

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

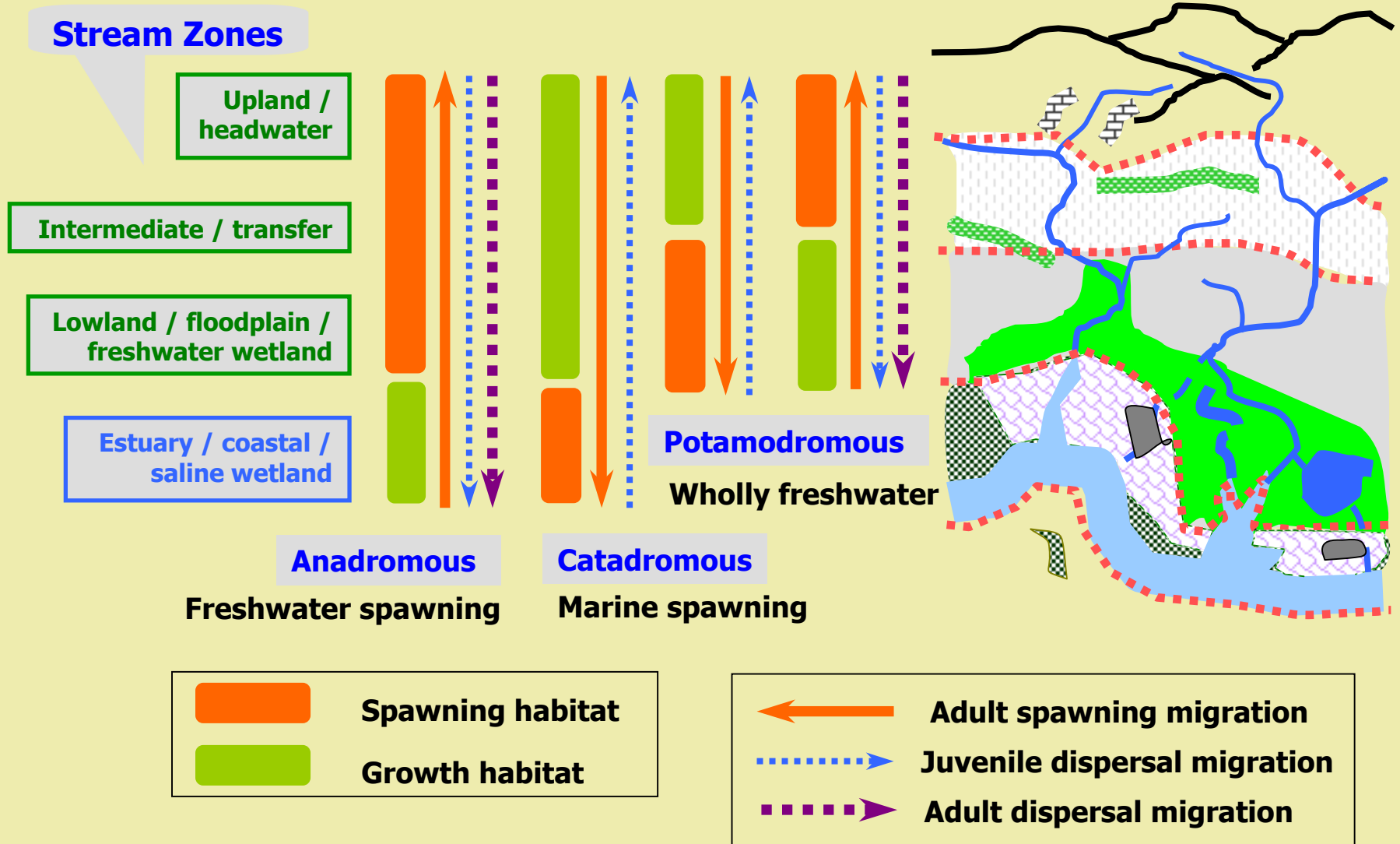
featuring prototype culvert fishways on University Creek, Townsville

Ross Kapitzke, School of Engineering, James Cook University

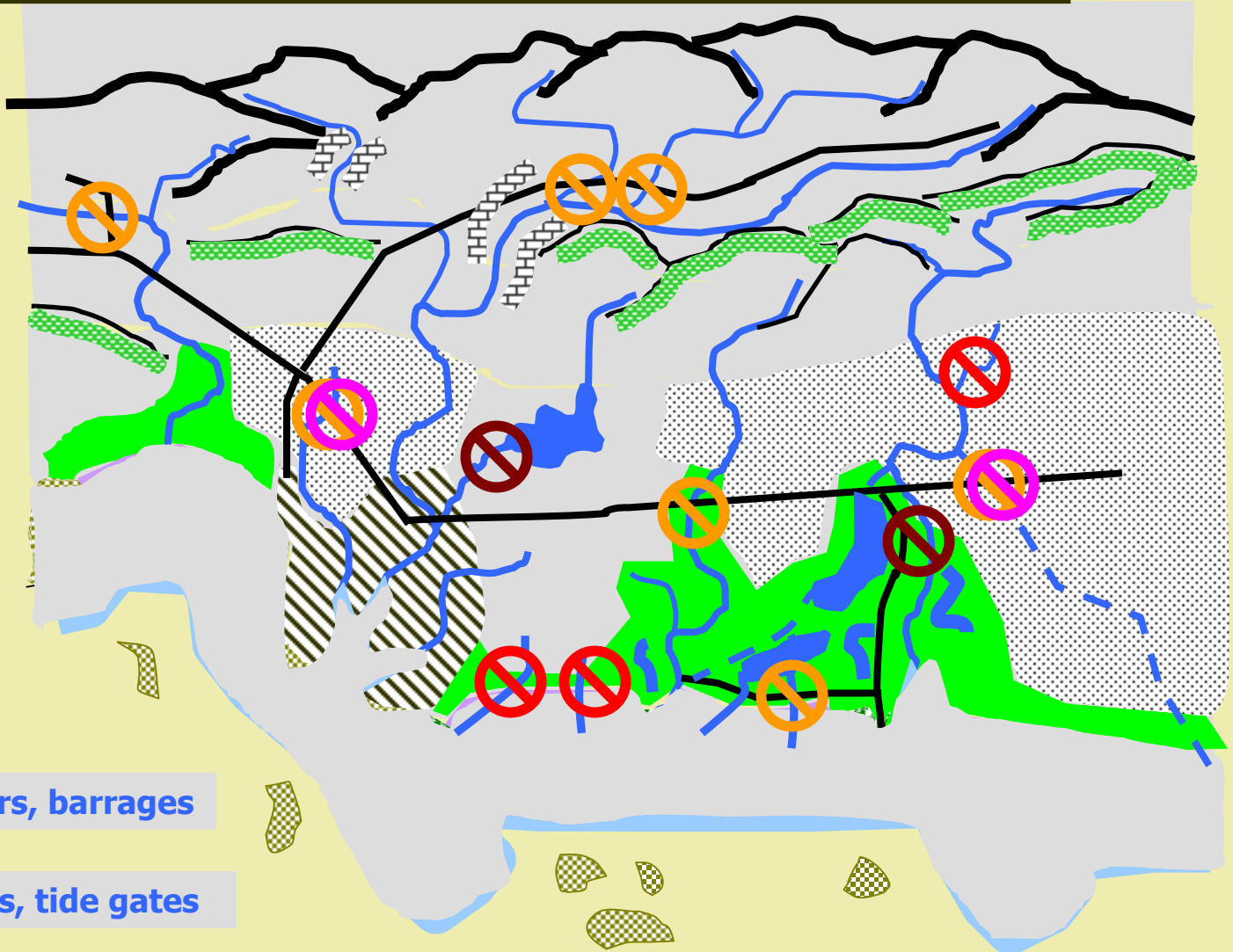
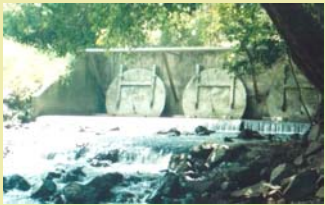
*Research undertaken through the Rainforest CRC,
Department of Main Roads and James Cook University*




Stream zones, fish life cycles, habitat zones & migration





Fish migration barriers in a catchment



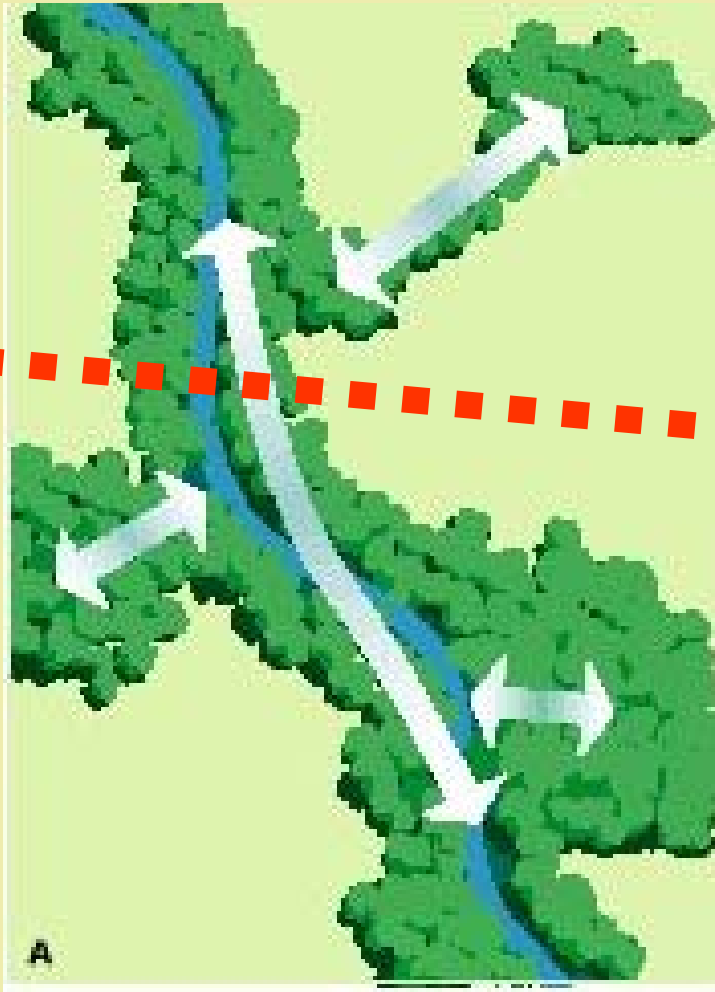
 Dams, weirs, barrages

 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

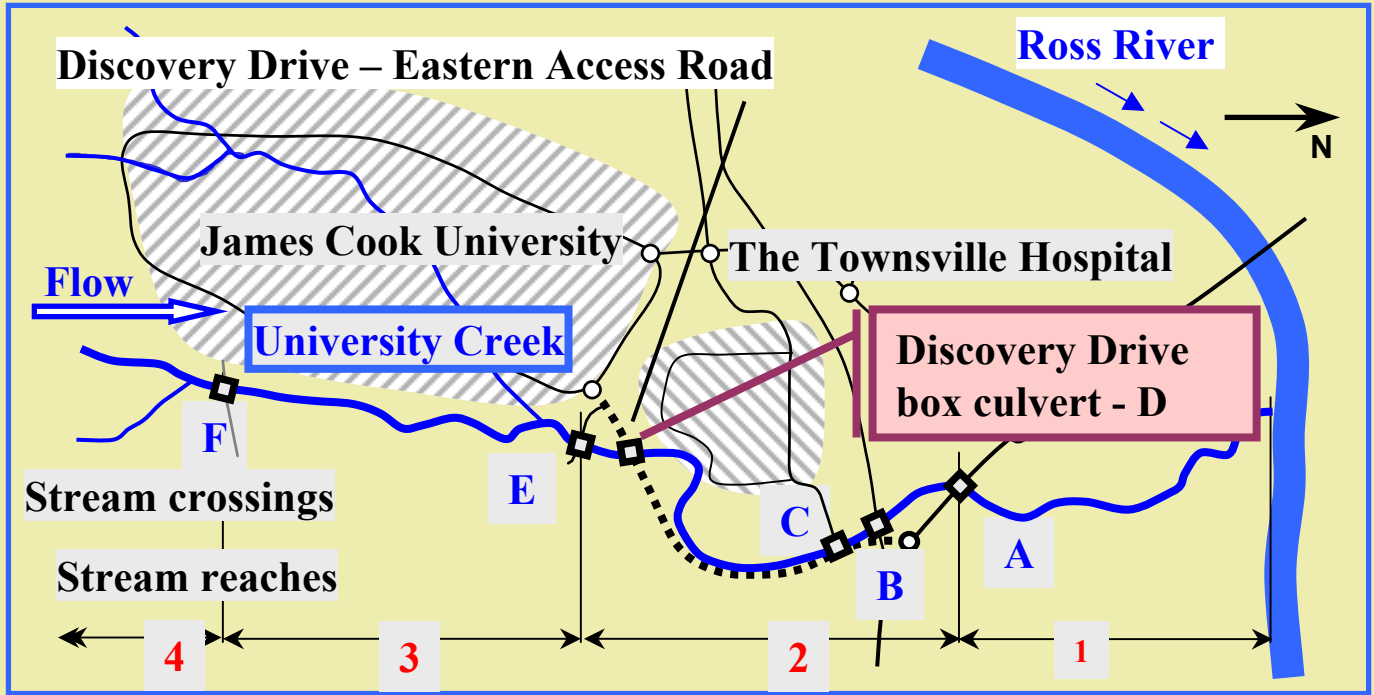


Darkness ?

Study site: University Creek, Discovery Drive crossing



Plotosid Catfish



University Creek prototype culvert fishway

Offset baffle fishway

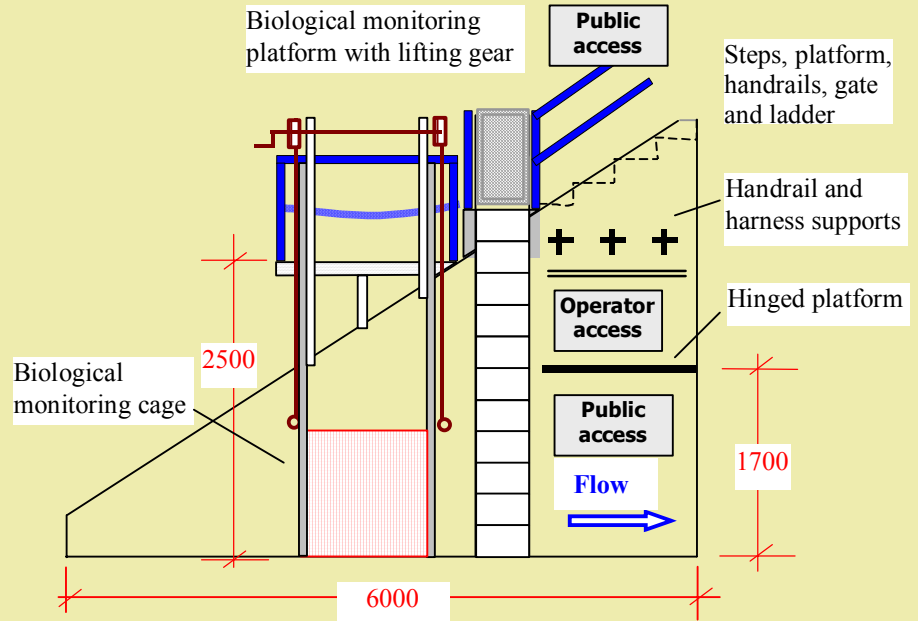


View from upstream - nib walls in place

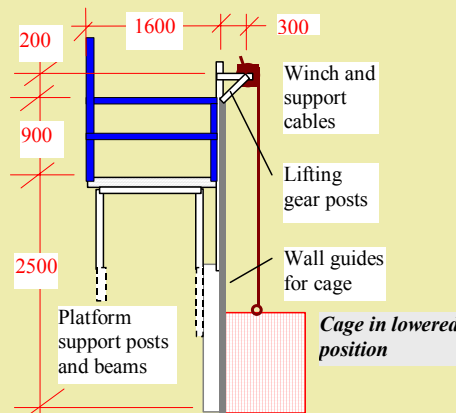
Barrel 1 - looking downstream



Site monitoring facilities: Access & safety features

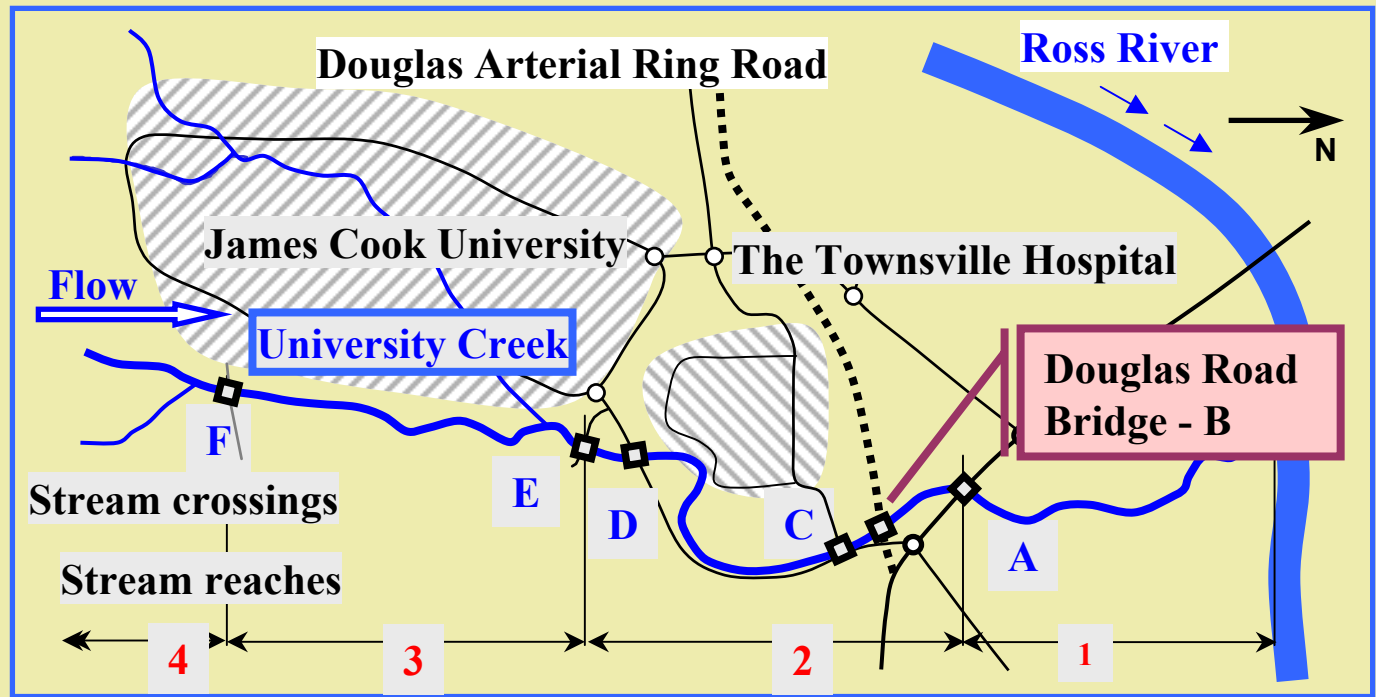


Culvert wingwall elevation



Monitoring platform & cage

Study site: University Creek, Douglas Road crossing



Hyrtl's tandan



Black catfish

Spangled perch



Purple spotted gudgeon



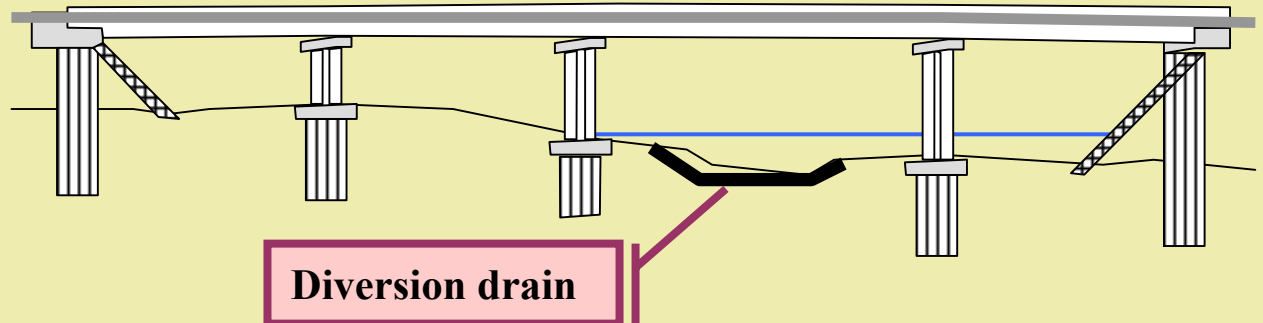
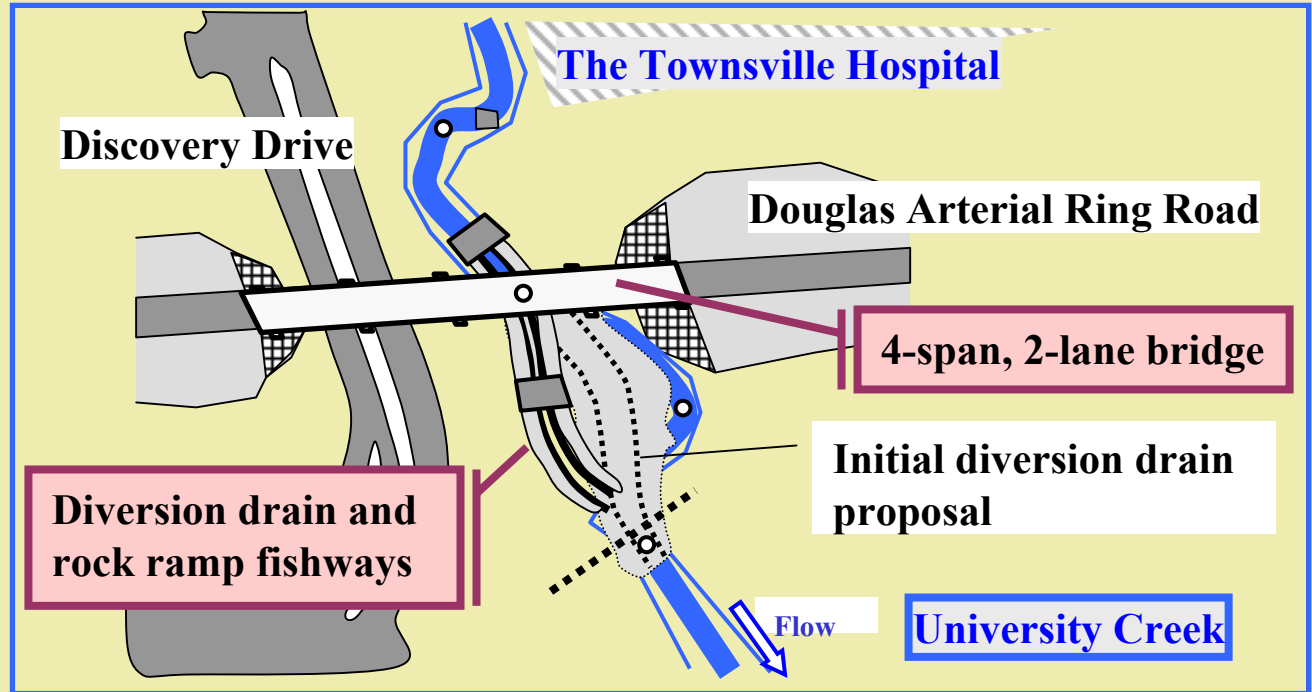
Rainbowfish



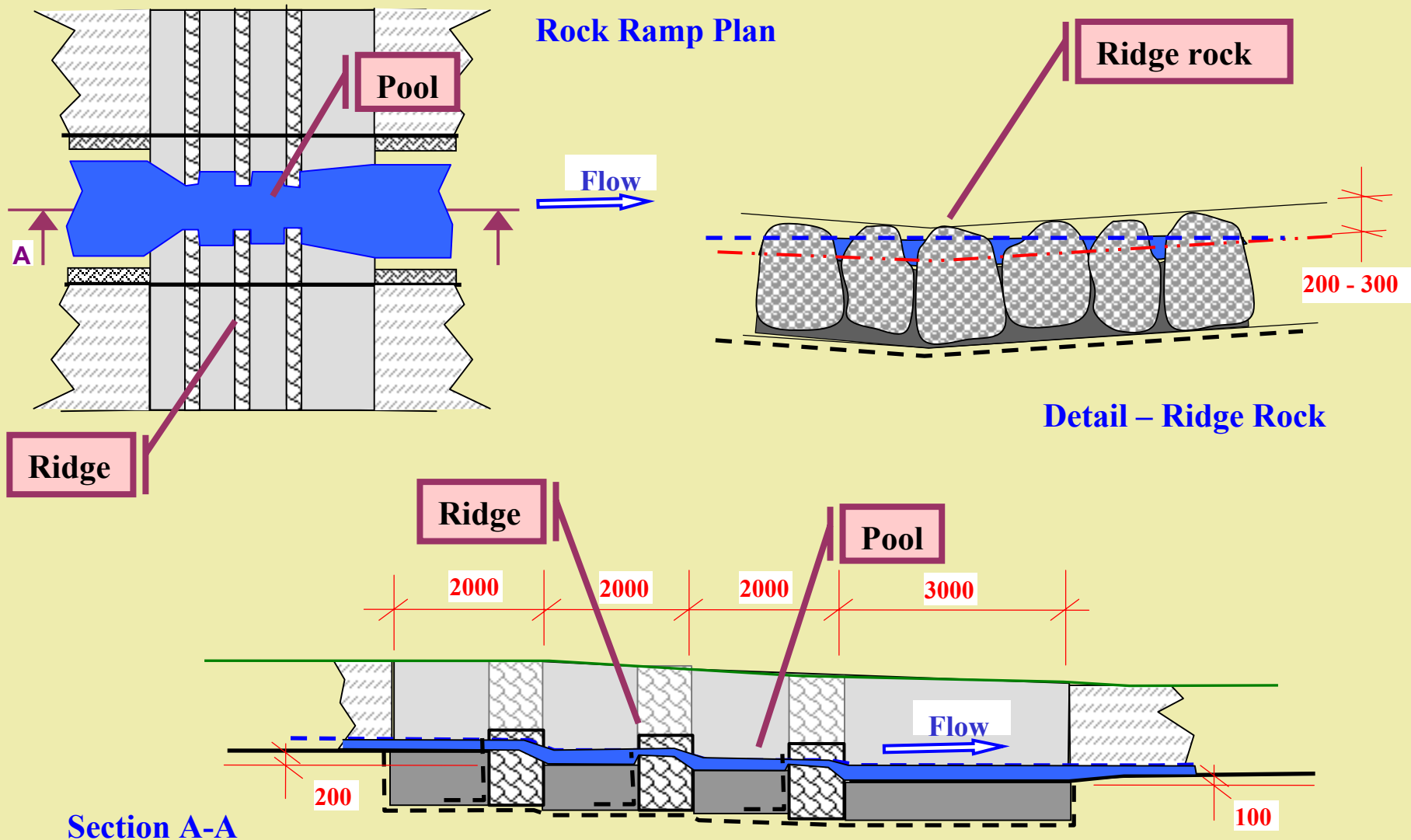
Migrating species: Plotosid Catfish

Other species

Douglas Road crossing – Bridge and diversion drain



Douglas Road crossing – Rock ramps



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



Design variables / criteria to be determined

- » **Stream hydrology**
- » **Geomorphology & stream processes**
- » **Fish species distribution & movement**
- » **Fish swimming characteristics**
- » **Culvert & fishway hydraulics**
- » **Fishway layout & configuration**
- » **Landscape design & amenity**
- » **Operation, maintenance & safety**

Hydraulic

Biological

Other



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

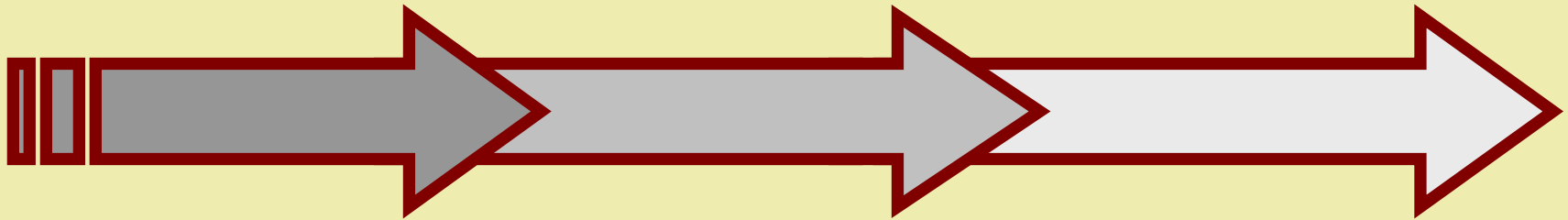


Outcomes produced progressively as the research proceeds

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**



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