River red gum assessment

Further advice on long term sustainable wood yields and standing stock volumes of quota sawlogs

Context

The NSW Government is considering the Natural Resources Commission's (NRC) recommendation on the future management of the State's river red gum forests prior to a final decision being made.

The NRC's Final Assessment Report presented estimates of long term sustainable yields from the main river red gum forests of the Central Murray Management Area. These estimates were deliberately conservative, given the limitations of the information available to the NRC and the timeframe of the assessment process. The NRC's Report recognised that further modelling would be required in order to provide more precise estimates of future yields, product classes and wood supply options.

To help inform the its response to the NRC's recommendations, the Government has asked for a more precise estimate of the timber yields to be prepared for each forest group in the Riverina bioregion. In order to meet this requirement, the NRC has consulted with Forests NSW on the following questions:

1. What is the range of timber yields that could be sustained over a 100 year timeframe from the forests under current silvicultural systems and management practices for the watering scenarios outlined in the NRC's Final Assessment Report? What level of uncertainty is attached to each scenario? What are the assumptions that underpin the yield ranges?
2. Using the silvicultural systems, management practices and principles recommended in the NRC's Final Assessment Report, with a focus on standing volume, what timber yields could be expected from the Central Murray forests over 5, 10 and 20 year timeframes?

In response to the Government's request, this document provides further advice on:

- The NRC's estimates of long term, 100 year, sustainable yields of quota sawlogs
- Forests NSW estimates of standing stock of quota sawlogs

Long term sustained yield

- Long term sustained yield is an estimate of the average volume of wood a given forest area can produce over a long timeframe, without reducing potential future yields. It is customary to express this as a volume which is available on an annual basis. This figure is one of the significant factors which forest managers take into account when allocating sawlogs to industry. Long term sustainable yield estimates are normally reviewed on a regular basis (say, each 5 – 10 years) to account for updated information e.g. on forest health, structure and growth rates.
- As Forests NSW manages river red gums for wood production on a planned rotation of 90 to 120 years, the NRC nominated 100 years as an appropriate timeframe over which to estimate long term sustained yield. Long-term sustained yield estimates are subject to relatively high levels of uncertainty compared to those estimates for shorter periods, because of the extended timeframe over which they are made, and their consequent sensitivity to underlying assumptions.

- In its Final Assessment Report the NRC published estimates of long term sustainable yields of quota and ex-quota sawlogs for selected forests in the Central Murray area. Long term sustainable yield estimates were prepared for the Millewa and Koondrook-Perricoota/Campbells Island forests because:
    - Inundation modelling was available for these areas
    - They account for 86% of current timber yield (and a greater percentage of quota yield) from the Central Murray, and
    - Advice from Forests NSW and local experts indicated that the long term sustainable yields from other forests were likely to be minimal.
- The NRC's published estimates for the Millewa and Koondrook-Perricoota/Campbells Island forests were 4,500 to 8,500 m^3/year of quota sawlogs. After consultation with Forests NSW, these have been revised to 6,300 to 13,600 m^3/year of quota sawlogs. An outline of the level of uncertainty and assumptions behind these ranges is provided in the next two sections.
- Separate to the NRC's estimates, Forests NSW has estimated an average minimum yield of 14,000 m^3/year and a drought impacted yield of 17,000 m^3/year of quota sawlogs from all Central Murray State Forests. This includes yields from Werai and other areas not incorporated in the NRC's estimates. The NRC's view is that these estimates are more optimistic than is warranted by the scenarios outlined in the Final Assessment Report.

Estimates for Millewa and Koondrook-Perricoota/Campbells Island forests published in the NRC's Final Assessment Report

- The NRC published estimates of long term sustained yield in its Final Assessment Report of 4,500 to 8,500 m^3/year, based on the long term growth rate of the forests. Because of data and methodological limitations, NRC estimates of growth rates assumed no active management of the forests over the 100 year growing cycle. This assumption generates conservative estimates of yield, which the NRC considered was appropriate given the uncertainty of future water availability for many areas of the forests.
- As the future health and growth, and therefore productive yield, of the river red gum forests is highly dependent on water availability, the NRC presented yield estimates for three watering scenarios in its Final Assessment Report. These watering scenarios were based on hydrological modelling of likely areas of flooding in the Millewa forest group and Koondrook-Perricoota/Campbell's Island forests, given assumed availability of water (and delivery infrastructure) under predicted climate change scenarios.
- Areas of forest which were modelled as receiving regular inundation were assumed to maintain historic growth rates of sawlogs and to produce quota as well as ex-quota timber. Areas which were modelled as not receiving inundation were assumed to yield only 25% of historic growth rates of sawlogs, and to produce only ex-quota timber (ie to transition to Site Quality 3 condition).
- Table 1 shows the NRC's published estimates of long-term sustainable yield of quota and ex-quota sawlogs from the Millewa forest group and Koondrook-Perricoota/Campbell's Island forests under three different watering scenarios.
    - A 'minimum watering' scenario[1], which was assessed as having a reasonable likelihood of being achieved. This produced 4,500 m^3/year of quota sawlogs.

[1] The 'minimum watering' scenario assumed flooding related to flow regimes of 18,300 ML/day for 60+ days for the Millewa forests and 2,000 ML/day for the Koondrook-Perricoota forests. Campbells Island was assumed to have the same extent of flooding as for Koondrook-Perricoota.

- An 'upper bound watering' scenario[2], which was assessed as having a low likelihood of being achieved. This produced 8,500 m³/year of quota sawlogs.
- A 'continuation of historic growth' scenario in which all areas of forest were received sufficient water to maintain historic growth and sawlog yield. This produced 16,000 m³/year of quota sawlogs.

- The NRC's published estimates of long-term sustainable yield of quota and ex-quota sawlogs did not include yields from Werai or other smaller forests in the Central Murray area. These areas were considered unlikely to produce significant volumes of sawlogs over a 100 year timeframe due to their relatively small size and poor condition.

Table 1: Estimates of long term sustainable yield of quota and ex-quota timber from Millewa, Koondrook-Perricoota and Campbells Island forests published in the NRC's Final Assessment Report (m³/year)

	Areas flooded		Areas not flooded (assumed to produce ex-quota sawlogs)	Total
	Quota	Ex-quota		
Minimum watering scenario				
Millewa Forests	2,000	1,400	3,600	7,000
Koondrook-Perricoota & Campbells Island forests	2,500	1,700	1,400	5,700
Total	**4,500**	**3,200**	**5,000**	**12,700**
Upper bound watering scenario				
Millewa forests	5,000	3,500	2,300	10,700
Koondrook-Perricoota & Campbells Island forests	3,500	2,500	1,000	7,000
Total	**8,500**	**6,000**	**3,300**	**17,700**
Continuation of historic growth				
Millewa forests	10,500	7,300		17,800
Koondrook-Perricoota & Campbells Island forests	5,700	4,100		9,800
Total	**16,200**	**11,400**		**27,600**

[2] The 'upper bound watering' scenario assumed flooding related to flow regimes of 35,000 ML/day for 60+ days for the Millewa forests and up to 6,000 ML/day for the Koondrook-Perricoota forests. Campbells Island was assumed to have the same extent of flooding as for Koondrook-Perricoota.

NRC revised estimates for Millewa and Koondrook-Perricoota/Campbells Island

- After further discussion with (and modelling by) Forests NSW, the NRC has prepared revised estimates of long term sustainable yield under the 'minimum watering' and 'upper bound watering' scenarios to take into account:
    - More precise estimates of growth rates for forest areas predicted to be in the 'watered' and 'non-watered' zones, based on Forests NSW strategic inventory plots located in those zones in each forest area[3].
    - Forests NSW expert advice that the NRC's assumption, that all forest areas not modelled as receiving regular watering would transition to a condition in which they yielded no quota quality sawlogs, was too pessimistic.
- Table 2 shows the NRC's revised estimates of quota long term sustainable yield from the Millewa forest group and Koondrook-Perricoota/Campbell's Island forests. The main differences between the NRC's initial estimates and revised estimates are due to:
    - Adjustment of the Net Harvestable Area and growth rates for watered areas to match more precise estimates from FRAMES. This accounts for an additional 0 – 3,900 m^3/year, and
    - The assumption that 36%of sawlogs from areas previously modelled as unwatered could be of quota quality. This accounts for an additional 1,800 – 1,200 m^3/year of quota yield.
- In the absence of better data, the NRC assumed the percentage of sawlogs of quota quality produced by sites modelled as 'non-watered' would be equivalent to that realised from Koondrook forest over the past 3 years.
- While the recent proportion of quota quality sawlogs produced from Koondrook will to some extent reflect the growth of trees prior to river regulation, the NRC's view is that this is the best available estimate of the proportion of sawlogs of quota quality able to be produced by Site Quality 1 and 2 sites that do not receive regular watering.
- Monitoring to provide updated data on stand dynamics and the growth rate of quota quality trees in these areas will be necessary to test this assumption and should be conducted in line with regular reviews of long term sustainable yield estimates.

[3] Growth rates were derived over a 50 year period for current standing stock, assuming no silviculture and therefore no silviculture-induced regeneration of new trees. The NRC acknowledged in its Final Assessment Report that this estimate takes a conservative view of the potential impact of silviculture on growth rates. The NRC believes this is warranted for two reasons. The first is the NRC's judgement the likely long-term impacts of water stress will over-ride any silvicultural enhancement of growth rates, particularly in forests which do not receive regular watering. The second is that future silvicultural interventions are expected to be more conservative (in line with the NRC's recommendations and the provisions of any IFOA) than those practiced in the past, limiting the extent to which enhanced growth rates can be achieved in practice.

Table 2: Comparison of NRC published and revised estimates of long term sustained yield of quota sawlogs (m^3/year)

	'Minimum watering' scenario			'Upper bound watering' scenario		
	Millewa	Koondrook-Perricoota	Total	Millewa	Koondrook-Perricoota	Total
Published estimates of quota sawlogs	2,000	2,500	**4,500**	5,000	3,500	**8,500**
Adjustment to quota sawlogs from regularly flooded areas						
Adjustment for more precise area estimates	-1,100	100	**- 1,000**	500	200	**700**
Adjustment for more precise growth rate estimates*	300	700	**1,000**	2,000	1,200	**3,200**
Adjustment to quota sawlogs from non-flooded areas						
Published estimates of sawlogs from non-flooded areas (assumed all ex-quota)	3,600	1,400	**5,000**	2,300	900	**3,200**
Revised percentage of quota sawlogs from non-flooded areas**	36%	36%	**36%**	36%	36%	**36%**
Adjustment for percentage of quota sawlogs	1,300	500	**1,800**	850	350	**1,200**
Revised estimates of quota sawlogs	2,500	3,800	**6,300**	8,350	5,250	**13,600**

* Revised growth rates for quota quality sawlogs were based on strategic inventory plots matched to areas modelled as being inundated under the scenarios used in the NRC's Final Annual Report. A growth rate of 0.64 m3/ha/year was used for the Millewa forests, and a growth rate of 0.34 m3/ha/year for Koondrook-Perricoota and Campbells Island. By comparison, growth rates used to prepare the estimates in the Final Assessment Report were 0.60 m3/ha/year for SQ1 areas and 0.26 m3/ha/year for SQ2 areas.

** Based on production of quota sawlogs as a proportion of all sawlogs from Koondrook forest between 2007 and 2009.

- The NRC's revised long term sustainable yield estimates acknowledge that some better quality (SQ1 and SQ2) sites in modelled non-watered areas have potential to produce quota quality sawlogs due to:
    - A greater extent of flooding being realised in practice than was predicted by the Water Tech and TLM modelling, through 'smart' local management of available water, subject to well-managed delivery infrastructure being in place and being used.
    - The application of silviculture to improve the health (rather than the growth rate) of remaining trees in areas receiving minimal water.
- The NRC has not revised its assessment of the likelihood of the 'minimum watering' and 'upper bound watering' scenarios being achieved, but has revised its assessment of the likely outcome from a given amount of water.
- The NRC's judgement is that, overall, the modelled non-watered areas will continue to receive enough water to produce proportions of quota timber intermediate between well watered sites and SQ3 sites. This takes into account Forests NSW and other expert local knowledge on the extent of inundation achievable with good local-level water management and appropriate infrastructure, compared to hydrological modelling predictions.
- However, the extent to which good local-level water management occurs in practice, and generates associated higher wood yields, obviously depends on the investment of resources (both expertise and infrastructure) necessary to realise the maximum extent of inundation for a given watering regime.
- Table 3 below summarises the key assumptions behind the NRC's revised estimates of long term sustainable quota yields.

Table 3: Comparison of key assumptions associated with long term sustainable yield estimates (NRC assumptions shown in bold)

Issue	Conservative assumptions	Optimistic assumptions
Growth rates	**Growth rates on all areas assume no response due to silviculture, reflecting in part the greater constraints of IFOA requirements.**	Growth rates for regularly watered areas reflect historic (1970-2002) responses to silviculture. Those for 'non-watered' areas reflect recent drought impacted (2003 – 2008) responses. Additional silvicultural constraints have little impact on average yields.
Extent of inundation	**Areas receiving regular watering are per the Water Tech and TLM modelling from the Final Assessment Report .**	"Smart" local water management extends the area inundated beyond the modelled area.
Quota log yield	Quota log yield from non-watered areas is zero.	**Quota log yield from non-watered areas is 36% of total sawlog volumes**.
Wood production from other forests	**Negligible wood production from Werai and other Central Murray forests.**	Over 1,500 m^3/year from other forests.

Forests NSW estimates

- Forests NSW have also prepared estimates of long term yield that may be achieved by harvesting according to rules agreed with the NRC as approximating the implementation of the NRC's silvicultural recommendations[4].
- These estimates of the long term sustained yield of quota sawlogs from all Central Murray forests are between 14,000 and 17,000 m^3/year. These estimates include yields from Werai and other Central Murray forests. The NRC did not include all of these areas in its published estimates. This reflected their low potential to produce quota sawlogs given what the NRC understands to be the current condition and harvesting history of these forests.
- The growth rates used by Forests NSW are less conservative than those used by the NRC, as they assume active management of the forests reduces competition between trees and delivers a growth response in the residual stand. For watered areas, 75% AGS and 25% STS was applied. For non-watered areas, only STS was applied. Both forms of harvesting drive a modest response in growth rates and therefore yields.
- However, there are two principal sources of uncertainty in these estimates. The first is the extent to which the AGS assumptions will be met in practice; the second is the extent to which reducing stand density through STS in non-watered areas can overcome the impact of long term lack of access to water (compared with improving stand stand health). In the NRC's view, current PGP data sets do not adequately reflect the cumulative effects of long term river regulation and associated depletion of groundwater on forest health, growth and sawlog yield.

Standing stock volumes

- As noted in the NRC's Final Assessment Report, some proportion of current standing stock could be harvested in the near term, for a defined period of time, as part of a managed industry transition strategy. As noted in the Final Assessment Report, this is a defensible management option as long as:
    - The basis for any decision on near term yields is transparent
    - The silvicultural principles outlined in the NRC's Final Assessment Report are respected
    - The consequences in terms of the ultimate reduction in long term sustainable yields are clear
    - A strategy is put in place to manage the ultimate decline in timber volumes available to the red gum forestry industry.
- Table 4 shows Forests NSW estimates of the standing stock of quota sawlogs available for harvest by forest group. These estimates have been adjusted to take account of a range of issues that reduce the volume of sawlogs available for harvest compared to total assessed standing volumes. Issues considered include: appropriate threatened species management; application of Forests NSW silvicultural regimes; implementation of NRC recommendations for adaptive management and future forest structures; and the commercial viability of harvesting operations, amongst others.
- While these figures provide a useful frame of reference for considering the yield of quota sawlogs that may be produced by each forest over defined shorter-term timeframes (eg 5, 10 or 20 years), the NRC is not able to assess the accuracy or otherwise of these standing stock

[4] These approximate those which might apply under an Integrated Forestry Operations Approval.

estimates. However, it is not clear that estimates based on Forests NSW strategic inventory data take sufficient account of the cumulative impacts of river regulation and drought on the standing volume of quota timber.

- The NRC believes that, in practice, the process of setting transitional yields should involve:
  - Specifying the tenure for each forest area, and thus the management objectives and constraints
  - Conducting a detailed inventory of the current volume and quality of timber in each forest area
  - Estimating the yields that would be realised from the application of appropriate silviculture to each forest area. These estimates should include yields that may come from managing specific for fire hazard reduction, asset protection and enhancement of stand health.

Table 4: Forests NSW estimates of available standing quota volume

Forest group	Net harvestable area (ha)	Harvestable standing quota volume	
		(m^3/ha)	(m^3)
Murray Management Area			
Koondrook-Perricoota/Campbells Island SF	27,779	6.2	173,400*
Millewa SF	15,399	19.0	292,600**
Gulpa Island SF	4,520	13.1	59,200
Werai SF	8,309	3.3	27,700
Other Murray SF	12,815	9.8	125,300
Mildura Management Area			
Mildura SF	7,531	0.2	1,800
Mildura WLL	24,126	1.6	38,600
Murrumbidgee MA	10,629	5.4	57,400

* Harvesting since 2008 has reduced available quota within Koondrook-Perricoota and Campbells Island forests by approximately 20,000 m^3.

** Harvesting since 2008 has reduced available quota within Millewa State Forest by approximately 15,000 m^3.

Conclusion

- The NRC's has revised its estimates of long term sustainable quota yield from the Millewa and Koondrook-Perricoota/Campbell's Island to 6,300 to 13,600 m^3/year.
- We note that Forests NSW estimates annual yields of 14,000 to 17,000 m^3/year from all Central Murray forests. However, the NRC's view is that Forests NSW estimates are based on a more optimistic set of assumptions than the NRC believes are appropriate.
- The NRC believes that appropriate 5, 10 or 20 year transitional yields should be determined once tenure and management regimes have been specified and a detailed inventory of the current volume and quality of timber has been prepared for each forest.