

*With thanks to:*

**Thames Water Utilities Limited**



# RESTORATION DESIGN FOR REROUTED WATERCOURSES



# Project Design Team

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**Geomorphology**

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**GIS and Mapping**

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**Channel Design**

**Kieran Conlan, Steve Dangerfield**

**Project Management**

**Tom Coulthard**

**Sediment Modelling**

**Steve Dunthorne**

**Hydraulics**

**Jenny Mant**

**River Restoration**

**Nick Reynard**

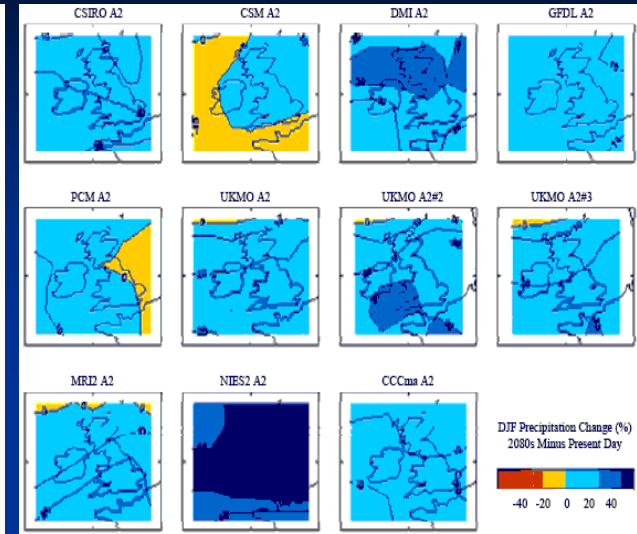
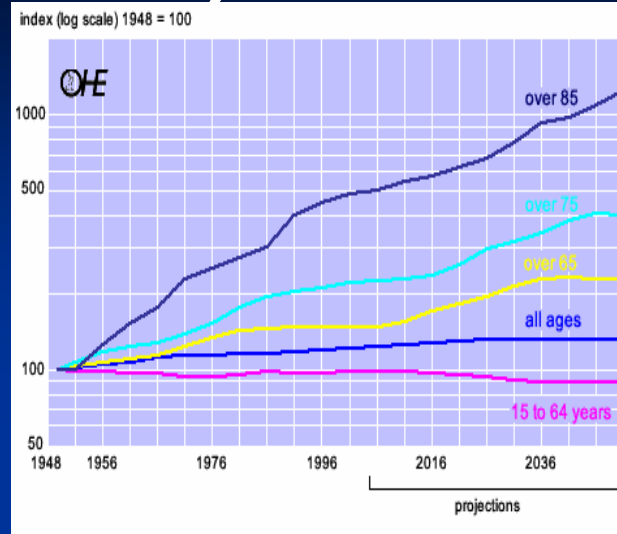
**Climate Change**

# Overview

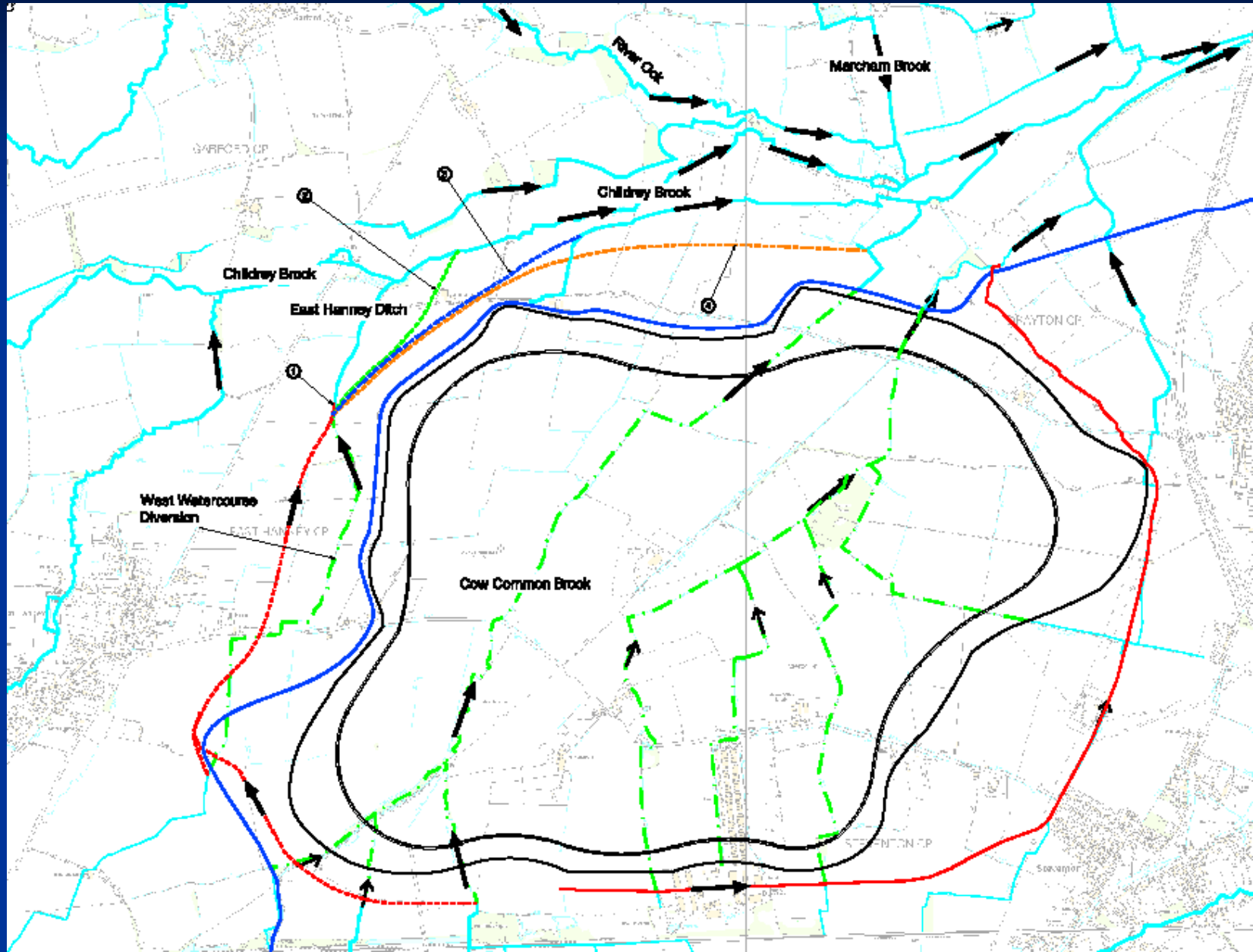
1. Project Context
2. Need to Reroute Watercourses
3. Watercourse Design Objectives
4. Design Elements and Tools
5. Design Outcome
6. Conclusions

# 1. Project Context

- Significant difficulties predicted in supplying sufficient water in the Southeast over the next 25 years.
- A preferred solution is an embanked reservoir.
- But, there are objectors who will challenge every aspect during Planning Enquiries.



# 2. Need to Reroute Watercourses



# 3. Watercourse Design Objectives

## Core design criteria:

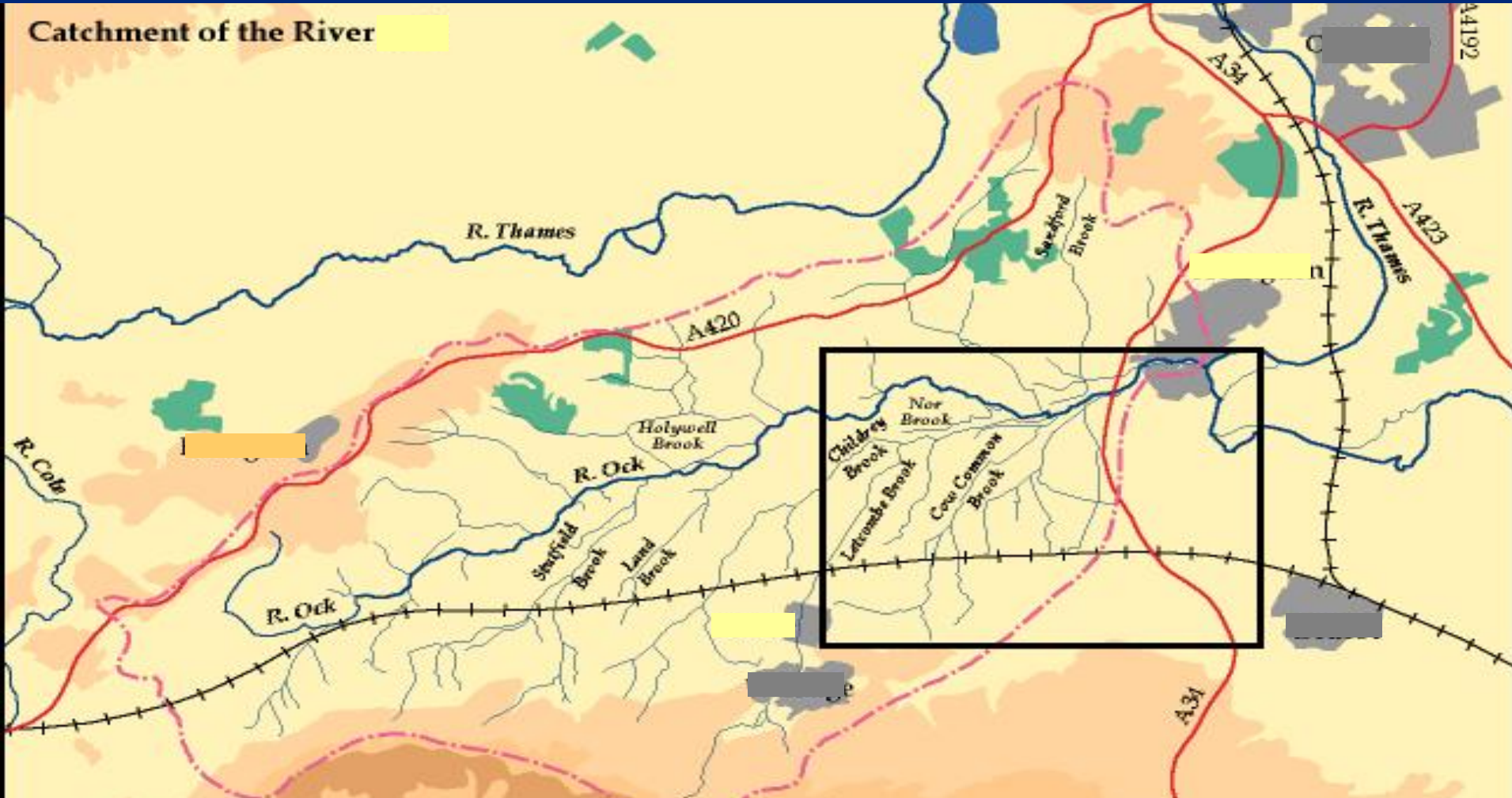
- Flood storage compensation
- Surface water drainage and conveyance
- Maintain sediment regime
- Biodiversity gains

## Key assessment criteria:

- Local community acceptability
- Minimise future maintenance



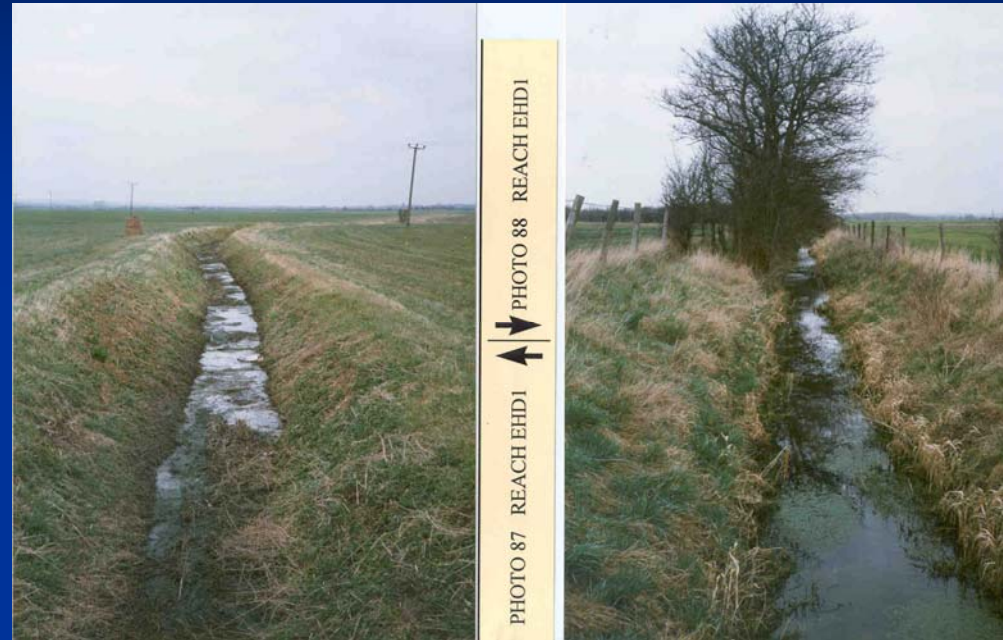
# Catchment Baseline Survey



# Underlying Geology



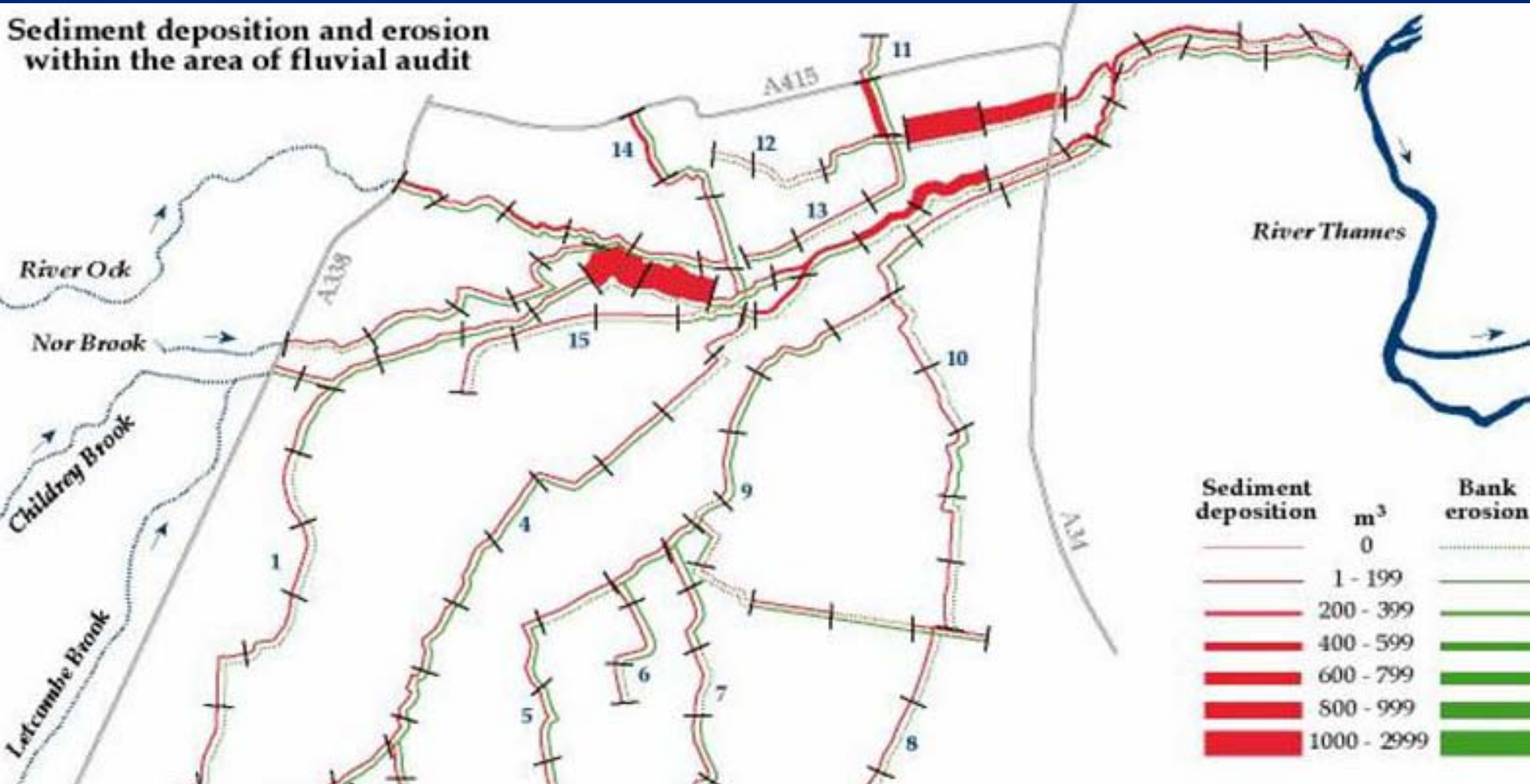
# Geomorphologic Susceptibility



Channel Susceptibility	Catchment Totals		Channels not directly affected by proposed reservoir		Channels directly affected by proposed reservoir	
	Length (km)	Percentage	Length (km)	Percentage	Length (km)	Percentage
High	5.57	4.76	5.57	6.59	0	0
Moderate	39.78	34.03	39.08	46.21	0.7	2.17
Low	70.83	60.59	39.45	46.64	31.38	97.09
<u>Channelized</u>	0.72	0.62	0.48	0.57	0.24	0.74
Total	116.90	100	84.58	100	32.32	100

# Fluvial Audit

Sediment deposition and erosion within the area of fluvial audit



# Reference Reaches



Meandering planform with cut banks



Complex cross-sections and margins

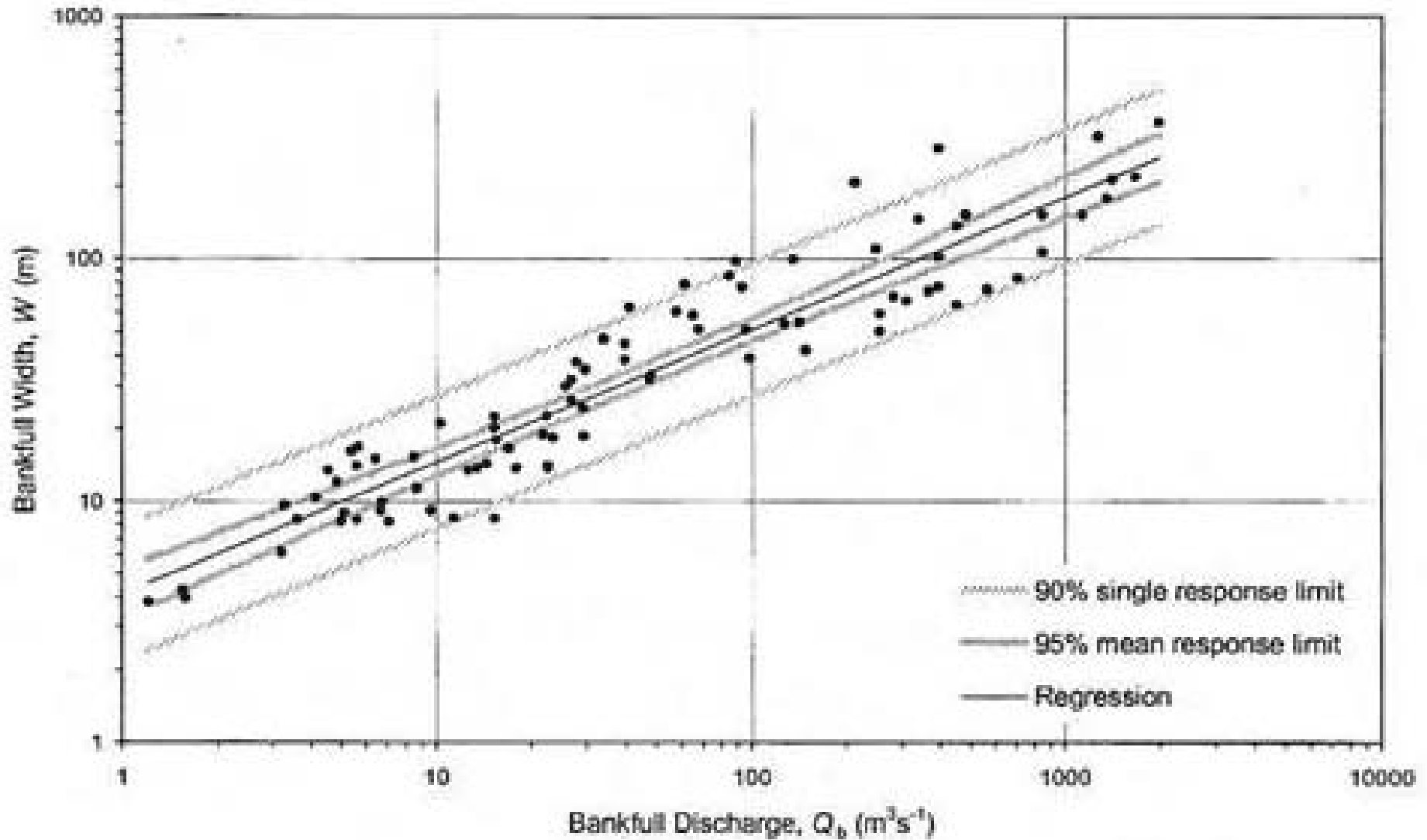


Wood jams and complex flows



Riparian corridor to trap and store silt

# Regime & Hydraulic Geometry Analysis



# RRC experience with clay streams

“Above all, remember that whatever bank profile you dig will be there for a long time and that re-adjustment can be a very slow process”

*What you build  
is what you get!*



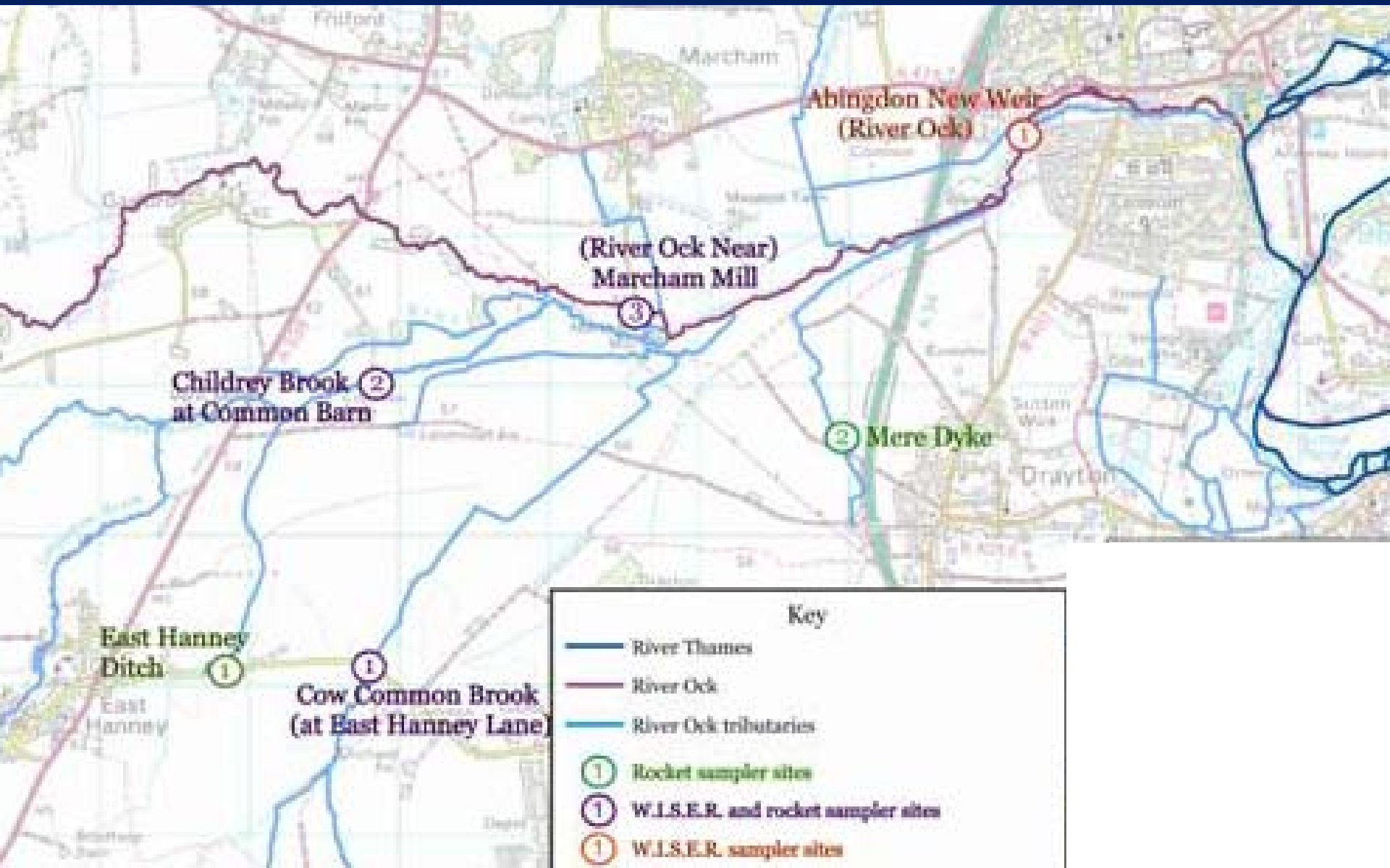
River Wandle – as built (1998)



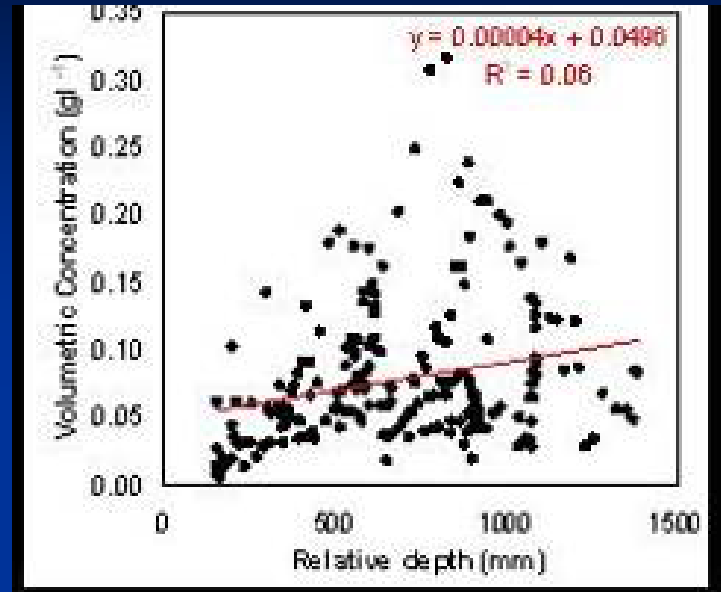
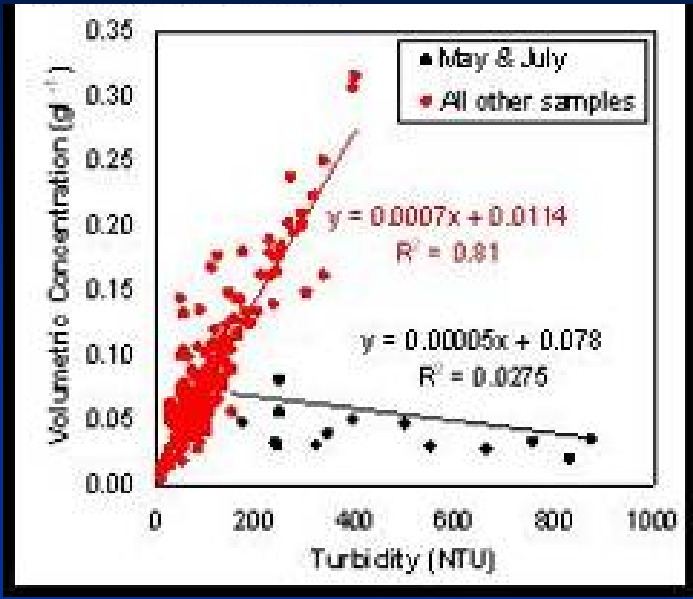
River Wandle – 8 years on (2006)



# Sediment Monitoring

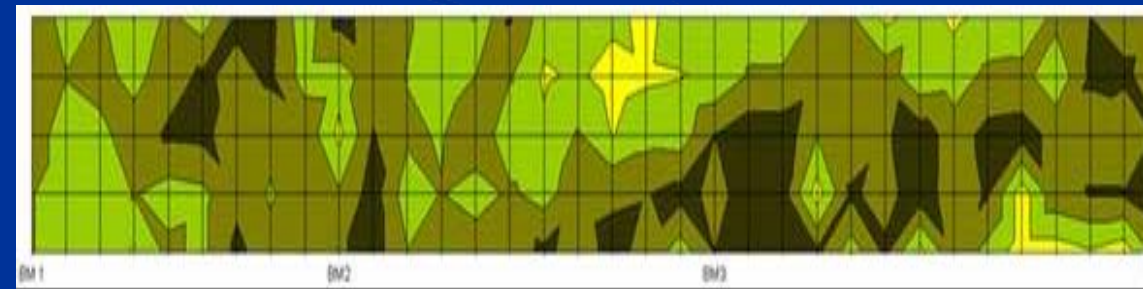
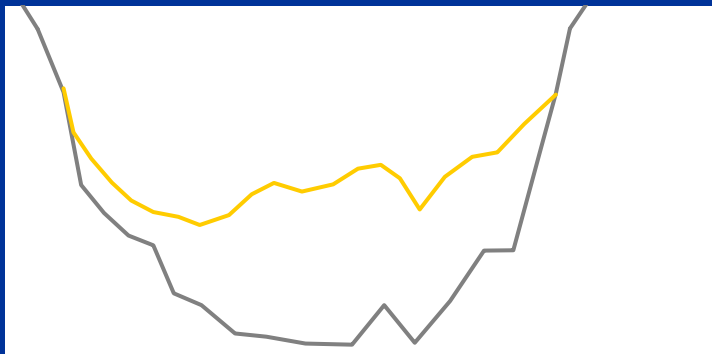


# Sediment Monitoring Results



Turbidity not simply related to suspended sediment concentration

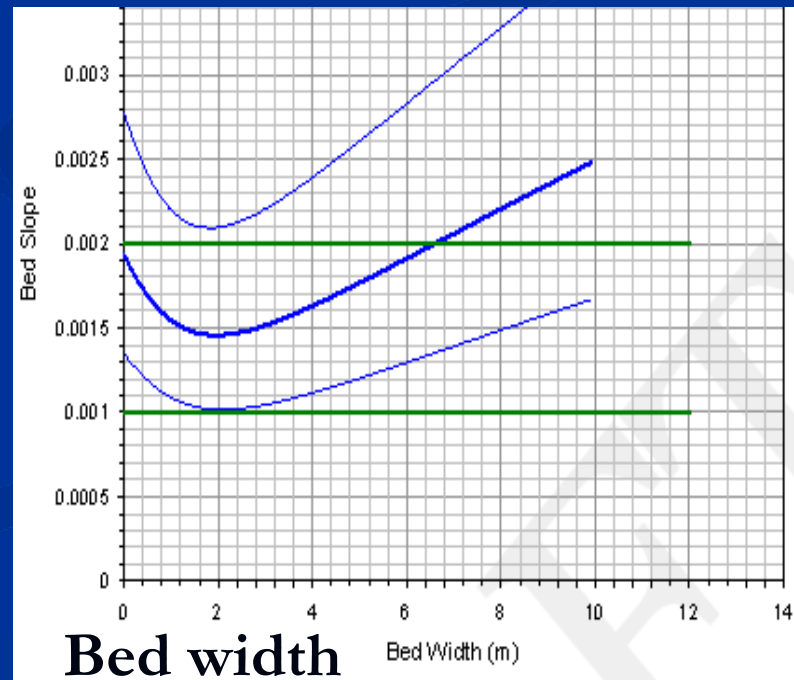
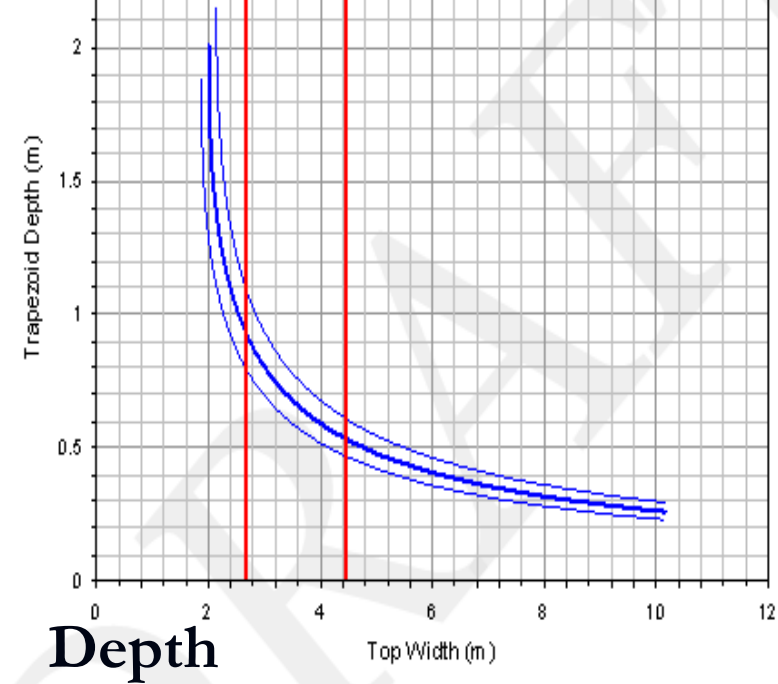
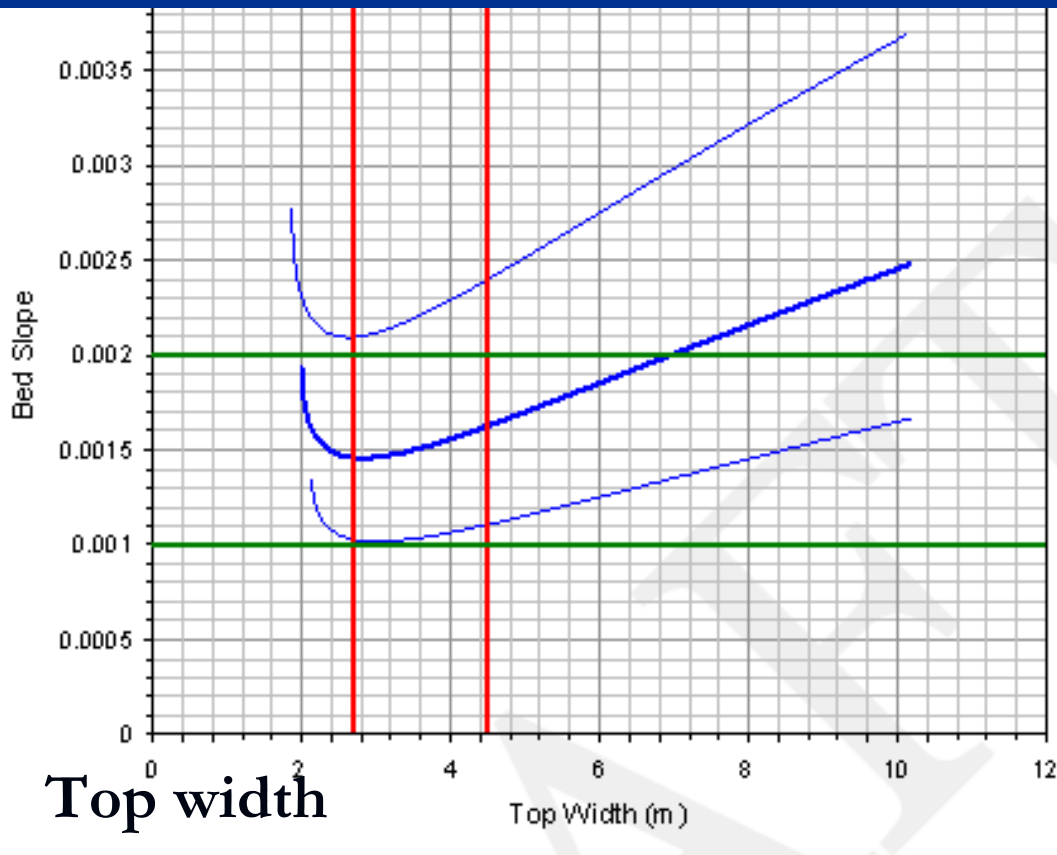
No significant relationship between suspended load and flow intensity



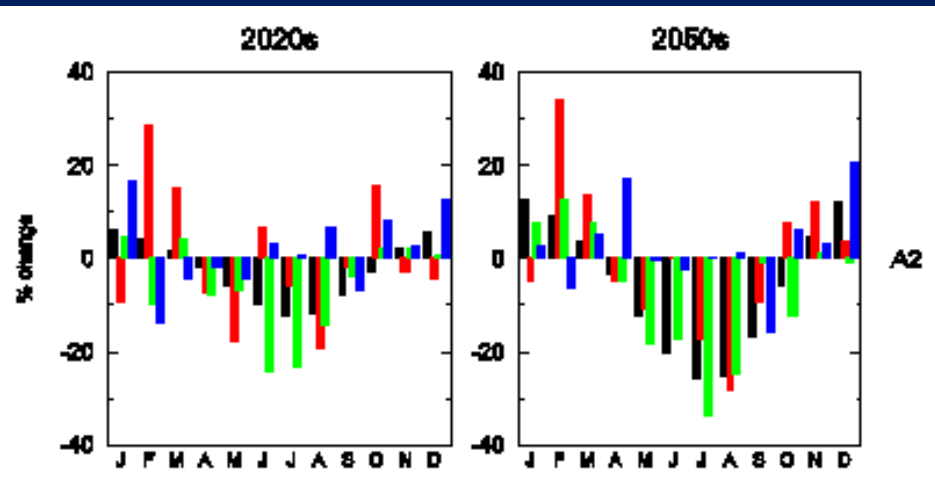
Channels prone to siltation

Gravel/sand bed smothered by layer of silt-clay 0.1 to 0.8 m thick

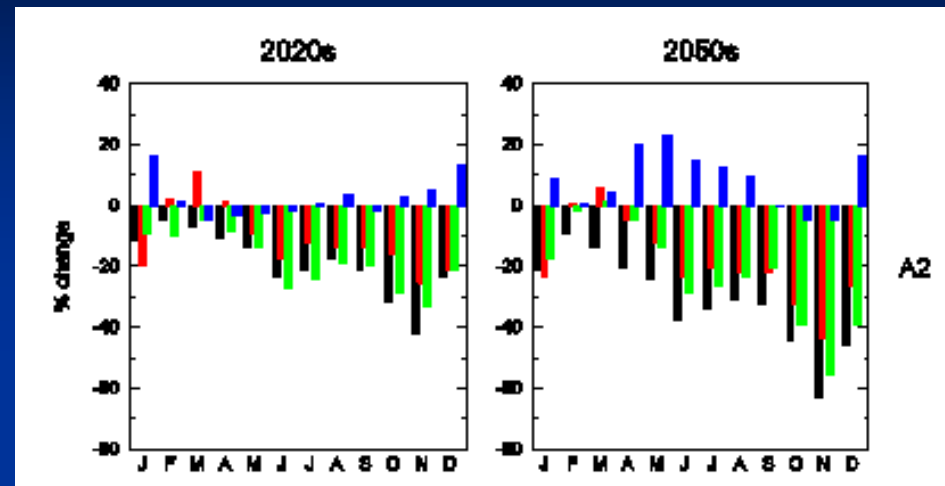
# Copeland Method - Design Curves



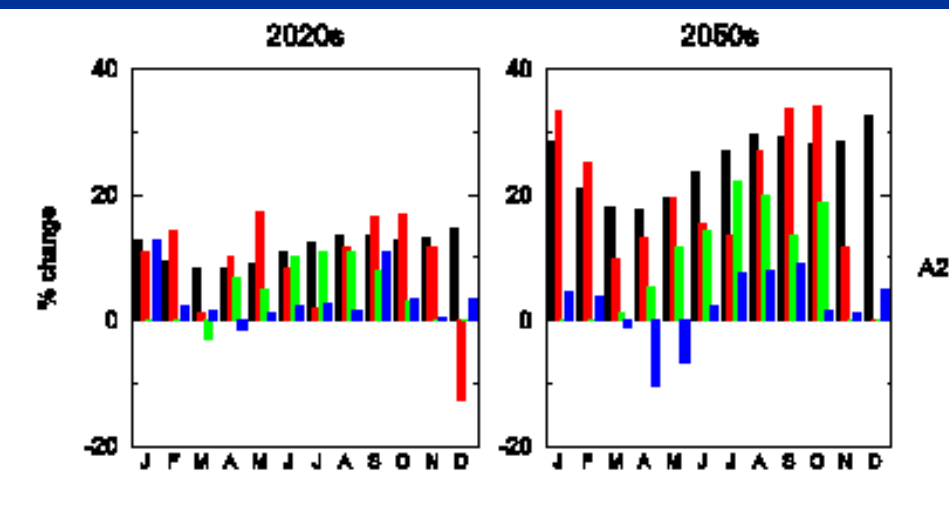
# Climate Change Predictions



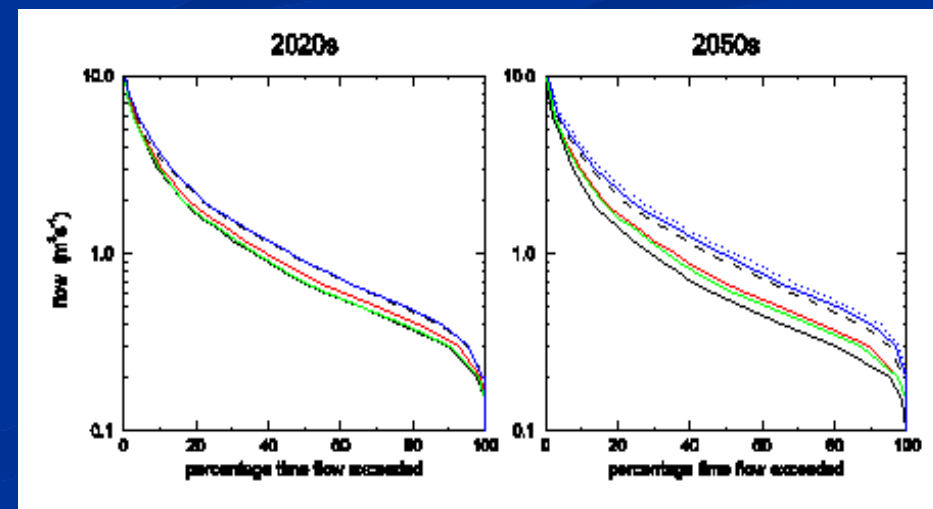
Rainfall



Average Discharges

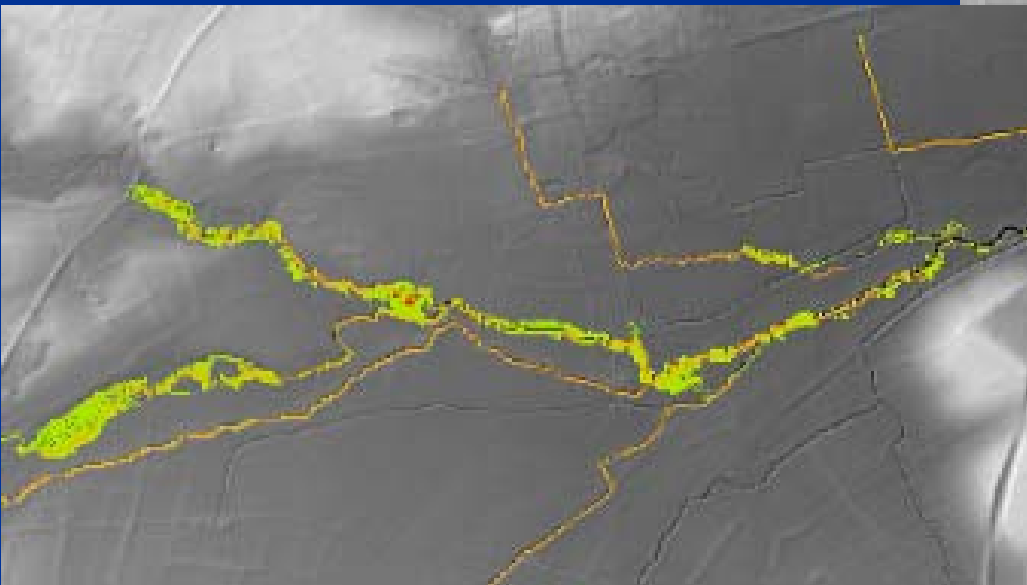


Evapotranspiration

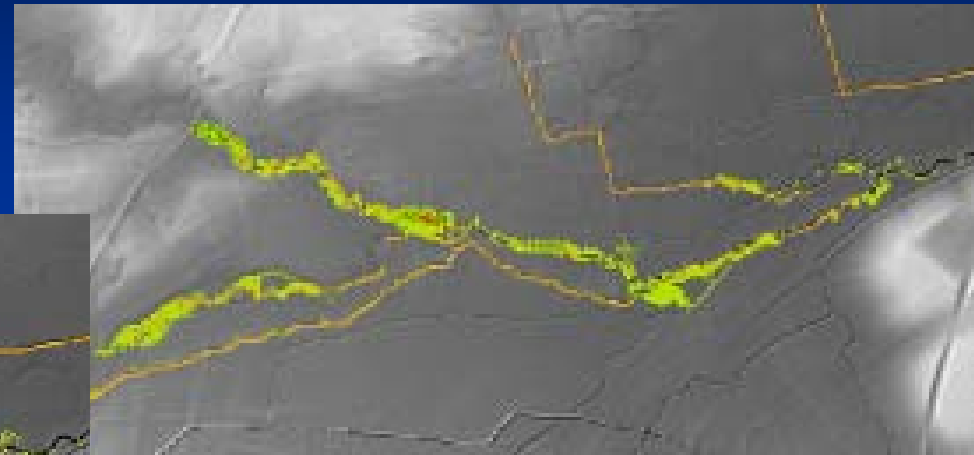


Flow Duration

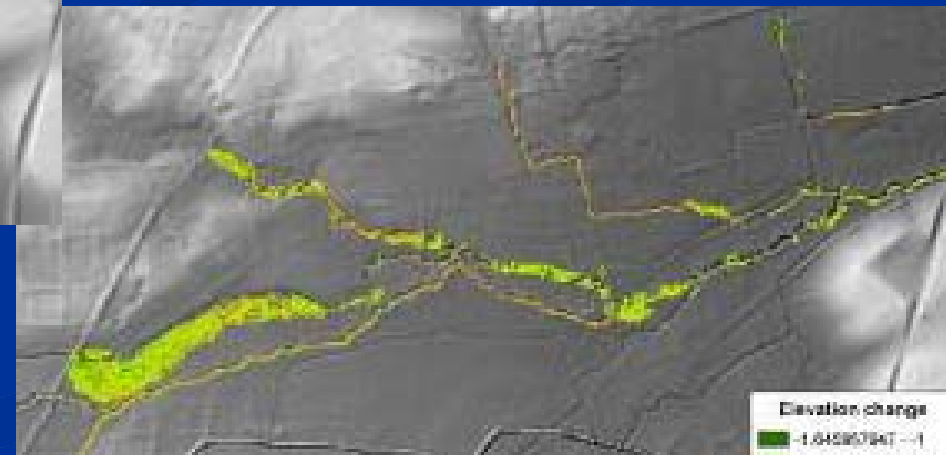
# Longterm Sediment Modelling



2050 – without project



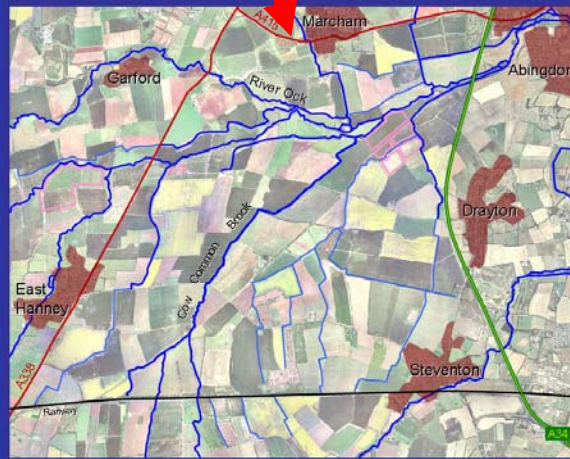
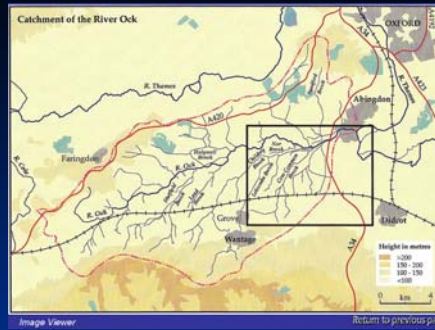
2050 -- with project



2050 -- with project and climate change

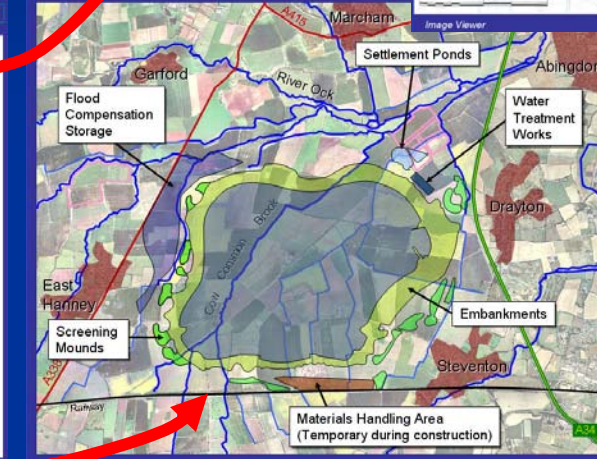
# Reservoir Interactive CD

Next >



EXIT X

View wider context



Impact of climate change on the flows of the River Ock

Sue Crooks, Nick Reynolds and Helen Davies

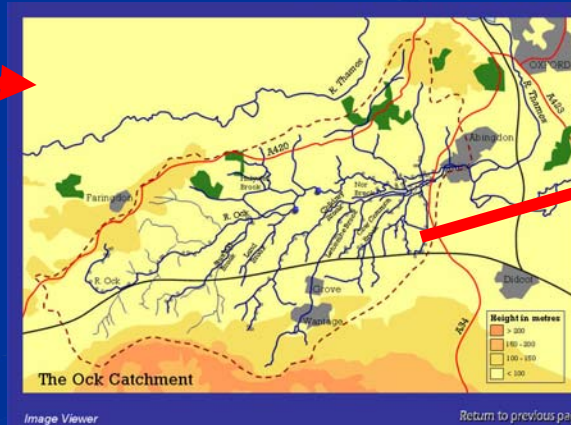
**Introduction**

The Ock is a tributary of the Thames, joining it at Abingdon, a few kilometres downstream of Oxford. The purpose of this short report is to determine the potential impact of climate change on the flows of the river using a continuous simulation rainfall-runoff model with a limited range of climatic change scenarios.

**Hydrological modelling**

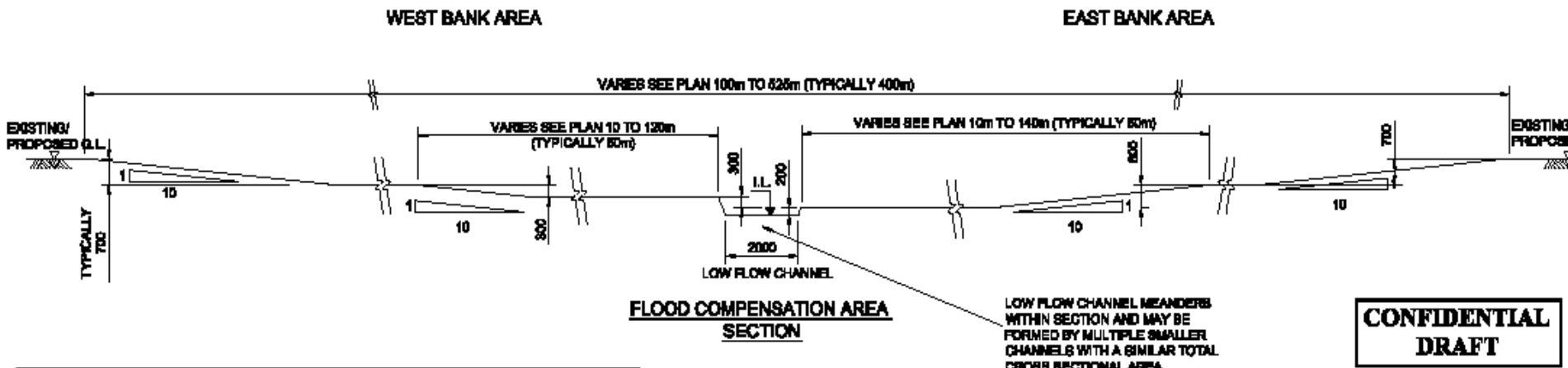
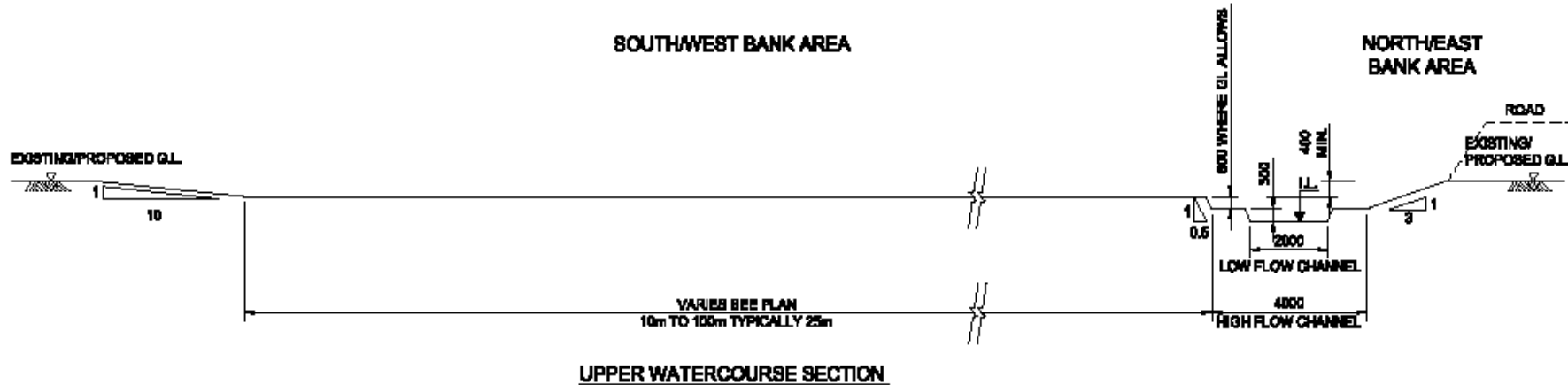
The semi-distributed rainfall-runoff model, CLASSIC (Climate and Land-use Scenario Simulation in Catchments), has been used for the impact assessment and has also been used in previous climatic change impact studies (Reynolds et al, 2001, 2004). The model comprises three component modules: for soil moisture balance, soil drainage and channel routing and is applied on a grid framework with climatic inputs of rainfall and potential evapotranspiration to each grid square.

The model was setup for the Ock using a 20 km grid size previously used for modelling the Thames catchment to Kingston. Land use and soil type are used to determine the initial parameter values for each grid while those for the channel routing and flow values for the soil moisture and soil drainage parameters are obtained through calibration. The model is normally run at a daily time step using grid square averages of observed daily rainfall (Osman, 1995) and M05RECS monthly PE (Thompson et al, 1992) divided equally into daily values to simulate mean daily flow. The model was calibrated using observed mean daily flows for the catchment to the gauging station at Allott Oxendon (National Water Archive (NWA), 1000210181030000 reference number 10001), and reference NS1 481960) with records from October 1962. The calibration procedure provides a good fit between observed and modelled runoff both for response during flood events and baseflow recession characteristics, as well as ensuring that the long term modelled water





# Watercourse Diversion Design Template



# 6. Conclusions

- Provided a practical demonstration of the value of using of *multiple* design tools and team work.
- Highlighted the challenges of river restoration design with tight budgets and time constraints.
- Produced a design template that meets the needs of the client AND is acceptable to regulators.
- Demonstrates the value of interdisciplinary collaboration.
- Design matches form to function, providing a sustainable basis for optimisation of biodiversity.