



1. Ben Andersen Barrage – Vertical Slot Fishway



2. Bromelton Weir – Vertical Slot Fishway



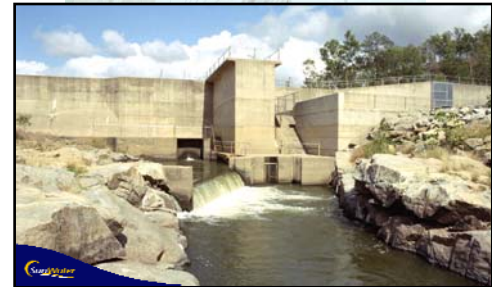
3. Clare Weir – Fish Lock



4. Claude Wharton Weir – Fish Lock



5. Dumbleton Weir – Fish Lock



6. Eden Bann Weir – Fish Lock



7. Kolan Barrage – Vertical Slot Fishway



8. Mary River Barrage – Vertical Slot Fishway



9. Moura Weir – Vertical Slot Fishway



10. Neville Hewitt Weir – Fish Lock



11. Tinana Barrage – Vertical Slot Fishway



12. Ned Churchward Weir – Fish Lock

Prepared by:-  
Infrastructure Development



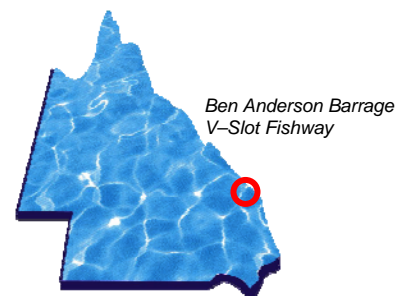
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# FW1 Ben Anderson Barrage Vertical Slot Fishway



## Project description

The fishway is part of the Ben Anderson Barrage located at Bundaberg in Queensland.

The Ben Anderson Barrage is a tidal barrier in the Burnett River at AMTD 25.9 km. It is 4.0 m high, 265 m long, and was built in 1974. In addition to the fishway, the barrage has 110 – 1.83 m high – collapsible steel shutters and 6 fixed-wheel floodgates with a combined capacity of 10,080 ML/d.

The current vertical-slot fishway is the refurbished 1997-version of the original pool-and-weir fishway built in 1974. The refurbishment reduced the fishway grade from 10% to 6.7% by extending the upstream and downstream ends and increasing the number of cells from 16 to 41. In addition, the upstream extension was fitted with 4 exit gates to accommodate the 2.0 m variation in storage level caused by pumping for irrigation.

The fishway is principally designed for fish moving upstream, but also accommodates fish moving downstream.

The fishway was the forerunner for similar structures in the Fitzroy and Mary River basins.

## Technical data

Location	Burnett River, AMTD 25.9 km
Water storage	Ben Anderson Barrage
Barrage structure	Mass concrete crest over sand fill, supported by sheet and concrete piles, and fitted with collapsible steel shutters
Height of crest above mean tide level	4 m (approximately)
Storage capacity	30,300 ML
Fishway type	Vertical slot
Year fishway completed	1997
Total cost	\$ 0.8 million
Length of fishway	65 m
No. of bays	41
No. of resting pools	nil
Bay dimensions	2.18 x 2.44 x 1.5 m
Slot width	150 mm
Slope	1:15 (6.7%)
Drop between bays	100 mm
Discharge	Max. 13.1 ML/day
Velocity range	0.35 – 1.4 m/s
Maximum turbulence	33 W/m <sup>3</sup>
Upstream operating range	2.0 m
Exit(s)	4 sliding gates (upstream)

# FW1 Ben Anderson Barrage Vertical Slot Fishway



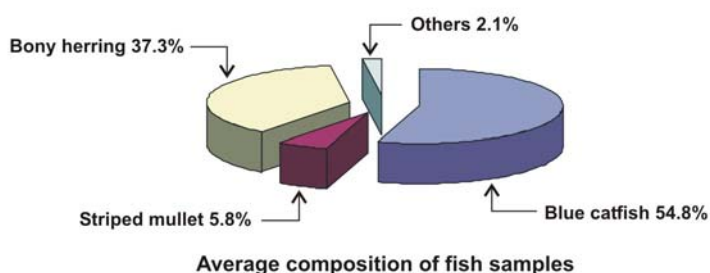
## Performance summary

The new vertical slot Ben Anderson Barrage Fishway has proven to be very successful, returning many fish species that had disappeared from the Burnett River basin. A 17-month survey after the new fishway was built, identified 34 fish species and counted 52,000 fish. By comparison, a 32-month survey on the old pool-and-weir fishway some years earlier, only identified 18 fish species and counted 2000 fish.

The survey proved that the vertical-slot fishway suits Australian native fish. It also showed that 150 mm wide slots are too narrow for fully adult lungfish to return to the storage after having been swept downstream by floods.

## Performance data

Period monitored	December 1997 – April 1999
No. samples taken	50 paired samples
Max. fish count	4,500/day
Species counted	34
Total fish sampled	52,000
Size range of fish moving up the fishway	24 – 930 mm
Downstream migration through fishway	Yes



## References

Stuart I.G. and Berghuis A.P. *Passage of native fish in a modified vertical-slot fishway on the Burnett River barrage, South-eastern Queensland*. Department of Primary Industries July 1999.

# FW2 Bromelton Weir Vertical Slot Fishway



Bromelton Weir  
V – Slot Fishway

## Project description

The Bromelton Weir Fishlock is located on the Logan River at AMTD 113.2 km west of Beaudesert.

The weir and the fishway were built in 1997. It stores 414 ML at FSL EL 40.8 m. In between natural flows, the storage is refilled by releasing water from Maroon Dam.

The weir consists of three stepped rows of steel sheet piling interspaced with reinforced concrete slabs overlaying a clay fill and banks protected by concrete slabs and rock mattresses.

The vertical slot fishway has 32 only 1.5 m wide x 2.0 m long cells with 150 mm wide slots and 100 mm drops in between. The upstream exit has a single 1.5 m x 1.6 m opening, but the downstream exit has 5 only 150 mm wide slots at 500 mm centres.

The weir's outlet and the fishway are on opposite banks of the river. The outlet is at the right bank. The fishway is close to the left bank.

## Technical data

Location	Logan River, AMTD 113.2 km
Water storage	Bromelton Weir
Weir structure	Sheet pile rows with concrete and rockfill infill.
Height of crest above river bed level	4.8 m
Storage capacity	414 ML
Fishway type	Vertical-slot fishway
Year fishway completed	1996
Total cost	\$ 0.4 million
Length of fishway	73.9
No. of bays	32
No. of resting pools	2
Bay dimensions	2.0 m (L) x 1.5 m (W)
Slot width	150 mm
Slope	1: 20 (5%)
Drop between bays	100 mm
Discharge	15 ML/d (design)
Velocity range	1.4 m/s (design)
Maximum turbulence	50 W/m <sup>3</sup> (design)
Upstream operating range	0.6 m (40.8 m – 40.2 m)
Exits	1 (large) upstream, 5 (narrow slots) downstream



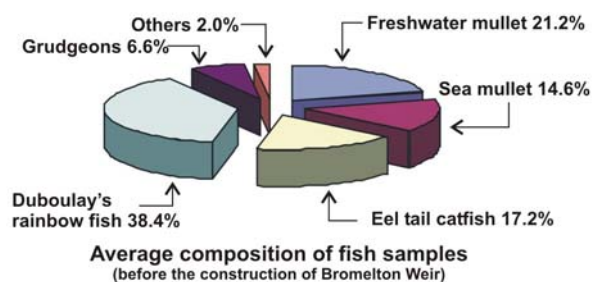
## Performance summary

To date (December 2002) no survey has been undertaken to measure the fishway's performance.

As part of the decision process, Fisheries personnel of the Department of Primary Industry undertook a fish-netting survey between 11 and 13 January 1995. This survey identified the presence of 8 fish species with the notable exception of Australian bass and freshwater cod, which on anecdotal advice, were there in the past.

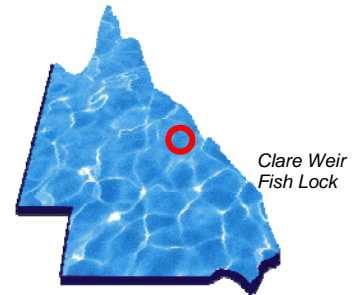
## Performance data

Period monitored	Not available
No. samples taken	Not available
Max. 24 hour fish count	Not available
Species counted	Not available
Total fish sampled	Not available
Size range of fish moving up the fishway	Not available
Downstream migration through fishway	Not available



## References:

Engineering Services. *Bromelton Weir – Stage 2 Logan River AMTD 113.2 km. Preliminary Design*. Civil Design Report No. REP/48. DPI Water Resources, June 1995.



## Project description

Clare Weir is on the Burdekin River at AMTD 50.3 km. The weir's original fishway was built in 1978. Records show that its design was optimised to avoid silting and modified later to accommodate a travelling crane.

Field observations coupled with ambient monitoring have shown underperformance of the fishway over a number of years, and a reduction in both fish numbers and species. The fishway did not suit our native fish species and was therefore ineffective. For these reasons the old fishway was recently replaced with a new improved fish lock type fishway.

The lift height for the fish lock is 6.5m and it can operate with a maximum river discharge of up to 580m<sup>3</sup>/s.

## Fish Attraction

Fish attraction flow was a major consideration when designing the new fishway. A two-dimensional river model (RIVER-2D) was used in combination with physical modelling to evaluate the tailwater entrance flow conditions in conjunction with hydraulic jumps and heavy turbulence below the weir's energy dissipater. Combining these two methodologies provided a

## Technical data

Location	Burdekin River, AMTD 50.3km
Water storage	Clare Weir
Weir structure	Mass concrete (1978) with added collapsible gates (1988)
Height of weir above river bed	8.0 m with gates up (FSL 20.5m), 6.2 m with gates down
Storage capacity	15,500 ML (FSL 20.5 m)
Fishway type	Fish Lock
Estimated cost	\$2.5 million (budget)
Maximum lift height	6.5m
Holding chamber	2.0m(W) x 4.0m(L)
Lock chamber	2.0m(W) x 3.5m(L)
Exit channel	1.5m(W) x 40m(L)
Headwater operating range	1.0m (19.5m – 20.5m AHD)
Tailwater operating range	2.0 m (14.0m – 16.0m AHD)
Discharge	Variable (0.75 m <sup>3</sup> /s max)
Holding chamber entrance velocity	Variable (1.0 m/s maximum)
Exit channel velocity	Variable (1.0 m/s maximum)
Cycle time	Variable (operator adjustable)
Operating system for gates and valves	Hydraulic
Control system	PLC with remote monitoring

better understanding of the hydrodynamics around the fishway entrance.

The fish lock design is based on previous proven installations with the following significant variation. An Attraction Valve has been added to provide fish attraction flow for a larger percentage of the operating cycle.

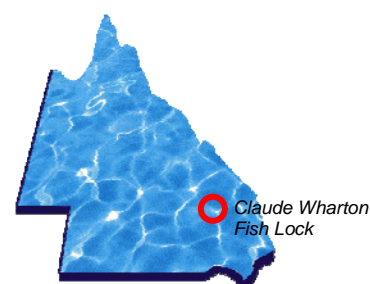
### **Construction**

The retrofit construction was undertaken in 2004 by a Contractor under SunWater supervision. Commissioning of the fishway was completed in early 2005.

Reference: Engineering Services Report, *Design Report for Clare Weir Fishway Upgrade, May 2005*. Project E-02011



# FW4 Claude Wharton Weir Fish Lock



## Project description

Claude Wharton Weir is located on the Burnett River at AMTD 202.4 km, about 2km upstream from the town of Gayndah. The weir's construction was completed in 1986 with a fixed crest elevation of 92.9m AHD. In 1992 the full supply level was raised to 94.4m AHD (storage volume 11,917 ML) by the addition of two inflatable rubber dams (fabridams).

While no special provisions were made for a fish passage in the original design, more recent structures on the river have included facilities for fish migration and so it was desirable to update Claude Wharton Weir to include a fish passage also. Because of the height of the weir, a fish lock was determined to be the best option and so plans were made for one to be retrofitted. The nominal lift height for the fishway is some 8.6 metres (94.4m – 85.8m).

## Fish Lock Design and Layout

The design adopted for the fish lock at Claude Wharton Weir was based on previous successful designs where fish locks were retrofitted to existing structures. Differences occur to accommodate site specific conditions and where enhancements are

## Technical data

Location	Burnett River, AMTD 202.4km
Water storage	Claude Wharton Weir
Weir structure	Mass concrete (1986) with added inflatable dams (1992)
Height of weir above river bed	7.9m with dams deflated, 9.4m with dams inflated
Storage capacity	11,900 ML (FSL 94.4 m)
Fishway type	Fish Lock
Estimated cost	\$4.5 million (budget)
Maximum lift height	8.6m
Holding chamber	2.0m(W) x 4.2m(L)
Lock chamber	2.0m(W) x 3.5m(L) x 8.0m(H)
Exit channel	1.0m(W) x 13m(L)
Headwater operating range	3.6m (91.1m – 94.7m AHD)
Tailwater operating range	3.0m (85.8m – 88.8m AHD)
Discharge	Variable (0.82 m <sup>3</sup> /s max)
Holding chamber entrance velocity	Variable (1.0 m/s maximum)
Exit channel velocity	Variable (1.0 m/s maximum)
Cycle time	Variable (operator adjustable)
Operating system for gates and valves	Hydraulic
Control system	PLC with remote monitoring and control

made to the design following research and/or feedback.

The lock has been located on the left bank side adjacent to the outlet works monolith where the existing rubber dam is mounted. It was necessary to cut the left side rubber dam and reset it to a new concrete fillet beside the lock, making it 3.0 m shorter overall. The inflatable dam service lines pass through the lock exit channel encased in a concrete beam.

### **Fish Attraction**

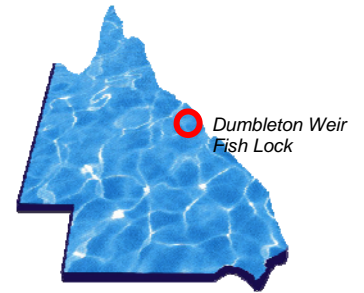
One of the most important aspects of fishway design is to provide entrance conditions so that fish will be attracted to enter. In this case fish attraction is required during outlet releases and also for a range of Weir overtopping flows. An assessment of the interaction between these flows and the attraction flow was made using a physical scale hydraulic model.

A 3.0m long wall extending out from the streamside of the Holding Chamber was incorporated after scale model testing. This improves entrance conditions during high spillway overflow. Another detail incorporated was a side entrance slot in the right hand side holding chamber wall. This provides fish with an alternate entrance when the weir is overflowing. The physical model was also used to finalise the arrangement of the apron and sill below the outlet works.

### **Construction**

The retrofit construction was undertaken by SunWater utilising direct management. Approximately twenty separate contracts were let covering; supply of labour, materials, provision of plant, and supply and installation of equipment. Construction commenced in late May 2007 and was completed in February 2008. Commissioning of the fishway was completed in early 2005. Initial test trapping has proved very successful.

**Reference:** Asset Solutions, *Claude Wharton Weir, Design Report on Fishway, February 2008.*



## Project description

The Dumbleton Weir Fish Lock was Australia's first automated lock-type fishway. It is located on the Pioneer River at AMTD 16.4 km, just west of Mackay. The weir and the fish lock are an integral part of the Pioneer River Water Supply Scheme.

The weir was built in 1992 and modified on two occasions, in 1992 and 1998. The original weir had no fishway, but when the crest of the mass concrete gravity structure was raised in 1992 the work included the construction of a fish lock. The fish lock was modified in 1998 – when the weir crest was raised again with the addition of rubber bags – followed by further enhancements in 1999 to improve the locks reliability. The weir's current storage capacity is 8,700 ML at FSL 16.0 m AHD.

The lock has a maximum lift height of 12.5 m. It has a PLC-governed automated cycling system that controls the lock's valve and gate positions as well as the duration of entry and exit phases of the operating cycle.

Fish surveys have shown that flow patterns downstream from the weir tend to reduce the effectiveness of the fish lock. Consequently, further enhancements are being considered.

## Technical data

Location	Pioneer River, AMTD 16.4 km
Water storage	Dumbleton Weir
Weir structure	Mass concrete gravity with two inflatable rubber dams
Height of crest above river bed level	12.5 m (to top of fixed crest) 14.5 m (to top of rubber dams)
Storage capacity	8,700 ML (FSL 16.0 m AHD)
Fishway type	Fish Lock
Year fishway completed	Built 1992, raised 1998, and upgraded 1999
Total cost	\$0.8 million
Maximum lift height	12.5 m
Holding Chamber	2.8 m (W) x 4.4 m (L)
Lock chamber	2.0 m (W) x 3.65 m (L)
Exit channel	1.05 m (W) x 10.8 m (L)
Headwater operating range	3.3 m (13.0 – 16.3 m AHD)
Tailwater operating range	2.0 m (3.5 – 5.5 m AHD)
Discharge	1 m <sup>3</sup> /s
Holding chamber entrance velocity	0.8 m/s (design)
Exit channel velocity	0.6 m/s (design)
Operating system for gates and valves	Hydraulic
Control system	PLC with local and remote monitoring and control



## Performance summary

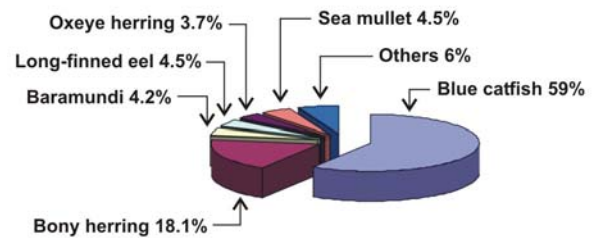
Fish surveys to date have only been partially successful, because of difficulty with downstream trapping. The survey team also observed that some of the adult species would not enter the fish lock, but found no clear single reason. Therefore, the fish count may not be indicative of the performance of the lock itself.

The 2000 fish survey did show that there is room for improvement. It found that the fish lock is limited by riverbed topography, fish lock geometry, and operational strategy. The survey found that the 1.0 m submergence of the top of the entrance gate below tailwater is restricting the migration of surface dwelling fish species and that the downstream rock bar was an aggravating factor.

The survey also found that weir crest flows create downstream currents that confuse fish and stop them from finding the lock entrance. It found that this problem was aggravated by the current practice of simultaneously deflating and inflating the two side-by-side rubber dams to minimise upstream flooding and minimise structural stress without considering the efficiency of the lock.

## Performance data

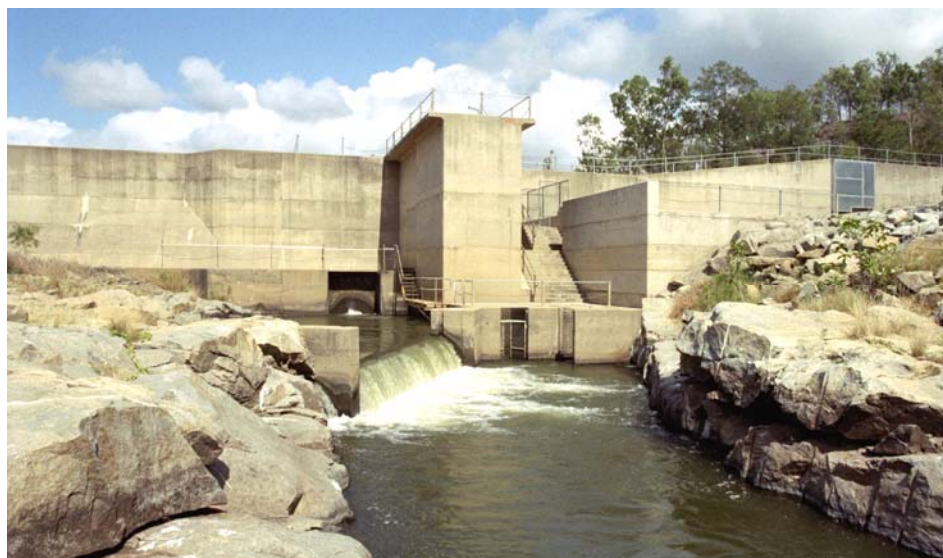
Period monitored	January 2000 – May 2000
No. samples taken	32
Max. 24 hour fish count	Not available
Species counted	23
Total fish sampled	7068 (estimate)
Size range of fish moving up the fishway	54 – 660
Downstream migration through fishway	No data available



## References

- Beitz E.N.. *Dumbleton Weir Fishlock*. 1992 ANCOLD Conference on Dams
- McGill D. and Marsden T. *Dumbleton Weir Fishlock Assessment*. Queensland Fisheries Services, Mackay Region
- Engineering Services E-30031(20). *Report on Dumbleton Weir Fishlock – proposed enhancements*. SunWater, December 2001

# FW6 Eden Bann Weir Fish Lock



## Project description

The Eden Bann Weir fish lock is located on the Fitzroy River at AMTD 141.2 km, 81 km upstream from Rockhampton. The weir was constructed in 1994 and is a mass concrete structure storing 35,900 ML at FSL 14.5 m AHD.

The weir and the fish lock were built at the same time. The lock sits between the weir's left abutment and the weir's outlet works, well away from the main river-channel; it relies on a long outlet works channel to attract fish from the main river channel downstream. The Eden Bann Weir Fish lock is an open-lock, capable of lifting fish over 8 m, and was the second of its type to be built in Queensland.

The fish lock's valves and gates operate hydraulically. All are PLC controlled. The operator can supervise the operation and vary the time-settings either locally, using the control board, or remotely, using a MS-Windows computer.

Plans exist to increase weir storage level. If they eventuate, the fish lock's entry exit channel and the outlet work's intake structure must be modified to accommodate the larger range of water levels and use the better quality of water usually found near the surface.

## Technical data

Location	Fitzroy River, AMTD 141.2 km
Water storage	Eden Bann Weir
Weir structure	Mass concrete gravity, 412 m wide
Height of weir above river bed	9.5 m
Storage capacity	35,900 ML (FSL 14.5 m AHD)
Fishway type	Fish Lock
Year fishway completed	1994
Total cost	\$1.0 million
Maximum lift height	8.0 m (6.5 – 14.5 m AHD)
Holding chamber	2.4 m (W) x 4.0 m (L)
Lock chamber	2.0 m (W) x 3.65 m (L)
Exit channel	1.5 m (W) x 12.8 m (L)
Headwater operating range	2.0 m (12.8 – 14.8 m AHD)
Tailwater operating range	1.5 m (7.0 – 8.0 m AHD)
Discharge	1 m <sup>3</sup> /s
Holding chamber entrance velocity	0.8 m/s (design)
Exit channel velocity	0.6 m/s (design)
Cycle time	Variable
Operating system for gates and valves	Hydraulic
Control system	PLC with local and remote monitoring and control



# FW6 Eden Bann Weir Fish Lock



## Performance summary

Fish surveys (Jan 1996-Jan 1997 and Sep 1999-Mar 2000) indicate that the fish lock is transferring fish effectively, but that fish have difficulty finding the entrance. The fish biologists involved in the surveys nominated three possible reasons:

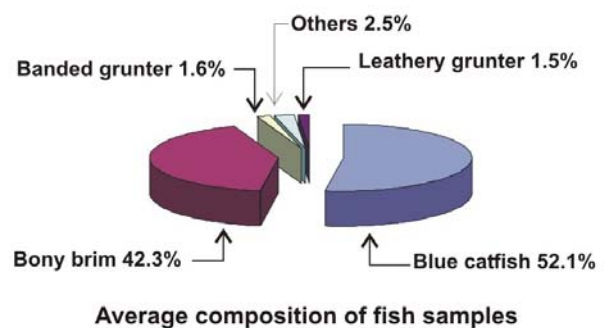
- Competing attraction flows from the weir's outlet works and the weir's spillway
- Intermittent operation of the fish lock
- Sparseness of fishway-channel habitat compared with that of the original river channel.

The survey found that the best results were obtained during low flow conditions, when there were no spillway and outlet works flows.

The surveys also confirmed the results from similar surveys elsewhere that the migratory behaviour of certain fish species is governed by flood conditions and water temperature, especially during spring and early summer.

## Performance data

Period monitored	September 1999-March 2000
No. samples taken	39, including 6 paired samples
Max. 24 hour fish count	3000 (mostly bony bream)
Species counted	16
Total fish sampled	11,835
Size range of fish moving up the fishway	45 – 700 mm
Downstream migration through fishway	No available data



Fish sampling/monitoring  
Eden Bann Weir - Fish Lock

## References:

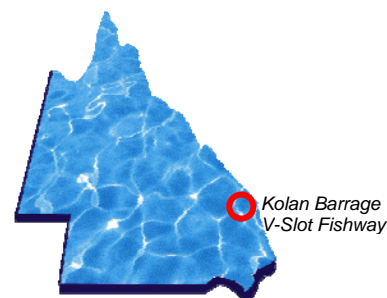
Engineering Services. *Eden Bann Weir Stages 2&3 – Preliminary Design Report*. Natural Resources State Water Projects. July 1999. Reference No. ES 1053

Stuart I.G. and Berghuis A.P. *Assessment of Eden Bann Weir Fishlock Fitzroy River, Queensland*. Queensland Department of Primary Industries, July 1997

Long P.E. and Meager M.J. *The Assessment of Eden Bann Weir Fishlock, Fitzroy River, Queensland 1996-2000 Supplementary Report*. Queensland Fisheries Services, Department of Primary Industries, Queensland 2000.



# FW7 Kolan Barrage Vertical Slot Fishway



## Project description

The fishway is part of the Kolan Barrage located 25 km northeast of Bundaberg on the Kolan River at AMTD 14.5 km.

The barrage is a 4.5 m high steel sheet pile structure with a reinforced concrete cap. It was constructed in 1974 and included a combined submerged-orifice and v-notch fishway on a 13% slope, which was lengthened and changed to the current vertical-slot fishway in 1998.

The modified fishway has 23 only 2.4 m wide x 1.5 m long cells with 100 mm drops between cells. Its slope is 6.7%.

Water velocity and turbulence are 1.4 m/s and 43 W/m<sup>3</sup> respectively. A single gate at the top of the fishway channel allows the fishway to be closed during high spring tides, low headwater, or when water must be conserved.

The difference between low and high tide is 2.0 m. The top of the downstream baffle is positioned at mean tide level.

## Technical data

Location	Kolan River, 14.5 km AMTD
Water storage	Kolan Barrage
Barrage structure	Mass concrete crest supported by sheet piling
Height of crest above mean tide level	1.9 m
Storage capacity	3810 ML (FSL 2.40 m)
Fishway type	Vertical slot
Year fishway completed	1998
Total cost	\$ 0.9 million
Length of fishway	35.75 m
No. of bays	23
No. of resting pools	nil
Bay dimensions	2.4 (W) x 1.5 (L)
Slot width	150 mm
Slope	1:15 (6.7%)
Drop between bays	100 mm
Discharge	varies
Velocity range	1.4 m/s maximum
Maximum turbulence	43 W/m <sup>3</sup>
Upstream operating range	0.7 m (1.7 – 2.4 AHD)
Exits	1 (upstream)

## Performance summary

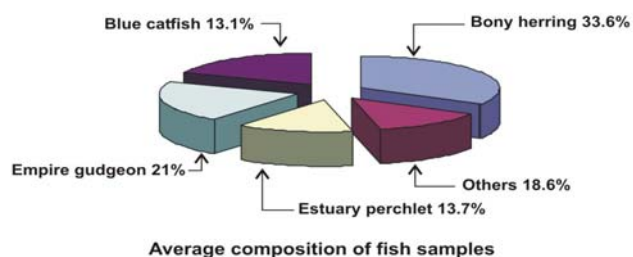
The modified fishway has increased the number and diversity of fish migrating upstream. Fifty-eight days of sampling over a 14-month period counted 22 fish species and 9220 fish varying in length between 24 and 486 mm. In contrast surveys undertaken before the modification found hardly any fish.

The modified fishway is providing vastly improved access for a wide range of fish species, although water velocity and turbulence appear still too high for a large proportion of upstream migrating fish less than 40 mm long. In addition, accumulated water hyacinth sometimes restricts the upstream fishway entrance and hinders fish dispersion and downstream fish migration.

Incoming high tides tend to drown the lower fishway cells and reduce the attraction to the fishway.

## Performance data

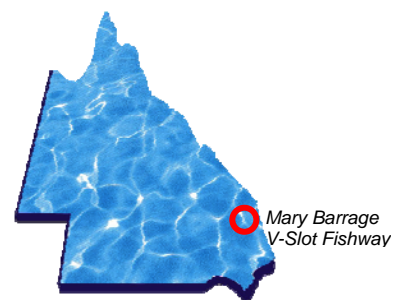
Period monitored	November 1998 – March 2000
No. samples taken	47 at top and 11 at bottom of which 10 were paired samples
Max. 24 hour fish count	831
Species counted	22
Total fish sampled	9220
Size range of fish moving up the fishway	24 – 486 mm
Downstream migration through fishway	Yes



## References

Broadfoot C.D., Berghuis A.P., and Heidenreich M.J. *Assessment of the Kolan Barrage vertical-slot fishway*. Department of Primary Industries. Bundaberg, September 2000.

# FW8 Mary Barrage Vertical Slot Fishway



## Project description

The fishway is an integral part of the Mary Barrage located southwest of Maryborough on the Mary River at AMTD 59.3 km

The Mary Barrage is a tidal barrage. It was constructed in 1982 and consists of steel sheet piles capped with a concrete crest. The crest is approximately 3 m above mean tide level. The barrage stores 12,000 ML water for Lower Mary Valley irrigators.

The original fishway was located near the right bank. It was a complex arrangement consisting of two separate pool and weir type fishways hampered by poor lighting, tortuous geometry, restrictions for bottom swimmers, and limited downstream tidal entry.

The fishway was upgraded in 2001 to the current vertical-slot type. Upgrading involved extending the fishway both upstream and downstream, flattening the slope, and realigning the fishway. The new fishway has 30 cells, each 2.4 m wide and 1.8 m long, separated by baffles with 200mm slots. The fishway includes a 37 m long downstream entrance channel cut into the riverbed.

## Technical data

Location	Mary River AMTD 59.3 km
Water storage	Mary Tidal Barrage
Barrage structure	Sheet piling and concrete
Height of crest above mean tide level	3 m approximately
Storage capacity	12,000 ML
Fishway type	Vertical slot
Year fishway completed	2001
Total cost	\$ 0.9 million
Length of fishway	56 m
No. of bays	30
No. of resting pools	nil
Bay dimensions	2.4 m (W) x 1.8 m (L)
Slot width	200 mm
Slope	1:18.5 (5.4%)
Drop between bays	100 mm
Discharge	10 – 27 ML/d
Velocity range	0.4 – 1.4 m/s
Maximum turbulence	Varies (45 W/m <sup>3</sup> design condition)
Upstream operating range	1.5 m (1.7 – 3.4 m AHD)
Downstream operating range	3.6 m (-0.6 – 3.0 m AHD)
Upstream exits	2 gates



# FW8 Mary Barrage Vertical Slot Fishway



## Performance summary

Upgrading the Mary River Barrage fishway has meant that migrating fish have a greater chance of success in passing over the tidal barrage. This design is successfully allowing the passage of a wide variety of species and size classes of fish.

The vertical slot design has wider slots to allow larger fish species (eg Mary River cod) which may be displaced during flooding, to return upstream to their natural habitats. Lower velocity and turbulence levels also assist small fish species (and juveniles) such as barramundi, bass, and striped mullet, to negotiate the fishway more effectively than before.

The Mary River Barrage fishway entrance height varies between high and low tide. Migrating fish which are attracted by flowing water below the barrage congregate in an area where the entrance to the fishway has been located.

Monitoring began in January 2002, and during Autumn and Summer approximately 25 species and over 60,000 fish were captured including barramundi, bass, striped mullet, tarpon, bream, and estuary perch. Over the same period in 2001, the original fishway only produced 12 species and 1500 fish, showing the new design is a vast improvement.

Migration of adult fish D/S to estuaries and the ocean to breed is an integral part of the life cycle for many native fish.

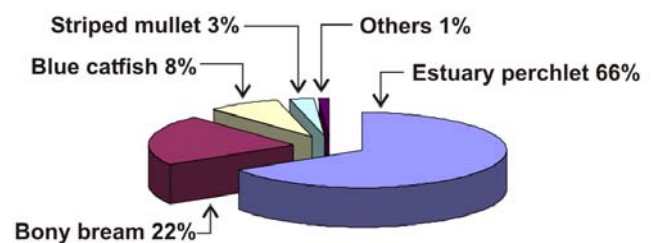
One species- the striped mullet, a major commercial fish, generally migrates downstream during the late Autumn. However at the Mary River Barrage a build up of hyacinth above the barrage is effectively blocking the D/S access by migrating mullet. These fish prove unwilling to swim below the weed, so to ensure the fishway is operating effectively, it is necessary to control hyacinth growth in this area.

## References

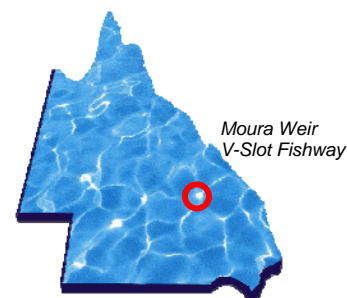
Engineering Services. *Mary River Barrage Fishway Design Report*. SunWater, June 2001.

## Performance data

Period monitored	January 2001 – ongoing
No. samples taken	34 paired
Max. 24 hour fish count	50,895
Species counted	25
Total fish sampled	over 100,000
Size range of fish moving up the fishway	18mm – 1300mm
Downstream migration through fishway	Yes



# FW9 Moura Weir Vertical Slot Fishway



## Project description

The Moura Weir Fishway is located on the Dawson River at AMTD 150.2 km, 10 km west of Moura in Central Queensland.

The Moura Weir was built in the early 1940's and refurbished in 1999 by encapsulating its timber structure with concrete. The original weir had no fishway, but the refurbished weir does. The refurbished weir has a storage capacity of 7,700 ML at FSL (104.75 m AHD)

The fishway has a 7.0 m operating head and is 142 m long, which makes it the highest and largest vertical-slot fish passage facility in Australia. It has 59 cells and 3 resting bays. The baffles have 200 mm slots and 120 mm drops.

The fishway is designed to operate over a headwater variation of 2.4 m and a tailwater variation of 2.9 m requiring 4 upstream and 3 downstream control gates. The fishway is only used when water releases are required.

## Technical data

Location	Dawson River, AMTD 150.2 km
Water storage	Moura Weir
Weir structure	Concrete encapsulated timber weir
Height of weir above riverbed	6.2 m
Storage capacity	7,700 ML (FSL 104.75)
Fishway type	Vertical slot
Year fishway completed	2000
Total cost	\$ 1.9 million
Length of fishway	142 m
No. of bays	59
No. of resting pools	3
Bay dimensions	2.4 x 1.5 m (W x L)
Slot width	200
Slope	1:20 (5%)
Maximum drop between bays	120 mm
Discharge	9.0 – 26.4 ML/d
Velocity range	0.8 – 1.5 m/s
Maximum turbulence	70W/m <sup>3</sup> (maximum)
Upstream operating range	2.4 m (EL 102.8m –105.2m)
Downstream operating range	2.9 m (EL 97.9 m – 100.6 m)
Exits	4 upstream and 3 downstream



# FW9 Moura Weir Vertical Slot Fishway



## Performance summary

The Dawson River is the habitat for 33 different fish species. DPI Queensland Fisheries Service personnel spent a week in March 2002 surveying the movement of fish species through Neville Hewitt Weir fish lock, and the Moura Weir vertical slot fishway.

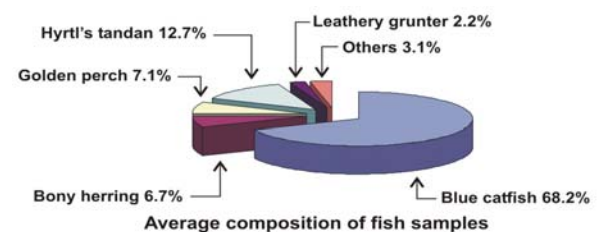
It was noted that successful design and performance of fishways was contributing to the overall health of Queensland's river systems.

Early March 2002 storms in the upper Dawson catchment resulted in a significant river fresh, the flow from which overtopped the Moura Weir to a depth of 30cm, and in turn this stimulated an upstream migration of yellowbelly (golden perch), barramundi, and a range of native fish species including eel tailed catfish, black bream, and bony herring.

It was noted that fish movement through the Moura fishway - the longest vertical slot fishway in Australia, was not as prolific as the numbers recorded at Neville Hewitt Weir fish lock, but it was still early days in the long term monitoring process.

## Performance data

Period monitored	January 2001 – March 2001
No. samples taken	17 paired samples
Max. 24 hour fish count	222/day
Species counted	Not stated
Total fish sampled	2,270
Size range of fish moving up the fishway	36 – 950 mm
Downstream migration through fishway	Yes

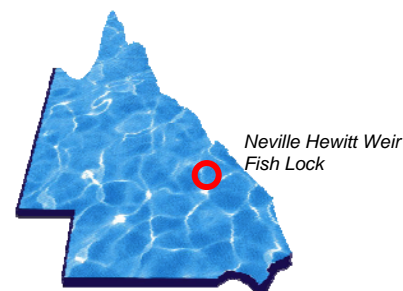


## References:

- Engineering Services. *Definition of Project Requirements*. SunWater, November 2000
- Engineering Services. *Moura Weir Fishway Design Report*. SunWater, November 2000
- Engineering Services. *Moura Weir Fishway Commissioning Procedure*. SunWater, November 2000
- Marsden T.J and McGill D.A. *Moura Vertical Slot Fishway*. Department of Primary Industries (paper in prep. December 2002)



# FW10 Neville Hewitt Weir Fish Lock



## Project description

Neville Hewitt Weir fish lock is located on the Dawson River at AMTD 82.7 km near Baralaba in Central Queensland.

The weir – of which the fish lock is a part – is an 8 m high mass concrete gravity structure built in 1975. The weir has a fixed crest and stores 1,300 ML at FSL (80.3 m AHD) over a 31km long stretch.

The fishway was added in 2000. It involved cutting a 3.2 m deep slot through the weir's spillway to accommodate the exit channel and the necessary modifications to the weir's outlet works.

The lock has a maximum lift height of 8.7 m and will operate over a headwater range of 2.8 m (EL 78.3 – 74.8 m AHD), but is only used during weir overflows (up to 110 m<sup>3</sup>/s) or when releases are made to supply downstream entitlements. If demand exceeds 0.5 m<sup>3</sup>/s, releases through the fish lock are supplemented with simultaneous releases from the outlet works.

The weir's operation is PLC controlled with operator supervision by local or remote interaction with a SCADA PC. All the fish lock gates and valves are operated hydraulically.

## Technical data

Location	Dawson River, AMTD 82.7 km
Water storage	Neville Hewitt Weir
Weir structure	Mass concrete gravity
Height of weir above river bed	8.0 m
Storage capacity	11,300 ML (FSL 80.3 AHD)
Fishway type	Fish lock
Year fishway completed	2000
Total cost	\$ 1.8 million
Maximum lift height	8.7 m
Holding chamber	2.0 m (W) x 4.0 m (L)
Lock chamber	2.0 m (W) x 3.5 m (L)
Exit channel	1.0 m (W) x 14.5 m (L)
Headwater operating range	2.8 m (78.3 – 81.1 m AHD)
Tailwater operating range	3.2 m (71.6 – 74.8 m AHD)
Discharge	Variable. (0.84 m <sup>3</sup> /s maximum)
Holding chamber entrance velocity	Variable. (1.0 m/s maximum)
Exit channel velocity	Variable (0.6 m/s maximum)
Cycle time	Variable
Operating system for gates and valves	Hydraulic
Control system	PLC with remote monitoring and control

## Performance summary

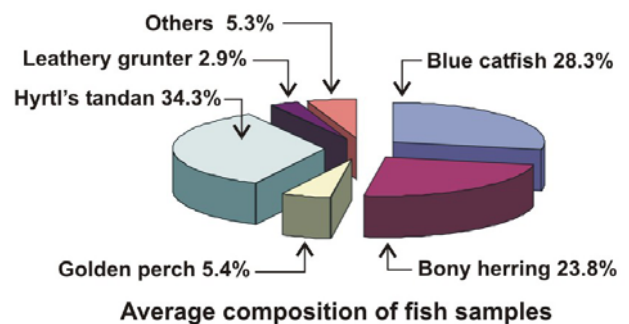
During the first 3 months of operation, volunteer members of the Baralaba Fish Stocking Group recorded a throughput of 6200 fish including 2000 yellowbelly (golden perch), stocked barramundi fingerlings (now 2-3 years old), and native species through the fish lock. Some of the barramundi were 50 - 60cm long and were tagged in conjunction with Suntag Qld which will provide future valuable fish migration information and the overall effectiveness of the fish lock.

In March 2002, storms in the upper Dawson catchment caused Neville Hewitt Weir to overtop to a depth of 300mm which stimulated U/S migration of yellowbelly, barramundi and a range of other native species including blue catfish and black bream.

During this week DPI officers recorded a daily tally of 350 – 700 fish which proved the fish lock was operating efficiently and contributing toward the overall health of Queensland river systems.

## Performance data

Period monitored	January 2001 – April 2002
No. samples taken	12 paired samples
Max. 24 hour fish count	837/ day
Species counted	23
Total fish sampled	4947
Size range of fish moving up the fishway	23 – 979 mm
Downstream migration through fishway	Yes

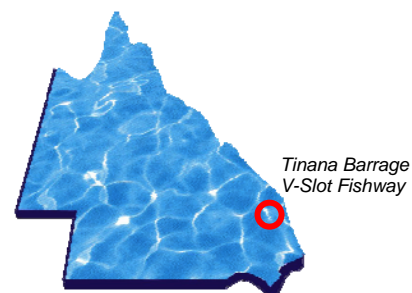


Fish sampling - Neville Hewitt Weir - Fish Lock

## References

Marsden T.J., & McGill D.A., *Neville Hewitt Weir Lock Fishway Assessment*. Department of Primary Industries (Paper in Prep December 2002)

# FW11 Tinana Barrage Vertical Slot Fishway



## Project description

The fishway is an integral part of the Tinana Barrage located on Tinana Creek at AMTD 1.6 km southeast of Maryborough.

Tinana Barrage is a steel sheet pile concrete capped tidal barrage storing 4,700 ML at FSL 2.5 m AHD.

The barrage was built in 1980 together with the original pool-and-weir type fishway near the right abutment. The original fishway had 200 mm drops between baffles. The drops were reduced to 100 mm in 1982 by inserting extra baffles. However, the 1982 modification did not address the fishway's other troublesome features such as confusing entry conditions, slightly excessive slopes (1:12), poor lighting, and upstream exit restrictions for surface swimming fish species.

The fishway was modified to a vertical slot type in 2000 by removing the concrete covers, heightening the downstream walls, reducing the slope, extending the fishway upstream, and changing the baffles. The newly modified fishway now comprises 25 bays, each 2.4 m wide and 1.8 m long, operating over a headwater range of 1.0 m.

## Technical data

Location	Tinana Creek. AMTD 1.6 km
Water storage	Tinana Barrage
Barrage structure	Concrete capped steel sheet piles
Height of crest above mean tide level	2.35 m
Storage capacity	4700 ML, FSL 2.5 m AHD
Fishway type	Vertical slot
Year fishway completed	2000
Total cost	\$ 0.7 million
Length of fishway	39 m
No. of bays	25
No. of resting pools	nil
Bay dimensions	2.4 x 1.8 m (W x L)
Slot width	200 mm
Slope	1:19 (5.3%)
Drop between bays	100 mm
Discharge	Varies (20 ML/d design condition)
Velocity range	0.4 – 1.4 m/s
Maximum turbulence	Varies (50 W/m <sup>3</sup> design condition)
Upstream operating range	1.0 m (1.9 – 2.9 m AHD)
Downstream operating range	1.9 m (0.0 – 1.9 m AHD)
Upstream exits	1



# FW11 Tinana Barrage Vertical Slot Fishway



## Performance summary

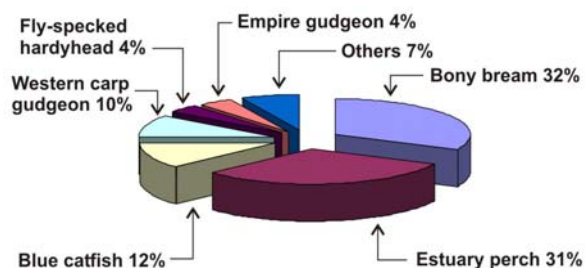
The vertical slot fishway at Tinana Creek Barrage was designed with wider slots to allow larger species such as the Queensland lungfish and Mary River cod, to return upstream if displaced during flooding.

Lower velocities and turbulence levels in the fishway enables recorded species such as estuary perch, bony bream, blue catfish, and other small fish species to utilise the fishway effectively.

QFS monitoring of the fishway has identified 30 species of fish ranging from a 12mm long gudgeon (smallest), to a 1 metre long Queensland lungfish (largest), which have successfully migrated upstream.

## Performance data

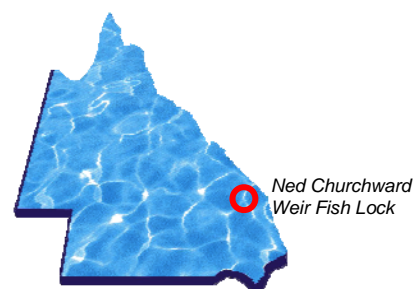
Period monitored	December 2000 – ongoing
No. samples taken	32 paired
Max. 24 hour fish count	2,470
Species counted	30
Total fish sampled	12,000
Size range of fish moving up the fishway	15mm – 1062mm
Downstream migration through fishway	Yes



## References:

Engineering Services. *Tinana Barrage Fishway Design Report*. SunWater, November 2000

# FW12 Ned Churchward Weir Fish Lock



## Project description

The Ned Churchward Weir Fish lock (formerly Walla Weir Fish lock) is located on the Burnett River at AMTD 74.5 km near Wallaville, approximately 30 km southwest of Bundaberg.

The fish lock and the weir were completed in 1998. The weir stores 29,500 ML at FSL (19.0 m AHD). The weir's right abutment, spillway, and apron are mass concrete, but the left abutment is a stepped sheet-pile structure capped with concrete. Both weir and fish lock were designed for the future raising of the crest by 2.0m.

The lock is an open lock, capable of lifting fish over 14 m. It was the third of its type built in Queensland and – when constructed – the highest fish passage in Australia.

The lock has 2 upstream exit channels to cover the large range of water levels resulting from irrigation withdrawals and weir and fish lock releases. The screens on the selective withdrawal outlet works have been angled at 45° to produce a behavioural effect to deter downstream migrants from entering. All fish lock gates and valves are opened and closed hydraulically.

The lock's operation is PLC controlled, with the operator able to intervene either directly or by remote interaction with a SCADA PC. By changing PLC settings, the fish lock operating cycle can be selectively optimised for either upstream or downstream moving fish.

## Technical data

Location	Burnett River, AMTD 74.5 km
Water storage	Ned Churchward Weir
Weir structure	Mass concrete. Left abutment concrete capped sheet piling.
Height of weir above river bed	15.0 m approx (1 <sup>st</sup> stage only)
Storage capacity	29,500ML (FSL 19.0 m AHD)
Fishway type	Fish lock
Year fishway completed	1998
Total cost	\$ 2.0 million (incl. fish channel)
Maximum lift height	14.0 m
Holding chamber	3.0 m (W) x 4.5 m (L)
Lock chamber	3.0 m (W) x 4.1 m (L)
Exit channel	2 only 1.0 m (W) x 5.0 m (L)
Headwater operating range (1 <sup>st</sup> stage)	Upper exit: 17.0 – 19.3 m AHD Lower exit: 13.6 – 17.0 m AHD
Tailwater operating range	Relatively stable (5.5 m AHD approximately)
Discharge	1 m <sup>3</sup> /s (design)
Holding chamber entrance velocity	0.8 m/s (design)
Exit channel velocity	0.6 m/s (design)
Cycle time	Variable (operator adjustable)
Operating system for gates and valves	Hydraulic
Control system	PLC with remote monitoring and control

# FW12 Ned Churchward Weir Fish Lock



## Performance summary

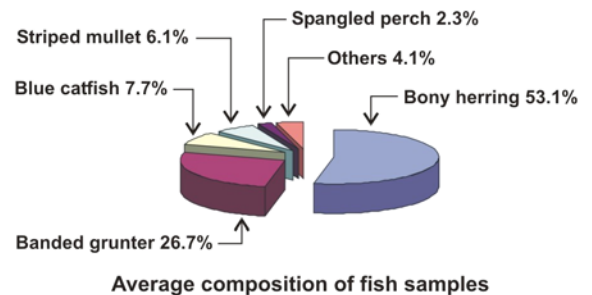
The design improvements that were incorporated into the Ned Churchward Weir Fish lock have resulted in a more reliable and improved fish passage for high weirs than those of previous designs. The study confirmed that a well-designed fishway goes a long way towards ameliorating the adverse effects of a weir on migratory fish communities.

The majority of fish species and fish sizes collected during the study were able to successfully ascend the lock. The number of lungfish that moved through the lock was smaller than had been expected, but as lungfish were not found to be congregating near the lock entrance this may relate more to a lack of understanding the species' biology than to a deficiency in the lock itself.

The study also highlighted that the migration of fish is not only governed by the physical attributes and the reliability of the lock but also by seasonal, climatic, and hydrological factors as well as the biology and the maturity of the fish species involved.

## Performance data

Period monitored	January 1999 – June 2000 (104 sampling days)
No. samples taken	Top 71 and bottom 33 of which 32 were paired
Max. 24 hour fish count	3,823
Species counted	27
Total fish sampled	31,534
Size range of fish moving up the fishway	30 mm – 1130 mm
Downstream migration through fishway	Yes



## References

State Water Projects Engineering Services. *Walla Weir. Report on the evaluation & monitoring of the fishlock.* Department of Natural Resources, November 1997

Berghuis A.P., Broadfoot C.D., and Heidenreich M.J. *Assessment of the Walla Weir Fishlock, Burnett River.* Queensland Fisheries Service, Bundaberg. December 2000.