FISH PASSAGE PRINCIPLES AT MANMADE STRUCTURES & EROSION CONTROL SYSTEMS

Assuming it is agreed that there is fish habitat upstream, fish passage mitigation/remediation interventions should subscribe to the following principles regardless of the species or life stage:

Fish Passage Principles

1st Principles (imperative for all species and life-stages)

1. Provide sufficient depths and swimmable velocities or climbable surfaces.
2. Ensure continuity of the steam bed - not perched or undercut.
3. Maintain surface flow - avoid flow going sub-surface.

2nd Principles: (ideal)

1. Create hydrological conditions (depth, velocity & complexity) akin to those occurring naturally upstream - this should provide passage for local fish species.
2. Provide complex flows (various flow directions and velocities down through the water column) – giving a higher chance of meeting a range of fish migration needs.
3. Provide rest pools - areas to rest and/or feed between high velocity zones.
4. Provide a range of options, including wetted margins/splash zones - to cater to fish with climbing ability.

3rd Principles: (aspirational)

1. Constrain flows and/or increase depth - maximise whatever water is available
2. Provide shade and cover – structural or vegetation
3. Retain bed material - without causing blockages

Practice principles:

Only use mussel-rope for existing structures when no other option is available e.g. small diameter pipes, or to augment other interventions such as ramps.
Avoid pouring concrete on site – highly toxic and prone to failure over time
Avoid dewatering existing structures for simple remediation – stressful for fish, costly, and requires permits.

Practitioners' notes:

1. The diameter, gradient and length of the structure, along with site specific characteristics, will also determine the nature of interventions.
2. The areas immediately upstream and downstream need to be considered, particularly within the construction zone where ground has been broken.

Outcomes

Ecological Outcomes

1. Fish and other aquatic organisms that arrive at the downstream end of a structure are able to migrate upstream to suitable habitat.
2. Where practical, bed material accumulates and is retained within the structure providing both roughening and, to some degree benthonic habitat for fish and invertebrate communities.
3. Maintain and manage flows to allow for passage for as many days as possible.
4. If possible, provide habitat within structures e.g., provide shade, rest pools, refugia.

Engineering and Hydrological outcomes:

1. Match or better the upstream flow characteristics - depth, complexity, velocity etc.
2. Reduce exit velocities - prevent or reverse scouring and the creation of plunge-pools at the outlet.
3. Maintain or improve water depth - maintain surface flow, constrain available flow without inducing fast laminar flows.
4. Meet catchment capacity requirements - pipes of sufficient size to prevent overtopping in flood events.
5. Meet load bearing requirements - culverts selected that will withstand design loads
6. Increase life of the structure - reducing abrasion/corrosion of the invert

Cultural outcomes:

1. Sanctity of the waterway conserved.
2. Connectivity maintained.

Overall outcomes:

1. Meet regulatory requirements - compliant across all regulations and consent conditions.
2. Reasonable cost - within budget.
3. Minimal maintenance - durable and robust.
4. Minimal risk of blockage or failure - design to avoid long-term risk to asset.

Footnotes:

1. Maximum water velocities (e.g. 0.3M/sec) are irrelevant and essentially unmeasurable when the flow is nature-like or complex, therefore are misleading.
2. In small (<1800mm) and/or long (>30M) the embedment or the placing of bed material withing the culvert comes with significant risk, and does not necessarily provide better fish passage than other methods e.g. backwatering or well configured baffles.