Hydrological extremes and feedbacks in the changing water cycle (HydEF)

Imperial College London
British Geological Survey
University of Reading
University College London

Board meeting 2, February 15th 2012, Imperial College

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

The role of groundwater in the changing water cycle for the Thames and Eden catchments: An update of BGS activities

Imperial College- 15th February 2012

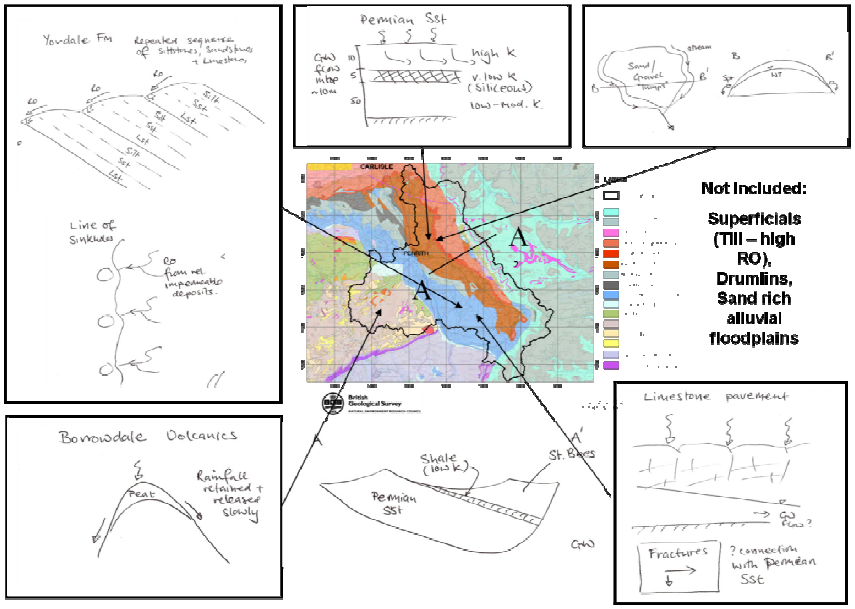
Denis Peach, Chris Jackson, Stephanie Bricker
and Andrew Hughes

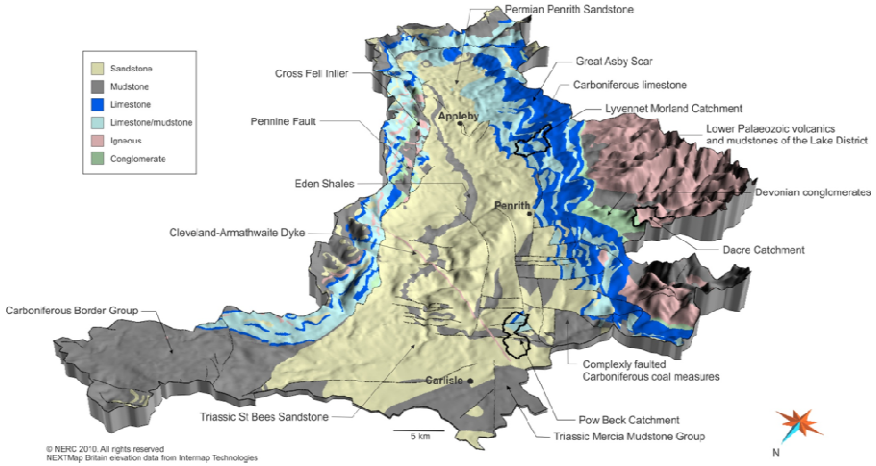
HydEF – Summary of BGS' tasks

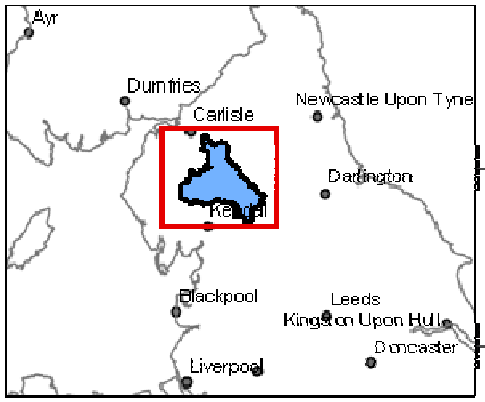
Catchment	Area	Geology	Issue	Current understanding	Approach
Eden	DTC test catchments	Permo-Triassic Sandstone overlain by superficials	Groundwater availability during drought	Good - background u/s Limited – DTC catchments	Develop CM and GW model – recharge through superficials likely to be higher important
Thames	Oxford	Oxford Clay overlain by superficials	Groundwater flooding	Very good	Build on existing understanding/model
	Pang and Lambourn	Chalk overlain by superficials	Groundwater flooding and drought	Very good	Build on existing understanding/model
	Cotswolds Jurassics	Sub-karstic limestone and complex structure	Baseflow to River Thames during droughts	Limited	Develop understanding of whole area then apply simplified approach.
	Colne Valley	Chalk overlain by superficials	Behaviour of adited sources during droughts	Good in valleys, poor elsewhere	Extend MaBSWeC to east by one catchment and then develop understanding/simulation of adited sources in the Colne Valley.
Isle of Wight	Chalk	Cretaceous overlain by superficials	Groundwater availability during drought	Good - background u/s	Develop understanding of whole area then support PhD student.

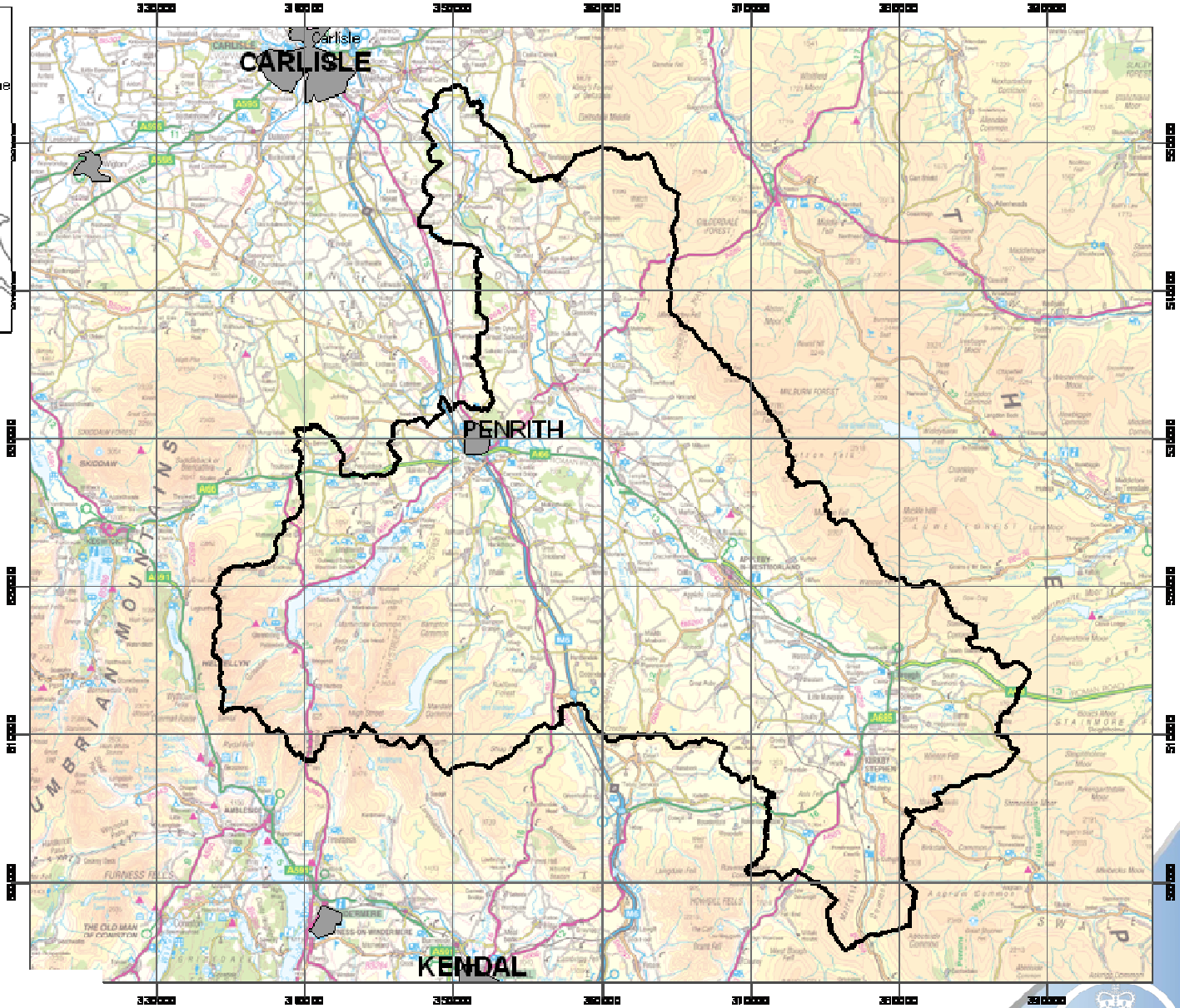
HydEF – Eden Valley

- Geological understanding: Catchment scale, Lazonby Gorge and granulation seams
- Hydrogeological understanding – DTC
- Project-based: conceptualisation









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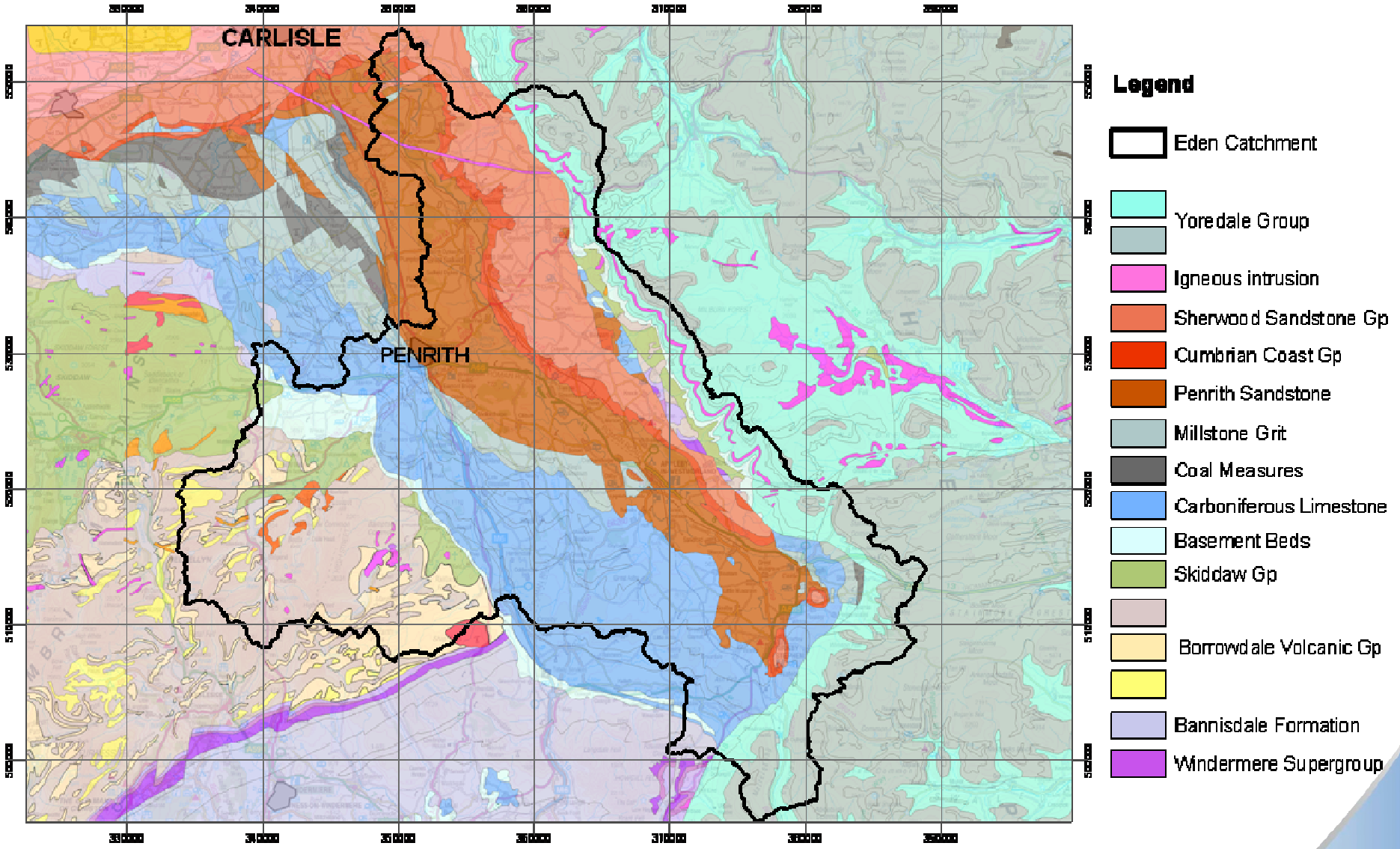

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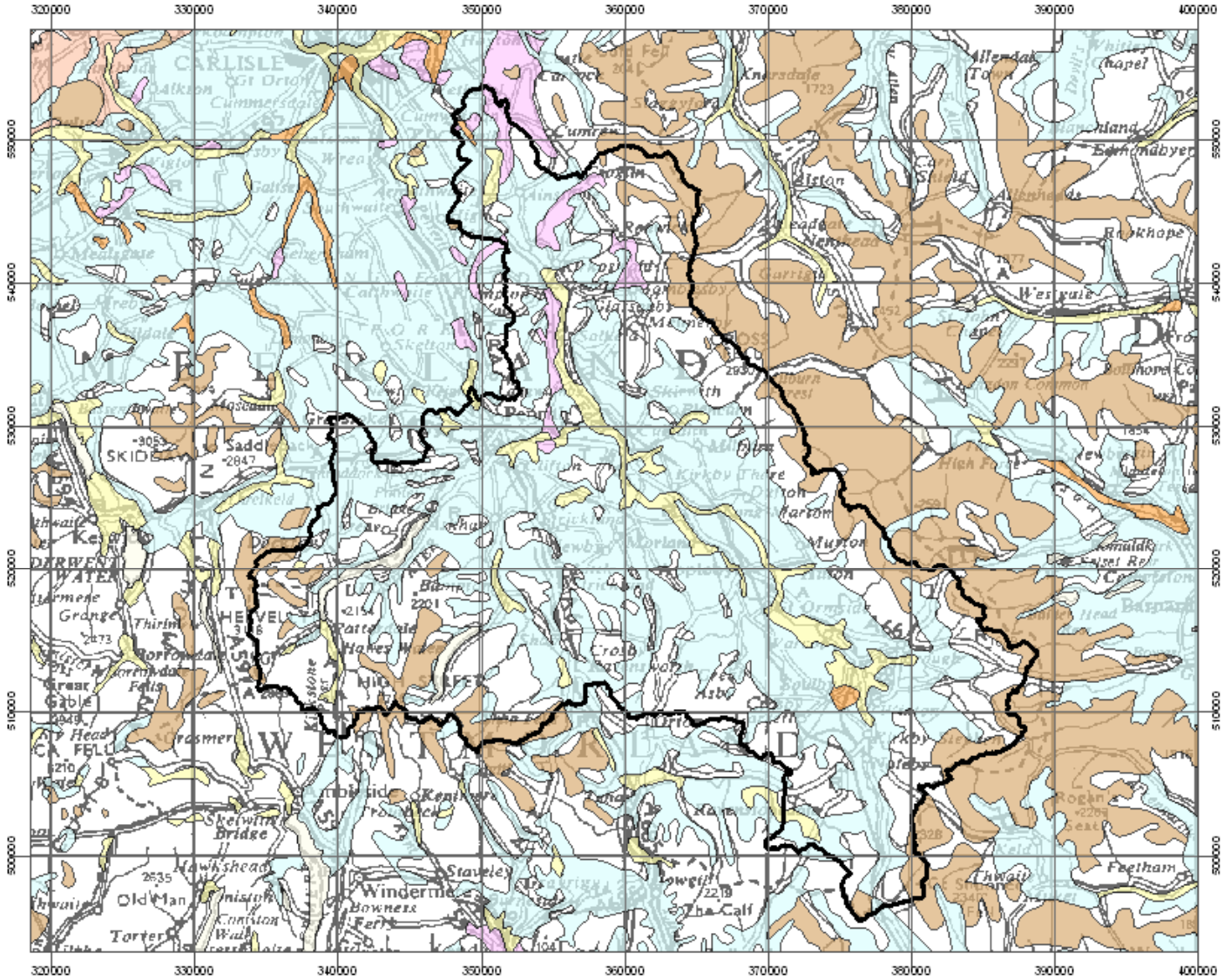

Superficial deposits within the Eden Catchment

Legend

- Eden Catchment
- Alluvium
- Glacial Sand and Gravel
- Peat
- Raised marine deposits (Sand and gravel)
- River Terrace Deposits (Sand and gravel)
- Till
- Unknown

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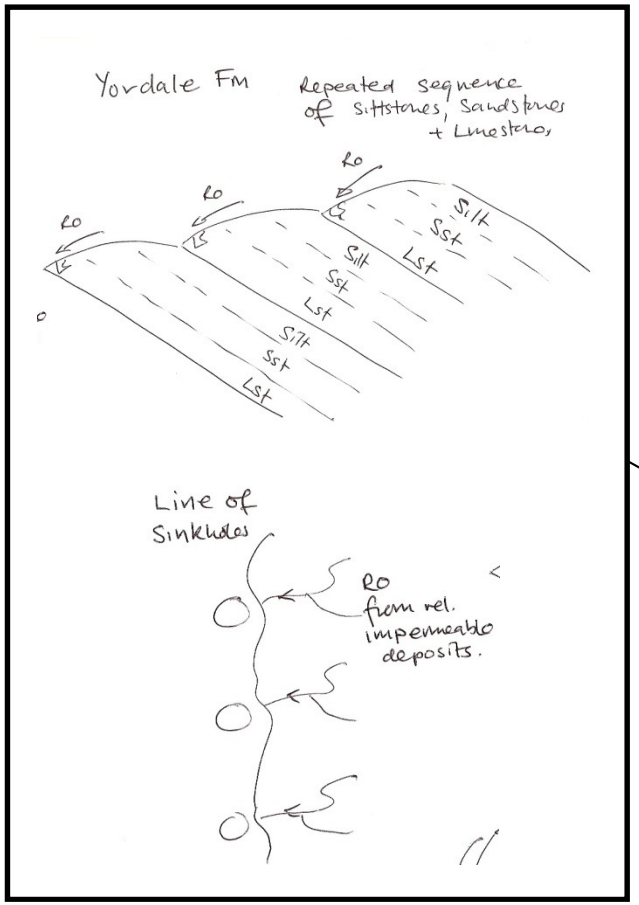
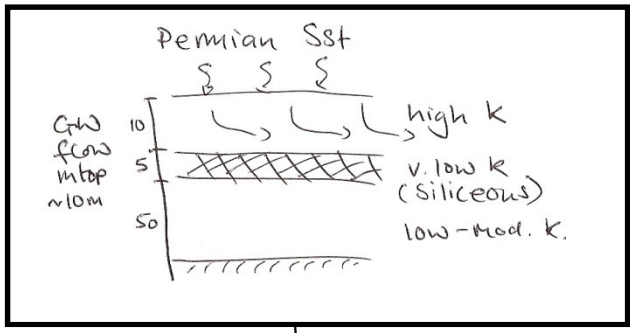
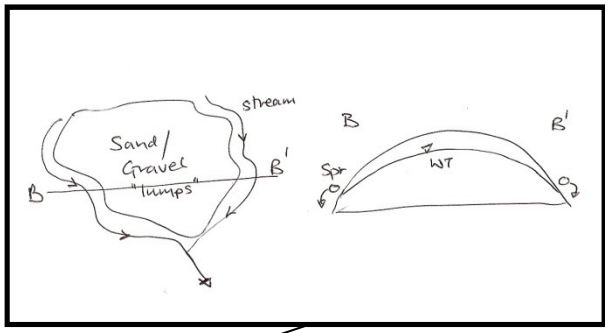
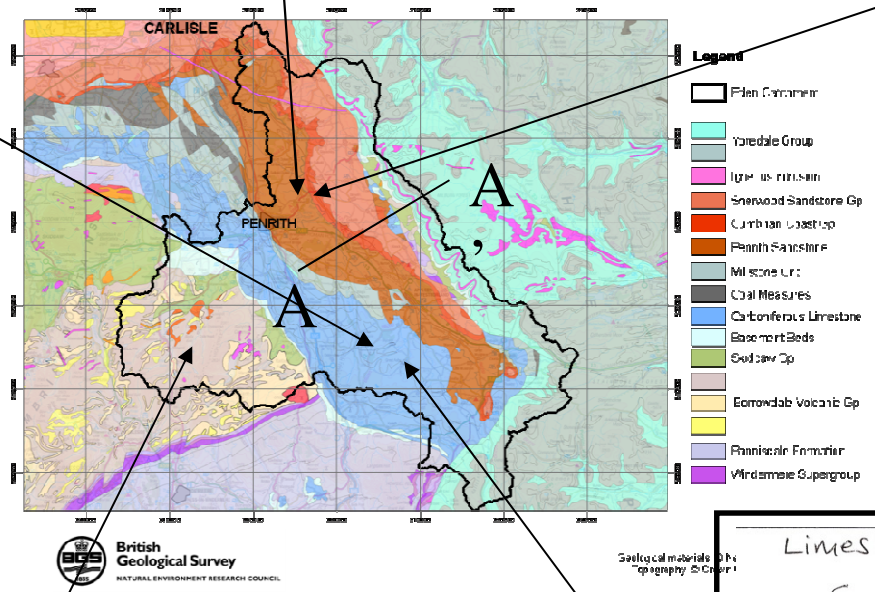


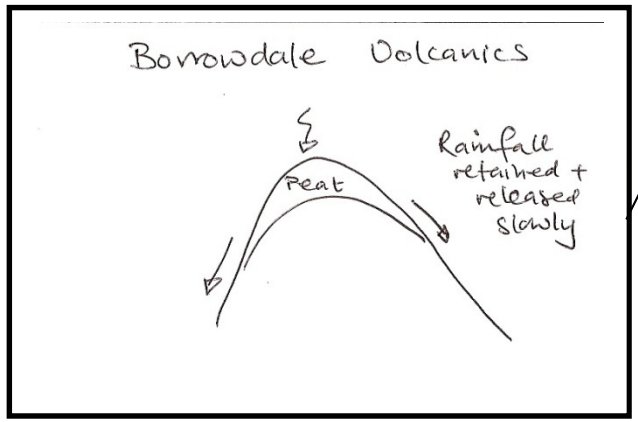


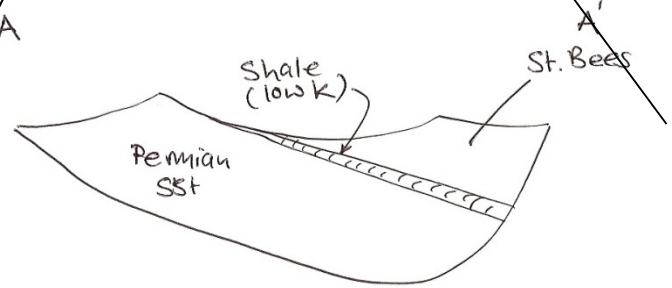


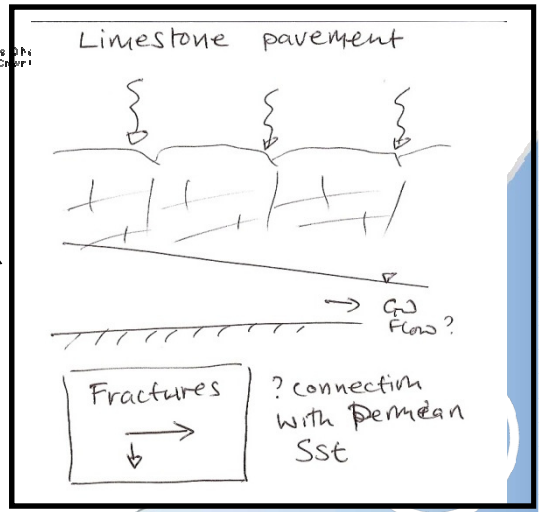


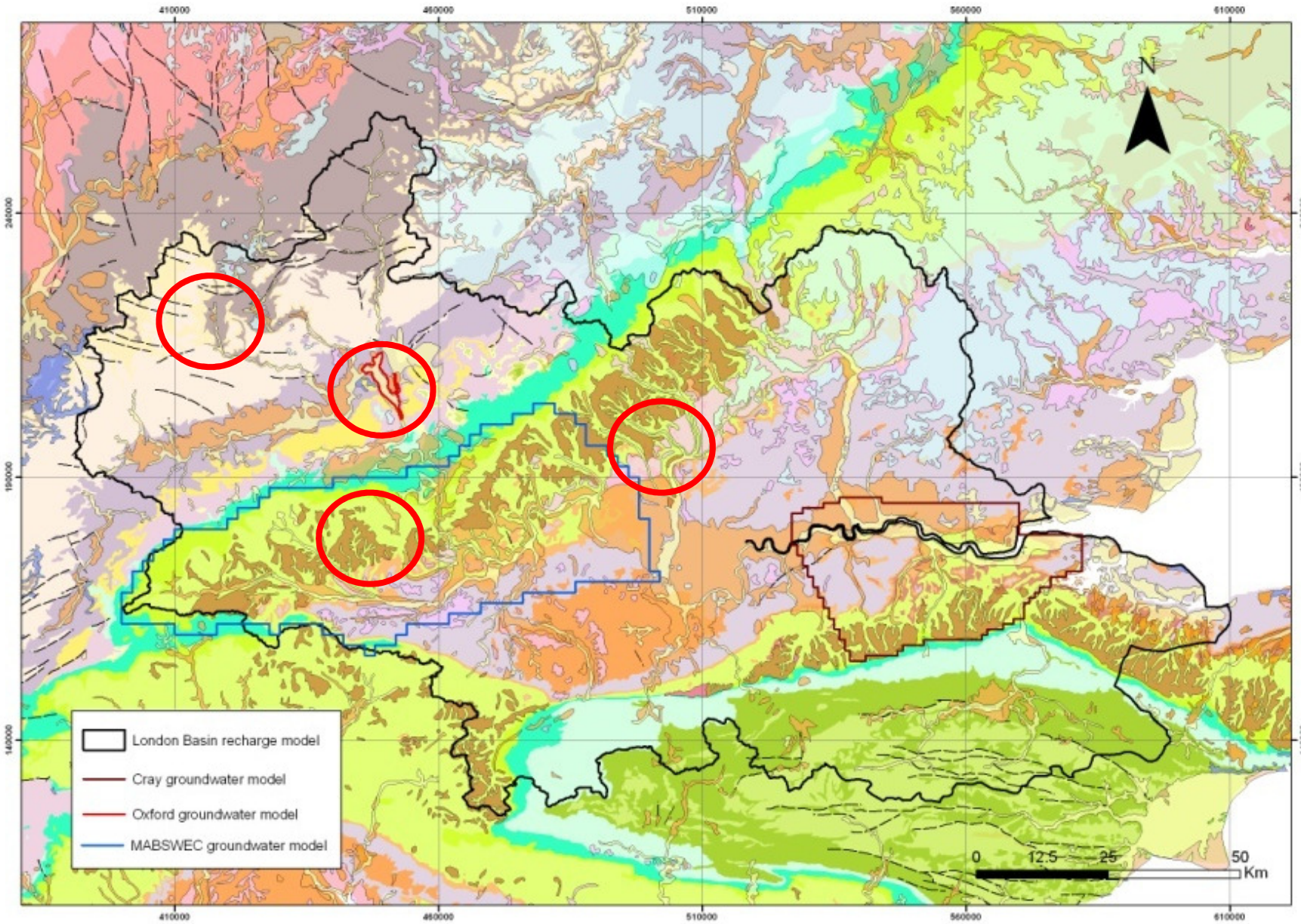
Not included:

Superficials (Till – high RO), Drumlins, Sand rich alluvial floodplains

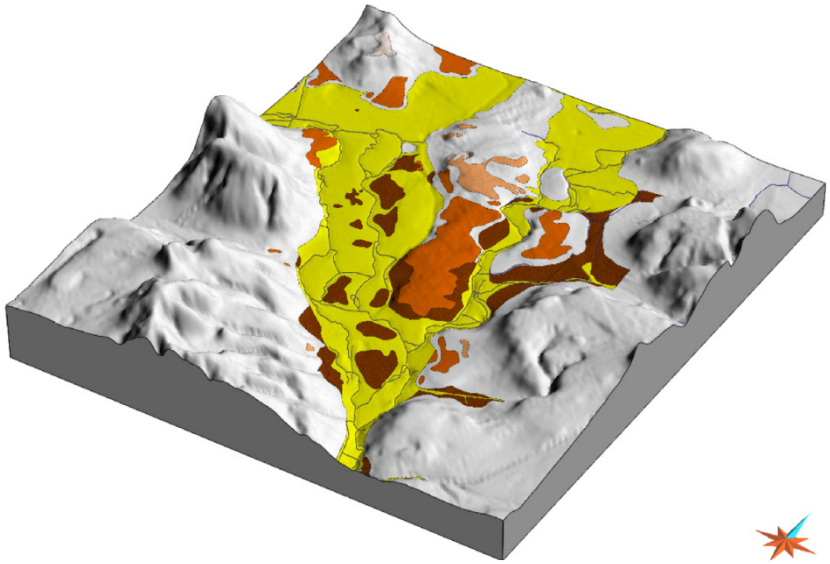




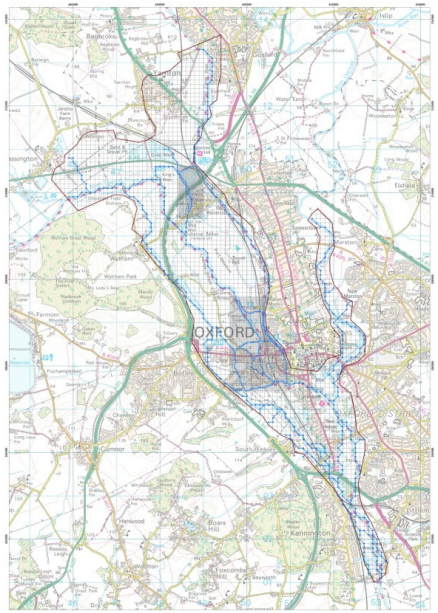


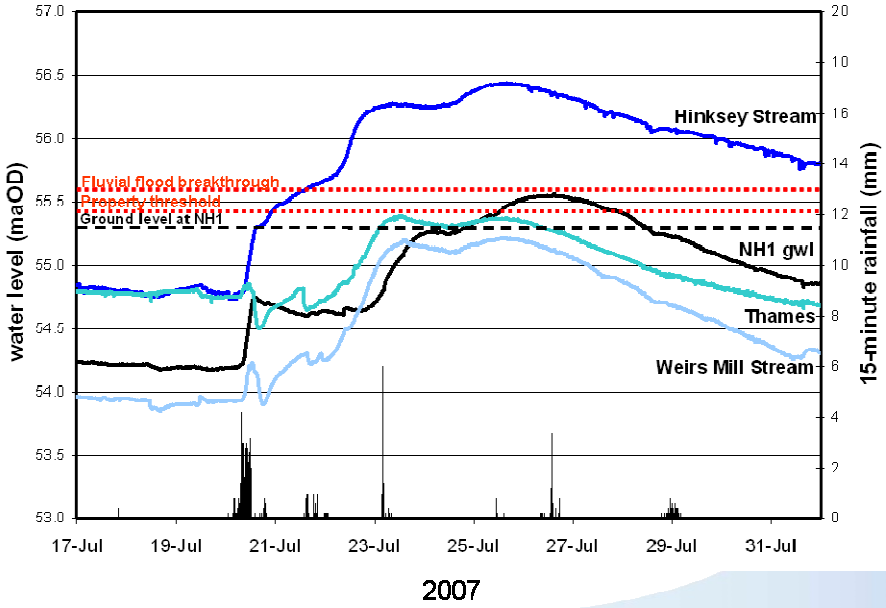


HydEF – Oxford



- Model composition under development
- BGS now has RS Infoworks licence for 1 years and model files
- Linked model only north of Botley Road
- Issue over representation of flood plain storage





HydEF – Understanding the hydrogeology

Pang - Lambourn

MSc project on Blue Pool (Tim Foster – Imperial)

- Dual response system – rapid karstic flow chalk, sustained diffuse flow from palaeogene and chalk
- Model for diffuse & point recharge and rapid & sustained flow

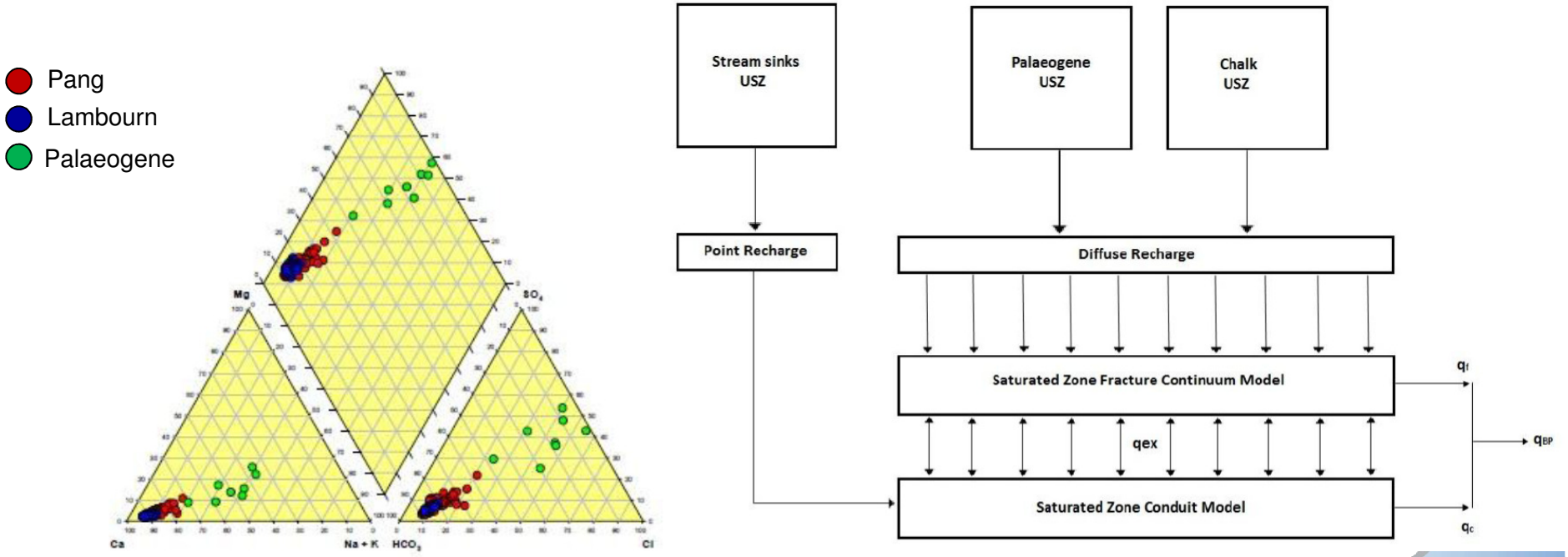


Figure 4.1 – PIPER plot of major ion chemistry at sites in the Pang and Lambourn catchments as well as for Palaeogene springs samples on the Reading Beds (from Wheater et al, 2006).

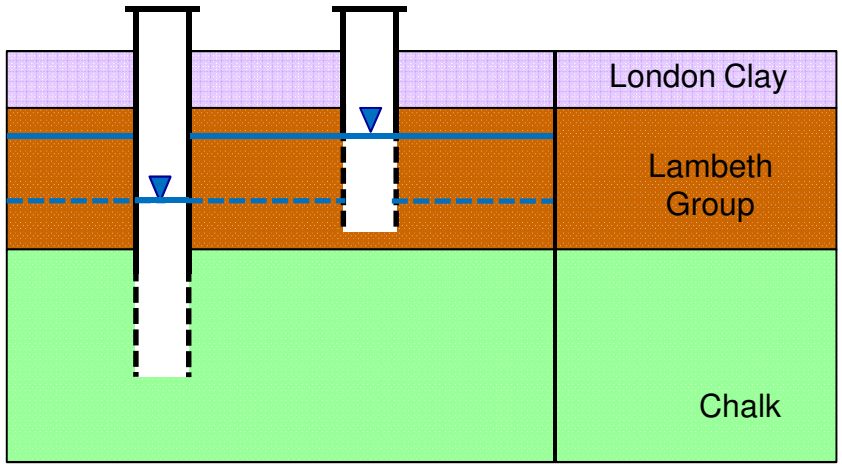
HydEF – Understanding the hydrogeology

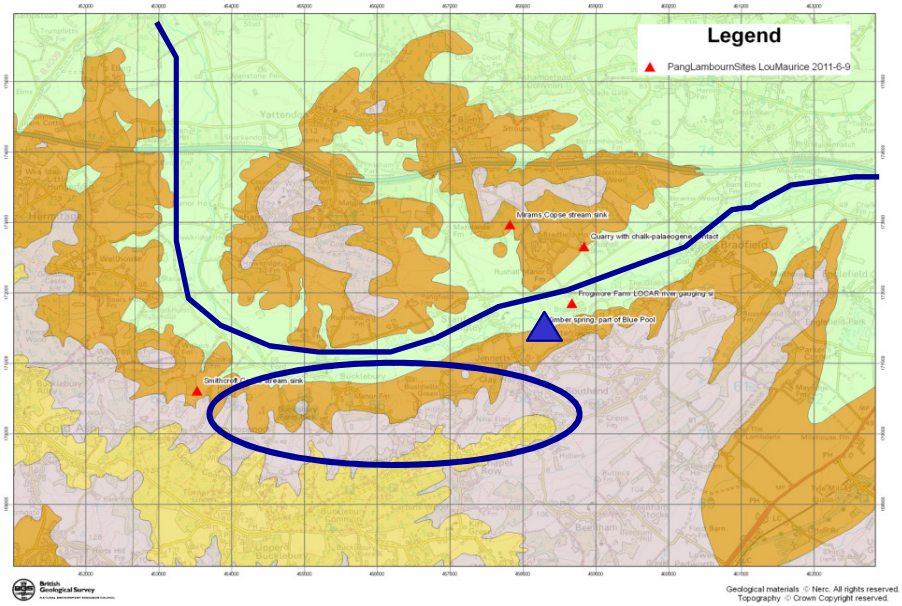
Pang - Lambourn

Drilling project (BGS funded)

- To assess the contribution of the Palaeogene deposits to the Blue Pool
- Two boreholes side by side (one chalk, one Palaeogene)

Another MSc project to follow on from the work Tim did.

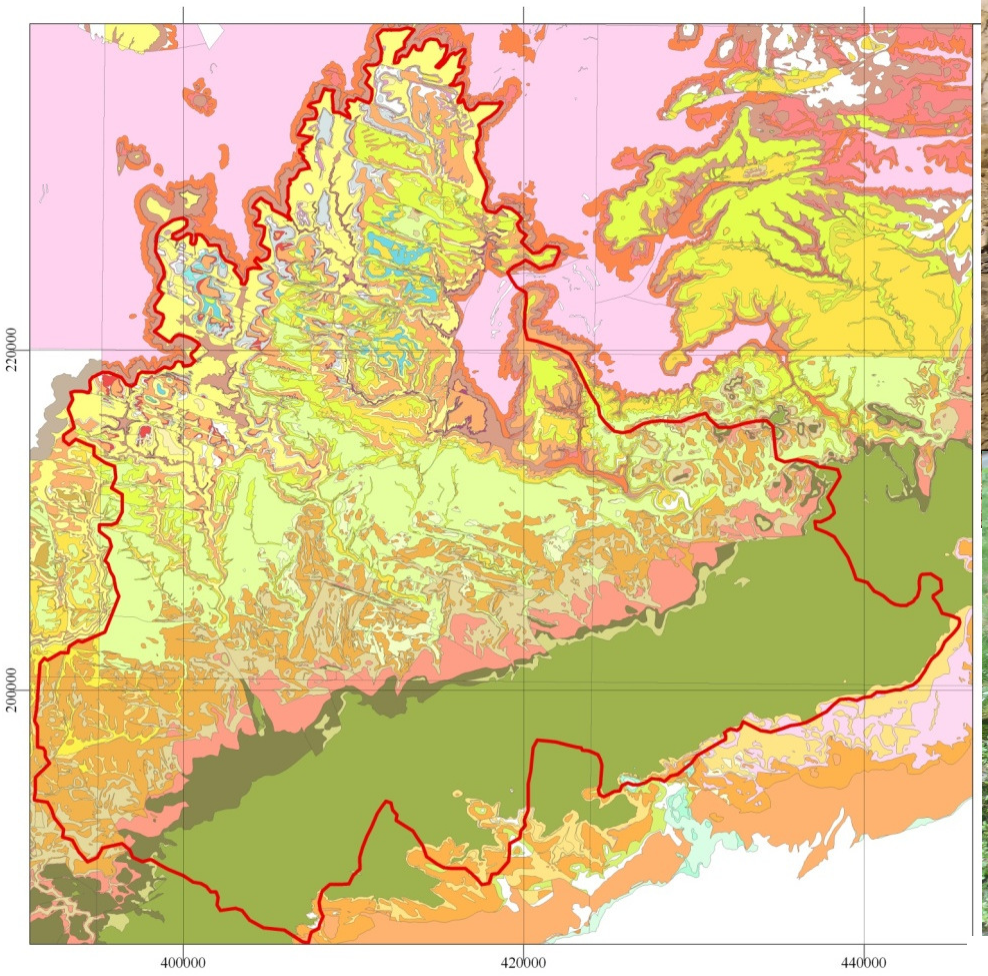




HydEF – Understanding the hydrogeology

Cotswolds

MSc Project - hydro conceptualisation and neural networks (Katy James – Cardiff Uni)



HydEF – Understanding the hydrogeology

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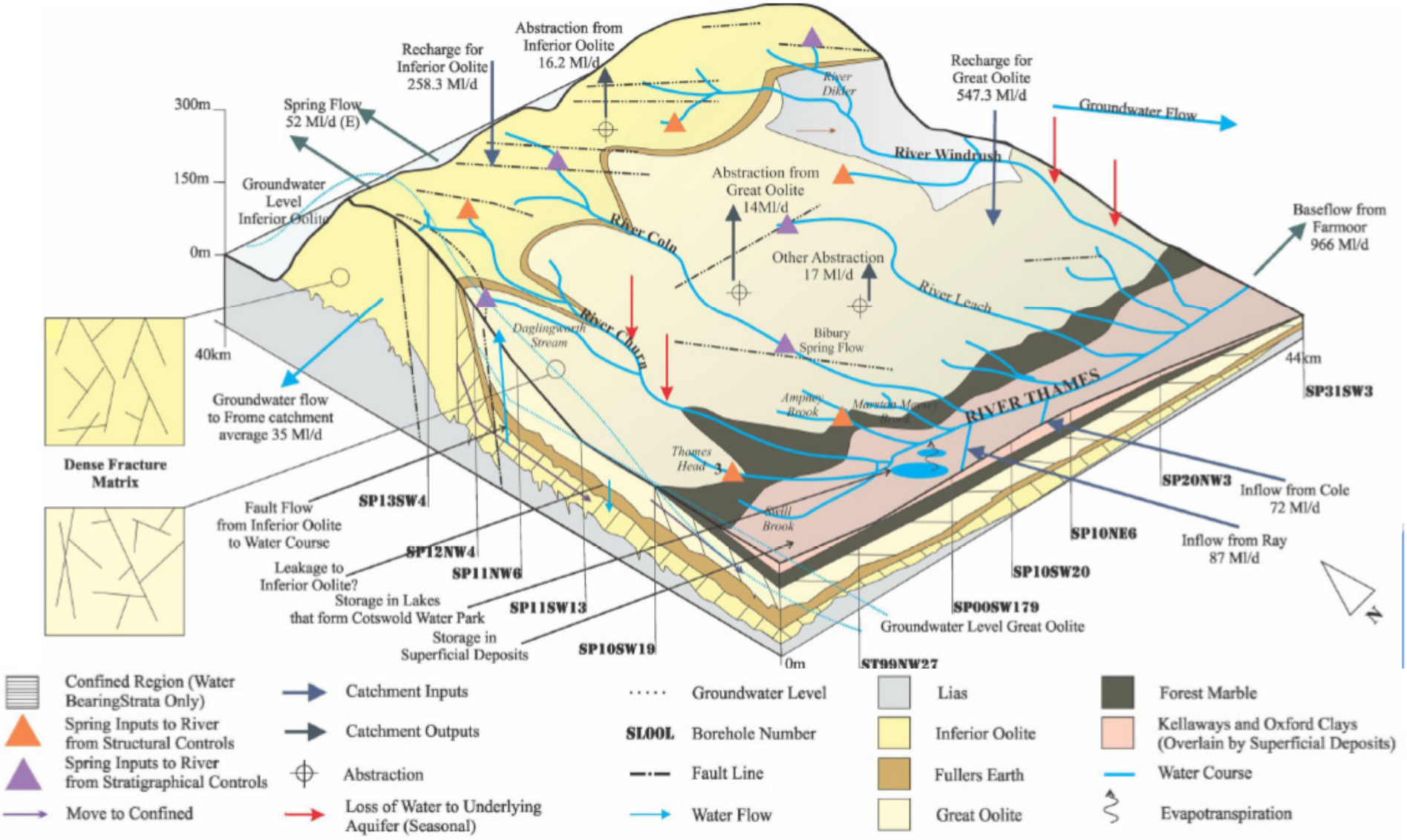
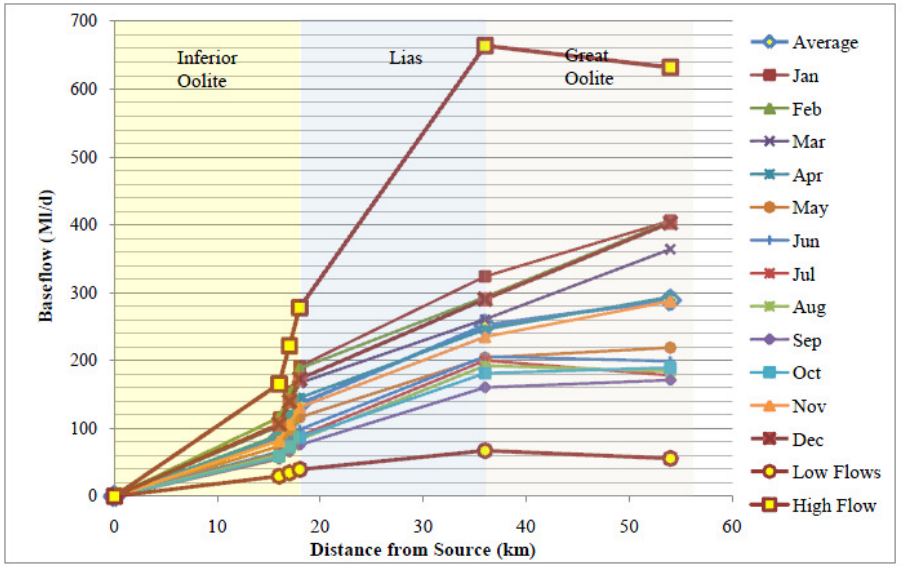


HydEF – Understanding the hydrogeology

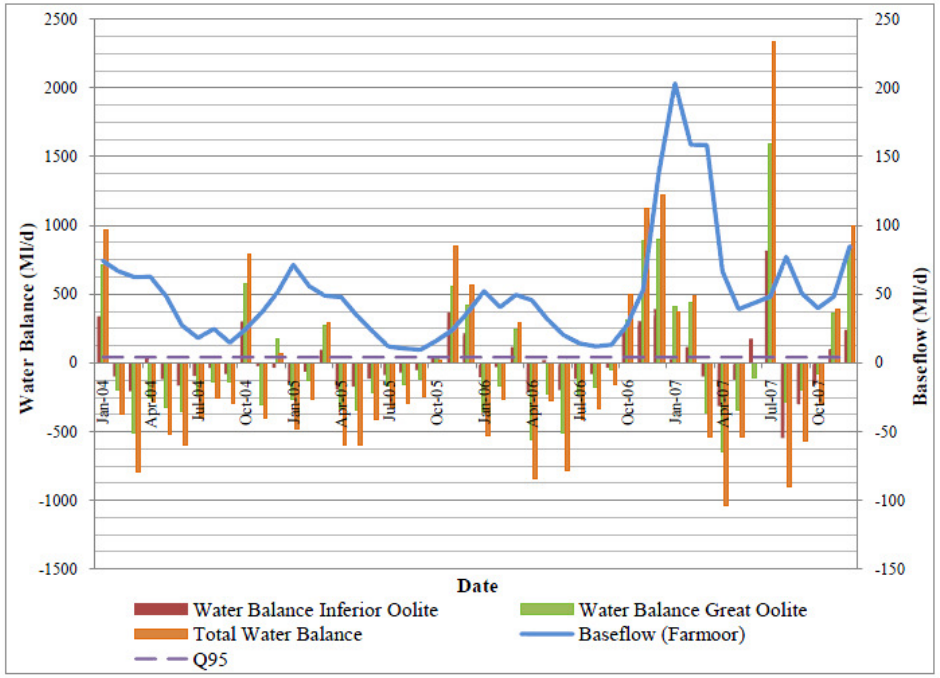
Cotswolds

- Water balances
- Lithological vs structural control on flow
- Stream head migration
- Flow accretion profiles



Catchment	Water balance
Cotswolds @ Farmoor	- 20 Ml/d – springs (Deficit)

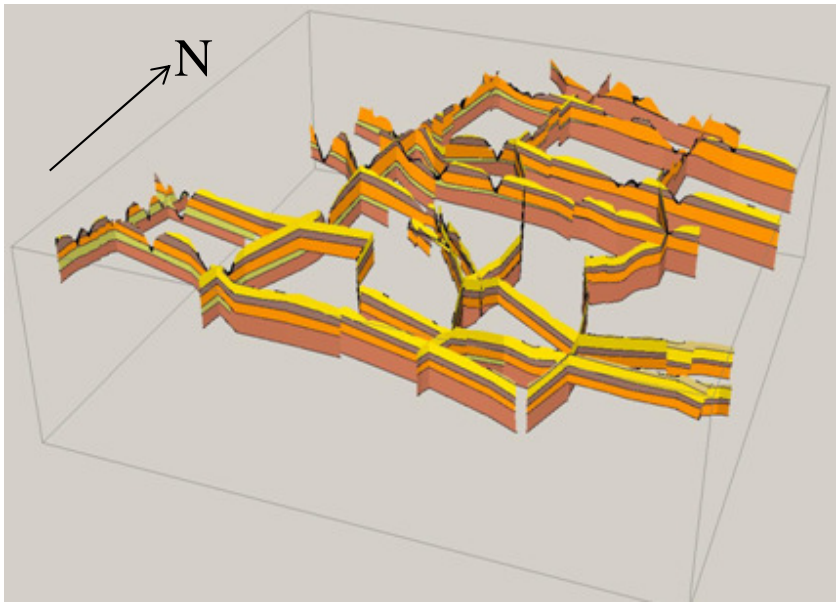
Water balance	Ml/d
Inferior Oolite	+ 8
Great Oolite	+ 112
Abstraction (non-Oolite)	- 22
Springs (Estimated)	- 52
Outflow to R. Frome (E)	- 35
Total	**+11 Ml/d (~balanced)**



HydEF – Understanding the hydrogeology

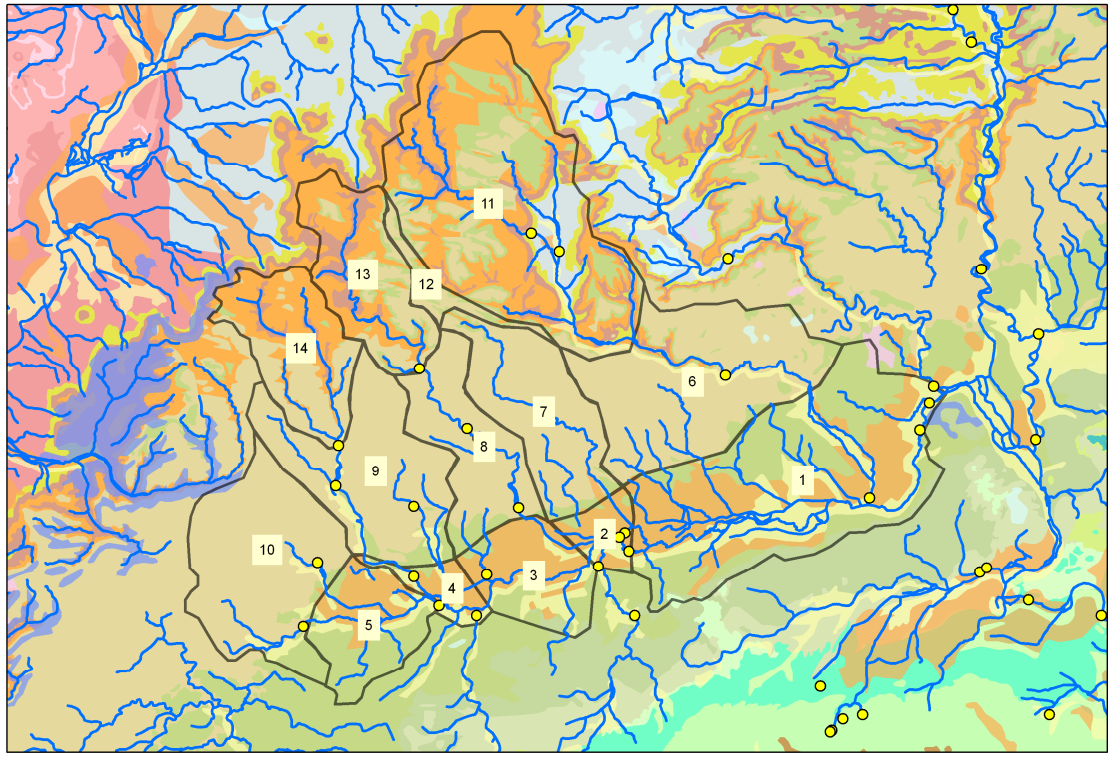
Cotswolds, next steps…

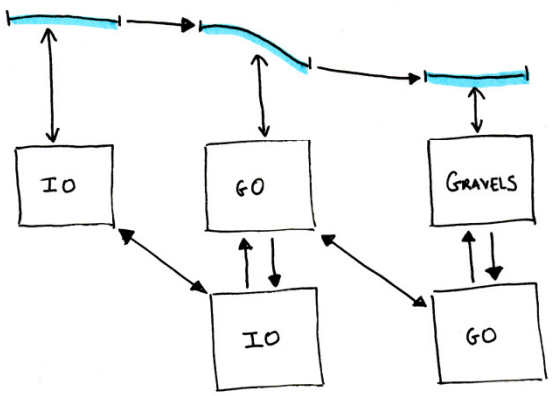
- BGS funded 3D geological model
- More interpretation of existing hydro data and integrate with 3D model
- MSc project – field based, Birmingham University
- Abstract accepted at the IAH Fractured Rock conference in Prague, May 2012
- Paper - using a geological framework to underpin hydrogeology understanding of extremes



HydEF – Cotswolds groundwater modelling

- Developing semi-distributed model of aquifer system.
- Will be incorporated into multi-aquifer model of Thames catchment.
- OpenMI compliant code almost complete.

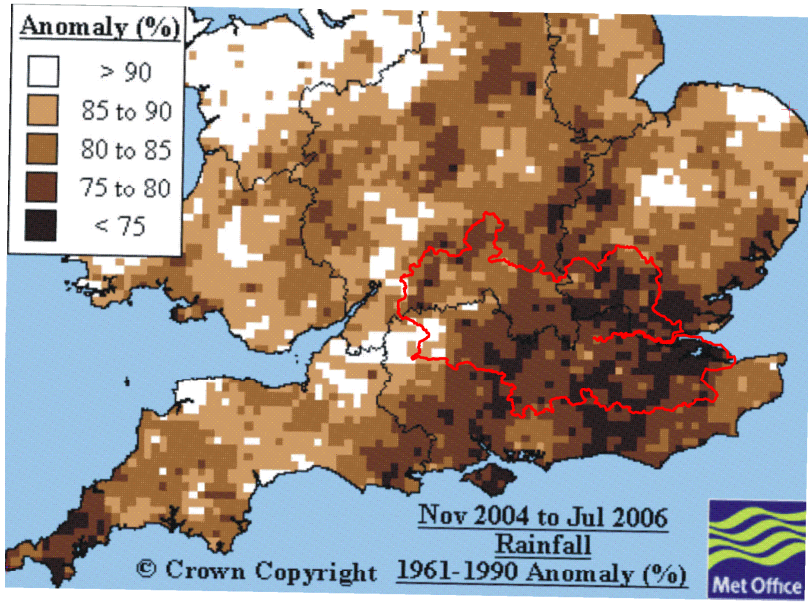


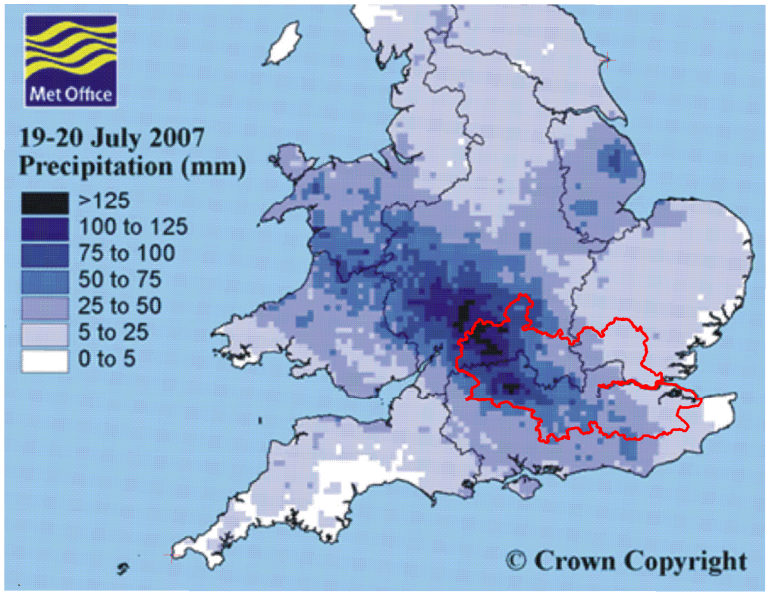


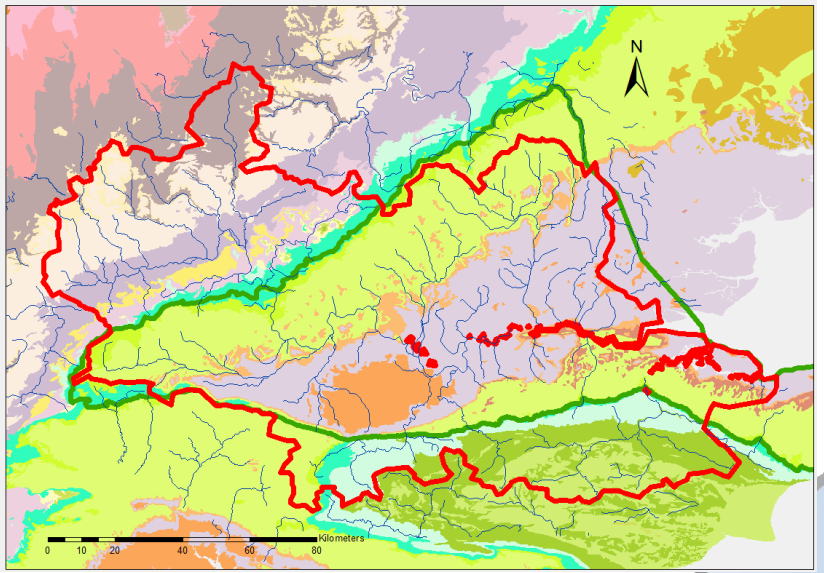
HydEF – Complexity

Spatial variability in extreme events

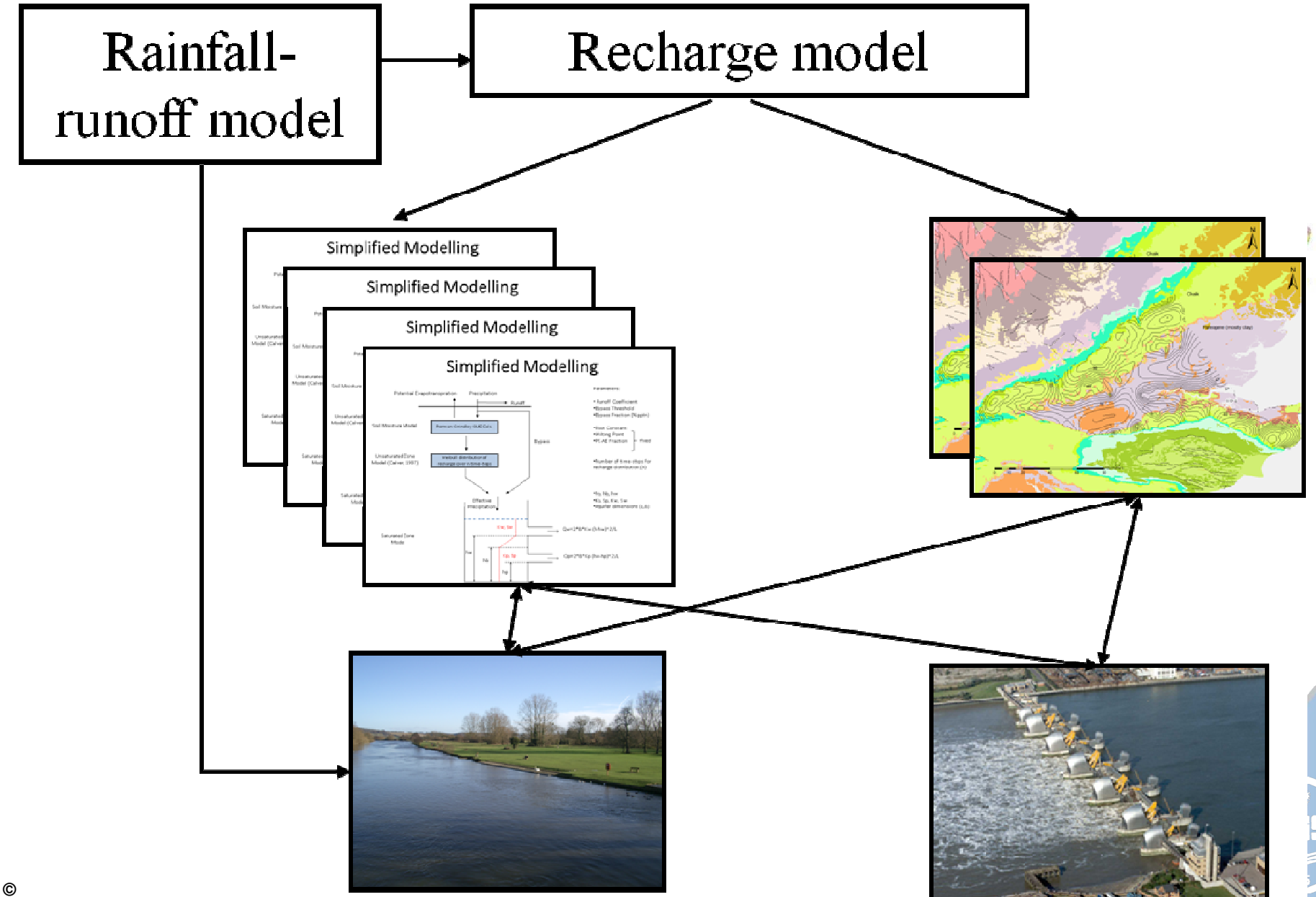
- Rainfall extremes exhibit high variability – even across (relatively) modest sized basin
- Hydrogeology impacts on flood response
- Variation of rainfall anomalies during droughts



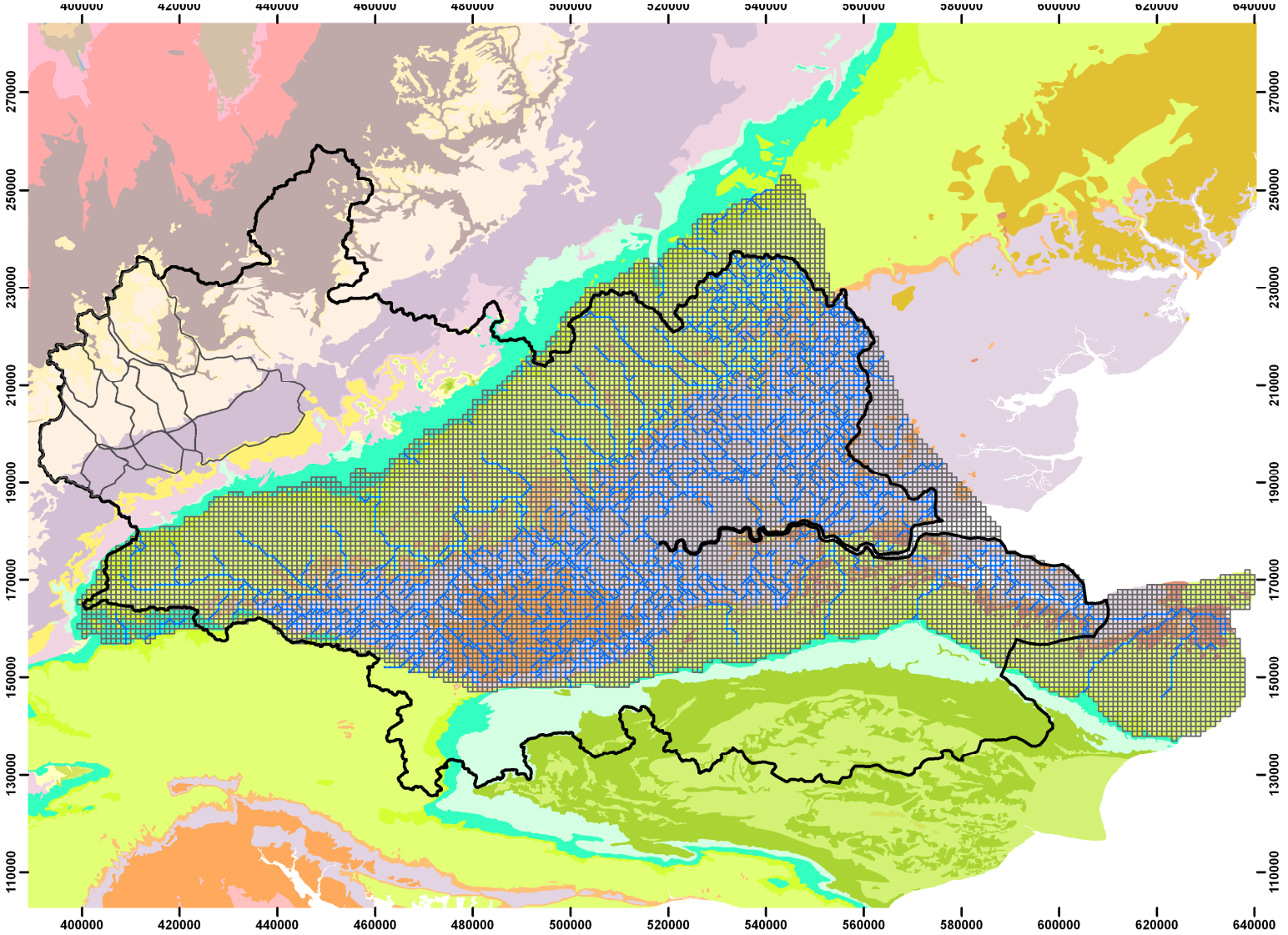




HydEF – Complexity



HydEF – Thames catchment multi-model composition



HydEF – next steps

- Eden – Continue to support MEng student and await PDRA (interviews 12th/13th march)
- Pang/Lambourn – Blue Pool modelling supported by drilling the borehole
- Thames Basin – finalise paper and continue develop a multi-model composition
- Colne – Start!!
- Cotswolds – continue with modelling
- Oxford – Continue to develop linked GW-SW model
- IOW – support through hydrogeologists at Wallingford/Geologists at Keyworth as appropriate