Introduction On Aussie Fish Passage

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Agenda

- Fishway structures
  - Stepped pool fishways
  - Mechanical fishways
  - Downstream Passage

- Fish passage design process
  - General Biology, hydrology & hydraulics
  - Takes a team!

But First…. 3 Fishways, Which is Australian?

Which is Australian?

- Iceland
- Ægissíðufoss Waterfall
- Atlantic Salmon Passage

Credit – reddit user u/der_pudel

- USA
- French Lake Dam Fish Ladder
- Salmon Passage

Credit – flickr user lsmith2010

- Australia!
- Fitzroy Barrage (QLD)
- Broad range of species, even < 14mm Gudgeons

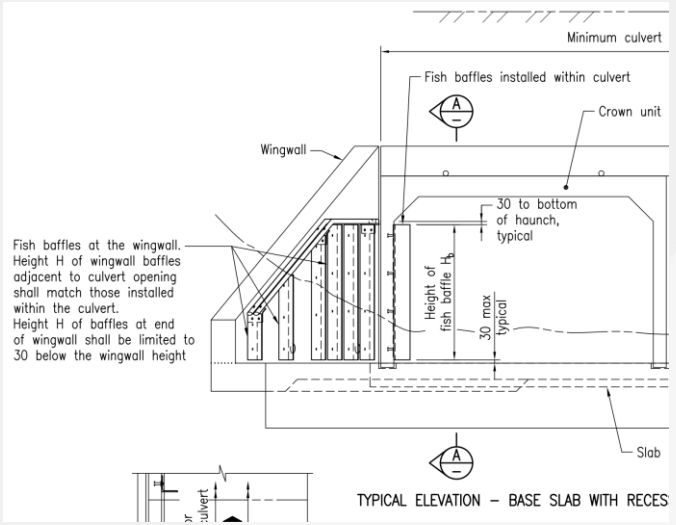
Credit – Tim Marsden

Marsden, T. "Fitzroy Barrage Cone Fishway Upgrade and Monitoring Report". 2017.

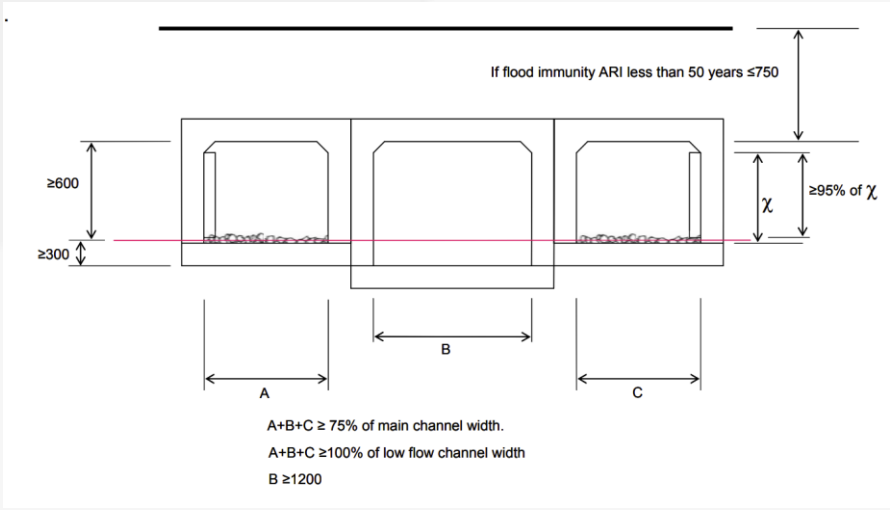
Something Fishy Part 1 Follow Up - Culvert and other crossing design

Where to find AUS specific culvert guidance?

- Great work from Hubert Chanson - http://staff.civil.uq.edu.au/h.chanson/fish_culvert.html
- DAF provides good compliance requirements
- Main roads, catchment management authorities, state and local government guidelines
- Talk to an expert!



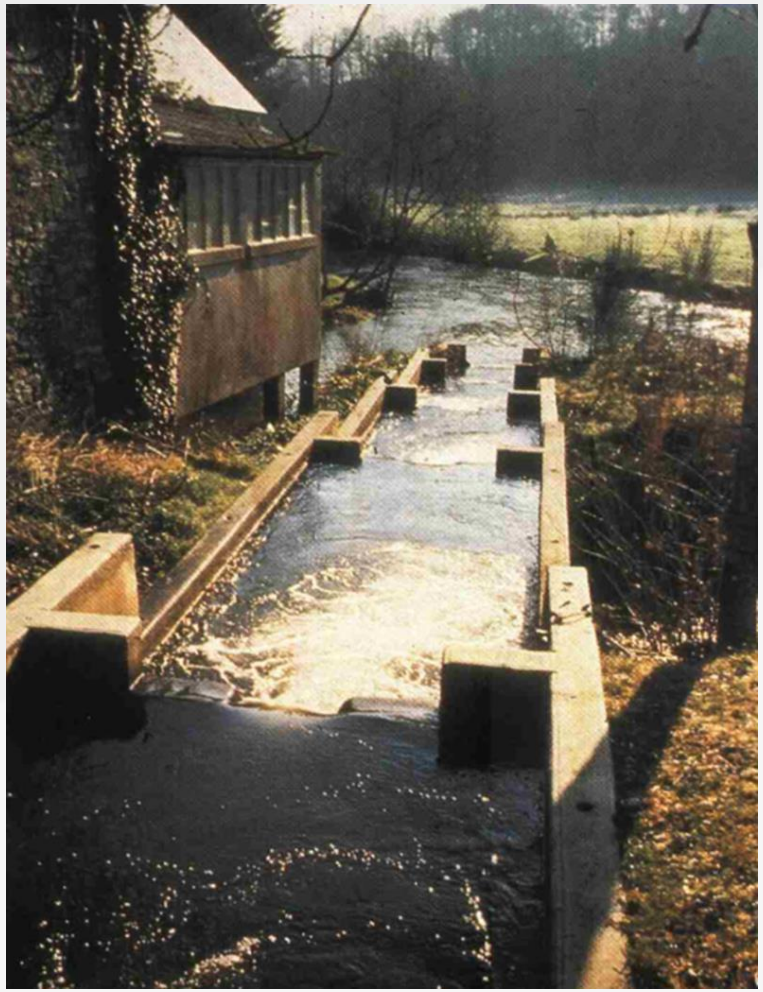
TMR fish passage standard drawing - 1270

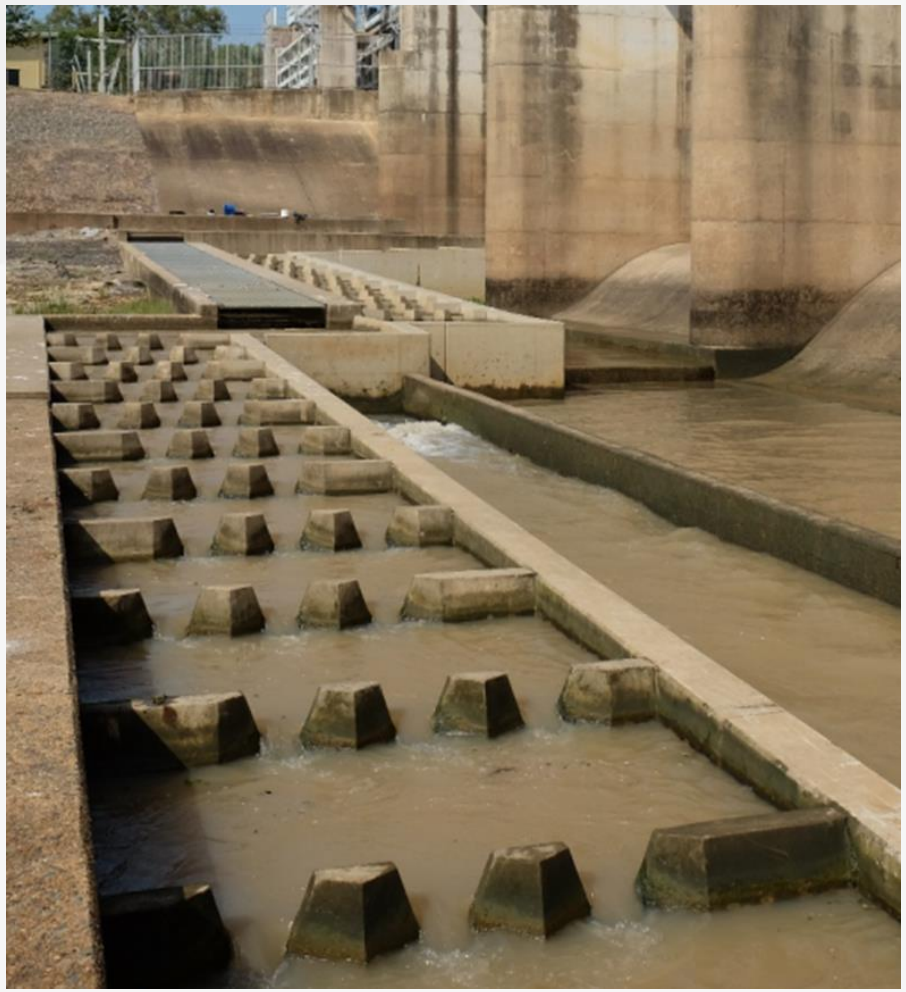


https://www.daf.qld.gov.au/__data/assets/pdf_file/0018/54720/culvert-code-WWBW01.pdf

Fishway Structures – Stepped Pools

- Stepped pool fishways:
  - **Weir**
  - **Trapezoidal**
  - **Cone**
  - Vertical Slot





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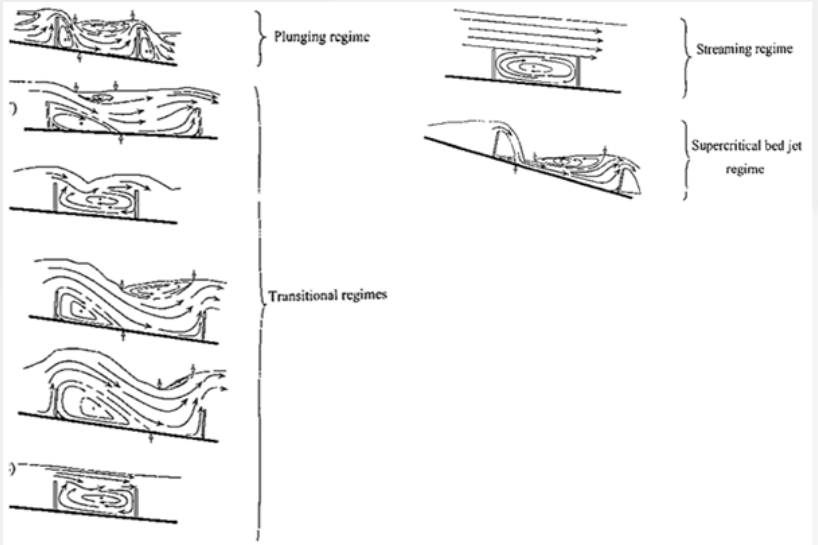

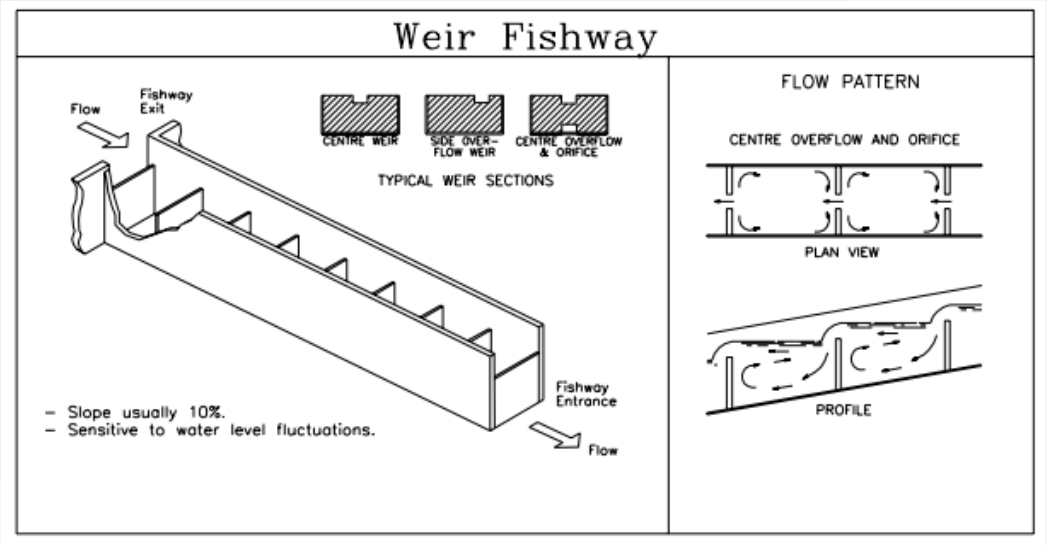

$$Q = C\,b\,h^{\frac{3}{2}}$$ Sharp crested weir equation

$$Q = K_u \tan\left(\frac{\theta}{2}\right) H^{2.5}$$ V notch equation

$$K = \frac{Q_{submerged}}{Q_{free}} = \left(1 - \left(\frac{h_t}{h}\right)^n\right)^{0.385}$$ Submerged weir equation

Katopodis, C. & Sikora, G & Rajaratnam, N. & Ead, SA. "Flow regimes and structure in pool and fishways". 2004.
Katopodis, C. "Introduction to fishway design". 1992.
Thomson, K. & Redenbach, M. "Understanding Cone Fishway Flow Regimes with CFD". 2022.
Villemonte, J.R. "Submerged weir discharge studies". 1947.

Fishway Structures – Stepped Pools

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Image credit – Ivor Stuart

Image credit – u/der_pudel

O'Connor, J & Mallen-Cooper, M & Stuart, I. "Performance, Operation and Maintenance Guidelines for Fishways and Fish Passage Works". 2015.
O'Connor, J & Stuart, I & Jones, M. "Guidelines for the design, approval and construction of fishways". 2017.

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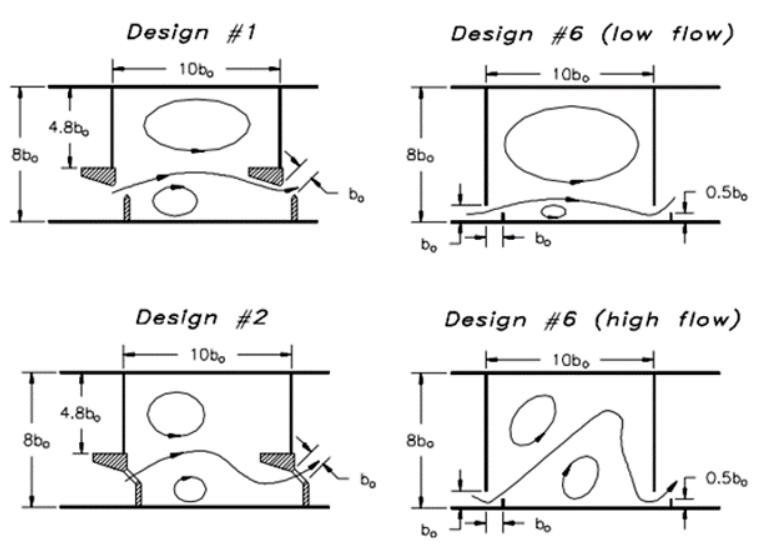

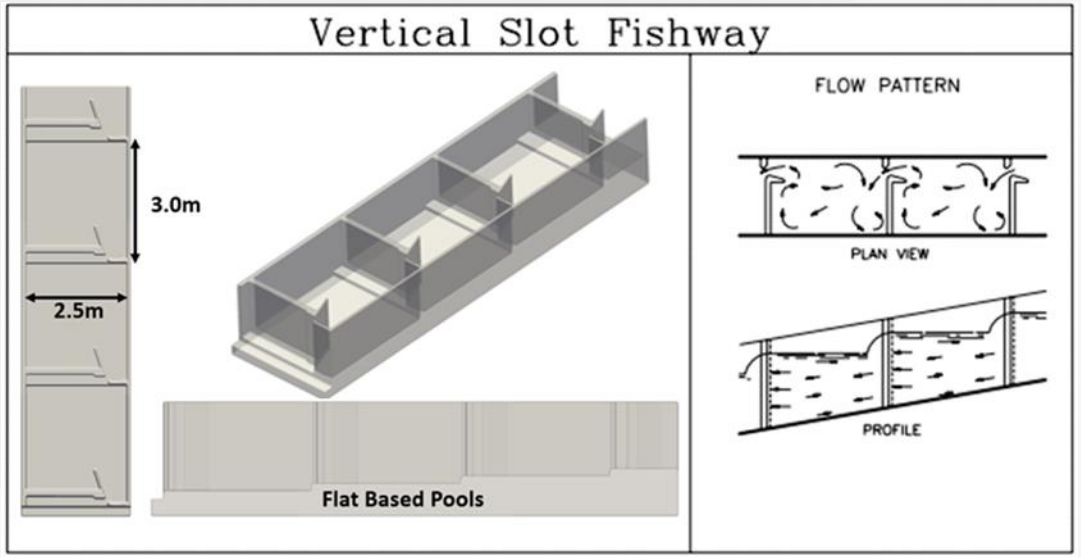

$V = \sqrt{(2g\Delta h)}$ Baffle vena contracta

$Q = C_d V A$ Baffle flow rate

C_d – Typically between 0.65 – 0.85

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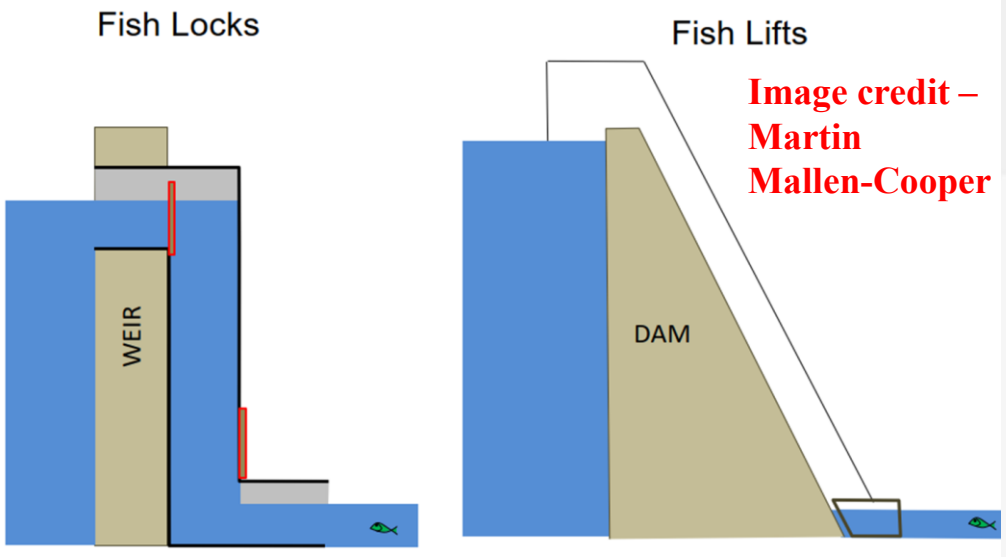
O'Connor, J & Mallen-Cooper, M & Stuart, I. "Performance, Operation and Maintenance Guidelines for Fishways and Fish Passage Works". 2015.
Thomson, K. "Practical Application of CFD for Fish Passage Design". 2022.

Fishway Structures – Mechanical

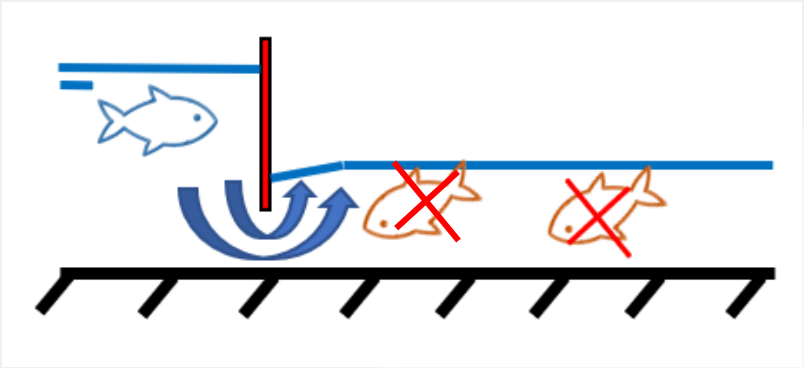
- Mechanical fishways:
  - **Locks**
  - **Lifts**
  - **Traps**

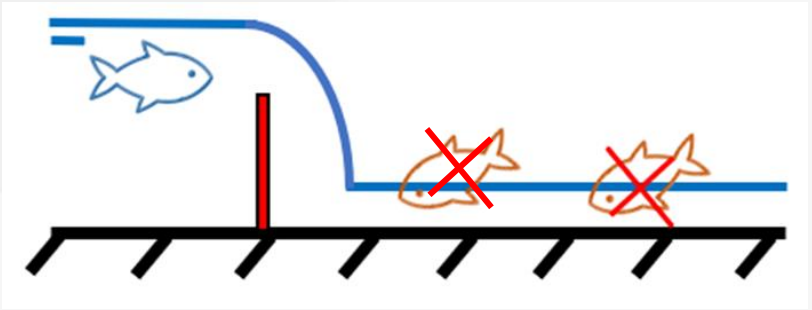


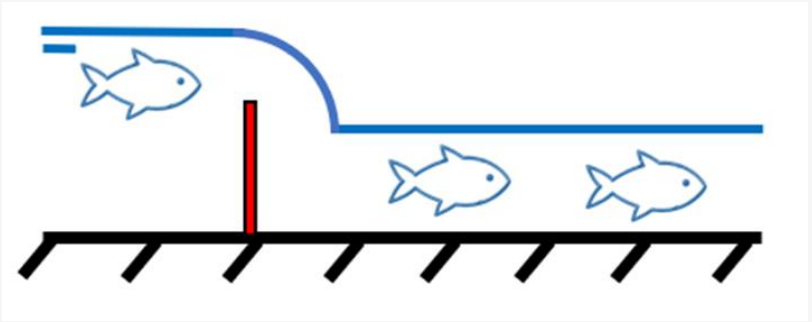
NSW DPI. “Improving fish passage in the Shoalhaven – Fish monitoring at Tallowa Dam". 2016. https://www.waternsw.com.au/supply/Greater-Sydney/weirs/fishways

Fishway Structures – Downstream Passage

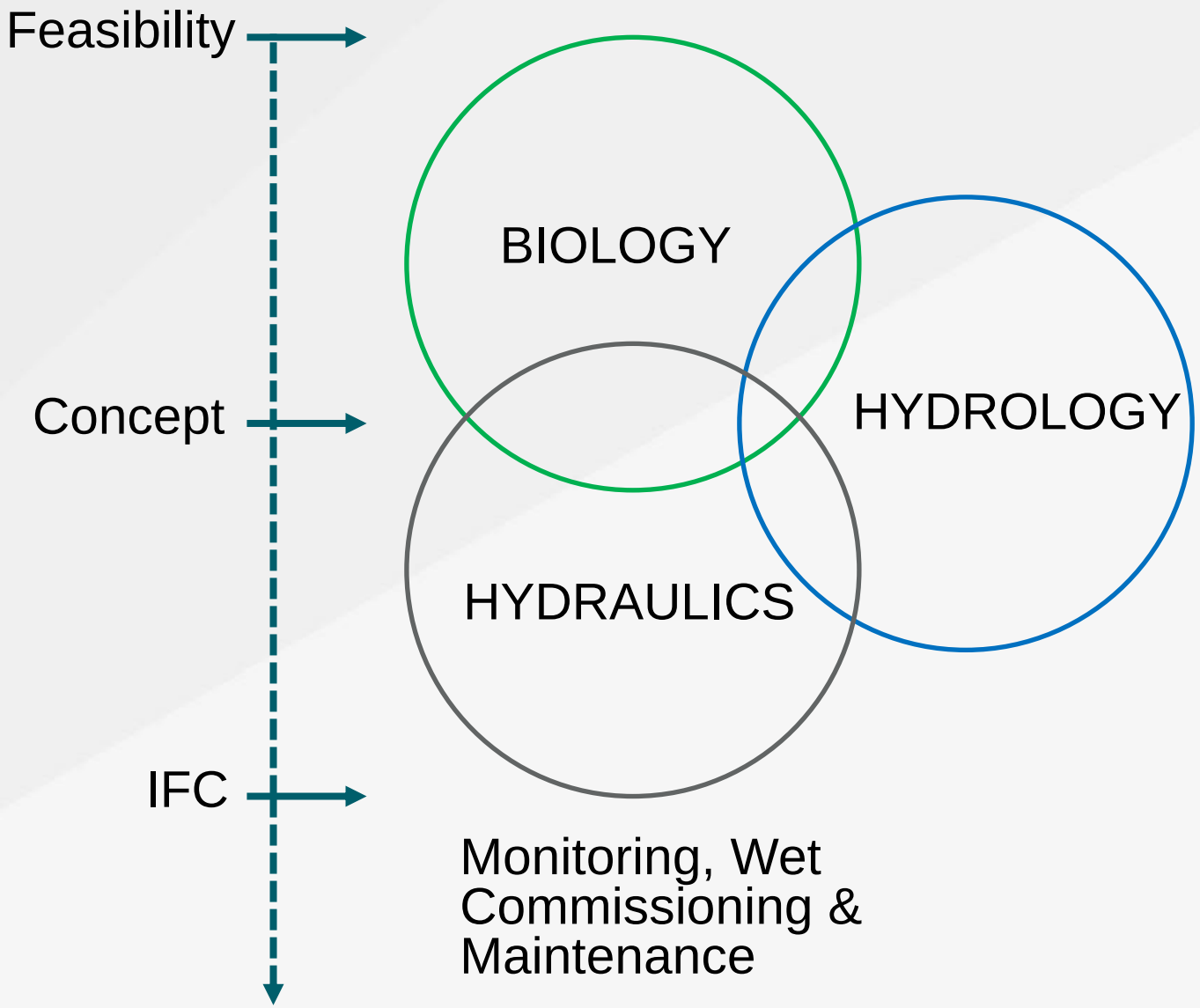
- Downstream Passage:
  - **Overshot**
  - **Undershot**







Fish passage design process

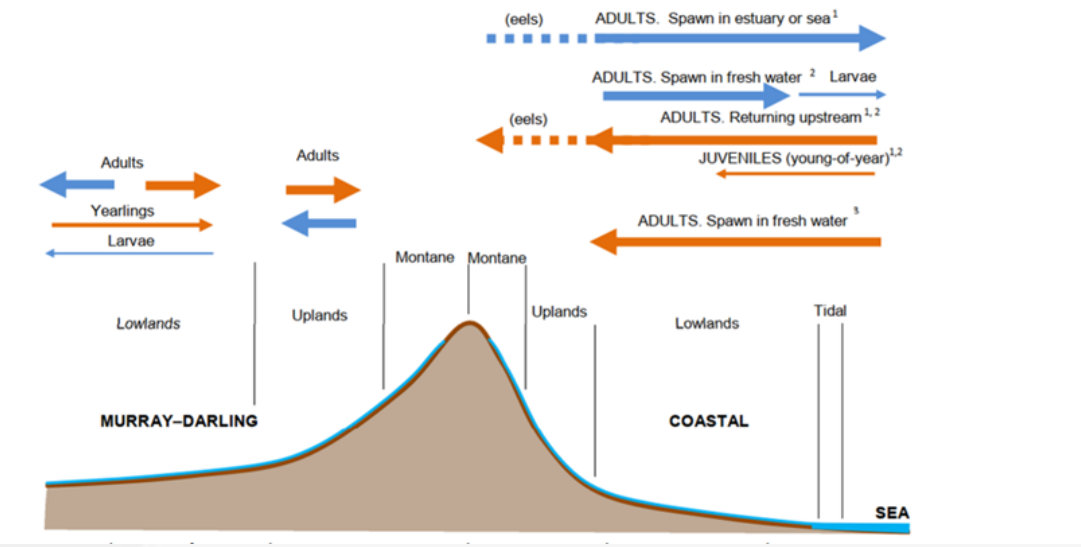


Design advice from other engineering disciplines from feasibility through to IFC including:

- Structural
- Civil
- Geotech
- Mechanical

Fish passage design process - Feasibility

- Knowledge of existing fish species and movement before design process commences, including:
  - Fish distribution and abundance
  - Migration ecology and behaviour
  - Population and biomass



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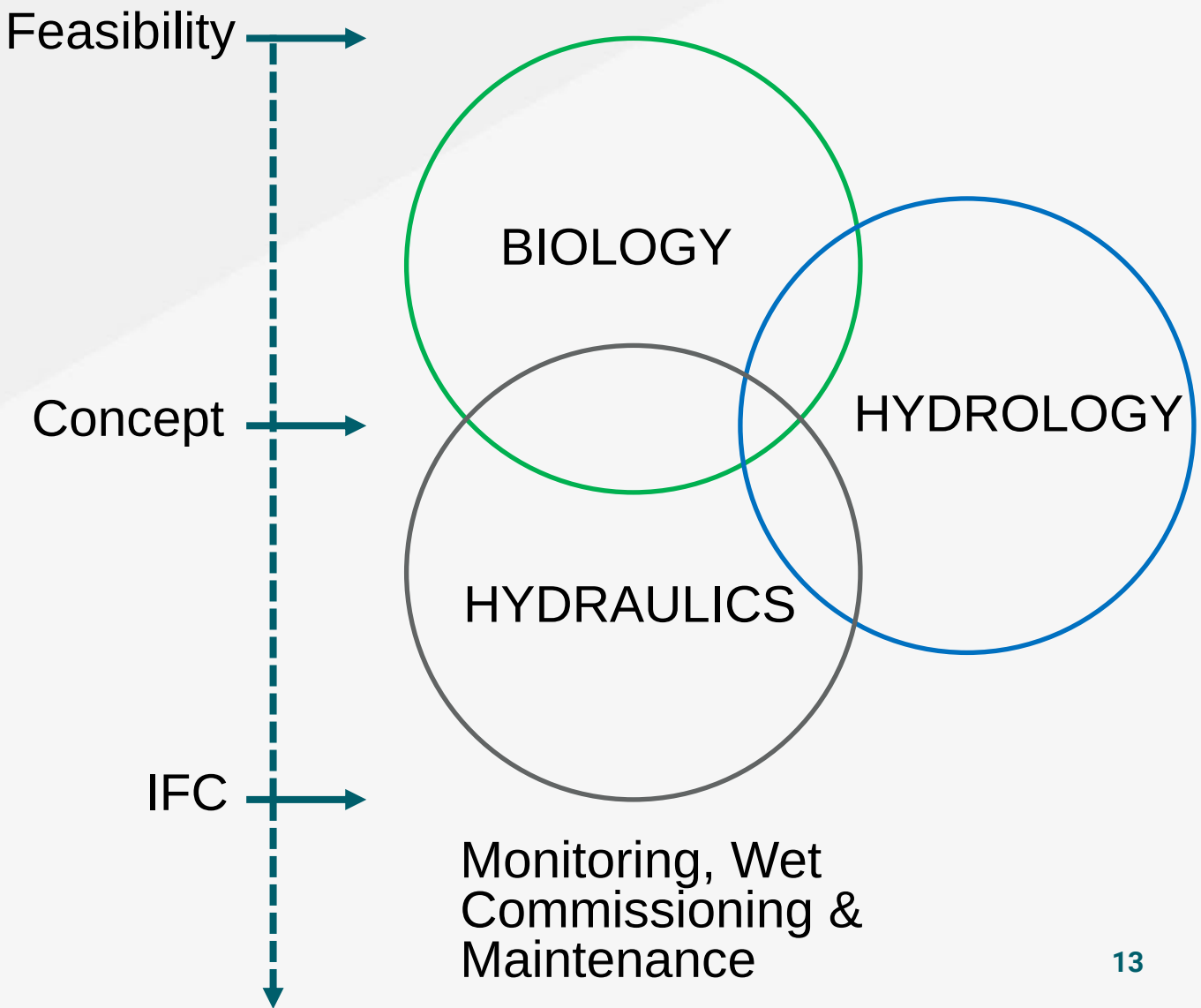
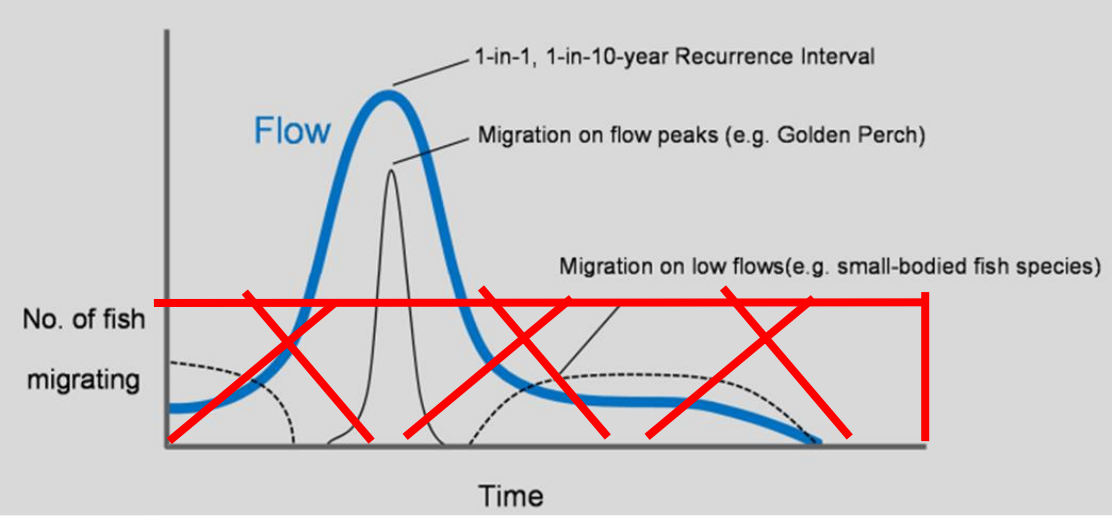


Fish passage design process - Feasibility

- Understand catchment flow rates, frequencies, existing waterway barriers
- Quantify delay in passage from waterway barrier (barrier impacts)
- Decide on a fish passage type and initial design
- Estimate operating conditions to meet transparency requirements
- Fisheries advisor begins stakeholder engagement (depends on the project)
- Develop a hydraulic performance standard



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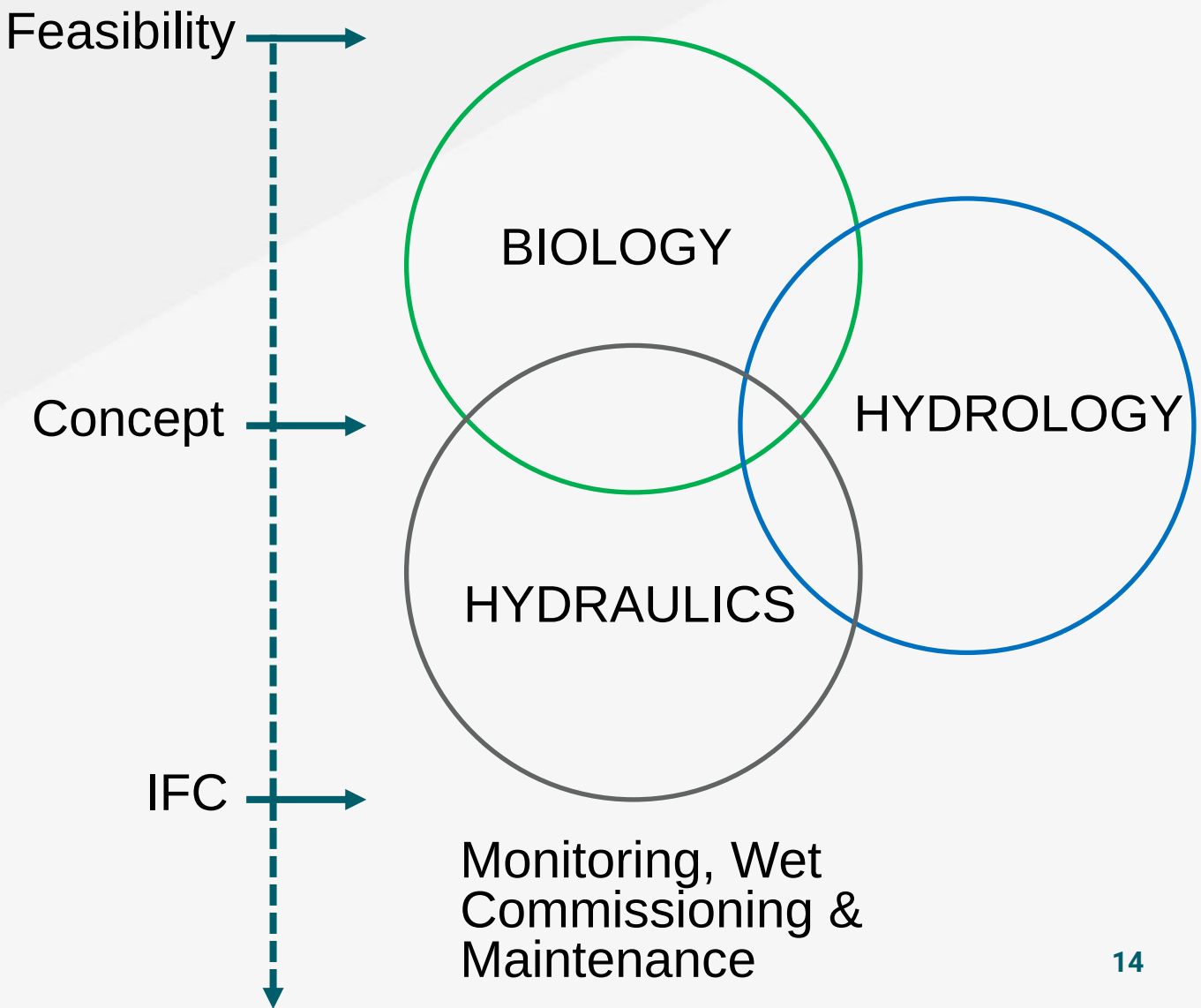
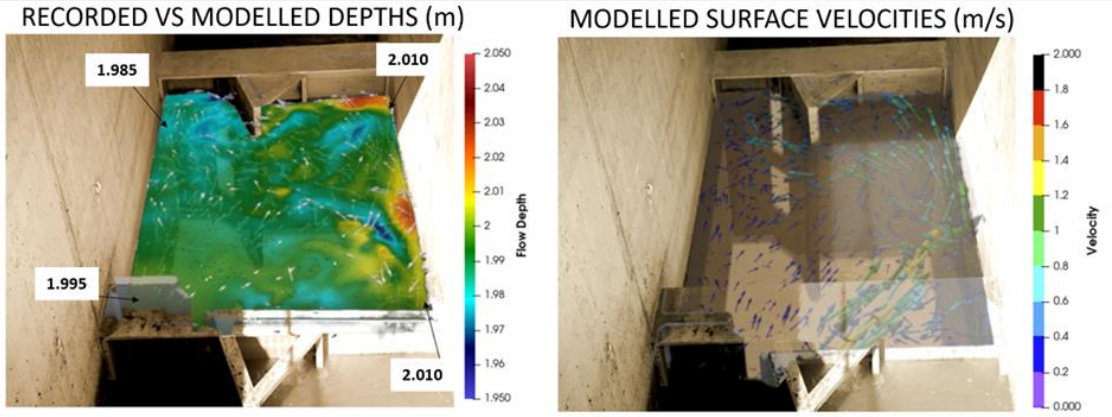
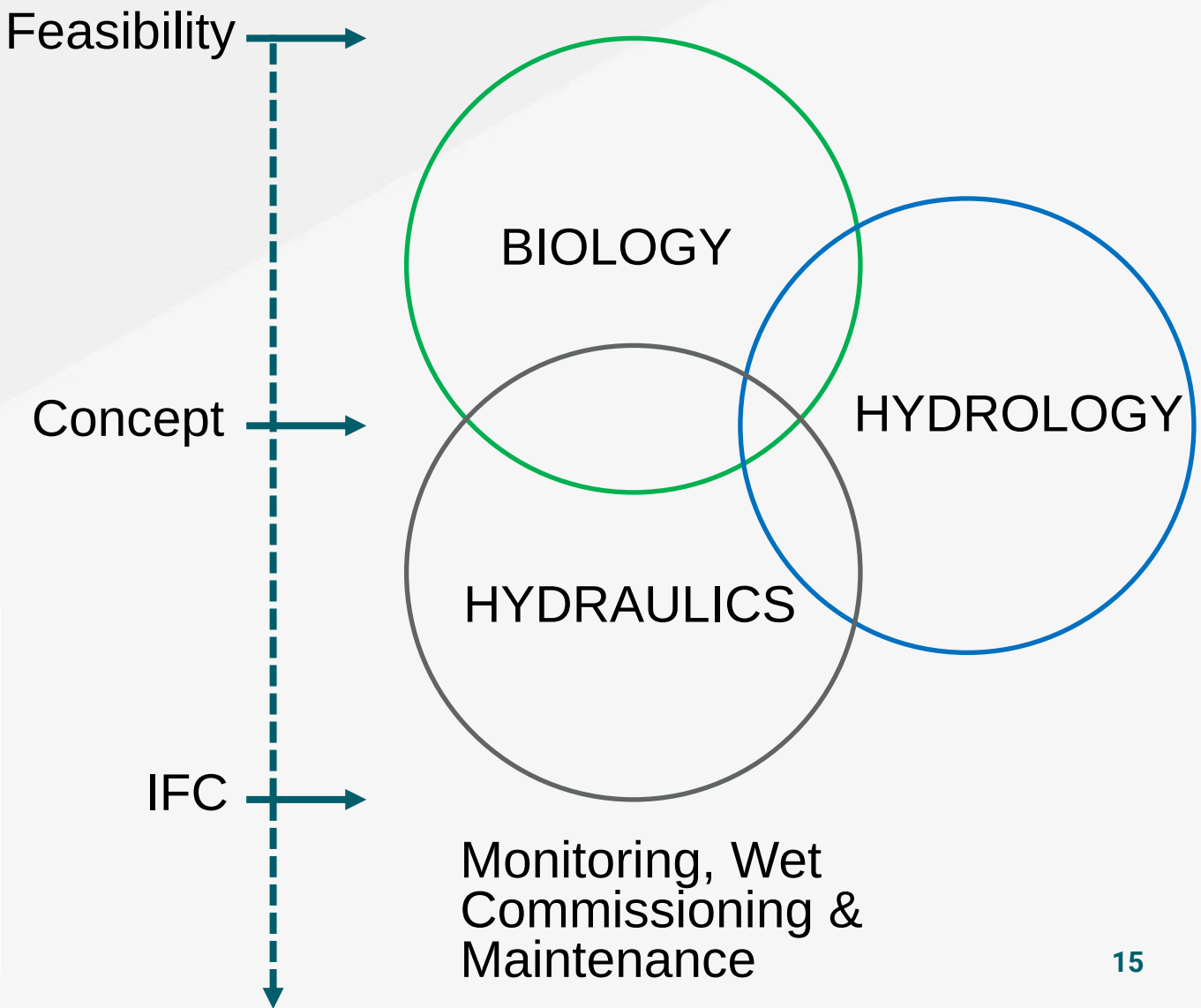


Fish passage design process – Concept to IFC

- Extensive design process including:
  - Hydraulic modelling of attraction flows, comparing results to hydraulic performance standards
  - Quantifying lost storage volumes
  - Design optimisation (modelling of internals, auxiliary flow ect to maximise biomass passage)
  - Checking failure models (ie hydraulic impact of gates or locks)
  - Minimising potential for fish injury or fatality
- Finalising design components across multi-disciplines
- Confirming design compliance





Thank You!