

REOPENING A HIGHWAY

Abstract

Reopening highways after flooding or infrastructure failure requires coordinated assessment of safety, logistics, and stakeholder impacts. In the West Midlands, flooding along the River Severn has disrupted transport networks and damaged critical infrastructure. As highways also host essential utilities, reopening decisions must address risk, resilience, and service continuity to support affected communities.

Purpose:

The purpose of this study is to assess whether an integrated flood risk management approach can improve highway resilience and reduce disruption in flood-prone areas of Worcestershire and Shropshire.

Hypothesis:

It is hypothesized that combining engineered flood defences, nature-based solutions, resilient transport infrastructure, flood-aware urban planning, and coordinated emergency response will significantly reduce flood-related highway closures, infrastructure damage, and community disruption when compared to isolated mitigation measures.

Introduction

When considering the reopening of a highway following flooding or disruption, it is essential to understand not only the immediate cause of the closure but also the underlying factors that increase future risk. Elements such as local geology, patterns of urban development, and the impacts of climate change all play a significant role in how flood events develop and how road infrastructure is affected. In flood-prone areas, impermeable geological formations can limit natural water absorption, while urbanization further increases surface runoff by reducing drainage capacity. In addition, climate change has altered rainfall patterns, with extreme flood events occurring more frequently than historical classifications would suggest. Together, these factors highlight the need for a holistic, risk-based approach when planning safe and resilient highway reopening strategies.

Gant chart

Task	Status	Due Date	Priority	Notes
Public Consultation (Emerging Plan)	To do	18 Mar 2026	High	Upcoming milestone – preparation likely required
Nature-Based Solutions (Planting)	To do	30 Sep 2026	Normal	Align with seasonal constraints
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Operational WBS Table: Inputs, Outputs, and KPIs

WBS Component	Inputs	Outputs	Key Performance Indicators (KPIs)
Flood Defences	Hydrological data; flood risk maps; demountable barriers; pumping systems; engineering teams; maintenance funding	Maintained and deployed flood barriers; rehabilitated flood retention basins; cleared river channels	- Reduction in flooded area (m²) - Reduction in peak river levels (m) - Number of assets protected - Frequency of barrier deployment success
Environmental & Ecosystem Management	Land access agreements; ecological surveys; NFM designs; monitoring equipment; environmental specialists	Upstream NFM areas; restored riverbanks; water quality monitoring datasets	- Reduction in downstream runoff (%) - Improvement in water quality indices - Increase in vegetated riverbanks (km) - Biodiversity indicators (species counts)
Transport Infrastructure & Connectivity	Structural inspection reports; drainage designs; construction crews; materials; transport authority coordination	Reinforced bridges; improved highway drainage; protected rail embankments	- Reduction in flood-related road/rail closures - Structural compliance ratings - Drainage performance during storm events - Network availability (%)
Urban Planning & Development	Flood zone maps; planning policies; SuDS designs; coordination with local authorities	Flood-sensitive land-use plans; SuDS-integrated developments; planning compliance measures	% of developments compliant with flood policy - Reduction in surface water runoff volume - SuDS adoption rate - Long-term flood damage reduction
Emergency Preparedness & Response	Real-time river level sensors; warning systems; emergency response plans; communication protocols	Early flood warnings; coordinated evacuations; road closure plans; inter-agency response	- Warning lead time (hours) - Response activation time - Evacuation effectiveness - Reduction in human and economic losses

Reflection

When approaching project management planning, it is essential to consider a wide range of external and internal factors that can influence the success of a project. These include **political, economic, social, technological, legal, and environmental (PESTLE)** aspects. Through reviewing my colleagues' poster presentations and reflecting on the feedback provided by my tutor, I recognised that effective planning requires more than just selecting a task—it requires a structured approach that accounts for the wider context in which a project operates. This reflection highlighted the importance of using analytical tools such as PESTLE to support informed decision-making and develop solutions that consider the needs of all stakeholders involved.

After analysing my peers' project choices, I noticed that some projects lacked focus or were not sufficiently targeted towards addressing environmental risks or preventing future disasters. This observation, combined with additional research and self-reflection, led me to decide on a project centred on **reopening a highway following flooding**. I selected this project because it represents a practical and achievable task that requires comparatively less labour while delivering significant benefits to communities. Highways are critical to everyday life, enabling access to employment, education, healthcare, and essential services. As a result, the reopening of a highway has an immediate and tangible impact on social and economic activity, making it a high-priority project within the context of disaster recovery and infrastructure resilience.

The next step in my process was **project planning**, which I consider to be one of the most important stages of project management. Observing that some colleagues experienced difficulties due to limited planning reinforced what I had already learned from past experiences: projects that are not well planned frequently encounter problems with time management, coordination, and clarity of objectives. Without a structured plan, it becomes difficult to define goals, allocate resources effectively, and measure progress. Recognising this, I placed strong emphasis on managing my time and developing a clear understanding of what I wanted to achieve through this project before moving on to implementation.

Following this, I began researching potential solutions that would support the successful delivery of the project. Through this research, I concluded that applying a **PESTLE analysis** would be the most effective way to ensure comprehensive project planning. Using PESTLE allows consideration of government policies and regulations affecting highways (political), funding constraints and economic impacts, social implications for communities, technological solutions for monitoring and safety, environmental challenges such as flooding and climate change, and relevant legal requirements. This structured approach provides a clear framework to evaluate risks and opportunities from multiple perspectives rather than focusing on a single issue.

By aligning my work philosophy with the PESTLE framework, I was able to maintain strong professional values and avoid compromising work ethic. Overall, this reflective planning process has helped me develop a more disciplined and analytical mindset towards project management, ensuring that decisions are informed, ethical, and focused on long-term benefits rather than short-term outcomes. These lessons will support me in my future professional practice and strengthen my ability to deliver complex infrastructure projects responsibly effectively.

Introduction

Reopening a highway after a disaster, seasonal closure, or roadworks involves many aspects, including safety, logistics, and communication with stakeholders. The West Midlands has been significantly affected by flooding, which has transformed both the landscape and the lives of local communities. These flood events have caused substantial damage to vital infrastructure and flood defence systems. The most affected areas are towns located along the River Severn, such as Worcester, Shrewsbury, and Kidderminster.

Road networks, and the way they are operated, have a major impact on everyday life. The primary purpose of highways is to facilitate safe and convenient travel for all users; however, they also play a critical role in hosting essential services, including water, gas, electricity, and telecommunications infrastructure. When considering the reopening of a highway, it is essential to understand the causes of the closure and the challenges involved.

One important factor is the geology of the area, which must be carefully examined when developing solutions to prevent future disasters. Research indicates that some flood-prone areas are underlain by impermeable rock formations that do not absorb water, forcing surface water to rise rapidly and overwhelm canals and drainage systems. Urbanisation is another contributing factor, as many developed surfaces are impermeable, reducing natural drainage and increasing surface runoff. Climate change must also be considered, as studies show that extreme flood events previously classified as “once-in-100-years” are now occurring with increasing frequency.

Objectives

This component of the project focuses on mapping the extent of flood-related damage to both residential and commercial properties within the affected areas. Spatial analysis is used to identify the severity and distribution of impacts across communities, providing a clear understanding of the scale of disruption.

An evaluation is conducted on the performance of both temporary and permanent flood defence barriers in Shrewsbury, Worcester, and Bewdley. This analysis examines their effectiveness during recent flood events, identifies structural or operational weaknesses, and assesses their role in protecting critical transport and utility infrastructure.

The project documents the human experience of post-flood recovery, with particular emphasis on community resilience and the economic impact on local businesses. This includes insights into displacement, recovery timelines, financial losses, and the effectiveness of local support mechanisms.

Based on the findings, the study develops data-driven recommendations aimed at sustainable urban planning and enhanced flood mitigation strategies. These recommendations seek to improve long-term resilience, reduce future risk, and support more adaptive infrastructure planning.

The project utilises a combination of hydrological data analysis, field observations, and interviews with local stakeholders and emergency services. By comparing historical flood data from 2020 to 2024, the study aims to identify critical failure points as well as successful mitigation measures that can inform future decision-making.

Scope

Geographic and Hydrographic Reach

The project focuses on the River Severn catchment, one of the UK's largest and most flood-risk-prone river systems, in line with the Environment Agency's catchment-based approach. Priority locations include Worcester, Shrewsbury, and Kidderminster, which are identified as key flood risk management areas due to repeated fluvial flooding. Neighbouring settlements such as Bewdley and Stourport-on-Severn are also included, reflecting their downstream dependency and cumulative flood risk within the Severn Catchment Flood Management Plan (CFMP) area.

In accordance with EA integrated catchment management principles, the assessment includes major tributaries such as the River Stour (Kidderminster) and the River Teme. These watercourses significantly influence peak flows and flood behaviour within the main River Severn and are critical to managing fluvial flood risk at a catchment scale.

Infrastructure and Physical Flood Defences

The scope includes Environment Agency-led and partnership flood defence assets, including permanent engineered structures such as the Toronto Close Flood Alleviation Scheme (Worcester), along with current and proposed works in Bewdley and Severn Stoke. These assets are evaluated in line with EA asset performance standards, design levels of protection, and climate change allowances.

The project assesses the deployment, operational effectiveness, and maintenance of temporary and demountable flood defences, including those used in Ironbridge and Shrewsbury. Emphasis is placed on asset readiness, response times, and alignment with EA flood warning and incident response procedures.

In line with EA and DEFRA guidance on property-level protection, the study considers installed PFR measures such as flood doors, air brick covers, non-return valves, and sump pumps across properties in Evesham, Worcester, and Droitwich. Their performance is assessed in terms of damage limitation, recovery time, and long-term resilience.

Nature-Based Solutions (Natural Flood Management – NFM)

Consistent with EA Natural Flood Management policy, the project evaluates NFM interventions such as leaky woody dams, targeted woodland creation, soil management, and wetland restoration. These measures aim to reduce runoff rates, increase catchment storage, and attenuate peak flows during extreme rainfall events.

Opportunities for floodplain reconnection and flood storage in rural areas are assessed to increase natural water retention and reduce downstream flood risk. This aligns with EA objectives to work with natural processes and relieve hydraulic pressure on vulnerable urban areas such as Worcester and Shrewsbury.

Planning, Risk Management, and Data Integration

The project reviews the coverage and effectiveness of EA Flood Warning Services, including opportunities to expand warning areas, improve forecasting accuracy, and enhance community preparedness through better risk communication.

Strategic Flood Risk Assessment (SFRA) and Planning Policy

Updated Strategic Flood Risk Assessments (Level 1 and Level 2) are reviewed to support risk-informed spatial planning in accordance with the National Planning Policy Framework (NPPF) and EA planning guidance. Emphasis is placed on managing development within Flood Zones 2 and 3, applying the Sequential and Exception Tests, and avoiding inappropriate development in areas at highest flood risk.

Work breakdown structure

The work breakdown structure (WBS) for this project is organised into five interrelated components: **Flood Defences, Environmental and Ecosystem Management, Transport Infrastructure and Connectivity, Urban Planning and Development, and Emergency Preparedness and Response**. This structured approach ensures that flood risk management across Worcestershire and Shropshire is comprehensive, site-specific, and aligned with long-term resilience objectives.

Flood Defences

Flood defence interventions are tailored to the hydrological characteristics and exposure levels of each location.

In **Worcester**, particularly along **New Road and Hylton Road**, the strategy prioritises the continued maintenance and effective deployment of existing mobile flood barriers and pumping systems. These assets are critical for protecting key transport corridors and adjacent urban areas during periods of elevated river levels.

For **Shrewsbury**, with a focus on **Frankwell and Coleham**, flood risk management involves a combination of permanent and temporary defences situated within the River Severn loop. These measures are designed to reduce flood impacts on densely populated residential and commercial zones that are historically vulnerable to inundation.

In **Kidderminster**, along the **River Stour and the River Severn**, the programme includes the rehabilitation of flood retention basins to improve peak flow storage capacity, alongside targeted channel clearance works. These actions aim to enhance river conveyance, minimise obstructions, and reduce the likelihood of localised flooding.

Environmental and Ecosystem Management

Environmental sustainability is embedded within the flood management strategy through the implementation of the **Severn Valley Water Management Scheme**.

A key element of this approach is the development of **upstream natural flood management (NFM) areas**, which utilise natural processes to slow surface runoff and river flow, thereby reducing downstream flood risk. In parallel, comprehensive **water quality monitoring** is undertaken to identify and mitigate pollution arising from agricultural practices and urban runoff.

Biodiversity conservation is also prioritised through **riverbank restoration initiatives**, including the re-establishment of native vegetation. These measures support ecological resilience, stabilise riverbanks, and contribute positively to the overall health of the river system.

Transport Infrastructure and Connectivity

The protection of transport networks is essential to maintaining regional connectivity during extreme weather events.

This work package includes detailed **structural inspections of Worcester Bridge** and several **historic bridges in Shrewsbury** to assess vulnerability to flood-induced scour, structural fatigue, and hydraulic loading. Additionally, **drainage improvement schemes** are implemented along major routes such as the **A44 and A449**, with the objective of preventing surface water accumulation and reducing winter-related road closures.

Further measures are directed towards safeguarding critical **rail connections between Kidderminster and Birmingham**, including embankment protection and drainage reinforcement to prevent erosion, instability, and service disruption related to flooding.

Urban Planning and Development

Urban planning considerations underpin the long-term effectiveness of flood risk management strategies.

This component promotes **flood-sensitive land-use planning**, discouraging development within high-risk flood zones while encouraging resilient design in areas of moderate risk. The integration of **Sustainable Drainage Systems (SuDS)** within new and existing developments supports improved surface water management and reduces pressure on conventional drainage infrastructure.

Collaboration with local planning authorities ensures that regeneration and development projects are consistently aligned with broader flood resilience and climate adaptation objectives.

Emergency Preparedness and Response

Robust emergency preparedness and response mechanisms are essential to minimising human, economic, and infrastructural impacts during flood events.

Key actions include the deployment of **advanced early warning systems**, such as real-time river level sensors, to enable proactive decision-making. Coordinated **evacuation and road closure plans** have been developed in partnership between Worcestershire and Shropshire councils to ensure a consistent and efficient response across administrative boundaries.

Enhanced communication protocols further support timely information sharing between local authorities, emergency services, and affected communities, thereby strengthening overall flood response capability.

Quad Chart

Objectives Climate Resilience: Protecting ~3,000 homes and businesses from both floods and droughts. Nature-Based Solutions (NFM): Focus on "working with nature" to slow the river flow upstream. Economic Growth: Ensuring cities like Worcester remain "open for business" even during peak floods. 2030 Vision: Creating a vibrant, resilient ecosystem that supports agriculture and biodiversity.	Project Severn Stoke (Worcestershire): Construction of a £5 million embankment and drainage system started in April 2026. Demonstrator Projects: Installing leaky woody dams, planting 4,000 trees, and creating 8.6 ha of new habitats. Maintenance: Operation of mobile barriers in Shrewsbury and basin clearing in Kidderminster.
Timeline and Milestone Dec 2025 – Mar 2026: Public consultation on the "Emerging Plan" successfully completed. April 2026: Commencement of physical works at Severn Stoke. Christmas 2026: Projected completion of the Severn Stoke flood protection scheme. Early 2027: Presentation of the final SVWMS strategy to the UK and Welsh governments.	Resources and budget National Investment: £830 million allocated for 600 schemes across England for the 2026/27 fiscal year. Long-term Commitment: £10.5 billion pledged by the government through 2036 for flood defences. Partnership: Joint funding between the Environment Agency (£5M) and Worcestershire County Council (£250k).

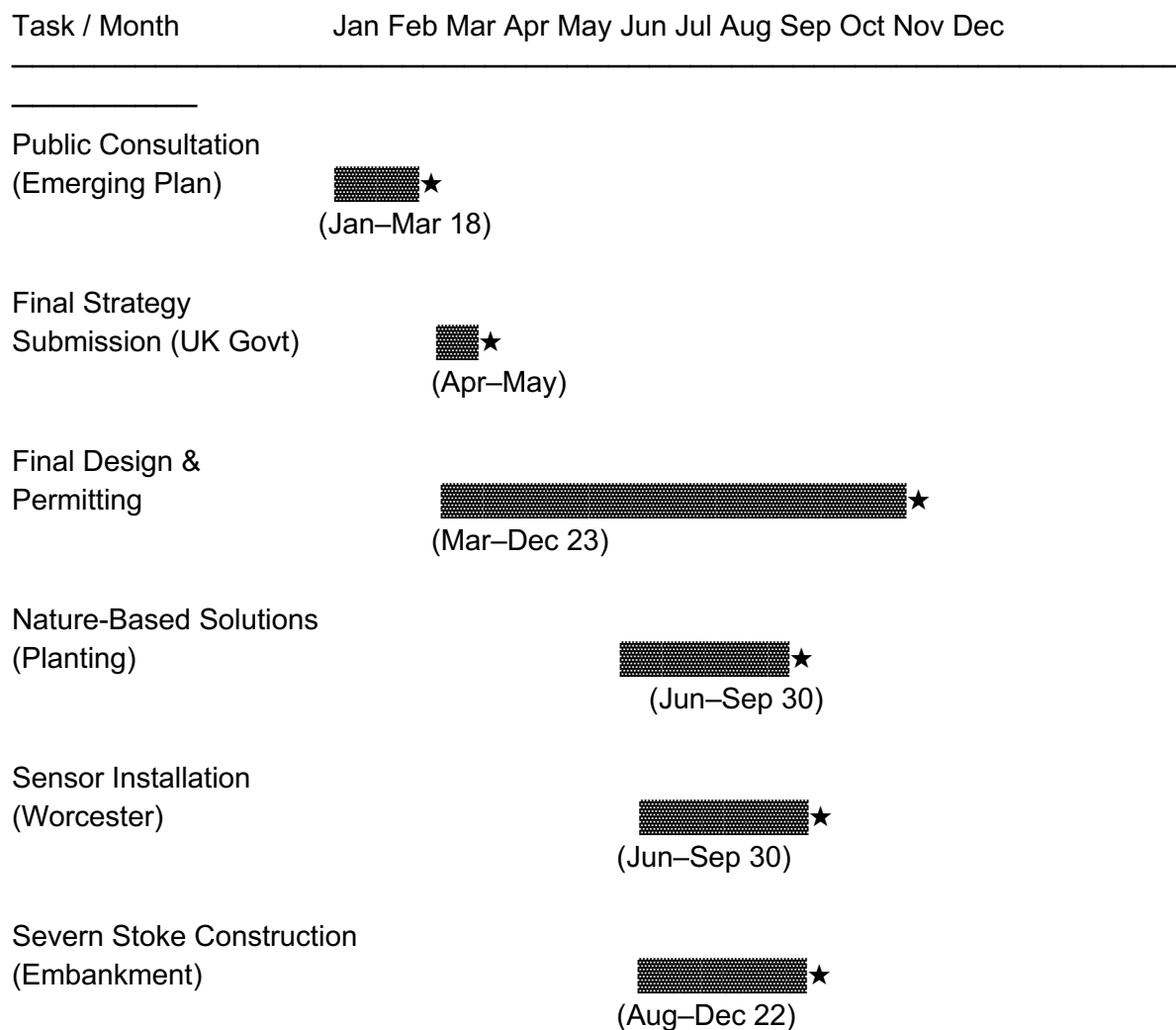
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Gantt timeline (2026)

Key

-  = active period
- ★ = milestone / deadline



Dependency logic

- **Public Consultation → Final Design & Permitting**
- **Final Design & Permitting → Construction**
- **Design progress informs Sensors & Planting**
- **Final Strategy Submission** follows consultation outcomes and early design

Critical Path

1. Public Consultation (Jan–Mar)
2. Final Design & Permitting (Mar–Dec)
3. Severn Stoke Construction (Aug–Dec)

Stakeholders’ involvement

Stakeholder involvement is essential to the effective delivery of this flood risk management and highway reopening project. Given its broad social, environmental, and infrastructural

impacts, collaboration between multiple organisations ensures coordinated planning and implementation.

The **Environment Agency (EA)** acts as the lead authority, providing strategic oversight, asset management, flood warning services, and technical guidance. **Local authorities**, including Worcestershire County Council and Shropshire Council, play a key role through their responsibilities for highways, spatial planning, emergency response, and community engagement.

Infrastructure operators, such as National Highways, Network Rail, and utility providers, support the protection of road, rail, and service networks, helping to maintain connectivity during flood events. **Residents and businesses** in flood-prone areas are engaged through consultations and preparedness initiatives, ensuring local knowledge informs decision-making and builds community resilience.

Environmental organisations, landowners, and agricultural stakeholders contribute to the delivery of Natural Flood Management measures, while **emergency services** support coordinated evacuation, road closures, and incident response. Together, these stakeholders enable a balanced and integrated approach to flood resilience and recovery.

Allocation of Resources

Resources for this project are allocated using a risk-based approach to support effective flood resilience across Worcestershire and Shropshire. **Financial resources** are primarily provided through Environment Agency funding, supported by local authority contributions and national flood defence programmes. Funding is prioritised for critical flood defences, transport infrastructure protection, and emergency response measures.

Human resources include engineers, environmental specialists, planners, and emergency response teams, deployed according to project phase. **Technical resources**, such as flood monitoring sensors, demountable barriers, and drainage systems, support risk assessment and rapid response. **Environmental resources** are delivered through partnerships with landowners to implement Natural Flood Management measures. Overall, resources are directed toward high-impact actions that protect communities, maintain connectivity, and support long-term resilience.

Risk Analysis

A structured risk analysis has been undertaken to identify and mitigate factors that may affect project delivery. **Flood and climate risk** is the primary concern, as increased rainfall intensity may exceed design thresholds; this is addressed through climate change allowances, adaptive design, and combined engineered and nature-based solutions. **Programme risks**, including planning delays and adverse weather, are managed through phased delivery and alignment with Environment Agency procedures. **Technical risks** related to asset performance are reduced through routine inspection, maintenance, and real-time monitoring. **Financial risks** are mitigated through contingency planning and partnership funding, while **stakeholder risks** are addressed via ongoing consultation and integration with local emergency planning. Overall, the project applies a proactive, resilience-focused risk management approach throughout its lifecycle.

Conclusion

This project highlights the importance of adopting an integrated, risk-based approach to flood risk management and infrastructure resilience across Worcestershire and Shropshire. By combining engineered flood defences, nature-based solutions, resilient transport infrastructure, flood-sensitive urban planning, and coordinated emergency preparedness, the study addresses both immediate flood impacts and long-term climate challenges, particularly within the River Severn catchment.

The use of a structured Work Breakdown Structure (WBS) ensured that interventions were comprehensive, site-specific, and aligned with Environment Agency standards, national policy, and climate change allowances. The inclusion of Natural Flood Management

measures alongside traditional defences demonstrates the value of working with natural processes to reduce peak flows and relieve pressure on vulnerable urban areas. In addition, the focus on safeguarding transport networks and reopening highways emphasises the critical role of infrastructure resilience in supporting economic activity, social connectivity, and community well-being during flood events.

Effective stakeholder engagement, targeted resource allocation, and proactive risk management were identified as key enablers of project success. Although flood and climate risks remain significant, the analysis shows that their impacts can be reduced through adaptive design, continuous monitoring, and coordinated governance. Overall, the project concludes that integrated and collaborative flood risk management is essential to enhancing resilience, reducing disruption, and protecting communities in the context of increasing climatic uncertainty.

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