

Are Sustainable Drainage Systems More Effective than Conventional Drainage in Managing Flood Risk?

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1. INTRODUCTION

Flooding in the UK is increasing due to:

- Urbanisation
- Climate change
- Overloaded conventional drainage systems

Conventional drainage systems aim to rapidly convey runoff but often become overwhelmed during heavy rainfall, leading to surface water flooding.

Sustainable Drainage Systems (SuDS) aim to:



- Manage water at the source
- Reduce runoff rates
- Mimic natural hydrology
- Improving water quality

AIM & OBJECTIVES

Aim: Assess the effectiveness of SuDS vs conventional drainage using hydrological modelling.

Objectives:

- Review flood risk and drainage practices in the UK
- Explain the key principles of SuDS and conventional systems
- Compare hydrological performance using key performance metrics
- Evaluate effectiveness of SuDS in reducing flood risk through hydrological modelling

FLOOD RISK CONTEXT

Increase in flooding frequency within the UK



Storm Christoph 2021:

- 198mm of rainfall over 72 hours in Wales
- 900 flooded properties in England
- Over 2,000 evacuations in England

Rising number of properties at risk of flooding:

Location	2020/21 Flood Report	2024/25 Flood Report
Wales	~ 291,070	~ 342,436
England	~ 5,671,000	~ 7,035,600

Key Drivers:



Climate Change



Urbanisation

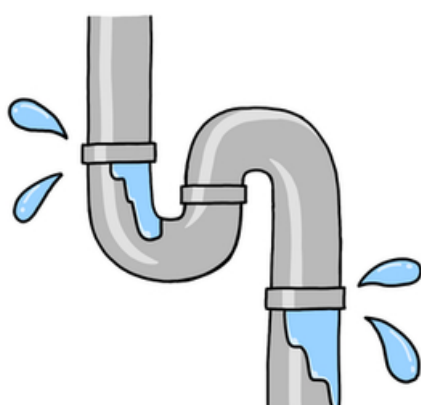


Reduced Infiltration

CONVENTIONAL DRAINAGE

Limitations:

- Overwhelmed during extreme rainfall
- Limited storage capacity
- Ageing infrastructure
- Unsuitable for climate change



2. METHODOLOGY

MODELLING APPROACH



- Hydrological simulation using InfoDrainage software
- Conceptual site layout of 5 dwelling residential development with associated infrastructure
- Two drainage layouts: SuDS and conventional drainage



RAINFALL DESIGN



- Return periods: 1 in 1, 30, 100 year
- +40% climate change allowance
- FSR rainfall method
- Multiple storm durations (15 - 1440 minutes)

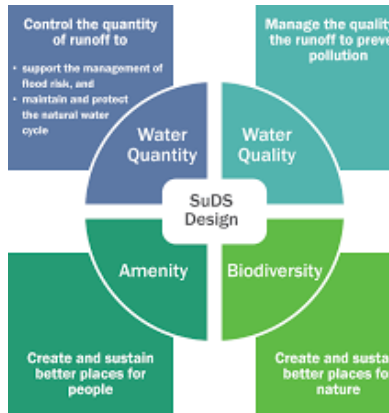


INFILTRATION SCENARIOS



Scenario	Infiltration (m/hr)	Typical Soil Type
High	0.25	Sandy Gravel
Low	0.025	Loam
None	0	Clay / Concrete (Impermeable)

SuDS DESIGN (TREATMENT TRAIN APPROACH)



- Permeable paving (driveways)
- Swales (conveyance & storage)
- Detention Basin (primary attenuation)
- Designed using **CIRIA C753 guidance**



PERFORMANCE METRICS



- Peak flow rate (L/s)
- Runoff Volume (m3)
- System status: "OK", "Surcharging", "Flood Risk", "Flood"
- Available capacity (%)

LIMITATIONS



- Simplified survey data (DEM based)
- FSR rainfall method over FEH for simplicity
- Standardised conventional drainage design
- Idealised SuDS performance
- No existing soil moisture consideration
- No maintenance degradation

3. RESULTS SUMMARY

CONVENTIONAL DRAINAGE

- Peak flow 17 to 47.7L/s
- No attenuation capacity
- System surcharge & flooding in extreme events
- Direct rainfall response

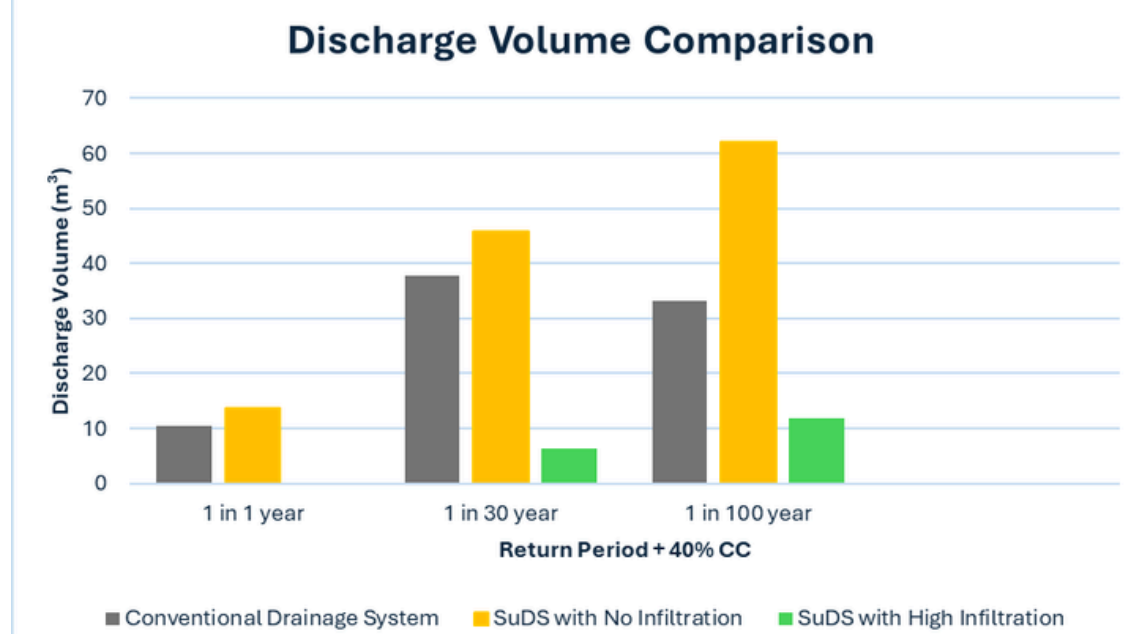
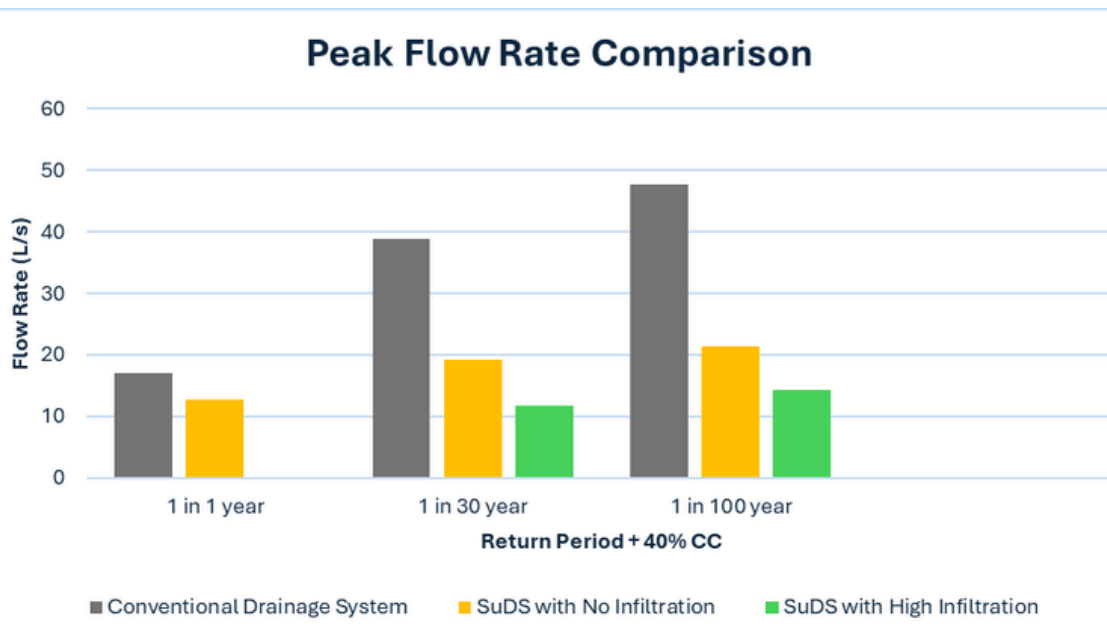


SuDS PERFORMANCE

High Infiltration Low Infiltration No Infiltration

- High Infiltration:** Strong attenuation, Very low peak flows, No outflow in small storms
- Low Infiltration:** Moderate increase in flow, System is still operational
- No Infiltration:** Higher discharge (up to 63m3), Localised flooding under extreme events

COMPARATIVE ANALYSIS



✓ SuDS consistently lower peak flows than conventional system

✓ Best performance under high infiltration

✓ Conventional drainage shows increasing hydraulic loading with storm intensity

✓ No infiltration increased delayed discharge volumes

SuDS significantly improves flood attenuation!

DISCUSSION

- SuDS reduce peak flow and runoff volume
- Conventional systems show rapid exceedance
- Detention basin is the key attenuation feature
- Infiltration is the main performance driver



LITERATURE AGREEMENT

- Supports Coventry modelling results
- Proves that conventional systems focus on rapidly conveying runoff
- Matches Lamb Drove findings (peak flow reduction + lag time increase)

4. CONCLUSION



SuDS are more effective than conventional drainage systems in managing flood risk.

- Lower peak flows across all scenarios
- Reduced flood risk under moderate to high rainfall
- Performance strongly depends on infiltration capacity
- Conventional systems fail under extreme rainfall events
- Improved runoff attenuation compared to conventional drainage

5. DESIGN IMPLICATIONS



SuDS should be implemented within new developments.

- SuDS should replace conventional systems in new developments
- Infiltration testing is essential in early design
- SuDS treatment train approach improves resilience
- Early engagement with local authorities is essential for effective SuDS implementation

6. FUTURE WORK



Future research is highly recommended to maximise long term effectiveness

- Long term performance monitoring
- Seasonal soil moisture variation
- Larger catchment modelling and monitoring
- Field work vs simulation result comparison
- Variation in SuDS components to assess how they work together