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A method for monetising the mental
health costs of flooding

Project SC150007

Flood and Coastal Erosion Risk Management Research and Development Programme

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Professor Doug Wilson
Director, Research, Analysis and Evaluation

Executive summary

Over the last 30 years, our knowledge of how to estimate the cost and benefits of flood risk management (flood damages avoided) has improved progressively and evolved to include a wider range of benefits. There is growing evidence to suggest that flooding has a negative impact on the mental health of those affected. We need to further develop our approaches and data to include the costs to mental health caused by flooding.

This project reports on 3 main objectives: to review the literature that assesses the impacts of flooding on people's mental health, to carry out a review of the available data concerning the mental health impacts of flooding (in particular the Public Health England (PHE) longitudinal study into the mental health impacts of flooding), and to develop a methodology to assess the benefits of avoiding the costs due to the mental health impacts of flooding for FCRM economic appraisal.

We carried out an extensive review of around 50 studies concerning the impact of flooding on mental health. The review focused on examining 6 main criteria: the type and severity of mental health impacts recorded, the prevalence of the impacts due to flooding, the duration of impacts, associations between impacts and socio-economic characteristics, associations between impacts and flood characteristics, and evidence of actions that can reduce or worsen impacts on mental health.

Although there is now a substantial number of studies on flooding and mental health impacts throughout international literature, not all findings were comparable to the situation in England and so it was difficult to transfer some of the results. There was also a lack of consistent evidence about, for example, the association of mental health impacts and different demographic and socio-economic conditions, with the findings of some studies proving contradictory.

We identified 7 important studies relevant to England. However, due to the different methods used, for example, cross-sectional surveys, qualitative interview surveys, cohort studies, analysis of prescription records, and target populations it was very difficult to compare the results between them. In particular, although broadly similar, we could not compare aspects such as the prevalence of health impacts.

The longitudinal data set gathered by Public Health England was the most useful data for assessing benefits. From this data, we could work out the rise in number of people experiencing mental health conditions such as depression, anxiety or post-traumatic stress disorder who have been flooded. This data also allowed us to establish the different impacts on health according to the depth of flood water inside the property. Although this data provided additional information on the health impacts of being 'disrupted' by flooding, the focus of the methodology was on those people whose property has actually been flooded. This allowed us to attribute the benefits of avoiding flooding on a property-by-property basis.

We considered various approaches to working out the cost of the impacts of flooding on mental health. Estimating the costs of treatment and work-based losses is the most appropriate as that can be applied to individuals at a property level. This approach excludes people who do not seek treatment or who still attend work, but are not fully productive, known as presenteeism. Some of this missing value is covered by the current approach to assessing health impacts which is based on the willingness to pay approach. This is the maximum amount a consumer is willing to pay to avoid losses. This approach would also still apply as it captures the costs to society associated with other negative impacts on general health.

The research has presented a range of figures that can be used as part of benefit appraisal. Costs of treatment are based on an approach that considers a range of treatments and associated costs, for example in-patient hospitalisation, GP care and drug treatment. From this, we can estimate the average number of patients accessing these services for the different mental health conditions. We have had to adopt these values based on evidence of treatment within the general population as the Public Health England data provides no evidence of the severity of the mental health impacts experienced.

The Public Health England data provided 3 values for work-based losses based on different data and methods for estimating the economic activity lost due to suffering a mental health condition. The recommended approach (average losses) uses data on the average number of days an employee with each of the mental health conditions is absent from work multiplied by the median hourly wage (net of taxes) for a full-time adult. This approach is preferred as it uses an approach that is compatible with the current benefit appraisal methodologies. This can then be added to the cost of treatment to provide a total loss per adult for each mental health condition.

We have adjusted the estimated costs to account for 2 factors. Firstly, not everyone suffering from mental health conditions seeks treatment, meaning that there are no associated treatment costs. Secondly, there is likely to be co-morbidity (people suffering from more than one condition at the same time), with some of those affected suffering from 2 or even 3 conditions. As the treatment of these mental health conditions may be similar, not accounting for this would overestimate the total losses. Values were provided for 3 different depths of flooding, per adult and per flood event, and have estimated that treatment and absence will continue for 2 years after the flooding. The recommended values (as at 2018) for estimating the mental health costs from flooding (per adult household, per flood depth band within a property) are: less than 30cm flooding - £1,878; 30cm to 100cm flooding - £3,028 and more than 100cm flooding - £4,136.

The methodology, driven by the data available, still omits some of the social and welfare costs of flooding, for example, presenteeism and being ill, but not seeking treatment. This could be a significant under estimate. These and other welfare costs are legitimate economic impacts as defined under the Treasury Green Book. Also, for some people, the impacts will be much longer lasting than the 2 years assumed, but this was the limit of the PHE data available at the time. This will be reassessed in future revisions of this report and revisions to the existing willingness to pay study.

The proposed benefit appraisal methodology for including mental health impact within FCRM economic appraisal is similar to that used to calculate residential property losses. The methodology differentiates the likely number of adult residents for each property in the benefit area; estimates the flood depth inside each property and associated health losses for each return period of the considered options; and uses the Environment Agency FCRM supporting spreadsheet to calculate expected annual average damages.

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1 Previous multi-coloured manual (MCM) methodology for assessing health impacts

Economic valuation techniques must be used to consider the economic effect of flooding on health or the environment. Various techniques may be used to provide an approximate value, such as hedonic pricing, travel costs, replacement costs, dose-response and the contingent valuation method. The method used in previous versions of the multi-coloured manual (MCM) involved calculating a weighted annual benefit per property, derived from a wide range of responses obtained by a willingness to pay (WTP) approach (contingent valuation method). Responses are based on the value of avoiding the health impacts from flooding.

The willingness to pay survey was carried out in autumn 2002 in various locations in England and Wales previously flooded from April 1998 to November 2000. 1,510 people responded, of whom 983 experienced flooding and 527 were 'at risk'. The questionnaire also included questions related to the flood characteristics and to various flood impacts such as the potential health impacts, measured by specific self-response health questionnaires (GHQ-12 on current health and at worst-time from the flooding) and post-traumatic stress scale (to diagnose PTSD). Results indicate that problems with insurance, age, slow recovery and prior health issues were the main factors contributing to short-term and long-term effects, with insurance and prior health issues being the most significant. Depth of flooding only contributed to long-term effects.

The WTP strictly relates to payment to improve flood defence to avoid the stress and inconvenience resulting from impacts on physical health (for example, headaches, colds, and injuries), disruption to normal life, and loss of irreplaceable items due to flooding. The study concluded on a WTP of £200 (2005 values) per household per year, based on the average value obtained from those people who had been flooded. The 'at-risk' respondents provided a lower average value of £154, but this was excluded on the grounds that those who had experienced flooding provided a more reliable and true figure. The study concluded that the WTP is influenced by long-term psychological effects and ability to pay.

From the WTP average values of £200 and the assumption that the 'intangible benefits' associated with flood defence improvement followed a sigmoidal function, we derived the benefits associated with a range of flood defence improvements (Table 1). These values are presented as a benefit per household.

Table 1: Intangible risk reduction matrix (from Defra/ Environment Agency 2005), annual benefits per residential property

Standard of protection (annual exceedance probability)								
	After							
Before flood alleviation scheme is built	0.007	0.008	0.01	0.013	0.02	0.033	0.05	0.1
1	£218	£215	£200	£153	£73	£25	£12	£5
0.1	£214	£210	£195	£148	£68	£21	£8	£0
0.05	£206	£202	£188	£141	£60	£13	£0	
0.033	£193	£189	£175	£128	£47	£0		
0.02	£145	£142	£127	£80	£0			
0.013	£65	£62	£47	£0				
0.01	£18	£15	£0					
0.008	£4	£0						

2 Analysis of the evidence of the impact of flooding on health

2.1 Introduction and background

This review aims to find evidence of the impacts of flooding on mental health. We have, therefore, not included analysis of fatalities, risk to life and physical injuries suffered during flooding.

Since the last update to the MCM health figures, there has been considerable additional research focusing on the health impacts of flooding, providing evidence from a variety of contexts. Initially, this review will not limit analysis to evidence from the UK, but also consider studies from other countries. We will also review existing methodologies for assessing the impacts of flooding on people's mental health.

The main evidence on the mental health impacts of flooding comes from analysing past flooding events, and surveys. It is important to recognise the value and limitations of this data. The main issues to consider include the sample size and how representative the survey data is of the people affected by flooding, the timing of any survey and if it was repeated, the methods used to analyse the health impacts (for example, self-reported, standardised health questionnaires) and any associated information about the flood characteristics. It is also important to recognise that flood events can be quite unique and so events that have happened in the past are not necessarily always good indicators of impacts in the future. Consequently, when analysing the evidence and how useful it is, it is also essential to report the characteristics and context of where it has been reported.

2.2 Scope

There is evidence that the flooding can have a considerable effect on people's health. Before exploring the existing literature on the implications of flooding on health, it is important to outline some considerations relating to the scope of this analysis, which does not examine fatalities or risk to life caused by flooding. These are as follows:

- Health impacts are often divided into physical and mental health. In reality, there are some instances when people who experience flooding will suffer both kinds of health impact and many studies note the influence that mental and physical health can have on each other (Mason and others, 2010; Paranjothy and others 2011; Tapsell and others, 2009; Jakubika and others, 2010). However, these links are very complex and difficult to predict before flooding happens. Therefore, we will, at least initially, assess them and consider their contribution separately.
- The approach to health impacts in this project assumes that, in most situations in this country, flooding does not have a significant long-term effect on sanitation and water supply. We are assuming therefore, that clean or bottled water is available and/or that those who are flooded can live away from the directly flooded area and have adequate sanitation. From a health perspective, this means that the risk of some of the diseases or infectious illnesses caused by a lack of sanitation, hygiene or clean drinking water such as dysentery, E. coli, which are sometimes observed in developing countries following flooding, are mainly avoided.

2.3 Main criteria for analysis

We will review existing literature and data to help develop a methodology to include the health impacts of flooding within benefit appraisal. To develop an appropriate methodology, we need to consider 3 main areas: (i) the degree of mental health impacts caused by flooding, (ii) how to value these impacts, and (iii) how to apply the values within an appraisal methodology.

More specifically, we will analyse the literature and data according to the following factors:

- i. **type and severity** of mental health impacts recorded – this is linked to the following 2 factors, but specifically considers the type of impacts experienced. This information may be useful for working out the cost of health impacts.
- ii. **prevalence** of the mental health impacts of flooding – this will highlight the potential scale of health impacts within a flooded community. From existing studies, it may be appropriate to separate out the physical and mental impacts, or these may be reported together.
- iii. **duration** of any mental health impacts (how long the health impacts typically last following a flood) – this information is important in working out the severity of any health impacts as well as the cost (from number of work days lost or the cost of medical treatment).
- iv. **association** between the severity, prevalence or duration of mental health impacts and **socio-economic characteristics** of the community (in other words, are there characteristics within a particular community that make them more or less vulnerable than others). This information will provide evidence as to whether the expected health benefits are different for different communities.
- v. **association** between the severity, prevalence or duration of health impacts and **flood characteristics** (in other words, deeper, faster flowing floods are more likely to have a negative effect on people's mental health). This relationship is important when establishing how to apply any potential benefits to an area, and the impacts avoided by avoiding certain flood characteristics.
- vi. any other aspects that may reduce or worsen any impacts on mental health (for example, how long people are displaced from their homes, whether or not people have insurance). Similar to the socio-economic and flood characteristics, these may be used to inform the methodology to apply the potential benefits of a FRM measure within an appraisal.

2.4 Nature of the evidence and data quality issues

There are a number of important considerations concerning the type of evidence that is used to identify and quantify the negative health impacts and the data that it used. These issues concern the extent to which findings can be transferred and compared.

- **Type of studies carried out:** Because the previous studies carried out are very different, comparing and verifying evidence between studies can be a problem. They use different surveying techniques in different ways after the flood has happened. Some surveys are carried out before the flooding takes place and then repeated after the flooding. However, many surveys ask questions after the flood to find out if people's mental health has deteriorated. This relies on people answering the survey understanding and remembering their situation. Some studies have control populations (people that have not been affected by the flooding), whereas others only sample those people whose homes were flooded (affected populations). Even where control

populations have been included, it can often be difficult to make comparisons between those affected and those unaffected by flooding. Other studies have used data from healthcare surveillance processes, which collect and analyse health-related data for planning, implementation and evaluation of public health practice. These studies have their own challenges; variable quality of surveillance, people moving following flooding can affect how representative of the population the results are, and the healthcare systems themselves are often impacted and this can disrupt surveillance systems and cause difficulties in attributing the health impacts to a flood event.

- **Sampling:** Many studies rely on convenience/volunteer sampling and, as a result, outcomes could be biased, as those who are more severely affected are more likely to be interested and complete the surveys.
- **Context:** There are many studies that have focused on a very specific group of people. So, although these studies may provide evidence of how to support these people after flooding, it can be difficult to transfer the results of these studies. There are also many flood context, cultural and different healthcare factors that make transferring results difficult.
- **Self-reporting most commonly retrospectively:** Results are subject to error due to inaccurate or incomplete recollection of past experiences. This is particularly important when considering the scale of the event. It is extremely difficult to reliably measure the extent or severity of the flooding, and surveys often have to rely on self-reporting.
- **General health and wellbeing diagnoses:** Some studies have chosen to use general scales of overall health and wellbeing or mental health. Although these are suitable for assessing negative impacts, they offer less firm evidence for a benefit appraisal methodology as it is hard to associate a more general reduction in health to treatment costs.
- **Diagnosis tools:** Although clinical diagnosis questionnaires are well used and offer a more standardised approach to estimating the probable diagnosis of certain conditions, a range of different questionnaires have been used. In some cases, different threshold scores with the same questionnaires have also been used to offer a probable diagnosis. Therefore, there is a question about the consistency of diagnoses and whether the results of studies are comparable.
- **Lack of longitudinal evidence:** There are very few long-term studies following those flooded over many years and therefore there is little evidence on the duration of impacts.
- **Complexity of the influencing factors:** There are many confounding factors that influence the likelihood and severity of any negative health impacts. It is challenging to record all of these different factors and understand how they interact.

2.5 Public Health England data set

The national study of flooding and health began in 2015 for a period of 10 years. It aims to investigate the long-term impact of flooding and disruption from flooding on mental illness, mental health and wellbeing (Waite and others, 2017a; b), measuring the increased chance of depression, general anxiety disorder and post-traumatic stress disorder (PTSD). The current study results are from the first survey of 6 local councils (Sedgemoor, South Somerset, Wiltshire, Gloucestershire, Surrey, Tonbridge and Malling) affected by the winter floods in 2013 to 2014. 2,126 adults responded to the questionnaires. The survey was aimed at 3 target groups: those unaffected by flooding (control group), those that were flooded, and those that were disrupted (for example, either by being evacuated, flooding only happening in surrounded areas, utilities' services being

disrupted, being unable to get to work, schools, amenity). The flood hazard characteristics considered in the study were depth of flooding in the property (less than 30cm, 30 to 100cm, more than 100cm) and flood duration (less than one day, one to 7 days, 8 to 14 days, more than 14 days). Validated survey and screening tools were used in the survey to measure health and wellbeing outcomes (these were, PHQ-2 for probable depression, GAD-2 for probable general anxiety disorder and PCL-6 for probable PTSD).

The dose-response function (mathematical relationship measuring the level of outcomes with the level of exposure) highlighted by these data means it is now possible to improve the economic losses associated with certain health impacts. In the Public Health England (PHE) data it is not possible to derive a linear relationship and, therefore, a stepped relationship marking several thresholds is preferred. The authors (Waite and others, 2017b) reported some sampling issues on the age distribution (more elderly than average population), poverty co-morbidistribution (deprived less represented than average population - 2.7% in the two most deprived fifths compared with 40% of England population) and ethnicity (white population dominant). Odds ratios, adjusted to account for socio-demographic factors, were used on the outcomes, but as deprived areas and ethnicity were underrepresented, the adjustment efficiency remains limited. Potential responses bias was also reported as those not affected, displaced and those suffering from PTSD are less likely to respond. The authors also report that it was not possible to assess whether the sample was representative of the population. Therefore, future MCM updates will have to consider any additional results from the national study of flooding and health to confirm the values used.

2.6 Evidence from existing studies and their relevance for flood risk benefit appraisal in England

Table A1 (Appendix A: Literature) provides a list of the most important literature on the reported and recognised health impacts due to flooding. As well as existing studies, which are generally carried out after flooding and study the impacts retrospectively, there are a number of papers (Ahern and others, 2005; Alderman and others, 2012; Auger and others, 2000; Doocy and others, 2013; Fernandez and others, 2015; Lamond and others, 2015; Lowe and others, 2013; Mason and others, 2010; Murray and others, 2011; Pendlebury and Bates, 2015; Solomon and Green, 1992; Stanke and others, 2012) that review and combine these primary surveys. These have been used to identify primary data sets, as well as considering their comparative conclusions.

2.6.1 Type and severity of health impacts

Existing literature discusses a vast range of different health impacts that can be associated with flooding. We summarise the most relevant and commonly discussed under the 2 groups of physical and mental health impacts.

Physical health impacts

Many existing studies focus on the numbers and causes of mortality from flood events. However, non-fatal injuries are relatively more poorly recorded after the event and reported in the literature (Ahern and others, 2005). Prevalence data is further complicated by reporting difficulties and whether certain injuries have been caused by the flooding. There is general evidence from many studies (Bennet 1970; Brown and Murray, 2017; CDC 1993; Collins and others, 2013; Duclos and others, 1991; Heo and others, 2008; Jimenez and others, 2013; Lock and others, 2012; Okafor and Hill 2015; Price 1978; Reacher and others, 2004; Rhodes and others, 2010; Sastry and Gregory, 2013; Schnitzler and others, 2002; Steinfuhrer and Kuhlicke 2007; Strelau and others, 2005; Tapsell and others, 2002; Tunstall and others, 2006; Wade and others, 2004) suggesting that there are other (non-injury) impacts on physical health. However, these studies have tended to be very specific and/or related to mixed events, for example, hurricanes with associated flooding, and so it is not easy to transfer the results to the situation faced in England. The severity of some of these

impacts is also not always clear, making it difficult to estimate the economic impacts of avoiding these losses.

Some studies concentrate on an increase in rodent-borne (mainly leptospirosis), vector-borne (West Nile virus (WNV), dengue fever) and water-borne (cholera, gastrointestinal illnesses) diseases as well as injuries and existing physical conditions getting worse. There is little evidence, however, of the first 2 types of disease following flooding in Europe (Brown and Murray, 2017; Ahern and others, 2005). Milojevic (2015) concludes that there is no evidence to highlight the importance of infectious diseases in the UK. Therefore, we will not consider either of these further. The most meaningful impacts relate to water-borne disease and specifically, the potential increase in gastro illnesses. Reacher and others (2004) reported an increase (70%) in (self-reported) gastroenteritis following the floods in Lewes in 2001. However, in contrast, Milojevic (2015) indicates that the PHE syndromic surveillance data (for example, GP attendances and 111 calls) collected around the time of the 2007 floods did not indicate any increase in infectious diseases. More recent, definitive evidence from the UK is lacking, and the general impact of these diseases on people impacted by flooding seems to be low and/or short lived.

The more significant physical impact is due to existing health conditions getting worse. Studies highlight the impact that flooding can have on this, especially concerning respiratory-related illnesses (Du and others, 2010; Alderman and others, 2013; Mason and others, 2010; WHO, 2013).

Alderman and others (2012) highlight the complexity of the cause of physical impacts and the link between flood-related consequences, existing physical health conditions and aspects related to recovery. Mould growth and its impacts on respiratory health is a commonly discussed issue (through respiratory infections, immune responses or ingestion of toxins) (for example, Alderman and others, 2013; Jimenez and others, 2013). Despite evidence that there are particular negative impacts on health, there can be many complicating factors affecting how floods directly impact the probability of different illnesses. Given this, we need specific evidence to help the methodology for FRM appraisal. For instance, we have little data to identify the prevalence of a specific condition and also to attribute an increased cost. This makes it extremely challenging to take account of existing physical conditions getting worse.

In summary, from a UK context, there is a lack of clear data to identify and attribute any injuries after flooding or to identify the prevalence of physical impacts. Without being able to attribute additional prevalence of physical conditions, we cannot include these within any economic assessment of flood-related health impacts. We therefore, propose to exclude physical injuries from any methodology until relevant data becomes available. In particular, more research could be carried out to interrogate data already collected, such as studying the PHE syndromic surveillance data in greater detail. This may capture additional evidence on the increased prevalence of certain health conditions, allowing them to be included in economic appraisals. Further longitudinal studies (studies tracking effects over time) are needed to assess the longer-term impacts on physical health, to quantify the increase in conditions and the reoccurrence or exacerbation of existing conditions.

Mental health impacts

Many studies have corroborated the short to medium-term, and fewer studies, the longer-term impacts on psychological health. Applying different types of post-flood survey methodologies and using standardised diagnostic tools have allowed probable diagnoses of different illnesses to be made. Some studies use more general mental wellbeing scores and, although they can be used to confirm the association between flooding and its negative impact on health, they provide little data to inform the likelihood of treatment costs.

Common specific mental health conditions that have been investigated more specifically are: stress, anxiety, depression and post-traumatic stress disorders (PTSD). Eighteen of the studies investigated have examined one or all of these conditions, in addition to the longitudinal study

carried out by PHE (Alderman and others, 2013; Bei and others, 2013; Canino and others, 1990; Carroll and others, 2009; Carroll and others, 2010; Chae and others, 2005; Collins and others, 2013; Ginexi and others, 2000; Heo and others, 2008; Lamond and others, 2015; Lui and others, 2006; Mason and others, 2010; Milojevic and others, 2017; Norris and others, 2001a; 2001b; 2002; 2004; Paranjothy and others, 2011; Verger and others, 2003; Wang and others, 2007; 2008). These are the conditions that we will consider moving forward within the benefit appraisal. We present the prevalence data of these health impacts in the following section.

The increased use of services is another way in which the impact of floods on health have been identified and measured, however much of this has been from the US or elsewhere. Due to differences in healthcare systems that may affect the chance of seeking and/or continuing treatment and prescribing practices, we feel that, in this instance, we cannot transfer these results. Milojevic and others (2017) provide a recent study that has directly investigated the increase use of prescription antidepressants in GP practices located in close proximity to flooded areas. This highlighted a very small overall increase (0.4% to 1%) in rates of antidepressant prescribing. However, these values have been diluted as the numbers of affected households served by any practices is low when compared to the overall number of households.

It is noted that it is often difficult to separate and represent the interconnections between the physical and mental health impacts, in particular those related to common psychosocial symptoms (earache, headache and general body pain) (Alderman and others, 2012).

2.6.2 Prevalence of health impacts

As discussed previously, particular caution should be taken when comparing the results of studies. Although many have used standardised diagnostic tools, there are multiple surveys available (Milojevic, 2015 notes 42 different diagnostic tools) and selecting the threshold score that must be exceeded for a positive probable diagnosis to be made is much debated and can vary between studies. Furthermore, care also needs to be taken when considering the point(s) at which the population were contacted, which also varies and may affect the findings. A further complication concerns how the prevalence data is presented. For instance, is it accounting for an **increase** in any condition being experienced and, if this is the case, which data has been used to make this comparison, and how well are affected households represented within the population considered. Table 2 highlights those studies where the prevalence information can be transferred to the situation in England and is relevant for FRM benefit appraisal. This table provides a commentary on the type of study, the sampling size and strategy and comparability with other studies.

Frustratingly, the different metrics used to describe the impacts make it difficult to compare the different studies. Also, from an appraisal perspective, the degree to which any of these conditions exist together needs to be considered. Most of the studies considered were only concerned with the overall prevalence of these conditions or the increased likelihood of someone who has been flooded having a specific condition, rather than whether they are experiencing a number of health conditions. The importance of co-morbidity (suffering from more than one condition at the same time) is raised by existing studies (Mason and others, 2010; Lamond and others, 2015) and will be highlighted as a major issue when we discuss treatments.

The PHE data adds an important finding to previous studies, which is to consider health impacts on people indirectly affected by flooding. Although this is relevant to consider within an appraisal methodology, we will discuss later the difficulty in applying it.

Table 2: Data on the prevalence of negative mental health impacts in flooded populations

Study	Flood studied	Study details	Time since event	Prevalence of mental health impacts				Commentary
				General measures	Depression	Anxiety	PTSD	
Reacher and others (2004)	Lewes, East Sussex	Retrospective cohort study. 9 months after the flood. Telephone interviews with those whose house was flooded (227 people) as well as those from the same area who were not affected (240 people – control group). Used the General Health Questionnaire (GHQ-12) to identify psychological distress (score 4+).	9 months	4-fold higher risk in flooded group for psychological distress (RR = 4.1, 95% CI: 2.6, 6.4). Ratios adjusted for age and gender.	-	-	-	Milojevic (2015; p8) notes some limitations of the study: <ul style="list-style-type: none"> retrospective self-reported survey measures only prevalent cases, not the increase or the onset of cases afterflooding (incident cases) relative risk is a comparison between flooded and non-flooded postcodes, therefore there may be underlying differences in areas between distress or factors that may affect it (for example, socio-economic)
Tunstall and others (2006)	Floods in England and Wales (1998 to 2002) – 30 locations	Systematic qualitative interview survey of those flooded (983 people) versus those not flooded (527 people) (total number of people =1,510). Used self-reported health check list, and general health questionnaires as well as the post-traumatic stress scale. Used predictors of age, gender and socio-economic variables. Used the General Health Questionnaire (GHQ-12) to identify psychological distress (score 4+) (comparable to Reacher and others 2004).	Various	Two-thirds (64%) of the measured population indicated that they had psychological distress at their worst point. However, at the point of interview this had reduced to 25%.	-	-	15% of respondents	Self-reported questionnaire with all of the stated limitations. Additionally, the time from survey to the point at which it has been reported is variable – therefore it is difficult to draw definitive conclusions here. Also, no repeat survey within an adjacent area.
Mason and others (2010)	England (assuming it is 2007 floods – but paper does not state)	Cross-sectional survey (postal) of flood-affected adults (440 people) (not clear what flood-affected constitutes). Diagnostic tests were used: Harvard Trauma Questionnaire (with a score 2+) for PTSD and the Hopkins Symptoms Checklist (with a score 1.75+) for anxiety.	Not stated	-	35.1%	24.5%	27.9%	Milojevic (2015) comments on the low response rate to this postal questionnaire. Therefore, we have to be mindful of the fact that those experiencing symptoms might be more likely to complete the survey and may be overestimating. Also, limits the transferability of the data outside of the group. No comparison with a control group – therefore only flood affected individuals considered and prevalence provided, rather increased rates.
Paranjothy and others (2011)	England (South Yorkshire and Worcestershire), 2007 floods	Qualitative population-based survey (2,166 people) to identify prevalence of risk factors. Using health questionnaires and indexes to compare individuals who were flooded and those not flooded: psychological distress (GHQ-12), anxiety (GAD-7), depression (PHQ-9) and probable post-traumatic stress disorder (PTSD checklist short form).	3 to 6 months	69% water in home 14% no water in home When water above floor level: OR 12.8, 95% CI: 9.3, 17.6; anxiety	43% water in home 7% no water in home When water above floor level: OR 7.7, 95% CI: 5.2, 11.4	48% water in home 5% no water in home When water above floor level: OR 13.9, 95% CI: 9.3, 20.8	22% water in home 2% no water in home When water above floor level: OR 11.9, 95% CI: 6.6, 21.5	The prevalence of all mental health symptoms was significantly higher among individuals who reported flood water in the home than those who did not. 2 to 5-times higher prevalence of mental health symptoms in those flooded compared to those non-flooded. Odds ratios are adjusted for all variables shown in the table, as well as age, previous medical problems, gender, employment, area and method of data collection. Highest prevalence was observed where water was above floor level.
Lamond and others (2015)	Areas of England and Wales 2007 floods	Cross-sectional postal questionnaire (280 people) of owner-occupied households – no diagnostics tests used, as these formed part of a wider post-event survey. Considered socio-economic variables and also flood warning and mitigation. Survey carried out 6 years after the floods.	6 years	One-third of respondents reported moderate, high and extreme impact of flooding on deterioration of mental health.	Frequently feeling depressed (9.5%) and always suffering depression (7.4%).	Over 60% of respondents reported always or very often experiencing anxiety when it rains.		Relies on a very retrospective perspective of the incident and therefore difficult to attribute the feelings with the incident and associated factors. Results are interesting due to the time passed since the event. However, since diagnostic tests were not used, it is hard to compare the results. Also, the study does not try to adjust these figures to account for the percentage of people that we might expect to suffer from these conditions in the general population – needs further consideration with reference to the specific questionnaire.
Milojevic and others (2017)	Various locations in England, examining floods in 2011 to 2014	Analysis of prescription records from GP practice data in areas in the vicinity of flood events in England (2011 to 2014). Considered floods where more than 500 properties were affected (2013 north-east tidal surge, the east coast tidal event, the east Midland tidal surge, the east of England tidal surge and the south-west floods in winter 2013 to 2014) and 930 targeted GP practices using the flood outline maps. Monthly prescriptions for antidepressants were compared in	Analyses one-year after the flood		Small relative increase of 0.59% (95% CI 0.24 to 0.94) in the use of antidepressants for those within 1 km of a flooded area within the 12 months after the flood.			Results adjusted for control for deprivation and population density. The authors state that the results may be being diluted as they do not know the degree to which the observed increase in prescriptions is confined only to flooded households. If it is assumed that it is, there would be a substantial 2 to 5-fold increase in use and comparable with survey based findings.

		the 12 months before and after flooding and arranged by the distance of the GP from the flood outline.			If we assume that this applies only to flooded households, a 2 to 5-fold increase is observed.			
PHE (2017)	Various locations following the 2013 to 2014 floods (including first survey of 6 local councils (Sedgemoor, south Somerset, Wiltshire, Gloucestershire, Surrey, Tonbridge and Malling) impacted by the winter floods 2013 to 2014)	Studies carried out in 6 local authorities with 3 different groups (unaffected (control), disrupted, flooded). (2,616 people). Validated instruments were used in the survey to measure health and wellbeing outcomes (PHQ-2 for probable depression, GAD-2 for probable general anxiety disorder, PCL-6 for probable PTSD).	Analyses initially collected one year after the flood	Flood affected	5.91 (3.91 – 10.99; 95% CI) adjusted odds ratio (AOR) Prevalence = 20.1% of those flooded	5.91 (3.91 – 10.99; 95% CI) adjusted odds ratio (AOR) Prevalence = 28.3% of those flooded	7.19 (4.33– 11.93; 95% CI) adjusted odds ratio (AOR) Prevalence = 36.2% of those flooded	The most recent data collected with a broad sample. However, the findings currently available still only concentrate on one flood event, albeit from different locations. Only providing a one-year post flood perspective.
				Disrupted	 9.6% of those disrupted	1.61 (0.94–2.77; 95% CI) adjusted odds ratio (AOR) 10.7% of those disrupted	2.06 (1.27–3.35; 95% CI) adjusted odds ratio (AOR) 15.2% of those disrupted	

RR = risk ratio, CI = confidence interval, OR = odds ratio, AOR = adjusted odds ratio

2.6.3 Duration of health impacts

This is one area where data is particularly lacking as there are few longitudinal studies. Mental health issues can be very difficult to characterise as there may be a lag between the event occurring and the onset of symptoms, which may emerge many months after the event. Some studies have looked at the mental health impacts on a group of affected residents after flooding has taken place, and demonstrate that there is a rise in health conditions in the months following a flood. Studies (for example, Assanangkornchai and others, 2007) also suggest that there is an 'anniversary effect', which highlights the re-occurrence or increase in severity of a condition, particularly anxiety, 12 months after a flood. This may be important to consider if we are using data on prevalence which is collected at this point, such as PHE data.

A couple of studies followed affected people more than 2 years after flooding had occurred to monitor how long people suffer negative impacts. For instance, Norris and others (2004) in considering floods in Mexico found that the prevalence of trauma and depression was still higher in those affected than in the general population more than 2 years after the flooding, even though there was a decline in symptoms from those initially measured. The example from Thailand, which followed those impacted up to 5 times over the year following the flooding, showed that the negative psychological health effects declined over the following months, before increasing again. Tunstall and Tapsell (2008) highlighted, through their self-reported longitudinal study of those affected by flooding in Oxfordshire in 1998, that some of the psychological impacts could last over 4 years.

Verger and others (1999; 2000; 2002) in considering the impact of flooding in France identified that the higher scores for PTSD and depression remained 4 and 5 years after the event. Lamond and others (2015) also found in their study of the 2007 floods that residents' mental health was still affected when they were surveyed 6 months after the flooding. Table 2 shows the continued prevalence of these conditions, and highlights that 7.4% suggested that they always suffer depression, with 9.5% reporting frequently feeling depressed.

Briere and Elliott (2000) also highlighted in their study of multiple disasters that there are some signs that the trauma can last decades after the event, particularly the fear of another event happening.

What is not clear from these studies is whether those suffering symptoms are still also seeking treatment so long after the event. The longitudinal nature of the PHE data, which involves repeating the survey in subsequent years, can potentially provide further insight into the duration of impacts experienced. This, in turn, may be used to update values in the future.

In summary, there is a lack of specific data concerning the duration of health conditions caused and/or made worse by flooding. There is often a complex link between other circumstances, which may contribute to the likelihood and severity of suffering health impacts. For example, the flood event and its consequences might be the tipping point for developing a mental health condition, but there may be many other contributing factors. Therefore, there is more evidence (and certainty) about the general pathology of mental health conditions and how they respond to treatments. For this reason, we propose using this general information until further data on the likely duration of health impacts caused by flooding is collected.

2.6.4 Relation of health impacts to flood characteristics

When considering the data to use in a benefit appraisal methodology, it is necessary to identify whether health impacts vary depending on the severity of an event, and specifically, in relation to characteristics of flooding that can be assessed in advance (for example, depth, velocity). Broadly speaking, the evidence (Collins and others, 2013; Ginexi and others, 2000; Handmer and others, 1983; Lamond and others, 2015; Lock and others, 2012; Lui and others, 2006; Norris and others, 2004; Schnitzler and others, 2002; Verger and others, 2003; Wade and others, 2004) indicates that there is an association between the 'severity' of the event experienced and the likelihood and severity of suffering negative health impacts. In other words, the greater the exposure, the greater the impact, particularly in relation to mental health.

However, the relationships are often complex, and most studies that have considered event-based or main causes of stress have also considered a set of broader event characteristics. For instance, there is data to indicate the **association between health impact and the proximity to an event and degree of exposure** (Assanangkornchai and others, 2004; Galea and others, 2005; Ginexi and others, 2000; Handmer and others, 1983; Heo and others, 2008; Lamond and others, 2015; Lock and others, 2012; Lui and others, 2006; Mason and others, 2010; Norris and others, 2004; Reacher and others, 2004; Schnitzler and others, 2002; Tunstall and others, 2006; Verger and others, 2003; Wade and others, 2004); **how victims have experienced the event** (for example, the level of trauma experienced through the loss of loved ones or from what they have seen) (Assanangkornchai and others, 2004; Heo and others, 2008; Liu and others, 2006; Lock and others, 2012; Mason and others, 2010; Norris and others, 2002; 2004; Reacher and others, 2004; Rhodes and others, 2010; Verger, and others, 2003); **levels of property damage** (Assanangkornchai and others, 2004; Carroll and others, 2009; 2010; Hayes and others, 2009; Norris and others, 2004; Rhodes and others, 2010; Verger and others, 2003); **relocation/displacement** (Abramson and others, 2008; Bei and others, 2013; Bennet 1970; Carroll and others, 2009; 2010; Hayes and others, 2009; Lamond and others, 2015; Mason and others, 2010; Paranjothy and others, 2011; Tunstall and others, 2006) or **exposure to event-related stress** such as loss of water, sanitation or electricity (for example, see Assanangkornchai and others, 2007; Carroll and others, 2009; 2010; Lock and others, 2012; Paranjothy and others, 2011; Rhodes and others, 2010).

Some of these factors can continue over a longer period after an event, with a relationship between the experience of a previous event and the potential for lasting impacts on psychological health (Assanangkornchai and others, 2004; Norris and others, 2002; Paranjothy and others, 2011; Lamond and others, 2015; Tunstall and others, 2006). However, Mason and others (2010) argue that there is evidence that previous experience can either negatively (people are more anxious of it happening again) or positively (people know how to respond and are able to cope) influence health outcomes. So, while there is a 'dose-response' relationship (Mason and others, 2010) between the severity of an event or proximity to it and the resulting health impacts, there are 2 main challenges when considering how to use this evidence within an appraisal methodology. Firstly, these factors are often combined or grouped when relating them to the negative health impacts and would be very difficult to assess in advance. There are also confounding factors between the direct impact of the flood event and secondary (or indirect) stressors, such as problems with insurers, employment loss/disruption or loss of services.

There are a few studies that do provide useful data relating health impacts to flood characteristics, which can be useful for flood benefit appraisal methods. These specifically relate health outcomes to depth of flooding. Lamond and others (2015) report this association and highlight in their study of the summer 2007 floods in England, that those flooded at depths of less than one metre are one-third as likely to

experience severe mental health deterioration when compared with those experiencing floods of a depth greater than one metre. Norris and others (2002) also noted a relationship between an increase in the prevalence of mental health symptoms and also the severity of those symptoms and the flood level experienced in the home.

The PHE data offers a relationship of particular significance. In the first-year survey of southern England flooded during the 2013 to 2014 winter floods, participants were questioned about their experience (depth of flood in their property, type of losses, evacuation, and disruption of services) and their wellbeing (feelings, stressful experience, and physical health problems). The prevalence of probable depression, anxiety and PTSD (odds ratio) were derived from the survey, and the study indicates 'statistically significant trends with increased depth of flooding for the 3 different health impacts'. This indicates therefore, that those flooded to a depth of less than 30 cm are four and a half times more likely to suffer depression than those not flooded.

Table 3: Adjusted odds ratios between mental health outcomes and flood depth in the property (from Waite and others, 2017)

Flood depth (in the lowest liveable room)	Depression	Anxiety	PTSD
<30cm	4.58	5.28	5.72
30-100cm	8.48	8.97	10.12
>100cm	14.71	11.40	17.79

2.6.5 Relation of health impacts to socio-economic characteristics

Many studies have looked for an association between the negative health impacts of flooding and socio-demographic characteristics. In the appraisal context, the socio-demographic data is available to consider the existing characteristics of the at-risk population and identify where the negative health impacts may be more frequent and/or severe than other areas. As such, the potential benefits of FRM in these areas would also be higher. Many studies consider different socio-economic variables and the strength of association with health outcomes: **age** (Collins and others, 2013; Green and others, 1985; Heo and others, 2008; Lui and others, 2006; Norris and others, 2002; Price 1978; Steinfuhrer and Kuhlicke 2007; Tunstall and others, 2006; Wade and others, 2004); **gender** (Alderman and others, 2013; Bennet 1970; Collins and others, 2013; Ginexi and others, 2000; Handmer and others, 1983; Heo and others, 2008; Lui and others, 2006; Norris and others, 2002; Price 1978; Phifer 1990; Schnitzler and others, 2002; Tunstall and others, 2006); **socio-economic status** (Collins and others, 2013; Ginexi and others, 2000; Jimenez and others, 2013; Lamond and others, 2015; Tunstall and others, 2006); **family structure** (Assanangkornchai and others, 2004, and **religion** (Assanangkornchai and others, 2004).

Some frequent findings include women being more susceptible than men to mental health issues (Norris and others, 2002; Tunstall and others, 2006). Other studies found those on lower incomes and from lower socio-economic classes were more likely to experience negative health impacts following flooding (Lamond and others, 2015; Norris and others, 2002, Verger and others, 2003).

However, these relationships are very complex and not clear cut. Lowe and others (2013) discuss the conflicting evidence about those factors that influence the likelihood of suffering negative physical and mental health impacts due to flooding. The data presented here agrees with this, as when considering these studies as a comprehensive body of work, there is contradictory evidence. There are many differences in the variables which studies find most significantly correlated with health

outcomes, suggesting the context specific nature of events. More problematic is that studies have found conflicting results. For instance, Tunstall and others (2006) suggested that younger females were more likely to have post-traumatic stress symptoms, whereas Norris and others (2002) and Collins and others (2013) found older people were more likely to score highly. Additionally, some relationships between gender and mental health impacts are not significant for all ages. Therefore, if we are to use this data in a benefit appraisal we would need sufficient certainty and resolution of data to be able to attribute these findings, which is unlikely.

The complex interaction between various socio-demographic characteristics and other primary (for example, property damage experienced, fatalities among family and friends,) and secondary (for example, problems with insurers) stressors, and the lack of clear consistent evidence from the English or UK context makes it unwise to promote applying any one or more variables. In particular, the evidence is not strong enough for an appraisal methodology to recognise any change in the type, prevalence or severity of health impacts to a benefit area based on its socio-demographic characteristics. This is one area that particularly should be reviewed as additional data becomes available.

Importantly, the PHE data offers adjusted odds ratios that have been corrected based on differences in the following criteria: age, sex, pre-existing illness, deprivation, local authority, ethnicity, marital, education and employment statuses.

However, the evidence suggesting that there is this relationship, might be used in a broad sense to determine which prevalence or costing value to apply. For instance, if an appraiser can demonstrate that the population within the benefit area has a higher than average number of people with existing health conditions, then this could justify selecting the higher value.

2.6.6 Factors that increase or reduce health impacts

Secondary stressors are a focus of a number of existing studies (Abramson and others, 2008; Carroll and others, 2009; 2010; Collins and others, 2013; Lock and others, 2012; Paranjothy and others, 2011; Tunstall and others, 2006; Verger and others, 2003). As mentioned previously, a number of different characteristics or experiences are associated with the likelihood of suffering negative health impacts or making existing conditions worse, or providing a positive impact. Of course, these may be directly or indirectly related to some of the socio-demographic characteristics of the affected population.

The types of secondary stressors considered important include: the location and duration of displacement, state of housing reconstruction, problems with recovery/builders/insurers, loss of employment, and loss/disruption to services. Other factors considered important are support after the flood and recovery efforts to reduce negative effects on health (Bei and others, 2013; Lamond and others, 2015; Wang and others, 2000) as well as personality traits and coping factors (for example, being prepared and proactive) (Abramson and others, 2008; Alderman and others, 2013; Bei and others, 2013; Collins and others, 2013; Lamond and others, 2015; Lowe and others, 2013; Strelau and others, 2005). The influence of psycho-social factors in increasing or reducing health impacts as Mason and others (2010) highlights, events are only traumatic if they are perceived as such. Although interesting from an academic perspective and in providing services after flooding has occurred, most of these are difficult not only to assess in advance, but also to attribute to benefit areas.

These secondary stressors provide some indication of the potential negative impacts of those disrupted by flood events. Studies have focused almost exclusively on those directly impacted by the flooding, although, in many cases what this actually means is very poorly articulated. Those studies where there is a comparison between affected

and unaffected populations, have made this sole distinction, rather than considering those directly flooded, those who may have been disrupted and those who were unaffected. The PHE data in particular found a statistically significant relationship between flood warning and impacts. This could be an area of further work in the future.

2.7 Main findings for benefit appraisal

From a review of the wealth of existing literature and the findings from the current PHE study, we propose that the revised methodology (in the first instance):

- only takes into account the psychological impacts caused by flooding. Although physical impacts are noted, the variability in these and in relation to their treatment makes it difficult to make a reliable assessment
- considers the main conditions of depression, anxiety and PTSD
- uses general information about the duration of conditions. Current evidence from existing flood studies highlights that impacts can last a long time, but it is not enough to suggest reliable duration of impact (although it is hoped that the PHE longitudinal study may be able to provide some specific information to inform this in future)
- incorporates the evidence that the odds of having a condition increases by the depth of water experienced. The flood depth bands established by the PHE data will be used to better understand the likelihood of suffering one of the 3 conditions
- is only categorised by flood depth. There is not enough evidence to account for specific socio-economic characteristics of the population being affected, and there is conflicting evidence from existing literature. Studies are mainly drawn from retrospective post-flood surveys of specific locations. This makes it even more difficult to obtain a representative sample of a general population that would allow enough confidence in the data to suggest any differences. The PHE data is presented as adjusted odds ratio, so has tried to remove any differences in the results created by different characteristics and therefore, we will use these
- does not take account of those disrupted. Although the PHE evidence does suggest that the 'disrupted population' displayed negative health impacts and, if possible, these should be represented within the revised MCM methodology. However, without further analysis of the data, it will currently be difficult to have an evidence-based approach to including these potential benefits

2.8 Methods and data for costing the benefits of avoiding health impacts

Two broad approaches can be used to work out the cost benefits of avoiding the health impacts due to flooding. Firstly, **valuation approaches** that use data about medical expenditure and treatment or labour market information; and secondly **preference-based approaches** that consider the willingness to pay to avoid negative health impacts. The following sections consider the specific approaches that might be used.

Cost of illness (COI) approach: Costing potential benefits by considering the direct medical expenses or treatment costs associated with any illness. Furthermore, this approach also considers any income lost related to sick leave or to attend

appointments. Using flood risk management measures to avoid or reduce health impacts will result in a subsequent reduction in medical expenditure and lost income, which can be used to work out the cost of the benefits. To use this approach as part of a flood benefit appraisal methodology, you need to know the following:

- specific conditions/illnesses
- prevalence of these conditions
- presence of known treatment plans
- duration of any treatment
- likely impact of illnesses over the short term in terms of days of work lost

Human capital approach: This case is not considering loss of life from flooding, however there is the potential for flooding to cause disabilities or make existing ones worse. This approach considers the loss of future earnings caused by these conditions and the lower productivity that may result. It works out the cost of impacts by considering the sum of discounted future earnings. It most commonly uses average lifetime earnings values to make sure that those who might be outside of the labour market (for example, unemployed and retired) are also captured. In addition to all of the points considered in the COI approach, using this approach within a flood benefit appraisal methodology means understanding the longer term impact of any flood-induced health impacts, in particular how they affect the ability to work.

Neither of the above methods account for a broader view of costs to society such as the value individuals may place on maintaining their own health. Therefore, to be comprehensive, these may be considered together with a preference valuation approach (those affected providing their own measure of the significance of any impact). This approach would need to be adapted to ensure that those on low wages or who are retired are not considered to have less valuable health impacts than those on high wages.

Willingness to pay (WTP): This involves considering how much individuals would be willing to pay to avoid certain negative health impacts. As there is no updated information or survey gathering new primary data, we will use the Defra (2004) survey to try and quantify this and capture the benefits to society of avoiding losses.

2.8.1 Summary of approaches considered

The proposed methodology will therefore consider 3 ways in which to work out the value of the potential benefits of avoiding the mental health impacts of flooding. These are:

- costs of treating the conditions
- lost productivity – this includes missing days of work, either due to the condition or for treatment, for those who are employed, and also to account for those who are out of work because of the condition
- social costs associated with having the condition

We will combine these into different scenarios to provide low, medium and high estimates for accounting for the benefits of avoiding health losses. We discuss these in the following section.

2.9 Costs of treatment

This section will consider the potential benefits of avoiding treatment costs.

2.9.1 Definitions and treatment of depression, anxiety and PTSD

Table 4 shows the NHS definitions of the 3 health conditions and suggests various treatments.

Table 4: Definitions and treatment of depression, anxiety and PTSD

Condition	Potential treatments
Depression: sadness is over weeks or months. 'Depression affects people in different ways and can cause a wide variety of symptoms. They range from lasting feelings of unhappiness and hopelessness, to losing interest in the things you used to enjoy and feeling very tearful. Many people with depression also have symptoms of anxiety.'	Stepped treatment is recommended: For mild cases of depression 'watchful waiting' is frequently recommended initially, and additionally patients may be recommended guided self-help tools. For mild to moderate depression, the National Institute for Health and Care Excellence (NICE) recommendations suggest more active intervention, including cognitive behavioural therapy, counselling and potentially antidepressant medication. More severe cases or those that are resistant to treatment, reoccurring or cause psychosis may require more specialist mental health care and potentially inpatient treatment. From a general perspective, NICE estimated in 2004 that around 70% of cases of depression were considered mild, 20% moderate and 10% severe.
General anxiety disorder (GAD): 'a long-term condition that causes you to feel anxious about a wide range of situations and issues, rather than one specific event.'	Stepped treatment is recommended: Psychological therapy (cognitive behavioural therapy), medication (antidepressant serotine reuptake inhibitors)
Post-traumatic stress disorder (PTSD): 'an anxiety disorder caused by very stressful, frightening or distressing events. Someone with PTSD often relives the traumatic event through nightmares and flashbacks, and may experience feelings of isolation, irritability and guilt.'	Stepped treatment is recommended: Trauma-focused cognitive behavioural therapy and medication. Additionally, the NICE guidance suggests that PTSD should be focused on before the depression, as the cause of the depression may be linked to PTSD.

We have consulted the NICE guidelines on treatment and the treatment pathways to better understand the preferred treatment options for these 3 conditions. These give some insight into the preferred best practices for treating these conditions.

Reviewing these guidelines highlights some important considerations for the methodology. These focus on 3 issues, and we will discuss their implications for costing in later sections. The issues are as follows:

Identifying and reflecting the complexity in treatment(s)

- For these conditions, there is not ONE standard approach to treating a condition and therefore, costing that treatment.
- Specific treatments vary and a stepped approach is recommended by NICE for all of the conditions. Treatment is increased according to the severity of the conditions and how well specific groups respond to treatments. Therefore, the levels (and costs) of treatments cannot always be compared. A decision will need to be made about whether to select a conservative estimate (a single course of group CBT or community-care treatment is costed), to assume individuals are receiving a range of different treatments or multiple courses, or to attempt to suggest an average of these.
- Even within the same treatments, there are different ways treatment can be provided. For example, different healthcare professionals might provide different talking therapies in group or individual settings, each with a different associated cost. Indeed, there is an increased use of online (self-paced) materials that can be provided at relatively low cost. The most severely affected may have crises where they have to be admitted as an inpatient or seek specialist outpatient treatment. Therefore, the potential scope of the potential costs is broad, and the aim in the appraisal would be to find a mean annual cost of treatment.
- Evidence also suggests that due to a number of issues (for example, lack of skilled therapists, resources) the NICE treatment guidelines are often not followed and few people receive the full standard of care even when they seek it. The Adult Psychiatric Morbidity Survey (APMS) 2014 suggests that 1 in 10 patients with severe mental health conditions had **un-met treatment needs**.

The interconnectedness of these mental health conditions

- It is well recognised that **co-morbidity** may exist among conditions. This creates particular issues when combined with the fact that the treatments for each condition may overlap. For instance, talking therapies and CBT are common treatments for all 3 conditions. So, if we were to consider each of the conditions separately, this may lead to double counting. The current data we have from PHE does not provide any detail on whether co-morbidity existed within the group studied.

Whether those with a condition are seeking treatment

- There is much evidence to suggest that many people with these conditions remain **undiagnosed** and therefore untreated. The PHE data might be over-representing those within a population that would be diagnosed with depression, anxiety or PTSD and therefore have an associated treatment cost.
- The APMS 2014 indicates that around one in 3 (39.4%) of those who had symptoms of common mental disorder was receiving treatment. However, the treatment rates for the specific disorders identified here were higher: depression (61.3%), general anxiety disorder (49.9%) and PTSD (50.9%).
- Therefore, there is a question about whether within a benefit appraisal this reality of under-diagnosis and under-treatment should be reflected and a

more conservative scenario adopted, where only a third of those with symptoms will be treated. Alternatively, a high-cost scenario approach could be adopted (where everyone might seek treatment).

2.9.2 Valuing depression, anxiety and PTSD

The NHS produces standardised data sets that consider the unit costs of various conditions. As previously mentioned, the difficulty with using these values within this methodology is identifying the number of people who will receive a specific course of treatment(s), especially given the different options available and that patients are often offered different treatments at the same time or a series of treatments (medicated and unmedicated). The APMS 2014¹ can give us some insight into the types of treatment that those with certain conditions are receiving and whether they are receiving both medication and psychological therapy (Table 5).

Table 5: % of those surveyed by the APMS (2014), who are diagnosed with a mental health condition and what type of treatment they are receiving

Condition	Those receiving treatment – as a % of those with a condition	% of those with the condition who were only taking medication	% of those with the condition who were only having psychological therapy	% of those with the condition receiving both medication and psychological	% with the condition receiving no treatment
Depression	61.3	38.4	6	16.8	38.7
GAD	49.9	32.1	6	11.9	50.1
PTSD	50.9	26.9	7.3	16.7	49.1

These figures indicate that the most common treatment is medication for all 3 conditions, despite the NICE guidance placing increasing emphasis on the value and potential successful impact of talking therapies. Therefore, the first consideration is the costs of these treatments. The Regional Drug and Treatment Centre (RDTC) (2017) has published comparison charts for a wide variety of different drugs. There is a wide range of antidepressants that can be used, and the RDTC provides comparative costs to the NHS for 25 of these drugs for one year's treatment at the standard daily dose. Costs are variable, with one very expensive drug costing £7,820 per patient per year, 10 drugs costing in the range of £120 to £390 a year and the remaining 11 drugs costing below £36 a year (2017 rates). The costs of all of those drugs, are mentioned on the NHS website (<https://www.nhs.uk/conditions>). One of these costs £360.36 a year and is used to treat severe depression, the remaining ones are all in the range of £9.36 to £35.49. A mid-value annual estimate of these drugs per patient is therefore quite minimal at £23. Of course, this figure only considers the cost of the medication, rather than the costs associated with administering it through health professionals. This may be more or less frequent depending on the severity, progression or success of treatment of the condition.

Furthermore, for those receiving psychological therapy, there are many different combinations of therapies in different settings (such as one to one, groups), different numbers of sessions and different levels of health professionals, each of which have different associated costs. Layard and others (2007) estimated the costs of treatment

¹ NB: this report only had access to the main report and associated summary tables (<https://digital.nhs.uk/data-and-information/publications/statistical/adult-psychiatric-morbidity-survey/adult-psychiatric-morbidity-survey-of-mental-health-and-wellbeing-england-2014>) and not the raw data, and this limited the use of these data.

for a standard course of cognitive behavioural therapy was £750. They estimate this is for an average of 10 meetings, accounting for a range of different durations of treatment and/or those who may drop out. They suggest that there would only be a maximum of 16 sessions provided, which would provide an equivalent upper estimate of £1,200.

The approach adopted by the Personal Social Services Research Unit (PSSRU, 2016) and the associated calculator (which draws on NHS reference costs) is useful as it allows the costs of different parts of treatment to be tailored and combined. It also allows both staff and non-staff costs (such as room hire, training costs) to be calculated. Within this approach, there are various costs (see Table 6) attributed to different types of therapy. The values are considerably lower than those suggested by Layard and others (2007), and may reflect the setting in which treatment is provided.

Table 6: Different types of treatment for mental health conditions

Type of treatment	Unit costs (as at 2015 to 2016)
Behavioural activation provided by a non-specialist (mental health nurse) - treatment for depression that can be provided in a group setting or to individuals	Cost per 12 sessions per person is £185
Mindfulness-based cognitive therapy – group-based treatment	£52 per hour, £86 per hour of direct contact, £173 per session, £14 per service user. So, assuming a course of 12 sessions = £168 per user.

In addition to the more frequent types of treatment, those who are more severely affected may need more frequent and specialist treatment, such as hospital outpatient or inpatient treatment. All of these options have different associated costs and may be substantially higher than for those only receiving medication or weekly group therapy.

Currently, the existing evidence available to this study provides no indication of the severity of the conditions experienced by those affected by flooding. Therefore, it is more appropriate to try to represent the range of treatments sufferers are receiving.

An existing study by McCrone and others (2008) produced a report² that examined the future costs of mental health care in England. It looked at the current and future profile of people (by age and gender) with mental health conditions, the cost of treating them, and losses to productivity. Within this report, they used data from a range of national data sets to provide a weighted annual treatment cost for different conditions.

This approach aimed to account for the wide range of severities of conditions and differences in the associated treatments by considering data from the APMS. This reports the treatment sought by condition and then estimates the costs of different types of treatment. By doing this, the authors have taken into account that the majority of those with these conditions will be at the lower end of the treatment scale (with a lower associated cost) with fewer with more severe conditions (with a higher associated cost). The authors have then made these values into annual rates by dividing the overall numbers that they identified being treated. Although there are many assumptions and estimates from a range of data sets (of different types and ages), these values are attractive as they have tried to identify a weighted average cost of treatment. They have done this by using data on the access to services and providing a range of treatment costs.

² *Paying the Price: The cost of mental health care in England to 2026*

Depression: McCrone and others (2008) have attempted to estimate the total national costs of treating depression by considering prescribed drugs, inpatient care, other NHS services, supported accommodation and social services (Figure 1). They recognise that there would be other costs that are unaccounted for, but these are considered to be less significant. Importantly, in their report, they highlight the significance of non-inpatient health care (for example, contacts with psychiatrists, psychologists, other doctors and community mental health nurses) in treating those with depression. Overall, this care was the most expensive. They recognise that while the cost of inpatient care per patient is high, the actual rates of admission for cases of depression are quite low.

Using this approach, McCrone and others (2008) provided an **average annual service cost** (including the range of treatment and medication) to be £2,085 per person (2007 values) for those people being treated for depression, or where their condition was recognised.

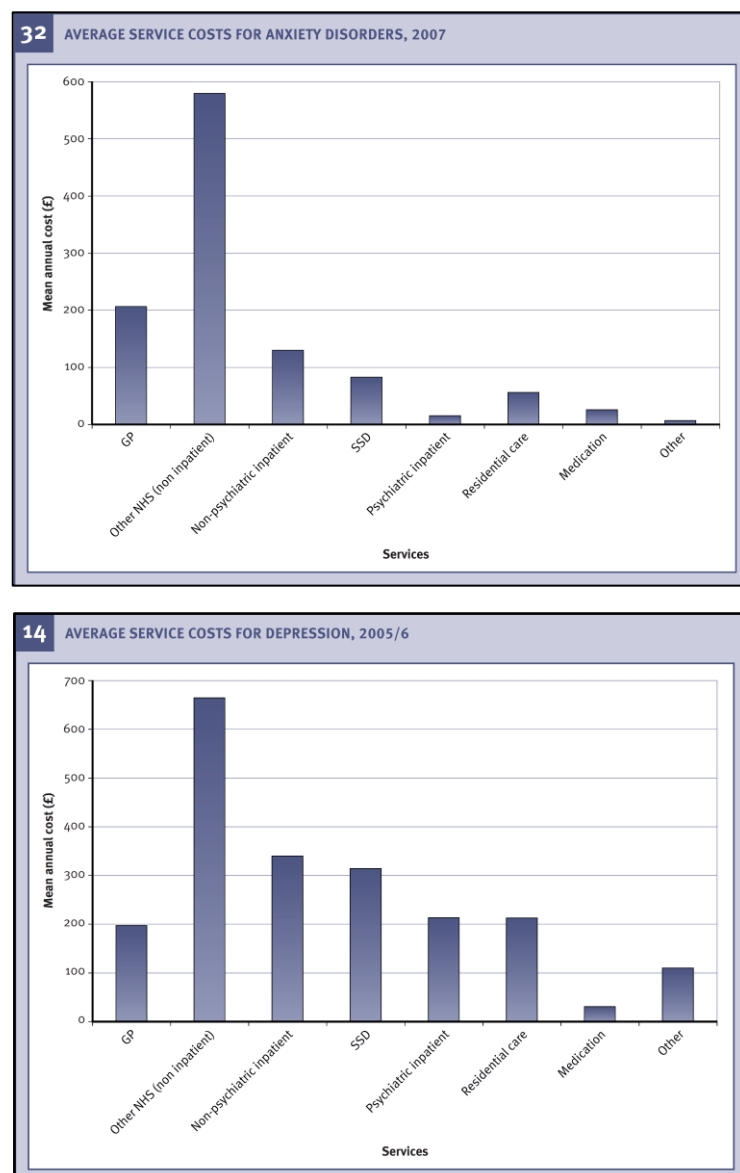


Figure 1: Average service costs for the mental health conditions of depression and anxiety in 2005 to 2006 and 2007 respectively

Anxiety disorders: McCrone and others (2008) followed a similar approach when considering anxiety (Figure 1). It should be noted however, that they considered a wider range of anxiety-related disorders, including generalised anxiety disorder,

agoraphobia, social phobia, panic disorder and obsessive compulsive disorder, than are perhaps considered in the PHE data. Nevertheless, the results are still useful. Similar to depression, inpatient care would be expensive, but this is also considered to be quite rare for those suffering only with anxiety. Average annual service costs for people being treated for anxiety or where their condition was recognised, were estimated to be £1,104 per person (2007 values).

PTSD: Unfortunately, McCrone and others (2008) have not provided an equivalent figure for the treatment of PTSD. However, the NICE guidelines suggest similar treatments as for depression, and so one suggestion is to use the same annual average figure of £2,085 per person seeking treatment. However, we might suggest that the specific nature of the condition, including how the trauma is experienced, means that patients are more likely to have one-on-one treatments at a potentially higher cost, and so this might be on the conservative side.

The health cost-benefit appraisals that we have consulted that consider health treatments have mainly adopted a cross-sectional approach and only provide an annual consideration of the figures. Less attention has been paid to the longitudinal economic perspective. This complicates the overall costs of treatment for a specific condition by the duration of an illness, and how to apply these within a flood risk benefit appraisal context. For instance, unlike assessing the damages to a property where the assumption is that it is back to normal once it has been repaired, the health impacts can manifest and improve or deteriorate over a longer period of time. This duration of treatment component is therefore challenging to apply when flood risks of different probabilities are being considered. The McCrone and others' (2008) values may overcome some of these concerns as the data sets they have used capture information from patients with different severity of conditions and also who are at varying stages of having that condition. It is initially suggested to test the methodology by using the 3 figures (adjusted to 2018) from McCrone and others (2008).

Table 7: Estimates of the annual costs per person seeking treatment for each mental health condition (2018 values)

	Depression	Anxiety	PTSD
Annual average service costs per person seeking treatment	£2,482	£1,314	£2,482

Based on the values of McCrone and others (2008), adjusted to 2018 values by using the GDP deflator with a value of 1.19.

2.10 Work-based losses

It is important to recognise the potential losses associated with the impacts of these mental health conditions on working life. Mental illness is considered to be the leading cause of sickness absence in the UK (Office for National Statistics (ONS), 2014). Employed workers may be unable to go to work because of the condition or because they are seeking treatment. They may also be less productive when they are at work and some may simply not be well enough to be in employment. This is a complicated area as any benefit appraisal methodology should only account for potential benefits to the nation in avoiding these losses, and it may be difficult to isolate these purely economic aspects.

Two potential approaches are used that aim to estimate these losses and which can be used to provide low, medium and high estimates of the potential benefits of avoiding these losses. The first focuses solely on absenteeism of employed people with mental health conditions (those in employment are more likely to have more days off). The second approach considers the increased prevalence of economic inactivity within those with these conditions.

2.10.1 Increased absenteeism among employed workers

This first approach considers those who are employed and recognises that those with mental health conditions have more days off in a year than those who are unaffected. Layard and others (2007) provide an estimate of the number of working days lost per year due to sickness absence for a range of mental health disorders of interest to this appraisal methodology. These are displayed in Table 8: The report also suggests that the average number of sick days for someone without a mental health condition is 5 days and therefore, we are able to provide an estimate for the increased number or 'excess' sick days per person with the condition.

Table 8: Increased numbers of sick days for those with mental health conditions

Condition	Annual average number of sick days for those with the condition	Annual 'excess sick days' for those with the condition*
Depression	24	19
Anxiety	14	9
PTSD	24	19

Data from Layard and others (2007); * Calculated by subtracting the average number of sick days for someone without the condition.

The MCM already details a methodology to quantify the losses that occur when parents have to miss work to care for children when a school is closed (based on Coulthard and others (2007) and Sadique and others (2008)). The approach uses average income values (adjusted for taxation and NI contributions) to estimate the value of a lost day's work. The MCM data set (see MCM Table 6.20, www.mcm-online.co.uk) currently provides 2 indicative estimates; a minimum value based on the national living wage and an average estimate that uses the median hourly wage for a full time adult, although appraisers may wish to provide their own estimates based on local information about average wages levels (Table 9).

Table 9: Estimates of the value of a lost day's work – 2018 estimates³ (NB – this is Table 6.20 in the MCM)

	Base data	Calculation	Estimate of the value of a lost work day
Minimum estimate	<ul style="list-style-type: none"> £7.83 per hour National Living Wage for an adult (April 2018) £7.036 the average hourly value net taxation 7.6 hour working day/ 38 hour working week 	7.036*7.6	£53.48
Average estimate	<ul style="list-style-type: none"> £13.94 median hourly wage for a full-time adult (excluding overtime) in April 2017 (ONS, 2017) £11.19 the average hourly value net taxation Based on a 7.6 hour working day/ 38 hour working week 	11.19*7.6	£85.05

* taxation was removed using

<http://tools.hmrc.gov.uk/hmrc-tax-calculator/screen/Personal+Tax+Calculator/en-GB/summary?user=guest>

The minimum and average values of a lost work day can then be combined with the information from Layard and others (2007) to produce estimates of the costs of the increased absenteeism of workers for each of the mental health conditions as seen in Table 10.

Table 10: Estimates of the annual cost of employment absenteeism per person with each of the 3 mental health conditions (2018 estimates)

Minimum estimates		
Mental health condition	Calculation (see also Table 8: and Table 9)	Minimum estimate for the annual cost of employment absenteeism
Depression	<ul style="list-style-type: none"> Based on per hour National Living Wage for an adult (April 2018) 7.6 hour working day Layard and others (2007) estimates of 19 excess sick days due to having the condition (see Table 9) 	£1,016.12
Anxiety	<ul style="list-style-type: none"> Based on per hour National Living Wage for an adult (April 2018) 7.6 hour working day Layard and others (2007) estimates of 9 excess sick days due to having the condition (see Table 9) 	£481.32
PTSD	<ul style="list-style-type: none"> Based on per hour National Living Wage for an adult (April 2018) 7.6 hour working day Layard and others (2007) estimates of 19 excess sick days due to having the condition (see Table 9) 	£1,016.12
Average estimates		

³ HMRC (2018) 'HMRC Tax Calculator', <http://tools.hmrc.gov.uk/hmrc-tax-calculator/screen/Personal+Tax+Calculator/en-GB/summary?user=guest>, accessed 21 July 2018. (Last accessed 11 February 2020)

Office for National Statistics (ONS) (2016) 'Annual Survey of Hours and Earnings, 2016 Provisional Results' ASHE: Table 6.6b 26 October 2016,

<https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/datasets/agegroupasheta-ble6>, accessed 21 March 2017. (Last accessed 11 February 2020)

Mental health condition	Calculation (see also Table 8: and Table 9)	Average estimate for the annual cost of employment absenteeism
Depression	$= £85.05 \times 19$ <ul style="list-style-type: none"> Median hourly wage for a full-time adult (excluding overtime) (ONS, 2017) 7.6 hour working day Layard and others (2007) estimates of 19 excess sick days due to having the condition (see Table 9) 	£1,615.95
Anxiety	$= £85.05 \times 9$ <ul style="list-style-type: none"> Median hourly wage for a full-time adult (excluding overtime) (ONS, 2017) 7.6 hour working day Layard and others (2007) estimates of 9 excess sick days due to having the condition (see Table 9) 	£765.45
PTSD	$= £85.05 \times 19$ <ul style="list-style-type: none"> Median hourly wage for a full-time adult (excluding overtime) (ONS, 2017) 7.6 hour working day Layard and others (2007) estimates of 19 excess sick days due to having the condition (see Table 9) 	£1,615.95

The following section will consider the potential losses from people of working age not being employed due to suffering from a mental health condition.

2.10.2 Economic inactivity due to mental health conditions

Layard and others (2007) highlight the high impact that depression and anxiety can have on national productivity. They stated that in 2007, around one million people were on incapacity benefits due to these disorders. Therefore, it is important to try to account for this inactivity and avoiding these potential losses within a flood benefit appraisal. Data is available on the prevalence of economic inactivity among those with mental health conditions. For instance, Layard and others (2007) provide some general national estimates of the numbers of those who are employed and inactive. Furthermore, the APMS 2014 reported that 42% of those diagnosed with depression were on state benefits; 24% of those had GAD and 42% were suffering from PTSD. So, we have some idea of the scale of the issue, however there is some complexity with attributing purely economic losses to these values. It is important we don't assume that all of those who are economically inactive are so only because of their mental health condition – there are likely to be some people who might be unemployed for other reasons.

The previously mentioned study 'Paying the Price', McCrone and others (2008) also considered what the authors termed 'lost employment costs' to estimate the impact on workers of having a mental health condition. Using data from the APMS 2007, they identified those respondents who were in the 'working age' brackets (under 45 and between 45 and 64 years) who reported being unemployed or economically inactive at the time of the survey and also who had not worked in the previous year. The authors identified those with or without a mental health condition. This allowed them to compare those with a condition and those without (they called this the 'excess probability of not working' due to having an illness (see Table 11). Table 11 indicates the percentages of those unemployed survey respondents who did not have depression, those who had depression and were in contact with treatment services, and those who had depression but who were not in contact with treatment services. The data indicated that "having depression results in higher levels of unemployment

and economic inactivity than would exist in its absence” (McCrone and others, 2008; p23).

These results were then further arranged by gender in order to account for the differences in average wage between males and females, considering that women are more likely to be part-time workers and also earn lower salaries. The mean annual earnings for men and women (£30,589 and £17,758 respectively for 2006; National Statistics 2007) was multiplied by the average excess probabilities.

Table 11: Data from McCrone and others (2008, p24) highlighting the mental health status of those who are unemployed or economically inactive

TABLE 5: PERCENTAGE OF PEOPLE WITH DEPRESSION WHO ARE UNEMPLOYED OR ECONOMICALLY INACTIVE

Men	No depression	Depression and in service contact	Depression and not in service contact
<45	11.1	55.1	17.6
45–64	23.9	71.9	71.4
Women	No depression	Depression and in service contact	Depression and not in service contact
<45	23.2	47.9	24
45–64	36.5	60.5	40

Source: Psychiatric Morbidity Survey 2000 (Singleton *et al* 2001)

NB: Service contact in the table highlights those who are in contact with professional medical services for care about their mental health condition.

For those individuals who reported working in the previous year, McCrone and others (2008) used a similar approach to the one used in the above section for the minimum and average estimates. They calculated the mean number of days off work as a proportion of one year for both the depressed and non-depressed groups, and identified from this the excess loss of work because of the condition. They then multiplied this average proportion by the mean annual salaries to give an estimate of the average employment losses due to having depression and anxiety.

From this, annual average employment losses of £7,226 (2006 values) for depression and £6,850 (2006 values) for anxiety were estimated. When adjusted using the GDP deflator to 2018 values, these are £8,603 for depression and £8,155 for anxiety.

However, the McCrone and others (2008) study does not appear to adjust these values for income tax and national insurance. Therefore, they might be including costs that are not economic and, as a result, overestimating the potential benefits of avoiding these losses. There is not enough detail within the McCrone and others (2008) report to re-calculate these figures precisely, as the exact excess probabilities are not directly reported nor arranged by gender. This has meant that we have had to produce a crude estimate of what the taxable elements might be. We have reduced the 2018 values by 17% to account for this. We chose 17% as this was the average of the proportions of the tax element McCrone and others (2008) used. We calculated the approximate tax elements using the HMRC tax calculator (2018). These were 21% and 13% for the male and female salaries respectively. Although this is a very crude estimate, it does aim to represent a taxable element within the calculation (Table 12).

Similar to the situation with the treatment costs, McCrone and others (2008) did not provide a value for PTSD and proposed using the depression estimate for the treatment costs. The final values are in Table 10 and provide a higher estimate than those suggested for absenteeism.

Table 12: Estimates of the annual economic inactivity losses due to suffering from one of the 3 mental health conditions per person (based on 2018 values)

	Base data	Calculation	Annual economic inactivity losses per person (2018 values)
Depression	<ul style="list-style-type: none"> £8,603 value from McCrone (2008) adjusted to 2018 values using the GDP deflator Estimate of 17% reduction applied to account for taxation components 	$\text{£8,603} \times 17\% = \text{£1,462.51}$ $\text{£8,603} - \text{£1,462.51} = \text{£7,140}$	£7,140
Anxiety	<ul style="list-style-type: none"> £8,155 value from McCrone (2008) adjusted to 2018 values using the GDP deflator Estimate of 17% reduction applied to account for taxation components 	$\text{£8,155} \times 17\% = \text{£1,386.35}$ $\text{£8,155} - \text{£1,386.35} = \text{£6,769}$	£6,769
PTSD	<ul style="list-style-type: none"> £8,603 value from McCrone (2008) adjusted to 2018 values using the GDP deflator Estimate of 17% reduction applied to account for taxation components 	$\text{£8,603} \times 17\% = \text{£1,462.51}$ $\text{£8,603} - \text{£1,462.51} = \text{£7,140}$	£7,140

* taxation was removed using

<http://tools.hmrc.gov.uk/hmrc-tax-calculator/screen/Personal+Tax+Calculator/en-GB/summary?user=quest>

Table 13 highlights the range of different values that might be used to include the work-based losses.

Table 13: Annual work-based loss estimates per person suffering from the 3 mental health conditions (2018 values)

	Low estimate (see Table 10:)	Average estimate (see Table 10:)	High estimate (see Error! Reference source not found.)
Depression	£1,016	£1,616	£7,140
GAD	£481	£765	£6,769
PTSD	£1,016	£1,616	£7,140

NB: It is important to recognise that you cannot add the estimates in Tables 10 and 12. This is because there is some degree of overlap in the approaches used in the estimation. All 3 approaches account for the additional time taken off by employed workers due to their conditions, although McCrone and others limit the calculation to those who were unemployed at the time of the survey by working in the previous 12 months. The higher estimate presented in Table 12 using the data from McCrone and others (2008) in their estimate of 'lost employment costs' also considers the different rates of employment between depressed and non-depressed respondents.

Applying these work-based losses to the PHE data

It is difficult to apply these figures as there is no information from the PHE data to suggest the severity of impacts sustained by those flooded. This is because the data

output only suggests whether someone has a probable diagnosis of a condition or not, rather than indicating the severity of any of the conditions. Therefore, we know little about the likelihood that any condition will prevent someone from working entirely or mean that they need time off work to seek treatment. Therefore, within the PHE sample we cannot identify those who are depressed and unemployed or those who are depressed and still working and make some assumptions when applying the values. We will consequently apply these values directly to the increased prevalence figure.

Therefore, when we apply the low and average estimates, the assumption is that all those affected are working and miss an average number of days of work due to each condition. The assumption is different when we apply the higher estimate. As described in the above section, the McCrone and others' (2008) figures do separate those who are economically inactive and those who are employed and miss work. As such, they offer different estimates of the 'lost employment costs' for these 2 groups. They recognise that the losses will be different and offer an average value, which is what will be used with the PHE data. Therefore, although it does not directly reflect the flood-affected population, it does offer a general way of accounting for the unemployed and employed within the working-age group.

However, the approach will aim to distinguish between 2 different elements to account for the fact that not everyone may seek treatment, have the associated treatment costs, and not miss work or be signed off work for a period due to the condition. The approach also aims to reflect that some people will have more than one condition (co-morbidity). This is important as there can be some overlap with the treatments and therefore, some savings.

We describe each of the approaches in more detail and apply them to the average estimate below.

2.11 Seeking treatment

It is widely recognised that not all of those who have these mental health conditions seek treatment and therefore, there is not always an associated treatment cost. The PHE survey (Waite, 2017b) provides some information about the numbers of participants seeking treatment for their conditions.

The study asked whether those surveyed had sought help from different sources (GP, hospital, counsellor/therapist, friends/family, NHS 111 and voluntary/charity) since December 2013 and in the preceding 4 weeks (the survey was carried out in January 2015, approximately one year after the 2013 to 2014 winter floods).

The survey highlighted that those affected by flooding were more likely to seek help from all sources since 2013 and in the 4 weeks before completing the survey than those disrupted and those unaffected. Furthermore, it provided some detail on the number of participants exposed to flooding or disrupted, with a probable diagnosis and who have sought help since 2013. It highlighted that of 86.2% of people with depression, 84.6% of those with anxiety and 84.9% of those with PTSD sought some help, but this would also include help from sources that may have a treatment cost.

When we consider the results only from those who experienced flooding (601 people) and consider only access to services that have a treatment cost, 68.9% reported visiting a GP, 28.1% sought help from the hospital, 7.7% consulted a counsellor/therapist and 5.2% rang NHS 111 (Waite and others., 2017b; Table 7), these figures are not separated by mental health condition. Therefore, although the results of the PHE survey highlight that there appears to be an increased chance that those impacted by flooding display more help-seeking behaviour than those not

affected⁴, the survey is only able to infer that this help-seeking was brought about by the diagnosis of a probable mental health condition⁵.

As the PHE data on people seeking help is not separated by specific mental health condition, and has been adjusted for some variables with little explanation, the benefit appraisal approach relies on more general data from a national data set. This gives a more average picture of the numbers of those with a mental health condition that seek treatment for that condition.

The APMS 2014 (p81) provides some evidence on the numbers of those surveyed with the condition who were actively being treated. This survey indicated that for the 3 specific conditions being considered the treatment rates were: depression (61.3%), general anxiety disorder (49.9%) and PTSD (50.9%). Therefore, prevalence values will be reduced by 60% for depression, 50% for GAD and 50% for PTSD within the scenarios presented in Table 24 and Table 25. These will offer a reduction in the total amounts to account for the fact that many of those with conditions will not incur any treatment costs. In addition, a more conservative approach is adopted to applying these values to the total prevalence rate. This approach will be therefore applied to both the treatment cost AND the work-based losses within the average scenario. The assumption here is that those not seeking treatment would not have the same numbers of days off (because they are not missing work to attend treatment appointments) as someone who is being treated. Also, for someone to be signed off work they would need to be seeing their GP about the condition. To be less conservative, the percentage reduction could be applied to only the treatment cost value, so that the original prevalence for work-based costs is retained. However, this might overestimate the potential benefits of avoiding the negative health impacts of flooding.

2.12 Co-morbidity

The close connection between mental health conditions is well recognised. This is important for a benefit-appraisal approach as there is likely to be an overlap between the treatment of conditions (talking therapies and CBT are common to all 3 conditions) and this could lead to double counting the cost of treatments. However, the current data provided by the PHE survey does not provide any detail on whether co-morbidity existed within the sample and therefore, we need another source of information.

We have analysed data from the APMS 2007 to provide an overall indication of the presence of multiple conditions within the sample population with a probable diagnosis of depression, anxiety and PTSD. Of the total sample of the APMS 2007 (7,403 people), 760 had a probable diagnosis of depression, anxiety or PTSD or multiple probable diagnoses (2 or more of these conditions). We analysed the 760 participants to highlight those that had a single probable diagnosis of one condition and those with multiple diagnoses (see Table 14).

Table 14: Table highlighting the % of the APMS 2007 sample with single or multiple probable diagnoses of mental health conditions

Probable diagnosis(es)	Number of participants (% of 760 participants)
Only depression	85 (11.2%)
Only anxiety	328 (43.2%)
Only PTSD	124 (16.3%)
Depression and anxiety	106 (13.9%)

⁴ aOR: 1.92 95% CI:1.38-2.66 p=<0.001

⁵ NB: not having direct access to the data here limits what can be inferred from the presented results in Waite and others (2017), as they adjust the data for confounding variables with little explanation.

Depression and PTSD	14 (1.8%)
Anxiety and PTSD	53 (7%)
All 3 conditions	50 (6.6%)

It is too complicated to assign the different combinations of conditions. It would also be inappropriate to assign these results in a very detailed way to the PHE data set as different diagnostic tools and thresholds have been used in both the PHE and APMS 2007 data sets. However, we can draw some basic lessons from the results. The APMS 2007 data indicate that for the survey population, around 70% only had one of the 3 conditions, whereas the remaining 30% had different combinations of 2 or more conditions. Therefore, we have adopted a simple approach by reducing the prevalence of each of the conditions by 30% to account for the potential co-morbidity and, as such, the reduced rate of treatment as well as double counting the costs of work-based losses (see Table 24 and Table 25).

2.13 Social costs: willingness to pay to avoid losses

It still remains to represent the potential societal benefits of avoiding flooding and so avoiding the negative impacts on health. The willingness to pay (WTP) value currently presented in the MCM relates strictly to the payment for improving flood defences to avoid the stress and hassle from physical health impacts (for example, headaches, colds, and injuries), disruption to normal life, and loss of irreplaceable items due to flooding. Although there may be links with the psychological impacts, we propose to continue to use this data set, as it allows us to include some element of the costs to society of the health impacts.

Appraisers should therefore, apply the most up-to-date values (corrected for inflation) from the MCM, noting that this value is applied separately to the methodology presented here.

2.14 Mental health outcomes and associated economic losses

Using the values identified in sections 2.9 and 2.10 we present 4 different scenarios for representing the economic losses associated with mental health outcomes. These are: only with treatment costs; low, average and high total estimates, which combine the treatment costs with work-based losses.

Table 15: Total annual costs per adult associated with having each condition based on 4 different scenarios (2018 values)

	Only treatment costs (H _{OT})	Low estimate total health value (H _{Low})	Average estimate total health value (H _{Ave})	High estimate total health value(H _{High})
Description	This includes only treatment costs of each condition (see Table 7)	Treatment costs for each condition (see Table 7) plus the low work-based loss estimate (see Table 10:)	Treatment costs for each condition (see Table 7) plus the average work-based loss estimate (see Table 10)	Treatment costs for each condition (see Table 7) plus the high work-based loss estimate (see Table 12)
Depression	£2,482	=2,482+1,016 £3,498	=2,482+1,616 £4,098	=2,482+7,140 £9,622

GAD	£1,314	=1,314+481 £1,795	=1,314+£765 £2,079	=1,314+6,769 £8,083
PTSD	£2,482	=2,482+1,016 £3,498	=2,482+1,616 £4,098	=2,482+7,140 £9,622
Base data	<ul style="list-style-type: none"> • McCrone and others (2008), adjusted to 2018 values by using the GDP deflator (of 1.19) 	<ul style="list-style-type: none"> • McCrone and others (2008), adjusted to 2018 values by using the GDP deflator (of 1.19) • Based on hourly National Living Wage for an adult (April 2018) • 7.6 hour working day • Layard and others (2007) estimates of excess sick days due to having the condition (see Table 9) 	<ul style="list-style-type: none"> • McCrone and others (2008), adjusted to 2018 values by using the GDP deflator (of 1.19) • Median hourly wage for a full-time adult (excluding overtime) (ONS, 2017) • 7.6 hour working day • Layard and others (2007) estimates of excess sick days due to having the condition (see Table 9) 	<ul style="list-style-type: none"> • McCrone and others (2008), adjusted to 2018 values by using the GDP deflator (of 1.19) • Estimate of 17% reduction applied to the work-based estimates to account for taxation components (see Table 12)

The 3 mental health conditions will exist within a population irrespective of flooding. For that reason, an economic flood loss assessment needs to only consider the extra losses to society associated with any flood event. As such, we only need to consider the increased prevalence of mental health conditions in the flood benefit appraisal (and not individual financial losses) and, for this, we use the PHE data. This data only provides prevalence values by exposure group (those unaffected, disrupted and flooded) and it is not separated by depth of flooding. Therefore, we are limited to using these general prevalence data (see Table 16) and the extra losses for the overall data can be produced (Table 17) using the values in (Table 15).

Table 16: Difference in prevalence of having each condition between unaffected and affected participants (Waite and others, 2017b; Table 8)

Outcome	Unaffected	Flooded	Increased prevalence for economic appraisal
Probable depression	0.058	0.21	0.152
Probable GAD	0.065	0.283	0.218
Probable PTSD	0.079	0.362	0.283

Table 17: Only treatment, lower, average and higher estimates of additional annual economic losses per adult (2018 values)

	Only treatment costs per adult costs (£)	Lower estimate of extra economic losses per adult (£)	Average estimate of the extra economic losses per adult (£)	Higher estimate of extra economic losses per adult (£)
Depression	= increased prevalence for depression (0.152) *treatment cost per adult (2,482)	= increased prevalence for depression (0.152)* lower total cost estimate per adult (3,498)	= increased prevalence for depression (0.152)* average total cost estimate per adult (4,098)	= increased prevalence for depression (0.152)* higher total cost estimate per adult (9,622)
	£377	£532	£623	£1,463

GAD	= increased prevalence for GAD (0.218) *treatment cost per adult (1,314)	= increased prevalence for GAD (0.218)* lower total cost estimate per adult (1,795)	= increased prevalence for GAD (0.218)* average total cost estimate per adult (2,079)	= increased prevalence for GAD (0.218)* higher total cost estimate per adult (8,083)
	£286	£391	£453	£1,762
PTSD	= increased prevalence for PTSD (0.283) *treatment cost per adult (2,482)	= increased prevalence for PTSD (0.283)* lower total cost estimate per adult (3,498)	= increased prevalence for PTSD (0.283)* average total cost estimate per adult (4,098)	= increased prevalence for PTSD (0.283)* higher total cost estimate per adult (9,622)
	£702	£990	£1,160	£2,723
Total	£1,365	£1,913	£2,236	£5,948

NB: The total values here provide estimates of the additional annual economic losses per adult related to the likely prevalence for all conditions. They are calculated by multiplying the increased prevalence associated with each condition by the total treatment cost identified in [Table 15](#). Note the base data for these values are the same as for Table 13 in addition to the PHE prevalence data specified in [Table 16](#).

Separating by depth of flooding⁶

As previously mentioned, the PHE data highlighted a positive relationship between the probability of having a mental health condition and the depth of flooding experienced. Therefore, a better approach would be to separate the data by depth and consider the change in prevalence associated with experiencing a lower or higher depth of flooding (see Table 3). Since we do not have disaggregated prevalence data and only the adjusted odd ratios for different depths, we need to use an approach to convert these into prevalence (odds/(1+odds)).

Converting adjusted odds ratios into prevalence

The relative risk ratio (RR) is the ratio of the probability of the exposed group by the probability of the non-exposed group. RR can be calculated using the adjusted odds ratio (OR) according to the following formula:

$$\text{Risk Ratio} = \frac{OR}{(1 - P_{ref}) + (P_{ref} * OR)}$$

Where,

OR = Odds Ratio

P_{ref} = Prevalence of the outcome in the reference group

(<http://clincalc.com/stats/convertor.aspx>)

⁶ Although prevalence data is provided for the overall cohort, only adjusted odds ratios are provided disaggregated into the 3 depth bands. This has meant that in order to translate these into relative risk ratios we have needed to apply the overall cohort prevalence.

We use the prevalence data for each outcome of the unaffected (reference) group (Table 16) to calculate RR for each depth band (Table 18) and then subsequently use these values to calculate the increase prevalence (Prevalence * (RR-1)) for each flood depth band (Table 19).

Table 18: Relative risk ratio for each outcome and depth band (based on Waite and others, 2017)

Prevalence ref group (unaffected) ⁷	0.058	0.065	0.079
Risk ratio			
Flood depth inside a residential property ⁸	Depression	Anxiety	PTSD
<30cm	3.793	4.131	4.166
30 to 100cm	5.914	5.909	5.882
>100cm	8.194	6.802	7.647

Table 19: Increase in prevalence of each outcome per depth band (based on PHE, 2017)

Increased prevalence			
Flood depth inside a residential property	Depression	Anxiety	PTSD
<30cm	0.162	0.204	0.250
30 to 100cm	0.285	0.319	0.386
>100cm	0.417	0.377	0.525

The resulting additional economic losses can then be derived using:

$$\text{Additional economic losses} = (\text{costs of treatment} + \text{work-based losses}) * \text{increased prevalence of having the condition due to flooding}$$

Firstly, we need to combine the 2 values to provide a total of the costs associated with treating each of these conditions and to represent absenteeism/employment inactivity (see sections 2.9 and 2.10 and Table 15 for the total costs and calculations for the 4 scenarios (treatment only, low, average and high estimates). NB – for the first scenario where only treatment costs are considered work-based losses are zero.

see Table 19

The following tables (Table 20 to Table 23) present the estimates of the additional economic losses that can be applied in the revised appraisal methodology.

⁷ Waite and others (2017) The English national cohort study of flooding and health: cross-sectional analysis of mental health outcomes at year one, *BMC Public Health*, 17:129

⁸ Calculated from PHE (2017) The national study of flooding and health: first year report, Public Health England: Table 8.

Table 20: Only treatment cost estimate of additional economic losses per adult per year (2018 values) disaggregated by condition and flood depth band (see Table 15, column 2 and Table 19 for values)

Flood depth inside a residential property	Depression	Anxiety	PTSD	Total (sum of depression, anxiety and PTSD)
<30cm	£402 2,482*0.162	£268 1,314*0.204	£621 2,482*0.250	£1,291 402+268+621
30 to 100cm	£707 2,482*0.285	£419 1,314*0.319	£958 2,482*0.386	£2,084 707+419+958
>100cm	£1,035 2,482*0.417	£495 1,314*0.377	£1,303 2,482*0.525	£2,833 1,035+495+1,303

NB: These values are based on 'only treatment' costs from McCrone and others (2008); Table 7. These totals assume that everyone seeks treatment and there is no adjustment for co-morbidity.

Table 21: Lower estimates of additional economic losses per adult per year (2018 values) disaggregated by condition and flood depth band (see Table 15, column 3 and Table 19 for values)

Flood depth inside a residential property	Depression	Anxiety	PTSD	Total (sum of depression, anxiety and PTSD)
<30cm	£567 3,498*0.162	£366 1,795*0.204	£875 3,498*0.250	£1,808 567+366+875
30 to 100cm	£996 3,498*0.285	£573 1,795*0.319	£1,350 3,498*0.386	£2,919 996+573+1,350
>100cm	£1,458 3,498*0.417	£677 1,795*0.377	£1,836 3,498*0.525	£3,971 1,458+677+1,836

NB: These values are based on the low estimates (treatment costs from McCrone and others (2008); Table 7) and low estimate of work-based losses (see Table 10:)). These totals assume that everyone seeks treatment and there is no adjustment for co-morbidity.

Table 22: Average estimates of additional economic losses per adult per year (2018 values) disaggregated by condition and flood depth band (see Table 15, column 4 and Table 19 for values)

Flood depth inside a residential property	Depression	Anxiety	PTSD	Total (sum of depression, anxiety and PTSD)
<30cm	£664 4,098*0.162	£424 2,079*0.204	£1,025 4,098*0.250	£2,113 664+424+1,025
30 to 100cm	£1,168 4,098*0.285	£663 2,079*0.319	£1,582 4,098*0.386	£3,413 1,168+663+1,582
>100cm	£1,709 4,098*0.417	£784 2,079*0.377	£2,151 4,098*0.525	£4,644 1,709+784+2,151

NB: These values are based on the average estimates (treatment costs from McCrone and others (2008); Table 7) and average estimate of work-based losses (see Table 10:)). These totals assume that everyone seeks treatment and there is no adjustment for co-morbidity.

Table 23: High estimates of additional economic losses per adult per year (2018 values) disaggregated by condition and flood depth band (see Table 15 column 5 and Table 19 for values)

Flood depth inside a residential property	Depression	Anxiety	PTSD	Total (sum of depression, anxiety and PTSD)
<30cm	£1,559 9,622*0.162	£1,649 8,083*0.204	£2,406 9,622*0.250	£5,614 1,559+1,649+2,406
30 to 100cm	£2,742 9,622*0.285	£2,578 8,083*0.319	£3,714 9,622*0.386	£9,034 2,742+2,578+3,714
>100cm	£4,012 9,622*0.417	£3,047 8,083*0.377	£5,052 9,622*0.525	£12,111 4,012+3,047+5,052

NB: These values are based on the higher estimates (treatment costs from McCrone and others (2008); Table 7) and high estimates of work-based losses (based on the values from McCrone and others (2008); Table 12)). These totals assume that everyone seeks treatment and there is no adjustment for co-morbidity.

Accounting for co-morbidity and the numbers seeking treatment

As discussed previously, any approach needs to take account of co-morbidity and the numbers of those affected by a condition who seek treatment, otherwise there is the danger that the values presented will overestimate losses. Therefore, we present 3 additional scenarios that take account of these conditions. These have only been applied here as an illustration of the average estimate health value, but equally may be applied to the other scenarios. The scenarios are:

- average estimate health value (H_{Ave}) with 30% co-morbidity
- average estimate health value (H_{Ave}) with 50 to 60% seeking treatment; 60% seeking treatment for depression and 50% for anxiety and PTSD respectively
- average estimate health value (H_{Ave}) with 30% co-morbidity and 50 to 60% seeking treatment

Table 24: Average estimates of additional economic losses per adult per year (2018 values) disaggregated by condition and flood depth band (see Table 15, column 4 and Table 19 for values), with 30% having co-morbidity of conditions

Flood depth inside a residential property	Depression	Anxiety	PTSD	Total (sum of depression, anxiety and PTSD)
<30cm	£465 4,098*(0.162*70%†)	£297 2,079*(0.204*70%†)	£1,025 4,098*(0.250*100%†)	£1,479 465+297+717
30 to 100cm	£818 4,098*(0.285*70%†)	£464 2,079*(0.319*70%†)	£1,582 4,098*(0.386*100%†)	£2,389 818+464+1,107
>100cm	£1,196 4,098*(0.417*70%†)	£549 2,079*(0.377*70%†)	£2,151 4,098*(0.525*100%†)	£3,251 1,196+549+1,506

† NB: If we assume that 30% of those with conditions are co-morbid (that is, they also have other conditions), this means that 70% of those should be treated as a single condition. This is based on interrogation of the data from the Adult Psychiatric Morbidity Survey 2007 (Table 14).

It would be very complicated to adopt all 7 scenarios of co-morbidity, so we have followed a simplified approach that retains 100% of the prevalence for PTSD (as this was the most prevalent condition) and adjusted the prevalence of those with depression and anxiety to 70% to account for co-morbidity. We acknowledge that this simplified approach omits a percentage of depression and anxiety, but we have applied the simplified approach so that the formulas can be followed easier in this report.

Table 24: Average estimates of additional economic losses per adult per year (2018 values) disaggregated by condition and flood depth band (see Table 15, column 4 and Table 19 for values), with 60% of those with conditions seeking treatment for depression and 50% seeking treatment for anxiety and PTSD

Flood depth inside a residential property	Depression	Anxiety	PTSD	Total (sum of depression, anxiety and PTSD)
<30cm	£398 $4,098 \times (0.162 \times 60\%^\dagger)$	£212 $2,079 \times (0.204 \times 50\%^\dagger)$	£512 $4,098 \times (0.250 \times 50\%^\dagger)$	£1,122 $398 + 212 + 512$
30 to 100cm	£701 $4,098 \times (0.285 \times 60\%^\dagger)$	£332 $2,079 \times (0.319 \times 50\%^\dagger)$	£791 $4,098 \times (0.386 \times 50\%^\dagger)$	£1,824 $701 + 332 + 791$
>100cm	£1,025 $4,098 \times (0.417 \times 60\%^\dagger)$	£392 $2,079 \times (0.377 \times 50\%^\dagger)$	£1,076 $4,098 \times (0.525 \times 50\%^\dagger)$	£2,493 $1,025 + 392 + 1,076$

† NB: The approach here assumes that only 60% of those people with depression and 50% of those with anxiety and PTSD seek treatment. This is based on data from the Adult Psychiatric Morbidity Survey 2014. It is important to note that we have applied the percentages to the total economic estimates ⁹(treatment costs and work-based costs) rather than only treatment costs. This decision reflects that for the average scenario the approach we adopted is based on the assumption that those in employment miss a number of days of work for attending treatment, which of course would not occur if they were not seeking treatment. Furthermore, if those days off work are due to having the condition and being unfit for work, they are likely to be officially signed off from work and therefore will have sought treatment. Therefore, it is considered appropriate to offer a conservative estimate by applying the percentage to the total value, and assume, for instance, that the 40% of those with depression do not have associated treatment costs or work-based losses.

Table 25: Average estimates of additional economic losses per adult per year (2018 values) disaggregated by condition and flood depth band (see Table 15, column 4 and Table 19 for values), with 30% having co-morbidity of conditions and 50 to 60% of those with conditions seeking treatment

Flood depth inside a residential property	Depression	Anxiety	PTSD	Total (sum of depression, anxiety and PTSD)
<30cm	£279 $4,098 \times (0.162 \times 70\% \times 60\%^\dagger)$	£148 $2,079 \times (0.204 \times 70\% \times 50\%^\dagger)$	£512 $4,098 \times (0.250 \times 100\% \times 50\%^\dagger)$	£939 $279 + 148 + 512$
30 to 100cm	£491 $4,098 \times (0.285 \times 70\% \times 60\%^\dagger)$	£232 $2,079 \times (0.319 \times 70\% \times 50\%^\dagger)$	£791 $4,098 \times (0.386 \times 100\% \times 50\%^\dagger)$	£1,514 $491 + 232 + 791$

⁹ NB: for the higher estimate case, there is a stronger rationale for only applying the value to the treatment costs as the value is estimated from the values used by McCrone and others (2008), which is considering those who are economically inactive as well as those missing days from work. However, even in this case, we might assume that those who have conditions that are so severe that they are unable to work would need to be in contact with healthcare professionals (and therefore are seeking treatment) to be officially signed off from work and able to receive benefits.

	£718	£274	£1,076	£2,068
>100cm	4,098*(0.417*70%*60%†)	2,079*(0.377*70%*50%†)	4,098*(0.525*100%*50%†)	718+274+1,076

† NB: The approach here assumes that 30% of all conditions are co-morbid. Only 60% of those with depression and 50% of those with anxiety and PTSD seek treatment. This is based on data from both the Adult Psychiatric Morbidity Survey 2014 and interrogation of the Adult Psychiatric Morbidity Survey 2007. See footnote to Table 24 for rationale for applying the seeking treatment percentage to the total value.

3 Proposed revised benefit appraisal methodology

The current multi-coloured manual methodology for calculating 'intangible benefits' associated with flood defence improvement does not include mental health impacts. Therefore, the revised methodology complements rather than replaces the existing methodology. This proposed approach is unique and should be applied separately. We have developed it to be adopted at a property level and to be compatible with the full-scale appraisal methodologies used to calculate losses to residential property.

We recommend using the average health values as they adopt an approach to estimating work-based losses that is already used for benefit appraisal in education when parents are required to care for minors following a school closure due to flooding. We have also selected a period of impact of 2 years. It is recognised (section 2.6.3) that the mental health conditions, and the costs associated with them, extend beyond one year. However, evidence from previous studies varies, with impacts ranging from 2 years to decades. Individuals also experience the impacts differently. Until more specific and refined information is available on how long impacts are likely to last, we recommend a conservative approach where these values are doubled and applied over a 2-year period. Table 26 shows the costs to be applied per adult per flood.

Table 26: Average estimates of additional economic losses per adult per flood (2018 values) disaggregated by condition and flood depth band (see Table 15, column 4 and Table 19 for values), with 30% having co-morbidity of conditions and 50 to 60% of those with conditions seeking treatment

Flood depth inside a residential property	Depression	Anxiety	PTSD	Total (sum of depression, anxiety and PTSD) per flood
<30cm	£279 $4,098 \times (0.162 \times 70\% \times 60\%^\dagger)$	£148 $2,079 \times (0.204 \times 70\% \times 50\%^\dagger)$	£512 $4,098 \times (0.250 \times 100\% \times 50\%^\dagger)$	£1,878 $(279 + 148 + 512) \times 2$
30 to 100cm	£491 $4,098 \times (0.285 \times 70\% \times 60\%^\dagger)$	£232 $2,079 \times (0.319 \times 70\% \times 50\%^\dagger)$	£791 $4,098 \times (0.386 \times 100\% \times 50\%^\dagger)$	£3,028 $(491 + 232 + 791) \times 2$
>100cm	£718 $4,098 \times (0.417 \times 70\% \times 60\%^\dagger)$	£274 $2,079 \times (0.377 \times 70\% \times 50\%^\dagger)$	£1,076 $4,098 \times (0.525 \times 100\% \times 50\%^\dagger)$	£4,136 $(718 + 274 + 1,076) \times 2$

The proposed methodology uses the current Environment Agency supporting spreadsheet for benefit appraisal and should be applied for each residential property affected by flooding. It can be carried out in 3 steps:

1. differentiate the likely number of adult residents for each property in the benefit area
2. estimate the economic mental health costs for each residential property per return period
3. calculate the total expected annual damage for mental health

3.1 Step 1: Differentiate residential properties in the benefit area

To apply the costs of flooding on mental health it is necessary to identify the likely number of adults living in each property within the benefit area. Ideally, this should be differentiated by the type of property affected, recognising that certain types of property are likely to have more adult residents than others. Unfortunately, although there are census data that can be used for this, there is no one data set that provides a breakdown of the number of adults residing in different types of property.

To provide an example estimate we have used 3 data sets from the 2011 Census: QS402EW - Accommodation type households; QS401EW - Accommodation type – people; and QS103EW - Age by single year. We have calculated the average number of residents (of any age) in a particular type of accommodation in England by dividing the total number of residents for each property type (from QS401EW) by the total number of properties of that type in England (QS402EW). We have adjusted this downwards using age data from the census (QS103EW) to account for those residents who are under 18¹⁰. Table 28 shows the national average number of adults per property by property type. It is important to note that these are average values and may not reflect local demographics. Local census data or survey information may be used to better reflect the local population characteristics if these data are available.

Table 27: National average number of adults per property in England

Property type	Number of adults per property
Average (all categories)	1.85
Detached	2.01
Semi-detached	2.00
Terraced	1.95
Bungalow	1.99
Flat	1.45

NB – These are based on the MCM property types

The outcome for this step will be the expected number of adults residing in each property within the benefit area. The ground floor threshold level of properties also has to be determined by survey or estimates to derive the flood depth within the properties. This information is already required to calculate the losses to properties.

3.2 Step 2: Estimate the economic mental health outcomes for each residential property per return period

Step 2 is to classify for each property the ‘mental health outcomes’ according to the flood depth inside a residential property for each return period and for the values per adult per flood.

¹⁰ These data suggested that 79% of English residents are 18 years or over.

The economic mental health impact per property for a considered return period (MHI_p) can then be calculated according to Equation 1 and using the information provided in Table 27 and Table 28.

Equation 1

$$MHI_p = n_{adult} * L_{mh}$$

Where:

n_{adult} is the number of adults

L_{mh} are the economic losses associated with the increased prevalence (likelihood) of experiencing mental health impact.

Table 28: Average estimates of additional economic losses† per adult per flood (2018 values) disaggregated by condition and flood depth inside a property

Flood depth inside a residential property	Additional economic losses per adult per flood (calculated over the 2 years)
<30 cm	£1,878
30 to 100cm (inclusive)	£3,028
>100cm	£4,136

† This is based on the percentage seeking treatment and co-morbidity scenarios presented in Table 26.

The values in Table 28 are also presented graphically in Figure 2. This highlights the stepped nature of the expected losses. There is insufficient data to further explore variation within the different depth bands, and therefore this should not be attempted when utilising the values. Additionally, losses should only accrue when depths are above internal floor level.

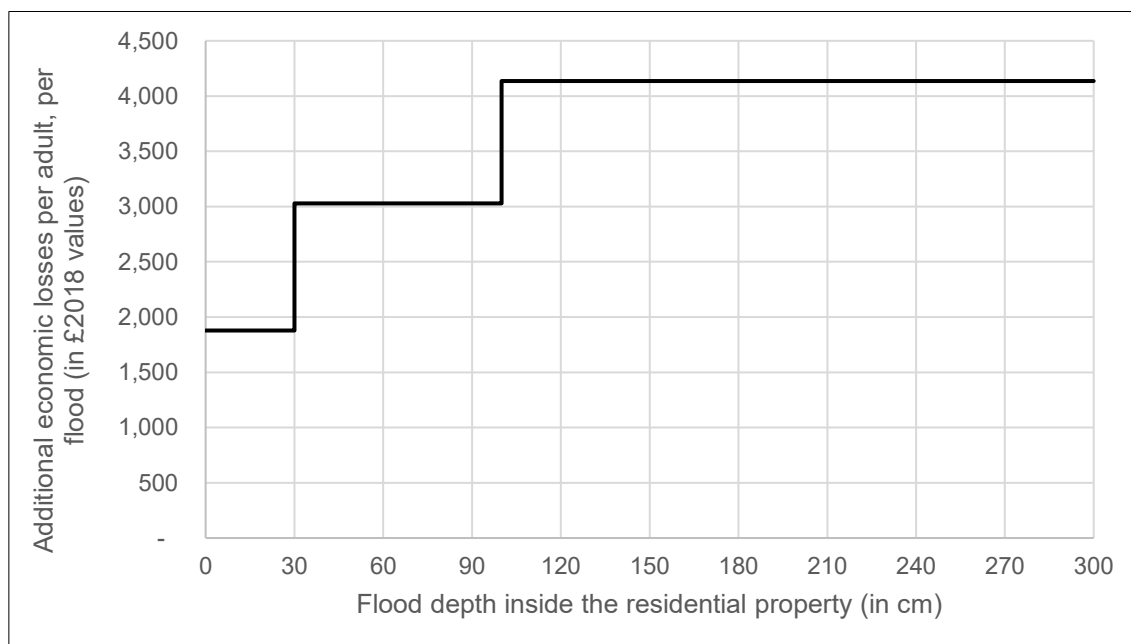


Figure 2: Graphical representation of the additional economic losses per adult per flood for each depth band

3.3 Step 3: Calculate the total expected annual damage for mental health

Once MHI_p has been calculated for all the considered return periods, the expected annual damage for mental health impact (MHE) should be calculated for each property following equation 2 and summed to estimate the total expected annual damage for mental health impact in the benefitting area.

Equation 2:

$$MHE = \int_p MHI_p dp$$

In practice, the Environment Agency's FCRM economic appraisal: supporting spreadsheet¹¹ can be used for estimating the expected annual average damages (see Figure 3). Calculate the total economic mental health losses for each considered return period (MHI_p) (5, 10, 20, 50, 100, 200, 500) for all properties in the benefit area and enter the values in the Environment Agency supporting spreadsheet in the 'Other' category box for the considered scenario (Asset-AAD Do nothing/do something spreadsheet tabs).

1	2	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
1					Asset Annual Average Damage - Other							Sheet Nr.	
2			Client/Authority										
3			0										
4			Project name						Option:				
5			0						Do-nothing				
6			Project reference										
7			Base date for estimates (year 0)			Jan-03			Prepared (date)		00/01/1900		
8			Scaling factor (e.g. £m, £k, £)			£			Printed		18/04/2018		
9			Discount rate			3.5%			Prepared by		0		
10									Checked by		0		
11			Applicable year (if time varying)			0			Checked date		0		
12									Average waiting time (yrs) between events/frequency per year				
13						5	10	20	50	100	200	300	500
14						0.200	0.100	0.050	0.020	0.010	0.005	0.003	0.002
15													
16			Other										
17													
18			Agricultural land									0	0.00
19			Mental Health									0	0.00
20												0	0.00
21												0	0.00
117			Total Other (£)		0	0	0	0	0	0	0	0	0.00
118			(transferred to C1,2)										
119													
120													
121													
122													
123													
124													
125													
126													
127													

Figure 3: Screenshot of the Environment Agency's FCRM economic appraisal supporting spreadsheet

¹¹ <https://www.gov.uk/government/publications/fcrm-economic-appraisal-supporting-spreadsheet>

4 Limitations and future research needs

We have developed the proposed methodology based on the best available evidence and accounting for the relevant needs for benefit appraisal (for example, effort of application, method of attributing the impacts). There are some limitations to both data and methodology approach. The following bullet points discuss future data and research needs.

- This methodology as focused on valuing the mental health impacts of flooding. No references were found in the literature detailing the mental health impacts associated with being at risk of erosion. This is an equally valid impact and should be considered for future research.
- The available data does not make it possible to differentiate increases in prevalence between different types of flooding (for example, fluvial, pluvial). Therefore, flood depth experienced inside a property is the only distinguishing factor.
- A lack of England-specific data on the physical health impacts of flooding has meant this has been excluded from the methodology.
- The Public Health England data provided information on prevalence, but little about the severity of conditions. From the current report, we only have information about whether a respondent had a probable diagnosis for each of the conditions or not. It is not clear whether data on the levels of severity of each of these conditions was also collected. If it was collected, this additional information about the numbers of respondents suffering from mild, moderate or severe symptoms would be useful when considering the nature of treatment. As a result, we have had to make assumptions about the average costs of treatment.
- The Public Health England data we analysed was limited to certain flood situations and narrow socio-demographic profiles. Future evidence from additional flood scenarios could strengthen the data used to estimate the expected losses.

This methodology has focussed on the direct costs to the nation of the mental health impacts of flooding. However, significant elements of the social cost of flooding are still omitted, for example, costs for those who are ill but do not seek treatment, and those who still attend work, even though they are not fully productive (presenteeism). This is mitigated to some limited extent by applying the existing willingness to pay values, however future work should consider how to value and incorporate these and other impacts.

- Only limited evidence is available to suggest the duration of any impacts. The methodology has been developed to be flexible so that we can update the data if further information becomes available.
- There is a lack of information within the published data about co-morbidity (that is, whether the same individuals are suffering from more than one of the conditions). Therefore, there is a lack of specific flood-related data on which to base our decisions. This has meant we have had to use average national data from the APMS 2014.

- One of the main findings from the PHE data is that those disrupted by flooding can also have an increased chance of having one or more of the conditions. The data identified that this was significantly related to loss of electricity. However, this information on its own is difficult to apply within an appraisal approach. If it was possible to review participants' location from the PHE data set and link this to the incidents of disruption, this would provide a better basis on which to understand the type of disruptions. It would also provide more evidence for, and more confidence in, an approach to apply these and establish a wider benefit area. At the moment, the approach has focused on those whose properties have been directly flooded.

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Appendix A: Literature

Table A1: Evidence from existing studies about the health impacts of flooding

Study reference	Type of health impact	Location and event studied	Study information	Characteristic(s) of interest*	Details of findings	Usefulness of the result for benefit appraisal methodology
Abramson and others (2008)	Mental health impacts	Katrina, US 2005	Longitudinal study: Baseline face-to-face interview carried out 6 to 12 months after the flood and a follow up telephone interview 20 to 23 months after the event. Stratified cluster sampling (1,077 people) of emergency housing from impacted areas of Louisiana and Mississippi. Diagnostic questionnaires used to measure mental health condition. Considered various socio-demographic, situational and attitudinal characteristics.	<ul style="list-style-type: none"> ▪ Association with socio-demographic characteristics ▪ Duration of health impacts 	<p>Provides some indication of those factors influencing the mental health scores within 3 distinct locations (disaggregating by those displaced or not displaced). The main findings include that health distress and disability continue for longer than expected, and do not stop once the displaced people move back into their communities. Reinforces the role of continued displacement in predicting poor mental health as time goes on. Also highlights the importance of informal support networks, and underlying attitudes of fatalism or self-reliance on mental health. These have a greater impact on mental health than that of structural or economic factors.</p>	<p>Highlights that the predictors of poor mental health change over time and are complex. Suggests that it would be difficult in a project appraisal to guarantee the influence of any one predictor.</p> <p>Directly, the context of the paper and its participants are not readily transferable to the UK (for example, flood severity, socio-demographic characteristics of participants) and data on total prevalence and severity of impacts is lacking.</p>

Alderman and others (2013)	Overall, physical (respiratory) and mental health impacts considered	Brisbane, Australia, 2011	Questionnaire study: Random sample of 3,000 residents chosen from areas affected, so captured directly and indirectly affected. Carried out approximately 6 to 7 months after the flood (960 people)	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics ▪ Association with flood characteristics 	<p>Direct flood impact considered to be a significant risk factor, that is those directly affected more likely to report:</p> <ul style="list-style-type: none"> ▪ poor overall health (OR=5.3) ▪ poor respiratory health (OR=2.3) ▪ psychological distress (OR=1.9) ▪ poor sleep quality (OR 2.3) ▪ probably PTSD (OR=2.3) <p>Socio-demographics: those with existing underlying health conditions had higher odds ratios of the conditions considered. Females were more likely to report worse overall health compared with males as were renters compared with homeowners. Age and socio-economic status showed no significant differences.</p>	Possible lessons here – consider comparing the odds ratio for PTSD with those from PHE. Although there are differences between the timing of the questionnaires and also the specific diagnostic tools.
Assanangkornchai and others (2004; 2007)	Mental health impacts (emotional response)	2000 Hat Yai municipality, Thailand (3 urban areas)	Randomly selected households from 4 sites (91 households, with a total of 590 people). Subjects all aged over 14 years. 10 weeks after the flood - structured interview questionnaire with a mix of demographic and other questions considering their exposure to stressors (for	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics ▪ Association with flood characteristics ▪ Duration of health impacts 	40% of subjects scored highly enough on the general health questionnaire scale to suggest that they had a mental health problem. The increased likelihood of suffering mental health illness was associated with a measure of severe personal loss (OR= 2.22), knowing someone killed (OR: 1.98) and reporting negative consequences after the flood	Contextual background and factors are interesting, but lacks a control sample. The flood and cultural context are significantly different and only consider the general health impacts, rather than focusing on the

			<p>example, injury, fatality of family, personal loss, flood experience) as well as a diagnostic questionnaire (general mental health status and impact of event scale). Follow-up interviews repeated the 2 diagnostic questionnaires mainly with the same subjects at 8 to 10 week intervals up to 5 times (sample size varies).</p>		<p>(OR: 1.49). There was an unexpected relationship observed, which showed that those who were able to collect some (OR: 2.06) or almost all (OR: 2.14) their possessions had a higher risk of mental illness. This may relate to the trauma of seeing their home flooded and what they have lost.</p> <p><i>Follow up study:</i> Generally, there is a pattern of decreasing prevalence of mental health impacts over the 5 interviews; from 39.49% to 9.40% at interview 4 (approximately 9 months after the flood). The stress reactions appear therefore to have remitted by 6 months after the event, and many appear to have adapted to flood-related issues. However, the prevalence increased again to 16.6% at around 12 months after the flood, coinciding with when the rainy season returned known as 'anniversary reaction').</p> <p>Results using the event impact score showed a relationship between a positive score for mental health problems and the scores related to a categorisation of how severely they found the event.</p>	evidence of specific conditions.
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					<p>Additionally, there were relationships with other factors. The impact score was significantly lower for those who expected the flood event, and those of a higher socio-economic status. <i>Follow up study</i>: The average impact score increased slightly at interview 2, but significantly decreased from the third interview.</p>	
Bei and others (2013)	Physical and mental health impacts (stress, anxiety, depression, PTSD, general health)	Victoria and New South Wales, Australia in 2010 to 2011	<p>Longitudinal design with older adults (60 and over) (274 people). Surveyed before and after flooding. Used several standard clinical questionnaires (some specifically targeted at older individuals). Divided into 3 groups: not affected (179 people), indirectly affected (37) and personally affected (58). The groups did not differ in terms of composition and pre-existing health.</p>	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Presence/absence of mitigating factors 	<p>Those personally affected scored more highly on the tests of stress symptoms than those not affected. 15.1% (8 people) of those personally affected displayed scores that may indicate clinical concern for PTSD. The others were in lower categories, with two thirds displaying low or no PTSD symptoms. Overall decrease in satisfaction with life in the whole sample. Higher levels of PTSD symptoms recorded by those who received government support.</p>	<p>Provides detail of impacts on older adults. Should not be extended to general population as other studies have indicated that age can be a significant variable. Also, a small sample (58 people) of personally affected older people.</p>
Bennet (1970)	Physical and mental health impacts	Bristol, UK in 1968	<p>Survey before and after floods. Data on hospital referrals/admissions and GP attendance compared with a year before and after flooding.</p>	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics 	<p>Rise in mortality generally in the 12 months after flooding. GP attendance increased on average by 53% (males – 81% and females – 25%), with the young (one to 4 years) and older (over 55 years) having increased attendance rates.</p>	<p>Although from the UK, the data is from a flood that occurred in 1968. Also, the type of study is different to most others, drawing conclusions from data on presentations at GP. This is therefore,</p>

				<ul style="list-style-type: none"> ▪ Association with flood characteristics ▪ Duration of health impacts 	Relationship between male GP attendance and those extensively flooded and not-rehoused. 33% of males reported new physical symptoms as compared within non-flooded males (16%). 18% of flooded females reported psychological symptoms (these may have been present before the flood) compared with only 6% of non-flooded females.	measuring those only seeking healthcare services rather than the more common approach, which is to consider prevalence within the general population.
Brown and Murray (2017)	Physical impacts (specifically infectious diseases)	Europe	Systematic literature review of 38 existing studies	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Association with flood characteristics 	Details evidence of the outbreak of infectious diseases related to flooding from the following categories: rodent borne (mainly leptospirosis), vector borne (for example, West Nile virus (WNV), dengue fever) and water borne (for example, cholera, gastrointestinal illnesses). Concluded that some studies indicated that instances of some diseases increased in the weeks after a flood, but that the strength of association between the occurrence of a disease and flooding is still scientifically uncertain. Also, the context of a flood has significant impacts on the likelihood of disease increase and outcomes (for example, displacement of population, availability of clean water, access to healthcare services).	The relationship between flooding and increased instance of infectious disease is noted to be very context and country specific. Therefore, the potential transferability of results is low. Only one study is from the UK (Reacher and others (2004) – see specific entry in this table for information) and from floods in 2000. There is generally a lack of corroborated evidence on this, although from an infectious disease perspective, gastro-intestinal diseases appear to be the most

						significant in the aftermath of flooding in the UK.
Canino and others (1990)	Mental health impacts (depression, PTS, anxiety, alcohol and drug dependence, panic and anti-social personality disorder)	Flooding and landslides in Puerto Rico in 1985	<p>Cohort study before and after floods. 912 interviews after flooding (375 were prospective and 537 retrospective sample (non-impacted served as control). Two years after flooding.</p> <p>77 of prospective sample exposed to the flood (more males and significantly less educated – but other characteristics comparable).</p>	<ul style="list-style-type: none"> ▪ Association with socio-demographic characteristics ▪ Association with flood characteristics 	No association between new symptoms after flooding and variables considered: sex, age, education, and previous symptoms.	Counter example to many other studies. Highlighting that socio-economic variables are not always significant.
Carroll and others (2009); Carroll and others (2010)	Mental health impacts (sense of home psychological health)	Carlisle, UK 2009	Five focus groups (4 to 6 people in each – total number = 40). Qualitative interviews (6 people) with flooded residents and support workers. Perceptions and behaviour before, during and after the floods. Carried out 10 to 13 months after flooding.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Presence/absence of mitigating factors 	Most respondents reported anxiety and stress – due to a range of factors; danger, loss and damage to property/possessions, disruption and displacement, dealing with insurers and builders. Importance of flood preparation and awareness indicated.	Only contextual information provided. Sample insufficient to use directly due to the lack of quantitative information.
CDC (1993)	Physical and mental health impacts considered	Midwest flood-Missouri, 1993	Additional public health surveillance activities after flooding. Emergency departments used a standardised questionnaire to provide	<ul style="list-style-type: none"> ▪ Type and severity of health impacts 	Over the 7 weeks of surveillance 524 flood-related conditions reported and were separated as: 47.7% injuries (of which 34% were sprains/strains; 24% lacerations; 11% abrasions/contusions; 11%	Results are of interest, however the physical conditions may not be transferable due to differences in the scale and severity of the flooding.

			daily reports of visits for injuries and illnesses.		other), 44.5% illnesses (of which 17% were gastrointestinal, 16% rashes/dermatitis, 13% heat-related and 20% other), 7.4% other and the remaining (0.4%) unknown.	
Chae and others (2005)	Mental health impacts	Typhoon Rusa No. 15, 2002, South Korea	Post-event survey with a convenience sampling method (339 people affected) and (246 people in the adjacent unaffected location). Took a retrospective approach, collecting data from both the present and the past. Used diagnostic questionnaires 3 months after the disaster.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts 	For those impacted, the overall social and psychological health deteriorated, highlighted by changes to the wellbeing index. Self-reported anxiety-related stress also showed a significant increase compared to before the event. 21.3% of respondents reported newly developed anxiety-related stress. Data suggested that 39.5% of affected residents showed some level of PTSD after the flood compared with the adjacent area where there was no increase. Need to be wary about cultural differences in relation to how mental health is viewed as this will impact on reporting and willingness to participate in the study.	There was a clear difference in instances of the conditions between the control (unaffected) and those affected by the flood. However, some limitations in sampling and the nature and context of the flood make it difficult to transfer results to the UK context.
Collins and others (2013)	Physical and mental health impacts	El Paso, Texas, US in 2006	Cross-sectional survey (475 people) of respondents impacted by the flood, 4 months after the event. Focused on a range of variables, but particularly focused on migrants and non-native speakers.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics 	43% of survey respondents reported physical impacts (including allergies, throat irritations/coughing/wheezing, headaches and nose/eye/skin irritations. 28% suggested that they had one or more impacts related to clean-up activities (for	One of the main studies focusing on physical impacts (other than fatalities). However, the sample is particularly limiting as it focuses on migrants and non-native speakers.

				<ul style="list-style-type: none"> Association with flood characteristics 	<p>example, strained muscles, bruises, stiffness, abrasions). 18% reported mental health impacts, including 17% depression and 8.6% PTS. Associated variables included older age, lower social-economic status, low health care access, non-US citizenship and proficiency.</p>	
Duclos and others (1991)	Physical and mental health impacts	Nîmes, France flood 1988	Case study (included an affected and unaffected case control comparison). Considered mainly age as a factor. Looked at data on medical care and monitoring of infectious diseases. Survey of 108 families (228 people)	<ul style="list-style-type: none"> Association with socio-demographic characteristics Prevalence of health impacts Type and severity of health impacts 	<p>There was a similar average age of the respondents to the general survey population, suggesting that age has little impact. 32% of survey respondents had health related issues. Of these 59 reported mental health/stress related issues (insomnia/anxiety). Other impacts included influenza, bronchitis, rhinitis, sinusitis and rheumatism.</p>	The specific fast-onset and severe nature potentially makes the results difficult to transfer.
Ginexi and others (2000)	Mental health impacts (depression)	Iowa, US in 1993 (Midwest floods)	Cohort study – Before (2,379 people) and after flood (1,735 of the original people) survey 30 to 90 days after flooding. 893 people impacted. Used various standard health questionnaires.	<ul style="list-style-type: none"> Prevalence of health impacts Association with socio-demographic characteristics Association with flood characteristics 	<p>Significant associated variables with depression after flooding are: depression before flooding (OR=8.6), flood impact level (OR=1.1), age (OR=0.98), income (OR=0.84) and those separated/divorced. Results may be biased by the sample who were not surveyed after the flooding as they were more likely to be male, single, lower socio-economic status,</p>	Results not generally transferable due to the nature and scale of the floods and the passage of time (25 years) since the event. But some quantified evidence of socio-economic conditions impacting on the health outcomes.

					have depression before the floods and live in non-farm rural communities. Affects prevalence information, but not the relationships between depression and other variables.	
Handmer and others (1983)	Mainly physical impacts	Lismore Australia. 1974 floods	Compared hospital admission data before and following the 1974 floods.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics ▪ Association with flood characteristics 	No evidence of increased admissions after the floods (when compared with data before the flooding). But, those whose homes were flooded over 1m were twice as likely to be admitted as those not flooded. Gender differences: for those whose homes were severely flooded, female admissions reduced (halved), while admissions of males doubled.	Transferability of results questionable, due to age of survey and lack of data concerning the specific nature of the hospital admissions.
Hayes and others (2009)	Mental health impacts	2007 flood, Oxfordshire, UK	Details experiences of a community mental health team. Recorded minutes from team meetings and observations of the team. 87 residents known to the team were living in affected areas. Two new people referred to the team following flooding.	<ul style="list-style-type: none"> ▪ Association with socio-demographic characteristics 	Confirmed the increased vulnerability of those with pre-existing mental health conditions to psychological impacts after flooding, with 11 individuals having deteriorating symptoms or new psychological problems. "The risk of individuals suffering from anxiety or depressive symptoms following an episode of flooding is greatly increased by pre-existing symptoms of depression, living alone and having limited social networks" (p335). Identifies factors that particularly make existing conditions worse, including	Further confirms the importance of pre-existing conditions. Professional experience-driven study and so provides limited data about prevalence or severity of impact. Lack of quantitative evidence to input into an appraisal methodology.

					displacement and property damage.	
Heo and others (2008)	Mainly mental health impacts, but some physical impacts considered.	Garisan-ni, Inje-gun, Gangwondo, South Korea in 2006	Pre-disaster survey on general health carried out 2 weeks before the flood and a survey carried out 18 months afterwards. (58 respondents). Diagnostic questionnaires considering the health-related quality of life were carried out before and after flooding. Further diagnostic questionnaires carried out after the flooding to measure PTSD, depression and trauma experience. Various socio-economic and demographic variables considered.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics ▪ Association with flood characteristics 	<p>After the flood 53% of respondents reported mild and 17% severe depression. 22% displayed PTSD. Results showed significant reduction in health-related quality of life (additional detail provided about the specific elements of the scores). Those groups more significantly affected included males, under 45 years, married, lower education (< middle school) and those earning over \$10,000. Nearly one-third (31.03%; 18 people) scored high enough to be given a clinical diagnosis of PTSD on one scale and 43.1% (25 people) on the other. When considering the responses on both scales 22.41% (13 people) qualified for PTSD diagnosis. The results from the depression scale indicated that 53.45% (31 people) had at least mild depression, with 10 respondents recording scores high enough to be considered to have severe depression (17.24%).</p> <p>A benefit of the study was that it was able to compare health status before and after the flood based on data collected just before the disaster rather than</p>	Provides a before and after flood event comparison of conditions, however cultural differences very pronounced. Small sample size.

					only retrospectively considering the changes. But it was a very small sample and affected by people moving following the disaster. Also, it may overestimate prevalence of PTSD as sample contained a higher proportion of older individuals, who are considered to be more vulnerable to PTSD than the general population.	
Jimenez and others (2013)	Physical health impacts	El Paso, Texas, US in 2006	Cross-sectional survey of (363 people from 176 households) Carried out 4 months after the floods with Hispanic respondents whose homes were flooded. Focused on respiratory health impacts. Considered a range of variables.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics ▪ Association with flood characteristics 	41% of respondents reported having one or more respiratory illnesses after the flooding. Significant associations of the respiratory illness with lower income and exposure to mould. Age and gender not significant variables.	Focused on specific demographic groups, so although there are some lessons, data are not generally transferable.
Lamond and others (2015)	Mental health impacts	Areas of UK post 2007 floods	Cross-sectional postal questionnaire (280 people) of owner occupied households – no diagnostics tests used as these formed part of a wider post-event survey. Considered socio-economic variables and also flood warning and mitigation. Survey carried out six years after the floods.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Association with socio-demographic characteristics ▪ Prevalence of health impacts ▪ Association with flood characteristics 	One-third of respondents reported moderate, high and extreme impact of flooding on deterioration of mental health. Those reporting frequently feeling depressed (9.5%) and always suffering depression (7.4%). Over 60% of respondents reported always or very often experiencing anxiety when it rains (6 years after the floods). Reported mental health deterioration is negatively correlated with household	Results are from the 2007 floods and so can be used and transferred in terms of the UK context. Will offer a good comparison to the PHE study data, although need to consider the influence of the differences in time after the event that the studies were carried out. Also, the nature of the studies

					<p>income – that is, those with lower income are more likely to experience severe mental health deterioration after a flood (also this may be a proxy for other socio-demographic characteristics (for example, age, occupation).</p> <p>There is also a positive correlation between flood depth and mental health deterioration, and a negative correlation between mental health deterioration and mitigation actions (greater impact on mental health, the less you do, such as moving precious objects to safety).</p> <p>Provides some evidence of the impact of resilience actions after flooding and mental health outcomes.</p>	are quite different – no diagnostic tools used.
Lock and others (2012)	Physical and mental health impacts considered	Global	Systematic literature review.	<ul style="list-style-type: none"> ▪ Presence/absence of mitigating factors or stressors 	<p>Reviews existing literature to consider the influence of secondary stressors – that is, aspects other than the flood that make the negative health impacts of flooding worse.</p> <p>“Distress and mental disorders can be caused by the direct effects of the extreme event (primary stressors), and also by the knock-on effects of secondary stressors.” (p9).</p> <p>These are organised into the following categories: economic,</p>	Although provides a useful review of those aspects that may influence or exacerbate the psychological impacts of disasters, these factors are many and varied and will be hard to predict and take into account within an appraisal methodology.

					difficulties with compensation, problems with recovery and rebuilding homes, loss of physical possessions or resources, health, education and schooling, the media, familial, social, leisure and recreation and changes in the view of the world or oneself.	
Lui and others (2006)	Mental health impacts (PTSD)	1998 and 1999 floods Hunan, China	Retrospective questionnaire survey carried out face to face (33, 340 respondents) carried out approximately 12 to 18 months after the floods. Used diagnostic tools. Subjects divided between those who experienced flash flooding, flooding from river or from a collapsed embankment, and also into mild, moderate or severe flood experience. Range of ages: all 7 years or over.	<ul style="list-style-type: none"> ▪ Severity of health impacts ▪ Association with socio-demographic characteristics ▪ Prevalence of health impacts ▪ Association with flood characteristics 	8.6% of the respondents displayed symptoms of PTSD. Socio-economic characteristics: more likely to be female (OR = 1.12), being older, over 60 years (OR = 2.42), whereas 18 to 59 years (OR = 2.28). Type of flood was also seen to be a factor with those affected by the collapsed embankment (OR = 1.84) and flash flooding (OR = 3.12) as well as flood severity (OR = 2.98).	A very large population studied. The authors acknowledge that these results may not apply to other populations. The context and the nature of flooding (especially the collapsed embankment) may not be transferable. The odds ratios here for PTSD seem considerably lower than those experienced in the UK context.
Mason and others (2010)	Mental health impacts (PTSD, depression and anxiety)	UK – paper fails to mention which flood participants experienced – assuming it is 2007. But does suggest	Cross-sectional survey (postal) of flood-affected individuals (not clear what flood-affected constitutes). Diagnostic tests were used. 440 people questioned.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Association with socio-demographic characteristics ▪ Prevalence of health impacts 	Provided the following prevalence of symptoms for the following conditions after the floods: PTSD (27.9%), anxiety (24.5%) and depression (35.1%). Provides further detail about other related factors that could predict the chance of suffering	Despite the reported potential shortcomings of the study, the authors suggested that the levels were comparable with other studies (Galea and others, 2005, Neria and others, 2008 and

		that the flooding was relatively mild compared to other studies.		<ul style="list-style-type: none"> ▪ Association with flood characteristics 	<p>impacts (for example, leaving the home, previous experience of flooding). But the authors question the results in the context of the relatively mild flooding experienced (although there is no real detail on the flood itself to put this into context with other studies). The study also only surveyed flood-affected households. The authors also comment that other studies may be underestimating the impacts as these have not ensured that only those directly impacted were surveyed. They comment that the results may be biased as those most distressed are more likely to complete the survey.</p> <p>Highlighted the commonly found factor that those participants who reported existing poor health were 2 to 4.2 times more likely to suffer from the 3 mental health conditions following the flooding.</p>	<p>Norris and others, 2002; 2005). Can be used in conjunction with the recent PHE reports to provide some corroborative evidence.</p>
Milojevic and others (2011)	Considers mortality (but longer-term – in other words, not caused directly by the event)	England and Wales (floods between 1993 and 2006)	Long-term analysis of mortality registrations between 1993 and 2006. Compared postcodes that have been directly flooded, those unaffected and those adjacent to flooding. Considered the conditions of infectious	<ul style="list-style-type: none"> ▪ Prevalence of health impacts ▪ Association with flood characteristics ▪ Duration of health impacts 	<p>Considered the mortality figures in the year before versus the year after the flooding, considering distance bands around the flood zone. Also, considered expected versus observed deaths. Both of these indicated a reduction in mortality in the year following an event,</p>	<p>Highlights the complexity of the issue, although the results are counter-intuitive and contrary to other survey based studies. However, this study is only analysing change in mortality</p>

			disease, cardiovascular disease, respiratory disease, mental illness and others.		when compared with the data from the year before it. Results seem counter-intuitive, primarily because of the unexpected apparent 'reduction' in mortality in the year following flooding. Some limitations of the study include that flood severity could not be identified separately and analysis was carried out by postcode, not by individual. Therefore, it is not certain whether individuals were affected by flooding. This would mean that it would not capture individuals who have been evacuated and moved outside of the area. The results may also indicate the additional support that flood victims may receive.	rates and there may be individuals with significant health concerns caused or made worse by the flooding. These may have significant impacts on that individual's life but that does not lead to death or a fatality within the following 12 months.
Milojevic and others (2017)	Mental health impacts (use of antidepressants)	Various locations in England, examining floods in 2011 to 2014	Analysis of prescription records from GP practice data in areas in the vicinity of flood events in England (2011 to 2014). Considered floods where more than 500 properties were affected (2013 north- east tidal surge, the east coast tidal event, the east Midland tidal surge, the east of England tidal surge and the south-west floods in winter 2013 to 2014) and targeted GP	<ul style="list-style-type: none"> Prevalence of health impacts 	Highlights an increase in the prescription of antidepressants in the 12 months following a flood event; although the numbers are relatively small (0.4% to 1% increase for those within 1 km of a flooded area), the numbers of registered patients flooded is also very low (estimation of only 0.5% of postcodes within 5 km of the flood outline would have been impacted). Only practice level data is available, which the authors	Provides an alternative to studies based on post-event questionnaires which may be subject to responder bias or lack of baseline data. Worth comparing this different approach as corroborative evidence.

			practices (930) using the flood outline maps. Monthly prescriptions for antidepressants were compared in the 12 months before and after flooding and arranged by the distance of the GP from the flood outline.		suggest may reduce the impact on the results, because the number affected by flooding would be small compared with the total number of households served by a practice. This limits the extent to which the observed change in numbers of antidepressants prescribed reflects the recent flood event.	
Norris and others (2001a); Norris and others (2001b)	Mental health	Various floods and geographical locations	Analysis of empirical literature.	<ul style="list-style-type: none"> ▪ Prevalence of health impacts ▪ Type and severity of health impacts 	Most of those affected will experience some symptoms, and up to a third of all affected will be severely impacted, suffering from one or more of severe stress symptoms, which, the authors argue, can lead to lasting PTSD, anxiety disorders or depression. Severe stress symptoms include disassociation, intrusive re-experiencing, extreme emotional numbing, hyper arousal, severe anxiety and severe depression. The authors highlight that most survivors of disasters will experience some less severe stress-related symptoms for several days.	Some general evidence of interest about different variables.
Norris and others (2002)	Mental health impacts (PTSD)	Mixed study considering PTSD impacts due to flooding in Poland and hurricanes in	A sample (285 people) of those with symptoms of PTSD in Poland were considered using (30-item revised civilian Mississippi Scale) at different points	<ul style="list-style-type: none"> ▪ Duration of health impacts ▪ Association with socio-demographic characteristics 	Symptoms of PTSD increased as the level of trauma increased and level of education decreased. Women reported more symptoms, while older people demonstrated being most distressed.	Some evidence of link between PTSD severity and socio-demographic characteristics.

		Mexico and US: Polish Floods 1997	after the flood (6 to 12 months). Concentrated on age/gender as variables.			Also highlights symptoms still occur and last after the event. But the study only considered symptoms up to 12 months after the event. The mixed nature of this study makes it difficult to compare with other studies.
Norris and others (2004)	Mental health impacts (PTSD and major depressive disorder, MDD)	Mexico 1999	Interview-based approach (561 people) assessed 4 times (at 6 monthly intervals) after the floods, and considered mental health impacts over time.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Duration of health impacts 	24% of respondents at the 2 sites were reported as having PTS symptoms. Over time, these symptoms initially decreased, but then stabilised around 18 months after the flood. The authors argue that in about a third of cases if recovery is not achieved after 18 months, symptoms are likely to become chronic. For many, recovery was achieved after 12 months.	Despite the different context, this is one of the only studies to consider the impacts over time. Therefore, it is important to consider the pattern, even if the specific values are not transferable.
Norris and others (2001a) Reported in Tapsell and others (2009)	Impacts of disasters on mental health	Various	80 different mixed disasters.	<ul style="list-style-type: none"> ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics 	Presence or absence of pre-disaster health symptoms are the best possible predictors of post-disaster symptoms - those with greater health symptoms before the flooding were more significantly affected than those with fewer health problems. This means that areas with a higher prevalence of people suffering from physiological health issues before an event	Provides some evidence of the consistency of negative impacts – but a combination of data sets.

					are more vulnerable to physiological health impacts after an event.	
Ogden (2001)	Mainly physical impacts	SE Louisiana, 1995	Survey of hospitals in disaster-affected areas – looked at number of patient visits. Compared visits, before, during and after the impact.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts 	Increase in the number of people presenting with injuries (during and after the event) in those hospitals not affected or moderately impacted, but a reduction in those hospitals severely impacted. Other conditions do not suggest an increase.	Data generally not transferable due to the differing health care situation and the severity of the flooding experienced.
Okafor and Hill (2015)	Physical and mental health impacts considered	Katrina, US 2005	Retrospective electronic health record review of Katrina evacuees, identified. The study included patient visits between August 2005 and August 2006 taken from Houston Fire Department's (HFD) data on emergency calls. There were 815 Katrina evacuees, with 1,354 patient visits. Study limitations include selection bias due to HFD run call data not capturing the most unwell, and a lack of sensitivity analysis.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics ▪ Association with flood characteristics 	The most common diagnoses among the visits of Katrina evacuees included chronic conditions: hypertension (6.4%) and diabetes mellitus (2.3%). Non-chronic conditions, including headaches (2.7%), back pain (2.2%), chest pain (2.0%) and abdominal pain (1.9%) were in the top 6 individual diagnoses. The main diagnoses of the evacuees examined were considered to be different from the main diagnoses reported nationally. The following were leading diagnoses among those evacuated: spinal disorders (5.4%), arthropathies and related disorders (3.1%), contusions with intact skin surface (2.9%) and headache (2.7%).	Context and severity of the event makes this not transferable – not clear if the impacts were due to the hurricane or flooding.

Paranjothy and others (2011)	Mental health impacts (psychological distress, anxiety, depression, PTSD)	South Yorkshire and Worcestershire, UK in summer 2007	Qualitative population-based survey (2,166 people) to identify prevalence of risk factors. Using health questionnaires and indexes to compare individuals who were flooded and those not flooded.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics ▪ Association with flood characteristics 	Prevalence of each of the 4 health symptoms was significantly higher for those who reported floodwater in their home, than those who were not flooded: psychological distress (69%), probable anxiety (48%), probable depression (43%) and probable PTSD (22%). Association was seen for the following variables between all mental health measures: concern that the floods would affect people's health (OR = 3.0), perception of an adverse impact on finances (OR = 1.8), disruption to essential services (OR = 1.8). Finally, there was an association between evacuation and psychological distress (OR = 1.7).	Useful for comparison with the PHE results – data from an earlier English flood.
Phifer (1990)	Mainly mental health impacts and general health and wellbeing – increases in symptoms considered.	Kentucky, US in 1984	Cohort study (200 people - all over 55 years old) of residents before and 18 months after flooding. Considered various socio-demographic characteristics. Used various standard and revised health questionnaires.	<ul style="list-style-type: none"> ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics ▪ Duration of health impacts 	Study reports similar pre-flooding symptoms for those later affected and unaffected by flooding. Flood impacted on anxiety, depression and physical symptoms when measured after the flood. Associated variables included: male, local occupational status and age group of 55 to 64 years. Socio-demographic factors didn't increase risk of physical health deteriorating after the flood.	Not useable – flooding in a different context and passage of time since the event.

Price (1978)	Physical and mental health impacts (general health)	Brisbane floods in 1974	Comparative survey of flooded (246) and non-flooded (507) households immediately following and again one year after the floods. Considered various socio-demographic characteristics and considered people's health before and after flooding, and compared with controls.	<ul style="list-style-type: none"> ▪ Association with socio-demographic characteristics 	Greater numbers of respondents claimed that their health had deteriorated in the year following the flood (except those over 75), although GP visits did not really increase. Females under 65 had greater psychological impacts than males. The study suggests that this was because males were more likely to be working and not confronted with the flood damage in the same way as females and retired people. Survey highlighted that flood impact increased for those 35 and older, which author suggests relates to being a home owner.	Not useable – flooding in a different context and passage of time since the event.
Reacher and others (2004)	Physical and (general) mental health impacts	Lewes, UK in 2000	Retrospective cohort study. 9 months after the flooding. Telephone interviews with those whose homes were flooded (227 people) as well as those from the same area who were not affected (240 people – control group)	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts 	Those who are flooded have a 4 times higher risk of psychological distress than those not exposed to flooding. Suggests it is difficult to identify in advance who may be impacted. Flooding associated with a significant increased (1.7 times) risk of gastroenteritis related to the depth of flooding.	Is useful to put the PHE (2017) data in context, but this paper has a general condition of psychological distress.
Rhodes and others (2010)	Physical and mental health impacts considered	Katrina, US 2005 (focused on a particular group of community college students in	Focused on low income parents. Followed a group (392 people) for more than a year before the hurricane to 18 months afterwards who were living in Katrina affected areas.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics 	General mental health outcomes worsened significantly from before to after the hurricane, with the prevalence of mild to moderate or serious mental illness, increasing from 23.7% to 37.5% (with probable serious mental illness doubling from	Is one of the only data sets that follows participants before and for some time (18 months) afterwards. However, the study focused on one particular

		New Orleans)	The data before and after the hurricane allows the change in physical and mental health over time and mitigating factors to be assessed. Used diagnostic questionnaire surveys to measure mood and anxiety disorders, perceived stress and PTSD. It also used scales to measure physical health and counted the number of conditions diagnosed.	<ul style="list-style-type: none"> ▪ Association with flood characteristics ▪ Duration of health impact ▪ Presence/absence of mitigating factors 	6.9% to 14.3%). Prevalence of high perceived stress also increased from 20.2% to 30.9%. There is no comparison of PTSD before and after the hurricane. However, at the time of the post-Katrina survey, 47.7% of participants were classified as having probable PTSD. This is higher than other reported rates, but the authors discuss this may be related to the particular characteristics of the sampled group. Data highlights a relationship between all mental health outcomes and the number of 8 pre-defined hurricane-related stressors (including no fresh water, felt in danger, lacked knowledge about safety of family/children lacking medication). PTSD was associated with property damage experienced.	demographic group (mainly, single, low income African American females, therefore transferability of results is limited.
Sastry and Gregory (2013)	Physical and mental health impacts considered	Katrina, New Orleans, US 2005	Used data from the American Community Survey (ACS) to compare the rates of disability in the Katrina population of New Orleans before (3,525 people) and after (2,784 people) the hurricane. This included those who had moved away after the hurricane.	<ul style="list-style-type: none"> ▪ Type and severity of health impacts ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics ▪ Association with flood characteristics 	Within the New Orleans population there were statistically significant increases before and after the disaster in physical impairment (from 14.1% to 16.3%), mental impairment (from 5.8% to 8.5%) and overall disability (from 20.6% to 24.6%). "This increase in disability reflected a large rise in mental impairments and, to a	Had a more general and representative sample than many of the other targeted investigations of the health impacts of Hurricane Katrina. But limited transferability of results.

			Survey questions for disability were based on the standard International Classification of Functioning, Disability and Health and also socio-demographic information.	<ul style="list-style-type: none"> ▪ Duration of health impact ▪ Presence/absence of mitigating factors 	lesser extent, in physical impairments. These increases were, in turn, concentrated among young and middle-aged black females" (p8).	
Schnitzler and others (2002)	Physical impacts: diarrhoea and/or injury	Saxony flood 2002 Risk factors for health	Qualitative survey: Random survey of 477 people flooded in 42 Saxony communities. Included an analysis of onset of diarrhoea or injury during or immediately after flood. Analysis of exposures associated with onset of diarrhoea or injury.	<ul style="list-style-type: none"> ▪ Prevalence of health impacts ▪ Type and severity of health impacts ▪ Association with socio-demographic characteristics 	6.9% had diarrhoea during or shortly after the flood, whereas 11.7% had injuries. Variables linked to onset of diarrhoea where contact with the flood waters (OR = 5.8), being female (OR = 3.9) and having a private water supply (OR = 3.5). Similarly, those variables of significance for the risk of injuries included skin contact with flood waters (OR = 17.8).	Provides some prevalence data for gastrointestinal health impacts and injuries and those variables that increase the likelihood of suffering these symptoms.
Steinfuhrer and Kuhlicke (2007)	Physical and mental health	Mulde River, Germany 2002	404 households in 5 locations of Mulde river. Broad question on psychological and physical health effects. Survey collected 3 years after the flood.	<ul style="list-style-type: none"> ▪ Association between health impacts and socio-demographic characteristics 	Over 60 years of age more likely to self-evaluate the risk of both psychological and physical health impacts as being 'very bad'. Not significant: home tenure, gender, location	Self-reported survey carried out 3 years after the flood and may introduce recall bias through inaccurate or incomplete recollection of past experiences.
Strelau and others (2005)	Mainly mental health impacts (PTSD), but threat to life and injuries also included	Mixed study with a range of disasters - Poland floods 1997 and 2001	Mix of studies with slightly different methods. Four flood related with a total of 1,041 respondents. PTSD symptoms measured at different points after the flood using different medical scales, examining	<ul style="list-style-type: none"> ▪ Prevalence of health impacts ▪ Duration of health impacts 	PTS scores decreased between a few weeks to 2 years after the event. For all time points (3 months, 15 months or 3 years after flooding) trauma and emotional reactivity were the strongest predictors of intensity of PTS symptoms experienced	Provides some indication of the longer-term (up to 3 years) duration of health impacts.

			how scores varied over time. Also, considered other consequences (financial, housing, socio-economic status).		during the flood. At 3 years after the floods emotional reactivity and prolonged consequences of trauma became the most essential predictors of PTSD. The interaction between these variables explained the variance of post-traumatic stress symptoms.	
Tapsell and others (2002)	Physical and mental health impacts	NE England – June 2000	Qualitative approach: focus groups 4 months after the flood, reported impacts – used social flood vulnerability index (SFVI), (age, lone parents and pre-existing health problems and 4 financial indicators: non-home owners, unemployed, non-car owners and overcrowding).	<ul style="list-style-type: none"> Type and severity of health impacts Association with socio-demographic characteristics 	Those health impacts reported were quite broad: blood disorder; chest infections /asthma /coughs /colds /flu /pleurisy; kidney infection; diarrhoea/ vomiting/ upset stomachs; headaches; high blood pressure; skin irritations/rashes/spots; panic attacks; swollen glands; throat and ear infections /laryngitis; viral infections. Suggests a link with affluence using the SFVI, but insufficient evidence.	Provides indication of the types of health impacts experienced in England and Wales and variables that impact them. However, no data on prevalence or duration of impacts.
Tapsell and others (1999)	Physical and mental health impacts	Not event specific	Draws on a range of existing research.	<ul style="list-style-type: none"> Association with socio-demographic characteristics Presence/absence of mitigating factors 	Provides a conceptual model of the links between flooding and its consequences and the resultant impacts on human health.	Provides some useful contextual information that may be relevant for assessment but only for broad understanding.
Tunstall and others (2006)	Physical and mental health impacts	Floods in England and Wales (1998 to 2002) – 30 locations	Qualitative survey of those flooded (983 people) versus those not flooded (527 people) (total number - 1510). Used self-reported health check list and general health	<ul style="list-style-type: none"> Prevalence of health impacts Type and severity of health impacts Association with socio-demographic characteristics 	25% of survey respondents reported a reduction in mental health. Of physical conditions: 10% gastrointestinal illness; 9% joint stiffness; 8% respiratory illnesses; 7% high blood pressure and 6% skin	Useful to compare with the results of the PHE study.

			questionnaires as well as the post-traumatic stress scale. Used predictors of age, gender and socio-economic variables.	<ul style="list-style-type: none"> ▪ Presence/absence of mitigating factors 	<p>conditions. Therefore, psychological impacts were more common than physical health impacts. 15% had mild to moderate PTS; 10 individuals reported high and 4 extreme results.</p> <p>For a deterioration in psychological health (GHQ12 scores) significant differences observed between flooded and non-flooded for: age (except 60+yrs), gender (female), social class, length of residence and also for gender and age when considering the national average GHQ-12 scores.</p>	
Verger et al (2003)	Mental health impacts	1992, SE France	Retrospective cross-sectional study carried out in 1997 (5 years after the flood). Telephone survey (500 people) with a mix of demographic, stressor and experience-based questions and a diagnostic tool to measure PTSD.	<ul style="list-style-type: none"> ▪ Type and severity of health impact ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics 	6.2% (31) respondents reported seeking flood-related medical treatment for physical conditions (traumas, fractures and wounds: 7 people; otorhinolaryngological (ENT) respiratory, or digestive disorders: 17 people; skin disorders: 4 people and cardiac: 6 people) - 2 of those reported being hospitalised).	No clear reference to the prevalence of those with PTSD post flood. Performs statistical analysis to identify the most significant primary and secondary stressors, but these are too complex to identify in advance and inform project appraisal.
Wade and others (2004)	Physical	Flooding in mid-west USA 2001	Prospective longitudinal cohort study (1,110 people, 143 of whom reported direct or indirect (clean up) contact with flood waters.	<ul style="list-style-type: none"> ▪ Type and severity of health impact ▪ Prevalence of health impacts ▪ Association with socio-demographic characteristics 	Increased rates (1.29 times) of gastrointestinal symptoms and diarrhoea during the flood. Rates after the flood were not significantly different.	

				<ul style="list-style-type: none"> Association with flood characteristics 	The main factor was the contact with the flood waters and some relationships with age.	
Wang and others (2007; 2008); Galea and others (2007)	Mental health impacts	Katrina, US 2005	Telephone survey carried out early 2006 with 1,043 people, approximately 6 months after the event. Suggests a representative geographical sample of English speakers. Used diagnostic questionnaires to consider psychological distress (mood and anxiety disorders). Also, considered use of mental health services and medication.	<ul style="list-style-type: none"> Type and severity of health impacts Prevalence of health impacts Association with socio-demographic characteristics Association with flood characteristics 	<p>31% of the sample met the score for having a mood or anxiety disorder (in 30 days before the interview); 11% of respondents with having seriously impairing mood or anxiety and 20% with having mild to moderate anxiety disorder.</p> <p>Treatment: 9% (of all 1,043 respondents) sought only pharmacotherapy, 4% sought only psychotherapy alone and 3% pharmacotherapy plus psychotherapy. Of those 11% of respondents who were using medication following Hurricane Katrina the following drugs were used: antidepressants (60%), benzodiazepines (30%), mood stabilizers (6%), nonbenzodiazepine hypnotics (5%), and antipsychotics (3%).</p>	Gives some comparative data on prevalence and severity, but the context and scale of impact is relatively incomparable. Similarly, it would be difficult to directly compare health care access and medicine use from a different health system context.
WHO (2013)	Physical and mental health (importantly also considers mortality)	Not event specific	Draws on existing research and a variety of examples.	<ul style="list-style-type: none"> Association with socio-demographic characteristics Presence/absence of mitigating factors 	Identifies 10 factors that increase vulnerability to health impacts: limited physical capacity; limited mobility; reliance on medication; reliance on regular home care, reliance on regular care at a health facility; weak social networks, poor flood awareness; lack of	Although useful for context, it is rather general and can therefore only provide some basic background contextual information about the types of impacts that might be considered,

					resources for resilience and response; little access to public guidance and guidance and high-risk build environment. As such, they identify the following groups as being more vulnerable to health effects: elderly, children, people with chronic conditions or disabilities or who rely on home care, substance misusers, homeless or live alone, ethnic minorities, rural inhabitants, low income and tourists.	and potential groups to target.
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