Winter 2013-14: *"The Remote Control Flood"*

And other tales of the advancement of hydrological science through technology.....

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Environment Agency

The tale of a small green boat.....

.....and some pretty clever gadgets onboard

- Benefits during flood
- New applications after flood

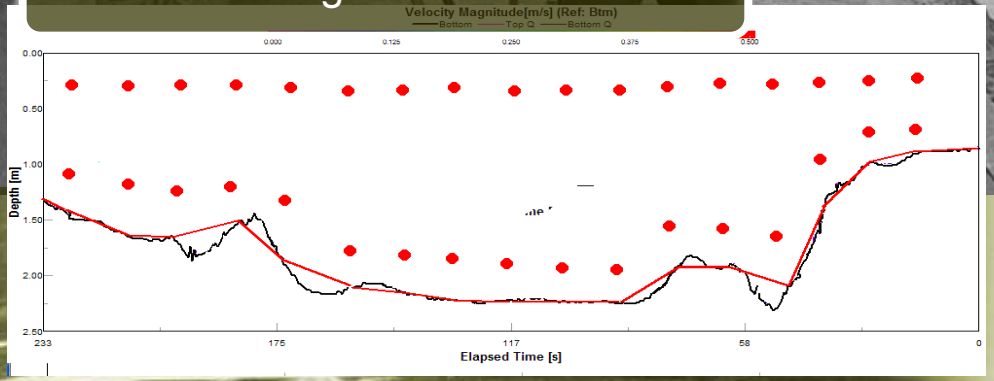
.....but first, some history.....

Gauging – the bad old days

Gauging required many people and took a long time

Was potentially hazardous

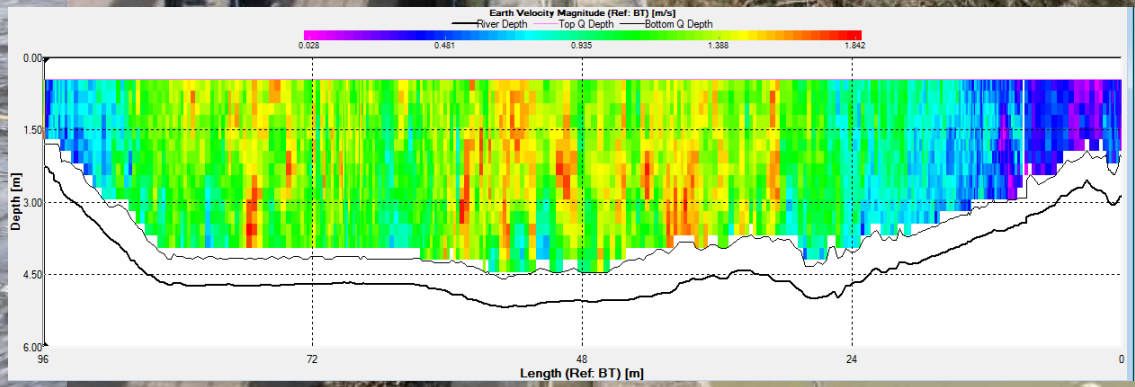
We didn't get much data....



Cable across river

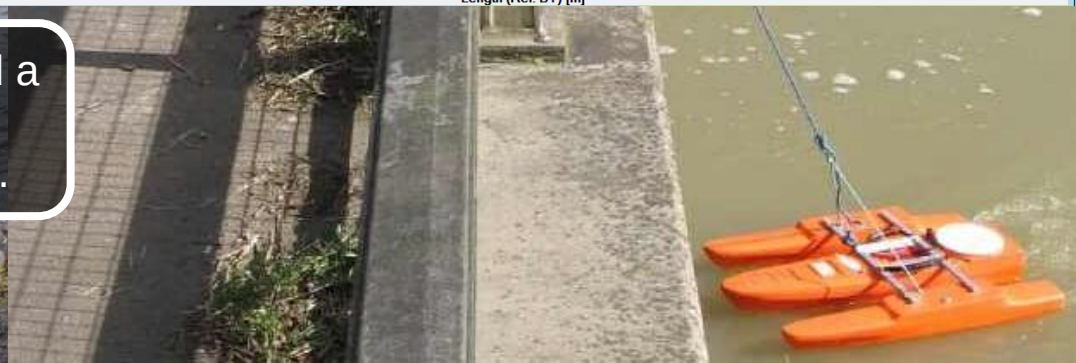
2002 – then came ADCPs

Deployed with ropes
- Bank to bank
- From bridges or cableways



- Efficiency increased greatly
- Much more data

But still some disadvantages: needed a bridge, access to both banks, cableway infrastructure, safety risks...



Gauging – the bad old days...

2012 - The ARC-Boat

A 2-metre long remote control river gauging and survey boat

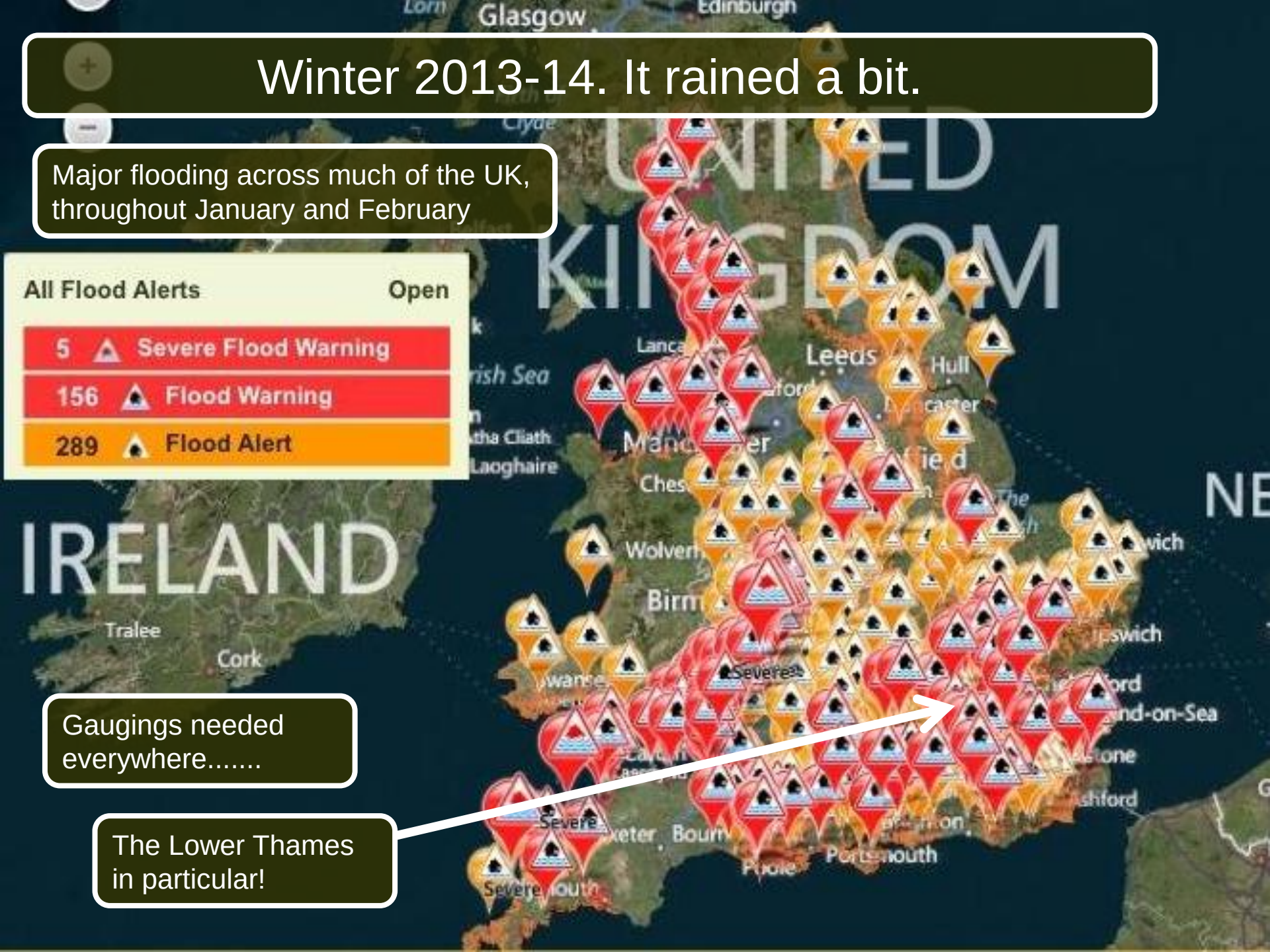
Primary purpose is river flow measurements

Benefits:
- Quicker
- Safer
- Fewer staff
- Better data

Combined with GPS-equipped ADCP it makes great survey solution.

Winter 2013-14. It rained a bit.

Major flooding across much of the UK, throughout January and February



Gaugings needed everywhere.....

The Lower Thames in particular!

Call for the ARC-Boat.....

Now 2 people can gauge up to 6 sites in a day.

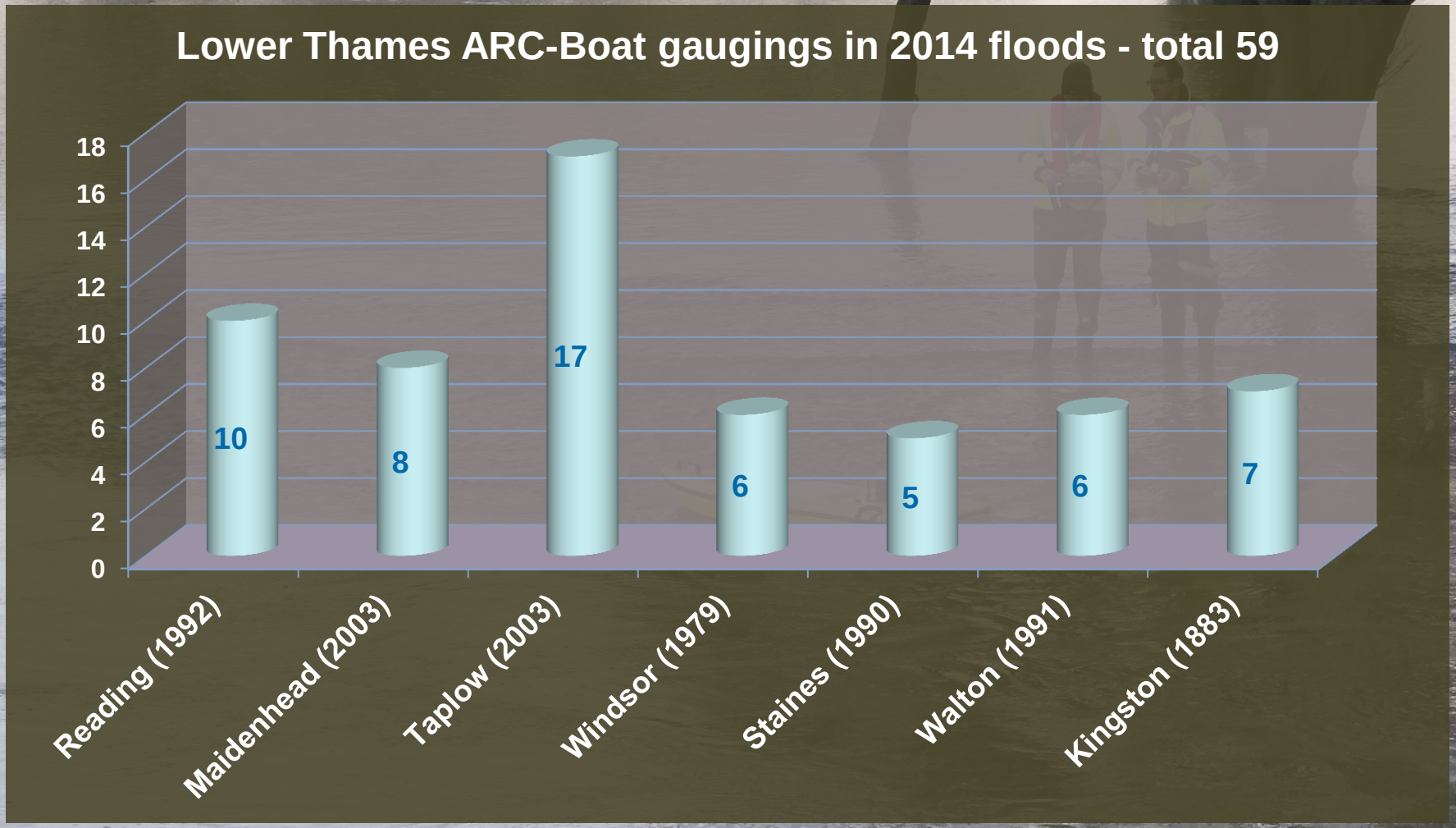
Nobody goes in a boat.

Or dangles stuff off a bridge.

All gaugings on Lower Thames done with ARC-Boat and ADCP.

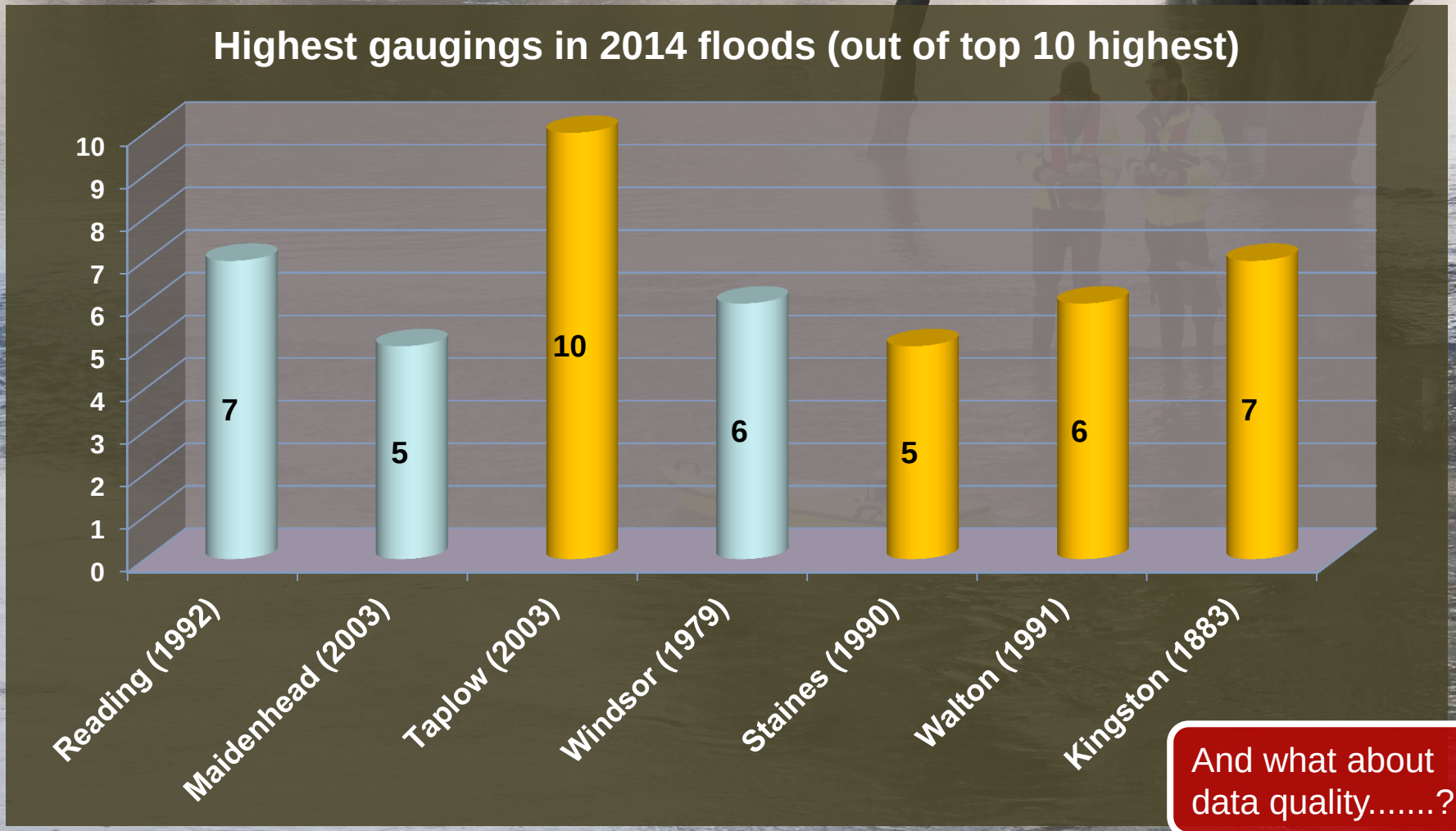
River Thames January-February 2014

January/February 2014: **59** high flow gaugings on Lower Thames. All used RC boat and ADCP.



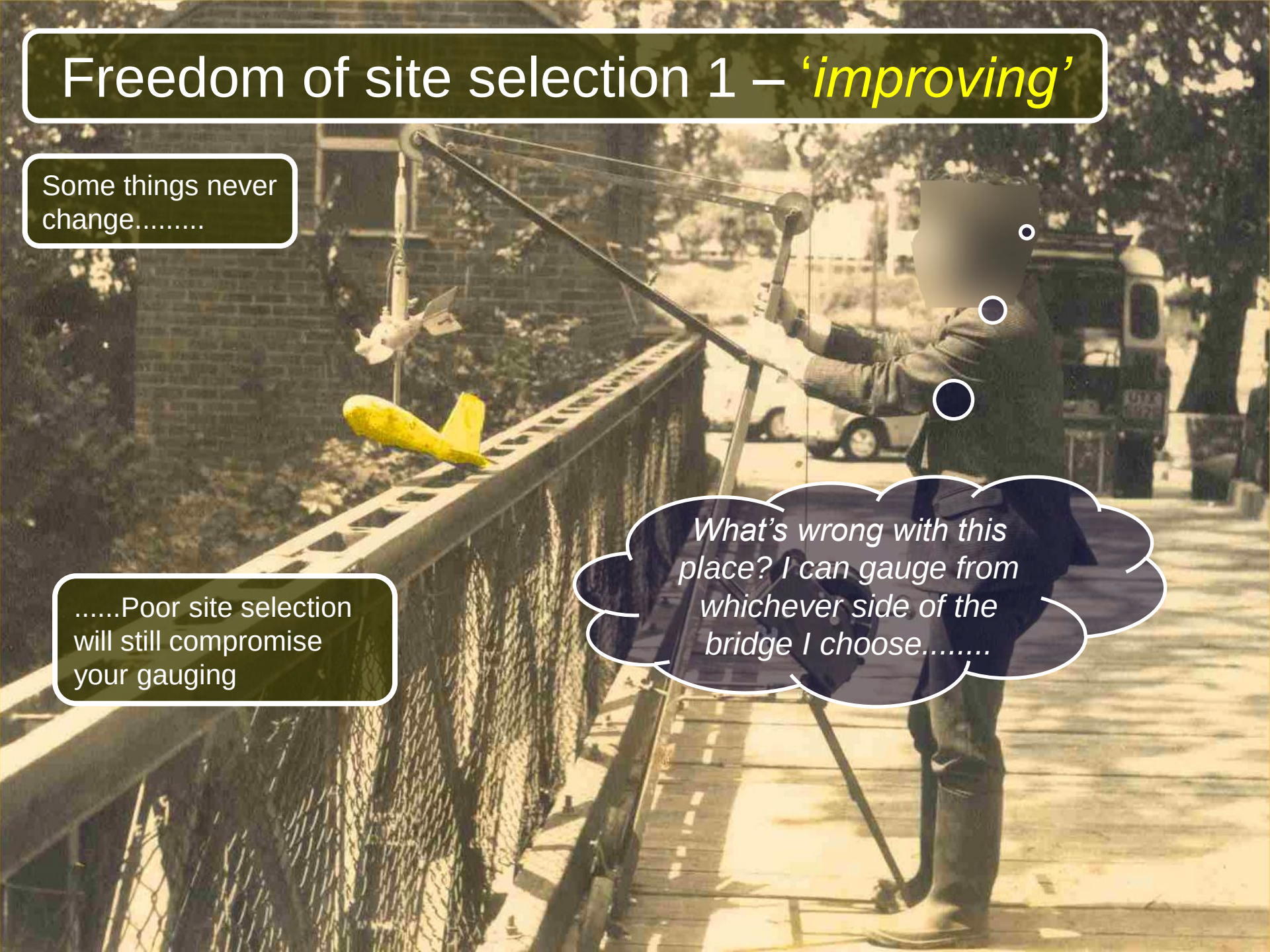
River Thames January-February 2014

At all sites on Lower Thames at least 5/10 highest ever gaugings this year, with RC boat.
Highest ever gaugings at 4 sites

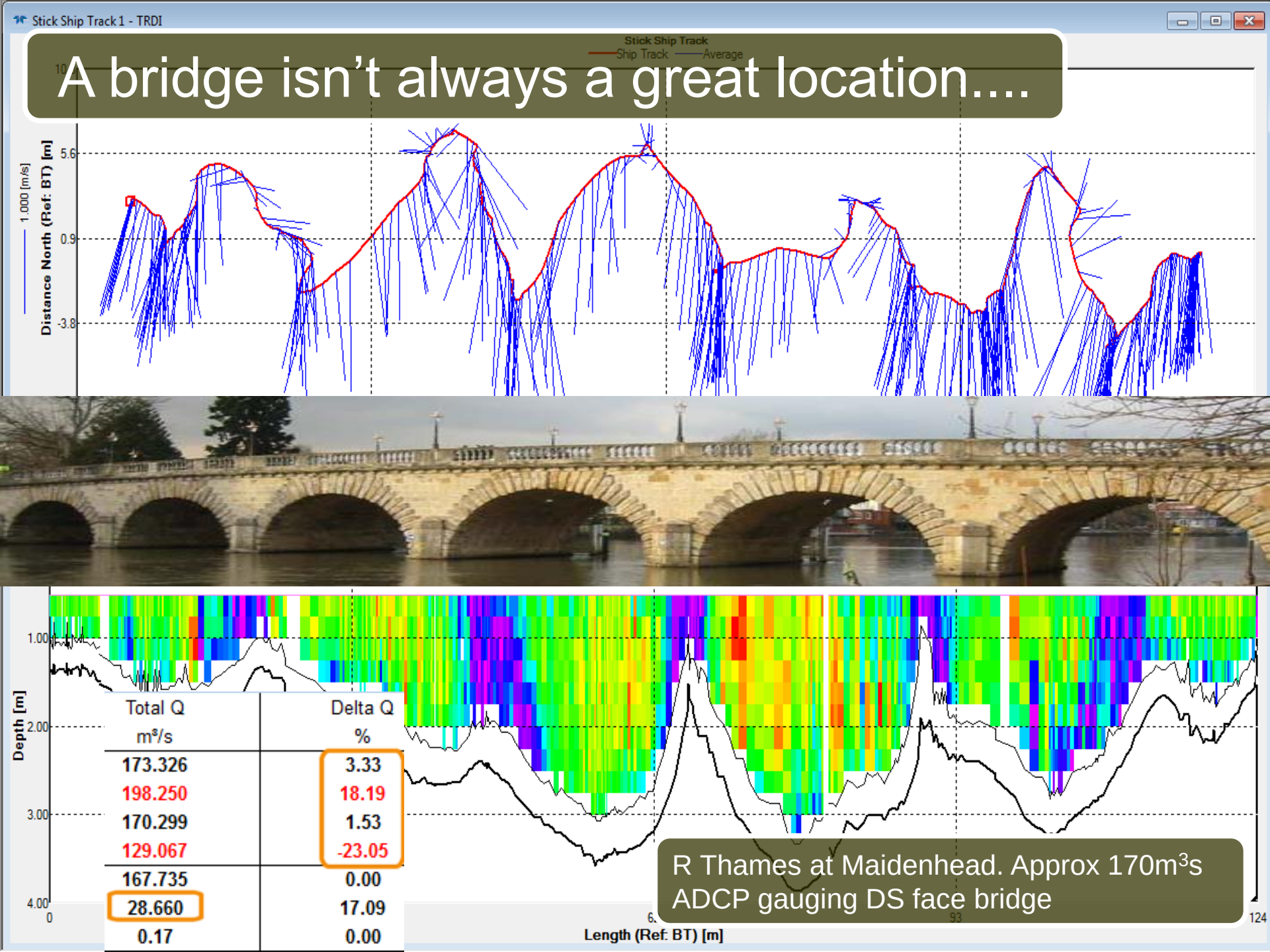


And what about data quality.....?

Freedom of site selection 1 – '*improving*'

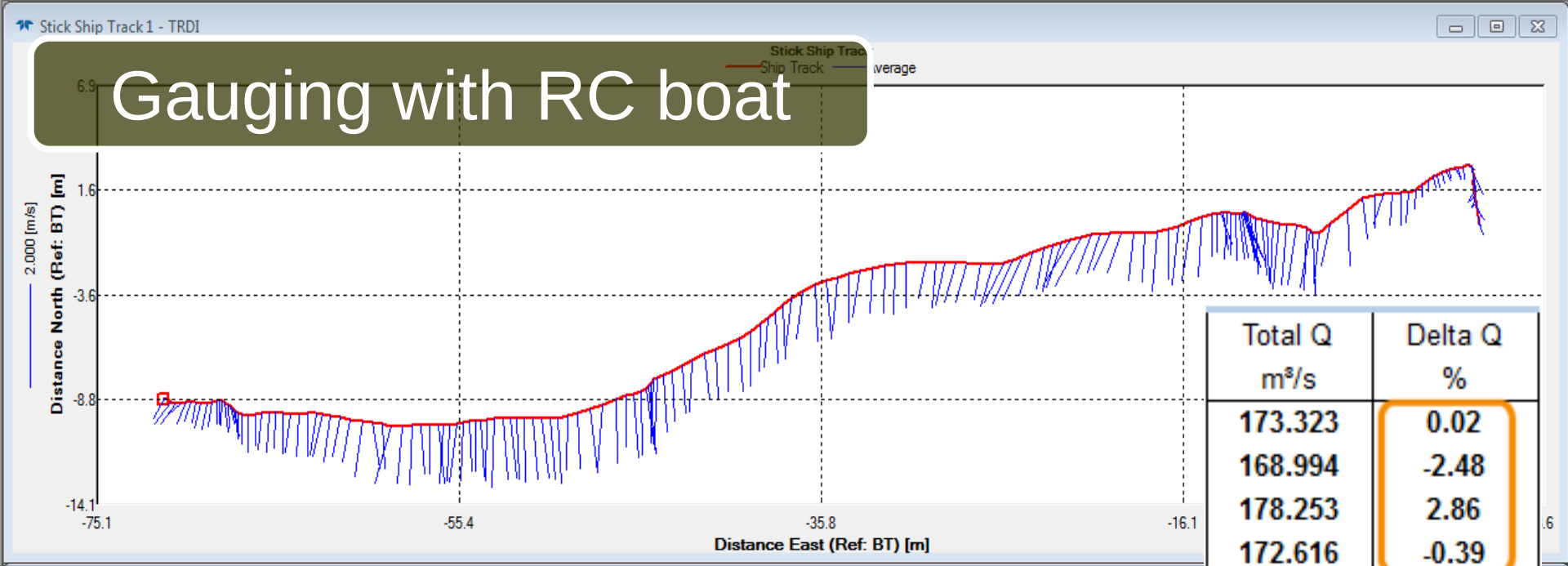


A bridge isn't always a great location....

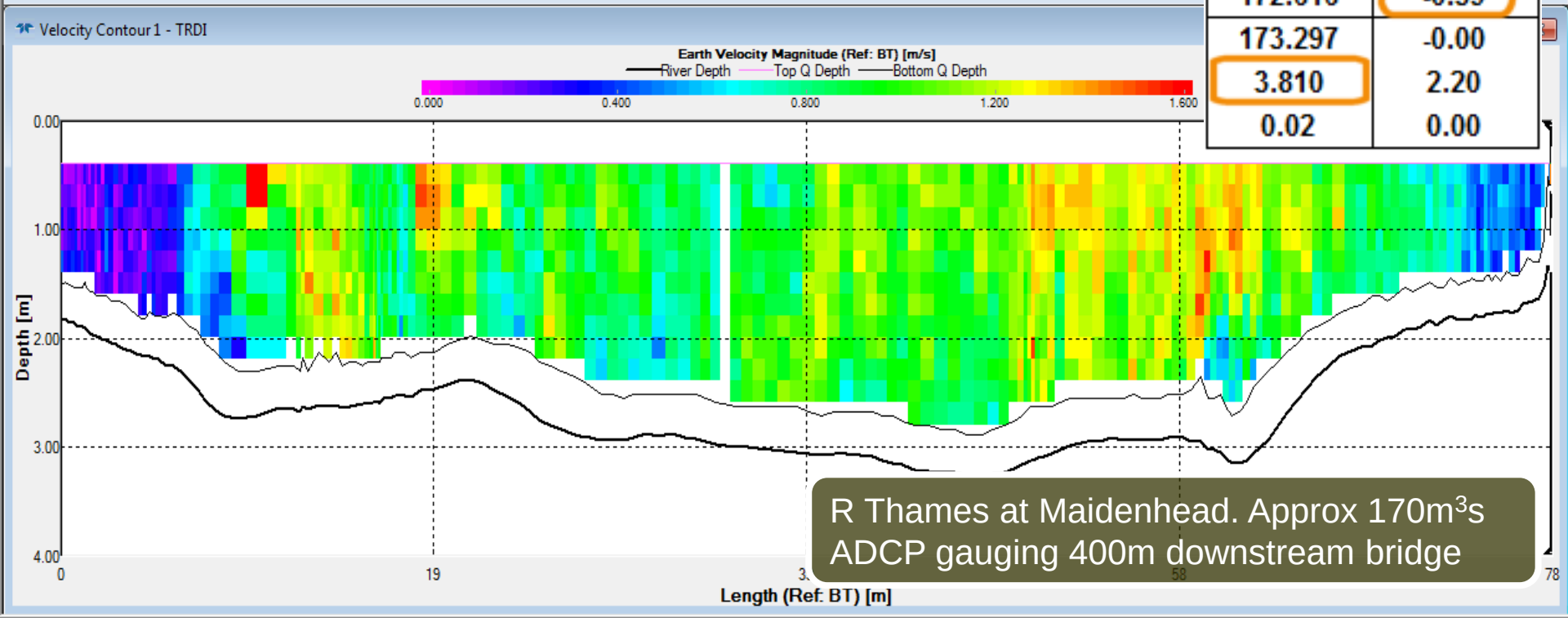


R Thames at Maidenhead. Approx 170m^{3}s ADCP gauging DS face bridge

Gauging with RC boat



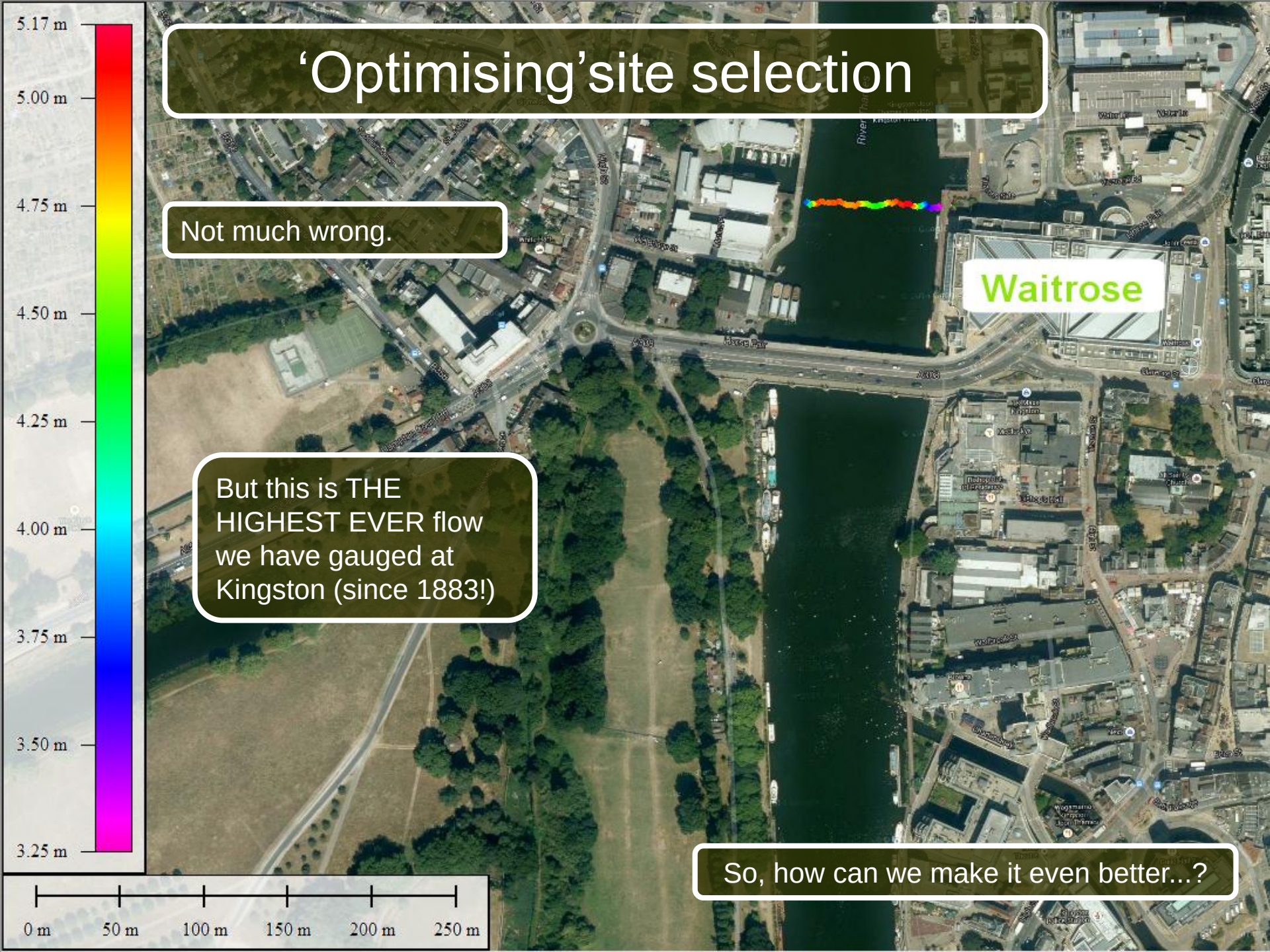
Total Q m³/s	Delta Q %
173.323	0.02
168.994	-2.48
178.253	2.86
172.616	-0.39
173.297	-0.00
3.810	2.20
0.02	0.00



R Thames at Maidenhead. Approx 170m³s
ADCP gauging 400m downstream bridge

Freedom of site selection 2 – *'optimising'*

‘Optimising’site selection



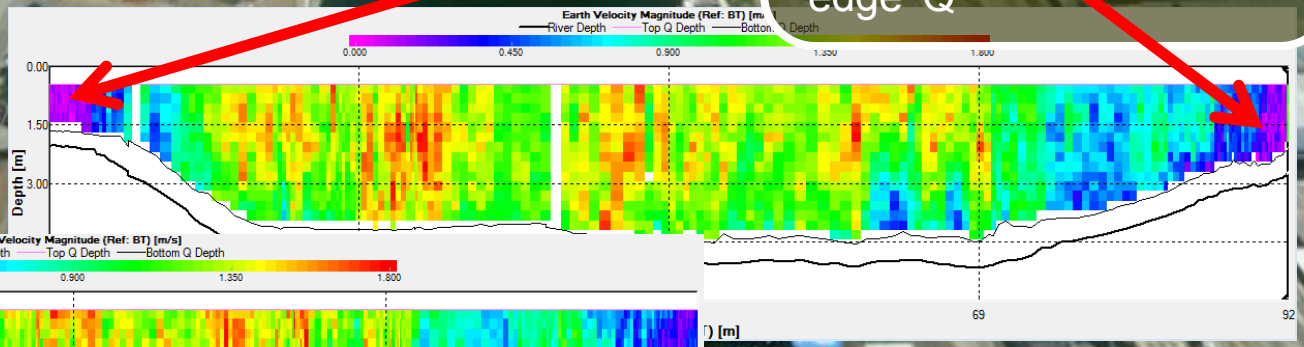
Not much wrong.

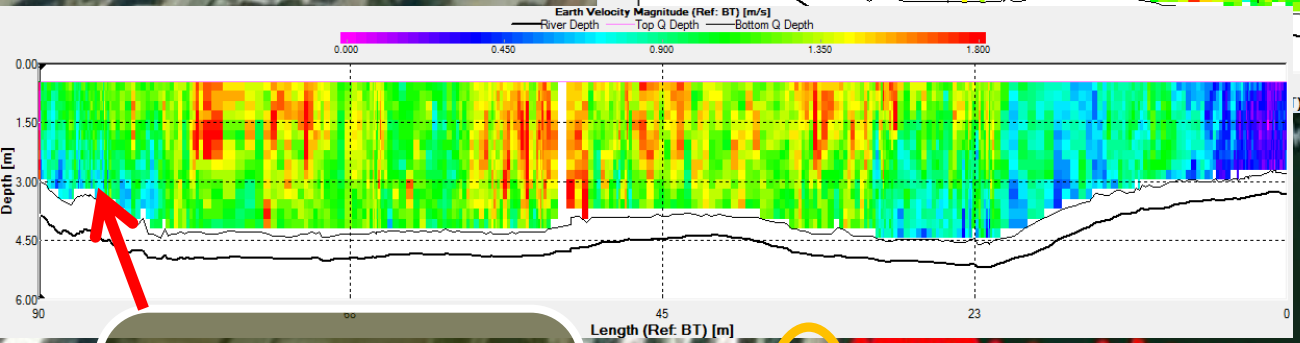
But this is THE HIGHEST EVER flow we have gauged at Kingston (since 1883!)

So, how can we make it even better…?

Site selection - optimising

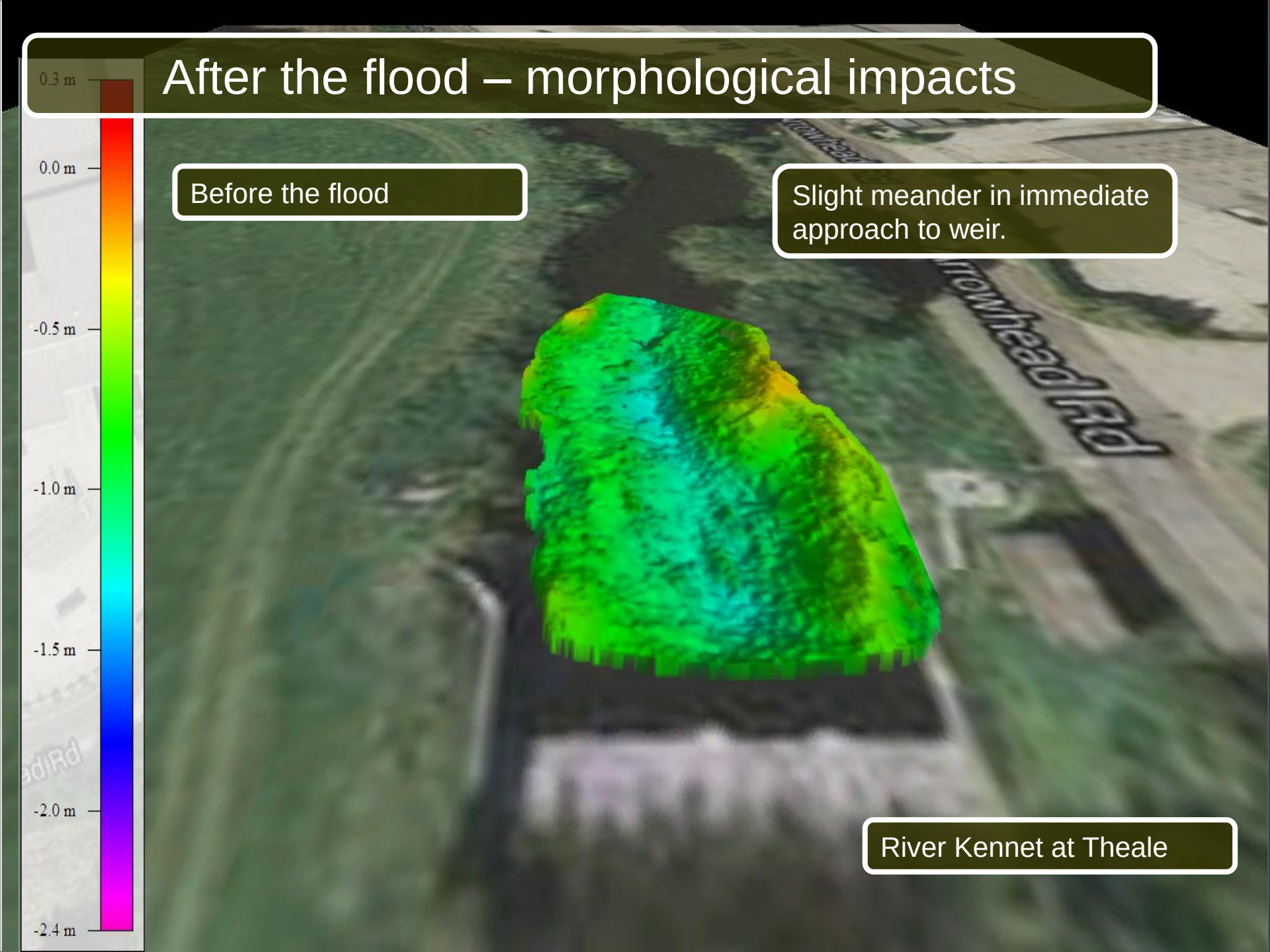
New site
• Very low velocities at both edges
= reduced uncertainty in ‘edge’ Q





Original site:
• High velocity near <u>both</u> banks
• Far bank 90 metres away!

After the flood – morphological impacts



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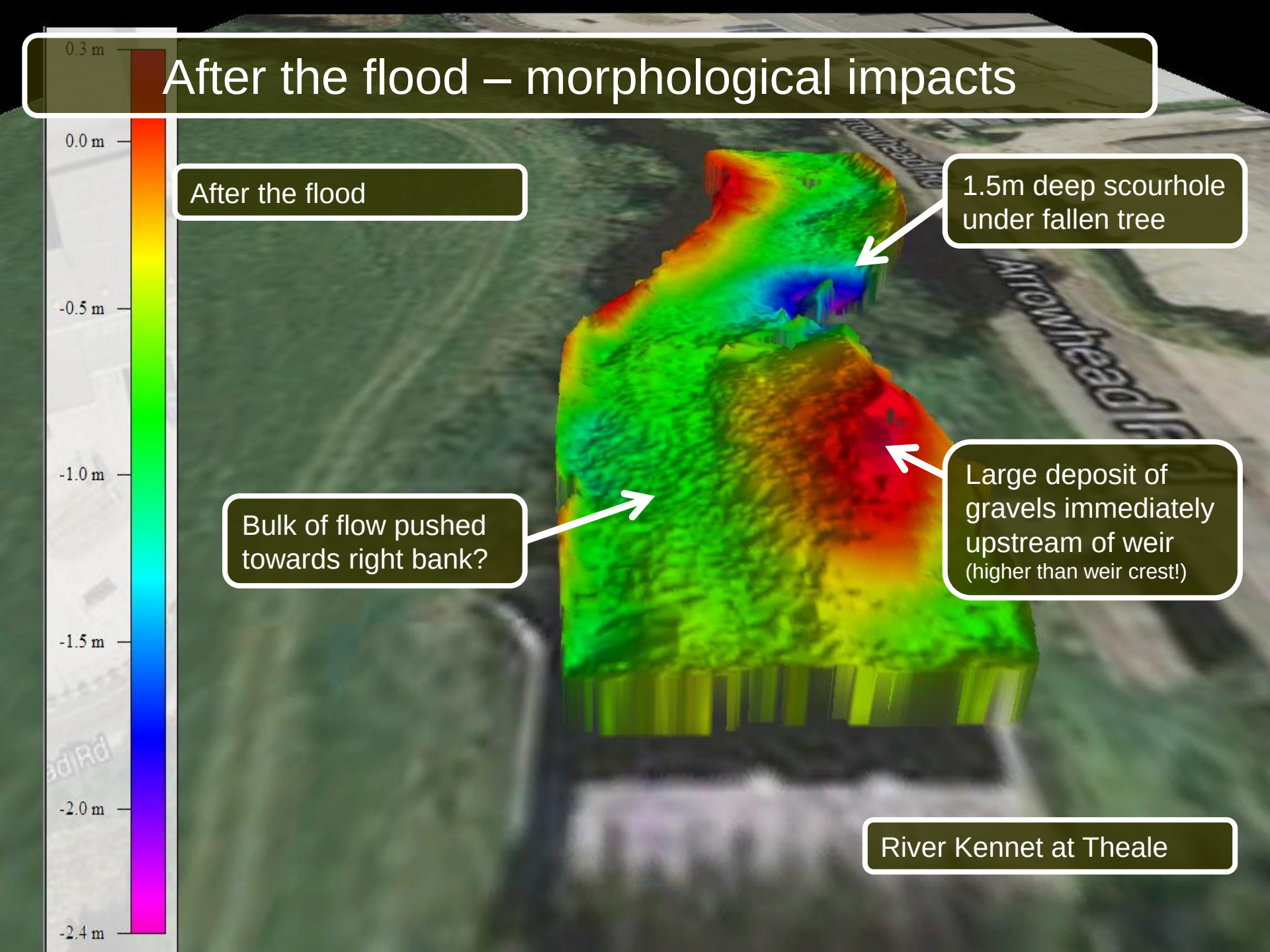

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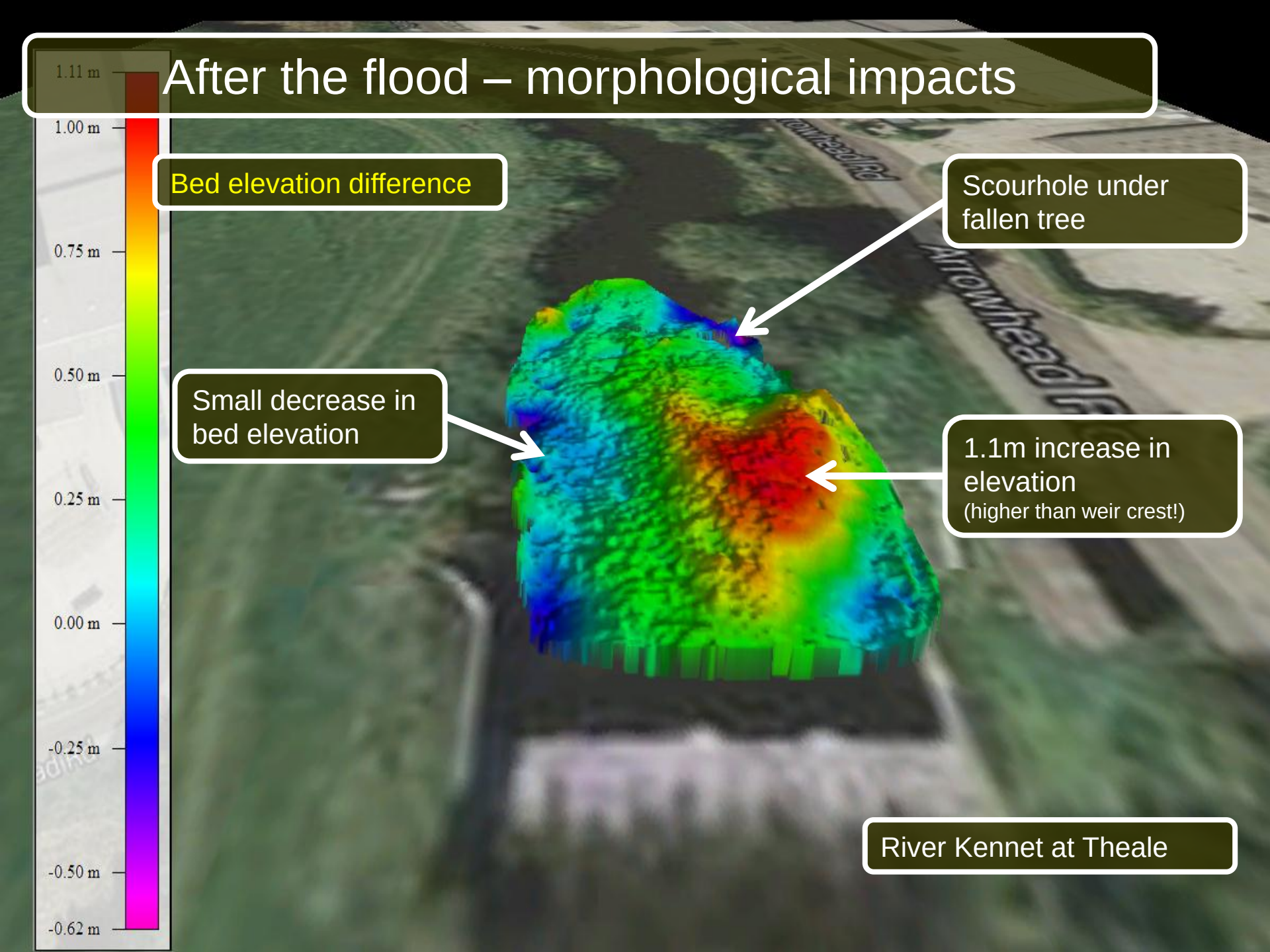
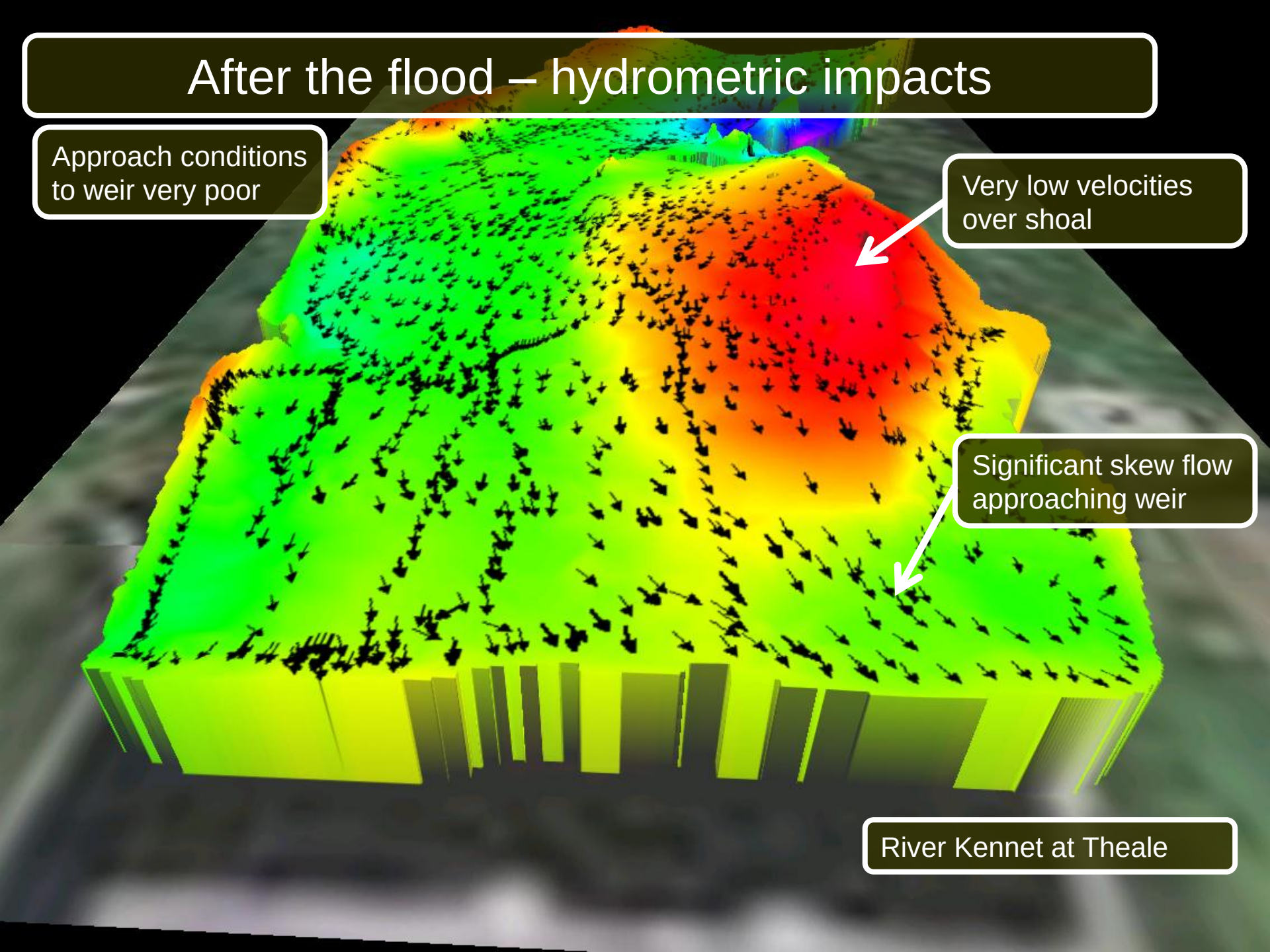


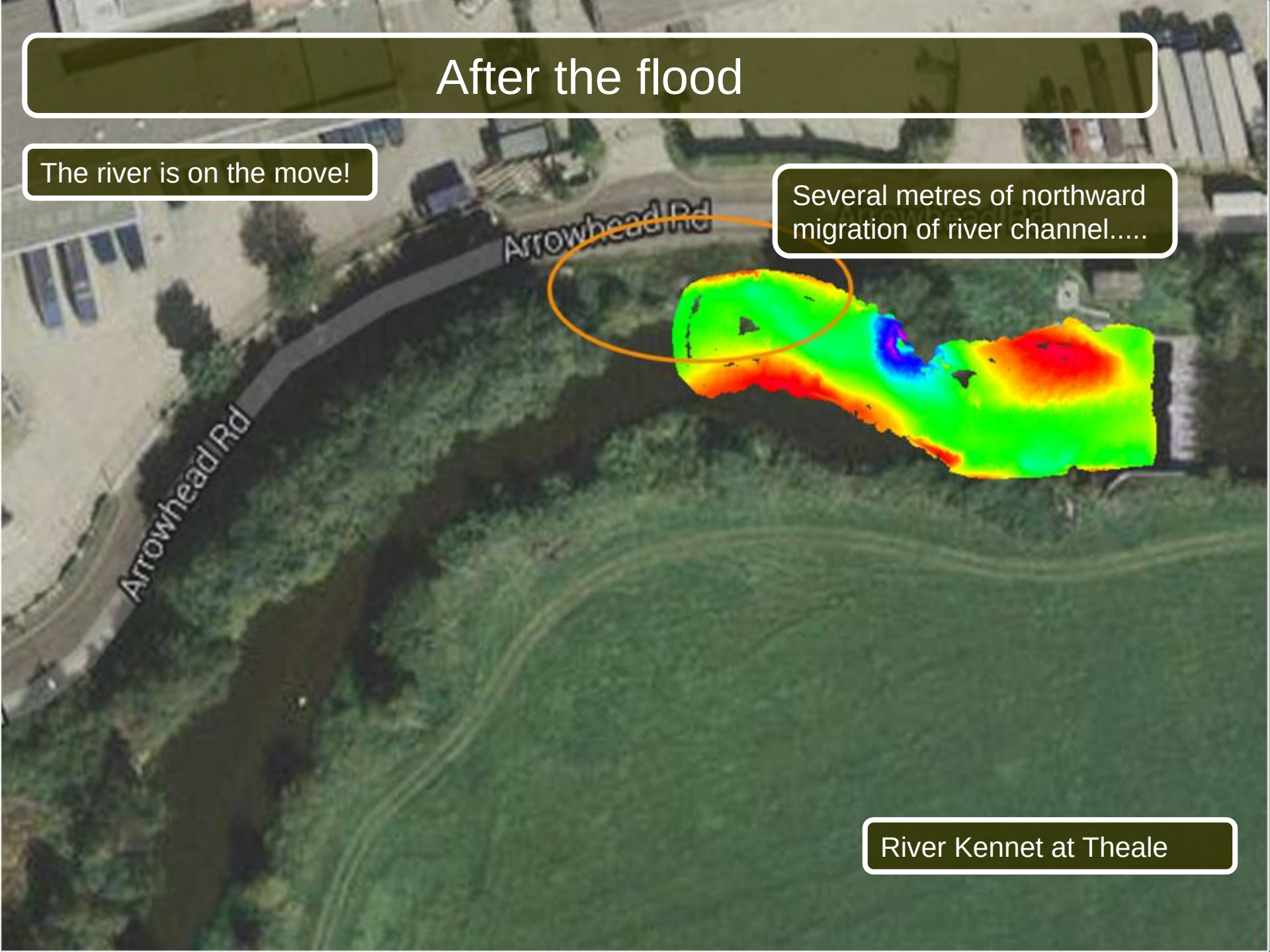
After the flood – hydrometric impacts



After the flood

The river is on the move!

Several metres of northward migration of river channel.....



River Kennet at Theale

Weirpool surveys for hydropower proposals

Weirpools on River Thames = a valuable habitat

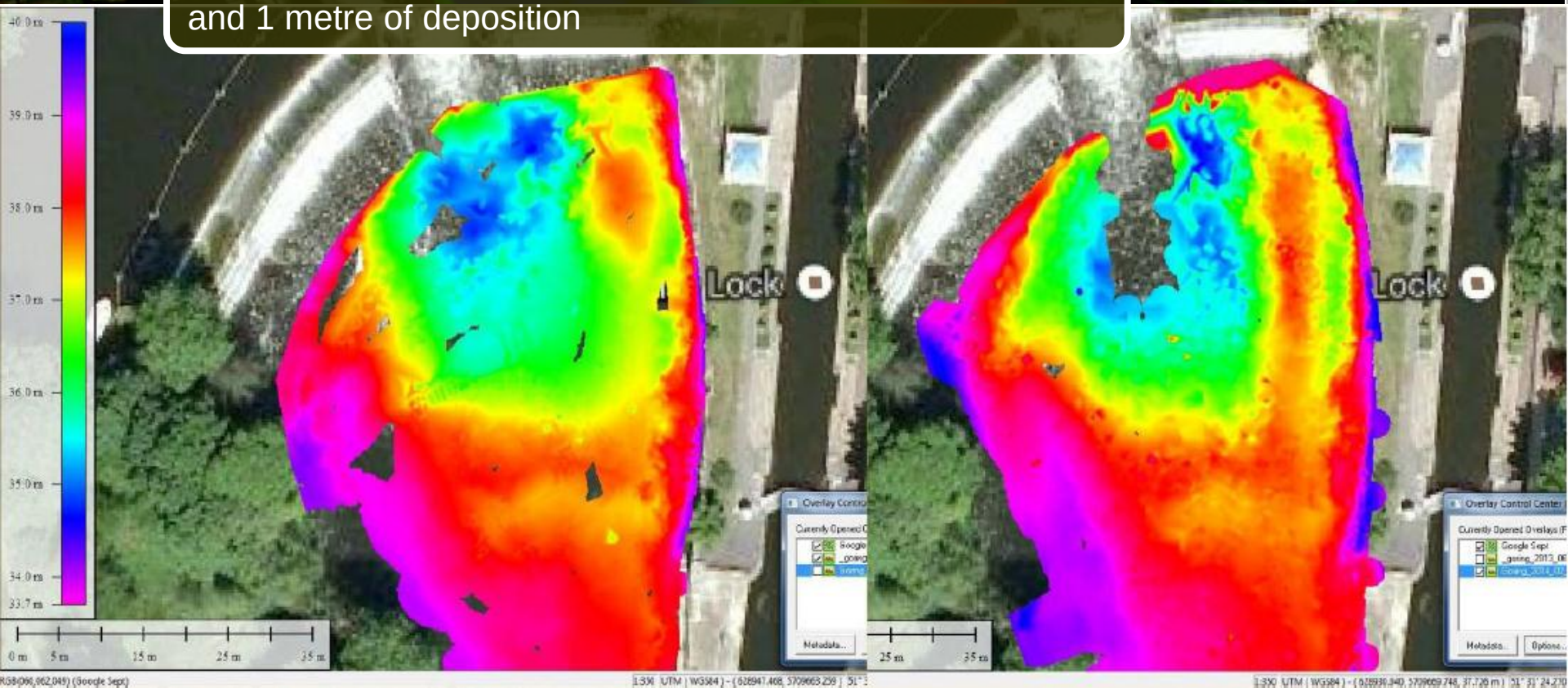
ADCP and RC boat = a great tool to assess habitat by mapping bathymetry and velocity

But what impact a flood?

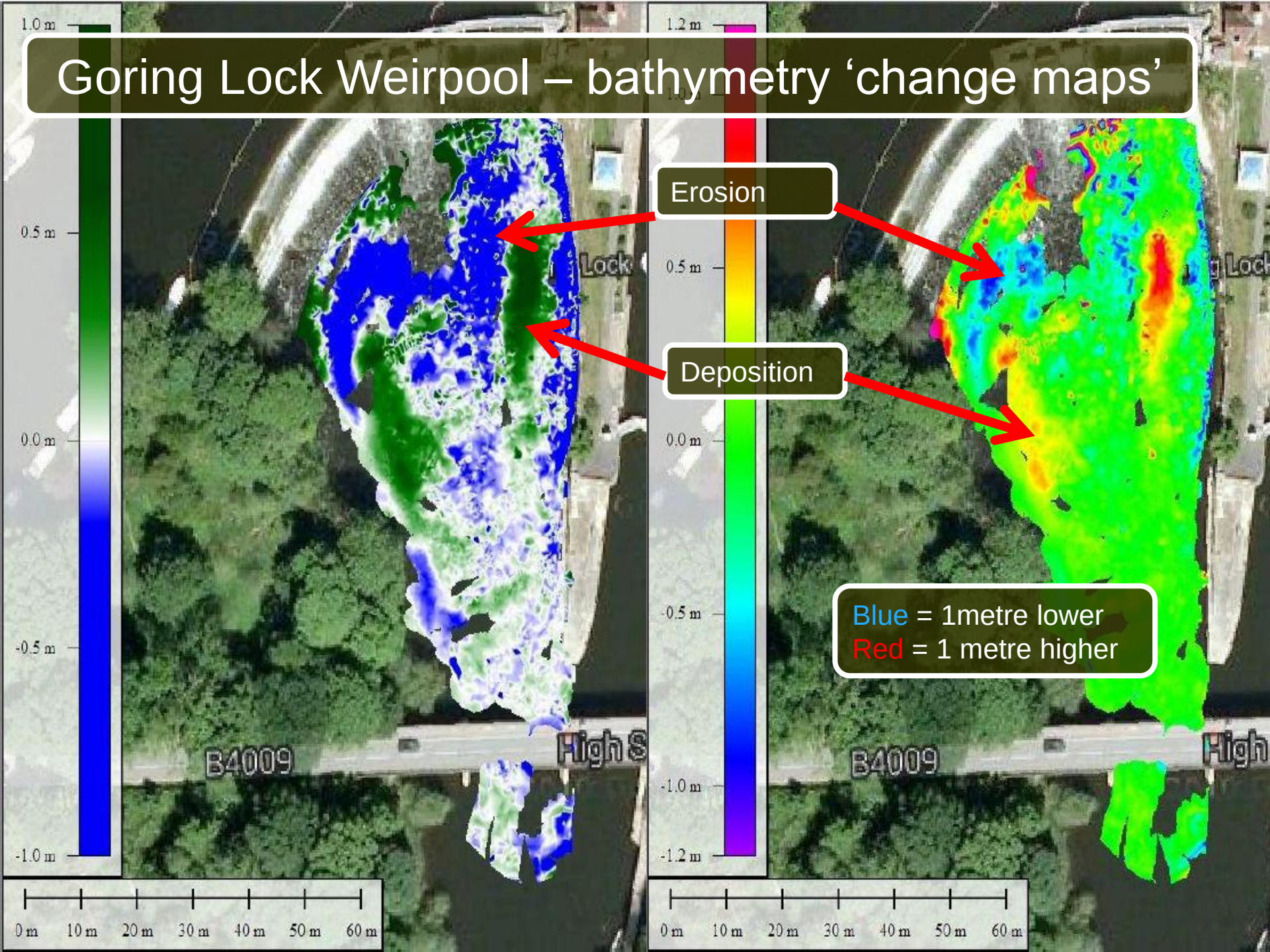
Weirpool survey, Romney Lock, River Thames

Goring Lock Weirpool – before and after the flood

Significant changes in bathymetry – up to 1 metre of scour and 1 metre of deposition



Goring Lock Weirpool – bathymetry ‘change maps’



East coast tidal surge December 2013

Highest tidal surge for 150 years

East coast tidal surge – Seal Sands breach

80m breach in major coastal flood defence

East coast tidal surge – Seal Sands breach

RAF Chinooks made temporary repairs

East coast tidal surge – Seal Sands breach

ARC-Boat/ADCP survey attempt no.1

☑ Daylight
☒ Low tide

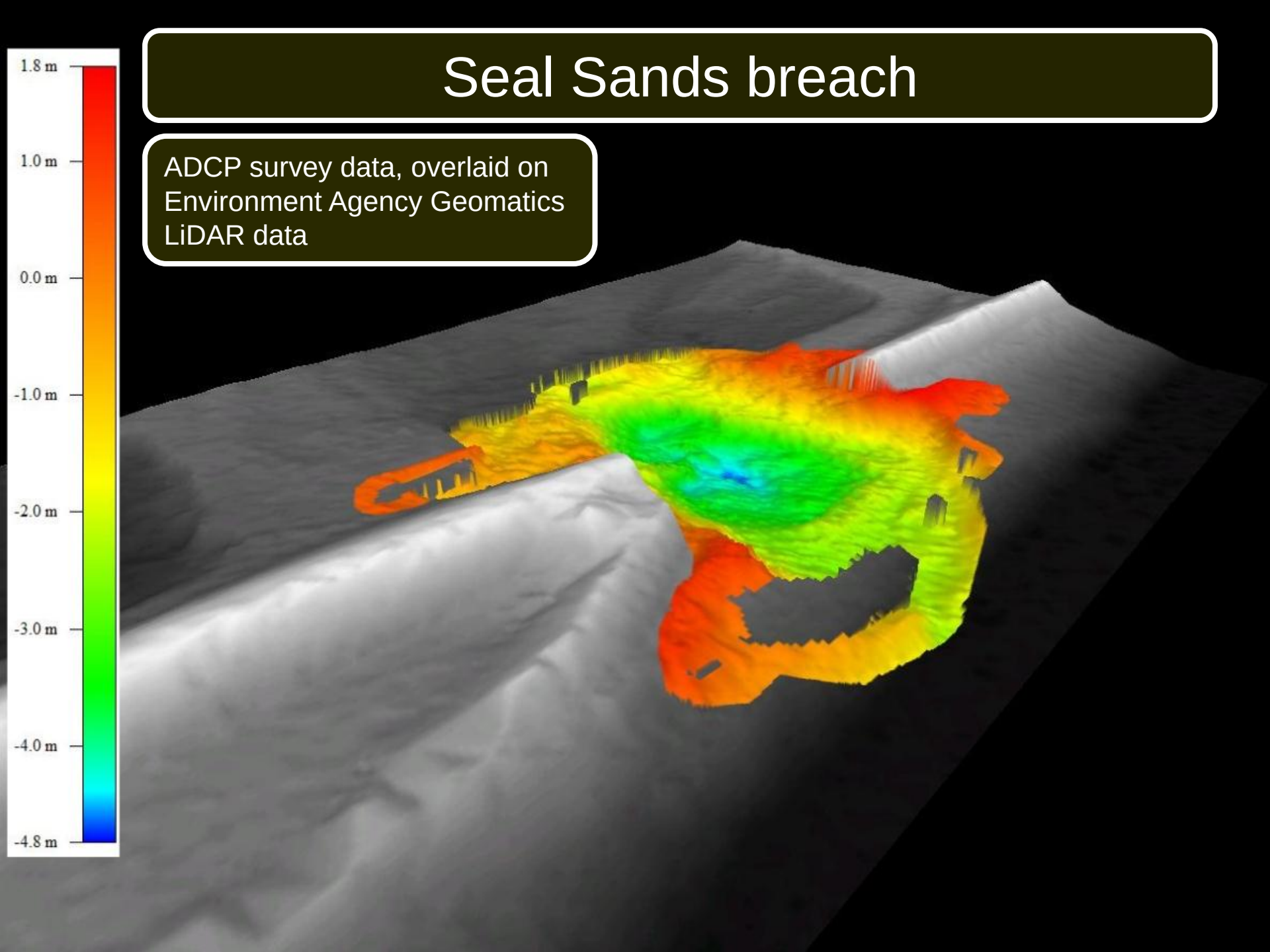
East coast tidal surge – Seal Sands breach

ARC-Boat/ADCP survey attempt no.2

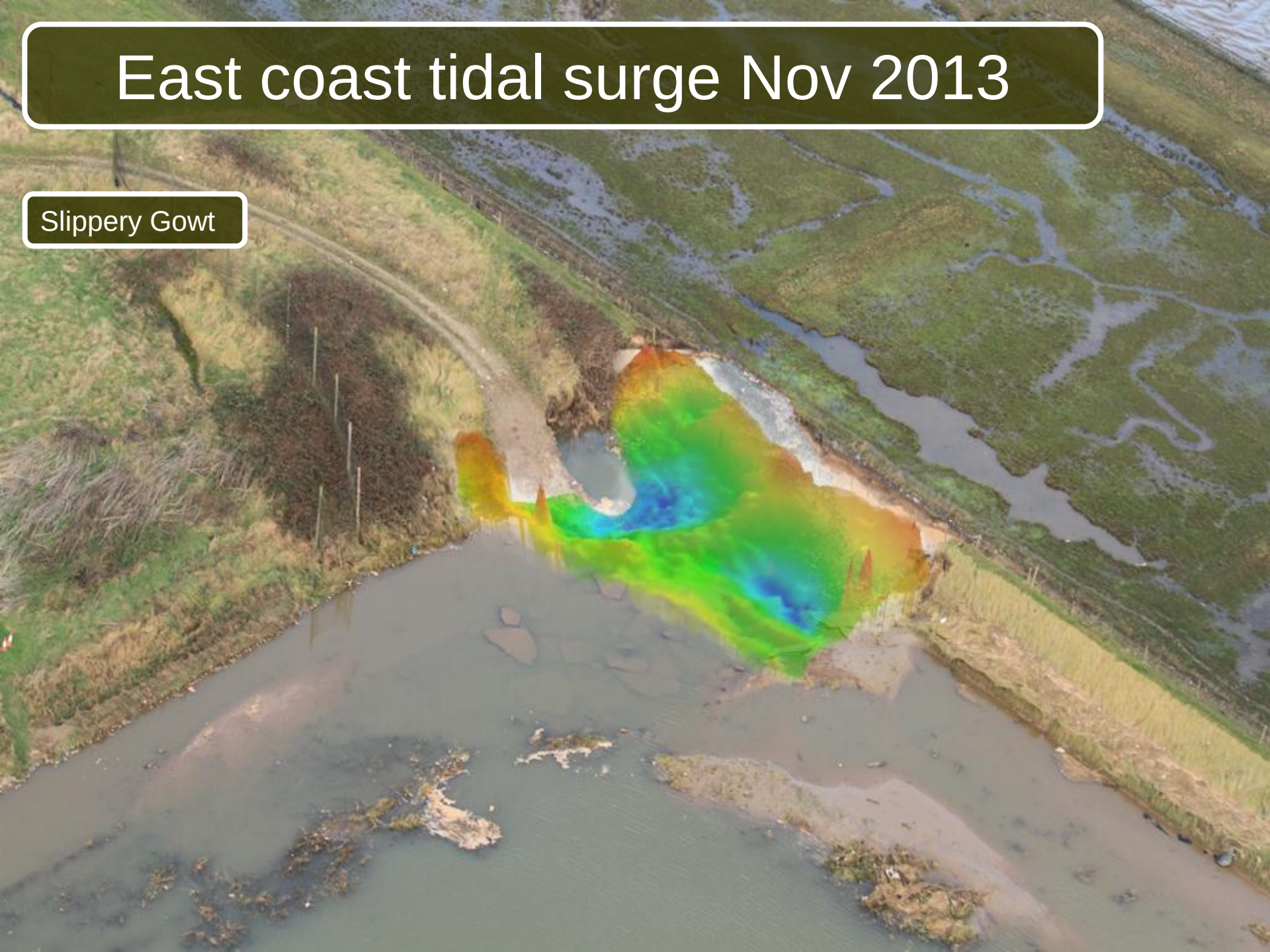
☒ Night time
☑ High tide

Seal Sands breach

ADCP survey data, overlaid on Environment Agency Geomatics LiDAR data



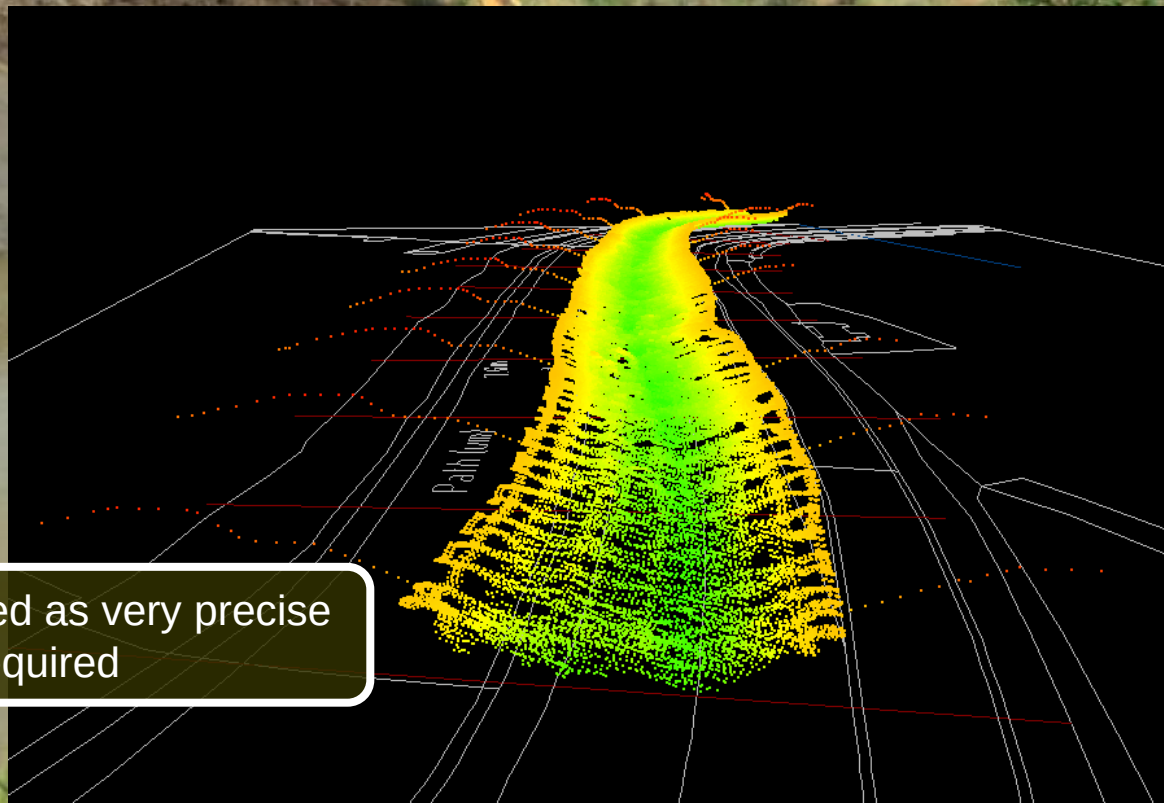
East coast tidal surge Nov 2013



Tidal defence repair – Slippery Gowt

Not a small repair job.....

Meanwhile, in Somerset.....



Pre and post-dredge surveys

RC boat not used as very precise transect lines required

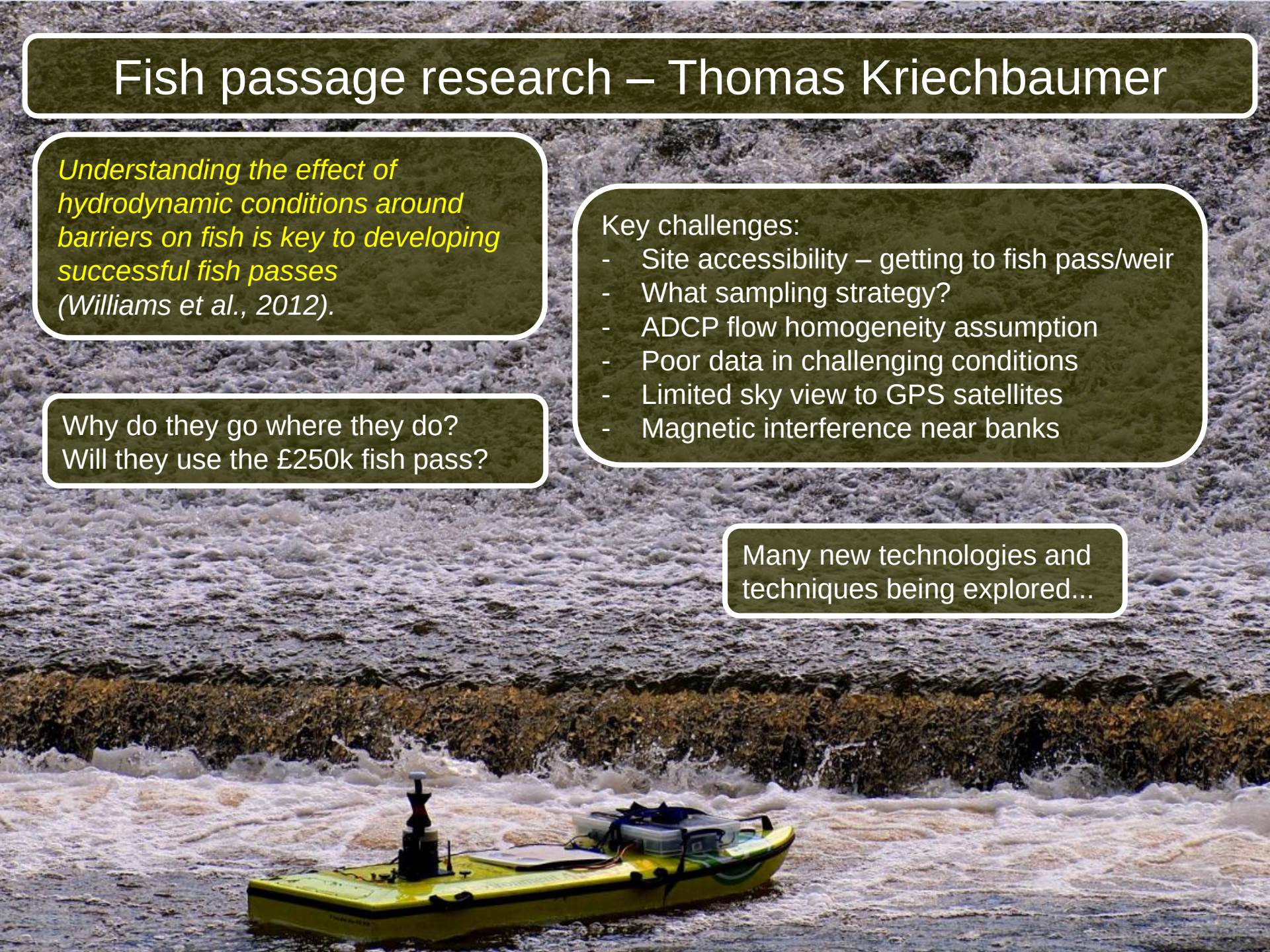
Fish passage research – Thomas Kriechbaumer

Understanding the effect of hydrodynamic conditions around barriers on fish is key to developing successful fish passes (Williams et al., 2012).

Why do they go where they do?
Will they use the £250k fish pass?

Key challenges:
- Site accessibility – getting to fish pass/weir
- What sampling strategy?
- ADCP flow homogeneity assumption
- Poor data in challenging conditions
- Limited sky view to GPS satellites
- Magnetic interference near banks

Many new technologies and techniques being explored...



Coming soon - ARC-Lite

- Developed with Cranfield University
- Optimised for hydro-dynamics surveys
- Hydraulic factors influencing fish passage.

- Single person handling and operation
- Fit in small car
- Autonomous control
- Very low draft
- Accommodates all EA ADCPs

Oh yeah, and the media love the ‘drone boat’!

TV appearances on :

- CountryFile
- BBC news
- BBC Flood special

Environment Agency

OK, there are still a few sites where our marvellous boats may not work.