



# ARSINOE

# Impacts of Floods on Critical Infrastructures in England

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A Case Study in Torbay & Devon  
County, England



# Background



**Torbay and Devon County**, located in the Southwest of England, has long been **susceptible to flooding**, which has posed significant challenges to both local communities and infrastructure. Over the years, the region has **experienced repeated flooding events** caused by a variety of sources, including surface water runoff, highway flooding, sewer system overflows, and flooding from main rivers and ordinary watercourses. These events are often **triggered by intense rainfall**, which has become increasingly frequent and severe due to changing climate patterns. The impacts of flooding are widespread, **affecting residential areas, transportation networks, and critical infrastructure**. As the region continues to face growing risks from both flash flooding and longer-term sea-level rise, it is essential to address these vulnerabilities and develop strategies to mitigate future flood risks while safeguarding local communities and the environment.

## Key challenges

The key challenges in Torbay and Devon County revolve around the complex **interconnections between water management, public health, community well-being, and infrastructure**. Flood events, which can occur in multiple forms, such as surface water runoff, river flooding, and coastal surges, pose a significant threat to all of these interconnected systems. Ensuring resilience requires a holistic approach that protects both the built environment and the health of local communities. The challenge lies in developing integrated flood management solutions that safeguard water resources, **maintain the functionality of critical infrastructure during and after disasters** to ensure vulnerable communities are protected from the adverse effects of flooding and **to enable rapid recovery** that minimises societal disruptions. Collaborative efforts are needed across sectors to build adaptive resilience and reduce the risks posed by future flooding events, ensuring the long-term sustainability and well-being of Torbay and Devon.

**The Torbay and Devon County case study presents the common challenges of climate change impacts on a coastal region with a wide variety of features that are interconnected infrastructures and services. Stakeholders in the case study are also keen to identify the implemented innovations to strengthen the climate resilience of the community.**



## Main Goals

The primary goal of the case study in Torbay and Devon was to **assess** and **address the increasing risks posed by sea-level rise**, which is projected to exceed 1 metre over the next century, and **more frequent extreme rainfall events**. As this leads to more frequent overtopping of sea defences and surface water, the case study aimed to **understand the impacts of flooding** on infrastructure, residential properties, and the water supply network. In addition to **evaluating the risks to human settlements**, the study investigated the effects of flooding on the environment, including local ecosystems and biodiversity. Through the involvement of key stakeholders, the case study **identified vulnerable areas** and developed strategies to improve the protection of infrastructure and communities from future flood risks, ensuring long-term resilience.




## Expected outcomes and benefits

The expected outcomes of the case study include a **comprehensive understanding of flood risks**, particularly related to sea-level rise and storm surges, as well as pluvial flooding, and their impacts on both the built environment and local ecosystems. The study provided **essential data to identify areas at risk** from flooding and informed measures to protect infrastructure and enhance flood resilience. Additionally, the findings **supported local authorities in securing national funding** for coastal protection and **flood alleviation projects**, leading to the implementation of effective solutions to mitigate flooding risks. The broader benefits include increased **protection for residential properties**, improved water supply infrastructure, and greater resilience for local ecosystems, contributing to a safer and more sustainable future for Torbay, Devon and the surrounding region.

## Methodology & Approach

The case study has combined a number of **novel methodologies** to enhance the understanding of flood risk in Torbay, including a **comprehensive flood mapping** to analyse the hydrodynamics under plausible future climate change scenarios, the assessment of direct damage induced by floods, the analysis of cascading failure of critical infrastructure and services, traffic modelling to evaluate flood impact on transportation, development of resource allocation model to prioritise crisis management actions. An **integration dashboard** has been established to serve as the platform that provides the information to support decision making. A **digital twin** was also built to utilise the real-time weather observations to enable flood forecasting and risk-based early warning to support emergency response.



Throughout ARSINOE, **five Living Labs** were held to include multiple stakeholders in the case study **to discuss** the approach, highlight communities' main concerns on climate change impacts, **pilot and test the modelling tools and solutions**, review the research outcomes, collect feedbacks to enhance the development of methodologies and tools, explore and co-design the interventions for enhancing climate resilience.

## Open Tender for Innovation solutions selected and used

### ARGOS

A decision-making tool for climate change adaptation, serving **as an advanced early warning system for local and regional administrations**. It provides **real-time monitoring** of extreme weather events, issuing warnings and guiding communities in emergency management. As a **Flood Focused Digital Solution**, ARGOS combines sensor networks with state-of-the-art algorithms for radar nowcasting and derived products, **anticipating rainfall impact up to two hours**. Vulnerability layers integrate hydrological, hydraulic, environmental, agronomic, economic, and social data to inform coordinated responses during floods, optimising resource allocation and communication. It activates protocol actions to enhance emergency management.

### Ripple Effects

It integrates **local initiatives** and **nature-based** solutions through community engagement via activities including Rewilding and Living Shorelines to restore natural ecosystems; Community-Based Nature Reserves for environmental stewardship; **Micro-Projects for Flood Mitigation** using rain gardens and green roofs; **Citizen Science, River and Coastal Monitoring** for data collection; **Regenerative Horticulture for Climate Adaptation** through soil health improvement; **Community-Led Flood Forecasting Systems** for timely alerts; **Resilience Gardens and Community Food Hubs** for food security and community bonds; **Eco-Tourism and Sustainable Local Businesses** for economic resilience; and **Digital Platforms for Community Engagement and Skills Development Training Programs**. Through the close interactions with citizens, it is expected that communities will be able to co-develop a sustainable program that enhances climate resilience.



# Key results & Achievements

The Torbay and Devon County case study has successfully demonstrated that a holistic approach to **analysing flood risks under different future scenarios is critical** to understanding the impacts of climate change. The research has included hazard simulations, damage estimations, assessment of cascading impacts due to critical infrastructure failures, traffic modelling, and resource prioritisation strategies.

The **collaboration with stakeholders** in the case study helped **shape research direction to fulfil the expectations of the end-users**. The visualisation dashboard was developed to display the spatiotemporal information from research outcomes to support the co-creation of climate adaptation strategies and interventions. The results were **further integrated to evaluate the societal capacity for coping** with climate hazards via the **ARSINOE Resilience Wheel**.

## Lessons learned

**High quality data** will significantly improve the quality of analysis, despite many open data could be obtained freely, the data resolution may not be sufficient for detailed assessment.

The **participation of stakeholders** in the Torbay and Devon case study is **completely voluntary** such that the engagement activities required careful planning to **ensure the interest and active contribution** from the stakeholders, and to avoid stakeholder fatigue. Information to be shared and discussed with stakeholders from variety backgrounds also need careful consideration to avoid misinterpretation or misunderstanding.

## Local communities and ecosystems

ARSINOE Torbay and Devon County case study provides **scientific evidence to raise public awareness** on climate change impacts, facilitating **dialogues** between local authorities and communities for sustainable development. The outcome will support the **creation of new policies and measures** to better protect vulnerable communities and ecosystems, boosting climate resilience.





# Replicability & Scalability

The methodologies and tools developed for the Torbay and Devon case study are generic approaches that can be replicated other regions where are facing similar challenges, if required data are available for modelling analysis. The access to localised data and knowledge, and the engagement with local stakeholders will further enhance the outcomes.

## Key success factors and barriers to consider

**Trusted partnership, which requires regular and effective communication, is a key to connecting scientific research with local authorities, stakeholders and citizens to collaborate in climate resilience planning.**

**The accessibility to high quality data (cost and security concerns) and the resources to support multi-stakeholder collaboration could be barriers for sustaining long-term implementation of the solutions.**



# Next steps & sustainability

The platform will continue operation and remain accessible beyond ARSINOE.

ARSINOE has been collaborating with the **Devon County Council** and the **Environment Agency** in the Devon Resilience Innovation Project to exchange and share the knowledge and information.



Learn more about the ARSINOE Case studies: [HERE](#).

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## The ARSINOE consortium



This project has received funding from the European Union's Horizon 2020 innovation programme under grant agreement No 101037424