

Research at the Environment Agency

Scientific research and analysis underpins everything the Environment Agency does. It helps us to understand and manage the environment effectively. Our own experts work with leading scientific organisations, universities and other parts of the Defra group to bring the best knowledge to bear on the environmental problems that we face now and in the future. Our scientific work is published as summaries and reports, freely available to all.

This report is the result of research commissioned and funded by the Joint Flood and Coastal Erosion Risk Management Research and Development Programme. Our vision is that the nation is recognised as a world leader in researching and managing flooding and coastal change.

The Joint Programme is overseen by Defra, the Environment Agency, Natural Resources Wales and the Welsh Government on behalf of all risk management authorities in England and Wales.

You can find out more about our current science programmes at Research at the Environment Agency.

If you have any comments or questions about this report or the Environment Agency's other flood and coastal erosion risk management work, please contact fcerm.evidence@environment-agency.gov.uk.

Dr Robert Bradburne	Julie Foley
Chief Scientist	**Director of Flood Strategy and Adaptation**.

Contents

Contents 4

Executive summary 6

1 Introduction 8

1.1 About the research project 8

1.2 About this report 9

2 Focused literature review 10

2.1 Approach and method 10

2.2 Understanding the potential negative impacts on mental health 13

2.3 Economic valuation: approaches and methods 18

2.4 Synthesis of evidence, gaps and implications 22

2.5 Summary 23

3 Conceptual framework 24

3.1 Mental health impact pathway for coastal erosion 24

3.2 Expert workshop 26

4 Secondary data identification and access 28

4.1 Rationale for identifying and selecting secondary data sets 28

4.2 Available and accessible data sets 29

4.3 Data gaps and limitations 33

4.4 Summary 34

5 Testing the relationship between coastal erosion risk and depression 36

5.1 Approach and method 36

5.2 Data analysis 41

5.3 Summary and findings 55

5.4 Constraints and limitations 56

6 Conclusions 57

6.1 Findings 57

6.2 Future research 59

References 60

List of abbreviations 66

Glossary 68

Appendix 1: data scoping 70

Data set used 70

Data sets explored but not suitable for analysis 71

Executive summary

This research looked at how coastal erosion may affect mental health. It also looked at how these effects could be included in economic appraisal of flood risk management investment in England and Wales.

Background

Current economic appraisal focuses on the cost of assets lost to coastal erosion and the options to avoid, reduce or manage the risk. Existing FCERM appraisal guidance recognises mental health impacts associated with coastal erosion, but limited evidence and data make it difficult to assess and incorporate these costs robustly in decisions about intervention feasibility.

Research approach

The research reviewed available secondary data to understand how coastal erosion may affect mental health. It focused on 3 mental health conditions - anxiety, depression and post-traumatic stress disorder (PTSD).

The research included:

- a focused review of the academic and grey literature
- developing a conceptual framework that explains how coastal erosion can affect mental health, including insights from coastal practitioners
- identifying available and accessible secondary data sets
- analysis of secondary data to understand the relationship between people living in areas at risk of coastal erosion and diagnosis of depression

Findings

There is limited research on how coastal erosion affects mental health and evidence directly linking coastal erosion to clinically defined mental health conditions is scarce. Current national data sets do not capture the mental health impacts of coastal erosion. The only data sets we were able to access and use at appropriate spatial scales in this research examine depression. The available scales and indicators are not sufficient to reliably detect a relationship with coastal erosion risk.

Case studies and practitioner insights show that some people experience stress, anxiety, and other negative wellbeing impacts linked to coastal erosion. However, these findings cannot be generalised to wider populations.

With the limited data available, this research could not improve upon the current method of economically appraising the mental health costs of coastal erosion, as set out on GOV.UK. Our secondary data analysis found no measurable relationship between coastal erosion risk and new depression diagnoses. Data gaps meant anxiety or PTSD could not be analysed.

The conceptual framework we developed through this research helps to explain the complex pathways through which coastal erosion may affect mental health. It includes risk factors,

mediating factors and potential impact pathways, but further research is needed to validate these pathways.

The review of valuation methods found that two potential approaches could, in principle, be used to improve or supplement the existing appraisal treatment of mental health costs associated with coastal erosion. However, both would require further research before they could be applied robustly in practice:

- cost of illness
- willingness to pay

Future research

Future research could focus on collecting primary data directly from communities at risk, ideally at property or local area level. This would help us understand how mental health impacts arise and how those impacts could be used in economic appraisal.

1 Introduction

1.1 About the research project

Coastal erosion already poses risks in England and Wales, and these risks are expected to increase over time as climate change and sea level rise intensify coastal processes.

The national assessment of flood and coastal erosion risk in England 2024 estimates that approximately 3,500 properties are vulnerable to coastal erosion over the next 30 years. A further 10,100 properties in England may become vulnerable over the next 80 years (Environment Agency, 2024a).

There is ongoing work to assess the feasibility of physical interventions to avoid, reduce and manage coastal erosion risk. However, there is currently limited evidence and guidance to support the appraisal of the wider social impacts of coastal erosion, in particular mental health impacts.

Economic appraisal for coastal erosion risk management in England and Wales follows Environment Agency guidance (Environment Agency, 2024b) and applies data and methods set out in the Multi-Coloured Manual (MCM) (Penning-Rowsell and others, 2014). The appraisal process assesses whether the economic benefits of different mitigation options outweigh their costs (Environment Agency, 2024c). Existing FCERM appraisal guidance already recognises and values mental health costs associated with flooding and coastal erosion. This project sought to strengthen the evidence base supporting that guidance by improving understanding of how coastal erosion affects mental health and exploring whether existing valuation methods could be refined.

This research reviewed approaches for valuing mental health impacts that could, in principle, be incorporated into economic appraisal. The research aimed to improve understanding of how coastal change may affect mental health and to explore whether, and how, these effects could be better considered within existing appraisal frameworks. This was done by:

- a focused review of the academic and grey literature
- developing a conceptual framework that explains how coastal erosion can affect mental health, including insights from coastal practitioners
- identifying available and accessible secondary data sets
- analysis of secondary data to understand the relationship between people living in areas at risk of coastal erosion and diagnosis of depression

The project was guided by the following research question: how can the Environment Agency, Natural Resources Wales (NRW) and local risk management authorities appraise the mental health costs of coastal erosion in England and Wales?

There can be different ways to define the terms coastal erosion (sometimes referred to as shoreline retreat) mental health condition, mental disorder and psychosocial-disability.

The definitions we use in this project are listed in the glossary.

The research focused on 3 specific mental disorders: depression, anxiety and post-traumatic stress disorder (PTSD). We selected these conditions as they offer a practical way to apply the concept of mental health in this study. This focus also meant we could measure potential mental health impacts associated with coastal erosion at a national scale using available and accessible secondary data sets for England and Wales. The project team recognises the limitations of this approach, including the likelihood that some mental health impacts, such as those that are undiagnosed or unreported, are not captured (Findlater and others, 2023).

1.2 About this report

This research report brings together the 4 main components of the project:

- the focused literature review
- developing the conceptual framework
- identifying secondary data sets
- secondary data analysis

These are set out in the following sections.

Section 2 explains the focused literature review, including the approach and method, and the main findings related to the 2 research questions that guided the review.

Section 3 introduces the conceptual framework, namely the mental health impact pathway for coastal erosion that guided the identification, selection and analysis of secondary data sets.

Section 4 describes the process for identifying, selecting and requesting available and accessible secondary data sources and related data gaps and limitations.

Section 5 elaborates on the secondary data analysis, covering the approach and method, a detailed overview of the data analysis for England and Wales, and a synthesis of the findings.

Section 6 brings together the main conclusions of the research project and a proposal of potential pathways to an economic approach to valuing the mental health costs of coastal erosion that could be taken forward by future research.

2 Focused literature review

The literature review builds on the research carried out by Simmonds (2023) by identifying and assessing additional relevant publications. The review also considered relevant literature from related fields, where this evidence could help inform the project objectives.

The review adopted a focused approach reflecting the relatively limited number of relevant publications available across academic and grey literature. In total, 25 publications were screened and ranked, with 10 sources selected for more in-depth analysis.

2.1 Approach and method

The literature review had 2 main objectives:

- to improve understanding of the potential negative impacts of coastal erosion on mental health and related mechanisms through which these impacts may arise
- to identify economic valuation methods that have been used to estimate the monetary costs of mental health impacts associated with coastal erosion

Therefore, 2 research questions (RQs) guided the focused literature review:

- RQ1: what are the potential mental health impacts associated with coastal erosion?
- RQ2: which economic valuation methods does the research propose for estimating the cost of mental health impacts from coastal erosion?

The focused nature of the review required a structured approach and method which consisted of:

1. Literature search.
2. Relevance ranking and shortlisting.
3. Analysis of shortlisted sources.

2.1.1 Literature search

Literature searches were conducted using Google Scholar and ScienceDirect search engines. ScienceDirect provided access to peer-reviewed academic literature, while Google Scholar broadened coverage to include relevant grey literature.

Sources identified through the searches were collated into a longlist. The search was limited to sources published in English, although studies were not excluded based on geographical context. Table 1 presents the search strings used in the literature search.

Table 1: Literature review search strings

Search string	Number of sources identified
Mental illness AND coastal erosion	5
Mental health AND coastal erosion	7
Valuing mental health impacts AND coastal erosion	2
Economic assessment AND mental illness AND coastal erosion	2
Environmental valuation AND coastal erosion	5
Mental wellbeing AND coastal erosion	2
Coastal erosion AND (depression OR anxiety OR post-traumatic stress disorder)	2

The review builds on Simmonds (2023) therefore excluded literature already reviewed in that study. Following initial screening, 25 relevant sources were identified and grouped into 2 broad areas aligned with the research questions:

1. literature relating coastal erosion to mental health impacts.
2. literature on the valuation of the impacts of coastal erosion.

The first group of studies helps to understand the pathways linking coastal erosion to mental health outcomes. The evidence gathered came from studies either undertaking systematic literature reviews or collecting primary data using research methods such as surveys and focus groups or interviews (or both).

The second group of studies focuses on the valuation of the impacts of coastal erosion, though not all studies focused on mental health impacts. This literature includes research applying valuation techniques such as hedonic pricing and contingent valuation.

The literature search did not identify any studies that assign monetary values to the mental health impacts of coastal erosion. As part of the initial screening process, the project team briefly considered whether evidence from related areas, such as slow onset environmental hazards or other causes of permanent land loss, could offer relevant methodological or conceptual insights as proxies. 7 additional sources were selected. However, the review concluded that such studies do not provide valid proxies for coastal erosion in the UK context, due to differences in the nature of the hazard, the characteristics of affected populations, and institutional and policy settings. Findings from this screening exercise are therefore not presented in this report.

An additional 9 sources were added to the longlist based on the project team's expert knowledge of the literature (for example, prominent authors in the field) and by identifying relevant references from sources identified in the literature search (for example, snowballing).

2.1.2 Relevance ranking and shortlisting

The literature search generated a longlist of 40 sources. For each source, the project team collated descriptive information, including lead author, year of publication, publication outlet, key words, and abstract or summary of the publication. Details of the literature screening process are available in a separate background note and can be requested if needed.

Each source was assessed for relevance against 3 criteria:

- relevance to RQ1: mental health impacts of coastal erosion
- relevance to RQ2: valuation methods
- geographical context

For each criterion, sources were scored using the following scale:

- 0 = not relevant
- 1 = some relevance
- 2 = clear relevance

Total scores for each source, were calculated by summing the scores across the 3 criteria, ranging from 1 to 6 (6 being the highest score). 6 sources with scores of 4 or above were shortlisted for detailed review.

A further 4 sources were identified based on their potential to address knowledge or methodological gaps not covered by the shortlisted literature. These additional sources were:

- Ninomiya and others (2023)
- Bakolis and others (2021)
- Murray and others (2024)
- Kabir and others (2024)

Ninomiya and others (2023) and Bakolis and others (2021) were selected because they study the effects of land dispossession due to industrial resource development and air pollution on mental health. While not specific to coastal erosion, these studies provide relevant conceptual and methodological insights into how environmental and displacement-related pressures can affect mental health.

Murray and others (2024) was selected because of its focus on the UK context and the use of UK-specific secondary data, specifically, the UK Household Longitudinal Study. In contrast, other shortlisted literature either drew on international evidence or UK case-based studies that did not use national representative secondary data.

Kabir and others (2024) was selected because it is a recent systematic review drawing on both quantitative and qualitative evidence, addressing a gap in the coverage of quantitative evidence

within the shortlisted literature. Following initial shortlisting, expert judgement from the project team and project steering group was used to review and refine the selection, ensuring that the main conceptual and methodological gaps were addressed. As part of this process an additional 5 literature sources were reviewed in detail following recommendations form the project steering group. This process resulted in a final set of 15 studies being taken forward for detailed analysis.

2.1.3 Analysis of shortlisted sources

All 10 shortlisted studies were reviewed in detail using an analysis matrix. For each study, we recorded information on the type of hazard studied, the research design, the main findings, relevant data sets and research methods used, and any knowledge or methodological gaps. The findings from this analysis are organised by research question 1 and research question 2 and are presented in section 2.2 and section 2.3.

As mentioned previously, studies relating to slow-onset environmental hazards and phenomena with similar impacts to coastal erosion were not included in the detailed analysis, as they were not considered valid proxies for coastal erosion in the UK context.

2.2 Understanding the potential negative impacts on mental health

In this review, mental health is interpreted in line with the World Health Organisation (WHO) definition. The WHO defines mental health as "a state of well-being in which the individual realises his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community" (World Health Organization, 2022b). Under this definition, good mental health extends beyond the absence of mental disorders.

Mental disorders are defined as diagnosable conditions that affect an individual’s cognition, emotional regulation, or behaviour (World Health Organization, 2022b). Depression, anxiety and post-traumatic stress disorder (PTSD) are examples of mental disorders.

The studies reviewed use a range of terms to describe aspects of mental health and mental disorders, but explicit conceptual definitions are often not provided; meaning is inferred from the methods used to measure a given outcome. A summary of the measurement approaches used in the reviewed literature is provided in the following sub-section.

The remainder of the section presents the findings relevant to research question 1 (RQ1) which are organised by themes. It first examines the relationship between coastal hazards and mental health outcomes, before considering potential mediating factors. Knowledge and methodological gaps are then discussed.

2.2.1 Coastal hazards and mental health impacts

The reviewed literature indicates that exposure to coastal hazards may be associated with adverse mental health outcomes. Evidence is drawn from studies examining a range of coastal contexts.

Hooper Bay, Alaska (Schwoerer and others, 2023)

Survey-based research conducted in the remote rural community in Hooper Bay, Alaska found evidence of PTSD-related symptoms among individuals following exposure to a coastal storm (Schwoerer and others, 2023). In this setting, the erosion of the protective sand dunes contributed to increased storm surges and coastal flooding.

This study used the Impact of Event Scale (IES) to measure the severity of reported symptoms. The IES is a self-report questionnaire commonly used in research and clinical settings to measure symptoms related to PTSD. Respondents use a 5-point Likert scale, with scores ranging from 0 (not at all) to 4 (extremely), to respond to statements about distress related to a specific traumatic event.

The IES assesses 3 symptom clusters:

- intrusion (for example, experiencing flashbacks, intrusive thoughts)
- avoidance or numbing (for example, avoiding reminders of the trauma)
- hyperarousal (for example, irritability, hypervigilance) (Weiss and Marmar, 1997)

In this study, symptoms related to intrusion and hyperarousal were common among respondents. Respondents reported strong feelings of being watchful or on guard in the following a coastal storm.

Asia-Pacific region (Kabir and others, 2024)

Kabir and others (2024) conducted a systematic review of evidence from coastal communities in the Asia-Pacific region, examining the relationship between coastal hazards and psychological wellbeing. The research reported 77% of the studies identified evidence of a negative association between coastal hazards and psychological health (Kabir and others, 2024).

Across the reviewed studies, reported mental health impacts included increased prevalence of depression, anxiety, psychological distress, general stress, PTSD, bipolar disorder, psychosis and other psychiatric conditions, as well as suicidal tendencies.

The coastal hazards considered extended beyond coastal erosion and included sea level rise which is particularly relevant for understanding longer-term and cumulative coastal change.

Solomon Islands (Asugeni and others, 2015)

A study of coastal communities in the Soloman Islands reported high levels of psychological concern related to sea level rise. As reported in Kabir and others (2024) 98% of participants indicated feelings of worry associated with exposure to sea level rise, and 95% acknowledged negative effects on their psychological health (Asugeni and others 2015).

Coastal Transition Accelerator Programme project (Coastwise)

Survey evidence from North Norfolk, UK collected as part of a Defra and Environment Agency-funded Coastal Transition Accelerator Programme project (Coastwise) gathered responses from 957 individuals with a range of connections to the coast, including residents, business owners and

visitors (Copping and others, 2024). Of the individuals who completed the survey 271 provided open-text responses to a question asking whether they or someone they knew had been affected by coastal erosion.

Among those open-text responses, 24 respondents (approximately 9%) referred to experiences of stress or anxiety in relation to coastal erosion, commonly linked to concerns such as potential property loss, fear of cliff collapse, or difficulty selling homes (Copping and others, 2024). A smaller number of respondents (3 individuals around 1%) explicitly mentioned loss of peace of mind, whilst 7 respondents (approximately 3%) described feelings of sadness associated with loss of familiar places or changes to the local landscape (Copping and others, 2024).

Some respondents reported direct personal experience of coastal erosion: of the 830 individuals who answered this survey question, 54 respondents (around 7%) stated that they themselves had been affected (Copping and others 2024). Respondents varied widely in their proximity to, and experience of, coastal erosion, which limits interpretation of these findings and the extent to which they can be generalised.

When asked to rate the extent to which coastal erosion affected their personal wellbeing on a scale from 1 to 10, responses were more frequently concentrated towards the negative end of the scale than the positive. Higher scores were more commonly reported by respondents who expressed greater concern about coastal erosion and who lived closer to the coast, while lower scores tended to be reported by respondents living further inland (Copping and others, 2024). Interpretation of responses to this question is subject to uncertainty, as the wording may have been understood differently by respondents. This highlights the importance of careful question design in future surveys exploring the wellbeing impacts of coastal erosion.

A second survey was conducted as part of the Coastwise project explored wellbeing using the Office for National Statistics (ONS) standard wellbeing questions, alongside an additional question asking whether coastal erosion in North Norfolk affected respondents' wellbeing (Copping and others, 2025). This survey included 53 respondents, most of whom lived in communities already experiencing coastal erosion. Reported levels of overall life satisfaction and sense of worth showed limited variation between respondents. However, anxiety scores differed more noticeably: of the 15 respondents reporting high anxiety, 14 (93%) stated that coastal erosion affected their wellbeing, compared with 9 out of 19 respondents (47%) reporting very low anxiety scores (Copping and others, 2025). Open-text responses accompanying these findings frequently referred to worry about future change, potential property loss, and perceived lack of support.

Findings from this second survey should be interpreted with caution due to the small sample size, the exploratory nature of the analysis, and the inclusion of a non-standard, erosion-specific wellbeing question alongside the ONS measures (Copping and others, 2025). Evidence from this survey is also drawn from a draft report shared for the purposes of this research. Overall, the Coastwise surveys provide context-specific examples of how coastal erosion is perceived and experienced by some individuals, rather than robust estimates of population-level mental health or wellbeing impacts.

Fairbourne

Evidence from the Health Impact Assessment for Fairbourne (Savils, 2023) provides insight into how coastal change may influence mental health through prolonged uncertainty and indirect social and economic impacts.

Fairbourne is a village in North Wales, where residents face a high risk of displacement linked to coastal change. This is due to direct exposure to hazards and increased media messaging since 2014 about the possibility that people might have to leave the village due to the permanent inundation.

Community consultation, including questionnaires, drop-in sessions and interviews, indicates that this uncertainty has had significant social and economic effects with implications for mental health. Residents reported sharp reductions in property values when the possibility of managed retreat in Fairbourne was first raised, alongside subsequent difficulties accessing mortgages and equity release, outward migration of younger residents, an ageing population, and a decline in local amenities and services (Savills, 2023). These changes are reported to have contributed to increased stress and anxiety among some residents.

Population-level data from the National Survey for Wales (2016–17) show that average mental wellbeing and life satisfaction scores for the relevant health board area are higher than the Welsh average (Welsh Government, 2017). This contrast highlights the limitations of aggregated wellbeing measures for capturing localised or unevenly distributed mental health impacts associated with long-term environmental change and community-level disruption.

2.2.2 Measurement approaches and evidence in the literature

The reviewed literature uses a range of approaches to measure mental health and wellbeing impacts, reflecting differences in study design, data availability, and research objectives.

Several studies assess mental health outcomes using established quantitative instruments. These include measures of common mental disorders and psychological distress, such as:

- the Revised Clinical Interview Schedule (CIS-R) (Bakolis and others, 2020)
- the General Health Questionnaire (GHQ-12) (Murray and others, 2024)

as well as broader measures of mental health functioning and wellbeing, including:

- the Mental Component Summary of the SF-12 (Murray and others, 2024)
- the Office for National Statistics (ONS) wellbeing questions (Copping and others, 2025).

Other studies rely on self-reported qualitative evidence, including open-text survey responses, to capture experiences of stress, anxiety, trauma, and changes in identity associated with coastal change (Copping and others, 2024). In addition, some reviews identify mental health impacts through reported changes in the prevalence or occurrence of a wide range of psychological outcomes, including depression, anxiety, psychological distress, and stress-related conditions (Kabir and others, 2024).

Overall, this diversity of measurement approaches makes direct comparison across studies challenging. In many cases, mental health impacts are defined implicitly through the measures used rather than through consistent conceptual definitions. This has important implications for synthesising evidence and for assessing the suitability of different approaches for inclusion in economic appraisal.

In some cases, measured mental health outcomes are interpreted within broader conceptual frameworks that consider environmental stressors and social or economic context, although these frameworks are not themselves used as measurement methods (Kabir and others, 2024).

Longitudinal measurement using UK population data

Murray and others (2024) provide an example of how mental health outcomes have been measured using longitudinal data in a UK context. The study draws on data from the UK Household Longitudinal Study to examine differences in health outcomes across individuals with different residential contexts, including those who had lived in coastal communities at earlier life stages.

Mental health outcomes are assessed using established quantitative measures, including the General Health Questionnaire (GHQ-12), a 12-item self-reported measure of psychological distress, and the Mental Component Summary (MCS) score from the SF-12, which reflects mental health functioning. The study also considers the presence of long-standing impairment, illness or disability.

The study found that individuals who lived in a coastal community during adolescence later experienced higher levels of long-standing impairment, illness or disability than those who lived inland during adolescence. However, a negative relationship for psychological health, as measured by the GHQ-12 and the MCS score, is observed only for the most deprived coastal communities.

For example, for the most deprived fifth of communities, predicted mean Mental Component Summary (MCS) scores are lower for individuals who lived in a coastal community during adolescence compared with those who lived in inland communities. This suggests that level of deprivation is a mediating factor influencing observed differences.

Population-level evidence on coastal mental health impacts

Evidence from the Chief Medical Officer's Annual Report 2021 indicates that coastal communities experience a disproportionately high burden of ill-health, including mental ill-health, compared with non-coastal communities (Asthana and Gibson, 2021). Analysis using the Small Area Mental Health Index shows that observed differences in rates of depression and mental ill-health are largely explained by demographic factors, particularly age profiles and higher levels of deprivation in coastal areas.

However, the research identifies a residual 'coastal excess' in depression and mental ill-health after accounting for age and deprivation; 5.37% and 6.62%, respectively. This suggests that factors beyond demographic composition may contribute to mental health outcomes in coastal

communities, although the mechanisms underlying this excess are not fully understood (Asthana and Gibson, 2021).

Conceptual perspectives on environmental change and mental health

The research from Berry and others (2018) suggests that climate change is unlikely to generate new categories of psychiatric disorder, but may exacerbate existing risk factors for mental ill-health through social, economic and environmental stressors (Berry and others, 2018). This perspective is consistent with the reviewed evidence, which highlights the role of contextual and mediating factors—such as deprivation, uncertainty and disruption—in shaping observed mental health outcomes, rather than direct effects of environmental exposure alone.

Illustrative qualitative evidence from coastal change contexts

Qualitative evidence can provide illustrative insight into how mental health experiences may be shaped in specific coastal change contexts. A case study on the demolition of Cliff Farm (Trimingham, UK) following a cliff slip in March 2024, describes how structured communication and practical support during a coastal erosion event influenced the experience of a displaced household.

After the demolition, the property owner described reduced stress associated with feeling informed and supported throughout the process, and with avoiding personal financial liability for demolition costs. While based on a single case and not generalisable, this example illustrates how processes surrounding coastal erosion responses, may shape individual experiences of stress during periods of displacement.

2.3 Economic valuation: approaches and methods

The literature review identified 5 studies containing information relevant to the valuation of the mental health impacts of coastal erosion. These were:

- three studies using contingent valuation approaches:
    - Rulleau, Rey-Valette and Hérivaux, 2015
    - Landry, Shonkwiler and Whitehead, 2020
    - Schwoerer and others, 2023
- two studies estimating a hedonic pricing model:
    - Landry and Hindsley, 2011
    - Jin and others, 2015

2.3.1 Contingent valuation

Contingent valuation is a stated-preference method that uses surveys to estimate how much people are willing to pay (WTP) or willing to accept (WTA) compensation for hypothetical changes in the level of the provision of the good. Respondents are presented with a defined scenario and asked to express their preference under a constructed or hypothetical market setting (Eunomia Research & Consulting, 2023).

These methods are widely used in environmental economics but are sensitive to survey design and behavioural bias. For example, responses may be influenced by how payment mechanisms are framed or by respondents having difficulty distinguishing between partial and complete changes in environmental outcomes. (Quah and Tan, 2019).

Several studies have applied contingent valuation approaches in coastal contexts, however the studies reviewed in this section estimate overall values for coastal hazard management or avoidance; they do not isolate or value mental health impacts separately.

Schwoerer and others (2023)

This study conducted a contingent valuation survey of 84 residents in Hooper Bay, Alaska, a remote coastal community of 1,375 residents in 146 households (containing multiple families). The study elicited residents' WTA compensation for a federal buyout that would allow residents to permanently relocate within the next 10 years due to rising sea levels. WTA values were obtained for both a one-time community level buyout and for one-time payouts to individual households.

The findings suggest that 58% of respondents supported a $500 million federal community buyout. The 25th percentile of WTA values for the community buyout was $0.8 million and the 75th percentile was $1 billion. For the individual level payout, mean WTA was $68,468 with a median of $66,000 (25th percentile $28,000, and 75th percentile $92,000) (all in 2021 USD). Individual households' WTA amounts between the 25th and 75th percentile fall within a range consistent with real estate values in the area.

The study notes that these WTA amounts should be interpreted considering the economic context. A housing market is largely non-existent in Hooper Bay and housing is subsidised, keeping house prices for Indian/Alaska Native restricted deed title homes low.

Landry and others (2020)

This study applied contingent valuation to estimate the WTP of North Carolina households for beach erosion management (Landry, Shonkwiler and Whitehead, 2020). The findings suggest that households have mean (median) WTP of $7.91 ($10.70) per household per year (hh/year) for beach erosion management (in 2013 USD) with substantial variation across policy options. Median WTP was $22.20/hh/year for shoreline retreat, $7.45/hh/year for beach nourishment and $0.10/hh/year for shoreline armouring (in 2013 USD). The authors attribute the weak preference for armouring to its negative environmental impacts, while noting that the relatively strong support for managed retreat merits further investigation.

Rulleau and others (2015)

Similarly, this study used a double-bounded dichotomous choice contingent valuation survey to estimate WTP for protection against coastal flooding in the Languedoc-Roussillon region in south-eastern France. This technique involves, first, proposing a take-it-or-leave-it choice, consisting of a scenario and a cost. If the respondent accepts the first choice, a second choice is offered with higher cost. If the first choice is rejected, a second choice is offered with lower cost.

Following this approach, it was estimated that permanent and second homeowners have WTP of €229.40/hh/year or €4,588 per household over a 20-year period (non-discounted) for protection against coastal flooding. This study highlights that WTP is influenced more by risk 'perception' variables, which include talking about flood risk with family and friends, and taking precautionary action to self-protect one's house, than by socioeconomic variables.

Across these studies, WTA and WTP values reflect overall valuations of coastal hazard management or avoidance. These values capture a combination of physical, economic, social and wellbeing considerations associated with coastal erosion or other coastal hazards.

Mental health impacts are not identified or valued separately within these approaches, and the resulting estimates therefore cannot be interpreted as valuations of avoided mental health impacts alone. This limits the suitability of contingent valuation for directly estimating mental health costs in isolation, but does not preclude its use as part of broader valuation evidence within economic appraisal.

2.3.2 Hedonic pricing approach

Hedonic pricing is a revealed-preference valuation approach based on the idea that the price of a good, such as housing, reflects the bundle of characteristics it offers, including features of the surrounding environment (Beukering, Tompkins and MacKenzie, 2007). In the context of coastal environments, these characteristics may include exposure to hazards, proximity to the shoreline, and the presence of coastal protection measures.

Hedonic pricing typically uses statistical regression techniques applied to housing market data to estimate how observed property prices vary within different structural, neighbourhood and environmental attributes (Sander and Polasky, 2009). By controlling for a range of observable characteristics, the approach can be used to estimate the marginal contribution of specific attributes, such as flood risk or coastal protection, to property values. Its application depends on the availability of sufficient transaction data and the existence of relatively well-functioning property markets.

Several studies have applied hedonic pricing methods in coastal settings to estimate the value of environmental and protective attributes, although these studies do not value mental health impacts separately.

Jin and others (2015)

This study applied a hedonic pricing model to coastal towns in Massachusetts, USA, to assess the effect of coastal protection measures, such as seawalls, on property prices. The study found that the presence of seawalls was associated with higher property values, particularly for homes located close to the shoreline. For waterfront residences, seawalls were associated with a 10% ($48,000) average marginal increase in property value (in 2013 USD).

Landry and Hindsley (2011)

Similarly this study used a hedonic pricing approach to estimate the marginal value of beach width and dune width in Tybee Island, Georgia, USA. The results suggested that the marginal WTP for

houses near the beach (for example, within 300 m of the shore) was $421 to $487 for an additional metre of high tide beach, $272 to $465 for an additional metre of low tide beach or $212 to $383 per metre for increases in dune width (in 1999 USD). The authors note that these values reflect a combination of perceived storm and flood protection benefits alongside recreation and amenity values associated with wider beaches and dunes.

A limitation of the hedonic pricing approach is that it estimates the overall changes in property value associated with coastal protection or erosion prevention. The resulting values bundle multiple components of benefit, and the method cannot typically separate the contribution of specific elements, such as mental health benefits, from the total effect. As a result, hedonic pricing does not estimate mental health impacts in isolation, although it may still contribute to broader economic appraisal where mental health effects form part of wider changes in welfare.

2.3.3 Valuation methods used in mental health

A small body of literature applies economic valuation approaches to mental health outcomes more broadly, which may offer conceptual insights for valuing the mental health impacts of coastal erosion. Given the limited literature applying valuation methods specifically to the mental health impacts of coastal erosion, we expanded our search to also consider valuation methods being applied more broadly in the mental health field.

Revealed-preference valuation

One approach is revealed-preference valuation, including cost-of-illness methods, which estimate economic impacts using observed outcomes such as lost earnings, reduced productivity and healthcare costs. While no applications were identified for coastal erosion specifically, similar approaches have been applied to estimate the mental health costs of other hazards, such as flooding (Viavattene and Priest, 2020). These methods rely primarily on secondary data and may offer a potential route for capturing some mental health-related economic impacts where appropriate data are available.

Subjective wellbeing valuation

A second approach is subjective wellbeing valuation, which monetises changes in self-reported wellbeing, for example by converting changes in life satisfaction into monetary values using wellbeing-adjusted life-years (WELLBYs) (OECD, 2018). Application of this method would require primary data collection on wellbeing outcomes linked to coastal erosion, and no such studies were identified. As a result, this approach is not directly applicable within the scope of the present review.

Value or benefit transfer

A third approach is value or benefit transfer, which involves applying valuation estimates from existing studies to a new context (Boutwell and Westra, 2013). No valuation estimates were identified that quantify the mental health impacts of coastal erosion, limiting the scope for direct transfer. In principle, transfer may be possible from other contexts if estimates relate to clearly defined components of impact, such as asset loss or social disruption, although this would require careful consideration of context and transferability.

Recent work by the Centre for Mental Health (2024) illustrates how a combination of valuation approaches, including revealed-preference methods, value transfer, and wellbeing-based measures, has been used to estimate the economic and social costs associated with mental ill-health at a national scale. This work demonstrates how mental health impacts can be monetised across a range of cost categories, including productivity losses, health and care costs, and reductions in quality of life, while also highlighting the methodological challenges involved in disaggregating and attributing these impacts. However, these estimates relate to mental ill-health across the population as a whole and are not attributable to specific environmental hazards or events. As such, they cannot be applied to coastal erosion contexts directly. Instead, this body of work is included to illustrate the types of valuation techniques that have been applied in mental health research and to provide insight into the methodological building blocks that might inform future approaches to valuing the mental health impacts of coastal erosion, subject to appropriate data and attribution methods.

2.4 Synthesis of evidence, gaps and implications

The reviewed literature highlights significant challenges in establishing clear causal links between coastal erosion and mental health outcomes. Associations between coastal hazards and mental health have been reported. However, there is limited empirical evidence that explains how coastal erosion influences mental health outcomes over time. There is also limited understanding of the mechanisms through which it may contribute to the onset or worsening of mental health conditions. Evidence that focuses specifically on coastal erosion, as distinct from broader coastal hazards or climate change, remains limited.

One challenge relates to the nature of coastal erosion itself. Unlike sudden onset events, coastal erosion typically unfolds over extended periods, with changing risk profiles, decision points and lived experiences. This makes it difficult for studies to capture mental health impacts consistently across time, particularly where exposure, risk perception and outcomes evolve gradually. As a result, short-term or cross-sectional studies may not fully reflect cumulative or longer-term mental health effects.

Further challenges arise from population mobility and displacement. Individuals and households who relocate because of coastal erosion may no longer be captured in surveys or studies focused on current residents of high-risk areas. This limits the ability of existing research to track mental health outcomes before and after relocation, or to examine longer-term consequences for those who have already moved away from eroding coastlines.

The literature highlights limitations in the current evidence base. Quantitative evidence on the mental health impacts of coastal erosion and related environmental stressors remains limited, particularly in relation to specific conditions such as anxiety and post-traumatic stress disorder. More broadly, studies highlight the difficulty of assessing the mental health burden associated with environmental change due to the complex and interacting causal pathways involved (Berry and others, 2018; Ninomiya and others, 2023; Kabir and others, 2024). Empirical studies focusing on psychological outcomes in coastal communities exposed to hazards remain relatively sparse (Kabir and others, 2024). These challenges limit the extent to which mental health impacts can be robustly quantified using existing approaches.

The literature also highlights limitations related to economic appraisal. There is a lack of studies that apply economic valuation methods specifically to the mental health impacts of coastal erosion. Existing valuation studies related to coastal erosion or coastal hazard management tend to estimate aggregate values for risk reduction or protection measures. They do not isolate mental health impacts as a separate component. This constrains the ability to monetise mental health outcomes within appraisal frameworks using existing evidence.

Mental health impacts associated with coastal erosion are likely to be varied and context-dependent. They are influenced by mediating factors such as socioeconomic circumstances, access to health services, and the nature of community support. This further complicates both measurement and valuation and reinforces the challenge of defining a practicable and proportionate scope for inclusions within appraisal.

Some authors suggest that alternative or complementary approaches, such as systems-based or systems thinking methods, may help to better capture the complex and interacting factors through which environmental change can influence mental health (Berry and others, 2018). However, these approaches are not yet widely applied in the context of coastal erosion.

Limitations of the literature review

Due to the methodological approach adopted, the findings of this review are subject to limitations. The review was designed as a focused review of available literature, reflecting its defined scope and objectives. It builds on the work of Simmonds (2023) by identifying and reviewing relevant academic and grey literature published since that time, alongside evidence from related fields where appropriate.

The review involved the screening of 40 publications and an in-depth review of 15 sources selected to address the defined research objectives. As a result, relevant studies may have been missed or not included, particularly where they do not explicitly link mental health or valuation to coastal erosion. The review built on Simmonds (2023) by focusing on additional relevant literature identified through structured searches and expert input, rather than duplicating earlier work.

2.5 Summary

The literature review indicates that evidence linking coastal erosion to mental health impacts remains limited, fragmented and largely context-specific. While existing studies suggest that coastal hazards can be associated with outcomes, such as stress, anxiety and trauma, empirical evidence focused specifically on coastal erosion is scarce and often based on qualitative or small-scale survey data.

Quantitative evidence at population scale is limited, and causal pathways linking erosion exposure to mental health outcomes are not well established. In addition, existing economic valuation studies do not isolate mental health impacts, limiting the ability to estimate associated costs within appraisal frameworks.

Overall, the literature highlights significant evidence gaps and methodological challenges that constrain the measurement and valuation of mental health impacts of coastal erosion.

3 Conceptual framework

3.1 Mental health impact pathway for coastal erosion

Figure 4 presents a conceptual framework developed for this project to illustrate potential pathways through which coastal erosion may be associated with adverse mental health impacts. The framework is intended as an analytical aid to support interpretation of the literature and to structure thinking around appraisal, rather than as a causal or predictive model.

The layout of the framework is informed by earlier conceptual work on health impacts of climate-related hazards (Few, 2007) and has been adapted to reflect evidence and insights specific to coastal erosion identified through the literature review. It sets out a series of linked components that may interact to influence mental health outcomes in coastal settings.

The framework includes five main components:

- coastal erosion: capturing the physical hazard and its interaction with residential and non-residential properties, land uses and communities
- mental health risk factors: understood as conditions or changes arising from coastal erosion that may increase vulnerability to adverse mental health impacts (for example, damage to property, disruption to livelihoods, or loss of community assets)
- mediating factors: referring to social, demographic or contextual characteristics that independently shape mental health outcomes, such as age, income, or levels of deprivation
- mechanisms: representing the processes through which combinations of erosion-related risk factors and mediating factors may influence mental health (for example, prolonged uncertainty, financial strain or social isolation)
- mental health outcomes: reflecting potential adverse impacts on mental health and wellbeing, which may include diagnosed mental health disorders such as depression, anxiety or post-traumatic stress disorder, as well as broader experiences of distress

The framework also acknowledges that actions and support provided in response to coastal erosion may influence these pathways by mitigating or buffering adverse effects. However, the framework does not assess the effectiveness of such actions, nor does it imply that they generate positive mental health outcomes. Their inclusion is solely to recognise that mental health impacts may be shaped by wider institutional and community contexts.

The framework does not capture undiagnosed or sub-clinical mental health impacts explicitly, nor does it represent the full range of wellbeing effects that may arise in coastal communities. This limitation reflects the constraints of the available evidence and is consistent with findings from the literature review, which highlight challenges in measuring and attributing mental health impacts associated with coastal change. As such, the framework should be interpreted as a simplified representation of complex and interacting processes.

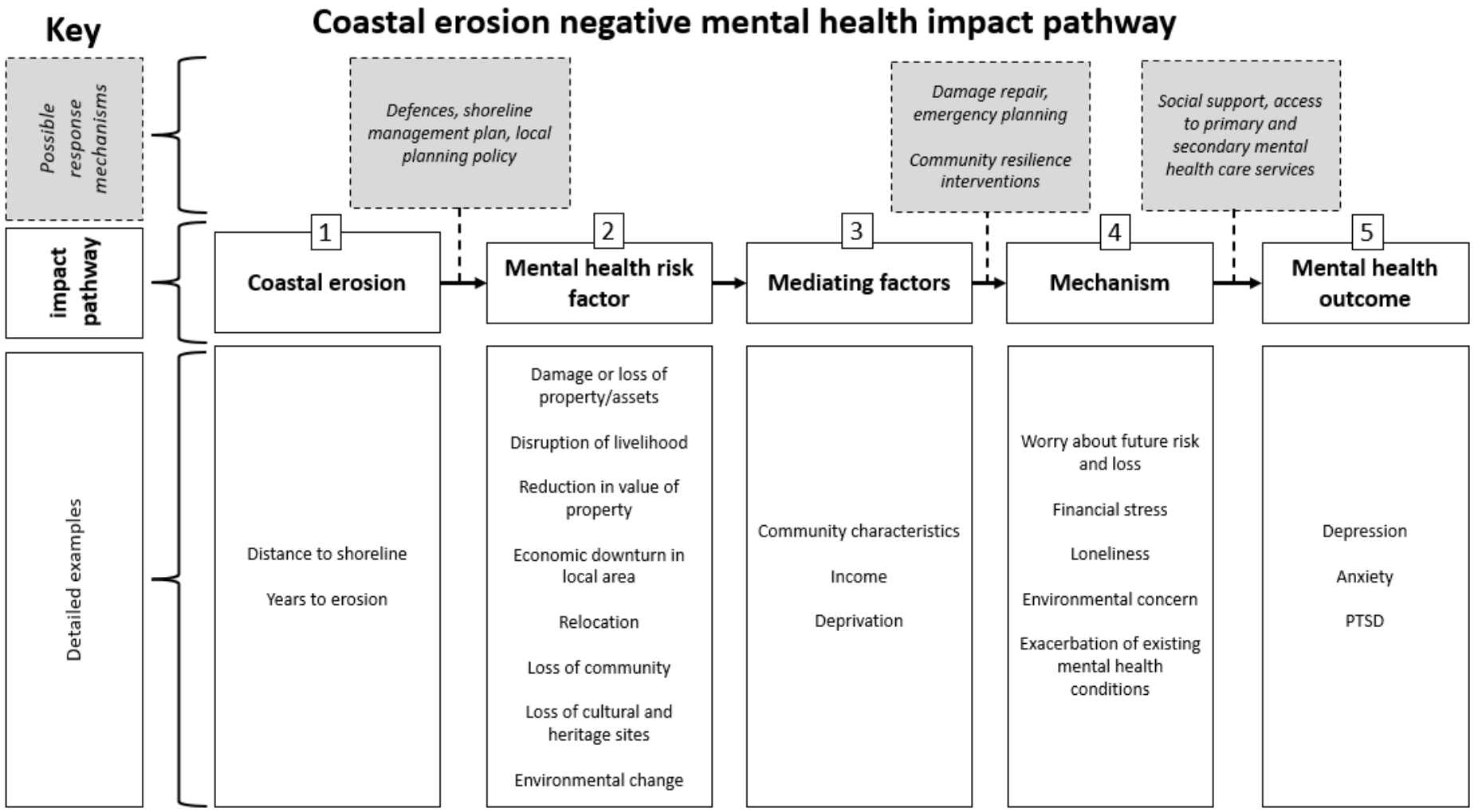


Figure 1: Conceptual framework – mental health impact pathway for coastal erosion

3.2 Expert workshop

As part of the project, an online workshop with coastal practitioners in England and Wales was designed and facilitated by the Environment Agency in February 2025. Members of the project research team from Eunomia and Middlesex University Flood Hazard Research Centre (FHRC) also attended. The purpose of the workshop was to gather practitioner perspectives on mental health impacts associated with coastal erosion and to explore how these experiences could be structured using the project's conceptual framework. The workshop was not intended to generate new empirical evidence and to formally validate the framework.

Participants included 24 coastal practitioners from the Environment Agency, local councils, universities as well as charities working in coastal locations exposed to coastal erosion across England (Cornwall, Dorset, Eastbourne, Isle of Wight, North Norfolk, Sefton, North Yorkshire) and Wales (Gwynedd, Vale of Glamorgan).

The workshop was structured around 2 facilitated breakout sessions.

In the first session, coastal practitioners were invited to share their observations of issues commonly raised by people living in coastal communities affected by erosion. Participants described persistent anxiety associated with uncertainty about the timing and extent of erosion, difficulties in decision-making related to housing and finances and emotional responses such as denial, anger, frustration and grief. Loss of attachment to place and disruption to social networks were also frequently mentioned, particularly where erosion risk had led to relocation or the prospect of displacement. Practitioners noted that this anxiety is always present but becomes much stronger during events like storms. This session was designed to capture a qualitative picture of practitioner-reported experiences and did not attempt to assess prevalence, severity or causality.

The second session used examples discussed in the first session as inputs to an exploratory mapping exercise. Participants were asked to consider how the issues raised could be positioned within the components of the project's mental health impact pathway for coastal erosion (figure 4).

Each group was able to map examples such as:

- coastal erosion and inundation: homes at risk of coastal erosion within 3 years based on average rates
- mental health risk factor: social deprivation, poor quality home and much lower value than elsewhere in the area
- mediating factors: no value in property, no financial means to move and need to rely on council accommodation
- mechanism: worry about where they will live, loss of access to current school and jobs
- mental health outcome: anxiety and grief

Participants discussed how different response mechanisms might change the mental health impact from coastal erosion, including when these impacts begin. They also discussed adaptation being a mediating factor and how this could affect a personal mental health pathway.

Overall, participants indicated that the conceptual framework could be useful for structuring and communicating discussions about different types of responses to coastal erosion. The workshop did not assess the effectiveness of responses or interventions and should be interpreted as complementary to, rather than a substitute for, the evidence presented in the literature review.

4 Secondary data identification and access

Section 2 reviewed the available literature on the mental health impacts associated with coastal erosion. This review informed the development of a conceptual framework (section 3) which helped guide the identification and selection of suitable secondary data sources for the project. This section sets out the rationale for selecting secondary data sets (section 4.1) and summarises the most relevant and accessible data sets identified for this project (section 4.2).

The scope of the project focused on the use of existing secondary data sources available in England and Wales. The secondary data sources identified for this project enable analysis across broad spatial scales and populations, but place constraints on the level of geographic detail, the ability to attribute mental health outcomes specifically to coastal erosion, and the range of mental health impacts that can be examined. Similar limitations have been highlighted in previous UK research, including the 'Chief Medical Officer's Annual Report 2021 - Health in Coastal Communities' (Whitty, 2021), which notes that the availability and spatial resolution of health data for coastal communities strongly influence the type and robustness of analysis that can be undertaken. That report analyses several public health indicators in England, including mental health in coastal areas.

Specific limitations relevant to the data sets identified for this project are summarised in section 4.3.

4.1 Rationale for identifying and selecting secondary data sets

The main components of the project's conceptual framework were used to inform the categorisation and prioritisation of secondary data considered for analysis. These categories reflect different aspects of the potential mental health impact pathway for coastal erosion and are intended as analytical groupings rather than as indicators of direct causal measurement.

These data set categories used to scope and prioritise secondary data set were:

Hazard data sets, and data sets to explain receptors and measure mental health risk factors: Data sets detailing coastal erosion hazard extents and projections. The conceptual framework highlights the link between people who experience mental disorders and other impacted receptor types such as land-use, properties, businesses and communities. Data was sought which could relate coastal erosion risk to a range of receptors.

Measurement of mediating factors: Socioeconomic data can help to quantify links between coastal erosion hazard and mental health impacts. It can also identify any potential mediating factors such as data sets that provide insight into general wellbeing, economic stress and deprivation.

Measurement of mental health outcomes: Data providing measurement of mental health outcomes (mental disorders including depression, anxiety, and PTSD).

Further considerations were also applied for identifying and selecting secondary data sets, namely:

- whether data set was identified through UK studies included in the focused literature review
- whether the data set was supplied by relevant UK data providers including:
    - Environment Agency
    - Natural Resources Wales (NRW)
    - Office for National Statistics (ONS)
    - NHS Digital
    - UK Health Security Agency (UKHSA)

other data providers also considered included:

- the Clinical Practice Research Datalink (CPRD)
- the National Institute for Healthcare Research (NIHR)
- and the National Institute for Health and Care Excellence (NICE)

To assess the suitability of data sets for this project, additional data characteristics were recorded, including:

- spatial coverage and spatial scale (for example, data set with national coverage, provided at Lower layer Super Output Area (LSOA) level), with data with national coverage, but available at a local scale considered the most suitable to assess the impacts of coastal erosion
- project appropriateness (consideration of the mechanisms through which coastal erosion and mental health are linked, as well as consideration of how the mental health impacts may be linked to economic impacts)
- licensing, cost, access requirements, and additional ethics

4.2 Available and accessible data sets

A data scoping template was developed based on the rationale described in section 4.1 to identify secondary data sets within each datamset category that are both available and accessible for use in the project. The full data scoping is provided in Appendix 4.

Many of the data sets identified for this project are published as aggregated or summary outputs derived from primary data sources, such as:

- Census 2021 (Office for National Statistics, 2022)
- Annual Population Survey (Office for National Statistics, UK Data Service, 2024)
- Opinions and Lifestyle Survey (Office for National Statistics, UK Data Service, 2023)

Where relevant, the original underlying data sources are noted in the data-scoping template, as these may also be suitable for more detailed analysis.

Simmonds (2023) previously reviewed secondary data provided by the Environment Agency for the analysis of coastal erosion hazard on residential and non-residential properties. That data provides an overview of the areas at risk from coastal erosion, the level of risk, and the property

and community characteristics and locations within England. Equivalent data sets were also available for Wales and supplied by Natural Resources Wales (NRW). These were also reviewed within this project to extend consideration to Wales.

The following subsections summarise the data sets identified as being most suitable within each category.

4.2.1 Data sources related to the coastal erosion hazard, receptors and measurement of mental health risk factors

Four data sets were considered suitable to represent the coastal erosion hazard and to describe receptors to measure mental health risk factors.

National Coastal Erosion Risk Mapping

The National Coastal Erosion Risk Mapping is a data set provided by the Environment Agency and Natural Resources Wales. The data set outlines coastal 'frontages', defined as segments with consistent cliff behaviour and defence characteristics. It provides coastal erosion hazard extents and rates over 3 timeframes: 0 to 20 years; 20 to 50 years; 50 to 100 years. Two scenarios are considered within the data set: 'No active intervention' policy scenario; and 'With the implementation of Shoreline Management Plan 2 policies.

This data set provides insight into defining vulnerable areas based on coastal erosion hazard, that is, projected coastal erosion-induced coastline change. Multi-Coloured Manual (MCM) methods for benefit appraisal of coastal erosion make use of hazard data in this format to assess the delayed loss of assets due to coastal erosion.

National Receptor Data

The National Receptor Data (NRD) provided by the Environment Agency and Natural Resources Wales is a collection of receptors intended for use in flood and coastal erosion risk management within England and Wales. The NRD comprises property points derived from Ordnance Survey data with information on property type, floor area and Multi-Coloured Manual (MCM) property codes attributed.

This data set provides a link between coastal erosion hazard and building types. It is available on request from the Environment Agency and NRW, with the most recent data set published in 2023.

Long-Term Investment Scenarios

The Environment Agency's Long-Term Investment Scenarios (LTIS) provide an economic assessment of future flood and coastal erosion risk management. The study contains data on specific properties within England that have eroded since 2009 and provides insight into potential case study areas. The Environment Agency provided the 2023 list of eroded properties from the LTIS project.

NRW runs a similar project to LTIS entitled Long-Term Investment Requirements (LTIR). However, this only focuses on flooding and, as such, there is no equivalent coastal erosion data set available for Wales.

Shoreline Management Plans

Shoreline Management Plans (SMPs) produced by the Environment Agency and Natural Resources Wales provide data and policies applicable to particular stretches of coastline. These data are freely available and provide insight into the local mitigation measures (response mechanism for coastal erosion) that will influence risk to receptors.

4.2.2 Data sets to measure mediating factors and mechanisms

This subsection presents relevant data sets that could be used to measure factors which may mediate the impact of coastal erosion on mental health outcomes. These concern broader socioeconomic data related to factors that may influence general wellbeing, economic stress or deprivation or both.

Index of Multiple Deprivation

The first data set is the Index of Multiple Deprivation (IMD) which is freely available and can be accessed by GOV.UK with an Open Government Licence. The IMD data sets are measures of relative deprivation for small areas within the UK. Areas are ranked across broad themes, including income, employment, health, crime, housing and the living environment.

The relationship between different IMD indicators and the prevalence of mental health issues can be explored for vulnerable coastal areas. At the time of conducting this analysis, the most recent data set had been published in 2019 (a new IMD data set was published in 2025, prior to the publication of this report). Data can be accessed at Lower layer Super Output Area (LSOA) level.

Small Area Income Data

The Small Area Income Data has a more recent release of 2023. However, it is available only at the lesser detail of Middle layer Super Output Area (MSOA) scale. These data are provided by the ONS and provide estimates for average total income for the 4 income types. Two are equivalised, meaning they are adjusted to account for differences in household size and composition, so that incomes or expenditures from different types of households can be compared fairly. The 4 income types are:

- total annual household income
- net annual household income
- net annual household income before housing costs (equivalised)
- net annual household income after housing costs (equivalised)

The data set can be used to identify economically vulnerable coastal areas, and to identify and quantify any link between financial stress, mental health and coastal erosion hazard. The data set is freely available via an Open Government Licence.

Characteristics of coastal communities

The third type of data in this category are data sets concerning the characteristics of coastal communities which can be derived from the UK Census 2021. Provided by the ONS, data sets with a focus on coastal settlements can provide insight into population and household characteristics by coastal classification for built-up area size and individual built-up areas, as well as salary comparisons for coastal and non-coastal areas. These data are available at different geographical scales (national and local) and are freely available via Open Government Licence.

4.2.3 Data sets for measuring mental health outcomes

5 NHS data sets were identified as relevant for measuring mental health outcomes from coastal erosion. They are:

- Quality and Outcomes Framework (QOF)
- Talking Therapies data set
- Mental Health services Data set
- Adult Psychiatric Morbidity survey
- Practice Level Prescribing Data set

Quality and Outcomes Framework

QOF is provided by the NHS and was designed to measure the quality of care delivered by GP practices. It financially incentivised practices based on their performance across various clinical and public health indicators. Annual reporting covers the period from April to March, and data is collected at GP practice level. A yearly time series of diagnosed depression (QOF Depression (DEP) indicators) can be derived using this data set and aggregated to a LSOA level, allowing comparison between coastal and non-coastal areas.

QOF indicator definitions have been revised since 2004 which affects the ability to create a stationary time series. However, this data set still provides the best available assessment of depression prevalence at a national and local scale. Data are freely available via an Open Government Licence and available from 2004 to the present day.

NHS Talking Therapies

The NHS Talking Therapies data set (formerly known as the Improving Access to Psychological Therapies Data Set) aims to track outcomes of NHS-provided psychological therapies for common mental health conditions, including depression, anxiety, and PTSD. NHS Talking Therapies are available to patients via GP referral and via self-referral (NHS, n.d.). It has been collected since 2012 to present day. Data on referrals are available at a regional level via the NHS Talking Therapies dashboards.

Patient-level data is not publicly available due to their sensitive and confidential nature. However, aggregated and anonymised reports and summaries are publicly available. More bespoke aggregated outputs, such as those to LSOA level which would be most relevant to this project, were declined through Freedom of Information routes, and access through the NHS Digital Data Access Request Service would require additional processes and costs.

Mental Health Services Data Set

The third NHS data set of interest is the Mental Health Services Data Set (MHSDS) which collects detailed, patient-level data from providers of mental health, learning disabilities, and autism spectrum disorder services.

The data set provides detail on access rates to secondary mental health care and may provide data on depression, anxiety and PTSD. The link between this and coastal erosion risk can be explored as data is available down to Integrated Care Board (ICB) level.

Patient-level data is not publicly available due to their sensitive and confidential nature. However, aggregated and anonymised reports and summaries are publicly available. More bespoke aggregated outputs, such as those to LSOA level, can also be requested via FOI to NHS Digital.

Adult Psychiatric Morbidity Survey

The Adult Psychiatric Morbidity Survey (APMS) series provides data on the prevalence of both treated and untreated psychiatric disorders in the English adult population (aged 16 and over) and is collected every 7 years (for example, 1993, 2000, 2007, 2014). The APMS typically samples around 7,000 individuals from a nationally representative pool.

The most recent survey (2014) provides data collected from a single point in time. This makes it difficult when considering how long-term coastal erosion hazard may impact mental health, as no specific questions relating to this have ever been asked in the APMS. However, it can provide a good baseline indication of national mental health condition prevalence and give more specific insights due to the nature of the survey questions that other NHS data sets are not able to provide.

Conditions of particular interest to this project and covered by this data set include depression, anxiety and PTSD. Summary reporting is available freely with detailed data sets available via the UK Data Service.

Practice Level Prescribing

The final NHS data set (data previously released as GP Practice Prescribing) contains information on prescriptions issued by primary care providers that have been dispensed in England, Wales, Scotland, Guernsey, Alderney, Jersey, and the Isle of Man. The cost and prescribing data for specific drugs can support economic valuation of diagnosed mental health conditions and rates. Since 2011, these data have been collected monthly at the GP practice level. They cover all health areas, including specific mental health medications and are freely available via an Open Government Licence.

4.3 Data gaps and limitations

There is no single, consistent secondary data set that provides comparable statistics for rates of depression, anxiety and PTSD in relation to coastal erosion. Available data sets capture different aspects of mental health at different points in the care pathway, limiting comparability across conditions.

This inconsistency limits the ability to examine mental health outcomes across conditions in a uniform way and constrains interpretation of relative patterns in coastal areas.

Data on diagnosed depression are available through the Quality and Outcomes Framework (QOF), which is derived from GP (primary care) records. In contrast, data on anxiety and PTSD are only available from referral and secondary care data. This inconsistency limits the ability to examine mental health outcomes across conditions in a uniform way and constrains interpretation of relative patterns in coastal areas.

Analysis using QOF data is further limited by changes in the definition and structure of depression indicators over time. While depression indicators have been included in QOF since the mid-2000s, revisions to indicator definitions mean that only a shorter, more recent period provides a consistent time series suitable for analysis. This restricts the ability to examine longer-term trends in diagnosed depression in relation to coastal erosion exposure.

Patient-level mental health data sets such as that contained within the NHS Talking Therapies data set and the Mental Health Services data set would provide more detailed insight into mental health conditions. However, this is not routinely accessible due to confidentiality and data protection requirements. Only aggregated summaries are publicly available, and requests for small-area outputs appropriate for this project were not successful. As a result, analysis is limited to higher-level indicators.

Available secondary data also do not capture rates of undiagnosed or sub-clinical mental health conditions. This is an important limitation, particularly given evidence from other environmental hazard contexts, such as flooding, that undiagnosed mental ill-health can represent a substantial proportion of overall mental health burden (Findlater and others, 2023). Associated economic impacts, such as reduced workplace productivity linked to undiagnosed conditions, are similarly not captured.

Many areas at risk of coastal erosion are small rural communities. The scale of available secondary data is often larger than the population size of these communities and, as such, will impact any statistical analysis. This limits the ability to detect localised relationships between coastal erosion exposure and mental health outcomes and may reduce the statistical sensitivity of analysis.

This project used the National Coastal Erosion Risk Mapping 2018 (NCERM) data set that was available at the time of the analysis. An updated version was released in January 2025. As a result, any future replication of this analysis using the new data set may produce different conclusions from those presented in this report. Whilst this possibility should be considered when interpretating the findings, previously discussed limitations still apply. Therefore, it is considered unlikely that the updated NCERM data would significantly alter the conclusions presented in this report.

4.4 Summary

The secondary data scoping exercise reviewed data sets supplied by UK providers to identify sources relevant to analysing the mental health impacts of coastal erosion. Selection was guided

by the project's conceptual framework prioritising data sets covering coastal erosion hazard, exposure socioeconomics and demographics characteristics, and indicators of mental health at a national scale, with finer spatial resolution used where available.

Coastal erosion hazard data supplied by the Environment Agency and NRW through the NCERM data provide projections of shoreline change and from the basis of identifying exposed areas.

NHS data sets provide indicators of diagnosed mental health conditions, including depression through the Quality and Outcomes Framework (QOF) data (NHS England, n.d.), and insight into other conditions through the Talking Therapies Data set (NHS, n.d.) and the MHSDS (NHS England, n.d.). The QOF data provide the most consistent measure of diagnosed depression when considered over a stable reporting period between 2013 and 2023.

However, differences in coverage and definitions across data sets limit comparability, and available data support only partial assessment of mental health outcomes.

In addition, more granular data from NHS sources were not available at the spatial scales required, due to data access and disclosure constraints. These limitations restrict the extent to which mental health outcomes associated with coastal erosion can be examined using available secondary data.

5 Testing the relationship between coastal erosion risk and depression

5.1 Approach and method

We examined whether coastal erosion risk is associated with new depression diagnoses in England and Wales using secondary data sets described in section 4.2. Analyses were conducted separately for England and Wales due to differences in data availability and reporting.

For England, analysis was undertaken at multiple spatial scales, including national-level, coastal-inland comparisons, variation across SMP areas and local analysis at LSOA. For Wales, analysis was limited to national-level comparisons due to data constraints. At LSOA scale (England only) both correlation analysis and multiple linear regression were applied, incorporating selected socio-demographic variables as potential mediating factors.

The analysis started by examining the direct relationship between coastal erosion hazard and the measurable mental health outcome (depression) at different spatial scales. Following this, a multiple linear regression model was applied at LSOA level in England based on the approach developed by Simmonds (2023) and examined whether observed associations persisted when accounting for selected mediating factors.

The analysis involved:

- comparison of differences in new depression diagnoses at GP practice level between coastal (GP practices within 1 km from coastline) and inland area
- evaluation of variation in new depression diagnoses within SMP areas
- correlation analysis between new depression diagnoses and risk score in coastal LSOAs in England
- multiple linear regression model at LSOA level (England) evaluating relationship between new depression diagnoses and coastal erosion, including mediating factors

Figure 5 summarises the available data sets used to represent coastal erosion hazard (NCERM), property exposure (NRD), and mental health impact (QOF).

For coastal erosion hazard, it shows 3 time periods selected from the NCERM:

- short-term period of 2005 to 2025
- medium term of 2025 to 2055
- long-term period of 2055 to 2105

The NRD is available to identify and model receptors and is used to identify the numbers of properties which have been, or will be, at risk.

Finally, the NHS QOF is available to provide LSOA-level data on new depression diagnoses. As part of preparing the analysis, the incoming data was reviewed to assess its accuracy and any constraints.

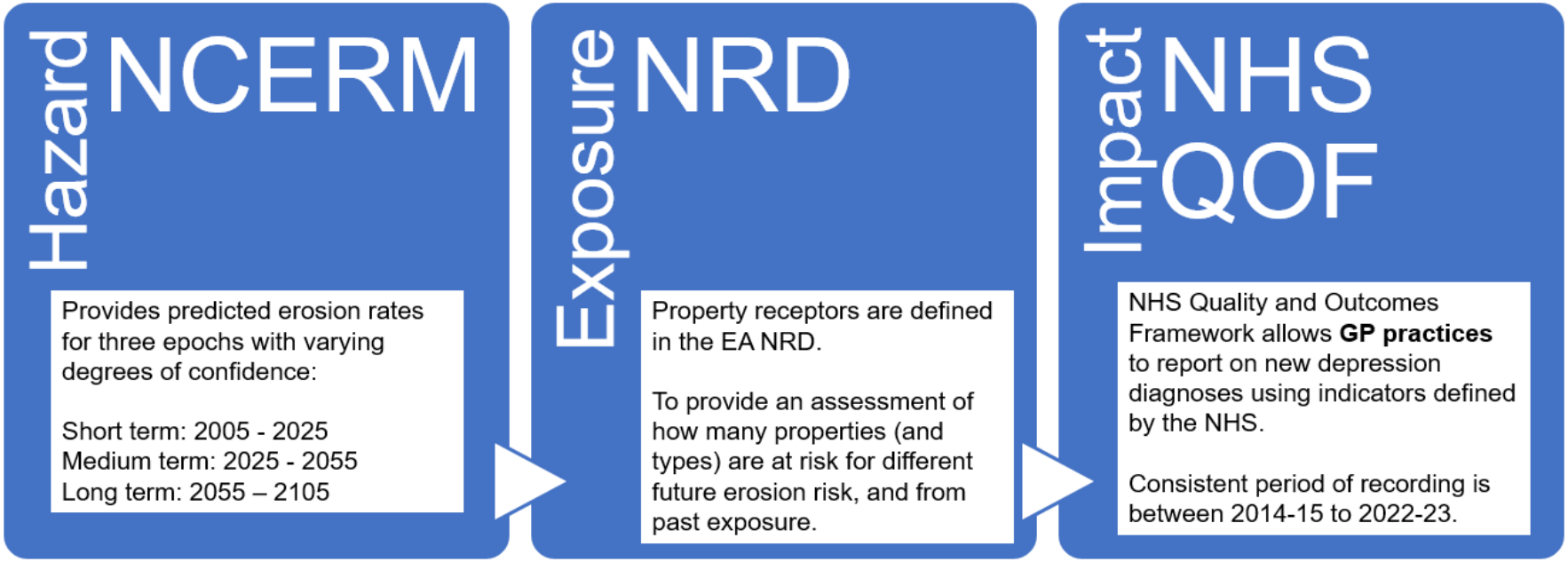


Figure 2: Suitable secondary data sets available to measure coastal erosion hazard, exposure and mental health impact

The data sets used in this analysis do not share a single reference year. For England, QOF data for 2022–2023 were used for national- and SMP-level analyses, while analysis at LSOA level used SAMHI 2021 indicators to align with Census 2021 socioeconomic covariates. Coastal erosion risk data from NCERM are expressed as modelled risk horizons (short-, medium- and long-term) rather than as observed outcomes at a specific point in time. As a result, the analysis examines cross-sectional spatial associations between areas of elevated erosion risk and patterns in new depression diagnoses, rather than temporal causation. This is a recognised limitation of the approach and is discussed further in Section 5.4.

To support quantitative analysis at local and SMP scales, an ordinal coastal erosion risk score was assigned to properties based on the NCERM risk band in which they were located (0 = no risk; 1 = long-term risk; 2 = medium-term risk; 3 = short-term risk). Average risk scores were calculated at LSOA and SMP scales to enable exploration of spatial associations between erosion risk and depression outcomes.

5.1.1 Review of hazard data

England

The NCERM 2018 data set provided by the Environment Agency is published as a GIS polyline layer at the 2005 coastline baseline, with attributes detailing modelled forecast erosion extents for the 3 erosion epochs. Figure 6 shows an example of the NCERM data following these pre-processing steps along the Happisburgh coastline.

These erosion epochs represent modelled future risk horizons rather than observed shoreline change for specific time periods.

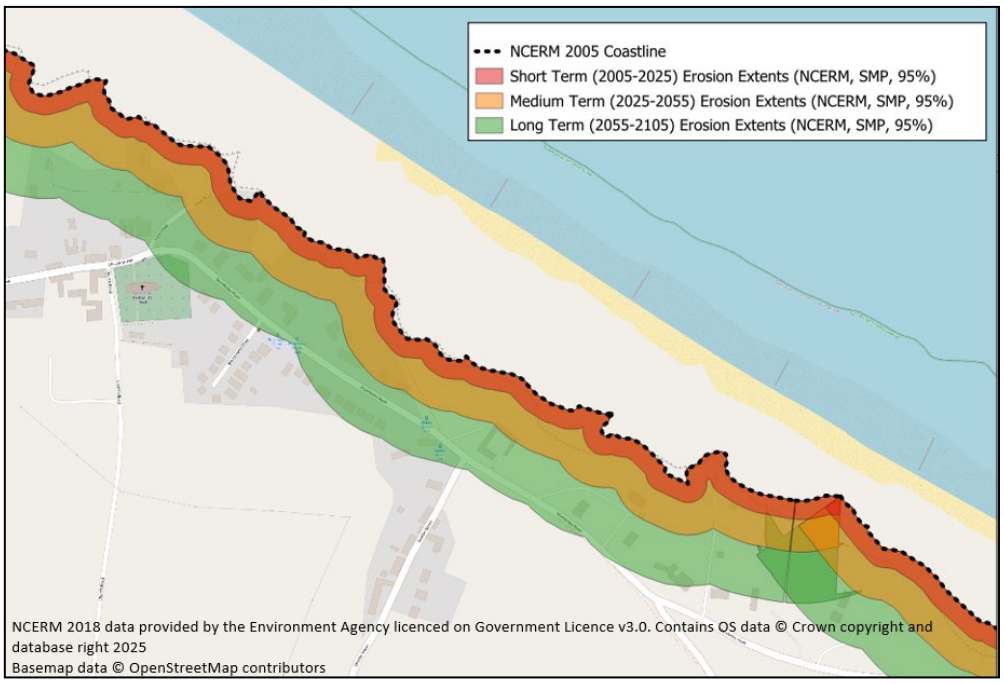


Figure 3: Illustrative example of NCERM data following pre-processing to derive polygon hazard extents for the 3 coastal erosion time periods (epochs)

Figure 6 illustrates the short term (2005 to 2025, shown in red), medium term (2025 to 2055, shown in yellow) and long term (2055 to 2105, shown in green) erosion extents. This example is a one-sided buffer of the polyline based on the erosion extents as applied to produce erosion extent polygons for each coastal erosion time period. These polygons were clipped based on one another to ensure that properties, for example, that fall within the short-term polygon were not also considered to be medium-term or long-term risk for analytical purposes (as following the short-term epoch these properties would be eroded).

Wales

NRW provides a NCERM data set for Wales using the same method as the NCERM data for England. However, the supply of the data is different. It is provided as GIS polygons representing the 3 different risk bands (short term, medium term, long term) for both scenarios (SMP and no active intervention) however, the data set supplies the 50th percentile extents for each risk band. The data provided by NRW does not include a polyline representation of the 2005 baseline coastline as is contained in the Environment Agency data.

5.1.2 Review of GP practice data and associated mental health data

England

The NHS QOF data is provided at GP practice scale. In several areas, there are fewer than one GP practice per LSOA, meaning that attributing new depression diagnosis indicators to LSOA scale involves variable levels of uncertainty as data will be based on the surrounding GP practice data.

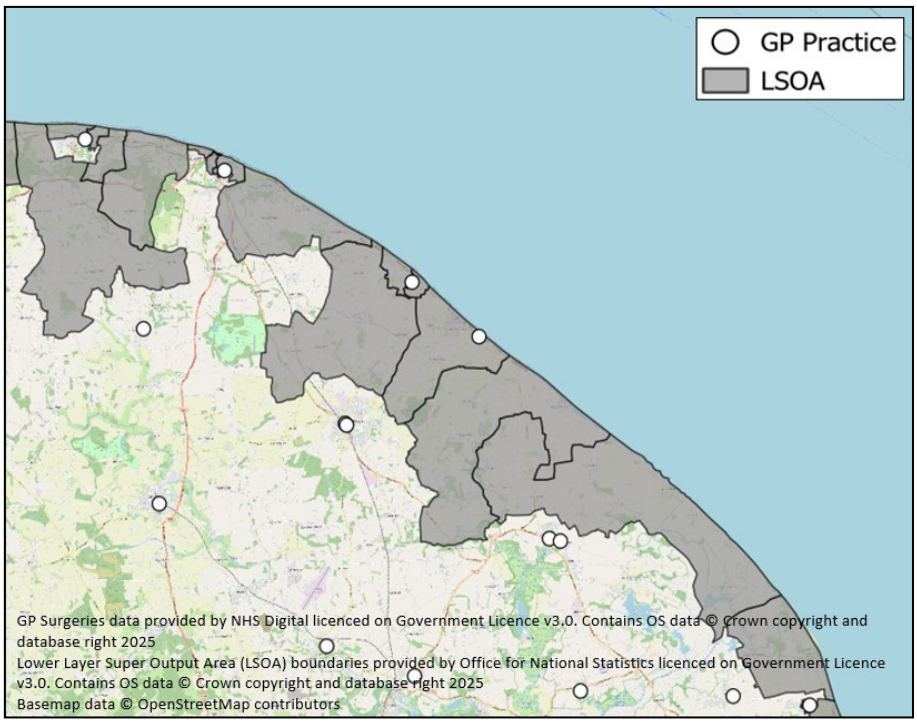


Figure 4: Example of sparse spatial distribution of GP practices in some coastal areas of England - Figure centred on Happisburgh coastline

Figure 7 shows an example of the limited spatial distribution of GP practices (white circles) along the Happisburgh coastline, an area with sections of high erosion risk in England. For analysis at LSOA scale, the Small Area Mental Health Index (SAMHI) data were identified as these provide spatially attributed indicators of depression derived from QOF data at LSOA level.

Wales

GP practice locations for Wales are provided as 2 spatial data sets: one containing locations of main sites, and one containing locations of branch sites. These were reviewed to understand the full spatial distribution of GP practices in Wales.

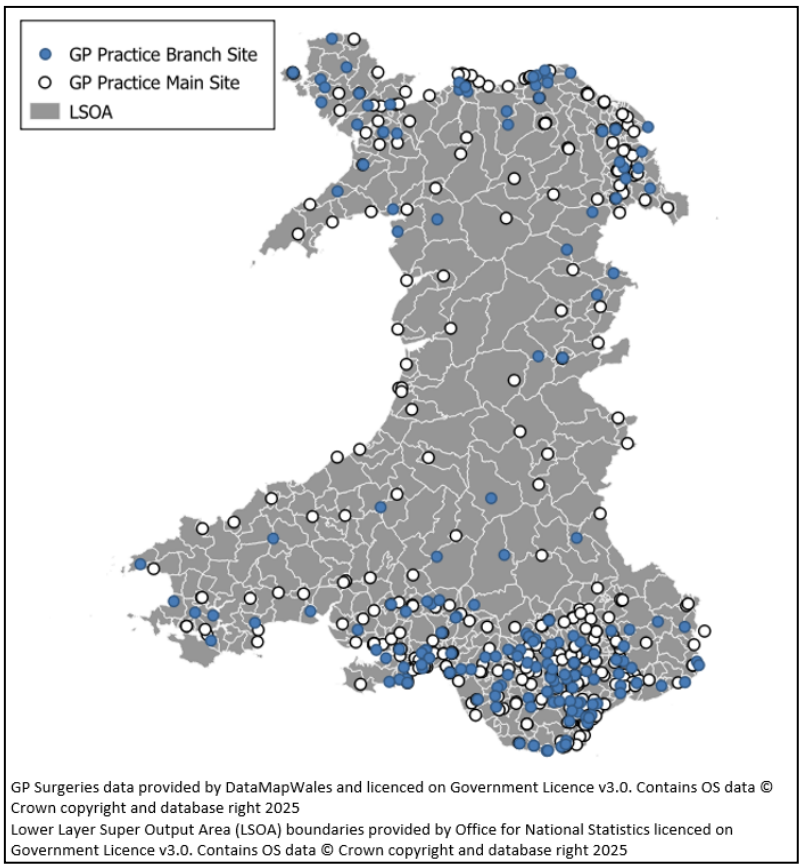


Figure 5: Spatial distribution of GP practices in Wales

As shown in the map in Figure 8, the spatial distribution of GP practices in Wales is sparse. GP practice branch sites are shown by blue circles, GP practice main site is shown by white circles and LSOA areas are marked in grey.

Evaluation of primary care in Wales has moved away from using the same indicator-based QOF system that is used in England. Since 2019 Wales has used the QAIF (Quality Assurance and Improvement Framework), a more qualitative, peer-reviewed approach. As a result, data provided under QOF and QAIF are not directly comparable, and analysis must therefore be undertaken separately for England and Wales. Wales has previously reported on new depression diagnoses as per the QOF indicator. However, these data are only available up until the 2016 to 2017 reporting period. This QOF reporting only provided data at the main GP practice sites, and not the branch sites, meaning there are only data for 371 GP practice sites for 2016 to 2017 across the whole country (Statistics for Wales, 2019).

The SAMHI data set has not been produced for Wales.

5.2 Data analysis

Analysis at national scale was carried out to understand the differences in new depression diagnoses (based on GP practice level data) between coastal (GP practices within 1 km from coastline) and inland settings.

Across this section, England classifies GP practices as coastal if within 1 km of the 2005 coastline (derived from the NCERM lines); all others were inland. In Wales, because the NCERM data set does not include the 2005 baseline coastline and only maps polygons where some erosion risk exists, GP practices were classified as close to a coastal risk area if they were within 1 km of an NCERM erosion-risk polygon; otherwise they were classified as not close to a coastal risk area. As a result, Wales practices are classified only as ‘close to’ or ‘not close to’ coastal erosion risk areas, using a similar 1 km threshold.

5.2.1 National comparison between inland and coastal settings

England

This section considers the comparison between inland and coastal settings in England.

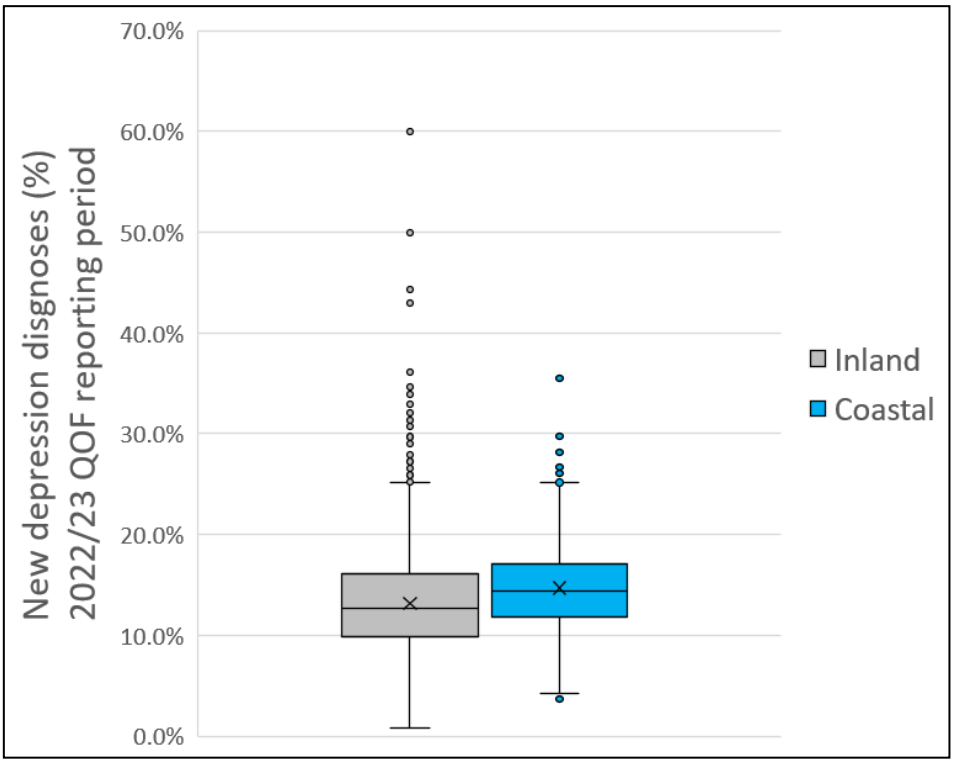


Figure 6: New depression diagnoses (%) 2022 to 2023 reporting period - comparison between coastal and inland average % (coastal n = 695 GP practices, inland n = 5,683 GP practices)

Figure 9 shows the comparison between coastal (blue plots) and inland (grey plots) depression diagnoses for the 2022 to 2023 NHS QOF reporting period in England. At this scale of analysis, the average rate of depression diagnoses in coastal settings is marginally greater than in inland settings. However, it is not possible to attribute this small difference to erosion as there are other factors influencing mental health outcomes in both coastal and inland settings. These factors include other natural hazards such as flood and mediating factors such as difference in deprivation.

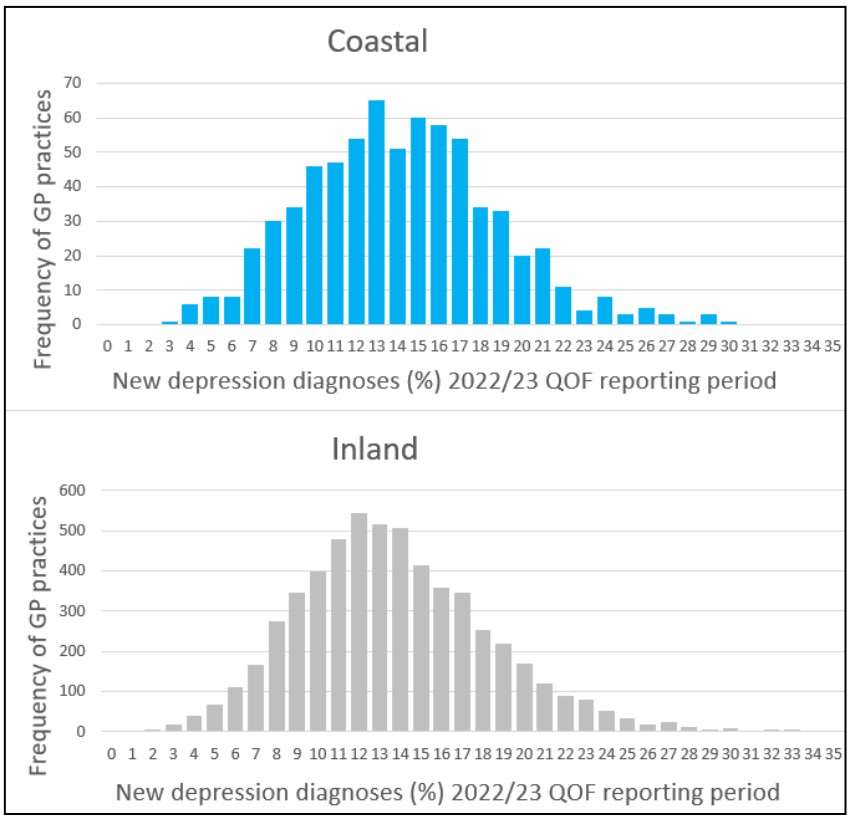


Figure 7: Distribution of new depression diagnoses - coastal and inland comparison

Both distributions in Figure 10 are approximately symmetric with a peak around 13%. It shows that there is essentially no observable difference between coastal and inland distributions of new depression diagnoses for settings at this scale.

Wales

This section considers the comparison between inland and coastal settings in Wales.

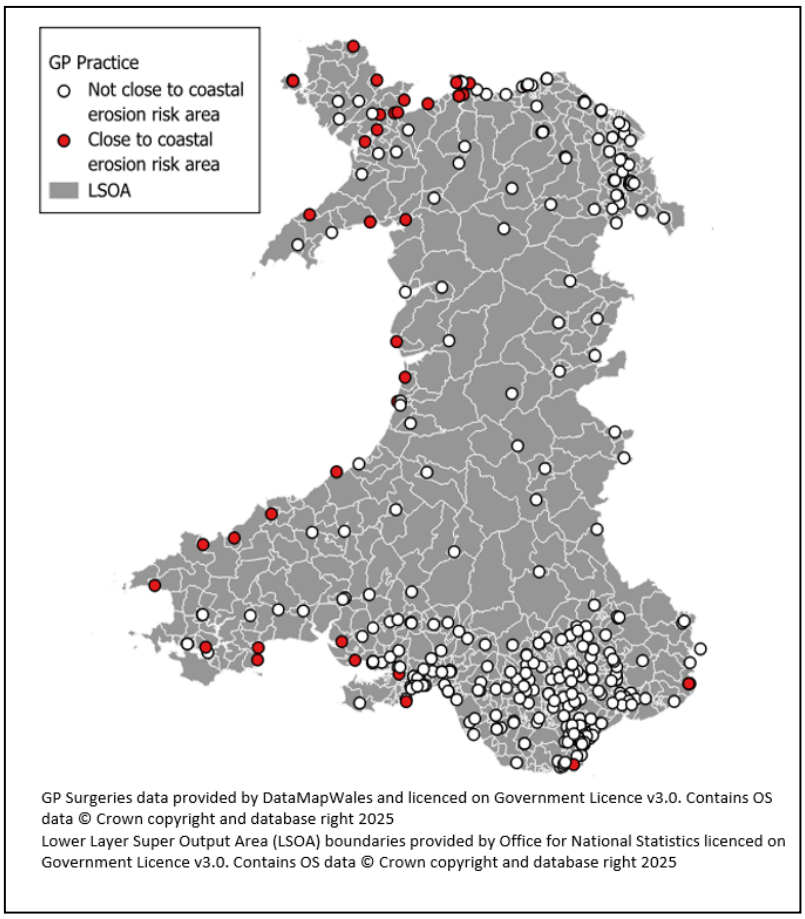


Figure 8: Distribution of GP practices in Wales classified by proximity to NCERM coastal risk areas

In Figure 11 GP practices not close to coastal erosion risk areas are shown as white circles. Those close to coastal erosion risk areas are shown as red circles.

As discussed in section 5.1.2, the most recent depression data for Wales is 2016 to 2017, which was the last year of QOF reporting in Wales.

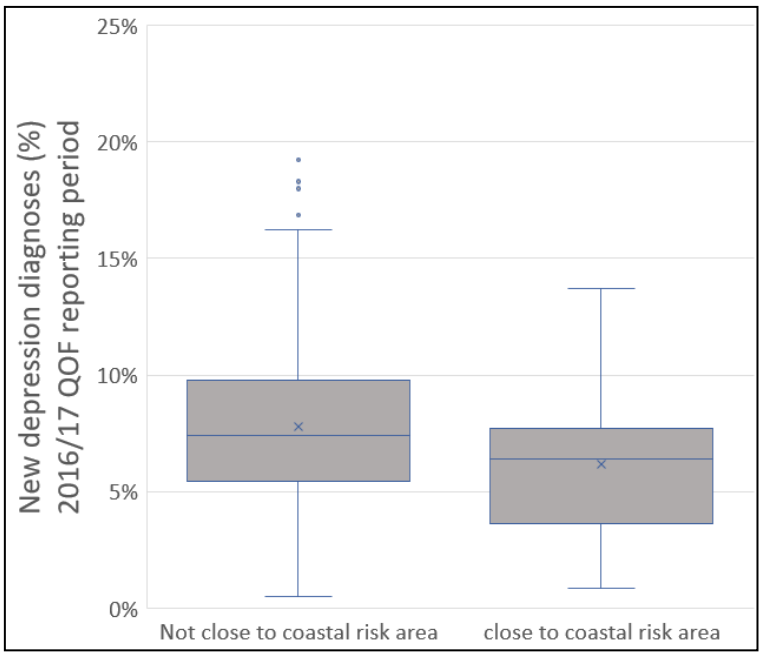


Figure 9: New depression diagnoses (%) 2016 to 2017 reporting period - comparison between GP practices 'close to coastal risk areas (<1 km)' and GP practices 'not close to coastal risk areas (>1 km) (Not close to coastal risk area n = 333 GP practices, close to coastal risk area n = 38 GP practices)

Figure 12 shows the comparison between GP practices 'close to coastal risk areas (<1 km)' and GP practices 'not close to coastal risk areas (>1 km)' for the 2016 to 2017 QOF reporting period in Wales. Lower rates of new depression diagnoses were observed for GP practices located close to areas of coastal erosion risk. The findings differs from the general direction suggested by the literature review in section 2 and the conceptual pathway set out in Figure 4, but is based on older data and small sample sizes and should therefore be interpreted with caution. It may reflect limitations of the analysis, including the use of cross-sectional data, differences in population composition or unobserved confounding factors. Further research would be required to better understand the relationship between coastal erosion risk and mental health outcomes.

5.2.2 Variation in depression and erosion risk at SMP scale

England

Analysis at SMP scale was completed to assess whether the variation in new depression diagnoses was broadly comparable with variation at a national scale.

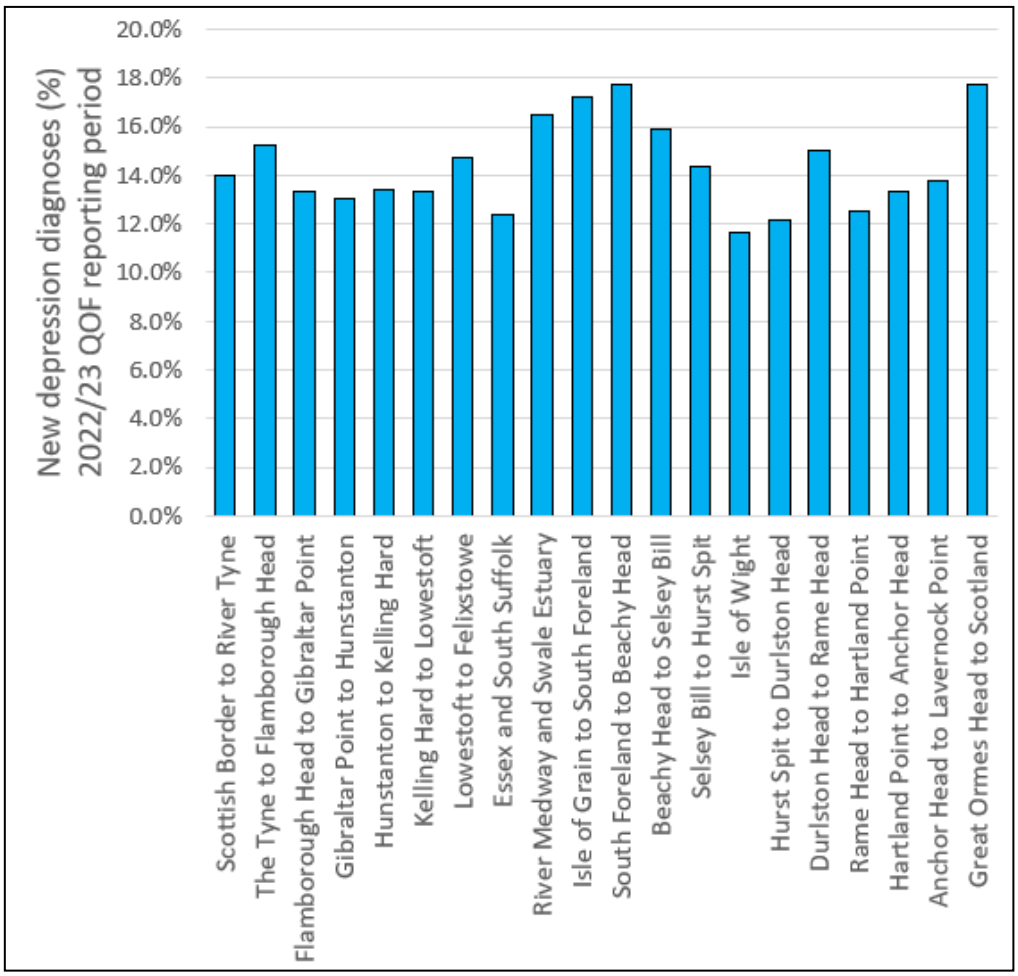


Figure 10: Variation in new depression diagnoses (%) (2022 to 2023 QOF reporting period) per SMP

Figure 13 shows new depression diagnoses (%) for the 2022 to 2023 NHS QOF reporting period per SMP region. GP practices were assigned to a specific SMP region based on proximity. There is variation between new depression diagnoses in SMP areas between 11% and 17%. This variation is similar to that at the national context and highlights that for SMPs which are known to contain areas with the highest erosion rates, there is not an observable increase in depression diagnoses at this scale of analysis.

A risk scoring approach was also considered at SMP scale to understand if there is an observable relationship between the average property risk score in an SMP area with new depression diagnoses.

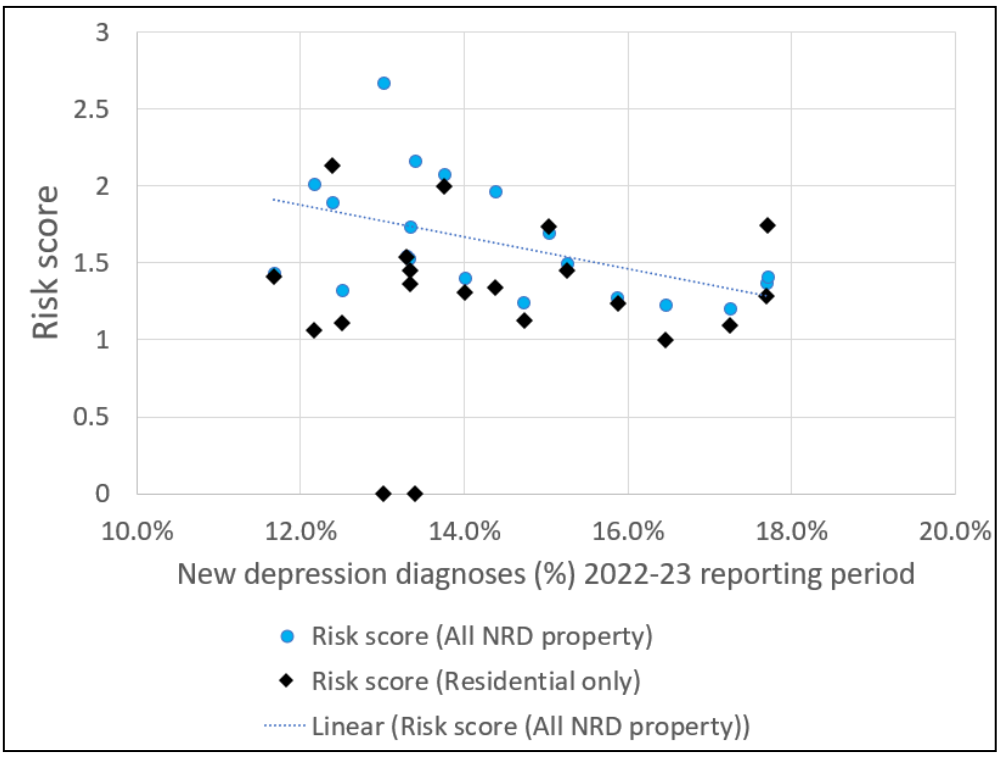


Figure 11: Average risk score at SMP level considering both all NRD receptors and just residential (MCM code = 1) receptors

Figure 14 shows a scatter plot containing risk score and new depression diagnoses for all SMP areas. Two data sets are presented here:

- SMP risk score for all properties within the NRD (residential and non-residential) (blue circle plots)
- SMP risk score for only residential NRD properties (MCM code = 1) (black diamond pots).

This separation was done to understand if mental health outcomes could be linked to risk to homes (residential property only) or if it was linked to community risk (homes and businesses). A negative association is observed in the plotted data between SMP-level risk score and new depression diagnoses – therefore, higher risk SMPs show lower proportions of new depression diagnoses in this analysis. This pattern is not consistent with the conceptual pathway set out in Figure 4, which reflects broader evidence in the literature linking exposure to coastal hazards with adverse mental health outcomes. This may reflect limitations of the analysis, included the scale of aggregation and the use of GP-level QOF data, which may not capture localised variation. As such, the available evidence is insufficient to draw robust conclusions about the relationship between erosion risk and mental health outcomes at this scale.

Wales

Due to the sparsity of GP practices and associated data along the Wales coastline, analysis at this spatial scale was not carried out.

5.2.3 Variation in depression and erosion risk at LSOA scale

England

The NHS QOF data is provided at GP practice scale. The SAMHI data set provides a spatial interpolation and aggregation of these data to LSOA scale. An equivalent risk scoring approach as discussed for NRD receptors in section 5.2.2 has been used for NRD receptors at this scale, to assess correlation between new depression diagnoses and coastal erosion risk.

As outlined in section 5.1.2, there are limitations with using the QOF data at this scale. In some areas, there are fewer than one GP practice per LSOA, meaning that the SAMHI estimation of new depression diagnoses has been calculated based on the surrounding GP practice data. This has variable uncertainty depending on the distribution of GP practices local to the LSOA. As illustrated in Figure 7, this could lead to major uncertainty in some areas of high coastal erosion risk, for example, the Happisburgh coastline.

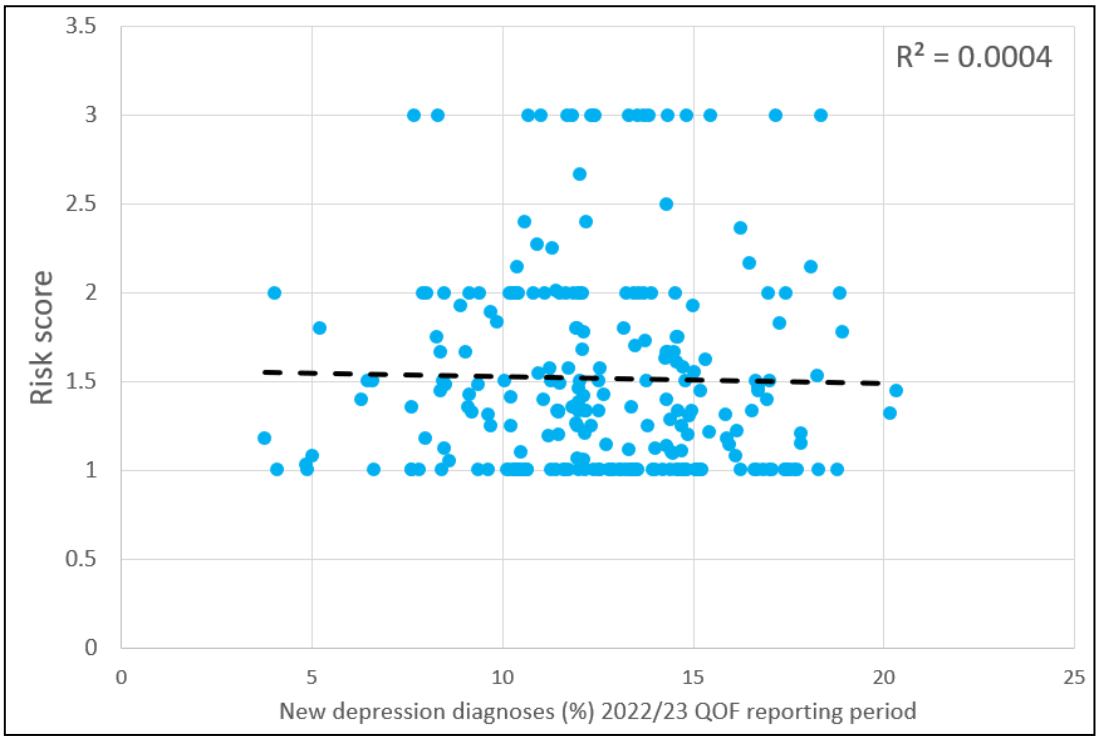


Figure 12: Average risk score at LSOA level considering all NRD receptors per LSOA (n=245)

The scatter plot in Figure 15 shows at LSOA scale there is no observable linear relationship between the risk score and new depression diagnoses (correlation coefficient of R^2=0.0004).

The risk scoring approach at LSOA was then considered with respect to the population of each LSOA. This was to understand the differences in depression distribution between LSOAs with high numbers of assets at risk compared with those with fewer assets at risk or with no risk. This provides another method to visualise the differences (Figure 16) between depression diagnoses at LSOA, and the associated coastal risk in relation to the size of (and, therefore, potential impact to) the local communities.

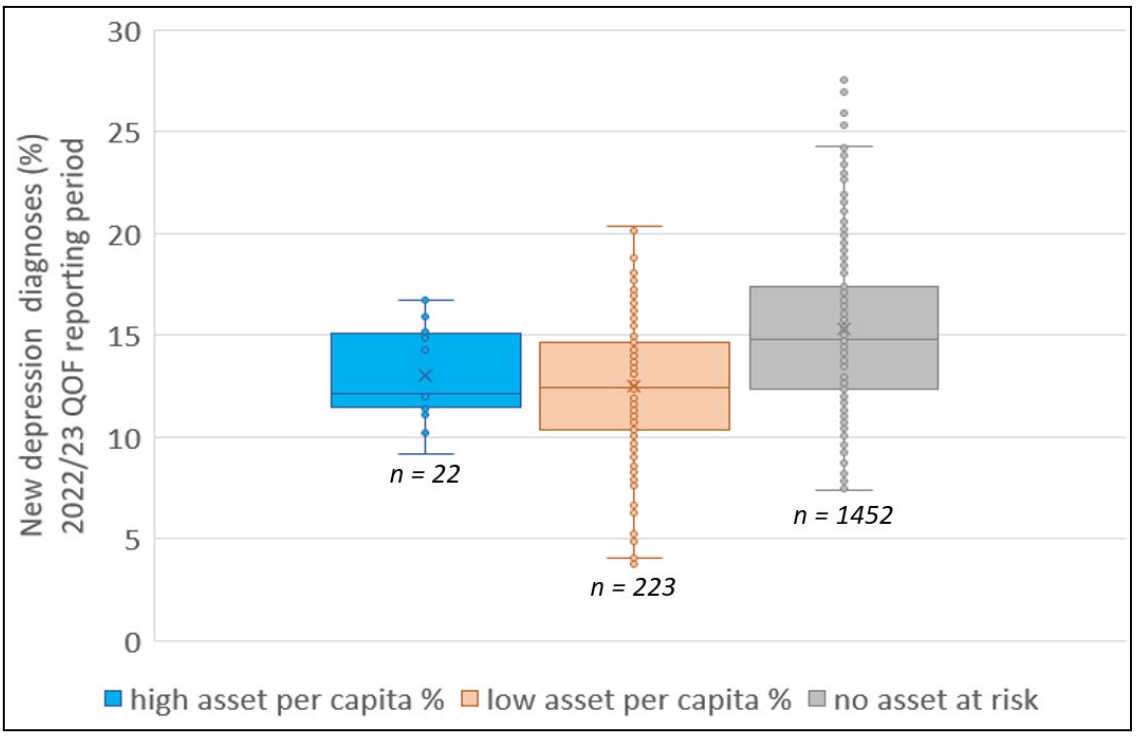


Figure 13: Distribution of new depression diagnoses for LSOAs split by: high (>10%) assets at erosion risk per capita, low (<10%) assets at erosion risk per capita and no assets at erosion risk

Figure 16 provides the distribution of new depression diagnoses (% 2022 to 2023 QOF reporting period) for LSOAs split by LSOAs with no assets at erosion risk (grey plots), LSOAs with a low proportion (<10%) of assets at erosion risk per capita (orange plots) and LSOAs with a high proportion (>10%) of assets at erosion risk per capita (blue plots). For the purposes of this analysis, an asset refers to a National Receptor Data set (NRD) point, representing a potentially affected receptor such as a residential property, non-residential property or infrastructure asset.

The median percentage of new depression diagnoses is higher in areas with no coastal erosion risk – this is where only a small share of assets per person is at risk and higher than in areas where a large share of assets per person is at risk. Similarly, the lower and upper quartiles for LSOAs with no risk represent higher levels of new depression diagnoses than for LSOAs with assets at risk.

Wales

The SAMHI data set has not been produced for Wales and, therefore, analysis at this spatial scale was not carried for Wales.

5.2.4 Multiple linear regression model

England

The analysis in this report so far examined only the direct correlation between coastal erosion risk and new depression diagnoses. To assess this in more detail, a multiple linear regression model

was developed to assess the significance of other mediating factors to changes in new depression diagnoses at LSOA scale.

The model builds on the approach used in Simmonds (2023) and has been updated with recent data and assumptions. The input data was prepared at LSOA scale with a data frame of NRD receptors at risk with the following attributes:

- NCERM risk band, using the 5%, 50% and 95% confidence levels (short-, medium- and long-term) erosion risk for each property with the following rules:
    - a property assessed as being at short-term risk was not counted as medium- or long-term risk
    - a property assessed as medium-term risk was not counted as long-term risk
- Census 2021 data, using the same variables as selected in the Simmonds (2023) analysis, included as percentages they were:
    - of households with no cars or vans
    - with level 4 education and above
    - without employment
    - with disability where day-to-day activities are limited a lot
    - with disability where day-to-day activities are limited a little
    - of households owned outright
    - in social rented housing
    - of households with no central heating
    - of one-person households with adults aged 66 years and over
    - of one-person households with adults aged under 66 years
    - of lone parent households
    - in professional or managerial occupations
    - of people who cannot speak English well and
    - of overcrowded households based on bedrooms
- Small Area Income Data, providing income-related indicators at LSOA level
- SAMHI estimated QOF new depression diagnoses data (2021)

Because the most recent Census data is from 2021, it was appropriate to use the SAMHI estimated QOF new depression diagnoses data alongside it.

Although the model attributes LSOA scale data at individual property level, not all properties will be representative of the LSOA averages. For example, a property at risk of erosion may not be typical of the wider community characteristics. In some LSOAs, a very small number of receptors are shown to be at risk compared with the size of an LSOA (typically 400 to 1,200 households). In such cases, it would be inappropriate to associate LSOA scale community characteristics with these properties at risk.

To avoid this issue, LSOAs where fewer than 10% of residential properties were at some level of risk were excluded from the model. After this filtering, 23 LSOAs were considered in the model.

The multiple linear regression model is based on a small sample of LSOAs, after filtering, with 23 observations included. The model also includes a large number of explanatory variables including coastal erosion risk bands and multiple socioeconomic covariates. As a result, the model is likely

to be over-parameterised, with limited residual degrees of freedom, low statistical power and a high risk of overfitting. Formal diagnostic testing of model assumptions, including multicollinearity among explanatory variables, residual behaviour, heteroscedasticity and the influence of individual observations, was not systematically assessed or documented as part of this study. The coefficient estimates, standard errors, p-values and confidence intervals should therefore be interpreted with caution. The results should be treated as exploratory indications of spatial association within this data set, rather than robust estimates of effect size or evidence of causal relationships.

Table 3 summarises the results of the multiple linear regression model showing the scale and significance of the relationship between NCERM risk bands and new depression diagnoses at LSOA level, alongside the socioeconomic variables included as mediating factors. Coefficients are expressed as percentage point changes in the depression diagnoses rates associated with each variable.

The results indicate that LSOAs with a higher proportion of properties at short-term or long-term coastal erosion are associated with lower rates of new depression diagnoses, once other factors are accounted for. No statistically meaningful relationship is observed between medium-term erosion risk and depression diagnoses.

These findings are consistent with earlier LSOA-level analysis presented in this section, which show no positive association between coastal erosion risk and diagnosed depression. As discussed previously, this differs from the general direction suggested by the literature review and insights from the practitioner workshop and is likely to reflect limitations of the data and analytical scale.

Table 2: Multiple linear regression results for new depression diagnoses at LSOA level

Note: Coefficients represent percentage point changes in the LSOA diagnosis rate

Variable	Coefficient	Standard error	*T*	P>|t|	Lower band 95% confidence intervals	Upper band 95% confidence intervals
Short-term risk	-0.2192	0.067	-3.284	0.001	-0.350	-0.088
Medium-term risk	-0.0451	0.059	-0.769	0.442	-0.160	0.070
Long-term risk	-0.2176	0.054	-4.051	0.00	-0.323	-0.112
Percentage no cars or vans	6.7326	1.233	5.458	0.00	4.314	9.151
Percentage level 4 education and above	-21.0136	0.933	-22.531	0.00	-22.842	-19.185
Percentage without employment	1.8123	5.586	0.324	0.746	-9.139	12.764
Disability – day-to-day activities limited a lot	-0.5706	0.021	-26.927	0.00	-0.612	-0.53

Variable	Coefficient	Standard error	*T*	P>|t|	Lower band 95% confidence intervals	Upper band 95% confidence intervals
Disability – day-to-day activities limited a little	-0.4513	0.029	-15.654	0.00	-0.508	-0.395
Percentage owned outright	0.3425	0.013	27.228	0.000	0.318	0.367
Percentage social rented	0.0682	0.004	16.239	0.000	0.060	0.076
Percentage no central heating	0.7556	0.044	17.069	0.000	0.669	0.842
Percentage one person household (adult >= 66 years)	-0.1173	0.012	-10.076	0.000	-0.140	-0.094
Percentage one person household (adult < 66 years)	0.5711	0.016	35.335	0.000	0.539	0.603
Percentage lone parent	0.2870	0.038	7.653	0.000	0.214	0.361
Percentage professional managerial	-0.4097	0.012	-32.893	0.000	-0.434	-0.385

Variable	Coefficient	Standard error	*T*	P>|t|	Lower band 95% confidence intervals	Upper band 95% confidence intervals
Percentage can't speak English well	0.9762	0.110	8.901	0.000	-0.761	1.191
Percentage overcrowded (bedrooms)	-1.2429	0.04	-33.18	0.000	-1.32	-1.169
Log(pay)	3.0825	0.175	17.614	0.00	2.739	3.426

Adjusted R-Squared = 0.68; F-Statistic = 666.4

The regression results show that some socioeconomic variables such as the proportion of households without access to cars and vans, and the proportion of the population with level 4 education and above are associated with much larger changes in new depression rates than coastal erosion risk. While these factors may plausibly influence mental health outcomes, the size of their estimated effects in this model is substantially greater than for other variables, including coastal erosion risk. This indicates that the model is likely capturing broader socioeconomic patterns rather than isolating the effects of coastal erosion. It suggests that the available data and cross-sectional analysis at this scale are not well suited to detecting the mental health impacts of coastal erosion. This is partly due to coastal erosion hazard data and mental health data sets not aligning well spatially or temporally. Further investigation would require more appropriate data and methods specifically designed to examine these relationships.

Wales

The SAMHI data set is not provided for Wales and, therefore, the multiple linear regression model was not developed for Wales.

5.3 Summary and findings

This analysis examined whether an observable relationship exists between coastal erosion risk and mental health outcomes, specifically new depression diagnoses, using the most suitable secondary data available across three spatial scales: national, Shoreline Management Plan (SMP), and Lower Layer Super Output Area (LSOA).

Across all spatial scales examined, no positive association between coastal erosion risk and new depression diagnoses was detected. Where differences were observed, these did not align with the pattern suggested by the literature and should be interpreted in the context of data and scale limitations.

At a national scale in England, no meaningful differences was observed between coastal and inland rates of new depression diagnoses. The scale of analysis is too large to detect potential impacts arising from property or community level exposure to coastal erosion.

Lower rates of new depression diagnoses were observed in GP practices close to areas of coastal erosion risk in Wales. This finding differs from the general direction suggested by the literature and the conceptual pathway (Figure 4) but is based on older data (2016-2017) and small sample sizes and should be interpreted cautiously.

At SMP level in England, variation in new depression diagnoses was observed, but this variation was consistent with national variation and did not indicate higher diagnoses rates in SMPs containing higher levels of erosion risk. The resolution of both the mental health and hazard data at this scale is likely insufficient to draw conclusions about the influence of Shoreline Management Plans on the reduction in mental health outcomes. SMP-scale analysis was not suitable for Wales due to sparse data coverage.

At Lower layer Super Output Area (LSOA) scale in England exploratory analysis, including correlation analysis and multiple linear regression, consistently identified patterns opposite to

those suggested by the literature. This is the finest spatial scale at which analysis was feasible using secondary data. However, the small numbers of properties at risk relative to typical LSOA population sizes (approximately 400 to 1,200 households) means this scale may still be unsuitable for detecting erosion-related mental health impacts using available data.

5.4 Constraints and limitations

The primary limitation of this study is the availability and suitability of secondary data for assessing the mental health impacts of coastal erosion. While the analysis used the most appropriate data sets currently available at national scale, these data impose significant constraints on both spatial resolution and the range of mental health outcomes that can be examined.

First, the analysis was limited to newly diagnosed depression, as this is the only mental health outcome for which consistent, spatially detailed primary indicators were available. Other important outcomes identified in the literature, including anxiety and post-traumatic stress disorder could not be analysed. Although data sets such as the Mental Health Services Data set and NHS Talking Therapies data set may offer some insight into these conditions, access to suitably aggregated data was not available for this project due to data protection constraints. Moreover, these data sets do not provide household or community level measures and therefore remain limited in their suitability for erosion-related analysis.

Second, the use of the QOF new-diagnoses indicators provide only a partial view of mental health impacts. The indicator captures new diagnoses within a reporting year and does not reflect ongoing prevalence, cumulative mental health burden, or undiagnosed distress within communities. Differences in healthcare seeking behaviour, access to services, and recording practices may also influence observed patterns.

Third, there is a substantial mismatch in spatial scales between coastal erosion risk and mental health data. Areas affected by erosion often contain small numbers of properties at risk, whereas the smallest spatial unit for which reliable mental health indicators are available (LSOA) typically includes hundreds of households. This dilution effect limits the ability of secondary data to detect localised impacts, even where they may exist.

Finally, the analysis relies on cross-sectional data, combining future erosion-risk projections with current mental health indicators. Differences in temporal and spatial alignment between hazard and health data sets further constrain interpretation.

As a result, conclusions drawn from this analysis are constrained by the limitations inherent in currently available secondary data sets.

6 Conclusions

6.1 Findings

This project investigated the mental health impacts of living with coastal erosion and explored whether these impacts could be incorporated into Flood and Coastal Erosion Risk Management (FCERM) appraisal. Findings draw together evidence from the literature review, practitioner insights, and analysis of available secondary data. Together, these sources highlight what is currently understood, where evidence is limited, and what this means for appraisal.

6.1.1 Evidence of stress and distress in affected communities

Experience based evidence from the focused literature review and practitioner insights indicates that some people living in areas at risk of coastal erosion experience stress, anxiety and psychological distress. These accounts suggest that coastal erosion can have meaningful mental health impacts for some residents, although experiences vary considerably between individuals and communities.

6.1.2 Limited robust empirical data and inconsistent measures

Robust empirical evidence linking coastal erosion to specific mental health outcomes remains limited. Available data sets (for example, those emerging from Coastwise) use a range of measures—such as wellbeing or general anxiety scales—that are not directly comparable and are hard to generalise to the wider population. This limits the ability to quantify mental health impacts consistently or at scale.

6.1.3 No observed relationship between coastal erosion and depression

Using national secondary data sets, the analysis found no positive association between projected coastal erosion exposure and rates of new depression diagnoses at national, Shoreline Management Plan (SMP), or Lower layer Super Output Area (LSOA) scales in England. Practitioner insights suggest that anxiety may be a more relevant outcome in this context but this project was unable to test that pathway using available secondary data.

Lower rates of new depression diagnoses were observed in GP practices close to areas of coastal erosion risk in Wales; however, this finding is based on older data (2016–17), small sample sizes, and should be interpreted cautiously.

6.1.4 Complexity of mental health pathways

Mental health impacts associated with coastal erosion are mediated by multiple pathways and coping strategies that vary across individuals and groups. This complexity, together with heterogeneous exposure and community contexts, makes it difficult to establish causal relationships or produce population level estimates from current evidence. The conceptual pathway framework developed as part of this project (Section 3) reflects this complexity, illustrating

the range of interacting mechanisms through which coastal erosion may influence mental health outcomes.

6.1.5 Options for improving economic valuation approaches

Existing FCERM appraisal guidance includes a method for considering the mental health costs of flooding and erosion. However, this research explored whether the evidence base could support improvements to that approach. Subject to future evidence collection, two potential routes for strengthening or refining valuation methods were identified:

- cost of illness approach
- willingness to pay

Cost-of-illness approach

A cost-of-illness approach underpins the current method used to monetise mental health costs associated with flooding. Viavattene and Priest (2020) developed the valuation methodology using evidence from the English National Cohort Study of Flooding led by Public Health England (now UKHSA). Therefore, the cost-of-illness approach may be the most appropriate, as it avoids the limitation of relying on existing secondary data to infer relationships between erosion and mental health. It would require:

- a bespoke survey for primary data collection, designed with public health experts
- an approach similar to the English national cohort study of flooding and health (Waite and others, 2017)

Willingness-to-pay approach

This approach is used in current appraisal practice. For example, the Multi-Coloured Manual estimates the average economic value of avoiding stress and inconvenience from flood-related physical health impacts at £279 per property per year (Penning-Rowsell and others, 2013). Applying this approach to coastal erosion would require:

- developing a specific survey instrument for primary data collection
- fieldwork in different coastal contexts - for example, as in Defra (2004) on intangible human impacts of flooding

6.1.6 Challenges in sampling and generalisability

Both options assume statistically representative samples may be obtained for coastal erosion. Also, that surveys are comprehensive and will consider the different pathways and affected groups. This may be difficult because:

- fewer properties are exposed to coastal erosion than to flooding
- some affected people may have relocated and cannot be surveyed
- case studies and household stories may be highly context-specific and not generalisable

As a result, developing a robust average value derived specifically from coastal erosion survey evidence may prove challenging.

6.2 Future research

This research identified significant evidence and data gaps that limit understanding of the relationship between coastal erosion and mental health.

Future research should prioritise the collection of primary data from communities exposed to coastal erosion risk to improve understanding of:

- how mental health impacts arise
- how they vary between places and individuals
- and how they can be measured consistently.

A stronger evidence base is needed before more robust conclusions can be drawn about the mental health impacts associated with coastal erosion.

Future work could include systematic case studies across coastal communities at risk, using mixed method approaches to examine how experiences and impacts vary across different social, demographic and geographic contexts. Research should be designed and delivered with appropriate social and health science expertise, using standardised measures where possible to support comparison between locations and with existing data sets.

References

ASTHANA, S. AND GIBSON, A., 2021. Analysis of Coastal health outcomes. In C. Whitty & B. Loveless (Eds.), Chief Medical Officer's Annual Report, 2021: Health in Coastal Communities.

ASUGENI, J., MACLAREN, D., MASSEY, P.D. AND SPEARE, R., 2015. Mental health issues from rising sea level in a remote coastal region of the Solomon Islands: current and future. Australasian Psychiatry, 23(6_suppl), 22–25.

BAKOLIS, I., HAMMOUD, R., STEWART, R., BEEVERS, S., DAJNAK, D., MACCRIMMON, S., BROADBENT, M., PRITCHARD, M., SHIODE, N., FECHT, D., GULLIVER, J., HOTOPF, M., HATCH, S.L. AND MUDWAY, I.S., 2021. Mental health consequences of urban air pollution: prospective population-based longitudinal survey. Social Psychiatry and Psychiatric Epidemiology, 56(9), 1587–1599.

BERRY, H.L., WAITE, T.D., DEAR, K.B.G., CAPON, A.G. AND MURRAY, V., 2018. The case for systems thinking about climate change and mental health. Nature Climate Change, 8(4), 282–290.

BEUKERING, P.V., BRANDER, L., TOMPKINS, E.L. AND MACKENZIE, E., 2007. Valuing the Environment in Small Islands: An Environmental Economics Toolkit.

BOUTWELL, J. AND WESTRA, J., 2013. Benefit Transfer: A Review of Methodologies and Challenges. Resources, 2(4), 517–527.

CLINICAL DIGITAL RESOURCE COLLABORATIVE (CDRC), 2024. Quality and Outcomes Framework (QOF) Guidance for 2023/24 [online]. Available from: https://cdrc.nhs.uk/resources/systmone-resource-centre/contract-management/quality-and-outcomes-framework-qof-guidance-for-2023-24/ [accessed 23 September 2025].

CENTRE FOR MENTAL HEALTH, 2024. The Economic and Social Costs of Mental Ill Health.

COPPING, D., STARR, M., WEBB, S. AND FENN, T., 2025. Coastwise Survey Analysis – Wellbeing Extension. North Norfolk District Council. Please note, this is a draft version of the final report, shared by the Environment Agency.

COPPING, D., WEBB, S., STANDING, H. AND WAKEFIELD, L., 2024. Coastwise survey analysis. North Norfolk District Council.

DARAS, K, ROSE, T., TSIMPIDA, D. AND BARR, B., 2023. Quality and Outcomes Framework Indicators: Depression prevalence (QOF_4_12) Version 1.00 [Open Data set]. Place-based Longitudinal Data Resource. Available from: https://pldr.org/dataset/2ldz5/quality-and-outcomes-framework-indicators-depression-prevalence-qof412 [accessed 23 September 2025].

DAY, S., 2025. Demolition of Cliff Farm, Trimingham (Spring 2024): Case study and lessons learned – full report. Coastwise.

DEPARTMENT FOR ENVIRONMENT, FOOD AND RURAL AFFAIRS, 2004. The Appraisal of Human related Intangible Impacts of flooding - R&D Technical Report FD2005/TR [online].

Available from: https://assets.publishing.service.gov.uk/media/602a5cfd8fa8f503809d0304/The_appraisal_of_human_related_intangible_impacts_of_flooding_technical_report.pdf [accessed 23 September 2025].

ENVIRONMENT AGENCY, 2021. Guidance: Mental health costs of flooding and erosion [online]. Available from: https://www.gov.uk/government/publications/mental-health-costs-of-flooding-and-erosion/mental-health-costs-of-flooding-and-erosion#incorporate-mental-health-effects-into-a-flood-economic-appraisal [accessed 23 September 2025].

ENVIRONMENT AGENCY, 2024a. National assessment of flood and coastal erosion risk in England 2024 [online]. GOV.UK. Available from: https://www.gov.uk/government/publications/national-assessment-of-flood-and-coastal-erosion-risk-in-england-2024/national-assessment-of-flood-and-coastal-erosion-risk-in-england-2024 [accessed 23 September 2025].

ENVIRONMENT AGENCY, 2024b. Flood and Coastal Erosion Risk Management appraisal guidance manual [online]. Available from: https://www.gov.uk/guidance/flood-and-coastal-erosion-risk-management-appraisal-guidance [accessed 23 September 2025].

ENVIRONMENT AGENCY, 2024c. Flood and coastal erosion risk management (FCERM) appraisal. Technical Guidance [online]. Available from: https://www.gov.uk/government/publications/fcerm-appraisal-technical-guidance [accessed 23 September 2025].

ENVIRONMENT AGENCY, 2024d. National Coastal Erosion Risk Mapping (NCERM) - National (2018 to 2021).

ENVIRONMENT AGENCY, 2024e. National assessment of flood and coastal erosion risk in England 2024. [online]. Available at: https://www.gov.uk/government/publications/national-assessment-of-flood-and-coastal-erosion-risk-in-england-2024/national-assessment-of-flood-and-coastal-erosion-risk-in-england-2024 [accessed 23 September 2025].

ENVIRONMENT AGENCY, 2025a. Coastal erosion and climate change [online]. Available from: https://environment.data.gov.uk/shoreline-planning/help/coastal-erosion-and-climate-change [accessed 23 September 2025].

ENVIRONMENT AGENCY, 2025b. Coastal Transition Accelerator Programme (CTAP) [online]. Available from: https://engageenvironmentagency.uk.engagementhq.com/ctap [accessed 23 September 2025].

EUNOMIA RESEARCH & CONSULTING, 2023. Updating social amenity valuation factors for waste crime.

FEW, R., 2007. Health and climatic hazards: Framing social research on vulnerability, response and adaptation. Global Environmental Change, 17(2), 281–295.

FINDLATER, L., ROBIN, C., HOPGOOD, K., WAITE, T., NATIONAL STUDY OF FLOODING AND HEALTH STUDY GROUP, RUBIN, G., BECK, C.R. AND OLIVER, I., 2023. Help-seeking following

a flooding event: a cross-sectional analysis of adults affected by flooding in England in winter 2013/14.

HM TREASURY, 2022. The Green Book: central government guidance on appraisal and evaluation. HM Treasury. Available from: https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government/the-green-book-2020; Last updated 16 May 2024. [accessed 23 September 2025].

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC), 2023. Annex II Glossary. In Climate Change 2022 – Impacts, Adaptation and Vulnerability: Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. 1st ed. [online]. Cambridge University Press.

JIN, D., HOAGLAND, P., AU, D.K. AND QIU, J., 2015. Shoreline change, seawalls, and coastal property values. Ocean & Coastal Management, 114, 185–193.

KABIR, S., NEWNHAM, E.A., DEWAN, A., KOK, K.Q.X. AND HAMAMURA, T., 2024. Climate hazards and psychological health among coastal communities in the Asia-Pacific region: a systematic review of quantitative and qualitative evidence. Health Psychology Review, 1–19.

LANDRY, C.E. AND HINDSLEY, P., 2011. Valuing Beach Quality with Hedonic Property Models. Land Economics, 87(1), 92–108.

LANDRY, C.E., SHONKWILER, J.S. AND WHITEHEAD, J.C., 2020. Economic Values of Coastal Erosion Management: Joint Estimation of Use and Existence Values with recreation demand and contingent valuation data. Journal of Environmental Economics and Management, 103, 102364.

MURRAY, E.T., KEATING, A., CAMERON, C., BENCHEKROUN, R., WHEWALL, S., BOOKER, C. AND JIVRAJ, S., 2024. Residence in coastal communities in adolescence and health in young adulthood: An 11-year follow-up of English UKHLS youth questionnaire respondents. Health & Place, 87, 103239.

NHS, n.d. NHS talking therapies for anxiety and depression [online]. Available from: https://www.nhs.uk/mental-health/talking-therapies-medicine-treatments/talking-therapies-and-counselling/nhs-talking-therapies/ [accessed 23 September 2025].

NHS ENGLAND, n.d. Data Access Request Service (DARS) [online]. Available from: https://digital.nhs.uk/services/data-access-request-service-dars [accessed 23 September 2025].

NHS ENGLAND, n.d. Mental Health Services Data Set (MHSDS) [online]. Available from: https://digital.nhs.uk/data-and-information/data-collections-and-data-sets/data-sets/mental-health-services-data-set [accessed 23 September 2025].

NHS ENGLAND, n.d. Quality and Outcomes Framework (QOF) [online]. Available from: https://digital.nhs.uk/data-and-information/data-tools-and-services/data-services/general-practice-data-hub/quality-outcomes-framework-qof [accessed 23 September 2025].

NHS ENGLAND, n.d. SF-12 Health Survey. [online] Available from: https://www.england.nhs.uk/wp-content/uploads/2022/12/Short-form-12-health-survey-questionnaire.pdf [accessed 23 September 2025].

NHS ENGLAND, 2015. Quality and Outcomes Framework (QOF) 2014–15: Achievement, prevalence, and exceptions data – Indicator definitions [online]. Available from: https://digital.nhs.uk/data-and-information/publications/statistical/quality-and-outcomes-framework-achievement-prevalence-and-exceptions-data/quality-and-outcomes-framework-qof-2014-15 [accessed 23 September 2025].

NHS ENGLAND, 2024. Quality and Outcomes Framework (QOF) guidance for 2023/24. [online] Available from: https://www.england.nhs.uk/long-read/quality-and-outcomes-framework-guidance-for-2023-24/ [accessed 23 September 2025].

NINOMIYA, M.E.M., BURNS, N., POLLOCK, N.J., GREEN, N.T.G., MARTIN, J., LINTON, J., RAND, J.R., BRUBACHER, L.J., KEELING, A. AND LATTA, A., 2023. Indigenous communities and the mental health impacts of land dispossession related to industrial resource development: a systematic review. The Lancet Planetary Health, 7(6), e501–e517.

NORTH NORFOLK DISTRICT COUNCIL, n.d. Coastwise. Available from: https://www.north-norfolk.gov.uk/projects/coastwise/ [accessed 23 September 2025].

OECD, 2018. Cost-Benefit Analysis and the Environment: Further Developments and Policy Use [online]. OECD. Available from: https://doi.org/10.1787/9789264085169-en [accessed 23 September 2025].

OFFICE FOR NATIONAL STATISTICS, 2022. Census 2021 [online]. Available from: https://www.ons.gov.uk/census [accessed 23 September 2025].

OFFICE FOR NATIONAL STATISTICS, UK DATA SERVICE, 2023. Opinions and Lifestyle Survey. 5th Release [online]. Available from: http://doi.org/10.5255/UKDA-Series-2000043 [accessed 23 September 2025].

OFFICE FOR NATIONAL STATISTICS, UK DATA SERVICE, 2024. Annual Population Survey. 8th Release [online]. Available from: http://doi.org/10.5255/UKDA-Series-200002 [accessed 23 September 2025].

PENNING-ROWSELL, E., PRIEST, S., PARKER, D., MORRIS, J., TUNSTALL, S., VIAVATTENE, C., CHATTERTON, J. AND OWEN, D., 2014. Flood and Coastal Erosion Risk Management: A Manual for Economic Appraisal. 1st ed. Routledge.

QUAH, E. AND TAN, T.S., 2019. Valuing the Environment.

RULLEAU, B., REY-VALETTE, H. AND HÉRIVAUX, C., 2015. Valuing welfare impacts of climate change in coastal areas: a French case study. Journal of Environmental Planning and Management, 58(3), 482–494.

SANDER, H.A. AND POLASKY, S., 2009. The value of views and open space: Estimates from a hedonic pricing model for Ramsey County, Minnesota, USA. Land Use Policy, 26(3), 837–845.

SAVILLS, 2023. Fairbourne Health Impact Assessment.

SCHWOERER, T., BERRY, K., RASMUS, S.M., JOE, J.P., NANENG, N.W. AND RAVENS, T.M., 2023. Climate policy must account for community-specific socio-economic, health, and biophysical conditions—evidence from coastal Alaska. Regional Environmental Change, 23(3), 90.

SHAW, E.J., SUTCLIFFE, D., LACEY, T., AND STOKES, T., 2013. Assessing depression severity using the UK Quality and Outcomes Framework depression indicators: a systematic review. British Journal of General Practice, 63(610), e309-e317.

SIMMONDS, C., 2023. The community mental health impacts of coastal erosion and the benefits of adaptation. MSc Economics Work Based Project Submission, Economics Masters Apprenticeship Programme, Queen Mary University of London (not published).

STATISTICS FOR WALES, 2019. General Medical Services Contract: Quality and Outcomes Framework Statistics for Wales, 2018-19 [online]. Available from: https://www.gov.wales/sites/default/files/statistics-and-research/2019-09/general-medical-services-contract-quality-and-outcomes-framework-april-2018-march-20199-599.pdf [accessed 23 September 2025].

TSIMPIDA, D., TSAKIRIDI, A., DARAS, K., CORCORAN, R. AND GABBAY, M., 2024. Unravelling the dynamics of mental health inequalities in England: A 12-year nationwide longitudinal spatial analysis of recorded depression prevalence. SSM - Population Health, 26, 101669.

VIAVATTENE, C. AND PRIEST, S., 2020. A method for monetising the mental health costs of flooding, Environment Agency Project Report (SC150007). Bristol, UK.

WAITE, T.D., CHAINTARLI, K., BECK, C.R., BONE, A., AMLÔT, R., KOVATS, S., REACHER, M., ARMSTRONG, B., LEONARDI, G., RUBIN, G.J. AND OLIVER, I., 2017. The English national cohort study of flooding and health: cross-sectional analysis of mental health outcomes at year one. BMC Public Health. Jan 28;17(1):129. doi: 10.1186/s12889-016-4000-2.

WARE, J.E., KOSINSKI, M., TURNER-BOWKER, D.M., GANDEK, B. AND KELLER, SUSAN.D., 2005. How to score version 2 of the SF-12(R) health survey (with a supplement documenting version 1).

WEISS, D.S. AND MARMAR, C.R., 1997. The Impact of Event Scale—Revised. In: Assessing psychological trauma and PTSD. New York, NY, US: The Guilford Press. 399–411.

WELSH GOVERNMENT, 2017. National Survey for Wales: April 2016 to March 2017 [online]. Available from: https://www.gov.wales/national-survey-wales-april-2016-march-2017 [accessed 23 September 2025].

WHITTY, C., 2021. Chief Medical Officer's Annual Report 2021 - Health in Coastal Communities [online]. Department of Health and Social Care. Available from: https://www.gov.uk/government/publications/chief-medical-officers-annual-report-2021-health-in-coastal-communities. [accessed 23 September 2025].

WORLD HEALTH ORGANIZATION, 2022a. World Mental Health Report: Transforming mental health for all [online]. Geneva. Available from: https://www.who.int/teams/mental-health-and-substance-use/world-mental-health-report [accessed 23 September 2025].

WORLD HEALTH ORGANIZATION, 2022b. Mental health [online]. Available from: https://www.who.int/health-topics/mental-health [Accessed 5 November 2024]. [accessed 23 September 2025].

List of abbreviations

APMS	Adult Psychiatric Morbidity Survey
CIS-R	Revised Clinical Interview Schedule
CMD	Common mental disorder
COI	Cost of illness
CPRD	Clinical Practice Research Datalink
CTAP	Coastal Transition Accelerator Programme
DARS	Data Access Request Service
FCERM	Flood and Coastal Erosion Risk Management
FOI	Freedom of Information
GHQ-12	12-item General Health Questionnaire
GP	General practitioner
IES	Impact of Event Scale
ICB	Integrated Care Board
IMD	Index of Multiple Deprivation
LSIID	Long-standing impairment, illness or disability
LSOA	Lower layer Super Output Area
LTIR	Long-term Investment Requirements
LTIS	Long -term investment scenarios
MCM	Multi-Coloured Manual
MCS	Mental Component Summary
MHSDS	Mental Health Services Data Set
MSOA	Middle layer Super Output Area
NCERM	National Coastal Erosion Risk Mapping
NHS	National Health Service
NICE	National Institute for Health and Care Excellence

NIHR	National Institute for Health and Care Research
NRD	National Receptor Data set
NRW	Natural Resources Wales
ONS	Office for National Statistics
OS	Ordnance Survey
PTSD	Post-traumatic stress disorder
QALY	Quality-adjusted life year
QOF	Quality and Outcomes Framework
RQ	Research question
SF-12	12-item Short-Form Survey
SLR	Sea level rise
SMP	Shoreline Management Plan
UKHLS	UK Household Longitudinal Study
UKHSA	UK Health Security Agency
WELLBY	Wellbeing-adjusted life year
WTA	Willingness to accept
WTP	Willingness to pay

Glossary

Anxiety: Apprehensiveness or anticipation of future danger or misfortune accompanied by a feeling of worry, distress, or somatic symptoms of tension. The focus of anticipated danger may be internal or external. (World Health Organization, n.d.).

Coastal erosion (also referred to as **shoreline retreat**): It occurs when a net loss of sediment or bedrock from the shoreline results in landward movement of the high-tide mark (Intergovernmental Panel On Climate Change (IPCC), 2023). The Environment Agency defines coastal erosion as "[a] natural process which leads to the movement and loss of soil, sand and bedrock. Coastal erosion can be influenced by human activity and by climate change. The type of erosion and its impact varies depending on local geology and coastal processes. Two important processes are: (1) tides, waves and storms can erode rocks, cliffs, beaches, dunes and marshes; and (2) rainfall, groundwater and the sea can make the ground unstable and lead to landslides and slumps" (Environment Agency, 2025a).

For the purposes of economic appraisal, the most important difference between losses owing to coastal erosion and losses owing to flooding is that coastal erosion is effectively irreversible: once land has been eroded or the cliff-top edge is deemed too close to a property for that property to be used safely, the land or property cannot be regained. This irreversibility means that future options for the use of that land or property are also lost. Hence, there is a permanent loss at one point in time of a capital asset (for example, land, property or both) which had offered a future stream of uses and therefore values (Penning-Rowsell and others, 2014).

Depression: Depressive disorders are characterised by depressive mood (for example, sad, irritable, empty) or loss of pleasure accompanied by other cognitive, behavioural or neurovegetative symptoms that significantly affect the individual's ability to function. (World Health Organization, n.d.).

Mental disorder: A syndrome characterised by clinically significant disturbance in an individual's cognition, emotional regulation or behaviour that reflects a dysfunction in the psychological, biological or developmental processes that underlie mental and behavioural functioning. These disturbances are usually associated with distress or impairment in personal, family, social, educational, occupational or other important areas of functioning (World Health Organization, 2022a).

Mental health: A state of mental well-being that enables people to cope with the stresses of life, to realise their abilities, to learn well and work well, and to contribute to their communities. Mental health is an integral component of health and well-being and is more than the absence of mental disorder (World Health Organization, 2022a).

Mental health condition: A broad term covering mental disorders and psychosocial disabilities. It also covers other mental states associated with significant distress, impairment in functioning or risk of self-harm (World Health Organization, 2022a).

Post-traumatic stress disorder (PTSD): this may develop following exposure to an extremely threatening or horrific event or series of events. It is characterised by all of the following: 1) re-

experiencing the traumatic event or events in the present in the form of vivid intrusive memories, flashbacks or nightmares. Re-experiencing may occur via one or multiple sensory modalities and is typically accompanied by strong or overwhelming emotions, particularly fear or horror, and strong physical sensations; 2) avoidance of thoughts and memories of the event or events or avoidance of activities, situations or people reminiscent of the event(s); and 3) persistent perceptions of heightened current threat, for example as indicated by hypervigilance or an enhanced startle reaction to stimuli such as unexpected noises. The symptoms persist for at least several weeks and cause significant impairment in personal, family, social, educational, occupational or other important areas of functioning. (World Health Organization, n.d.).

Psychosocial disability: Disability that arises when someone with a long-term mental impairment interacts with various barriers that may hinder their full and effective participation in society on an equal basis with others. Examples of such barriers are discrimination, stigma and exclusion (World Health Organization, 2022a).

Appendix 1: data scoping

Data set used

The data sets used in this research are listed in the table A1, along with who provided them and a short description of each one. A full list of all data sources that were identified but not used can be requested.

Table A1: Data scoping used in this project

Data set	Provider	Role in analysis	Conceptual framework component	Spatial scale
National Receptor Data set (NRD)	Environment Agency, NRW	Coastal erosion hazard and future risk horizons, including short-, medium- and long-term erosion epochs	Coastal erosion	Shoreline frontages
National Coastal Erosion Risk Mapping (NCERM) (2018 - 2021)	Environment Agency, NRW	Identification of residential and non-residential properties exposed to erosion risk	Coastal erosion/risk factor	Property
Shoreline Management Plan (SMP) Mapping	Environment Agency	Management and policy context	Response/context	SMP
Long-Term Investment Scenarios (LTIS) eroded properties	Environment Agency	Contextual information on properties historically lost to coastal erosion; used to inform understanding of exposure and case-study context rather than statistical analysis	Coastal erosion/exposure context	Property
NHS Quality and Outcomes Framework (QOF) depression indicators	NHS England	Indicator of newly diagnosed depression (DEP indicators) used at GP practice level	Mental health outcome	GP practice

Data set	Provider	Role in analysis	Conceptual framework component	Spatial scale
Census 2021	Office for National Statistics	Socio-demographic mediating factors including: • household composition • housing tenure • disability status • education level • employment status • overcrowding • English language proficiency	Mediating factors	LSOA
Small Area Income Data	Office for National Statistics	Economic context including average household income measures.	Mediating factors	LSOA
Small Area Mental Health Index (SAMHI)	Various data sources	Composite LSOA-level mental health indicator derived from QOF depression prevalence, antidepressant prescribing data, mental-health-related hospital attendances, and DWP incapacity and employment-related benefit indicators (England only).	Mental health outcome	LSOA

Data sets explored but not suitable for analysis

Many data sets were explored during the scoping phase of this research, but could not be used to support a robust analysis. The data sets we identified and our reasons for not using them are summarised below.

Please note: we have a detailed table of all data sets identified in this project which can be requested.

Coastal and hazard data sets such as BGS GeoCoast and Eurostat

NCERM data was favoured instead of BGS GeoCoast as it had all data required for the project. Eurostat had outdated UK coverage post-Brexit and lacked alignment with UK administrative geographies.

Administrative and benefits data sets from DWP

Can’t be reliably linked to coastal erosion exposure.

NHS patient-level mental health data sets

For example:

- Mental Health Services Dataset
- NHS Talking therapies
- Clinical Practice Research Datalink

These were not suitable due to: the cost constraints, raw data not publicly accessible, and aggregated outputs are not available at spatial scales suitable for linking to coastal erosion exposure.

General health, wellbeing and survey data sets

For example:

- ONS wellbeing and anxiety surveys
- Health Survey for England
- General Health Questionnaire (GHQ-12)
- UK measure of National Wellbeing
- Community Life Survey,
- Telephone-operated Crime Survey for England and Wales
- Labour Force Survey
- UK Household Longitudinal Study

Data are generally only available at national or regional scales and cannot be reliably attributed to communities exposed to coastal erosion.

Prescribing and secondary-care medicines data sets

Data cannot be reliably attributed to place of residence or exposure to coastal erosion risk.

Economic and housing data set

For example private rent and house prices data set.

These provide indirect economic indicators rather than direct measure of mental health outcomes and would require additional assumptions to infer mental health impacts.

Wales mental health data sets post-2017

Discontinuation of Quality and Outcomes Framework reporting limits comparability with England and prevents small-area analysis.

Although many additional data sets exist, limitations relating to access, spatial resolution, timing and comparability meant that only a limited subset were suitable for the analyses undertaken in this study.

Would you like to find out more about us or your environment?

Then call us on:

03708 506 506 (Monday to Friday, 8am to 6pm)

Email: enquiries@environment-agency.gov.uk

Or visit our website
www.gov.uk/environment-agency

Incident hotline

0800 807060 **(24 hours)**

Floodline

0345 988 1188 **(24 hours)**

Find out about call charges (https://www.gov.uk/call-charges)

Environment first

Are you viewing this onscreen? Please consider the environment and only print if absolutely necessary. If you are reading a paper copy, please don't forget to reuse and recycle.

Environment Agency
Horizon House,
Deanery Road,
Bristol
BS1 5AH

