

APPENDIX A: SUPPORTING DATASETS

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A.1 Hazard: Coastal, fluvial, surface water and groundwater flooding

The input data sets relating to present and, where available, future coastal, fluvial, surface water and groundwater hazards are summarised in Table A1-1 together with the supporting ancillary data in Table A1-2.

Table A1-1 Hazard data: All sources of flooding

Flood Hazard Data				
Country	Fluvial	Coastal	Surface Water	Groundwater
England	<p><i>Including the performance of defences:</i> State of the Nation – Environment Agency Product: Risk of Flooding from Rivers and the Sea – Detailed (50m resolution). March 2018</p> <p><i>Excluding defences:</i> England Flood Risk Map for Planning (Flood Zones) for 0.1% (FZ 3), 1% (FZ 2). January 2019</p> <p>Note: FZ3 plus a buffer of 100m fluvial and 500m coast used to define the floodplain with a notional 1in5000 return period assigned.</p>		<p>As used in CCRA2 (Sayers et al, 2015) based on uFMfSW (updated Flood Map for Surface Water), 2m resolution grid for 0.1%, 1% and 3.3% probabilities.</p> <p>Note: 1in1000 year used to define the limit of the floodplain</p>	<p>From CCRA2 (Sayers et al, 2015) based on BGS groundwater susceptibility map (MacDonald et al, 2008)</p>
Wales	<p>National Flood Risk Assessment (Natural Resources Wales). Resolution 2m resampled to 20m (Received February 2019).</p> <p><i>Excluding defences:</i> All three sources for six present day return periods, 10, 30, 75, 100, 200, 1000 years (20m resolution)</p> <p>Note: The 1in1000 with climate change (upper) used to define the floodplain (assumed notionally to be 1in5000)</p>			As above
Scotland	<p>SEPA national fluvial flood maps (April 2018). Variable resolution: 5m/10m/20m</p> <p><i>Including defences</i> Assumed to perform perfectly to their standard of protection - 10, 30, 50, 100, 200 and 1000 year return period and 200 year plus climate change by 2080</p> <p><i>Excluding defences</i> 1in1000 year (note that defences that feature in the underlying DTM have not been removed as part of the SEPA analysis)</p>	<p>SEPA national coastal map (February 2019) Variable resolution: 5m/10m/20m</p> <p><i>Including defences</i> Excluding the influence of waves, and defences assumed to perform perfectly to their standard of protection - 10, 30, 50, 100, 200 and 1000 year return period.</p> <p><i>Excluding defences</i> The 1in10000 still water level (present day) is used to define the limit</p>	<p>SEPA national and regional surface water studies (regional analysis used where available). Resolution variable. Return periods available variable 10, 30, 50, 100 and 200 year. Assumed drainage capacity of 1in5 years (for regional analysis) and 12mm/hr (national analysis).</p> <p>Note: Here adaptation influences present day drainage from a baseline of 12mm/yr</p>	As above

	Note: The 1in1000 undefended plus a buffer of 100m is used to define the limit of the floodplain (notional return period of 1in5000)	of the undefended floodplain	Note: 1in200 is assumed to define the surface water boundary extent	
Northern Ireland	<p>Flood Maps (NI) - Floodplain Rivers - Premium (LPS / Dfl Rivers - Flooding: Product 5).</p> <p><i>Including defences</i></p> <p>Assumed to perform perfectly - Present day 2,5,10,25,50,75,100,200 and 1000 return period flows; Climate Change 100 yr return period flow (19th Dec 2018)</p> <p><i>Excluding defences</i></p> <p>Undefended flood map, extent for 1in100 year return period (present day)</p> <p>Note: The 1in100 undefended is used to define the limit of the floodplain</p>	<p>Flood Maps (NI) – Floodplain Tidal – Premium (LPS / Dfl Rivers Flooding: Product 6).</p> <p><i>Including defences</i></p> <p>Assumed to perform perfectly - Present day 10,50,75,100, 200 and 1000 return period flows; Climate change 200 yr return period (19th Dec 2018)</p> <p><i>Excluding defences</i></p> <p>Undefended flood map, extent for 1in200 year return period (present day)</p> <p>Note: The 1in200 undefended is used to define the limit of the floodplain</p>	<p>Flood Maps (NI) – Surface Water (LPS / Dfl Rivers Flooding Product 3).</p> <p>Contains All NI - I200, I200CC, depths and extents. With I30 + I1000 data added to Product. (19th Dec 2018)</p> <p>Note: The 1in1000 present day is used to define the limit of flood extent</p>	As in CCRA2 (Sayers et al, 2015)

Table A1-2 Ancillary data

Ancillary data		
Country	River and Coastal Assets	River centreline and coastline
England	<p>Continuous Defence Line (CDL), March 2018:</p> <ul style="list-style-type: none"> • Location • Condition Grade • Standard of Protection • RASP Type 	Embedded in CDL (so no longer used here)
Wales	<p>Data extracted from AMX by Chris Powell 29th November 2018.</p> <ul style="list-style-type: none"> • Location • Condition Grade • Standard of Protection • RASP Type 	Via the NRW Ordnance survey Mastermap
Scotland	<p><i>Inland (river) defences:</i> From SEPA – January 2019 and infilled as necessary using the CCRA2 datasets</p> <p>Coastal defences From Dynamic coast Scotland (July, 2018 type and location only) – Standards and condition from CCRA2 (based on SFDAD v1_1, February 2015)</p> <p><i>Spatial data</i></p> <ul style="list-style-type: none"> • Location • Condition Grade • Standard of Protection <p>SEPA highlight these data continue to evolve and has known inaccuracies but represents the best available and is assumed corrected here.</p>	<p>River centreline – (DRN for Scotland – as used in CCRA2 based on May 2015)</p> <p>Coastline (from dynamic coast - NCCA_SCOTLAND_MHWS_MODERN, Oct 2018 infilled with CCRA2 dataset based on OS MM Jan 2015)</p>
Northern Ireland	<p>Flood Defences from the asset register / database (March 2019)</p> <p><i>Spatial data</i></p> <ul style="list-style-type: none"> • Location • Condition Grade • Standard of Protection <p>Areas benefiting from defences (February 2019)</p>	<p>Enhanced River Centreline dataset (LPS / DfI Rivers Flooding Product 8) - Detailed River Network (received February 2019)</p> <p>Coastline (received February 2019)</p>

A.2 Property: Residential and non-residential

The datasets used to support the property-based risk metrics are listed in Table A2-1

Table A2-1 Property related metrics and data sources.

Data sources				
Type	England	Wales	Scotland	Northern Ireland
Property residential	National Receptor	National Receptor Dataset	Receptor data as used in 2018 NFRA	OSNI Fusion Largescale Buildings (Dec 2018) and POINTER datasets
Property non-residential	Dataset (as used in State of Nation 2018)	(NRD,2018 – draft final)	(based on OS address base plus) – 28 Nov 2018	
Proportion of basements	Probability of basements defined using Census datasets (Sayers, et al, 2017) Scotland: from Receptor datasets			
Economic damages residential	WAAD (Weighted Annual Average Damages) tables per property from Multi-Coloured Manual (MCM - September 2015) with an uplift to present day (using ONS GDP growth) and to account for basements (1.5 * probability of being present)			
Economic damages non-residential	Floor areas from footprint in OS Mastermap/OSNI Large Scale Vector WAAD tables per unit floor area from MCM (September 2015) with an uplift to present day (2019).			
In-direct and intangible economic damages	<p>Indirect damages are assumed 70% of the direct residential damages, disaggregated as follows: 11% uplift to account for indirect losses associated with emergency services and provision of temporary accommodation (applied to residential losses only); 16% uplift to account for indirect losses for risk to life and physical injury; 43% uplift to account for indirect losses for impacts on infrastructure, transport, schools and leisure. This value is broadly confirmed by a review of the winter 2015 and 2016 floods by the Environment Agency (2018) that infers the following contributions:</p> <ul style="list-style-type: none"> • Temporary accommodation (the costs of temporary accommodation) – 3% • Vehicle damage (physical damage to vehicles) – 3% • Loss of life and physical injury – 15% (based on 2007 floods) • Emergency services (additional costs (for example, overtime) incurred by the emergency services (fire, police and ambulance services) – 0.5% • Local authorities (damages to public buildings, public spaces and additional costs faced by local authorities such as recovery grants) – 10% • Transport (costs of repairs and induced losses from disrupted journeys for road and rail) – 20% • Utilities (costs for repairs and induced losses caused by loss and/or interrupted utility services for water and electricity) – 5% • Flood risk management infrastructure and service (cost of repairs to flood defence assets and additional service costs including staff and contractor overtime and materials) – Not included here • Other including tourism, heritage and wildlife sites: damage to physical assets and, where possible to determine, indirect impacts on the wider economy – 5% <p>Intangible damages are considered here to refer to mental health impacts, assessed through a proxy of the additional costs associated treatment and the economic impact of absenteeism from work etc. The uplift applied is 20% of direct (residential) damages.</p>			

A.3 People (present and future projections): Number, vulnerability and household occupancy

The datasets used to support the people-based risk metrics are listed in Table A3-1

Table A3-1 People related metrics and data sources

Metric	Data sources			
	England	Wales	Scotland	Northern Ireland
Population distribution	<p><i>Present day:</i> Census 2011</p> <p><i>Future:</i> UK, country and local authority areas based on data by Cambridge Econometrics (2019) for the CCC, from the ONS population projections (2016). Providing yearly projections for alternative projections. Received February 2019.</p>			
Household occupancy	<p><i>Present day:</i> Variation at a neighbourhood scale based on 2011 Census (household size)</p> <p><i>Future: Modification from present day</i> based on data from Cambridge Econometrics (2019) for the CCC, derived from the ONS population projections (2016). Received February 2019. Implemented here as multiplier to the neighbourhood Census 2011 occupancy.</p>			
Social vulnerability	<p>Neighbourhood Flood Vulnerability Index, 2016 (Sayers et al, 2016, as used in the analysis for the JRF, Lower Super Output Areas in England, Wales and Northern Ireland and Data Zones in Scotland, based on the 2011 census). This remains unchanged with time for the analysis here.</p>			

A.4 Natural capital

The sources of the data used to determine the location of Special Protection Areas (SPA), Special Areas of Conservation (SAC) and Ramsar sites are summarised in the below. These locations and extents are all assumed unchanged with time.

Table A4-1 Natural environment data

Focus	Description
Special Protection Areas (SPAs)	For England and Wales as used in CCRA2 Downloaded from Joint Nature Conservation Council (JNCC) - 17/11/2014. For Scotland downloaded from https://gateway.snh.gov.uk/natural-spaces/ 20/6/2019 For Northern Ireland downloaded from Open Data NI – 24/02/2019.
Special Areas of Conservation (SACs)	For England and Wales as used in CCRA2 downloaded from Joint Nature Conservation Council (JNCC) - 17/11/2014. For Scotland downloaded from https://gateway.snh.gov.uk/natural-spaces/ 20/6/2019 For Northern Ireland downloaded from Open Data NI – 24/02/2019.
Ramsar	For England and Wales as used in CCRA2 downloaded from Joint Nature Conservation Council (JNCC) - 02/01/2015. For Scotland downloaded from https://gateway.snh.gov.uk/natural-spaces/ 20/6/2019 For Northern Ireland downloaded from Open Data NI – 24/02/2019.

A.5 Agriculture

The sources of data used to determine the location of the Best and Most Versatile Land (BMV) and Not-Best and Most Versatile land are unchanged from the CCRA2 (Sayers et al, 2015) and are follows:

- **England** – the Strategic Land Cover Map developed by Natural England, where ‘best and most versatile’ agricultural land taken as ALC Grades 1, 2 and 3a.
- **Wales** - DEFRA’s Agricultural Land Classification (ALC), 1988 is used, with Grades 1-3 used to identified BMV land (Grade 3a is also included in BMV description but this is not included in the ALC, hence Grades 1-3 will be used)
- **Scotland** - the Macaulay Land Use Research Institute’s Land Capability Classification for Agriculture is used (based upon the ALC 1981 and LCM2007), with Classes 1-3 (including 3.1) identified as BMV land.¹
- **Northern Ireland** – the Agri-Food and Biosciences Institute agricultural land classification map is used with classes 2 and 3A identified as BMV (there is no class 1 land in Northern Ireland).

These are assumed unchanged into the future.

Note:

Extensive areas of the UK agricultural land has subsurface field drains (tiles or pipes) to improve drainage. These are not typically accounted for in the surface flood assessments (in any detail).

Further discussion of these classes can be found in Sayers et al, 2015 – Appendix F (Annex B).

¹ We note that JHI are developing a future LCA layer based on the UKCP18 climate projections (contact Mike Rivington) – this update has not been considered here

A.6 Infrastructure networks and systems

The data sources used to support ‘important infrastructure’ risk metrics are listed below.

A.6.1 -Infrastructure risk metrics and data sources

Metric	Basic description	Data sources			
		England	Wales	Scotland	Northern Ireland
Water	Water distribution	As CCRA2 – based on Clean water treatment works (OS MasterMap, downloaded 2014)	As in CCRA2- based on NRD 2014	As in CCRA2 Based on Scottish Property Data Set (SPDS) ²	As CCRA2 – based on NIW Corporate Asset Register (CAR) - List of Facilities (15/12/2014) ³
	Wastewater treatment (major sites only)	As CCRA2 based on Wastewater treatment works (estimated from Environment Agency licenced discharge consent dataset by ASC, 2014)			
Energy	Power stations (generation)	Power stations as geo-coded for CCRA1, Ramsbottom et al, 2010		As in CCRA2 Based on Scottish Property Data Set (SPDS) ²	As CCRA2 – based on Northern Ireland Electricity dataset
	Sub-stations (transmission/distribution) (major sites only > 5000 customers – notionally)	Distribution substations: from Energy Network Association (minimum 5000 customers) (as CCRA2, Sayers et al 2015)			
Transport	Railway stations and length (km) of major roads and railway track	Roadways from NRD, with ‘major’ defined (SoN 2018). As CCRA2 From Network Rail	As England	A dataset provided by SEPA: Rail data from network rail and the OS. Roads data from transport Scotland	Acquired 24/2/2019 from OpenDataNI portal
Waste:	Operational (and licenced) landfill sites)	As CCRA2 - From Environment Agency datashare ‘Permitted Waste Sites - Authorised Landfill Site Boundaries’ – 2015 (current only used)		As CCRA2 - From the Repomaster_SV_Landfill_Sites_Operational dataset provided by SEPA. (dated 2011). (current only)	Acquired 24/2/2019 from OpenDataNI portal (current, authorised, only)

² SEPA have noted that this dataset is known to be incomplete/not suitable to be used to identify individual infrastructure assets.

³ known to be incomplete

A.6.2 – Infrastructure networks and systems cont.

Metric	Basic description	Data sources			
		England	Wales	Scotland	Northern Ireland
Emergency Services	Blue light service stations (police, ambulance, fire stations)	Blue light services: As CCRA2 - OSMM: Emergency Services locations (October 2013)			Blue light services: Acquired 24/2/2019 from OpenDataNI portal
	Hospitals	Hospitals: As CCRA2 - Health and Social Care Information Centre (2012/13) – from CCC 2014		Hospitals: – 2018 NFRA receptors (Hospital)	Hospitals: Acquired 24/2/2019 from NINIS
Social support networks: Number of care homes, GP surgeries, and schools exposed to flooding (by flood probability band, reported separately)	Care Homes	As CCRA2 - Care Quality Commission: Registered care homes (November 2013) (downloaded 28/10/14 – England only)	From National Receptor Database (NRD), (2018)	2018 NFRA receptors Hospice Medical Care Accommodation	Acquired 24/2/2019 from the Regulation and Quality Improvement (RQIA) portal.
	GP surgeries	As CCRA2 - From Public Health England	From National Receptor Database (NRD), (2018)	2018 NFRA receptors	Acquired 24/2/2019 from OpenDataNI portal
	Schools	As CCRA2 - DfE: 2013 Performance Statistics Spine Data (School location), 2013 School census (number of pupils) (downloaded 29/9/14 – England Only)	From National Receptor Database (NRD), (2018)	2018 NFRA receptors Non-state and state (CE)	As CCRA2 As latest data 2016 on OpenDataNI portal

A.7 Spatial structure of reporting and analysis

Several spatial units are used in the analysis. This is set out below.

Data sources				
Unit	England	Wales	Scotland	Northern Ireland
Regions	River Basin Districts (England – cycle2)			
Local Authorities	Local_Authority_Districts_December_2015 as defined by ONS and used in the population projections by Cambridge Econometrics			As used in JRF, Sayers et al, 2016 – Council districts, 2016
Water companies	Water drainage boundaries (provided by the 21 st Century Drainage Project, 2018)		No further subdivision beyond country level	No further subdivision beyond country level
Flood source	Fluvial, coastal, surface water and groundwater – see earlier tables for sources.			
Settlement type	Settlement types are defined by ONS using a combination of metrics (as set out by Bibby and Brindley, 2013). UK wide categories approach as used in JRF, Sayers et al, 2016 and subsequently the NIC analysis, Sayers et al, 2018			
Economic setting	As used in JRF, cities in decline, Sayers et al, 2017			
Neighbourhoods	Lower super-output Area (2011 census)	Lower super-output Area (2011 census)	Data Zones (2011 Census)	Lower-super output areas (2011 Census)

A.8 Climate change

The sources of data used in determining future climates are set out in Table A8-1. The methods applied to these are set out in Appendix C.

Table A8-1 Sources of climate change data

Climate change indicator	England and Wales	Scotland	Northern Ireland
Coastal floods Changes in coastal overtopping as a function of relative sea level rise	New analysis here: based on probabilistic projections from UKCP18 then transferred through offshore to nearshore, nearshore to overtopping analysis to determine a change in overtopping rates and hence a change in standard of protection. For Scotland, Wales and Northern Ireland the response to local rSLR projections on overtopping have been developed using analogous responses from England. See Main Report for discussion. Data from England is used as proxy responses for elsewhere in the UK.		
Fluvial floods Changes in return period of extreme river levels as a function of changes in peak river flows	New analysis here: based on probabilistic projections from UKCP18 then translated through a hydrological analysis (at 1km grid) and local FEH analysis (50m) to determine the change in extreme water levels. See Main Report for discussion.		
Surface water floods Changes in intensity of short duration rainfall	Taken from a combination of sources – CCRA2 (UKWIR, 2015a&b) – updated with Dale et al, 2015 – Dale et al., 2017 and discussions. Note: UKCP18 2.2km outputs unavailable at time of writing and will not be used here. See Main Report for discussion.		
Groundwater floods Changes in groundwater flooding	As used in CCRA2- Sayers et al, 2015, based on BGS – Groundwater Susceptibility Model but updated with changes in fluvial flooding here.		

A.9 References

See Main Report