<u>Plantations and Reafforestation Act and Code Review.</u>

Mick Harewood, July, 2005-07-22

Section 5.3 : Fire Protection.

This section seems to have been written without regard to lessons learned from the behaviour of the Canberra bushfires of January 2003. The description printed in the Canberra Times of the fire convection column by Wendy Catchpole, mathematician at the Australian defence Force Academy with an interest in fire behaviour modelling, is informative. Wendy Catchpole said that the fuel loads in the pine plantations near Canberra were so high that, under conditions of high temperature, the fire created its own convection column and winds from all directions were drawn to the base of that column. The strength of these winds caused the trunks of fully grown Pine trees to snap well before the fire front had reached them. Newspaper photographs around this time verify the phenomenon.

Fire protection in Australia has relied in part on fuels management by prescribed burning. The work of MacArthur established that, in wet schlerophyll forest with limited understory, fire rate of spread and intensity was proportional to the square of fuel loads. Attempts to apply the method of prescribed burning to pine plantations have been an abject failure. The damage to crop trees by relatively low intensity prescribed fire precludes its commercial application.

Given that under severe fire weather conditions pine plantations can create their own cyclonic winds, and that fuels management by prescribed burning is impractical, a precautionary approach to locating plantations within the landscape is required. This would include wider buffers of grazing (or otherwise fuels-managed) land between plantation blocks or strips and well-developed surface water assets for fire suppression by initial attack.

Section 6.1: Landscape Planning.

This section describes landscape planning as being concerned with the "broadscale allocation of resources". It mentions four criteria for making decisions about this:

1. infrastructure (which one assumes means transport facilities like roads and bridges, since processing facilities is mentioned separately)
2. land availability (In the case of private lands, this is generally determined by the market, and in Australia it is hard to see how this might change. However, market distortion through the operation of tax incentives has had a huge impact on plantation establishment. The forest industries sector has pointed to a large trade imbalance as a justification for expanding plantations. In a country with low and erratic rainfall, self –sufficiency in low value wood products should not be achieved at the expense of sensible water resource allocation.)
3. location in the catchment (The proportion of the catchment occupied by plantations, and the relevance of groundwater salinity issues which might be ameliorated by plantation establishment are probably more pertinent considerations)
4. Processing facilities

Water use by plantations and fire protection are mentioned in the regional context of the Monaro. These issues also have great relevance to the Towamba Valley, and probably many other areas. It is rather shocking to see the extent of pine plantations in the catchment of the Warragamba Dam, for example.

Recent evidence on the impact of plantation establishment and the change from oldgrowth to dense regrowth following intensive logging has shown that:

- Intensive logging and plantation establishment over a smaller proportion (than 20%) of the catchment can result in detectable water yield reductions. Detection of change depends in part upon the particular sequence of rainfall events experienced before and after logging/plantation establishment. (See Lane and Mackay, 2002, and Watson et al, cited in the review by Vertessey, 1999)
- The effect on <u>annual</u> water yield may be misleading if the environmental and economic impact are what one is interested in. Logging and roading can increase quickflow runoff

but the subsequent establishment of plantations or dense regrowth can reduce dry-weather water yield.
(Cornish, 1993, Wronski, 1993, Watson et al, 1999, Bosch and von Gadow, 1990 (last two cited in Vertessey 1999))
Roads increase Hortonian overland flow and road culverts tend to concentrate flows, resulting in more direct connection to drainage lines. Logging of oldgrowth forest tends to increase sub-surface throughflow runoff because tree roots decay and become, in effect, pipes which conduct water in the general direction of drainage lines, more often than not. The duration of water yield increases following logging (as short as 18 months, but up to about 5 years in some cases) does not generally offset the reduction in water yield following the establishment of plantations or regrowth. Kuczera (1985) found the nadir in annual water yield was at about 28 years and the return to oldgrowth water yield may take 150 years.

- The greatest impact of plantation establishment on water yield is likely to occur in the summer months, since evapotranspiration is highly dependent on temperature. (See Section 6, page 101 of the review by Vertessey, 1999,). The Bemboka Catchment Study (Franklin 1997) showed that the summer time water yield reduction predicted by the application of the Kuczera curve on a monthly time step would be 50%, compared to 25% for winter time water yield reduction. The warmer months are when the streams are likely to be under the greatest hydrological stress due to greater extraction demand, greater evapotranspiration and the increased risk of algal blooms.
- Water yield reductions due to the establishment of pine plantations are likely to be more severe than for eucalypts. (Scott and Smith, 1997, cited in Vertessey 1999). This is in part due to increased canopy interception (Dunin and MaKay, 1982).
- Conversion of grasslands or pasture to plantations has an even greater impact on water yields than conversion of existing forest. (Holmes and Sinclair, 1986)

Taking this evidence into account, I propose that when there is a likelihood that plantation establishment could have a significant adverse effect on the aquatic environment and water resources, formal assessment of the impact on <u>flow duration</u> in streams should be required. Therefore, the trigger for such an assessment would be:

Conversion of more than 15% of the area of the catchment of any third (or higher) order stream (a) to any tree plantation cover from pasture/grassland
(b) to pine plantation from eucalypt forest
(c) to dense eucalypt plantation from oldgrowth eucalypt.

The reason for choosing a third or higher order stream is that, mapped on the 1:25,000 scale, streams of a third or higher order potentially support significant aquatic habitats. This is also the trigger for the requirement for a license to construct a dam on a drainage line.

In geologies where the hydrograph is dominated by stormflow run-off, it may be that even third order streams do not support much aquatic habitat. However, these geologies (such as shales, siltstones and mudstones of the ordovicien metasediments in coastal areas of the Bega Valley and Eurobodalla Shire) generally do not develop soils of sufficient quality to support successful pine plantations.

The value of streams as a drought refuge or water supply is principally determined by the persistence of low flows. In the Ecologically Sustainable Forest Management (ESFM) review for the Eden Comprehensive Review of Forest (CRA), an indicator of changes to water yield was proposed, namely **long-term trends in baseflow**. State Forests argued that this was impossible to measure in a realistic time scale. I agree with this point. One really has to rely on model predictions in order to gain information useful to management.

If the indicator of catchment yield change is simply baseflow, it is impossible to compare effects across different catchments or subcatchments because the starting hydrological regime is influenced by natural differences in catchments. A useful indicator of change over time within any particular catchment might be:
Flow Duration Index= 95^{th} percentile daily flow/Average daily flow.

The average daily flow is chosen because this would capture increases in stormflow runoff. If the median daily flow were used as the divisor, increases in stormflow runoff due to road construction and soil compaction would not be measured.

Some streams do not have any surface flow at the 95th percentile. Therefore, the 80th or 60th percentile daily flow could be used in these streams. This kind of approach was used in the Stressed Rivers Assessment Report (DLWC 1999) in the index of hydrological stress (defined as the ratio of licensed volume to flow at the 80th or 50th percentile of daily flows, depending on the natural flow duration of the stream).

Model predictions of changes to the flow duration index would require the construction of relatively simple "black box" models. Kuczera has written extensively on the complexity of models that is justified by the available data. (See Kuczera et al, 1993, and subsequent papers). The CRC for Catchment Hydrology series on Model Choice, volume 1 (2005) also provides a useful guide. DEC has set out guidelines for the acceptable standards of water balance and nutrient modelling to be used in the assessment of the impact of sewerage effluent disposal by irrigation. (DEC, 2005).

I wrote the following paragraphs in my submission on the five-year review of Ecologically Sustainable Forest Management for the Eden Regional Forest Agreement:

"Selecting an indicator that is measurable in a reasonable period of time is difficult. Ideally, a flow duration curve, constructed from a record of 20 years or so streamflow data, would be used to assess tends in baseflow. This is far too long a time scale for practical use.

However, an understanding of model parameters that can adequately describe catchment behaviour could be useful if they can be objectively assessed in a shorter period of time. Key parameters in the widely accepted AQUALM (modified Broughton) model for determining flow duration are the size of the soil moisture stores and baseflow recession constant. A reproducible method of estimating the baseflow recession constant from a relatively short hydrograph has been recently published. (Podger and Best, in Catchword No. 134, February 2005).

By combining an estimate of baseflow recession with estimates of the size of soil moisture stores, robust predictions of the likely flow duration curve applicable at the time of data collection for a relatively short hydrograph should be possible. In order to express trends following intensive logging and regeneration succinctly, a new indicator, "flow duration index", is proposed. I suggest that the flow duration index be defined as the ratio of the 95th percentile of flows to the average flow. This index would not only capture trends in water yield reduction at low flows, it would also reflect increases in stormflow runoff."

The use of model predictions of changes in daily flow duration, especially for the warmer months, would enable assessment of plantation proposals at the property scale, rather than waiting for a landscape planning approach to be developed for all affected catchments. The introduction of formal assessment of the impact on flow duration is long overdue. For many decades, it has been know that pine plantations can turn perennial streams into winter flow only streams.

The only justification for permitting water yield reductions at low flows would be if there is a beneficial effect on salt yield from catchments affected by high salinity groundwater. This would require further evidence and modelling to support the proposal.

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