



FISH SUPERHIGHWAYS

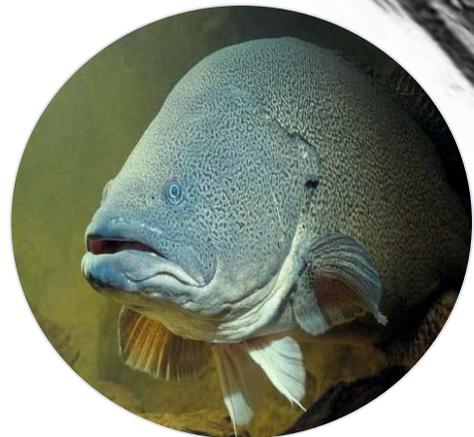
A strategic program for securing fish passage

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V6	Nov 2008		
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V9	Jul 2010	Updating Capex	Gina Pavlovic
V10		DPI Fisheries Comments	
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"We were sitting on the bank of the river ... and we noticed a couple of fairly large cod swimming upstream through a narrow channel near a sand bank. We watched for a while and presently two more fish passed the same spot, also travelling upstream. We stayed watching for over an hour and there was an almost continual procession of four or five pound cod passing the same spot. We could only come to one conclusion and that is that the fish were making a general migration up stream
(National Advocate 13/1/1925)

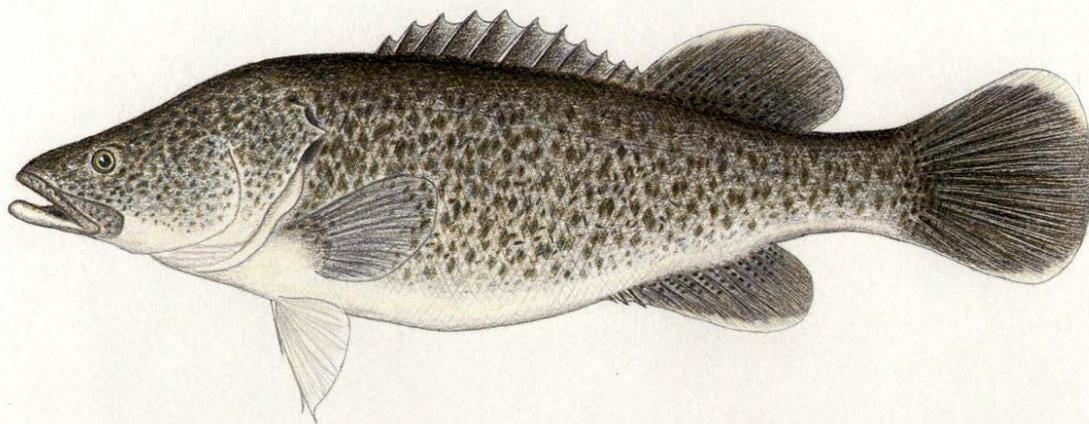
[M]ore and more dams will be erected, until there will be many hundreds of such throughout the length and breadth of the land. Without the provision of fish-passes there is a grave danger of fish fauna being cut up into isolated colonies...



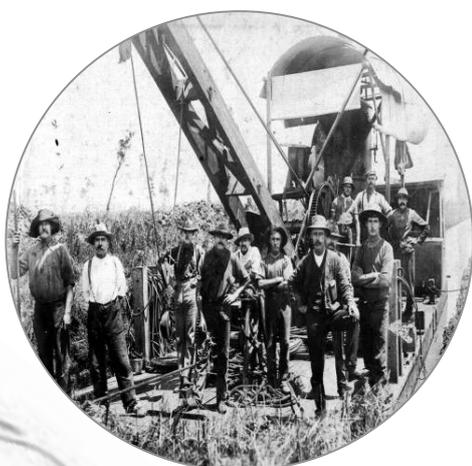
... the water being beautifully transparent, the bottom was visible at great depths, showing large fishes in shoals, floating like birds in mid-air.
(From the Journal of Thomas Mitchell (1839): 1st June, 1835, Darling River at Bourke)

If however the country is poor, the river is rich in the most excellent fish, procurable in the utmost abundance.
(From the Journal of John Oxley (1820): 6th May 1817. Lachlan)



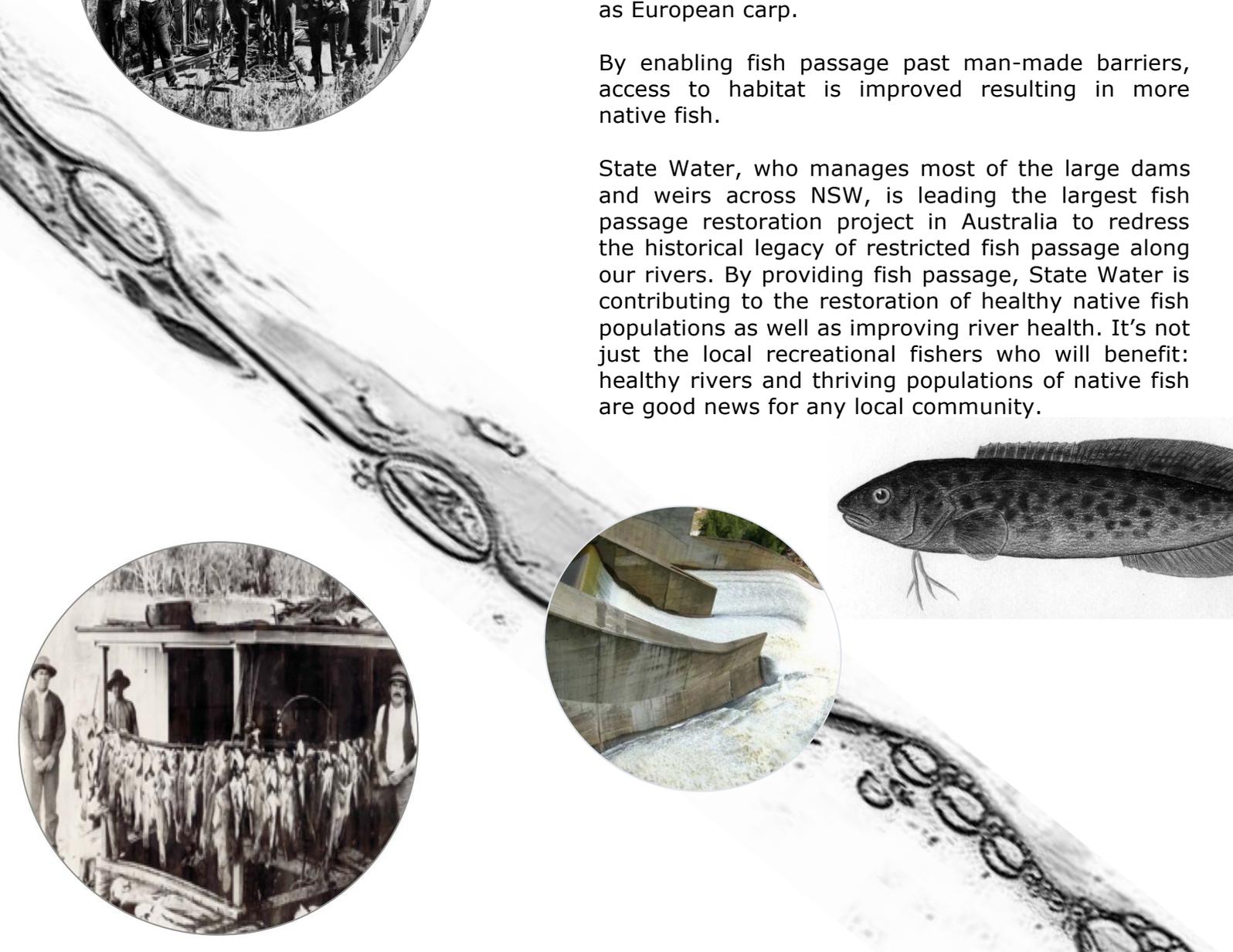
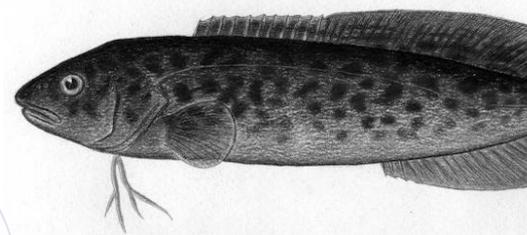


Australian native fish are dependent upon migration to breed as adults, to find nursery habitat as juveniles, and to access refuges during droughts. However, over 10,000 instream structures such as weirs, culverts, and floodgates exist across New South Wales waterways. These structures are major barriers to the movement of native fish up- and downstream – and the bigger the structure, the bigger the problem for fish. The restriction of fish passage has reduced the abundance, health and viability of native fish populations while simultaneously advantaging introduced species such as European carp.



By enabling fish passage past man-made barriers, access to habitat is improved resulting in more native fish.

State Water, who manages most of the large dams and weirs across NSW, is leading the largest fish passage restoration project in Australia to redress the historical legacy of restricted fish passage along our rivers. By providing fish passage, State Water is contributing to the restoration of healthy native fish populations as well as improving river health. It's not just the local recreational fishers who will benefit: healthy rivers and thriving populations of native fish are good news for any local community.



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Acronyms

CSC	Carp Separation Cage
CSO	Community Service Obligation
IPART	Independent Pricing and Regulatory Tribunal
MOU	Memorandum of Understanding
NSW DPI	New South Wales Department of Primary Industries
PIT	Passive Internal Transmitter
RERP	Rivers Environmental Restoration Project

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The what and why

Fish Superhighways is a strategic program to improve the capacity of fish to move within and between waterways in New South Wales. The ability to access healthy habitat is a significant factor affecting the sustainability of native fish. However, fish populations in New South Wales, particularly west of the Great Dividing Range, have declined by up to 90 % from pre-European levels. Barriers to fish migration are one of several factors contributing to this decline. State Water, which manages, operates and maintains over 300 dams, weirs and regulators throughout New South Wales, therefore has a significant role to play in ensuring native fish viability.

Purpose of the Program

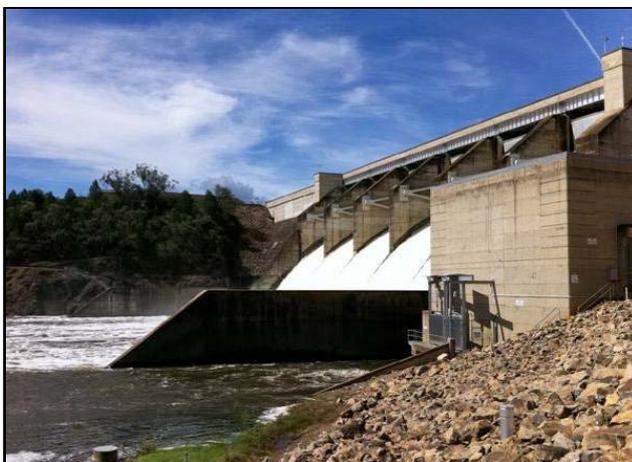
State Water is responsible for the maintenance and operation of its waterway assets. *Fish Superhighways* outlines a strategic approach to integrate State Water's asset and financial planning processes with requirements to provide effective fish passage at instream migration barriers under Section 218 (s218) of the *Fisheries Management Act 1994*. Specifically, the program will:

- incorporate fish passage construction, maintenance and monitoring activities and costs into State Water's asset management planning and maintenance schedules
- identify assets that are ecological priorities for improved fish migration, for which coordinated strategic partnerships can be developed.
- identify redundant assets that are candidates for removal.

Fish Superhighways will continually evolve as existing projects progress and new projects are developed.

Fish passage facts

- Native Australian fish rely on a variety of habitat types to complete their life cycle
- Many species need to move within waterways and between estuarine and freshwater environments
- Approximately half of all freshwater fish species found in NSW migrate as part of their life cycle
- Native fish can't jump. A ledge or a waterfall of 10cm is enough to prevent them moving up- or downstream



Barriers such as Keepit Dam interrupt spawning and seasonal migration, thereby restricting access to preferred habitat which results in fewer native fish.



Migration barriers can result in accumulations of fish which increases their susceptibility to predation and disease.

What we aim to achieve

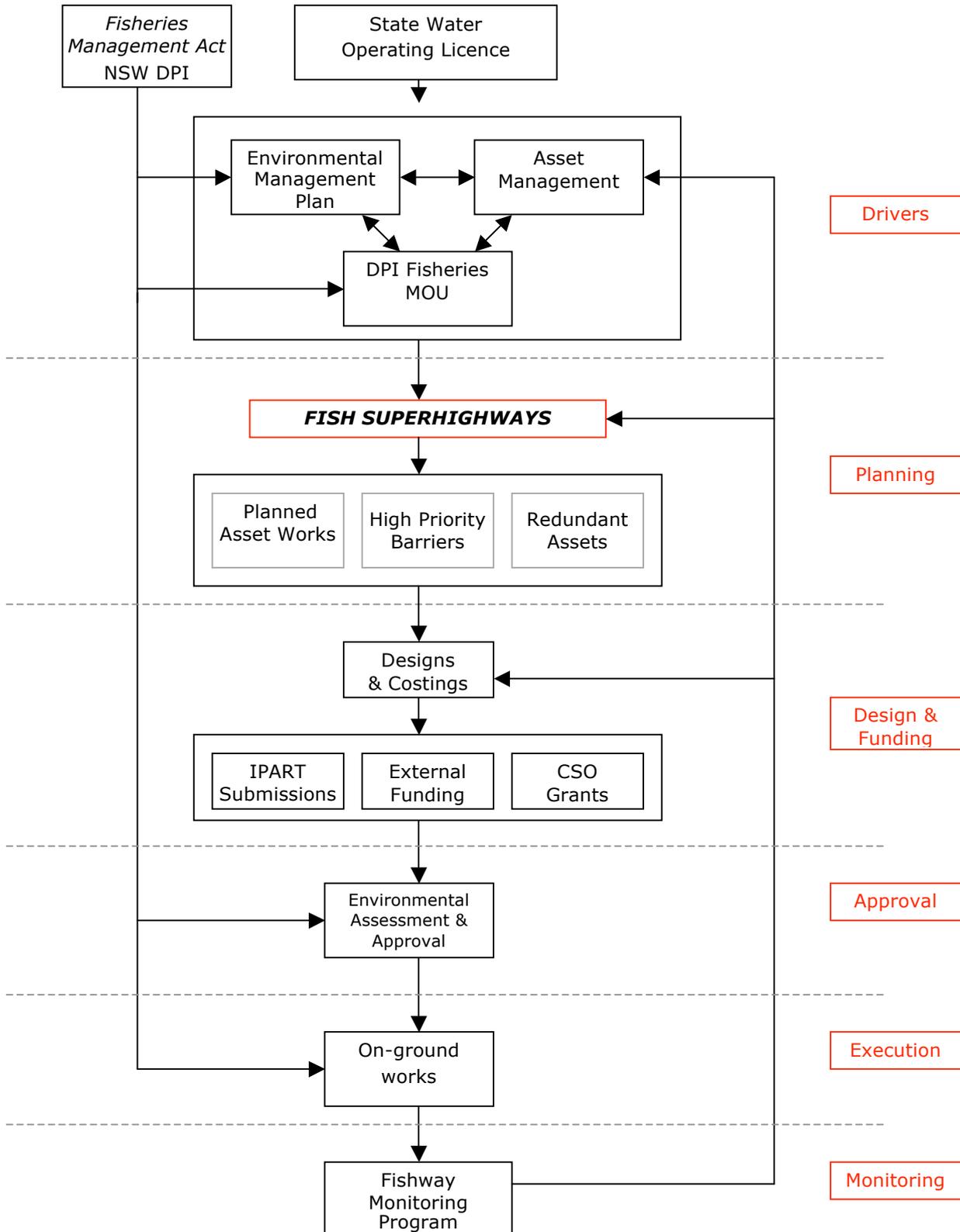
- To improve native fish migration through major asset planning and operation without impacting on State Water's core business of water delivery.
- To address strategic fish passage priorities while remaining cost neutral by including expenditure in IPART budget submissions and business plans.
- To identify partnership and trade-off opportunities to improve fish passage.
- To monitor the effectiveness of newly installed fishways and provide feedback into fishway design processes.
- To ensure State Water is compliant with fish passage requirements under s218 of the *Fisheries Management Act 1994*.
- To engage the local community about benefits to native fish.

Achievements to date

- Complete assessment of State Water assets as barriers to migrating fish.
- Identification of high priority assets to target for improved fish migration.
- Construction of state-of-the-art fishways at high priority sites, including Stevens Weir and Edwards River Offtake Regulator.
- Initiation of fishway construction at a further 8 priority sites in 2010 alone.
- Identification and disposal of redundant assets that restrict fish passage.
- Initiation of the Fishway Monitoring Program to track native fish migration across the Murray-Darling Basin.
- Installation of carp separation cages at fishways within the Lachlan and Macquarie catchments.

How the Plan Works

Fish Superhighways sits within a legislative and corporate context. The framework for decisions relating to fish passage and the *Fish Superhighways* program are shown below.



Drivers

State Water is governed by its *Operating License* which oversees the interactions between responsible *Asset Management* and implementation of its *Environmental Management Plan (2011 – 2016)*. Additionally, State Water and NSW Department of Primary Industries Fisheries address all fisheries related matters that arise through State Water's operations by means of a *Memorandum of Understanding (MOU)*. Under the MOU, State Water and DPI Fisheries work cooperatively in addressing the impacts of State Water operations on aquatic habitat and fish passage in compliance with NSW and commonwealth legislation including the *Fisheries Management Act 1994*. Section 218 of the *Fisheries Management Act 1994* requires the provision of fish passage when waterway infrastructure is constructed, altered or modified.

Planning

State Water's Environmental Management Plan calls for improved fish passage at State Water barriers (see Objective 2). *Fish Superhighways* provides a strategic program to address fish passage barriers by identifying *Planned Asset Works* that trigger s218 provisions of the *Fisheries Management Act 1994*, as well as *Redundant Assets* that can be considered for removal.

Fish Superhighways also identifies *High Priority Barriers* to fish passage where no asset works are currently planned. Priority fish passage assets are determined by biological, spatial and practical attributes. Over time, planned asset works can be developed for identified high priority barriers, thus resulting in a rolling strategic fish passage works program.

Design & Funding

Designs & Costings are produced to develop a business case for the provision of fish passage. For compliance driven Planned Asset Works, fish passage costs are incorporated into future *IPART Submissions*. This ensures costs are considered when water prices are determined, thus improving cost recovery. Recent IPART determinations stated that environmental compliance work has a 50:50 cost share arrangement between the State Government and water users, while maintenance costs are 100% customer funded. Redundant assets that are proposed for removal are funded by *Community Service Obligation Grants*. *External Funding* opportunities are explored for non-compliance High Priority Barriers.

Approval

Once funding has been allocated, project *Environmental Assessment & Approval* occurs in collaboration with the development of Asset Management plans. The Environmental Assessment & Approval also details mitigation measures to limit potentially deleterious ecological impacts.

Execution

Operational and environmental approval allows the site to go to tender to select a preferred contractor. *On-Ground Works* involves planned refurbishment or removal of the waterway asset, as well as provision of fish passage.

Monitoring

Under the MOU between DPI Fisheries and State Water, the *Fishway Monitoring Program* aims to verify how effective individual fishways are in terms of enabling fish to pass the barrier. Monitoring results drive continual improvement in the biological understanding of native fish and in fishway design processes and feed directly into Asset Management and future Designs & Costings.

What happens in practice (1)

Colligen Creek Weir – planned upgrade requiring fishway

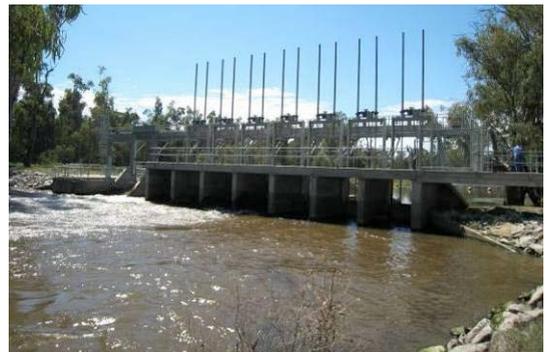
- Weir located on the Colligen Creek in Edwards catchment near Wakool.
- Weir constructed in 1935 to divert water to local irrigators along Colligen Creek and the Neimur River.
- Safety audit in 1998 highlighted structural stability concerns for the aging structure.
- New weir proposed with 7 electrically operated and automated vertical lift gates.
- Fishway required under s218 of the *Fisheries Management Act 1994*.
- Vertical slot fishway incorporating 14 cells and two exit gates proposed.
- Fishway designed to pass a range of fish species and size classes, including Murray cod, golden perch and silver perch.
- Weir and fishway constructed in 2007 during dry conditions and was funded through IPART.
- Monitoring system installed to verify fishway effectiveness.



The ageing weir as seen in 2002 provided water for irrigators.



Construction, with water diverted by a coffer dam.



Completion: the vertical slot fishway (below) sits beside the series of vertical lift gates.





Manyweathers weir in 2009 with inset showing structural damage.



Removal required heavy machinery to work from the bedrock river bed.



On completion the natural hydrology of the river was restored with no monitoring needed.



What happens in practice (2)

Manyweathers Weir – removal of redundant asset

- Weir located on Richmond River in Casino.
- Weir constructed in 1966 to augment Casino's town water supply; however, the weir was never utilised for its original purpose.
- By the early 2000s, repair work was needed that would have required a fishway at a cost of more than \$1 million.
- State Water considered the weir redundant and proposed removal in 2009.
- Review of Environmental Factors included a detailed bed survey, geomorphic assessment, biodiversity assessment, platypus assessment and Heritage Impact Statement.
- Extensive community consultation was undertaken given the high profile location of the weir and the fact that the asset was named after a long-serving mayor.
- Funding for the weir's removal was provided by Community Service Obligation grants, the NSW Recreational Fishing Grant and the Federally funded 'Bringing Back the Fish' program.
- In July 2009, Manyweathers Weir was removed over a 10 day period using an excavator equipped with a rock hammer.
- A two metre section of the weir was saved as a memorial to Richmond Manyweathers.
- No ongoing monitoring was required as the weir was removed in its entirety.

Asset Management Categories

Managing fish passage will be specific to each asset within a catchment context. State Water assets fall within one of the following 7 categories.

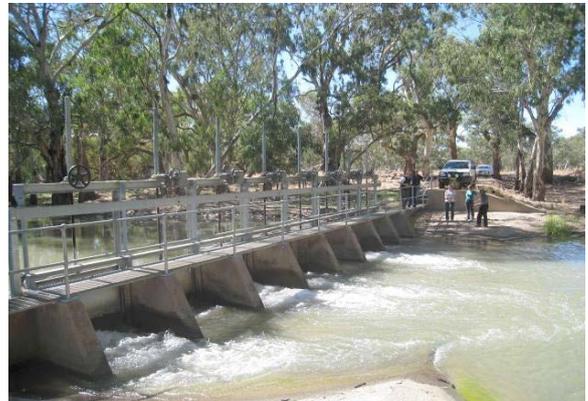
1. Planned Asset Works

The majority of fish passage works are due to significant upgrades to structures which trigger s218 of the *Fisheries Management Act 1994*. Planned asset works which incorporate fishway construction, along with proposed timeframes.

As projects progress and more detailed information concerning expected costs and timeframes are obtained, Planned Asset Works will be updated.

Tarabah Weir

- Yanco Creek regulating structure, Murrumbidgee Catchment
- High priority fish passage barrier
- Vertical Slot fishway planned
- Funding provided by River Environmental Restoration Program (RERP) through DECCW and State Water
- Construction 2010 / 2011



2. Barrier Assets

Barrier Assets are State Water assets that restrict fish migration, but where no structural or operational works are proposed in the near future. Barrier Assets are ranked within their respective catchments regarding their priority as a barrier to migrating fish using a decision support matrix based on biological, spatial and practical attributes.

High priority Barrier Assets can be explored as potential trade-offs or for external funding opportunities. Over time, Barrier Assets will move to Planned Asset Works or another category depending on the circumstances.

Yallakool Creek Weir

- Edwards River catchment
- 75 year old regulating structure
- Planned weir refurbishment triggered s.218 of *Fisheries Management Act 1994*
- Vertical Slot fishway planned
- Funded by IPART determination
- Construction 2010 / 2011.



3. Redundant Assets

Redundant Assets include State Water managed weirs, regulators and levees that no longer serve an identified water management purpose or that have sustained significant structural damage and are considered to have failed. State Water is charged with the ongoing responsibility to manage and maintain such structures, despite the assets providing little to no financial return to State Water. Such assets are viewed as financial, legal and environmental liabilities and, where appropriate, should be considered for disposal. Ongoing Community Service Obligation funding is available to assist in investigating asset disposal options.

Cob-o-Corn Creek Weir

- Significant barrier to migrating fish in Richmond catchment
- Pools water for only 250 m
- Restricts access to 40 km of upstream habitat
- Not utilised for original purpose
- Extensive community consultation
- Weir is acting as bed control structure
- Weir proposed for removal in 2011-2012



4. No Fishway

A fishway may not be needed under s218 of the *Fisheries Management Act 1994* if one or more of the following apply:

- a fishway is not justified on biological grounds
- the structure does not stop fish migrating
- the structure regularly drowns out

For sites where a fishway is deemed unnecessary, consultation and written confirmation is required from NSW DPI.

Chaffey Dam

- Barrier to migrating fish on Peel River
- Dam Safety Upgrade required, triggering s218 of *Fisheries Management Act*
- Extent and quality of upstream fish habitat is limited
- Cost of high level fishway significant relative to perceived effectiveness
- No fishway required



5. Operational Opportunities

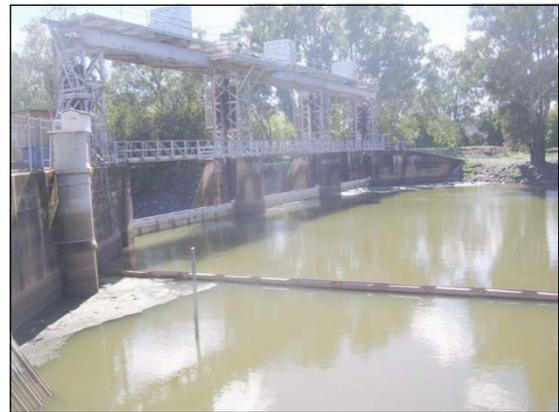
In some circumstances, non-structural operational options are available to improve fish passage and environmental outcomes, including:

- removal of weir gates when not required for regulation
- managing gates to decrease the impact on downstream fish passage, improving water quality and creating variable flows
- managing the timing of regulator gate opening and closing during water delivery to allow fish movement at key times

State Water has committed to improve flow management to closely mimic natural variability. However, operational measures developed to improve fish passage cannot impact negatively on State Water's core business of delivering water and must be cost neutral to customers.

Jemalong Weir

- Situated on the Lachlan River
- Gates lifted when demand is low
- Permits fish passage



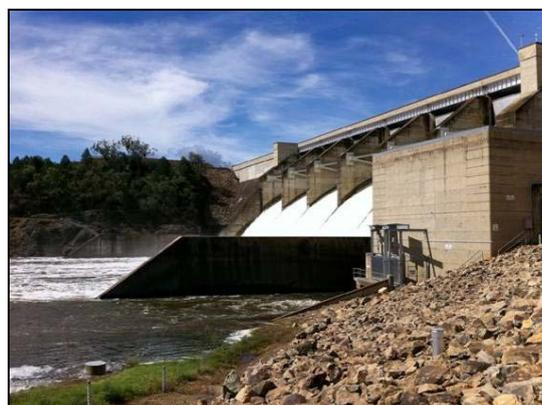
6. Trade-offs

For a small number of State Water assets, the location of the works, the nature of the structure or other factors mean that, despite the biological need for fish passage, reasonable cost-effective solutions are not available. In such situations, the biological significance of the site can be considered in view of other high priority Barrier Assets and a 'trade-off' applied. Trade-offs involve ensuring equal or more cost-effective fish passage outcomes through transferral of fish passage works from the original s218 compliance site to an alternative site or sites assessed as more appropriate. The potential need and use of trade-offs is on a case-by-case basis.

Note: The majority of projects will not require the consideration of trade-offs. If fish passage is determined to be cost-effective during initial investigations, planning should continue through to concept and detailed design in consultation with NSW DPI.

Keepit Dam

- Significant barrier to migrating fish on Namoi River
- Dam Safety Upgrade required, triggering s.218 of *Fisheries Management Act*
- Extensive quality fish habitat upstream
- Cost of high level fishway significant
- Trade-off fishways proposed at Mollee and Gunidgera Weirs, and removal of Weeta Weir.



7. Asset with Working Fishway

As part of the MOU, State Water and DPI Fisheries have developed a biological and operational monitoring program to gauge the effectiveness of newly constructed fishways in passing native fish.

Island Creek Weir

- Active water supply and regulation function
- Significant barrier to migrating fish
- Rebuild triggered s.218 of *Fisheries Management Act*
- Vertical slot fishway constructed
- PIT Tag monitoring system installed



Carp Separation Cages

Carp is an introduced pest fish with a widespread distribution throughout NSW. The fish is a declared Class 3 noxious fish under the *Fisheries Management Act 1994*, and as such, State Water is committed to working with NSW DPI to manage carp.

Carp are a migratory species that, similar to native fish, utilise fishways to disperse. Although fishway construction can facilitate the spread of carp, fishways also offer an opportunity for targeted carp control because fish have to travel through the defined fishway channel.

Observations of carp trying to jump out of fish traps led to the development of the Williams Carp Separation Cage (CSC). The CSC is installed into fishway channels, with carp becoming trapped when they attempt to jump past the trap, a behaviour not observed in native fish. Following an allotted time, the CSC is raised from the fishway where the carp are removed, leaving the native fish to continue their upstream migration.



Carp trapped in a carp separation cage.
Photo: Tom Coull

Fishway Monitoring

What is the purpose of monitoring?

Where a fishway is constructed a monitoring program is required to:

- determine if biological and operational design criteria with regards to effective fish migration are being met; and to
- provide adaptive management feedback into the fishway design process.

What types of monitoring will occur?

Biological monitoring: Biological monitoring utilises Passive Internal Transmitter (PIT) Tags that are inserted into fish immediately upstream and downstream of the fishway on an annual basis. As fish enter and exit the fishway, fixed antennae communicate with the PIT tags to identify the species and size classes that are successfully using the fishway. PIT Tagging occurs at all new fishway sites where practical.

Operational monitoring: The ability of native fish to ascend a fishway is governed by specific design criteria relating to water flow through the structure, including water velocity, turbulence, depth and head differential.

Operational monitoring will be conducted during fishway commissioning, then once every four years, to ensure that design criteria are being complied with. Even subtle changes can significantly alter hydraulic performance and therefore its effectiveness as a fishway.

Who does the monitoring?

As agreed in the MoU, DPI Fisheries will undertake fishway monitoring with State Water providing assistance with site logistics and fishway maintenance as required. NSW DPI staff will be responsible for adopting local OH&S management strategies, including prior notification of State Water of timing and access to such sites.

NSW DPI will provide a summary of monitoring results to State Water in the annual MOU report.

When to monitor

Biological monitoring using PIT tags will occur during the key migration months of September to April inclusive. Operational monitoring will occur during a similar time period, but only when flows are considered suitable to stimulate fish migration as determined by NSW DPI.

Monitoring expenditure

The monitoring requirements and expenditure have been integrated into *Fish Superhighways* to ensure all aspects relating to fishway construction, maintenance and operations are captured in budgeting and planning schedules .

The first two years of post-construction monitoring, including PIT tag setup and tag-outs, are funded under capital works. Ongoing monitoring costs after the second year are funded via operational expenditure.

Monitoring costs are inclusive of staff, services, management, activities and long term data management reporting. Further costs (e.g. maintenance associated with vandalism) will be incurred following the written consent of State Water.

Program elements

Integration

The effectiveness of the *Fish Superhighways* program is dependent upon integration into State Water’s planning and budgeting processes.

Total Asset Management Plan (TAMP)

Information about planned fish passage activities and expenditure should be considered during TAMP updates.

Responsibility: Strategic Assets

State Water Asset Management Plan (SWAMP)

Short term progression of works identified under TAMP and review of completed tasks.

Responsibility: Strategic Assets

Asset plans

Information about fishway compliance requirements and operational and maintenance costs for fishway management, including monitoring costs, should be included during updates to Asset Plans.

Responsibility: Strategic Assets

Asset register

Information to include fishways as a structural component. Asset attribute fields should identify the existence of a fishway and its type.

Responsibility: Strategic Assets

IPART submission

All compliance operating and capital costs should be included in the development of the submission. These occur every 3-4 years

Responsibility: Major Projects
Strategic Assets

Environmental Management Plan

Fish Superhighways program is progression of State Water obligations identified in the Environmental Management Plan (EMP). All results should be linked back to the targets outlined in the EMP.

Responsibility: Major Projects
Strategic Assets

Project charters

Information needed includes the rationale and justification behind fish passage works and its costings. Once a Project Charter has been approved by the BERP it should be included in the fish passage program.

Responsibility: Major Projects
Strategic Assets

Project plan

Fish passage information should be incorporated during plan development and integrated into the PMS. Progress updates should be provided to Natural Assets and Sustainability.

Responsibility: Major Projects
Strategic Assets

Annual budgets

All costs associated with investigation, construction and monitoring to be included in pre-budget planning and Section budget bids during the budget development process.

Responsibility: Major Projects,
Maintenance and Services
Strategic Assets

Who should I talk to?

Both internal and external stakeholders are to be included in the development, implementation, and ongoing review of *Fish Superhighways*. In the first instance, contact the State Water Natural Assets and Sustainability section and NSW DPI State Water Liaison Officer to discuss fish passage requirements at State Water assets.

Stakeholder	Key messages
Natural Assets and Sustainability	Interface between Industry and Investment and State Water, and any other parties interested in fish passage activities. Coordination of fish passage activities in State Water.
Strategic Assets Branch (ongoing)	Integration with Asset Plans, future TAMPs, IPART Submissions. Input into decision-making process regarding designs and trade-off scenarios to be provided by Dam Safety and Strategic Planning.
Major Projects (ongoing)	Updates on progress and cost implications to Natural Assets and Sustainability. Natural Assets and Sustainability provide costings for inclusion in project estimates / budgets.
SWC Operations Team, Executive and Board (ongoing)	Be provided with updates on the progress of the 10 year fish passage program, how it works and how it is used. Integration with asset planning process.
Industry and Investment NSW (ongoing)	Updates to biological priorities as required. Negotiations regarding potential trade-off sites. Partnership opportunities when seeking external funds.
NSW Treasury (New projects, business cases)	Provide total package of costs for works associated with compliance requirements.
IPART (IPART Submission)	Provide total costs associated with fish passage program to ensure cost recovery.
CMAs (As required)	Use identified priorities to discuss potential partnership opportunities with individual CMAs on a project by project basis.
OEH (As required)	Use program to discuss potential partnership opportunities especially regarding sourcing external funding.

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