Informing

ABERDEEN ADAPTS

Evidence base

January 2020

Version 0.1	December 2019
Version 0.2	January 2020

Introduction

This evidence base aims to identify the impacts from climate change for Aberdeen. Many of the decisions we make now will have consequences for the future. Understanding how climate change will affect the city will help with managing these risks; it can inform decision-making and by gathering information on local adaptation actions already in place can be used to assess the actions and policy needed to strengthen resilience.

It is anticipated this will be a live document, with information developed as evidence and research becomes available and as national data on climate risks and projections is updated.

The changing climate

Observed changes

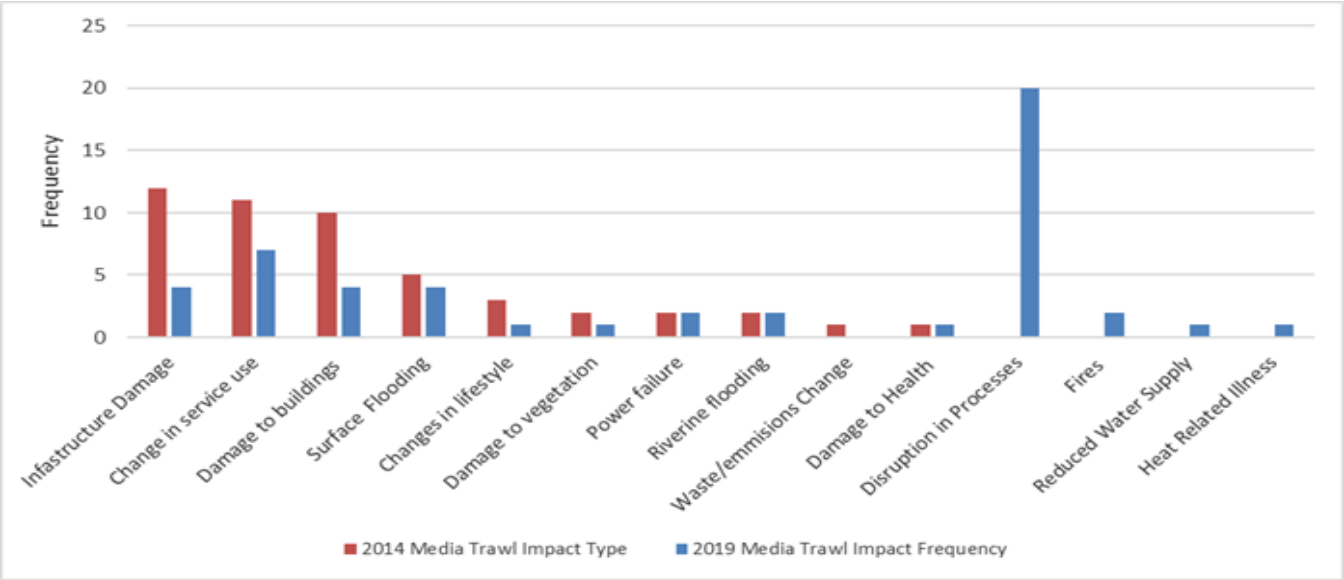
There are already signs of changes to the climate, sea level has been rising by about 3mm a year and increases in average global temperatures have accelerated to around 0.2ºC a decade in the last 25 years.

In Scotland, there is evidence of this trend. Temperature and rainfall increases have been observed over the last few decades and there has been a reduction in air and ground frost, as well as snow cover.[1]

The mean annual temperature in Scotland has increased for all seasons, in all regions, by at least 1°C. Average annual rainfall is up by 27% since 1961.

In Aberdeen trend data has shown temperature increases but less variability in annual average rainfall. A media trawl of the effects of weather in the city *(Figure 1)* reflects some of the changes in weather impacts over the last 10 years.

Figure 1 – Weather Impacts Aberdeen



About climate change

Climate refers to long term weather patterns, averaged over a period of time. While there is a natural climate variability, the influence of greenhouse gas emissions in the atmosphere is causing a more rapid change in climate and this will accelerate in the decades to come.
The impacts could include species extinction, risks to global and regional food security and in some areas, for parts of the year, high temperature and humidity could impact on normal human activities, such as growing food or working outdoors. [2]

Global agreements to reduce emissions aim to limit global warming to 1.5ºC but change will still happen. Even if greenhouse gas emissions were to stop tomorrow, past and present emissions in the atmosphere will continue to drive a change in climate for several decades.

What will climate change mean for Aberdeen?

The UK Climate Projections (UKCP18) [3] provide comprehensive data on future climate projections for the UK. Scenarios for the east of Scotland, indicate an increase in the frequency and severity of extreme weather events. For Aberdeen, this will mean warmer temperatures, wetter winters, drier summers, a rise in sea level and less snow ice and frost. Data for the east of Scotland* shows:

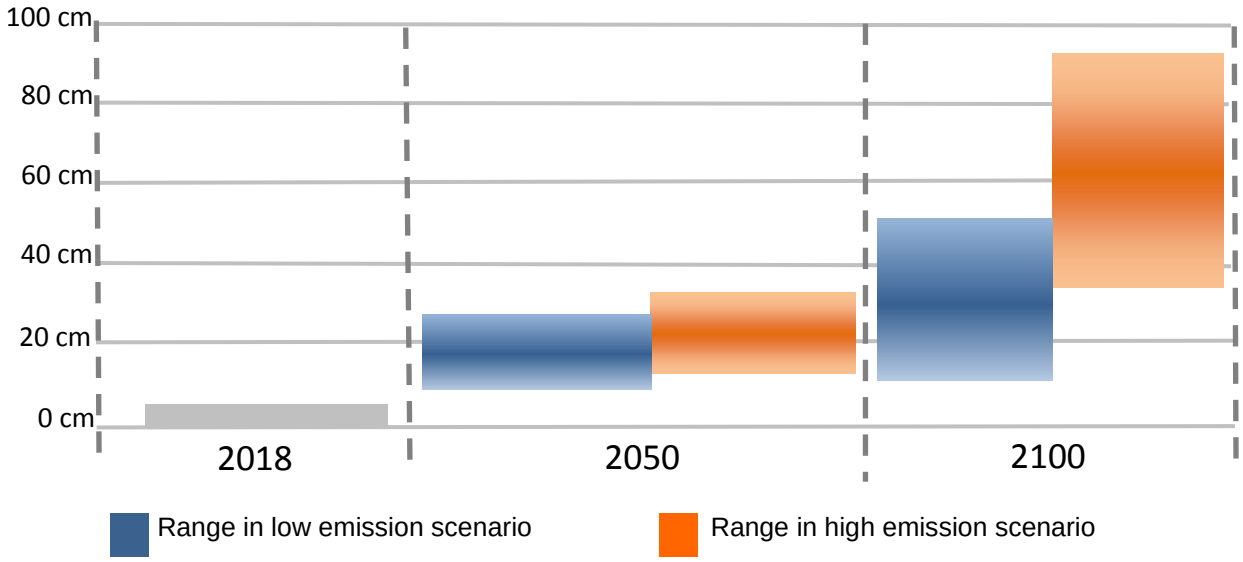
**This Evidence Base is a live document. Information on Climate Projections for the north east of Scotland will be updated regularly as more information becomes available.*

Rise in sea level

Sea level is gradually rising and this will rapidly accelerate in the coming decades. Change will happen under all emission scenarios. By the end of the century it is likely to be in the range of 0.32m to 0.92m under a **high emission scenario** and in the range of 0.11m to 0.52m under a **low emission scenario**. Alongside the risk of tidal surges and wave overtopping, this could cause flooding and erosion for coastal areas.

The National Coastal Change Assessment [4] has identified areas at risk of future erosion, highlighting a few small areas along Aberdeen's soft coastal areas, north of the River Don that may be susceptible to future erosion. A dynamic coastline is a natural process. However, coastal innundation has potential consequences for natural habitats and defences, such as the coastal dune ridge north of the River Don. Change in sedimentation pattern may lead to erosion at the coast or sedimentation processes in adjacent areas to existing coastal defences.

Figure 2: Projections for sea level rise at Aberdeen - by 2100



UKCP18 - mean estimates when compared to 1981–2000 (range 10% - 90% probability)

Temperature

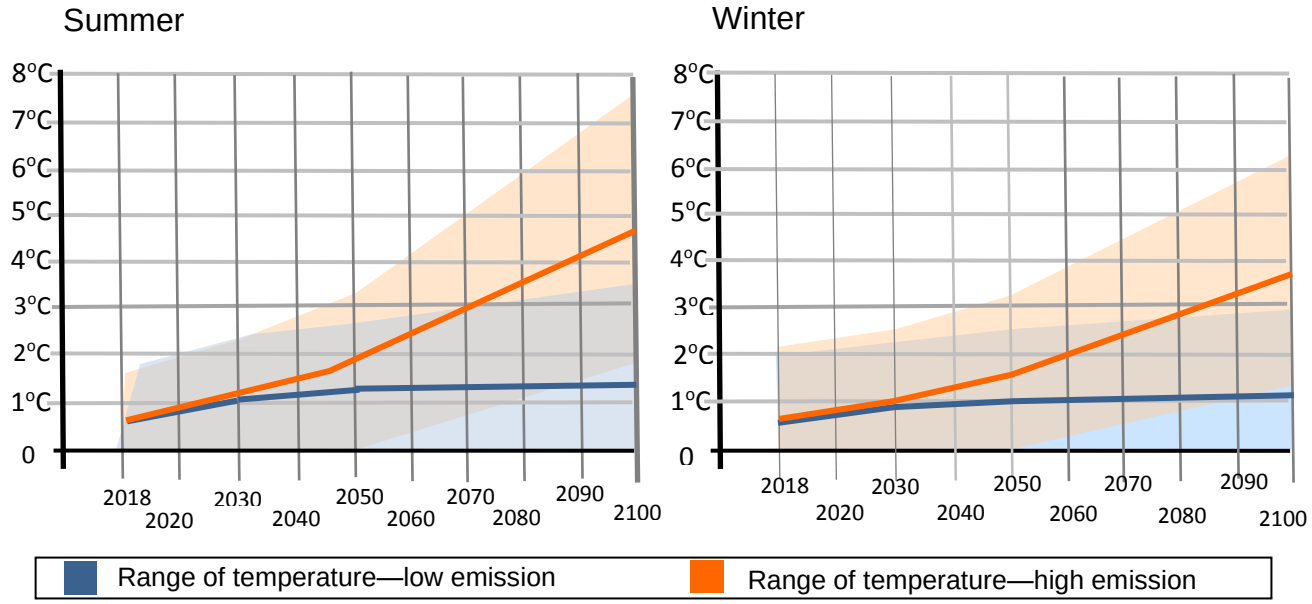
In the UK an increase in temperatures is projected across all seasons. Current average temperature for July in the north east coast of Scotland is 17ºC.

- By the end of the century an increase in **summer temperatures** for the north east of Scotland is likely.

low emission scenario	high emission scenario
-0.5ºC to 1.8ºC	*1.8ºC to 7.5ºC*

- For **winter temperatures** an increase in temperatures is likely. There will be less snow, ice and frost days, however the potential for an extreme snowfall event will remain. By 2100 projections indicate:

low emission scenario	high emission scenario
0.3 ºC to 4.1 ºC	*1.2 ºC to 6.2ºC*



Rainfall

There will be a **reduction** in **spring/ summer rainfall** which could affect water quality and availability in the long term.

There will be an **increase** in **autumn/winter rainfall.** This won't mean more rainy days, but when it does rain it will be much heavier, significantly increasing the risk of surface water, river and groundwater flooding.

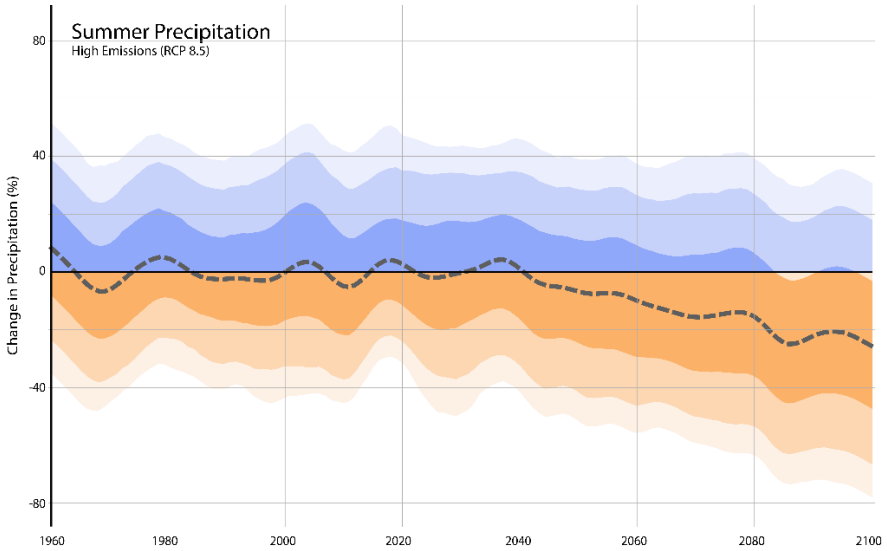
River levels - Average water levels for the **River Dee are 1.021m** and for the **River Don 1.196m**.

Peak flows *- SEPA records show that in December 2015 river levels on the River Dee reached the highest level at Garthdee of 6.195m following extreme rainfall. This caused widespread flooding and damage and hundreds of tonnes of riverbed and bank materials were washed out onto riverbanks and floodplains.*

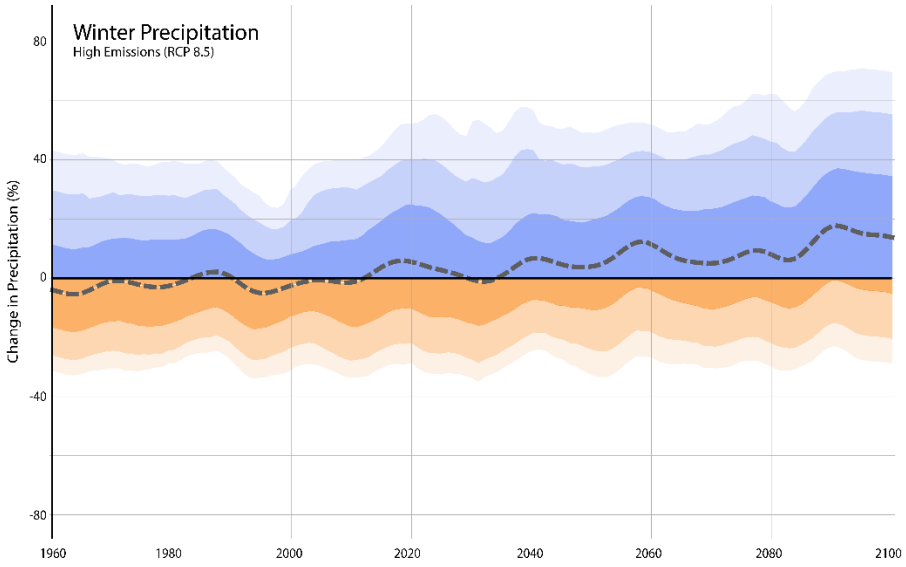
A highest level of 5.56m was recorded on the River Don during extreme weather events in January 2016 (Storm Frank), resulting in widespread damage and high volumes of debris.

Low flows *– The lowest water level on record at the Garthdee station is 0.531m. The River Dee is the main source of public drinking water, supplying around 300,000 homes in Aberdeen and Aberdeenshire. The River Dee is a Special Area of Conservation, it has good water quality and contains protected species of freshwater pearl mussel, Atlantic salmon and otter.*

Summer rainfall (high emission scenario) – north east Scotland



Winter rainfall (high emission scenario) – north east Scotland



Climate Hazard type - summary

Climate hazard type	Expected changes in intensity	Expected changes in frequency
Extreme heat	Increase	Increase
Extreme cold	Decrease	Decrease
Extreme rainfall	Increase	Increase
Floods	Increase	Increase
Sea level Rise	Increase	Increase
Droughts	Increase	Increase
Storms	Not known	Not known
Wildfire	Increase	Increase

Climate risks and implications for Aberdeen

The UK Climate Risk Assessment (CCRA) 2017 Evidence Report [5] sets out the risks from climate change that will need priority action over the next 5 years. This includes risk of: flooding and coastal change; water shortages; as well as risks to health, well-being and productivity from high temperatures; to nature and wildlife; and to food production and trade. The report includes a national summary for Scotland.

Information on risks and opportunities for Aberdeen was gathered using desk-based research, to inform the development of Aberdeen Adapts. This section:

- **Sets out climate risks and opportunities relevant to Aberdeen Adapts stakeholders.**

A. Buildings and heritage	E. Soil	I. Health and wellbeing
B. Transport and infrastructure	F. Trees and woodlands	J. Economy
C. Water and energy	G. Watercourses and coastline	K. Food
D. Species, habitats and landscape	H. Communities	

- **Includes additional information challenge and opportunities for research and awareness.**
- **Summarises the current policies and actions relating to adaptation in Aberdeen.**
- **Identifies ways to strengthen resilience including:**

Build capacity	Take action	Research/ Monitor

A. Buildings and heritage

Context

- ***115,080*** *dwellings in Aberdeen,* ***33%*** *were built before 1945* [6]
- ***5%*** *of city homes are affected by damp and* ***16%*** *by condensation.* [7]
- ***10,440*** *residential properties in Aberdeen are in areas potentially vulnerable to flooding* [8]

Climate hazard		Climate impact
Flooding/ storms	A.1	Damage to buildings and heritage. Loss of/ or damage or degradation of city heritage.
	A.2	Temporary, long term closure or relocation of buildings.
	A.3	Risk of waste water entering property, backing up through toilets, sinks, doorways, cable ducts or air bricks.
	A.4	Waterlogged grounds, playing fields and sports pitches, access and use restricted.
	A.5	Suitability of areas for future development may be restricted.
Extreme rainfall/ storms	A.6	Risk of water penetration, damage and erosion to stonework, risk of falling masonry.
	A.7	Risk of damp and mould.
Extreme heat	A.8	Buildings at risk from glare and heat gain during hotter temperatures affecting thermal comfort levels.
Sea level rise	A.9	Coastal inundation and wave overtopping - damage and degradation to coastal buildings and heritage.
Extreme cold	A.10	Snow, ice and frost increase energy demand and result in burst pipes.

Current adaptation actions

Planning

- The Aberdeen City and Shire Strategic Development Plan has objectives to mitigate and adapt to the effects of climate change.
- Aberdeen Local Development Plan 2017 includes policy and guidance on Flooding, Drainage and Water Quality. This aims to manage and reduce flood risk, ensuring that new development does not take place on areas susceptible to flooding and incorporates appropriate, sustainable surface water management measures. It also covers protection of land and green infrastructure, with the potential to contribute to natural flood risk management. Supplementary Guidance provides guidance on statutory roles and responsibilities, Flood Risk Assessments, Drainage Impact Assessments, Sustainable Drainage Systems (SuDS), Regional SuDS and Waste and Foul Drainage. These plans also aim to encourage water efficiency in new development.

Buildings

- Conservation Area Regeneration Scheme (CARS)[9] aims to encourage the regeneration and conservation initiatives within Union Street Conservation Area.
- Traditional construction skills and training, including property owner training by Aberdeen City Heritage Trust and partners.

Ways to strengthen resilience

Build capacity	Take action	Research/ Monitor
• Review and strengthen plans, policy. • Develop skills and knowledge. • Increase understanding. • Guidance and training.	• Retrofit, property protection. • Reduce water and energy demand. • Protect historic assets. • Green Infrastructure.	• Assess buildings at risk. • Monitor change. • Condition and suitability assessments.

B. Transport and infrastructure

Context

- *There are around **200** road/ foot bridges in the city, with **100** over waterways.* [10]
- *Around **50%** of school pupils walk to school in the city. **24%** adults in Aberdeen walk or cycle to work* [11]
- *Local Roads Authority covers **913km** of city roads* [10]

Climate hazard		Climate impact
Flooding and storms	B.1	Pressure on drainage systems from increased rainfall.
	B.2	Damage and corrosion to transport surfaces.
	B.3	Peak river flows result in erosion to riverbanks, undermining bridge structures.
	B.4	Risk of structural damage or failure, if bridges are hit by floating debris.
	B.5	Threat of scour on bridges with footings in the watercourse.
Extreme rainfall	B.6	Run off from transport routes causes contamination of water courses.
Extreme heat	B.7	Prolonged high temperatures damage rails, road, footway surfaces.
	B.8	Thermal comfort levels of public transport staff and passengers may be affected.
Sea level rise	B.9	Coastal surge/ wave overtopping affects coastal transport routes.
	B.10	Scour to sea walls and defences.
	B.11	Coastal erosion and recession, especially to soft coastal areas Aberdeen Beach and northward.
Landslide	B.12	Risk of landslide and landslip disrupting transport networks.
Extreme cold	B.13	Damage to transport surfaces, such as pot holes.

Current adaptation actions

- Aberdeen's Local Transport Strategy 2016 - 2021 includes objectives for resilient transport networks and infrastructure.
- Regional Transport Strategy
- National Roads Development Guide[12] takes into account climate threats in new road developments, however much of the road network pre-dates current guidance.
- Aberdeen City Council has a Roads Safety Inspection Manual outlining inspection, assessment and recording. Roads under the Local Roads Authority are maintained and protected through a Winter Services Plan 2019-20, Roads Asset Management Plan and Roads Maintenance Programme. Footways are inspected at intervals and a skeleton 24 hour roads operation squad is in operation.
- Core path remediation took place to address flooding erosion on a number of paths and this has included adaptation measures to help future proof these paths. The measures primarily relate to drainage which has been designed to cope with higher rainfall events.
- Transport Scotland and Aberdeen City Council operate routine bridge safety and inspection schemes.
- Network Rail have Route Weather Resilience and Climate Adaptation Plans[13]. Weather impacts on routes include work to repair minor incidences of earth slip between Aberdeen and Stonehaven and indicates several incidences of delays due to snow and cold.
- FirstGroup UK Bus (Scotland), together with ScotRail, participated in a pilot project run by Adaptation Scotland and backed by Scotland's 2020 Climate Group to develop a climate change risk assessment.

Ways to strengthen resilience

Build capacity	Take action	Research/ Monitor
• Strengthen plans, policy. • Develop skills and knowledge. • Public information. • Increase understanding.	• Improve transport connections. • Remote working. • Use of porous surfaces, SUDs • Long term - protect and strengthen coastal defences.	• Assess infrastructure at risk. • Maintain inspections. • Monitor change.

C. Water and energy

Context

- *North East Flood Risk Management Plan [14] has indicated **33** utilities assets as potentially vulnerable to flooding.*
- *Around **150** private water supplies in Aberdeen.[15]*
- *River Dee provides water to around **300,000** homes in the city and shire.*

Climate hazard		Climate impact
Flooding/extreme rainfall/ storms	C.1	Communication and IT network disruptions.
	C.2	Damage to IT infrastructure.
	C.3	Risks to decentralised energy networks from extreme weather.
Extreme heat	C.4	Overheating of IT servers and equipment.
	C.5	Opportunities for renewable energy generation.
Drought	C.6	Low water flows affect power production - water generating energy schemes.
	C.7	Low flows in the River Dee, alongside demand for water supply, affects water quality and availability.
	C.8	Low flows in the River Dee increase concentrations of pollutants.
	C.9	A reduction in groundwater affects the quality and water levels in private water supplies.
	C.10	City growth/ low flows limit levels of water abstraction.

Current adaptation actions

Planning

- The City and Shire Strategic Development Plan has set targets to avoid having to increase the amount of water abstracted from the River Dee and for all new developments to use water-saving technology. The Aberdeen Local Development Plan includes policies on water efficiency as well as Supplementary Guidance on Flooding, Drainage and Water Quality.

Water

- There are only a few examples of use of rainwater harvesting and grey water recycling in the city. Although there is evidence of water efficiency measures in new development and upgrades, the Beach Ballroom has shown a 20-30% reduction in water consumption with automatic taps in toilets.
- Aberdeen City Council has a responsibility for sampling and the risk assessment of private water supplies in the city and investigating pollution incidences. Contingency arrangements are in place for city private water supplies in case of dry spells.
- SEPA Water Scarcity reports[16] monitor groundwater levels in Scotland.

Flood management

- A North East Flood Risk Management Plan has assessed local areas potentially vulnerable to flooding and outlined actions to contribute to managing flood risk and recovering from any future flood events. Measures to address these risks have been prioritised for phase 1 of this plan 2016-2022. An Integrated Catchment Study, has involved surveying sewers and watercourses, measuring flows and rainfalls and building a computer model all water courses in Aberdeen and how they integrate. Key liaison meetings are held every quarter on drainage
- A number of Flood Prevention Schemes currently in place or under construction in Aberdeen. Flood gates at Bridge of Dee Court, as part of the Dee View Court Flood Protection Scheme. Merchant Quarter, collaborative project with Scottish Water to prevent city centre sewer flooding. Inchgarth, flood wall to protect road and properties. Deeview Court, flood gates. Riverside Drive. River Don early warning system.
- Introduction of Sustainable Urban Drainage systems.
- Aberdeen is a partner in the EU Score project [17], this includes a community trial in Peterculter, using technology and data to increase flood resilience.

- Aberdeen City Council operates a Property Level Protection Flood Grant[18] to help residents protect their property from flooding.
- Aberdeen is a partner in the EU BEGIN[19] (Blue Green Infrastructure through Social Innovation) project. This has delivered a flood alleviation project at Maidencraig.

Utilities

- Utility companies manage and maintain their own assets.
- City decentralised energy networks, such as the Combined Heat and Power network are diversifying the energy mix, helping to support local energy security.

Ways to strengthen resilience

Build capacity	Take action	Research/ Monitor
• Collaboration on integrated infrastructure. • Liaison on water conservation.	• Collaboration on integrated infrastructure. • Improve water efficiency. • Protect developing digital infrastructure.	• Assess vulnerability, improve understanding of impacts.

D. Species, habitats and landscape

Context

- ***6** city parks, **7** local parks, **32** neighbourhood parks, **4** Local Nature Reserves.*
- ***25%** moths disappeared Scotland, butterflies risen by **9%**, decline in seabirds.*[20]
- *Scottish Fire and Rescue Service spent **307** hours tackling wildfires in Aberdeen 2018/19. Weather during this period involved long spells of high temperatures and low rainfall.*

Climate hazard		Climate impact
Flooding	D.1	Risk of habitat fragmentation.
	D.2	Erosion of habitats.
	D.3	Damage to parks/ greenspace areas. Loss of and/or contamination of amenities.
Extreme rainfall	D.4	Increased risk of landslip.
Extreme heat	D.5	Increased risk of wildfire due to drought, dry surfaces, wind and low humidity.
	D.6	A northward movement of some species with warmer temperatures. Change to bird migratory patterns and movement of aquatic species.
	D.7	Increased length of growing season.
	D.8	Increased risk of wildfire - drought, dry surfaces, coupled with wind and low humidity.
Drought	D.9	Degradation of green spaces and vegetation.
	D.10	High temperatures/ a reduction in summer rainfall may dry out wetland areas.
Cumulative impacts	D.11	An increase in invasive non-native species (INNS).
	D.12	Change in species distribution and numbers.
	D.13	Increase in pests and diseases. More pests will be able to survive over winter as temperatures increase.
	D.14	Loss of habitats, reduced food sources. Hard for some species to survive.

Current adaptation actions

- Climate change is considered in the Aberdeen Nature Conservation Strategy, and Aberdeen's Open Space Strategy.
- A city Green Space Network aims to improve connectivity between habitats and open spaces. It also takes into account climate change adaptation opportunities and flood risk or alleviation.
- The North East Scotland Biodiversity Partnership works collaboratively to deliver a range of projects that aim to make a difference for biodiversity in the region.
- Monitoring and recording of current species numbers and distribution takes place through North East Scotland Biological Records Centre.
- Work has taken place at Hazlehead Park to develop a Climate Change Park.[21]
- Warmer, wetter weather has had a negative impact on moths.
- A multi partnership education programme has worked to reduce wilful fire raising at a number of city nature reserves.
- City projects working with nature to improve water management include the Seaton Wetland Project, the East Tullos Burn Environmental Improvement Project, the Middlefield Greenspace and Regeneration Project, Maidencraig flood alleviation scheme.

Ways to strengthen resilience

Build capacity	Take action	Research/ Monitor
• Collaboration on biodiversity • Liaison on water conservation.	• Improve habitat connections. • Expand greenspace networks.	• Improve understanding of climate impacts on local habitats and wildlife.

	• Implement and maintain buffer zones. • Expand use of blue, green infrastructure. • Highlight co-benefits of actions.	• Vigilance for INNS and pests and disease.

E. Soil

Context

- There are some small pockets of peat soil in Aberdeen[22]

Climate hazard		Climate impact
Flooding	E.1	Contamination of soil.
	E.2	Erosion of habitats.
	E.3	Damage to parks/ greenspace areas. Loss of and/or contamination of amenities.
	E.4	Increase risk of run off and flooding due to soil sealing and compaction.
Extreme rainfall	E.5	Prolonged rainfall results in soil saturation.
	E.6	Soil instability, increased risk of landslip.
	E.7	Loss of soil organic matter. Impact on growing.
	E.8	Increased risk of water-based soil erosion and loss of top soil. Risk of pollutants to water courses due to run off from bare soil in agricultural areas.
Drought	E.9	Dry, bare and unprotected soil is less able to absorb rainfall.
Cumulative impacts	E.10	Reduction in soil quality and function - soil less able to store and retain water and filter pollutants.
	E.11	Invasive non-native species (INNS) affect soil biodiversity, such as New Zealand flat worm.
	E.12	Risk of subsidence from the shrinkage and swelling of soils.
	E.13	Loss of soil carbon.

Current adaptation actions

Planning

- Policies under the Aberdeen Local Development Plan cover carbon-rich soils and degraded and contaminated land. Scottish Planning Policy (2014) states that the land-use planning system should seek to protect soils from damage such as erosion or compaction.
- There is some use of permeable and porous surfaces in the city.
- The Scottish Soil Framework[23] aims to protect soils.
- A high risk of sediment loss featured in the Pan European Soil Erosion Risk Assessment [24] and low risk of landslide susceptibility.
- Meterological Office Rainfall and Evaporation Calculation System [25] – includes soil moisture deficit.
- Further information on risk to soils is available at Scotland's soils risk maps [26]

Ways to strengthen resilience

Build capacity	Take action	Research/ Monitor
• Protection of soil carbon. • Soil protection embedded in policy. • Need for soil protection, good soil management.	• Measures to reduce erosion. • Permeable/ porous surfaces. • Measures to reduce soil sealing and compaction.	• Reductions in soil health/ quality.

F. Trees and woodlands

Context

- *Area of native woodland in Aberdeen is **514ha**.*[27]
- *Area of woodland affected by invasive non-native species is **10.3ha**.*
- *Total tree canopy cover in Aberdeen is 10%.*
- ***140** sites of ancient woodland.*

Climate hazard		Climate impact
Extreme rainfall	F.1	Waterlogged soils, weaken tree roots. Trees vulnerable to wind throw.
	F.2	Trees and vegetation alongside river banks can help to absorb excess water, slowing run off to rivers.
Storms	F.3	Loss of branches, fallen trees.
Extreme heat	F.4	Increased risk of wildfire due to drought, dry surfaces, wind and low humidity.
	F.5	Risk of leaf scorch to street trees in the vicinity of buildings –glass reflection.
	F.6	Opportunity - Increased length of growing season. Eastern Scotland favourable for growth high-quality broadleaved trees.
	F.7	Opportunity -Trees and vegetation provide shade. Can help with cooling/ insulating.
	F.8	Increased risk of wildfire - drought, dry surfaces, coupled with wind and low humidity.
Drought	F.9	High temperatures and a reduction in summer rainfall affect drought sensitive trees, such as Sitka Spruce. Trees with restricted root growth vulnerable to less summer rainfall.
Cumulative impacts	F.10	Increase in pests and diseases, such as green-spruce aphid. Pinewood already affected by red band needle blight due to warmer conditions.
	F.11	Some tree species may not enter full dormancy - warmer winters. Damage during colder periods.
	F.12	Warmer temperatures/ less in summer rainfall impacts tree condition/ growth.
	F.13	Opportunity - Trees including Scots pine, Common Alder and Silver Birch can reduce air pollution.

Current adaptation actions

Plans and strategy

- The Aberdeen Local Development Plan includes policy and Supplementary Guidance on trees and woodlands.
- A proposed Trees and Woodland Strategy is in development for the city.
- A Survey of Native Woodland in Aberdeen indicated the main priority habitat types are Upland birchwoods, Native pinewoods and Wet woodland. The most common native species in the upper canopy are downy birch & Scots pine.
- Invasive non-native species affecting woodland includes rhododendron, Himalayan balsam, giant hogweed, Japanese knotweed, snowberry.

Tree planting

- The Tree for Every Citizen project planted a tree for every resident of Aberdeen, approximately 210,000. The Granite City Forest project is a programme of new woodland creation, combined with enhanced management of existing woodlands.
- Outwith the city, community reforestation work is taking place in catchment areas of the Dee, helping to slow down run off and reduce downstream flooding.

Ways to strengthen resilience

Build capacity	Take action	Research/ Monitor
• Tree species suitable for a changing climate. • Liaison with Aberdeenshire on use of riparian planting. • A wider species mix, to increase resilience	• Increased tree planting (woodlands and street trees). • Use of trees and woodlands, for shade and shelter and to slow run off.	• Wet woodland creation. • Tree health, including vigilance for pests and disease

G. Watercourses and coastline

Context

- *The River Dee is a designated a Special Area of Conservation SAC. There are protected species in the river.*
- Aberdeen has over **600km** of waterbodies (open & culverted).
- *The area at the mouth of the Don has moved over 200 m landwards [14] in the last one 100 years and continues to do so.*

Climate hazard		Climate impact
Flooding	G.1	Increased peak flows. Damage and debris to water courses. Adverse impact on river corridors.
	G.2	Erosion of river banks.
Extreme rainfall	G.3	Water courses affected by diffuse pollutants.
Drought	G.4	Low flows/ warmer rivers. Water quality and health of invertebrates and fish affected. Protected species in the River Dee
Rise in sea level	G.5	Movement of sand dune systems and sediment. Leads to coastal erosion.
	G.6	A rise in sea level -affects shoreline and cliff nesting birds.
Cumulative impacts	G.7	Increased risk of algal bloom - warm temperatures/ low river flows.
	G.8	Shifts in ranges of plankton and fish abundance - contributes to a decline in seabirds [28]
	G.9	Warmer North Sea drives cold-water species north.
	G.10	A northwards movement of marine invasive non-native species.

Current adaptation actions

- **Partnership working** -The Dee Catchment Partnership aims to return the River Dee catchment to good order throughout, with sufficient high quality water, habitat and amenity to allow all its inhabitants, flora and fauna to flourish.
- At the coast, the East Grampian Coastal Partnership is facilitating the delivery of Integrated Coastal Management between Fraserburgh and the mouth of the River North Esk, on the east coast of Scotland.
- **Planning** - A River Basin Management Plan (RBMP) [29] is addressing issues of water quantity and quality.
- The Aberdeen Local Development Plan includes policy on coastal planning and has Supplementary Guidance on flooding, drainage and water quality.
- Scotland's National Marine Plan [30] states: Wherever possible, flood risk management and coastal protection solutions should work with natural processes and features.
- **Managing erosion** - At Aberdeen beach groynes are in place to protect the beach from coastal erosion by interrupt long-shore water flow, this limits sediment movement and removal.

Ways to strengthen resilience

Build capacity	Take action	Research/ Monitor
• Awareness and understanding. • Liaise with current partnerships/ disseminate knowledge	• Joined up shoreline planning. Taking on board wider risks to nature and people.	• Erosion - Dynamic Coast • Data on impacts for watercourses

H. Communities

Context

- *Population Aberdeen **227,560** and is projected to increase from to **237,169** by 2026.* [31]
- ***1** Community Risk Register and **2** Community Resilience Plans.*
- *8 of Aberdeen's 37 communities are recognised as deprived under the Scottish Index of Multiple Deprivation.*[32]
- *Climate change can widen inequalities - health, social and economic factors.*[33]
- ***24%** homes fuel poverty.*

Climate hazard		Climate impact
Flooding/ storm/ sea level rise	H.1	Flood/ storm events may result in displacement, isolation.
	H.2	May be a need to evacuation of residents in flood/ emergency.
	H.3	Damage to homes and property.
Extreme rainfall	H.4	Increased risk of damp affecting health.
Snow	H.5	Injury from slips, trips and falls.
Cumulative impacts	H.6	Climate change can widen inequalities - health, social and economic factors.
	H.7	Opportunity - Warmer temperatures less winter heat demand.

Current adaptation actions

- **Resilience plans** - Community resilience is a priority under the Local Outcome Improvement Plan[34]. Culter Community Council has put together the Culter Community Resilience Plan[35] to increase individual, family and community resilience to emergency situations. This plan aims to: raise awareness and understanding of the local risks and emergency response capability in order to motivate and support self-help; increase community resilience against emergencies; and enable self-help arrangements to commence until support from the emergency services or other agencies are in place. Work to develop a resilience plan has also taken place in Cults, Bieldside and Milltimber and supporting community resilience, community flood wardens are in place in a couple of city areas.
- **Regional resilience** - The North of Scotland Regional Resilience Partnership[36] has produced a Community Risk Register which highlights the risks likely to cause disruption to the region and its communities. This plan highlights risks that have the highest likelihood and potential to have significant impact, causing disruption to the North of Scotland region and its communities. It includes potential areas for emergency response including severe weather, flooding, influenza pandemic, interruptions to utilities, transport disruptions, pollution & contamination.
- **Property protection** - a Property Protection Flood Scheme is open to residential and business properties meeting relevant criteria. If the property has been previously flooded internally and damage was sustained; that the property is in an area at risk of flooding shown on the SEPA flood maps[37] or shown on the Integrated Catchment Study model.
- Sandbags are provided to support community resilience.
- **Community action** - Friends of Seaton Park achieved an Overcoming Adversity Award from Britain in Bloom for volunteer work to clean up the park following extensive flooding during Storm Frank in 2016.

Ways to strengthen resilience

Build capacity	Take action	Research/ Monitor
• Increase number of community resilience plans. • Assess community risks and vulnerability - addressing inequalities	• Signpost to resources and public information sources. • Increase knowledge and awareness. • Links to resources. • Encourage citizen science.	• Tools and technology to support communities with monitoring change.

• Raise awareness of community funding routes.		

I. Health and wellbeing

Context

- ***3*** *Air Quality Management Areas in Aberdeen.*[38]
- *Growth in* ***12%*** *of over 65s by 2026.*[39]
- *26% of people aged 65 years and over, with high care needs are cared for at home.* [40]

Climate hazard		Climate impact
Flooding	I.1	Flooded areas contaminated by raw sewage present a public health risk.
	I.2	Increase in injury or ill health from severe weather events eg storms and flooding.
	I.3	High volumes of standing water. Breeding grounds for disease. Increase in water borne infectious diseases.
	I.4	Damage to health and social care premises.
	I.5	Damp caused by cold houses and condensation could lead to an increase in fungal growth in buildings, affecting people with respiratory illness.
Extreme temperatures	I.6	Warmer weather increases the rate that pollutants are formed. Impact on respiratory health.
	I.7	People with pre-existing health problems may be affected by heat.
	I.8	Increased UV exposure.
	I.9	Increased risk of gastro-intestinal illness and food poisoning.
	I.10	Increase in vector borne disease, e.g. tick borne, Lyme disease.
Snow, ice and frost	I.11	A reduction in risk for cold related illnesses and accidents.
Cumulative impacts	I.12	Increased levels of stress. Impact on mental health due to extreme weather.
	I.13	Residents with health conditions may be less able to prepare for and respond to extreme weather.
	I.14	Disruption to health and social care services and patient transport**.**
	I.15	Demands on health & social care during, after extreme weather.
	I.16	Incidences of disease and changes in health and disease patterns.

Current adaptation actions

- Measures to improve air quality are being delivered through a city Air Quality Action Plan**.**[41]
- Business Continuity Planning is in place for health and social care providers, to ensure the continuous operational delivery of critical health and wellbeing services.
- The Aberdeen Health and Social Care Partnership Strategic Plan[42] has priorities including health inequalities and to strengthen existing community assets and resources to help local people.

Ways to strengthen resilience

Build capacity	Take action	Research/ Monitor
• Better understanding of the impacts of climate change on local health. • Education to support preventative measures.	• Protect critical health and social care facilities. • Embed climate change in contingency planning.	• Monitoring for incidences in disease/ change in disease patterns.

J. Economy

Context

- *Tourism in the region supports **20,000** jobs.*[43]
- *Registered businesses in Aberdeen **9,715.*** [44]
- *GVA per head in Aberdeen highest in Scotland. Food, Drink, Agriculture employ over **22,000** - North East Scotland. 51% in agriculture, 32% in food manufacturing, 11% fishing and 6% drinks.*

Climate hazard		Climate impact
Flooding	J.1	Damage to business stock, assets and premises.
Extreme rainfall	J.2	Construction sites water logged by heavy rainfall. Delays to city development.
Extreme temperatures	J.3	Warmer seas impact the fishing industry - cold water species move north.
Rise in sea level	J.4	Water dependent businesses affected by drought.
	J.5	Impacts to maritime industries including the harbour, ferry, fisheries, marine tourism and offshore service industry.
	J.6	Stress from high waves may cause impacts for offshore infrastructure.
Cumulative impacts	J.7	Businesses vulnerable to utility, communication and transport disruptions.
	J.8	High temperatures and drought. Global availability/ price of products affected.
	J.9	Failure to prepare for and respond to extreme weather events impacts city investment and economic growth.
	J.10	Weather events may impact the agriculture and forestry sector in the city and wider region.
	J.11	Financial losses. Increased insurance costs.
	J.12	Loss of land and property values
	J.13	Business opportunities for adaptation skills, products and technology.
	J.14	Flooding, snow ice and frost restrict staff travel to work.
	J.15	Flooding, storms and snow, ice and frost disrupts supply chains.

Current actions

- The Regional Economic Strategy - states “The region’s natural assets and clean environment are also its economic assets and therefore must be safeguarded to support our sectors particularly tourism, food, drink, agriculture and fisheries.
- The Scottish Cities Alliance carried out a Mini Stern review for all 7 cities in Scotland. This included the identification of potential economic risks and opportunities arising from climate change and the low carbon agenda.

Ways to strengthen resilience

Build capacity	Take action	Research/ Monitor
• Ensure local skills are in place for adaptation. • Opportunities for tourist, food growing sectors.	• Business resilience. • Integrate climate adaptation Work into the implementation of the Regional Economic Strategy. • Remote/ flexible working.	• Investigate new economic opportunities from a changing climate.

K. Food

Context

- ***487*** *city allotment plots managed by Aberdeen City Council.*
- *Approximately* ***140*** *additional allotment plots are offered privately in the city.*

Climate hazard		Climate impact
Flooding	K.1	Flooding and heavy rainfall. Damage to crops.
	K.2	Soil erosion and flooding. Loss of land at food growing sites.
	K.3	Extreme weather events including storms and floods result in food supply chain disruptions, delays to deliveries.
Extreme rainfall	K.4	Run off from fertilisers and pesticides affects water courses.
Extreme temperatures	K.5	Higher summer temperatures/ reduced rainfall. Degraded crops.
	K.6	Higher global temperatures and drought affect the availability and cost of goods.
Drought	K.7	Increased watering requirements. Reduction in water availability.
Cumulative impacts	K.8	Supply chain disruptions from flooding and landslide may affect food transportation and distribution.
	K.9	Food safety risks due to pathogens or contamination.
	K.10	An increase in pests and disease affects food growing.
	K.11	Longer growing season. Opportunities for food growing.

Current actions

- **Food growing** - Aberdeen is developing a Food Growing Strategy, to meet the Community Empowerment (Scotland) Act 2015.[45] Identifying land in its area that may be used as allotment sites - and other areas of land in its area that could be used by a community for the cultivation of vegetables, fruit, herbs or flowers.
- Partnership work is taking place locally under **Granite City Good Food**[46] to promote healthy and sustainable food.
- **Food safety** - The Food Standards Agency and the Council's Protective Services work to protect city food standards and safety.

Ways to strengthen resilience

Build capacity	Take action	Research/ Monitor
• Improve understanding of impact of climate change on local food growing and agriculture.	• Build resilience into growing sites.	• Monitor threats of pest and disease on local crops under a changing climate.

L. Research

Challenge

- **Aberdeen can learn from innovative ideas, tools and examples in other cities and places.**
- **Aberdeen can showcase adaptation work taking place in the city.**
- **Exploring opportunities to link mitigation and adaptation agendas through the Covenant of Mayors[47] SECAP.**
- **Aberdeen can share practical experiences.**
- **There is a lack of information in many key sector areas.**
- **There is a range of local and national research, further research taking place under the National Adaptation Programme.**
- **Research may not be effectively used by practitioners.**
- **Gaps between research and practical application, especially at the local scale.**
- **Time and resources.**

Current actions

- The University of Aberdeen has been a partner in Aberdeen Adapts working with the MSc course in Environmental Partnership Management. Further work relating to adaptation includes; a range of research projects at James Hutton Institute, RGU and SRUC.
- At national level CREW – Scotland's Centre for Expertise for Waters is a partnership connecting policy and research between the James Hutton Institute and all Scottish Higher Education Institutes.
- Aberdeen Institute for Coastal Science and Management this incorporates the Centre for Marine and Coastal Zone Management.
- ClimateXChange is Scotland's Centre of Expertise Connecting Climate Change Research and Policy

Ways to strengthen resilience

Research/ Monitor
• Research into applied forms of adaptation. • Better use of data science and modelling. • Evaluate local adaptation measures • Improve monitoring systems • Opportunities for students • Demonstration projects to support research programmes. • Capture the learning from national research as part of a wider evidence base for Aberdeen. • Collaboration in research

M. Awareness

Context

- ***21%** of the public in Aberdeen would welcome support for the community to prepare for severe weather.*
- ***36%** of the public in Aberdeen would like more information about what to do to address climate change.* [48]

Challenge

- **Raising awareness and understanding of the long-term impacts of climate change. this is required across all sectors - general public, community awareness, businesses etc.**
- **There is varying levels of awareness and understanding about climate change across stakeholder groups.**
- **Need to present climate change in a way that resonates and is meaningful to people.**
- **Provide clear, consistent messages.**
- **Educate others, engaging, getting others on board. Education and information on all topics for all age groups.**
- **There needs to be understanding of the scale and predicted climate change impacts. As well as knowledge of risk areas and priorities for action.**

Current actions

- Aberdeen Adapts has engaged stakeholders through surveys, newsletters and a web page.
- The development of the Aberdeen Adapts included 6 stakeholder workshops.
- Questions on climate change were included in a survey issued to all 895 *City Voice* members with the overall survey receiving a response rate of 63%.
- Fernielea School took part in a *Flood Awareness' Week*, where pupils learned about how to become more resilient to flooding events.
- 6 *Climate Ready Place* workshops were held in 3 city schools.
- A Climate Week North East programme co-ordinated by Aberdeen Climate Action takes place every March, in addition, Climate Cafe events take place every month on a wide range of topics.
- A Climate Change and Arts Festival mini pilot took place at Middlefield.

Ways to strengthen resilience

Build capacity
• Public information on adaptation • Encourage a common level of understanding • Opportunities for knowledge exchange • Link to school education.

N. Partnership working

Current actions

- Through the **Local Resilience Partnership**, ACC works with emergency services and other agencies to provide an emergency planning response and leads on recovery from emergency planning situations. Emergency Planning Policy and procedures are in place.
- **North East Flood Liaison Group** - Production of the North East Local Flood Risk Management Plan.
- **Community Planning Aberdeen** - works to link public bodies with the community, for planning and the delivery of more efficient services.
- **Aberdeen City Health and Social Care Partnership** - working with communities to enable people to achieve fulfilling, healthier lives and wellbeing.
- **Strategic Planning Authority** Prepare and keep up-to-date a strategic development plan, engaging with both stakeholders and communities.
- **Aberdeen City Heritage Trust**, preservation, maintenance and enhancement of the historic, architectural and landscape heritage.
- **NESTRANS**, developing and delivering a long-term regional transport strategy.
- **Powering Aberdeen** developing a network of organisations interested in delivering sustainable energy.
- **Dee Catchment Partnership**, return the River Dee catchment to good order throughout, with sufficient high quality water.
- **East Grampian Coastal Partnership**, delivery of the Integrated Coastal Management.
- **North East Scotland Biological Records Centre (NESBReC)** - Collating, managing and providing biological information. North East Scotland Biodiversity Partnership.

Ways to strengthen resilience

Build capacity
• Collaborative planning and projects. • Links relevant partners/ existing partnerships • Adaptation funding and resources • Integration of climate adaptation in plans, programmes and policy. • Adaptation governance • Adaptation performance monitoring

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