Water, Wood & Wildlife

Part II September 2006

**WATER THE LIFEBLOOD
FOR SUSTAINABLY MANAGED
RIVER RED GUM FORESTS**

*LIVING WORKING RIVER NURTURING
LIVING WORKING FORESTS*

VAFI NAFI TCA NSWFPA

Supporting: EQUITABLE SOCIAL, CULTURAL, ENVIRONMENTAL & ECONOMIC OUTCOMES.

*Compiled by Barrie Dexter
September 2006*

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- It is recommended that more detailed information be sourced from:

  Submission to Victorian Environment Assessment Council (VEAC) River Red Gum Forests Investigation.

  "Water, Wood & Wildlife: Opportunities for the Riverain Red Gum Forests of the Central Murray."

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  1. Water, Wood & Wildlife – Opportunities for the Riverain Red Gum Forests of the Central Murray. October 2005. Available in Ringbound [ISBN 0-9803079-0-2] and CD [ISBN 0-9803079-1-0].
  2. Water, Wood & Wildlife Part I – The Case for Sustainable River Red Gum Forest Industries. May 2006. [ISBN *Pending*]. Available on CD.
  3. Water, Wood & Wildlife Part II – Water the Lifeblood for Sustainably Managed River Red Gum Forests. September 2006 [ISBN *Pending*] Available on CD.

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The 21 Century Challenge.

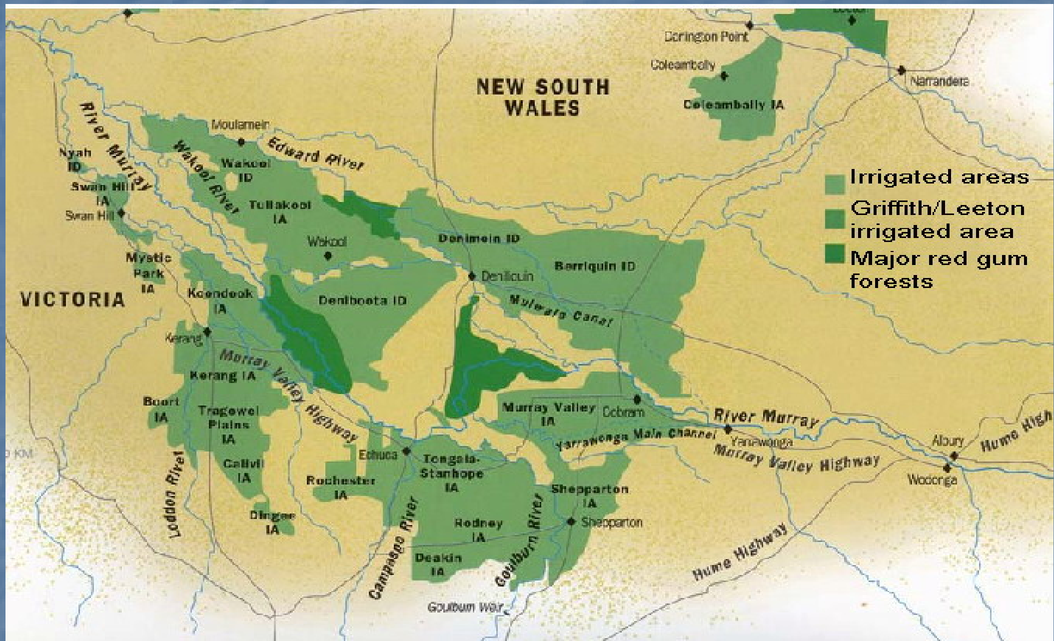
How are we to conserve and manage our water resources:

- to sustain a living working river
- meet our urban, industrial, agricultural, forest and environmental demands for water
- ensure sustainability of our land and water resources for future generations?

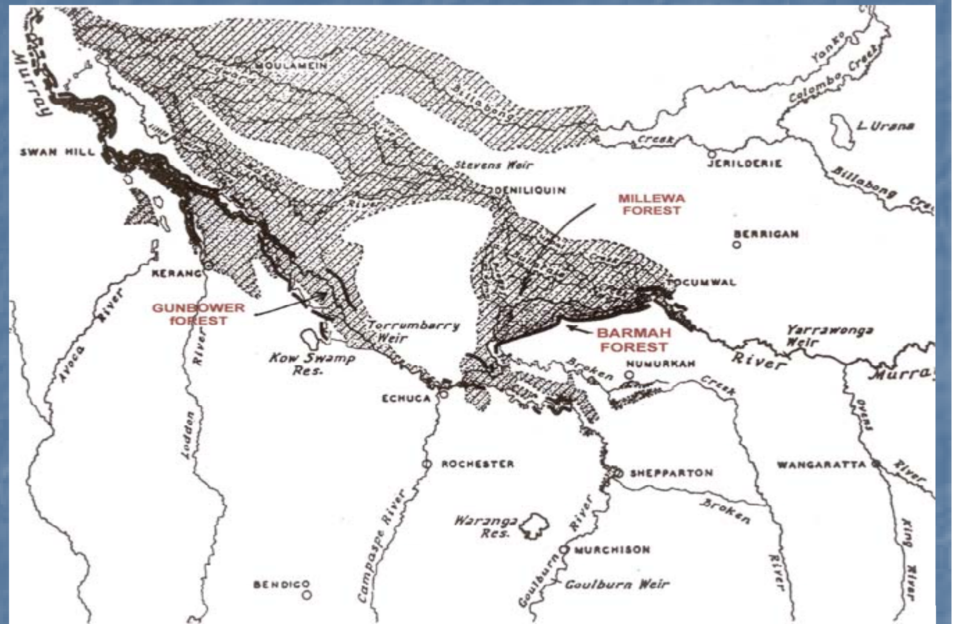
MAKING THE CONNECTIONS

Major river red gum forests and irrigation areas of the Central Murray River

Central Murray River Red Gum forests and Irrigation areas (Courtesy MDBC)



Flooding in the Central Murray River 1956 Flood (Courtesy RMC)

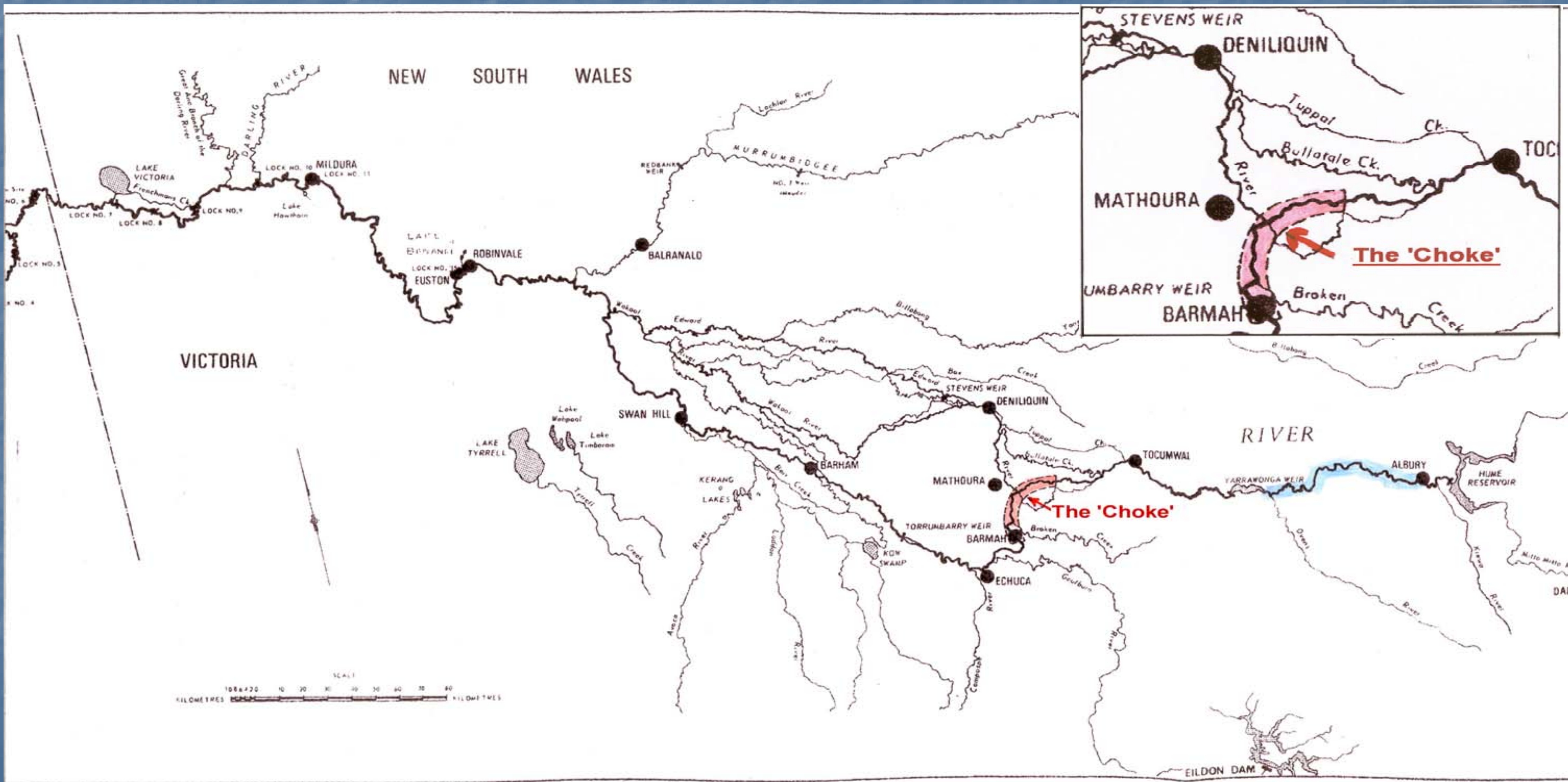


- Strong interdependence between the river & the flood plain forests
- Floodplain forests traditionally operate as temporary natural storages for several months in winter & spring providing habitat for flood dependent flora & fauna
- The system also influences downstream regimes when much of the water drains back into the river for re-use.
- Inter-connectivity between irrigation areas & floodplain forests & wetlands important for some waterbirds

Threats to the on-going sustainability of the red gum forests.

- The greatest threat is altered river flow & forest watering
- The extent to which altered flood regimes have impacted on the forests varies for different reaches of the river according to floodplain characteristics
- River and floodplain biological activity & overall health is inextricably linked to forest flooding
- Flood regimes have been drastically altered in frequency, extent, timing & duration since the construction of upstream dams & associated river regulation for irrigated agriculture
- Due to the huge contribution of irrigated agriculture to the region's & nation's prosperity, a return to natural (unregulated) conditions is not an option

Bankful channel capacity constraints affecting management of irrigation & environmental flows.



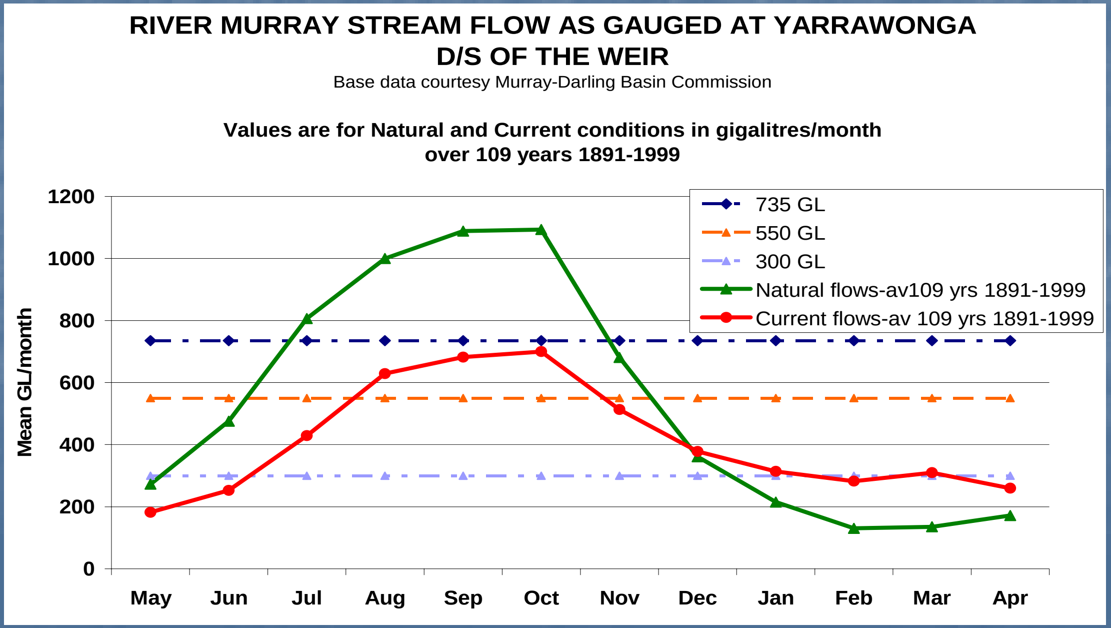
Bankful channel capacity constraints affecting management of irrigation & environmental flows.

- The 25,000 Ml/d channel capacity between Doctors' Pt (just upstream of Albury) & Yarrawonga Weir constrains effective & efficient river management & can result in a greater volume of the Barmah-Millewa EWA being used.
- Lifting channel capacity constraints to 31,000 Ml/d D/S of Doctors' Pt improves efficiency but may increase minor rainfall rejections compared to 25,000 Ml/d
- The 10,000 Ml/d channel capacity in the region of the Barmah Choke severely constrains river management options particularly from mid-December to late April.
- The problem will be exacerbated under recommendations to open up inter-district water entitlement trade (d/s of the Barmah Choke)
- Channel constraints now taking effect more often due to less water available to call from mid-Murray tributaries & changes in demand patterns
- Solving problems related to the Barmah Choke have been under investigation for over 25 years; so far without resolution.

What are the streamflow characteristics that govern frequency, extent & duration of flooding the Barmah Forest?

Flows in the Murray River downstream of Yarrawonga Weir governing flooding of the Barmah Forest are:

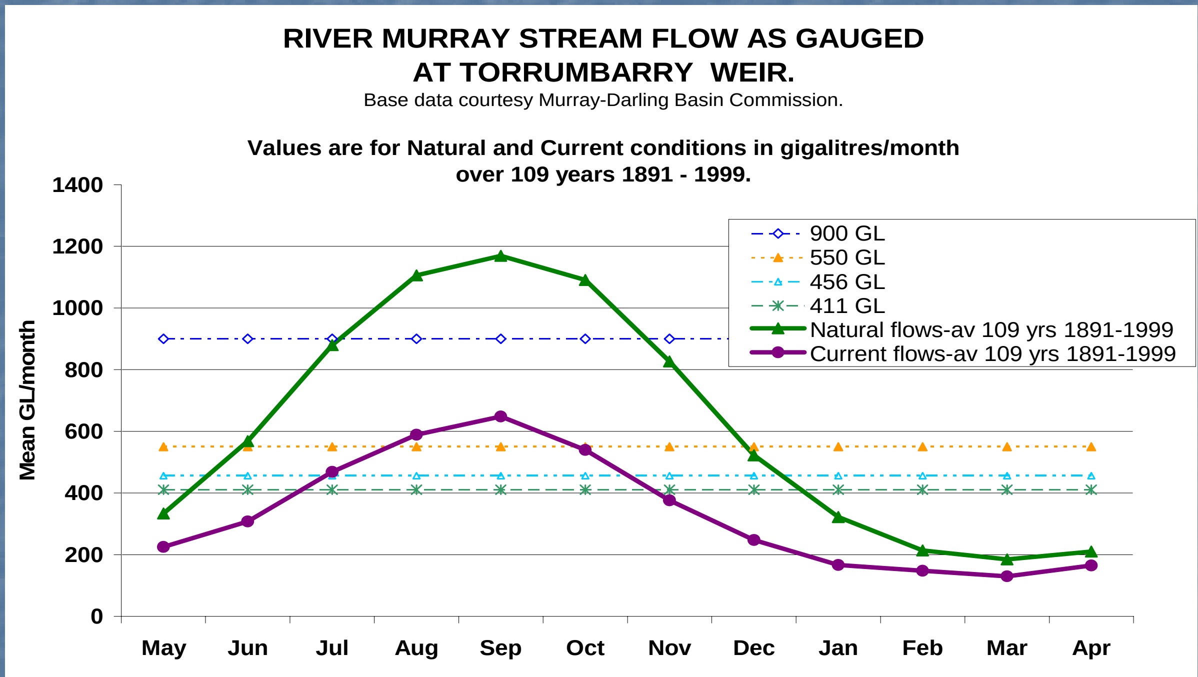
- A monthly flow of about 735 GL (average 24,500 Ml/day for 30 days) results in flooding about 75-80% of the Barmah Forest. Typical peak flows are 45,000 Ml/day
- A monthly flow of about 550 GL (av. 18,300 ML/day for 30 days) generally extends over 35-50% of the Barmah forest depending on consecutive days duration of the peak flows. Typical peak flows are 30,000 M/day
- A monthly flow of about 735 GL followed by 550 GL for a similar period results in about 80% of the forest being flooded for 3-4 months duration. Prior to intensive river regulation 75-80% of Barmah forest was flooded in 80% + of years
- For the river section known as the Barmah Choke, flows greater than 330 GL (av. 10,000 Ml/day for 30 days with typical peak flows of 11,500-15,000 Ml/day) exceed bankful capacity with on-river regulators shut. Exceeding these typical summer irrigation flows leads to unseasonal flooding of lower lying areas.



- The hydrograph shows average monthly Murray River flows at Yarrawonga over a 109 year period 1891 to 1999
- It allows comparison between estimates of natural flows & actual flows under specified demand strategies
- It depicts the huge change in flow regime affecting the Barmah Forest & wetlands as a result of storages for river regulation
- Note the large reduction in winter/spring flows & the significantly increased summer/autumn flows that now occur compared to the natural flow regime
- This results in much reduced winter/spring frequency, duration & extent of flooding over a range of flood dependent habitats & unseasonal summer/early autumn flooding of lower lying areas of the Barmah Forest

What are the streamflow characteristics that govern frequency, extent & duration of flooding the Gunbower Forest?

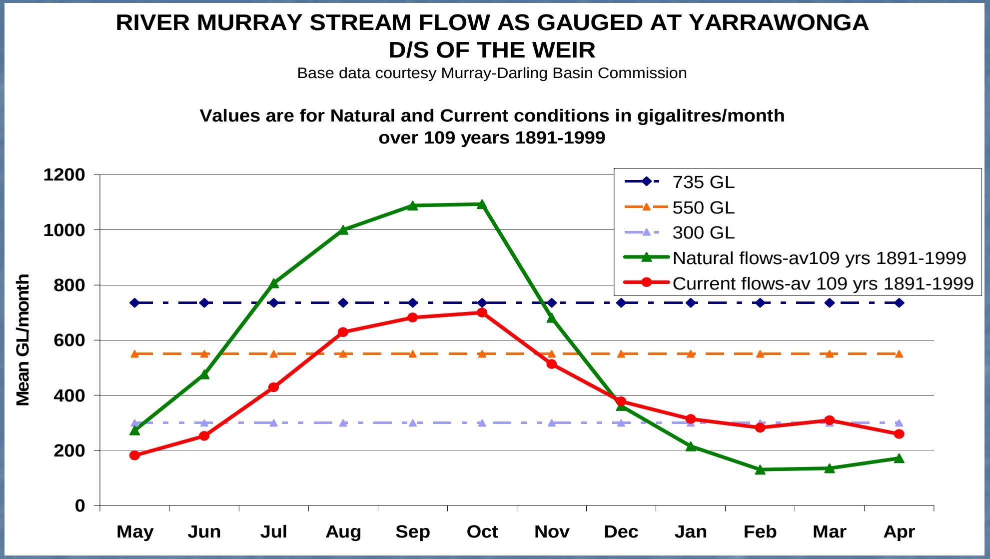
Flows in the Murray River d/s of Torrumbarry Weir governing flooding of the Gunbower Forest are:

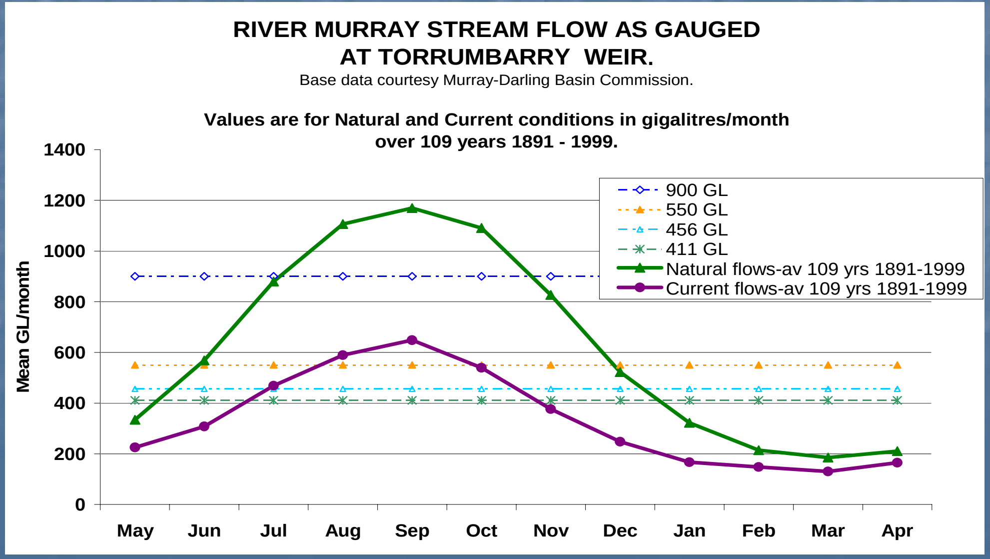


This graph shows average monthly Murray River flows at Torrumbarry Weir over the same 109 year period 1891-1999 comparing estimates of natural flows & actual flows under specified demand strategies

- The natural flooding of the forest was mainly sourced via overbank flows of the Murray River entering Gunbower Creek & returning to the river at Koondrook. Construction of levees & structures for irrigated agriculture disrupted natural flow patterns
- Flows into the forest (Spur Creek & Yarran Creek) commence at about 13,700 Ml/day (411 GL/month)
- As river levels rise flows through these channels increase & start at other locations
- Barham cut at 15,200 ML/day (456 GL/m), Wattles regulator at 18,300 Ml/day (550 GL/m) & progressively until bankful conditions occur at 27,803 Ml/day (834 GL/m)
- For widespread forest flooding to occur flows in the Murray River below Torrumbarry Weir must exceed 30,000 Ml/day (900 GL/m)

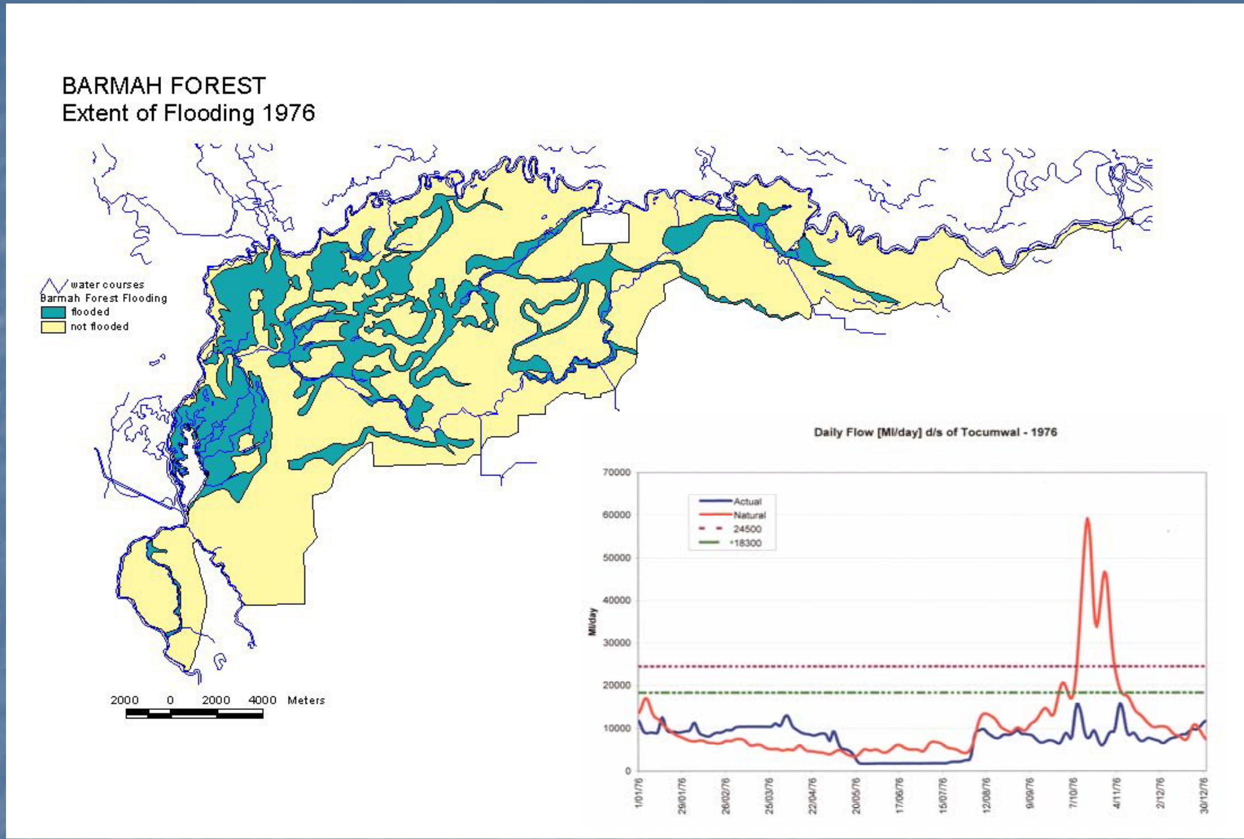
What are the changes in Murray River stream flow that have led to significantly altered flood regimes?





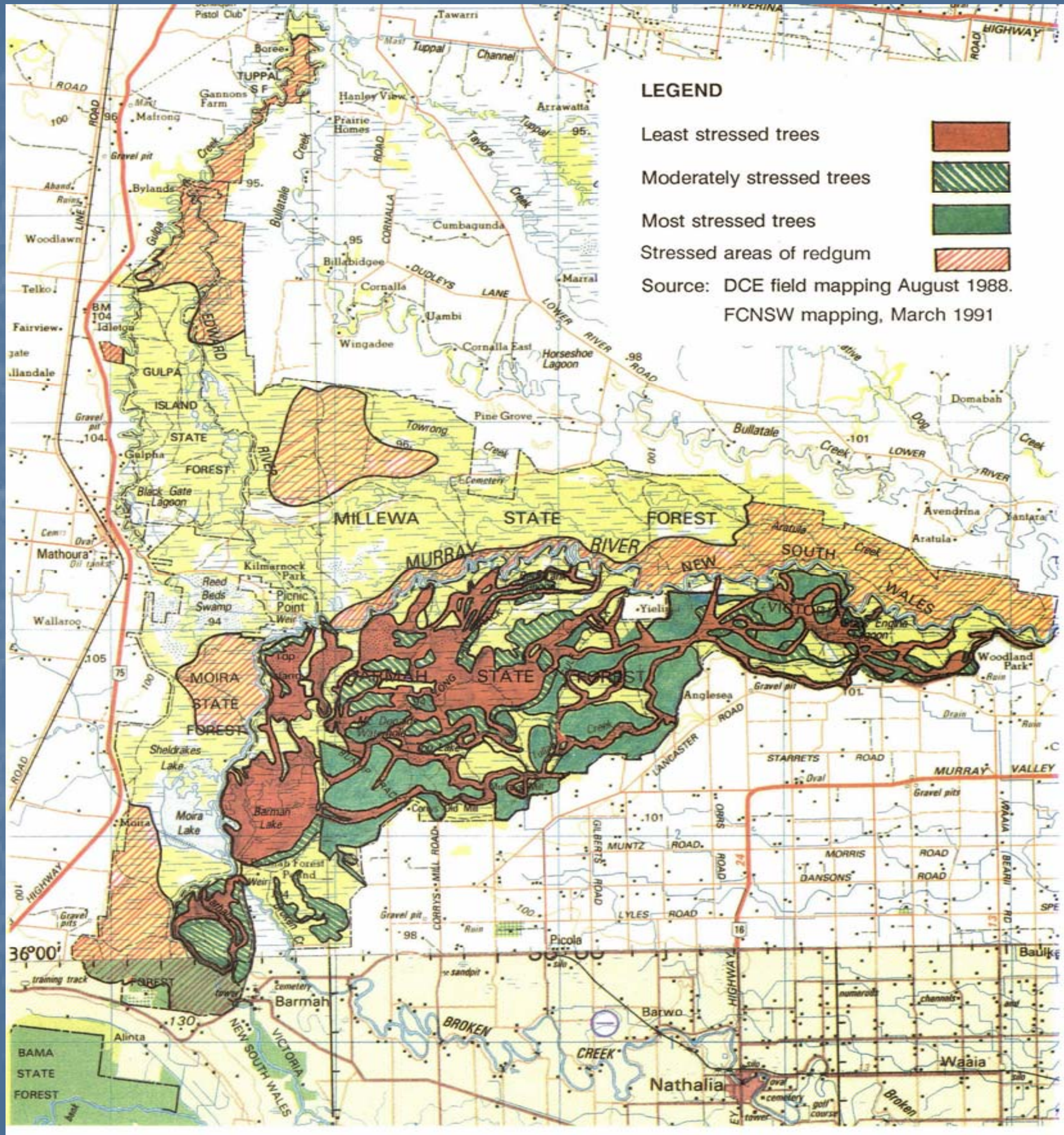
- Separate graphs for the Barmah Forest & Gunbower Forest show the estimated changes in average monthly flow over 109 years 1891 – 1999
- Estimates of natural flows & actual flows under specified demand strategies illustrate the huge impact of storage & river regulation on the hydrograph
- Under natural conditions 80%+ of the Barmah & Gunbower forests & wetlands were flooded for some 3-4 months duration on average 7.5 – 8 years in every 10 years with few periods of 2 consecutive years without substantial flooding
- Under intensive river regulation winter-spring flows are much reduced in magnitude & duration & huge areas of forest suffer drought stress. Barmah Forest also suffers from unseasonal summer/autumn flooding of lower lying areas.

Flood maps



- Flood maps are a basic management tool and their continued measurement is essential
- Regulated river flows do not produce forest flooding that meets the water requirements of flood dependent flora & fauna
- Such flows only result in short term flooding of a small proportion of red gum forest.

Barmah-Millewa Forest – Drought Stressed Areas



What is an environmental water allocation (EWA)?

The term describes a particular high security amount of water released from storage to meet nominated river management & environmental objectives.

Can EWAs efficiently and effectively flood red gum forests and wetlands to:

- Meet the needs of flood dependent flora and fauna;
- Reduce cumulative drought stress and restore forest productivity;
- Minimise losses and optimise returns for downstream re-use?

Government policy.
The example given is for the Barmah-Millewa Forest

- At present the Barmah-Millewa forest is the only red gum forest under the Living Murray initiative to have an allocated EWA;
- 100 GL (100,000 ML) was approved by the MDBMC in 1993. It may be augmented by an additional 50 GL in seasons when there is improved water availability for irrigation. The EWA is supplied ½ each by Victoria and NSW;
- Use of the EWA is governed by strict operating rules – currently under revision.

Key objectives are to:

- Achieve an average of three medium-sized floods every 10 years;
- Ensure that there are no more than 5 years between these events;
- Manage river flows d/s Yarrawonga; exceed 500 GL/month during September, October and November and exceed 400 GL/month in December.

Note:

- Saving up 4 – 5 year's annual EWA accumulates enough water, released from Hume Reservoir to prolong medium-sized floods in the forest originating from surplus flows. Releases are conditional on there being sufficient water in storage & are usually piggybacked onto surplus flows;
- These targeted flows are sufficient to maintain flooding of some wetlands and red gum fringes for 3-4 months hoping to induce/sustain a bird breeding event;
- Flows of this magnitude below Yarrawonga typically result in flooding up to 50 % of the forest and wetlands, but only 20-35% of the red gums;
- As a consequence of this policy and practice, 50% + of the forest and 65-80% of red gums regularly suffer from cumulative drought stress.

Experience with the use of the Barmah-Millewa Forest EWA.

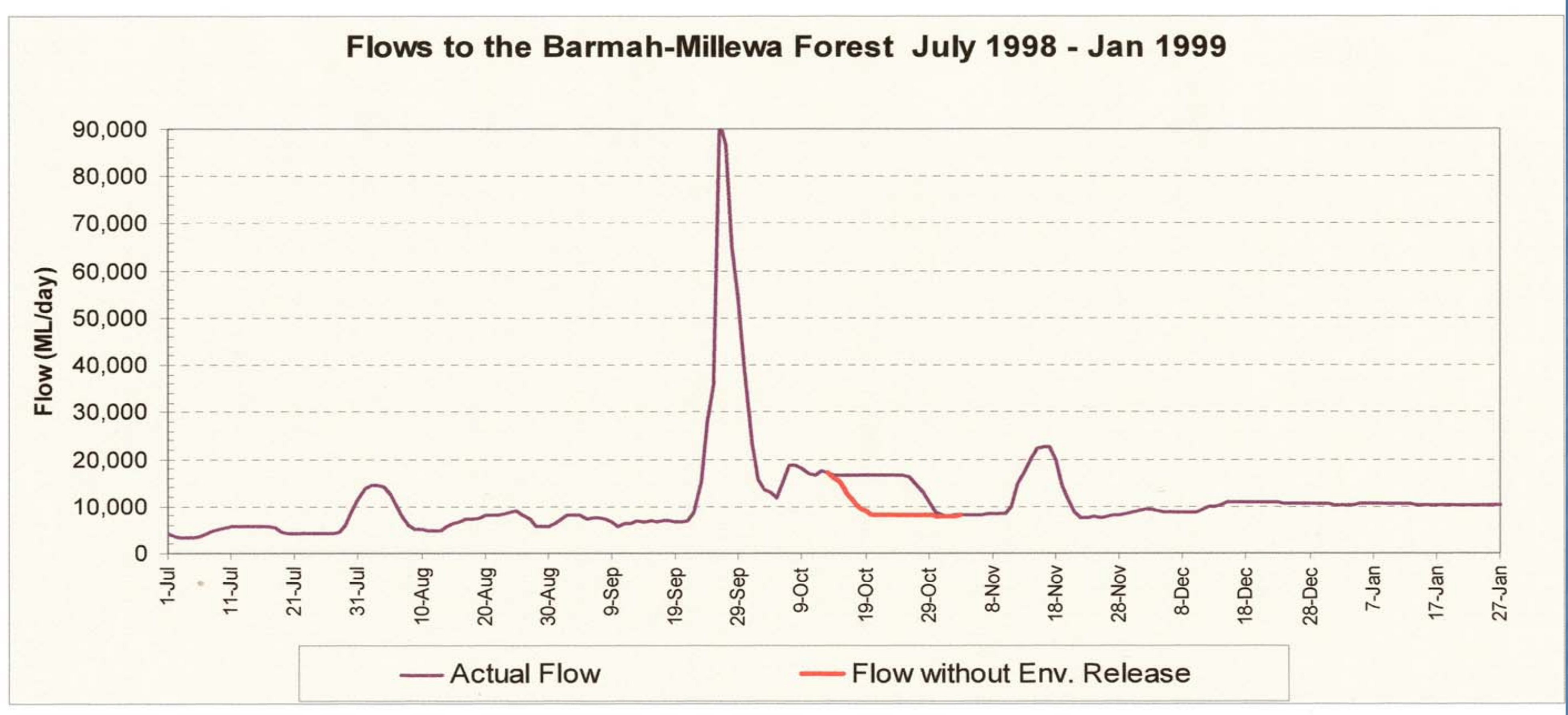
- Since approval in 1993 the Barmah-Millewa Forest EWA has been used on 3 occasions: 1998, 2000/01 and 2005/06.

First use of the EWA, Spring/Summer 1998.

Objectives of releasing the EWA accumulated in Hume Reservoir were:

- to extend the duration of extensive flooding originating from Ovens River inflows to parts of the forest. (These "Ovens" flows were 1 in 25 year events.)
- to identify operational and other issues and recommend improvements.

First use of the EWA, Spring/Summer 1998.



The hydrograph shows:

- September flows d/s Tocumwal briefly peaked around 90,000 Ml/d & rapidly fell to below 20,000 Ml/d
- Flows around 17,000 Ml/d were extended from 14 to 35 days.

Outcomes

- Field inspections observed flooded areas, forest & floodplain vegetation health, bird counts, fish breeding
- Short term peak flow flooded 47% of the Barmah Forest (21% Millewa Forest)
- More sustained lower flows around 17,000 Ml/d only flooded lower lying areas; i.e. some wetlands & red gum fringes
- Approximately 20% of SQI & SQII red gum forest remained flooded for about 5 weeks as a result of the EWA release

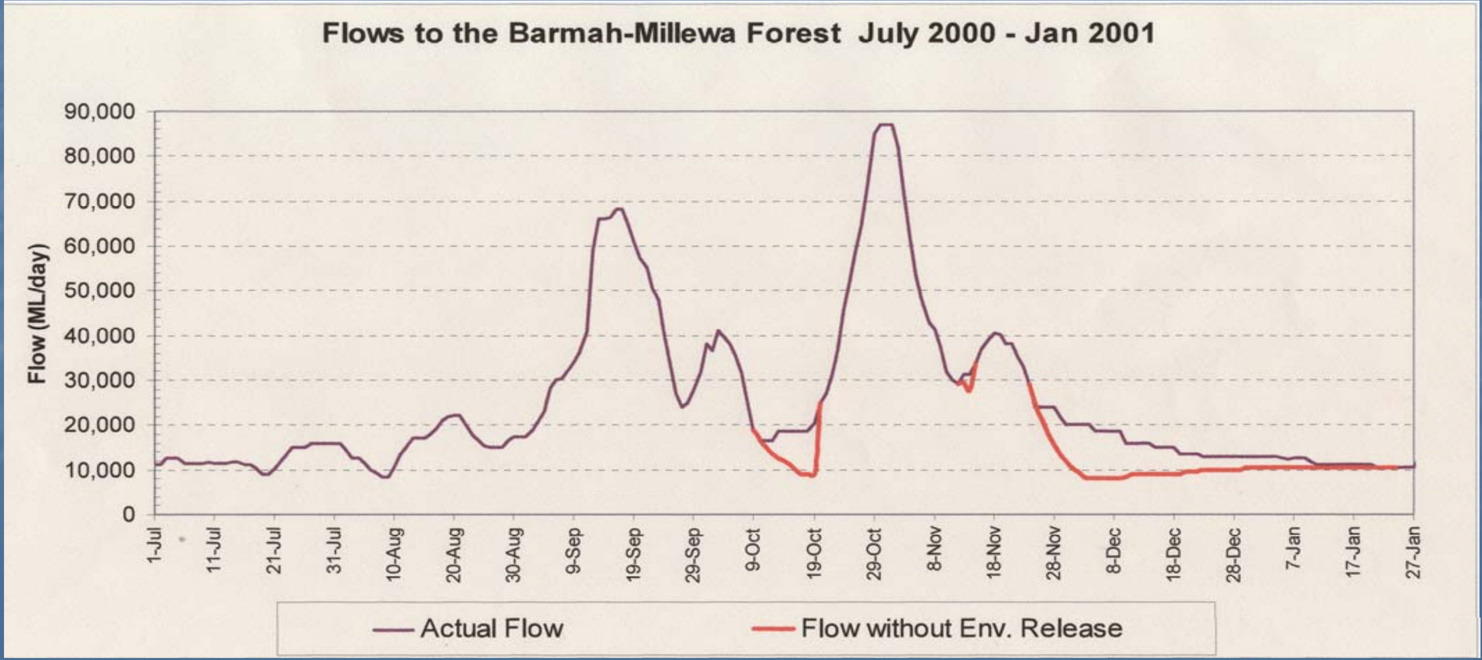
Issues

- Bird numbers were thought to be low in the forests before, during and after the release but high in the surrounding farmland and more research is needed to explain why and developed as a supplementary trigger for environmental water releases.
- Extending the period of environmental flows might, in future years:
  - allow bird breeding events to be completed
  - allow Moira Grass to flower
  - kill unwanted Red Gum seedlings on formerly open moira grass plains
  - encourage fish breeding
  - mitigate accumulated drought stress of red gums
- In the absence of within forest water management, such flows do not provide water to 80% of the river red gum forest

Second use of the EWA, Spring/Summer 2000/2001.

Decisions to use the EWA were based on:

- The last "good floods" were in 1992 & 1993. 1996 was a "lesser" flood;
- A "default release" in the 5th year to break the drought & allow recovery of the ecosystem which derived little benefit from the 1998 EWA release;
- As the EWA had been accumulating since 1998 irrigators could no longer afford to borrow, adding more to EWA accumulated loans which require storage capacity in Hume & payback against future irrigation allocations
- There had been a good initial biological response to September freshes from the Ovens River;
- There was a very large resource available;



Second use of the EWA, Spring/Summer 2000/2001.

The hydrograph shows:

- Two significant flood flows in the Murray River d/s of Yarrawonga Weir;
- Flows peaked in September (68,000 Ml/d) & November (≈92,000 Ml/d), the first originating from the Ovens River catchment, the second from the Hume catchment.
- EWA total of 341,000 Ml worth some $ 409 M ($ 1,200/Ml) was part (7.7%) of the total flow (4,426 GL) passing d/s of Yarrawonga;

Outcomes of high river flows supplemented by using the EWA.

- The forest was flooded for about 3.5 months, a 1 in 5 year event in terms of flood duration. Significant wetlands remained flooded with the aid of managed flows for a further 1 to 1.5 months
- Sophisticated aerial photography revealed 33,642ha (91%) of the Millewa Forest and 25,680ha (85%) of the Barmah Forest was flooded in November 2000
- In January 2001 at the end of the EWA event flooded areas were Millewa 3,430ha (9%) and Barmah 1,870ha (6%)
- The managed late November 2000 flood recession closely matched historic November flood recessions recorded for 1924, 1934, 1955 & 1974 and therefore historically not a common event
- Flooding produced significant biological outcomes including the best colonial bird breeding event since the mid-1970s, frog breeding & temporarily relieved drought stressed red gums
- An estimated 78% of the total flow was available for re-use downstream
- There was no requirement to proportionally credit EWA returns for downstream environmental purposes, thus all stakeholders benefited from the significant additional volume (EWA) of water returned to the system
- With improved management significantly less of the EWA would have kept wetlands flooded to meet bird breeding requirements

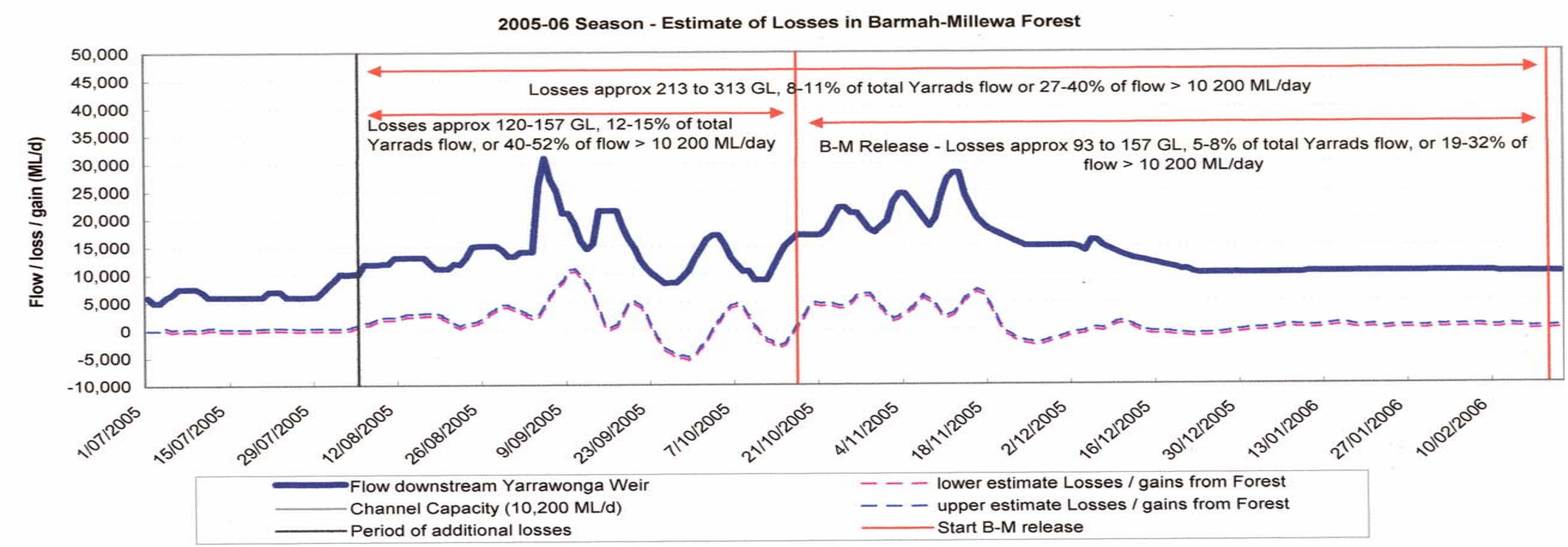
Third use of the EWA 2005

Decision to use the accumulated EWA was based on:

- Improve red gum health & flush out the system following 4 years since a significant flood *.
- Stimulate breeding of native fish, frogs, birdlife & meet needs of other flood dependent flora & fauna.

Note: Under natural conditions effective flooding of the forests occurred in 80% of years with rare occasions of 2 consecutive years without such a flood.

Third use of the EWA 2005



Source: MDBC

The hydrograph shows:

- Short term flow of 32,000 Ml/d in early September originating from inflows to the Murray from the Kiewa & Ovens Rivers;
- These flows produced an extended period of above channel capacity through the Barmah Choke & also through all on-river regulators which commenced watering the Barmah-Millewa Forest;
- From mid-October progressive release of the EWA from Hume Reservoir maintained flows d/s Yarrawonga >20,000 Ml/d through late October/early November with a peak to approx. 28,000 Ml/d in mid-November;
- Managed flows remained above the Barmah Choke capacity into February maintaining water in some wetlands where bird breeding had been artificially induced later than normal in the breeding cycle;
- From mid-October to mid-December some 480,000 Ml of EWA worth $576m was used to boost tributary flows to initiate & maintain ecological responses;
- Estimated "losses", August 2005 to mid-February 2006 (initial floodplain absorption, evapo-transpiration, accessions to groundwater, unaccounted) within the channel, forest & wetlands based on differences in flow rates upstream & downstream of the forest estimated in the range 8% - 11% [213 – 313 GL] of total flow d/s of Yarrawonga.

Outcomes of September Ovens & Kiewa inflows supplemented with EWA release from 12 October 2005 to 8 February 2006.

- The release of accumulated water (480 GL+) extended the area & duration of flooding to about 50% of the Barmah-Millewa Forest for 2-3 months &, later, selected wetlands (9-15%) for a further 2-3 months
- MDBC reported in December 2005 flooded sections of forest were showing signs of recovery from cumulative drought stress. Some species of native fish including *Murray Cod* & significant numbers of waterbirds had started breeding & moira grass was flowering
- Of the estimated flows passing through the forest & wetlands, 89 - 92% of the total flow measured d/s Yarrawonga Weir was re-used benefiting:
  - River Murray Channel & Murray Mouth
  - 10% of total area of living Murray icon sites (including Barmah-Millewa Forest)
  - Irrigated agriculture/horticulture
  - Drought stressed flood plain which had not been flooded for up to 9 years

Issues 2005

- Inspite of the large volume of the accumulated EWA at best only 50% of the forest & wetlands were flooded.
  - Timing of the EWA release in relation to tributary freshes disadvantaged forest coverage & many biological processes.
- Maintaining river flows above Barmah Choke capacity & very late closure of on-river regulators (Feb 2006) caused unseasonal flooding of low lying areas

Late inducement of bird breeding in some wetlands resulted in significant losses of eggs & newly hatched chicks [see photo] due to high temperatures

Photo: Max Moor

- A better environmental outcome could have been achieved with less EWA if flows had been effectively managed within the forest
- The whole concept of water "losses" needs evaluation. "Losses" were significant gains in forest health & for many flood dependent flora & fauna on up to 50% of the forest & wetlands (25 – 30% of red gums) & for all downstream stakeholders
- Allocation of specific EWAs to individual Living Murray icon sites needs re-evaluating given that only a small proportion is utilized within the site: eg, estimate "losses" mid-October 2005 to mid-February 2006 were in the range 5% - 8% (93 – 157 GL) of total flow d/s Yarrawonga
- Improve accounting of re-use of significant returns (92 – 95%) to the system including quantifying benefits to downstream stakeholders

SUMMARY: Experience with Use of Barmah-Millewa Forest EWA

- since approval in 1993 the EWA has been used 3 times.

Use of EWA – 1998, 2000/01, 2005/06 Total Volume used ≈ 921 GL

Value - $ 1.105 b

Criteria for Use

- Identify operational issues
- Allow recovery (short term) of ecosystem following cumulative drought stress
- Capitalise on biological responses triggered by high surplus flows
- Extend duration of flooding originating from short term tributary inflows
- Trigger/sustain water bird breeding
- Industry can no longer afford to borrow/ pay back EWA accumulated loans
- Lack of storage space in Hume Reservoir

Key Outcomes

- One year's EWA alone floods only 10% of forest short term
- Extending flooding originating from high surplus flows meets requirements of most flood dependent flora & fauna over large sections of forest & wetlands, including significant bird breeding
- Extending flooding of short term tributary inflows does not meet requirements of most flood dependent flora & fauna & does not maintain flooding on the bulk of the river red gums
- 78% - 92% of total flow drain back into the system & is available for downstream re-use.

Experience with Use of Barmah-Millewa Forest EWA

- since approval in 1993 the EWA has been used 3 times.

Use of EWA – 1998, 2000/01, 2005/06 Total Volume used ≈ 921 GL

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Issues

- Current floodplain watering policy & practice, together with greatly reduced community consultation is preventing the trialling of measures that could make more efficient use of water & flood larger areas of forest to sustain flood dependent flora & fauna and improve productivity
- Agricultural & environmental water allocations should be seen as complementary in order to optimise benefits for ALL stakeholders
- EWA not effective unless piggy backed onto managed & surplus flows
- Current policy does not mimic natural flooding of this icon site & only gives short term relief from cumulative drought stress
- Current operating rules deny water to 50% + of the forest – 70% to 75% of red gums
- Forest health severely affected for long periods – huge reduction in productivity
- Better environmental outcomes can be achieved with much less of EWA – better water management within the forest
- Huge evaporation losses when EWA is used later in the season – high temperatures detrimental to water birds
- Improve accounting of significant returns & their re-use
- Quantify benefits to all downstream stakeholders

Agricultural & Environmental Demands on Water in the Central Murray

Should they be seen as competing or complementary demands on finite & possibly diminishing water resources to satisfy social, economic & environmental outcomes?

YIELDS FROM IRRIGATED AGRICULTURE, FLOODPLAIN FORESTS & ASSOCIATED WATER CONSUMPTION IN THE CENTRAL MURRAY REGION

CROP	YIELD tonnes/ha			Water consumption Ml/ha			COMMENTS
	mid 1960s	mid 1990s	mid 2000s	mid 1960s	mid 1990s	mid 2000s	Data for yield & consumption are generalised values - influenced by: soil type, seasonal conditions, farming efficiency, crop variery & market segment
Tomatoes	50.3	80	80	9.1	8.0	5 - 9	Lower water use with drip irrigation
Oranges	30.2	40	35-45	12.2	15.0	6-8	Lower water use with drip irrigation
Grapes	25	30	20 - 30	10.7	8.0	7-8	Red grapes & white grapes respectiviely
Apples			40 - 70			4.7 - 8.7	Water use varies widely according to season, market segment & farm efficiency
Pears			30 - 60			4.7 - 8.7	
Peaches (canning)			35 - 60			4.7 - 8.7	
Pasture (dry matter)			6-15			8.0 - 15.0	Dry matter production varies widely with soil, plant species, season & farm efficiency
Rice	5.1	5.8	7.3-12.25	15.2	12.0	10-14	Rice production as a farming system: [1] Residual soil moisture equvalent to 1.5 Ml/ha supports following years direct drill cereal crop adding 2 - 3 tonnes/ha yield [2] Additional 5 tonnes/ha of rice straw for livestock feed
Wheat	0.9	3.7	4.5	4.6	5.0	3.0	
Floodplain Forests							There are two quantifiable yields from the floodplain forest, (1) & (2)
(1) River red gum forest	3	0.4 - 0.7	0.4 - 0.7			7.0 - 10.4	Yield refers to pre-1950s (prior to main effects of river regulation) & current growth
(2) CO2 sequestration	8.4	2.4	2.4				Includes carbon in new growth laid down each year, carbon removed in harvesting & locked up in wood products. Minus CO2 emitted in harvesting & converting logs to wood products
Flood dependent flora & fauna							
frogs							
fish							
water birds							
invertebrates							
understorey & wetland vegetation							

NOTE:

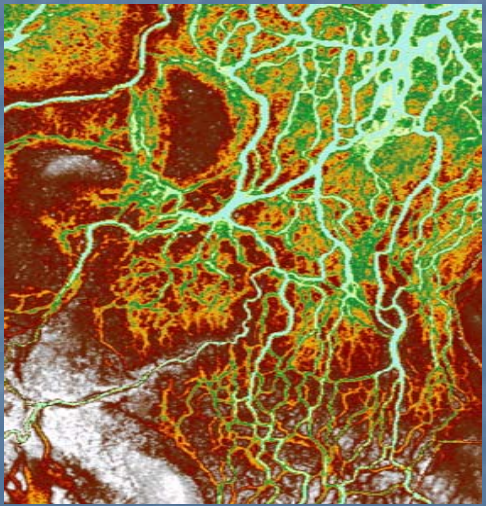
- Significant gains in irrigated agriculture productivity (yield) across a range of products
- More efficient use of water resources
- Huge reduction in forest productivity (5-8 fold) due to regularly depriving water from 75 – 80% of red gum forest for extended periods. In several areas yields are negative, that is, dead & dying trees
- Huge reduction in forest health has greatly diminished forest contribution for CO_2 sequestration

  Example: Under natural flood regimes net carbon dioxide sequestration in Victoria's Central Murray forests now available for harvesting totalled some 386,500 tonnes per year. Compare with a study of Victoria's wind farms indicating a saving of about 250,000 tonnes of greenhouse gas emissions per year
- No efficiency gains in managed watering of selected wetlands & forest fringes. In fact, floodplain water consumption is unnecessarily high

Where to From Here?

Data acquired by laser scanning (LIDAR) has enabled the production of a digital elevation model (DEM) of the floodplain forests & wetlands suitable for:

Intricate micro elevations



- Investigating the role of the floodplain forests as a temporary mid-Murray storage in winter & spring to:
  - *increase flexibility of river & storage management*
  - *Improve frequency, extent & duration of winter/spring flooding*
- Investigating the potential for Tuppal & Bullatale (NSW) & Smiths (Vic) creeks to pass additional summer/autumn irrigation flows around the Barmah Choke
- Developing more effective & efficient ways to use EWAs coupled with managed & surplus flows for winter/spring flooding
  - *Quantify & test the efficiency, separately & conjointly, of on-river forest regulators in Vic & NSW for introducing low to medium river flows below Yarrawonga into the Barmah-Millewa Forest*
  - *Identify & trial a range of within forest works for distributing, holding (x time) & returning introduced flows to the river*
  - *Investigate the extent to which managed river flows & internal engineered hydrology supports improved biological outcomes*
  - *Identify & quantify the operational inputs to ensure the infrastructure (regulators & works) is operated effectively to achieve specified outcomes*