cbec eco engineering

'designing with nature'

The sustainable 'nature-based' management of sediment at dam structures: design and implementation case studies from Scotland, England and Iceland.

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cbec eco-engineering UK Ltd

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Sediment continuity in rivers

- Geomorphic processes
  - channel stability
  - channel morphology
- Biodiversity/ ecological condition
- Flood risk
- Infrastructure, services etc

Different size structures, different approaches? (not just removal!)

CASE STUDIES:

Increasing size of structure/
decreasing degree of removal

- Bronie Burn – full removal
- Bowston Weir – partial removal (full removal but rock ramp replacement)
- Andakílsá (Iceland) – retrofit of dam structure (sediment management)??

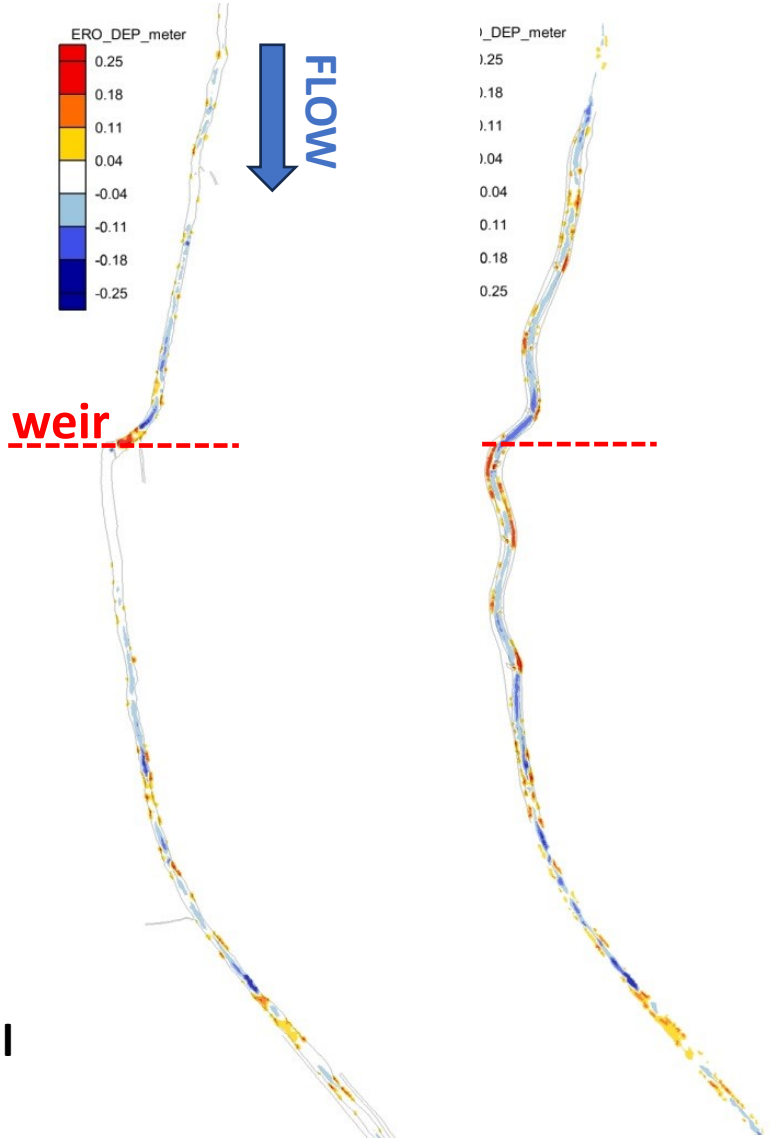
Significant risk in dam/ weir management!

- Bronie Burn – full removal
- Bowston Weir – partial removal (full removal but rock ramp replacement)
- Andakílsá (Iceland) – retrofit of dam structure (sediment management) – effectively temporary full removal?

COMMON THEME – RISK!

Managed through application of morphodynamic modelling

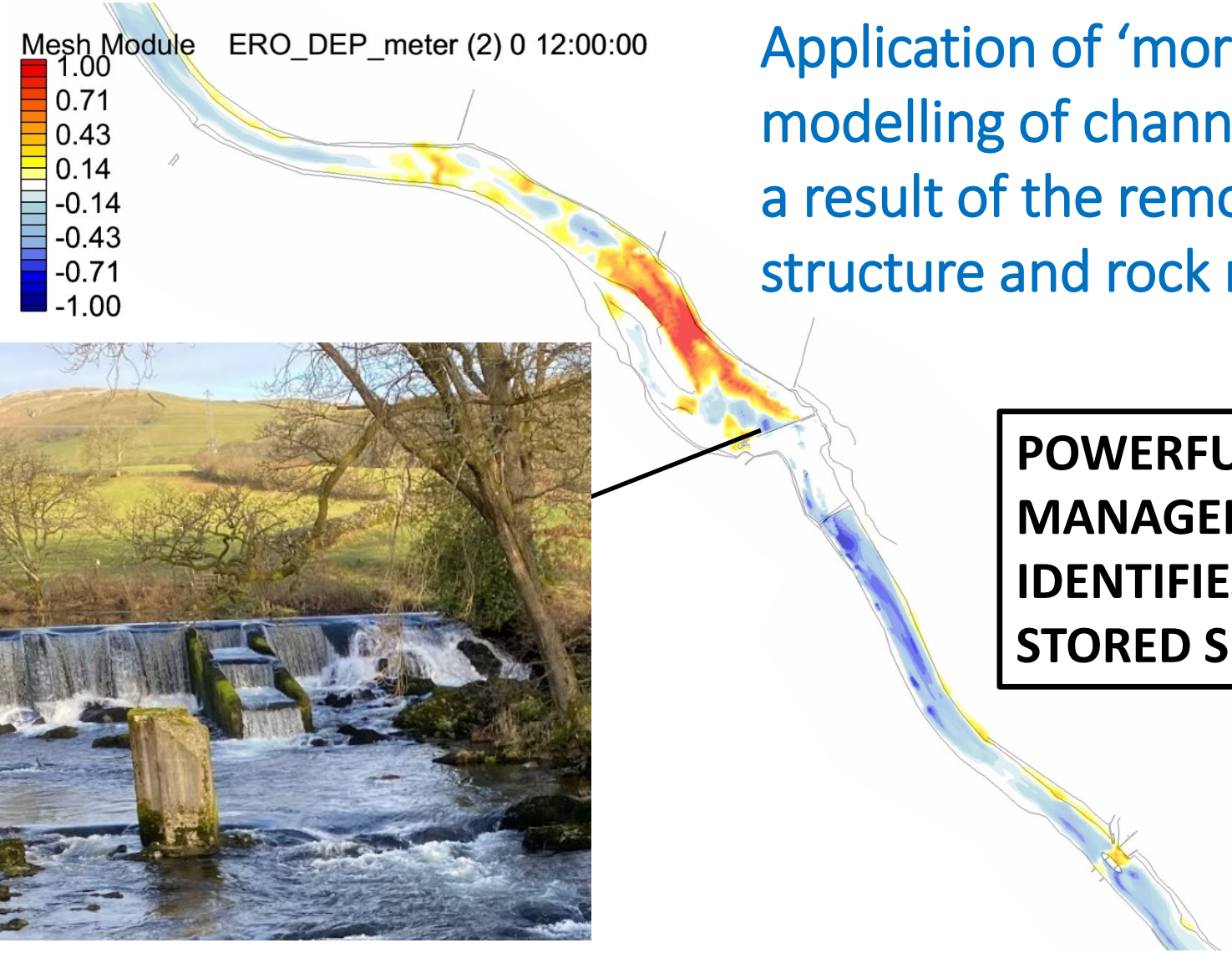
Bronie Burn – full removal



- **morphodynamic modelling identified channel instability resulting from simple weir removal**
- **channel reprofiling upstream and downstream necessary → significant additional biodiversity benefit**

Bronie Burn – full removal

Bowston Weir – partial removal/ rock ramp



Application of 'morphodynamic' modelling of channel bed evolution as a result of the removal of large weir structure and rock ramp replacement.

POWERFUL DESIGN/ RISK MANAGEMENT TOOL - IDENTIFIES 'FATE' OF STORED SEDIMENT.

Bowston Weir – partial removal/ rock ramp

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Andakílsá – sediment management/ ‘dam retrofit’

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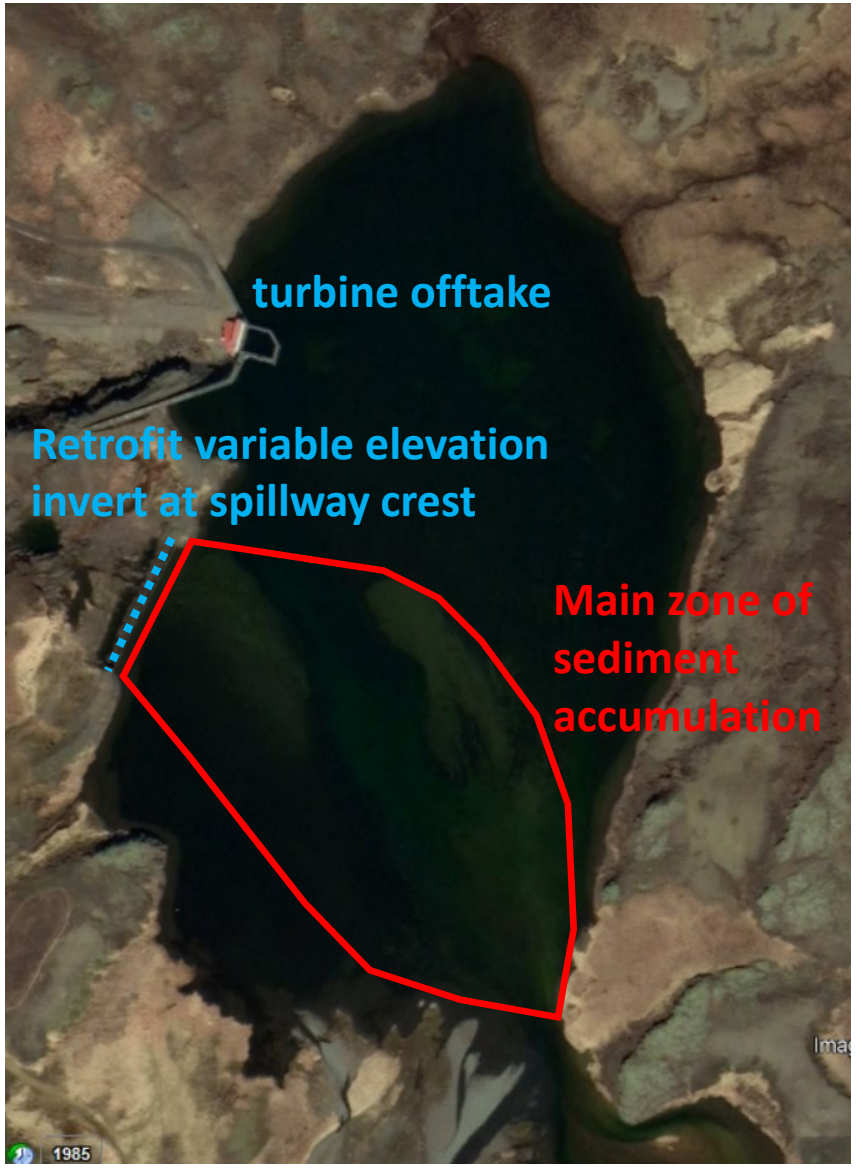
Retrofit spillway structure to permit natural transport of coarse sediment downstream.



Andakílsá – sediment management/ ‘dam retrofit’

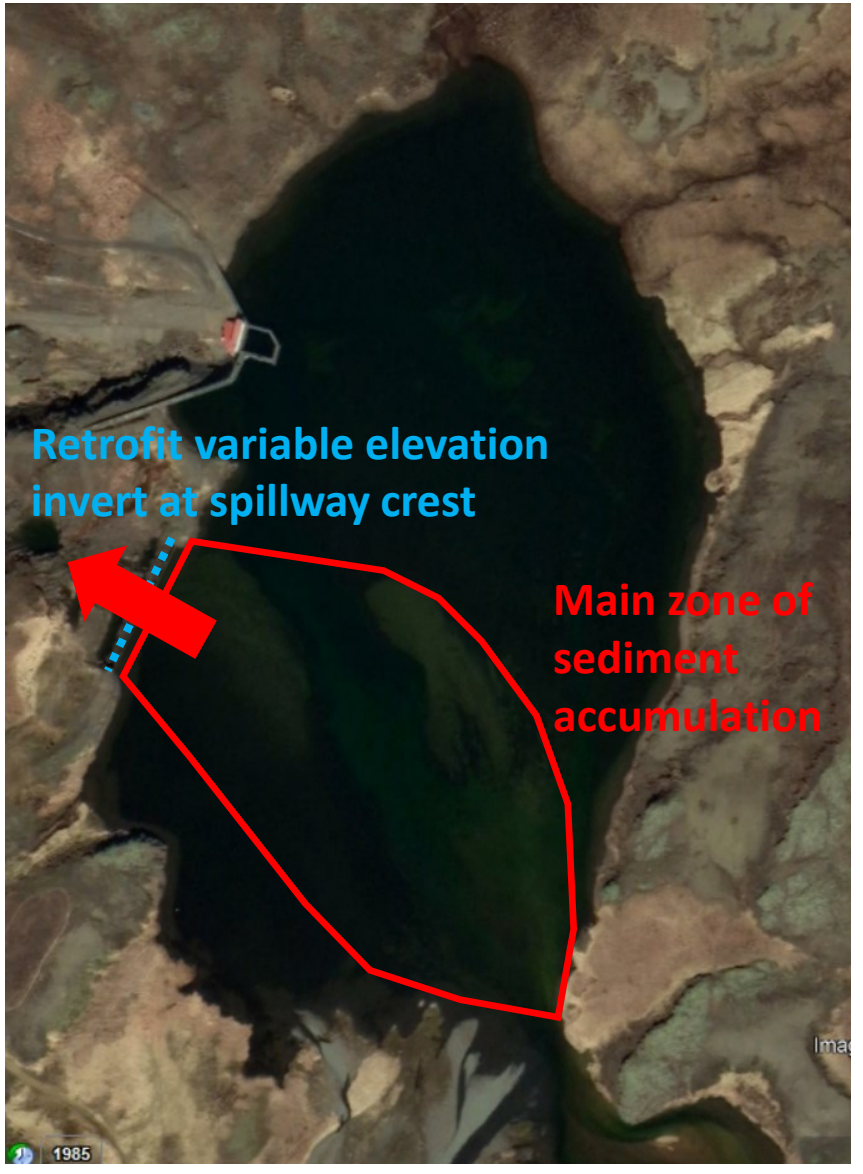
Retrofit spillway structure to permit natural transport of coarse sediment downstream.

Lower spillway crest elevation during sufficiently high flow events

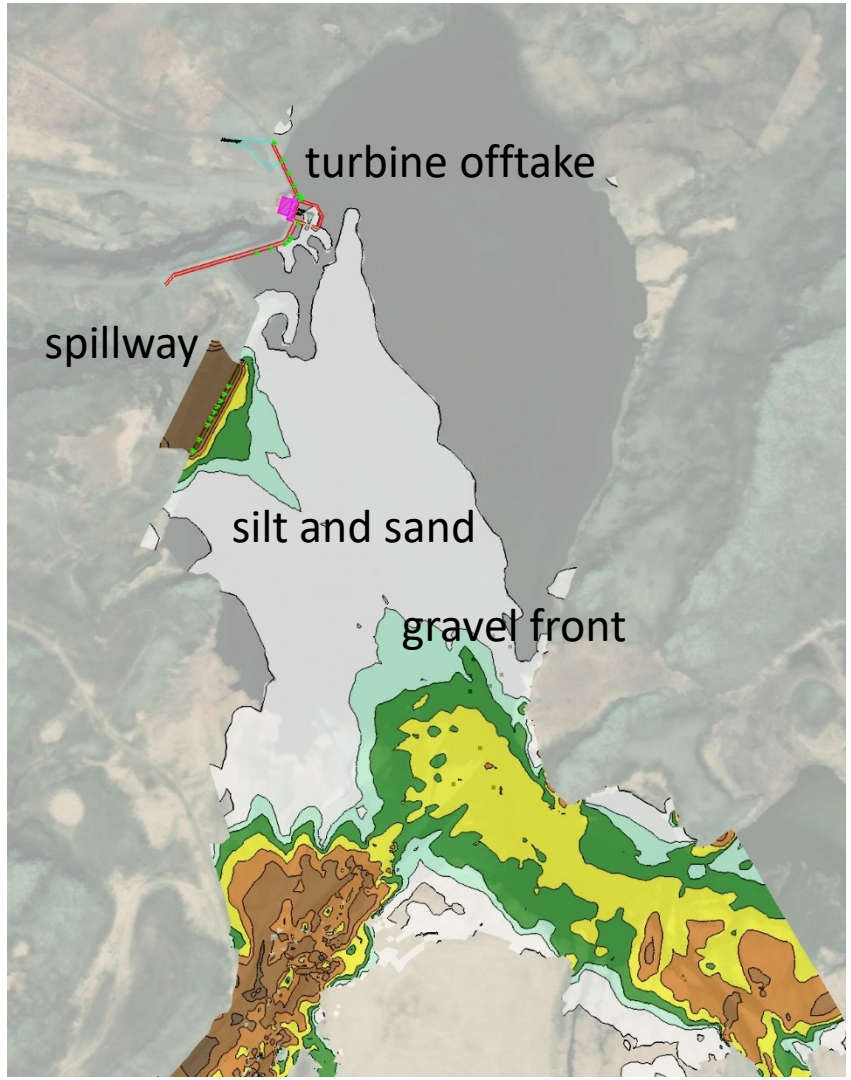
→ increased water surface slope/ energy gradient

→ transport of coarse sediment over spillway crest and downstream

→ effectively (in terms of sediment transport) temporary full removal?



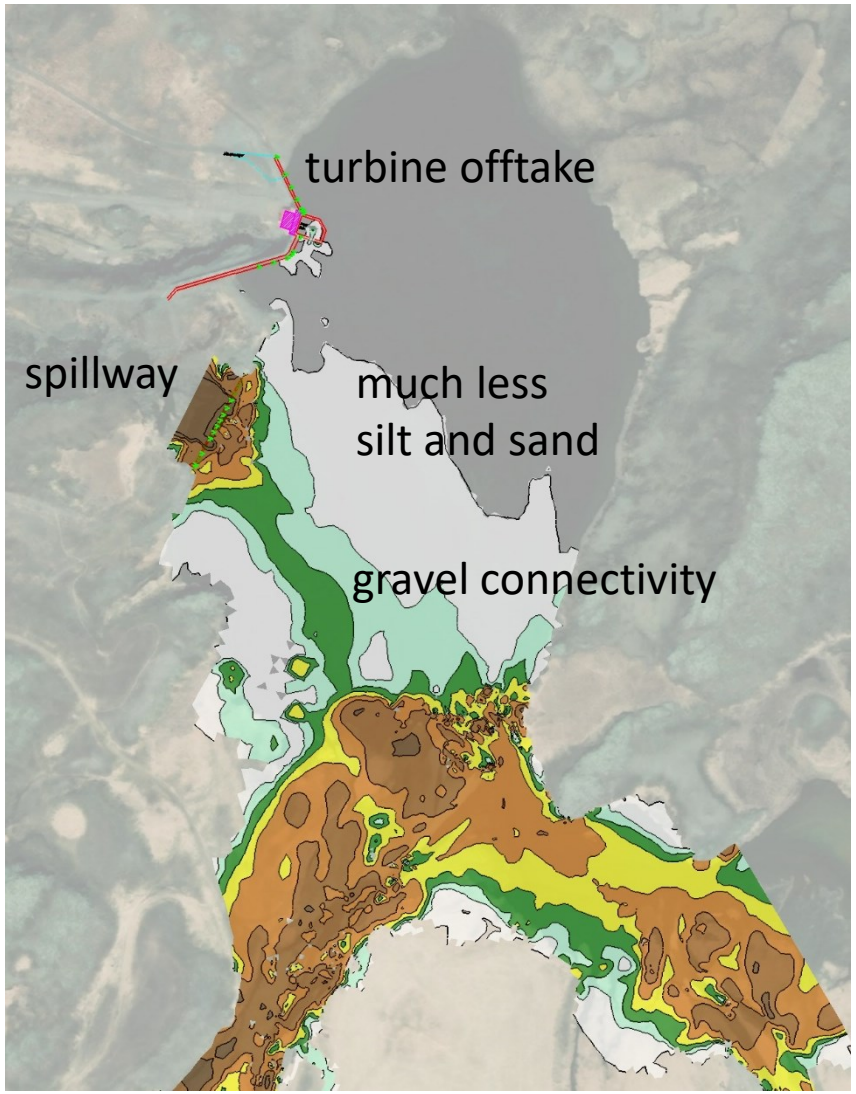
Andakilsa reservoir sediment transport modelling



Existing conditions

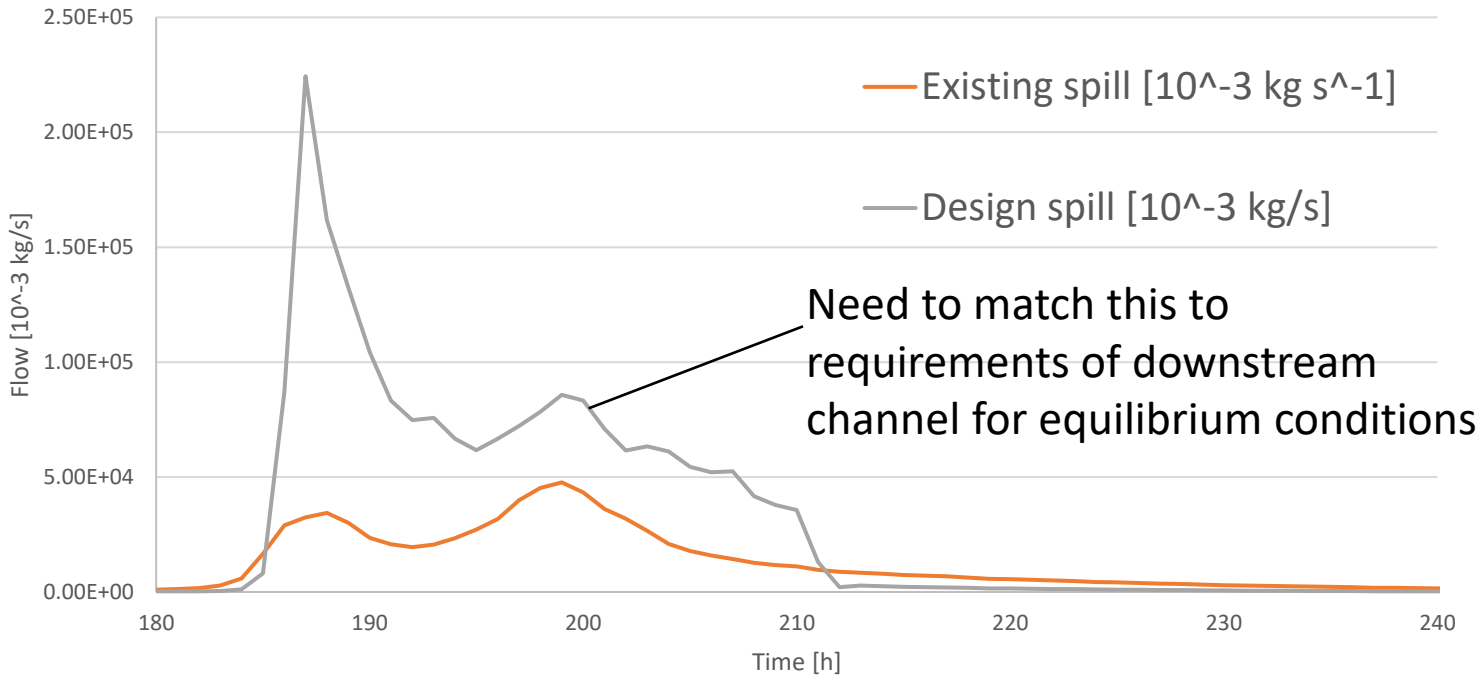
- Even in highest flows, gravel-sized material does not transport over spillway crest
- Large volumes of fine sediments filling reservoir and impacting HP offtake
- Unsustainable for physical and ecological condition of river downstream

Andakilsa reservoir sediment transport modelling

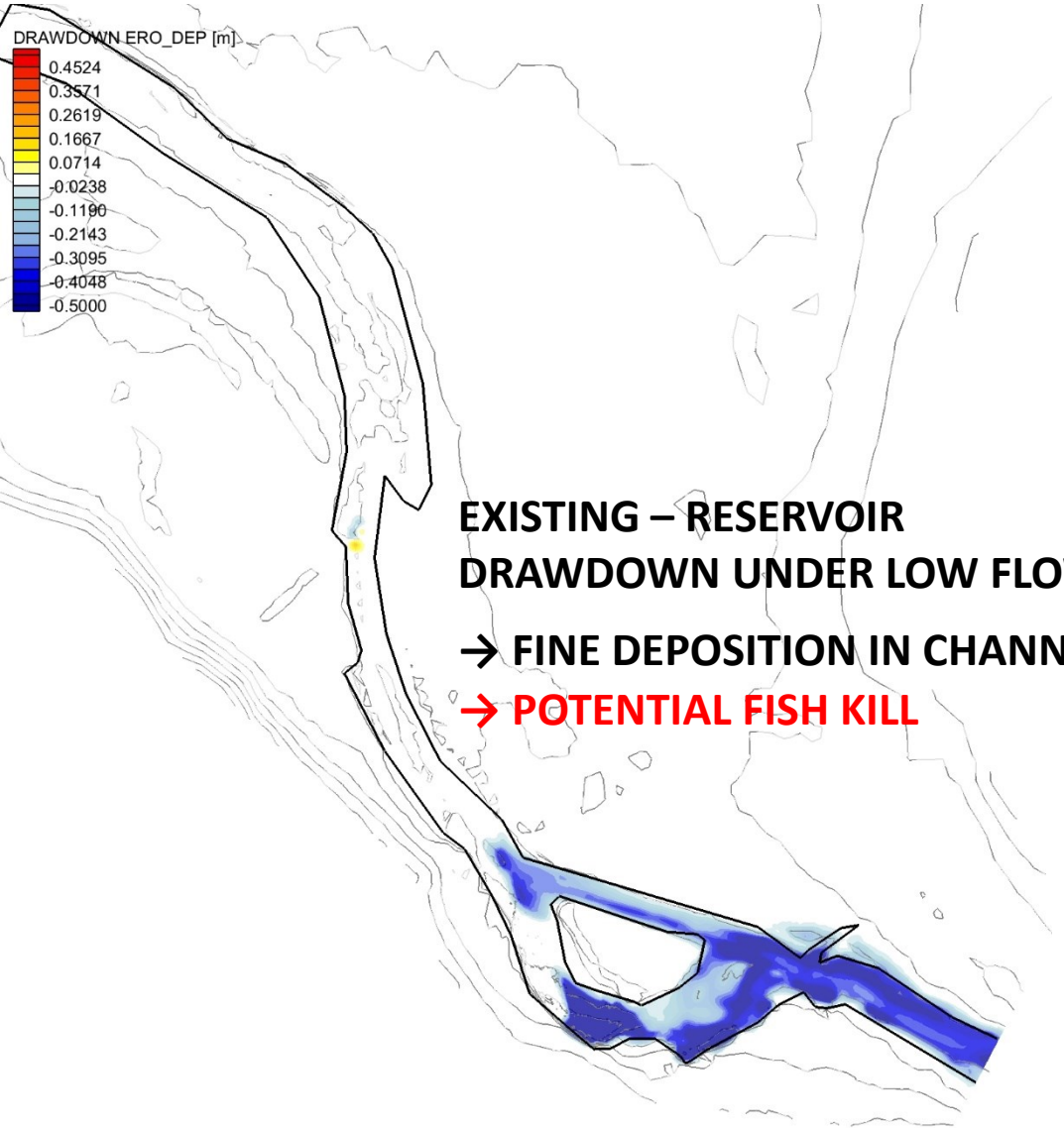


Hypothetical design case (2 m variable head spillway crest):

- **Greatly increased transport of sediment over spillway, much reduced deposition in reservoir.**
- **Stresses capable of transport of bedload over spillway → supply to downstream reach → channel equilibrium?**



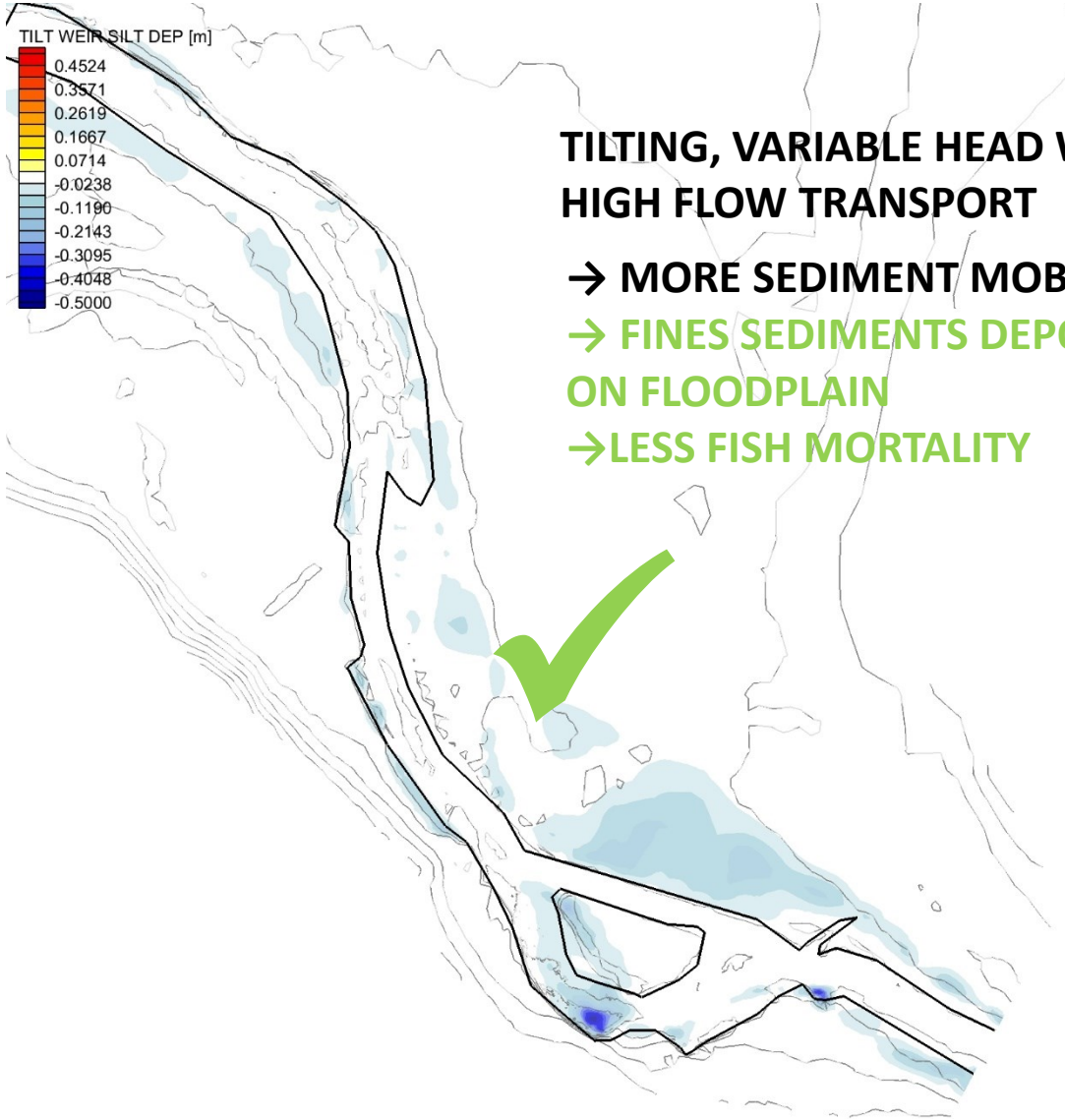
Existing vs proposed management of fine sediments



EXISTING – RESERVOIR DRAWDOWN UNDER LOW FLOW

→ FINE DEPOSITION IN CHANNEL

→ POTENTIAL FISH KILL



TILTING, VARIABLE HEAD WEIR HIGH FLOW TRANSPORT

→ MORE SEDIMENT MOBILITY

→ FINES SEDIMENTS DEPOSITED ON FLOODPLAIN

→LESS FISH MORTALITY

Different size structures, different approaches? (not just removal!)

- Bronie Burn
- Bowston Weir
- Andakílsá, Iceland

Greater benefit from full removal – long-term aspiration?

‘MORPHODYNAMIC’ MODELLING ESSENTIAL FOR MANAGING DESIGN RISK RELATING TO SEDIMENT MANAGEMENT

Thank-you for your attention!

Thank-you!

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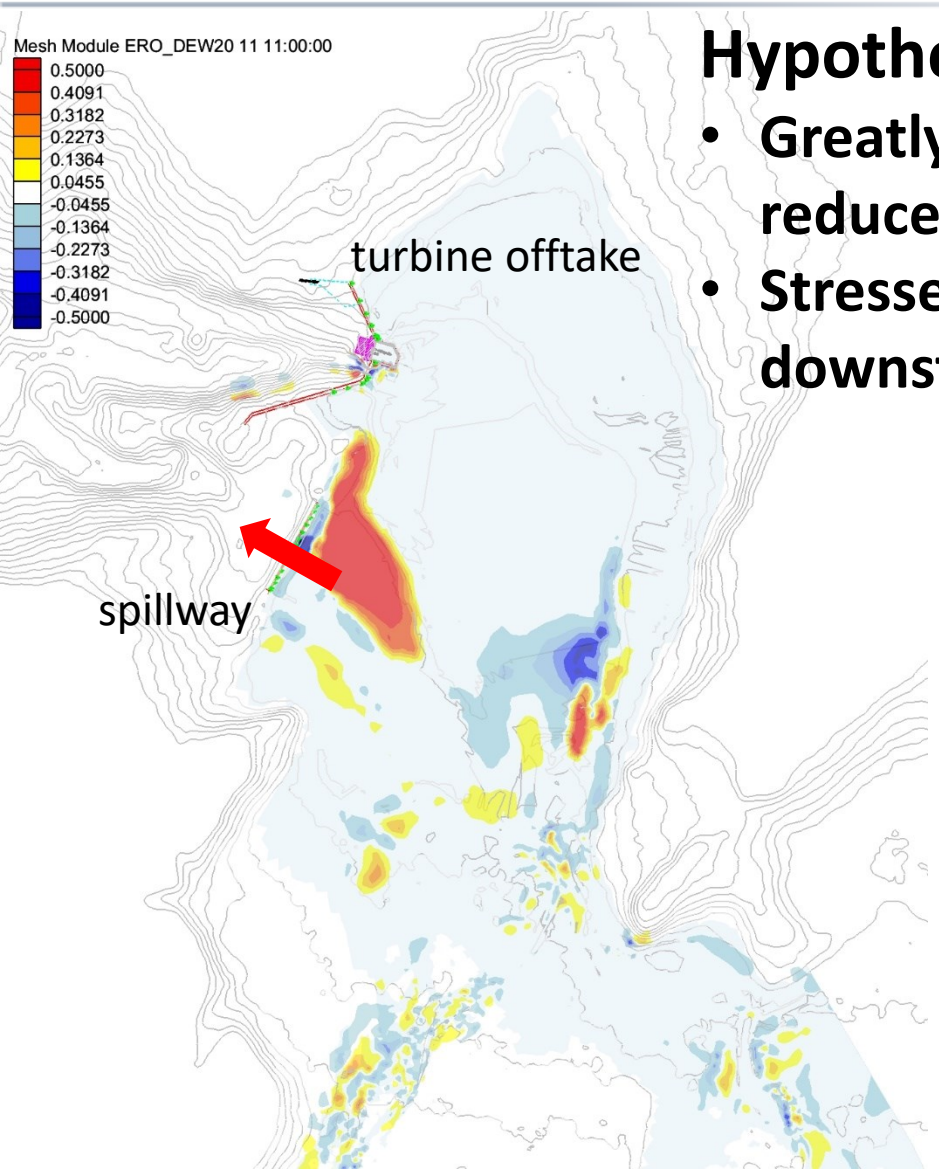
Andakilsa reservoir sediment transport modelling



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