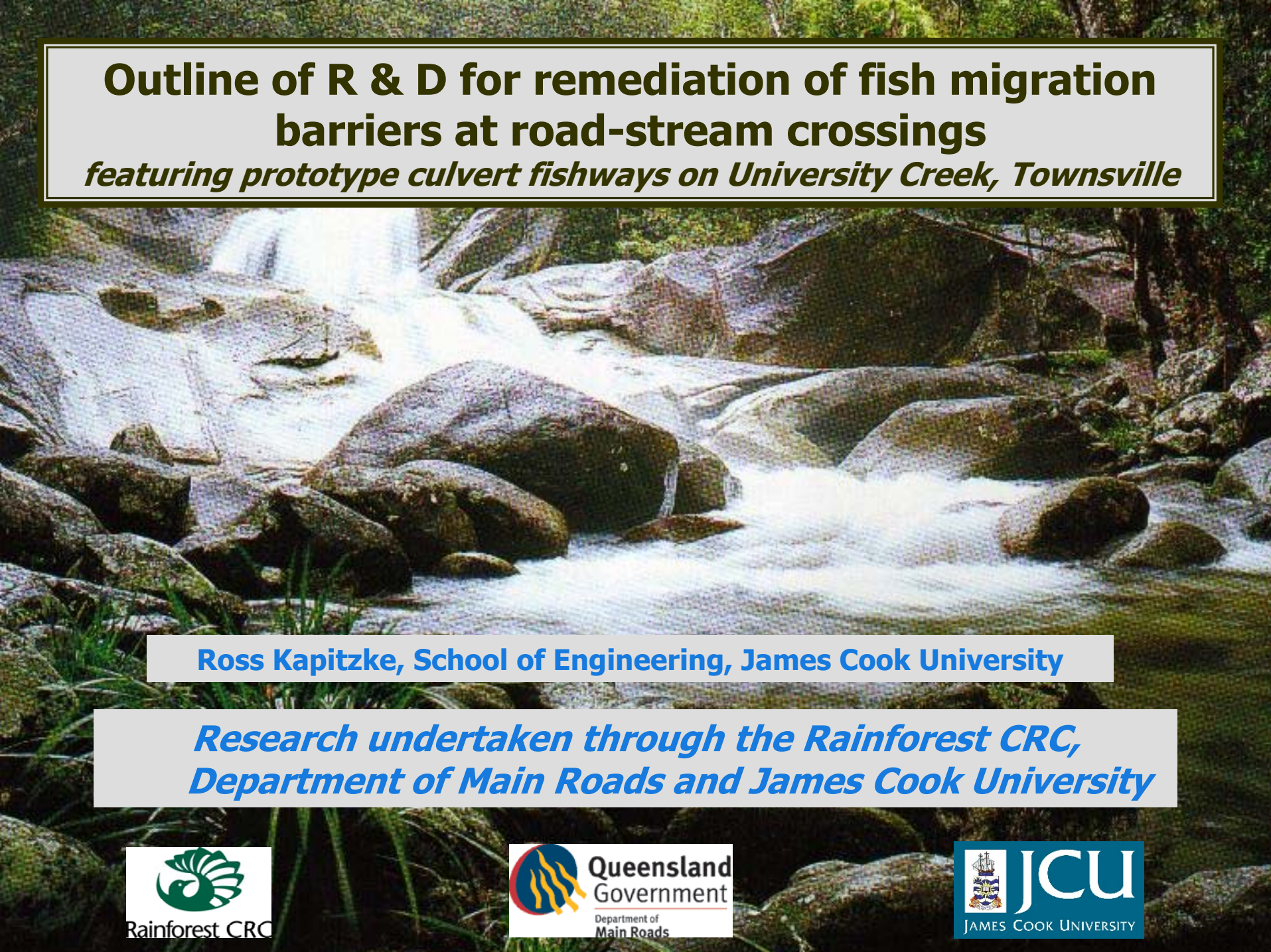
Outline of R & D for remediation of fish migration barriers at road-stream crossings

featuring prototype culvert fishways on University Creek, Townsville



Ross Kapitzke, School of Engineering, James Cook University

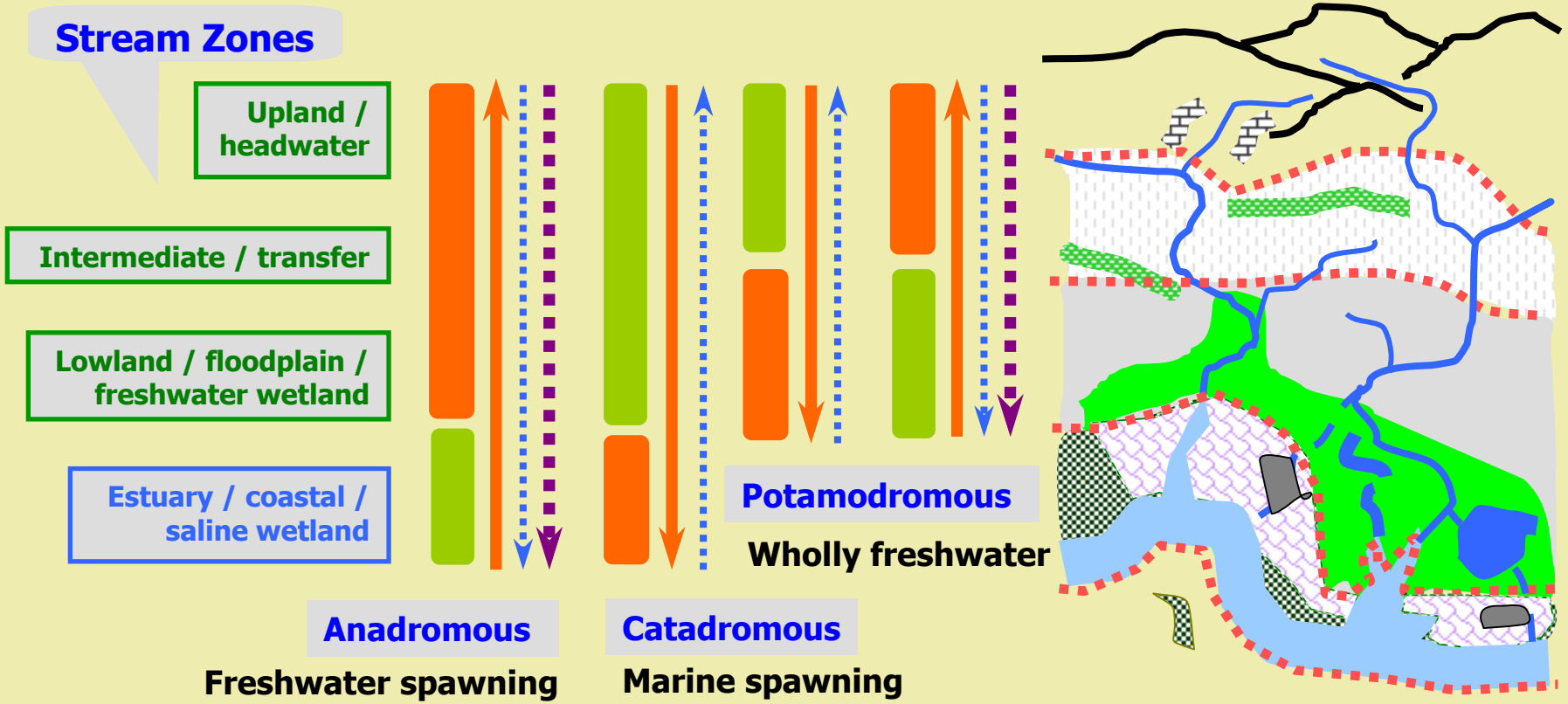
Research undertaken through the Rainforest CRC, Department of Main Roads and James Cook University

Rainforest CRC

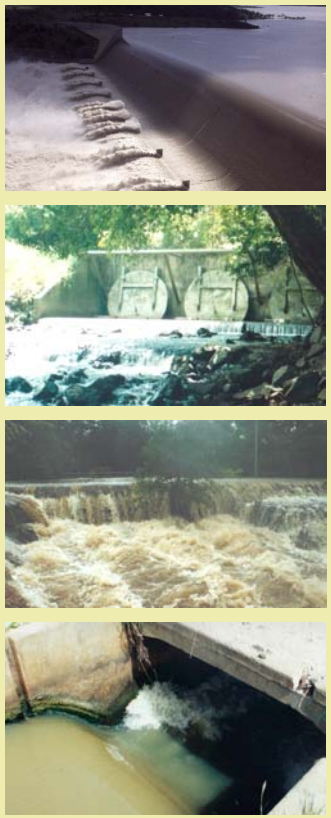
Queensland Government
Department of Main Roads

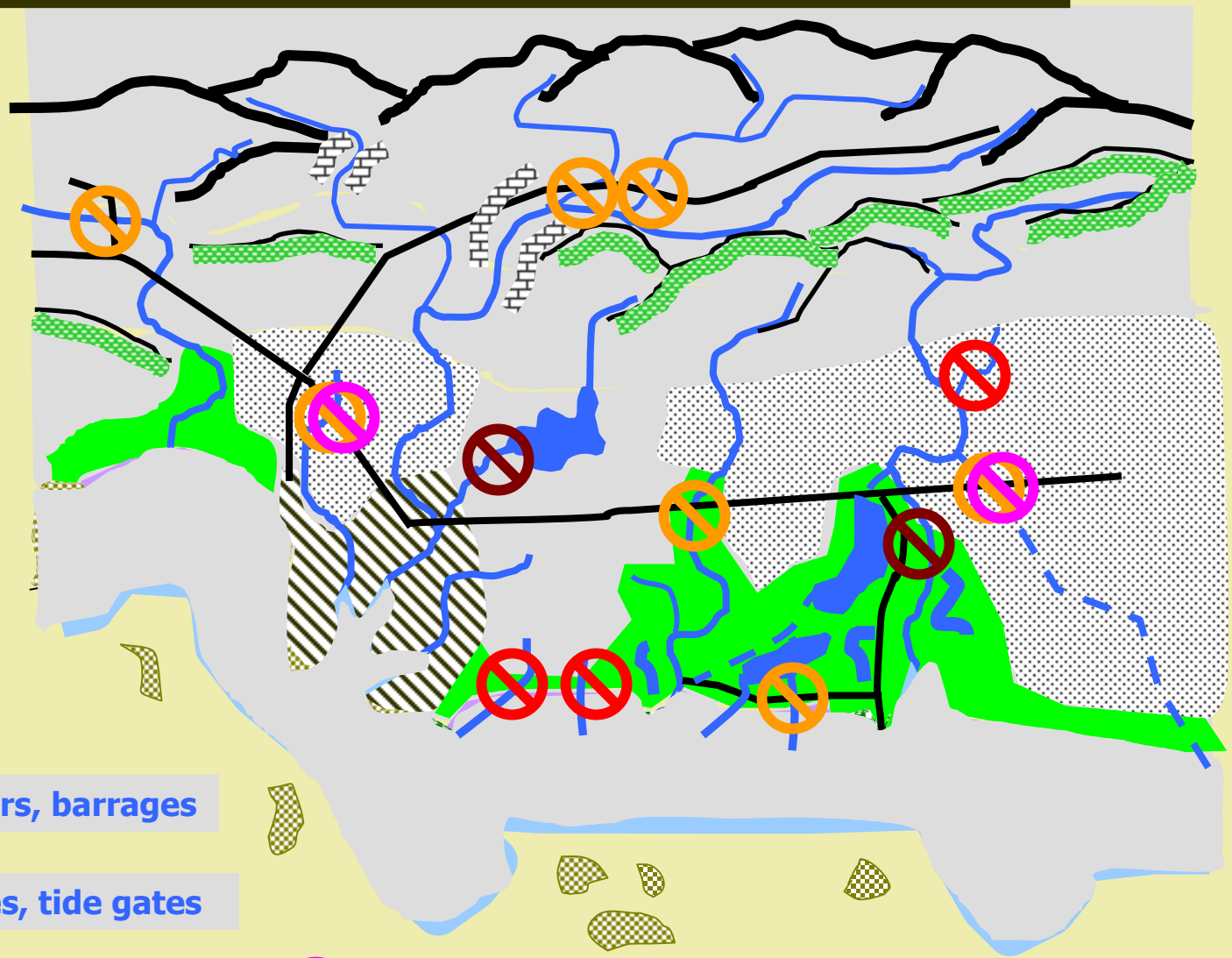
JCU
James Cook University

Stream zones, fish life cycles, habitat zones & migration



Fish migration barriers in a catchment





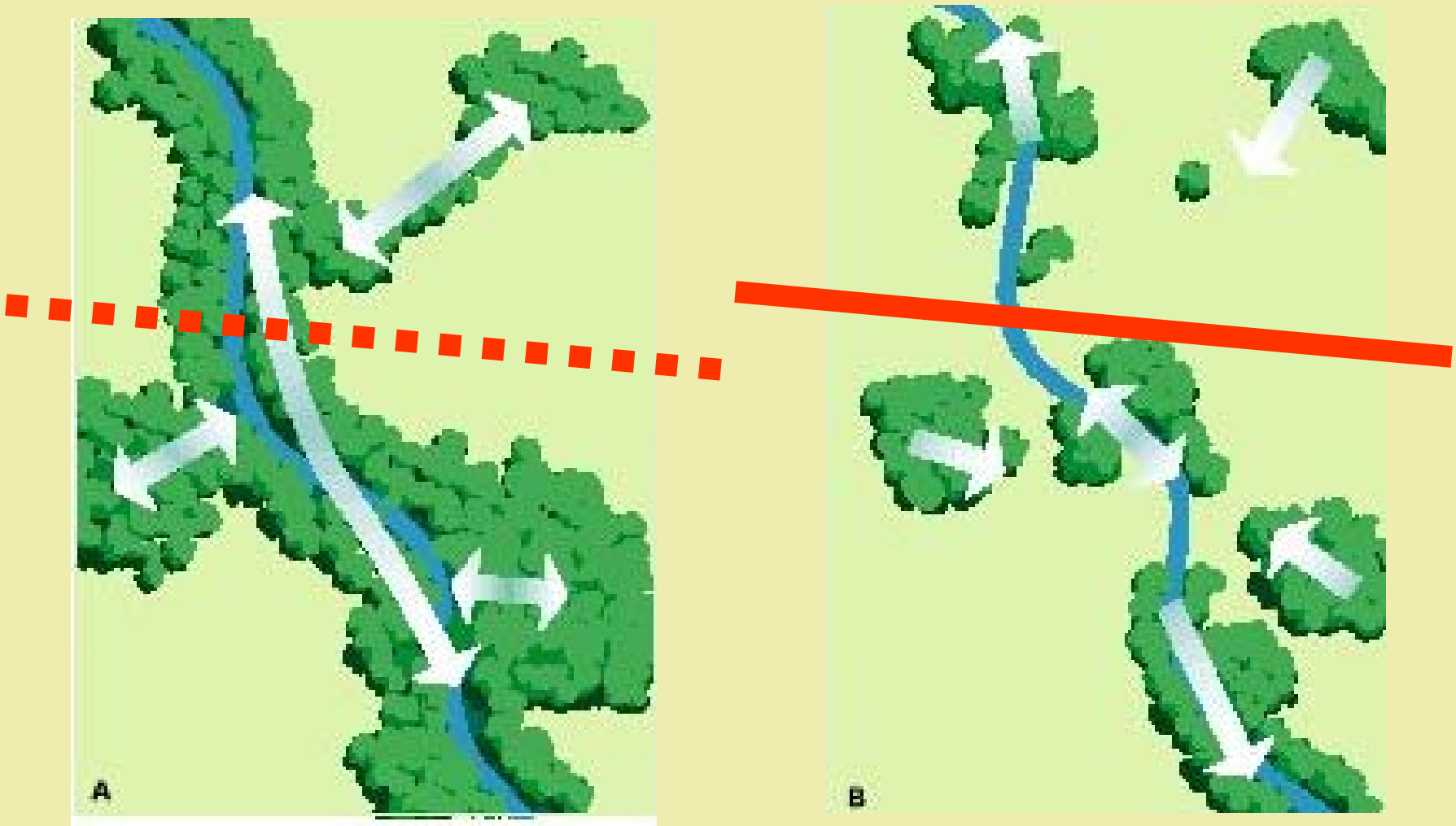
Dams, weirs, barrages

Flood gates, tide gates

Culverts, causeways

Drop structures

Stream corridors and barriers to fish & fauna passage



Freshwater fish, road crossings and migration barriers

Commercial fisheries

Mullet

Recreational fishing

Jungle perch

Conservation & biodiversity

Gudgeon

Traditional/cultural values

Barramundi

?

Migration barriers at road crossings

Velocity

Turbulence

Water surface drop

Water depth

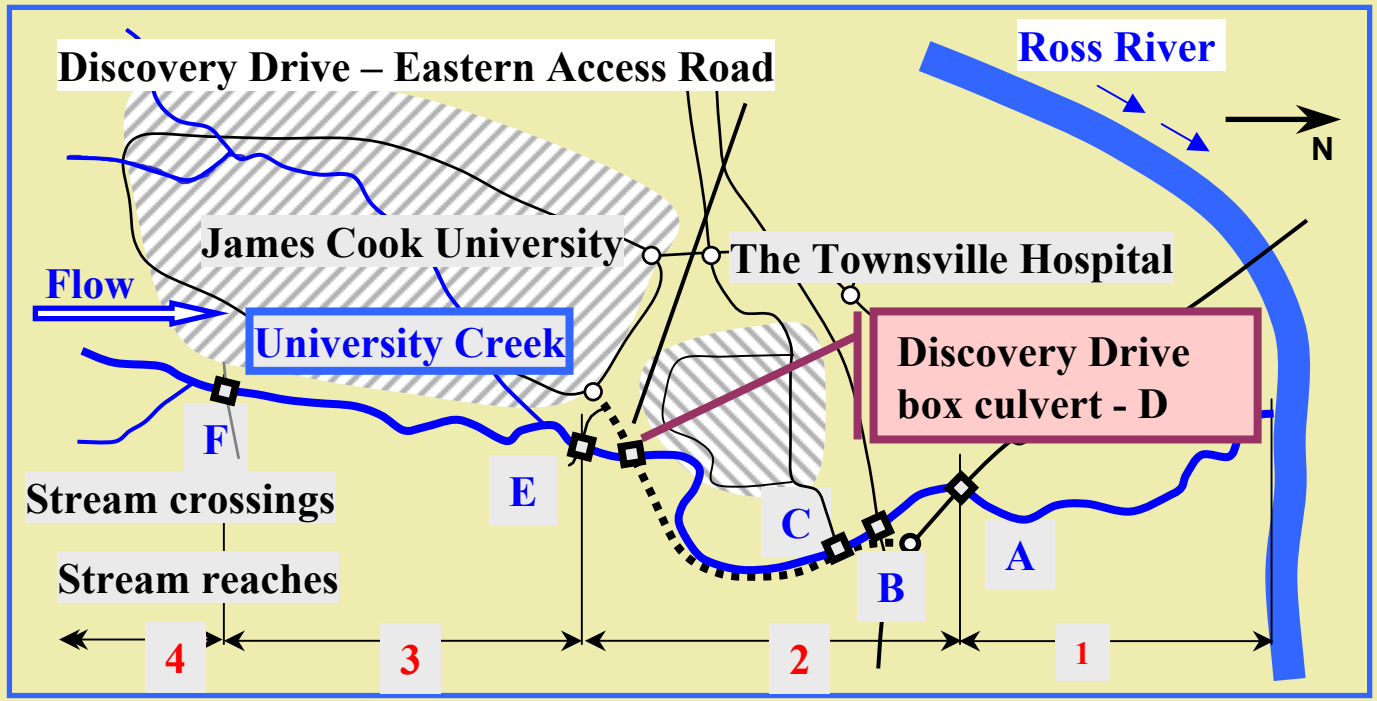
No resting place

Channel simplification

Darkness ?

Study site: University Creek, Discovery Drive crossing

Plotosid Catfish



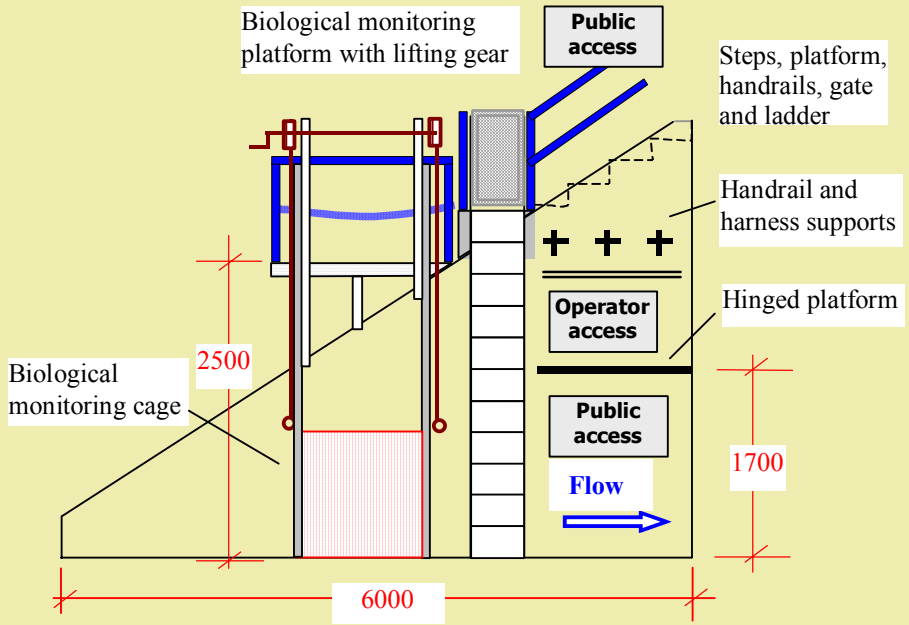
University Creek prototype culvert fishway

Offset baffle fishway

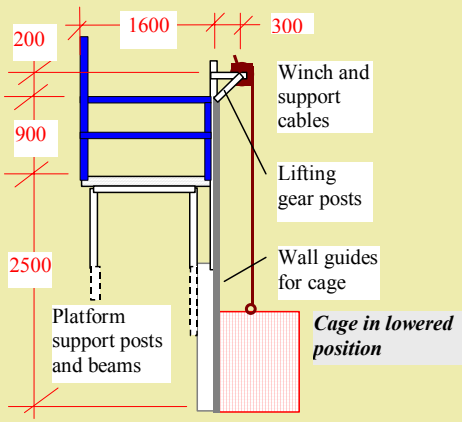
View from upstream - nib walls in place

Barrel 1 - looking downstream

Site monitoring facilities: Access & safety features

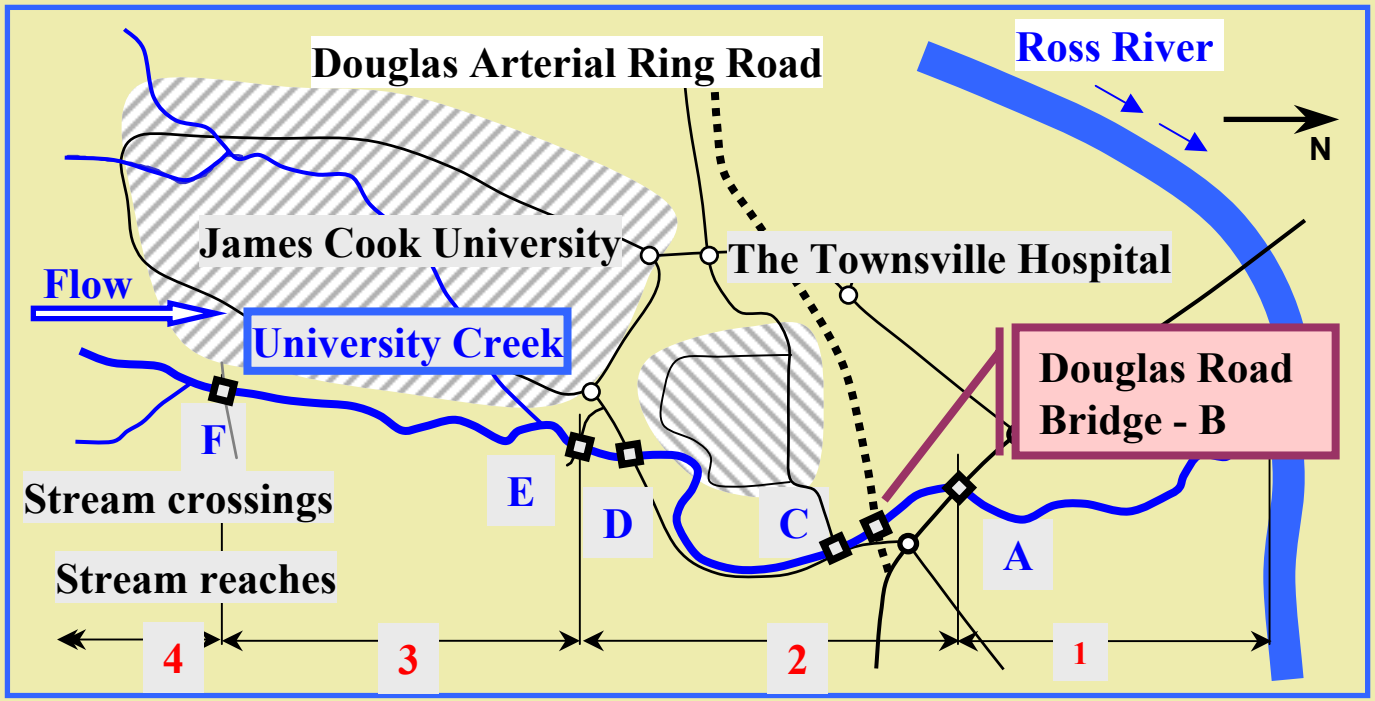


Culvert wingwall elevation



Monitoring platform & cage

Study site: University Creek, Douglas Road crossing



Hyrtl's tandan

Black catfish

Migrating species: Plotosid Catfish

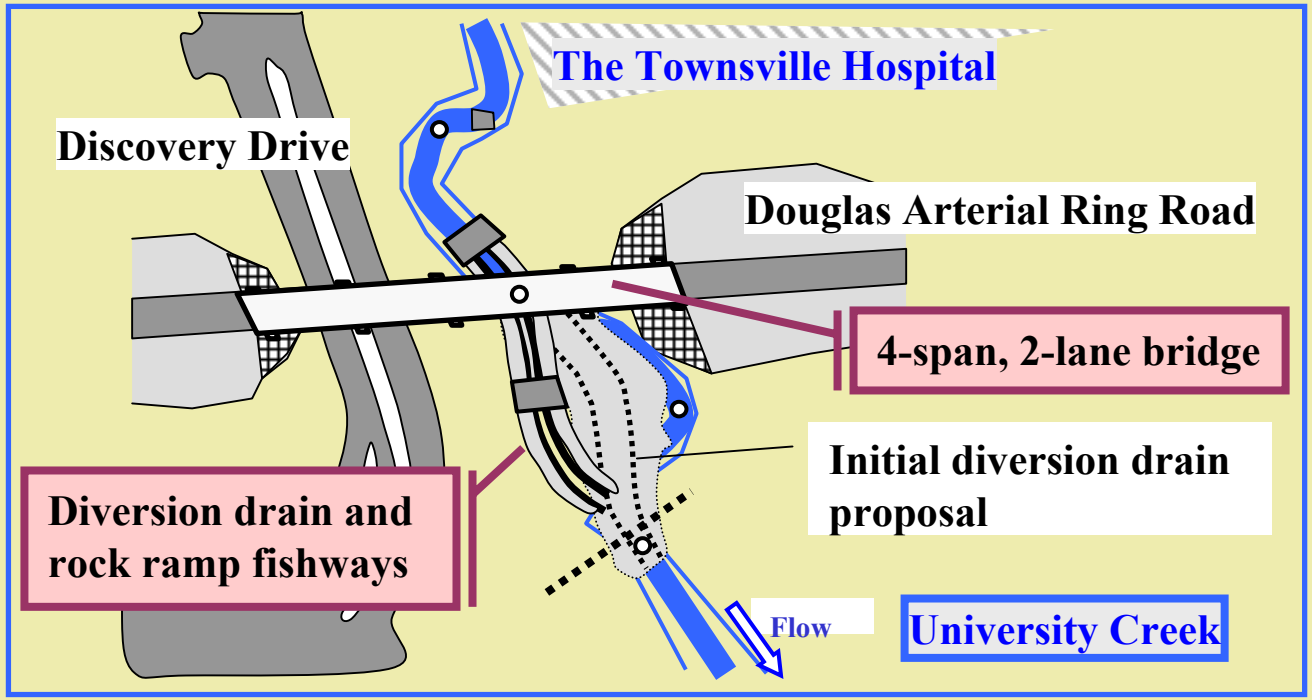
Spangled perch

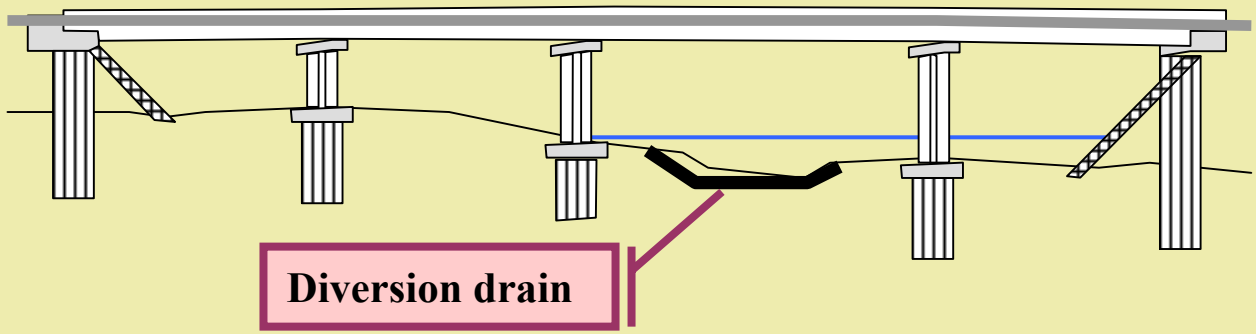
Purple spotted gudgeon

Rainbowfish

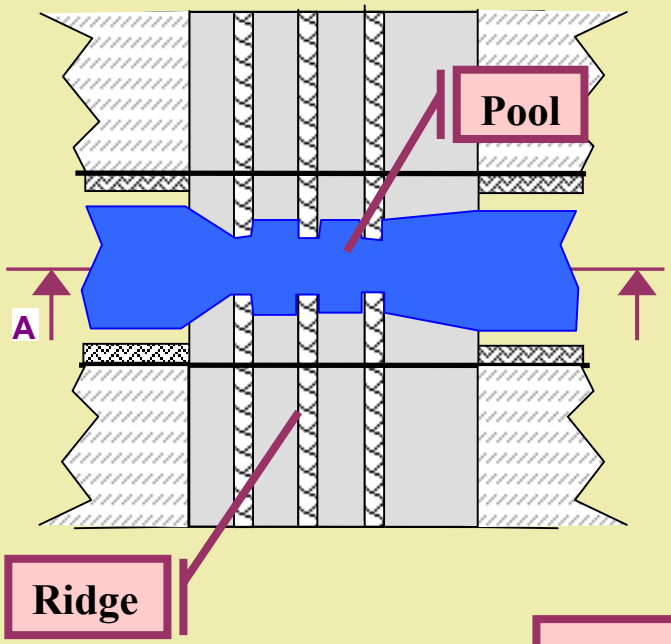
Other species

Douglas Road crossing – Bridge and diversion drain



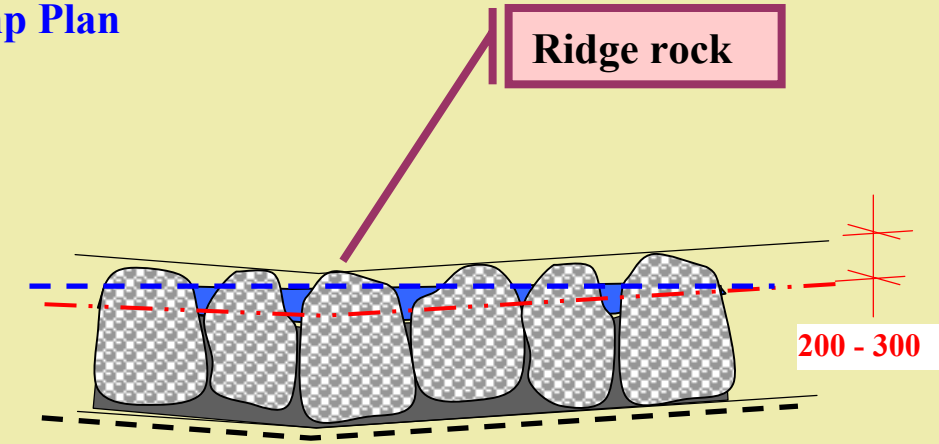


Douglas Road crossing – Rock ramps

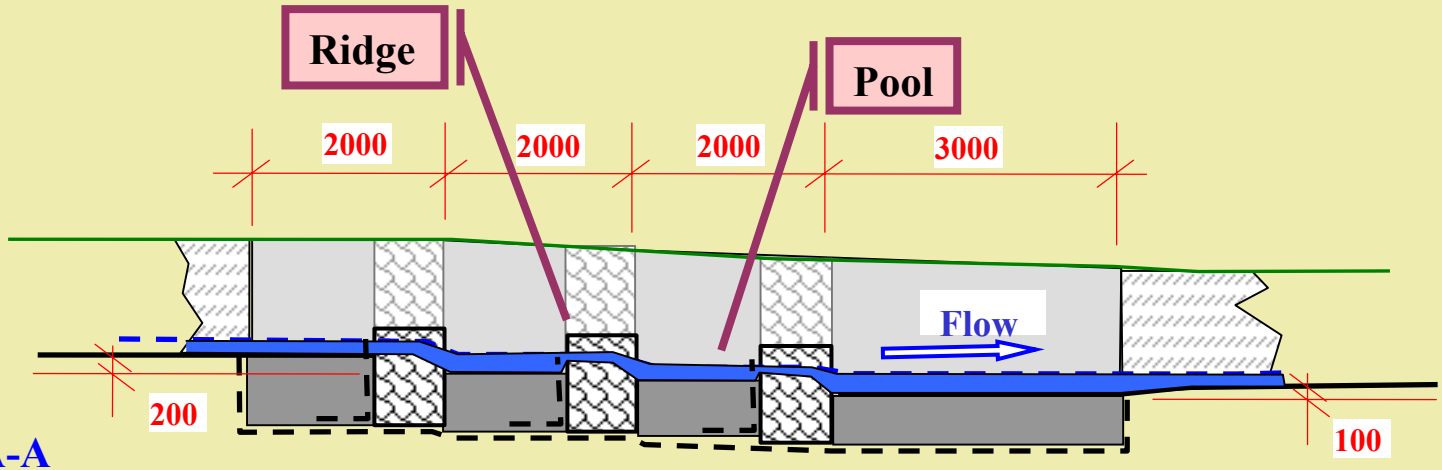


Rock Ramp Plan

Flow



Detail – Ridge Rock



Section A-A

Culvert fishway design objectives -> R & D goals

Drainage & infrastructure

- Maintain culvert flow capacity
- Minimise debris & sediment block
- Minimise erosion effects
- Protect land and infrastructure

Environmental aspects

- Retain natural stream processes
- Protect aquatic ecosystems
- Prevent public health problems

Fish passage

- Provide for critical flow periods
- Provide continuous fish pathway
- Ensure suitable water velocities
- Ensure suitable water depths
- Prevent adverse flow turbulence

Safety, operation & amenity

- Provide for ready maintenance
- Ensure public & operator safety
- Consider visual amenity
- Minimise impact on recreation

Monitoring, modelling & evaluation methods & parameters

Rainforest CRC

Queensland Government Department of Main Roads

JCU James Cook University

Design variables / criteria to be determined	Hydraulic	Biological	Other
» Stream hydrology	✓	✓	
» Geomorphology & stream processes			✓
» Fish species distribution & movement		✓	
» Fish swimming characteristics	✓	✓	
» Culvert & fishway hydraulics	✓		
» Fishway layout & configuration	✓	✓	✓
» Landscape design & amenity			✓
» Operation, maintenance & safety			✓

Prototype – University Creek

Stream – University Creek

Laboratory – Hydraulic model

Desktop – Case studies

Fishway design tasks: Catchment and site scales

Statutory provisions

- policy & legislative compliance
- agency consultation
- permits, licences & approvals

Community/stakeholder consultations

- property owners
- other stakeholders

Site assessment

- topographic mapping/survey
- catchment hydrology
- stream geomorphology
- stream water quality
- fish habitat assessment
- fish species distribution
- amenity/cultural heritage

Planning and design

- layout & configuration
- fish passage barrier evaluation
- culvert & fishway hydraulics
- landscape design & amenity
- structural design
- environmental impacts & risks
- costing / economic assessment
- option evaluation
- management plans
- report/tender documentation

Evaluation factors for catchment scale prioritisation

Fish habitat accessed

- length of habitat upstream
- quality of habitat
- type of habitat: spawn, breed

Fish species

- fish values: commercial, recreation
- significant native species
- exclude exotic species

Effectiveness of fishway

- range of species provided for
- number of fish passed
- design flow range
- fish passage delay time

Fishway feasibility and cost

- appropriate fishway technology
- suitability of site and structure
- owner & stakeholder support
- implementation cost
- construction timing & logistics

Planning and design guidelines for culvert fishways

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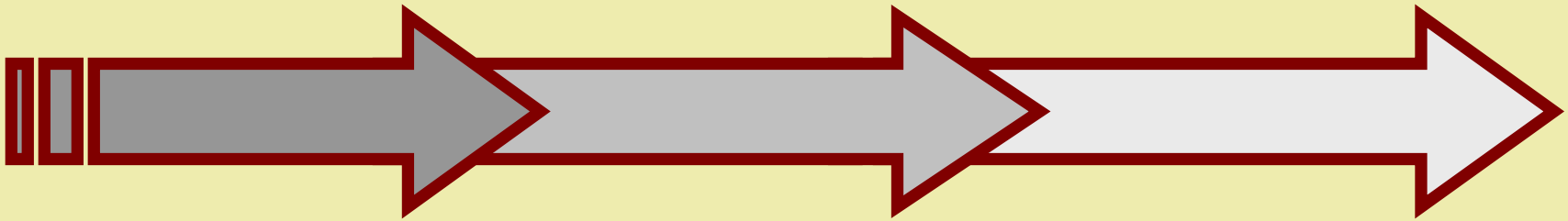
James Cook University

Outcomes produced progressively as the research proceeds

Stage 1 Guideline
Project based

Stage 2 Guideline
Good practice

Stage 3 Guideline
Substantive



- **Rock ramp fishways**
- **Baffle fishways for box culverts**
- **Fishways for pipe culverts**
- **Bypass fishways for culverts & causeways**
- **Fishway design protocol - site scale**
- **Fishway design protocol - catchment scale**

CRC/DMR/JCU Engineering culvert fishway R & D

Rainforest CRC

Queensland Government Department of Main Roads

JCU James Cook University

An integrated hydraulic and biological approach, featuring:

- ***prototype*** **culvert fishway and monitoring facility**
- **physical and biological** ***monitoring*** **of field sites**
- **hydraulic** ***laboratory*** **modelling and evaluation of designs**
- ***case study*** **analysis and demonstration sites**

R & D outcomes – new and existing culverts

- **flow characteristics and** ***performance*** **of fishway components**
- **suitable culvert** ***fishway designs*** **for Queensland streams**
- **planning and design** ***protocols*** **at catchment and site scales**
- **collaboration and** ***capacity building*** **for practitioners & managers**