Delivering River Restoration: Recipes for Success

13th Annual Network Conference

Restoring Europe’s Rivers

Sponsors and Partners:
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Sustainable, Cost-Effective Reservoir Discontinuance - Re-Naturalising Whicham Beck, Lake District National Park

Evan Dollar, Paul Bradley, Carl Sanders, Dale Gibbons & Gavin Hulme
• Baystone Bank IR:
  - 6 km North of Millom
  - Completed 1876 – earth fill construction, puddle clay core, by-wash, overflow & scour facilities
  - Impounded Whicham Beck
  - 125 Ml capacity
  - Lanthwaite WTW decommissioned 1995
Project Drivers

- Baystone Bank IR:
  - No operational function
  - Undersized overflow capacity
  - ITIOS requirements – discontinuance options – with / without residual storage
  - Continuing liability, routine maintenance costs
  - Unforeseen future costs - legislative changes
Discontinuance & Restoration

• Agreement with stakeholders:
  ➢ Full discontinuance, no residual storage
  ➢ Full restoration of Whicham Beck (upland gravel-bed river), floodplain & valley
  ➢ Restore access to the upper catchment for migrant fish
  ➢ Maintain high standards of water quality throughout the project works
  ➢ Provision of still water habitat for spring quillwort and foraging for Daubenton’s bat

• No existing full discontinuance & gravel-bed river restoration schemes in England & Wales (260) for learning
Stakeholder Agreement on Design Philosophy & Principles

• Design philosophy (success - when):
  ➢ ‘... Whicham Beck & floodplain restored... restitution of natural forms and processes... provision of still water habitat...’

• Design principles (success – how sustainable):
  ➢ Work with natural processes towards the establishment of natural, habitat-forming processes
  ➢ Allow for variability in four dimensions
  ➢ Allow for wide tolerances
  ➢ Create the initial conditions conducive to allow for self-restoration
Design Approach – 5-Stage Process

- **Stage 1**: Geomorphological context, data collection & assessment
- **Stage 2**: Initial channel, floodplain & pond design
- **Stage 3**: Channel & floodplain design to sustain geomorphic processes
- **Stage 4**: Final channel, floodplain, valley & pond design
- **Stage 5**: Accept design & construct
Stage 1: Geomorphological Context, Data Collection & Assessment
Stage 2: Initial Channel, Floodplain & Pond Design

- Information collected in Stage 1 was used to design:
  - Channel / floodplain complex
  - Planform
  - Slope
  - Geometry
- Pond for spring quillwort & Daubenton’s bat

<table>
<thead>
<tr>
<th>Typical Pool, Riffle, Floodplain Dimensions for Whicham Beck &amp; Tributary</th>
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<tbody>
<tr>
<td>Bottom width (m)</td>
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<tr>
<td>Top width (m)</td>
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<tr>
<td>Bankfull depth (m)</td>
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<td>Slope (m)</td>
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Stage 3: Channel & Floodplain Design to Sustain Geomorphic Processes

- Resistance equations
- Bathurst (2007) Phase 1 / 2 transport calculations
- Bed material samples
- Representative pool & riffle cross-sections
- Channels designed to transport as per representative upstream pool & riffle cross-sections
Stage 4: Final Channel, Floodplain & Valley Design (1/2)

- Design channel dimensions burnt into 3D ground model
- Allowed for cut / fill volumes and locations & contour plan
- Design laid out on site
- Adjustments made for construction & where relict bed unearthed
Stage 4: Final Channel, Floodplain & Valley Design (2/2)

- Mike-21 HD & ST model built
- Pool / riffle spacing & geometries added
- Interactions between pond & channel and channel & floodplain
- Areas of erosion, deposition & bank instability
Stage 5: Accept Design & Construct
Ecological Management

- Water quality targets agreed with stakeholders & maintained during earthworks
- By-wash discontinued over 5 days
- Electro-fish rescue – 400 brown trout, 38 European eel
- Gradual turning of the flow to new channel
- No perceived fish mortality
- New channel running clear within hours
Before and After – Reconnection of Upper Catchment

2010

2011
Before and After

2010

2012
Main Benefits

• All on site material reused
• Accumulated sediment blended with landscaping material
• 2,500 wagon movements avoided
• Estimated 175 tCO2e in transport emissions avoided
• Removal of barrier to fish migration
• Habitat for otter, eel, brook lamprey, brown trout, sea trout, salmon, Daubenton’s bat & spring quillwort
• Terrestrial habitat connectivity
• Downstream sediment conveyance
Main Benefits

- Cost-effective discontinuance – substantially cheaper than spillway repair & embankment stabilisation
- No future cost / liability
- Sustainable pond design that does not disrupt flow & sediment continuity
- Climate change resilience